Fraunhofer Institute Systems and Innovation Research

Feed-In Systems in Germany, Spain and Slovenia

- A comparison -

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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 1st 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.1 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 2007 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.

1.2 Current legislation (amended EEG / August 2004)

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 are included in the revised EEG (amending law) which is valid from 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 shall be improved. The revised act provides 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.

1 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·

Furthermore, special incentives are 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 order to provide incentives for more rapid technological progress. **Offshore wind energy** plants receive 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 is the integration of capacity extensions by refurbishing **large hydro-power** plants, which are now entitled to feed-in tariffs if certain conditions (including increasing output) are met.[2] A further adjustment of the law is that the rule of decreasing tariffs over time is now 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.

At the moment the second review of the German EEG is finalised, which will lead to amendments to be implemented by the beginning of 2009. It is yet too early to document all changes to be implemented in a revised EEG from 2009.

The following table gives an overview of the current tariff structure of the EEG of 2007.

[2] Only the additional generation due to plant extension/refurbishment will be reimbursed.

Table 1 Tariff structure of the EEG in 2007

Renewable energy source		Range of performance	Feed-in tariff in €/MWh				Degression[3]
Solar			installed on buildings	integrated in the façade of buildings	all other systems		5% 6.5% from 2006 in "all other systems"
		<30 kW 30 kW-100 kW >100 kW	492 468 463	542 518 513	380		
Biomass[4]			general	renewable feed-stock	CHP	Used wood 1.7.2006	1.5%
		< 150 kW 150 -500 kW 500 kW - 5 MW 5 MW - 20 MW	110 95 85 80	170 155 125 (110 for wood) 80	130 115 105 100	110 110 80 80	
Hydro	**large**	< 500kW 500kW - 10MW 10MW - 20MW 20MW - 50MW 50MW – 150MW	74 64 59 44 36				1%
	small	500 kW 5 MW	97 66				
Geothermal		5 MW 10 MW 20 MW >20 MW	150 140 90 72				1% starting in 2010
Wind	**offshore**		installed before 31.12.2010 for 12 years	installed after 31.12.2010 and after 12 years			2% after 2008
			91	62			
	onshore		for at least 5 years after installation	after, time depending on yield of system			2%
			82	52			
Landfill gas, sewage gas, Mine gas				using specific innovative technologies			1.5%
		500 kW 500 kW - 5 MW	73 63	93 83			
		> 5 MW	Market price is paid for the capacity above 5 MW				

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][5], which is responsible for the promotion of renewable energies, is the main actor. Two other important actors are the Federal Ministry of Eco-

3 Reduction of tariffs every year for new installed systems

4 For CHP-plants using renewable feedstock a combination of boni is possible. Further bonus of 20-40 €/MWh is possible for specific innovative features.

5 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.

nomics and Labour [BMWA], 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 Electricity Association [VDEW], 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. The grid operators are represented by the Association of German Network Operators [VDN]. On the side of consumers, the Federal Association of German Industry [BDI] is an important player in the political debate.

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 recently 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). A new plan setting new objectives for RES-development from 2011 to 2020 will be carried out during 2008.

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 27th 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 23rd 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 12th 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:

$$P = Pm + Pr \pm RE \quad \text{where:}$$

P= Payment of the kWh
Pm= Market price
Pr= 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 12th 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.

2.2 Current legislation – 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).

2.2.1 Major modifications

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.

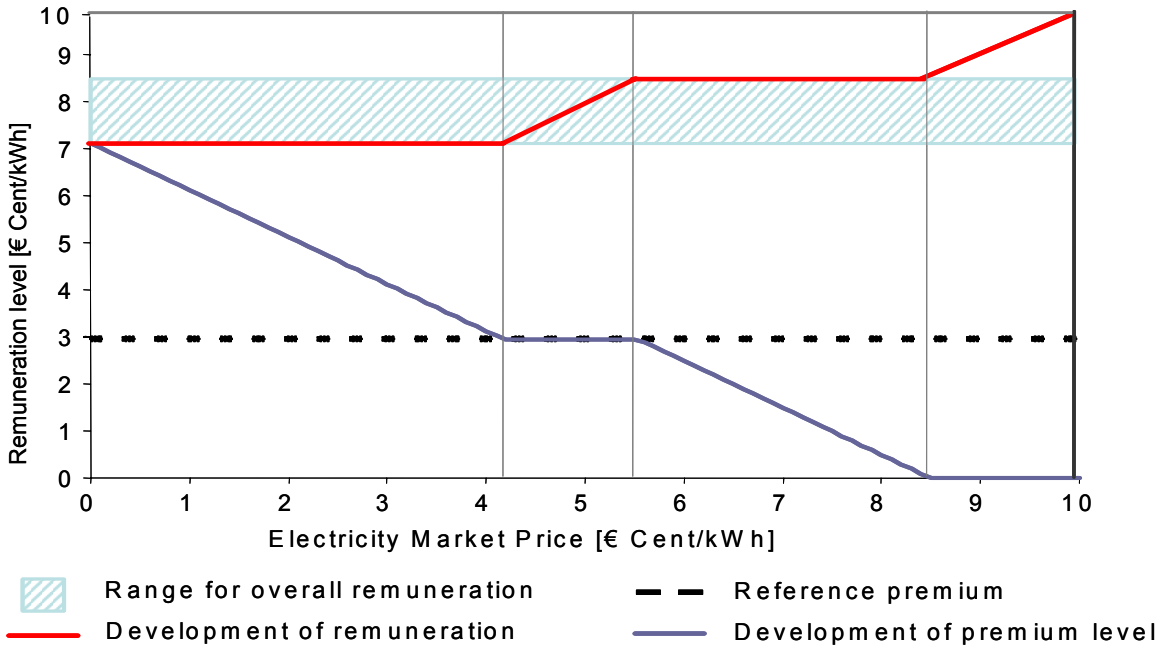

Figure 1 Progression of the remuneration level for wind onshore within the market option

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).

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

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	≤ 0.1MW	1 - 25	44.0381			
			> 25	35.2305			
		0.1MW – 10MW	1 - 25	41.7500			
			> 25	33.4000			
		10MW – 50MW	1 - 25	22.9375			
			> 25	18.3811			
	b.1.2 Solar Thermal		1 - 25	26.9375	25.4000	34.3976	25.4038
			> 25	21.5498	20.3200		
b.2 Wind	b.2.1 Onshore		1 - 20	7.3228	2.9291	8.4944	7.1275
			> 20	6.1200			
b.3 Geothermal and Ocean			1 - 20	6.8900	3.8444		
			> 20	6.5100	3.0600		
b.4 Small-scale Hydro		< 10MW	1 - 25	7.8000	2.5044	8.5200	6.5200
			> 25	7.0200	1.3444		
b.5 Large-scale Hydro		10MW – 50 MW	1 - 25	$6.60+1.20\times\frac{50-P}{40}$	2.1044	8.0000	6.1200
			> 25	$5.94+1.08\times\frac{50-P}{40}$	1.3444		
b.6 Biomass	b.6.1 Energy crops	≤ 2MW	1 - 15	15.8890	11.5294	16.6300	15.4100
			> 15	11.7931	0		
		> 2MW	1 - 15	14.6590	10.0964	15.0900	14.2700
			> 15	12.3470	0		
	b.6.2 Agricultural wastes	≤ 2MW	1 - 15	12.5710	8.2114	13.3100	12.0900
			> 15	8.4752	0		
		> 2MW	1 - 15	10.7540	6.1914	11.1900	10.3790
			> 15	8.0660	0		
	b.6.3 Forestry wastes	≤ 2MW	1 - 15	12.5710	8.2114	13.3100	12.0900
			> 15	8.4752	0		
		> 2MW	1 - 15	11.8294	7.2674	12.2600	11.4400
			> 15	8.0660	0		
b.7 Biomass	b.7.1 Landfill gas		1 - 15	7.9920	3.7784	8.9600	7.4400
			> 15	6.5100	0		
	b.7.2 Gas from anaerobic digestion	≤ 0.5MW	1 - 15	13.0690	9.7696	15.3300	12.3500
			> 15	6.5100	0		
		> 0.5MW	1 - 15	9.6800	5.7774	11.0300	9.5500
			> 15	6.5100	0		
	b.7.3 Liquid bio-fuels, Manure		1 - 15	5.3600	3.0844	8.3300	5.1000
			> 15	5.3600	0		
b.8 Biomass from industrial processes	b.8.1 Agricultural wastes	≤ 2MW	1 - 15	12.5710	8.2114	13.3100	12.0900
			> 15	8.4752	0		
		> 2MW	1 - 15	10.7540	6.1914	11.1900	10.3790
			> 15	8.0660	0		
	b.8.2 Forestry wastes	≤ 2MW	1 - 15	9.2800	4.9214	10.0200	8.7900
			> 15	6.5100	0		
		> 2MW	1 - 15	6.5080	1.9454	6.9400	6.1200
			> 15	6.5080	0		
	b.8.3 Black liquor	≤ 2MW	1 - 15	9.2800	5.1696	10.0200	8.7900
			> 15	6.5100	0		
		> 2MW	1 - 15	8.0000	3.2199	9.0000	7.5000
			> 15	6.5080	0		

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[6]

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.7.1Landfill 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.

6 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

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	16.0113	11.668
			> 15	11.8839	
		> 2MW	1 - 15	14.659	1.9640
			> 15	12.347	
	b.6.2 Agricultural wastes	≤ 2MW	1 - 15	12.7998	8.4643
			> 15	8.6294	
		> 2MW	1 - 15	10.7540	6.1914
			> 15	8.0606	
	b.6.3 Forestry wastes	≤ 2MW	1 - 15	12.7998	8.4643
			> 15	8.6294	
		> 2MW	1 - 15	11.8294	7.2674
			> 15	8.0660	
	b.7.1 Landfill gas	≤ 2MW	1 - 15	8.2302	4.7880
			> 15	6.7040	
	b.7.2 Gas from an-aerobic digestion	> 2MW	1 - 15	13.3474	1.842
			> 15	6.6487	
		≤ 2MW	1 - 15	9.9598	6.190
			> 15	6.6981	
	b.7.3 Liquid biofuels, manure	> 2MW	1 - 15	5.3600	3.844
			> 15	5.3600	
	b.8.1 Agricultural wastes from industrial processing	≤ 2MW	1 - 15	12.7998	8.4643
			> 15	8.6294	
		> 2MW	1 - 15	10.9497	6.3821
			> 15	8.2128	
	b.8.2 Forestry wastes from industrial proc-essing	≤ 2MW	1 - 15	9.4804	5.1591
			> 15	6.6506	
		> 2MW	1 - 15	7.1347	2.9959
			> 15	7.1347	
	b.8.3 Black liquor	≤ 2MW	1 - 15	9.4804	5.4193
			> 15	6.6506	
		> 2MW	1 - 15	9.3000	4.9586
			> 15	7.5656	

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 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 dur-

ing 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.

2.3 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 Empresial - 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.

2.3.1 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.

2.3.2 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 7th October, on the Hydrocarbon Sector, and developed by the Royal Decree 1339/1999 of 31st 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 Law on Energy (1999, amended 2000, 2002, 2004, 2005, 2007); the regulation on CO_2 emission tax (1996, amended 2002); the National Energy Programme (2004) and the Decree on Prices and Premiums for Purchase of Electricity from Qualified Producers (2002, amended 2004, 2006).

According to the Law on Energy the network operators are obliged to purchase electricity from "qualified producers" either for fixed feed-in tariffs or premium feed-in tariffs. The RES-E producer chooses between the fixed and the premium tariff. The network operator and the qualified producer sign a Purchase Agreement covering the purchase of electricity from the qualified producer for a period of 10 years. On the basis of the Purchase Agreement, the network operator then buys electricity at the uniform annual price or pays the qualified producer a uniform annual premium for electricity which the latter has sold independently or via an intermediary on the market.

Uniform annual prices and uniform annual premiums are set at least once a year by the Slovenian Government. The Government takes into account the growth in the costs of essential goods published by the Statistical Office of the Republic of Slovenia for the past period, changes in the prices of the basic fuel that is used to generate electricity in qualified power plants, and the expected average annual price of electricity on the market. So far prices and premiums remain unchanged from 2006 prices and premiums. But there are currently studies to change prices and premiums.

Uniform annual prices and premiums for an individual qualified power plant apply for five years from the start of operation, and are then reduced by 5%. Ten years after the start of operation they are reduced by 10% relative to the original tariff. The start of operation is the day the plant begins to deliver electricity to a public network on the basis of their operating licence. Also for every 10% of investment subsidy the tariffs are reduced by 5%.

Subsidies or loans with reduced interest-rates are also available. Financial incentives aim at using RES for heating and electricity and for highly efficient cogeneration plants.

Two different soft loans are normally offered every year by the "Environmental fund of the Republic of Slovenia"[7].

Public tender for loaning ecological investment 38PO07A

This soft loan for companies, municipalities and other legal entities located in the Republic of Slovenia amounted in total to 12 million €. The object of this tender was the stimulation of investments in RES-E. The call in 2007 is already closed. The loan can cover up to 90 % of the investment. There was a fixed annual interest rate of 3m-Euribor+0.3 % for a maximum duration of 15 years with moratory interest of up to 2 years.

[7] www.ekosklad.si

Public tender for loaning ecological investments 37OB07A

This soft loan for citizens located in the Republic of Slovenia amounted in total to 10 million €. The object of the tender was to stimulate investment in small-scale RES-E plants with a nominal power of up to 50 kW. Loans can cover up to 90% of the investment. There was a fixed annual interest rate of 3,9 % for a duration of up to 10 years and not more then 40.000 € per PV plants. For the remaining RES-E plants the credit limit is 20.000 € per installation.

Irreversible subsidies for electricity from renewable energy sources for households are assigned by the department of the Ministry for Environment and Spatial Planning responsible for activity of effective use of alternative energy sources[8]. The subsidies encouraged investment in the use RES in households in the year 2006. There was a 40 % subsidy for correctly installed PV power plants, restricted to 600 SIT (2.5 €)/Wp for modules installed and to 500,000 SIT (2,086 €) for the whole system. For investments in remote areas with no possibility of connection to the electricity network (solar collectors, PV and biomass), there is the possibility to apply for an additional 20% subsidy (in total up to 60%) of the investment costs.

The department of the Ministry also assigned irreversible means for the stimulation of investments in RES to legal entities and self-employed individuals. The level of irreversible means for construction for an independent solar power plant in 2004 amounted to 30 % of the entitled investment costs or to 40 % of entitled costs in case the produced energy covers the need for electrical energy. After 2004 no more subsidies for RES-E from this ministry have been conceded.

3.2 Current legislation and recent amendments

The Energy Act (OJ RS, No. 26/05 amendment 2007)

The energy Act defines qualified producers of electricity. Qualified producers are producers that generate electricity in an individual generating facility with a higher-than-average efficiency for heat and electricity cogeneration, or that use RES in a manner which is in accordance with environmental protection. The Energy Act defines the method of promoting electricity generated by qualified producers. The system operator of the electricity distribution or transmission network is responsible for purchasing all electricity from all qualified electricity producers which are connected to its distribution or transmission network 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. The premium shall be paid to the producer by the system operator of the distribution or transmission network to the network, the qualified power plant is connected to. Further details on conditions to acquire the status of a qualified producer, including production volume, type of energy source and useful efficiency, are be prescribed by the Government of the Republic of Slovenia in separate decrees.

National Energy Programme (2004)

[8] www.aure.si

A document setting the long term vision of the energy sector is the National Energy Programme from 2004. It provides a legal basis and political consensus for the instruments/ mechanisms to achieve the main requirements regarding energy services, which are key element for the prosperity, economic and technical development. According to National Energy Programme Slovenia plans to:

- Increase the share of RES in primary energy balance from 9% to 12% by 2010,
- Increase the share of RES in heat supply from 22% in 2002 to 15% by 2010,
- Increase the share of electricity produced with RES from 32 % in 2002 to 33,6 % in 2010
- Increase the share of biofuels in transport to 5,75 % by 2010.

Governmental regulation of rules for definition of prices and for purchase of electricity from qualified producers of electricity (OJ RS, No. 15/02)

This regulation sets out the rules and starting points for contractual relations between qualified electricity producers and the operators of the networks to which qualified power plants are connected, and the rules for setting prices and premiums for the purchase of electricity from qualified electricity producers. The provisions of the Decree applies to electricity producers who have obtained the status of qualified producer, except for qualified producers generating electricity in large hydroelectric plants, large power plants using municipal waste, large district heating plants and medium or large industrial heating plants. In setting uniform annual prices and uniform annual premiums, the Government of the Republic of Slovenia shall take into account the growth in the costs of essential goods published by the Statistical Office of the Republic of Slovenia for the past period, changes in the prices of the basic fuel that is used to generate electricity in qualified power plants, and the expected average annual price of electricity on the market. Uniform annual prices and uniform annual premiums for an individual qualified power plant shall apply for a period of five years from the start of operation, and shall then be reduced by 5 %. Ten years after the start of operation they shall be reduced by 10 %. The start of operation of a qualified power plant shall be counted as the day that it began to deliver electricity to a public network on the basis of an operating licence. For qualified power plants receiving a non-refundable state subsidy, for every 10 % of non-refundable state subsidy received, depending on the level of the investment, the uniform annual price or uniform annual subsidy shall be reduced by 5 %. Qualified producers shall not draw up daily schedules for micro and small qualified power plants from which the purchase of electricity takes place on the basis of a decree. Qualified producers shall not pay for non-permitted deviations. It is further determined that costs incurred by the network operator because of this shall be included in priority dispatch costs. The operator of a network to whose network a qualified power plant is connected and the qualified producer shall conclude an Agreement covering the purchase of electricity from the qualified producer for a period of ten years.

Decree on prices and premiums for purchase of electricity from qualified producers of electricity (Off.Gaz. of RS No. 29/01, 15/02, 8/04, 75/06)

This decree sets the actual feed-in tariffs and premiums on an annual basis. The currently valid tariffs have not been changed since 2006 and are depicted in Table 5.

Table 5 Level of feed-in tariffs in Slovenia in 2007

Technology	Capacity	Duration		2006 – present*			
		fixed	premium	fixed	premium	fixed	premium
		(years)	(years)	(SIT/MWh)	(SIT/MWh)	(€/MWh)	(€/MWh)
Hydro	≤ 1MW	After 5 years tariff reduced by 5%. After 10 years tariff reduced by 10%.		14,750	5,750	62	24
	1MW - 10MW			14,230	5,230	59	22
Biomass	≤ 1MW			22,550	13,550	94	57
	> 1MW			21,850	12,850	91	54
Biogas (landfill and sewage gas)	≤ 1MW			12,740	37,4	53	16
	>1MW			11,870	28,7	50	12
Biogas (animal waste)	-			28,970	19,97	121	83
Wind	≤ 1MW			14,550	5,550	61	23
	> 1MW			14,050	5,050	59	21
Geothermal	-			14,050	5,050	59	21
Solar	-			89,670	80,670	374	337

* Exchange rate used €1 = 239,66 SIT from FXConverter http://www.oanda.com/convert/classic

Tariffs shown in Table 5 might be adjusted within the double tariff system, if RES-E producers choose the option to get variable tariffs depending on load categories defined within the FIT-system. Three different seasons and two daily categories are distinguished as shown in Table 6.

Table 6: Factors in the double-tariff-system in Slovenia

	Higher daily tariff item (HDT)	Lower daily tariff item (LDT)
High season (Jan, Feb, Dec)	1.40	1.00
Middle season (Mar, Apr, Oct, Nov)	1.20	0.85
Low season (May – Sept)	1.00	0.70

In the case of the double tariff option, the FITs are multiplied by the factors shown in Table 6. The lowest tariff is applied from May to September during the night or in the early afternoon. During this time RES-E producers receive only 70% of the regular tariff level. The highest tariff is paid from December to February during the morning and during the late afternoon. During this time RES-E producers receive 140 % of the regular tariff level. The result is that the producers of RES-E, who can adapt their operation, are able to achieve a higher price for their electricity and the supply is more demand-orientated. This makes especially sense for biomass and biogas plants (Republic of Slovenia - Ministry of the Economy 2006, pp. 9).

Regulation for the conditions to acquire the status of qualified electricity producer of Energy law (OJ RS, Nos. 71/07)

The new Decree on the conditions for obtaining the status of a qualified electricity producer sets out types of qualified electricity producers in terms of primary source of electricity and nominal

electrical power, conditions for obtaining the status of qualified electricity producer and the procedure for obtaining the status of a qualified electricity producer. Taking into account the maximum potential quantity of electricity generated in one year, qualified power stations are be divided into different size classes with regard to the type of energy source, plants are divided into renewable power plants, combined power plants and thermal power plants. The plant size categorisation is the following:

1) Micro: < 50 kW
2) Small: 50 kW -1 MW
3) Middle: 1 MW -10 MW
4) Large: 10 MWe

Conditions for obtaining qualified power plant status are also specified for individual types of qualified power plants. No conditions are prescribed for renewable power plants, with the exception of hydropower plants obliged to satisfy environmental criteria and biomass power plants, obliged to satisfy the following conditions:

a) Biomass has to represent at least 90 % of the fuel used, measured by the lower heating value, in the annual average
b) Power stations may use biomass as fuel if they operate in accordance with the laws and executive regulations governing waste management and biomass management.

The decision on the status of a qualified producer is taken by the minister responsible for energy at the request of the producer. The application must be accompanied by documentation on proof of the quantity of electricity and heat generated and fuel consumed in the past year, a connection licence, technical documentation and measurements, legal identification of the company selling the RES-E and the energy licence for power plants over 1 MW.

The application to obtain the status of qualified electricity producer is contained in the annex to the Decree and can be accessed on the homepage of the Official Journal.

3.3 Identification of key agents in Slovenia

In the field of feed-in tariffs the public body preparing legislation is the ministry responsible for energy corresponding to the Ministry for Economy.

Ministry of the Economy

The Energy Directorate of the Slovenian Ministry of the Economy is responsible for the development of systemic energy legislation and for implementing procedures in the area of energy use and supply. It performs professional tasks in the area of management and privatisation of state assets in companies in the energy sector that are state owned. It also covers energy matters in the international relations of the country and directs and co-ordinates 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 from the Ministry for Environment and Spatial Planning.

The Energy Office actively cooperates with the Energy Agency and non-governmental organisations operating in the energy field. The directorate defines, orders studies and accepts laws and decrees on feed-in tariffs.

The 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 Act 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. It also runs the register of qualified producers and grants the status of qualified producers.

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. Renewable energy sources, cogeneration, energy efficiency and the commitment to reduce greenhouse gas emissions were recognised as the cornerstone for the sustainable energy and environment policy. The department for activities of the Efficient Use and Renewable Energy Sources, operating within the Ministry of the Environment, Spatial Planning, was founded in 1995 to implement these targets. The Sector is running several programs, supported by financial measures and grants to promote the afore-mentioned tasks. But they do not prepare the legislation on the feed in tariffs.

In addition ,there are some and public bodies such as Institute Jožef Stefan Centre for Energy Efficiency, electricity distribution companies, the biggest electricity generation company Holding slovenske elektrarne, corporate institutions; Agencija za prestrukturiranje energetike, Borzen, interest groups; the Association of Self-Producers of RES for small hydropower plants, a technology platform for Photovoltaic, etc. that give opinions, influence public opinion and execute research on feed-in tariffs.

4 Analysis of the main properties of the tariff system[9]

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, 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 2007.

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.

9 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 costs for society 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.

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[10]

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.

10 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 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 by roughly 50 % since the introduction of the first feed-in system. Furthermore there was a noticeable increase of the installed capacity of hydro-power.

Additionally Spain 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 the two schemes the high dynamic efficiency is reached through the early promotion of presently less matured technologies such as solar thermal electricity or photovoltaics. Both 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[11]	generally 20 years[12]	1 year
General duration of support	during the whole lifetime	generally 20 years	10 years guaranteed
Are the tariffs stepped (regarding time, local conditions, etc)?	yes	yes	yes
Degression of tariffs for new installations	set in a flexible way	predefined (2-6.5% per year)	no
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
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 hydropower, 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	not to be covered by RES generator	not to be covered by RES generator
Demand orientation	yes, for selected technologies under the fixed price option	no	yes, for selected technologies
Forecast obligation	yes	no	yes
Do specific tariffs for the following (sub)-technologies exist?			
Biogas	yes	yes	yes
Off-shore wind	yes[13]	yes	-
PV	yes	yes	yes, Solar
Building integration of PV	no (only size dependent)[14]	yes	no
Geothermal electricity	yes	yes	yes
Solar-thermal electricity	yes	no	yes, Solar
Ocean technologies	yes	no	no
Refurbishment large hydro	no	yes	no
Biomass-CHP[15]	yes	yes	no
Renewable biomass resources	yes	yes	yes
Inno. techn. incl. fuel cells, microturbines, etc	no	yes	no

11 Annual changes can be only very moderate.

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

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

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

15 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 i.e. in Spain, and tariffs have not been changing in Slovenia since 2006, there is not 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 was 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 10 years with the possibility of extension. However, the support duration of 10 years might be insufficient for some technologies, as i.e. Photovoltaics.

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[16], 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 Slove-

16 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.

nian 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:

The stepped design of tariffs gives the opportunity to reimburse RES-E generation in different bands of the (marginal) cost potential curve[17] 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, were 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).

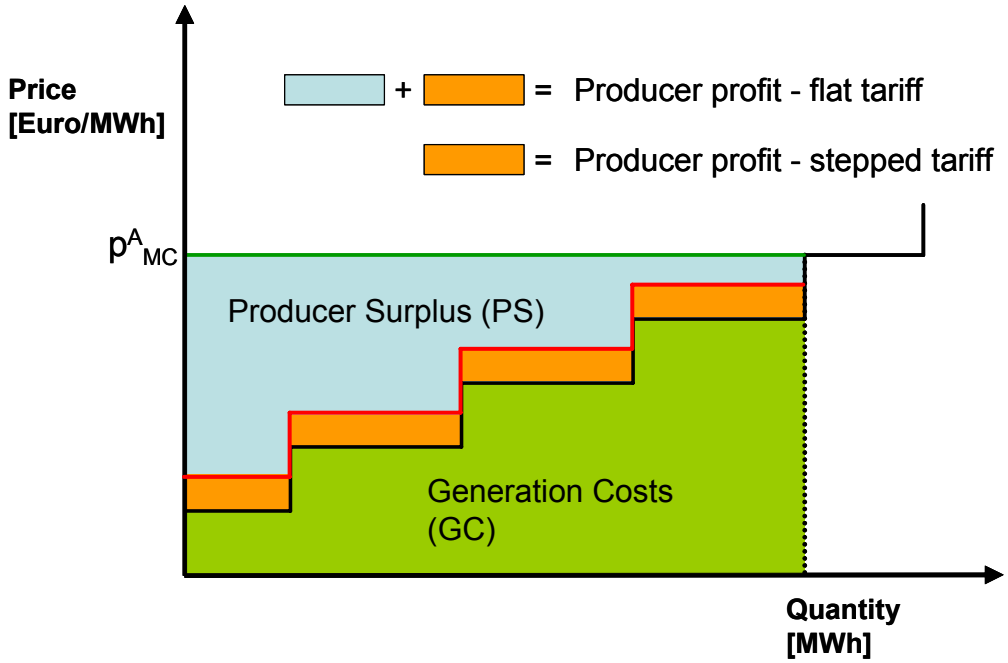

Figure 2: The structure of generation costs and producer profit for different design of feed-in systems; green line = guaranteed flat tariff; red curve = guaranteed stepped tariff (depending on efficiency of plant)

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)[18]. 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-

17 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.

18 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).[19] Another difference between the three systems is based on the fact that degression affects only new investments in the German case but new and existing installations in the Spanish case. In the Slovenian System uniform annual prices and premiums for an individual qualified power plant apply for five years from the start of operation, and are then reduced by 5% and by 10% after 10 years.

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 lowed.[20] 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.

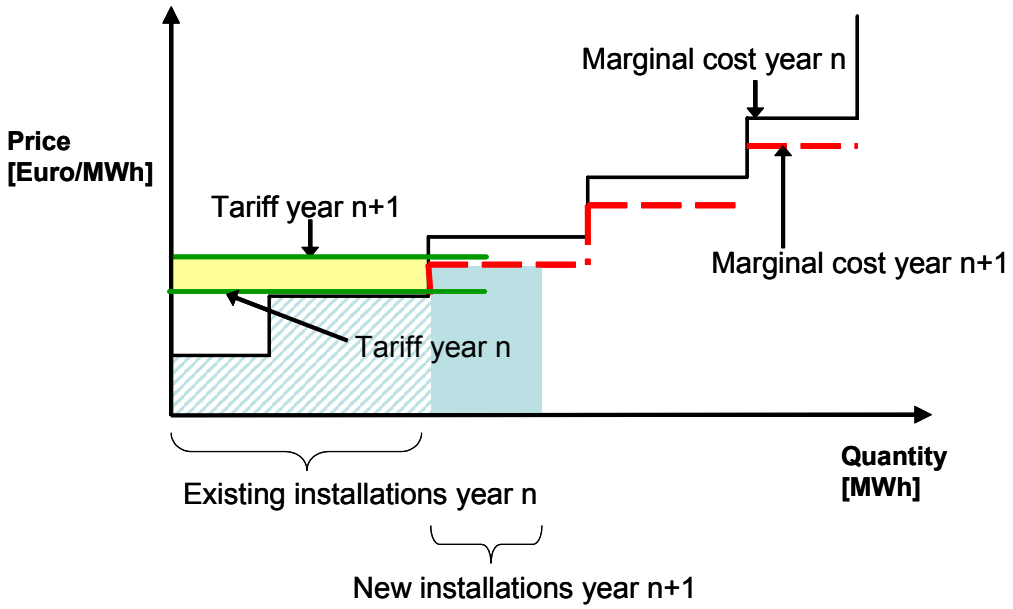

Figure 3: The effect of different systems of degression of feed-in tariffs

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

[19] 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.

[20] 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

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 go ahead with higher investor risks as well as potential windfall profits and support costs.

Differences with regard to the implementation of a premium feed-in tariff scheme instead of a 'fixed' tariff concerning the interaction with the conventional electricity market, which are as follows:

- Firstly both supply and demand on the spot market are higher. The reason is that under this scenario no market separation between conventional and renewable power market takes place. This can be essential if the power market is small, as the degree of competition rises due to the higher trading volume;
- Secondly, as the revenues for RES-E are more uncertain than under a 'fixed' feed-in tariff scheme, investors will require a higher risk premium, leading to a lower RES-E deployment if not compensated by e.g. an additional premium, ensured by minimum prices or the possibility to change to the fixed tariff scheme.
- Thirdly, in the case of an increasing conventional power price producer surplus for RES-E generators rises too. On the contrary, by applying a fixed feed-in scheme the gap between the (rising) power market prices and RES-E generation costs decreases - instead of being constant in the case of a premium design - leading to lower costs for society. On the other hand, additional costs occur in case of the fixed tariff scheme if the conventional power price drops.

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

In Slovenia, RES-E generators might sell a part 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 (Republic of Slovenia - Ministry of the Economy, 2006).

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-oriented. 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 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. Both elements contribute to a better integration of RES-E in the electricity system.

Demand orientation

The electricity demand varies according to the time of day and the season of the year. In this way, electricity demand tends to be higher during day time than during night time. With regard to the season, there are several characteristic factors in summer and in winter influencing the electricity demand. Lower temperature and longer nights in winter increase electricity demand e.g. in Northern European countries. The use of air-conditioning leads to higher electricity demand in Southern European countries. Thus, the value of electricity prices on the spot market varies. In order to allow for this circumstance when setting the level of FITs, Slovenia and Spain provide the option to choose time-variable FITs instead of fixed FITs. At present, Germany does not use this FIT-feature within its FIT-system.

The demand oriented tariffs established within the Slovenian system show a higher range than in Spain, tariffs amount from 70 % up to 140 % of the standard tariff (see also Table 6), whereas Spanish fixed tariffs only vary slightly between 96.70 % and 104.62 %.

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