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Feed-In Systems in Germany and Spain and 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 consum-

ers 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.

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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.

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. 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 hydropower** 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.

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

The following table gives an overview of the current tariff structure of the EEG of August 2004.

Table 1: Current tariff structure of the EEG from August 2004

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	574 546 540	624 596 590	457		
Biomass			general	renewable resources	CHP	Used wood 1.7.2006	1.5%
		< 150 kW 150 -500 kW 500 kW - 5 MW 5 MW - 20 MW	115 99 89 84	175 159 129 (114 for wood) 84	135 119 109 104	39	
Hydro	**large**	< 500kW 500kW - 10MW 10MW - 20MW 20MW - 50MW 50MW – 150MW	77 66 61 46 37				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	**off-shore**		installed before 31.12.2010 for 12 years	installed after 31.12.2010 and after 12 years			2% after 2008
			91	619			
	on-shore		for at least 5 years after installation	after, time depending on yield of system			2%
			87	55			
Landfill gas, sewage gas, Mine gas				using specific innovative technologies			1.5%
		500 kW 500 kW - 5 MW	77 66	96 86			
		> 5 MW	Market price is paid for the capacity above 5 MW				

3 Reduction of tariffs every year for new installed systems

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

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[4] 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 Overview

The theory that explains the feed-in system for the remuneration of RE technologies used to produce electricity is well known and will not be explained in great detail here. The system 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, RE producers receive preferential treatment and can sell all their RE electricity to the grid at the prices agreed. The premiums are set by the Government, usually on an annual basis. This system is paid for by electricity consumers through a charge that is added to their bill, proportional to their consumption. Arguments used to justify the implementation of the tariff system include the need to internalise the relative environmental benefits of RES in comparison with fossil fuels, considerations regarding the security of supply, the reduction of imports dependence and employment creation.

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 (*Ley 54/1997 del Sector Eléctrico Español,* Jefatura de Estado, 1997) and has recently been modified by Royal Decree 436/2004 (*Real Decreto 436/2004, por el que se establece la metodología para la sistematización y actualización del régimen jurídico y económico de la actividad de producción de energía eléctrica en régimen especial*)[5]. 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 (*Plan de Fomento de las Energías Renovables en España,* IDAE, 1999). The Plan has an indicative character and implies no compulsory behaviour for energy actors.

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

5 See bibliography: Ministerio de Economía 2004.

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, allow 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, which makes a readjustment in the tariffs paid and some changes in the mechanism of payment. The following sections explain the Spanish tariff system in more detail, with special emphasis on the latest developments.

2.2 Past legislation: the Electric Power Act 54/1997 and the Royal Decree 2818/1998

2.2.1 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 *(Ley 54/1997, de 27 de noviembre, del Sector Eléctrico).* 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 biomass or any other kinds of biofuels whose installed power 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.

2.2.2 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 (*Real Decreto 2818/1998, de 23 de diciembre, sobre producción de Energía Eléctrica por Instalaciones Abastecidas por Recursos o Fuentes de Energía Renovables, Residuos y Cogeneración)* has recently been replaced by Royal Decree 436/2004, of 12th March. The first Decree is still included here because, firstly, the new Royal Decree is based on and is very similar to R.D. 2818, so that understanding the former makes it easier to understand the latter; and secondly, because its enforcement represented the greatest development in renewable energies in Spain. Therefore, this provides an appropriate analysis framework when coming to terms with the suitability of this system.

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 ± RE 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.

2.3 Current legislation: The Royal Decree 436/2004

2.3.1 Brief description of the new tariff system

The Royal Decree 436/2001, of 12th March, which establishes the methodology to update and systematise the legal and economic framework of the electric power production activity within the Special Scheme, *(Real Decreto 436/2004, de 12 de marzo, por el que se establece la metodología para la actualización y sistematización del régimen jurídico y económico de la actividad de producción de energía eléctrica en régimen especial)* consolidates the regulatory framework laid down by Law 54/1997 on the Electricity Sector for producers operating in the *Special System* and derogates the previous legislation under Decree 2818/98.

Royal Decree 436/2004 modifies the legal and economic framework for electricity generation under the *Special System*, making it **more stable and predictable** and establishes a system to support electricity generation based on the free choice of the producer, who can decide between two options: (A) a regulated tariff or (B) sale on the open market. E-RES producers can choose, for periods of not less than one year, the option that suits them best.

A) Option 1: Sale to the distributor at the **regulated tariff**, which is the same for all scheduling periods, calculated as a % of the yearly average tariff as defined in R.D. 1432/2002, which approved the methodology for determining this tariff.

B) Option 2: **Free market sale**, through the bidding system managed by the market operator (OMEL), the bilateral contracting system or 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*. The incentive for participation in the market and the premium are calculated as percentages of the yearly average tariff (defined in R.D. 1432/2002, which approves the methodology for determining this tariff).

Regardless of the payment system opted for, this Royal Decree intends 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 is 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.

Scope of application of the RD 436/2004:

a) Self-producers using CHP or other forms of production associated with business activity other than electricity generation, provided the plant has a high energy efficiency.

b) Installations using renewable non-consumable sources of energy, biomass or biofuels. The categories are the following:

b.1. Solar.

b.1.1. Solar photovoltaic.

b.1.2. Solar-thermal for electricity generation (with the possibility of using natural gas or propane: up to 12-15% of electricity production)**.**

b.2. Wind power.

b.2.1. Onshore wind power.

b.2.2. Offshore wind power.

b.3. Geothermal power and ocean power.

b.4. Hydroelectric with power ≤ 10 MW.

b.5. Hydroelectric with power > 10 MW and ≤ 50 MW.

b.6. Biomass/energy crops or wastes from agriculture and forestry.

b.7. Biomass/biogas/sewage sludge/controlled landfill gases.

b.8. Biomass/industrial installations in the agriculture and forestry sector.

c) Installations recovering energy from waste material (MSW and others).

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 obliges 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 will be 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 comes into force on 1 January 2006. The cost of deviations for installations opting to sell directly to the market will be 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.

The tariffs, premiums and incentives set out in RD 436/2004 will be reviewed in 2006 and every four years thereafter (or when the targets of the *2002-2011 Plan* are met). This review will apply to new installations, not existing ones. A transitional period has been established for electricity producers operating under the *Special System* defined by RD 2818/98. This will last until 1 January 2007.

Table 2: Special regime modified by RD 436/2004

YEAR 2004		FIXED	VARIABLE		
		Fixed Prices	**Premiums**	**Incentive participa-tion in the market**	**Prem. + incentive**
		(€/MWh)	**(€/MWh)**	**(€/MWh)**	**(€/MWh)**
Solar Thermoelec-tric		216.216	180.180	0.7.207	187.387
Primary Biomass	Energy crops	64.865	28.829	7.207	36.036
Secondary Biomass	Forest residues	64.865	28.829	7.207	36.036
	Biogas/ sludge	64.865	28.829	7.207	36.036
	Agri. & forestry industries	57.658	21.622	7.207	28.829
Wind Energy	Onshore	64.865	28.829	7.207	36.036
	Offshore	64.865	28.829	7.207	36.036
Geothermal	< 50 MW	64.865	28.829	7.207	36.036
Small Hydro	<= 10 MW	64.865	28.829	7.207	36.036
	> 10 MW to <= 25 MW	64.865	28.829	7.207	36.036
	> 25 MW to <= 50 MW	57.658	21.622	7.207	28.829
Solar Photovoltaic	<= 100 kW	414.414			
	> 100 kW	216.216	180.180	7.207	187.387

Source: Royal Decree 234/2004 12th March (Spanish Official Gazette, 27th March 2004).

2.3.2 What is new in the Royal Decree 436/2004 – a summary of the main changes and perspectives concerning RES

- RD 436/2004 consolidates the system of support for renewable energy already in effect, which is based on the guarantee to buy all the electricity produced at a price above that of the market (fixed rate or market average plus a premium).
- RD 436/2004 makes the prices for electricity under the *Special System* more predictable, as the prices, premiums and incentives are determined as a fixed percentage of the average electricity tariff published at the end of each year, and which apply to the following year.
- Decree 436/2004 improves the payment for electricity generated in photovoltaic installations (the threshold for receiving the higher premium goes from 5 kW to 100 kW).

- The regulated tariff for electricity produced in photovoltaic plants of ≤ 100 kW is 575% of the average electricity tariff. Producers cannot opt to sell on the free market.
- Decree 436/2004 differentiates between onshore and offshore wind power, but the regulated tariff, premiums and incentives are the same for both. The tariff for installations of > 5 MW drops to 85% 5 years after commissioning of the plant.
- The premium for renewable electricity is set at 40% of the average electricity tariff, with the exception of solar power (250%), hydropower > 25 MW and ≤ 50 MW (30%) and electricity from biomass plants using wastes from agriculture and forestry (30%).
- The incentive to participate in the market is 10% of the average electricity tariff for renewable electricity, waste-powered and CHP plants treating and reducing wastes.
- The regulated tariff for electricity from renewable sources generally drops after 5, 15, 20 or 25 years from when the installations were commissioned. The premiums and incentives, on the other hand, remain at a fixed percentage throughout the useful life of the plant (with the exception of the premium set for solar power).

2.4 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, Trade and SMEs (*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, Trade and SMEs (*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*), Wind Platform (*Plataforma Eólica*), etc.

Other agents indirectly involved in the implementation of the tariff system are the electric companies and the distributor, 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.

2.4.1 General Secretary of Energy

Recently (since July 2000), energy planning (inclusive the design of tariffs) has become the responsibility of the Directorate-General for Energy Policy, Ministry of Economic Affairs. With the change of Government in March 2004, there has been a cabinet reshuffle which has affected the competences of this Directorate-General. Thus, this Directorate-General is presently reporting to a new Ministry, the Ministry of Industry, Trade, and SMEs, taking with it the former competences.

2.4.2 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, Trade, and SMEs.

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 Analysis of the main properties of the tariff system[6]

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.).

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.

Low costs for society

Feed-in tariffs can lower costs for society in two ways. The application of stepped tariffs reduces producer profits in comparison to support schemes with uniform market clear-

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

ing, 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.

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[7]

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, over-achievement of the set targets is also possible.

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7 As long as sufficient low cost potentials of a specific technology, e.g. of wind energy, are available

4 Main similarities and differences between the Spanish and the German system

Generally it should be emphasised that despite the numerous differences between the Spanish and the German system most important similarities with regard to the observed **high effectiveness** of the schemes exist. Based on the feed-in schemes implemented in the two countries the highest absolute increase of RES-E compared to all other EU Member States has been achieved. Both systems are largely responsible for the increase of European RES-E generation in general and for the 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.

Additionally both systems 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 very crucial similarity between both 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 two schemes is summarised in the following table and relevant differences between the schemes are explained in more detail in the text below.

Table 3: Comparison of the main implantation characteristics of the Spanish and the German feed-in tariff system

	Spain	Germany
Guaranteed duration of level of tariff	1 year[8]	generally 20 years[9]
General duration of support	long term duration implemented in R.D. 436/2004, technology dependent (10 to 25 years)	generally 20 years
Are the tariffs stepped?	no	yes
Degression of tariffs	set in a flexible way	predefined (2-6.5% per year)
Implementation of burden sharing	through system operator OMEL - leads to equal distribution among all electricity consumers	equal distribution among all electricity consumers
Premium tariff possible?	yes	no
Direct access to the spot market in combination with FIT possible	yes	no
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 were defined under the "*Plan de Fomento de las Energias Renovables*" (RES Promotion Plan), whose aim is to support RES investments with 13.1 % public financial sources	Soft loans and investment incentives by the market incentive programme for biomass CHP, small hydropower, PV in schools. Tax incentives (reduction of income tax granted in the federal tax law especially for wind energy investments), Soft loans by a federal investment bank DtA (a relevant share of Germanys wind energy investments is financed by government loans)
Grid access	guaranteed by the act	guaranteed by the act
Costs of balancing power	not to be coved by RES generator	not to be coved by RES generator
Do specific tariffs for the following (sub)-technologies exist?		
Biogas	yes	yes
Off-shore wind	yes[10]	yes
PV	yes	yes
Building integration of PV	no (only size dependent)[11]	yes
Geothermal electricity	yes	yes
Solar-thermal electricity	yes	no
Ocean technologies	yes	no
Refurbishment large hydro	no	yes
Biomass-CHP[12]	no	yes
Renewable biomass resources	yes	yes
Inno. techn. incl. fuel cells, microturbines, etc	no	yes

8 The possible annual change of tariffs in the new act R.D. 436/2004 is linked to the general electricity tariffs. Annual changes can therefore be only very moderate.

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

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

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

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

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

Guaranteed period of level of tariffs

The relatively short period of guaranteed level of the tariffs in the Spanish system creates *in theory* a (substantially) higher risk for investors.[13] Therefore higher requested internal rates of return on investments (and therefore higher interest rates) should have been observed in the Spanish market for RES-E investments compared to the German case in the past. Generally the statement holds, that longer periods of guaranteed tariffs decreases investment risks and therefore costs for society. However, the comparably low level of RES-E tariffs at high growth rates for RES-E installations suggests that investment risks in Spain are not significantly higher, which could be caused by the generally very stable policy environment for renewables in Spain created especially by the *Plan de Formento de las Energias Renovables*. Therefore the high investment security observed in the two markets was more of an "informal" nature in the Spanish system than in the German one. Although this has not created major problems in the past in Spain it could be a relevant issue for building up concentrating solar thermal (CST) capacities. Since for CST is currently still less mature, risk plays a more pronounced role for this technology. This is of high importance in combination with the significantly higher necessary investment costs for individual plants compared to other technologies.

Total duration of support

Both systems offer long term duration of support of the order of the lifetime of the plants, although in Spain the exact level of support is in principle flexible (see above). 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 both countries the feed-in laws are reviewed periodically.

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[13] Whereas the changes in the Spanish tariff could have been rather substantial until 2004, the possible annual change of tariffs in the new act R.D. 436/2004 is linked to the general electricity tariffs. Annual changes can therefore be only very moderate since the year 2004.

Stepped tariff design[14]

One relevant difference between both systems is the stepped design of the German system compared to the flat structure of the Spanish tariffs. We would like to discuss the main features of both approaches here:

The stepped design of tariffs gives the opportunity to reimburse RES-E generation in different bands of the (marginal) cost potential curve[15] 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 1, 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).

14 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.

15 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.

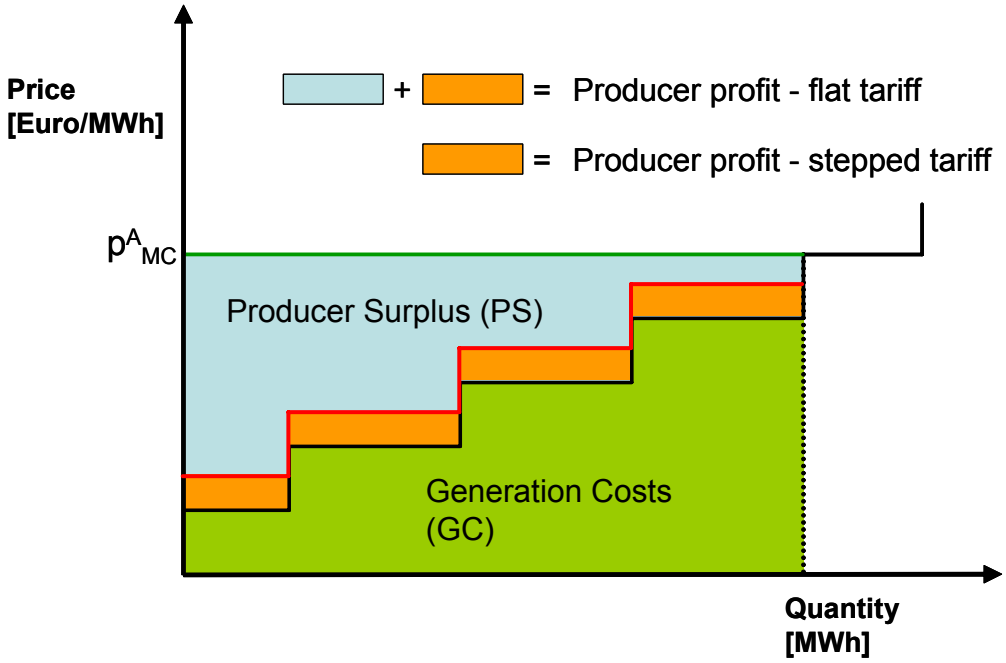

Figure 1: The structure of generation costs and producer profit for different design of feed-in systems; green line = guaranteed flat tariff; red curve = guaranteed stepped tariff (depending on efficiency of plant)

Degression of tariffs

Another difference between both 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). Rather than determining the future tariff structure beforehand the Spanish system offers the flexibility of annual adjustments of the tariffs, which are determined year by year based on the current status of the market (tariffs might increase or decrease).[16] Another difference between the two 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. Therefore the Spanish system leads to "overpaying" existing plants if the tariffs are increased and to financial underperfor-

[16] In the case of a premium tariff scheme, as applied in Spain, a higher level of flexibility is necessary to avoid unnecessary over-payments. The reason is that, in contrast to the fixed tariff scheme, the changes on the power market must be considered and compensated as well.

mance for investors if the tariffs are lowed.[17] 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.

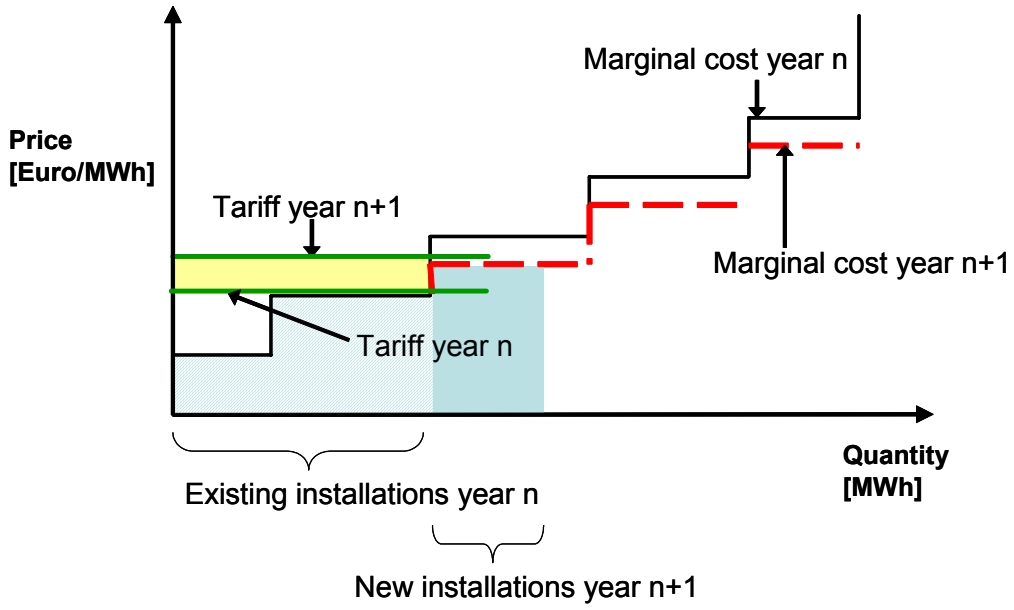

Figure 2: The effect of different systems of degression of feed-in tariffs

Existence of a premium tariff

One of the main benefits of implementing a premium tariff as in the Spanish system is that RES-E generation shows higher compatibility with principles of liberalised electric-

[17] 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

ity 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.

Further 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 an additional premium (as in the Spanish system[18]);
- 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 if the conventional power price drops.

Technology choices

The (sub)technologies supported by the feed-in systems in both countries with *special rates* exhibit some relevant differences, as shown in Table 3. 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.

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[18] The incentive to participate in the market is 10% of the average electricity tariff for renewable electricity, waste-powered and CHP plants treating and reducing wastes

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