Report on Energy Resources and Utilization of Slovak Republic

by

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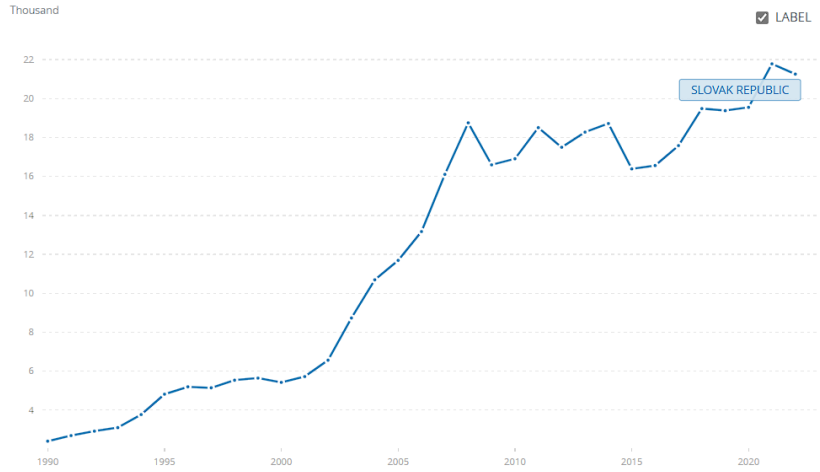
Overview

Slovak Republic often known as Slovakia is a nation situated in the Carpathian Mountains of central Europe. It became an independent nation after separating from the Czech Republic. The Slovak Republic is divided into 8 regions which are further divided into 79 districts and share borders with the Czech Republic, Poland, Ukraine, Hungary, and Austria. The country has a decent population of 5428792 and a population density of 110.78 per square km.

The country has a decent GDP of 109645.2 million euros with a GDP per capita of 21258.1 US dollars as of 2022. Slovakia's economy is based on a mix of services, industry, and agriculture. The country's main industries include automotive, machinery, electronics, and chemicals. Slovakia's economy has grown steadily in recent years. In 2022, GDP growth was 3.1%, which is expected to be 1.3% in 2023. The unemployment rate is low, at 5.7%. Inflation is high, at over 12%, but it is expected to moderate in 2024. The country is facing economic challenges like income disparities and regional development imbalances and great dependence on automobile industries.

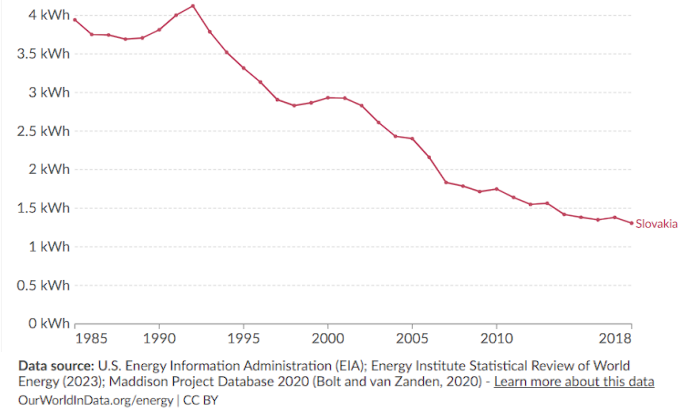


DATA FROM WORLD BANK

Slovak Republic's Human Development Index value for 2021 was 0.858, positioning at 37th out of 191 countries in the 2021 Human Development Report which is pretty impressive considering the country's economy and size.

Slovakia has made significant progress in achieving the Sustainable Development Goals (SDGs) since their adoption in 2015 particularly well on SDG 6 (Clean Water and Sanitation), SDG 7 (Affordable and Clean Energy), and SDG 11 (Sustainable Cities and Communities). The country has also made good progress on SDG 1 (No Poverty), SDG 3 (Good Health and Well-being), and SDG 4 (Quality Education).

Energy Intensity of Slovak republic has demonstrated a consistent decline in energy intensity in recent years, indicating efficient energy use within the country. This reduction is a result of energy efficiency measures and a transition to cleaner and more sustainable energy sources. Slovakia's commitment to energy efficiency and sustainability aligns with global efforts to reduce the environmental footprint.



FOSSIL FUELS

Brown coal: Slovakia has an estimated 1.6 billion tonnes of brown coal reserves, which is the largest fossil fuel reserve in the country. The current rate of extraction is approximately 10 million tonnes per year.

Natural gas: Slovakia has estimated natural gas reserves of 150 billion cubic meters. The current rate of extraction is approximately 1 billion cubic meters per year.

Renewable sources of energy

Hydropower: Slovakia has a potential hydroelectric capacity of 10 GW. The current installed capacity is approximately 2.7 GW, and the generation of electricity from hydropower in 2022 was 8 TWh.

Solar energy: Slovakia has a solar energy potential of 1 GW. The current installed capacity is approximately 0.5 GW, and the generation of electricity from solar energy in 2022 was 0.5 TWh.

Wind energy: Slovakia has a wind energy potential of 1 GW. The current installed capacity is approximately 0.5 GW, and the generation of electricity from wind energy in 2022 was 0.5 TWh.

Other

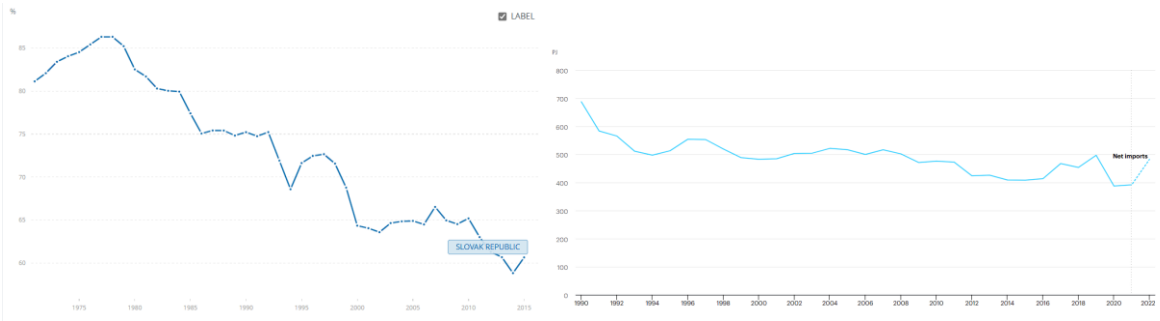
Uranium: Slovakia has a small uranium deposit at Novoveska Huta, with estimated reserves of 3,680 tonnes of uranium oxide (U3O8). The deposit is not currently being mined, but there are plans to develop it in the future.

Geothermal energy: Slovakia has significant geothermal energy potential, estimated at 6 GW of electrical capacity. The country has several geothermal power plants in operation, with a total installed capacity of approximately 15 MW.

Biomass energy: Slovakia has a large biomass potential, estimated at 6 million tonnes per year. Biomass can be used to generate electricity and heat. There are a number of biomass power plants in operation in Slovakia, with a total installed capacity of approximately 100 MW.

ENERGY IMPORTS

As per Ministry of Economy of the Slovak Republic, Slovakia imported 20.6 million tonnes of oil equivalent (toe) of energy in 2021, at a cost of €7.9 billion. This represents approximately 55% of Slovakia's total energy consumption.



SOURCE: INTERNATIONAL ENERGY AGENCY

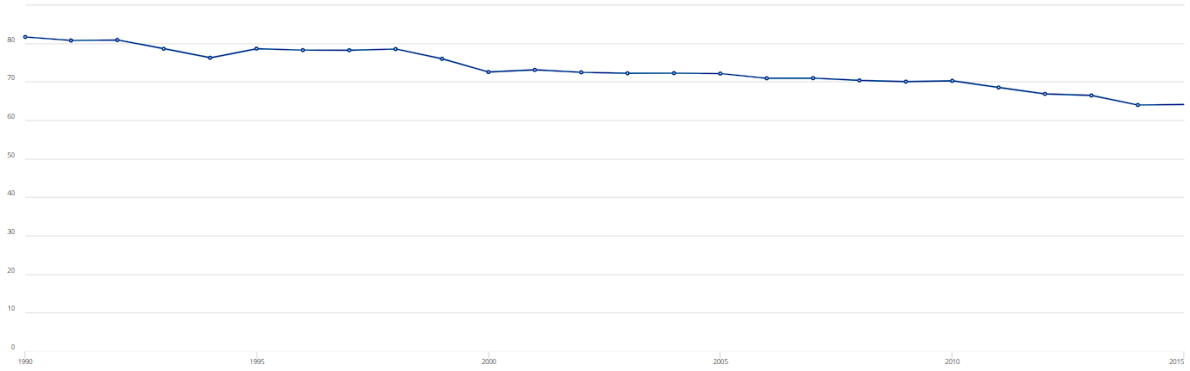
Although Slovak Republic depends a lot on energy imports, but it has a lot of energy potential in geothermal energy which the government is trying to focus on. Slovakia's reliance on imported energy makes it vulnerable to energy price shocks and supply disruptions. For example, the sharp rise in energy prices in 2022 has had a significant impact on the Slovakian economy, leading to higher inflation and slower economic growth. The Slovakian government is taking steps to reduce its reliance on imported energy, such as investing in renewable energy and energy efficiency. However, it is likely that Slovakia will remain a net importer of energy for the foreseeable future.

FOSSIL FUEL INFRASTRUCTURE

About 468000 TJ of energy is produced form fossil fuels in 2021. The country has 2 major and 3 small oil refineries, with a total refining capacity of approximately 12 million tonnes per year. The refineries produce a variety of products, including gasoline, diesel fuel, heating oil, and jet fuel. It also has an installed capacity of 2,500 MW heating plants. Slovak Republic have 3 Coal mines and 2 thermal power plants. It also has 2 gas power plants.

Slovakia has a well-developed distribution network for petroleum products, including gasoline, diesel, and other refined products. This network enables the transportation of fuels from refineries to retail outlets and end-users. Natural gas distribution infrastructure is also present, with a network of pipelines that transport natural gas for heating, industrial processes, and electricity generation.

The Slovakian government is committed to reducing its reliance on fossil fuels and increasing the share of renewable energy in its energy mix and they did reduce it by a significant amount. However, the country will continue to rely on fossil fuels for a significant share of its energy needs for the foreseeable future. The refining and conversion infrastructure for fossil fuels in Slovakia is essential for meeting the country's energy needs.



Percentage of energy from fossil fuels

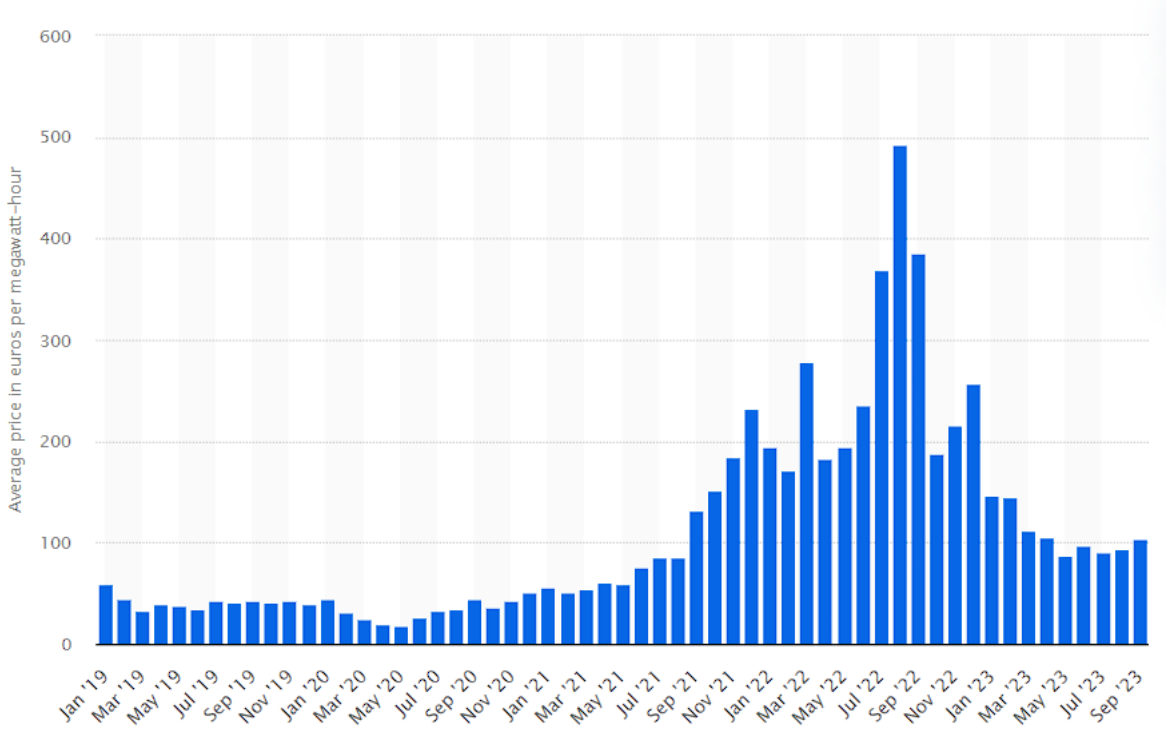
COST OF DIFFERENT ENERGY CARRIERS IN THE COUNTRY AND ITS TIME VARIATION

We can about it from the data below that the cost of each have increased this is due to inflation and many other factors at work and the prices also wary from place to place due to many factors like availability of it and it also vary depending on who the consumer is like prices of electricity is different for residentials and industries.

Energy Carrier	2022	2021	2020
Natural gas	50	35	25
Electricity	55	50	45
Coal	40	30	25
Heating Oil	70	60	50
Gasoline	100	90	80
Diesel	110	100	90

Renewable energy sources, such as solar and wind, have become more competitive in terms of cost as technology advances and economies of scale are realized. The cost of renewable energy can vary based on the specific technology, location, and government incentives. The cost of technology for renewable

energy in Slovakia has decreased significantly in recent years. For example, the cost of solar photovoltaic (PV) panels has fallen by more than 80% in the past decade. The cost of renewable energy technologies in Slovakia is generally lower than the cost of fossil fuels. For example, the cost of solar PV electricity is lower than the cost of natural gas electricity.



Data above is prices of electricity in slovakia and we can see that it vary greatly from time to time.

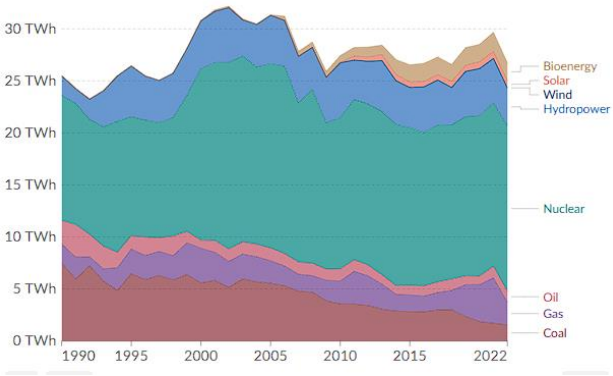
ELECTRICITY GENERATION CAPACITY INSTALLED IN THE COUNTRY AND ITS ENERGY SOURCE WISE BREAK UP

Most of the country's electricity is generated from nuclear power plants which can be seen from below data.

	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007
Gross electricity production	26 215	29 582	27 904	27 806	25 381	26 649	25 521	25 669	26 102	27 870	27 922	27 704	27 430	26 214	29 488	27 949
of which equipment: thermal	5 777	8 662	7 023	7 097	5 971	6 080	6 021	6 263	5 985	7 026	8 038	8 186	7 226	7 370	8 392	8 026
hydro	3 791	4 457	4 739	4 542	3 903	4 772	4 727	4 260	4 497	5 125	4 389	4 105	5 630	4 763	4 391	4 588
nuclear	15 921	15 730	15 417	15 505	14 843	15 125	14 773	15 146	15 620	15 719	15 495	15 413	14 574	14 081	16 705	15 335
Imports	16 707	13 882	13 285	13 536	12 427	15 563	13 249	14 956	12 927	10 673	13 422	10 860	6 657	8 336	8 532	12 729
Exports	15 318	13 095	12 967	11 837	8 746	12 533	10 596	12 608	11 861	10 626	13 078	10 498	6 292	7 680	8 889	11 853
Sources total	27 604	30 369	28 222	29 505	29 062	29 679	28 174	28 017	27 168	27 917	28 266	28 066	27 795	26 870	29 131	28 825

Slovakia	
Solar photovoltaic	
On-grid	
2022	537.00
Pumped storage	
On-grid	
2022	916.00
Fossil fuels n.e.s.	
On-grid	
2022	2,133.00
Nuclear	
On-grid	
2022	2,003.00

Renewable hydropower	
On-grid	
2022	1,615.00
Solid biofuels	
On-grid	
2022	163.00

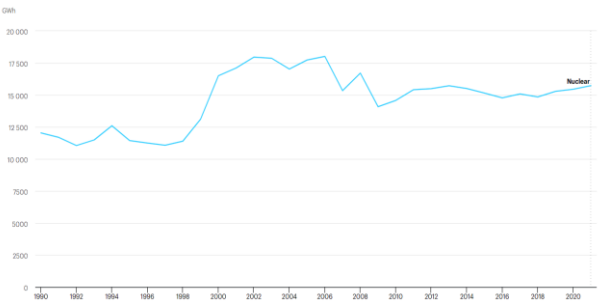


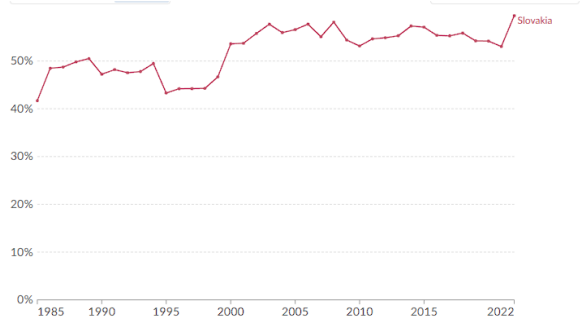
Energy source	Installed capacity (MW)
Nuclear	2308
Hydropower	2700
Solar	500
Wind	500
Biomass	100
Coal	1000
Natural gas	1000

Nuclear energy forms a substantial and consistently operating part of Slovakia's energy infrastructure. In contrast, despite having significant hydropower capacity, its electricity generation varies due to water availability, especially during low rainfall periods. Older hydropower plants, less efficient and susceptible to operational constraints like sediment buildup, further impact hydropower output. Slovakia's environmental regulations impose limits on water diversion for hydropower. Nevertheless, the Slovakian government is committed to increasing hydropower's role, setting an ambitious target of achieving 40% hydropower in the energy mix by 2040, promoting sustainability and diversification. According to me the country has a lot of potential in terms of renewable energy to generate electricity and they should focus more on it there are even many geothermal projects running there.

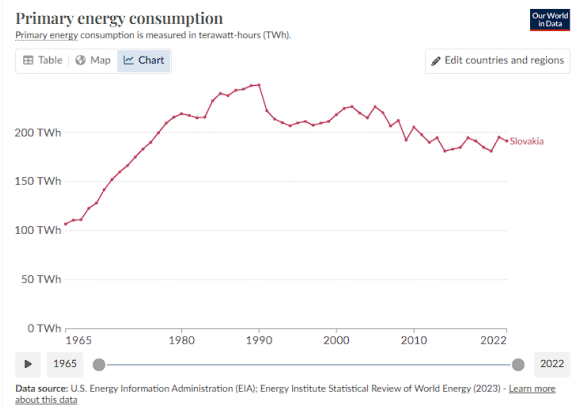
NUCLEAR

Nuclear energy is a major source of electricity generation in Slovakia, which have a share of approximately 55% of the country's electricity production. Slovakia has five operational nuclear reactors, all of which are of the VVER-440 type. The reactors are located at two power plants: Bohunice and Mochovce. The Slovakian government is committed to nuclear energy as a source of clean and reliable energy.





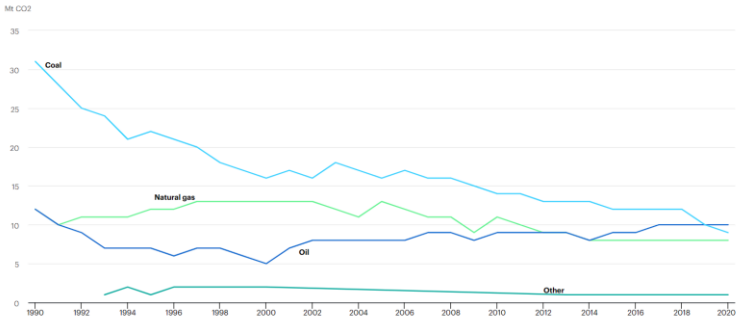
ENERGY BALANCE

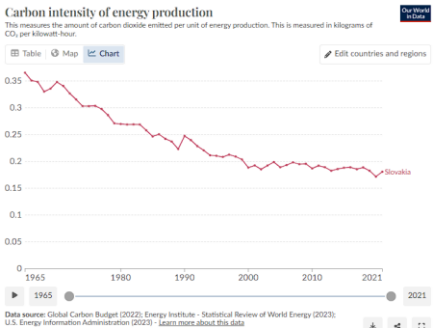


Country's energy usage has increased and decreased due to increase in demand and efficiency of power plants as this is primary energy consumption and it can be compared with electricity demand curve and then we can see overall final energy consumption have increased while primary energy consumption have decreased in recent year which is really impressive and is possible due to new technology.

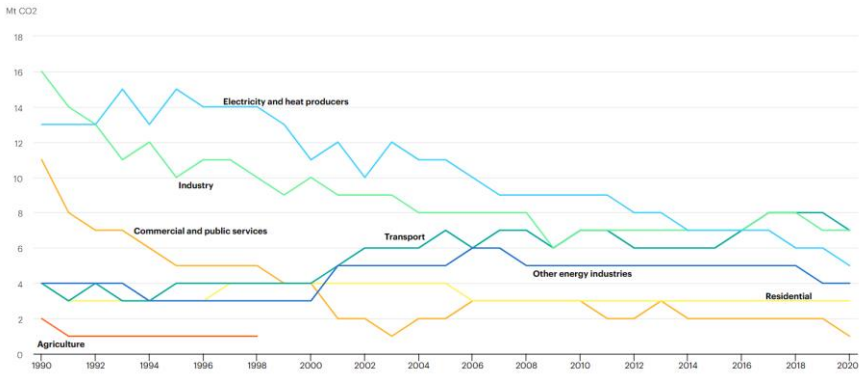
CARBON DIOXIDE AND OTHER GREENHOUSE GAS (GHG) EMISSIONS FROM THE COUNTRY

Slovakia, like many other country, contributes to global CO2 emissions through the burning of fossil fuels for energy production and transportation and industries. The country's industrial sector also plays a role in CO2 emissions, particularly in heavy industries such as steel production and automobile manufacturing industries. These emissions are harmful to the environment and can have negative impacts on public health. To decrease GHG emissions, Slovakia has been taking steps to transition to cleaner energy sources, including increasing the share of renewable energy and improving energy efficiency. Slovakia also emits other greenhouse gases such as methane (CH4) and nitrous oxide (N2O), primarily from agriculture, waste management, and industrial processes..





Based on the data presented above, it is clear that there has been a significant decrease in CO2 emissions over the past century. The government is implementing policies and taking action to continue this trend. One of the main reasons for this decline in emissions is the increased use of nuclear power plants to generate electricity. However, it's important to note that nuclear power is not a permanent solution as it leads to the accumulation of nuclear waste. Nonetheless, it is still a significant step towards reducing carbon emissions.



It is evident that in the past, the majority of CO2 and GHG emissions were from electricity generation, which is now not as big of an issue. However, emissions from industries are still significant and can be improved by implementing newer and better technologies.

Slovakia has signed many international climate agreements, including the Paris Agreement, and has set targets for reducing GHG emissions. Reducing GHG emissions can have co-benefits for air quality and public health, as cleaner energy sources and technologies often produce fewer pollutants. Slovakia has been addressing air quality concerns.

POLLUTION AND ITS RELATION TO ENERGY

AIR POLLUTION

Air pollution is a serious problem in Slovakia, primarily caused by traffic, industry, and domestic heating. The average concentration of particulate matter in Slovakia in 2022 was 35 µg/m³, exceeding the WHO guideline of 15 µg/m³. High levels of PM can lead to respiratory infections, heart disease and stroke. The government is taking measures to reduce air pollution through sustainable transportation, improved energy efficiency, and the promotion of renewable energy sources.

Energy Sector have a significant contribution in air pollution this can be seen from the data in previous heading.

WATER POLLUTION

Water pollution in Slovakia is a significant problem caused by agricultural runoff, industrial discharges, and inadequate wastewater treatment. It harms aquatic life and renders water unsafe for human consumption. Efforts are underway to improve water quality through better management practices and infrastructure upgrades.

The energy sector does not have much of a hand in water pollution.

LAND POLLUTION

Land pollution in Slovakia primarily stems from farming, industrial activities, and improper waste disposal. Farmers' use of pesticides, fertilizers, and livestock waste can introduce contaminants into the soil. Industries, including mining and manufacturing, contribute to soil pollution by releasing pollutants into the environment. Improper trash disposal also plays a role in soil contamination. Proper soil management and waste disposal practices are essential to mitigate this issue and prevent further pollution.

The energy sector is causing land pollution in form of nuclear waste which is generated by nuclear plants.

GLOBAL COMMITMENTS TOWARDS GHG EMISSIONS

Slovakia has made several global commitments towards reducing greenhouse gas (GHG) emissions.

Paris Agreement

Slovakia is a party to the Paris Agreement, which is a global agreement to combat climate change. Under the Paris Agreement, Slovakia has committed to reducing its GHG emissions by 55% by 2030 compared to 1990 levels.

Effort Sharing Regulation

Slovakia is also subject to the Effort Sharing Regulation (ESR), which is a European Union (EU) regulation that sets binding targets for GHG emissions from sectors outside of the EU Emissions Trading System (ETS). Under the ESR, Slovakia has committed to reducing its GHG emissions from non-ETS sectors by 40% by 2030 compared to 2005 levels.

Energy Efficiency Directive

Slovakia is also subject to the Energy Efficiency Directive (EED), which is an EU directive that sets binding targets for energy efficiency. Under the EED, Slovakia has committed to reducing its primary energy consumption by 32% by 2030 compared to 2007 levels.

Renewable Energy Directive

Slovakia is also subject to the Renewable Energy Directive (RED), which is an EU directive that sets binding targets for renewable energy. Under the RED, Slovakia has committed to increasing its share of renewable energy in its energy mix to 25% by 2030.

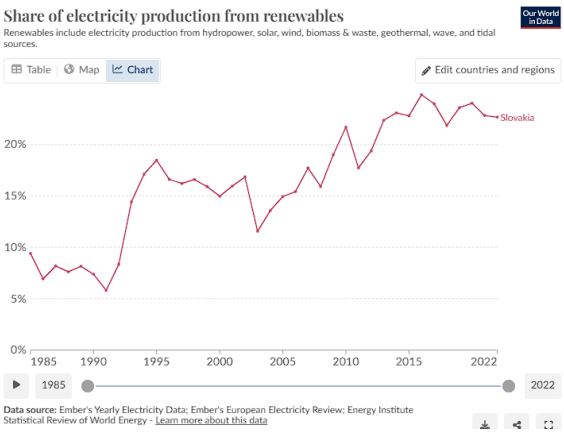
Land Use, Land-Use Change and Forestry (LULUCF) Regulation

Slovakia is also subject to the LULUCF Regulation, which is an EU regulation that sets accounting rules for GHG emissions and removals from LULUCF activities. Under the LULUCF Regulation, Slovakia has committed to ensuring that its LULUCF sector remains at least carbon neutral by 2030.

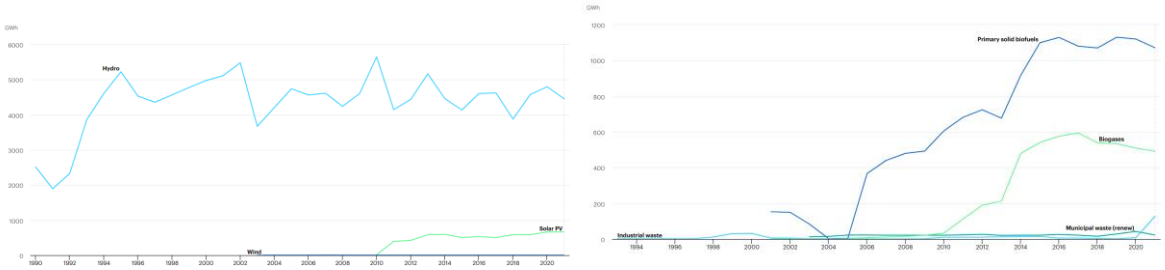
In addition to these global and EU commitments, Slovakia has also made a number of national commitments to reduce GHG emissions. For example, the Slovakian government has committed to phasing out coal-fired power plants by 2030 and to increasing the share of renewable energy in its energy mix to 38% by 2030.

PROGRESS IN RENEWABLE ENERGY DEPLOYMENT AND ITS RESOURCE-WISE BREAKUP

In Slovakia, a significant amount of energy is developed from renewable sources like solar, geothermal, hydro, and biomass.



We can see about 24% of the energy is produced from renewable sources and this is expected to increase with time as the country have great potential in terms of geothermal energy and use of solar power is increasing across the globe so it is also expected to increase.



Here we can see that most of the renewable part of energy is developed from hydro and biofuels which is to be expected from any country as solar sources came into existence recently and their share is expected to increase. The country has many geothermal projects also which will make geothermal energy a major source soon.

POLICY MEASURES TAKEN BY THE COUNTRY FOR THE ENERGY SECTOR TOWARDS IMPROVING ENERGY EFFICIENCY, HARNESSING RENEWABLE SOURCES OF ENERGY, AND CARBON MITIGATION

Energy efficiency

- The government has set a target of reducing primary energy consumption by 32% by 2030 compared to 2007 levels.
- The government has implemented several energy efficiency programs and initiatives, including:
    - Energy efficiency audits and retrofits for buildings
    - Energy efficiency standards for appliances and equipment
    - Public education and awareness campaigns
    - Financial incentives for energy efficiency improvements

Renewable energy

- The government has set a target of increasing the share of renewable energy in its energy mix to 25% by 2030.
- The government is supporting the development of renewable energy technologies through several policy measures, including:
    - Feed-in tariffs for renewable energy electricity
    - Net metering for rooftop solar PV systems
    - Public-private partnerships
    - Research and development funding

Carbon mitigation

- The government has set a target of reducing greenhouse gas emissions by 55% by 2030 compared to 1990 levels.
- The government is implementing several carbon mitigation measures, including:
    - Carbon pricing
    - Emissions trading
    - Phase-out of coal-fired power plants
    - Promotion of electric vehicles

The Slovakian government is also taking steps to support the development of new energy technologies, such as smart grids.

The government's policy measures are having a positive impact on the energy sector. Primary energy consumption has decreased in recent years, and the share of renewable energy in the energy mix has increased. The government's policies are also helping to reduce greenhouse gas emissions from the energy sector.

Here are some specific examples of the Slovakian government's policy measures in the energy sector:

- Energy efficiency: The government's energy efficiency audit program has helped to identify and implement energy efficiency measures in buildings, businesses, and industry. For example, the program has helped to retrofit buildings with energy-efficient insulation, windows, and lighting.
- Renewable energy: The government's feed-in tariff program has helped to stimulate the development of renewable energy projects, such as solar and wind farms. The government has also supported the development of rooftop solar PV systems through its net metering program.
- Carbon mitigation: The government's carbon pricing system puts a price on carbon emissions. This helps to create incentives for businesses and individuals to reduce their emissions. The government's emissions trading system allows businesses to buy and sell carbon emissions allowances. This helps to create a market for carbon emissions and to reduce the overall cost of reducing emissions.

Sources:

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