Slovak Market Outlook for Renewables 2023

Slovak Association of Photovoltaic Industry and RES (SAPI)

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SAPI Slovak Association of Photovoltaic Industry and RES

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Foreword

Welcome to the second edition of our market Report on the development of renewable energy in Slovakia.

It is easy to notice that compared to other EU Member States, Slovakia is far from being a major market for renewable energy deployment. However, as our analysis shows, Slovakia has a huge untapped potential for future expansion of various renewable energy technologies, which can ultimately pave the way towards climate neutrality in 2050.

This Report provides a comprehensive snapshot of what happened in 2023 and how it might affect the future development of the renewables market. In the last year, we experienced a strong push in the solar PV sector, partly driven by investment subsidies, but mostly as a result of fundamental investment decisions by commercial and industrial consumers who began to recognise the need for an energy transition. On the flip side, there are other technologies - notably wind and geothermal - that have yet to prove their worth. Their development depends largely on political support to create the right legal and regulatory framework to facilitate permitting, access to grids and energy markets.

In the Report, we also continue to compare the current development of all renewable technologies with the 2023 Draft Updated NECP and also zero-emission scenarios, as envisioned by the Slovak Government, an expert model developed at the Slovak Academy of Sciences respectively. Our main aim is to paint a bigger picture of where we are now and where we need to be in the future.

I am convinced that this annual Report will contribute to a lively and information-driven discussion about the renewables market in Slovakia and generate further interest in its development.

Ján Karaba
Director, SAPI

Executive Summary

SAPI's annual Report on the Slovak electricity market provides a comprehensive overview of the renewable energy technologies (RES-E) that are crucial to the country's energy landscape. Focusing on solar PV, onshore wind, hydropower, bioenergy and geothermal, the Report analyses their past development, future deployment scenarios, including key information on barriers, energy potential and policy measures. At the end of 2023, hydropower dominates with 71% of total installed renewable capacity, followed by solar PV (23%) and bioenergy (6%). The deployment of solar PV in 2023 exceeded expectations, leading to a relative annual increase of 47% compared to 2022. However, wind and geothermal energy made negligible to no contributions. The Draft Updated National Energy and Climate Plan (NECP) aims to set milestones for these technologies by 2030, but projections suggest a significant shortfall in meeting the targets, with the exception of solar PV.

To achieve carbon neutrality by 2050, specific 2030 capacity milestones for each RES-E technology are essential. The Report outlines progress towards these 2030 milestones under different scenarios, highlighting the importance of aligning national targets with long-term EU ones. It assesses RES-E deployment to date and presents three scenarios, namely business as usual, NECP target and zero emissions. While the NECP scenario is based on current and planned policies, the zero emissions scenario, supported by rigorous modelling, outlines a trajectory towards carbon neutrality by 2050. Data for mapping market growth has been provided by key stakeholders, ensuring the reliability and relevance of the Report. Despite challenges, including limited wind and no geothermal capacity, ongoing projects offer hope for future progress, underlining the importance of continued policy support and investment.

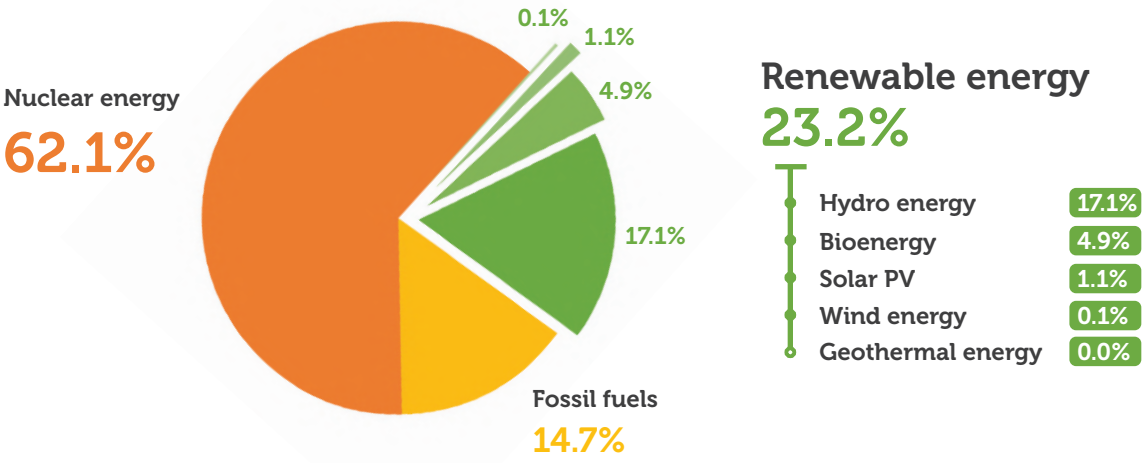
Introduction

SAPI's annual Report provides a quantitative description of the Slovak electricity market, focusing on five renewable energy technologies (RES-E) with potential and a foreseen role in the national energy market. Together with brief qualitative assessments of barriers and recent policies and measures (PaMs), it examines the deployment of solar PV, onshore wind, hydropower, bioenergy and geothermal sources in Slovakia.

This Report is the second in a series of annual reports that map the country's RES-E development to date and forecast future market growth based on three deployment scenarios. It is based on annual progress reports for each technology.

At the end of 2023, hydropower accounts for around three quarters (71%) of total installed renewable capacity, followed by solar PV with around a quarter (23%) and bioenergy, including biogas, with around 6%. Slovakia has only 3 MW of installed wind capacity and no existing geothermal plants generating electricity. Both RES-E technologies therefore make a negligible contribution to Slovakia's renewable electricity mix, as shown in Figure 1 below.

Figure 1 | Shares of energy sources on the total electricity generation in Slovakia (2023)



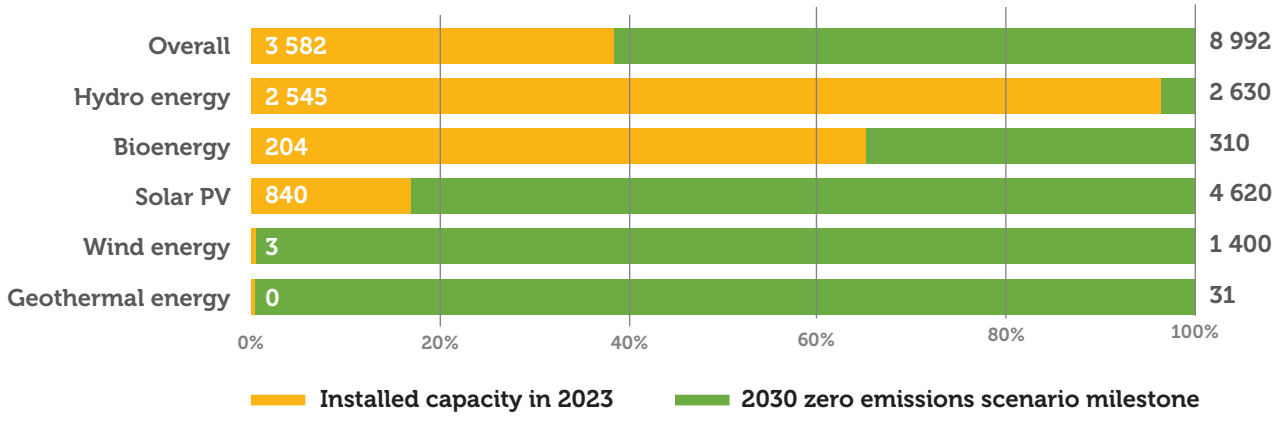
Source: OKTE (2024)

The Draft Updated National Energy and Climate Plan (NECP) submitted to the European Commission (EC) in August 2023 sets milestones for these technologies up to 2030. With the exception of hydropower and bioenergy sources, the installed RES-E capacity in 2030 needed to stay on track towards carbon neutrality by 2050 appears to be much higher than envisaged in the document. In addition, apart from the solar PV sector, which experienced a significant boom in 2023, the recent development of other RES-E technologies does not show a trend that is likely to lead to the achievement of the NECP targets. On the other hand, this could change with several projects in the pipeline as of early 2024, as outlined in the Report.

In order to achieve carbon neutrality by 2050, certain milestones of total installed capacity need to be reached for each RES-E technology. While 2050 is considered to be the deadline by which neutrality should be achieved, 2030 is generally considered to be a so-called milestone to which the majority of Slovak national policy documents of a strategic nature are aligned. However, the national targets for 2030 need to have a clear outlook for 2050 to ensure that EU Member States, if they follow a certain trajectory, will reach the installed capacity necessary to achieve carbon neutrality.

The Figure 2 below shows the progress towards the 2030 milestones from the end of 2023 for each RES-E technology under the zero emissions scenario targets, based on the 2050 Pathways Explorer model described below.

Figure 2 | Progress as of 2023 towards the 2030 zero emissions scenario milestones (MW)



Source: OKTE; SIEA; ÚRSO; regional DSOs; IF SAS (2024)

The Report examines past RES-E deployment since 2010 to provide a context for the state of the market at the end of 2023, as well as a starting point for possible future developments across all RES-E technologies. The document presents an outlook based on three possible scenarios. The scenarios are referred to as business-as-usual, NECP target and zero emissions scenario. Each scenario follows a different set of data and development trajectories, and then various targets are set for each scenario, with 2030 as the key milestone and 2050 as the deadline for decarbonisation.

The business-as-usual scenario uses the data available for previous years to predict the future development of each RES-E technology. The scenario models a trajectory that can be expected if past trends are followed. The projections are modelled from the average growth in installed capacity over the last three calendar years (2021-23).

The NECP scenario uses figures from the most recent Draft Updated NECP submitted to the EC in August 2023, which projects the expected installed capacity for each RES-E technology for the years 2023-30. Based on these annual targets, the Report predicts a trajectory beyond 2030 with the expected installed capacities if the NECP is followed. In calculating the NECP scenario path beyond 2030 (i.e. towards 2050), the forecasts are modelled on the average increase in installed capacity over the last three calendar years included in the 2023 Draft Updated NECP (2028-30). The NECP scenario therefore represents the development of RES-E under the assumption that the current NECP is followed until 2030 and that this level of growth is maintained thereafter.

The reference basis for the zero emissions scenario was provided by the energy and emissions modelling tool. The specification and calibration of the model tailored to the Slovak electricity sector, as well as the analysis of the resulting data, is provided by the Institute for Forecasting of the Slovak Academy of Sciences (IF SAS) (2024). The model takes into account the expected increase in electricity consumption and the resulting increase in carbon emissions, including the introduction of new technologies to mitigate this increase, such as carbon capture and storage (CCS), and other factors. Based on these conditions, it presents annual targets that would put the Slovak electricity market on a path towards carbon neutrality by 2050.

The datasets used to map past market growth are not publicly available and were provided to SAPI for the purposes of this Report by the Short Term Electricity Market Operator (OKTE, a.s.), the Slovak Innovation and Energy Agency (SIEA), the Regulatory Office for Network Industries (ÚRSO) and, in the case of solar PV, three regional Distribution System Operators (DSOs).

Solar PV

01

At the end of 2023, Slovakia set a new solar PV record with 840 MW of cumulative installed capacity. This represents the second highest relative annual increase since 2010 amounting to 267 MW or 47% compared to 573 MW in 2022. In total, over 21,300 solar PV plants were installed in 2023. Small-scale residential sources (of up to 10.8 kW) accounted for slightly more than half (52%) of the recent annual capacity increase, with an average size of around 7 kW. Almost all of the rest of annual increased installed capacity was connected by commercial and industrial prosumers, while only 23 MW was deployed in utility-scale PV plants. In 2023, solar PV had a share of 1.1% of the country's total electricity generation.

In total, there are about 450 utility-scale ground-mounted solar PV plants (with almost 550 MW of installed capacity) and roughly 290 MW of rooftop systems in Slovakia. The largest solar PV plants in the country are sized at 4 MW and they were put into operation in 2010. According to the latest data of the National Energy Regulator (ÚRSO) from 2022, around 2,000 solar PV plants were supported by a feed-in tariff. Following an amendment to the Act on Promotion of Renewable Energy Sources and High-Efficiency Cogeneration from 2018, no new PV systems have been eligible for the aforesaid operational support since then.

The past development of solar PV capacities is illustrated in Figure 3 provided below.

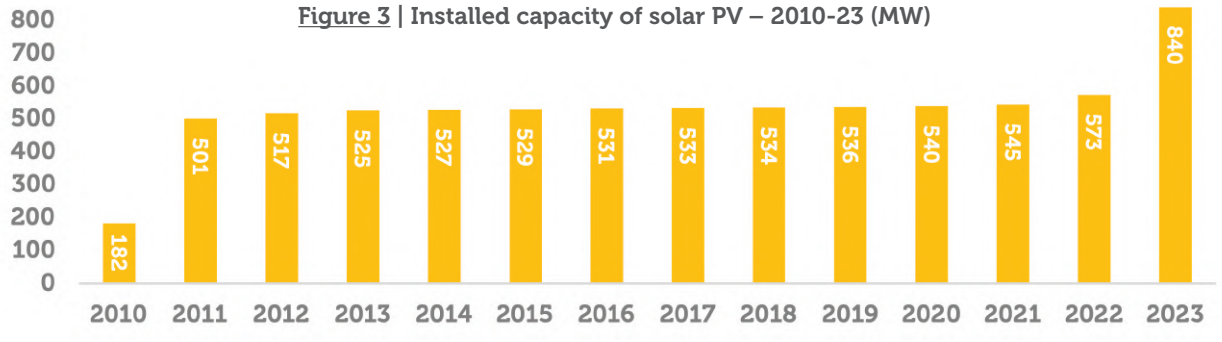


Figure 3 | Installed capacity of solar PV – 2010-23 (MW)

Source: OKTE; SIEA; ÚRSO; regional DSOs (2024)

As with other electricity generation technologies, the development of solar PV (excluding small-scale installations of up to 10 kW or 10.8 kW since December 2022 respectively) was severely hampered by an almost eight-year moratorium on grid connection (the so-called stop state), which ended in April 2021. However, there are some less serious barriers, such as those related to the prolonged grid connection process due to grid constraints. In addition, the utility-scale PV segment still faces one of the highest grid connection costs in the EU-27. All PV sources which are directly connected to the grid (i.e. not prosumers) at medium or high-voltage level have to pay grid connection fees ranging between EUR 53 and 88 per kW of installed capacity.

According to the report Rooftop Photovoltaic Energy Potential in Slovakia, completed in February 2023 and prepared for SAPI by Energiewerkstatt, Slovakia has a theoretical (realisable) rooftop PV potential of around 37 GW. To put this into perspective, about 70% of this potential would have to be used to reach the overall target of the zero emissions scenario for 2050. In line with the latest Photovoltaic Barometer (April 2023), Slovakia ranks fifth from the bottom in terms of installed photovoltaic capacity per inhabitant, with almost 99 W compared to the EU-27 average of 437 W.

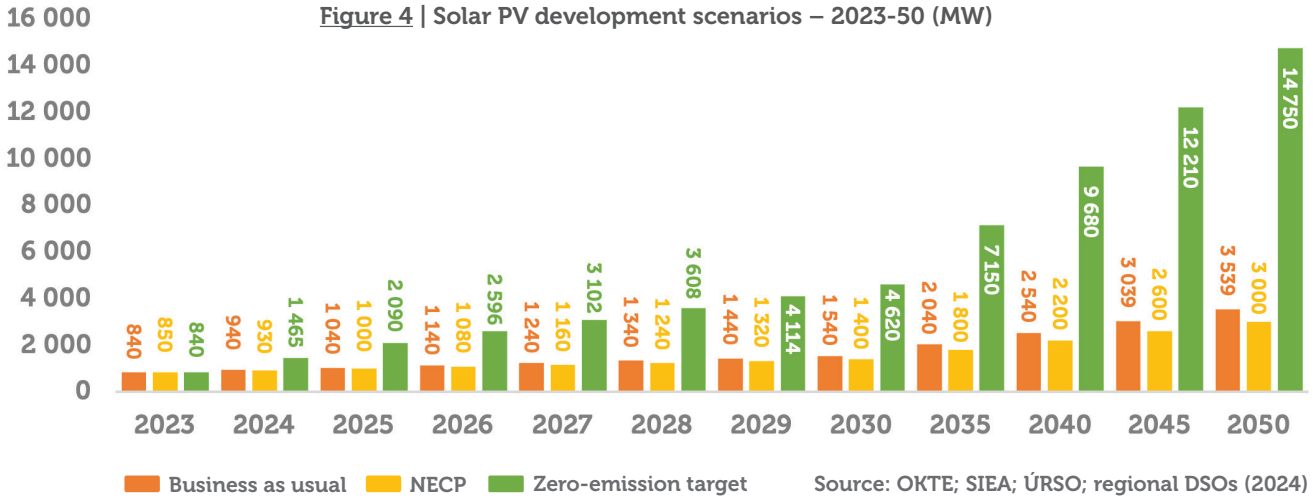
The country experienced the aforementioned significant acceleration of the solar PV sector, mainly due to a favourable legal framework for so-called energy prosumers (legally defined as Small Sources and Local Sources), various funding schemes to incentivise solar PV systems (funded by EU funds and the NRRP), and the continuation of the (new) Green to Households subsidy scheme from 2023. The old one, which has helped to build a positive reputation for RES in general in the country, promoted the installation of more than 11,300 small residential PV systems in the period 2015-23.

Future development scenarios

Over the past three years, Slovakia has seen an accelerating growth trend in installed capacity. In particular, the highest annual increase of 267 MW between 2022 and 2023 pushes the business-as-usual curve significantly higher. Therefore, if the average annual growth rate from 2021 to 2023 were to continue, the expected installed capacity would almost double to 1,540 MW in 2030. In the long term, this should lead to 3,539 MW of installed PV capacity in 2050.

Business-as-usual scenario

Figure 4 | Solar PV development scenarios – 2023-50 (MW)



Source: OKTE; SIEA; ÚRSO; regional DSOs (2024)

The 2023 Draft Updated NECP proposes a cumulative installed PV target of 1,400 MW in 2030, an increase of 200 MW compared to the 2019 Final NECP. However, the document still does not provide a breakdown between ground-mounted and rooftop PV systems. The current installed capacity is 10 MW lower than the one the NECP projected for year 2023. The 2023 Draft Updated NECP assumes linear growth in new capacity of around 80 MW per year until 2030. If at least this trend is followed without any increase, the projection would result in a total of 3,000 MW installed in 2050.

NECP scenario

According to the Pathways Explorer model, based on data from the Institute for Forecasting of the Slovak Academy of Sciences (2024), to reach the zero emissions trajectory, the solar PV installed capacity needs to increase by 625 MW compared to 2023 by the end of 2024. To stay on track, Slovakia should install a total of 4,620 MW of solar PV capacity in 2030. In the target year of 2050, the country should aim for a capacity of 14,750 MW, which would ensure that it meets its climate change commitments, in particular climate neutrality.

Zero emissions scenario

Figure 4 above graphically summarises all three scenarios for the future development of solar PV up to 2050.

Wind power

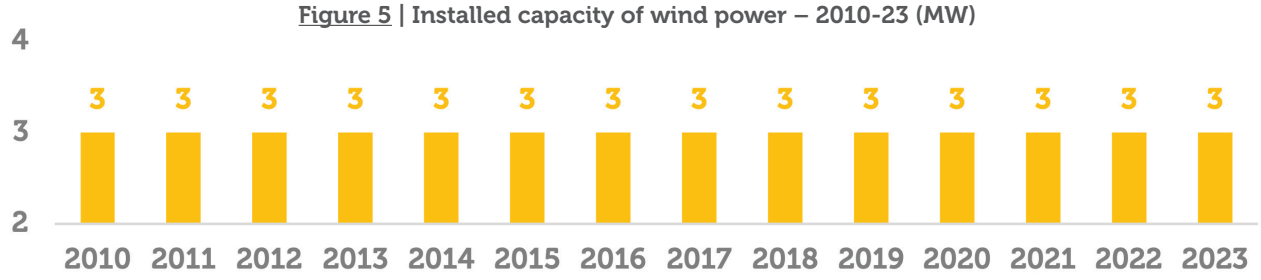
02

At the end of 2023, Slovakia has still only 3.1 MW of installed wind power capacity. As a result, the share of wind energy in Slovakia's total electricity generation (2023) remains negligible (below 0.01%). With these figures, the country ranks second in the EU-27 (2022) after Malta in terms of not exploiting its wind energy potential.

In total, there are 2 wind farms with 5 turbines in operation in Slovakia. The latest wind farm, with an installed capacity of 0.5 MW, was built in 2004 and is located in Ostrý vrch (Trenčín Region). The other, commissioned a year earlier, is the Cerová Wind Farm (Trnava Region), which consists of 4 wind turbines with a total capacity of 2.6 MW. Both wind farms are nearing the end of their originally planned lifespan. With no new wind projects coming online since 2003, wind power deployment has come to a standstill.

The past development of wind power capacities is illustrated in Figure 5 provided below.

Figure 5 | Installed capacity of wind power – 2010-23 (MW)



Source: OKTE; SIEA; ÚRSO; regional DSOs (2024)

In addition to the connection moratorium from December 2013 to April 2021, there are a number of other reasons why no new wind farms have been built. According to the Study of Wind Energy Deployment in Slovakia, prepared by SAPI and published in October 2022, the most significant barrier is the environmental impact assessment (EIA) process, with reference to its non-existent thresholds (the so-called full EIA is applied from 0 kW) and the unpredictability of such a process, accompanied by the lack of an EIA scoping period. However, the NIMBY syndrome and the poor land-use planning by local authorities should not be overlooked, too. Mainly for the reasons mentioned above, in mid-2022 nearly 90% of respondents rated the quality of the investment environment, specifically for wind energy projects in Slovakia, as very poor or poor.

According to a non-public study, Study of Wind Energy Potential in Slovakia completed in September 2022, prepared by Energiewerkstatt for SAPI, the country has an excellent (theoretical) potential for wind energy. Despite various restrictions on wind energy projects in Slovakia, it was

estimated at around 168 GW, covering about 20% of the country's territory. Such data clearly shows that the reason for the almost complete absence of wind energy plants is not due to natural conditions, but mainly to a number of prevailing barriers.

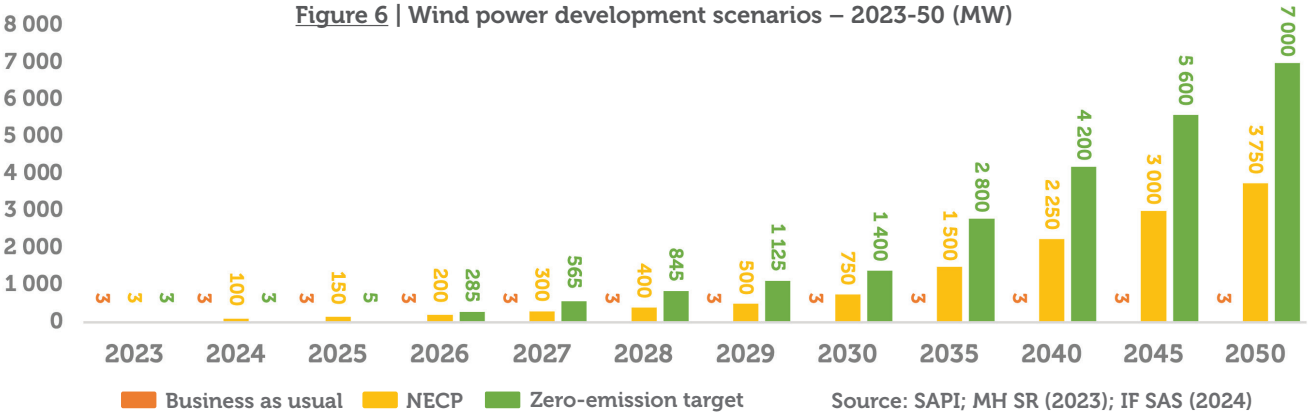
In order to kick-start the deployment of wind energy in the country, the Slovak Government approved the Update of the National Recovery and Resilience Plan (NRRP) in April 2023, which includes a new REPowerEU chapter. It introduced the establishment of two pilot acceleration zones for the development of wind energy with a total potential installed capacity of at least 300 MW. As a milestone (due to be fulfilled by Q4 2024) embedded in the NRRP, Slovakia was also supposed to develop a methodology for permitting rules for wind energy projects. However, according to the March 2024 Progress Report on the Implementation of the NRRP, little to no progress has been made so far.

Future development scenarios

Business-as-usual scenario

Should the past growth rate be strictly followed, there would be no new wind power plants in the coming decades. In other words, in line with the methodology used in this Report, 3.1 MW would remain all the way through to 2050. However, this is unlikely to be the case, as there is significant development of wind projects under way, according to the EIA/SEA Information System operated by the Ministry of the Environment. As of March 2024, the platform lists a total of 23 wind energy projects (consisting of 147 wind turbines) with a total capacity of at least 906 MW. The capacity of these wind projects ranges from 12 to 66 MW. All the projects are currently at the screening and/or scoping stage.

Figure 6 | Wind power development scenarios – 2023-50 (MW)



NECP scenario

The 2023 Draft Updated NECP sets an increased target of 750 MW of installed capacity by 2030 compared to the 2019 Final NECP, with only 500 MW by the end of the decade. Given the natural characteristics of the Slovakian territory, all plants are expected to be onshore. It is worth noting that the medium-term plan foresees 100 MW of installed wind capacity as early as 2024. This is an altogether unrealistic assumption given the fact that no new wind project has been granted a positive EIA approval yet. Moreover, the 2023 Draft Updated NECP anticipates a linear annual increase of 100 MW between 2026-9. A quantum leap of a further 250 MW is expected in 2029-30. If at least this trend is followed without any increase, the projection would lead to a total installed capacity of 3,750 MW installed in 2050.

Zero emissions scenario

According to the Pathways Explorer model, based on data from the Institute for Forecasting of the Slovak Academy of Sciences (2024), to reach the zero emissions trajectory, the capacity needs to increase by 282 MW compared to the capacity installed in March 2023 by the end of 2026. To stay on track, Slovakia should install a total of 1,400 MW of wind power in 2030. In the target year of 2050, the country should aim for a capacity of 7,000 MW, which would ensure that it meets its climate change commitments, in particular climate neutrality.

Figure 6 above graphically summarises all three scenarios for the future development of wind energy up to 2050.

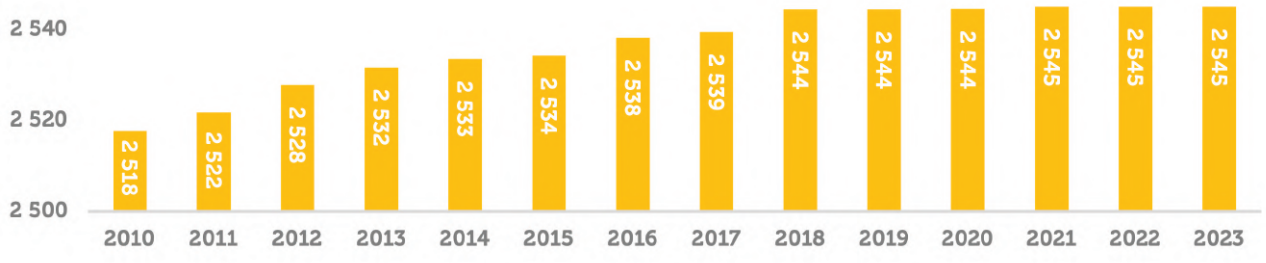
Hydro energy 03

At the end of 2023, Slovakia has an installed capacity of 1,629 MW of hydropower plants (HPPs) and 916 MW of pumped hydroelectricity storage plants (PHSPs). The share of hydropower energy in Slovakia's total electricity generation (2023) is around 17.1%. Hydropower has long been the most important RES-E in Slovakia, as it plays a significant role not only in the RES sector, but also in the overall electricity supply.

Over the last decade, Slovakia has witnessed a gradual increase in the installed capacity of hydropower plants - mainly those falling into the category of small HPPs of up to 10 MW and micro-ones of up to 100 kW. In total, Slovakia has 26 (large) HPPs, 126 small HPPs, 120 micro HPPs and 4 PHSPs. The largest hydropower plant in the country is Gabčíkovo Hydropower Plant, which was put into operation in 1992 and is located in Gabčíkovo (Trnava Region) with an installed capacity of 720 MW. In 2022, according to the latest data of the National Energy Regulator (ÚRSO), 185 small HPPs were supported by a feed-in tariff.

The past development of hydropower capacities is illustrated in Figure 7 provided below.

Figure 7 | Installed capacity of hydro energy – 2010-23 (MW)



Source: OKTE; SIEA; ÚRSO (2024)

The development of new hydropower projects has almost ceased due to the bad examples set in the past. Several small HPPs have not been projected and constructed in accordance with key EU directives on the protection of biotopes and the environment. In 2014, the EU launched an ongoing infringement procedure against Slovakia for inadequate assessments of the impact of hydropower plants on hydromorphology and biodiversity. As a result, the Ministry of Environment and environmental NGOs are closely monitoring the approval of new hydropower projects, and a number of disputes over new small HPPs have arisen. In some cases, the Supreme Court of the Slovak Republic has overturned the approval and licensing of projected small HPPs, such as those located at Žiar nad Hronom and Hronský Beňadik (both in the Banská Bystrica Region).

According to the Updated Concept of Hydroelectric Use of Waterways in Slovakia (2016), the technically exploitable potential of hydropower plants in the country amounts to 6,683 GWh and

is currently used by about 70%. The potential for the construction of new (large) hydropower plants with an installed capacity of over 10 MW is practically exhausted, and there is also a limited potential for new small HPPs. Some increase in installed capacity can be achieved through reconstructing or modernising existing HPPs.

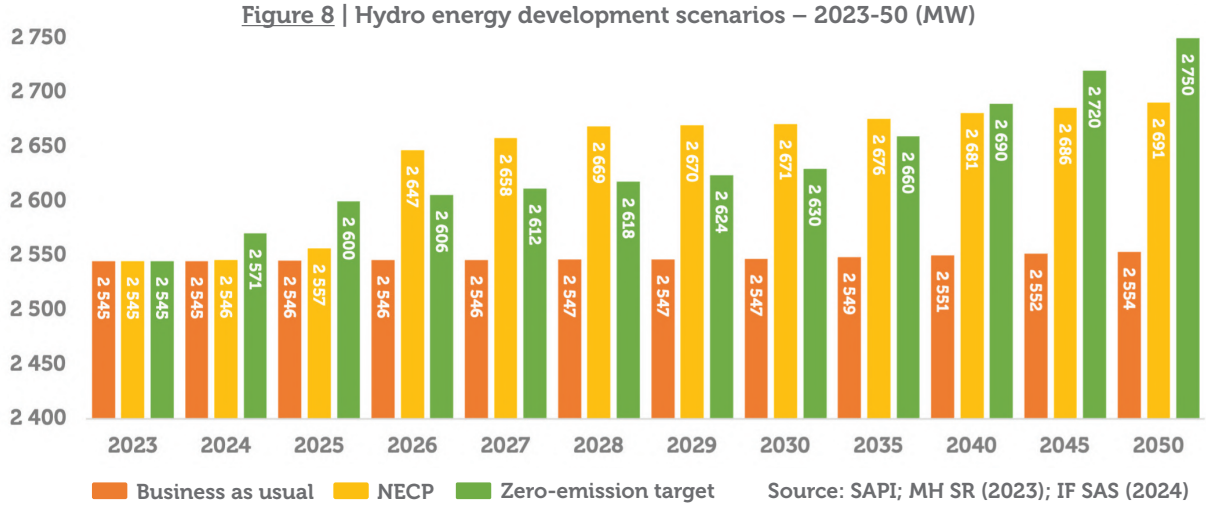
The further deployment of hydropower energy will depend on the new concept of Slovakia's hydropower potential, the new water policy, and, finally, the regulations governing the EIA process. In this context, it should be noted that the Slovak Government approved a major revision of the EIA law in March 2024, which could significantly simplify and speed up the approval of HPP projects.

Future development scenarios

Business-as-usual scenario

Slovakia's hydropower sector has not seen any significant installed capacity in recent years, which is directly reflected in the business-as-usual projection. On this basis, only 330 kW of hydropower capacity is projected to be connected to the grid annually. This would bring the total capacity to only 2,547 MW by 2030, and by extent to 2,554 MW by 2050. As far as large hydropower plants with an installed capacity of more than 10 MW are concerned, there is one project in the EIA process, namely the Čunovo II Hydropower Plant (Bratislava Region). This plant is designed to have an installed capacity of 24 MW and its construction is scheduled to start in 2026, with a planned construction period of two years. In the category of small HPPs, no proposal for the construction of a new plant has been submitted for EIA since 2021. Nevertheless, the construction of around 10 new small HPPs and the reconstruction of existing ones is envisaged by 2030.

Figure 8 | Hydro energy development scenarios – 2023-50 (MW)



Source: SAPI; MH SR (2023); IF SAS (2024)

NECP scenario

The 2023 Draft Updated NECP presents no changes for hydropower, and the targets remain the same as they were in the 2019 Final NECP - an increase to 1,755 MW of hydropower generation by 2030, while the PHSPs are to remain at the current level of 916 MW, for a total of 2,671 MW in 2030. The main increase is expected to take place between 2025 and 2026, with only minor increases thereafter. This affects the projection up to 2050, where, under the current assumption, the installed hydropower capacity would increase by only 1 MW per year, eventually bringing Slovakia to 2,691 MW in 2050.

Zero emissions scenario

According to the Pathways Explorer model, based on data from the Institute for Forecasting of the Slovak Academy of Sciences (2024), Slovakia should aim for 2,630 MW by 2030. Although this number is lower than the target in the 2023 Draft Updated NECP, Slovakia will need to continue these increases and gradually work towards an installed capacity of 2,750 MW by 2050. This would imply an increase in installed capacity of at least 6 MW per year to stay on track towards the zero emissions target.

Figure 8 above graphically summarises all three scenarios for the future development of hydropower up to 2050.

Bioenergy

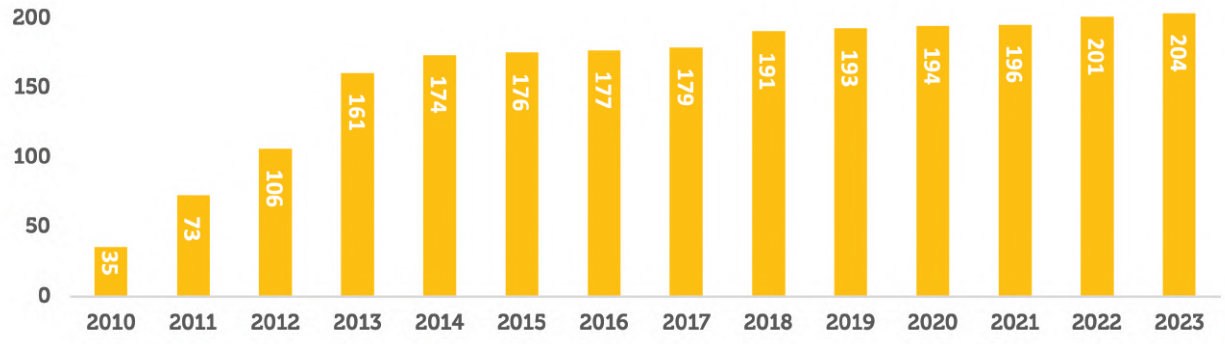
04

At the end of 2023, bioenergy sources[1] accounted for around 204 MW of installed capacity for electricity generation. Compared to 2022, only 3 MW of new plants was installed. In 2023, the share of bioenergy in the country's total electricity generation was around 4.9%.

In total, there are 24 biomass power plants with over 58 MW of installed capacity and 123 biogas plants in Slovakia totalling 102 MW. The largest bioenergy power plant in the country is located in Žarnovica (Banská Bystrica Region), which was commissioned in 2010 with an installed capacity of 11 MW. In 2022, according to the latest data of the National Energy Regulator (ÚRSO), 88 biogas and 18 biomass plants were supported by a feed-in tariff.

The past development of bioenergy capacities is illustrated in Figure 9 provided below.

Figure 9 | Installed capacity of bioenergy – 2010-23 (MW)



Source: OKTE; SIEA; ÚRSO (2024)

The use of bioenergy ensured that Slovakia (statistically) met its overall 2020 renewable target. This was due to the inclusion of the estimated contribution of households to the total RES share, mainly through biomass combustion and the use of heat pumps. However, similar to other RES-E technologies, the development of biogas was hampered by the connection moratorium for new projects. While there were more than 140 biogas plants in 2014, the moratorium meant that no new biogas stations were connected to the grid since then. As a result, their number has gradually fallen. Although the moratorium was lifted in 2021, no new biogas plants have yet been connected to the grid and are only used locally.

[1] Energy from biological materials can come from two different types of fuel - biogas, including biomethane, and solid biomass. Energy-rich biogas can be produced from a number of sources, including waste from wastewater treatment plants, municipal waste, and agricultural and livestock waste. Solid biomass, on the other hand, includes wood, waste produced from its extraction and processing, and energy crops grown for their high energy potential, such as maize and rapeseed.

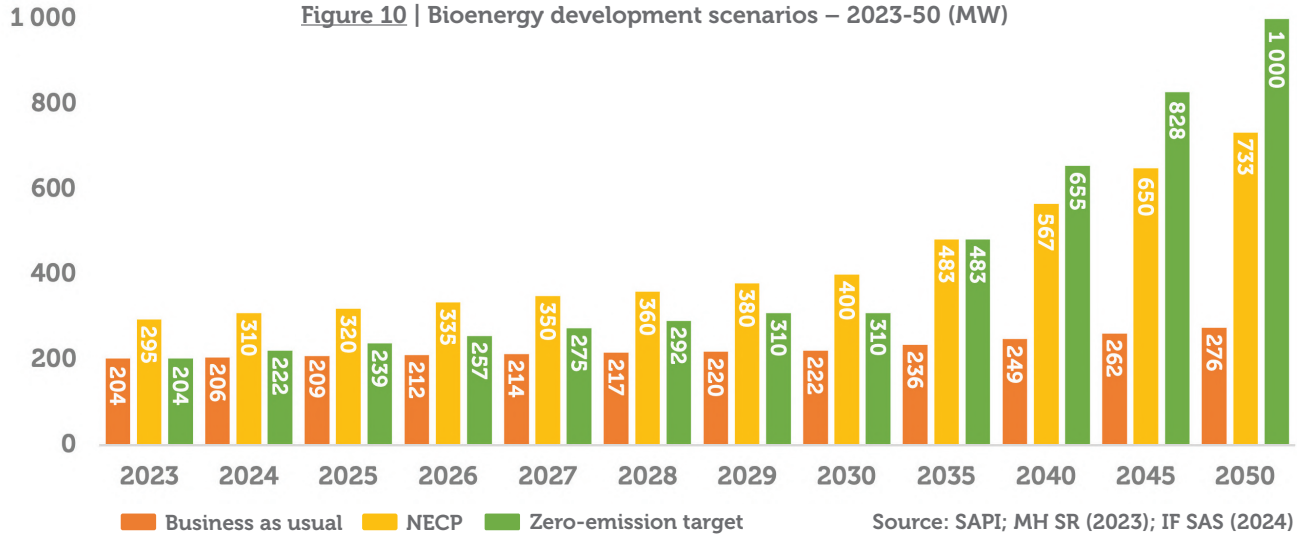
In February 2024, the Ministry of Agriculture and Rural Development presented its proposal for the new National Forestry Programme for the years 2025-2030, which was approved by the Slovak Government in March. One of its strategic goals is to optimise the energy use of wood biomass, both in the electricity and heating sectors. However, the document states that the use of solid biomass should be promoted by improving the efficiency of existing power plants and not by overexploitation of forests. This is also in line with the NRRP, where its REPowerEU chapter reiterates the need to support solid biomass through efficiency measures. The chapter also states that the development and construction of new biogas and biomethane plants will be supported.

Future development scenarios

Business-as-usual scenario

Due to the rather slow development of bioenergy fuels in the electricity sector in recent years, the business-as-usual scenario expects an annual increase of only 3 MW. This would bring the bioenergy sector to 222 MW by 2030 and if this increase continues Slovakia would only reach 276 MW by 2050. On the flip side, several projects are currently in the pipeline, including new biogas plants. Approximately EUR 26 million has been allocated by the NRRP for the development of the sector and 23 projects have successfully applied for, either for brand new biogas plants or for the modernisation of existing ones. Ten of the accepted projects involve the conversion of existing biogas plants into biomethane facilities. The biomethane produced will be used as a production fuel in cogeneration units for highly efficient combined production of heat and power (CHP).

Figure 10 | Bioenergy development scenarios – 2023-50 (MW)



Source: SAPI; MH SR (2023); IF SAS (2024)

NECP scenario

The 2023 Draft Updated NECP has not altered the targets set for solid biomass and biogas to 2030, both remaining at 200 MW each – taking bioenergy fuels to 400 MW by 2030. However, compared to the 2019 Final NECP, the trajectory itself has changed and the plan now expects a slower start for biogas and biomethane, peaking in 2030 instead of 2027. As the capacity increase is now foreseen to be gradual until 2030, it is possible to project the increases with a view to 2050, with a total of 733 MW of bioenergy capacity installed. Solid biomass is expected to play an additional role in this increase, and not only biogas and biomethane. The current installed capacity of 204 MW is 91 MW below the target Slovakia should have reached by the end of 2023.

Zero emissions scenario

According to the Pathways Explorer model, based on data from the Institute for Forecasting of the Slovak Academy of Sciences (2024), Slovakia should reach at least 222 MW by the end of 2024 - a total increase of 18 MW compared to the current installed capacity. After that, an annual increase of 17 MW would be needed to continue towards the zero emissions target, which sets the bioenergy at 310 MW by 2030. The model predicts that efforts would then need to be doubled, with an annual capacity additions rising to 34 MW, in order to reach the target of 1 GW installed by 2050.

Figure 10 above graphically summarises all three scenarios for the future development of bioenergy sources up to 2050.

Geothermal power 05

At the end of 2023, geothermal energy has not been utilised for electricity generation and its use has been so far limited to centralised heat production and recreational use for thermal swimming pools and spas. This makes it the only RES-E technology in Slovakia with no installed electric power capacity, and therefore no share (0%) in the country's electricity generation.

Currently, only three geothermal power plants projects are in development – the most advanced of them to be located in Ďurkov (Košice Region), with a planned installed capacity of 4 MW. The other two projects are developed in Žiar nad Hronom (Banská Bystrica Region) and in the vicinity of Prešov (Prešov Region), each with an estimated installed capacity of 20 MW. All of these plants have the potential to be commissioned by 2028, with the possibility of further expansion.

The past development of geothermal capacities is illustrated in Figure 11 provided below.

Figure 11 | Installed capacity of geothermal power – 2010-23 (MW)

Source: OKTE; SIEA; ÚRSO (2024)

The main barriers to the use of geothermal energy for electricity generation are high investment costs related to the exploration of the energy yield of geothermal boreholes, and the administrative barriers associated with assessing the environmental impact and obtaining permits for the construction and operation of the plants.

The use of geothermal energy in Slovakia has a comparatively high technical potential of renewable energy sources. According to the Dionýz Štúr State Institute of Geology (2019), Slovakia's overall (probable) geothermal potential is estimated at around 6,200 MWt capacity for heating. The technical potential suitable for electricity generation is estimated at about 6,300 GWh.

Geothermal energy is included in the NRRP under the new REPowerEU chapter, similar to the wind energy. As part of the measures to promote sustainable energy, the proposal to shorten and simplify the EIA approval process directly affects geothermal energy, which should no longer be

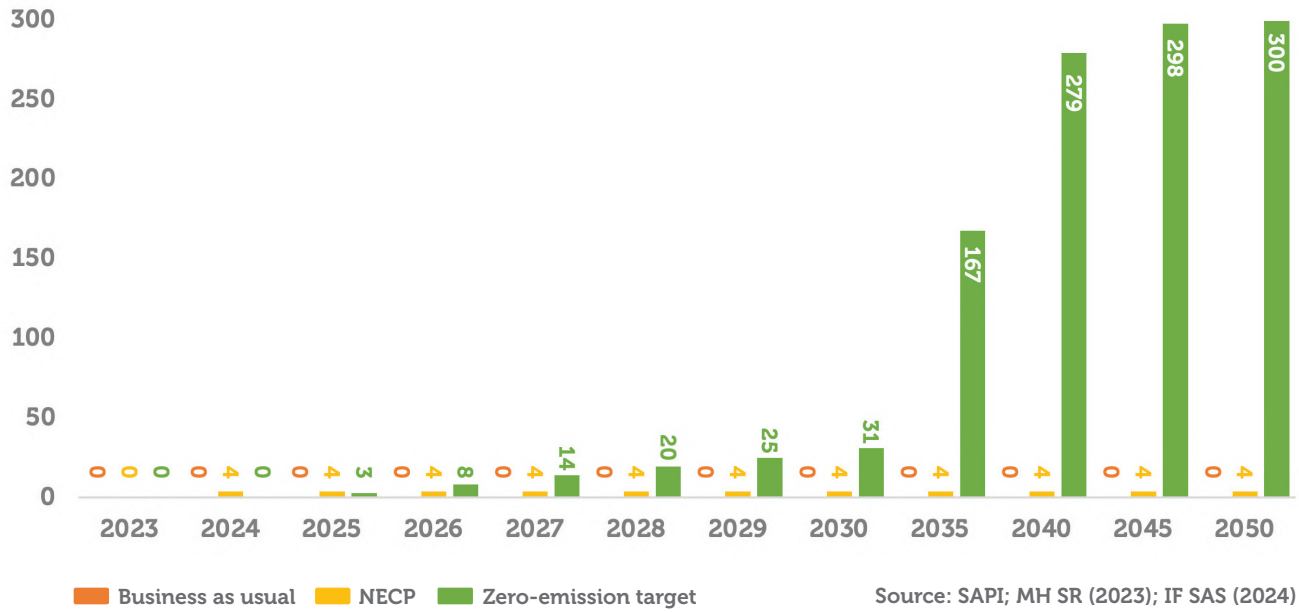
subject to a so-called full EIA. While the measures introduced in the document are partly in line with those suggested in the European Parliament (EP) Resolution on Geothermal Energy (2023), Slovakia has yet to develop a sectoral strategy for the development of geothermal energy in the country, which was also suggested by the EP as a necessary step to kick-start this sector.

Future development scenarios

Business-as-usual scenario

As there were no geothermal power plants in operation at the end of 2023, the business-as-usual scenario and associated methodology used in this Report assumes that geothermal energy will remain unused in the coming decades. However, due to the advanced state of the three planned geothermal plants mentioned above, it is unlikely that the zero installed capacity by 2030 shown below will remain and we should see some limited use of geothermal energy for electricity generation before that year.

Figure 12 | Geothermal power development scenarios – 2023-50 (MW)



Source: SAPI; MH SR (2023); IF SAS (2024)

NECP scenario

The 2023 Draft Updated NECP sets a target of 4 MW of installed capacity by 2030, the same figure as in the 2019 Final NECP. According to the 2023 Draft Updated NECP, this installed capacity should be reached by the end of 2024 and then remain constant for the next six years. However, this is unlikely to happen due to delays in the commissioning of the Ďurkov Geothermal Plant. If the expected installed capacity is projected beyond 2030, Slovakia would remain at 4 MW of installed capacity even in 2050.

Zero emissions scenario

According to the Pathways Explorer model, based on data from the Institute for Forecasting of the Slovak Academy of Sciences (2024), to reach the zero emissions trajectory, the installed capacity needs to be at least 31 MW by 2030, compared to the 4 MW included in the 2023 Draft Updated NECP. In order to stay on the decarbonisation path, Slovakia should increase the installed capacity by about 20-30 MW per year until at least 2040. Thereafter, the target of meeting the total expected capacity of 300 MW by 2050 should be achievable through small additions of further installed capacity.

Figure 12 above graphically summarises all three scenarios for the future development of geothermal power up to 2050.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