



# Feed-In Systems in Germany, Spain and Slovenia

## - A comparison -

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# 1 Brief description of the German tariff system

## 1.1 General overview and past legislation

The promotion of renewable electricity in the 1980s was dominated by substantial **R&D** programmes of the Federal Ministry for Research and Technology (BMFT) which were supplemented by demonstration projects.

Programmes aiming at the direct market diffusion of renewable energies started promoting significant amounts of RES investments in 1989, when a **market stimulation programme** was introduced which called for the installation of 250 MW of wind power. It guaranteed a fixed payment per kWh of electricity produced, together with investment incentives for private operators such as farmers. This programme was effective until 1995.

On top of the 250 MW programme, the **Electricity Feed-in Act** was introduced in **1991**. It mandated that grid operators pay 80 % of (average historical) electricity retail prices as feed-in tariffs for electricity generated by certain Renewable Energy Sources (RES). Furthermore, it required electricity suppliers to accept the electricity fed into the grid.

The Electricity Feed-in Act in its later stage had a cap to prevent very uneven burdens for regional grid operators: a grid operator had to pay these feed-in prices until the share of electricity from RES reached the cap of 5 %. Nevertheless, this regulation still had an asymmetric impact on the utilities operating the grid. For example, the wind turbines which benefited most under the Energy Feed-in Law are concentrated in Northern Germany. Thus, grid operators in the North were at a (slight) competitive disadvantage, which caused a problem, especially after electricity market liberalisation. Furthermore, the falling electricity (retail) prices resulting from liberalisation also led to lower feed-in prices for electricity from RES. This started to undermine their economic basis, in particular that of the numerous wind turbines which had been installed in the previous years. Thus, an intensive debate arose about the future of the Electricity Feed-in Act.

In 2000, the **Renewable Energy Act** ("Erneuerbare Energien-Gesetz", **EEG**) (BMU 2000b) replaced the Electricity Feed-in Act. As a consequence of the developments described above, under the new EEG, feed-in prices are no longer linked to electricity retail prices, but fixed for 20 years. The cap on the share of electricity from RES was abolished. Instead, the total amount of feed-in reimbursements will be distributed evenly among all high voltage grid operators and equally among all electricity consumers there. Furthermore, the feed-in tariffs for some RES such as wind are decreased annually for plants installed after 1<sup>st</sup> January 2002 (see below).

The EEG guarantees preferential prices with respect to the favoured group (the RES producers), but with the special feature of financing by the end-users of electricity. The incentive is a positive sanction in the form of guaranteed payments for the total amount of electricity produced. As noted before, the Electricity Feed-in Act was enforced in 1991 and was replaced by the EEG in April 2000. In the EEG, two important and innovative features were implemented:

- **Degression of tariffs** - supporting technology learning: from 2002 on, new installations receive lower tariffs. From 2003 on, new installations of these types receive tariffs lowered at the

same rate, and so on for the following years.<sup>1</sup> This is to retain the incentive for manufacturers to systematically reduce production costs and to offer more efficient products every year. The rate of degression is based on the empirically derived progress ratios (from the theory of technology learning) for the different technologies.

- **Stepped nature of tariffs** - supporting financial efficiency: the tariffs for the different technologies defined in the act are determined based on the yield / generation costs of each particular plant. This feature is especially important for wind energy but applies to other RES as well, e.g. to biomass with respect to plant size and fuel type. Investors in wind power at sites above a reference value receive a substantially lower feed-in tariff starting 5 years after installation. At sites with below average wind yield, the time period for the higher feed-in tariff is prolonged. This feature leads to a lower level of promotion at sites with very good wind conditions and higher promotion levels under less advantageous wind conditions. Therefore the price of the tariff mirrors the cost resource curve of the technology. This results in a reduction of the producer profit and therefore in lower transfer costs for society.

Furthermore, the feed-in tariffs are reviewed every two years according to the new act, first in 2002 and then every four years in the light of technological and price developments; feed-in tariffs for new sites installed at a later point in time can be modified accordingly. For every single installation, the date of *expiration* is twenty years after the date of installation.

The first review process of the EEG was carried out in 2002 and a number of recommendations for amendments were made. In particular, the following features were included in the revised EEG (amending law) which became valid in August 2004:

A detailed target for the share of renewables in electricity production of at least 12.5 % (2010) and at least 20 % (2020) was set in order to underpin the importance of long-term stability of the German RES-E policy. The integration of RES plants into the electricity system should be improved. The revised act provided incentives for operators of RES plants and grid operators to participate in a power management of RES facilities. Furthermore the priority right for access and connection to the grid has been enforced.

With regard to individual technologies, the following major changes were implemented in the amending law of 2004: Generally, tariffs have been adjusted to better reflect the cost situation of renewable technologies. Noteworthy are the higher tariffs for **geothermal electricity** and **PV** as well as for certain fractions of **biomass**. In the case of **PV**, tariffs have risen in order to compensate for the termination of the 100,000 roofs programme. PV tariffs are also differentiated according to the application, e.g. roof top or wall mounted. In the case of **bioenergy**, the tariffs have been adjusted to increase market competitiveness, in particular for small-scale biomass plants. Furthermore, special incentives were provided for the use of innovative technologies, plant/crop-based renewable resources and CHP. In the case of **onshore wind energy**, the support level has been decreased significantly for installations at locations with very high yield. For installations at locations characterised by average yields, the tariff level has been decreased moderately in

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<sup>1</sup> The level of the tariff for a newly commissioned plant remains constant for the duration of the guaranteed tariff (normally 20 years), but depends on the year of commissioning. Therefore, the later a new plant is installed, the lower the reimbursements received. This means there is a continuous incentive for efficiency improvements and cost reductions for new plants.

order to provide incentives for more rapid technological progress. **Offshore wind energy** plants have received high level feed-in tariffs for the initial 12 years after installation (compared to 5 years for wind onshore), which should guarantee the rapid uptake of this technology in the next few years. Another important step was the integration of capacity extensions by refurbishing **large hydropower** plants, which were then entitled to feed-in tariffs if certain conditions (including increasing output) were met.<sup>2</sup> A further adjustment of the law was that the rule of decreasing tariffs over time was then applied to most technologies except small hydropower plants. For wind energy and PV, the annual degression rate of the tariffs has been increased to 2% and 6.5%, respectively.

## 1.2 Current legislation - amended EEG as of January 2009

The second review of the German EEG was finalised in 2008, which led to amendments to be implemented by the beginning of 2009. First the detailed target for the share of renewables in electricity production was increased to at least 30 % in 2020. The energy concept of the German federal government published in September 2010 increased the RES-E target to 35% in 2020.

Regarding the regulations for individual technologies key elements were a moderate increase of tariffs for **wind energy** due to increased raw material prices and therefore turbine prices. Furthermore the annual degression for **photovoltaic** plants was substantially increased from 6.5% to 9% as default value per year. If the overall newly installed capacity in one year exceeds a certain amount (originally set at 1500 MW per year) the degression is raised by 1%, if it falls short of a certain value it is lowered by 1%. The growth corridor was amended in 2010, such that a reduction of the tariff by 1 / 2 / 3 / 4 % applies if an amount of 3500 / 4500 / 5500 / 6500 MW per year is exceeded. This newly introduced procedure might be an important complement to a tariff revision. Additionally small-scale producers with PV installations up to 500 kW have the option of a "split tariff". Electricity fed into the grid is supported with the usual feed-in tariff. Autoconsumed electricity from PV also receives a payment depending on the size of the application and share that is consumed by the producer. The tariffs for **geothermal electricity** have been substantially increased and further disaggregated into further categories, e.g. CHP systems. Tariffs for **small hydro-power** plants were increased.

Since increasing shares of fluctuating renewable energy sources cause additional challenges for the electricity grid the revised German Renewable Energy Sources Act makes it mandatory for newly (after 2008) built wind turbines to actively contribute to grid stability and thus integrate this energy source better. **Onshore wind turbines** built between 01.01.2009 and 01.01.2014 have to fulfil certain technical standards in the field of reactive and real power in order to be connected to the grid and receive the feed-in tariff. Their feed-in tariff increases by 0.5 €/kWh, this extra bonus is called "Systemdienstleistungs-Bonus". In addition, the revised act also introduces an incentive for older turbines to be retrofitted on a voluntary basis. If turbines built between 2002 and 2008 are upgraded to fulfil the technical standards for new turbines until the end of 2010, they receive an extra bonus on top of their feed-in tariff of 0.7 €/kWh for five years.

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<sup>2</sup> Only the additional generation due to plant extension/refurbishment will be reimbursed.

The next review of the German EEG will be finalised in 2011, with the revised law entering into force on 1<sup>st</sup> of January 2012.

The following table gives an overview of the current tariff structure of the EEG of 2010. It should be noted that the tariffs were adjusted to their 2010 level, thus departing from the nominal tariff levels indicated in the EEG 2009 and taking into account the individual depression rates.

Table 1 Tariff structure of the EEG in 2010

Renewable energy source		Range of performance	Feed-in tariff in €cent / kWh					Depression <sup>3</sup>
Solar <sup>4</sup>			installed on buildings or noise barriers	Sealed areas and conversion areas	all other open areas		9% from 2011 <sup>5</sup>	
		<30 kW	33.03	25.73	24.26			
		30 kW-100 kW	31.42					
		100 kW-1 MW	29.73					
	>1 MW	24.79						
Biomass <sup>6</sup>			general	renewable feedstock	CHP	technology bonus	Used wood	1.0%
		< 150 kW	11.55	17.55	14.55	13.55	14.05	
		150-500 kW	9.09	15.09	12.09	11.09	11.59	
		500 kW-5 MW	8.17	12.17	11.17	10.17	10.67	
		5 MW - 20 MW	7.71	7.71	10.71	9.71	7.71	
Hydro	large	<500 kW	7.22				1%	
		500 kW-10 MW	6.26					
		10 MW-20 MW	5.74					
		20 MW-50 MW	4.3					
	50 MW-150 MW	3.47						
small	<500 kW	12.54				0%		
	500 kW-2 MW	8.56						
	2 MW-5 MW	7.57						
Geothermal		<10 MW >10 MW	General <sup>7</sup>	CHP	Petrothermal technology		1% starting in 2010	
			19.84	22.84	23.84			
			14.4	17.4	18.4			
Wind	offshore		installed before 01.01.2016 for at least 12 years <sup>8</sup>		installed before 01.01.2016 after 12 years		5% starting 2015	
			15.0		3.5			
	onshore		for at least 5 years after installation (plus system service bonus for installations before 01.01.2014)		After 5 years, depending on yield of system		1%	
			9.2 (9.7)		5.02			
Landfill gas, sewage gas, Mine gas			Landfill gas (plus technology bonus)	Sewage gas (plus technology bonus)	Mine gas (plus technology bonus)		1.5%	
			<500 kW	8.87 (10.7)	7.0 (9.0)	7.05 (9.05)		
			500 kW-5 MW	6.07 (8.07)	6.07 (8.07)	5.08 (7.08)		
			>5 MW	-	-	4.1 (6.1)		

<sup>3</sup> Reduction of tariffs every year for new installed systems

<sup>4</sup> The feed-in tariffs outlined here apply from 1 October 2010 following the „PV amendment“ from July 2010 which set exceptional tariff degressions for plants installed after 30 June 2010 (8% for sealed or conversion areas, 12% for all other open areas, 13% for PV on installed buildings) with an additional depression (3%) for all installations commissioned after 30 September 2010.

<sup>5</sup> For SO-PV dynamic depression applies: the depression rate is adjusted upward by up to 4% in 2011 (12% in 2012) and downward by up to 3% in 2011 (7.5% in 2012) according to the installation within a (one-year) period.

<sup>6</sup> Boni for CHP, technology and renewable feedstock can be combined.

<sup>7</sup> Onl valid until 2016. For plants starting operation after 1st of January 2016 all tariffs are reduced by 4 cents / kWh.

<sup>8</sup> For plants installed after 01.01.2016 the remuneration is reduced by 2 cents / kWh.

### 1.3 Identification of key agents in Germany

Since the development of renewables is still dependent on financial support, political institutions are important key agents. On the administrative level, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety [BMU]<sup>9</sup>, which is responsible for the promotion of renewable energies, is the main actor. Two other important actors are the Federal Ministry of Economics [BMWi], responsible for energy policy in general, and the Federal Ministry for Agriculture, responsible for the development of the different forms of biomass. The German parliament also plays a significant role in the development of the German feed-in tariff since active lobbying groups have organized cross-party support for the law. Another state-related actor is the German Bank for Reconstruction and Development - KfW, which provides loans at reduced rates for investment in renewables, energy efficiency and generally for investments in environmental measures. Other relevant actors on the federal level include the Federal Environmental Agency and the German Energy Agency. Besides the federal administrative level, the state level (Bundesländer) also has a significant impact on the development of renewables. Typically, specific renewable technologies tend to be supported by state programmes, e.g. different biomass technologies are being promoted with particular emphasis in some German states.

The considerable growth in renewable energies has led to the establishment of sector associations which promote renewables in general, e.g. Bundesverbandes Erneuerbare Energie [BEE], or single technologies, e.g. the German Wind Energy Association [BWE]. Other industry-related actors are equipment producers and service providers. Since the number of jobs in the renewables-related industry is rising, trade unions are also becoming involved in the policy arena. Other important actors are the major utilities and a considerable number of communal enterprises and their associations, e.g. the German Association of Energy and Water Utilities [BDEW], Verband kommunaler Unternehmen [VKU the Association of Local Authority Enterprises] and the Verband der Industriellen Energie- und Kraftwirtschaft [VIK]. An important role is assigned to the grid operators who are responsible for grid connection and the physical and financial coordination of the integration of renewables into the electricity system. On the side of consumers, the Federal Association of German Industry [BDI] is an important player in the political debate.

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<sup>9</sup> The following units are established within the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety [BMU] to support the development of RES: General aspects of RES; Biomass, Geothermal, Solar Energy; Hydro and Wind Power; International Affairs of RES; RES Research and Development; Legal Aspects of RES.

## 2 Brief description of the Spanish tariff system

### 2.1 General overview and past legislation

The feed-in system in Spain consists of the implementation of a regime by which each kWh produced with renewable energies is paid to the producer at a special price, higher than the market one. In addition, RES-E producers receive preferential treatment and can sell all their RE electricity to the grid at the prices agreed.

This is the system that, with a few variations, is being applied in Spain, a country where the support for RE technologies began quite early, in 1980, with the approval of the first law on RE the “Law for Energy Conservation” (*Ley 82/80 de Conservación de la Energía*). Since then, a variety of instruments have been used, mainly legislative measures and financial support. The current tariff system entered into force in 1997, through the Electric Power Act (Jefatura de Estado, 1997), Royal Decree 2818/1998 (Ministerio de Industria y Energía, 1998), Royal Decree 436/2004 (Ministerio de Economía, 2004) and was modified by Royal Decree 661/2007 (Ministerio de Industria, Turismo y Comercio, 2007). The tariff system aims to contribute to achieving the national target of 12 % of total energy consumption and 29 % of electricity from RES by the year 2010. These targets were defined in the Plan for the Promotion of RES (IDAE, 1999). The Plan has an indicative character and implies no compulsory behaviour for energy actors. In 2005 the plan was revised (IDAE, 2005). The decree was amended by the Royal Decree 1578/2008 which set new regulation for photovoltaic systems commissioned after September 29<sup>th</sup> 2008. Furthermore, Royal Decree 6/2009 adopted particular measures within the energy sector. Specifically, requirements to sign up in the pre-assignment registry to be rewarded under the special regime were established. The Royal Decree 1003/2010 aims to tackle too high remuneration encountered at plants still profiting from the tariff as of RD 661/2007 although they were commissioned after the deadline. RD 1003/2010 thus imposes more stringent obligations to provide evidence on PV installations (documentation on devices, receipts etc.).

In general terms, the laws define a premium which is paid to producers of RE electricity for each kWh produced (there are different levels of tariffs depending on the technology and on the capacity of the installation producing RES). The producer can choose between a fixed price and a “premium” added to the price negotiated in the electricity market. The choice is valid for one year; after that the producer can decide to maintain the formula or swap to the alternative. The two basic issues to be tackled when developing renewable energy sources in a liberalised electricity sector are, firstly, how concessionary operators of distribution systems are to accept electricity supplied by self-producers and, secondly, the price to be paid for that electricity, which must supplement the market price of the kWh contributed to the grid by a *premium* established in the corresponding regulations. This premium should reflect the social and ecological benefits of renewable energy sources, allows an adequate return on generating installations in special regimes and reduce the uncertainty regarding the economic viability of generation projects using renewable energy sources.

The liberalisation of the energy markets was the most recent transformation with effects on renewable energy installations. This is well advanced in Spain in comparison with the developments in other countries, shown by the approval of the Royal Decree 436/2004 introducing a market oriented option for the support of RES-E. Nevertheless, this market option involved some

problems. Due to a strong rise in electricity prices, the costs for consumers under the market option increased more than expected. In order to improve the emerged problems, the Spanish system was revised in spring 2007 by the introduction of the Royal Decree 661/2007. The following sections explain the Spanish tariff system in more detail, with special emphasis on the latest developments.

### **2.1.1 Electric Power Act 54/1997**

The basic regulation establishing a favourable legislative framework for renewable energies is the Electric Power Act 54/1997, of 27<sup>th</sup> November (Jefatura del Estado, 1997). This Act introduced the liberalisation of the electric sector in Spain. This law differentiates between the average rate of electricity production and what the law labels the "Special Scheme" for facilities using non-consumable renewable energies as primary energy, such as solar, wind, hydro, biomass or any other kinds of biofuels whose installed capacity does not exceed 50MW.

This act also prescribes the producers' obligations and rights in the Special Scheme, among which these two stand out: the incorporation into the electric grid of the energy produced, and the payment of a premium for this energy that may improve its market price. It also sets forth that the said premiums will be considered as diversification and supply security costs of the power grid.

Moreover, Act 54/97 established a new Plan for the Promotion of Renewable Energies, with the aim that by the year 2010 renewable energy sources should meet at least 12 % of the total energy demand in Spain. These goals were taken into account when establishing premiums.

In the **Electric Power Act**, the traditional notion of public service is cast aside and replaced with the guarantee of quality and supply to all customers requiring the service. The operation of the national electricity system thus ceases to be a state-owned public service performed by the State through a quasi-public undertaking and its duties are taken over by two private undertakings responsible for the economic and technical management of the system, respectively. State planning is now limited to transmission installations and is no longer effective for investments in electric companies. Unrestricted entry to electricity generation is acknowledged and organised under the principle of free competition. The economic remuneration of the activity is based on the organisation of a wholesale market. Transmission and distribution are opened up through a generalised third-party access to the grid. Ownership of the grids does not guarantee exclusive use. The remuneration of transmission and distribution will continue to be set by the Government, thereby avoiding any possible abuse of a dominant position derived from the existence of a single grid. A transitional period is established for the liberalisation of electricity supplies, whereby all consumers gradually acquire the freedom of choice of supplier over a period of 10 years.

### **2.1.2 Royal Decree 2818/1998**

The Royal Decree 2818/1998, of 23<sup>rd</sup> December on the production of Electric Power by Facilities Supplied with Renewable Energy Sources, Waste and Co-generation (Ministerio de Industria y Energía, 1998) was replaced by Royal Decree 436/2004, of 12<sup>th</sup> March. The Royal Decree 2818/1998 regulated the requirements and procedures able to recourse to the Special Scheme, the registration procedures for the facilities in the corresponding registry, the conditions of energy delivery, and the applicable economic scheme. As regards renewable energies, it set forth the

producers' right to incorporate the whole of the electric power produced into the electric grid, among other issues, and their entitlement to be paid the price on the wholesale market plus a bonus or a premium. The final price, which is specific for each technology, was determined by means of the following formula:

$$P = P_m + P_r \pm RE \quad \text{where:}$$

P= Payment of the kWh

P<sub>m</sub>= Market price

P<sub>r</sub>= Premium

RE: a supplement for reactive energy

The same Royal Decree established the initial values for these premiums and their annual updates, taking into account the variation of the average price of electricity sales. It also established a revision every four years in accordance with the evolution of the electricity power price on the market, the inclusion of renewable energies to cover the demand and the technical management of the electricity grid.

### 2.1.3 Royal Decree 436/2004

The Royal Decree 436/2001, of 12<sup>th</sup> March, which established the methodology to update and systematise the legal and economic framework of the electric power production activity within the Special Scheme (Ministerio de Economía, 2004), consolidated the regulatory framework laid down by Law 54/1997 on the Electricity Sector for producers operating in the *Special System* and derogated the previous legislation under Royal Decree 2818/98. A transitional period was established for electricity producers operating under the *Special System* defined by RD 2818/98. This period expired on January 1, 2007.

Royal Decree 436/2004 modified the legal and economic framework for electricity generation under the *Special System*, making it **more stable and predictable** and established a system to support electricity generation based on the free choice of the producer, who can decide between two options:

- Sale to the distributor at a regulated tariff
- Sale on the open market through the bidding system managed by the market operator (OMEL), the bilateral contracting system or the forward contracting system (or both). The price is set by the market or negotiated by the parties in the case of a bilateral contract, plus an incentive and a premium for the power guarantee, like other producers under the *Ordinary System*.

Both, the regulated tariff and the premium were calculated as percentage of the yearly average tariff as defined in RD 1432/2002. E-RES producers can choose, for periods of not less than one year, the option that suits them best.

Regardless of the payment system opted for, this Royal Decree intended to grant the titleholders of the facilities under the Special Scheme a reasonable payment for their investments, and to grant consumers also an allotment of the cost ascribable to the electric grid. Nevertheless, participation in the market was encouraged as this involves less administrative intervention when

fixing the electricity prices, as well as a better and more efficient assignment of the grid costs, particularly as regards the management of the alternative routings and supplementary services.

**Main features of the special system:**

The electricity distributor has an obligation to buy electricity produced under the *Special System* (provided this is technically possible) at the price set in RD 436/2004 and the National Commission of Energy (CNE, in its Spanish acronym) performs settlement of costs incurred under the *Special System* by reimbursing distributors who have paid the prices, premiums and incentives laid down in RD 436/2004.

The costs of electricity generation under the *Special System* are taken into account for the annual calculation of the tariff, together with other costs: costs of generating electricity in the *Ordinary System*, permanent costs, competition transition costs, transport and distribution, commercial management, diversification and security of supply (nuclear moratorium; 2nd part of the nuclear fuel cycle).

In this way, the additional cost of the *Special System* is met by electricity consumers in a way that is proportional to their electricity consumption.

**Forecasts for feeding electricity to the grid:** Decree 436/2004 obliged operators of installations (> 10 MW) to provide the distributor with a forecast of the electricity they intend to feed into the grid at least 30 hours before the start of each day. Penalties are established for deviations.

**Cost of deviation:** The cost of deviation was 10% of the average electricity tariff applied to the difference between the forecast and the electricity measured (when the permitted tolerance is exceeded – the tolerances are 20% for solar and wind power, and 5% for the rest). For renewable energy installations, this came into force on 1 January 2006. The cost of deviations for installations opting to sell directly to the market were the same as that applied to installations operating in the *Ordinary System*. The obligation to make forecasts and the penalties for deviations improve the functioning of the system and the quality of the electricity fed into the grid.

## 2.1.4 The Royal Decree 661/2007

There are two main reasons for the introduction of the new RD in Spain, motivated above all by the experiences made with the existing legislation.

- Increase in consumer costs and windfall profits under the market option
- Insufficient development of biomass and cogeneration technologies

First, the introduction of the market option within the RD 436/2004 resulted in a strong increase of the RES-E share sold under this new alternative amounting up to 72 % in July 2006 as a consequence of rising electricity prices (Klein et al. 2007). In the case of wind energy more than 90 % of the generated electricity was disposed under the market option in summer 2006. After the introduction of RD 436/2004 windfall profits occurred and consumer costs of RES-E support have been rising more than expected due to the following reasons:

First, the level of fixed tariffs and premiums increased slightly, since their calculation was indirectly linked to the development of the average electricity market price. Nevertheless, the impact on costs and windfall profits was only moderate.

The main reason for windfall profits and cost increases was provoked within the premium option, since the electricity prices form a direct component of the overall remuneration for RES-E.

The described circumstances conducted the Spanish Ministry of Industry, Tourism and Trade, responsible for the RES-legislation, to abolish the indirect linkage of the FITs to the electricity price within the Royal Decree Act 7/2006 (Ministerio de Industria, Turismo y Comercio, 2006). This change in legislation caused some uncertainty among investors and developers, as the tariff level for new RES-E plants was neither published nor established until the end of the year.

Second, the development of biomass and cogeneration technologies lagged behind the expectations elaborated in the Renewable Energies Plan (PER) 2005-2010 (IDAE, 2005).

### Major modifications to RD 661/2007

The crucial modifications of the RD 661/2007 are the following:

- Introduction of cap and floor prices
- Introduction of voluntary demand orientation within the fixed tariff option
- Changes concerning biomass tariffs
  - General increase of biomass tariffs
  - Higher disaggregation of tariff categories for biomass
  - Cofiring of biomass resources from the different tariff categories is included into support
- Introduction of a generation control centre for large-scale installations (> 10 MW)
- Introduction of optional demand orientation
- Repowering bonus

## Cap and floor prices

Minimum and maximum prices for the overall remuneration level were introduced under RD 661/2007. In this way, the system reduces the flexibility of the market option determined in RD 436/2004 introducing a range for the sum of electricity price and premium. The variable premium is determined on an hourly basis. Figure 1 shows the progression of the different remuneration components within the premium option in case of wind onshore energy.

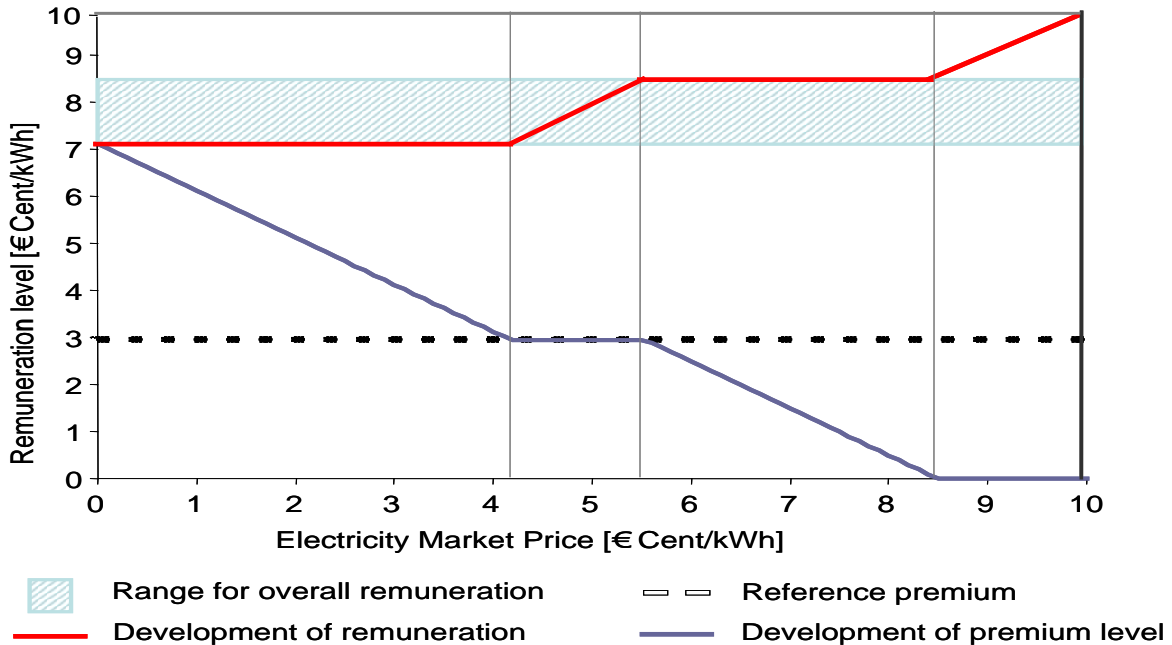


Figure 1 Progression of the remuneration level for wind onshore within the market option

There are four different calculation areas to determine the overall remuneration within the market option.

- (1) As long as the sum of the electricity market price and the reference premium amounts to less than the minimum limit, the overall remuneration level is equal to the minimum. The resulting premium is calculated as the difference between the minimum level and the electricity market price. In this area, the overall remuneration level is constant whereas the real premium declines depending on the electricity market price.
- (2) If the sum of the electricity market price and the reference premium ranges between the minimum and the maximum limit, the reference premium is paid in addition to the electricity market price. Thus, the overall remuneration level increases, whilst the real premium is constant.
- (3) Until the electricity price exceeds the cap price, the overall remuneration level corresponds to the cap and the real premium is calculated as the difference between the cap and the electricity price. The overall remuneration remains constant and the real premium declines.
- (4) If the market electricity price exceeds the cap, no premium is paid and the overall remuneration is equal to the electricity market price.

The new calculation mechanism for the premium guarantees the RES-plant producer a minimum income providing investment certainty for RES-projects on the one hand and cuts off windfall

profits that have occurred due to rising electricity prices without a technology cost increase on the other hand.

The following three categories apply for the support under the special regime in Spain:

- a) Producers using cogeneration or other options of electricity production using waste energy.
- b) Power plants using any type of renewable energies that are not assigned to the ordinary scheme.
- c) Installations using types of wastes not mentioned within group b).
- d)

The current tariff level of the fixed price and the premium are shown below in Table 2.

Table 2 Special regime for RES in Spain modified by RD 661/2007 as of 2

Technology category		Installed Power	Period [years]	Fixed price	Market option		
				Fixed Tariff [€ Cent/kWh]	Reference premium [€ Cent/kWh]	Cap [€ Cent/kWh]	Floor [€ Cent/kWh]
b.1 Solar	b.1.1 Photovoltaic registered prior to 29.09.2008	≤ 0.1MW	1 - 25	46.5897			
			> 25	37.2718			
		0.1MW – 10MW	1 - 25	44.169			
			> 25	35.3352			
		10MW – 50MW	1 - 25	24.3077			
			> 25	19.4462			
	b.1.1 Photovoltaic registered after 29.09.2008	roof/buildings ≤ 20kW	25	34.0			
		roof/buildings > 20kW and ≤ 20MW	25	32.0			
Free-field plants ≤ 20MW		25	32.0				
b.1.2 Solar Thermal		1 - 25	28.4983	26.8717	36.3906	26.8757	
		> 25	22.7984	21.4973			
b.2 Wind	b.2.1 Onshore		1 - 20	7.7471	3.0988	8.9866	7.5405
			> 20	6.4746			
	b.2.2 Offshore				8.9184	17.3502	
b.3 Geothermal and Ocean			1 - 20	7.2892	4.0672		
			> 20	6.8872	3.2373		
b.4 Small-scale Hydro		< 10MW	1 - 25	8.2519	2.6495	9.0137	6.8978
			> 25	7.4268	1.4233		
b.5 Large-scale Hydro		10MW – 50 MW	1 - 25	$(6.60 + 1.20 \times \frac{50-p}{40}) \times 1.0605$	2.2263	8.4635	6.4746
			> 25	$(5.94 + 1.08 \times \frac{50-p}{40}) \times 1.0605$	1.4223		
b.6 Biomass	b.6.1 Energy crops	≤ 2MW	1 - 15	16.8096	12.6723	17.5936	16.3029
			> 15	12.4764			
		> 2MW	1 - 15	15.5084	11.1562	15.9643	15.0968
			> 15	13.0624			
	b.6.2 Agricultural wastes	≤ 2MW	1 - 15	13.2994	9.1620	14.0812	12.7905
			> 15	8.9663			
		> 2MW	1 - 15	11.3771	7.0249	11.8384	10.9804
			> 15	8.5334			
	b.6.3 Forestry wastes	≤ 2MW	1 - 15	13.2994	9.1620	14.0812	12.7905
			> 15	8.9663			
		> 2MW	1 - 15	12.5148	8.1633	12.9704	12.1028
			> 15	8.5334			
b.7 Biomass	b.7.1 Landfill gas		1 - 15	8.4551	4.4721	9.4792	7.8711
			> 15	6.8872			
	b.7.2 Gas from anaerobic digestion	≤ 0.5MW	1 - 15	13.82620	10.8104	16.2182	13-0656
			> 15	6.8872			
	> 0.5MW	1 - 15	10.2409	6.5870	11.6691	10.1033	
		> 15	6.8872				
b.7.3 Liquid bio-fuels, Manure		1 - 15	5.6706	3.7380	8.8126	5.3955	
		> 15	5.6706				
b.8 Biomass from industrial processes	b.8.1 Agricultural wastes	≤ 2MW	1 - 15	13.2994	9.1620	14.0812	12.7905
			> 15	8.9633			
		> 2MW	1 - 15	11.3771	7.0249	11.8384	10.9804
			> 15	8.5334			
	b.8.2 Forestry wastes	≤ 2MW	1 - 15	9.8177	5.6814	10.6006	9.2993
			> 15	6.8872			

		> 2MW	1 - 15	6.8851	2.5329	7.3421	6.4746
			> 15	6.8851			
	b.8.3 Black liquor	≤ 2MW	1 - 15	9.8177	5.9439	10.6006	9.2993
			> 15	6.8872			
	> 2MW	1 - 15	8.4635	3.8813	9.5215	7.9346	
		> 15	6.8851				

Source: Own depiction based on Ministerio de Industria, Turismo y Comercio (2007)

### Tariffs for biomass and biogas installations

Since biomass development lagged behind the expectations of the objectives established in the Renewable Energy Plan 2005 - 2010 (IDAE, 2005), considerable changes were undertaken within the RD 661/2007.

In general, tariffs for biomass technologies were increased, additional differences were made between biomass resources and new biomass subcategories were introduced. Table 3 compares the tariff structure for the recently implemented legislation with the former one.

Table 3 Comparison of tariffs for biomass installations in RD 661/2007 and RD 436/2004<sup>10</sup>

Technology category		Installed Power	Fixed Tariff in RD 661/2007 [€/Cent/kWh]	Fixed Tariff in RD 436/2004 [€/Cent/kWh]	Tariff increase
b.6 Primary biomass	b.6.1 Energy crops	≤ 2MW	15.8890	6.8929	+131%
		> 2MW	14.6590		+113%
	b.6.2 Agricultural wastes	≤ 2MW	12.5710		+82%
		> 2MW	10.7540		+56%
	b.6.3 Forestry wastes	≤ 2MW	12.5710		+82%
		> 2MW	11.8294		+72%
b.7 Gaseous and liquid biomass	b.7.1 Landfill gas		7.9920	6.8929	+16%
	b.7.2 Gas from anaerobic digestion	≤ 0.5MW	13.0690		+90%
		> 0.5MW	9.6800		+40%
	b.7.3 Liquid biofuels, Manure		5.3600	not included	-
b.8 Secondary biomass from industrial processes	b.8.1 Agricultural wastes	≤ 2MW	12.5710	6.1270	+105%
		> 2MW	10.7540		+76%
	b.8.2 Forestry wastes	≤ 2MW	9.2800		+51%
		> 2MW	6.5080		+6%
	b.8.3 Black liquor	≤ 2MW	9.2800	not included	-
		> 2MW	8.0000		

Source: Own depiction based on Ministerio de Industria, Turismo y Comercio (2007); Ministerio de Industria, Turismo y Comercio (2004)

Tariffs for biomass were risen by between 6 % and 131 %. In particular, tariffs for energy crops showed increases of more than 100 % leading to a doubling of the former fixed price. The use of liquid biofuels, manure and black liquor were included into the support system for RES-E.

The RD 661/2007 introduced a premium for cogeneration of biomass resources with a tariff level above the tariffs for cogeneration with conventional fuels (see Table 4). The right to perceive a premium and the calculation of the premium for each plant is to be determined specifically for each project.

<sup>10</sup> Tariffs are displayed for the first 15 years in case of RD 661 and for the first 25 years in RD 436.

Table 4 Tariffs for biomass cogeneration within the RD 661/2007 as of 2010

Technology	Biomass resource category	Installed Power	Period [years]	Fixed Tariff [€Cent/kWh]	Premium [€Cent/kWh]
a.1.3 Cogeneration using biomass resources	b.6.1 Energy Crops	≤ 2MW	1 - 15	16.939	12.8113
			> 15	12.5725	
		> 2MW	1 - 15	15.5084	11.1562
			> 15	13.0624	
	b.6.2 Agricultural wastes	≤ 2MW	1 - 15	13.5414	9.4295
			> 15	9.1294	
		> 2MW	1 - 15	11.3771	7.0249
			> 15	8.5333	
	b.6.3 Forestry wastes	≤ 2MW	1 - 15	13.5414	9.4295
			> 15	9.1294	
		> 2MW	1 - 15	12.5148	8.1633
			> 15	8.5333	
	b.7.1 Landfill gas	≤ 2MW	1 - 15	8.7071	4.79
			> 15	7.0925	
	b.7.2 Gas from anaerobic digestion	> 2MW	1 - 15	14.1207	11.1433
			> 15	7.0339	
		≤ 2MW	1 - 15	10.5369	6.9292
			> 15	7.0862	
	b.7.3 Liquid biofuels, manure	> 2MW	1 - 15	5.6706	3.738
			> 15	5.6706	
b.8.1 Agricultural wastes from industrial processing	≤ 2MW	1 - 15	13.5414	9.4295	
		> 15	9.1294		
	> 2MW	1 - 15	7.2267		
		> 15	8.6886		
b.8.2 Forestry wastes from industrial processing	≤ 2MW	1 - 15	10.0297	5.9329	
		> 15	7.0359		
	> 2MW	1 - 15	3.6443		
		> 15	7.5481		
b.8.3 Black liquor	≤ 2MW	1 - 15	10.0297	6.2081	
		> 15	7.0359		
	> 2MW	1 - 15	9.8389	5.7207	
		> 15	8.0039		

The fixed feed-tariffs for renewables from category c) are paid for municipal solid wastes (MSW), co-firing of biowastes (with the share of biomass above 50 %) and for mining residues range between 3.83 € Cent/kWh and 5.36 € Cent/kWh. The corresponding premium amounts to 1.74 € Cent/kWh to 2.3 € Cent/kWh.

### Generation Control Centre

Installations with an installed power exceeding 10 MW are obliged to connect to a generation control centre representing the interface between RES-producers and the system operator. The generation control centre sends information about the installations in real time to the system operator in order to contribute to the stability of the system. Investment and maintenance costs of the control centre are to be borne by the installations assigned to the control centre.

## Demand orientation

One component of the RD 661/2007 allows the installations selling their RES-E under the fixed price option to apply for an option that distinguishes tariffs depending on two load categories during a day. In peak hours, the remuneration corresponds to 104.62 % of the fixed tariff in peak load hours and to 96.70 % in base load hours respectively. The selection for this option can be changed is valid for at least one year.

## Repowering bonus

Wind power plants that started operation before end of 2001 might apply for an additional premium for repowering, that is to be determined specifically on project base and must not exceed 0.7 €Cent/kWh.

### 2.1.5 RD 1578/2008

Royal Decree 1578/2008, dated on September 26<sup>th</sup> 2008, addresses the feed-in-tariffs for electricity generated by photovoltaic systems and produced by plants commissioned after the period of payment for this technology defined in Royal Decree 661/2007. Prior to September 29<sup>th</sup> 2008 only photovoltaic and solar-thermal plants that did not exceed fixed capacity limits were eligible for remuneration. These limits were set at 371 MW for photovoltaic and 500 MW for solar-thermal systems. Royal Decree 1578/2008 applies to systems registered after September 29<sup>th</sup> 2008. Under the decree, the premium tariffs for the different system types are re-defined as part of the application procedure every quarter according to the subsequent formula:

$$\begin{aligned} & \text{If } P \geq 0,75 \times P_0, \\ \text{then: } T_n &= T_{n-1} [(1 - A) \times (P_0 - P) / (0,25 \times P_0) + A] \end{aligned}$$

$$\begin{aligned} & \text{If } P < 0,75 \times P_0, \\ \text{then: } T_n &= T_{n-1} \end{aligned}$$

*Where:*

P, capacity preregistered in previous notification n-1

P<sub>0</sub>, capacity allocation for notification n-1

T<sub>n-1</sub>, tariff for installations preregistered and assigned to application procedure n-1

T<sub>n</sub>, tariff for installations preregistered and assigned to application procedure n

A, the factor 0,9 (1/m) and m the number of annual application procedure

The initial cap for Solar PV was set at 400 MW per year. If only 50 % of the capacity quota is achieved, the tariff may be increased for the next application procedure. Prior to the conclusion of an application procedure, the market caps specified for each system type are published on the website of the Ministry of Industry, Tourism and Trade (Annex III RD 1578/2008)<sup>11</sup>. The annual capacity limits are increased by the same percental rate, the remuneration is reduced in the same

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<sup>11</sup> See: <http://www.mityc.es/energia/electricidad/RegimenEspecial/Paginas/InstalacionesFotovoltaicas.aspx>

time horizon up to 10%. In addition, this RD requires solar PV power plants to provide system services as a necessary condition to receive the financial support from the feed-in system.

### **2.1.6 Resolution of November 19, 2009**

The next change in Spanish legislation was not realised by introducing a new Royal Decree, but in terms of a resolution published by the State Secretary for Energy. The Resolution of November 19, 2009 introduced capacity limits for wind power plants and for solar thermal power plants. It foresees an annual capacity increase of 1.700 MW for wind energy until the end of 2012 and 500 MW until the end of 2013 for solar thermal plants, respectively.

### **2.1.7 RD 1565/2010**

The Spanish government adopted a new Royal Decree (RD 1565/2010) end of November 2010, amending certain aspects of renewable energy support under the Special regime defined in RD 661/2007, RD 1110/2007 and RD 1578/2008. The aim of the new RD is to guarantee an accurate operation of the Spanish electricity system with a comparatively high share of RES-E (about 25 %) and to restrict high support costs, caused in part by strong growth of Solar PV. Before the publication of the RD rumours about planned retroactive tariff adaptations and measures led to quite some uncertainty for plant operators and investors, posing a serious risk for the formerly perceived regulatory stability in Spain.

The realised modifications comprise the restriction of tariff payment for **Solar PV** from initially 30 (RD 661/2007/ to 25 years from the start of plant operation. In addition, PV power plants with a capacity exceeding 2 MW have to comply with response requirements to voltage dips from summer 2011 onwards. The tariffs for Solar PV electricity stipulated in RD 1578/2008 are reduced by 5 % for small roof-integrated installations ( $\leq 20$  kW), 25% for medium-size roof-installations ( $>20$  kW), and 45 % for free-field installations. With regard to the simplification of administrative procedure this RD foresees the use of electronic media for requests for support.

### **2.1.8 RD 1614/2010**

After the government had agreed on a tariff cut with the wind and solar thermal industry associations in summer 2010, the RD 1614/2010 provides the legal framework for this agreement. The RD requires premium tariffs for wind power plants built under RD 661/2007 to be cut by 35 % by 2013. However, the cut in premium only has an impact if the electricity price exceeds 45 €/MWh, since wind parks currently receive minimum tariff (fixed) of 75.1 €/MWh. The premium reduction represent a temporary measure, premiums specified in RD 661/2007 are planned to be re-established from 2014 onwards. In addition, the number of hours during which wind power plant producers receive financial support for wind is limited to 2,589 h/a, but only in the years when the average full-load hours exceed 2,350 h/a. Depending on the applied technology, the equivalent hours during which solar thermal installations receive support are restricted too according to Table 5.

Table 5 Limit of hours during which solar thermal power plants receive financial support

Technology	Full-load hours [h/a]
Parabolic trough without storage	2,855
Parabolic trough with 9h storage facilities	4,000
Parabolic trough with 7h storage facilities	3,950
Parabolic trough with 4h storage facilities	3,450
Tower with steam cycle	2,750
Tower with 15h salt storage	6,450
Fresnel	2,450
Stirling	2,350

Solar thermal electricity must not receive a premium during the first year of installation.

## 2.2 Identification of key agents in Spain

The implementation of the tariff system in Spain requires the participation of a number of public and private actors. The most important are:

1. General Secretary of Energy, Ministry of Industry, Tourism and Trade (*Secretaría General de la Energía, Ministerio de Industria, Turismo y Comercio*).
2. National Commission of Energy (*Comisión Nacional de la Energía*).
3. Institute for the Diversification and Saving of Energy, IDAE, Ministry of Industry, Tourism and Trade (*Instituto para la Diversificación y Ahorro de la Energía, IDAE*).
4. Interest groups such as the Association of Self-Producers of RES (*Asociación de Productores de Energías Renovables, APPA*), Spanish Wind Platform (*Asociación Eólica Empresarial - AEE*), etc.

Other agents indirectly involved in the implementation of the tariff system are the electric companies and the transmission company, Spanish Electric Grid, (*Red Eléctrica Española, REE*).

The following paragraphs briefly explain the role of the two most important agents in Spain, regarding feed in: the General Secretary of Energy and the National Commission of Energy.

### 2.2.1 General Secretary of Energy

Energy policy (inclusive the design of the FITs) is a responsibility of the Directorate-General for Energy Policy and Mining. This Directorate-General is presently reporting to the Secretary of Energy from the Ministry of Industry, Tourism and Trade.

### 2.2.2 National Commission of Energy

The National Commission of Energy is the regulating body of energy systems (including the electric ones) and was created by the 34/1998 Act of 7<sup>th</sup> October, on the Hydrocarbon Sector, and developed by the Royal Decree 1339/1999 of 31<sup>st</sup> July, which approved these regulations. Its goals are to ensure an effective competence with regard to energy systems, and objectivity and

accountability in its performance. The Commission is a public body reporting at present to the Ministry of Industry, Tourism and Trade.

Here are the main functions of the tariff systems for the electricity produced with renewable energies:

- To prepare energy planning proposals in relation to the tariff systems, as well as projects for their implementation.
- To write reports on the negotiated amounts under the special scheme, prices, and electricity balances.
- To work out the distributors' liquidation for the tariffs paid to the producers under the special scheme.
- To solve all the possible conflicts that may arise in relation to the economic and technical management of the system and of transport.
- To inspect the technical conditions of the facilities under the special scheme, as well as checking the compliance with the requirements established in the authorisations, requested either by the State's General Administration or by the relevant Autonomous Communities.

## **3 Brief description of the tariff system of Slovenia**

### **3.1 Overview**

The relevant legislation affecting RES-E in Slovenia are the Energy Law (1999, last amended in 2009); the regulation on CO<sub>2</sub> emission tax; the National Energy Programme (2004); the Decree on Prices and Premiums for Purchase of Electricity from Qualified Producers (2002, amended 2004, 2006); the Regulation on Support of Electricity Produced from RES (2009) and Regulation on the Issue of Declarations of RES-E Production Facilities and Guaranties of Origin for Electricity (2009).

According to the Energy Law the system operators are obliged to purchase electricity from “RES and CHP with high efficiency” either for fixed feed-in tariffs or premium feed-in tariffs. The RES-E producer can choose between the fixed and the premium tariff.

Under the old support scheme the system operator and the qualified producer signed a Purchase Agreement covering the purchase of electricity for a period of 10 years.

Under the current support scheme, in order to receive support, the owner of RES or CHP plant has to obtain a Declaration for the production facility from the Energy Agency. The declaration is obtained for a period of 5 years for RES-E producers and for 1 year for CHP. A producer that has obtained the declaration for a CHP production facility that is not older than 10 years and for RES-E production facility not older than 15 years are eligible to get the support. Refurbished RES power plants, older than 15 years, are eligible for support if the refurbishing costs are higher than 50% of investment costs into such new power plant. In this case the support lasts 15 years as well. Qualified producers whose production facilities do not meet the age requirement for obtaining support under the new system (CHP facilities being older than 10 years and RES facilities being older than 15 years) can receive support until 31 December 2011.

Since 1 January 2009 support scheme is organized by the Support Centre within the electricity market operator Borzen.

Under the new RES-E support scheme two instruments are available [2]:

- Feed-in tariff or guaranteed purchase prices, for RES plants up to 5 MW and CHP plants up to 1 MW.
- Feed-in premium or operational support for all sizes of RES and CHP plants.

The support levels are based on the Reference Costs of Electricity (RCE), which represents the overall annual costs of operation of specific typical RES or CHP generating plants, minus all revenues and benefits of operation. RCE is divided into two parts: fixed and variable costs (Fixed part=Capital cost + O&M cost; Variable part=Fuel cost - revenues). The fixed part of the RCE are adjusted every five years or more frequently in case of substantial change of conditions. The variable part of RCE are determined annually or more frequently on the basis of forecast of reference energy market prices.

## 3.2 Current legislation and recent amendments

### **The Energy Law (OJ RS, No. 108/09 amendment 2009)**

The Energy Law defines conditions and priorities for RES and CHP electricity producers with high efficiency. The Energy Law defines the methods of promoting electricity generated by these producers. The system operators of the distribution or transmission electricity network are responsible for connection of all RES and CHP electricity producers to their distribution or transmission network. The Centre of Support is responsible to purchase all produced electricity at a price set by the Government. The electricity producers referred to in the preceding paragraph may sell all or part of the electricity they generate independently and shall in that case be entitled to a payment of a premium for that energy, set by the Government. Further details on conditions to acquire the status of an eligible producer, including production volume, type of energy source and useful efficiency, are prescribed by the Government of the Republic of Slovenia in Energy Law and Governmental Decrees.

### **Action Plan for RES for the period 2010-2020**

The Action plan for RES for the period 2010 - 2020 was approved by the government in July 2010 and sent according the RES Directive (2008/28/EC) to EC. Slovenia has to achieve 25% of RES in final energy consumption and 10% of RES in transport. The most important instruments for achieving these targets will be:

- Continuation of the already well accepted and operational Feed-in Tariff System for RES and CHP and introduction of a similar system for use of RES heat.
- Introduction of a heating and cooling obligation for RES.
- Better planning of RES, their inclusion in the environmental regulations and removal of the administrative barriers.
- Systematic promotion of the best practice approach in introduction of RES and energy efficiency.

In the sector of heating and cooling the target is to increase the share of 19.5% in 2005 to 30.8% in 2020. The far biggest contribution is expected to come from the wood biomass. Important shares will be contributed by heat pumps, solar and geothermal energy and biofuels.

In the sector of electricity production the target is to increase the share of 28.5% in 2005 to 39.3% in 2020. The far biggest contribution is expected to come from the hydro power. Important shares will be contributed by biogas, wood biomass, wind and PV plants.

The transport sector represented in 2008 a share of 39% in the final energy consumption. The share of RES in 2005 was only 0.3% and the obligatory target for 2020 is 10%. This target will be achieved with the mix of 7% of biodiesel and bioethanol to the normal fuels. The rest is expected to come through the electrical cars, supplied by electricity produced with RES.

## **Decree on Support of Electricity Produced from RES (No. 37/2009)**

The Feed-in Tariff System has to comply with EU legislation regarding state aid, was approved on 18.5.2009 and entered in operation on 1.11.2009. The adopted Government Decree in 2009 on financial support for produced electricity from RES (Official gazette of RS, No. 37/2009) uses the feed-in principle. Fixed prices (which are estimated as own cost prices for the RES power technologies and power plant sizes) are published as “tariff prices”. Fixed purchase prices (tariff prices) are valid for all electricity fed into the public grid. The producers have to provide and present the guarantee of origin for the electricity, in order to get the higher tariff price. Purchase prices are fixed for a period of 15 years for completely new or refurbished power plants. Purchase contracts for 15 years are made for new power plants between the plant operator and Support Centre (Borzen). The prices are subject to changes on an annual basis. For PV plants the regulatory framework foresees the yearly decrease of purchase prices by 7 %, for new power plants and a cap of 5 MW for large scale PV plants on fields.

The electricity power producers were divided into different size classes, for which the reference costs for operation were calculated. The plant size categorisation is the following:

- 1) Micro: < 50 kW
- 2) Small: 50 kW -1 MW
- 3) Medium: 1 MW -10 MW
- 4) Large: 10 MW - 125 MW

The Slovenian government will recalculate generation costs and set tariff prices for each technology and size of power plant every 5 years. Eventually new prices will be valid only for the new power plants entering the support scheme.

Reference tariff prices are calculated based on the economic variables taking into account fixed costs of investments and variable costs of fuels and price of electricity and type of the support. In the Governmental Decree they are defined as two possible options. The first option for power producers is selling of the produced electricity to the Support Centre (Borzen) at classical guaranteed purchase prices. The second option for power producers is selling of the produced electricity to electricity traders at individually contracted price and getting from the operational Support Centre (Borzen) the operational support as shown in the following table.

Table 6 Level of feed-in tariffs and premiums in Slovenia in 2009

Technology	Capacity	Duration		2009 – present*	
		fixed	Operational support	fixed	Operational support
		(years)	(years)	(€cent / kWh)	(€cent / kWh)
Hydro	≤ 50kW	15 years		10.55	4.96
	50kW – 1MW			9.26	3.67
	1MW - 10MW			8.23	2.38
	10MW - 125MW			7.66	1.81
Biomass	≤ 1MW			22.54	16.52
	1MW - 10MW			16.74	10.76
Co-firing biomass	≤ 50kW			10.25	4.27
	50kW – 1MW			10.25	4.27
	1MW - 10MW			10.25	4.27
Biogas (biomass)	≤ 50kW			16.01	10.29
	50kW – 1MW			15.58	9.66
	1MW - 10MW			14.08	8.10
Biogas (animal waste)	≤ 50kW			13.92	8.01
	50kW – 1MW			13.92	8.01
	1MW - 10MW			12.92	6.94
Sewage gas	≤ 50kW			8.58	2.60
	50kW – 1MW			7.44	1.46
	1MW - 10MW			6.61	0.69
Landfill gas	≤ 50kW			9.93	3.95
	50kW – 1MW			6.75	0.77
	1MW - 10MW			6.17	0.25
Biodegradable waste	≤ 1MW			7.74	1.76
	1MW - 10MW			7.43	1.45
Wind	≤ 50kW			9.54	4.34
	50kW – 1MW			9.54	4.34
	1MW - 10MW			9.54	4.34
	10MW - 125MW			8.67	3.08
Geothermal	≤ 50kW			15.25	15.25
	50kW – 1MW		15.25	9.27	
	1MW - 10MW		15.25	9.27	
Solar PV – on build-ings, integrated	≤ 50kW		47.78	42.06	
	50kW – 1MW		43.70	37.98	
	1MW - 10MW		36.27	30.35	
	10MW - 125MW		32.28	25.78	
Solar PV – on build-ings	≤ 50kW		41.55	35.86	
	50kW – 1MW		38.00	32.28	
	1MW - 10MW		31.54	25.62	
	10MW - 125MW		28.07	21.57	
Solar PV – independ-ent plants on the ground	≤ 50kW		39.04	33.32	
	50kW – 1MW		35.97	30.25	
	1MW - 10MW		29.00	23.08	
	10MW - 125MW		26.92	20.42	

## **Changes of the Decree on Support of Electricity Produced from RES (No. 53/2009, 68/2009, 76/2009, 17/2010 and 94/2010)**

The EC has requested that the Slovenian FIT scheme had to be organized according the rules for environmental state aids and therefore the FIT entered in operation only after EC approval. For these reasons the start of the decree was postponed few times and finally entered in operation on 1.11.2009. The changes of the decree regulated more precisely the ranking system for reaching the yearly cap for PV plants on fields, reporting of Distribution System Operators to the Energy Agency, calculation of reduction of guaranteed prices or operational supports for cases when the investors are getting the investment subsidies and many other details. The last change of the decree No. 94/2010 foresees new yearly decreases of purchase prices for PV plants. The reduction of the purchase price for the PV plants entered in operation in 2010 was 7 % regarding the prices in 2009. The reduction for 2011 will be 20%, for 2012 it will be 30% and for 2014 it will be 40%, regarding the prices in 2009. The changes also foresee the abolishment of the category of 15% higher purchase prices for building integrated PV plants.

## **Changes of Decree on Energy Infrastructure (No. 75/2010)**

The decree introduced for RES and CHP the category of simple producing devices for the following devices:

- CHP, fuel cells and wind mills producing devices up to including 50 kW
- PV producing devices up to including 1 MW.

For these producing devices the construction permit is not required. The investors have to assure that these devices are constructed according the prescribed rules, with static judgment, fire, lightning and noise protection. The investor is presenting the assurance of these requirements in a signed Declaration to the system network operator. The control on execution of these requirements and connection to the electrical network is in the competence of the energy inspectorate.

## **The role of Guarantees of Origin (GoO) in Slovenia**

The Decree on Declarations for Producing Plants and Certificates of Origin (Official gazette of RS, No. 8/2009) defines that financial supports are possible only for produced electricity, which obtained guarantees of origin (GoOs). The RES production plants, which wish to get the financial support, have to install registered measuring and registering devices, for measurement of the net produced electricity. The RES producing plants, which are getting the financial support, have to obtain GoO for each reporting year. For invoicing the produced electricity from RES, also provisional monthly reporting periods are foreseen. The receiver of GoOs for a provisional period is not obtaining GoO, but only notification from the editor of the GoO about the provisional account based on reported produced electricity.

Only on the base of reporting the yearly GoO the RES electricity producer is entitled for financial support for the sold electricity. With the final yearly invoice and payment of the electricity or operational support by the Centre of supports the GoO are consumed and entered in the register of the realized GoOs.

## **Rules regarding access to the grid**

### **Priority access to the grid and priority dispatch**

The tariff prices are set for eligible micro and small RES electricity producers up to 5 MW, taking into account current market conditions for the costs of technologies and natural resources and conditions for operations. Small and micro power plants up to 5 MW have as the base stimulation the guaranteed power purchase obligation. These plants have also the possibility to choose between guaranteed purchase obligation at fixed prices or selling the electricity to the market and receiving the operational support. When having fixed tariff prices there is no obligation to follow the operating load pattern, balancing costs and system costs are covered by the Support Centre.

Eligible power producers from RES above 5 MW have to sell their electricity on the market and have to follow the operating load pattern, take care for their balancing and system costs and will be, if they are eligible, entitled only for operational support – premium payments which will depend on actual market conditions and the price of the electricity. The premiums were calculated as the difference between fixed prices (as declared in the fixed price tables for different technologies) and expected average market price in the coming years. For calculation of the operational support prices, the average market price for the electricity of 65 €/MWh in 2009 was taken into account.

### **Costs for Grid extension, access to Grid, connection costs responsibility**

The distribution and transmission system operators are obliged to connect to the grid each new producer of electricity from RES, which has the energy permission, consent for connection and declaration of producing plant. The request for connection by the RES producer is eligible also without the declaration of the producing plant with the precondition to be obtained in a six months period. In such cases the owner of RES producing plant is not bearing the costs of potential reinforcements of the grid. Also the costs for the required analysis for the consent for connection have to be financed by the system grid operator. The costs for the connection line from the producing plant to the electrical grid have to be financed by the RES producer.

### **Access to information, transparency, balancing mechanisms**

The system electricity grid operators have to prepare and publish within the system operation guidelines the principles for connection points and technical requirements for connections for plants up to 10 MW. Within these system operation guidelines standard rules for establishing the costs for the technical execution of the grid connection must be applied. Rules have to be objective, transparent and non discriminatory and have to be based on the same principles as for connection of the consumers.

For RES power plants exceeding 10 MW, requirements for the technical equipment are defined in the specific energy permit for each individual plant. For RES power plant exceeding 10 MW and for which the energy permit was already issued, the system grid operators is obliged to prepare in 60 days a comprehensive and detailed estimation of the connection costs and the time schedule for the execution of the connection, on the demand of the investor.

### **3.3 Identification of key agents in Slovenia**

The responsibility for the legislation for feed-in tariffs system and support for RES and CHP is within the Ministry for Economy, which is responsible also for energy.

#### **Ministry of the Economy**

The Energy Directorate of the Slovenian Ministry of the Economy is responsible for the development of energy legislation and for implementing procedures in the area of energy use and supply. It performs professional tasks in the area of management of the state owned energy companies. It also covers energy matters in the international relations of the country and directs and coordinates the work of official bodies in the energy sphere including i.e. the Energy Inspectorate of Slovenia and the department for activities of the Efficient Use and Renewable Energy Sources.

The directorate for energy defines and orders required studies and analysis, prepare the laws and decrees, in this respect also the organisation and regulation of the feed-in tariff system. Renewable energy sources, cogeneration, energy efficiency and the commitment to reduce greenhouse gas emissions are recognised as the cornerstone for the sustainable energy and environment policy. The department for activities of the Efficient Use of Energy and Renewable Energy Sources was founded in 1995.

#### **Energy Agency of the Republic of Slovenia**

The Slovenian energy agency is the energy regulatory authority, whose responsibilities and duties are defined in the EU directives, defining common rules for electricity and gas markets, the Slovenian Energy Law and the corresponding secondary legislation. Its main tasks are related to energy networks, network price and network access apart from licensing. They work on the determination of pricing methodologies for the use of electricity and gas networks, determination of electricity network charge, approval of gas network charge, and methodologies for setting tariff systems. In its duty of market monitoring, the regulatory authority publishes annual reports on the state of the energy sector and some aspects of competition. The regulatory authority is also the dispute settlement body for disputes, arising from network access, network connections, breach of general conditions or system network codes. The agency is responsible for issuing the Declaration for producer facilities and Orders for guaranteed purchase prices and operational supports for RES and CHP electricity producers.

#### **Support Centre (Borzen) for RES and CHP**

The financial support of electricity produced by RES and CHP is one of the tasks performed by Borzen, the Slovenian Power Market Operator. This service was introduced by the change of the Energy Law in 2008. The Support Centre collect the incomes from consumers of electricity, which have to pay monthly a special rate according their connection power and administers the electricity feed-in support scheme for RES and CHP (cogeneration with high-efficiency) power plants. Based on the Declaration for production facilities and Order for guaranteed purchase price or operational support issued by the Energy Agency, Borzen is obliged to conclude the contracts with eligible electricity producers. Borzen purchase the produced electricity, organise equalisation and balancing production group for the RES producers and sell this electricity on the market. Borzen carries out also tasks related to guaranteeing the security of electricity supply based on us-

age of domestic primary energy sources, ensuring an adequate level of installed capacity and production.

### **The Ministry of the Environment and Spatial Planning**

It promotes and coordinates efforts towards sustainable development, while striving for social well-being based on a wise and efficient use of natural resources. The ministry is responsible for space planning, protection and conservation of the environment and formal procedures for obtaining the location and construction permits.

### **Ecological Fund**

The public Slovenian Ecological fund manages the investment subsidies and loans at lower interest rates for RES are by. Subsidies for investments are available for households upon the regular public calls, for thermo solar systems for sanitary hot water or space heating, biomass boilers, heat pumps, installation of low energy windows, isolation of facades, roofs and floors and for refurbishment and construction of low energy or passive houses.

The loans at lower interest rate for RES investments for companies and households are available for investments in RES, CHP and energy efficiency, upon the regular public calls. For companies the loans could amount up to 90 % of the eligible investment costs, for citizens the loans could amount up to 80 % of eligible investment costs, but not more than 16.660 €. The information regarding subsidies and loans are available on the web site [www.ekosklad.si](http://www.ekosklad.si).

### **Other institutions**

In the field of development of supporting systems for RES, CHP and energy efficiency there are few specialised and active companies like ApE Agencija za prestrukturiranje energetike, Centre for Energy Efficiency within Institute Jožef Stefan and the Building Institute ZRMK. The investments in RES and CHP are mainly executed by electricity distribution companies, the electricity generation company Holding slovenske elektrarne, GEN Energija and many private investors not coming from the energy sector. There are also many interest groups, Association of Self-Producers for small hydropower plants, Slovenian technology platform for Photovoltaic, Slovenian association of photovoltaic industry etc. that give opinions, influence public opinion and execute research on feed-in tariffs.

## **4 Analysis of the main properties of the tariff system<sup>12</sup>**

### **Proven to be successful and effective**

Feed-in tariffs (FITs) have been successful in triggering a considerable increase of RES-E technologies in almost all the countries in which they have been introduced and where their effectiveness was not significantly hampered by major barriers (administrative barriers, grid access, etc.). In its 2005 Communication COM (2005) 627 and again in 2008 in SEC (2008) 57, the European Commission concluded that national feed-in systems are typically more effective and efficient than quota systems. Current analyses continue to show that this result is still valid in 2010.

### **The risk premium required by investors can be minimised by the high level of price security in the system**

The capital costs for RES investments observed in countries with established feed-in systems have proven to be significantly lower than in countries with other instruments which involve higher risks of future return on investments.

### **Low (to medium) administration and transaction costs**

In general, both administration and transaction costs are low. Nevertheless, greater administration efforts occur if intensive RES-E benchmarking is necessary to define the 'correct' tariff levels. Consequently, administrative (as well as transaction) costs might rise to a medium level in the case of a complex tariff scheme.

### **No market liquidity problems**

Feed-in tariffs can also be used in very small markets without causing market distortions and avoid the abuse of market power by "big players".

### **Helps to develop high-quality components**

If the tariff is guaranteed for a longer period, e.g. 20 years in Germany, it is possible to encourage the development of components with higher technical efficiency or a longer lifetime compared to the situation of full competition and short term markets.

### **Low costs for society**

Feed-in tariffs can lower costs for society in three ways. The design of feed-in tariffs is typically technology specific reducing windfall profits for cheaper technology options. The application of stepped tariffs reduces producer profits in comparison to support schemes with uniform market clearing, thus reducing the cost for society. A tariff which is reduced over time in line with technology learning can also reduce the cost for society.

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12 For an in-depth analysis of this issue see also (Huber et al. 2004)

### **Helps to promote a specific portfolio among different RES-E technologies**

The technological differentiation of feed-in tariffs helps to promote a specific portfolio of technologies. In this way, learning can be stimulated across the portfolio which helps to reduce future costs. Another way to express this fact is that feed-in tariffs typically have a very high dynamic efficiency. Due to an early market diffusion of technologies that are important for stable RES growth in the long term, the future costs for society can be significantly reduced. The latter advantage might, however cause higher RES-E generation costs in the short term (see next item).

### **Leads to a minimisation of policy costs but not necessarily to minimisation of generation costs (depending on the technology portfolio supported under the feed-in system)**

A feed-in tariff does not necessarily lead to the minimisation of generation costs, especially if technology-specific tariffs and stepped tariffs are applied. Nevertheless, a feed-in tariff can lead to cost minimisation for society if the tariffs are selected appropriately. Important aspects of so doing are:

1. The risk reduction for investors due to guaranteed tariffs leads to lower generation costs since capital can be acquired at lower interest rates.
2. Stepped tariffs can help to reduce producer surplus.
3. Decreasing tariffs over time helps to reduce costs for society and encourages cost reductions.
4. Since market liquidity problems cannot occur, the abuse of market power can be excluded.

### **Additional elements for quantity control in feed-in systems help to limit total policy costs**

Many EU Member States want to support also currently more expensive technologies with substantial future cost reduction potential but are afraid that support costs may increase uncontrollably. Some countries set caps, limiting the amount of annual installations to a certain capacity or financial amount. The downside of caps is the reduced investment stability for market parties and a frequent stop-and-go in the market. Therefore other countries set growth corridors with continuous automatic adjustments of tariffs. The latter option preserves investment stability to a higher degree but may be less effective in limiting the increase of support expenditures.

### **Helps to reach an area or plant-size specific distribution of a RES-E technology**

As the tariffs can be stepped according to plant size or location, a more homogenous distribution with regard to plant size and location can be achieved. In this way, the acceptance of renewable technologies can be enhanced as more people have contact with the technology and their density in hot-spot areas is lower at the beginning.

### **Relatively homogenous premium costs for society over time**

The combination of technology-specific tariffs and stepped tariffs can lead to more homogeneous costs for society over time. This is because technologies with higher costs can be integrated into the support from the beginning thus inducing technology learning at an early stage, which helps to overcome price hikes later on when the growth of cheaper technologies reaches its limits.

### **RES-E deployment is (largely) independent of the total electricity demand in the case of fixed tariffs**

No direct link exists between RES-E deployment and electricity demand. As a consequence, the development of renewables is independent of the development of electricity demand.

### **Encourages competition among manufacturers but not among investors in the early phase of deployment<sup>13</sup>**

A tariff system does not encourage the same degree of competition among investors for the cheapest generation costs in the early phase of development which might occur under the conditions of a perfect market. Therefore it is not guaranteed that the entire potential for the reduction of specific generation costs is being exploited. However, competition among manufacturers is encouraged to a full degree, since perfect market conditions exist for RES plants and components. This results in the realisation of cost-efficient RES installations under feed-in systems.

Furthermore even if generation costs are slightly above the theoretical minimum due to the absence of competition among investors, the costs for society are not necessarily higher, depending on the analysed time frame, RES-E target and the setting of the feed-in tariffs (see item "Does not necessarily lead to minimisation of generation costs (if RES-E specific tariffs are applied) but to minimisation of costs for society").

### **RES-E targets cannot be exactly met - flexible in use and time**

A tariffs system creates a protected market which is not linked to the development of electricity demand. Therefore it is not possible to exactly meet a specific target for RES-E. But as tariffs for new contracts can be adjusted, there is flexibility for the modification of the system in line with set targets. In contrast to other systems, overachievement of the set targets is also possible.

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<sup>13</sup> As long as sufficient low cost potentials of a specific technology, e.g. of wind energy, are available

## 5 Main similarities and differences between the Spanish, the German and the Slovenian system

Although all three countries use a feed-in system to support electricity using RES, there are important differences in the instrument design. Whereas Spain and Slovenia offer a premium option as an alternative to the fixed option, Germany bases its support exclusively on fixed feed-in tariffs.

The support in **Spain** and **Germany** was highly **effective** now leading to the highest absolute increase of RES-E capacity compared to all other EU Member States and to a significant uptake of European wind capacity in particular during the recent past. The feed-in systems have triggered major investments in renewable energies and are responsible for creating lead markets for RES technologies in both countries. Since **Slovenia** started to support RES-E by means of feed-in tariffs considerably later than both of the other countries, it seems still too early to assess seriously the impacts of the system. It can be assessed however, that some key technologies such as biogas and biomass electricity generation have increased substantially since the introduction of the first feed-in system. Furthermore there was a noticeable increase of the installed capacity of hydro-power.

Additionally Spain, Slovenia and Germany are characterised by both a relatively **high static and dynamic efficiency**. Whereas the high static efficiency is mainly based on the high investment security offered by these schemes the high dynamic efficiency is reached through the early promotion of presently less matured technologies such as solar thermal electricity or photovoltaics. All three systems support a broad portfolio of RES technologies with specific tariffs and therefore provide the basis for a long term and sustainable development of renewable energy sources.

A further similarity between all three countries is that the feed-in tariffs are supplemented by a **broad portfolio of additional support measures** in particular by tax deductions on RES investments, soft loans with stable financing conditions as well as investment incentives (subsidies, partial debt relief) for some selected technologies. This well balanced policy mix, increasing the stability of the investments, is one of the key success factors of the applied promotion scheme.

A comparison between the main parameters of the three schemes is summarised in the following table and relevant differences between the schemes are explained in more detail in the text below.

Table 7 Comparison of the main implantation characteristics of the Spanish, the German and the Slovenian feed-in tariff system

Criterion	Spain	Germany	Slovenia
Guaranteed duration of tariff level	1 year <sup>14</sup>	generally 20 years <sup>15</sup>	1 year
General duration of support	during the whole lifetime	generally 20 years	15 years guaranteed
Are the tariffs stepped (regarding time, local conditions, etc)?	yes	yes	yes
Degression of tariffs for new installations	Yes for PV	predefined (1-9% per year)	Yes for PV
Implementation of burden sharing	through system operator OMEL - leads to equal distribution among all electricity consumers	equal distribution among all electricity consumers with exceptions for energy-intensive industries	equal distribution among electricity consumers, payment of contribution fee
Premium tariff possible?	yes	no	yes
Direct access to the spot market in combination with FIT possible	yes	no	yes
Supplemented by what kind of main additional support mechanisms	ICO-IDAE funding line, which provides with special conditions to investments in RE and RUE investments. In general, investment incentives, soft loans and tax incentives	Soft loans and investment incentives by the market incentive programme for biomass CHP, small hydro-power, PV in schools.	Soft loans and investment incentives
Grid access	guaranteed by the act	guaranteed by the act	guaranteed by the act
Costs of balancing power	not to be covered by RES generator in the fixed price option	not to be covered by RES generator	not to be covered by RES generator in the fixed price option
Demand orientation	yes, for selected technologies under the fixed price option	no	no
Forecast obligation	yes	no	yes
Do specific tariffs for the following (sub)-technologies exist?			
Biogas	yes	yes	yes
Off-shore wind	yes <sup>16</sup>	yes	-
PV	yes	yes	yes
Building integration of PV	no (only size dependent) <sup>17</sup>	yes	yes
Geothermal electricity	yes	yes	yes
Solar-thermal electricity	yes	no	yes
Ocean technologies	yes	no	no
Refurbishment large hydro	no	yes	yes
Biomass-CHP <sup>18</sup>	yes	yes	yes
Renewable biomass resources	yes	yes	yes
Inno. techn. incl. fuel cells, microturbines, etc	no	yes	no

14 Annual changes can be only very moderate.

15 Except hydro power (15 years for refurbishment of large hydro, 30 years for small hydro)

16 In principle a special category but in fact the same tariff as for wind on-shore

17 No special tariff for building integrated PV exists but a size depended differentiation (> 100 kW)

18 Separate (additional) tariffs for biomass electricity production with CHP

We would like to address the **main differences** between the schemes in more detail in the following:

### **Guaranteed period of tariff level**

Regarding the guaranteed period of tariff levels, Germany fixes the tariff level for an installation in advance for the overall payment period, whereas Slovenia and Spain maintain the possibility to undertake annual tariff revisions applying also for existing plants. In theory, the possibility to adjust tariffs might lead to some uncertainty among investors, but since tariff adjustments are restricted in Spain, and tariffs have not been changing in Slovenia since 2006, there is no investment uncertainty caused by possible tariff adjustments in practice.

The adjustment of tariffs might be linked to different reference indicators such as inflation, electricity prices, oil or gas prices or to the electricity generation costs. In Spain the adjustment is linked to a combination of the electricity price, the oil and gas price development and inflation, but was limited to a maximum change of annually 2 % (since 2004) in order to avoid too abrupt changes. The linkage to indicators that do not include cost development of RES runs the risk of enabling windfall profits due to a diverging development between support level and real generation costs.

### **Overall duration of support**

RES-E support is guaranteed during a long-term horizon in all three countries, but the overall duration of support diverges. Spain does not restrict the duration of support (it reduces only the tariff level after certain years) with the consequence that controllability of support costs might be affected. Germany limits support duration to the assumed lifetime of RES-plants guaranteeing investment security and maintaining cost controllability at the same time. In Slovenia the guaranteed support duration amounts to 15 years.

The general long term stability of feed-in systems leads to a stable investment climate and technologically to the installation of high quality components. In all three countries the feed-in laws are reviewed periodically.

### **Stepped tariff design**

One relevant difference between the systems in the three countries concerns the degree in which a stepped design is applied for different technology options. Whereas Germany has implemented stepped tariffs for nearly all technologies<sup>19</sup>, i.e. also for wind energy, Spain applies most differentiation in the field of biomass technologies, i.e. with respect to plant size and fuel type. The Slovenian system shows a stepped design only with respect to the plant size. We would like to discuss the main features of a stepped versus un-stepped approach in the following:

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<sup>19</sup> Stepped nature of tariffs in the German system: the tariffs for the different technologies defined in the act are determined based on the yield / generation costs of each particular system. This feature is especially important for wind energy but applies to other RES as well, e.g. to small hydro and biomass. Investors in wind power at sites above a reference value receive a substantially lower feed-in tariff starting 5 years after installation. At sites with below average wind yield, the time period for the higher feed-in tariff is prolonged. This feature leads to a lower level of promotion at sites with very good wind conditions and higher promotion levels under less advantageous wind conditions. Therefore the price of the tariff mirrors the cost resource curve of the technology. This results in a reduction of the producer profit and therefore in lower transfer costs for society.

The stepped design of tariffs gives the opportunity to reimburse RES-E generation in different bands of the (marginal) cost potential curve<sup>20</sup> according to the actual generation costs. The main advantage of this approach is the lowering of the producer profits compared to a flat tariff design in the case of (very) efficient generation options. This can be seen in Figure 2, where the cost potential curve for a specific technology is shown. The integral below the cost potential curve (green area) shows the generation costs. The integral between the guaranteed tariff (green line in the case of a flat tariff, red line in the case of a stepped tariff) and the (marginal) cost potential curve denotes the producer profit. Depending on the steepness of the cost curve and on the ambitiousness of the target the producer profit in case of a stepped tariff (orange area) can be significantly smaller than in case of a flat tariff design (blue plus orange area).

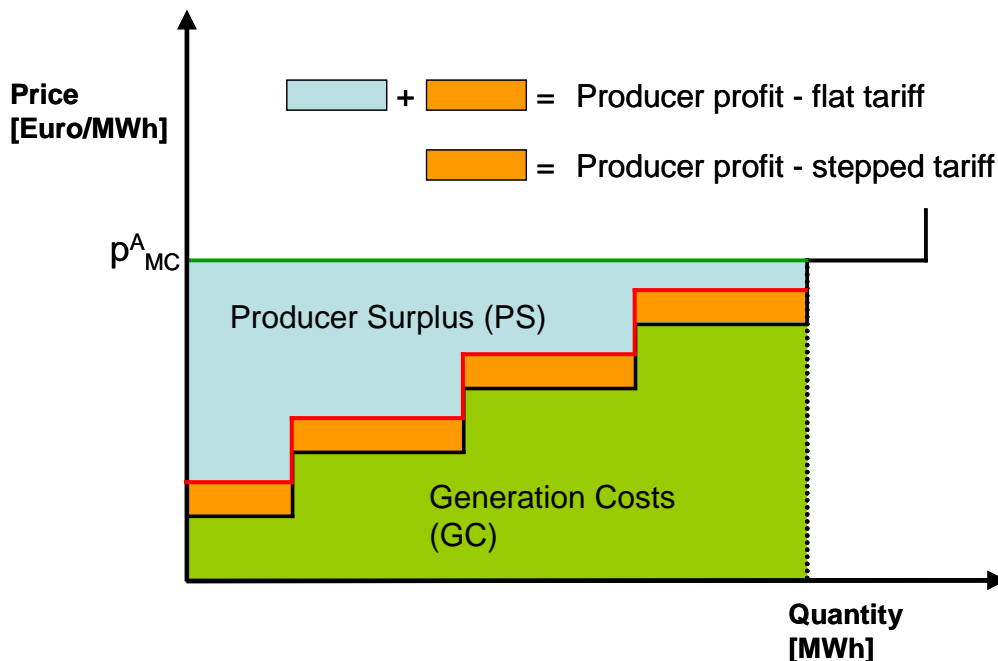


Figure 2: The structure of generation costs and producer profit for different design of feed-in systems; green line = guaranteed flat tariff; red curve = guaranteed stepped tariff (depending on efficiency of plant)

### Degression of tariffs

Another difference between the three systems is the temporal degression of tariffs, which is implemented in the German case based on progress ratios of the different technologies applying the concept of technology learning (tariffs for new installations are reduced by a fixed rate on a yearly basis)<sup>21</sup>. Rather than determining the future tariff structure for new plants beforehand the Spanish and Slovenian systems offer the flexibility of annual adjustments of the tariffs, which are deter-

<sup>20</sup> A band is a group of RES-E installations, which produces RES-E at similar generation costs due to similar techno-economic conditions within the band, e.g. similar full-load hours for wind energy.

<sup>21</sup> The level of the tariff for a newly commissioned plant remains constant for the duration of the guaranteed tariff (normally 20 years), but depends on the year of commissioning. Therefore, the later a new plant is installed, the lower the reimbursements received. This means there is a continuous incentive for efficiency improvements and cost reductions for new plants.

mined year by year based on the current status of the market (tariffs might increase or decrease).<sup>22</sup>

A system that adjusts prices for existing plants involves the risk to "overpaying" existing plants if the tariffs are increased and to financial underperformance for investors if the tariffs are lowered.<sup>23</sup> The effect of possible overpayment of existing installations in case of increasing the tariffs is presented in the following figure. The marginal cost curve for the year  $n$  is shown as solid black line and the corresponding curve after technology learning as broken red line. The achieved potential in year  $n$  and year  $n+1$  are shown as well as the level of the feed-in tariffs necessary to generate the investments. The adjustment of the tariff in the year  $n+1$  has two conceptual reasons: (a) the generation costs decrease due to technology learning, (b) the generation costs increase because the cheaper potentials are exploited. In the example shown below the second effect dominates. Therefore the tariff needs to be increased from a level that was just above costs of generation in year  $n$  to a new level that makes investments profitable in year  $n+1$ . The amount of money that is used to overpay existing installations is given by the area depicted in yellow.

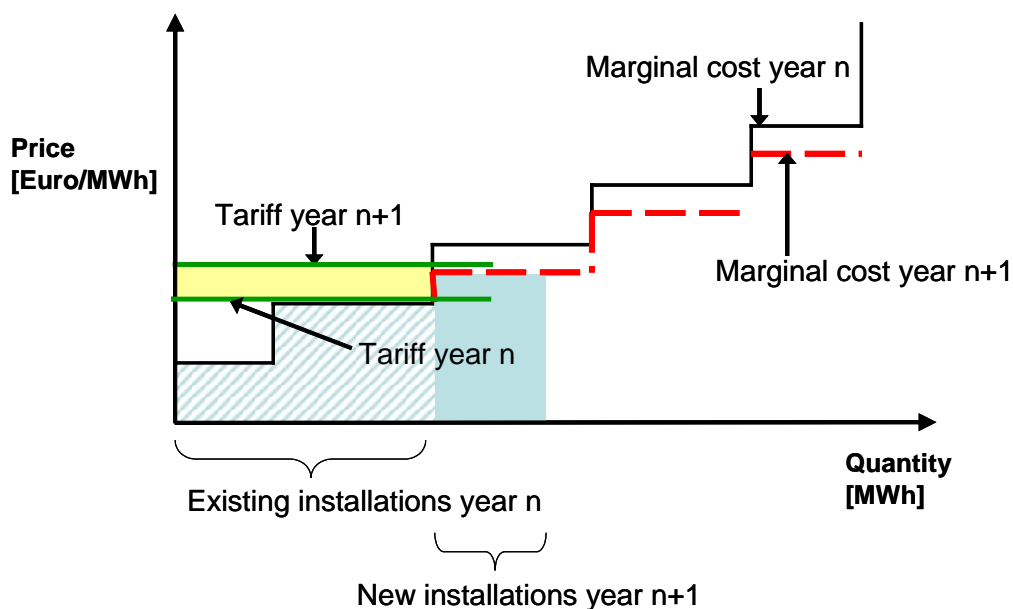


Figure 3: The effect of different systems of degression of feed-in tariffs

### Existence of a premium tariff

One of the main benefits of implementing a premium tariff as in the Spanish or the Slovenian system is that RES-E generation shows higher compatibility with principles of liberalised electricity markets. Furthermore the costs of social and environmental benefits of RES-E are directly measurable, which might cause a positive effect on the social acceptance of the tariff system. Nevertheless, the stronger market orientation might be combined with higher investor risks as well as

<sup>22</sup> In the case of a premium tariff scheme, as applied in Spain, a higher level of flexibility is necessary to avoid unnecessary overpayments. The reason is that, in contrast to the fixed tariff scheme, the changes on the power market must be considered and compensated as well.

<sup>23</sup> This statement refers to the annual adjustment of the tariffs, which applies to old and new plants, whereas the review of the tariffs, taking place every four years, applies only to new plants

potentially higher support costs if the risk of future electricity market prices have to be fully covered by the RES operators.

Spain and Slovenia offer the premium option as an alternative to the fixed tariff scheme, but the design of both premium options diverge, as described subsequently.

In Slovenia, RES-E generators might sell of their electricity on the market and receive a constant premium payment in addition to the market price. The overall remuneration under the market option in Slovenia is supposed to be on a similar level as for the fixed option. For power plants bigger than 5 MW, only the constant premium option is possible. For plants up to 5 MW, the change between the fixed price option and constant premium is possible every two years, upon an in advance request.

The Spanish premium option was introduced in 1998 and experienced already two major modifications. In 2004, the existing premium option was adapted to create a stronger market-orientation. The additional tariff components included a premium and an incentive for participation in the market leading to a higher remuneration level in case of the premium option than under the fixed tariff scheme. A fixed range per technology for the sum of electricity market price and premium was established in 2007, in order to avoid the windfall profits generated as a consequence of strongly increasing electricity prices. Hence the variability of the remuneration level under the premium option is restricted by a cap and a floor level in Spain, whereas it is completely flexible in Slovenia.

### **Technology choices**

The (sub) technologies supported by the feed-in systems in all three countries with *special rates* exhibit some relevant differences, as shown in Table 7. Some of these choices are the obvious consequence of the available potentials for individual technologies, e.g. the non-existence of a separate tariff for concentrating solar thermal systems for electricity generation in Germany. Other important differences with regard to technology differentiation are the existing support for ocean (wave and tide) applications in the Spanish system and the existence of separate tariffs or bonus systems for off-shore wind installations, for building integrated PV systems, for Biomass CHP applications in the German system.

### **System Integration**

The Spanish system obliges RES-E installations exceeding 10 MW to connect to a generation control centre that coordinates electricity offer of RES-E. RES-E producers in Spain and Slovenia (in Slovenia installations exceeding 1 MW) are committed to forecast their electricity production. Whilst Spain penalises too high forecast deviations, RES-E producers in Slovenia do not have to pay for deviations in the fixed price option. Both elements contribute to a better integration of RES-E in the electricity system.

### **Additional elements for quantity control for expensive technologies**

Many EU Member States want to support (especially high price) technologies but are afraid that support costs may increase uncontrollably. Therefore some Member States complement existing

feed-in tariffs by additional elements to control the quantity of newly installed capacity. Spain for example has set caps for different technologies, limiting the amount of annual installations to a certain capacity or financial amount. Germany on the other hand set a growth corridor for photovoltaics with continuous automatic adjustments of tariffs. The latter option preserves investment stability to a higher degree but may be less effective in limiting the increase of support expenditures.

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