MSc Program
Renewable Energy in Central and Eastern Europe

Renewable energy premium – price of renewable electricity in Austria, Czech Republic and Slovak Republic

A Master's Thesis submitted for the degree of
"Master of Science"

supervised by
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Affidavit

I, **Ladislav Tolmáči**, hereby declare

1. that I am the sole author of the present Master Thesis, " Renewable energy premium – price of renewable electricity in Austria, Czech Republic and Slovak Republic", 61 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master Thesis as an examination paper in any form in Austria or abroad.

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Date Signature

Abstract

Core question of this work is: What are the costs linked to electricity production from renewable electricity sources in selected CEE countries? It covers Austria, Czech Republic and Slovak Republic – analyzing and predicting the costs through projections of renewable electricity production, current structure of electricity market and regulatory policies. Findings of this work sets out that by 2020 support in respective countries could reach in case of Austria approx. 1,23 bln. EUR, Czech Rep. 1,46 bln. EUR and in case of Slovak Rep, 0,49 bln. EUR annually. It also tries to assess investments needed to reach the targets of the Directive 2009/28/EC where Austria is to have most capital expenditures in the period from 2011-2020. These figures compared to different criteria however show that impact compared to GDP is higher in Czech and Slovak Rep. When simulations in terms of sensitivities and different scenarios are applied the costs differ according to indexation of feed in tariffs or technologies for renewable electricity production implemented.

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Contents

List of Tables

List of Figures

Abbreviations

CAPEX – Capital expenditures

ČEPS – ČEPS, a.s. company operating Transmission System of the Czech Republic

CHP – Combined heat and power production

ERU – Energetický regulační úřad – Czech Energy Regulatory Office

FIT – Feed in tariffs

GDP – Gross domestic product

NREAP – National Renewable Energy Action Plan

PV – Photovoltaic

RES – Renewable energy sources

SEPS – Slovenská elektrizačná prenosová sústava, a.s. - company operating Transmission System of the Slovak Republic

ÚRSO – Úrad pre reguláciu sieťových odvetví – Slovak Regulatory Office for Network Industries

1 Introduction

Currently the opinions on supporting renewable energy production diverge deeply on the point of final costs of supporting these energy sources. It is often simply expressed that through renewable energy support schemes such as feed in tariffs the energy tends to be more expensive. Without proper analysis this cannot be distinguished. But it is not only the feed in tariffs that influence the final energy price and the premium so a deeper analysis should be performed to identify factors steering it.

Simple approach using just bare data of energy produced from RES fails to take account of other costs attributable to renewable energy sources. These include, for example, the additional cost for basic and balancing energy that is needed because of the fluctuating input of electricity from photovoltaic and especially wind energy systems (BMU 2009, 34). However it must be emphasized that this study does not aim to prefer any energy source to other – on the contrary it aims to provide information for fair comparison base and energy price is just one aspect of energy policy (further are energy security, environmental aspects, social impacts etc.).

There are number of other factors that should be attributed in order for fair assessment of renewable energy costs:

1) energy production costs
2) FIT support,
3) balancing energy,
4) energy distribution costs
5) grid expansion costs,
6) administrative costs[1].

[1] These are not only costs of the regulator but are also attributed to the for example electricity distributors etc.

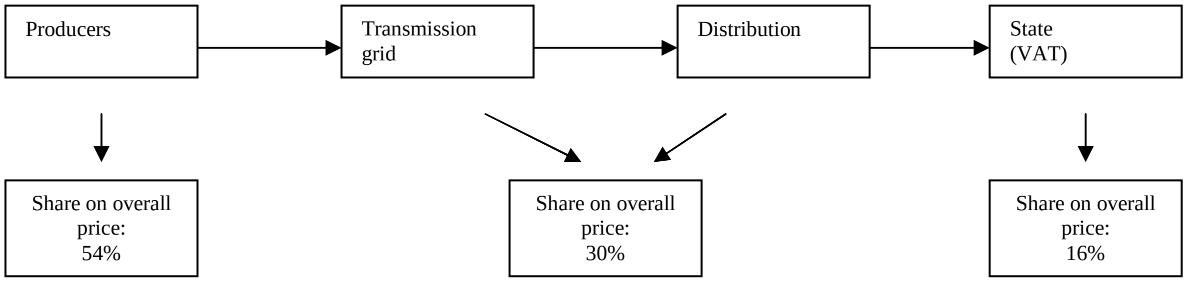

Figure 1 Approximate price structure of electricity (Source: URSO 2009)

1.1 Motivation

Available studies have covered this topic already but mostly focusing on whole European Union or just a single country. Motivation was to analyze and compare three smaller countries Austria, Czech Republic and Slovak Republic – sharing the same region but having different approach and conditions for generation of electricity from RES.

1.2 Targets of this master thesis

The research question of this master thesis is: What are the costs linked to electricity production from renewable electricity sources in selected CEE countries?

And this question is answered by setting three main targets:

1) to analyze and predict renewable electricity costs of the countries,
2) compare the results on basis of criteria of GDP, inhabitance and energy consumption,
3) prepare sensitivities based on alternative scenarios.

1.3 Citation of main literature

This master thesis is based on calculations based on National Renewable Action Plans and further regulatory policies – setting the feed in tariffs in respective countries. Further to this it is based on studies analyzing renewable electricity costs such as Knápek, J. (2010): Effectiveness of Feed-In Tariff Scheme – A Lessons Learnt in the Czech Republic and EGU Brno (2010): Connecting Renewable Electricity Sources to the Electricity Network of Czech Republic.

1.4 Limits of this research

This research aims to evaluate overall costs related to production of electricity from renewables – therefore it is dependent on the inputs that relate to them – mainly assessment of future renewable electricity mix and regulatory framework. This research however does not compare the extra cost burden towards utilizing conventional electricity sources – therefore it is limited to evaluation of costs and their prediction.

1.5 Structure of work

In line with the targets the work starts with analyzing current status and predictions of renewable electricity production. Crucial role of price regulation will be also analyzed in this work.

Emphasis will be put upon analyzing the intended share of renewable energy sources on total electricity production as defined by the National Action Plans in order to reach the widely discussed 2020 targets.

Further the work compares the results on the basis of criteria as GDP, electricity consumption or inhabitance.

Following part of the master thesis is devoted to outline three possible scenarios of RES electricity production. Last part of the work gives recommendations in relation to the topic of electricity production from RES.

2 Current and future renewable electricity market, renewable electricity production in selected countries

This part of Master Thesis will focus on description of renewable electricity market in selected countries. These information will serve for developing projections on future costs of renewable electricity and will provide inputs on its current level. Here it is important to note that all three countries have different predispositions for renewable energy production whereas hydropower and wind are dominant in Austrian renewable energy market, large hydro in Slovakia and a wider range of technologies in Czech Republic with fast grown PV production capacity[2].
These differences in neighboring countries stem from landscape features and different policies in the past – influenced by centralized decision making of communistic regime in former Czechoslovakia and discussions linked to utilization of nuclear energy in Austria.

First the structure of the electricity sector will be described followed by description of current renewable energy production in the countries. Main part of this section will be devoted to presenting outlooks based on National Renewable Energy Action Plans (NREAP[3]) that will be used further in the work to calculate future renewable energy premiums and cost of renewables.

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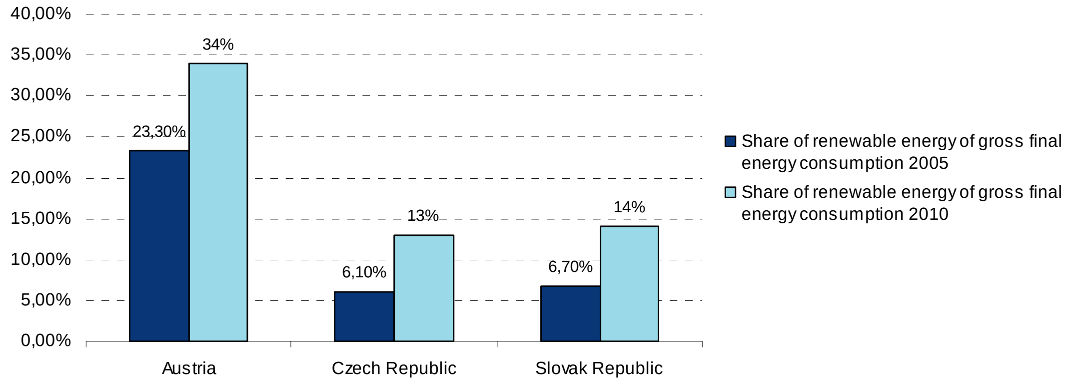
[2] Asi it will be mentioned further – this fast development was a result of legislative fault and impacts will be subject to analysis.

[3] NREAP according to Directive 2009/28/EC reflects Member States' national targets for the share of energy from renewable sources consumed in transport, electricity, heating and cooling in 2020, as well as the chosen trajectory to achieve them. It must detail national policies on biomass resources and on the implementation of biofuel sustainability schemes while taking into account effects of other policy measures related to energy efficiency. http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/1055

2.1 Future of renewable electricity

Before analyzing in detail expected development and costs impacts of renewable electricity production the basic driving force shaping energy market in the EU has to be mentioned: Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources. This directive sets targets in order to reach 20% share of energy from renewable energy sources and aims also to include 10% of energy in transport to be from renewable energy source by 2020 in the EU. Each member state has its target set individually taking into account a mandatory increase of 5,5% compared to 2005 for each of them and further increase based on GDP.
Targets for Austria, Czech and Slovak Republic are the following:



In order to notify the the European Comission the Member states are to present above mentioned NREAP. Member states are free to select given mix of how to achieve these targets however should follow a given trajectory:

20% average between 2011 and 2012;

30% average between 2013 and 2014;

45% average between 2015 and 2016, and;

65% average between 2017 and 2018.

The given targets have implaction for electricity prices as will be analyzed further in the text – first analysis of current market and expected development in respective countries follows.

2.2 Austria

Austrian energy market is characterized by strong preference of renewable energy sources however the country is known for its opposition towards utilization of nuclear power. The main discussion in Austria is around topics of renewables, energy prices and also a widely discussed concept of energy independence.

2.2.1 Current electricity mix

Austria with currently installed 12 009 MW in hydro is definitely among the leaders in renewable energy production – this is also thanks to landscape and conditions for electricity generation from hydropower sources.

Total output was 63,43 GWh in 2007. Approximately 60 % of production comes from hydropower stations, i. e. run-of-river and storage power stations, as well as small hydro generating stations. Natural gas is the second-most important primary energy source for power generation, at some 17 %. Hard coal and coal derivatives were responsible for approx. 10 % of output (E-control 2010: 22).

High level of pump storage and storage plants similarly ensures that Austria should be able to cope with unplanned generation outages (E-control 2009: 3).

Table 1 Austria – electricity mix 2007

	Electricity production capacity 2007 in MW	Gross Electricity Generation 2007 in TWh
Conventional Thermal	6441	19,073
Nuclear		41,865
Wind	977	
Geothermal	2	
Hydro	12009	
of which pumping	3580	2,492
Total	19429	63,43

Source: Eurostat, May 2009

Total generation capacity amounts to 19 429 MW. Dominant market player is majority state owned Verbund and 14 regional energy companies.

2.2.2 Current renewable electricity market

The 2003 – 2008 period in Austira saw a sharp increase in the output of electricity from renewable technologies (E-control 2010: 22). Supported renewable energy (excluding hydro power) as a proportion of total electricity supply across the public grid was 8.1 % in 2008. Wind power accounted for 3.6 % of total supply, followed by supported electricity from solid biomass at 3.4 % and from biogas at 0.9 %. Some 4.5 TWh of renewable electricity and 0.9 TWh from small hydro stations were supported under the feed-in tariff system established by the Ökostromgesetz Green Electricity Act (E-control 2010: 22).

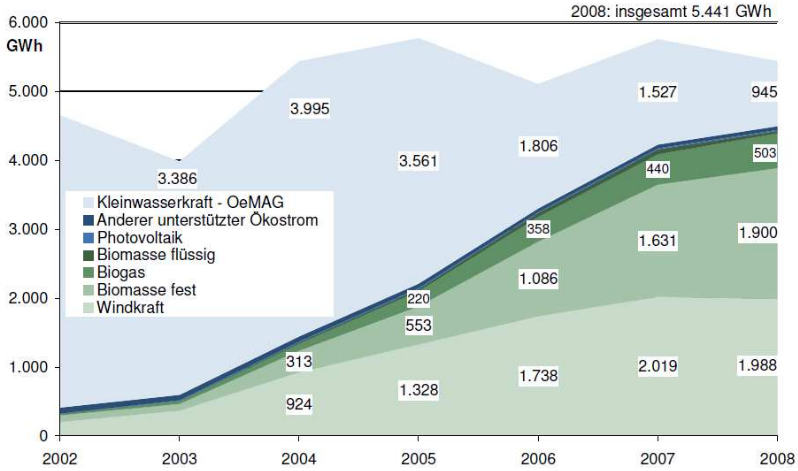


Figure 2 Renewable electricity production development in Austria (Source: Ökostrombericht 2009, p. 28)

Here also variations on the production from small-hydro have to be noted and steady decrease due to hydrological conditions, which is also the case of other countries in the region. Wind energy production after sharp increase in installed capacity has reached a stable level because of lowering of feed-in tariffs. Their increase in 2010 leads to renewed interest of investors and development of new wind parks in amounts of hundreds MW as observed from press articles.

2.2.3 Future development of renewable electricity production

The NREAP for Austria provides detailed information on development of electricity production from renewables. Under Austrian conditions it must be noted that the potential in hydro-power utilization is almost already depleted – this can be also observed from the chart below.

Target is 70,6%, 4503 ktoe.

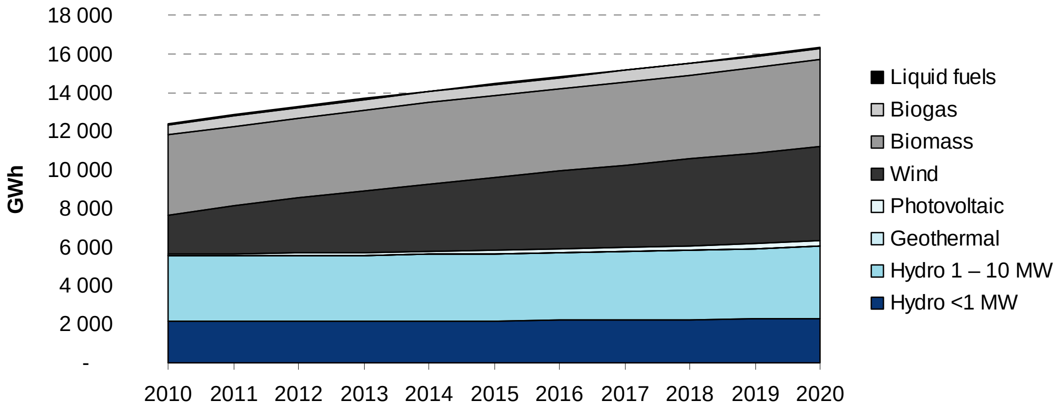


Figure 3 Expected development of renewable electricity production in Austria (Source: NREAP for Austria)

These charts don't provide information on large-hydro production due to the fact that this doesn't fall under FIT regime. Greatest increase in installed power is in wind but also slight development in other fields with immense theoretical but small economical potential such as geothermal is expected.

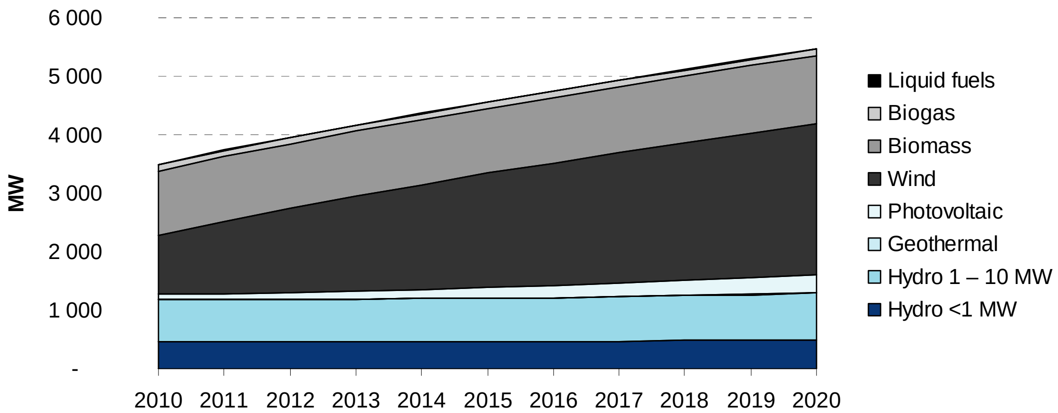


Figure 4 Expected installed power of electricity sources in Austria (Source: NREAP for Austria)

2.3 Czech Republic

Czech electricity production relies on two main sources nuclear power and coal – both of which are in the case of Czech Republic local energy sources. However in case of coal power plants a drop in production is expected – until 2020 three major coal power plants are to be shut down due to coal shortage and environmental legislation (ČEZ 2010). Fact that most of the power is produced from local source is on one hand a positive aspect but on the other in the EU coal is considered to be a source to be acceptable only marginally and nuclear energy is utilized in 15 of the 27 states but the discussion on its future are ongoing (Pacesova komise 2009: 15).

2.3.1 Current electricity mix

Czech Republic has the highest electricity production from all three countries. After year 2000 the country has witnessed a growth in electricity consumption and Czech Republic is also an electricity exporter. As already mentioned high level of self-sufficiency is achieved in electricity production, where net production from domestic sources practically fully covers domestic demand (approx. 96%) (Czech Energy strategy 2009, MPO: 15). Currently further expansion of nuclear power stations is expected – Environmental Impact Assessment study is being carried out in order to construct two blocs at Temelin nuclear power plant.

Table 2 Czech Republic– electricity mix 2009

	Electricity production capacity 2009 in MW	Gross Electricity Generation 2009 in TWh
Conventional Thermal	10.720	48,457
Nuclear	3.830	27,207
Wind	193	6,584
Solar	464	
Hydro	2.183	
of which pumping	1.146	0,553
Total	18.325	82,250

Source: Energetický Regulační Úřad 2010

Most of the production capacity is in conventional thermal energy sources utilizing domestic coal with the production capacity of 10 720 MW – 58% conventional thermal. Nuclear power generation capacity of 3830 MW is in two nuclear power stations with plans to build further reactors.

Main market player is joint stock company ČEZ with approx, 70% ownership of Czech Republic. As part of unbundling energy distributors have been created that operate as independent companies the main players are ČEZ Distribuce and EON that is also active on the Czech market with regional player Pražská energetika.

2.3.2 Current renewable electricity market

Czech Republic due to its terrain has limited potential regarding hydro-power stations (with value of 350 kWh/ha this is considerably lover than in any of the EU countries). Substantial part of the suitable locations has already been used (Paces 188). Still hydro power constitutes the most significant source of renewable electricity with 2176 MW of installed capacity and 2,11 TWh produced on average.

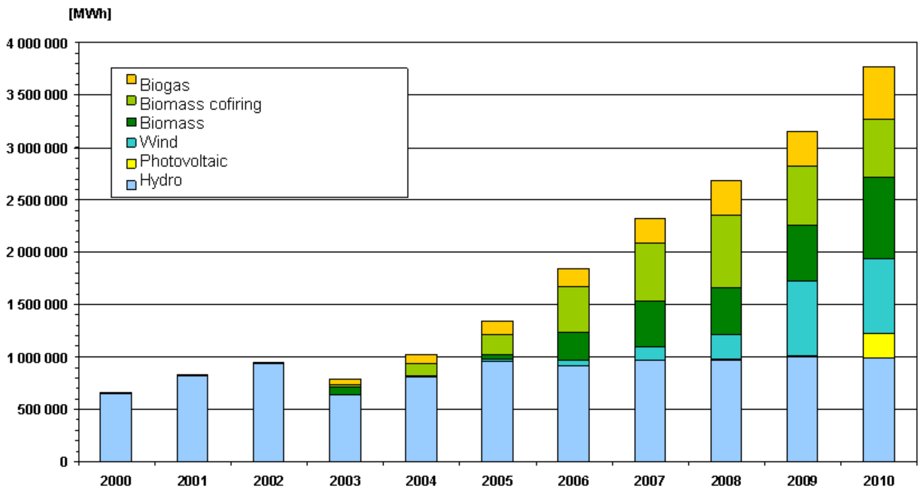


Figure 5 Renewable electricity production development in Czech Republic (Source: ERU 2010)

In the past two years Czech Republic has seen an unprecedented growth of photovoltaic plants development and it is expected that by end of 2010 of solar power plants with output of at approx. 1000-2000 MW will be operating (assumptions differ due to large number of licenses and unpredictable development). Status as of September 2010 was 693 MW – price of feed in tariffs is however to drop significantly to 0,22 €/kWh from 2011.

Wind and biogas are further two sources that are expected to gain momentum in the coming period. Large scale biomass co-firing was also a widely discussed topic in the past.

Biomass co-firing with fossil fuels also gained strength – however due to currently limited available resource (but considerable potential) biomass does not have much further possibility to grow – preference of biomass utilization for heat production is also expressed in energy policy of Czech Republic (MPO 2010: 36).

2.3.3 Future development of renewable electricity production

Outlook for production of renewable electricity in Czech Republic already includes current rise in production from PV plants and for the future counts with development of production from biogas and wind.

The PV production capacities should be kept at levels of approx. 1650 MW what is the expected level as of end 2010.

By 2020 mainly production in wind by (500 MW) and biogas (by 300 MW) is expected to rise. This will have also implications on renewable energy premiums but also depends on investment intensity development of this technology.

A large portion of production of approx. 31% is to come from biomass – however no given installed capacity is provided in the NAP as this should be mainly biomass cofiring and cogeneration.

Approximate target according to NAP is 10 600 GWh of renewable electricity production in 2020.

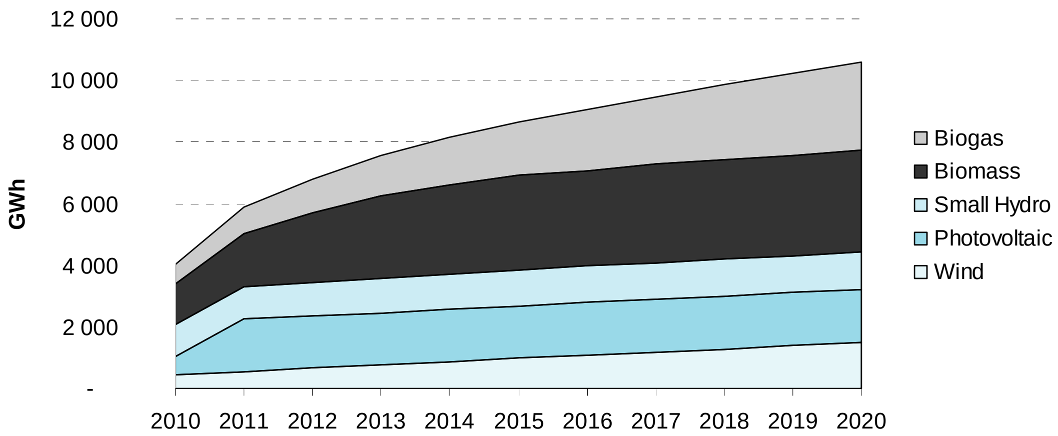


Figure 6 Expected development of renewable electricity production in Czech Republic (Source: NREAP for CR)

When looking at the installed power of the respective technologies – photovoltaic is by far leading. All other renewable electricity production capacities have the same share combined as photovoltaic has alone – expected development is rise of installed output by 50 MW a year in wind and 30 MW in biogas a year. As noted before this does not include installed capacities of biomass electricity sources.

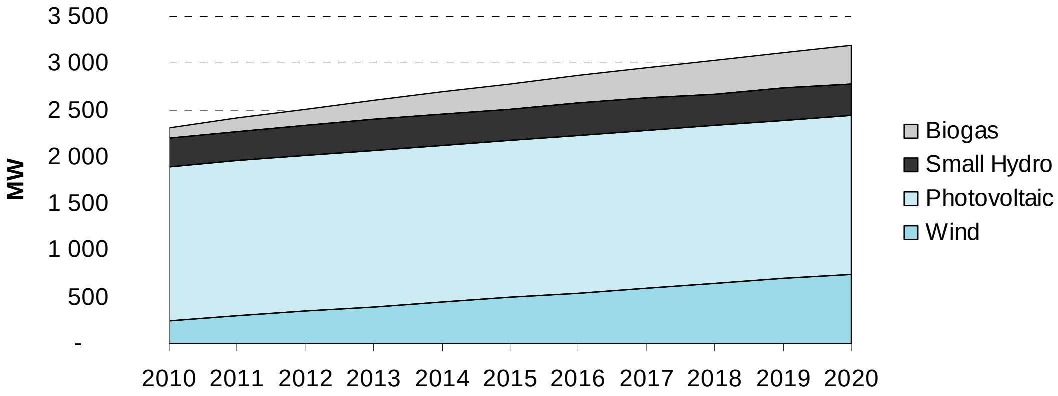


Figure 7 Expected installed power of electricity sources in Czech Rep. (Source: NREAP for CR)

2.4 Slovak Republic

Electricity generation in Slovakia was linked to number of policy decisions in the past – following main topics shape the energy discussion in the country currently:

1. utilization of nuclear energy with works on nuclear reactors of Mochovce nuclear power plant, shutdown of Bohunice V1 nuclear power plant reactors;
2. utilization of domestic coal – that is subsidized;
3. large hydro utilization with hydro-power plant Gabcikovo;
4. Slovakia becoming a net energy importer.

utilization of renewable energy sources with discussion mainly shaped by opposition towards wind energy and other energy sources deemed to be unreliable.

2.4.1 Current electricity mix

Electricity mix in Slovakia is characterized by three main sources – each of these has approximately a share of one third on energy production in the country – fossil energy (thermal power plants Novaky, Vojany), nuclear (nuclear power plants Jaslovske Bohunice and Mochovce) and hydroelectric (Gabcikovo, Vazska Kaskada etc.).

Following table shows basic information related to the electricity generation capacities in Slovakia.

Table 3 Slovak Republic– electricity mix 2007

	Electricity production capacity 2007 in MW	Gross Electricity Generation 2007 in TWh
Conventional Thermal	2609	7,602
Nuclear	2200	15,334
Wind		4,956
Geothermal		
Hydro	2515	
of which pumping	916	0,164
Total	8240	28,056

Source: Eurostat, May 2009

Total generation capacity amounts to 8240 MW and total electricity generation was 28,1 TWh with 54% being produced by nuclear sources. Main market players are privatized Slovenske elektrarne a.s. and three regional distribution companies.

2.4.2 Current renewable electricity market

Table below shows the development of electricity production from renewable sources. Large hydro has been dominant and we can see how variable the flow of the rivers was in the past. Biomass electricity production is mainly linked to biomass co-firing.

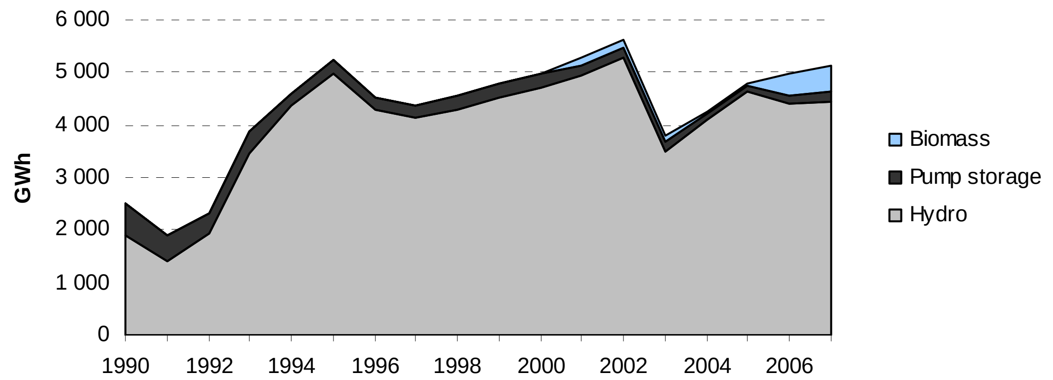


Figure 8 Renewable electricity production development in Slovak Republic (Source: Eurostat May 2009)

Most potential is devoted to biomass but also solar energy in approved Strategy for higher utilization of Renewable Energy sources.

As number of press articles point there might be a strong opposition from the public towards utilization of wind which has a very small installed capacity with only three smaller wind parks operated.

Slovakia is currently not on track with reaching its RES-E target of 31% gross electricity consumption for 2010. Besides biomass, hydro and wind, also geothermal and solar energy offer significant future potentials (Resch et al.: 2010, p.5).

Number of new investments are being planned as feed-in tariffs are motivating investors to develop projects. Pipeline of planned wind and solar installations that is evidenced by regional grid operators is already robust. Stable development is seen in small-hydro and biogas where the projects are more demanding.

2.4.3 Future development of renewable electricity production

The NREAP for Slovakia provides information on expected electricity production from renewables to reach the 2020 targets[4]. Target is 24% of electricity from RES 688 ktoe.

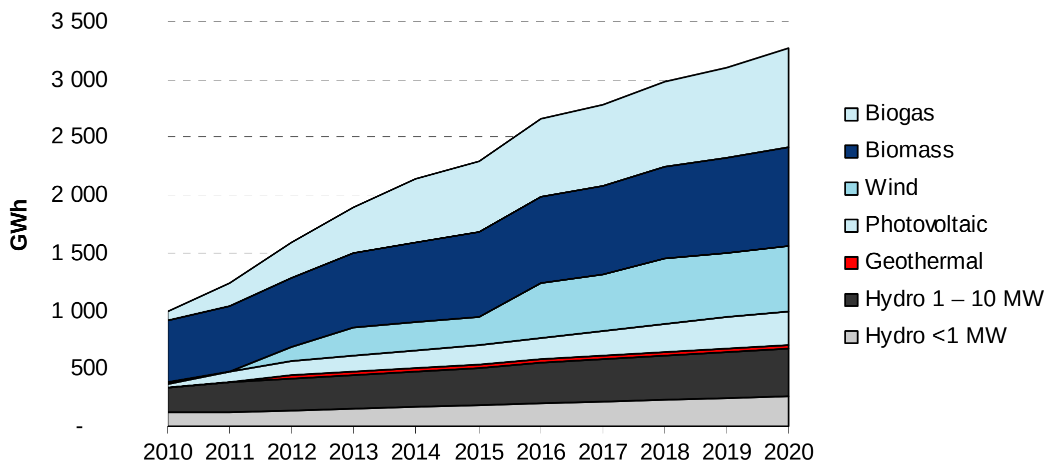


Figure 9 Expected development of renewable electricity production in Slovak Republic (Source: NREAP for SR)

As can be observed from the figure above most of the production from renewables is expected to come from large hydro. However development that will have the most impact on renewable energy premium will be support of other renewable sources.

[4] In this work 2020 targets refers to targets set by Directive 2009/28/EC

The installed capacity has is also to be compared – most of the installed output should also be in hydro-power. Photovoltaic energy production has the worst ratio of GWh/MW installed – only 0,75 that is also reflected in its share on the installed capacity with 60 MW in 2010 to 300 in 2020.

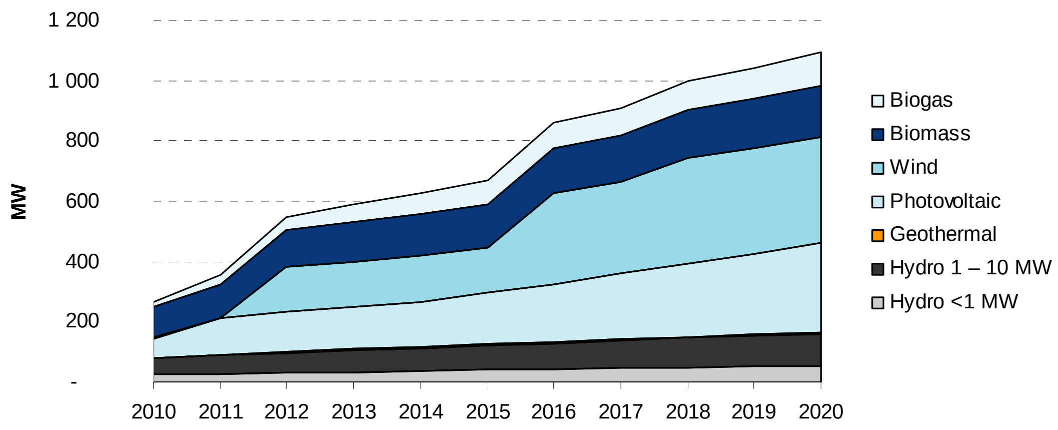


Figure 10 Expected installed power of electricity sources in Slovak Rep. (Source: NREAP for SR)

3 Price of renewable electricity – regulation and its composition

Price of renewable electricity is in our countries mostly determined by policy decisions regulating the feed in tariffs supporting the production and amount of electricity produced by these sources. Previous part focused on determining the amount of rewable energy produced by looking into predictions of NREAPs that elaborate scenarios to reach the targets given by Directive 2009/28/EC.

First part describes the regulation structure, who is the regulator in the respective country. Further FIT and subsidy structure will be analyzed that will provide data to fill the variables concerning price of renewable electricity.

3.1 Regulation structure

Currently each of the EU countries has its own energy regulatory office who is an independent body within state administration with powers over: 1) transport, distribution, storage, grid connection in relation to energy, 2) price regulation and 3) conditions for operation of the operation of the whole network.

Within these competences fall also powers over renewable energy sources which will be further specified.

3.1.1 Austria – E-Control

Austria is the only country where regulatory office functuions as a private sector compared to other two countries. The establishment of Energie-Control GmbH (E-Control) took place in 2001. E-Control is 100 % state-owned. The Federal Ministry of Economy, Family and Youth manages the interests. E-Control's tasks and duties are set out in the Energie-Regulierungsbehördengesetz (Energy Regulatory Authorities Act) (E-Control 2010).

E-Control in Austria not only sets the rules for basic functioning of the renwable energy market – it is also responsible for monitoring and reporting on the field of rnewables. Annually it prepares the Ökostrombericht (Renewable Electricity Report) where it describes in detail describes development of renewable electricity market.

3.1.2 Czech Republic – Energetický regulační úřad

In Czech Republic the The Energy Regulatory Office (ERO) was established on 1 January 2001. It has its offices based in Jihlava but also in Prague. The Regulation section of the ERO also covers electricity under the Electricity Industry Department. It also deals with support for electricity generation from renewable and other environmentally friendly resources and prepares electricity industry statistics (ERU 2010 web). Renewable energy regulation is developed within periods where strategy for the whole duration of number of years is set. Currently the rules for third regulatory period apply.

3.1.3 Slovak Republic – Úrad pre reguláciu sieťových odvetví

The price regulation under Slovak office for regulation of network industries includes generation of electricity from renewable sources of energy, generation of electricity generated by combined generation of electricity and heat, generation of electricity from domestic coal, connection to the network, access to the network, transmission and distribution of electricity, electricity supply for households, provision of system services in electricity sector and provision of ancillary services in electricity sector (URSO 2010).
Regulatory office publishes each year decrees that determine the FIT for a period of upcoming year.

3.2 Regulating price of renewable electricity

Each country has a different set of rules how price of renewable electricity is passed on into the electricity price for the consumer. The system works either through electricity traders, regional distribution companies or Green power settlements agent as in case of Austria – following part describes schemes implemented in countries that this theses focuses on.

3.2.1 Austria

Compared to other two countries Austrian system of including RES surcharge to electricity prices differs considerably. RES costs are transferred through electricity traders but the main difference is based on introducing a green power settlement agent (OeMAG) who acts as a registry and intermediate between electricity producers and traders. The whole system is based on current Ökostrom-Gesetzesnovelle from 2008 (BGBl. I Nr 114/2008). Interesting feature of this system is that it does not include combined heat and power production (is part of separate CHP-law (BGBl I Nr. 111/2008) and also small hydro support is based on direct subsidies and not feed in tariffs.

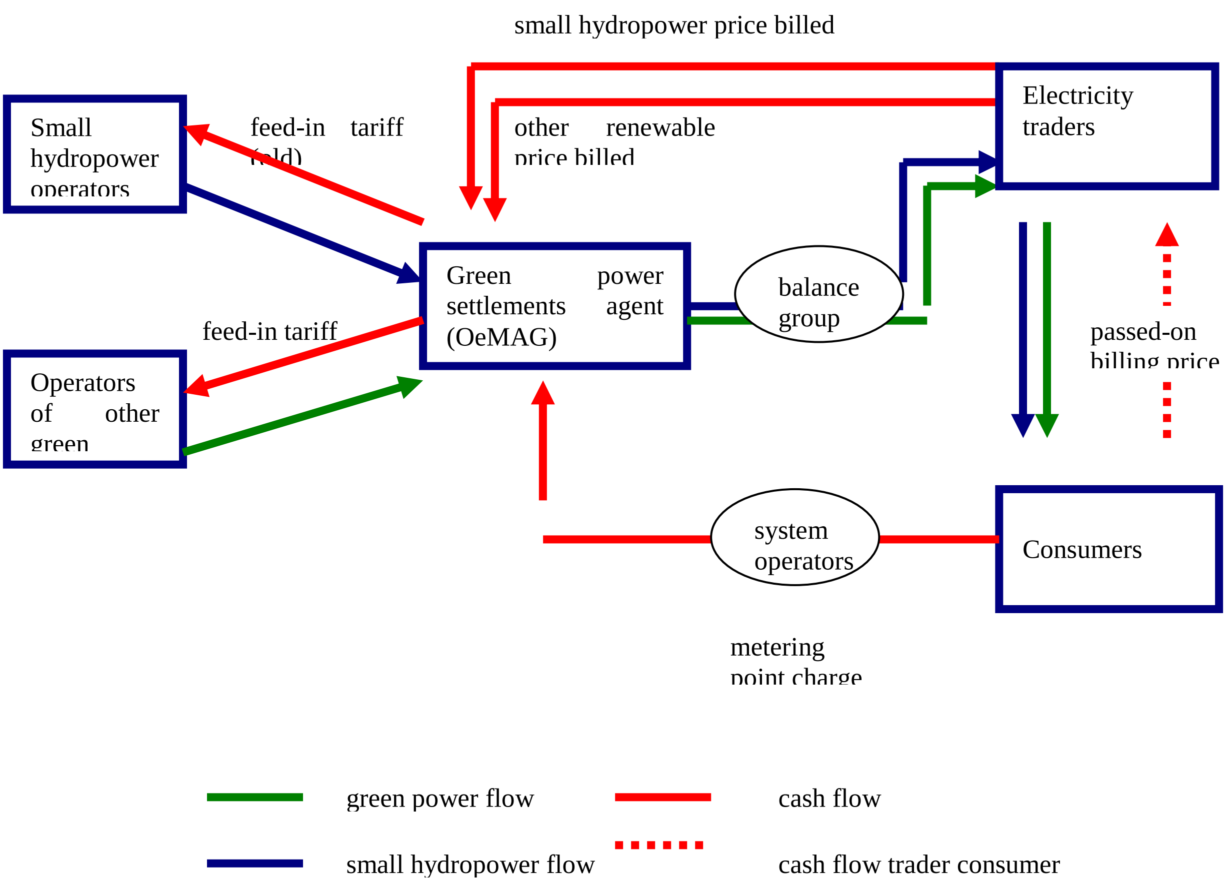


Figure 11 Austrian green power subsidies system

(Source: E-control)

3.2.2 Czech Republic

The compensation for RES production in Czech Republic also works with overall extra costs that are bared by all energy consumers. In Czech republic there were three regulatory periods with different methods for estimation of these costs[5]:

1) first regulatory period 2002 - 2004 – the amount of support was based on expected RES production, it did not involve energy consumption to cover losses – however it should be noted that regulatory period and support of RES do not match as the implementation of legislature. In 2002-2005 also FIT system was in place but the tariffs were not guaranteed for a period longer than 1 year – with ERU declaring long-term support,
2) second regulatory period 2005-2009 – unlike in the first regulatory period, the support and expenditures were based on the real values of the supported amount in the previous calendar year, as they were reported by the system operators, rather than planned amounts. The motivation for adopting this approach was the negative experience from the first regulatory period with the use of planned values furnished by system operators, when higher revenues were collected from consumers than the amount of the overall extra costs of the support paid to the generators – this lead to deficits in the system of compensation for extra costs. (ERU 2009, p.56).
3) third regulatory period 2010 – 2014 - mechanism of compensation for extra costs related to support for renewables, CHP and SR will be based on the same basis as in second period, but the trends in the development of the supported electricity quantities will be used for determining the expected extra costs (ERU 2009, p.56). In determining the expected level of supported quantities, data provided by system operators and also other information from independent sources will be used.

[5] Please note that these regulatory periods do not match the actual support mechanisms as application of policies differed from the regulatory periods defined by the regulator.

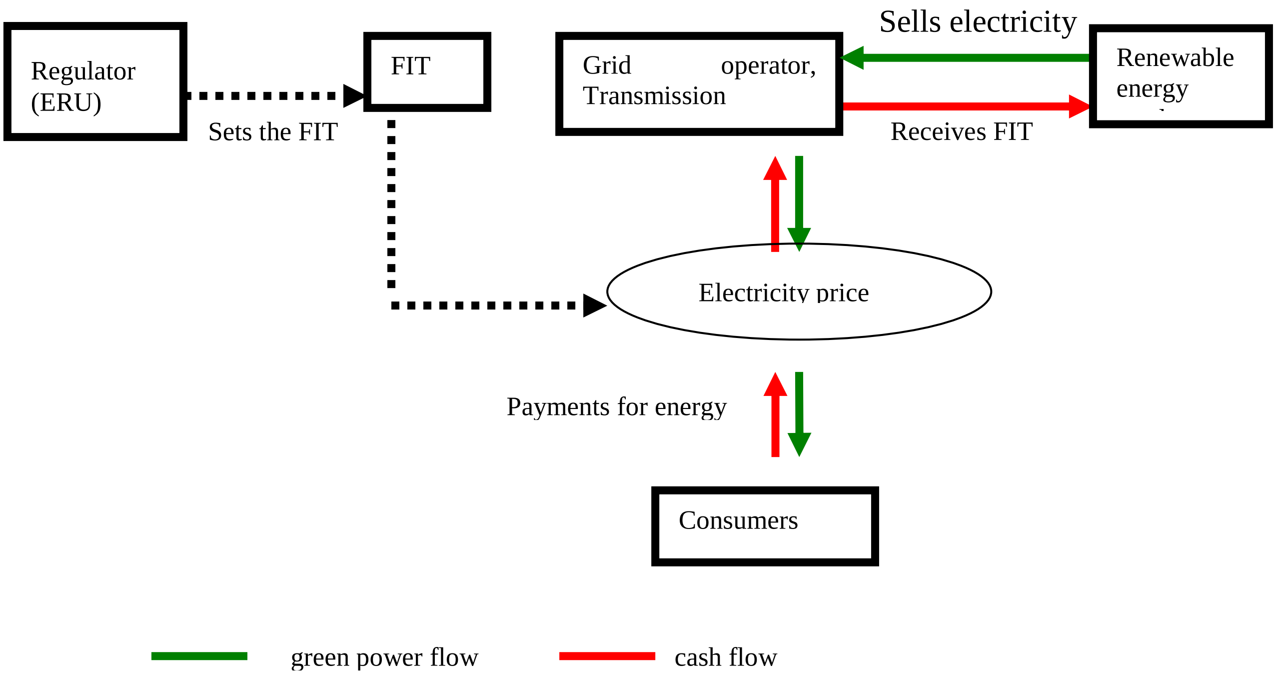


Figure 12 Czech green power subsidies system

From 2011 a new system of transfer of funds from consumers to producers is to be established – with cash flows through OTE a.s. (joint stock company - Operator of the Electricity Market).

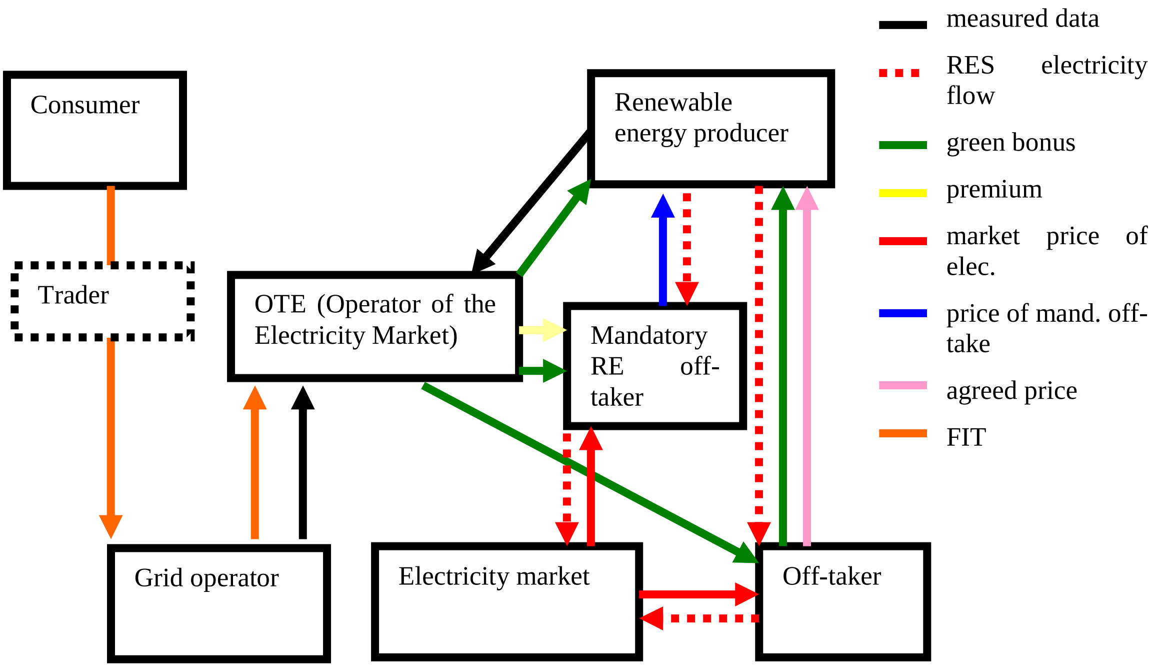


Figure 13 Czech green power subsidies system from 2011 (source: Update of Renewable electricity support act 180/2005)

3.2.3 Slovak republic

In Slovak Republic the FIT is being included into energy prices for consumers through regional distribution companies and transmission grid operater – so called System operation tariff includes costs for renewable energy production and CHP production premium, costs for covering grid losses, costs for support of domestic coal production, costs for organizing access to short term energy balancing market. Slovak system of including the costs into energy price is based on planned amounts of energy from renewables – this could lead to over or under allocation for the following year.

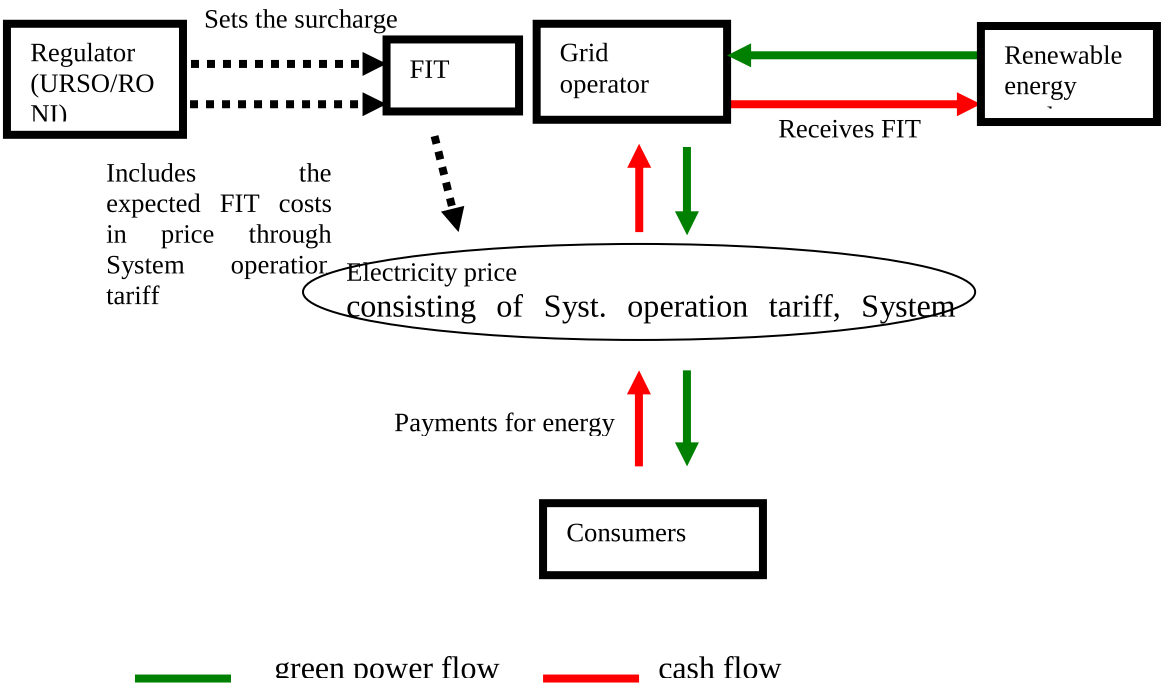


Figure 14 Slovak green power subsidies system

The basic formula for calculating System operation tariff according to RONI 02/2008 decree:

System operation tariff (VPS) = PNOZEKV + PNNhu + PNOT

In this formula the value PNOZEKV directly involves costs related to electricity production from renewable energy sources and CHP, including costs for balancing energy in the distribution networks. However two further variables are included:

PNN costs dedicated to coal production from domestic coal and

PNOT planned costs related to organizing short term electricity market, approved by price decision, for access to the transmission grid and transmission of energy for current year.

Development of system operation tariff and other regulated items for consumer connected to distribution grid is included in the following table.

Table 4 Costs of renewable electricity support in Slovak regulation

Development of regulated charges of consumers connected to DS	2006 (SKK/MWh)	2007 (SKK/MWh)	2008 (SKK/MWh)	2009 (SKK/MWh)	change 07/06 (%)	change 08/07 (%)	change 09/08 (%)
System operation tariff	133	127	88	82	-4,51	-30,71	-6,82
System charge	365	323	293	282	-11,51	-9,29	-3,75
Transmission charge	914	883	952	960	-3,44	7,91	0,78
Transmission losses	157	225	231	277	43,60	2,24	20,26
Total regulated charges	**1 569**	**1 558**	**1 564**	**1 601**	**-0,70**	**0,38**	**2,38**

3.3 Feed in tariff and subsidy structure

Feed-in tariffs are one of the most important tools for renewable energy sources support for power generation. Value of FIT should create adequate motivation for the investors to invest into projects for power generation using RES. Difference between market price of power and FIT is transferred to the final consumers of electricity (Knápek 2010). Premium feed-in tariffs are defined as technology-specific; settings are applied so as to achieve an overall low burden for consumers (Resch 2010: 42).

Basic characteristic of the feed-in system in all three countries:

1. each country has a specific legislature linked to feed in tariffs with wide competences for regulatory authority over this topic;
2. FIT are technology-specific[6];
3. FIT are being changed to reflect current market conditions;

[6] In some cases FIT are not only technology specific but also differ due to different fuel types and other conditions - for example with utilization of biomass to cope with different kinds of biomass quality and sources (waste biomass, energy crops etc.).

4. since the respective technology installation is put into operation the tariffs are usually not obliged to decrease – in some cases they could be adjusted reflecting inflation, fuel prices development etc[7].

Following table includes feed-in tariff values valid in respective countries in 2010 that will be used for further analysis.

Table 5 FIT in respective countries[8]

		Austria	Slovak Rep.	Czech Rep.*
Hydro <1 MW	EUR/MWh	1500**	112,86	115,38
Hydro 1 MW – 10 MW	EUR/MWh	400-1500**	101,57	115,38
Geothermal	EUR/MWh	75,00	195,84	173,08
Photovoltaic	EUR/MWh	350,00	430,72	467,31
Wind	EUR/MWh	97,00	80,91	85,77
Biomass	EUR/MWh	126,00	125,98	56,15-176,15
Biogas	EUR/MWh	130,00	148,72	158,46
Liquid fuels	EUR/MWh	78,00	159,85	136,54
Duration of support	Years	13	15	20-30

Source: FIT 2010 Regulation in respective countries, *Exchange rate of 26 CZK/EUR was used, ** Investment subsidy EUR/kW (explained below)

Table above gives us technology specific values of FIT support that are result of each countries policy.

[7] For example current draft of update of law 180/2005 in Czech Republic includes the possibility to adjust prices both ways in relation to biogas.

[8] As different types of tariffs exist with regards to some categories for example based on biomass type and utilization (cofiring or pure biomass firing) – only one value for easier reference is given that is considered to have highest relevancy.

3.3.1 Austria

In Austria a clear indication of support for wind power in regulatory period of 2010 can be observed. FIT for wind energy in the amount of 97 EUR/MWh is the highest in the countries in the region and support duration of 13 years make Austria an interesting market however with mostly local players with good knowledge of environment being active.

Regarding small-hydro support scheme Austria saw an interesting development.

During 2007 and partly 2008 the electricity prices rose to a high level so that it was more interesting for small hydro power producers to sell their electricity on the free market rather than to profit from feed in tariffs (Wasserkraft Mar 2008 pp. 4). This situation, however changed, when the electricity prices dumped by the end of 2008 (Wasserkraft Mar 2009, pp. 6) and therefore producers again tried to change to the balance group of ÖMAG (the official trader for green electricity) to profit from green electricity prices.

Table 6: Federal investment subsidy for small hydro power plants

	50 kW	50-100 kW	100-500 kW	500–2000 kW	2000–10000 kW
Volume (€ / kW)	1,500	1,500	1,500	1,000-1,500	400-1,000
Max. volume of investment	-	30%	30%	20-30%	10-20%
Additional limits				Subsidy eligibility to be proved by dyn. investment calculation (6%)	

Source: OE-MAG

Up to 2009 small hydro was eligible for feed in tariffs. Since 2009, this FIT system is replaced by an investment subsidy for extension investments and for new projects. The subsidy is linked to the size as well as an investment calculation for plants > 500 kW. In addition to this subsidy, local subsidies may apply. As an example, the government of Lower Austria grants an additional investment subsidy of max. 50,000 / max. 25% of the investment for revitalization measures[9].

[9] http://www.noel.gv.at/bilder/d36/NOE_Kleinwasserkraftfoerderung__03-2009.pdf (1 November 2009)

In addition to the investment subsidy, the ÖMAG has to buy the produced electricity from small hydro power plants at market prices.

3.3.2 Czech Republic

As noted previously Czech Republic became one of the most interesting markets for photovoltaic projects in the past two years. Mainly thanks to the considerably high FIT of 467,31 EUR/MWh and predictable market environment. The FIT in Czech Republic are set according to formula taking into account costs of the technology, price escalation calculating net present value of the investment. The driving principle is to achieve reasonable profit for the investor in relation to capital invested – the basis of the calculation is to achieve an NPV=0 throughout the lifetime of the project (Knápek, Beneš 2007). The profit of the investor is then the discount rate used for calculation of NPV. In Czech Republic this discount rate is considered to be the Weighted Average Cost of Capital – WACC that has been used at the level of 7%. That when considering the costs of debt capital of 6% gives us return on equity of approx. 10%.

3.3.3 Slovak Republic

Similarly to Czech Republic also Slovakia has adopted considerably high FIT for photovoltaics but due to unstable and less predictable conditions there was not such a boom observed. FIT rules have been changed a number of times during the period since 2008 and also unclear grid connection rules the market was perceived too risky by inventors. Wind projects have also seen its boom in Slovak republic but due to stringent rules also a considerably high FIT has not been used by investors and it also has been lowered numerous times to its current level.

3.4 Development of FIT – prognosis

In order to determine the FIT impact on energy prices it is important to assess its future development. Here we will be analyzing only one scenario – compared to other approaches (Resch, EGU) and working with business as usual assumptiuns where FIT will be indexed according to given percentage to be in line with inflationary development.

Basis for this prognosis will be FIT for 2010 – however some alterations will be applied compared to 2010 tariff values as:

to incorporate expectations of tariff change in coming years (e.g. photovoltaics in Czech Republic),

to enable the calculation to be more transparent some technology specific FIT values for different type of output of given technology have been unified (e.g. small hydro, or solar in Slovakia).

Table 7 Expected development of FIT until 2020

	Slovakia				Czech Rep.				Austria			
	2010	2012	2015	2020	2010	2012	2015	2020	2010	2012	2015	2020
<1 MW	113	111	118	130	115	120	127	141				
1 MW – 10 MW	102	100	106	117	115	120	127	141				
Geothermal	196	200	212	234	173	180	191	211	75	78	83	91
Photovoltaic	431	390	414	457	467	292	310	342	350	364	386	427
Wind	81	83	88	97	86	89	95	105	97	101	107	118
Biomass	126	131	139	153	176	183	194	215	126	131	139	154
Biogas	149	152	161	178	158	165	175	193	130	135	144	158
Liquid fuels	160	166	176	195	137	142	151	166	78	81	86	95

Source: FIT regulations in respective countries, own projections

Table of expected FIT development is working with an assumption of FIT increase of 2% for each subsequent year. This will be applied to expected energy generation from each technology to derive renewable electricity costs derived from FIT further in the text. However some specific inputs for each country had to be reflected in the table:

Slovak Rep. – FIT for Slovak Rep. is already derived from FIT tariffs applicable for the year 2011 as published in the URSO 02/2010 Decree on regulation of electricity tariffs – here a drop in support of photovoltaics can be observed – but also expected increase of other tariffs – that is in line with assumption of annual 2% indexation.

Czech Rep. – FIT related to photovoltaic projects has been lowered in Czech Republic in line with the prevailing assumptions of its decrease – here the assumption is of 40% decrease of FIT levels.

Austria – due to investment subsidy for small hydro the relevant expenditure in this field will be assessed taking into account planned new installations and therefore the calculation will reflect it however here the figure would not be relevant.

3.4.1 Overall costs of feed-in tariff support

In this the overall burden of feed in tariff support evaluated in financial terms will be analyzed it will use inputs from two previous parts: Development of FIT prognosis and current and future RES development (insert references here).

The overall cost will be based on NAP scenario as described above (reaching the targets set by each countries targets for 2020 and business as usual development of FIT.

As FIT change each consecutive year this is reflected in calculation as FIT for that year apply only for generation capacities that started operation in that year[10]:

$$C_Y=R_{Y-1}*FIT_{Y-1}+(R_Y-R_{Y-1})*FIT_Y$$

C_Y costs for renewable electricity support in current year
R_{Y-1} renewable electricity production in previous year
FIT_{Y-1} FIT in year preceding the calculation
R_Y renewable electricity production in current year
$FIT_{Y\ FIT}$ in year of calculation

Inputs of these calculations are technology specific and to assess the overall value of support they will be summed up to find the overall expenditure per annum.

Expected costs development for each country will be specified further also including technology specific impact description.

[10] The aim of this formula is to calculate overall electricity support in respective year – the surplus paid by consumer should be then derived by subtracting price of substituted electricity. This formula will calculate the overall support necessary for particular calendar year.

3.4.2 Expenditure on FIT support in Austria

Support scheme in Austria is clearly aimed at wind and biomass. Photovoltaics will have only smaller share on energy costs – compared to both Czech Rep. and Slovakia (9,5% in 2020).

However continuous growth of support of wind and biomass electricity production leads to lower costs as these technologies are not that investment intensive - in 2020 Austria should have average support of 67 EUR/MWh produced.

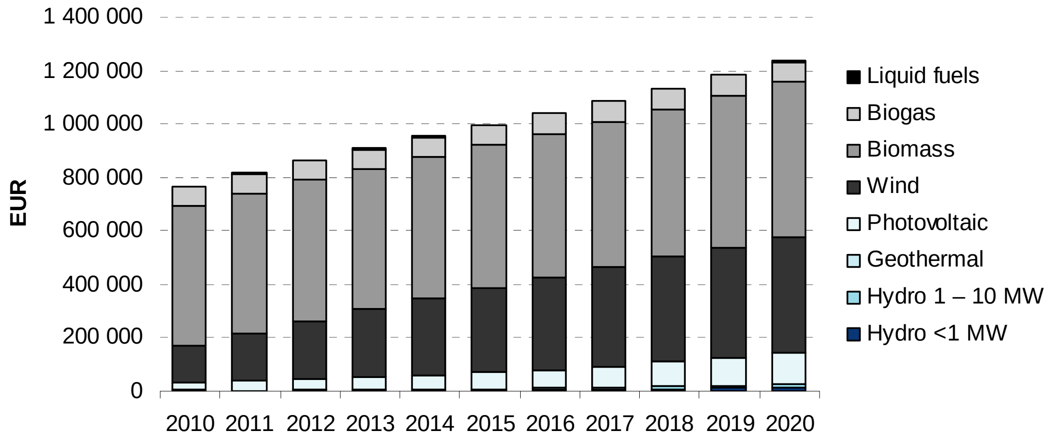


Figure 15 Expenditure on FIT support in Austria

When setting the target renewable energy mix to reach the 2020 targets also factors like cost efficiency, availability of resources and environmental issues were considered (NREAP AT 1)

Maximal year on year increase of total expenditure is by 6% - and in line with policy outlined above Austria will only develop, support renewable electricity from sources that it is using currently – no leap is expected.

Figures for small hydro support were assessed according to expected new capacity installed in the current year – multiplied by investment support expecting that current scheme will be also kept for the future.

3.4.3 Expenditure on FIT support in Czech Republic

Chart below immediately gives us information on the most cost intensive technology that is currently being deployed in Czech Rep. – photovoltaics will have substantial influence also in following years even if current level of support of 12,15 CZK/kWh was immediately lowered.

However according to predictions photovolaics will not be implemented further and the focus will be aimed at wind – but also to biogas.

Taking into account following assumptions for 2020:

Biogas installed capacity	417 MW
Biogas production	2871 GWh
Production per MWh/MW	6884 MWh/MW
FIT in 2020	193 €/MWh[11]

We can observe that expenditures in relation to support will reach almost the level of support of photovoltaics – however at much more efficient level as 1 MW of biomass output capacity has much higher ratio of production of MWh/MW.

Just for comparison – assumptions for calculation of support for photovoltaics on 2020:

Photovoltaics installed capacity	1695 MW
PV electricity production	1725 GWh
Production per MWh/MW	1018 MWh/MW
FIT in 2020	342 €/MWh

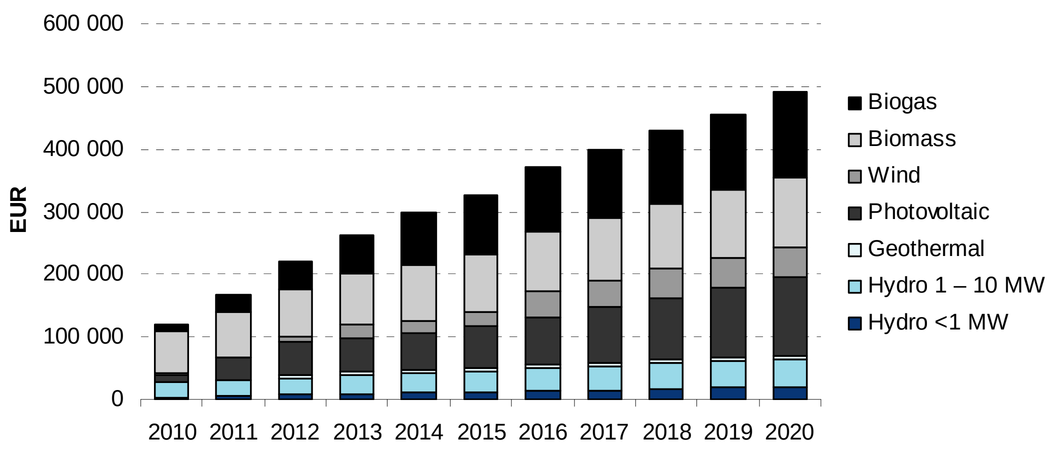


Figure 16 Expenditure on FIT support in Czech Rep.

[11] Assuming indexation of 2% of current FIT 4120 Kc/MWh until 2020.

It is important to mention that the speed of development of PV industry surpassed expectations. For example for 2010 it was budgeted that total support expenditure for renewable electricity will be 7,76 bln. CZK (310 M EUR) however according to NAP prediction and result of calculation above this figure should be almost triple. However trend outlined in the NAP preferring wind and biogas in coming years will lead to lowering of support for unit of electricity produced from renewables that will be analyzed further.

3.4.4 Expenditure on FIT support in Slovak Republic

Fit support in Slovakia will be devoted to a wide range of renewable energy mix. However surprisingly highest support in 2020 is expected to be into biogas rising from today's approx. 10 ths. EUR to 136 ths. EUR in ten years. This is closely followed by support of photovoltaics with 125 ths. EUR – also with a gradual increase from levels of today. However wind energy production and support expenditure is still expected to be weak despite potential in the country. Substantial production of renewable electricity will come from small hydro – but these power sources have usually been built in the pre-support period and new development thanks to limited new potential and low FIT will not contribute to expenditure that much.

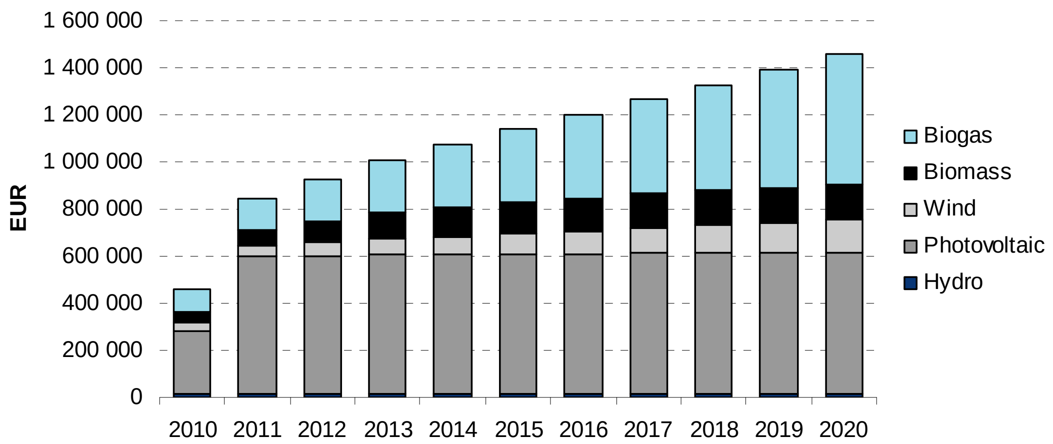


Figure 17 Expenditure on FIT support in Slovak Rep.

If we divide the support from FIT with total production from renewable electricity sources – we will reach a figure of 150 EUR/MWh in 2020 – this is more or less the average FIT and could be used as a tool to measure cost intensity of support to unit of electricity produced.

Renewable electricity support in Slovkia should be in 2020 almost four times higher than it is today – but compared to current low level the absolute figure of approx. 500 ths. EUR is not that significant.

According to RES Industry roadmap the support for RES in scenarios analyzed under this study the investments of 3.51 billion € to 6.09 billion € into RES until 2020 are expected. In all cases the electricity sector will be responsible for the largest part of these expenditures, amounting to more than half of the total required investments (RES Roadmap: 30).

3.4.5 Expenditure on FIT support – comparison

As could be already observed from evaluations of different countries expenditure and RES electricity production capacities above – each country will reach its target using different paths. It is interesting to compare the approach. In each of the countries we could characterize them as follows:

Austria – further development of current RES electricity sources, low costs

Czech Republic – photovoltaics, and development of biogas

Slovak Republic – support of various energy sources, strong growth but middle average costs

Figure of support of EUR/MWh of renewable electricity nicely illustrates this development.

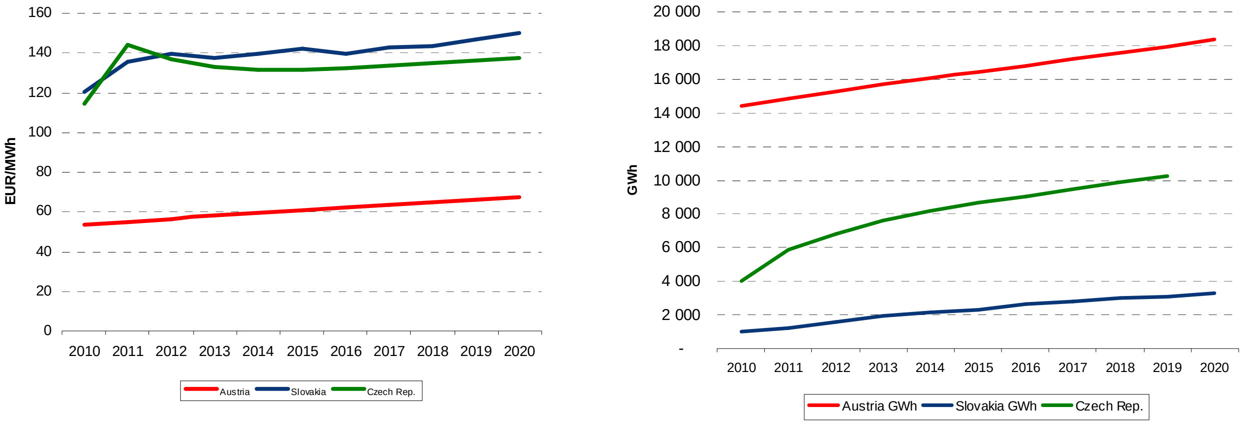


Figure 18 Support of renewable electricity EUR/MWh

This analysis shows various levels of support in countries – in average however the FIT in Austria will be the lowest throughout the 10 years analyzed here (relation to strong wind power sector). Under this comparison Austria produces almost double the amount of renewable electricity compared to Czech republic in 2020 for 40% of the average feed in tariff.

Table 8 Total FIT support in respective countries – period 2010-2020

	Ths. EUR	FIT Ø EUR/MWh
Austria	10 983 317	61
Czech Republic	12 097 403	152
Slovak Republic	3 542 279	140

According to summing up total fit support in respective countries it can be noted that support through FIT will reach substantial amounts – that will have impact on electricity prices. Total expenditure on FIT in Slovak Republic will be only 29% of that in Czech Republic – however population of Czech Republic is double in size.

3.5 Capital expenditure into renewable electricity production facilities

Envisaged new production capacities will require new investments into production base. These will be repaid from FIT support revenues. However it is also interesting to asses the total investment that these new assets will require and how they develop over time.

To be able to assess this volume of investments technology specific investment costs of EUR/MW will be used in further analysis. These will not be indexed as for comparison base prices as of 2010 have been used.

Table 9 Technology specific investment EUR/MW

Hydro <1 MW	2.000.000	€/MW
Hydro 1 – 10 MW	1.800.000	€/MW
Geothermal	4.500.000	€/MW
Photovoltaic	3.000.000[12]	€/MW
Wind	1.300.000	€/MW
Biomass	2.500.000	€/MW
Biogas	3.000.000	€/MW
Liquid fuels	3.000.000	€/MW

Source: E-control and own research

Figures differ in each specific investment but as a general average they can be useful for this assessment. This analysis also shows us development of investments in time – that will have to be reflected in policy of each respective country (e.g. adjusting FIT or direct investment support).

3.5.1 CAPEX in Austria

Capital expenditure in Austria can be expected in the region of 300-350 M EUR a year. Most investment should go into wind energy approx. 2 000 M EUR (almost 60% of total investments), followed by solar 696 M EUR of investments. It is interesting to note that in the future no major investments will be achieved in biogas.

[12] Currently the technology specific investments in photovoltaics varies as the marke tis influenced by number of factors such as supply of panels – but for 2011 it could be expected that the price range will drop and will be howering around 2100-2600 EUR/kW (according to own research).

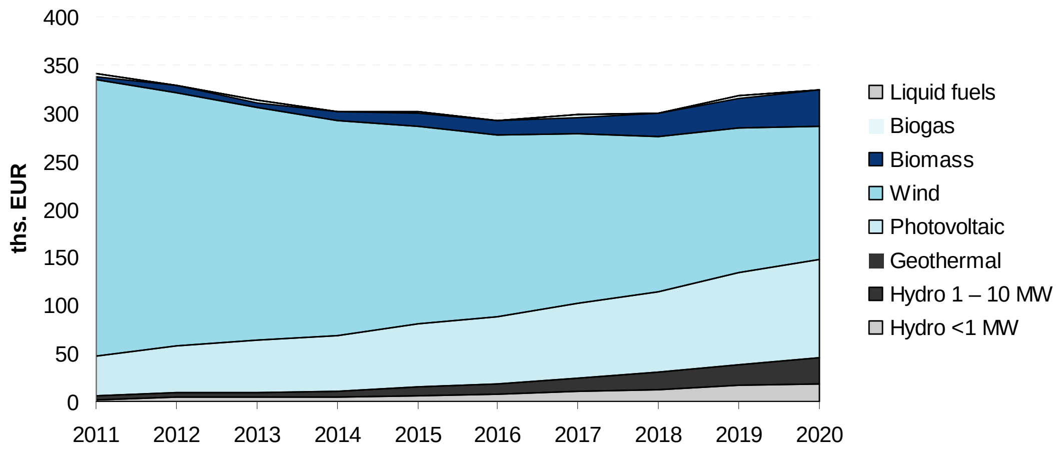


Figure 19 CAPEX into renewable energy in Austria

3.5.2 CAPEX in Czech Republic

Development of CAPEX into renewable electricity production facilities had a much steeper shape in Czech republic. Where in 2009 but mostly in 2010 the massive development has taken place. This however will not be true for the future – as expectations are mainly of investments coming into the field of wind energy utilization and biomass.

From 2011 it will not be possible to develop green-field solar projects and current Renewable electricity act counts with maximum annual installation of 4,5MW of solar installations a year.

A down-word trend from 2011 is expected in investments. Maximum annual investments into new renewable energy capacities to be 178 M EUR. Total investment of approx. 1 424 M EUR can be expected according to these assumptions. As expected and stemming from the NAP – 50% of the investments will go into wind generating capacities – 40% into biogas and rest will be shared by other sources.

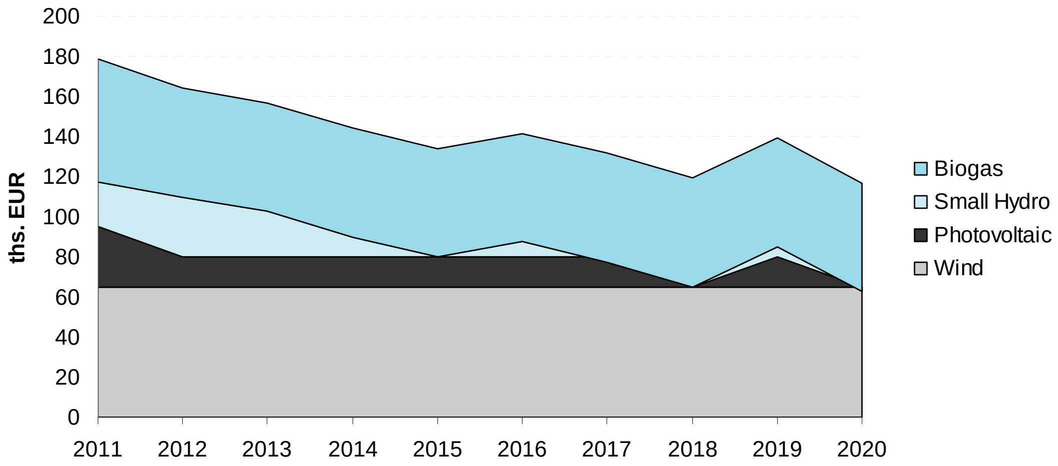


Figure 20 CAPEX into renewable energy in Czech Republic

3.5.3 CAPEX in Slovakia

Following figure with overview of expected CAPEX is showing that according to Slovak NREAP expectations investments should follow in two main surges. First one occurring until end of 2013 and second one starts in 2015. Here investments should be reaching at least 300 M EUR a year. Again photovoltaic should have 40% share on investments with 720 M EUR cumulatively and wind with 25% and 448 M EUR follows. But the investments structure is much more diversified – as in previous cases policy will have to drive this process.

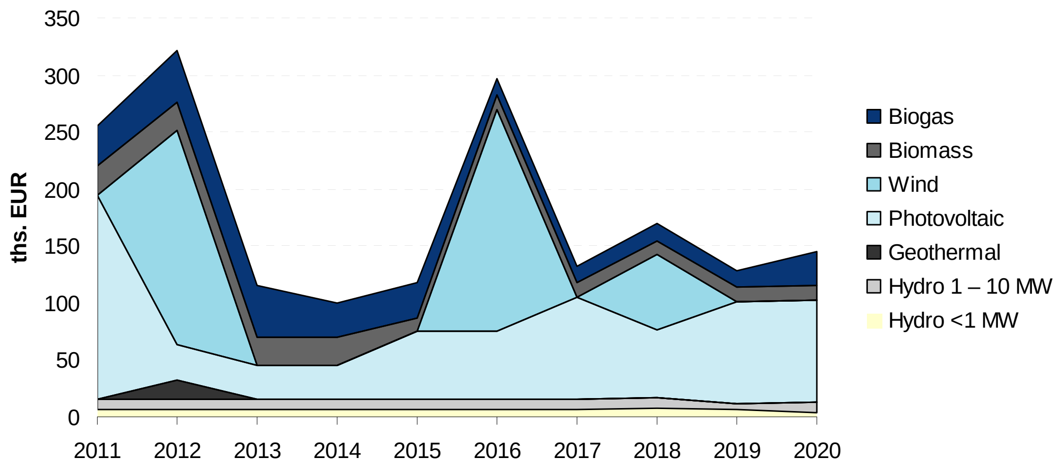


Figure 21 CAPEX into renewable energy in Slovakia

3.5.4 Comparison of CAPEX in analyzed countries

The highest nominal CAPEX between 2011-2020 into renewable electricity facilities will be in Austria – however all of these figures will be highly dependent in development of investment costs of respective technologies. Lowest ration of investments to installed capacity is however in Czech Republic 446.000 EUR/MW – as for the period after 2011 renewable technologies with lower investment costs will be preferred.

Table 10 Comparison of CAPEX into renewable electricity facilities by 2020

	ths EUR	ths EUR/MW	MW
Austria	3 117 000	570	5 473
Czech Republic	1 424 700	446	3 196
Slovak Republic	1 783 900	1 631	1 094

Highest ratio of EUR/MW regarding investments is in Slovak Republic – but this is due to high share of hydro-power production in plants >10 MW – these should have installed power of 1630 MW in 2020.

4 Impact compared to electricity consumption

The most substantial impact on consumer as has been also noted in other related studies is in terms of impact on electricity price the influence of feed in tariffs (EGU 2010). The influence is far more significant than that of balancing electricity or other price impacts of RES (these constitute of 30-40% of impact). Therefore this part will mainly focus on price impact of FIT compared to electricity consumption.

As different groups of off-takers could be considered to calculate FIT impacts – here the most general figure of total consumption has been used. Data were derived from transmission grid operators (CEPS, SEPS, TIWAG Netz, Verbund - Austrian Power Grid, VKW-Netz) for 2009. These were further predicted to grow with 2% p.a. as used by UCTE System Adequacy Forecast 2009-2020 (UCTE 2010).

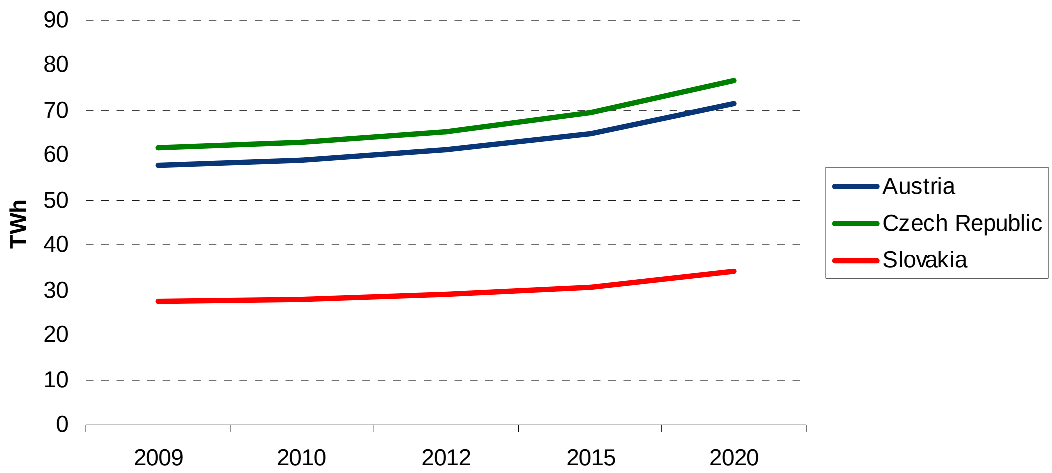


Figure 22 Electricity consumption in respective countries

To achieve final impact compared to energy consumption FIT cumulative support as analyzed above has been used. Downside of this approach is that it does not provide exact information on premium that consumer has to pay. However on comparatory basis total impact to energy consumption to be observed only number of electricity consumers billed should be taken into account. Here we must make an assumption that net end-consumption or electricity billed (without losses etc.) is 70% of total electricity consumption (approximate figure based on e.g. EGU 2010).

Therefore this particular electricity consumption value has development as can be observed in the figure below.

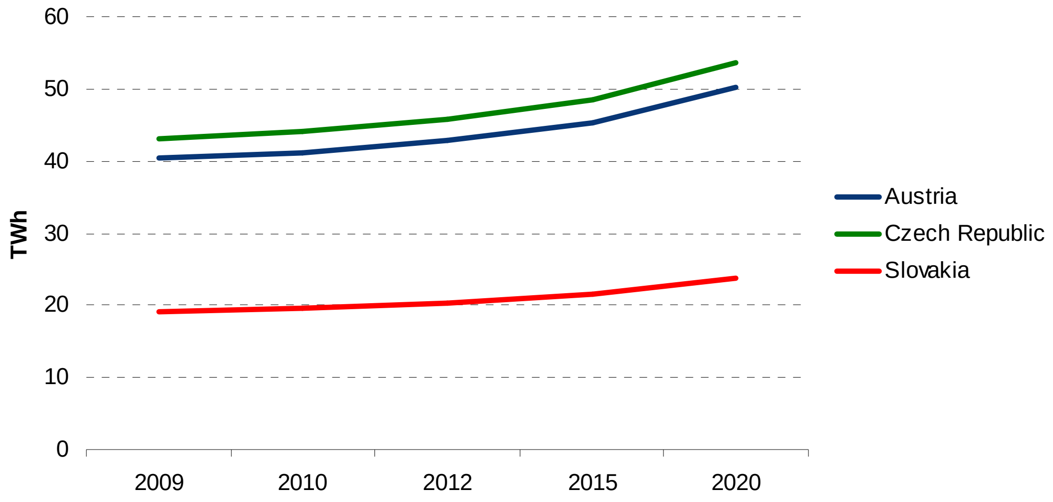


Figure 23 Electricity consumption for FIT impact calc.

As can be observed Slovakia has approximately half of electricity of consumption of its two western neighbors – what is a function of its population size and size of its economy – that is also approx. one half. All three countries have observed a drop in electricity consumption in 2009 as impacts of financial crises were mainly observed by industry (e.g. Slovak Rep. from approx. 29,83 TWh to 27,39 TWh).

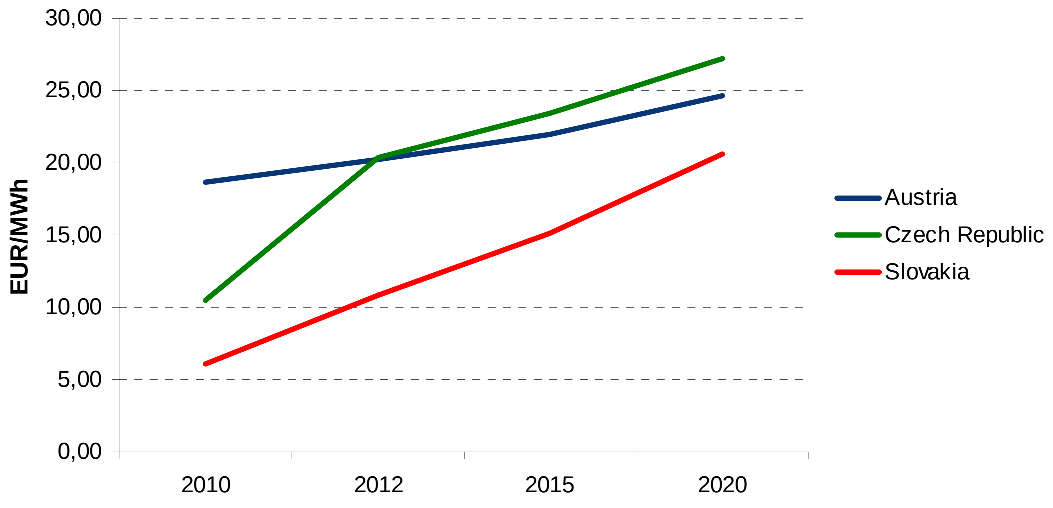


Figure 24 Impact of FIT on electricity price for consumers EUR/MWh (approximation)

As can be observed from the figure above the most significant impact on FIT will be visible in the Czech Republic. However Slovakia compared to its energy consumption will have the lowest ratio – starting at 6,09 EUR/MWh but with rapid growth reaching 20,60 in 2020. This will still be lover than current starting position of Czech Republic. Compared to outcomes of study of EGU 2010 Connecting RES Electricity Sources to Electricity Network of Czech Republic we can observe that calculations above more or less copy findings of EGU – (2012: 556 CZK/MWh; 2020: 710 CZK/MWh).

4.1 Comparison of renewable electricity costs per capita and according to GDP

All three neighboring countries have common history – however they differ when it comes to structure of their economy expressed in GDP.

Table 11 GDP at current market prices and number of inhabitants

	2010	2 010	2012	2015	2020
	Inhabitants	GDP (EUR million)			
Austria	8 375 290	279 607	290 903	308 709	340 839
Czech Republic	10 506 813	143 237	149 024	158 145	174 605
Slovakia	5 424 925	65 884	68 546	72 741	80 312

Source: EUROSTAT 2010

Czech Republic is the largest country in terms of headcount however 51% of GDP of Austria and Slovakia has only 23% of GDP of that Austria. This is due to number of factors as number of inhabitants, economic output and etc. substantially influenced by history.

If we apply these data to calculated FIT support we reach results enabling comparison with regards to GDP and number of inhabitants.

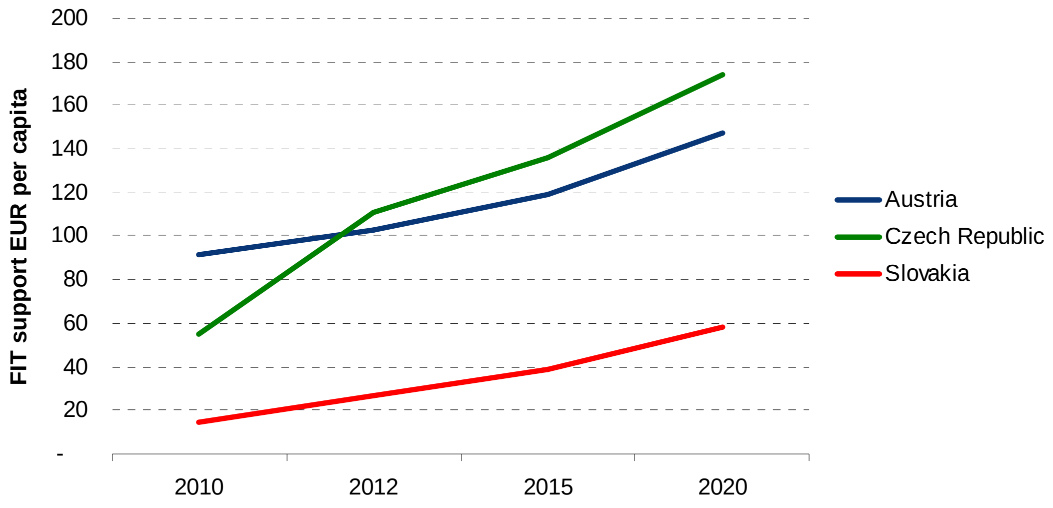


Figure 25 FIT support EUR per capita

This would show us that in 2020 if we take into account Czech Republic average expenditure per inhabitant would be approx. 170 EUR if the figures indicated in National Renewable Energy Action Plans are followed. Slovakia has this ratio approx. a quarter of that of Czech Republic. Current starting point is with approx. 100 EUR. However this comparison could be misleading to a certain extant as it is not only inhabitants that bear the burden of FIT but it is also transferred into goods and services provided as they are also linked to electricity consumption. Therefore the ratio linking FIT impact it to electricity consumption is more precise. Table below illustrates this as it gives precise structure of electricity end-consumption for Austria – where directly to individuals only 23,8% of consumption are linked.

Table 12 Structure of energy end consumption – Austria GWh 2008

Households	12.967	23,8%
Other small off-takers	9.084	16,6%
Agricalture	1.445	2,7%
Small industry (consumption up to 2 GWh)	9.117	14,7%
Middle industry (consumption from 2 GWh up to 20 GWh)	9.469	18,0%
Large Industry (consumption from 20 GWh)	13.225	24,2%
Statistical difference	51	0,0%
Total	55.359	

Source: E-Control 2009

Further comparison based on GDP figures reveals what should the total support in form of feed in tariffs as set out in the case of National Renewable Energy Action Plans shows us the ratio comparing how much will the expenditure be compared to the economic potential of respective country.

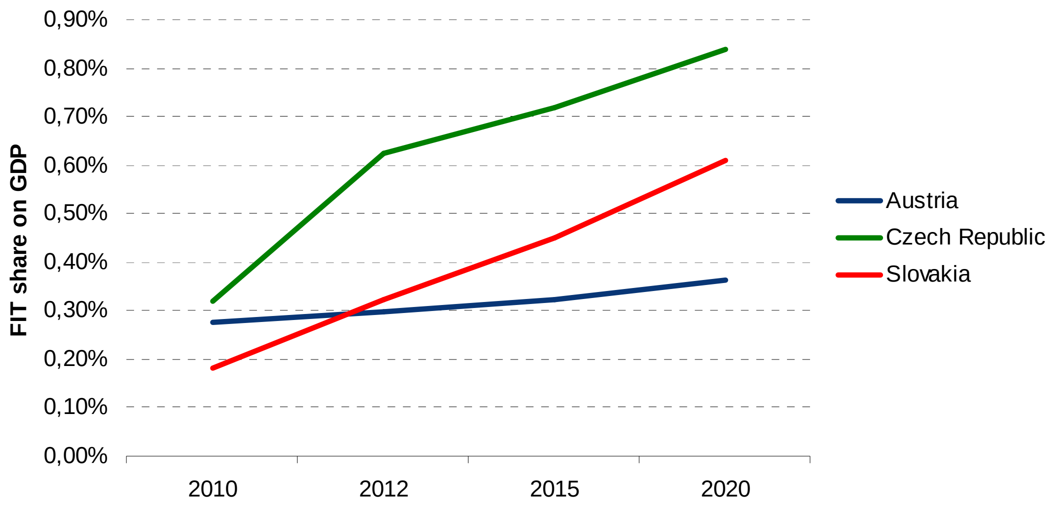


Figure 26 FIT share on Gross Domestic Product

Outcome of this comparison is that despite the overall expenses on FIT compared to other countries are low in case of Slovakia as shown above – the ratio compared to GDP surpasses that of Austria and should end up in the region of 0,60% of GDP. Czech Republic again with the highest figure of costs compared to GDP – these reach almost 0,9%.

4.2 Sensitivity analysis of costs related to renewable electricity production

On the basis of calculations made previously it is possible to create scenarios related to renewable electricity costs. These could show impact of different policies that could be implemented in terms of FIT or specific technology preferences.

4.2.1 FIT escalation scenarios

The first sensitivity works with different escalation of FIT – to show how this impacts total expenditures for support of renewable electricity. As base case 2% growth of FIT has been used. The other scenarios alter this growth rate – one setting FIT growth rate to be 4% for all categories and the scenario on the other end has as its base 0% growth of FIT.

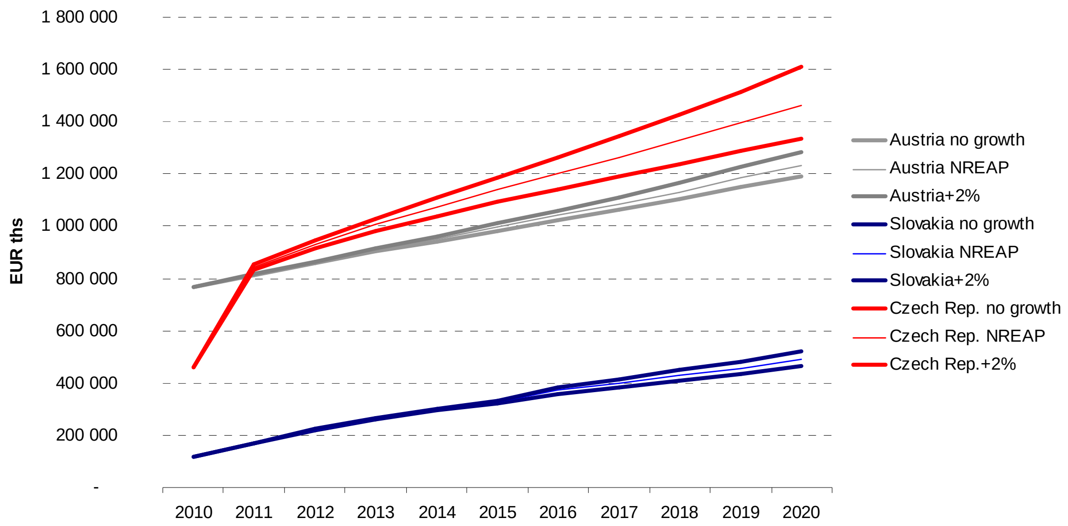


Figure 27 Costs of RES electricity support – sensitivity to indexation of FIT

As the calculation and tariffs escalation influence only price for support paid in the following year – the impact of escalation is not that substantial – however the most impact is being shown in case technologies more demanding in relation to FIT are being implemented according to NREAP. Therefore the widest gap between two extremes can be seen in case of Czech Republic – where the two scenarios diverge by a margin of 18% - compared to Austria with only 8% difference. All three countries have tools to influence FIT in both ways – however this sensitivity shows us what could be the impacts of both trends. This sensitivity proves that just pure change of escalation of FIT does not lead to substantial difference in expenditures – it is the structure of sources and dynamics of development that matter.

4.2.2 Support of photovoltaics

Another sensitivity analysis works with a fictional scenario of not supporting production from photovoltaic power sources – this would eliminate the most cost intensive electricity source from the renewable electricity production mix – impact on expenditure can be most visible in Czech Republic as could be expected – with 50% drop in amount of funds paid annually to support renewable electricity production. This would have implacations of course on reaching of renewable electricity targets by Czech Republic.

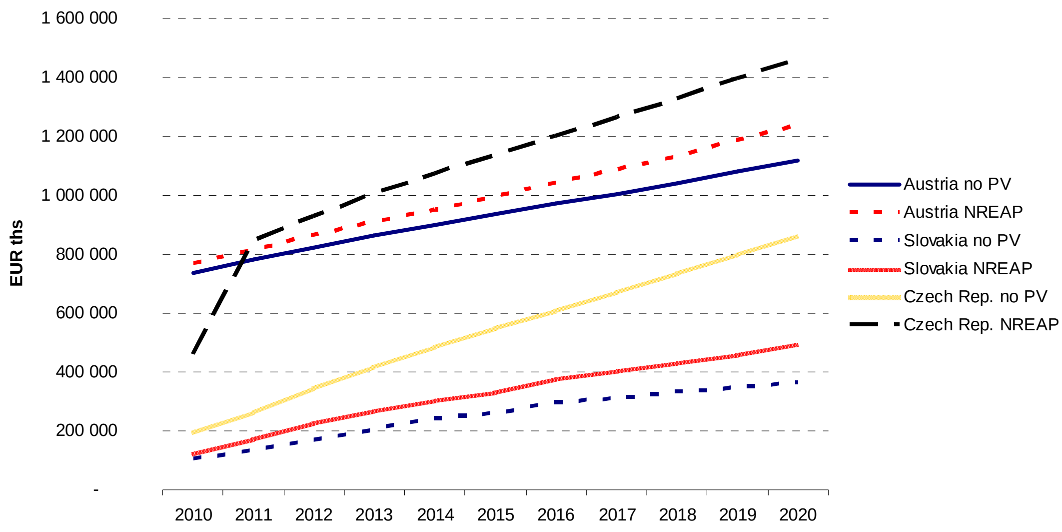


Figure 28 Costs of RES electricity support – abolishing photovoltaics

4.2.3 Support of wind energy

This scenario works with fictional assumption that no more wind turbines would be installed in period 2011-2020 and all the new power generation would come instead from photovoltaic power sources. This would mean that in 2020 Czech Republic would be producing approximately 3100 GWh of electricity per year from PV panels – while Austria would end up at a figure of approx. 2800 GWh of PV production (with wind having the same output as in 2010). As could be observed from the figure below – Czech Republic would again be leading with annual costs related to RES support – however followed by Austria but still by a significant margin of 500 M EUR a year.

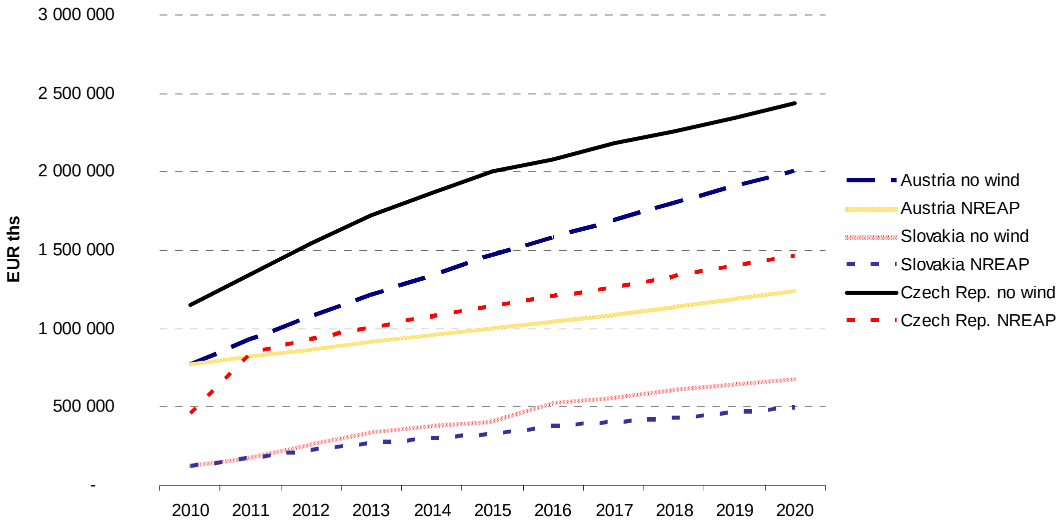


Figure 29 Costs of RES electricity support – abolishing wind energy

5 Other cost factors of energy production from renewable energy sources

Feed in tariffs are not the only single cost factor related to production from renewable electricity sources. Due to their nature and demands number of other costs are related to RES that are to be bared by the consumer and are mentioned below – they are mainly linked to unpredictable nature of wind and solar sources. These costs have not been covered in this master thesis but in order to provide a complete picture of costs related to renewables they should be mentioned.

Other capital expenditures to accommodate renewable electricity sources such as grid expensions, prevention of bottlenecks need to be covered by these costs and also included in calculation of electricity price.

Methods for including these costs into electricity bill differ in all three countries – however are subject to certain regulations.

5.1 Price of system services

Price impact of renewable energy on price of system services and balancing energy is not that easy to express as balancing energy price is also driven by electricity consumption patterns, the whole production base (not just renewable electricity production) and also electricity wholesale prices (EGU 2010: 35).

5.2 Price of grid service

This price component has the most impact in case electricity distribution and transmission grid would have to be upgraded in order to cope with growing share of renewable energy production (e.g. wind in regions where grid has not been designed to cope with these flows). These would be primary capital expanditures into the network.

5.3 Price of deviation (balancing)

Under influence of uneven production from renewable energy sources (mainly photovoltaics and wind) the costs for the electricity traders (or other entities that are responsible for inclusion of renewable electricity price into electricity prices such as distribution companies) to acquire balancing energy in order to cope with uneven production.

6 Findings and recommendations

Linked to this master thesis and experience gathered through its writing number of recommendations and findings can be mentioned. These recommendations may lead to optimizing implementation of renewable electricity policies. Some of them have their positive applications in practice already.

6.1 Information database

For future studies and better orientation in the field of renewables the information framework is still insufficient and available data are in some cases outdated[13]. It is mainly related to information on electricity production from renewable and installed capacities. This could be also seen in reports of state institutions that instant feedback on the effect of the policies is lagging. Therefore it would be best if effort was given to as much transparency as possible from all sides of market participants: 1) the regulator, 2) energy producers, 3) energy distributors and 4) settlement agents.

6.2 Introduction of market mechanisms

Currently the system in all three countries works through a system of feed in tariffs that are calculated to give reasonable profit to the investor – however in some cases it might be beneficial to include market mechanisms such as competition of producers in relation to level of FIT. The producer would through tender be given preference to receive FIT thanks to lover level of support he requests[14].

[13] For example annual Renewable Energy Report (Ökostrombericht) of Austrian E-Control is a good example of functional reporting – however limited daily data are available http://e-control.at/de/publikationen/oeko-energie-und-energie-effizienz/berichte/oekostrombericht .

[14] Another example for this case is a recent tender in Hungary realted to wind capacities – despite its cancelation due to political reasons it recieved much appraisal among developers. http://www.eh.gov.hu/home/html/index.asp?msid=1&sid=0&hkl=596&lng=2

6.3 Reacting to market trends

It is true that renewable energy projects have a long time of implementation – ranging in some cases to numerous years – but on the other hand are in some cases subject to swift changes due to:

1) technological development (as could be seen in the example of photovoltaics),
2) development of price of raw materials (such as biomass),
3) development of price of fossile energy sources that could be used as substitutes.

These factors should be followed and the regulator – authority with power over support mechanisms should be able to quickly react to changing conditions[15].

6.4 Adaptable policies

As none of the countries is homogenous in terms of landscape and potential for renewable electricity production – policies that would enable optimal deployment of technologies may be implemented. That means not having just one nationwide feed in tariff[16] – but creating a more regionally oriented system to try to foster adaptable renewable electricity policies.

[15] This could be achieved by publishing FIT for specific Technologies semi-annually – which would be linked to prices on the commodities – but since markets with biomass lack transparency and there is no central Exchange what would have to be remedied.

[16] A good example might be wind energy where also locations with scarce inhabitance but low wind potential could be preferred – or other regional preferences to be followed.

7 Conclusion

Costs related to renewable electricity production have recently become a topic of public discussion – however all arguments used should be based on sound analysis.
Research question of this work was what are the costs linked to electricity production from renewable electricity sources. Calculation has shown that the price impacts are mainly a function of policies in terms of feed in tariffs and also regulation.
Based on the inputs described in detail in previous parts of the master thesis it can be predicted that the renewable electricity costs will take following shape in the years to come in Austria, Czech and Slovak Republic.

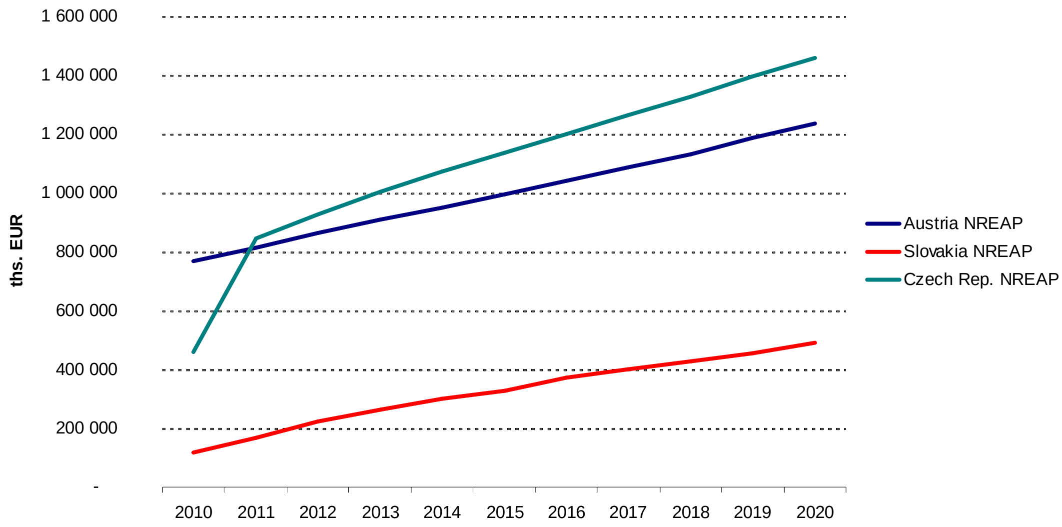


Figure 30 Cost of RES electricity support according to NREAP

This assumption does not give us a whole picture therefore comparison has shown that the impacts differ when put into relation with GDP – where for example it has far higher burden in Slovakia and Czech Republic compared to Austria (almost double). Other comparisons towards size of the population, electricity production etc. gives us different results that should also be emphasized in public discussions over renewables.
Under assumptions in this master thesis these three countries will invest 6,325 bln. EUR from 2011 into renewable electricity production capacities – and still also current costs have to be considered as for example major investments in Czech Republic are already due as a result of massive development of PV plants in 2010.

This work has based its assessments on National Renewable Action Plans – however reality may differ substantially from these documents – therefore it is important to show sensitivities of development – mainly deep changes in FIT have implications on costs related to renewable electricity production. However it has to be remembered that it is also the current pipeline of operational projects that also shapes the future – because FIT are set and guaranteed over longer periods – bringing the effects of today's policies into the next decade.

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