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RÉPUBLIQUE FRANÇAISE

NOTE FROM THE FRENCH AUTHORITIES

RE.: Report pursuant to Article 10(1) of Directive 2004/8/EC of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market

The French authorities have the honour to submit to the European Commission (DG TREN) the report pursuant to Article 10(1) of Directive 2004/8/EC of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market

The French authorities wished to produce a global report integrating the presentation of the system of guarantee of origin, the evaluation of the existing legislative and regulatory framework and the results of an appraisal of the potential of high-efficiency cogeneration. However, the present report does not include the study of this potential: as an initial study on the subject proved inconclusive, a new study will be submitted shortly to supplement this report.

GENERAL DIRECTORATE FOR ENERGY AND RAW MATERIALS

Report pursuant to Article 10(1) of Directive 2004/8/EC of 11 February 2004

System of guarantee of origin
Administrative procedures associated with cogeneration installations

Articles of Directive 2004/8/EC
applicable to this report:

Article 10(1) of Directive 2004/8/EC:

"Member States shall, not later than 21 February 2006, publish a report with the results of the analysis and evaluations carried out in accordance with Articles 5(3), 6(1), 9(1) and 9(2)."

Article 5(3) of Directive 2004/8/EC:

"Member States or the competent bodies shall put in place appropriate mechanisms to ensure that the guarantee of origin is both accurate and reliable and they shall outline in the report referred to in Article 10(1) the measures taken to ensure the reliability of the guarantee system."

Article 9 of Directive 2004/8/EC:

"Member States or the competent bodies appointed by the Member States shall evaluate the existing legislative and regulatory framework with regard to authorisation procedures or the other procedures laid down in Article 6 of Directive 2003/54/EC, which are applicable to high-efficiency cogeneration units. Such evaluation shall be made with a view to:

a) encouraging the design of cogeneration units to match economically justifiable demands for useful heat output and avoiding production of more heat than useful heat;
b) reducing the regulatory and non-regulatory barriers to an increase in cogeneration;
c) streamlining and expediting procedures at the appropriate administrative level; and
d) ensuring that the rules are objective, transparent and non-discriminatory, and taking fully into account the particularities of the various cogeneration technologies."

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FOREWORD

The French authorities wished to produce a global report integrating the presentation of the system of guarantee of origin, the evaluation of the existing legislative and regulatory framework and the results of an appraisal of the potential of high-efficiency cogeneration.

However, the present report does not include the study of this potential: an initial study on the subject, conducted by the student engineers of a Junior Enterprise, proved inconclusive, mainly due to the conceptual difficulty of carrying out the evaluation of potentials. A new study will therefore be commissioned shortly to supplement this report.

INTRODUCTION

The simultaneous production of heat and electricity in a single process offers several benefits which result from the recovery and utilisation of the heat produced by cogeneration, whereas in the case of thermal power stations, the steam passed through a turbine to produce electricity is then discarded into the environment.

Cogeneration is therefore characterised by an excellent energy efficiency. It allows primary energy savings compared with separate productions of electricity (power stations) and heat (users' boilers). Cogeneration is also interesting in terms of the diversification of the electricity production stock and as a decentralised means of production may under certain conditions allow the development costs of electricity networks and losses in lines to be avoided.

It may constitute a competitive factor for enterprises that require large amounts of steam (chemistry, paper industry, sugar industry, automobile industry, etc.). By combining steam production with electricity production, either for auto-consumption or sold to the network, cogeneration can cut their energy bill and emissions of pollutants, reduce sensitivity to changes in energy costs and guarantee emergency electrical power in the event of an incident on the public network.

Cogeneration is also an attractive energy solution for the tertiary sector (hospitals, airports, schools, etc.) as well as for local authorities (heating networks supplying complexes of buildings and energy recovery from household waste).

Finally, on the environmental front, cogeneration's record in terms of emissions is generally considered to be positive. This is undeniably the case when the electricity produced by cogeneration acts as a substitute for electricity production based on fossil fuels. However, this record has to be qualified within the specific context of the French electricity system, where most of the centralised production is provided by nuclear and hydraulic power stations, which do not emit greenhouse gases.

The interest and stakes associated with the development of cogeneration on an energy and industrial level led the French Public Authorities to introduce a specific policy in aid of the development of this energy system which fits into the general framework of a global energy policy based in particular on the multiannual programmes of investments in electricity production.

Thus, measures were taken to put in place a legal, fiscal, technical and economic framework to encourage its development. These measures have proved effective, since they are now represented by a large number of cogeneration installations in all sectors of the industry, both tertiary and heating networks, for the entire power range from several hundred electrical kW to a hundred or so electrical MW.

The production of electricity by cogeneration installations now represents a significant part of France's classic thermal electricity production (flame generating stations), in the order of 40%. From the point of view of total electricity production, cogeneration remains under-developed in France in comparison with our European neighbours, but this can be explained by France's choice to favour nuclear development, allowing electricity to be produced at low cost and with few carbon dioxide emissions.

1. THE SYSTEM OF GUARANTEE OF ORIGIN

1.1 Description of the system

In accordance with the provisions of the Directive, the French authorities have transposed the guarantee of origin system specified in Article 5 of this Directive by Article 33 of Programme Law No 2005-781 of 13 July 2005 establishing energy policy guidelines. This Law is supplemented in particular by a Decree in Council of State No 2006-1118 of 5 September 2006 on the guarantees of origin of the electricity produced from renewable energy sources or by cogeneration. All these texts have been sent to the Commission.

These provisions ensure the transposition of the system for guaranteeing the origin of the electricity produced by cogeneration but also from renewable energy sources. Article 5 of Directive 2004/8/EC of 11 February 2004 on the promotion of cogeneration based on a useful heat demand provides for a guarantee of origin system identical to that of Directive 2001/77/EC, and the French authorities felt it was appropriate to put in place a common system for the production of electricity from renewable sources and by cogeneration.

The French authorities have put in place a system for issuing guarantees of origin which ensures greater reliability.

To avoid a request for a guarantee of origin being made purely by the producer entering in a database elements relating to a production and this leading, automatically and without verification, to a guarantee of origin being issued, the French authorities have decided to entrust this issuing to the bodies that manage the existing meters which measure the quantities of electricity in question fed into the public transmission and distribution systems.

The French system stipulates that the request for a guarantee of origin be addressed to the operators of the distribution systems or of the transmission system depending on whether the installation is connected to a distribution system or a transmission system. If the installation is not connected to the system or the electricity is produced for own consumption, it is the operator of the transmission system to whom the request should be sent and who defines the metering conditions in agreement with the applicant.

The reliability of this system also results from the provision stipulating that the start and end dates of the production periods for which guarantees of origin may be requested must coincide with the meter data recording dates of the grid access contracts, which facilitates the controls of the body that issues the guarantees of origin. The operators of the systems in question are best placed to verify these criteria.

The guarantees of origin thus issued are entered in a national register of guarantees of origin managed by the sole operator of the electricity transmission system. Certain elements of this register are accessible to the public on the website of the transmission system operator at the following address:
http://www.rte-france.com/htm/fr/offre/offre_garanties.jsp

In accordance with the Directive, the French authorities feel that bodies whose activities involve the production, sale and supply of energy should logically not be involved in operating the system. It is therefore the operators of the transmission and distribution systems who have been appointed to issue guarantees of origin reliably, efficiently and neutrally. It should be pointed out that operators of transmission or distribution systems provide the same function, each operating a network level according to the voltage levels concerned.

Thus, the bodies chosen to issue guarantees of origin guarantee equal treatment for all producers. This equality of treatment is backed up by an issuing procedure which allows any electricity-producing installation to benefit from guarantees of origin (requests from producers whose installations are not connected to the system or who auto-consume are managed directly by the operator of the electricity transmission system responsible for the metering conditions). The cost of issuing a guarantee of origin is fixed by the State (Article 10 of Decree 2006-1118 of 5.06.2006, Order of 26.09.2006 fixing the price for

issuing guarantees of origin) and is a function of the actual cost incurred by the operator on the basis of the costs run up by the system operators. No threshold for quantity generated is set for submitting a request.

1.2 Initial results

No guarantee of origin has yet been issued for electricity produced by cogeneration.

The system of guarantees of origin was finalised by Order of 8 November 2007, published on 14 November 2007, which specifies the technologies, the performance criteria of the cogeneration processes and the calculation methods allowing the electricity cogenerated to be identified. This text transposes the criteria of the Directive but also the harmonised reference efficiency values for the separate production of electricity and heat defined pursuant to the Directive by decision of the Commission of 21 December 2006, published in the Official Journal of the European Union of 6 February 2007.

This Technical Order allowed for an entry into force deferred by six months from the date of its publication in the Official Journal of the French Republic at the express request of the bodies responsible for issuing guarantees of origin, who justified their request by the need for their tool to evolve in order to allow requests for guarantees of origin to be processed on an industrial scale. A considerable amount of work was needed to reconfigure the information systems in order to take account of the many parameters involved in producing the guarantees of origin associated with the application of this Order.

However, it should be made clear that the initial technical results of the issuing of guarantees of origin concerning electricity produced from renewable energy sources are satisfactory: 297 guarantees of origin were issued in 2007 for a volume of 32 856 735 MWh, these guarantees of origin relating to annual, half-yearly and monthly periods and to production for 2006 and 2007. The issue and publication time-limits are respected (19 days on average to issue a guarantee, whereas the regulatory time-limit is set at 30 days and a monthly publication frequency in the register of guarantees on the transmission system operator's website).

2. THE LEGISLATIVE AND REGULATORY FRAMEWORK OF COGENERATION INSTALLATIONS WITH REGARD TO AUTHORISATION PROCEDURES (ARTICLE 9 OF THE DIRECTIVE)

3.1 The operating system for electricity-producing installations

The activity of electricity production is a competitive activity carried on under a system of ministerial authorisations provided for by the Act of 10 February 2000 on electric utilities. This system corresponds to the procedure provided for in Article 6 of Directive 2003/54/EC. Requests for authorisation to operate or the operational declaration are sent to the minister for energy in accordance with the thresholds in the following table:

Regulation of the operation of electricity-producing installations	Authorisation	Declaration
New electricity-producing installation, or replacement of an existing installation	If the installed electrical power is greater than 4.5 MW	If the installed electrical power is less than 4.5 MW
Increase in the installed power of a production installation with an initial power greater than 4.5 MW	If the increase, alone or combined with other modifications, is greater than 10%	If the increase is less than 10%
Increase in the installed power of a production installation with an initial power less than 4.5 MW	If the increase takes the installed power beyond 4.5 MW	If the increase keeps the installed power below 4.5 MW
Change in primary energy	If the installed power is greater	If the installed power is less than

	than 4.5 MW, new authorisation	4.5 MW, new declaration

3.2 The system of classified installations for environmental protection

In connection with controlling the prevention of pollution and industrial risks, legislation on classified installations for environmental protection constituting the legal basis of the industrial environment policy in France has been drawn up and codified in Title I of Book V of the Environmental Code. Apart from nuclear installations and mines (which are covered by other legislation), it covers all industrial activities, intensive farming and waste processing.

The legislation for classified installations puts in place a system where the industrial activities covered by this legislation are listed in a schedule which subjects them either to an authorisation system or a declaration system.

Declaration concerns the least polluting or least dangerous activities. It consists of notifying one's activity to the prefect and of satisfying standardised requirements. Authorisation concerns the most polluting or most dangerous activities. Compared with the requirements of declaration, which are standardised, the requirements of authorisation are drawn up on a case-by-case basis, tailor-made.

These regulations therefore lay down a declaration or authorisation procedure for combustion installations according to their installed power.

Authorisation is required if the maximum thermal power of the installation is greater than or equal to 20 MW, while a simple declaration is required when the maximum thermal power of the installation is greater than 2 MW and less than 20 MW. The maximum thermal power is defined as the maximum quantity of fuel, expressed as a net calorific value, to be consumed per second.

ANNEXES

1 - THE FRENCH STOCK OF COGENERATION EQUIPMENT

2 - THE LEGISLATIVE AND REGULATORY FRAMEWORK OF COGENERATION INSTALLATIONS

ANNEX 1
THE FRENCH STOCK OF COGENERATION EQUIPMENT

The data presented in this annex present the results of a study carried out in 2005 by CEREN (centre d'études et de recherches économiques sur l'énergie = Research Centre for Economic Studies of Energy) on **the French stock of cogeneration equipment as at 31 December 2003**. The data from this study remain necessary inasmuch as they concern all cogeneration equipment and the stock has remained globally stable since this date, albeit with the closure of certain installations in particular equipped with steam turbines and a falling energy production due to the rise in the price of fossil fuels, especially natural gas.

1.1 - French stock of cogeneration equipment

On this date, the existing stock of cogeneration equipment in France is estimated at 1 488 units, with a total power in terms of electricity of 6 669 MW and heat of 20 489 MW. Annual energy production is 25.3 TWh of electricity and 68 TWh of heat in 2003. Consumption of fuels is 120 TWh or 10.3 Mtep. This equipment is installed in 832 installations.

Number of units	1 488
Electrical power (MW)	6 669
Electrical power in cogeneration (MW) [3]	6 336
Calorific power (MW)	20 489
Production[1] of electricity (GWh)	25 262
Production of cogenerated electricity (GWh) [3]	23 408
Sale of electricity (GWh)	17 168
Production[2] of heat (GWh)	68 009
Consumption of fuels (GWh)	119 773

1.2 - French stock of cogeneration equipment by type of unit

	Steam turbines	Combustion turbines	Combustion engines	TOTAL
Number of units	267	227	994	1 488
Electrical power (MW)	1 914	3 268	1 488	6 669
Calorific power (MW)	13 713	5 118	1 657	20 489
Production of electricity (GWh)	7 320	13 375	4 567	25 262
Production of heat (GWh)	43 941	19 287	4 781	68 009
Consumption of fuels (GWh)	64 767	42 475	12 530	119 773
Ratio heat/electricity (kWhth/kWhe)	6.0	1.4	1.05	2.7
Global efficiency (%)	79%	77%	75%	78%
Electrical efficiency (%)	11%	31%	36%	21%

[1] the production requested in the questionnaire is net production (i.e. the auto-consumption of the cogeneration equipment is taken off)
[2] at the outlet of the recovery exchanger (or exchangers).
[3] the concepts of power and production of cogenerated electricity are taken from Eurostat definitions

Despite high sales from combustion turbines and combustion engines in recent years, the existing stock of cogeneration installations remains characterised by the predominance of steam turbines.

Conversely, it is the combustion turbines that generate by far the majority of the electricity produced (53% compared with 50% in 2002) and which have the greatest electrical power (more than 3 000 MW).

However, this majority share of steam turbines is falling noticeably: the stock of steam turbines has hardly changed since 31 December 1993, while the stock of combustion turbines has multiplied by 3 and that of thermal engines by 6. Comparison of our two successive surveys corroborates this development, since the number of steam turbines falls significantly between 2002 and 2003 while the number of combustion turbines increases. The proportion of steam turbines, estimated at 65% of heat production, was in the order of 73% in 2002.

The stock currently under construction distinguishes itself completely from the existing stock by the small number of steam turbines, the extremely high number of combustion engines and the predominance of combustion turbines in the commissioned power.

- Steam turbines

The steam turbine remains a cogeneration technique that provides a lot of energy:

267 units (most of which have a power of between 2 and 20 MW: 80%), or 18% of the stock of cogeneration equipment.

Power: 1 914 MW_e, or 29% of the total, and **13 713 MW_{th}**, or 67% of the total.

Production: 7.3 TWh_e, or 29% of the total, and **44 TWh_{th}**, or 65% of the total.

74% of these are back-pressure steam turbines, 15% condensing steam turbines with bleeding, 11% back-pressure steam turbines with bleeding. The power of this equipment is considerable, with an average electrical power of 7 MW.

Their energy efficiency is high, with an average of 79%. Their electrical efficiency is low, around 11%.

Steam turbines are very old, with 47% of the stock more than 30 years old.

- Combustion engines

Engines are the predominant cogeneration technique used in terms of the stock:

994 units (with a power greater than 100 kW), or 67% of the stock.

The stock is very young, and expanded considerably at the end of the 1990s, growing by 150% in 5 years. Nevertheless, the stock fell slightly between 2002 and 2003. 91% of the engine stock is less than 10 years old (of which 55% less than 5 years old).

The power of this equipment is not that high: the power of 75% of the stock is less than 2 MW_e. The average power is 1.5 MW_e.

Their total electrical power is 1 488 MW, or 22% of the installed power in cogeneration.

Their electrical efficiency is high, on average 36%.

Their characteristic heat/power ratio is low, on average 1.05 kWh_{th}/kWh_e. It is in fact lower when heat is only recovered from the exhaust gases of the thermal engine or the engine's cooling water, and higher when recovery is double.

- Combustion turbines

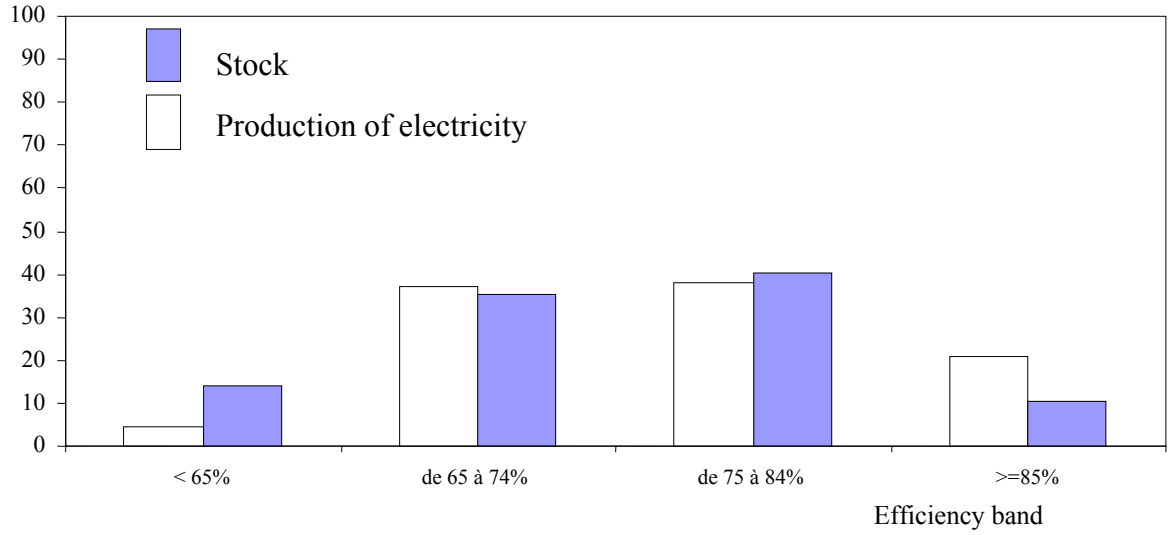
In terms of electrical power or production of electricity, combustion turbines are the primary technique of cogeneration. There are 227 of them, 127 with a recovery boiler with post-combustion (with a power greater than or equal to 500 kW).

The unit power of this equipment ranges from 500 kW to more than 100 MW, with an average of 14 MW. Several larger turbines have recently been commissioned, around 40 MW and up to 130 MW.

The power of 48% of combustion turbines is between 2 and 10 MW.
Their characteristic heat/power ratio resembles that of engines, being on average 1.4 kWh_{th}/kWh_e which is explained by the breakthrough of aeroderivative turbines with a high electrical efficiency of between 35 and 40%, notably in the higher power segment.

The average electrical efficiency therefore rose from 24% for the stock as at 31 December 1993 to 31% for the stock as at 31 December 2003.

The average efficiency of combustion turbines is 77%. The stock is divided as follows by efficiency band:



Engines are relatively young, with 56% less than 5 years old.

1.3 - Energy use

In 2003, the fuel consumption of cogeneration equipment is 10.3 Mtep or 120 TWh, around 3.8% of primary energy consumption in France (274 Mtep, after correction for climate).

Steam turbines are supplied by boilers using a wide range of fuels. Across all techniques, the fuels used can be broken down as follows:

1. natural gas, with 65 TWh (or 55% of the total), concentrates 14.4% of natural gas consumption in France (451 TWh); household waste, with 15 TWh (or 12% of the total);
2. paper waste, with 10 TWh (or 8% of the total);
3. other gases (refinery gas, blast furnace gas, coke oven and steel furnace gas and fatal gases), with 9 TWh (or 8% of the total)

4. heavy fuel (including high-viscosity fuel), with 9 TWh (or 7% of the total);
5. coal, with 4 TWh (or 4% of the total);
6. wood, wood and straw waste, with 2.5 TWh (or 2% of the total);
7. bought steam, with 2.1 TWh; most of the time, the primary energy behind this consumption is natural gas;
8. other waste, with 1.2 TWh (or 1% of the total);
9. recovery heat (i.e. recovery of heat from furnaces or exothermic reactions), with 824 GWh, mainly in the chemistry sector, where production of recovery boilers is estimated at between 15 and 20 TWh;
10. LPG, with 421 GWh (or 0.4% of the total);
11. Domestic heating oil, with 56 GWh;

- Steam turbines

Their consumption of fuels is 65 TWh, or 54% of the total consumption of existing cogeneration equipment as at 31 December 2003. 50% of their consumption is due to back-pressure turbines, 31% to turbines with bleeding and back-pressure and 19% to turbines with bleeding and condensation.

Steam turbines are mainly used in industry (54%), but also in refineries (23%) and household waste incineration plants (23%).

Various fuels are used, and none is dominant. Household waste and natural gas are the most frequently used fuels (23% and 18% of the total respectively), ahead of paper waste (15%), heavy fuel (13%) and refinery gases (13%).

- Combustion turbines

Their consumption of fuels is 42 TWh, or 35% of the total consumption of cogeneration equipment. Combustion turbines are mainly operated by the heat suppliers sector (66%) and the industrial sector (24%). 74% of fuels are consumed in industry as user sector (of steam).

Although less numerous, turbines with boilers with post-combustion consume more than those with boilers without post-combustion. Natural gas is by far the fuel most often used (97%).

We should point out the presence among combustion turbines of several combined cycles.

- Engines

Their consumption of fuels rose from 1.2 TWh in 1994 to 3.5 TWh at the end of 1997, 10 TWh at the end of 2000 and 12.5 TWh at the end of 2002 and the end of 2003.

Natural gas is by far the fuel most often used (99%).

In terms of user sector, heating networks are home to most of the stock of engines, with 56%. The tertiary and industry sectors concentrate 20% and 14% respectively of the stock of engines. Moreover, these are mostly operated by the heat suppliers sector, with 69% of installations.

1.4 - Electricity production by type of energy

The following table shows the breakdown of electricity production by type of energy. In the case of steam turbines, where the primary energy comes from several fuels, we have broken the production of electricity down according to the consumption of each of these fuels.

Production of electricity in GWh in 2003

Type of energy	
Natural gas	18 934
Special fuels	2 902
Heavy fuel oil	1 355
Other gases	1 077
Coal	620
Bought steam	164
Balance	209
Total	25 262

1.5 - Stock of cogeneration equipment by electrical power band

Power band in Mwe

	P≤1 MW	1<P≤2	2<P≤5	5<P≤10	10<P≤20	20<P≤50	>50 MW	TOTAL
Number of units	184	645	357	152	84	55	11	1488
Electrical power (MW)	108	840	1015	984	1071	1878	773	6669
Electrical power in cogeneration (Eurostat) (MW)	103	822	979	935	1051	1741	705	6336
Calorific power (MW)	203	1349	3510	4233	5966	4101	1127	20489
Electricity production (GWh)	308	2634	3386	3493	4109	8154	3178	25262
Production of cogenerated electricity (Eurostat) (GWh)	284	2487	3166	3272	4028	7265	2907	23408
Sale of electricity (GWh)	171	1860	2289	1921	1515	6300	3114	17168
Production of heat (GWh)	550	3805	9942	13533	19566	15949	4665	68009
Consumption of fuels (GWh)	1362	8405	18211	21944	28826	30832	10193	119773

80% of the installed stock has an electrical power less than or equal to 5 MW. Conversely, 71% of the installed electrical power and 75% of the installed thermal power is concentrated by equipment with a power greater than 5 MW, equipment of more than 20 MW producing 11.3 TWh_e, or 45% of total cogeneration.

Below 1 MW, by far the most common equipment is combustion engines (84% of the stock and 85% of electricity production).

Between 1 and 5 MW, the predominant equipment is also engines (83% of stock and 70% of electricity production), but there is also a considerable number of steam turbines (12% of stock and 18% of electricity production), mainly back-pressure and in the 2 to 5 MW power band (24% of stock and 28% of electricity production).

Between 5 and 20 MW, the steam turbine is still the most common cogeneration equipment in the existing stock (54% of installations and 62% of electricity production).

Beyond 20 MW, combustion turbines, more often than not with post-combustion boilers, are by far the most common type of equipment (82% of installations and 87% of electricity production).

The powers of combustion turbines range between 500 kW and 130 MW, with few between 10 and 20 MW.

Natural gas is the main fuel used for all installed equipment with a power less than or equal to 10 MW, or those with a power greater than 20 MW.

Refinery gas, renewable energies and heavy fuel take precedence over natural gas for equipment with a power between 10 and 20 MW.

1.6 - Stock of cogeneration equipment by age band as at 31.12.2003

Power in MW and production, sales and consumption in GWh

	<5 yrs	**6-10 yrs**	**11-15 yrs**	**16-20 yrs**	**21-25 yrs**	**25-30 yrs**	**>30 yrs**	**Sub-total***
Number of units	710	444	48	25	50	36	127	1440
Electrical power	3712	1017	177	111	239	264	863	6409
Cogenerated electrical power (Eurostat)	3438	976	174	111	235	260	858	6052
Calorific power	5611	2122	833	627	1505	1990	5473	18161
Electricity production	14524	3670	951	560	900	930	2636	24171
Cogenerated electricity production (Eurostat)	12937	3471	945	560	889	913	2613	22328
Sale of electricity	13596	2201	327	77	12	281	609	17103
Production of heat	20638	8078	4428	2851	5277	7769	14953	63994
Consumption of fuels	46480	15360	6908	3861	7601	10289	23168	113667

*there are also 48 units of unknown age.

The development of sales of cogeneration equipment in the 1990s and especially after 1998 thanks to the creation of the 97-01 contract is reflected in the young age of the stock: 49% of equipment is 5 years old or less, 31% is between 6 and 10 years old. Most of this equipment is thermal engines or combustion turbines. The equipment less than 5 years old contributes to more than half (60%) of electricity production and only 32% of heat production.
It is worth noting that there is a significant old stock (25 years and above) (11% of the total stock) that consumes a considerable amount of energy (29% of the total) and produces relatively little electricity (15%) but a lot of heat (36%), consisting mainly as it does of steam turbines.

There is less cogeneration equipment of moderate age, especially between 16 and 20 years old (2%). It is moreover striking to note that almost two-thirds of older equipment (more than 20 years old) is more than 30 years old.

1.7 - Stock of cogeneration equipment by efficiency band

Power in MW and production, sales and consumption in GWh

	<65%	65 - 74%	75 - 84%	≥85%	TOTAL
Number of units	137	614	523	214	1488
Electrical power	493	2153	2445	1578	6669
Electrical power in cogeneration (Eurostat)	409	1904	2445	1578	6336
Thermal power	1311	3459	8337	7382	20489
Electricity production	1780	8267	8937	6279	25262
Cogenerated electricity production (Eurostat)	1449	6747	8933	6279	23408
Sale of electricity	1164	6766	5988	3251	17168
Production of heat (GWh)	5450	12521	24019	26019	68009
Consumption of fuels (GWh)	13452	29126	40956	36239	119773

76% of cogeneration equipment in existence as at 31 December 2003 has a global efficiency (electrical + calorific) of between 65 and 85%;

It is worth noting that 137 units (or 9% of the stock) has a global efficiency of less than 65%, which can explained for some by the difficulty in recycling low-temperature heat in the establishment, or for household waste incineration plants due to the poor efficiency of the furnace.

Conversely, 214 cogeneration units with a significant energy consumption (30% of the total) have a very high global efficiency, greater than 85%. These are mainly back-pressure steam turbines and combustion engines.

1.8 - Stock of cogeneration equipment by operator's sector of activity

In the case of outsourcing, the activity (APE code) of the operator is very mixed: of 84 establishments that have outsourced their installation:

- 70 installations in 403Z, production of heat;
- 7 installations in 401Z, electricity production;
- 2 installations in the tertiary sector, 742C (engineering, technical studies) and 748K (services ancillary to production);
- 4 installations in industry (2 identical to the code of the user establishment and 2 in different activities).

Power in MW and production, sales and consumption in GWh

	Industry	Tertiary	Heat suppliers	Energy	Agriculture	TOTAL
Number of units	385	120	790	166	27	1488
Electrical power	1990	123	3705	812	39	6669

Cogenerated electrical power (Eurostat)	1932	119	3472	777	37	6336
Calorific power	10139	165	6432	3705	48	20489
Electricity production	6692	461	14250	3722	138	25262
Cogenerated electricity production (Eurostat)	6309	432	13007	3532	128	23408
Sale of electricity	2164	312	13052	1515	125	17168
Production of heat	29169	607	24338	13733	162	68009
Consumption of fuels	45487	1410	51869	20604	402	119773

The operator's sector of activity is defined by the NAF (Nomenclature d'Activité Française - French Activity Nomenclature) of the establishment operating the cogeneration installation. It is worth noting that the operating establishment may be situated on the same site as another establishment with a different activity.

The heat suppliers sector plays a leading role in the stock of cogeneration equipment; it contains:

- 53% of equipment,
- 56% of the installed electrical power,
- 56% of electricity production,
- 43% of energy consumption.

This phenomenon can be explained by the decision of a large majority of establishments that ordered a cogeneration installation benefiting from the 97-01 contract to entrust the operation of the cogeneration installation to a third-party investor who sells the steam or heat produced back to them (and the electricity to the network).
This movement mainly involves industrial sites that have increased their purchases of steam to the detriment of fuels such as natural gas, fuel-oil or coal.

Direct operation by the industrial sector nevertheless remains the dominant, if not the primary, sector in terms of thermal power, production of heat and even consumption of fuels.

Household waste incineration plants are also classified in the sector of heat suppliers. The energy sector in turn includes both refineries and electricity producers.

1.9 - Stock of cogeneration equipment by heat user's sector of activity

Power in MW and production, sales and consumption in GWh

	Industry	**Tertiary**	**Heat suppliers**	**Energy**	**Agriculture**	**TOTAL**
Number of units	530	246	554	108	50	1488
Electrical power	3955	324	1769	546	75	6669

Cogenerated electrical power	3743	310	1666	544	74	6336
Calorific power	13066	391	3540	3401	91	20489
Electricity production	14407	1108	6667	2812	268	25262
Cogenerated electricity production (Eurostat)	13124	1011	6225	2796	252	23408
Sale of electricity	9675	814	5624	802	252	17168
Production of heat	39908	1307	14382	12104	307	68009
Consumption of fuels	69087	3213	29227	17496	750	119773

Comparing the tables by operator and user sector it appears that, of a total of 530 units located in the industrial sector, 385 are operated by the industrial establishment itself, representing an electricity production of 6 692 out of a total of 14 407 GWh. The electricity production of the other 145 is operated by an operator from the "heat suppliers" or "energy" sector, who sells the steam to the user establishment and the electricity to the network more often than not (7 715 GWh of electricity production).

In the tertiary sector, of 246 units, 120 are operated by the establishment itself and 126 by an operator, representing an electricity production of 461 GWh internally and 647 by recourse to a third party. For agriculture, of 50 units, 27 are operated by the establishment itself and 23 by an operator, representing an electricity production of 138 GWh internally and 130 by purchase from a third party.

1.10 - Industrial stock

Whether from the point of view of the operator or user, cogeneration installations are chiefly found in three sectors of activity:

In the operator sector,

- **agri-foodstuffs:** 129 units with a total power of 709 MW_e and 3 764 MW_{th}
- **chemistry**: 75 installations with a total power of 468 MW_e and 2 895 MW_{th}
- **paper**: 63 installations with a total power of 462 MW_e and 2 498 MW_{th}

In the user sector,

- **agri-foodstuffs:** 166 units with a total power of 826 MW_e and 3 942 MW_{th}
- **chemistry**: 115 installations with a total power of 1 518 MW_e and 4 473 MW_{th}
- **paper**: 88 installations with a total power of 930 MW_e and 3 195 MW_{th}

These are sectors with considerable requirements in terms of electricity and low-temperature heat, as well as the availability of special or recovery fuels in the last two sectors. These sectors are also characterised by the predominant use of back-pressure steam turbines, whereas the other sectors use more combustion turbines.

Sugar factories stand out thanks to the low number of hours' use during the year, which can be explained by the brevity of the sugar year. As a consequence, annual production of electricity and heat is much lower here than in the chemistry and paper sectors.

Electricity production is estimated at 6.7 TWh in the Industry operator sector and at 14.4 TWh in the Industry user sector.

Production of heat is intended almost exclusively for manufacturing.

Consumption of fuels, which is 45.5 TWh if seen from the operator's point of view (or 3.9 Mtep), can be broken down as follows:

- **47% natural gas,**
- 32% renewable energies (more than half relates to black liquor in the paper sector),
- 10% heavy fuel,
- 10% coal.

The breakdown of consumption by type of energy if seen from the user's point of view (69.0 TWh) becomes:

- **64% natural gas,**
- 20% renewable energies (more than half relates to black liquor in the paper sector),
- 6% heavy fuel,
- 6% coal.

The stock under construction is limited to a single piece of equipment in a paper mill (8 MW). The industrial stock should therefore hardly change at all in the short term.

1.11 - Tertiary stock

Tertiary stock brings together installations from the following main user or operator sectors: **transport**, **commerce, telecoms, hotels-cafés-restaurants, education, health.**

50% of the existing stock (55% if seen from the point of view of the user sector) is concentrated in the health sector. According to the user criterion, the airports sector amounts to about ten (11) fairly large units (6 according to the operator criterion) producing 209 GWh of electricity (20 only if one refers to the operator sector).

Consumption of fuels can be broken down as follows:

In the operator sector,

- **99% natural gas**
- 1% domestic fuel.

In the heat user sector,

- **86% natural gas**
- 14% household and other waste

93% of the cogeneration equipment is combustion engines. To these can be added 10 combustion turbines. In the user sector, 95% of the equipment is combustion engines. There is also one steam turbine and 12 combustion turbines.

The electrical power of the engines ranges from 270 kW to almost 3 MW, and is generally close to 1 MW.

The vast majority of commissioned engines recover heat from both the exhaust gases and the engine cooling water, which allows them to have a "heat" efficiency in the order of 40%. Natural gas engines mostly operate 5 months a year, from 1 November to 31 March, or 3 600 hours a year.

1.12 - Heat supplier stock

From the operator's point of view, it consists of 790 installations producing 14 TWh of electricity. This stock was in full expansion at the end of the 1990s, mainly because of the outsourcing of cogeneration installations supplying an industrial or tertiary site with steam or hot water.

The fuel consumption of heat suppliers can be broken down as follows:

- **73% natural gas**
- 26% household waste
- 0.2% other waste
- 0.2% coal

Consumption of fuels by user sector concerning the 554 installations producing 6.7 TWh of electricity can be broken down as follows:

- **51% natural gas**
- 48% household waste

The heat suppliers possess a stock composed mainly of thermal engines with an electrical power in the region of 1 to 2 MW_e. However, there is a not inconsiderable stock of steam turbines in household waste incineration plants (outsourced or otherwise) and a large stock of recent combustion turbines (115 units).

There is a significant increase in the size of the equipment, which can be explained by the recent commissioning of these combustion turbines.

1. 13 - Energy sector stock

The energy sector brings together installations from the following main user or operator sectors: **refineries, electricity production, coal production**, **petrol and natural gas extraction.**

According to the operator criterion of the installation, 22% of the energy sector stock belongs to refineries, the balance to the electricity distribution and production sector.

The fuel consumption of the entire energy sector as an operator sector can be broken down as follows:

- **42% refinery gas,**
- 21% heavy fuel,
- 21% natural gas,

The refinery sector concentrates 29% of installations and 82% of the electricity produced of the energy user sector.

The fuel consumption of the entire energy sector as a user sector can be broken down as follows:

- **49% refinery gas,**
- 25% heavy fuel,
- 14% natural gas,

1.14 - Agriculture sector park

This stock is extremely young, and situated mostly in the greenhouse sector.

It consists of 32 installations as an operator sector and 50 as a user sector. These are mainly thermal engines running on natural gas and with an average thermal power of around 1 MW. It also includes 1 combustion turbine. The original use of heat is worthy of note: the combustion gases from the equipment are used directly in the greenhouse, which benefits from the caloric intake as well as the intake of CO_2 used by the plants for photosynthesis.

1.15 – Other cogeneration installations

A documentary search was carried out to establish the stock of small cogeneration equipment such as microturbines, Stirling engines, fuel cells and Rankine cycles for biomass.

The data collected are as follows: one fuel cell (PEMFC) of 250 kWe, one fuel cell (SOFC) of 230 kWe and 180kWth in Paris supplying 283 homes with heat and domestic hot water, small fuel cells of 4 kWe and 5.6 kWth, 8 microturbines of 30 kWe and 52 kWth in a waste processing centre.

2. THE GENERAL LEGISLATIVE AND REGULATORY FRAMEWORK OF COGENERATION INSTALLATIONS

2.1 Trends in French energy policy

2.1.1 The Programme Law of 13 July 2005

Programme Law No 2005-781 of 13 July 2005 establishing energy policy guidelines lays down the four main objectives of French energy policy and the resources to be implemented to achieve these:

- To contribute to national energy independence and guarantee security of supply;
- To ensure a competitive price for energy;
- To preserve human health and the environment, in particular by combating the worsening of the greenhouse effect;
- To guarantee social and territorial cohesion by ensuring access to energy for all.

These are long-term objectives, which put a cap on energy policy action for the next 30 years, even though the current scenario of high energy prices makes them particularly topical. To achieve these objectives, four main priorities have been defined:

- To control the demand for energy;
- To diversify the energy mix;
- To develop research and innovation in the energy sector;
- To provide means of transmission and storage that are adapted to requirements.

To define the parameters of the actions to be undertaken in application of this Law, France is setting itself ambitious performance targets and defining a certain number of mobilising programmes for energy savings and the development of renewable energies:

- Support for an international objective of halving global greenhouse gas emissions by 2050, which requires emissions to be divided by 4 or 5 for developed countries;

- An average reduction of 2% a year between now and 2015 of the final energy intensity (relationship between energy consumption and economic growth) and of 2.5% between now and 2030;

- The production of 10% of French energy requirements from renewable energy sources by 2010;
    - domestic production of electricity from renewable sources to the tune of 21% of consumption in 2010 as opposed to 14% at present, i.e. +50%;
    - the development of renewable thermal energies to allow a 50% increase in the production of heat from renewable sources by 2010;
    - the incorporation of biofuels and other renewable fuels to the tune of 2% between now and 31 December 2005 and 5.75% between now and 31 December 2010.

However, these objectives will shortly be revised and supplemented by a Programme Law on the implementation of the Grenelle Environment Forum currently being examined by the French Parliament.

The Programme Law on energy policy guidelines also provides for maintaining the nuclear option in France**.** Nuclear contributes decisively to achieving three of the energy policy objectives defined in the Law: guaranteeing national energy independence and security of supply, combating the greenhouse effect and finally ensuring competitive and steady electricity prices. As regards guaranteeing the security of electrical supply, it is also right that France makes sure that the means of thermal production based on domestic fuel oil, coal or gas are sufficiently developed in order to guarantee its security of electrical supply. Pursuant to the Law, the multiannual programme of investments has thus reaffirmed the role of the stock of power stations and specified its composition.
Finally, the Programme Law on energy policy guidelines contains several practical measures to initiate the achievement of the objectives set:

- the transposition of the legislative provisions of Directive 2002/91/EC of 16 December 2002 on the energy performance of buildings:

- a system of energy-saving certificates ("white certificates") which mobilises operators in the energy sector towards energy savings.

- the reaffirmation of the role of local authorities, who see their ability to intervene in terms of managing energy extended. In tandem with the action of the State, local and regional authorities, in the front line to relaunch an active energy management policy, because of their knowledge of areas and their proximity to residents constitute the relays among the most valued of citizens. They are therefore a preferred carrier for raising awareness of and providing information about the stakes of managing energy and encouraging new behaviour. They also have to set an example by reducing their own energy consumption.

- the importance assigned to information for consumers. The Law strengthens information for consumers. It also establishes an obligation for companies selling energy or energy services to introduce the promotion of energy savings into their advertising messages.

- For renewable energies and cogeneration, the system of guarantee of origin has been created.

- For the development of hydroelectricity, the first renewable source of energy in France, in addition to administrative simplification measures, the Law encourages the setting up of hydroelectric equipment intended to turbine the minimum flow of water that every operator has to leave downstream from its storage facilities by making the electricity thus produced benefit from the obligation to buy. The Law also allows the use of water to be devoted to developing the production of renewable energy, and to include in the water management policy consideration for the stakes associated with securing electricity supplies. For wind farms, regulations favourable to their managed development are put in place. Wind farm development zones are defined at the suggestion of the local authorities concerned, taking local characteristics into account (electricity systems, protection of sites and countrysides).

Finally, in the terms of Article 50 of this Law, "the minister for energy shall establish and make public a multiannual programme of investments in the production of energies used to generate heat. Within this framework he shall in particular lay down objectives by renewable energy production chain and if need be by geographical area." The first work of this multiannual programme of "heat" investments did not get beyond the working draft stage and were recently relaunched within the context of the Grenelle Environment Forum and its new objectives. The target for the MPI is now 2020, with a crossing point in 2012 and the objective of renewable heat, currently being revised by the Programme Law on the implementation of the Grenelle Environment Forum, will be integrated into the global objective of 20% of energy from renewable sources by 2020.

2.1.2 The Grenelle Environment Forum

In 2007 the French authorities initiated an original approach, the "Grenelle Environment Forum": the Grenelle Environment Forum brought together for the first time State, local and regional authorities and representatives of civil society to define a road map for ecology, sustainable development and regional action. In particular, it is aimed at establishing a plan of concrete, quantifiable measures gathering together the agreement of as many of the participants as possible. This plan, the measures of which will be evaluated a priori and a posteriori, will therefore be a starting point for mobilising French society to set its development within a sustainable perspective.

The Grenelle Environment Forum aims to create the conditions that will encourage the emergence of this new French order on behalf of the environment.
The first stage, from 15 July to the end of September 2007, was devoted to dialogue and to drafting proposals within groups. Six working groups will be formed to prepare this horizon:

- a group “to combat climate change and manage energy demand”
- a group “to preserve biodiversity and natural resources”
- a group “to establish an environment that respects health”
- a group “to adopt sustainable methods of production and consumption”
- a group “to construct an ecological democracy”
- a group “to promote ecological methods of development that promote employment and competition”

The working groups were composed of 40 members split into 5 colleges. The task of these colleges was to represent the main players in sustainable development: the State, local authorities, NGOs, employers and employees. The working groups’ thoughts and proposals were the subject of an extremely wide-ranging public debate from September to October 2007. The conclusions of this process were reproduced by the President of the Republic at the end of October 2007 in four themes: combat climate change, preserve and manage biodiversity and natural environments, preserve health and the environment while stimulating the economy, and establish an ecological democracy.

Concerning the fight against climate change and energy management, the objectives that emerged from the Grenelle are:

- To contribute in an ambitious, determined way to the European objective of “3x20 in 2020”
- To sign France up to the “factor 4” – division of our emissions by four between now and 2050
- “+20 Mtep in 2020”: to increase by 20 million tonnes petrol equivalent our production of renewable energy in 2020 and exceed a proportion of 20% of renewable energy in final energy consumption
- Energy savings and reduction in greenhouse gas emissions: opening of sectoral sites and putting in place of immediate and/or structuring operational measures;
- Buildings: to reduce energy consumption by around 20% in tertiary buildings and 12% in residential buildings in 5 years, and by more than a third by 2020
- transport / mobility: to lower greenhouse gas emissions by 20% in 12 years

Furthermore, several programmes have been defined:

Programme for renewable energies (hydraulic, wind, biomass, geothermal, photovoltaic, solar)
- Consumption of 30 to 50% renewable energies in overseas departments and local authorities by 2020.
- Research into second-generation biofuels.
- R&D programme for the capture and geological storage of CO_2.
- Plan for highly economical farms in terms of energy and inputs.
- Carbon inventory of administrations and 20% improvement in their energy efficiency.
- Incorporation of environmental clauses into the Procurement Contract Code.
- Thoughts on the creation of a climate-energy contribution.

Programme “Modernise buildings and towns”

- Construction of new housing with a very high energy performance from 2010 and with passive or positive energy from 2020.
- Construction of offices, buildings and public facilities to low consumption or positive energy standards from 2010.
- Ban from 2010 on conventional lamp bulbs and single glazing.
- Thermal renovation of public buildings over the next five years.
- Financial incentive for the thermal renovation of private buildings.
- Carbon-energy inventory of all organisations of more than 50 people.

Programme “Spatial planning and territorial governance”

- Recapture of town centres in decline.
- Creation of eco-districts
- Generalisation of territorial climate-energy plans between now and the end of 2012 in built-up areas and urban communities, taking up the objective of cutting greenhouse gas emissions by 20% in 2020.

- Fight against urban expansion and the destruction of the countryside.
- Environmental impact study for new areas in the process of urbanisation, integrating secondary transport and the consumption of agricultural and natural land with a view to preservation.

Programme "Mobility and transport"

- Priority to public transport: construction of more than 1 500 km of bus lanes and tramways and cycle paths/lanes.
- Railway: construction of 2 000 km of high-speed lines by 2020.
- Increase the share of rail freight to 25% by 2012.
- Restoration of the classic rail network.
- Creation of rail motorways.
- Development of maritime motorways and river transport.
- Massive reduction in emissions from air transport.
- 50% reduction in air transport noise by 2020.
- New private vehicles: introduction of an "ecopastille".
- Development of low-emission vehicles.
- Mileage ecotax for trucks on the unlicensed road network.

33 "Operational Committees", each dedicated to a thematic site, have been set up to finalise definition and implementation and to ensure the plan produced from Grenelle Environment Forum is followed up.

As regards cogeneration, Operational Committee No 10, responsible for the development plan for renewable energies of high environmental quality, emphasised for the production of electricity from biomass that priority should be given to heat use wherever possible in view of the scarcity of timber and recommended supporting renewable electricity production units that were particularly effective in terms of energy efficiency, therefore essentially cogeneration units.

The Grenelle Environment Forum is now entering its legislative phase. A draft Programme Law on the implementation of the Grenelle Environment Forum known as "Grenelle 1", which transposes the aforementioned undertakings into law, was adopted by the Council of Ministers at the beginning of June 2008 and is presently being examined by the French Parliament. This draft Law is supplemented by implementing texts, including the Finance Act. All the undertakings made should begin to be implemented as of the second half of 2009.

2.2 The Act of 10 February 2000 and its implementing decrees

The Act of 10 February 2000 on the modernisation and development of electric utilities defines the framework of the French electricity system, the content of the missions of the electric utilities, the categories of customer targeted by these, and the operators who are responsible for them, as well as the terms of their funding.

The Act stipulates that the first mission of the electric utilities concerns the balanced development of electricity production capacities, in other words the implementation of a public energy policy in the choices of different sources of energy.

The Act puts in place a multiannual programme of investments in electricity production, a system of authorisation for electricity production as well as support mechanisms (obligation to buy, calls for tender) financed by the contribution to the electric utilities.

2.2.1. The operating system for electricity-producing installations

The activity of electricity production is a competitive activity carried on under a system of ministerial authorisations provided for by the Act of 10 February 2000 on electric utilities. This system corresponds to the procedure provided for in Article 6 of Directive 2003/54/EC. Requests for authorisation to operate or the

operational declaration are sent to the minister for energy in accordance with the thresholds in the following table:

Regulation of the operation of electricity-producing installations	Authorisation	Declaration
New electricity-producing installation, or replacement of an existing installation	If the installed electrical power is greater than 4.5 MW	If the installed electrical power is less than 4.5 MW
Increase in the installed power of a production installation with an initial power greater than 4.5 MW	If the increase, alone or combined with other modifications, is greater than 10%	If the increase is less than 10%
Increase in the installed power of a production installation with an initial power less than 4.5 MW	If the increase takes the installed power beyond 4.5 MW	If the increase keeps the installed power below 4.5 MW
Change in primary energy	If the installed power is greater than 4.5 MW, new authorisation	If the installed power is less than 4.5 MW, new declaration

2.2.2 The multiannual programme of investments in electricity production and the system of calls for tender

Article 6 of the Act of 10 February 2000 on the modernisation and development of electric utilities stipulates that *"The minister for energy shall lay down and make public the multiannual programme of investments in production establishing objectives in respect of the distribution of production capacities by primary energy source and, where appropriate, by production technique and geographical area. This programme shall be drawn up so as to leave room for decentralised production, cogeneration and new technologies. This programme shall be the subject of a report submitted to Parliament by the minister for energy in the year following any re-election of the National Assembly."*

The multiannual programme of investments (MPI) is laid down by the minister for energy and establishes objectives in terms of the distribution of production capacities by primary energy source and, where appropriate, by production technique and geographical area. This programme is the subject of a report submitted to Parliament.

The Act of 10 February 2000 also makes provision for mechanisms of action to achieve the objectives of the MPI: the minister for energy may resort to calls for tender. Article 8 stipulates that when production capacities do not meet the objectives of the multiannual programme of investments, in particular those concerning production techniques and the geographical location of installations, the minister for energy may resort to the call for tenders procedure. The minister for energy defines the terms of the call for tenders implemented by the Energy Regulation Commission on the basis of a detailed set of specifications. The following in particular are specified: energy, technical, economic and financial characteristics, expected use and location of the production installation that is the subject of the call for tenders.

2.2.3 The obligation to buy the electricity produced by cogeneration

Cogeneration has undergone several periods of development in France in line with contractual conditions. During the period 1991-1996, the contractual framework was fixed by EDF, which proposed tariffs for buying the cogenerated electricity that were close to the conditions of the regulated market of the time. In total, 185 installations were developed within this framework.

The development of cogeneration in France truly took off thanks to the standard contract known as "97-01", then to a lesser degree the "99-02", within the context of the old system of obligation to buy (Decree of 20

May 1955). This system of obligation to buy was ratified by the Act of 10 February 2000 on the modernisation and development of electric utilities, Article 10 of which stipulates: *"subject to the need to preserve the proper operation of the networks, EDF and (...) non-nationalised distributors (...) shall be obliged to conclude, if the producers concerned so request, a contract for the purchase of electricity produced on national territory by (...) (2°) the installations that use renewable energies (...) or which use effective techniques in terms of energy efficiency, such as cogeneration. A decree in Council of State shall fix the installed power limits of production installations that may benefit from the obligation to buy."*

This Article also stipulates that the ministers for economic affairs and energy lay down the conditions for purchasing the electricity, having consulted the Energy Regulation Commission (ERC). The contracts concluded must provide for conditions of purchase taking into account the investment and operational costs avoided by purchasers of electricity, to which can be added a premium allowing for the contribution of the production delivered or the sectors to achieving the objectives defined in paragraph 2 of Article 1 of the Act of 10 February 2000 (Article 10 of the Act of 10 February 2000). The level of this premium may only result in the remuneration of the capital tied up in installations benefiting from these conditions of purchase exceeding a normal capital remuneration, taking into consideration the risks inherent in these activities and the guarantee from which these installations benefit of selling all their production at a determined tariff. The conditions of purchase are subject to periodic review in order to take account of developments in the avoided costs and charges mentioned in Article 5 (Article 10 of the same Act).

Article 3 of the Implementing Decree of 6 December 2000, enacted pursuant to this Act, stipulates that the obligation to buy is limited to installations with a maximum power of 12 MW except where the installation supplies a heating network, in which case its power is not limited.

Article 8 of the Implementing Decree of 10 May 2001 stipulates that the conditions of purchase specify in particular the conditions relating to the supply of electricity, the tariffs for buying the electricity, as well as the term of the contract. These tariffs for buying the electricity supplied are equal to the costs of production, including investment and operation, spared the electricity system in the long term, to which can be added a supplementary remuneration corresponding to the installations' contribution to achieving the objectives defined in Article 1 of the Act of 10 February 2000.

The Decree of 3 July 2001 imposes observance of three conditions in order to access the obligation to buy: the quantity of heat produced must be at least half the quantity of electricity produced, this produced heat must be used or auto-consumed, this combined production of heat and electricity must result in a primary energy saving of at least 5% compared with the separate production, with the best available technologies, of the same quantity of heat and electricity. However, the comparison is made purely with reference efficiencies relating to production using natural gas.

Finally, the Decree of 31 July 2001 currently in force lays down the conditions for buying the electricity produced by recovered electricity and heat cogeneration installations with a power less than or equal to 12 MW.

Electricity producers wishing to benefit from the obligation to buy must submit to the prefect (Regional Directorate for Industry, Research and Development) a file containing the information specified in the legislation. Where the installation intends supplying a heating network, the file must also contain elements establishing that the installation's power is in proportion to the size of the existing or future heating network that will be supplied by this installation (Article 1 of the Decree of 10 May 2001). Within two months of receiving the file, the prefect will issue a certificate granting entitlement to the obligation to buy electricity (Article 1 of the same Decree).

Draft contracts have been approved by the minister for energy. These contracts, concluded for 12 years, present modulated tariffs according to the availability of the installations and their energy efficiency. Agreements signed prior to the entry into force of the Act of 10 February 2000 will continue provided they have not been annulled by their beneficiaries.

2.2.4 The scheme for compensating the obligation to buy

The Act of 8 April 1946 on the nationalisation of electricity and gas nationalised the activity of electricity production, with the exception of production installations with a power less than or equal to 8 000 kVA. The Decree of 20 may 1955 governing relations between EDF and autonomous producers of electrical energy in turn organised the obligation to buy the electricity of autonomous producers and the obligation to conclude a contract. The Decree fixed the minimum prices which EDF was obliged to grant autonomous producers. However, no allowance was made in this Decree for a procedure for compensating the additional costs incurred by EDF. The Decree of 20 December 1994 made permanent the obligation to conclude a contract to buy with respect to installations using cogeneration techniques (Article 1).

The Act of 10 February 2000 introduces compensation for electric utility charges: the additional costs incurred by EDF and non-nationalised distributors by virtue of the obligation to buy are reimbursed in full. Article 10 provides for compensation of the additional costs incurred by EDF or non-nationalised distributors, in accordance with the terms specified in Article 5. Article 5 of the Act of 10 February 2000 puts in place compensation in full of the costs chargeable to the public utility missions assigned to electricity operators. These costs are calculated on the basis of an appropriate accounting system applied by the operators who incur them. Compensation is provided by the contributions due from end-consumers situated on national territory. It is collected then paid to the electricity operators by the Deposit and Consignment Office (Caisse des dépôts et consignations, CDC). Additional costs are calculated in accordance with the terms set out in the Decree of 29 January 2004 on compensating electric utility charges. Article 4 of this Decree stipulates that "costs chargeable to public utility missions, which give rise to compensation in full, shall be constituted by the additional costs of production and supply". It follows from these combined provisions that the additional cost incurred by EDF or non-nationalised distributors when buying back electricity from producers of electricity by cogeneration is not met by the electricity buyer, but by end-consumers, via compensation.

The compensation of electric utility charges passes through the Scientific Committee on Problems of the Environment (Comité scientifique sur les problèmes de l'environnement, CSPE): electric utility charges, as defined by Article 5 of the Act of 10 February 2000, initially concerned the additional costs resulting from the obligation to buy the electricity produced by certain types of installation (wind farms, photovoltaic, cogeneration, etc.) and the additional production costs in non-interconnected zones such as overseas departments. This Article was amended by the Act of 3 January 2003, which supplemented the previous definitions by the costs resulting, for electricity distributors, from the implementation of the "staple product" electricity tariff, provided for by Article 4 of the Act of 10 February 2000, and some of the costs incurred by electricity supply bodies by virtue of their financial participation in the system introduced to benefit persons in difficult situations.

Article 5 of the Act of 10 February 2000 establishes a framework for the evolution of costs, as well as a ceiling for the contribution per consumption site. The framework for the unit contribution per kWh is fixed at 7% of the 6 kVA blue tariff, which currently corresponds to a unit contribution ceiling of 0.5355 eurocents per kWh. This is a maximum, which can be compared with the 0.45 eurocent contribution fixed in 2004. Moreover, the amount of the contribution due, per consumption site, was capped at EUR 500 000. This measure concerns around 150 consumption sites. The Decree of 28 January 2004 on the compensation of electric utility charges lays down the rules of operation of the Scientific Committee's system.

2.2.5 - Connecting electricity-producing installations

For the French government, the development of decentralised electricity production is one of the main priorities of its energy policy, directly in line with the undertakings given by the European Union and its Member States at international level.

The integration of this decentralised production into the French electricity system, and more generally into the interconnected European electricity system, is therefore also a priority, as this decentralised production must represent a substantial proportion of overall electricity production in the near future.

To this end, the conditions for connecting decentralised electricity-producing installations must contribute, in the same way as the other means of production and according to their installed power, to the smooth running of the electricity system. It is these principles that are enshrined in the corresponding French regulations and which are listed and detailed in the reference technical documentation of operators of public electricity networks charged with implementing the connections of production installations.

The French procedure for processing connection requests is based on a non-discriminatory queuing principle and applies to all electricity production chains. This procedure is the result of a dialogue conducted by the Energy Regulation Commission and guarantees all producers respect for the principle of equality before the public utility and the non-discriminatory and transparent processing of their requests. Access to the queue is reserved for completed projects able to present an administrative document proving as much, for example a copy of the decision granting the construction permit or the operating licence. To guide project initiators in the initial phases of studies, the connection capacities per offtake station are published on the website of the operator of the public electricity transmission system. In the event of a dispute between producers and operators of public electricity distribution and transmission systems, it is possible to lodge an appeal with the Energy Regulation Commission, the independent authority for dealing with such disputes.

2.3 - The system of classified installations for environmental protection

In connection with controlling the prevention of pollution and industrial risks, legislation on classified installations for environmental protection constituting the legal basis of the industrial environment policy in France has been drawn up and codified in Title I of Book V of the Environmental Code. Outside of nuclear installations and mines (which are covered by other legislation), it covers all industrial activities, intensive farming and waste processing.

The legislation for classified installations puts in place a system where the industrial activities covered by this legislation are listed in a schedule which subjects them either to an authorisation system or a declaration system.

Declaration concerns the least polluting or least dangerous activities. It consists of notifying one's activity to the prefect and of satisfying standardised requirements. Authorisation concerns the most polluting or most dangerous activities. Compared with the requirements of declaration, which are standardised, the requirements of authorisation are drawn up on a case-by-case basis, individually.
These regulations therefore lay down a procedure of declaration or authorisation for combustion installations according to their installed power.

Authorisation is required if the maximum thermal power of the installation is greater than or equal to 20 MW, while a simple declaration is required when the maximum thermal power of the installation is greater than 2 MW and less than 20 MW. The maximum thermal power is defined as the maximum quantity of fuel, expressed as a net calorific value, to be consumed per second.

2.4 - Objectives and measures to develop cogeneration

2.4.1 The multiannual programme of investments in electricity production

After an initial MPI exercise which led to a report to Parliament in 2002 and to calls for tenders for the development of renewable energies and a means of production in Martinique based on the MPI Decree of 7 March 2003, a new exercise was carried out in 2006 with a view to 2015, allowing the question to be addressed of the renovation of the classic thermal stock and the inclusion of an EPR demonstrator in 2012 in accordance with the Programme Act of 13 July 2005.

- The work of the MPI 2006

The 2006 exercise had comprised four main topics: the launch of the EPR, the continuation of the development of renewable energies, the renovation of the flame-based thermal stock and the identification of the need for and the development capacity of gas-based thermal production.

To begin with, the 2006 work emphasised the importance of managing the demand for electricity, more specifically peak demand, which produces greenhouse gases and atmospheric pollution. It is important to remember that the French electricity sector produces very few greenhouse gases compared with our European neighbours, due to the development of hydraulic and nuclear energy, especially for basic production.

In accordance with the aforementioned Programme Law laying down energy policy guidelines, the MPI had integrated the commissioning of an EPR reactor in 2012 in Flamanville, the incorporation of this EPR reactor into the French electricity stock being justified in terms of a balance between supply and demand inasmuch as the annual operating time of this reactor exceeds 5000 hours in all scenarios of the MPI, including the renewable energies development scenario, the "reference costs" of the production of electricity establishing that nuclear is competitive from 5000 annual hours. This threshold of 5000 hours could be lowered in the event of a sustainable rise in the cost of fossil fuels and CO_2 on the swaps market.

In particular, the MPI 2006 had demonstrated:

- the need to develop wind power for a significant development of renewable energies in electricity production, a development which by necessity must take place largely on land, as the potential of marine wind power seems more limited in France, given current technologies and costs. The work had also demonstrated that, for around ten gigawatts, the quantity associated with the intermittency of wind power could be managed provided the wind farms were suitably spread across mainland France.
- The importance of hydroelectricity to the French electricity system. Current production should be maintained within the context of a balanced management of water resources, all the more so since the potential for developing hydroelectricity is limited. A potential of an additional 7 TWh by 2015 had been identified.
- Finally, despite the strong rate of growth of photovoltaic solar power, which is the subject of intensified support with the increase in its purchase tariff decided in November 2005, this method is only likely to contribute significantly to national electricity production after 2015.

As regards requirements in terms of classic thermal investments, the 2006 work had integrated the evolution of the regulatory framework relating to classic thermal resources by 2015 (directives "large combustion installations" and "national emission ceilings") leading to the decommissioning of more than half of existing coal-fired power stations and also limiting the operation of fuel oil power stations currently in service. The additional requirements in terms of classic thermal investments according to the scenarios of demand and development of renewable energies had been estimated at 0.8 GW (semi-base load) in service at the end of 2009 and 5.2 GW (2.6 GW semi-base load and 2.6 GW peak) in service at the end of 2015.

For the choice of additional semi-base resources, the MPI recommended using combined gas cycles, justified compared with coal-fired power stations from an environmental point of view in particular. Gas-fired power stations emit around two times less CO_2 than clean coal-fired power stations. Achieving this recommendation, accompanied by the development of renewable energies, should lead in the central scenario of the MPI to a reduction in the order of 25% of CO_2 emissions by the centralised French electricity sector in 2015 (on average excluding weather hazards, excluding cogeneration). For the choice of extreme peak resources, the MPI recommended using combustion turbines running on fuel oil, without excluding the development of hydraulic pumping stations.

The MPI 2006 and the role of cogeneration in the French production stock

As regards **cogeneration installations** that produce around 40% of the classic French thermal production, the MPI provided for the volume of electricity produced annually to be maintained over the period 2005-2015.

From the point of view of electricity production, cogeneration produces electricity with a guaranteed and continuous availability, especially throughout winter, when demand for electricity is at its highest. Cogeneration therefore produces a winter ribbon, but is not a semi-base resource. During abnormal periods,

no source of electricity should be neglected, but the question has to be asked of the peak availability of cogeneration. Furthermore, cogeneration cannot function without a heat outlet, and there are other margins for manoeuvre such as classic coal- or fuel oil-fired power stations, so it is a matter of finding a balance between CO_2 savings, primary energy savings and electricity prices.

Cogeneration nevertheless remains a reserve for the French electricity system in the order of 22 to 23 TWh/year. The MPI 2006 had therefore retained the hypothesis of maintaining the volume of installed cogeneration until 2015. Based on the idea that installations that are still young should not be decommissioned, this comes down to assuming that most of the installations will have a marginal cost below the market price. This hypothesis is a structuring one inasmuch as the volume of cogeneration under obligation to buy represents 5 GW, and by 2012 most of the installations will return to a market logic at the end of their 12-year obligation-to-buy contract, and will have to adjust the timings of their capacities to guarantee their economic equilibrium.

Summary of investments in the central scenario of the MPI 2006:
Taking into account the investments decided on, all the investments identified in the central scenario of this MPI are listed below:

- development of renewable energies
- to the tune of at least 5 GW in 2010 and 12.5 GW in 2016 for wind power,
- to the tune of at least an additional 6 TWh from biomass in 2016, relying as a minimum on maintaining the level of hydroelectric production (a development potential of 7 TWh having been identified),
- commissioning of an EPR in 2012,
- reopening of 2.6 GW of fuel oil-fired power stations decided on by EDF,

the commissioning of 500 MW of combustion turbines decided on by EDF, 0.8 GW (semi-base load) in service by the end of 2009, 5.2 GW (2.6 GW semi-base load and 2.6 GW peak) in service by the end of 2015.

- Revision of the MPI

Work to update the MPI 2006 began in the autumn of 2008 as part of the joint revision of multiannual programmes of investments (MPI) in the production of electricity and heat and the multiannual indicative plan for investments in the gas sector (MIP). This work was decided on to establish an energy road map between now and 2020 in line with European objectives and the targets identified in the conclusion to the Grenelle Environment Forum.

On the occasion of the revision of the MPI, which is scheduled to be published very shortly, the prospects for the development of natural gas-based cogeneration are currently being debated from the point of view of the objectives of developing renewable energies, reducing CO_2 emissions and competitiveness and the management of the CSPE's expenditure.

The next MPI should confirm the evolution of the current stock of natural gas-based cogeneration installations a result of the end of the first obligation-to-buy contracts, the evolution in heat requirements and the expected increase in the use of biomass. The MPI 2009 should not fix the objective for the development of the natural gas-based cogeneration stock and favour only the development of biomass cogeneration, notably through the substitution of current installations running on natural gas.

- The role of microcogeneration in the French production stock

Microcogeneration (between 1 and 5 kWe) is intended for individual household equipment to cover heating requirements (heating and hot water) and electricity requirements. This is a sector with considerable potential if one considers boiler replacements: 800 000 annually in France.

Various technologies exist, but these are not all at the same stage of development: internal combustion engines, at the industrial pre-series stage; Stirling engines, Rankine cycles and fuel cells, all still at the

prototype stage. The development of fuel cells is led by the automobile industry. The most mature product is currently being developed by Honda. In France, there are around ten cells.

As regards fuel cells, the current cost is EUR 60 000/kW (compared with EUR 600/kW for a combined gas cycle). The deployment objectives of European Platform H2 & PAC are 1 MW for the period 2007-2010 with a cost of EUR 12 000/kW, and 200 MW for the period 2010/2015 with a cost of EUR 4 000/kW.

A study has been carried out for a single home with high thermal needs (15 to 20% greater than the French average). It compared the savings made by microcogeneration with its investment cost, the rate of return on investment in question being 6 years. The cost of microcogeneration being that in the deployment objectives, it therefore assumes an industrial deployment on a global scale. This study had found that in 2006 microcogeneration represented an additional cost in the order of 40-50% in France and a situation pretty much balanced in 2015. However, in terms of CO_2, the kWh_e produced by microcogeneration contains between 330 and 440 g CO_2. When compared with a condensing boiler and the country's electrical mix, this produces an increase in emissions for France (with a CO_2 content of electrical heating in France of $180g/kWh_e$).

It therefore seems that microcogeneration is not currently of any interest to France from an economic and environmental point of view. Conversely, this technology may prove interesting in time in countries where the energy mix is heavily loaded with CO_2, subject to a switch to industrial deployment on a global scale.

2.4.2 The support put in place

2.4.2.1 Obligation-to-buy contracts for electricity produced by cogeneration

The 97-01 contract is based on the principle of avoided costs, and uses as its reference a combined-cycle gas turbine (CCGT) with a nominal electrical power of 650 MW supplied at the best gas tariff (large transport tariff STS). The purchase tariff put in place within this contractual framework ensures an obligation to buy cogenerated electricity for 12 years. The 99-02 contract, which came into force in the summer of 2000, contains the essential conditions of the 97-01 contract and updates the reference efficiencies of the CCGT. The current period since 2002 sits within the framework defined by the Act of 10 February 2000, from which came the C01 obligation-to-buy contracts which came into effect in December 2002.

The purchase tariffs are intended to select efficient installations from an energy viewpoint. The level of tariffs is based on the costs (investment and operational) avoided by the electricity system, and includes an environmental premium. It includes an annual degression of 1% to translate the gains in productivity of this chain. This level is between EUR 61 and 91.5/MWh depending on the price of the gas, the operating time and the power.

The tariff is made up of a fixed premium and a variable part, a fixed premium representing the value of the investments avoided, modulated according to the actual availability of the installation, decreases with the power of the installation. The variable part is proportional to the energy and is calculated according to three components: the system costs avoided, the price of natural gas and an energy efficiency premium, remunerating the primary energy savings. The remuneration linked to the price of natural gas is calculated using the STS index, and is capped so that cogeneration remains attractive to the electricity system. If the ceiling of the price of gas is reached, the installations also have the option of switching to dispatchable mode, in other words of putting themselves at the disposal of the electricity purchaser in order to meet the needs of the electricity system. These installations are called on, for example, in the event of a cold spell, which places heavy demands on power to run electrical heating systems.

Installations benefiting from the obligation to buy can only benefit once from an obligation-to-buy contract. Around 80% of cogeneration installations currently operate under the obligation-to-buy system.

Cogeneration installations under an obligation to buy currently represent an installed power in the order of 4 800 MW, consuming natural gas and producing around 14.4 TWh of electricity. The price for EDF to buy back the electricity produced by cogeneration is valued for 2008 at an average of EUR 110/MWh. In 2008,

the provisional additional cost reimbursed to EDF for cogeneration is valued at around EUR 580m and represents 80% of the total additional costs of the obligation to buy in mainland France.

- Improvement projects currently being studied

Cogeneration installations under an obligation to buy currently represent an installed power in the order of 4 800 MW, consuming natural gas and producing around 14.4 TWh of electricity. The price for EDF to buy back the electricity produced by cogeneration is valued for 2008 at an average of EUR 110/MWh. In 2008, the provisional additional cost reimbursed to EDF for cogeneration is valued at around EUR 580m and represents 80% of the total additional costs of the obligation to buy in mainland France.

However, a report on cogeneration installations under an obligation to buy published in January 2007 noted the high cost per tonne of CO_2 avoided by cogeneration and recommended continuing public aid, provided the system assigns more importance to remunerating energy efficiency and provides the system with greater flexibility, notably by allowing production to be modulated according to heat requirements.

In particular, this report pointed out that the purchase tariff formula encourages continuous production at full power through the entire winter period. In the formula, the modulation of the electrical power delivered and production outside the winter period actually significantly reduce the remuneration of the electrical energy supplied. To obtain the best tariff for buying back their electricity, cogenerated energy producers therefore have to produce constantly at the maximum installed power. This practice takes the opposite course of the principle according to which cogeneration installations must above all satisfy a thermal demand. The current system, on the other hand, favours the production of electricity at the risk of having an excess of heat production which is then released into the atmosphere. This is the case, *de facto*, for district heating when the winter period experiences mild weather, like this year.

The French authorities therefore put in place a working group uniting cogeneration operators, electricity suppliers and the ERC, in order to examine the adjustments to be made to the current and future operation of cogeneration installations.

Several possible means of improvement were identified by this working group, including in particular relaxing the operation of cogeneration installations with a view to improving their energy efficiency and their integration into the electricity market and the launch of work in connection with drawing up a new buy-back tariff for cogeneration installations by targeting this tariff at the most energy-efficient cogeneration installations.

Relaxing the operation of cogeneration installations, if implemented, would consist in allowing these installations to free themselves from the constraints associated with guaranteed power, by allowing them better to adapt their operating power to fluctuations in heat outlets and to temporarily come out of the obligation-to-buy contract during the summer, by recycling the electricity on the market.

2.4.2.2 Calls for tender for electricity produced from biomass

Biomass calls for tender are a complementary support measure to develop the industry and achieve the objectives set in relation to the production of renewable electricity and heat. The effective recovery of biomass is encouraged by demanding that outlets be found for the heat produced. These calls for tenders are based primarily on unexploited forestry and agricultural resources so that power stations do not disturb the supplies of pre-existing chains.

An initial call for tenders, for the construction with effect from 1 January 2007 of power stations of more than 12 MW supplied by biomass and biogas, was launched in 2003. This call for tenders was opened for a cumulative power of 200 MW of biomass and 50 MW of biogas. When the ERC had finished instructing the files, the minister for industry chose 14 biomass projects representing 216 MW and 1 biogas project of 16 MW. In January 2005 he issued an operating permit to the chosen candidates, who benefit from a contract to buy electricity for 15 years.

Within the framework of the objectives laid down by the multiannual programme of investments in electricity, a second call for tenders for the construction of electricity-generating power stations supplied with biomass was launched in 2006.

It concerned the construction of power stations producing electricity from biomass or biogas. Open to a cumulative power of 300 MW split into two bands: one of 220 MW for installations with a power strictly greater than 9 MW, the other of 80 MW for installations with a power greater than or equal to 5 MW and less than or equal to 9 MW. The projects must be commissioned before 1 January 2010.

The energy efficiency characteristics of this second call for tenders had been calibrated to systematically obtain a combined heat and electricity production:

- obligation to recover at least 50% of the primary energy of the biomass;
- reduction in the minimum eligible power threshold to 5 MWe, which will make it easier to find outlets for the cogenerated heat;

Energy efficiency was also the subject of a disqualifying mark if it was less than 50%. However, a tolerance of 10% in the event of a reduction in mean energy efficiency over the year is accepted, if the reduction is greater than 10%, a penalty (reimbursement to the purchaser of the difference in price between the "price indicated in the offer" and the price taken into account when calculating the provisional avoided cost of the obligation to buy) is applied. However, this penalty does not apply if the reduction in energy efficiency is the result after the first two years of operation of a reduction or cessation in the recovery of heat due to the cessation of activity of one or more of the heat buyers. If this situation arises within 10 years of commissioning, the remuneration is maintained for 2 years, then the price is reduced by 5% until performance is re-established.

Within the context of this second call for tenders, the French authorities selected 12 projects situated in band 1 (84 MW) and 10 in band 2 (230 MW) for an average sale price of the electricity of EUR 128/MWh, based on an examination by the Energy Regulation Commission. Most of the sites chosen are situated on industrial sites: 1 distillery, 3 pellet factories, 1 greenhouse grower, 7 biofuel sites, 3 chemical or mining industrial sites, 4 paper mills, 1 dairy, 1 timber manufacturer. Furthermore, one project is to supply a heating network.

These new projects, together with the power stations commissioned within the context of the first call for tenders, represent a power of more than 400 MW. Taking pre-existing installations into account, the electricity production capacity from biomass would be in the order of 700 MW in 2010.

Finally, a third call for tender relating to a maximum supplementary installed power of 250 MWe from biomass was launched in December 2008. The total power subject to this new call for tenders is spread over 2 bands as follows:

* Band 1: a band of 150 MWe for biomass energy recovery installations with a power greater than or equal to 3 MWe situated in the following areas: areas of massifs within the meaning of Decree No 2004-69, the regions of Alsace, Lorraine, Champagne-Ardenne, Nord-Pas-de-Calais, Picardy, Brittany, as well as the department of Seine-et-Marne;

* Band 2: a band of 100 MWe for biomass energy recovery installations with a power greater than or equal to 3 MWe situated in mainland France (including Corsica). The projects must be commissioned before 1 January 2010.

The conditions of this call for tenders emphasise the following objectives: Strict control of the risks of conflict of use of biomass, High energy efficiency, Targeting of priority territories in terms of economic development.

2.4.2.3 Fiscal arrangements

Cogeneration installations benefit from special depreciation over 12 months, this was extended until 1 January 2011 by the amending Finance Act for 2008. Finally, since 1991 they have benefited from a reduction in the assessment basis for business tax of 50%, which may be increased to 100% by local and regional authorities; this reduction has moreover no longer been conditional on the use of the special depreciation since the Finance Act for 2002.