# The European Union's strategy against climate change: analysing the member states

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## Contents

## 1. Introduction

Climate change gets an increasing focus in the XXI century. The issue of climate protection has yet to be elevated to the EU policy level, with strategies currently being developed at the national level. It is difficult for economic policy in all member states to establish a clear list of priorities, because the long-term challenge of climate change. This is further compounded by the threat of epidemics, rising foreign policy tensions, economic recessionary problems and the apparent disruption of international strategic balances.

Our study reveals significant discrepancies between national climate strategies. Following the presentation of the methodology and a general overview of EU climate strategies, we compare the climate strategies of the 27 Member States based on the same perspective. The country studies commence with an economic outlook, given the strong correlation between the state of the economy and climate policy. The analysis of the climate strategy in details begins with a general overview of each country's climate programme. A series of indicators are used to assess the effectiveness of national climate policies and describe the current version of national climate policies.

The focus here is necessarily on good practice. Attention is also paid to the extent to which these successful policies at the national level are being implemented in other Member States. When evaluating good practices, we give priority to those aspects that are important for Hungary. Additionally, particular attention is paid to those areas where Hungary's success rates are above average.

## 2. Methodology

**Definitions**

This chapter describes the definitions and methodology of the indicators that will be illustrated in figures for each country in the following chapters. The indicators are presented in accordance with the sequence of the data specific to each country. Table 1 summarizes the aforementioned indicators.

**Table 1. Indicators**

| indicator | | year(s) | unit of measure | source |
|---|---|---|---|---|
| 1. | economic outlook: | 2020 | | Eurostat |
| | 1.1. EMU convergence criterion bond yields | | % | |
| | 1.2. HICP | | average index, 2015=100 | |
| | 1.3. net lending (+) / net borrowing (-) | | % of gross domestic product (GDP) | |
| | 1.4. real GDP per capita | | % of EU27 | |
| | 1.5. unemployment rate | | % of population in the labour force | |
| 2. | primary energy consumption | 2000-2019 | million tons of oil equivalent | |
| 3. | share of fossil fuels in gross available energy | 2010-2019 | % | |
| 4. | greenhouse gas (GHG) emissions by capita | 2000-2019 | $CO_2$ equivalent per capita | |
| 5. | share of energy from renewable sources | 2010-2019 | % | |
| 6. | environmental performance index (EPI) | 2014-2020 | score | McCall MacBain Foundation of Canada, Yale University, Columbia University |
| 7. | ecological footprint per person | 2014-2017 | global hectares (gha) per capita | Global Footprint Network |
| 8. | climate change performance index (CCPI) | 2014-2021 | score | Germanwatch, NewClimate Institute, Climate Action Network |

1. **Economic outlook:**

**1.1. EMU (Economic and Monetary Union) convergence criterion bond yields**

Source of the data: Eurostat

https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table

Original abbreviation of the indicator: irt_lt_mcby_a

Unit of measure: %

Description: "Maastricht criterion bond yields (mcby) are long-term interest rates, used as a convergence criterion for the European Monetary Union, based on the Maastricht Treaty." (Source: https://ec.europa.eu/eurostat/cache/metadata/en/irt_lt_mcby_esms.htm)

More detailed metadata is available at:

https://ec.europa.eu/eurostat/cache/metadata/en/irt_lt_mcby_esms.htm

**1.2. HICP (Harmonised index of consumer prices)**

Source of the data: Eurostat

https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table

Original abbreviation of the indicator: prc_hicp_aind

Unit of measure: average index 2015=100

Description: "HICP, is the consumer price index as it is calculated in the European Union (EU), according to a harmonised approach and a single set of definitions. It is mainly used to measure inflation." (Source: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Harmonised_index_of_consumer_prices_(HICP))

More detailed metadata is available at:

https://ec.europa.eu/eurostat/cache/metadata/en/prc_hicp_esms.htm

**1.3. Net lending (+) / net borrowing (-)**

Source of the data: Eurostat

https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table

Original abbreviation of the indicator: gov_10a_main

Unit of measure: % of gross domestic product (GDP)

Description: "The indicators are compiled on a national accounts (ESA 2010) basis. They comprise main aggregates (total revenue and expenditure, main components (ESA 2010 economic categories as well as balancing items) for the general government sector and its subsectors (central, state, local government and social security funds) The difference between total revenue and total expenditure equals net lending/net borrowing" (Source: https://ec.europa.eu/eurostat/cache/metadata/en/gov_10a_main_esms.htm)

More detailed metadata is available at:

https://ec.europa.eu/eurostat/cache/metadata/en/gov_10a_main_esms.htm

### 1.4. Real GDP per capita

Source of the data: Eurostat

https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table

Original abbreviation of the indicator: sdg_08_10

Unit of measure: % of EU27

Description: "The indicator is calculated as the ratio of *real* GDP to the average population of a specific year. GDP measures the value of total final output of goods and services produced by an economy within a certain period of time. It includes goods and services that have markets (or which could have markets) and products which are produced by general government and non-profit institutions. It is a measure of economic activity and is also used as a proxy for the development in a country's material living standards. However, it is a limited measure of economic welfare. For example, neither does GDP include most unpaid household work nor does GDP take account of negative effects of economic activity, like environmental degradation."

(Source: https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table)

More detailed metadata is available at:

https://ec.europa.eu/eurostat/cache/metadata/en/sdg_08_10_esmsip2.htm

### 1.5. Unemployment rate

Source of the data: Eurostat

https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table

Original abbreviation of the indicator: une_rt_a_h

Unit of measure: % of population in the labour force

Description: "The unemployment rate is the number of unemployed persons as a percentage of the active population (labour force). The labour force is the total number of people employed and unemployed." (Source: https://ec.europa.eu/eurostat/cache/metadata/en/lfsi_esms.htm#unit_measure1645711702136)

More detailed metadata is available at:
https://ec.europa.eu/eurostat/cache/metadata/en/lfsi_esms.htm

**2. Primary energy consumption**

Source of the data: Eurostat
https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table
Original abbreviation of the indicator: sdg_07_10
Unit of measure: million tons of oil equivalent
Description: "The indicator measures the total energy requirements of a nation excluding all non-energy utilisation of energy carriers (e.g. natural gas used not for combustion but for producing chemicals). "Primary Energy Consumption" is defined as the energy consumption by end users, including industry, transport, households, services and agriculture, plus energy consumption of the energy sector itself for production and transformation of energies, losses occurring during the transformation of energies (e.g. the efficiency of electricity production from combustible fuels) and the transmission and distribution losses of energy)."
(Source: https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table)
More detailed metadata is available at:
https://ec.europa.eu/eurostat/cache/metadata/en/sdg_07_10_esmsip2.htm

**3. Share of fossil fuels in gross available energy**

Source of the data: Eurostat
https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table
Original abbreviation of the indicator: nrg_ind_ffgae
Unit of measure: %
Description: "*Fossil fuels* encompass coal and coal products, natural gas, crude oil and petroleum products, peat and peat products, oil shale and oil sands and non-renewable municipal/industrial waste). *Gross available energy* signifies the overall supply of energy for all activities on the territory of the country. This also includes energy transformation (including generating electricity from combustible fuels), distribution losses and use of fossil fuel products for non-energy purposes (e.g. in the chemical industry). It also includes fossil fuel used for transport, encompassing fuel purchased within the country that is used elsewhere (e.g. international aviation, international maritime bunkers and, in the case of road transport "fuel tourism")."

(Source: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210204-1)

More detailed metadata is available at:

https://ec.europa.eu/eurostat/databrowser/view/nrg_ind_ffgae/default/table?lang=en

**4. Greenhouse gas (GHG) emissions by capita**

Source of the data: Eurostat

https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table

Original abbreviation of the indicator: t2020_rd300

Unit of measure: $CO_2$ equivalent per capita

Description: "The indicator is designed to measures total national emissions of the so called 'Kyoto basket' of greenhouse gases, including carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and the so-called F-gases (hydrofluorocarbons, perfluorocarbons, nitrogen triflouride (NF3) and sulphur hexafluoride (SF6)). Using each gas' individual global warming potential (GWP), they are being integrated into a single indicator expressed in units of CO2 equivalents. Emissions data are submitted on an annual basis by the EU Member States as part of the reporting under the United Nations Framework Convention on Climate Change (UNFCCC). The average population of the reference year (calculated as the arithmetic mean of the population on 1st January of two consecutive years) is used as denominator (per capita). The indicator also excludes emissions and removals related to land use, land-use change and forestry (LULUCF); it does not include emissions reported as a memorandum item according to UNFCCC Guidelines but does include emissions from international aviation as well as indirect CO2 emissions."

(Soruce: https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table)

More detailed metadata is available at:

https://ec.europa.eu/eurostat/cache/metadata/en/t2020_rd300_esmsip2.htm

**5. Share of energy from renewable sources**

Source of the data: Eurostat

https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table

Original abbreviation of the indicator: nrg_ind_share

Unit of measure: %

Description: "The use of renewable energy sources is seen as a key element in energy policy, reducing the dependence on fuel imported from non-EU countries, reducing emissions from fossil fuel sources, and decoupling energy costs from oil prices. Directive 2009/28/EC on promotion of the use of energy from renewable sources established accounting criteria for the 2020 targets on renewable energy sources.” (Soruce: https://ec.europa.eu/eurostat/web/energy/data/shares)

More detailed metadata is available at:

https://ec.europa.eu/eurostat/cache/metadata/en/nrg_ind_share_esms.htm

**6. Environmental performance index (EPI)**

Source of the data: Funding from the McCall MacBain Foundation of Canada supports the EPI work at both Yale and Columbia University: Yale Center for Environmental Law & Policy; Center for International Earth Science Information Network Earth Institute, Columbia University.

- the latest EPI: https://epi.yale.edu/epi-results/2022/component/epi
- the previous EPIs: https://sedac.ciesin.columbia.edu/data/collection/epi/sets/browse

Original abbreviation of the indicator: EPI

Unit of measure: score

Description: “The EPI 2020 provides a data-driven summary of the state of sustainability around the world. Using 32 performance indicators across 11 issue categories, the EPI ranks 180 countries on environmental health and ecosystem vitality. These indicators provide a gauge at a national scale of how close countries are to established environmental policy targets. Overall EPI rankings indicate which countries are best addressing the environmental challenges that every nation faces.” (Source: https://epi.yale.edu/).

Organization of the 2020 EPI (Source: https://sedac.ciesin.columbia.edu/downloads/data/epi/epi-environmental-performance-index-2020/2020-epi-technical-appendix.pdf page 2):

- 40% environmental health
    1. 50% air quality
    2. 40% sanitation & drinking water
    3. 5% heavy metals
    4. 5% waste management
- 60% ecosystem vitality
    5. 25% biodiversity & habitat
    6. 10% ecosystem services
    7. 10% fisheries

8. 40% climate change
9. 5% pollution emissions
10. 5% agriculture
11. 5% water resources

More detailed metadata is available at:

- the latest EPI: https://epi.yale.edu/
- the previous EPIs: https://sedac.ciesin.columbia.edu/data/collection/epi/sets/browse

**7. Ecological footprint per person**

Source of the data: Global Footprint Network
https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017

Original abbreviation of the indicator: ecological footprint

Unit of measure: global hectares (gha) per capita

Description: "Ecological Footprint accounting measures the *demand* on and *supply* of nature.
On the *demand* side, the Ecological Footprint adds up all the productive areas for which a population, a person or a product competes. It measures the ecological assets that a given population or product requires to produce the natural resources it consumes (including plant-based food and fibre products, livestock and fish products, timber and other forest products, space for urban infrastructure) and to absorb its waste, especially carbon emissions.
The Ecological Footprint tracks the use of productive surface areas. Typically, these areas are the followings: cropland, grazing land, fishing grounds, built-up land, forest area, and carbon demand on land.
On the *supply* side, a city, state or nations biocapacity represents the productivity of its ecological assets (including cropland, grazing land, forest land, fishing grounds, and built-up land). These areas, especially if left unharvested, can also serve to absorb the waste we generate, especially our carbon emissions from burning fossil fuel.
Both the Ecological Footprint and biocapacity are expressed in global hectares - globally comparable, standardized hectares with world average productivity." (Source: https://www.footprintnetwork.org/our-work/ecological-footprint/)

More detailed metadata is available at: https://www.footprintnetwork.org/resources/data/

**8. Climate change performance index (CCPI)**

Source of the data: Germanwatch, the NewClimate Institute and the Climate Action Network https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI

Original abbreviation of the indicator: CCPI

Unit of measure: score

Description: "Published annually since 2005, the Climate Change Performance Index (CCPI) tracks countries' efforts to combat climate change. As an independent monitoring tool, it aims to enhance transparency in international climate politics and enables comparison of climate protection efforts and progress made by individual countries. The implementation phase of the Paris Agreement enters a crucial phase in the end of 2020, where countries are due to submit their updated Nationally Determined Contributions (NDCs). In light of this, the CCPI aims to inform the process of raising climate ambition. As a long-standing and reliable tool for identifying leaders and laggards in climate protection, the CCPI can be a powerful instrument to hold governments accountable for their responsibility to act on the climate crisis and of stimulating a race to the top in climate action. Germanwatch, the NewClimate Institute and the Climate Action Network publish the index annually. The CCPI's unique climate policy section, evaluating countries' national and international climate policy performance, is only possible through the continued support and contributions of around 350-400 climate and energy experts." (Source: https://germanwatch.org/en/CCPI)

CCPI 2021 "compares 57 countries and the EU in the areas of Greenhouse Gas Emissions, Renewable Energies, Energy Use and Climate Policy, thus providing a comprehensive overview of the current efforts and progress of the countries analysed. Besides, it measures how well countries are on track to meet the global goals of the Paris Agreement by evaluating the current status and future targets of each category with reference to a well-below 2°C pathway." (Source: https://www.germanwatch.org/en/19602)

CCPI 2021 "assesses countries' performance in four categories:

- 40% GHG emissions
- 20% renewable energy
- 20% energy use
- 20% climate policy

Aiming to provide a comprehensive and balanced evaluation of the diverse countries evaluated, a total of 14 indicators are taken into account." (Source: https://ccpi.org/wp-content/uploads/Climate-change-performance-index-2021.pdf)

More detailed metadata is available at: https://ccpi.org/methodology/

## 3. Climate Policy in European Union

The European Union has several environment and climate protection targets for the near and longer term. In 2020, the Commission proposed to increase the greenhouse gas emission reduction target for 2030. This proposal included emissions and removals, to no less than 55% of 1990 levels. It urges actions in all sectors mainly steps toward energy efficiency and the use of more renewable energy (ec.europa.eu).

The key targets for 2030 are the following:

- Minimum 40% cuts in greenhouse gas emission (compared to 1990 levels),
- Minimum 32% share for renewable energy,
- Minimum 32.5% improvement in energy efficiency (ec.europa.eu).

As a long-term strategy, the European Union aims to be completely climate-neutral by 2050, which means a completely new economic system with net-zero greenhouse gas emissions. This is one of the most crucial parts of the European Green Deal and is in harmony with the global actions of the Paris Agreement (ec.europa.eu). To achieve this goal, all parts of the society and economic sectors should take responsibility. The EU is trying to support this urgent process by investing more in realistic technological solutions, empowering citizens and taking actions in industrial policy, finance and research. In line with this, the EU continues to address social justice for a just transition that provides equal opportunities for everybody (ec.europa.eu).

The Member States of the EU are obligated to develop and implement national long-term strategies on their own responsibilities and potential actions to achieve the aims of the EU and the Paris Agreement (ec.europa.eu). Russia's invasion of Ukraine has added new urgency to the climate actions of the EU. In the light of this pressure, there is an urgent need to reduce dependence on fossil fuel imports. The former Russian sources should be replaced by new supplies from other countries, or decisive actions need to be taken, such as switching from non-renewable to renewable resources at national level (Climate Action Tracker).

The REPowerEU plan, introduced in May 2022, includes steps in the right direction. It suggests to raising the share of renewables in final energy from 40% to 45% by 2030. It also recommends reducing final energy consumption to 750 Mtoe instead of the formerly defined 787 Mtoe by the "Fit for 55" package (Climate Action Tracker).

**References**

ec.europa.eu: https://ec.europa.eu/clima/eu-action/climate-strategies-targets_en: 05.31.2022.

Climate Action Tracker: https://climateactiontracker.org/countries/eu/ 05.31.2022.

# 4. Country Profiles

## 4.1. AUSTRIA

Austria covers 83 858 km$^2$ and is located in Central Europe. Most of the country is mountainous, mainly covered by the Eastern Alps. As a result, only 37% of the country is permanently inhabited. Forests cover almost half of Austria's total land area, while agricultural land, including alpine pastures, accounts for more than a third. Austria's highly variable topography leads to a diversity of climatic conditions. Over the last century, average temperatures have risen by more than 1°C. (Climate Adapt, 2021)

Austria was one of the first EU Member States to develop a strategy for adapting to climate change to prevent the adverse effects of climate change on the environment, society and the economy. Climate action and adaptation are essential for the implementation of the 2030 Agenda in Austria. The Austrian Federal Government has set climate neutrality as its goal for 2040 and is committed to achieving it in its current government programme. The country is adopting measures in several areas, such as public transport, housing, regional planning, fossil fuel phase-out, bioeconomy and circular economy, and technological innovation. (Gov., 2020)

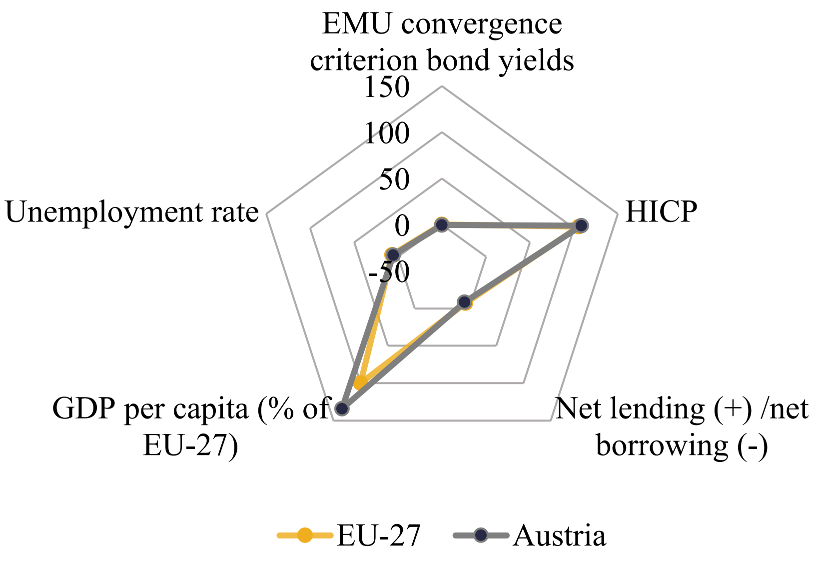



**Figure 1: Austria vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

As the Figure 1 shows that Austria is above behind the EU-27 average in one key indicator. Austria's GDP per capita is 134% of the EU average.

## Climate Strategy

### Primary energy consumption

Figure 2 visualises the total energy demand of Austria compared to the EU28. On average the Austrian share of the total primary energy consumption in the European integration between 2000 and 2019 was negligible. (Eurostat 2022)

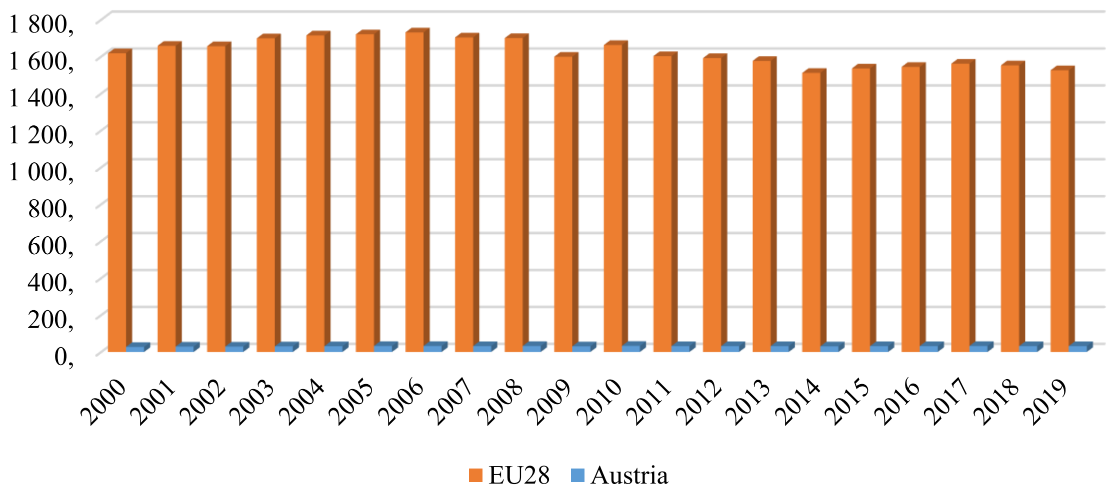



**Figure 2: Austria vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

In 2010, Austria's final energy consumption was 1,116 petajoules (PJ). The energy balance in 2018 was 1,126 PJ, an increase of 1%. The energy efficiency target for 2020 is 1,050 PJ. (Gov., 2020)

### Share of Fossil Fuels in Gross Available Energy

The absolute value of the Austrian fossil fuel consumption decreased with 70 terawatt-hours (6%) between 2000 and 2019 (Our World in Data, 2021).

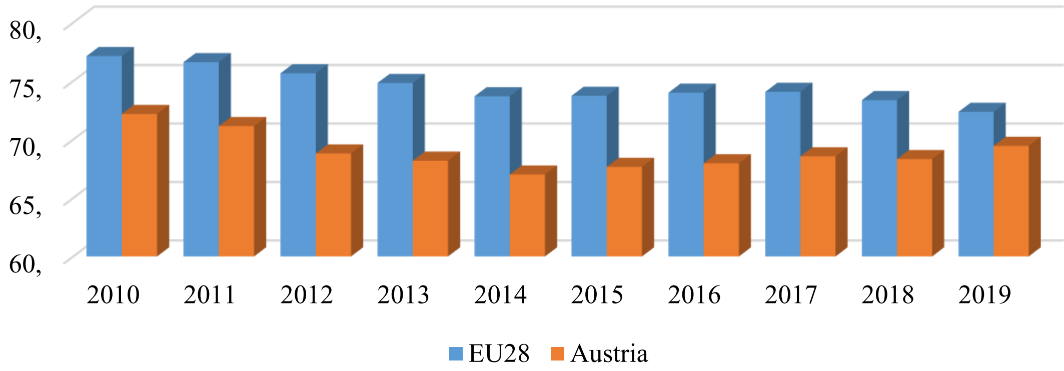



**Figure 3:** **Austria vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

Austria's domestic material consumption (biomass, metal ores, non-metallic minerals and fossil fuels) increased by 4.2% between 2010 and 2018 (Eurostat provisional estimates). In 2018, Austria’s per capita material consumption (20 tonnes) was much higher than the EU28 average (13.8 tonnes), even though Austria – like the highly industrialized countries – outsourced material-intensive production processes abroad. (Gov., 2020)

### Greenhouse Gas Emissions by Capita

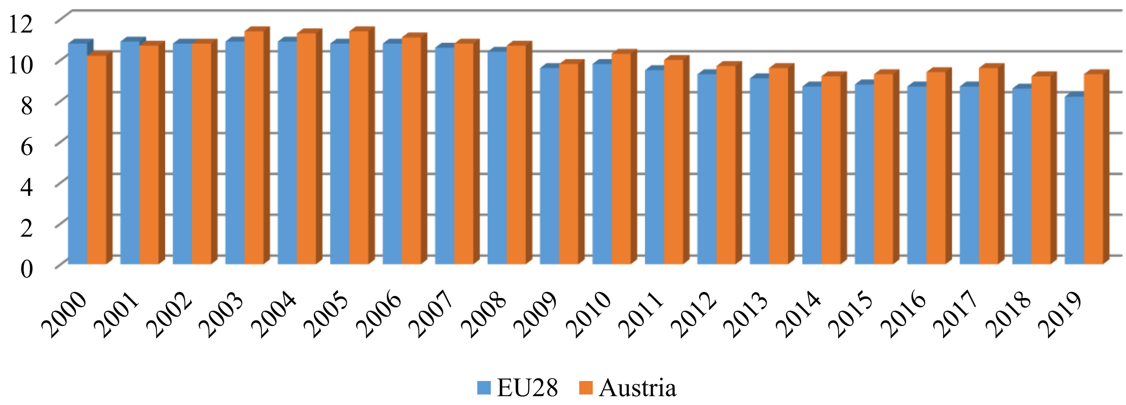



**Figure 4:** **Austria vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 ($CO_2$ equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

From 2000 to 2019, Austria’s greenhouse gas emissions decreased by 0.9%. However, emissions in 2019 were thus 1.2 million tonnes higher than in 2018. The decisive factors for this development were an increase in steel production and an increase in electricity production in natural gas power plants. In terms of economic growth (1.6% in real terms) and population growth (0.4%), 2019 was an average year. After a very mild weather in 2018, the number of heating degree days increased slightly in 2019 (+ 1.4%), although it was still slightly below the long-term trend. (Umweltbundesamt, 2021)

### Share of Energy from Renewable Sources

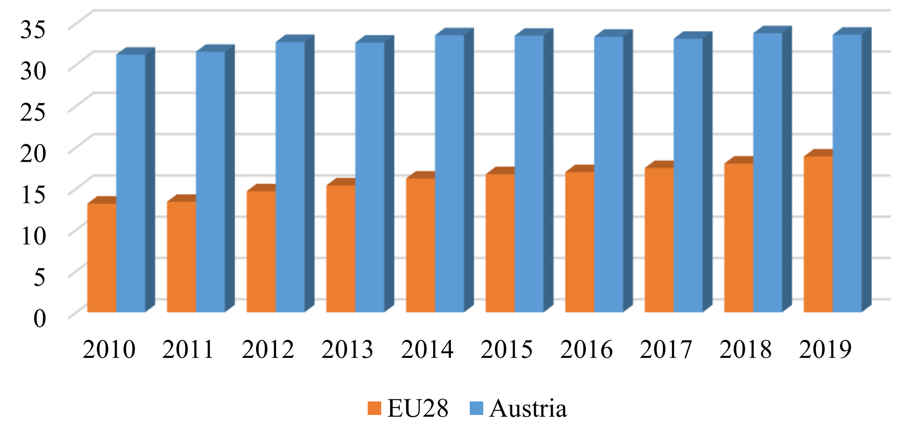



**Figure 5: Austria vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

Austria has become a leader in the utilisation of renewable energy sources, encompassing solar, wind, hydropower and electromobility. The country is offering innovative companies a combination of know-how and a dynamic business environment. Additionally, bioenergy has also grown in importance in recent years, currently representing the most important renewable energy source. (ABA, 2022)

### Composite Indicators

### Environmental Performance Index

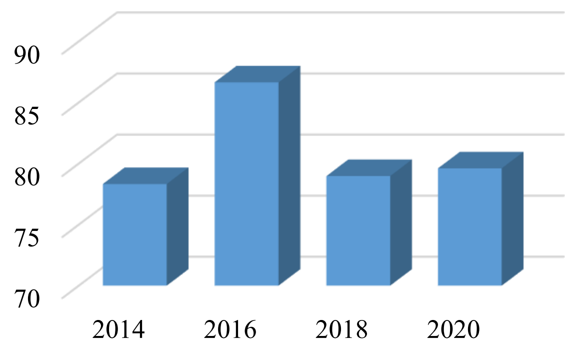



**Figure 6: Austria – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

### Ecological Footprint per Person

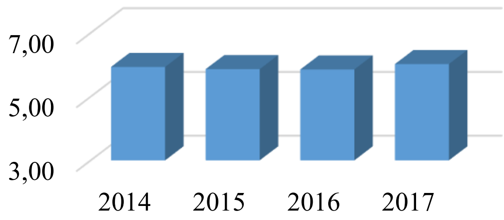



**Figure 7: Austria – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

An average Austrian consumes as much as 6 global hectares per person to satisfy personal needs in 2017.

### Climate Change Performance Index

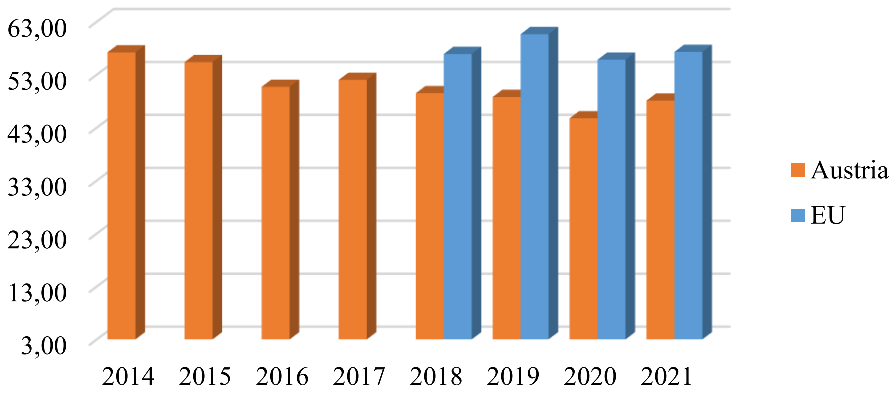



**Figure 8: Austria vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Austria maintains its place as a low performer, with the value of 48.09, in 2021 Climate Change Performance Index (CCPI).

According to the government's new climate policy plans, climate neutrality is to be achieved by 2040, with a target of 100% renewable electricity by 2030. Furthermore, the government intends to announce plans to phase out the use of oil and gas boilers, and to introduce an energy efficiency law. (CCPI, 2022)

**Good Practices**

Austria has introduced or will introduce series of measures to advance sustainability goals. Awareness campaigns have been launched to increase demand for and investment in climate-friendly and energy-efficient products, services and technologies. In addition, increased private investment is essential to successfully drive the transition to sustainable energy. Public funding should be aimed at stimulating private funding to focus more on innovation, technology development and research. In this context, the Green Finance Agenda comes into play as part of the Climate and Energy Strategy 2018 (#mission2030), by creating the right framework conditions to mobilize private capital to address societal challenges, especially climate protection. Furthermore, Austria is involved in international projects to address the consequences of climate change (see "Resilience programme for human and cultural landscapes"). The nation also provides its expertise in climate protection to partner countries through development partnerships in joint design projects. (Gov., 2020)

Austria participates in international and transnational networks, working groups and cooperation structures dedicated to the exchange of knowledge, experience and joint research projects. To illustrate, at the international/EU level, Austria contributes to the OECD Task Force, the EU WG 6, the EPA IG, and the European Topic Centre on climate adaptation. (Climate Adapt, 2021)

- Vienna's management developed the UHI-START project with external experts to combat the city's heat island effect (UHI). These include measures such as planting parks, trees or rainwater management practice. The project also deals with calling the attention of the population and promoting measures for better reception. (https://vizmegtartomegoldasok.bm.hu/storage/dokumentumok/Jo%20gyakorlatok%20a%20Polgarmesterek%20Szoevetsegenek%20alairoitol.pdf)
- Solar powered ski lift in Tyrol. In Söll, some rooms of the lift complex are heated with the heat generated during the operation of the cabin lift. (https://hutte.blog.hu/2012/02/17/kornyezetbarat_sikozpontok)
- Value-added recycling of truck tarpaulins. For example, after washing, cutting and sewing, tarpaulins are made into fashionable shoulder bags and toiletry bags. (https://www.cargo-partner.com/hu/ceguenkrol/fenntarthatosag)

**References**


- ABA, Invest in Austria (2022): Renewable Energies in Austria. https://investinaustria.at/en/sectors/environmental-technologies/renewable-energies.php
- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.

- CCPI (2022): Austria. https://ccpi.org/country/aut/
- Climate Adapt (2021): National circumstances relevant to adaptation actions. https://climate-adapt.eea.europa.eu/countries-regions/countries/austria
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Gov. (2020): Austria and the 2030 Agenda. Voluntary National Review – Report on the Implementation of the Sustainable Development Goals. Austrian Federal Chancellery. https://sustainabledevelopment.un.org/content/documents/26511VNR_2020_Austria_Report_English.pdf
- Our World in Data (2021): Austria: Energy Country Profile. https://ourworldindata.org/energy/country/austria
- Umweltbundesamt (2021): Austria's greenhouse gas emissions in 2019. Environment Agency Austria. https://www.umweltbundesamt.at/en/news210122en

## 4.2. BELGIUM

Belgium's population was 11,589,623 people in 2020, a population density of 383 per km$^2$ and a total land area of 30,280 km$^2$. The 98.3% of the total population resides in urban areas. Its biggest cities are Brussels, Antwerpen and Gent (worldometers.info). The northern part of the country is more densely populated than the southern part (climate-adapt.eea.europa.eu).

According to the OECD's forecast Belgium's economy is anticipated to expand by 3.2% in 2022 and 1.4% in 2023. Private consumption and business investments could support economic rebound. The labour market is started to normalise in 2021, therefore the unemployment rate is forecasted to peak 6.6% in 2022 and then decline. In parallel with it, labour and skill shortages in the most important sectors will also grow. Inflation is ending up and emerging increasing energy prices could lead to wage inflation through indexation (OECD Economic Outlook, 2021, pp. 79-81).

Workers' reallocation is necessary to reach the government's employment targets by encouraging lifelong learning and active labour market policies mainly in the case of the most vulnerable worker groups. Product market reforms are crucial for reviving productivity growth. Due to the high ratio of public dept to GDP fiscal buffers, green and digital investments are imperative to handle future shocks (OECD Economic Outlook, 2021, pp. 79-81).

The country's most important economic statistics compared to the EU-27 average can be seen in Figure 9.

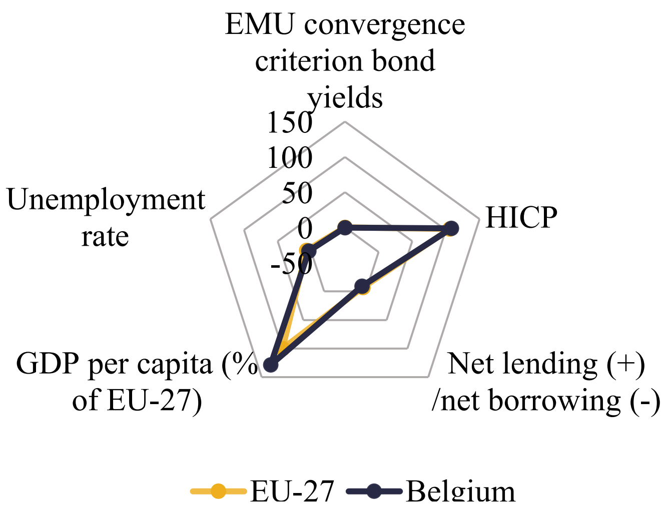



**Figure 9: Belgium vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

Economic growth is mainly driven by resilient business investment and increasing private consumption. GDP surpassed its pre-pandemic level in the third quarter of 2021, moreover private consumption is expected to rise, and household savings ratio will normalise in 2022. Business investments are also expected to increase in 2022. Energy prices are forecast to increase and creating the risk of labour cost inflation in 2022 (OECD Economic Outlook, 2021, pp. 79-81).

Belgium has excellent metal and chemical/refining industries. However, the service sector is also dominant. It accounts for 70% of the GDP. The agriculture of the country is specialised in cereals, industrial crops, forage plants, vegetables and horticultural crops, potatoes, livestock and milk production. Contrary to the fact that the share of agricultural areas in Belgium is significant, the number of farmers is decreasing. As a result of this negative process, the ratio of agriculture is less than 1% of the GDP (climate-adapt.eea.europa.eu).

**Climate Strategy**

Belgium's National Climate Change Adaptation Strategy dates back to 2010 and its oldest National Adaptation Plan was created for the period of 2017–2020. The National Climate Change Adaptation Strategy had three main objectives:

- "to provide coherence between the existing Belgian adaptation activities (evaluations of the impact and vulnerability to climate change, as well as adaptation measures already implemented)
- to better communicate on a national, European and international levels,
- to start developing a National Adaptation Plan" (Belgian National Climate Change Adaptation Strategy, 2010, p. 7.)

According to the studies water and heat will be affected the most by the negative effects of climate change in Belgium. Water shortages and high temperatures will have a serious impact on public health. It is anticipated that the agriculture and forestry sectors will also suffer encounter water management issues. Low water levels in rivers and canals is of particular concern, as they have the potential to disrupt transport system, especially inland navigation. Extreme weather conditions such as heavy rainfall and heightened precipitation intensity may cause flooding, subsequent salinity issues, erosion and other problems in urban areas like difficulties regarding infrastructures, sewage systems, roads. Overall, all economic sectors will be affected by the impacts of climate change. In order to mitigate these effects, concerted efforts on the part of the nation as a whole are essential. (Belgian National Climate Change Adaptation Strategy, 2010).

According to the strategy, the following sectors are projected to be most impacted by the climate change: health (through heat waves, high temperatures, and diseases), tourism, agriculture, forestry, biodiversity, ecosystems and water, coastal, marine and tidal areas, production systems and physical infrastructure (Belgian National Climate Change Adaptation Strategy, 2010).

The National Adaptation Plan 2017–2020 identified the measures as the part of the national actions:

- ❖ Development of high-resolution climate scenarios for Belgium
- ❖ Development of a roadmap for a Belgian climate knowledge centre
- ❖ Development of a national online platform for climate adaptation
- ❖ Strengthening of the sectorial coordination on a national level
- ❖ Including climate change in the risk assessment of exotic invasive species
- ❖ Evaluation of the impact of climate change on the energy supply security and on the transport and distribution infrastructures for energy
- ❖ Evaluation of the socio-economic impact of climate change in Belgium
- ❖ Including the impact of climate change and need for adaptation into the framework to the future national action plan for environment and health
- ❖ Make specialists in the field of healthcare aware of the effects of climate change
- ❖ Transnational cooperation for adaptation (Belgian National Adaptation Plan 2017–2020, 2016).

Belgium’s primary energy consumption comparing with EU-28 can be seen in Figure 10.

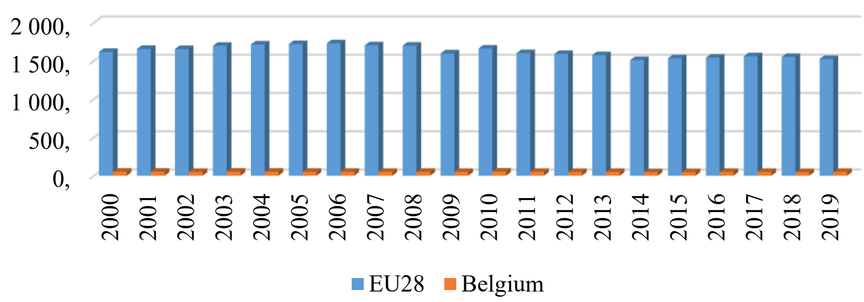



**Figure 10: Belgium vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**

Source: own compilation based on Eurostat (2022a)

Total energy usage per person is 57% higher than the EU average, at 4.5 toe in 2020. However, the electricity consumption per capita is one third higher than the EU average and amounted to around 7,100 kWh in the same year (enerdata.net).

Energy consumption per person has increased from 1965 to 2019. The highest value was 72,761 kWh in 2008 and the lowest was 43,720 kWh in 1965. In 2019, the average person consumed 65,303 kWh of electricity (ourworldindata.org)

The following sectors utilised the most energy from 1990 until 2019: industry, residential and transport. In terms of sources, most of the total energy consumption owing to oil products, natural gas and electricity over the same period (eia.org).

Regarding fossil fuels, Belgium follows the EU climate target and plans to eliminate all fossil fuels by 2050 from its energy production by 2050. Today, fossil fuels play important role in the country's heating, but new sustainable forms of heating with modern technologies are needed to achieve this goal (Belgian Integrated National Energy and Climate Plan 2021-2030, 2019).

The share of fossil fuels in gross available energy can be viewed in Figure 11.

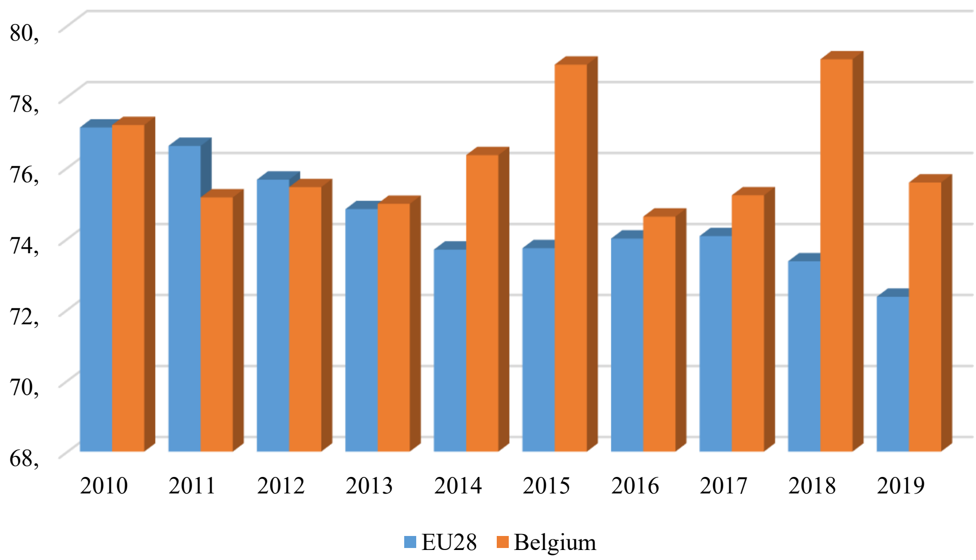



**Figure 11: Belgium vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

Belgium's fossil fuel consumption is higher than the EU average and its share in gross available energy is higher than the EU average.

Belgium is responsible for 3.3% of the total greenhouse gas emissions in the EU however, decreased its volume in a slower rate than the EU average since 2005. The carbon intensity of the Belgian economy is lower than the EU average with a decreasing trend since 2005.

Emissions from the energy industries decreased by 30% between 2005 and 2019. Waste management was responsible for the largest reduction (55%) since 2005, while transport and agriculture were the least successful in this regard. Per capita emissions in 2019 were the 7th highest in the EU (Simões, 2021a).

Belgium accounts for net emissions of 123 $MtCO_2e$ in 2019 with 17.2 reduction compared to 2005. The LULUCF (Land use, land use change and forestry) emissions and its carbon sink functions have not changed since 2005. The country is planning to increase LULUCF functions by sustainable agricultural management. At the same time, changes in agricultural practices are also encouraged by the country's government (e.g. biomass instead of fossil fuels, increasing long-term carbon storage in soils, fossil fuel-based raw material from sustainable management) (Simões, 2021a).

Belgium's greenhouse gas emissions by capita compared to EU-28 average from 2000 till 2019 can be seen in Figure 12.

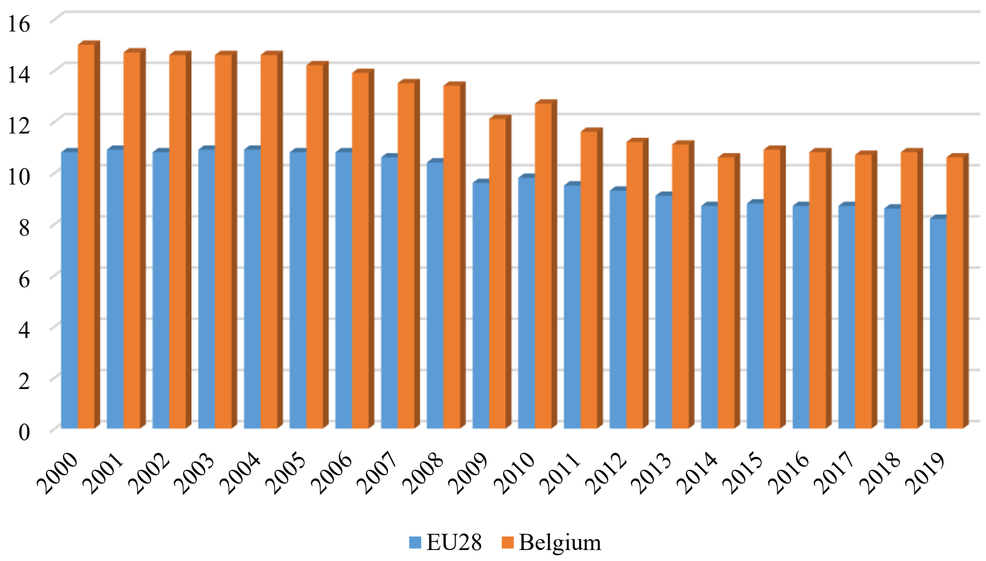



**Figure 12: Belgium vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

$CO_2$ emissions per capita has decreased between 1990 and 2020. Total $CO_2$ emission has decreased from 1990 to 2020. The highest emission was measured in 1996, from which year onwards the values decreased. Overviewing the main energy sources, most of the $CO_2$ emissions belongs to oil that is followed by natural gas and coal. From 1990 until 2018 $CO_2$ emissions has remain almost stable with smaller jumps regarding the oil, natural gas and coal (iea.rog).

Belgium’s share of energy from renewable sources can be seen in Figure 13.

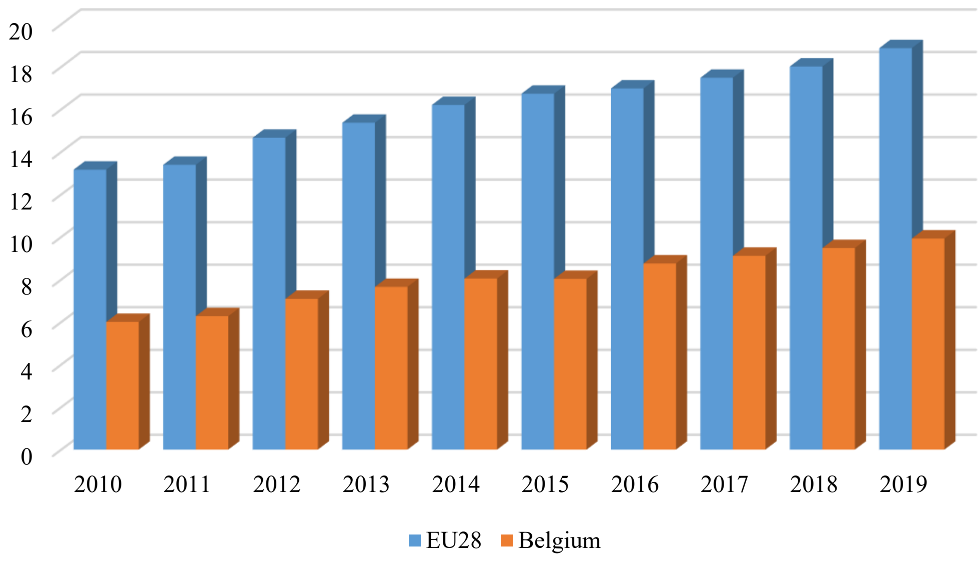



**Figure 13: Belgium vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

Belgium rose its renewable energy ration of total energy consumption by 7.6 percentage points during the period 2005–2019. Its target for 2030 is 17.5%, but the European Commission found it less ambitious. By 2030, the country aims to increase the share of renewables regarding electricity (37.4), transport (23.7%) and heating and cooling (11.3%). This can be achieved by investing in wind and photovoltaic energy production, biofuels and the use of waste heat (Simões, 2021a).

**Composite Indicators**

Belgium's performance is noteworthy in terms of the performance indicators that measure sustainability and climate protection. The Environmental Performance Index (EPI) scores from 2014 to 2020 is illustrated in Figure 14. Regarding the EPI it only was in the best 20 among the 180 ranked countries in 2018 and 2020. However, its results were always around the EU-27 average.

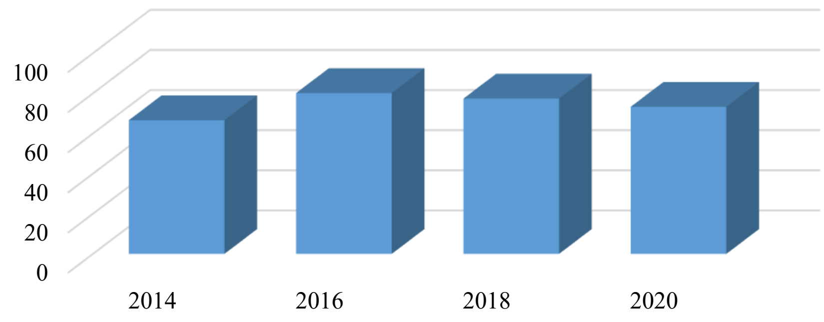



**Figure 14: Belgium – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Its ranks and scores were following in the EPI:

- ❖ 2014: 36. with 66.61 points (EU-27 average: 72.17)
- ❖ 2016: 41. with 80.15 points (EU-27 average: 82.91)
- ❖ 2018: 15. with 77.38 points (EU-27 average: 73.33)
- ❖ 2020: 15. with 73.30 points (EU-27 average: 70,95)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Belgium's ecological footprint per person from 2014 to 2020 can be seen in Figure 15.

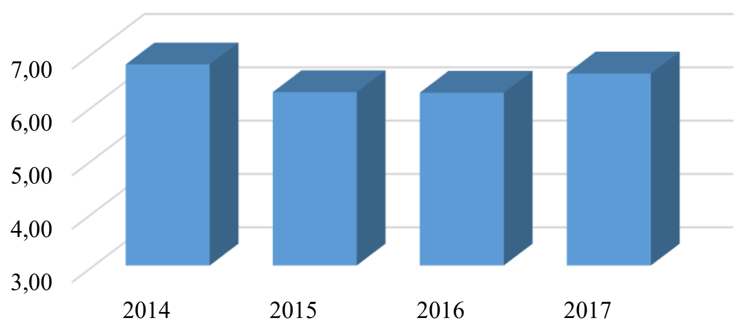



**Figure 15: Belgium– Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

The nation's ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

- ❖ total score in 2014: 6.77 (EU-25 average: 5.23)
- ❖ total score in 2015: 6.25 (EU-25 average: 5.25)
- ❖ total score in 2016: 6.24 (EU-25 average: 5.26)
- ❖ total score in 2017: 6.60 (EU-25 average: 5.34)

The country performs excellently regarding the ecological footprint as its scores are always higher than the EU-25 average.

Concerning the Climate Change Performance Index (CCPI), Belgium's performance is inconstant. The scores of the CCPI for the country can be seen in Figure 16.

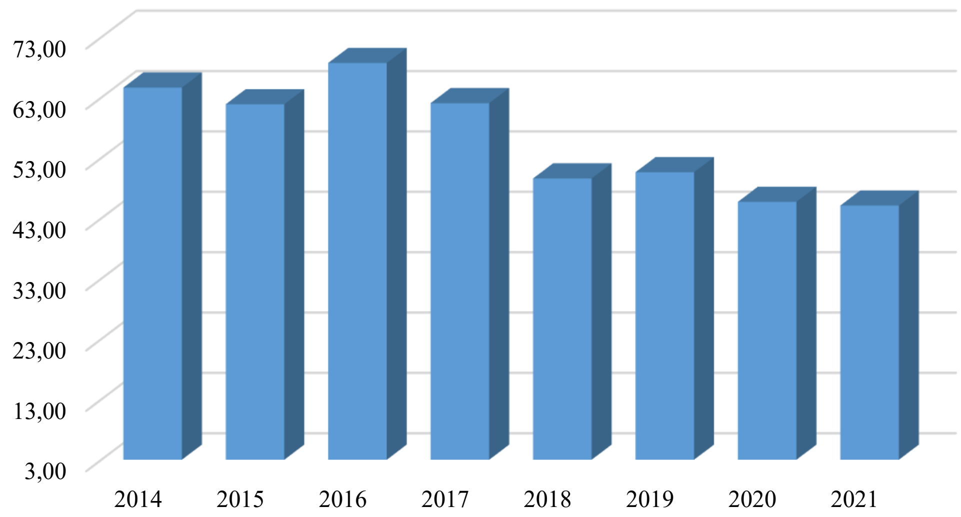



**Figure 16: Belgium vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

- 2014: 14. with 64.65 points (global average: 55.72)
- 2015: 16. with 61.89 points (global average: 55.36)
- 2016: 7. with 63.87 points (global average: 54.15)
- 2017: 12. with 62.08 points (global average: 53.77)
- 2018: 32. with 49.60 points (global average: 49.09)
- 2019: 31. with 50.63 points (global average: 50.35)
- 2020: 35. with 45.73 points (global average: 48.61)
- 2020: 40. with 45.11 points (global average: 50.96)

**Good Practices**

**Low emission zones**

In Belgium, low-emission zones (LEZ) have been implemented in several cities, Depending on the environmental classification of vehicles, entry is permitted only with either registration or a temporary permit. Examples of this include Brussels, Antwerp and Ghent (lez.belgium.be)

Moreover, from 1 January 2022, diesel cars with a Euro 4 rating or lower and certain vehicles over the age of 11 will not be allowed to drive in the Brussels region for environmental reasons. In terms of future projections, the government of Brussels is planning to phase out of commission most diesel vehicles by 2025. According to some surveys, diesel vehicles are responsible for some part of the air pollution problems that causes serious health issues (24.hu, 2022).

**LightCather**

"The LightCatcher is an intelligent skylight, that features a revolving mirror, which captures the daylight and reflects it downward. It is the most cost effective daylighting solution and thus the leading ecological alternative to traditional skylights. The LightCatcher ensure diffused and comfortable daylight indoors whilst mitigating temperature fluctuations." (solarimpulse.com) Light Catcher brings natural light into the darkest buildings. It employs a polycarbonate light dome with an integrated mirror tracking system identifies the brightest available light source and directs it into the building. Brings in natural light without energy consumption.

**Omegabaars**

A new and innovative farming method can provide an alternative for traditional way of breeding fish. It presents an excellent solution to avoid the problems of overfishing, water pollution and loss of biodiversity (omegabaars.be).

Rainwater is collected in the greenhouses of tomato plantations to fill fish reservoirs. The heat produced in the greenhouses is utilised for the heating of water in the reservoirs. The fish feed is entirely plant-based, resulting in the wastewater being treated in reeds and the manure is utilised as an energy source on arable land or in biogas plants. Excess water is used for irrigation of tomatoes (omegabaars.be).

**Ecover**

A detergent manufacturer has developed a sugar cane-based polyethylene for packaging use. This renewable plastic has the potential to reduce the company's environmental impact. The bottles are notable for their durability, with a service life in excess of 50 refills. Refilling is a viable option throughout Belgium. In 2016, Ecover sold over 1,5 million litres of refills in Europe, and the company has stated its intention to increase this number in the future (ecover.com) (https://www.ecover.com/mission/clean-plastic/). Their objective is to set a precedent for other companies, offering a sustainable type of plastic and reducing the industry's plastic footprint. Ecover's effort is the identification of novel biodegradable materials (ecover.com).

**Volvo in Ghent**

One of the first climate-neutral vehicle plant factory is in Ghent in Belgium (volvotrucks.hu)

Other examples:

- Meat-free meal one day a week.
- Use of environmentally friendly detergents.

  (https://www.ecover.com)
- Introduction of low-emission zones (LEZ), where you can enter by vehicle temporarily or only with registration.

  (https://www.lez-belgium.be/en/)
- The company Belvas collects organic waste and uses it in biogas plants to melt its chocolates with the extracted green energy.

  (https://www.cocoatraders.co.nz/collections/belvas, https://www.chocolaterie-belvas.be/en/our-commitments/ )

  (https://solarimpulse.com/companies/econation#)
- **Sustainable fish farm** - Rainwater is collected in tomato greenhouses to fill the fish reservoirs. The heat produced in the tomato greenhouses is used to heat the water in the reservoirs. The fish feed is 100% plant-based, so the wastewater is treated in reeds and the manure goes to the fields or to biogas plants as an energy source. Excess water is used to irrigate tomatoes.

  (https://www.omegabaars.be/en/what-is-the-omegabaars)
- **Prohibition of certain vehicle types** - From January 1, 2022, diesel cars rated Euro 4 and below, as well as certain vehicles older than 11 years, will not be allowed to drive in the Brussels region for environmental reasons.

  (https://24.hu/kulfold/2022/01/03/dizel-gazolaj-auto-kitilt-euro-4-brusszel-belgium-11-ev-dizelauto/)
- **Environmentally aware street art** - The Belgian painter-sculptor Strook creates captivating works on the walls of houses from discarded furniture and doors.

  (https://www.nyugat.hu/cikk/strook_street_art)

**References**


- 24.hu (2022): Kitiltották Brüsszelből az Euro 4-es, meg a 11 évesnél idősebb dízelautók nagy részét. 24.hu. Available: https://24.hu/kulfold/2022/01/03/dizel-gazolaj-auto-kitilt-euro-4-brusszel-belgium-11-ev-dizelauto/ (03.03.2022)

- Belgian Integrated National Energy and Climate Plan 2021-2030, 2019. Available: https://ec.europa.eu/energy/sites/default/files/documents/be_final_necp_parta_en.pdf (26.11.2021)
- Belgian National Adaptation Plan 2017-2020 (2016). Available: https://climat.be/doc/NAP_EN.pdf (05.12.2021)
- Belgian National Climate Change Adaptation Strategy (2010). Available: https://www.cnc-nkc.be/sites/default/files/report/file/be_nas_2010_1.pdf (11.12.2021)
- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Novák, Zs. (2022): Hogyan lett Hollandia bringanagyhatalom? Greendex. Available: https://greendex.hu/hogyan-lett-hollandia-bringanagyhatalom/ (03.03.2022)
- OECD (2020). OECD Economic Surveys: Ireland 2020, OECD Publishing, Paris, https://doi.org/10.1787/dec600f3-en (11.11.2021)
- OECD (2021). OECD Economic Outlook, Volume 2021 Issue 2: Preliminary version, No. 110, OECD Publishing, Paris, https://doi.org/10.1787/66c5ac2c-en (11.11.2021)
- Simões, H. M. (2021a). Climate action in Belgium- Latest state of play. Available: https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/690578/EPRS_BRI(2021)690578_EN.pdf (16.12.2021)
- https://www.volvotrucks.hu/hu-hu/about-us/environmental-care.html (03.03.2022)
- https://www.ecover.com/mission/clean-plastic/ (03.03.2022)
- https://www.omegabaars.be/en/what-is-the-omegabaars (03.03.2022)

- https://solarimpulse.com/companies/econation# (03.03.2022)
- https://www.lez-belgium.be/en/ (03.03.2022)
- https://www.worldometers.info/ (15.12.2021)
- https://climate-adapt.eea.europa.eu/ (12.12.2021)
- https://ourworldindata.org/ (12.12.2021)
- https://www.iea.org/ (12.12.2021)
- https://www.enerdata.net/
- https://www.worldbank.org/en/home (12.12.2021)

## 4.3. BULGARIA

In 2017, Bulgaria had an urban population of 5 181 755, which constituted 73.5 percent of the total population Approximately 45.6 percent of the urban population was concentrated in six large cities. Despite projections indicating an overall decline in the population, the urban population is anticipated to reach 81 percent of the total population by 2050. This urban concentration exerts pressure on land, infrastructure and services, and exposes more people to disaster risks due to the higher concentration of vulnerable groups. The unfavourable demographic has a significant impact on economic development, as well as placing considerable strain on the national health system, which is at risk of financial instability. In terms of regional development, there are still large disparities between urban and rural areas, as well as between Bulgaria's development regions. Problems such as negative natural population growth, migration, poor age structure, low employment levels and poor infrastructure urgently need to be addressed, particularly in the NUTS 2 North West region and smaller municipalities (Climate Adapt, 2022a).

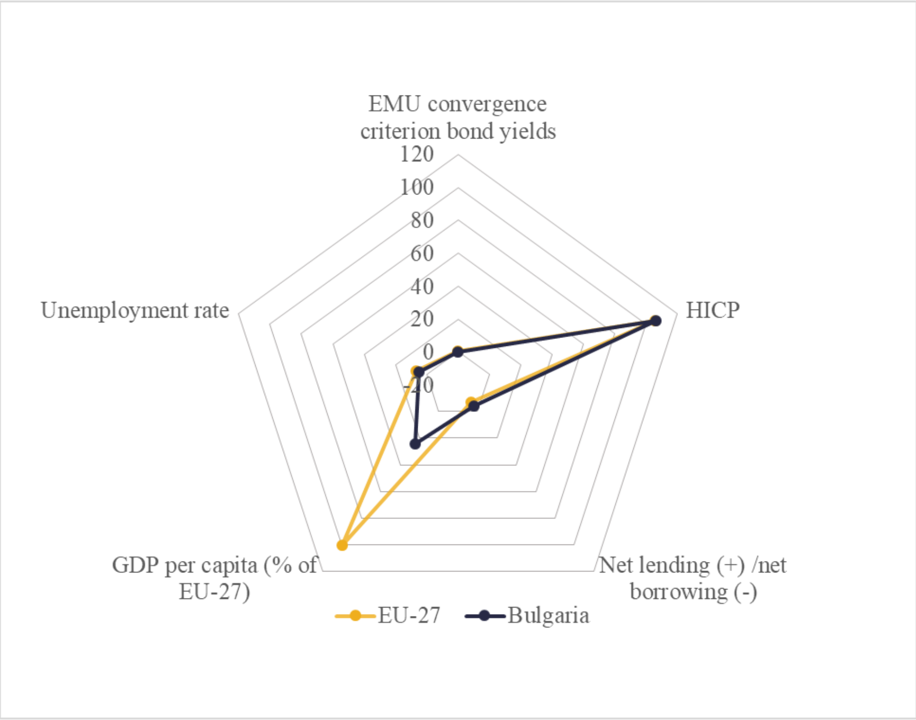



**Figure 17: Bulgaria vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

Some of the selected economic indicators in Figure 17 shows significant deviations from the EU-27 average. The interest rates in accordance with Maastricht criterion are below the EU average and GDP per capita is only a quarter of the EU average. The unemployment rate is considerably lower than the EU average (2%) and government expenditure is less than the proportion of government revenue in comparison to EU countries. The harmonised index of consumer prices is 1% higher than the EU average.

**Climate Strategy**

The Government of Bulgaria has requested the assistance of the World Bank to provide advisory services on the following: *strengthening of strategic planning for climate change adaptation, including inputs for the preparation of the National Strategy for Climate Change Adaptation and the Action Plan of the Ministry of Environment and Water*. The development objectives of the project are threefold: firstly, to assess the management of climate risks and opportunities across the economy; secondly to develop a national climate change adaptation strategy and action plan for the period up to 2030; and thirdly to strengthen implementation and cross-sectoral coordination capacity for climate change adaptation. In developing this strategy and action plan, the principles and methodology of strategic planning in the Republic of Bulgaria have been followed as far as possible (Council for Administrative Reform 2010). This approach includes the structure, methodologies and content of strategy documents and the principle of public partnership between public institutions, citizens, and their respective organisations. The 'Strategy and Action Plan' also draws on the resources available for the development of climate change adaptation strategies and action plans, including the European Commission's Guidelines for the Development of Adaptation Strategies and the European Climate Change Platform (Climate-ADAPT).

The proposal for the National Strategy and Action Plan for Climate Change Adaptation of the Republic of Bulgaria sets out a framework for climate change adaptation (CCA) measures and priority directions for the period up to 2030, identifying and reinforcing the necessity for CCA measures at both economic and sectoral levels. The sectors concerned are agriculture, biodiversity and ecosystem services, energy, forestry, human health, transport, tourism, urban environment and water. Disaster risk management is also included as a cross-cutting issue. The reason for developing an adaptation strategy and action plan is that Bulgaria is situated within a region particularly vulnerable to climate change (primarily due to rising temperatures and extreme precipitation) and to the increase in extreme climate-related events such as droughts and floods. The risks posed by climate-related events can lead to loss of human life or inflict significant damage, affecting economic growth and prosperity at both national and cross-border levels. There is a broad scientific consensus that climate change is likely to increase the frequency and magnitude of extreme weather events, while annual air temperatures and precipitation patterns are expected to rise and change in the coming decades (The World Bank, 2018).

The expected changes are likely to affect all sectors of the economy. These changes are also assumed to have an impact on society and its citizens, as well as on the economy in its entirety. The general conclusions of the report on the macroeconomic consequences of climate change highlight the costs of adaptation measures. It is important to note that not all people and areas will be affected equally by the impacts of climate change, as exposure, existing vulnerabilities and adaptive capacities will vary. It is therefore logical to infer that less prepared and more vulnerable segments of society and businesses will be at greater risk. For all sectors, there are significant uncertainties in assessing the nature and extent of vulnerability to climate change. However, the main common themes in climate risk and vulnerability assessments across all sectors in the country are as follows: firstly, the increasing frequency of extreme climate-related events and secondly, the potential impacts of gradual changes in temperature and precipitation on infrastructure, production, human health and ecosystem services, with implications for economic growth and livelihoods. The economic analysis prepared for this strategy estimates that the cumulative decline in real Gross Domestic Product (GDP) in 2050 compared to the baseline scenario will be between 1 and 3.5 percent (Ministry of Environment and Water Republic of Bulgaria, 2012).

### Climate change

Bulgaria is located in a region that is particularly vulnerable to climate change (mainly due to rising temperatures and extreme precipitation) and to an increase in the frequency of extreme climate-related events such as droughts and floods. The risks posed by climate-related events can lead to loss of human life or cause significant damage, affecting economic growth and welfare at both national and cross-border levels. There is a broad scientific consensus that climate change is likely to increase the frequency and magnitude of extreme weather events, which have increased significantly in Bulgaria in recent decades. The most prevalent hydrometeorological and natural hazards include extreme precipitation and temperature, storms, floods, forest fires, landslides and droughts. The mortality and injury toll resulting from natural hazards underscores the vulnerability of populations to weather and climate extremes. The vulnerability of Bulgarian population and businesses to the effects of climate change is further compounded by the relatively high levels of poverty in the most affected areas, the continued concentration of the country's population in some industrial and urban regions, and the various consequences of the transition from a state-controlled to a free market economy (Republic of Bulgaria, 2019).

In the context of the Bulgarian economy, the energy sector is a significant contributor to the national gross domestic product (GDP) with industry and the energy sector accounting for around 20 percent of it. Energy production is heavily reliant on domestic coal production, which constitutes over 50% of the primary energy supply, followed by nuclear power accounting for 34%. Figure x shows total EU energy demand. The data demonstrate an average of 1% per year decrease in total EU energy demand over the 20-year period.

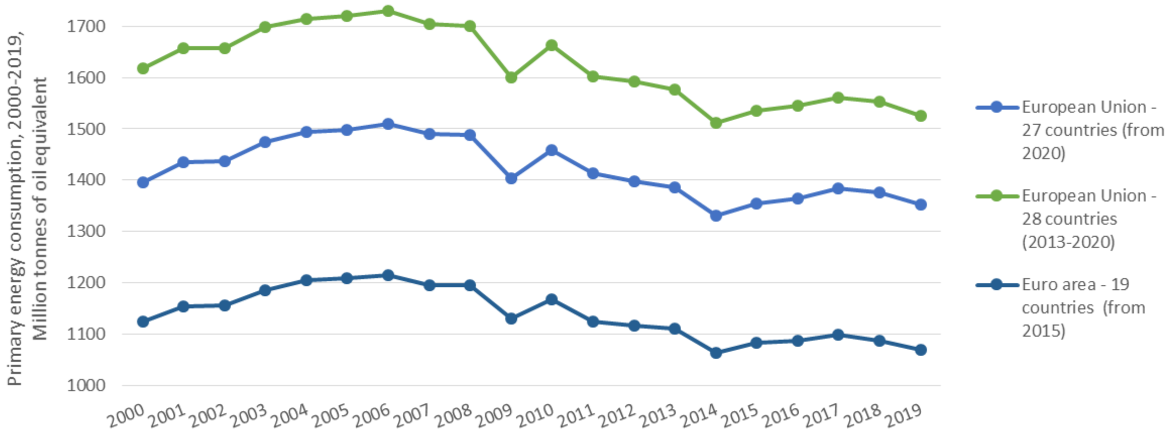



**Figure 18: Primary energy consumption, 2000-2019 (million tons of oil equivalent)**

Source: own compilation based on Eurostat (2022a)

For Bulgaria, however, the average rate of change does not follow this trend and shows stagnation and even a slight increase over the same period.

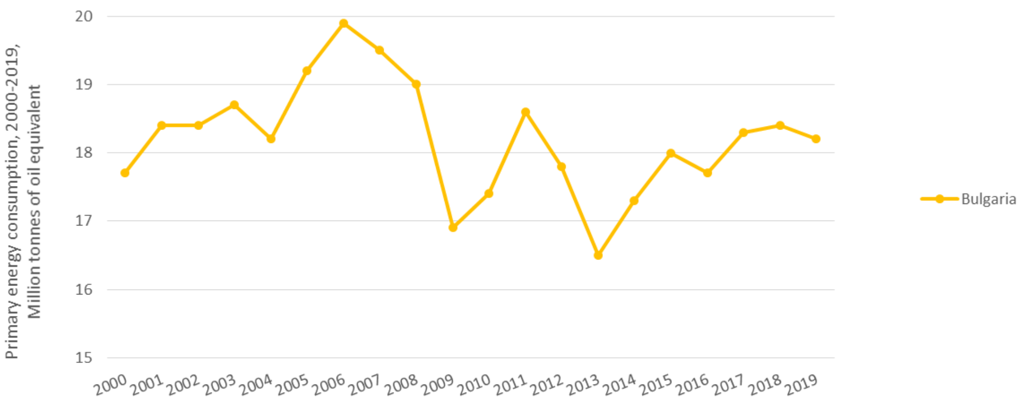



**Figure 19: Bulgaria vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**

Source: own compilation based on Eurostat (2022a)

At the same time, Bulgaria is similarly heavily dependent on imported energy sources, including natural gas, oil and nuclear fuel. The energy sector in Bulgaria is projected to be affected by climate change. The country is already exposed to several natural hazards, including floods, droughts, forest fires, earthquakes and landslides. Increased temperatures, reduced rainfall, changes in river flows and ecosystems, and the occurrence of extreme events have already resulted in damage and disruption to the energy sector. However, these events have not yet had a significant impact on energy infrastructure, with the majority of damage being confined to the electricity grid and the resultant temporary power outages. Nevertheless, an increase in the frequency and intensity of such weather events is likely to challenge the sector in the future. Energy infrastructure is vulnerable to a number of climate stressors, including temperature, precipitation, sea level rise and extreme events. Of particular concern is the expected alteration of extreme heat, precipitation and storm intensity, frequency and distribution, increasing the vulnerability of energy infrastructure. This is due to the need to consider a number of factors, including future environmental, economic and social changes. A significant source of uncertainty is pertains to the extent to which future emissions of greenhouse gases (GHGs) will modify the radiation over the next century. Unfortunately for Bulgaria, it shows fluctuations between 2000 and 2019, but overall, on average, a 1% increase in GHG emissions (Ministry of Environment and Water Republic of Bulgaria, 2012).

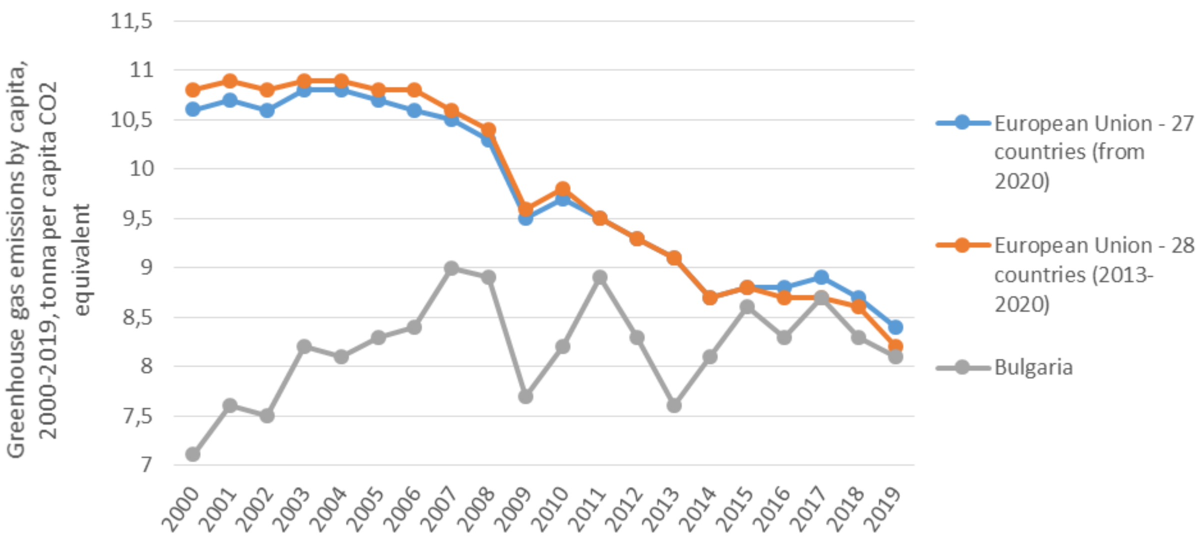



**Figure 20: Bulgaria vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

Greenhouse gas emissions are affected by complex factors including population growth, economic growth and energy policy. The EU and its Member States have committed in their Intended Nationally Determined Contributions (INDCs) to reduce greenhouse gas emissions by a minimum of 40% below 1990 levels by the year 2030. In light of the global nature of these processes, Bulgaria's climate policy measures have been primarily guided by its international commitments, as outlined in the United Nations Framework Convention on Climate Change (UNFCCC), and its obligations within the European Union.

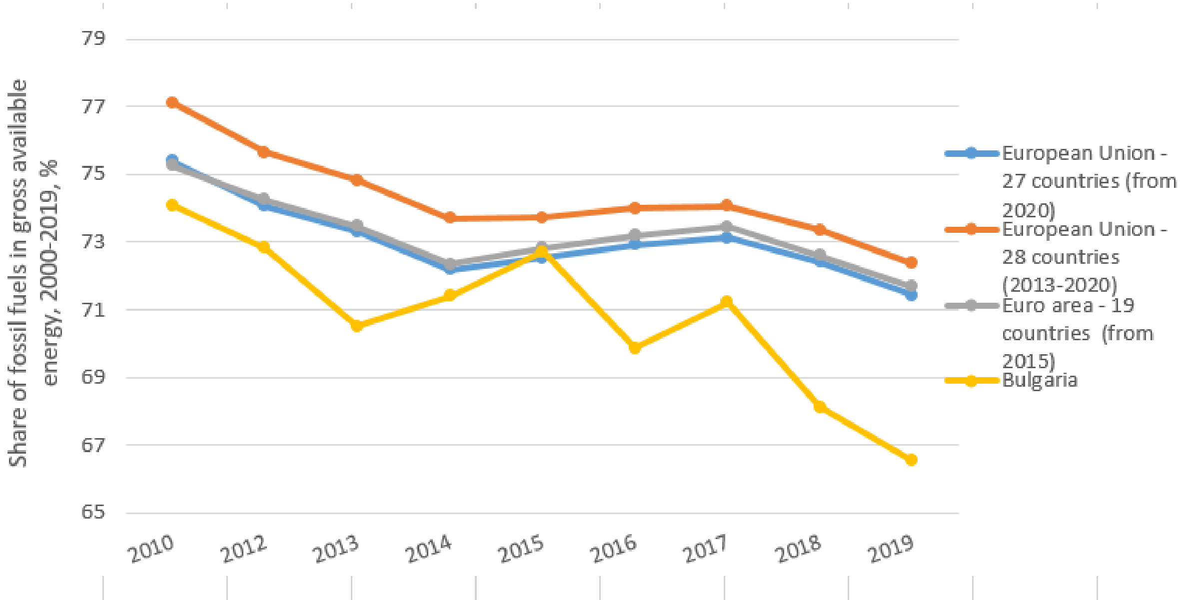



**Figure 21: Bulgaria vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

These include reducing greenhouse gas emissions (mitigation) and improving resilience to climate change and natural disasters (adaptation). Another important factor is the evolution of the share of fossil fuels in gross available energy, as the use of these fuels increases carbon dioxide emissions. In Bulgaria, fossil fuel use has been decreasing at a higher rate than the EU average since 2010.

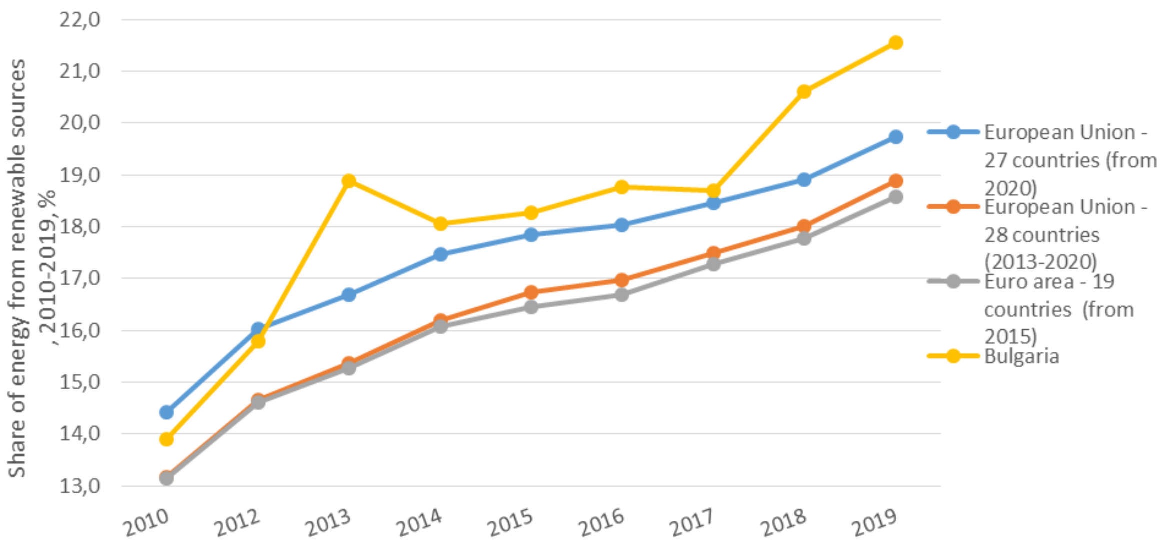



**Figure 22: Bulgaria vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

Nevertheless, the policy and legal framework (CCMA and NAPCC) have hitherto concentrated chiefly on mitigation aspects. Since 2007, Bulgaria has been contributing to the EU's common targets of a 20% in GHG reduction by 2020, a 20% share of renewable energy use in final consumption and a 20% increase in energy efficiency (Republic of Bulgaria, 2019).

The nation is on track to meet its individual share of these targets and, following the adoption of the new climate and energy package, it has also committed to the EU's collective target of a 40% reduction in greenhouse gas emissions by 2030 (The World Bank Group, 2021).

Hydropower production is predicted to be adversely affected by reduced rainfall, particularly during the summer months. River flows will vary due to changes in precipitation patterns and reduced snow and ice cover in mountainous regions. Solar may be particularly vulnerable to increased cloud cover associated with increased rainfall. Furthermore, changes in wind patterns and intensity due to climate change may affect the productivity of existing wind farms. In addition, extreme storm conditions have the potential to damage wind turbines and result in downtime. The synergies identified relate to renewable energy, mainly bioenergy, in addition to solar and water energy. These synergies encompass aspects such as income generation and energy security, and energy efficiency, both for end-users and for transmission and conversion processes (Ministry of Environment and Water Republic of Bulgaria, 2012).

The enhancement of access to energy and the reduction of energy poverty are important opportunities for climate change mitigation and adaptation. The development and accessibility of energy, with a specific focus on bioenergy, can be regarded as a mitigation strategy. However it should be also noted that this also as a means to increase people's adaptive capacity. Within energy sector, the mitigation opportunities are expected to engender co-benefits such as improved air quality through increased renewable energy sources and improved access to energy, for example through local biogas production. The increased use of biogas systems has the additional benefit of providing organic fertiliser, which will increase food production (Republic of Bulgaria, 2019).

Biodiversity, terrestrial and aquatic ecosystems, water resources, agriculture and forestry sectors are expected to be affected by the projected changes. These changes would also affect society and its citizens, as well as the economy as a whole. The most threatened ecosystems are the forest areas along the southern border and other lowland regions of the country. In Bulgaria, forested areas cover approximately one third of the country's land area, amounting to 4.230 million hectares, of which 3.864 million hectares are classified as forest. The volume of standing timber in Bulgarian forests has almost tripled since the 1960s reaching around 680 million $m^3$. Bulgarian forests have an outstanding biodiversity, with 4 102 species of vascular flora alone (Ministry of Environment and Water Republic of Bulgaria, 2012).

**Composite Indicators**

The Environmental Performance Index (EPI) provides a summary of the state of sustainability around the world, including Bulgaria. The EPI employs 32 performance indicators across 11 categories of questions and ranks 180 countries on the basis of environmental health and ecosystem vitality (Wendling et al., 2020). These indicators demonstrate, at the national level, the extent to which countries are approaching the achievement of their environmental policy objectives. The Environmental Performance Index (EPI) scores of Bulgaria from 2014 to 2020 are presented in Figure 23. Concerning the EPI, Bulgaria has persistently been positioned in the bottom half of the ranking, with results consistently falling below the EU-27 average.

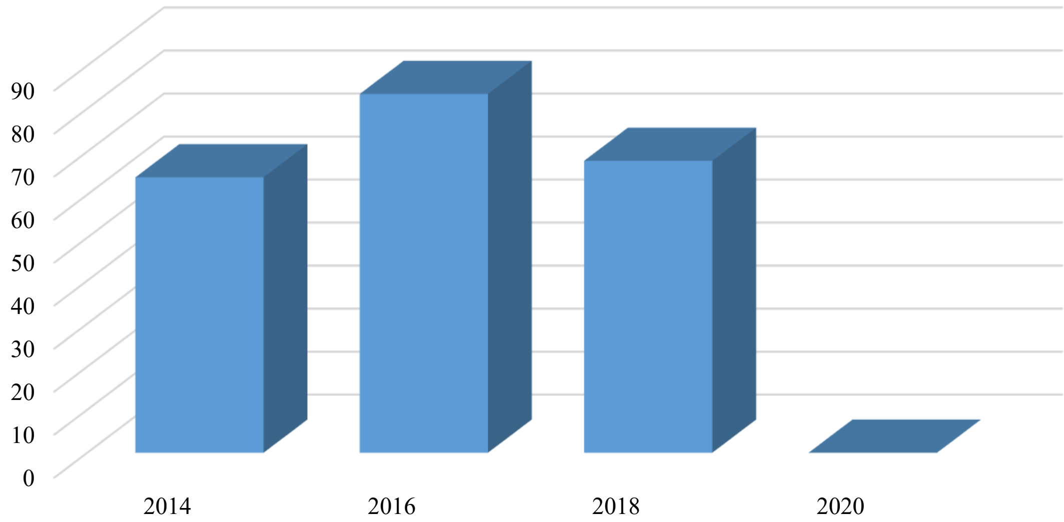



**Figure 23:** **Bulgaria – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Its ranks and scores were following in the EPI:

- 2014: 24. with 66.61 points (EU-27 average: 72.17)
- 2016: 22. with 83.4 points (EU-27 average: 82.91)
- 2018: 19. with 67.85 points (EU-27 average: 73.33)
- 2020: 27. with 57.0 points. (EU-27 average: 70,95)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Bulgaria's ecological footprint per person from 2014 till 2020 can be seen in Figure 24. Bulgaria performs quite bad regarding the ecological footprint as its scores are always below the EU-25 average level.

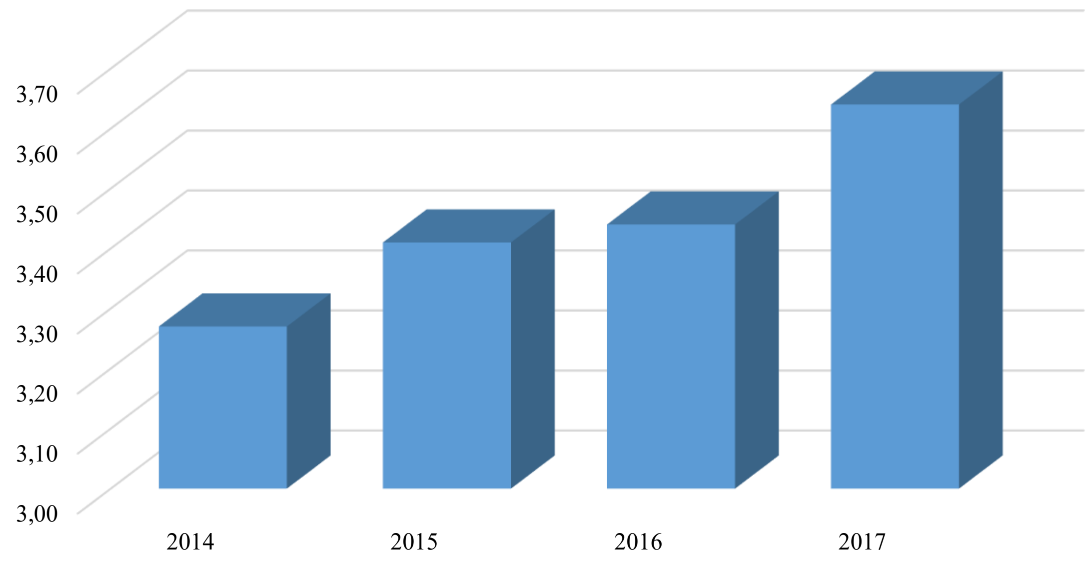



**Figure 24: Bulgaria– Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Its ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

- total score in 2014: 3.27 (EU-25 average: 5.23)
- total score in 2015: 3.41 (EU-25 average: 5.25)
- total score in 2016: 3.44 (EU-25 average: 5.26)
- total score in 2017: 3.64 (EU-25 average: 5.34)

Concerning the Climate Change Performance Index (CCPI) Bulgaria's performance is inconstant. The scores of the CCPI for the country can be seen in Figure 25.

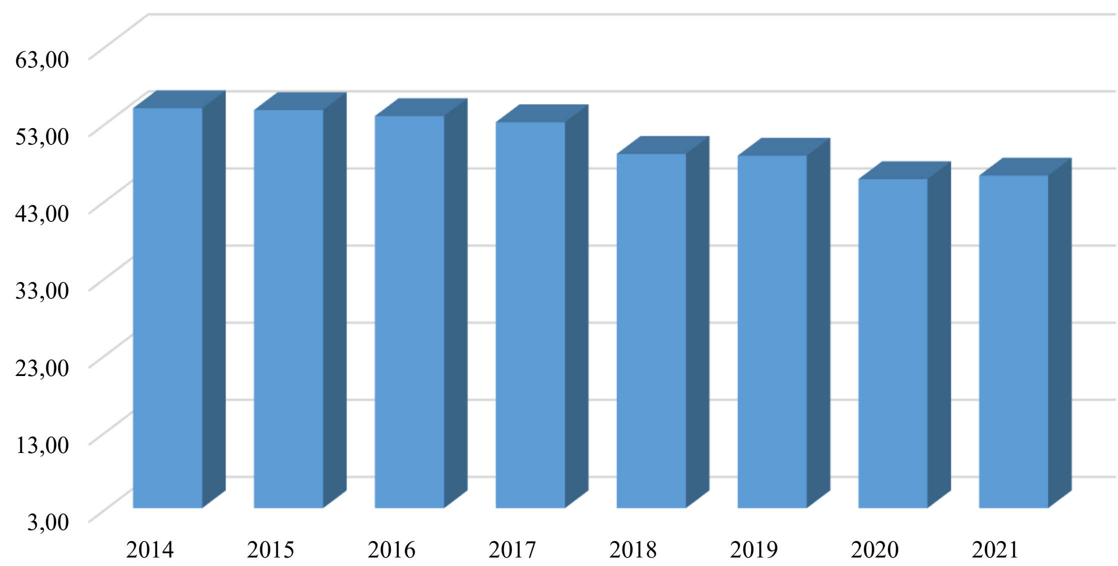



**Figure 25: Bulgaria vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

- 2014: 37. with 54.87 points (global average: 55.72)
- 2015: 41. with 54.05 points (global average: 55.36)
- 2016: 37. with 53.85 points (global average: 54.15)
- 2017: 37. with 53.06 points (global average: 53.77)
- 2018: 42. with 45.35 points (global average: 49.09)
- 2019: 40. with 48.11 points (global average: 50.35)
- 2020: 49. with 40.12 points (global average: 48.61)
- 2021: 44. with 42.64 points (global average: 47.90)

Mostly, Bulgaria's scores were below the average, only in 2014 was above it.

**Good Practices**

Bulgaria will adopt its first "Climate Change Adaptation Strategy and Action Plan" at the end of 2019. Given the time horizon it covers, currently up to 2030, Bulgaria still lacks information to report in the framework of cooperation with EU Member States, international cooperation and regional and international organisations to enhance adaptation actions at sub-national, national, macro-regional and international levels. The country is divided into 6 regions for the purpose of assessing and managing air quality. The municipality of Sofia falls into the region of Excessive Particulate Matter (PM) pollution, mainly caused by domestic heating and transport. In order to comply with national legislation and Directive 2008/50/EC, the municipality has developed an Air Quality Programme (AQP), which is regularly updated. In 2015, the municipality joined the Covenant of Mayors Global Initiative (CMGI) with the aim of reducing greenhouse gas (GHG) emissions. This was achieved through the development of a municipal strategy for adaptation to climate change and preparation of a GHG emissions inventory for 2015.

**Summary**

In 2017, Bulgaria celebrated 10 years of EU membership with real GDP growth of 3.6 percent and is forecast to grow by 3.8 percent in 2018 (DG ECFIN forecast, Spring 2018), a real rebound from the modest average growth rate of around 1 percent during the global economic downturn of 2009-2014. The primary catalyst of GDP growth is investment spending by the government to absorb EU funds for the 2014-2020 programming period. The macroeconomic consequences of climate change assess the economic consequences of climate change impacts in Bulgaria, highlighting the costs of inaction and the economic aspects of choosing adaptation options. The analysis provides estimates of overall economic activity (i.e. GDP), economic welfare, sectoral output levels and employment levels, with and without adaptation to climate change. This analysis was facilitated by the development of the first integrated assessment model for climate change adaptation in Bulgaria.

While awareness of climate change in Bulgaria is increasing, awareness of specific adaptation issues is more limited, both among the population and among some other stakeholders. At the political and policy-making levels, there is a high general awareness of the possible future consequences of climate change. Nevertheless, considerable uncertainty remains regarding the precise nature of its potential manifestations in different sectors. The policy-making process has thus far focused on the identification and implementation of mitigation measures rather than adaptation. A general conclusion from the review of current CCA actions is that it is rather limited in some sectors and that a new impetus is needed, which should be provided by a national strategy. Concurrently, the response to CCA in general is impeded by a number of gaps and barriers, which are also pertinent to Bulgaria and which must be taken into account when designing the strategy. These include awareness and communication, institutional capacity, knowledge and data gaps, policy and legal frameworks, and financial and human resource constraints. The role of education and information can be regarded as a fundamental prerequisite for the successful implementation of other adaptation measures. The Strengths, Weaknesses, Opportunities and Threats (SWOT) and Political, Economic, Social and Technical (PEST) analyses prepared for this strategy analyse these issues in the Bulgarian context and provide a basis for defining the overall strategic objectives of the CCA for the country.

**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Adapt (2022a). Bulgaria. Download from https://climate-adapt.eea.europa.eu/countries-regions/countries/bulgaria
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate

https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.

- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Ministry of Environment and Water Republic of Bulgaria (2012). Third National Action Plan on Climate Change. For the period 2013-2020. Ministry of Environment and Water Republic of Bulgaria, Sofia.
- Republic of Bulgaria (2019). National Climate Change Adaptation Strategy and Action Plan. Sofia, Republic of Bulgaria.
- The World Bank (2018). Strategy and Action Plan: Bulgaria. Download from https://thedocs.worldbank.org/en/doc/336901539798319342-0080022018/original/CCAFactsheetsEN2018Oct17.pdf
- The World Bank Group (2021). Climate Risk Country Profile: Bulgaria. World Bank Publications, Washington.

## 4.4. CROATIA

In 2020, the population of Croatia was 4,105,267 people with a population density of 73 per km$^2$. The country's total land area is 55,960 km$^2$ , with approximately about the 55.7% of the population is residing in urban areas. The biggest cities in the country are Zagreb, Split and Rijeka (worldometers.info).

In 2016, the total area dedicated to agriculture was 2.7 million hectares, representing 27.31% of the total land area of Croatia. From 2007 onwards, there has been a positive trend in agriculture, with the majority of the lands being heavily utilised by the industry. The most important products are oranges with a relatively high share (56.4%) and permanent grassland (38.8%), which is also significant in the country. However, the number of livestock has declined since 2008. The significance of mariculture is considerable, with total catches in 2016 amounting to 85,028 tonnes (climate-adapt.eea.europa.eu).

In order to facilitate sustainable forestry, Croatia developed a Forest Management Plan for the period of 2015–2025. In 2016, total area of forest and forestland was 2,759,039 hectares in 2016, representing 49% of the total inland area. The majority of the territory (90%) is productive forest land with tree cover. According to its Forest Management Plan, the territory of growing stocks is to be expanded with a variety of trees species (climate-adapt.eea.europa.eu).

Figure 26 represents the country's most important economic statistics compared to the EU-27 average.

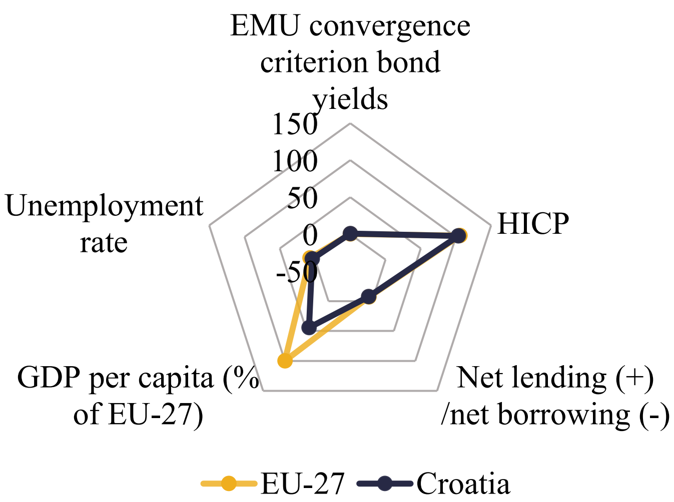



**Figure 26: Croatia vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

The pace of economic recovery in Croatia was considerably slower due to the reintroduction of social distancing measures at the end of 2020. The tourism sector was among the most severely impacted industries by the pandemic. However, an increase in private consumption, investment and the construction industry served to mitigate the negative effects of the decline in the manufacturing industry. The decline in unemployment was relatively modesty yet those with low incomes were the most adversely affected by the crisis. Approximately 30% of the country's households reported an annual reduction in their overall income in 2020, while 80% had inadequate savings if the pandemic is persists. Furthermore, poverty was forecasted to rise to 2.6 in 2020 (worldbank.org).

It is anticipated that the economic activity of the country will recover from the crisis caused by the pandemic. It is projected that the annual growth rate will be 4.5% between 2021 and 2023. The implementation of the vaccination strategy and other epidemiological measures are crucial for the country as this is the sole means of allowing to tourists to return during the season. An increase in tourism and a recovery in trade with partners could result in a significant growth regarding export of goods and services. Investments by EU funds are also projected. The economic situation of the country is forecasted to improve after the recovery from the pandemic and the EU funds. The continuation of economic growth and the phasing out of the fiscal support measures will result in a reduction of the fiscal deficit and bring public debt below 80% of GDP by 2030 (worldbank.org)

This growth will contribute to decline in poverty levels, however the compounding effects of the COVID-19 and the low savings rates among poorer households will take more time to recover for this vulnerable group (worldbank.org).

**Climate Strategy**

The country has already experienced the negative effects of climate change through severe economic losses. According to the European Environment Agency Report, Croatia is among the three countries (along with the Czech Republic and Hungary) in the EU where extreme weather and other climate events cause damage in Gross Domestic Product. The estimated losses amount to about EUR 2.25 billion (EUR 68 million per year) for the period 1980-2013. Moreover, the situation is getting worse in 2014 and 2015 and some economic sectors were influenced significantly in these years. In agriculture, extreme weather events are estimated to have caused losses EUR 173 million. In addition, the energy industry (EUR 63-96 million loss) and public health (4% increase in mortality due to heat stroke) were also affected in 2003 (climate-adapt.eea.europa.eu).

According to the document "Adaptation to Climate Change in Croatia", the country is focusing on the following sectors: hydrology and water, resources; agriculture; forestry; biodiversity and natural ecosystems; coastal zone management; tourism; and human health. These are identified as the most vulnerable sectors where the effects of climate change have already caused serious problems. Priority actions are defined for these sectors, which are also highlighted in other strategic documents (Peleikis – Grätz – Brnada, 2014).

Nowadays, there are no sectoral strategies in Croatia, but some practical adaptation activities have already taken place:

- "Agriculture: changes in the orientation of wine production in response to earlier flowering and development of grapes, expansion of the wine production assortments on the continent;
- Civil protection: adaptation of fire-fighting activities to the longer fire-fighting season and rising average summer temperatures, extension of activities from island/coastal to inner continental areas; strengthening of health services' emergency preparedness for heat-waves ;
- Protection of coastal biodiversity and ecosystems: ex-situ and in-situ protection of endangered species to protect the genetic fund; preservation of migratory corridors for species that can adapt to changing habitats; modification of management plans and physical plans of protected areas; adaptation of protection programmes at the level of taxa; development of infrastructure for scientific evaluation of the status, prediction and monitoring of changes in ecosystems;
- Coastal zone management: In 2012, Croatia ratified the Protocol on Integrated Coastal Zone management in the Mediterranean and committed to develop a national strategy for integrated coastal zone management with action plans and programmes in line with the joint regional framework. The national strategy should include vulnerability and risk assessments of coastal zones, as well as planning for prevention, mitigation and adaptation measures to address the effects of natural disasters, in particular of climate change." Peleikis – Grätz – Brnada, 2014, p. 8).

Croatia's primary energy consumption comparing with EU-28 can be seen in Figure 27.

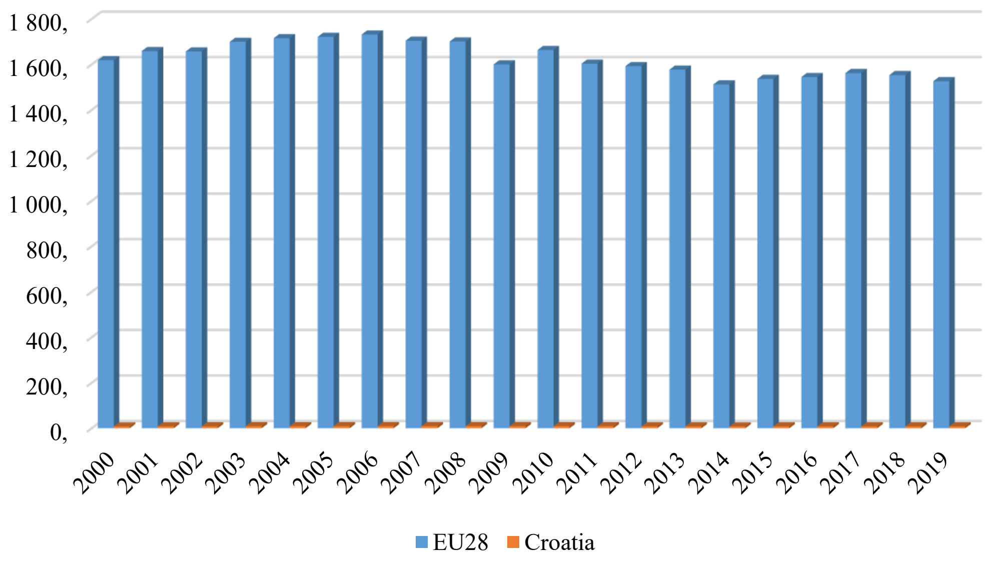



**Figure 27: Croatia vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**

Source: own compilation based on Eurostat (2022a)

Energy consumption per person has increased from 1965 to 2019. The highest value was 24,650 kWh in 2010 and the lowest was 16,848 kWh in 1992. In 2019, the average person consumed 22,870 kWh of electricity. Their primary energy consumption has decreased over the same period. From 1992 onwards, the tendency was increasing, but from 2010 onwards the values started to decrease with only small jumps (ourworldindata.org). The sectors that condumed the most energy between 1990 and 2019 were: housing, transport and industry. In terms of sources, petroleum products, natural gas and electricity accounted for the largest share of total energy consumption over the same period (eia.org).

The share of fossil fuels in gross available energy demonstrated in Figure 28.

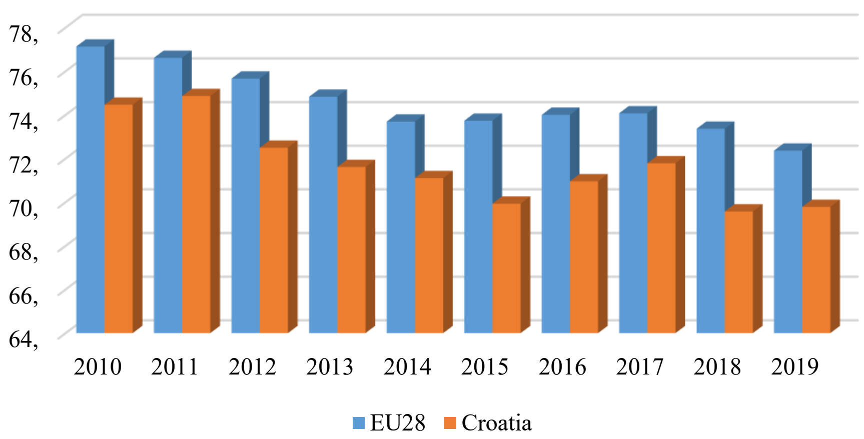



**Figure 28: Croatia vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**

Source: own compilation based on Eurostat (2022b)

The country's share of fossil fuels in gross available energy is lower than the EU average level. There is a decreasing trend in it in parallel with the EU's level, however in the case of Croatia, the performance changes after 2015.

Overall, the share of primary energy from fossil fuels has decreased from 89.41% to 78.11% between 1990 and 2019. In 2019, this value was 21.54%, and the highest value was 26.82% (2014) and the lowest was 10.59% in 1990 (ourworldindata.org).

The Croatian industry is heavily influenced by foreign energy imports, including oil, gas and electricity. Croatia accounts for 0.7% of the total greenhouse gas emissions. Since 2005, the country has decreased its emissions at a rate that is lower than the EU average since 2005 and its emission intensity is also higher comparing to the EU data. The transportation sector is responsible for the majority of these, accounting for 25% of the country's total emissions in 2019. Besides, the building industry has also been identified as a significant contributor to the amount of GHG. Conversely, the energy industry has witnessed a substantial decline in emissions by almost 40% between 2005 and 2019. The primary factor contributing to this is the diversification of energy sources and the subsequent reduction in demand. Croatia had initially permitted to increase its emissions until 2020 but was required to reduce them by 7% by 2030 compared to 2005 levels. Croatia's per capita emissions were the 4$^{th}$ lowest among the Member States in 2019. A decline was observed in it from 2005 to 2014 but this period was followed by a slight rise from 2014 (Jensen, 2021a).The country accounted for net emissions of 19.3 million tons of $CO_2$ equivalent ($MtCO_2e$) in 2018. Furthermore, the LULUCF (land use, land use change and forestry sectors) carbon sink capacity reduced by 35% (2005-2018) (Jensen, 2021a).

Figure 29 illustrates the comparison of Croatia's greenhouse gas emissions per capita with the EU-28 average from 2000 to 2019.

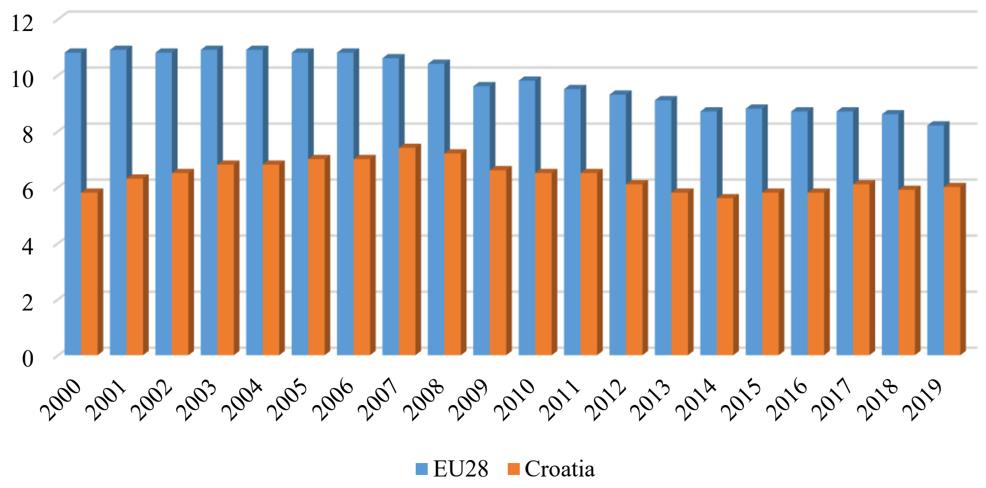



**Figure 29: Croatia vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

The transport sector is the industry with the highest emissions and it increased its emissions by 22% between 2005 and 2019. However, the energy industry could reduce it by 39% during the same period. The most significant decline was observed in the manufacturing and construction sectors, where the share of total emissions decreased from 12% to 9%, representing a 43% reduction since 2005. Concurrently, industrial processes and product use emissions underwent a 25% decline during the same period. Unfortunately, the agricultural and waste management sectors have experienced an increase in their respective shares of total emissions (Jensen, 2021a).

During the period 2005–2020, Croatia maintained its renewable energy levels above the targeted 20% for 2020 (28.5% in 2019). The country's identified share regarding is 36.4% renewables by 2030. To reach this objective, aim Croatia has mainly focuses on photovoltaics and wind with energy efficiency measures. The share of biofuels is predicted to rise significantly above that of electrification, driven by the transportation industry's target of utilising 13.2% renewable energy sources by 2030 (Jensen, 2021a).

Figure 30 provides Croatia's share of energy from renewable.

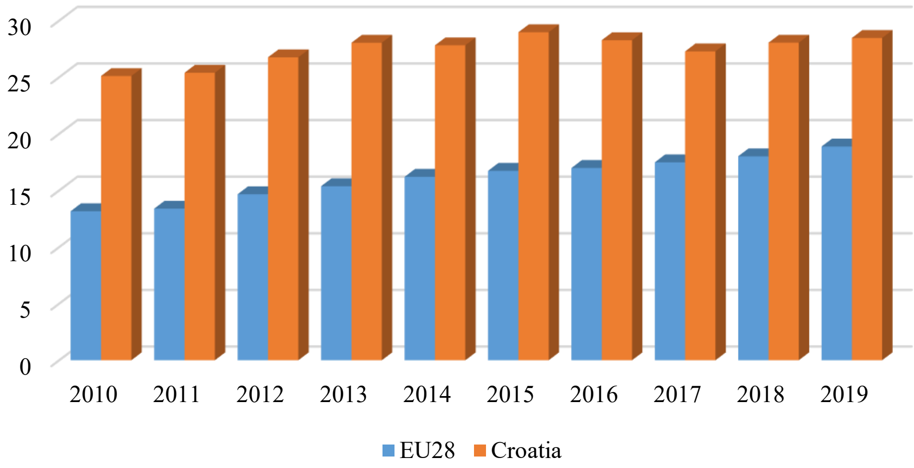



**Figure 30:** **Croatia vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

It is anticipated that the share of renewables will increase by 36.6% in gross direct consumption of electricity in 2030. With regard to cooling and heating, the targeted value is also 36.6% for 2030. The usage of solar and geothermal energy for heating is also projected to rise, although the primary heating source will remain solid biomass (Jensen, 2021a).

**Composite Indicators**

Croatia's performance is satisfactory with regard to sustainability and climate protection indicators. The Environmental Performance Index (EPI) scores from 2014 to 2020 can be seen in Figure 31. In the context of the EPI, Croatia was positioned 20 among the 180 ranked countries in 2018 and 2020. However, it is noteworthy that its results consistently approximated the EU-27 average.

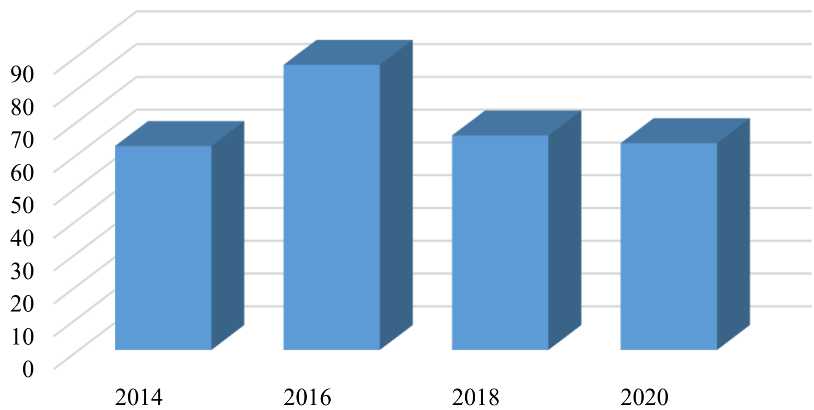



**Figure 31:** **Croatia – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Its ranks and scores were following in the EPI:

- 2014: 45. with 62.23 points (EU-27 average: 72.17)
- 2016: 15. with 86.98 points (EU-27 average: 82.91)
- 2018: 41. with 64.45 points (EU-27 average: 73.33)
- 2020: 34. with 63.10 points. (EU-27 average: 70,95)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Croatia's ecological footprint per person from 2014 till 2020 can be seen in Figure 32.

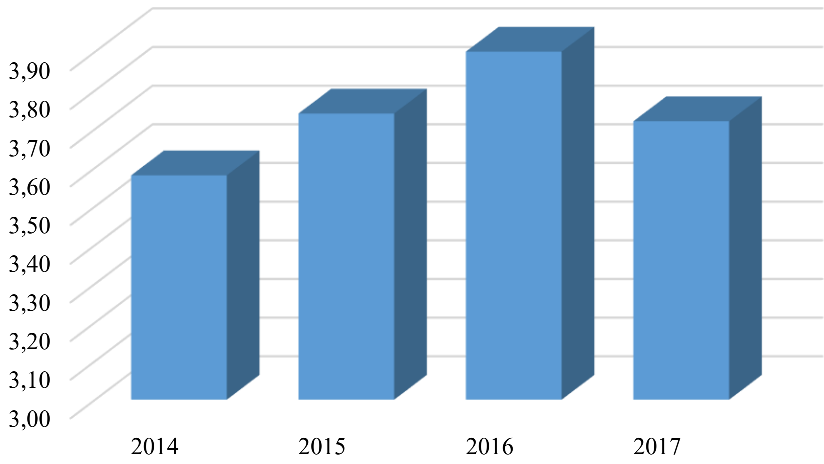



**Figure 32:** **Croatia – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Its ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

- total score in 2014: 3.58 (EU-25 average: 5.23)
- total score in 2015: 3.74 (EU-25 average: 5.25)
- total score in 2016: 3.90 (EU-25 average: 5.26)
- total score in 2017: 3.72 (EU-25 average: 5.34)

The country performance in terms of ecological footprint is suboptimal, with its scores constantly falling below the EU-25 average benchmark.

Concerning the Climate Change Performance Index (CCPI), its performance is inconstant. The scores of the CCPI for the country can be seen in Figure 33.

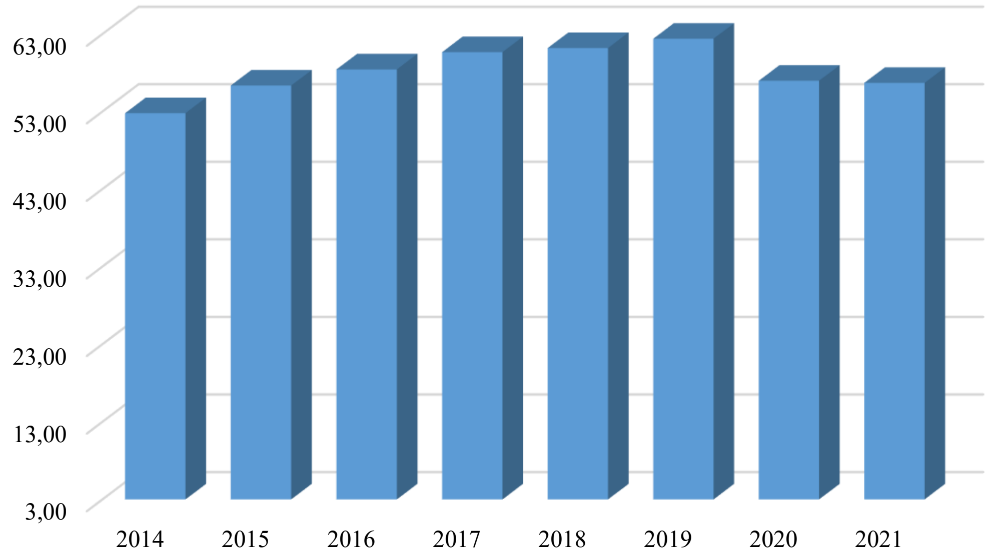



**Figure 33: Croatia vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

The ranks and scores were following in the CCPI (among 61 countries):

- 2014: 44. with 52.79 points (global average: 55.72)
- 2015: 33. with 56.35 points (global average: 55.36)
- 2016: 21. with 58.43 points (global average: 54.15)
- 2017: 17. with 60.66 points (global average: 53.77)
- 2018: 13. with 61.19 points (global average: 49.09)
- 2019: 14. with 62.39 points (global average: 50.35)
- 2020: 20. with 56.97 points (global average: 48.61)
- 2020: 18. with 56.69 points (global average: 50.96)

**Good Practices**

**Waste management in the Adriatic Sea**

Croatia has demonstrated a commitment to the protection of the marine environment, recognising pivotal role that tourism plays in its economy. Consequently, the government of Croatia allocates a significant amount of its budget to prevent the pollution of the sea and to help Albania in this regard. The influx of waste from Albania, estimated at several tonnes, are causing serious problems to the flora, fauna and the tourism sectors. Most of the waste consists of plastic or microplastic that decomposes slowly and pollute the environment for longer period of time (hulladekvadasz.hu, 2018).

**English oak protection**

A joint initiative between Hungary and Croatia was launched in order to protect English oaks and other indigenous tree species in the border regions of the two nations. Beside this, the common project also aimed to gather data about the state of the local forest stock and to measure the negative effects of the invasive species (European Commission).

A significant outcome of the project was the containment of the invasive species and the development of an adaptable methodological process that can be utilised effectively non- native species worldwide (European Commission).

**Windfarm in Zengg**

The most substantial windfarm in the country was opened in Zengg (Senj),comprising 39 wind-turbine facilities. The project costs about 200 million euros and has an area of 60 $km^2$. The facility is reported to have a capacity of 156 megawatts, with an anticipated annual generation of 530 million kilowatt-hours of electricity (Hordósi, 2021).

In alignment with the EU's climate targets, Croatia is set to decommission its sole coal-fired power plant in Plomin. The nation is relatively advanced in using renewables as the 35% of its electricity being generated from environmentally sustainable sources. In addition to these initiatives, they would like to open new windfarms and harness geothermal energy more extensively (Hordósi, 2021).

**Closure coal energy plants**

In harmony with the provisions of the 2015 Paris Climate Agreement, the Republic of Croatia has also announced to eliminate coal energy from its energy portfolio. The country’s last coal-fired power plant is scheduled to close by 2033 (Stubnya, 2021).

**Green Sail**

The initiative was established to protect and promote sustainable tourism in coastal regions. They provide educative content for their partners and members to support their sustainability endeavours (Green-sail.com). Its stated aims are to educate, inspire and motivate the maritime community to protect its seas and oceans through sustainable environmental practices. The vision of the initiative is closely related to the sustainable development goal created by the United Nations entitled "Life under water". The cooperation with Charter Companies aims to support charter companies in the prevention of marine and coastal pollution, improve education and cultivating environmentally friendly practices for both their internal and external customers. In order to support maritime tourism in Croatia, a map of Dalmatia was created, showcasing ports that offer recycling opportunities to their employees and guests within the framework of their cooperation with Marinas.(Source: www.green-sail.com)

**Sun Gardens Dubrovnik**

Its primary objective is to contribute to the improvement of the quality of life in the region from a social, economic and tourist perspective. In collaboration with Tesla Motors, the resort offers Tesla owners complimentary electric car charging. Furthermore, the resort supports green energy efforts with guest bike rentals, themed walking tours and excursions, and shuttle bus and boat services. They pay special attention to the protection of the sea and coastal areas. This commitment is evidenced by the annual participation of a team of special divers participates in an underwater cleaning ecological action every year. In addition, the resort organizes beach clean-ups along the coast, which helps protect marine ecosystems. (Source: www.dubrovniksungardens.com)

**Bottle collection**

In 2006, the Ministry of Environmental Protection of the Republic of Croatia implemented a policy that effectively eliminated 100% of glass and plastic bottle waste throughout the country. According to the plan, individuals can bring any glass or plastic beverage bottle to any market larger than 200 square metres and half a Kuna for each bottle returned, irrespective of the purchase location. It is estimated that more than two billion bottles have been collected since the introduction of the return policy, which is practically every bottle sold in the country. Therefore, the presence of glass or plastic bottles littering the landscape, beaches, rivers or streets in Croatia has become a rarity. The programme has also led to the creation of numerous employment opportunities within the recycling industry. (Source: www.frommers.com)

**Environmentally conscious hotels**

The vast majority of Croatian hotels have installed smart rooms, which feature on-demand electricity that is activated by the key fob. In an effort to minimise machine washing, many hotels no longer change towels on a daily basis. Guests are encouraged to leave them on the bathroom floor or to hang them to dry, as this signifies their consent to recycle. Radisson BLU boasts a green roof and an HVAC system (heating, ventilation, air conditioning) that draws cooling from the ocean. The Kempinski Adriatic utilises stored rainwater exclusively for irrigating its 18-hole golf course , while the hotel also grows its own herbs, which are used in its restaurants. (Source: eobnb.com)

**Solar panels in Croatia**

As of the middle of 2014, 30 MW of solar capacity had been installed , which, when compared with Hungary, where only 20-22 MW of solar capacity was present at the same time, demonstrates a significant disparity in favour of the Croatian situation. The construction of an additional 25.5 MW of capacity commenced in the second half of 2014. The Croatian electricity buyback system was introduced in 2013, but only 7 MW were put into operation then. However, the figures a year later indicated an upswing in the market. The Croatian feed-in tariff subsidy supports solar and hydropower-based electricity production with a fixed and predictable buyback price, up to a maximum capacity of 1 MW. (Source: https://zerovillanyszamla.hu/horvatorszag-belehuzott-a-napelem-telepitesbe/)

**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- European Commision: A kocsányos tölgy védelme Magyarország–Horvátország határ menti régióiban. Available: https://ec.europa.eu/regional_policy/hu/projects/Croatia/protecting-the-english-oak-in-the-hungary-croatia-cross-border-region (03.03.2022)
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-

1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Hordósi, D. (2021): Kínai segítséggel zöldít Horvátország. VG.hu. Available: https://www.vg.hu/nemzetkozi-gazdasag/2021/12/kinai-segitseggel-zoldit-horvatorszag (03.03.2022)
- Hulladekvadasz.hu (2018): Adriai-tenger hulladékszennyezés kezelését segíti Horvátország. Hulladekvadasz.hu. Available: https://hulladekvadasz.hu/2018/07/20/adriai-tenger-hulladekszennyezes/ (03.03.2022)
- Jensen, L. (2021a). Climate action in Croatia- Latest state of play. Available: https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/690662/EPRS_BRI(2021)690662_EN.pdf (05.11.2021)
- Peleikis, J. – Grätz, M.– Brnada,I. (2014). Adaptation to Climate Change in Croatia-Country Brief. Available: https://www4.unfccc.int/sites/NAPC/Documents%20NAP/Adaptation%20Strategies%20and%20Plans/Adaptation%20to%20Climate%20Change%20in%20Croatia.pdf (05.12.2021)
- Stubnya, B. (2021): A horvátok mellett több másik ország is nagy lépést tett a szénerőművek nyugdíjazása felé. G7.hu. Available: https://g7.hu/vilag/20211103/a-horvatok-mellett-tobb-masik-orszag-is-nagy-lepest-tett-a-szeneromuvek-nyugdijazasa-fele/ (03.03.2022)
- https://www.green-sail.com/ (03.03.2022)
- https://www.worldometers.info/ (15.12.2021)
- https://climate-adapt.eea.europa.eu/ (12.12.2021)
- https://ourworldindata.org/ (12.12.2021)
- https://www.iea.org/ (12.12.2021)
- https://www.enerdata.net/
- https://www.worldbank.org/en/home (12.12.2021)

## 4.5. CYPRUS

Cyprus exhibits all the characteristics of a semi-arid climate, while also displaying some of the consequences of global climate change due to its geographical location in the eastern Mediterranean. The geographical structure of the island country, its isolation, the combination of the surrounding sea, its topography, its geological structure and its climatic conditions, makes it a biologically diverse island. The country's flora and fauna have adapted to the various natural biotopes and climatic conditions, resulting in the establishment of numerous rare species. The most noticeable impacts of climate change on biodiversity are the followings: reduced rainfall, increased temperatures, droughts, more intense rainfall fluctuations, sea level rise and carbon dioxide emissions. These impacts are expected to worsen between 2021 and 2050, as indicated by the PRECIS and ENSEMBLES forecasting systems. The Cyprus Sustainable Development Strategy launched by MARDE in 2007, identifies climate change a a key objectives. The strategy goals to develop a set of principles that are consistent with the national action plan, in line with EU policies and adapted to specific national circumstances. (Climate Adapt, 2021)

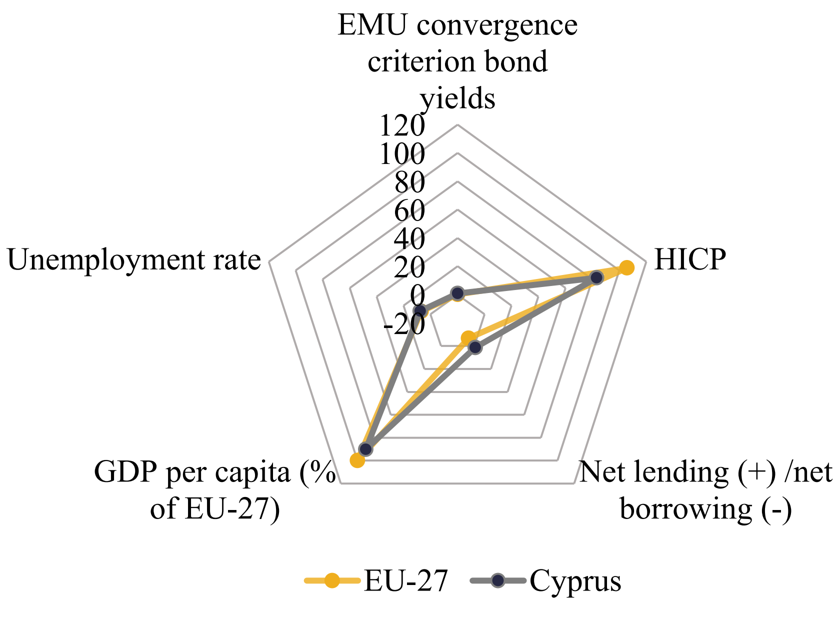



**Figure 34: Cyprus vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

As the Figure 34 demonstrates, Cyprus is exhibits a below-average performance in three key indicators in comparison with the EU-27 average. Cyprus's GDP per capita stands at 90% of the EU average, while the Harmonized Index of Consumer Prices (HICP) value was recorded at 83.2 in contrast to the EU-27 average of 105,76.

**Climate Strategy**

**Primary energy consumption**

Figure 35 visualizes the total energy needs of Cyprus compared to the EU28. Averagely the country's amount was negligible from the total primary energy consumption in the European integration between 2000 and 2019. (Eurostat 2022).

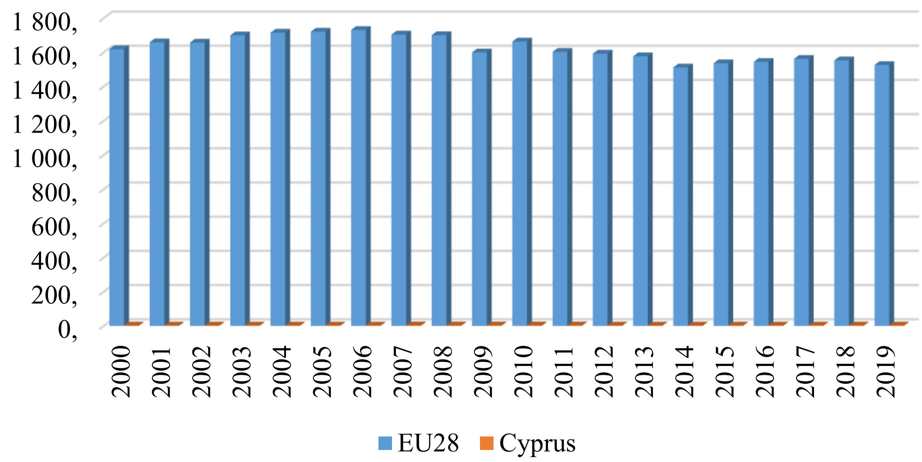



**Figure 35: Cyprus vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**

Source: own compilation based on Eurostat (2022a)

**Share of Fossil Fuels in Gross Available Energy**

According to the latest data from Eurostat, Cyprus recorded the third-largest share (89%) of fossil fuels in gross available energy in the European Union in 2020.

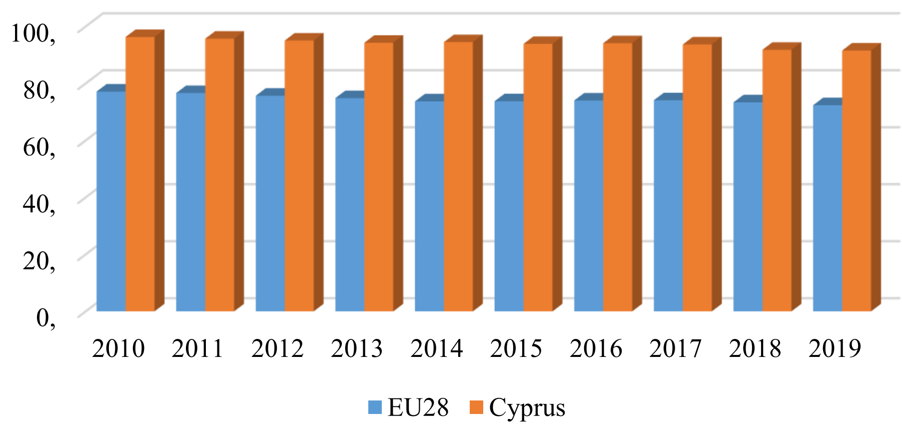



**Figure 36: Cyprus vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**

Source: own compilation based on Eurostat (2022b)

The use of fossil fuels decreased in Cyprus over the past ten years, from 96% in 2010 to 91% in 2020. (Financial Mirror, 2022)

## Greenhouse Gas Emissions by Capita

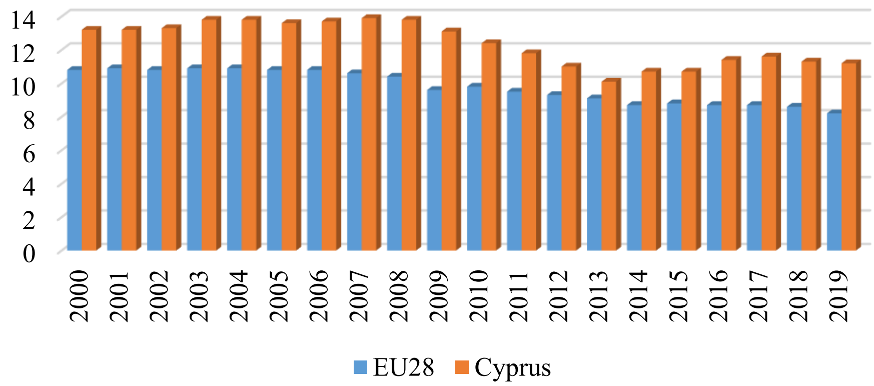



**Figure 37: Cyprus vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 ($CO_2$ equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

Cyprus accounts for 0.26% of total EU greenhouse gas (GHG) emissions and has reduced its emissions at a slower pace than the EU average since 2005. The carbon intensity of the Cypriot economy decreased by close to 25% between 2005 and 2019, at a rate slower than the EU average. (EU, 2021)

## Share of Energy from Renewable Sources

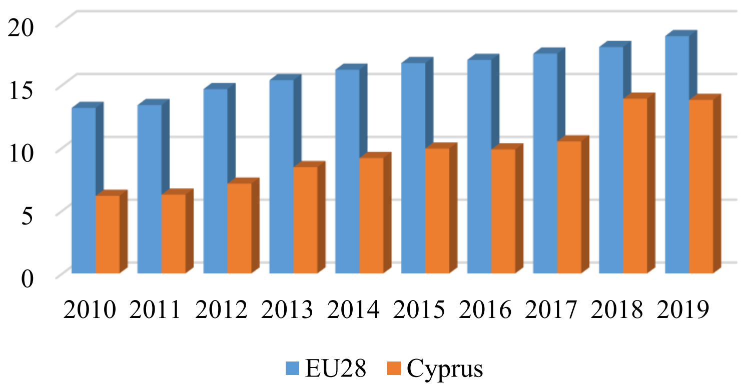



**Figure 38: Cyprus vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

Between 2005 and 2019, Cyprus increased the share of renewable energy in gross final energy consumption by 10.7 percentage points, leaving it only 9.1% away from reaching the 2030 target. The Commission's assessment of the Cypriot national energy and climate plans (NECPs) finds the indicative target of 22.9% renewable energy share in the energy mix to be appropriate, although 0.1% below the 23% calculation in the government decree. (EU, 2021)

## Composite Indicators

### Environmental Performance Index

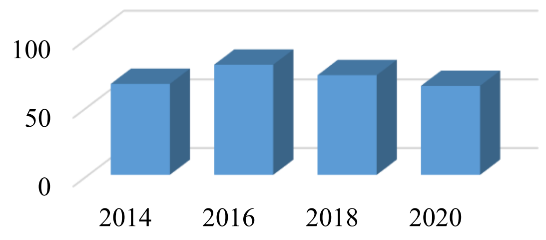



**Figure 39: Cyprus – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

### Ecological Footprint per Person

The ecological footprint data is not available for Cyprus. (GFN, 2022)

### Climate Change Performance Index

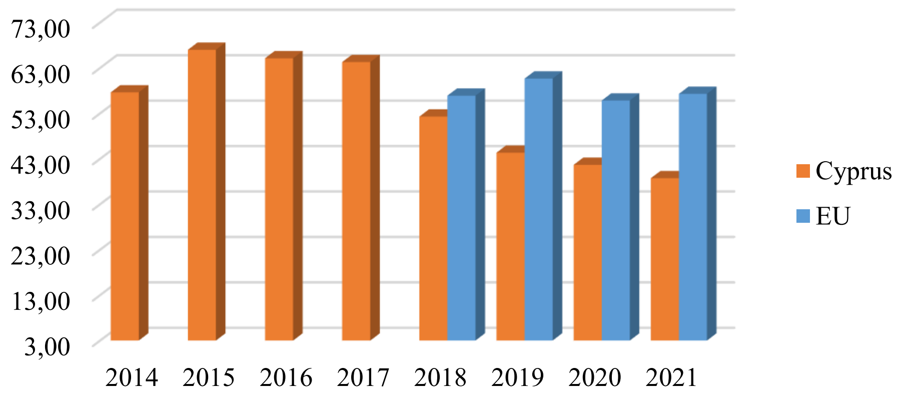



**Figure 40: Cyprus vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Cyprus' performance in the areas of renewable energy use, climate policy and greenhouse gas emissions is not exceptional. The initial two were rated medium and the latter low. The main improvements are seen in the GHG Emissions and category. The most significant developments are observed within the category of GHG Emissions and Energy Use. (CCPI, 2022)

**Good Practices**

With regards to collaborative efforts to enhance adaptation measures, the present focus of formal cooperation appears to be oriented towards knowledge dissemination. A number of bilateral and multilateral projects are currently in progress. The funding for these initiatives is primarily derived from the EU's competitive programmes such as Interreg and LIFE. Observable cooperation has been identified with Greece and other, predominantly neighbouring, EU Member States in the fields of agriculture (e.g. LIFE Adapt2Clim a project), urban adaptation (e.g. LIFE UrbanProof) and health (e.g. LIFE Medea). (Climate Adapt, 2021)

- **Underwater Museum** - A brand new underwater museum has been created off the coast of Ayia Napa by sculptor, environmentalist and photographer Jason de Caires Taylor. The works, located at a depth of eight to ten metres, have been designed to attract marine life on the one hand, and to be accessible to divers on the other. The museum is noteworthy not only for its function as an exhibition space, but also as an environmental protection project. About ten to fifteen percent of the seabed has properties that allow the natural formation of reefs, however, in order to preserve them, it is also necessary to create artificial reefs. The sculptures, with their textured surfaces, provide a substrate for the attachment and growth of corals, sponges and other microscopic organisms thereby creating a habitat and a food source for marine life. These sculptures will subsequently act as breathable, artificial reefs.
(https://roadster.hu/ciprus-viz-alatti-muzeum/)
- **Preservation of biodiversity** - Since 1978, turtles have been protected in the island nation with great efforts and cages have been placed over their nests to deter predators. To raise awareness of environmental issues small exhibitions are organised on the beach. Volunteers of the organisation monitor the hatchlings on a 24-hour basis to ensure their safe passage to the sea. This is a difficult and perilous path for them. Turtles are extremely smart and loyal animals, since after 20-30 years they return to lay eggs where they were born. Therefore, it is of critical importance of safeguarding the coastline of Northern Cyprus.
(https://terracypria.org/protect/)
- **Education** - The Cyprus Environmental Science Centre was established in 1995. Its primary objectives are the followings: the promotion of environmental sustainability in Cyprus; the enhancement of environmental education within the Cypriot education system; the demonstration of practical examples of environmental protection and the support of the local rural economy. The students learn through practical experiences,

they have lessons in nature. They studies encompass coastal zones, adventure trips, and educational games. Subsequent, to these learning activities, a microscopic examination is then carried out in the classroom. The programme also introduces young farmers to the concept of sustainability.

(https://www.eurosite.org/wp-content/uploads/2011-09-08_P2_Artemis_Yiordamli.pdf)

**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- CCPI (2022): Cyprus. https://ccpi.org/country/cyp/
- Climate Adapt (2021): National circumstances relevant to adaptation actions. https://climate-adapt.eea.europa.eu/countries-regions/countries/cyprus
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- Financial Mirror (2022): Cyprus third in EU for fossil fuel energy. https://www.financialmirror.com/2022/02/17/cyprus-third-in-eu-for-fossil-fuel-energy/
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.

## 4.6. CZECH REPUBLIC

The Czech Republic became a member of the European Union in 2004. The country's principal economic sectors are industry (28%), wholesale and retail trade, transport, accommodation and food services (17%) and public administration, defence, education, human health and social work activities (17%). It is notable that Intra-EU trade accounts for 80% of Czech exports and 73% of imports into the Czech Republic originate from EU countries (Climate Adapt, 2022b).

The population of the Czech Republic was 10.71 million on 30 September 2020. The average population density is 139 inhabitants per $km^2$, making the Czech Republic one of the most densely populated countries in Europe, and 73.5% of the population live in urban areas. This indicates that a large proportion of the population resides in areas where environmental degradation is prevalent, especially by intensive transport, solid fuel heating of households, which is typically a concern in smaller settlements. Other health risks associated with climate change include illness, heat stress and an increased incidence of gastrointestinal diseases and respiratory diseases due to ambient air pollution. The National Action Plan delineates health adaptation measures, including the provision of adequate health infrastructure for epidemic emergencies, the introduction of early warning systems for water-borne diseases, and the dissemination of information to enhance decision-making on health risk situations (Hanzlik et al., 2020).

Over the past decade, inequality and poverty have remained low compared to OECD countries. Nevertheless, considerable regional disparities in poverty persist, with high poverty rates observed in the Northwest and Moravia-Silesia regions. This phenomenon can be attributed to significant wage differentials across sectors due to skills and productivity gaps. The highest economic inequality can be found in Prague, while the low-income population in Prague is comparatively 'better off' than those in the 'peripheral' regions. Higher levels of poverty in the Northwest are due to the relatively low wages/income of most workers (Climate Adapt, 2022b).

Figure 41 shows significant deviations from the EU-27 average for most selected economic indicators. The Maastricht criterion interest rates are 3.5 times the EU average, while GDP per capita exceeds 65% of the EU average. The unemployment rate is considerably lower than the EU average (2.6%) and government expenditure is less than the EU average in terms of government revenue. The harmonised index of consumer prices is 6% above the EU average.

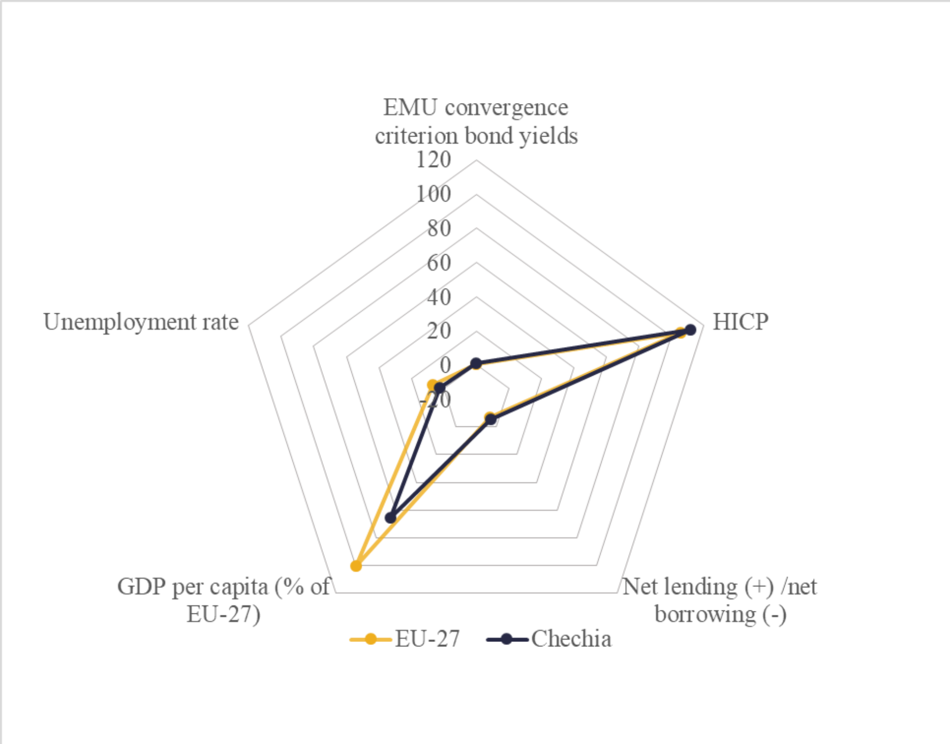



**Figure 41: Czech Republic vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

The Czech Republic is currently undergoing a period of economic growth, which can be attributed to an increase in domestic demand, as well as an expansion in net exports and increased private investment. Household consumption has been boosted by developments in the labour market , an increase in disposable income and high levels of consumer confidence. From a sectoral perspective, industry was the primary contributor to real gross value-added growth, which is consistent with the higher volatility observed over the business cycle and the structure of the Czech economy. Concurrently, other sectors of the economy also increased their gross value added. Real GDP is expected to grow slightly below 2.5% in the coming years. Economic growth should be driven almost exclusively by domestic demand, including both consumption (especially private consumption) and investment by firms and the government. This growth structure can be considered healthy. Labour shortages are becoming an obstacle to faster economic growth due to tight labour market conditions (Ministry of the Environment of the Czech Republic, 2017).

**Climate Strategy**

The National Energy and Climate Change Plan of the Czech Republic is based on Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on governance and climate action in the Energy Union. The document incorporates the primary targets and policies for all five dimensions of the Energy Union for the years 2021-2030, with a forward look to 2050. The main objective of the National Plan is to define the Czech Republic's contribution to the European climate and energy policy goals to reduce greenhouse gas emissions, increase the share of renewable energy sources and enhance energy efficiency. This constitutes a revised version of the national plan, which was adopted by the Czech government on 28 January 2019 and subsequently submitted to the European Commission on 30 January 2019. The National Plan is grounded in two key strategic documents, namely the State Energy Policy of the Czech Republic adopted in 2015 and the Climate Change Policy of the Czech Republic adopted in 2017 (Ministry of the Environment, 2000).

The implementation of the Strategy's objectives is monitored by the Interministerial Working Group on Climate Protection. In order to ensure the Czech Republic's adaptation strategy up to date, it is essential to continuously acquire and assess new knowledge on climate change and its impacts on various sectors. This should include the identification of new knowledge and the monitoring of its effectiveness. In view of these facts and the need to optimise the approach at national and international level, the adaptation strategy of the Czech Republic should be updated. It is intended to review the strategy every 10 years after the initial period (Ministry of the Environment, 2015).

**Climate change**

The Czech Republic is located within the Atlantic-continental temperate climate zone of the Northern Hemisphere, a region characterised by variable annual temperatures. The territory alternates between mountainous and plains, with an average altitude of 450 metres above sea level. Temperatures are already rising, with an increase in the average number of hot days and more frequent rainfall. This phenomenon has precipitated a decline in biodiversity, changes in water balance, periods of drought and heightened frequency flooding (Climate Adapt, 2022b).

The average annual temperature varies between 1.1 and 9.7°C depending on geographical factors. The lowest average temperatures are recorded in the mountainous regions situated along the northern, eastern and south-western borders. Conversely, the highest temperatures are typically observed in low-lying areas located at altitudes below 200m, such as the south-eastern lowlands and the stretch of the Elbe River. Prague and Brno, major cities, are distinguished by an average annual temperature within their heat island that is approximately 1-2°C higher than the standard value or their geographical location. The short-term projection (2030) shows that the average annual air temperature in the Czech Republic will rise by approx. 1°C; with summer and winter warming exhibiting only a slight decrease compared to spring and autumn warming respectively. The medium-term projection (2050) indicates that the simulated warming will become more significant with temperatures rising most in summer (2.7°C) and least in winter (1.8°C) (Climate Adapt, 2022b).

The climate policy of the Czech Republic consists of two key elements: a strategy for the year 2030 and an economic development plan focusing on low-emission initiatives for the year 2050. The strategy places a particular emphasis on measures to reduce greenhouse gas emissions, thereby complementing the approved Strategy for Adaptation to Climate Change in the Czech Republic, which is dedicated to the issue of adaptation to climate change. The overarching objectives of the Czech Republic's climate policy are centred on the reduction of greenhouse gas emissions, with the establishment of long-term indicative targets. The targets set for each Member State range from 0 to 40% compared to 2005 levels. The Regulation stipulates a binding emission reduction target of 14% for the Czech Republic compared to 2005 levels, along with a mandatory linear path to achieve this, commencing from the average of greenhouse gas emissions in 2016, 2017 and 2018 and concluding in 2030. The linear path for a Member State will start either at the five twelfths of the 2019-2020 gap or in 2020, whichever results in a lower allocation for that Member State. The regulation also sets out the flexibility options that member states can utilise. With regard to the reduction of greenhouse gas emissions, priority is also given to lowering emissions into the air that pose a health risk. This includes the urgent reduction and elimination of local coal-fired furnaces and stoves in households as well as an increase in the energy efficiency of buildings (Hanzlik et al., 2020).

*Greenhouse gas emissions*

The European target for reducing greenhouse gas emissions (Figure 42) is 43% for sectors covered by the EU ETS and 30% for sectors outside the EU ETS compared to 2005.

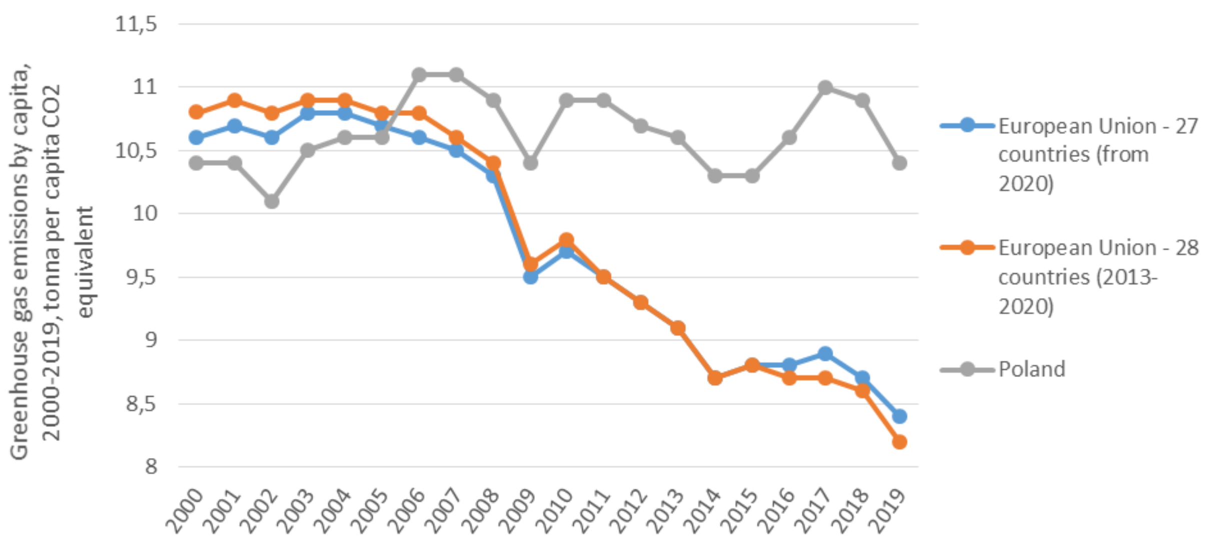



**Figure 42: Czech Republic vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

For Czech Republic, there is no change in the average annual rate of greenhouse gas emissions over the period under review.

The main objective for the Czech Republic is to curtail its aggregate greenhouse gas emissions by 30% by 2030 compared to 2005 levels, which corresponds to a reduction of 44 million tonnes of CO2 equivalent. The national plan incorporates long-term indicative targets to be achieved by 2050 based on the adopted climate change policy. The emission projections show that the implementation of the policies and measures outlined in the national plan will result in a 34% reduction in greenhouse gas emissions (compared to 2005). It is important to note that these projections have been updated for the preparation of the national plan and are consistent with the energy projections. These projections are made on a two-year basis (Ministry of the Environment of the Czech Republic, 2019).

The process of decarbonisation includes the utilisation of renewable energy sources. The EU has set a target of 32% for 2030, expressed as the share of renewables in gross final energy consumption. The recast of the Renewable Energy Directive (2018/2001) incorporates for sub-targets for heating and cooling as well as transport. Since 2010, the Czech Republic has witnessed an increase in the adoption of renewable energy sources, however this figure remains below the EU average (Ministry of the Environment, 2015).

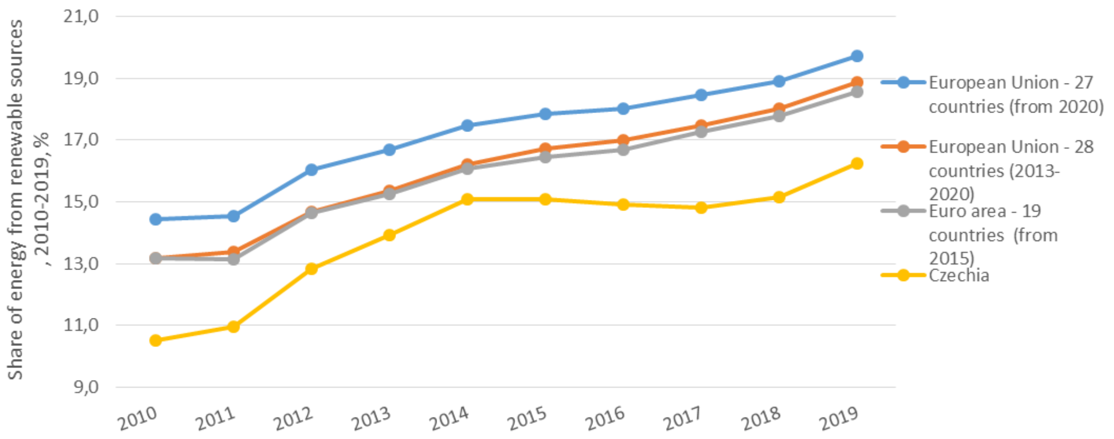



**Figure 43: Czech Republic vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

The Czech Republic has proposed a 22% contribution to the European target by 2030, representing an increase of 9 percentage points compared to the Czech national target of 13% by 2020. The average annual increase in the share of renewable energy in heating and cooling is proposed at 1%. In the domain of transport, the target has been set at 14% for all Member States. The primary policies for meeting the proposed contributions include those articulated in the draft amendment to Law No 165/2012 concerning subsidised energy sources, which establishes a novel support scheme for renewable or subsidised energy sources subsequent to 2020. It should be noted, however, that this proposal has not yet been subject to the full legislative process. To achieve the proposed RES contribution, other policies outside the scope of the proposed amendment, is imperative(Ministry of the Environment of the Czech Republic, 2017).

In the field of energy efficiency, three targets have been established for the period 2021-2030: (i) an indicative target for primary energy sources, final consumption and energy intensity; (ii) a mandatory energy savings target for public buildings; (iii) a mandatory annual rate of final consumption savings. These targets correspond to Articles 3, 5 and 7 of the amended Energy Efficiency Directive 2012/27/EU. The Czech Republic aims to achieve a primary energy level of 1 735 PJ, a final consumption level of 990 PJ and an energy intensity of GDP of 0.157 MJ/CZK by 2030. The Czech Republic has chosen the target expressed in energy intensity of GDP as its primary target (Ministry of the Environment of the Czech Republic, 2019).

Figure 44 shows the total EU energy demand. The data show that total energy demand in the EU has decreased by an average of 1% per year over 20 years.

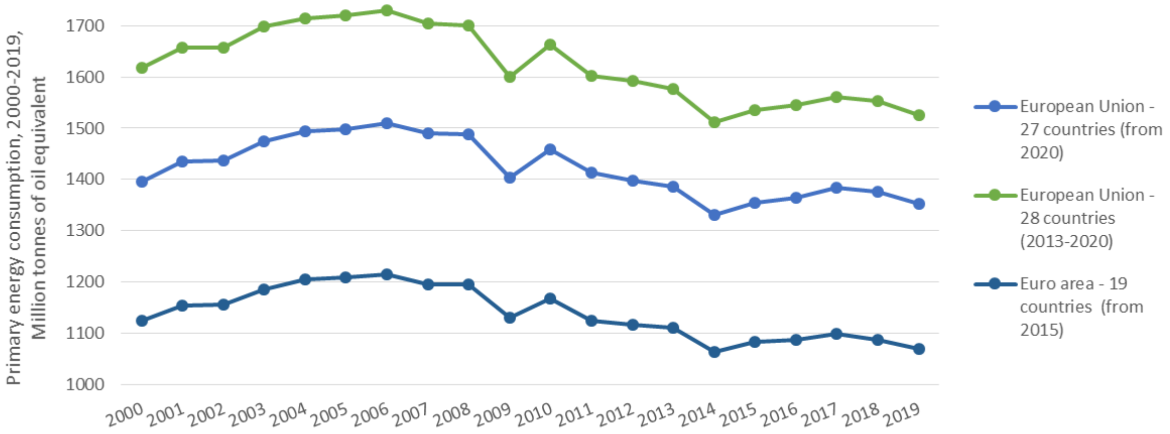



**Figure 44: Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

However, the average rate of change in the Czech Republic is higher than the EU average, reaching an average annual rate of 1%.

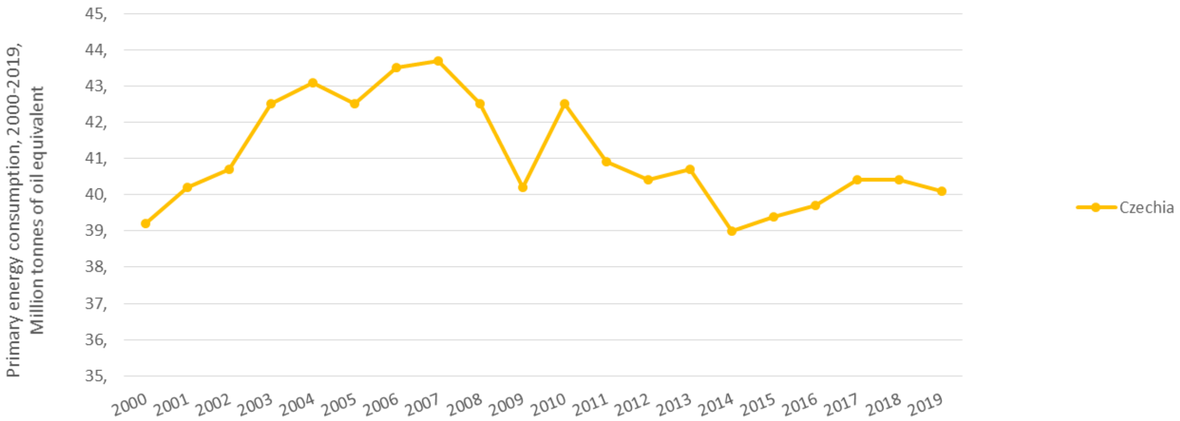



**Figure 45: Czech Republic vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

The Czech Republic has committed to achieve 124 TJ of energy savings in low energy buildings by 2020, in accordance with the rules of the Energy Efficiency Directive. This commitment is based on the assumed energy performance of central institutions' buildings in 2020. Furthermore, a commitment for cumulative energy savings of 462 PJ has been established in accordance with Article 7 on the basis of available data. This estimation is derived from data provided by EUROSTAT and consumption forecasts for the years 2018 and 2019. The commitment in Articles 5 and 7 is provisional in nature and is subject to recalculation based on the actual data that was available in 2020 (Ministry of the Environment of the Czech Republic, 2019).

The evolution of the share of fossil fuels is at a higher level compared to the EU average, however as illustrated in Figure 46, the data series for the Czech Republic exhibits a more pronounced downward trend. As a result, between 200 and 2019 the share of fossil fuels is projected to decline by slightly more than 1% per year on average, in contrast to the EU's average rate of change, which is estimated to be between 0.6 and 0.8%.

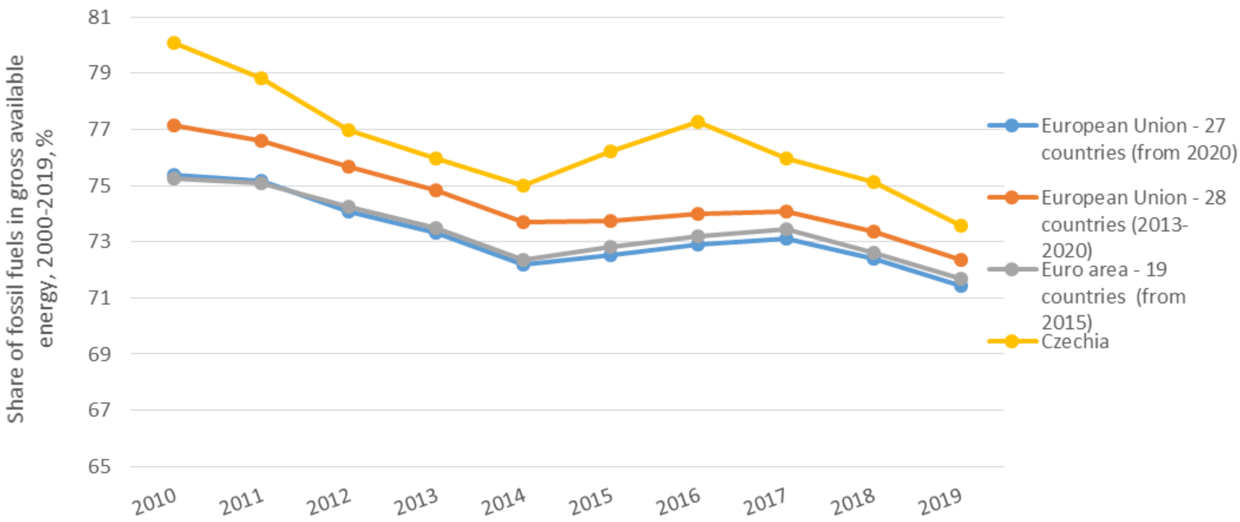



**Figure 46: Czech Republic vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

To meet energy efficiency targets and commitments, the Czech Republic will continue to utilise a range of economic measures. These include state aid, legislative measures, education and advisory measures.

In the period leading up to 2030, the Czech Republic considers it most appropriate to set a national target for the energy performance of the economy that better reflects the impact of external factors on final energy consumption, such as economic growth. The Czech Republic's national target for 2030 is set at 0.157 MJ/CZK for the energy intensity of GDP generation and 0.174 MJ/CZK for GVA generation. The national target is defined as the maximum potential for reducing energy consumption in each economic sector, that is to say, the limit of final energy consumption that the Czech Republic can realistically achieve, taking into account the assumption of the evolution of "boundary conditions". It is imperative to augment the intensity of endeavours to curtail primary energy consumption, taking into account the need to step up efforts to achieve the EU's 2030 energy efficiency target. This should be supported by the implementation of policies and measures that will engender additional energy savings by the year 2030. The policies and measures to be adopted in the period 2021-2030 must be better defined, for example by assessing their expected impact. Achieving the 2020/2030 final and primary energy consumption target will be influenced by a number of factors and assumptions that may change over time. In this context, the definition of "boundary conditions" emerges as a pivotal element, complementing the contribution of the Czech Republic. Significant changes in these input parameters may require the Czech Republic to reassess its indicative national targets in the future (Ministry of the Environment of the Czech Republic, 2019).

Fossil fuels have been responsible more than 70% of the increase in global in energy usage. The demand for natural gas has exhibited the most rapid growth, reaching a record 22% share of total energy demand. Concurrently, renewable energy sources demonstrated robust growth, for accounting for approximately 25% of the increase in global energy demand, with nuclear energy accounting for the remainder. The overall share of fossil fuels in global energy demand remained at 81% in 2017, which has remained stable for more than three decades despite the strong growth of renewables. Fossil fuel subsidies are estimated at around €55 billion. Unfortunately, the Czech Republic does not have primary data in this respect. However, the Czech Republic also reports on fossil fuel subsidies within its OECD membership (Ministry of the Environment of the Czech Republic, 2017).

**Composite Indicators**

Environmental Performance Index (EPI) was developed by the Yale University and provides summary of sustainability around the world, including also the Czech Republic.

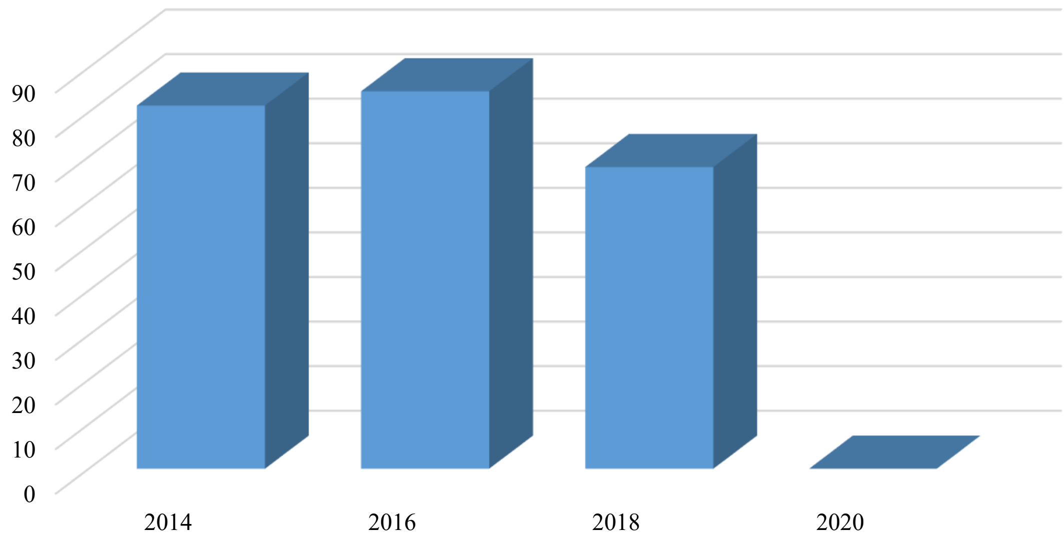



**Figure 47: Czech Republic – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

The indicators which comprise the EPI show at the national level the proximity of countries are to achieving their environmental policy goals. The Czech Republic's Environmental

Performance Index (EPI) scores from 2014 to 2020 are displayed in Figure 47. With regard to the EPI, the Czech Republic has consistently demonstrated a position in the upper-middle range of the ranking, with results that have always exceeded the EU-27 average. Notably, in 2018, the average was below the EU standard.

Its ranks and scores were following in the EPI:

- 2014: 2. with 81.47 points (EU-27 average: 72.17)
- 2016: 18. with 84.67 points (EU-27 average: 82.91)
- 2018: 20. with 67.68 points (EU-27 average: 73.33)
- 2020: 4. with 71.0 points. (EU-27 average: 70,95)

Ecological Footprint constitutes an additional index that quantifies nations' sustainable activities by ecological footprint. The Czech Republic's ecological footprint per capita from 2014 till 2020 is illustrated in Figure 48. The Czech Republic performs quite well in relation to its ecological footprint, with its systematically below the EU-25 average level.

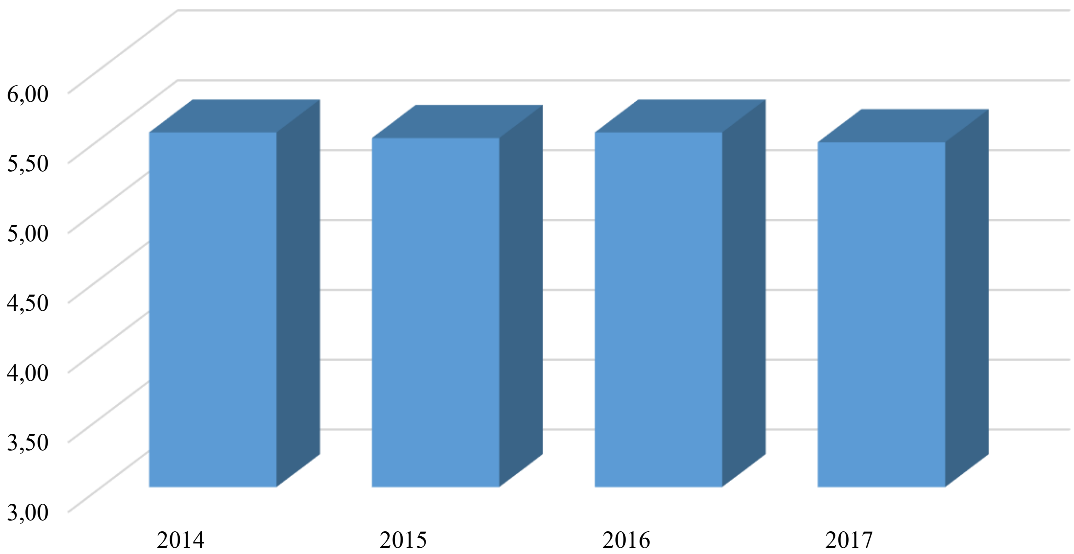



**Figure 48: Czech Republic – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**

Source: own compilation based on (GFN, 2022)

Its ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

- total score in 2014: 5.54 (EU-25 average: 5.23)
- total score in 2015: 5.50 (EU-25 average: 5.25)
- total score in 2016: 5.54 (EU-25 average: 5.26)
- total score in 2017: 5.47 (EU-25 average: 5.34)

Concerning the Climate Change Performance Index (CCPI) the Czech Republic's performance is inconstant. The scores of the CCPI for the country can be seen in Figure 49.

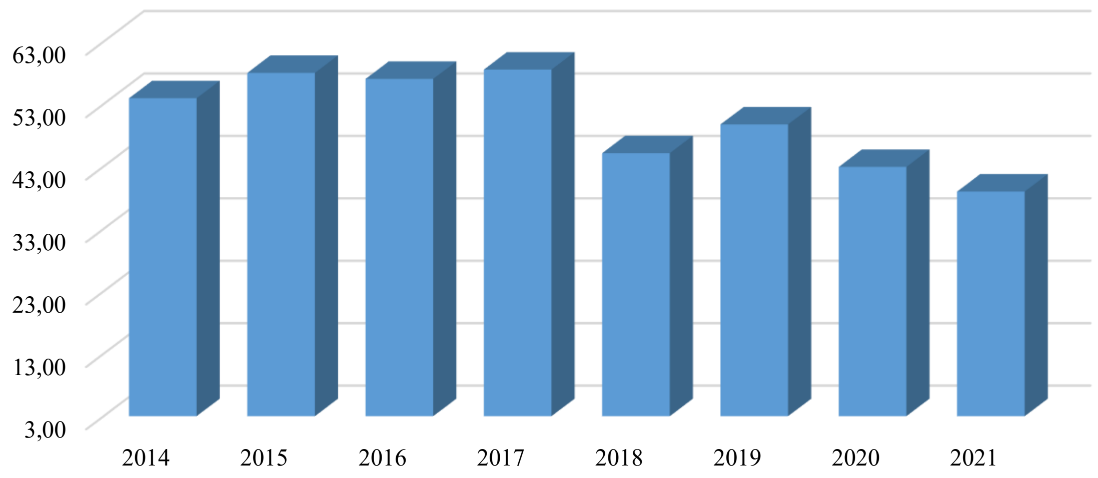



**Figure 49: Czech Republic vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

- 2014: 40. with 53.93 points (global average: 55.72)
- 2015: 26. with 57.99 points (global average: 55.36)
- 2016: 29. with 57.03 points (global average: 54.15)
- 2017: 24. with 58.52 points (global average: 53.77)
- 2018: 43. with 45.13 points (global average: 49.09)
- 2019: 32. with 49.73 points (global average: 50.35)
- 2020: 43. with 42.93 points (global average: 48.61)
- 2021: 47. with 38.98 points (global average: 47.90)

Mostly, the Czech Republic's scores were above the average in 2015, 2016 and 2017, during the other years the scores are below the average.

**Summary**

Prior to the COVID pandemic, the Czech Republic was experiencing a period of economic growth, largely attributable to an augmentation in domestic demand, in addition to net exports and heightened private investment. Unemployment is relatively low, and labour shortages are increasingly beginning to impede the potential for accelerated economic growth. The primary driver of economic growth in the Czech Republic is the industrial sector, with the country boasting one of the highest shares of industry in GDP among EU nations.

The predominance of energy-intensive industry within the Czech Republic is a primary factor contributing to the robustness and reliability of its transmission network. Extreme weather events have already caused significant damage to the transmission and distribution networks, but distribution companies have managed to maintain a stable power supply and low levels of blackouts. Nevertheless, the grid will also have to adapt to the expected increased demand for cooling during summer peak periods, increased demand for electromobility and the development of decentralised energy sources.

The majority of goods are transported by lorries and road transport is by far the most common mode of passenger transport. The Czech Republic is also one of the main transit corridors in the EU, due to its central location in Europe and its dense network of transport routes. However, much of the transport infrastructure is rather outdated, lacking fast transport links between major cities and neighbouring countries. Significant investments in transport infrastructure are planned over the next few years, and these will need to be adapted to climate change. The Czech Republic also has one of the densest rail networks in the EU, which is also negatively affected by the increased frequency of extreme weather events. Air transport is used almost exclusively for international transport, and water transport is not a significant mode of transport in the Czech Republic. The Czech Republic has adopted strategies, plans and measures to protect critical infrastructure. The National Action Plan also details measures to address the aforementioned risks.

**Good Practices**

A synergy exists between adaptation actions outlined in NAS and NAP, and mitigation efforts and activities, with measures exhibiting both adaptation and mitigation impact being favoured. A recent and prominent illustration is the New Green Savings Programme, primarily focused on energy savings and mitigation. Within the scope of this programme, initiatives such as construction of green roofs are being undertaken. The synergy between adaptation and mitigation is one of the original ideas of Covenant of Mayors for Climate & Energy.

Moreover, the country has committed to the Strategic Framework Czech Republic 2030, which is aligned with the global Sustainable Development Goals) and Sendai Framework for Disaster Risk Reduction.

In the field of water management, the Czech Republic maintains close collaboration with all neighbouring states through bilateral commissions concerning transboundary rivers and their management (e.g. transboundary early warning systems, flood prevention measures etc.).

Furthermore, the nation actively participates in the operations of the international commissions for Elbe, Oder and Danube river basins. In these forums the country proactively disseminates information pertaining to climate change, water protection, and the prevention and mitigation of extreme hydrological events. The Czech Republic's commitment to these initiatives is further evidenced by its active involvement in the 2018 update of the Climate Adaptation Strategy for the Danube River Basin.

The Czech Republic is supported by the Norwegian funds, whose main purpose is to reduce social and economic disparities in Europe and to strengthen bilateral relations and mutual cooperation. A notable programme that has been earmarked for support is the Environment, Ecosystems and Climate Change project, which is administered by the State Environmental Fund. It is structured around 5 distinct areas of support, with a total budget of approximately 800 million CZK. Around one third of this allocation is designated for "Climate Change Mitigation and Adaptation" measures. These measures encompass the development of novel local or regional adaptation and mitigation strategies and plans, their implementation, and the raising of public awareness on these issues, particularly at the local or regional level.

Since 2020 the Ministry of Environment has been responsible for coordinating the Working group on climate education with the aim to publish the Policy paper for climate education as well as the Methodology for educators in the second half of 2021.

**The Czech national action plan**

The state has demonstrated support for home renovation initiatives that facilitate the utilisation of renewable energy sources The country, being neither excessively nor particularly northerly situated, is a country in which citizens may consider the installation of solar panels. The Czech government not only financially supports such initiatives, in order for the projects to reach the implementation stage, it had to be promoted beforehand that the residents have this opportunity and should take advantage of it. To this end, the state has invested great emphasis on providing information in the form of various posters, advertisements, videos, and pictures to promote steps individuals can take towards sustainability.

In addition to solar energy, wind energy is also available to both industry and the population in the country. Moreover, wind energy can be utilised for cooling and heating purposes within residential parks, for example. However, the development of a wind farm must first realised in terms of infrastructure. By the year 2040, the Czech Republic has set itself the ambitious target of achieving a substantial reduction in the utilisation of non-renewable energy sources in the state, whether in industrial or private context.

Firstly, the focus is naturally on industry and the economy, given their significant energy consumption. However, individual households can also contribute to more sustainable, greener country through numerous small actions.[1]

Two prominent industrial entities within the Czech Republic, have demonstrated a notable degree of foresight, operating a similar level of awareness in their own fields. One of the companies is none other than Skoda Auto. A visit to their website reveals that the predominant colour scheme is therein green, with various shades. This choice symbolises the company's commitment to a future-oriented approach, not only at a company, but also at an individual level.

A dedicated tab on their website introduces their sustainability to visitors. A simple but great motto appears on the page: *"Electric is here, let's make it simple."* The company's position on the primary motivator of environmental consciousness is that the existence of electricity should be leveraged to its maximum potential, eschewing the utilisation of non-renewable energy sources for daily necessities such as personal transportation. By acting in the spirit of sustainability, they achieve not only economic but also social development. They have reduced their carbon dioxide emissions to a minimum during the production of cars, and they are manufactured using the most advanced technology available. Their main objective is to reach net zero emissions, meaning that the production of cars is entirely free of any harmful substances. Their goals include complete carbon neutral by 2050. In addition, it is expected to reduce the emission of harmful substances by 30% by the year 2025 in comparison with the levels recorded in 2015. Furthermore, the company is committed to improving air quality by increasing the number of electric [2]cars available on the market.

Another company that faces the future with a similar awareness is Pizensky Prazdroj brewery. They have formulated "green goals" for themselves, with the intention of achieving and implementing them as soon as possible. Their main goal is to minimise the ecological footprint and derive energy from renewable energy sources. The brewery has set a target of achieving complete carbon neutrality by 2030. They only buy raw materials for brewing from farms that pay attention to sustainability and refrain from heavily chemical use in crop production. Furthermore, they emphasize the significance of recycling, with the objective of utilising exclusively recycled and recyclable packaging by 2030.[3]

1 https://www.iea.org/articles/czech - republic - climate - resilience - policy - indicator

2 https://www.skoda-auto.com/company/environment _ _

3 https://www.prazdroj.cz/en

## References


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Adapt (2022b). Czech Republic. Retrieved from https://climate-adapt.eea.europa.eu/countries-regions/countries/czechia
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Hanzlik, V., Javurek, V., Smeets, J., Svoboda, D. (2020). Pathways to decarbonize the Czech Republic. Carbon-neutral Czech Republic 2050. Chicago: McKinsey & Company.
- Ministry of the Environment (2000). National Program to Abate the Climate Change Impacts in the Czech Republic. Prague: Ministry of the Environment.
- Ministry of the Environment (2015). Strategy on Adaptation to Climate Change in the Czech Republic. Prague: Ministry of the Environment.
- Ministry of the Environment of the Czech Republic (2017). Climate Protection Policy of the Czech Republic. Executive summary. Prague: Ministry of the Environment of the Czech Republic.
- Ministry of the Environment of the Czech Republic (2019). National Energy and Climate Plan of the Czech Republic. Prague: Ministry of the Environment of the Czech Republic.

## 4.7. DENMARK

Denmark characterised by a temperate climate, with mild winters and cool summers. The mean temperature in January is 1.5 °C (34.7 °F), while that in August is 17.2 °C (63.0 °F).[61] The most extreme temperatures recorded in Denmark, since 1874 when recordings began, were 36.4 °C (97.5 °F) in 1975 and −31.2 °C (−24.2 °F) in 1982. The average annual precipitation in Denmark is 765 millimetres (30 in), distributed across 179 days. The wettest season is autumn, while spring is the driest. The location between a continent and an ocean results in a climate that is frequently characterised by instability.

Denmark has a developed mixed economy, which is classed as a high-income economy by the World Bank. In 2017, the country was ranked 16th in the world in terms of gross national income (PPP) per capita and 10th in nominal GNI per capita. Denmark's economy stands out as one of the most free in the Index of Economic Freedom and the Economic Freedom of the World. It is the 10th most competitive economy in the world, and 6th in Europe, according to the World Economic Forum in its Global Competitiveness Report 2018.

The country's most important economic statistics compared to the EU-27 average can be seen in Figure 50.

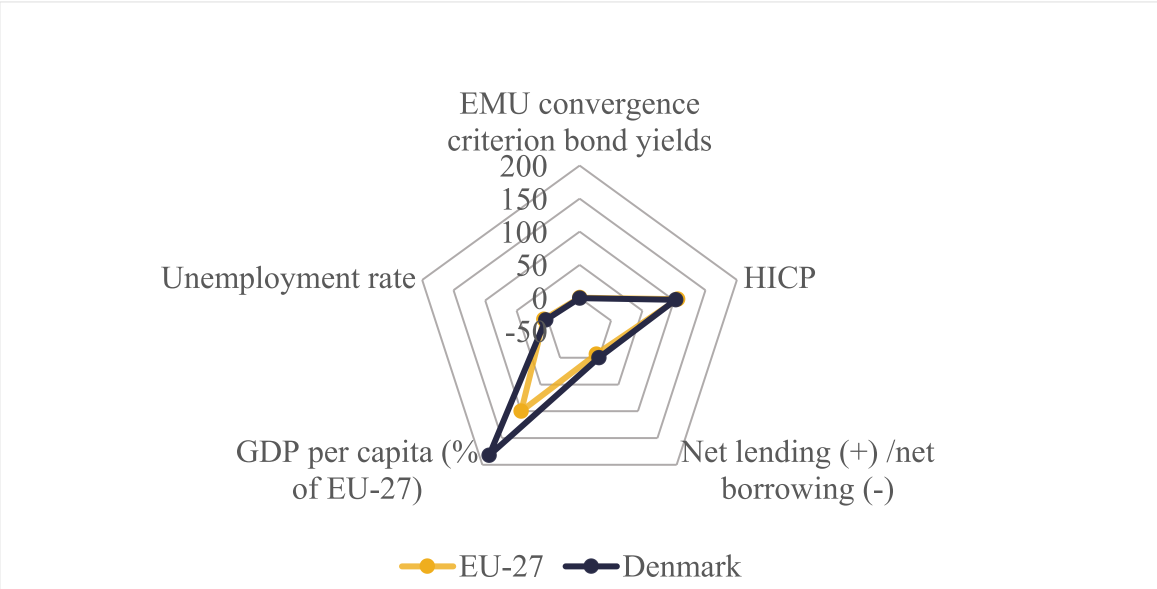



**Figure 50: Demark vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

Denmark has the fourth highest ratio of tertiary degree holders in the world. In terms of workers' rights the country ranks highest in the world. GDP per hour worked was the 13th highest in

2009. The country has a market income inequality close to the OECD average, but after taxes and public cash transfers the income inequality is considerably lower. According to Eurostat, Denmark's Gini coefficient for disposable income was the 7th-lowest among EU countries in 2017. According to the International Monetary Fund, Denmark has the world's highest minimum wage. As Denmark has no minimum wage legislation, the high wage floor has been attributed to the influence of trade unions. Once a predominantly agricultural country on account of its arable landscape, since 1945 Denmark has greatly expanded its industrial base and service sector. By 2017 services contributed circa 75% of GDP, manufacturing about 15% and agriculture less than 2%. The country's major industries include wind turbines, pharmaceuticals, medical equipment, machinery and transportation equipment, food processing, and construction. Approximately 60% of the total export value is derived from the export of goods, while the remaining 40% is from service exports, primarily sea transport. The country's main export commodities are the followings: wind turbines, pharmaceuticals, machinery and instruments, meat and meat products, dairy products, fish, furniture and design. Denmark is a net exporter of food and energy and has for a number of years had a balance of payments surplus which has transformed the country from a net debtor to a net creditor country. As of 1 July 2018, the net international investment position (or net foreign assets) of Denmark equalled 64.6% of its GDP.

**Climate Strategy**

Denmark is a leader in the energy transition, with the highest share of wind energy in both total primary energy consumption and electricity. The integration of variable renewable energy is supported by a flexible domestic power system and a high level of interconnection, thereby ensuring the maintenance of a highly reliable and secure electrical-power grid. The country has committed to achieving net-zero emissions and aims to become independent of fossil fuels by 2050. In the meantime, it has set out several goals for 2030. These includes the following:

- cut GHG emissions by 70% from 1990 levels,
- phase out all coal-fired power,
- cover 100% of electricity and 55% of overall consumption with renewable energy,
- cover 90% of district heating from non-fossil sources,
- end sale of petrol and diesel cars.

Its primary energy consumption comparing EU-28 is illustrated in Figure 51 The Primary Energy Consumption indicator shows the total energy needs in Denmark including the industry, transport, households, among others.

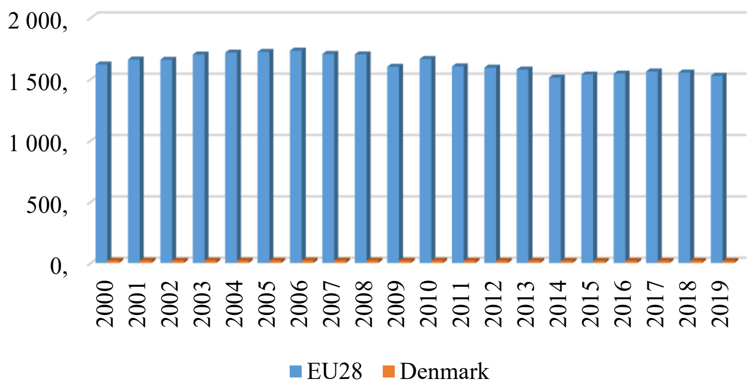



***Figure 51:*** **Denmark vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

Denmark has implemented several measures to address climate adaptation. The country has adopted a National Adaptation Strategy and a National Adaptation Plan. "The Danish approach to climate adaptation revolves around key priority sectors. The overarching goal is to gather and create knowledge in these particular areas for further use. The sectors involved are as follows: coastal management, buildings and construction, water energy, agriculture, forest, fisheries, planning, health preparedness, nature, insurance, transport. In addition to the sectors, the web portal Klimatilpasning.dk collects and presents technologies and technological development in the field of climate adaptation and combines it with prospects of financing and government subsidies."

The share of fossil fuels in gross available energy can be seen in Figure 52.

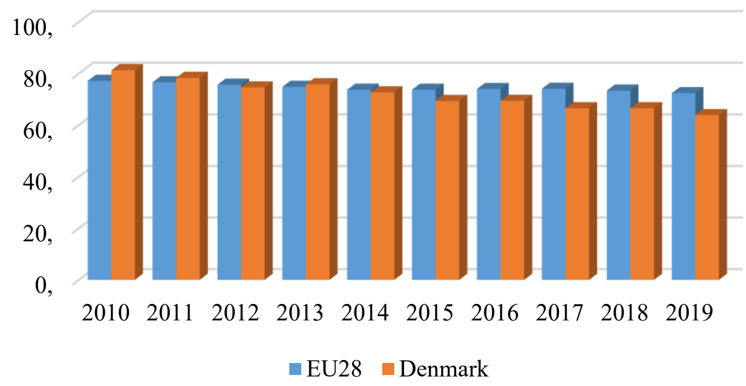



**Figure 52:** **Denmark vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

In 1990, the total CO2 emission of Denmark was 50,96 Mt, whereas in 2020 it was 25,57 Mt. This represents a total reduction of 49,82%. The total energy production in 1990 was 422,0294 TJ and in 2020 it was 393,1405 TJ, which is a 6,85% reduction over the years. The total primary energy supply in 1990 was 17,35 Mtoe, while in 2020 it was 15.36 Mtoe, with a total reduction of 11,47%. In 1990 the total electricity consumption was 30,56 TWh and 33,34 TWh in 2020, it means a 9,1% increase in the given period.

Figure 53 shows the greenhouse gas emission per capita in Denmark and in the EU-28 from 2000 till 2019.

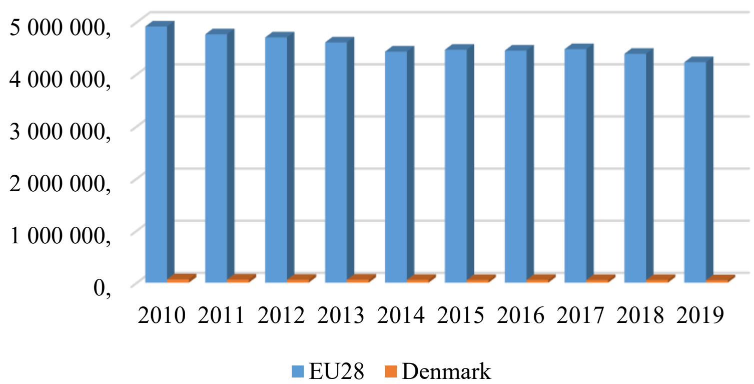



**Figure 53:** **Denmark vs. EU28 – Greenhouse gas emissions, 2000-2019 (CO2 equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

In 1990 the total energy supply by source was 319 910 TJ of oil, 254 894 TJ of coal, 76 099 TJ of natural gas, 47 723 TJ of biofuels and waste, 2344 TJ of wind, solar and other, and 101 TJ of hydro. In 2020 it was 233 361 TJ of oil, 30 008 TJ of coal, 86 828 TJ of natural gas, 203 086 TJ of biofuels and waste, 66 424 TJ of wind, solar etc., 58 TJ of hydro. The figures show a decrease in fossil energy sources and a significant increase in renewable energy supply.

Denmark's share of energy from renewable sources can be seen in Figure 54.

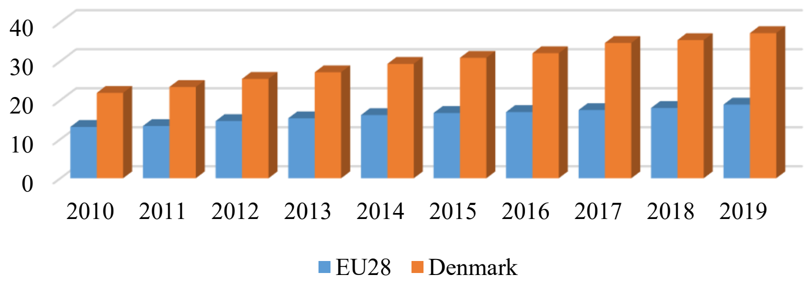



**Figure 54: Denmark vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

**Other key indicators in the topic:**

| Name | 1990 | 2020 | Difference |
|---|---|---|---|
| CO2 emissions per capita | 9,9 t | 4,4 t | -55,55% |
| CO2 emissions per unit of GDP | 0,3 kg CO2/2015 USD | 0,1 kg CO2/2015 USD | -33,33% |
| Net energy imports | 362,2 TJ | 309,0 TJ | -14,69% |
| Total energy supply per capita | 141,5 GJ | 110,1 GJ | -22,19% |
| Total energy supply per GDP | 3,6 GJ/Thousand USD | 2,0 GJ/Thousand USD | -44,44% |
| Total public energy RD&D budget | 54,0 USD Million | 160 USD Million | +196,3% |
| Renewable share (modern renewables) in final energy consumption | 7% | 35,3% (2018 data) | +28,3% |
| Energy consumption by capita | 39,245 kWh | 33,535 kWh (in 2019) | -14,55% |

Own editing based on data from https://www.iea.org/ and https://ourworldindata.org/

"A review of the significance of climate change up to 2050 shows that Danish society may experience both positive and negative impacts. The positive impacts will relate primarily to the higher temperatures that will result in, for example a longer growing season and increased productivity for forestry and agriculture. Furthermore, milder winters are expected to lead to a decline in energy consumption and construction costs, and the expenditure of winter-weather readiness and road salt usage. On the other hand, the adverse effects of climate change will relate primarily to more frequent extreme precipitation, elevated sea levels and more intense storms. These phenomena can potentially result in flooding and damage to infrastructure and buildings as well as erosion along coastal regions."

**Composite Indicators**

Denmark's Environmental Performance Index (EPI) scores from 2014 to 2020 can be seen in Figure 55.

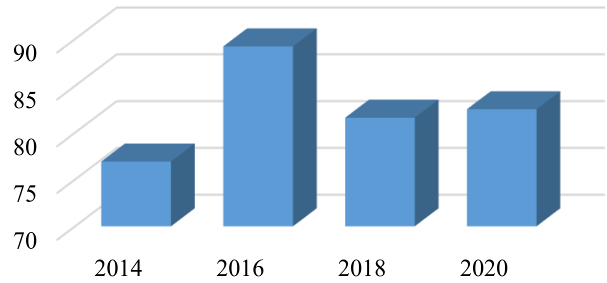



**Figure 55: Denmark – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Ireland's ecological footprint per person from 2014 until 2020 can be visualised in Figure 56.

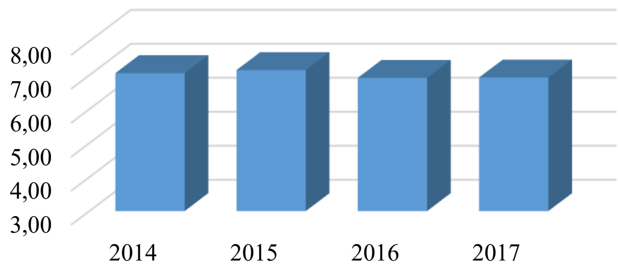



**Figure 56: Denmark – Ecological footprint, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Concerning the Climate Change Performance Index (CCPI) Denmark's performance is inconstant. The scores of the CCPI for the country can be seen in Figure 57.

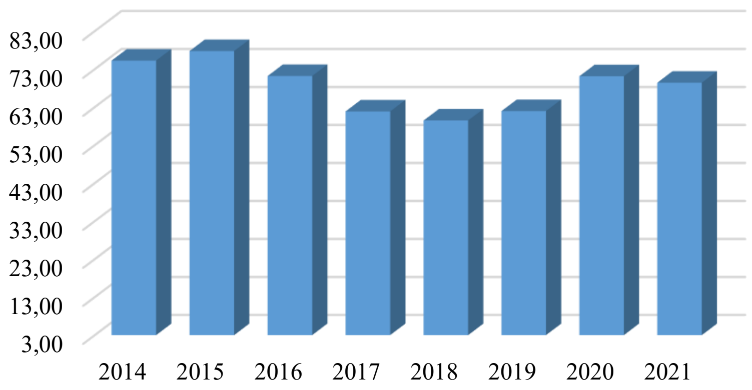



**Figure 57: Denmark vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

**Good Practices**

Denmark's National Adaptation Plan is frequently reviewed and reassessed, then supplemented with the newly found gasps and additional challenges. The most recent iteration of the plan is expected to be adopted in 2022. All municipalities have also adopted local adaptation action plans. It is a municipal responsibility to plan and implement measures for climate adaptation, in accordance with legislative framework established by the central government. Each plan incorporates flood risk mapping and establishes the priorities for local climate adaptation measures. „22 municipalities also had to prepare a risk management plan pursuant to the Danish Flood Risk Act, that relates to the EU Floods Directive. The evaluation reveals that incorporation of climate change adaptation in municipal development planning has served as a basis for coordination of climate change adaptation efforts with other spatial planning efforts."

The monitoring of the country's climate is conducted under the auspices of the World Meteorological Organisation's programmes and sub-programmes mainly through atmospheric and oceanic observations. "Danish observations and model results from international frameworks are combined to inform climate adaptation in Denmark through the Danish Climate Atlas. The Danish Climate Atlas provides data on municipality, drainage basin and coastal stretch levels showing future changes in temperature, precipitation, extreme precipitation, relative sea level and storm surge heights. It thereby gives an indication of areas with a particular future risk of being impacted by extremes. The tool provides fundamental climate data, so municipalities can take the necessary precautions and guard citizens, infrastructure and buildings against the expected extreme weather in the future. Results are displayed for different future emissions scenarios, and the uncertainties illustrated as the range of projections from the different climate models employed."

Specifically, the models include:

- Regional dynamic ocean models for calculating changes in regional sea level, ocean and sea ice. The focus areas are the North Sea, the Baltic Sea and Greenland waters.
- Regional dynamic atmosphere-climate models for calculating regional/local climate change and variations. Important focus areas for Denmark are changes in (extreme) precipitation, drought risk and heat waves. For Greenland, special focus is on the ice sheet and changes in snow accumulation, melting and refreezing.
- Global Earth System modelling: dynamic coupled atmosphere-ocean-sea-ice models, which are used to study climate change and internal variability in the climate on decadal to centennial time scales. The work includes active coupling to ice-sheet models for studies of the changes of the Greenland and Antarctic ice sheets.

The assessment of climate dynamics, as observed through monitoring, modelling, and statistical analyses has identified the following climate hazards: wildfires, changing temperatures, heavy precipitation, sea level rise, coal erosion, blizzards, dust and sandstorms. In the future these hazards are expected to be further compounded by changing wind patterns.

Currently, there is no methodology for evaluating the reduction of climate impacts. In response to this gap, the Danish EPA initiated a research project in 2020 with the aim of developing relevant indicators for monitoring, reporting. The project is being carried out by Aarhus University.

In Denmark, contributions to climate adaptation are made by private and public stakeholders . These stakeholders share their newly established technologies and methods on climate adaptation at Klimatilpasning.dk. Currently, the website features over 70 selected case studies, which represent the collective knowledge and insights of the actors involved. For each project, a comprehensive description is provided, including the project's status, background, solution, gains and added value, financing, process, stakeholder involvement, and any encountered barriers.

Public organisations have also established a mobile team as a part of the Task Force on Climate Change Adaptation. The primary objective of this team is to provide guidance to municipalities and municipal authorities through seminars, workshops, trainings sessions, and other educational initiatives. In 2020, a joint effort was made public and private organisations to create a new National Network for Climate Adaptation, with the aim of setting up a robust, collaborative common framework for professional activities in the domains of research and development, projects and competence development.

"The Danish Coastal Authority participates in the EU Interreg co-financed project on adaptation in the North Sea, 'Building with Nature'. Furthermore, a number of Danish municipalities and stakeholders are participating Interreg adaptation projects, including in dealing with flood, water and soil resilience. Finally, several recent LIFE projects in Denmark have adaptation dimensions, particularly the Inter-municipal cooperation on 'Water Management and Climate Change Adaptation for The Stream of Usserød', and the Central Denmark Region leads the EU-funded project 'Coast to Coast Climate Challenge', which has a goal of formulating and implementing a coordinated adaptation strategy for the region between 2017 and 2022."

- **Sustainable nutrition** – In October 2021, an agriculture-climate agreement was adopted in Denmark with the objective of reducing the amount of greenhouse gases and nitrogen emitted by the country's food systems. A support programme has been outlined, within the framework of which a sum amounting to 78 million euros will be allocated to farmers producing plant-based protein crops intended for human consumption for a period of five years.

  (https://elelmiszervilag.hu/dania-es-a-fenntarthato-taplalkozas/)

- **CopenHill** - CopenHill is a waste-to-energy plant located in Copenhagen, with additional facilities, including a ski slope, a hiking trail and a climbing wall on top. The plant has a process capacity of 440,000 tonnes of waste, which is converted into sufficient clean energy to power 150,000 homes and provide district heating on an annual basis. Approximately half of the 41,000 $m^2$ area is dedicated to the cleaning of smoke, which is generated during the incineration of incinerated garbage.

  (https://emag.directindustry.com/copenhill-a-waste-to-energy-plant-with-a-ski-slope/)

- **Denmark's first climate law** – On 18 June 2020, the Folketing passed on the first climate law in the Kingdom of Denmark. The law stipulates that the country should reduce the presence of greenhouse gases in the atmosphere by approximately 70 percent by 2030 compared to the 1990 level. The "green tax reform", part of the nation's agenda, with the establishment of two "energy islands" in the North and Baltic seas with a total output of 4 gigawatts, along with the introduction of green fuels such as green hydrogen and biogas) and the transition to "green" district heating.

  (https://precedens.mandiner.hu/cikk/20200624_megszavaztak_dania_elso_klimatorvenyet)

- **Replacing piped water with rainwater** - in the city of Nye, a pioneering environmental project is currently being implemented.: This initiative involves the utilisation of rainwater fornon-potable purposes, sauch as flushing the toilets and operating washing machines. This is advantageous, because they save on drinking water, and they prevent floods. The adoption of this method, has enabled the replacement of approximately a one-third of the groundwater utilised by households.

  (https://hu.euronews.com/2021/08/26/uttoro-klimaprojekt-daniaban)

- **Cycling for a healthier future** - Almost everyone in Denmark travels by bike. Most Danish people believe that this is an important part of environmental protection. In prominent cities such as Copenhagen, Århus and Odense, numerous major companies advertise different products on billboards, while simultaneously directing attention to people who travel by bicycle. They believe that this will lead to a significant increase the number of bicycle users, thereby contributing to the creation of cleaner, healthier and more liveable cities.

  (https://greenfo.hu/hir/dania-zold-szokasai/)

- **Recycling centres** - Denmark has many recycling centres. A wide range of materials, including water bottles and cans of beer, can be recycled. In many Danish workplaces, such as at Trendhim, there is a systematic separation of food waste, paper, plastic waste, and soda cans. This method facilitates the efficient transportation of residual waste. Danish Minister of Environment has emphasised the necessity of reducing the country's wasteful habits and the focus will now be directed towards the use of clothes. It is important to know that Danes accumulate a substantial amount of clothes. On average, each Danish generates 16 kg of clothes per year.

  (https://greenfo.hu/hir/dania-zold-szokasai/)

**References**


- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table,

Unemployment rate
https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.

- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- https://climate-adapt.eea.europa.eu/countries-regions/countries/denmark?fbclid=IwAR1sV44lVu1agXzFOsRYHZl6AbzwG32Ws-585TlxIn_dZeBaAPFBwoV1dr4
- https://ourworldindata.org/energy/country/denmarkű CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- https://www.iea.org/countries/denmark

## 4.8. ESTONIA

Estonia is situated in the northern part of the temperate climate zone and in the transition zone between maritime and continental climate. The climate is more continental in the eastern part of the country and more maritime in the western part, especially on the islands. Estonia has four seasons of near-equal length. Average temperatures range from 17.8 °C (64.0 °F) on the islands to 18.4 °C (65.1 °F) inland in July, the warmest month, and from −1.4 °C (29.5 °F) on the islands to −5.3 °C (22.5 °F) inland in February, the coldest month. The mean annual temperature in Estonia is 6.4 °C (43.5 °F). The annual average precipitation is 662mm. The average for the year is 1829.6 hours of sunshine. The duration of sunshine is highest in coastal areas and lowest inland in northern Estonia.

As a member of the European Union, Estonia is classified as a high-income economy by the World Bank. The GDP (PPP) per capita of the country was $29,312 in 2016 according to the International Monetary Fund. Due to its rapid economic growth, Estonia has often been described as a Baltic Tiger alongside Lithuania and Latvia. On 1 January 2011, Estonia adopted the euro, thereby becoming the 17th member state of the eurozone.

According to Eurostat at the end of 2010, Estonia had the lowest ratio of government debt to GDP among EU countries at 6.7%. A balanced budget, minimal public debt, a flat-rate income tax, a free trade regime, a competitive commercial banking sector, innovative e-Services and even mobile-based services are all hallmarks of Estonia's market economy.

The country’s most important economic statistics compared to the EU-27 average can be seen in Figure 58.

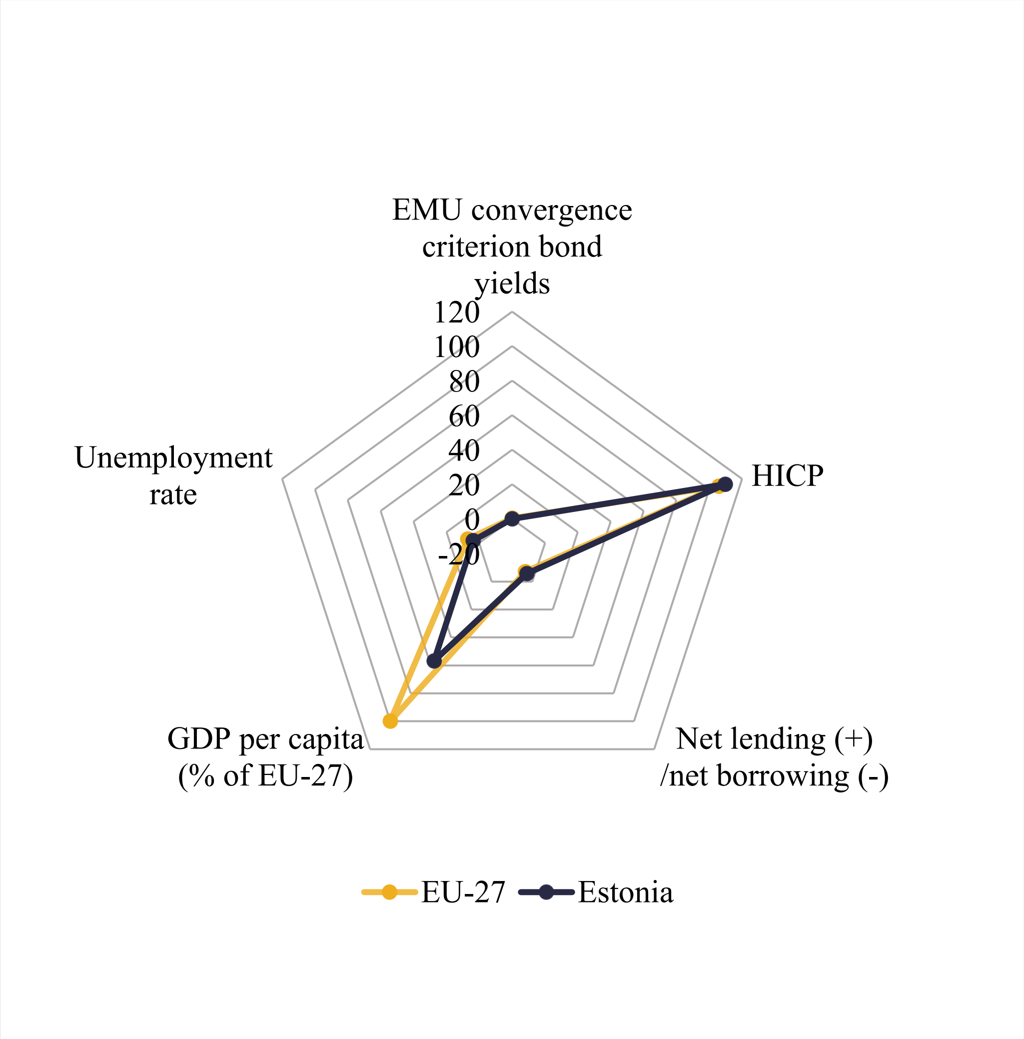



***Figure 58:*** **Estonia vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

Estonia produces about 75% of its consumed electricity. In 2011, approx. 85% of it was derived from locally mined oil shale. Alternative energy sources such as wood, peat, and biomass make up approximately 9% of primary energy production. Renewable wind energy was about 6% of total consumption in 2009. Estonia imports petroleum products from Western Europe and Russia. Estonia imports 100% of its natural gas from Russia. Oil shale energy, telecommunications, textiles, chemical products, banking, services, food and fishing, timber, shipbuilding, electronics, and transportation are key sectors of the economy. The ice-free port of Muuga, situated near Tallinn, is a modern facility featuring good transhipment capabilities, a high-capacity grain elevator, chill/frozen storage, and recently upgraded oil tanker off-loading capabilities. The railroad serves as a crucial conduit between the West, Russia, and other key points.

**Climate Strategy**

Climate change policies are very important for many countries nowadays. Estonia, situated in north-eastern Europe and bordering the Baltic Sea is among these countries. This small country was formerly a part of the Soviet Union, but following the regime change, it became one of the fastest developing post-Soviet countries. Today the country is a member of both NATO and EU, and the official currency is Euro. The Estonian government has developed climate change and environmental targets. These include the National Adaptation Strategy (NAS) and the National Action Plan (NAP), both of which were created in 2017. These targets involve the work of several Estonian ministries: The Ministry of Rural Affairs, the Ministry of Economic Affairs and Communication, the Ministry of Social Affairs, the Ministry of Finance, the Ministry of the Interior, and the Ministry of Education and Research. Each ministry employs a unique approach to the issue. The main objective of the NAS is to improve the preparedness of the state, regions, and local communities to mitigate the impact of climate change. The adaptation of priorities affects the following eight sectors:

- Health and rescue capability
- Land use and planning
- Natural environment
- Bioeconomy
- Economy
- Society, awareness, and cooperation
- Infrastructure and buildings
- Energy and security of supply

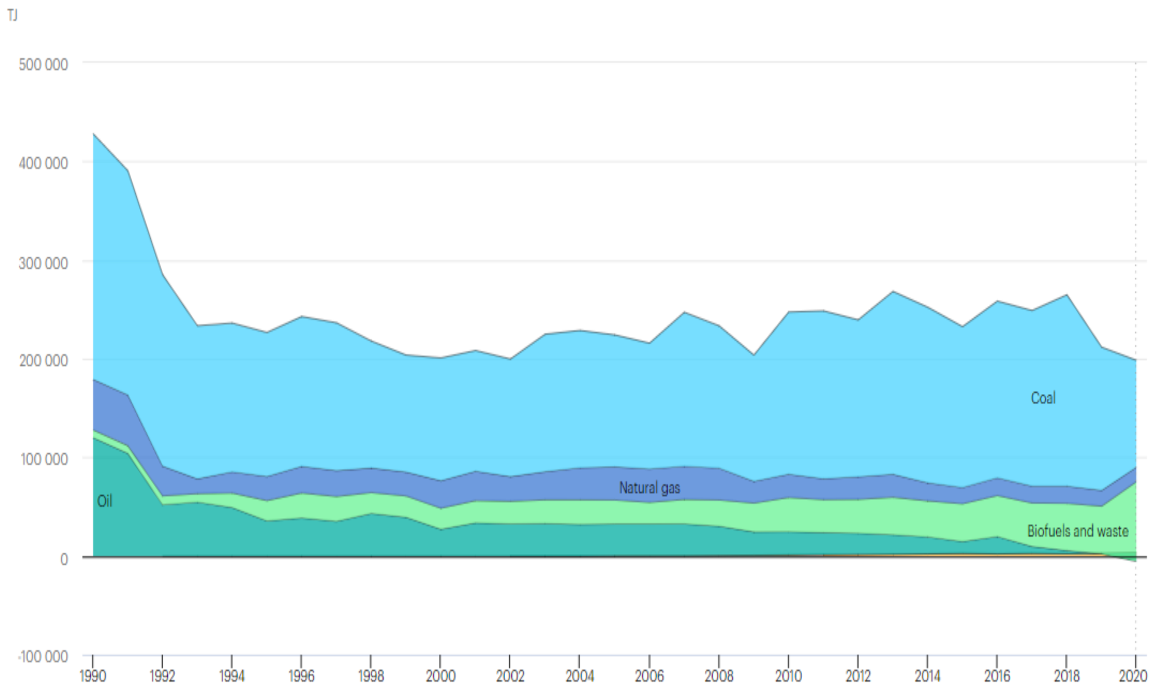
**$CO_2$ emissions**

Carbon dioxide (CO2) emissions are widely regarded as a primary sustainability indicator. In 2020, the total $CO_2$ emissions in Estonia amounted to 8.6 million tons. By comparison, the total emissions figure for 1990 was 35.3 million tons. This rapid decline can be attributed to the system change and the disintegration of the Soviet Union, especially during the early 1990s. The primary contributors to $CO_2$ emissions were identified as electricity and heating production. Currently, the second-largest contributor is transport, followed by industry, which is the third-largest. There is an absence of discernible decline in transport $CO_2$ emissions in Estonia. The

$CO_2$ emissions for electricity, heating, and industrial production originate from the following sources according to consumption: coal, oil, and natural gas.

**Total energy supply**

It is interesting to observe the total energy supply (TES) (iea.org), for which the terajoule (TJ) is the unit of measurement. TES provides a quantitative indication of the energy supply in the market. For the case of Estonia, the figures of TES were 428,086 TJ in 1990, 223,920 TJ in 2005, and 194,752 TJ in 2020. The diagram below illustrates the composition of the total energy supply during this period in the country. It is evident that the composition of each energy resource has undergone a substantial transformation over the past three decades. Although, coal remains the primary energy source, its share in the total energy supply has declined. In 1990, it accounted for 58.2%, whereas in 2020, this figure has decreased to 55.6%. Parallel to this process, the contribution of oil-produced energy has almost ceased, representing 28.1% of the total energy supply. Biofuels and waste play important roles in the energy supply today, indicating a crucial step in the use of greener energy resources. It is noteworthy that in 1990, oil accounted for more than 40% of the total energy supply. Estonia had no wind or solar energy after it achieved independence from the Soviet Union. The rate of these renewable energy sources was still very low in 2020 as well. In contrast, many European countries have adopted nuclear energy; however, Estonia has not followed this course, instead opting for a policy devoid of nuclear energy.




Total primary energy supply in Estonia in 1990-2020

Estonia's primary energy consumption comparing EU-28 is illustrated in Figure 59. The Primary Energy Consumption indicator shows the total energy requirements of the country including the industry, transport, households, among others.

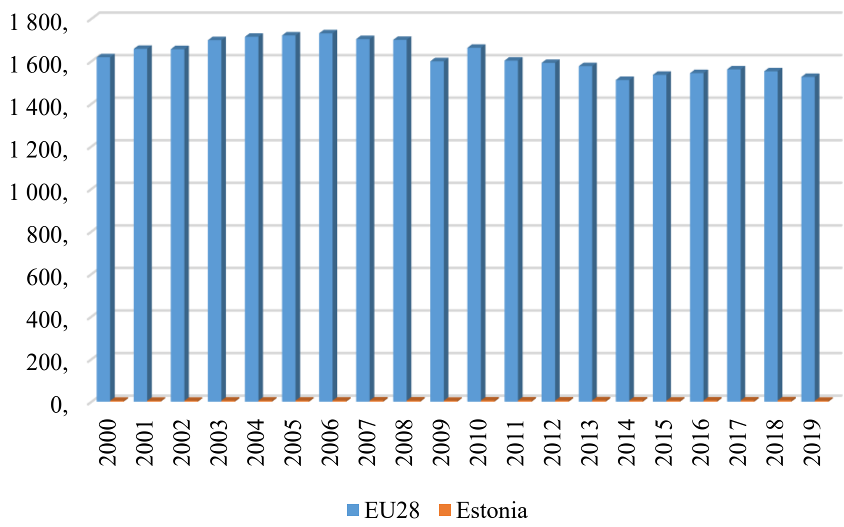



***Figure 59:*** **Estonia vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

The share of fossil fuels in gross available energy can be seen in Figure 60.

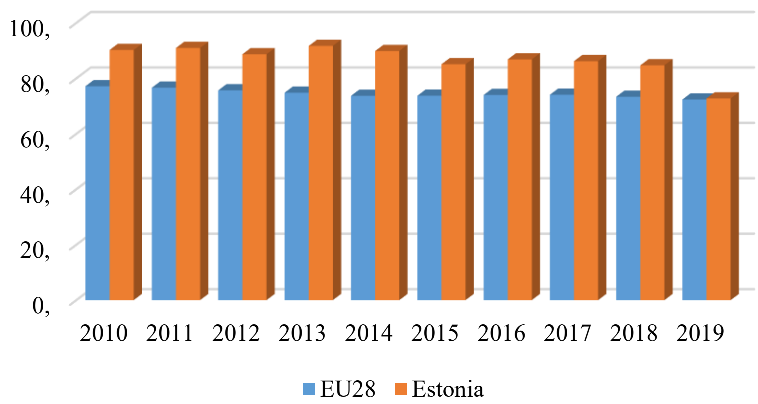



**Figure 60:** **Estonia vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

In order to gain a more comprehensive understanding of energy sustainability in Estonia, further indicators are required. The ensuing table offers a concise summary of these indicators. The chart reflects the situation at the time of regime change and, subsequently, 30 years later.

**Other indicators**

| Name | 1990 | 2020 | Difference |
|---|---|---|---|
| $CO_2$ emissions per capita | 22.2t | 6.5 t | -70.72% |
| $CO_2$ emissions per unit of GDP | 2.5 kg CO2/2015 USD | 0.3 kg CO2/2015 USD | -88% |
| Net energy imports | 188 TJ | 46.1 TJ | -75.48% |
| Total energy supply per capita | 253.7 GJ | 159.1 GJ | -37.29% |
| Total energy supply per GDP | 28.7 GJ/Thousand USD | 7.9 GJ/Thousand USD | -72.47% |
| Total public energy RD&D budget | 19 USD Million | 5 USD Million | -73.68% |
| Renewable share (modern renewables) in final energy consumption | 3.5% | 28.8% (2018 data) | +87.85% |

Source: iea.org/countries/estonia

The table above illustrates the operation of environmental policies in Estonia. The data indicates that the country underwent rapid development following its independence. A comparative analysis reveals that the majority of these indicators exhibited faster development in Estonia than in Denmark. Consequently, it can be concluded that the Baltic state has successfully update its environmental policies in the after the system change, thereby transitioning from a Sovietized economy to a contemporary, sustainable, market-based economy.

Figure 61 shows the greenhouse gas emission per capita in Estonia and in the EU-28 from 2000 to 2019.

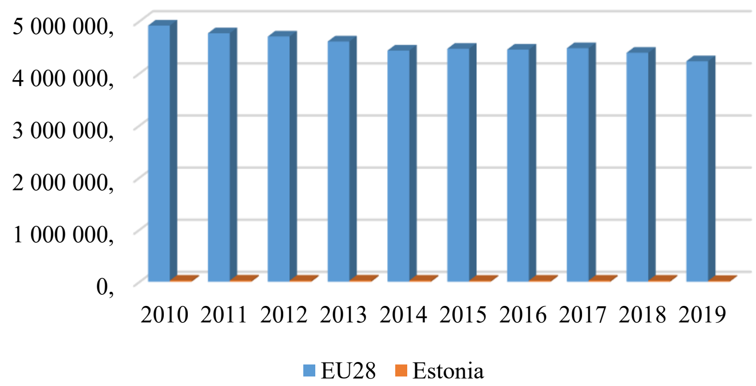



**Figure 61: Estonia vs. EU28 – Greenhouse gas emissions, 2000-2019 ($CO_2$ equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

Estonia's share of energy from renewable sources can be seen in Figure 62.

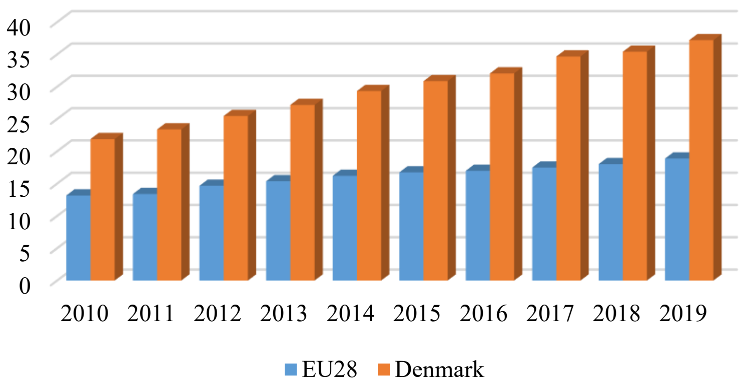



**Figure 62:** **Estonia vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

The International Energy Agency has statistics from Lithuania, another Baltic state, which had a different energy policy due to its nuclear power plant, which closed in 2009. This resulted in a sudden decrease in the country's total energy supply , although this decrease was comparable to the overall decline. A comparison of Estonia and Lithuania reveals that coal constitutes a substantial proportion of the total energy supply in Estonia (55.7%), while in Lithuania it has barely any. In Lithuania, oil has a significant role in the TES: The rate of biofuel and waste energy has increase in both countries.

The iea.org page website provides insights into the total energy supply various sources, along with their respective $CO_2$ emissions. The indicator highlights a substantial decrease in $CO_2$ emissions across both countries, with a reduction of 75% from 1990 to 2019. The initial amount of 24 million tons during the period of regime change has decreased to 6 million tons three years ago. The composition has also changed, attributable to the large quantity drops in coal production. Furthermore, there has been a smaller decrease in $CO_2$ emissions from. Notably, biofuel and waste have no $CO_2$ emissions.

**Composite Indicators**

Estonia's Environmental Performance Indicator (EPI) scores from 2014 to 2020 can be seen in Figure 63.

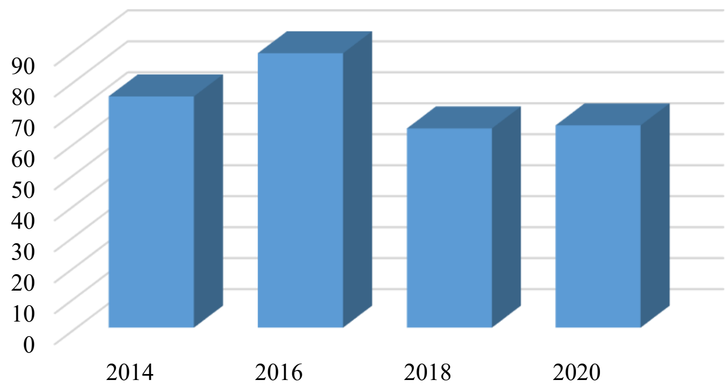



**Figure 63:** **Estonia – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Estonia's ecological footprint per person from 2014 until 2020 can be seen in Figure 64.

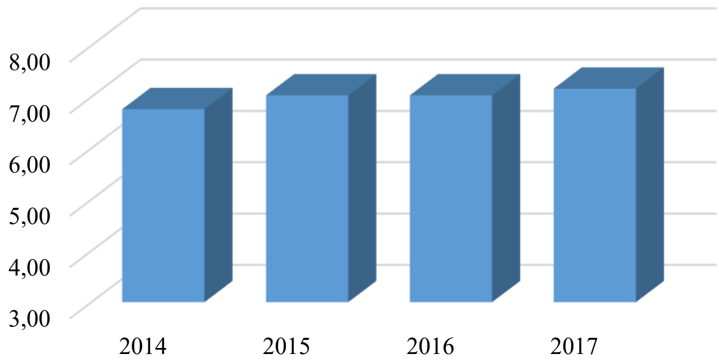



**Figure 64:** **Estonia– Ecological footprint, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Concerning the Climate Change Performance Index (CCPI) Estonia's performance is inconstant. The scores of the CCPI for the country can be viewed in Figure 65.

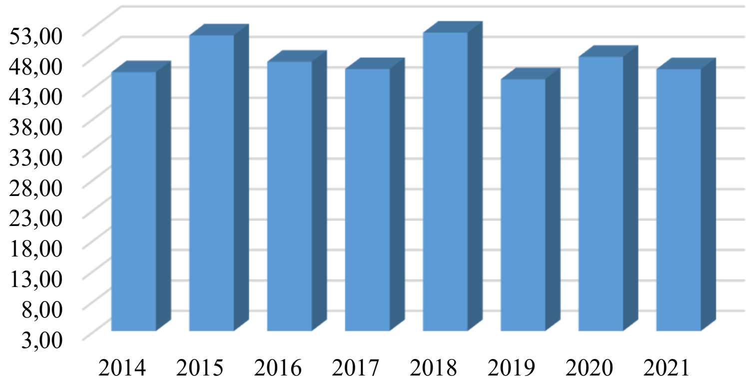



**Figure 65: Estonia vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

**Development Plan**

Estonia has also formulated a Climate Change Adaptation and Development Plan (hereafter referred to as Development Plan), which was established by the Estonian Environmental Ministry. According to the plan, the Estonian economy is one of the most energy-intensive economies in Europe. Present study has five main topics: an analysis of the current situation, the anticipated future climate of Estonia, the impact on various sectors, the subsequent effects of these impacts; and the metrics and measures objectives. The latter include the estimation of costs and a description of the management structure of the Development Plan.

Although Estonia is in Northern-Europe, it is concerned on climate change. There has been an observed increase in the frequency of storms during the winter months, and a concomitant rise in temperatures has been recorded in the Baltic Sea. The ice and snow cover has decreased, and the amount of precipitation has increased (by approximately 20% per year). Less precipitation occurs only in summer. The total amount of rain is expected to rise, with the greatest surge anticipated during the winter and spring months.

The Development Plan notes that contrary to the IEA's TES statistics, the biggest non-renewable energy resource in Estonia is oil shale. The available oil shale is enough until at least 2050, and it remains in the first place according to the forecasting. This was the largest use of primary energy in Estonia in 2015.

The Development Plan also alludes to the potential ramification of climate change on human health and sanitation. An increase in the frequency and duration of heat waves has been observed, with detrimental consequences for human health and sanitation. Consequently, the number of related illnesses and diseases is set to increase. Projections indicate an escalation in the anticipated excess mortalities.

According to the Estonian government's Development Plan, climate change has the greatest impact on, the capital Tallinn, and other cities such as Tartu and Pärnu. The majority of the country's inhabitants – more than two thirds according to databank.worldbank.org. – live in these cities. These cities are home to the majority of economic activities, property, capital, and cultural values. Consequently, the investigation into the impact of climate change on these Estonian cities is of paramount importance. Nevertheless, the country is in a relatively favourable position due to its geographical location. The primary concern is that the current urban planning practices within these cities have not considered climate change. The country's leadership must pay attention to the issue of climate change in future planning. The main risk to Estonian cities are extreme weather phenomena, including heavy storms, floods and heat waves.

Severe storms are uncommon in Estonia. The primary weather-related risk concerns buildings in western Estonia, where the quality of construction is substandard in comparison to other regions of the country. In order to mitigate the risks, contractors are obliged to adhere strictly to the terms and conditions for land use and construction stipulated in the general and detailed plans of the Development Plan.

Climate change has not only affected built areas and human settlements; however, the consequences for the natural environment are also significant. Freshwater bodies constitute a considerable proportion of the land surface in Estonia, and the country aims to maintain these bodies. This target may be more difficult to achieve because of climate change. The reasons for this include the rise in water temperature, transport of nutrients and increase in internal load, increase in the transfer of hazardous substances that may deposit in either silt or aquatic biota, and the increase in toxic algal blooms. The Development Plan addresses these challenges. Estonia should ensure constant climate change and risk management measures.

Forests cover half of Estonia's territory, which entails that forestry has a pivotal role in the country. Forestry currently accounts for about 2% of Estonia's GDP, while the sector directly employs approximately 38,000 people. The private sector exerts a significant influence on forestry in Estonia. However, climate change poses specific problems to the sector, which may lead to a decline in capacity, an increase in costs, and a deterioration in product quality. In response, the government is implementing measures to protect forestry stocks and maintaining current stands.

To date, the impact of climate change on the Estonian economy has been negligible. Conversely, most negative impacts to the economy stem from global economic processes. Nevertheless, climate change remains a potent threat, and the country hopes to tackle it through technological innovation, which has recently experienced a recent boom in Estonia. The nation's response to climate change affects economic actors mainly through government regulations such as tax increases). The pressure from the customers is low in the country.

The Development Plan includes an important statement: renewable energy resources are the future. In the case of Estonia, wood materials are a notable renewable energy resource. The Estonian government has expressed its support for the transition to renewable resources. This represents a significant opportunity for the locals to transition to wood-based heating solutions. According to European Union statistics, Estonia ranked fifth in the EU and second among the Baltic states behind Latvia in terms of wood energy rate in total energy consumption in 2005. While utilisation of renewable energy resources are expected to reduce climate change effects, they need to become more reliable (for example, solar energy depends entirely on the presence of sunlight).

Cost is a crucial factor to estimate the implementation of renewable energy sources. Furthermore, cost has also an important role in the Development Plan. The estimated financial outlay required for this undertaking is €47,745,000 for the period of 2017-2030. The Climate Change Development Plan incorporates the cost estimations for numerous many other plans, including Development Plan for Transport, Forestry, Nature Conservation and Internal Security. The table below illustrates the cost estimations according to the secondary goals. It is evident that the most substantial goal will be the Bioeconomy, which accounts for 15% of the total estimated costs.

In 2018, this figure was still under 10%. Bioeconomy includes agriculture, forestry, wildlife management, food delivery systems, and peat extraction. Society, awareness and cooperation also have a big quota between the total. The third most costly point is land use and planning.

| Budget forecast according to subgoals | 2017 | 2018 | 2019 | 2020 | 2017-2020 | 2017-2030 |
|---|---|---|---|---|---|---|
| 1. Health and rescue capability | 0 | 220,000 | 110,000 | 100,000 | 430,000 | 5,570,000 |
| 2. Land use and planning | 10,000 | 370,000 | 316,000 | 109,000 | 805,000 | 6,585,000 |
| 3. Natural environment | 0 | 500,000 | 625,000 | 575,000 | 1,700,000 | 6,000,000 |
| 4. Bioeconomy | 0 | 180,000 | 850,000 | 890,000 | 1,920,000 | 16,875,000 |
| 5. Economy | 0 | 0 | 0 | 40,000 | 40,000 | 1,025,000 |
| 6. Society, awareness and cooperation | 0 | 575,000 | 505,000 | 435,000 | 1,515,000 | 7,140,000 |
| 7. Infrastructure and buildings | 0 | 80,000 | 40,000 | 120,000 | 240,000 | 320,000 |
| 8. Energy and security of supply | 0 | 50,000 | 0 | 0 | 50,000 | 230,000 |
| TOTAL | 10,000 | 1,975,000 | 2,446,000 | 2,269,000 | 6,700,000 | 43,745,000 |

Source: Climate Change Adaption Development Plan until 2030

**Conclusion**

This chapter reassessed the climate change situation in Estonia, a member state of the EU. This small Baltic state has implemented numerous measures to protect against climate change. The current eight sub-goals of Estonia are implemented to make life more sustainable. These sub-goals encompass health, land use, natural environment, bioeconomy, economy, society, infrastructure, and energy.

The information on the iea.org website reveals a continuing decline in $CO_2$ emissions for the country, both by population and by energy production. Both reductions emerged from the country's independence and system change. The primary contributors to $CO_2$ emissions were identified as electricity and heating production.

The total energy supply in Estonia has also decreased steadily over the last three decades. Renewable resources have played a significant role in this decrease. Specifically, biofuels and waste have increased in use during the period from 1990 to 2020. Concurrently, Estonia has also demonstrated notable advancement in sustainable development indicators. The tendency is ongoing and stable.

The present paper also addressed the Development Plan. It is evident that Estonia has formulated myriad strategies aimed at mitigating the impact of climate change; plans which include both rural and urban areas. The geographical location of this country is such that it is among the least affected by climate change. Nevertheless, the Development Plan presents a viable sustainability model delineated by eight development goals. While the present state of affairs suggest that climate change does not currently pose a threat to the country's economy, this is not to say that the increasing risks of climate change may pose to the country in the future have been ruled out.

**Good Practices**

Firstly, it is important to acknowledge the significant advancements made by the Estonian capital, Tallinn, in its commitment to sustainability. The objective is to make the city carbon neutral by the year 2050. In recognition the strides Tallinn has made in this objective, the city was bestowed with the European Green Capital Award in Lahti, Finland on 9 September 2021, and is set to assume the Green Capital title in 2023. The Estonian government has expressed its support for the capital Tallinn and its goals to create a sustainable and green city, which it believes can serve as an example for the rest of Eastern Europe.

The city had an opportunity to develop itself after the collapse of the Soviet Union. Estonia, being a significant exporter of machinery, equipment, timber. The presence of conscious leadership was another important factor. In this regard, the city established a green academy to train local leadership, citizens, and assemblies on green innovations. A major outcome of this initiative has been the consumption of green electricity. A wide range of stakeholders have adopted the use of electricity from green sources. These include public transport, city buildings, and street lighting, which all use renewable energy resources.

The Estonian capital has its own plan for going to green – the so-called Tallinn model. This model has four pillars including “A New Way of Thinking”, “Enhancing Urban Biodiversity”, “Carbon Neutral City” “Clean Baltic Sea”. These objectives are accompanied by a detailed plan, which is very important because it affects not only Tallinn and Estonia, but millions of people around the Baltic Sea.

The first point is “A New Way of Thinking”, which consists of three parts: Education, digital solutions and circular economy. This point also means that Tallinn can achieve a better result if the companies, the public, and the private sector work together. In the universities, students can study all the modern knowledge about sustainability, which they can use in the corporate sector and in the private household sector, especially how to create sustainable households. Each region and city must adopt this at regional level and help the others to do the same. According to the project leaders, the European Green Deal is based on this assumption. A good example of this is “A New Way of Thinking”, which is still working in the Estonian capital.

Another significant issue for Tallinn pertains to the imperative of enhancing the city’ cleanliness. A potential approach involves the implementation of digital solutions. In alignment with global trends, Tallinn boasts a thriving ecosystem of start-up companies, that are dedicated to digital cleanliness. The city has established a dashboard webpage- that serves as a comprehensive information hub, providing insights into various aspects of the capital of Estonia. The site integrates both informational data and visual data, enabling cleaning companies to effectively monitor where intervention is needed.

In line with the rest of Estonia, Tallinn emphasizes sustainability education, with initiatives extending from early childhood education to adult learning, specifically in nursery school. The children at school are introduced to environmental stewardship learning about the importance of trees and bushes and acquiring skills for producing self-sufficient fruits and vegetables. The curriculum is comprehensive, encompassing sustainability education at all levels. According to OECD’s ranking, Estonia holds the top position in sustainability education among Eastern European countries, serving as a notable example for other nations to emulate.

Tallinn was the first capital in the European Union to provide free public transport for its inhabitants from January 2013. Utilising the system without incurring a fee requires the use of a “Green card”, which is also referred to as a “Smart card”. The card is available at a cost of two euros. Access to this service is exclusively reserved for the residents of Tallinn. Individuals residing outside of the city are required to load a nominal amount of money onto the card prior utilisation. It is arbitrary, although it must be adjusted to local tariffs. The introduction of this free access policy has had a significant impact on the local population, leading to a notable increase in the utilisation of local transportation. The aim of this initiative was to expeditiously mitigate environmental degradation.

Tallinn has also prioritised the promotion of sustainability through urban greenification. The urban area is among the most environmentally sustainable in Europe. The capital is ranked within the top 10 greenest cities. It is noteworthy that Tallin was recognised with an award from the EU for its exceptional green spaces. Almost one-fifth of Tallinn's area is covered by nationally and locally protected areas. It is also the only EU capital to be home to a bog. The leadership of the city asserts that the proliferation of green spaces has a favourable effect on both the younger and older demographics. The benefits of this include improved mental health and learning abilities. Therefore, the mortality rate has declined, and the life expectancy has increased.

As is the case in every capital city, Tallinn also had a significant problem with noise. In response, the leadership of the city developed a noise-reduction strategy. This plan involves the creation of a noise map in the city centre, specifically in Freedom square. A noise indicator board has also been installed in the city centre. In addition, the city authorities have implemented a series of measures aimed at reducing the use of private cars in the city centre. These measures include the introduction of parking charges, a practice that has also been adopted in other major cities. In the historic district of the old town, the leadership of the city restricted the number of vehicles. Quiet areas for citizens have been designated for recreational purposes as well.

Water transportation is a significant component of business operations in Tallinn, a coastal capital city, which is not unexpected. The city is home to many companies that are stakeholders in sea transportation. The CEO of the Port of Tallinn has clarified that the port's leadership heavily supports the city's target to create a sustainable and modern capital in Estonia. They also have innovations and agenda for a sustainable maritime.

In previous years, smart applications utilised to control the mainland transport vehicles. The present project entails the establishment of an onshore power supply for the vessels. The other significant project currently underway is the installation of an outer mirroring system for free keys, which is designated to reduce emissions and noise, as well as prevent waste from entering the sea. The Port of Tallinn also emphasizes the creation of a circular economy.

In Tallinn, approximately 10 kilometres of tram tracks have been renewed across the city. This development has the potential to reduce noise and enhance the efficiency of tram transport. This is expected to encourage more residents to opt for tram travel instead of their cars. The renovation of the tramway has also entailed the acquisition of new trams. Furthermore, the railway infrastructure surrounding Tallinn underwent significant upgrades in 2013, leading to a substantial reduction in noise levels associated with train transportation to other cities. .

The urban transportation is a commendable initiative on the part of the city. Green corridors serve to connect many districts, and important locations. These provide cyclists and pedestrians with the opportunity to travel in a healthier manner, avoiding the use of roads with high traffic and elevated levels of pollutants. It is also good for animals; people can walk with dogs; and it provides a habitat for butterflies and pigeons as well. The city's leaders planned the integration of these green corridors across ten different areas until the year 2030.

Tallinn's commitment to eco-innovation is evident in its strategic investment in clusters, research and business parks and the sponsorship of students in eco-innovation competitions. This initiative is of significant importance, as it facilitates the exchange of experiences, results and the application of lessons learned in Estonia and the capital. It is also preventing disease and extending life expectancy.

Estonia is conducting an investigation into the discharge of microplastics into the sea, and the measures that can be implemented to prevent it. That initiative constitutes a substantial international project, with 11 additional countries participating It encompasses a diverse geographical range, including countries situated along the Baltic and Mediterranean seaboard. The objective of this project is to ascertain the extent of the threat posed to the marine environment by microplastics. The investigative approach involves the analysis of biota samples.

In the following discussion, the focus will be on practices, that had a national impact. Firstly, the issue of the fight against property must be addressed. The primary priority is the prevention in this case. In the event of an individual's loss of employment, government-funded social protection measures are implemented, with the objective of facilitating the reintegration of the unemployed into the workforce. This approach aligns with the total absolute property indicator, which has undergone a decline. Furthermore, individuals with low incomes are granted the opportunity to request a comprehensive tax summery subsequent to their tax declaration.

The healthcare system has also an important role in the sustainable policies. The Estonian government has created health care centres at regional levels, ensuring that every inhabitants has ready access to professional care when required. The health system is associated with an e-health strategy. The aim of this strategy is to create a well-cooperating network of primary-level e-solutions and related services by 2025, with a view to enhancing patient satisfaction. The e-ambulance service, which enables patients to see treatment expenses, remains operational.

Concerning illness, prevention is also important. For public health, the Green Book provides a series of suggestions on how people should can foster their own health. The book incorporates policies concerning tobacco and alcohol consumption. There are various social campaigns highlighting the negative consequence of alcohol consumption and smoking, in order to decrease the number of smokers and drinkers.

In the following discussion, the focus shall be on the Estonian education system. Within the primary and secondary school sectors, the financial responsibility for education is invariably shouldered by the institutions providing it. For instance, in the case of schools in public property, the state finances education. A substantial reform is imminent in primary education in the next couple of years. The aim of this reform is childcare is bought under a single regulated property, the state finances education. Regarding education, harmonizing the different levels becomes paramount importance. “Every education level must start where the other was ended. In order for schools to become a career option for the best and brightest, the average salary of teachers will be raised to a higher level.” This objective is a central tenet of sustainable Estonian education model. A further key objective is to enhance the participation rate in higher education. Ensuring universal access to education is paramount, and the government is committed to supporting students from disadvantaged economic backgrounds. This approach is currently employed in the majority of European countries. In addition to learning, it is also important to consider the social and spiritual well-being of students. A noteworthy initiative in this regard is the NGO programme entitled “Bully-free School - Let’s free Estonian schools of bullying!”, which is dedicated to the coordination of the bullying prevention programmes in educational institutions.

The energy policies a complex topic, it is evident needed a broader approach from the government. In order to increase the number and rate of renewable energy resources, it is essential that the various economic stakeholders collaborate. In Estonia, wind, and biomass, are the primary renewable energy sources, with a steady increase in their production.

The country is a significant producer of modern technologies including wind turbines, solar panels, inverters, technology for smart home technology, software solution and other advanced equipment. A significant proportion of these products are exported by Estonia. The state contributes to the promotion of energy efficiency and energy conservation in construction and heating mainly via support mechanisms. According to the national plan based on UN criterions. But for the currently buildings can people also get supports for more sustainable heating, which has a less CO2 emission. On the electric vehicles network are planned to create supports to produce and consume biomethane. The government of Estonia promoting electric car use with develop network of quick charger for e-cars, it supports by the so-called ELMO programme.

It is imperative to emphasise the significance of energy policies in fostering awareness among young people. The Estonian Environmental Investment Centre, in collaboration with several NGOs organises competitive events for university students, such as the Negavatt contest, where the students present how to save energy sources.

The Eesti Energia mobile application is possibly a very useful method. It enables users to monitor their energy consumption, disaggregated by hours, and comparative periods. A further advantage of the app is that it allows users to visualise their data on a weekly, monthly, or yearly basis. Notifications can be enabled within the settings menu. This feature ensures that users remained informed about their electricity charges and prices.

Since 1998, Estonia has been engaged in the ongoing international cooperation for sustainability. A significant aspect of this commitment involves providing aid to the most underdeveloped countries. The leadership of Estonia are paying attention to this objective. The implementation of effective migration policies is crucial for support the development goals of these countries, and enhancing security measures. The integration of immigrants into Estonian society is facilitated through educational initiatives, including language courses, cultural orientation, and religious programmes.

- **Education** – In Estonia, environmental awareness is instilled from a young age in order to ensure that the process becomes as natural as possible. The foundations for this initiative were laid in 2000, and it was already in operation the following year. The Minister of Environmental Protection collaborates closely with the Minister of Education and Research, as well as with other institutions, to form the education system for environmental awareness. Specialised teachers are required for this educational paradigm.
(https://envir.ee/en/climate-and-environment-protection/environmental-awareness)
- **Circular economy** - The purpose of the circular economy is to optimise the utilisation of materials and facilitate their recycling, thus avoiding the issue of littering and excessive waste production. The efficient management of resources throughout the entire life cycle is central to the concept. The overarching objective of this system is the effective reuse, repair and recycling of existing materials and products.

(https://envir.ee/en/circular-economy)

- **Cityntel** - The Estonian startup, specialises in the field of urban lighting. The company has developed a system in which the lights communicate with each other and are able to ascertain the exact date and time, as well as the time of sunset. The system is programmed to activate the lights when it gets dark and stay on as long until traffic (both vehicular and pedestrian) ceases. Conversely, in the absence of traffic, the lights are deactivated. The system is designed to initiate lighting in sequence, with each light activating in response to the presence of traffic, and then deactivating when traffic is absent. This method is also used for public lighting in Tallinn and Tartu. This reduces energy consumption by 80%, system maintenance costs by 70%, and carbon dioxide emissions have also decreased correspondingly.
  (https://cityntel.com/)
- **Roofit Solar** - Roofit Solar is an integrated metal solar roof company. Instead of the conventional solar panels that are typically placed on the roof, a metal solar roof was implemented. The 2-in-1 roof integrates a metal substrate with a thin photovoltaic (PV) layer, which is serves the primary function of generating electricity. The utilisation of premium materials is imperative, as the roof must be weather-resistant, ensuring complete waterproofing and resistance to both wind and snow. Roofit Solar offer a 25-year warranty on these roofs. This approach offers significant financial savings and reduces reliance on external electricity sources. The utilisation of weather factors, particularly during periods of extended daylight, can further enhance the efficiency of this system.
  (https://roofit.solar/solar-roof/)

**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Change Adaption and Development Plan - Estonia
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP

per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.

- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- http://www.res-legal.eu/search-by-country/estonia/
- https://www.eea.europa.eu/data-and-maps/figures/contribution-of-wood-energy-to-total-energy-consumption-2005
- https://www.iea.org/countries/estonia

## 4.9. FINLAND

Finland is situated between latitudes 60 and 70 degrees north, with a quarter of the country extending north of the Arctic Circle. Finland's climate displays features of both maritime and continental climates. The mean annual temperature is ca. 5.5 °C in south-western Finland and decreases towards the north. The highest and lowest temperatures recorded are +37.2°C and -51.5°C respectively. The mean annual precipitation in southern and central Finland is typically between 600 and 750 mm. The main factor influencing Finland's climate is the country's geographical position between the 60th and 70th northern parallels in the Eurasian continent's coastal zone. In accordance with the Köppen climate classification, the entirety of Finland lies in the boreal zone, characterised by warm summers and freezing winters. Within the country, the temperateness varies considerably between the southern coastal regions and the extreme north, exhibiting characteristics of both a maritime and a continental climate. Finland is situated in close proximity to the Atlantic Ocean to be continuously warmed by the Gulf Stream. The Gulf Stream combines with the moderating effects of the Baltic Sea and numerous inland lakes to explain the unusually warm climate compared with other regions that share the same latitude, such as Alaska, Siberia, and southern Greenland.

The economy of Finland has a per capita output equal to that of other European economies, including those of France, Germany, Belgium, and the UK. The largest sector of the economy is the service sector at 66% of GDP. This is followed by manufacturing and refining, which accounts for 31%. Primary production represents 2.9%. With respect to foreign trade, the key economic sector is manufacturing. The largest industries in 2007 were electronics (22%); machinery, vehicles, and other engineered metal products (21.1%); forest industry (13%); and chemicals (11%). The gross domestic product peaked in 2008. As of 2015, the country's economy is at the 2006 level. Finland is ranked as the 7th most innovative country in the Global Innovation Index in 2021.

The country’s most important economic statistics compared to the EU-27 average can be seen in Figure 66.

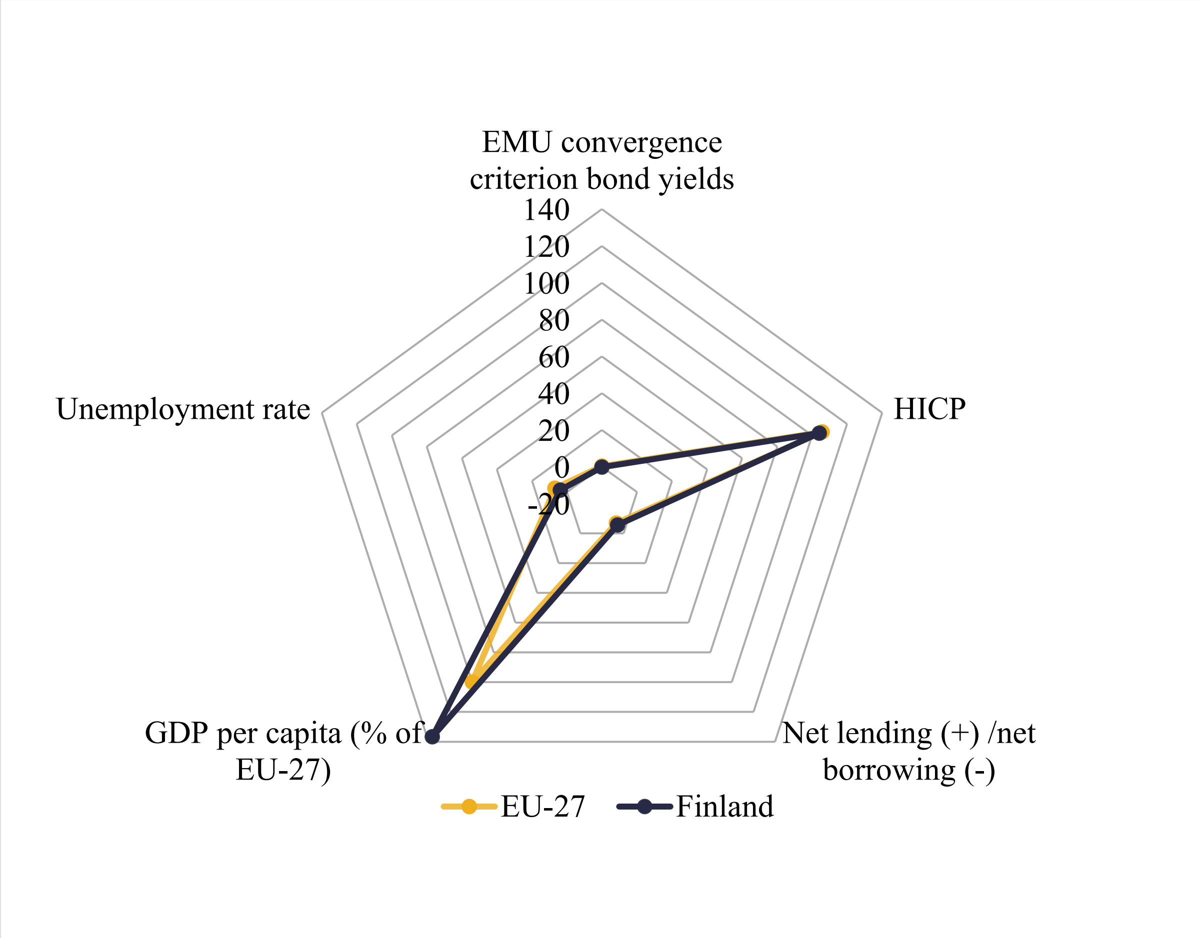



**Figure 66: Finland vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

Finland is endowed with substantial timber, mineral (iron, chromium, copper, nickel, and gold), and freshwater resources. Forestry, paper factories, and the agricultural sector (on which taxpayers spend around €3 billion annually) are important for rural residents so any policy changes affecting these sectors are politically sensitive for decision makers, dependent on rural votes. The Greater Helsinki area is responsible approximately one-third of Finland's GDP. In a 2004 OECD comparison, high-technology manufacturing in Finland was ranked the second largest after Ireland. Furthermore, knowledge-intensive services have also resulted in the smallest and slowest-growing sectors, especially agriculture and low-technology manufacturing, being ranked the second largest only to Ireland.

Finland's climate and soils make growing crops a particularly challenging. The country lies between the latitudes 60°N and 70°N, and it has severe winters and relatively short growing seasons that are sometimes interrupted by frost. However, because the Gulf Stream and the North Atlantic Drift Current moderate the climate, Finland contains half of the world's arable land north of 60° north latitude. Annual precipitation is usually sufficient, but it occurs almost exclusively during the winter months, making summer droughts a constant threat. In response to the climate, farmers have relied on fast-ripening and frost-resistant varieties of crops, and they have cultivated south-facing slopes as well as richer bottomlands to ensure production even in years with summer frosts. Most farmland was originally either forest or swamp, and the soil has usually required treatment with lime and years of cultivation to neutralise the excess acidity and to improve fertility. Irrigation has generally not been necessary, but drainage systems are often needed to remove excess water. Finland's agriculture has been efficient and productive—at least when compared with farming in other European countries. The population of Finland was 5.5 million at the end of 2020 (increased by 0.33 % between 2010 and 2019, this increase is constantly slowing) Population density: population density average is 18 inhabitants per km² (2 inhabitants/km² in Lapland, 178 inhabitants/km² in the Helsinki-Uusimaa region) 71.7% of the population lives in rural areas. Average household consists of 2 people; the population is aging. Life expectancy is increasing: 84.5 years (female) and 79.2 years (male). Yield levels of the field crop species are low, growing season is short.75% of the total area (including inland waters) is covered with forests. GDP per capita (2017): 39 893 USD Annual growth of GDP per capita: 2.95% (2017), 1.18% (2018), 1.16% (2019), -2.93% (2020) GDP share spent on R&D activities (2014): 3.17% HDI (2019): 0.938, 11. World ranking

**Climate Strategy**

Finland is dependent on imported fuels and electricity. Nearly 38% of total energy consumption and 43% of final consumption were covered with renewable energy sources in 2019.

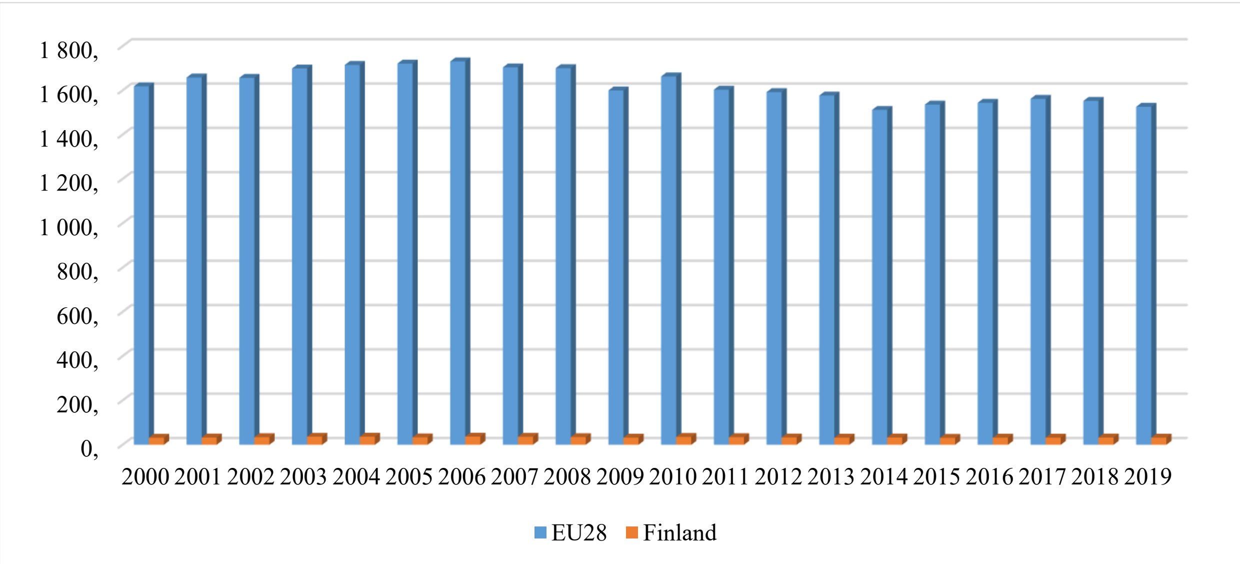



**Figure 67: Finland vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**

Source: own compilation based on Eurostat (2022a)

The share of fossil fuels in gross available energy can be seen in Figure 68.

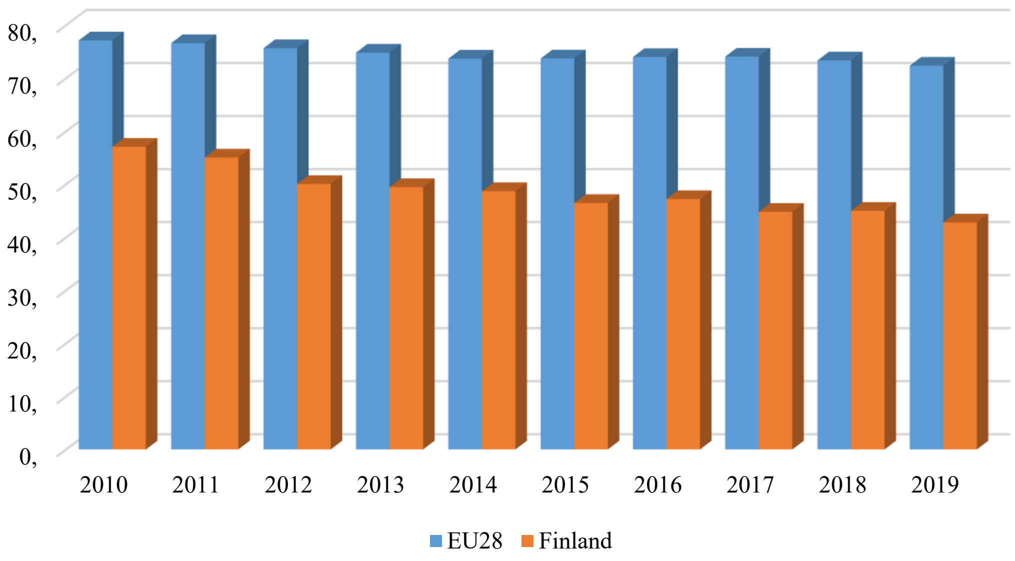



**Figure 68: Finland vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

Total $CO_2$ emissions: 53.83 Mt in 1990, 54.59 Mt in 2000, 62 Mt in 2010, 35.7 Mt in 2020

Primary energy consumption was increasing until 2003, decreasing since then: 262 TWh in 1980, 320 TWh in 1990, 356 TWh in 2000, 394 TWh in 2003, 369 TWh in 2010, 305 TWh in 2019

Primary energy consumption from renewables is increasing: 28 TWh in 1980, 44 TWh in 1990, 65 TWh in 2000, 64 TWh in 2010, 80 TWh in 2019

Annual change in fossil fuel consumption is not steady: -0.04 TWh in 1980, +10.97 TWh in 1990, -2.17 TWh in 2000, +26.09 TWh in 2010, -14.28 TWh in 2019

Renewable freshwater resources per capita is decreasing: 22 167 m3 in 1982, 21 221 m3 in 1992, 20 574 m3 in 2002, 19 763 m3 in 2012, 19 425 m3 in 2017

Greenhouse gas emission per capita over the years: 15.98 t in 1980, 15.15 t in 1990, 14.51 t in 2000, 15.73 t in 2010

In 2019, 15.68% of global primary energy came from low-carbon sources – either nuclear or renewables, in Finland this ratio was 44.77%

Total greenhouse gas emissions (excluding land use and forestry) are slowly decreasing: 69.4 M t in 1990, 68.45 M t in 2000, 74.12 M t in 2010, 54.49 M t in 2018

Share of primary energy from wind was less than 0.01% until 1998, slowly increased until 2010 up to 0.21%, to 0.87% in 2014 and 4.86% in 2019

Share of primary energy from hydroelectric power is varying: 10.81% in 1980, 9.44% in 1990, 11.38% in 2000, 9.09% in 2010, and 9.98% in 2019

Share of primary energy from low-carbon sources is increasing: 18.20% in 1980, 30.49% in 1990, 35.85% in 2000, 33.72% in 2010, and 44.77% in 2019

Electricity consumption by capita is slowly increasing: 12.5 MWh/cap in 1990, 15.3 MWh/cap in 2000, 16.5 MWh/cap in 2010, since 2018 it is decreasing: 14.7 MWh/cap in 2020

Sectoral share of electricity consumption has been steady in the recent years (1990-2019): 5% agriculture and forestry, 20% commercial and public services, 30% transportation, 45% industry

Figure 69 shows the greenhouse gas emission per capita in Finland and in the EU-28 from 2000 till 2019.

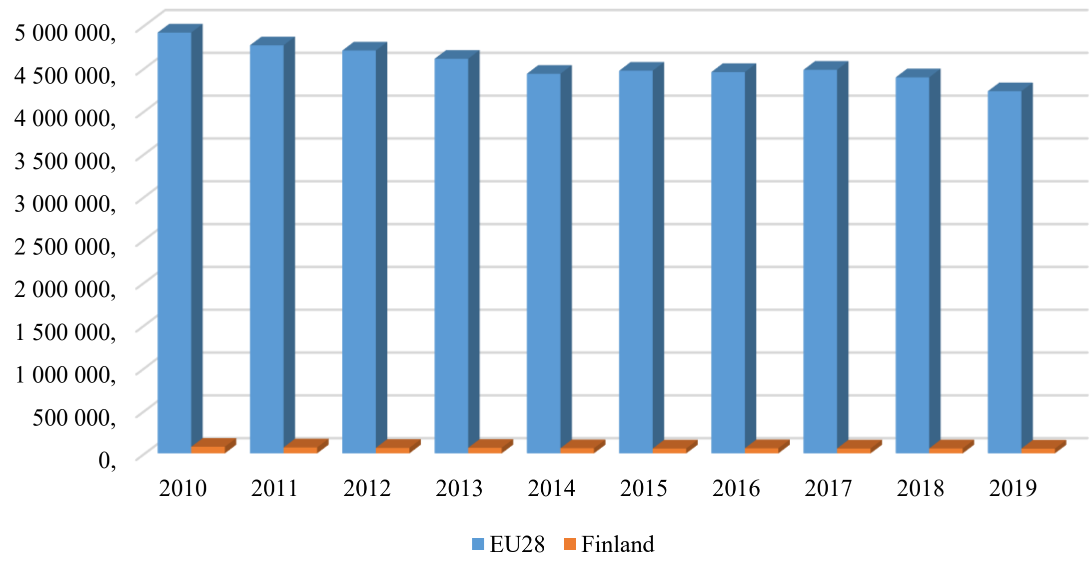



**Figure 69: Finland vs. EU28 – Greenhouse gas emissions, 2000-2019 ($CO_2$ equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

Finland's share of energy from renewable sources can be visualised in Figure 70.

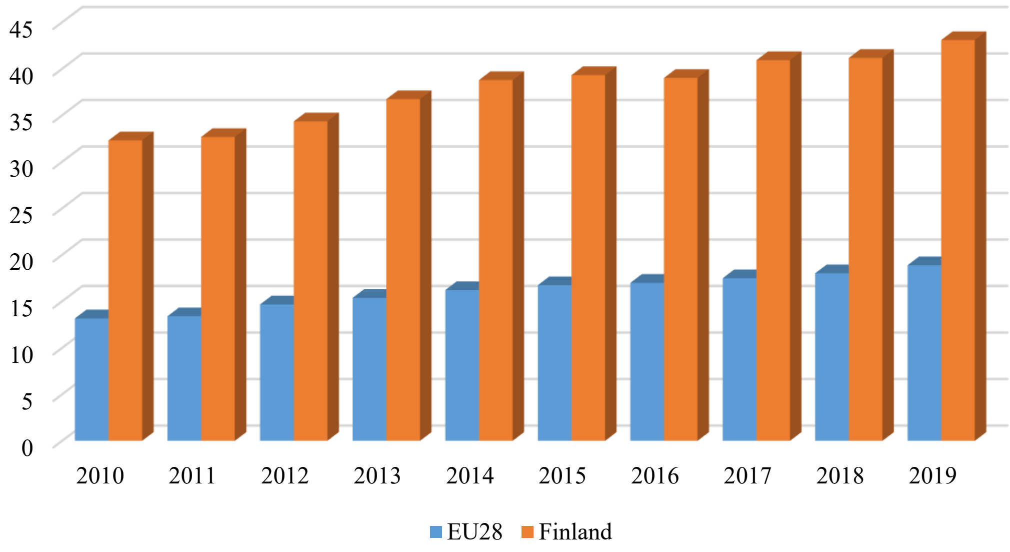



**Figure 70:** **Finland vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

**Composite Indicators**

Finland's Environmental Performance Index (EPI) scores from 2014 to 2020 can be seen in Figure 71.

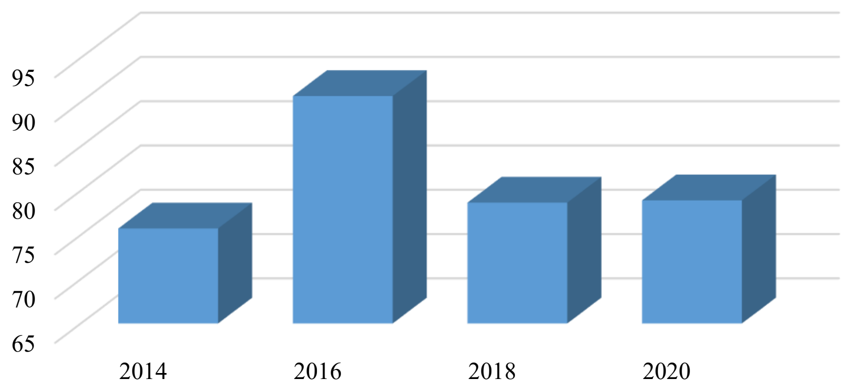



**Figure 71:** **Finland – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Finland's ecological footprint per person from 2014 until 2020 can be seen in Figure 72.

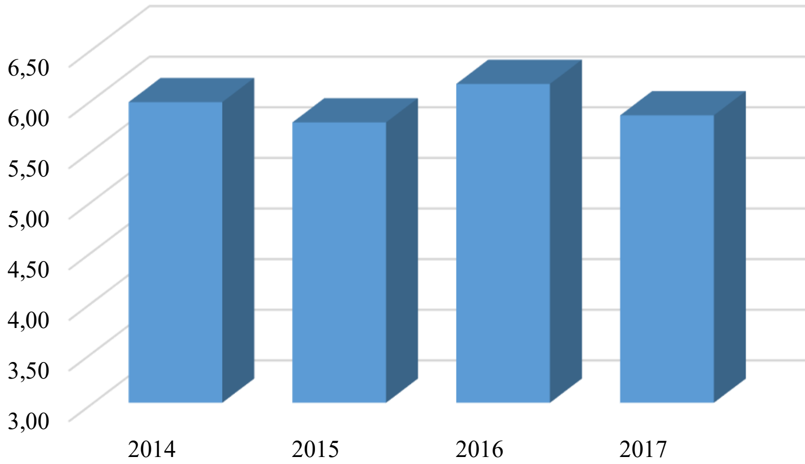



**Figure 72:** **Finland– Ecological footprint, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Concerning the Climate Change Performance Index (CCPI) Finland's performance is inconstant. The scores of the CCPI for the country can be seen in Figure 73.

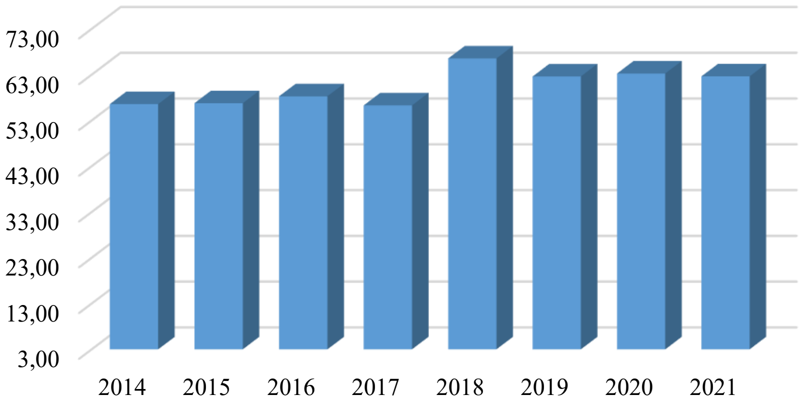



**Figure 73:** **Finland vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

### Climate hazards in Finland

- Freezing and thawing cycles
- Occasion tornados
- Snow and ice load
- Wildfires
- Temperature variability

Climate change is likely to exacerbate loss of biodiversity and poor agricultural harvests that are highly vulnerable to changing conditions at northern latitudes. Secondary effects can be new pests and more harassment by insects, marine transportation (ice), road surface erosion due to melting, change of vegetation. According to climate projections Finland is likely to experience greater than average warming due to its northern location

**Key affected sectors by climate hazards in Finland**

- Biodiversity (especially in bird and butterfly species distributions)
- Buildings (wet land and ground problems, storms blowing off roofs)
- Coastal areas (water levels vary very much)
- Energy (unexpected weather conditions)
- Health (heat waves, vector borne diseases as the surroundings and micro-climate is changing)
- Water management (heavy precipitation and droughts both cause problems locally)

**National climate action strategies in Finland**

National Adaptation Plan (2014): three objectives are set until the year 2022.

Firstly, adaptation has been integrated into the planning and activities of both the various sectors and their respective actors. Secondly, relevant actors have been granted access to the necessary tools and methods for the assessment and management of climate risks. Thirdly, research and development work, communication, and education and training have enhanced the adaptive capacity of the society, developed innovative solutions and improved citizens' awareness of climate change adaptation.

In order to achieve the aforementioned objectives, twelve primary fields of action have been identified, including communication on adaptation, education and training, climate risk assessment and management, adaptation research and cooperation in EU-wide and regional projects.

In addition to the NAP, there are sectoral adaptation (action) plans that provide more detailed specific actions in different sectors

- Ministry of Agriculture and Forestry adaptation plan
- Ministry of Social Affairs and Health
- Ministry of the Environment's Action Plan (2016)

**Sub-national strategies**

14 Finnish municipalities have formally endorsed the Covenant of Mayors initiative, thereby committing to the establishment of 2030 targets including climate adaptation as part of Sustainable Energy and Climate Action Plan

Helsinki Metropolitan Area's Climate Change Adaptation Strategy: strategic starting points and policy guidelines

Sectoral policies, plans and programs

Water resources: climate change has been integrated to the implementation of EUs water framework and flood directives, national dam safety legislation, water supply site risk assessment and review process of water course regulation permits.

National Forest Strategy 2025: maintain and improve forests' resilience by integrating considerations related to climate change in forest management practices.

Energy and climate: the national climate and energy strategy is a comprehensive plan that integrates and coordinates the Government Programme's energy and climate policies, the Climate Change Act (2015), and the EU's energy and climate targets for 2030 as well as the Energy Union Strategy.

**Good Practices**

Since 2020 a newsletter has been published on a quarterly basis, dedicated to the climate change adaptation. It contains articles and recent research results related to adaptation in it.

The focus of adaptation planning has shifted from the regional strategy to city level strategies and plans. This transition is demonstrated by all four cities within the Helsinki metropolitan area cities signing up to the Covenant of Mayors for Climate & Energy initiative.

The 2019 monitoring report, it was found that the 2012 strategy measures have been realised to a significant extent, and that the climate change and future climate risks are being taken into account in the region's urban planning and as the cities grow.

Finland, in collaboration with the United States, is leading a project on Arctic Marine Protected Areas, with the objective of preparing two information briefs: Marine Protected Areas in a Changing Arctic and Indigenous Food Security in the Arctic – Implications of a Changing Ocean

Finland contributes to different international partnerships: the Green Belt of Fennoscandia (Finland, Russia and Norway), the Nordic Development Fund, the Climate Risks and Early Warning Systems Initiative, and various civil society projects and programme fundings.

The National Risk Assessment 2018, examines climate change as a driver of change in the security environment, and the management of weather and climate risks is of high relevance in

regional risk assessments, where the impacts of climate change have been clearly identified: the risks assessments create a framework for the types of risks that different administrative branches and other actors must prepare for, and they help to identify development needs and support prioritisation.
The Finnish development policy is firmly grounded in the Paris Agreement on Climate Change and the goals of the 2030 Agenda for Sustainable Development.

- **Woodly** – The issue of food waste represents a growing global problem. One solution that has been proposed is to extend the shelf-life of food by utilising packaging made from oil-derived plastic. However, this has been resulted in increased $CO_2$ emissions. Motivated by this dilemma, has led to the establishment of Woodly in 2011, a company under the auspices of the Finnish solution agency Seedi to develop **carbon dioxide-neutral, recyclable foil packaging solutions**. A significant milestone in Woodly's development was the signing of a strategic agreement in 2019 with Wipak, one of the world's largest flexible packaging companies. 'Woodly is a very versatile and unique wood-based transparent packaging material that can be used in a variety of applications, products and packaging,' said Jaakko, CEO of Kaminen.

  (https://woodly.com/ )

- **Plastic bag-free shop** - The first plastic bag-free store in the entire EU was opened in Kerava.

  (https://forest.fi/article/small-town-declared-itself-pioneer-of-freedom-from-plastic-bags-gave-out-wood-based-carrier-bags-to-every-home/)

**Sustainable Development Goals status 2021**

Country ranking: 1/165
Country score: 85.9 (regional average: 77.2)
4 SDGs achieved: No Poverty, Quality education, Clean water and sanitation, Affordable and clean energy
Major challenges: Responsible consumption and production, Climate action

## References


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.

## 4.10. FRANCE

With an area 550,000 km$^2$, France is the largest country in the European Union (around 13% of the EU's territory). Situated between the Atlantic and the Mediterranean, France has about 3,200 km of coastline. Most of the country is covered by plains and hills, with the Alps and Pyrenees ranges to the east and south. In the Alps is Mont Blanc (4,810 m), the highest point in France, on the Italian border. The Massif Central, in the centre of the country, plays an important role in the distribution of water into four main basins. France has a temperate climate, with rainfall evenly distributed throughout the year and relatively mild temperatures. This is due to its average latitude and the dominant wind currents of the Atlantic Ocean. (Climate Adapt, 2021)
The road network could be threatened by many of the consequences of the gradient change and may need to be improved. The heat waves of 2003 and 2019 do not appear to have caused significant damage to roads or engineering structures however, they could recur or worsen at any time. In addition, there is a risk of roads being submerged due to possible expected sea level rise. This could also affect national roads ion mainland France (excluding motorways and other roads). Their reconstruction would cost between €500 million and €1.2 billion. This could reach €2 billion if current defences prove inadequate. (Climate Adapt, 2021)
The French government's new climate change plan for 2017 would accelerate the implementation of the Paris Agreement. The goals of the plan include achieving carbon neutrality, energy modernisation, including the elimination of thermal sieves. They plan to shut down coal-fired power plants by 2022 and to stop selling conventional vehicles emitting greenhouse gases by 2040 and to stop producing hydrocarbons. They would also raise the price of carbon more quickly and spend twice as much on energy conversion research. (UN, 2017)

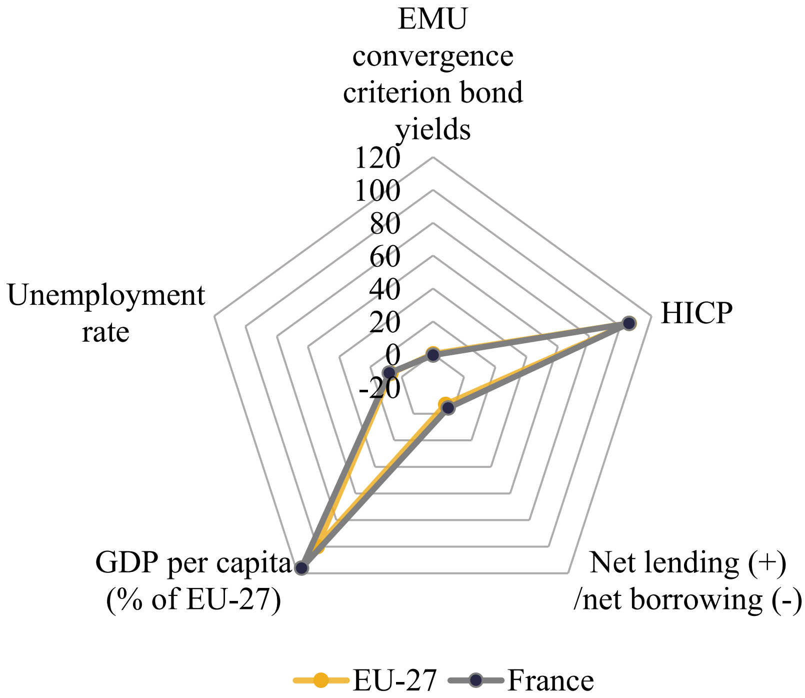



**Figure 74: France vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

## Climate Strategy

### ***Primary energy consumption***

The total energy needs in France are covered between 2000 and 2019 by the Figure 75 of the Primary Energy Consumption indicator. The France primary energy consumption was one of the highest in the EU28 in 2019.

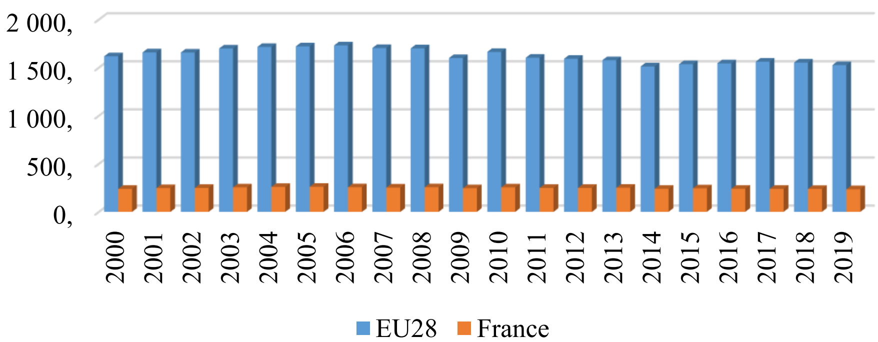



**Figure 75: France vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

### ***Share of Fossil Fuels in Gross Available Energy***

The absolute value of the France fossil fuel consumption decreased with 2% between 2010 and 2019 (Our World in Data, 2021).

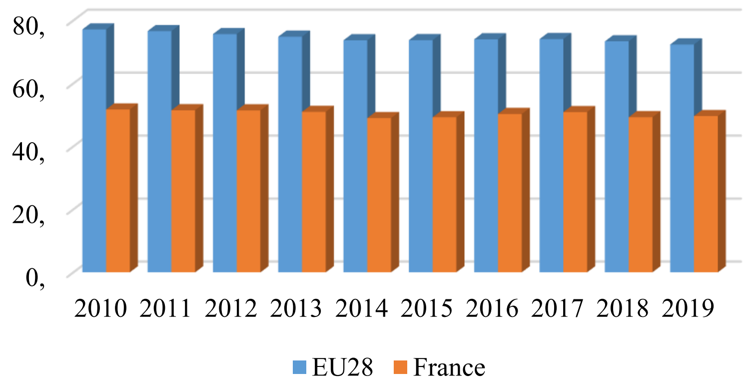



**Figure 76: France vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

The electricity sector is dominated by nuclear power, which accounted for 72.3% of total production in 2016, while renewables and fossil fuels accounted for 17.8% and 8.6%, respectively. (Our World in Data, 2021)

### *Greenhouse Gas Emissions by Capita*

Figure 77 highlights per capita greenhouse gas (GHG) emissions in France from 2000 to 2019, in tonnes of $CO_2$ equivalent.

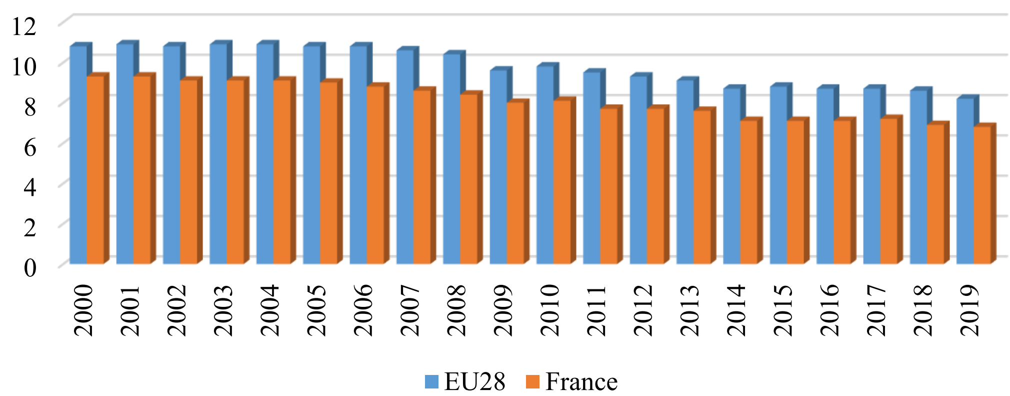



**Figure 77: France vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 ($CO_2$ equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

In 2014, around 7.2 metric tons of $CO_2$ equivalent of greenhouse gases were emitted per capita. In 2019, that value was estimated at 6.8 metric tons of $CO_2$ equivalent. (Statista, 2021)

*Share of Energy from Renewable Sources*

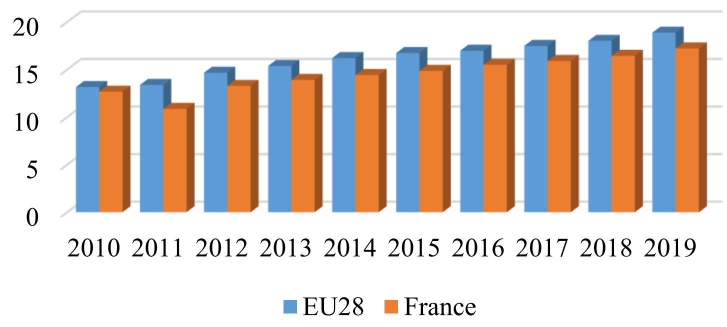



**Figure 78:** **France vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

In France, the share of renewable energy sources has steadily increased in recent years and will reach 11.7% of primary energy consumption and 25.3% of gross final energy consumption in 2019. Renewable energy provides jobs and livelihoods for 60,000 people. The renewable energy sector is very diverse and comprises ten different sub-sectors: Wood energy: 35.2% - Hydropower 17.3% - Biofuels 12.1% - Wind 10.4% - Heat pumps 9.6% - Renewable waste 4.8% - Biogas 3.4% Solar energy 3.4% Others (geothermal, agricultural, marine) 3.6%. Wood and hydropower are still the most advanced, but other sectors are also emerging. For example, onshore wind farms and heat pumps, which have developed the most in recent years with offshore wind farms. They are currently being developed. In the 2018 EU ranking, France is 16th in terms of the share of renewable energy in gross final energy consumption. The nation is at the forefront of hydroelectric power generation and is second in biofuels production. (ITA, 2021)

**Composite Indicators**

*Environmental Performance Index*

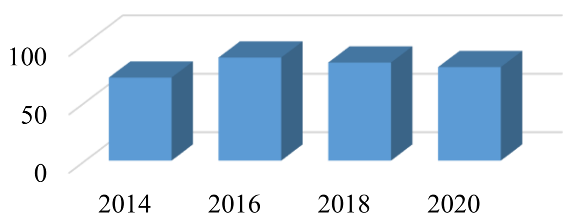



**Figure 79:** **France – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

There are also a certain areas where France could improve: pollution, natural resources and the management of biogenic diversity. The OECD's assessment of France's environmental performance highlights the effectiveness of the country's environmental policies however, also makes 49 recommendations aimed at strengthening ongoing sustainable development initiatives in France. Some of these are of paramount importance (OECD, 2022):

- to review taxation policy from an environmental perspective;
- to reduce the damage caused by excessive use of nitrates and pesticides in agriculture;
- to reduce the energy intensity of the economy;
- to implement the measures planned to combat climate change;
- to integrate environmental concerns into the energy, transport and agriculture sectors;
- to improve enforcement of the legislation on mountain areas, coasts and landscapes, and of the EU habitats and birds, directives at both the national and local level.

### *Ecological Footprint per Person*

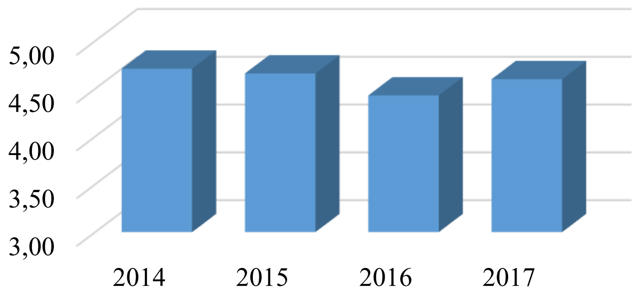



**Figure 80: France – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

An average French resident consumes as much as 4.7 global hectares per person to satisfy personal needs in 2017.

### *Climate Change Performance Index*

Figure 81 shows the development of France CCPI performance over the past years.

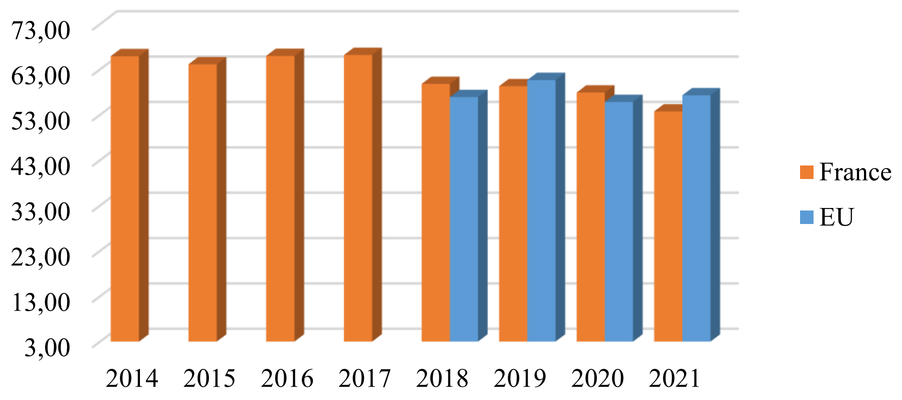



**Figure 81: France vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

**Good Practices**

France's relatively strong performance is due to the adoption of a new climate law, which sets out the country climate neutrality target for 2050. The CCPI's national experts see this as a significant step forward in the country's climate policy, and an improvement from last year. As well as providing a legal basis for the 2050 target, it strengthens measures to decarbonise buildings, transport, and agriculture. (CCPI, 2022)

The Alpine Convention is the legal basis for safeguarding sensitive Alpine ecosystems, regional cultural identities, heritage and traditions in the Alps. The versatility and effectiveness of the Convention can be illustrated by the example of the global issue of climate change in the Alps. In April 2019, the ministers of the Alpine countries approved the Alpine Climate Target System 2050, which formulates an Alpine response to the global need for climate change mitigation and adaptation. This system complements national and international targets and through cooperative approaches based on multi-level governance and stakeholder participation. (Climate Adapt, 2021)

- **Prohibition of short domestic flights** - The main goal of the measure is to reduce emissions by 40% by 2030. An environmental tax would be included in the price of plane tickets, which would make the price of plane tickets higher. The measure is at plan level. (https://airportal.hu/a-vilag-legdurvabb-kornyezetvedelmi-adojat-rona-ki-franciaorszag-a-repulojijetre/)
- **Prohibition of the use of plastic bags in trade** - The purpose of the provision is to reduce the environmental impacts associated with the production and use of bags.

Instead of plastic bags, the utilisation of biodegradable vegetable and algae bags has been advocated. (https://impressmagazin.hu/betiltotkat-a-franciak-a-muanyag-zacskok-hasznalatat-a-kereskelimben/)

- **10-point action plan on French nuclear energy** - The French want to build at least 2 GW of onshore wind turbine facilities per year. Moreover, the proportion of green energy production in the energy mix will be increased to 40% by 2030. The restrictions related to boilers were brought into force on 01.01.2022. (https://www.napi.hu/nemzetkozi-gazdasag/energia-franciaorszag-jovo-napelem.739827.html)
- **Crit'Air - Environmental protection sticker (2016)** - Vehicles are classified into 6 different categories, thus enabling law enforcement officials to regulate entry into the traffic-reduced zones. The sticker must be placed on the windshield of the vehicle. The decree also applies to foreign drivers. (https://at.france.fr/hu/hasznos-informaciok/critair-francia-kornyezetvedelmi-matrica)
- **Mandatory solar panel or green roof (2015)** - The provision applicable exclusively to houses built in commercial and industrial zones. A green roof has many environmental benefits. Vegetation cleans the air and has an insulating effect. You can choose a solar panel instead of a green roof. (https://impressmagazin.hu/franciaorszagban-kotelezo-a-napelem-vagy-a-zoldteto/)

**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- CCPI (2022): France. https://ccpi.org/country/fra/
- Climate Adapt (2021): National circumstances relevant to adaptation actions. https://climate-adapt.eea.europa.eu/countries-regions/countries/france
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.

- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- ITA, International Trade Administration (2021): France - Country Commercial Guide. https://www.trade.gov/country-commercial-guides/france-energy-eng
- OECD (2022): OECD environmental performance review of France - A positive but demanding assessment. https://www.oecd.org/env/country-reviews/oecdenvironmentalperformancereviewoffrance-apositivebutdemandingassessment.htm
- Our World in Data (2021): France: Energy Country Profile. https://ourworldindata.org/energy/country/france
- Statista (2021): Greenhouse gas emissions in France from 2005 to 2019, per capita. https://www.statista.com/statistics/784338/gas-effect-greenhouse-emissions-by-person-france/
- UN, United Nations (2017): The Seventh national communication of France. United Nations Framework Convention on Climate Change. https://unfccc.int/sites/default/files/resource/France-NC7-2-NC%20-%20FRANCE%20%20-%20EN%20-VF15022018_0.pdf

## 4.11. GERMANY

Germany, located in Central Europe, is the largest country in the EU27 in terms of population. The mean temperature increased by 1.4 °C between 1881 and 2015. The number of days with the extreme temperatures is also increasing, so that heatwaves are becoming more frequent (Climate Change Knowledge Portal 2022).

Germany's real GDP per capita indicator fell by 5% in 2020 compared to the previous year (Eurostat 2021a). The main reason for that drop can be the COVID-19, which hit the German economy with the hard-lockdowns. Economic growth was forecast at 2.9% in 2021 however, the spread of the virus and the shortages of key manufacturing inputs can impede economic recovery (OECD 2021).

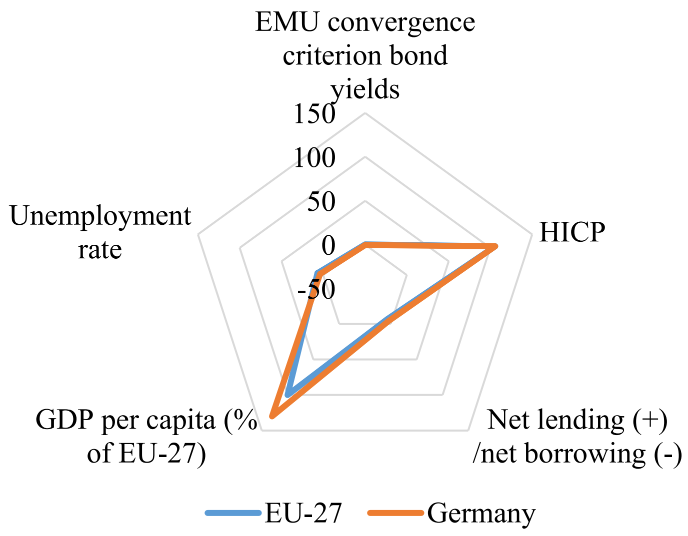



**Figure 82: Germany vs. EU27 – Economic outlook, 2020**
Sources: own compilation based on Eurostat (2021a)

The unemployment rate in 2019 was very low (3.4%). In 2020 the ratio became 3.8%. Despite the growth, it is still one of the lowest rates in the German economy between 1993 and 2020 and it was the third lowest in the European Union after the Czech Republic and Poland (Eurostat 2021a).

Analysing the period between 2000 and 2020, the German long-term interest rate followed a decreasing tendency, and it reached its minimum point (-0.51%) in 2020 (Eurostat 2021a). It was the lowest rate in the European Union in the given year (Eurostat 2021a). The German harmonised index of consumer prices (HICP) was similar to that of the EU27 in 2020 (Eurostat 2021a) as shown in Figure 82 .

The net lending/net borrowing is the difference between the total general government revenue and expenditure as a percentage of gross domestic product. In the case of Germany, the ratio was -4.3% in 2020, which has been the first negative value since 2012 (Eurostat 2021a). In 2020, the country could not keep the 60% of the government debt ratio as required by the Maastricht criteria. However, the government debt-to-GDP ratios increased in all members of the EU27 members compared to 2019 (Eurostat 2022e).

**Climate Strategy**

Germany is one of the leading nations within the European Union, consequently, its climate strategy and actions are essential because it can guide the development of climate policy. If Germany can successfully transit to fossil fuel-free energy sector without sacrificing economic growth, then it can motivate the other nations to support renewable energy sources. Germany has different plans (like Energiewende or Climate Action Plan 2050) and programs (for example Climate Protection Programme 2030) to protect the environment and reduce emissions. A dedicated agency also has established to support these initiatives. These plans will be discussed briefly, in the following paragraphs.

The German Environment Agency (Umweltbundesamt – UBA) was established in 1974 to protect the environment. Its remit collects data and text recommendations for the Ministries. The institution conducts diverse analysis to support the knowledge of the government, private sector, and households. For instance, the German Environment Agency has published a report that assesses the climate impacts and risks across various sectors, including biodiversity, soil, coastal and marine protection, water balance and management, based on more scenarios. Thid document subsequently recommend 31 very urgent and 23 urgent actions (German Environment Agency 2021).

Energiewende is the German plan that transforms the nation's energy system to achieve a low-carbon, and a nuclear-free economy that is primarily reliant primarily on renewable energy sources (Clean Energy Wire 2021, IEA 2020). The country has set a target to of eliminating nuclear power by 2022 and phasing out coal completely by 2038 (Clean Energy Wire 2021, IEA 2020). However, several experts have expressed scepticism regarding the ambitious plan, suggesting that a phase-out of nuclear power could potentially lead to an increase in coal power (Wendling et al. 2020).

In order to achieve the climate targets set out in the Climate Action Programme 2030 and the Climate Action Act were announced in Germany. The programme focuses on a new $CO_2$ pricing scheme within the transport sector and for heating buildings, while delineating specific policy measures (The Federal Government 2022, Wehrmann 2019). It aligns with the objectives of the Climate Action Plan 2050, "which sets out a longer-term pathway for sector-specific emissions reductions, as part of the Energiewende" (IEA 2020). The programme aims to reduce the greenhouse emissions by 55 percent below 1990 levels (Clean Energy Wire 2021), indicating the necessity for more effective actions on the part of Germany.

### Primary Energy Consumption

As demonstrated in Figure 83 the total energy needs of Germany compared to the EU28. In this case, the indicator covers the energy consumption of end-users (e.g. industry, transport, households, etc.). On average, 19% of the total primary energy consumption in the European integration was accounted for by Germany between 2000 and 2019. This proportion was the highest in the EU28 during the period analysed. Additionally, the German energy import dependency increased steadily from 2000 onwards, reaching a maximum of 67% in 2019 (Eurostat 2022).These results are not unexpected, given Germany's status as one of the largest and strongest economies in the EU. Consequently, it is one of the leading countries in the field of environmental protection.

In Germany, the primary energy consumption has exhibited a downward trend between 2000 and 2019, especially after 2006. The lowest recorded value of 282.7 million tonnes of oil equivalent was attained happens in 2019. A study by BDEW identifies improvements in energy efficiency and a reduction in energy consumption by industry as the primary drivers behind this decline (BDEW 2020).

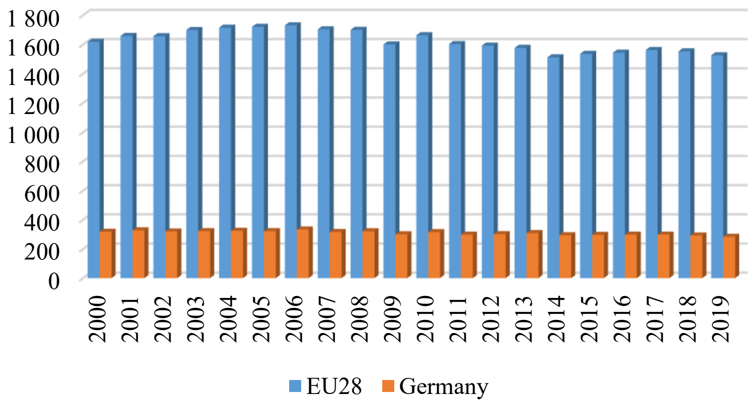



**Figure 83: Germany vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**

Source: own compilation based on Eurostat (2022a)

The role of the households as a significant energy consumers in Germany, second only to the industry and transportation, has been highlighted (Lopez et al. 2018). Based on the report by the Federal Statistical Office (Destatis), gas accounted for 41.2 % of the German energy consumption for housing by energy source. It is followed by the electricity (17.6%), mineral oil (17.2%), renewable energies (15.1%), district heating (8.3%) and coal (0.6%) in 2019 (Destatis 2021). It can thus be concluded that renewable energies are in still in their infancy in Germany. The energy consumption can be influenced by weather conditions; for example, in 2010 increased energy consumption was observed in colder weather, while a warmer year might result in decreased demand, as evidenced in 2007 or 2014 (BDEW 2020, Lopez et al. 2018). On the other hand, Valeriia Denisova (2020) found a robust positive linear correlation between the energy consumption and both the GDP per capita or the energy consumption and the urbanisation (a proportion of the population in city areas) in Germany during the 1990-2018 period.

### Share of Fossil Fuels in Gross Available Energy

Germany has a higher proportion of the fossil fuels in gross available energy than in the European Union. The distribution ranging from 80% to 82% as demonstrated in Figure 84. In 2019, the energy from fossil fuels per capita in Germany was almost double the global average (33,836 kilowatt-hours as opposed to 17,730 kilowatt-hours, (Ritchie and Roser 2020b).

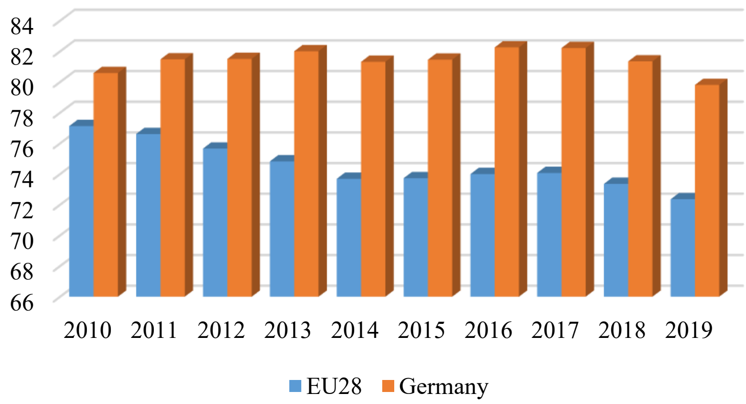



**Figure 84: Germany vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

The absolute value of Germany's fossil fuel consumption decreased by 309 terawatt-hours (10%) between 2010 and 2019 (Ritchie and Roser 2020b). This decline can be attributed to the significant drop in coal consumption, which fell by 272 terawatt-hours (30% reduction) in 2019 compared to 2010 (Our World in Data 2021). Germany has set a target of eliminating coal by 2038 (Clean Energy Wire 2021). One of its reasons is the energy sector that plays a main role in the emission reduction goals. The sector has set itself an ambitious target of reducing emission by 61 - 62% before 2030, which is remarkably high among the sectors. To achieve this objective, a significant cut will be necessary in coal power generation (Pfeiffer et al. 2018). However, the closure is not simple, since it will be accompanied by structural change. Various questions are necessary to be answered, like the followings (Ragnitz et al. 2021):

- How to mitigate the effects of the closure on the region, especially its employment? Do the locals have other job alternatives within the residential environment?
- How can the decision-makers balance between the winners and the losers in this situation?
- What kind of structural policy and actions is effective and needed in this case?

To obtain a comprehensive understanding of the situation, the German Environment Agency published a case study of Lusatia, with the objective to ascertaining the impact of the massive decline in lignite mining and the structural policies implemented on the region (Ragnitz et al. 2021). An additional case study focuses on the Ruhr area in relation to this topic (Dahlbeck et al. 2021).

Among the fossil fuels, only the gas consumption in Germany exhibited an increase, with a 6 terawatt-hour rise recorded in 2019 compared to 2010 (Ritchie and Roser 2020b). A study by Destatis (2021) revealed that gas was the primary energy source in Germany was gas from 2000 to 2019. The proportion increased from 38.6% to 41.2% over the given period. Conversely, the importance of mineral oil decreased significantly, with its proportion dropping from 30.3% in 2000 to 17.2% in 2019. The planned nuclear and coal phase-out in Germany has led to a corresponding increase in the importance of natural gas as an energy source, thereby increasing the country's reliance on it (IAE 2020a). On the other hand, there has been a notable increase in the adoption of renewable energies by households in Germany, with a rise from 6.8% (in 2000) to 15.1% in 2019 (Destatis 2021).

A positive fact in Germany in this case is that the share of the electricity comes from fossil fuels decreased from 61% to 47% between 2010 and 2019 in Germany (Ritchie and Roser 2020b). However, the 2019 value is higher than the EU27 average (40%), indicating the need for further actions.

### Greenhouse Gas Emissions by Capita

The Figure 85 shows a slow decreasing tendency in the German greenhouse gas emissions. In 2019, the value of the indicator was lower by 13% compared to 2010, and it was 1.2 times more than the EU27 average. A comparison with the most developed countries reveals that the

Germany's emissions are 1.34 times higher than the G20 (German Watch 2021). These results underscore the necessity for Germany to prioritise this area in its climate policy.

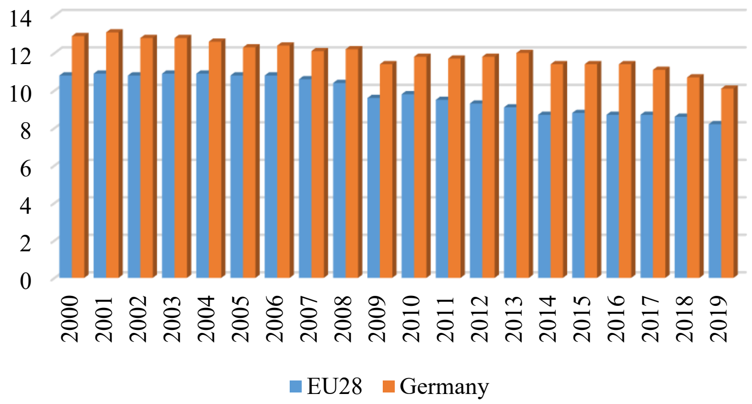



**Figure 85: Germany vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

The primary contributor to greenhouse gas emissions is the energy sector, with the power sector accounting for 16% of total emissions in 2020. The transportation sector closely follows, producing 26% (German Watch, 2021). The industrial and building sectors are responsible for 22% and 20% of emissions, respectively in 2020. The key point is that while the power, the industrial and the building sectors have the potential to significantly decrease their emissions, the transportation sector has shown stability over the past 30 years (German Watch, 2021).

In 2019, the final energy consumption of transport come from various sources: 93.5% oil, 4.5% biofuels, 1.8% electricity and 0.2% gas. It is therefore evident that the proportion of biofuels and electricity was negligible (German Watch, 2021). In order to reduce greenhouse gas emissions, Germany has attempted to regulate vehicle emissions. Specifically, the objective is to reduce the emissions of passenger cars by 55% in 2030 compared to 2021. Additionally, another target is to ensure that all new light-duty vehicles have zero tailpipe $CO_2$ emissions in 2030 (IEA 2021). To achieve those targets, various actions will be necessary in Germany.

The Electric Mobility Act, which was announced in 2015, focused on the spread of electric cars. In order to encourage customers to purchase these vehicles, the German government provided financial support(IEA 2021). In 2020, Germany passed an amendment to the Motor Vehicle Tax Act that required owners of LDVs to pay increasingly higher taxes based on the size of the engine and $CO_2$ emissions of the vehicle.

## Share of Energy from Renewable

As Figure 86 illustrates, the share of energy from renewable sources in Germany followed an upward trend between 2010 and 2019, though it remains below the European average. Despite the divergent values, Germany stands as a prominent global contributor to renewable energy generator. This is not a random phenomenon, the investors (for instance, energy companies, banks, or households) have spent over €150 billion on renewable energy in the country analysed between 2005 and 2015 (Nelson et al. 2016). The Federal Cabinet, within the 7th Energy Research Programme, allocated €6.8 billion for projects between 2018 and 2022 (Federal Ministry for Economic Affairs and Energy, 2019). According to the plans, by 2050, 60% of gross energy consumption is projected to come from renewable sources (Federal Ministry for Economic Affairs and Energy 2019).

Germany's main renewable energy source is the wind power, and in 2019, it is ranked first in Europe for wind energy production was the highest in 2019. It was almost double that of the UK, which was the second-highest wind energy producer (Ritchie and Roser 2020c). However, a significant challenge remains in the network required to transport wind power from the northern to the southern regions. A significant part of wind capacity is situated in the northern region of the country, while the southern region exhibits the highest energy consumption, primarily due to the metropolitan areas and industrial zones (IEA 2020).

Following wind energy, solar energy, and other renewables like hydropower is the next most important source. However, hydropower may be expected to have a lesser role among renewable energy sources because of the decreasing annual renewable water supply in Germany during the last decades (German Environment Agency 2021).

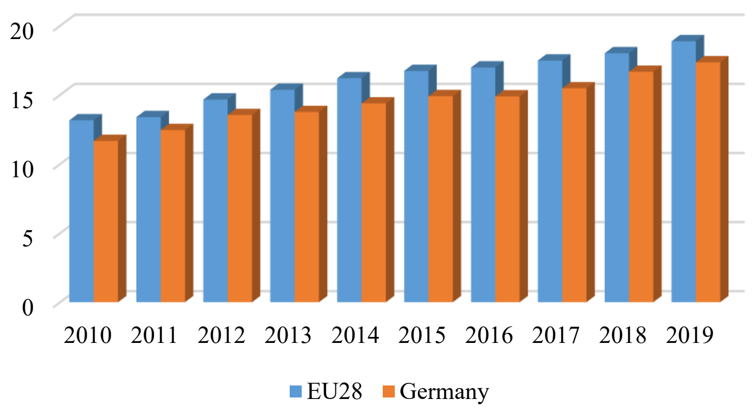



**Figure 86: Germany vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

The analysis of the data set provided by the Umwelt Bundesamt reveals a substantial increase in the share of the renewable energy sources in the total electricity. For instance, the percentage of electricity generated from renewable energy sources increased from 10 % in 2005 to 25% in 2013, further to 41% in 2021. This indicates a favourable trend, as it signifies that in2021, a greater proportion of electricity was produced by renewable energy sources in comparison to fossil fuels (Umwelt Bundesamt 2022).

The German Renewable Energy Act (Erneuerbare Energien Gesetz, or EEG) was introduced in 2000 to promote renewable power sources in the country. Its newest version came into force in 2021. It aims to increase solar PV capacity to 100 GW, onshore wind to 71 GW, offshore wind to 20 GW, and biomass to 8.4 GW by 2030 (EEG 2021). These targets are higher than the goals in the Climate Action Programme 2030 (Appunn 2021).

**Composite Indicators**

**Environmental Performance Index**

EPI uses 32 indicators within the environmental health and ecosystem vitality categories (Wendling et al. 2020). The Figure 87 visualizes the EPI score in Germany from 2016 to 2020.

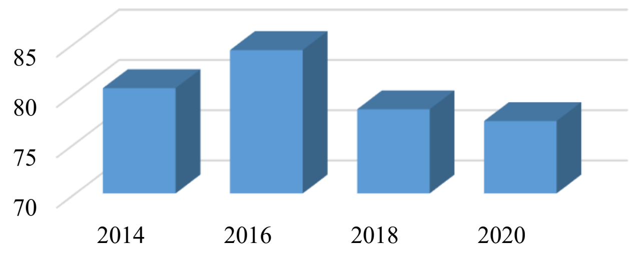



**Figure 87: Germany – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022a)

The score of the country was 77.2 in 2020, which was 5.3 scores lower than the rank leader, Denmark. Germany was the 10th based on the EPI methodology among 180 countries in 2020. To improve its rank, the country should pay attention to the GHG per capita, Biodiversity Habitat Index, and Wetland loss, as these three indicators exhibited the most deficient performance among all those evaluated (based on (EPI 2022b)).

**Ecological Footprint per person**

The values of the Ecological Footprint per person follow a downward trend between 2014 and 2017 in Germany as the Figure 88 presents. This tendency can be attributed mainly to the annual reduction in the Carbon indicator, which holds the highest value in each year analysed among the other factors (Built-up Land, Cropland, Fishing Grounds, Forest Products, and Grazing

Land) in the Ecological Footprint per person. The carbon factor accounts for the 65% of the indicator in 2017, with housing and personal transportation contributing the most (based on Lin et al. 2020). The second largest proportion is attributed to Cropland with 16% in 2017 consisting of the agricultural products, agricultural products, market animal feed, and cropped grasses used for livestock feed, and market animal feed (Lin et al. 2019).

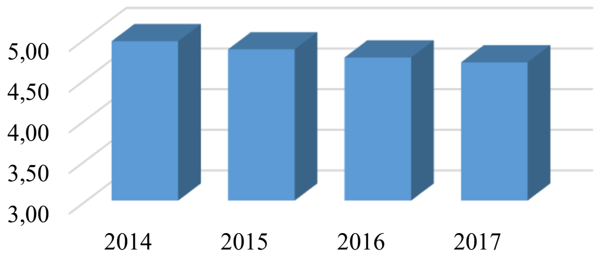



**Figure 88: Germany – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

The German Ecological Footprint per person was 4.8 global hectares in 2017, representing a decrease of 2.5 global hectares compared to its maximum of 7.3 global hectares recorded in 1979 (National Footprint and Biocapacity Accounts, 2022). The German Biocapacity deficit was 3.2 global hectares in 2017 (National Footprint and Biocapacity Accounts, 2022). The EEA (2020) identifies three possible explanations for this deficit: "(1) over-exploitation of their domestic ecological capital, e.g. through overfishing; (2) the import of products leading to exploitation of the biocapacity of other nations; or (3) exploitation of the global commons" (EEA 2020).

### Climate Change Performance Index

The Figure 89 shows the points of Germany in the CCPI between 2014 and 2021. This composite index summarizes the GHG Emissions (40% of overall score), the Renewable Energy (20% of overall score), the Energy Use (20% of overall score), and the Climate Policy (20% of overall score).

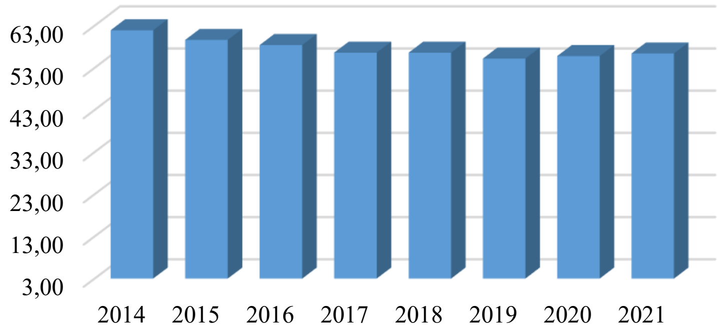



**Figure 89: Germany vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

The data demonstrate a downward trend between 2014 and 2019 in Germany. National experts have criticised the ambitions of the German government with regard to climate protection in both national and international negotiations (Burck et al. 2018, Burck et al. 2017, Burck et al. 2016, Burck et al. 2013). On the other hand, the preponderance of lignite in the energy supply was identified as a contributing factor to the suboptimal performance, as evidenced by the CCPI (Burck et al. 2015). In recent years, experts have emphasized the necessity for Germany to enhance its efforts to curtail its greenhouse gas emissions by 2020 at the planned pace and achieve the set goal (Burck et al. 2017).

Despite the fact that the score indicates an improvement in CCPI in 2020 and 2021, but the challenges previously mentioned pose a risk of the climate targets not being met by the deadline. In 2019, the German government announced several actions, including the phase-out coal by 2038, and the introduction of a carbon pricing system (Burck et al. 2019).

The German government has set more ambitious climate targets for 2021: reducing emissions by 65% by 2030 compared to the 1990 levels, and a net-zero target for 2045 (CCPI, 2022). However, the decision-makers should pay attention to the measurements, as setting targets without implementing appropriate measurements is insufficient for ensuring effective climate protection.

**Good Practices**

**Climate protection practices at the country level**

- Germany, as one of the most important economic powers within the EU, assumes a significant role in the financing of climate action, both domestically and internationally. For example, in 2020, Germany contributed to the international climate financing with a total of €4 billion from its public funds (https://climate-adapt.eea.europa.eu/countries-regions/countries/germany).

- Significant companies have also expressed support for the efforts to combat climate change, with the Volkswagen Group, for instance, aiming to achieve net carbon neutrality by 2050 (https://www.volkswagenag.com/en/sustainability/decarbonization.html). The Group has also published different reports related to this topic, including, the Responsible Raw Materials Report, which examines raw material supply chains are identifies 16 high-risk materials. This is the first report to address supply chains and name the countries of origin. It is essential, since problems linked to the human rights or environmental pollution often appear in those suppliers with which the manufacturer does not have direct contact (https://www.volkswagenag.com/en/news/2022/05/volkswagen-publishes--responsible-raw-materials-report-2021.html). There are several other examples about the good practices in Volkswagen Group:
  - Volkswagen Group has a strategy to reduce emissions and protect the environment. It is the „go-to-zero" strategy (Audi 2019).
  - Audi Hungaria launched a brainstorming campaign in 2019 (which was called: "Year of Sustainability") to sensitize and motivate employees (Audi 2019).
  - The Hungarian factory within the Audi promised that it become a carbon-neutral company by 1 January 2020 (Audi 2019; https://www.audi.hu/hu/audi-hungaria-a-kornyezetert/).
  - Audi Hungaria works with the University of Győr to find the best solutions (Audi 2019).
  - Audi delivers parts, engines, and cars between Ingolstadt, Brussels, and Győr (https://www.audi.hu/hu/audi-hungaria-a-kornyezetert/).

- Flaschenpfand and dosenpfand

  The Pfand system is not only present in Germany, but also in the German-speaking regions. This system functions by requiring traders to pay a specific amount to the government in the form of tax for each bottle produced. This amount is then charged by the manufacturer to the store, subsequently passes this cost on to the customers. Customers receive a certain amount of money for each bottle returned to the store. This system serves to return the used glasses to the manufacturers and reuse them, thus saving resources and energy.

- Paperless schools

To this day, in schools, especially in secondary and primary schools, students and teachers taking notes on paper, receiving paper-based books, and generally utilising substantial amounts of paper. It is technologically possible to replace this with virtual notes or books to reduce the use of paper. This transition, however, is a gradual process and it does not happen overnight, but this process has begun. While this is not yet a commonplace phenomenon in Germany, it is gradually gaining traction and is poised to become more widespread. Paperless schools operate in a way that the school provides each student with a tablet, which they can use to take notes, and the teachers can also send the material to the students electronically.
(https://www.t-online.de/leben/familie/schulkind-und-jugendliche/id_46185522/deutschlands-erste-papierlose-schule.html)

- Renewable energy sources

The German government has been putting a lot of pressure on the development of renewable energy sources, which of course contribute to achieving climate neutrality. The government aims to reduce greenhouse gas emissions by 38.7 percent by 2021 compared to 1990. However, it should be noted that the emission of such gases has only decreased in the last 32 years and the climate protection report does not consider this to be fast enough. The German government's primary objective is to reduce gas emissions and minimise the electricity produced from coal to a minimum. By 2030, envisions that 80% of Germany's gross electricity consumption will be derived from renewable energy sources. In addition, the German government is implementing a programme entitled the "Klimaschutz- Sofortprogramm" (in English: Climate protection-immediate-program), details of which are yet to be revealed. This programme will outline the government's strategy for halving CO2 emissions by 2030.
https://www.bundesregierung.de/breg-de/themen/klimaschutz/klimaschutzbericht-2022-2130484#:~:text=Der%20Ausbau%20Erneuerbarer%20Energien%20tr%C3%A4gt%20ma%C3%9Fgeblich%20zur%20Emissionsreduktion%20bei.&text=Der%20aktuelle%20Klimaschutzbericht%202022%20macht,762%20Millionen%20Tonnen%20Treibhausgase%20freigesetzt

- Nature conservation areas

Following the reunification of Germany, the proportion of land per western Bundesland was 1.38%. Subsequent to the entry of the new Bundeslands in 2002, legislation pertaining to nature conservation areas for the protection of the environment began to be enacted. By the end of 2008, there were already 8,413 environmental protection areas in Germany with an area of ~1.3 million hectares. This constitutes 3.6% of the entire territory of Germany. This means that specific legal provisions are in place there to protect the integrity and health of nature and the earth, thereby facilitating unimpeded natural development in these areas.

- Volkswagen

The German car manufacturer Volkswagen, akin to Tesla, produces electric vehicles (EVs). However, this does not inherently imply a climate-friendly outcome, as the end-of--life phase of EVs poses significant challenges due to the presence of hazardous substances. Consequently, the environmentally sound disposal of EVs remains a pending issue. However, Volkswagen's manufacturing process utilises electricity extracted from renewable energy sources, a practice mandated by the manufacturers' commitment to eco-electricity. In an effort to promote this practice among households, Volkswagen has initiated a project called Elli founded in 2018. The primary objective of the project is to introduce eco-electricity in households, initially for the purpose of charging electric vehicles and subsequently for supplying electricity to entire households.
(https://www.volkswagen.at/elektroauto/nachhaltigkeit/klimaschutz)

- Shopping centres

In Germany, shopping centres, especially those operated by Aldi, have been using LED lighting since 2016, which consumes 50% less electricity than conventional lighting. Since 2017, these establishments have also transitioned to LED lighting in their refrigeration units which, since it consumes less electricity, generates less heat, consequently reducing the energy required for cooling. Following that, there is an ongoing strategy to extend the use of LED lighting to logistics centres and office spaces. The implementation of these measures has resulted in a reduction in $CO_2$ emissions, amounting 3,000 tons per year. In addition, this energy can be used in data management, i.e. in process management programs that help the companies understand their financial,

temporal and energy cost-effectiveness. With their help, processes can converged to become more time-, money- and environment-effective.
(https://www.aldi-nord.de/nachhaltigkeitsbericht/2017/kernthemen/klimaschutz.html)

- Deutsche Telekom

  Deutsche Telekom's operations are already entirely sustainable on a global scale, which means that their activities do not contribute to greenhouse gases. However, this does not imply that customers are not responsible for the release of environmentally harmful substances through their products. The company has set this goal for 2040, therefore, no harmful substances would be emitted from their products. This commitment encompasses not only the operation of the company, but also all associated processes, thereby ensuring a green business model.
  (https://www.telekom.com/de/medien/medieninformationen/detail/telekom-verschaerft-klimaziele-623554)

**Climate protection practices at the level of individuals**

- An annual waste calendar is utilised to help residents in understanding the rules for selection and the schedule. Coupons are usually placed on the calendar and can be exchanged at the town hall for the various bins (plastic, biodegradable)
- (https://www.tisztajovo.hu/kornyezetvedelem/2011/03/24/egy-kisvaros-nemetorszagban-ahol-az-ujrahasznositas-fizet-a-lakoknak).
- Luisa-Marie Neubauer is a German climate activist who has been influential in the establishment of the school strike movement inspired by Greta Thunberg called “Fridays for Main organizer of “Future”. This is an international movement, primarily involving school-aged children who are keen to take swift and effective action to protect the climate and raise awareness of the issue. She has contributed to several magazines, online magazines, blogs and movements, including Stern, ONE, Huffpost and WWF, to name a few. She also maintains ongoing communication and collaboration with many philosophers, scientists and other climate activists, such as Richard David Precht, Harald Welzer, Aleida Assmann and Bernd Ulrich.

## References


- Appunn, K. (2021): What's new in Germany's Renewable Energy Act 2021. Clean Energy Wire. Link: https://www.cleanenergywire.org/factsheets/whats-new-germanys-renewable-energy-act-2021. Downloaded: 31.05.2022.
- Audi (2019): Környezetvédelmi Nyilatkozat 2019. Audi Hungária: Győr.
- BDEW (2020): Energy Market Germany 2020. Link: https://www.bdew.de/media/documents/Energiemarkt_Deutschland_2020_englisch.pdf. Downloaded: 11.01.2022.
- Burck, J., Hagen, U., Höhne, N., Nascimento, L. and Bals, C. (2019): Climate Change Performance Index. Results 2020. Link: https://ccpi.org/wp-content/uploads/ccpi-2020-results-the_climate_change_performance_index-1.pdf.
- Burck, J., Hagen, U., Marten, F., Bals, C. and Höhne, N. (2018): The Climate Change Performance Index. Results 2019. Link: https://ccpi.org/wp-content/uploads/CCPI-2019-Results-190614-WEB-A3.pdf.
- Burck, J., Marten, F., and Bals, C. (2013): The Climate Change Performance Index. Results 2014. Link: https://ccpi.org/wp-content/uploads/CCPI-2014.pdf.
- Burck, J., Marten, F., and Bals, C. (2015): The Climate Change Performance Index. Results 2016. Link: https://ccpi.org/wp-content/uploads/The-Climate-Change-Performance-Index-2016.pdf.
- Burck, J., Marten, F., and Bals, C. (2016): The Climate Change Performance Index. Results 2017. Link: https://ccpi.org/wp-content/uploads/CCPI-2017.pdf.
- Burck, J., Marten, F., Bals, C. and Höhne, N. (2017): The Climate Change Performance Index. Results 2018. Link: https://ccpi.org/wp-content/uploads/climate_change_performance_index_2018_20503.pdf.
- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- CCPI (2022): Germany. Link: https://ccpi.org/country/DEU/. Downloaded: 26.05.2022.
- Clean Energy Wire (2021): Germany's Energiewende in brief. Link: https://www.cleanenergywire.org/germanys-energiewende-brief. Downloaded: 22.12.2021.
- Climate Change Knowledge Portal (2022): Germany. Link: https://climateknowledgeportal.worldbank.org/country/germany. Downloaded: 01.06.2022.
- Dahlbeck, E., Gärtner, S., Best, B., Kurwan, J., Wehnert, T. and Beutel, J. (2021): Analysis of the historical structural change in the German hard coal mining Ruhr area. Case study. Climate Change 30/2021.
- Destatis (2021): Household energy consumption for housing continued to increase in 2019. Link: https://www.destatis.de/EN/Press/2021/08/PE21_383_85.html. Downloaded: 11.01.2022.
- EEA (2020): Ecological footprint of European countries. Link: https://www.eea.europa.eu/data-and-maps/indicators/ecological-footprint-of-european-countries-2/assessment. Downloaded: 20.04.2022.
- EEG (2021): Gesetz für den Ausbau erneuerbarer Energien (Erneuerbare Energien-Gesetz - EEG 2021). Link: https://www.gesetze-im-internet.de/eeg_2014/EEG_2021.pdf.
- EPI, Environmental Performance Index (2022b): Germany. Link: https://epi.yale.edu/epi-results/2020/country/deu. Downloaded: 26.05.2022.

- EPI, Environmental Performance Index (2022a): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021a): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2021b): Energy import dependency by products. Link: https://ec.europa.eu/eurostat/databrowser/view/sdg_07_50/default/table?lang=en. Downloaded: 14.01.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- Eurostat (2022e): Government finance statistics. Link: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_finance_statistics#Government_debt. Downloaded: 02.06.2022.
- Federal Ministry for Economic Affairs and Energy (2019): Renewable energy sources in figures. National and International Development, 2018. Berlin: Federal Ministry for Economic Affairs and Energy. Link: https://www.bmwk.de/Redaktion/EN/Publikationen/renewable-energy-sources-in-figures-2018.pdf?__blob=publicationFile&v=2.
- German Environment Agency (2021): Climate Impact and Risk Assessment 2021 for Germany. Umweltbundesamt. Link: https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/cc_27-2021_climate_impact_and_risk_assessment_2021_for_germany_english_summary_bf.pdf
- German Watch (2021): Germany. Climate Transparency Report 2021: Comparing G20 Climate Action towards Net Zero. Link: https://www.germanwatch.org/sites/default/files/ct_report_2021_-_country_profile_germany.pdf.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.

- IAE (2020): Germany 2020, Energy Policy Review, Country report — February 2020. Link: https://www.iea.org/reports/germany-2020. Downloaded: 18.01.2021.
- IAE (2021): Fuel economy in Germany. Link: https://www.iea.org/articles/fuel-economy-in-germany. Downloaded: 18.01.2021.
- Lin, D., Hanscom, L., Martindill, J., Borucke, M., Cohen, L., Galli, A., Lazarus, E., Zokai, G., Iha, K., Eaton, D. and Wackernagel, M. (2019): Working Guidebook to the National Footprint and Biocapacity Accounts. Oakland: Global Footprint Network. Link: https://www.footprintnetwork.org/content/uploads/2019/05/National_Footprint_Accounts_Guidebook_2019.pdf.
- Lin, D., Wambersie, L. and Wackernagel, M. (2020): Ecological Footprint and Biocapacity Germany's Nowcast for 2020. Link: https://www.overshootday.org/content/uploads/2021/04/germany_nowcast_2020_final.pdf#:~:text=See%20Figure%202%20below%20for%20the%20nowcasting%20results,per%20person%2C%20of%20which%2066%25%20is%20carbon%20Footprint.
- Lopez, E., Schlomann, B., Reuter, M., and Eichhammer, W. (2018): Energy Efficiency Trends and Policies in Germany – An Analysis Based on the ODYSSEE and MURE Databases. Link: https://www.odyssee-mure.eu/publications/national-reports/energy-efficiency-germany.pdf. Downloaded: 11.01.2022.
- National Footprint and Biocapacity Accounts (2022): EcologicaL Footprint per Person. Link: https://data.footprintnetwork.org/#/??_ga=2.4934325.764780885.1653572487-1885991649.1653572487. Downloaded: 26.05.2022.
- Nelson, D., Huxham, M., Muench, S. and O'Connel, B. (2016): Policy and Investment in German Renewable Energy. Climate Policy Initiative. Link: https://climatepolicyinitiative.org/wp-content/uploads/2016/04/Policy-and-investment-in-German-renewable-energy-Summary.pdf.
- OECD (2021): Fuel economy in Germany. Link: https://www.iea.org/articles/fuel-economy-in-germany
- Pfeiffer, D., Lünenbürger, B., Klaus, T., Gibis, C., Hain, B., Knoche, G., Landgrebe, J., Leprich, U., Matthey, A., Purr, K. Unnerstall H., Werlein, M. and Weiss, I. (2019): Coal-fired power generation and climate protection until 2030. Discussion contribution of the German Environment Agency for achieving the climate targets in Germany. German Environment Agency: Dessau-Roßlau. Link: https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2018-04-27_position_kohleverstromung-klimaschutz_2030_en.pdf.
- Ragnitz, J., Markwardt, G., Schwartzkopff, J., Reitzenstein, A., Wehnert, T. Kurwan, J. and Beutel, J. (2021): Analysis of the historical structural change in the German lignite mining area of Lusatia (case study). German Environment Agency: Dessau-Roßlau. Link: https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2021-12-28_cc_32-2021_case-study_analysis_historical_structural_change_lusatia.pdf.
- Ritchie, H. and Roser, M. (2020b): Fossil Fuels. Link: https://ourworldindata.org/fossil-fuels. Downloaded: 14.01.2021.
- Ritchie, H. and Roser, M. (2020c): Renewable Energy. Link: https://ourworldindata.org/renewable-energy. Downloaded: 14.01.2021.
- The Federal Government (2022): Climate policy, the energy transition and mobility. What is the German government doing for the climate? Link:

https://www.bundesregierung.de/breg-en/issues/climate-action/government-climate-policy-1779414. Downloaded: 01.06.2022.

- Umwelt Bundesamt (2020): Climate protection and energy policy in Germany. Link: https://www.umweltbundesamt.de/en/topics/climate-energy/climate-protection-energy-policy-in-germany. Downloaded: 30.05.2022.
- Umwelt Bundesamt (2022): Renewable Energies in Figures. Link: https://www.umweltbundesamt.de/en/topics/climate-energy/renewable-energies/renewable-energies-in-figures. Downloaded: 30.05.2022.
  Valeriia Denisova (2020): Financial Development and Energy Consumption: Evidence from Germany. International Journal of Energy Economics and Policy, 10(2), 35-39. Link: https://www.proquest.com/docview/2459596120?pq-origsite=gscholar&fromopenview=true.
- Wehrmann, B. (2019): Germany's Climate Action Programme 2030. • Clean Energy Wire. Link: https://www.cleanenergywire.org/factsheets/germanys-climate-action-programme-2030. Downloaded: 31.05.2022.
- Wendling, Z. A., Emerson, J. W., de Sherbinin, A., and Esty, D. C., et al. (2020): 2020 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy. Link: https://epi.yale.edu/downloads/epi2020report20210112.pdf.

## 4.12. GREECE

Greece, nation with a Mediterranean climate, is located on the Balkan Peninsula and comprises almost 3,000 islands (Climate Change Knowledge Portal 2022). From its 15,000 km coastline, 1,000 km is considered to be at risk due to the rise in average sea level, with Greece experiencing heightened exposure to earthquakes and fluvial disasters (Climate Change Knowledge Portal 2022). The floods mainly were caused by heavy rainfall in a short period of time, affecting 22,324 people between 1980 and 2020.

Furthermore, Greece experienced a 9% decrease in its real GDP per capita in 2020 when compared with the previous year. The service sector, which accounts for the 70% of the total value added (Climate Adapt 2021), was particularly vulnerable to the impact of the pandemic. The decline in tourism due to COVID-19 represented a serious risk factor for the Greek economy.

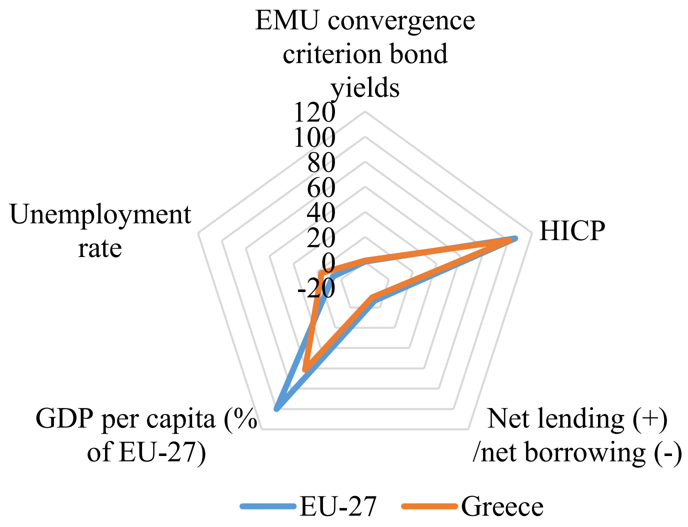



**Figure 90: Greece vs. EU27 – Economic outlook, 2020**
Sources: own compilation based on Eurostat (2021)

The unemployment rate reached 16.53% in 2020, representing the highest ratio within the European Union. However, this figure represented a downward trend since 2013 (Eurostat 2021). On the other hand, the youth unemployment rate within the European Union remains among the highest. For instance, the given ratio was higher than 34% on a monthly basis in 2019 (Eurostat 2022e).

In 2020, Greece experienced one of the highest long-term interest rates (1.27%) in the European Union after Romania, Hungary, and Poland (Eurostat 2021). Concurrently, Greece recorded the lowest harmonised index of consumer prices (HICP) in Greece (101.17) in the EU27 (Eurostat 2021).

Furthermore, in 2020, the Greek net lending/net borrowing was -10.1, which indicates the difference between the total general government revenue and expenditure in the percentage of gross domestic product. This substantial decline is particularly noteworthy when viewed in the context of the previous 4 years, during which the indicator had remained within the positive range of 0.2 to 1.1 (Eurostat 2021). Notably, Greece holds the highest general government debt in the European Union in 2020 (Eurostat 2022f). This poses a significant risk, as an elevated debt ratio can impede economic growth (Reinhart & Rogoff, 2010).

**Climate Strategy**

Prior to the analysis of the data, it is first necessary to consider the main milestones of the Greek strategy in the concept of climate change. The National Strategy for Adaptation to Climate Change (ΕΘΝΙΚΗ ΣΤΡΑΤΗΓΙΚΗ ΓΙΑ ΤΗΝ ΠΡΟΣΑΡΜΟΓΗ ΣΤΗΝ ΚΛΙΜΑΤΙΚΗ ΑΛΛΑΓΗ) was established in 2016. The primary purpose of this strategy is to strengthen the country's resilience to the impacts of climate change, key pillars including the following: climate risk and vulnerability analysis, sectoral adaptation policies (such as energy, transport, or agriculture), presentation of the main evaluation tools, adaptive investment policies, integration of adaptation policies into wider policies and monitoring, review of adaptation policies (Ministry of Environment and Energy 2016).

The Climate Change Impacts Study Committee conducted a study in 2011 entitled The Environmental, Economic and Social Impacts of Climate Change in Greece. This document comprises five chapters, which addresses the following topics: the climatic characteristics of Greece; the risks and impacts of climate change by sector; the cost of climate change for Greece; the transition to a low-emissions economy; and findings and strategies for addressing climate change (Climate Change Impacts Study Committee 2011).

The National Energy and Climate Plan, which was announced at the end of 2019, defined its main objective as such: "The increased penetration of renewable energy sources (RES) and the improvement of energy efficiency through a broader policy approach for reducing greenhouse gas emissions, also taking into account such key parameters as energy security and achieving lower costs across the energy sector, are a key objective for Greece." (Ministry of Environment and Energy 2019, pp.6)

The long-term renovation strategy for Greece was introduced in 2021. The focus of the document is the building stock (like age, quantity, location, and energy consumption). To support the climate action initiatives the government has outlined plans to provide subsidies to the private individuals for upgrading buildings or units, or for implementing measures aimed at energy autonomy (European Parliament, 2021).

### Primary Energy Consumption

The Primary Energy Consumption in Greece indicator captures the total energy demands across various sectors within the domestic economy, including the industry, transportation, households, and other sectors. As demonstrated in Figure 91, Greece's primary energy consumption as a percentage of the total EU28 consumption remained modest, averaging around 1.6% between 2000 and 2019. This average proportion is analogous to the value of Hungary (averagely 1.5% between 2000 and 2019).

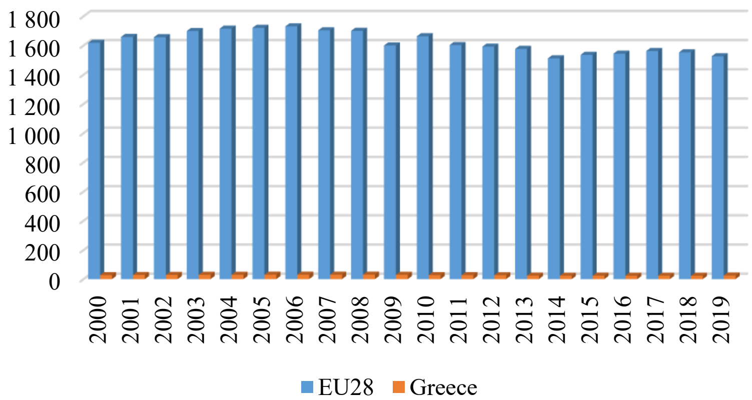



**Figure 91: Greece vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

The global financial crisis led to a shift in the trend of Greek primary energy consumption, which exhibited a gradual increase between 2000 and 2008. However, following the global financial crisis, the indicator demonstrated a decline until 2013. The economic crisis had influenced the household income, which in turn affected the energy consumption. Azam et al. (2016) examined the Greek energy demand 1975–2013 and realized that income trade, urbanisation, foreign direct investment and existing infrastructure were the main macroeconomic determinants of energy demand. In the subsequent five-year period (2014 - 2018), Greek primary energy consumption remained stable at 23 million tonnes of oil equivalent. However, in 2019, this figure increased by 8%.

The energy consumption of the Greek households fluctuated during the period under analysis, with the economic crisis having a discernible impact, as evidenced by Figure 91. The extant literature has also analysed the correlation between the economic crisis, income level, and the energy consumption of the household (Santamouris et al. 2013, Sardianou 2008). A further strand of investigation has sought to detect the factors that could influence the energy consumption (or specific components thereof, like electricity consumption or heating) among households. This research has highlighted the importance of the socio-demographic and economic parameters (Kostakis 2020, Tyralis et al. 2017, Sardianou 2008, Assimakopoulos and Domenikos, 1991).

### Share of Fossil Fuels in Gross Available Energy

The absolute value of the Greek fossil fuel consumption decreased by 72 terawatt-hours, may appear insignificant; however, it represented a 21% decrease between 2010 and 2019 (Ritchie and Roser 2020b). As demonstrated in Figure 92, the share of fossil fuels in Greek gross available energy was higher than the percentage of the EU28. However, the ratio exhibited a decreasing tendency during the specific period.

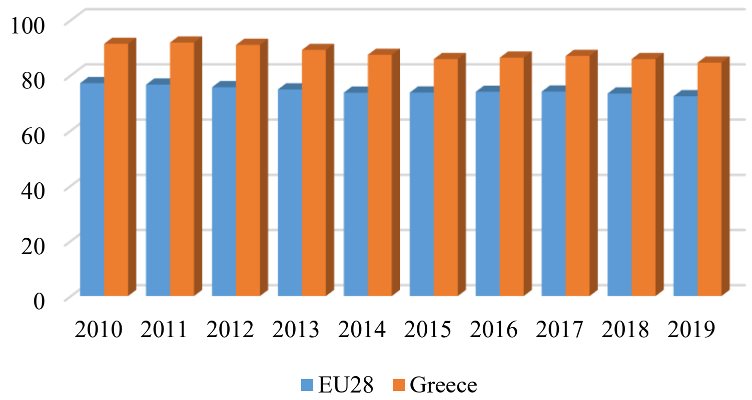



**Figure 92: Greece vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

The fossil fuels came from oil (177 terawatt-hours), coal (60 terawatt-hours), and gas (52 terawatt-hours) in 2019. The rank was consistent across the period under analysis (Ritchie and Roser 2020b). However, it was observed that the amount of the gas consumption began to approach that of coal. Greece has announced its intention to phase out the coal power by 2025 (Our World in Data 2021).

Based on the dataset of the Our World in Data, the main source of energy consumption is the oil in Greece, which was accounting for 58.99% of the total in 2019 (Ritchie and Roser 2020a). A decline in the proportion was observed between 2000 and 2013, with a nadir of 52.47% in 2013. However, following 2014, a marked upward trend was evident. An interesting finding is the persistent increase in the share of gas, despite it not being the main energy source in Greece, its proportion continuously increased between 1997 and 2019 (Ritchie and Roser 2020a).

### Greenhouse Gas Emissions by Capita

In Greece, a stable decreasing tendency could be realized between 2010 and 2019 based on the Figure 93. The most significant decrease (8%) in the Greek greenhouse gas emission occurred in 2013. The reduction – between 2008 and 2016 – was primarily attributed to the economic recession and the effect of mitigation efforts (Ministry of Environment and Energy 2020).

In Greece, the sector with the highest carbon dioxide emissions is electricity generation, due to the combustion of lignite (Ministry of Environment and Energy 2016). Therefore, instead of lignite, the use of renewable resources is more favourable, which appeared in the National Energy and Climate Plan of the country as a goal. According to the report by the European Parliament, the energy sector experienced a nearly 45 % decrease in emissions between 2005 and 2019 (European Parliament 2021).

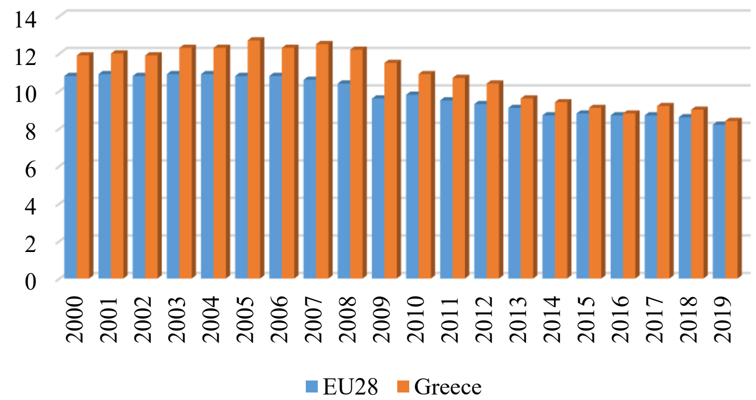



**Figure 93: Greece vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

The most significant reduction was observed in the manufacturing industries and construction sector. However, these two sectors contributed only 5% of the total national emissions in 2019 (European Parliament 2021). The concerning trend is that the sector with the second highest emission (transportation) between 2005 and 2019 performed one of the lowest reductions (21%) in Greece (European Parliament 2021).

The expected greenhouse gas emissions in Greece are estimated to be 60.6 $MtCO_2e$ in 2030, representing a 32% reduction compared to 2019 levels. To achieve this target, the Greek NECP has determined various strategies, with the energy sector expected to play a pivotal role in reducing diesel-fired plants, decommissioning lignite-fired power plants, and establishing interconnection between autonomous island systems. Moreover, the NECP emphasised the promotion of renewable energy sources, such as the enhancing the energy efficiency of buildings, industry, and infrastructure, and reducing emissions in transportation (European Parliament 2021, IEA 2022).

The transport sector is susceptible to challenges in relation to emission targets. For instance, the average emissions of new passenger cars followed an increasing tendency between 2016 and 2019 (the most recent year for which data is available) based on the report by the European Parliament (European Parliament 2021). In addition to the NECP, the Greek government introduced the draft version of climate law in 2021 with the objective of promoting the reduction of greenhouse gas emissions. The transportation sector was assigned the following deadlines (Greekreporter 2021):

- By 2025, new taxis should have zero emissions in the capital city (Athens) and the second-biggest city (Thessaloniki).
- From 2030 on, the sale of new cars with internal combustion engines is banned.

### Share of Energy from Renewable Sources

As Figure 94 shows, the share of energy derived from renewable sources in Greece almost reached the EU average and preceded it from 2018 onwards. In 2019, wind power dominated the renewable energy generation, accounting for 19.8% of the total renewable energy, but hydropower (14%) and solar energy (12%). However, it is noteworthy that these three predominant renewable sources collectively contributed a mere 9.1% of the total energy in 2019 (European Parliament 2021).

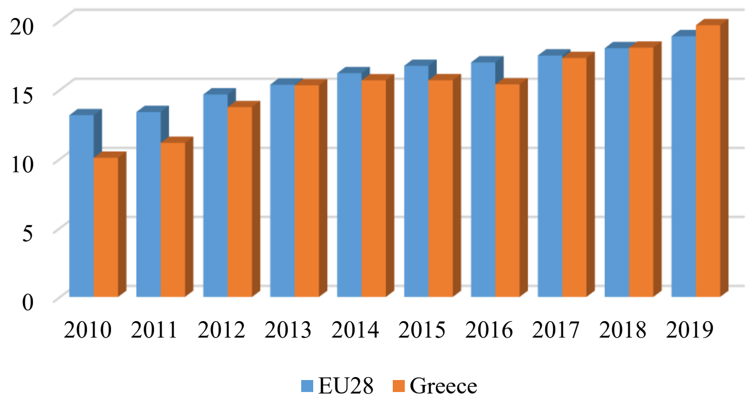



**Figure 94: Greece vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

As illustrated in Figure 94, Greece's share of energy from renewable sources should increase from 19.7% in 2019 to 35% by 2030 (European Parliament 2021). This target is to be achieved through the implementation of various projects related to solar photovoltaic parks and stations, as well as wind power investments, which were approved by the Greek government at the end of 2020 (European Parliament 2021). Concurrently, the draft version of climate law in Greece introduced that by 2030 the target is that the ratio of renewable energy sources in final energy consumption approximates the 70% (Greekreporter 2021).

**Composite Indicators**

**Environmental Performance Index**

Figure 95 presents the score of Greece based on EPI, which prioritises on environmental health and ecosystem vitality, was 69.1, placing the nation 25th among 180 countries. Notably, within Eastern Europe, Greece ranked 3rd, surpassed only by Slovenia and the Czech Republic (Wendling et al. 2020).

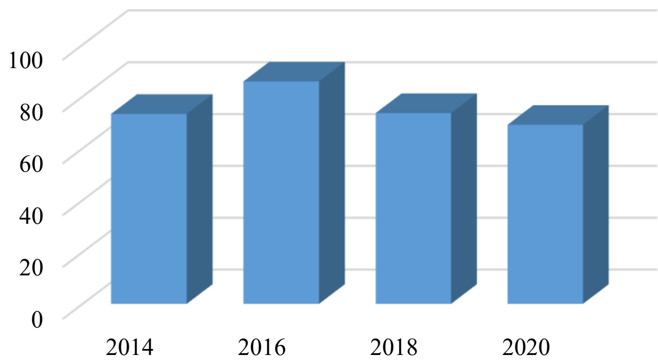



**Figure 95: Greece – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022a)

The report emphasises that the water quality is outstanding in some European states despite their less developed economic status. Greece has invested significantly in monitoring its water supply upgrading its water and sanitation services (Wendling et al. 2020). As a result, Greece has achieved 1st place in the water drinking category, closely followed by the Terrestrial biomes (based on EPI 2022b).

The EPI includes 32 indicators. Among them, the weakest position of Greece is in the Biodiversity Habitat Index (170th), GHG intensity trend (148th), and the GHG per capita (138th) indicators (based on EPI 2022b).

## Ecological Footprint per Person

The Ecological Footprint per Person in Greece exhibited an upward trend until 2007, at which point it reached its peak of 6.3 global hectares. However, following this, the country experienced a substantial decrease in the value of the given indicator; however, the rate of change has slowed significantly from 2013 (National Footprint and Biocapacity Accounts 2022), as the Figure 96 presents it.

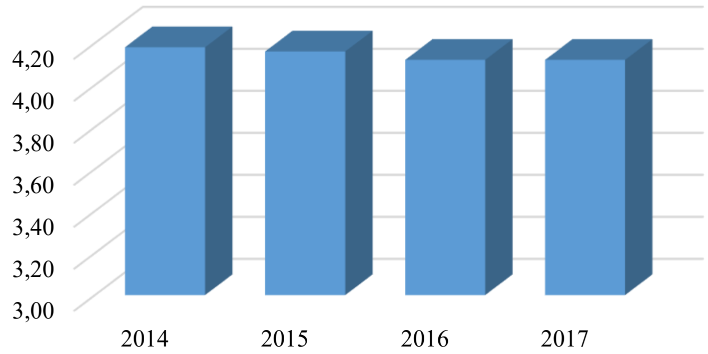



**Figure 96: Greece – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

In Greece, the two principal components of the given indicator are the Carbon and the Cropland, yet these two categories changes in the opposite direction, with Carbon increasing gradually between 2014 and 2017, and Cropland continuously decreasing.
In 2017, the Ecological Footprint per Person in Greece was 4.12 global hectares. This indicates that the country is experiencing a biocapacity deficit of 2.4 global hectares. These values are comparable to the results observed in the mid-1980s (National Footprint and Biocapacity Accounts, 2022).

## Climate Change Performance Index

The CCPI index is divided into 5 categories, namely very high, high, medium, low, and very low, on the basis of the climate change performance of the countries analysed. In 2014, the initial classification was the very low category in 2014; however, the next year saw its results falling into the low or the medium categories.

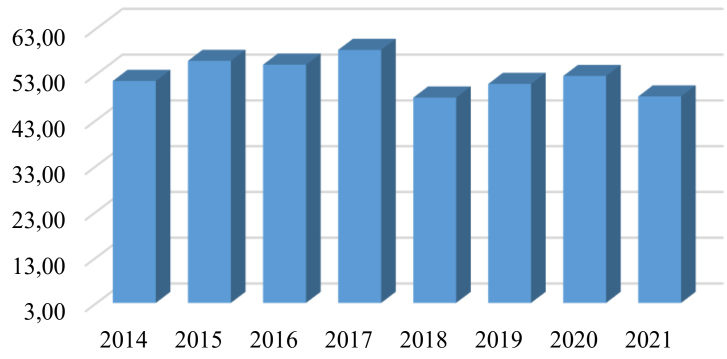



**Figure 97: Greece vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

In 2021, the strongest evaluation was in the Energy Use category (rank 18). The Greenhouse Gas Emission and the Climate Policy categories received low ratings. The weakest performance of the country was in the Greenhouse Gas Emission category, which accounted for the 40% of the total score. The weights allocated to the other 3 categories are 20% each. The experts of the CCPI index recommend that the country formulate a plan of actions for fossil fuel subsidies, the augmentation of financing for climate protection projects, and the enhancement of energy efficiency targets (CCPI 2022).

**Good Practices**

- Voluntary programmes for individuals over the age of 18. These encompass a variety of activities, such as after the care of wildcats, the support of eco-communities, marine ecosystems, and permaculture, an experimental ecological fruit and vegetable farm. (https://www.volunteeringsolutions.com/greece/wildlife-environment-protection-greece)
- Astypalaia, the smart island - Thanks to Greece and the Volkswagen Group, the island has become a climate-neutral model. The overarching framework of the project is predicated on four pillars: vehicle electrification, smart mobility, charging and energy, and autonomous driving. This collaboration signifies a ground-breaking milestone in the broader efforts to decarbonize the Greek economy. Energy is primarily produced from green energy sources on the island, and there is an expressed intention to create more green jobs in the future. (https://hu.euronews.com/2021/06/02/okosszigetet-adtak-at-gorogorszagban-a-volkswagen-tamogatasaval, https://smartastypalea.gov.gr/).
- The draft of the First Climate Law in Greece was announced in 2021. The regulation plans the closure of all lignite facilities by 2028 and it determines the road to neutrality

by 2050 (https://wwfeu.awsassets.panda.org/downloads/explanatory_report_climatelaw_2021_el.pdf).

- The TUI Group, the TUI Care Foundation, and the Government of the Southern Aegean Region are collaborating to achieved objective of transforming Rhodes into a sustainable tourist destination (https://www.tuigroup.com/en-en/media/press-releases/2022/2022-01-20-tui-and-greece-launch-futures-lab-for-sustainable-tourism). Green tourism in Rhodes - Rhodes is set to become the world's first sustainable tourist destination. In cooperation with the international tourism company TUI, the island has established a 'Co-Lab' with the objective of preserving biodiversity and resources. The initiative also places emphasis on electric mobility and environmental awareness. (https://utazasielmenyek.hu/utazasi-magazin-hirek/erdekessegek/1616-rodosz-zold-turisztikai-celpontta-valik , https://www.euronews.com/travel/2022/01/24/a-sustainable -tourism-lab-is-transforming-the-island-of-rhodes-in-greece)

- Sustainable Greece 2020: "Initiative aims, through a systematic and extended dialogue, to create a development model that promotes competitiveness and openness of entrepreneurship in order to promote a Sustainable Economy" (https://www.sustainablegreece2020.com/en/sustainable-greece-initiative/initiative.123.html). Its website highlights the sustainability ambassador, sustainable company, and most sustainable company in Greece as well (https://www.sustainablegreece2020.com/home).
- The "Adopt your city" programme, which was initiated in Athens, aims to enhance the capital city's cleanliness, environmental sustainability collaborative spirit among its residents, the businesses and the public sector entities (https://adoptathens.gr/en/). A notable initiative under this programme is the establishment of pocket parks, which are small-scale green spaces are often situated in densely populated or abandoned areas. These elements contribute to environmental protection, stress relief and alleviation of feelings of isolation (https://adoptathens.gr/en/thematic-area/prasino-parka-tsepis/, https://www.greeknewsagenda.gr/topics/culture-society/7486-pocket-parks).
- **Halki Project** - Under an agreement between the Greek Ministry of Environment and Energy and private companies, the island of Halki in the Aegean Sea will be greened. The plan, known as the Halki project, aims to replace diesel-based energy production

on the tiny island and supply it with green energy. The small island is not connected to the mainland, but according to the contract signed in Athens, a 1 MW solar power plant will be established and generate electricity for Halki. (https://innovativnapelem.hu/hir-kulonallo-gorog-sziget-megujulo-energiaval-2021-07-09-711207.fb.html) The GR-Eco Island plan is a key driver in the transition of Halki and other small Aegean islands to a sustainable energy model. The green transformation of Halki is characterised by the utilisation of renewable energy sources, such as the 1 MW photovoltaic park, the donation of e-vehicles, and the enhancement of the telecommunication network by Vodafone Greece (https://www.greece-is.com/news/halki-become-greeces-next-green-island/).

- LIFE integrated environmental protection programme - A significant percentage of municipal waste still ends up in landfills in Greece. The LIFE programme, therefore aims to reduce this and also seeks to prevent waste from being generated and to facilitate the recycling of waste materials. (https://mfk.gov.hu/hulladekkezeles-gorogorszagban-a-korkoros-gazdasag-kialakitasa-celjabol-life-ip-cei-greece-life-integralt-kornyezetvedelmi-pro.html)

**References**


- Assimakopoulos, V. and Domenikos, H.G. (1991): Consumption preferences structure of Greek households. Energy Economics, 13(3), 163–167.
- Azam, M., Khan, A.Q., Zafeiriou, E., Arabatzis, G., 2016. Socio-economic determinants of energy consumption: an empirical survey for Greece. Renewable and Sustainable Energy Reviews, 57(May), 1556–1567.
- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- CCPI (2022): Greece. Link: https://ccpi.org/country/GRC/. Downloaded: 25.05.2022.
- Climate Adapt (2021): Greece. Link: https://climate-adapt.eea.europa.eu/countries-regions/countries/greece. Download: 20.05.2022.
- Climate Change Impacts Study Committee (2011): The Environmental, Economic and Social Impacts of Climate Change. Link: https://www.bankofgreece.gr/Publications/ClimateChange_FullReport_bm.pdf
- Climate Change Knowledge Portal (2022): Greece. Link: https://climateknowledgeportal.worldbank.org/country/greece. Downloaded: 01.06.2022.
- EPI, Environmental Performance Index (2022a): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- EPI, Environmental Performance Index (2022b): Greece. Link https://epi.yale.edu/epi-results/2020/country/grc. Downloaded: 26.05.2022.
- European Parliament (2021): Climate action in Greece. Latest state of play. Link: https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2021)690685.

- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- Eurostat (2022e): Unemployment by sex and age – monthly data. Link: https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_M__custom_2846741/default/table?lang=en. Downloaded: 02.06.2022.
- Eurostat (2022f): Government finance statistics. Link: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_finance_statistics#Government_debt. Downloaded: 02.06.2022.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Greekreporter (2021): Greece Brings Sweeping Changes in New Climate Law. Link: https://greekreporter.com/2021/11/15/greece-sweeping-changes-new-climate-law/.
- IEA (2022): Greek National Energy and Climate Plan. Link: https://www.iea.org/policies/12750-greek-national-energy-and-climate-plan.
- Kostakis, I. (2020): Socio-demographic determinants of household electricity consumption: evidence from Greece using quantile regression analysis. Current Research in Environmental Sustainability, 1(January), 23–30.
- Ministry of Environment and Energy (2016): National Strategy for Adaptation to Climate Change (ΕΘΝΙΚΗ ΣΤΡΑΤΗΓΙΚΗ ΓΙΑ ΤΗΝ ΠΡΟΣΑΡΜΟΓΗ ΣΤΗΝ ΚΛΙΜΑΤΙΚΗ ΑΛΛΑΓΗ). Link: https://ypen.gov.gr/wp-content/uploads/legacy/Files/Klimatiki%20Allagi/Prosarmogi/20160406_ESPKA_teliko.pdf
- Ministry of Environment and Energy (2019): National Energy and Climate Plan. Link https://energy.ec.europa.eu/system/files/2019-03/ec_courtesy_translation_el_necp_0.pdf.

- Ministry of Environment and Energy (2020): Fourth Biennial Report under the United Nations Framework Convention on Climate Change. Link: https://unfccc.int/sites/default/files/resource/BR4_Greece.pdf.
- National Footprint and Biocapacity Accounts (2022): EcologicaL Footprint per Person. Link: https://data.footprintnetwork.org/#/??_ga=2.4934325.764780885.1653572487-1885991649.1653572487. Downloaded: 26.05.2022.
- Reinhart, C. M., and Rogoff, K. S. (2010): Growth in a time of debt. American Economic Review, 100(2), 573–578.
- Ritchie, H. and Roser, M (2020a): Energy. Link: https://ourworldindata.org/energy/country/greece. Downloaded: 11.01.2022.
- Ritchie, H. and Roser, M (2020b): Fossil Fuels. Link: https://ourworldindata.org/fossil-fuels. Downloaded: 14.01.2022.
- Ritchie, H. and Roser, M. (2020c): Renewable Energy. Link: https://ourworldindata.org/renewable-energy. Downloaded: 14.01.2022.
- Santamouris, M., Paravantis, J.A., Founda, D., Kolokotsa, D., Michalakakou, P., Papadopoulos, A.M., Kontoulis, N., Tzavali, A., Stigka, E.K., Ioannidis, Z., and Mehilli, A. (2013): Financial crisis and energy consumption: a household survey in Greece. Energy and Buildings, 65(October), 477–487.
- Sardianou, E. (2008): Estimating space heating determinants: an analysis of Greek households. Energy and Buildings, 40(6), 1084–1093.
- Tyralis, H., Mamassis, N., and Photis, Y.N. (2017): Spatial analysis of the electrical energy demand in Greece. Energy Policy, 102(March), 340–352.
- Wendling, Z. A., Emerson, J. W., de Sherbinin, A., and Esty, D. C., et al. (2020): 2020 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy. Link: https://epi.yale.edu/downloads/epi2020report20210112.pdf.

## 4.13. HUNGARY

According to statistics from the Hungarian Central Statistical Office (KSH), the population of Hungary is projected to reach 9.73 million inhabitants in 2021. This population is distributed across a total of 3155 settlements, including 346 towns and 2809 villages. It is noteworthy that approximately one-third of these settlement has fewer than 500 inhabitants, although, only 3% of the total population resides in these small communities. Around 17.9% of the population, 1.75 million inhabitants, live in Budapest. Hungary's capital is a prime city and is much larger than the second largest city, Debrecen (201 432 inhabitants in 2019). Meanwhile, Szeged, Miskolc and Pécs all had more than 150 000 inhabitants in 2019. According to the 2011 census, the urbanisation rate was 69.5%, and in terms of vulnerability, urban areas are among those most affected by climate change (e.g. heat waves, urban heat islands) (Climate Adapt, 2022c).

Hungary is experiencing an ageing population, with an increasing proportion of the society aged 65 and over, which renders the nation more exposed to the negative effects of climate change (e.g. heat waves, cold waves). Projections indicate that the life expectancy for men will be 72.9 years, while for women it is expected to be 76.2 years in 2020. Notably, there exist pronounced disparities in life expectancy between the more developed districts in the western counties and the less developed peripheries in the north-eastern and south-eastern regions (Climate Adapt, 2022c).

Significant regional differences in income (along with other general socio-economic indicators) also exert an influence on adaptability. Within the country these variations can be partially attributed to geographical factors. Regions in Northern Hungary and Southern Transdanubia characteristically exhibit suboptimal socio-economic indicators in comparison to Central and Western Hungary. However, distance from regional cities and Budapest is also a salient factor. Socio-economic disadvantage is commonly linked to diminished adaptability (Climate Adapt, 2022c).

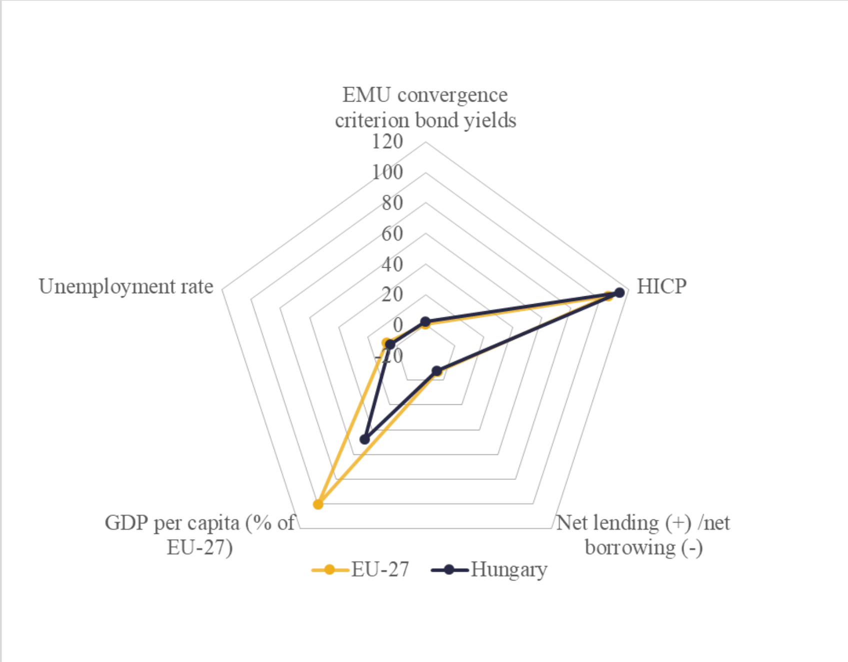



**Figure 98: Hungary vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

Figure 98 shows significant deviations from the EU-27 average for most of the selected economic indicators. The Maastricht criterion interest rates are approximately 7 times the EU average, and GDP per capita is only half the EU average. The unemployment rate is almost 3 percentage points lower than the EU average, and government expenditure exceeds government revenue by a larger margin than in EU countries. The harmonised index of consumer prices is 7% above the EU average.

**Climate Strategy**

Climate change cannot be considered in isolation from social, economic and environmental policies; rather, it must be addressed in accordance with sustainable development principles. Adaptation strategies must take into account the varying levels of economic development across different regions of the country, a factor which is linked intrinsically linked to the uneven distribution of economic and infrastructure facilities. To assess the economic and infrastructural situation, it is necessary to examine several relevant sectors (Ministry of Innovation and Technology, 2018).

Agriculture is one of the most vulnerable sectors to climate change in Hungary. The increased likelihood of droughts represents the most significant challenge facing the agriculture sector, a hypothesis that is underpinned by the high volume and variety of risks identified. These include the increased likelihood of floods and groundwater flooding, flood-like rainfall, mudslides, landslides and soil erosion. Shifts in wind patterns suggest that windstorms and wind erosion could also cause an issue. Early and late frosts and frost damage could also pose a threat to food supplies. In addition, forest fires, wildfires and grass fires can also be dangerous, especially during periods of drought. The emergence of new pathogens, pests and weeds; the increasing threat of certain pests are native to Hungary, but hitherto of minor importance, will affect yield losses. The spatial distribution of these threats is introduced by NAGiS. Furthermore, infrastructure and utility security, industrial security and ecological security are essential for adaptation (Innovációs és Technológiai Minisztérium, 2018).

Metropolitan areas such as Budapest are particularly vulnerable to climate change, with urban heat islands making cities more vulnerable to heat waves, which is anticipated to have negative consequences for human health. Asphalt damage is also expected to become more frequent in the summer months and the expected increase in wind speeds and frequency of windstorms will pose a direct physical threat to urban infrastructure and people. Increased frequency of sudden, heavy rainfall is forecasted across the country. The two most dominant changes, warming and more frequent and intense extremes are expected to affect cities and villages in many ways. Increasing frequency of floods and storms also threatens surface transport infrastructure and underground transport in lower parts of cities, floodplains and along watercourses. For flood protection, embankments, bunds and subsoil flow can damage infrastructure and sudden rainfall can sometimes lead to landslides. Furthermore prolonged periods of drought can lead to subsidence, thereby impairing the stability of these structures. The damaging effects of flooding, extreme rainfall and wind speeds, also render tall buildings highly vulnerable to extreme daily and annual temperature fluctuations and frequent changes in freezing/thawing (Faragó et al., 2010).

Increases in risk have been identified in energy transmission systems and utility services. The expanding frequency of storms accompanied by strong wind gusts has the potential to severely damage linear elements of electrical infrastructure networks. Changes in energy demand, due to climate change, may also pose challenges for energy suppliers. Tourism, as an important economic sector, is highly exposed to the effects of climate change because of its strong dependence on geographical and climatic conditions. On the one hand, climatic elements are a valuable resource for the sector. On the other hand, climate change is anticipated to exert a substantial influence on outdoor activities, including cultural heritage tourism, active tourism, coastal tourism and city tourism (Climate Adapt, 2022c).

The second National Climate Change Strategy for 2018-2030, which also looks ahead to 2050 (hereafter: NES-2), was developed with the public policy objective of creating a national climate change strategy that sets out the objectives that will address the impacts of climate change in the long term. This can be achieved in two ways. In accordance with international commitments, it is imperative to reduce greenhouse gas emissions and, in the national interest, augment carbon dioxide absorption capacity (Ministry of Innovation and Technology, 2018).

### Climate change

Hungary situated in the heart of the Carpathian Basin, covering 93.036 km$^2$. The country's topography, characterised by plains surrounded by mountains, renders it particularly susceptible to the negative effects of climate change. Most of the nation's territory, specifically 84%, lies below an altitude of 200 metres, while a mere 2% of the country exceeds 400 metres in height. The area is part of the Danube River basin (417km). Hungary is strongly affected by the fact that 95% of its surface water originates from neighbouring countries, resulting in extensive floodplains cover 25% of the territory. Lake Balaton, the largest lake in Central Europe, is also located in Hungary. Some other large and shallow lakes, such as Lake Fertő and Lake Velence, are also particularly vulnerable to the effects of climate change. The country's forest cover was 20.8% in 2019 (Hunkár Zemankovics, 2012).

The Pannonian biogeographical region constitutes a substantial portion of the Carpathian Basin, exhibiting a unique flora and fauna due to its isolation from other geographical regions. This region is distinguished by the presence of numerous endemic and relict endemic species, many of these species are not found anywhere else in the world. The identification of 42.000 animal species and 3.000 plant species within the region highlights the biodiversity of the area. Hungary's climate is categorised as temperate with a strong continental influence. According to long-term statistics from the National Meteorological Service (NMS) and data from the National Adaptation Geospatial Information System, the average annual mean temperature in the region rose by 1.23°C between 1901 and 2018. This increase is much higher than the global estimate of 0.9 C° C° annual mean temperature. Today, the average annual mean temperature in Hungary is 10.3 C°. Deviations from this temperature are typical only in small areas where they are determined by topographical factors (Climate Adapt, 2022c).

The average annual precipitation is 590mm, based on the 1981-2010 normal period. Even the dispersion of precipitation shows a truly variable pattern in space and time. In terms of seasons, the average precipitation is 140mm in spring, 200mm in summer, 145mm in autumn and 110mm in winter. The spatial distribution of precipitation is determined by two main factors: distance to the sea, in particular the Mediterranean Sea, and topography. In some areas of the driest sub-regions of the Hungarian Great Plain, annual precipitation is below 500mm, while extensive areas exhibit average multiannual precipitation of 500-550mm. Precipitation levels of up to 800mm, are observed in isolated regions near the peaks of the Mátra and Bükk mountains, as well as the Kőszeg mountains. No discernible trend in annual rainfall has been identified over half a century. However, there has been a consistent increase in the intensity of precipitation events, characterised by an increase in precipitation and a decrease in the number of days with precipitation. Over the past fifty years, the series indicates a slight, albeit non-significant, increase of approximately 5% compared to the national average between 1961 and 2018 (Climate Adapt, 2022c).

Hungary's emissions of around 6 tonnes per capita are lower than the European average of over 8 tonnes per capita, largely due to lower per capita energy consumption and the dominance of carbon neutral nuclear power and natural gas in power generation with relatively lower specific GHG emissions. It is important to note that the majority of GHG emissions are linked to the energy production and use of energy, including electricity generation, heating and cooling, and transport fuel use (Innovációs és Technológiai Minisztérium, 2018).

Decarbonisation vision: 'Towards sustainable development' Hungary is gradual transition towards a low-carbon economy, with consideration for economic competitiveness and growth, social welfare and poverty reduction, as well as climate protection. The right choice of climate policies and sufficiently ambitious emission reduction targets will also have a positive impact on the country's competitiveness, especially in the long term. The primary driver for the transition is not the desire to comply with international obligations, but to achieve national strategic goals for sustainable development, in particular to reduce dependence on fossil fuels, to promote the uptake of material and energy efficient technologies and to adopt the use of renewable energy sources. The total energy consumption of the EU and Hungary is illustrated in Figures 99 and 100. The data demonstrate that total energy demand in the EU has decreased by an average of 1% per year over 20 years (Huszár, 2018).

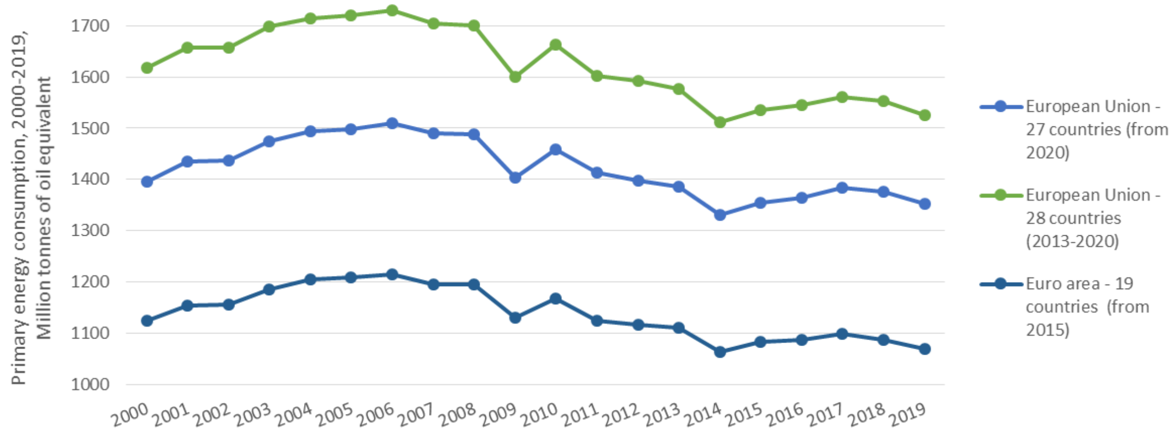



**Figure 99:** **Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

In the case of Hungary, however, the average rate of change does not follow this trend and shows stagnation or even a slight increase over the same period.

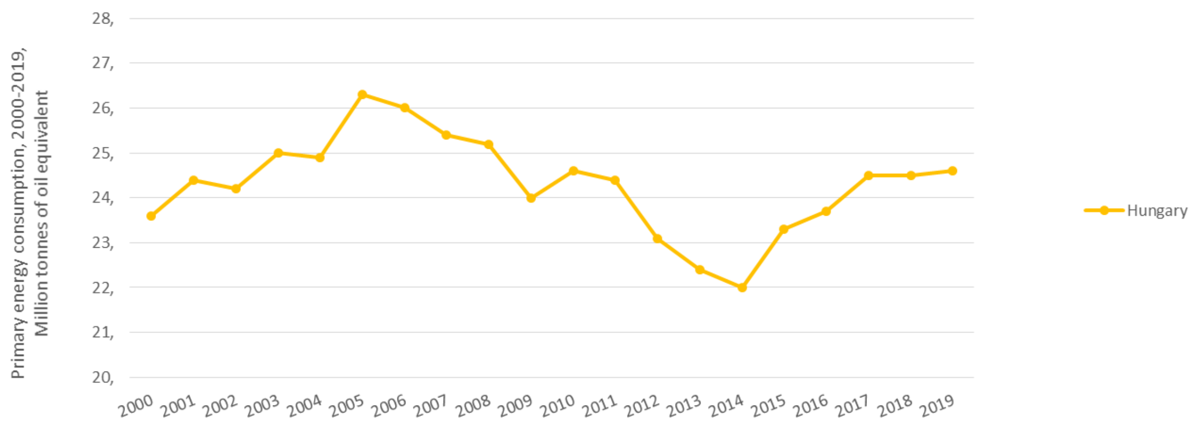



**Figure 100:** **Hungary vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

The greenhouse effect is a natural process; in the absence of this phenomenon the average global temperature would be 33°C lower than today. Greenhouse gases are gases that absorb some of the infrared radiation from the Earth's surface towards space and then partially re-radiate the absorbed energy back towards the surface, leading to an overall warming of the lower atmosphere. The most significant natural greenhouse gases are water vapour ($H_2O$), carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$). Water vapour is the largest contributor to the greenhouse effect, but its atmospheric residence time is very short, around 10 days. The quantity is mainly determined by natural processes and the temperature of the atmosphere. In contrast, the other three gases have relatively long atmospheric lifetimes (10-

200 years) and their atmospheric concentrations and rates of entry and exit are strongly influenced by human activities. Hungary is in a favourable position in the European Union in terms of greenhouse gas emissions. Hungary's greenhouse gas emissions in 2016 were 61.5 million tonnes of $CO_2$ equivalent. If we also take into account the carbon dioxide absorbed by our forests, our (net) emissions decrease to 57.2 million tonnes $CO_2$ equivalent (Ministry of Innovation and Technology, 2018).

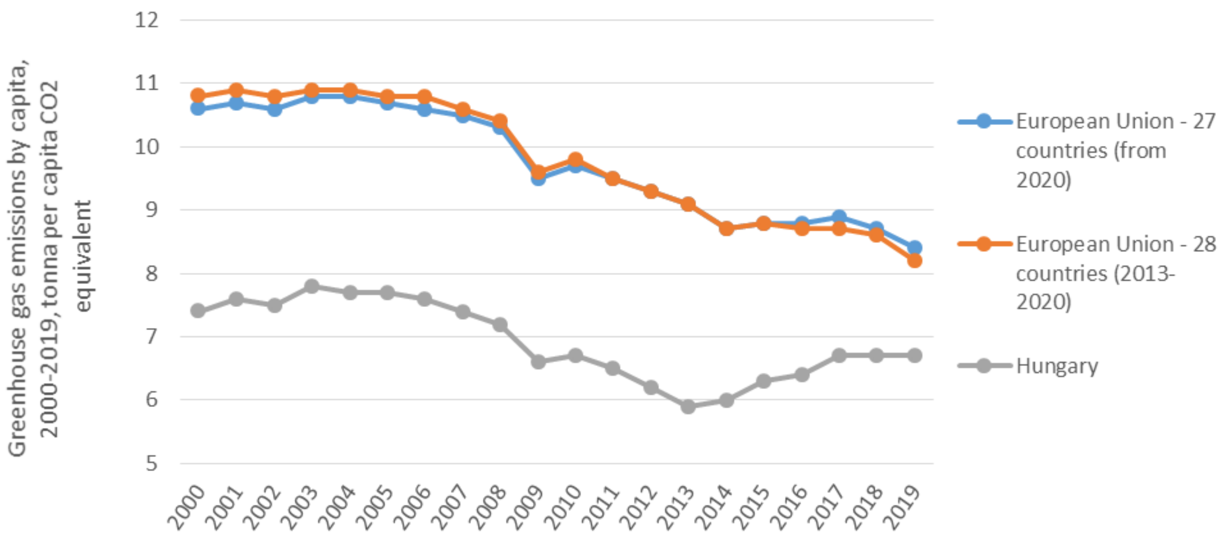



**Figure 101: Hungary vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

Greenhouse gas emissions in Hungary fluctuate between 2000 and 2019, however the average rate of change over the whole period shows a stagnating trend (Figure 101).

The fuel structure change in the 1990s, resulted in solid fuels, which had previously been the primary source, being replaced by natural gas, which has lower specific carbon dioxide emissions. Natural gas is now one of the most important energy carriers in Hungary, accounting for more than 30% of final consumption. A good example is household consumption of natural gas, which experienced a 42% between 2005 and 2014. Agriculture, the second largest emitter of greenhouse gas in Hungary, accounted for 11% of Hungary's greenhouse gas emissions in 2016. The proportion of fossil fuels is shown in Figure 102.

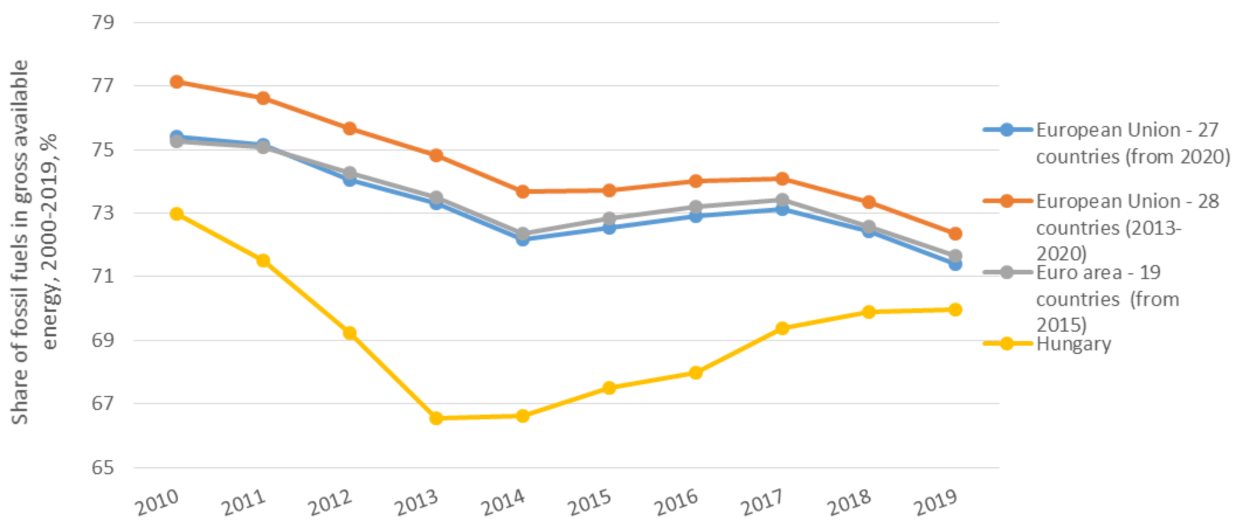



**Figure 102: Hungary vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

As demonstrated in Figure 102, there has been an increase in the share of fossil fuels in Hungary after 2014, which is analogous to the EU as a whole. However, it is evident that, for the entire period, there has been a decline in Hungary, although to a lesser extent than the EU average.

The implementation of these measures will contribute to international climate cooperation, a strategy that, if executed successfully, will contribute to a long-term reduction in atmospheric concentrations of greenhouse gases, thereby leading to a further reduction in the rate of increase in global atmospheric temperatures. In addition to reducing $CO_2$ emissions and augmenting absorption capacity, an objective assessment of the impact on the country's territory is needed. The effects and consequences of biodiversity loss, the worsening of floods and droughts, the destruction of arable land, water and air pollution, the spread of invasive alien species and pests, the increase in environmentally-induced diseases and their consequences, together with climate change, form a complex set of problems that can only be effectively addressed by coordinated, long-term approaches. The NÉS-2 set of objectives and instruments, in alignment with other sectoral and horizontal strategies, will facilitate a focused utilisation and monitoring of EU and national financial resources for climate protection (Faragó et al., 2010).

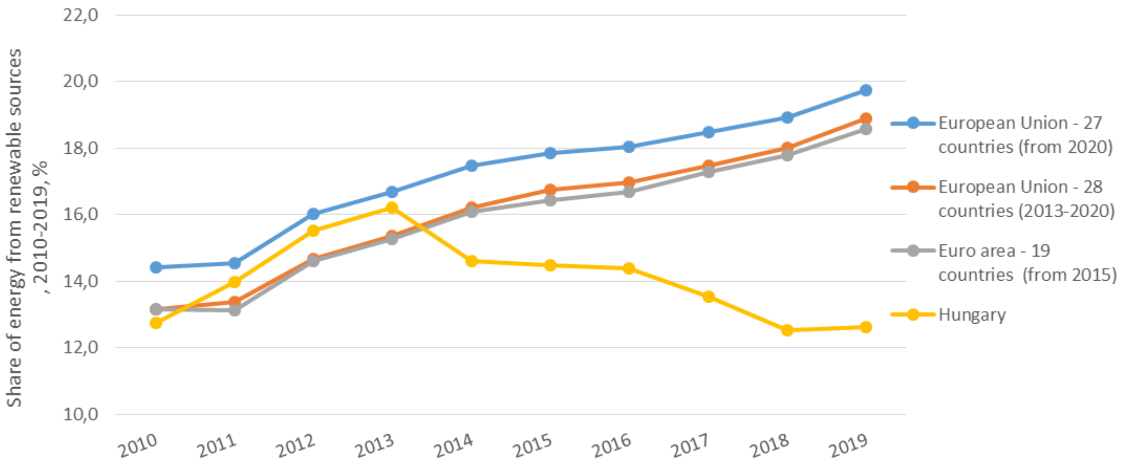



**Figure 103:** **Hungary vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

In terms of renewable energy sources, Hungary still has a lot of work to do (Figure 103). Following a period of growth that extended until 2013, these resources have displayed a downward trend, indicating that the average annual rate of change in Hungary since 2010 is negative.

## Composite Indicators

The Environmental Performance Index (EPI) provides a summary of the state of sustainability around the world, including the status of Hungary. The EPI employs 32 performance indicators across 11 categories of questions to assess environmental health and ecosystem vitality of 180 countries.

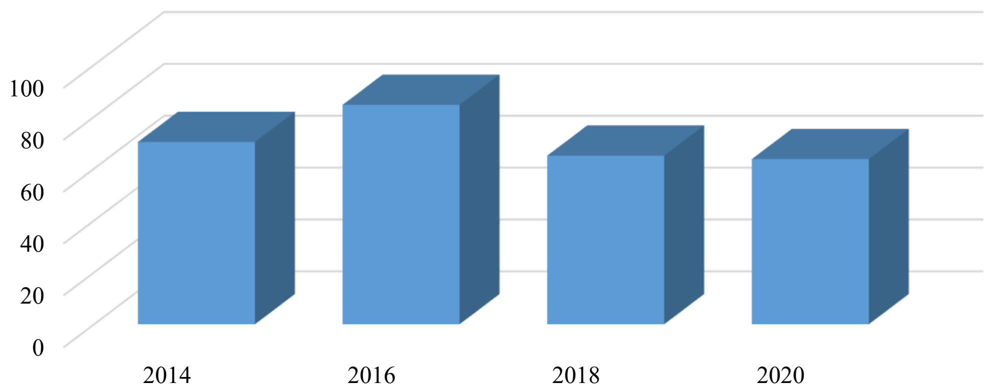



**Figure 104:** **Hungary – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

These indicators demonstrate the extent to which countries are to achieving their environmental policy goals at the national level. Hungary's Environmental Performance Index (EPI) scores from 2014 to 2020 are presented in Figure 104. Regarding the EPI, Hungary consistently occupied a position in the lower echelons of the ranking, with its results generally falling short of the EU-27 average. A notable exception was observed in 2016, when Hungary's score surpassed the average. The nation's ranks and scores were the following in the EPI:

- 2014: 18. with 70.28 points (EU-27 average: 72.17)
- 2016: 19. with 84.60 points (EU-27 average: 82.91)
- 2018: 24. with 65.01 points (EU-27 average: 73.33)
- 2020: 23. with 63.70 points. (EU-27 average: 70,95)

The Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Hungary's ecological footprint per person from 2014 to 2020 can be seen in Figure 105. The country performs poorly regarding the ecological footprint, with scores consistently below the EU-25 average.

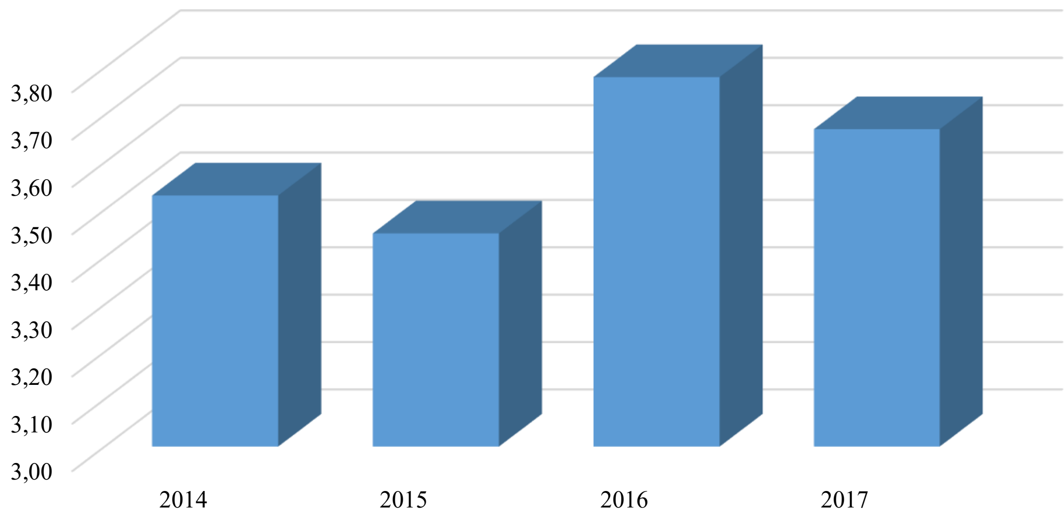



**Figure 105: Hungary – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

The nation's ecological footprint per person was the following comparing with the EU-25 average (Malta and Cyprus are not scored):

- total score in 2014: 3.53 (EU-25 average: 5.23)
- total score in 2015: 3.45 (EU-25 average: 5.25)
- total score in 2016: 3.87 (EU-25 average: 5.26)
- total score in 2017: 3.67 (EU-25 average: 5.34)

Concerning the Climate Change Performance Index (CCPI) Hungary's performance is inconstant, which means that rank score varies. The scores of the CCPI for the country can be seen in Figure 106.

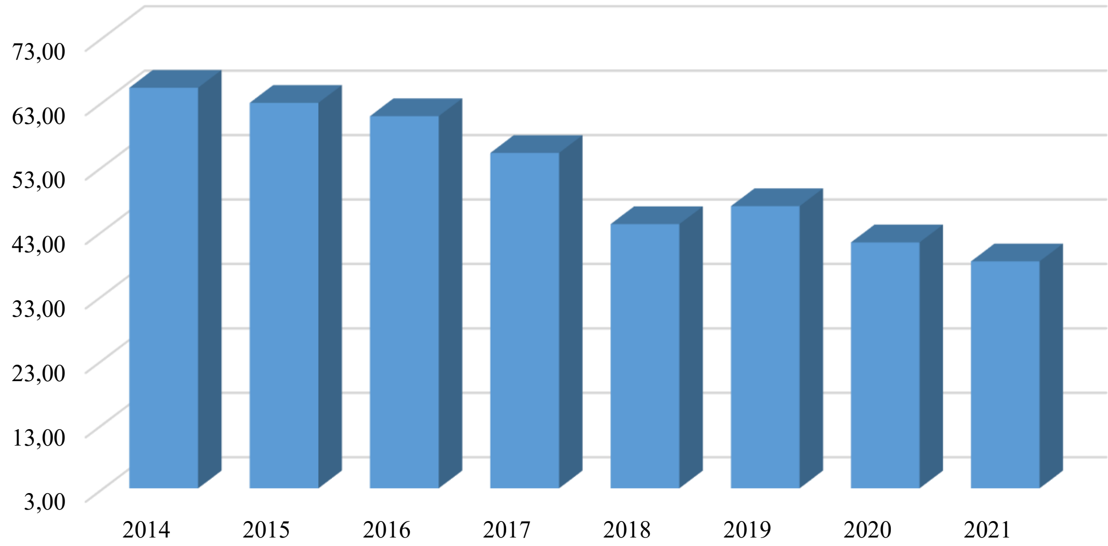



**Figure 106: Hungary vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Ranks and scores of the country were the following in the CCPI (among 61 countries):

- 2014: 11. with 65.17 points (global average: 55.72)
- 2015: 14. with 62.82 points (global average: 55.36)
- 2016: 17. with 60.76 points (global average: 54.15)
- 2017: 34. with 55.05 points (global average: 53.77)
- 2018: 44. with 44.00 points (global average: 49.09)
- 2019: 42. with 46.79 points (global average: 50.35)
- 2020: 47. with 41.17 points (global average: 48.61)
- 2021: 50. with 38.22 points (global average: 47.90)

Hungary's scores were primarily below the average in 2018, 2019, 2020 and 2021, while in 2014, 2015, 2016 and 2017 were above it.

**Summary**

In the coming decades, the structure of the Hungarian population is expected to change, with an increase in the proportion of elderly people in the total population, which may exacerbate the adverse health effects of heat waves. The over-65s are more vulnerable to heat waves and it is therefore appropriate to take into account their increasing proportion in the population when planning the capacity of the health care system in order to prepare for them. The principal health threats are therefore: a gradual and steady increase in average temperatures; more frequent periods of extreme heat; rapid and intense frontal movements; intermittent increases in UV-B radiation; and more frequent winter smog situations. Changes in environmental conditions can have a significant impact on the living conditions and income of rural populations, especially in vulnerable areas more exposed to drought. It can be assumed that in these areas the carrying capacity of the population will deteriorate and further out-migration and depopulation can be expected. Research by the Hungarian Academy of Sciences (MTA KRTK) estimates that most of Hungary's districts will experience a decline in population by 2050, reaching up to 50% in some districts (in the south-western part of Transdanubia and in north-eastern Hungary).

**Good Practices**

The National Adaptation Geospatial Information System (NAGiS) is a multi-purpose geospatial information system that has the capacity to facilitate the policy, strategy and decision-making processes related to climate change impact assessment and the establishment of the necessary adaptation measures in Hungary. NAGiS directly supports the implementation, monitoring and evaluation of the second National Climate Change Strategy and the implementation and evaluation of the Environment and Energy Operational Programme. Assess the system (structure, capacity) of electricity, gas and district heating transmission and distribution networks (transformer network, distribution network) in the light of the long-term impacts of climate change, with a view to guaranteeing security of supply. The project commenced in 2020 and is expected to be completed in 2022. The overarching objective of the LIFE-CLIMCOOP project is to develop, test and demonstrate collaborative measures between a city municipality and a multinational company in the selected region, namely Hungary and Central and Eastern Europe, with a view to reducing local climate risks and enhancing joint adaptation to climate change in vulnerable urban and industrial areas. The DEEPWATER-CE transnational cooperation project (funded by the Interreg CENTRAL EUROPE programme) started in 2019. The initiative, in cooperation with 5 Central European countries (Slovakia, Germany, Hungary, Poland and Croatia), aims to promote the use of managed aquifer recharge (MAR) and water storage technologies in Western and Southern Europe. The implementation of the project started in 2017 under the leadership of the Ministry of Interior (Municipal Coordination Office under the Municipal Secretariat) and its primary objective of the project is to raise awareness and knowledge on the impacts of climate change impacts and ecosystem-based natural water retention measures (NWRM). Hungary’s strategic ambition is to align its adaptation policies with those of the EU. The National Adaptation Strategy of Hungary, which was adopted by the National Assembly on 30 October 2018 as part of NCCS-2, took into account both the EU Adaptation Strategy and the Paris Agreement. Hungary is a member of the Carpathian Convention, which was adopted and signed by the seven Parties (Czech Republic, Hungary, Poland, Romania, Serbia, Slovakia, Ukraine) in May 2003 in Kiev (Ukraine) and entered into force in January 2006. It is the only multi-level governance mechanism encompassing the entire expanse of the Carpathian region and it is the second sub-regional treaty-based system globally, following the Alpine Convention, which is specifically focused on for the preservation and sustainable development of mountainous regions. The Convention has a dedicated working group on adaptation to climate change. The primary objective of this working group is to acknowledge the heightened vulnerability of fragile mountain ecosystems and to recognise the exposure of key economic sectors and mountainous communities to the adverse impacts of climate change.

The following are illustrative examples of initiatives::

- Csatári Plast Kft. solved the technological challenge that has made the cleaning of foil waste difficult and expensive for a long time. The company's innovative approach has not only facilitated the recycling of these foils at a reduced cost but also earned the company the prestigious Eco-Friendly Product Mark, due to the fact that at least 80% of the plastic in these products is recycled. The company's patent is about producing marketable secondary raw materials and plastic products without the need for film cleaning. (https://xn--krnyezetvdelem-jkb3r.hu/node/805)
- Nespresso initiated a campaign in Hungary that enabled the return of used capsules to Nespresso's headquarters in the country for recycling in exchange for a discount on subsequent purchases. The return of used capsules was facilitated free of charge, when the customer ordered a shipment of coffee capsules, the used capsules were taken by the courier. (https://www.nespresso.com/hu/hu/kapszula-ujrahasznositas)
- Dolce is already there for that Gusto also joined in Hungary together with Media Markt. The Dolce for Gusto capsules, can be requested via a collection bag, which is free of charge at the designated Media Markt stores. These capsules can be deposited at any of the listed collection points. Alternatively, a collection bag can be obtained for free when shopping online. NESCAFÉ Dolce Gusto aims for all capsules and packaging to be made from 100% recycled materials by 2025. The capsule collection bag is plastic, but the company also recycles it, according to their website, where it is described as a film

used in logistics. After the capsules are recycled, they become seasonal products, such as gardening tools. Due to strict regulations, it cannot be recycled as a capsule. (https://www.dolce-gusto.hu/ujrahasznositas)

- The financial institutions have also noticed the deteriorating environmental situation. Consequently, in Hungary, the majority of ATMs now request that customers specify whether they wish to receive a receipt upon transaction completion. This initiative serves to minimise the utilisation of paper, thereby reducing its disposal.
- Katica Tanya is an Eco -Conscious Experience Center. In 2016, they won the award for the sustainable experience centre at the European Enterprises Environmental Award in the "business management (micro and small business)" category, due to their outstanding commitment to environmental protection. They only make improvements that do not consume energy, but if they do, they may generate it themselves. The company is not interested in the fact that a development is financially worth implementing, if it is harmful to the environment. (E.g. instead of gasoline go-karts, they have electric go-karts).
- The Spar Hungary chain was the first to introduce reusable fruit and vegetable storage bags. Furthermore, customers are obligated to pay for nylon bags if they wish to use them. (https://www.hellovidek.hu/eletmod/2019/09/10/kornyezetbarat-lepes-mutatjuk-a-magyar-uzletlanc-nagy-dobasast)

  Individual

- Peti Puskás-Dallos is one of the most environmentally conscious prominent figure in Hungary. Primarily active on Instagram, he utilises his platform to promote events and initiatives that contribute to a cleaner environment. Peti follows a vegan lifestyle, which is partly for the sake of animals and a sustainable future. He is primarily against large-scale livestock farming, while expressing support for the most rural livestock breeders. Peti’s objective is to facilitate a harmonious balance between humanity and nature, where the consumption of animals is not excessive.
- Bogi Puskás-Dallos, shares her husband’s Peti Puskás-Dallos commitment to environmental protection and similarly engages in activism, advocating for the environment with veganism.
- Anna Kőnig is a former competitor in Exatlon and is currently works as an influencer. She participated in a campaign that involved planting a tree together with Peti Puskás-Dallos to reduce $CO_2$ emissions. The essence of the campaign was to direct attention to

the issue that the athletes coming to the men's handball European Championships offset the $CO_2$ emissions. This campaign was realised in collaboration with WWF and watchgames.

- Anita Ábel primary focus is the elimination of plastic bottles and campaigns against refillable bottles, otherwise referred to as water bottles. She also participates in the Plastic-Free July campaign. (https://magyarnemzet.hu/sztarvilag/2022/02/ezt-teszik-a-sztarok-a-kornyezettudatossagert)

- In Hungary, the Italos Karton Environmental Association launched a social movement known as, the "#greenbetter", which uses the influence of social media to raise awareness about environmental protection. The campaign involves the use of images of individuals wearing green t-shirts, symbolising their participation in selective waste collection, with the objective of inspiring and encouraging more individuals to engage in similar practices.

**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Adapt (2022c). Hungary. Download from https://climate-adapt.eea.europa.eu/countries-regions/countries/hungary
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.

- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- Faragó, T., Láng, I., Csete, L. (2010). Climate Change and Hungary: Mitigating the Hazard and Preparing for the Impacts. The "VAHAVA" Report.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Hunkár Zemankovics, M. (2012). Mitigation and adaptation to Climate Change in Hungary. Journal of Central European Agriculture, Vol. 13, No. 1, pp. 58-72.
- Huszár, A. (2018). A Párizsi megállapodás az éghajlatváltozás elleni küzdelemre az Európai Unióban és Magyarországon. Magyar Tudomány, 179. évf, 9. szám, pp. 1277-1288.
- Innovációs és Technológiai Minisztérium (2018). A 2018-2030 közötti időszakra vonatkozó, 2050-ig tartó időszakra is kitekintést is nyújtó második Nemzeti Éghajlatváltozási Stratégia. Innovációs és Technológiai Minisztérium, Budapest.
- Ministry of Innovation and Technology (2018). National Climate Change Strategy 2008-2025. Ministry of Innovation and Technology, Budapest.
- http://www.kod.hu/2005/10/a-kornyezetvedelem-megitelese.html
- https://nkvh.kormany.hu/download/d/fe/42000/Konferencia_eloadas_2016_11_23.pdf

## 4.14. IRELAND

The population of Ireland was 4,937,786 people in 2020, with a population density of 71 people per km$^2$ in 2019. The total land area is 68,890 km$^2$, and 63% of the total population is living in urban areas (worldometers.info). The most populous cities (e.g. Dublin, Cork, Galway, Limerick and Waterford) are situated in coastal areas, exerting a significant influence on the country's economic and industrial characteristics. Most of Ireland's industry and general infrastructure is concentrated along the coast, including power stations or transport hubs. Since the 1980s, there has been an increase in the number of people residing in these areas with 40% of the total population (1.9 million persons) living within 5 km of the coast by 2016 (climate-adapt.eea.europa.eu).

The country has fertile soils and temperate climate that makes it favourable for numerous kinds of farming activities. Gross Income Based System (dairy and beef) are the main forms of agriculture, while concurrently emphasising sustainable forest management that supports the national objective of delivering abatement of carbon dioxide (climate-adapt.eea.europa.eu).

Ireland plans to increase the importance of the ocean economy, which contributed 1.16% of GDP in 2018. According to the vision outlined in the document 'Harnessing Our Ocean Wealth Our Ocean Wealth – An Integrated Marine Plan for Ireland' this value is projected to double by 2030 (climate-adapt.eea.europa.eu).

The country's most important economic statistics compared to the EU-27 average are shown in Figure 107.

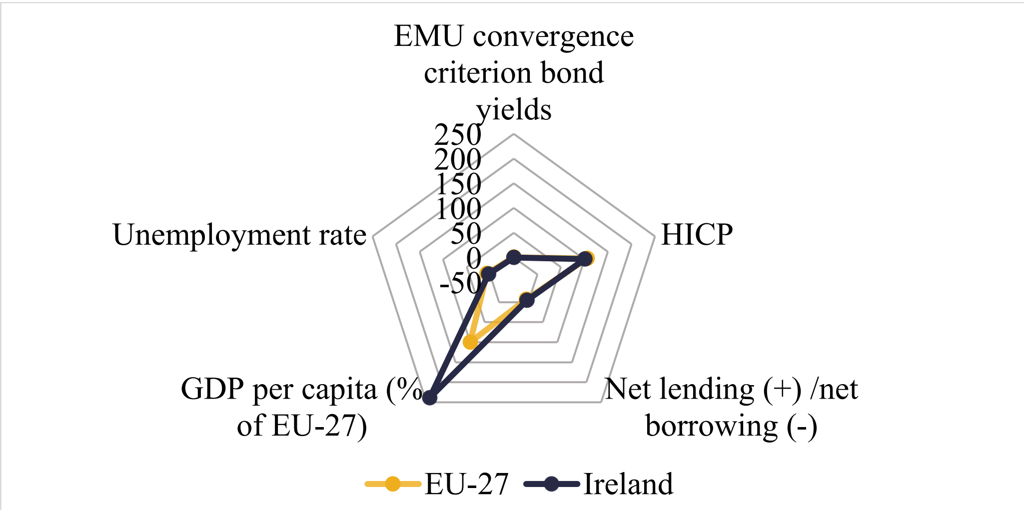



**Figure 107: Ireland vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

The Irish economy has experienced significant growth in the last decade. The unemployment rate has decreased by more than 10% since 2012 and the average real wage well exceeds the OECD average. Moreover, different dimensions of well-being, including elevated levels of perceived personal safety and community engagement. Furthermore, the low levels of air pollution experienced in Ireland contribute to its desirability as a place of residence (OECD, 2020).

The creation of employment and subsequent wage gains provided support to the labour market participation, thereby facilitating an increase in household consumption. Nevertheless, the impact of BREXIT and the economic slowdown experienced by major trading partners have held back investment (OECD, 2020).

Despite the economy's rapid growth, Ireland is faced various challenges, including capacity constraints, skill shortages, strains on critical infrastructure or ageing population. The structure of the economy is also undergoing changes, with the utilisation of new technologies being a potential solution to the country's problems. However, the effects of this are thus far modest. The prevailing global uncertainty, characterised by the lingering effects of the financial crisis, high general government debt, fragility of the banking sector and high long-term unemployment, continue to pose significant challenges (OECD, 2020).

The global pandemic of Coronavirus has affected many sectors within the Irish economy, leading to a deterioration in the labour market. In response, Ireland initiated to boost its economy by using reforms regarding tax and welfare system. These involved the removal of high effective tax rates to simulate employment (OECD, 2021).

**Climate Strategy**

Ireland is located on the north-west coast of the European continent and is characterised by a mild temperate oceanic climate. However, according to the recent observations, Ireland's climate is changing and the country is affected by climate change. In line with global trends, sea levels are rising, average temperatures are increasing and patterns of extremes weather events (e.g. flooding, flash food, amount of precipitation, etc.) are changing. These processes are predicted to continue and intensify over the coming decades, affecting the social and economic situation of the country. Ireland therefore has a strong climate change strategy to minimise the negative impacts (climate-adapt.eea.europa.eu).

The first National Adaptation Framework (NAF) for Ireland was published in 2018. The national climate policy recognised numerous threats posed by climate change to humanity and supported the efforts of the transition to a low-carbon future.

The key actions of climate Action Plan 2021 are the following:

- ❖ increase the proportion of renewable electricity to up to 80% by 2030,
- ❖ support small-scale generation scheme for farmers, businesses and communities to generate their own electricity and feed this back into the grid,
- ❖ significant reduction in transport emissions by 2030 (500,000 extra walking, cycling and public transport journeys per day by 2030),
- ❖ reach 1 million Electric Vehicles in the private transport fleet by 2030,
- ❖ increase the biofuels mix to reduce emissions,
- ❖ make agriculture more carbon efficient and build a more resilient agri-food sector (Climate Action Plan 2019, 2019).

The decrease in energy usage is a crucial aim for Ireland. Its primary energy consumption comparing EU-28 is illustrated in Figure 108.

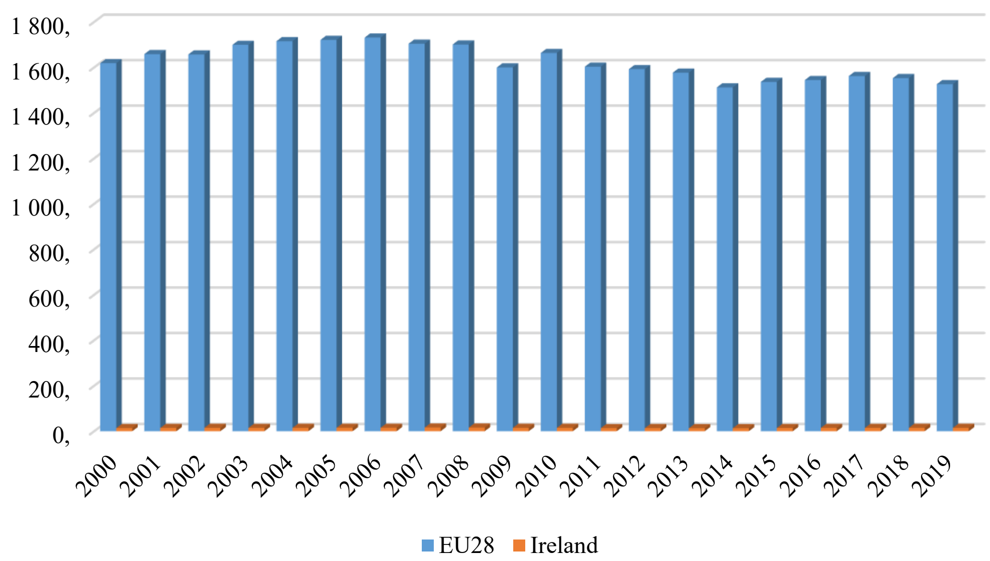



**Figure 108: Ireland vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

While energy use per capita has increased from 1965 to 2019, a downward trend is observed from 2001 onwards. The highest recorded value was 47,597 kWh in 2001, while the lowest was 35,288 kWh in 2014. In 2019, the average consumption of electricity per capita was 6,407 kWh and the total demand of the country was 31.64 TWh (ourworldindata.org).

Most energy usage is generated by the transport, the residential and the industry sectors. In descending order, the next largest consumers of energy are commercial and public services, followed by fishing and agriculture/forestry. The period between 2007 and 2010 witnessed the highest energy consumption, after which a decline in usage was observed. With regard to energy source, the highest total final consumption belongs to oil products, electricity, coal, natural gas, renewables and biofuels (iea.org).

COVID-19 has also affected Ireland's energy total energy usage. In 2020, a significant decline in total energy consumption was observed, reaching -8.7% compared to previous years. The most substantial reduction was recorded in the transport sector, with a decrease of -26%. Meanwhile, the energy usage of businesses witnessed a 1.7% decline, while residential consumption surged by 8.4%. (Energy in Ireland 2021 Report, 2021)

Fossil fuels accounted for 73% of final energy consumption in 2020. This represented a decrease of 12.7% compared to 2019 levels. Conversely, there was an increase in the use of coal and peat has increased in 2020 (Energy in Ireland 2021 Report, 2021). The proportion of fossil fuels in gross available energy is illustrated in Figure 109.

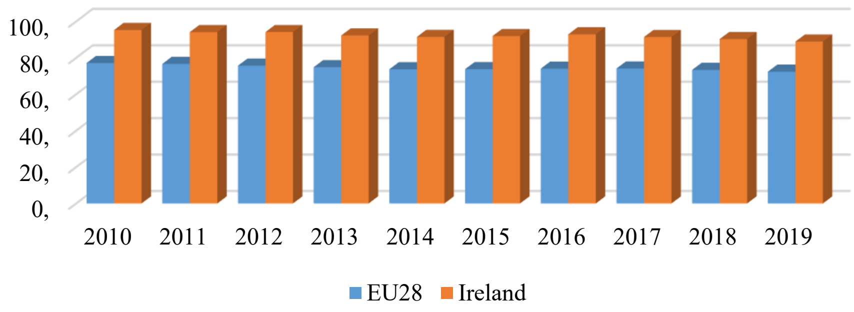



**Figure 109: Ireland vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

In 2020, fossil fuels (oil, natural gas, coal and peat) accounted for 86% of Ireland's total primary energy supply. Of this, oil is constituted 45%, making it the most significant energy source. Over the past 15 years, there has been a decline in the consumption of certain fossil fuels (oil, coal, peat) by around 30-40%, while natural gas consumption has increased by 43%. Consequently, Ireland has experienced a 20% decrease in fossil fuel consumption since 2005 (Energy in Ireland 2021 Report, 2021).

Ireland started to reduce greenhouse gas emissions from 2005, however the impact is still modest. Figure 110 shows the GHG emissions per capita in Ireland and in the EU-28 from 2000 to 2019. As it can be seen, Ireland is moving closer to the EU-28 average however, the tendency in emission is decreasing.

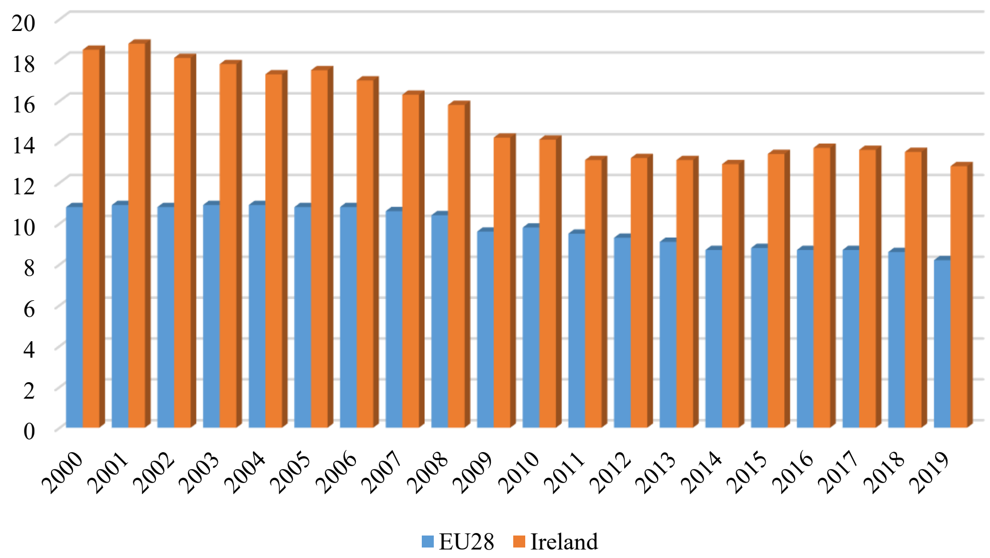



**Figure 110: Ireland vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

However, the nation has thus far been unsuccessful in dismantling the correlation between emissions and growing prosperity. Ireland's target for 2021 to 2030 is to take more serious actions to reduce greenhouse gas emissions in the country regarding both the Emissions Trading System (ETS) and non-ETS systems. It is expected that a more substantial emission reduction in the ETS sector will only be achieved after 2025, when the policies contributing to fuel switching in power generation come into effect. The overarching binding target will be for cumulative emissions. Furthermore, a 30% reduction in non-ETS sector greenhouse gas emissions consistent by 2030 is also planned. Besides, the Government is in favour of the adoption of a net zero target by 2050 at EU level (Climate Action Plan 2019, 2019)

The total $CO_2$ emissions has increased by 5.15% between 1990 and 2018, with the highest emission levels measured in 2016, after which a decline was observed. An analysis of the primary energy sources reveals that most of the $CO_2$ emissions are attributable to oil, that is followed by natural gas and coal. Nonetheless, it is encouraging to not that a decreasing tendency is also evident. While a decline in $CO_2$ emissions has been recorded from 1990 to 2018 for oil and coal, natural gas has shown an increase. The primary contributors to $CO_2$ emissions remain transportation, electricity, production and the residential sources (iea.rog).

Regarding renewable energy targets Ireland did not meet EU 2020 goals. Ireland's share of energy from renewable sources are visualised in Figure 111.

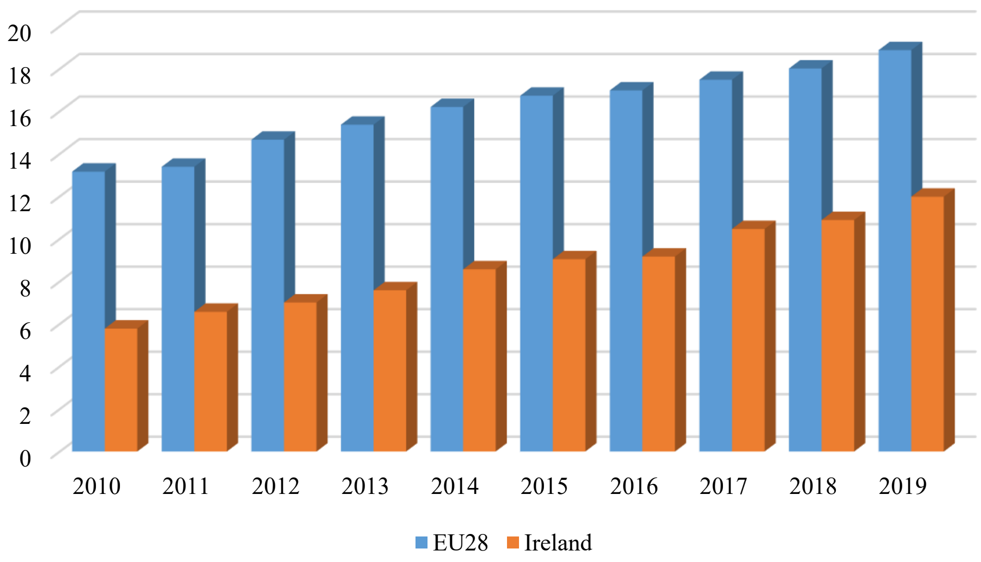



**Figure 111: Ireland vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

The overall share of renewable energy was 13.5%, falling short of the targeted 16%. However, there was an increase of 8.9% in energy from renewable sources in 2020. The transportation industry was the most successful sector, achieving 10.2% instead of the targeted 10%. Regarding electricity, the country almost reached the target at 40% achieving 39.1%, while the goal for heating and cooling was 12%, and it was only achieved to the extent of 6.3%.

**Composite Indicators**

Ireland performs commendably in terms of sustainability and climate protection performance indicators. Figure 112 presents Ireland's Environmental Performance Index (EPI) scores from 2014 to 2020. Notably, Ireland constantly ranked the top 20 out of 180 evaluated countries, with its results consistently surpassing the EU-27 average.

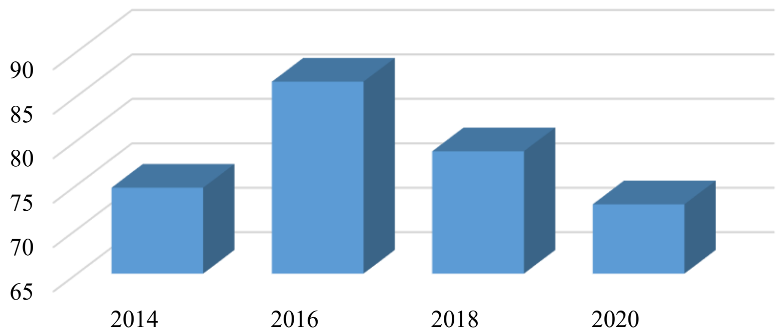



**Figure 112:** **Ireland – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Its ranks and scores were following in the EPI:

- 2014: 19. with 74.67 points (EU-27 average: 72.17)
- 2016: 19. with 86.6 points (EU-27 average: 82.91)
- 2018: 9. with 78.77 points (EU-27 average: 73.33)
- 2020: 16. with 72.8 points. (EU-27 average: 70,95)

The Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Figure 113 illustrates Ireland's ecological footprint per person from 2014 to 2020. Ireland performs comparatively well in relation to the ecological footprint, with its scores consistently around the EU-25 average level.

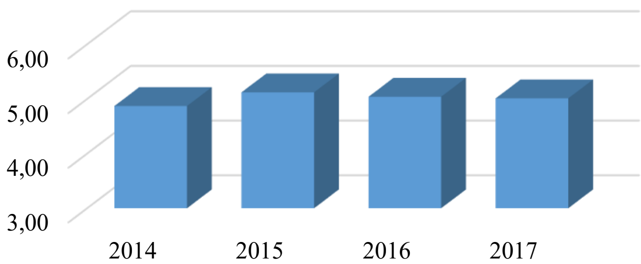



**Figure 113:** **Ireland – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Its ecological footprint per capita was the following, comparing with the EU-25 average (Malta and Cyprus are not scored):

- total score in 2014: 4.87 (EU-25 average: 5.23)
- total score in 2015: 5.12 (EU-25 average: 5.25)
- total score in 2016: 5.04 (EU-25 average: 5.26)
- total score in 2017: 5.01 (EU-25 average: 5.34)

Concerning the Climate Change Performance Index (CCPI) Ireland's performance is inconstant. The scores of the CCPI for the country can be viewed in Figure 114.

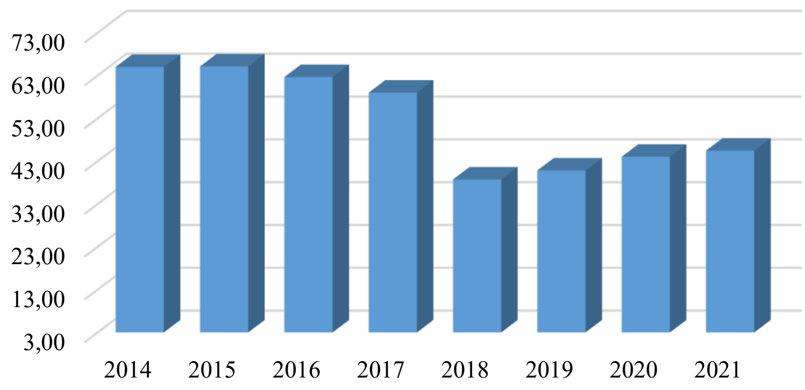



**Figure 114: Ireland vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

- 2014: 12. with 65.01 points (global average: 55.72)
- 2015: 10. with 65.15 points (global average: 55.36)
- 2016: 12. with 62.65 points (global average: 54.15)
- 2017: 21. with 59.02 points (global average: 53.77)
- 2018: 49. with 38.74 points (global average: 49.09)
- 2019: 48. with 40.84 points (global average: 50.35)
- 2020: 41. with 44.04 points (global average: 48.61)
- 2020: 39. with 45.47 points (global average: 47.90)

Prior to 2018 the nation's scores were among the best, however, subsequent to that year there was a decline in both the points earned and its overall ranking.

**Good Practices**

**Reforestation**

Ireland decided to become greener by embarking on a substantial afforestation initiative aimed at combating climate change. By the year 2040 the country has set a target to plant approximately 440 million trees, at a rate of 22 million trees annually. The tree composition has been carefully delineated, with 70% of them designated as conifers and the remaining 30% classified as broad–leaved species. This program has several benefits as it contributes to decrease the level of carbon dioxide, lower cooling costs and clean the environment (air and water). However, Ireland is one of the least forested countries in the EU with only the 11% of its territory covered by forests in 2014 (Charlton, 2019).

**To reduce the level of climate anxiety**

The government of Ireland recognised that climate anxiety has the potential to exacerbate stress levels among individuals from both the older and the younger generations. In response, a competition was launched that invited schoolchildren to write an essay-writing sharing their feelings and opinions on this pressing issue. The texts of the children revealed that they see clearly the prevailing circumstances and possesses the capacity to the fight against climate change in their daily lives (The Irish Times, 2021).

**Aran-project**

In 2011, a three-year electric vehicle (EV) project was initiated in the Aran Islands. During this period 8 families were selected to utilise EVs. The island was an ideal location for this experiment due to the abundance of wind and ocean power, which provides sufficient energy for the operation of vehicles. By allowing the use of EVs, scientists can accurately calculate the energy consumption and $CO_2$ emissions of the cars. According to the initial estimations, the electricity cost of charging on the island at €60, which was marginally higher than the typical urban running cost. However, if the vehicles were to be fully charged daily, the annual cost would amount to approximately €200, representing a 70% reduction in fuel costs when compared to a diesel car of similar size (Doyle, 2011).

**Recycling calculations**

In 2012, the 79% of the wrappers (packaging materials) were recycled, which signifies that Ireland had achieved the second-best result, surpassed only by Germany (Vigh, 2016).

**Changing nutrition habits**

The 5-a-day campaign promotes the daily consumption of fruits and vegetables. It was implemented on the majority of packages containing 100% juices, fruits, and vegetables (Vigh, 2016).

The Go Vegan initiative aims to raise awareness about the ethical concerns surrounding the treatment of animals in the industry (Vigh, 2016).

**WEEE (Waste Electrical and Electronic Equipment)**

Every company that sells electric goods is obligated to take back the old products from the customers. In 2008, 30,000 tonnes of electrical waste was collected from the households, which equates to an approximate 9 kg/person (Vigh, 2016).

**Green company service**

In Ireland special service providers offer companies environmentally-friendly services. Within the framework of this initiative, experts visit the company's locations, survey their operational habits, and advise them on how to become more environmentally sustainable (Vigh, 2016).

**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Charlton, E. (2019): Ireland's inspiring idea to go greener. World Economic Forum. Available: https://www.weforum.org/agenda/2019/09/ireland-reforestation-environment-trees (06.01.2022)
- Climate Action Plan 2019- Securing Our Future (2019). Available: https://www.gov.ie/en/publication/6223e-climate-action-plan-2021/ (10.11.2021)
- Doyle, C. (2011): E-cars accelerate green island on Europe's western-most edge. Siliconrepublic.com. Available: https://www.siliconrepublic.com/climate/e-cars-accelerate-green-island-on-europes-western-most-edge (01.03.2022)
- Energy in Ireland 2021 Report (2021). Available: https://www.seai.ie/publications/Energy-in-Ireland-2021_Final.pdf (10.11.2021)
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.

- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- OECD (2020). OECD Economic Surveys: Ireland 2020, OECD Publishing, Paris, https://doi.org/10.1787/dec600f3-en (11.11.2021)
- OECD (2021). OECD Economic Outlook, Volume 2021 Issue 2: Preliminary version, No. 110, OECD Publishing, Paris, https://doi.org/10.1787/66c5ac2c-en (11.11.2021)
- The Irish Times (2021): Dear World: 'No one is ready for the cold hard reality of climate change'. Available: https://www.irishtimes.com/life-and-style/dear-world-no-one-is-ready-for-the-cold-hard-reality-of-climate-change-1.4681791?mode=amp (01.03.2022)
- Vigh, M. (2016): Európa zöld szigete: Írország. Hellomagyarok.hu. Available: https://hellomagyarok.hu/szubjektiv/europa-zold-szigete-irorszag (01.03.2022)
- https://www.worldometers.info/ (15.12.2021)
- https://climate-adapt.eea.europa.eu/ (12.12.2021)
- https://ourworldindata.org/ (12.12.2021)
- https://www.iea.org/ (12.12.2021)
- https://www.enerdata.net/
- https://www.worldbank.org/en/home (12.12.2021)

## 4.15. ITALY

The demographic and social trends of countries are important for assessing the spatial distribution of the most vulnerable population groups. According to national surveys, the national population increased in 2011 compared to 2001 due to migratory movements. The population ageing trend has increased due to low birth rates and a steady increase in the elderly population. The combination of these two factors suggests a decline in the working-age population and even positive migration flows from abroad cannot avoid an imbalance in the proportion of young and older people (Climate Adapt, 2022d).

Urban areas are home to the majority of Italy's population. They are both the primary drivers and the main "victims" of climate change. Given their predominantly artificial nature, the resilience of such systems is, to a large extent, dependent on human agency. This poses an unprecedented challenge for land management, as short-term measures must be combined with those that will have an impact in the medium and long term. It is imperative to recognise that urban settlements are home to 90% of Italian citizens. Consequently, cities, both large and small, are therefore an essential element of the national strategy for adapting to climate change, as they are characterised by a high concentration of individuals who are susceptible to the adverse effects impacts of climate change (Climate Adapt, 2022d).

There is a high probability of an increase in the magnitude, duration, frequency and intensity of heat waves in Italy, as evidenced by observational data from the past few decades. Furthermore, there is evidence to suggest that extreme precipitation events in Italy will become more intense and concentrated over shorter periods, even when the total amount of precipitation remains unchanged. The exacerbating impacts of climate change on critical situations in urban areas, necessitate the incorporation of adaptation measures into all territorial government policies and actions. The anticipated consequences of climate change on urban settlements are numerous and varied, including impacts on health and quality of life (particularly among vulnerable populations), buildings, water, energy and transport infrastructure, on cultural heritage (due to landslides, floods and heat waves), and energy production and supply. The management of these impacts requires the coordination of a wide-ranging institutional network, a concept-termed multi-level governance (Cetara et al., 2019).

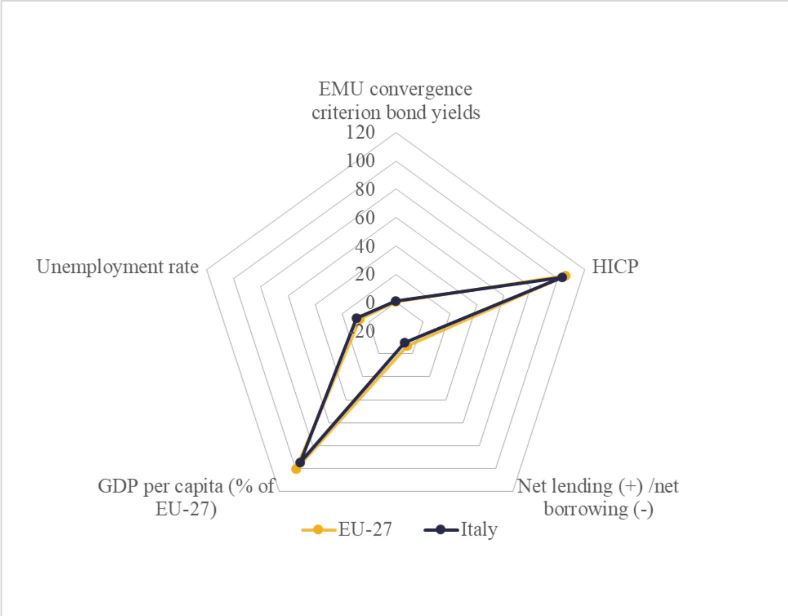



**Figure 115: Italy vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

As demonstrated in Figure 115, a number of significant deviations from the EU-27 average are evident for the majority of the selected economic indicators. The Maastricht criterion interest rates are more than 3 times the EU average, GDP per capita is more than 90% of the EU average, unemployment is 2% above the EU average and government expenditure exceeds government revenue by a larger percentage than in EU countries.

**Climate Strategy**

The Ministry of the Environment, Land and Sea (MATTM - Ministero dell'Ambiente e della Tutela del Territorio e del Mare) has already included climate change adaptation measures in some sectoral strategy documents in 2010, as well as in the preparatory documents for the "National Biodiversity Strategy" and the "Marine Strategy". The overarching objective of the SNAC (La Strategia Nazionale di adattamento ai cambiamenti climatici - National Strategy for Adaptation to Climate Change) is to develop a national vision on shared approaches to address climate change through climate change mitigation and adaptation. To this end, the SNAC identifies measures and orientations to minimise the risks from climate change, to protect the health, well-being and assets of the population, to preserve the natural heritage, to maintain or improve the resilience and adaptive capacity of natural, social and economic systems, and to take advantage of opportunities that may arise under new climate conditions (Ministero dell’Ambiente e della Tuttela del Territorio e del Mare, 2015).

To achieve this goal, the document sets out five strategic axes of action to: - improving current knowledge on climate change and its impacts; - describing the vulnerability of the area, the adaptation options for all natural systems and socio-economic sectors concerned, and the associated opportunities; - promoting stakeholder participation and awareness in the definition of sectoral adaptation strategies and plans through a broad process of communication and dialogue, also with a view to better integrating adaptation into sectoral policies; - support awareness raising and information on adaptation through broad communication on the potential threats, risks and opportunities arising from climate change; - identify tools to be used to identify the best options for adaptation measures, highlighting co-benefits (Salvia et al., 2013).

The document has been prepared using principles developed and refined in the context of national strategies in other European countries. In particular, lessons have been learnt from the experiences of Belgium, Denmark, Finland, France, Germany, Finland, France, Spain, Switzerland, the United Kingdom and the United Kingdom. In addition, a comprehensive review of relevant reports and technical papers from the European Environment Agency has been conducted, including "Adapting in Europe" (EEA, 2013) and "Guiding Principles for Adapting to Climate Change in Europe" (2010); and the European Commission's "Adapting to Climate Change: Towards a European framework for action on climate change" (EC, 2009); documents and reports accompanying the definition of the European Adaptation Strategy, in particular the "Guidelines for developing adaptation strategies" and the "Guidelines for project managers: making vulnerable investments climate resilient" (Ministry for the Environment and Territory, 2016).

**Climate change**

Italy is located in an area considered particularly vulnerable to climate change: the Mediterranean region is considered a hotspot for climate change impacts. the country’s topography is characterised by a diverse landscape, encompassing high mountain ranges such as the Alps and Apennines along with varied coastlines. The nation’s position within the Mediterranean Sea further contributes to its unique climatic characteristics, being influenced by the arid climate of North Africa and the temperate and rainy climate of Central Europe (Climate Adapt, 2022d).

In Italy, the utilisation of land has undergone significant alterations over the past two decades have resulted in an increase in forest area, grassland and municipal land; there has also been a decrease in arable land compared to 1990. Italian land under the 'forest' category accounted for about 31% of the national land area in 2015. Despite a decline in the expansion of forests over the last decade, the Italian forested area is expanding due to the abandonment of agricultural practices, particularly in mountainous regions, and the natural conversion of cultivated land and pastures into forests. Italy is home to a large proportion of Europe's animal and plant species. The most significant impacts expected in Italy in the coming decades are an extreme increase in temperatures (especially in summer), an increase in the frequency of extreme weather events (heat waves, droughts, intense rainfall), and a decrease in average annual rainfall and annual river flows (Ministry for the Environment and Territory, 2016).

The energy sector is a particularly sensitive economic sector when it comes to climate change. This is due to the high sensitivity of energy production and consumption to temperature trends and extremes, as well as the stringent requirements that energy services must meet stringent requirements in terms of both quantity and quality, especially with regard to continuity. As global average temperatures rise, less energy will be required for space heating and more for cooling. However, in southern European countries, the demand for cooling energy is expected to increase at a greater rate than that for heating. Electricity consumption is expected to undergo substantial increase during the summer months. The increased utilisation of air conditioning systems has been identified as a key factor in the potential for an escalation in power cuts (Cetara et al., 2019).

In the context of adaptation strategies are, especially for long-life infrastructures involving large investments, it is necessary to incorporate climate change considerations at an early stage of the project, by applying appropriate design criteria and adopting specific technological measures. This imperative is particularly pronounced in the context of projects subject to environmental impact assessment. Environmental impact assessments must take into account the changes in reference climatic conditions that may occur over the average lifetime of the project (Carraro – Sgobbi, 2008).

In 2015, the tertiary sector accounted for 44.1% of total final energy consumption, the transport sector for 29.3% and the industrial sector for 22.3%. In the electricity sector, around 68% of production in 2015 was generated by thermal power plants (77% in 2010 and 82% in 1990), with the remainder coming from renewable energy sources (hydro, wind, photovoltaic and landfill gas), whose share has been steadily increasing in recent years. Italy has a lower energy intensity than the EU average, mainly due to the shift of the Italian economy from industrial activities to services (Ministero dell'Ambiente e della Tuttela del Territorio e del Mare, 2015).

In 2016, the final energy consumption (excluding non-energy uses) was 115.9 Mtoe (source: Eurostat energy balances), a slight decrease compared to 2015 (-0.3%). The transport sector continued the downward trend of recent years, consuming 39.1 Mtoe (-1.1%), while the residential sector consumed 32.2 Mtoe (-1.0% compared to 2015). However, contrary to the trend, the services and industry sectors registered consumption growth of +0.3% and +1.4% respectively, mainly due to the development of economic activity (Ministry for the Environment and Territory, 2016).

Following a decade of almost uninterrupted decline, primary energy demand exhibited an uptick in 2017 (+1.5% compared to 2016). This demand is increasingly being met by oil (which nevertheless still accounts for a third of the total), solid fuels (6.1%) and imported electricity (4.9%). Conversely, the contribution of gas has been on the rise (36.2%), as has that of renewable sources (slightly less than a fifth). The energy demand of Italy and the EU is illustrated in Figures 116 and 117.

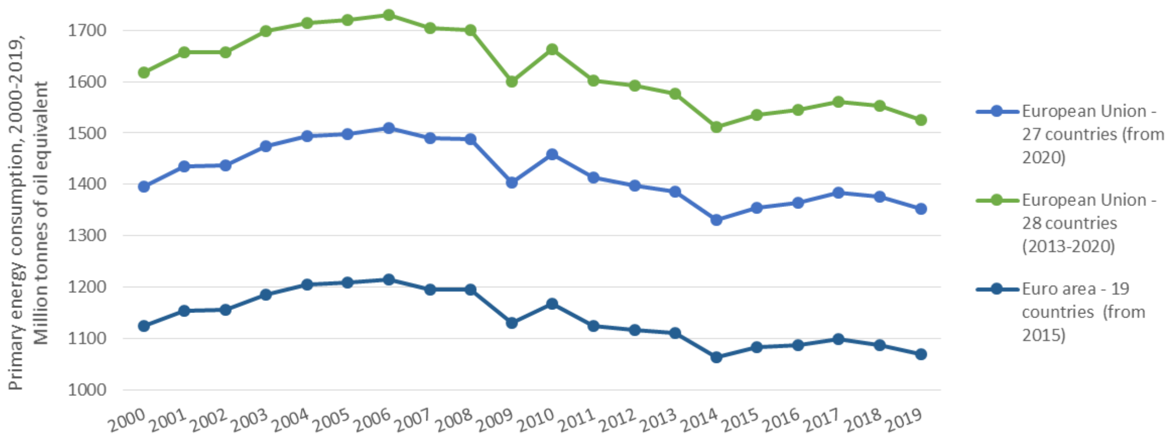



**Figure 116: Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

Data show that total energy demand in the EU has fallen by an average of 1% per year over a 20-year period. Italy, once again performs better than the EU average.

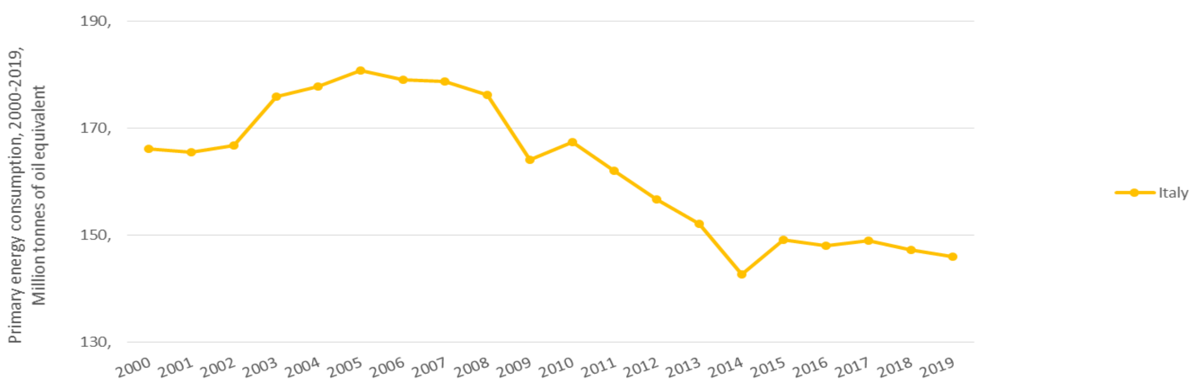



**Figure 117: Italy vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

Greenhouse gas emissions and the resultant global climate change has the potential to modify terrestrial ecosystems and the organisms and populations that inhabit them, both directly (through altered biogeochemical cycles and increased temperatures) and indirectly (through physical and chemical factors or biological interactions between species). The consequences of global climate change for terrestrial ecosystems are manifold, affecting the physiology, behaviour, life cycle (phenology) and geographical distribution of species, the composition of terrestrial ecological communities and species interactions.

Changes in the distribution of plant and animal species have been observed. Specifically, mountain plant species have been documented to have moved to higher altitudes, resulting in their presence in the highlands. Correspondingly, mountain animal species have also moved to higher altitudes, leading to a contraction of their range. The region’s most vulnerable to biodiversity loss are the high-altitude areas of the Alps and the Apennines and, to a lesser extent, the Mediterranean biogeographical region. These areas have experienced the most evident impacts to date (Climate Adapt, 2022d).

The impact of climate change and greenhouse gas emissions is exacerbated by a multitude of global and local drivers of change, including habitat fragmentation and degradation, the introduction of alien species, and in the case of northern Italy, emissions of air pollutants (nitrogen oxides, sulphur oxides, ozone) and land use change. Projections indicate that by 2100, approximately 60% of plant species in the Alps and the Apennines will have disappeared, and that Mediterranean forests will be partially replaced by shrubbery (Massetti et al., 2007).

A significant proportion of initiatives concerning climate change impacts comprise research and monitoring activities. However, the present moment calls for a strategic environmental policy that can effectively utilise this knowledge to guide practices for the conservation and management of biodiversity assets, mitigation measures and future research. Figure 118 provides a visual representation of Italy's greenhouse gas emissions.

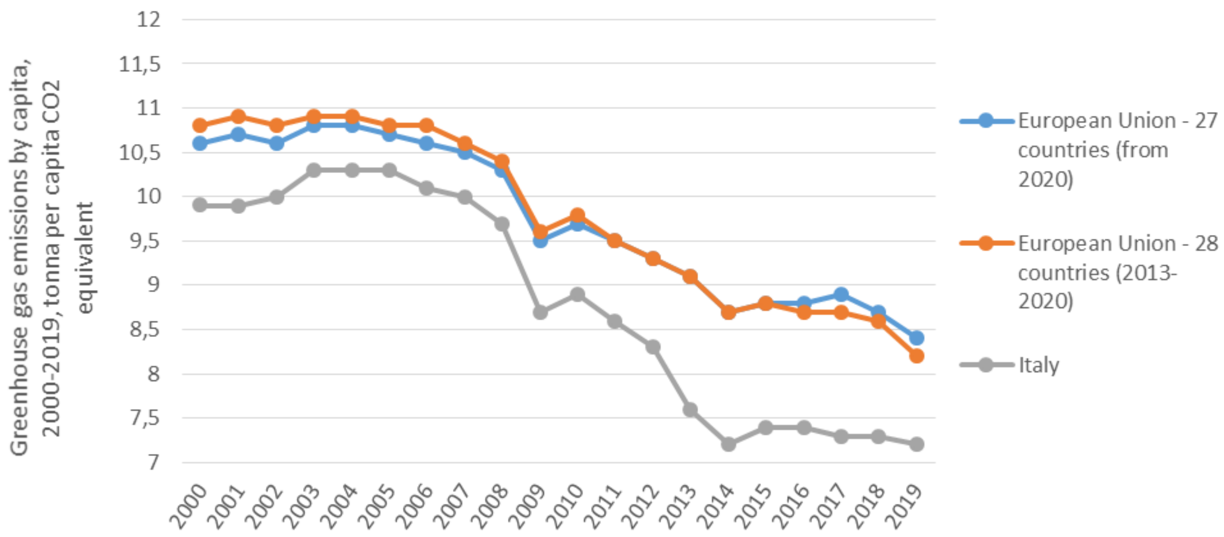



**Figure 118: Italy vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

Italy is below the EU average over the whole period, and the rate of decline is also higher than in EU countries.

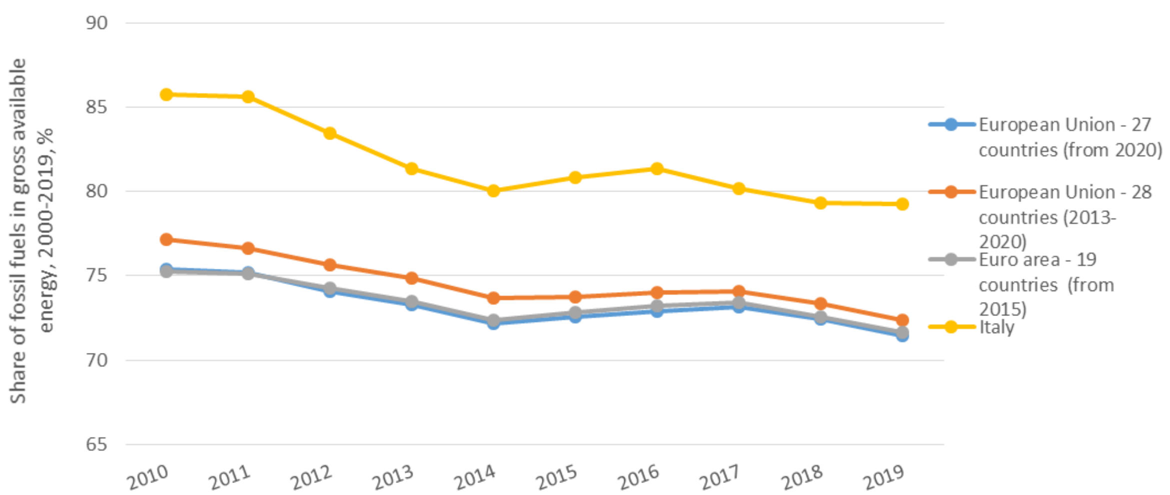



**Figure 119: Italy vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**

Source: own compilation based on Eurostat (2022b)

Unfortunately, the same conclusions cannot be drawn for the share of fossil fuels, which is higher in Italy than in the EU (Figure 119). However, the rate of decrease follows the EU average.

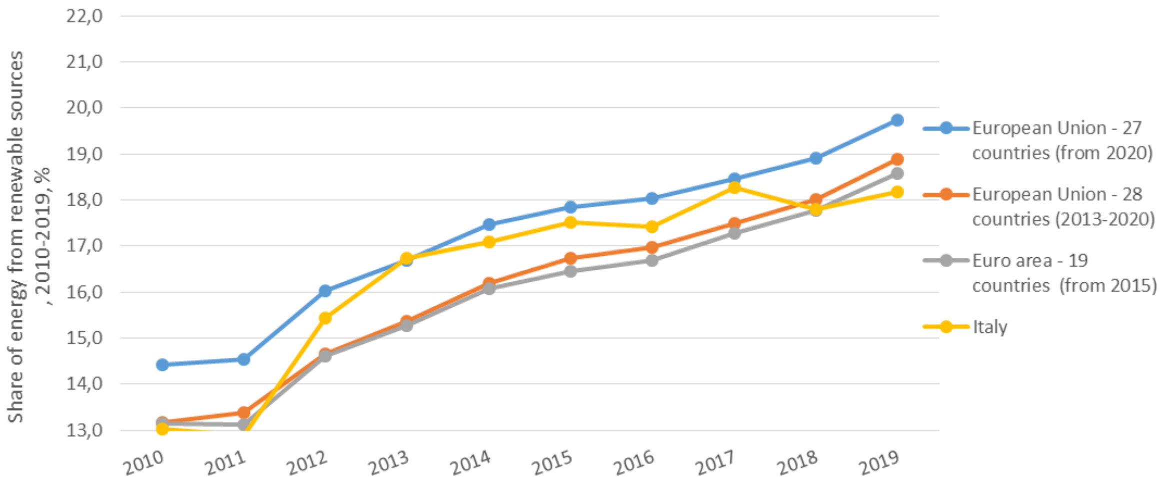
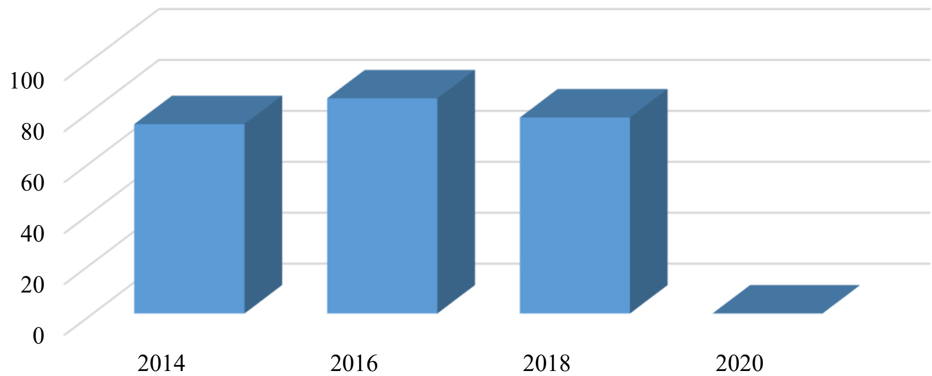



**Figure 120: Italy vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

The share of renewable energy is increasing (Figure 120) and is in line with EU levels.

**Composite Indicators**

The Environmental Performance Index (EPI) is a comprehensive metric that assesses the environmental sustainability of nations worldwide, including Italy. The EPI employs 32 performance indicators across 11 categories of questions and ranks 180 countries based on




environmental health and ecosystem vitality.

**Figure 121: Italy– Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

These indicators demonstrate at the national level, the proximity of countries to achieving their environmental policy objectives. Italy's Environmental Performance Index (EPI) scores from 2014 to 2020 are displayed in Figure 121. Regarding the EPI, Italy consistently occupied a position in the upper half of the ranking, with its results consistently exceeding the EU-27 average.

Its ranks and scores were following in the EPI:

- 2014: 15. with 74.36 points (EU-27 average: 72.17)
- 2016: 20. with 84.48 points (EU-27 average: 82.91)
- 2018: 12. with 76.96 points (EU-27 average: 73.33)
- 2020: 5. with 71.00 points. (EU-27 average: 70,95)

The Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Italy's data per person from 2014 to 2020 is illustrated in Figure 122. The country's performance in terms of its ecological footprint is suboptimal, as evidenced by its consistently below-average scores relative to the EU-25 average.

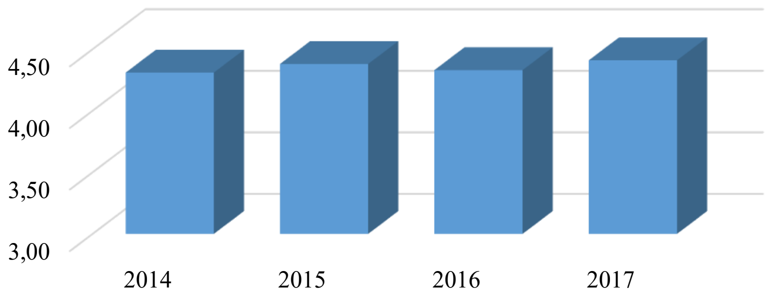



**Figure 122: Italy – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Its ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

- total score in 2014: 4.31 (EU-25 average: 5.23)
- total score in 2015: 4.38 (EU-25 average: 5.25)
- total score in 2016: 4.33 (EU-25 average: 5.26)
- total score in 2017: 4.41 (EU-25 average: 5.34)

Concerning the Climate Change Performance Index (CCPI) Italy's performance is inconstant. The scores of the CCPI for the country can be seen in Figure 123.

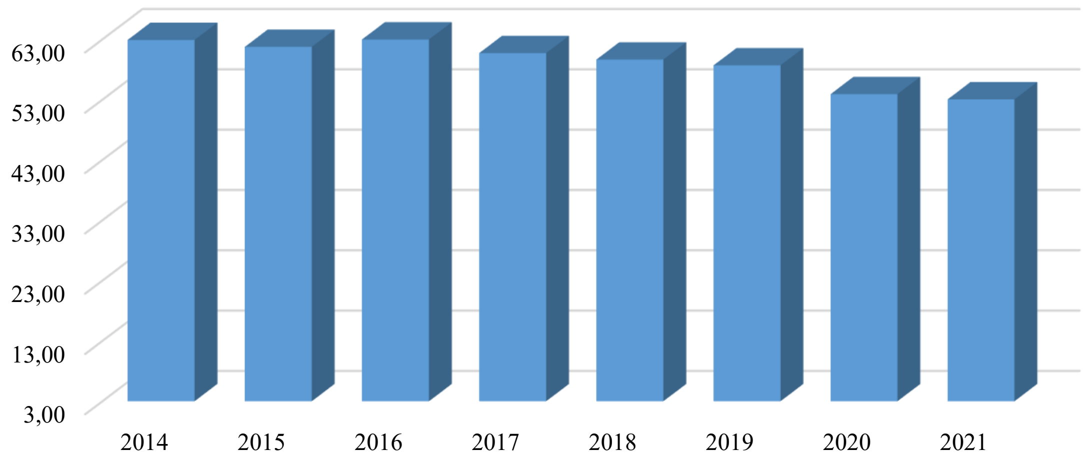



**Figure 123: Italy vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

- 2014: 18. with 62.90 points (global average: 55.72)
- 2015: 17. with 61.75 points (global average: 55.36)
- 2016: 11. with 62.98 points (global average: 54.15)
- 2017: 16. with 60.72 points (global average: 53.77)
- 2018: 16. with 59.65 points (global average: 49.09)
- 2019: 23. with 58.69 points (global average: 50.35)
- 2020: 26. with 53.92 points (global average: 48.61)
- 2021: 27. with 53.05 points (global average: 47.90)

Mostly, Italy's scores were above the average in all the examined years.

## Summary

Since 2000, Italian exports and imports have been subject to a persistent decline in market share on a global scale. In 2016, Italian merchandise exports were driven by machinery and motor vehicles, pharmaceuticals, footwear, oil refinery products and iron and steel products. Conversely, imports of goods exhibited an upward trajectory between 1990 and 2007, followed by a period of instability, attributable to the volatility of domestic demand in recent years. The global financial and economic crisis of the last decade hit advanced economies, leading to a severe recession in the EU. Between 2012 and 2013, Italy, akin to numerous other advanced economies, experienced a return to recession. However, in recent years the national economy has exhibited a modest recovery. The services sector continues to be the primary driving force behind the national economy.

The crisis, caused by the effects of the health emergency, impacted the Italian economy at a stage characterised by a prolonged cycle of weakness. Following a gradual acceleration over the three-year period 2015-2017, the recovery exhibited a considerable weakening, resulting in activity transitioning to a phase of near stagnation. GDP expanded by 0.3 percent in 2019, indicating a slowdown compared to 2018. In the first quarter of 2020, the partial blocking of activity due to the health crisis had a negative impact on the demand and supply side. GDP fell by 5.3 percent.

In general, the energy intensity decreases recorded by Italy in 2016 was among the largest in the European Union. The steadily increasing impact of renewable energy sources and the decline in energy intensity over the last few years have contributed to Italy's reduced dependence on foreign sources of supply. The share of national energy demand covered by net foreign imports remains high (77.7%) but is about five percentage points lower than in 2010.

Few studies offer a comprehensive and up-to-date analysis of the impact of climate change on Italian GDP. These include Carraro and Sgobbi's (2008) study, which, using a computable general equilibrium model, suggests that even in a scenario with a minimal temperature increase of about 0.93°C compared to 2001, the climate change loss in 2050 could be between 0.12% and 0.16% of GDP. For Italy, if the value of its GDP in 2009 is taken as a reference point, the loss would amount to about €2.5 billion in lost production of goods and services; the economic loss could reach 0.2% of GDP if the temperature change were +1.2°C. Moreover, if the impacts were to increase exponentially in the second half of the century, GDP would fall six times more in 2100 than in 2050.

**Good Practices**

Italy is currently engaged in efforts to align the SDGs with economic, social and environmental planning. The implementation and enforcement of the NSDS will serve to integrate the national programming documents, namely the National Reform Programme and the Economic and Financial Document. The Italian Government has committed to an annual review of the implementation of the NSDS and to an assessment of progress made. With regard to the "planet" area of the strategy, an integrated and inclusive approach is essential to build sustainable and efficient cities, more resilient and safer communities, and better-connected areas with stronger green infrastructure. Italy is a proponent of the exchange of information between local, national and international institutions, involving a range of stakeholders. Furthermore, Italy supports initiatives such as LIFE-AR, which promote more effective adaptation and resilience measures led by LDCs.

**Companies for the sake of environmental protection**

- Gruppo Cap is originally an integrated water utility company operating in Lombardy (based in Milan). Since 2016, the company has engaged in the recovery of biofuels using water cycles. In 2016, the Gruppo established a specialised team tasked with the implementation of eco-innovative and energy-efficient solutions for the extraction of biomethane from sludge, then convert it into biogas, and the production of biofuel from the residual sludge. This recycling process strengthens the circular economy and contributes to sustainable mobility.[4]
- EcodesignLab is a start-up from the University of Camerino. The core objective of this initiative is to facilitate the development of eco-innovative designs and manufacturing processes with a view to promoting environmental sustainability. In addition, the initiative provides a forum for advice on the creation of innovative and sustainable products. The scope of their activities encompasses a diverse range of product types, including grape transport boxes and radiators. Their main goals include recycling, producing new environmentally friendly products and increasing sustainability.[5]
- Orange Fiber is an innovative Italian start-up. Textiles are produced from citrus waste, mainly from orange peel. According to surveys, 700,000 tons of orange waste are recycled annually. Utilising a special process, yarns are manufactured from the orange peel, subsequently employed in the creation of fashionable garments. The company's slogan: "Orange is the new green!" This method has already been adopted in Spain.[6]
- Officine Italiane Parquet is an Italian parquet manufacturing company. This company strives to use ethical and environmentally friendly methods during its production processes. In addition to protecting their employees, they reduce $CO_2$ emissions during the entire production process. Their products are provided with an FSC certificate, the

[4] Carolina Spaini: Eco-innovation in Italy. EIO Country Profile 2016-2017. Country Profile 2016-2017: Italy. Coordinator of the work package: Technopolis Group Belgium. p. 9
[5] Carolina Spaini: Eco-innovation in Italy. EIO Country Profile 2016-2017. Country Profile 2016-2017: Italy. Coordinator of the work package: Technopolis Group Belgium. p. 8
[6] Carolina Spaini: Eco-innovation in Italy. EIO Country Profile 2016-2017. Country Profile 2016-2017: Italy. Coordinator of the work package: Technopolis Group Belgium. 9-10. p.

significance of which is to prove that they comply with the rules of forest management. The company guarantees that it produces ecological and sustainable floors.[7]

- There are alternative solutions for environmental protection, including: Support for synthetic fuels and E-fuels, as well as the advancement of hydrogen propulsion. The president of the automotive industry association has expressed his belief that it is important to clarify his stance on electric cars. He asserts that he does not oppose EVs, rather he advocates for augmentation that a greater role should be given to other alternative solutions, in conclusion his criticism is against exclusivity.[8]

**Good practices at individual and local level**

- Jojob solution form was originally created as a phone application. The application's utilisation experienced a notable surge from 2014 onwards. The Jojob is designed to facilitate efficient and cost-effective travel between home and work. Its functionality is centred on collaborative trip planning among colleagues for commutes to the workplace together. By using Jojob, parking becomes easier, reduces road congestion, and curtails traffic jams, thereby contributing to a reduction in harmful emissions and enhancing environmental protection. This is an effective solution, on an individual level.
- A number of measures have been introduced at local levels as well. These include the prohibition of diesel cars in Northern Italy, specifically in the following four provinces: Lombardy, Piedmont, Veneto and Emilia-Romagna. This ban has been in place since 2018, but it is not yet complete. The ban is in effect on weekdays, but at different time intervals for each province. Violators can expect a minimum fine of 80 euros, with the possibility of an upper limit exceeding 600 euros for repeated violations. There is also the possibility of evading the ban, as in Lombardy, for example, if there are at least three people travelling in a car, motorists are permitted to drive at any time, regardless of classification.
- Since 2011, the city of Mantua has been paying special attention to environmental protection. The city of Mantova is committed to integrating art and culture with climate protection. Cultural events related to environmental protection and the commitment to

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[7] Officine Italiane Parquet. In: https://www.officineparquet.it/hu/k%C3%B6rnyezetv%C3%A9delmi-politika/?fbclid=IwAR1ez9fTXU1XHieNyL_tZSdpB7k1S1V9TOTBmmOLRcAxo5a7LVJkAP8s-Sg

[8] Gábor Várkonyi: According to the president of the Italian Automobile Industry Association, the electric car is not the only way to $CO_2$ neutral driving. 2022. In: https://varkonyigabor.blog.hu/2022/06/01/az_olasz_autoipari_szovetseg_elnoke_szerint_sem_az_elektromos_auto_az_egyetlen_ut_a_co2_semleges_aut?fbclid=IwAR33iN4__tTk80mGbUEyZuKosRDzgNCzOTllz_wxJU5ZAHkPaorn7lXm6cs

reducing carbon dioxide emissions have become increasingly popular in the city. The cross-sector activity of the city of Mantova represented progress, with initiatives ranging from reusable glasses to biogas-powered buses. This efforts have contributed to the formulation of a novel "plastic-free" city strategy, which is an integral component of the environmental protection criteria delineated in the city's UNESCO management plan and environmentally friendly public procurement related to cultural events.

- Another praiseworthy Italian example of the intersection of culture and environmental protection is the Biblioteca Degli Alberi in Milan. As part of the "More green cities for Europe" campaign, the institute was established in the city. The Library of Trees located right in the heart of Milan represents a brand-new cultural district and botanical garden. The Biblioteca Degli Alberi is an excellent place to spend your free time.

**Smoking is prohibited on the beach**

Smoking is restricted on most beaches. Bibione is the first Italian resort to introduce such a ban. The main purpose of this regulation is to guarantee that all visitors can enjoy unpolluted, clean beach air and an undisturbed holiday. This regulation builds on previous years’ restrictions, which already prohibited smoking near the water. The new ban extends to the entire sandy beach, including the area under personal umbrellas. Bibione’s regulation prohibited both smoking and discarding butts. A fine of up to 500 euros can be imposed if this is violated. https://www.italieonline.eu/hu/tilos-a-dohanyzas-bibione-strandjain-829.htm

**The use of non-degradable ear cleaning sticks is prohibited**

The utilisation of non-degradable ear cleaning sticks is prohibited throughout the nation. This regulation has been in force since 1 January 2019. Furthermore, the use of non-degradable plastic plates, glasses and cutlery is prohibited on selected beaches. https://olasznyelvtan.hu/a-kornyezetvedelem-jegyeben-mi-tilos-olaszorszagban-2019-tol/

**It is forbidden to scatter paper confetti and streamers at weddings**

In Matera, the European Capital of Culture in 2019, there was a local custom during weddings: rather than the customary rice or rose petals, the newlyweds were besprinkled with paper confetti. However, as of May 1, 2019, a new ordinance has been implemented, prohibiting the use of paper confetti or streamers during wedding celebrations. The penalty for contravening this law can amount to a fine of up to 500 euros.
https://winklergyula.ro/wp-content/uploads/2021/04/ZOLDKISOKOS_2021.pdf

**References**


- Carraro, C., Sgobbi, A. (2008). Climate Change Impacts and Adaptation Strategies in Italy. An Economic Assessment. Fondazione Eni Enrico Mattei, Milano.
- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Cetara, L., Pregnolato, M., Ballarin Denti, A. (2019). Climate Adaptation Governance in Italy. Country Report Italy (WP1). Interreg Alpine Space GoApply, Milano.
- Climate Adapt (2022d). Italy. Downloaded from https://climate-adapt.eea.europa.eu/countries-regions/countries/italy
- Climate Adapt (2022d). Italy. Retrieved from https://climate-adapt.eea.europa.eu/countries-regions/countries/italy
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. 22.10.2021.
- Massetti, E., Pinton, S., Zanoni, D. (2007). National through to local climate policy in Italy. Environmental Sciences, Vol. 4, No. 3, pp. 149-158.
- Ministero dell'Ambiente e della Tuttela del Territorio e del Mare (2015). Strategia Nazionale di Adattamento ai Cambiamenti Climatici. Ministero dell'Ambiente e della Tuttela del Territorio e del, Roma.
- Ministry for the Environment and Territory (2016). Environmental Action Strategy for Sustainable Development in Italy. Ministry for the Environment and Territory, Roma.
- Salvia, M., Pietrapertosa, F., De Gregorio Hurtado, S., Geneletti, D., D'Alonzo, V., Di Leo, S., Reckien, D. (2013). Urban responses to Climate Change in Italy. 3rd International Exergy, Life Cycle Assessment, and Sustainability Workshop & Symposium (ELCAS3), Mykonos.

## 4.16. LATVIA

Latvia joined the European Union in 2004. The most significant economic sectors include wholesale and retail trade, transport, accommodation and food services (23%), public administration, defence, education, human health and social work activities (18%) and industry (15%). Intra-EU trade accounts for 62% of Latvia's exports, with 76% of its imports originating from EU countries (Climate Adapt, 2022e).

At the beginning of 2020, the population of Latvia stood at 1 million 908 thousand people (46.2% male, 53.8% female). The population decline in 2019 was recorded at 0.64% (compared to 2.16% in 2010). In 2019, the natural population decrease was 8.9 thousand people, due to a higher number of deaths than births. Additionally, the population decreased by 3.4 due to long-term migration, representing the lowest indicator since 1989. At the beginning of 2020, Latvia's urban population was 1 million 306 thousand people (68%), while the rural population was 602 thousand. The population of Riga (627 thousand) accounted for 33% of the total population. Over the preceding three-year period, there has been an upward trend in immigration, while emigration has decreased (Green Growth Knowledge Platform, 2021).

At the beginning of 2020, the average age of the population of Latvia was 42.7 years, with males averaging 39.4 years and females 45.5 years (for comparison, the figures at the beginning of 2011 were 41.1, 37.9 and 43.8 years). The Pieriga region recorded the lowest average age of 40.8 years, while the highest was observed in Latgale at 44.8 years. The average life expectancy of individuals born in 2019 was 75.6 years, with a range of 70.8 years for men and 79.9 years for women (Climate Adapt, 2022e).

Member States whose GDP per capita in 2013 was below 60% of the EU average GDP (at market prices) will be eligible for funding from the Modernisation Fund after 2020. The Modernisation Fund will be available in ten EU Member States, including Latvia, to finance projects (including small-scale projects) to improve energy efficiency and modernise the energy industry (Latvian Government, 2018).

Figure 124 shows significant deviations from the EU-27 average for most of the selected economic indicators. The Maastricht criterion interest rates are negative, and GDP per capita stands at 46% of the EU average. The unemployment rate is almost 1% higher than the EU average, yet government expenditure is less than government revenue than in EU countries. The harmonised index of consumer prices, on the other hand, is 3% above the EU average.

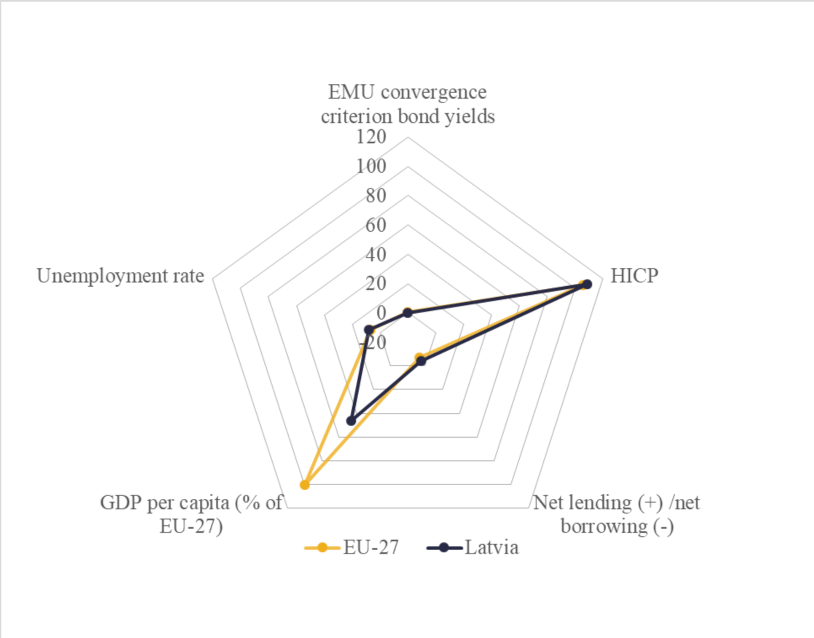



**Figure 124: Latvia vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

The demand for energy is directly linked to the economic development of the country. The future requirement for energy services (net energy) is therefore calculated using the Ministry of Economy's 2018 projections of the dynamics of the indicators reflecting macroeconomic development (population, GDP, value added of economic sectors and industrial sub-sectors, private consumption) (Melece – Shena, 2019).

**Climate Strategy**

The National Energy and Climate Plan 2021-2030 is a long-term policy planning document developed in accordance with the Government Action Plan for the implementation of the Declaration of the Cabinet of Ministers headed by Māris Kučinskis on planned activities, No 275 of 3 May 2016. The plan includes an assessment of the economic impact of the measures identified to achieve the objectives, such as the required investments, potential benefits and cost-effectiveness, which allows measuring the overall impact of the plan on Latvia's national economy (impact on gross domestic product) and thus the socio-economic impact on society. In preparing the plan, due consideration has been given to both extant and emerging technologies, developmental trends and plans in diverse economic sectors, and energy and greenhouse gas emission projections based on the latest data, with 2016 established as the baseline (Avotniece et al., 2017).

For the Republic of Latvia, the increase in greenhouse gas emissions is significant (Figure 125). While the EU, has experienced an average annual decrease of 1%, Latvia has shown contrasting trend, with greenhouse gas emissions are increasing by an average of nearly 2% per year.

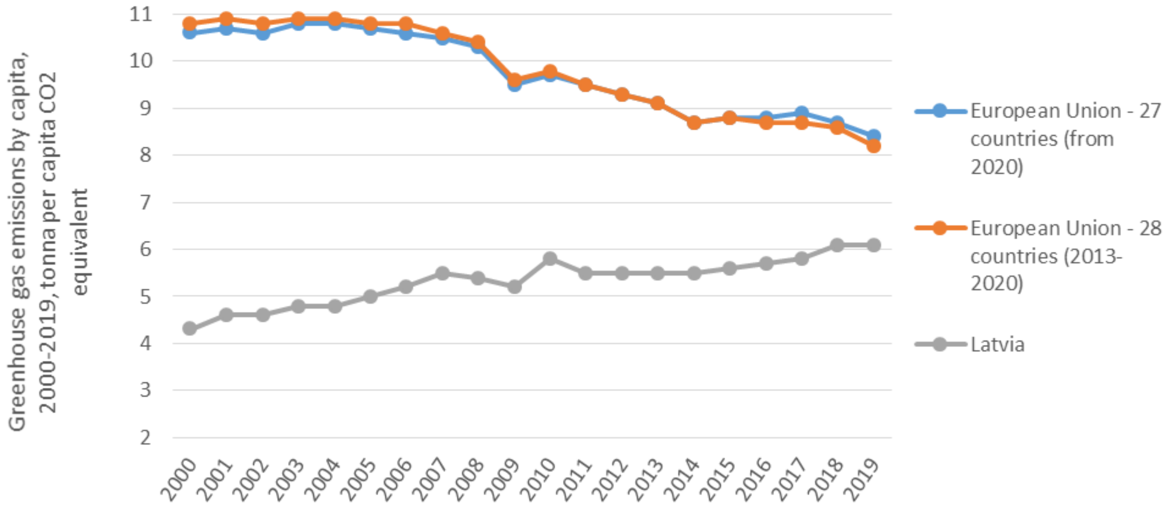



**Figure 125: Latvia vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 ($CO_2$ equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

The transition to a low-carbon economy that is competitive in the region and globally can be achieved through development of a balanced and efficient energy policy based on market principles. This will contribute to the further development of the Latvian economy and the well-being of society (Bankwatch Network, 2020).

Latvia is located on the edge of the Eastern European Plain, in close proximity to the Baltic Sea. The total border of Latvia on land is 1,387 km (with Estonia, Lithuania, Belarus and Russia) and 498 km along the long maritime border with Sweden. The country's total area is 64,573 km$^2$, with a length of 210 km in a north-south direction and a width of 450 km in a west-east direction. The topographical characteristics of Latvia are predominantly low-lying, with extensive flatlands interspersed with undulating hills. The average altitude is 87 m above sea level, the highest peak being Gaizinkalns reaching 311.6 m. The country also has a substantial water infrastructure, with more than 3, 000 lakes and 12, 000 rivers (Climate Adapt, 2022e).

Latvia is in the temperate climate zone, characterised by the relatively flat terrain, proximity to the sea and the influence of air masses from the Atlantic Ocean. The country experiences a mild and humid climate, with four distinct seasons. In 2020, the average air temperature in Latvia was recorded at +8.8 ºC, marking a 2.4-degreeincrease compared to the 1981-2010 average. The temperature constitutes the warmest year since 1924, exceeding the record set in 2019 by

0.6 °C. The total precipitation in Latvia in 2020 was 641.5 mm, which is 7% below the annual mean of 692.3 mm. Despite the drier conditions, 2020 was the wettest year of the last three. The average air temperature for the winter of 2019/2020 was +2.7°C (5.7°C above normal), making it the warmest winter on record, surpassing the previous record set in the winter of 1924/1925 by 1.7°C. January, with an average air temperature of +3.1°C, was the warmest on record, while February (average air temperature +2.2°C) was the second warmest, following February 1990 (Latvija Republikas Ministru, 2019).

Energy is one of the sectors that directly contributes to the country's economic growth and accounts for a significant share of total costs in some industries, particularly manufacturing. The most important factor contributing to the growth of the industry has been and continues to be the lowest possible sustainable energy price, which encompasses safety and quality. The development of the energy sector is dependent on significant investment, which in turn requires a stable and predictable investment environment to attract investors. In 2016, Latvia's total primary (primary) energy consumption stood at 184.5 PJ, representing a mere 0.3% increase compared to 2015. However, in 2017, this figure witnessed a notable rise of 5.5% reaching 194.9 PJ. It is evident that over the past five years, from 2013 to 2017, there has been no substantial change in total primary energy consumption. Meanwhile the share of renewable energy sources increased by 2.55% (Green Growth Knowledge Platform, 2021).

Figure 126 shows total EU energy demand. The data show that total energy demand in the EU has decreased by an average of 1% per year over 20 years.

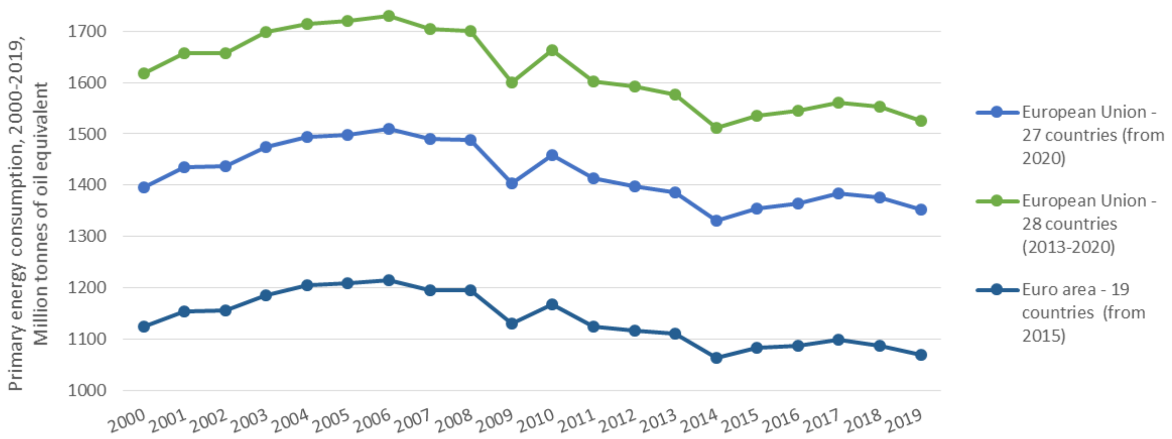



**Figure 126: Primary energy consumption, 2000-2019 (million tons of oil equivalent)**

Source: own compilation based on Eurostat (2022a)

In the case of Latvia, however, the average rate of change does not follow this trend and there is a spectacular increase in total energy use over the same period.

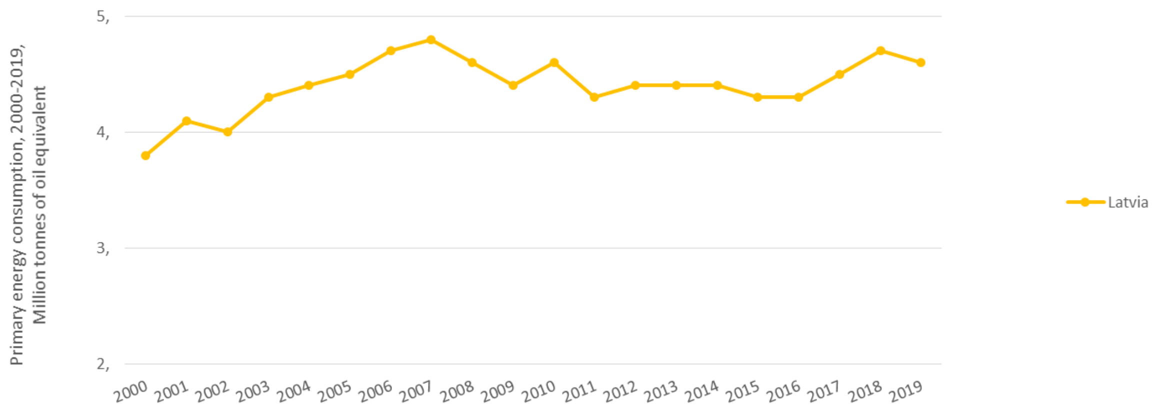



**Figure 127: Latvia vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**

Source: own compilation based on Eurostat (2022a)

In contrast to the EU, both total primary energy consumption and final energy consumption in Latvia have decreased significantly between 1990 and 2000 and since 2011, while the EU has seen a significant increase in energy consumption since 2014, more sharply than Latvia (Green Growth Knowledge Platform, 2021).

Recent years have witnessed a shift in the structure of primary energy consumption. While the share of renewables in total primary energy consumption has increased in parallel with the decrease in natural gas consumption, the share of natural gas consumption has decreased by 4.2% over the last decade, reaching 25.4% in 2016 and 23.4% in 2017. Renewable energy sources utilised in Latvia domestic in nature. Consequently, in accordance with the augmentation of the aggregate consumption of renewable energy sources, Latvia's energy reliance on imported energy diminished from 63,9 % in 2005 to 47,2 % in 2016. In both 2016 and 2017, the transport sector emerged as the foremost energy consumer, accounting for30.4% and 30% respectively. This was followed by households, which accounted for 29% and 29.2%, and industry with 20.8% and 21% (Latvija Republikas Ministru, 2019).

Another important factor is the evolution of the share of fossil fuels in gross available energy, as the use of these fuels increases carbon dioxide emissions. In Latvia, fossil fuel use has been decreasing at a higher rate than the EU average since 2010 (Figure 128).

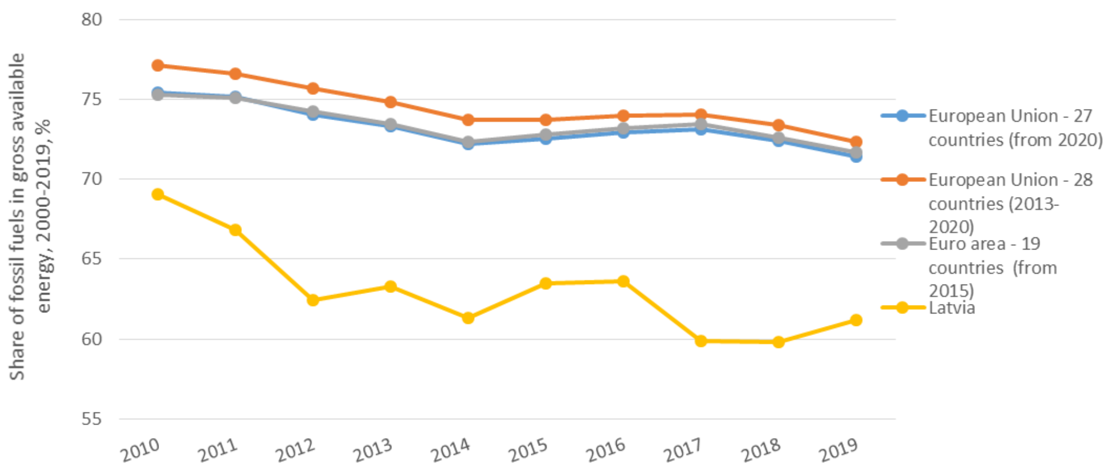



**Figure 128: Latvia vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

The SDSL2030 (Sustainable Development Strategy of Latvia 2030) establishes a target for the reduction of greenhouse gas emissions for 2030. The objective is for Latvia's total GHG emissions in 2030 to be less than 45% of Latvia's total greenhouse gas emissions in 1990. In alignment with the broader EU agenda, Latvia's national climate policy framework are in line with the EU's climate policy objectives and international climate policies, such as the Convention, the Kyoto Protocol and the Paris Agreement (Bankwatch Network, 2020).

The target for greenhouse gas emission reductions from activities outside the European Union Emissions Trading System (EU ETS) (hereafter referred to as the "EU ETS target") will be redistributed among all EU Member States, including Latvia. The target for each EU Member State, along with the compliance criteria for the period 2021-2030 are set out in Regulation 2018/84270. Latvia is obligated to ensure a 6% reduction in greenhouse gas emissions from non-ETS activities in the period 2021-2030 compared to 2005 levels. The target for the entire period is divided into binding annual targets (Latvian Government, 2018).

The annual GHG emission reduction targets for Latvia for the period 2021-2030 will be established in 2020, utilising the most recent verified data from the 2005, 2016, 2017 and 2018 GHG inventories, and following the adoption of the EC implementing act referenced in Article 4 of Regulation (EC) No 2018/842/EC. The annual greenhouse gas emission reductions outlined in the plan are therefore merely indicative (Green Growth Knowledge Platform, 2021).

The extant data demonstrate that Latvia's total GHG emissions decreased by 1.6% between 2005 and 2017, whilst Latvian GDP increased by 24% over the same period. Despite the notable strength of GDP growth and the marginal decline in total GHG emissions, the correlation between economic development and rising greenhouse gas emissions persist. Consequently, it can be deduced that the decoupling of GHG emissions and Latvian GDP is almost relative, as the environmental indicator of decoupling - the amount of GHG emissions - is only marginally decreasing. However, since 1995, the intensity of greenhouse gases in the Latvian economy has been decreasing, and it is projected that this trend will continue until 2030 (Ministry of Environmental Protection and Regional Development Republic of Latvia, 2020).

At EU level, the proposal to amend Directive 2009/28/EC establishes a binding common target for Member States for the share of renewable energy in total final energy consumption by 2030, which is 32% of total EU final energy consumption (including electricity, heating and transport). This includes national targets for 2020 (from 2021, the share of renewables in final energy consumption cannot be lower than the national targets for 2020). Each EU Member State is obliged to define its national contribution to the common EU target. Under the proposal to amend Directive 2009/28/EC, Latvia has offered the following contribution to the EU's common binding renewable energy target: a minimum share of 45% of renewable energy in Latvia's final energy consumption by 2030 (Melece – Shena, 2019).

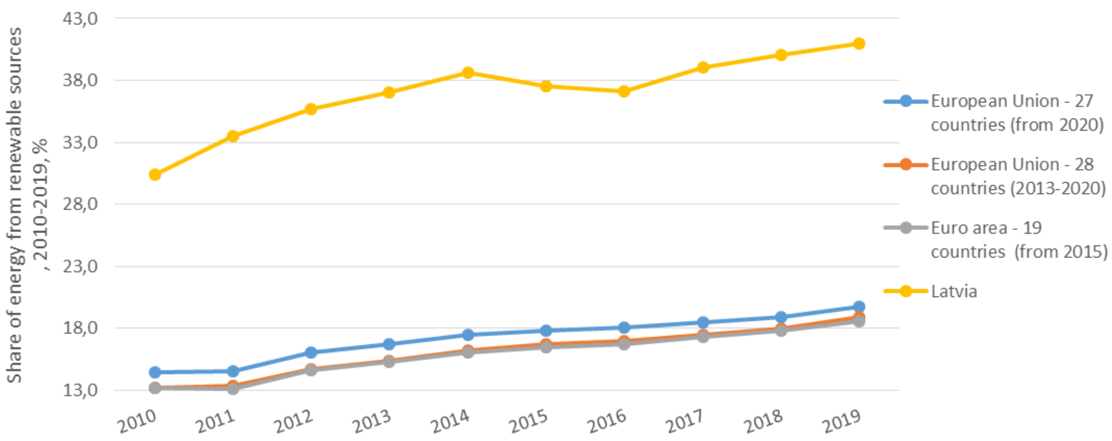



**Figure 129: Latvia vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

Latvia is currently among the EU leaders in the use of renewable energy sources (Figure 129).

**Composite Indicators**

The Environmental Performance Index (EPI) is a comprehensive metric that assesses the state of sustainability across the globe, including Latvia. The EPI employs 32 performance indicators across 11 categories of questions and ranks 180 countries based on environmental health and ecosystem vitality. These indicators illustrate, at the national level, the extent to which countries are approaching the realisation of their environmental policy goals. The Environmental Performance Index (EPI) scores of Latvia from 2014 to 2020 are presented in Figure 130.

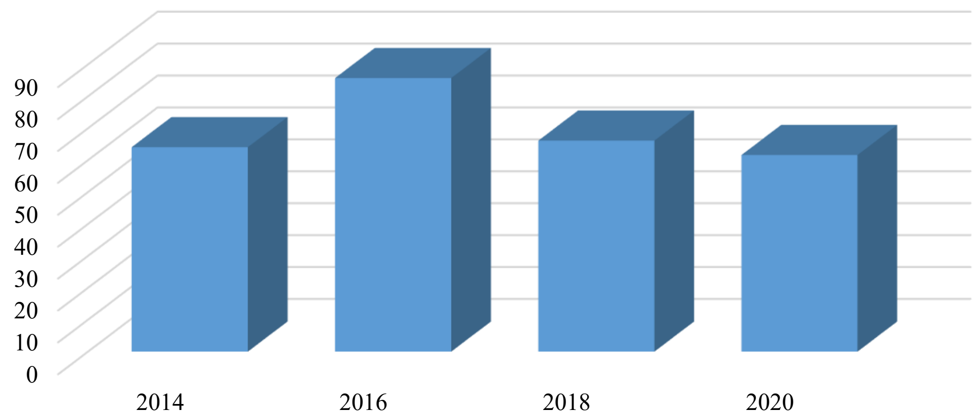
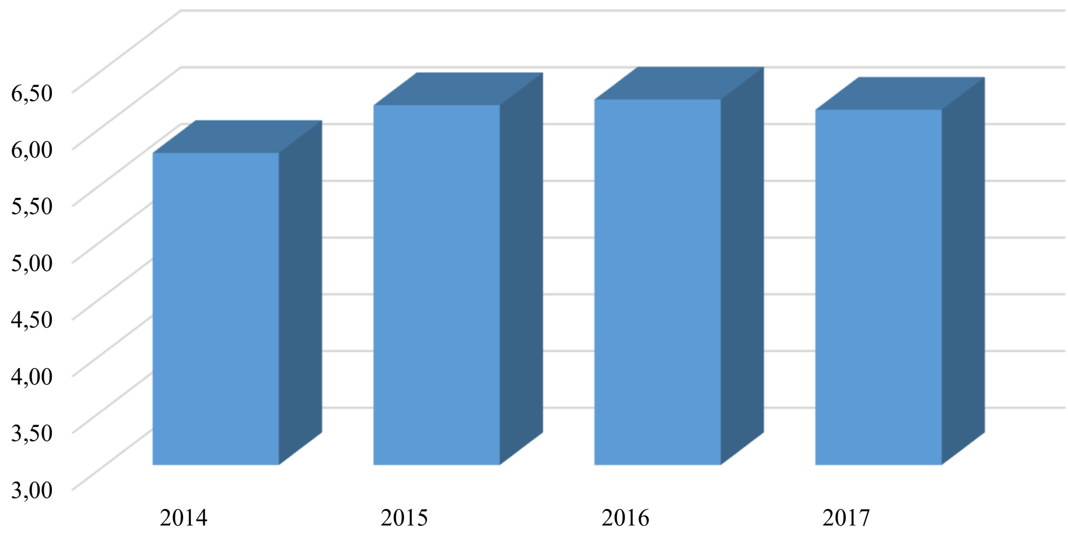



**Figure 130: Latvia - Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

With regard to the EPI, in 2016 Latvia's score was higher than the EU-17 average, thus occupying a median position within the ranking. In subsequent years, it was positioned in the lower half of the ranking, with its results consistently falling short of the EU-27 average. The following table illustrates the ranking and score of Latvia in the EPI:

- 2014: 23. with 64.05 points (EU-27 average: 72.17)
- 2016: 15. with 85.71 points (EU-27 average: 82.91)
- 2018: 22. with 66.12 points (EU-27 average: 73.33)
- 2020: 26. with 61.60 points. (EU-27 average: 70,95)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Latvia's ecological footprint per person from 2014 till 2020 can be seen in Figure 131. It is evident that Latvia consistently outperforms the EU-25 average, with consistently higher scores, indicating a commendable commitment to environmental sustainability. Latvia – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)




Source: own compilation based on (GFN, 2022)

Its ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

- total score in 2014: 5.75 (EU-25 average: 5.23)
- total score in 2015: 6.17 (EU-25 average: 5.25)
- total score in 2016: 6.22 (EU-25 average: 5.26)
- total score in 2017: 6.13 (EU-25 average: 5.34)

Concerning the Climate Change Performance Index (CCPI) Latvia's performance is approximately constant. The scores of the CCPI for the country can be seen in Figure 132.

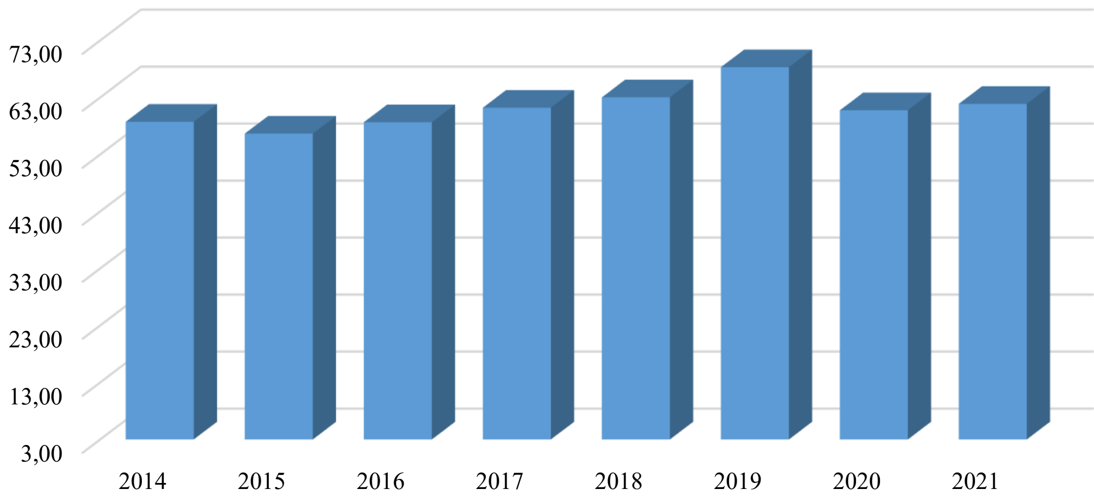



**Figure 131: Latvia vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

- ❖ 2014: 27. with 58.73 points (global average: 55.72)
- ❖ 2015: 33. with 56.65 points (global average: 55.36)
- ❖ 2016: 16. with 58.65 points (global average: 54.15)
- ❖ 2017: 15. with 61.20 points (global average: 53.77)
- ❖ 2018: 10. with 63.02 points (global average: 49.09)
- ❖ 2019: 7. with 68.31 points (global average: 50.35)
- ❖ 2020: 15. with 60.75 points (global average: 48.61)
- ❖ 2021: 13. with 61.88 points (global average: 47.90)

Latvia's scores were mostly in all examined year higher than the average; there are no outliers during the years.

**Summary**

Latvia's economy, being small and open, it is highly dependent on global economic trends. Exports of goods and services are significant component of foreign trade, accounting for about 60% of gross domestic product (GDP). The services sector added was dominated Latvia's value followed by manufacturing and construction, while agriculture and other industries played a comparatively minor role. In 2020, the most significant manufacturing sectors were wood processing, food and beverages, electrical equipment, fabricated metal products and chemicals.

It is projected that economic growth will decelerate in the medium term (2023) and in the long term (2030). The convergence of wages with those of Western European countries will continue in the medium term, driven by the openness of the labour market. This will exert a negative impact on the competitiveness of companies in low value-added segments. However, the transition to a higher value-added economy will be gradual. Population decline and lower income growth will affect private consumption in the long run. Demographic projections indicate a persistent decline in Latvia's population in the medium and long term. Moreover, the working age population is projected to decline at a faster rate than the total population. The primary cause of this medium and long term decline is the ageing of the population, which will lead to a widening of the gap between birth and death rates.

**Good Practices**

At the sub-national level local governments integrate adaptation objectives into various infrastructure projects with a particular focus on flood risk management and coastal erosion solutions. Latvia's involvement in the LIFE Adaptate project is indicative of its commitment of

European municipalities with the Covenant of Mayors The project has facilitated the development of several energy and climate plans for urban areas, with the pilot city Smiltene of implementing a critical adaptation project. Furthermore, Latvia is a participant in the LIFE Local Adapt project, among other initiatives.

The strategic goals and adaptation measures outlined in the Latvian National Plan for Adaptation to Climate Change until 2030 are consistent with the Paris Agreement on Climate Change, the Sustainable Development Goals, and the Sendai Framework for Disaster Risk Reduction.

Latvia is a member of IPCC, WMO, EUMETSAT, NORDMET, ECMWF, HELCOM. Cooperation to share information and to strengthen science, institutions and adaptive knowledge mostly is implemented though participation in scientific organizations and projects. In addition, Latvian parties actively participate in various EU programmes, such as Horizon 2020, LIFE 2014-2020, its sub-programme Action Climate and Interreg projects, which underscores its commitment to addressing environmental concerns, particularly those pertaining to climate change, from the perspectives of environmental and urban environmental quality, as well as climate change adaptation.

To enhance adaptation action, an international cooperation is mostly related to international initiatives, programmes and projects, such as “Integration of climate change adaptation into the work of local authorities”/ LIFE LOCAL ADAPT (LIFE15 CCA/DE/000133), “Common methodology for the development of Sustainable Energy and Climate Action Plans”/LIFE Adaptate (LIFE16 CCA/ES/000049). Norwegian Financial Instrument (NFI) pre-defined project (PDP) “Integration of climate change policy into sectoral and regional policies” is under implementation, where climate change adaption related activities are included.

Currently, Latvian municipalities are participating in the initiative “Covenant of Mayors Europe” activities. Twenty-five Latvian municipalities, as members, should be initiating action and developing their Sustainable Energy and Climate Change Strategies (SECAP), which would be prerequisite for fulfilling requirements in order to develop their climate change action plans in 2021. It is noteworthy that several municipalities have already initiated the development of adaption plans extending to 2030.

## References


- Avotniece, Z., Aniskevich, S., Malinovskis, E. (2017). Climate Change Scenariois for Latvia. Report summary. Riga, State Ltd. Latvian Environment, Geology and Meteorology Centre.
- Bankwatch Network (2020). Latvia adopts climate and energy plan and long term strategy. Retrieved from https://bankwatch.org/blog/latvia-adopts-climate-and-energy-plan-and-long-term-strategy
- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Adapt (2022e). Latvia. Retrieved from https://climate-adapt.eea.europa.eu/countries-regions/countries/latvia
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Green Growth Knowledge Platform (2021). Latvia – Create a 2050 National Low Carbon Development Strategy. Retrieved from https://www.greengrowthknowledge.org/big-e/latvia-create-2050-national-low-carbon-development-strategy
- Latvian Government (2018). National Energy and Climate Plan of Latvia 2021-2030. Draft for Submitting to the European Commission for Evaluation. Riga, Latvian Government.
- Latvija Republikas Ministru (2019). Latvijas strategija klimatneitralitates sasniegsanai lidz 2050. gadam. Riga: Latvija Republikas Ministru.

- Melece, L., Shena, I. (2019). Climate Change Adaptation Policy: Issues in Latvia. Engineering for Rural Development. 18th International Scientific Conference Engineering for Rural Development.
- Ministry of Environmental Protection and Regional Development Republic of Latvia (2020). Global Climate Change. Retrieved from https://www.varam.gov.lv/en/global-climate-change

## 4.17. LITHUANIA

Lithuania joined the European Union in 2004. The most important economy sectors include wholesale and retail trade, transport, accommodation and food services (~30%), industry (20%) and public administration, defence, education, human health and social work activities (16%). Intra-EU trade accounts for nearly 60% of Lithuanian exports, with 70% of imports into Lithuania being sourced from EU countries (Lietuvos Respublikos, 2020).

Since 1992, when Lithuania reached a maximum population of 3 706 000, this indicator has decreased by 23% at an average of 1.28% per year until 2017. The population on 1 January 2017 was 2 848 000, indicating a net loss of 859 000 inhabitants over a period exceeding 25 years. The overall demographic situation in Lithuania is aggravated by high emigration, low birth rates and high mortality rates. Consequently, the demographic composition of the population is undergoing significant changes, the number of children and working-age adults in relation to the total population is declining and the proportion of elderly dependants in the population is increasing. In the period 2018-2040, the ongoing monitoring of population decline trends and population ageing trends will continue to be monitored in Lithuania. Lithuania's permanent population is projected to decline, but not as drastically as the UN projections predict. The forecasts for the Lithuanian population were based on rather pessimistic assumptions about migration, as they were based on particularly unfavourable developments in the past. According to the Lithuanian Statistical Office, the country’s population stood at 2 794 000 permanent residents on 1 January 2019. A decline of 14,900 persons (0.5%) was observed in 2018 and by 39,000 persons (1.4%) in 2017. The majority of the population decrease in 2018 can be attributed to negative natural population change. Given the current situation and taking into account the gradual slowing down of emigration, the population decline is expected to be more moderate than the European Commission's forecast. The estimated population of Lithuania in 2020 is 2 789 000, 2 727 000 in 2030 and 2 675 000 in 2040 (Climate Adapt, 2022f).

The most populated areas are the largest cities, namely Vilnius, Kaunas and Klaipeda. The population density of these three cities was 83.3 inhabitants per square kilometre (inhabitants/km$^2$), 69.4 inhabitants/km$^2$ and 60.8 inhabitants/km$^2$ respectively at the beginning of 2019. According to data from the Lithuanian Statistical Office, the population of Lithuania was 2 794 184 inhabitants in early 2019. The demographic trend has been declining in recent years due to various reasons such as natural population change, mortality and emigration. Following a modest uptick between 2005 and 2009, the birth rate has remained relatively stable in recent years. The natural population change (increase/decrease) remains negative. In general, population change is recognised as a key factors influencing energy consumption and, consequently, the dynamics of greenhouse gas emissions (Climate Adapt, 2022f).

Figure 133 presents significant deviations from the EU-27 average for most of the selected economic indicators. Maastricht criterion interest rates are below the EU-27 average and GDP per capita is only half the EU average.

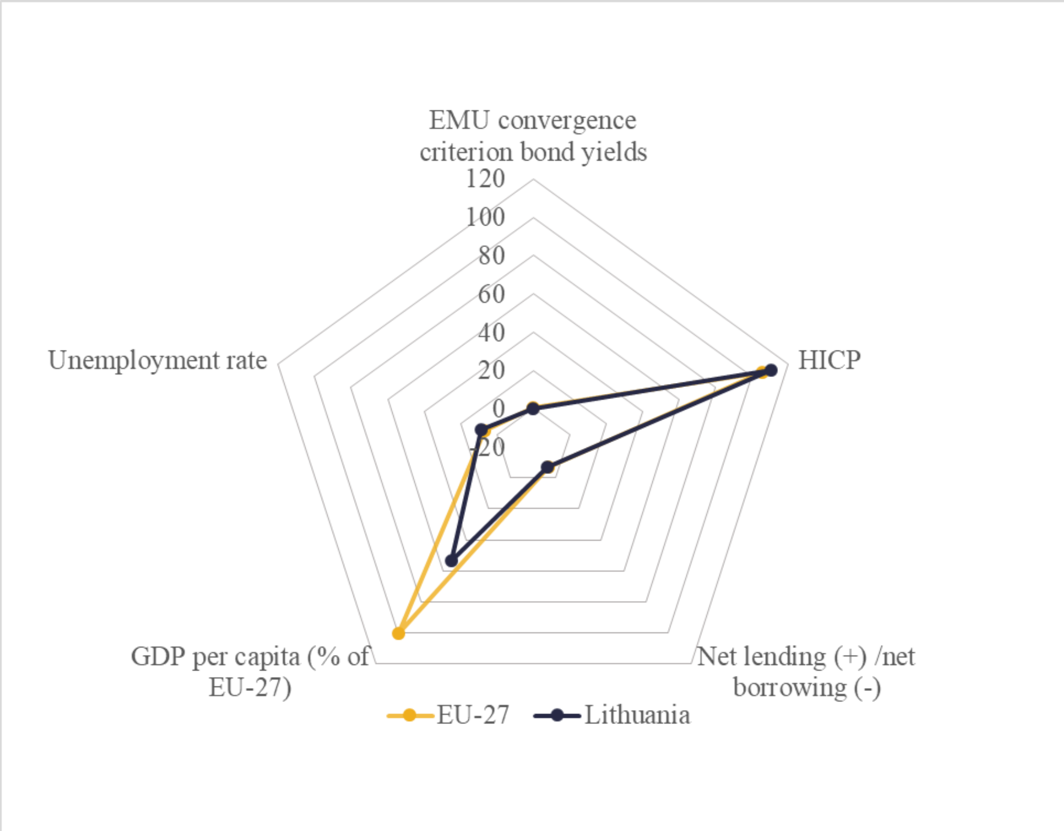



**Figure 132: Lithuania vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

The unemployment rate is around 1.5% higher than the EU average, but government spending is lower than the share of government revenue than in EU countries. The harmonised index of consumer prices is 5% above the EU average (Lietuvos Respublikos, 2020).

## Climate Strategy

Lithuania has prepared a National Energy and Climate Action Plan 2021-2030 in accordance with the Energy Union Regulation on Governance and Energy Efficiency. The national plan is based on various documents and integrates them into the provisions implemented and planned in Lithuanian national legislation. The main strategic documents that have been integrated into the national plan include the National Energy Independence Strategy (NEIS), which was adopted in June 2018 and the National Strategy for Climate Change Policies, which was approved in 2012 and updated in 2019, as well as the National Air Pollution Reduction Plan adapted in April. Certain strategies remain in conceptual phase, whilst others are at an early stage of development. Consequently their intended content will reflect planned (unapproved) policies and measures where applicable. The NEIS has identified four priority areas: reducing the impact on climate change and air pollution, reliability, competitiveness and the involvement of the country's businesses in energy development efforts (Lietuvos Respublikos Seimo Nutarimas, 2012).

The regulation governing the Energy Union includes decarbonisation, energy efficiency, energy security, internal energy market and research, innovation and competitiveness. In compliance with the NEIS, Lithuania has set ambitious targets to make a significant contribution to the Energy Union and to the implementation of the policy objectives of the EU's energy and climate policy framework. Lithuania, in collaboration with Latvia and Estonia, Lithuania is committed to synchronising a reliable and unified electricity system in continental Europe by 2025, a goal it shares with Poland. By 2030, the target is to attain 45% of renewable energy in final energy consumption (one of the highest targets for renewable energy development in the EU), of which 45% is renewable energy. In addition, at least 30% of consumers are expected to generate electricity for their own use. In Lithuania, the share of domestic electricity generation is expected to rise from 35% to 70%, while the renewable energy share in transport is projected to reach 15%. These developments are anticipated to position Lithuania as a regional leader in energy innovation (Ministry of Environment of the Republic of Lithuania, 2017).

Recent decades have seen a significant degree of progress in Lithuania with regard to the field of environmental protection. Compared to 1990 levels, the country achieved a 57% decline in GHG emissions, the largest reduction among EU-28 countries. In 2017, Lithuania achieved the ninth lowest per capita greenhouse gas emissions result in the European Union. It is noteworthy that these achievements have been accomplished in the context of the country's economic growth and positive downward trends are expected to continue. This creates favourable conditions for achieving a zero-GHG economy in the future. Lithuania is a notable leader among European countries in terms of the rate of GHG removals from forests, ranking ahead of only Sweden and Denmark within the EU. In 2017, removals from forests amounted to 7.8 million tonnes of $CO_2$ equivalent, which represents 1/3 of the country's total GHG emissions. Despite these strengths, Lithuania lags behind EU countries in terms of tax policy. According to the EC, Lithuania's environmental tax rate as a share of GDP is significantly lower (1.9% of GDP) than that of EU Member States and the EU average (2.4% of GDP in 2017) (Peleikis et al., 2012).

The social context of the national plan can be described as an indicator of energy poverty. In Lithuania, it reached 28% in 2018, indicating that 28% of Lithuanians believe that their homes are underheated and, although this figure is highly subjective, Lithuania is the country most affected by energy poverty. Accordingly, existing and planned measures on energy efficiency, financial support for vulnerable consumers, appropriate energy pricing and consumer education and information will be used to tackle the problem (Lietuvos Respublikos Seimo Nutarimas, 2012).

In order to ensure the implementation of the targets set for Lithuania in international climate change agreements and EU legislation, the Sejm of the Republic of Lithuania approved in 2012 the National Strategy for Climate Change, which sets short-term goals and targets for climate change mitigation and adaptation up to 2020 and long-term indicative goals and targets up to 2050. Taking into account the results of the implementation of the National Strategy for Climate Change and Lithuania's new EU energy and climate change objectives for 2030, the strategy undergo a process of renewal with a view to achieving the long-term objectives of the Paris Agreement and the EU vision for climate neutrality by 2050 (Peleikis et al., 2012).

Lithuania is a central European country located on the eastern shore of the Baltic Sea, with a total area of 65 302 km$^2$. The Lithuanian coastline extends for 90.6 km long. The topographical characteristic of the country is predominantly plains. The highest mountain range is 293.8 m above sea level. The country's territory is composed of the following geographical features: clay plains (55.2% of the nation’s territory), sandy plains (17.8%), hilly moraine plateaus (21.2%), coastal plains (2.2%) and river valleys (3.6% of the territory). Arable land constitutes more than half of Lithuania's territory, i.e. it is used for agricultural production. Forests cover 33.5% of the total area, and rivers cover 332 km$^2$, which is 0.5% of the country's territory. The country is home to an extensive network of watercourses, with a total length of 76.8 thousand km, comprising 22.2 thousand rivers and streams. The longest river in the country is the Nemunas (475 km) (Climate Adapt, 2022f).

Lithuania's climate is shaped and influenced by a combination of global factors and local geography. The prevailing climatic characteristics of a region are dependent on the geographical location. Lithuania is situated in the northern section of the temperate climate zone. The second global factor is the prevailing westerly air flow. The country is akin to the broader European region, lies in the zone of influence of the Atlantic and the westerly flow, with respect to parameters such as of air temperature, precipitation and runoff patterns, sea level and others (Nemaniute-Guziene – Kazys, 2017).

The average annual temperature in Lithuania is 7.4°C (1991-2020 climatic normal). The number of extremely hot days, when the daily maximum air temperature reached or exceeded 30°C, increased at the end of the twentieth century. Meanwhile, the frequency of frosty days, defined as those with a daily minimum air temperature falling to -20°C or below, underwent a substantial decline. The climatological precipitation for the period 1991-2020 is 695 mm. However, due to the climate change, precipitation patterns across Lithuania are subject of variation, with increases and decreases occurring in different regions (though these changes are not substantial). Nevertheless, a general tendency for increased precipitation during the cold season (Ministry of Environment of the Republic of Lithuania, 2017).

Current levels of primary and final energy consumption are reflected in actual consumption in 2018 for each economic sector. It is noteworthy that the transport sector is the main energy consumers in Lithuania, accounting for 40% of the final energy consumption, followed by households (27%), industry (19%) and services (12%). The remaining sectors, including construction, agriculture and fisheries, collectively account for approximately 3% of final energy consumption. Projections for primary and final energy consumption are derived from systematic modelling of fuel and energy consumption in individual sectors of the Lithuanian economy. The model is based on statistical data reflecting the current energy consumption situation and on specific assumptions influencing energy consumption forecasts through measures to change consumer behaviour, technological trends in the market (Climate Adapt, 2022f).

Figure 134 shows the total energy demand in the EU. The data show that total energy demand in the EU has decreased by an average of 1% per year over 20 years.

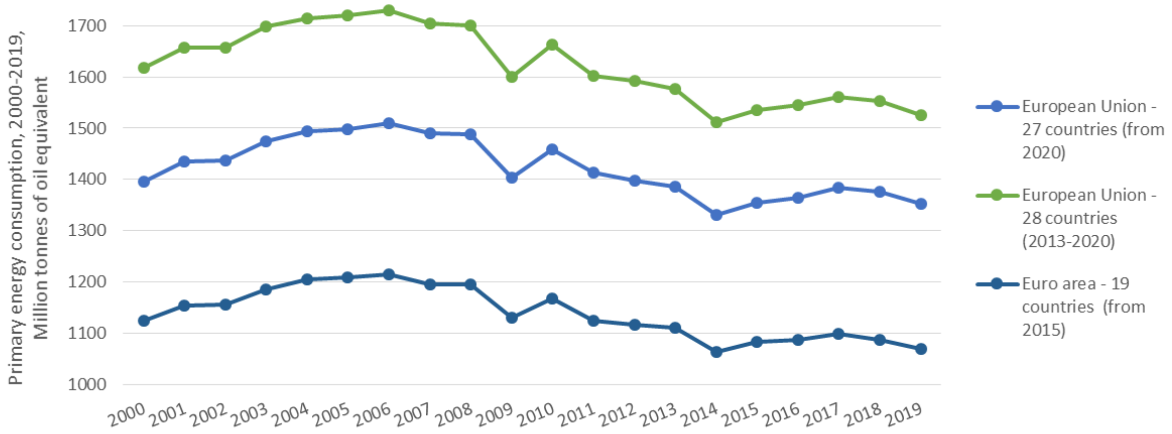



**Figure 133: Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

In the case of Lithuania, however, the average rate of change does not follow this trend and, despite fluctuations over the same period, there is overall stagnation (Figure 135).

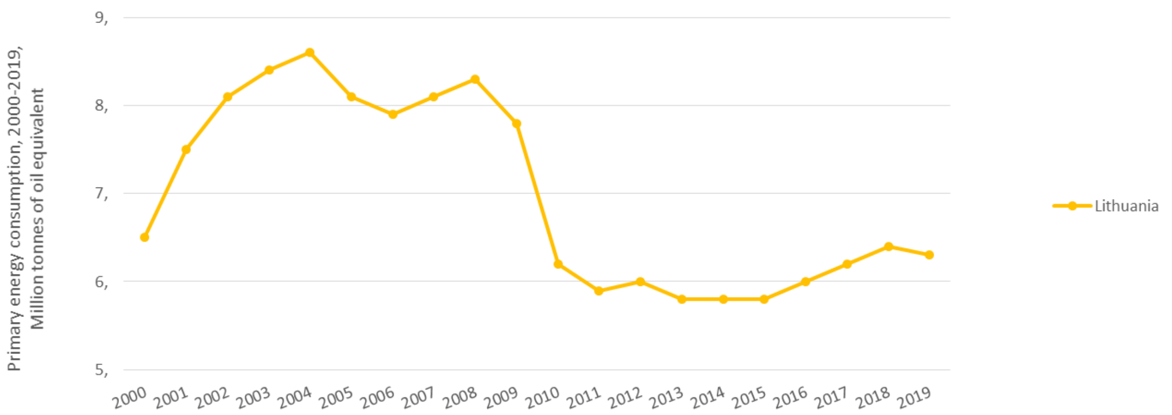



**Figure 134: Lithuania vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

Lithuania is implementing measures to reduce its greenhouse gas emissions on the basis of a national strategy for addressing climate change. This strategy establishes short-term (up to 2030), indicative medium-term (up to 2040) and long-term (up to 2050) climate change mitigation targets and objectives (Peleikis et al., 2012).

Lithuania's GHG emissions are below the EU average but have been steadily increasing by more than 1% per year on average since 2009 (Figure 136).

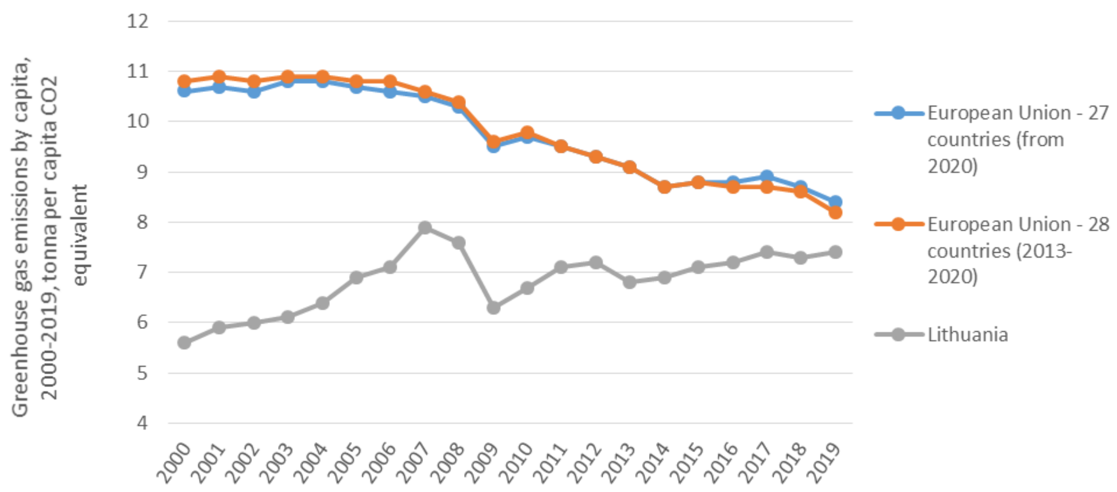



**Figure 135: Greenhouse gas emissions by capita in Lithuania vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 ($CO_2$ equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

Lithuania signed and ratified the Paris Agreement in 2016. The agreement obliges Lithuania has made a binding commitment with the EU and its Member States to reduce greenhouse gas emissions from all sectors of the economy by a minimum of 40% below 1990 levels by 2030 through the EU's domestic efforts. Lithuania's strategic objective in mitigating climate change is twofold: firstly, ensure sustainable development and secondly, to ensure that the national economy grows rapidly whilst greenhouse gas emissions are reduced; and to work with the EU and its Member States to achieve the long-term objectives of the Paris Agreement, namely to stabilise temperatures and neutralise greenhouse gas impacts by 2050 (Nemaniute-Guziene – Kazys, 2017).

Lithuania has committed to increasing the share of renewable energy sources in the EU's final energy consumption to 23% by 2020, a target which was already met in 2014. The implementation of renewable energy development in Lithuania is guided by the NEIS, which establishes long-term energy targets. In this case, the utilisation of renewable energy sources is notably higher than the EU average, although the growth rate has decreased after 2015 (Figure 137).

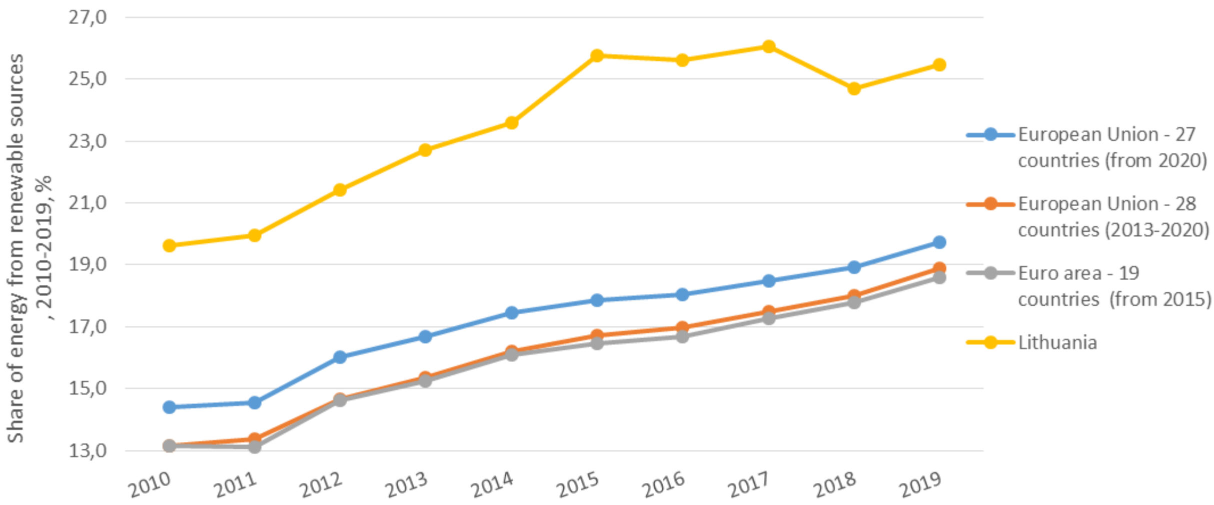



**Figure 136:** **Lithuania vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

The strategy sets targets for the share of renewable energy in gross final energy consumption and for the heat, transport and electricity sectors by 2050.

In view of the fact no renewable energy development has been undertaken since 2015 to meet the targets, it is clear that the 30% goal set by NEIS will not be reached in 2020. Consequently, the share of renewables is determined by taking into account the volume of electricity generation in 2020 when setting Lithuania's obligations. The integration of renewables in the transport sector has been deemed inefficient and too slow. However, the Law on Alternative Fuels currently under development and the transposition of Directive 2018/2001 are expected to accelerate the process. Following the allocation of the full support quota foreseen in the Renewable Energy Act for the period up to 2020, the assistance for electricity from renewable energy sources has been suspended since 2015, leading to a slight slowdown in the development of renewable energy sources. In Lithuania, the primary measures employed to promote the development of renewable electricity by 2020, namely the financial incentives provided, are anticipated to will have a negligible impact on the development of renewable electricity. Therefore, the 30% target set by NEIS for 2020 is deemed unlikely to be met (Nemaniute-Guziene – Kazys, 2017).

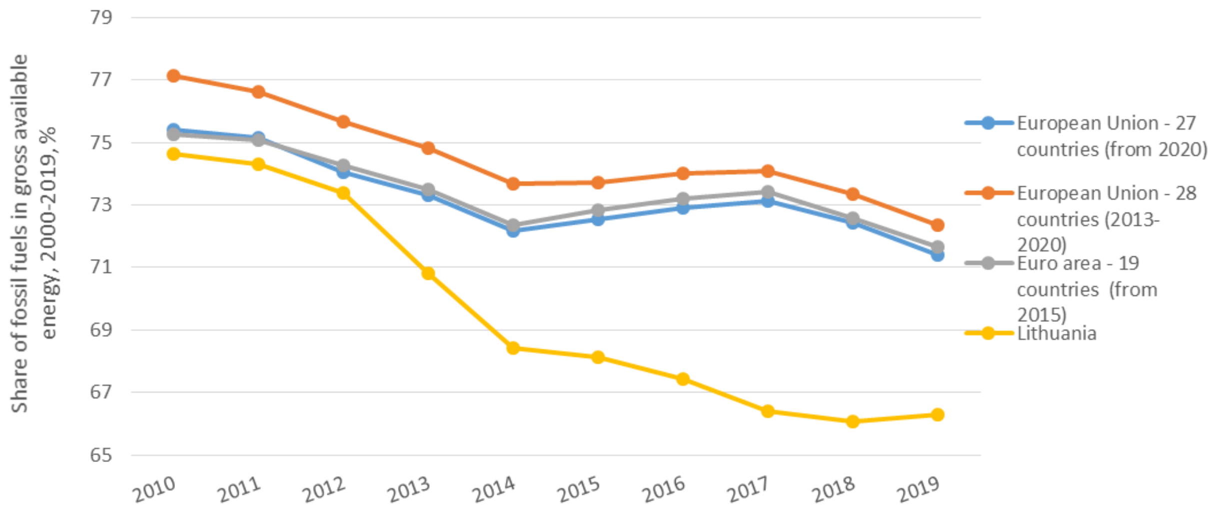



**Figure 137: Lithuania vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

The evolution of the share of fossil fuels in gross available energy is also an important factor, as the use of fossil fuels increases carbon dioxide emissions. In Lithuania, fossil fuel use has been decreasing at a higher rate than the EU average since 2010.

**Composite Indicators**

The Environmental Performance Index (EPI) is a comprehensive metric that assesses the state of sustainability across the globe, including Lithuania. The EPI employs 32 performance indicators across 11 categories of questions and utilises a ranking system to position180 countries according to their environmental health and ecosystem vitality. These indicators demonstrate, at the national level, the extent to which countries are approaching the realisation of their environmental policy goals. The Environmental Performance Index scores of Lithuania from 2014 to 2020 are presented in Figure 139. Regarding the EPI, Lithuania has consistently occupied the middle-bottom half of the ranking and its results were also (2014, 2018, 2020) falling below the EU-27 average and (2016) only surpassing it in 2016.

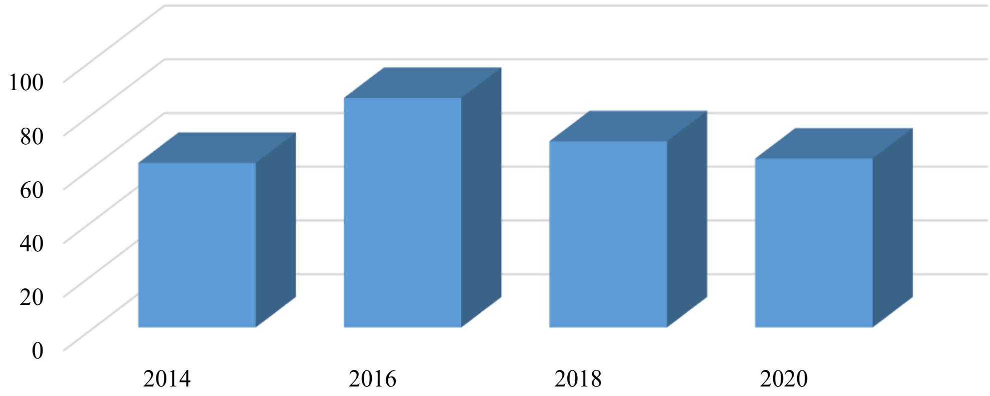



**Figure 138:** **Lithuania – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Its ranks and scores were following in the EPI:

- 2014: 26. with 61.26 points (EU-27 average: 72.17)
- 2016: 16. with 85.49 points (EU-27 average: 82.91)
- 2018: 18. with 69.33 points (EU-27 average: 73.33)
- 2020: 25. with 62.90 points. (EU-27 average: 70,95)

The Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Lithuania's ecological footprint per capita from 2014 until 2020 is illustrated in Figure 140. Lithuania performs quite well in this regard, with its scores consistently exceeding than the EU-25 average level.

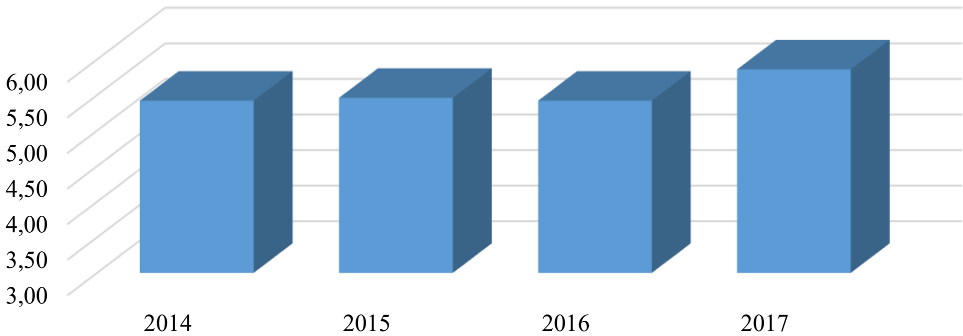



**Figure 139:** **Lithuania – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Its ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

- total score in 2014: 5.45 (EU-25 average: 5.23)
- total score in 2015: 5.46 (EU-25 average: 5.25)
- total score in 2016: 5.42 (EU-25 average: 5.26)

- total score in 2017: 5.86 (EU-25 average: 5.34)

Concerning the Climate Change Performance Index (CCPI) Lithuania's performance is inconstant. This means that between 2014 and 2017 the country ranks at the bottom of the ranking, while between 2018 and 2020 is in the upper line and in 2021 the rank returned to the bottom. The scores of the CCPI for the country can be seen in Figure 141.

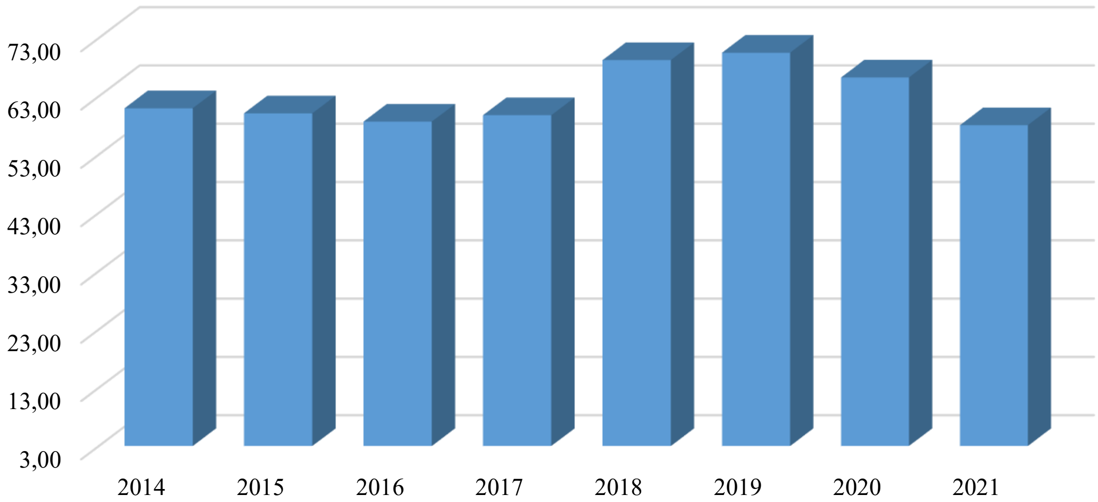



**Figure 140: Lithuania vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

- 2014: 21. with 54.87 points (global average: 55.72)
- 2015: 21. with 54.05 points (global average: 55.36)
- 2016: 20. with 53.85 points (global average: 54.15)
- 2017: 19. with 53.06 points (global average: 53.77)
- 2018: 5. with 45.35 points (global average: 49.09)
- 2019: 6. with 48.11 points (global average: 50.35)
- 2020: 8. with 40.12 points (global average: 48.61)
- 2021: 15. with 42.64 points (global average: 47.90)

Mostly, Lithuania's scores were below the average.

**Summary**

Since regaining its political independence in 1990, Lithuania has undergone significant political and economic changes. Major economic reforms were implemented, including price liberalisation and the privatisation of small and medium-sized enterprises between 1991 and 2000. During the initial decade of market reforms, the institutional aspects of the transition emerged as the predominant national and international concern, culminating in the granting of functional market economy status upon accession to the EU in 2004.

The country's economy and macroeconomic indicators have been the primary drivers of development over the past decade. The period from 2000 onwards witnessed the fastest economic growth in 2003 (GDP growth of 10.5% compared to the previous year), after the recovery from the Russian crisis (GDP fell by 1.1% in 1999). In the subsequent years, GDP growth exhibited a modest decline. Since 2004, Lithuania has experienced significant growth as a member of the EU, coupled with rapid modernisation of the economy, and in 2018 it became a member of the OECD. Notably, the country demonstrated the most rapid recovery in Europe following the 2009 global financial crisis, a feat partly attributable to the robust performance of its banking system and the diversified nature of its industrial sector.

Agriculture contributes 3.2% to GDP and employs 7% of the labour force (World Bank, 2020). The main agricultural products of Lithuania are wheat, timber, barley, potatoes, sugar beet, wine and meat (beef, sheep and pork). Arable land and permanent crops cover 2 million hectares, which is more than a third of the country's total land area. The industrial sector, meanwhile, accounts for 25.3% of GDP and employs approximately 26% of the active population. The primary industrial sectors include electronics, chemical products, machine tools, metalworking, construction materials, household appliances, food processing, light industry (including textiles), clothing and furniture. Furthermore, the country is undergoing a development phase with regard to oil refineries and shipyards. The World Bank estimates that manufacturing alone accounts for 16% of the country's GDP. The services sector by contrast, is responsible for the generation of61.4% of GDP and account for more than two thirds (67%) of the active population. The information technology and communication sectors are the main contributors to GDP. Tourism has been one of the fastest-growing sectors of the country's economy in recent years.

The sustainable growth of the Lithuanian economy has been driven by the growth of national GDP and the reduction of greenhouse gas emissions (total greenhouse gas emissions from all sectors of the economy decreased by 9.8% and the country's GDP increased by 36% between 2005 and 2017). These developments have been achieved in line with the targets set out in international agreements and EU legislation.

Recent years have seen a moderate growth in GDP (2012-2016), averaging 3%, with stronger economic growth observed in 2017. The change in real GDP compared to 2016 was 3.9%. The change in GDP was mainly driven by the increase in value added in the services sector and industry between 2015 and 2017. Between 1990 and 2017, GDP grew by 45% and GHG emissions decreased by 58%. According to the forecasts of the Ministry of Finance of the Republic of Lithuania, taking into account the following factors in the changed external environment, Lithuania's GDP is projected to grow by an average of 2.4% per year in 2019-2022, which is about 0.8 percentage points above the EU average. GDP is expected to grow by 2.6% in 2019, 0.2 percentage points below the autumn 2018 estimate. GDP is expected to grow by 2.4% in 2020, 2.3% in 2021 and 2.3% in 2022. Domestic demand will remain a key driver of the Lithuanian economy. The government's strategy to enhance personal income and investment incentives is expected to stimulate domestic demand, along with foreign direct investment (FDI) and the implementation of investment projects financed by EU financial support.

**Good practices**

Paris Agreement on Climate Change, the 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR) have synergies with adaptation actions and are of great importance for the progress of this field.

Lithuania has demonstrated a commitment to the Baltic Sea Region Climate Change Adaptation Strategy and Action Plan through its active involvement. Furthermore, Lithuanian non-governmental and academic institutions have demonstrated notable activity in various regional projects being implemented in the area of adaptation to climate change. The focus of these projects is on analysing and elaborating adaptation options to be implemented at the local level.

The Strategy sets goals and targets in the most vulnerable sectors which are relevant to transboundary cooperation. The transboundary cooperation is invoked responding to the needs to address common challenges with relevant countries. The transboundary cooperation in flood risk management is organised within the framework of already existing intergovernmental agreements between Lithuania, Latvia and Poland. These agreements facilitate cooperation and the exchange of information and data in environmental fields. The implementation of four River Basin Management Plans is also fundamental to ensuring transboundary cooperation.

**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Adapt (2022f). Lithuania. Retrieved from https://climate-adapt.eea.europa.eu/countries-regions/countries/lithuania

- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Lietuvos Respublikos (2020). Nacionalinis energetikos ir klimato srities veiksmu planas 2021-2030 m. Vilnius, Lietuvos Respublikos.
- Lietuvos Respublikos Seimo Nutarimas (2012). DĖL NACIONALINĖS KLIMATO KAITOS VALDYMO POLITIKOS STRATEGIJOS PATVIRTINIMO. Vilnius, Lietuvos Respublikos Seimo.
- Ministry of Environment of the Republic of Lithuania (2017). Lithuania’s Seventh National Communication under the United Nations Framework Convention on Climate Change. Vilnius, Ministry of Environment of the Republic of.
- Nemaniute-Guziene, J., Kazys, J. (2017). Climate Change and Lithuanian Roads: Impacts, Vulnerability and Adaptation. Environmental Engineering 10th International Conference.
- Peleikis, J., Gratz, M., Hirschfeld, J. (2012). Adaptation to Climate Change in the Baltic States. Berlin, Institute for Ecological Economy Research.

## 4.18. LUXEMBOURG

Luxembourg's population in 2020 was estimated at 625,978 people and its population density is 242 per $km^2$. The total land area is 2,590 $km^2$ and the 88.2% of the population is living in urban areas. The biggest cities are Luxembourg (76,684 persons), Esch-sur-Alzette (28,228 persons) and Dudelange (18,013 persons) (worldometers.info).

The average annual growth rate is elevated in Luxembourg compared to the neighbouring regions. his phenomenon can be attributed to significant immigration patterns, with 47.4% of the residential population lacking citizenship in 2020. This figure has increased significantly from 30% three decades prior. This area appears to be attractive to foreigners for several reasons and the country's economic restructuring and development processes towards the tertiary sector have resulted in high wages (climate-adapt.eea.europa.eu).

Luxembourg's economy is defined by its small size and openness to external markets, which renders it susceptible to the impact of global economic fluctuations. Its economic cycle is analogous to that of other European countries; however, the amplitude of GDP variations is more pronounced. The following economic cycles have been observed since 1990:

- until 1992: exceptional growth
- 1992–1996: economic slowdown
- 2002–2004: less impressive economic growth, stagnation of the GDP level per inhabitant compared to the EU-15 level
- 2005–2008: good economic performance
- 2008: economic crisis
- from 2010: slow recovery and it flattened quickly for the industry and commercial sectors
- nowadays: economic growth is dominated in the financial sector, real estate, services and business sector. Luxembourg is a global leader in the investment fund industry and the private banking centre of the Euro area's (climate-adapt.eea.europa.eu).

The country's major economic statistics compared to the EU-27 average are illustrated in Figure 142.

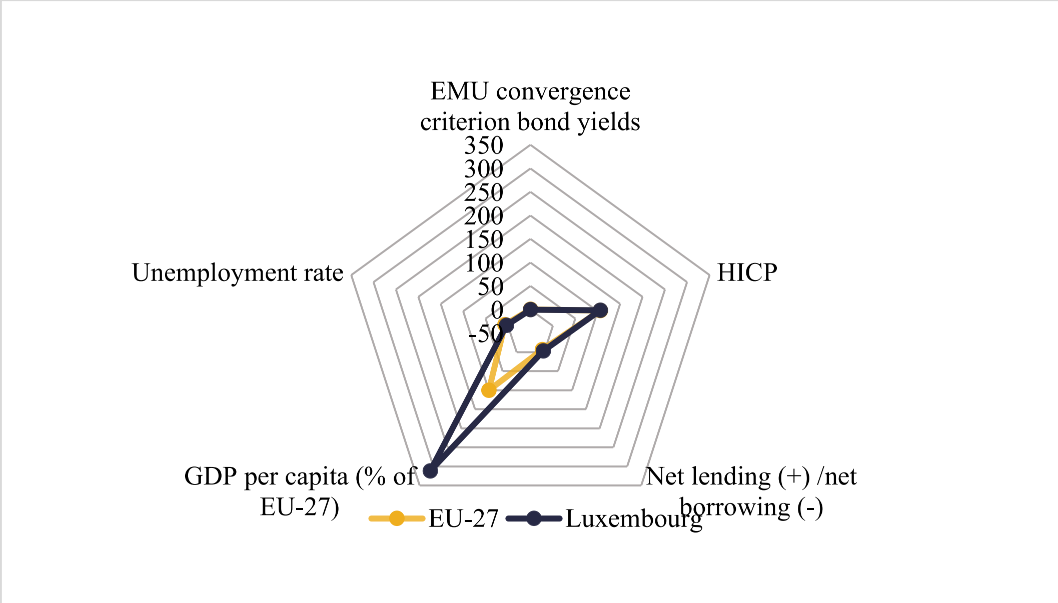



**Figure 141: Luxembourg vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

According to the latest statistics and forecasts, Luxembourg's economy is poised to undergo a period of robust growth, with projections indicating a 3.7% growth in 2022 and 3.1% in 2023. Investment and consumption are also expected to increase, and financial and business services are predicted to return to normal level. Conversely, employment and wage levels are expected to remain stable. Covid-related incentives that encourage greener investments are projected to support the private sector. Export growth is predicted to remain positive, despite its muted expectations, as the ongoing relaxation of supply-chain restrictions lift. While core inflation is expected to rise, the risks to the outlook are considered balanced (OECD Economic Outlook, 2021, pp.170-172.)

## Climate Strategy

The effects of climate change are also clearly measurable in Luxembourg. Between the period of 1981 and 2010, the average temperature in the country rose to 9.3°C, representing a 1°C increment compared to the period between 1961-1990 and the 21st century’s 16 warmest temperatures were measured than. Precipitation changed, extreme weather conditions also happened and according to the forecasts the risk of flooding increased. In response to these challenges, Luxembourg developed a strategy and action plan for the adaptation to the effects of climate change for the period 2018-2030. The strategy identifies the following sectors as being the most vulnerable: construction and housing, energy, forestry, infrastructure, crisis and major accident management, land use planning, agriculture (including plant and animal health), human health, ecosystems and biodiversity, tourism, urban spaces, hydrological regime and water management, and the economy. In cooperation with scientific institutions, a strategic plan was developed for these sectors to minimise the negative effects in the future. (Stratégie Et Plan D'action Pour L'adaptation Aux Effets Du Changement Climatique Au Luxembourg 2018–2023).

In this plan the following are highlighted:

- support energy saving projects and solar energy development projects
- expand biomass power plants considering the aspects of sustainability
- create building standards that prove against extreme weather conditions
- develop infrastructure to reduce vulnerability (Stratégie Et Plan D'action Pour L'adaptation Aux Effets Du Changement Climatique Au Luxembourg 2018–2023).

However, these aims are not budgeting and there is no separate financial support has been allocated for their implementation. Instead, it will be executed within the framework of current resources of the different Ministries and administrations (climate-adapt.eea.europa.eu).

In 2020, Luxembourg has adopted its climate law, which established the objective of achieving climate neutrality by 2050 and a 55% reduction in emissions by 2030. The law also introduced sectoral targets for a 10-year long period to facilitate the achievement of the overarching goals. Luxembourg has one of the lowest levels of environmental taxes, accounting for only 4.4% of total tax revenue. This is in conjunction with a relatively high average purchasing power, which may pose challenges in the future. Luxembourg has introduced a carbon price (€20 per tonne of $CO_2$) that will increase in the upcoming years, and passenger car registration taxes will also increase (Jensen, 2021b).

The country's geographical location is a key factor in its high energy dependent, importing electricity, gas and mineral oil products. Consequently, there is a necessity to enhance energy efficiency and curtail demand. Pentalateral Energy Forum, a regional cooperation initiative is essential in this context. In 2021, Luxembourg unveiled its circular economy strategy, that contained guidelines to reduce and optimize the utilisation of the nation's finite natural resources, thereby fostering the realisation of its and support climate targets (Jensen, 2021b).

Luxembourg's ultimate objective with regard to the reduction of energy consumption by 2030 is a 44% decrease in relation to 2005 levels. The country has commenced investment in significant energy efficiency programmes, with the objective of ensuring comprehensive coverage of all sectors during the 2021-2030 period (Jensen, 2021b).

Luxembourg's primary energy consumption comparing with EU-28 can be seen in Figure 143.

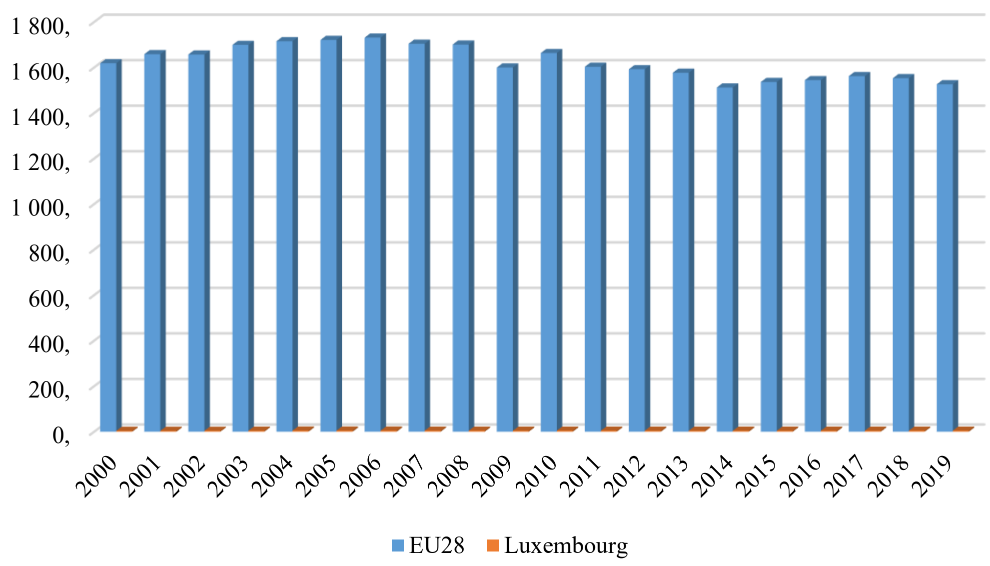



**Figure 142: Luxembourg vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**

Source: own compilation based on Eurostat (2022a)

The energy use per person has decreased from 1965 to 2019. The highest value was 144,959 kWh in 1974 and the lowest was 76,658 kWh in 2019. In 2020, an average person consumed 1,529 kWh electricity (ourworldindata.org).

Regarding the energy efficiency Luxembourg has the following central objectives:

- ❖ Energy efficiency target of 40-44% by 2030 (compared to the EU PRIMES model (2007)
- ❖ New fossil-free single-purpose and residential buildings
- ❖ High rate of renovation and highly efficient building renovations
- ❖ Developing renewable heating networks
- ❖ Preventing traffic through massive expansion of public transportation and 49% share of electromobility by 2030
- ❖ Developing a large energy efficiency market for industry, SMEs and office buildings (Luxembourg's Integrated National Energy and Climate Plan For 2021–2030, pp: 9-10.)

The share of fossil fuels in gross available energy is demonstrated in Figure 144.

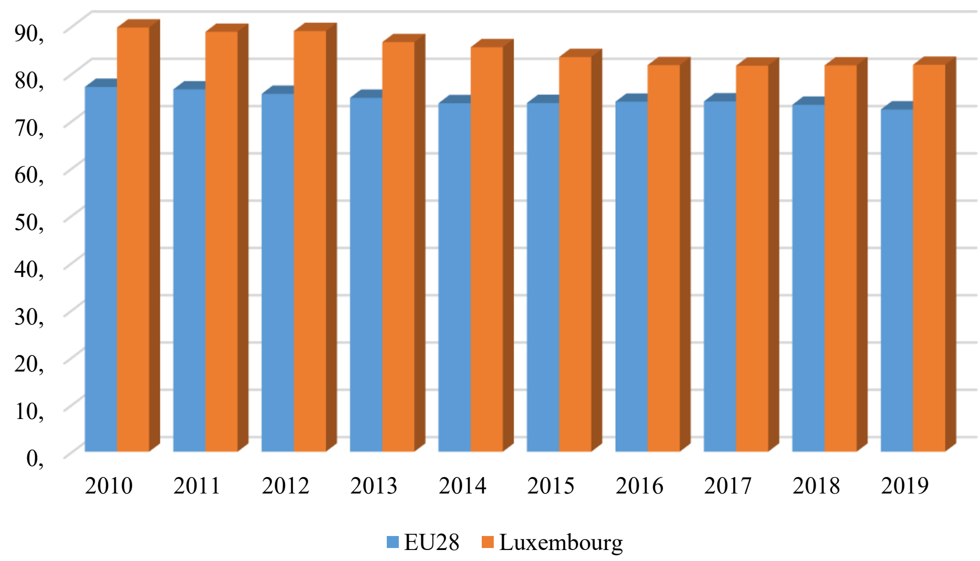



**Figure 143: Luxembourg vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

Luxembourg's fossil fuel consumption is closely aligned with the EU-28 average. However, in accordance with the European Union's principles the country will not support project plans based on fossil fuels (Luxembourg's Integrated National Energy and Climate Plan For 2021–2030).

Luxembourg has been observed to have one of the highest per capita emissions levels with GHG emissions per inhabitant (20.6 tons of $CO_2$ equivalent) in 2019. However, the country reduced it with 34% between 2005 and 2019. The nation's contribution to the EU's aggregate $CO_2$ emissions stood at 0.34%. Approximately 50% of the total emissions are connected to the transportation, although they have been reduced by 14% since 2005. A similar reduction has been observed in other sectors, excluding agriculture, building and the tertiary sector. The former increased by 10% while the latter rose by 20% since 2005. The most significant reduction happened in the energy industry sector (-81% between 2005 and 2019). The emissions in connection with industrial processes and products increased by 9% in this period, yet the proportion of total emissions attributed to this sector remained constant. The highest emission was coming from the transportation sector, the second one was in connection with manufacturing and the third belongs to the industrial processes and product use and agriculture in 2019 (Jensen, 2021b).

Luxembourg's greenhouse gas emissions by capita compared to EU-28 average from 2000 to 2019 can be seen in Figure 145.

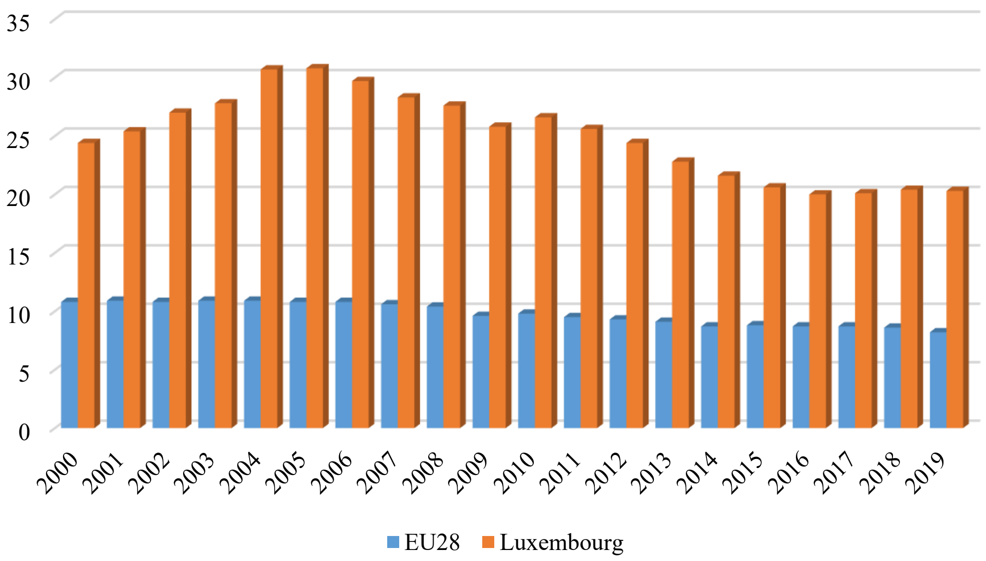



**Figure 144: Luxembourg vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

A decline in $CO_2$ emissions per capita has been recorded between 1990 and 2020. The total $CO_2$ emissions has also decreased from 1990 until 2020. The highest emission was measured in 2005 from that year the values were declined. An analysis of the main energy sources reveals that the majority of $CO_2$ emissions are attributable to the oil, followed by natural gas and coal. From 1990 to 2018 $CO_2$ emissions has increased regarding oil and natural gas, while coal emissions decreased (iea.rog).

Luxembourg's share of energy from renewable sources are illustrated in Figure 146.

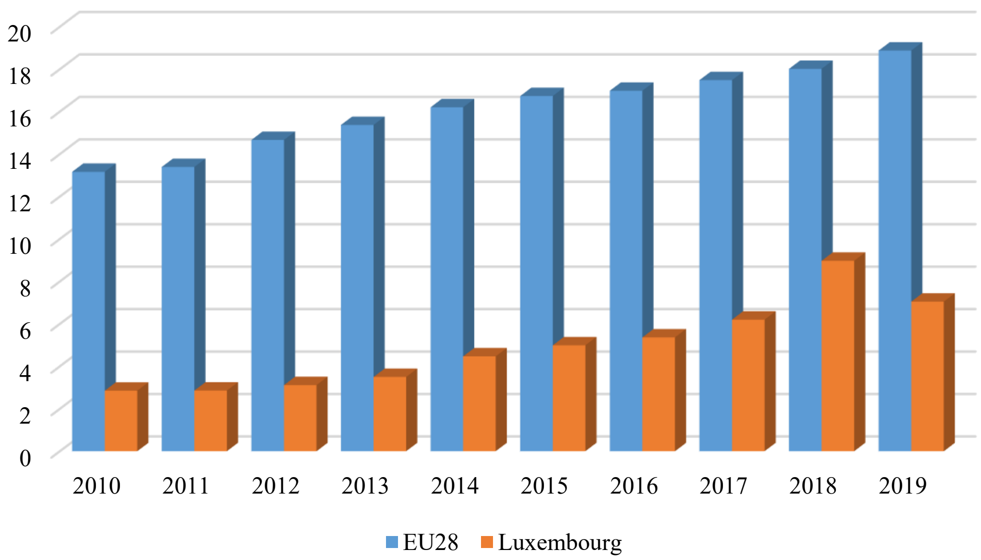



**Figure 145: Luxembourg vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**

Source: own compilation based on Eurostat (2022d)

Luxembourg’s target achieving a 7% share of renewable energy sources in 2019 appears ambitious, particularly in light of the challenges posed by its geographical characteristics. According to the country’s previously mentioned scenario the goal is to increase the current7% to 19.6% by 2030. In order to achieve the 25% target, it is crucial for Luxemburg to engage in cooperative endeavours with other Member States. Statistical transfers and agreements with Lithuania and Estonia have already been established, and cooperation in the area of off-shore wind projects and solar installations in southern Europe are under consideration. According to the forecasts, by 2030, renewables are expected to become the primary energy sources for electricity consumption, heating sector and biomass generation (Jensen, 2021b).

**Composite Indicators**

Luxembourg's performance is excellent regarding those performance indicators that measure sustainability and climate protection. Luxembourg’s Environmental Performance Index (EPI) scores from 2014 to 2020 are presented in Figure 147. It is noteworthy that Luxembourg consistently ranked within the top 20 out of the 180 countries evaluated. Furthermore, the results obtained by Luxembourg consistently surpassed the EU-27 average.

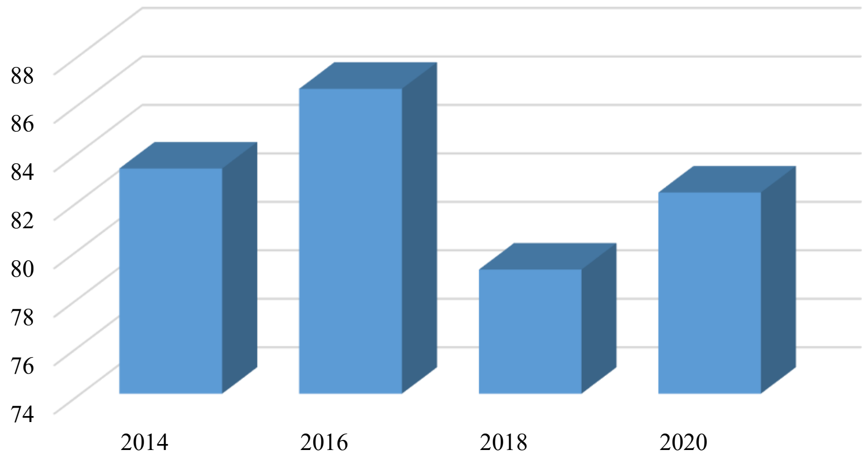



**Figure 146: Luxembourg – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Its ranks and scores were following in the EPI:

- 2014: 2. with 83.29 points (EU-27 average: 72.17)
- 2016: 20. with 86.58 points (EU-27 average: 82.91)
- 2018: 7. with 79.12 points (EU-27 average: 73.33)

❖ 2020: 2. with 82.30 points. (EU-27 average: 70,95)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Luxembourg's ecological footprint per person from 2014 to 2020 can be seen in Figure 148.

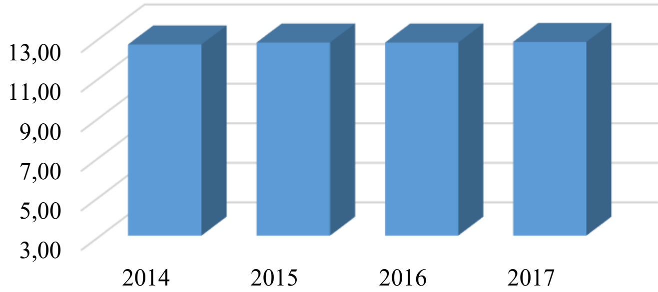



**Figure 147: Luxembourg – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Its ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

- ❖ total score in 2014: 12.66 (EU-25 average: 5.23)
- ❖ total score in 2015: 12.76 (EU-25 average: 5.25)
- ❖ total score in 2016: 12.76 (EU-25 average: 5.26)
- ❖ total score in 2017: 12.79 (EU-25 average: 5.34)

Luxembourg performs relatively well regarding the ecological footprint as its scores are better than EU-25 average level.

Concerning the Climate Change Performance Index (CCPI) Luxembourg's performance is inconstant. The scores of the CCPI for the country can be examined in Figure 149.

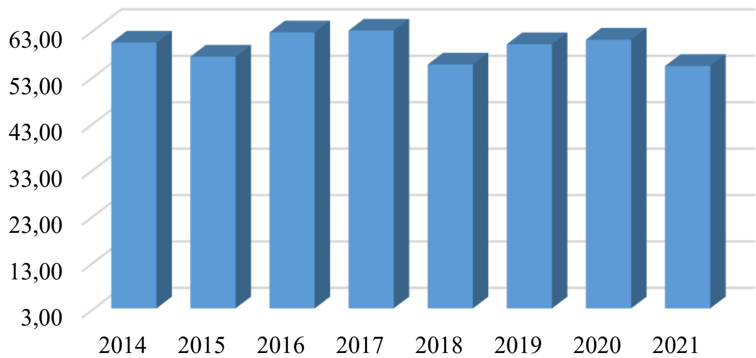



**Figure 148: Luxembourg vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

- 2014: 23. with 60.27 points (global average: 55.72)
- 2015: 29. with 67.25 points (global average: 55.36)
- 2016: 13. with 62.47 points (global average: 54.15)
- 2017: 9. with 62.86 points (global average: 53.77)
- 2018: 25. with 55.54 points (global average: 49.09)
- 2019: 19. with 59.92 points (global average: 50.35)
- 2020: 13. with 60.91 points (global average: 48.61)
- 2020: 21. with 55.23 points (global average: 47.90)

**Good practises**

**Free public transportation**

In 2020, Luxembourg introduced a policy of universal access to public transportation. This initiative is unique in the world, and its scope encompasses all modes of public transport, including trains, buses and trams in the whole territory of the country. According to the plans, it will enhance the quality of the transportation, provide economic support to low-income households, and to contribute to reduction of the air pollution. This initiative was deemed imperative since over 50%of greenhouse gases are coming from the transportation. he policy is expected to encourage a shift in personal transportation choices, with a reduced reliance on private vehicles in favour of public transport. Moreover, among the additional targets were the elimination of road congestion, the support of low-income people, and the reduction of air pollution (24.hu, 2020).

**Financial support for buying e-cars**

In May 2020, the government launched a subsidy programme with the aim of encouraging the acquisition of electric vehicles. Financial incentives amounting to between €5000 and €8000 are available to the buyers of purely electric or plug-in-hybrid cars. This system was extended until March 2022. The primary goal of this initiative is to promote the purchase of compact and energy-efficient vehicles. The country would like to increase the number of e-cars on the road, with a target of 49% by 2030. However, in 2021, electrified vehicles constituted a mere 3-4% of the newly registered cars (autoapro.hu, 2021).

**Luxembourg City's commitment to the environment**

Luxembourg City is the 8th greenest city worldwide. The city is dedicated to take actions to protect the environment. The municipality has implemented the following measures to reduce the use of hazardous products:

- toxic waste is forbidden to be thrown in bins or down the drain,
- empty containers and other packages of hazardous waste must be disposed according to the regulations (vdl.lu).

As the result of the city's efforts toward environment protection in 2015 it received the "Naturgemeng 2014 Label". They were evaluated in the following categories where they reached excellent results: participation in national projects; residential area; green area; agriculture; forestry; water (vdl.lu). Sustainability is a key part of Luxembourg City's spatial planning policy:

Part of their mission is balanced development, the preservation of green areas, and environmentally friendly city management.

The city is committed to preserve the vegetation not only in the outdoor areas, but also within the buildings, with a clear objective to establish an extensive network of green areas.

The city has become a signatory of the GMO-Free Luxembourg initiative and refuse the exclusion of GM ingredients to be served in its municipal cafeterias, crèches and childcare centres. In addition to the prohibition of genetically modified crops, a clause has been incorporated into farm leases stipulating the exclusion of GMOs in the event of their renewal (vdl.lu).

**Regulation of paper use**

Since 2008, they authorities have been encouraging the general populace to use paper moderately and reasonably, and to be more environmentally conscious in their office practices (e.g. benefits of recycled papers, selective recycling of papers). The workers of the municipality were the informal ambassadors for this initiative (vdl.lu).

**Avoiding insecticides**

In order to respect and protect the environment and increase the standard of living, Luxembourg refrain from using insecticides in all areas, especially in areas frequented by children (near schools, playgrounds). The objective is to augment biodiversity, for instance, by preserving the native flowers to ensure a sufficient supply of nectar, in addition to enhancing the standard of living and mitigating air and water pollution https://24.hu/kulfold/2020/03/01/luxemburg-tomegkozlekedes-ingyenes-vonat-busz-villamos/

https://autopro.hu/gazdasag/egy-evvel-meghosszabbitja-luxemburg-az-elektromos-autok-tamogatasat/485861

https://www.vdl.lu/en/city/projects-and-commitments/environment/luxembourg-citys-commitment-environment

**Luxembourg City Recycling Center**

There is a modern waste collection and recycling centre in the Luxembourg capital. The company has many off-site containers for the collection of toxic waste, which residents are required to use, and the company also arranges for its further transport and disposal (Rao, 2022).

- Application for monitoring the carbon dioxide emissions of passenger vehicles in your own country.(https://www.ccacoalition.org/en/partners/luxembourg)

- Four-day work week or telecommuting option to reduce car use.(https://www.oecd-ilibrary.org/sites/b35b6f18-en/index.html?itemId=/content/component/b35b6f18-en

**References**


- 24.hu (2020): Mostantól ingyenes a tömegközlekedés Luxemburgban. 24.hu. Available: https://24.hu/kulfold/2020/03/01/luxemburg-tomegkozlekedes-ingyenes-vonat-busz-villamos/ (01.03.2022)
- Autoapro.hu (2021): Egy évvel meghosszabbítja Luxemburg az elektromos autók támogatását. Available: https://autopro.hu/gazdasag/egy-evvel-meghosszabbitja-luxemburg-az-elektromos-autok-tamogatasat/485861 (01.03.2022)
- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.

- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Jensen, L. (2021b). Climate action in Luxembourg- Latest state of play. Available: https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/690664/EPRS_BRI(2021)690664_EN.pdf (12.11.2021)
- Luxembourg's Integrated National Energy and Climate Plan For 2021–2030, Available: https://ec.europa.eu/energy/sites/ener/files/documents/lu_final_necp_main_en.pdf (13.12.2021)
- OECD (2021). OECD Economic Outlook, Volume 2021 Issue 2: Preliminary version, No. 110, OECD Publishing, Paris, https://doi.org/10.1787/66c5ac2c-en (11.11.2021)
- Rao, S. (2022): A guide to recycling your waste. Luxembourg Times. Available: https://www.luxtimes.lu/en/living-in-luxembourg/a-guide-to-recycling-your-waste-60e720e3de135b9236dcc16b (03.03.2022)
- Stratégie Et Plan D'action Pour L'adaptation Aux Effets Du Changement Climatique Au Luxembourg 2018–2023. Available: https://environnement.public.lu/content/dam/environnement/documents/klima_an_energie/Strategie-Adaptation-Changement-climatique-Clean.pdf (13.12.2021.)
- vdl.lu: Luxembourg City's commitment to the environment. Available: https://www.vdl.lu/en/city/projects-and-commitments/environment/luxembourg-citys-commitment-environment (01.03.2022)
- https://www.worldometers.info/ (15.12.2021)
- https://climate-adapt.eea.europa.eu/ (12.12.2021)
- https://ourworldindata.org/ (12.12.2021)
- https://www.iea.org/ (12.12.2021)
- https://www.enerdata.net/
- https://www.worldbank.org/en/home (12.12.2021)

## 4.19. MALTA

Malta is an archipelago in the centre of the Mediterranean Sea (316 km$^2$, coastline 271 km). The country comprised of three mainly inhabited islands and a number of other small uninhabited islands. The southern coast facing the African continent, is distinguished by its cliffs, while the northern coast is dominated by a low-lying coastline. The northern region is characterised by the presence of low hills, while the southern region is predominantly plain. The Maltese Islands are notable for the absence of mountains, lakes, and rivers. The island nation experiences a typical Mediterranean climate, with hot and dry summers and relatively mild winters. The country has few natural resources such as limestone and sea salt. Despite the lack of carbon monoxide-intensive industry, the country is still affected by greenhouse gas emissions. (Climate Adapt, 2020)

In 2012, the Maltese government passed the Sustainable Development Act, thereby establishing a legal framework that obliges the government to incorporate sustainable development into its policies. (UN, 2018)

Figure 150 shows the main economic statistics of Malta compared to the EU-27 average.

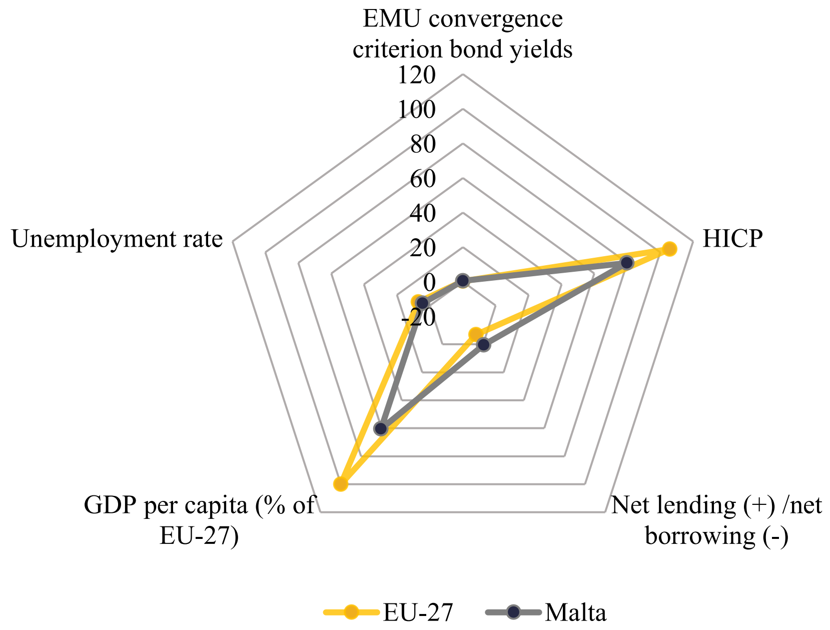



**Figure 149: Malta vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

As demonstrated in Figure 150 Malta exhibits a significant deviation from the EU-27 average in two key indicators. Specifically, Malta's GDP per capita stands at 60% of the EU average, while the Maltese Harmonized Index of Consumer Prices (HICP) value was 79.68 at the same time this value was 105.76 in the EU-27.

Since 2013, the lead agency for sustainable development has been the Ministry for the Environment, Sustainable Development and Climate Change (MESDC), as outlined in Malta`s Sustainable Development Act. The overarching objective of the law is to promote the sustainable development, and it establishes three distinct structures to facilitate this aim:

- the competent authority (MESDC) responsible for a range of functions set out in the law
- the Guardian of Future Generations, responsible for promoting the principles of sustainable development, maintaining the interests of future generations
- the Sustainable Development Network.

The Malta Sustainable Development Strategy encompasses 20 priority areas. These are linked to targets and indicators, also include the environment, the economy and society. To this end, a policy is required that will adapt to local geo-climatic conditions through adaptation and organic farming, whilst also ensuring better management and provision of an adequate supply of drinking water, wastewater treatment and rainwater harvesting. Furthermore, the country's carbon footprint and greenhouse gas emissions must be reduced through energy efficiency and the replacement of heavy fuel oil with natural gas and diesel and renewable sources. The Maltese government is currently engaged in the formulation of a national vision for 2050. This aims to provide long-term guidance for sustainable development. In parallel, the 2030 Agenda will be integrated into sustainable development policies at all levels of government. (EEA, 2020)

In 2012, the Ministry of Resources and Rural Affairs (Government of Malta) published the National Climate Change Adaptation Strategy. It states that Malta cannot continue to rely exclusively on active cooling to counter the effects of poor building design. Designs should be improved, when necessary, through the use of legislation and economic dis/incentives, to maximize passive cooling supported by the education of households/industry on cost effective retrofitted of energy and water technologies onto existing buildings. A core pillar of the adaptation strategy is the continued conservation of biodiversity and ecologically dependent ecosystems and, wherever possible, the restoration of habitats to a favourable conservation status. The discourse surrounding the present generation’s utilisation of natural resources and the natural resources that this generation will bequeath to future generations is pivotal to the climate change debate, the design and development of policy, and the subsequent implementation thereof. (Gov., 2012).

## Climate Strategy

### Primary Energy Consumption

Figure 151 visualizes the total energy needs of Malta compared to the EU28. Averagely the Maltese amount was negligible from the total primary energy consumption in the European integration between 2000 and 2019. (Eurostat 2022a).

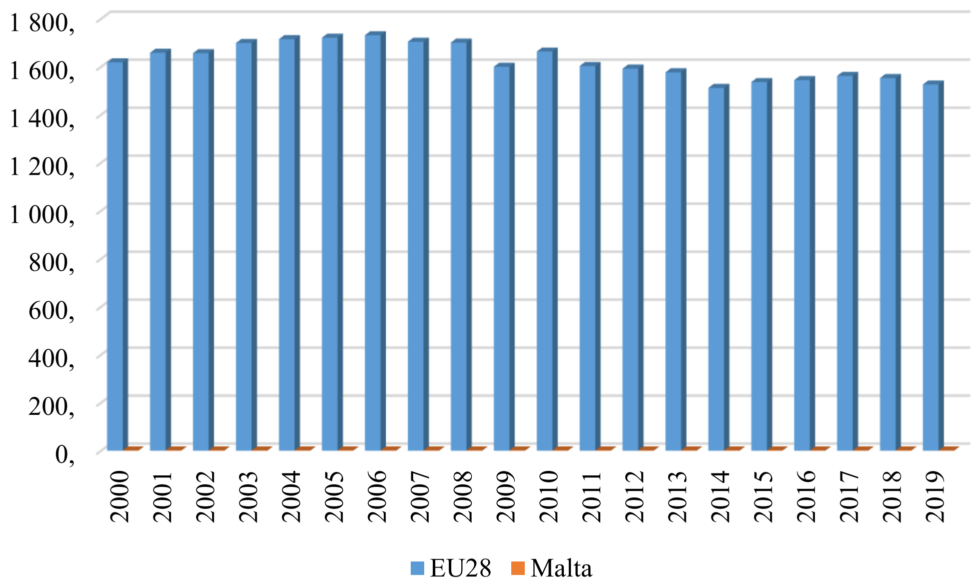



**Figure 150:** **Malta vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

### Share of Fossil Fuels in Gross Available Energy

In 2019, Malta was the EU Member State with the highest share (97%) of fossil fuels in gross available energy. Figure 152 shows the share of fossil fuels in gross available energy in Malta compared to the EU28 between 2010 and 2019 (%). (Eurostat, 2022b)

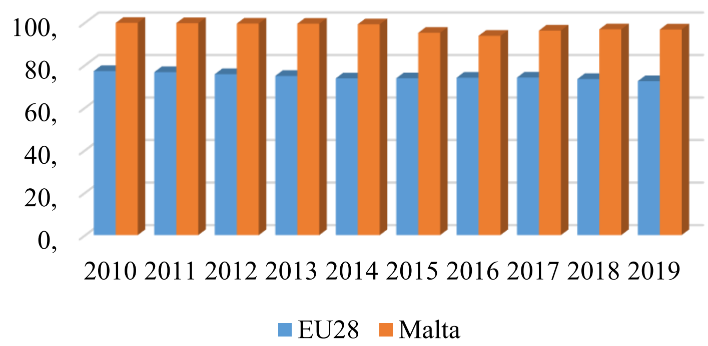



**Figure 151:** **Malta vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

Malta lacks domestic resource of fossil fuels and gas distribution network and relies overwhelmingly on imports of fossil fuels and electricity to cover its energy needs (EU, 2019).

### Greenhouse Gas Emissions by Capita

In the Maltese context, the overwhelming majority of energy is derived from imported oil products, rendering the country particularly vulnerable to oil price fluctuations. Energy policies are oriented towards on reducing energy dependency, including support for renewable energy sources, subsidies for building insulation and the establishment of electricity interconnections with Sicily. In particular, the interconnection will increase the stability of the grid, allow for the import/export of electricity, thereby reducing the reliance on oil, while concurrently lowering the greenhouse gas (GHG) intensity of the domestic electricity sector. The non-ETS emission reduction target is as follows: The Maltese 2020 target is a limitation to emission growth of +5% compared to 2005. (Banasiak, 2013)

Figure 153 presents the greenhouse gas emissions by capita in Malta compared to the EU28 between 2010 and 2019. (Eurostat, 2022c)

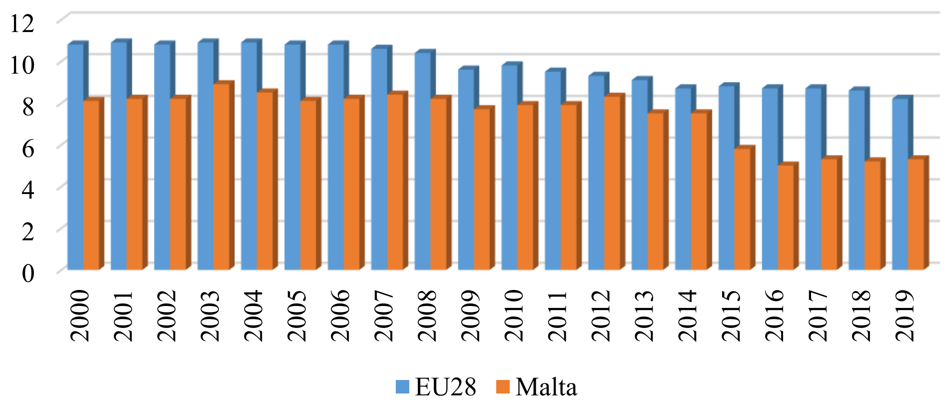



**Figure 152: Malta vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 ($CO_2$ equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

### Share of energy from renewable

Figure 154 shows the share of energy from renewable sources in Malta compared to the EU28 between 2010 and 2019. (Eurostat, 2022d)

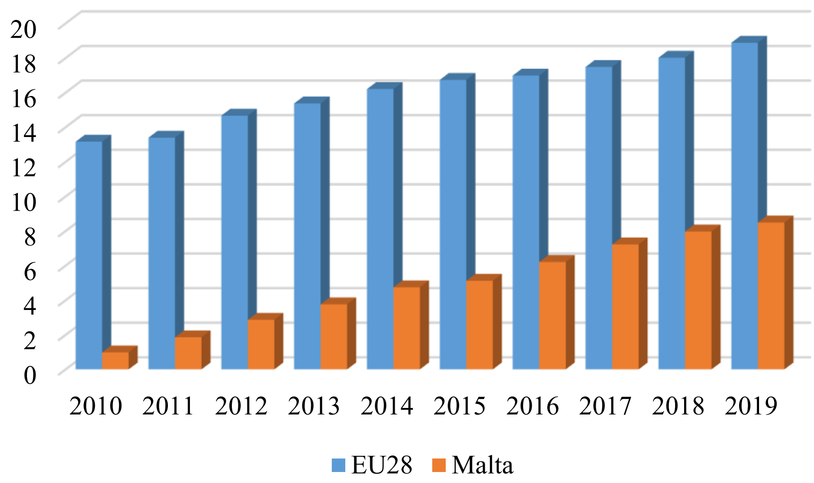



**Figure 153:** **Malta vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

Malta's development of renewable energy has fallen behind the EU28 average. In 2019, the share of renewable energy in total final consumption in 2019 was 8.5%. This figure signifies a substantial increase when contrasted with the 2010 statistics, which recorded a mere 1%. However, to achieve the 2020 target of 10%, significant actions are imperative.

**Composite Indicators**

**Environmental Performance Index**

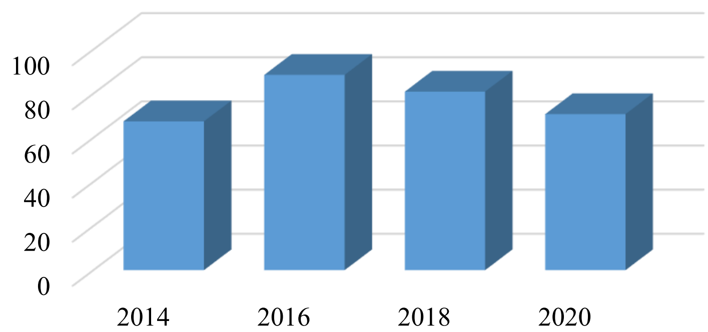



**Figure 154:** **Malta – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

The Environmental Performance Index for the year 2020 ranks 180 countries. Malta with 70.7 score is the 23rd in this list.

**Ecological Footprint per person**

The ecological footprint data is not available for Malta. (GFN, 2022)

### *Climate Change Performance Index*

Figure 156 illustrates the points of Malta's CCPI between 2014 and 2021. This composite index summarizes the GHG Emissions (40% of overall score), the Renewable Energy (20% of overall score), the Energy Use (20% of overall score) and the Climate Policy (20% of overall score).

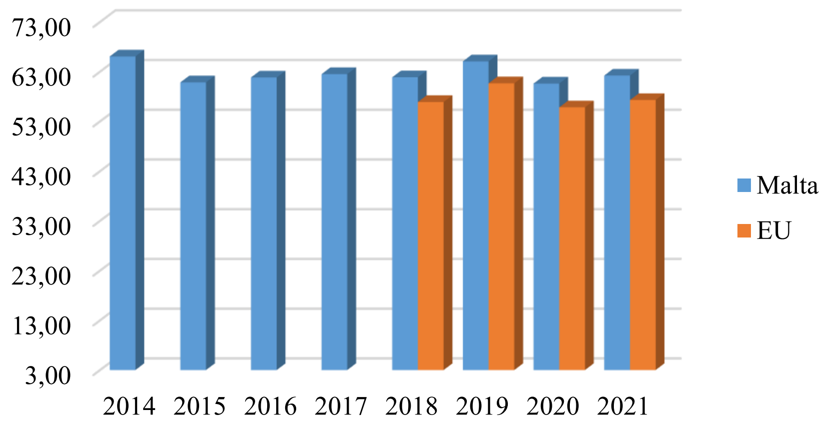



**Figure 155: Malta vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Malta remains a high performer in CCPI, with its data closely aligning with the EU average.

According to the Low Carbon Development Strategy (Gov., 2017) of Malta, the island nation's limited land space must be planned in a manner, that utilises its potential to generate renewable sources. The revised Malta National Renewable Energy Action Plan (NREAP) was launched for public consultation in November 2016. In the longer term, technologies with a higher efficiency in terms of space utilisation/peak power, especially in solar energy harvesting, need to be sought. Regarding to the transportation:

- reducing congestion and the removal of traffic bottlenecks, strengthening transport links and connectivity
- reducing and mitigating GHG emissions, ensuring efficient and sustainable use and management of resources
- easy access to daily facilities
- ensuring that travel options and journey quality are suitable for all user groups
- a clean and pleasant public realm, reduced pollution

**Good Practices**

Households represent the most significant demand for water, accounting for approximately 70% of the total billed consumption. The reduction in the loss of the municipal water supply network has been successful, as municipal water demand has fallen by almost 40% compared to the 1990s. This is a noteworthy development, particularly in light of the concurrent rise in both the population and the living standard. Malta's water resources are very limited due to the lack of permanent surface water bodies and low rainfall. Natural freshwater is largely found below the surface and is supplied by water pumped from springs and wells. The desalination of seawater using reverse osmosis membrane technology at three strategically located desalination plants along the Maltese coast is responsible for more than half of Malta's municipal water supply. A fourth seawater desalination plant is currently under construction, with the stated aim of producing drinking water with very low specific energy consumption. (Climate Adapt, 2020)

**References**


- Banasiak, Jörn (2013): Assessment of climate change policies in the context of the European Semester. Country Report: Malta. https://www.ecologic.eu/sites/default/files/publication/2014/countryreport_mt_ecologiceclareon_jan2014_0.pdf
- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Adapt (2020): National circumstances relevant to adaptation actions. https://climate-adapt.eea.europa.eu/countries-regions/countries/malta
- EEA, European Environment Agency (2020): Malta country profile - SDGs and the environment. https://www.eea.europa.eu/themes/sustainability-transitions/sustainable-development-goals-and-the/country-profiles/malta-country-profile-sdgs-and
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- EU, European Union (2019): Energy, transport and environment statistics – 2019 edition. https://ec.europa.eu/eurostat/web/products-statistical-books/-/ks-dk-19-001
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.

- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Gov. (2012): National Climate Change Adaptation Strategy. Ministry for Resources and Rural Affairs, Government of Malta. https://environment.gov.mt/en/Documents/Downloads/maltaClimateChangeAdaptationStrategy/nationalAdaptationStrategy.pdf
- Gov. (2017): Malta's Low Carbon Development Strategy: our vision. Ministry for Sustainable Development, the Environment and Climate Change, Government of Malta. https://meae.gov.mt/en/Public_Consultations/MSDEC/Documents/MSDEC%20LCDS%20Vision.PDF
- UN, United Nations (2018): Malta's Main Messages in preparation of the Voluntary National Review. https://sustainabledevelopment.un.org/memberstates/malta

## 4.20. NETHERLANDS

The Netherlands has the second-highest population density on the continent (508 people per $km^2$) and has 17.4 million inhabitants, 92.5% of whom live in urban areas. The regions below sea level are the most densely populated, and consequently, a significant portion of the population is exposed to the risk of flooding. The total area of the country's is 41,545 $km^2$, including water surface. The nation's most populous cities are Amsterdam, Rotterdam and The Hague (climate-adapt.eea.europa.eu; worldometers.info).

The gross annual domestic product of the country is 800 billion Euros. The Netherland has an outstanding infrastructural facility, including ports, airports, roads, railways and inland waterways. Additionally, it boasts a highly efficient telecommunications and energy infrastructure. However, due to its geographical characteristics (e.g. large coastal area), effective flood risk management and adaptive strategies to extreme weather conditions are crucial. In response to these challenges, the "national Delta Programme" has been implemented to safeguard the Netherlands against the potential impacts of climate change, ensure a sufficient supply of fresh water and encourage to support climate-proof and water-resilient (climate-adapt.eea.europa.eu).

The Dutch economy is predicted to demonstrate robust growth in 2022 (3.2%) and in 2023 (1.8%). According to the forecast, households' saving rates will normalise, private consumption will rise but private investments will only recover in a slower level (OECD Economic Outlook, 2021, pp. 176-178.)

The country's most important economic statistics compared to the EU-27 average can be observed in Figure 157.

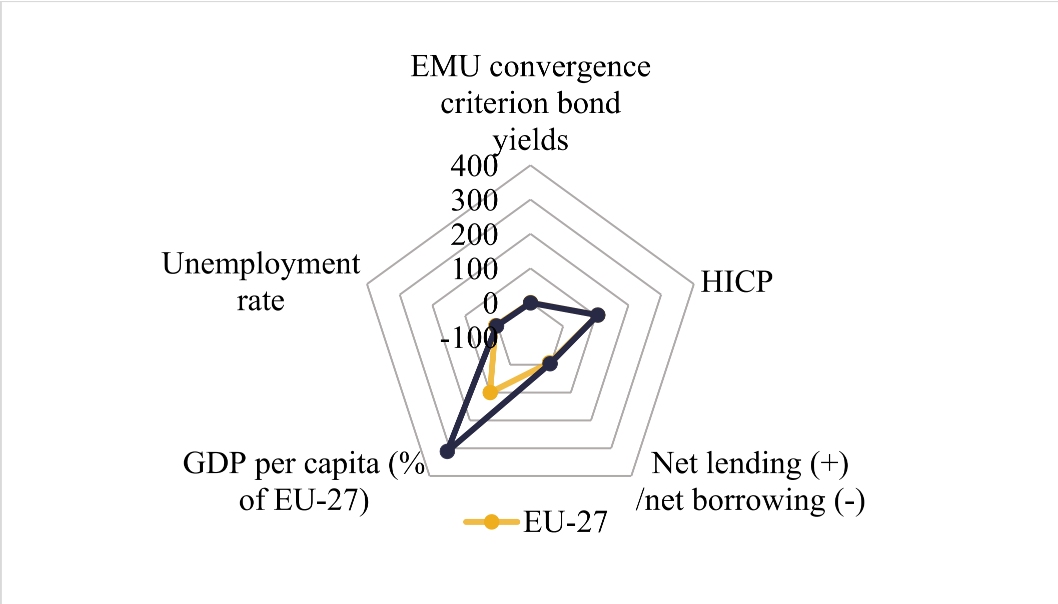



**Figure 156: Netherlands vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

As the economy experiences growth, the number of job vacancies are expected to rise, while the unemployment rate remains low. Fiscal policy will underpin economic growth and structural changes. The promotion of the retraining and upskilling programmes will be in the focus and the creation of clear strategies to address climate change, nitrogen emissions and housing supply shortages is anticipated. Public debt is expected to remain below the Maastricht benchmark and stable over 2022 and 2023 (OECD Economic Outlook, 2021, pp. 176–178).

In the third quarter of 2021, GDP exhibited an increase of 1.9% driven by private consumption. The labour market demonstrated notable resilience, with a rebound observed across by all sectors. In October 2021, the unemployment rate returned to the pre-pandemic level of 2.9%. Concurrently, headline inflation rose to 3.7% in October 2021, marking the highest rate in almost two decades, primarily driven by the surges in electricity, gas and other fuel prices (OECD Economic Outlook, 2021, pp. 176-178).

In order to achieve further economic development, a more targeted fiscal policy is required. Students from disadvantaged backgrounds are more likely to abandon their education prematurely. The National Education Programme constitutes the primary initiative in addressing this issue. Furthermore, have been shown to have a detrimental effect on society, with temporary workers being more sensitive to job termination during the crisis, although many of them are able to secure alternative employment within a relatively short space. Greater equity on the job market can also be ensured by aligning tax rates and social security contributions between different contract types for workers who are doing similar jobs (OECD Economic Outlook, 2021, pp. 176–178).

### Climate Strategy

The inaugural Dutch National Climate Adaptation Strategy (NAS) was issued in 2007; however, it did not cover all the aspects of this global problem. The subsequent National Climate Adaptation Strategy, promulgated in 2016, addressed all issues related to climate change.

This document focuses mainly on the following nine sectors: water and spatial management; nature; agriculture, horticulture and fisheries; health and welfare; recreation and tourism; infrastructure (road, rail, water and aviation); energy; IT and telecommunications; public safety and security (National Climate Adaptation Strategy 2016, 2016).

Beside this, it identifies six climate effects, which call for immediate action:

- "1. Greater heat stress leading to increased morbidity, hospital admissions and mortality, as well as reduced productivity.
- 2. More frequent failure of vital systems: energy, telecommunications, IT and transport infrastructures.
- 3. More frequent crop failures or other problems in the agricultural sector, such as decreased yields or damage to production resources.
- 4. Shifting climate zones whereby some flora and fauna species will be unable to migrate or adapt, due in part to the lack of an internationally coordinated spatial policy.
- 5. Greater health burden and loss of productivity due to possible increase in infectious diseases or allergic (respiratory) conditions such as hay fever.
- 6. Cumulative effects whereby a systems failure in one sector or at one location triggers further problems elsewhere." (National Climate Adaptation Strategy 2016, 2016, p. 3.)

Further risks are also mentioned in the documents for which preparation is also required. These are as follows: "electricity supply grid due to extreme weather, restriction of shipping due to unusually high or low water levels, the loss of habitats and species due to extremely low water in river systems, large-scale failure of IT systems due to problems experienced by crucial IT service providers elsewhere in the world, large-scale failure of IT services due to overheating, and changing migration patterns of various migratory animal and bird species" (National Climate Adaptation Strategy 2016, 2016, p. 3.)

Furthermore, according to the document identifies several potential benefits associated with climate change. Specifically, the projected warming trend could potentially enhance the productivity of certain crops and promote increased tourism. Conversely, milder winters will decrease energy requirement for heating (National Climate Adaptation Strategy 2016, 2016).

National Climate Agreement was conducted in June 2019 to support to achieve the desired climate goals in all sectors. The involved sectors are electricity, industry, the built environment, traffic and transport, and agriculture. The overarching principle of the Agreement is to reduce carbon emissions and to identify cost-efficient measures for both business and private stakeholders. The additional annual costs for the Netherlands in connection with the Climate Agreement are projected to be less than 0.5% of the GDP in 2030. According to the plans, the country will make optimal time use and create measures to follow up the processes and the results (government.nl).

The latest document to be published on the subject of climate change is the Dutch Integrated National Energy and Climate Plan (NECP) 2021–2030. It is largely determined by the Climate Agreement, which was established in June 2019.

In 2019, 50% of the country's energy consumption was distributed for heating, around 25% for motor fuel use and 25% for electricity. However, final energy consumption was reduced significantly during 2005 to 2019. Notably, a discernible downward trend has been observed in heating with the most substantial decline occurring from 2005 onwards (Netherlands Climate and Energy Outlook 2020, 2020).

The Netherlands's primary energy consumption comparing with EU-28 can be seen in Figure 158.

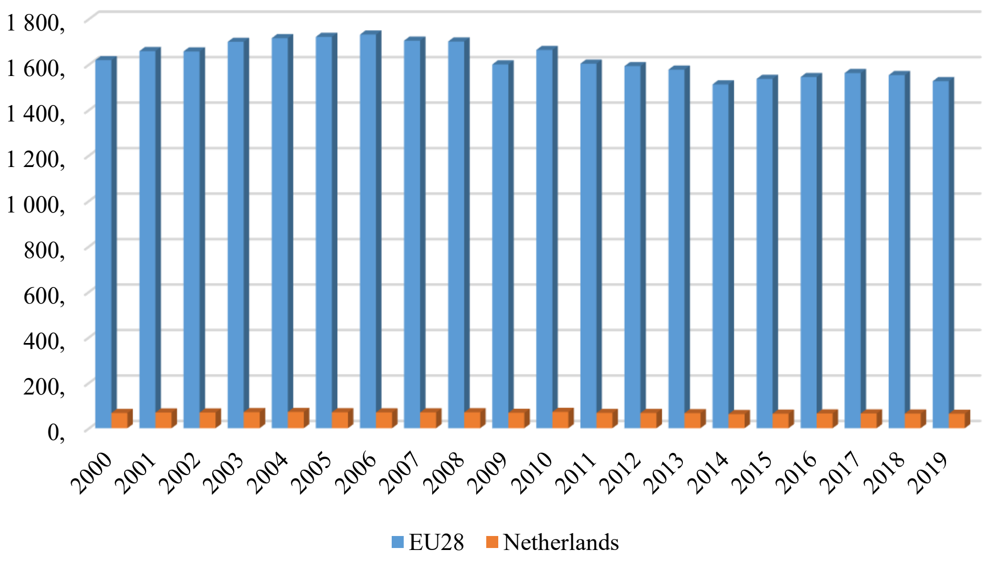



**Figure 157: Netherlands vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

The energy use per person has increased from 1965 till 2019. The highest value was 68,190 kWh in 2010 and the lowest was 33,798 kWh in 1965. In 2020, an average person consumed 57,047 kWh electricity (ourworldindata.org).

The Netherlands aims to achieve primary energy consumption of 1,950 petajoules by 2030 (excluding use for non-energy purposes). That means 1,837 petajoules by 2030 concerning final energy consumption (Integrated National Energy and Climate Plan 2021–2030, 2019).

The share of fossil fuels in gross available energy can be observed in Figure 159.

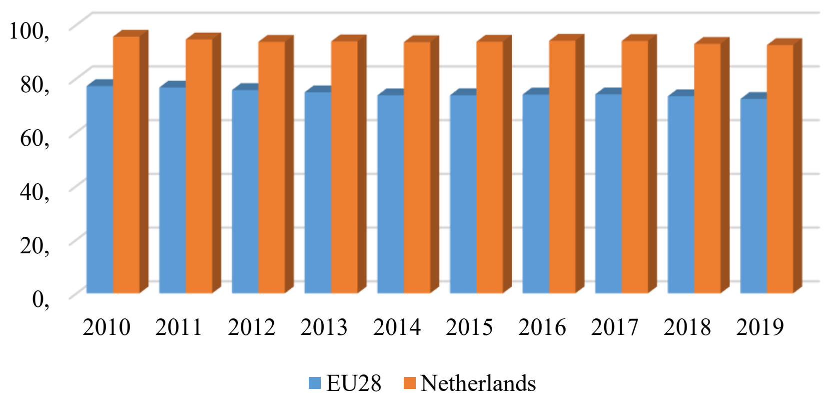



**Figure 158: Netherlands vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

There are no direct subsidies in the country for fossil fuels, therefore resources are allocated for their utilisation. However, these resources are heavily taxed by means of excise duties. Besides the national energy policy is oriented towards the transition from fossil fuels to renewable energy sources, particularly in the electricity sector (Integrated National Energy and Climate Plan 2021-2030, 2019).

The Netherlands is responsible for 5.2% of the total EU greenhouse gas emissions and its reduction process is slower than the EU's average. The energy sector has seen a 15% decrease in emissions during the period of 2005-2019. The introduction of carbon pricing scheme is expected to result in a further decrease. The most substantial reduction in emissions (55%) was registered in the waste management sector during the same period, followed by industrial processes and products (-33.7 %), transport (-12.5 %), 'other emissions' (buildings and tertiary sector, -10.4 %), agriculture (-2.3 %) and manufacturing industries and construction (-0.6 %) (Simões, 2021b).

In accordance with the Effort-sharing Decision (2013–2020) and the Effort-sharing Regulation (2021-2030), the country is obligated to reduce the emissions in those sectors that are not included in the EU Emissions Trading System by 16% and 36% respectively, compared with 2005 levels. The Dutch government has set itself the target of reducing total GHG emissions by 49% by 2030. In 2019, the energy industry was responsible for the majority of GHG emissions. (Simões, 2021b).

The Netherlands proposed a minimum carbon price for electricity generation (€12.3/t$CO_2$) in 2020, which would increase 159% up to 2030. In 2021, a carbon tax for the industry has been introduced (€30/t$CO_2$) with a linear increase in 2030 (Simões, 2021b).

The Netherlands's greenhouse gas emissions by capita compared to EU-28 average from 2000 to 2019 can be seen in Figure 160.

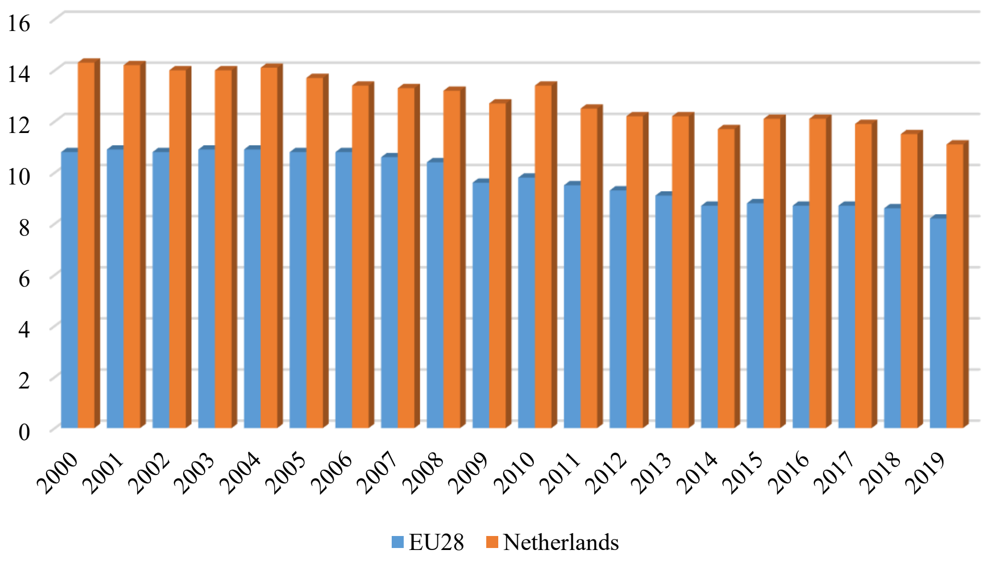



**Figure 159: Netherlands vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

A decline in $CO_2$ emissions per capita has been observed between 1990 and 2020. Concurrently, the total $CO_2$ emission has decreased from 1990 to 2020. The year 2010 recorded the highest emissions, after which a decline in values was registered. Overviewing the primary energy sources reveals that the majority of the $CO_2$ emissions are attributable to natural gas, with oil and coal ranking second and third, respectively. From 1990 to 2018, $CO_2$ emissions remained relatively stable with, minor fluctuations in relation to oil, natural gas and coal (iea.rog).

With regard to carbon dioxide equivalent per capita, the country's value was higher than the EU average, with a total of 11 tonnes of carbon. A decline in the per capita level was noted from 2005 to 2009, with the highest value was measured in 2010 during the period spanning 2005 to 2019. Overall, the country has demonstrated the capacity to maintain a reduction in its carbon dioxide emissions. In 2019, the Netherlands's net emission was 200 million tonnes $CO_2e$. (Simões, 2021b).

The nation's LULUCF sector (comprising land use, land use change and forestry) has identified as a carbon source, exhibiting stability from 2005 until 2019. However, projections indicate an anticipated escalation in emissions from the LULUCF sector to 5.6 $MtCO_2e$ attributable to augmented emissions from arable land, from shifts in the acreage of agricultural land, and diminished carbon capture from forests. To address these challenges the NECP has incorporated several indicators for the agricultural sector. Furthermore, the country plans to manage all soils in a sustainable manner (Simões, 2021b).

The country increased its renewable energy share of gross final energy consumption by 6.3 percentage points between 2005 and 2019. The target for 2030 is 27%. (Simões, 2021b). The Netherlands's share of energy from renewable sources is illustrated in Figure 161.

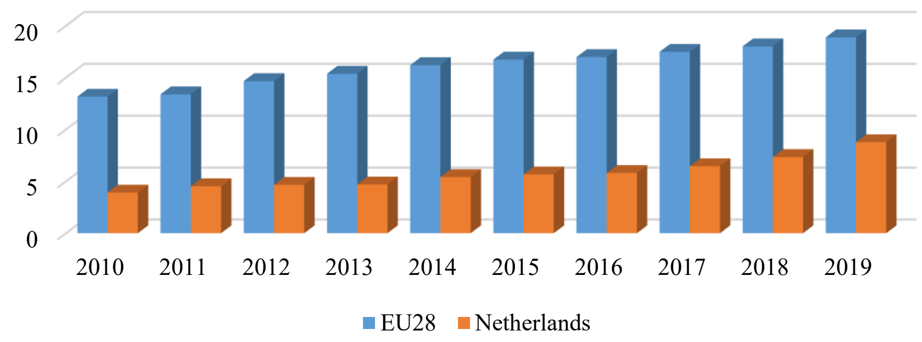



**Figure 160: Netherlands vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

In order to reach the targeted level of 2030, it is necessary to increase the renewable energy share of gross energy consumption from 8.8 % to 27 % in approximately 10 years. To this end, the following development projects are required with regard to minimum RE share: 13% in heating and cooling, 32% in transport and 73% in the electricity sector, where solar power and offshore and onshore wind farms are among the technologies set to grow (Simões, 2021b).

### Composite Indicators

The Netherlands has demonstrated an exemplary performance with regard to the performance indicators that measure sustainability and climate protection. The Environmental Performance Index (EPI) scores from 2014 to 2020 are presented in Figure 162. Regarding the EPI, the Netherlands consistently ranked within n the top 20 out of the 180 ranked countries expect in 2016. Its results were consistently superior to the EU-27 average.

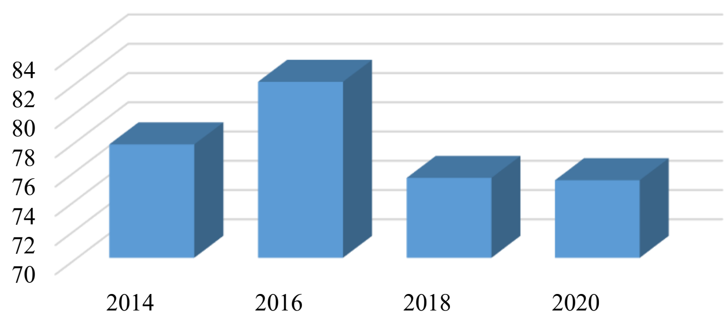



**Figure 161: Netherlands – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Its ranks and scores were following in the EPI:

- ❖ 2014: 11. with 77.75 points (EU-27 average: 72.17)
- ❖ 2016: 36. with 82.03 points (EU-27 average: 82.91)
- ❖ 2018: 18. with 75.46 points (EU-27 average: 73.33)
- ❖ 2020: 11. with 75.30 points (EU-27 average: 70,95)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. The Netherlands's ecological footprint per person from 2014 until 2020 can be seen in Figure 163.

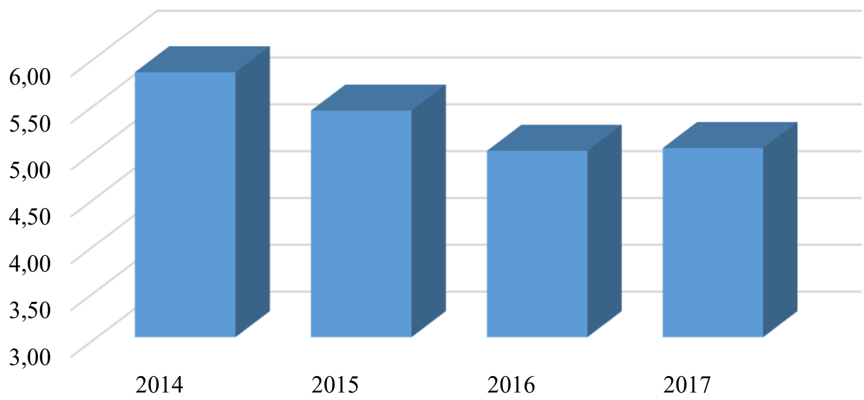



**Figure 162: Netherlands – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Its ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

- ❖ total score in 2014: 5.83 (EU-25 average: 5.23)
- ❖ total score in 2015: 5.42 (EU-25 average: 5.25)
- ❖ total score in 2016: 4.99 (EU-25 average: 5.26)
- ❖ total score in 2017: 5.02 (EU-25 average: 5.34)

The country performs well regarding the ecological footprint as its scores are always around the EU-25 average level.

Concerning the Climate Change Performance Index (CCPI), its performance is inconstant. The scores of the CCPI for the country can be seen in Figure 164.

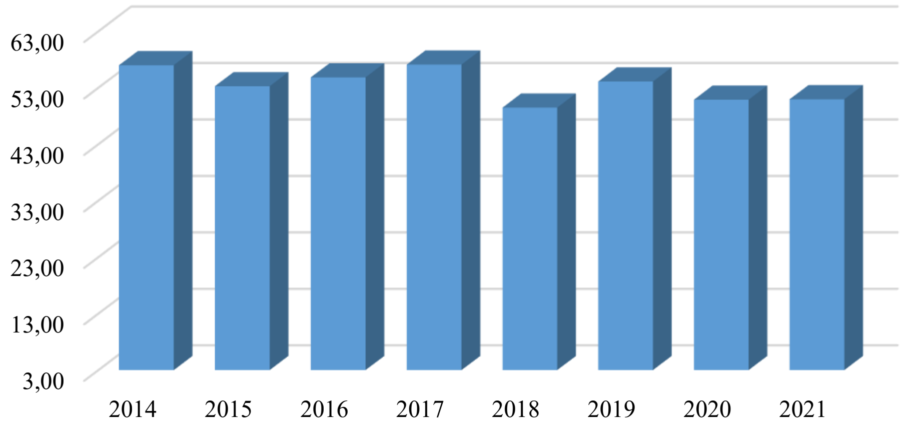



**Figure 163: Netherlands vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

- 2014: 31. with 56.99 points (global average: 55.72)
- 2015: 42. with 53.27 points (global average: 55.36)
- 2016: 35. with 54.84 points (global average: 54.15)
- 2017: 27. with 67.1 points (global average: 53.77)
- 2018: 34. with 49.49 points (global average: 49.09)
- 2019: 28. with 54.11 points (global average: 50.35)
- 2020: 29. with 50.89 points (global average: 48.61)
- 2020: 29. with 55.23 points (global average: 50.96)

**Good Practices**

**Bicycles in the Netherlands**

The development of cycling is now being aided by a growing number of measures that simultaneously make driving by car more difficult. For instance, the proliferation of car-free zones offers cyclists a secure environment, while simultaneously enhancing the liveability and air quality of the local area. Furthermore, the increasing popularity of electric bicycle has led to a notable increase in the number of cyclists, including among the elderly, and led to the replacement of cars with bikes in many cases. In addition to e-bikes, specialised bikes are becoming more increasing prevalent, including cargo bikes, recumbent bikes and velomobiles, or folding bikes, which can also be utilised on public transport free of charge.

n the Netherlands, the education system places a strong emphasis on the promotion of cycling among children. A mandatory component of the school curriculum is dedicated to teaching children about cycling, ensuring that they acquire the necessary skills and knowledge to safely and responsibly navigate their surroundings by bicycle. It is perhaps for this reason that there are schools where more than 90% of students arrive on two wheels.

This country is famous for its high number of cycling citizens. According to a survey, the 36% of the Dutch population utilises bicycles as their primary mode of transportation, with 27% of all journeys being made by bicycle. This figure is even higher in larger urban areas, with 38% of people in Amsterdam and 46% in Zwolle using bicycles as their primary mode of transportation (Novák, 2022).

Since the 1980s, there has been an increasing emphasis on initiatives designed to promote the utilisation of bicycles. These initiatives encompass the implementation of bicycle-friendly regulations, the development of new cycling routes and infrastructure) (Novák, 2022).

**Compocity**

In addition to selective waste, local governments are also responsible for the collection municipal waste *(restafval)* generated in households. This is typically done through the placement of containers placed on the street or underground. As part of the goal set by the Netherlands of developing a circular economy by 2050, the authorities seek to implement measures aimed at reducing, recycling and collecting waste selectively through the framework of specific campaigns. However, in the interim, residents in need of such services are provided with selective trash cans.

**Smart bin**

The smart bin was developed by the Hungarian designer, Emese Pancsa, in Dutch laboratories The development of this microorganism was a key aspect of the project. Since that time, the Compocity project has been developed into a complete urban system, and the indoor composter automatically turns household waste into compost material and biospray. The user is tasked with two responsibilities: the initial placement of waste into the bin, and its subsequent emptying. The application provides a comprehensive overview of acceptable and unacceptable materials. In addition to the composting process itself, it is imperative to ensure the sustainability of the system and the appropriate utilisation of the resulting compost. Compocity's system has sensors that monitor weight accumulation in the capsule, as well as the moisture content and temperature of the compost.

"We arrange the filling of the microorganisms and the delivery of the filled capsule, if the user does not require it. It's part of the service, it's like waste collection," says Emese. It is acknowledged that this area is one of significant complexity, involving numerous regulations and permits. Consequently, the search continues for participants with their own green space who can utilise the compost are still being sought for the 2-3-month pilot programme, which is still ongoing. Thus, composting is faster and of better quality.

As the result of the cooperation of Dutch and Hungarian engineers and designers a new of compost pile was born. This innovation is a smart bin that uses microorganisms to facilitate the decomposition of household waste. The development of an application is a further innovation, with the dual purpose of providing assistance to and educational material to users. The application provides a visual representation of the composting process, highlighting the types of materials that can be added to the bin. Utilising integrated sensors, the system can assess parameters such as humidity and compost temperature, thereby providing users with recommendations regarding the optimal application of the compost (Melis, 2020).

This machine has several benefits, extending beyond the provision of high-quality soil to inhabitants of big cities. With the help of the household composting activities the logistical and other financial burden of waste transportation can be reduced. Additionally, the Composity has been identified as a promising solution for the catering industry (Melis, 2020).

**Green bus-stops**

In the city of Utrecht, the Netherlands, 316 bus-stops were equipped with green roofs. The main aim of this initiative is to provide an optimal environment for bees and to enhance the air quality in the city. The initiative offers several advantages, including the ability of the flowers to collect the rainwater, trap airborne dust particles, and contribute to reducing the city’s summertime air temperature (sokszinuvidek.24.hu, 2019).

In addition to the aforementioned benefits, the project has the potential to safeguard the region’s flora and fauna as it provides bee diverse environment biodiversity by providing bees with a diverse environment”. The municipality of Utrecht encourages citizens to follow the example, offering financial incentives for those who create their own green roof that is more than 20 $m^2$. Furthermore, plans are in place to use solar cells to provide energy for the bus-stops in the future (sokszinuvidek.24.hu, 2019).

**Green energy from the oceans**

The wind farm Borssele 1 and Borssele 2, located in the North Sea have the potential to contribute significantly to the country's energy mix by displacing a substantial portion of fossil fuels and providing a reliable source of clean energy for many households. Ninety-four turbines were attached to the seabed at a depth ranging from 14 to 40 metres. Upon completion, it will be the largest offshore wind farm in the Netherlands. It is estimated that the project will be capable of supplying the energy needs of approximately 1 million Dutch households and will contribute to decarbonisation of the regional industry (Loctier – Euronews, 2020).

**Low emission zones**

The number of low emission zones in the country is increasing. Within the geographical confines of these zones, the operation of vehicles (cars, scooters, motorcycles) are permitted exclusively for those emitting negligible levels of air pollution. The following cities have implemented this policy: Amsterdam, Arnhem, The Hague and Utrecht (Siklai, 2021). A growing number of cities in the Netherlands are establishing their own environmental protection zones, i.e. pollution-free zones. In these zones, entry is restricted to vehicles (cars, scooters, motorcycles) that pollute the air to a minimal extent. Restrictions are imposed on the entry of diesel vehicles of specific years of manufacture. Failure to comply with this legislation can result in financial penalties. As of the beginning of next year, the entry of Euro VI trucks and electric vehicles will be permitted in the environmental protection zones of 14 Dutch cities as announced by the local transport and logistics association, TLN (Transport and Logistics Netherlands ). This includes Amsterdam, Rotterdam and The Hague.

**Circular economy**

The Netherlands has become the first nation in the world to declare its economy will be fully circular by 2050. According to the plans, this will result in a recycling rate of100%. Achieving a 50% reduction in the use of primary raw materials (minerals, metals, fossil fuels) by 2030 is imperative. The government and the actors of the business life have already created a detailed action plan for this purpose, which contains several pieces of advice for the stakeholders (elobolygonk.hu, 2017).

- **Speed limit -** In an effort to address the issue of nitrogen pollution, the Netherlands has implemented speed limits on public roads, thereby limiting the maximum permissible speed of vehicles on highways to 100 kilometres per hour. The decision was taken due to the primary source of nitrogen oxides in the atmosphere being automobiles, trucks and heavy diesel commercial vehicles utilised in the construction industry.

  (https://www.agroinform.hu/allattenyesztes/rengeteg-marhat-vagnanak-le-a-hollandok-kornyezetvedelmi-okokbol-51320-001)

- **Beef slaughter** -The Netherlands plans to reduce the cattle population by 30 percent, citing environmental concerns as the primary motivation. The small and densely populated Netherlands has a livestock-to-population ratio that is approaching the upper limit of what is considered tolerable in terms of environmental impact. The presence of cattle urine and manure in drinking water has been demonstrated to induce the formation of algae, thereby depleting and thus uses up the oxygen content of surface waters.

  (https://www.agroinform.hu/allattenyesztes/rengeteg-marhat-vagnanak-le-a-hollandok-kornyezetvedelmi-okokbol-51320-001)

- **Environmentally friendly marine hydrogen production** – The production of green hydrogen entails the utilisation of electricity and seawater, both of which are obtained through sustainable means. The objective of the experiment is to demonstrate the feasibility of repurposing, the extant gas infrastructure of the North Sea for the transport of hydrogen. This initiative, undertaken by Gasunie and TNO, seeks to utilise the existing infrastructure to facilitate the transportation of hydrogen from large wind farms in the North Sea to the coast. The proposed method involves the storage of electricity and the utilisation of natural gas as an alternative energy source.

  (https://hollandhirek.nl/kornyezetbarat-tengeri-hydrogentermeles-a-holland-partoknal-tenyleg-megeri/)

- **Wind turbines, "modern windmills":**
  Windmills are national symbols, and their function extends beyond mere decorative elements to practical applications, such as the utilisation of water from low-lying areas. However, the majority of these are merely of historical significance. Turbines, called "new" or "modern" windmills in the Netherlands. These turbines have been found to contribute significantly more to environmental protection than previously thought.

  The utilisation of coastal wind energy has emerged as a viable alternative to traditional fossil energy sources and has become a clean energy source characterised by its environmental sustainability and cost-effectiveness, with a return on investment that is often substantial. The Borssele 1 and 2 wind farms are located in the North Sea, 22 kilometres from the Dutch coastline. Ninety-four turbines have been anchored to the seabed at depths ranging from 14 and 40 metres. Upon completion, it will be the largest offshore wind farm in the Netherlands. This wind farm supplies electricity to one million Dutch households. n addition, the process under discussion has been demonstrated to assist in the decarbonisation of industry located in coastal areas. Indeed, it has been shown to produce renewable hydrogen and carbon-neutral disinfectants.

Cars: The entry of gasoline cars is permitted, whereas only diesel cars with emission class 4 or higher are permitted to enter. As of March 1, 2021, the city will adopt a stringent approach to this matter, with the implementation of penalties without prior notice for vehicles found to be in violation of these restrictions. It is an established fact that motorcycles and scooters od a smaller size, which were first placed on the market (DET) in January 2011 or later, are only permitted to be driven in built-up areas.

https://greendex.hu/hogyan-lett-hollandia-bringanagyhatalom/

https://forbes.hu/uzlet/okoskuka-belteri-komposztalas-lakasban-compocity-pancsa-emese/

https://sokszinuvidek.24.hu/mozaik/2019/07/11/hollandia-utrecht-316-buszmegallo-zoldites-mehek/

https://hu.euronews.com/green/2020/11/24/zold-energia-a-tengerrol

**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Elobolygonk.hu (2017): HOLLANDIA ÚTON A KÖRFORGÁSOS GAZDASÁG FELÉ. Elobolygonk.hu. Available: https://www.elobolygonk.hu/Klimahirek/Gazdasag/2017_12_01/hollandia_uton_a_korforgasos_gazdasag_fele?fbclid=IwAR10xEYSw9GsHBI8LPv3CEqCRjmS78aT1Iicq2Y-4zsK30V11L764aUfPY0 (03.03.2022)
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.

- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- https://www.government.nl/topics/climate-change/climate-policy (11.12.2021)
- Integrated National Energy and Climate Plan 2021-2030, (2019). Available: https://ec.europa.eu/energy/sites/ener/files/documents/nl_final_necp_main_en.pdf (11.12.2021)
- Loctier, D. – Euronews (2020): Zöld energia a tengerről. Euronews.com. Available: https://hu.euronews.com/green/2020/11/24/zold-energia-a-tengerrol (03.03.2022)
- Melis, D. (2020): Okoskukával könnyítené meg a beltéri komposztálást a magyar formatervező. Forbes.hu. Available: https://forbes.hu/uzlet/okoskuka-belteri-komposztalas-lakasban-compocity-pancsa-emese/ (03.03.2022)
- National Climate Adaptation Strategy 2016 (2016). Available: https://klimaatadaptatienederland.nl/en/policy-programmes/nas/ (11.12.2021)
- Netherlands Climate and Energy Outlook 2020 – Summary, 2020 (2020). Available: https://www.pbl.nl/sites/default/files/downloads/pbl-2020-netherlands-climate-and-energy-outlook-2020-summary-4299.pdf (11.12.2021)
- Novák, Zs. (2022): Hogyan lett Hollandia bringanagyhatalom? Greendex. Available: https://greendex.hu/hogyan-lett-hollandia-bringanagyhatalom/ (03.03.2022)
- OECD (2021). OECD Economic Outlook, Volume 2021 Issue 2: Preliminary version, No. 110, OECD Publishing, Paris, https://doi.org/10.1787/66c5ac2c-en (11.11.2021)
- Siklai, S. (2021): Hollandia mely városaiba tilos behajtani dízelautóval?. Hollandiamagyarok.nl Available: https://hollandiaimagyarok.nl/hollandia-mely-varosaiba-tilos-behajtani-dizelautoval/ (03.03.2022)
- Simões, H. M. (2021b). Climate action in the Netherlands- Latest state of play. Available: https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/696184/EPRS_BRI(2021)696184_EN.pdf (11.12.2021)
- Sokszinuvidek.24.hu (2019): 316 buszmegállót zöldítettek be a méheknek a hollandiai városban. Sokszínű Vidék 24.hu. Available: https://sokszinuvidek.24.hu/mozaik/2019/07/11/hollandia-utrecht-316-buszmegallo-zoldites-mehek/ (03.03.2022)
- https://www.worldometers.info/ (15.12.2021)
- https://climate-adapt.eea.europa.eu/ (12.12.2021)
- https://ourworldindata.org/ (12.12.2021)
- https://www.iea.org/ (12.12.2021)
- https://www.enerdata.net/
- https://www.worldbank.org/en/home (12.12.2021)

## 4.21. POLAND

Poland accession to the European Union in 2004 marked a significant political and economic transition for the nation. The most significant economic sectors include wholesale and retail trade, transport, accommodation and food services (25%), industry (24%), and public administration, defence, education and human health and social work activities (15%). 67% of goods imported into Poland come from EU countries (Climate Adapt, 2022g).

At the end of 2018, Poland had a population of 38.411 million, with a negative birth rate of -0.06%. The decline in the number of births observed in recent years is indicative of a new demographic crisis in Poland, as evidenced by the country's changing demographic trends over past 30 years, This decline may have a longer-term implications for the nation’s future. The contemporary demographic shifts that are being observed present two particularly significant challenges. The initial phenomenon is the decline in the total population, which can be further categorised as depopulation and urban shrinkage in extreme cases. A 2014 forecast published by the Polish Statistical Office posits that Poland's population will contract by approximately 4.5 million by 2050. This is projected to be predominantly attributed to the diminution of the urban residents. The second main challenge is the ageing of the population. The change in the age structure of the population is due to three main factors: the increase in life expectancy, the decline in the birth rate and migration processes. The Polish Statistical Office (GUS has published projections indicating a decline of 5.5 million in the working-age population between 2013 and 2050. The decline in the urban population has consequences for the development and functioning of cities, including budgetary considerations (which entail higher expenditure, especially in the health and social security sectors, and a reduction in revenue due to a lower tax base), the organisation of public services, the design of urban space, facilitating access to adequate housing, and participatory models of problem-solving. Furthermore, it is important to note the impact that this phenomenon has the labour market and the economic potential of cities. Given that migration is predominantly composed of younger demographics, there is a potential risk of a local exodus of enterprising individuals, which could further exacerbate the prevailing decline in the birth rate. This predicament represents a significant challenge to the development agenda in small and medium-sized towns. On the other hand, metropolitan areas, especially those of considerable size, are confronted with the challenge of providing decent living conditions for those who migrate to work in them (Climate Adapt, 2022g).

Figure 165 shows significant deviations from the EU-27 average for most of the selected economic indicators. The Maastricht criterion interest rates are close to five times the EU average, and GDP per capita is 48% of the EU average. The unemployment rate is much lower than the EU average of 3%, lower but government expenditure is less than the EU average in terms of government revenue. The harmonised index of consumer prices has increased by 3% in comparison with the EU average.

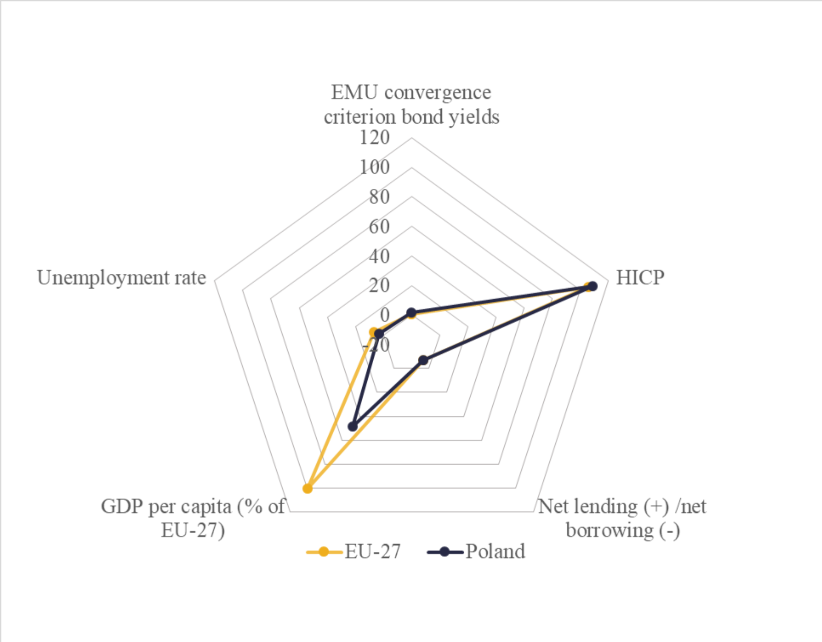



**Figure 164: Poland vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

The demographic shifts observed, in conjunction with the ongoing process of suburbanisation in Poland, will necessitate that many cities must sustain their infrastructure and provide public services to these expanding urbanised regions in the near future. This is particularly important in the context of measures to adapt to climate change. The challenge, therefore, is to create suitable living and activity conditions for all groups of inhabitants. It is imperative to capitalise on the demographic shift towards an ageing population, to implement measures to combat social exclusion and inactivity, and to foster liveable cities in the face of climate change (Poblocka, 2013).

**Climate Strategy**

Poland's international obligations with regard to climate change are derived from the provisions of the United Nations Framework Convention on Climate Change, with particular reference to the Kyoto Protocol. Poland ratified the Convention on 28 July 1994, and its commitments include the following:

1. the development and implementation of a national strategy for greenhouse gas emissions, a reduction strategy, including economic and administrative mechanisms, as well as periodic monitoring of its implementation;

2. the process of recording greenhouse gas emissions and removals, the storage of greenhouse gas emissions for each year in accordance with the methodology adopted by the Conference on Greenhouse Gases, and monitoring of changes in emissions;

3. the development of long-term scenarios for emission reductions, accompanied by economic projections for all economic sectors, separately for each gas;

4. carrying out scientific research on climate change problems;

5. the preparation of periodic national communications (every two years) to the Conference of the Parties on climate change, providing detailed information on the implementation of climate change commitments (Ministry of the Environment Republic of Poland, 2013).

Climate change represents a global problem and the mitigation of which will require the concerted efforts of all nations. It is imperative that endeavours undertaken by individual countries are to be mutually coordinated, as significant beneficial effects of policies are expected to result from synergies. The proposed mitigation measures and instruments are contingent on the specific circumstances of each country, the implementation of which is subject to conditions that are appropriate to their economic capabilities. The strategic goal of climate policy in Poland is to facilitate nation's integration into the international community's endeavours to protect the global climate. This integration is to be achieved through the implementation of the principles of sustainable development, with a particular emphasis on the following areas: the enhancement of energy efficiency, the expansion of national forest and soil resources, the optimalisation of raw materials and industrial product utilisation, and the improvement of waste management. The primary aim of these efforts is to ensure the maximisation of long-term economic, social, and political benefits" (The Ministry of the Environment, 2003).

The increasing dynamics of atmospheric phenomena observed in recent years in the world, in Europe and in Poland may indicate the first signs of climate change. The IPCC projections published in the Third Assessment Report in 2000 (IPPC, 2000) suggest that in the coming years, by 2100, climate change could lead to a temperature rise of between 1 and 6ºC, which could contribute to a rise in sea levels of around 90 cm and a significant increase in climate phenomena such as droughts, floods, intermittent cold spells and severe storms. The IPCC analysis demonstrates that unless current trends are halted, projected climate change could occur at a rate that will prove to be beyond the capacity of the natural environment, society and the economy will not be able to adapt to the new climate conditions without incurring additional costs (Poblocka, 2013).

It is unfortunate that Poland has not succeeded in reducing its greenhouse gas emissions between 2000 and 2019. While the EU average has been decreasing by more than 1% per year on average over the period, Poland has been stagnating (Figure 166).

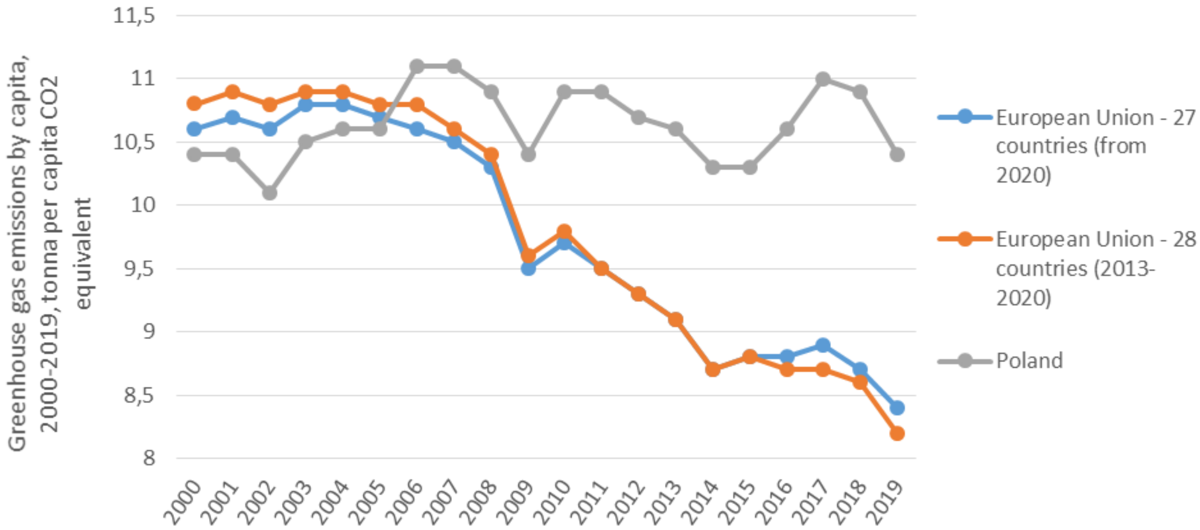



**Figure 165: Poland vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 ($CO_2$ equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

Poland's climate is characterised by a high degree of weather variability and significant seasonal variation, based on the experience of successive years. The average annual air temperature ranges from more than 5 °C to almost 9 °C. The south-west of Poland is the warmest area, while the north-east and the southern mountainous regions are the coldest. The average annual temperature amplitude ranges from 19°C at the coast to 23°C in the eastern part of the country. The climatic variability is characterised by the number of days with temperatures below 0 °C from early autumn to late spring, ranging from 80 (on the coast) to more than 120 in the north-eastern areas and over 200 in the mountain areas. It is evident that alterations in air temperature have a significant impact on the length of the growing season and the active growth period of plants. In Poland, the mean duration of the growing season is 214 days, with a temperature gradient from northeast to southwest ranging from 199 to 233 days. The daily average air temperature, six seasons are distinguished in Poland: early spring (0-5 °C), spring (5-15 °C), summer (above 15 °C), autumn (5-15 °C), early winter (0-5 °C), winter (below 0 °C).

Precipitation is highly dependent on the terrain. The average rainfall is close to 600 mm, but in central Poland, for example, rainfall is below 500 mm, on the coast close to 800 mm and in the Tatra Mountains it exceeds 1000 mm. Rainfall is highest in the summer months, when it is 2-3 times higher than in winter, and up to 4 times higher in the Carpathians. Heavy rainfall is observed from April to September, with the highest frequency in July, and is often accompanied by the development of thunderstorms (Ministry of the Environment Republic of Poland, 2013).

The most significant impact on climatic conditions is exerted by extreme events, the current intensification of which is noticeably changing the dynamics of climatic characteristics in Poland. The occurrence of thermal phenomena that are unfavourable and stressful for the Polish population includes the occurrence of severe heat waves, especially since the 1990s (a series of days with a daily maximum air temperature of 30 °C for at least three days) and hot days (maximum temperature of 30 °C), which occur most frequently in south-west Poland. In the majority of Poland, there has been a decline trend in the number of frosty and very frosty days (The Ministry of the Environment, 2003).

In most of the regions within Poland, there has been an alteration in the precipitation structure. It is evident that there has been an increase in the number of days characterised by high precipitation intensity, defined as daily precipitation level above 50 mm, especially in the southern regions. A detailed examination of the duration of the rain-free periods reveals that throughout eastern Poland (east of the Vistula) the rain-free period has increased by up to 5 days/decade. This region is particularly vulnerable to drought disasters, including hydrological droughts. The intermittent occurrence of droughts is a characteristic feature of the Polish climate. In the 20th century, 24 droughts occurred, and since the beginning of the 21st century, between 2001 and 2011, there have been 9 droughts at different times of the year (Baran et al., 2018).

Drought is by far the most important challenge posed by climate change to Poland. By early 2020, analytical models predicted that in the absence of long-term moderate rainfall in the coming weeks, Poland would experience a drought of unprecedented severity, the worst in 50 years. The evaluation of the drought period 1987-2018 reveals that 55.6% of the country's territory is classified as high risk with respect to drought. The areas at the highest extreme risk cover almost 5% of the country (Institute of Environmental Protection – National Research Institute, 2019).

The Polish strategy establishes specific targets for the energy sector: - implementation of the provisions of Community legislation; - energy security and diversification of energy sources (non-nuclear); - improvement of the competitiveness of national economic units and their products and services; - protection of the natural environment against the harmful effects of energy production processes, including by programming measures in the energy sector to ensure the conservation of resources for present and future generations; - energy saving production; - liberalisation of the energy market; - increasing the use of energy from renewable sources; - promoting energy efficiency and the economical use of energy; - the use of emissions trading and other complementary mechanisms of the Kyoto Protocol (Ministry of the Environment Republic of Poland, 2013).

Figure 167 illustrates the total energy needs of the EU. The data show that total energy demand in the EU has decreased by an average of 1% per year over 20 years.

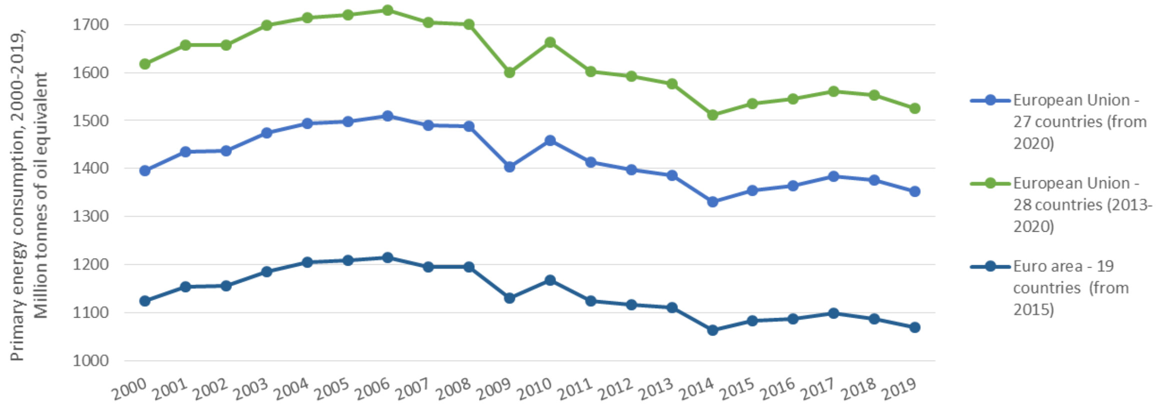



**Figure 166: Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

However, an alternative trend is evidenced in Poland, where the average rate of change demonstrates a lesser increase (+0.8%) over the same period.

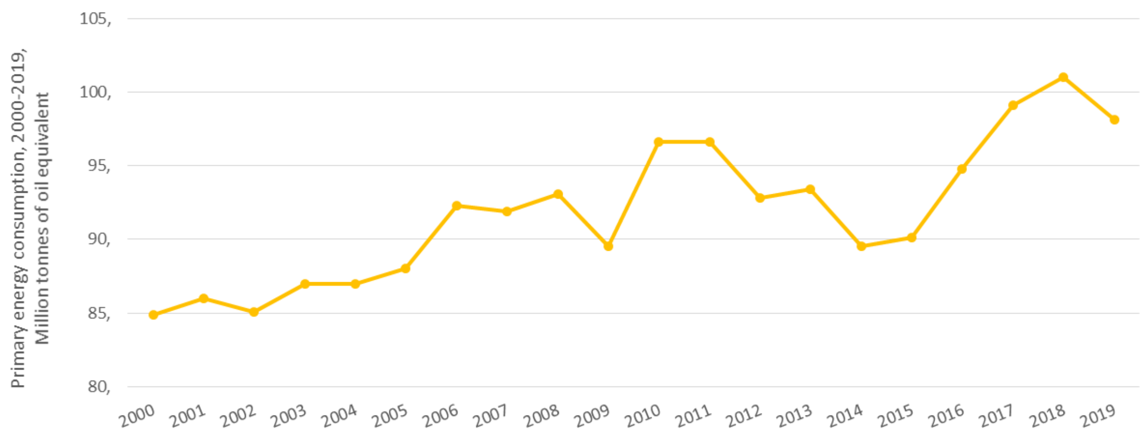



**Figure 167: Poland vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

Furthermore, Poland exhibits a significant disparity in the utilisation in the utilisation of renewable resources when compared to the EU average (Figure 169). Although there has been an upward trend since 2014, the figure remains below the EU average.

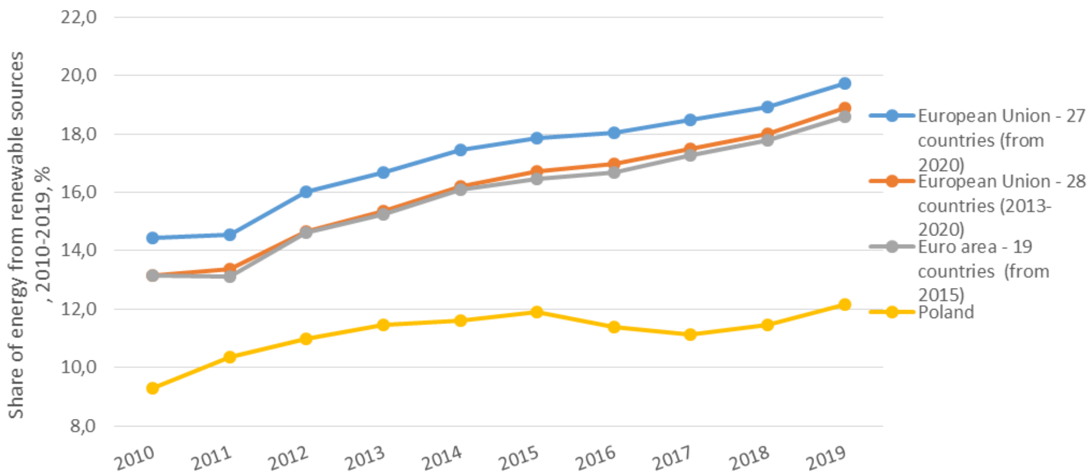



**Figure 168: Poland vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

The most significant impact of climate change in Poland is expected to be an increase in the frequency of extreme weather events and disasters, which will have a major impact on vulnerable areas, the country's infrastructure and economy. The risk of heavy rainfall, flooding and inundation, and landslides will be most important in mountainous and hilly areas, but also on river valley slopes and coastal cliffs. The ongoing drought is set to have a detrimental effect on the agricultural sector and drinking water, which in turn will have implications for the national economy. Increasingly strong winds, tornadoes and storms will have a significant impact on infrastructure, including but not limited to construction, energy and transport infrastructure (Baran et al., 2018).

The share of fossil fuels is also a factor of concern. The share of these fuels is significantly higher than the EU average, and its decline is not accelerating (Figure 170).

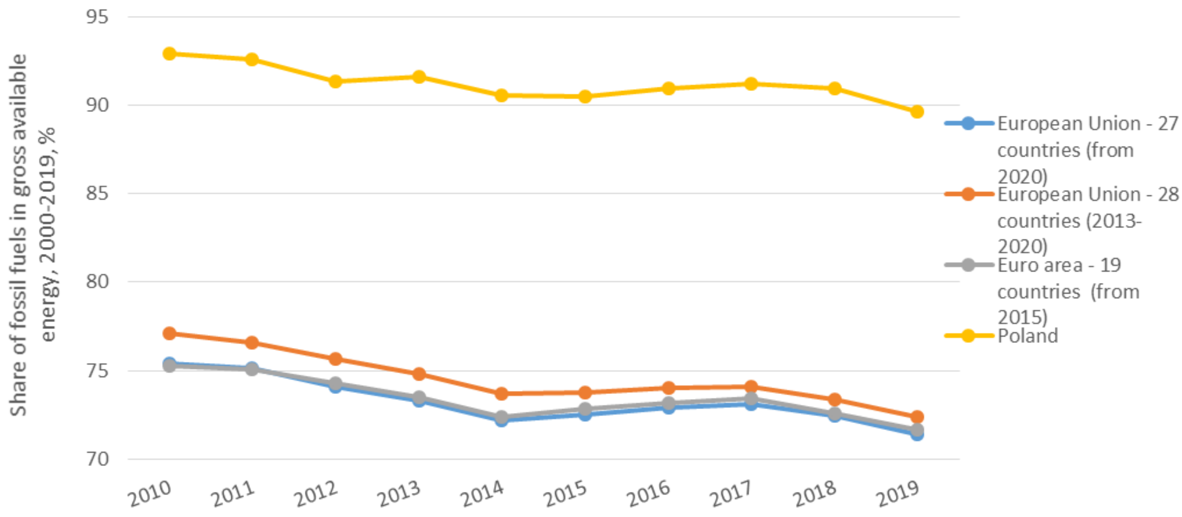



**Figure 169: Poland vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**

Source: own compilation based on Eurostat (2022b)

The proposed course of action in the field of infrastructure adaptation to climate change is set out in a number of strategic documents, including the National Adaptation Strategy 2020, the National Environmental Policy 2030, the National Urban Policy 2023 and the Climate Change Agenda. The most relevant measures for adaptation to climate change in terms of infrastructure and economy are as follows:

1. consideration of the possibility of public support for non-life insurance and measures to minimise the impacts of extreme events, adapted to suit the specific requirements of each area, including infrastructure and construction.

2. flood risk management, encompassing the provision of critical infrastructure; increasing the retention capacity and restoration of water courses.

3. developing drainage infrastructure and other infrastructure to mitigate natural hazards.

4. water management to protect against floods, droughts and water scarcity.

5. strengthening the protection against forest fires through the development of fire risk monitoring systems and fire protection infrastructure related to forest protection.

6. developing local adaptation plans, upgrading and proper functioning of wastewater and stormwater infrastructure, applying innovative solutions in construction and infrastructure, and developing green urban areas as a model.

7. adapting legislation and technical specifications to document changes in geological conditions and natural resources, to design and build transport infrastructure as well as to adapt it to climate change, particularly in areas at risk of flooding, inland water and landslides.

8. advance monitoring of climate change, which is particularly important in agricultural production. The results of this monitoring should form an element of information activities to support the development of agricultural production and the use of modern agrotechnical methods. On the other hand, in rural areas, monitoring of emergencies is vital for the population, infrastructure and farms and should be directly linked to the local alert system.

9. establishment of permanent monitoring systems or adaptation of existing monitoring systems to monitor climate-sensitive elements of building and transport infrastructure, and establishment or adaptation of warning systems for technical services.

10. improving water demand management, adapting water tariffs to the 'water scarcity' of the area concerned, and strengthening the incentive function of water tariffs.

11. gradual replacement of overhead lines by cable lines (especially low voltage lines).

12. giving preference to the construction of blocks with closed cooling systems, in particular through environmental choices (Institute of Environmental Protection – National Research Institute (2019).

**Composite Indicators**

Environmental Performance Index (EPI) was developed by the Yale University and provides summary of sustainability around the world, including also Poland.

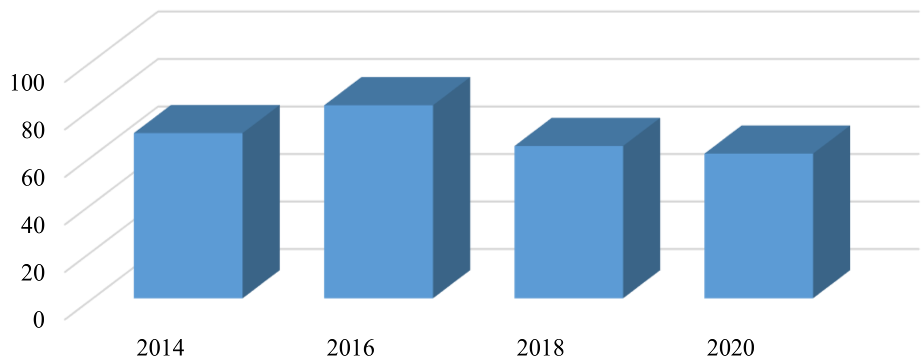


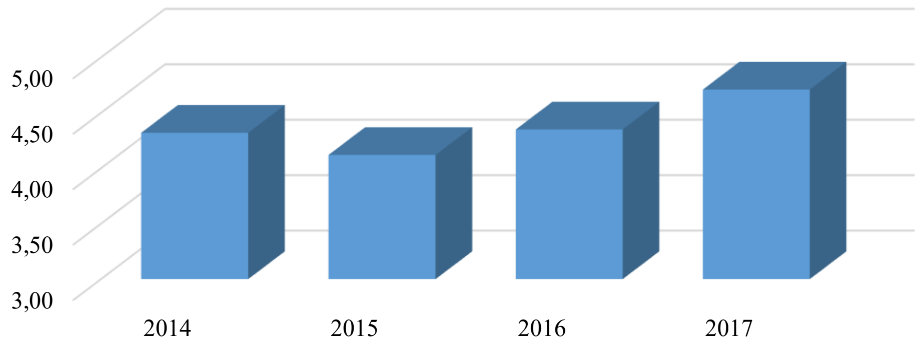

**Figure 170: Poland – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

The indicators that comprise the EPI demonstrate at the national level the proximity of countries are to achieving their environmental policy goals. The Environmental Performance Index (EPI) scores of Poland from 2014 to 2020 are presented in Figure 171. Regarding the EPI, Poland has consistently in the bottom range of the ranking and exhibiting results that fall below the EU-27 average. It is noteworthy that there have been no years in which the nation has achieved a value that surpasses the mean average.

Its ranks and scores were following in the EPI:

- 2014: 19. with 69.53 points (EU-27 average: 72.17)
- 2016: 25. with 81.26 points (EU-27 average: 82.91)
- 2018: 27. with 64.11 points (EU-27 average: 73.33)
- 2020: 27. with 60.90 points. (EU-27 average: 70,95)

Ecological Footprint is another index that measures countries' sustainable activities by




ecological footprint. Poland's ecological footprint per person from 2014 till 2020 can be seen in Figure 172. Poland performs less well in the ecological footprint as its scores are always below the EU-25 average level.

**Figure 171: Poland – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Its ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

- total score in 2014: 4.32 (EU-25 average: 5.23)
- total score in 2015: 4.12 (EU-25 average: 5.25)
- total score in 2016: 4.35 (EU-25 average: 5.26)
- total score in 2017: 4.71 (EU-25 average: 5.34)

Concerning the Climate Change Performance Index (CCPI) Poland's performance is inconstant. The scores of the CCPI for the country can be seen in Figure 173.

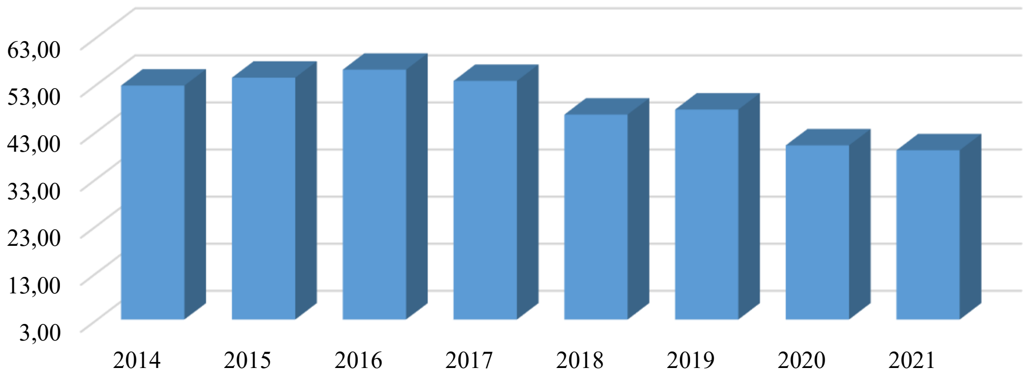



**Figure 172: Poland vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

- ❖ 2014: 45. with 52.69 points (global average: 55.72)
- ❖ 2015: 40. with 54.36 points (global average: 55.36)
- ❖ 2016: 32. with 56.06 points (global average: 54.15)
- ❖ 2017: 35. with 53.68 points (global average: 53.77)
- ❖ 2018: 40. with 46.53 points (global average: 49.09)
- ❖ 2019: 41. with 47.59 points (global average: 50.35)
- ❖ 2020: 50. with 39.98 points (global average: 48.61)
- ❖ 2021: 48. with 38.94 points (global average: 47.90)

Mostly, Poland's scores are below the average, just in 2016 is higher.

**Summary**

All these measures are directly linked to the most prevalent and important risks that climate change poses to Poland's infrastructure and economy.

**Good Practices**

The following measures have been implemented to facilitate climate adaptation:

- Climate Adaptation Plans (44MPA),
- funding programmes in cooperation with local governments,
- promotional activities,
- educational campaigns,
- activities promoting environmental and educational attitudes,

- involvement of local governments (City with Climate),
- Guide to Investment Preparation Respecting Climate Change Mitigation and Adaptation (MKiS),
- "Adaptation Manual for Cities" (MKiS),
- Working goups in the Partnership - Environment for the Development (GDOS).

The MPA should be a requirement for all cities. Its implementation must be overseen by climate resilience experts. This necessitates the provision of education and guidance for local governments in the preparation and implementation of MPAs.

The Government Centre for Security functions as the United Nations National Contact Point for the implementation of the Sendai Agenda for Action. A key element of the aforementioned activities is the establishment of a platform for the exchange of information on national and international initiatives aimed at reducing the risk of disasters. The platform is attended not only by representatives of government and self-government administration, but also research institutes, universities, non-governmental organisations and the private sector. The Government Centre for Security, as part of the platform organised the first National Forum for Disaster Risk Reduction on 25-26 November 2019.

The most significant issue, however, is that of amending the law on crisis management, a measure which will facilitate the implementation of a risk management system in Poland. In January 2020, the Government submitted a draft act amending the Act on Crisis Management and Certain Other Acts was submitted to the National Assembly, where it was referred to 1st reading in the Administration and Home Affairs Committee for its first reading and for further work.

As posted in the draft amendment to the Act on Crisis Management, correlation between national and EU regulations will be conducted without the necessity for the development of new planning documents from the beginning; rather existing documents will be utilised. The report on threats to national security will continue to priorities risk assessment. Following the identification of the most significant threats to national security, it will be essential to establish strategic objectives aimed at mitigating the risk of their materialisation. This process will necessitate the utilisation of existing provisions and the synthesis of conclusions containing a hierarchically structured list of projects deemed essential for achieving the stipulated objectives. Furthermore, it is imperative to consider regional or local initiatives within the context of the voivodeship, thereby ensuring a comprehensive and nuanced approach to security threats. It is imperative to acknowledge that only a properly conducted risk assessment identifies threats and determining areas necessitating action, including the allocation of increased financial resources to projects aimed at mitigating the risk of disasters.

It is proposed that crisis management plans, be divided into two distinct categories: risk management plans and crisis response plans. It is imperative to emphasise that these solutions have already been initiated in the 2018 National Crisis Management Plan.

The interconnection of climate change, biological diversity, desertification, land degradation and drought are intricately related on the social, economic and environmental fronts is well-documented. It is evident that these issues are closely interlinked; therefore, secretariats of the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD) and the United Nations Convention to Combat Desertification (UNCCD) are engaged in collaborative actions to solve these challenges at all levels. MKiS is actively involved in the work of all these conventions.

Poland is a member of the United Nations Framework Convention on Climate Change (UNFCCC) and therefore strives to reduce emissions of greenhouse gases responsible for global warming. Poland has organised three United Nations Climate Change Conferences. The conferences were held in Poznań (2008), Warsaw (2013) and Katowice (2018). The primary objective of the COP24 summit was to establish comprehensive regulations for the execution of the 2015 Paris Agreement. These were defined in the document "Katowice Climate Package" (Katowice Rulebook) and were adopted by all Parties.

Polish cities are engaged in the Covenant of Mayors, a European partnership programme that encourages settlements to learn, find inspiration and take action on climate and energy challenges. At present, 80 signatories in Poland have taken the political decision to adhere to the Covenant. As of yet, 39 cities have submitted their Sustainable Energy and Climate Action Plans.

By the end of 2020, 400 Ukrainian energy auditors were trained. This is an undertaking organised by the National Energy Conservation Agency S.A. (KAPE) in collaboration with the Foundation for Energy Conservation (FPE) as part of the E-ETAP (Energy Efficiency Training and Auditing Project) training programme. The financial support provided by NFOSiGW, has enabled the project to successfully train 400 individuals.

Moreover, as a signatory to the Helsinki Convention, Poland is obliged to monitors and protects the Baltic Sea environment. A team of experts working for HELCOM is responsible for the collection of information pertaining to the state of the environment and pollution discharged into the sea. The data is then analysed, and recommendations are formulated for Member States, obliging them to take specific actions aimed at protecting the Baltic area.

In the course of its adaptation activities, Poland cooperates with EU countries. The initiation of cooperative endeavours between Poland and the Slovak Republic, the Czech Republic and Lithuania in the domain of border waters is a notable development. The focal point of this cooperation encompass the assessment of water status, the collaborative effort in hydrology and flood control in border waters as well as implementation of tasks under the Water Framework Directive and the Floods Directive.

At the international level, Poland also cooperates with Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Russia and Sweden. Poland is a member of the Baltic Marine Environment Protection Commission - also known as the Helsinki Commission (HELCOM).

**Good practices at country level:**

Poland allocated 3.2% of its GDP to environmental protection issues. Since its accession to the European Union in 2004, the country has constructed over than 1,000 new water treatment facilities, renovated over than 1,000 km of pipe infrastructure, and has achieved a 30% reduction in $CO_2$ emissions. In addition to these measures, the country has established several new hazardous waste collection points in the country, as well as developed a long-term plan for the protection of endangered plant and animal species. [3]

**Anti-smog law**

The introduction of the "anti-smog" law in Poland was a response to the country's high levels of air pollution. Given the considerable number of mines in the country, coal mining plays a pivotal role in the economy, but it also causes serious air pollution. Mined coal is also the country's primary source of fuel. In 2020, fossil fuels accounted for 70% of Poland's energy source and it is expected that coal will remain the country's main energy resource until 2049. Legislation exists that enables local authorities to prohibit the burning of coal and other pollutants in private residences and properties. [4]

**Clean Air program**

The Clean Air" programme was initiated in 2018 and is scheduled to remain operational until 2029. The programme is closely linked to the "anti-smog" law. The project's target is to provide support to individual homeowners for the replacement of their outdated heating devices with environmentally sustainable heating systems. The programme was successful in promoting the adoption of eco-friendly heating solutions among the Polish population, with the majority now opting for environmentally sustainable heating options. As illustrated in the following table, the introduction of these two programmes signified a substantial advancement. [5]

**Sludge treatment**

In Poland, the treatment and reuse of sludge is also a major environmental concern. The country produces more than 700,000 tons of sludge on an annual basis. According to the national waste management plan, 60% of this should be processed by incineration, which would result in an increase of 25%. According to another proposal, the utilisation of treated sludge as biomass fuel would assist in the fulfilment of the nation's renewable energy goals. It is asserted that greater emphasis should be placed on the development and operation of technologies for the burning and drying of sludge, with a view to achieving the latter goal. [7]

**Water pollution**

Poland is one of the countries suffering from water scarcity, so the problems related to water pollution are considered very important. The use of water resources requires the acquisition of a water law permit, a right that various authorities are entitled to grant. These authorities include staroste (senior) and the voivodeship marshal. In the event that the relevant authorities becomes aware of water contamination, they are empowered to mandate compensation, thereby obliging the responsible party to undertake the necessary remediation of the environmental harm inflicted, including water. In case of a violation of the Water Act, the most stringent sanctions to be imposed are administrative fines and criminal prosecution. Authorities retain the power to revoke permits and contravening the law can result in custodial sentences. [8]

**Company-level good practices:**

**Schneider Energy**

Schneider Energy is a pioneering company in Poland specialising in energy management. As part of their Electricity 4.0 programme, they also published their book, in which they draw attention to the general trends in home energy supply and demand are highlighted, and a discussion of their complexity is initiated. In conclusion, the publication presents an energy management system that has the capacity to assist help home builders and homeowners in making their homes more sustainable and resilient. [9] (Schneider Electric. Forrás: https://www.se.com/ww/en/insights/sustainability/)

**Baltic Power**

The Baltic Power is an offshore wind farm, which is owned by ORLEN and Northland, is an essential element of transformation of the Polish energy sector and a milestone in its development. Construction of a 1.2 GW wind farm is scheduled to commence in 2024, with the projected capacity to supply clean electricity to over 1.5 million Polish households. According to the plans, the park of 70 wind turbines is scheduled for completion by 2026. [10]

**Tel- Eko Project**

The company has been present since 1987 and manufactures modern equipment to meet the requirements of environmental protection. Tel- Eko specialises in the design and manufacture of equipment for the industrial physio-chemical measurement of water and aqueous solutions. The company provides a range of devices for the measurement of various parameters, including pH, redox, chlorides, dissolved oxygen, and conductivity The CE marking on their products indicates that these products comply with all relevant provisions of the Community Technical Harmonization. In addition, the company offers electromagnetic flow meters and level measuring systems. They cooperate with power plants, design and service offices, and companies in the field of industrial automation. [11] (http://www.teleko.pl/ofirmie.html)

**SKORUT Systemy Solarne**

The company manufactures highly efficient solar collectors that enable the convert solar energy into heat without emitting $CO_2$. It has already installed solar collector investments in hospitals, health centres, nursing homes, sports facilities, aqua parks, swimming pools, hotels, boarding houses, schools, single- and multi-family houses, and housing estates. The company has implemented photovoltaic systems in a variety of settings, public lighting, roadside advertising, and small plots of land in holiday homes and animal shelters. [12] (Skorut Systemy Solarne. Forrás: https://www.skorut-solar.pl/oferta)

**LitterAct**

LitterAct adopts a pioneering approach to addressing the issue of litter. It has found a way to combine solutions to one of the most significant challenges of our time by making it accessible to everyone. The company organises garbage collections in numerous locations around the world. LitterAct is a micro-company with a staff between 2-10 employees. However, the collection of litter is a voluntary activity. In this manner, the company tries to demonstrate the problem of the littering and that people do not throw their garbage on the street, on the ground or in the water sources. they are encouraged to utilise designated refuse containers. Furthermore, it also draws attention to the danger to the animal world. They give people hope that they can have a cleaner life, from which the living world and our environment cannot be left out. The company believes that being part of this positive change, acting and being in the middle of a journey for a better tomorrow is worth everything. [13] (Litteract,: https://www.linkedin.com/company/litteract)

**Good practices at the individual level**

**Selective waste collection**

Selective waste collection represents a fundamental strategy for environmental protection. The Polish people place significant emphasis on this issue, engaging in selective waste collection not only in households, but also in fast food restaurants and even smaller shops. In urban areas, there are often designated locations for the collection of refuse, where individuals have the opportunity to dispose of their own waste.

**Małgorzata Górska**

Górska is a Polish activist and conservationist who has played a pivotal role in the protection of the Rospuda Valley in north-eastern Poland and considered to be one of the last authentic wilderness areas in Europe. When Via leading through the unique and untouched areas of the Rospuda Valley, the initial plans for the Baltica expressway emerged, Górska launched a campaign to encourage politicians to change their proposals. In 2002, he mobilised a coalition of activists and organisations, including Greenpeace, the Polish Green Network, and the Polish Bird Protection Association. He was a co-planner of the public movement, during which people expressed their support for Górska's vision by affixing a green ribbon to various locations. Following its accession to the European Union in 2004, the Rospuda Valley was designated a protected area under the Natura 2000 programme, marking a significant environmental victory. Following extensive negotiations in 2009, the Polish government declared a modification to the route, which would no longer traverse the Rospuda valleys. The alteration of the route was imperative to ensure that the protected areas of the Knyszyn primeval forest, the Biebrza marshes and the Augustów primeval forest would not be affected. Consequently, the route underwent redesign these sections, thereby preserving the areas. [14]

**Production of environmentally friendly products/parts**

Poland is a leading nation in global comparisons of production of environmentally sustainable economic products and their components. Poland ranks 5th in the European Union and 15th worldwide in terms of the export of these products. The export of goods related to the environmentally friendly industry increased by a third globally between 2010 and 2018, while in the case of Poland this expansion was double. In the forthcoming years, this phenomenon will persist, in part due to the imperative to curtail carbon dioxide emissions, and in part due to the consequent increase at the expense of other sectors in the rebuilding world economy.

Among the products of the eco-friendly economy, the production of batteries for electric vehicles has garnered significant attention. It is anticipated that Poland will assume a prominent role in this domain within the European context.

https://www.lengyelorszag.travel/hu/csaladdal/falusi-vakacio/a-napfenyes-kis-lengyelorszag-kornyezettudatos-projektje

**The environmentally conscious project of "Sunny Little Poland".**

It is evident that agrotourism, the production of high-quality food and the use of renewable energy sources are of critical importance - these 3 elements are connected and realized by the Napfényes Gazdaság.

The " Sunny Little Poland - holiday full of sunshine" project, which is patronised by several prominent figures, including the President of the Polish Parliament, encompassing farms and ranches that produce their high-quality food in the spirit of renewable energy and environmental protection. By adopting this approach, are able to select a course of action that is both unsoiled and environmentally sustainable for the future.

https://www.lengyelorszag.travel/hu/csaladdal/falusi-vakacio/a-napfenyes-kis-lengyelorszag-kornyezettudatos-projektje

**A concrete tax would be introduced to protect the environment in Poland**

In Poland, a specific tax is colloquially referred as the ‘concrete tax’. It is typically levied by hypermarkets located on the periphery of the cities, as their extensive parking facilities have resulted in the significant loss of large areas of previously green space.

The official justification, the tax asserts that it is necessary due to the disruption of the natural flow of precipitation, which has resulted in environmental problems that necessitate state compensation.

The ministry responsible for water affairs is currently proposing an extension of the tax to a significantly broader area. The majority of private individuals would remain exempt from taxation, as a minimum of 600 square metres of green space would need to be removed to exceed the lower limit. The key change is that the government would now also consider municipalities as taxpayers.In urban areas, there is a prevalence of large squares that are deficient in green space, such as the substantial central market squares. Consequently, the imposition of a concrete tax would be necessary. According to estimates, the number of properties subject to taxation may increase to 20 times the current figure.

https://g7.hu/vilag/20200829/betonadot-vetnenek-be-a-kornyezet-vedelmeert-lengyelorszagban/

**Poland is drastically reducing its coal-based electricity production**

At the US-organized climate protection summit, the Polish president declared that his country's share of coal-based electricity production would be reduced from the current level of 70% to 11% by 2040.

This "climate-friendly" transformation represents a substantial opportunity for the population and all sectors of the economy; however, it also poses a considerable challenge. The process of "greening" predicated on the implementation of profound economic changes, including the elimination of certain sectors, such as mining.

In the near future, Poland is set to establish a balanced and low-emission energy portfolio, with a foundation rooted in nuclear energy, renewable sources, and gas-derived energy.

https://greendex.hu/drasztikusan-csokkenti-a-szenalapu-aramtermeleset-lengyelorszag/

**References**


- Baran, J., Lewandowski, P., Szpor, A., Witajewski-Baltvilks, J. (2018). Coal transition in Poland. Options for a fair and feasible transition for the Polish coal sector. Berlin, IDDRI & Institute for structural research.
- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Adapt (2022g). Poland. Retrieved from https://climate-adapt.eea.europa.eu/countries-regions/countries/poland
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP

https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.

- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Institute of Environmental Protection – National Research Institute (2019). Actions and challenges for climate protection in Poland – brief overview 1988 – 2018 – 2050. Warsaw, Institute of Environmental Protection – National Research Institute.
- Ministry of the Environment Republic of Poland (2013). Polish National Strategy for Adaptation to Climate Change (NAS 2020). Warsaw, Ministry of the Environment Republic of Poland.
- Poblocka, A. (2013). Assessment of climate change policies in the context of the European Semester. Country Report: Poland. Berlin, Ecologic Institute.
- The Ministry of the Environment (2003). Poland’s Climate Policy. The strategies for greenhouse gas emission reductions in Poland until 2020. Warsaw, The Ministry of the Environment.

## 4.22. PORTUGAL

Portugal is located in the southwestern part of Europe, occupying a position on the Iberian Peninsula. The region's predominant climatic characteristics are those of a Mediterranean climate, typified by rainy winters and hot, dry summers. Portugal has been recorded as having one of the highest temperatures in Europe. The country is vulnerable to the effects of climate change, which include extreme weather events such as droughts, floods, and heat waves (Climate Change Knowledge Portal 2022). Based on the dataset of the Climate Change Knowledge Portal, Portugal has experienced a higher incidence of wildfires, storms, and floods in the years following 2000 compared to the period between 1980 and 2020. The most notable natural hazard was the wildfire in 2003, which impacted approximately 150,000 people (Climate Change Knowledge Portal 2022). Another pertinent issue is that of desertification, a problem which is set to impact over 50 percent of the mainland. It is estimated that three-quarters of the Portuguese population reside in coastal areas, yet these regions are susceptible to various hazards, including coastal erosion, coastal floods, cliff instability, and landslides (Climate Adapt 2021).

The financial crisis of 2008 had a significant impact on Portugal. The real GDP per capita ratio has only surpassed pre-crisis levels in 2017. The economic growth of the country was once again halted by the COVID-19 in 2020. A decline of 9% in the real GDP per capita of Portugal was observed in 2020 in comparison with 2019 (Eurostat 2021).For instance, in March 2020, Portugal unveiled a stimulus package of EUR 9.2 billion with the aim of facilitating economic recovery. The measures primarily encompassed broad fiscal policies, state-backed credit guarantees, and augmented social expenditure (IEA 2021).

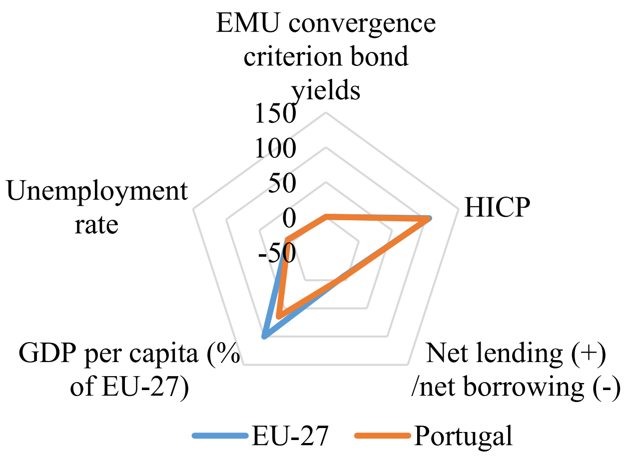



**Figure 173: Portugal vs. EU27 – Economic outlook, 2020**
Sources: own compilation based on Eurostat (2021)

The predominant segment of the active population is employed in the tertiary sector (Climate Adapt 2021). The unemployment rate (6.9%) was below the EU27 in 2020 and, compared to the previous year, it increased by only 0.4% (Eurostat 2021). This figure represented a decrease in value when compared with the year 2018. This finding suggests that the impact of the pandemic o on the Portuguese unemployment rate in 2020 was negligible.

In 2020, the Portuguese long-term interest rate (0.41%) was higher than the mean (0.32%) of the EU27 (Eurostat 2021). The harmonised index of consumer prices (HICP) in Portugal (103.58) was lower than the EU27 average (Eurostat 2021).

The Portuguese net lending/net borrowing ratio was -5.8 in 2020. This indicator is defined as the difference between the total general government revenue and expenditure of general government in relation to gross domestic product, expressed as percentage. From 2012 to 2020 the values of the indicator were negative in Portugal, except for the year 2019 (Eurostat 2021). This indicates that the total expenditure of the general government exceeded its revenue. Based on the study by Baer et al, Portugal has experienced considerable fiscal and external imbalances since 1995 (Baer et al. 2013). in 2020, the general government debt (compared to the GDP) was among the highest values recorded in the EU (Eurostat 2022b).

**Climate Strategy**

The policies associated with climate change were implemented in a range of sectoral policies (Ministry of Foreign Affairs 2017). The National Energy and Climate Plan 2021-2030 (shortly NECP2030) in Portugal was established in 2019 in parallel with the Roadmap for Carbon Neutrality 2050 (Roteiro para a Neutralidade Carbónica, RCN2050). The NECP2030 places particular emphasis on decarbonisation, energy efficiency, as well as the security, internal energy market, research, innovation, and competitiveness (NECP2030). 'The RNC2050 establishes a strategy for achieving carbon neutrality in a sustained manner, establishes the main guidelines, and identifies cost-effective options to achieve this end in different socio-economic development scenarios' (RNC2050).

Previously there were other plans and strategies in place, such as the National Strategy for Adaptation to Climate Change (ENAAC2010) between 2010 and 2013. The two dimensions of the concept under discussion were adaptation and mitigation. The strategy is focused on the updated and available scientific knowledge, the mitigation of the vulnerability, minimization of the climate change effects, the enhancement of awareness, and the promotion of international cooperation (Ministry of Foreign Affairs 2017).

The National Strategy for Adaptation to Climate Change 2020 (ENAAC2020) draws on the experience of the ENAAC2010, while also aligning with to the EU framework (Ministry of Foreign Affairs 2017). The three objectives of this strategy were as follows: "i) improvement of knowledge regarding climate change risks, impacts and consequences; ii) the implementation of adaptation measures; and iii) the promotion of integration and monitoring of climate change adaptation into public policies and sectoral policies, including planning, sustainable urban development and the management of water resources" (Ministry of Foreign Affairs 2017, pp. 66).

**Primary Energy Consumption**

As demonstrated Figure 175, Portugal's primary energy consumption as a percentage of the total EU28 primary energy consumption was found to be relatively low. The mean average it was 1.4%. The total energy requirements in Portugal between 2000 and 2019 exhibited a gradual decline.

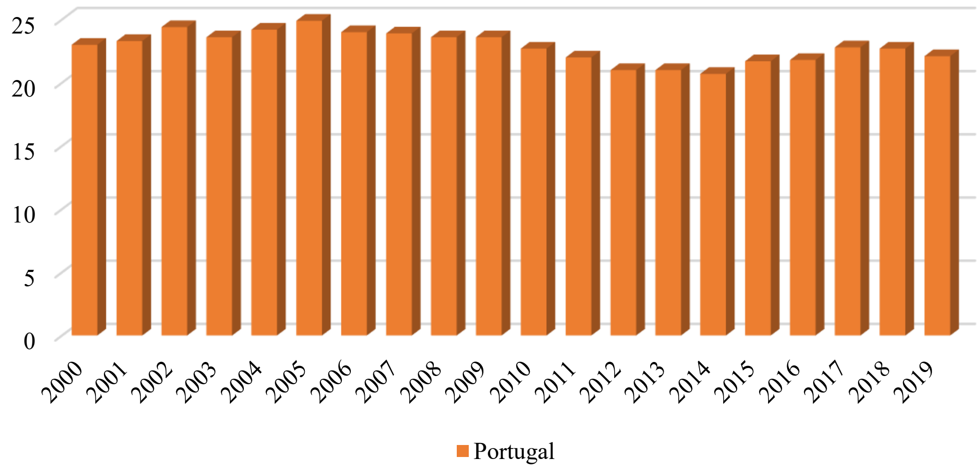



**Figure 174: Portugal vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

From 2000 to 2019, the primary, the primary energy source utilised in Portugal was oil . However, the proportion of oil as a total energy source in Portugal exhibited a downward tendency during the specific period. In 2019, its value was 48.86% (Ritchie and Roser 2020a). In the context of the oil, there was an increase in the proportion of the gas among the source of energy consumption increased from 7.97% to 21.16% between 2000 and 2019 (Ritchie and Roser 2020a).

A substantial discrepancy has been identified in the energy consumption patterns of the Portuguese and Union households. Within the members of the EU28, the value of the average consumption per dwelling is one of the lowest in Portugal. It is notable that the index in Malta is the only one to be lower than in Portugal in 2019 (Odyssee-mure 2021).

In this instance, the reduced low consumption levels present a series of challenges for the nation. The EU survey revealed that Portugal was in the fifth position in terms of its the inability to maintain dwellings at an adequate temperature during the winter months, as measured by the European Integration Index. In 2017, it exhibited the second-highest rate of the population residing in dwellings afflicted with structural deficiencies, including leaking roofs, damp walls, floors, or foundation, or instances rot in window frames or floors within the European Union in 2017 (Horta et al. 2019). Moreover, the Portuguese price level index for electricity, gas, and other fuels was the third highest among the members (Horta et al. 2019). To decrease energy poverty, the government instigated social tariffs for electricity (from 2010) and natural gas (from 2011) for households (Horta et al. 2019).

It is noteworthy that the end-use index of the specific consumption of households provides a divergent perspective on Portugal in comparison to the EU average. In 2019, the primary energy consumption of households in Portugal were attributed to the domain of cooking, surpassing the categories of space heating per dwelling, electrical appliances and lighting, and water heating. In the EU28, the primary component of household energy consumption was space heating per dwelling (Odyssee-mure 2021).

### Share of Fossil Fuels in Gross Available Energy

The absolute value of fossil fuel consumption decreased by 3 terawatt-hours (1%) between 2000 and 2019 (Ritchie and Roser 2020b). As the Figure 176 shows, the share of fuels in gross available energy in Portugal exceeded the EU28 values.

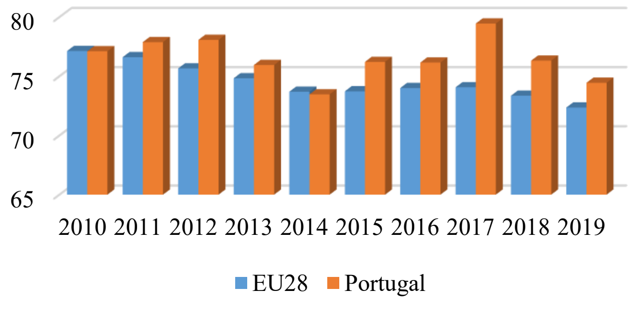



**Figure 175: Portugal vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b**)**

The maximum value was recorded in 2017 (80%), coinciding with a period of heightened forest fire activity. Consequently, the utilisation of fossil fuel-fired plants was deemed a more viable option, given the dwindling water resources available for hydropower plants (Burck et al. 2019). In addition, the government maintained its commitment to the coal industry, allocating substantial financial subsidies (Burck et al. 2019).

The primary sources of fossil fuel consumption in Portugal in 2019 were oil (140 terawatt-hours), gas (61 terawatt-hours), and coal (15 terawatt-hours), (Ritchie and Roser 2020b). It is interesting to note that, although the coal could give only a small proportion of Portugal's energy sources, the country exhibits the second highest (122%) energy import dependency on coal among the European integration in 2019 (Eurostat 2022). As demonstrated by Ritchie and Roser (2020b), coal production was non-existent. It is noteworthy that two coal-fired power plants are scheduled to cease operations in 2021 (IEA 2021).

In contrast, Portugal is reliant on the importation of not only coal, but also oil and natural gas. The objective is to substitute fossil fuels with renewable sources to reduce emissions and increase energy efficiency, thereby reducing the energy dependency on foreign countries can be less than 20% by 2050, as opposed to the 78% in 2019 (RNC2050 2019).

### Greenhouse Gas Emissions by Capita

As Figure 177 shows, Portugal's greenhouse gas emissions per capita were lower than the EU average between 2000 and 2019. While the indicator initially followed a downward trend, this reversed between 2015 and 2017. One of the possible explanations is that the land use and forestry contributed to reducing the Portuguese GHG emissions from 2005 onwards. However, extreme wildfires burned 50,000 hectares (Global Forest Watch, 2020)in 2017 and 2018, causing an increase in the greenhouse gas emissions (IEA 2021) .

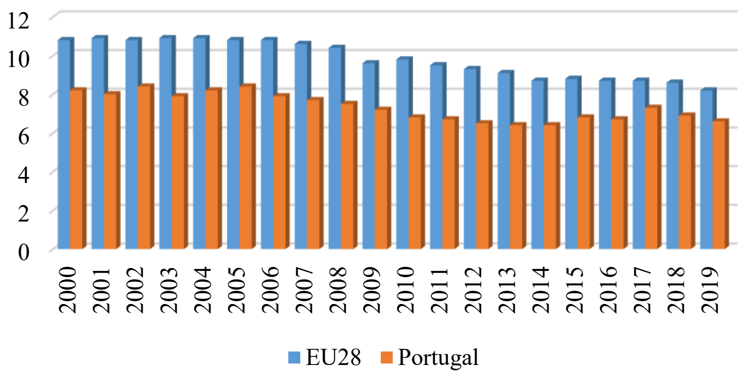



**Figure 176: Portugal vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

The plan for a carbon-neutral economy was included in the RNC2050 national strategy. However, the National Energy and Climate Plan set the national targets between 2021 and 2030 relating to the reduction of the greenhouse gas emissions and the promotion of renewable energy. The RNC2050 was Portugal's first long-term strategy for national emission. The Portuguese goal is "a reduction in national emissions of between -65% and -70%, compared to 2005, and a reduction of -70% to -80% in the energy sector compared to 2005" (RNC2050 2019, pp. 10).

Interestingly, is that the GDP and the greenhouse gas emissions have followed different tendencies since 2005. This makes Portugal is a good example of economic growth with fewer emissions (RNC2050, 2019). Portugal's reduction in greenhouse gas emissions was caused by several factors such as the growth of renewable energy sources, the implementation of energy efficiency measures and the replacement of more polluting energy sources (RNC2050 2019).

The climate strategies and plans that were built in the sectoral policies also had a positive effect on it. For instance, as other European countries, Portugal also tries to decrease greenhouse gas emissions with the increase of the electric vehicle fleet. Therefore, a financial supporting system and other motivations were used such as the green taxation or expanse of the electric mobility network (IEA 2021, RNC2050 2019)

### Share of Energy from Renewable Sources

In 2019, 54% of Portugal's electricity production came from renewable sources(Ritchie and Roser 2020c). As the Figure 178 shows, the share of energy from renewable sources was higher in Portugal than in the EU between 2010 to 2019. The Portuguese ratio exceeded 30% in 2015, however, it did not follow a significantly increasing tendency. To promote the use of renewable sources, Portugal is completing a new 1.2-gigawatt hydropower project (IEA 2021).

In 2019, wind and hydropower were the most significant renewable resources. The share of primary energy that comes from wind was 11.74% (Ritchie and Roser 2020c). This figure represented one of the highest within the European Union. The share of the primary energy from hydroelectric power was 7.47% in 2019 (Ritchie and Roser 2020c). According to the Portuguese projection, renewable energy sources (particularly solar and hydropower) are projected to account 80% of the primary energy consumption by 2050 (RNC2050 2019).

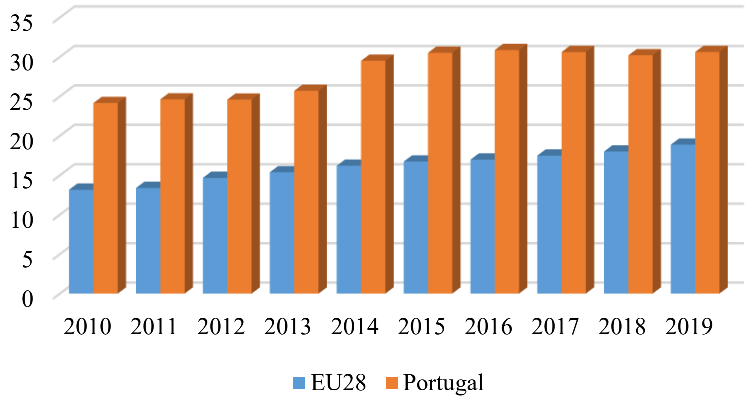



**Figure 177: Portugal vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

The weather can affect energy production from renewable sources. For instance, in 2017 the Mediterranean drought in Portugal led to a decrease in the water level in almost half of the reservoirs in the country (IAE 2021). Therefore, hydroelectric production diminished by 62.5% compared to the preceding year (IAE 2021; Ritchie and Roser 2020c).

It is imperative that the proportion of energy from renewable sources in Portugal is essential because it is an alternative to replacing a given part of the fossil fuels, therefore, reducing the emission. As the International Energy Agency (IEA) summarized: "Portugal's energy and climate policies push for carbon neutrality, primarily through broad electrification of energy demand and a rapid expansion of renewable electricity generation, along with increased energy efficiency. There is a strong focus on reducing energy import dependency and maintaining affordable access to energy. In the longer-term Portugal's strategic objective is to establish hydrogen as a pivotal role in achieving carbon neutrality." (IEA 2021). Therefore, Portugal has created the *National Hydrogen Strategy (EN-H2)*. The objective is for hydrogen, produced from renewable energy sources to account for 1.5-2.0% of Portugal's energy demand by 2030 (IEA 2021).

**Composite Indicators**

**Environmental Performance Index**

The Figure 179 highlights the score of Portugal based on the EPI in 2014, 2016, 2018, and 2020. The country analysed was on the rank 27th with a score of 67 in 2020. Among the 180 countries, the position of Portugal does not appear to be weak however, in the Global West, its position is also similar (22nd). In the EPI, there are just three indicators in which Portugal can achieve the best result (1st) with the maximum score (100): Terrestrial biomes (national), Terrestrial biomes (global), and $SO_2$ growth rate (EPI 2022d)).

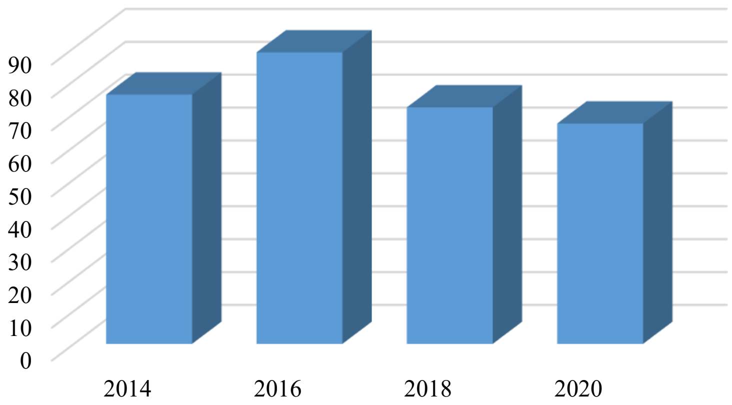



**Figure 178:** **Portugal – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

The EPI report indicates that Portugal is exhibits a lower performance index than its neighbouring countries. In the aftermath of the 2008 economic crisis, the country witnessed a substantial surge in emissions, attributable to the government's decision to provide subsidies to the coal industry and the concurrent decline in hydropower generation (Wendling et al. 2020). Furthermore, Portugal has a leading position as the exporter of eucalyptus pulp in Europe that supports the forest lost in the wake of the 2017 and 2018 wildfires (Wendling et al. 2020).It is therefore unsurprising that the weakest positions of Portugal were in the GHG intensity trend (173rd), Biodiversity Habitat Index (169th), and Tree cover loss (167th) indicators in 2020 (EPI 2022d)).

### Ecological Footprint per Person

The Figure 180 demonstrates increasing values of the Ecological Footprint per Person in Portugal between 2014 and 2017. One reason for the rising tendency can be the Carbon category. It gives the main proportion of the given indicator, and it follows an increasing trend in the 4 years.

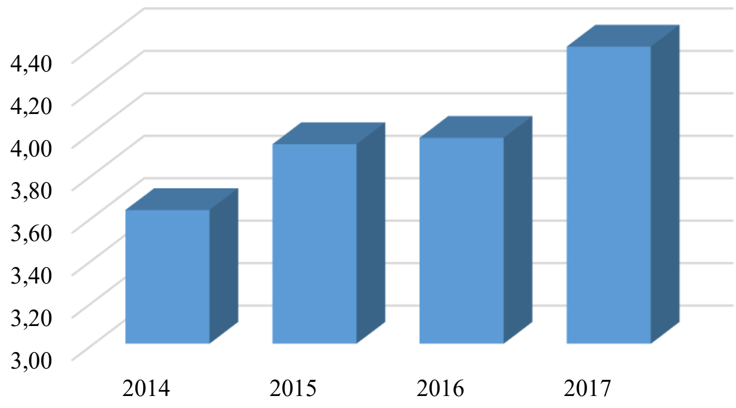



**Figure 179:** **Portugal – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

The second largest category is the Cropland, which exhibits a value that fluctuates between 0.74 and 0.8 global hectares. Forest product does not account for a significant proportion of the Ecological Footprint per capita in Portugal. Its value is between 0.14 and 0.36 global hectares. However, undergoes dynamic fluctuations over the specified period. The value of the asset has increased substantially, with a 2.6-fold rise observed between 2014 and 2017.

### Climate Change Performance Index

The Figure 181 shows the score of Portugal in the CCPI between 2014 and 2021. In the first year analysed (2014), the performance of Portugal was evaluated as good, and in the last year (2021) it reached the high classification with the rank of 17. That was a significant raise from position 25.

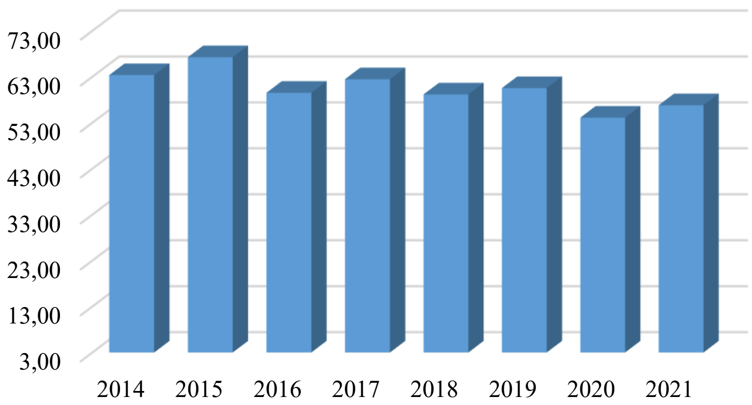



**Figure 180:** **Portugal vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

The experts evaluate the Portugal International Climate Policy Performance as very high because the country sets ambitious goals in the negotiations (Burck et al. 2019). These include the objective of achieving net-zero emissions by 2050, a 55% emission reduction by 2030, and the phase-out of coal by 2023 (Burck et al. 2019). On the other hand, the report suggests that Portugal should direct more attention towards its national climate policy. For instance, its objectives are not embedded in industry strategies and policies (CCPI 2022).

**Good Practices**

Portugal has international cooperation on climate change with not just the EU, but also the PALOP (Países Africanos de Língua Oficial Portuguesa – African countries where the official language is Portuguese) or East Timor. For instance, the PlanºC was cooperation between Portugal and Cape Verde, Mozambique, São Tomé and Príncipe. It aimed to support the given developing countries in enhancing their resilience to climate change, promoting the development of low-carbon economies and facilitating the efficient and rational utilisation of renewable resources. Based on the timetables, the project was conducted between 2013 and 2016 (Palanoc 2022). Another pertinent example is the Atlas of the Renewable Energies of Mozambique between 2011 and 2013. Its purpose was to map the renewable resources, like wind, solar, water, or geothermal in Mozambique (Agéncia Portuguesa Do Ambiente: https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TTF_tei/7c66015a716b4ee2a630cb590cbb2841/17bb23959b294da4b7aad0b5ab0885ec.pdf).

- **Portugal's national energy and climate plan until 2030**

  Portugal's 2030 National Energy and Climate Plan sets a target of more than double renewable electricity generation, mainly solar, by 2030. According to the plan, the share of electricity consumption in Portugal accounted for by renewable energy sources are expected to amount to 80 percent of electricity consumption in Portugal in 2030. (https://www.theportugalnews.com/news/portugal-among-greenest-to-live-in/49138)

- **Fruita Feia**

  In Portugal, between 2015 and 2018, the project was implemented with considerable success. The objective of initiative was to change food consumption habits and to create an alternative market for "ugly" (i.e. imperfect-looking) fruits and vegetables. As planned, the same marketing strategy was employed for different quality fruits and vegetables, irrespective of their size, colour and shape. The project has reached its goal. An innovative method tested in Lisbon was applied on a national cale: the "Fruta Feia", or "Ugly fruit" method.

The essence of the "Fruta Feia" method entailed the procurement of small, large, or shapeless products from local producers on a weekly basis , which could not be sold in the conventional market. Conversely, the produce was sold to customers who joined "Fruta Feiá" scheme, who subsequently collected the goods from specified pick-up points at the end of the day. During the course of the project, 11 such collection points were established in Portugal, thereby preventing the generation of approximately 460 tons of food waste on an annual basis.

- **Life Lines**

Roads are an almost impenetrable barrier for many animals and are particularly problematic during active mating seasons. The LIFE LINES project is transforming roads in Portugal's Alentejo region to protect endangered wildlife. A wide range of species, including owls, woodpeckers, frogs and salamanders exhibit diverse behavioural patterns, and are adversely affected by the presence of roads that cross their habitats. The impact of roads on populations is well-documented, as is their role in the genetic isolation of species and breeding and foraging areas. The so-called grey infrastructure - power lines and railways - also pose a challenge to the movement of animal life.

In the Alentejo region, LIFE LINES addresses the threats posed to wildlife habitats in proximity to such infrastructure. The region is a suitable choice as it includes the main land transport links between Lisbon and Madrid.

- **Floating solar park**

The floating solar power plant, which is the size of four football fields and consists of 12,000 panels, has a peak power of 5.06 MW and can produce 7.5 GWh of electricity per year. The cost of the electricity produced at this facility is one-third of that g in the gas power plant. A battery energy storage system with a capacity of 2 MWh is connected to the renewable energy source and can supply 1,500 households, 25% of the area, with electricity. Once the tanks are at capacity, water is pumped back into the reservoir with the excess electricity, which will later drive the generators of the hydroelectric power plant. A key benefit of floating solar panels is their ability to mitigate one of the technology’s persistent challenges: the overheating of the panels. The cooling effect of water counteracts this issue, enhancing efficiency by up to 5-10 percent. This improvement is attributed to the water continuously cools them from below. Moreover, floating solar cells do not require valuable real estate, and panels placed on reservoirs used to generate hydropower are particularly cost-effective because they can be connected to the existing electrical grid. The excess energy can be utilised to pump water into the lake, which is then stored during periods of cloud cover or nocturnal hours.

- **Secasol Project**

  Portuguese and Spanish researchers have developed a new kind of environmentally conscious method: the use solar energy to dry urban garbage and sewage sludge. The Secasol project is largely financed by the European Union. Sludge from sewage treatment and municipal waste both contain large amounts of water. And this makes it more expensive to transport and use. This method is suitable for an immediate solution to the problem - emphasized the Portuguese coordinator of the project, David Loureiro. It reduces the moisture content of sludge and other waste materials. Furthermore, the cost of transportation will be reduced. The objective of the project is to optimize the concentration of solar energy to a level that elevates the temperature to 200 degrees, thus facilitating the effective drying of the waste. The final product has the potential for utilisation in a variety of applications, including agriculture. According to experts, this technology has the capacity to reduce not only pathogens, but also sludge. Moreover, renewable energy is utilised for all of these processes, with no additional costs incurred.

- **Closure of coal-fired power plants**

  Portugal closed its last coal-fired power plant in 2021, thus becoming the fourth coal-free country in the European Union after Austria, Belgium and Sweden. However, it should be noted that, despite this development, the country will continue to rely heavily on fossil fuels for energy production; nevertheless, the proportion of renewables is already around 60-70%. Consequently, the nation is anticipated to achieve its 2030 goal of phasing out the use of fossil fuels in power plants by the same date.

- **Mobi E Program**

  The main objective of the network is to contribute to the establishment of sustainable mobility, to exploit as much as possible and integrate the benefits from renewable resources into the operation and development of cities in a coordinated manner.

- **The world's largest floating wind turbine**
  In 2019, the inaugural 8.4 MW turbine for the "Windfloat Atlantic Phase 1" offshore wind platform was installed in Portugal. On 27 July, 2020, the third floating wind turbine of the WindFloat Atlantic project (25 MW) was connected to the grid. This turbine, the first floating wind farm in continental Europe, was installed by Bourbon Subsea Services, and the wind farm pair was brought into full operation.
- **Collecting Pet Bottles**
  According to the statement of the Ministry of Environment, consumers receive 2 euro cents for 100-500 ml bottles, and 5 euro cents for 0.5-2 litre bottles
- **Urban- Eco System:** The firm offers proactive solutions for future developments that have the potential to curtail the current way of life, thereby achieving sustainability and human-nature balance. The company also endeavours to create urban systems that integrate the needs of society with the integration of nature, thereby creating building associations and residential communities that protect the ecosystem.
- The Water and Waste Regulatory Authority launched a mobile app in 2014 to provide users with enhanced information about water and waste services. The application allows citizens to compare their services with 278 other municipalities across Portugal. Furthermore, people are able to ascertain methods by which they can reduce their own water consumption and waste production.
- **Tazzi:** This is the first shared mobility platform to be operating at 100% carbon-free. Its main goal is to ensure sustainable mobilisation. The platform is designed to register drivers and taxi drivers who use electric vehicles exclusively. In collaboration with a company named Frog, they also offer electric scooters, as well as electric bicycles and motorcycles.
- **Trash4Goods:** Its mission is to raise awareness, educate and motivate people to take a more active role in recycling. Their goal is to revolutionize the recycling experience of the common man by building a platform that rewards users for every recycling through a system of gamification points and components.
  https://www.f6s.com/programs/portugal
- **Lisbon** was the European Green Capital in 2020 (https://ec.europa.eu/environment/topics/urban-environment/european-green-capital-award/winning-cities/previous-winning-cities_en). The city was distinguished from the other applicants on the basis of its advanced transport network, which covered the entire

city area, bioconstruction, many green areas, and exemplary methods of energy saving and waste processing, sustainable urban mobility. Lisbon prioritises bike-sharing scheme, sustainable mobility, walking, cycling, public transport as well as the restriction of car use. In addition, the city has implemented initiatives to support the use of alternative fuel vehicles and it boasts one of the largest electric-vehicle charging point networks in the world. The city management is committed to protecting its green spaces, evidenced by the planting of 20,000 trees, in 2020.

- **Introduction of green visa**
  In order to be as environmentally friendly as possible, Portugal has instituted the green visa. Through investments in organic agriculture, renewable energy, ecotourism and a wide range of environmental projects, foreigners can obtain residency and subsequently Portuguese citizenship. https://www.theportugalnews.com/news/portugal-among-greenest-to-live-in/49138
- **Ending the use of coal in electricity production**
  Eight years before the 2030 deadline, Portugal has succesfully eliminated the use of coal in its two remaining coal-fired power plants. This significant environmental protection decision will result in a reduction of carbon dioxide emissions. https://blueandgreentomorrow.com/travel/why-eco-conscious-citizens-should-consider-moving-to-portugal/
- **Transport reform:** Portugal plans to replace more than 500 buses with electric vehicles and invest in two new underground networks. https://borgenproject.org/10-facts-about-sustainability-in-portugal/

**References**


- Baer, W., Dias, D. A., and Duarte, J. B. (2013): The economy of Portugal and the European Union: From high growth prospects to the debt crisis. The Quarterly Review of Economics and Finance, 53(4), 345–352.
- Burck, J., Hagen, U., Höhne, N., Nascimento, L. and Bals, C. (2019): Climate Change Performance Index. Results 2020. Link: https://ccpi.org/wp-content/uploads/ccpi-2020-results-the_climate_change_performance_index-1.pdf.
- CCPI (2022): Portugal. Link: https://ccpi.org/country/prt/. Downloaded: 25.05.2022.
- Climate Adapt (2021): Portugal. Link: https://climate-adapt.eea.europa.eu/countries-regions/countries/portugal. Downloaded: 20.04.2022.
- Climate Change Knowledge Portal (2022): Portugal. Link: https://climateknowledgeportal.worldbank.org/country/portugal. Downloaded: 01.06.2022.

- EPI (2022d): Portugal. Link: https://epi.yale.edu/epi-results/2020/country/prt. Downloaded: 26.05.2022.
- Eurostat (2022): Energy import dependency by products. Link: https://ec.europa.eu/eurostat/databrowser/view/sdg_07_50/default/table?lang=en. Downloaded: 14.01.2021.
- Eurostat (2022b): Government finance statistics. Link: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_finance_statistics#Government_debt. Downloaded: 02.06.2022.
- Global Forest Watch (2020): Portugal. Link: https://www.globalforestwatch.org/dashboards/country/PRT.
- Horta, A., Gouveia, J. P., Schmidt, l., Sousa, J. C., Palma, P., and Simões, S. (2019): Energy poverty in Portugal: Combining vulnerability mapping with household interviews. Energy and Buildings, 203(November), 109423.
- IEA (2021): Portugal 2021. Energy Policy Review. Link: https://www.iea.org/reports/portugal-2021. Downloaded: 14.01.2021.
- Ministry of Foreign Affairs (2017): National report on the implementation of the 2030 Agenda for Sustainable Development, on the occasion of the Voluntary National Review at the United Nations High-level Political Forum on Sustainable Development. Portugal. Link: https://sustainabledevelopment.un.org/content/documents/15766Portugal2017_EN.pdf
- NECP2030 (2019): National Energy and Climate Plan 2021-2030 (NECP 2030). Portugal. Link: https://ec.europa.eu/energy/sites/default/files/documents/pt_final_necp_main_en.pdf
- Odyssee-mure (2021): Sectoral Profile – Households. Link: https://www.odyssee-mure.eu/publications/efficiency-by-sector/households/household-eu.pdf. Downloaded: 12.01.2021.
- Planoc 2022: http://www.planoc.com.pt/en
- Ritchie, H. and Roser, M. (2020a): Energy. Link: https://ourworldindata.org/energy/country/portugal
- Ritchie, H. and Roser, M. (2020b): Fossil Fuels. Link: https://ourworldindata.org/fossil-fuels. Downloaded: 14.01.2021.
- Ritchie, H. and Roser, M. (2020c): Renewable Energy. Link: https://ourworldindata.org/renewable-energy. Downloaded: 14.01.2021.
- RNC2050 (2019): Roadmap for Carbon Neutrality 2050 (RNC2050). Long-term Strategy for Carbon Neutrality of the Portuguese Economy by 2050. Link: https://www.portugal.gov.pt/download-ficheiros/ficheiro.aspx?v=%3D%3DBAAAAB%2BLCAAAAAAABACzMDexBAC4h9DRBAAAAA%3D%3D
- Wendling, Z. A., Emerson, J. W., de Sherbinin, A., and Esty, D. C., et al. (2020): 2020 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy. Link: https://epi.yale.edu/downloads/epi2020report20210112.pdf

### 4.23. ROMANIA

Romania's population is 20 million with a GDP of 189 billion dollars. The estimated average annual losses for the country as a whole are approximately USD 2.2 billion and 335,000 people are affected, representing 1.2% of Romania's GDP and 1.7% of its population. Officially, the urbanisation rate in Romania is stands at approximately 55%, which is notably lower compared to other regions within Europe. This rate has remained stable over the past two decades, a phenomenon that is analogous to the experience of numerous other Eastern European countries that have undergone a transition from a centrally planned to a free market economy (Climate Adapt, 2022h).

However, recent research by the World Bank has shown that Romania is undergoing a process of suburbanisation, with the immediate vicinity of major cities expanding by 300,000 people, despite the ongoing significant out-migration from the country. As a proportion of the regions outside the urban core are still classified as rural by the central government, this change has yet to be reflected in official population statistics. Should this scenario materialise, it is estimated that the urbanisation rate could rise to 65.2%. Population loss and displacement are reflected in changes in the density ratios of cities in Romania's growth pole, while density levels in these cities are generally decreasing, in some cases by as much as 48% (Climate Adapt, 2022h).

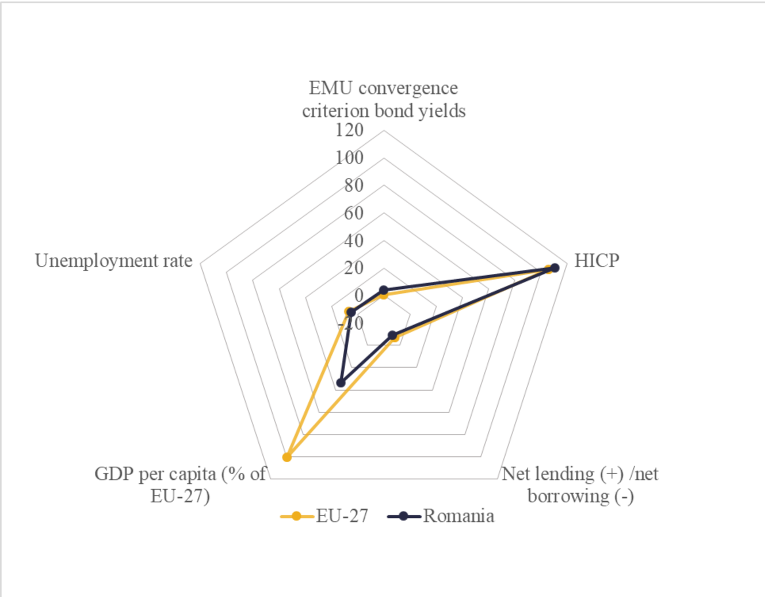



**Figure 181: Romania vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

Figure 182 shows significant deviations from the EU-27 average for most of the selected economic indicators. The Maastricht criterion interest rates are more than 10 times the EU average, GDP per capita is only one third of the EU average, unemployment is 2% above the EU average and government expenditure exceeds government revenue by a larger proportion than in EU countries.

**Climate Strategy**

The National Climate Change Strategy (2013-2020) consists of two separate parts: reducing greenhouse gas emissions to meet national targets and adapting to the impacts of climate change, taking into account the European Union's climate change policy and the relevant documents developed at European level and mentioned above, as well as the experience and knowledge gained through cooperation with foreign partners and prestigious international institutions. The implementation of the proposed strategy is the responsibility of the Government, coordinated by the Ministry of Environment and Climate Change (MMSC - Ministerului Mediului şi Schimbărilor Climatice) (Ministerul Mediului si Schimbarilor Climatice, 2013).

Romania is located in the south-eastern part of central Europe and covers an area of 238 397 km2.The country is crossed from north to south-west by the Carpathians, while the Danube, Europe's second longest river, runs from west to east for 2 857 km, forming a border in the south and flowing into the Black Sea, creating Europe's second largest and best-preserved delta. Romania's major topographical features are distributed proportionally, with an estimated 35% mountains, 35% hills and plateaus and 30% plains. The climate of Romania is moderately continental, with the Atlantic Ocean in the west and centre of the country, the Mediterranean Sea in the south-west, the Nordic-Baltic region in the north-east and east, the Black Sea in the east and a transition zone between an oceanic and a continental climate in the south (Ministry of the Environment and Climate Change, 2013).

According to the Köppen classification, the climate types in Romania are: Tundra climate (ET), typical for the alpine areas of the Southern Carpathians (above 2000-2200 m); Subarctic continental climate, with cold summers and no dry season; this climate type is typical for the high altitude areas of the Eastern, Southern and Western Carpathians (1700-2000 m); Humid continental climate, without dry season and with warm summers; this climate type is well represented in the Eastern Carpathians (especially in areas below 1700-1800 m), in the eastern parts of the Transylvanian Plain, however it is also limited to certain low-lying areas of the Southern and Western Carpathians (e.g. Moderate or oceanic) climate, without a dry season, with warm summers; this climate type is typical for the western hilly areas of the country, as well as for the Transylvanian-Miberian, the Moldavian Plateau and the Carpathian Basin; The Romanian Plain, parts of the Western Plain and the Dobruja Plateau is characterised by humid subtropical temperate climate with warm summers. In contrast, the Danube Delta and the Razim-Sinoe lagoon complex are marked by the cold semi-arid climate with hot and dry summers and cold winters (Romanian Ministry of Environment and Water Management, 2005).

In Romania, natural and semi-natural ecosystems cover about half of the country's land area, while the other half is consists of agricultural ecosystems, buildings and infrastructure. The main types of natural ecosystems found in Romania are the followings: forest, meadow, freshwater and brackish water, marine and coastal, and underground (cave) ecosystems (Nesterenko et al., 2015).

Romania is experiencing a climate change characterised by variability and extremes. Observational data spanning the period 1901-2020 from 29 weather stations with long-term time series reveals a continuous warming on both annual (1.3 °C, over the entire period) and seasonal (particularly evident in summer, winter and spring) time scales. An increase in the frequency and duration of extreme heat events has been observed across the nation. The warmest year on record was 2019 (with an average temperature of 12.1°C) and the coldest was 1940 (with an average temperature of 8.1°C). The year 2020 is the second warmest year in the 1901-2020 period (with an average temperature of 11.9°C). In terms of precipitation, the trends observed over the 1901-2020 period demonstrate a lack of significant change in annual rainfall. Depending on the season, some regions of Romania (e.g. the Transylvanian Plain, the Apuan Mountains) exhibit an increase in autumn precipitation, while others (e.g. the Danube Delta, the Banat region) show a decrease in winter and spring (Climate Adapt, 2022h).

This sector of economic activity encompasses emissions of greenhouse gases from stationary and mobile sources, from fuel combustion processes and from equipment failure or accidents, known as fugitive emissions. At the European level, greenhouse gas emissions from electricity and heat generation accounted for approximately 27% of total emissions in 2009, according to EEA greenhouse gas data, which show no significant differences between 2004 and 2009. According to the 2012 National Inventory of Greenhouse Gas Emissions in Romania, greenhouse gas emissions from the energy sector accounted for 87% of total emissions in 2010.

Figure 183 demonstrates the total energy demand in the EU. The data show that total energy demand in the EU has decreased by an average of 1% per year over 20 years.

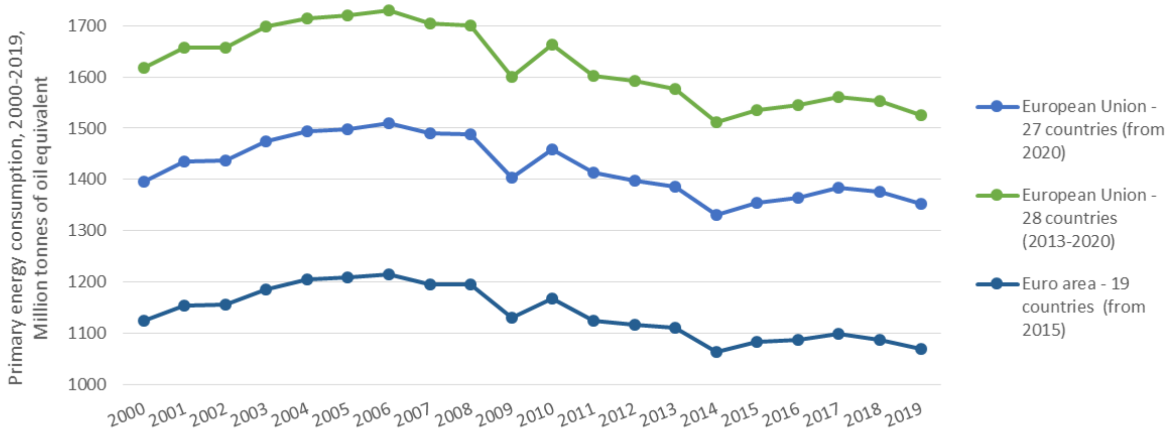



**Figure 182: Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

However, the average rate of change in Romania shows a faster trend compared to EU countries (Figure 184).

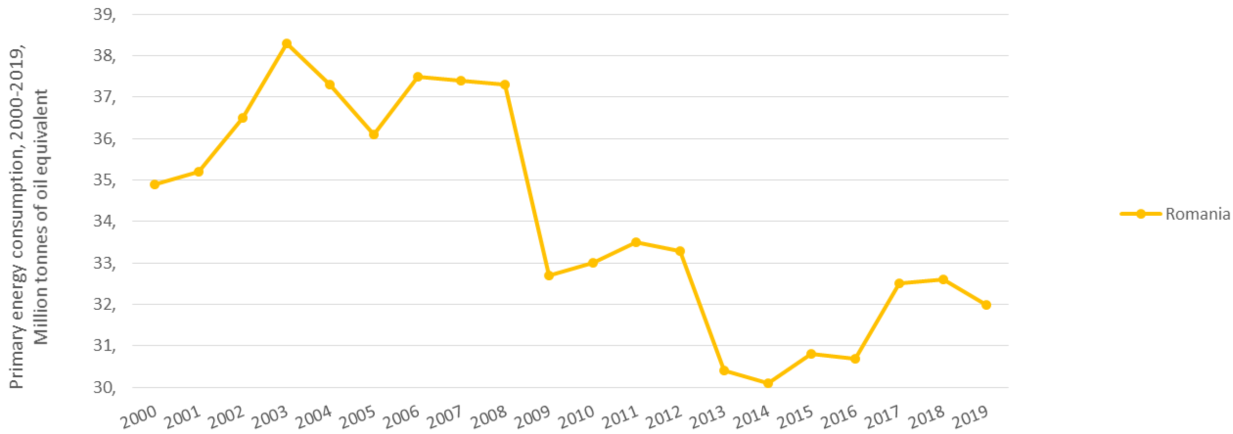



**Figure 183: Romania vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

Greenhouse gas emissions from the combustion of fuels in buildings, machinery and equipment are included in the national greenhouse gas inventory in the energy sector. Emissions resulting from these activities have been estimated to account for around 1% of total national emissions. In order to satisfy the energy requirements of development in a sustainable manner, energy efficiency policies and measures should be promoted as a priority as an alternative to increasing energy sources. The utilisation of renewable energy sources in electricity and heat production should be further promoted. Romania is currently on track to meet its renewable energy target. The share of electricity from renewable sources was 23.4% in 2012 and the target for 2020 is 24%.

The energy sector is the largest emitter of greenhouse gases, accounting for 70% of total greenhouse gas emissions in Romania and has contributed to a 70% reduction in greenhouse gas emissions since 1989. The sector is naturally given full attention in terms of emission reductions. Three quarters of the energy sector's GHG emissions come from electricity and heat production and from fuel consumption for non-transport purposes. Economic growth and energy consumption have not been correlated in Romania since 1998 and the energy intensity of the economy, measured by the unit primary energy consumption of gross domestic product, is decreasing. Per capita energy consumption in the country is significantly lower than in high-income EU countries. If the economy continues to grow, energy demand is expected to increase significantly (Ministerul Mediului si Schimbarilor Climatice, 2013).

Romania's greenhouse gas emissions are lower compared to the EU average, but their decrease is below the EU average (Figure 185).

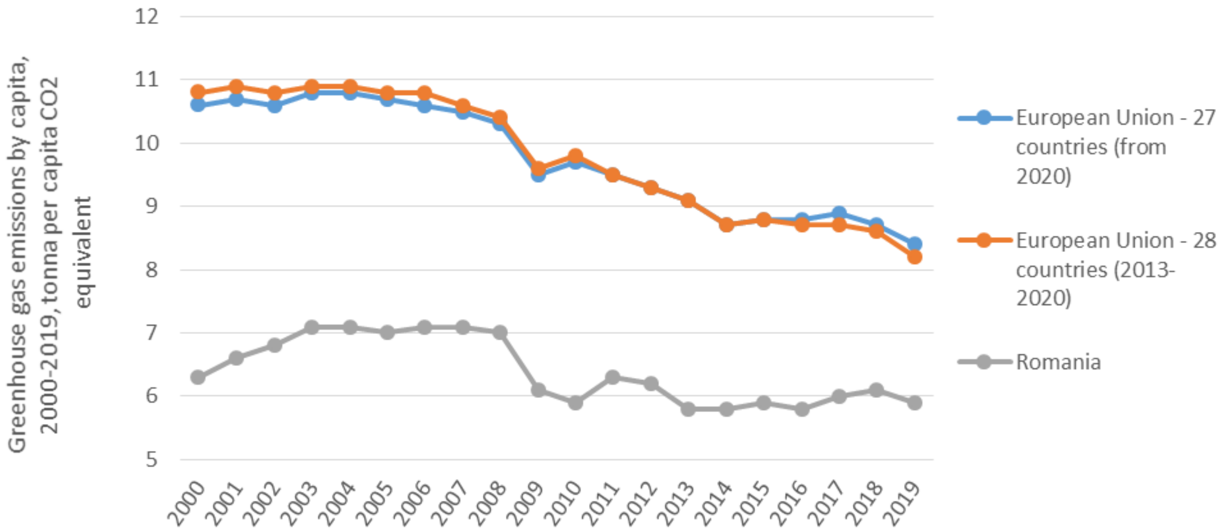



**Figure 184: Romania vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

The strategy outlines measures designed to reduce emissions from combustion processes in the electricity and heat generation industries, transport and the housing and urban planning sub-sectors. The combustion of fossil fuels is the largest contributor to global greenhouse gas emissions, accounting for about 57% of total CO2 equivalent emissions in 2004 - IPCC 2007 report.

Promoting measures to reduce greenhouse gas emissions and sectoral emission planning to achieve international and European reduction targets requires a high level of professional competence on the part of public authorities; improving professional training in this area can be achieved by promoting and funding appropriate training programmes/projects and exchanges of experience with more experienced countries in this field. The country's contribution to the European target of 20% share of renewable energy in gross final energy consumption by 2020 is to produce at least 24% of final energy consumption from renewable energy sources - RES. Romania has adopted the Law No 220/2008 on the establishment of a system for the promotion of energy from renewable sources at a national level, as amended and supplemented by subsequent amendments and additions, which ensures the transposition of the above-mentioned Directive. The evolution of the share of fossil fuels in gross available energy is an important factor, as the use of these fuels increases carbon dioxide emissions. In Romania, fossil fuel use has been decreasing at a higher rate than the EU average since 2010 (Ministry of Environment and Climate Change, 2013).

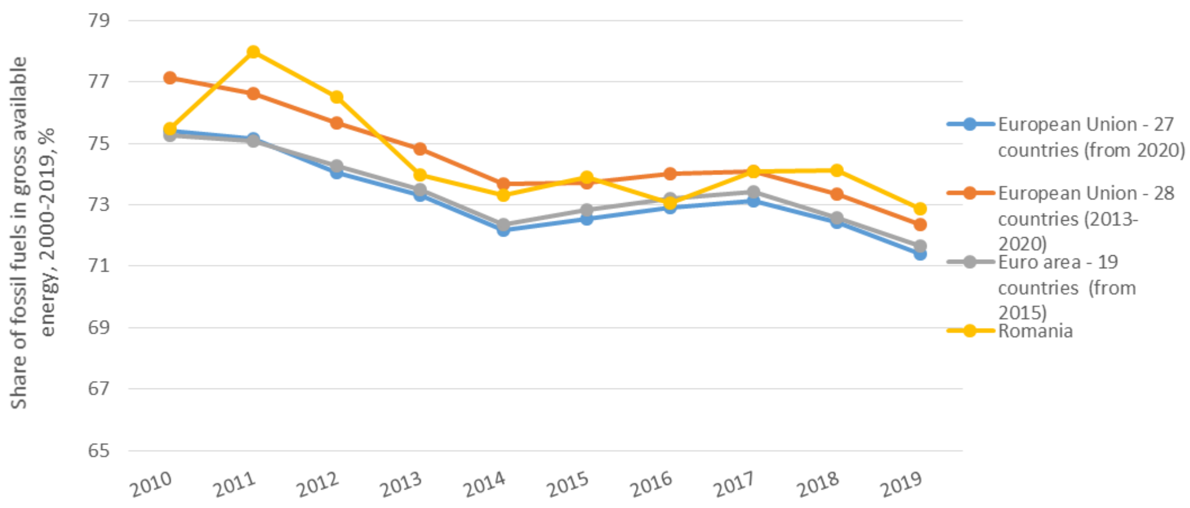



**Figure 185:** **Romania vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

Romania started from a high level of renewable energy use compared to EU countries in 2010, with an average rate of change in line with the EU trend.

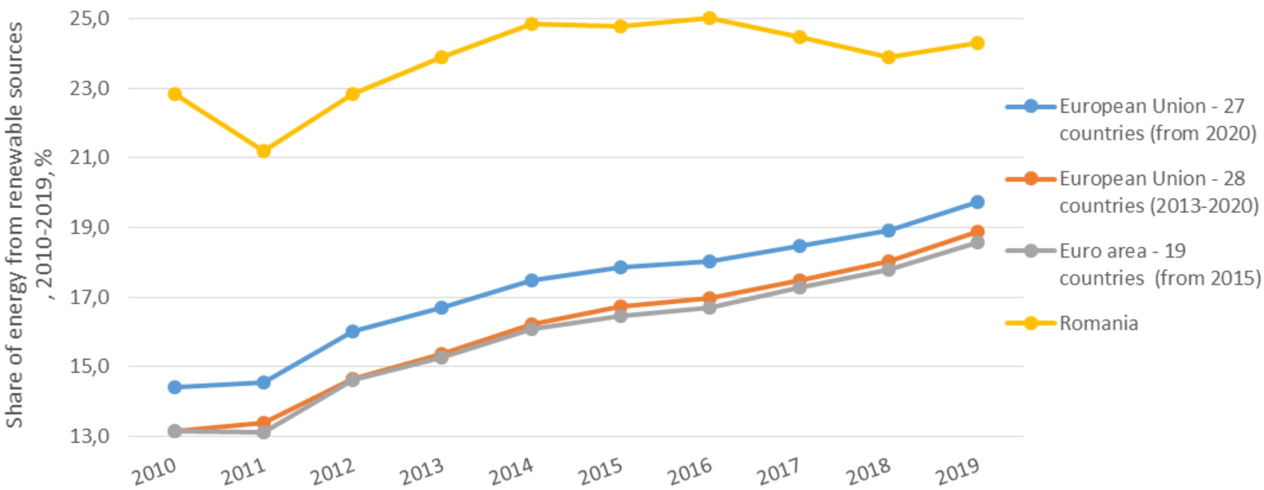



**Figure 186: Romania vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

International expert bodies do not recommend the utilisation of nuclear energy to reduce greenhouse gas emissions in the context of international climate change policies. However, due to the current energy situation and at the current stage of development of renewable energy technologies, nuclear technology as a source of energy production must be realistically assessed, in the light of Romania's international commitments to reduce emissions. In order to meet the national energy development priorities for the future, which include the increased use of our own coal resources, Romania has taken all legislative steps to promote CO2 capture and geological storage technology, CCS.

**Composite Indicators**

The Environmental Performance Index (EPI) provides a summary of the state of sustainability around the world, including Romania. The EPI uses 32 performance indicators across 11 categories of questions and ranks 180 countries on the basis of environmental health and ecosystem vitality. These indicators show at the national level how close countries are to achieving their environmental policy goals. Romania’s Environmental Performance Index scores from 2014 to 2020 can be seen in Figure 188. Regarding the EPI, Romania was always in the bottom half of the ranking, and its results were mostly worse than the EU-27 average except in 2016 when the score was higher than the average.

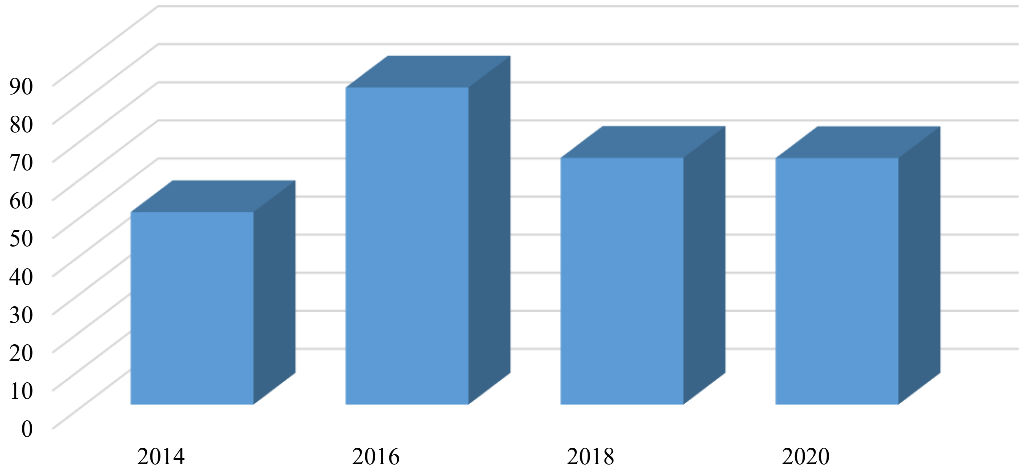



**Figure 187:** **Romania– Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Its ranks and scores were following in the EPI:

- 2014: 27. with 50.52 points (EU-27 average: 72.17)
- 2016: 23. with 83.24 points (EU-27 average: 82.91)
- 2018: 25. with 64.78 points (EU-27 average: 73.33)
- 2020: 22. with 64.70 points. (EU-27 average: 70,95)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Romania's ecological footprint per person from 2014 until 2020 is visible in Figure 189. Romania performs relatively bad regarding the ecological footprint as its scores are always below the EU-25 average level.

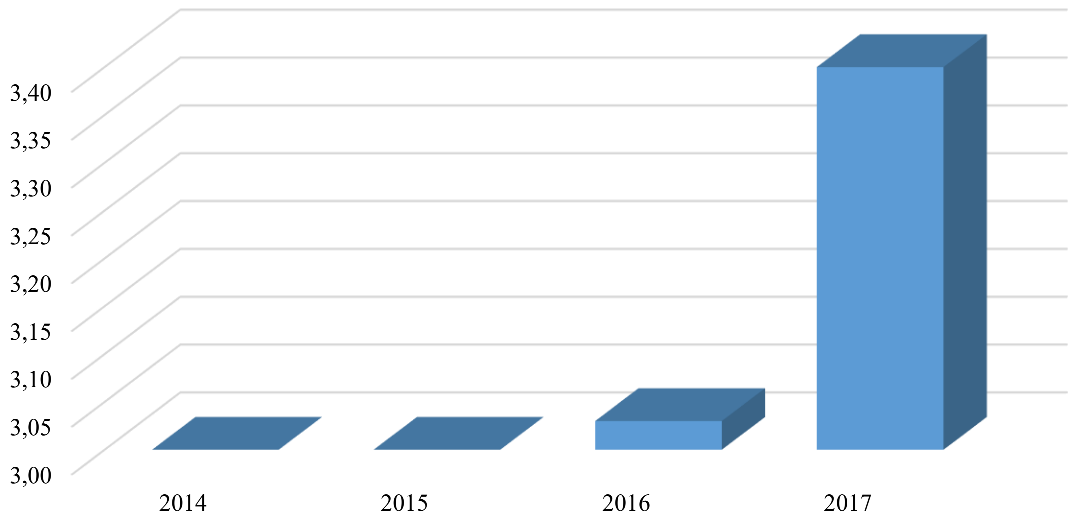



**Figure 188:** **Romania – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Its ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

❖ total score in 2014: 2.73 (EU-25 average: 5.23)

❖ total score in 2015: 2.93 (EU-25 average: 5.25)

❖ total score in 2016: 3.03 (EU-25 average: 5.26)

❖ total score in 2017: 3.40 (EU-25 average: 5.34)

Concerning the Climate Change Performance Index (CCPI) Romania's performance is mostly constant in the sense that its values were always above average. The scores of the CCPI for the country can be seen in Figure 190.

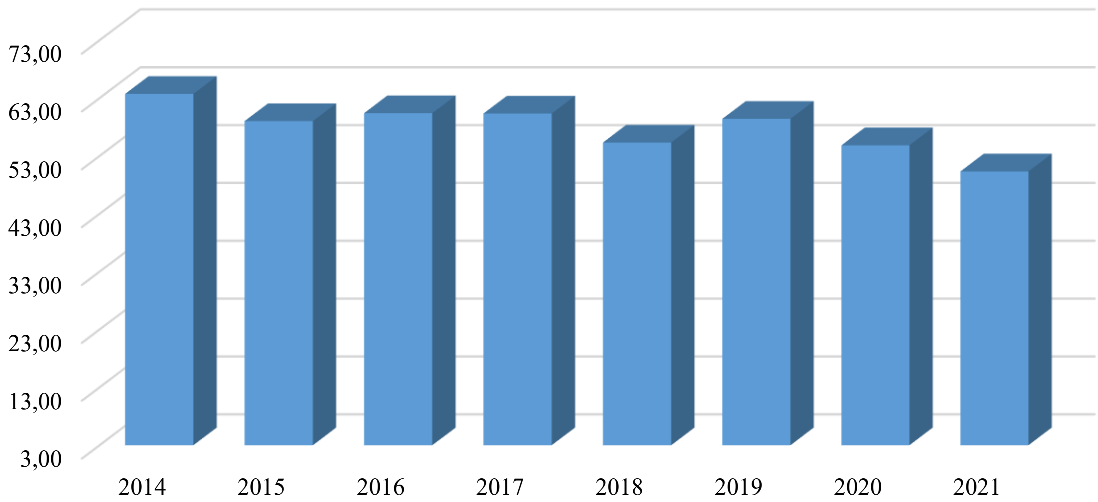



**Figure 189: Romania vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

❖ 2014: 16. with 63.73 points (global average: 55.72)

❖ 2015: 25. with 59.02 points (global average: 55.36)

❖ 2016: 18. with 60.39 points (global average: 54.15)

❖ 2017: 18. with 60.33 points (global average: 53.77)

❖ 2018: 26. with 55.32 points (global average: 49.09)

❖ 2019: 20. with 59.42 points (global average: 50.35)

❖ 2020: 24. with 54.85 points (global average: 48.61)

❖ 2021: 30. with 50.33 points (global average: 47.90)

Romania's scores were mostly above the average in all the examined years.

**Summary**

In Romania, which currently has 20 million inhabitants, the average available water is 2,000 cubic metres per capita per year. There are significant inter-annual variations in the availability of water resources. In the driest years, water availability has decreased. There are significant water shortage variations within Romania, with the most severe being in the Jiu, Arges-Vedea, Buzua-Ialomita, Siret, Prut-Barlad and Dobrogea-Littoral basins. At present, water demand is based on industrial (67%), agricultural (18%) and municipal (15%) usage. Irrigated areas in Romania have decreased from 2 million ha in the late 1908/early 1990s to about 0.8 million ha (which can be considered irrigable with a functioning infrastructure) as economically unviable systems have been closed.

Approximately 70% of domestic water supply comes from surface water, while 95% of industrial water supply depends on surface water. Romania's hydropower potential is estimated to be at 36 TWh/year, and the total installed hydropower capacity is currently 6 400 MW. Hydropower generation accounts for 32% of the nation’s total electricity generation and 16% of total energy use. The total agricultural area of Romania is 15.9 million hectares, of which about 13.3 million hectares (about 56% of the total area) are currently utilised. Of the total agricultural area, approximately 1.5 million hectares are covered by economically viable/viable irrigation systems, although only circa 800 000 hectares are currently operational. In comparison to other EU Member States, the agricultural and rural development sector in Romania is extensive, covering 59.8% of the total land area and 44.9% of the total population. A relatively high share of national gross value added (32.4%) and employment (41.5%) is also generated in rural areas.

The ARD sector in Romania is also diverse and complex, with wide variations in terms of socio-economic environment and human/institutional capacity. Rural areas in Romania are characterised by a low level of infrastructure and relatively underdeveloped basic services (health and education systems, financial and credit facilities, etc.) compared to urban areas. The agricultural and rural development sector consists of two distinct and clearly defined sub-sectors: i) approximately half of the agricultural land is managed by a small number of very large, capital-intensive and technologically advanced farms, and ii) the other half of the agricultural land is occupied by communities of very small farmers using more traditional farming methods, largely for own consumption. In total, there are 3.86 million agricultural holdings in Romania, 96.6% of which belong to this sub-sector of "small-scale subsistence farms". These small farms provide an important socio-economic buffer and basic livelihood for a significant part of the rural population. They also play an important role in maintaining the viability of rural communities and provide important social, cultural and environmental services to the wider Romanian society.

**Good Practices**

In the CAMARO-D project, the NMA has developed an innovative transnational guide for sustainable land use planning (GUIDR), a practice-oriented decision support tool for relevant stakeholders and decision-makers, in a transnational cooperation between 14 partners from 9 different countries. The NMA and 14 partners from 9 countries participating in the transnational cooperation (CAMARO-D) signed a joint declaration of cooperation to further develop the different forms of collaboration, recognising the importance of coordination within the Danube river basin, taking into account the need for coordinated actions and promoting the topic of "water resources protection and flood prevention" to the general public, as well as promoting cooperation in the field of strategic policy. In the framework of the project "Joint Disaster Risk Assessment and Preparedness in the Danube macro-region", the NMA has cooperated to improve coherence and consistency between risk assessments carried out by countries at national and local level, in particular for disasters amplified by climate change in the Danube macro-region. The SEERISK project developed a common risk assessment methodology for the Danube macro-region and guidelines for climate change adaptation and risk assessment in the Danube macro-region. In the framework of the DRIDANUBE project, NMA? has established a network of communicators (beneficiaries) through questionnaires and contributed to the assessment of the impact of the drought phenomenon in both Romania and the agricultural areas of the partner countries of the Danube Region. This transnational cooperation has led to an improved response (strategy) to drought emergencies and better cooperation between operational services and decision-making authorities in the Danube Region at national and regional level.

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**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Adapt (2022h). Romania. Downloaded from https://climate-adapt.eea.europa.eu/countries-regions/countries/romania
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table,

Unemployment rate
https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.

- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Ministerul Mediului si Schimbarilor Climatice (2013). Strategia nationala a Romaniei privind schimbarile climatice 2013-2020. Ministerul Mediului si Schimbarilor Climatice, Bucuresti.
- Ministry of Environment and Climate Change (2013). Romania's Sixth National Communication on Climate Change and First Biennial Report, Bucharest.
- Nesterenko, M., Dyakov, O., Drumea, D., Doroftei, M. (2015). Adapting to Change. Climate Change Adaptation Strategy and Action Plan for Danube Delta Region.
- Romanian Ministry of Environment and Water Management (2005). National Strategy on Climate Change of Romania 2005-2007. Romanian Ministry of Environment and Water Management, Bucharest.

## 4.24. SLOVAKIA

The Slovak population is over 5.4 million, with an average population density of 110 inhabitants per km$^2$. According to the 2011 census, the majority of Slovakia's population is Slovak (80.7%), with Hungarians being the largest ethnic minority (8.5%). Other ethnic groups include Roma (2%), Czechs (0.6%), Rusyns (0.6%) and other or unspecified (7.6%). Unofficial estimates for the Roma population are much higher, at around 5.6% (Climate Adapt, 2022i).

The territory of Slovakia is situated between 47° and 50° north latitude and 16° and 23° east longitude. The topography of Slovakia is predominantly mountainous, with the Carpathian Mountains extending along a significant portion of the northern half of the country. The mountain ranges in question include the high peaks of the Tatra-Tatras region (including the Tatras, the Great Tatras and the Little Tatras), the Slovak Ore Mountains, and the Slovak Central Mountains or Beskidek. The largest lowland is the fertile Danube Plain in the south-west, followed by the Eastern Slovak Plain in the south-east (Climate Adapt, 2022i).

Figure 191 demonstrates a close position to the EU-27 average for most of the selected economic indicators. However, GDP per capita is only close to 60% of the EU average and the Maastricht criterion interest rates show a negative sign.

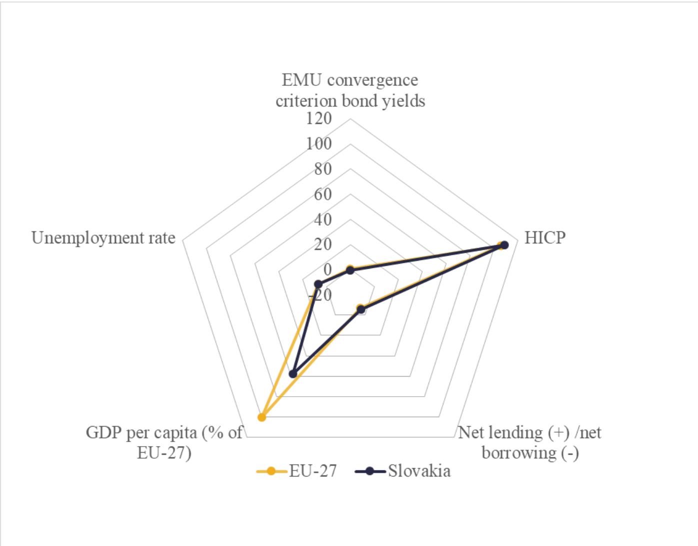


**Figure 190: Slovakia vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

The Slovak economy is considered to be advanced and high-income economy, with GDP per capita in 2018 reaching 78% of the EU average. The country is encountering challenges to address regional disparities in wealth and employment. The GDP per capita ranges from 188% of the EU average in Bratislava to 54% in Eastern Slovakia. Despite the prevalence of significant regional income inequalities, 90% of the population owns their own home (Climate Adapt, 2022i).

The Slovak Republic has demonstrated a r economic performance, with a robust financial sector, minimal public debt and considerable international competitiveness underpinned by substantial foreign investment and strong growth. In 2020, the International Monetary Fund ranked Slovakia as the 38th richest country in the world (out of 187 countries), with a GDP per capita at purchasing power parity of $38,321. The country was formerly referred as the 'Tatra tiger'. Slovakia has successfully transitioned from a centrally planned to a market-driven economy. Significant privatisations have been completed, the banking sector is predominantly private, and foreign investment has increased (Climate Adapt, 2022i).

The Slovak economy has been identified as one of the fastest growing economies in Europe and the third fastest growing in the euro area (2017), with GDP growth of 10.5%, 6% and 4% in 2007, 2008 and 2010 respectively. In 2016, over 86% of Slovak exports were destined for the European Union, and more than 50% of Slovak imports came from other EU countries. The public debt-to-GDP ratio in Slovakia reached 49.4% at the end of 2018, well below the OECD average.

**Climate Strategy**

Slovakia is among the most energy-intensive economies in the EU, with a number of high-carbon manufacturing sectors, and the government often prioritises the protection of industry over low-carbon targets. The mining industry is the recipient of substantial policy support in the form of carbon subsidies, while the policy environment for renewables is less favourable. Slovakia has a high share of nuclear energy, but also a high share of hydropower in the energy mix, which represents a very high proportion of the renewable energy mix. The targets for renewables are therefore met, yet the further expansion of other renewable energy sources and technologies would be welcomed. This could result in a more decarbonised and decentralised energy market, which could in turn lead to lower electricity bills, as Slovakia has one of the highest electricity bills in the EU (Ministry of Environment of the Slovak Republic, 2014).

Given that Slovakia is a Member State of the European Union, its policies respect European environmental and energy strategy documents and objectives. Slovakia was one of the first countries to ratify the Paris Global Agreement in 2016 and, as it was holding the Presidency of the EU Council at that time, it also prioritised the completion of the ratification process at

European level. Slovak climate policy is set out in the document "Envirostrategy - Greener Slovakia", prepared by the Ministry of Environment in September 2018. Slovakia is currently facing a number of environmental challenges, related to air quality, low waste recycling rates and the protection of ecosystems. The issue of air pollution has been identified as a significant contributing factor to mortality, it accounts for more than 5,000 premature deaths in the country every year. Environmental problems are having a growing impact on the economy, employment opportunities and the quality of life for citizens. The Strategy for the Environmental Policy of the Slovak Republic to 2030 (Environmental Strategy 2030 - Enviro-strategy 2030) sets out a vision for 2030. This vision is based on possible, probable and desirable future developments, and it identifies the key issues of the system, sets objectives to 2030, proposes framework measures to improve the current situation and includes key performance indicators to monitor results (Ministerstvo Zivotneho Prostredia Slovenskej Republiky, 2018).

The Enviro-Strategy has set the following objectives: - Slovakia will achieve its air protection targets and reduce greenhouse gas emissions by 43% in the ETS sectors and a 20% non- ETS sectors compared to 2005 levels; - in addition to the continuation of the ETS, the introduction of a green tax, underpinned by the polluter pays principle. This would involve the transfer of the tax burden to environmental taxes; - environmentally harmful subsidies and regulations should be eliminated - adaptation measures should reflect the specific characteristics of the regions and respond adequately to climate change; - the energy intensity of Slovakia's industry should approximate the EU average, and all forms of renewable resources used in energy production should be subject to development and agreement sustainable use criteria by 2020; - there is a necessity for a gradual reduction of electricity and heat production from coal; - the state in cooperation with professional institutions, the business sector, employers, municipalities and NGOs should be responsible for the creation of environmental education programmes (Ministry of Environment of the Slovak Republic, 2014).

The objectives and priorities of the Slovak energy sector are set out in the Strategic Energy Policy of the Slovak Republic. This policy is prepared by the Ministry of Economy for the long term (at least 20 years) and updated in 5-year cycles. Figure 192 illustrates the total energy demand in the EU. The data show that total energy demand in the EU has decreased by an average of 1% per year over 20 years (Ministry of Environment of the Slovak Republic, 2017).

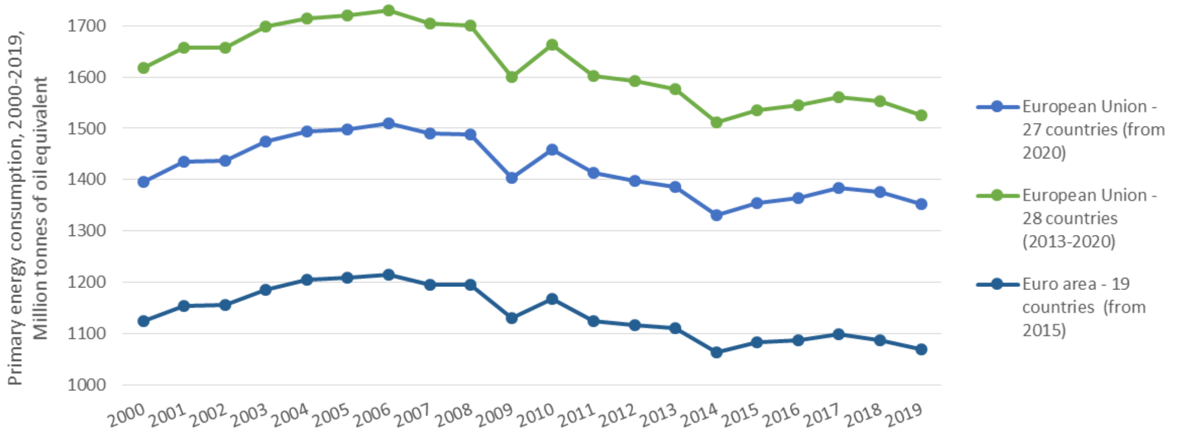


**Figure 191: Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: Edited by the authors based on Eurostat

Slovakia is reducing its energy needs in line with the EU trend (Figure 193).

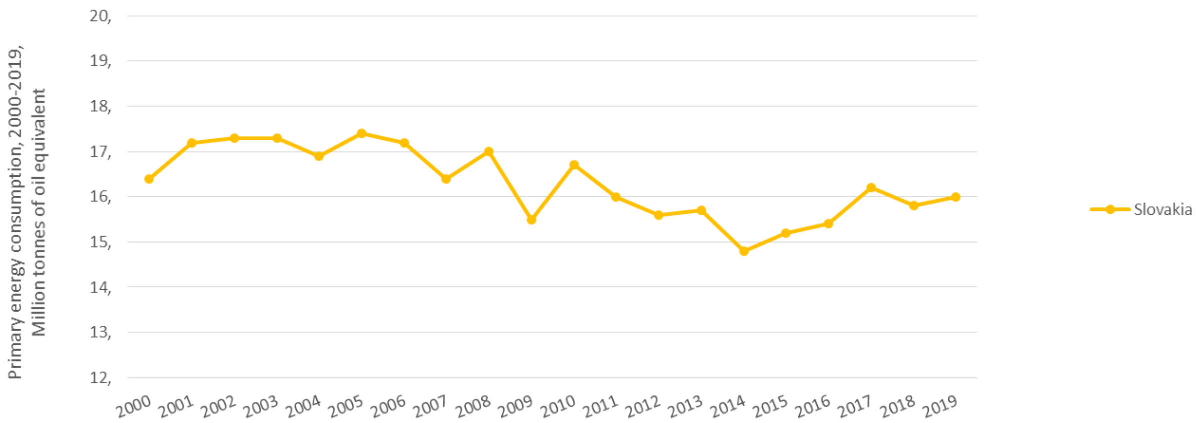


**Figure 192: Slovakia vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: Edited by the authors based on Eurostat

Slovakia exhibits a performance better than the EU average in terms of greenhouse gas emissions. Figure 194 shows that the emissions of these gases are smaller in Slovakia however, it should also be noted that the rate of decrease is smaller than the EU average.

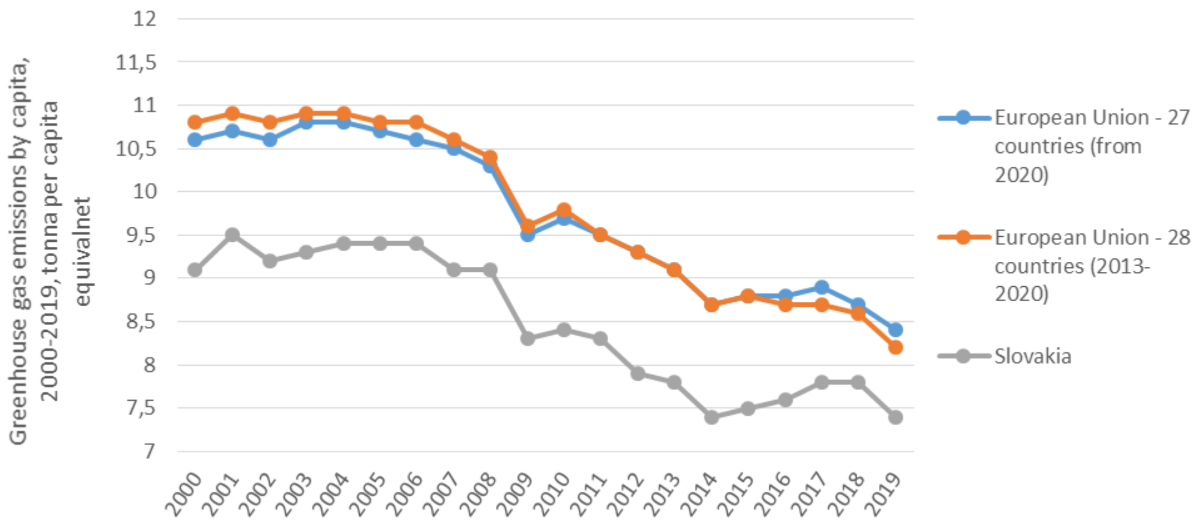


**Figure 193: Slovakia vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**

Source: own compilation based on Eurostat (2022c)

The focus is on domestic energy sources, low-carbon technologies such as renewable resources and nuclear energy. In recent years, there has been a gradual increase in the use of renewable energy sources, reaching 12.0% in 2017 (compared to around 6.5% in 2005). The augmentation of the share of renewable energy sources is crucial to increase self-sufficiency and, by consequence, energy security. In addition, the utilisation of renewable resources constitutes a major environmental asset and thus representing a priority within Slovak energy policy (Furmanczuk, 2018).

The share of fossil fuel is shown in Figure 195. Slovakia performs superior to the EU, and the decline is more pronounced than the average.

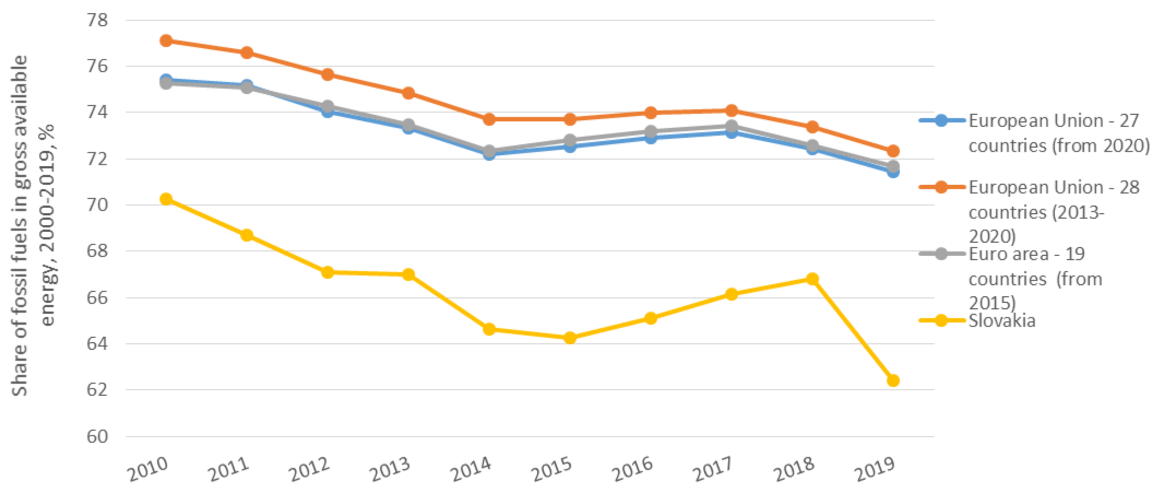


**Figure 194: Slovakia vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**

Source: own compilation based on Eurostat (2022b)

Nuclear fuel is supplied under long-term contracts with the Russian Federation. Given the natural conditions and current technological possibilities, Slovakia has few primary energy sources. Nearly 90% of primary energy sources (including nuclear fuel) are imported. Domestic fossil fuel sources include lignite. For liquid and gaseous energy sources, domestic production accounts for only approximately 4%. A critical issue for the use of fossil fuels for electricity generation is the storage of spent nuclear fuel and the decommissioning of retired nuclear facilities. The Slovak Republic is acting in line with EU policy on these issues (Filcak, R., 2016).

Slovakia has set itself to achieve a 14% share of renewable energy in its energy production by 2020. In 2010, EU countries presented their national renewable energy action plans, outlining their strategies for achieving these targets. In these plans, each Member State has established an estimated trajectory for increasing the share. Slovakia attained a 12% share of energy from renewable sources in 2016, exceeding the projected growth path, as the state has set the share of energy from renewable sources to 11.4% for the 2017-2018 period (Furmanczuk, 2018).

The primary objectives of the Slovak Republic in the field of renewable energy sources, following the priorities of the European Union, are: - Increasing the share of renewable energy sources to 14% by 2020 (compared to 6.7% in 2005); - Gradually increase the share of renewable energy installations to 80 production units before 2020 and 120 production units before 2030; - Increasing the share of renewable energy sources in transport to 10% (Ministerstvo Zivotneho Prostredia Slovenskej Republiky, 2018).

The latest update of the Energy Strategy was published in October 2019. This document's main objective is articulated as "to support sustainable growth and competitiveness of the national economy by ensuring a sustainable energy sector in Slovakia in the long term, while achieving reliability and stability of energy supply, efficient use of energy at optimal cost and environmental protection". The Slovak energy policy is significantly influenced by the EU's targets under the Europe 2020 strategy, which aims to reduce greenhouse gas emissions by 20%, increase energy efficiency by 20% and use 20% of renewable energy sources by 2020. In 2010, Slovakia's share of renewable energy use was well below the EU average. Figure 196 illustrates the expansion of this energy source, with Slovakia approaching the EU average by 2019.

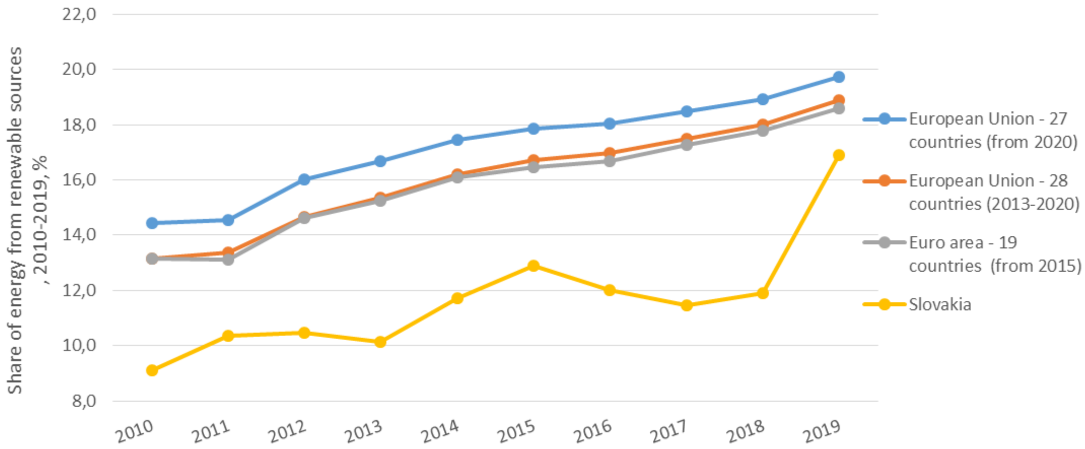


**Figure 195:** **Slovakia vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

Since energy production and consumption have a significant impact on the environment, reducing energy consumption by implementing various conservation measures and increasing energy efficiency, as well as by changing the mix of primary energy sources, has a major impact on reducing greenhouse gas emissions and improving air quality. According to Slávka Štroffeková of the Slovak Environment Protection Agency, Slovakia's energy development focuses on optimising the energy mix to maximise energy efficiency and thoroughly protect the environment from an energy security perspective (Ministerstvo Zivotneho Prostredia Slovenskej Republiky, 2018).

In the Slovak Republic, the share of each energy source in gross domestic consumption is as follows: nuclear fuel (heat) 23.8%, gaseous fuels (natural gas) 23.8%, oil and oil products 20.4%, fossil fuels 20.0% and renewable energy sources (RES) 12.0%. Slovakia is highly dependent on primary energy sources.

## Composite Indicators

The Environmental Performance Index (EPI) provides a summary of the state of sustainability around the world, including Slovakia. The EPI uses 32 performance indicators across 11 categories of questions and ranks 180 countries on the basis of environmental health and ecosystem vitality. These indicators show at the national level how close countries are to achieving their environmental policy goals. Slovakia's Environmental Performance Index scores from 2014 to 2020 can be viewed in Figure 197. Regarding the EPI, Slovakia was always in the middle part of the ranking, and its results were worse in 2018 and 2020 than the EU-27 average and in 2014 and 2016 the results were better.

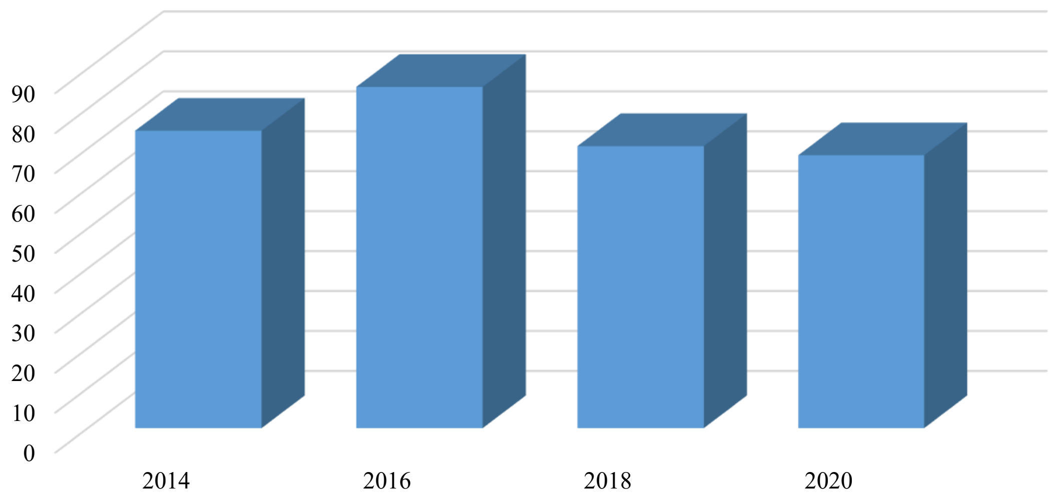


**Figure 196: Slovakia – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Its ranks and scores were following in the EPI:

- 2014: 14. with 74.45 points (EU-27 average: 72.17)
- 2016: 17. with 85.42 points (EU-27 average: 82.91)
- 2018: 17. with 70.60 points (EU-27 average: 73.33)
- 2020: 18. with 68.30 points. (EU-27 average: 70,95)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint.

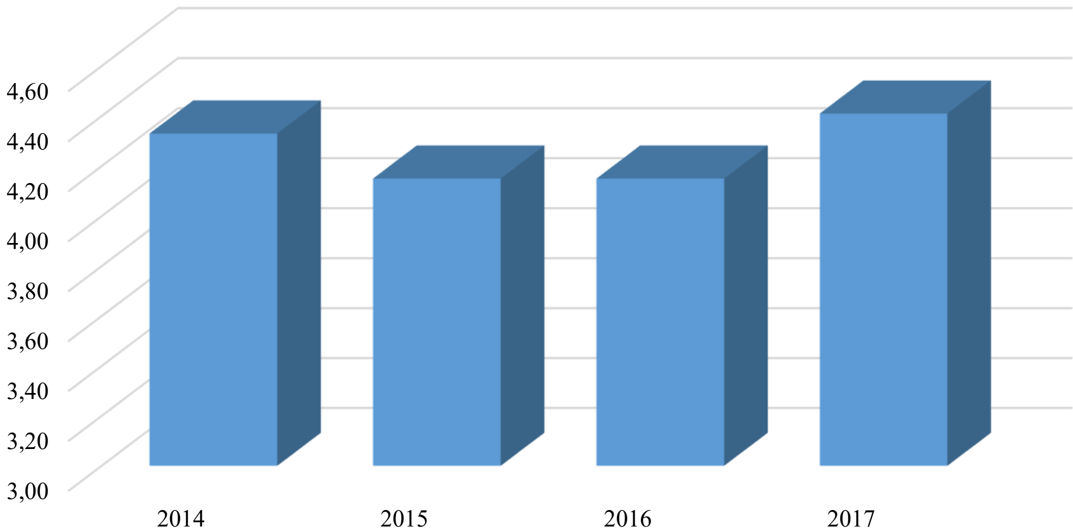


**Figure 197: Slovakia – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Slovakia's ecological footprint per person from 2014 until 2020 can is visualised in Figure 198. Slovakia performs relatively bad regarding the ecological footprint as its scores are always below the EU-25 average level. Its ecological footprint per person comparing with the EU-25 average was the following (Malta and Cyprus are not scored):

- total score in 2014: 4.33 (EU-25 average: 5.23)
- total score in 2015: 4.15 (EU-25 average: 5.25)
- total score in 2016: 4.15 (EU-25 average: 5.26)
- total score in 2017: 4.41 (EU-25 average: 5.34)

Concerning the Climate Change Performance Index (CCPI) Slovakia's performance is inconstant. The scores of the CCPI for the country can be seen in Figure 199.

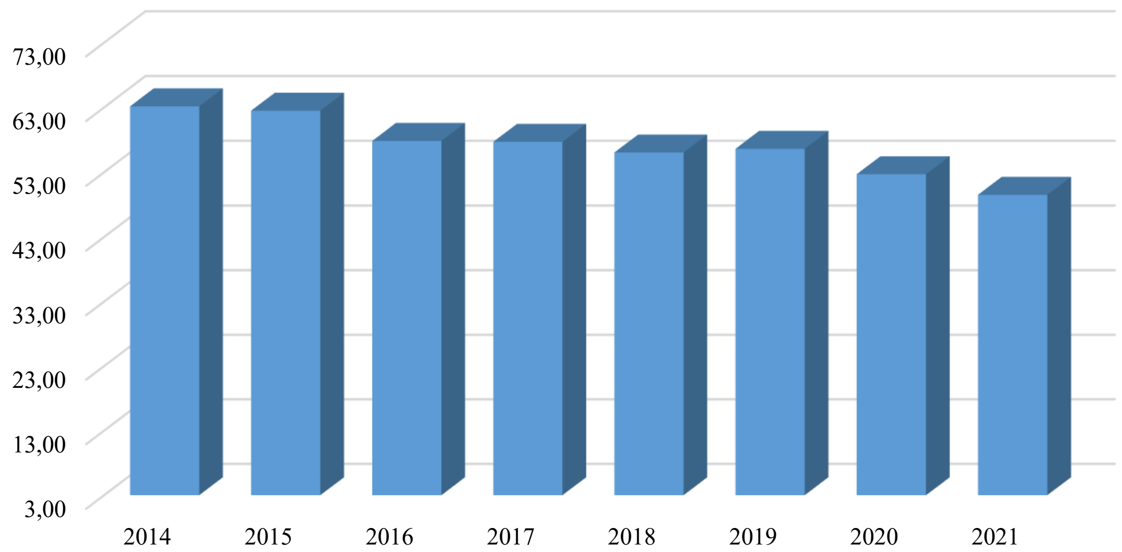


**Figure 198: Slovakia vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Its ranks and scores were following in the CCPI (among 61 countries):

- ❖ 2014: 17. with 63.17 points (global average: 55.72)
- ❖ 2015: 15. with 62.50 points (global average: 55.36)
- ❖ 2016: 26. with 57.83 points (global average: 54.15)
- ❖ 2017: 26. with 57.69 points (global average: 53.77)
- ❖ 2018: 24. with 56.04 points (global average: 49.09)
- ❖ 2019: 26. with 56.61 points (global average: 50.35)
- ❖ 2020: 27. with 52.69 points (global average: 48.61)
- ❖ 2021: 31. with 49.51 points (global average: 47.90)

Slovakia's scores were mainly below the average, however in 2014 the scores were above average.

### Summary

In 2016, the Slovak Republic was one of the first four countries (among the V4) to ratify the Paris Climate Agreement. In 2018, representatives of the Ministry of Environment presented the Environmental Strategy - Enviro-Strategy 2030, which reflects Slovakia's direction and objectives in the field of climate policy. In addition, the Ministry of Environment is currently starting the preparation of the Low Carbon Development Strategy for Slovakia 2030, which includes a 2050 outlook for selected sectors of economic activity. The Low Carbon Strategy should include efficient and cost-effective measures in the sectors of industry, energy production, energy efficiency, transport, agriculture, forestry and waste management. The direction and objectives of Slovakia's energy policy are derived from the common EU objectives articulated in the Europe 2020 strategy. These objectives are further influenced by the Clean Energy for All Europeans document, which was presented by the European Commission in 2016.

The national strategy papers prepared by the Slovak Ministry of Economy and the Ministry of Environment present optimistic targets and solutions in the field of climate change and energy. Should Slovakia adhere to these trends and optimistic scenarios, and should its national strategies not remain on paper, the country has the potential to become a role model for other developed countries in meeting the objectives of the Paris Climate Agreement.

Economic analyses must answer a key question for the decision-making process and for investors: namely, when and how to adapt to the adverse impacts of climate change. On the one hand, there are many scientific studies available on the physical consequences of climate change, but on the other hand, there is still a lack of standardised procedures for assessing the costs and benefits of adaptation measures ("cost-benefit analysis") relative to other response options or the costs of the status quo.

The economic model is comprised of two sub-models. The first one determined the intensity of the impacts of climate change. Its results were entered into a macroeconomic structural sub-model which, depending on the nature of the adaptation measures and the manner in which they were financed, quantified their impact on selected macroeconomic indicators, such as GDP and employment, both at the national level and at the level of selected production sectors according to the classification of economic activities. The exogenous input to the model comprised the results of climate scenarios for key indicators such as temperature and, precipitation. These objectives were used to establish a consistent linkage between the effects of climate change on economic behaviour. The results of the project indicate that projections of future developments up to 2050 suggest that, in the absence of adaptation measures are, economic growth is likely to decelerate to 0.4-0.7% of GDP; Conversely, the implementation of preventive adaptation measures are has the potential to mitigate these impacts reducing them to 0.1-0.15% of annual GDP. While the direct impacts in terms of increased costs, reduced output or loss of market share are relatively straightforward to identify, the challenge lies in the identification of the cumulative indirect and sectoral economic impacts.

**Good Practices**

Carpathian Development Institute is an independent, non-governmental organisation that works to support and promote a systemic approach to the innovative and sustainable development of regions and local municipalities. It has a particular focus on climate change adaptation projects. The institute has established collaborative relationships with several municipalities for the purpose of developing local climate plans. The activities of the research project "Data and Knowledge Support for Decision-Making and Strategic Planning Systems in Adapting Agricultural Land to Climate Change and Minimising Degradation of Agricultural Land" (URANOS) aim at generating new approaches and data for early drought assessment, monitoring and forecasting; climate change prediction and comprehensive assessment of impacts on agricultural landscape; assessment of soil degradation rates and proposals for optimal land use. Info Days - In the framework of the national project "Awareness raising and advisory services to improve the quality of the environment in Slovakia", four Info Days "Green measures for municipalities" and four Info Days "Landslides - current situation, associated risks, prevention and management" were held in 2019. The aim of the Info Days was to provide information on ways to reduce the adverse effects of climate change and to raise awareness of slope deformation as a climate change phenomenon. EnviroCity competition (in Slovak "Enviromesto") - for two years (2017 and 2019), the competition to promote green infrastructure has also focused on promoting green infrastructure and building its elements in cities. The benefit of the competition was to create a platform of good examples and inspiring solutions in the field of green infrastructure, which will serve as a platform for an intensive exchange of experience between cities in this field. The green economy - information platform - will enable the presentation and sharing of solutions for instance climate change adaptation, energy and resource efficiency and sustainable use, waste management, water management, green buildings and housing, etc. It is aimed at entrepreneurs, municipalities, non-governmental non-profit organisations and the general public. The platform offers general information and a database of companies and their environmental solutions in line with green economy principles. Support Programme Village Renewal Programme (in Slovak: Program obnovy dediny) - creates economic, organisational and professional conditions to support rural communities in their efforts to achieve harmonious development. The programme supports specific activities aimed at addressing the acute problems of rural authorities in caring for the rural environment, in the field of green infrastructure and adaptation measures to mitigate the effects of climate change and care for the countryside.

- **Returnable PET bottles**

  Returnable PET bottles and tins were introduced. In Slovakia, approximately one billion PET bottles are sold annually, of which 400 million are disposed of in landfills or in nature. The implementation of this measure has resulted in the successful return of 95 percent of the bottles to their designated locations. Redemption of bottles is facilitated through vending machines, with deposit fees amounting to approximately 10-12 cents. https://parameter.sk/2019-szeptembere-amikor-szlovakia-egy-nagyobbat-lepett-kornyezetvedelem-teren

- **Banning single-use plastic:**

  Banning the use of single-use plastic. The ban affects plastic plates, cutlery, drink stirrers, straws, balloon sticks, disposable food containers made of polystyrene and cups. The registration of waste is also evolving, as garbage trucks are equipped with scales, obliging the declaration of the weight of their contents. https://parameter.sk/2019-szeptembere-amikor-szlovakia-egy-nagyobbat-lepett-kornyezetvedelem-teren

- **Protection of forests**

  Parliament adopted the bill on the protection of forests. A new primeval forest reserve was established . The main goal is to improve the protection of biological diversity and prevent the deterioration of species and habitats. Logging will be prohibited in these areas, and nature-friendly farming must be carried out in the other areas. Control of logging is also becoming more intensive. Another goal is to attain optimal water quality and to ensure increased flood protection through the implementation of green measures. To prevent droughts and water shortages by retaining water, better planning and more responsible water management practices are required. https://ng.24.hu/fold/2021/11/13/uj-termeszetvedelmi-terulet-szlovakiaban/

- **Reduction of carbon burning**

  The proposed measures in the area of air protection are aimed at curbing coal burning, as well as supporting environmentally friendly transport and more efficient and cleaner heating systems. In addition, the more consistent application of the "polluter pays" principle and the withdrawal of coal or biomass subsidies would be beneficial. In the context of climate change, Slovakia has committed to reducing its greenhouse gas emissions by 43 percent. Consequently, The Ministry of Environment is progressively concentrating its efforts on the promotion of renewable energy sources and the revitalisation of coal-producing regions. https://ujszo.com/kozelet/szigorodik-a-kornyezetvedelem-szlovakiaban?fbclid=IwAR2RAoZwwroMqj7riRv1rRUIlqb3WxSOzx47vncTaM-k8UUeDuL8mUMTR44

- **Circular economy**
  Slovakia is gradually introducing the principles of a circular economy. Restaurants and supermarkets are obliged to utilise food, to offer the impeccable food to charity or to compost it after the warranty period has expired, or to use it energetically. https://www.minzp.sk/hu/sajtokapcsolat/sajtokozlemenyek/zoldebb-lesz-szlovakia-kabinet-elfogadta-kornyezetvedelmi-strategiat.html
- **Environmental education**
  The government pays special attention to environmental education and introduces monitoring and evaluation of educational activities. https://www.minzp.sk/hu/sajtokapcsolat/sajtokozlemenyek/zoldebb-lesz-szlovakia-kabinet-elfogadta-kornyezetvedelmi-strategiat.html

## References


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Adapt (2022i). Slovakia. Downloaded from https://climate-adapt.eea.europa.eu/countries-regions/countries/slovakia
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.

- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- Filcak, R. (2016). Slovakia and the landscape of climate change policies: drivers, barriers and stakeholder analysis. Prognostické práce, Vol. 8, pp. 5-22.
- Furmanczuk, Z. (2018). Climate and energy policy in Slovakia. Slovak Renewable Energy Agency, Bratislava.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Ministerstvo Zivotneho Prostredia Slovenskej Republiky (2018). Stratégia adaptácie Slovenskej Republiky na Zemnu Klímy. Ministerstvo Zivotneho Prostredia Slovenskej Republiky, Bratislava.
- Ministry of Environment of the Slovak Republic (2014). Adaptation Strategy of the Slovak Republic on Adverse Impacts of Climate Change. Overview: Executive Summary. Ministry of Environment of the Slovak Republic, Bratislava.
- Ministry of Environment of the Slovak Republic (2018). The Seventh National Communication of the Slovak Republic on Climate Change. Ministry of Environment of the Slovak Republic, Bratislava.

### 4.25. SLOVENIA

Slovenia's total area is 20 271 km$^2$. The region's diverse topography is characterised by the influence of four prominent European geographical entities - the Alps, the Mediterranean, the Pannonian Basin and the Dinaric Alps. The geology of this small area is highly varied, which renders it more susceptible to landslides and debris flows. Slovenia is renowned for its warm, humid temperate climate, yet this is not a typical climate for the region due to the transit character and variability of its territorial types. Slovenia's climate has already changed significantly in the period up to 2021, with average temperatures more than 2.5 degrees Celsius higher than in pre-industrial times. (Climate Adapt, 2021)

In Slovenia, the Slovenian Development Strategy 2030 was adopted in 2017. The document is based on five strategic orientations and twelve development goals. The 17 Sustainable Development Goals (SDGs) are also included. The key objective is to ensure "a high quality of life for all". (UN, 2020)

Figure 200 shows the main economic statistics of Slovenia compared to the EU-27 average.

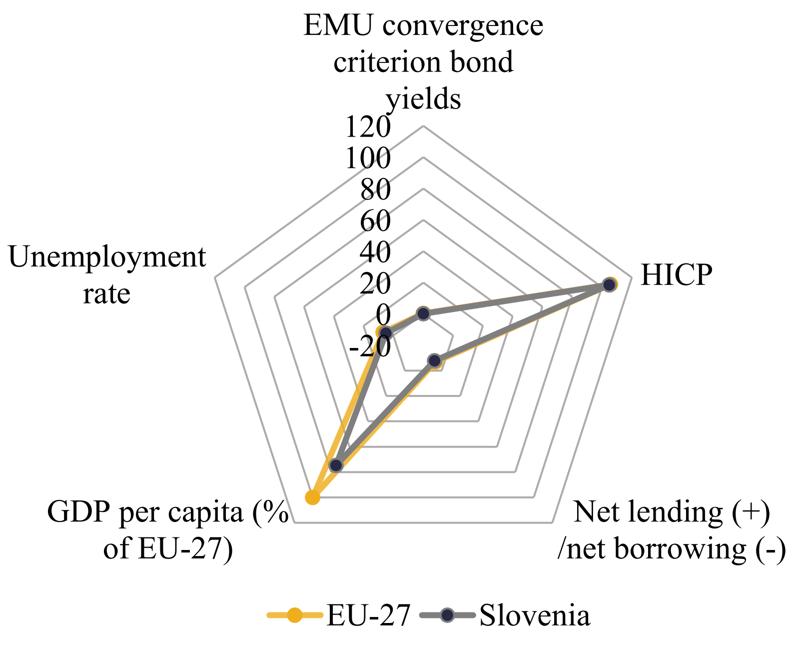


**Figure 199: Slovenia vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

As the Figure 200 shows that Slovenia exhibits a marginal deviation from the EU-27 average in only one key indicator. Slovenia's GDP per capita is 75% of the EU average.

**Climate Strategy**

**Primary energy consumption**

The Primary Energy Consumption indicator demonstrates the total energy needs of Slovenia including the industry, transport, households. As the Figure 201 shows, Slovenia's primary energy consumption from the total EU28 figure was minimal.

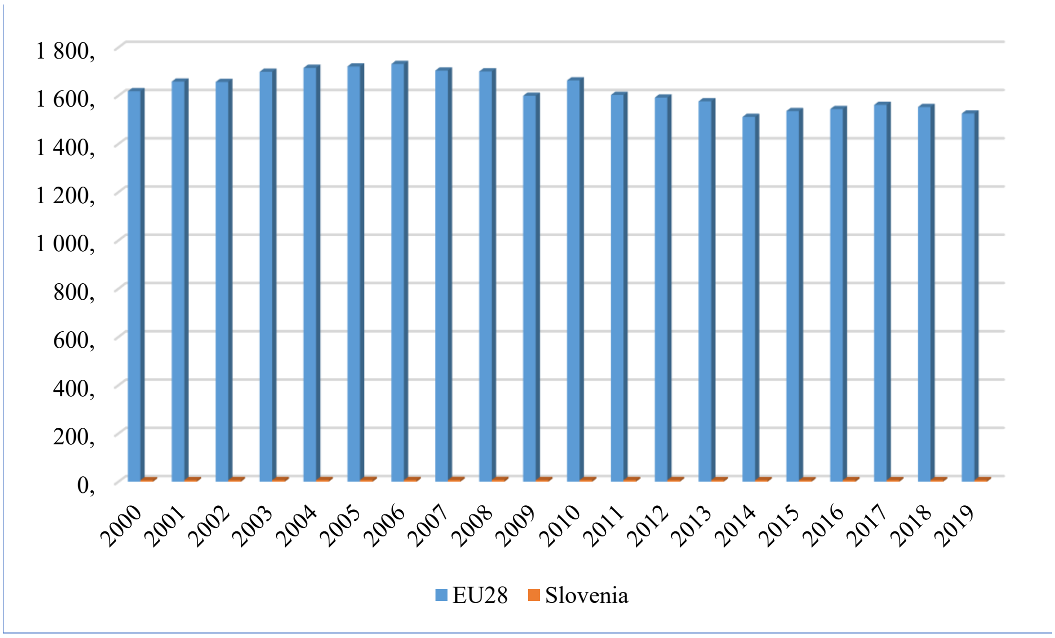


**Figure 200: Slovenia vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

However, it should be noted that the consumption of resources per inhabitant in Slovenia is equivalent to the EU average. Nevertheless, Slovenia exhibits a lower efficiency in terms of resources and energy consumption when compared to the EU average, and also demonstrates inadequate progress in enhancing the productivity of carbon consumption. In order to facilitate a successful transition to a low-carbon circular economy, it is necessary to eliminate the connection between economic growth and growth in the consumption of raw materials and non-renewable energy sources, which is associated with an escalated environmental burden. Achieving this objective would require fundamental changes in consumption and production patterns. In addition, improved utilisation of resources already integrated into systems would be necessary. Examples of such systems include mobility, the built environment, food supply chains, and production chains. Furthermore, it would be essential to prevent the generation of waste and to use waste as a source of secondary raw materials. Finally, an effective waste management system would need to be established. (Gov., 2017)

### Share of Fossil Fuels in Gross Available Energy

Figure 202 shows the share of fossil fuels in gross available energy in Malta compared to the EU28 between 2010 and 2019 (%). (Eurostat, 2022b)

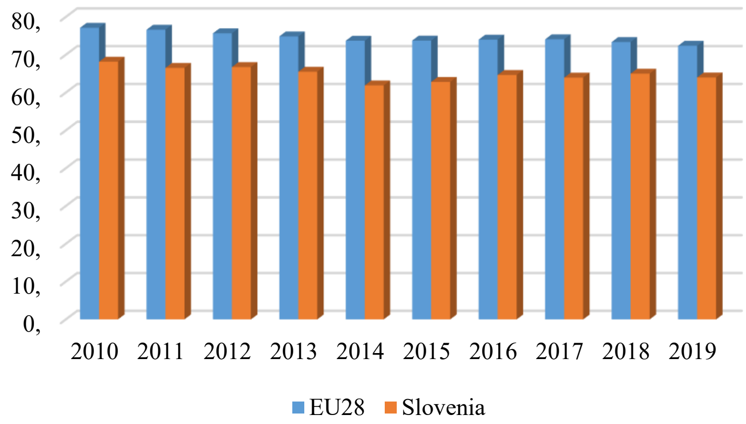


**Figure 201: Slovenia vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

Fossil fuel energy consumption of Slovenia fell gradually from 68% in 2010 to 64% in 2019.

### Greenhouse Gas Emissions by Capita

Figure 203 shows the greenhouse gas emissions by capita in Slovenia compared to the EU28 between 2010 and 2019. (Eurostat, 2022c)

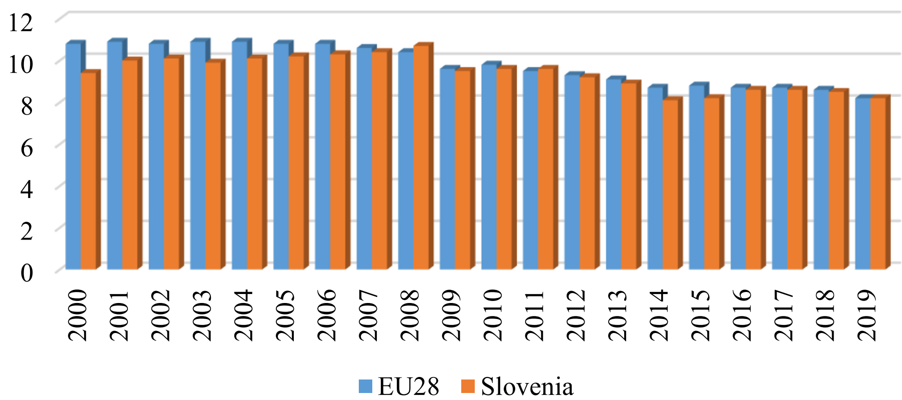


**Figure 202: Slovenia vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 ($CO_2$ equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

The economic downturn consequent to the global financial crisis of 2008 has led to a reduction in greenhouse gas emissions; yet this remains higher than the EU average per unit of GDP. The issue of increasing road transit traffic and unsustainable mobility is a matter of particular concern. Although lower consumption in households and industry is reducing energy consumption, the overall figure remains relatively high when expressed per unit of GDP due to the high share of energy-intensive activities. By 2030, considering the Energy Union dimension, Slovenia will actively pursue the decarbonisation of energy-intensive industry, whilst concomitantly providing financial incentives for the transformation of production processes. (Climate Adapt, 2021)

### Share of Energy from Renewable Sources

Figure 204 illustrates the share of energy from renewable sources in Slovenia compared to the EU28 between 2010 and 2019. (Eurostat, 2022d)

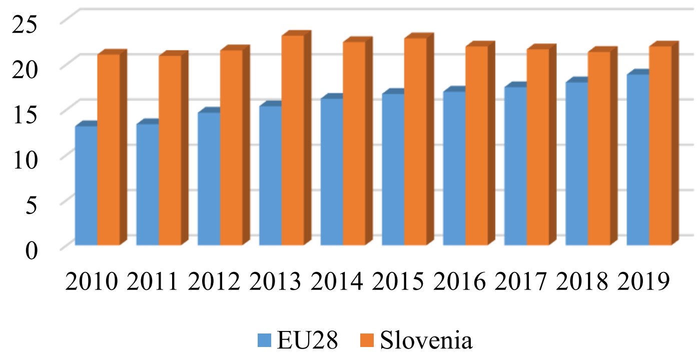


**Figure 203: Slovenia vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

The National Renewable Action Plan to 2020 aimed to achieve the share of renewable energy 25% in gross final energy and 39% in electricity generation. (IEA, 2022)

### Composite Indicators

### Environmental Performance Index

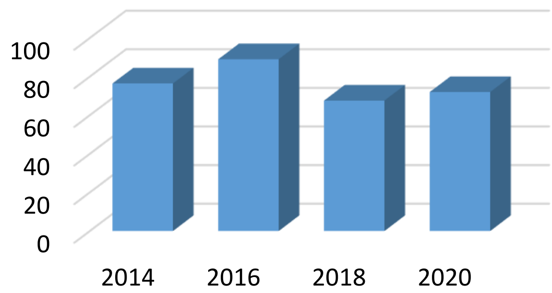


**Figure 204: Slovenia – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

The Environmental Performance Index for the year 2020 ranks 180 countries. Slovenia with the score of 72 is the 18th in this list.

### Ecological Footprint per Person

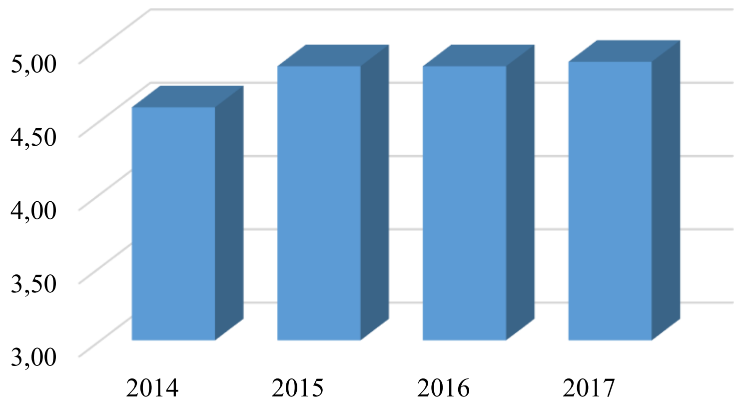


**Figure 205: Slovenia – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

In the aftermath of the global financial crisis of 2008, Slovenia's ecological footprint reached its nadir in 2013 and has since exhibited an increase of 4.9 ha per capita. It can be posited that the ecological footprint per capita shows minimal variation across different regions. Housing and passenger transport account for the highest ecological footprint in the Slovenian regions. The identification of population centres and fast-growing areas will be particularly important in laying the foundations for Slovenia's success in 2030. With regard to biocapacity, more than 75% of Slovenia's biocapacity is derived from forests. Furthermore, with respect to ecological footprint, per capita consumption of forest products is among the 10 highest in the world. (GFN, 2020)

### Climate Change Performance Index

This composite index summarizes the GHG Emissions (40% of overall score), the Renewable Energy (20% of overall score), the Energy Use (20% of overall score) and the Climate Policy (20% of overall score). Figure 207 illustrates the points of Slovenia’s CCPI between 2014 and 2021 compared to EU average. Slovenia overall performance remains relatively minimal.

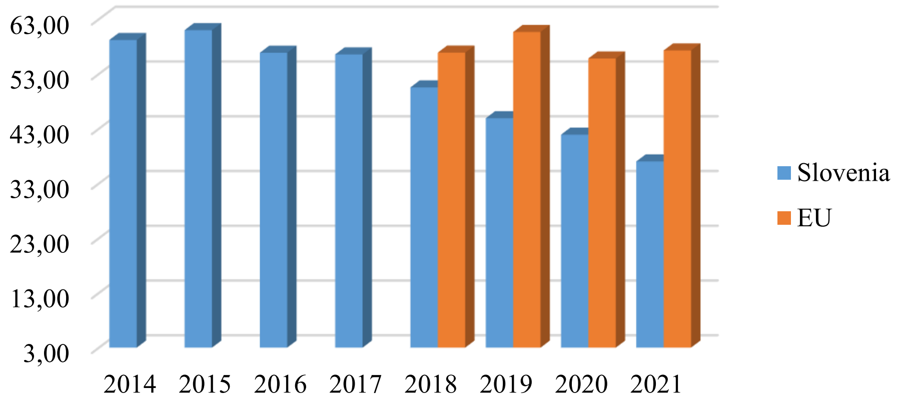


**Figure 206: Slovenia vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

In order to thrive in the future, it is imperative that the country is able to responding and adapt to the global environment. Trends point to profound changes, especially in relation to demographic trends, pressures on ecosystems, competition for global resources and economic development. Cooperation is vital from national and regional levels to European and global domains. (Cimate Adapt, 2021)

**Good Practices**

The Slovenian Tourism Board has developed a unique national plan the Slovenian Green Plan for Tourism (GSST). It is a mix of the Green Destinations standard and the European Commission's European Tourism Indicators System (ETIS) tool. Service providers such as accommodations, travel agencies, parks and whole destinations are rewarded with the "Slovenia Green" label if they meet the criteria. Service providers must have one of the six internationally recognized labels of the following: Travellife, Green Globe, Ecolabel, Bio Hotels, Emas, Green Key. An additional criterion for parks is to bear the Slovenian Green Park and UNESCO MAB or Europarc Federation label. In order to be granted the "Slovenia Green" designation, service providers are obligated to complete an application form and submit payment for a designated fee. Should there be a significant number of service providers bearing the "Slovenia Green" label in a given destination, it is then possible for that location to apply for the "Slovenian Green Destinations" label. Therefore, a membership fee must also be paid. All certified members benefit from promotional activities which are planned and implemented by the Slovenian Tourist Board. (Franze-Jordanov, 2018)

**Sustainable transport**

Slovenia dedicated a considerable amount of time and resources to the development of a sustainable transport system. First, it is imperative to assess the condition of the vehicles involved in traffic h, a process which remains in place as the primary objective continues to reduce the emission of greenhouse gases. If a sufficient number of these means of transport are available, it is essential that the population is made aware of this fact. As in the case of other countries, there has been an increasing trend of individuals in Slovenia opting for personal transportation, utilising their personal vehicles for both professional and recreational purposes. This shift can be attributed to the convenience and flexibility it offers, as it eliminates the need to rely on public transportation or to risk arriving late due to a potential delays. However, the government initiated a shift in focus towards the promotion of public transport. The country has one public transport system that is becoming increasingly modern, accurate and environmentally friendly. Discounts are available for students, senior citizens and pensioners. The introduction of additional vehicles into service was undertaken with the aim of ensuring universal accessibility; however, this does not imply an increase in carbon dioxide emissions within the country. Instead, it can be posited that, within the constraints of the nation's financial budget, a strategic initiative was implemented to promote the marketing of electric or hybrid vehicles that potentially exhibited lower consumption rates.[9]

The Slovenian government is also positive about the different renewable energy sources. Home renovation programs and projects that include alternative cooling-heating technologies are encouraged.

**Cars are prohibited from Ljubljana and the larger centre**

In Ljubljana and the larger centre areas, pedestrians and cyclists are accorded absolute priority. Most people in cities travel by bicycle or on foot, and only low-floor and natural gas-powered buses are allowed to enter the city centre.

https://egy.hu/golfaramlat/szlovenia-a-fenntarthatosag-bezzegorszaga-igy-csinaljak-a-szomszedban-107787

9 https://www.gov.si/en/policies/transport - and - energy/sustainable - mobility/

**Natural gas-powered buses, 74% of houses are heated with natural gas**

Natural gas has an advantage over fossil fuels, which contribute significantly to global carbon dioxide emissions. These advantages have been identified in the transport sector as well as in the provision of heat to households. 74% of houses in Ljubljana are heated by natural gas. The utilisation of natural gas is also preferable, as the associated equipment or vehicles emit a comparatively reduced volume of greenhouse gases during their operation. Consequently, their emission values are thus significantly more favourable than those of diesel buses. https://kozelestavol.hu/ljubljana-zold-csodaja/

**Green accommodation**

In 2016, Ljubljana was awarded the title of Green Capital of Europe, which is given to the most environmentally conscious cities. Slovenia has a number of green spaces, indicating a nationwide commitment to environmental awareness. This endeavour is not limited to the capital, but is a nationwide effort. The array of destinations on offer comprises58 locations, with 101 accommodations, four parks, eight travel agencies, six attractions, 40 restaurants and a beach. The Hotel Park in Ljubljana has been identified as the most sustainable accommodation. This is due to its commitment to environmental responsibility, as demonstrated by its maintenance of beehives and a herb garden on its roof terrace. Furthermore, the hotel serves the ingredients produced here for breakfast to its guests. The Hotel Ribno, which opened in 2018 adjacent to Bled is notable as Slovenia's inaugural zero-waste accommodation.

https://www.slovenia.info/en/business/green-scheme-of-slovenian-tourism

https://epiteszforum.hu/ljubljana-europa-zold-fovarosa

**63% of household waste is collected selectively**

Residents collect 63% of household waste selectively, the population of Slovenia committed for a waste-free life, and municipalities support this dedication by providing 2,500 waste collection points in total, of which some are located underground.

**Green area per inhabitant is 500 square meters**

In recent years, the city has embarked on a significant initiative to enhance its green spaces, with the planting of 2,000 trees and the establishment of five new parks. This initiative has also encompassed the transformation of numerous degraded areas, including those formerly utilised as unauthorised waste disposal sites, into recreational green spaces. In Ljubljana, the amount of green space per person is 542 square metres, which is noteworthy when compared to other cities, such as Budapest, where the figure is only 13. The expansion of green spaces is an ongoing phenomenon.

https://www.bled.si/hu/ihlet/zold-bled/

**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Adapt (2021): National circumstances relevant to adaptation actions. https://climate-adapt.eea.europa.eu/countries-regions/countries/slovenia
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- Franze-Jordanov, Anne (2018): Good example: Slovenia. https://northflash.com/good-example-slovenia/
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-

1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Gov. (2017): Slovenian Development Strategy 2030. Republic of Slovenia. https://www.gov.si/assets/vladne-sluzbe/SVRK/Strategija-razvoja-Slovenije-2030/Slovenian-Development-Strategy-2030.pdf
- IEA, International Energy Agency (2022): Slovenia. https://www.iea.org/countries/slovenia
- UN, United Nations (2020): Main Messages from Slovenia's Second Voluntary National Review of Progress Towards Sustainable Development Goals. https://sustainabledevelopment.un.org/memberstates/slovenia

## 4.26. SPAIN

Spain is the second-largest country in Europe in terms of territory. According to the Climate Change Knowledge Portal (2022), the average annual temperature on the Iberian Peninsula, has increased by 1.5°C between 1965 and 2015. The amount of rainfall has declined, therefore the country has been affected by droughts. On the other hand, precipitation rates are highly variable. One of the main natural hazards in Spain is flooding, which affected 754,148 people between 1980 and 2020 based on the dataset of Climate Change Knowledge Portal. Since the mid-1940s, the average sea levels have risen by 0.8 mm and 2.4 mm/year next to the Spanish coast (Climate Change Knowledge Portal 2022).

Real GPD per capita in Spain decreased by 11% in 2020 compared to 2019. The service sector one of the most important in Spain. It is the second-largest tourist destination globally (Climate Adopt 2021). In 2019, its gross added value (75%) was much higher than that of the industry (16%), construction (6%), and agriculture (3%) sectors (Climate Adopt 2021). Therefore, the Spanish service sector has been negatively affected by the border closures caused by the pandemic.

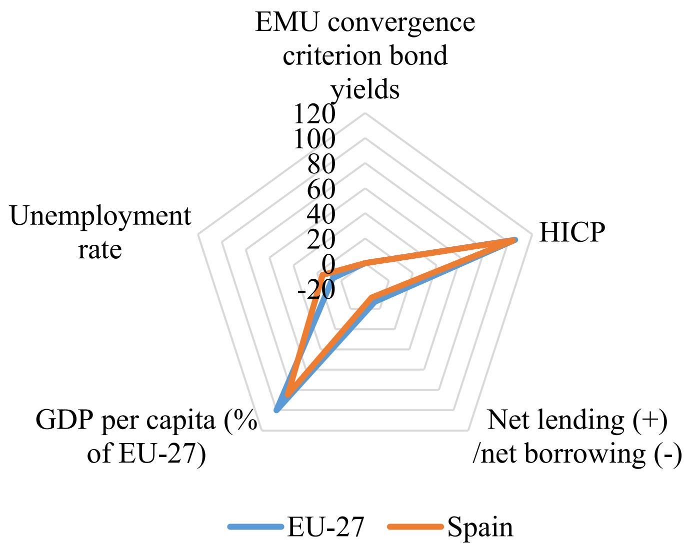


**Figure 207: Spain vs. EU27 – Economic outlook, 2020**
Sources: own compilation based on Eurostat (2021)

The unemployment rate was the second highest in the European Union (15.5%). Although this figure was lower in the previous two years, it is still higher than after the economic crisis (Eurostat 2021). Nevertheless, Spain still has a high youth unemployment rate, as do Greece and Italy. In 2019, it was higher than 30% (Eurostat 2021). Youth unemployment can be dangerous as it affects the development, attitude, and psyche of young workers. It can also cause economic, and social problems.

In 2020, the long-term interest rate in Spain (0.38%) was higher than the mean of the EU27 (0.32%) (Eurostat 2021). That same year, Spain's harmonised index of consumer prices (HICP) (103.97) was below the EU27 average (Eurostat 2021).

Net lending/net borrowing was -11.0 in Spain. This indicator demonstrates the difference between the total general government revenue and expenditure as a percentage of gross domestic product. In the previous years (2012-2019), the indicator was also negative, but the values were lower than (-11.0) in 2020 (Eurostat 2021). The Spanish government debt was the fourth highest in the European Union after Greece, Italy, and Portugal in 2020 (Eurostat 2022e). A high debt ratio can endanger a country's economic growth (Reinhart & Rogoff, 2010).

**Climate Strategy**

Spain has implemented various plans, policies, and strategies to support the resilience of energy sector and the reduce climate risks and impacts including the National Climate Change Adaptation Plan (Plan Nacional de Adaptación al Cambio Climático 2021-2030), the Climate Change and Energy Transition Law, the Long-Term Strategy for a Modern, Competitive and Climate-Neutral Economy by 2050 (Estrategia de Descarbonización a Largo Plazo 2050), the National Energy and Climate Plan (Plan Nacional Integrado de Energía y Clima 2021-2030, or NECP 2021-2030) and the Just Transition Strategy (IEA 2021a).

The previous strategy was called the National Adaptation Plan 2006-2020, was based on the Preliminary General Assessment from the previous year. The Preliminary General Assessment introduced the impact of the climate change on various sectors, including human health, the insurance sector, the tourism sector and the energy sector (Ministry of the Environment and University of Castilla La Mancha 2005). Therefore, the National Adaptation Plan 2006-2020 (Plan Nacional de Adaptación 2006-2020) also devoted significant attention to the impacts of climate change. The coordination of the actions was the task of the Oficina Española de Cambio Climático (Spanish Climate Change Office, OECC), which was related to the Ministerio de Medio Ambiente (Ministry of the Environment). The document highlighted the main global, national and local actors that could play an important role in the environmental protection (Ministerio de Medio Ambiente 2006), whose cooperation would be required. The plan was continuously tacked with detailed monitoring reports (IEA 2021a).

The National Climate Change Adaptation Plan 2021-2030 has several objectives. These include the generation of knowledge regarding the impacts, risks and adaptation to climate change in

Spain; the integration of adaptation in public policies; the promotion of the participation of all stakeholders, including the various levels of administration, the private sector, social organisations and citizens; the ensuring of administrative coordination; and monitoring, evaluation of adaptation policies and measures. In order to facilitate the integration of adaptation actions in the different fields, 18 areas were identified (for instance climate and climate scenarios, human health, energy, cultural heritage, or education and society). The document defined the objectives of each category. Conversely, the aforementioned strategy addressed the topic of information, financing, evaluation, coordination and management of the actions in the climate change context (Gobierno de Espana 2020a).

In comparison to the National Climate Change Adaptation Plan, the National Energy and Climate Plan 2021-2030 demonstrated a reduced focus on specific areas. The main objectives were connected to the energy sector, the decarbonization and the innovation. It also described the policies and the measurements related to the plan (Gobierno de Espana 2020b).

The Long-Term Strategy for a Modern, Competitive and Climate-Neutral Economy by 2050 also analysed the energy sector and outlined the decarbonisation process. Its three distinct domains were the energy sector, the industries associated with the decarbonisation (including renewable electricity, transportation, and building), and the factors that can influence the economy or the society during the transition to a climate-neutral economy. These factors include challenges in demographics, gender equality, education, research and development, and innovation. The strategy outlined aims to achieve climate neutrality by mid-century, with the objective of modernising the economy and improving its competitiveness, thereby generating quality employment and positively impacting people's quality of life (Gobierno de Espana 2020c).

### Primary Energy Consumption

The total energy needs of Spain are illustrated by Figure 209 of the Primary Energy Consumption indicator between 2000 and 2019. The Spanish primary energy consumption was the fifth highest in the EU28 surpassed only by Germany, France, the United Kingdom, and Italy. The Spanish dataset demonstrated an initial upward trend that was subsequently halted by the economic crisis of 2008.

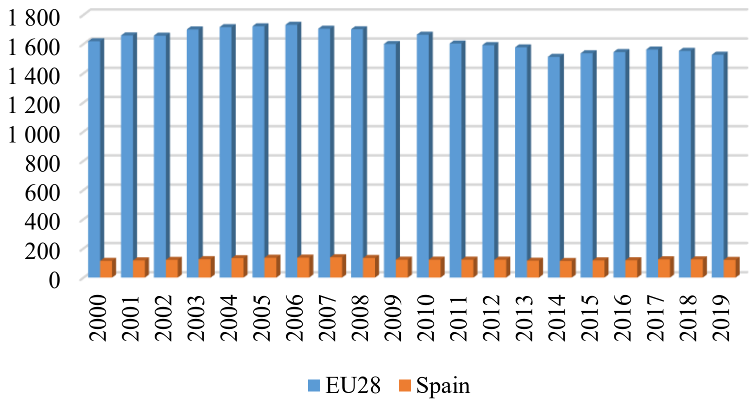


**Figure 208: Spain vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

The main energy source in Spain was oil in the given period. However, its proportion compared to the other energy sources decreased between 2000 and 2013, and from 2014 it followed a slowly growing trend. In 2019, the proportion was 47.53% (Ritchie and Roser 2020a). This situation presented a considerable challenge for the country, given Spain's lack of domestic petroleum resources. This indicated that the country is reliant on substantial oil imports, which could increase its dependence on other countries.

In contrast, a relevant change occurred in the structure of Spanish energy production (Román-Collado and Colinet 2018) primarily attributable to the renewable sources, especially power energy gets a higher weight in it. In the year 2000, wind energy constituted a mere 0.86% of the energy consumption by the source, however in 2019, this proportion had increased to 8.75% (Ritchie and Roser 2020a).

Residential energy consumption was the most relevant component of energy consumption in Spain during the period 2000-2013. Moreover, the residential consumption (25.1%) exhibited a higher increase compared to the private transport (22.3%), suggesting that sectors of production may be able to reduced their energy consumption (Román-Collado and Colinet 2018). In 2019, the primary energy consumption of households in Spain was attributed to space heating, as evidenced by the majority of union members (Odyssee-mure 2021).

The NECP 2021-2030 strategy focused on the energy system climate resilience. Furthermore, it also highlighted and demonstrated the importance of mitigation measures. For instance, it described that the lower energy demand supports climate adaptation in the medium and long term (IEA 2021a). In accordance with the outlined strategy, the final energy consumption (excluding non-energy uses) is anticipated to experience a reduction of 1.1% between the years 2017 and 2030, reaching a total of 73.6 Mtoe (Gobierno de Espana 2020b).

### Share of Fossil Fuels in Gross Available Energy

The absolute value of fossil fuel consumption reduced by 94 terawatt-hours (7%) between 2010 and 2019 in Spain (Ritchie and Roser 2020b). The Figure 210 marks the Spanish share of fossil fuels in gross available energy was above the data of EU28.

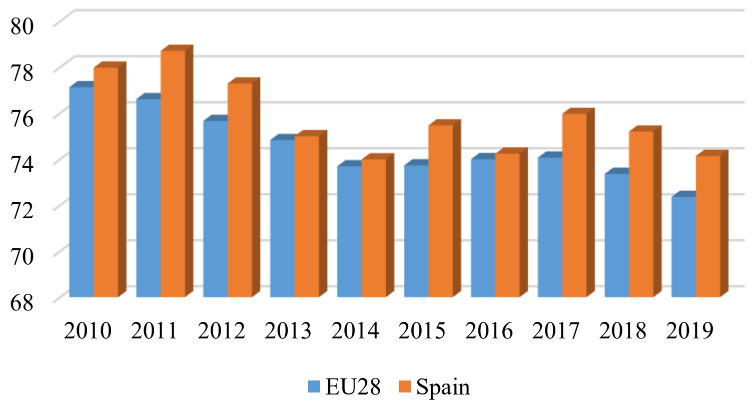


**Figure 209: Spain vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

It is noteworthy that in 2010, the Spanish energy sector reliance on fossil fuels were lower than that of Europe. However, a shift in the rankings occurred in 2019, resulting in a higher percentage of Spanish energy production compared to the European average. Conversely, the index in Spain (42%) was lower the global percentage (62%) in 2019 (Ritchie and Roser 2020b).

In the same year, the Spanish fossil fuel consumption originated from oil (65%), gas (31%), and coal (4%). Compared to 2010, the share of the oil remained constant, while the proportion of the gas increased from 29%. The coal consumption witnessed a substantial decline, amounting to a 46% reduction. The phenomenon can be attributed to the drop in Spanish coal production, which was less than 1 terawatt-hour in 2019 (Ritchie and Roser 2020b). Spain has announced its intention to phase out the coal power by 2030 (Our World in Data 2021).

The Spanish energy import dependency rate exhibited a gradual decline; however, it was the seventh highest (75%) in the European Union in 2019 (Eurostat 2022f). This particular indicator was the most significant in the case of oil and petroleum products. In 2019, it was the fourth highest in European integration in 2019 (Eurostat 2022f). The Long-Term Strategy for a Modern, Competitive, and Climate-Neutral Economy by 2050 sets out plans to achieve an index of be approximately 13% by 2050. This is due to the replacement of imported fossil fuels (coal, oil, and gas) with renewable sources from Spain (Gobierno de Espana 2020c).

### Greenhouse Gas Emissions by Capita

The Spanish greenhouse gas emission fluctuated between 2010 and 2019, aligning with the trends observed in the indicator of the European Union. The data indicates a decrease in size over the period in question, with a decline observed in each year from 2017 to 2019.

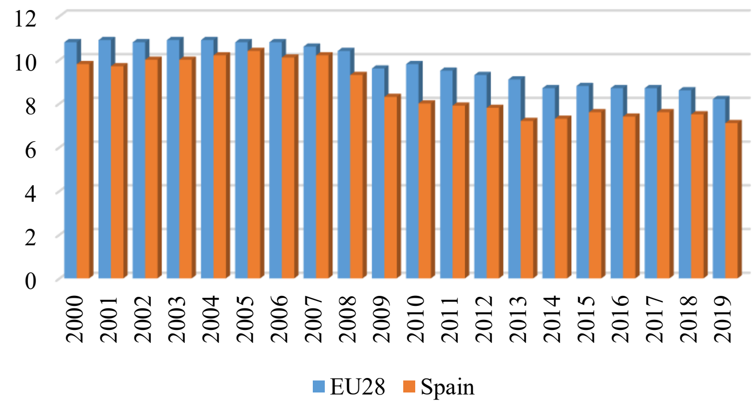


**Figure 210: Spain vs. EU28 – Greenhouse gas emissions by capita, 2000-2019 (CO2 equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

The reduction of greenhouse gas emissions can be supported by the sectoral transitions. Accordingly, the Long-Term Strategy for a Modern, Competitive and Climate-Neutral Economy by 2050 focused on the following domains: renewable electricity sector, sustainable mobility and transportation, sustainable building, sustainable and competitive industry, agriculture, waste, and fluorinated gases. For instance, by 2030, owing to shifts in mobility patterns and heightened electrification, a share of renewable energy in transport-mobility will reach 28%, accompanied by a reduction in emissions exceeding 30% within the same decade (Gobierno de Espana 2020c).

### Share of Energy from Renewable Sources

As demonstrated in Figure 212, the share of energy derived from renewable sources was comparable in the EU and Spain. It is evident that both ratios displayed an upward trend between 2010 and 2019. In Spain, wind and hydropower are the main renewable sources. However, since 2007 solar energy has garnered increased attention. Hydropower has been utilised for an extended period; however, since 2005 wind energy generation has surpassed hydropower energy generation (Ritchie and Roser 2020c).

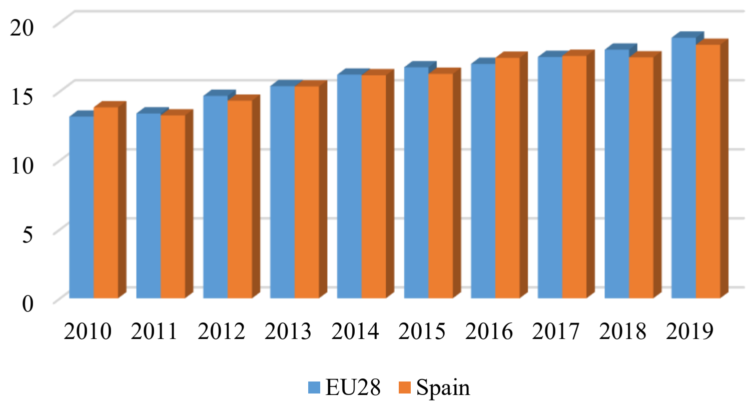


**Figure 211:** **Spain vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

The Long-Term Strategy for a Modern, Competitive and Climate-Neutral Economy by 2050 emphasised the role of renewable sources, as this sector is expected to be the first to substantially reduce its GHG emissions. Advances in technology have rendered electrical renewable energies a highly competitive electricity generation option, thereby allowing a reduction in electricity costs for consumers. Consequently, the NECP 2021-2030 plans to achieve a significant reduction in emissions in the electricity sector and reach 74% of renewable electricity production in 2030 (Gobierno de Espana 2020c).

### Composite Indicators

### Environmental Performance Index

The EPI score in Spain was 74.3, which resulted rank 14th among 180 countries in 2020 as the Figure 213 shows. Spain's superior ranking is can be attributed to its receipt of maximum points for a range of EPI indicators, including sanitation, F-gas, black carbon, $SO_2$, and $NO_x$ growth rate (based on EPI 2022b).

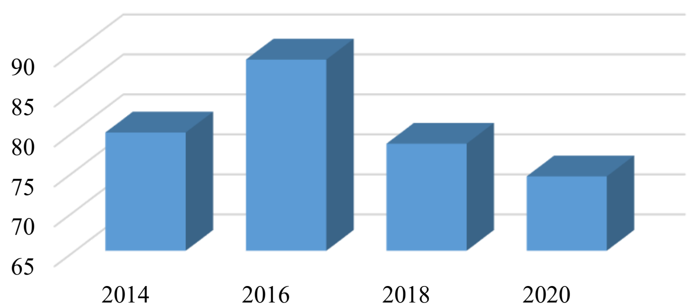


**Figure 212:** **Spain– Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022a)

In the context of the Biodiversity category, with respect to terrestrial biomes, marine protected areas, and other European countries, Spain has been identified as a leading nation (Wendling et al. 2020). This distinction can be attributed to the initiatives undertaken within the European Union. The indicators that demonstrated the weakest performance for Spain in the EPI were in the case of the Biodiversity Habitat Index (163rd), Wetland loss (137th), and Tree cover loss (129th) indicators (based on EPI 2022b).

### Ecological Footprint per Person

In 2017, Ecological Footprint per Person in Spain is 4.03 global hectares based on the Figure 214. This can be evaluated positively because it is lower by 1.77 global hectares than the maximum point (5.8 global hectares in 2007) of the Spanish dataset (National Footprint and Biocapacity Accounts 2022). Its two most significant components are the Carbon (59%) and the Cropland (20%) in 2017. The proportion of the Carbon category decreased between 2014 (59%) and 2016 (55%), however, in 2017 it has risen to the level of 2014.

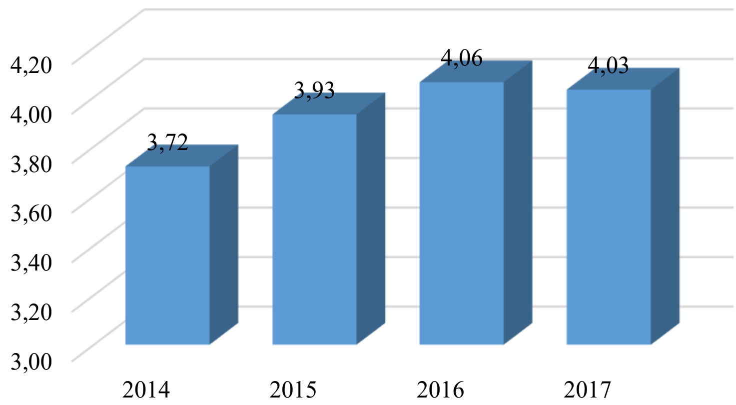


**Figure 213: Spain – Ecological footprint per person, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

The Ecological Footprint per Person in Spain shows an increasing tendency between 2014 and 2016. It is evident that the magnitude of the Carbon and Cropland is subject to annual augmentation. The tendency displayed by Carbon 2017 persists. Nevertheless, the Ecological Footprint per Person in Spain underwent a decrease in the given year. The underlying cause may be attributed to a decline in Cropland that exceeds the increase in Carbon. The question is whether the increasing values of 2015 and 2016 represents outliers, or whether, in the long term, Spain is unable to continue the downward trend that began in 2008.

### Climate Change Performance Index

As the Figure 215 demonstrates the highest score in the CCPI index of Spain was in 2014 when the country was listed rank 22nd with medium classification. Unfortunately, Spain was unable to sustain in that category. In 2021, its rank was 41st with a minimal evaluation based on the CCPI.

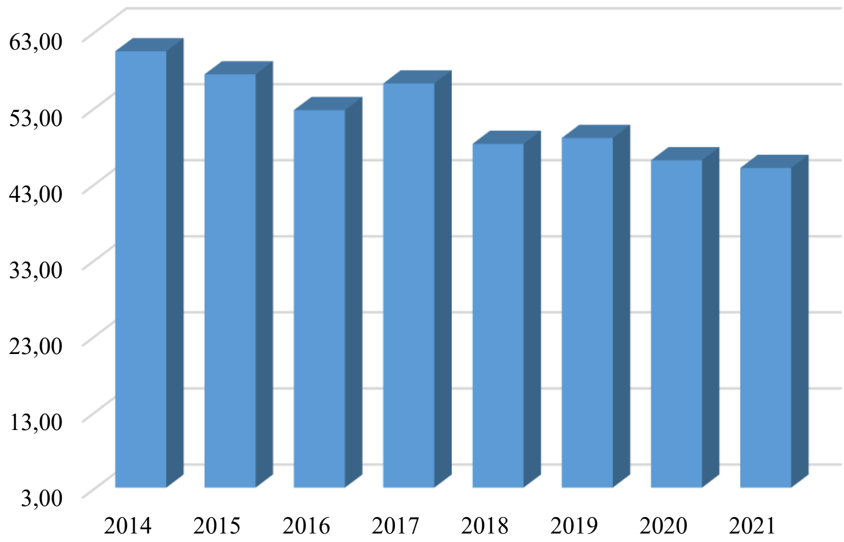


**Figure 214: Spain vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

Within the index, all components (GHG Emissions, Renewable Energy, Energy Use, and Climate Policy) are classified as low risk, with the exception of Climate Policy, which is evaluated as medium risk. The downward trend was primarily attributable to the renewables sector, where the current trend of renewable energy was found to be minimal, and the share of renewable energy in energy use was inadequate, as per the categorization of CCPI in 2021.
Experts have positively assessed targets in line with EU targets, yet these objectives are even less reflected in domestic initiatives. In this field, the nation has the opportunity to realign its position with that of Spain's Climate Change and Energy Transition Act, approved in May 2021 (CCPI 2022).

**Good Practices**

**Restriction of plastic packaging:**

According to a draft law, the use of disposable packaging materials for the purchase of small quantities of fruit and vegetables may be banned in Spain from 2023. At the present time, the application of this provision is restricted to nylon bags; however, it is anticipated that, in due course, it will be expanded to Styrofoam and other plastic boxes as well. By 2030, the

government plans to reduce the distribution of PET bottles, thereby reducing the amount of waste generated.
https://www.magro.hu/agrarhirek/betilthatjak-a-zoldsegek-es-gyumolcsok-muanyag-csomagolasat-spanyolorszagban-2023-tol/

**Environmentally friendly transport:**

The transportation sector is the largest consumer of energy- in Spain, which has been mostly covered by imported petroleum. In 2017, the Spanish railway company (RENFE) initiated an investigation into self-propelled passenger trains powered by LNG, recognising the fundamental role of the railway in achieving emission reduction targets.
https://solvergroup.hu/sajtoszoba/spanyolorszag:-lng-hajtasu-szemelyvonat-fejlesztese-

**Green jobs - Navarre region**

The term "green jobs" is employed to denote any professional activities that in some way contribute to the protection of the environment and the fight against climate change (e.g. reducing the amount of waste, using renewable energy sources, saving money, protecting biodiversity). In addition, such activities give rise to new jobs based on a sustainability model with fair pay, social protection and healthy working conditions. In Spain, the Navarre region serves as a notable example, where the primary goal entails the establishment of a regional renewable energy sector and a flexible economy, along with the creation of stable employment opportunities, with the overarching aim of reducing reliance on fossil fuels. Successes achieved so far: the creation of 3,800 new jobs, the attainment of 81% renewable energy consumption, and the enhancement of the regional economy resilience to the crisis, surpassing the national average.
https://www.greensefa.eu/legacy/fileadmin/dam/Documents/Publications/GND/Green_jobs_HU.pdf

**Renewable Energy Project**

In 2020, the coast of Spain was battered by extreme weather conditions, such as Cyclone Gloria. Consequently, the Spanish government has declared a climate emergency. In order to adapt to climate change and reduce the emission of harmful substances, it introduced a package of 30 measures was introduced, one of which is to make electricity production 100% from renewable energy sources by 2050.

**Ecotourism**

Ecotourism can be defined as a trip that involves responsibility for the environment, during which the values of nature can be appreciated. Spain has been supporting this form of tourism since the 1990s, with numerous national parks in the country offering opportunities for this type of tourism. These parks also provide a range of environmentally friendly accommodation options, including selective waste collectors, compost bins, specific water limits, food from organic gardens, and eco-cleaning agents.

https://ng.24.hu/fold/2016/07/03/negy-kereken-folvillanyozva/

http://ecolounge.hu/nagyvilag/mar-spanyolorszagban-is-klimaveszhelyzetet-hirdettek

https://www.expatica.com/es/lifestyle/things-to-do/national-parks-in-spain-107334/

**La Núcia** is a smart city in Spain, where residents can reduce their taxes by recycling. Furthermore, electric car recharging is provided for free of charge (https://www.euronews.com/green/2021/10/14/la-nucia-the-spanish-town-where-you-can-recycle-your-way-to-lower-taxes). the municipal webpage contains a variety of information, including details regarding complimentary parking provisions and the operational capacity of designated waste collection services. (http://www.lanucia.es/SmartCity#Zonas).

**Modernization of the olive grove**

The aim of the project is to facilitate investments that will adapt the olive grove farms to enhance the quality, homogeneity and stability of production over time, thereby improving their overall performance and greater sustainability, whilst concurrently improving the competitiveness of the olive grove farms in Extremadura. In Extremadura, the largest extent of olive groves are found in depopulated rural areas; thus, so the recruitment of the population into jobs related to this plant culture may contribute to the mitigation of depopulation. The production of olives requires a substantial amount of water, and the addition of ingredients can compromise its quality. However, the utilisation of water is subject to certain stipulations in Serranía where the annual precipitation is approximately 500 mm. (http://www.h2olivetree.es/proyecto/).

**Quantification and certification of organic carbon in Mediterranean agricultural soils (CARBOCERT)**

The project is focused on mitigating the loss of organic carbon in the soil. This is achieved through the formulation of agronomic recommendations that improve the carbon retention of the studied plants. In addition, the project defines methods that enable the objective quantification of carbon sequestration. This strategy allows farmers to distinguish the appropriate environmental behaviour from the market dynamics, thereby deriving benefits that surpass those of their competitors.

**Ecological Subbética**

Subbética Ecológica is an association related to the direct distribution of organic foodstuffs, including vegetables, fruits, bread, pasta, mushrooms, and oil, among other items. The non-profit organisation is located in the region of Subbética. The concept encompasses various producers, consumers' families, or school canteens, consumer families, small establishments, consumer groups and school canteens. The company has a complex known as the Eco Center, which houses its facilities. These include the order centre, the office, the eco store, and the workshop that transforms and produces canned vegetables. (https://subbeticaecologica.com/).

Real Decreto 293/2018, de 18 de mayo, sobre reducción del consumo de bolsas de plástico y por el que se crea el Registro de Productores (https://www.boe.es/buscar/doc.php?id=BOE-A-2018-6651): the aforementioned law targets to reduce the use of plastic bags.

**Urban Klima** 2050 aspires to transform the Basque Country with 40 concrete actions. The dual goal setting methodology is outlined as follows: (1) reduce the greenhouse gas emission by 80% in 2050 compared to 2005, (2) provide the resilience of the area to the effects of climate change (https://urbanklima2050.eu/en/what-is-it/).

To interpret the different climate change scenarios a user-friendly website supports the visitors to gain data about the given areas in Spain

(http://escenarios.adaptecca.es/#&model=EURO-CORDEX-EQM.average&variable=tasmax&scenario=rcp85&temporalFilter=year&layers=AREAS&period=NEAR_FUTURE&anomaly=RAW_VALUE&ids=12).

AdapteCCa assist in the collection and alteration of data pertaining to climate change in Spain (https://www.adaptecca.es/).

Bilateral cooperation within the LIFE SHARA project between Spain and Portugal contributes to the exchange of information and the undertaking of common actions (Climate Adopt 2021).

**DANA project. Employment and entrepreneurship in equality**

The DANA Program is a project that aims to address inequalities in the labour market through a program that promotes women's employment and entrepreneurship skills, while also developing job placement or entrepreneurship routes. The project specifically developed for rural women in Castilla-La Mancha. The programme provides an advisory and training service for labour market structures and organisations to prepare equality plans and integrate gender perspectives. In addition, it operates an equality and employment observatory that offers information and resources.

**H2OliveTree**

The objective of this project is to explore the potential of utilising residual salt water from the table olive harvesting industry for drip irrigation of olive groves. Concurrently, the aim is to reduce the amount of salt water stored in rafts and the water footprint in the production process of edible olives, whilst increase the productivity of olive groves. The test is conducted out in eight areas of the mountain range southwest of Seville.

**Public awareness campaign to prevent forest fires**

The environmental awareness campaign, which, was developed in all the schools and institutions of the ADEZOS territory, located in the western part of the province Salamanca was based on the following slogan: "Every fire burns something of you". The content of the interactive discussions was adapted to the age of the students. Concurrently, the Local Action Group issued targeted appeals to local governments, with the objective of providing quick intervention materials or forest fire extinguishment (e.g. hoses, pressurized water pump trailers, fire extinguishers).

https://redruralnacional.es/visores_rrn/bbpp?fbclid=IwAR2ZfjIEPoJU7r8wbrkhaJ2IUHYIjt8rhz05Fd4EpJnpHeDh3kds50ORMR0

**References**


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- CCPI (2022): Spain. Link: https://ccpi.org/country/ESP/. Downloaded: 26.05.2022.
- Climate Adopt (2021): Spain. Link: https://climate-adapt.eea.europa.eu/countries-regions/countries/spain. Downloaded: 01.06.2022.
- Climate Change Knowledge Portal (2022): Spain. Link: https://climateknowledgeportal.worldbank.org/country/spain. Downloaded: 01.06.2022.

- EPI (2022b): Spain. Link: https://epi.yale.edu/epi-results/2020/country/esp. Downloaded: 26.05.2022.
- EPI, Environmental Performance Index (2022a): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.
- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- Eurostat (2022e): Government finance statistics. Link: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Government_finance_statistics#Government_debt. Downloaded: 02.06.2022.
- Eurostat (2022f): Energy import dependency by products. Link: https://ec.europa.eu/eurostat/databrowser/view/sdg_07_50/default/table?lang=en. Downloaded: 14.01.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.
- Gobierno de Espana (2020a): Plan Nacional de Adaptación al Cambio Climático 2021-2030. Link: https://www.miteco.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/pnacc-2021-2030_tcm30-512163.pdf.
- Gobierno de Espana (2020b): Plan Nacional Integrado de Energía y Clima 2021-2030. Link: https://ec.europa.eu/energy/sites/ener/files/documents/es_final_necp_main_es.pdf.
- Gobierno de Espana (2020c): Estrategia de Descarbonización a Largo Plazo 2050. Link: https://ec.europa.eu/clima/sites/lts/lts_es_es.pdf.
- IEA (2021a): Spain Climate Resilience Policy Indicator. Part of Climate Resilience Policy Indicator. Link: https://www.iea.org/articles/spain-climate-resilience-policy-indicator.

- IEA (2021b): Spain 2021 Energy Policy Review. Link: https://www.iea.org/reports/spain-2021.
- Ministerio de Medio Ambiente (2006): Plan Nacional de Apatación al Cambio Climático. Link: https://www.miteco.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/pna_v3_tcm7-12445_tcm30-70393.pdf.
- Ministry of the Environment and University of Castilla La Mancha (2005): A Preliminary Assessment of the Impacts in Spain due to the Effects of Climate Change. Ecce Project - Final Report. Link: https://www.miteco.gob.es/es/cambio-climatico/temas/impactos-vulnerabilidad-y-adaptacion/Full%20report_tcm30-178514.pdf.
- National Footprint and Biocapacity Accounts (2022): EcologicaL Footprint per Person. Link: https://data.footprintnetwork.org/#/??_ga=2.4934325.764780885.1653572487-1885991649.1653572487. Downloaded: 26.05.2022.
- Odyssee-mure (2021): Sectoral Profile – Households. Link: https://www.odyssee-mure.eu/publications/efficiency-by-sector/households/household-eu.pdf. Downloaded: 12.01.2021.
- Reinhart, C. M., and Rogoff, K. S. (2010): Growth in a time of debt. American Economic Review, 100(2), 573–578.
- Ritchie, H. and Roser, M. (2020a): Energy. Link: https://ourworldindata.org/energy/country/spain
- Ritchie, H. and Roser, M. (2020b): Fossil Fuels. Link: https://ourworldindata.org/fossil-fuels. Downloaded: 14.01.2021.
- Ritchie, H. and Roser, M. (2020c): Renewable Energy. Link: https://ourworldindata.org/renewable-energy. Downloaded: 14.01.2021.
- Román-Collado, R. and Colinet, M. J. (2018): Is energy efficiency a driver or an inhibitor of energy consumption changes in Spain? Two decomposition approaches. Energy Policy, 115(April), 409-417.
- Wendling, Z. A., Emerson, J. W., de Sherbinin, A., and Esty, D. C., et al. (2020): 2020 Environmental Performance Index. New Haven, CT: Yale Center for Environmental Law & Policy. Link: https://epi.yale.edu/downloads/epi2020report20210112.pdf.

## 4.27. SWEDEN

Despite its northern latitude, the majority of Sweden experiences a temperate climate, , characterised by four distinct seasons and mild temperatures throughout the year. The winter season in the far southern regions is usually weak and is manifested by sporadic snowfall and sub-zero temperatures. It is noteworthy that the transition from autumn to spring may occur without a distinct period of winter. The northern parts of the country are defined by a subarctic climate while the central regions exhibit a humid continental climate. The coastal south is distinguished by either a humid continental climate, where the 0 °C isotherm is employed, or an oceanic climate, where the –3 °C isotherm is utilised.

Sweden is the sixteenth-richest country in the world in terms of GDP (gross domestic product) per capita and a high standard of living is experienced by its citizens. Sweden is an export-oriented mixed economy. The economy is primarily reliant on timber, hydropower and iron ore, with a strong focus on foreign trade. Sweden's engineering sector accounts for 50% of output and exports, while telecommunications, the automotive industry and the pharmaceutical industries are also of great importance. Sweden is positioned as the ninth-largest arms exporter on a global scale. Agriculture accounts for 2% of GDP and employment. The country has been found to be among the highest ranking in terms of telephone and Internet access penetration.

In 2010, Sweden's income Gini coefficient was the third lowest among developed countries, at 0.25—slightly higher than Japan and Denmark—suggesting Sweden had low-income inequality. However, Sweden's wealth Gini coefficient of 0.853 was the second highest in developed countries, and above the European and North American averages, suggesting high levels of wealth inequality. It is evident that even when considering a disposable income basis, the geographical distribution of the Gini coefficient of income inequality varies across different regions and municipalities of Sweden. The municipality of Danderyd, outside Stockholm, exhibits Sweden's highest Gini coefficient of income inequality, at 0.55, while Hofors near Gävle has the lowest at 0.25. In and around Stockholm and Scania, two of the more densely populated regions of Sweden, the income Gini coefficient is ranges from 0.35 to 0.55.

The country’s most important economic statistics compared to the EU-27 average is visible in Figure 216.

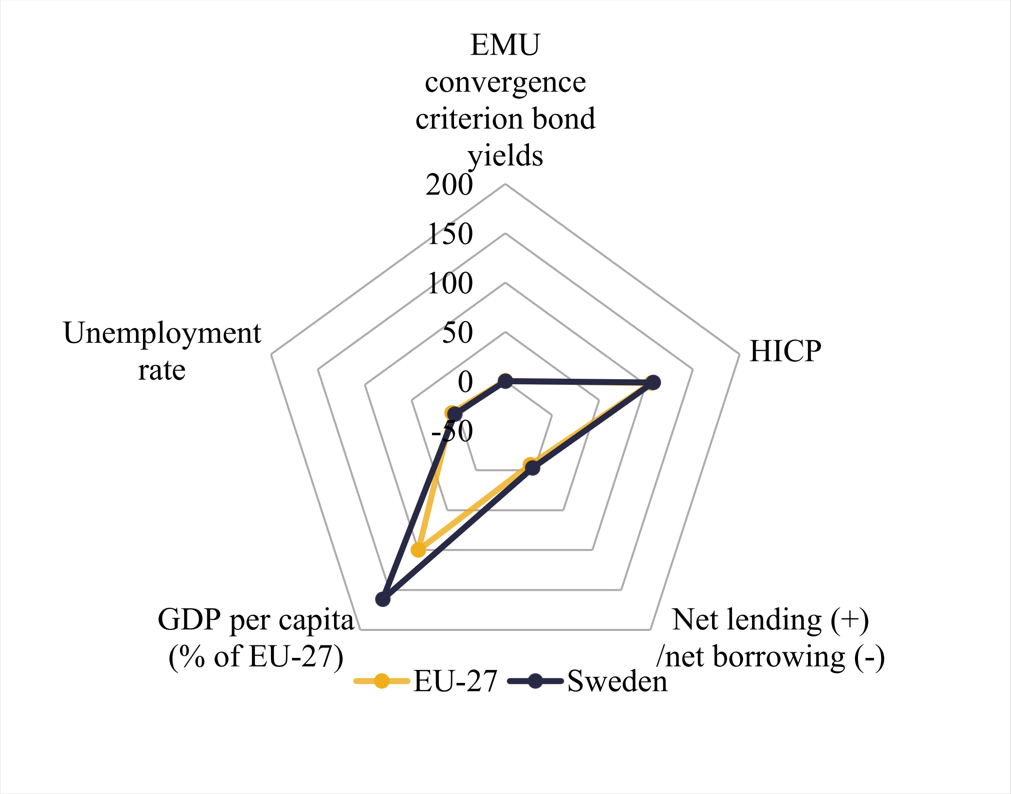


**Figure 215: Sweden vs. EU27 – Economic outlook, 2020**
Source: own compilation based on Eurostat (2021)

**Climate Strategy**

In the contemporary era, climate change is assuming an increasingly pivotal role in the political agendas of every nation worldwide. Sweden is a global leader in decarbonisation and with targets to reduce greenhouse gas emissions by 59% by 2030 compared with 2005 levels and to achieve a net-zero carbon economy by 2045. Sweden was the first country to introduce carbon pricing and it currently holds the highest carbon price in the world. This outcome serves as a testament to the efficacy of the decarbonisation process.

Its primary energy consumption comparing EU-28 is illustrated in Figure 217.

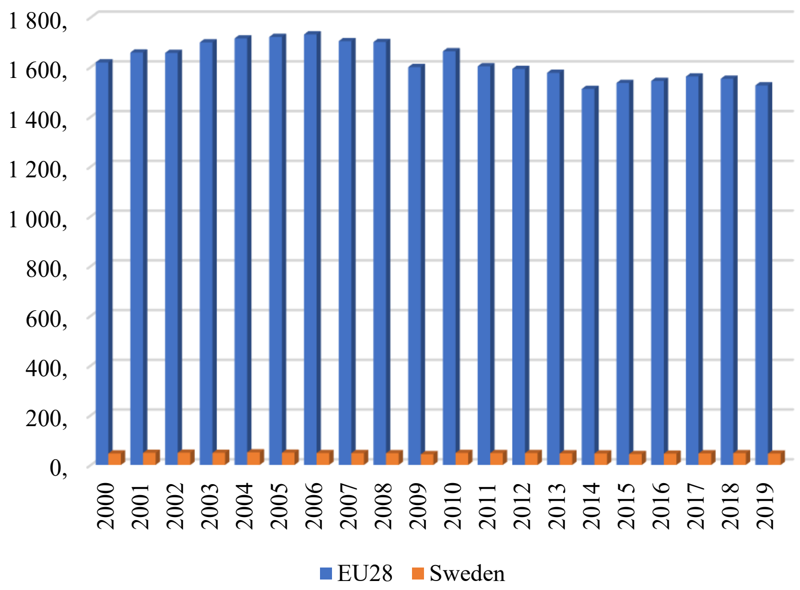


*Figure 216:* **Sweden vs. EU28 – Primary energy consumption, 2000-2019 (million tons of oil equivalent)**
Source: own compilation based on Eurostat (2022a)

Sweden's electricity supply largely comes from hydro and nuclear energy but there is a growing amount of electricity coming from wind. Heating is mainly bioenergy-based, supplied by district heating and heat pumps. The transport sector in Sweden is responsible for the majority of the country's greenhouse gas emissions.

The share of fossil fuels in gross available energy can be seen in Figure 218.

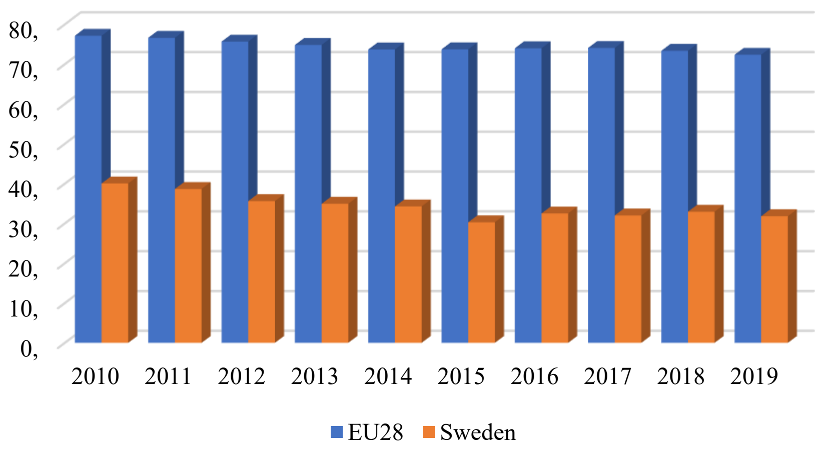


**Figure 217: Sweden vs. EU28 – Share of fossil fuels in gross available energy, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022b)

The Swedish Government has set a target to reduce transport emissions by 70% from 2010 to 2030. In order to achieve this, it is supporting the transition from oil-based fuels to electricity and advanced biofuels. Sweden is also providing backing for the decarbonisation industry. This nation is the home for one of the first major projects for the production hydrogen-based steel. Figure 218 shows the greenhouse gas emission per capita in Sweden and in the EU-28 from 2000 until 2019.

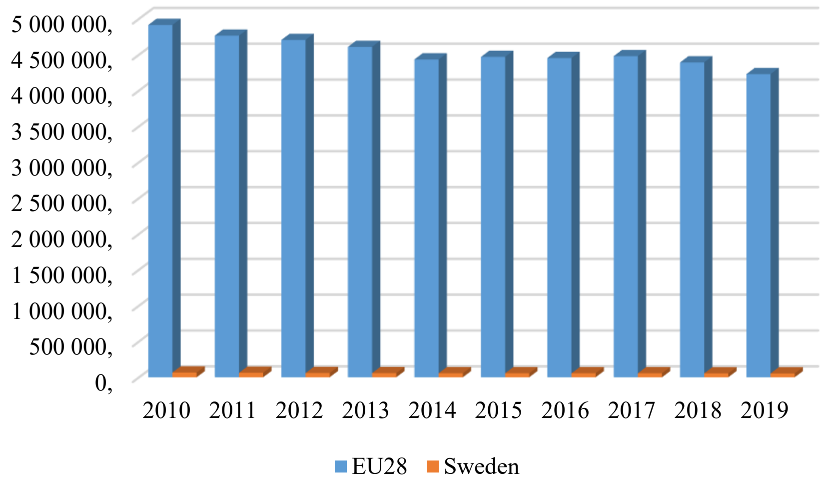


**Figure 218: Sweden vs. EU28 – Greenhouse gas emissions, 2000-2019 ($CO_2$ equivalent per capita)**
Source: own compilation based on Eurostat (2022c)

Sweden's share of energy from renewable sources can be seen in Figure 219.

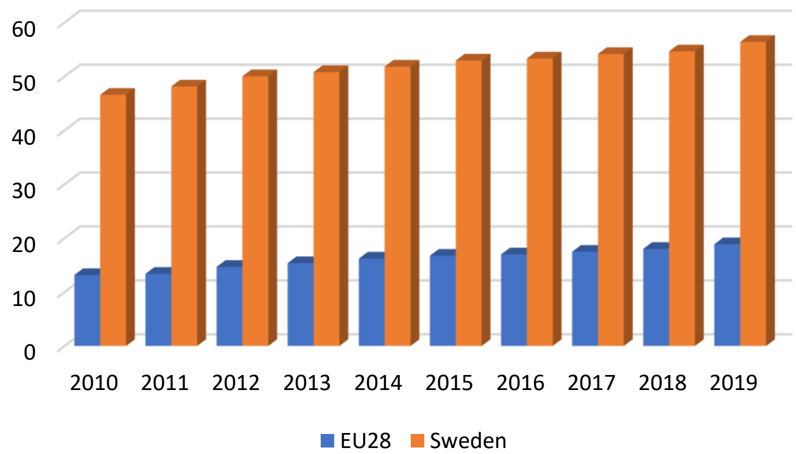


**Figure 219: Sweden vs. EU28 – Share of energy from renewable sources, 2010-2019 (%)**
Source: own compilation based on Eurostat (2022d)

**Composite Indicators**

Sweden's Environmental Performance Index (EPI) scores from 2014 to 2020 can be examined in Figure 221.

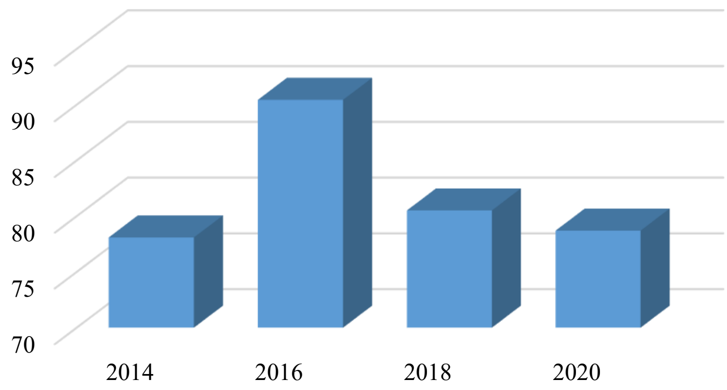


**Figure 220: Sweden – Environmental Performance Index, 2014-2020 (score)**
Source: own compilation based on EPI (2022)

Ecological Footprint is another index that measures countries' sustainable activities by ecological footprint. Sweden's ecological footprint per person from 2014 until 2020 can be seen in Figure 222.

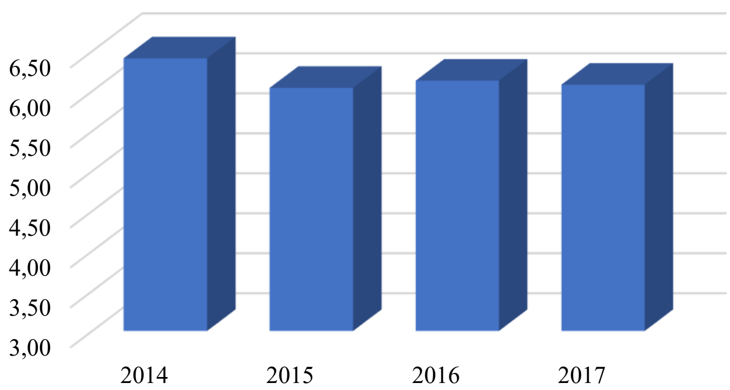


**Figure 221: Sweden– Ecological footprint, 2014-2017 (global hectares (gha) per capita)**
Source: own compilation based on (GFN, 2022)

Concerning the Climate Change Performance Index (CCPI) Sweden's performance is inconstant. The scores of the CCPI for the country can be observed in Figure 223.

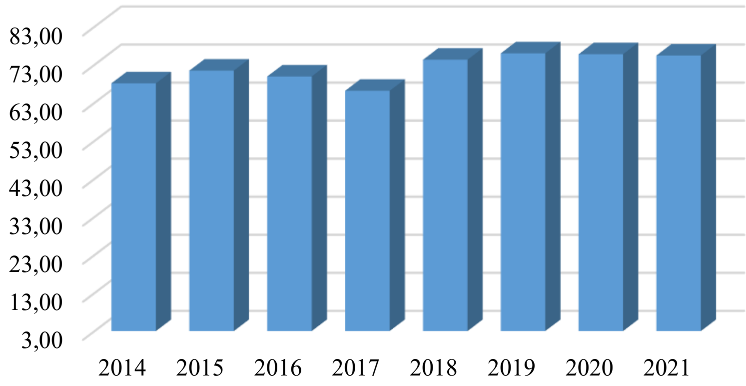


**Figure 222: Sweden vs. EU28 – CCPI, 2014-2021 (score)**
Source: own compilation based on CCPI (2021)

**Development Plan**

A significant number of universities and institutes in Sweden are engaged in research related to climate and climate change around Sweden. The Rossby Centre at SMHI is a prominent institute that is dedicated to increasing the understanding of the future climate with regards to meteorological, oceanographic and hydrological aspects. Sweden is taking significant contributions to climate research efforts on climate models, effects of climate change on ecosystems and society, measures for reducing emissions and adapting to climate change, including technology. Research on climate change is also becoming increasingly transdisciplinary and integrated with the society.

The climate change will have a profound impact on numerous facets of the Swedish society. The main climate hazards can be classified into two categories: acute climate hazards and chronic climate hazards. The acute hazards are wildfire, storms (including blizzards dust and sandstorms), snow and ice load, and subsidence. In the chronic category there are permafrost thawing, precipitation and/or hydrological variability and solifluction. Heavy rainfall is already causing significant economic damages, and it is anticipated that such occurrences will become more prevalent in the future. It is an established fact that climate change affects human health; however, the extent is challenging to predict with precision and is contingent on local preconditions and vulnerability. In addition, significant ramifications have been observed in domains as diverse as infrastructure, agriculture, and cultural heritage, among others. Sweden has extensive international operations; as such; it is particularly important to direct attention to possible impacts from changes in the wider world. The repercussions of climate change on a global scale could be shortages of food, water and safe living environments, with consequences including poverty, social unrest and armed conflict. It is acknowledged that there are some areas, where only an indirect impact of climate change could be predicted, such as trade flows, economic development and migration.

Significant secondary effects of the climate change in Sweden are also a possibility. The length of the growing season is expected to increase by one to two months, with the exception of the far south, where the increase is estimated to be up to three months. Alterations in the timing of the growing season have the potential to engender a multitude of issues for both plant and animal life.

**Legal and policy frameworks**

The inaugural vulnerability assessment of climate change impacts on Sweden was a report presented to the government in 2007. This report addressed various aspects of society's vulnerability to global climate change, the regional and local impacts of these changes, and an assessment of the possible financial consequences of climate change. Sweden has devised a national strategy for climate change adaptation. This strategy encompasses climate change adaptation goals, guiding principles, the allocation of responsibilities, monitoring, financing principles and knowledge-boosting initiatives. The National Adaptation Strategy is subject to an evaluation on a quinquennial basis, in which the SMHI Centre has a significant role. In 2020, SMHI developed a proposal for a system evaluation and monitoring of the work on adaptation in Sweden. The endeavours to attain the Swedish Environmental Targets are subject to periodic evaluation. In 2019, the evaluation contained a description of the repercussions of climate change on the prospects of accomplishing these environmental targets. All national authorities, municipalities and regions are required to undertake risk and vulnerability analysis for their area of responsibility, including climate related risks. All these institutions incorporate climate change into their risk management strategies , including the management of disaster risk.

**Strategies, plans and goals**

The National Adaptation Strategy identified seven priority areas, where adaptation measures should be taken, based on the predicted consequences for society:

- Landslides and erosion that threaten communities, infrastructure and businesses
- Flooding that threatens communities, infrastructure and businesses
- High temperatures that involve risks for the health and wellbeing of people and animals
- Water supply shortages for individuals, agriculture and industry
- Biological and ecological effects that impact sustainable development

- The impact on domestic and international food production and commerce
- Increased incidence of pests, diseases and invasive non-native species that affect people, animals and plants.

Several challenges were identified in Sweden in the context of efforts to adapt to climate change in 2015. Relevant agencies lack a clear mandate, and there are shortcomings in the cooperation between sectors and across administrative boundaries. It was evident that a coherent framework for the monitoring and evaluation of the climate change adaption work was lacking.

The Swedish Government's National Adaptation Strategy asserts that in order to adapt to the changed climate, it is imperative to develop a sustainable society that is robust in the long term. This society must be proactive addressing climate change by reducing vulnerabilities and capitalising on opportunities. It is vital that Sweden should also achieve the climate change Adaptation Goals set out in the Paris Agreement, Agenda 2030 and the Sustainable Development Goals. These goals are imperative to be incorporated into the policies, strategies and planning processes at the national level. Furthermore, they must be integrated into the standard operations and responsibilities.

The Swedish Government is establishing a five-year policy cycle with the following steps as part of the National Adaptation Strategy:

- 2018: The Government presents a national strategy for climate change adaptation.
- 2019–2022: The national expert council at SMHI is responsible for an updated climate and vulnerability analysis, and for monitoring and evaluating the climate change adaptation work carried out. A proposal for an updated strategy is currently being formulated.
- 2023: The Government presents an updated national strategy for climate change adaptation. A national strategy is subject to review and re-evaluation on a quinquennial basis.

There are two-time horizons, in which the climate change adaptation plans are made. Plans have been formulated for the present situation and the decades ahead into the next century. It is important to consider climate change adaptation in the context of long-term investments in sectors deemed to be vulnerable and socially significant. This includes investments in infrastructure, technical support systems, buildings and structures, and agriculture. It is crucial to adapt the novel investments in accordance with a shifting climate or that they are prepared to be adapted in the future in a cost-effective manner.

The formation of a national Expert Council on Adaptation has been undertaken to provide an overall picture of society's vulnerability to climate change in Sweden. This council is also charged with the responsibility of providing a comprehensive overview of the development of climate change adaptation initiatives within the nation. The Expert Council is associated with SMHI, yet operates autonomously. The Swedish Government has assigned a specific task to the National Board of Housing, Building and Planning. The primary function of the organisation is to coordinate the national climate change adaptation work for the built environment.

**Good practices**

Sweden supports international goals of adaptation. The Sustainable Development Goals, the Paris Agreement, the final document from the conference on financing sustainable development (the Addis Ababa Action Agenda), and the Sendai Framework for Disaster Risk Reduction 2015-2030 have been identified as the key elements in establishing a global framework for long-term sustainable development.

The primary objective of the Paris Agreement are adaptation and the promotion of climate-resilient development. Agenda 2030 comprises 17 goals, including adaptation aspects. Goal 13: „Take urgent action to combat climate change and its impacts", is of the utmost importance. Adaptation is also a component of Goal 11: „Sustainable cities and communities, which involves adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and developing and implementing, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels." The Swedish Government's adaptation work is based on the goals of Agenda 2030. The National Adaptation Strategy integrates these objectives and the Sendai Framework by establishing guiding principles of adaptation:

- sustainable development
- mutuality
- a scientific basis
- the precautionary principle
- integration of adaptation measures
- flexibility
- dealing with uncertainty and risk factors

- a time perspective and transparency.

It is important to emphasise that there exist nature-based solutions capable of assisting in the preservation and sustainable utilisation of biodiversity and ecosystem services, and to reduce effects of the climate change. This guidance has been formulated within the framework of the Convention on Biological Diversity. Sweden has established voluntary guidelines and will continue to work towards enhancing collaboration between the work on biodiversity and the climate change. In 2009, during its EU Presidency, Sweden adapted the EU's Baltic Sea Strategy. This strategy proposed climate change adaptations for the Baltic Sea Region within the BaltAdapt flagship project. The responsibility for the compilation of the strategy fell to Sweden, with the relevant body being the SMHI. BaltAdapt's proposals encompassed the establishment of shared knowledge databases, collaboration on funding, and cooperation within research and industry. The Arctic Resilience Report was initiated by Sweden to provide the need of an overall perspective on the activities of Arctic Council's Arctic Monitoring and Assessment Programme's working group.

The Nordic Council of Ministers (NCIM) is an intergovernmental organisation comprising Sweden, Denmark, Finland, Norway and Iceland. Nordforsk, the common Nordic research body, supports research and cooperation in many areas relevant to adaptation. Sweden is engaged in several collaborations and programmes to improve the science behind adaptation. A notable example of this is EC-Earth, a global climate model system that has been developed through collaborative efforts, led by SMHI, between institutes and universities across Europe. Sweden also participates in the European Strategy Forum on Research Infrastructure (ESFRI), European Polar Board, European Incoherent Scatter Scientific Association – Tromsø (EISCAT) and several EU projects via various funders and providers. Sweden contributes to strengthening European funding and cooperation in research and long-term development by participating in the European Research Area networks ERA-NET, ERA-NET + and ERA-NET Cofund. Sweden plays an active role in climate research by involvement in the Joint Programming Initiative JPI Climate, wherein Swedish funding agencies and researchers actively contribute to a common strategic research agenda. Furthermore, the Swedish research council Formas and the Swedish Research Council have provided funding for research into the Arctic climate, as well as research into the social sciences and humanities on climate change within the framework of JPI Climate.

Researchers in Sweden participate in several organizations and global research activities. The most significant of these is the Intergovernmental Panel on Climate Change (IPCC). SMHI is the designated Swedish Focal Point. Furthermore, Sweden is involved in a number of other organisations engaged in climate change issues, such as the World Climate Research Program (WCRP), the International Council for Science (ICSU), the International Arctic Science Committee (IASC), the Science Committee on Antarctic Research (SCAR), the International Ocean Discovery/Drilling Program (IODP), the Global Biodiversity Information Facility (GBIF), and the Future Earth. Sweden plays an active role in the assessments conducted by the Arctic Monitoring Assessment Program (AMAP) within the framework of the Arctic Council. SMHI is responsible for the international project office for the Coordinated Regional Climate Downscaling Experiment (CORDEX), on behalf of WCRP, due to Sweden's strategic emphasis on resilience and social-ecological issues. The Rossby Centre at SMHI is a leading institution in the field of producing and publishing regional climate change projections, and having produced such projections for numerous regions, including Europe, Africa, the Arctic, the Middle East and North Africa, South Asia as well as South, Central and North America. These scenarios can be utilised by Sweden and Europe primarily for the purpose of adaptation, However, it is noteworthy that also other continents, including developing countries, may also be able to derive can find valuable insights from them. The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is a notable entity in this context, given its significance in the realm of climate-related initiatives. Sweden is a member of this initiative, and the Swedish EPA serves as the Focal Point.

The Swedish International Development Cooperation Agency (Sida) also plays a significant role, given that the majority of Swedish support for adaptation in developing countries is channelled through this agency. The Sida's work is concerned with the environment and climate change. This objective is pursued through the incorporation of environment and climate change considerations into all sectors, complemented by the facilitation of dialogue with partner countries, multilateral institutions, and relevant stakeholders. Sida's support to environment and climate change is focused on the following main areas:

- increased resilience to environmental and climate change
- improved institutional capacity for environmental management
- sustainable management and utilisation of biodiversity and ecosystem services: sustainable cities
- food security and sustainable agriculture
- integrated water resource management and sanitation
- improved access to sustainable energy.

In 2019, Sida provided a total of 12.2 billion SEK to contributions, with climate change and the environment designated as the primary objectives. There is ongoing cooperation between the various Nordic climate change adaptation portals and European adaptation knowledge hubs, with contact facilitated through the EU's climate change adaptation portal, Climate-ADAPT. In the European Union member states have the opportunity to apply for research funding in the domain of climate change adaptation. A range of projects have been initiated with the objective of developing further knowledge in this area. These include the EU's Copernicus environmental data programme, a global leader in the collection of data about the Earth's climate and other global systems. It is anticipated that Copernicus will provide reliable environmental information over time, thus enabling the observation of long-term trends such as changes to vegetation and water environments. The programme's data and services can be used for climate change adaptation as has been demonstrated by the Swedish Agency for Marine and Water Management by producing the report 'Öppna data från Copernicus – Möjligheter för klimatanpassningen' ('Open data from Copernicus – Opportunities for climate change adaptation').

**Corporate-level climate and environmental protection good practices**

- **IKEA**

The worldwide popular Swedish furniture manufacturing company, IKEA, also makes significant contributions to the pursuit of a sustainable future. Their environmental plan is centred on four key areas: energy, air, water and waste. By 2028, the use of plastic in the packaging of products offered for sale will be phased out. In summary, the organisation's products will be packaging-free or recycled packaging. In addition, they furnish blog posts with concepts for renovation and transformation of aged furniture designed by them. In an effort to maximise energy savings, new types of induction hobs and light bulbs are being introduced. In addition, in order to avoid heat loss in the home the modernisation of apartment heating systems is being promoted. It is imperative to acknowledge the meticulous efforts undertaken to mitigate air pollution even during the product transportation. The organisation has been instrumental in effecting change through the provision of water-saving faucets, reusable bottles and promoting water purification equipment. Furthermore, the area of forest that has been converted for use in sustainable logging is estimated to be in excess of 44 square kilometres. However, it should be noted that certain areas are accessible to the public.

- **VOLVO**

Sustainability is a cornerstone of Volvo Cars' way of doing business, and their primary objective has always been to lead by example. The company's commitments to the environment can be traced back to the 1940s, when it was founded on the principle of refurbishing spare parts, and they continue to this day. The major automotive company Volvo has announced its intention to create a climate-neutral circular economy by 2040. In order to achieve this goal, the company claims that: “We are also part of the problem. So is our responsibility to change what we do and how we do it. Let's all be a part of the solution." The company encourage both its employees and its customers to embrace sustainable practices. For instance, it has set a target that all new Volvos will be purely electric by 2030. However, it should be noted that the company's current range already includes electric and (plug -in) hybrid versions of all its models.[10]

- **Electrolux**

The household appliance manufacturer Electrolux has adopted the “For better 2030" initiative to combat climate change through its sustainable development strategy. During product development, the focus is on the identification of solutions that assist consumers in the adoption of a more sustainable lifestyle. In addition to promoting the conservation of energy and water by using their devices, these technologies assist individuals in the maintenance of their attire, ensuring their longevity and optimal condition for extended periods. Environmental protection requirements have been expanded to their suppliers as well. 74% of their main raw material suppliers have already committed to making their $CO_2$ emissions public and reducing them systematically. Furthermore, efforts are underway to mitigate $CO_2$ emissions associated with transportation. Since 2015, a 24% reduction in emissions from goods transportation has been achieved. The company has also committed to sustainable nutrition. The Foundation [11] supports solutions to global food problems such as hunger, malnutrition and food waste.

- **H&M**

The clothing brand H&M has adopted a policy of incentivising and encouraging its customers to purchase sustainable products. Furthermore, customers are given the option of returning items of clothing that they no longer wish to retain, which are then recycled. The company's stated objective is that, by 2030, all its products will be manufactured using recycled or other sustainably produced materials. (Pineapple leaves, hemp waste, beach trash, and recycled glass are just a few of the materials H&M utilised in previous Conscious collections.) This is already the case with 80% of the materials they use. The brand's latest collection entitled Conscious Choice: demonstrates a conscientious commitment to environmental sustainability throughout the design process. The products of the selection are consisted of at least 50% more sustainable materials including organic cotton and recycled polyester. The only exception to this is recycled

10 The tradition of sustainability – www.volvocars.com

11What Electrolux does for sustainability - www.electrolux.hu cotton, for which the company has accepted the 20% level. The incorporation of a greater quantity of recycled cotton is challenging due to the inherent quality of the material. The implementation of these methodologies resulted in the establishment of a sustainable cycle within the brand.[12]

- **Ericsson**

Ericsson, the Swedish telecommunications company, adopts the motto "Technology for good ". Annually, the company disseminates its Sustainability and Corporate Responsibility Report, which provides insight into the company's responsible management in the domains of energy, environmental protection, climate change and, almost significantly, communication. According to his professional standpoint: The global economy must collectively reduce global greenhouse gas emissions by 50% by 2030 and reach net zero before 2050, as is desired. "Ericsson has a long history back in helping to create sustainable change. For more than a century, our technologies have transformed all sectors of society, and Ericsson remains committed to leading the way. Through research, science and industrial ecosystems, we are convinced that digitization and 5G can help address the climate challenge."[13]

**Good practices for climate and environmental protection at the individual level**

**GreenKayak**

GreenKayak is an environmental NGO that engages volunteers in the fight against environmental pollution while kayaking. The utilisation of a GreenKayak is complimentary for all individuals, contingent upon the fulfilment of two stipulated criteria "Spend your time on the water collecting waste. Share this experience on social media using #GreenKayak." Since 2017, tens of thousands of volunteers have paddled stable two-seater GreenKayaks in the harbours, rivers and lakes of five European countries, and collected more, thereby amassing a total of over a 60 tons of refuse. GreenKayak has been demonstrated to be an efficacious method of encouraging local action. Furthermore, the organisation collaborate with other NGOs, and companies, sharing their expertise on engagement knowledge with institutions such as the European Environment Agency to increase the impact of their efforts.[14]

12Conscious _ about choice products – www.hm.com

13 Climate action – www. ericsson.com

14 About Us – www.greenkayak.org

- The Swedish people collect their own used clothes and drop them off at the store's collection points Consequently, this approach facilitates the transfer of intact and still perfectly wearable items of clothing to those in need. In such clothing boutiques, it is also possible to purchase garments that are manufactured using sustainable materials. Indeed, a number of commercial outlets specialise in the sale of attire in conjunction with household furnishings and furniture. Furthermore, the apartment can be furnished our apartment with objects found there by others who have become disinterested in them yet are in satisfactory condition. Selective waste collection is a closely related issue, and one, which Swedes attach great importance to in their homes, in schools and at work. This phenomenon has become entrenched in the cultural fabric, with the result that even children are exposed to it from a very early age.
- Electric and hybrid vehicles have been identified as pivotal elements in the ongoing transport revolution. In Sweden, the transition to electric transport has met with a generally positive response from the public. However, the northern region of the country may encounter challenges in the initial stages, primarily due to the long distances and the limited range of electric vehicles available.
- **Waste recycling**

Sweden has achieved a recycling rate of 99%, which has resulted in a minimal presence of, unnecessary waste within the country. Sweden has recently developed a waste management system that is both economical and efficient. Within each residential area there is a selective waste collection or disposal site located approximately within a range of 300 metres. This can be considered a way of life, as selective waste collection has become an integral part of their daily lives. In certain settlements, food waste is also sorted, with the resultant biogas fuel being produced. There are 32 waste power plants operating in the country, which are an integral part of the process shown in the diagram. The discarded garbage is collected by electric refuse trucks, and the majority of it is transported to such power plants, where it is burned and converted into energy. Sweden was the first nation to set a target of achieving total zero waste. https://impressmagazin.hu/svedorszag-mar-nem-szemetel-a-hulladek-99-at-ujrahasznositjak/

- **2/3 of Sweden is covered by forest**

In the contemporary era, it is noteworthy that only a limited number of nations can make such a claim. This classifies as a good practice is predicated on the contemporary prevalence of deforestation, a phenomenon that has profound consequences for native species. Conversely, Sweden, has demonstrated a commitment to forest conservation, despite the prevalence of paper production.

The majority of the forests are privately owned, with a 25% share held by private companies. However, the state is the largest independent. Among other things, these forests are home to moose, which have become one of Sweden's symbols. 10-15 years ago, moose were threatened with extinction due to hunting, but now their population has grown greatly.

https://svedotthon.blog.hu/2019/10/15/12_erdekes_teny_svedorszagrol

- **Eco taxes**

In the context of environmental concerns, there is an increasing emphasis on the adoption of green technologies, coupled with the imposition of stringent tax policies as a regulatory measure. For instance, in 1991, a tax was introduced on companies emitting carbon dioxide. Within two years, there was a one-third decrease in carbon dioxide emissions within the country. It is recommended that the public sector purchases environmentally friendly or recycled office furniture and products.

https://www.bbc.co.uk/hungarian/peoples_europe/individual_environment_3.html

- **The Swedish railways**

In Sweden, 95% of trains are environmentally friendly. The pride of the railway is the X-2000 high-speed train, which boasts almost zero emissions. Furthermore, they ensure that their suppliers comply with the environmental regulations stipulated by the company. The trains are also treated using environmentally friendly cleaning agents.

https://www.bbc.co.uk/hungarian/peoples_europe/individual_environment_3.html

- **The recycling plaza**

Retuna plaza was constructed in Eskilstuna in 2015. The objective of the initiative is to establish a paradigm of sustainable shopping. The facility operates in close proximity to the local recycling yard. All individuals are welcome to contribute items that may be of interest. The company's business model entails the conversion, repair and resale of these returned items. This lends further support to the well-known adage that "one man's trash is another man's treasure".

https://greenfo.hu/hir/ime-az-elso-ujrahasznosito-plaza-sajnos-nem-nalunk/

## Conclusion

Sweden is a leader in the energy transition which is proved by its efforts and effectiveness towards a decarbonated economy, including fuels, heating and electricity. Furthermore, it has participated proactively in several projects and collaborations in order to address the mounting necessity for climate change adaptation. is the nation is participating in numerous global and regional organisations with the overarching objective being to promote a more sustainable and environmentally responsible global ecosystem in harmony with the principles of climate change adaptation. Sweden is prolific in its research output in these areas, consistently providing up-to-date knowledge on climate change and environmental shifts. This research is of direct relevance to the various projects and programmes in which the country is engaged. As a consequence of these activities, Sweden has the potential to become a global leader in environmentally sustainable practices, thereby contributing to the construction of a more promising future for the next generations.

## References


- CCPI (2021): Climate Change Performance Index. https://ccpi.org/downloads/ https://www.germanwatch.org/en/CCPI. Downloaded: 22.10.2021.
- Climate Adapt - Sweden (link: https://climate-adapt.eea.europa.eu/countries-regions/countries/sweden)
- EPI, Environmental Performance Index (2022): EPI2022 Results. https://epi.yale.edu/downloads. Downloaded: 22.10.2021.
- Eurostat (2021): EMU convergence criterion series bond yields https://ec.europa.eu/eurostat/databrowser/view/IRT_LT_MCBY_A__custom_1499757/default/table, HICP https://ec.europa.eu/eurostat/databrowser/view/PRC_HICP_AIND__custom_1499825/default/table, Net lending (+) /net borrowing (-) https://ec.europa.eu/eurostat/databrowser/view/gov_10a_main/default/table, Real GDP per capita https://ec.europa.eu/eurostat/databrowser/view/SDG_08_10/default/table, Unemployment rate https://ec.europa.eu/eurostat/databrowser/view/UNE_RT_A_H__custom_1499885/default/table. Downloaded: 02.11.2021.
- International Energy Agency – Sweden (link: https://www.iea.org/countries/sweden)
- Our World in Data – Sweden (link: https://ourworldindata.org/energy/country/sweden?fbclid=IwAR3Jhl0-cpq6_bGy47uJdTcIZYKvWpCIOWrK13S1rTA9hR8-oXTAWecGJbA)
- Eurostat (2022a): Primary energy consumption. https://ec.europa.eu/eurostat/databrowser/view/SDG_07_10/default/table. Downloaded: 22.10.2021.
- Eurostat (2022b): Share of fossil fuels in gross available energy. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_FFGAE$DEFAULTVIEW/default/table. Downloaded: 22.10.2021.

- Eurostat (2022c): Greenhouse gas emissions per capita. https://ec.europa.eu/eurostat/databrowser/view/t2020_rd300/default/table. Downloaded: 22.10.2021.
- Eurostat (2022d): Share of energy from renewable sources. https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN/default/table. Downloaded: 22.10.2021.
- GFN, Global Footprint Network (2022): Ecological Footprint of Countries. https://data.footprintnetwork.org/?_ga=2.213014356.193975080.1607636931-1228825067.1607467693#/compareCountries?cn=all&type=EFCpc&yr=2017. Downloaded: 22.10.2021.

## 5. Afterword

This report is embedded in the broader strategic framework of the European Union's long-term approach to sustainable development and climate adaptation. As climate change increasingly shapes environmental conditions, economic performance, and social systems across Europe, adaptation has emerged as a central policy priority. The analysis and perspectives presented throughout this document reflect the EU's recognition that climate-related risks must be addressed in a systematic, coordinated, and forward-looking manner.

Climate adaptation within the European Union is understood as a cross-cutting process that extends across sectors, governance levels, and time horizons. Rather than functioning as an isolated policy domain, adaptation is increasingly integrated into areas such as spatial planning, infrastructure development, water and ecosystem management, public health, and economic policy. This integrated approach is essential for managing compound and cascading risks, including extreme weather events, long-term environmental degradation, and growing socio-economic vulnerabilities.

The evidence base underpinning this report highlights the importance of anticipatory action and robust risk assessment. Effective climate adaptation relies on the ability to identify present and future risks, assess potential impacts, and design measures that remain effective under conditions of uncertainty. Long-term planning, supported by scientific analysis and reliable data, plays a key role in avoiding maladaptation and minimizing future economic and social costs. In this context, climate adaptation is closely aligned with the objectives of sustainable development, resilience, and long-term prosperity.

Governance capacity and institutional coordination are also critical factors in delivering successful adaptation outcomes. Translating strategic objectives into concrete action requires clear policy frameworks, alignment between European, national, and local levels, and mechanisms that support continuous learning and adjustment. Strengthening administrative capacity and policy coherence enhances the EU's ability to respond effectively to evolving climate challenges while ensuring consistency with broader sustainability goals.

Within the EU policy landscape, climate adaptation is increasingly linked to competitiveness, security, and social cohesion. By integrating adaptation considerations into investment decisions and long-term planning processes, the European Union seeks to protect natural capital, safeguard critical infrastructure, and enhance the resilience of communities and economies. This approach reinforces the EU's commitment to a sustainable development pathway that is both environmentally sound and economically viable.

In conclusion, this report contributes to the ongoing policy dialogue on climate adaptation by consolidating analytical insights within an established European strategic context. It reinforces the view that climate adaptation is an essential component of sustainable development and underscores the need for coordinated, evidence-based action. By supporting informed decision-making and long-term planning, the document aims to contribute to a more resilient, sustainable, and future-oriented European Union.