ePolicy

Engineering the Policy–making Life Cycle

Deliverable D2.2
"Impacts, constraints, objectives and implementation strategies in Regional Planning: General Aspects"

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ABSTRACT

This deliverable provides a general overview of the regional plans features that are modelled and supported within the ePolicy framework. In particular, the following aspects have been considered: Objectives, Financial Constraints, Environmental, Social and Economic Impacts, and Implementation Strategies. This document provides a general overview of how the ePolicy approach treats and models these aspects.

SEVENTH FRAMEWORK PROGRAMME

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Authors of this document:

Attilio Raimondi[1], Federico Chesani[2], Tony Woods[3]

[1]Regione Emilia-Romagna
Email: ARaimondi@regione.emilia-romagna.it
[2]DISI – Università di Bologna
Email: federico.chesani@unibo.it
[3]PPA Energy
Email: tony.woods@ppaenergy.co.uk

Reviewers of this document:

Michela Milano
University of Bologna
Marco Gavanelli
University of Ferrara
Tina Balke
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1 Introduction

This deliverable provides a summarized description of the general aspects that characterize the regional plans. Within the ePolicy approach, a plan consists of a set of activities that should be carried out to achieve some objectives. Together with the activities name, also their magnitude and expected (estimated) costs are provided. To the end of aiding the policy maker to devise such a plan, the policy model does indeed takes into account the following aspects:

- **Objectives**. Regional plans usually tackle different aspects related to the regional functioning, infrastructures, social, environment, and any other possible aspect for which the public body is entailed to provide directions and rules. To name a few, typical regional plans can be Agriculture, Forest, Fishing, Energy, Industry, Transport, Waste, Water, Telecommunication, Tourism, Urban and Environmental. For each plan, a number of possible, different objectives are settled. When constructing the plan, the policy maker should try to take into account multiple objectives at the same time: however, dealing with them is a difficult task, since the objectives can be conflicting with each other.
- **Financial Constraints**. The implementation of a plan is limited by a set of financial constraints, typically provided in terms of a budget available for the plan implementation, and estimated private costs.
- **Environmental, social and economic impacts.** The implementation of a plan always affects the environment, as well as the society. Quite often, such impacts can be positive, negative, or both (by affecting different environmental aspects).
- **Implementation strategies.** The implementation strategies are the mechanisms used to carry out the activities devised within a plan. The definition of the implementation strategies is a core activity of the planning process, since they have a direct impact and feedback on the achievement of the plan objectives.

Objectives and financial constraints are an input of the policy modeling process, while the various impacts are consequences of the chosen plan and implementation strategies. Of course, among the objectives, the policy maker can specify to minimize/maximize the impact of the plan towards some environmental receptor, or social/economic indicator.

Implementation strategies are about *how to* carry out the activities that have been identified within the plan. They play a fundamental role, since they directly impact on the allocated budget, as well as on the private costs; they have direct consequences towards social, economical and environmental aspects; and, most important, implementation strategies directly affect the achievement of the objectives.

This deliverable provides a general overview of the regional plans features that are modeled and supported within the ePolicy framework. While some aspects such as the objectives, the financial constraints and the impacts have been already discussed in previous deliverable (see for example D2.1 and D8.1), implementation strategies are presented here for the first time. Hence, the deliverable is organized as follow: In Section 2 the objectives of a plan, and the techniques

exploited by ePolicy are briefly recalled and summarized. In Section 3 some considerations about the financial constraints, public and private costs are discussed. In Section 4 ePolicy techniques and algorithms to evaluate environmental, social and economic impacts are presented and summarized. Finally, Section 5 is devoted to provide an overview of the implementation strategies, w.r.t. the renewable energy domain.

2 Financial Constraints

The implementation of a plan comprises two different types of costs:

a) public costs, i.e. the costs that are directly supported by the public bodies;
b) private costs, i.e. the costs that are supported by private stakeholders when involved in some of the plan-related activities.

Public bodies costs are usually covered by the budget allocated for plan implementation. In the Emilia-Romagna region the budget is allocated through the Regional Operational Programme (POR) [4] (see also [5] and [6] for examples related to other italian regions). The POR programme comes under the Regional Competitiveness and Employment EU objective, and it has a total budget of some 347 eM. The assistance provided by the European Union through the Regional Development Fund (ERDF) amounts to nearly 128 eM, which represents around 0.4% of EC contributions to Italy under the cohesion policy for the current period 2007-2013.

The strategy of the Operational Programme is based mainly on: (i) the regional issues, identified after an analysis of the region's potential; and (ii) the EC and national strategic frameworks, which set out the principles for the allocation of EC funding. The operational programme is divided into five priorities:

1. Industrial research and technology transfer
2. Entrepreneurial development and innovation
3. Improved energy and environmental efficiency, and sustainable development
4. Enhancing and better exploiting the environmental and cultural heritage
5. Technical assistance

Financial constraints coming from the allocated budget are directly modelled within the ePolicy approach by means of constraints on the foreseen costs, computed on the base of the activities identified as being part of the plan, together with the costs of the implementation strategies.

Private costs can have a dramatic impact on the achievement of plan objectives: high private costs might discourage stakeholders to get involved into the plan activities, while low private costs might push to some excess the stakeholders involvement. ePolicy takes into account the effects of these costs by proper considering them within the social simulation component.

3 Environmental, social and economic impacts

Each plan has environmental, social and economic impacts. To achieve the objectives, a plan foresees the execution of a number of different activities. Within the expert of Emilia-Romagna Region, we have identified two different types of activities:

- **Primary activities** are those ones that are directly related to the achievement of one or more plan objectives. I.e., primary activities are those that produce a measurable outcome that directly affects the objectives of a plan. E.g., w.r.t. the energy plan a primary activity is the building of a new power plant; w.r.t. the transport plan a primary activity is the building of a new road.
- **Secondary activities** are those that do not affect directly the objectives, but are mandatory for the implementation of primary activities. I.e., secondary activities are those that are needed to support primary activities, but do not produce a measurable outcome that affects the objectives of the regional plan. E.g., w.r.t. the energy plan, secondary activities strictly related to the construction of a new power plant (the primary activity) are the building of roads to reach the plant, and the construction of aerial power lines and supports.

There is a direct relation between primary and secondary activities. The ePolicy model fully supports such correlation by allowing the definition of such relation. In particular, domain experts can provide estimations of "how much" of each secondary activity is indeed required to support a "quantity" of a certain primary activity. More precisely, the domain experts can provide a function for each couple of primary/secondary activity: such function takes in input the quantity of the desired primary activity, and returns an estimation of the needed quantity of a certain secondary activity.

Summing up, ePolicy takes as input a N_a x N_a square matrix D (N_a being the total number of considered activities), where each element d_{ij} is a function that relates activity j with activity i. Notice that the function can be a linear relation, as well as a non-linear one.

3.1 Evaluation of the environmental impacts

Different solutions and tools have been used to perform the environmental assessment. Among many, we consider here a state-of-the-art methodology adopted within the region Emilia-Romagna. This methodology is based on coaxial matrices [1], and it has been developed from the "network method" [2]. In this methodology, each activity affects the environment in terms of **positive** and **negative pressures**: an example of positive pressure is the increased availability of energy, while a negative pressure is the production of pollutants. Pressures are themselves linked to environmental receptors such as the quality of the air, or the quality of the surface water. On both pressures and receptors, there are constraints: e.g., a constraint limits the maximum amount of greenhouse gas emissions of the overall plan.

A matrix *M* defines the dependencies between the above mentioned activities contained in a plan and positive and negative pressures on the environment. Each element m_{ij} of the matrix *M* defines a qualitative dependency between the activity i and the negative or positive impact j. The dependency can be *high*, *medium*, *low* or *null*.

A second matrix *N* defines how the impacts/pressures influence environmental receptors. Each element n_{ij} of the matrix *N* defines a qualitative dependency between the negative or positive impact *i* and an environmental receptor *j*. Again the dependency can be *high*, *medium*, *low* or *null*.

The impacts of a plan towards environmental receptors is computed starting from matrices *M* and *N*. An example of such computed impacts, for a specific plan is shown in Figure 1. Note that the activity "Aerial Power Line Supports! Has a negative impact on receptor #2 ("Embankments Stability"), while it has a positive impact on receptor #22 ("Availability of productive resources").

Action	rec(1)	rec(2)	rec(3)	rec(4)	rec(5)	rec(6)	rec(7)	rec(8)	rec(9)	rec(10)	rec(11)	rec(12)	rec(13)	rec(14)	rec(15)	rec(16)	rec(17)	rec(18)	rec(19)	rec(20)	rec(21)	rec(22)	rec(23)
Aerial Power Line Supports	0.0	-2040.0	-510.0	-1020.0	-2550.0	-510.0	-1020.0	-1020.0	-510.0	-510.0	-2040.0	-3570.0	-1530.0	3060.0	-10200.0	-8160.0	-2040.0	-510.0	-3570.0	0.0	0.0	7140.0	5610.0
Aerial Power Lines	0.0	-3570.0	0.0	-1020.0	-3060.0	-2550.0	-2550.0	-2040.0	-2550.0	-1530.0	-5100.0	-5610.0	-4590.0	-5100.0	-7140.0	-4590.0	-510.0	-510.0	-3570.0	0.0	0.0	6120.0	4080.0
Agricultural and Forestry Works	-165.64	-386.49	-55.21	-92.02	-220.85	-184.04	-404.89	-515.32	-220.85	18.4	-588.93	-460.1	-607.34	-128.83	-699.36	-368.08	-276.06	-552.12	-312.87	55.21	0.0	276.06	331.27
Artificial Lake for Multiple Uses	-0.26	-1.09	-0.22	-0.56	-0.56	-0.04	-0.37	-0.79	-0.45	-0.15	-1.24	-1.12	-1.16	-0.49	-1.42	-0.56	-0.04	-0.97	-1.01	0.0	-0.15	0.3	0.08
Artificial Lakes For Polluting Substances	18.38	-73.5	0.0	-18.38	-73.5	110.25	91.88	110.25	-202.12	-91.88	-36.75	-128.62	91.88	55.12	-110.25	-55.12	36.75	-18.38	-91.88	18.38	-18.38	294.0	147.0
Biofuel Production Plants	918.75	0.0	183.75	183.75	-551.25	367.5	183.75	-918.75	-551.25	2388.75	-1653.75	-3123.75	-2205.0	2756.25	-2388.75	-1653.75	-367.5	-1286.25	918.75	2021.25	2021.25	7901.25	6615.0
Casualty Control Systems	11.48	9.57	11.48	11.48	17.22	19.14	30.62	30.62	30.62	3.83	26.79	13.4	19.14	66.98	30.62	26.79	38.28	3.83	3.83	5.74	5.74	55.5	51.67
Caves and Mines	-0.34	-1.27	-0.41	-0.6	-0.64	-0.68	-0.94	-1.09	-0.6	-0.41	-1.31	-1.72	-1.35	-1.65	-1.95	-1.12	-0.82	-1.01	-0.94	-0.34	-0.11	-0.34	-0.34
Construction Sites (artifacts, traffic)	-0.11	-0.82	-0.41	-0.49	-0.6	-0.15	-0.45	-0.52	-0.6	-0.41	-0.68	-1.2	-0.56	-0.56	-1.5	-0.56	-0.37	-0.56	-0.86	-0.34	-0.11	0.41	0.56
Dams, dikes, beams, thresholds	-0.04	-0.86	-0.11	-0.41	-0.19	-0.23	-0.11	-0.37	-0.0	0.04	-0.97	-0.97	-1.01	-0.22	-1.12	-0.52	-0.38	-0.34	-0.56	0.0	0.22	0.19	-0.15
Dangerous Substances Treatment Plants	0.22	-0.28	0.06	0.0	-0.67	0.56	0.61	0.11	-0.28	-0.5	-0.06	-0.5	-0.06	-0.45	-0.39	-0.56	0.67	-0.45	-0.61	0.11	-0.17	1.56	0.78
Disposal of Obsolete Facilities	1.91	7.62	7.62	7.62	9.53	28.58	32.39	15.24	3.81	-5.72	13.34	15.24	19.05	45.72	20.96	13.34	30.48	0.0	11.43	11.43	-5.72	36.2	41.91
Environmental Quality Certification	338.99	203.4	203.4	203.4	271.2	926.58	1197.78	903.99	949.18	655.39	881.39	1016.98	971.78	2598.96	790.99	542.39	1401.18	271.2	271.2	203.4	271.2	1920.97	2033.97
Excavation and Soil Movements	-34.5	-138.0	-40.25	-63.25	-80.5	-69.0	-92.0	-115.0	-69.0	-51.75	-132.25	-172.5	-138.0	-166.75	-195.5	-126.5	-97.75	-103.5	-120.75	-17.25	-17.25	-23.0	-51.75
Exstinguishing Fire Systems	112.5	112.5	112.5	112.5	168.75	112.5	168.75	187.5	281.25	168.75	225.0	187.5	112.5	600.0	262.5	206.25	281.25	-56.25	37.5	56.25	56.25	506.25	525.0
External handling hazardous materials	0.0	-0.06	0.0	0.0	-0.17	-0.08	-0.08	-0.28	-0.13	-0.08	-0.26	-0.32	-0.34	-0.28	0.0	-0.09	0.02	-0.11	-0.11	0.0	0.0	0.24	0.08
Fences (industrial areas)	0.0	-19.0	-4.75	-9.5	-23.76	-14.25	-19.0	-9.5	-14.25	-4.75	-47.51	-66.52	-38.01	19.0	-80.77	-33.26	-14.25	-4.75	-28.51	0.0	0.0	47.51	42.76
Gas, Oil and Vapor Pipelines	0.0	-0.04	-0.0	-0.01	-0.03	-0.04	-0.04	-0.03	-0.08	-0.03	-0.07	-0.11	-0.06	-0.01	-0.09	-0.05	-0.04	-0.02	-0.04	0.0	-0.01	0.07	0.03
Groundwater Extraction Plants	-1687.5	-2062.5	-750.0	-1875.0	-375.0	-937.5	-2812.5	-4312.5	-750.0	-750.0	-1687.5	-1312.5	-4500.0	-187.5	-2062.5	-750.0	375.0	-4312.5	-1875.0	0.0	-562.5	187.5	375.0
Heavy Material Handling	0.0	-187.25	0.0	0.0	0.0	-561.75	-561.75	-374.5	-1498.0	-1310.75	-936.25	-2059.75	-1123.5	-936.25	-1498.0	-2247.0	-187.25	-187.25	-374.5	0.0	-561.75	2059.75	749.0
Houses and Residential Areas	-55.14	-330.82	-110.27	-183.79	-294.06	-202.17	-404.33	-349.2	-367.58	-275.68	-624.88	-624.88	-588.12	-312.44	-808.67	-349.2	-147.03	-422.71	-422.71	0.0	-91.89	220.54	238.92
Hydraulic Facilities (Pipes, Pumps, Valves, etc.)	56.25	-75.0	0.0	-18.75	-75.0	93.75	112.5	112.5	-225.0	-131.25	-56.25	-262.5	93.75	18.75	-243.75	-131.25	-37.5	37.5	-75.0	18.75	-18.75	393.75	187.5
Industrial Processing	0.0	-56.1	-37.4	-37.4	-168.3	-112.2	-224.4	-355.3	-486.2	-355.3	-261.8	-617.1	-355.3	-673.2	-467.5	-243.1	-187.0	-374.0	-130.9	-56.1	-243.1	168.3	56.1
Information, Educational, and Decision Support Systems	17.45	15.51	15.51	15.51	21.33	34.9	50.41	38.78	36.84	23.26	31.02	31.02	34.9	122.14	34.9	25.2	60.1	11.63	13.57	11.63	11.63	98.88	102.75
Internal Handling of Hazardous Materials	0.0	-0.07	0.0	0.0	-0.2	-0.27	-0.27	-0.42	-0.24	-0.2	-0.4	-0.46	-0.53	-0.38	-0.02	-0.11	-0.02	-0.27	-0.13	0.0	-0.07	0.2	0.02
Lighting Systems	0.0	-65.74	0.0	-21.91	-65.74	-21.91	-21.91	-21.91	-65.74	-87.65	-65.74	-328.69	-21.91	87.65	-394.42	-219.12	-21.91	0.0	-43.82	0.0	-65.74	175.3	153.39
Maritime Trade	0.0	-367.5	0.0	0.0	-1653.75	-2021.25	-2021.25	-3491.25	-1837.5	-1653.75	-3675.0	-3675.0	-4961.25	-367.5	-367.5	-1286.25	1102.5	-2572.5	-918.75	0.0	-551.25	5696.25	4410.0

Figure 1 – How a specific plan impacts a set of receptors. Rows are labelled with the whole set of activities (primary and secondary), while columns are labelled with environmental receptors (numbered from 1 up to 23).

3.2 Evaluation of the social impacts

Knowing what people think about some process is of key importance to decision-making. People frequently express their opinions through text. It is often the case that policy makers propose a participation process before starting a planning activity by collecting opinions through meetings and workshops of all relevant stakeholders. Therefore, the first part of the plan contains the result of the opinions collected during this participatory phase. ePolicy wants to deal with opinion collection in an automatic way.

Opinion mining and sentiment analysis is an area of text mining that aims at uncovering these opinions from textual sources. This area aims at developing computational tools that enable to uncover opinion, sentiment and subjectivity in text.

ePolicy considers social impacts in terms of social acceptance, by mining the free web and extracting the sentiment. We have decided to have for each relevant message a five ranked scale: from -2 which means a very negative opinion to +2 meaning a very positive opinion.

Unfortunately, there is not much generality in this process. First because the collection of relevant web sites depends on the type of plan. Second, because the model we learn with opinion mining is topic dependent.

3.3 Evaluation of economic impacts

In the ePolicy framework economic impacts are evaluated through the techniques and methods developed within the project RAMEA [3], one of the 16 cooperation projects financed by the INTERREG IIIC Program 2005-2007 under GROW, the Regional Framework Operation (RFO) which main topic is to help European regions in adopting strategies coherent with the Lisbon and Gothenburg Agendas goals. RAMEA project started in May 2006, with the involvement of seven institutes from four EU regions.

RAMEA is an environmental accounting system useful to evaluate the economic and environmental performance of regions and to inform regional policies/strategies about sustainable development, coherently with the tools developed at national level (NAMEA). The main objectives of these synergic studies have been aimed at defining helpful accounting tools to:

- link the economic knowledge on production and consumption activities to the emissions in air exerted on the environment;
- build a tool useful for reports, studies, scenarios, regional planning;
- provide useful indicators for the policy makers to measure, control and forecast key regional performances;
- identify how a region could develop economically and socially without causing environmental damages.

Moreover, RAMEA could be used for different kinds of analyses, to explore some of the possibilities that this type of tool offer to the regional planning/reporting, e.g.: monitoring regional air emissions and eco-efficiency, comparing regional eco-efficiency with the national one (Shift-Share analysis) and understanding the effects and responsibilities of production and consumption chains on the environment.

RAM

	Current Prices (Millions of euros)				Costant Prices (Millions of euros)				ftes/n. jobs
	Output	Value Added	Intermed. Consumpt.	Final Consumpt.	Output	Value Added	Intermed. Consumpt.	Final Consumpt.	Employment
NACE rev. 1.1 industry classification (27 codes)									
Household									
Total									

EA

	GHG emissions (Mg)				Acidification (Mg)				Local air quality (Mg)		
	CO_2	N_2O	CH_4	CO2 eq	NO_X	SO_x	NH_3	H+ eq	NMVOC	CO	PM
NACE rev. 1.1 industry classification (27 codes)											
Household											
Total											

Figure 2 – General tables provided by the RAMEA project

For this purpose, we report here a table linking industrial sectors taken from the NACE classification plus households with economic and environmental parameters: In detail we have:

- 27 industries (NACE rev. 1.1 classification) and 2 household categories (COICOP 07 Transports plus Other consumptions);
- 5 economic variables (Output, Value Added, Intermediate Consumption, Final Consumption and Employment);
- 9 air emissions (CO2, N2O, CH4, NOX, SOX, NH3, NMVOC, CO, PM) plus 2 aggregated impact categories (Global Warming Potential and Acidification).

As an example of RAMEA table applied to the specific case of the Emilia Romagna region, we report in Figure 3.

Emilia-Romagna 2000		RAM				EA				
		Economic aggregates				GHG	Acidification	Local air quality (Mg)		
NACE	Industries	Output	Value Added	Final Cons.	Labour input	CO2 eq	H+ eq	NMVOC	CO	PM
A,B	Agriculture, hunting, forestry, fishing	2,6%	3,5%		6,2%	12,2%	47,0%	4,6%	9,8%	24,2%
C	Mining/quarrying	0,1%	0,2%		0,1%	0,1%	0,1%	0,2%	0,0%	0,2%
D	Manufacturing activities	39,6%	26,6%		27,4%	31,5%	21,2%	30,7%	2,4%	31,3%
E	Electricity, gas, water supply	1,5%	1,3%		0,5%	14,3%	10,2%	3,2%	0,5%	4,6%
F	Construction	5,4%	4,9%		5,8%	0,2%	0,1%	3,9%	0,1%	2,2%
G,H	Wholesale, retail trade, hotels, restaurants	14,4%	17,2%		21,4%	2,0%	0,7%	1,7%	0,5%	0,9%
I	Transport, storage, communication	6,2%	6,8%		5,8%	7,0%	7,5%	6,9%	5,6%	13,2%
J-Q	Other services	30,1%	39,5%		32,8%	6,2%	1,9%	1,3%	2,1%	2,1%
COICOP	**Households**									
07	Transport			12,7%		12,3%	9,1%	34,1%	70,3%	13,3%
-	Other consumptions			87,3%		14,2%	2,1%	13,3%	8,7%	8,0%
Total - Industries		**100,0%**	**100,0%**		**100,0%**	**73,5%**	**88,8%**	**52,6%**	**21,0%**	**78,7%**
Total - Households				**100,0%**		**26,5%**	**11,2%**	**47,4%**	**79,0%**	**21,3%**
Total		**100,0%**	**100,0%**	**100,0%**	**100,0%**	**100,0%**	**100,0%**	**100,0%**	**100,0%**	**100,0%**

Figure 3 - Ramea table instantiated to the Emilia Romagna Region.

The RAMEA project however could not only be considered as a data collection project aimed at filling in the tables above. It also aims at providing:

- a monitoring system, RAMEA allows analyzing the pressures placed on the environment by the economic sectors and households, helps identifying the "hot spots" in terms of environmental pressures and potential decoupling patterns, and allows the construction of eco-efficiency indexes: we can understand, as an example, the regional key sectors for CO_2 emissions, establish a direct link with their economic performances, see if a positive/negative relation exists between economic growth and environmental pollution and develop eco-efficiency indexes;
- as a forecasting tool, RAMEA, together with the help of environmental input-output analysis, allows Scenario analysis: e.g. after having identified the key sectors for CO_2 we may evaluate and quantify the effects of different regional policies/strategies aiming to the reduction of emissions, including the baseline scenario (no action).
- as a benchmarking tool RAMEA gives the possibility of comparisons between regions: the partners compared the performances of the four regions (and of the four nations of which regions are part) in term of eco-efficiency of eight macro economic sectors (Agriculture, Mining/Quarrying, Manufacturing activities, Electricity, Construction, Commerce, Transport, Other services).

4 Objectives of a plan: dealing with multiple and/or conflicting objectives

The definition of the objectives of a plan is a process that takes into account many different sources of information. Primarily, the EC and the national operational programs, which identify objectives

and intervention fields at a very general level. Secondly, the specific needs of the region: generic goals are tailored into more detailed objectives that fit the local situation. Within this phase, political choices play an important role in determining the objectives, as well as citizen and stakeholder public opinions. Thirdly, previous plans and the achieved results influence the determination of the objectives for the new plan.

As a consequence, each plan is equipped with a number of different objectives. The policy maker has to take into account all the objectives, thus requiring the merge of multiple objective functions. Moreover, the objectives can conflict each other. This in turn calls for multiple optimization criteria.

When a problem presents a single criteria to select among different solutions, we have a single optimal value (that may correspond to many equivalent solutions). On the other hand, when several objectives are considered we have many Pareto optimal solutions, i.e., solutions that are non dominated by other solution. A solution x is non dominated with respect to a number of objective functions (f_1, f_2, …f_n) by other solutions if there does not exist any solution that improves on x on at least one objective function and is the same on the other.

In general regional plants have a number of objectives to respect. One could be the cost of the plan. With cost, we consider both public and private money. Public money is invested both into the realization of the plan and into implementation strategies described later.

Other interesting objectives are environmental receptors. A receptor is an indicator of the quality of a given environmental aspect. We have previously described the Strategic Environmental assessment providing us with 22 receptors:

- Subsidence limitation
- Embankments stability
- Stability of coasts or seafloor
- Stability of river banks and beds
- Soil quality
- Quality of sea water
- Quality of inland surface waters
- Groundwater quality
- Air quality
- Quality of climate
- Wellness of terrestrial vegetation
- Wellness of wildlife
- Wellness of aquatic plants
- Wellness and health of mankind
- Quality of sensitive landscapes
- Cultural/historical heritage value
- Recreation resources accessibility
- Water availability
- Availability of agricultural fertile land
- Lithoid resource availability

- Energy availability
- Availability of productive resources
- Value of material goods

Clearly, depending on the region, the regional plan might take into account a different combination of receptor to optimize. For example in Emilia Romagna, the air quality in general is very poor being the region a flat area called Pianura Padana with Alps on the North and Appennins on the South and therefore having limited ways of dissipating pollutant emissions. Therefore for the Emilia Romagna one receptor that is usually considered is the Air quality. However, in the same region we have the Po river delta. In that area the water quality is extremely important.

So, we might have a plan minimizing the cost and maximizing the air quality. Having two objective functions, we could visualize on a Cartesian diagram alternative plans that are non dominated. In Figure 4 we show the Pareto optimal curve containing non dominated plans.

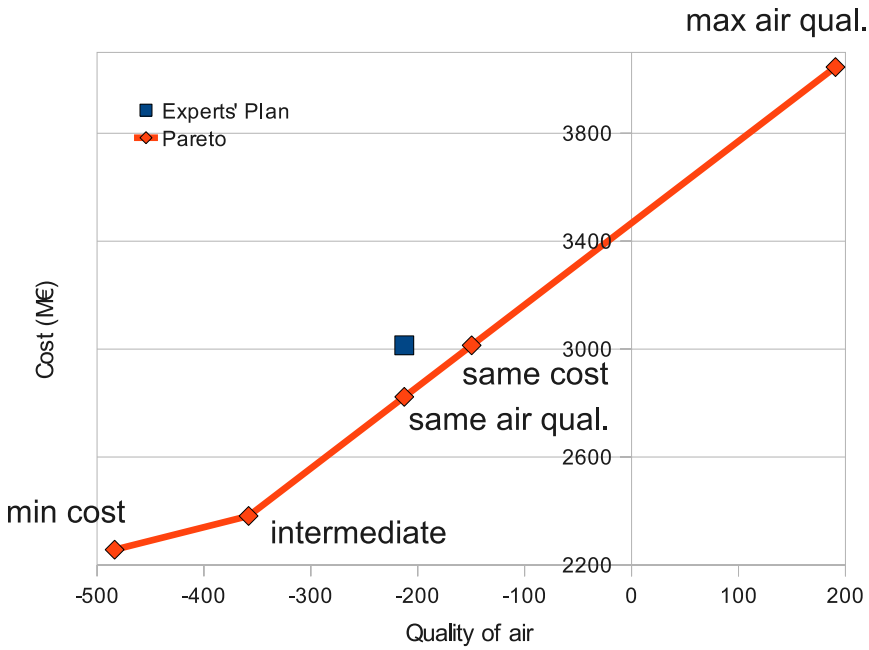


Figure 4: Pareto Optimal frontier for energy plans and two objective functions

5 Implementation Strategies

Many different implementation strategies are available in the literature. Reviewing all the possible strategies for any possible plan is out of the scope of this deliverable. However, to better assess the possible strategies that have been used within the energy-related field, an extensive study of the incentive mechanism has been conducted by considering several different countries. In particular, incentives methods utilised to promote renewable energy have been taken into account, w.r.t. **UK**, **Italy** (with particular reference to the Emilia Romagna region), **France**, more generally in the **European Union**, **South Africa** and in the **US** (with a more detailed examination of the states of **California** and **Florida**).

The complete list of incentive mechanisms is available as the project internal report "Report on Incentive Mechanisms for Renewable Energy Generation and related topics", available to all partners. Here we report only the results that can be directly referred to EU coutries.

5.1 Incentives types

The forms of incentive mechanisms that have been identified are as follows

- **Feed-in tariffs** - 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.
- **Premium** - 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 obligation** - 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.
- **Investment Grant** - grants for renewable generation are often devised to stimulate the take-up of less mature technologies such as photo-voltaic.
- **Tax exemptions** - Some countries 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 approaches are production tax incentives that provide income tax deduction or credits at a set rate per unit of produced renewable electricity, thereby reducing operational costs.
- **Fiscal Incentives** – This category includes 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.
- **Compulsion** – A more radical approach would involve an element of compulsion. Whilst no examples of this have been directly identified in the renewable generation market, some similar circumstances have been established. For example in at least some urban parts of Scandinavia it is a legal obligation for new constructed homes to be connected to the local heat network.

- **Green Power marketing** – Under this arrangement, electricity customers can choose to buy electricity which is sourced partially or wholly from renewable sources. Typically they pay a premium compared to other tariffs that may be available. This can be used in both competitive and regulated markets. Sometimes standards need to be set to ensure that sufficient and appropriate renewable generation is supporting the product.

It should also be noted that the various categories listed above are not necessarily mutually exclusive so that, in some jurisdictions, more than one policy instrument or approach may be in use at the same time.

These various incentive schemes can also generally be characterised as either

- **Production-based incentives** – where the benefit of the scheme is broadly related to the amount of energy generated. This includes feed-in tariffs and quota obligations. The features of such arrangements may include the following:
    - *Technological differentiation* – as different renewable technologies are at varying levels of development and cost levels in relation to existing market prices there is a risk of "free riding" (i.e. a potential ongoing windfall benefit) for technologies that are close to being economic in the absence of subsidy if only one support level is provided to all technologies. Thus increasingly technological differentiation has been introduced into the support mechanisms used.
    - *Inflation adjustment* – the level of support (i.e. feed-in tariff price) may vary in line with inflation.
    - *Digression* – the level and availability of support may be varied according to take-up. Thus if such take-up is large then the support may be curtailed. Whilst this sometimes happens by unexpected Government decisions, arrangements are increasingly being established during the design of the incentive mechanism.
    - *Own-use arrangements* – for feed-in tariffs there may be differences in the rate paid for electricity used on the premises where the electricity is generated rather than that feed into the distribution network. This also raises questions in regard to metering or the assumptions made about the proportion of the electricity generated used for each purpose.
- **Investment-based incentives** – these schemes tend to provide support for the initial investment irrespective of the amount of electricity that is actually generated. Examples of such arrangements include:
    - *loans* (either interest free or at rates below the market level)
    - *loan guarantees* (where the repayment of the loan may be guaranteed by an external agency, such as national or regional government) which has the effect of facilitating both the availability of loan finance and reducing its cost
    - *tax benefits* – such as VAT exemption or reduction or reduced corporate taxation via accelerated depreciation or improved capital allowances, although this will only provide advantages to profit making companies

Although not an incentive mechanism as such, it is also vital that a robust and reliable legal framework is in place to reassure investors and users. The elements of such a framework include:-

- A simple and predictable planning process.
- What priority do local authorities give to renewable energy? Will such authorities support or oppose installations? This will have a significant impact on the chances of gaining approval and the related time and costs.
- Building Regulation including the approval processes and the extent to which the use of renewable energy may be mandated (although in reality this may be a matter of negotiation between a developer and the relevant authority).

It is also important that there is clarity about the role of transmission and distribution utility companies and organisations. These need to be suitably incentivised to support the connection of renewable generation and encouraged to contribute to the demolition of any barriers that may be inhibiting it both within their own organisations and elsewhere.

Whilst each of the mechanisms outlined above have their advantages and disadvantages it is interesting to consider which are the most effective and efficient at promoting renewable generation. There is some evidence that a greater effect at lower cost may be achieved by a stable feed-in tariff regime that is sustained over a significant period. For example, in 2009 on average, countries with fixed feed-in tariffs had tended to either be growing at a faster rate and/or have a much larger renewable energy base than countries using other approaches. In addition fixed tariffs also appear to be more efficient. As an example prices paid for wind energy in UK and Italy (without fixed tariffs at that time) were higher than the fixed tariffs. For instance, the UK was paying about a third more for its wind energy than Germany. There are many potential reasons for this difference but an element of it may be due to the price uncertainty surrounding renewable certificates. However it is not clear that this trend will persist over time or may be different for different technologies or scale of investment.

5.2 Renewable energy incentives in Italy

Italy in general and Emilia-Romagna region in particular has been selected to carry out a case study for the ePolicy project. The Italy's electricity sector, historically dominated by Enel, was unbundled in 2005. Despite government measures to reduce the dominance of Enel in the generation market, it remains Italy's largest power generator (with 21% of the company in direct government ownership and 10% indirectly). The retail electricity market in Italy was fully liberalised in 2007. Electricity prices remain among the highest in the EU. Prices are formulated on the basis of wholesale prices, bilateral contracts, transmission and distribution tariffs (where relevant) and taxation.

In 2011 about 24% of total energy production was from renewable sources. The total installed renewable capacity was 812 MW and 84 GWh was produced from renewable energy sources (see Figure 39).

	Capacity (MW)		Energy (GWh)	
	2010	2011	2010	2011
hydro	17.8	17.9	51.1	46.3
Wind	5.8	6.8	9.1	10.1
Solar	3.4	12.7	1.9	10.7
Geothermal	772	772	5.3	5.6
Bioenergy	2.35	3	9.4	11.3
Total	801.35	812.4	76.8	84

Gross domestic consumption GWh	342	344
rcentage Renewable/Gross domestic consumption	22%	24%

Figure 5: Renewable sources in Italy (2011)

The Italian National Renewable Energy Action Plan has a target to reach the total share of renewable energy of 26% - 39% in the electricity sector, 17% in the heating/cooling sector and 14% in the transport sector by 2020.

Italy has a well-developed system of incentives for renewable energy generated from solar, wind and biomass. In particular, the Renewable Energy Decree, which entered into force on 29 March 2011, revises the system of incentives for the production of electricity from renewable sources (described under 'Operating Subsidies') and simplifies the authorization process for building new plants.

5.2.1 Feed-in tariff premiums

5.2.1.1 Feed-In premium for photovoltaic systems

The Ministerial Decree of 19 February 2007 introduced in Italy a new version of the feed-in premium scheme applied to photovoltaic plants connected to the grid with a nominal capacity higher than 1 kWp installed by individuals, registered companies, condominiums and public bodies. The current EU driver for this policy is the EU Directive on the promotion of the use of energy from renewable sources (2009/28/EC). The decree provided a set of tariffs, valid for a period of 20 years, with a bonus in cases where there is a high degree of photovoltaic integration in the buildings. Three types of systems are considered:

- not integrated,
- partially integrated and
- fully integrated.

For 2010 the premium for building integration of the systems varies, from a minimum of €0.346/kWh (for un-integrated plants with capacity less than 20 kW) to a maximum of€0.471/kWh (for fully integrated plants with capacity between 1 and 3 MW).

A tariff bonus of 5% is provided for:

- energy self-producers, as defined by the Decree 79/1999;
- public schools and public health centres;
- installations integrated to building substituting asbestos roofs;
- municipalities with less than 5 000 inhabitants.

Plants with a capacity lower than 20 kWp can further benefit from on the "spot trading service". Producers receive, in addition to the premium, the price of the electricity they sell either on the market or through bilateral contracts. (International Energy Agency, 2012) (GSE, 2012).

5.2.1.2 Feed-In Tariff for Solar Thermodynamic Energy

The Decree of 11 April 2008 lays down the criteria to stimulate the production of electricity from solar thermodynamic plants; including hybrid ones, connected to the electricity grid, and built in Italy. Plants must be equipped with thermal accumulation systems.

The current EU driver for this policy is the EU Directive on the promotion of the use of energy from renewable sources (2009/28/EC). On top of the selling price, net electricity produced by thermodynamic solar plants commissioned after 18 July 2008 can obtain a feed-in premium for 25 years. Up to 2012 the bonus varies from €0.22 to €0.28 per kWh depending on the level of integration of the plants. In the case of hybrid plants, the feed-in tariff decreases depending on the ratio between the amount of energy not produced by a solar energy source and the amount produced by a solar energy source.

The maximum cumulative power of all solar thermodynamic plants eligible for the incentives corresponds to 1.5 million square meters of cumulative surface. The national objective of total power to be installed by 2016 corresponds to 2 million square meters of cumulative surface.

During 2013-2014, such bonus values will be reduced by 2% a year; from 2014 onward special Ministerial Decree will define further cuts. (GSE, 2012) (International Energy Agency, 2012).

Solar plants that started to operate before 31 May 2011:

According to the Ministerial Decree of 6 August 2010 (the "Third Energy Incentive") there is a fixed premium (a bonus on top of the market price of electricity) The size of the premium depends on:

- the type of plant
- its nominal output
- when the plant started to operate.

The premium ranges from €0.251 to €0.402 per kWh. The premium will be paid for 20 years after the plant starts operating. For thermodynamic plants, the premium will be paid for 25 years.

Solar plants which started operating between 31 May 2011 and 31 December 2012.

According to the Ministerial Decree of 5 May 2011 (the "Fourth Energy Incentive") a fixed premium computed on the basis of the type and the nominal power of the plant is available up to 31 December 2012. In the first six months of 2012 the premium ranges from €0.148 per kWh to €0.274 per kWh and in the second six months of 2012 the premium will range from €0.133 per kWh to €0.252 per kWh. This type of subsidy will expire on 31 December 2012 and will be replaced by a feed-in tariff system

The Central government set the maximum amount of public expenditure for this incentive program for plants with a production power that exceeds certain levels at €580 million for 2012. The premium will be paid for 20 years after the plant starts operating, as long as it does so by 31 December 2016. For thermodynamic plants, the premium will be paid for 25 years.

5.2.2 Feed-in tariff

5.2.2.1 Solar plants

Feed-in tariffs apply to solar plants that started operating between 31 May 2011 and 1 January 2013. According to the Ministerial Decree of 5 May 2011 (Fourth Energy Incentive), a feed-in tariff, including a premium based on the type of plant and its nominal output, will be available until 31

December 2016. In the first six months of 2013 the feed-in tariff, including the premium, will range from €0.121 per kWh to €0.375. per kWh.

5.2.2.2 Wind plants

The incentive scheme for wind plants is based on the two-fold mechanism of an all-inclusive tariff ("Tariffa Onnicomprensiva") for micro-generation plants with an output of up to 200 kWp and green certificates ("Certificati Verdi") for larger plants. These certificates are issued for free to those producing energy from wind power and can be sold at a market price to enable conventional producers to increase their production power from conventional sources.

The"Tariffa Onnicomprensiva", which is a type of feed-in tariff, includes both a premium and the sale price for electricity. This tariff will be paid for 15 years after the plant starts operating, as long as it does so by 31 December 2012.

Green certificates will be abolished after 2015. The ministerial decrees implementing future incentive systems will establish how the transition will be coordinated from the green certificates system to a new system based on feed-in tariffs.

5.2.2.3 Biogas and biomass

Like the wind energy sector, the incentive scheme for the biogas and biomass energy sector is based on the Tariffa Onnicomprensiva for plants with an output of up to 1 MWp and green certificates for larger plants. The tariff will be paid for 15 years after the plant starts operating, as long as it does so by 31 December 2012.

As for all other renewable energy plants, a new feed-in tariff system will be introduced for biogas and biomass plants on 1 January 2013. The ministerial decrees that will implement this new system will consider the origin and the traceability of the raw materials in order to channel each specific product toward its most productive use. The decrees will also consider how to promote the efficient use of waste products, the construction of co-generation plants, and the construction of micro and mini co-generation plants. (source : KPMG.com)

5.2.2.4 Green Certificates

The 1999 Electricity Liberalisation Act and Decrees from Italy's Ministries of Trade and Industry and of Environment (MICA Decree 11/11/99) introduced a cap and trade mechanism to promote renewable energy sources. It required Italian energy producers and importers (producing or importing more than 100 GWh/year from conventional sources) to ensure that a certain quota of electricity fed into the grid comes from renewable energy sources. The budget law of 2008 (Law No 244 24-12-2007) set the following minimum obligation quotas:

- 2007: 3.8%

- 2008: 4.6%
- 2009: 5.3%
- 2010: 6.1%
- 2011: 6.8%

Producers and importers can comply with the obligation by means of green certificates. They can buy those certificates through bilateral contracts or participating in the green certificates platform (managed by GME, the energy markets operator). Suppliers can fulfill the obligation by:

- buying green certificates from entitled new renewable energy plants,
- building new renewable energy plants, or
- importing electricity from new renewable energy plants from countries with similar instruments on the basis of reciprocity.

Renewable source plants that came into operation before 31 December 2007 can obtain green certificates for 12 years. Subsequent regulatory interventions have increased the incentive period to 15 years.

On 29 March 2011, the Legislative Decree no. 28 came into force. This Decree, also known as "Renewables Decree", constitutes the implementation Directive 2009/28/EC on the promotion of the use of energy from renewable sources. This basically reforms Italy's Green Certificate System. For plants built up to December 2012, the current scheme would still be used but by 2015, a feed-in tariff would be applied (GSE, 2012).

5.3 Renewable energy incentives in the Emilia Romagna Region

Emilia-Romagna is a governmental region of Northern Italy, comprising the former regions of Emilia and Romagna. Its capital is Bologna (see Figure 5 and Figure 6 below).

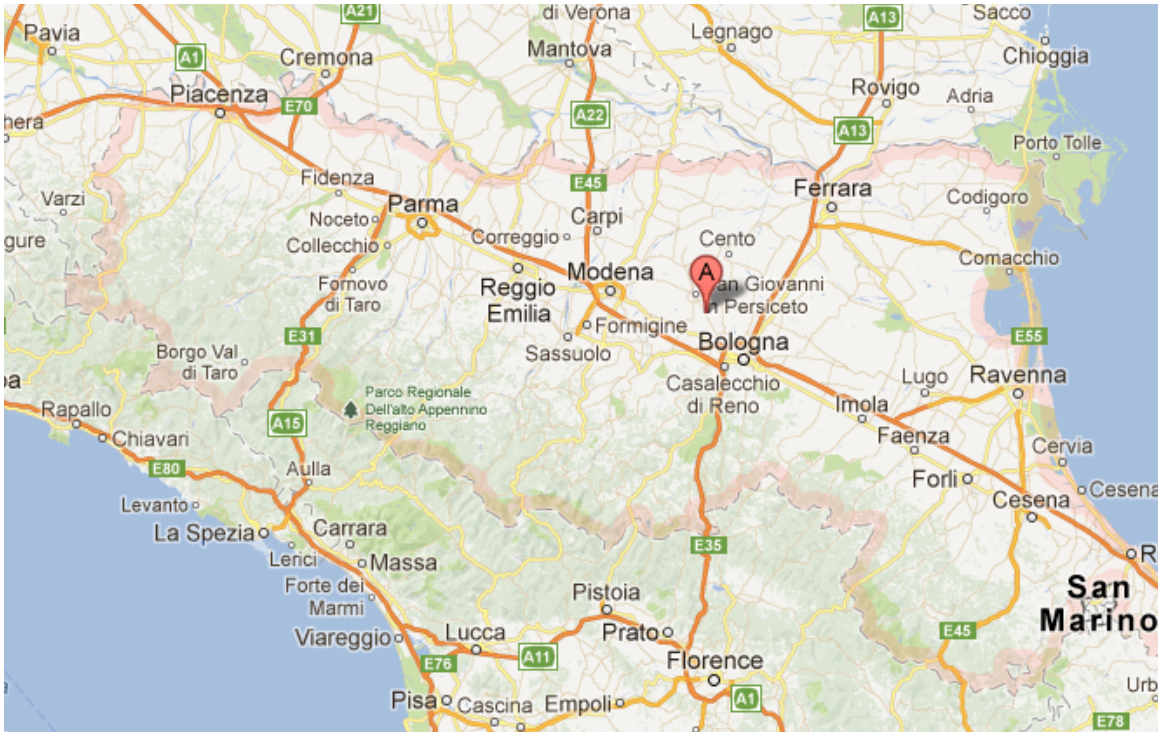


Figure 5 - Map of Emilia Romagna

Capital	Bologna
Area	22,446 km2 (8,666 sq. mi)
Population (2010-11-30)	4,429,766
Density	200/km2 (510/sq. mi)
GDP/ Nominal	€138.7 billion (2008)
GDP per capita	€31,900 (2008)
Rate of unemployment	3.2%

Figure 6 - Some Key facts about Emilia-Romagna

5.3.1 Incentive mechanisms in the Emilia Romagna Region

The Emilia Romagna Region considers that the following mechanisms are feasible to be implemented:

1. **Capital account**: incentives are given as a grant, and no money is returned to the Region. Grants are about a percentage of the total plant cost. Previous economic incentives (2003, 2004 and 2007) have been distributed by means of a single, sealed bid english auction. Other auction types can be considered within ePolicy.
2. **Interests account**: incentives are given as a grant only to pay (part of) interests on bank loans (again no money is returned to the Region).
3. **Rotation fund**: the Region lends money and interests are returned after a given period.

4. **Guarantee fund**: the Region guarantees for the investor that obtains a bank loan, thus easing the loan request.

It is understood that so far Emilia Romagna has made three calls offering to provide incentives to photovoltaics:

- 2001 with incentives given in 2002,
- 2003 with incentives given in 2004
- 2009 program

These programs are briefly analysed below. However, the data for the 2009 program is currently not available. It is not known if there have been any further calls since 2009.

5.3.2 Grants

5.3.2.1 2001 program

In 2001 the Emilia Romagna Region opened an auction for providing incentives for the construction of photovoltaic plants. Requests could be made in four different sectors:

1. Residential areas (private citizens or industries collecting requests from private citizens)
2. Schools and services for University students
3. Hotels and related activities, touristic buildings (in rural areas and mountains)
4. Infrastructures for sport, cultural, entertainment activities

The available budget was divided between these sectors taking account of the number of proposals that were submitted.

In each group, for each proposal the proposal being funded by the applicant was identified.

Overall the 779 proposals were eligible. The total investment required by these proposals amounted to €22.3 million whereas the budget available for grants was around €1.8 million. This was divided between the sectors, as follows:

- Sector 1: €1,236,000
- Sector 2: €177,000
- Sector 3: €282,000
- Sector 4: €134,000

From the 779 applications, 122 were funded based on the following selection criteria:

1. For each group applications were sorted according to the percentage funding requested from the region in ascending order
2. The fund was allocated to the projects with the lowest percentage requested until the budget was exhausted.

Figure 7 shows the average, minimum and maximum accepted bid for the funded projects. As it can be seen, the successful bids ranged from a minimum of 4% to a maximum of 63% funding requested from the region.

It is not clear why the Emilio Romagna regional government chose to segment the applications into the four sectors described above.

Sector	Average Capacity kWp	Average %	Max %	Min %
1	3	52	63	40
2	7	42	50	4
3	12	48	63	10
4	20	31	40	13

Figure 7 - Average, Maximum and minimum accepted bid for the renewable energy program in 2001

Almost all of the funded projects had a capacity of less than 2kW (i.e. PV installed in residences). Figure 11 shows the distribution of funded PV projects based on the size and the contribution requested. As can be seen more than 80% of the funded projects are less than 10 kW and requested less than €50,000.

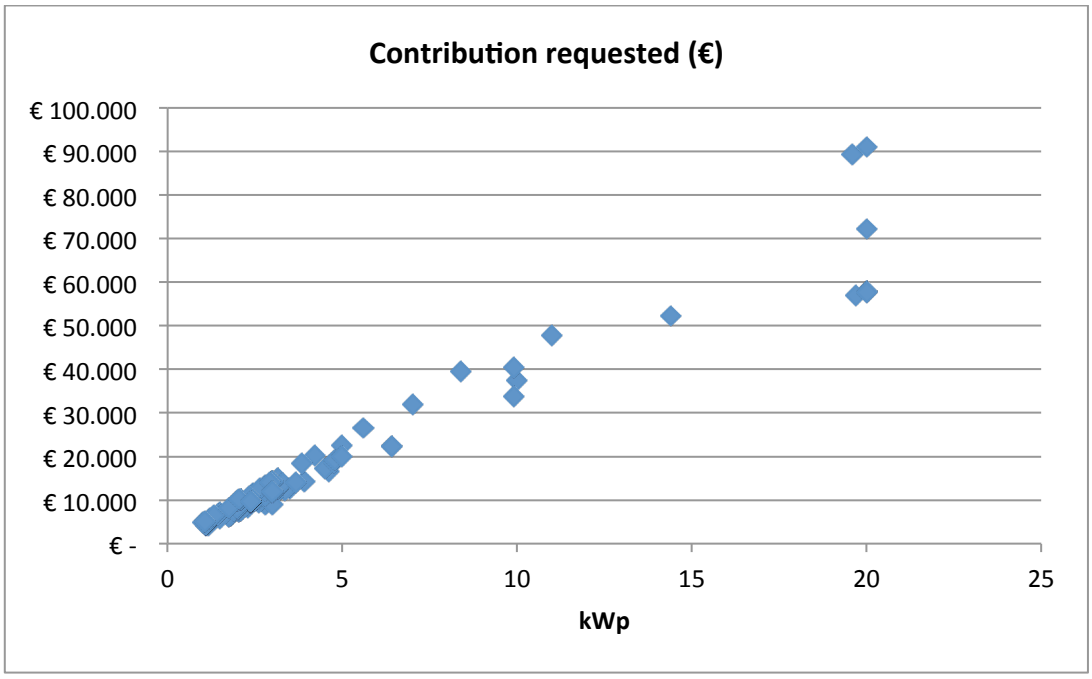


Figure 8 - Distribution of funded PV project based on the size and the contribution requested

5.3.2.2 2003 program

In 2003 the second regional program was launched. The available budget amounted to about €3.3 million (mainly sourced from the capital account). The eligibility criteria included the following

- Plants should be in the range 1 kWp to 20 kWp
- Architectural integration would be an advantage
- Plants should be compliant to a technical specification designed by ENEA (Italian National agency for new technologies, Energy and sustainable economic development)
- Connection to the electricity distribution network should be considered

An evaluation criteria was developed and expressed in the equation shown below

$$X = 100*K*(C*P)/(Y*Z)$$

Where:

- C is the unit cost (€/kW)
- P is nominal power of the plant between 1 and 20 kW
- Y is expected expenses (in €)
- Z is percentage of incentive required
- K is multiplicative factor of 1 or 3 (if architectural integration is performed)
-

5.3.2.3 2009 program

The data for this program is not currently available.

5.3.3 Fiscal incentives

The following fiscal incentives have been considered but not applied:

- **Interests account**: Incentives are given as a grant only to pay interests on bank loans (no money is returned to the region).
- **Rotation fund**: The region lends money and interests are returned after a given period.
- **Guarantee fund**: The region guarantees for the investor that obtains a bank loan.

5.4 Renewable energy incentives in France

A number of acronyms are used in this section. These are defined below:

- ADEME: French Agency for Environment and Energy Management
- CHP: Combined Heat and Power, the use of a heat engine or a power station to simultaneously generate both electricity and useful heat
- CRE: Commission for the Regulation of Energy (in France)
- CSPE: Contribution to the Public Service of Electricity, tax on electricity bills
- DOM: Overseas Territories
- EDF: Electricity Of France
- ERDF: Electrical Distribution Network of France
- RTE: Transmission Network of France
- FIT: Feed-in Tariffs
- kWc: kWp or kiloWatt-peak, a measure of the nominal power of a photovoltaic solar energy under laboratory illumination conditions
- kWhEP: kWhPE or kiloWatt of Primary Energy. It takes into account the energy necessary to the production and transport of electricity. By convention, 1kWh charged by the supplier = 2,58kWhEP

5.4.1 Political approach to Energy

The French presidential campaign lasted from October 2011 to May 2012, when François Hollande (socialist) was elected President of France.

Energy was one of the most discussed topics during this campaign – including two competing visions regarding nuclear power; one approach in favour supported by the right-wing parties and another opposed to it and supported by anti-nuclear ecologists. François Hollande appeared to be seeking to promote a compromise: committing himself – if elected – to undertake a "green revolution", including a decrease of the nuclear share in France's energy mix from 75% to 50% until 2025. In the short-term (the 5-year period until the next Presidential election) this implied the closure of a potentially less safe nuclear plant in Flamanville, France. Over the longer term, this necessarily implied an increase in the generation of electricity from renewable generation in France which is somewhat lower than that of many other EU countries (see Figure 9 below). He declared during the campaign that any job lost in the nuclear industry would be transferred to the renewable energies one.

However it is generally believed in France that investment in renewable generation is unlikely to be sufficient to compensate for the decrease in the nuclear share of the energy mix. The newly elected French government seems willing to fundamentally restructure energy markets as well as giving a major boost to renewable energies. The right-wing opposition states that this approach will drastically increase the electricity costs in France. Figure 10 below shows the energy mix in 2010 in France and for the world as a whole showing France's relatively high dependence on nuclear power. These issues are further discussed below.

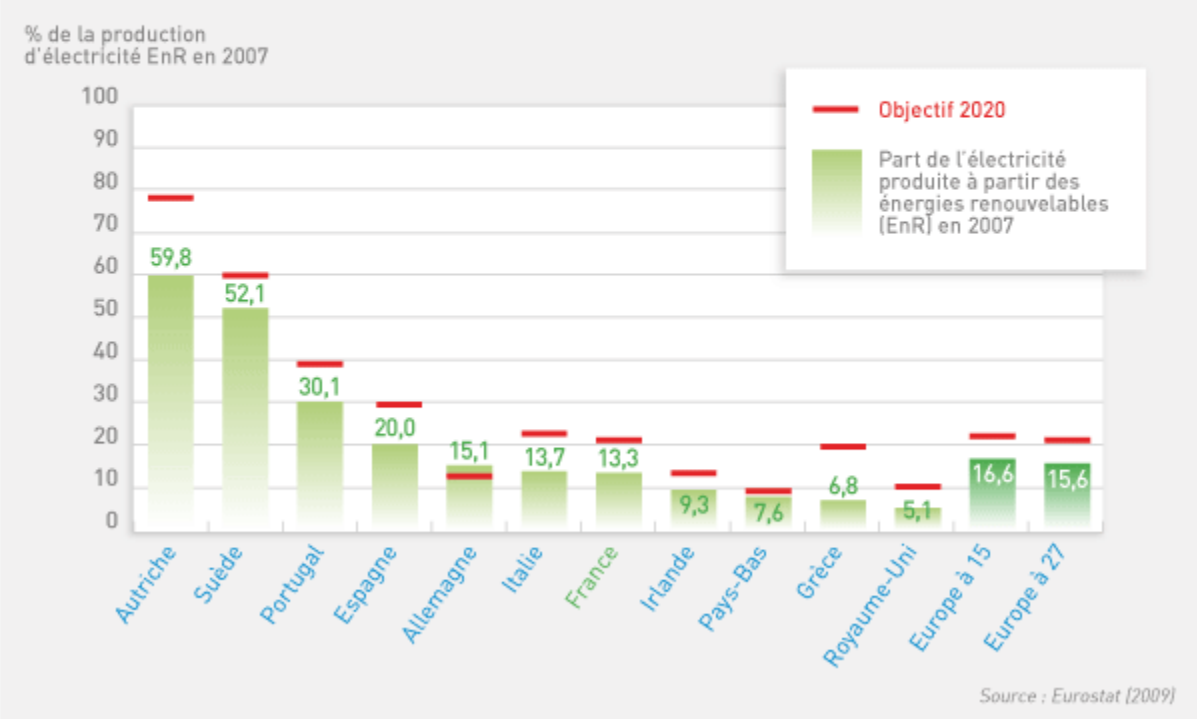


Figure 9 - Percentage of production from renewable sources in European countries in 2007

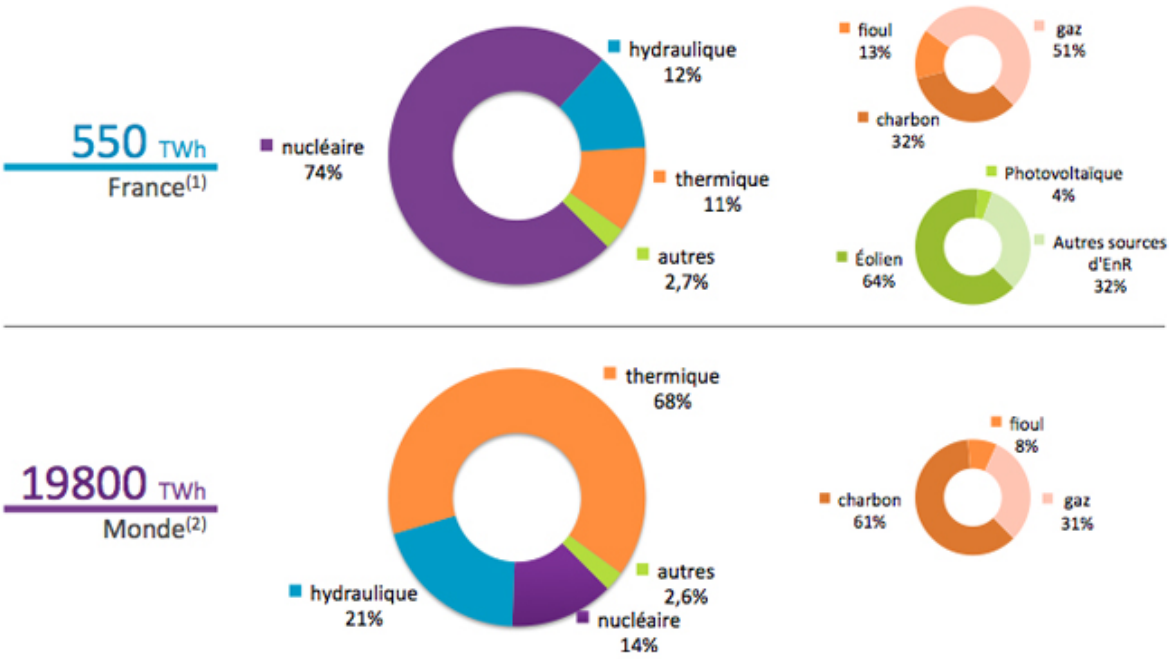


Figure 10 - Energy mix in France in 2010

5.4.2 Energy stakeholders in France

- The CRE (Commission for Regulation of Energy) is the French regulator
- RTE is the (only) transmission system operator
- (and is a wholly owned subsidiary of EDF)
- ERDF is the main distribution operator, but not the only one. Private companies like Poweo, GDF Suez or Direct Energie and regionally based utilities like Gaz de Barr, Gaz de Strasbourg, Gaz de Grenoble are also distribution companies. However none of these are the owners of the parts of the network that they are operating. These remain the property of either ERDF or of the relevant local authority.
- EDF is the main producer of energy, and is partially state-owned (84.48%). EDF owns all of the nuclear facilities in France as well as solar, wind and thermal plants.
- The main customer groups together with their relative sizes (in terms of electricity consumption) are shown on the chart below – Figure 11 (Source: EDF). In 2010, residential and tertiary customers consumed the main share of total electricity consumed in France, with a constant steady growth in recent years (of around approximately 4%).

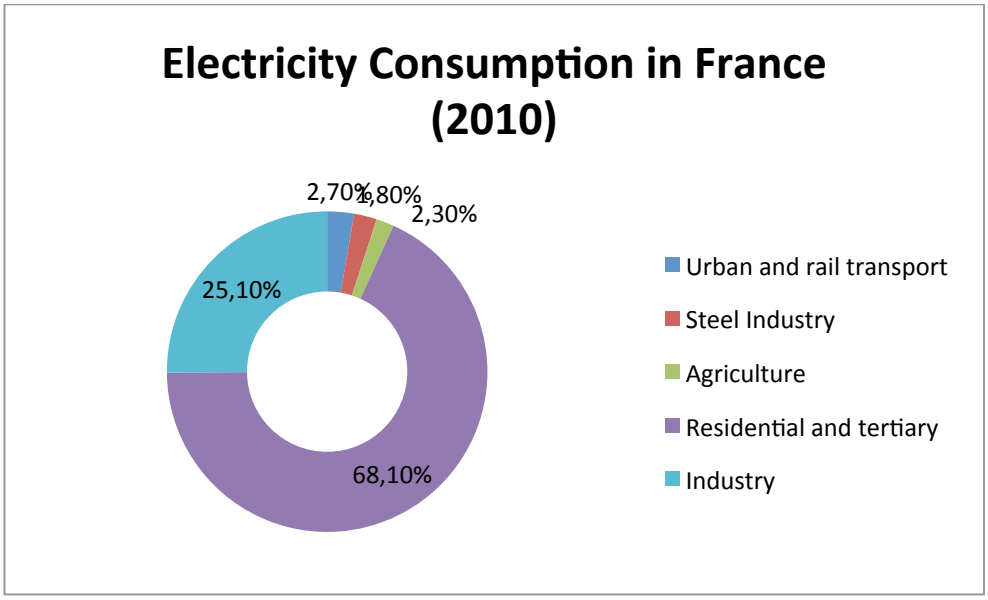


Figure 11 - Electricity Consumption in France (2010)

5.4.3 Energy markets

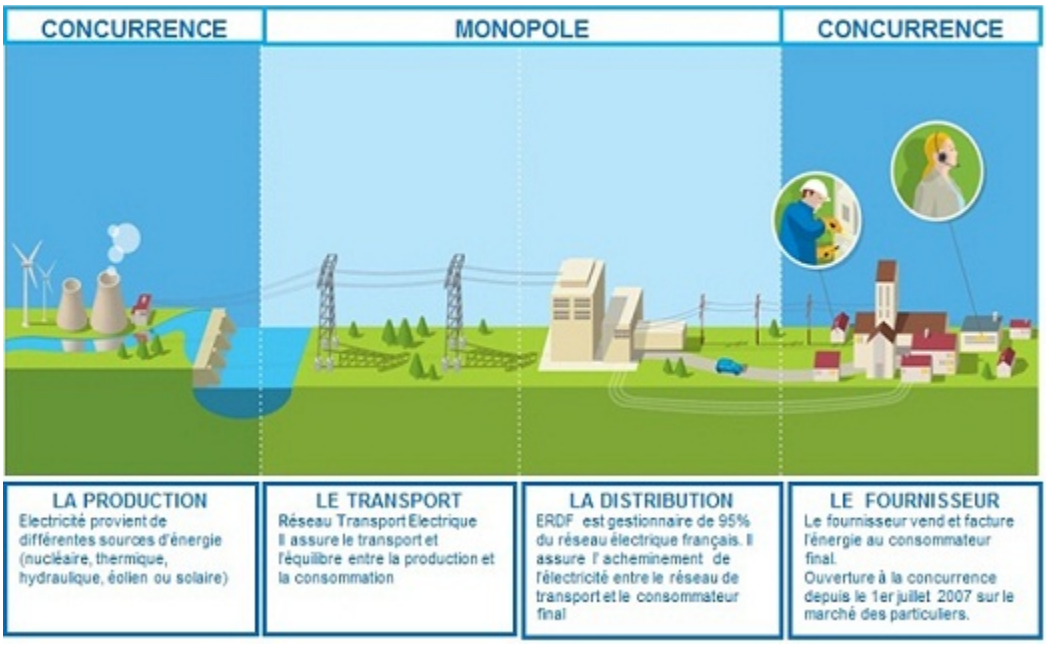


Figure 12 - Energy sectors in France

Legislation

The "NOME" Act (December 2010) reorganised the French energy market by opening it to competition.

With the Act, the market for the production of energy has been opened to competition. However this would have created problems for newly emerging, currently relatively expensive renewable technologies without some further policy initiatives.

The response has been the Code of Energy, which gives a significant boost to renewable energy, through the purchasing obligation .

The opposite effects on renewable energy of these two pieces of legislation are described in the two sections below.

The NOME Act

Prior to NOME, EDF had a full monopoly of the use of nuclear production in supplying end use customers. However following the implementation of NOME, EDF is required to sell up to 100TWh per year of such nuclear production to their competitors who use this to compete for such end-use customers. Conditions for the sale of this nuclear production are defined and evaluated by the CRE (French regulator). The nuclear buying price is fixed by the Ministry of Energy. From 1st January 2012, this price is 42€ per MWh. This may be revised when a new nuclear generation facility (EPR) becomes operational which is not expected until 2015.

While opening the energy market to competition can be seen as a positive development, it brings about a key change in terms of connection fees. Article 11 of NOME states that all connection fees have to be paid by the generator. Prior to NOME, 40% of the connection cost was borne by the transmission utility RTE for transmission network connected generators. For distribution network connected generators, all costs were and are to be borne by the generator (these are estimated and the work associated with these costs is performed by the distribution utility). This measure has the potential to have a serious detrimental impact on the implementation of renewable technologies on the French network, especially when compared to nuclear generation.

The Code of Energy

Since February 2000 there has been a purchasing obligation on distribution companies to buy renewable production. This was subsequently incorporated in the 2011 Code of Energy. The money that distribution companies lose by buying such electricity at a cost that exceeds that of more conventional or mature generation, are recovered from end-use customer through a tax called CSPE.

Feed-in tariffs apply to any renewable energy installation satisfying any one of the following conditions (in addition to certain size limitations):

- Any installation transforming residential waste
- Any installation feeding a heat network
- Any installation using renewable technologies including wind, solar, hydroelectricity, geothermic, cogeneration, biogas, methanisation

5.4.4 Feed-in Tariffs (FIT)

In the previous section it is explained that any renewable generation that meets the conditions has to be purchased by distribution companies (mainly ERDF). The material below discusses the conditions and the price for such sales.

The value of FITs and the conditions under which these are applicable to various renewable technologies are discussed in the sections below.

5.4.4.1 Photovoltaic

In France different FIT terms apply to solar panels without and with full building integration.

Figure 13 - PV Full-building integration

Full-building integration means part of the roof is removed (and replaced by the solar panel) and that the installation includes insulation work (see opposite). Without Full integration means that the solar panels are placed on top of the existing roof surface. Solar panels with full-building integration get premium feed-in tariff

The PV FIT tariffs in Figure 14 are the latest available, apply to connections made in the period, and are fixed for the next 20 years (i.e. up to 2032). Figure 15 illustrates the FIT price variations for different capacity ranges and shows the difference between simplified and full building integration.

Type of building	Type of installation	Installed Capacity	FITs valid between 01/10/2012 – 31/12/2012 (c€/kWh)
Residential	Full building-integration	0-9kWc	34.15
		9-36kWc	29.88
	Simplified building-integration	0-36kWc	17.04
		36-100kWc	16.19
School, university or hospital	Full building-integration	0-9kWc	22.79
		9-36kWc	22.79
	Simplified building-integration	0-36kWc	17.04
		36-100kWc	16.19
Others (farms, commercial buildings…)	Full building-integration	0-9kWc	19.76
	Simplified building-integration	0-36kWc	17.04
		36-100kWc	16.19

Figure 14 - PV FIT for PV in France

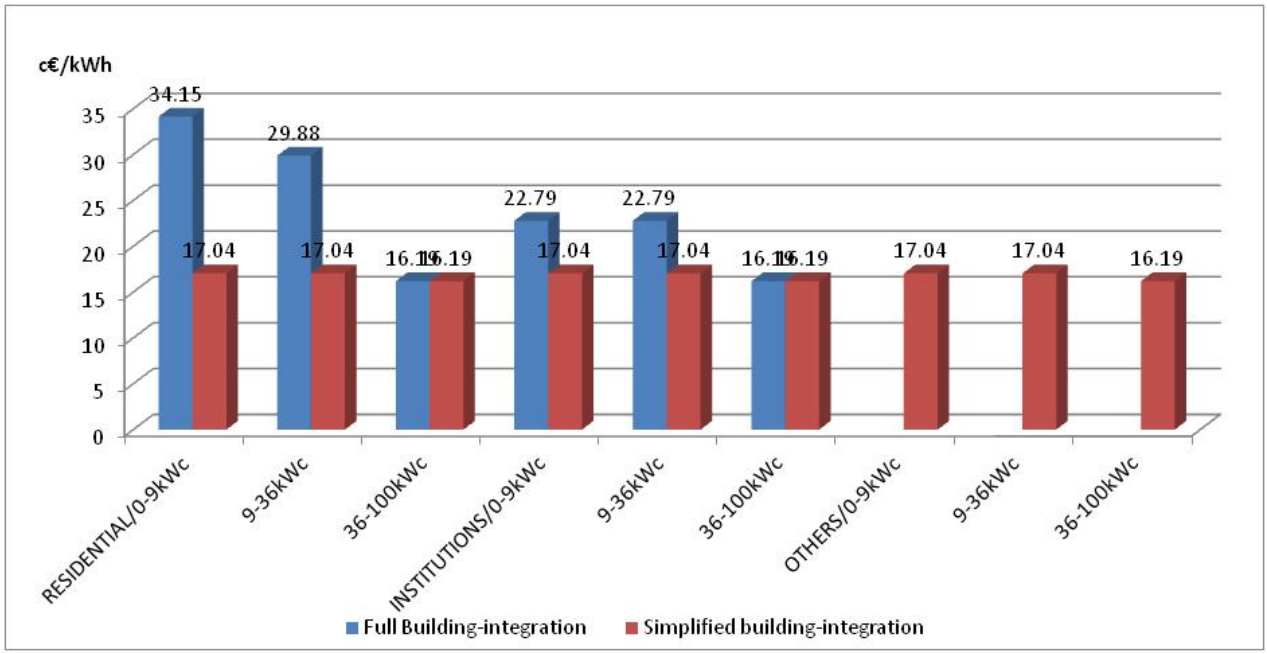


Figure 15 - FIT for PV in France.

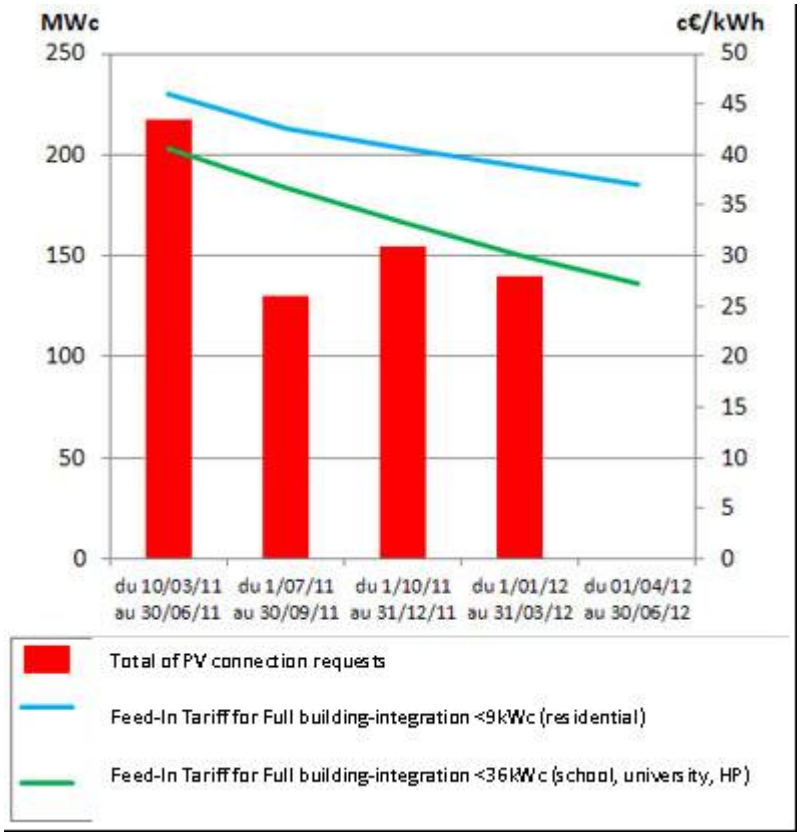


Figure 16 - Evolution of FIT for PV in France

As shown in Figure 16, the PV FIT value has varied over the last few years. In 2011, the decrease in FIT was prompted by the French government in view of the large number of connections that were occurring. The decrease in the value of the FIT was seen as necessary to limit the costs of subsidisation of PV which were being recovered from addition to customer bills. This decrease

may have led to a reduced number of connections. This has prompted the government to increase the FIT value for all full-building integration installations of 36-100kWc, whose FIT increases from 16.19 to 18.4 c€ per kWh or around 12%.

It is clear from Figure 16 that a strong correlation exists between PV feed-in tariffs and the number of PV connection requests.

5.4.4.2 Wind farms

Connection: If a wind farm installation seeking connection is rated less than or equal to 12MW capacity then it is connected to the distribution network. Installations with capacity greater than 12MW are connected to the transmission network.

Various mechanisms that fix the wind power prices are described below:

Responses to a call for tenders fix the prices

Some onshore and all offshore wind project proposals are requested by a call for tenders by the Ministry of Energy. The first call for tenders for 3000MW of offshore wind production in five areas in the west of France was launched in April 2012. The call for tenders stated that:

- The participant has to include technical, financial and environmental commitments.
- The feed-in price is proposed by the participant and the process can be seen as an "auction".

The selling tariff of energy produced is one of the parameters of a wind producer's offer, alongside with investment cost, technology, and environmental factors.

Subsidiaries of EDF won four out of the five areas of offshore wind farm installations whilst the fifth one was not attributed to any participant.

Another call for tenders for 2000MW is expected in the first Semester of 2013.

The government aims to reach the target of 6000MW of offshore wind production in France by 2020.

Figure 17 below indicates the criteria under which the schemes were assessed and their relative weights in the marking scheme

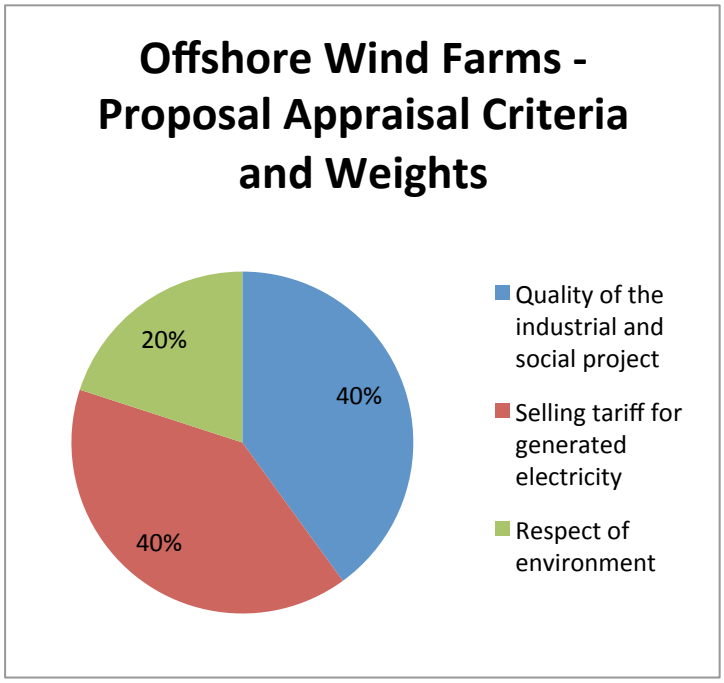


Figure 17 - Offshore Wind Farms Proposal Assessment

Other initiatives: Government set price resulting from the purchasing obligation

As a result of the purchasing obligation, state-fixed feed-in tariff exist for households and producers not participating in a tender process. The values are quoted in Figure 18.

	Period	Tariff (c€/kWh)
Onshore	0-10Y	8.2
	10-15Y	2.8-8.2
Offshore	0-10Y	13
	10-20Y	3-13

Figure 18 - FIT for wind production in France

5.4.4.3 Other renewables

The French government ensures through the Purchasing Obligation that a minimum Feed-In tariff exists for all renewable technologies and these values are quoted in Figure 19.

Type	Effective from	Duration of contracts (years)	Tariffs
Wind	17th November 2008	15/20	See Figure 11
Photovoltaic	4th March 2011	20	See Figure 11
Hydraulic	1st March 2007	20	**- 6.07 c€/kWh** + feed-in premium of **0.5- 2.5** for small installations +

			feed-in premium **0 – 1.68 c€/kWh** in winter depending on regularity of production **- 15 c€/kWh** for ocean energy
Geothermal	23rd July 2010	15	- **Mainland France** : **20 c€/kWh** , + feed-in premium depending on efficiency of **0 - 8 c€/kWh** - **Overseas territories (DOM)** : **13 c€/kWh** , + feed-in premium depending on efficiency of **0 - 3 c€/kWh**
Combined heat and power (CHP)[1]	31st July 2001	12	**6.1 to 9,15 c€/kWh** depending on gas price, operating time and power.
Burning household waste	2nd October 2001	15	**4.5 - 5 c€/kWh** + feed-in premium depending on efficiency of **0 – 0.3 c€/kWh**
Biomass (non vegetal and/or animal) +Gross or transformed (animal flour) animal wastes	27th January 2011	20	4.34 **c€/kWh** + feed-in premium tariff **7.71 – 12.53 c€/kWh** depending on power, resources used, and especially efficiency criteria.
Biogas	19th May 2011	15	**8.121 – 9.745 c€/kWh** depending on power + feed-in premium depending on efficiency of **0 – 4 c€/kWh**
Methanization	19th May 2011	15	**11.19 – 13.37 c€/kWh** depending on power feed-in premium depending on efficiency of **0 – 4 c€/kWh** + feed-in premium depending on manure processing of **0 - 2,6 c€/kWh**
Other installations (S < 36kVA)	13th March 2002	15	**7.87 – 9.60 c€/kWh**

Figure 19 - FIT for other renewable energies in France

1 Cogeneration (also combined heat and power, CHP) is the use of a heat engine or a power station to simultaneously generate both electricity and useful heat.

5.4.4.4 Funding of renewable energies

Tariff equalisation

One of the main principles in electricity billing in France is that each customer (mainland and overseas territories) has the same tariff for electricity, whatever investments have been made in the region or the income that is received from end-use customers within it. Thus, as shown in Figure 20 is that some regions make a significant loss, whilst others have profits or even large profits.

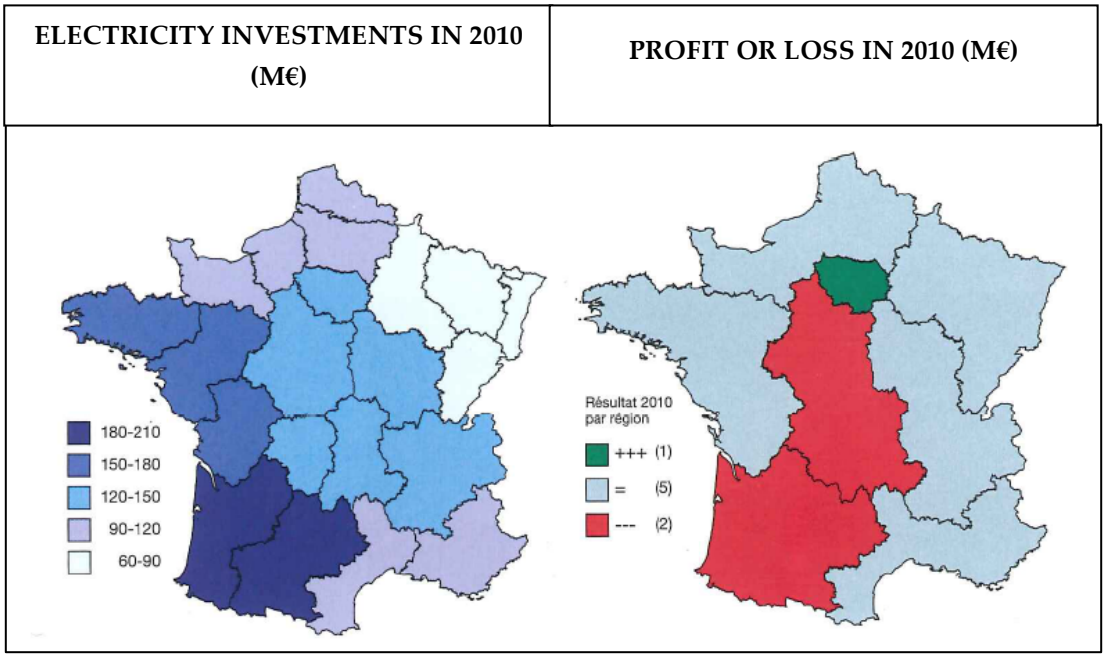


Figure 20 - Tariff equalisation

CSPE

CPSE can be defined as a tax on energy bills to finance renewable energies expansion

All investments of EDF (essentially state-owned) have to be paid by all customers one way or another (income tax or directly on the bill), and as result of tariff equalisation the location of the individual customer does not impact on the amount that is required to be paid.

The French government created in 2003 a tax on the electricity bill called CSPE (contribution to the public service of electricity). It was originally created to finance and support CHP and renewable technologies (essentially photovoltaic feed-in tariffs, onshore and offshore wind projects, and sustainable energy supplying in isolated areas). In 2011, it was allocated between the following categories:

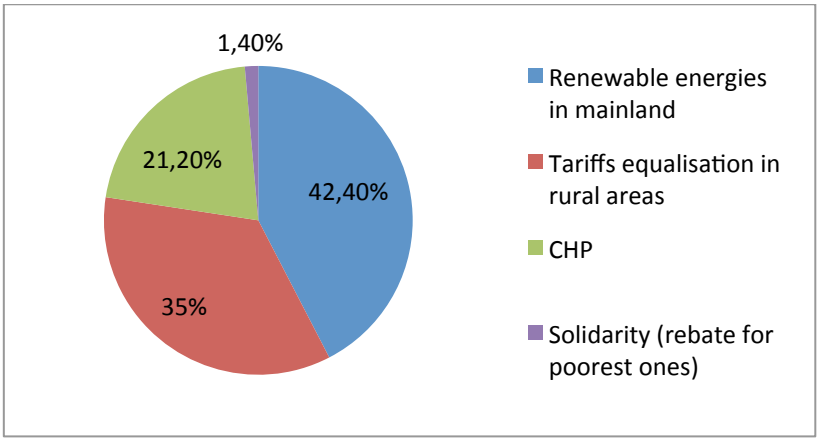


Figure 21 - Allocation of CSPE incomes

More precisely, in 2013 every domestic consumer will be paying 4€ per year via CSPE to sustain wind energy production. This has to be compared to the average 3000€ paid per year for energy by every household.

During year 2011 the CSPE increased from 4.5€ per MWh to 7.5€ per MWh which on average represented 8% of domestic energy bills. In 2012 the CSPE tax stands at 10.5€/MWh. Larger non domestic companies are also paying this tax, in some cases (the top 400 industrial companies) with a specific ceiling. Overall contributions are shown in Figure 22.

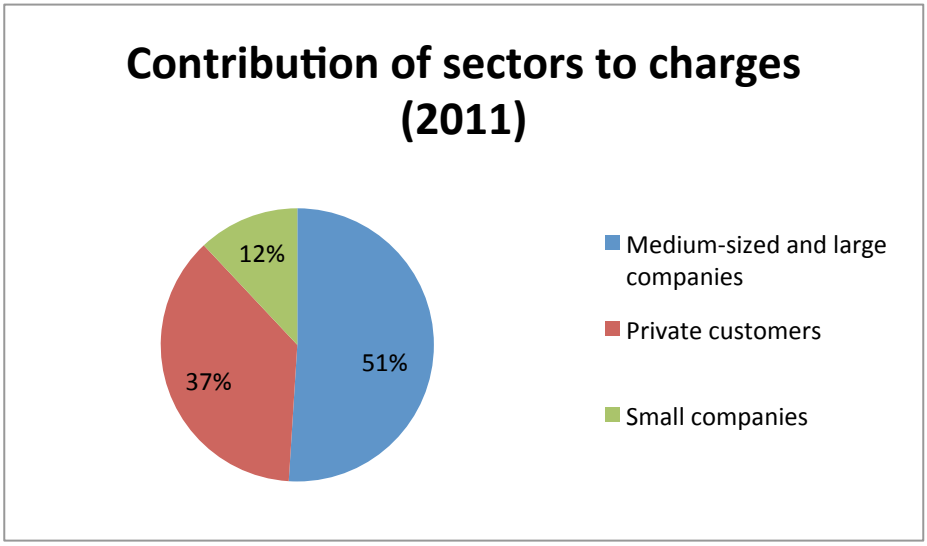


Figure 22 - Contribution of sectors to charges (2011)

5.4.5 Fiscal incentives

Eco-credit was launched in 2009; it represents a new type of financing option available to landlords for various refurbishment works that are carried out to improve the energy efficiency of a building.

Loans in the range of 10000€ to 30000€ are available depending on the nature and number of refurbishment works (less than 300€ per m2). The repayment of the loan is expected to be over 10 years.

Eligibility:

- **Technical**
  - Credit for the financing of certain categories of works including:
    - Set of operations improving energy efficiency
    - Operation(s) targeting a new level of energy efficiency:
      - consumption lower than 150kWhEP per m2 per year if consumption before refurbishment works was over 180 kWhEP per m2 per year;
      - consumption lower than 80 kWhEP per m2 per year if consumption before refurbishment works was less than 180 kWhEP per m2 per year.
  - Refurbishing a collective sanitation system with a solution based on renewable energy
- **Financial**
  - No minimum basic or income-tested benefits
  - Credit subscribed by the landlord/owner of the property

The eco-credit finance is designed to cover delivery and installation of new equipment and any associated operations including new air ventilation system and electrical operations.

5.4.6 Investment grants

5.4.6.1 At a national scale

Subvention fund for isolated areas

This national fund is managed by ADEME (French Agency for Environment and Energy Management), the state-founded national environment agency and is available to any installation capable of producing electricity by renewable means. This includes small and medium-sized domestic wind turbines.

This subvention fund covers up to:

- 90% of investment cost in rural areas
- 70% of investment cost in urban areas

For DOM (overseas territories) such as La Réunion, Martinique and Guyane, these subventions are higher.

Heat Fund ("Fonds Chaleur")

The Heating fund is also managed by ADEME. Basically it is an auction floor for projects linked to renewable energy. It selects the best renewable projects within eligible categories, and gives them an additional grant to any other of the more usual ones that the project may also be eligible to. Categories of eligible projects are the following:

- Solar thermal
- Geothermal
- Biomass
- Biogas and transformation of domestic wastes
- Heating networks

This fund has 1.2billion € to spend on a five-year period of time (2009-2014).

5.4.6.2 At a regional and local scales

Solar Energy

Solar investment grants depend on the region where the customer lives in France. These grants are provided by the region, the ADEME, local authorities (towns, groups of towns), and energy utilities. A wide range of policies have been set up in France, depending on the technology and region. Figure 23 to Figure 30 below provide more information about these arrangements.

"X" means this kind of grant exists in at least one region/town/utility in France

	Solar Water Heaters	Collective Solar Water Heaters	Combined Solar System	Photovoltaic for private customers	Photovoltaic for groups of customers
Global	X		X	X	
per m2	X	X			
per kWc		X		X	X
per kWh					X
per unit					
% of handwork	X				
% of total cost		X		X	X

Figure 23: Investment grants from Regions and ADEME - types

	Solar Water Heaters	Collective Solar Water Heaters	Combined Solar System	Photovoltaic for private customers	Photovoltaic for groups of customers
Global	X		X	X	
per m2	X	X	X	X	
per kWc					
per kWh				X	
per unit					

% of handwork			x	x	
% of material					
% of total cost		x			

Figure 24 - Investment grants from Local Authorities – types

	Solar Water Heaters	Collective Solar Water Heaters	Combined Solar System	Photovoltaic for private customers	Photovoltaic for groups of customers
Global	x				
per m2	x				
per kWc					
per kWh					
per unit	x				
% of handwork					
% of material					

Figure 25 - Investment grants from Utilities – types

average on values > 0	Region	number of regions	Local Authorities	number of regions	Utilities	number of regions
Grant (global)	935.71 €	*7*	349.71 €	*7*	250 €	*1*
% of handwork	33%	*3*	25%	*2*	-	
% of material	-	*1*	4%	*1*	-	
% of investment cost	-		-		-	
per kWc	-		-		-	
per m2	-		67.50 €	*5*	300 €	*1*
per kWh	-		-		-	
per unit	-		-		210 €	*2*

Figure 26 - Investment grants for Solar Water Heaters

average on values > 0	Region	number of regions (/27)	Local Authorities	number of regions (/27)	Utilities	number of regions (/27)
Grant (global)	-		-		-	
% of handwork	-		-		-	
% of material	-		-		-	
% of investment cost	50%	*11*	17%	*4*	-	
per kWc	-		-		-	
per m2	445 €	*5*	90.00 €	*3*	-	
per kWh	1.42 €	*5*	-		-	
per unit	-		-		-	

Figure 27 - Investment grants for Collective Solar Water Heaters

average on values > 0	Region	number of regions	Local Authorities	number of regions	Utilities	number of regions
Grant (global)	830.56 €	*9*	594.34 €	*11*	-	
% of handwork	-		28%	*5*	-	
% of material	-		-		-	
% of investment cost	-		-		-	
per kWc	-		-		-	
per m2	-		67.86 €	*5*	-	
per kWh	-		-		-	
per unit	-		-		-	

Figure 28 - Investment grants for Combined solar systems

average on values > 0	Region	number of regions (/27)	Local Authorities	number of regions (/27)	Utilities	number of regions (/27)
Grant (global)	750.00 €	*1*	327.26 €	*4*	-	
% of handwork	-		25%	*3*	-	
% of material	-		-		-	
% of investment cost	94.50%	*2*[2]	-		-	
per kWc	-		-		-	
per m2	-		100.00 €	*2*	-	
per kWh	-		1.00 €	*1*	-	
per unit	-		-		-	

Figure 29 - Investment grants for photovoltaic for domestic customers

average on values > 0	Region	number of regions (/27)	Local Authorities	number of regions (/27)	Utilities	number of regions (/27)
Grant (global)	-		-		-	
% of handwork	-		-		-	
% of material	-		-		-	
% of investment cost	50.00%	*4*	-		-	
per kWc	-		3,000.00 €	*3*	-	
per m2	-		-		-	
per kWh	0.60 €	*1*	-		-	
per unit	-		-		-	

Figure 30 - Investment grants for photovoltaic for groups of domestic customers

[2] Both are isolated overseas territories (Martinique and La Réunion)

5.4.7 Tax exemptions

5.4.7.1 Tax rebates

Consumption tax

VAT in France is a form of consumption tax. From the perspective of the buyer, it is a tax on the purchase price. From that of the seller, it is a tax only on the value added to a product, material, or service, from an accounting point of view, by this stage of its manufacture or distribution. The rate is usually 19.6%.

A rebate on purchase of renewable production and its installation

For the purchase and installation of renewable energy, this VAT is decreased to 5.5%.

A rebate on energy bills for customers subscribing to "green" heating suppliers

Besides, this VAT is also decreased down since 2002 to 5.5% on the electricity bill of any consumer having subscribed to a heating supplier whose heat is produced from at least 80% of renewable energies from biomass.

Finance tax

This "credit on taxes" has been set up by the Government in 2005 and applies to the total material cost, after deduction of consumption taxes and any subvention.

Some ceilings apply depending on the subscriber, as follows:

	Spending limits
For singles, divorced or widowed individuals	8000€
For couples paying taxes together	16000€
By additional adult/children	400€
By property rented	8000€

Figure 31 - Spending limits for the French credit on taxes

This is applied to the purchase of at least one (or more) of the following devices, and under certain conditions including technology, surface and the age of the property/building:

- generators using a renewable energy,
- heat pumps other than air/air aiming at producing heat or heated water (such as air/water or geothermal heat pumps),
- solar thermal installations,
- condensing boilers.

Also included are insulation works such as

- insulation of glazed walls and works relating to the improvement of the efficiency of a heating network,
- the insulation of a part or all of an asset of a heating network,
- the purchase of heating control systems or other equipment to a heating network.

The implementation of energy efficiency assessments is eligible as well.

Lastly, this credit can only cover a given percentage of material cost. The percentage depends on the equipment purchase as listed below in Figure 32:

Equipment/Provision	% of material cost considered as "credit on finance taxes"
Generators using a renewable source of energy other than solar	45%
Generators using solar as primary energy	22%
Air/Water Heat Pumps	22%
Geothermal Heat Pumps	36%
Solar Thermal	45%
Equipment for connection to a heating network	22%
Energetic efficiency assessment	45%

Figure 32 - Ceilings by type of equipment purchased for the French credit on taxes

The combination of finance credit with the eco-credit is possible, but this finance option is limited to 2 years and available only for low income households with an income of less than 45000€.

5.4.7.2 Tax exemptions

Tax exemptions, such as property tax exemption and tax exemption on renewable income are available for households or private customers with micro generation on site and the properties that have taken up some energy efficiency improvement works.

Property tax

This tax is the one any landlord/owner of a property has to pay every year.

Since 2007, local authorities may decrease property taxes by 50% or exempt landlords from paying them.

This applies to properties bought before 1st January 1989 for which the owner has undertaken refurbishment works improving energy efficiency. Eligible refurbishments works are the same as for the credit on taxes.

Some financial conditions apply: the total amount of money spent the year before exemption has to be over 10,000€ housing or the total amount of money spent the last 3 years before exemption has to be over 15,000€.

Tax on incomes from renewable production

The finance law of 2008 applies to any private customer producing electricity on site. It is applicable to photo voltaic installations and micro turbines etc. This law exempts the need to declare this income if the installed power capacity does not exceed 3kWc.

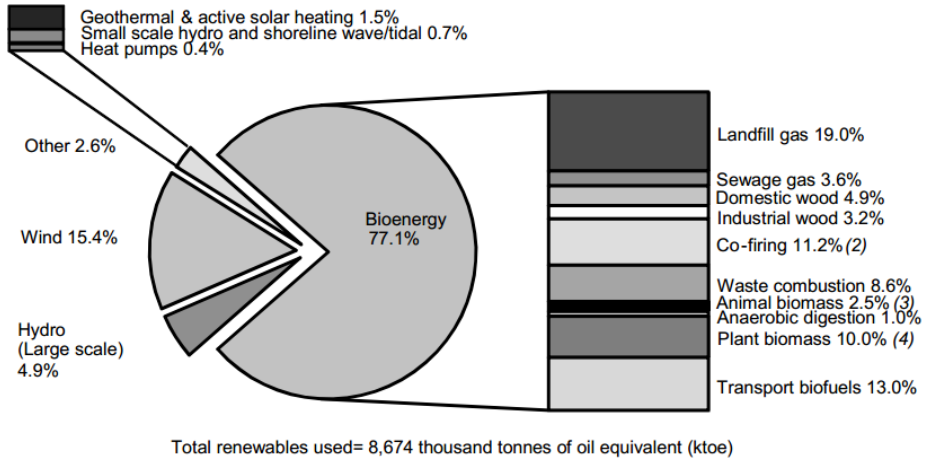
5.5 UK Energy incentives

The UK is committed to reducing its greenhouse gas emissions by at least 80% by 2050, relative to 1990 levels as well as other interim targets. In fact, the Climate Change Act 2008 established a legally binding target to reduce the UK's greenhouse gas emissions by at least this figure, to be achieved through action at home and abroad. To drive progress and set the UK on a pathway towards this target, the Act introduced a system of carbon budgets which provide legally binding limits on the amount of emissions that may be produced in successive five-year periods, beginning in 2008. The first three carbon budgets were set in law in May 2009 and require emissions to be reduced by at least 34% below base year levels in 2020. Figure 33 below sets out the details of the first four carbon budgets.

	First carbon budget (2008–12)	Second carbon budget (2013–17)	Third carbon budget (2018–22)	Fourth carbon budget (2023–27)
Carbon budget level (million tonnes carbon dioxide equivalent (MtCO2e))	3,018	2,782	2,544	1,950
Percentage reduction below base year levels	23%	29%	35%	50%

Figure 33 - UK Carbon Plan Budgets: 2008-2027

Between 2010 and 2011 electricity generation from renewable sources increased. The increase amounted to around one third - to reach 34.4 TWh. Capacity grew by a similar proportion (to 12.3 GW) over the same period (DECC, 2012). Figure 34 shows the capacity of, and the amounts of electricity generated from, each type of renewable source. Total electricity generation from renewables in 2011 amounted to 34,410 GWh, an increase of 8,565 GWh (plus 33%) on 2010. The largest absolute increase in generation came from onshore wind, rising by 3,235 GWh to 10,372 GWh (a 45 per cent increase on the previous year), reflecting increased installed capacity over the course of the year and also higher average wind speeds.



(1) Excludes all passive use of solar energy and all (540 ktoe) non-biodegradable wastes. In this chart renewables are measured in primary input terms.
(2) Biomass co-fired with fossil fuels in power stations; imported 10.5% of total renewables, home produced 0.7%
(3) 'Animal biomass' includes farm waste, poultry litter, and meat and bone combustion.
(4) 'Plant biomass' includes straw and energy crops.

Figure 34 - Percentage of sources renewable energy in the UK

A range of policy instruments are being used to encourage the meeting of these greenhouse gas emission targets – with different approaches being used in various parts of the economy. The following incentives related to electricity generation have been or are in use in the UK:

1. Renewable Obligation Certificate (ROC)
2. Feed-in Tariffs
3. Grants

Other policy instruments relating to transport and heat (i.e. the renewable heat incentive (RHI) and the renewable transport fuel obligation (RTFO)) are also being utilised.

5.5.1 Renewable Obligation Certificates (ROC)

The renewable obligation (RO) is currently the main financial mechanism by which the UK Government incentivises the deployment of large-scale renewable electricity generation. Support is granted for 20 years, which balances the need to provide investors with long-term certainty with the need to keep costs to consumers to a minimum.

Since the RO's introduction in 2002, it has succeeded in supporting the deployment of increasing amounts of renewables generation from 3.1GW in 2002 to 8GW in 2009 and more than tripling the level of renewable electricity in the UK from 1.8% in 2002 to 6.6% in 2010. It is currently worth around £1.3 billion a year in support to the renewable electricity industry.

In April 2010, the end date of the RO was extended from 2027 to 2037 for new projects to provide long-term certainty for investors and to ensure continued deployment of renewables to meet the UK's 2020 target and beyond.

The RO places a mandatory requirement on licensed UK electricity suppliers to source a specified and annually increasing proportion of electricity they supply to customers from eligible renewable sources or pay a penalty. The scheme is administered by the energy regulator, Ofgem, who issues Renewables Obligation Certificates (ROCs) to renewable electricity generators for every megawatt hour (MWh) of eligible renewable electricity they generate. Generators sell their ROCs to suppliers or traders which allows them to receive a premium in addition to the wholesale electricity price.

Suppliers present ROCs to Ofgem to demonstrate their compliance with the obligation. Where they do not present sufficient ROCs, suppliers have to pay a penalty known as the buy-out price. This is set at £40.71 per ROC for 2012/13 (this is linked to changes in retail prices). The money collected by Ofgem in the buy-out fund is recycled on a pro-rata basis to suppliers who presented ROCs. Suppliers that do not present ROCs pay into the buy-out fund at the buy-out price, but do not receive any portion of the recycled fund.

Thus, a ROC is a green certificate issued to an accredited generator for eligible renewable electricity generated within the UK and supplied to customers within the UK by a licensed electricity supplier. The number of ROCs issued for each megawatt hour (MWh) of eligible renewable output generated depends on the generating technology.

This is illustrated in the diagram below which shows

1) Generators providing renewable generation output information to Ofgem
2) Ofgem issuing ROC's in respect of the generation reported in 1)
3) Generators sell ROC's to electricity Suppliers
4) Suppliers present ROC's or payment - the buy-out (where they have insufficient ROC's) to fulfil the obligation.

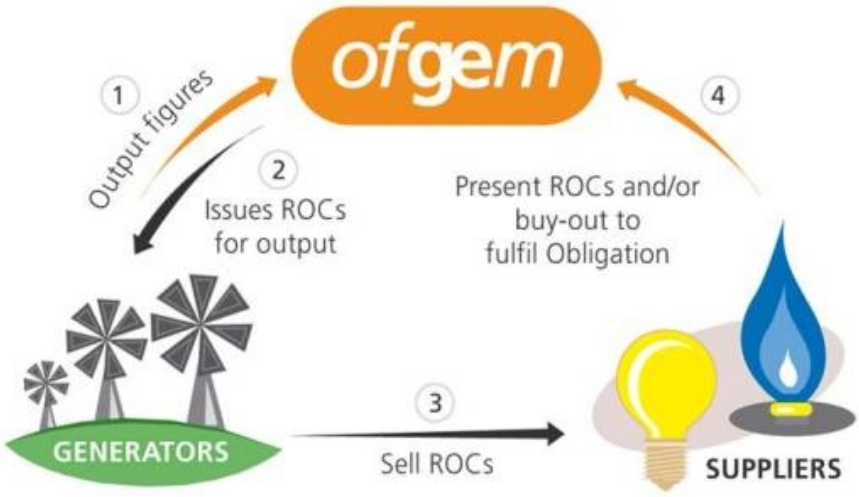


Figure 35 – UK Renewable Obligation: ROC flows

5.5.1.1 Supported level

ROCs are intended to create a market, and be traded at market prices that differ from the official buy-out price. If there is an excess of renewable production, beyond the supplier obligation, the price of ROCs would fall below the buy-out price. If there is less renewable production than the obligation, the price of ROCs would increase above the buy-out price, as purchasers anticipate later payments from the buy-out fund on each ROC.

Obligation periods run for one year, beginning on 1 April and running to 31 March. Supply companies have until the 31 September following the period to submit sufficient ROCs to cover their obligation, or to submit sufficient payment to the buy-out fund to cover the shortfall. Figure 4 below shows the percentage of the amount that they supply that electricity suppliers are required to source from renewable generation and the buy-out price to be paid for any of this which is not achieved for the period from 2002/03 to 2012/13.

Obligation period (1st April - 31st March)	Buy-out price	Obligation for England & Wales and Scotland (ROCs per MWh of electricity supplied)	Obligation for Northern Ireland (ROCs per MWh of electricity supplied)
2002-2003	£30.00	0.030	
2003-2004	£30.51	0.043	
2004-2005	£31.39	0.049	
2005-2006	£32.33	0.055	0.025
2006-2007	£33.24	0.067	0.026
2007-2008	£34.30	0.079	0.028
2008-2009	£35.76	0.091	0.030
2009-2010	£37.19	0.097	0.035
2010-2011	£36.99	0.111	0.0427
2011-2012	£38.69	0.124	0.055
2012-2013	£40.71	0.158	0.081

Figure 36 - UK Renewable Obligation: Percentage of supply and buy-out price – 2002/03 to 2012/13

5.5.1.2 Bands of support: Technology

When the renewable obligation was first introduced in 2002 there was no differentiation between the renewable generation technologies used to generate electricity, qualify for ROC's, and thus fulfil the renewable obligation. However in 2009 bands of support were introduced which allowed the RO to offer varied support levels by technology. The UK Government indicated that these bands would be set for four years and then reviewed. The decisions resulting from the first review of these bands which are for implementation in April 2013 for the following four year period until 2017 have recently been announced.

The Government stated during the recently completed consultation process that its aims for the banding review were to:

- Ensure that support levels under the RO will support renewables growth to help meet our 2020 and interim renewables target
- Drive greater value for money in the operation and support levels set under the RO

- Support technologies with the potential for mass deployment
- Ensure coordination with other Government financial incentive schemes
- Contribute to the effective delivery of wider energy and climate change goals to 2050, including greenhouse gas emissions reductions, decarbonising the energy sector and ensuring energy security.

This review was broad and complex and is publicly available. The detailed proposals seem aimed at limiting costs to customers, focusing support where it is needed most, and recognising that certain technologies are likely to become economic and self sustainable.

The position regarding two of the technologies is reported below.

However firstly it may be worth outlining in a little more detail how the technology banded RO works. In brief, each MWh of electricity generated by a renewable generator qualifies for a certain number of ROC's depending on the technology. Thus in the period 2009 to 2013 this support level generally fell in the range 0.25 to two. Specifically for onshore wind the figure was one and for solar PV it was two i.e. each MWh of electricity generated from on-shore wind qualified for one ROC whereas each MWh of electricity generated from solar PV qualified for two ROCs.

Solar Photovoltaics (PV)

The UK government's initial proposals - that it publicly consulted on - were to maintain the support level at two ROCs per MWh for 2013/14 and 2014/15 and then to decrease this to 1.9 and 1.8 ROCs per MWh for 2015/16 and 2016/17 respectively.

However in its recently published (July 2012) decision document these have been substantially amended. Despite arguments from industry that further support was required the Government has concluded that its aim is to encourage cost-effective deployment of solar PV through the RO but that costs had continued to fall dramatically since the original consultation was published and new evidence has become available which indicates that the level of support proposed in the consultation would substantially over-reward this technology.

Analysis of the new evidence by the government suggests that RO support rates should be set significantly lower than was proposed in the consultation. Because such a reduction in support would represent a significant departure from the consultation proposals and would be based largely on new evidence it has been considered appropriate to re-consult on the issue. Thus a consultation will shortly be published on proposals for reduced ROC support for solar PV generating stations which accredit or add additional capacity on or after 1 April 2013.

Onshore wind

The support level for onshore wind will be reduced from one ROC per MWh to 0.9 ROCs per MWh for 2013/14 onwards. In addition a further call for evidence is to be made which could lead to a further reduction later in the period.

5.5.2 Feed-in tariffs

This instrument fits into the feed-in tariffs category outlined in Section 2 above.

The Feed-in Tariffs (FITs) scheme was introduced on 1 April 2010, under powers in the UK Energy Act 2008. Through the use of FITs, the UK government hopes to encourage deployment of additional small-scale (less than 5MW) low-carbon electricity generation, particularly by organisations, businesses, communities and individuals that have not traditionally engaged in the electricity market.

This will allow many people to invest in small-scale low-carbon electricity, in return for a guaranteed payment from an electricity supplier of their choice for the electricity they generate and use as well as a guaranteed payment for unused surplus electricity they export back to the grid.

5.5.2.1 Technologies supported

Small-scale low-carbon electricity technologies eligible for FITs are:

- wind
- solar photovoltaics (PV)
- hydro
- anaerobic digestion
- domestic scale microCHP (with a capacity of 2kW or less) – although this is subject to review as the volume of installations increase.

5.5.2.2 Supported level

There are three financial benefits for the small-scale generator from FITs:

- Generation tariff – the electricity supplier of the generators choice will pay for each unit (kilowatt) of electricity generated throughout the lifetime of the installation's eligibility for FITs payments.
- Export tariff – if electricity is generated that is not used by the generator it can be exported to the grid for an additional payment (on top of the generation tariff)
- Energy bill savings – not as much electricity will need to be imported from your supplier because a proportion of what has been used will have generated by the generator thus reducing the electricity bill.

The Feed-in tariffs are adjusted annually for retail inflation by being linked to the Retail Price Index (RPI).

The Feed-in tariffs are adjusted annually for retail inflation by being linked to the Retail Price Index (RPI). DECC have released the results of their latest PV Feed-in Tariff consultation which will introduce new lower rates for installations from 1st August 2012 (See Figure 37).

Band (kW)	Standard generation tariff (p/kWh)	Multi-installation tariff (p/kWh)	Lower tariff (if energy efficiency requirement not met) (p/kWh)
• 4kW (new build)	16.0	14.4	7.1
• 4kW (retrofit)	16.0	14.4	7.1
>4-10kW	14.5	13.05	7.1
>10-50kW	13.5	12.15	7.1
>50-100kW	11.5	10.35	7.1
>100-150kW	11.5	10.35	7.1
>150-250kW	11.0	9.9	7.1
>250kW-5MW	7.1	N/A	N/A
stand-alone	7.1	N/A	N/A

Figure 37 - New PV feed-in tariffs from 1st of August 2012

5.5.2.3 Cost of metering

The payment of export tariffs is based on either metered or estimated quantities. At the start of the FITs scheme it was made clear that payment of export tariffs based on deemed or estimated values was an interim measure and that all FITs payments should where possible be made on the basis of accurately metered electricity flows. However, the cost of metering and registering small quantities of electricity in the electricity market systems makes this uneconomic at present at the smallest scale (up to 30 kW). This is expected to change with the rollout of smart meters, but not therefore in the immediate future. The amount of electricity that is deemed to be exported by different categories of accredited FITs installations with a total installed capacity of up to 30 kW that is not measured by export meters is determined annually by the Secretary of State.

This is currently estimated to be 50% for small scale PV generators.

5.5.3 Grants

Whilst the UK previously had a number of schemes which provided grants for renewable generation, particularly PV, these have now substantially been replaced by Feed-in Tariffs and the renewable heat incentive.

5.5.4 Renewable Heat Incentive (RHI)

- The RHI's objective is to increase significantly the level of renewable heat;
- Non-domestic sectors will be have an RHI tariff from the outset – the industrial and commercial sectors; the public sector, not-for-profit organisations and communities;

- RHI Premium Payments will be available in 2011 and RHI tariffs will be introduced from 2012 alongside the Green Deal for homes.
- Ofgem will administer the RHI tariff scheme; and
- Owners of eligible installations for the RHI tariff scheme to apply to Ofgem for support.

5.5.4.1 Technologies supported

Biomass, solar thermal, heat-pumps, on-site biogas, deep geothermal, energy from waste and injection of biomethane into the gas grid;

5.5.4.2 Supported level

- RHI tariff levels have been designed to bring forward a wide range of renewable heat technologies, including heat pumps, solar thermal and various types of bio-heat such as biomass and biomethane;
- The RHI focuses on cost-effective technologies and fuels such as large-scale industrial or commercial installations using biomass;
- The principle for setting the tariffs has been to base them on the costs of each technology plus providing a return on capital, in order to provide sufficient support but at the same time avoid over-subsidising; and
- Compensation is provided only for additional costs of renewable technologies over fossil fuel heating.

Payments will be calculated by multiplying the appropriate tariff (depending on the technology and size of the installation) by the eligible heat use. The eligible heat use will be metered actual generation or use.

Levels of support					
Tariff name	**Eligible technology**	**Eligible sizes**	**Tariff rate (pence/ kWh)**	**Tariff duration (Years)**	**Support calculation**
Small biomass	Solid biomass; Municipal Solid Waste (incl. CHP)	Less than 200 kWth	Tier 1: **7.6**	20	Metering Tier 1 applies annually up to the Tier Break, Tier 2 above the Tier Break. The Tier Break is: installed capacity x 1,314 peak load hours, i.e.: **kWth x 1,314**
			Tier 2: **1.9**		
Medium biomass		200 kWth and above; less than 1,000 kWth	Tier 1: **4.7**		
			Tier 2: **1.9**		
Large biomass		1,000 kWth and above	**2.6**		Metering
Small ground source	Ground-source heat pumps; Water-source heat pumps; deep geothermal	Less than 100 kWth	**4.3**	20	Metering
Large ground source		100 kWth and above	**3**		
Solar thermal	Solar thermal	Less than 200 kWth	**8.5**	20	Metering
Biomethane	Biomethane injection and biogas combustion, except from landfill gas	Biomethane all scales, biogas combustion less than 200 kWth	**6.5**	20	Metering

Figure 38 – UK Renewable Heat Incentive (RHI): Levels of Support [9]

5.5.5 Renewable Transport Fuel Obligation (RTFO)

The Renewable Transport Fuel Obligation (RTFO) in the United Kingdom is a requirement on transport fuel suppliers to ensure that 5 percent of all road vehicle fuel is supplied is from sustainable renewable sources by 2010. The Government intends to set variable targets for the level of carbon and sustainability performance expected from all transport fuel suppliers claiming certificates for biofuels in the early years of the RTFO.

The RTFO will help bring the UK into line with European Union biofuels directive, which sets targets for all EU countries for biofuel usage of 2% by the end of 2005 and 5.75% by the end of 2010.

The RTFO will be implemented through a certification scheme administered by the Renewable Fuels Agency. Companies certified as having sold more than the 5% obligation will be able to sell their certificates for the excess to those who sold less.

5.6 European Union (EU) Renewable Generation Incentives and Policy Instruments

The EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources (RES) sets an overall target to reach 20% of gross final energy consumption being produced from renewable sources by 2020.

Figure 39 below provides an overview of the renewable electricity support instruments that are in place in the EU Member States. As outlined in Section 2 six categories of support instruments have been identified as follows:-

- feed-in tariff;
- premium;
- quota obligation;
- investment grants;
- tax exemptions; and
- fiscal incentives.

Country	FIT	Premium	Quota obligation	Investment grants	Tax exemptions	Fiscal incentives
AT	x					
BE	x		x	x	x	
BG	x			x		x
CY	x			x		
CZ	x	x				
DE	x					x
DK		x				
EE	x	x				x
ES	x	x			x	
FI				x	x	
FR	x					
GR	x			x	x	
HU	x			x		
IE	x					
IT	x		x			
LT	x			x		
LU	x			x		
LV	x			x	x	
MT	x			x		x
NL		x			x	x
PL			x		x	x
PT	x					
RO			x			
SE			x		x	

Country	FIT	Premium	Quota obligation	Investment grants	Tax exemptions	Fiscal incentives
SI	x	x				x
SK	x				x	
UK	x		x		x	

Figure 39 - An overview of the renewable electricity support instruments that are in place in EU Member States. Source: [7].

5.6.1 Feed-in tariffs (FITs)

FITs are currently in use in many EU countries. Prices are in Euros per kilowatt-hour (€/kWh). '0.29-0.46' is a price range from 0.29 €/kWh to 0.46 €/kWh, depending on the amount produced. Figure 40 below provides feed-in tariffs by EU country and technology (prices valid for April 1st, 2010).

Member state	Windpower 'On-shore'	Wind power 'Off-shore'	Solar PV	Biomass	Hydro
Austria	0.073	0.073	0.29 - 0.46	0.06 -0.16	n/a
Belgium	n/a	n/a	n/a	n/a	n/a
Bulgaria	0.07 - 0.09	0.07 - 0.09	0.34 - 0.38	0.08 - 0.10	0.045
Cyprus	0.166	0.166	0.34	0.135	n/a
Czech Republic	0.108	0.108	0.455	0.077 - 0.103	0.081
Denmark	0.035	n/a	n/a	0.039	n/a
• Estonia	0.051	0.051	0.051	0.051	0.051
Finland	n/a	n/a	n/a	n/a	n/a
France	0.082	0.31 - 0.58	n/a	0.125	0.06
Germany	0.05 - 0.09	0.13 - 0.15	0.29 - 0.55	0.08 - 0.12	0.04 - 0.13
Greece	0.07 - 0.09	0.07 - 0.09	0.55	0.07 - 0.08	0.07 - 0.08
Hungary	n/a	n/a	0.097	n/a	0.029 - 0.052
Ireland	0.059	0.059	n/a	0.072	0.072
Italy	0.3	0.3	0.36 - 0.44	0.2 - 0.3	0.22
Latvia	0.11	0.11	n/a	n/a	n/a
Lithuania	0.1	0.1	n/a	0.08	0.07
Luxembourg	0.08 - 0.10	0.08 - 0.10	0.28 - 0.56	0.103 - 0.128	0.079 - 0.103
Malta	n/a	n/a	n/a	n/a	n/a
Netherlands	0.118	0.186	0.459 - 0.583	0.115 - 0.177	0.073 - 0.125
Poland	n/a	n/a	n/a	0.038	n/a
Portugal	0.074	0.074	0.31 - 0.45	0.1 - 0.11	0.075
Romania	n/a	n/a	n/a	n/a	n/a
Slovakia	0.05- 0.09	0.05- 0.09	0.27	0.072 - 0.10	0.066 - 0.10
Slovenia	0.087 - 0.094	0.087 - 0.095	0.267 - 0.414	0.074 - 0.224	0.077 - 0.105

Member state	Windpower 'On-shore'	Wind power 'Off-shore'	Solar PV	Biomass	Hydro
Spain	0.073	0.073	0.32 - 0.34	0.107 - 0.158	0.077
Sweden	n/a	n/a	n/a	n/a	n/a
United Kingdom	0.31	n/a	0.42	0.12	0.23

Figure 40 – Feed-in Tariffs by EU country and technology (April 2010) [8]

5.6.2 Feed-in Premium system

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.

5.6.3 Renewable or quota obligations

As previously explained, in this case 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.

An 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).

5.6.4 Investments grants

Investment grants are sometimes available and are often devised to stimulate the take-up of less mature technologies such as photo-voltaics.

5.6.5 Tax incentives or exemptions

Again, as previously mentioned, some countries 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). Some other countries 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.

5.6.6 Fiscal incentives

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.

5.6.7 Tender

These are sometimes used for larger-scale projects and most commonly for offshore wind. 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.

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