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An overview of the EU Member States support schemes for the promotion of renewable energy sources

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Abstract
In this work, an overview of the European Union (EU) Member States support schemes for the promotion of renewable energy sources (RES) is provided. In particular, the status of the electricity generation capacity as well as the RES mixture in the Member States is described. Moreover, the different support schemes such as, investment support, feed-in tariffs (FiTs), tradable green certificates, and fiscal and financial measures which the Member States have adopted for the promotion of RES technologies are discussed in detail. Some Member States are implementing a single support scheme for the promotion of RES for power generation (RES-E), e.g., seven Member States use FiTs, or implement a hybrid support scheme by combining all or some of the four categories of the RES-E supporting schemes. Although, these support schemes have increased the penetration of the RES-E technologies in the Member States, still there is a long way in order to achieve the 2020 target. The reason for this may be that the way these schemes have been used so far, i.e., either as single support schemes or in combination of FiTs or tradable green certificates with investment support and fiscal and financial measures, has been ineffective. A more effective combination could be a hybrid scheme consisting of FiTs with tradable green certificates measures, as in the case of Italy and United Kingdom, that will increase the RES-E penetration and eliminate the possible technical problems which will arise from this increased penetration and have an effect in the stability of the power system.

Keywords: RES directive; Feed-in tariffs; Green certificates; Renewable energy sources.

1. Introduction

The European Union (EU) has already tuned its energy policy into achieving maximum carbon dioxide (CO_2) emissions reduction from power generation plants. In this context, it has already set out a strategic objective of achieving at least a 20% reduction of greenhouse gases by 2020 compared to 1990 levels [4]. This strategic objective represents the core of the new European energy policy. Recognizing the positive effects of renewable energy sources (RES) technologies towards achieving this goal, the EU has taken a range of specific actions in the direction of enhancing the integration of RES in the existing European power generation system as a major step towards the reduction of global warming and climate change phenomena.

Specifically, an action plan in the form of an EU Directive on the promotion of the use of energy from RES [3] has been introduced by the EU whereby a target of RES share of 20% out of the gross final energy consumption of the EU has been set to be reached by the year 2020. According to this Directive [3], different supporting schemes can be used by the Member States for the promotion of RES

technologies, either by the implementation of a single support scheme or by the implementation of a hybrid combination of two or more support schemes.
The purpose of this work is to provide an overview of the EU Member States support schemes for the promotion of RES. In particular, the current status of the electricity generation capacity as well as the RES mixture in the Member States is described. Moreover, the different support schemes such as, investment support, feed-in tariffs (FiTs), tradable green certificates, and fiscal and financial measures which the Member States have adopted for the promotion of RES technologies are discussed in detail.
In section 2, a brief description of the EU RES Directive is provided. The status of the current electricity generation capacity in the Member States is provided in section 3, whereas the different EU Member States support schemes for the promotion of RES technologies are described in section 4. Finally, the conclusions are summarized in section 5.

2. The EU RES directive

The EU policy on RES is set out in the relevant Directive [3] of the European parliament and of the Council. The Directive concerns the promotion and use of energy from RES and establishes a common framework for the promotion of energy from RES. It sets mandatory national targets for each Member State for the overall share of energy from RES in gross final consumption of energy and for the share of energy from RES in transport. Also, it lays down rules relating to statistical transfers between Member States, joint projects between Member States and with third countries, guarantees of origin, administrative procedures, information and training, and access to the electricity grid for energy from RES.

Table 1. EU member states RES targets for 2020

Member State	Share of energy from renewable sources in gross final consumption of energy, 2005 (S_{2005}) [%]	Target for share of energy from renewable sources in gross final consumption of energy, 2020 (S_{2020}) [%]
Austria	23.3	34
Belgium	2.2	13
Bulgaria	9.4	16
Cyprus	2.9	13
Czech Republic	6.1	13
Denmark	17.0	30
Estonia	18.0	25
Finland	28.5	38
France	10.3	23
Germany	5.8	18
Greece	6.9	18
Hungary	4.3	13
Ireland	3.1	16
Italy	5.2	17
Latvia	32.6	40
Lithuania	15.0	23
Luxembourg	0.9	11
Malta	0.0	10
Netherlands	2.4	14
Poland	7.2	15
Portugal	20.5	31
Romania	17.8	24
Slovak Republic	6.7	14
Slovenia	16.0	25
Spain	8.7	20
Sweden	39.8	49
United Kingdom	1.3	15

Based on the Directive, each Member State shall ensure that the share of energy from RES, calculated in accordance with specific EU guidelines, in gross final consumption of energy in 2020 is at least its national overall target for the share of energy from RES in that year, as set out in Table 1. Such mandatory national overall targets are consistent with a target of at least a 20% share of energy from RES in the Community's gross final consumption of energy in 2020. In order to achieve the national targets, each Member State is encouraged to promote energy efficiency and energy saving. In addition, Member States are required to introduce measures effectively designed to ensure that the share of energy from RES for each year leading up to the year 2020, equals or exceeds a pre-specified indicative trajectory set out in the RES Directive for each individual Member State, as shown in Table 2. Finally, each Member State shall ensure that the share of energy from RES in all forms of transport in 2020 is at least 10 % of the final consumption of energy in transport in that Member State.

Table 2. EU Member States RES countries indicative trajectory up to 2020

Indicative trajectory	Notes
$S_{2005} + 0.2 (S_{2020}-S_{2005})$	As an average for the two year period 2011 to 2012
$S_{2005} + 0.3 (S_{2020}-S_{2005})$	As an average for the two year period 2013 to 2014
$S_{2005} + 0.45 (S_{2020}-S_{2005})$	As an average for the two year period 2015 to 2016
$S_{2005} + 0.65 (S_{2020}-S_{2005})$	As an average for the two year period 2017 to 2018

S_{2005}= The share for that EU country in 2005 as indicated in Table 1
S_{2020}= The share for that EU country in 2020 as indicated in Table 1

The gross final consumption of energy from RES in each Member State is calculated as the sum of (a) the gross final consumption of electricity from RES, (b) the gross final consumption of energy from RES for heating and cooling and (c) the final consumption of energy from RES in transport. The share of energy from RES is calculated as the gross final consumption of energy from RES divided by the gross final consumption of energy from all energy sources, expressed as a percentage.

In order to reach the targets set in Table 1, each Member State may apply financial support schemes for facilitating the domestic production of RES or, in case a Member State cannot fully achieve the targets by relying on domestic renewable production, it may opt for any of the four types of measures of cooperation between different Member States and/or third countries. The four types of measures are the (a) statistical transfers between Member States, (b) joint projects between Member States, (c) joint projects between Member States and third countries and (d) joint support schemes.

In the statistical transfers between Member States measure, Member States may agree and make arrangements for the statistical transfer of a specified amount of energy from RES from one Member State (which expects to have a surplus of generated renewable energy) to another Member State (which expects to have a deficit). The transferred quantity shall be deducted from the country making the transfer and added to the country accepting the transfer. In the joint projects between Member States measure, two or more Member States may cooperate on all types of joint projects relating to the production of electricity, heating or cooling from RES. That cooperation may involve private operators. Effectively, the renewable energy produced by a joint project in the territory of one Member State can be agreed to count towards the national overall target of another Member State. The joint projects between Member States and third countries measure, is very similar to the joint projects between Member States measure, but it refers only to the production of electricity from RES. The renewable electricity produced can count towards the national target of the Member State, under the condition that the produced electricity is consumed in the European Community. In the joint support schemes measure, two or more Member States may decide, on a voluntary basis, to join or partly coordinate their national support schemes. In such cases, a certain amount of energy from RES produced in the territory of one participating Member State may count towards the national overall target of another participating Member State.

As part of the national policies and measures for the promotion of RES, according to the EU RES policy, Member States must ensure that transmission system operators and distribution system operators in their territory guarantee the transmission and distribution of electricity produced from RES. For this purpose, Member States must arrange for either priority access or guaranteed access to the electricity grid for electricity produced from RES.

In addition, Member States must ensure that the origin of electricity produced from RES can be guaranteed in accordance with objective, transparent and non-discriminatory criteria. To that end, Member States must ensure that a guarantee of origin is issued in response to a request from a producer of electricity from RES. Member States may arrange for guarantees of origin to be issued in response to a request from producers of heating and cooling from RES. Such an arrangement may be made subject to a minimum capacity limit. A guarantee of origin shall be of the standard size of 1MWh. No more than one guarantee of origin shall be issued in respect of each unit of energy produced.

In line with the EU RES policy, each Member State already adopted a national RES action plan. The national RES action plans set out Member States' national targets for the share of energy from RES consumed in transport, electricity and heating and cooling in 2020, taking into account the effects of other policy measures relating to energy efficiency on final consumption of energy, and adequate measures to be taken to achieve those national overall targets.

The national RES action plans were submitted to the Commission on the 30th June 2010. In addition, each Member State published and notified to the Commission, six months before its national RES action plan was due, a forecast document indicating (a) its estimated excess production of energy from RES compared to the indicative trajectory which could be transferred to other Member States, as well as its estimated potential for joint projects, until 2020 and (b) its estimated demand for energy from RES to be satisfied by means other than domestic production until 2020. The individual country data resulting from the forecast documents are shown in Table 3. Based on this data, the proposed measures of cooperation between Member States are likely to be activated since some countries expect to have excess amount of RES energy generated while some others expect to have deficits of RES energy. Finally, each Member State shall submit a report to the Commission on its progress in the promotion and use of energy from RES by 31 December 2011, and every two years thereafter. The sixth report, to be submitted by 31 December 2021, shall be the last report required.

Table 3. EU Member States forecast for national RES targets for 2020

Member State	Projected RES energy in 2020 compared to national RES energy target		
	Excess [ktoe]	Deficit [ktoe]	On target by domestic production
Austria			Yes
Belgium		200	
Bulgaria		140	
Cyprus			Yes
Czech Republic			Yes
Denmark		337	
Estonia	3		
Finland			Yes
France			Yes
Germany	1387		
Greece			Yes
Hungary			Yes
Ireland			Yes
Italy		4000	
Latvia			Yes
Lithuania			Yes
Luxembourg		43-300	
Malta		4	
Netherlands			Yes
Poland	333		
Portugal	not defined		
Romania			Yes
Slovak Republic	143		
Slovenia			Yes
Spain	690		
Sweden	485		
United Kingdom			Yes

3. Status of electricity generation capacity in the EU member states

After the implementation of the previous EU RES policies, the share of RES for power generation (RES-E) in each of the EU Member States' electric power mixture in the last years has started to grow significantly [8]. Referring to Figure 1, for the year 2009, in fourteen Member States the power generation system installed capacity primarily depended on conventional (excluding nuclear) and nuclear systems. Both systems' generation capacity amounted to more than 50% of the total installed electric power capacity. An example of this case is Germany where the conventional and nuclear capacity amounted to 67% of the total installed capacity, with a RES-E capacity of 33%, which is 50GW out of 153GW of the total national electric power capacity. Furthermore, in eight Member States the power system installed capacity was primarily depended on conventional systems (excluding nuclear), which amounted to more than 50% of the total installed electric power capacity. An example of this case is Italy where the conventional capacity amounted to 71% of the total installed capacity, with a RES-E capacity of 29%, which is 30GW out of 103GW of the total national electric power capacity. Also, six Member States had a total RES-E capacity greater than 40% of their total installed national electric power capacity. An example of this case is Sweden where the RES-E installed capacity was 56.5% amounting to 19GW out of the 34GW of the total national electric power capacity. At the same time, the conventional systems capacity (excluding nuclear) was only 5.5GW, while the nuclear systems capacity was 9.3GW.

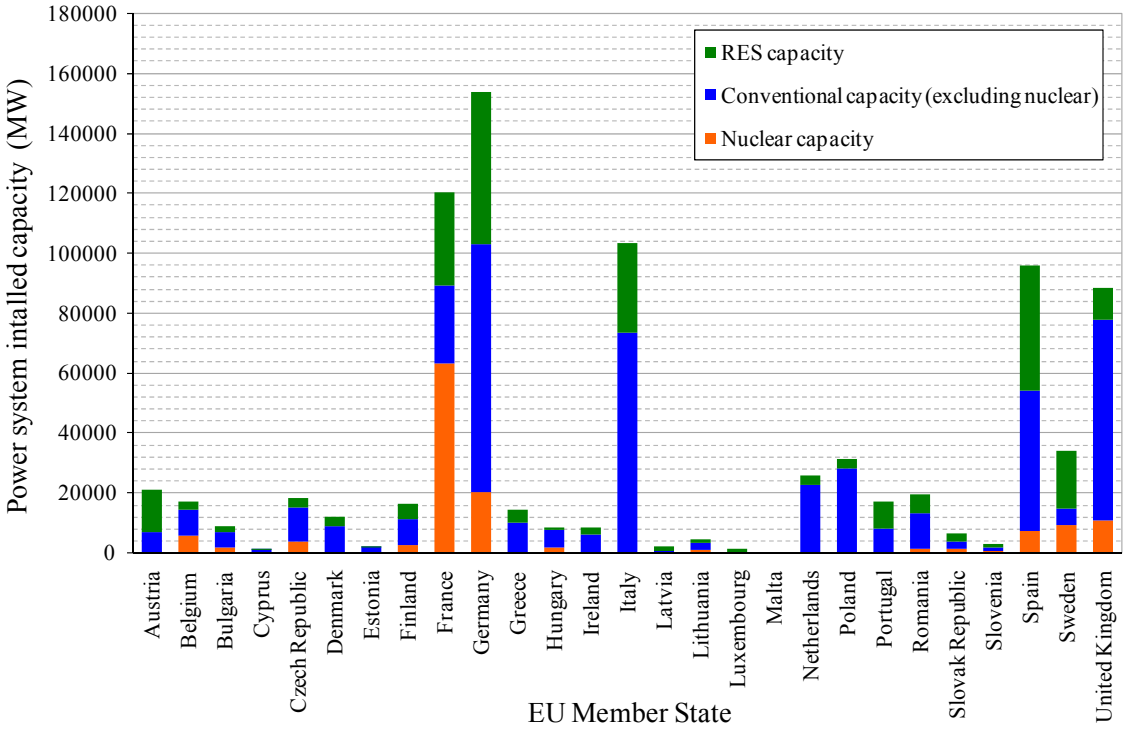

Figure 1. EU-27 power system installed capacity in 2009

The RES-E installed capacity share of the EU Member States, for the year 2009, is illustrated in Figure 2. As before, by considering the examples of Germany, Italy and Sweden, it can be observed that in Germany, wind systems with total installed capacity of 26GW were the most developed RES-E technology, followed by hydro systems of 11GW installed capacity and PV systems of 9.8GW installed capacity out of the 50GW of the total installed national RES-E capacity. In Italy, hydro systems with total installed capacity of 21GW were the most developed RES-E technology, followed by wind systems of 4.9GW installed capacity and other RES-E systems of 2.2GW installed capacity out of the 30GW of the total installed national RES-E capacity. Finally in Sweden, hydro systems with total installed capacity of 16GW were the most developed RES-E technology, followed by wind systems of 1.6GW installed capacity and other RES-E systems of 1.5GW installed capacity out of the 19GW of the total installed national RES-E capacity.

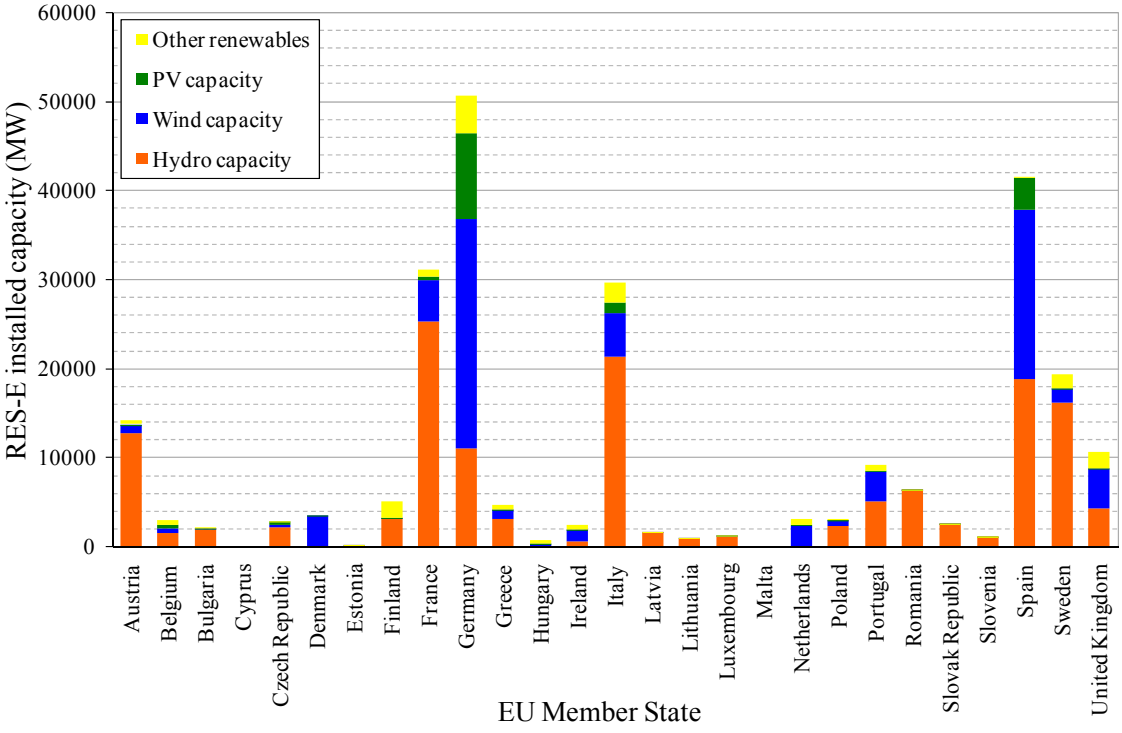

Figure 2. EU-27 RES-E installed capacity in 2009

4. EU Member States support schemes

The policies and measures currently implemented in the European RES market have so far been mainly directed towards the promotion of RES-E. The measures that a Member State can use for the promotion of RES-E are (a) investment support, (b) FiTs, (c) tradable green certificates, and (d) fiscal and financial measures. The current measures used by each Member State, are tabulated in Table 4. Some Member States are implementing a single support scheme for the promotion of RES-E, e.g., seven Member states use FiTs. However, other Member States implement a hybrid support scheme by combining all or some of the above RES-E supporting schemes [2, 5, 11].

4.1 Investment support

The investment support measure involves direct financial subsidies for building RES-E capacity. It is a measure that stimulates the supply side and can easily be tailored to encourage particular forms of renewable energy in line with national and regional policies. In particular, fifteen Member States are using investment support schemes in combination with other support schemes, usually FiTs or fiscal and financial measures. Some examples of such Member States which cover geographically all the areas of Europe are the Czech Republic, France, Lithuania, Malta, the Netherlands and Sweden.

In the Czech Republic, the investment support measure is provided through some governmental programs. The National Program for the promotion of energy saving measures and the use of RES, provides subsidies of up to 40% of the eligible costs of small hydro power systems with the maximum amount being 124k€. The Operational Program Enterprise and Innovations gives entrepreneurs the opportunity to apply for investment subsidies or low interest loans funded by European Regional Development Fund for RES projects with maximum subsidy of 75% of the eligible costs and maximum amount 2M€. Also, the same program gives entrepreneurs the opportunity to apply for investment subsidies or low interest loans for RES projects with minimum subsidy of 20k€ and maximum subsidy of a certain percentage of the eligible costs, which differs according to the region and the size of the company and must not exceed 4.15M€. Finally, the Operational Program Environment allocates investment subsidies from the Cohesion Fund to individual and large RES projects with the maximum subsidy not to exceed 20% of the total project costs, and a maximum amount of 2M€.

In France, investment support is provided through a special FiT which is awarded to the winners of tenders for the construction of RES systems. With this, the French government hopes to reach the target production of electricity from RES-E, which is laid down in the multi-annual investment plant. In

Lithuania, investment support is provided through a governmental program, the Lithuanian Environmental Investment Fund, which allocates subsidies to projects aiming to reduce environmental damage in the long run with maximum subsidy of 200M€ in a three year period and up to 80% of total investment.
In Malta, the government provides the investment support measure through once-only grants for small wind energy systems and solar energy systems to private investors of 25% of the purchase price of the installation, with maximum subsidy of 233€ and 50% of the purchase price with maximum subsidy of 3k€, respectively. In the Netherlands, the investment support measure is provided through a governmental program, which provides subsidies for research, development and market research RES projects up to 40% of investment costs.
In Sweden, the government provides subsidies for large scale wind energy projects, which includes (a) measures for promoting environmental sustainability, (b) technology grants which may amount to a maximum of 50% of the additional costs and must not exceed a total of 200k€ within a period of three calendar years and (c) development costs prior to market entry.

Table 4. EU-27 RES supporting schemes

Member State	Investment support	FiTs	Tradable green certificates	Fiscal and financial measures
Austria	√	√		
Belgium			√	√
Bulgaria		√		
Cyprus	√	√		
Czech Republic	√	√		√
Denmark	√	√		
Estonia		√		
Finland	√	√		
France	√	√		√
Germany		√		
Greece		√		
Hungary		√		
Ireland		√		
Italy		√	√	√
Latvia		√		
Lithuania	√	√		√
Luxembourg	√	√		√
Malta	√	√		
Netherlands	√	√		√
Poland	√		√	√
Portugal		√		√
Romania	√		√	
Slovak Republic	√	√		√
Slovenia	√	√		
Spain		√		√
Sweden	√		√	√
United Kingdom		√	√	√

According to the measures for promoting environmental sustainability, up to 40% of eligible costs are subsidized, which include the cost difference between RES-E and a conventional system and the costs of implementation. For small and medium sized enterprises the subsidy is 50% of the eligible costs. Up to 100% of eligible costs may be returned if the applicant can prove that the system cannot be erected without the grant and assures that no other investment subsidy will be received for the very same system in the future. According to the development costs prior to market entry, up to 25% of the costs arising directly from the development of energy technology products may be reimbursed.
Also, the Swedish government provides subsidies for municipalities that are planning to implement wind energy projects, which amount to 50% of the estimated planning costs and subsidies for the installation

of PV systems, which amount to 55% of the costs of labour and service, material and planning for large enterprises and 60% of these costs for all other enterprises. The maximum subsidy is 218k€ per project and the total project costs must not exceed 9k€/kW of installed maximum capacity.

4.2 FiTs

FiTs set a guaranteed premium price to the green electricity producer and put an obligation on the grid operators to purchase the generated electricity output [1]. The price is typically guaranteed for a long period in order to encourage investment in new RES-E plants. FiTs are supply-side measures that push green electricity onto the market. Except from Belgium, Poland, Romania and Sweden, the main support scheme implemented by Member States to support the generation of RES-E, is the system of fixed FiTs. The system is well known for its success in deploying large amounts of wind, biomass and solar energy in Germany, Denmark and Spain among others. The biggest advantage of the systems as designed in these countries is the long-term certainty of financial support, which lowers investment risks considerably. Another key advantage is the possibility of technology-specific support, which leads to a relatively broad technology portfolio at low windfall profits for low-cost technologies. Referring to Table 4, twenty-three Member States use this measure. The Czech Republic, Denmark, France, Italy, Lithuania and the Netherlands are some examples of such Member States which cover geographically all the areas of Europe.

The level of each FiT scheme [2, 7, 10, 11] provided in each EU Member State for various types of RES-E technology, such as on-shore wind, off-shore wind, PV, biomass and hydro is shown in Figures 3-7, which depends on the individual RES-E technology available potential of each Member State (all currency exchange rates used are dated 1/9/2011 from [9]). In the Czech Republic the FiT for both on-shore and off-shore wind systems is the same and accounts to 9.3€c/kWh for large capacity wind systems and 14.7€c/kWh for small capacity wind systems. In the case of PV systems, the Czech Republic has a FiT of 22.8€c/kWh for large capacity PV systems and 60.8€c/kWh for small capacity PV systems, which is the highest FiT amongst all Member States. In the case of systems that utilize biomass for producing electricity, the FiT is 10.9€c/kWh for large capacity biomass systems and 19€c/kWh for small capacity biomass systems, whereas for hydro systems, the FiT is 7.8€c/kWh for large capacity hydro systems and 12.7€c/kWh for small capacity hydro systems.

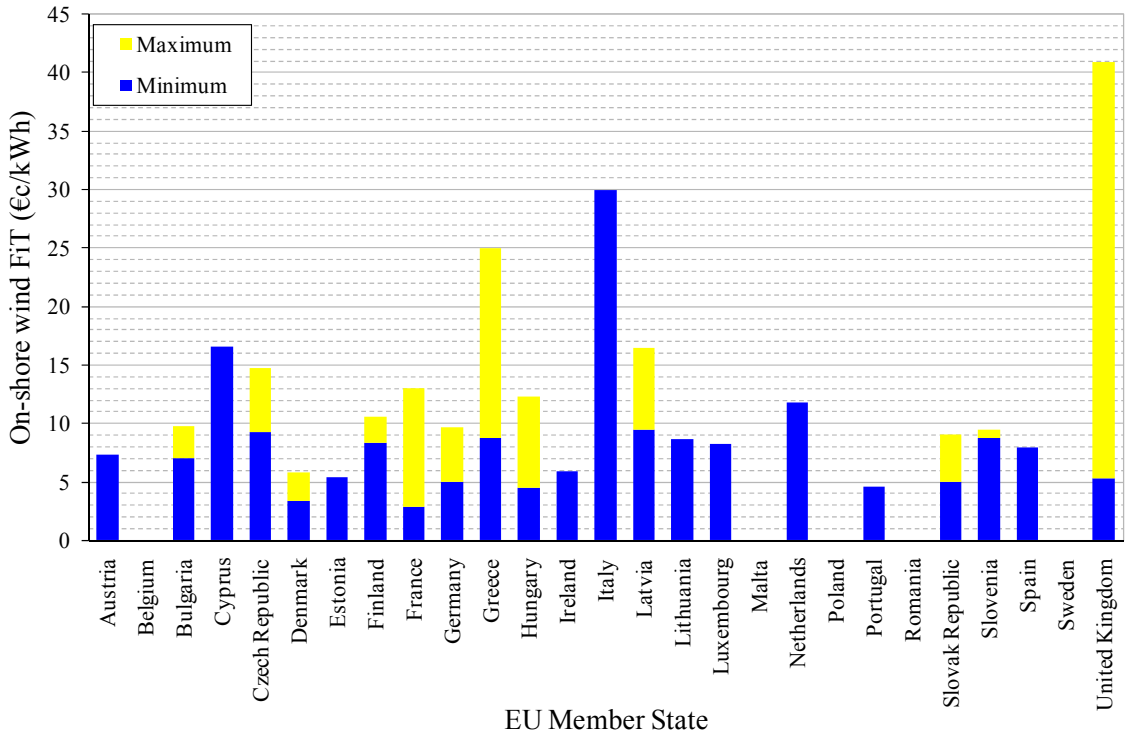

Figure 3. EU-27 on-shore wind FiT

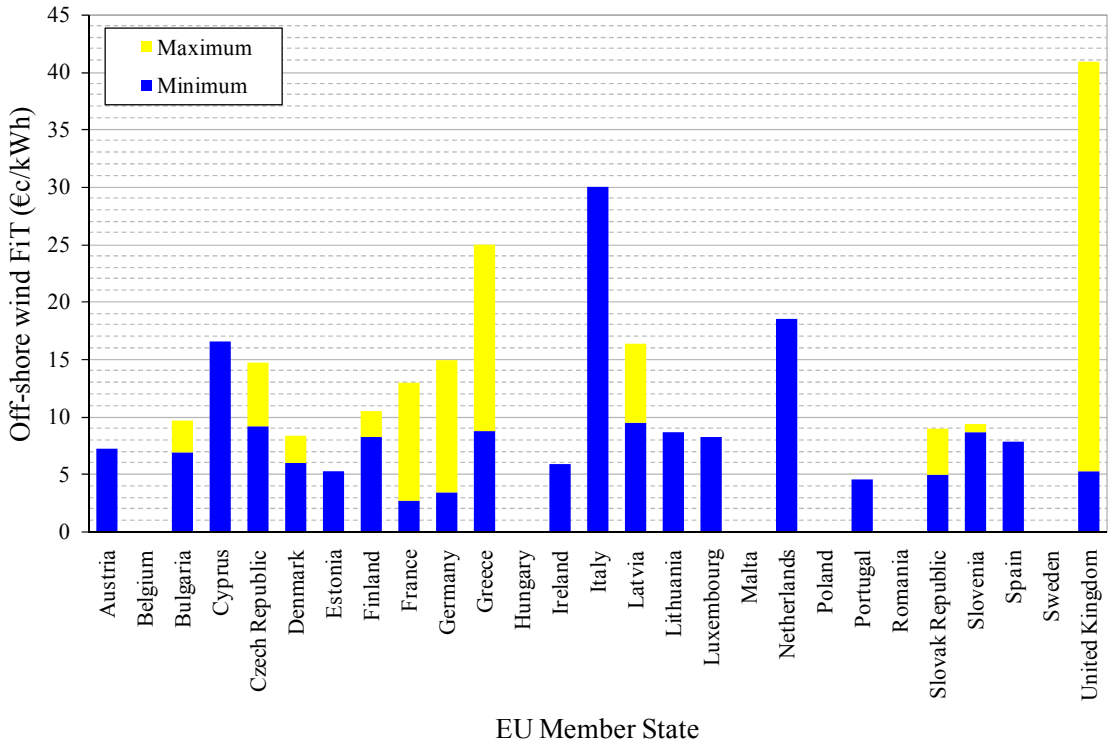

Figure 4. EU-27 off-shore wind FiT

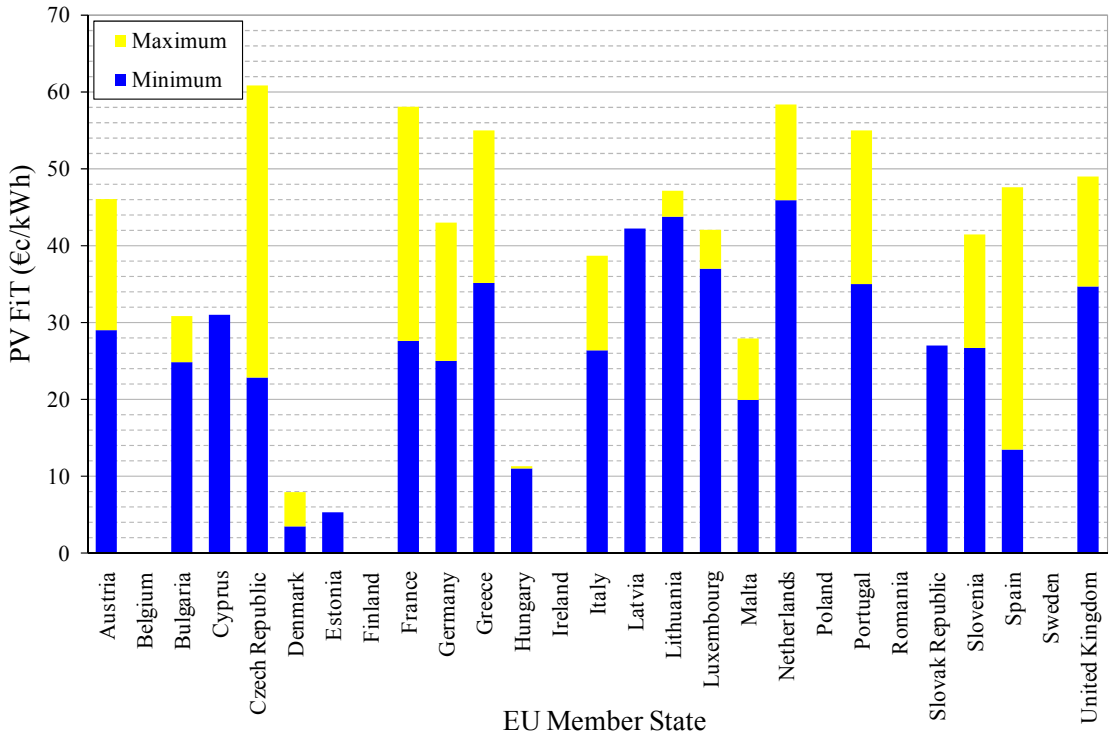

Figure 5. EU-27 PV FiT

In Denmark the FiT for on-shore wind systems is 3.4€c/kWh for large capacity wind systems and 5.8€c/kWh for small capacity wind systems, which is the third lowest FiT after amongst all Member States, whereas for off-shore wind systems the FiT is higher and it accounts to 6.1€c/kWh for large capacity wind systems and 8.4€c/kWh for small capacity wind systems. In the case of PV systems, Denmark has a FiT of 3.5€c/kWh for large capacity PV systems, which is the lowest FiT for large capacity PV systems amongst all Member States, and 8.1€c/kWh for small capacity PV systems, which

is the second lowest FiT after that of Estonia. In the case of systems that utilize biomass for producing electricity, the FiT is 5.4€c/kWh for any capacity size of biomass system, which is the lowest FiT with that of Estonia amongst all other Member States, whereas for hydro systems, the FiT is 3.5€c/kWh for large capacity hydro systems, which is the lowest FiT for large capacity hydro systems with that of Germany amongst all other Member States, and 8.1€c/kWh for small capacity hydro systems. In France the FiT for both on-shore and off-shore wind systems is the same and accounts to 2.8€c/kWh for large capacity wind systems, which is the lowest FiT for large capacity on-shore and off-shore wind systems amongst all Member States, and 13€c/kWh for small capacity wind systems. In the case of PV systems, France has a FiT of 27.6€c/kWh for large capacity PV systems and 58€c/kWh for small capacity PV systems, which is the third highest FiT amongst all Member States. In the case of systems that utilize biomass for producing electricity, the FiT is 11.9€c/kWh for any capacity size of biomass system, whereas for hydro systems, the FiT is 6.1€c/kWh for large capacity hydro systems and 15€c/kWh for small capacity hydro systems.

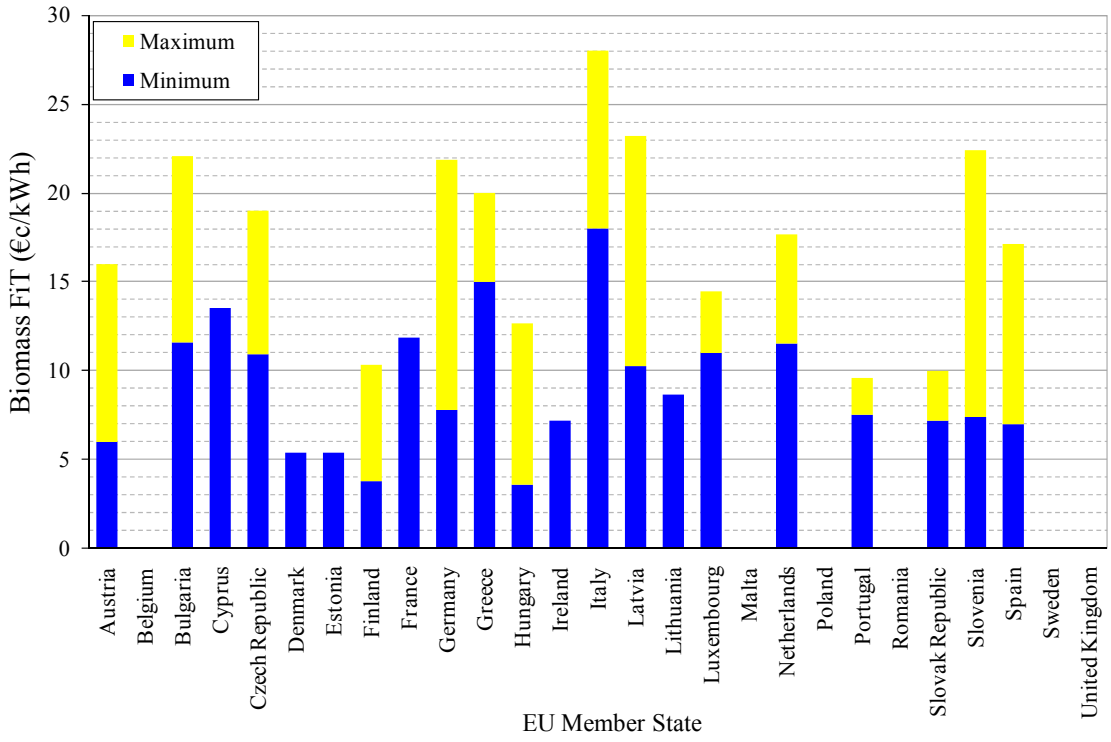

Figure 6. EU-27 biomass FiT

In Italy the FiT for both on-shore and off-shore wind systems is the same and accounts to 30€c/kWh for any capacity size of wind systems, which is the second highest FiT after that of the United Kingdom for both wind systems. In the case of PV systems, Italy has a FiT of 26.4€c/kWh for large capacity PV systems and 38.7€c/kWh for small capacity PV systems. In the case of systems that utilize biomass for producing electricity, the FiT is 18€c/kWh for large capacity biomass systems and 28€c/kWh for small capacity biomass systems, which is the highest FiT amongst all Member States, whereas for hydro systems, the FiT is 22€c/kWh for any capacity size of hydro systems, which is the second highest FiT together with that of Greece after that of the United Kingdom. In Lithuania the FiT for both on-shore and off-shore wind systems is the same and accounts to 8.7€c/kWh for any capacity size of wind systems. In the case of PV systems, Lithuania has a FiT of 43.7€c/kWh for large capacity PV systems, which is the second highest FiT for small capacity PV systems after that of the Netherlands, and 47.2€c/kWh for small capacity PV systems. In the case of systems that utilize biomass for producing electricity, the FiT is 8.7€c/kWh for any capacity size of biomass system, whereas for hydro systems, the FiT is 7.5€c/kWh for any capacity size of hydro systems.

In the Netherlands the FiT for on-shore wind systems is 11.8€c/kWh for any capacity size of wind systems, whereas for off-shore wind systems the FiT is higher and it accounts to 18.6€c/kWh for any capacity size of wind systems. In the case of PV systems, the Netherlands has a FiT of 45.9€c/kWh for

large capacity PV systems, which is the highest FiT for large capacity PV systems amongst all Member States, and 58.3€c/kWh for small capacity PV systems, which is the second highest FiT after that of the Czech Republic. In the case of systems that utilize biomass for producing electricity, the FiT is 11.5€c/kWh for large capacity biomass systems and 17.7€c/kWh for small capacity biomass systems, whereas for hydro systems, the FiT is 7.3€c/kWh for large capacity hydro systems and 12.5€c/kWh for small capacity hydro systems.

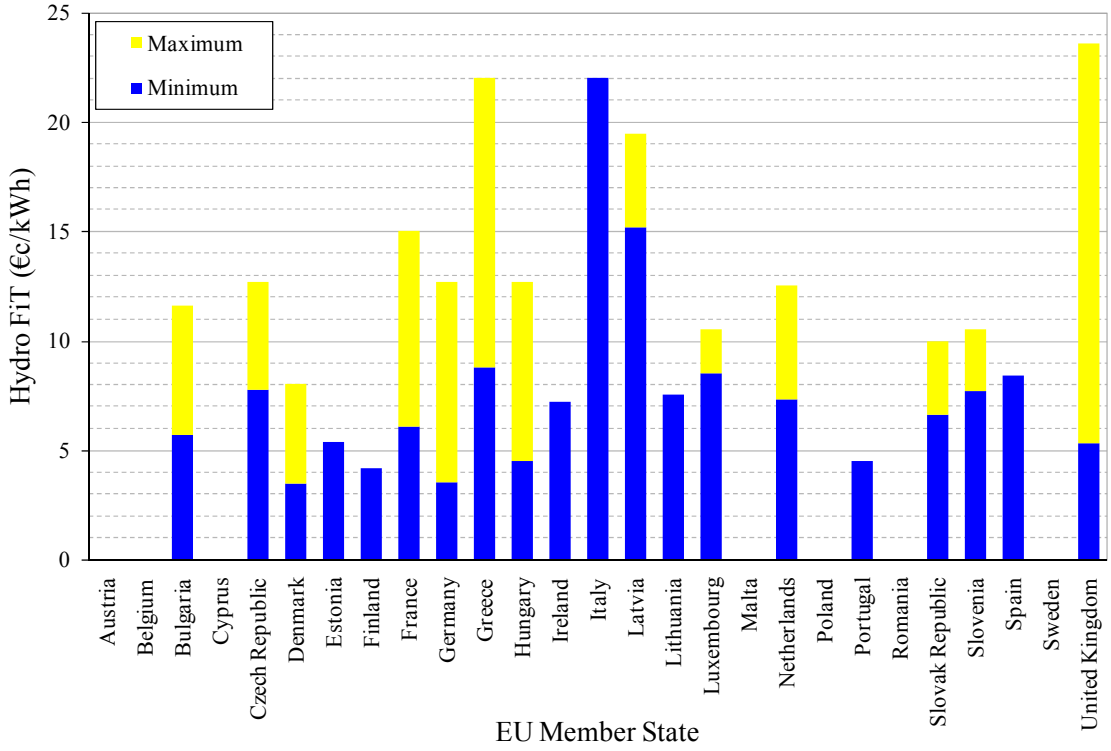

Figure 7. EU-27 hydro FiT

A new special type of FiT is the net metering scheme. Net metering is an electricity policy which allows utility customers to offset some or all of their energy use with self produced renewable energy. Net metering works by utilizing a meter that is able to spin and record energy flow in both directions. The meter spins forward when a customer is drawing power from the utility grid (i.e., using more energy than they are producing) and spins backward when energy is being sent back to the grid. At the end of a given month, the customer is billed only for the net energy used.

Net metering works only for grid-tied systems and what makes it so beneficial, besides offsetting a home's energy consumption with a renewable source, is that excess energy sent to the utility can be sold back at retail price. Usually any surplus energy is credited on the customer's account toward the next billing cycle. If at the end of the year a surplus remains, then the customer is paid for the difference. Net metering is gaining recognition as a simple and effective RES-E promotion incentive [6].

In Europe, only Denmark and Italy are using net metering [11]. In particular, in Denmark, the regulation on net metering for the electricity producers for own needs is based on the act on electricity supply and authorizes the exemption of certain producers from Public Service Obligation (PSO). According to this, the systems which have an exemption to pay PSO, as they use all of the electricity produced for their own needs, are PV systems up to 50kW, wind energy plants up to 25kW and other RES-E technologies up to 11kW. Also, the systems which have an exemption to pay PSO for the support of renewable energy, as they use part of the electricity produced for their own needs, are PV systems more than 50kW, wind energy plants more than 25kW and other RES-E technologies more than 11kW. In Italy, RES-E systems up to 20kW or from 20kW up to 200kW which have been commissioned after 31 December of 2007, can consume as much energy they produce for free. If more energy is produced than consumed, producers receive credit for this positive balance, which will be available for an unlimited period of time and could be used as a compensation for a possible negative balance in the following years. If the energy produced is less than their consumption the difference is subject to a payment.

4.3 Tradable green certificates

Tradable green certificates are financial certificates that are issued to a RES-E producer when electricity from a RES-E technology is produced. Green electricity quotas can be imposed on utilities and large consumers, which they can fulfill either by actually using electricity produced by RES-E or by buying green certificates. Tradable green certificates are a demand-side measure driven by quota obligations that pull RES-E electricity onto the market.

Tradable green certificates combined with quota obligations are often considered to be more in line with the requirements of market-conformity and competitive policies that provide an incentive for short-term technology cost reductions. The perceived drawbacks of the systems currently in place include lack of experience with the system and the young markets for tradable green certificates, making financial actors reluctant to invest. In addition, the complexity of some existing systems and the risk of supporting only lower-cost technologies are also considered as disadvantages.

Belgium, Italy, Poland, Romania, Sweden and United Kingdom are using tradable green certificates, with the quota obligations as illustrated in Figure 8. Italy has quota obligations up to the end of 2012 and Poland has quota obligations up to the end of 2017. Also, in the United Kingdom the quota obligations will increase from 11.4% (of the total national electricity consumption) in 2011, up to 15.4% in year 2015 and it will remain constant up to year 2037. In Romania, the quota obligations will increase from 10% in year 2011 up to 20% by the year 2020 and then it will remain constant up to year 2030. In the case of Flanders in Belgium, the quota obligations will increase from 6% in year 2011 up to 13% in 2021, whereas for the case of Sweden, first the quota obligation will decrease from 17.9% in year 2011 down to 13.5% in year 2013. Then an increase up to 19.5% in year 2020 is expected, followed by a decrease to 0.8% by the year 2035.

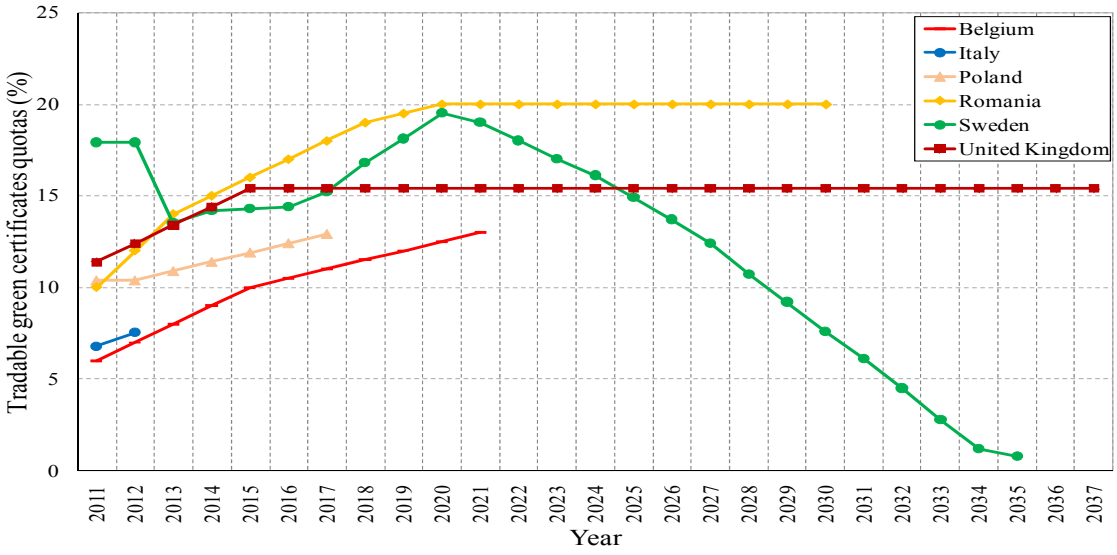

Figure 8. EU Member States quota obligations planned trajectory

4.4 Fiscal and financial measures

Fiscal and financial measures are tax reductions for RES-E electricity investments, production or consumption and are simple examples of fiscal measures to stimulate supply or demand. Often this can take the form of exemption from 'ecotaxes' or 'carbon taxes' that are placed on fossil-fuel energy sources. Financial measures can also include reduced interest rates on loans, which lower the cost of investments and encourage new RES-E generating capacity. They are attractive because of the direct message transmitted to final energy consumers about the added value of RES-E. Their biggest shortcoming is the fact that they do not provide long-term certainty about investments, thus increasing the investment risks for project developers and other RES investors. Thirteen Member States are using fiscal and financial measures support schemes. The same examples of the Member States used before for the investment support, with the only exemption the use of Italy in place of Malta, are used here for comparison reasons.

In Czech Republic, the income tax for natural persons amounts to 15% and for legal entities is 20%. Therefore, as a fiscal and financial measure the government decided that RES systems must have an

exemption from income tax of electricity generation in the year in which the systems were commissioned and in the five years following directly thereafter. In France, the fiscal and financial measures state that individuals may deduct from the income tax of electricity generation a certain percentage of investments in RES systems as a tax credit. According to this, individuals that install RES systems at their principal residence may deduce 50% of the net costs of hardware from income tax for RES systems up to 3kWp. For systems with higher capacity, these would be considered eligible, only if the electricity consumption of the building is higher than half of the nominal installed capacity. As another measure, RES systems are subject to a reduced value added tax (VAT) for services, equipment and delivery, which in the French mainland and Corsica amounts to 5.5% and in the overseas departments and regions of Guadeloupe, Martinique and Réunion amounts to 2.1%.

In Italy, the fiscal and financial measures state that for RES systems the VAT for deliveries and services is reduced at 10% from 20%. Also, the municipalities grant a reduction in property tax to buildings equipped with RES systems, which depends on the value of the property and differs from municipality to municipality. In Lithuania, the obligation to pay tax on electricity arises when it is sold or otherwise transmitted to a person having no business license, or it is received by an unlicensed person from another EU Member State, or it is imported by an unlicensed person, or it is consumed by the holder of a license or a producer of electricity for his own needs. As a fiscal and financial measure, the government decided that RES systems must have an exemption from the consumption tax of electricity.

In the Netherlands, the consumption of electricity is taxable in terms of an environmental protection tax. The tax amount depends on the total energy consumption and amounts to the following sum per consumption period of 12 months, (a) 7.16€c/kWh for consumption of less than 10MWh, (b) 3.69€c/kWh for consumption between 10MWh and 50MWh, (c) 1.02€c/kWh for consumption between 50MWh and 10GWh and (d) 0.10€c/kWh for private consumers and 0.05€c/kWh for commercial use for consumption of more than 10GWh. Therefore, as a fiscal and financial measure, the government decided that the environmental protection tax is reduced for consumers of electricity from RES-E systems by 199€ during every consumption period of 12 months per electricity connection. Also, a tax allowance is given to enterprises that invest in RES-E plants, which may be up to 44% of the total investments of one calendar year. The maximum amount paid per company is 113M€ of total investments per calendar year. Investments of less than 450€ are not eligible and the total sum of investments in eligible projects shall reach 2.2k€ within one year. In Sweden, the fiscal and financial measures state that the wind energy systems and hydro-electric systems are subject to a reduced real estate tax depending on the value of the power plant, and wind energy systems are not subject to taxes if they generate electricity for non-commercial use. However, wind energy systems for producing electricity for commercial use under certain conditions, are also exempted from energy tax.

5. Conclusion

The EU, in order to achieve at least a 20% reduction of greenhouse gases by 2020 compared to 1990 levels, has issued the RES Directive [3] on the promotion of the use of energy from RES. The integration of RES in the existing European power generation system is enhanced with the use of different support schemes such as, investment support, FiTs, tradable green certificates, and fiscal and financial measures by the EU Member States. Some Member States are implementing a single support scheme for the promotion of RES-E and others implement a hybrid support scheme by combining all or some of the four categories of the RES-E supporting schemes. Twenty-three Member States are using fixed FiTs as the main support scheme, whereas Belgium, Poland, Romania and Sweden are using tradable green certificates as the main support scheme. Also, thirteen Member States are using fiscal and financial measures support schemes and fifteen Member States are using investment support schemes in combination with other support schemes, usually FiTs or tradable green certificates.

Although, these support schemes have increased the penetration of the RES-E technologies in the Member States, still there is a long way in order to achieve the 2020 target. The reason for this may be that the way these schemes have been used so far, i.e., either as single support schemes or in combination of FiTs or tradable green certificates with investment support and fiscal and financial measures, has been ineffective. A more effective combination could be a hybrid scheme consisting of FiTs with tradable green certificates measures, as in the case of Italy and United Kingdom, which will increase the RES-E penetration and eliminate the possible technical problems which will arise from this increased penetration and have an effect in the stability of the power system.

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