Competitiveness of Renewable Energies
Comparison of Major European Countries

François Julien

Michael Lamla

European University Viadrina Frankfurt (Oder)

Department of Business Administration and Economics

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FRANCOIS JULIEN / Hon.-Prof. Dr. MICHAEL LAMLA

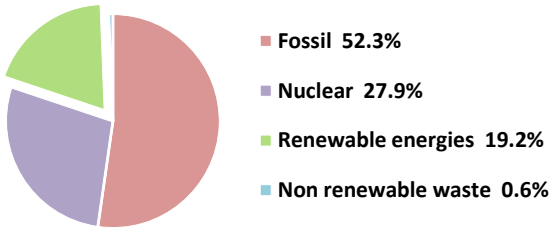
Abstract

This paper aims at presenting the support schemes promoting the development of renewable energies in five major European countries, namely Germany, France, Italy, Spain and the United Kingdom. At first the reader will find brief country profiles, followed by a comparison of their competitiveness with regard to the type of public support available for project developers, the current level of feed-in tariffs, the stability of the regulatory framework, the quality of the wind or solar resource available, etc. Finally, a mapping will give a quick overview of the competitiveness of the five countries for each renewable energy reviewed in this study. The paper focuses on four technologies generating electricity from renewable sources: Onshore wind, Offshore wind, Photovoltaic solar energy and Concentrating solar power ("CSP", also known as solar thermoelectric power).

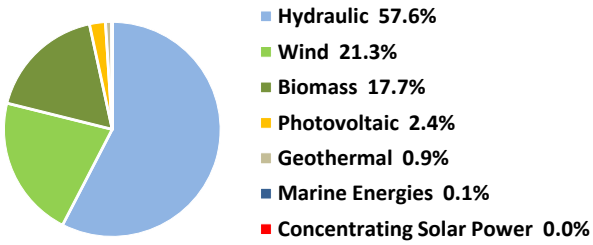
Content

I. Renewable energies in the European Union

Electricity mix (2009, Observ'ER)



Electricity mix from renewable sources (2009, Observ'ER)



- ***European Directive***

Like other major industrialized regions, the European Union primarily relies on fossil fuels to produce its electricity, though limited by the size of the nuclear power production. Since 2001, its member states have committed to reduce their dependence on fossil fuels and to develop renewable energies. The 2001/77/EC directive proposed a 22.1% indicative (non binding) share of electricity produced from renewable energy sources in total Community electricity consumption by 2010. Although this target could not be met, the European Council reaffirmed in 2007 the EU-wide commitment to develop the renewable energies and called for a mandatory target. The Directive 2009/28/EC set a more binding target of a **20% share of energy from renewable sources in the Community's gross final consumption of energy in 2020**, as well as a minimum 10% share of renewables in transport.

To take into account the different energy mix and renewable energy potential of each country, the global target has been translated into **individual targets** each state is required to reach by 2020 (ranging from 10% for Malta to 49% for Sweden). The evolution of the shares of energy from renewable sources in **gross final consumption of energy** and the levels targeted in 2020 by the countries selected in this study are as follows[1]:

	2005	2020
Germany	5.8%	**18%**
France	10.3%	**23%**
Italy	5.2%	**17%**
Spain	8.7%	**20%**
United Kingdom	1.3%	**15%**
EU-27	8.5%	**20%**

In order to achieve this objective, the member states are free to decide to which extent they wish to support renewable energies and implement **support schemes** (feed-in-tariff, subsidy, quota system, tax incentives, etc.) as well as to choose their preferred renewable energy mix, according to their own potential. Measures of cooperation between different member states allow them to trade excess renewable credits to another. Moreover, each state has to *"provide for either priority access or guaranteed access to the grid-system of electricity produced from renewable energy sources."*[2]

1 European Directive 2009/28/EC, Annex 1, National overall targets
2 European Directive 2009/28/EC, Article 16, 2 (b)

- ***Production of electricity from renewable sources***

The European Union has become the **world's largest producer** of solar and wind energy, accounting for 48.9% of the global wind power production and for 68.4% of the global solar production[3].

	1999	2006	2007	2008	2009
Total electricity production (TWh)	2 941	3 353	3 367	3 374	3 199
Wind share	0.5%	2.5%	3.1%	3.5%	4.1%
Solar share	0.0%	0.1%	0.1%	0.2%	0.5%
Renewables total share*	14.2%	15.3%	16.2%	17.4%	19.2%

*Source: Observ'ER. *renewables include geothermal, wind, biomass, solar, hydraulic and marine energies*

Note that the above displayed renewable total share in the electricity production cannot be compared with the targets set by the European directive, as these are expressed in percent of the gross final consumption of energy. Indeed, the final consumption of energy comprises not only electricity consumption (e.g. only 22% of energy consumption in France[4]) but also consumption of natural gas (21%), oil (46%), thermal energies from renewable sources (8%) and coal (3%) for transportation and heating. These values are all converted into **tons of oil equivalent (toe)** so that they can be added. The following indicator calculated by *Eurostat* for the each member country and for the European Union as a whole gives the best estimate of the fulfillment of the European requirements:

	2006	2007	2008	2009	**2020**
Share of renewables in energy consumption*	8.9%	9.7%	10.3%	11.6%	**20%**

**in tons of oil equivalent (toe), energy consumption includes electricity, transport and heat*
Source: Eurostat, provisional figures for 2009

- ***Installed capacity***

In the past few years, the installed capacity for both wind and solar power has been growing rapidly. During 2010, more renewable power capacity was installed in Europe than in any other year. However, the rise in wind power capacity experienced its first slowdown in 2010 and photovoltaic expansion has been compromised by unfavorable changes in the support schemes of several countries (tariff suspensions and/or reductions in Spain, Germany and France).

The United Kingdom and Denmark are the most active countries on the offshore wind market, while nearly all European CSP projects are built in Spain (world leading producer since July 2010).

	installed in 2008	installed in 2009	installed in 2010	**total capacity end 2010**	target for 2020**
Onshore Wind (in MW)	8 089	9 309	8 162	**81 289**	164 685
Offshore Wind* (in MW)	359	430	1 139	**3 050**	41 324
Photovoltaic (in MWp)	5 080	5 918	13 023	**29 328**	84 376
CSP (in MW)	72	201	305	**439**	7 044

*Sources: Observ'ER. *offshore wind includes nearshore and test projects*
***projections as published in the National Renewable Energy Action Plans (NREAP), source: ECN*

3 As of 2009, source: Observ'ER, Worldwide electricity production from renewable energy sources, Edition 2010
4 As stated in the 2009 French energy balance (source: Commissariat Général au Développement Durable, Chiffres clés de l'énergie, Octobre 2010)

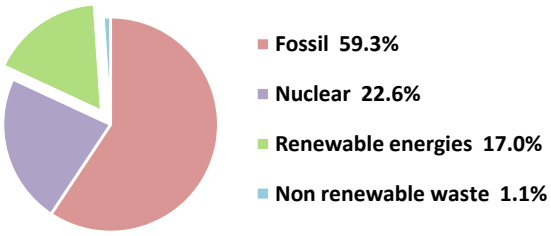
II. Country focus

II.1. Germany

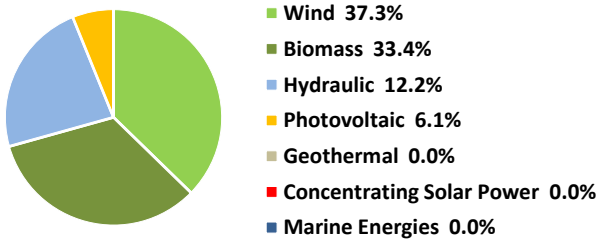
Support scheme:	
- Feed-in tariff	✓
- Premium	✗
- Quota system	✗
- Tax incentives	✗

country evaluation *(for methodology elements, please refer to page 27)*	onshore wind	offshore wind	PV
Feed-in tariffs	++	+	+
Gap to the electricity market prices	++	+	-
Quality of the resource	+	+	--
Regulatory framework	+	+	+
Stability of the support scheme	+		+
Installed capacity	++	--	+
Share of the electricity production	+	--	-

Electricity mix (2009, Observ'ER)



Electricity mix from renewable sources (2009, Observ'ER)



- ***Importance of renewable energies***

Germany has taken climate change issues very seriously and constantly invests in renewable energies, having become the European embodiment of excellence for the development of wind and solar electricity production. In 2009, Germany accounted for 14% of the world's wind electricity production, ranking second behind the USA (27%). Although it has poorer solar resource than Spain and the USA, Germany is the world's largest producer of photovoltaic electricity (second largest when including CSP, with 29% of the world solar electricity production)[5].

- ***Production of electricity from renewable sources***

Beyond the targeted share of energy from renewable sources in gross final consumption of energy set by the European directive (18% by 2020), Germany aims at producing at least 30% of its electricity from renewable sources by 2020.

	1999	2006	2007	2008	2009
Total electricity production (TWh)	556	637	637	637	597
Wind share	1.0%	4.8%	6.2%	6.4%	6.3%
Solar share	0.0%	0.3%	0.5%	0.7%	1.0%
Renewables total share*	5.8%	12.2%	14.9%	15.1%	17.0%

Source: Observ'ER. **renewables include geothermal, wind, biomass, solar, hydraulic and marine energies*

	2006	2007	2008	2009	**2020**
Share of renewables in energy consumption*	7.0%	9.1%	9.1%	9.7%	**18%**

Source: Eurostat **in tons of oil equivalent (toe), energy consumption includes electricity, transport and heat*

[5] *As of 2009, source: Observ'ER, Worldwide electricity production from renewable energy sources, Edition 2010*

- ***Installed capacity***

Wind power: In accordance with the downward trend in the global wind market, which experienced in 2010 its first slowdown in the past 20 years, the newly installed wind capacity in Germany decreased by almost 20% in 2010 compared to 2009. Many operators expressed concerns about finding **onshore areas with adequate wind resources**, as well as new sources of funding. Therefore, the offshore wind market will become a major growth driver, since it started up in 2009 with the connection of the 60 MW Alphas Ventus wind farm to the grid. Further growth potential comes from the replacement of elder turbines ("repowering"), which will require large investments from 2015 onwards.

Solar power: In spite of the successive reductions of feed-in tariffs for photovoltaic power *(see below)*, Germany had a record year regarding installation of new PV-capacity in 2010. The significant fall in PV manufacturing costs supported the strong growth experienced in 2009 and 2010. Note that because of the poor concentrating solar resource in Germany, the government does not promote this energy source. The only German CSP-project (1.5 MW) was exclusively built for research purpose.

	installed in 2008	installed in 2009	installed in 2010	**total capacity end 2010**	target for 2020**
Onshore Wind (in MW)	1 660	1 857	1 443	**27 034**	35 750
Offshore Wind* (in MW)	5	60	108	**180**	10 000
Photovoltaic (in MWp)	1 814	3 940	7 411	**17 370**	51 750
CSP (in MW)	2	-	-	**2**	0

*Sources: Observ'ER. *offshore wind includes nearshore and test projects*
***projections as published in the National Renewable Energy Action Plans (NREAP), source: ECN*

- ***Support scheme***

Germany's public support scheme is organised by the Renewable Energy Sources Act *("Erneuerbare-Energien-Gesetz" or "EEG")*. It mainly relies on a **feed-in tariff**, which the grid operator has to pay to the producer of electricity from renewable sources.

- ***Funding***

An equalisation scheme allows grid operators and utilities to pass through the additional costs arising from electricity produced by renewable energy sources to the final customers.

- ***Recent changes in the regulatory framework***

Since it was laid down in 2000, the EEG has been amended twice, in 2004 and 2009. The photovoltaic industry has experienced several substantial reductions of the feed-in tariffs in the past two years, as well as their suppression for PV-plants built on arable land. Indeed, in order to reflect the significant decreases in the construction costs of the PV-modules and to guarantee the sustainability of the support scheme, Germany decided not only to introduce a degression mechanism in the EEG, but also to substantially lower the tariffs twice by way of exception in 2010. The mechanism provides for a tariff reduction depending on the capacity newly installed in the past year: every autumn, the Federal Network Agency ("Bundesnetzagentur" or "BNA") fixes the tariffs which will be applicable in the following year.

- ***Feed-in tariffs***

As mentioned above, the tariffs set by law are subject to **degressions** depending on the year of commissioning. As the feed-in tariffs are calculated with regard to the constructing and operating costs of the plants, this gradual reduction by a fixed percentage each year guarantees the cost-effectiveness of the support scheme and gives an incentive for operators to reduce construction costs by technical progress. The term of the purchase obligation is usually 20 years, with tariffs and eligibility criteria depending on the source of energy:

	Onshore wind	**Offshore wind**	**Photovoltaic**
Price (€cent/kWh)	• **9.02** (for at least 5 years after commissioning[1], 5.02 afterwards)	• **13.0** (for at least 12 years after commissioning[2], 3.5 afterwards)	• **21.11** (greenfield site) • **22.07** (conversion site[3]) • 21.56-28.74 (building-integrated)
Bonus	+ 0.5 ct/kWh when satisfying special system requirements and commissioned prior to 1.1.2014	+ 2 ct/kWh if commissioned prior to 1.1.2016	
Degression	1% each year from 2009 onwards	5% each year from 2015 onwards	variable (set by law each year depending on the PV-capacity installed the year before)
Term	20 years	20 years	20 years

[1] *term of extension is subject to the respective proceeds.* [2] *term of extension is subject to distance and water depth.* [3] *former military or industrial areas*

The record of new photovoltaic modules installation in 2010 in spite of the substantial tariff drops led the BNA to fix the degression rate for 2011 at 13%, thus decreasing the feed-in tariff for PV-plants on greenfield site to 21.11 €ct./kWh.

Commisioning	Tariffs
2009	31.94
2010	28.43
from July 2010	25.02
from Oct. 2010	24.26
from Jan. 2011	**21.11**

- ***Grid connection***

The EEG also guarantees system operators of renewable energies the preferential connection to the grid, as well as preferential transmission and distribution of the electricity produced. Upon request, grid operators are obliged to optimise and expand the grid in accordance with the best available technology.

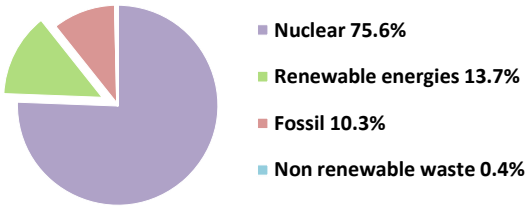
II.2. France

Support scheme:

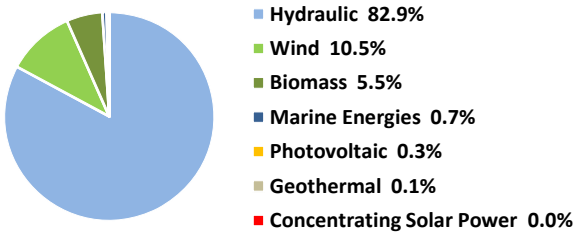
- Feed-in tariff ✓
- Premium ✗
- Quota system ✗
- Tax incentives ✓

country evaluation (*for methodology elements, please refer to page 27*)	onshore wind	offshore wind	PV	CSP
Feed-in tariffs	+	+	-	++
Gap to the electricity market prices	+	-	-	--
Quality of the resource	+	+	+	-
Regulatory framework	-	-	-	+
Stability of the support scheme	-		-	+
Installed capacity	-	--	-	--
Share of the electricity production	-	--	--	--

Electricity mix (2009, Observ'ER)



Electricity mix from renewable sources (2009, Observ'ER)



- ***Importance of renewable energies***

Since the oil crises in the 70's, France has been mainly relying on nuclear energy to produce electricity. On the one hand, it has the highest share of nuclear energy (75.6%) in its electricity mix in Europe; on the other hand, fossil fuels account for only 10% of the country's electricity production, which is far below the levels seen in most industrialised countries (69.3% in the USA, 59.3% in Germany[6]) and contributes to limit carbon emissions. This explains France's historical little interest for renewable energies. However, the ambitious target set by the European Directive encouraged the government to establish a favourable regulatory framework to promote production of electricity from renewable sources.

- ***Production of electricity from renewable sources***

Although France lags behind its European neighbours regarding the development of wind and solar energy, renewable energies already account for 13.7% of the electricity produced, thanks to hydroelectricity with around 2 100 hydro power plants[7]. To take into account its high wind, solar and hydraulic potentials, France was assigned a higher target under the European Directive.

	1999	2006	2007	2008	2009
Total electricity production (TWh)	526	575	570	575	542
Wind share	0.0%	0.4%	0.7%	1.0%	1.4%
Solar share	0.0%	0.0%	0.0%	0.0%	0.0%
Renewables total share*	15.2%	11.8%	12.7%	13.7%	13.7%

*Source: Observ'ER. *renewables include geothermal, wind, biomass, solar, hydraulic and marine energies*

	2006	2007	2008	2009	**2020**
Share of renewables in energy consumption*	9.6%	10.2%	11.0%	12.4%	**23%**

*Source: Eurostat *in tons of oil equivalent (toe), energy consumption includes electricity, transport and heat*

[6] *As of 2009, source : Observ'ER, Worldwide electricity production from renewable energy sources, Edition 2010*
[7] *Note that the renewal of the concession contracts for 49 large hydro power plants will be called for tender from 2011 onwards*

- ***Installed capacity***

Wind power: France is said to have the second best wind resource in Europe, after the United Kingdom. However, the installed capacity remains low and has been steadily growing by only 1 000 MW in the past three years. The expected growth momentum was destabilised by the enactment of the less favourable "Grenelle II Law" in July 2010 *(see below)*.

After several postponements, the French tender for offshore wind farms was finally announced in January 2011 (for issuance in Mai 2011). The first segment of this two-step tender accounts for 3 000 MW, to be built on five selected areas. However, construction is not expected to start prior to 2015. Note that as the ocean floor sharply drops off when moving away from the coast, the offshore conditions in France are not as favourable as in the North Sea.

Solar power: France is currently making up for its late start with dramatic annual growth rates of newly installed PV-capacity. With 1 054 MW installed at the end of 2010 and an estimated capacity of 4 000 MW of applications in the waiting line, France's PV-installation target for 2020 could have already been achieved in the near term. However, the fear of a speculative bubble led the government to suspend the power purchase obligation for 3 months from December 2010 and to introduce, among other measures *(see below)*, an annual cap of 500 MW for new installations (of which 200 MW for ground-based PV-plants). Considering the applications which came before the suspension, the PV-capacity is expected to rise by 1 000 to 1 500 MW in 2011 and 2012. Regarding concentrating solar power, France's potential is very limited and only few prototypes have been built so far.

	installed in 2008	installed in 2009	installed in 2010	**total capacity end 2010**	target for 2020**
Onshore Wind (in MW)	949	979	1 034	**5 660**	19 000
Offshore Wind* (in MW)	-	-	-	**-**	6 000
Photovoltaic (in MWp)	63	221	719	**1 054**	4 860
CSP (in MW)	-	-	-	**-**	540

*Sources: Observ'ER. *offshore wind includes nearshore and test projects*
***projections as published in the National Renewable Energy Action Plans (NREAP), source: ECN*

- ***Support scheme***

The development of renewable energies is supported by the French Electricity Act (*"Loi n°2000-108")*. The historical, state-owned electricity supplier *Electricité de France (EDF)* and the private electricity distributors are obliged to purchase electricity produced from renewable energies at a preferential tariff. Beside the **feed-in tariffs** set by the Ministry of Energy, France's support scheme also includes **tender processes** and tax incentives.

- ***Funding***

The additional costs arising for the electricity suppliers, who have to pay the feed-in tariffs, are passed through to the customers with the payment of a dedicated tax *("Contribution au Service Public de l'Electricité")*. This tax is expected to increase from 2015 onwards to finance onshore wind energy.

- ***Recent changes in the regulatory framework***

France's support scheme has been relatively unstable in the past few years, slowing down the growth momentum for renewable energies.

Onshore-wind: The *"Grenelle II Law"* enacted in July 2010 tightened the requirements to build onshore wind installations: wind farms must comprise at least 5 turbines, be located in dedicated authorised areas *("Zones de Développement de l'Eolien terrestre")*, at least 500 meters away from residential areas, and comply with the environmental regulations for classified installations *("ICPE")*, which regulate the construction of environmentally unfriendly installations.

Photovoltaic: As mentioned above, the French government had to temporarily suspend the power purchase obligation in December 2010, in order to save the sustainability of the support scheme and to limit the financial burden of renewable energies for the customers. The new support scheme finally announced by the government in March 2011 differentiates between small installations and larger ones:

(i) Building-integrated PV-modules with a total capacity not exceeding 100 kWc will still benefit from feed-in tariffs. These have been substantially cut (-20% on average compared to 2010) and a degression mechanism has been implemented, leading to quarterly tariff reductions depending on the newly installed capacity

(ii) Larger building-integrated installations and ground-based PV-plants will be awarded through a tender process, in which system operators will compete on the feed-in tariff they propose. The first invitations to tender are expected during the summer 2011.

- ***Feed-in tariffs***

The tariffs are fixed with regard to the actual construction and operating costs supported by renewable energy producers. They benefit from an indexation mechanism taking into account the evolution of labour costs and production prices. As the actual feed-in tariff for offshore wind farms is too low to be viable, the oncoming 3 000 MW tender will award the best bidder with a special feed-in tariff. Note that the feed-in tariffs displayed below tend to become less important, as the French government now prefers tender processes to award the projects.

	Onshore wind	Offshore wind	Photovoltaic	CSP
Price (€cent/kWh)	• **8.2** (for at least 10 years[1]) • 11.0 (overseas departments) • Tenders	• **Tenders** • 13.0 (for at least 10 years[1])	• **Tenders** • 12.0 (ground-based plants[2]) • 28.8-46.0 (building-integrated)	• **Tenders** • 32.8
Bonus	partly inflation-indexed	partly inflation-indexed	partly inflation-indexed	
Degression	variable (indexation coefficient adjusted every year)	variable (indexation coefficient adjusted every year)	variable (set every 4 months depending on the newly installed PV-capacity)	
Term	15 years	20 years	20 years	20 years

[1] *the tariff in the extension period is subject to the respective proceeds and can be reduced up to 2.8 €ct./kWh* [2] *up to 12 MW*

- ***Tax incentives***

The above-mentioned tax incentives tend to be reduced. The tax credit for individuals, who could deduct a given percentage of expenses for renewable energy installations from their income tax, was withdrawn in 2011. Installations producing solar energy are exempted from land tax.

- ***Grid connection***

Although the connection to the grid is guaranteed by law, as grid operators are obliged to provide an access without discrimination against the system operators, producers of electricity from renewable sources do not benefit from priority access.

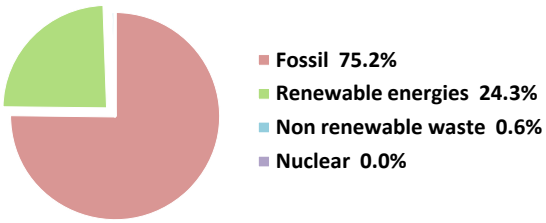
II.3. Italy

Support scheme:

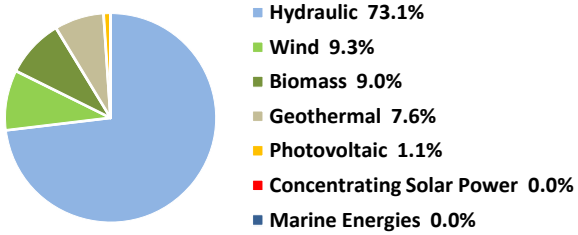
- Feed-in tariff ✓
- Premium ✓
- Quota system ✓
- Tax incentives ✓

country evaluation (for methodology elements, please refer to page 27)	onshore wind	offshore wind	PV	CSP
Feed-in tariffs			++	++
Gap to the electricity market prices			-	-
Quality of the resource	-	-	++	+
Regulatory framework	+	-	+	+
Stability of the support scheme	-		-	+
Installed capacity	+	--	+	--
Share of the electricity production	-	--	--	--

Electricity mix (2009, Observ'ER)



Electricity mix from renewable sources (2009, Observ'ER)



- ***Importance of renewable energies***

Beside its strong reliance on fossil fuels, it is noteworthy that Italy has to import more than 86% of its total energy consumption, 15% thereof electricity[8], due to a lack of natural resources and of electricity generation capacities. Thus, the country is currently eager to promote renewable energies in order to reduce its high dependence on imported fossil fuels and electricity. Energy producers are urging the government to increase financial incentives and to simplify administrative procedures in order to speed up the development of renewable energies.

- ***Production of electricity from renewable sources***

Although Italy produces almost one fourth of its electricity from renewable energies, their share in the country's final energy consumption lags behind its European neighbours. Italy is one the few European countries which predicted in their National Renewable Energy Action Plan a deficit with regards to the target assigned by the European directive. Indeed, according to the forecasts of the national energy market operator (GME), Italy will have to import 4 million tons of oil equivalent of green energy (28% thereof electricity) in order to meet its 17% target in 2020[9].

	1999	2006	2007	2008	2009
Total electricity production (TWh)	265	313	313	318	289
Wind share	0.2%	1.0%	1.3%	1.5%	2.2%
Solar share	0.0%	0.0%	0.0%	0.1%	0.3%
Renewables total share*	21.8%	18.2%	17.1%	20.0%	24.3%

*Source: Observ'ER. *renewables include geothermal, wind, biomass, solar, hydraulic and marine energies*

	2006	2007	2008	2009	**2020**
Share of renewables in energy consumption*	5.3%	5.2%	6.8%	7.8%	**17%**

*Source: Eurostat *in tons of oil equivalent (toe), energy consumption includes electricity, transport and heat*

[8] *Source: Eurostat, Panorama of Energy, 2009 Edition*
[9] *See Italian National Renewable Energy Action Plan: 0,85% will come from the European cooperation mechanism*

- ***Installed capacity***

Wind power: After two years of strong growth in 2008 and 2009 stimulated by an attractive support mechanism, the decrease in the value of green certificates and the uncertainty about the upcoming change in the regulatory framework (see below) slowed down new installations in 2010.

Solar power: The photovoltaic electricity production capacity of Italy increased by 200% in 2010. According to EurObserv'ER, when taking into account the PV-plants not connected to the grid yet but already installed in large numbers in 2010 due to the high feed-in premiums under the "Conto energia II" (see below), the country may already reach its 2020 target in 2011.

Italy's first CSP-plant, an innovating 5 MW parabolic collector located in Sicily, was commissioned in 2010.

	installed in 2008	installed in 2009	installed in 2010	**total capacity end 2010**	target for 2020**
Onshore Wind (in MW)	1 010	1 114	899	**5 797**	12 000
Offshore Wind* (in MW)	-	-	-	**-**	680
Photovoltaic (in MWp)	338	699	2 321	**3 479**	8 000
CSP (in MW)	-	-	5	**5**	600

*Sources: Observ'ER. *offshore wind includes nearshore and test projects*
***projections as published in the National Renewable Energy Action Plans (NREAP), source: ECN*

- ***Support scheme***

Italy's support scheme for wind energy consists of a **quota system** with green certificates ("certificate verdi"), obliging not only producers but also importers of electricity to provide evidence that a certain quota (6.8% in 2010, 7.55% in 2012) of electricity comes from renewable sources. A **feed-in tariff** was also introduced for small capacity power plants operating after December 2007, as an alternative to the green certificates. To be eligible, the capacity of wind installations must not exceed 0.2 MW (30 €ct./kWh for 15 years).

Solar energy is exclusively promoted by a **premium tariff**, providing a bonus of the market price of electricity. This incentive scheme created in 2007 is currently regulated under the "Conto Energia III", which was enacted in August 2010.

- ***Funding***

The additional costs arising for electricity producers and importers are borne by the customers through a higher market price.

- ***Expected changes in the regulatory framework***

Note that Italy's support scheme is currently **under review** and a new regulatory framework is expected this year. The new decree transposing the European Directive 2009/28/CE, which sets the renewable energy targets for each member country, is currently being discussed. The financial incentives for photovoltaic are expected to be reduced[10], for instance with the implementation of tender processes for larger PV-plants (> 5 MW). The quota system may be gradually replaced by a feed-in tariff system similar to the "Conto Energia".

[10] *See "Italy: update on the legislative framework affecting solar plants", Clifford Chance, January 2011*

- ***Renewable Energy Certificates (RECs)***

The injection of green electricity into the grid is rewarded with the issuance of **green certificates for 15 years** by GSE (Gestore dei Servizi Elettrici). These may be traded at both national and international levels. GME (Gestore dei Mercati Energitici) organizes and manages the Green Certificates Market, where producers showing a deficit can purchase RECs once a week. GSE acts as market regulator and can purchase excess certificates or issue and sell additional ones. Producers failing to meet their requirements are subject to sanctions. The number of RECs obtained for each MWh of electricity produced is as follows:

Green Certificate Banding	Onshore wind **1** REC/MWh	Offshore wind **1.5** REC/MWh

- ***Feed-in premium***

The regulatory framework for photovoltaic electricity has been rapidly evolving since the implementation of the "Conto Energia" incentive scheme in 2005. It started with the Ministerial Decrees 28/07/2005 and 06/02/2006 (Conto Energia I), then amended by MD 19/02/2007 (Conto Energia II). The requirements and the lower feed-in premiums applying to plants starting operations from January 2011 are set by MD 06/08/2010 (Conto Energia III). The decree distinguishes between six different categories of power capacity (ranging from 1 kW to above 5 MW), each benefiting from a different premium depending on whether they are building-integrated or not.

Regarding CSP, the premium granted to plants commissioned from January 2013 to December 2014 will be increased by 2% each year following 2008. Hybrid CSP-plants are also eligible for the feed-in premiums, but the level of incentive varies according to the fraction of non solar electricity generation of the plant.

Note that the national electricity production capacity benefiting from the premium is capped at 3 000 MW for PV-plants, 300 MW for building-integrated modules with innovative characteristics and 200 MW for CSP-plants.

	Photovoltaic	**CSP**[1]
Premium (€ct./kWh)	• **market price +** capactity > 5 MW: **33.3** (on buildings) **29.7** (others) 1 kW - 5 MW: 35.1 - 40.2 (on buildings) 31.3 - 36.2 (others)	• **market price + 28.0** (for a solar fraction of the plant > 85%)
Term	20 years	25 years

[1] *capturing surface must exceed 2 500 m²*

- ***Tax incentives***

The construction of wind and solar plants is also promoted, among other fiscal regulation mechanisms, through a reduced VAT rate on deliveries and services (10% instead of 20%).

- ***Grid connection***

In Italy, electricity producers from renewable sources benefit from priority access to the grid, must be connected without delay (subject to legal proceedings and financial compensation in case of delays) and are given priority dispatch of the electricity produced. Besides, the "net metering" allows small scale producers to feed into the power grid a part of the electricity they generate but do not consume, receiving an electricity credit which can be used at a different time.

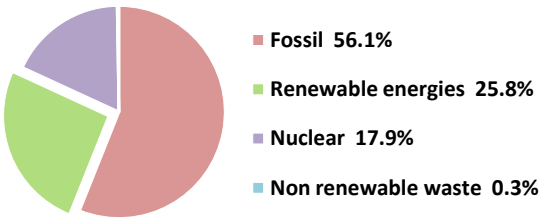
II.4. Spain

Support scheme:

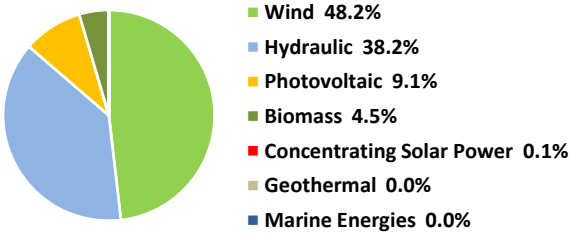
- Feed-in tariff ✓
- Premium ✓
- Quota system ✘
- Tax incentives ✓

country evaluation *(for methodology elements, please refer to page 27)*	onshore wind	offshore wind	PV	CSP
Feed-in tariffs	+		-	+
Gap to the electricity market prices	++		-	--
Quality of the resource	+	-	++	+
Regulatory framework	-	-	-	+
Stability of the support scheme	-		--	-
Installed capacity	++	--	+	-
Share of the electricity production	++	--	+	--

Electricity mix (2009, Observ'ER)



Electricity mix from renewable sources (2009, Observ'ER)



- ***Importance of renewable energies***

Spain can be considered as the European pioneers for renewable energies, starting to promote their development shortly after the second oil crisis with the enactment of Law 82/1980 on energy conservation. The 2000-2010 Plan for the Promotion of Renewable Energies already included a target for the share of renewable energies in Spain's power consumption. As a consequence of its efforts, Spain has not only become the **global leader for solar electricity production** (32% of the world production in 2009[11]), but also has the fourth largest installed wind capacity in the world (second largest in Europe).

- ***Production of electricity from renewable sources***

Renewable Energies Electricity produced from renewable sources is now the number two power source in Spain, accounting for slightly more than one fourth of the country's total production. With 2.4%, Spain has by far the highest share of solar power in its electricity mix. The country seems to be well positioned to reach the target set by the European directive.

[11] *Source : Observ'ER, Worldwide electricity production from renewable energy sources, Edition 2010*

	1999	2006	2007	2008	2009
Total electricity production (TWh)	209	299	305	314	295
Wind share	1.3%	7.8%	9.0%	10.3%	12.4%
Solar share	0.0%	0.0%	0.2%	0.8%	2.4%
Renewables total share*	14.3%	18.7%	20.3%	20.4%	25.8%

*Source: Observ'ER. *renewables include geothermal, wind, biomass, solar, hydraulic and marine energies*

	2006	2007	2008	2009	**2020**
Share of renewables in energy consumption*	9.1%	9.6%	10.7%	13.0%	**20%**

*Source: Eurostat *in tons of oil equivalent (toe), energy consumption includes electricity, transport and heat*

- ***Installed capacity***

Wind power: In 2010, the contraction of the Spanish wind market was relatively severe, with 38% fewer installations of new production capacity than in 2009. The main explanation lies in the implementation of the new administrative procedures in 2009, detailed hereafter. The roadmap decided by the government limits the new capacity to 3 000 MW in total for 2011 and 2012[12]. Note that the first offshore project (Zèfir Test Station) is not expected to be launched before 2012.

Solar power: Supported by high feed-in tariffs for large installations, constantly falling PV-module prices and financial optimism, the Spanish PV-market boomed in 2008: the capacity installed in that year (2 687 MW) increased by 350% compared to 2007, largely surpassing the national target of 400 MW in 2010. In order to put an end to this uncontrollable progression and to limit the costs of renewable energies in context of the economic crisis, the government slashed the tariffs (see below) and introduced an annual cap of 500 MW. As a consequence, the Spanish market collapsed in 2009.

Regarding concentrating solar power ("CSP"), Spain is the only significant market in Europe, thanks to its superior solar resource. In July 2010, the country has even become the world leader for CSP with 432 MW connected to the grid (mainly parabolic trough receivers), compared to 422 MW in the USA. The know-how accumulated by Spanish developers allow them to conduct projects worldwide and thus to mitigate the impact of the recent regulatory changes on the domestic market.

	installed in 2008	installed in 2009	installed in 2010	**total capacity end 2010**	target for 2020**
Onshore Wind (in MW)	1 609	2 459	1 516	**20 676**	35 000
Offshore Wind* (in MW)	-	-	-	**-**	3 000
Photovoltaic (in MWp)	2 687	17	370	**3 808**	8 367
CSP (in MW)	70	201	300	**582**	5 079

*Sources: Observ'ER. *offshore wind includes nearshore and test projects*
**projections as published in the National Renewable Energy Action Plans (NREAP), source: ECN*

- ***Support scheme***

The promotion of renewable energies in Spain is organised under the Special Regime *("Régimen especial")*, as opposed to the ordinary regime applicable to conventional power plants. It is regulated by the Royal Decrees 661/2007 and 1578/2008 (recently amended by RD 1614/2010, 1565/2010 and 14/2010, see below), which set the power purchase obligation for distributors and the remuneration mechanism. Electricity producers from renewable sources can choose between selling their production to the distributor at a **regulated tariff** or selling it on the energy market, then receiving the negotiated market price plus a complementary **premium** (subject to a lower and an upper limit).

[12] *Source: EurObserv'ER, Wind Power Barometer, The journal of renewable energies, n°201, February 2011*

- ***Funding***

The major concern regarding Spain's support scheme is that the additional costs of renewable energies are **not passed through to the customers,** resulting in an accumulated **electricity tariff deficit** for Spanish utilities estimated at €16.5 billion. Indeed, because customers are currently paying electricity at a lower price than it really costs, utilities have to book a provision amounting to the difference, while expecting regulated electricity prices to be increased by law in the future. Establishing urgent measures to correct this tariff deficit is actually a priority for the Spanish government.

- ***Recent changes in the regulatory framework***

Spain has had difficulties to channel the rapid development of renewable energies in the past few years and could not prevent the formation of a speculative bubble in the photovoltaic industry. This led the government to act firmly with several substantial tariff cuts and the tightening of the regulatory framework. Although similar measures had to be implemented in other major European countries to control a booming market, the relatively heavy restrictions imposed in Spain significantly slowed down the wind market and led to the collapse of the PV-market.

Onshore-wind: As mentioned above, in November 2009, the Spanish government decided to control the growth of the domestic market by implementing new administrative procedures: new wind farms have to be approved as part of the pre-allocation register establishing a roadmap of installed capacity for the coming years. Besides, RD 1614/2010 limited the number of equivalent hours of operation which can benefit from the premium (2 589 hours/year) as well as a temporary reduction of the premium by 35% in 2011 and 2012 (for those producers which opted for the premium system).

Photovoltaic: The PV-industry had to deal with several severe changes in the regulatory framework, bearing most of the efforts to reduce the above mentioned **electricity tariff deficit**. As a consequence of the extraordinary progression of ground-based PV-plants in 2008, supported by attractive feed-in tariffs, the government decided to redirect the support scheme towards building-integrated PV-modules ("Type I") and slash the subsidies for large PV-plants ("Type II"). Major measures include:

(i) Limitation of the period benefiting from the regulated tariff (25 years under RD 1565/2010, then extended to 30 years in March 2011).

(ii) RD 1565/2010 decreased the regulated PV-tariffs for all future applications for the annual calls recorded at the "Remuneration Pre-Assignment Registry". Tariffs are cut by 45% for ground-based PV-plants ("Type II"), by 25% for large building-integrated installations ("Type I.2") and by 5% for smaller roof installations ("Type I.1").

(iii) The heavily-criticized RD 14/2010 imposed a **retroactive** limit on the number of equivalent hours of operation which can benefit from the regulated tariff (1 250 hours/year until 31 December 2013 for non-tracking PV-installations, then the limit will vary from 1 232 to 1 753 hours/year depending on in which of the five climatic zones the plant is located). Note that the Decree is **still in dispute** (turbulent legislative process with disagreement of the senate, arguments of unconstitutionality, demonstrations, etc.)

Concentrating Solar Power: RD 1614/2010 imposed on operators of CSP-plants to sell the electricity produced to the regulated tariff during the first year of operation. The number of equivalent hours of operation entitled to the premium has also been limited, depending on the technology used by the plant (Parabolic cylinder, Tower, Fresnel, etc.)

- ***Feed-in tariffs and premiums***

The actual regulated tariffs and premiums are as follows. Note that installations with a capacity exceeding 50 MW have to negotiate the price at which they sell electricity directly on the market, without benefiting from any premium.

	Onshore wind	Photovoltaic	CSP
Regulated tariff (€ct./kWh)	• **7.3** (for the first 20 years[1], 6.1 afterwards)	• **17.6** (Type II) • **24.0** (Type I.2)	• **26.9** (for the first 25 years[3], 21.5 afterwards)
Premium (€ct./kWh)	• **market price + 2.9** (for 20 years only) cap: 8.5 / floor: 7.1		• **market price + 25.4** (for the first 25 years, + 20.3 afterwards) cap: 34.4 / floor: 25.4
Annual limitation of the hours of operation	2 589 h	1 250 h until Dec. 2013[2] then 1 232-1 753 h (5 zones)	2 350 - 6 450 h (depending on the technology)
Term	permanent	30 years	permanent

[1] *reduced by 35% from 01.2011 to 12.2012* [2] *for non-tracking installations* [3] *the regulated tariff is mandatory for the first year*

- ***Grid connection***

Producers of electricity from renewable energies benefit from priority connection to and usage of the grid. RD 14/2010 recently imposed a toll for grid access and electricity transport and distribution (€0.5/MWh) on electricity producers (regulated under both special and ordinary regimes).

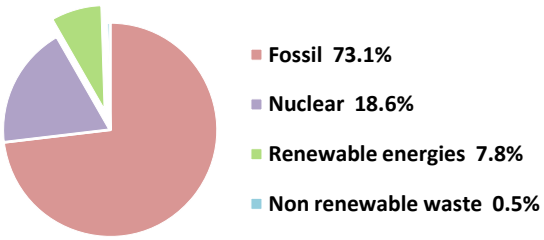
II.5. United Kingdom

Support scheme:

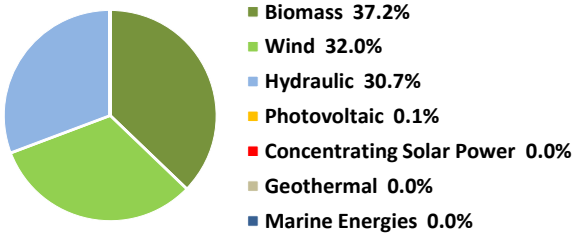
- Feed-in tariff ✓
- Premium ✘
- Quota system ✓
- Tax incentives ✓

country evaluation *(for methodology elements, please refer to page 27)*	onshore wind	offshore wind	PV
Feed-in tariffs			
Gap to the electricity market prices			
Quality of the resource	++	++	--
Regulatory framework	+	++	+
Stability of the support scheme	+	+	+
Installed capacity	+	-	--
Share of the electricity production	-	--	--

Electricity mix (2009, Observ'ER)



Electricity mix from renewable sources (2009, Observ'ER)



- ***Importance of renewable energies***

With a cumulated share of fossil and nuclear electricity above 92%, the United Kingdom is one of the European countries with the strongest dependence on conventional energies for electricity production.

Therefore, the British government has shown a strong commitment to change for a low carbon economy. The Climate Change Act 2008 set binding targets for the reduction of greenhouse gas emissions well above the objectives of the Kyoto agreement: -34% for 2020 and -80% for 2050 (compared to the 1990 level).

- ***Production of electricity from renewable sources***

In order to meet the target set by the European Directive in terms of renewable energies in the final energy consumption, the government estimates that the UK will have to generate as much as 30% of its electricity from renewable sources[13]. This requires speeding up the development of green electricity generation capacities. Note that although the UK lagged behind its European neighbours regarding their share of renewable energies when the targets were fixed under the European Directive, it was assigned a relatively high target for 2020, taking into account the UK's superior wind potential. Indeed, its shore benefits not only from high average wind speed, but also from relatively good wind predictability and low variability, thus guaranteeing high number of full load hours.

	1999	2006	2007	2008	2009
Total electricity production (TWh)	368	398	397	389	373
Wind share	0.2%	1.1%	1.3%	1.8%	2.5%
Solar share	0.0%	0.0%	0.0%	0.0%	0.0%
Renewables total share*	3.4%	5.5%	5.9%	6.6%	7.8%

*Source: Observ'ER. *renewables include geothermal, wind, biomass, solar, hydraulic and marine energies*

	2006	2007	2008	2009	**2020**
Share of renewables in energy consumption*	1.5%	1.7%	2.2%	2.9%	**15%**

*Source: Eurostat *in tons of oil equivalent (toe), energy consumption includes electricity, transport and heat*

- ***Installed capacity***

Wind power: Although the United Kingdom benefits from the best wind resource in Europe, it only has the fifth largest installed wind capacity, far behind Spain and Germany. Nevertheless, the UK is a pioneer of the offshore wind market (together with Denmark). With 1 341 MW of installed offshore capacity, which represents one quarter of its total wind capacity, the UK is the global leader on the offshore wind market. The significant pipeline of projects either in construction or already approved will consolidate its leadership on this market.

Solar power: The UK's relatively poor solar resource limits the development of photovoltaic electricity generation. However, the southern quarter of the island, particularly Cornwall, benefits from acceptable solar conditions. The government logically decided to promote small building-integrated installations rather than larger ground-based PV-plants. The feed-in tariff introduced in 2010 (see below) should stimulate this market and help the UK to meet its target of 2 680 MW in 2020.

	installed in 2008	installed in 2009	installed in 2010	**total capacity end 2010**	target for 2020**
Onshore Wind (in MW)	869	645	780	**5 204**	14 890
Offshore Wind* (in MW)	182	102	653	**1 341**	12 990
Photovoltaic (in MWp)	4	7	45	**75**	2 680
CSP (in MW)	-	-	-	**-**	0

*Sources: Observ'ER. *offshore wind includes nearshore and test projects*
**projections as published in the National Renewable Energy Action Plans (NREAP), source: ECN*

[13] *Together with a target of 11% of renewable energies for heating and 10% for transports*

- ***Support scheme***

The support scheme for renewable energies in the United Kingdom is mainly based on a **quota system**. Under the Renewables Obligation Order, which came into effect in April 2002[14], electricity suppliers registered in England, Wales, Scotland and Northern Ireland are required to source an increasing percentage of their electricity from renewable sources (from 3% in 2003 to 15.4% in 2015). In order to meet their obligations, electricity suppliers have to present green certificates called **Renewables Obligation Certificates** ("ROCs", *see below*) to the regulatory bodies (Ofgem, or Ofreg in Northern Ireland).

- ***Funding***

The additional costs of the quota system arising for electricity suppliers are passed through to the final customers by adding it on their electricity bill.

- ***Renewables Obligation Certificates (ROCs)***

ROCs are issued to energy producers generating green electricity in the United Kingdom. The number of ROCs awarded for each eligible Megawatt hour (MWh) generated varies depending on the technology used ("banding"):

Green Certificate Banding	Onshore wind **1** ROC/MWh	Offshore wind **2** ROCs/MWh	Photovoltaic **2** ROCs/MWh

ROCs are **tradable** and can be bought by suppliers showing a deficit on "e-ROC" (on-line auctions), thus generating additional revenue for electricity producers from renewable energies. Electricity suppliers may also meet their quota requirement by paying a **penalty** to Ofgem. This "buy-out" payment, actually amounting to £36.99/MWh, is updated annually to reflect changes in the Retail Prices Index. The proceeds are distributed to suppliers in proportion to the number of ROCs they present.

- ***Feed-in tariffs***

In order to accelerate the development of renewable energies in the UK, in April 2010, the government introduced a feed-in tariff applying to **small-scale** installations (< 5 MW). Under this new scheme designed for households, suppliers are required to pay a generation tariff to "microgenerators", plus an export tariff if the electricity is exported to the grid. The tariffs (29.3 p/kWh for PV and 4.5 p/kWh for wind) are inflated annually and granted for 20 (wind) or 25 years (PV).

- ***Expected changes in the regulatory framework***

The support scheme promoting renewable energies in the United Kingdom is currently under review[15]. The Electricity Market Reform, which is expected in 2013, should confirm the **transition from a quota system to a feed-in tariff system**. Learning from the experience of the Spanish premium-based scheme and the German fixed tariff, the United Kingdom is likely to choose another feed-in tariff system to guarantee the level of revenue for developers: it should be based on a **contract for difference** with

[14] *In April 2005 for Northern Ireland*
[15] *See "Energy Market Reforms – A major new consultation package", Clifford Chance, December 2010*

variable payments based on average market prices (i.e. amounting to the difference between the tariff negotiated in the tender process and the wholesale electricity prices.)

Projects currently operated under the RO scheme will continue to be awarded with ROCs. The government intends to maintain the renewables obligation for suppliers until 2037. Developers of new projects may be able to choose between both systems until 2017. From 2017 onwards projects would be eligible for feed-in tariffs only. Note that nuclear energy would also benefit from the new feed-in tariff system, as it is a carbon-free technology.

- ***Tax incentives***

Companies generating electricity from renewable sources are exempt from paying the Climate Change Levy, which is a tax paid by suppliers of conventional electricity and passed through to the final customers.

- ***Grid connection***

Electricity producers using renewable energy sources do not benefit from any priority connection to the grid.

III. European analysis

III.1. Production of electricity from renewable sources

- ***Wind power***

In 2009, almost half of the world's wind energy production was generated in the European Union (48.9%), which also accounted for 48.1% of the installed generation capacity, far ahead of the United States of America (22.1%) and China (16.2%)[16]. However, the Asian market is growing extremly fast, representing half of the new installations in 2010. The most striking example is that at the end of 2010 China became the global leader with 42 287 MW of wind power generation capacity, thus surpassing Spain, Germany and even the US. In terms of production and capacity per inhabitants, European pioneers Germany and Spain keep their lead.

	Production capacities		Production	Share of world
	MW	kW per 1000 inhab.	TWh	production
United States	35 086	**113**	71.2	26.5%
Germany	25 719	**314**	37.8	14.1%
Spain	19 160	**414**	36.6	13.7%
China	25 805	**19**	27.8	10.4%
United Kingdom	4 424	**72**	9.3	3.5%
France	4 626	**74**	7.8	2.9%
Italy	4 898	**81**	6.5	2.4%

Figures for 2009. Source: Observ'ER

[16] *Source: EurObserv'ER, Wind Power Barometer, The journal of renewable energies, n°201, February 2011*

- ***Solar power***

In 2009, global leaders Spain and Germany accounted together for 61% of the world's solar production (including both photovoltaic and concentrating solar power). It is noteworthy that thanks to its superior solar resource, Spain produced sligthly more solar electricity in 2009 than Germany, altough its solar power production capacities represent only a bit less than 40% of Germany's ones.

	Production capacities		Production	Share of world
	MW	kW per 1000 inhab.	TWh	production
Spain	3 720	**80**	6.9	32.1%
Germany	9 959	**121**	6.2	28.9%
United States	1 992	**6**	2.4	11.3%
Italy	1 157	**19**	0.8	3.5%
China	300	**0**	0.2	1.0%
France	335	**5**	0.2	1.0%
United Kingdom	30	**0**	0.0	0.0%

Figures for 2009. Source: Observ'ER

- ***European target***

While Sweden has already reached its targeted share of 49% of renewable energies in gross final energy consumption, there is still uncertainty about whether all countries reviewed in this study will be able to do so by 2020. As mentioned above, Italy predicted in its National Renewable Energy Action Plan a deficit with regards to the target assigned by the European directive, whereas the other countries of this study predicted either to reach or even to surpass their assigned target. Note that according to Observ'ER, the rise in the share of renewable energies from 2008 to 2009 has to be viewed in consideration of the impact of the economic slowdown. Indeed, the drop in the energy consumption (denominator of the ratio) as a consequence of the crisis resulted in a mechanical increase of the share of renewable energies.

	2006	2009	**2020**
Germany	5.8%	9.7%	**18%**
France	10.3%	12.4%	**23%**
Italy	5.2%	7.8%	**17%**
Spain	8.7%	13.0%	**20%**
United Kingdom	1.3%	2.9%	**15%**
EU-27	8.5%	11.6%	**20%**

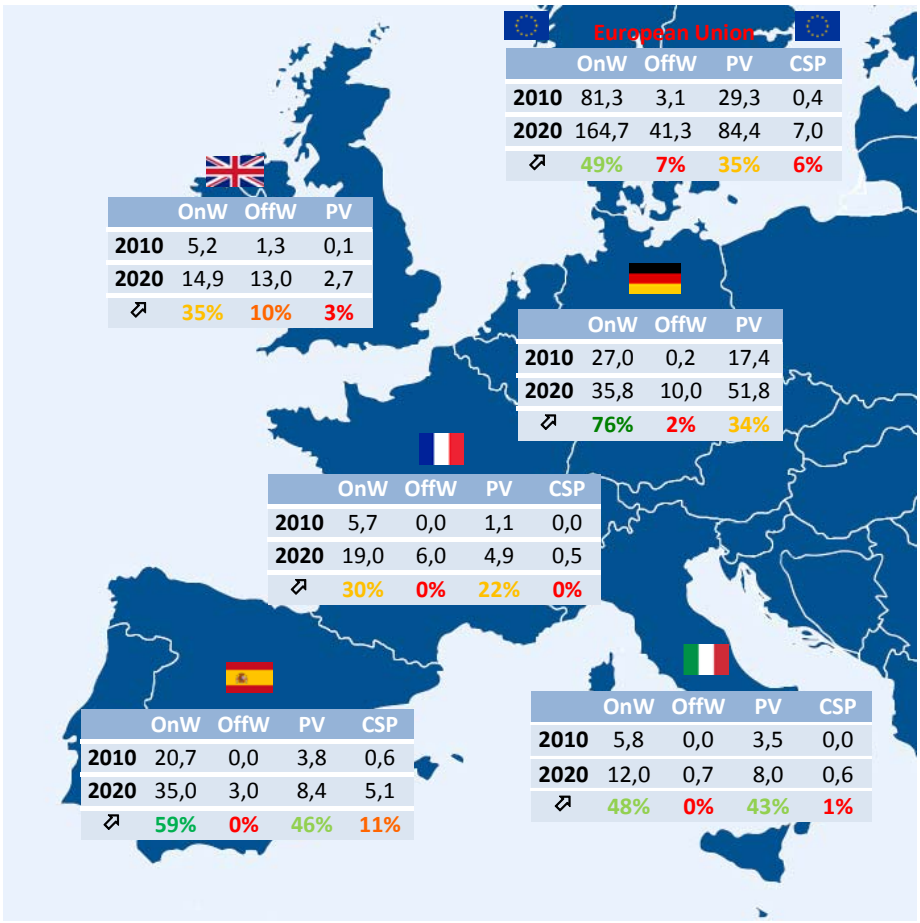
Source: Eurostat, provisional figures for 2009

It is worth pointing out that because the final energy consumption comprises not only electricity but also energy for transportation and heating, member countries will have to promote the development of renewable energies in transports too (e.g. electric cars). Thus, their total capacities of electricity production will have to increase, creating further opportunities for the development of wind and solar plants.

III.2. Installed and targeted capacity

According to Article 4 of the European Directive 2009/28/EC, which sets the national targets for 2020, *"each Member State shall adopt a National Renewable Energy Action Plan [...] [setting] out national targets for the share of energy from renewable sources consumed in transport, electricity, heating and cooling in 2020 [...] and adequate measures to be taken to achieve those national overall targets"*. The deadline for member states to submit their NREAP to the European Commission was 30 June 2010.

The following map shows the installed power generation capacity from onshore wind ("OnW"), offshore wind ("OffW"), photovoltaic ("PV") and concentrating solar power ("CSP") for each country at the end of 2010 *(source: EurObserv'ER)*, their targeted capacity for 2020 *(as published in their NREAP)*, as well as the actual target achievement percentage ("⇗" = capacity in 2010 / targeted capacity in 2020)



The target achievement percentage may be seen as an indicator of the future dynamics of the renewable energy market of each country. Indeed, a **low current level of installed capacity represents development potential** as governments of such countries are **more likely to increase the support for renewable energies** so that they can meet their requirements for 2020. The onshore wind market provides a good evidence of this: On the one hand, mature markets like Germany and Spain are becoming less attractive as it gets harder to find areas with good wind conditions; On the other hand, France and the United Kingdom appear to be underdeveloped markets, considering their high potential and their targets for 2020.

- ***Grid issues***

The grid capacity is one of the challenges that the further development of renewable energies in Europe will have to face. Indeed, not only the growth of the electricity production capacities requires the grid to be adapted and extended, but also the remote areas where green electricity may be produced (e.g. offshore wind farms) will need to be connected. In some countries, the grid capacity has already reached its limits, for example in Italy where producers reported delays in the connection of authorized, newly constructed installations to the existent grid.

III.3. Support schemes

- ***Promoting renewable energies***

The financial incentives implemented in most industrialised countries in order to promote renewable energies attracted new or existing private companies and encouraged the development of national and global wind and solar industries. Large investments in R&D and increased competition have permitted to continuously reduce the construction and operation costs of power plants using renewable energies. However, with significantly higher costs per MWh, these energies still remain **less competitive** than most conventional energies. The development of renewable energies is thus **entirely relying on national support schemes and public financial incentives**.

In Europe, two main forms of support schemes have been implemented: the majority of the countries opted for a **feed-in tariff system** (see country profile of Germany, France and Spain), whereas some preferred to set up a **quota system**, also known as green certificates (see country profile of Italy and the UK).

- ***Finding the appropriate support scheme***

Setting up a national renewables support scheme that will be favorable to a sound and sustainable development of renewable energies and which will hence attract electricity producers and project developers on this market while preventing the formation of speculative bubbles is not an easy task for European governments. The past few years have shown a "try and error" process, where countries had to constantly arbitrate between:

- **Sufficient financial incentives** providing adequate support to develop a national industry and to increase the green power generation capacity at a rate that will allow the country to meet the target assigned by the European Directive;

- **Regularly decreasing construction and maintenance costs,** thanks to constantly improving technologies (such as the sharp decrease in the construction costs of PV modules in the last three years);

- **The limitation of the financial burden** arising from the support scheme for public entities, electricity providers and in particular for final consumers, to which the additional costs are most often transferred. This is especially true for countries like Spain, which currently have to face serious public debt issues and where the additional costs arising from the support scheme promoting renewables are not borne by the final consumers (yet).

Thus, the regulatory frameworks in European countries have been relatively unstable, with successive tariff drops, the implementation of degression mechanisms and the tightening of the requirements for new installations. Spain, which had fixed too attractive tariffs for solar energy, even had to retroactively limit the number of hours of operation benefiting from the tariffs.

Learning from their neighbors' mistakes, each European country has been regularly reviewing its support scheme, so that "best practice schemes" tend to emerge in Europe with the recourse to feed-in tariffs periodically readjusted by an automatic degression mechanism, or the recourse to tender processes.

Indeed, **quota systems seem not to have been as successful as feed-in tariffs in encouraging the development of renewable energies.** Their major disadvantage is their financial instability for developers and investors: As the value of the green certificate can fluctuate over time, the total level of support over the entire project life is hardly predictable. Italy and the United Kingdom, which had partially or fully opted for a quota system are currently reviewing their support scheme and are expected to gradually change to a feed-in tariff system.

- ***European comparison***

Feed-in tariffs are usually fixed with regard to the actual construction and operating costs supported by renewable energy producers and thus adjusted by governments in order to reflect cost decreases. Considering that the electricity purchase prices for large industrial customers gives the **closest estimates to the production costs**[17] supported by domestic energy producers, these figures give an indication of the competitiveness of renewable energies compared to conventional energies. Indeed, if support scheme were (retroactively?) cancelled, electricity from renewable sources would have to be sold to energy providers. Their willingness to pay higher prices than for conventional energies would then depend on their goodwill to offer a greener energy mix to their customers, as well as on the willingness and/or the ability of customers to pay a **higher electricity bill.**

	Germany	France	Italy	Spain	United Kingdom
Support scheme					
Means of support	Feed-in tariff	Feed-in tariff Tax incentives	Quota system Premium Feed-in tariff Tax incentives	Feed-in tariff Premium Tax incentives	Quota system Tax incentives Feed-in tariff
Additional costs passed through to the customers	✓	✓	✓	✗	✓
Feed-in tariffs or premium in the first years of operation (range)					
Onshore wind					
Price (€ct./kWh)	9.0	8.2 - 11.0	REC	7.3 or 2.9*	ROC
Term	20 years	15 years	15 years	permanent	-
Offshore wind					
Price (€ct./kWh)	13.0	13.0	REC	-	ROC
Term	20 years	20 years	15 years	-	-
Photovoltaic					
Price (€ct./kWh)	21.1 - 28.7	12.0 - 46.0	29.7* - 40.2*	17.6 - 24.0	ROC
Term	20 years	20 years	20 years	30 years	-
Concentrating Solar Power					
Price (€ct./kWh)	-	32.8	28.0*	26.9 or 25.4*	-
Term	-	20 years	25 years	permanent	-
Electricity purchase prices for large industrial customers (consumption: 24000 MWh/year)					
Price (€ct./kWh)	**9.2**	**5.6**	**10.7**	**8.8**	**9.2**

**premium on top the market price*

**average prices effective in January 2011. Source: Europe's energy portal*

[17] *Regarding the estimation of the production costs by the electricity prices paid by large industrial customers, in France, the production costs can be better approached by the price at which the historical electricity producer EDF will have to sell up to one quarter of its nuclear energy production to its smaller private competitors from 2012 onwards according to the French New Electricity Act ("loi Nome"), which is 4.2 cts/kWh.*

Note that any competitiveness analysis of the financial incentives implemented in the different countries on the basis of the previous table needs to be viewed cautiously as:

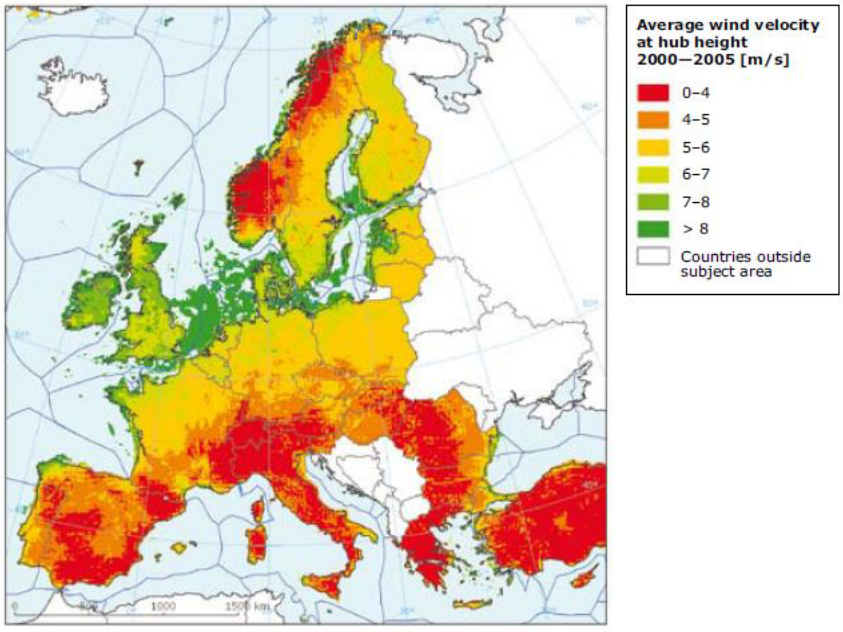
(i) The tariffs are often subject to limitations, additional requirements and/or bonuses which are specific to each country, such as: degression mechanisms, inflation indexation, national cap on new installations, limitation of the hours of operation benefiting from the tariffs, etc.

(ii) The quality of the wind and especially solar **resource** can vary dramatically from one country to another. As a consequence, a PV-module, which is identical to one located in another country rewarding solar electricity production with a higher feed-in tariff but benefiting from lower average annual insolation levels, would generate a higher annual electricity output, which may be sufficient to compensate or even exceed the initial tariff difference.

III.4. Quality of the resource

- ***Wind resource***

ECMFW wind field data after correction for orography and local roughness (80m onshore, 120m offshore)[18]:



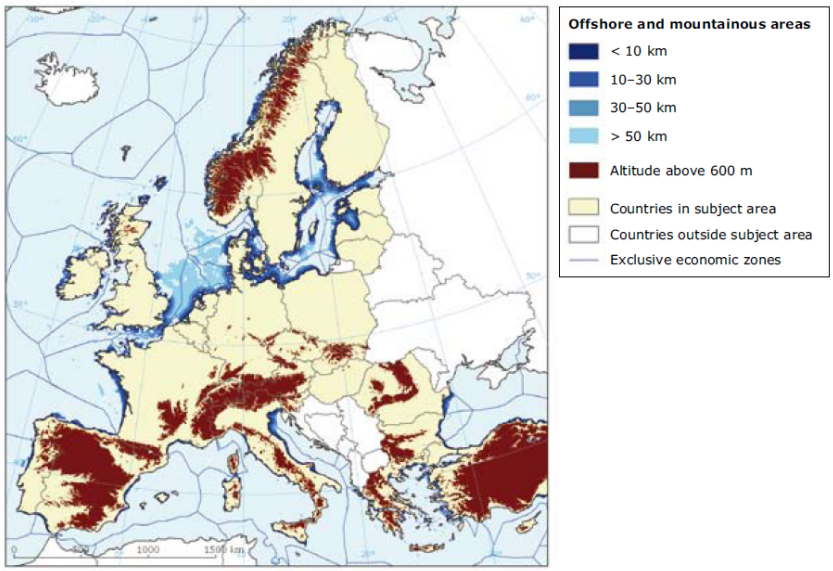
Source: EEA, 2008.

Beside a high average wind speed at hub height, other important factors contributing to a higher annual number of full load hours are the variability and the predictability of the wind (number of non operating days due to little wind). For example, production data gives an adjusted annual wind speed standard deviation of 4.9% for the United Kingdom and 5.8% for Germany[19]. Note that as mentioned above, developers operating in mature markets like Spain and especially Germany begin to experience difficulties in finding areas with adequate onshore wind resource. This highlights once again the potential of the British wind market, which is still underdeveloped when considering its superior wind resource.

[18] *Source: European Environment Agency, Europe's onshore and offshore wind energy potential*

[19] *Garrad Hassan, Long-term wind speed trends in Northwestern Europe, 2009*

The map below displays European wind offshore locations with a water depth of less than 50 meters[20]. Not only does the North Sea benefit from above average wind resource and good predictability, but also from large areas with relatively low water depth, even far away from the shore. On the contrary, the Atlantic Ocean floor sharply drops off when moving away from the coast.



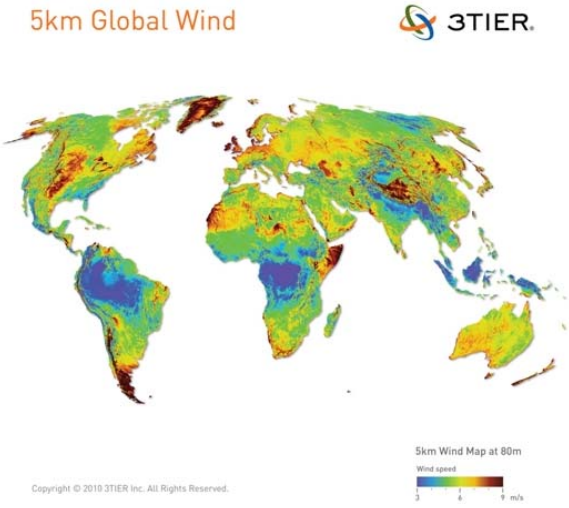
Source: EEA, 2008.

Available offshore area (in km^2) for wind energy farms within national jurisdictions:

	total available offshore area	thereof distance to shore < 50 km	**thereof distance to shore < 30 km**
Germany	47 500	26 500	**20 000**
France	45 500	40 500	**34 500**
Italy	36 000	35 000	**32 500**
Spain	25 500	25 500	**24 500**
United Kingdom	116 500	77 500	**63 000**

source: approximate figures calculated from the EEA report mentioned in the references

A look at the wind world map gives evidence of the good wind resource in Northern Europe, together with central North America, North Africa and Argentina.



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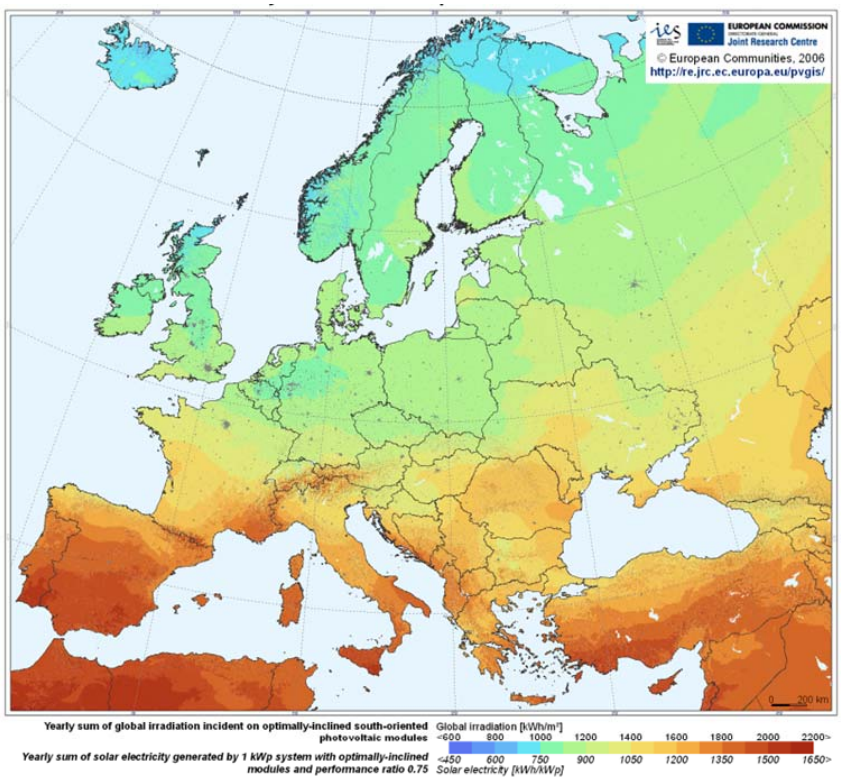
[20] *Source: European Environment Agency, Europe's onshore and offshore wind energy potential*

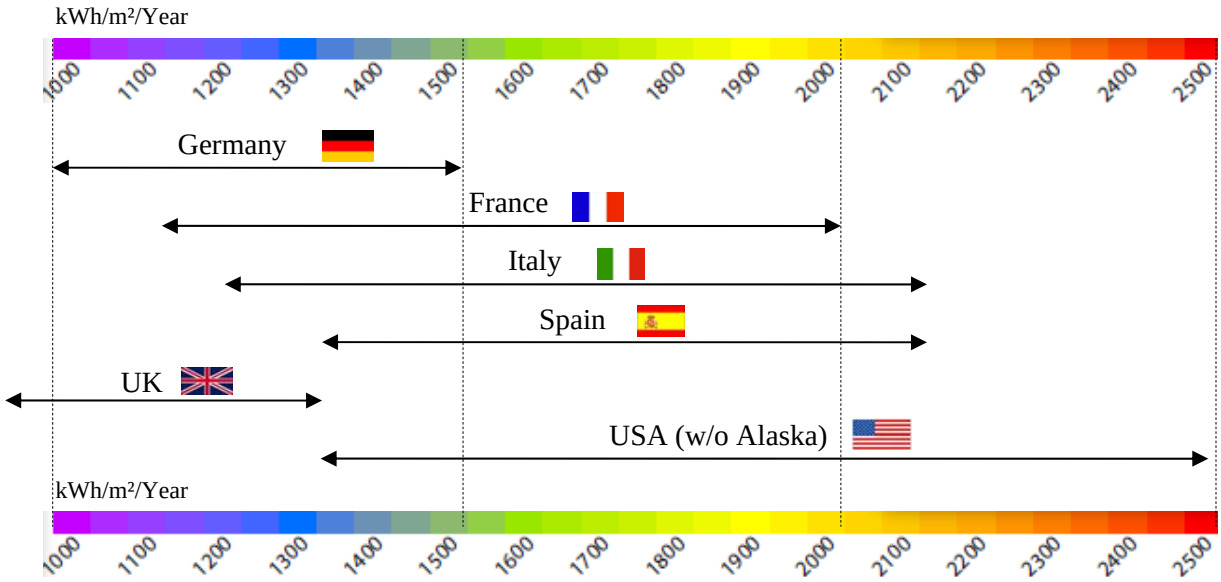
- ***Solar resource***

Photovoltaic solar electricity potential in European countries, as measured by the yearly sum of global irradiation incident on optimally-inclined south-oriented photovoltaic modules (kWh/m²):



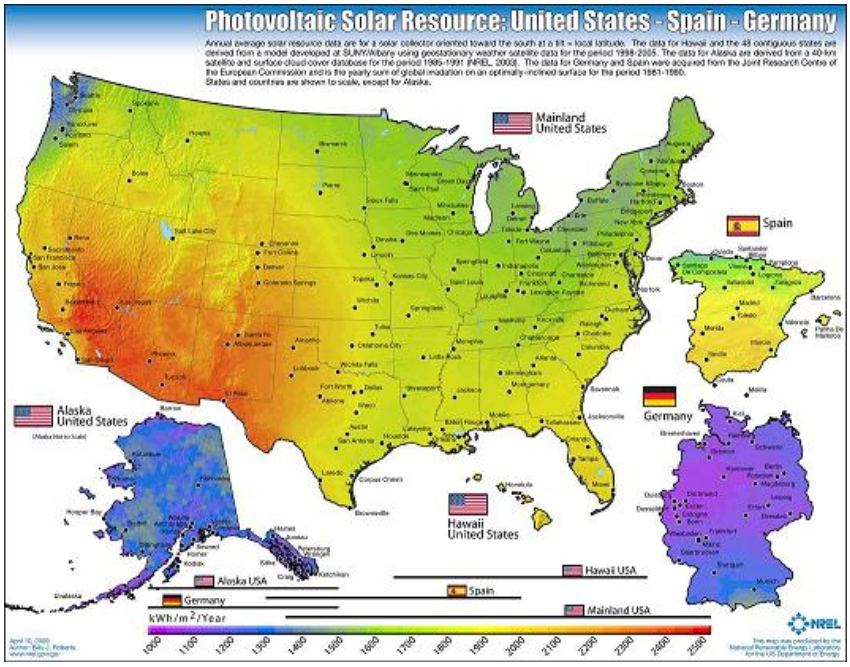
Source: PVGIS © European Communities, 2001-2008, Joint Research Center (JRC), European Commission

The diagram below compares the range of insolation levels[21] in the countries presented in this study with the insolation levels seen in the United States of America:



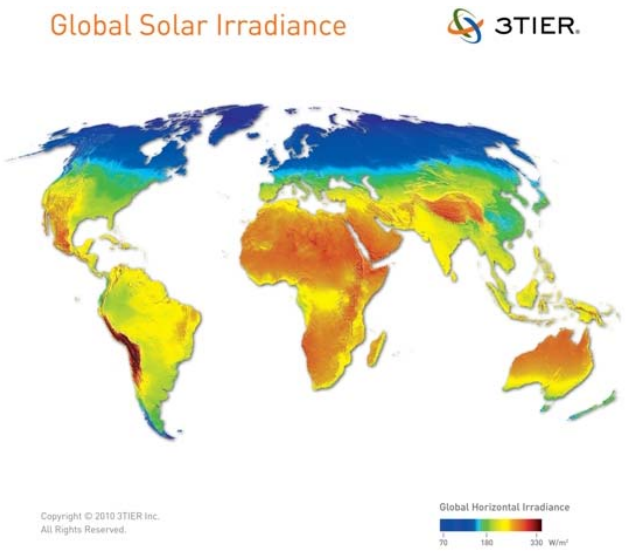
[21] *For European countries: yearly sum of global irradiation incident on optimally-inclined south-oriented photovoltaic modules. Source: PVGIS, Joint Research Center, European Commission.*
For the USA: annual average solar resource available to south-facing photovoltaic panels, at an angle from horizontal equal to the latitude of the collector location. Source: National Renewable Energy Laboratory

The following map shows the huge **potential** for photovoltaic and concentrating solar power in Southern California, Arizona, New Mexico and Texas. This is even more striking when considering that in 2009, Germany and Spain were by far the global leaders for solar electricity production (incl. PV and CSP), with a share of the world production reaching 32.1% (6.9 TWh) and 28.9% (6.2 TWh) respectively, when the USA represented only 11.3% (2.9 TWh), ranking 4th behind Japan[22].



Source: US Department of energy, National Renewable Energy Laboratory (NREL)

A look at the entire world map gives evidence of the greater potential of **desert regions**, especially in Africa, provided that the electricity produced can be transported to populated areas through high-voltage direct current cables with acceptable loss ratios. According to the DESERTEC foundation[23], *"within 6 hours, deserts receive more energy from the sun than humankind consumes within a year"*.



[22] *Source: Observ'ER, Worldwide electricity production from renewable energy sources, Edition 2010*
[23] *The Desertec Project aims at constructing a large scale infrastructure producing electricity with PV and CSP systems as well as wind farms in Northern Africa in order to supply Europe with power. http://www.desertec.org/*

IV. Mapping of the competitiveness of the selected countries

- ***Methodology elements***

The following methodology has been used to evaluate the competiveness of the countries reviewed in this study. For each criterion, the marks range from -- to ++.

Feed-in tariffs: The marks compare the level of the feed-in tariff or feed-in premium with the highest tariff seen among the five countries, without consideration of the quality of the resource available (see point (ii) on page 23), plus:
(i) a bonus point in case of feed-in premiums (as these are paid on top of market prices);
(ii) a bonus *(minus)* point for a purchase obligation lasting longer *(less)* than 20 years;
(iii) a bonus *(minus)* point for additional positive *(negative)* mechanisms, such as inflation indexation *(degression mechanism, limitation of the hours of operation).*

The tariffs considered for photovoltaic are for ground-based PV plants. Support schemes relying on a quota system are not rated with regard to the feed-in tariff criterion.

Gap to the electricity market prices: When the feed-in tariff or premium is below the national electricity market price, the country is awarded with a ++. When the tariff lies above, the following scale has been used:

up to +50%	+
+50% to +200%	-
> +200%	--

Quality of the resource: For wind resource, the marks take into account the average wind speed, its variability as well as the available areas for potential offshore wind farms.
For solar resource, they evaluate the upper part of the range of insolation levels seen in the country.

Regulatory framework: The marks attributed to the regulatory frameworks assess whether these have been favourable to the (sound) development of both wind and solar energies and a dynamic national industry in the respective countries

Stability of the support scheme: This criterion evaluates how often tariff decreases and important modifications have been implemented in the past few years and in particular how they have had an impact on the wind and/or solar industry in the country. The marks can be decreased if the support scheme is currently under review and is expected to be notably transformed (Italy, UK)

Installed capacity: The marks evaluate the actual target achievement percentage of the country (= capacity in 2010 / targeted capacity in 2020), as presented on page 20. The evaluation scale that was used is as follows:

0% to 10%	--
10% to 30%	-
30% to 50%	+
>50%	++

As mentioned above, from an investor or bank perspective, a country lagging far behind its 2020 objective represents greater opportunities while high current installation marked with "++" offers less financing potential and suggests rather little willingness of the government to keep subsidizing the development of renewable energies.

Share of the electricity production:

For wind power:

0% to 1%	--
1% to 5%	-
5% to 10%	+
>10%	++

For solar power:

0% to 1%	--
1% to 2%	-
2% to 3%	+
>3%	++

- ***Onshore wind***

country evaluation (for methodology elements, please refer to page 27)	Germany	France	Italy	Spain	UK
Feed-in tariffs	++	+		+	
Gap to the electricity market prices	++	+		++	
Quality of the resource	+	+	-	+	++
Regulatory framework	+	-	+	-	+
Stability of the support scheme	+	-	-	-	+
Installed capacity	++	-	+	++	+
Share of the electricity production	+	-	-	++	-

- ***Offshore wind***

country evaluation (for methodology elements, please refer to page 27)	Germany	France	Italy	Spain	UK
Feed-in tariffs	+	+			
Gap to the electricity market prices	+	-			
Quality of the resource	+	+	-	-	++
Regulatory framework	+	-	-	-	++
Stability of the support scheme					+
Installed capacity	--	--	--	--	-
Share of the electricity production	--	--	--	--	--

- ***Photovoltaic***

country evaluation (for methodology elements, please refer to page 27)	Germany	France	Italy	Spain	UK
Feed-in tariffs	+	-	++	-	
Gap to the electricity market prices	-	-	-	-	
Quality of the resource	--	+	++	++	--
Regulatory framework	+	-	+	-	+
Stability of the support scheme	+	-	-	--	+
Installed capacity	+	-	+	+	--
Share of the electricity production	-	--	--	+	--

- ***Concentrating Solar Power***

country evaluation (for methodology elements, please refer to page 27)	France	Italy	Spain
Feed-in tariffs	++	++	+
Gap to the electricity market prices	--	-	--
Quality of the resource	-	+	+
Regulatory framework	+	+	+
Stability of the support scheme	+	+	-
Installed capacity	--	--	-
Share of the electricity production	--	--	--

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