Financing Renewable Energy in the European Energy Market

A SUSTAINABLE ENERGY SUPPLY FOR EVERYONE

Financing Renewable Energy in the European Energy Market

-Final Report-

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Introduction

The Directive 2009/28/EC on the promotion of the use of energy from renewable sources (RES) sets the overall target to reach 20% renewable energy in gross final energy consumption in 2020. This target is broken down into binding individual Member State targets. Reaching these targets will require a huge mobilization of investments in renewable energies in the coming decade.

In order to improve financing and coordination with a view to the achievement of the 20 % target, Article 23 (7) of the Directive requires the Commission to present an analysis and action plan with a view to:

a. The better use of structural funds and framework programmes;
b. The better and increased use of funds from the European Investment Bank and other public finance institutions;
c. Better access to risk capital;
d. The better coordination of Community and national funding and other forms of support;
e. The better coordination in support of renewable energy initiatives whose success depends on action by actors in several Member States.

This report presents the results of the project 'Financing Renewable Energy in the European energy market' commissioned by the European Commission. The study provides an up to date and thorough assessment of the costs of renewable energy and the support and financing instruments available for renewable energy R&D, demonstration projects and large-scale deployment. This includes details of each Member State's expenditure (via grants, support schemes, loans etc.) and use of Community funds, including loans of EIB and EBRD. It also explores the possible instruments for use in the future and constraints in the capital market, which hinder the development of renewable energy. Finally, it develops recommendations for improving financing and support instruments, improving the sector's access to capital, and closing the financing gap for reaching the 2020 targets.
The chapters of the report represent separate tasks. Chapter 1-5 can be read independent of each other, while chapter 6 and 7 draw overall conclusions:

1. Costs of renewable energy technologies;
2. Overview of available support instruments and support expenditures in the Member States;
3. Current and planned EU funding inside and beyond the EU;
4. Cost scenarios for reaching the 2020 RES objectives;
5. Evaluation of financing instruments, support instruments, and the sector's access to capital;
6. Review and evaluation of existing and alternative support and financing instruments: reducing the costs of reaching the EU 2020 targets;
7. Conclusions and recommendations.

1 Costs of Renewable Energy Technologies

The aim of this section is to provide a comprehensive depiction of the current cost and the related future potentials of all available RES technologies for all EU Member States. This serves as crucial input for all subsequent analysis of financing and support instruments, to enable understanding of deviations between support and cost levels.

Nowadays, a broad set of different RES technologies exists. Obviously, for a comprehensive investigation of the future development of RES technologies it is of crucial importance to provide a detailed investigation of the country-specific situation – e.g. with respect to the potential of the certain technologies in general as well as their regional distribution and the corresponding cost. This section illustrates the consolidated outcomes on Europe's RES cost and accompanying potentials of an intensive assessment process conducted within several studies in this topical area. The derived data on realisable mid-term potentials (up to the year 2020) for RES technologies and corresponding costs fits to the requirements of the model ***Green*-X** and served as key input for the assessment of future cost and corresponding expenditure requirements in light of Europe's target to increase renewable energy by 20% by 2020 (see section 5).

1.1 State-of-the-art of cost for RES technologies

The economic performance of a specific energy source determines its future market penetration. In the following cost assumptions as applied in the ***Green*-X** database for various RES technologies are illustrated. Thereby, first a concise description of its assessment is undertaken, followed by an overview on the derived data. Please note that the presented data refers to the year 2009 and is also expressed in €$_{2009}$.

> *The Green-X database on potentials*
> *and cost for RES technologies in the European Union*
>
> *The Green-X database on potentials and cost for RES technologies in Europe provides detailed information on current cost (i.e. investment -, operation & maintenance -, fuel and generation cost) and potentials for all RES technologies within each EU Member State. The assessment of the economic parameter and accompanying technical specifications for the various RES technologies builds on a long track record of European and global studies in this topical area. From a historical perspective the starting point for the assessment of realisable mid-term potentials was geographically the European Union as of 2001 (EU-15), where corresponding data was derived for all Member States initially in 2001 based on a detailed literature survey and an expert consultation. In the following, within the framework of the study "Analysis of the Renewable Energy Sources' evolution up to 2020 (FORRES 2020)" (see Ragwitz et al., 2005) and various follow-up activities comprehensive revisions and updates have been undertaken, taking into account recent market developments*

Within this project again a comprehensive update of cost parameter was undertaken, incorporating recent developments – i.e. the past cost increase mainly caused by high oil and raw material prices, and, later on, the significant cost decline as observed for various energy technologies throughout 2008 and 2009. The process included besides a survey of related studies (e.g. Krewitt et al. (2009), Wiser (2009) and Ernst & Young (2009)) also data gathering with respect to recent RES projects in different countries.

Economic conditions of the various RES technologies are based on both economic and technical specifications, varying across the EU countries.[1] In order to illustrate the economic figures for each technology Table 1 represents the economic parameters and accompanying technical specifications for RES technologies in the electricity sector, whilst Table 2 and Table 3 offer the corresponding depiction for RES technologies for heating and cooling and biofuel refineries as relevant for the transport sector.

The ***Green-X*** database and the corresponding model use a quite detailed level of specifying costs and potentials. The analysis is not based on average costs per technology. For each technology, a detailed cost-curve is specified for each year, based on so-called cost-bands. These cost-bands summarize a range of production sites that can be described by similar cost factors. For each technology a minimum of 6 to 10 cost bands are specified by country. For biomass, at least 50 cost bands are specified for each year in each country.

In the following the current investment cost for RES technologies are described alongside the data provided in Table 1, Table 2 and Table 3, whereby a focus may be put on the description of some key technology options. Since the last update of the ***Green-X*** database, several adjustments have become necessary due to recent cost dynamics of RES technologies. In many cases, there was a trend for an increase of investment costs.

Firstly, explanatory notes are provided on the technology-specific investment costs as depicted in Table 1:

- The current costs of biogas plants range from 1280 €/kW_{el} to 4525 €/kW_{el} with landfill gas plants offering the most cost efficient option (1350 €/kW_{el} – 2100 €/kW_{el}) and agricultural biogas plants (2550 €/kW_{el} – 4290 €/kW_{el}) being the highest cost option within this category;
- The costs of medium- to large-scale biomass plants only changed slightly and currently lie in the range of 2225 €/kW_{el} to 2995 €/kW_{el}. Biomass CHP plants typically show a broader range (2600 €/kW_{el} – 4375 €/kW_{el}) as plant sizes are typically lower compared to pure power generation. Among all bioelectricity

[1] Note that in the model ***Green-X*** the calculation of generation costs for the various generation options is done by a rather complex mechanism, internalized within the overall set of modelling procedures. Thereby, band-specific data (e.g. investment costs, efficiencies, full load-hours, etc.) is linked to general model parameters as interest rate and depreciation time.

options waste incineration plants have the highest investment costs ranging from 5500 €/kW_{el} to 7125 €/kW_{el} with the corresponding CHP option being about 5% more expensive;

- The current investment costs of geothermal power plants are in the range of 2575 €/kW_{el} to 6750 €/kW_{el}., whereby the lower boundary refers to large-scale deep geothermal units as applicable e.g. in Italy, while the upper range comprises enhanced geothermal systems;
- Looking at the investment costs of hydropower as electricity generation option it has to be distinguished between large-scale and small-scale hydropower plants. Within these two categories, the costs depend besides the scale of the units also on site-specific conditions and additional requirements to meet e.g. national / local environmental standards etc. This leads to a comparatively broad cost range from 850 €/kW_{el} to 5750 €/kW_{el} for new large-scale hydropower plants. Corresponding figures for small-scale units vary from 975 €/kW_{el} to 6050 €/kW_{el};
- In 2009 typical PV system costs were in the range 2950 €/kW_{el} to 4750 €/kW_{el}. These cost levels were reached after strong cost declines in the years 2008 and 2009. This reduction in investment cost marks an important departure from the trend of the years 2005 to 2007, during which costs remained flat, as rapidly expanding global PV markets and a shortage of silicon feedstock put upward pressure on both module prices and non-module costs (see e.g. Wiser et al 2009). Before this period of stagnation PV systems had experienced a continuous decline in cost since the start of commercial manufacture in the mid 1970's following a typical learning curve. The new dynamic began to shift in 2008, as expansions on the supply-side coupled with the financial crisis led to a relaxation of the PV markets and the cost reductions achieved on the learning curve in the meantime factored in again. Furthermore, the cost decrease has been stimulated by the increasing globalization of the PV market, especially the stronger market appearance of Asian manufacturers.
- The investment costs of wind onshore power plants are currently in the range of 1125 €/kW_{el} and 1525 €/kW_{el} and thereby slightly higher than in the last year. Two major trends have been characteristic for the wind turbine development for a long time: While the rated capacity of new machines has increased steadily, the corresponding investment costs per kW dropped. Increases of capacity were mainly achieved by up-scaling both tower height and rotor size. The largest wind turbines currently available have a capacity of 5 to 6 MW and come with a rotor diameter of up to 126 meters. The impact of economies of scale associated with the turbine up-scaling on turbine cost is evident: The power delivered is proportional to the diameter squared, but the costs of labour and material for building a turbine larger are constant or even fall with increasing turbine size, so that turbine capacity increases disproportionally faster than costs increase. From around 2005 on the investment costs have started to increase again. This increase of investment cost was largely driven by the tremendous rise of energy and raw material prices as observed in recent years, but also a move by manufacturers to improve their profitability, shortages in certain turbine components and improved sophistication of turbine design factored in.

Table 1: Overview on economic-& technical-specifications for new RES-E plant

RES-E sub-category	Plant specification	Investment costs	O&M costs	Efficiency (electricity)	Efficiency (heat)	Lifetime (average)	Typical plant size
		[€/kW$_{el}$]	[€/(kW$_{el}$* year)]	[1]	[1]	[years]	[MW$_{el}$]
Biogas	Agricultural biogas plant	2550 - 4290	115 - 140	0.28 - 0.34	-	25	0.1 - 0.5
	Agricultural biogas plant - CHP	2765 - 4525	120 - 145	0.27 - 0.33	0.55 - 0.59	25	0.1 - 0.5
	Landfill gas plant	1350 - 1950	50 - 80	0.32 - 0.36	-	25	0.75 - 8
	Landfill gas plant - CHP	1500 - 2100	55 - 85	0.31 - 0.35	0.5 - 0.54	25	0.75 - 8
	Sewage gas plant	2300 - 3400	115 - 165	0.28 - 0.32	-	25	0.1 - 0.6
	Sewage gas plant - CHP	2400 - 3550	125 - 175	0.26 - 0.3	0.54 - 0.58	25	0.1 - 0.6
Biomass	Biomass plant	2225 - 2995	84 - 146	0.26 - 0.3	-	30	1 – 25
	Cofiring	450 - 650	65 - 95	0.37	-	30	-
	Biomass plant - CHP	2600 - 4375	86 - 176	0.22 - 0.27	0.63 - 0.66	30	1 – 25
	Cofiring – CHP	450 - 650	85 - 125	0.2	0.6	30	-
Biowaste	Waste incineration plant	5500 - 7125	145 - 249	0.18 - 0.22	-	30	2 – 50
	Waste incineration plant - CHP	5800 - 7425	172 - 258	0.14 - 0.16	0.64 - 0.66	30	2 – 50
Geothermal Eletricity	Geothermal power plant	2575 - 6750	113 - 185	0.11 - 0.14	-	30	5 – 50
Hydro large-scale	Large-scale unit	850 - 3650	35	-	-	50	250
	Medium-scale unit	1125 - 4875	35	-	-	50	75
	Small-scale unit	1450 - 5750	35	-	-	50	20
	Upgrading	800 - 3600	35	-	-	50	-
Hydro small-scale	Large-scale unit	975 - 1600	40	-	-	50	9.5
	Medium-scale unit	1275 - 5025	40	-	-	50	2
	Small-scale unit	1550 - 6050	40	-	-	50	0.25
	Upgrading	900 - 3700	40	-	-	50	-
Photovoltaics	PV plant	2950 - 4750	30 - 42	-	-	25	0.005 - 0.05
Solar thermal electricity	Concentrating solar power plant	3600 - 5025	150 - 200	0.33 - 0.38	-	30	2 – 50
Tidal stream energy	Tidal (stream) power plant - shoreline	5650	145	-	-	25	0.5
	Tidal (stream) power plant - nearshore	6825	150	-	-	25	1
	Tidal (stream) power plant - offshore	8000	160	-	-	25	2
Wave energy	Wave power plant - shoreline	4750	140	-	-	25	0.5
	Wave power plant - nearshore	6125	145	-	-	25	1
	Wave power plant - offshore	7500	155	-	-	25	2
Wind onshore	Wind power plant	1125 - 1525	35 - 45	-	-	25	2
Wind offshore	Wind power plant - nearshore	2450 - 2850	90	-	-	25	5
	Wind power plant - offshore: 5…30km	2750 - 3150	100	-	-	25	5
	Wind power plant - offshore: 30…50km	3100 - 3350	110	-	-	25	5
	Wind power plant - offshore: 50km…	3350 - 3500	120	-	-	25	5

Table 2: Overview on economic-& technical-specifications for new RES-H plant (grid & non-grid)

RES-H sub-category	Plant specification	Investment costs	O&M costs	Efficiency (heat)[1]	Lifetime (average)	Typical plant size
		[€/kW_{heat}][2]	[€/(kW_{heat}*yr)][2]	[1]	[years]	[MW_{heat}][2]
Grid-connected heating systems						
Biomass - district heat	Large-scale unit	350 - 380	16 - 17	0.89	30	10
	Medium-scale unit	390 - 420	17 - 19	0.87	30	5
	Small-scale unit	475 - 550	20 - 22	0.85	30	0.5 - 1
Geothermal - district heat	Large-scale unit	800	50	0.9	30	10
	Medium-scale unit	1200 - 1500	55	0.88	30	5
	Small-scale unit	2000 - 2200	57 - 60	0.87	30	0.5 - 1
Non-grid heating systems						
Biomass - non-grid heat	log wood	255 - 340	6 - 10	0.75 - 0.85*	20	0.015 - 0.04
	wood chips	340 - 610	6 - 10	0.78 - 0.85*	20	0.02 - 0.3
	Pellets	390 - 530	6 - 10	0.85 - 0.9*	20	0.01 - 0.25
Heat pumps	ground coupled	900 - 1100	5.5 - 7.5	3 - 4[1]	20	0.015 - 0.03
	earth water	650 - 1050	10.5 - 18	3.5 - 4.5[1]	20	0.015 - 0.03
Solar thermal heating & hot water supply	Large-scale unit	400 - 420[2]	5 - 7[2]	-	20	100 - 200
	Medium-scale unit	540 - 560[2]	7 - 9[2]	-	20	50
	Small-scale unit	900 - 930[2]	13 - 15[2]	-	20	5 - 10

Remarks: [1] In case of heat pumps we specify under the terminology "efficiency (heat)" the *seasonal performance factor* - i.e. the output in terms of produced heat per unit of electricity input

[2] In case of solar thermal heating & hot water supply we specify under the investment and O&M cost per unit of m^2 collector surface (instead of kW). Accordingly, expressed figures with regard to plant sizes are also expressed in m^2 (instead of MW).

For RES-H plants as displayed in Table 2 the distinction between grid-connected and non-grid heating systems is important. Among the first category are biomass and geothermal district heating systems and among the latter one biomass non-grid heating systems, solar thermal heating systems and heat pumps. Depending on the scale investment costs for biomass district heating systems currently range between 350 €/kW_{heat} and 550 €/kW_{heat} , and for geothermal district heating systems between 800 €/kW_{heat} and 2200 €/kW_{heat}. In case of non-grid biomass heating systems the investment costs differ depending on fuel type between 255 €/kW_{heat} and 610 €/kW_{heat}. Heat pumps currently cost from 650 €/kW_{heat} up to 1100 €/kW_{heat} and for solar thermal heating systems depending on scale the specific investment costs reach from 400 €/kW_{heat} to 930 €/kW_{heat}.

Table 3 provides the current investment cost data for biofuel refineries. With regard to the fuel input / output different plant types are included in the database. Biodiesel plant (FAME) currently cost from 210 €/kW_{trans} to 860 €/kW_{trans}, bio ethanol plants from 640 €/kW_{trans} to 2200 €/kW_{trans} and BTL plant from 750 €/kW_{trans} to 5600 €/kW_{trans}. Please note that in the case of advanced bio ethanol and BtL the expressed cost and performance data represent expected values for the year 2015 - the year of possible market entrance with regard to both novel technology options.

Table 3: Overview on economic-& technical-specifications for new biofuel refineries

RES-T sub-category	Fuel input	Investment costs	O&M costs	Efficiency (transport)	Efficiency (electricity)	Lifetime (average)	Typical plant size
		[€/kW_{trans}]	[€/(kW_{trans}*year)]	[1]	[1]	[years]	[MW_{trans}]
Biodiesel plant (FAME)	rape and sunflower seed	210 - 860	10.5 - 45	0.66	-	20	5 - 25
Bio ethanol plant (EtOH)	energy crops (i.e. sorghum and corn from maize, triticale, wheat)	640 - 2200	32 - 110	0.57 - 0.65	-	20	5 - 25
Advanced bio ethanol plant (EtOH+)	energy crops (i.e. sorghum and whole plants of maize, triticale, wheat)	1130 - 1510[1]	57 -76[1]	0.58 - 0.65[1]	0.05 - 0.12[1]	20	5 - 25
BtL (from gasifier)	energy crops (i.e. SRC, miscanthus, red canary grass, switchgrass, giant red), selected waste streams (e.g. straw) and forestry	750 - 5600[1]	38 - 280[1]	0.36 - 0.43[1]	0.02 - 0.09[1]	20	50 - 750

Remarks: [1] In case of Advanced bio ethanol and BtL cost and performance data refer to 2015 - the year of possible market entrance with regard to both novel technology options.

While the investments costs of RES technologies as described above are suitable for an analysis at the technology level, for the comparison of technologies the generation costs are relevant. Consequently, the broad range of the resulting generation costs, due to several influences, for several RES technologies is addressed subsequently. Impacts as, variations in resource- (e.g. for photovoltaics or wind energy) or demand-specific conditions (e.g. full load hours in case of heating systems) within and between countries as well as variations in technological options such as plant sizes and/or conversion technologies are taken into account. Figure 1 depicts the typical current bandwidth of long-run marginal generation costs[2] per RES technology for the electricity sector in Europe. A corresponding depiction is shown in Figure 2 for the RES options in the heat sector, whilst Figure 3 indicates the cost of biofuels. In this context, for the calculation of the capital recovery factor a default setting is applied with respect to a payback time of 15 years, which represents rather an investor's view than the full levelized costs over the lifetime of an installation and weighted average cost of capital (6.5%).

[2] Long-run marginal costs are relevant for the economic decision whether to build a new plant or not.

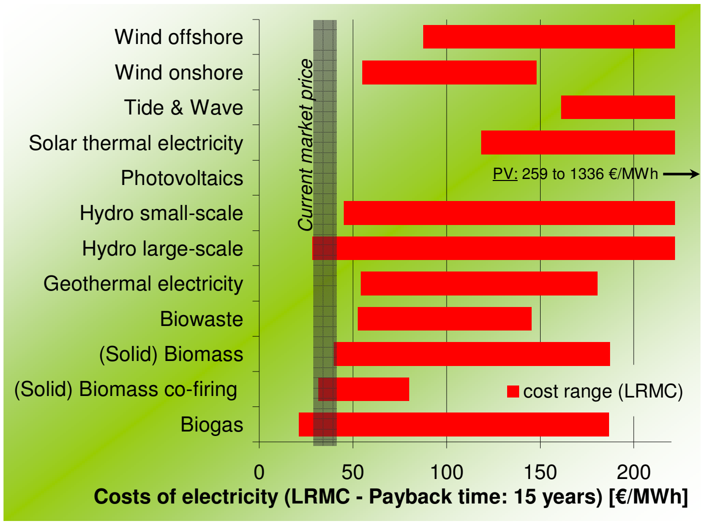

Figure 1: Long-run marginal generation costs (for the year 2009) for various RES-E options in EU countries

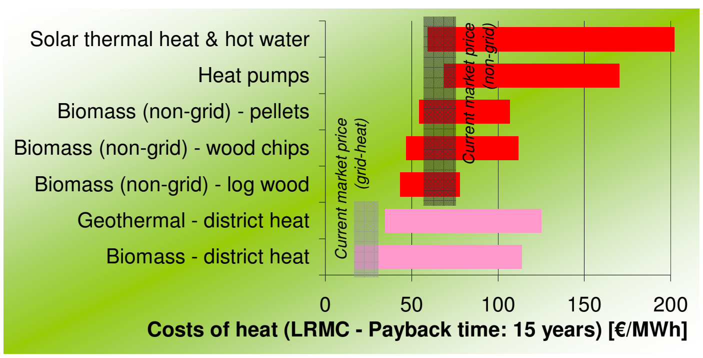

Figure 2: Long-run marginal generation costs (for the year 2009) for various RES-H options in EU countries

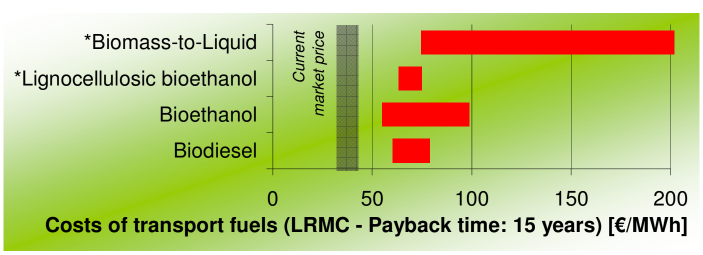

Figure 3: Long-run marginal generation costs (for the year 2009) for various RES-T options in EU countries

As can be observed from Figure 1, Figure 2 and Figure 3 the general cost level as well as the magnitude of the cost ranges vary strongly between the different technologies. It is thereby striking that RES-H options under favourable conditions are either competitive or close to competitiveness, while all RES-T options still are above the market price. Looking at RES-E options the situation is more diverse. The most conventional and cost efficient options like large hydropower and biogas can generate electricity below market prices. It is also noticeable that wind power (onshore) cannot deliver electricity at market prices even at the best sites. Of course, this proposition holds only for current market prices which have decreased substantially in the wholesale market in the near past. As for most RES-E technologies the cost range at the EU level appears comparatively broad, a more detailed depiction of electricity generation costs for selected RES-E technologies is given in Figure 4 to Figure 6 where the bandwidth of generation costs is illustrated by country. More precisely, these graphs show the minimum, maximum and average electricity generation costs for wind onshore, wind offshore and photovoltaics. It can be observed that to some extent both the average weighted generation costs and the ranges differ considerably. To a lesser extent this can be ascribed to (small) differences in investment costs between the Member States, but more crucial in this respect are the differences in resource conditions (i.e. the site-specific wind conditions in terms of wind speeds and roughness classes or solar irradiation and their formal interpretation as feasible full load hours) between the Member States. In the case of photovoltaics the broad cost range results also from differences in terms of application whereby the upper boundary refers to facade-integrated PV systems.

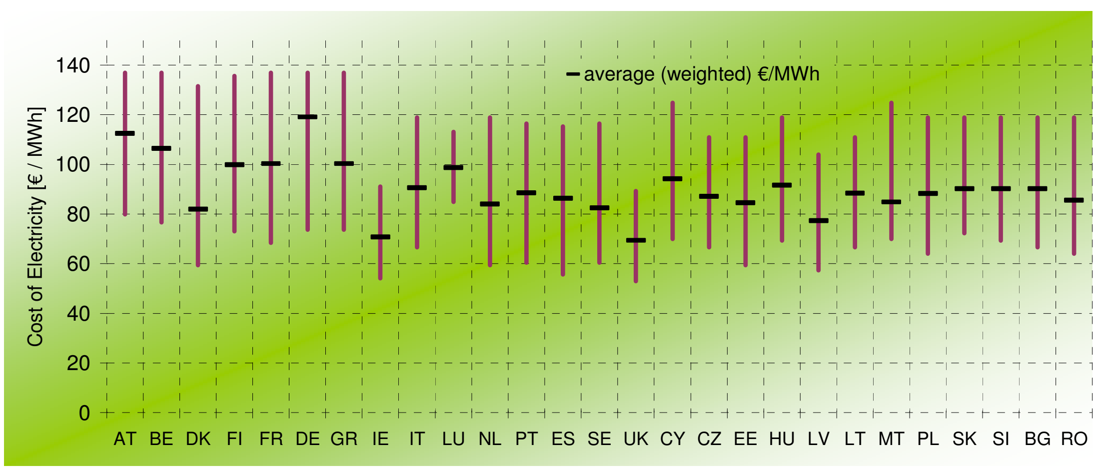

Figure 4: Bandwidth of long-run marginal generation costs (for the year 2009) for wind onshore by EU countries

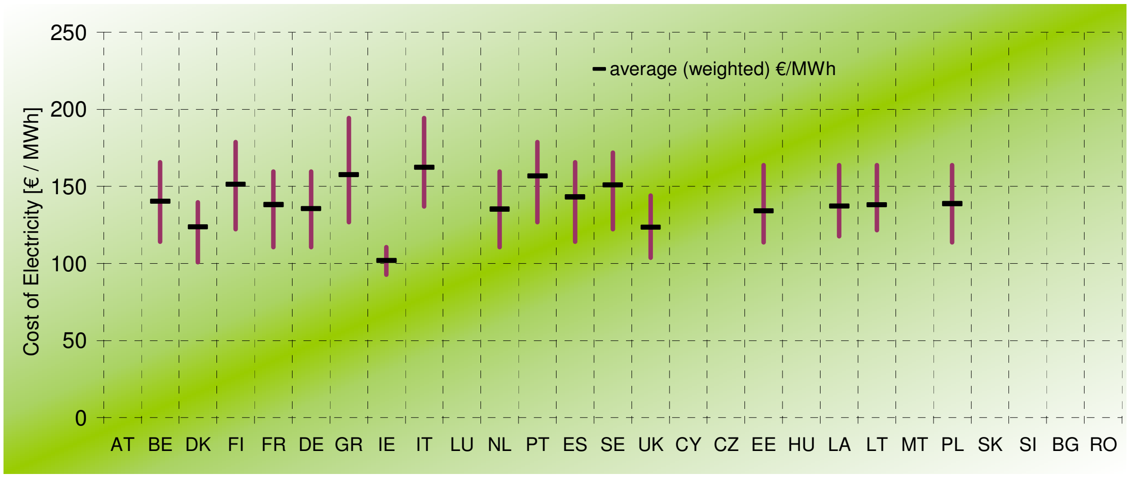

Figure 5: Bandwith of long-run marginal generation costs (for the year 2009) for wind offshore by EU countries

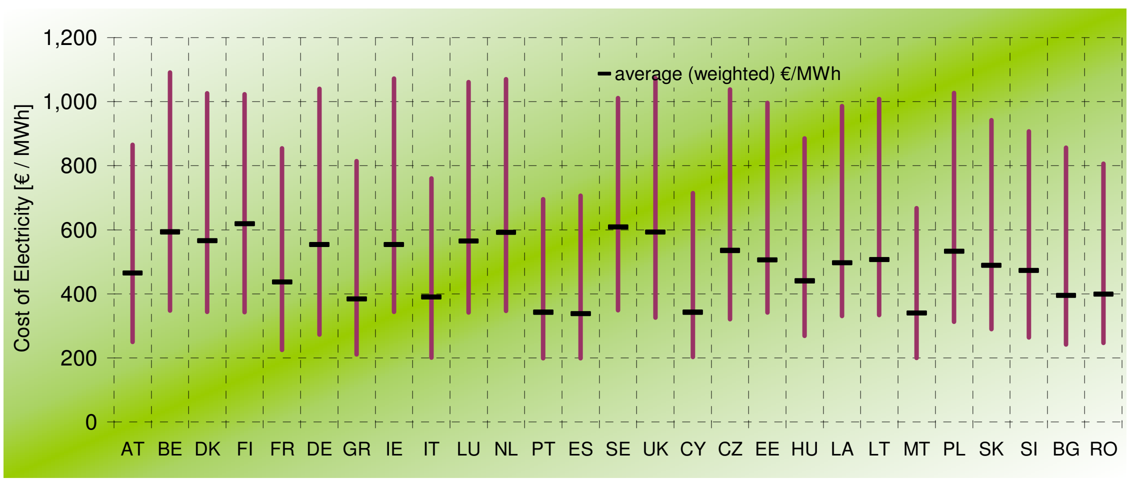

Figure 6: Bandwidth of long-run marginal generation costs (for the year 2009) for photovoltaics by EU countries

1.2 Future potentials for RES technologies in EU countries

In this section, complementary to the description of cost parameter for RES technologies, an illustration of future potentials for RES technologies in the European Union is provided. This represents the consolidated outcomes on Europe's RES potentials as conducted within an intensive assessment process undertaken within several studies in this topical area.

Assessment of RES potentials in Europe – Method of approach

From a historical perspective the starting point for the assessment of realisable mid-term potentials was geographically the European Union as of 2001 (EU-15), where corresponding data was derived for all Member States initially in 2001 based on a detailed literature survey and a development of an overall methodology with respect to the assessment of specific resource conditions of several RES options. In the following, within the framework of the study "Analysis of the Renewable Energy Sources' evolution up to 2020 (FORRES 2020)" (see Ragwitz et al., 2005) comprehensive revisions and updates have been undertaken, taking into account reviews of national experts etc.. Consolidated outcomes of this process were presented in the European Commission's Communication "The share of renewable energy" (European Commission, 2004). Within the scope of the futures-e project (2006 to 2008 – see www.futures-e.org) again an intensive feedback process at the national and regional level was established. A series of six regional workshops was hosted by the futures-e consortium around the EU within 2008. The active involvement of key stakeholders and their direct feedback on data and scenario outcomes helped to reshape, validate and complement the previously assessed information.

1.2.1 Classification of potential categories

The possible use of RES depends in particular on the available resources and the associated costs. In this context, the term "available resources" or RES potential has to be clarified. In literature, potentials of various energy resources or technologies are intensively discussed. However, often no common terminology is applied. In order to contribute to the comprehension of the derived data, we start with an introduction on the applied terminology:

- *Theoretical potential:* For deriving the theoretical potential general physical parameters have to be taken into account (e.g. based on the determination of the energy flow resulting from a certain energy resource within the investigated region). It represents the upper limit of what can be produced from a certain energy resource from a theoretical point-of-view – of course, based on current scientific knowledge;
- *Technical potential:* If technical boundary conditions (i.e. efficiencies of conversion technologies, overall technical limitations as e.g. the available land area to install wind turbines as well as the availability of raw materials) are considered the technical potential can be derived. For most resources the technical potential must be considered in a dynamic context – e.g. with increased R&D conversion technologies might be improved and, hence, the technical potential would increase;
- *Realisable potentia*l: The realisable potential represents the maximal achievable potential assuming that all existing barriers can be overcome and all driving forces are active. Thereby, general parameters as e.g. market growth rates, planning constraints are taken into account. It is important to mention that this potential

term must be seen in a dynamic context – i.e. the realizable potential has to refer to a certain year;

- *Mid-term potential:* The mid-term potential is equal to the realizable potential for the year 2020.

Figure 7 shows the general concept of the realisable mid-term potential up to 2020, the technical and the theoretical potential in a graphical way.

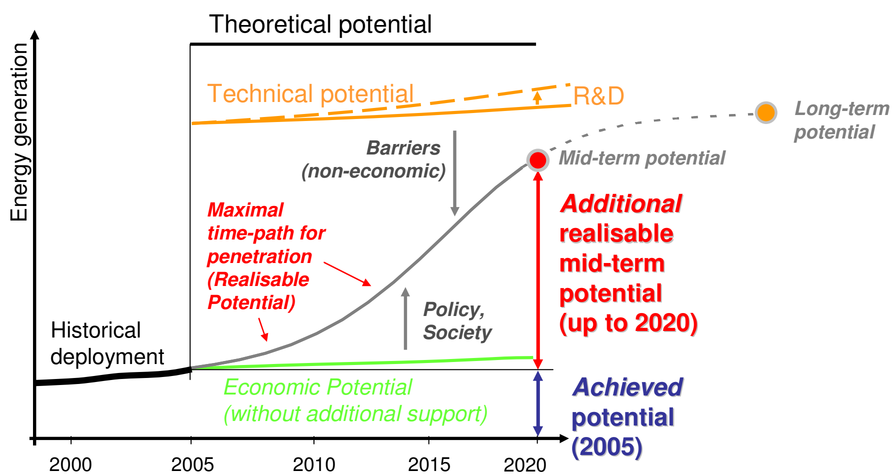

Figure 7: Methodology for the definition of potentials

1.2.2 Realisable 2020 potentials for RES in Europe

The following depiction aims to illustrate to what extent RES may contribute to meet the energy demand within the European Union (EU-27) up to 2020 by considering the specific resource conditions and current technical conversion possibilities[3] as well as realization constraints in the investigated countries. As explained before, *2020 potentials* are derived, describing the possible RES contribution. Thereby, only the domestic resource base is taken into consideration – except for forestry biomass, where a small proportion of the overall potential refers to imports from abroad.[4]

Please note that within this illustration the future potential for considered biomass feedstock's is pre-allocated to feasible technologies and sectors based on simple rules of thumb. In contrast to this, within the Green-X model no pre-allocation to the sectors of electricity, heat or transport is undertaken as technology competition within and across sectors is well reflected in the applied modelling approach.

[3] The illustrated mid-term potentials describe the feasible amount of e.g. electricity generation from combusting biomass feedstocks considering current conversion technologies. Future improvements of the conversion efficiencies (as typically considered in model-based prospective analyses) would lead to an increase of the overall mid-term potentials.

[4] 12.5% of the overall forestry potential or approximately 30% of the additional forestry resources that may be tapped in the considered time horizon refer to such imports from abroad.

Next, only a concise overview is given on the overall 2020 potentials in terms of final energy by country, while for a detailed discussion of the provided data we refer to Reach et al. (2009).

Summing up all RES options applicable at country level, Figure 8 depicts the achieved and additional mid-term potential for RES in all EU Member States. Potentials are thereby expressed in absolute terms and, consequently, large countries or, more precisely, those Member States possessing large RES potentials are becoming apparent – compare e.g. France, Germany, Italy, Poland, Spain, Sweden and the UK. In order to illustrate the situation in a suitable manner for small countries (or countries with a lack of RES options available), Figure 9 offers a similar depiction in relative terms, expressing the 2020 potential as share on gross final energy demand.

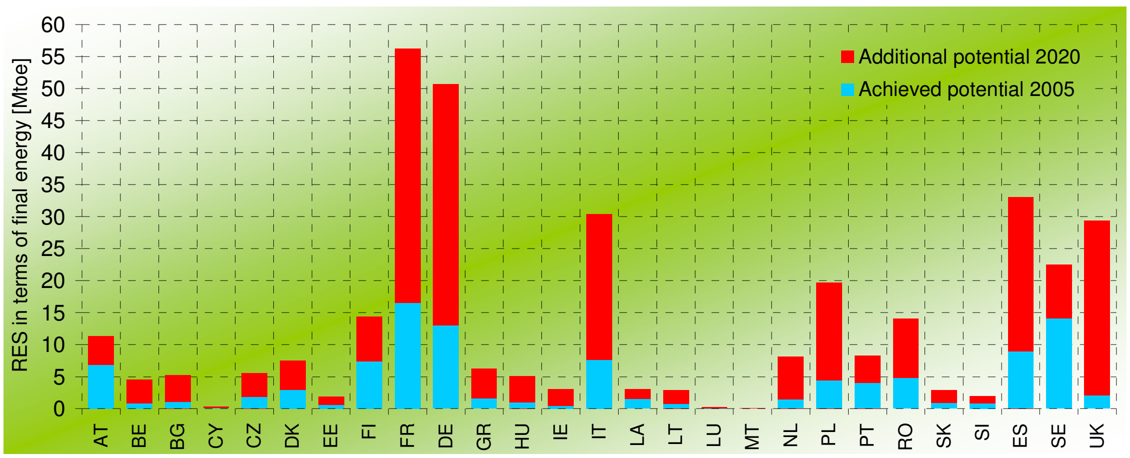

Figure 8: Achieved (2005) and additional 2020 potential for RES in terms of final energy for all EU Member States (EU27) – expressed in absolute terms

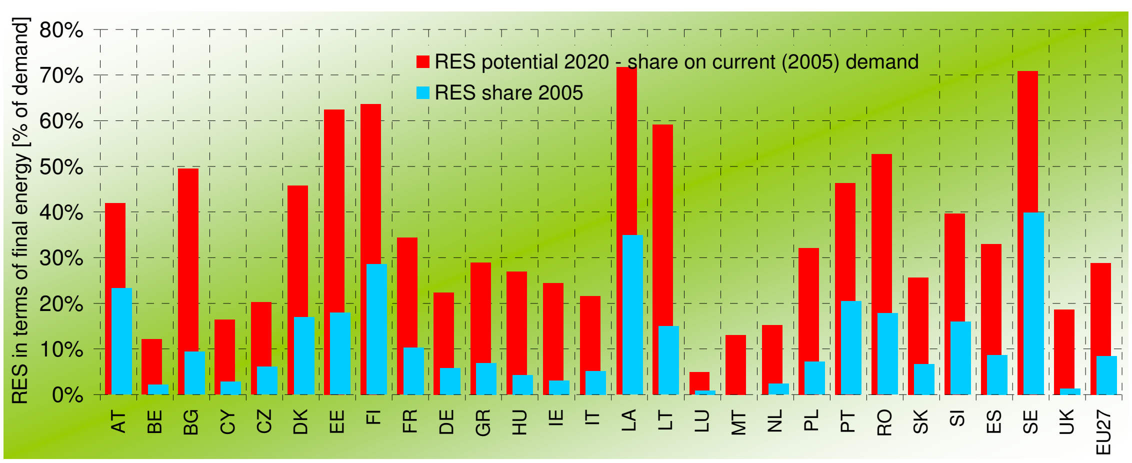

Figure 9: Achieved (2005) and 2020 potential for RES in terms of final energy for all EU Member States (EU27) – expressed in relative terms, as share on gross final energy demand

The overall 2020 potential for RES in the European Union amounts to 349 Mote, corresponding to a share of 28.5% compared to the overall current gross final energy demand. This indicates the high level of ambition of the recently agreed target of meeting 20% RES by 2020[5]. In general, large differences between the individual countries with regard to the achieved and the feasible future potentials for RES are observable. For example, Sweden, Latvia, Finland and Austria represent countries with a high RES share already at present, whilst Bulgaria and Lithuania offer the highest additional potential compared to their current energy demand.
However, in absolute terms both are rather small compared to other countries large in size or, more precisely, with large 2020 potentials.

Figure 10 (below) relates derived potentials to the expected future energy demand. More precisely, it depicts at country level the total realizable 2020 potentials[6] for RES as share on final energy demand in 2005 and in 2020, considering three different demand projections – i.e. a recent (as of 2009) and an older (2007) baseline case both assuming a continuation of past trends and a reference scenario where a moderate demand reduction occurs as a side-effect of proactive energy policy measures tailored to meet the 2020 RES and GHG commitments[7].

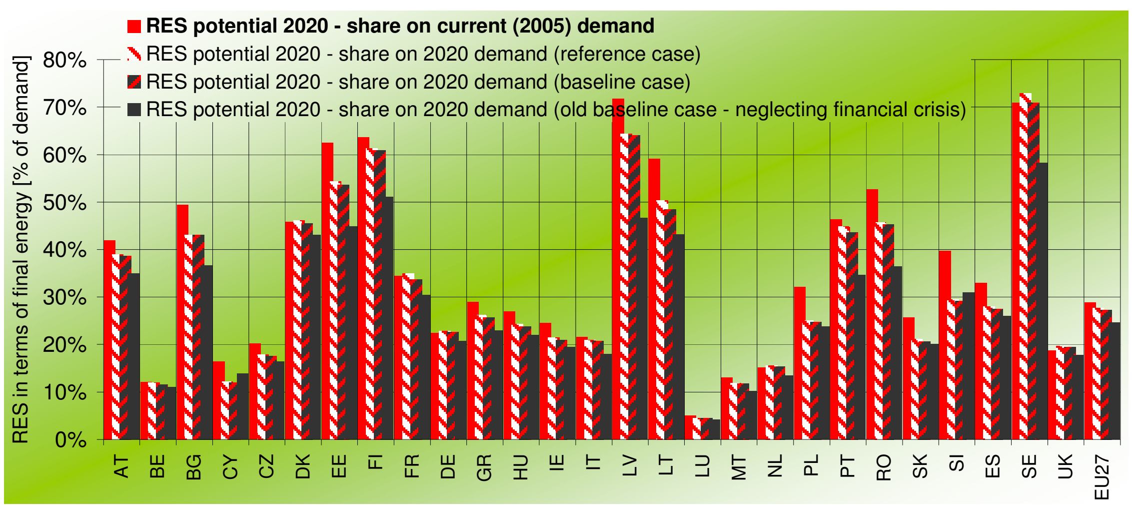

Figure 10: The impact of demand growth - 2020 potential for RES as share on current (2005) and expected future (2020) gross final energy demand.

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[5] It is worth to mention that biofuel imports from abroad are not considered in this depiction. Adding such in size of 5% of the current demand for diesel and gasoline (i.e. half of the minimum target of 10% biofuels by 2020) would increase the overall RES potential by 1.2%.

[6] The total realisable mid-term potential comprises the already achieved (as of 2005) as well as the additional realisable potential up to 2020.

[7] In order to ensure maximum consistency with existing EU scenarios and projections, data on current (2005) and expected future energy demand was taken from PRIMES. The used PRIMES scenarios are:

- the Baseline Scenario as of December 2009 (NTUA, 2009)
- the Reference Scenario as of April 2010 (NTUA, 2010)

Please note that this data (and also the depiction of corresponding RES shares in demand) may deviate from actual statistics.

Both baseline trend projections differ with respect to the incorporation of the financial crisis. While the recent baseline case (as of 2009) takes into account the lately observable decrease of energy consumption within all energy sectors in consequence of the financial crisis, the older version (as of 2007) obviously ignores it. This affects the feasible RES contribution in relative terms – i.e. the RES share on energy demand - significantly: If demand increased as expected under 'business as usual' conditions before the crisis, a full exploitation of the 2020 potential for RES would correspond to a share of 25% on EU's gross final consumption (by 2020). In contrast to that, the new baseline trend indicates a maximum RES-share of 27% by 2020.
Obviously, also financing conditions for RES projects have been affected by the crisis, but this is subject of the subsequent model based scenario assessment (see section 4 of this report).

The difference between both recent demand projections (reference and baseline case) is of comparative smaller magnitude: Only a slightly lower energy demand will arise in 2020 if proactive GHG and RES policies in line with the given policy commitments are implemented – i.e. the 2020 potential of all available RES options adds up to 28% when expressed as share on gross consumption by 2020 according to the reference case. Moreover, it can be expected that with additional strong energy efficiency measures a significantly higher RES share would be feasible.

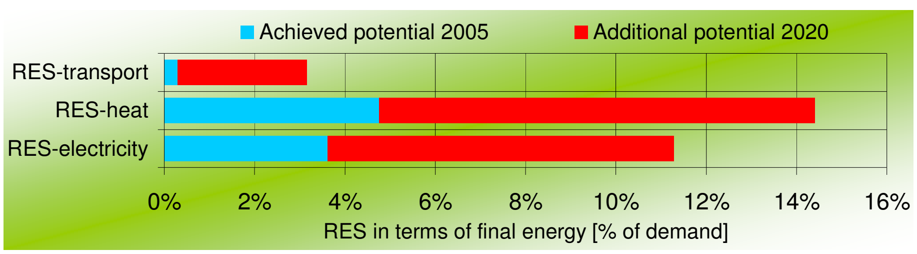

Figure 11: Sect oral breakdown of the achieved (2005) and additional 2020 potential for RES in terms of final energy at EU27 level – expressed in relative terms, as share on gross final energy demand

Finally, a sect oral breakdown of the 2020 RES potentials at European level is given in Figure 11. As applicable therein, the largest contributor to meet future RES targets represents the heat sector, where the highest exploitation is already achieved at present, but still a large amount appears feasible for the near to mid future. The overall 2020 potential for RES-heat is in size of 14.2% compared to the current final energy demand, followed by RES in the electricity sector, which may achieve in case of a full exploitation a share in total final energy demand of 11.2%. The smallest contribution can be expected from biofuels in the transport sector, which offer, considering solely domestic resources, a potential of about 3.1% on current final energy demand.

1.3 The role of biomass – a key contributor within all energy sectors

The availability of biomass is crucial as this energy is faced with high expectations with regard to its future potentials. The total domestic availability of solid biomass by 2020 was set at 229 Mtoe/yr. Biomass data has been cross-checked with DG ENER, EEA and the GEMIS database.[8]

In this context, Table 4 indicates the identified biomass primary potentials on EU27-level by feedstock category as well as corresponding fuel price assumptions.

Table 4: Breakdown of average biomass fuel prices (2009) and corresponding primary potentials (at EU-27 level) by feedstock category

Solid biomass - Primary potentials for 2020 & corresponding fuel prices (2009)	Realisable mid-term potential for 2020 in terms of primary energy	Fuel price ranges (2009)		
		Minimum	Maximum	Weighted average
	[Mtoe/yr.]	[€/MWh$_{primary}$]		
AP1 - rape & sunflower	67.0	34.1	42.6	38.8
AP2 - maize, wheat (corn)		28.1	35.0	28.7
AP3 - maize, wheat (whole plant)		31.4	31.4	29.3
AP4 - SRC willow..		28.8	34.7	23.9
AP5 - miscanthus		28.6	36.0	23.6
AP6 - switch grass		18.9	33.6	20.9
AP7 - sweet sorghum		32.7	43.1	43.1
Agricultural products - TOTAL		**18.9**	**43.1**	**29.7**
AR1 - straw	30.0	12.8	15.4	13.0
AR2 - other agricultural residues		12.8	15.4	13.4
Agricultural residues - TOTAL		**12.8**	**15.4**	**13.1**
FP1 - forestry products (current use (wood chips, log wood))	69.7	18.5	23.1	19.3
FP2 - forestry products (complementary fellings (moderate))		19.8	24.7	21.6
FP3 - forestry products (complementary fellings (expensive))		26.8	33.5	29.3
Forestry products - TOTAL		**18.5**	**33.5**	**20.6**
FR1 - black liquor	35.8	5.8	8.0	6.3
FR2 - forestry residues (current use)		6.5	8.9	7.4
FR3 - forestry residues (additional)		13.0	17.8	13.4
FR4 - demolition wood, industrial residues		5.2	7.1	5.7
FR5 - additional wood processing residues (sawmill, bark)		6.5	8.8	6.9
Forestry residues - TOTAL		**5.2**	**17.8**	**7.0**
BW1 – biodegrade. fraction of municipal waste	17.9	-3.8	-3.8	-3.8
Biowaste - TOTAL		**-3.8**	**-3.8**	**-3.8**
FR6 - forestry imports from abroad	8.7	20.3	20.5	20.4
Solid biomass - TOTAL	**229.1**	**-4.0**	**43.1**	**16.8**
… of which domestic biomass	**220.4**	**-3.8**	**40.9**	**16.4**

[8] For example the European Environment Agency's report "How much bio-energy can Europe produce without harming the environment?" (EEA Report No 7/2006) gives 235 Mtoe in 2030 for total biomass under the assumption of significant ecological constraints on biomass use.

As biomass may play a role in all sectors, also the allocation of biomass resources is a key issue. Within the Green-X model the allocation of biomass feedstocks to feasible technologies and sectors is fully internalized into the overall calculation procedure. For each feedstock category technology options (and their corresponding demands) are ranked based on the feasible revenue streams as applicable for a possible investor under the conditioned scenario-specific energy policy framework which obviously may change year by year. In other words, the supporting framework may have a significant impact on the resulting biomass allocation and use.

As applicable from Table 4 above, default ranges for fuel costs with respect to the various fractions of biomass are comparatively large at EU level, indicating differences between countries in the applicable resources and the related harvesting conditions. The country-specific price assumptions are based on information gained from various recent studies or projects (EUBIONET III, IEA Task 40 on bio energy trade, etc.). For biowaste as default a negative price is used, representing revenue for the power producer, i.e. a "gate fee" for the waste treatment. Please note that these prices refer to the year 2009. Their future development is internalized in the overall model – linked to fossil fuel prices[9] as well as the available additional potentials. A depiction of the future evolution up to 2020 of biomass feedstock prices (on average at EU-27 level) is exemplarily given in Figure 12 for the default case of low to moderate energy prices.

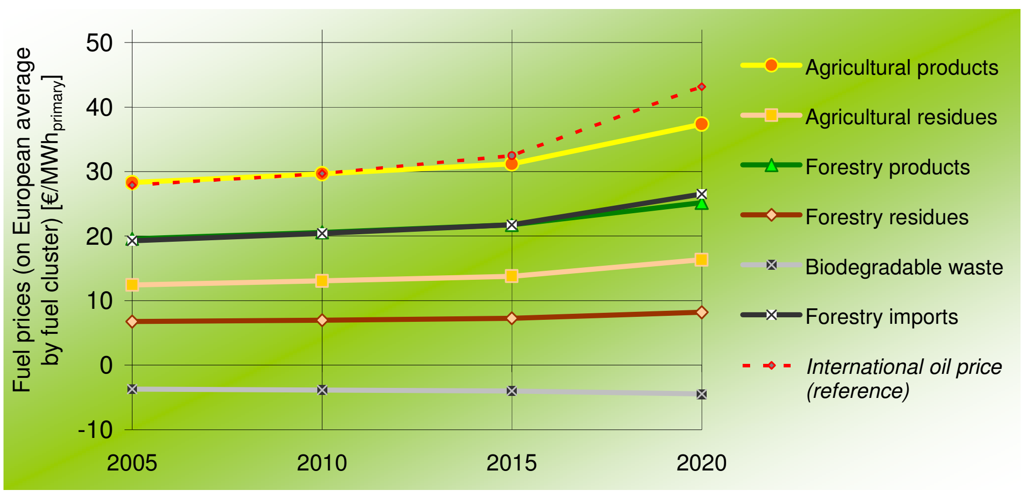

Figure 12: Future development of biomass fuel prices (on average at EU-27 level) in case of default energy price assumptions (low to moderate energy prices)

[9] The linkage and correlation of fossil and bioenergy prices and in particular their price volatility has been comprehensively assessed recently in Kranzl et al. (2009). Thereby, the following reasons have been identified for the empirically observable and partly high correlation of various biomass commodities to the historic oil price development: On the one hand, volatile fossil energy prices are indeed a cost factor for the production of biomass, specifically for biomass steming from the agricultural sector. On the other hand, the coupling of bioenergy to energy markets is increasing (i.e. bioenergy is used as substitute of fossil energy). Thus, price volatility on one market (e.g. oil) impacts the price stability on the other market (e.g. vegetable oil).

Prices for imported biomass are set exogenously:

- The price of imported wood is set country specific, indicating trade constraints and transport premiums. On European average a figure of 20.4 €/MWh is assumed for 2009, increasing in dependence of the assumed oil price development to a level of 26.6 (according to the default reference energy price development);
- The price of imported biofuels is assumed to equal a European average range of 59.8 to 72.5 €/MWh by 2009, rising up until 2020 to a level of 76 to 90 €/MWh (according to the default reference oil price development).

2 Overview of available support instruments

The aim of this chapter is to provide a concise overview of support, current support expenditure and a comparison with long-term marginal generation costs in the EU-27.
In section 2.1 an overview is provided of current RES support instruments (for each Member State), the main support instruments (e.g. feed-in, quota) as well as secondary support instruments (e.g. fiscal measures, loans) for RES-E, RES-H&C and RES-T. Section 2.2 gives an estimate of the support expenditures for RES technologies on country level for the year 2007 to 2009 based on the Green-X model. Section 2.3 is a comparison of current average support levels and long-term (2020) marginal generation cost for a selection of technologies, for each MS. Overview charts are presented indicating whether support is sufficient to cover the costs of generation.

2.1 Support instruments in the sectors electricity, heating & cooling and transport in the EU-27

This subsection builds on the work conducted for the ongoing EU project RE-SHAPING, for which country profiles on RES support schemes in the EU-27 have been compiled. The data has been further refined and is presented for the sectors RES-electricity, RES-heating and cooling, as well as RES-transport in the overview tables below (per MS, per technology). More detailed, technology-specific data on the different support instruments in place in the Member States can be found in Annex 2.1. Note that only support that is available on a national scale (compared to regional instruments) and which significantly contributes to RES development has been included.

2.1.1 Instruments to support RES-electricity

Table 5 provides an overview of the renewable electricity (RES-E) support instruments that are in place in the EU Member States. We differentiate six categories of support instruments: feed-in tariff, premium, quota obligation, investment grants, tax exemptions and fiscal incentives. Following the overview tables, a description of the most prominent support instruments and their usage in the Member States is given. The pros and cons of these main support schemes are briefly discussed, mainly based on European Economic Papers (408) 2010 and OPTRES 2007. A detailed evaluation is provided in section 5.2.

Table 5: Overview of RES-E support instruments in the EU-27

	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
FIT	X	X	X	x	x	X		X	x		X	x	x	x
Premium					x		x	X	x					
Quota obligation		X												
Investment grants		X		x	x					x		x	x	
Tax exemptions		X							x	x		x		
Fiscal incentives			X			X		X						

	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
FIT	x	x	X	x	X			x			X	x	x
Premium						x					X		
Quota obligation	x						X		x	x			x
Investment grants		X	X	x	X								
Tax exemptions				x		x	X			x		x	x
Fiscal incentives					X	x	X				X		

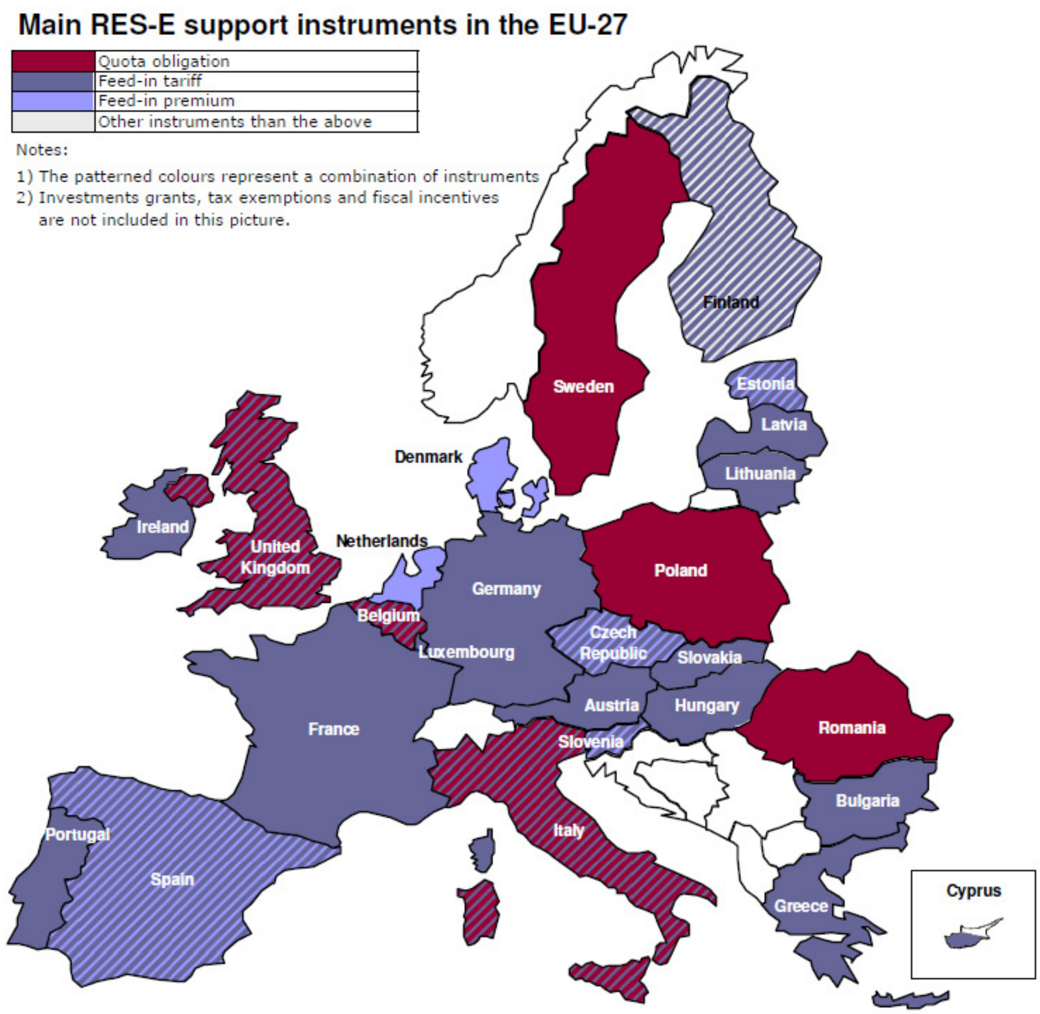

Figure 13: Main RES-E support instruments in the EU-27

Figure 13 provides a visual depiction of the deployment of main support instruments in the EU Member States. The main support instruments used in the EU are feed-in tariffs, feed-in premiums and quota obligations. A feed-in tariff is a fixed and guaranteed price paid to the eligible producers of electricity from renewable sources, for the power they feed into the grid. In a feed-in premium system, a guaranteed

premium is paid in addition to the income producers receive for the electricity from renewable sources that is being sold on the electricity market.
Quota obligations create a market for the renewable property of electricity. The government creates a demand through imposing an obligation on consumers or suppliers to source a certain percentage of their electricity from renewable sources.

Feed-in tariff systems have been historically and currently still are the main instruments of support in the EU. They are used in the following Member States: France, Germany, Spain, Greece, Ireland, Luxembourg, Austria, Hungary, Portugal, Bulgaria, Cyprus, Malta, Lithuania, Latvia and Slovakia. Most countries use a differentiation according to technology, which facilitates the development of a range of technologies due to the different level of tariffs they receive. However, a few countries, including Cyprus and Estonia do not differentiate according to technologies and apply a common feed-in tariff for all technologies.

The advantage of tariffs, compared to feed-in premiums and quota obligations (see below), lies in the long-term certainty of receiving a fixed level support, which lowers investment risks considerably. The costs of capital for RES investments observed in countries with established tariff systems have proven to be significantly lower than in countries with other instruments that involve higher risks of future returns on investments. Also, the weighted average costs of capital are notably higher in countries with quota obligations, compared to tariff-based systems. By guaranteeing the price and providing a secure demand, feed-in tariffs reduce both the price and market risks, and create certainty for the investor regarding the rate of return of a project. The lower cost for the investor result lower average support cost for society (for a detailed evaluation of cost-efficiency, see section 5.2)

The cost-efficiency of tariffs for society decreases when policy makers overestimate the cost of producing renewable electricity. This is because the level of tariffs is based on future expectations of the generation cost of renewable electricity. When these turn out lower than expected, producers receive a windfall profit. It is therefore important that tariffs are reviewed regularly in order to adjust the system to the latest available generation cost projections and to stimulate technology learning. Furthermore, payments should be guaranteed for a limited time period (approx. 15-20 years) that allows recovery of the investment, but avoids windfall profits over the lifetime of the plant.

In tariff systems, RES generators do not sell the produced electricity on the power market, but a single buyer, e.g. the TSO, fulfils this role. Therefore the producers are generally not stimulated to adjust their production according to the price signals on the market (i.e. electricity demand), unless this is provided by other means (e.g. peak/off-peak tariffs). This may be a disadvantage in terms of market compatibility. For a detailed evaluation of feed-in tariffs against market compatibility and further evaluation criteria (long-term competitiveness, governance, etc.) see section 5.

Feed-in *premium* systems have gained ground over the last years and are used as main support instruments in Denmark and the Netherlands. In Spain, Czech Republic, Estonia and Slovenia premiums exist in parallel to the tariff system. These Member States have introduced the possibility to choose between feed-in tariffs and premiums for a selection of technologies. The flexibility and coverage of the systems differs from country to country.

Premium systems provide a secure additional return for producers, while exposing them to the electricity price risk. Compared to feed-in tariffs, premiums provide less certainty for investors and hence, imply higher risk premiums and total costs of capital. There are different design options for premium systems. Premiums that are linked to electricity price developments, e.g. limited by cap and floor prices, provide higher certainty and less risk of over-compensation than fixed premiums.

The level of premiums is based on future expectations regarding the generation costs of renewable electricity and the average electricity market revenues. Therefore premium systems also embody the risk of inducing additional costs for society and windfall profits for producers when production costs are over-estimated, or electricity prices and learning rates are underestimated by policy makers. Time limits and a regular review of cost projections and adjustment of premiums based on these projections is therefore also important in feed-in premium systems. Both Denmark and the Netherlands have applied such practices. Denmark has put a cap on the overall return for producers, thereby limiting societal costs. In the Netherlands the level of the premium is determined annually and an overall cap is set on the total cost of the support.

In premium systems, the renewable electricity producer participates in the wholesale electricity market. The advantage of premiums is therefore that producers of renewables are stimulated to adjust their production according to the price signals on the market (i.e. electricity demand), at least if they have fuel costs. This can be beneficial for power system operation. For a detailed evaluation of feed-in premiums against market compatibility and further evaluation criteria (long-term competitiveness, governance etc.) see section 5.

Renewable or quota obligations. Renewable obligations have been introduced in Belgium, Italy, Sweden, UK, Poland and Romania. In countries with quota obligations, governments impose minimum shares of renewable electricity on suppliers (or consumers and producers) that increase over time. If obligations are not met, financial penalties are to be paid. Penalties are recycled back to suppliers in proportion to how much renewable electricity they have supplied. Obligations are combined with renewable obligation certificates (ROCs) that can be traded. Hence, ROCs provide support in addition to the electricity price and used as proof of compliance. A ROC represents the value of renewable electricity and facilitates trade in the green property of electricity.

Quota obligations with certificates expose producers to market signals, which can be beneficial from a power system operation perspective (see section 5).

Another related advantage of quota obligations compared to feed-in tariff and premium systems, is the fact that support is automatically phased out once the technology manages to compete. Tradable certificates represent the value of the renewable electricity at a certain time. When the costs of renewable technologies come down through learning, this is represented by the adjustment of the price of certificates. On the other hand, this might be a challenge for plants already in operation that did not profit from this technological learning. Furthermore, certificate prices are volatile to other market influences (e.g. exercise of market power).

Uncertainty about the current and future price of certicates increases financial risks faced by developers. This uncertainty can have a negative impact on the willingness to invest. Because producers do not only sell their electricity on the market, but also their certificates, the risk on the certicate market is added to the risk on the electricity market. This uncertainty increases the level of risk premiums and cost of capital. As these costs are usually transferred to consumers, the societal costs of renewable electricity support are usually higher than under feed-in tariff and premium systems.

Depending on the design, quota obligations tend to stimulate the development and deployment of lower-cost technologies and generally discard innovations in more costly options. This is particularly the case for quota obligation systems that are technology-neutral and do not make a distinction between renewable energy options. For more mature technologies such biomass combustion and possibly onshore wind, such a system may be appropriate, but can lead to windfall profit if the marginal price is set by more expensive technologies. Depending on the specific market and resource conditions, less mature technologies would best be supported under a quota obligation system with technology or band specifications. For example, technology specific certification periods have been introduced in Italy. In the UK and Belgium, the government has awarded technology-specific multiples of certificates. Technology-specific obligations, another example of technology banding, could lead to a separation of the TGC market and negatively influence market liquidity.

Also, to stimulate less-mature options under a quota obligation system, these technologies are sometimes combined with more targeted support (tariffs or premiums) for more expensive RES-E options. Such a combination of instruments has been introduced in the UK for solar PV and has been introduced in Italy for a range of smaller projects and options.

Hence, technology banding or a combination of support instruments could address specific learning rates for less mature technologies, while at the same time providing adequate support from more mature technologies.

For a detailed evaluation of quota obligations against further evaluation criteria (market compatibility, long-term competitiveness, governance etc.) see section 5.

On a national level, **investments grants** for RES-E are available in several Member States and are often devised to stimulate the take-up of less mature technologies such as photovoltaics. In Finland, investment grants and subsidies are the only support available on a national level.

Tax incentives or exemptions. Tax incentives or exemptions are often complementary to other types of renewable energy incentive programmes. They are powerful and highly flexible policy tools that can be targeted to encourage specific renewable energy technologies and to impact selected renewable energy market participants, especially when used in combination with other policy instruments. A wide range of tax incentives are present in the EU (see Annex).

Some countries, including Spain, the Netherlands, Finland and Greece provide tax incentives related to investments (including income tax deductions or credits for some fraction of the capital investment made in renewable energy projects, or accelerated depreciation). Other Member States, including Latvia, Poland, Slovakia, Sweden and the UK, have devised production tax incentives that provide income tax deduction or credits at a set rate per unit of produced renewable electricity, thereby reducing operational costs. Investment and production tax exemptions are most prominently present in the EU[10].

A fifth and related category are **fiscal incentives**, including soft – or low-interest loans that are loans with a rate below the market rate of interest. Soft loans may also provide other concessions to borrowers, including longer repayment periods or interest holidays. On a national level, soft-loans are available in Germany, Netherlands, Bulgaria, Estonia, Malta and Poland.

Tenders are used for larger-scale projects and most commonly for offshore wind. Tendering schemes for offshore wind are employed in the Netherlands, UK, Denmark and Spain. Its advantages include the amount of attention it draws towards renewable energy investment opportunities and the competitive element incorporated in its design. Its handicap is that the overall number of projects actually implemented so far has proven to be very low.

Annex 2.1 includes a detailed overview of support instruments (situation October 2009) for the following RES-E categories: biomass, biogas, biowaste, geothermal, photo-voltaics, small-scale hydro, solar thermal, wave and tidal, wind on – and offshore. Quantitative information is provided for the main support instruments.

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[10] Because the focus of this study has been on the most prominent national support instruments, other tax incentives than investment or production/operation that are used by Member States have not been investigated. Also taxes on conventional fuels or CO_2, fall outside the scope of this study. CO_2 taxes are generally not considered tax exemptions. They correct for the externality related to CO_2 emissions and thus generate better relative prices. However, in some cases where CO_2 taxes are the main means of support, these are grouped under the heading of tax exemptions in the tables in the Annex and explicitly mentioned as such.

2.1.2 Instruments to support RES heat and cooling

While European as well as Member States' policies have provided relatively few incentives for the application of RES heat and cooling (RES-H&C) in the past. In recent years, these options are receiving more attention from policy makers.

Table 6 gives an overview of the main renewable heat and cooling support instruments used in the EU-27 Member States. Below, a short description of the instruments and their usage in the Member States is given.

Table 6: Overview of main RES-H&C support instruments in the EU-27

	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
Investment grants	X	x	x	x	x	x		x		X	x	x	x	X
Tax exemptions	X	x					x				x	x		
Financial incentives			x			x		x			x			

	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Investment grants		x	X	X	x	x	x	x		x	x	X	X
Tax exemptions	X	x				x				x			X
Financial incentives								x					

Financial support instruments for RES heat and cooling can be grouped into four categories: investment grants, tax exemptions, financial incentives and premiums/boni. The deployment of (combinations) of these instruments varies largely from country to country and from technology to technology. The main support comes in the form of investment grants and tax exemptions[11]. These are available in quite some Member States for most RES-H&C technologies. Financial incentives such as soft loans are less commonly available. (RES based) district heating receives relatively little attention from Member States. Austria, Finland, Hungary and Lithuania are exceptions. Use obligations are applied in Spain and Germany, but they are rather a regulatory than a financial instrument.

Annex 2.1 provides an overview of support instruments for the different RES-H&C technology categories.

[11] CO_2 taxes are generally not considered tax exemptions. They correct for the externality related to CO_2 emissions and thus generate better relative prices. However, in some cases where CO_2 taxes are the main means of support, these are grouped under the heading of tax exemptions in the tables in the Annex and explicitly mentioned as such. This is for example the case in Finland. In Denmark and Sweden, for some RES-H&C technologies, CO2 taxation of conventional power generation are main drivers, whereas other technologies, are also exempt from energy tax.

2.1.3 Instruments to support biofuels (RES-T)

The Biofuels Directive of 2003 instigated a growth of biofuels production and application in Europe, and now the Renewable Energy Directive will shape the European market for biofuels until 2020. Under current EU policies, Member States are aiming to produce a tenth of their road fuels from renewable sources such as biofuels by 2020. Also, the directive has led most Member States to adopt intermediate targets.

Due to increased concerns over the sustainability of biofuels, the EU is currently working on new rules designed to ensure that only biofuels made from energy crops and waste from sustainable plantations are allowed to count towards the targets.

The support for biofuel consumption in the Member States is often a combination of an obligation with tax exemptions. In few instances, only one of these two instruments are used (see Table 7). The levels of support for biofuel obligations are very difficult to assess since the prices implied by these obligations are typically not public.

Table 7: Overview of main biofuels support instruments in the EU-27

	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
Quota obligation	x		x	x	x	x	x		x	x	x			x
Tax exemptions	x	X		x	x	x	x	x	x		x	X	x	x

	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Quota obligation		X	x	x		x	x	x	x		X	x	x
Tax exemptions	x	X	x	x	x		x	x	x	x	X	x	x

Annex 2.1 provides a detailed overview of support instruments for the RES-T sector. The tables also include the intermediate biofuels targets as well as other, secondary forms of support.

2.2 Aggregated data on support expenditure per MS

The aim of this section is to give an estimate of the net support expenditures for RES technologies, i.e. the premium on top of the revenues from the conventional power market, on country level for the years 2007 to 2009. At first we summarize the methodological approach that has been applied, before the results of this section are presented.

2.2.1 Approach

The approach chosen for the estimation of the support expenditures is twofold. On the one hand, a top-down approach is applied to derive the aggregated picture with respect to current (2009) support expenditures for RES within all energy sectors and, on the other hand, the outcomes of this regarding renewable electricity are then contrasted with bottom-up calculations.[12] For the top-down calculations the Green-X model is used in the setting of a "business as usual" (BAU) scenario. For further details with respect to the model and calculations we refer to section 4 where applied model and derived scenarios are discussed. In the following the approach applied in the bottom-up calculations will be explained.[13]

In the case of operational support[14] which represents the common practice with respect to financial incentives for RES-E in Europe, support expenditures are calculated based on information about the total amount of electricity generated in one year on technology level and the corresponding support level. Owing to the heterogeneity and the complexity of the national support schemes it is rather challenging to estimate the support expenditures based on the information available. These circumstances apply in particular for the application of feed-in tariffs, as described below.

Feed-in tariffs are partially more differentiated than the technology specification of the historic data available. For example, in case of biomass, tariffs may be determined according to the type of feedstock used or to the size of the renewable power plant, whilst the statistical data only provides data on higher aggregation level. As a consequence, average values are taken for the calculation of the available support level.

Since in case of feed-in tariffs different tariff levels may be paid according to the initial year of operation of the corresponding renewable power plant, one should split up the technology-specific electricity generation according to the initial year of operation. It is also not always obvious if older plants such as small-scale hydropower plants still receive support for the electricity produced. In addition, older plants may still receive support from a support scheme that has been already substituted.

To estimate the support expenditures, we draw on data on the average support level for the years 2005, 2007 and 2009, which has been compiled in the context of several other research projects such as OPTRES, futures-E and Re-Shaping.

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[12] Extending the bottom-up calculations to RES-H and biofuels was not feasible with given time and budget constraints. Besides, statistics are also not applicabe up to now that provide the complete picture for specifically RES in the heat sector.

[13] In principle, the Green-X model follows a similar approach than explained for the bottom-up calculations subsequently, whereby several steps can be endogenised properly and consequently do not represent a major challenge. However, in contrast to bottom-up style calculations, derived results on deployment may at technology level differ slightly from actual generation as applicable in statistics, which represents a deficit compared to the them.

[14] In the case of investment focussed support, the calculation of support expenditures is typically more straight forward, as the amount of (net) support expenditures directly arises from the offered up-front support as determined commonly per unit of installed capacity and the corresponding plant size (i.e. the installed capacity).

These support levels have been multiplied with the amount of electricity generated in the respective technology in a certain year.
Thereby, the total electricity generation was split up according to its initial year of operation. This means that the annual additional electricity generation of one technology is assumed to correspond to the electricity output of the newly installed capacity. This amount is then multiplied with the support level available in the respective year. For renewable power plants that have been installed between 1990 and 2005 the 2005 support level is assumed, since no time series for the time horizon before 2005 are available. In case of small-scale hydropower, we assume that plants, that have been built before 1990 do not receive any financial support anymore. In a final step, total support payment calculated is reduced by the product of renewable electricity generation and the reference electricity price of the respective year.

Given the explained circumstances, the calculation of the support expenditures realized in this section should be interpreted carefully, as they are only indicative values based on estimations. To get an idea about the quality of the estimations, the support expenditures are compared exemplarily to figures published by national governments. In this case, data on support expenditure published by Spain, Germany and the United Kingdom are compared with our estimations.

2.2.2 Results

At first the results derived from the Green-X calculations are presented, followed by the findings of the bottom-up estimation. Finally, a comparison of the results of both approaches is undertaken.

The general results from Green-X calculations indicating the net support expenditures in million € for RES technologies by sector are depicted in Figure 14, referring to the year 2009.

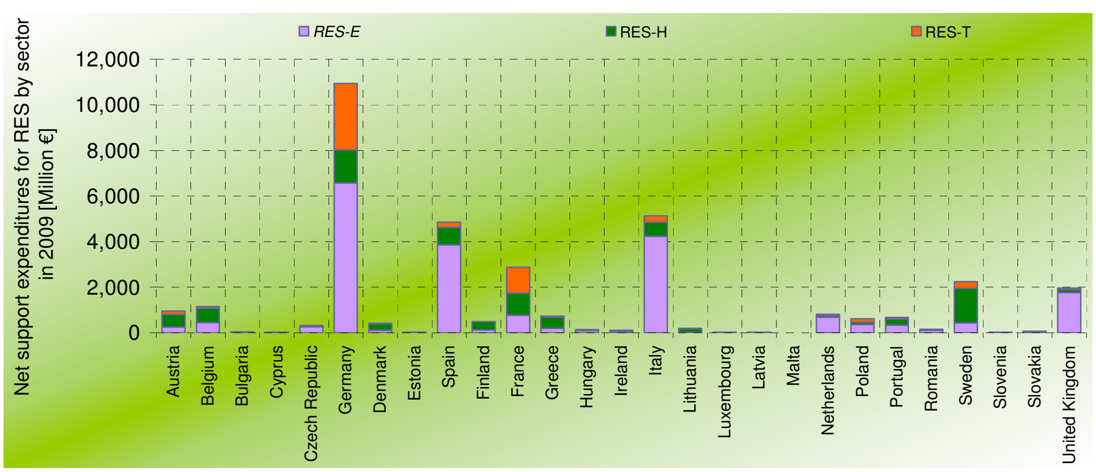


Figure 14: Net support expenditures for RES by sector in 2009 in absolute terms

The most evident conclusion that can be drawn from this figure is that in absolute terms only a few countries hold a major part of the current overall net support expenditures as arising at EU level. Thereby Germany takes the "lead" with almost 11 billion €, followed by Italy and Spain with about 5 billion €. Somewhat further distant are France with about 3 billion €, followed by Sweden and the UK with both slightly more or less than 2 billion € net expenditures. Of interest, at EU level overall net support expenditures for RES in 2009 amounted to about 35 billion €.

The second conclusion that can be drawn from this figure is that support expenditures for RES-E are dominant, while RES-H with exception of Austria, Denmark, Finland and Sweden, and RES-T[15] with exception of France and Germany account only for a minor share of the total expenditures. In general, this pattern correlates properly to the achieved growth within the different sectors in past years. Other important reasons are the fact that on average most RES-E technologies require higher specific support (i.e. per MWh stimulated RES generation) than RES-H options, specifically this can be observed for photovoltaics or small to medium-scale biomass CHP.

As could easily be seen from Figure 14 the countries with the highest expenditures are also among the largest in the EU in terms of population with exception of Sweden. In order to put the numbers in a more specific perspective in Figure 15 the support expenditures are related to the countries overall gross final energy demand. This reflects properly the burden for the energy consumer / the society arising from current RES policy practice and appears well suitable for a cross-country comparison. Compared to Figure 14, Figure 15 is providing a more balanced picture across the EU Member States. It is well observable how the high level of expenditures compared to the relatively small size (in terms of population) of Sweden factors in now.

[15] Please note that with respect to biofuels only support via tax incentives are considered in this tentative analysis as in the case of pure obligation systems the support levels are comparatively difficult to assess since the prices implied by these obligations are typically not public.

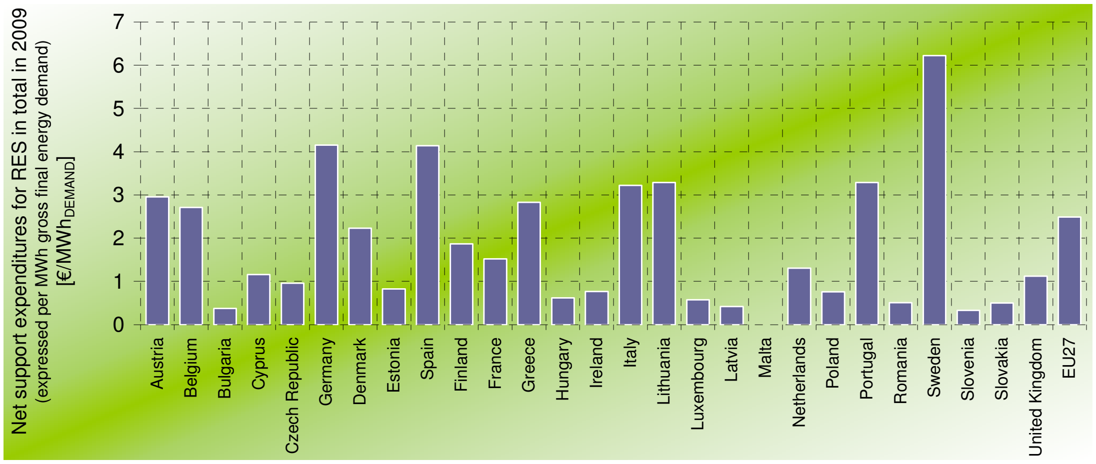


Figure 15: Net support expenditures for RES in total in 2009 in relative terms – expressed as RES support per unit of overall gross final energy consumed.

When only relating the RES-E support to the corresponding (gross final) electricity consumption like it is done in Figure 16, the relative distribution of support levels among the Member States does not change much (only Sweden goes down). However, it is striking that the specific support level almost rises by a factor two to three or even higher in many cases. For example in the case of Spain the specific support level goes up from slightly under 4 €/MWh to more than 13 €/MWh. Especially with the high levels that are reached in Spain and Germany the strong expansion of PV systems has factored in significantly. This indicates that past policy attention focused in most countries on renewables in the electricity sector. Consequently, a high deployment of RES-E was achieved but RES-E technologies generally also require a higher specific support (per unit of energy produced) than RES-H.

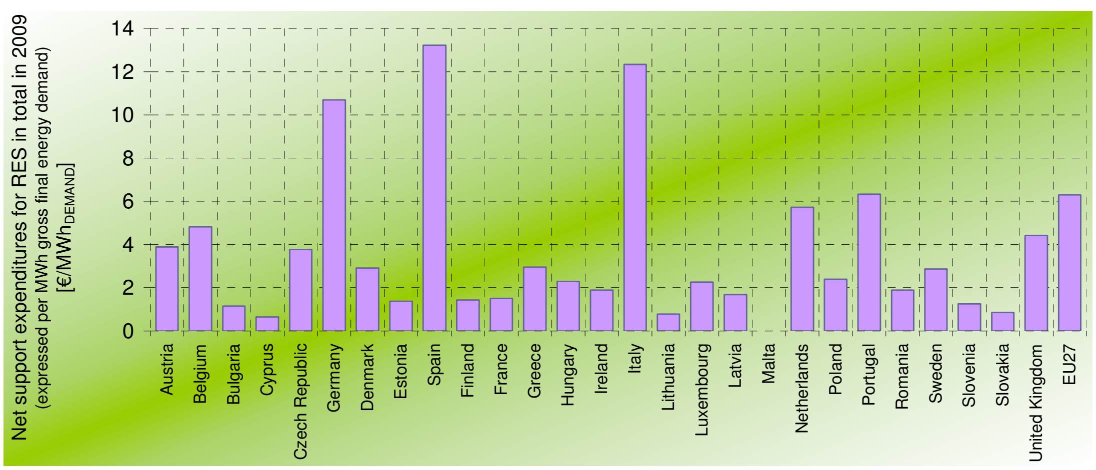


Figure 16: Net support expenditures for RES-E in total in 2009 in relative terms – expressed as RES-E support per unit of overall gross final electricity consumed.

As a next step, the results obtained from the bottom-up calculations are presented in further detail in Table 8. According to the estimation performed in this section, the net support costs of the EU have increased from roughly 9 billion € in 2007 to 16.9 billion Euro in 2009. However, it should be noted that the estimations are indicative and may deviate from the real net support expenditures on national level. Looking at the year 2009, Germany appears to spend the largest amount for the support of renewable electricity, amounting to 6 billion € or to more than one third of total EU net support expenditures. According to these estimations, Spain spent 3.8 billion €, followed by Italy with 2.5 billion €.

Table 8: Results for bottom-up estimation of net support costs [16]

	Estimated net support expenditures in 2007 [Mio €]	Estimated net support expenditures in 2008 [Mio €]	Estimated net support expenditures in 2009 [Mio €]
Austria	361	384	454
Belgium	250	309	413
Bulgaria	3	4	18
Cyprus	1	2	2
Czech Republic	96	120	207
Germany	3.564	4.058	6.148
Denmark	152	150	142
Estonia	6	7	8
Spain	942	1.832	3.804
Finland	6	8	8
France	121	338	496
Greece	33	40	49
Hungary	52	60	82
Ireland	13	14	32
Italy	1.752	2.191	2.473
Lithuania	1	1	2
Luxembourg	13	15	17
Latvia	1	1	1
Malta	0	0	0
Netherlands	203	250	391
Poland	159	200	320
Portugal	104	130	195
Romania	10	10	11
Sweden	81	94	143
Slovenia	7	20	8
Slovakia	8	10	8
United Kingdom	1.061	1.159	1.435
EU27	**9.001**	**11.408**	**16.867**

[16] Net support expenditures (FIT or the sum of reference electricity price and green certificate price) are the total support payments reduced by the product of reference electricity price and the total amount of RES-E generation.

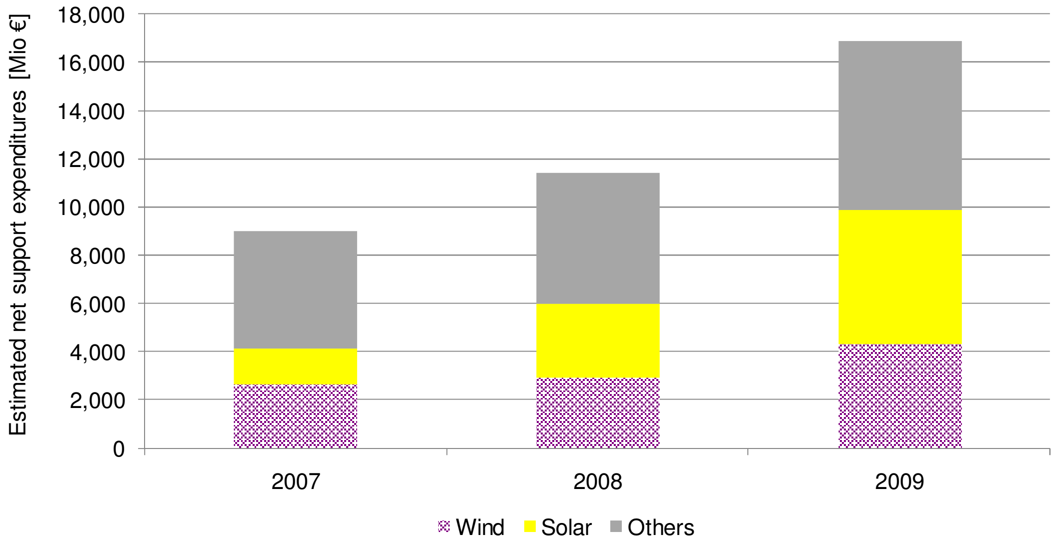


Figure 17: Technology-specific breakdown of net support expenditures for RES-E in the period 2007 to 2009 at EU level (based on bottom-up estimates).

Further insights on the composition of net support expenditures are given in Figure 17, indicating a technology-specific breakdown of expenditures for the period 2007 to 2009 at EU level. Remarkable, the increasing share of wind power which correlates well with the share on corresponding total RES-E deployment and the high increase of support expenditures for solar electricity, specifically due to the high growth of photovoltaics in several EU countries like Germany, Italy, Belgium or Czech Republic.

For the comparison with data published on national level, we compare the total payments without subtracting the reference electricity price. In the Spanish case, remuneration paid for cogeneration plants which do not necessarily have to be based on RES are excluded. With regard to British data, there might be small deviations, since the accounting period for the quota system starts in spring and not in January, as assumed in our calculations. Table 9 shows, that we estimated support expenditures in Germany to be slightly below real data, amounting to 8 % less than stated by the BDEW. In Spain our estimations underestimate support payments by up to 25% in 2008, whilst our calculations for the United Kingdom show an overestimation of up to 12%. Additional comparisons appear to be necessary in order to evaluate the quality of these bottom-up estimations.

Table 9: Exemplary comparison of support expenditures with data published on country-level for Germany, Spain and United Kingdom

	Germany	Spain	United Kingdom
Estimated support expenditure in 2007 [Mio €]	7.476	3.091	1.894
National support expenditure in 2007 [Mio €]	7.879	3.370	1.690
Difference of estimation to national data	-5%	-8%	12%
Estimated support expenditure in 2008 [Mio €]	8.051	4.609	2.118
National support expenditure in 2008 [Mio €]	8.717	5.705	1.975
Difference of estimation to national data	-8%	-19%	7%
Estimated support expenditure in 2009 [Mio €]	10.503	5.931	2.542
National support expenditure in 2009 [Mio €]	9.982	6.589	n.a.
Difference of estimation to national data	5%	-10%	

Source: based on data from BDEW 2009; BDEW 2008a; BDEW 2008b; CNE 2009; Ofgem 2010

As a final step in this section the results of the two approaches (top-down; bottom-up) employed are now compared as it is done in Figure 18. First of all it can be seen that there is a clear tendency in the same direction in both approaches, which confirms the methodologies employed. In general the calculations made with Green-X are of higher magnitude than the bottom-up calculations. There may be two possible explanations for this. On the one hand, the Green-X model represents a more accurate depiction of historic development as changes in parameters (as e.g. support conditions for specific RES technologies) are adjusted in every year and therefore leads to more precise accounting of support expenditures per installation. On the other hand, in the Green-X model new installations factor in for the whole year that they were installed, while in the bottom-up calculations the actual generation is considered. How strongly the results are affected by that, depends thereby on the market growth. Besides, RES technologies like wind, solar or hydro are characterised by a natural volatility with impact on the actual yearly generation. Hence, within the model-based assessment for these technologies only the potential generation based on average meteroligal conditions can be considered, while the bottom-up calculations directly build on actual generation in the researched year. Consequently, the results from the Green-X calculations should be considered as upper bound for the support expenditures, whereas the findings from the bottom-up calculations can be considered as lower bound.

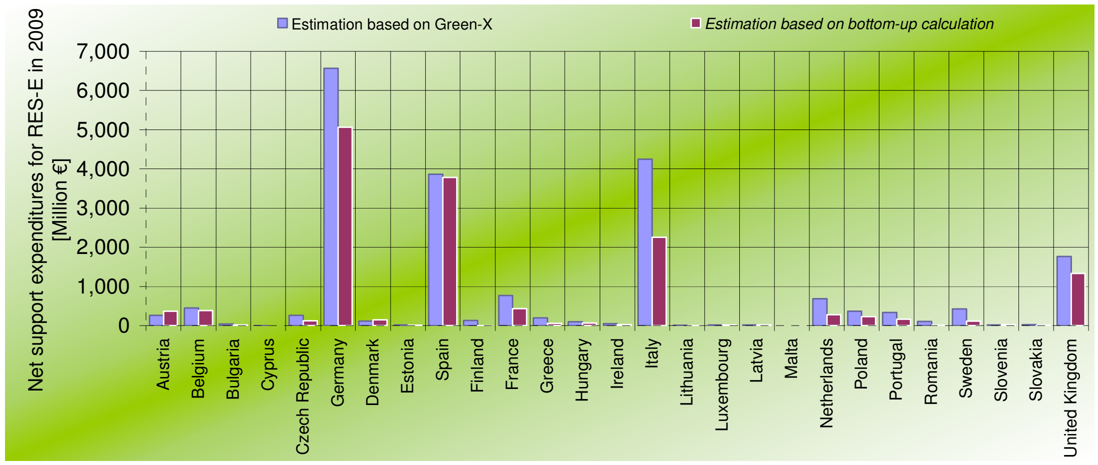


Figure 18: Comparison net support expenditures for RES-E in 2009

2.3 Comparison of the average support level and the average generation cost per RES-E technology and MS

This section compares average support levels and average generation costs per RES-E technology and MS. Refer to Held et al. 2010 for details on the calculation methodology.

Figure 19 shows the range for the support level[17] paid for electricity generated by wind onshore power plants and compares it with the minimum to average electricity generation costs. Electricity generation costs of wind onshore power plants have increased during the last few years as a result of increasing steel prices and a strong demand for wind turbines. In general, almost all EU Member States appear to provide a sufficiently high support level for wind onshore electricity. Only in Austria, Luxemburg and Finland, the support level is just high enough to cover the lower limit of electricity generation costs. In contrast, countries applying a quota obligation with tradable green certificates such as Belgium, Italy, Poland, Romania and the UK provide a support level which clearly exceeds the average level of generation costs. Likewise, the feed-in tariff in Cyprus leads to a rather high support level of roughly 160 €/MWh.

Also shown is the level of system services costs in all countries where these costs have to be paid by the RES generator. When analysing grid connection costs one needs to differentiate between shallow and deep grid connection. The shallow part of the total costs, i.e. the connection to the closest existing grid are typically allocated to the plant operator and are contained in the generation costs of the plant for all countries. The deep element of the connection costs, i.e. grid extensions and

[17] In this section support level shall mean gross support in the notion of the previous chapter.

enforcements of distribution and transmission grids, need to be covered by the RES plant operator in countries with deep connection charging. In these countries these costs are allocated to the plant operator, whereas they are socialised in all other countries.

This leads to the fact that the generation costs for wind onshore are increased by the amount shown in the graphs. This amount called "system services costs" includes such grid extensions and enforcements as well as balancing power. System services costs notably contribute to the generation costs in Denmark, Spain and the Netherlands[18]. These cost levels particularly assume that an efficient market for balancing power exists, which is not the case in all countries. Therefore the costs shown can be considered as a lower estimate of the real costs occurring to the RES generator. Furthermore, system services costs become substantial only when the share of wind power becomes significant in a country's electricity mix. Therefore, these costs are at present still very low in some countries, e.g. UK.

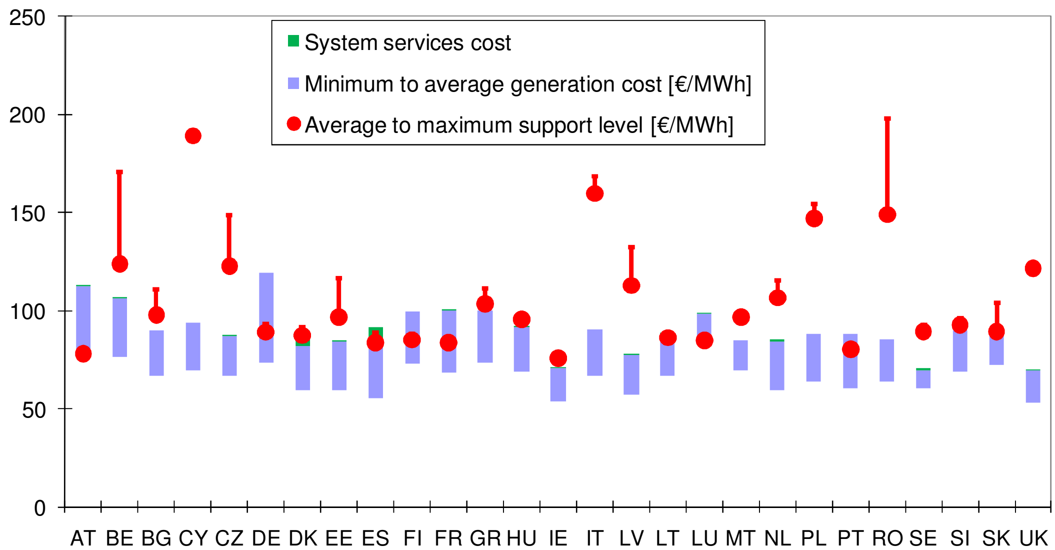


Figure 19: Support level ranges (average to maximum support) for Wind Onshore in the EU-27 MS in 2009 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs)

In contrast to the case of wind onshore electricity, Figure 20 shows that the support level paid for electricity from Solar PV power plants is far below electricity generation costs in some countries. These countries include some Northern European countries with less favourable solar conditions such as Denmark, Estonia, Finland, Ireland, Poland, Sweden and the UK. However, also Southern European countries including Hungary, Malta and Romania provide a support level significantly below the range of electricity generation costs. In Belgium and Italy, both countries using a quota obligation as their dominant support scheme offer special feed-in tariffs for Solar PV

[18] The system services costs are comprised of grid extension/reinforcement costs and balancing costs based on (Weissensteiner et al., 2009)

electricity. In the United Kingdom, the technology-banding option, which provides two certificates for one MWh of Solar PV electricity, implies a support level which is still far below generation costs.

In the Czech Republic tariffs clearly exceed the level of average generation costs, whilst Bulgaria, France, Greece, Italy, Portugal and Spain support photovoltaic electricity with stable and technology-specific feed-in tariffs.

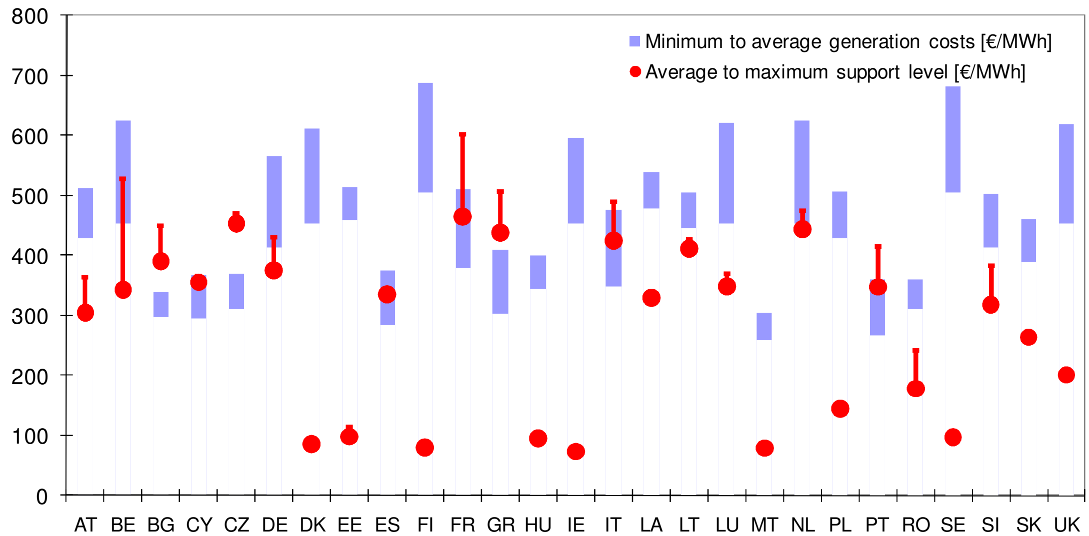


Figure 20: Support level ranges (average to maximum support) for Solar PV in the EU-27 MS in 2009 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs)

In case of small-scale hydropower or hydropower plants with a capacity below 10 MW the country-specific costs show very large differences (see Figure 21). It can be seen that the existing feed-in tariffs are quite well adjusted to generation costs. Similar to the case of wind onshore, the support level resulting from the application of a quota obligation appears to exceed clearly electricity generation costs of small-scale hydropower plants in Belgium, Italy, Romania and the United Kingdom. This can be explained by the fact that electricity generation costs of small-scale hydropower are at the lower end of the cost range of renewable electricity. Likewise, the support level resulting from feed-in tariffs are considerably above generation costs in Eastern European countries such as the Czech Republic, Estonia, Latvia, Slovenia and Slovakia. Due to the fact that there is still some unexploited potential available this technology is especially relevant for these new Member States. In contrast, the available potential for the use of small-scale hydropower is already exploited to a large extent.

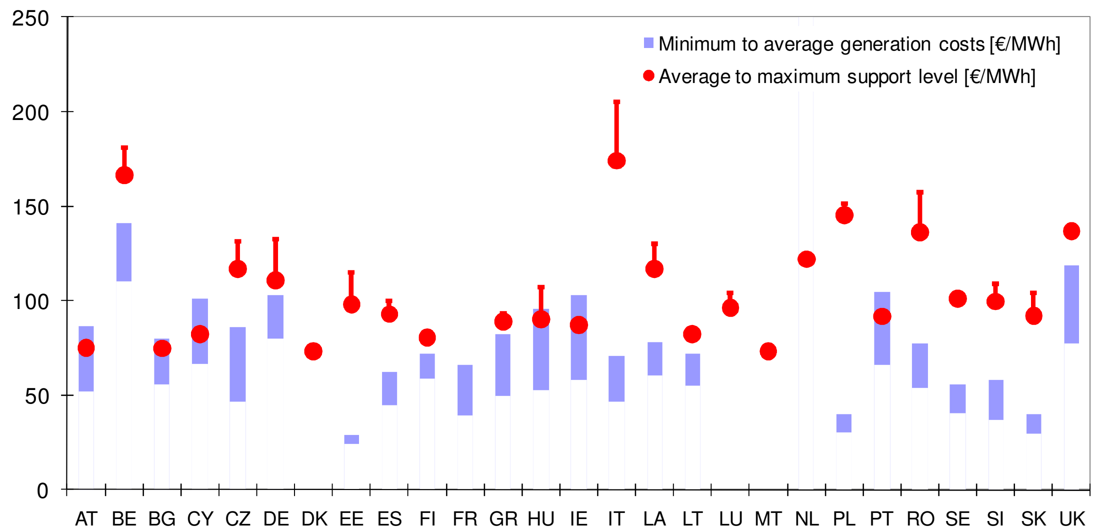


Figure 21: Support level ranges (average to maximum support) for hydropower plants with a capacity below 10 MW in the EU-27 MS in 2009 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs)

Figure 22 illustrates the current support level and minium to average generation costs of biogas power plants. Since generation costs may vary strongly for the different types of biogas plants and feedstocks, the average cost indication should be considered with care. Particularly Germany, Italy and the United Kingdom offer a very high support level compared to minimum to average electricity generation costs. Whilst the possible accumulation of different feed-in tariff components for biomass-based electricity leads to very high maximum support level in Germany, the certificate coefficient of 1.8 for electricity from biogas power plants is responsible for the high support level in Italy. Similarly, 1.5 certificates may be assigned to one MWh of electricity in the United Kingdom. In the other countries, the support level is either slightly above or in the range of the average generation cost level.

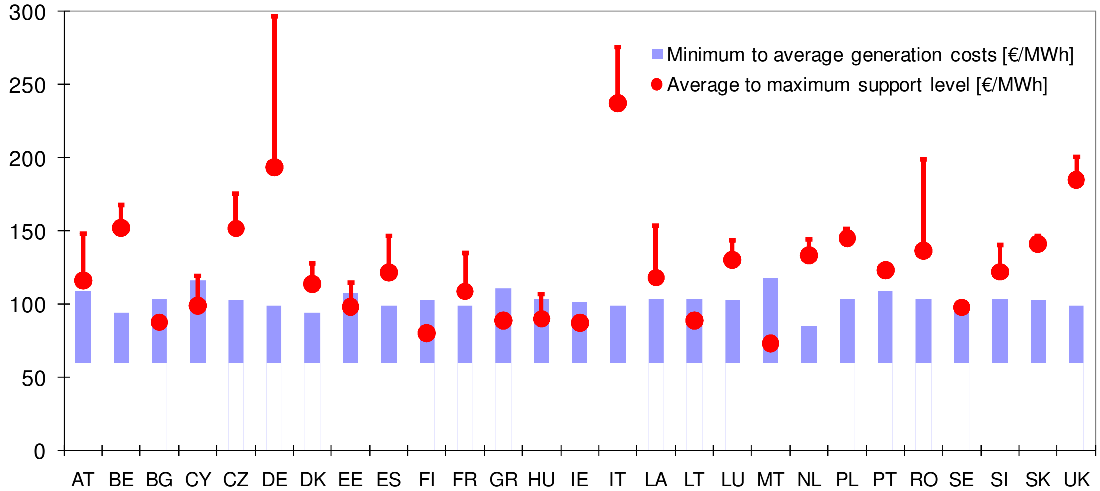


Figure 22: Support level ranges (average to maximum support) for biogas power plants in the EU-27 MS in 2009 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs)

Figure 23 illustrates the current support level and the generation costs of biomass electricity generation. Since both costs and the support level may vary strongly for the many different types of biomass resources, price ranges are shown for electricity production from forestry residues. However, there are considerable differences in generation costs even within this option. This is partly due to the fact that the support systems of countries with comparatively low minimum generation costs allow the application of cost-efficient co-firing. Moreover, it should be added that the generation costs in biomass sectors are also heavily dependent on plant size.

The general support situation for biomass-based electricity generation in the EU appears to rather favourable. Again, the support level in some countries is considerably above generation costs. These countries apply both feed-in tariffs, such as the Czech Republic, Germany, Spain, the Netherlands, Portugal and Slovenia and quota obligations such as Belgium, Italy, Poland and the United Kingdom.

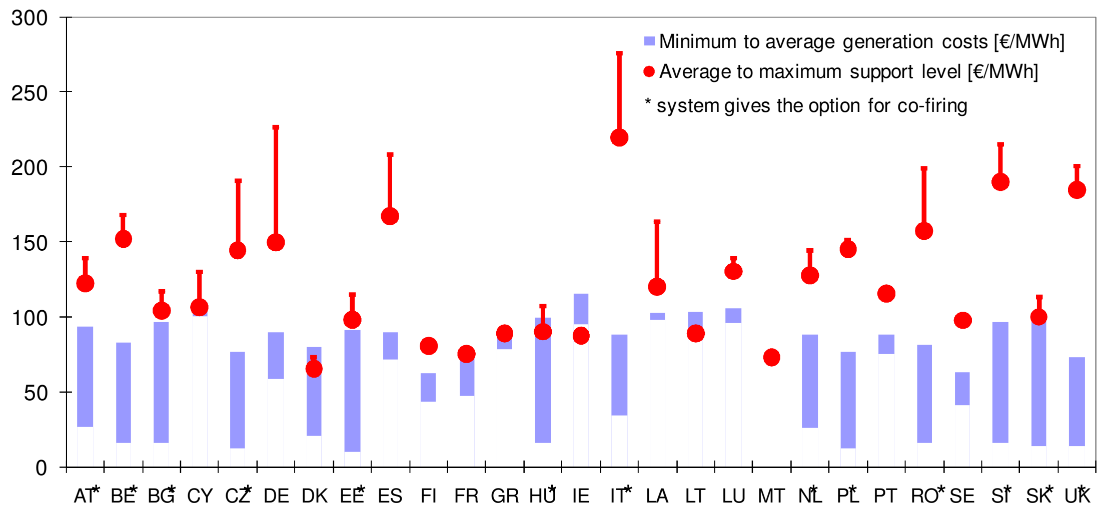


Figure 23: Support level ranges (average to maximum support) for biomass power plants in the EU-27 MS in 2009 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs)

2.4 Temporal evolution of support levels paid for RES-E

After the evaluation of the static efficiency in terms of comparing support level ranges with average generation costs, this section addresses the dynamic efficiency of support schemes. Figure 24 shows an aggregate depiction of the evolution of support tariffs paid for wind onshore, biomass and solar PV arranged according to the respective main support scheme applied for the years 2005, 2007 and 2009. Support levels are weighted according the additional electricity generation in the respective year. Since the amount of additional electricity generation of Solar PV power plants for countries using quota obligations is nearly zero, the average support level is not shown. Solar PV electricity in countries using quota obligations such as Belgium, Italy and the United Kingdom is supported by some kind of supplementary feed-in tariffs. Thus, the respective tariff levels show up in the feed-in system group – corresponding to the blue bars.

Observing Figure 24 it becomes clear that the dynamic efficiency in terms of the average support level shows different trends depending on the technology. In case of wind onshore, a rather cost-effective RET, the average feed-in tariff shows a constant trend between 2005 and 2009. In contrast, the average support level resulting from the revenues of green certificates rises between 2005 and 2007 and clearly decreases in 2009. Looking at the support levels for biomass power plants, tariff levels from both systems - the feed-in systems and quota obligations - show a slightly decreasing trend. In case of the cost-intensive Solar PV technology, the trend of average tariffs is clearly downwards, bearing in mind the high initial support level of slightly above 450 €/MWh. The high tariffs paid in 2005 and 2007 involved moderate additional electricity generation compared to the other two technologies shown, whilst electricity generation from additionally installed PV power plants increased considerably in 2009.

It should be mentioned here that the assessment f the average support levels as shown in Figure 24 should be interpreted carefully. The reason for this is that changing average tariffs may be due to changing weights of nationally differing tariffs in terms of additional electricity generation. Thus, the assessment of the temporal evolution could be improved by analysing it on a Member State level. In addition, we took the actual additional electricity generation as the reference value and not weather-normalised generation data. Thus, the strong decrease of additional electricity generation from wind onshore power plants between 2007 and 2009 is due very unfavourable wind conditions in Germany in 2009.

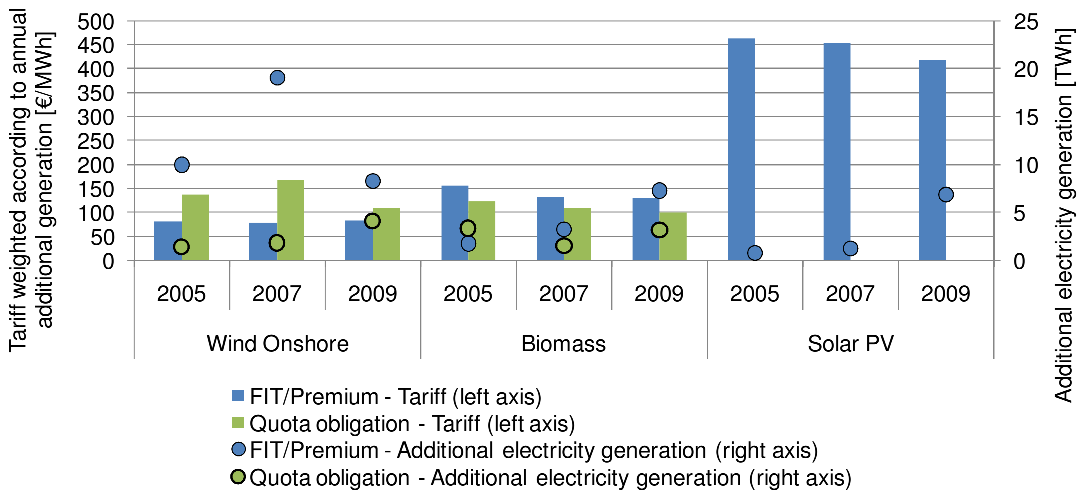


Figure 24: Temporal evolution of support levels summed up by country groups using either feed-in systems or quota obligations as their main support scheme. The figure also shows the additional electricity generation (right axis), which was used to weight the support level.

Figure 25 shows the temporal evaluation of the certificate prices for the countries that use a quota obligation as their main support instrument. Whilst the certificate price in Wallonia, Poland, the United Kingdom remains on a rather constant level, the certificate price in Flanders increased considerably in the early stage of the quota obligation between 2002 and 2005. Certificate prices in Italia increase up to 120 €/MWh in 2007, followed by a strong decrease in 2008. The lowest TGC prices can be observed in Sweden ranging from about 20 €/MWh in 2006 to 32 €/MWh in 2010.

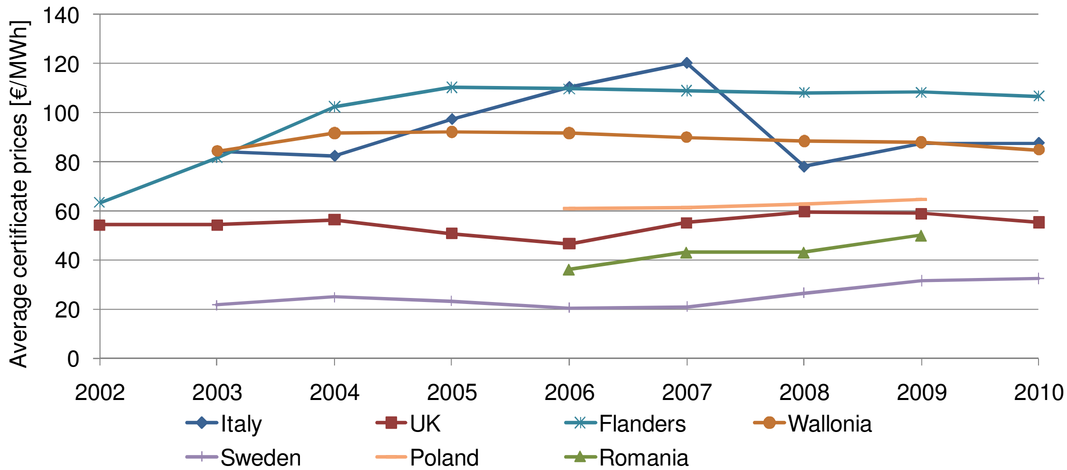


Figure 25: Temporal evolution of average annual certificate prices. National currencies have been converted to Euro using the exchange rate as of October 2009.

2.5 Comparison of the average support level and the average generation cost per RES-H technology and MS

In this section, the remuneration levels of RES-H policies in Europe is discussed in a similar fashion as for RES-E policies in the preceding section.
The RES-H technologies considered are RES district heating, biomass heat non-grid, solar thermal heat and heat pumps.

Figure 26 shows the range of the remuneration level for heat generated by RES district heating plants and compares it with the minimum to average heat generation costs. District heating by RES in this section typically refers to large biomass plants, which produce centralized heat for a heating grid.

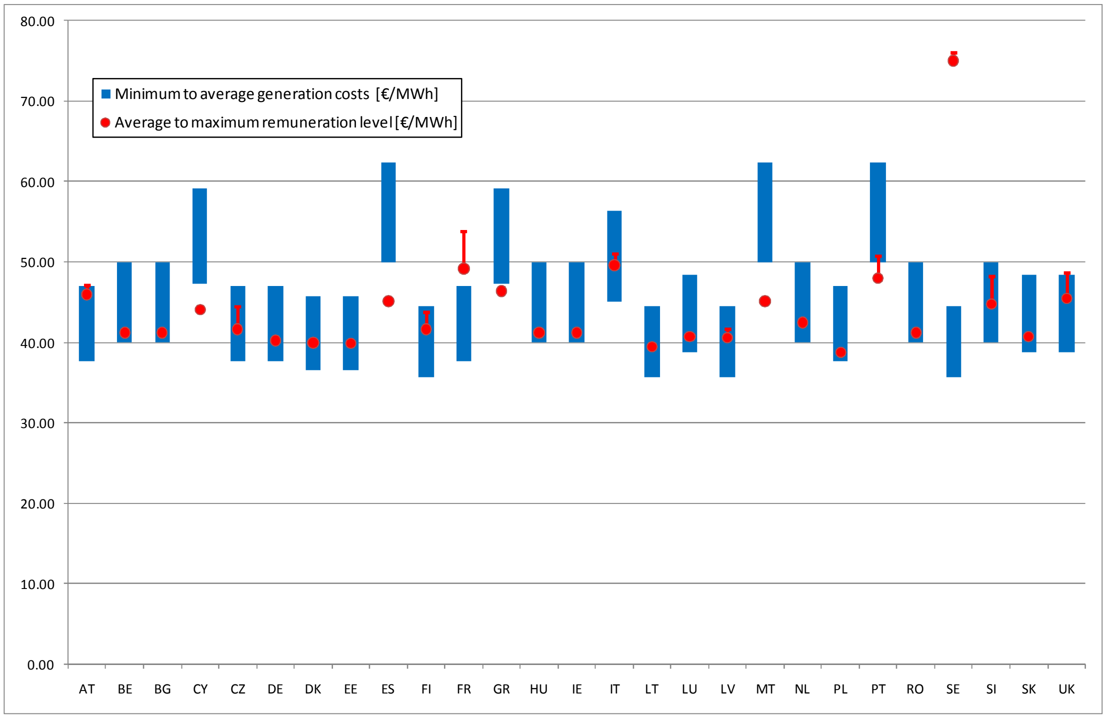


Figure 26: Support level ranges (average to maximum support) for RES district heating in the EU-27 MS in 2009 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs)

Sweden has the highest level of remuneration. It is comprised of the conventional reference price for grid connected heat and the level of renumeration of RES district heating. The main support instruments applied in Sweden are direct subsidies and exemption from energy, CO_2, sulphur and the NO_x taxes. France is ranked second with a maximum remuneration level of 54 €/MWh. Investors in RES-H grid in France benefit from a regional feed-in premium for large-scale installations or from a zero-interest loan for small-scale district heating. Italy and Portugal also have above-average levels of remuneration in the range of 50 €/MWh. In the EU-12 Member States relevant support of district heat is provided in the Czech Republic, in Latvia and Slovenia.

Figure 27 shows the range for the remuneration level for heat generated by biomass heat non-grid plants and compares it with the minimum to average heat generation costs. Biomass non-grid includes decentralized heating systems based on pellets, wood chips and logwood.

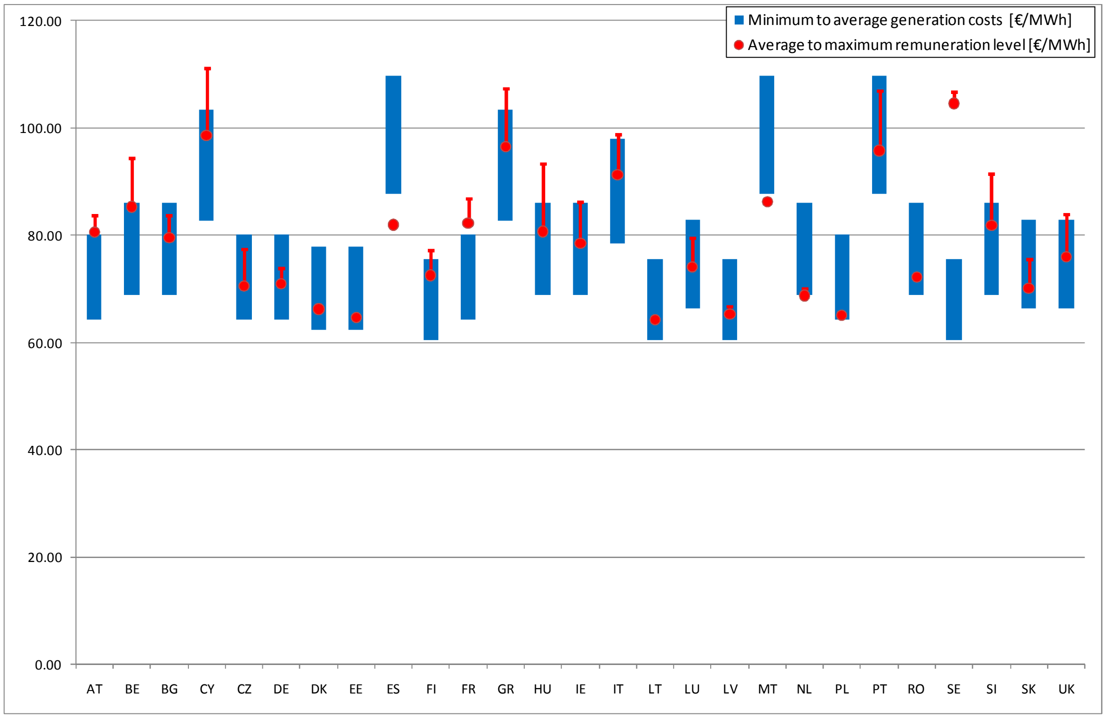


Figure 27: Support level ranges (average to maximum support) for biomass non-grid in the EU-27 MS in 2009 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs)

Cyprus shows the highest remuneration level among all Member States. This is due to a relatively high reference price for heat non-grid and investment subsidies that amount to 55% in Cyprus. In terms of the average remuneration level, Sweden ranks first. Here, biomass heat non-grid is promoted by investment incentives and tax exemption. Furthermore, Greece, Portugal, Italy and Belgium have high remuneration levels. There is no promotion of biomass heat non-grid via investment grants, tax exemption or fiscal incentives for Estonia, Spain, Lithuania, Malta, Poland and Romania. However, there is a building obligation in Spain that is not accounted for in the efficiency indicator.

Figure 28 shows the range for the remuneration level for solar thermal heat and compares it with the minimum to average heat generation costs.

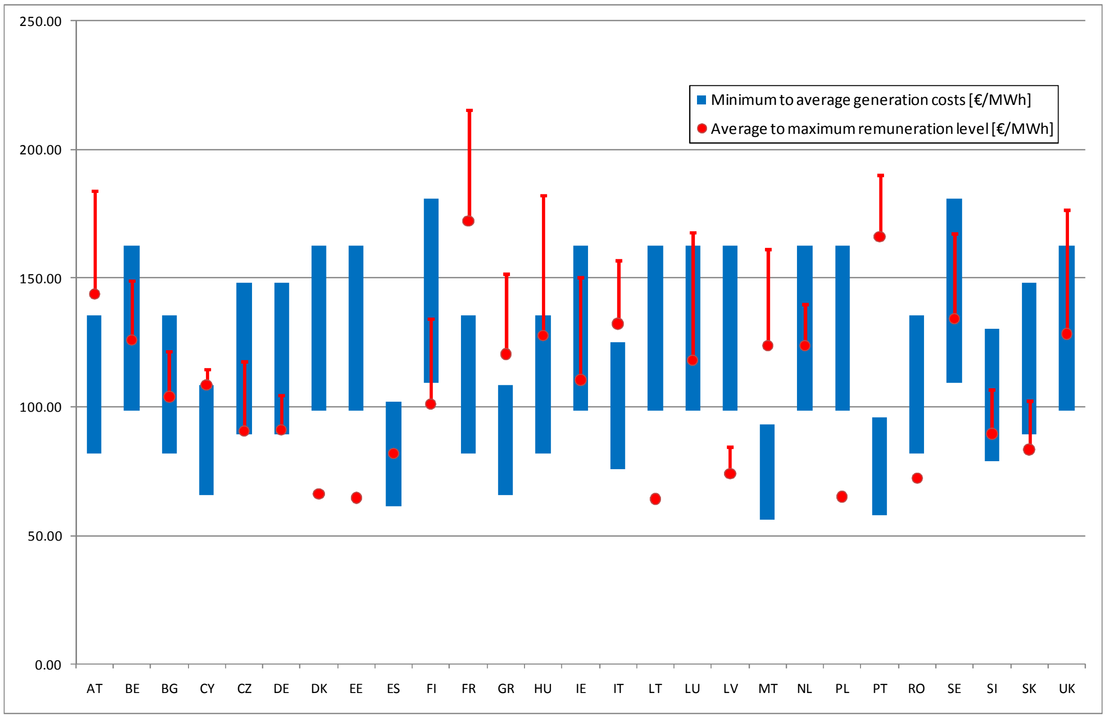


Figure 28: Support level ranges (average to maximum support) for solar thermal heating in the EU-27 MS in 2009 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs)

France, Portugal and Austria have the highest maximum remuneration for solar thermal heat with levels of 215 €/MWh, 188 €/MWh and 184 €/MWh respectively. In France, there is a regional feed-in premium in place for large-scale installations and an income tax and VAT reduction and a zero-interest loan for small-scale installations. Besides investment incentives, the promotion consists of a tax credit and a VAT decrease in Portugal. In Austria, solar thermal heat is promoted by a direct investment incentive and an income tax reduction.

There is no support in Denmark, Spain[19], Estonia, Lithuania, Poland, Romania and Slovakia. This leaves those countries at the price level of heat non-grid which is in the range of 64 €/MWh to 82 €/MWh.

[19] Again the building obligation in Spain is not accounted for in the efficiency indicator.

Figure 29 shows the range for the remuneration level for heat pumps and compares it with the minimum to average heat generation costs.

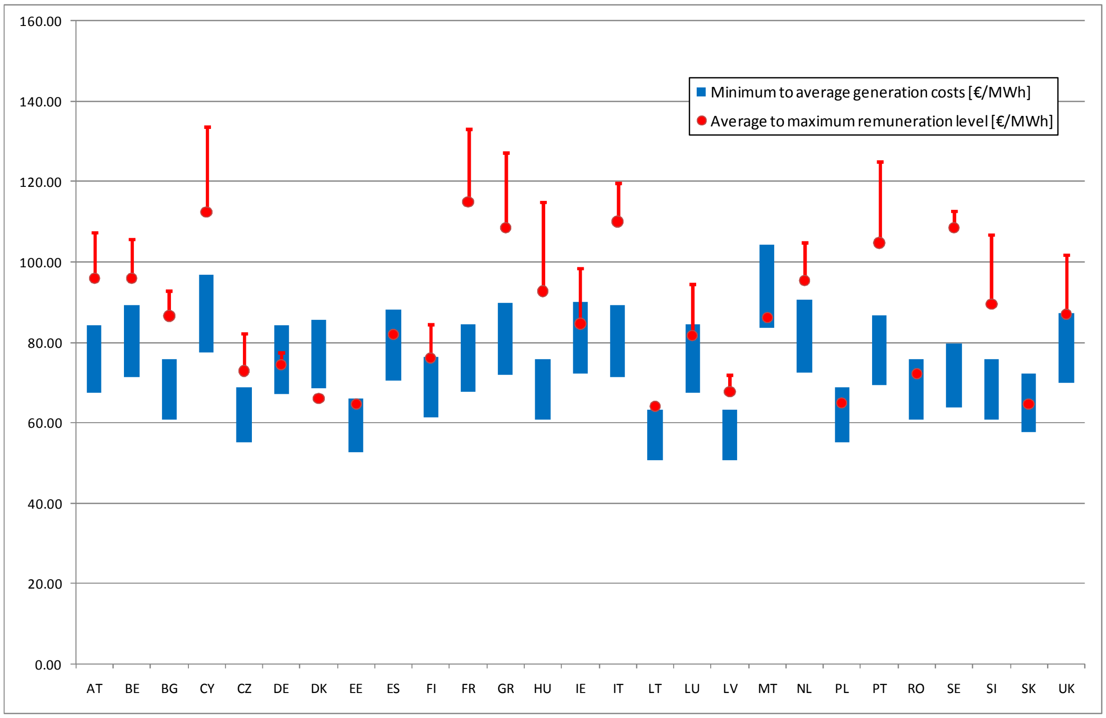


Figure 29: Support level ranges (average to maximum support) for heat pumps in the EU-27 MS in 2009 (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs)

It becomes evident from the figure above that France has the highest remuneration level in terms of the maximum and the average. Heat pumps are promoted by either a combination of an income tax, a VAT reduction and a zero-interest loan or by a regional feed-premium.

The remuneration level in Cyprus, Greece and Portugal is in the same range as France. No support schemes are in place in Denmark, Spain[20], Estonia, Lithuania, Malta, Poland, Romania and Slovakia. This leaves those countries at the price level of heat non-grid which is in the range of 64 €/MWh to 86 €/MWh.

2.6 Tax reduction for biofuel consumption in EU Member States

Since biofuels are assumed to be an internationally traded commodity in this case not the cost levels between Member States are compared with the remuneration / support levels, but only the support levels have been assessed. The support for biofuel consumption in EU Member States is often a combination of an obligation and tax reductions or only one of these two instruments is applied.

[20] Again the building obligation in Spain is not accounted for in the efficiency indicator.

In case of biofuel obligations the level of support is very difficult to assess since the prices implied by these obligations are typically not public (different to the case of quota systems in the electricity sector where TGC prices are generally transparent). Therefore we only show the level of tax reductions for biofuels in each Member State. This is shown in Figure 30 for the case of biodiesel. For some countries like Bulgaria, Finland and the Netherlands, only a tax reduction is applied. Other countries such as Germany apply a mixed support based on quota obligations and tax reductions, whereas tax reductions are subsequently phased out. The overall picture shows a rather homogenous level of support in terms of tax reduction among EU Member States. Figure 31 shows the level of tax reductions for the case of bio ethanol.

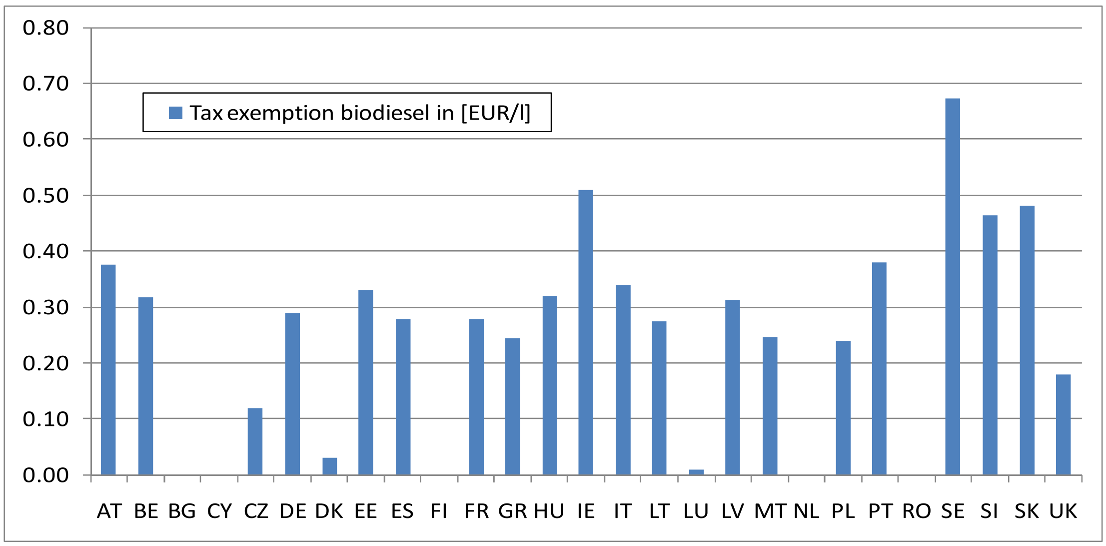


Figure 30: Level of tax reductions for biodiesel in the EU-27 MS in 2009

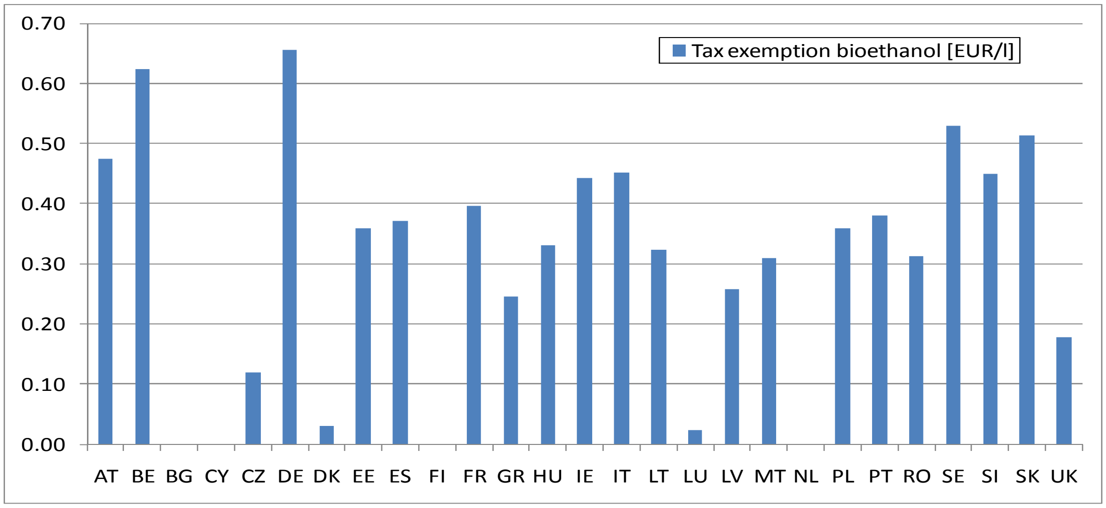


Figure 31: Level of tax reductions for bio ethanol in the EU-27 MS in 2009

3 Current and planned EU funding

The aim of section 3 is to give an overview on current and planned EU funding for renewable energy projects inside and outside the European Union. The following paragraphs present an overview on the different European bodies involved in financing RES employment and list specific funding programmes, pointing out the type of financial support, financial volumes, as well as eligible beneficiaries.

3.1 Current and planned EU funding inside the EU

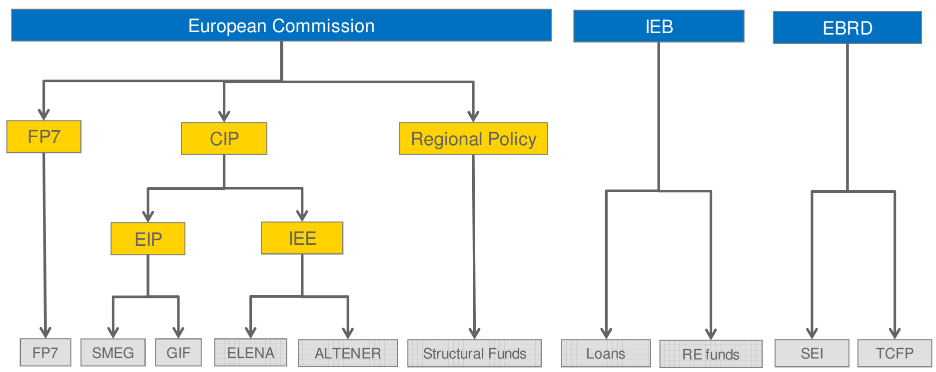


Figure 32 : Organization of the financing of Renewable Energy in Europe

Figure 32 depicts the organisation of the RES financing programmes within the EU. As will be seen in the following paragraph, the main portion of the available funding is dedicated to large scale investments through the European Funds funds (particularly ERDF and CF) of the EC and the European banks: IEB and EBRD.

The suitability of a given financing instrument depends on the respective stage of maturity a RES technology or project has reached. For instance, a feed-in system has proven to be very successful in fostering market diffusion, while being rather inappropriate for supporting projects in an R&D or pilot plant phase. Figure 33 gives an overview on the different financing instruments that can be used in each phase of RES technology and project development.

Shortcomings in financing the development of RES have been identified for both, the project as well as the technology dimension. On the project side, it seems that the small and medium sized renewable energy projects have difficulties to access bank financing, especially during the project start-up phase. The new ELENA instrument partly bridges this gap. On the technology side, the pre-commercialisation and the commercialisation phases may need further financial instruments. Emerging financial instruments, such as guarantees, venture capital or mezzanine finance will be described and evaluated in chapter 5.

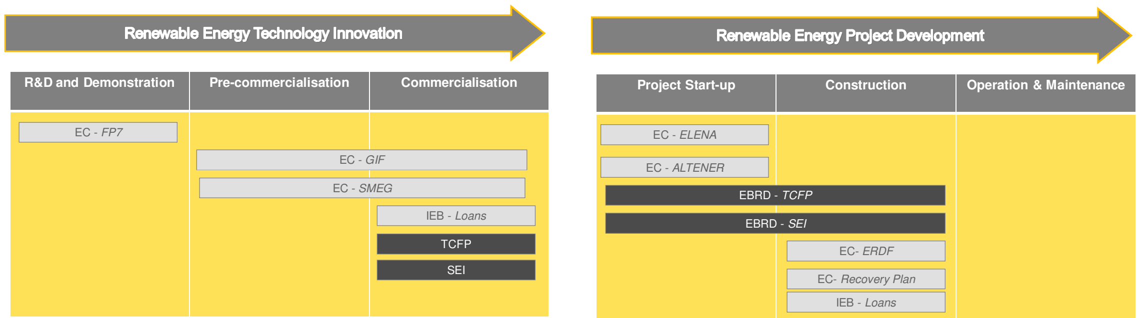


Figure 33: Renewable Energy Finance Continuum

Table 10 shows the main financing instruments existing within the EU for the development of RES projects and Technologies.

ECOFYS

Table 10: Different RES funding programmes in EU

Fund(s) of	Programme	Programme total budget	Budget allocated for RE in 2008	Budget allocated for RE in 2009	Main Financing instruments	Expected expanditure (until 2020)	Countries	RE Technologies	Types of projects funded
EBRD	**SEI** (Sustainable Energy Initiative)	SEI phase 1 results (2006-2008) : € 362 million signed for SEI 2 (Sustainable energy - RE and EE-credit line) € 227 million signed for SEI 4 (Renwable energy) => **€ 277 million signed in RE sector**	€ 141 million (SEI4)	€ 138 million (SEI4)	- Credit lines : loans through local banks - Long-term debt financing / Equity Investment / Senior Loans	SEI phase 2 (2009-2011) : RE financing > € 500 million	EBRD Countries	Wind, Hydro	RE installations investments/ Credit lines
EBRD	**TCFP** (Technical Cooperation Funds Programme)	NA	€ 12 million	-	Grant co-financing and TC grants	-	EBRD Countries	RE&EE	Pre-development phase
EC	**IEE > ELENA** (European Local Energy Assistance)	2007 - 2013 : € 150 million	0	€ 15 million	Grant support	€ 30 million / year or more	EU Member States, Norway, Iceland, Liechtenstein and Croatia.	RE / EE / Urban Transport	Technical Assistance - Project development
EC	**IEE** (Intelligent Energy Europe)	2007-2013 : € 730 million (total EIE Budget) of which € 78 million in 2008 and € 96 million in 2009	€ 19 million	NA	Grant support	Not yet decided	EU Member States, Norway, Iceland, Liechtenstein and Croatia.	RE-E / RE - H&C / RE - CHP / Biofuels	Capacity building
EC	**FP7** (Seventh Framework Programme)	Total budget for the period of 2007-13: € 50 billion, **including € 1 billion for Renewable Energy**	€ 150 million	€ 150 million	Grant support	€ 150 million / year until 2013.	EU Members States	RE & EE	R&D and Demonstration
EC	**EU Recovery Plan**	Total budget for 2009-2010 : € 5 bn, including **Offshore wind energy (€565 million)**	0	€ 565 million	Grant support	€ 565 million in 2009-2010	EU Members States	RE	RE installations investments
EC	**EIP > GIF** (High Growth and Innovative SME Facility)	2007 - 2013 : € 550 million. The part of this budget which is allocated to RE is not available.	€ 79 million	€ 79 million	Venture Capital	€ 79 million per year on average until 2013	EU Member States, Norway, Iceland, Liechtenstein and candidate countries for enlargement.	NA	Early and expansion stage companies
EC	**EIP > SMEG** (SME Guarantee Facility)	2007 - 2013 : € 506 million. The part of this budget which is allocated to RE is not available.	€ 72 million	€ 72 million	Guarantees	€ 72 million per year on average until 2013	EU Member States, Norway, Iceland, Liechtenstein and candidate countries for enlargement.	NA	Early and expansion stage companies
EC	**ERDF** (European Regional Development Fund) and **CF** (Cohesion Fund)	2007-2013 : € 4,760 million.	€ 680 million	€ 680 million	NA	€ 680 million per year on average until 2013	EU Member States.	Biomass, hydroelectric, geothermal, solar and wind	RE installations investments
EIB	NA	NA	NA	€ 2,800 million	Loan and framework loans	NA	Mainly EU Member States	Mainly wind, hydroelectric and solar PV	RE installations investments

Note: The budget displayed for ERDF also includes Cohesion funds

3.1.1 Regional Policy: The European Regional Development Fund (ERDF) and the Cohesion Fund (CF)

The EU MS decided to reduce the gaps in development and disparities of well-being between their citizens and between the regions. A goal is to make the EU the most competitive and knowledge-driven economy by 2010. The policy that will support achievement of this goal is the European cohesion policy. The European cohesion policy supports the regions through the financial instruments called the European Funds.

The European Funds
1. The Structural Funds
– European Regional Development Fund (ERDF) – European Social Fund (ESF)
2. The Cohesion Fund

Note that the European Funds are often simply called the Structural Funds.

The regulation on the ERDF defines its role and fields of interventions as the promotion of public and private investments to help reduce regional disparities across the Union.
The detailed management of programmes which receive support from the Structural Funds is the Member States' responsibility. For every programme, they designate a managing authority (at national, regional or other levels) which will inform potential beneficiaries, select the projects and generally monitor implementation.

The expenditure planned by ERDF and CF on RE for the 2007-2013 period amounts 4,760 M€. This represents a total of 680 M€ per year. The breakdown of this expenditure per sector is presented in the figure below:

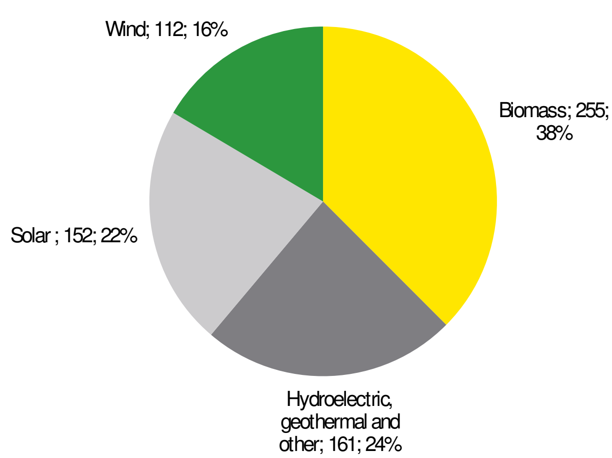


Figure 34: Estimated ERDF and CF expenditure on RES per sector in 2009 (source: ERDF and CF, E&Y)

For information, this breakdown is based on the planned expenditures under the ERDF and CF programmes 2007-2013 (http://ec.europa.eu/regional_policy/policy/reporting/cs_reports_en.htm). As a consequence, the data above is calculated as 1/6 of the total planned expenditure.

Biomass energy is the main beneficiary of ERDF and CF funding where the others sectors benefit from roughly the same support, e.g. around 200 M€.

As shown in the figure below, the three main countries benefiting from ERDF and CF funding on RES are Italy, Poland and the Czech Republic, totalising half of the total expenditure.

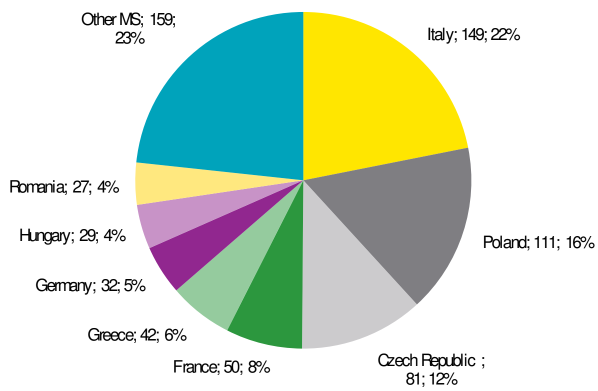


Figure 35: ERDF and CF expenditure on RES per sector in 2009 (source: ERDF and CF, E&Y)

Even if the expenditures linked to this innovative instrument are not significant within ERDF and CF expenditures, it is worth analyzing the new instrument JEREMI (Joint European Resources for Small and Medium-sized Enterprises) for its leverage potential in SME finance and in particular those in RE sector.

JEREMI offers EU MS to use part of their structural funds to finance SME by means of equity, loans or guarantees through a **revolving Holding Fund**.

JEREMI does not target SME directly but financial intermediaries that will provide loans and equity participation to SME. It actually works as a multiplier to leverage private funds through risk sharing. This innovative programme allows reducing the dependence of SME towards grants.

Besides, the Holding Fund is of a revolving nature, receiving repayments from the financial intermediaries for further investments in the SME sector. This makes SME support via EU Structural Funds sustainable

Because of the financial crisis and the need for grants by RE projects, JEREMI has a slow start-up but begins a speed roll-out development.

Eventually, to respond to the economic crisis, the ERDF regulation was amended in May 2009. Up to 4% of national ERDF amounts can now be invested on energy efficiency and renewable energies in residential buildings throughout all the 27 Member States. This adds a potential 8 billion euro to the above allocations, depending on to what extent the Member States will choose to use these new possibilities. Furthermore, a new amendment was recently adopted, in June 2010, to the Cohesion Policy General Regulation, in order to facilitate the use of financial engineering instruments to promote sustainable energies in buildings, including residential buildings.

In additional to the traditional support through grants, Structural Funds can also provide other forms of financing such as equity investments, loans, guarantees or their combination. Financial engineering instruments have acquired a new emphasis in the current programming period, namely through specific provisions in legislation made to promote the use of these instruments and a stronger association of the IFIs, in particular the EIB/the EIF into the development and implementation of some products. Focused on enterprises (primarily SMEs) and urban development funds, including renewable energy investments, the focus was further strengthened recently to energy efficiency and use of renewable energy sources in buildings, including existing ones. Financial engineering instruments based on repayable assistance offer a more sustainable alternative compared to grant assistance and bring leverage effect since Structural Funds can be combined with complementary sources of investment in order to boost resources and provide support to a larger number of projects. Member States can benefit from the expertise from the banking and private sectors and so enhance the effectiveness of their investments. JEREMIE is joint initiative developed by the Commission together with the EIF/EIB for the 2007-2013 programming period to improve access to finance for SMEs and new business creation through financial engineering instruments. Total amount of funds legally committed under JEREMIE holding fund agreements exceeds EUR 3.1 billion, of that EUR 1.1 billion is managed directly by the EIF. Many Member States and regions are implementing JEREMIE with national and regional financial institutions acting as holding funds and there are also financial engineering instruments for SMEs implemented without holding funds in other regions. The JESSICA initiative - Joint European Support for Sustainable Investment in City Areas - was designed to support investment in sustainable urban development and regeneration, to which the promotion of renewable energies and related infrastructures is inherent. To date, seven JESSICA funds with an energy component are implemented in six Member States, committed to invest a total of EUR 784m in energy efficiency measures and renewable energies infrastructure in cities. For example, a JESSICA Holding Fund for London (UK) was set-up to invest EUR 110m of Structural Funds in urban projects with a focus on waste-to-energy and decentralised energy schemes.

3.1.2 The Seventh Framework Programme (FP7)

The Seventh Framework Programme bundles all research-related EU initiatives together under a common programme. The FP7 is playing a critical role in reaching the goals of growth, competitiveness and employment. It is one of the tools to reach the European Union’s Lisbon objective to become the “most dynamic competitive knowledge-based economy in the world". The programme will last for seven years from 2007 until 2013 and has a total budget of over € 50 billion. It is divided in 4 main specific programmes:

- The Cooperation Programmes: EUR 32,413 million;
- The Ideas Programmes: EUR 7,513 million;
- The People Programmes: EUR 4,750 million;
- The Capacity Programmes: EUR 4,097 million.

The Cooperation programmes will be devoted to supporting cooperation between universities, industry, research centres and public authorities throughout the EU and beyond. The Cooperation programme is sub-divided into ten distinct themes, one of them is Energy (2,300 MEUR). The Energy theme covers: hydrogen and fuel cells, renewable electricity generation, renewable fuel production, renewables for heating and cooling, CO2 capture and storage technologies for zero emission power generation, clean coal technologies, smart energy networks, energy efficiency and savings, knowledge for energy policy making.
It is expected that renewable energies will cover 45% of the energy sector total budget: around EUR 1,035 million between 2007 and 2013 (€ 150 million per year on average).
The FP7 Energy Theme is managed by DG RTD and DG Energy. The latest statistical overview of the implementation of the FP7 Energy Theme is presented below (data extracted from the CORDA database on 8.10.2009).

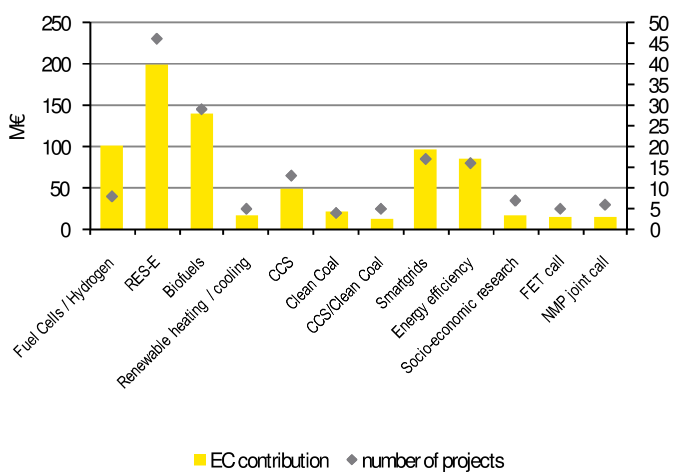


Figure 36 : Number of projects and EC contribution under the FP7 Energy Theme (8.10.2009). Source: Statistical overview of the implementation of the FP7 Energy Theme

In the FP7 Energy theme, 45 % of the EC contribution has been dedicated to renewable energies (RES-E, Biofuels, Renewable heating/cooling). 11% of the total funding was addressed to Energy Efficiency projects.

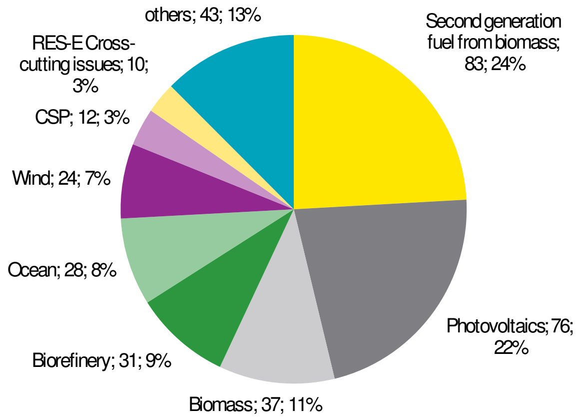


Figure 37 : EC funding for renewable energies (€M). Source: Statistical overview of the implementation of the FP7 Energy Theme

At the end of 2009, second generation fuel from biomass and photovoltaics were the most subsidized technologies.
There is a huge financing need during the early-stage of RE technology development that EC only partially covers. Indeed, the demand for grant under the FP7 Energy Theme of the renewable energy activities is between six and eight times higher than the EC contribution according to the statistical overview of the implementation of the FP7 Energy Theme.

Entrepreneurship and Innovation Programme (EIP)
Two financial instruments have been developed by the EIP: High Growth and Innovative SME Facility (GIF 1 & GIF 2) and SME Guarantee Facility (SMEG). GIF 1 and 2 are capital risk instruments, while SMEG is a guarantee instrument. The budget for 2007-2013 of the former is €550 million, and €506 millions for the latter. Those CIP financial instruments are not directly available to SMEs but implemented by the European Investment Fund (EIF) and selected financial institutions. For GIF, EIF invests in funds focused on early and expansion stage of specialized sectors, particularly eco-innovation. In this "eco-innovation" group, some companies are likely to be in one of the renewable energy technologies. The total amount dedicated to renewable energies can not be estimated, however it should not be very significant. Concerning the SMEG scheme, around 5% of the total budget would be allocated to "eco-innovation" (including some renewable energy companies). Similarly to GIF, the total amount dedicated to renewable energies can not be estimated, but it should not be very significant.

3.1.3 Competitiveness and Innovation Framework Programme (CIP)

3.1.3.1 IEE

The IEE Program is a part of the CIP. It aims at being a catalyst for innovation and
The IEE Programme is a part of the CIP. It aims at being a catalyst for innovation and new market opportunities. It is therefore aiming at market development and capacity building and not hardware investment or R&D. IEE Programme raises awareness on new market transformations.

The 2009 funding areas of IEE are the following:

- Energy Efficiency;
- **RE sources** ("ALTENER" priority);
- Mobility;
- Local Leadership;
- Special initiatives.

The IEE Program is implemented largely by means of two main instruments:

- Grants : Grant agreements / Direct Grant;
- Procurement.

The IEE Programme finances different initiatives: usual projects, and specific initiatives such as "Covenant of Mayors", ELENA, Mangenergy.
The "usual" projects financed in 2008 in the field of RE concern €19 millions distributed as follows:

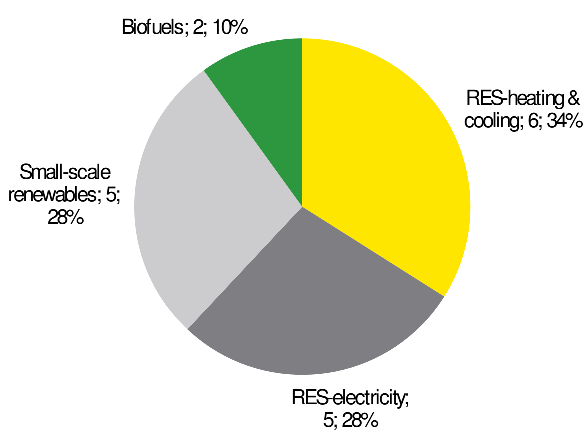


Figure 38 : Distribution of "usual" projects financed by IEE programme per RE technology in 2008 (source: IEE)

Usual projects aim at raising awareness in European territories (example of projects : Developing a target-group-specific financial scheme with experts overcoming financial barriers in geothermal projects ; enhancing proactive land valorisation policies within a strategic eco-sustainable approach to local developments, promotion of Renewable Energy for Water production through Desalination, …).

The average size of a usual project is €1 million.
Financed projects have to involve a minimum of 3 different countries per project and the average number of countries involved in one project is around 7 or 8.

3.1.3.2 ELENA

ELENA is a new initiative of EC-EIB to support cities and regions through technical assistance during the preparatory phase of a RE project. For now, no project were funded through ELENA, a few projects are being studied.
ELENA gives support to Final Beneficiaries with:

- Feasibility studies;
- Additional technical staff;
- Technical studies;
- Procurement/tendering;
- Financial structuring (identify potential lenders, appropriate financial instruments to mobilize, …).

ELENA is managed by EIB and funded by EU budget (CIP/IEE programme). It support covers up to 90% of the costs associated with technical assistance for preparing large sustainable energy investment programmes in cities and regions, which may also be eligible for EIB or other banks funding. The investment leverage required is a ratio of 25.

ELENA bridges a gap for RE projects that has difficulties having access to private sector finance. It acts as a catalyst in preparing a future investment program.
ELENA budget for 2009 was only €15 million but, depending on its success, it might improve rapidly.

3.1.4 EU Recovery Plan

The European Parliament passed the €5 billion European Union (EU) Economic Recovery Plan on 6 May 2009, which will see investment in energy projects, broadband internet infrastructure and rural development. In the energy sector, 3 activities are concerned:

- Gas and electricity infrastructure (€2.365bn);
- Offshore wind energy (€565 million);
- Carbon capture and storage (CCS) projects (€1.05bn).

The budget will be allocated in 2009 and 2010 for the selected projects. For the Offshore wind energy, 9 projects representing €565 million have been selected. These projects will be implemented in Germany, Sweden, Denmark, The Netherlands, Denmark, United Kingdom and Belgium.

3.1.5 EIB

Sectoral scope

Since 2006, EIB spending on RE has strongly increased (from € 0.5 bn to 2.8 bn in 2009). Renewables represent about a third of EIB's total energy spending (11 bn within Europe in 2009). The rest is conventional energy capacities, transmission, etc.

As shown in the figure below, sectors of EIB's intervention in renewable energy cover all mature technologies:

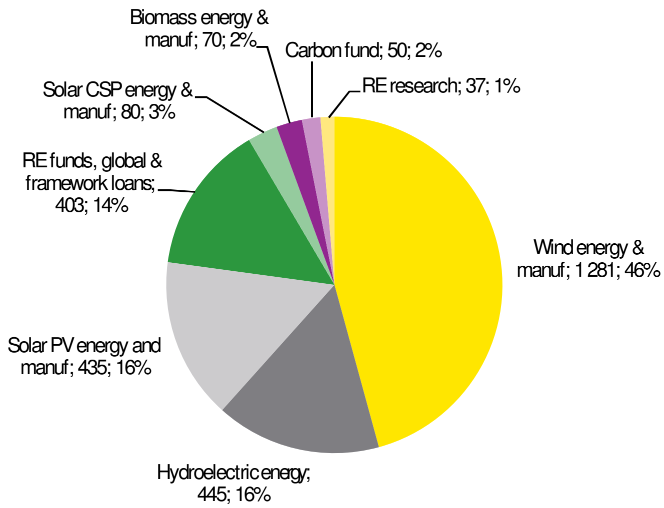


Figure 39 – EIB expenditure per RE sector in 2009, in M€ (source: EIB, E&Y)

For information, this breakdown is based on the EIB project pipeline (http://www.eib.org/projects/loans/). The projects taken into account for 2009 are the projects for which the loan has been signed in 2009.

Wind was the principal sector funded by EIB in 2009, with 1.28 billion euros representing 46% of total EIB expenditure on RE that year. Hydroelectric energy and solar PV energy rank after wind energy with 16% of total RE EIB expenditure each. Solar CSP and biomass energy remain behind with around 5% of total EIB expenditure on RE in 2009.

Key words of EIB's intervention in the sector are « clean, secure, competitive ». Their goal also includes setting the trend to decrease the cost curves of emerging technologies.

The EIB has also provided credit lines to banks and financial institutions to help them provide finance to small and medium-sized enterprises or public institutions active on various RE projects, including wind, solar PV and biomass.

Other minor investment sectors are EIB carbon fund of 50 M€ (purchase of carbon credits) and a 185 M€ loan attributed to Acciona's Research, Development and Innovation programme.

Geographic scope

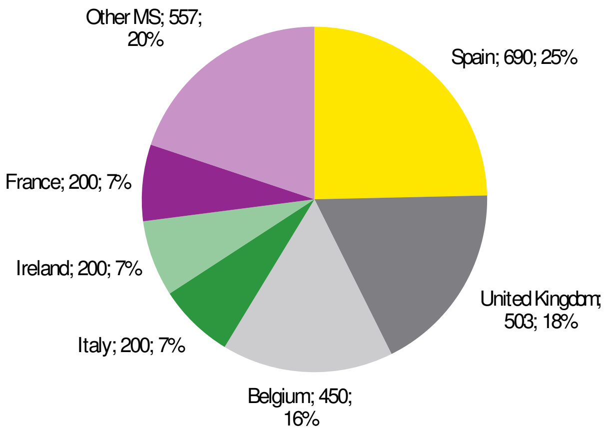


Figure 40 – EIB expenditure on RE per country in 2009 (source: EIB, E&Y)

90% of spending of EIB on RE is done within EU. The main beneficiaries were Spain, UK, Belgium, Italy and Ireland benefiting from almost three quarters of EIB expenditures in 2009.

Main EIB instruments for RES funding

The EIB normally finances projects up to 50% of investment costs; however, exceptionally the EIB is willing to provide a larger percentage for renewable energy projects and projects making a significant contribution to energy efficiency.

Financing may be combined with EU grants depending on the scope and definition of the individual project. Debt tenors are usually 12-15 years.

Other financing instruments include infrastructure investment funds through which the EIB indirectly participates in companies and projects promoting EU priority objectives in energy and renewable energy projects.

Equity and quasi equity is also offered as the Lisbon Treaty provides the EIB with more latitude to offer equity to project proponents EIB is a limited partner (LP) in 15 infrastructure funds (not limited to renewables). Recently EIB invested in the "Marguerite" fund for energy, climate change and infrastructure. This is a joint fund of the EIB, the Caisse des Dépôts (France), the Cassa Depositi e Prestiti (Italy), KfW (Germany), the Instituto de Crédito Oficial (Spain) and the Powszechna Kasa Oszczednosci Bank Polski (Poland). It is aiming at providing finance for the implementation of strategic EU policy objectives and projects in the energy, climate change and transport sectors. The Marguerite Fund is part of the European Economic Recovery Plan.

Furthermore, EIB purchases carbon credits and manages carbon funds (6 in total), including:

- EIB/EBRD fund focused on JI;
- EIB/KfW funds : 2 funds, fully committed;
- WB carbon fund;
- EIB post 2012 facility (80% committed);
- Moroccan Carbon Fund.

Eventually technical assistance with a renewable energy focus is offered through the facilities described below:

- Technical assistance accompanying the Bank's lending is offered together with the European Commission, under the so-called European Energy and Climate Change Initiative. This aims to finance energy efficiency and renewable energy projects within the EU, with a focus on SMEs and municipalities;
- The European Strategic Energy Technology Plan (SET-Plan) is designed to accelerate the development and use of cost-effective low-carbon technologies. It offers grants for technical assistance and advisory services from the Cohesion Policy Funds plus access to flexible financing lines together with the provision of loan financing from the EIB;
- European Local Energy Assistance (ELENA) described above is an EU technical assistance facility managed by the EIB, which aims to accelerate the preparation and implementation of energy efficiency and renewable energy projects developed by municipalities, regions and other local authorities. The Commission's ELENA Facility may also cover technical assistance expenses with grants.

Expected developments in EIB's activity

EIB's Corporate Operational Plan (COP) for the next 3 years (2010-2012) highlights 2 key objectives:

- 25% of total lending should be related to Climate Change (RE, EE, Transport, etc.);
- 20% of all energy financing should be dedicated to renewables (this target is already achieved).

Currently the EIB plays a strong role on the market as the credit market is holding back RE projects, but the EIB is not inexhaustible. State-owned banks should also do the effort to get more involved in RE financing.

The EIB on its side could also contribute to catalyzing private equity. The EIB encourages the Commission to support the risk-sharing facility. It can be a very good multiplier of money invested in this facility.

The EIF also has a Venture Capital activity in the sector but which is not much developed yet.

3.1.6 EBRD

Sectoral scope

The EBRD supports Renewable Energy projects from Central Europe to Central Asia mostly through the Sustainable Energy Initiative (SEI). The SEI, launched in 2006, responds to specific needs of the energy transition in the EBRD countries of operation[21] : regulatory frameworks not in place in many countries, preferential tariffs not always adequate, problematic grid access, technical and financial skills gaps.

The first phase of SEI ended up in 2008 with an amount of investments of € 2,7 billion (above its original targets) in the following categories:

- SEI 1 : Industrial energy efficiency;
- **SEI 2 : Sustainable Energy credit lines;**
- SEI 3 : Cleaner energy production;
- **SEI 4 Renewable energy;**
- SEI 5 municipal infrastructure energy efficiency.

SEI 2 and SEI 4 fall under the scope of « renewable energy financing ».

During the first period of SEI implementation (2006-2008), 10% of investments were signed in the Renewable Energy sector[22] that is to say **€277 million over 3 years**.

Through **SEI 4**, The EBRD works with developers and governments to support the effective development of renewable energy projects for generation of electricity and heat. In 2008, the following investments were signed:

Table 11: Investments assigned in 2008

Type of RE	Tech.	Allocated budget (M€)	Signed in	Instruments	Countries
RES-E	Wind	70	2008	Long-term debt financing	Bulgaria
RES-E	Wind	1	2008	Equity investment	Estonia
Small scale	All	70	2008	Senior loans	Bulgaria, Slovak Republic, Ukraine, Georgia

Through **SEI 2**, The EBRD promotes sustainable energy through targeted credit lines to local banks called Sustainable Energy Financing Facilities (SEFFs). Every credit line is supported by a comprehensive free-of-charge technical assistance package. The part of investments dedicated to renewable energy is low.

[21] Albania, Armenia, Azerbaijan, belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Former Yugoslav Republic of Macedonia, Georgia, Hungary, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Moldova, Mongolia, Montenegro, Poland, Romania, Rusia, Serbia, Slovak Republic, Slovenia, Tajikistan, Turkey, Turkmenistan, Ukraine, Uzbekistan

[22] Source : Terry McCallion presentation : « EBRD : Mainstreaming Energy efficiency across banking operations » (Moscow, 29th April 2009)

Expected developments in EBRD's activity

Bulding on this first experience, SEI phase two objectives for the period 2009-11 include:

- EBRD SEI financing target range of €3 to 5 billion for total project value of €9 to 15 billion : the same rate of investments in the RE sector as during the first period can be expected, that is to say **€500 million over the 3 years**;
- Technical assistance grant funding of €100 million and investment grant funding target of €250 million for EE and RE projects.

In the RE sector, the priority is to finance standalone RE projects such as **wind and hydropower**. Besides, Bank will work in strengthening the institutional and regulatory framework for RE which remains weak in most countries.
In 2009, the following investments have been signed:

Table 12: Investments assigned in 2009

Type of RE	Tech.	Allocated budget (M€)	Signed in	Instruments	Countries
RE-H	Biomass	30	2009	Long-term debt financing	Pologne
RE-E	Wind	40	2009	Long-term debt financing	Bulgaria
RE-E	Wind	45	2009	Long-term debt financing	Turkey
RE-E	Wind	22,5	2009	Equity investment	Estonia
RE-E	Wind	0,5	2009	Equity Investment	Mongolia

3.2 Current and planned EU funding beyond the EU

The source of European expenditures on RES beyond the EU is twofold: on the one hand from Member State funds, on the other hand from EU instruments and programmes.
The information on significant spendings on Member State level can be found in Annex 3.2; not all countries indicate their expenditures in a consistent way, but the information available is summarized.

3.2.1 The European Neighbourhood Policy (ENP)

The European Neighbourhood Policy is aimed at the EU's neighbours, by land or sea: Algeria, Armenia, Azerbaijan, Belarus, Egypt, Georgia, Israel, Jordan, Lebanon, Libya, Moldova, Morocco, Occupied Palestinian Territory, Syria, Tunisia and Ukraine. For the period 2007-2013, 12 bio € of funding by the European Commission is available, which is supposed to support country programmes in neighbouring countries as well as regional and cross-border cooperation.
The Neighbourhood Investment Facility, aimed at mobilising additional funding for neighbouring countries of the EU, is one of the instruments to implement the ENP.

It combines two sources of funding: the European Commission earmarked 700 mio € for the period 2007-2013, the Member States made pledges for 47 mio € in addition. The focus of support is the infrastructure sector, including transport, energy, environment and social issues.
There is no split of resources regarding individual sectors; the budget is allocated on a case-by-case base to projects that apply for funding through a European public financing institution that has to be recognized as eligible by the NIF board. In 2009, 15% (15.6 mio €) of the NIF contribution to projects was distributed to energy projects, including an energy efficiency project, a hydropower project, and a project for a transmission network.

Expenditures through EU instruments and programmes are presented by Directorate General (DG).

3.2.2 DG ELARG

The focus of DG ELARG's work are the Western Balkans and Turkey. The Regional Programmes Unit in DG Enlargement manages the Instrument for Pre-Accessions Assistance (IPA) Multi-Beneficiary Assistance Programme for Candidate Countries and Potential Candidates (Albania, Bosnia and Herzegovina, Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Serbia as well as Kosovo under UNSCR 1244/99; Turkey). The current IPA Multi-Beneficiary Programme for 2009 is designed to address priority axes identified in the IPA Multi-Beneficiary MIPD 2009-2011.
Under Priority Axis 2: economic criteria, the scope of assistance in the energy sector is twofold:

1. Help beneficiaries promote investments in energy efficiency and renewable energy sources in order to improve the energy performance of building and industry sector, thereby offering opportunities for higher energy savings and reduction of CO_2 emissions;
2. Support the preparation of projects that maybe financed by grants and/or loans provided by the beneficiaries, the International Financial Institutions (IFIs), IPA resources, and other donors. Thus, IPA resources allocated to the energy sector are extensively combined with loans and credit lines from major IFIs and and/or pulled together into energy facilities to support EE and RES development via close cooperation with the IFIs.

The assistance is channelled into programmes and projects implemented at regional or horizontal level, i.e. aiming at facilitating regional cooperation among IPA beneficiaries or addressing common needs across several IPA beneficiaries. Given the peculiarities of the market in the target countries as well as the definition of priorities in the enlargement process, the renewable energy sector was added only recently to the energy efficiency windows in close cooperation with the IFIs. No specific focus on special technologies applies to the assistance.

There are two ongoing programmes under the IPA covering the energy sector

3. IPA 2009 Crisis Response Package
4. EEFF2007 - Energy Efficiency Finance Facility

The **IPA 2009 Crisis Response Package** is a Multi-Beneficiary Programme under the IPA Transition Assistance and institutional building component for the year 2009. The total IPA contributions amount to 85.45 mio €. Within this package, two funds cover the energy sector:

a) Green for Growth Fund

b1) Private Sector Support Facility for the Western Balkans (including an Energy Efficiency Window in cooperation with the EBRD and the EIB)

b2) Private Sector Support Facility for Turkey (including an Energy Efficiency Window in cooperation with the EBRD and the EIB)

Further details on the scope of financing lines (duration, objective, eligible beneficiaries type of investment) can be found in Annex 3.2.

The other programme is the **EEFF2007 - Energy Efficiency Finance Facility** under IPA 2007, which also is a Multi-Beneficiary Programme. This is a horizontal programme on the Energy Efficiency Finance Facility implemented in Joint Management with the EIB, the EBRD, CoE-Kfw. The total IPA contribution to EEFF2007 amounts to 34.7 mio €

Further details on the split can be found in Annex 3.2.

It is important to note that all above Facilities have been launched recently; most of the projects and sub-projects are therefore still under preparation. Thus it is difficult at this stage to estimate which types of sub-projects will be signed, in which sector exactly (EE or RE), which technology will be involved, and which amount out of the total Community contribution will be allocated to RES or/and EE projects. Each project may include an EE or/and RES component through approved sub-projects.

The overall budget on energy efficiency and renewable energies for the above actions is as follows:

Table 13: Overall budget for EE / RES through IPA (Source: DG ELARG 2010)

	Community Contribution mio €	**Total cost of the Action mio €**	**Expenditures already disbursed (2009)**	**Future expenditures**
EEFF2007 – CA with the EIB	13.50	67.5	9	4.5
EEFF2007 – CA with the EBRD	13.50	67.5	9	4.5
EEFF2007 – CA with Kfw- CeB	7.7	38.5	5	2.7
EEFF2007 - TOTAL	**34.7**	**165**	**23**	**11.7**
Energy Efficiency Window (Private Sector Support Facility) Western Balkan	31.5	141.5	15.5	16
Energy Efficiency Window (Private Sector Support Facility – Turkey	22.5	272,5	11.25	11.25
GFG	20	100	67,273	19.9
Total costs for EC Actions in the energy sector	**108.7**		**49.75**	**58.95**

DG Elarg is currently undertaking a comprehensive analysis of the financing needs/gaps in the energy sector, with a view to adapt future programming to the concrete needs of the energy market in Southeast Europe. This will take into account the actual impact of energy investments as well as the priorities to be addressed in the forthcoming years to efficiently support these countries in the implementation of their national strategies and action plans in the energy sector. The results of this ongoing process will most likely have a substantial impact on future programming and planned expenditures in Renewable Energy.

3.2.3 DG Energy

The aim of **Intelligent Energy Europe (IEE)** is to fund actions to improve the conditions for energy efficiency and renewable energy projects in Europe if market conditions are not favourable enough to develop the potential that lays in this area.
Within the second phase of IEE from 2007-2013, only EU Member States, Iceland, Norway, Liechtenstein and Croatia are eligible for projects. The clear focus of expenditures is the EU.

To be eligible for project support from IEE, countries beyond EU have to sign a memorandum of understanding (MoU). Currently there are discussions with several countries (e.g. Albania, Ukraine, Israel), but no further MoU have been signed so far.

3.2.4 DG DEV

DG Development is responsible for the programming of projects in developing countries, including projects with renewable energies. However, the funding is not done through DG Development. The implementation of DG Development's policy is done through EuropeAid / DG AIDCO. Thus, relevant projects running under DG DEV are included in the information about EuropeAid.

3.2.5 DG RELEX

As DG Development, the DG for external relations DG RELEX does not fund projects directly, but rather defines strategies. The EuropeAid Co-operation Office is responsible for the implementation of these policies and strategies.

3.2.6 DG AIDCO

The European Commission's EuropeAid Cooperation Office (DG AIDCO) is responsible for implementing the Commission's external aid instruments, both those funded by the Union's budget and the European Development Fund. DG AIDCO / EuropeAid is responsible for all the steps of an aid delivery project: identifying needs, carrying out feasibility studies, preparing the necessary financial decisions and controls and drawing up the required tendering, monitoring and evaluation procedures.
In principle, energy is not among the priority sectors of EuropeAid, as such projects usually have financial returns and loans are considered to be more appropriate for those projects; EuropeAid's aid usually is via grants. Therefore, to deal with energy projects n a global scale, EuropeAid uses the instrument of co-financing to support energy projects, including renewable energies.
There are two main funding lines within EuropeAid which are relevant for renewable energies:

1. Thematic Programme for Environment and Sustainable Management of Natural Resources including Energy (ENRTP)
2. Energy Facility

ENRTP

To rationalize and simplify the legislative framework for external actions of the Community, one of the new instruments is the Development Cooperation Instrument (DCI). The DCI includes a thematic programme for the environment and sustainable management of natural resources including energy (ENRTP). It will address the environmental dimension of development and other external policies as well as it will help promote the European Union's environmental and energy policies abroad. The European Commission adopted the ENRTP on 25 January 2006.

Of ENRTP's areas of priorities, the **Support for sustainable energy options in partner countries / regions and GEEREF** is the one under which RES projects can apply. It is endowed with a budget of 115.4 Mio €, so roughly one fourth of the total budget. The budget is split as follows:

Table 14: Indicative funding allocation to priority area 5 of ENRTP in mio € (Source: EC 2007)

	2007	2008	2009	2010	Total 2007-2010	Total 2011-2013	Total 2007-2013
Integration of sustainable energy; institutional support, creating favourable legislative/policy framework, energy for the poor, innovative financing, regional cooperation	7.9	9.1	11.3	12.1	40.4	43.5	**83.9**
Global Energy Efficiency and Renewable Energy Fund (GEEREF)	15	20	20	20	75	-	**75**
Total	**22.9**	**29.1**	**31.3**	**32.1**	**115.4**	**43.5**	**158.9**

Energy Facility

The Energy Facility (EF) was established in 2004 as financing instrument to implement the European Union Energy Initiative for Sustainable Development and Eradication of Poverty (EUEI). The Energy Facility is aimed at African, Caribbean and Pacific countries (ACP).

The Energy Facility is financed under the European Development Fund (EDF). The first Energy Facility (EF I) was created with a total budget of 220 mio €. Of this, 198 mio € were spent through a first call for proposals which took place in June 2006.

From this funding, around 65% went into projects in the field of energy production, transformation and distribution. 66% of these funds (43% of total funds) were allocated to "electricity generation, transformation, distribution", 9% (6% of total) to "energy for cooking" and 25% (16% of total) to "both electricity generation and energy for cooking) (EuropeAid 2009).

In the field of electricity generation, 44 projects were financed from the EF I. For the RES only projects, 78.15 mio € were contracted in 2007/2008, their implementation started in 2008/2009. The split of expenditures for all electricity generation projects can be seen in the following table

Table 15: EC contribution to electricity generation projects of EF I (Source: EuropeAid 2009)

	Projects	EC contribution	
		mio €	%
Renewable sources of energy only	34	78.15	71.2%
Hybrid systems (renewable / fossil)	9	26.96	24.5%
Fossil fuels only	1	4.71	4.3%
Total	44	109.82	100.0%

The second Energy Facility (EF II) will be financed under the tenth EDF. EF II is endowed with 200 mio € for the period 2009-2013 and an emphasis is set on the use of renewable energies and energy efficiency measures. 150 mio € of the total of 200 mio € will be distributed through two calls of proposals of which the first with 100 mio € took place in November 2009. The second one is foreseen for 2011. As this approach is very much driven by the proposals handed in, it is not possible to say which technologies and which countries will receive how much funding. However, from the proposals in the first call, it currently is expected that 90 – 95% will be spent on renewable energies (EuropeAid 2010). This would mean 135 – 142.5 mio € in the period 2009-2013, or 27 - 28.5 mio € per year.
The funding of projects through a next Energy Facility depends on the eleventh EDF, which can be expected around 2011. Currently, no statements about the amount of future expenditures for RES can thus be made.

3.2.7 European Investment Bank (EIB)

Expenditures from the European Investment Bank EIB focus largely on the EU. In 2009, 510 mio € were spent on RES projects beyond EU (EIB 2010). Seven projects in Nicaragua, Turkey, Egypt, Vanuatu, Panama, Iceland, and Pakistan were financed with the help of EIB.
The split of these expenditures on the single RES technologies can be seen in the following figure.

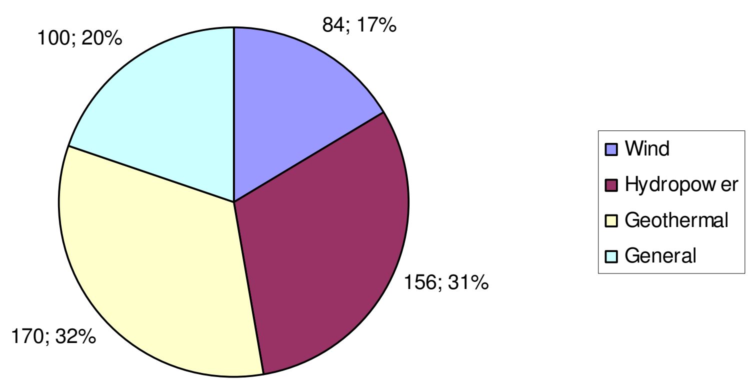


Figure 41: EIB expenditure beyond EU per RES sector in 2009, in mio € (Source: EIB 2010/Ecofys)

3.2.8 European Bank for Reconstruction and Development (EBRD)

In 2006, the Sustainable Energy Initiative (SEI) was launched by EBRD. Through this initiative, also renewable energy projects are financed through loans. In phase I of SEI from 2006 – 2008, 227 mio € were assigned to renewable energy projects. Of this, 121.9 mio € were assigned to projects beyond EU in Armenia, Georgia, Russia, Ukraine and regional programmes; three projects are in Bulgaria and Estonia (EBRD 2009).

3.2.9 Summary and conclusions

The focus of expenditures on RES beyond EU is twofold: on the one hand, projects in pre-accession countries can benefit from programmes under the Instrument for Pre-Accession (IPA); on the other hand, projects in developing countries are supported through EuropeAid's programmes.

The programmes under the IPA, the IPA 2009 Crisis Response Package and EEFF2007, Energy Efficiency Finance Facility, both include also renewable energies, but have been installed only recently and thus no information on the exact countries of projects or the split of technologies is available yet. For energy projects in general, 108.7 mio € are assigned of which 49.75 mio € have been disbursed in 2009.

EuropeAid's expenditures are allocated primarily through the Thematic Programme for Environment and Sustainable Management of Natural Resources including Energy (ENRTP) and the Energy Facility. Under ENRTP, 158.9 mio € are allocated for sustainable energy options and GEEREF until in the period 2007-2013. The Energy Facility which is financed under the European Development Fund was endowed with 220 mio € until 2008 of which 78.15 mio € were spent for renewable energy projects. The second Energy Facility is currently allocating its budget through two calls for proposals with a clear focus on renewable energies.

4 Cost scenarios for 2020 RES objectives

The **aim of this section** is to provide valuable estimates of the cost for reaching the 2020 RES objectives in the European Union as well as at MS level. A set of policy scenarios on the future deployment of RES technologies within the European Union up to 2020 has been calculated with the well-proven Green-X model. Besides analysing the consequences of policy choices on RES support instruments we focus in this model-based scenario assessment on the illustration of the impact of proactive risk mitigation measures to alleviate the financing of the necessary RES deployment.

Subsequently, depicted results provide details on the future development of technology-specific investment and generation cost, and a sound depiction of the required corresponding expenditures (i.e. capital – and support (consumer / societal) expenditures).

4.1 Methodology and key parameters

4.1.1 The policy assessment tool: the *Green*-X model

As in previous projects such as FORRES 2020, OPTRES or PROGRESS the Green-X model was applied to perform a detailed quantitative assessment of the future deployment of renewable energies on country-, sectoral- as well as technology level. The core strength of this tool lies on the detailed RES resource and technology representation accompanied by a thorough energy policy description, which allows assessing various policy options with respect to resulting costs and benefits. A short characterization of the model is given below, whilst for a detailed description we refer to www.green-x.at.

Short characterisation of the Green-X model

The model Green-X has been developed by the Energy Economics Group (EEG) at Vienna University of Technology in the research project "Green-X – Deriving optimal promotion strategies for increasing the share of RES-E in a dynamic European electricity market", a joint European research project funded within the 5th framework programme of the European Commission, DG Research (Contract No. ENG2-CT-2002-00607). Initially focussed on the electricity sector, this tool and its database on RES potentials and costs have been extended within follow-up activities to incorporate renewable energy technologies within all energy sectors.

Green-X covers geographically the EU-27, and can easily be extended to other countries such as Turkey, Croatia or Norway. It allows to investigate the future deployment of RES as well as accompanying cost – comprising capital expenditures, additional generation cost (of RES compared to conventional options), consumer expenditures due to applied supporting policies, etc. – and benefits – i.e.

contribution to supply security (avoidance of fossil fuels) and corresponding carbon emission avoidance. Thereby, results are derived at country- and technology-level on a yearly basis. The time-horizon allows for in-depth assessments up to 2020, accompanied by concise outlooks for the period beyond 2020 (up to 2030).

Within the model, the most important RES-Electricity (i.e. biogas, biomass, biowaste, wind on- & offshore, hydropower large- & small-scale, solar thermal electricity, photovoltaics, tidal stream & wave power, geothermal electricity), RES-Heat technologies (i.e. biomass – subdivided into log wood, wood chips, pellets, grid-connected heat -, geothermal (grid-connected) heat, heat pumps and solar thermal heat) and RES-Transport options (e.g. first generation biofuels (biodiesel and bio ethanol), second generation biofuels (lignocellulotic bio ethanol, BtL) as well as the impact of biofuel imports) are described for each investigated country by means of dynamic cost-resource curves. This allows besides the formal description of potentials and costs a detailed representation of dynamic aspects such as technological learning and technology diffusion.

Besides the detailed RES technology representation the core strength of the model is the in-depth energy policy representation. Green-X is fully suitable to investigate the impact of applying (combinations of) different energy policy instruments (e.g. quota obligations based on tradable green certificates / guarantees of origin, (premium) feed-in tariffs, tax incentives, investment incentives, impact of emission trading on reference energy prices) at country- or at European level in a dynamic framework. Sensitivity investigations on key input parameters such as non-economic barriers (influencing the technology diffusion), conventional energy prices, energy demand developments or technological progress (technological learning) typically complement a policy assessment.

4.1.2 Overview on key parameters[23]

Table 16: Main input sources for scenario parameters

Based on PRIMES	Defined for this study
Sectoral energy demand	20% target
Primary energy prices	Reference electricity prices
Conventional supply portfolio and conversion efficiencies	RES cost (Green-X database, incl. biomass)
CO_2 intensity of sectors	RES potential (Green-X database)
	Biomass import restrictions
	Technology diffusion
	Learning rates

[23] For a detailed representation of key parameter and assumptions we refer to corresponding Appendix to this chapter of the report.

In order to ensure maximum consistency with existing EU scenarios and projections the key input parameters of the scenarios presented in this report are derived from PRIMES modelling and from the Green-X database with respect to the potentials and cost of RES technologies (see section 1). Table 16 shows which parameters are based on PRIMES and which have been defined for this study. More precisely, the PRIMES scenarios used are:

- The Baseline Scenario as of December 2009 (NTUA, 2009);
- The Reference Scenario as of April 2010 (NTUA, 2010)

With the exception of the BAU scenario, the default reference for this prospective RES policy assessment represents the recently derived PRIMES reference case.
For a detailed representation of key parameter and assumptions, we refer to the corresponding Appendix to this chapter of the report.

4.1.3 Interest rate / weighted average cost of capital - the role of (investor's) risk

In line with the focus of this study, specific attention is dedicated in the model-based assessment to research the impact of investor's risk on RES deployment and corresponding (capital / support) expenditures. In contrast to the complementing detailed bottom-up analysis of illustrative financing cases performed with the Ecofys cashflow model (see section 6 and Annex), Green-X modelling aims to provide the aggregated view at the national and European level with less details on individual direct financing instruments. More precisely, debt and equity conditions as resulting from particular financing instruments are incorporated in the model-based assessment by applying different weighted average cost of capital (WACC) levels. The impact of this on the required expenditures for achieving the Member States 2020 RES targets can then however be clearly illustrated by means of sensitivity investigations to the assessed RES policy paths.

Table 17: Example of value setting for WACC calculation

WACC methodology	**Abbreviation / Calculation**	**High risk assessment** Debt (d)	Equity (e)	**Low risk assessment** (proactive risk mitigation) Debt (d)	Equity (e)
Share equity / debt	g	70.0%	30.0%	70.0%	30.0%
Nominal risk free rate	r_n	4.0%	4.0%	4.0%	4.0%
Inflation rate	i	2.0%	2.0%	2.0%	2.0%
Real risk free rate	$r_f = r_n - i$	2.0%	2.0%	2.0%	2.0%
Expected market rate of return	r_m	4.3%	8.4%	3.9%	7.7%
Risk premium	$r_p = r_m - r_f$	2.3%	6.4%	1.9%	5.7%
Equity beta	b		1.6		1.6
Tax rate (corporation tax)	r_t		30.0%		30.0%
Post-tax cost	r_{pt}	3.0%	12.2%	2.7%	11.1%
Pre-tax cost	$r = r_{pt} / (1-r_t)$	4.3%	17.5%	3.9%	15.9%
Weighted average cost of capital (pre-tax)	***WACC***	**8.3%**		**7.5%**	

Determining the necessary rate of return is based on the weighted average cost of capital (WACC) methodology. WACC is often used as an estimate of the internal discount rate of a project or the overall rate of return desired by all investors (equity and debt providers). This means that the WACC formula[24] determines the required rate of return on a company's total asset base and is determined by the Capital Asset Pricing Model (CAPM) and the return on debt. Formally, the pre-tax cost of capital is given by:

$$WACC^{\,pre\text{-}tax} = g_d \bullet r_d + g_e \bullet r_e = g_d \bullet [r_{fd} + r_{pd}] + g_e \bullet [r_{fe} + \beta \bullet r_{pe}] / (1 - r_t)$$

Table 17 illustrates the determination of the WACC exemplarily for two differing cases – a low and a high-risk assessment. Within the model-based analysis, a range of settings is applied to reflect investor's risk appropriate. Thereby, risk refers to two different issues:

- A *"policy risk"* related to uncertainty on future earnings caused by the support scheme itself – e.g. referring to the uncertain development of certificate prices within a RES trading system and / or uncertainty related to earnings from selling electricity on the spot market;
- A *"technology risk"* referring to uncertainty on future energy production due to unexpected production breaks, technical problems etc.. Such deficits may cause (unexpected) additional operational and maintenance cost or require substantial reinvestments which (after a phase out of operational guarantees) typically have to be born by the investors themselves. This type of risk is highly dependent on the chosen technology and, consequently, named as "technology risk". Default assumptions on investor's "technology risk" are expressed in Figure 42 (below).[25] Thereby, the illustrated technology-specific factor is used as multiplier for the default WACC of 6.5%, leading in case of mature RES technologies to a lower or in case of novel (immature) RES options to a higher value.

Please note that as default both policy and technology risks are considered in the assessment, leading to a higher WACC than the default level of 7.5%. Additionally, an alternative setting is used to illustrate the impact of proactive risk mitigation measures, contributing to mitigate both policy and technology risk.

[24] The WACC represents the necessary rate a prospective investor requires for investment in a new plant.

[25] Assumptions on technology-risk factors are set in line with the detailed bottom-up analysis of illustrative financing cases as performend with the Ecofys cashflow model (see section 6 and Annex) and reflect current / historic investor behaviour associated with different RES technologies as identified from a portfolio of investigated RES projects.

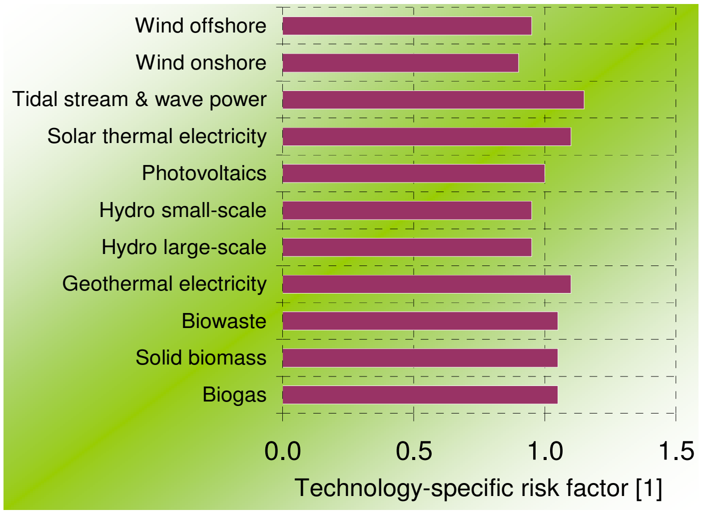


Figure 42: Technology-specific risk factors

4.2 Overview on assessed cases

Besides the business-as-usual case **four different policy scenarios to meet the European Union's 2020 RES commitment** have been conducted with the ***Green-X*** model, **all complemented by a sensitivity assessment on proactive risk mitigation measures**[26]. The following paragraphs give an overview of the conceptual definition of the scenarios. We start after a few general remarks with a brief definition of the characteristics of each policy case followed by a comparative classification as indicated in Table 18.

All researched policy cases (with the exception of BAU) are tailored to achieve the fulfilment of the target of 20% RES by 2020 at the EU level as well as corresponding national targets at the national level. They build on a continuation of current RES support (BAU case) for the near future. More precisely, it is assumed that researched policy changes will become effective by 2011.

Moreover, for all cases (except BAU) a removal of non-economic barriers (i.e. administrative deficiencies, grid access, etc.) is presumed for the future.[27] More precisely, a gradual removal of these deployment constraints, which allows an accelerated RES technology diffusion, is conditioned on the assumption that this process will be launched in 2011.

[26] Proactive risk mitigation comprises a portfolio of strategies to mitigate the two different elements of risk which a RES investor is facing at present occasionally – i.e. the "technology risk" and / or the "policy risk" (see section 4.1.3). On the hand, this may involve the provision of guarantees and insurance on specific technology and operational risks as well as of technology evaluations to cover technology risks. On the other hand, with respect to "policy risk" this may include an increased coordination of RES support at EU level to avoid unintended policy failures and to foster best-practice implementation of support design as well as the provision of guaranteed power purchase agreements (where necessary). For further details on proactive risk mitigation we refer to section 5.3.3 of this report where above issues are elaborated in a detailled manner.

[27] In general, and as also confirmed by this model-based assessment, it can be concluded that a removal of non-economic RES barriers represents a necessity for meeting the 2020 RES commitment. Moreover, a mitigation of these constraints would also significantly increase the cost efficiency of RES support.

For further insights on how this affects the feasible RES deployment within Green-X we refer to the corresponding Appendix to this chapter of the report.

The policy framework for biofuels in the transport sector is set equal under all assessed policy variants:[28] An EU-wide trading regime based on physical trade of refined biofuels is assumed to assure an effective and efficient fulfilment of the countries requirement to achieve (at least) 10% RES in the transport sector by 2020. Thereby, second generation biofuels receive a sort of prioritization (i.e. a higher support given via higher weighting factors within the biofuel quota regime) in line with the rules defined in the RES directive. Other novel options in this respect such as e-mobility or hydrogen have not been assessed within this analysis – as also no direct impact on the overall RES target fulfilment can be expected.

The characteristics of each assessed policy pathway are discussed subsequently:

- **BAU case:** RES policies are applied as currently implemented (without any adaptation) – until 2020, i.e. a **business as usual (BAU) forecast**. Under this scenario a moderate RES deployment can be expected for the future up to 2020;
- **Strengthened national RES policies:** A continuation of national RES policies until 2020 is conditioned for this policy pathway, whereby the assumption is taken that national RES support schemes will be further optimized in the future with regard to their effectiveness and efficiency in order to the meet the 2020 RES commitment. In particular, the further fine-tuning of national support schemes involves in case of both (premium) feed-in tariff and quota systems a technology-specification of RES support. No change of the in prior chosen policy track is assumed – i.e. all countries which currently apply a feed-in tariff or quota system are assumed to use this type of support instrument also in the future. However in case of fixed feed-in tariffs a switch towards a premium system is conditioned to assure market compatibility as relevant with increasing shares of RES-E in the electricity market.[29] [30];

  The following sub-variants have been assessed:
    - <u>"National perspective" – national target fulfillment:</u> Within this scenario each Member States tries to fulfill its national RES target by its own. The use of cooperation mechanisms as agreed in the RES Directive is reduced to necessary minimum: For the exceptional case that a Member State would

[28] An exception to this rule represents the BAU case where simply a continuation of current support policies for RES in transport is conditioned.

[29] For a detailled assessment of the individual support instruments and how to perform under different evaluation criteria – including market compatibility – we refer to section 5 of this report.

[30] In general, the process of strengthening of national RES policies for increasing their efficiency and effectiveness involves the following aspects:

- the provision of a stable planning horizon
- a continuous RES policy / long-term RES targets and
- a clear and well defined tariff structure / yearly targets for RES(-E) deployment
- a guaranteed but strictly limited duration of financial support
- a fine-tuning of incentives to country-specific needs for the individual RES technologies
- a dynamic adaptation / decrease of incentives in line with general market conditions (i.e. to incorporate the impact of changing energy and raw material prices) and specifically to stimulate technological progress and innovation.

not possess sufficient RES potentials, cooperation mechanisms would serve as a complementary option. Additionally, if a Member State possesses barely sufficient RES potentials, but their exploitation would cause significantly higher consumer expenditures compared to the EU average, cooperation would serve as complementary tool to assure target achievement. As a consequence of above, the required RES support will differ comparatively large among the countries;

- "European perspective": In contrast to the "national perspective" case as described above, within this scenario the use of cooperation mechanisms does not represent the exceptional case: If a Member State would not possess sufficient potentials that can be economically[31] exploited, cooperation mechanisms as defined in the RES directive would serve as a complementary option. Consequently, the prior aim of the "EU perspective" scenario is to fulfill the 20% RES target on EU level, rather than fulfilling each national RES target purely domestically. Generally, it reflects a 'least cost' strategy in terms of consumer expenditures (due to RES support). In contrast to simple short-term least cost policy approaches, the applied technology-specification of RES support does however still allow an EU-wide well balanced RES portfolio;
- "European perspective – less innovative technologies": This case presents a further subvariant of the strengthened national RES support path. Similar to above, the prior aim of this scenario is to fulfill the 20% RES target on EU level, rather than fulfilling each national RES target purely domestically. Thereby, in contrast to above, less emphasis is put on establishing a long-term oriented well-balanced RES portfolio. Consequently, novel RES technologies receive only a moderate support and major technology options have to compensate (as far as feasible) the gap to meet the RES commitment. Hence, it can be expected that this policy variant would cause the lowest support expenditures among all assessed cases in the short- to mid-term – i.e. within the researched period up to 2020. From a long-term perspective this may however change.

- **Alternative policy option - harmonisation for selected technologies:** Hereby it was assumed that a harmonization of support conditions at the EU level would be undertaken for selected RES-E technologies, complementing the process of policy strengthening at the national level. More precisely, the assumption was taken that wind offshore and biomass electricity (incl. CHP) would receive equal

[31] In the "European perspective" case economic restrictions are applied to limit differences in applied financial RES support among countries to an adequately low level – i.e. differences in country-specific support per MWh RES are limiited to a maximum of 8 €/MWh_{RES}.while in the "national perspective" variant this feasible bandwith is set to 20 €/MWh_{RES}. Consequently, if support in a country with low RES potentials and / or an ambitious RES target exceeds the upper boundary, the remaining gap to its RES target would be covered in line with the flexibility regime as defined in the RES Directive via (virtual) imports from other countries.

Moreover, in both variants a stronger alignment of support conditions between countries is presumed for wind energy and PV as for these technologies in the case of premium support a stepped tariff design is generally implemented, offering on the contrary a graduately differentiated support in dependence of the efficiency at the plant site (i.e. the site-specific fullloadhours). Such a system is currently implemented for example in Germany or France for wind onshore in order to trigger investments not only at best sites and to limit oversupport simoultanously.

support conditions all over Europe in order to assure an efficient resource allocation from the European viewpoint. Both technologies are selected exemplarity, however some reasoning was behind that:

  - In the case of wind offshore it is European dimension of this promising future option. As discussed prominently elsewhere, infrastructural prerequisites to achieve a large-scale deployment call for joint investments (i.e. the so-called "offshore supergrid" linking Northern European countries respectively the corresponding offshore sites) and incentives;
  - Biomass was selected as it represents a key option in almost all EU countries. Moreover, applying harmonized incentives would decrease the necessity for trade and allow an environmentally beneficial and enhanced use on site – i.e. there where the resources are.

  With regard to the conditioned financial support, a feed-in premium system was selected to offer well-tailored incentives for the corresponding technology options, which in case of wind offshore would be done via a stepped tariff design providing graduated incentives according to the site-specific resource conditions.

- As cooperation between MSs and the required (virtual) RES exchange was established primarily via the harmonization of support for wind offshore and biomass, no need for further alignment of support conditions between countries was assumed for the policy agenda under this case. Consequently, for other RES technologies comparatively similar policy settings as applied in the "national perspective" variant described above are used.

Table 18: Scenario definition – overview on assessed policy cases

Overview on assessed cases	Business as usual without non-cost barriers	Strengthened national policies - National perspective	Strengthened national policies - European perspective	Strengthened national policies - European perspective with less innovative technologies	Alternative policy option - harmonisation for selected technologies
Non-cost barriers[32]	Mitigated (gradual removal)	Mitigated	Mitigated	Mitigated	Mitigated
National support scheme	As default	Strengthened (according to best practice design criteria)	Strengthened (according to best practice design criteria)	Strengthened (according to best practice design criteria)	Strengthened (according to best practice design criteria)
Use of cooperation mechanisms	Weak	Average	Strong (incl. regional cooperation – i.e. joint support in the case of quota systems)	Strong (incl. regional cooperation – i.e. joint support in the case of quota systems)	Strong[33] (incl. regional cooperation – i.e. joint support in the case of quota systems)
Financing aspects[34]	Commercial loans accompanied by risk mitigation (soft loans) for selected technologies in selected countries	Proactive risk mitigation on a national level (loan guarantees, state involvement)	Proactive risk mitigation on a national and European level (loan guarantees, state involvement)	Proactive risk mitigation on a national and European level (loan guarantees, state involvement)	Proactive risk mitigation on a national and European level (loan guarantees, state involvement)
Incentivising infrastructure development	Moderate	Moderate	Strong ("offshore supergrid")	Strong ("offshore supergrid")	Strong ("offshore supergrid")
Coordination / Harmonisation of support levels	Weak	Moderate	Strong	Strong – with phase out of support for innovative technologies	Moderate / Harmonisation for selected technologies (e.g. wind offshore, biomass electricity)

[32] For further details on the applied modelling approach with respect to the impact of non-cost barriers on technology diffusion we refer to the Appendix corresponding to this section of the report.

[33] Beyond the scope of the mechanisms agreed under the current RES directive

[34] Subject to sensitivity analysis (in line with the scope of this study) – i.e. w/o proactive risk mitigation measures in the case of strengthened national and alternative policies in order to demonstrate the impact of them in a clear manner.

4.3 Results

Next, the outcomes of the model-based scenario elaboration are discussed. We start hereby with an illustration of identified recommended steps towards an achievement of the Member State's 2020 RES commitments in an effective and efficient manner – i.e. illustrating the impact of individual measures to move from a business-as-usual to a strengthened national policy path in line with the 2020 RES commitment. Subsequently, we show the aggregated picture for all key policy scenarios, illustrating the impact of assessed policy choices and complementary risk mitigation measures on RES deployment as well as related cost and expenditures. Finally, country-specific results as well as details for the electricity sector conclude this section.

4.3.1 Towards an effective and efficient RES target fulfillment – from BAU to strengthened national support with proactive risk mitigation

With currently implemented RES support – i.e. according to our scenario definition named as business-as-usual (BAU) case – it can be expected that the majority of EU countries would fail to trigger the required investments in new RES technologies as needed for 2020 RES target fulfillment. Subsequently we present the impact of individual measures to move from BAU to a policy path where all Member States would meet their RES commitments. Thereby, also the impact of proactive risk mitigation measures for alleviating the financing of the necessary RES deployment is depicted, aiming to improve the effectiveness and efficiency of the necessary RES support.

Next, Figure 43 illustrates the future deployment in relative terms for both RES-E (left) and RES in total (right) in the EU-27 in the period 2011 to 2020 for the BAU case (incl. a sensitivity variant of moderate demand & mitigated barriers) and the case of "strengthened national support", specifically the "national perspective" variant w/o proactive risk mitigation measures. More precisely this graph illustrates the RES-E share in gross electricity demand (left) and the share of RES (in total) in gross final energy demand (right). Complementary to this, Figure 44 shows the corresponding development of yearly consumer expenditures due to the underlying conditioned RES support for the identical scenario selection. Similar to above, results are presented for both RES-E (left) and RES in total (right) in the EU-27 for the forthcoming years up to 2020. Finally, Table 19 provides a concise depiction of key figures with respect to RES(-E) deployment by 2020 and corresponding consumer expenditures for the researched cases, indicating also the individual measures to move from BAU to strengthened national RES support with proactive risk mitigation.

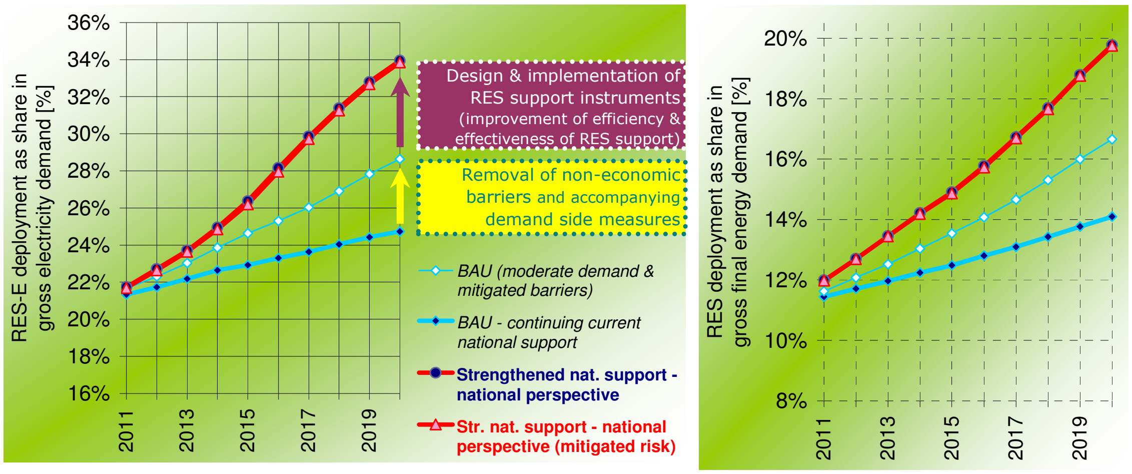


Figure 43: RES-E (left) and RES (right) deployment (expressed as share in gross electricity demand (left) / gross final energy demand (right)) in the period 2011 to 2020 in the EU-27 according to the BAU case (incl. a sensitivity variant of moderate demand & mitigated barriers) and the case of "strengthened national policies – national perspective" w/o proactive risk mitigation measures

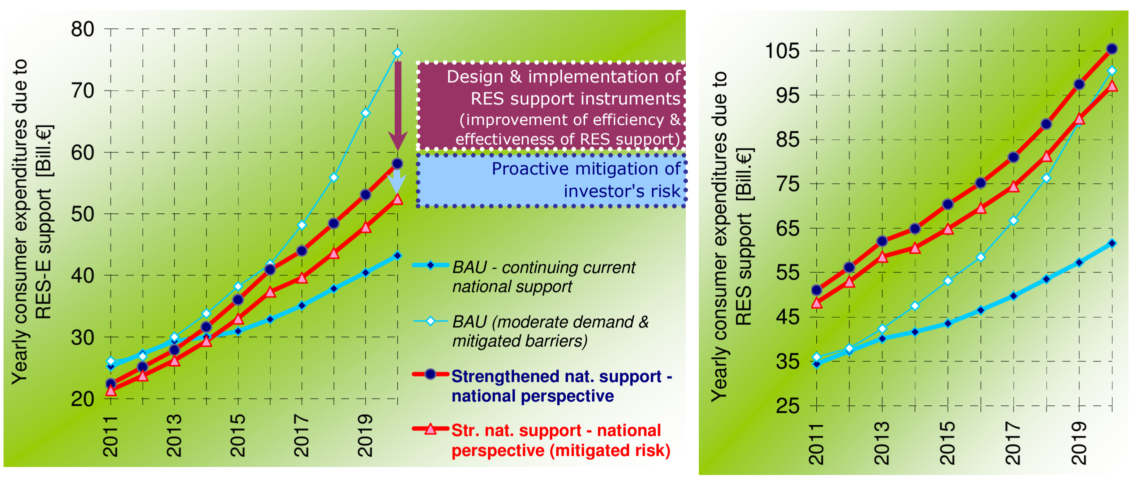


Figure 44: Yearly consumer expenditures due to RES-E (left) and RES (right) support (expressed as share in gross electricity demand (left) / gross final energy demand (right)) in the period 2011 to 2020 in the EU-27 according to the BAU case (incl. a sensitivity variant of moderate demand & mitigated barriers) and the case of "strengthened national policies – national perspective" w/o proactive risk mitigation measures

Table 19: Key figures on RES(-E) deployment by 2020 and corresponding consumer expenditures for research cases (from BAU to strengthened national support with proactive risk mitigtation)

Key figures for researched cases - from BAU to strengthened national support with proactive risk mitigation			Resulting deployment by 2020		Yearly consumer expenditures by 2020	
			RES-E share in gross electricity demand	RES share in gross final energy demand	RES-E support	Support for RES in total
Scenario		*Corresponding measures*	[%]	[%]	[Bill.€]	[Bill.€]
1	BAU - continuing current national support		24.7%	14.1%	43	62
2	BAU (moderate demand & mitigated barriers)	*(1 --> 2) Mitigation of non-economic RES barriers and strengthening of accompanying demand side measures*	28.6%	16.7%	76	101
3	Strengthened national support - national perspective	*(2 --> 3) Improvement of design and implementation of RES support instruments*	33.9%	19.8%	58	105
4	Strengthened national support - national perspective (mitigated risk)	*(3 --> 4) Proactive risk mitigation*	33.8%	19.8%	52	97

An accelerated expansion of RES-E as well as RES in total can be expected with effective and efficient RES support in place (as derived for all "strengthened national support" variants) while under BAU conditions a rather constant but moderate deployment is projected for the period up to 2020. Analysing the above illustrated sensitivity variants of the BAU and the "strengthened national policies" case indicates the impact of the individual key measures to move from a BAU to an enhanced RES deployment in line with 20% RES by 2020:

- Mitigation of non-economic RES barriers and strengthening of accompanying demand side measures: Retaining current financial RES support but supplemented by energy efficiency measures to reduce demand growth as well as a mitigation of non-economic deficits would allow for a 2020 RES-E share of 28.6% (compared to 24.7% as default). The corresponding figure for RES in total is 16.7% (instead of 14.1% as default). A significant impact can be also observed for the corresponding yearly consumer expenditures due to RES(-E) support. Required expenditures by 2020 would increase substantially under the assumed retaining of current support conditions (without any further adaptation) – i.e. rising from about 43 to 76 billion € in 2020 for RES-E solely, while expenditures for RES in total increase from 62 to 100 billion €. This indicates the need to align support conditions to the expected / observed market development, as otherwise specifically novel RES technologies would achieve significant oversupport in case of future mass deployment;
- Design and implementation of RES support instruments: The detailed policy design has a significant impact on the RES deployment and corresponding expenditures, specifically for the electricity sector. This can be seen from the comparison of the

“strengthened national policy” case with the BAU variant where similar framework conditions are applied (i.e. removed (non-economic) barriers and a moderate demand development). For RES-E the direct improvement of the efficiency and effectiveness of the underlying support instruments causes an increase of the RES-E share from 28.6% (BAU with removed barriers and moderate demand) to 33.9% (“strengthened national support”). For RES in total the impact on deployment is of similar magnitude – i.e. an increase of the RES share of gross final energy demand from 16.7% to 19.8% is observable. With respect to support expenditures the consequences are more significant for the electricity sector as then the required burden can be decreased substantially (while the deployment follows an opposite trend). More precisely, yearly expenditures in 2020 would decline from 76 to 58 billion € for RES-E, while for RES in total an insignificant increase is observable (i.e. from 100 to 105 billion € in 2020);

- Improving the financing conditions with proactive risk mitigation measures would finally allow reducing the cost burden while under the conditioned fulfilment of 2020 RES commitment deployment would remain unaffected. Yearly consumer expenditures can be decreased by about 10% for RES-E, i.e. from 58 to 52 billion € in 2020. For RES in total the impact is in magnitude of 8% for this specific policy path (of “strengthened national policies – national perspective”).

4.3.2 The aggregated picture – RES deployment vs. cost & expenditures

We start hereby with the aggregated picture, indicating the arising consequences of key policy choices briefly at the EU-27 level on the overall RES deployment and corresponding cost and expenditures. As a starting point, Figure 45 offers a comparison of both overall RES deployment by 2020 as well as the corresponding capital expenditures (on average per year for the period 2011 to 2020)). Thereby, besides BAU all key policy paths of strengthened and alternative RES support in line with the 2020 RES commitment are included in the depiction, but only with their sub-variant where proactive risk mitigation is assumed. Complementary to this, Figure 46 offers a detailed comparison of all key policy paths w/o proactive risk mitigation – i.e. accordingly, the impact of improving financing conditions becomes apparent. Subsequently, Figure 47 and Figure 48 show similar depictions for additional generation cost and consumer expenditures due to the policy support for new RES (installed 2011 to 2020) (both again on average per year for the period 2011 to 2020)). A closer look on the electricity sector is then given subsequently, whereby Figure 49 compares the resulting electricity generation (by 2020) from new RES-E installations with the present value (2006) of corresponding cumulated consumer expenditures due to their support (incl. residual cost after 2020) at EU-27 level for selected cases (i.e. BAU as well as strengthened national / alternative policy cases with proactive risk mitigation).

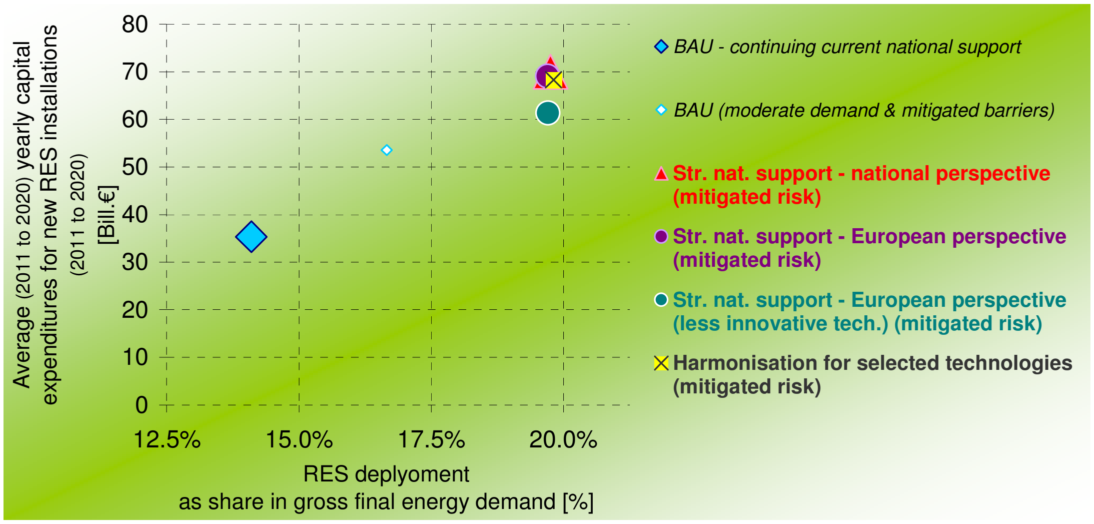


Figure 45: Comparison of the resulting 2020 RES deployment and the corresponding (yearly average) capital expenditures for new RES (installed 2006 to 2020) in the EU-27 for selected cases (i.e. BAU as well as strengthened national / alternative policy cases with proactive risk mitigation)

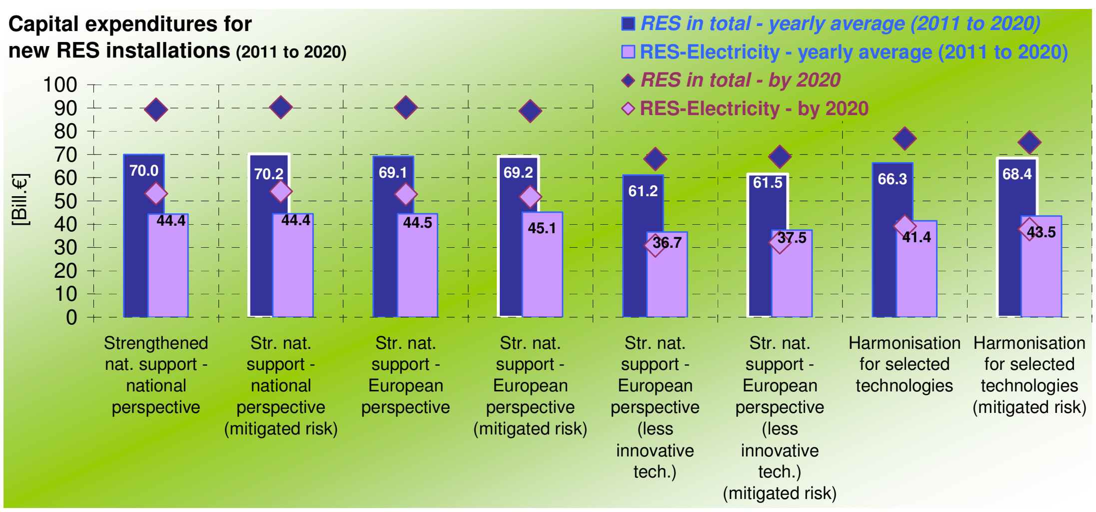


Figure 46: Comparison of the required (yearly average) capital expenditures for new RES (installed 2011 to 2020) in the EU-27 for all key policy paths (i.e. strengthened national / alternative policy cases w/o proactive risk mitigation)

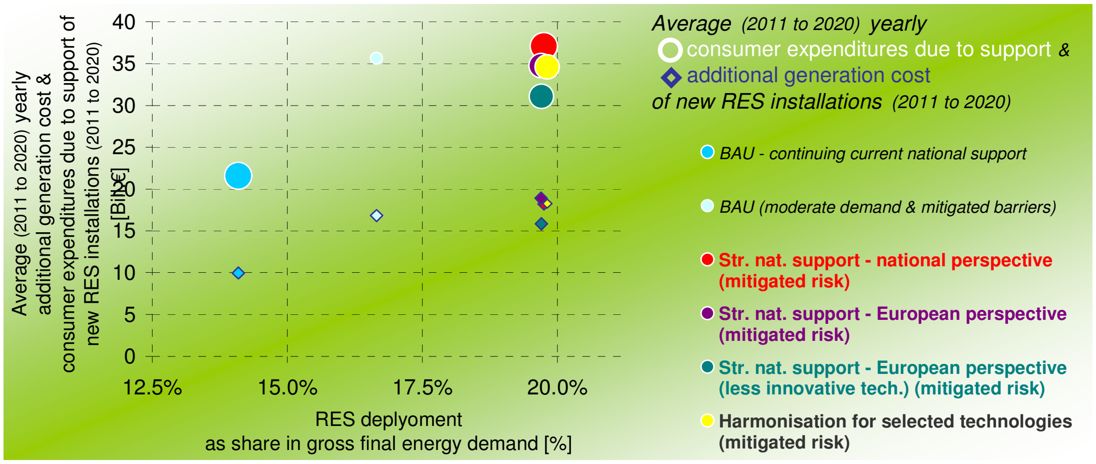


Figure 47: Comparison of the resulting 2020 RES deployment and the corresponding (yearly average) additional generation cost & consumer expenditures due to RES support for new RES (installed 2011 to 2020) in the EU-27 for selected cases (i.e. BAU as well as strengthened national / alternative policy cases with proactive risk mitigation)

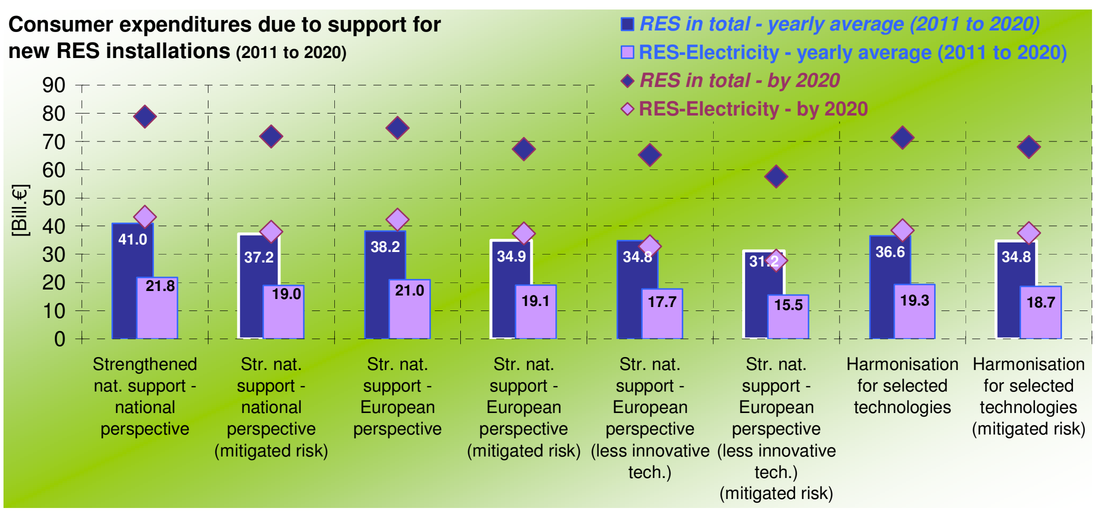


Figure 48: Comparison of the required (yearly average) consumer expenditures due to the support for new RES installations (2011 to 2020) in the EU-27 for all key policy paths (i.e. strengthened national / alternative policy cases w/o proactive risk mitigation)

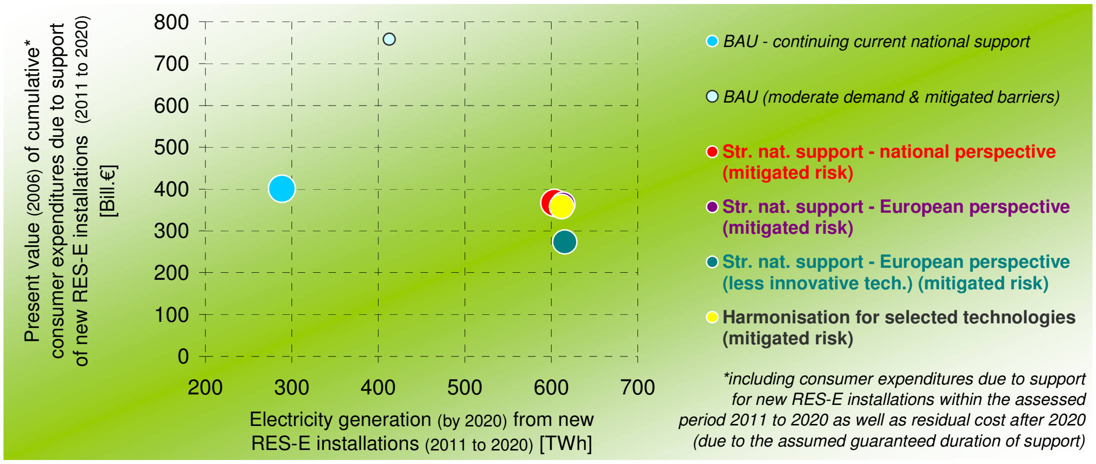


Figure 49: Comparison of the resulting electricity generation (by 2020) from new RES-E installations and the present value (2006) of corresponding cumulated consumer expenditures due to their support (incl. residual cost after 2020) at EU-27 level for selected cases (i.e. BAU as well as strengthened national / alternative policy cases with proactive risk mitigation)

It can be concluded that some sort of cooperation between countries represents an absolute necessity as otherwise some countries would fail to achieve their given 2020 RES commitment. Moreover, an alignment of financial support conditions for the individual RES technologies between the countries appears beneficial in order to increase the cost efficiency at the European level.

Other key findings from these depictions comprise:

- The impact of improving financing conditions is apparent: While overall capital expenditures remain unaffected, consumer expenditures due to RES support can be decreased by 5 to 10% depending on the specific policy path, whereby on average a reduction of about 9% appears reasonable. In general, the impact on RES in the electricity sector is of slightly larger magnitude as therein more novel technologies can be found that would benefit from proactive (technology) risk mitigation;
- Generally, minor differences are observable when comparing the policy cases for an accelerated RES deployment that strive for an effective and efficient RES target achievement. Obviously, it can be seen that capital and consumer expenditures as well as additional generation cost are lower if less innovative technologies deploy on the market (compare the variant "European perspective with less innovative technologies" with the other policy paths);
- An, as far as feasible, "pure" national RES target fulfilment would lead to an increase of costs and expenditures compared to its pendant reflecting more intensive cooperation between MS's ("European perspective"). This increase in expenditures is in magnitude of 5% with respect to consumer expenditures;
- No differences can be observed between both policy variants of more intensified cooperation at the European level. The policy case of "strengthened national support – European perspective" shows similar expenditure levels than the alternative policy case where a harmonization at the EU level is assumed for selected technology options. Hence, from the cost perspective it appears indifferent whether such intensified cooperation would be established via a full harmonization for few selected

RES technologies or by aligning support conditions strongly for the whole basket of RES options;

- A closer look at the electricity sector confirms above observations, whereby differences appear even larger in terms of cost and resulting RES deployment when comparing all key policy variants (in line with the 2020 RES commitment) with the default BAU case.

4.3.3 Impact on country-specific RES deployment & corresponding policy cost (consumer expenditures)

A closer look at the impact of the policy choices on the country-specific RES deployment by 2020 as well as the corresponding support costs – i.e. the consumer expenditures due to RES support – is envisaged subsequently. We start with the geographical changes in terms of deployment, i.e. the deviation of country-specific RES exploitation, and complement this thereafter with details on the corresponding cost.

RES exploitation at country level

Figure 50 depicts total RES deployment in 2020 by country for all key scenarios, expressing the overall RES penetration as share in gross final energy demand at country level. As becoming apparent from this graph, only small differences at country level are observable among the investigated cases. The changes are in the order of less than 5% compared to the national perspective scenario and arise when moving towards more EU wide policies, whereby the effects are slightly stronger for the "European perspective" cases than for the harmonisation case as more technologies have higher flexibility.

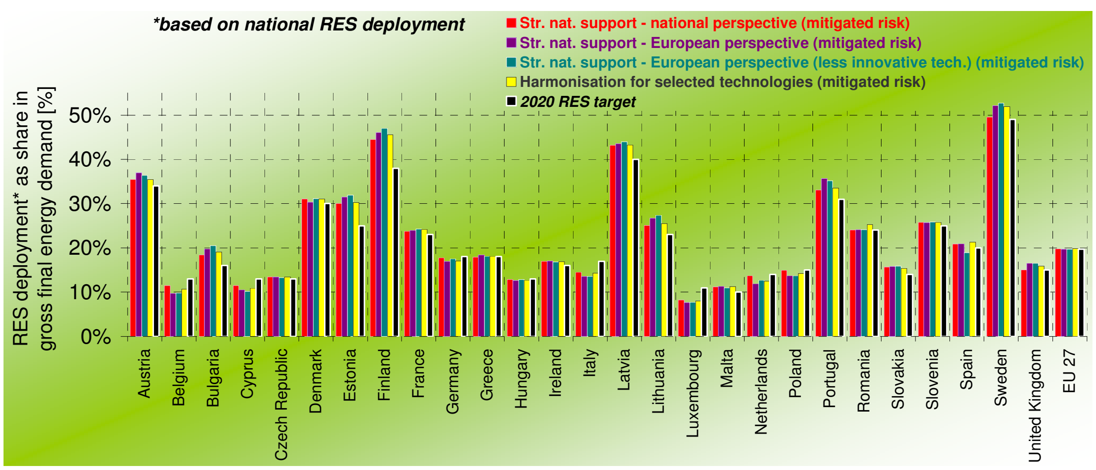


Figure 50: Country-specific RES exploitation by 2020 for all key cases

The very right bar in each country column represents the 2020 RES target which can then be compared to the actual deployment according to the investigated cases. As can be observed therein the deviations are significantly higher than among the key scenarios at EU level. This clearly illustrates for all cases including also the "national perspective" the necessity for trade – both physical trade as preconditioned for biofuels and virtual trade for RES-E and RES-H as e.g. under the cooperation mechanisms in the case of national policies. In case of harmonized RES support virtual trade can also be integrated into the overall policy approach.

Support costs (consumer expenditures) at country level

Figure 51 and Figure 52 illustrate subsequently the country-specific policy cost – i.e. the transfer costs or consumer expenditures due to RES support by 2020. Cost figures are in this context expressed in relative terms, i.e. as share of projected country-specific gross domestic product (GDP)[35] in 2020. Both graphs differ with respect to the national allocation of these costs: In Figure 51 transfer costs are accounted to the country where the corresponding RES exploitation takes place, whilst Figure 52 dedicates the costs to the country where they finally have to be borne by the consumer / society – i.e. in line with the national 2020 RES targets. Obviously, differences occur between both graphs when comparing the data at country level for a certain case, which indicates the required monetary transfer between countries.

A comparison of the different policy scenarios shows in general a common pattern of exporting and importing countries.[36] Obviously, for exporting countries cost figures are higher in Figure 51 (where accounting is based on national RES exploitation) compared to Figure 52 (where accounting follows the resulting actual expenses (in line with RES targets)), and vice versa for importing countries, respectively. This effect is stronger when the use of flexible mechanisms is employed (European perspective) than for the harmonized policy option, since under this variant only selected technologies are aimed to provide the required flexibility. Another effect that is striking is the resulting imbalance in terms of required consumer expenditures expressed as share of GDP. It can be observed from Figure 51 that especially new Member States with lower GDP´s are affected by a high burden. The reason for that is the methodology applied to allocate targets to the different Member States. On the one hand, the 50% flat allocation factors in significantly for Member States with relatively low GDP´s. On the other hand, Member States that start with a relatively low energy consumption, but a high RES share are in an unfavorable position as this will raise their target above average if their energy consumption increases (in order to achieve economic growth which is especially crucial for countries with relatively low GDP´s at present). For these countries, the 50% GDP distribution of the targets cannot fully compensate for the 50% flat distribution, like it can specifically be observed for Latvia. Finally, differences in consumer expenditures between support mechanisms cannot be generalized over all Member States and probably can to a large extent be explained through the function as exporting or importing country.

[35] Similar to other general reference data GDP projections are taken from PRIMES scenario (see NTUA, 2010).

[36] In other words, a similar list of countries would be classified as possible importers or exporters, respectively, independent of the applied policy variant.

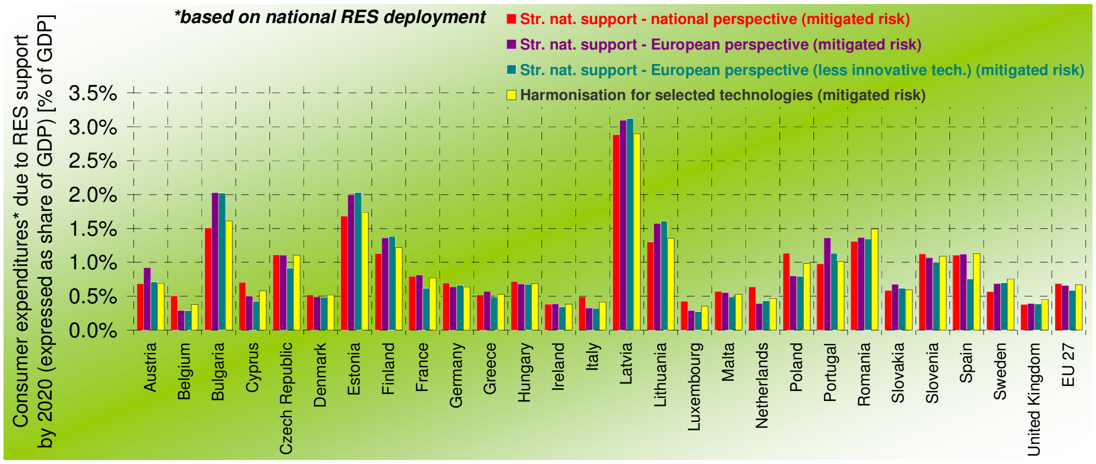


Figure 51: Transfer cost due to RES support by 2020 depicted by country according to the national RES exploitation for all key cases

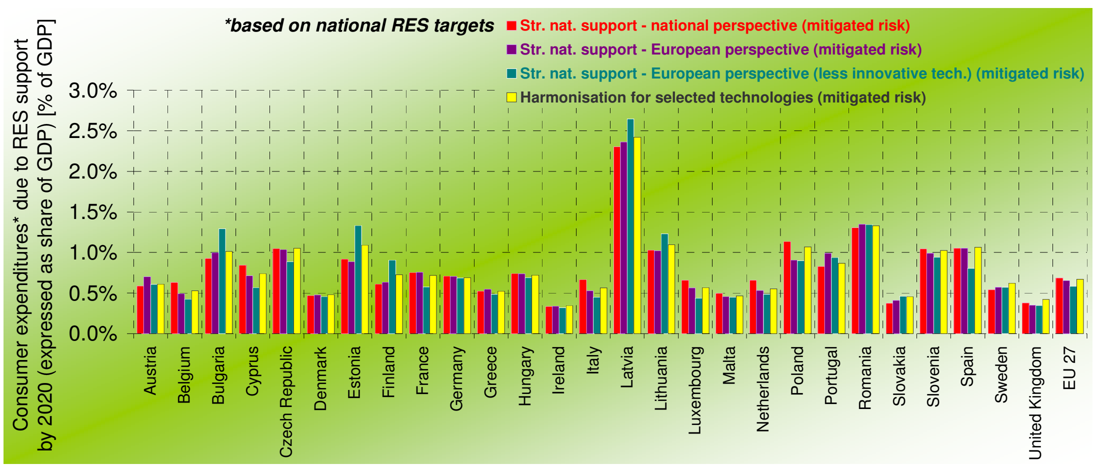


Figure 52: Resulting consumer expenditures due to RES support by 2020 accounted to the countries according to the national RES targets for all key cases

National RES targets (see Figure 52) as given by the new RES directive and preconditioned in this assessment lead to a redistribution of monetary expenses between the different countries. It appears that this process causes a fairer distribution of the resulting policy cost by country where economic wealth seems to be better reflected. This effect can be demonstrated well by taking a closer look at countries with a high share of consumer expenditures (Bulgaria, Estonia, Latvia, Lithuania), i.e. 1.5% of GDP or more, in Figure 51. This would significantly reduce the burden for the affected countries, but still an imbalance would remain with especially Latvia as outlier.

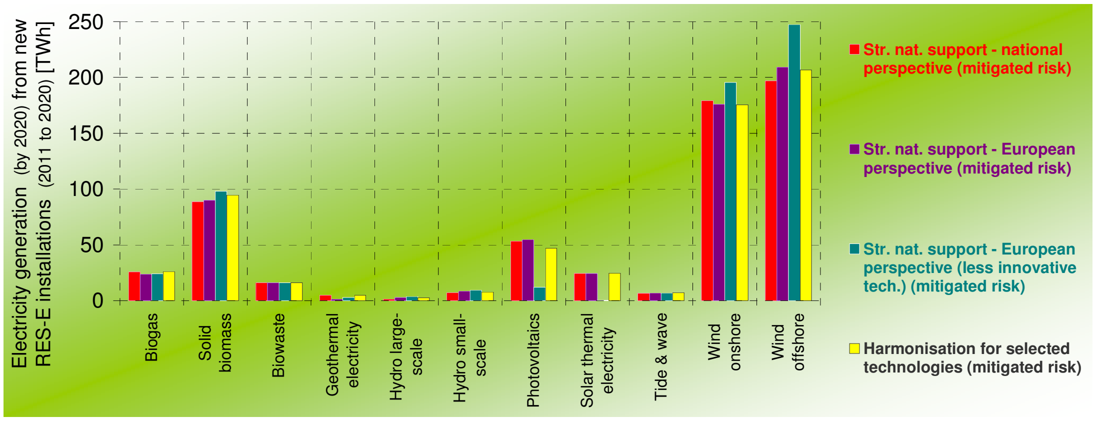


Figure 53: Technology-specific breakdown of RES-E generation from new installations (2011 to 2020) in the year 2020 at EU-27 level for all key cases

Figure 53 (above) illustrates which RES-E options would contribute most in the assessed period 2011 to 2020 depending on the applied policy pathway. It is becoming apparent that wind energy (on- & offshore) and biomass dominate the picture. Depending on the assumed support conditions, also PV would achieve a significant exploitation in various cases. At first glance, comparatively small differences among the investigated cases are applicable, as a more ambitious target generally requires a larger contribution of almost all available RES-E options. The most significant departure from this allocation arises in the scenario "European perspective with less innovative technologies". In this case innovative technologies, i.e. especially photovoltaics and solar thermal electricity will not be able to generate the necessary learning effects or to gain market maturity in order to be available at a larger scale by and moreover beyond 2020. The gap in electricity generation that arises in this scenario will mainly be covered through wind, onshore and especially offshore. Overall, new RES installations until 2020 will not significantly make use of the whole spectrum of applicable technologies and will focus to a large extent on a few technologies. From todays perspective only wind offshore would arise as new key option.

5 Evaluation of financing instruments

5.1 Overview financing instruments

A variety of public or private financing instruments currently exists within European countries to support renewable energy. The choice of instruments depends on the stage of development of the technologies or projects. Most RES financing instruments fall under three main categories:

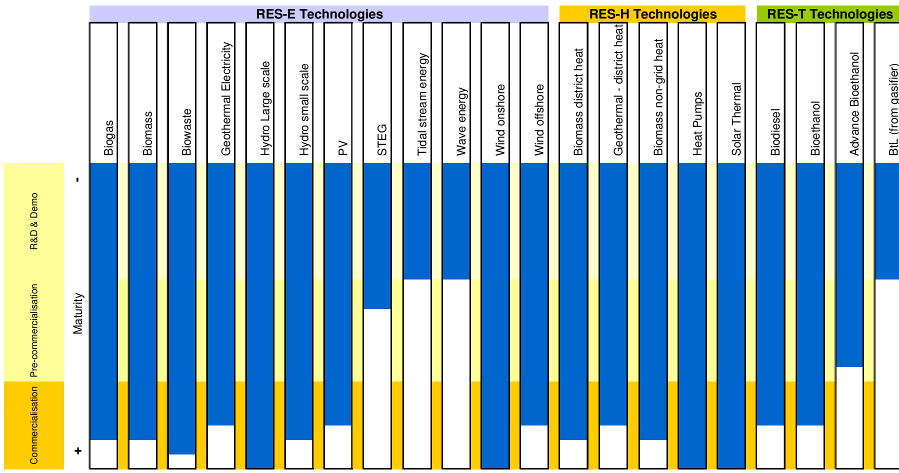
- Energy **Market** instruments (Feed-in Tariffs, Premium, Renewable obligations, Tenders, Fiscal incentives);
- **Equity** Finance Mechanisms (Venture Capital, Equity, R&D Grants, Capital/Project Grants, Contingent Grants);
- **Debt** Finance Mechanisms (Mezzanine Debt, Senior Debt, Guarantees).

This section provides an overview of the different instruments that can be used by stages of development for a technology or a project.

During the technology development stage, the first phases of R&D and demonstration are probably the most challenging in terms of access to finance and for this reason often referred to as a first "valley of death". This phase occurs after the initial research activities in university and national laboratories and before the commercial deployment of the technology. This stage is highly risky, and also requires fairly long periods: up to 5 years are required from R&D to proof of concept stages where the technology is developed, tested and refined. It is also a crucial step to gather statistical data on the performance of the technology that allows not only to identify promising research but also to minimize the perceived technology risk by investors. The next "valley of death" occurs between the pre-commercialisation and the commercialisation phase where funding is needed to finance full-scale manufacturing plants or power generating projects.

From a project development point of view, when the technology has reached the commercialisation stages, three steps can be distinguished: start-up, construction and operation. During the start-up phase, the project developer will undertake financial modelling, business plan preparation, resource assessment and stakeholder consultation. Fundraising is also one of the main tasks of this stage. It requires multiple competencies in finance, administrative, legal and technical skills. The construction phase will require capital to finance investments in equipment, land, etc. Stability of regulatory frameworks is the key requirement during the operation and maintenance phases. A number of support schemes and financial instruments are available for each phase of technology and project development as presented in the following table. They are further described in the next pages of this section, which also focuses on assessing the appropriateness of these instruments with regards to the needs of the RE sector.

Table 20: Overview of the main financing instruments by stages of technology development and project development



Stage	Challenges	Support Schemes	Financing Instruments	Support needs
R&D & Demo	Provide funding to promising research Mitigate the risk of technology demonstration Transfer academic research into commercial research Ensure availibility of statistical data on pilot projects	EC - R&D grants - FP7 MS - R&D grants MS - National laboratory MS - Incubators MS - R&D Fiscal incentives	Incubators	Finance for prototype testing Incubators
Pre-commercialisation	Provide support to SME in particular Ensure availibility of debt and capital Mitigate the risk of technology deployment	EC - Venture Capital - GIF EC - Guarantees - SMEG MS - Public equity MS - Grants	Venture Capital Private Equity	Guarantees on technology deployment Contingent grants Public/private Venture Capital Venture Capital for technologies developped by SME Soft and convertible Loans
Commercialisation	Ensure availibility of long-term capital Avoid boom-burst cycle	IEB - Loans MS - Fiscal incentives MS - FIT MS - Premium MS - Public Equity MS - Renewable obligations	Private Equity	Long-term policy
Project start-up	Provide debt capital at concessional interest rate Mitigate the risks linked to the ressource Reduce the need for Technical Assistance (admin, financial, communication, local issues)	EC - Grants - ELENA EC - Grants - ALTENER EBRD - Grants - TCFP EBRD - Debt - SEI MS - Grants MS - Tender	Bank Senior Debt	Debt and capital for small-medium project Technical assistance for administrative and local issues Contingent grants Soft Loans
Construction	development stage Mitigate the construction risk	EC - Grants - ERDF EC - Grants- Recovery Plan IEB - Loans MS - Grants MS - Mezzanine funds	Bank Mezzanine Debt	Guarantees Reassurance Mezzanine funds Reduce grant dependance Soft Loans
O&M	Ensure guaranteed cash flow Support/create customers Mitigate the political risk Mitigate the economic risk (volatility of energy prices) Mitigate the risks linked to the ressource availability and prices	MS - FIT MS - Premium MS - Renewable obligations		Long-term policy Guarantees for economic and ressource risks European associations for renewable ressources management

Table 20 gives an overview of the main financing instruments by stages of technology development and project development. Annex 5.1 provides a detailed description of all instruments.

5.2 Evaluation of support schemes, financing instruments and EU support scenarios

A large number of support schemes and financing instruments have been established over the years to support the development of RES technologies and projects. The assessment of the appropriateness of each instrument or approach requires to focus on the ability of each instrument to cover the financing needs of specific technologies or projects with various degrees of maturity, and to increase attractiveness for private sector investors. To evaluate the existing support schemes, financing instruments individually and a combination of these instruments in terms of complete EU-support scenarios we have developed a common set of evaluation criteria[37].

The following matrix provides a synthesis of the instruments' evaluation. The criterion used to evaluate the support schemes, the financing instruments and the overall support storylines are the following:

- **Efficiency**: This criterion assesses the question whether the instruments support efficiently the development of clean energy and avoid unintended consequences. Thereby, the term efficiency refers to the additional generation costs on the one hand and to the policy costs on the other hand. Whilst the additional generation costs reflect the welfare effects in general, the policy costs additionally consider distributional effects or the question which stakeholder pays for the additional costs. In our analysis, we focus on the policy costs. Thus, we compared the support level per unit of electricity generated with the requirements of each technology on country level in terms of generation costs, which results in an indication for the static efficiency (see section 2.3 and 2.5). Furthermore by looking at the contribution of the instruments on future cost reduction for the basket of renewable technologies the impact on dynamic efficiency is evaluated (see section 2.4 and 4.3);
- **Effectiveness**: Does the instrument contribute significantly to the 2020 RES objectives? The criterion of effectiveness analyses the impact of support schemes on market diffusion of renewable energy technologies. In other projects such as OPTRES, Futures-E and RE-Shaping an indicator to measure the policy effectiveness in terms of additional generation divided by the remaining 2020-potential was developed. With regard to financing instruments the criterion of the effectiveness investigates whether public money invested attracts follow-up funds from private investors;
- **Certainty for investors:** The certainty for investors analyses to what extent the policy instruments are able to lower RES project risks, which may be of economic, technological or political nature. Examples for economic risks are the volatility of fuel prices or the volatility of final energy prices, whilst

[37] Please note that the evaluation of different EU policy storylines is realised in section 6.1.

technological risks refer to construction risks or resource availability. Political risks include changes in the legislative framework conditions;

- **Long-term competitiveness** (of the RES sector): The impact of different policy instruments on the position of the European RES sector on global markets is analysed in the context of the competitiveness indicator. In detail this indicator shall make a statement whether the instruments are able to improve the long-term competitiveness of the RES sector. This includes the built-up of a powerful RES industry sector as well as the ability of the instrument to stimulate cost reductions in manufacturing;
- **Governance (political feasibility)**: This criterion analyses the impacts of the policy instrument on the governance structure dealing with the question whether the instrument is easy to implement or not;
- **Market compatibility** (only applicable for support schemes, not applicable for financing schemes): This criterion addresses in particular the question about the compatibility of support schemes with liberalized electricity markets.

In addition to the described criteria, the evaluation of EU-scenarios in chapter 6 is realized taking into account one additional criterion:

- **Realisable with limited EU-budget**: The chance to realize different policy options with a limited EU-budget is analysed in this indicator.

5.2.1 Support schemes

Figure 54 shows an evaluation of the different support schemes using the above described criteria. In the next columns, we indicate in which phase of market maturity the individual policy instruments appear to be adequate. For example, a feed-in tariff system, aiming at fostering the market diffusion of technologies appears not to be suitable for a technology which is still in the R&D and demo phase, but rather suitable for a technology which is already in its commercialization stage. In addition, we indicate in which state of the project development phase each instrument appears to be suitable.

In the last columns, the matrix shows a qualitative assessment according to the six criteria efficiency, effectiveness, certainty for investors, long term competitiveness, governance and market compatibility. Since this evaluation does not only depend on the type of policy instrument but also on its detailed policy design, we show ranges for each criterion. The dark part of the blue bar shows how we estimate the tendency of the experiences made with support instruments applied across the EU. However, the reader should consider this assessment rather as an indication. Given the wide range of design options, no clear and unique result can be expected for the individual instruments.

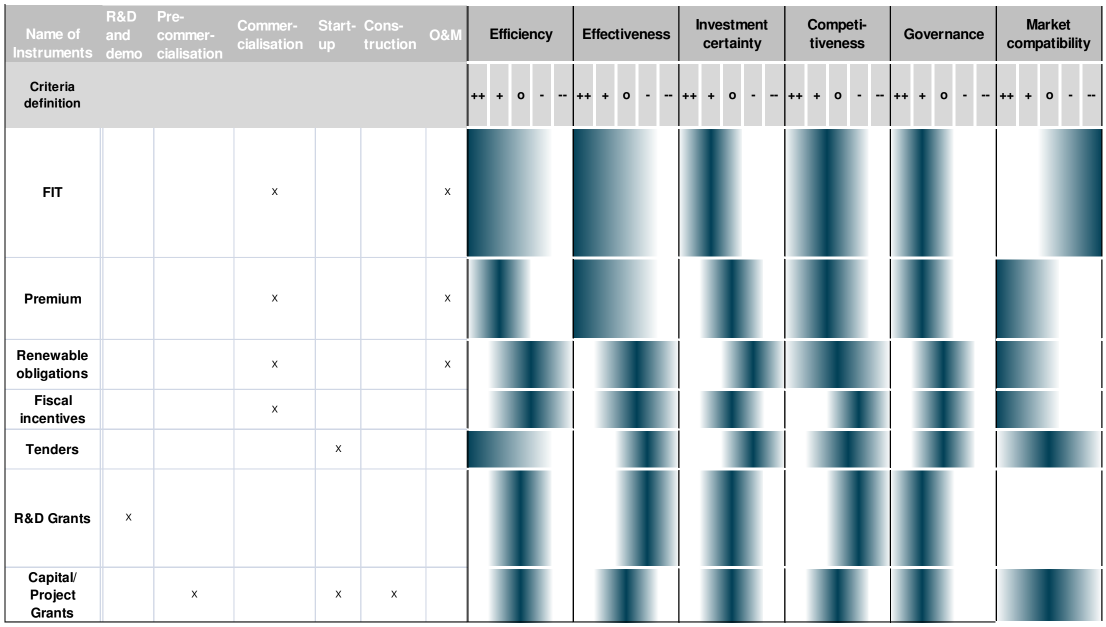


Figure 54: Evaluation matrix of support instruments using different critieria

Note: The mechanisms described should be understood as "generic" schemes as the table summarizes perception over a variety of country-specific schemes.

Observing the allocation of the various instruments to the technology development phases, R&D grants appear to be most suitable for technologies in its R&D phase. During the pre-commercialization phase, capital grants help reduce the investment for the technology, which still tends to be rather high during this phase. Market deployment policies such as feed-in tariffs (FIT), premiums and renewable obligations are essential to give certainty to investors on cash flow through long-term PPA during the commercialization phase. Subsequently, we evaluate the market deployment policies in more detail, using the proposed set of criteria.

Looking at the **cost efficiency** of support schemes the analysis realized in section 2 of this project reveals that feed-in tariffs and premiums appear to be able to adapt support levels well to the requirements of the respective technology in terms of electricity generation costs. Owing to the stability of tariffs, the cost efficiency of fixed FIT tends to be higher than in case of premium tariffs, where risk premiums may lead to a higher overall remuneration and to lower cost efficiency. The latter statement, however, strongly depends on the specific design of the premium tariffs, in particular on the fact whether the price risk on future wholesale electricity prices has to be borne by the RES generator.

Regarding the overall efficiency of FIT and premiums it can be observed that in some cases determined tariff levels may exceed the needs of a technology e.g. as a result of political lobbying activities or missing knowledge on electricity generation costs of RES technologies.
This overcompensation may occur in particular if technology cost development is strongly dynamic, as happened with solar PV costs during the last few years. To avoid such a kind of overcompensation the tariffs should be adapted on a regular basis to reflect cost development without destroying investors' confidence. In addition, competition between manufacturers should be stimulated, since a demand surplus may lead to excessive prices, which do not reflect anymore real manufacturing costs.

A renewables obligation tends to exploit the most cost-effective renewable energy potentials, but due to its predominant application in terms of a technology-uniform quota, it typically involves windfall profits for lower cost technologies. Thus, the overall welfare losses are generally lower than under FIT-support, whilst policy costs paid by the electricity consumer tend to be higher.

Tender schemes usually lead to rather cost-efficient renewables support in theory, as investors have to compete for support. Nevertheless, market imperfections such as strategic behaviour in illiquid markets may lead to increased prices.

The dynamic efficiency strongly depends on the design of the instrument. A design element of quota systems aiming at the increase of the dynamic efficiency is the banding approach in order to deploy also currently more expensive technologies. In feed-in tariffs technology specification and dynamic digression of tariffs have the aim of improving the dynamic efficiency.
Analysing the average support level for biomass and PV one observes steadily decreasing tariff levels in countries using feed-in tariffs and feed-in premiums in Europe (see Figure 24). For the case of wind onshore the average support level in countries using feed-in tariffs remained relatively stable. In countries using quota obligation systems the price development shows a decreasing trend in Italy, whilst TGC prices in other EU countries remain on a comparatively constant level (see Figure 25).

In summary, the table above indicates high **policy effectiveness** for FIT-systems and lower effectiveness associated to the quota obligations. The effectiveness of the different policy instruments has been evaluated in the context of other EU-projects such as OPTRES, FUTURES-E and Re-Shaping. The main outcomes of the most recent analysis indicate that feed-in tariff systems (fixed and premium) have proven to be very effective for several technologies. Nevertheless, the previously lower effectiveness of quota obligations appears to be improving regarding the support of lower cost technologies such as wind onshore in recent years. Assuming a technology-neutral quota obligation there is the risk that only lower-cost technologies are supported effectively.

Looking however at the effectiveness of quota obligations in the past e.g. with regard to wind onshore, it turned out to be still below that of feed-in tariff systems and premiums. The effectiveness of tenders may be only very punctual, depending in particular on the frequency of tender procedures.

The higher effectiveness in case of fixed feed-in tariffs is mainly due to the **certainty for investors**, while other mechanisms include a significant market risk. Feed-in tariffs can show the strongest reduction of investments risks by giving long-term price guarantees. In general, the risk of feed-in premium can be higher than that of feed-in tariffs, in case that the overall remuneration depends on the electricity market price. But for feed-in premiums the level of investment risk strongly depends on the design, in particular whether the level of the premium is indexed to the electricity price as for example done in the Dutch scheme or whether there are minimum limits or not. Quota systems are typically characterized by uncertainties with respect to the certificate price as well as the electricity price. Therefore, the risk coverage is significantly lower than for feed-in tariffs and feed-in premiums. Tender systems can reduce the risk substantially depending on the detailed design. Strongest risk coverage is reached in generation-based tendering involving long-term contracts for the electricity produced. Higher risks typically occur in investment based tendering schemes. Even for generation-based tenders the risk level during the project planning phase can be higher than for feed-in tariffs due to the uncertainty of the outcome of the tender. Linking the security for investors to financing issues, project finance lenders clearly prefer a long-term contract that ensures a relatively consistent and guaranteed revenue stream. However, the attractiveness of this scheme may vary according to country-specific design, and to potential changes in the regulatory framework (policy risks) as recent decreases in FIT schemes in several countries show. Long-term predictability of tariffs seems to be the key demand from market players here. International market players also ask for a greater coordination across countries.

The question whether a support scheme contributes to improve the **competitiveness** of the EU's RES sector depends a lot on the concrete policy design. Above all, the competitiveness of the RES sector is linked to the effectiveness and the general investment climate. High growth rates of RES induced by an effective support policy and a sound investment climate may contribute significantly to creating a competitive RES industry sector. Thus, the strong support for wind onshore in Denmark, Germany and Spain during the 1990s helped to build up a powerful wind industry in all three countries. Similarly, the strong growth of solar PV in Germany enabled the development of a new industry sector.

However, a strong growth is not the only prerequisite for creating a competitive industry sector. The other important factor is to achieve cost reductions in the associated manufacturing processes. Thus, the competitiveness of the RES industry also depends on the ability of a support scheme to enhance cost digression, expressed by the dynamic efficiency.
Given the link of the competitiveness to the effectiveness, feed-in systems perform best in terms of competitiveness, if tariff digression mechanisms are properly applied. Technology-uniform renewable obligations tend to exploit the most cost-effective potentials, but less mature technologies are often not able to develop under a quota scheme. In theory, potential efficiency gains in terms of total generation costs associated to the renewables obligation could be spent specifically for the support of innovative and promising technologies such as wind offshore. However, occurring windfall profits for RES-E producers in the case of technology-uniform quota obligations often cause higher policy costs for consumers and may impede that this money is really spent for the development of innovative technologies. The implementation of R&D grants is difficult to judge, as the impact on the competitiveness is rather of indirect nature. R&D grants may provide some first mover advantage for the respective country. However, there is a considerable risk to spend money for a promising technology, which does not develop as expected.

With regard to **governance,** the main question addressed was whether the instrument is easy to implement. Due to the substantial experience with feed-in tariffs in a large number of EU Member States and the simplicity of the system, this instrument seems to be most simple to implement. The most challenging issue is the tariff setting procedure, in particular if cost development is highly dynamic. Quota systems based on TGCs typically show a slightly higher complexity due to the fact that both, penalty prices and quantities have to be set. Also the transaction costs for involving a large number of actors into a certificate trading scheme can be significant in particular for small scale installations. In addition, the implementation of a quota obligation requires the organisation and management of a trading platform. Regarding the tender scheme, the call for bids requires substantial administrative capacity.

Looking at the **market compatibility** of the different support schemes significant differences exist between the instruments. Whereas RES generators are forced to sell the physical electricity in the power markets for the case of renewable obligations, feed-in premium systems, fiscal incentives and some tender schemes, a single buyer, e.g. the TSO, fulfils this role in case of a feed-in tariff. Therefore, the electricity market price influences the revenues of RES generators only in the former systems. Since electricity prices do not affect the remuneration of RES-E generators in fixed feed-in systems, there is usually no incentive to feed-in electricity according to the demand or to adjust schedules to improved forecasts. Hence, feed-in tariffs in its currently applied design do not enhance the ability of RES-E producers to react to price signals.

Alternative options for demand orientation of supply have to be implemented in fixed feed-in systems, e.g. peak/off-peak tariffs. Since stronger market integration tends to involve higher risks, the market compatibility is correlated negatively to the certainty for investors to some extent.
Generally, it should be considered that the value of market participation as well as the investment risk caused by stronger market integration strongly depends on the market design and the existence of fully liberalised spot-markets, liquid intra-day markets, the availability of long-term contracts and the absence of market power. As the latter conditions are not yet fulfilled in many European countries, also the exertion of market risks on RES generators may not be reasonable in these cases. For the future development of support schemes, stronger market participation should be pursued depending on the development of the design of power markets and therefore carefully considering the balance between improved system integration and resulting risk levels for RES investors and generators.

In general, the evaluation of the support instruments does not only depend on the type of instrument but also on the individual design. Potential disadvantages of a certain instrument type regarding a certain criterion may be compensated by several elements. However, this compensation may affect the instrument's performance with regard to another criterion. To put an example, minimum prices applied in quota obligations reduce the investors' risk but may decrease the instrument's market compatibility if the minimum prices are implemented on an hourly basis for example.

The decision, which support instrument to use depends on the relevance of each criterion. In turn, the weight of the criteria may change according to the development status of one technology or the renewables market in general. Whilst the effectiveness of support appears to be particularly important during an early stage of market commercialisation, market compatibility becomes increasingly relevant for more advanced renewables markets or technologies. Thus, the implementation of R&D support and investment grants is suitable for technologies in their R&D or demonstration phase. Then, technologies or markets in their early commercialisation phase may be supported with feed-in tariff systems due to their high effectiveness and the certainty for investors associated to the feed-in tariffs. Increasing market integration allows the change to instruments that perform better in terms of market compatibility, such as feed-in premium or a quota obligation. A precondition for efficient market integration are the existence of liquid spot and intra-day markets, the availability of long-term contracts and the absence of market power. The application of a technology-uniform quota seems to be reasonable in rather advanced renewables markets where renewable electricity is nearly competitive to electricity from conventional sources, and if cost resource curves are comparatively flat.

5.2.2 Financing instruments

	Technology Development			Project Development								
Name of Financial Instruments	R&D and demo	Pre-commercialisation	Commercialisation	Start-up	Construction	O&M	Efficiency	Effectivness	Certainty for investors	Competitiveness	Governance	Market Compatibility
							++ + o - --	++ + o - --	++ + o - --	++ + o - --	++ + o - --	++ + o - --
Equity Mechanisms		x	x	x	x							Not Applicable
Debt Mechanisms			x		x							Not Applicable
Venture Capital	x	x										Not Applicable
Guarantees		x		x	x							Not Applicable
Contingent grants				x								Not Applicable
Mezzanine Funds					x							Not Applicable

Figure 55: Evaluation matrix of financial instruments using different critieria

Note: the instruments described should be understood as "generic" schemes as the table summarizes perception over a variety of country-specific schemes.

The appropriateness of financial instruments is highly dependent on each technology or project's development stage. Current perceptions indicate that access to finance can be enhanced by **innovative public-private approaches** for equity provision to technology developers and by **guarantee mechanisms** for project developers. However, the need for capital depends on technology specificity, stage of development and country specificities. Some innovative instruments such as guarantees or mezzanine funds can have a significant multiplier effect as it contributes to cover technical and political risks (certainty for investors) but are still quite rare.

Figure 55 presents an evaluation of the different financing instruments based on the criteria described previously. The first columns of the table indicate for which phase of technology and project development the financial instrument appears to be required. For example, venture capital concerns emerging technologies (R&D and demonstration or pre-commercialization phases), and contingent grants finance projects at the start-up phase. In accordance with **Figure 54**, the last columns of the matrix show a qualitative assessment according to the evaluation criteria: efficiency, effectiveness, certainty for investor, long-term competitiveness, governance and market compatibility (the latter is considered applicable only to support schemes). Details on each criterion are presented in the introduction of section 5.2.

The cost **efficiency** of financing instruments highly depends on the design of each instrument. For example, the efficiency of public-supported grant mechanisms will depend on the ability of public R&D programmes to select the most promising technologies. This in turn implies a selective process to allocate financing, which can be detrimental to small companies who cannot spend significant resources in application procedures for grants. Overall R&D grants can hardly be considered as a cost-efficient funding solution since no return on investment can directly be linked to the expenses involved. Contingent grants can become much more efficient solution as the donors will recover their funds in case of successful outcome of the projects supported. These funds will therefore be available for supporting other projects. On the other end of the spectrum, guarantee mechanism are considered as cost-efficient as they have a strong multiplier effect for accessing private debt and equity. The cost-efficiency of guarantee mechanisms is also based on the fact that these instruments are usually designed with a fee level tailored to compensate costs of potential losses.

Based on the definitions provided earlier, the **effectiveness** criterion relates to the capacity of public money invested to attract follow-up funds from private investors. In this perspective, the instruments with the strongest leverage effect will be public-private mezzanine finance and guarantee mechanisms. In both cases public money invested allows to cover in part several risks related to the technology or to the project (or to a portfolio of projects). In this sense, these mechanisms enable to increase the confidence or private sector investors, with a limited amount committed by public budgets. Public equity can also in certain circumstances act as a "cushion" or risk mitigation instrument for private sector co-investors in a special purpose vehicle or in a technology company. This is based on the perception that public investors will have carried out very deep due diligence procedures before committing to finance or on the fact that public equity may in some cases carry more risks that other investors.

In fact, a number of public equity or public-backed equity funds (including by the EIF) have emerged over the last years. Examples include the High-Tech Gründerfonds in Germany (although not dedicated to renewable energy) or the UK Carbon Trust, which aims at leveraging its own resources with other private funding. On the other hand, grants for R&D and technology development do not allow raising private funds immediately (due to uncertainty over the technology at this early stage). The involvement of the private sector usually materializes later on, once the results of R&D programmes indicate that commercialisation and long-term profitability are likely to be reached.

Certainty for investors is mostly enhanced by guarantee mechanisms. These mechanisms are used when high-risk perceptions restrain private investment in RE technologies or projects. Guarantee mechanisms allow in these circumstances to facilitate the projects' or technology developers' access to finance, to reduce the developers' cost of capital and to expand loan tenor or grace period to match project cash flows.

The question whether a financial scheme contributes to improve the **competitiveness** of the EU's RES sector strongly depends on the overall policy design and existing support schemes. As already stated, the competitiveness of a sector depends on the growth dynamics, on the cost decrease in the manufacturing process and on the innovation process. Venture capital is essential for the emergence on the market of new technologies and for bridging the gap between research and commercialisation. Economies with a limited VC ecosystems usually need to develop complementary measures (incubators, public seed capital funds, grant programmes) to support the emergence of innovative technologies.

Regarding the **governance** criteria, the guarantee and the mezzanine fund mechanisms are the most complex financial instruments to implement. However the institutional arrangements of instruments such as VC, PE and credit lines in which the public investors are involved can also significantly increase the complexity of the establishment of the instrument. In any case the difficulties encountered here relate to operational procedures and to legal conditions, and are extremely limited in comparison to the setting up of a national support scheme.

Discussions carried out with VC/PE funds and with debt providers indicate that there is no one-size-fits all solution but rather a **mix of instruments** that will be appropriate to specific levels of maturity of technologies or projects, and to various country-specific context[38]. **Overall market players mostly favour instruments that ensure long-term stability** (matching the projects' long-term perspectives), transparency and a certain degree of harmonization at international level.

[38] Country-specific context is deteremined by multiple factors among which are public budget policy, industrial background of a country, existing public support schemes other than aimed at renewables, industry structure, existence of a strong equity and venture investment eco-system or position of importer/exporter of electricity.

5.3 Improving access to capital for the RES sector: assessment and options for improvement

Existing financing instruments have enabled investments in the RES sector to reach record-breaking levels over the past few years. However, the current capital inflow in the sector remains too low to enable the achievements of EC objectives at 2020 horizon.

According to Bloomberg New Energy Finance, capital flowing into the RES assets in Europe was worth €35bn[39] in 2008 (peak investment level over the period 2002-2009). Yet, capital expenditures needed to achieve the EU objectives would be approximately €70bn per year until 2020. This would lead to a gap of at least €35bn/year until 2020 that is to say a €350bn investment gap between 2010 and 2020. This total investment gap by 2010 is a gross estimate based on available data, it should therefore be used cautiously. The funding required for all the investments in the renewable energy sector including early stage technology funding is even higher than the above.

Above values are confirmed by the model-based assessment as conducted within this study. As illustrated in Figure 56 a gap in size of 26 to 35 billion € per year would occur at EU level according to the Green-X scenarios discussed in section 4 of this report, whereby the range refers to the different policy pathways as researched in this respect. Insights on the country-specific situation with respect to business-as-usual (BAU) and for fulfilling the 2020 RES targets required capital expenditures are given in Figure 57, illustrating the expected average yearly capital expenditures for RES in the period 2011 to 2020 at country level for selected illustrative policy scenarios. It is apparent from this figure that the majority of countries would have to take strong efforts to mobilize the needed investments – two exceptions from that common pattern are Italy and Spain where capital access is expected to be above the required levels assuming a continuation of current RES support.

[39] In 2008, Bloomberg New Energy Finance identified $43bn (€35bn) asset-based and structured funding deals related to renewable energy generating capacity in EU27.

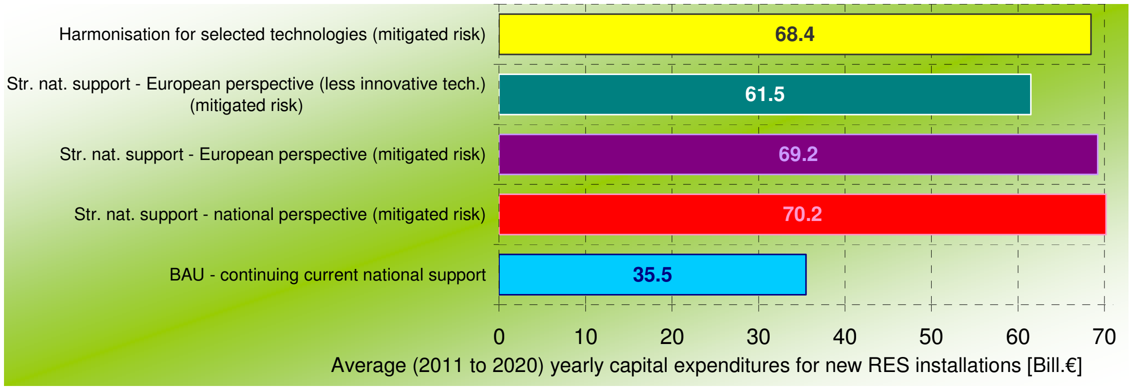


Figure 56: Comparison of yearly average capital expenditures for new RES (installed 2011 to 2020) in the EU-27 for selected cases (i.e. BAU as well as strengthened national / alternative policy cases with proactive risk mitigation)

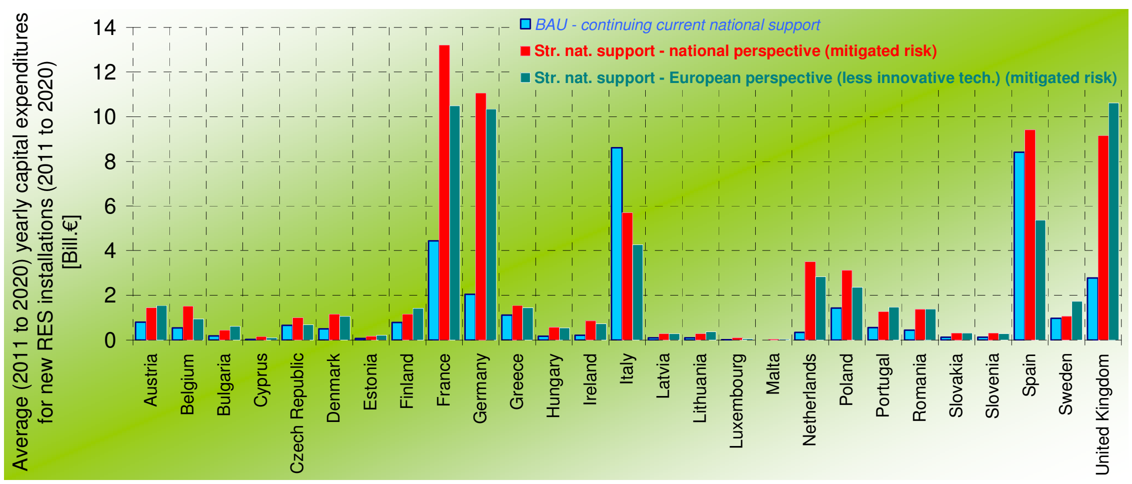


Figure 57: Comparison of yearly average capital expenditures for new RES (installed 2011 to 2020) by country for selected cases (i.e. BAU as well as selected strengthened national policy cases with proactive risk mitigation)

Existing financing instruments have permitted investments in the RES sector to strongly increase over the past few years. However, the capital inflow in the sector remains too low to enable the achievements of EC objectives at 2020 horizon. The following sections provide an estimate of the financing gaps until 2020, an overview of key barriers to financing RES deployment and a presentation of several potential improvements to the RES sector's access to capital.

5.3.1 Evaluation of the financing gaps

In 2009, an estimated $162 billion was invested in the renewable energy sector in the world, mainly invested in assets. Despite a reduction of 7% in 2009 over 2008, investments in the renewable energy sector has grown at a compound annual growth rate of 14% since 2004.

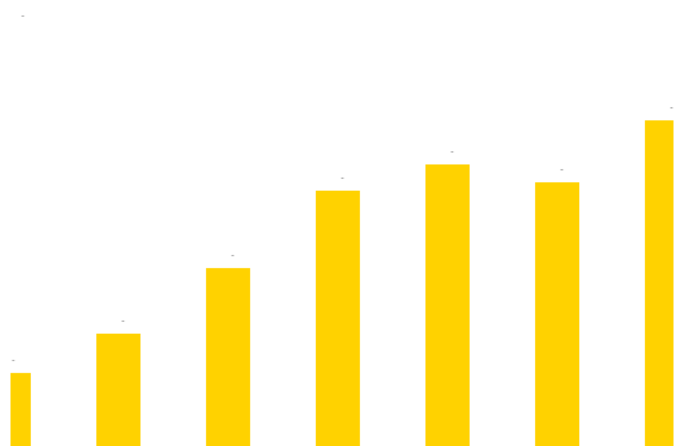


Figure 58: Investments in Renewable Energye (*Source: Bloomberg New Energy Finance)*

As per IEA World Energy Outlook 2009 numbers, the IEA base case projections estimate that over 42% of total new power capacity to be installed between 2008 and 2020 period will be renewable energy power capacity, representing an average annual growth rates of 4.1%.

By 2020, BNEF expects that $150bn will be invested in clean energy, though $500bn per year is required to limit global temperature rise to <2C.

Dealing with European figures, data for capital flowing into the renewable energy asset investments were €35bn in 2008 in Europe (Source: Bloomberg New Energy Finance), that was the peak investment over the period 2002-2009. Yet, capital expenditures needed to achieve the EU objectives would be approx. €70bn per year until 2020 (see above). This would lead to a gap of €35bn/year until 2020 that is to say **a €350bn investment gap between 2010 and 2020**. Data from NLD Taskforce Offshore Wind Energy forecasts that until 2020 an additional 40 GW of offshore wind energy will seek for capital, equalling 150 billion €. The financing gap would be 95 billion € for offshore wind energy alone that is to say about 10 billion € per year corresponding to 25% more than the actual investments for all RE-technologies per year.

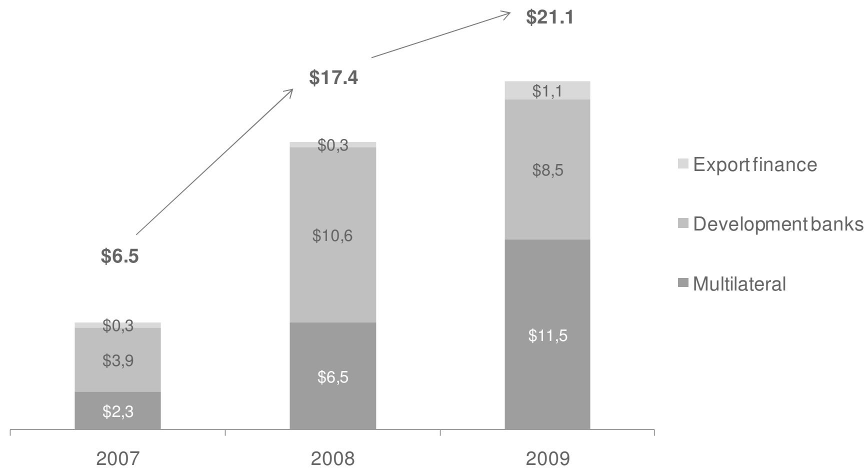
The funding required for all the investments in the renewable energy sector including early stage technology funding is yet higher than the above. The funding is materially influenced by the asset capital cost assumptions that in turn will depend on the cost of raw materials; labor etc for which all the countries having renewable energy targets will be competing for. Apart from solar, other renewable energy sectors are heavily dependent on materials that are likely to be in short supply (or pose constraints from an extraction and processing perspective). This implies that the asset capital costs on a unit basis is likely to stabilize or not decrease too much in real terms in turn implying that the estimated capital investment projections calculated above are not very aggressive.

The principal debt financiers in the European renewable energy sector have been the banking sector. A few projects have accessed debt capital markets but the depth in the institutional market is relatively low compared to the US institutional market, where projects in the energy and infrastructure sector have accessed debt capital markets. The situation has been exacerbated by the impact on the monolines. Almost all previous capital market issuances in the renewable energy sector have been insured by the monolines insurers who had AAA credit ratings. Therefore the investors in the capital market debt issued by renewable energy projects, benefited from the AAA credit ratings of the monolines and took substantial comfort from those ratings without having to review the complex renewable energy project structures. Post-crisis, most of these monolines have lost their AAA credit ratings thereby removing a source of insurance cover that the debt capital market investors can take comfort from. As the result of the financial crisis from mid 2008 onwards, the multilateral banks such as the European Investment Bank (EIB) have filled a void on the project finance market and significantly increased their involvement in supporting RES projects (see chart below). As an example, the EIB's loans to the RES sector reached over € 4 billion in 2009.

Capital availability in the renewable sector from the banks is influenced by a number of factors below:

1. Capacity of banks to lend long-term to the renewable energy sector;
2. Ability of banks to recycle that loan capital through secondary loan markets to other long term institutional lenders such as pension funds, insurance funds or other capital markets (through financial mechanisms through project loan securitizations etc.);
3. Impact of bank regulations on asset-liability mismatches.

Multilateral and development bank lending for clean energy projects ($ billion)



Source: Bloomberg New Energy Finance

Interviews with a sample of European banks actively lending to the renewable energy sector have also confirmed the appetite of banks to lend to projects in the sector, subject to certainty and long-term certainty in the regulatory framework for investments in this sector. However, due to the above factors, there is a large funding gap and banks have had to limit their lending to their core relationship clients and be selective about the countries in which they lend (home markets for example). For instance, the recent "Basel 3" banking regulations which will govern the capital and liquidity buffers banks carry, will also lead to much cautious lending policies from the banks. Some professionals interviewed consider that there is a risk of severe shortage of capital, which could hinder the achievement of the 2020 RES targets; however this view is not shared by all.

Interviews with banks have also confirmed that any additional capital from external financiers (EIB or the capital markets) or for risk mitigation (again releasing their capital on their balance sheet enabling them to lend more to new projects) will be very welcome. These aspects are detailed in the next sections of the report. On the capital markets, some quasi-governmental agencies are proposing to fulfil the role of the monolines. In some new renewable energy transactions, these agencies are proposing to provide insurance cover for debt capital market investors, thereby providing the latter with the same degree of comfort, that they used to obtain from the insurance cover of debt issuances from the monolines. However, these deals are being structured now and the acceptance of the financial markets has not been tested or known.

5.3.2 Key barriers in access to finance

A number of previous studies have attempted to identify the barriers encountered by RES projects in obtaining financial resources. The barriers or difficulties most frequently identified include insufficient awareness among financial institutions of sector-specific risks and opportunities (preventing them from adapting their standard corporate or project finance products to RES requirements and conditions) as well as concern about risks.

On the technology (upstream) side, lack of experience with new types of sponsors, business models, markets and/or technologies can render private investors reluctant to fund innovative projects/ventures.

On the project (downstream) side, the risks perceived by investors often relate to the performance of the installation (quality of equipment/availability of the resource), the experience and reliability of the project developer or owner, difficulties in obtaining operating licenses and other administrative hurdles, as well as the ability to negotiate and to secure an adequate PPA (which is critical for the risk level of a project in countries where no feed-in-tariff system exists). Although the technology risk can, to some extent, be mitigated by performance or completion guarantees, some consider for example that most manufacturers and suppliers of solar PV equipments do not have the financial capacity to back a completion or performance guarantee for large projects. In addition, performance guarantees from solar PV manufacturers are in most cases limited to a short period. This perceived risk leads to higher expectations from investors in terms of returns, and high collateral guarantees or risk premiums requested by lenders. Risks issues related to innovative technologies are also difficult to cover by the commercial insurance market: with the exception of onshore wind, there is a limited understanding of most RES projects and associated risks from insurance practitioners.

Risk management is therefore one of the keys to the deployment of RES as it influences the availability of finance. For instance, difficulties to raise project finance encountered since the last quarter of 2008 show that the credit crunch has impacted gearing ratios and margins whilst also focusing more attention on the risk management and mitigation, financing structure and sponsor track record. Understanding these risks is important to design the most appropriate financing instruments and improve access to capital to the most promising technologies that will help achieving the 2020 objectives. The following sections present the main risks that may have a significant impact on access to finance for RES technology. These risks are presented by technologies and by countries.

5.3.2.1 Specific risks by technology

On a technology point of view, financiers require evidence that the project will be developed with minimum risks. Financiers usually expect the project to be secured (single point EPC, building permit signed, resource secured, PPA contract signed) before lending. This section presents the main risks linked to technology development that constitutes barriers in the access to finance.

The synthesis table in Annex 5.3 shows the barriers by technology for the most promising technologies in achieving the 2020 objective (considered here as those that can scale up rapidly until 2020 – wind, solar and biomass essentially). It shows the specific barriers a project sponsors faces when developing a RES project. From the access to grid to the resource planning, these barriers specific to renewables make the access to finance for RES projects difficult.

The barriers identified in the Annex tables are developed below by category:

Planning and development

The planning and development phase can be lengthy depending upon the authorisation and approval processes in place in the host country and public opinion with respect to the technologies employed.

Depending on the technologies, this phase is more or less risky. Administrative requirements, contracting for resource supplying, resource exploration are different issues that can have impact on the timing of a project development and therefore on the IRR.

For many technologies, acquiring planning approval is a major hurdle and a key step in the valuation of the project. Several examples of planning risks are given below:

- Planning for **wind projects** typically attracts the most attention from various stakeholders and can therefore lead to approval taking extensive periods of time;
- Rooftop **solar PV** installations may be able to avoid the need for planning approval; whilst ground mounted systems will have more complex planning requirements due for example to the visual impact of these installations;
- **Biomass** plants tend to be located on brown field sites away from residential areas and therefore pose few planning difficulties, depending on national and local legal requirements.

Securing resources can also be an important factor of risk in the development of projects, for example:

- For biomass, it can be very difficult to secure a bankable feedstock contract providing long-term certainty over volume, specification and price;

- Development of CSP using parabolic trough technology may also be constrained by the need for an adequate supply of water for the purposes of evaporative cooling.

Access to grid/ infrastructure

Access to grid and infrastructure is one of the key risks for renewable projects and can vary widely depending upon the status of the existing infrastructure in a particular country and on the rules for connecting to the grid. Insufficient transmission grids for RES-E and RES-H are potentially one of the strongest barriers for reaching the target at lower costs. Lead times to obtain existing grid connections or the development of grid infrastructure to meet the needs of the development can be very long resulting in project delays. For example, the remote nature of CSP and offshore wind projects can often result in very intensive capital costs. This issue is directly related to the regulations existing in the host country. A simplification of the procedures could help reduce the risk perceived by financiers.

Construction risk

As mentioned in this section introduction, the contract structure and interfaces are also very important in creating a bankable project and the involvement of a large number of counterparties can lead to increased complexity resulting in higher construction risk. Sponsors may choose to manage contractor interface risk directly or through an EPC (Engineering, Procurement and Construction) "wrap" provider. EPC wraps take risk out of the project although the added cost must be factored into overall equity returns. In the current market, it is unlikely that a contractor will offer a fully wrapped EPC contract.

Other risks in construction include delay, which may result in the deadline for a tariff category being missed, sub contractor risk with regards to robustness of collateral warranties and supply chain issues relating to availability of key technology components. A guarantee on the construction risk is one of the instruments that some financiers mention as a possible means to mitigate this risk.

Operation risk

The O&M strategy employed will have a direct impact upon the production of the plant; this risk is typically passed out of a project through a long-term contract with counterparties with expertise in the plant operations of the particular technology. For example, operational risk for offshore wind is increased by the inability of turbine manufacturers to provide warranties for increasingly large-scale projects. On the contrary, solar PV has limited operational risk due to there being no moving parts and regular maintenance is limited to cleaning of the solar panels.

Any delays arising during the development phase may result in the project missing the deadline for its target tariff category, resulting in lower project returns. As this risk is quite important for the economy of the project in the long-term, its mitigation is key to ensure access to finance.

Resource quality risk

Forecast resource in terms of load factor and irradiation levels is particularly important for wind and solar technologies, with reliance placed upon reports provided by technical advisers.

Biomass depends also heavily upon the ability to contract feedstock at the required price, volume and specification. This specific resource risk gives biomass a very risky aspect for potential investors.

Conclusion

In raising finance, it is important that the technology has a proven track record and a minimum operational risk profile. Onshore wind and solar PV are considered to be the most proven technologies and relatively low risk from a project finance perspective according to projects financiers. Access to finance for these technologies will be less an issue than for biomass or offshore wind and yet these technologies have a high development potential as well. For example, traditional thermal treatment for biomass is considered bankable however gasifiers are not as proven in terms of technology and will be dependent upon the level of security from the EPC wrap. Equally, access to finance for offshore wind can be difficult when large amounts of capital are required to fund the large-scale offshore wind projects. Some investors still consider offshore wind to not be commercially viable and too high risk for investment, partly because a sound EPC model has not yet been developed for offshore wind.

Improving the access to finance for promising RES–technologies will have to include specific effort on the technologies with highest risks.

5.3.2.2 Specific country risks

Besides all the risks associated to one technology or one degree of maturity of a technology, the host country plays an important role in the investment decision. Investors need certainty of cash flow through long-term PPA. The certainty that policies once established will remain in place and that they will remain funded over the long term is a key criteria in their investment decision.

Security of PPA thanks to FIT or secure support scheme

Feed-in tariffs or secure support scheme for energy selling are existing in most western European countries providing an important security to investors. FIT currently implemented in Europe have different specific characteristics in terms of eligible technologies, tariff by technology, payment term that are essential for investors.

The greatest difficulty is finding the balance between satisfying investors with good FIT conditions, market flexibility and the burden of cost on the consumer. According to DB Climate Change advisors, the five crucial factors for FIT are the following:

- Guaranteed payment : ensure RES developers a minimum payment;
- Must take rules : priority purchase of RES on the grid;
- Long payments terms : more that 15 years;
- Determine pricing through generation cost;
- Provide ways to benefit from complementary incentives.

Stability is also a key element due to the projects' long-term horizon. As an example, the potential Spanish cut in tariffs for existing projects would be a negative signal in terms of policy security. According to the investors interviewed, the supply of debt would be put in danger even for countries such as Germany where the policy risk is quite low.

An example of the huge importance of regulation stability in RES financing can be given for UK. Following the introduction of technology-specific level of support for ROC / MWh in April 2009, the biomass level were put in question by the government since a large proportion of biomass generators'costs are ongoing varying fuel cost, as a consequence grandfathering the total level of biomass support for 20 years (RO support duration) would create distortion. As a consequence, the level of support for biomass were put in danger and investors began to place a higher discount rate on projects to account for the increased risk, making difficult for these projects to secure an adequate level of funding.

The current uncertainty around grandfathering means that both acquisitions and project financings of biomass projects have been put on hold until further clarity is gained from government. As a result, many of the identified 5 GW of biomass projects in planning or at pre-built phase have stalled. From an equity investor's perspective, it is likely that they could form a view on the floating element of the ROC (which may be linked to an index such as international wood chip prices), much as they do already on ROC Recycle and Levy Exemption Certificate (LECs) prices. The increased level of volatility and risk associated with such a scenario may be reflected in a higher hurdle rate by those equity players than required prior to the grandfathering issue.

Uncertainty about policy has been identified by most financiers as a key barrier to the development of RES technologies in a few European countries. When a mechanism does exist, it can be judged as uncertain or not adequate by investors. Countries where the tariff is paid in local currency, where the payment term is too low or where the policy is perceived as unstable are considered as risky by investors. For countries outside the Euro zone, the used of foreign currency will lead to exposure to foreign exchange risk.

The Greek credit crisis could have an impact for renewables by slowing down the availability of project finance. **Countries with the greatest debt exposure (Italy, Spain, Portugal and Greece) could find their renewable programmes more difficult to implement.**

Attractiveness of European countries

European countries have different level in terms of attractiveness and though access to capital for RES project.

According to Ernst&Young "Renewable energy country attractiveness indices", Germany is the most attractive country in terms of RES investment in Europe. This is linked to the maturity and stability of the country in terms of regulations and support schemes toward RE. Besides, the country's offshore potential has been confirmed with the launch of Alpha Ventus Project in 2010, the first German offshore wind farm. A rapid growth should be observed until 2020 in wind offshore in Germany.

Italy will be a very attractive country despite its debt exposure. Italy plans to build Europe's largest solar PV plant. Besides, the dynamism of Italy in onshore wind sector is worth noticing (+30% onshore wind power installed in 2009). Offshore wind is expected to experience a strong growth during the next few years, Italy has the potential to achieve 2 GW by 2020.

In the UK, the planned creation of a green investment bank which includes 2,3 billions of euros to bridge the "equity gap" in the funding of offshore wind projects make the country very attractive in this setor.

Conclusion

As RES projects are very capital intensive, access to capital and capital costs financing are of the main issues of RES-sector.

RES developers and sponsors are classified as **higher risk** clients because of their specific characteristics as:

- Newer technology;
- Smaller project sizes in some cases;
- Higher capital costs to operating costs;
- Strong dependence of policy and regulations horizon;
- Lack of full competitiveness on the market.

According to the interviews with banks, most lenders ask for an IRR between 12% (for the most mature technologies) and 20% (for the less mature ones), although this obviously varied according to the investment policies of each financial institutions and a full visibility on cash flow future. The full visibility includes visibility on the resource (availability, price), EPC (Engineering, Procurement and Construction) and PPA (Power Purchase Agreements) which can be a significant challenge for some technologies and some countries.

5.3.3 Options for improvements

The ambitious European 2020 targets on energy and climate - and more particular for renewable energy – ask for a huge mobilization of investments in the coming decade. The financial and economic crises add to the challenge of directing capital to the renewable energy sector. The deployment of most renewable energy technologies still needs both financial and non-financial policy support, due to the stage of development of either technology or market, and due to fact that renewables still do not have the same playing field as conventional energy technologies.

Policies are designed to level this playing field, but policies themselves might be reviewed critically due to the successive crises and the associated pressure on either government budgets or purchasing power of energy consumers. On the other hand, large-scale deployment of renewable energy may be an important element in overcoming these crises by paving the road for a new arrangement of the economy, with a stronger focus on sustainability in the broadest sense (e.g. see UNEP's Green Economy Initiative[40]). In the longer-term, these crises could be turned into a major opportunity for renewable energy deployment.

As we have seen in the previous section, **risk is a key parameter to explain the difficulties of RES technology and projects in accessing capital** due to the specific risk/return ratio for RES-projects. Indeed most RES technologies have high risk and long-term return.

Risk mitigation options are presented below. The following options are the main options that have been discussed during interviews; some of the ideas presented have been indicated in a study commissioned by the IEA-RETD and performed by Ecofys[41], which addresses several RES-E options in various countries.

5.3.3.1 Mitigate technology-specific risk

Provide technology evaluations to cover technology risks

Risk assessment tools and rating of renewable energy technologies and projects could be developed in order to:

- Offer an independent opinion on the likelihood of a project's ability to deliver the expected returns;
- Increase a developer's ability to attract investment. The possibility to rate some projects as "investment grade" projects (i.e. above a specific rating level) would attract investment and enable access to capital at reduced costs;

[40] The Green Economy Initiative, www.unep.org/greeneconomy, accessed 15/06/2010

[41] D. de Jager, M. Rathmann, 2008: Policy instrument design to reduce financing costs in renewable energy technology projects. Ecofys, by order of the IEA Implementing Agreement on Renewable Energy Technology Deployment (RETD)

- Create a sound basis for public institutions to state which RES technology/projects are lacking access to capital and, as a consequence, would need public fundings to bridge that gap, due to specific technology or country-specific risks;
- Encouraging a more rapid commercial-scale deployment of emerging technologies.

This rating would help to mitigate the technical and project specific risk. Typically, this would include a review of:

- **Project context risks:** covering country and site-specific risks (political, economic, financial, regulatory, force majeure, etc.);
- **Construction risk**: this would cover the risks involved with the build, the interfacing of different contracts, the degree of protection from liquidated damages for project delays, other damages, build timing;
- **Technological risk**: each RES technology would be assessed in the light of its maturity, operating history, fitness for purpose and warranties. The assessment would be undertaken by appropriate specialists often working closely with the technology supplier;
- **Environmental risk:** environmental and social risks associated with the project, often subject to legal requirement for an impact assessment;
- **Operation and management risk**: covering risks related to the project developer. Assessment would be made of staffing (management strength, staff competency etc.) and costs, as well as contracts required during the operational period and provisions required for decommissioning;
- Etc.

This rating could be performed by a dedicated EU rating agency or possibly by traditional rating agencies (such as Moodys or Standard and Poor´s, which have already launched clean technology indexes). If the option of an EU agency were to be pursued, it would require to provide direct advice to financial bodies in charge of issuing loans, loan guarantees, letters of credit, and insurance support, and/or by taking direct equity stakes.

Provide guarantees and insurance on specific technology and operational risks

Specific risks associated to a technology development have been presented in the previous section. The risks range from construction/completion risks, performance risks to Fuel supply/Weather resources risks, etc. Minimizing the risks is therefore one of the key challenges to gain access to capital.

These perceived risks can be mitigated by insurers. According to previous works from UNEP and SEFI (Financial Risk Management Instrument for RES Project, UNEP, SEFI), **if commercial insurance policies were available** for some specific technology and operational risks then private sector investment in the sector grows by a factor of four or more.

However, insurers need historical and technical data such as technology performance and weather data. Indeed, pricing structures for non-mature technologies (for example wind offshore, biomass or CSP) are not standardized and the need of statistical data is certain for measuring probability distributions and correlations between random loss events.

The development of technology-specific private insurances could be encouraged by public organizations. Indeed, public organisations could improve the flow of information about real insurance risks of RES-technology by funding pilot projects to acquire track records for less mature technology. However, this type of support would not be of huge efficiency to achieve medium-term objectives (in 2020) since obtaining consistent statistical data requires a sufficient period of time.

However, a financial risk mitigation instruments that would involve both public and private actors would be very interesting in a medium term perspectives. During the survey conducted by Clean Energy Group and BNEF, the innovative idea of **a private-public efficacy insurance** emerges from industry players. The concept is private-public cooperation in designing a **new type of insurance especially for RE-projects regarded as too risky for conventional insurances**. This insurance would provide a protection against a technology that does not perform at the level projected by its developers. For example, it could insure a reparation or replacement of the underperforming piece of equipment. It could also provide liquidated damages up to the value covered by the policy. Insurers have the requested technical skills to assess specific technology risks. Project developers would pay a premium and transfer the performance risk of the new technology elements to the insurance pool. However, given the risks involved, private insurers are not likely to create on their own pool. A portion of the risk could therefore be guaranteed or funded by a Public Organisation. At the MS level, policymakers and insurers could establish a pool of capital whose purpose would be insuring specific technology risk mitigation for projects that employ new non-mature RES technology. Policymakers could work directly with debt and equity providers to identify specific risks that they would not take.
Such schemes would remove much of the technology risk and facilitate access to capital for RES technology.

Provide a specific support to the less mature technologies
Especially for technologies that are at the early stage of development and/or with high technological/project risk, the level of support in feed-in tariff/premium schemes is hard to determine. This is one of the reasons why some governments use tender procedures to establish the ‘correct’ level of support. Due to the existence of regulatory and technological risks this level will be at the high end.

In an open book process, the level of support (or part of it) is determined on the actual finances of the project. The project investors (and maybe even other actors in the supply chain) are allowed to earn an agreed rate of return.
The default level of support is adjusted in case actual finances have changed, but the scheme incorporates a bonus for performing above expectations. In this approach, the tender will not be evaluated on price but on other criteria.

This is a far-stretching approach, both for governments and project developers/investors. However, several project developers have indicated that they would welcome such an approach. As indicated above, it is most relevant for technologies at the early stage of development and/or with high project risk, requiring significant investments. Once the technology or market has developed further, other procedures or support schemes could be applied.

5.3.3.2 Mitigate Policy Risks (Regulatory, Societal, Political)

A clear political and societal long-term commitment towards renewable energy is required. Based on this, a stable and reliable support mechanism can be designed. Commitment, stability, reliability and predictability are all elements that increase confidence of market actors, reduce regulatory risks, and hence significantly reduce cost of capital. This effect can be significant: the levelized cost of electricity can be reduced by 10 to 30%, as compared to a support scheme with no particular attention to risk mitigation.

Options for EC to support commitment, stability and predictability in the MS include the increase of EC interaction with national RES policies to harmonize the different support mechanisms and attractivity of countries.

As the policy or incentive mechanism is a key part of making RES project economics attractive, changes to these factors pose a risk: a long-term, stable policy regime with a sound legal basis is essential for serious investment to occur. Regulatory risk is also considered in depth for the permits, authorisations and licences required to plan, construct, operate and decommission RES projects.

RES developers and investors often complain about this lack of long term visibility on RES regulatory framework in most of MS. Recent regulatory developments, in particular the decrease of FIT in Spain, France and Germany and rumors on retroactivity of FIT decrees, do not improve the developers and investors confidence in the RES market.

Increase European Commission interaction with national RES policies
The EC could play a role in supporting MS setting up and maintaining stable and consistent regulation, well managed price or other reviews, and clarity over the development of regulations or policy to implement new RES legislation.

This role could consist in various actions:

- Issuing guidelines for MS on setting up and maintaining long term visibility RES regulation;
- Lobbying on RES development and achievement of the 2020 RES targets at the level of Member States;
- Putting conditions on support given on RES projects development in the beneficiaries States. As a example, long term loans or grants could be supplied by EC at the condition that the State benefiting from this support commits on putting sound RES regulation in place;
- Increasing control over the national policies and develop enforcement on compliance with RES objectives. As part of its mission, the Court of Justice of the European Union could play a key role in ensuring that the Member States comply with obligations under the EU directives on RES development.

Provide a guarantee on PPA

As it has been described above, the stability and certainty of PPA is of huge importance for investors and varies a lot between European countries. Most lenders are reluctant to lend money in some specific countries with high policy risks.

This would be all the more difficult to leverage money for a project when the support is not in Euros.

A guaranteed revenue over a sufficient fixed period of time (> 15 years) and in Euros would be very welcome by financiers. A guarantee mechanism could be implemented in Europe to cover the policy risks in specific countries. This guarantee would insure a minimum PPA by technology in every European country.

5.3.3.3 Increase public finance participation into projects

Especially for large-scale projects, requiring investments of 50 M€ or more, with significant technological, regulatory, or market risks, government participation may help to establish financial close at lower cost of capital. This would notably be relevant for offshore wind energy (with a large expected contribution in meeting the renewable energy targets), large geothermal projects, or large bio energy projects that may be susceptible to variations in biomass prices.

Different Public Private Partnership (PPP) models can be envisaged, all contributing to lower (societal) costs and increased deployment rates:

- Project development phase: The government and project developer may set up a joint venture in the project development phase. After achieving all permits for the project, the government may either sell its shares in the project or continue its participation;

- Financial closure: The government participation may be (re)structured, as equity or as subordinated debt – for instance together with the European Investment Bank (EIB);
- Construction of the project: After construction and successful operation of the project for a number of years, the government may again decide to terminate the participation by selling its shares, or through refinancing of the subordinated debt by another party. At this stage most of the construction and technological risks have been reduced significantly, which makes it easier to attract relative cheap finance.

This model is not new. For instance in the Netherlands and Denmark state-owned companies participate in the exploration, development and production of oil and natural gas by providing 20-40% of the equity[42]. The Crown Estate in the UK participates with 50% in joint ventures for project development of (a.o.) offshore wind energy.
The benefits of a pro-active and participating government are manifold and have a significant impact on the costs of capital:

- Government participation can provide a significant amount of capital, either equity, (subordinated) debt, or mezzanine finance;
- Project financing will be achieved easier and at lower cost. The percentage of project initiatives that actually will be realized will increase. This will strengthen the confidence of the market;
- By reducing the regulatory risk, the cost of capital can be reduced significantly (see example for offshore wind in the text box);
- Windfall profits can be avoided or reduced. Via the government participation part of these flow back to the treasury;
- By participating in projects, the government gets a better insight in the challenges and barriers that the market is facing. This allows the government to pro-actively develop supporting policies, e.g. for mobilizing the industry supply chain;
- A state-owned entity responsible for this type of participation can be a safeguard for ensuring a stable renewable energy policy.

Some initiatives of Public – Private partnership are already existing in Europe such as the French FIDEME, described in previous sections, a **public-private mezzanine fund** open to French SME who face debt/equity gaps. Risks were taken by the French agency for environment ADEME and leads to substantial investments in RES technology in France. Instruments such as FOGIME, a public-private loan guarantee mechanism, described in the previous sections, could also be replicated in other MS or at a European level as it offers important leverage potential.

[42] Since 1973, Energy Management Netherlands (EBN, www.ebn.nl) is participating on behalf of the Dutch State. It can claim a 40% share in oil and gas exploration and production. Since 2005, the Danish North Sea Fund (www.nordsoeen.dk) can claim a percentage of 20%. Both companies are 100% state-owned.

5.3.3.4 Patient equity

Part of the difficulties encountered by project developers to raise capital today lies in securing a sufficient proportion of equity in order to access to larger debt amounts. With the recent tensions on the credit market, the equity/debt ratio has increased, as well as the overall costs of available capital. Another issue relates to the fact that equity providers mostly aim at limited investment durations (4-5 years) before divesting, and expect relatively high profitability (often over 15% IRR for the entire portfolio).

For these reasons, discussions about developing a “patient capital” approach (i.e. equity funding with return requirements that are delayed in time or lower in profitability than normal commercial thresholds) have emerged over the last years. Equity providers whose investment horizon would match PPA durations (20 years for example) would significantly increase the attractiveness of the project for other investors and possibly lower the overall LCOE by reducing the costs of capital (WACC). Several players (family offices, insurance companies, pension funds) which traditionally seek long-term investments with low risks and secure returns would for example be potential “patient” investors.

6 Review and evaluation of existing and alternative support and financing instruments: reducing the costs of reaching the EU 2020 targets

Based on the analysis in chapter 4 and 5 and the RES financing case studies in Annex 6 a review and evaluation of all available instruments is performed in this section. In particular, the question shall be addressed, which contribution different measures can make on the compliance with different EU objectives for renewable energies and in particular on the impact of reaching and reducing the costs of the EU 20% target.

6.1 Qualitative evaluation of the developed policy pathways

The three cases analysed in chapter 4 “Cost scenarios for the 2020 objectives” have been assessed reflecting the range from nationally organized to internationally harmonized support schemes.

The three cases considered can be characterized by the following qualitative aspects (not all of these could be assessed in the model-based analysis and are therefore evaluated in qualitative terms).

1 Strengthened national policies - National perspective

In this case, national support schemes will carry most of the costs. These costs can be mitigated by:

- Moderate use of cooperation mechanisms (optimal resource allocation);
- Risk mitigation by national and international financing mechanisms (e.g. EIB loans) and other measures;
- Financial guarantees by national governments or EC;
- Long term guaranteed political framework, which reduces uncertainty;
- Improved design of national support schemes, e.g. reduced non-economic barriers, increased competition, reduction of producer rents, caps for very expensive technologies, etc.;
- Better coordination of R&D in Europe;
- Stronger efforts to supply the needed infrastructure, e.g. faster extension of transmission grids, support for vessels for offshore installations, etc.

2 Strengthened national policies - European perspective

In this case, national support schemes will still carry most of the costs. However, a stronger EU participation e.g. based on European loans will occur. These costs can be mitigated by:

- Extensive use of cooperation mechanisms in order to enhance an optimal resource allocation;
- One option could be that the EU strongly concentrates on the support of infrastructure for RES development – missing transmission grids for RES-E

and RES-H are probably one of the strongest barrier for reaching the target at lower costs;

- Establish an European working group on the "coordination of RES tariffs" (or broader: RES support, RES investment climate), which might for example reduce cherry-picking of investors between MS (e.g. in case of PV), the EC should have certain competences in this group;
- Loans by European Institutions might only apply if the MS support is given in certain band of a minimum and maximum support level (to penalizes excessive and insufficient support on MS level);
- Use of strong EU measures to enforce building obligation in all new and existing building (according to a maximum interpretation of Directive 2009/28/EC), e.g. give European investment incentives for RES projects in existing buildings, which are subject to an obligation.

3 Alternative policy option - harmonisation for selected technologies

In this case, national support schemes will carry most of the costs. These costs can be mitigated by:

- Optimal resource allocation across the EU, e.g. based on a common or convergent feed-in premium (FIP) scheme for selected technologies;
- Reduced deployment of very expensive technologies;
- Economies of scale;
- Accompanying international financing mechanisms (e.g. EIB loans) (these mechanisms could be used to define (and hence harmonize) the standard for financial support).

Table 21 shows an evaluation of the three main policy cases further defined above against some key assessment criteria. Being introduced in chapter 5, these criteria include:

Effectiveness: Generally, all three policy-cases are suitable for complying with the 20% target for 2020, assuming that the currently existing non-economic barriers can be overcome.

Efficiency (additional generation costs and policy costs): As shown in chapter 4 the additional generation costs as well as the policy costs are very similar in all three cases. The main reason is that efficiency gains in terms of additional generation costs, which can be achieved in the electricity sector for the two cases 2 and 3, are compensated by the fact that a stronger offshore wind energy deployment occurs in these cases as well due to better support to infrastructure development. Due to this fact, a shift from RES-H to RES-E appears to be reasonable in these two scenarios.

Certainty for investors: Regarding the certainty for investors, the two cases 1 and 2 show the best results as these build on the present EU policy implementation and no major policy changes are needed. These cases are characterized by the highest policy stability.

Due to a policy change for selected technologies the certainty for investors may be reduced in the third case "harmonisation for selected technologies" when this transition is not incorporated properly.

Economic competitiveness – long term: The long-term economic competitiveness shows the best score in the cases 2 and 3, because the efficiency gains due to better resource allocation are spent for stronger development for some innovative technologies, in particular wind offshore. Furthermore, an increased European cooperation helps to increase economies of scale and to mobilize synergies in the European innovation system.

Realisable with limited EU budget: Regarding the chances to realize the cases with limited EU budget only case number 2 shows some limitations because it would rely on European Union budgets for example for infrastructure development and the set up of funds for renewable energy financing. These elements may require substantial additional budgets for EU institutions.

Governance: Regarding the impacts on new governance structures and the feasibility to achieve those, the lowest problems are associated to case 1 since no major policy changes are needed here. In case 2, the establishment of some additional European programmes are required, which would involve some but no severe challenges in terms of additional governance structures. Major challenges in this respect are only expected for case 3, because a complete policy shift from the present paradigm of the implemented RES Directive is necessary.

Table 21: Assessment of the three main policy cases against key assessment criteria

Cases Evaluation Criteria	Case 1: Strengthened national policies - National perspective	Case 2: Strengthened national policies - European perspective	Case 3: Alternative policy option - harmonisation for selected technologies
Compliance with the 20% target	++	++	++
Efficiency - additional generation costs	+	+	++
Efficiency - policy costs	+	+	+
Certainty for investors	++	++	+
Economic competitiveness – long term	+	++	++
Realisable with limited EU budget	++	+	++
Governance	++	+	+/-

6.2 The importance of risk

Chapter 5 introduced the importance of risk and risk mitigation in both the access to and the cost of capital for renewable energy projects. As part of this project several case studies were explored in more detail (see Annex 6). The purpose of this analysis is threefold:

- To show in more detail how specific primary and secondary support schemes affect the costs of renewable electricity;
- To show how the levelized cost of electricity differs per country and technology due to differences in risk profiles of both support schemes and technologies;
- To indicate how much cost savings could be achieved by reducing these risks.

The case studies covered Germany, United Kingdom, and Poland and concerned on- and offshore wind energy, large-scale ground based solar photovoltaics, and small-scale building integrated solar photovoltaics (BIPV). The figure below presents a summary of the results.

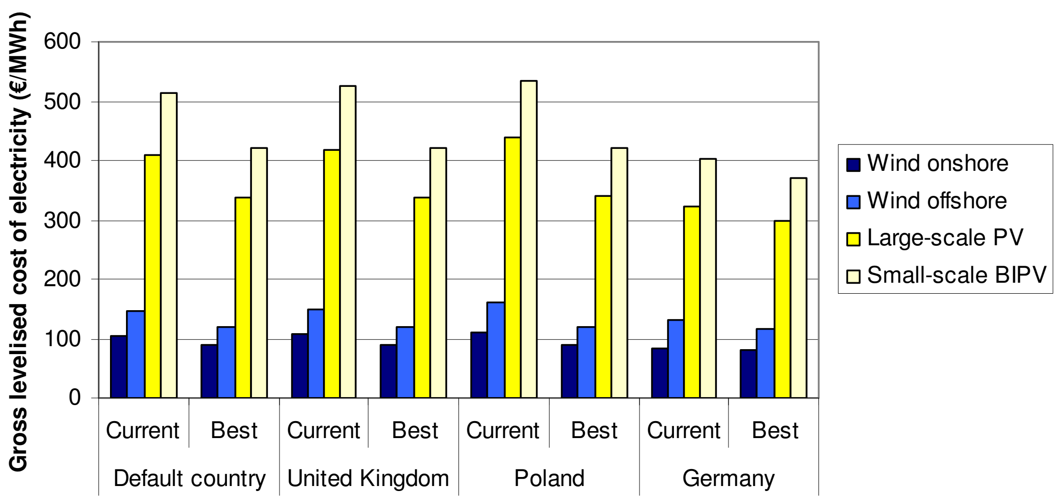


Figure 59: Gross levelized cost of electricity for several case studies

The figure shows the gross levelized cost of electricity (LCE) under different risk circumstances. 'Current' refers to the situation in 2009, with country and technology specific assumptions on costs and finance. 'Best' refers to a situation where regulatory and market risks have been mitigated significantly. In the next section and chapter 5 examples of these measures are given. The figure reflects the differences in the risk characteristics of the different support schemes. Furthermore, it shows significant cost reductions that can be attained, ranging from 3% to 25%.

These reductions are a consequence of the lower risk profiles, which are reflected in reductions in the weighted average costs of capital ranging from 1% to 25% (WACC before tax).

The figure also shows that none of the case studies is economically viable without additional support instruments. The gross LCE is simply higher than the electricity market prices in place. To illustrate the effect of support schemes and financial instruments on the viability and bankability of RES-E, the example of offshore wind energy is presented here in more detail.

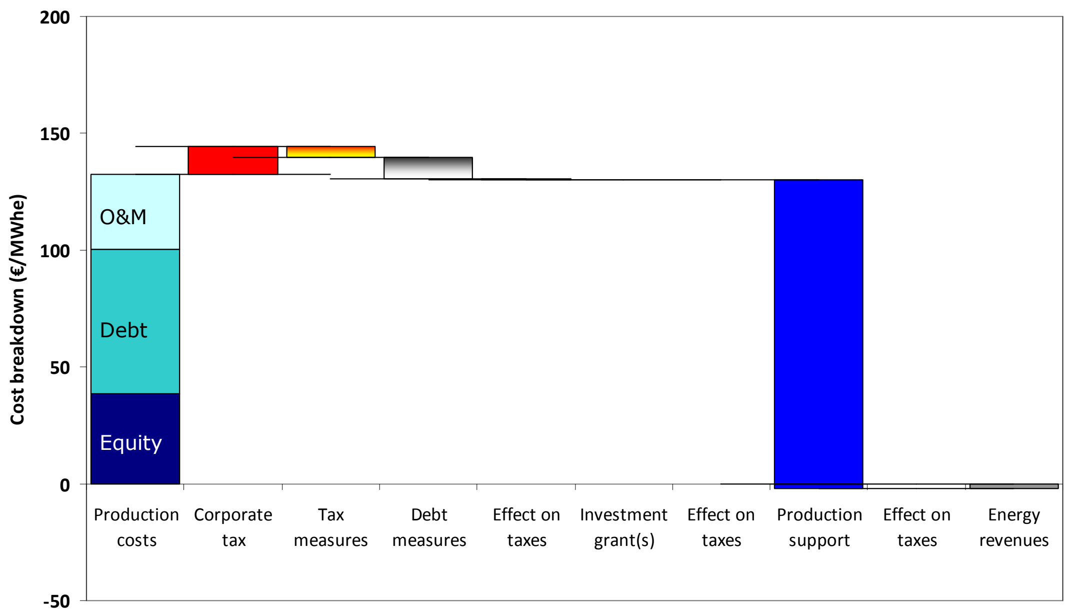


Figure 60: Levelized electricity cost (LCe) for offshore wind in Germany, 2009

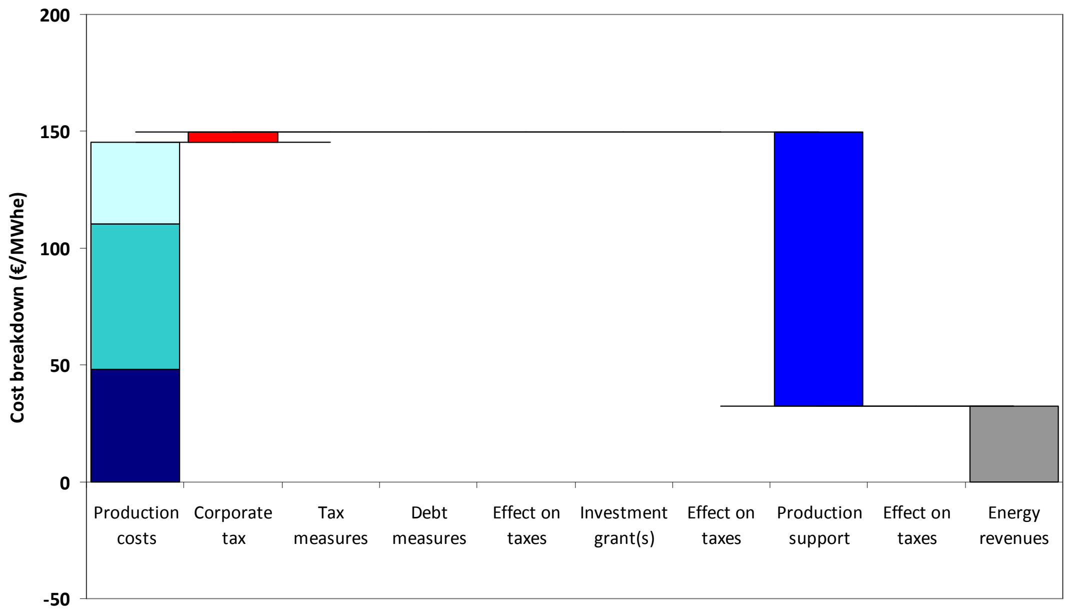


Figure 61: Levelized electricity cost (LCe) for offshore wind in United Kingdom, 2009

The gross levelized cost of electricity for offshore wind energy are between 130 and 160 €/MWh (this is typically the range for projects within 5-30 km offshore). Of the countries studied here, Germany has the lowest gross levelized cost of electricity (145 €/MWh, including taxes), due to the low cost of capital. Figure 60 shows how the German support scheme and financial instruments make this project viable. The main component is the feed-in tariff (150 €/MWh over 12 years, then dropping to 35 €/MWh until year 20, in net present value terms about 130 €/MWh), which generates slightly more income than strictly needed. The low cost of capital are related to the fixed income over 20 years, and the good alignment with fiscal and debt measures.

In the United Kingdom the gross LCE equals 150 €/MWh, which is covered by certificates from the renewable energy obligation (in 2009 2 ROCs per MWh of offshore wind) and a climate change levy, resulting in net levelized cost of electricity equalling 32 €/MWh. This minimum required value for the Power Purchase Agreement contract clearly shows that offshore wind is viable and bankable in the UK, as electricity market prices were about 53 €/MWh in 2009. Whereas both schemes result in viable projects, the UK currently attracts significant interest from the finance sector, resulting in lower opportunities for projects in Germany. This is a consequence of the interesting prospected returns (despite the uncertainty related to quota obligation schemes), in combination with a very pro-active government approach towards deployment of offshore wind energy. This favourable investment climate may, by itself, reduce the cost of capital in the longer term and reduce the difference in gross LCE.

6.3 Reducing costs of capital by addressing risk

6.3.1 Summary of risk mitigation strategies

The ambitious European 2020 targets on energy and climate - and more particular for renewable energy – ask for a huge mobilization of investments in the coming decade. The financial and economic crises add to the challenge of directing capital to the renewable energy sector. The deployment of most renewable energy technologies still needs both financial and non-financial policy support, due to the stage of development of either technology or market, and due to fact that renewables still do not have the same playing field as conventional energy technologies. Policies are designed to level this playing field, but policies themselves might be reviewed critically due to the successive crises and the associated pressure on either government budgets or purchasing power of energy consumers. On the other hand, large-scale deployment of renewable energy may be an important element in overcoming these crises by paving the road for a new arrangement of the economy, with a stronger focus on sustainability in the broadest sense. In the longer-term, these crises could be turned into a major opportunity for renewable energy deployment.

On the one hand, there are ambitious targets, on the other hand there are risks (at the project level, and regulatory, market and financial risks) that may hinder the willingness to invest in this sustainable development. The question is whether current RE support policies are able to attract sufficient amounts of capital, and whether reductions in the cost of capital can be attained, which should increase the pace of cost reductions of renewable energy. The solution should not necessarily be sought in a drastic change of the primary support scheme (e.g. from feed-in tariff to feed-in premium or obligation scheme, and other directions) as this could result in a delay of the deployment and an increase in the cost of capital. Instead, governments could reconsider their role and become more pro-active role in removing or sharing the risk of RE deployment, of which some examples are given below[43].

The overall level of financial support for renewable energy can be reduced significantly if government policies and financial support schemes are better aligned towards removing regulatory and market/financial risks. For many countries, this cost reduction lies in the range of 10-30%. The case studies addressed for this report show a similar range: 5-25% (see Annex 6). In chapter 4 an average figure of 10% was derived for RES-E in the EU27 scenario analyses. The following strategies help to reduce risks (see also section 5):

[43] Based on D.de Jager, 2009: "Something better change" - Pro-activating offshore energy government policies, Ecofys Netherlands B.V., Internal discussion paper (in Dutch/English), June 2008

1. **Ensure long-term commitment towards renewable energy.** A clear political and societal long-term commitment towards renewable energy is required. Based on this, a stable and reliable support mechanism can be designed. Commitment, stability, reliability and predictability are all elements that increase confidence of market actors, reduce regulatory risks, and hence significantly reduce cost of capital. This effect can be significant: the levelized cost of electricity can be reduced by 10 to 30%, as compared to a support scheme with no particular attention to risk mitigation.

2. **Remove risks by removing barriers.** Policies that improve the success rate of the project development phase will reduce the project investment and hence levelized energy costs of renewable energy technologies. This refers to amongst others improving permitting procedures and grid connection procedures. The overall effect on the cost of capital of removing barriers is hard to quantify. The direct effect on the levelized cost of electricity can be in the range of 5 to 10%. Next to the generic measures described above, governments can align their generic financial and fiscal regime towards the practice of renewable energy project development.

3. **Remove risk by sharing risk**. Government loan guarantees and government participation can significantly reduce the cost of capital:

- Government loan guarantees: By underwriting all or part of the debt for a project, lenders have significant lower risk in case of default or underperformance of the project. This risk reduction is translated in lower interest rates (e.g. 1-2%, resulting in reductions up to 5-10% in the levelized cost of electricity), but potentially also in longer debt terms and more favourable debt service requirements with even higher reductions in the cost of capital;
- Government project participation, for instance by investing in large-scale electrical infrastructure solutions for offshore wind energy, can reduce levelized cost of electricity by for instance 15% or more (with about one third as a direct effect of a reduction in the cost of capital). This option is elaborated upon further below.

4. **Debt measures: provide low interest loans and align the debt term with the technical lifetime.** Policies that anticipate on risk assessment practices by lenders can reduce costs of capital significantly by creating market conditions and designing support schemes that result in debt terms being close to technical lifetimes (e.g. longer duration of production support and power purchase agreements (PPAs)). Low-interest loans, with discounts on interest rate that are typically in the range of 1-2%, can contribute to this. The direct overall effect of these kinds of debt schemes is up to 5-10% on levelized cost of electricity. However, indirectly they can affect other key financial parameters used by investors and other lenders, such as the economic lifetime, debt term and debt service conditions.

5. **Fiscal measures.** Fiscal measures can have a significant impact on the levelized cost of electricity of a project. Investment tax deduction, production tax deduction, and flexible or accelerated depreciation schemes reduce levelized cost of electricity from several percent up to 10-20%, depending on the specific characteristics of the measure. Not all projects and finance models will be able to reap the tax benefits of these schemes. A critical issue is the dependency on policies as the fiscal measures result in lower tax income.

6. **Investment subsidies: for demonstration and market introduction.** Investment subsidies are believed to be more effective at the demonstration and market introduction phase, than during the deployment phase with a larger emphasis on stimulating production of renewable energy. Investment grants could be converted in equity (government participation) or debt after successful commissioning of a project. Doing so the effect on the government budget can be kept to a minimum.

7. **Production support.** An improved design of current production support schemes, and notably a good alignment with other support policies, can result in additional cost reductions in the range of 2-30% (on levelized costs of electricity). The high end concerns projects with relative high project risk, such as offshore wind energy or biomass co-generation. For onshore wind energy, these potential improvements are smaller (several percentages to 10-15%), notably for some feed-in tariff and -premium schemes.

8. *Feed-in tariff (FIT) and -premium (FIP) schemes:* The most important element of FIP and FIT schemes is that they fully (FIT) or partially (FIP) remove the market risks of a project during a fixed period of time. The longer this period of guaranteed prices, the lower the cost of capital. Because of this, FIT/FIP has in general a relatively large debt scare.

9. *Obligation schemes:* The cost of capital will generally be higher for obligation schemes due to both higher market risks and perceived regulatory risks. The certificate market - by its design - can not offer a fixed price directly as is the case in FIT/FIP schemes. Furthermore, the level and timeframe of the obligation as well as other key design parameters (e.g. penalties, issuing of certificates), are set by government policies and hence susceptible to policy changes. This results in lower contract periods in the PPA, lower debt terms and higher debt reserve conditions, or, in other words, in a higher levelized cost of electricity. Reducing the cost of capital in quota obligation schemes can be achieved via various routes, but is not as easily done as with FIT and FIP schemes. A strong government commitment towards the scheme is essential in this respect.

Tendering schemes for financial support: Tendering schemes designed to trigger competition on price result in guaranteed project-specific contract prices for a specific period of time. The tendering process is used to let the market determine what the required level of support should be. After winning the tender, a project developer has certainty about his operating income and can use and negotiate favourable financing terms. The project development phase has higher risks, as not all bids will be successful. Several European countries have used tender schemes in the past (e.g. UK, DK and NL, recently mostly for offshore wind energy), with different experiences. If the design of the tender procedure takes into account the regulatory and market/financial risks adequately, part of these risks can be transferred or shared by government, hence reducing the cost of capital. In other tendering schemes price is not, or no the only criterion in the assessment of bids. Other criteria include the financial strength of the bidding party, environmental impact, economic impact, and for example innovative aspects.

Three general recommendations can be given with respect to policy design:

Continuously improve the policy design. Policies that reduce the required return on equity by investors potentially have significant cost reduction implications. Improved design of existing policy support schemes may be more effective in this respect, than a switch to a different policy scheme.

Keep the financing of the support scheme outside the government budget. In general, it is recommended that the financing of the support scheme is kept outside the government budget, especially when a country has a track record of multiple changes in policy design and/or allocation of budgets.

Table 22: Example of the impact of a pro-active and participative government policy framework for the realisation of 4800 MW offshore wind energy in the Netherlands

Recommendation by the Dutch Taskforce Offshore Wind energy	Effect on societal cost		Savings[1]	Investment by government
	Qualitative	Quantitative[2]	Million €	Million €
Government target in production (TWh) instead of capacity (MW)	Lower investment and O&M through more efficient use of space	I: 5-10% lower O&M: 4% lower	1,200 – 1,900	0
Government lead in early stage (spatial planning, permits, infrastructure)	Lower investment and lower cost of capital due to lower risks	I: 1-2% lower Er: 0.5-1% lower	300 - 650	150 - 200
Transmission System Operator responsible for offshore grid connection	Lower cost of capital due to cheaper financing by TSO, phased implementation and improved buying power	I: 2% lower Er: lower	500 - 600	0
Improvement of feed-in premium system	Lower cost of capital and investment due to exclusion of certain risks in tender bids	I: 1% lower Er: 0.5% lower	about 300	0
Government participation	Lower cost of capital through leverage of low Re for government	Er: 3.5% lower[3] Dr: 0.5% lower	about 1,000	0 (revolving fund)
Invest in technology innovation	Lower investment cost due to cost reductions of turbines and foundations	I: 2% lower	about 300	50 - 100
Stimulate an evenly and serial development of large concessions	Lower investment through economies of scale	I: 2% lower	about 300	0
Increase concession period from 20 to 40 year	Lower investment cost through re-development and postponement of decommissioning	I: 1-2% lower	150-300	0
Appoint Dutch North Sea High-Commissioner	None	None	0	about 50

Recommendation by the Dutch Taskforce Offshore Wind energy	Effect on societal cost		Savings[1]	Investment by government
	Qualitative	Quantitative[2]	Million €	Million €
Total			**4,050-5,350**	**250-350**

[1] Net present value of the reduction of support via the feed-in premium;

[2] I: Investment; O&M: Operation and maintenance costs; Er: Required return on equity; Dr: Interest rate

[3] Assuming 25% government participation at 5.5% interest rate and 25% participation by the EIB at 8.5%.

Anticipate for different financing models in the policy instrument design. In designing new policy instruments and schemes, the changing landscape of renewable energy financing solutions should be closely monitored and incorporated. In designing support schemes, all market actors should be involved. Especially investment funds and banks will be able to provide feedback on the risks related to the design of these instruments.

6.3.2 Examples of innovative policy design and financial support

Government 'pro-activation' and participation

As discussed in chapter 5, government participation may help to establish financial close at lower cost of capital. This would notably be relevant for offshore wind energy (with a large expected contribution in meeting the renewable energy targets), large geothermal projects, or large bio energy projects that may be susceptible to variations in biomass prices. The 'pro-activation' relates to a change in the mind-set of the policy-making system, which is illustrated in Table 22.

In Table 22 an example is given of the cost savings that can be achieved for the realization of 4.8 GW offshore wind energy in the Netherlands, by implementing a pro-active and participative policy framework[44]. According to the Taskforce Offshore Wind Energy € 4 to 5 billion can be saved (net present value, rounded values) compared to a total investment of about € 20 billion, i.e. about 20-25%. Roughly half of this can be attributed to a lower cost of capital.

Risk reduction in tender procedures

In tender procedures that want to create competition on price (e.g. in feed-in tariff or premium schemes), governments could remove risk elements that cannot directly be influenced by the project developer himself through mitigation measures. This concerns both elements that can be affected by government (regulatory risk), project risk, and overall risk factors related to changes in the (global) economy. Examples of the latter changes in prices of raw materials (e.g. steel), energy prices, exchange rates, or inflation rates.

A first step is hence to remove (most of) the regulatory risk, e.g. by ensuring that all relevant generic licenses are in place. A second step is to remove the project risk by providing information on generic parameters that are crucial for a first cost assessment (e.g. for example for offshore wind energy: wind resource statistics, water depth, statistics on waves and currents, soil conditions, et cetera).

[44] Dutch Taskforce Windenergie op Zee, 2010: Final Report Taskforce Offshore Wind Energy http://www.rijksoverheid.nl/bestanden/documenten-en-publicaties/publicaties-pb51/windenergie-op-zee/publicatie-windenergie-op-zee.pdf (in Dutch)

The example in Table 22 shows that a 'government lead in the early stage' – a combination of these first two steps - is rewarded with lower investment costs (1-2%) and lower risk premiums at the investor side (0.5-1%).

A third step is to remove the external risk factors from the tender bid. The bid price is then based on default (actual) values for these parameters. If these values change (e.g. at the moment of financial close, but in some cases also during the operational phase), the level of financial support is adjusted. This approach will ensure that the bid price is not 'polluted' with external risk factors, and hence reduce the number of projects that either will be over-supported, or will default.

6.3.3 Conclusion

The realisation of the EU targets for renewable energy asks for a huge investment. The overall level of financial support for renewable energy can be reduced significantly if government policies and financial support schemes are better aligned towards removing regulatory and market/financial risks. For many countries, this cost reduction lies in the range of 10-30%. For this, the role of most European governments has to change. A pro-active and participative approach can speed up the deployment of renewable energy at lower societal cost, by mobilizing more and cheaper capital. This can be supported at the European level, for instance with the European Investment Bank.

It is expected that the scarcity for capital will increase in the coming years. An alignment of policies among Member States may be required in order to avoid competition between support schemes, which could increase the cost of capital for certain countries. This does not necessarily mean that the support schemes need to be aligned, but the related investment climate for renewable energy should not differ too much from country to country.

7 Conclusions and Recommendations

7.1 Introduction

The ambitious European 2020 targets on energy and climate - and more particular for renewable energy – ask for a huge mobilization of investments in the coming decade. The financial and economic crises add to the challenge of directing capital to the renewable energy sector. The deployment of most renewable energy technologies still needs both financial and non-financial policy support, due to the stage of development of either technology or market, and due to fact that renewables still do not have the same playing field as conventional energy technologies. This chapter will draw conclusions on the core questions that evolved from the analysis, such as:

- Can European Member States (MS) meet the targets from the RES directive with the current financing framework?;
- How could existing support and financing instruments be adapted or improved in order to meet the European 2020 targets in a cost-effective way?;
- Are new or additional instruments required? What are their design requirements?

Based on these conclusions, concrete recommendations for future actions will be presented.

7.2 The finance challenge

According to the scenario runs performed for this study, meeting the 2020 targets of the RES Directive involves the following:

- The **average annual capital expenditures** for new RES installations range from **60 to 70 billion €**. About 60 to 65% of these capital expenditures relate to renewable electricity, RES-E;
- Current (2008) annual capital expenditures are about 35 billion €. This equals the average annual capital expenditures in the Business as Usual (BAU) scenario assessed in this study for the period 2011-2020. The annual average finance gap is thus **25 to 35 billion €;**
- The **average annual consumer expenditures** due to the support for new RES installations range from **30 to 40 billion €**. About 50% relate to RES-E;
- Offshore wind energy, onshore wind energy and solid biomass are the predominant RES-E technologies to be installed in the next decade, requiring about half of the capital expenditures. In addition, individual projects require significant investments, notably offshore wind energy (e.g. 300 MW requires about up to one billion € of investment). The deployment of these technologies is hence very sensitive to the availability and cost of capital;

- RES in the sector of heating and cooling require less investments compared to RES-E – about 22 to 24 billion € occur on average per year throughout 2011 to 2020 according to the scenario analysis. However, mobilizing this may be even more challenging due to the small size of a particular installation (e.g. solar thermal collectors or modern biomass heating systems at household level) and the fact that in many countries the corresponding policy framework is quite fragile at present.

It is highly uncertain whether sufficient capital can be redirected to deployment of RES technologies, and whether the costs of capital can be further reduced. Financing in renewable energy competes with other investment opportunities, both in- and outside the energy sector, and in other regions in- and outside Europe. It is hence believed this 'redirecting' requires strong support from both governments and European Commission (EC).

Existing financing instruments have enabled investments in the RES sector to reach record-breaking levels over the past few years, but this growth has been distributed unevenly across Member States. The current capital inflow in the sector is believed to be too low to enable the achievements of EC objectives at the 2020 horizon. The financing gap, as compared to a Business-as-Usual practice, is roughly estimated to be 25 to 35 billion €/yr in the period 2011-2020.

7.3 Reducing the need for, and costs of capital

Member States have the opportunity to reduce the absolute need for capital in various ways. The first step is to remove the non-economical barriers that are still prohibiting an accelerated deployment of RES. This will reduce the investment needed during the project development phase in particular, which is reflected in the project cost at financial close. The non-economical barriers concern administrative deficiencies that are encountered during project development (permitting, grid access), but also deficiencies in the design of the support scheme. The scenarios used for this study (except for the BAU) have already assumed a gradual removal of these deployment constraints, but it is clear this requires a pro-active approach by all stakeholders.

Another direction is illustrated by the scenario "Strengthened national policies - European perspective – less innovative technologies": The prior aim of this scenario is to fulfil the 20% RES target on EU level, rather than fulfilling each national RES target purely domestically. Thereby, less emphasis is put on establishing a long-term oriented well-balanced RES portfolio on Member State level. Consequently, novel RES technologies receive only a moderate support and major technology options have to compensate (as far as feasible) the gap to meet the RES commitment. The scenario results show that the annual capital expenditures can be reduced by about **9 billion €**, as compared to most of the other scenarios that do not concentrate on the lowest-cost options

(61 as compared to 70 billion €/year until 2020) - from a long-term perspective this may however change when in later years beyond 2020 also novel RES options would be required.

Some general recommendations for reducing the need for capital include:

- Extensive use of cooperation mechanisms in order to enhance an optimal resource allocation;
- A strong EU focus on the support of infrastructure for RES development; and/or;
- Establishment of a European working group on the "coordination of RES support" (or RES tariffs), which might for example reduce cherry-picking of investors between MS.

Reducing the cost of capital will result in lower consumer expenditures and an accelerated uptake of RES. The main approach is to reduce risk at all stages in the project lifecycle, via:

- Ensuring a long-term commitment towards renewable energy;
- Removing deployment barriers; and;
- Sharing risk via improved financial instruments (e.g. government loan guarantees and/or project participation).

As discussed in this report, the design of the main support instrument is critical as well. Feed-in tariffs provide in principle more certainty than quota obligation schemes. However, the particular design and the combination with other financial instruments is an equally important factor, especially for attracting finance.

An analysis of the financial incentive level in relation to electricity generation costs shows that technology-specific support generally tends to be better adjusted to the requirements of these technologies. The technology-specific character allows offering sufficient money to stimulate investments, without providing excessive windfall profits and larger risk premiums, and thus helps to reduce policy support costs. Accordingly, the analysis of the economic characteristics of RES-E support and electricity generation costs revealed that the remuneration granted under a feed-in system tends to be lower for lower-costs technologies than under a quota obligation scheme. In contrast, the current quota obligation schemes – applied in a technology-uniform manner – generally offer lower remuneration levels (which are in most cases insufficient to incentivize investment) for more cost-intensive technologies such as solar PV, than feed-in systems.

Support levels for renewable heat generally provided either in terms of investment incentives or tax reductions, appear to provide less profit for investors than the ones provided in the electricity sector. In the heating sector the dependence of financial incentives – predominantly in terms of investment grants – on the public budget and a potential stop-and-go policy creates stronger uncertainty for investors in the heat sector than common in the electricity sector. In contrast to the electricity sector, there are predominantly no long-term commitments in the heating sector. The question is whether the shift from investment incentives and tax reductions to a use obligation, as required in the Renewable Energy Directive, will create a better investment climate for renewable heating technologies.

7.4 Increasing the access to low-cost finance

7.4.1 Stability, transparency and coordination

The appropriateness of financial instruments is highly dependent on technology or project's development stage. Current perceptions indicate that access to finance can be enhanced by innovative public-private approaches for equity provision to technology developers, and on guarantee mechanisms for project developers. Some innovative instruments such as guarantees or mezzanine funds can have a significant multiplier effect as they contribute to cover technical and political risks (certainty for investors). From the perspective of debt and equity providers, there are no one-size-fits all solutions, but rather a mix of instruments that will be appropriate to specific levels of maturity of technologies or projects, and to various country-specific contexts.

When evaluating the performance of different support schemes, the relevance of each evaluation criterion, which may change according to the development status of the technology or the overall renewable energy market in general, should be taken into account. In the context of existing financing gaps identified in this study, the ability of the support schemes to lower RES project risks is judged to be the crucial criterion if all the capital required to achieve the 2020 targets is to be mobilized. Market players mostly favour instruments that ensure long-term stability (matching the projects' long-term perspectives), transparency and a certain degree of coordination at international level (e.g. on support schemes, legislation). Therefore, not the type but in particular the design of the particular support scheme in place and its impact on long-term investment risk is crucial. This long-term stability could in principle be achieved for both feed-in tariff, –premium and quota obligation schemes.

The RES Directive, and the enforcement on compliance by Member States to the 2020 and intermediary targets, is a very important factor in creating this stable investment climate.

7.4.2 De-risking renewable energy

Risk is a key parameter to explain the difficulties of RES technology and projects in accessing capital due to the specific risk/return ratio for RES-projects. Indeed most RES technologies have high risk and long-term return.

Increasing the access to low-cost finance hence requires an extended use of - sometimes innovative - measures that reduce the financing risks.
The mitigated risk scenarios in this study show that the annual consumer expenditures can thus be reduced by 2 to 4 billion €.

The barriers or difficulties most frequently identified include insufficient awareness among financial institutions of sector-specific risks and opportunities as well as concern about risks. The perceived risks are directly related to a specific technology and to a particular country’s regulatory framework. On the technology (upstream) side, lack of experience with new types of sponsors, business models, markets and/or technologies can render private investors reluctant to fund innovative projects/ventures. On the project (downstream) side, the risks perceived by investors often relate to the performance of the installation, the experience and reliability of the project developer or owner, difficulties in obtaining operating licenses and other administrative hurdles, as well as the ability to negotiate and to secure an adequate Power Purchase Agreement (which is critical for the risk level of a project in countries where no feed-in-tariff system exists). The perceived risk leads to higher expectations from investors in terms of returns, and high collateral guarantees or risk premiums requested by lenders.

Risk issues related to innovative technologies are difficult to cover by the commercial insurance market. With the exception of onshore wind, there is a limited understanding of most RES projects and associated risks from insurance practitioners. Among relevant actions to mitigate technology-specific risk, the evaluation of early stage technologies could contribute to offer an independent opinion on the likelihood of a project's ability to deliver the expected returns and, therefore, increase a developer's ability to attract investment. Furthermore, appropriate commercial insurance policies could be made available for some specific technology and operational risks. This could make private sector investment in the RES sector grow by a factor of four or more. Eventually, less mature technologies should be supported by specific means, as call for tenders where default level of support would be adjusted in case actual finances have changed.

Besides all the risks associated to a specific technology, the host countries play a key role in the investment decision. Indeed, the local regulatory framework and supports schemes have to be mature, to make RES attractive for investors, and to be stable. The certainty that policies once established will remain in place and that they will remain funded over the long term is a key criteria in their investment decision.

The main key to bridge the RES financing gap is the private sector involvement. However, private investors will further invest in RES only if this sector is perceived as financially attractive.

Yet, financial attractiveness is subordinated to long term visibility and appropriateness of support schemes for RES development, which are directly dependent on political will at each decision level (EU, MS and regional).

The EC or Member States could provide guarantees on Power Purchase Agreements (PPA) and contribute to increased public finance participation into projects by developing innovative Public Private Partnership (PPP) models. With a more coercive approach, the EC could put conditions on support given on RES projects development in the beneficiaries States and develop enforcement on compliance with the 2020 RES targets.

7.4.3 Increasing public finance participation into projects

Especially for large-scale projects, requiring investments of 50 M€ or more, with significant technological, regulatory, or market risks, government involvement/participation may help to establish financial close at lower cost of capital. The benefits of a pro-active and participating government are manifold and have a significant impact on the access to, and costs of capital:

- Government participation can provide a significant amount of capital, either equity, (subordinated) debt, or mezzanine finance;
- Project financing will be achieved easier and at lower cost. The percentage of project initiatives that actually will be realized will increase. This will strengthen the confidence of the market;
- By reducing the regulatory risk, the cost of capital can be reduced significantly;
- Windfall profits can be avoided or reduced. Via the government participation, part of these profits flow back to the treasury;
- By participating in projects, the government gets a better insight in the challenges and barriers that the market is facing. This allows the government to pro-actively develop supporting policies, e.g. for mobilizing the industry supply chain;
- A state-owned entity responsible for this type of participation can be a safeguard for ensuring a stable renewable energy policy.

Different Public Private Partnership (PPP) models can be envisaged, all contributing to lower (societal) costs and increased deployment rates.

An important instrument at the European level is the European Investment Bank (EIB). The bank can provide loans and guarantees for senior and subordinated debt. The impact of the latter is that access to capital is increased (multiplier effect) while cost of capital can be reduced.

Both EIB and national banks that provide similar services, can and should further extend there presence in the financing of renewable energy.

7.5 Recommendations

In order to increase the attractiveness of RES for finance and hence bridge the finance gap - which is roughly estimated at 25 to 35 billion €/yr in the period 2011-2020 -, it is recommended that the European Commission and its Member States take the following actions:

- Via the enforcement on compliance by Member States to the 2020 and intermediary targets of the RES Directive, the EC can contribute to creation of a stable investment climate in Europe. At the same time, the Commission should monitor the competition between Member States in attracting finance;
- Increase the role of the European Investment Bank (EIB) and national equivalents in providing equity, debt or guarantees. These institutes have a strong multiplier effect by attracting other forms of finance at lower cost of capital;
- Enhance the use of the cooperation mechanisms as defined in the RES Directive. An intensified cooperation between Member States would reduce the need for capital at the European level and also appear beneficial with respect to the corresponding support expenditures. Harmonisation of support across Europe for selected technologies (e.g. offshore wind energy) represents an alternative option to above which may, on the one hand, once established increase the ability to attract finance but which may also, on the other hand, cause in the transitional phase uncertainty on the market;
- Member States are recommended to improve their support schemes, with a strong notion of the consequences for financing, rather than to restructure their support scheme too drastically. The introduction of new policy instruments should be assessed from the viewpoint of financers, in balance with the viewpoint of consumers / taxpayers. Thereby, also an alignment of financial support conditions for the individual RES technologies between the countries is highly recommended to increase the cost efficiency of RES support at the European level. Via the establishment of a European working group on the coordination of RES support (or RES tariffs) this could be moderated;
- In cooperation with the financial sector, risk assessment tools and ratings should be developed for renewable energy technologies, in order to offer an independent opinion on the likelihood of a project's ability to deliver the expected returns, increase a developer's ability to attract investment, allow to correct for undesired finance gaps for certain technologies, and to encourage a more rapid commercial-scale deployment of emerging technologies;

- The Commission and Member States are recommended to initiate advanced and/or innovative forms public-private-partnerships: government participation, loans and loan guarantees; dedicated support based on "open book" procedures; new types of insurances.

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Annex

Appendix to chapter 2: Overview of available support instruments

2.1 Support instruments in the sectors electricity, heating & cooling and transport in the EU-27

2.1.1 Instruments to support RES electricity

Table 23 - Table 32 provide an overview of support instruments for the different RES-E technology categories. The data in these tables are extracted from the RE-Shaping country profiles. If other, additional sources are used, this is explicitly stated. These incentives are difficult to quantify due to their complex and often detailed nature (with many exceptions and rules), and often depend on the size and type of projects.

Table 23: Overview of support for electricity from biomass in the EU-27

Country/ Subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU
FIT/ Premium (€/MWh)	FIT: 110.8-156.345		FIT: 84.88-110.9546	FIT: 13547	FIT: 97-168.9. Premium: 61.2-133.148	FIT: 77.9-296.7[49]	Premium: 20.2.	FIT: 73.5 Premium: 53.7.	FIT/premium 106.87-107.87[50]		Via tenders[51].	FIT: 80.14-91.7452	FIT: 11-9953
Quota System		Quota System with green certificates.						-					
Investment grants					Max 20% of total eligible expenses					30% of total investment[55]		20% - 40% of total investment56	Non-refundable subsidy of 35%57 or 40%-

45 Different categories apply. Guaranteed period: 15 years as of 2009.

46 Guaranteed period of 15 years. Agricultural residues 84.88 euro/MWh, Energy crops 95.91 euro/MWh, Wood waste 110.95 euro/MWh.

47 Guaranteed period of 25 years. For private parties and generally large-scale projects (no investment subsidies).

48 Guaranteed period of 20 years. Producers can choose between a premium or tariff. For 100% biomass plants started in 2010. For co-firing other premiums apply (no tariff). Different categories apply.

49 Including boni. For installations <20MW. Different categories apply. Guaranteed period of 20 years, 1% yearly degression of tariff.

50 Average selling prices (distribution company vs. direct participation in the supply market). 15 years support. Reduced support after 16 years.

51 In 2007, the tariff for the last tender was 128 euro/MWh.

52 Guaranteed period of 20 years. Min tariff refers to interconnected systems, max to non-interconnected island systems.

53 Amount depends on the size of the plant and the timing of production (lower tariff in low demand periods).

					and max. 40% for CHP[54]								60%58
Tax exemption									Up to 10 % of investment deductable from income tax	Electricity tax aid: 4.2 €/MWh			
Fiscal incentives			Keep 15-20% of the loan[59]			Low interest loans		The amount of loan: from 30,000 to 1.900.000 EUR. Up to 75% of investment costs					

54 Limit of €1.9 million (20%) and €3.85 miilion (40%).

55 The maximum amount of the subsidy is 250,000 EUR, but it can be extended by the Ministry of Employment and Economy.

56 This percentage depends on the region (zone) the promoted RES is to be constructed in: 20% in zone A, 30% in zone B and 40% in zone C.

57 The objective of the subsidy is to promote the wide-spread use of renewable energy sources in agriculture and reduce crop producers' dependence on fossil fuels.

58 Pursuant to the decree the planting and nurturing of ligneous energy crops multiplied by root suckers until their first harvest are deemed an activity eligible for subsidization. Non-ligneous energy crops existing for a minimum of 5 years without re-planting is deemed an activity eligible for subsidization.

59 The incentive can be maximally Euro 500,000.

Country / Subsidy	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
FIT/ Premium (€/MWh)	FIT: 83.81[60]	FIT: 220-280[61]	FIT: 86.9	FIT 109.7-144.6[62]	FIT: 50,32-116,99 63		Premium: 71-133[64]		FIT:104-109[65]			FIT: 167.43 - 224.35 (biomass) , 102.54 (co-firing) [66] Premium: 107.63-165.2 (biomass) , 42.74 (co-firing)[67]	FIT: 130-134[68]	FIT: 99 – 126.5[69]
Quota System		Quota System with green certificates.						Quota System with		Quota System with tradable green certificate	Quota System with green certificates.	-		Quota System with green certificates.

60 Guaranteed period of 15 years.

61 15 years feed-in tariff for RES-E schemes under 1 MW as alternative to TGCs and a coefficient for banding TGC according to technologies. Tariff is 220 euro/MWh for Biodegradable waste, biomass other than agricultural/forestry biomass that has a tariff of 280 euro/MWh.

62 Guaranteed period of 15 years. Solid biomass ≤ 1 MW 144.64 euro/MWh, > 1 MW; ≤ 5 MW 124.69 euro/MWh Waste wood ≤ 1 MW 129.68 euro/MWh, > 1 MW; ≤ 5 MW 109.73 euro/MWh.

63 PPs <4 MW: -for the first 10 years of operation: At gas price 130 LVL/thous. Nm3 91,05-116,99 €/MWh -for the next 10 years: At a gas price 130 LVL/thous. Nm3 68,79-88,40 €/MWh For biomass PPs >4 MW: -for the first 10 years: At gas price 130 LVL/thous. Nm3 60,38-72,84 €/MWh -for the next 10 years: At a gas price 130 LVL/thous. Nm3 50,32-60,70 €/MWh

64 Specific premiums are as follows: combustion (10-50 MW): 71-112; Fermentation of bio-degradable waste: 85-105; Co-fermentation and small-scale combustion (top-up) (</= 10 MW): 108-133; Other fermentation (liquid biomass) 114. Guaranteed period of 12 years.

65 Guaranteed period of 25 years. Tender for forest biomass as a source.

66 Biomass: 50kW-1MW 224.35 €/MWh - 1MW-10MW 167.43 €/MWh. Co-firing biomass: 102.54/MWh.

67 Biomass: 50kW-1MW 165.2 €/MWh - 1MW-10MW 107.63 €/MWh. Co-firing biomass: 42.74 €/MWh.

68 Tariff is based on a payback period of 12 years. 130 euro/MWh for biomass combustion. 134 euro/MWh for co-firing.

69 Anaerobic Digestion only: ≤ 500 - >500 kW. Scheme operational since 2010. http://www.decc.gov.uk Exchange rate used £1: €1.10

								green certificates.		s				
Investment grants			Up to 70% of investment costs (but not more than 199.838 EUR)		Up to 40% of investment costs							-		
Tax exemption			-		No tax rate for RES-E. General electricity tax rate was 0.77 €/MWh in 2009.		EIA: 11% of total investment deductable[70]	No consumption tax: 5.44 €/MWh71				-	No consumption tax: 1.30 €/MWh	No levy: 5.17 €/MWh

70 Renewable energy projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

71 Amount of tax iss et in 2008, varies annually.

Fiscal incentives			-		-	Soft loan at 2.5%72	Soft loans at an average interest rate of 1%[73].	Low interest loans for environmentally sustainable projects 74				Soft loans: €25 million[75]		

72 This loan ranges between 500 EUR and 60,000 EUR. Loans for non-residential systems amount to between. 25,000 and 200,000 EUR. For industry, the Maltese government also offers a tax credit on the investment.

73 Biomass is retricted to clean wood and energy crops

74 Minimum loan €459,000 and may amount up to 80% of the project costs.

75 For legal entities, at 90%, max credit period 15 yr., min interest rate three-months EURIBOR+1%, max loan 2 million, min 50,000€. 12 million € for natural persons75, max credit year 10, interest rate 3.9%, 20,000-40,000 €

Table 24: Overview of support for electricity from biogas in the EU-27

Country/ Subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
FIT/ Premium (€/MWh)	FIT: 78.96-169.3[76].		FIT: 84.52-101.1977	FIT: 114.578	Tariff: 130.9-151.9. Premium: 95.1-127.279	FIT: 41.6-110[80]	Premium: 54.4-100[81].	FIT: 73.5 Premium: 53.7 €/MWh	FIT & premium. 106.87-107.87[82]		FIT: 75-90[83]	FIT: 80.14-91.7484	FIT: 11-9985	FIT: 83.8186
Quota System								-						
Investment grants					Max 40% of total eligible expenses if CHP87					30% of total investment[88]		Min 20%, Max 40% of total investment89	Subsidy of 50-60%	

76 Different categories apply. Guaranteed period: 15 years as of 2009.

77 Guaranteed period of 15 years. Tariff depending on the size of the installation.

78 Guaranteed period of 25 years. For private parties and generally large-scale projects (no investment subsidies).

79 Guaranteed period of 20 years. Producers can choose between a premium or tariff. For plants started in 2010. Different categories apply.

80 Including boni. For installations <5MW. Different categories apply. Guaranteed period of 20 years, 1.5% yearly degression of tariff.

81 54.4 euro/MWh for elektricity production from mixed sources, 100.1 euro/MWh for 100% biogas installations.

82 Average selling prices (distribution company vs. direct participation in the supply market). 15 years support. Reduced support after 16 years.

83 Excluding energy efficiency bonus of 0-30 euro/MWh and a methanisation bonus of max 20 euro/MWh. 15 years of support.

84 Guaranteed period of 20 years. Min tariff refers to interconnected systems, max to non-interconnected island systems.

85 Amount depends on the size of the plant and the timing of production (lower tariff in low demand periods).

86 Guaranteed period of 15 years.

87 Limit of €3.85 million.

88 The maximum amount of the subsidy is 250,000 EUR, but it can be extended by the Ministry of Employment and Economy.

89 This percentage depends on the region (zone) the promoted RES is to be constructed in: 20% in zone A, 30% in zone B and 40% in zone C.

Tax exemption									Up to 10 % of investment deductable from income tax					
Fiscal incentives			Keep 15-20% of the loan90			Low interest loans		The amount of loan: from 30,000 to 1.900.000 EUR. Up to 75% of investment costs						

Country/ Subsidy	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
FIT/ Premium (€/MWh)	FIT:280[91]		FIT: 119.7-139.7[92].	FIT: 57.03 - 163,84[93]		Premium:85-133[94]		FIT:115-117[95]			FIT: 57,03-163,84 [96] Premium: 69.35-102.85 [97]	FIT: 104-179[98]	FIT: 99 – 126.5[99]

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90 The incentive can be maximally Euro 500,000.

91 15 years feed-in tariff for RES-E schemes under 1 MW as alternative to TGCs and a coefficient for banding TGC according to technologies.

92 Guaranteed period of 20 years. Tariff depends on the size of the installation.

93 Biogas PP > 2 MW: - For the first 10 years at gas price 130 LVL/thous. Nm3: 75,48-93,60 €/MWh - For the next 10 years at a price 130 LVL/thous. Nm3: 57,03-70,72 €/MWh.

Biogas PP < 2 MW: - For the first 10 years of operation: 133,18-163,84 €/MWh -For the next 10 years: 106,55-131,07 €/MWh

94 Specific premiums are as follows: Fermentation of bio-degradable waste: 85-105; Co-fermentation and small-scale combustion (top-up) (</= 10 MW): 108-133; Guaranteed period of 12 years.

95 Guaranteed period of 15 years. Tender for forest biomass as a source.

96 Up to 50 kW -160.05 €/MWh -Up to 1 MW-155.76 €/MWh -Up to 10 MW -140.77 €/MWh Biogas-waste: - Up to 1 MW-139.23 €/MWh -Up to 10-129.15 €/MWh

Quota System	Quota System with green certificates.						Quota System with green certificates.		Quota System with tradable green certificates.	Quota System with green certificates.	-		Quota System with green certificates.
Investment grants				Up to 40% of investment costs							-		
Tax exemption				No tax rate for RES-E. General electricity tax rate was 0.77 €/MWh in 2009		EIA: 11% of total investment deductable[100]	No consumption tax: 5.44 €/MWh101				Low interest loans[102]	No consumption tax: 1.30 €/MWh	No levy: 5.17 €/MWh
Fiscal incentives					Soft loan at 2.5%103	Soft loans at an average interest rate of 1%	Low interest loans for environmentally sustainable projects104				Soft loans: 25 million €[105106]		

97 Biogas-biomass -Up to 50 kW-102.85 €/MWh; Up to 1 MW-96.61 €/MWh; Up to 10 MW -80.97 €/MWh. Biogas-waste: - Up to 1 MW-80.08 €/MWh -Up to 10 MW -69.35 €/MWh.

98 Tariff is based on a payback period of 12 years. Tariff depending on size of the installation.

99 Anaerobic Digestion only: ≤ 500 - >500 kW. Scheme operational since 2010. http://www.decc.gov.uk Exchange rate used £1: €1.10

100 Renewable energy projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

101 Amount of tax iss et in 2008, varies annually.

102 Low interest loans covering between 50 and 90% of the predicted investment costs. The maximum for an individual loan is 2 million €, the minimum is 50,000 €. Low-interest loans to private citizens cover up to 100% of the investment costs.

103 This loan ranges between 500 EUR and 60,000 EUR. Loans for non-residential systems amount to between. 25,000 and 200,000 EUR. For industry, the Maltese government also offers a tax credit on the investment.

104 For legal entities, at 90%, max credit period 15 yr., min interest rate three-months EURIBOR+1%, max loan 2 million, min €50,000. 12 million € for natural persons (minimum loan €459,000 and may amount up to 80% of the project costs), max credit year 10, interest rate 3.9%, €20,000-40,000. 12 million € for natural persons, max credit year 10, interest rate 3.9%, €20,000-40,000.

106 Monthly repayment must not be lower than 40€ and must not exceed 1/3 of the average income of the last 3 months

Table 25: Overview of support for electricity from biowaste in the EU-27

Country / Subsidy	AT	BG	BE	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
FIT/ Premium (€/MWh)	Feed-in tariff: 48.8-117.22[107] .		Premium: 20.2.	FIT: 135108	FIT: 91.1. Premium : 55.3109	Tariff: 77.9-296.7[110]		FIT: 73.5 Premium : 53.7	FIT & premium. 60.46-121.12[111]		Tariff: 75-90[112]	Tariff: 80.14-91.74[113]	FIT: 11-99114	Tariff: 83.81[115]
Quota System														

107 Different categories apply. Guaranteed period: 15 years as of 2009.

108 Guaranteed period of 25 years. For private parties and generally large-scale projects (no investment subsidies).

109 Guaranteed period of 20 years. Producers can choose between a premium or tariff. For landfill and sewage gas plants started in 2010.

110 Including boni. For installations <20MW. Different categories apply. Guaranteed period of 20 years, 1% yearly degression of tariff.

111 Average selling prices (distribution company vs. direct participation in the supply market). 15 years support. Reduced support after 16 years.

112 Excluding energy efficiency bonus of 0-30 euro/MWh and a methanisation bonus of max 20 euro/MWh. 15 years of support.

113 Guaranteed period of 20 years. Min tariff refers to interconnected systems, max to non-interconnected island systems.

114 Amount depends on the size of the plant and the timing of production (lower tariff in low demand periods).

115 Guaranteed period of 15 years. Landfill gas receives 81.49 euro/MWh.

Investment grants					Max 40% of total eligible expenses if CHP116					30% of total investment[117]		Min 20%, Max 40% of total investment[118]		
Tax exemption									Up to 10 % of investment deductable from income tax	Electricity tax aid: 6.9 €/MWh				
Fiscal incentives		Keep 15-20% of the loan119				Low interest loans		Up to 75% of investment costs120						

116 Limit of €3.85 Million.

117 The maximum amount of the subsidy is 250,000 EUR, but it can be extended by the Ministry of Employment and Economy.

118 This percentage depends on the region (zone) the promoted RES is to be constructed in: 20% in zone A, 30% in zone B and 40% in zone C.

119 The incentive can be maximally Euro 500,000.

120 The amount of loan: from 30,000 to 1.900.000 EUR.

Country/ Subsidy	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
FIT/ Premium (€/MWh)	Quota System with green certificates.		Tariff:64.84[121].			Premium: 15.00[122]		Tariff: 53-76[123]			FIT: 77.44 (50kW-1MW); 74.34 (up to 10 MW) Premium 17.64 (-50kW-1MW) ;14.54 (-up to 10 MW)	FIT: 130-134124	FIT: 99 – 126.5[125]
Quota System							Quota System with tradable green certificates		Quota System with tradable green certificates	Quota System with green certificates.			0.25 ROCs/MWh for Landfill gas, 0.5 ROCs/MWh for Sewage gas.
Investment grants				Up to 40% of investment costs									
Tax exemption				No tax rate for RES-E. General electricity tax rate		EIA: 11% of total investment deductabl	No consumption tax: 5.44[127]					No consumption tax: 1.30 €/MWh	No levy: 5.17 €/MWh

121 Guaranteed period of 20 years. Tariff depends on the size of the installation. Sewage gas only.

122 Electricity production from landfills and sewage treatment (for power stations). Guaranteed period of 12 years.

123 Guaranteed period of 15 years. Unsorted urban waste (RSU) 53-54 euro/MWh ; Sorted/prepared urban waste (CdR) 74-76 euro/MWh. Tariff depends on the size of the installation.

124 Tariff is based on a payback period of 12 years. 130 euro/MWh for biomass combustion. 134 euro/MWh for co-firing.

125 Anaerobic Digestion only: ≤ 500 - >500 kW. Scheme operational since 2010. http://www.decc.gov.uk Exchange rate used £1: €1.10

				was 0.77 in 2009;		e[126]							
Fiscal incentives					Soft loan at 2.5%[128]		Low interest loans for environmentally sustainable projects[129]				Low interest loans[130]		

Table 26: Overview of support for electricity from geothermal in the EU-27

Country/ Subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
FIT/ Premium (€/MWh)	FIT: 72.8[131].				FIT:165.9. Premium: 130.2132	FIT: 105-230[133]		FIT: 73.5 Premium: 53.7	FIT: 68.90[134]		FIT: 100-120[135].	FIT: 80.14-91.74136	FIT: 11-99137	FIT: 83.81[138]

126 Renewable energy projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

127 Amount of tax is set in 2008, varies annually.

128 This loan ranges between 500 EUR and 60,000 EUR. Loans for non-residential systems amount to between. 25,000 and 200,000 EUR. For industry, the Maltese government also offers a tax credit on the investment.

129 Minimum loan €459,000 and may amount up to 80% of the project costs.

130 Low interest loans covering between 50 and 90% of the predicted investment costs. The maximum for an individual loan is 2 million €, the minimum is 50,000 €. Low-interest loans to private citizens cover up to 100% of the investment costs.

131 Guaranteed period: 13 years as of 2009.

132 Guaranteed period of 20 years. Producers can choose between a premium or tariff. For plants started in 2010.

133 For installations <20MW. Different categories apply. Guaranteed period of 20 years, except modernised hydropower plants: 15 years. 1% yearly degression of tariff.

Quota System														
Investment grants					Max 20% of total eligible expenses and max 40% if CHP[139]					30% of total investment[140]		Min 20%, Max 40% of total investment141		
Tax exemption														
Fiscal incentives			Keep 15-20% of the loan[142]			Low interest loans		The amount of loan: from 30,000 to 1.900.000 EUR. Up to 75% of investment costs						

134 Tariff as established in 2007. Adjusted every year. In 2009 no installations, therefore no specified tariff. 20 years support. Reduced support after 20 years.

135 Support guaranteed for 15 yeras, Minimum tariff applies to Frech territories, maximum tariff to France mainland.

136 Guaranteed period of 20 years. Min tariff refers to interconnected systems, max to non-interconnected island systems.

137 Amount depends on the size of the plant and the timing of production (lower tariff in low demand periods).

138 Guaranteed period of 15 years. Only co-firing.

139 Limit of €1.9 million (20%) and €3.85 million (40%).

140 The maximum amount of the subsidy is 250,000 EUR, but it can be extended by the Ministry of Employment and Economy.

141 This percentage depends on the region (zone) the promoted RES is to be constructed in: 20% in zone A, 30% in zone B and 40% in zone C.

142 The incentive can be maximally Euro 500,000.

Country/ Subsidy	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
FIT/ Premium (€/MWh)	FIT: 200[143]										FIT: 152.47 Premium: 152.47 (Up to 50 kW; 92.67 (50kW-10MW)		
Quota System	Quota System with green certificates						Quota System with tradable green certificates		Quota System with tradable green certificates	Quota System with green certificates.	-		Quota System with green certificates.
Investment grants				Up to 40% of investment costs									
Tax exemption				No tax rate for RES-E. General electricity tax rate was 0.77 €/MWh in 2009		EIA: 11% of total investment deductable[144]	No consumption tax: 5.44 €/MWh[145]					No consumption tax: 1.30 €/MWh	No levy: 5.17 €/MWh

143 15 years (optional) feed-in tariff for RES-E schemes under 1 MW as alternative to TGCs and a coefficient for banding TGC according to technologies.

144 Renewable energy projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

145 Amount of tax iss et in 2008, varies annually.

Fiscal incentives					Soft loan at 2.5%[146]	Soft loans at an average interest rate of 1%	Low interest loans for environmentally sustainable projects[147]				Low interest loans[148]		

Table 27: Overview of support for Photovoltaics in the EU-27

Country/ Subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
FIT/ Premium (€/MWh)	FIT: 299.8-459.8[149].	FIT: 450[150]	FIT:386.03-420.80[151]	FIT: 340-360[152]	FIT:448-451.7. Premium: 412.2-415.9[153]	FIT: 250.1-430.1[154]	FIT: 53.8-80.6[155]	FIT: 73.5 Premium: 53.7	FIT: 320-340[156]		FIT: 328-437[157].	FIT: 407.14-507.14[158]	FIT:95	

146 This loan ranges between 500 EUR and 60,000 EUR. Loans for non-residential systems amount to between. 25,000 and 200,000 EUR. For industry, the Maltese government also offers a tax credit on the investment.

147 Minimum loan €459,000 and may amount up to 80% of the project costs.

148 Low interest loans covering between 50 and 90% of the predicted investment costs. The maximum for an individual loan is 2 million €, the minimum is 50,000 €. Low-interest loans to private citizens cover up to 100% of the investment costs.

149 Guaranteed period: 13 years as of 2009. Only installations >5kW are eligible. <5kW investment incentives apply.

150 In Flanders only. Large and small-scale PV. The sceme is operational since 2010.

151 Guaranteed period of 25 years. Tariff depending on the size of the installation.

152 Guaranteed period of 15 years for small projects, 20 years for large-scale projects. <20kW 360 euro/MWh, 21-150kW 340 euro/MWh for private parties and generally large-scale projects (no investment subsidies). Public organisations and financial institutions get investment subsidies within framework 2. Public organisationa and other private companies get investment subsidies within framework 3 (see investment subsidies).

153 Guaranteed period of 20 years. Producers can choose between a premium or tariff. Low tariff/premium applies to >30kW, higher to <30kW. For plants started in 2010.

154 Including boni. Different categories apply. High tariff is for small installations <30kW. Guaranteed period of 20 years, 8% yearly degression of tariff (2009).

155 53.8 euro/MWh for the first 10 years, 80.6 for the years 10-20. Only for installations >6kW. <6kW exemption from energy taxes.

156 Depending on the size of the installations. 25 years of guaranteed support. Tariffs are updated every year.

157 Support guaranteed for 20 years, Minimum tariff applies to France mainland, maximum tariff to Frech territories. Bonus of respectively 273 €/MWh (164 €/kWh) in Mainland France (France Territories and Corsica) for integrated PV.

Quota System		Quota System with green certificates.												
Investment grants		20-50% of total investment[159]		40-55% of total investment[160]	Max 20% of total eligible expenses[161]					40% of total investment[162]		Min 20%, Max 40% of total investment[163]		
Tax exemption		40 % of investment deductable from income tax, max €3600 per				Low interest loans			Up to 10 % of investment deductable from income tax			Small residential PV: 20% tax deduction, max €700 per system		

158 Guaranteed period of 20 years. PV with an installed capacity <= 100 kW 457.14 euro/MWh Interconnected, 507.14 euro/MWh non-interconnected. PV with an installed capacity > 100 kW 407.14 euro/MWh Interconnected, 457.14 euro/MWh non-interconnected.

159 The budget is for investments in environmental improvements, not just for RES-E. The maximum budget per project is 1,750,000 Euros. This is a Federal instrument.

160 De minimus: 40% max 48.000 euro, price 205euro/MWh max 200euro/kW/a. Framework 3: choice 1 55% max 65.000 euro price 225/MWh. Choice 2: 0% Price 383/MWh. Public organisations and financial institutions get investment subsidies within framework 2. Public organisationa and other private companies get investment subsidies within framework 3.

161 Limit of €1.9 million.

162 The maximum amount of the subsidy is 250,000 EUR, but it can be extended by the Ministry of Employment and Economy.

163 This percentage depends on the region (zone) the promoted RES is to be constructed in: 20% in zone A, 30% in zone B and 40% in zone C.

164 For crystalline PV: IEC 61215 standard and minimum efficiency of 12 %; Thin film PV: IEC 61646 standard and minimum efficiency of 7 %; Invertors: Efficiency for grid connected systems must be higher than 91 %. This is a Federal instrument.

		installation[164]												
Fiscal incentives			Keep 15-20% of the loan[165]					The amount of loan: from 30,000 to 1.900.000 EUR. Up to 75% of investment costs						
Other														

Country/ Subsidy	IT	LT	LU	LV	MT	NL	PT	PL	RO	SE	SI	SK	UK
FIT/ Premium (€/MWh)	Premium: 35.3-48[166].	FIT (since 2010): 472.1 (up to 100 kW; – 451.8 (from 100 kW to 1 MW);	FIT: 358.9-407.4[167].	FIT: 330.10	FIT: 69.88[168]	Premium: 324-406[169]	FIT: 310-450[170]				FIT & Premium[171]	FIT: 450 [172]	FIT:322.3-454.3 [173]

165 The incentive can be maximally Euro 500,000.

		437,3 (from 1 MW)											
Quota System								Quota System with tradable green certificates	Quota System with tradable green certificates.	Quota System with green certificates.	-		Quota System with green certificates.
Investment grants		-	Max 30% of total invest-ment	Up to 40% of investment costs	Max 50% of total investment[174]	For at least 90 Wp, the max. 3000 €/kW.					-		
Tax exemption		-		No tax rate for RES-E. General electricity tax rate was 0.77 €/MWh in 2009		EIA: 11% of total investment deductable[175]		No consumption tax: 5.44 €/MWh[176]			-	No consumption tax: 1.30 €/MWh	No levy: 5.17 €/MWh

166 Support guaranteed for 20 years. Tariff depends on the capacity as well on whether plants are integrated architecturally or not. 2% yearly degression of tariff.

167 Guaranteed period of 15 years. Tariff depends on the size of the installation. Max 1MW.

168 For domestic installations only.

169 Guaranteed period of 15 years. Premium depends on the size of the installation. Max 100 kW.

170 Guaranteed period of 15 years, Tariff depends on the size of the installation. Max 150 kW (microgeneration-when installed in residential, commercial, services or industrial buildings.), max 5kW for normal PV.

171 FIT Solar PV – on buildings: -up to 50 kW-415.46 €/MWh; Up to 1 MW-380.02 €/MWh; Up to 10 MW-315.36€/MWh; Up to 125MW-280.71€/MWh; Solar PV-independent: Up to 50kW-90.42€/MWh; Up to 1 MW-359.71€/MWh; Up to 10-289.98€/MWh; Up to 125MW-369.22€/MWh; Premium Solar PV – on buildings: -up to 50 kW-358.26 €/MWh; Up to 1 MW-322.82 €/MWh; Up to 10 MW-256.21€/MWh; Up to 125MW-215.71; Solar PV-independent: Up to 50kW- 33.22€/MWh; Up to 1 MW-302.51€/MWh; Up to 10-230.83€/MWh; Up to 125MW-204.22€/MWh

172 Tariff is based on a payback period of 12 years.

173 Tarrif depends on the size of the installation and grid connectedness. Tarrifs are adjusted anually. Scheme operational since 2010. http://www.decc.gov.uk Exchange rate used £1: €1.10

174 Up to a max. of €3000 per family/installation. Up to 200 families can benefit from the scheme.

175 Renewable energy projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

176 Amount of tax iss et in 2008, varies annually.

Fiscal incentives					Soft loan at 2.5%[177]	Soft loans at an average interest rate of 1%.		Low interest loans for environmentally sustainable projects[178],[179]			Soft loans : €25 million [180]		
	Obligation to install PV on new buildings[181]												

Table 28: Overview of support for Small-scale hydro in the EU-27

Country/ Subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
FIT/ Premium (€/MWh)	FIT: 40,2-62,3182.		FIT: 53.69 [183]		Tariff:110.5 Premium: 74.9 [184]	FIT: 35.0-126.7185	FIT: 53.8-80.6186	FIT: 73.5 Premium: 53.7	FIT & Premium: 80.34-83.59187		FIT: 60.7188.	FIT: 80.14-91.74189	FIT:95 [190]	FIT: 83.81[191]

177 This loan ranges between 500 EUR and 60,000 EUR. Loans for non-residential systems amount to between. 25,000 and 200,000 EUR. For industry, the Maltese government also offers a tax credit on the investment.

178 Minimum loan €459,000 and may amount up to 80% of the project costs.

179 Only projects involving the construction of new plants are eligible.

180 For legal entities, at 90% max credit period 15 yr., min interest rate three-months EURIBOR+1%, max loan 2 million, min 50,000€.

12 million € for natural persons180, max credit year 10, interest rate 3.9%, 20,000-40,000 €, up to 50kW

181 A minimum of 1 kW for each residential unit has to be covered by RES and 5 kW in industrial buildings larger than 100 m2.

182 v: 13 years as of 2009. Only installations >10MW are eligible. <10MW investment incentives apply (10 or 30% of total investment, depending on the size).

183 Guaranteed period of 15 years. Max 10 MW.

184 Guaranteed period of 30 years. Producers can choose between a premium or tariff. For plants started in 2010.

185 Including boni. Different categories apply. Guaranteed period of 20 years, except modernised hydropower plants: 15 years. 1% yearly degression of tariff for >5MW, no degression for smaller plants.

186 53.8 euro/MWh for the first 10 years, 80.6 for the years 10-20.

187 Average selling prices (distribution company vs. direct participation in the supply market). 15 years support. Reduced support after 16 years. For installations <10MW. For installation 10-15 MW, a different formula applies. Guaranteed period of 25 years, reduced support after 25 years.

Quota System		Quota System with green certificates.												
Investment grants				15-40% of total investment192	Max 20% of total eligible expenses 193					30% of total investment[194]		Min 20%, Max 40% of total investment[195]		
Tax exemption					Low interest loans	Low interest loans				Electricity tax aid: 4.2 €/MWh				
Fiscal incentives			Keep 15-20% of the loan196					The amount of loan: from 30,000 to 1.900.000 EUR. Up to 75% of investment costs						

188 Guaranteed period 20 years. Bonus of 5 €/MWh to 25 €/MWh for small plants. Bonus of 0 €/MWh to 16.8 €/MWh for winter production regularity.

189 Guaranteed period of 20 years. Min tariff refers to interconnected systems, max to non-interconnected island systems. Maximum capacity of 15 MW.

190 For non-weather dependent hydro plants.

191 Guaranteed period of 15 years. Max size 5MW.

192 Regional differences: 15% LE; 25% ME; 35% SE (max 105.00 euro). De minimus: 40% ma x 105.000 euro. Agricultural 35% max 105.00 euro. Public organisations and financial institutions get investment subsidies within framework 2. Public organisationa and other private companies get investment subsidies within framework 3.

193 Limit of €1.9 million.

194 The maximum amount of the subsidy is 250,000 EUR, but it can be extended by the Ministry of Employment and Economy.

195 This percentage depends on the region (zone) the promoted RES is to be constructed in: 20% in zone A, 30% in zone B and 40% in zone C.

196 The incentive can be maximally Euro 500,000.

Country/ Subsidy	IT	LT	LU	LV	MT	NL	PT	PL	RO	SE	SI	SK	UK
FIT/ Premium (€/MWh)	FIT:220 [197]	FIT: 75.3	FIT: 84.79-104.74[198].	FIT: 107,83-138,56199; 86,27-110,85 200		Premium: 29-81[201]	FIT: 75-77[202]				FIT: 82.34 – 105.47[203] Premium: 23.84 - 49.57 [204]	FIT:102 [205]	FIT: 195.8-218.9[206]
Quota System	Quota System with green certificates							Quota System with tradable green certificates[207].		Quota System with green certificates.	-		Quota System with green certificates.
Investment grants				Up to 40% of investment									

197 15 years feed-in tariff for RES-E schemes under 1 MW as alternative to TGCs and a coefficient for banding TGC according to technologies.

198 Guaranteed period of 15 years. Tariff depends on the size of the installation. Max 6 MW.

199 <5 MW -for the first 10 years of operation

200 <5 MW -for the next 10 years

201 Guaranteed period of 15 years. Hydro power <5 meters 81 euro/MWh; Hydro power >5 meters 29 euro/MWh.

202 52 GWh/MW or 20 years. In exceptional cases 25 years. Up to 10 MW.

203 Up to 50kW-105.47 €/MWh; Up to 1MW-92.61 €/MWh; Up to 10MW-82.34€/MWh.

204 Up to 50kW-49.57 €/MWh; Up to 1MW-36.71 €/MWh; Up to 10MW-23.84 €/MWh.

205 Tariff is based on a payback period of 12 years. Max size is 1 MW. For plants between 1 and 5 MW 102 euro/MWh.

206 For installations 15-100kW, respectively <15kW. Tarrifs are adjusted anually. Scheme operational since 2010. http://www.decc.gov.uk. Exchange rate used £1: €1.10

207 2GC/1MWh for small-hydro with a max size of 1 MW. 1GC/2MWh for non-refurbished small hydro with size 1-10 MW. 1GC/1MWh for re-furbished small hydro <1MW.

				costs									
Tax exemption				No tax rate for RES-E. General electricity tax rate was 0.77 €/MWh in 2009; Water use in hydro PPs is exempt from natural resources tax		EIA: 11% of total investment deductable[208]		No consumption tax: 5.44 €/MWh209				No consumption tax: 1.30 €/MWh	No levy: 5.17 €/MWh
Fiscal incentives					Soft loan at 2.5%210	Soft loans at an average interest rate of 1%		Low interest loans for environmentally sustainable projects211			Soft loans: €25 million[212]		

208 Renewable energy projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

209 Amount of tax iss et in 2008, varies annually.

210 This loan ranges between 500 EUR and 60,000 EUR. Loans for non-residential systems amount to between. 25,000 and 200,000 EUR. For industry, the Maltese government also offers a tax credit on the investment.

211 Minimum loan €459,000 and may amount up to 80% of the project costs.

212 For legal entities, at 90%, max credit period 15 yr., min interest rate three-months EURIBOR+1%, max loan 2 million, min 50,000€, up to 50kW.12 million € for natural persons212, max credit year 10, interest rate 3.9%, 20,000-40,000 €, up to 50KW

Table 29: Overview of support for electricity from Solar thermal in the EU-27

Country/ Subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
FIT/ Premium (€/MWh)				FIT: 260[213]				FIT: 73.5 Premium: 53.7	FIT: 269.38[214].			FIT: 237.14-277.14[215]	FIT:95	
Quota System		Quota System with green certificates.						-						
Investment grants										40% of total investment[216]		Min 20%, Max 40% of total investment[217]		
Tax exemption									Up to 10 % of investment deductable from income tax					
Fiscal incentives			Keep 15-20% of the loan218			Low interest loans		The amount of loan: from 30,000 to 1.900.000 EUR. Up to 75% of investment costs						

213 Guaranteed period 20 years.

214 25 years support. Reduced support after 25 years.

215 Guaranteed period of 20 years. <=5 MW: 257.14 euro/MWh Interconnected, 277.14 euro/MWh non-interconnected; >5 MW .237.14 euro/MWh Interconnected, 275.14 euro/MWh non-interconnected.

216 The maximum amount of the subsidy is 250,000 EUR, but it can be extended by the Ministry of Employment and Economy.

217 This percentage depends on the region (zone) the promoted RES is to be constructed in: 20% in zone A, 30% in zone B and 40% in zone C.

218 The incentive can be maximally Euro 500,000.

Country/ Subsidy	IT	LT	LU	LV	MT	NL	PL	PT	SE	RO	SI	SK	UK
FIT/ Premium (€/MWh)			FIT: 358.9-407.4[219].					FIT: 267-273[220]					
Quota System	Quota System with green certificates.						Quota System with tradable green certificates		Quota System with green certificates.				Quota System with green certificates.
Investment grants				Max 40% of investment costs									
Tax exemption				No tax rate for electricity 0.77 €/MWh		EIA: 11% of total investment deductable[221]	No consumption tax: 5.44 €/MWh222					No consumption tax: 1.30 €/MWh	No levy: 5.17 €/MWh
Fiscal incentives					Soft loan at 2.5%223	Soft loans at an average interest rate of 1%	Low interest loans for environmentally sustainable projects224,225				Low interest loans[226]		

219 Guaranteed period of 15 years. Tariff depends on the size of the installation. Max 1MW.

220 21 GWh/MW or 15 years. Max 10 MW.

221 Renewable energy projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

222 Amount of tax iss et in 2008, varies annually.

223 This loan ranges between 500 EUR and 60,000 EUR. Loans for non-residential systems amount to between. 25,000 and 200,000 EUR. For industry, the Maltese government also offers a tax credit on the investment.

224 Minimum loan €459,000 and may amount up to 80% of the project costs.

225 Only projects involving the construction of new plants are eligible.

226 Low interest loans covering between 50 and 90% of the predicted investment costs. The maximum for an individual loan is 2 million €, the minimum is 50,000 €. Low-interest loans to private citizens cover up to 100% of the investment costs.

Table 30: Overview of support for Wave&Tide in the EU-27

Country/ Subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
FIT/ Premium (€/MWh)							FIT: 53.8-80.6[227]							FIT: 220[228]
Quota System		Quota System with green certificates.												
Investment grants										30% of total investment[229]		Min 20%, Max 40% of total investment[230]		
Tax exemption														
Fiscal incentives			Keep 15-20% of the loan231			Low interest loans								

227 53.8 euro/MWh for the first 10 years, 80.6 for the years 10-20.

228 Guaranteed period of 15 years. Only available until 2015.

229 The maximum amount of the subsidy is 250,000 EUR, but it can be extended by the Ministry of Employment and Economy.

230 This percentage depends on the region (zone) the promoted RES is to be constructed in: 20% in zone A, 30% in zone B and 40% in zone C.

231 The incentive can be maximally Euro 500,000.

Country/ Subsidy	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
FIT/ Premium (€/MWh)	FIT:340[232]							FIT: 131-191[233]					
Quota System	Quota System with green certificates						Quota System with tradable green certificates			Quota System with green certificates.			Quota System with green certificates.
Investment grants				Max 40% of investment costs									
Tax exemption				No tax rate for electricity 0.77 €/MWh		EIA: 11% of total investment deductable[234]	No consumption tax: 5.44 €/MWh235					No consumption tax: 1.30 €/MWh	No levy: 5.17 €/MWh
Fiscal incentives					Soft loan at 2.5%236	Soft loans at an average interest rate of 1%	Low interest loans for environmentally sustainable projects237				Low interest loans[238]		

232 15 years feed-in tariff for RES-E schemes under 1 MW as alternative to TGCs and a coefficient for banding TGC according to technologies. Tariff is 220 euro/MWh for Biodegradable waste, biomass other than agricultural/forestry biomass that has a tariff of 280 euro/MWh.

233 15 years. Waves (Pre-commercial up to 20 MW) 191 euro/MWh; Waves (Commercial): first 100 MW 131 euro/MWh, next 150 MW 101 euro/MWh, rest 76 euro/MWh. Wave dmonstration installations up to 4 MW receive 260 euro/MWh.

234 Renewable energy projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

235 Amount of tax iss et in 2008, varies annually.

236 This loan ranges between 500 EUR and 60,000 EUR. Loans for non-residential systems amount to between. 25,000 and 200,000 EUR. For industry, the Maltese government also offers a tax credit on the investment.

237 Minimum loan €459,000 and may amount up to 80% of the project costs.

238 Low interest loans covering between 50 and 90% of the predicted investment costs. The maximum for an individual loan is 2 million €, the minimum is 50,000 €. Low-interest loans to private citizens cover up to 100% of the investment costs.

Table 31: Overview of support for Wind onshore in the EU-27

Country/ Subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
FIT/ Premium (€/MWh)	FIT: 75.32[239].		FIT: 74.11-96.63[240]	FIT:166[241]	FIT:82.2. Premium: 67.52[242]	FIT: 50.2-92.02[243]	Premium: 33.62[244].	FIT: 73.52[245] Premium: 53.72[246]	FIT&premium:72.78-81.10[247].		FIT: 82[248].	FIT: 80.14-91.74[249]	FIT: 95[250]	FIT: 66.35-68.68[251]
Quota System		Quota System with green certificates.												
Investment grants				15-55% of total investment[252]	Max 20% of total eligible expenses[253]					40% of total investment[254]		Min 20%, Max 40% of total investment[255]		

239 Guaranteed period of 13 years.

240 Guaranteed period of 15 years. Tariff depending on the size of the installation and full load hours.

241 Guaranteed period 25 years. For private parties and generally large-scale projects (no investment subsidies). Public organisations and financial institutions get investment subsidies within framework 2. Public organisationa and other private companies get investment subsidies within framework 3 (see investment subsidies).

242 Guaranteed period of 20 years. Producers can choose between a premium or tariff. For plants started in 2010.

243 Guaranteed period of 20 years. 1% yearly degression of tariff.

244 For 22.000 full load hours. Small wind turbines <25kW receive a tariff of 80.6 euro/MWh.

245 Up to 200 GWh/year.

246 Up to 400 GWh/year

247 Average selling prices (distribution company vs. direct participation in the supply market). 20 years support. Reduced support after 21 years.

248 Guaranteed period of 15 years. 82 €/MWh for first 10 years. 28 €/MWh to 82 €/MWh for following 5 years. Following 5 years subsidy depending on number of FLH (3600 to 2400).

249 Guaranteed period of 20 years. Min tariff refers to interconnected systems, max to non-interconnected island systems.

250 Max plant size is 20 MW. >20MW 0.0018 euro cent/kWh deduction.

251 Guaranteed period of 15 years. >5MW 66.35 euro/MWh, <5MW 68.68 euro/MWh.

Tax exemption										Electricity tax aid: 6.9 €/MWh				
Fiscal incentives			Keep 15-20% of the loan[256]			Low interest loans		The amount of loan: from 30,000 to 1.900.000 EUR. Up to 75% of investment costs						

Country/ Subsidy	IT	LT	LU	LV	MT	NL	PT	PL	RO	SE	SI	SK	UK
FIT/ Premium (€/MWh)	FIT:220[257]	FIT: 86.9	FIT: 82.49[258].	FIT: 40,48-128,11259		Premium: 68[260].	FIT: 74-75[261]				FIT 86.74-95.38 [262] Premium 30.84-43.38[263]	FIT: 85[264]	FIT: 49.5-379.5[265]

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252 Regional differences: 15% LE; 25% ME; 35% SE (max 45000 euro). Framework 2: de minimus: 40% ma x 45000 euro. Agricultural 35% max 45000 euro. Framework 3: 55% max 51000 euro. Public organisations and financial institutions get investment subsidies within framework 2. Public organisationa and other private companies get investment subsidies within framework 3.

253 Limit of €1.9 million.

254 The maximum amount of the subsidy is 250,000 EUR, but it can be extended by the Ministry of Employment and Economy.

255 This percentage depends on the region (zone) the promoted RES is to be constructed in: 20% in zone A, 30% in zone B and 40% in zone C.

256 The incentive can be maximally Euro 500,000.

257 15 years feed-in tariff for RES-E schemes under 1 MW as alternative to TGCs and a coefficient for banding TGC according to technologies.

258 Guaranteed period of 15 years.

259 116,85-128,11 €/MWh < 0,25 MW: -for the first 10 years, for the next 10 years: 70,11-76,86 €/MWh. Other wind PPs: for the first 10 years: 67,47-95,38 €/MWh, for the next 10 years: 40,48-57,23 €/MWh.

260 Guaranteed period of 15 years.

Quota System	Quota System with green certificates							Quota system with tradable green certificates[266]		Quota System with green certificates.	-		Quota System with green certificates.
Investment grants		Up to 70% of investment costs (but not more than 199.838 EUR)		Up to 40% of investment costs, EU Structural funds: min 700 thous. €, max 4.3 mio. €	Max 25% of total investment[267]	EIA: For turbines >25 kW max 600€/kW, <25 kW max 3 €/MW					Low interest loans[268]		
Tax exemption		-		No tax rate for RES-E. General electricity tax rate was 0.77 €/MWh in 2009;		EIA: 11% of total investment deductable[269]		No consumption tax: 5.44 €/MWh[270]		Energy tax credit: 11.20 €/MWh		No consumption tax: 1.30 €/MWh	No levy: 5.17 €/MWh

261 Paid for 33 GWh/MW or 15 years.

262 Up to 10MW: 95.38 €/MWh, Up to 125MW: 86.74 €/MWh

263 Up to 10MW: 43.38 €/MWh, Up to 125MW: 30.84 €/MWh

264 Tariff is based on a payback period of 12 years. For plants started in 2009.

265 Tarrifs depend on the size of the installation. Tarrifs are adjusted anually. Scheme operational since 2010. http://www.decc.gov.uk. Exchange rate used £1: €1.10

266 2GC/1MWh wind – until 2015; 1GC/1 MWh – after 2015.

267 For micro-wind turbines (max 3.7 kW). Max €232.94

268 Low interest loans covering between 50 and 90% of the predicted investment costs. The maximum for an individual loan is 2 million €, the minimum is 50,000 €. Low-interest loans to private citizens cover up to 100% of the investment costs.

269 Renewable energy projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

270 Amount of tax iss et in 2008, varies annually.

Fiscal incentives		-			Soft loan at 2.5%[271]	Soft loans at an average interest rate of 1%		Low interest loans for environmentally sustainable projects[272,273]			Soft loans: 12 million € for natural persons*274*, max credit year 10, interest rate 3.9%, 20,000-40,000 €, up to 50kW		

271 This loan ranges between 500 EUR and 60,000 EUR. Loans for non-residential systems amount to between. 25,000 and 200,000 EUR. For industry, the Maltese government also offers a tax credit on the investment.

272 Minimum loan €459,000 and may amount up to 80% of the project costs.

273 Only projects involving the construction of new plants are eligible.

274 Monthly repayment must not be lower than 40€ and must not exceed 1/3 of the average income of the last 3 months

Table 32: Overview of support for Wind offshore in the EU-27

Country/ Subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
FIT/ Premium (€/MWh)				FIT:166[275]		FIT: 130-150[276]	Via tenders. (FIT:69.6-84.5) [277]	FIT is not differentiated between onshore and offshore technologies	Via tenders.		FIT: 130[278]	FIT: 97.14.		FIT:140 [279]
Quota System														
Investment grants				15-55% of total investment[280]						40% of total investment[281]		Min 20%, Max 40% of total investment[282]		
Tax exemption										Electricity tax aid: 6.9 €/MWh				
Fiscal incentives			Keep 15-20% of the loan283			Low interest loans								

275 Guaranteed period 25 years. For private parties and generally large-scale projects (no investment subsidies). Public organisations and financial institutions get investment subsidies within framework 2. Public organisationa and other private companies get investment subsidies within framework 3 (see investment subsidies).

276 Guaranteed period of 20 years. 5% yearly degression of tariff as of 2015.

277 Via tenders. The tarrifs apply to Horns Rev II and Rodsand II. For new projects, different tariffs apply. New onshore/offshore wind receives a standard premium of 33,6 euro/MWh and 3.1 euro/MWh for balancing.

278 Guaranteed period of 20 years. 130 €/MWh for first 10 years. 30 €/MWh to 130 €/MWh for following 5 to 10 years. Following 5-10 years subsidy depending on number of FLH (3900 to 2800).

279 Guaranteed period of 15 years.

280 Regional differences: 15% LE; 25% ME; 35% SE (max 45000 euro). Framework 2: de minimus: 40% ma x 45000 euro. Agricultural 35% max 45000 euro. Framework 3: 55% max 51000 euro. Public organisations and financial institutions get investment subsidies within framework 2. Public organisationa and other private companies get investment subsidies within framework 3.

281 The maximum amount of the subsidy is 250,000 EUR, but it can be extended by the Ministry of Employment and Economy.

282 This percentage depends on the region (zone) the promoted RES is to be constructed in: 20% in zone A, 30% in zone B and 40% in zone C.

283 The incentive can be maximally Euro 500,000.

Country/ Subsidy	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
FIT/ Premium (€/MWh)		FIT is not differentiated between onshore and offshore technologies		FIT is not differentiated between onshore and offshore technologies		Via tenders.		FIT: 74-75[284]				FIT: 85[285]	
Quota System	Quota System with green certificates						Quota System with tradable green certificates		Quota system with tradable green certificates[286]	Quota System with green certificates.			Quota System with green certificates.
Investment grants				Up 40% of investment costs; EU Structural funds: min 700 thous. €, max 4.3 mio. €		EIA: For turbines >25 kW max 1000€/kW							
Tax exemption				No tax rate for RES-E. General electricity tax rate was 0.77 €/MWh in 2009		EIA: 11% of total investment deductable[287]	No consumption tax: 5.44 €/MWh[288]			Energy tax credit: 11.20 €/MWh		No consumption tax: 1.30 €/MWh	No levy: 5.17 €/MWh

284 Paid for 33 GWh/MW or 15 years.

285 Tariff is based on a payback period of 12 years. For plants started in 2009.

286 2GC/1MWh wind – until 2015; 1GC/1 MWh – after 2015.

287 Renewable energy projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

288 Amount of tax iss et in 2008, varies annually.

Fiscal incentives					Soft loan at 2.5%289		Low interest loans for environmentally sustainable projects[290,291]				Low interest loans[292]		

289 This loan ranges between 500 EUR and 60,000 EUR. Loans for non-residential systems amount to between. 25,000 and 200,000 EUR. For industry, the Maltese government also offers a tax credit on the investment.

290 Minimum loan €459,000 and may amount up to 80% of the project costs.

291 Only projects involving the construction of new plants are eligible.

292 Low interest loans covering between 50 and 90% of the predicted investment costs. The maximum for an individual loan is 2 million €, the minimum is 50,000 €. Low-interest loans to private citizens cover up to 100% of the investment costs.

2.1.2 Instruments to support RES heat and cooling

Table 33 - Table 36 provide an overview of support instruments for the different RES-H&C technology categories. The data in these tables are extracted from the RE-Shaping country profiles. If other, additional sources are used, this is explicitly stated. These incentives are difficult to quantify due to their complex and often detailed nature (with many exceptions and rules), and often depend on the size and type of projects.

Table 33 Overview of support for district heat in the EU-15 Member States

Country/ subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
Investment grant	≤ 400 kW: 56 €/kW (0-100kW), 32€/kW for additional kW (100 - ≤400 kW)[293] >400kW[294]				Max 40%			Up to 75% of the toal investment cost. The amount of loan is between 30,000 and 1,900,000 €		Max 30%[295]	See bonus/ premium		Minimum 1 million HUF (3,600 €) and maximum 1000 million HUF (3.6 million €), and the supported rate is minimum 10% and maximum is 70% of eligible costs.	
Tax exemption	VAT 10% on agriculture and forestry products[296]; expenses for energy saving measures are deductable						No CO_2 tax on biomass used in CHP[298].			No taxes on net carbon emissions[299].		Tax deduction: 20% Max 700 €		

293 The support is granted "de-minimis" (costs may not exceed €300.000 in three fiscal years) and is limited to 30% of the environmentally relevant costs at the max.

294 Above de-minimis: 40% of the additional env. relevant investment costs

295 Only when using biomass. Source: Finland meteorological institute.

296 VAT on fossil fuels is 20%, plus additional tax costs for Austrian mineral oil

	from taxable income[297]													
Financial incentives (e.g. loans)								between 30,000 and 1,900,000			Zero interest loan caped at 20.000-30.000€			
Premium/bonus											Investment support combined with feed-in premium on national level to eligible heat production installations[300] Regional Feed-in premium[301,302]			

297 There is no restriction regarding the combination of tax allowance schemes and investment grants, thus a combination of these schemes is possible.

298 CO2 taxes are generally not considered tax exemptions. A CO2 tax corrects the externality related to CO2 emission and thus generate better relative prices for renewable heat production. However, because the CO2 tax supports RES most in this case, it is presented here.

299 CO2 taxes are generally not considered tax exemptions. A CO2 tax corrects the externality related to CO2 emission and thus generate better relative prices for renewable heat production. However, because the CO2 tax supports RES most in this case, it is presented here.

300 Maximum caped between 800m€ - 1000m€.

301 Regional feed-in premium for public service: 0 à 250 toe (0 à 2 900MWh/year) = 1750 €/toe, 250 à 500 toe (2 900 to 5 800 MWh/year) = 1250 €/toe, 500 à 1000 toe (5 800 to 11 630 MWh/year) = 600 €/toe and > 1000 toe (11 630MWh/year) = 300 €/toe.

302 Regional feed-in premium for industry and agriculture: 0 à 500 toe (0 à 5 800MWh/year) = 1100 €/toe (600 for wood industry), 500 à 1000 toe (5 800 to 11 630 MWh/year) = 600 €/toe, > 1000 toe (11 630MWh/year) = National scale call for tender by the BCIAT

Country/ subsidy	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Investment grant		Investment support from EU structural funds. It is planned to support 35 projects with a projected capacity of up to 100 MW. It is planned to provide total support of 127 million Litas (36,78 million EUR).		Min 0.14 million €, max. 5.6 million € per project (biomass, biogas). Total budget is 24.4 million €.							Max 50%		
Tax exemption													Expenses deductable from taxable income.
Financial incentives								Low interest loans[303].					
Premium													

303 1: Min project size 459.000 €, max 80% of project costs, 1.75-2.12 interest. 2: Min project size 10 mln€, max 75, 6% interest rate.

Table 34: Overview of support for heat from biomass plants in the EU-27

Country / subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
Investment grant	≤400kW: 56 €/kW (0-100kW), 60 €/kW for additional kW (100-400kW)[304,305] >400kW: all environmental investment costs[306,]	Max 40% for Flemish agrarians investing in energy crops	Rural Develop-ment Programme: grants 50-75% of investment needs	Investment subsidies, max. €680,000[310]	Max 40% for CHP biomass[311], biogas[312] and biowaste[313]	Pellet boilers & stoves (<100kW): 36 €/kW, max. €1450. Split log gasification (15-50kW), €1000-€1450 per installation		Up to 75% of the toal investment cost. The amount of loan is between 30,000 and 1,900,000 €		Max 30%		Up to 35% of investment costs	NEP: grants of max 35%[314] EEOP: min 10%, max 70% of eligible costs[315]	Up to 30% of investment costs (industrial, commercial, public, community)[316] Households: €800-€2500[317]

304 The support is granted "de-minimis" (costs may not exceed €300.000 in three fiscal years) and is limited to 30% of the environmentally relevant costs at the max

305 Boiler plants that fulfill "Umweltschutzrichtlinie Nr.37" are granted another € 10/kW

306 De-minimis: all environmental relevant investment costs; above de-minimis: additional environmental releant investment costs.

307 For biomass firing plants as central supply unit at operational level: 20% of environmental relevant costs; bonus of 5% if 80% woodchips (timber) are used. For biomass microgrid & biomass local heat: 25% environmental relevant costs; bonus of 5% if 80% woodchips (timber) are used.

308 Above de-minimis: 40% of the additional environmental relevant investmnet costs (max)

309 For flue gas cleaning a bonus of 5% or max € 20.000 is possible for installations with a capacity between 400 and 1.000 kW.

310 Framework 2 >> Regional: LE=15%, ME=25%, SE=30%, max=€680,000; de minimis: 40%, max=€200,000; Agricultural: 35%, max=€400,000 – 500,000. Framework 3 >> 55%, max=€19,000

311 Limit of €1.9 million (20%) and €3.85 million (40%).

312 Limit of €3.85 million.

313 Limit of €3.85 million.

314 Maximum of grant HUF 1,470,000 (€ 5,300)

	[307,308,309]													
Tax exemption	VAT 10% on agriculture and forestry products[318]; expenses for energy saving measures are deductable from taxable income[319]	Income tax reduction for households of 40% of the investment[320,321] Firing biomass[322] up to 300 kW is exempted from env.					No CO_2 tax on biomass[323]			No taxes on net carbon emissions[324]	Tax deduction: Max 25%[325] Reduced VAT (5.5%) on material and installation costs	Tax deduction: 20% Max 700 €		

315 The amount of subsidy can be minimum 1 million HUF (3,600 €) and maximum 1000 million HUF (3.6 million €), and the supported rate is minimum 10% and maximum is 70% of eligible costs.

316 Only wood chip and pellet boilers. Qualifying technologies must meet certain standards of manufacture, such as the CE mark, and certain efficiency standards in the case of biomass boilers

317 Wood Chip/Pellet Stove: €800; Biomass / Wood pellet Stove with integral boiler: €1,400; Wood Chip/Pellet Boiler: €2,500; Wood Gasification Boiler: €2,000

318 VAT on fossil fuels is 20%, plus additional tax costs for Austrian mineral oil

319 There is no restriction regarding the combination of tax allowance schemes and investment grants, thus a combination of these schemes is possible.

320 The maximum budget per installation is capped at €2,770 per installation. The measure can be cumulated with an investment premium.

321 Wood burning stove: The machine has to have an efficiency of 60% according to norm EN303-5 in order to get the subsidy.

322 Only for untreated wood and certified wood pellets

323 CO2 taxes are generally not considered tax exemptions. A CO2 tax corrects the externality related to CO2 emission and thus generate better relative prices for renewable heat production. However, because the CO2 tax supports RES most in this case, it is presented here.

		permit												
Financial incentives			Second EBRD credit line: keep 20 or 30% of the loan amount as incentive			Low-interest loans with fixed interest rate[326,327]		between 30,000 and 1,900,000			zero interest loan caped at 20000€ or 30.000€			
Premium											National Feed-in premium to eligible heat production installations[328] Regional Feed-in premium[329,330]			

[324] CO2 taxes are generally not considered tax exemptions. A CO2 tax corrects the externality related to CO2 emission and thus generate better relative prices for renewable heat production. However, because the CO2 tax supports RES most in this case, it is presented here.

325 A maximum deduction of 8000€ for a single person, 16000€ for a married couple, and a supplement of 400€ per dependant person is available.

326 Up to 100 % of the eligible net investment costs are supported, up to a maximum loan amount of usually €5 mln.

327 Only for biomass-installations with an installed capacity >100 kW

328 Maximum caped between 800m€ - 1000m€.

329 Regional feed-in premium for public service: 0 à 250 toe (0 à 2 900MWh/year) = 1750 €/toe, 250 à 500 toe (2 900 to 5 800 MWh/year) = 1250 €/toe, 500 à 1000 toe (5 800 to 11 630 MWh/year) = 600 €/toe and > 1000 toe (11 630MWh/year) = 300 €/toe.

330 Regional feed-in premium for industry and agriculture: 0 à 500 toe (0 à 5 800MWh/year) = 1100 €/toe (600 for wood industry), 500 à 1000 toe (5 800 to 11 630 MWh/year) = 600 €/toe, > 1000 toe (11 630MWh/year) = National scale call for tender by the BCIAT

Country/ subsidy	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Investment grant		Investment support from EU structural funds. LEIF supports up to 70% of the total investment cost	Up to 30% of total costs[331]	Min 0.14 million €, max. 5.6 million € per project (biomass, biogas). Total budget is 24.4 million €.			NFOSiGW: special funding for renewable energy projects, biomass CHP[332]	35% investment subsidy333			Up to 50% of total investment cost in households and public sector. Max 200,000 €. Beneficiary covers at least 25% of costs	Programme for Promotion of Biomass and Solar Energy Use, total budget: €8M[334], up to 30% of installation	Several grant schemes for biomass[335]
Tax exemption	Tax rebate of 55% for building renovation incl. RES-H[336]	Natural and legal persons who submit evidence on biofuels consumption are exempt from taxes								No CO_2[337] and energy tax for biomass, only sulphur tax for peat.			Inv. in energy saving tech. may be written off in one year[338]

331 Central heating (pellets or wood chips): 30% upt €4000 per family and €20000 per complex, Furnace (pellets): 30% up to €2500, Central heating (log wood): 25% up to €2500 per family and €10000 per complex.

332 Biomass projects (thermal power generation using biomass (below 20 MW thermal), CHP production under 3 MWe, CHP using sewage or other waste sources, as well as for high efficiency CHP.

333 Upper limit of €250,000 per SME. If the investment is higher, the remaining part can be financed with a loan up to € 750,000.

334 Requirements for supported biomass boilers are the following: boilers for burning wood pellets, wood briquettes, wood chips, wood logs; efficiency should be at least 84% (certified by EU laboratory); emissions should be less than 1500 mg/m3 for carbon monoxide and 100 mg/m3 for solid particles; some additional safety equipment is necessary. Total subsidy is max. € 1000

335 Bio-energy Capital Grant Scheme: no minimum grant aid in any one application and the maximum is £500,000 per installation; The Wood Energy Business Scheme (WEBS); The Scottish Biomass Heat Scheme: total £3.3 million of funding is available between April 2009 to March 2011. Of this, £1.3 million is available in the Highlands & Islands area and £2 million in the Lowlands & Uplands Scotland area; The Carbon Trust Biomass Heat Acceleration project: £5million of funding for R&D over the 5 year period from 2006.

336 The ceiling was set at 15 Meuro per year in 2007 – 2009. In 2008 Budget Law, the tax rebate was confirmed to be in effect until 2010.

337 CO2 taxes are generally not considered tax exemptions. A CO2 tax corrects the externality related to CO2 emission and thus generate better relative prices for renewable heat production. However, because the CO2 tax supports RES most in this case, it is presented here.

338 Also, there is a 0% interest loan under the Energy Efficiency Loans Scheme (mainly for SMEs, administered by the Carbon Trust)

		on pollution from stationary sources.											
Financial incentives													
Premium			30 €/ MWh_{th}										

Table 35: Overview of support for heat from solar thermal in the EU-27

Country/ subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
Investment grant	≤100m^2: € 100/m2 for standard collectors, € 150/m2 for vacuum collectors[339]. >100m^2: De-minimis: 20%, above up to 40%[340]			Investment subsidies, max. €85,500[341]		Warm water: 60 - 210 €/m^2, incl. heating: 105 – 210 €/m^2				Energy grants for households: 25% of eligible costs (only materials and equipment)		Up to 35% of investment costs, industrial installations up to 40%	Grants of max 35%[342] EEOP: min 10%, max 70% of eligible costs[343]	Up to 30% of investment costs (industrial, commercial, public, community)[344] Households: 250-300 €/m^2 [345]

339 The support is granted "de-minimis" (costs may not exceed €300.000 in three fiscal years) and is limited to 30% of the environmentally relevant costs at the max

340 De-minimis (costs may not exceed €300.000 in three fiscal years): all environmental relevant investment costs; above de-minimis: additional environmental relevant investment costs

341 Framework 2 Hot water >> Regional: LE=15%, ME=25%, SE=30%, max=€20,000; de minimis: 30%, max=€20,000; Agricultural: 30%, max=€20,000. Framework 3 Hot water>> 45%, max=€26,000

Framework 2 Space heating/cooling >> Regional: LE=15%, ME=25%, SE=30%, max=€85,500; de minimis: 40%, max=€85,500; Agricultural: 30%, max=€85,500. Framework 3 Hot water>> 55%, max=€120,000

342 Maximum of grant HUF 1,470,000 (€ 5,300)

343 The amount of subsidy can be minimum 1 million HUF (3,600 €) and maximum 1000 million HUF (3.6 million €), and the supported rate is minimum 10% and maximum is 70% of eligible costs.

344 Only wood chip and pellet boilers. Qualifying technologies must meet certain standards of manufacture, such as the CE mark, and certain efficiency standards in the case of biomass boilers

345 Solar Thermal Space and or Hot water heating (Evacuated Tube): €300 per m2(to max 6 m2); Solar Thermal Space and or Hot water heating (Flat Plate): €250 per m2 (to max 6 m2)

Tax exemption	Expenses for energy saving measures are deductable from taxable income[346]	Income tax reduction for households of 40% of the investment[347,348]					No CO_2[349] and energy tax on solar heating			No taxes on net carbon emissions[350].	Tax deduction of max. 40%[351] Reduced VAT (5.5%) on material and installation costs[352]	Tax deduction: 20% Max 700 €		
Financial incentives			Second EBRD credit line: keep 20 or 30% of the loan amount as incentive			Low-interest loans with fixed interest rate[353,354]		between 30,000 and 1,900,000			zero interest loan caped at 20000€ or 30.000€			

346 There is no restriction regarding the combination of tax allowance schemes and investment grants, thus a combination of these schemes is possible.

347 The maximum budget per installation is capped at €2,770 per installation. The measure can be cumulated with an investment premium.

348 Solar thermal: The panels are installed between east and west, facing south. The angle is between 0 and 70° with the horizon.

349 CO2 taxes are generally not considered tax exemptions. A CO2 tax corrects the externality related to CO2 emission and thus generate better relative prices for renewable heat production. However, because the CO2 tax supports RES most in this case, it is presented here.

350 CO2 taxes are generally not considered tax exemptions. A CO2 tax corrects the externality related to CO2 emission and thus generate better relative prices for renewable heat production. However, because the CO2 tax supports RES most in this case, it is presented here.

351 A maximum deduction of 8000€ for a single person, 16000€ for a married couple, and a supplement of 400€ per dependant person is available.

352 This incentive does not cover solar panels for installations bigger than 3kW

353 Up to 100 % of the eligible net investment costs are supported, up to a maximum loan amount of usually €5 mln.

354 Solar thermal installations with a collector area > 40 m² in apartment houses or commercially used buildings

Premium											National Feed-in premium to eligible heat production installations[355] Regional Feed-in premium[356,357]			

Country/ subsidy	**IT**	**LT**	**LU**	**LV**	**MT**	**NL**	**PL**	**PT**	**RO**	**SE**	**SI**	**SK**	**UK**
Investment grant			Up to 50% of total costs[358]	Min 25%	Once-only grants for investments in solar water heaters, max 66%[359]	Inv. subsidy[360]		Gov. rebate of €1642 for solar thermal kit. 35% investment subsidy[361]		House-holds: max €800, Public bld.: 30% of costs	Up to 25% of investment costs. Max 210 €/m^2	Programme for Promotion of Biomass and Solar Energy Use, total budget: €8M. Solar 50-300 €/m^2 [362]	

355 Maximum caped between 800m€ - 1000m€.

356 Regional feed-in premium for public service: 0 à 250 toe (0 à 2 900MWh/year) = 1750 €/toe, 250 à 500 toe (2 900 to 5 800 MWh/year) = 1250 €/toe, 500 à 1000 toe (5 800 to 11 630 MWh/year) = 600 €/toe and > 1000 toe (11 630MWh/year) = 300 €/toe.

357 Regional feed-in premium for industry and agriculture: 0 à 500 toe (0 à 5 800MWh/year) = 1100 €/toe (600 for wood industry), 500 à 1000 toe (5 800 to 11 630 MWh/year) = 600 €/toe, > 1000 toe (11 630MWh/year) = National scale call for tender by the BCIAT

358 DHW: 50% up to €3000 per family and €15000 per complex, DHW and heating: 50% up to €5000 and €15000 per complex.

359 Maximum of grant: €460 per family

360 €16 million for solar thermal and heat pumps

361 Upper limit of €250,000 per SME. If the investment is higher, the remaining part can be financed with a loan up to € 750,000.

362 Requirements: efficiency should be at least 525 kWh/m2 per year for installations completed as of 2010; certificate of Solar Keymark (issued in EU) is necessary. Subsidies: 200 EUR per 1 m2 for up to maximum 8 m2; 50 EUR per 1 m2 for installations above 8 m2; 300 EUR per 1 m2 for apartment houses, if area of solar collectors for one apartment is less than 3 m2.

Tax exemption	Tax rebate of 55% for building renovation incl. RES-H[363]					EIA: 11% of total investment deductable[364]		Tax credit[365] / reduction[366] of 30%		No CO_2[367] and energy tax			Inv. in energy saving tech. may be written off in one year[368]
Financial incentives								Preferential rate financing for costs solar thermal installations					
Premium			30 € / MWh_{th}										

363 The ceiling was set at 15 Meuro per year in 2007 – 2009. In 2008 Budget Law, the tax rebate was confirmed to be in effect until 2010.

364 Projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

365 Solar thermal: In addition, the incentive scheme can be combined with existing tax credit provisions for the installation of such systems (IRS deduction scheme, 30% with limit a limit of 796€ per installation).

366 For solar cooling plants a tax reduction 30% of the investment or up to a limit of €766 (valid in general for all the renewable energy investment).

367 CO2 taxes are generally not considered tax exemptions. A CO2 tax corrects the externality related to CO2 emission and thus generate better relative prices for renewable heat production. However, because the CO2 tax supports RES most in this case, it is presented here.

368 Also, there is a 0% interest loan under the Energy Efficiency Loans Scheme (mainly for SMEs, administered by the Carbon Trust)

Table 36: Overview of subsidies for heat pumps in the EU-27

Country/ subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
Investment grant	≤400kW: max 30% of env. relevant investment costs[369,370,371] >400kW: Deminimis: 15%, above up to 40%[372]	Max 20% subsidy for public organisations		Investment subsidies, max. €850,000[373]	Max of 40% if CHP[374]	Eff. heat pumps: 10 – 30 €/m² (NOT kW!)[375]				Energy grants for households: 25% of eligible costs (only materials and equipment)		Up to 35% of investment costs	Grants of max 35%[376] EEOP: min 10%, max 70% of eligible costs[377]	Up to 30% of investment costs (industrial, commercial, public, community)[378] Households: €2000 - €3500[379, 380]
Tax exemp-tion	Expenses for energy saving measures are deductable	Income tax reduction for households of 40% of the investment[382,383]					No CO_2 [384]and energy tax.			No taxes on net carbon emissions.[385]	Tax deduction[386] 25 – 40%[387] Reduced VAT (5.5%) on material and	Tax deduction: 20% Max 700 €		

369 The support is granted "de-minimis" (costs may not exceed €300.000 in three fiscal years) and is limited to 30% of the environmentally relevant costs at the max

370 Water heat pumps: 0-80 kW: € 85 kW, every other kW € 45 up to 400 kW

371 Air heat pumps: 0-80 kW: € 70 kW, every other kW € 35 up to 400 kW

372 De-minimis (costs may not exceed €300.000 in three fiscal years): all environmental relevant investment costs; above de-minimis: additional environmental relevant investment costs

373 Framework 2 >> Regional: LE=15%, ME=25%, SE=30%, max=€850,000; de minimis: 40%, max=€200,000; Agricultural: 35%, max=€400,000 - €500,000. Framework 3 >> 55%, max=€20,000

374 Limit of €3.85 million.

375 Max. €950 per installation and €1500 - €4500 per housing unit.

376 Maximum of grant HUF 1,470,000 (€ 5,300)

377 The amount of subsidy can be minimum 1 million HUF (3,600 €) and maximum 1000 million HUF (3.6 million €), and the supported rate is minimum 10% and maximum is 70% of eligible costs.

378 Only wood chip and pellet boilers. Qualifying technologies must meet certain standards of manufacture, such as the CE mark, and certain efficiency standards in the case of biomass boilers

379 Heat Pump - Horizontal ground collector: €2500; Heat Pump - Vertical ground collector: €3500; Heat Pump - Water (well) to water: €2500; Heat Pump - Air source: €2000.

380 Investment grant support to eligible projects, dependent on the size of the project and the technology.

	from taxable income[381]										installation costs			
Financial incentives			Second EBRD credit line: keep 20 or 30% of the loan amount as incentive					between 30,000 and 1,900,000			zero interest loan caped at 20000€ or 30.000€			
Premium											National Feed-in premium to eligible heat production installations[388] Regional Feed-in premium[389,390]			

381 There is no restriction regarding the combination of tax allowance schemes and investment grants, thus a combination of these schemes is possible.

382 The maximum budget per installation is capped at €2,770 per installation. The measure can be cumulated with an investment premium.

383 Heat pumps: The heat pump has an EG-label and its COP is higher than 3.

384 CO2 taxes are generally not considered tax exemptions. A CO2 tax corrects the externality related to CO2 emission and thus generate better relative prices for renewable heat production. However, because the CO2 tax supports RES most in this case, it is presented here.

385 CO2 taxes are generally not considered tax exemptions. A CO2 tax corrects the externality related to CO2 emission and thus generate better relative prices for renewable heat production. However, because the CO2 tax supports RES most in this case, it is presented here.

386 From 2010, air-air heat pumps are not eligible for tax deduction anymore.

387 A maximum deduction of 8000€ for a single person, 16000€ for a married couple, and a supplement of 400€ per dependant person is available.

388 Maximum caped between 800m€ - 1000m€.

389 Regional feed-in premium for public service: 0 à 250 toe (0 à 2 900MWh/year) = 1750 €/toe, 250 à 500 toe (2 900 to 5 800 MWh/year) = 1250 €/toe, 500 à 1000 toe (5 800 to 11 630 MWh/year) = 600 €/toe and > 1000 toe (11 630MWh/year) = 300 €/toe.

390 Regional feed-in premium for industry and agriculture: 0 à 500 toe (0 à 5 800MWh/year) = 1100 €/toe (600 for wood industry), 500 à 1000 toe (5 800 to 11 630 MWh/year) = 600 €/toe, > 1000 toe (11 630MWh/year) = National scale call for tender by the BCIAT

Country/ subsidy	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Investment grant			Up to 40% of total costs[391]	Min 25%		Inv. subsidy[392]		35% investment subsidy[393]		Grant of €3500	Up to 50% of total investment cost in households and public sector. Max 200,000 €. Beneficiary covers at least 25% of costs		
Tax exemption	Tax rebate of 55% for building renovation incl. RES-					EIA: 11% of total investment deductable[395]				No CO_2[396] and energy tax			Inv. in energy saving tech. may be written

391 Ground source: 40% up to €6000 per family and €20000 per complex, Air: 40% up to €3000 and €10000 per complex. For micro-CHP more detailed subsidies are eligible.

392 €16 million for solar thermal and heat pumps

393 Upper limit of €250,000 per SME. If the investment is higher, the remaining part can be financed with a loan up to € 750,000.

394 The ceiling was set at 15 Meuro per year in 2007 – 2009. In 2008 Budget Law, the tax rebate was confirmed to be in effect until 2010.

	H[394]												off in one year[397]
Financial incentives													
Premium													

395 Projects can deduct 44% of the total investment costs from annual profit in the year of installation considered by the corporate tax up to a maximum of 110 million € per installation (Law income tax, 2001)

396 CO2 taxes are generally not considered tax exemptions. A CO2 tax corrects the externality related to CO2 emission and thus generate better relative prices for renewable heat production. However, because the CO2 tax supports RES most in this case, it is presented here.

397 Also, there is a 0% interest loan under the Energy Efficiency Loans Scheme (mainly for SMEs, administered by the Carbon Trust)

2.1.3 Instruments to support biofuels (RES-T)

Table 37 provides an overview of support instruments for the RES-T. The data in the table is extracted from the RE-Shaping country profiles. If other, additional sources are used, this is explicitly stated. The table also includes the intermediate biofuels targets as well as other, secondary forms of support.

Table 37: Support for biofuels in the EU-27

Country/ subsidy	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	IE
Biofuels quota obligation	Yes	No	Yes	Yes	Yes	Yes[398]	Yes	No	Yes	Yes	Yes	No	No	Yes[399]
(Intermediate) target (2010)	5.75%[400]	5.75%[401]	5.75%	2.0% for biofuels, 2.5 for transport	3.5% (ethanol) 4% (diesel)[402]	5.75%	0.75%[403]	-	5.83%	4%	7%	5.75%	5.75%	4%
Tax exemption	Yes[404]	Yes[405]	**No**	Yes	Yes[406]	Yes[407]	Yes[408]	Yes	Yes	No	Yes[409]	Yes	Yes[410]	Yes
Other support	-	-	-	-		Yes[411]	Yes[412]	-	-	Yes[413]	-	-	Yes[414]	Yes[415]

398 6.25% overall biofuel quota, based on energy content

399 From 2010

Country/ subsidy	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Biofuels quota obligation (2010)	No	Yes	Yes	Yes[416]	No	Yes	Yes	Yes[417]	Yes	No[418]	Yes	Yes	Yes

400 2009 target. http://ec.europa.eu/energy/renewables/biofuels/doc/member_states_reports_directive_2003_30_ec_2009.zip

401 Biodiesel: 380,000 liters. Bio-ethanol: 250,000 liters

402 2009 target

403 5.75% target put forward to 2012.

404 Bioethanol 442 (normal: 475) €/1000liters with a least 44 liters of biofuel/1000 liters; Biodiesel 347 (normal: 375) €/1000liters with a least 44 liters of biofuel/1000 liters; Bioethanol 0 (normal: 475) €/1000liters 100 % biofuel; Biodiesel 0 ((normal: 375) €/1000liters 100 % biofuel; Bioethanol 0 ((normal: 475) €/1000liters With a bioethanol content of at least 65% and at most 75% by volume from 1 October to 31 March (autumn and winter) and of at least 75% and at most 85% by volume from 1 April to 30 September (spring and summer),

405 Tax levels: Diesel: 0.33 €/liter; B5: 0.31 €/liter; PPO: 0 €/liter; Gasoline 0.59 €/liter; ETBE15: 0.55 €/liter

406 Only for B31

407 Ruled out by 2013/2015. E5/ETBE are equally taxed as gasoline. Tax level 2010: Diesel: 0.47 €/liter; B100: 0.27 €/liter; PPO: 0.26 €/liter

408 Exemption on CO2 tax

409 Tax on biofuels increases annually, in 2012, it will be equal to excise on gasoline and diesel

410 8.3 HUF/liter tax deduction

411 BTL fuel projects support in 2008 was 10 € million

412 200 million DKK is available for 2nd generation biofuel demonstration projects in the period 2006-2010

413 In spring 2007, Tekes – the technology and innovation development centre – launched BioRefine – New biomass products technology programme. The programme began in 2007 and will run until 2012.

414 Support programmes for biofuel factories

415 Additional: National Energy Crop Premium

416 Introduced at the end of 2009.

417 Quota for FAME in diesel

418 Only for larger filling stations

(Intermediate) target (2010)	5.75%	5.75%	5.75%[419]	5.90 (bioethanol) 5.8% (biodiesel)	5.75%	4%	5.75%	5.75%	4%	10%	3%[420]	5.75%	3.5%[421]
Tax exemption	Yes[422]	Yes	Yes[423]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes[424]
Other support	-	Yes[425]	-	Yes[426]	-	Yes[427]	Yes[428]	-	-	Yes[429]	-	-	Yes[430]

419 Indicative Target set by the European Biofuels Directive from 2003

420 Obligation for distributers are set at 5% (energy content) in 2010

421 Target for 2009/2010.

422 Tax levels: Diesel: 0.41 €/liter; Biodiesel: 0.29 €/liter; Gasoline: 0.56 €/liter; Bioethanol: 0.29 €/liter

423 No tax exemption for blended fuel but a pollution tax (1.200 EUR/1000 litres) for not reaching the target value of 2% in 2007. Tax exemption of 100% for pure biofuel (B100/E100) consumed on the Luxembourg territory.

424 In the form of a duty incenstive

425 Pursuant to the Regulations for financing the development of the production of biofuels for transport, LTL 26.6 million (EUR 7.7 million) was appropriated for the development of biofuel production from the national budget, and 118 580 tonnes of rapeseed (crop area of 59 290 ha) and 78 300 tonnes of cereal grain (crop area of 26 181 ha) were purchased for biofuel production in 2008.

426 Reduced permit costs for warehousekeepers and traders

427 Besides the tax incentives, towards the end of 2006 the Dutch cabinet earmarked grants totalling sixty million euros for projects in the field of innovative biofuels that yield a significant reduction in CO2 emissions. This scheme has been extended to run until 2010. Companies that intend to invest in projects focusing on innovative or improved production of biofuels for transport and will incur extra costs for reducing CO2 emissions may qualify for grants. Besides investment projects, the programme also supports projects for applications or uses that reduce CO2 emissions in transport. 2006-2010

428 Several research (PLN 2.78 million in 2008) and development (PLN 13.435 million, in 2008) projects are supported

429 The development of second-generation biofuels will be supported and SEK 875 million will be earmarked between 2009 and 2011 for the commercialisation of new energy technology, including biofuel demonstration plants.

430 Refuelling Infrastructure Grant Programme

Appendix to chapter 3: Current and planned EU funding

3.2 Current and planned EU funding outside EU

3.2.1 Expenditures by EU Member State

In this section, the significant expenditures from EU Member States (MS) on renewable energy beyond EU are presented. To make sure that the information was collected in a consistent way and can be compared across the Member States, a common data base was selected.

The information was collected through an OECD database on 2008 ODA spendings, available for individual countries. The database can be filtered with several restrictions. Under purpose code 23030, expenditures on "power generation / renewable sources" are collected. This includes also expenditures for e.g. framework conditions for RES or those necessary to improve the administrative environment.

The following table summarizes the information on expenditures on renewable energies within ODA expenditures from the EU MS. However, not all EU MS are a member of the Development Assistance Committee (DAC). They therefore do not report on their ODA related spendings for RE. The DAC countries are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States.

In addition, not all countries have indicated the RES related expenditures for 2008. Where available, 2007 values were taken. In case no information on RES related expenditures was available, only total ODA amounts are included in the table.

Table 38: ODA Expenditures by EU MS, 2008 (Source: OECD 2010)

	total ODA	thereof RE	share
EU MS	mio US$	mio US$	
AT	1283.44	1	0.1%
BE**	1317.03	28.8	2.2%
BG*			
CY*			
CZ*			
DE	11043.06	566.3	5.1%
DK**	1443.05	56.4	3.9%
EE*			
ES	5411.29	5.6	0.1%
FI	695.11	3.2	0.5%
FR	7939.07	0.4	0.0%
GR**	247.82	1.2	0.5%
HU*			
IR	930.6		no info on RE
IT	2072.93	1.8	0.1%
LT*			
LU	278.66		no info on RE
LV*			
MT*			
NL	5489.3	77.2	1.4%
PL*			
PT	383.1		no info on RE
RO*			
SE	3142.3	5.3	0.2%
SI*			
SK*			
UK	7890.8	13.4	0.2%

* These countries do not belong to Development Assistance Committee countries and do not report their expenditures on RE
** For 2008, no information on RES spendings was indicated. These are 2007 values.

Another possible source for information on expenditures on RES in third countries are the fifth national reports handed in to the UNFCCC until January 2010. However, the information details and depths vary greatly from country to country. Not all countries include the most up to date data, and the categories of spendings also differ across the reports. Furthermore, the reports do not include details on expenditures for especially renewable energies. These expenditures are included in the category "bilateral / worldwide expenditures within ODA; mitigation; energy". This category also includes other topics like spendings for grids or energy efficiency measures.
As this information is thus not coherent and does not offer details on expenditures for RES only, the information is not considered in this report.

3.2.2 The IPA 2009 Crisis Response Package

Fund	Total Community contribution	Duration	Objective	Beneficiary	Types of investment (EE / RE)	Sectors covered
a) Green for Growth	20 mio € (EC participation in the Fund)	Dec 2009 – Nov 2016	Provide financial support and technical assistance for RES / EE	Households, businesses, energy services companies, municipalities and other public institutions	Credit lines for on-lending to end-borrowers and to energy savings companies, direct lending to end borrowers; Technical assistance to end-borrowers and financial intermediaries to engage in energy projects lending	Solar thermal, geothermal, Methane recovery, solar photovoltaic, small scale wind, biogas, biomass
b1) Private Sector Support Facility, Western Balkans	31.5 mio €	Nov 2009 – Nov 2015	Provide loans, supported by grants and technical assistance. Including for energy efficiency investments	SMEs, private sector	1) Direct lending projects ,i.e. projects in which the loan (supported by a grant and/or technical assistance financed by the European Union Contribution) is provided directly to the final beneficiary of such loan 2) Participating bank projects, i.e. projects in which the loan is provided to a commercial bank which is required to on-lend in the form of sub-loans to the final beneficiary	Not specified
b2) Private Sector Support Facility, Turkey	22.5 mio €	Dec 2009 – Nov 2021	Provide loans, supported by grants and technical assistance to beneficiaries in Turkey to improve access to finance and to promote energy efficiency investments	SMEs, including micro-enterprises, private sector	Participating bank projects, i.e. projects in which the loan is provided to a commercial bank which is required to on-lend in the form of sub-loans to the final beneficiary	Not specified

3.2.3 Details on EEFF2007

Table 39: Details on EEFF2007 (Source:DG ELARG 2010)

Duration	Objective	Beneficiary	Types of investment (EE / RE)	Sectors covered
Dec 2009 – Nov 2016	Promote EE investments / RES projects in the building and industry sector offering highest potentials for energy and CO_2 emissions savings	Private and public entities in the building and industry sector to pursue investments in energy efficiency and sustainable energy; Financial Intermediaries to encourage them to increase funding to these purposes	credit lines and/or risk sharing amounting to EUR 138.8 at least, extended by the IFIs; Investments on the demand and supply side supporting electricity generation and heating/cooling	Wind, solar, geothermal, wave/tidal, hydropower, biomass, landfill gas, sewage treatment plans, biogas

3.2.4 ENRTP and GEEREF

The budget line for the Thematic Programme for Environment and Sustainable Management of Natural Resources including Energy provides funding of 470 mio € for the years 2007-2010 which means an average annual funding of 117.5 mio €. For the period 2011-2013, 334.3 mio € are reserved (EC 2007). The countries profiting from this budget are all countries except EU and industrialized ones.
Within ENRTP, there are five areas of priority:

1. Working upstream on MDG7: promoting environmental sustainability;
2. Promoting implementation of EU initiatives and internationally agreed commitments;
3. Improving expertise for integration and coherence;
4. Strengthening environmental governance and EU leadership;
5. Support for sustainable energy options in partner countries / regions and GEEREF.

From this budget, several programmes are financed:

- The Capacity Enhancement and Mobilisation Action for Energy in Africa (CEMA);
- The EU Energy Initiative (EUEI);
- The EUEI Partnership Dialogue Facility (EUEI PDF);
- The Global Energy Efficiency and Renewable Energy Fund (GEEREF).

The total funding for **GEEREF** of about 108 mio € comes from ENRTP funding, Norway and Germany. The contribution from EU budget amounts to 80 mio €, including 5 mio € of technical assistance. The current funding is available in the period 2007-2011. Supported projects cover renewable energy and energy efficiency projects.
In 2009, two investments were made:

- -12.5 mio € investment for the Berkley Energy's Renewable Energy Asia Fund (REAF);

- - 10 mio € investment in the Evolution One Fund, focussing on clean energy investment in Southern Africa.

Currently, five further funds are in different stages of screening, the sum of potential GEEREF Commitment amounts to 55 mio €.

Appendix to chapter 4: Cost scenarios for 2020 RES objectives

4.1 Background information for the Green-X scenarios: Overview on key assumptions

The key assumptions for the scenario elaboration undertaken within this study will be discussed subsequently, describing in detail the parameters used for the model-based RES policy assessment.

4.1.1 Energy demand

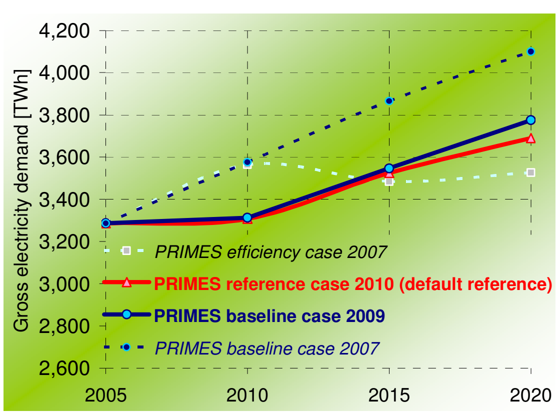
Figure 62 depicts the projected energy demand development at EU-27 level according to different PRIMES scenarios – i.e. with regard to (gross) final energy demand (right) as well as concerning the gross electricity demand (left).

A comparison of the different PRIMES demand projections at EU-27 levels shows the following trends: Both the recently conducted PRIMES baseline case as of 2009 (NTUA, 2009) and the PRIMES reference case as of 2010 (NTUA, 2010) draw a modified picture of future demand patterns compared to previous baseline and reference cases. It appears that the impacts of the global financial crisis are well reflected, leading to a reduction of overall gross final energy demand in the short term, and a moderate growth in final years close to 2020. The resulting 2020 demand lies in between the former baseline case as of 2007 and the related high energy efficiency. For the electricity sector, similar impacts are becoming apparent.

More precisely, the PRIMES scenarios used for this study are:

- The Baseline Scenario as of December 2009 (NTUA, 2009);
- The Reference Scenario as of April 2010 (NTUA, 2010).

With the exception of the BAU scenario, the default reference for this prospective RES policy assessment represents the recently derived PRIMES reference cases.



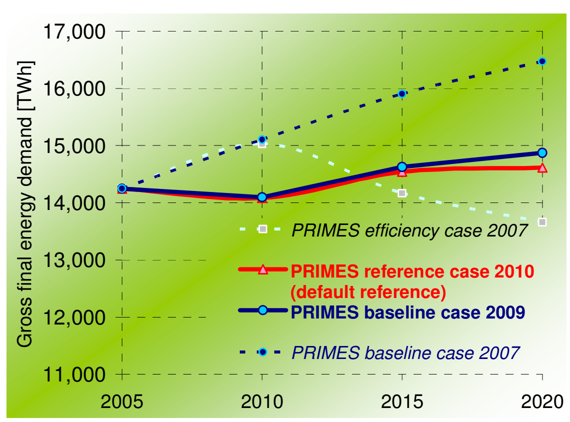


Figure 62: Comparison of projected energy demand development at EU-27 level – gross electricity demand (left) and gross final energy demand (right). (Source: PRIMES scenarios)

4.1.2 Fossil fuel and reference energy prices

National reference energy prices used in this analysis are based on the primary energy price assumptions as used in the recent draft PRIMES baseline case (as of December 2009). The applied assumptions are illustrated in Table 52. Compared to energy prices as observed in 2007 and the first three quarters of 2008 the price assumptions appear comparatively low for the later years up to 2020.

The CO_2-price in the scenarios presented in this report is also based on recent PRIMES modelling, see Table 39. Actual market prices (for 2006 EU Allowances) have fluctuated between 7 and 30 €/t, with averages fluctuating roughly between 15 and 20 €/t. In the model, it is assumed that CO_2-prices are directly passed through to electricity prices. This is done fuel-specific based on the PRIMES CO_2-emission factors.

Increased RES-deployment can have a CO_2-price reducing effect as it reduces the demand for CO_2-reductions. As RES-deployment should be anticipated in the EU Emission Trading System and the CO_2-price in the ***Green-X*** scenarios is exogenously set, this effect is not included, which represents a rather conservative approach.

Table 40: Primary energy price assumptions in US$2008/boe (source: PRIMES baseline (2009) and reference case (2010))

International (fossil) reference energy prices (low reference price development for imports to the EU - based on PRIMES low (default) energy prices)	[Unit]	2005	2010	2015	2020
Oil	[US$2008/boe]	59.4	71.9	72.6	88.4
	[€ 2006 /MWh]	*27.3*	*29.7*	*32.5*	*43.1*
Gas	[US$2008/boe]	39.7	44.2	49.5	62.1
	[€ 2006 /MWh]	*18.2*	*18.2*	*22.1*	*30.3*
Coal	[US$2008/boe]	14.0	17.2	21.7	25.8
	[€ 2006 /MWh]	*6.5*	*7.1*	*9.7*	*12.6*

Table 41: CO_2 price assumptions in €2006/ton (source: PRIMES baseline (2009) and reference case (2010))

CO_2 price assumptions for the European ETS	[Unit]	2005	2010	2015	2020
PRIMES reference case 2010 (moderate energy prices & demand)	[$€_{2006}$/t CO_2]	0.0	10.5	12.8	15.5
PRIMES baseline case 2009 (moderate energy prices & high energy demand)	[$€_{2006}$/t CO_2]	0.0	13.7	18.8	23.6

Reference prices for the electricity sector are taken from the ***Green-X*** model. Based on the primary energy prices, the CO_2-price and the country-specific power sector, the ***Green-X*** model determines country-specific reference electricity prices for each year in the period 2006 to 2020. Reference prices for the heat and transport sector are based on primary energy prices and the typical country-specific conventional conversion portfolio. Default sectoral reference energy prices for the ambitious policy pathway are illustrated in Table 42. More precisely, these prices represent the average at European level (EU-27) and refer to an energy demand development according to the PRIMES reference case as of 2010 and corresponding energy price assumptions. Note that heat prices in case of grid-connected heat supply from district heating and CHP-plant do not include the cost of distribution – i.e. they represent the price directly at defined hand over point. A graphical illustration of the EU average of all reference electricity prices used in this analysis is given in Figure 63.

Table 42: Reference prices for electricity, heat and transport fuels (referring to the default case of strengthened national policies)

Sectoral reference energy prices - on average at EU-27 level (default reference price development - based on PRIMES reference case)						
(expressed per MWh output)	[Unit]	2006	2010	2015	2020	average (11-20)
Electricity price (wholesale)	[€/MWh electricity]	59.9	41.4	48.7	47.9	47.3
Heat price (grid-connected)	[€/MWh heat, grid]	29.3	29.3	34.2	43.5	35.2
Heat price (decentral)	[€/MWh heat, decentral]	55.1	56.5	62.3	76.2	65.2
Transport fuel price	[€/MWh transport fuel]	34.8	37.1	40.6	53.9	43.7

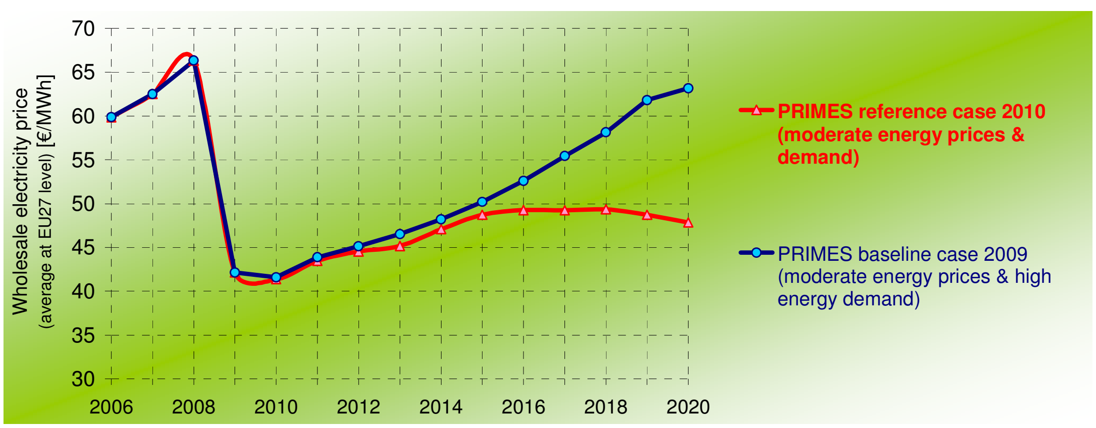


Figure 63: Assumed development of the wholesale electricity prices on average at EU-27 level (based on Green-X)

4.1.3 Interest rate / weighted average cost of capital - the role of (investor's) risk

In line with the focus of this study specific attention is dedicated in the model-based assessment to research the impact of investor's risk on RES deployment and corresponding (capital / support) expenditures. In contrast to the complementing detailed bottom-up analysis of illustrative financing cases, Green-X modelling aims to provide the aggregated view at the national and European level with less details on individual direct financing instruments. More precisely, debt and equity conditions as resulting from particular financing instruments are incorporated by applying different weighted average cost of capital (WACC) levels. The impact of this on the required expenditures for achieving the Member States 2020 RES targets can then however be clearly illustrated by means of sensitivity investigations to the assessed RES policy paths.

Table 43: Example of value setting for WACC calculation

WACC methodology	Abbreviation / Calculation	High risk assessment		Low risk assessment (proactive risk mitigation)	
		Debt (d)	Equity (e)	Debt (d)	Equity (e)
Share equity / debt	g	70.0%	30.0%	70.0%	30.0%
Nominal risk free rate	r_n	4.0%	4.0%	4.0%	4.0%
Inflation rate	i	2.0%	2.0%	2.0%	2.0%
Real risk free rate	$r_f = r_n - i$	2.0%	2.0%	2.0%	2.0%
Expected market rate of return	r_m	4.3%	8.4%	3.9%	7.7%
Risk premium	$r_p = r_m - r_f$	2.3%	6.4%	1.9%	5.7%
Equity beta	b		1.6		1.6
Tax rate (corporation tax)	r_t		30.0%		30.0%
Post-tax cost	r_{pt}	3.0%	12.2%	2.7%	11.1%
Pre-tax cost	$r = r_{pt} / (1-r_t)$	4.3%	17.5%	3.9%	15.9%
Weighted average cost of capital (pre-tax)	***WACC***	**8.3%**		**7.5%**	

Determining the necessary rate of return is based on the weighted average cost of capital (WACC) methodology. WACC is often used as an estimate of the internal discount rate of a project or the overall rate of return desired by all investors (equity and debt providers). This means that the WACC formula[431] determines the required rate of return on a company's total asset base and is determined by the Capital Asset Pricing Model (CAPM) and the return on debt. Formally, the pre-tax cost of capital is given by:

$$WACC^{pre\text{-}tax} = g_d \bullet r_d + g_e \bullet r_e = g_d \bullet [r_{fd} + r_{pd}] + g_e \bullet [r_{fe} + \beta \bullet r_{pe}] / (1 - r_t)$$

Table 55 illustrates the determination of the WACC exemplarily for two differing cases – a low and a high risk assessment. Within the model-based analysis, a range of settings is applied to reflect investor's risk appropriate. Thereby, risk refers to two different issues:

- A '*policy risk*' related to uncertainty on future earnings caused by the support scheme itself – e.g. referring to the uncertain development of certificate prices within a RES

[431] The WACC represents the necessary rate a prospective investor requires for investment in a new plant.

trading system and / or uncertainty related to earnings from selling electricity on the spot market;

- A *'technology risk'* referring to uncertainty on future energy production due to unexpected production breaks, technical problems etc.. Such deficits may cause (unexpected) additional operational and maintenance cost or require substantial reinvestments which (after a phase out of operational guarantees) typically have to be born by the investors themselves. In this context, Figure 64 (below) illustrates the default assumptions applied to consider investor's technology risk.

Please note that as default both policy and technology risk are considered in the assessment, leading to a higher WACC than the default level of 7.5%. Additionally, an alternative setting is used to illustrate the impact of proactive risk mitigation measures, contributing to mitigate both policy and technology risk.

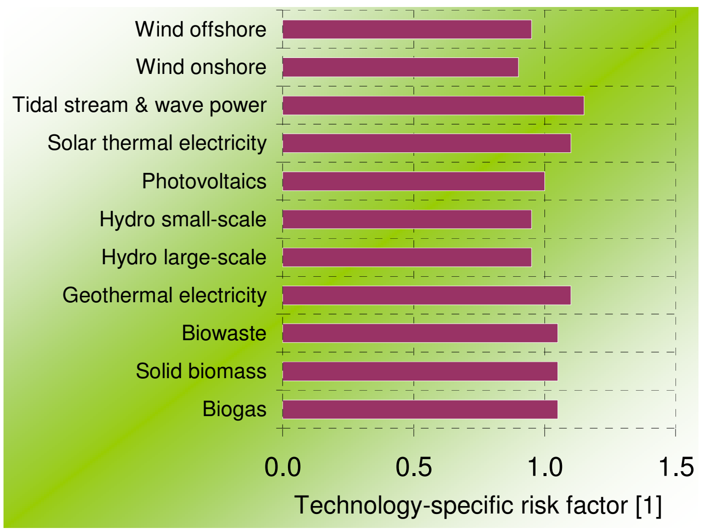


Figure 64: Technology-specific risk factors

4.1.4 Assumptions for simulated support schemes

A number of key input parameters were defined for each of the model runs referring to the specific design of the support instruments as described below.

General scenario conditions

Consumer expenditure is heavily dependent on the design of policy instruments. In the policy variants investigated, it is obvious that the design options of the various instruments were chosen in such a way that expenditure is low. Accordingly, it is assumed that the investigated schemes are characterized by:

- A stable planning horizon;
- A continuous RES-E policy / long-term RES-E targets and;
- A clear and well defined tariff structure / yearly targets for RES(-E) deployment.

In addition, for all investigated scenarios, with the exception of the BAU scenario (i.e. currently implemented policies remain without adaptation up to 2020), the following design options are assumed:

- Financial support is restricted to new capacity only,[432];
- The guaranteed duration of financial support is limited. [433].

With respect to model parameters reflecting dynamic aspects such as technology diffusion or technological change, the following settings are applied:

- *Removal of non-financial barriers and high public acceptance in the long term:* In several scenario runs it is assumed that the existing social, market and technical barriers (e.g. grid integration) can be overcome in time. More precisely, the assumption is taken that their impact is still relevant at least in the short-term as is reflected in the BAU-settings (referring to the BAU scenario) compared to, e.g. the more optimistic view assumed for reaching an accelerated RES deployment as preconditioned in the policy assessment referring to the ambitious target of 20% RES by 2020. Further details on the modelling approach to reflect the impact of non-economic barriers as well as the applied settings are provided in section A 5.;
- *A stimulation of 'technological learning' is considered – leading to reduced investment and O&M costs for RES over time:* Thereby, as default moderate technological learning is preconditioned for all policy cases.

In the following, the model settings and assumptions are described for each type of support instrument separately. These assumptions refer to advanced support schemes as applied in the discussion of strengthened national and harmonized European wide policy instruments.

Feed-in tariffs

Premium feed-in tariffs are defined as technology-specific; settings are applied so as to achieve an overall low burden for consumers. Tariffs decrease over time reflecting the achieved cost reductions on a technology level, but this annual adjustment in the level of support applies only to new installations. More precisely, whenever a new plant is installed, the level of support is fixed for the guaranteed duration (of 15 years as commonly applied in the case of generation-based support). A low risk premium (leading to a WACC of 7.5 %) is applied to reflect the small degree of uncertainty associated with the well-defined design of this instrument.

[432] This means that only plants constructed in the period 2006 to 2020 are eligible to receive support from the new schemes. Existing plants (constructed before 2006) remain in their old scheme.

[433] In the model runs, it is assumed that the time frame in which investors can receive (additional) financial support is restricted to 15 years for all instruments providing generation-based support.

Quota obligations with tradable green certificates (TGC) / guarantees of origin (GO)[434]

Two different trading schemes are investigated in this analysis:

- A common RES trading system (covering all RES(-E) options)[435] offering uniform support for all RES options; or;
- An advanced RES trading system where technology-specification of support is introduced via a banding approach.

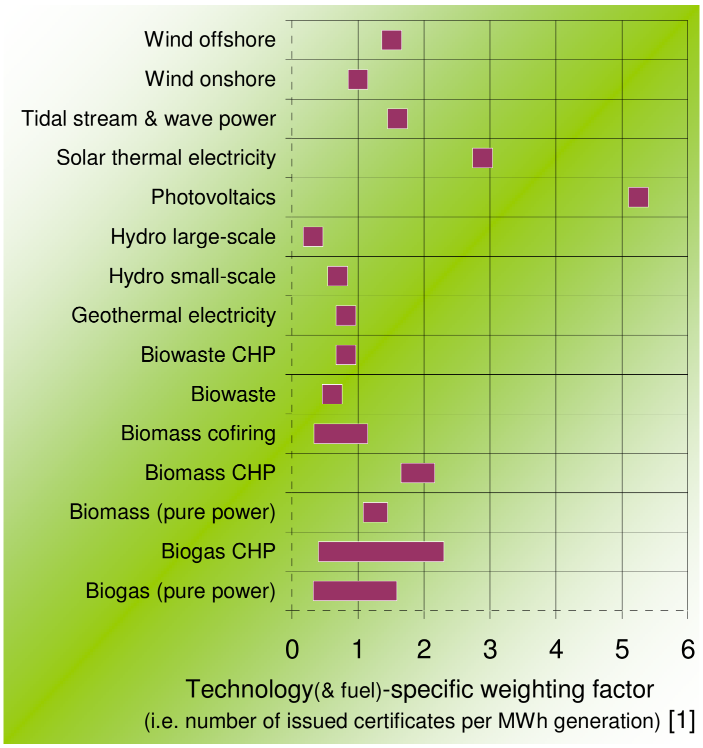


Figure 65: Technology-specific weighting factors (as assumed for the case of "strengthened national RES support – national perspective")

In the latter case different weighting is given to different RES technologies in terms of the number of green certificates / guarantees of origin granted per MWh generation, e.g. wind offshore obtains twice the weighting as wind onshore – aiming to reflect the differing cost level or stages of market maturity, respectively, among the involved RES technology options. This approach would be inline with the proposed adaptation of UK's ROC's scheme.

[434] Note that in the case of strengthened national policies, the assumption is taken that a technology-specific weighting is introduced in order to achieve the required deployment of novel RES(-E) options without over-subsidizing mature low-cost RES(-E) technologies.

[435] More precisely, it is assumed that this common TGC system includes neither technology-specific quotas nor any technology-specific weighting mechanisms etc. Accordingly, it represents a policy scheme suitable for supporting the most efficient RES(-E) options in a competitive environment.

Advanced RES trading systems are used in the case of "strengthened national RES support" in those countries which have already currently implemented or intend to apply this type of RES policy option in the future, namely Belgium, Bulgaria, Italy, Poland, Romania, Sweden and the UK. The applied assumptions with respect to technology-specific weighting factors are illustrated in Figure 65. Thereby, ranges indicate a further graduation of weighting factors by fuel (biomass) or technology (biomass (coffering), biogas). Please note further that as default a penalty payment of 45 €/TGC is preconditioned.

For both cases 'policy risk' is assumed to be at a higher level. Thereby, risk refers to the uncertainty about future earnings (on the power as well as on the TGC / GO market).

4.1.5 RES technology diffusion – the impact of non-economic RES barriers

In several countries, financial support appears sufficiently high to stimulate deployment of a RES technology, in practice actual deployment lacks however far behind expectations. This is a consequence of several deficits not directly linked to the financial support offered which in literature are frequently named "non-economic /non-cost barriers". These barriers refer to administrative deficiencies (e.g. a high level of bureaucracy), diminishing spatial planning, problems associated with grid access, possibly missing local acceptance, or even the non-existence of proper market structures.

In the ***Green-X*** model, dynamic diffusion constraints are used to describe the impact of such non-economic barriers. Details on the applied modelling approach are explained subsequently.

Modelling the impact of non-economic barriers on the feasible technology diffusion

Within the ***Green-X*** model, dynamic diffusion constraints are used to describe the impact of such non-economic barriers. They represent the key element to derive the feasible dynamic potential for a certain year from the overall remaining additional realisable mid- / long-term potential for a specific RES technology at country level. The application of such a constraint in the model calculations results in a technology penetration following an 'S-curve' pattern – obviously, only if financial incentives are set sufficiently high to allow a positive investment decision.

In accordance with general diffusion theory, penetration of a market by any new commodity typically follows an 'S-curve' pattern. The evolution is characterized by a growth, which is nearly exponential at the start and linear at half penetration before it saturates at the maximum penetration level. With regards to the technical estimate of the logistic curve, a novel method has been employed by a simple transformation of the logistic curve from a temporal evolution of the market penetration of a technology to a linear relation between annual penetration and growth rates. This novel procedure for estimating the precise form of the logistic curve is more robust against uncertainties in the historic data. Furthermore, this method allows the determination of the independent parameters of the logistic function by means of simple linear regression instead of nonlinear fits involving the problem of local minima, etc.

Analytically the initial function, as resulting from an econometric assessment has a similar form to equation (1). However, for model implementation a polynomial function is used, see equation (2).
This translation facilitates the derivation of the additional market potential for the year n if the market constraint is not binding, i.e. other applicable limitations provide stronger restrictions. As absolute growth rate is very low in the case of an immature market, a minimum level of the yearly realisable additional market potential has to be guaranteed – as indicated by equation (3).

$$X_n = \frac{a}{\left\{1 + b * e^{\left[-c * (year\,n - start\ year + 1)\right]}\right\}} \quad (1)$$

$$\Delta P_{Mne} = P_{stat\,long-term} * \left[A * X_n^{\ 2} + B * X_n + C\right] * \left[\chi_{Mmin} + \frac{\chi_{Mmax} - \chi_{Mmin}}{4} * b_M\right] \quad (2)$$

$$\Delta P_{Mn} = \mathrm{Max}\ [\Delta P_{M\,min}; \Delta P_{M\,ne}] \quad (3)$$

Where:

$\Delta P_{M\,n}$	realisable potential (year n, country level)
$\Delta P_{M\,min}$	lower boundary (minimum) for realisable potential (year n, country level)
$\Delta P_{M\,ne}$	realisable potential econometric analysis (year n, country level)
$P_{stat\ long-term}$ ..	static long-term potential (country level)
a	econometric factor, technology specific
b	econometric factor, technology specific
c	econometric factor, technology specific
A	quadratic factor yield from the econometric analysis
B	linear factor yield from the econometric analysis
C	constant factor yield from the econometric analysis (as default 0, considering market saturation in the long-term)
X_n	calculated factor - expressing the dynamic achieved long-term potential as percentage figure: In more detail … $X_n = \frac{\text{dynamic achieved potential (year n, country level)}}{\text{total long - term potential (country level)}}$; X_n [0, 1]
$\chi_{M\,max}$	absolute amount of market restriction assuming very low barriers; $\chi_{M\,max}$ [0, 1]; to minimize parameter setting $\chi_{M\,max} = 1$
$\chi_{M\,min}$	absolute amount of market restriction assuming very high barriers; $\chi_{M\,min}$ [0, $\chi_{M\,max}$]
b_M	barrier level market / administrative constraint assessment (level 0 - 5) [436]; i.e. the country-specific parameter to describe the impact of non-economic barriers

For parameter setting, the econometric assessment of past deployment of the individual RES technologies at country level represents the starting point, whereby factors A, B and C refer to the "best practice" situation as identified via a cross-country comparison.[437] [438]

[436] A value of 0 would mean the strongest limitation (i.e. no diffusion, except minimum level), while 4 would mean the strongest feasible diffusion (according to "best practice" observations).

Note, if the level number '5' is chosen, the default approach would be replaced by a simplified mechanism: In this case the yearly realisable potential is defined as share of the dynamic additional realisable mid-term potential on band level. Hence, it can be chosen separately how much of the remaining potential can be exploited each year.

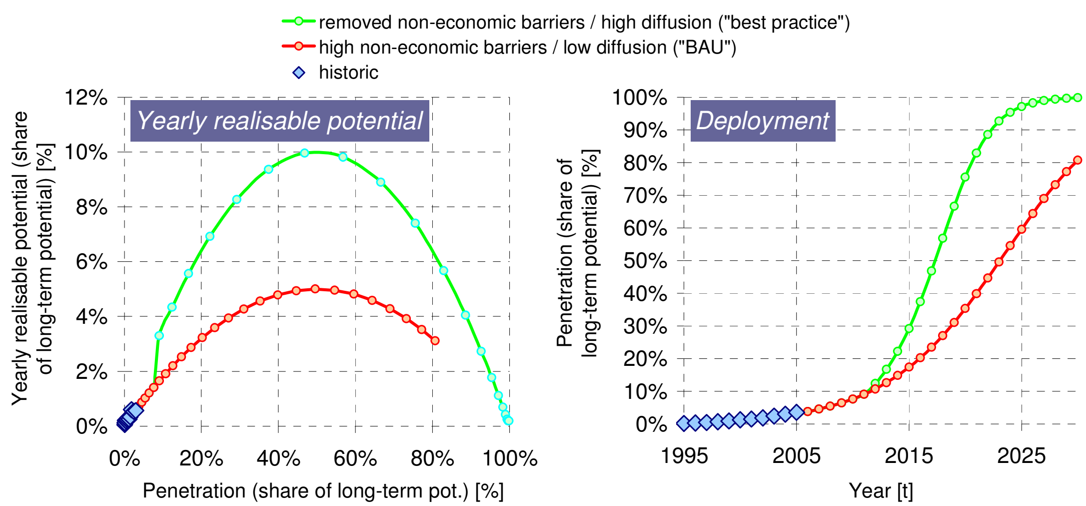
[437] For the "best practice" country the applied market barrier b_M equals 4 – see notes as given in the corresponding description. Consequently, the comparison to this "ideal" case delivers the barrier level b_M for other countries.

[438] For novel technologies being in an early stage of development and consequently not applicable in historic record similarities to comparable technologies are made.

Within the scenario work, two different variants of settings with respect to the non-economic barriers of individual RES technologies have been applied:

- *High non-economic barriers / low diffusion ("BAU settings"):* This case aims to reflect the current situation (BAU conditions) where non-economic barriers are of relevance for most RES technologies. The applied technology-specific parameters have been derived by an econometric assessment of past deployment of the individual RES technologies within the assessed country.
- *Removed non-economic barriers / high diffusion ("Best practice"):* This case represents the other extreme where the assumption is taken that non-economic barriers are overcome in time.[439] This more optimistic view is applied in the policy assessment referring to the ambitious target of 20% RES by 2020. Applied technology-specific settings refer to the "best practice" situation as identified by a cross-country comparison. Accordingly, an enhanced RES deployment can be expected – if financial support is also provided in an adequate manner.

Figure 66 illustrates the applied approach: On the right-hand side the resulting yearly realisable potential in dependence of applied barrier level and on the left-hand side related deployment – in case that no other (financial) constraint would exist – are depicted, illustrating schematically applied variants with respect to non-economic barriers as used in this study.



Note: Key parameter have been set in this schematic depiction as follows: A = (-B) = -0.4; b_M was varied from 2 (high barriers / low diffusion) to 4 (removed barriers / high diffusion)

Figure 66: Schematic depiction of the impact of non-economic barriers on the feasible diffusion at technology and country level: Yearly realisable potential (left) and corresponding resulting feasible deployment (right) in dependence of the barrier level

[439] More precisely, a stepwise removal of non-economic barriers is preconditioned which allows an accelerated RES technology diffusion. Thereby, the assumption is taken that this process will be launched in 2010.

4.2 Background information for the Green-X scenarios: Indicators on cost & benefits associated with the assessed RES deployment (at the EU level)

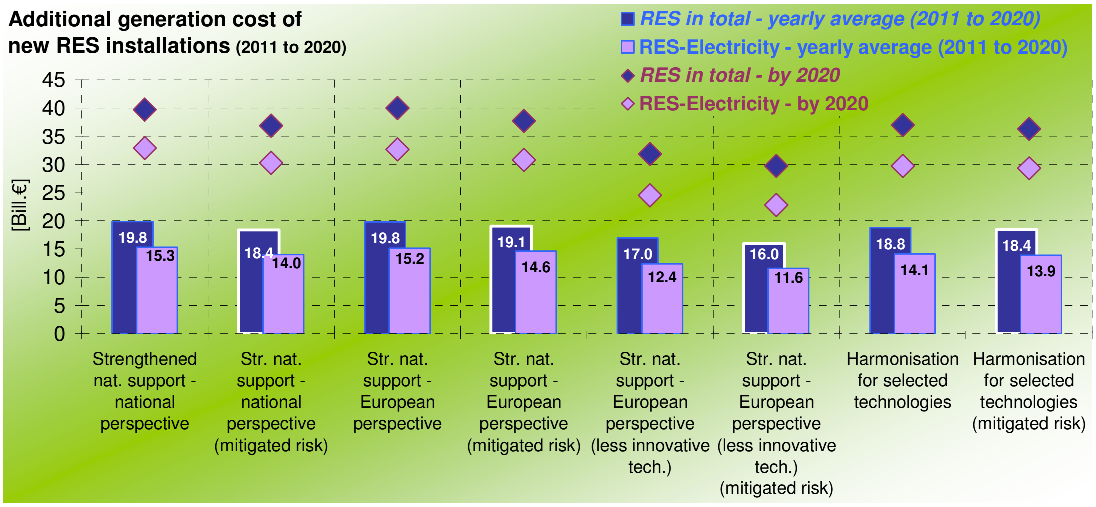


Figure 67: Additional generation cost of new RES installations

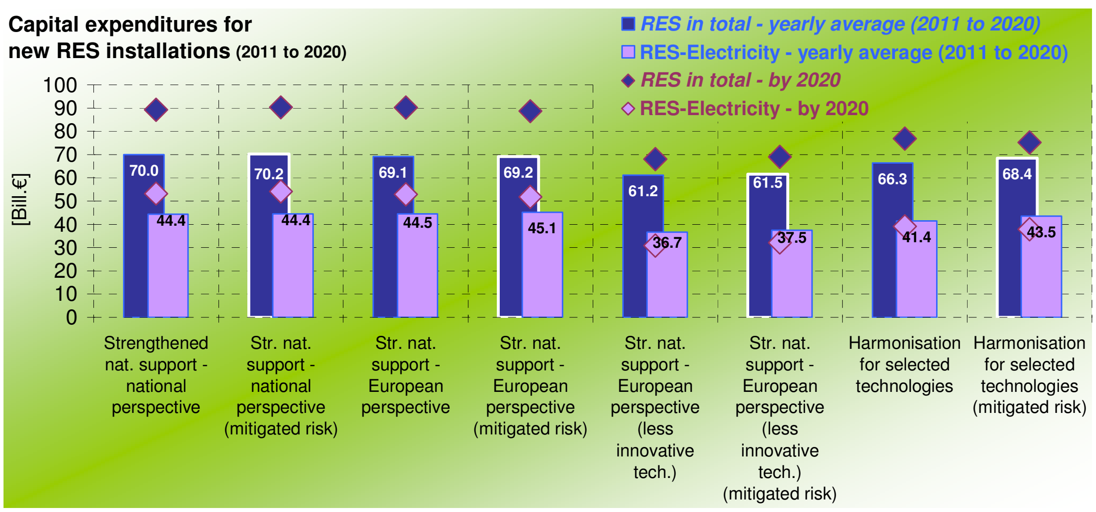


Figure 68: Capital expenditures for new RES installations

Appendix to chapter 5: Evaluation of financing instruments

5.1 Description of financing instruments

5.1.1 Energy Market Instruments (Support Schemes)

A range of different policy instruments is available to support increased deployment of RES. The next sections[440] cover the main financial support instruments that are being applied in different forms, such as:

- Feed-in and premium tariffs;
- Quota obligations;
- Tendering schemes, and;
- Fiscal and other support incentives such as direct production support, investment subsidies, low interest loans and different kinds of tax measures.

The examples given below mainly refer to renewable electricity (RES-E), but are applicable to renewable heat (RES-H) and fuels (RES-F) as well.

Methodological note:

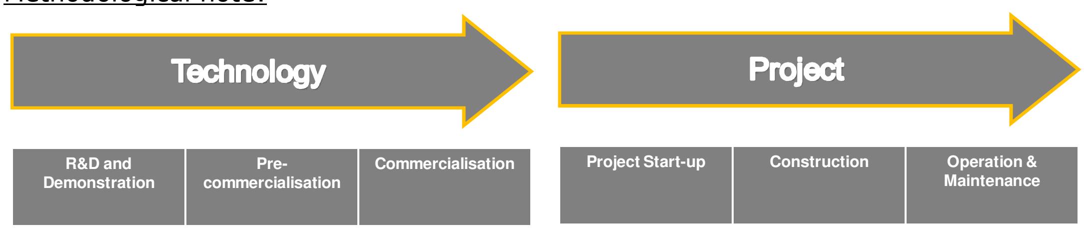
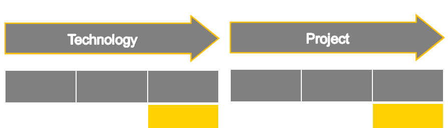


Figure 69 : Renewable Energy Finance Continuum

In the following part, a small RE finance Continuum will describe at which stage of the continuum each support scheme or financial mechanism is used (yellow rectangle).

5.1.1.1 Feed-in tariffs and premium tariffs



Feed-in tariffs guarantee a fixed financial payment per unit of electricity produced from renewable energy sources. This support can be for both the physical energy and the green value together (fixed feed-in tariff) or it can just be a premium for the green value, while the producer receives the rest of his income from selling (or buying) the energy on the regular energy market (premium tariff). A combination of both fixed feed-in tariffs and premium tariffs is also possible.

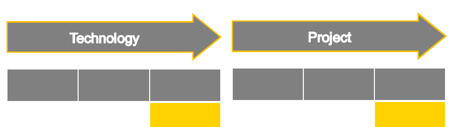
[440] Based on: D. de Jager, M. Rathmann, 2008: Policy instrument design to reduce financing costs in renewable energy technology projects. Ecofys, by order of the IEA Implementing Agreement on Renewable Energy Technology Deployment (RETD)

The following design aspects can influence the risk profile and hence the access to and costs of capital:

- Duration of tariffs: Tariff levels are usually guaranteed for a longer period, e.g. 10 up to 20 years. In this way they provide long-term certainty about receiving financial support, which is considered to lower investment risks considerably;
- Technology-specific tariffs: Technology-specific tariffs can be used in order to support different technologies while avoiding windfall profits for cheaper technologies;
- Stepped tariffs: Tariffs can be stepped according to site conditions (for example average wind speed) in order to avoid windfall profits for projects at the more favourable sites;
- Tariff digression: A fixed or regularly determined digression of tariffs over time for new installations can be used in order to reflect for economies of scale and learning. Tariff levels should be evaluated in regular intervals and be adjusted if necessary, but changes should only apply to new installations;
- Front-loading the payment stream: Instead of having a constant tariff level for the complete support duration, it can be considered to increase tariffs for the first years of a project while decreasing tariffs in the last years[441]. Without increasing the total sum of financial support, this can help to reduce financing cost.

Major highlights of FIT are their long-term stability and transparency. However, questions are asked about their efficiency. Indeed, FIT imposes to MS to pay for a significant tariff for a long period of time and it is difficult to anticipate the total amount of expenditures it will concerned and that will be paid by tax-payer.

5.1.1.2 Quota obligations



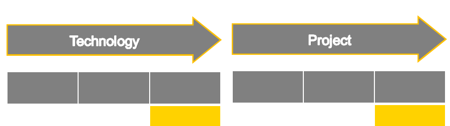
Quota obligations, also called renewable obligations or renewable portfolio standards (RPS) impose a minimum share of renewables in the overall energy mix. This obligation can be imposed on consumers, retailers or producers. A quota obligation system is often combined with tradable green certificates (as in the UK for RES-E), although this does not necessarily have to be the case. Financial support for the producer comes from the fact that an obligated party failing to meet its quota obligation faces a penalty. The financial value of the renewable energy or the green certificates is determined by the level of the quota obligation, the size and allocation of the penalty, and the duration of the RES technology being eligible under the quota system. Appropriate fine-tuning of a quota obligation system is of utmost importance for effective promotion of RES. If the quota obligation is set too low, or if the penalty is too low or not enforced, then the value of RES in the market will be low, generating insufficient stimulation to initiate new RES projects.

441 Compare Wiser, R. and S. Pickle (1997): Financing Investments in Renewable Energy: The Role of Policy Design and Restructuring, Berkeley, 1997

The following design aspects can influence the risk profile and hence the access to and costs of capital:

- Time horizon of the quota obligation: Obligation levels need to be set well in advance and the quota obligation should be guaranteed to be in place for a sufficiently long time period in the future in order to guarantee future demand for RES;
- Penalty: Penalties should be set well in advance, significantly above green certificate prices, and enforcement should be guaranteed. Recycling of penalties to RES projects as applied in UK for RES-E can add a 'positive' incentive for RES projects to the 'negative' incentive for obliged parties. However, in an oligopolistic market the penalty can lose its effectiveness if obliged parties manage to negotiate contracts for certificate purchase that foresee the recycling to be paid to them, and thus a loop is created where a large share of the penalty paid by the obliged party is recycled to its own pocket;
- Market liquidity: In order to have markets functioning well, market design, size and competition are key parameters. Via the obligation, a demand is being created, but with barriers still existing on the supply side (e.g. grid access, sitting problems) no real supply can be generated. This in turn could result in high prices being paid for only few realized projects;
- Minimum tariff: Minimum tariffs can be introduced in order to increase investment security in case of fluctuating prices. For instance in Belgium the obligation to purchase at a minimum price is on the Transmission and Distribution System Operator. Peculiar to the Belgian system are the technology-specific minimum tariffs, a feature that is usually only known from feed-in tariffs;
- Technology-specific support: There are several options to support currently less economic technologies while avoiding windfall profits for cheaper technologies: Separate quotas (bands) per technology, technology-specific certification periods (duration), or differentiated values. Also, a combination with a feed-in premium can be envisaged;
- Long-term contracts: Long-term contracts (e.g. 10 years) for both the physical energy and the green certificates can reduce price risks for both producers and obliged parties. Obliged parties might not always be interested in signing long-term contracts, especially if certificate prices are expected to decrease. Therefore, the government can oblige obligated parties to offer long-term contracts (i.a. as applied in California, USA).

5.1.1.3 Tendering schemes



A call for tender for renewable energy projects can be issued by a national government or other institutions, asking project developers to submit bids to develop renewable energy projects. Tenders usually specify the capacity and/or production to be achieved and can be technology- or even project/site-specific. Winning parties are usually offered standard long-term purchase contracts while the price is determined competitively within the tender procedure. Purchase can also be limited to green certificates in case of RES-E.

Thus, the support itself can be compared to feed-in tariffs/premium tariffs, while the support level is determined by the market. Quota systems with mandatory long-term contracts also have comparable features, despite for the counterparty risk in case of quota systems. Tendering allows for incorporation of additional conditions, e.g. regarding local manufacturing of technology.

A disadvantage of the system however is the risk that the actual cost of realisation of the project turns out to be higher than that predicted when drafting the bid, or that the project will not be bankable after all. This might lead to the granted project not being realized. Another disadvantage is that a successful tender procedure might result in many project initiatives being prepared in vain.

The following design aspects can influence the risk profile and hence the access to and costs of capital:

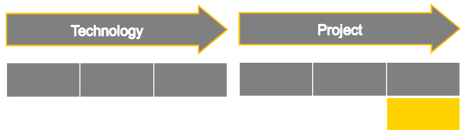
- Penalties: A penalty for non-compliance can be implemented in order to avoid unreasonably low bids. Penalties can also be applied to projects exceeding deadlines;
- Remove/Share part of the price risk: By incorporating corrections for inflation, currency exchange rates and market prices of key commodities (e.g. steel, biomass) between tender closure and realisation of the project, a significant part of the financial risk can be transferred from the project developer to the tendering body;
- Continuity of calls: Long-term continuity and predictability of calls should be ensured in order to avoid stop-and-go development of the renewable industry;
- Streamlining of interacting policies: Other policies affecting the realisation of winning projects, like for example spatial planning, should be streamlined in order to ensure the tendered capacities can actually be realized.

5.1.1.4 Fiscal incentives

Fiscal incentives play an important role in the promotion of RES, although unlike for biofuels - where tax exemptions have recently stimulated substantial development in some countries - fiscal incentives are mostly secondary instruments to support other RES instruments rather than being the main support instrument in the majority of countries. An exemption is Finland, where tax measures combined with investment subsidies are the main support instrument for the development of RES-E.

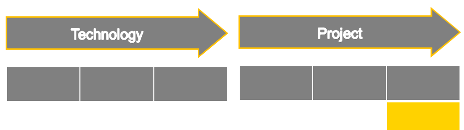
The largest shortcoming of fiscal incentives is their instability: They usually rely on government budgets and are thus subject to frequent political negotiations and annual budget constraints. Frequent policy changes increase risk in the project development phase and hinder the development of the renewable energy industry. Alternatively, fiscal incentives could be announced and guaranteed for a couple of years in advance. They could theoretically be financed through a surcharge on energy consumption, which adapts automatically to the amount of support paid, like it is done in some feed-in schemes. These measures are likely to increase stability and reduce regulatory risk.

5.1.1.5 Direct production incentives



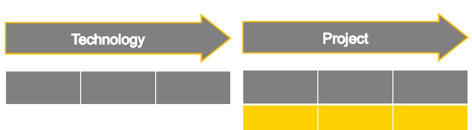
In certain schemes (notably outside Europe), a certain production incentive is given for each unit of renewable electricity produced over a given period of time. This production incentive is not intended to fully bridge the gap between electricity market prices and the price of renewable electricity, but it contributes to removing part of the market risks of a project. The direct production incentive is considered as gross revenue and hence taxable. This incentive typically requires other complementary measures to make the project viable and bankable (e.g. regional incentives).

5.1.1.6 Flexible/accelerated depreciation schemes



Flexible/accelerated depreciation schemes allow writing off a project faster (or differently) than usually would be allowed. Doing so, the tax benefit of depreciation can be maximized by the equity provider, provided that this equity provider has a net income that is large enough to absorb this tax deduction. In general, an accelerated depreciation scheme will result in a higher overall net present value of the project. The five year MACRS depreciation for RES in the US is an example of an accelerated depreciation with significant cost reductions as a consequence.

5.1.1.7 Investment or production tax exemptions



Investment or production tax exemptions (also called tax relief or tax credits) reduce the tax burden of a project. The former support is linked to installed production capacity while the latter is in relation to the amount of energy production. The effect of the former is similar to that of an investment subsidy (which benefits the project), whereas the latter only increases the profit for the equity provider. In project finance, the former has a favourable impact on the debt/equity structure under the same debt service requirements, the latter not.

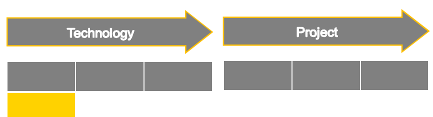
The following design aspects can influence the risk profile and hence the access to and costs of capital:

- Consistency with preferred debt-equity ratio: Some tax measures only concern the equity (provider) within a project. At the same time the majority of project developers strives to minimize the equity within a project (while maximizing the debt) in order to maximize return on equity. Thus, projects with a very low equity share might not be able to take advantage of all tax measures to the full extent. Only entities with other higher income can benefit from this scheme;

- Support of capacity versus production: If the amount of investment tax exemptions or accelerated depreciation of a project is linked to installed capacity, project developers can be stimulated to focus on capacity rather than production. However, combining a capacity-based support with any form of production incentive can overcome this problem. Capacity-based support might be especially helpful in case of prototype/demonstration projects, where the risk of lower than envisaged production would be prohibitive for the project in case of production-based support;
- Non-taxpaying companies benefiting from tax measures: A possibility to allow also not (yet) taxpaying companies to profit from tax measures can be applied via flow-through shares. Eligible companies issue these equity shares to investors, which receive an equity interest in the company and income tax deductions associated with new expenditures incurred by the company on exploration and development.

5.1.2 Equity Finance Mechanisms

5.1.2.1 R&D Grants from MS



R&D grants are provided by Member States to research organisations and laboratories in order to fund their research programmes in RE technologies. The purpose of these grants is to stimulate research. They provide a significant financing source in the early stages of a technology innovation, as the private sector is often reluctant to invest during this period because of the high uncertainties in terms of return on investment for non-mature technologies.

Although R&D costs can be very important for RE technologies, the level of investment required for early developments is likely to be non-significant when compared with the capital required for the next stages of development that entail the construction of prototypes for demonstration and pre-commercialisation.

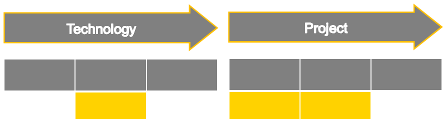
The efficiency of these grants depends on the ability of public R&D programmes to select the most promising technologies. Their allocation has to be selective, which can be detrimental to small companies who cannot spend significant time and money in application procedures for grants, although they play a significant role in the technology innovation process.

As any other type of subsidy, R&D grants cannot be considered as a cost-efficient funding solution since no return on investment can directly be linked to the expenses incurred.

Besides, these grants do not immediately contribute to lever private funds, since they do not guarantee the deployment of the technology, or perspective of return on investment at this early stage of the technology innovation process. They however allow potential private investors to better perceive the interest of public entities for selected technology segments. The involvement of the private sector usually materializes later on, once R&D programmes reach results suggesting that commercialisation and long-term profitability are likely to be attained.

Excessive use of public grants to stimulate R&D can have downsides when it leads to a financial dependence of recipient companies. This dependence turns out to be detrimental when removing public sector involvement as the technology reaches pre-commercialisation. Such subsidies must be allowed within a global strategy that ensures subsequent durable inflow of investment from other sources.

5.1.2.2 Capital/Project Grants from MS

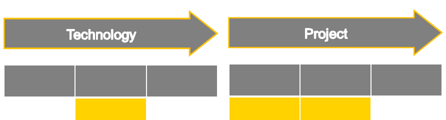


In order to prove the industrial potential of R&D innovations, significant funds are required to build prototypes, and to operated them in real-market conditions. This stage of demonstration is highly time- and capital-intensive.

Large corporates are able to support these costs through their internal R&D budgets. Small companies with limited financial resources must rely on external support. Business angel investors from the private sector can intervene at this stage of the technology innovation continuum, by taking over part of the company's equity when future profits are likely to fund this investment.

Therefore, capital grants from the public sector are an interesting alternative, especially for SMEs. Similarly to R&D subsidies, the difficulty lies in awarding these grants in priority to the most promising technologies, based on selective criteria.

5.1.2.3 Contingent Grants from MS



Contingent grants are subsidies that are converted into loans when a project turns out to be successful and profitable. Conditions are defined on a case-by-case basis depending on the national regulatory framework.

Contingent grants are more likely to be used once prototypes have proved the technology to be profitable in real-market conditions. This type of subsidy is therefore appropriate for technologies for which the innovation continuum has reached the end of its demonstration phase or the early stage of commercialisation.

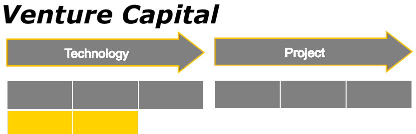
In case of success of the projects they support, contingent grants turn out to be cost-efficient, as no financial burden needs to be carried by donors, which can then re-invest the amounts reimbursed in other projects, in a "revolving" approach.

Contingent grants can play a strong role in proving private investors that return on investment can be achieved for a given technology and therefore contribute to raising private funds for similar projects. The selection of grants recipients is therefore crucial, since further technology deployment can be conditioned by the failure or the success of beneficiary projects.

Example: GEF Contingent Finance
The Global Environmental Facility (GEF) has provided grants and contingent financing for renewable energy project preparation and investment. The GEF offers contingent loans and grants to cover investment capital costs. Moreover, the GEF sponsors the up-front costs for project development, which can constitute up to 5 percent or more of the total investment cost.
From 1991 to June 2009, the renewable energy portion of the GEF's climate change portfolio amounted to about US$1.14 billion, with an average of US$5.5 million per project. This GEF funding has been supplemented with US$8.3 billion in co financing.

5.1.2.4 Venture Capital and Private Equity funds

Venture Capital



Venture Capital is considered in this report as a specific sub-segment of private equity investment. Venture Capital is the main private option for financing technology innovation in renewable energy. VC investors obtain equity shares in start-up companies and usually play a significant role in the management of the company (depending on each fund manager's investment policy).

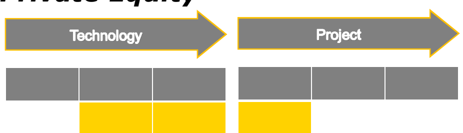
By definition, Venture Capital (VC) targets high return : IRR (Investment Return Rate) of 50 to 500%. To obtain this very high return, VC focus on early stage financing, which carries high risk of failure. VCs finance new technologies (typically between the early R&D and the pre-commercialisation stages) or new markets. The portfolio strategy is essential to achieve a fund's profitability targets. Some VC investors may provide equity for the first commercial applications of the technology financed at the beginning in order to lower risks (and consequently decrease returns). Money is raised from different sources with high risk appetite to include insurance companies, pension funds, mutual funds, high net worth individuals. The investment horizon of VC is around 4-7 years.

The typical technologies that are concerned by VC are the most innovative technologies, with high expected returns. VC investors are essentially incentivized by the exit expectations: without clear exit paths (through buyouts or IPOs-Initial Public Offering) within the expected investment horizon, VCs will be reluctant to invest. Generally, VC investments target high-growth companies, aiming at ticket sizes between € 1 and 5 million, although some smaller deals are also considered.
Some government agencies have developed venture capital mechanisms (US, Australia and the UK). In some case, the private sector can be involved in the mechanism for the initial investment as well as in the fund management. The High-Tech Gründerfonds is an example of employing private sector expertise in the management of a state-sponsored fund.

Example: Carbon Trust Investments
Carbon Trust Investments aims at promoting the development of the UK's clean energy technology sector by ***investing its own resources, leveraged with other private funding****. Investments target early stage UK clean energy technology companies. Carbon*

Trust Investments is among the UK's leading co-investors in clean technology. ***Average transaction size are between € 0,6 million and € 12 million.***

Private Equity



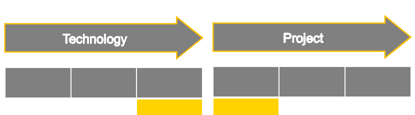
Private equity will focus on **later stage of projects** and **more mature technologies** (typically in the pre-commercialisation stage). Funds are raised from private players with medium risk appetite, including institutional investors and high net worth individuals, with an **IRR target of 25%, on a shorter investment time of 3-5 years**. In this respect, the long development periods of RE technologies and projects may appear as a drawback to some investors. The typical technologies that are concerned by private equity (PE) are biomass digesters, heat pumps, offshore wind as more mature technologies. PE investors also play an important role in providing equity to project companies or special purpose vehicles for RE projects.

VC and PE are key players for the emergence of new technologies and for bridging the gap between research and commercialisation (from "lab" to "fab"). Economies with a limited VC/PE ecoystems usually need to develop complementary measures (public seed capital funds, grant programmes) to support the emergence of innovative technologies.

Example: SITRA Energy Programme Venture Capital Investments

Sitra is a Finnish Innovation Fund, which is an independent public fund under the supervision of the Finnish Parliament. The Energy Programme makes ***venture capital investments in the establishment and growth phase of companies alone and as a co-investor with private investors and funds****. This fund is focused in energy technologies and services in energy efficiency, clean energy production and energy transfer, distribution and storage.* ***Typical size of initial investments rises from €0.5 to €2 million and Sitra adopt the role of an active minority shareholder in the portfolio companies****. Among others, this fund financed AW-Energy Oy, a company that has developed and patented a plant concept for generating electricity from bottom waves near ocean shores. The technology is currently being piloted off the coast of Portugal.*

5.1.2.5 Other Equity



During the project preparation phase, developers usually seek to attract equity investors willing to participate in the project company (special purpose vehicle). Typical players on this aspect will be infrastructure funds.
Equity funds such as infrastructures funds and pension funds invest in proven technology with low risk, and therefore require lower IRR (15 %) than VC and private equity.

Infrastructure funds are drawn from institutional investor and pensions funds and target long duration asset with steady low risk cash flow. Usually investing in roads, railways or power generating facilities, **infrastructure funds are looking for medium term investment (7-10 years)**. Equity can also be sourced from corporate resources, strategic investors, or capital markets.

These equity investors will be involved in the financing of RE project (between the pre-feasability studies and the start of construction). A 20% of equity is usually required by lenders for the most mature technologies (ie. onshore wind), although this ratio varies depending on credit markets (availability of debt) and on technology-specific risks. For less mature technology, lenders are usually more reluctant to lend money and a higher percentage of equity is required by lenders.

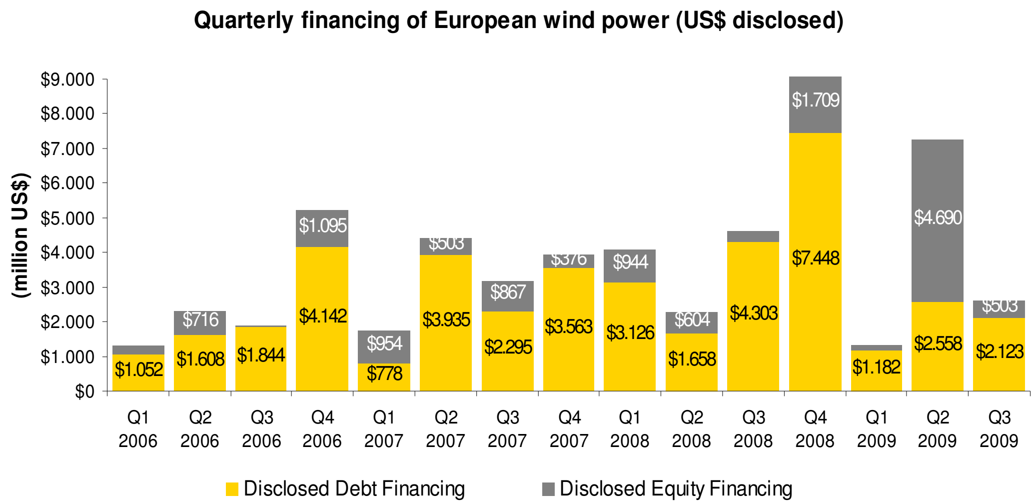


Figure 70: Quarterly financing of European wind power (US$ disclosed - Source: Ernst & Young / Bloomberg New Energy Finance)

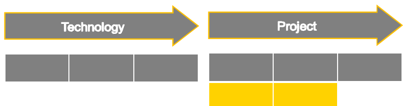
The most mature technology implemented on large scale projects have access to project equity financing without difficulty (ie. onshore wind). Small and medium projects (i.e. below € 50 million of total investments) will face stronger challenges to collect equity.

Most of the equity financing is provided by private investors, even if some public financing institutions provide equity for RE projects. Public equity can act as a good tool to unlock numbers of projects; however, the multiplier effect is very limited.

5.1.3 Debt Finance Mechanisms

5.1.3.1 Debt Mechanisms

Senior Debt



Senior Debt is provided by Banks to finance renewable energy projects, during the start-up and construction phases. Most lenders tend to be far more risk averse than equity investors. Lenders adjust debt interest rates and terms with inscreasing risks. The cost of lending is calculated by financial institutions by measuring the risks associated to the technology, the regulations, the returns offered, existing experience in the sector or activity.

If project finance were to be considered, an equity contribution of at least 15-20% of the funding requirement would likely be required. The principle of project finance is that lenders loan money for the development of a project solely based on the specific project's risks and future cash flows. As such, project finance is a method of financing in which the lenders to a project have either no recourse or only limited recourse to the parent company that develops or "sponsors" the project. Non-recourse refers to the lenders' inability to access the capital or assets of the Sponsor to repay the debt incurred by the special purpose vehicle that owns the project (or project company). One of the primary benefits of project financing is that the debt is held at the level of the Project Company and not on the corporate books of the developer or sponsor.
In principal the lenders have no recourse to any other source of funds to service and repay their loan, but in reality project finance lenders seek to pass some specific project risks either back to the project equity investors (typically, construction completion or cost overrun guarantees are sought) or to other third parties (contractors for construction completion risk, government export credit guarantee schemes for political risk), i.e. they seek "limited recourse".

Renewable energy project are facing technological and political risks which can make debt providers reluctant to lend.
The typical technologies that will have little difficulties in finding loans are the more mature technologies such as wind onshore and photovoltaïc. Risks associated to these technologies are quite low since a great amount of experience already exists.
The real challenge is facilitating access to debt to higher risks technologies such as wind offshore or CSP. KfW bank highlights an important need in offshore wind sector to reach 2020 European targets. According to the bank, banks could finance up to EUR2,4 billions per year corresponding to 700 MW per year until 2020 for offshore wind which is quite far from the target of 20 000 MW until 2020.
The political risks depend on the appropriateness and on the stability of regulatory frameworks. A predictable regulatory framework is key to attract investors. That is why countries with clear and long-term regulations will have less difficulty in finding loans than other countries.

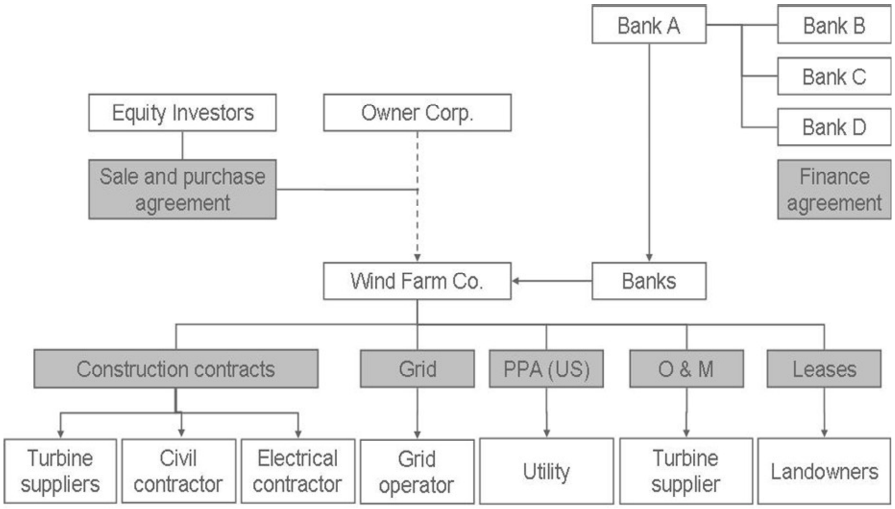


Figure 71: Renewable Energy project ownership structure (Source: Ernst & Young/Garrard Hassan)

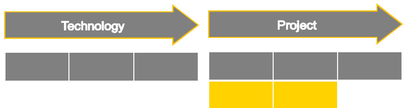
Senior Debt is mostly accessible for large scale and mature RE projects. One of the principal barriers from project developer's perspective is the reluctance of banks to lend money to new technologies and small to medium-size projects, due to transaction costs. Public sector facilities could play a significant role at raising awareness of financial institutions on market opportunities of these new technologies and at bridging this gap.

Example: The Netherlands-Green Funds

In the Dutch tax system, savers and investors normally pay 1.2% capital gains tax over the amount saved or invested (30% of the fixed return of 4% equals 1.2%). However, green capital is exempt from such tax, up to a maximum around €50,000 per person, which is indexed annually. In addition, green investors receive an extra tax reduction (1.3%) on the value of the green investment (up to the same maximum amount). Therefore, compared to standard savings or investments, ***green savers receive a total tax advantage of 2.5%****, which compensates for the lower interest or return paid by the green fund.*

The banks then use the capital in the green fund to offer soft green loans *(reduced interest loans) to finance green projects (green financing). Participating banks are ABN AMRO, ING, RABO, Triodos, Fortis and ASN. At least 70% of the capital in the green fund must be invested in so-called 'green projects': projects require Dutch government certification to be eligible for the soft loan. Experience shows that the green funds charge an* ***interest rate that is around 1-2% lower than commercial rates****.*

Asset finance

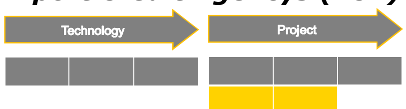


Lending secured on a physical asset, rather than the cash flows of a project or a company.

Gearing is limited (up to 60%) and there is typically a requirement for the bank to have a charge over the assets/land above other debt providers.

Transactions costs are typically lower than for project finance, although margins may be broadly similar.

Export Credit Agencys (ECA)



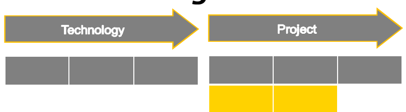
Export Credit finance is often associated with project finance where lenders may be willing to assume project risks, but not willing to assume the political risks(e.g. expropriation/nationalisation, foreign exchange remittance restrictions) of the country where the project is located.
This financing can take the form of credits and loans (financial support) or credit insurance and guarantees (pure cover) or both, depending on the mandate the Export Credit Agency (ECA) has been given by its government. ECAs can also offer credit or cover on their own account. This does not differ from normal banking activities. Some agencies are government-sponsored, others private, and others both.

Export underwriting and financing increases the bankability of projects. For example, EKF (Denmark) guaranteed a £250 million loan for London Array. Export financing is conditioned by the nationality of contractors and the services provided by that country's ECA.

Vendor / lease finance

Financing provided by the vendor of a technology, typically provided through the vendor's relationship with a financial institution. Major trade players, such as GE, can provide vendor financing on their own products through their own financing arm.
Vendor finance is typical for mature products and technologies, such as solar PV and wind turbines. It is typically a more expensive form of debt than project or asset finance, hence its limited use on large infrastructure projects.

Bond financing



Green bonds are a ‘plain vanilla’ fixed income product. The bonds have similar characteristics to ordinary bonds by the issuing entity, including credit risk and size. Because of the standard financial features and the dedication to climate change, they are quested by a broad range of investors. Many investors particularly appreciate the due diligence process that the issuer of green bonds conducts to identify and monitor ‘green’ projects.

Bond financing has precedence in the renewables sector, albeit pre-credit crunch, as exemplified by the Breeze bond financings led by Christoffersen Robb & Company (CRC), whereby CRC raised €350 million for the refinancing of a 330MW portfolio of onshore wind farms.

Bond finance will typically require a minimum deal size and there is increased liquidity in the credit markets to support such transactions. Key issues, however, will be bond investors’ appetite for construction risk and the need to obtain a credit-rating for the deal, which may be difficult in the absence of a large corporate balance sheet and track record.

Example: IFC Green Bonds

*IFC, a member of the World Bank Group, has launched in April 2010 a Green Bond programme. SEB, the North European financial group, is the sole manager for the four-year, **$200 million fixed-rate bond**. SEB will offer the bonds to investors through its distribution network.*

*Proceeds from the bond will be set aside in a separate “green account” for **investing exclusively in renewable energy, energy efficient, and other climate-friendly projects in developing countries**. This programme is part of IFC’s broader mandate to address climate change. However, this is the first time IFC is issuing bonds to raise funds that will be put into a separate account dedicated to a specific pool of loans. Projects eligible for funding include rehabilitation of power plants and transmission facilities to reduce greenhouse gas emissions, solar and wind installations.*

Debt Finance from public sector

Debt Finance from public sector mostly aims at supporting SMEs and small to medium sized projects.

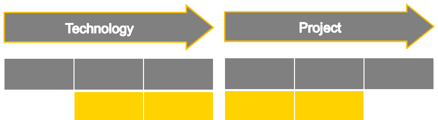
Public organisations will act as a key player in providing **soft loans** to projects in partnership with banks. Partner banks lend the financing provided by public entity and bear the credit risk. The soft loan can include an interest free grace period.

Example: EBRD Sustainable Energy credit lines

The first phase of EBRD’s Sustainable Energy Initiative (SEI) ended up in 2008 with an amount of investments reaching € 2.7 billion. Part of this budget has been spent through targeted credit lines to local banks called Sustainable Energy Financing Facilities (SEFFs).

Every credit line is supported by a comprehensive free-of-charge technical assistance package (detailed in Section 3).

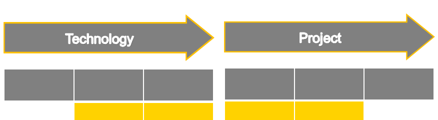
Mezzanine finance



Mezzanine finance is an innovative product that sits between senior bank debt and equity. Mezzanine loans take more risk than senior debt but less than equity. They are usually shorter duration and more expensive for borrowers but pay a greater return for the lender since debt payment is flexible. This kind of instrument is interesting for RE project when the amount of bank debt it can access is insufficient. Typical eligible projects are those, which may have highly volatile returns.
Public sector can get involved in Mezzanine finance with an important leverage capital ratio. An example of the public-private mezzanine fund FIDEME developed in France is provided below.

Example: FIDEME and EUROFIDEME 2
The FIDEME fund is a ***public-private mezzanine fund*** *open to French SMEs and project developers who face debt/equity gaps. It was created at the end of 2002 jointly with ADEME, the French Environment and Energy Management Agency. ADEME invested €15 Millions in the fund whereas senior lenders invested €30 Millions. ADEME has positioned its capital to a double leverage once by other lenders in the fund and a second time by external equity and senior lenders within the projects. At the end of 2006, it has provided subordinated debt loans for 27 projects, thereby helping to rise over €320 million for investments in the sector of renewable energies in France.*
Following the success of FIDEME, a new fund ***EUROFIDEME 2 comes as an extension of the FIDEME fund****. EUROFIDEME 2 was structured by Natixis Environnement & Infrastructures to reach the European objective of using 20% renewable energy as a primary energy source by 2020. Sponsored by Natixis up to €25 million, EUROFIDEME 2's subscription target is €250 million. It is managed by Natixis Environnement & Infrastructures and will invest in European Union countries. EUROFIDEME 2 invests in projects using mature technologies such as onshore wind, photovoltaïc, biomass solid and methanisation. It offers* ***subordinated debt*** *and equity.*

5.1.3.2 Guarantees



Publically Backed Guarantee (PBG) is a contractual obligation by which an institution assures compensating payment to a lender or an investor in case of default on an obligation that another party is committed to. Guarantees involves contracts between 3 parties, whereas insurance involve only 2 parties.

Publically Backed Guarantee	Partial Credit Guarantee	Partial Equity Guarantee
Linked to...	Bank loans	Angel & VC investments

Table 44: Financial products covered by PBGs

A bank loan can be guaranteed through a Partial Credit Guarantee (PCG). The loan agreement is between the lender and the borrower, and the guarantee agreement is between the lender and the guarantee provider. Partial Risk Guarantees (PRG) require contracts between the guarantor and investor/lender and between the guarantor and the host country Government (for example, a commitment not to modify the FIT).
Since risks exist at each stage of the development of RE projects, guarantees exist to cover each type of risk.

PBGs shall be used when high risk perceptions restrain private investment in RE technologies or projects. Therefore, PBGs can provide support to RE technologies or projects by:

- Facilitating projects' or technology developers' access to finance;
- Reducing their cost of capital;
- Expanding loan tenor or grace period to match project cash flows.

PBGs can be either complementary to other financing instruments in some cases, or a more cost-efficient instruments in others. Depending on the technology and the context, PBGs could be implemented alone to increase private VC investments, or PBGs can be implemented to alleviate risks of a Public-funded VC.

PBGs can be apply in 4 areas:

- PBGs for SME business finance, by giving innovative SME's access to equity and debt capital;
- PBGs for RE project finance, by assisting above average technology risks to access to debt and equity finance;
- PGBs for asset finance, by enabling the aggregation and the standardization of small-scale RE loans to end-users (Photovoltaic for households);
- PBGs can also assist the transfer of RE technology by reducing the risks in developing countries.

PBGs for SME corporate finance

PBGs can be used for start-up SMEs that have little access to bank loans. These start-up SMEs which are developing emerging technologies are Business Angels and VC targets. Public institutions can provide partial equity guarantees, and therefore attract more Business Angels and VC investments. PBGs can also support SMEs that have been through the demonstration phase, have a capital base and need to access to commercial banks loans. This can be done by a partial credit guarantee.

PBGs for RE project finance

Banks charge high-risk premiums on loans to projects using less mature technologies. These risk premiums are a significant barrier to the introduction of emerging technologies. Therefore, PBG for loans to projects with above average technology risk allow project developer to have access to debt financing. A typical technology concerned by this issue is the wave energy as an unmature technology.

PBGs can also support small-scale RE projects that are too small to interest professional investors.

According to the UNEP-SEF study on PBG (Publically Backed Guarantees as policy instruments to promote clean energy, UNPE-SEF Alliance, 2010), PBGs would be essential for emerging or higher risk technologies. In the case of higher risk technologies, two examples can be described:

- Offshore wind: Offshore wind is a mature technology. However, due to the higher risks during the construction and O&M phase of an offshore project compared to an onshore one, interest rates on loans are much higher;
- Biomass: unlike wind or solar energy, the availability and price of resource of biomass energy can be considered as a risk, therefore PBGs could be necessary.

Moreover, PBGs can be very valuable during period of tight credit, like during the actual economic crisis, to open the “credit valves”.

PBGs have the advantage to support the market to develop RE companies and projects, without picking “winners”. By giving access to private debt and equity, PBGs have a good multiplier effect. PBGs are also very cost-efficient, because the fees for guarantees can be set at a level, which compensates the cost of potential losses. PGBs are still little used in RE sector in Europe.

Example: FOGIME, a public-private loan guarantee mechanism

FOGIME provides guarantees of up to 70% loan amounts granted for SMEs investments in renewable energy and energy efficiency sectors, to a maximum of 750,000 euros. FOGIME has been launched by OSEO-BDPME (SME Development Bank) through its subsidiairy OSEO-SOFARIS, and ADEME (French Environment and Energy Management Agency), later joined by EDF and Charbonnages de France.

At the beginning, the annual service charge of the guarantee was 0.85% of the total loan, which made the mechanism not accessible for SMEs. Therefore, the fee has been brought in line with other French SME bank guarantee products: between 0.45% and 0.6%.

5.3 Improving Access to capital for RES sector: barriers per technology

	Planning and development	Access to grid/ infrastructure	Construction risk	Operation risk	Resource risk	Specific difficulties in the access to finance
Wind Onshore	- **Public objections** to large onshore wind parks affecting landscape overall appearance and local restrictions on turbine height / spacing - major project value accretion step	- **lead times** to obtain existing grid connection can be very long in most EU countries	In current market, it is unlikely that a contractor will offer a fully wrapped EPC contract resulting in projects structured with multiple contracts which is perceived as risky by most investors		- Generation profile is intermittent which may cause issues with direct energy balancing or contracting - Load factors affect efficiency of energy generation	- **Wind onshore is considered low risk for project finance as a mature technology** - However, a shift in lending policy has made it more difficult to raise project finance, with banks scrutinizing projects in terms of risk management and mitigation, financing structure and sponsor track record
	Needs : - Financing / Refinancing support from EIB, local MS banks helps in today's economic context - Ensure Wind speed data availability or modelling - Simplification of the permitting process in most countries to reduce lead times					

	Planning and development	Access to grid/ infrastructure	Construction risk	Operation risk	Resource risk	Specific difficulties in the access to finance
Solar PV	**Authorization and planning processes can be complex** and time consuming with limited ability to determine the final outcome. Planning requirements are more onerous for ground mounted than roof top solar due to the visual impact of these installations	Depending on the country and plant location, grid infrastructure development may be required resulting in delays in connection time and the risk of not being built and connected	Changes in regulatory regimes **causes very volatile trends in supply and demand** resulting in supply chain issues relating to availability of modules and inverters. Previous shortages in silicon for module manufacture are no longer an issue; however **inverters remain in short supply** due to competition with other technologies. Significant reductions in costs are seen as a result of the volume of installations and short construction period.	**Operational risk is minimal** as there are no moving parts and regular maintenance is limited to cleaning of the solar panels	Forecast risk in terms of irradiation levels.	**Solar PV is considered low risk for project finance** as a mature technology Recent discussion over retroactive tariff changes for solar PV in Spain has resulted in low investor confidence with projects on hold until a final decision is taken.
	Needs - Financing / Refinancing support from EIB, local MS banks helps in today's economic context - Regulation stability - Availability on reliable solar resource data - Funding of R&D in improving cells' efficiency					

	Planning and development	Access to grid/ infrastructure	Construction risk	Operation risk	Resource risk	Specific difficulties in the access to finance
Wind offshore	Approval processes often **more stringent with longer lead times** compared to onshore wind	Lack of sufficient and developed grid infrastructure due to intensive capital costs, undersea geographical factors and environmental constraints	- challenges in foundation design, installation techniques and electrical transmission for increasingly **deeper water projects** - relatively **few manufacturers specifically** producing off-shore wind turbines required for construction of projects - lack of ports to provide construction and operational facilities for offshore projects	- **higher operating costs** over the life of the project due to required preventative maintenance strategies - **inability of turbine manufacturers to provide warranties** for increasing large scale projects	- Generation profile is intermittent which may cause issues with direct energy balancing or contracting - Load factors affect efficiency of energy generation, however is typically higher than onshore wind	- Perceived as a young technology - insufficient availability of collectively large amounts of capital to are required to fund the scale offshore wind projects which tend to be **significantly larger than onshore wind projects** - cost of raising corporate debt has increased since the credit crunch, which has led to a **tightening of capital budgets** and the curtailment of investment programmes, particularly in the offshore wind sector - budgets for offshore wind project are increasingly being diverted to other low carbon sources of energy, including nuclear and carbon capture and storage (CCS)
	Needs : - Financial support from institutions such as EIB, MS banks, ECAs - Availability on guarantees on operation and construction risks for large scale projects - Ensure Wind speed data availability or modelisation - Funding of R&D in determination of best design and improvement of components reliability					

	Planning and development	Access to grid/ infrastructure	Construction risk	Operation risk	Resource risk	Specific difficulties in the access to finance
Biomass	Planning failure typically due to stack height, emissions and road movement; **Key issue in development is developing a robust feedstock strategy** securing a bankable feedstock contract providing long term certainty over volume, specification and price	Typically, grid interconnection is not an issue due to brown field locations with existing grid connection and export infrastructure. Sites also provide opportunities for private wire electric and heat/steam offtake	**- Construction risk is significant** as biomass infrastructure is highly capitally intensive and involves numerous contractual counter-parties. Sponsors may choose to manage contractor interface risk directly or through an EPC wrap provider. EPC wraps takes risk out of the project although the added cost must be factored into overall equity returns. - Other risks in construction include delay which is passed off through long stop date, fixed price risk and sub contractor risk with regards to robustness of collateral warranties	Independent sponsors would typically pass this risk out of a project through a long-term contract with a counterpart with expertise in thermal power plant operations. It is crucial for the Sponsor to ensure contract interface risk is continually managed between O&M, feedstock provider and EPC	The key resource risk is obtaining the volumes of feedstock at the required price and specification. -Obtaining a contract on resource over a sufficient period of times is also quite difficult	-Traditional thermal treatment is considered bankable - Less mature RES-E technologies such asgasifiers, methanizers, are not as proven in terms of technology and will be dependent upon level of security from EPC -Ability to secure a long term feedstock contract that offers the right level of performance guarantees in terms of feedstock composition -Project finance does not have a large trackrecord in the sector due to concerns over fuel supply. - Energy vs Food debate can be a reputation risks for Banks
	Needs - Securing long term supply (price and availability) - Possibility to contract with a single point EPC - Simplification of the permitting process - Availability of track records for the less mature technologies using biomass (gasification, methanisation, …)					

	Planning and development	Access to grid/ infrastructure	Construction risk	Operation risk	Resource risk	Specific difficulties in the access to finance
Solar CSP	CSP plants require a significant surface area Parabolic trough technology requires a supply of water which may be restrictive in the arid areas suited to CSP	Areas suited to CSP often require grid infrastructure development to export electricity resulting in a high cost of connection	**High initial investment** is required with **80% of project costs incurred during construction** and only 20% during operation. The CSP development market has low levels of competition and there are a limited number of technology suppliers. Due to the time taken to construct CSP projects, construction delays could result in the project missing the deadline for a target tariff category.		Suitable resource for CSP is located in a narrow band between 40 degrees of latitude north and south. Suitable sites require at least 2,000 kWh of sunlight radiation per sqm	Access to project finance for CSP is difficult as it is only available for commercially proven technology. Very few projects have been project financed with most financed on balance sheet and then refinanced once built.
	Needs - Substantial guarantees needed from sponsors, developers and EPC contractors - Ensure availability of reliable solar resource data - Funding of R&D in reducing costs of construction - Ensure the availability of track records					

Appendix to chapter 6: Review and evaluation of existing and alternative support and financing instruments: case studies

6.1 Case study overview

In this report, the financing requirements and availability of capital for meeting the EU27 2020 renewable energy targets were determined. Meeting these targets asks for an investment of approximately 70 billion euro per year in the period 2010-2020. In this section, the role of policies and policy instrument design in reducing the overall need for capital will be addressed. A good policy design will result in low regulatory and market risks and a good business case for renewable energy deployment, which in turn will mobilize cheaper financial resources as the debt share in project finance can increase. This will reduce the levelized cost of energy and hence the required level of support.

In order to make this a more tangible discussion, several case studies will be analyzed in more detail:

- Case studies will be done for following countries:
    - United Kingdom;
    - Poland;
    - Germany.
- For these type of renewable projects:
    - Onshore wind, 20 MW;
    - Offshore wind, 100 MW;
    - Large scale PV, 500 kW.
    - Small scale PV, 50 kW (commercial scale, medium system size)
- Base year:
    - 2009.

In section 6.2 to 6.4 the case studies will be presented and then assessed in section 6.5. In section 6.6 several opportunities for reducing the levelized cost of electricity will be presented.

6.2 United Kingdom

6.2.1 Production support - Renewables Obligation

The main supporting mechanism for financing renewable energy projects in the United Kingdom (UK) is the Renewables Obligation (RO), a quota scheme with tradable certificates.

Table 45: RO targets, buy-out price and amount recycled in 2008/2009

Year	Targets	Non-compliance buyout price		Amount recycled	Total value of ROC (buyout + recycle)	
	% supply (consumption target)	£/MWh	€/MWh	£/MWh	£/MWh	€/MWh
2008/09	9.1	35.76	42.05	18.54	54.30	63.54

Exchange rate used £1: €1.18 (on 1.7.2009)

Since its introduction, the RO has been subject to various reforms and improvements. The most significant change in the scheme has been the introduction of banding in April 2009. The technology banding implies that different technologies receive different levels of support, providing a greater incentive to those that are further from the market with potential to deploy on a large scale.
All plants accredited from first of April 2009 will earn ROCs in the new bands. In the April 2009 budget, the Government announced that it was temporarily increasing the banding for offshore wind from 1.5 to 2 for projects that reach financial close between 23 April 2009 and 31 March 2010, and from 1.5 to 1.75 for projects that reach financial close between 1 April 2010 and 31 March 2011.

Table 46: Technology banding

Generation type	ROCs/MWh #	ROC value £/MWh (2009)
Onshore wind	1	54.30
Offshore wind	2 (1.5 for other years)	54.30*2 = £108.6
Small scale PV	2	54.30*2 = £108.6
Large scale PV	2	54.30*2 = £108.6

Only part of the value of the ROC or ROC buyout, the recycled ROC, LEC and electricity market value is transferred to the RES-producer. The other fraction stays with the electricity utility and can be considered as a risk premium. In this study we used following assumptions on the prices paid to the RES-producer:

- 70 to 90% of the projected conventional wholesale electricity price, e.g. 35 to 40 £/MWh with prices for wind energy on the low-end, and for biomass-CHP on the high-end (this is not included in the spreadsheet model used for the analysis, but the results will be compared to this figure);
- 90% of the ROC buyout value (35.76 £/MWh in 2009, adjusted for inflation during the project lifetime);
- 85% of the value of the recycled ROC (18.54 £/MWh in 2009, changing each year depending on the level of compliance to the renewables obligation);
- 85% of the LEC (4.7 £/MWh).

In April 2010, further changes included the RO to extend from its current end date of 2027 to 2037 for new projects, in order to provide greater long-term certainty for investors, and an increase in support for offshore wind projects meeting certain criteria. This change is however not important for the renewable energy projects in this study as we apply the financial conditions of the year 2009.

6.2.2 Production support - Climate Change Levy Exemption

The Climate Change Levy (CCL) is an environmental tax on industrial and commercial users of electricity. Renewable electricity generation is exempted from the levy. For the period 2009/10 the levy is £4.70/MWh (5.17 €/MWh). It rises annually according to the retail prices index. Levy Exemption Certificates (LECs) are issued by Ofgem for eligible renewable energy generation and are earned to prove exemption from the Climate Change Levy (RE-SHAPING, 2009).

6.2.3 Tax relief – Enhanced Capital Allowances (ECA)

The Enhanced Capital Allowance (ECA) scheme is a key part of the Government's programme to manage climate change. It provides businesses with enhanced tax relief for investments in equipment that meets energy-saving criteria. The ECA scheme enables businesses to claim 100% first-year capital allowance on investments in energy-saving equipment, against the taxable profits of the period of investment. Currently neither wind projects nor solar PV projects are eligible under this scheme.

6.2.4 Other support measures

6.2.4.1 Production support - Feed-in Tariff

Came into force on 1 April 2010 and therefore it does not apply to the projects under study.

6.2.4.2 Investment support - Capital grant schemes

Both for wind projects and for solar PV projects various capital grants existed. In 2009 no investment support measures were available however to wind and solar PV projects.

The Department of Trade and Industry's (DTI) Capital Grants Scheme has funded a number of demonstration projects to help reducing the costs and risks involved in such developments and to maximize the contribution to the Government's target for renewable electricity supply within the UK. A significant amount of funding for capital grants has already been allocated to:

- Offshore wind: three rounds of offshore wind grants totalling £117 million have already been allocated. The aim was to stimulate early development of a significant number of offshore wind farms. The scheme is now closed;

- Biomass: approximately £66 million has been provided to help encourage the efficient use of biomass, particularly energy crops, for energy production by stimulating the early deployment of biomass-fuelled heat and electricity-generation projects. Of this, the New Opportunities Fund provided approximately £33 million for energy crops power generation and around £3 million for small-scale biomass/combined heat and power projects.

Solar PV is funded in the years 2002 -2006 by DTI under the Major PV Demonstration Programme. The additional funding allowed the programme to run until March 2006, with final grants claims having been submitted by 30 April 2007. The total available funding over these years was £31 million. Both grid-connected and off-grid PV systems were eligible for grant funding under the scheme.

6.3 Germany

6.3.1 Production support – Feed-in tariff

Since 1990, the main support scheme for renewable electricity is feed-in tariffs. In 2008, the scheme has been amended and on 1 January 2009, the new German Renewable Energies Act (Erneuerbare- Energien-Gesetz; EEG 2009) entered into force. In the table below the feed-in tariffs and digression rates for wind and solar PV technologies are given.

Table 47: 2009 support levels and degression rates for wind and solar PV

Technology	Feed-in tariff 2009 (€/kWh)	Digression rate (%/yr)
Wind onshore • Initial tariff (first 5 years from start of operation) • Base tariff (year 5 to 20): • Repowering bonus:	92 50.2 5	1%/yr
Wind offshore • Initial tariff (first 12 years from start of operation): • Additional bonus if commissioned before 1.1.2016: • Base tariff (year 12 to 20):	130 2 3.50	5%/yr (as of 2015, until then no regression)
Solar PV		
• Roof mounted facilities <30 kW	430.1 (remuneration for autoproduction: 250.1)	8% in 2010; 9% as of 2011
• Roof mounted facilities 30 kW -100 kW	409.1	
• Roof mounted facilities >100 kW	395.8	
• Roof mounted facilities >1000 kW	330	10% in 2010; 9% as of 2011
• Ground-mounted installations	319.4 (independent from inst. capacity)	

Tariffs for wind power plants depend on the site quality. The first five years all wind power plants receive the high tariff. Plants at the best sites receive the high tariff for just five years and the low tariff for the remaining 15 years. Plants at poorer quality sites receive the higher tariff for a longer period. For which period a plant receives the high tariff, depends on the average yield / generation cost of each single plant during the first five years. The model assumes full load hours (FLH) of a 20 MW onshore wind project of 2,000 and of a 100 MW offshore project at 3,000. Onshore wind projects receive the high tariff over a period of 19.5 years, offshore projects over a period of 12.8 years.
For PV the digression rate levels depend on the amount of installed capacity in the preceding year.

6.3.2 Debt measures – KfW Renewable Energies Programme

In 2009, the KfW consolidated their support programmes for renewable energy investments. One single programme superseded the following programmes: Producing Solar Power, ERP-Environment and Energy Saving Programme, KfW Environment Programme, KfW-Programme Renewable Energy. The new KfW Renewable Energies Programme consists of two parts - "standard" and "premium". The "standard" programme part comprises loans for

- Electricity from solar energy (photovoltaics), biomass, biogas, wind energy, hydropower, geothermal energy and;

- Electricity and heat from renewable energies generated in combined heat and power (CHP) stations.

The "premium" programme part offers loans and repayment bonuses for heat from renewable energies generated in large plants.

The standard programme has funds available up to 100% of the investment costs eligible for financing with a maximum of EUR 10 million. The loan is characterized by:

- Long-term, low-interest loans;
- Fixed interest period of 10 years; and;
- Repayment-free start-up period of 1 - 3 years depending on the duration.

The interest rates for the low-interest loans are given as 0.9 – 5.25% (nominal) and 2.25 - 6.87% (effective). For the wind and solar case studies, we use a reduced interest rate of 4% (default interest rate is set at 6%).

6.4 Poland

6.4.1 Production support – quota system

In Poland, renewable electricity is primarily promoted through a quota system. The quota obligation is imposed on electricity suppliers. Those suppliers are obliged to have a certain percentage of renewable energy in their sales to end customers. The minimal obligatory levels of share of RES in sales to end customers were updated in the Regulation of the Minister of Economy from 14 August 2008 (see Table 48).Table

Table 48: The annual amount of sold RES-E delivered to final users

Year	Share of RES (%)
2008	7.0%
2009	8.7%
2010	10.4%
2011	10.4%
2012	10.4%
2013	10.9%
2014	11.4%
2015	11.9%
2016	12.4%
2017	12.9%

Electricity suppliers have to obtain and present a specified number of Guarantees of Origin for electricity produced from renewable energy sources to the Energy Regulatory Office for redemption or they have to pay a so-called Substitute Fee.

A failure to comply with the abovementioned requirement is punished by a penalty amounting to at least 130% of the substitute fee which has to be paid to the National Fund for Environmental Protection and Water Management and which in turn may be used solely for supporting renewable energy.

The price of green certificates is determined by the level of a unit substitution charge. The initial level was determined a few years ago at PLN 240 per MWh (53.62 €/MWh) and is annually indexed for inflation. As for 2009 the substitution fee amounts to PLN 258.89 (57.84 €) for every 'lacking' MWh of renewable electricity[442].
The price of green certificates in June 2009 is 250 PLN/MWh (55.86 €/MWh).

6.4.2 Green energy purchase obligation

Besides the income from the sales of property rights from the certificates of origin, electricity suppliers also have income from the sale of electricity. Electricity suppliers are obliged to purchase the whole amount of electricity produced from renewable sources at an average market price of "conventional electricity" from the previous year. The guarantee price of electricity produced from renewable energy sources in 2009 is 155,44 PLN/MWh (35 euro/MWh, 1euro=4,4PLN).

6.4.3 Tax relief

An excise tax exemption on RES-electricity was introduced in 2002. It amounts to 20 PLN/MWh (4.4686 €/MWh)[443], being refunded after the submission of the certificate of origin as from 2009.

6.4.4 Capital grants – National Fund for Environmental Protection and Water Management

In Poland, there are no RES targeted development funds. Investors can apply for investment grant and/or for preferential loan to:

- The National Fund of Environmental Protection;
- The respective county and municipal funds;
- Environmental Protection Bank;
- ECOFUND and others.

Until 2013 the National Fund for Environmental Protection and Water Management (NFOŚiGW) will spend 1.5 billion PLN (335 M€) on the development of renewable sources, while the Provincial Funds for Environmental Protection and Water Management (WFOŚiGW) are going to spend almost 1 billion PLN (223 M€) for the same purpose.

[442] http://www.ure.gov.pl/wai/pdb/271/2861/Informacja_5__2009_w_sprawie_zwaloryzowanej_jednostkowej_oplaty_zastepczej_jaka_.html

[443] Exchange rate on 1 July 2009: 1 Polish Zloty (PLN) = 0.22343 Euro (EUR)

About 450 million PLN are available for renewable energy projects within the Infrastructure and Environment Operational Programme, 200 million EUR are available from other public sources and 1.3 billion EUR from private sources. Altogether, this amount of money will reach about 15 billion PLN (Polish Market Online, 2010)[444]. These capital investment grants are not included in the calculations since the support levels per renewable energy technology are not given.

[444] http://www.polishmarket.com.pl/document/:20633, "Enough money for renewable energy"

6.5 Comparative assessment

6.5.1 Technology assumptions

For the comparative assessment, we have used the following technology assumptions.

Table 49: Assumptions on technology characteristics

		Wind onshore	Wind offshore	Solar PV - large	Solar PV – small (BIPV)
Technical					
Capacity	MW_e	20	100	0.5	0.05
Full load hours default D	h	2000	3500	950	950
variant V	h	2300	3700	1400	1400
Electricity production D	GWh_e/yr	40	300	0.475	40
V	GWh_e/yr	46	370	0.700	75
Technical lifetime	yr	15-20	15-20	20-25	15-25
Economical lifetime	yr	15	15	15	10
Cost					
Investment	€/kW	1400 [1125-1525]	3100 [2450-3500]	3000 [2950-4750]	3850 [2950-4750]
O&M	€/kW/yr	40 [35-45]	110 [90-120]	35 [30-42]	35 [30-42]

6.5.2 Assumptions on equity and debt parameters

Based on previous work and consultation with project developers, investors and banks, the following country-specific assumptions on equity and debt parameters are used. The methodology is based on a study previously prepared for IEA-RETD[445].

Table 50: Assumptions on equity and debt parameters

	Wind onshore		Wind offshore		Solar PV - large		Solar PV - small	
	IRR	DSCR	IRR	DSCR	IRR	DSCR	IRR	DSCR
Default country	15%	1.35	18%	1.8	15%	1.35	15%	1.8
United Kingdom	15%	1.45	15%	1.8	15%	1.45	15%	1.3
Germany	9%	1.3	15%	1.7	9%	1.3	9%	1.3
Poland	15%	1.45	18%	1.8	15%	1.45	12%	1.3
Best country	9%	1.3[1]	9%	1.3	9%	1.3	9%	1.3

[1] In fact, lower DSCR (debt service coverage ratios) are applied today, e.g. 1.1

[445] D. de Jager, M. Rathmann, 2008: Policy instrument design to reduce financing costs in renewable energy technology projects. Ecofys, by order of the IEA Implementing Agreement on Renewable Energy Technology Deployment (RETD)

6.5.3 Onshore wind

Figure 72 to Figure 75 show the results for the assessment for onshore wind energy for both a default country and for UK, Germany and Poland. The 20 MW onshore wind project is assumed to have 2000 full load hours (by default). The gross levelized cost of electricity (including taxes, excluding incorporation of support measures) range from 83 to 110 €/MWh, the difference being the consequence of the various financial parameters applied.

In these countries the most important measures to cover the levelized cost of electricity is production support measures, e.g. feed-in tariffs in Germany and certificates in UK and Poland. Figure 6-3 shows that onshore wind in Germany – in this particular example - was over-supported in 2009. Based on 2000 full load hours (FLH) the high feed-in tariff level is received for a period of 19.5 years. For 1800 FLH the support system has a better match with calculate levelized cost of electricity. The effects of debt and tax measures, if existing, are rather limited for onshore wind projects in direct terms, but indirectly they have an impact on the applied financial parameters.

For the UK and Poland the net levelized cost of electricity is 45 and 53 €/MWh respectively. This can be compared to the electricity prices of 53 and 36 €/MWh in 2009. The PPA is based on these figures and price expectations for the future. It is evident that this 2000 FLH case cannot be financed in Poland, but depending on the PPA, could be a case in the UK.

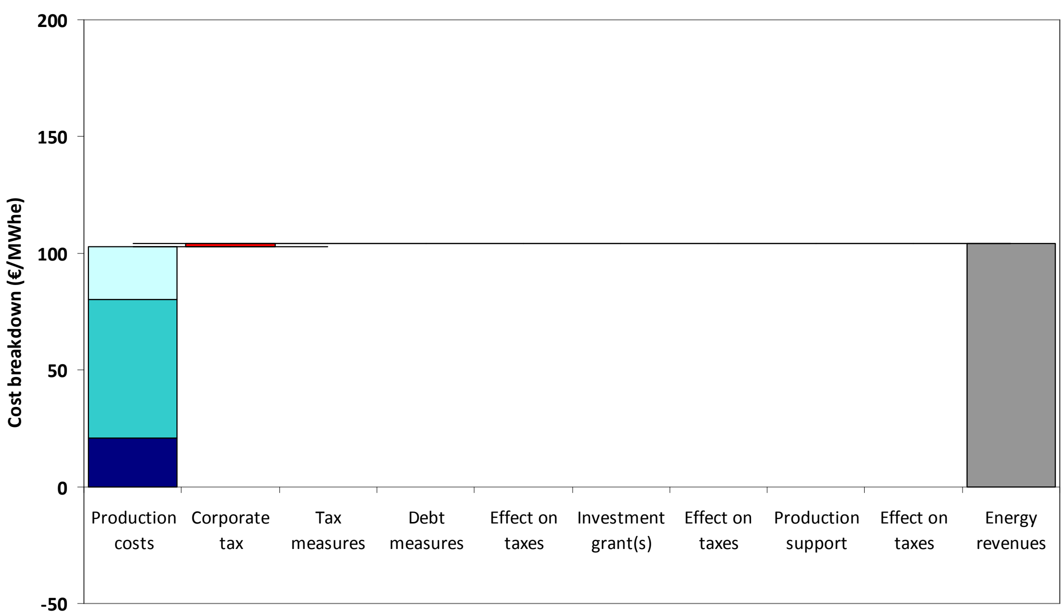


Figure 72: Levelized electricity cost (LCe) for onshore wind in a 'default' country

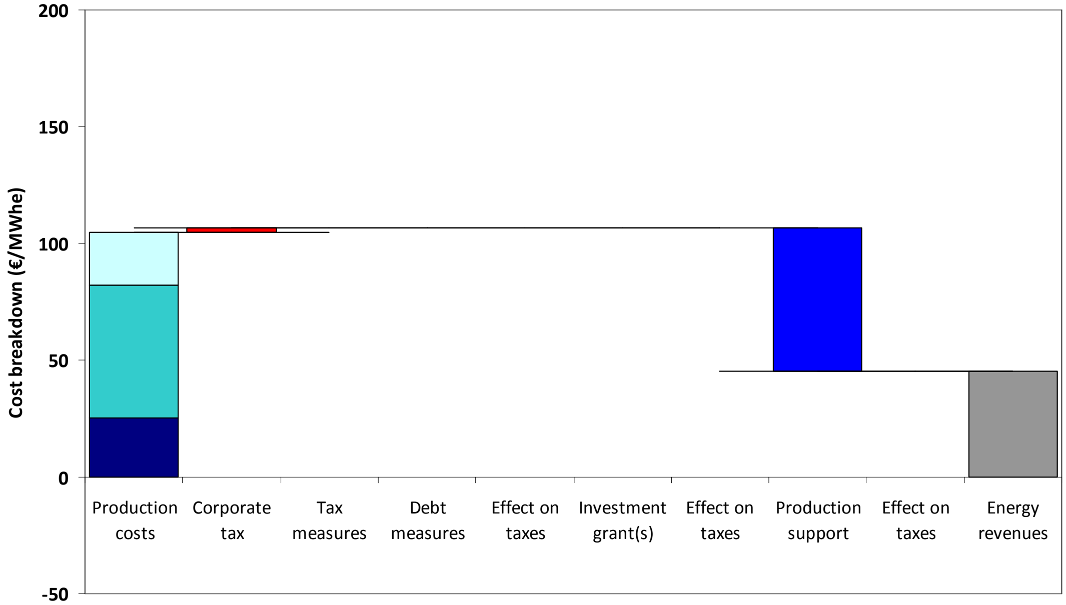


Figure 73: Levelized electricity cost (LCe) for onshore wind in United Kingdom, 2009

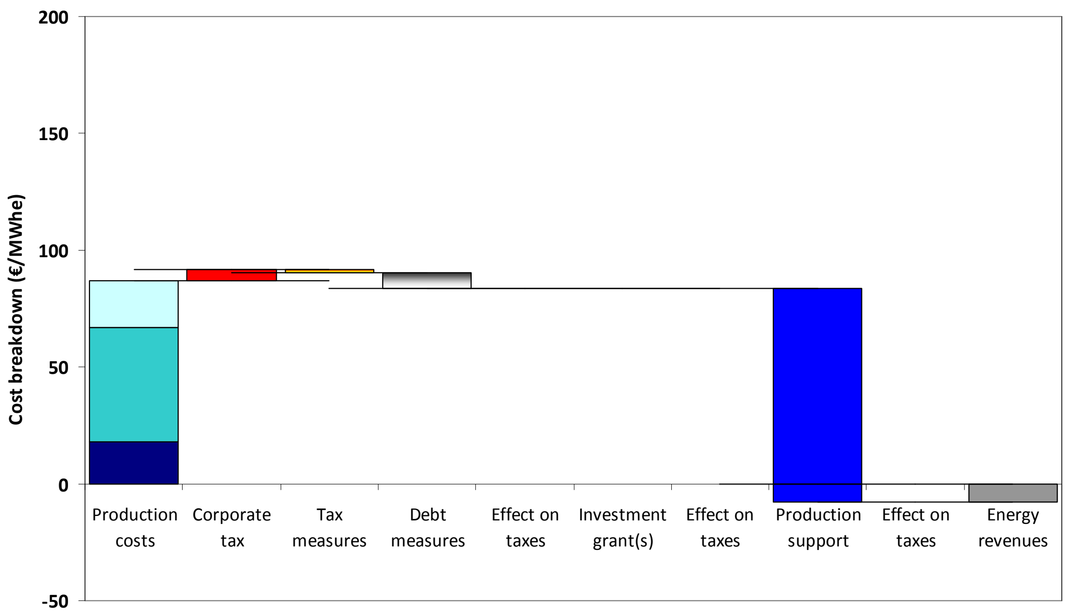


Figure 74: Levelized electricity cost (LCe) for onshore wind in Germany, 2009

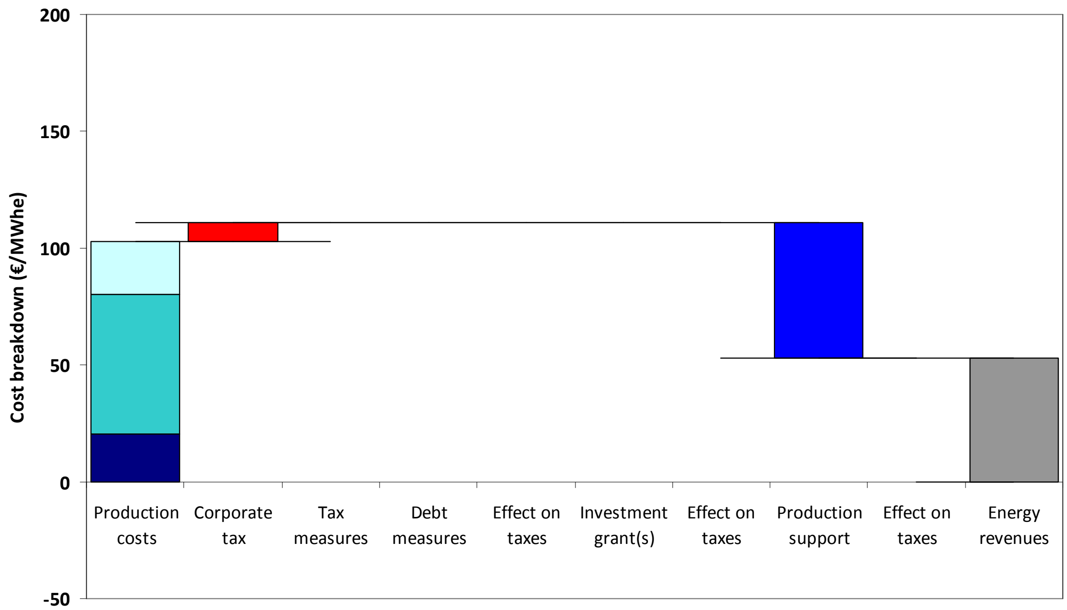


Figure 75: Levelized electricity cost (LCe) for onshore wind in Poland, 2009

6.5.4 Offshore wind

The gross levelized cost of electricity for electricity from offshore wind are between 130 and 160 €/MWh (this is typically the range for projects within 5-30 km offshore). Of the countries studied here, Germany has the lowest gross levelized cost of electricity (132 €/MWh) for offshore wind, due to the lower values for the financial parameters. The support measures for offshore wind projects are equal to the support measures for onshore wind projects.

In the United Kingdom and Poland, the net levelized cost of electricity equal 32 and 104 €/MWh respectively. These minimum value for the PPA contract clearly shows that offshore wind is bankable in the UK (compare 53 €/MWh for the 2009 electricity price) and is far from that in Poland. In Germany, the level of production support is sufficient to make this prototype project viable.

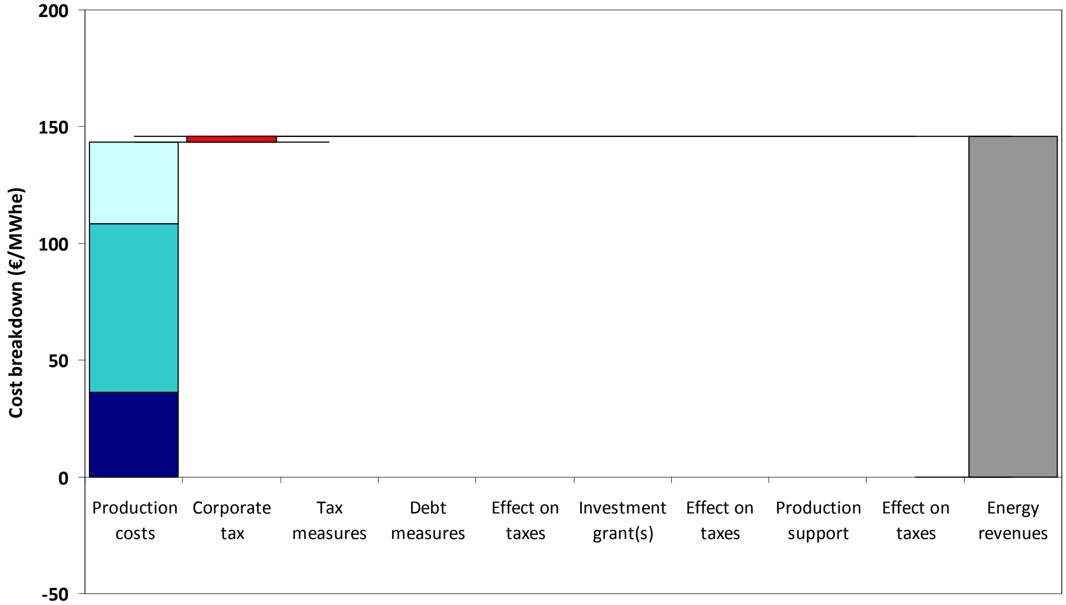


Figure 76: Levelized electricity cost (LCe) for offshore wind in 'default' country

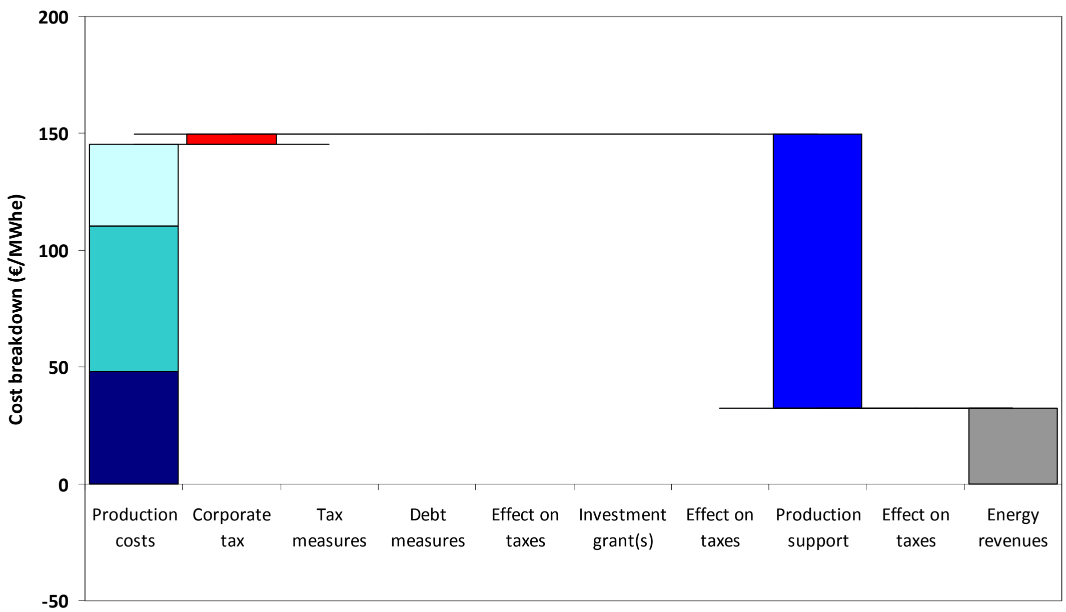


Figure 77: Levelized electricity cost (LCe) for offshore wind in United Kingdom, 2009

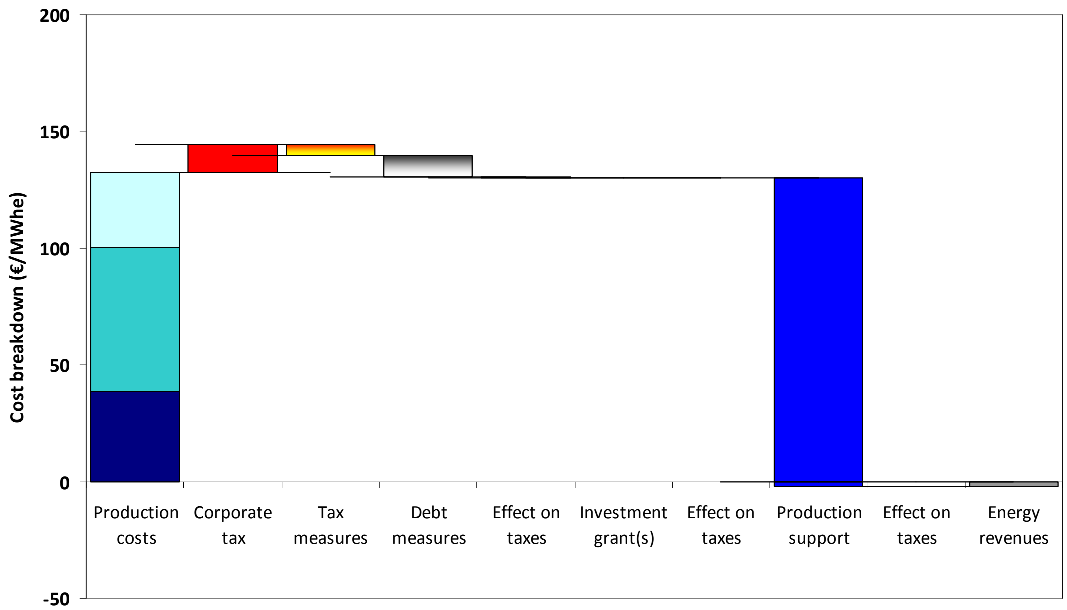


Figure 78: Levelized electricity cost (LCe) for offshore wind in Germany, 2009

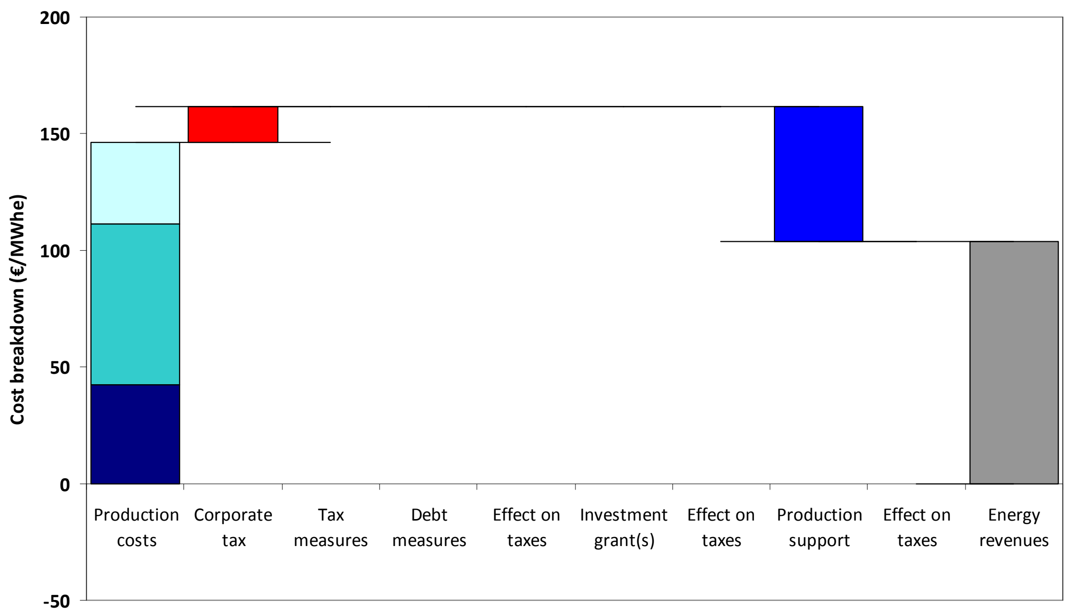


Figure 79: Levelized electricity cost (LCe) for offshore wind in Poland, 2009

6.5.5 Solar photovoltaics

Solar PV is currently one of the most expensive renewable energy technologies with production costs in the range of 300 to over 400 €/MWh for ground-based systems and 400 to over 500 €/MWh for building-integrated (BIPV) systems (both calculated at 950 FLH).

The figures below show that 2009 support levels in Germany are high enough to bring down the levelized electricity cost to even negative levels. Large scale (ground mounted) PV systems receive a feed-in tariff of 319.40 €/MWh over a period of 20 years.

In the United Kingdom, the situation is completely different. No medium to large-scale ground mounted PV systems have been installed up to 2010, because of the absence of sufficiently funded support schemes. The fact that solar PV does not qualify for Enhanced Capital Allowances also plays a role. In Poland, also no large-scale ground mounted systems have been installed, price levels are too high and no specific support schemes are in place (PV-legal database, 2010)[446]. For this reason, no graphs are shown here.

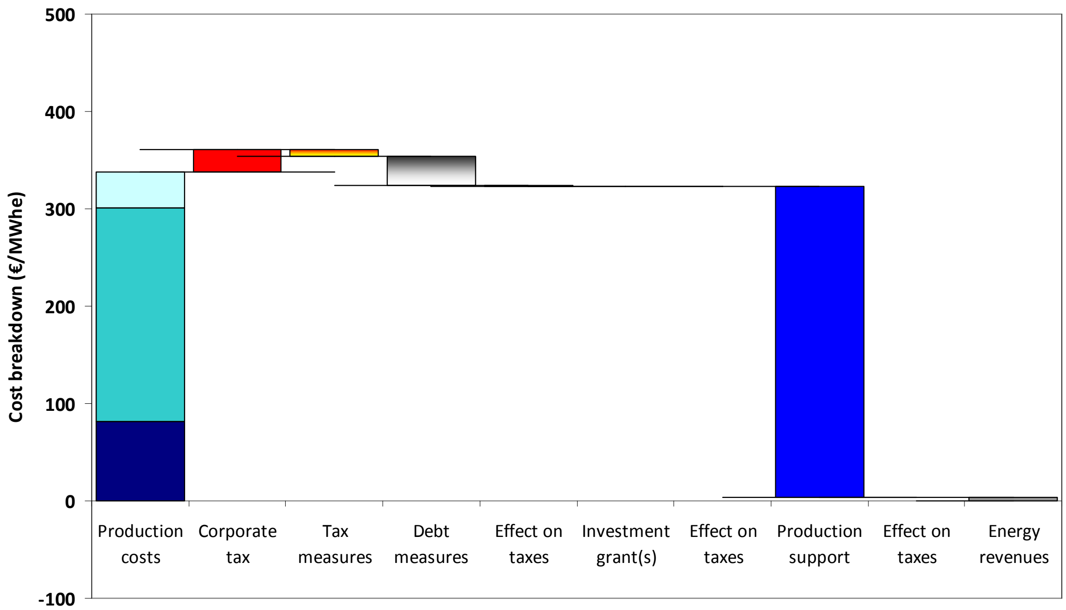


Figure 80: Levelized electricity cost (LCe) for large-scale gound based PV in Germany, 2009

[446] http://www.pvlegal.eu/en/home.html

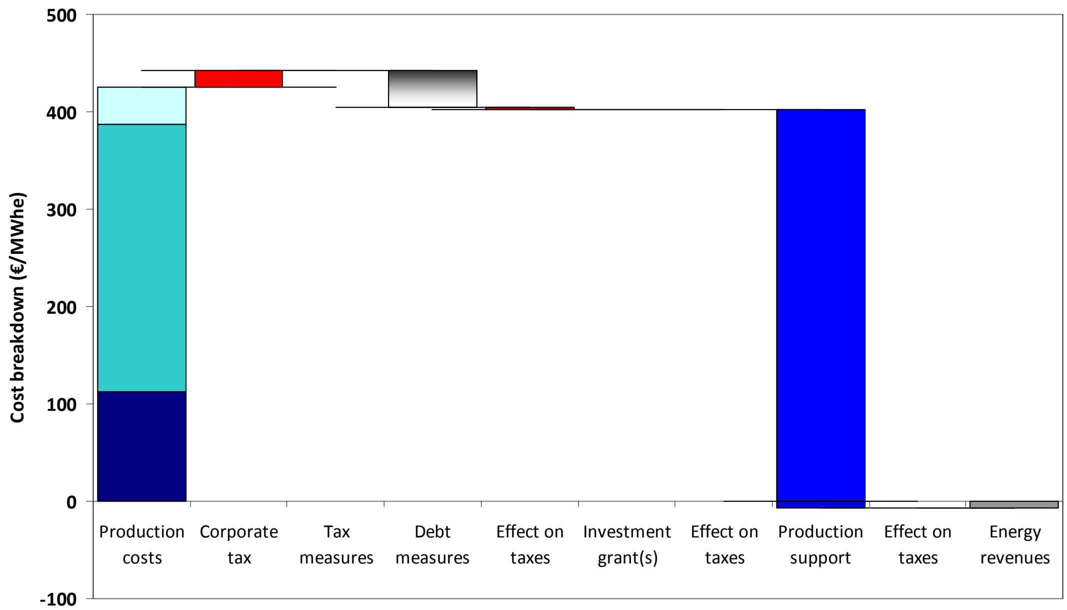


Figure 81: Levelized electricity cost (LCe) for small-scale BIPV in Germany, 2009

6.6 Conclusion

As part of this project, several case studies were explored in more detail. The purpose of this analysis is threefold:

- To show in more detail how specific primary and secondary support schemes affect the costs of renewable electricity;
- To show how the levelized cost of electricity differs per country and technology due to differences in risk profiles of both support schemes and technologies;
- To indicate how much cost savings could be achieved by reducing these risks.

The case studies covered Germany, United Kingdom, and Poland and concerned on- and offshore wind energy, large-scale ground based solar photovoltaics, and small-scale building integrated solar photovoltaics (BIPV). The figure below presents a summary of the results.

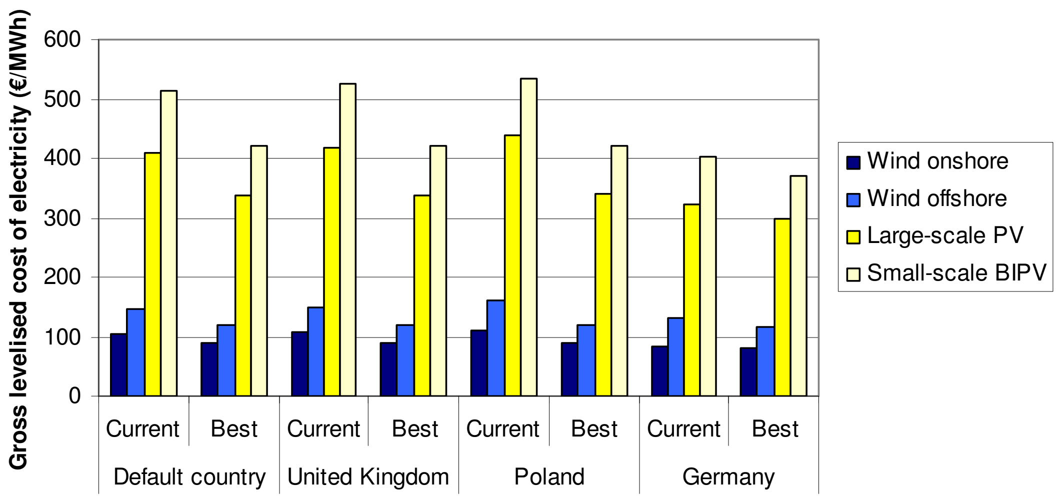


Figure 82: Gross levelized cost of electricity for several case studies

The figure shows the levelized cost of electricity (LCE) under different risk circumstances. 'Current' refers to the situation in 2009, with country and technology specific assumptions on costs and finance. 'Best' refers to a situation where regulatory and market risks have been mitigated significantly. In the next section examples of these measures are given. The figure reflects the differences in the risk characteristics of the different support schemes. Furthermore, it shows significant cost reductions that can be attained, ranging from 3% to 25%. These reductions are a consequence of the lower risk profiles, which are reflected in reductions in the weighted average costs of capital ranging from 1% to 25% (WACC before tax).

Appendix 8: Glossary

Contingent grant: Contingent grants are grant repaid in part or in full when the project has reached the operation and revenue-generating stages.

Corporate Finance, debt provided by banks to companies that have a proven track record, using 'on-balance sheet' assets as collateral. Most mature companies have access to corporate finance, but have limited total debt loads and therefore must rationalize each additional loan with other capital needs.

Equity: Renewable energy equity investors take an ownership stake in a project, or company.

Export Credits, Insurance, and other Risk Management Instruments are used to transfer specific risks away from the project sponsors and lenders to insurers and other parties better able to underwrite or manage the risk exposure.

Grant : Subsidy bestowed by a public organization (called the grantor) for specified purposes to an eligible recipient (called the grantee).

Mezzanine Finance groups together a variety of structures positioned in the financing package somewhere between the high risk / high upside equity position and the lower risk / fixed returns debt position.

Mezzanine fund: Debt that incorporates equity-based options, such as warrants, with a lower-priority debt. Mezzanine debt is actually closer to equity than debt, in that the debt is usually only of importance in the event of bankruptcy.

Quasi Equity: A category of debt taken on by a company that has some characteristics of equity, such as having flexible repayment options or being unsecured. Examples of quasi-equity include mezzanine debt.

Private Equity: Private equity is money invested in companies that are not publicly traded on a stock exchange.

Private Finance from personal savings or bank loans secured by private assets. This type of finance is concerned mainly with smaller companies and projects.

Project Finance, debt provided by banks to distinct, single-purpose companies, whose energy sales are guaranteed by power purchase agreements (PPA). Often known as off-balance sheet or non-recourse finance, since the financiers rely mostly on the certainty of project cash flows to pay back the loan, not the creditworthiness of the project sponsors.

Risk Capital, equity investment that comes from venture capitalists, private equity funds or strategic investors (e.g. equipment manufacturers). Besides the developers own equity and private finance, risk capital is generally the only financing option for new businesses.

Soft Loans: loans that offer flexible or lenient terms for repayment, usually at lower than market interest rates. Soft loans are provided customarily by government agencies and not by financial institutions. Also called concessional funding.

Senior debt: Debt that has priority for repayment in case of liquidation.

Third-Party Finance, where an independent party finances many individual energy systems. This can include hire-purchase, fee-for-service and leasing schemes, as well as various types of consumer finance.

Venture capital: Venture Capital is an equity investment focused on 'early stage' or 'growth stage' technology companies.