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WIND ENERGY IN SLOVENIA AND AUSTRIA

VETRNA ENERGIJA V SLOVENIJI IN AVSTRIJI

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Abstract

Due to obvious climate changes and increasing needs for electrical energy, increasing attention is dedicated to the use of renewable energy sources, which include wind energy. This article presents the current situation of wind energy exploitation in Slovenia and Austria and their national objectives for the near future. In contrast to Slovenia, Austria has a long tradition of wind energy use, due to its high wind energy potential. As member states of the European Union, Slovenia and Austria follow the European energy policy and its objectives of sustainable, competitive, and secure supplies of energy. This article deals with Slovenian and Austrian national energy policies and their incentive programs that encourage the exploitation of wind energy and other renewable energy sources. Both countries are increasing their renewable energy production by implementing financial support mechanisms, mostly feed-in tariffs, premium tariffs and loans.

Povzetek

Zaradi vse bolj očitnih klimatskih sprememb ter vedno večjih potreb po električni energiji je vedno več pozornosti namenjene uporabi obnovljivih virov. Med obnovljive vire energije uvrščamo tudi vetrno energijo. V članku je predstavljeno trenutno stanje glede izkoriščenosti vetrne energija v Sloveniji in Avstriji ter predstavljeni nacionalni cilji za prihodnost. V primerjavi s Slovenijo ima Avstrija dolgo tradicijo izrabe vetrne energije zaradi velikega vetrnega potenciala. Kot članici Evropske unije Slovenija in Avstrija sledita evropski energetski politiki in njenim ciljom trajnostne, konkurenčne in varne oskrbe z energijo. V drugem delu članka je posledično predstavljena tudi slovenska in avstrijska nacionalna energetska politika ter finančni podporni mehanizmi, ki spodbujajo izrabo vetrne energije in drugih obnovljivih virov. Obe državi spodbujata izrabo obnovljivih virov z uvedbo finančnih podpornih,

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mehanizmov, predvsem z zagotovljenimi odkupnimi cenami električne energije, obratovalnimi podporami in krediti.

1 INTRODUCTION

At present, electrical energy production has a pronounced role and a strong influence on the entire environment. Current trends in energy supply and use are economically, environmentally, and socially unsustainable. The European Union has set itself a goal of generating 20% of energy consumption from renewable energy sources (RES) by 2020. The introduction of sustainable and low-carbon energy technologies is crucial for the transition to a low-carbon society. As an alternative to fossil fuels, RES also contributes to the reduction of greenhouse gas emissions, the diversification of energy supplies, and the reduction of dependency on fossil fuel markets, [1,2].

To achieve the European energy policy goals, the introduction of financial support mechanisms for the promotion of RES is essential. Starting a wind power plant requires a significant amount of research, start-up capital and development. Since the efficiency of a wind power plant depends on its correct placement in the environment and local wind conditions, the precise assessment of wind resources in a certain area is the key element in successfully establishing an economically viable wind power plant. In the previous decade, the share of wind energy production has been increasing rapidly, [3].

The next chapters of this article present the current situation of wind energy exploitation in Slovenia and Austria, their national objectives for the near future, their energy policies, and their incentive programs that encourage the exploitation of wind energy and other RES.

2 WIND ENERGY IN SLOVENIA

2.1 National progress and objectives for wind energy

Slovenia does not have strong and constant winds. Higher velocities are evident in the mountainous part of Slovenia, particularly with the wind called “Burja” in the wider coastal area. It is an inconsistent and gusty wind, which is not suitable for exploitation of wind energy, [4].

Maximum wind speeds in Slovenia appear in spring and autumn. Figure 1 shows the average annual value of wind velocity at an elevation of 10 m.

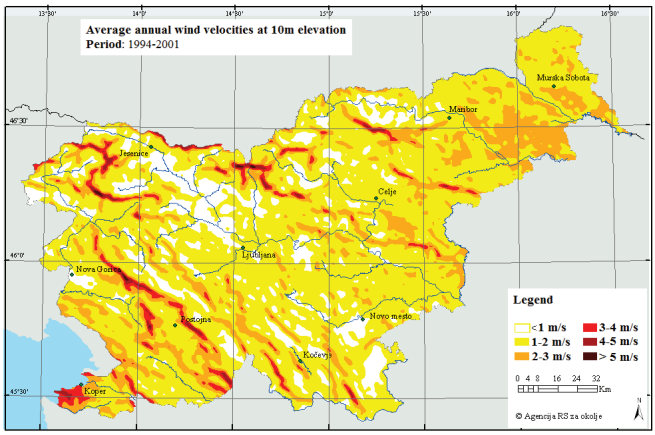

Figure 1: *Average annual wind velocities measured at 10 m elevation,* [5]

For most places in Slovenia, the average annual wind velocities are between 1 to 3 m/s, which is also not suitable for the exploitation of wind energy; only at higher altitudes are average annual wind velocities higher [6].

The Slovenian National Renewable Energy Action Plan (NREAP) plans the integration of wind power plants with an installed power of 106 MW by the end of 2020. Currently, the installed power capacity of wind power plants greatly lags behind the action plan. According to statistical data, there are officially only two operating wind power plants in Slovenia with a total power of 3.2 MW. In previous years, there was also a project called “Volovja reber” for the construction of 33 wind power plants, but it has failed because of environmental issues, [1].

The first wind power plant, named “Marjetica”, was built in June 2013 and is located in the village of Dolenja vas pri Senožečah. With an installed capacity of 2.3 MW, Marjetica has a three-bladed turbine with a diameter of 71 metres mounted on a 98-meter high tower. The wind turbine of type E-70 from a German manufacturer is owned by the company Alpen Adria Energie d.o.o., which is planning to build a large wind park in the vicinity of the existing power plant. The estimated annual production of the power plant is 4.5 GWh, which is enough to supply electrical energy to 1154 households. The total value of the investment amounts to 3 million euros, [7,8].

The second wind power plant is located at the foot of the Nanos mountain near the village of Razdrto; it was built in the spring of 2014 and is ranked among the smaller wind power plants. The diameter of a rotor from the Enercon E-44 wind turbine is 44 metres, and the rotor swept area is 1521 square metres. The three bladed rotor is made of high-quality glass-fibre reinforced plastic (GFRP). The rated power output is 900 kW. The Enercon E-44 has a steel tube tower with a height of 53 metres and a direct-drive synchronous generator. The average annual wind speed at the site is 6.43 m/s which enables the operation of the wind turbine near the optimal power coefficient. The estimated annual production of the power plant is 1.67 GWh, which is enough to supply electrical energy to 500 households, [9,10,11].

Figure 2 shows the characteristics of Enercon E-70 and E-44 wind turbines. A 3-D model of the wind turbine is presented on the left, and a photograph of the Marjetica wind turbine on the right.

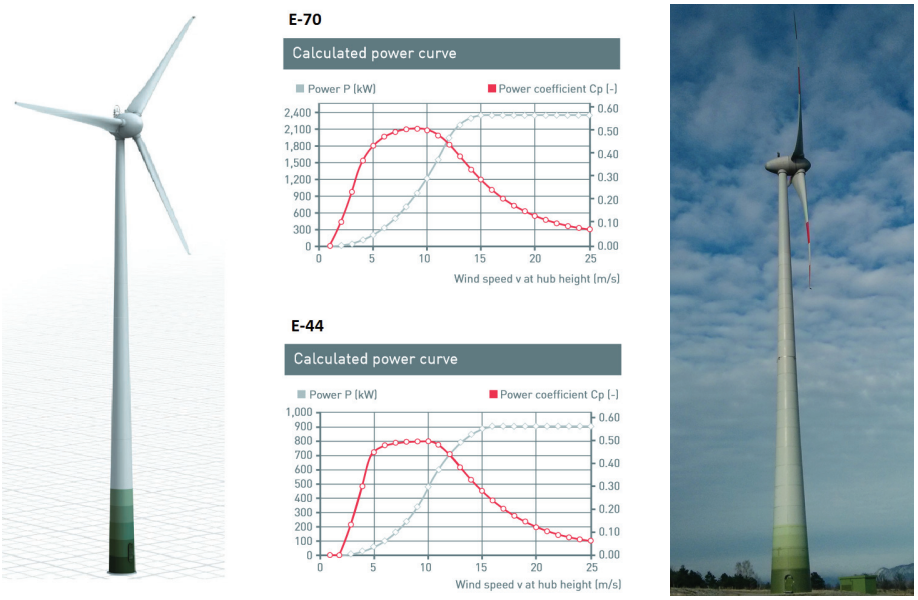

Figure 2: *Enercon E-70 and E-44 wind turbines,* [11,12]

Considering the current complications associated with the placing of wind power plants in the Slovenian environment, special attention should also be given to environmental issues, the appropriate management of projects, especially cooperation with the public and the decision-making process, [1].

2.2 National energy policy

As a member of the EU, Slovenia follows the European energy policy and its objectives of a sustainable, competitive and secure supply of energy. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from RES and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC provides that each Member State must adopt a national renewable energy action plan for the 2010-2020 period. These plans must set out the national targets of Member States for the shares of gross final energy from RES consumed in transport, electricity and heating and cooling in 2010, [13,14].

The Parliament of the Republic of Slovenia adopted a new Energy Act in 2014 (EZ-1, Official Gazette of the Republic of Slovenia No. 17/2014). This act establishes a legal framework for electrical energy generated from RES and transposes into Slovenian legislation several European directives and regulations relating to the energy market, energy efficiency and RES. It determines the principles of energy policy, the operating rules of the energy market, implementation methods and forms of public utilities in the energy sector, principles and measures for achieving reliable energy supply, for increasing energy efficiency and the use of energy from RES, it determines the conditions for the operation of energy facilities, and it regulates the competence, organization and functioning of the Energy Agency and the competencies of other authorities performing tasks under this act, [15,16].

In addition to the Energy Act, also noteworthy are the NREAP, the National Energy Efficiency Action Plan (NEEAP) and the Resolution on the National Energy Programme (ReNEP), which coordinates the functioning of institutions dealing with energy supply and determines the goals and mechanisms for the transition to a low-carbon society by 2030. With NEEP, in accordance with the requirements of the Energy Efficiency Directive (2012/27/EU), Slovenia raises the national objective of improving energy efficiency by 20% by 2020.

Slovenia also has a Decree on Support for Electricity Generated from RES (Official Gazette of the Republic of Slovenia, No. 37/2009). This decree includes provisions on financial support for system operators generating electricity from RES, on the relations between system operators and grid operators, and on the calculation of the uniform annual price and the uniform annual premium, [17].

2.3 Incentive programs

Most European Union member states increased their renewable energy production by implementing support policies, mostly feed-in-tariffs (FIT), premium tariffs and loans.

Pursuant to the Energy Act, a financial support mechanism has been established in Slovenia for producers of electrical energy from RES, which allows the selection between two types of supports. The Decree on Support for Electricity Generated from RES provides the mechanism for obtaining the support. Electrical energy generated from RES is supported mainly through a guaranteed feed-in tariff ("guaranteed purchase price") and a premium tariff (a "financial operating aid"). Qualified producers of electrical energy from RES can choose between a guaranteed FIT and a financial operating aid in addition to the electricity price achieved in the energy market. The producer is entitled to receive one or the other type of support, but cannot receive both at the same time. In Slovenia, all renewable energy generation technologies are generally eligible for support, with some exceptions for certain technologies in terms of system capacity limits. To obtain support, producers need to prove that electricity has been produced from RES through guarantees of origin and that the plant is operating in compliance with regulatory requirements. The Slovenian Energy Agency issues the guarantees of origin upon a producer's request. Support may be granted for a maximum period of 15 years or for a shorter period, depending on when the plant became operational for the first time, [15,18].

The ReNEP provides a number of measures and instruments to increase the share of RES. Pursuant to ReNEP, public calls for grant applications are organised in Slovenia, and loans are provided for renewable energy projects. The Ministry of the Economy invites applications for subsidies, and the Slovenian Environmental Fund (Eco Fund) provides financing opportunities with lower interest rates for investments in RES. The Eco Fund's main purpose is the promotion of development in the field of environmental protection, [15,18,19].

Table 1 shows the Slovenian FIT and premium tariff prices for 2014 and 2015 for electrical energy generated from wind power plants, depending on the power capacity of a wind turbine. The FIT price for 2015 for micro, small and medium wind power plants is fixed at €95.38/MWh, and it is equal to guaranteed purchase prices in previous years. Wind power plants larger than 10 MW are not eligible to receive FIT support, but can only receive financial operating aid, [20].

Table 1: *FIT and premium tariff prices for 2014 and 2015* [20]

	2014		2015	
	FIT price (€/MWh)	Premium tariff price (€/MWh)	FIT price (€/MWh)	Premium tariff price (€/MWh)
Micro >50 kW, 50 kW>Small>1 MW, 1 MW>Medium>10 MW	95.38	60.73	95.38	63.66
10 MW>Big>125 MW	not eligible	49.49	not eligible	52.64

3 WIND ENERGY IN AUSTRIA

3.1 National progress and objectives for wind energy

Austria is among the global leaders in energy production from RES with nearly 70% of renewable energy in its electricity mix. In contrast to Slovenia, Austria has a long tradition of wind energy use, due to its high wind energy potential. The Austrian wind power supplier industry is also globally leading in the fields of the wind power generators, control units and design. Table 2 shows Austria's key statistics in 2014. The large expansion of wind power installations started in 2012 due to an amendment to the Austrian Green Electricity Act (GEA), which is described in detail in the next chapter. Since then, the number of wind power installations has increased by more than 300 MW every year with a record 411 MW installed in 2014. By the end of 2014, approximately 2095 MW of wind power were operating in Austria. An additional 391 MW of wind power installations were constructed in Austria in 2015. The majority of wind turbines are located in Lower Austria (963 MW), Burgenland (962 MW), followed by Styria (121 MW), Upper Austria (41 MW), Vienna (7,4 MW) and Carinthia (0.5 MW). Figure 3 shows the cumulative installation of wind power in Austria, [21,22].

Table 2: *Key national statistics 2014,* [22]

Total (net) installed wind capacity	2095 MW
New wind capacity installed	411 MW
Total electrical output from wind	4.5 TWh
Wind generation as percent of national electric demand	7.2%
Average national capacity factor	24%
Target:	3000 MW wind power by 2020

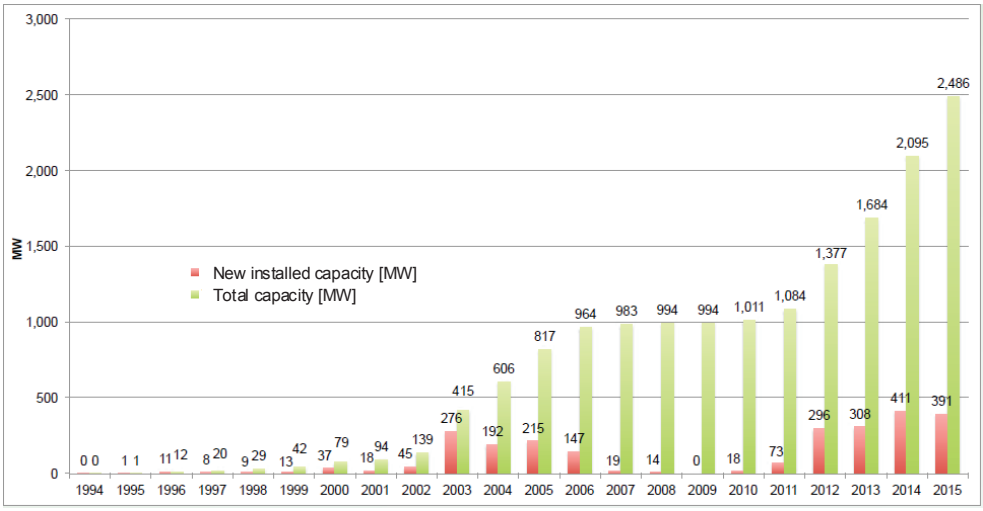

Figure 3: *Cumulative installation of wind power in Austria,* [22]

The most common suppliers of wind turbines in Austria are the companies Enercon and Vestas. Two of the largest wind turbines in the world E-126 models with a power capacity of 7.5 MW each were built by Enercon and Energie Burgenland Windkraft GmbH.

3.2 National energy policy

Austria, as a member of the EU, also follows the European energy policy and its objectives of a sustainable, competitive, and secure supplies of energy. As with other EU member states, Austria has also adopted NEEAP and NREAP, which propose concrete measures for achieving renewable energy targets and for increasing energy efficiency in different areas. The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management has published the Resource Efficiency Action Plan (REAP) in early 2012. REAP provides an analysis of recent resource efficiency trends and sets medium and long-term national targets for increased resource efficiency.

The large expansion of wind power installations in Austria started in 2012 and was launched by the Austrian Green Electricity Act (GEA or Ökostromgesetz). It entered into force in 2003, was amended in 2009 and again in 2011. The main objectives of this act are, [15,22,23]:

- contribution to the EU 20-20-20 target,
- promotion of RES and new technologies,
- to increase the capacity of renewable energy power plants,
- to provide investment protection for future and existing power plants.

As previously mentioned, the Austrian parliament adopted legislation in 2011 for electricity from RES, known as GEA 2012. It entered into force on 1 July 2012 and established a new long-term target of reaching a total wind power capacity of 3000 MW by 2020, which is even higher than Austria's target for wind energy in NREAP. In 2014, Energiewerkstatt, an Austrian

consultant, conducted a study and estimated that a total wind power capacity of 3808 MW can be achieved by 2020, followed by a total capacity of 6649 MW in 2030, [15,22,23].

3.3 Incentive programs

The GEA 2012 established a stable legal framework through 2020 and established a so-called FIT system for renewable energy, which is a support mechanism, a tariff support intended for green electricity producers. The GEA 2012 obliges the so-called Green Electricity Settlement Centre-OeMAG (Ökostromabwicklungsstelle) to purchase green electricity from eligible generators at fixed FIT prices. The Green Electricity Settlement Centre then attributes the purchased electricity to electricity traders, who are legally obliged to buy the attributed electricity at a fixed transfer price. The Green Electricity Settlement Centre is also responsible for giving contracts to green electricity producers as long as there are enough funds for new projects. In other words, the Green Electricity Settlement Centre is the institution that is in charge of buying green electricity at the FIT and selling it to the electricity traders, [15,22,23].

The FIT is set by an ordinance and is not fixed in the GEA 2012 itself. The FITs are fixed in the Green Electricity Regulation by the Minister of Economy in accordance with the Minister of Environment and the Minister of Social Affairs. The tariffs are guaranteed for 13 years. The purchase obligation is limited to a specific amount of capacity (depending on the available funds for new projects). In Austria, currently 1555.4 MW are supported by a FIT under the Green Electricity Regulation [15,22,23].

Figure 4 shows the Slovenian and Austrian FIT prices from 2010 to 2015. The FIT for 2010 and 2011 was fixed at €97.00/MWh, for 2012 it was fixed at €95.00/MWh, for 2013 it was fixed at €94.50/MWh, for 2014 it was fixed at €93.60/MWh and for 2015 it is fixed at €92.70/MWh. For 2016, the FIT has to be set by a new ordinance.

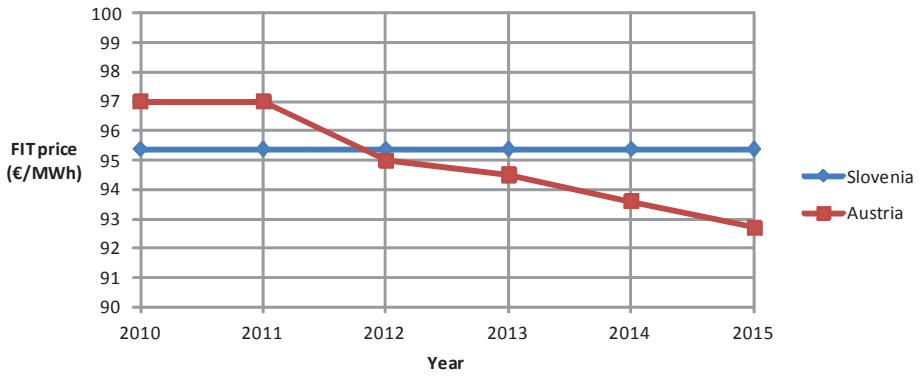

Figure 4: *Slovenian and Austrian feed in tariff prices from 2010 to 2015*

Until 2012, the Austrian FIT prices were higher than Slovenian FIT prices. Since then, the Austrian FIT prices have been reduced each year while Slovenian FIT prices remained fixed at €95.38/MWh during the whole period from 2010 to 2015.

4 CONCLUSION

The natural conditions for RES differ across Europe. As already mentioned, Slovenia is not a country with strong and constant winds. It is characterized by lower average annual wind speeds (with average annual wind velocities between 1 and 3 m/s), which are not suitable for the exploitation of wind energy, since the average wind speed is lower than the cut-in speed of a wind turbine, which is typically between 3 and 4 m/s, [24]. Only at certain micro-locations and at higher altitudes are average annual wind velocities in Slovenia higher. It would be advisable to carry out a study of the geographical distributions of wind resources on these micro-locations and examine the possibilities for the exploitation of wind energy. According to [4], Slovenian wind power production could also increase by taking advantage of already degraded areas, such as land along roads, industrial areas, bridges, etc., and by raising public awareness concerning wind energy. In the future, Slovenia should also investigate the use of small wind turbines in urban areas.

In contrast to Slovenia, Austria has a long tradition of wind energy use, due to a high wind energy potential. Slovenia has 3.2 MW of wind power installations while Austria has a total of 2486 MW of wind power installations. Since 2012, the number of wind power installations in Austria has increased by more than 300 MW every year. Austria is thus making good progress towards their RES targets concerning wind energy. The stability of the incentive program, the amounts of the FIT, and the annual amount of funding for new projects are essential for the growth of wind power capacity, [22].

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