Energy Savings Calculations for selected end use technologies and existing evaluation practices in France

A report produced for the IEA DSM Agreement, Task 21
Harmonisation of Energy Savings Calculations

Prepared by Bruno Lapillonne, Enerdata for ADEME

23 August 2012

In the IEA DSM Agreement, Task 21 Harmonisation of Energy Savings Calculations, the following countries are participating:

France,
Republic of Korea
Netherlands
Norway
Spain
Switzerland
USA

Each country prepared a report on the Energy Savings Calculations for selected end use technologies and existing evaluation practices. These reports are available at www.ieadsm.org

The report holds information on selected case applications. These cases are selected with a view to present information on the energy savings calculations that are or could be done for the selected end use technologies. The case applications are not selected as best practice examples, but are good examples for common practise.

For more information one can contact:

Bruno Lapillonne
Enerdata
47 Avenue Alsace Lorraine
38000 Grenoble
France
Bruno.lapillonne@enerdata.net

Or

Harry Vreuls
NL Agency
P.O. box 17
3160 AA Sittard
The Netherlands
Harry.vreuls@agentschapnl.nl

Table of Content

1. CASE APPLICATIONS

1.1 Introduction

The country experts discussed during the project how an overview could be created for the methods that are used for calculating or estimating (ex-post) energy savings. It was decided to use case applications in selected technology areas and energy end-users. For this project the selection of case applications is to illustrate what is or could be used for estimating energy savings from programme or project implementations. The case applications show the practise in a participating country, without suggesting that these are 'best practises'. They are a snapshot and sometimes also one of the applications that are in use in a country, but they clearly illustrate what key elements in the energy savings calculations are, how problems in data collections are handled and how default or standard values are used.

The case applications are selected for the following technologies and energy end-users:

a. Industry; Variable Speed Drive and High Efficient motor
b. Commercial Buildings; Heating system
c. Commercial Buildings; Integrated Air conditioning system
d. Households; Retrofit wall insulation
e. Households; Lighting

For France the following case applications are selected:

- Industry; Variable Speed Drive and High Efficient motor
- Commercial Buildings; Heating
- Households; Retrofit wall insulation
- Households; Lighting

These case applications are presented from section 1.2 onwards with additional information in Annex B.

Each of the case applications presents the information in a common format, a template. There are four groups:

1. Summary of the program
2. Formula for calculation of annual energy savings
3. Input data and calculations of energy savings
4. Greenhouse gas savings

Additional information is provided in references, one or more annex and on definitions

The template was improved during the project, based on experiences to present the information for case applications and discussions during the experts meetings. A workshop was held in April 2011 in Korea to get feedback on the final draft of the template. During the workshop three different case applications were presented to illustrate the use of the template and to discuss future application.

In Annex A the final version of the template with instructions is enclosed.

For France, the diffusion of all the techniques described below is part of a framework programme related to an energy savings obligation for energy suppliers. This programme concerns all suppliers with sales over 400 GWh/year for electricity, gas and heat and 100

GWh/year for LPG and resellers of heating oil[1], gasoline and diesel[2] . It has been introduced in Articles 14 and 15 of the energy law of 2005[3] setting the main objectives of the energy policy. A volume of savings has been defined by the government for a first period from July 1st 2006 to June 30th 2009. Obliged" energy suppliers ("obliged parties") can either implement actions to encourage energy savings investments or buy energy saving certificates; therefore the program is commonly known as "energy saving certificates" programme.

The programme has been extended for a second period with the adoption of a new law called Grenelle 2 in July 2010[4] with the same method for calculating the energy savings. The volume of the obligation is set at 345 TWh cumac[5] for the second 3 years period to be compared to a volume 54 TWh cumac for the first 3 years period.

The savings values have been standardized and correspond therefore to deemed savings. They have been agreed upon following a process involving various stakeholders on the basis of expert opinions and survey data. The process of standardisation is the following:

- a file containing all parameters an results of calculations is proposed and prepared by ATEE, Technical Association for Energy and Environment, organised for this purpose in various committees by sector;
- It is then submitted to consultation of ADEME;
- It is then validated by the Ministry in charge of the energy sector (DGEC) ;
- It is officially published through government decrees (7 decrees until now)
- It is publicly available on the Ministry web site: http://www.developpement-durable.gouv.fr[6]

Additional to the case application on energy savings, in Annex C one case application on the Demand Response programme "Tempo Tariff" is included. The information on the Demand Response programmes is used to gain knowledge on the role energy savings play in such programs.

Annex D holds a review of existing energy savings calculation standards in France

[1] For the second period, the obligation was restricted to resellers of heating oil with sales above 500 m^3/year.

[2] The extension to resellers of motors fuels took place in the ongoing second phase of the programme.

[3] Law"POPE" n° 2005-781 of July 2005

[4] Law n°2010-788 of 12 July 2010

[5] Cumac: life time cumulated and discounted

[6] http://www.developpement-durable.gouv.fr/Secteur-du-batiment-residentiel.html

1.2 High Efficient electric motors

1 Summary of the program.

1.1 Short description of the program

1.1.1 Purpose or goal of the program

The programme stimulates the introduction of Variable Speed Drive in the industrial sector and is a part of the energy saving certificates programme[7].

According to the latest evaluation in February 2011, the total volume of energy savings validated within the white certificate scheme between July 1st 2006 and December 31st 2010 reached 164 TWh, of which 3.8% was obtained through the installation of Variable Speed Drive (VSD) in the industrial sector[8]. This action is among the 10 most frequent actions implemented in the white certificate scheme and ranks in the eighth position.

1.1.2 Type of instrument(s) used

“Obliged" parties in the energy saving certificate program are free to determine their own strategy for encouraging customer investments, such as technical advice or support, bonuses and financial services.

For the promotion of the introduction of Variable Speed Drive parties use several instruments e.g. support to audits, to investments.

1.2 General and specific user category (economic sector and subgroups)

All industrial consumers are concerned.

1.3 Technologie(s) involved

The operation applies to all new or existing motors (pumps, fans and compressors[9]) with variable loads, regulated by a device giving rise to losses (bypass, throttling, etc.) in which the conventional system is replaced by an electronic variable speed drive. The motors to be considered should have with a rated power between 0.37 kW and 1000 kW.

1.4 Status of the evaluation and energy savings calculations

The evaluation of energy savings are officially used to measure the energy savings related for different standardised operations and equipment that obliged utilities concerned by the white certificates scheme can promote with their consumers. They are published in French on the Ministry web site and in a printed Memento by ATEE (“Mémento du Club C2E). A summary

---

7 See section 2.1 for the description of the programme.

8 Ministère de l’Ecologie, du Développement Durable, des Transports et du Logement, Lettre d’information Certificats d’économies d’énergie, Février 2011.

9 Compressors for air and for cold

description of the detailed calculation sheets with all assumptions are restricted to the stakeholders involved in the process of fixing the standard savings values.

1.5 Relevant as a Demand Response measure

No

2 Formula for calculation of annual energy savings

Energy savings are calculated in final energy in kWh. They are first expressed per year and then cumulated over the lifespan of the equipment; in addition they are not assumed as constant over this life time but are discounted at 4%, to reflect both a financial discount (economic value of the energy saving certificate) and a technical discount (gradual decrease in savings). The savings are therefore expressed in **kWh cumac** (cumulated and discounted). Only the discounted and cumulated values are officially published; the values for annual energy savings are considered as intermediate parameters. The total cumulated discounted energy savings resulting from the installation of VSD units in year t are allocated at year t.

The value of the energy savings accounted for in the energy certificate programme depends on the use of the motor and is expressed per kW of rated power. Three types of motors uses are considered: ventilation, pumping and compressed air.

2.1 Formula used for the calculation of annual energy savings

Annual savings in year t = n_s x PCES*h in kWh

PCES = % of energy savings from the installation of VSD

h = operating hours

n_s = power in kW of motors in which VSD units are installed in year t

2.2 Specification of the parameters in the calculation

PCES = rate of energy savings from the installation of VSD units

h = operating hours

2.3 Specification of the unit for the energy saving calculation

The energy savings is specified per kW of power rating installed or promoted.

2.4 Baseline issues

The baseline used for the energy savings calculations is a market average. This baseline is incorporated in the gross to net calculation

The baseline is static. The discounting (during the lifetime calculation) is considered to somehow take into account a dynamic baseline.

2.5 Normalization

No normalization has been applied.

2.6 Energy savings corrections

Annual savings are corrected to account for the average reference market share of VSD.
Net savings are equal to gross savings, as calculated above, multiplied by a coefficient reflecting the market share of the efficient appliance (MSEFF) = gross savings *(1-MSEFF).

There is no correction for double counting, free riders, technical interactions, and spill over effects or rebound effect.

3 Input data and calculations

3.1 Parameter operationalisation

The savings values have been standardized and correspond to deemed savings. They have been agreed upon following a process involving various stakeholders on the basis of expert opinions and survey data. The process of standardisation is shortly explained in section 2.1.

3.2 Calculation of the annual savings as applied

In the calculations, some simplifications and assumptions have been made as follows.
The value of the parameters depends on the use of the motor: three types of motors uses are considered: ventilation, pumping and compressed air.

Annual net savings in year t = (1- MSEFF) * {n_s x * PCES*h} in kWh
Where:

MSEFF = share of VSD (baseline situation) (see Table 1)
PCES = rate of energy savings from the installation of VSD units (see Table 2)
H = operating hours (see Table 3)
n_s = power in kW of motors in which VSD units are installed in year t

Table 1: Baseline situation: share of VSD

Application	Market share
Pumping	3,64%
Ventilation	3,86%
Compressed air	0,69%
Compressors cold	0%

Source: Annex 1

Table 2: Rate of energy savings from VSD[10]

Application	% savings
Pumping	30%

[10] There is no simple method for calculating the saving associated with the installation of variable speed drive systems. The key parameters involved characterize variation ranges (flow levels and associated times), which are highly variable and depend on installation design calculations, process type, production organisation, etc.

Ventilation	30%
Compressed air	15%
Compressors cold	15%

Table 3: Number of operating hours of electric motors

Application	Annual duration (hours)	Annual duration (hours)
	<630 kW	>630 kW
Pumping	5 091	8 300
Ventilation	6 148	8 400
Compressed air	4 709	7 500
Compressors cold	5 676	6 750

Source: see Annex 2

For instance for motors below 630 kW, the annual net savings in year t are the following:
For **pumping:**
= (1- 0.0364) * {n_s x 0.30*5091}
= 0.9636* n_s x 1527.3
= n_s x 1472 kWh

For **ventilation:**
= (1- 0.0386) * {n_s x 0.30*6148}
= 0.9614* n_s x 1844.4
= n_s x 1773 kWh

For **compressed air:**
= (1- 0.0069) * {n_s x 0.15*4709}
= 0.9931* n_s x 706.4
= n_s x 701 kWh

For **compressors cold:**
= {n_s x 0.15*5676}
= n_s x 851 kWh

3.3 Total savings over lifetime

3.3.1 Savings lifetime of VSD

The life time of variable speed drive is standardised and is assumed to be 15 years.

3.3.2 Lifetime savings calculation of VSD

The life time savings are not used for how long savings are accounted for, but for accounting the savings of the variable speed drive promoted in year t.

The life time savings are discounted (saving in kWh cumac) with a discount rate of 4%. This means that the annual savings are multiplied by a discount factor, function of the life time and discount rate. This results in the value of 11.56 years for the discounted lifetime (LT_{disc}) for variable speed drive (life time of 15 years).

For motors below 630 kW, lifetime savings[11] are as follows:

For pumping = LT_{disc} x n_s x 1472= 11.56 x n_s x 1472 = n_s x 17 016 kWh cumac
rounded to n_s x 17 000 kWh cumac

For ventilation = LT_{disc} x n_s x 1773= 11.56 x n_s x 1773 = n_s x 20 496 kWh cumac
rounded to n_s x 20 500 kWh cumac

For air compressors = LT_{disc} x n_s x 701= 11.56x n_s x 701 = n_s x 8 103 kWh cumac
rounded to n_s x 8 100 kWh cumac

For cold compressors = LT_{disc} x n_s x 851= 11.56x n_s x 851 = n_s x 9 840 kWh cumac
rounded to n_s x 9 800 kWh cumac

With: n = number of VSD installed in year t

For motors between 630 kW and 1 MW, lifetime savings are as follows:

For pumping = LT_{disc} x n_s x 2399= 11.56 x n_s x 2399 = n_s x 27 732 kWh cumac
rounded to n_s x 27 700 kWh cumac

For ventilation = LT_{disc} x n_s x 2419= 11.56 x n_s x 2419 = n_s x 27 960 kWh cumac
rounded to n_s x 28 000 kWh cumac

For air compressors = LT_{disc} x n_s x 1118= 11.56x n_s x 1118 = n_s x 12 924 kWh cumac
rounded to n_s x 12 900 kWh cumac

For cold compressors = LT_{disc} x n_s x 1012= 11.56x n_s x 1012 = n_s x 11 699 kWh cumac
rounded to n_s x 11 700 kWh cumac

4 GHG savings

There is no calculation of GHG savings in the white certificate scheme as the objective of the programme is to generate energy savings. However, CO_2 savings can be estimated on the basis of the electricity savings.

The average emission factors calculated on the basis of the average power mix is quite low because of the high contribution of nuclear in France: around 80 g CO_2/kWh[12]; in that case the lifetime discounted GHG savings (i.e. lifetime discounted avoided emissions) are the following for motors below 630 kW:

- For pumping: 1.36 t CO_2 (=17 000 kWh cumac *80 g CO_2/kWh)
- For ventilation: 1.64 t CO_2 (=20 500 kWh cumac *80 g CO_2/kWh)
- For air compressors 0.65 t CO_2 (= (8 100 kWh cumac *80 g CO_2/kWh)
- For cold compressors .0.78 t CO_2 (= (9 800 kWh cumac *80 g CO_2/kWh

For motors between 630 kW and 1 MW, the lifetime discounted GHG savings are:

- For pumping: 2.21 t CO_2 (=27 700 kWh cumac *80 g CO_2/kWh)
- For ventilation: 2.24 t CO_2 (=28 000 kWh cumac *80 g CO_2/kWh)
- For air compressors 1.03 t CO_2 (= (12 900 kWh cumac *80 g CO_2/kWh)
- For cold compressors .0.94 t CO_2 (= (11 700 kWh cumac *80 g CO_2/kWh

[11] The savings are presented as kWh cumac to clarify that they are cumulated and discounted.

[12] Source Enerdata data base, including own generation in industry; it is around 50-65 gCO2/kWh for public electricity only

References

Document IND-UT-02 on http://www.developpement-durable.gouv.fr/Secteur-de-l-industrie.html

Annexes (in Annex B1)

Annex 1: Market data on electric motors and variable speed drive in France and Europe
Annex 2: Operating hours of motors

1.3 Commercial buildings; Heating

1 Summary of the program

1.1 Short description of the program

1.1.1 Purpose or goal of the program

The programme stimulates the introduction of techniques aiming at saving energy for thermal uses (space heating and water heating) in the tertiary sector, i.e. in commercial and public buildings and is a part of a more general program, the energy saving certificates program[13].

According to the latest evaluation in February 2011, the total volume of energy savings validated within the white certificate scheme between July 1st 2006 and December 31st 2010 reached 164 TWh[14].

1.1.2 Type of instrument(s) used

“Obliged" parties in the energy saving certificate program are free to determine their own strategy for encouraging customer investments, such as technical advice or support, bonuses and financial services.

1.2 General and specific user category

The buildings concerned belong to the following categories:

- Offices
- Education buildings (e.g. schools)
- Health buildings (e.g. hospitals)
- Retail and wholesale buildings (e.g. department stores)
- Hotels and restaurants

1.3 Technology involved

The techniques involved are all techniques that enable to save energy with thermal systems (heating and hot water), such as insulation of wall, roofs, change of windows, control settings, ventilation, etc. For a change of boiler to condensing boiler or lighting equipment a different approach should be used, that is not described here[15].

1.4 Status of the evaluation and energy savings calculations

The evaluation of energy savings are officially used to measure the energy savings related for different standardised operations and equipment that obliged utilities concerned by the white certificates scheme can promote with their consumers. They are published in French on the Ministry web site and in a printed Memento by ATEE (“Mémento du Club C2E). A summary

---

[13] See section 2.1 for the description of the programme.

[14] Ministère de l’Ecologie, du Développement Durable, des Transports et du Logement, Lettre d’information Certificats d’économies d’énergie, Février 2011.

[15] It is similar in the methodology used to calculate the savings linked to the change from incandescent lamps to CFL for households or the installation of variable speed drive for electric motors.

description of the detailed calculation sheets with all assumptions are restricted to the stakeholders involved in the process of fixing the standard savings values.

1.5 Relevant as a Demand Response measure

No

2 Formula for calculation of annual energy savings

Energy savings are calculated in final energy in kWh. They are accounted cumulated over the lifespan of the equipment; in addition they are not assumed as constant over this life time but are discounted at 4%, to reflect both a financial discount (economic value of the energy saving certificate) and a technical discount (gradual decrease in savings). The savings are therefore expressed in **kWh cumac** (cumulated and discounted). Only the discounted and cumulated values are officially published; the values for annual energy savings are considered as intermediate parameters.

2.1 Formula used for the calculation of annual energy savings

Annual savings in year t = n_s x ES in kWh

with ES = unitary energy savings per m2 of building floor area (in kWh/m2)
n_s = floor area concerned by energy saving investments in year t

The unitary energy saving is calculated by multiplying a reference unitary consumption (baseline consumption) by a percentage energy saving f, corresponding to the reduction of the unitary consumption between the baseline t_0 and the final situation t.

To simplify the calculation for small buildings and to avoid data collection, default values of energy savings are proposed based on a reference consumption and a default value for the average rate of energy savings. This standardised approach is applicable to buildings with a total surface area of less than 5,000 m^2. Beyond this limit, institutions are required to carry out an assessment and the standard calculation is not applicable.

Therefore for a building type j heated with a fuel type k in climatic zone i, the annual energy savings are equal to:
ESijk= ES**CCi*ICj*ENk
With:
ES: reference unitary energy savings per m2 of building floor area (default value)
CCi: coefficient for climatic zone i,
ICj: coefficient for building type j
ENk: coefficient for heating energy k (electricity versus fuels based systems)

2.2 Specification of the parameters in the calculation

CCi: coefficient for climatic zone i,
ICj: coefficient for building type j
ENk: coefficient for heating energy k (electricity versus fuels based systems)

2.3 Specification of the unit for the energy saving calculation

The energy saving is specified per m^2.

2.4 Baseline issues

The baseline situation is the initial situation, prior to the energy saving investments works carried out[16].

The baseline is static; the discounting (during the lifetime calculation) is considered to somehow take into account a dynamic baseline.

2.5 Normalization

No normalization has been applied[17].

2.6 Energy savings corrections

There is no correction for double counting, free riders, technical interactions, and spill over effects or rebound effect.

3 Input data and calculations

3.1 Parameter operationalisation

The savings values have been standardized and correspond therefore to deemed savings. They have been agreed upon following a process involving various stakeholders on the basis of expert opinions and survey data. The process of standardisation is shortly explained in section 2.1.

3.2 Calculation of the annual savings as applied

Default energy savings values have been calculated for different types of actions (e.g. roof insulation, wall insulation) and have to be corrected with three coefficients to account for the climatic zone, the type of building and the energy used for heating, as follows:

- Coefficient for climate zones (CC), to account for the location of the building (see Table 1)
- Coefficient of intermittence and internal gain (IC) to account for the type of building or branch (Table 2); this coefficient is based on reference energy consumption data for heating and hot water by type of building and branch given in Annex 1.
- Coefficient for the type of energy (electricity vs. fuel) (based on the following reference efficiency of η = 95% for electricity and 60% for fuels)

[16] If there is a change of boiler or lighting, the baseline situation is based on the market for products or services performing a similar function.

[17] The energy savings calculations are done at normal climate.

Table 1: Correction coefficient for climatic zones (CC)

	H1	H2	H3
Climate coefficient	1.1	0.9	0.6

Table 2: Correction for the type of building or branch (IC)

	Education	Offices	Health	Hotels-Restaurants	Commerce
Internal gains	0,7	0,7	0,75	0,75	0,7
Intermittence and indoor temperature	0,78	0,78	1,52	0,79	0,78
Coefficient (gains, T°C and intermittence)	0,55 (rounded to 0.6)	0,54 (rounded to 0.5)	1,14 (rounded to 1.1)	0,59 (rounded to 0.6)	0,55 (rounded to 0.6)

Annual net savings in year t
= RES* IC * CC/η
With RES: Reference energy saving (depending on the type of action)
CC: coefficient for climate zones
IC: coefficient of intermittence and internal gain
η = 95% for electricity and 60% for fuels

3.3 Total savings over lifetime

3.3.1 Savings lifetime of heating commercial buildings

Each basic operation must set out the lifetime used for calculating discount values. This must be justified on the basis of survey documents or their equivalent.
For standard operation on building such as insulation of roof or wall the default value used is 35 years.

3.3.2 Lifetime savings calculation of heating commercial buildings

The life time savings are not used for how long savings are accounted for, but for accounting the savings of the investments promoted in year t.

The life time savings are discounted (saving in kWh cumac) with a discount rate of 4%. This means that the annual savings are multiplied by a discount factor, function of the life time and discount rate. This results in the value of 19,411 years for the discounted lifetime (LT_{disc}) for insulation of roof or wall (life time of 35 years).

Lifetime savings = LT_{disc} x annual saving

This lifetime saving is presented as kWh cumac to clarify that this value is cumulated and discounted.

For example the standardised lifetime savings for roof insulation of buildings is given in Table 3.

Table 3: Example of standardised lifetime savings: case of roof insulation of buildings[18]

Amount in kWh cumac / m^2 insulation					
$2.5\ m^2K/W \leq R < 5\ m^2K/W$[19]			$R \geq 5\ m^2K/W$		
Climatic area	Heating energy		Climatic area	Heating energy	
	Electricity	Fuel		Electricity	Fuel
H1	1,100	1,700	H1	2,400	3,800
H2	900	1,400	H2	2,000	3,100
H3	600	900	H3	1,300	2,100

X

Activity sector	Building factor
Offices	0.5
Education, commerce, hotels restaurants	0.6
Health	1.1

4 GHG savings

There is no calculation of GHG savings in the white certificate scheme as the objective of the programme is to generate energy savings.

However, it is possible to evaluate the CO_2 savings from average emission factors. For fuel we can take a mix between oil and gas based on the average consumption between these two fuels. In 2008, gas made up 60% of the consumption of fossil fuels, heating oil 30% and coal (through collective and district heating) 10%. This corresponds to an average emission factor for fossil fuels of 2.7 t CO_2/toe or 235 g CO_2/kWh.

For electricity savings, two emission factors are generally used:

- The average of the power mix, which is quite low because of the high contribution of nuclear: in a range of 50-65 g CO_2/kWh or an average of 60 g CO_2/kWh[20];

[18] Only for buildings in the tertiary sector with a total surface area of less than 5,000 m².
[19] Only for operations started before 01/01/2008 (not accounted for after this date).
[20] For public electricity only; including own generation in industry it is around 80 gCO2/kWh;

- A value of 180g CO_2/kWh based on the actual power mix estimated as corresponding to the heating load[21]; the value was estimated by a working group gathering experts from ADEME, the French national energy efficiency agency, and EDF, the dominant power utility.

Table 5: Lifetime discounted CO_2 savings by climatic area and fuel[22] (estimate)
(t CO_2/m2 insulation material)

Area	Fuel	Electricity (average)	Electricity (heating load)
H1	0,7	0,12	0,35
H2	0,6	0,10	0,29
H3	0,4	0,07	0,20

X

Activity sector	Building factor
Offices	0.5
Education, commerce, hotels	0.6
Health	1.1

References
Document BAT-EN-01 on http://www.developpement-durable.gouv.fr/Secteur-du-batiment-tertiaire.html

Annex (in B2)

Annex 1: Reference Baseline energy consumption for heating and hot water by type of building

[21] We assumed the same heating load for services as for households.
[22] Case of 2.5 $m^2K/W \leq R < 5\ m^2K/W$

1.4 Households; Retrofit wall insulation

1 Summary of the program

1.1 Short description of the program

1.1.1 Purpose or goal of the program

The programme stimulates the introduction of retrofit wall insulation in the household sector and is a part of the energy saving certificates programme[23].

According to the latest evaluation in February 2011, the total volume of energy savings validated within the white certificate scheme between July 1st 2006 and December 31st 2010 reached 164 TWh, of which 2.5% was obtained through wall insulation[24].

1.1.2 Type of instrument(s) used

“Obliged" parties in the energy saving certificate program are free to determine their own strategy for encouraging customer investments, such as technical advice or support, investment subsidies or soft loans.
For the retrofit of wall insulation parties use several instruments e.g. investment subsidies or soft loans.

1.2 General and specific user category (economic sector and subgroups)

All households are concerned: existing individual houses and apartments.

1.3 Technologie(s) involved

Installation of wall insulation with a thermal resistance R>2.4 m^2K/W[25].
Insulation materials should have a French certification label called ACERMI[26] or equivalent performances and quality characteristics proven by with legal documents from an EU country, or an EEE country or from Turkey. Insulation materials should be installed by a professional.

1.4 Status of the evaluation and energy savings calculations

The evaluation of energy savings are officially used to measure the energy savings related for different standardised operations and equipment that obliged utilities concerned by the white certificates scheme can promote with their consumers. They are published in French on the Ministry web site and in a printed Memento by ATEE (“Mémento du Club C2E). A summary

---

[23] See section 2.1 for the description of the programme.
[24] Ministère de l’Ecologie, du Développement Durable, des Transports et du Logement, Lettre d’information Certificats d’économies d’énergie, Février 2011.
[25] Until January 2008, insulation materials with a thermal resistance R between 1.2 m^2K/W and 2.4 m^2K/W were also eligible but the savings were valued at 50% of their real savings.
[26] « Association pour la Certification des Matériaux Isolants », http://acermi.cstb.fr/

description of the detailed calculation sheets with all assumptions are restricted to the stakeholders involved in the process of fixing the standard savings values.

1.5 Relevant as a Demand Response measure

No

2 Formula for calculation of annual energy savings

Energy savings are calculated in final energy in kWh. They are accounted cumulated over the lifespan of the equipment; in addition they are not assumed as constant over this life time but are discounted at 4%, to reflect both a financial discount (economic value of the energy saving certificate) and a technical discount (gradual decrease in savings). The savings are therefore expressed in **kWh cumac** (cumulated and discounted). Only the discounted and cumulated values are officially published; the values for annual energy savings are considered as intermediate parameters. The total cumulated discounted energy savings resulting from the installation of VSD units in year t are allocated at year t.

2.1 Formula used for the calculation of annual energy savings

Annual savings in year t = n_s x ES in kWh

ESij = energy savings per m2 of insulation materials for climatic zone i and heating fuel j (electricity versus fuels based systems)

n_s = surface area of insulation materials promoted or installed in year t

$ES_{ij} = (U_0-U_t)*\ DD*CC_i*\ 24h*IC/EFF_j/1000$ (formula reversed to get >0 savings)

Where:

U_t = U value after installation of insulation materials)

U_0 = U value before installation of insulation materials ($W/\ m^2K$)

R = thermal resistance of the insulation material (m^2K/W)

DD = Average number of degree days

CC_i = Climatic coefficient of climatic zone[27] i (=1 for average)

IC = Intermittency coefficient and incidental gain

DD = Average number of degree days

EFF_j = Efficiency of heating system j (electricity versus fossil fuels).

1/1000 = conversion factor from W to kW

As $U_t = 1/((1/U_0)+R)$, with R= thermal resistance of the insulation, the formula becomes:

[27] There are three climatic zones: H1, the coldest one, H2 intermediate climate, and H3 the warmest zone in the south of the country.

$$ES_{ij} = \{U_0 - (1/[(1/U_0)+R])\} * DD*CC_i* 24h*IC/EFF_{j/}1000$$

2.2 Specification of the parameters in the calculation

U_0 = U value before installation of insulation materials
R = thermal resistance of the insulation material (m^2K/W)
DD = Average number of degree days
CC_i = Climatic coefficient of climatic zone i (see Table 1)
IC = Intermittency coefficient and incidental gain
DD = Average number of degree days
EFF_j = Efficiency of heating system j

LT_{disc} = lifetime discounted

2.3 Specification of the unit for the energy saving calculation

The energy savings is specified per m2 of insulation materials installed or promoted.

2.4 Baseline issues

The baseline insulation coefficient used for external wall is U_o=3.3 W/ m^2K: it corresponds to a non insulated wall.[28]

The baseline used for the energy savings calculations is the stock average.

The baseline is static; the discounting (during the lifetime calculation) is considered to somehow take into account a dynamic baseline.

2.5 Normalization[29]

No normalization has been applied.

2.6 Energy savings corrections

There is no correction for double counting, free riders, technical interactions, and spill over effects or rebound effect.

3 Input data and calculations

3.1 Parameter operationalisation

[28] There are still in France between 9 and 11 million non insulated homes out of a total stock of 31 million; this represents about 1/3 of the total stock and about half of the stock of dwellings built after the first building regulation.
[29] The energy savings calculations are done at normal climate.

The savings values have been standardized and correspond therefore to deemed savings. They have been agreed upon following a process involving various stakeholders on the basis of expert opinions and survey data. The process of standardisation is shortly explained in section 2.1.

3.2 Calculation of the annual savings as applied

In the calculations, the following assumptions and simplifications are made.

Annual net savings in year t = ns* $\{U_0 - (1/[(1/U_0)+R])\}$* DD*$CC_i$* 24h*IC/$EFF_j$/1000 kWh/m^2

With:

n_s = area of insulation materials in m^2 promoted/installed in year t
U_0= U value before installation of insulation materials = 3.3 $W/m^2.K$
R = thermal resistance of the insulation material= 2.4 m^2K/W
DD = Average number of degree days = 2450
CC_i = Climatic coefficient of climatic zone i (see Table 1)
IC = Intermittency coefficient and incidental gain = 0.5
EFF_j = Efficiency of heating system=95% for electricity and 60% for fuel based heating

Table 1: Climatic coefficient by climatic area

Area	Climatic coefficient (cc)
average	1
H1	1.1
H2	0.9
H3	0.6

Annual net savings in year t for average climate and for electricity
= ns*{3.3 - (1/[(1/3.3)+2.4])}* 2450*1* 24*0.5/0.95/1000
= n_s x 91 kWh

Annual net savings in year t for average climate and for fuels
= ns*{3.3 -(1/[(1/3.3)+2.4])}* 2450*1* 24*0.5/0.6
= n_s x 144 kWh

The annual net savings in year t by climatic zone and fuels is shown in Table 2

Table 2: Annual savings by climatic area and fuel (kWh/m2 insulation material)[30]

Area	Fuel	Electricity
Average	144	91
H1	158	100
H2	129	82
H3	86	54

[30] Rounded values

3.3 Total savings over lifetime

3.3.1 Savings lifetime of retrofit wall insulation

The life time of insulation materials is standardised and is assumed to be 35 years.

3.3.2 Lifetime savings calculation of retrofit wall insulation

The life time savings are not used for how long savings are accounted for, but for accounting the savings of the insulation retrofit promoted/installed in year t.

The life time savings are discounted (saving in kWh cumac) with a discount rate of 4%. This means that the annual savings are multiplied by a discount factor, function of the life time and discount rate. This results in the value of 19.4 years for the discounted lifetime (LT_{disc}) for wall insulation with a life time of 35 years.

electricity = LT_{disc} x n_s x 91 = 19.4 x n_s x 91 = n_s x 1760 kWh (average climate)
fuels = LT_{disc} x n_s x 144 = 19.4 x n_s x 144 = n_s x 2787 kWh (average climate)

These savings are presented as kWh cumac to clarify that they are cumulated and discounted. Table 3 gives the calculated value by climatic zone and type of heating. Table 4 gives the final value after rounding used for the French energy savings certificate programme. They vary between a minimum of 1100 kWh cumac/m^2 of insulation materials (climatic zone H3, electricity) to 3100 kWh cumac /m^2 (zone H1, fossil fuel)[31].

Table 3: Lifetime discounted savings by climatic area and fuel (calculated values)
(kWh cumac/m2 insulation material)

Area	Fuel	Electricity
H1	3066	1936
H2	2508	1584
H3	1672	1056

[31] Until January 2008, the savings for insulation materials with a thermal resistance R between 1.2 m^{2}K/W and 2.4 m^{2}K/W varied between a minimum of 480 kWh cumac/m^2 of insulation materials (climatic zone H3, electricity) to 1400 kWh cumac/m^2 (zone H1, fossil fuel).

Table 4: Lifetime discounted savings by climatic area and fuel (official values)[32]
(kWh cumac/m2 insulation material)

Area	Fuel	Electricity
H1	3100	1900
H2	2500	1600
H3	1700	1100

4 GHG savings

There is no calculation of GHG savings in the white certificate scheme as the objective of the programme is to generate energy savings.

However, it is possible to evaluate the CO_2 savings from average emission factors. For fuel we can take a mix between oil and gas based on the average consumption between these two fuels. In 2008, gas made up 62% of the consumption of fossil fuels, heating oil 36% and coal 1%. This corresponds to an average emission factor for fossil fuels of 2.6 t CO_2/toe or 224 g CO_2/kWh. Wood is important in France for heating, if the dwelling is heated with wood there is no saving in CO_2 as wood is considered as neutral in terms of GHG emissions.

For electricity savings, two emission factors are generally used:

- The average of the power mix, which is quite low because of the high contribution of nuclear: in a range of 50-65 g CO_2/kWh or an average of 60 g CO_2/kWh[33];

- A value of 180g CO_2/kWh based on the actual power mix estimated as corresponding to the residential heating load; the value was estimated by a working group gathering experts from ADEME, the French national energy efficiency agency, and EDF, the dominant power utility.

Table 5: Lifetime discounted CO_2 savings by climatic area and fuel (estimate)
(t CO_2/m2 insulation material)

Area	Fuel	Electricity (average)	Electricity (heating coefficient)
H1	0,7	0,12	0,35
H2	0,6	0,10	0,29
H3	0,4	0,07	0,20

References

Document BAR-EN-02 on (http://www.developpement-durable.gouv.fr/Secteur-du-batiment-residentiel.html)

32 Rounded values
33 For public electricity only; including own generation in industry it is around 80 gCO2/kWh;

1.5 Households; Lighting

1 Summary of the program

1.1 Short description of the program

1.1.1 Purpose or goal of the program

The programme stimulates the introduction of Compact fluorescent lamps (class A) in the residential sector and is a part of the energy saving certificates programme[34].

According to the latest evaluation in February 2011, the total volume of energy savings validated within the white certificate scheme between July 1st 2006 and December 31st 2010 reached 164 TWh, of which about 2% was obtained through the installation of CFLs[35].

1.1.2 Type of instrument(s) used

“Obliged" parties in the energy saving certificate program are free to determine their own strategy for encouraging customer investments, such as technical advice or support, bonuses and financial services.
For the promotion of the introduction of CFL parties use several instruments e.g. free give a way, discounts and free installing

1.2 General and specific user category

All households are concerned: existing individual houses and apartments.

1.3 Technology involved

Compact fluorescent lamps (class A EU label)

1.4 Status of the evaluation and energy savings calculations

The evaluation of energy savings are officially used to measure the energy savings related for different standardised operations and equipment that obliged utilities concerned by the white certificates scheme can promote with their consumers. They are published in French on the Ministry web site and in a printed Memento by ATEE (“Mémento du Club C2E). A summary description of the detailed calculation sheets with all assumptions are restricted to the stakeholders involved in the process of fixing the standard savings values.

1.5 Relevant as a Demand Response measure

No

---

[34] See section 2.1 for the description of the programme.
[35] Ministère de l’Ecologie, du Développement Durable, des Transports et du Logement- DGEC, Lettre d’information Certificats d’économies d’énergie, February 2011.

2 Formula for calculation of annual energy savings

Energy savings are calculated in final energy in kWh. They are accounted cumulated over the lifespan of the equipment; in addition they are not assumed as constant over this life time but are discounted at 4%, to reflect both a financial discount (economic value of the energy saving certificate) and a technical discount (gradual decrease in savings). The savings are therefore expressed in **kWh cumac** (cumulated and discounted). Only the discounted and cumulated values are officially published; the values for annual energy savings are considered as intermediate parameters.

2.1 Formula used for the calculation of annual net energy savings

Annual net savings in year t = (1- MSEFF) * $\{n_s$ x $[1/1000$ x $(P_{old}$ x $t_{old} – P_{new}$ x $t_{new})]$ $\}$ in kWh

P_{old}	= the capacity in W of the (old) bulbs
P_{new}	= the capacity in W of the (new) CFL
t	= burning hours
n_s	= number of CFL units promoted/installed in year t
1/1000	= conversion factor from W to kW

2.2 Specification of the parameters in the calculation

P_{old}	= the capacity in W of the (old) bulbs
P_{new}	= the capacity in W of the (new) CFL
t	= burning hours

2.3 Specification of the unit for the energy saving calculation

The energy savings is specified per object of assessment, i.e. per lamp installed or promoted.

2.4 Baseline issues

The baseline is the stock average of incandescent lamps. It is taken as an 80 W incandescent lamp.
The baseline is static; the discounting (during the lifetime calculation) is considered to somehow take into account a dynamic baseline.

2.5 Normalization

No normalization has been applied.

2.6 Energy savings corrections

Annual savings are corrected to account for the fact that on average a CFL replaces in 70% of the case an incandescent lamp and in 30% of the cases a CFL[36]. Net savings are equal to gross savings, as calculated above, multiplied by a coefficient (MSEFF) reflecting the market share of CFL replacing a CFL and for which there is no saving.

Net savings equal gross savings *(1-MSEFF).

There is no correction for double counting, free riders, technical interactions, and spill over effects or rebound effect.

3 Input data and calculations

3.1 Parameter operationalisation

The savings values have been standardized and correspond therefore to deemed savings. They have been agreed upon following a process involving various stakeholders on the basis of expert opinions and survey data. The process of standardisation is shortly explained in section 2.1.

3.2 Calculation of the annual savings as applied

Annual net savings in year t = $(1- MSEFF) * \{n_s \times [1/1000 \times (P_{old} \times t_{old} – P_{new} \times t_{new})]\}$ kWh

Where:

MSEFF	= 0.3 (in 30% of the cases a CFL replaces a CFL)
P_{old}	= the capacity of 80 W of the (old) bulbs
P_{new}	= the capacity of 18 W of the (new) CFL
$t_{old} = t_{new}$	= 800 burning hours per year[37]; it is assumed that the burning hours does not change after the replacement;
n_s	= number of CFL units promoted/installed in year t
1/1000	= conversion factor from W to kW

Annual net savings in year t

$= (1- 0.3) * \{n_s \times [1/1000 \times (80 \times 800 – 18 \times 800)] \}$

$= 0.7* n_s \times 49.6$

$= n_s \times 34.72$ kWh

3.3 Total savings over lifetime

3.3.1 Savings lifetime of lighting in households

The life time of CFL Class A is standardised and is assumed to be 7.5 years. This is calculated based on 6,000 burning hours during lifetime and annual 800 burning hours: 6,000/800=7.5,

3.3.2 Lifetime savings calculation of lighting in households

[36] On an annual market of 8 million units of CFL, 70% of the CFL replaced an incandescent source and 30% replaced a CFL at its end of life (18W) (source SOFRES survey for ADEME 2001) (not public).

[37] Based on an assumed utilisation of 2 hours and 10 minutes per day on average.

The life time savings are not used for how long savings are accounted for, but for accounting the savings of the CFL promoted in year t.

The life time savings are discounted (saving in kWh cumac) with a discount rate of 4%. This means that the annual savings are multiplied by a discount factor, function of the life time and discount rate. This results in the value of 6.626 year for the discounted lifetime (LT_{disc}) for CFL (life time of 7.5 years).

Lifetime savings

$= LT_{disc} \times n_s \times 34.72 = 6.626 \times n_s \times 34.72$

$= n_s \times 230$ kWh cumac

This 230 kWh is presented as kWh cumac to clarify that this value is cumulated and discounted.

4 GHG savings

There is no calculation of GHG savings in the white certificate scheme as the objective of the programme is to generate energy savings.

However, there exists evaluation of CO_2 savings linked to electricity savings. Two emission factors are generally used:

- The average of the power mix, which is quite low because of the high contribution of nuclear: in a range of 50-65 g CO_2/kWh or an average of 60 g CO_2/kWh[38]; in that case the lifetime GHG savings would be 13.8 kg CO_2 per lamp (230 kWh * 60 g CO_2/kWh)

- A value of 100g CO_2/kWh based on the actual power mix estimated as corresponding to the residential lighting load; the value was estimated by a working group gathering experts from ADEME, the French national energy efficiency agency, and EDF, the dominant power utility. In that case the lifetime GHG savings would be almost twice higher: 23 kg CO_2 per lamp (230 kWh * 100 g CO_2/kWh).

References

Document BAR-EQ-01 on http://www.developpement-durable.gouv.fr/Les-Fiches-d-operations.html
http://www.developpement-durable.gouv.fr/IMG/pdf/BAR-EQ-01.pdf (last updating May 20 2010)

38 For public electricity only; including own generation in industry it is around 80 gCO2/kWh;

2. EVALUATION PRACTISE

2.1 Introduction

2.2 National Evaluation guidelines, guidances and selected reports on evaluations and energy savings calculations

There exist several evaluation of programmes carried out by ADEME, including calculation of energy/ CO_2 savings (e.g. energy audit scheme subsidised by ADEME for households and industrial companies in 2000/2001; mobility plan for enterprises; wood programme).

There exist also Energy Savings Calculation (ESC) standards linked to white certificates as explained above in the case applications, section 1.

Other standards to come are linked to European Standardisation (CEN) and EU Directive on Energy Services and End-use Efficiency (ESD) that is presently defining specific guidelines for measuring energy savings

There is no regional initiative in France on evaluation standards.

2.2.1 List of guidelines

The guidelines are on the one hand the guidelines on the energy saving certificates ("white certificates") (see standard below), and on the other hand some other guidelines related to specific calculations (see Table 1), such as

- Official calculation methods of energy performance diagnosis (DPE) (energy efficiency certificates for buildings)
- Measurement of energy consumption and calculation of energy savings resulting from upgrading of building
- Methods for defining the contribution of buildings occupants to the energy saving resulting from energy efficiency investments by the owner

Table 1: National guidelines on Energy Savings Calculation

Documents	Content	Date
Government decree approving methods for energy performance diagnosis (94 pages)	Description of 3 official calculation methods of energy consumption for performance diagnosis (DPE) (energy efficiency certificates for buildings): methods 3CL-DPE , Comfie-DPE and DEL6-DPE	November 9 2006
Annex to government decree: "Methode de calcul TH-C-Ex (TH-C-Ex calculation method) (192 pages)	Measurement of energy consumption and calculation of energy savings resulting from upgrading of building (method TH-C-Ex)	2008 (August 8)
Government decree 2009- 1439)	Methods for defining the contribution of buildings occupants to the energy saving resulting from energy efficiency investments by the owner	2009

2.2.2 List of guidance

There is none.

2.2.3 Selected reports

There exist several reports presenting the results of evaluation of energy savings of programmes carried out by ADEME, including calculation of energy/ CO_2 savings (e.g. energy audit scheme subsidised by ADEME for households and industrial companies in 2000/2001; mobility plan for enterprises; wood programme). A summary of these reports are given In Appendix D.

2.3 Use of international guidelines and guidance

2.3.1 List of guidelines

The main document is related to Energy Performance Contracting and relies on IPMVP. The report translating the IPMV approach to the French case is published by ClubS2E under the title: « Mesure et vérification: services d'efficacité énergétique » (Measure and verification: energy efficiency services) (36 pages).

2.3.2 List of guidance

There is none.

2.3.3 Selected reports

There is none.

3. STANDARDS RELATED TO ENERGY SAVINGS CALCULATIONS

3.1 Introduction

The main standard used relate to the white certificate scheme

3.2 National standards

The standards are described in various documents (see Table 2). The standardised savings for each standard operations/equipment are published officially through various government decrees (7 as of February 2011) as “energy savings certificates sheets” and are available on the Ministry web site .

Table 2 Documents on standards on energy savings calculation for white certificates

Type of document	Documents	Date
Government decrees	**Decree n° 2006-600 and 2010-1663 related to energy savings obligations within the energy certificate scheme;** **Decree n° 2006-603 and 2010-1664 related to energy savings certificates**	**May 23 2006 December 29 2010**
On line standardised operations on Ministry web site	**http://www.developpement-durable.gouv.fr/Secteur-du-batiment-residentiel.html)**	**February 2011 (last update)**
Technical sheet detailing the mode of calculation of energy savings for selected operations	**Compilation of calculation sheets (unofficial , prepared by ADEME for IEA-DSM Task XXI)**	**2010**

3.3 Developments on standards

3.3.1 Ongoing and expected developments

The process of standardisation for the white certificates is continuous : the number of standardised operation and equipment increased from 30 at the beginning to 214 now with revisions of previous evaluations.

3.3.2 Comments on (draft) international standards

France participates in the European and international standardisation work related to energy savings. France provides input for the CEN TaskForce 190 "Energy Efficiency and saving calculations" as well as for the ISO, Task Committee 257 “Rules for determination of energy saving”.

3.4 Relevant organisations

The relevant organisations and stakeholders concerned by energy savings calculation are ADEME, The Ministry in charge of energy savings (MEDDTL), the French standardisation body and ATEE in charge of the calculation for the white certificates

Table 3 Organisations involved in the standardisation of energy savings calculations

Stakeholder name	Stakeholder profile	Objective/use
○ Club S2E ○ http://www.clubs2e.org/	○ Gather federations and professionals associations representing large enterprises in the sectors of Energy, Buildings and Energy Efficiency Service . Aim at promoting good practices in the field of Energy Efficiency Services	○ Publication of a guide « Mesure et vérification - Services d'Efficacité Energétique », (Measures and verification –Service of Energy Efficiency), June 2007 ○ Relies on IPMVP, International Protocol of Measures and verification of Energy Efficiency published by EVO (www.evo-world.org)
○ ATEE	○ Technical Association for Energy and Environment	○ Preparation of draft estimates of energy savings for white certificates
○ MEDDTL (Ministry)	○ Ministry in charge of Environment and Energy	○ Validation of energy savings values for white certificates (DGEC) ○ Regulations and DPE (DHUP)
○ ADEME	○ French Environment and Energy Agency	○ Involved in the validation of energy savings values for white certificates

The organizations concerned by energy savings methods in France are described in Table 4.

Table 4: Organizations concerned by energy savings methods in France

1. Stakeholders	2. Full name	3. Sector of activity
○ GIMELEC	○ Groupement des Industries de l'équipement électrique, ○ du contrôle - commande et des services associés	○ Federation of Industries of Electric Equipment, and Control
○ SERCE	○ Syndicat des Entreprises de génie climatique et électrique	○ Association of electrical engineering companies
○ UCF/FFB ○ http://www.uecf.fr/	○ Union Climatique de France/ Fédération Française du Bâtiment)	○ French Union of energy and climate engineering
○ UFE ○ http://www.ufe-electricite.fr	○ Union Française de l'Electricité	○ Professional Association of producers and distributors of electricity
○ FG3E	○ Federation of Energy Service companies (" Sociétés de Services en Efficacité Energétique, SSEE)	○ Involved in Energy Performance Contract
○ Energie-Cités	○ Federation of Cities	○ Contrat de performance énergétique: guide pour les Municipalités 2004
○ CSTB	○ Research Centre on buildings	○ Involved in the preparation of buildings regulations (MEPS)

ANNEX A: Template energy savings calculation, with instructions, for case examples in IEA-DSM Task XXI

Frontpage:
Case application: [Name, including technology and user category]
Country: [Name]
Author(s): [Name]
Date and version: [day month year] [only full numbers of version]

Page 1

1 Summary of the program

1.1 Short description of the program

1.1.1 Purpose or goal of the program

[Also include the period the program was running or when it started.]

1.1.2 Type of instrument(s) used

[Please indicate the type of instrument used. E.g. financial support, subsidize, label and standard, agreements, tax reduction]

1.2 General and specific user category

[Please by a specific as possible. Make a clear distinction between households, industry, services (commercial and non-commercial. If more users are targeted, please give some specification, especially if formulas would be different for different user categories.]

1.3 Technologie(s) involved

[Present the technology or technologies; please clarify in case a not well-known technology is used]

1.4 Status of the evaluation and energy savings calculations

[Provide information whether the energy savings calculations are used in an evaluation report. Include references and source in the Annex]

[Provide information whether the energy savings calculations itself have been evaluated. Include references and source in the Annex]

[Use one of the following options to qualify the status: 1. Legal; 2. Official stamped; 3. Semi official; 4. Use in practice; 5. Under development; 6. Under research)

1.5 Relevant as a Demand Response measure

[Indicate when the case is relevant for DR; if so refer to the separate DR case application description]

2 Formula for calculation of Annual Energy Savings

2.1 Formula used for the calculation of annual energy savings

[Short introduction and provide information on the origin of the formula; please use one of the three options:

- an existing formula (give reference; also in reference list in Annex the traceable source), or
- an adapted version of an existing formula; please describe adaptations in short and give reference for the original formula (also in reference list in Annex the traceable source), or
- self developed (short description; present additional documentation in Annex)]

[Present the formula]

2.2 Specification of the parameters in the calculation

[Provide information on the parameters and the reasoning of selecting those parameters]

2.3 Specification of the unit for the calculation

[The most common units are: an object of assessment; an action or an energy end-user]

2.4 Baseline issues

[Brief description which type of baseline is used in the energy savings calculations. The most commonly used types are:

a. before situation; evaluate the measure against the technique used before
b. stock average; evaluate the measure against the average stock technique
c. market average; evaluate the measure against the average technique on the market
d. common practice; evaluate the measure against the most commonly used technique]

[Describe whether a static or a dynamic baseline is used.
The before situation is always a static baseline. The other methods can be either static (using the values of a base-year or base period) or dynamic (changing over time, for example reflecting the change in most commonly used techniques)]
[Specify if a combination of approaches is used]

[Describe the important assumptions and the reasoning of the choice]

2.5 Normalization

[Normalization is a way to adjust the data in line with a normal situation; most common this is normalization for degree heating or cooling days.]
[Please describe briefly and give sources / references for the normal situation].

2.6 Energy savings corrections

2.6.1 Gross-net corrections

[Specify which (gross to net) corrections have been applied and how these are calculated. Please be clear in the corrections taken into consideration and used to correct.
[The most common categories are: a) double counting; b) free riders; c) technical interactions; d) spill over effects and e) rebound effect]

2.6.2 Corrections due to data collection problem

[Specify which corrections have been applied to handle imperfect data collections e.g. using sales data as a proxy for installation data, using a secondary data source for a bigger region than the region a programme is implemented]

3 Input data and calculations

3.1 Parameter operationalisation

[Describe how the calculation parameters are obtained; both for actual and reference situation.]

[Please also clearly indicate what type of values is used:
a) deemed (rough approximations, expert opinions, etc.)
b) calculated (for example using survey data)
c) measured (for example real measurements taken, billing information, etc.)
d) combination]

3.2 Calculation of the annual savings as applied

[Present the calculation with the values used. Please provide the data is several steps as this improves transparency and understanding]

3.3 Total savings over lifetime
3.3.1 Savings lifetime of the measure or technique selected

[Present information on the lifetime used. Also indicated whether this is an economical lifetime or not.]
[Present the number of years and the source for this value; include the reference in the Annex]

3.3.2 Lifetime savings calculation of the measure or technique

[Present the formula and the conducted calculation. In most cases this will be the outcome of 3.3.1 multiplied with the lifetime years. Please clarify if the energy savings calculated are not the same in all years. Explain if this is the case.]

4 GHG savings

4.1 Annual GHG-savings
4.1.1 Emission factor for energy source

[Present the emission factor used and give reference; included the source in the appendix.]

[Please specify what GHG emissions are included in the calculation: CO_2; CH_4 or N_2O]

4.1.2 Annual GHG-savings calculation as applied

[Present the formula as well as the calculation]

4.2 GHG lifetime savings

4.2.1 Emission factor

[Present the emission factors used when not the same factor is used for the lifetime, and give reference; included the source in the appendix. Otherwise include: The same GHG emission factor(s) are used for the lifetime.]

4.2.2 GHG lifetime savings as applied

[Present the formula as well as the calculation]
[The lifetime should be the same as for the energy savings; if not please clarify]

References

[Please use: Report title, Author, year and if applicable the website]

Annex

[Present in the Annex additional information on methods, data sources etc. to elaborate the data, formulas etc]
[If no or no clear energy savings calculations is used in the case application, but a method could be used, please describe this in an Annex]

Definitions

[Provide definitions used for the target group, unit of saving etc.]

ANNEX B: Annexes to the case applications in chapter 1

ANNEX B1 Additional information on Case application electric motors

ANNEX B2 Additional information on Case application commercial buildings; heating

ANNEX B1 Additional information on case application electric motors

Annex 1: Market data on electric motors and variable speed drive in France and Europe[39]

According to a study carried out in 1999 by CEREN for ADEME on the potential of energy savings in industry, electric motors represent on average 70% of electrical energy consumption in industry, or 89 TWh in 1997. Pumps, fans and compressors represent about half of the total consumption of electric motors (43.5 TWh).

About 40% of the electricity used for pumps, fans and compressors correspond to operation in load fluctuation (16.4 TWh). Slightly less than 10% of this consumption (1.4 TWh) corresponds to motors already equipped with variable speed drives (mechanical or electronic).

Market condition and technical potential of variable speed drive for electric motors systems have been assessed from data made available in two SAVE II project of the European Commission[40]. Estimates of the VSD market by type of application given in table 3 have been derived from values given in tables 1 to 2. They have then been weighted according to the consumption of each power range to get average data given in Table 4 and used as a reference.

Table 1: Distribution of VSDs for asynchronous motors sold by type of application (EU)

Power ranges (kW)	Compressed air %	Ventilation %	Pumping %
[0.75 - 4[	2.00%	8.00%	6.00%
[4 - 10[	2.00%	11.00%	14.00%
[10 - 30[	5.00%	19.00%	16.00%
[30 - 70[	2.00%	22.00%	19.00%
[70 - 130[	3.00%	13.00%	12.00%
[130 - 500[	3.00%	20.00%	16.00%

Source: VSDs for electric motor systems

Table 2 : Distribution of VSDs for asynchronous motors sold by power range (EU)[41]

Power ranges (kW)	%
[0.75 - 4[	24.30%
[4 - 10[	9.60%
[10 - 30[	11.20%
[30 - 70[	10.60%
[70 - 130[	39.50%
[130 - 500[	43.10%

Source: VSDs for electric motor systems

[39] Based on ADEME-ATEEE calculation sheet prepared for calculating the deemed savings for the energy saving certificate programme.

[40] European Commission, Improving the penetration of energy efficient motors and drives, 2000 SAVE II project European Commission, VSDs for electric motor systems (SAVE II project).

[41] Sales in the EU in 1998.

Table 3: Estimate of the VSD market by type of application

Power ranges (kW)	Compressed air %	Ventilation %	Pumping %
[0.75 - 4[	0.49%	1.94%	1.46%
[4 - 10[	0.19%	1.06%	1.34%
[10 - 30[	0.56%	2.13%	1.79%
[30 - 70[	0.21%	2.33%	2.01%
[70 - 130[	1.19%	5.14%	4.74%
[130 - 500[	1.29%	8.62%	6.90%

Source: tables 1 and 2

Table 4 : VSD market average by type of application

Compressed air %	Ventilation %	Pumping %
0.69%	3.86%	3.64%

Annex 2: Operating hours of motors[42]

The determination of the number of operating hours depending by type of industrial application was based on the SAVE study "Improving the penetration of energy efficient motors and drives".

The numbers of hours have then been weighted according to the consumption of each power range in each sector to get the reference data by application shown in red in the table below.

PUMPING												
	NAF 15			NAF 24			NAF 28			cons.	%	
motor ratings kW	Food industry			Basic chemistry			Mechanical					
	consumption GWh	%	time	consumption GWh	%	time	consumption GWh	%	time			
0.75 - 4	1127	16.89%	3887	821	3.12%	3700	92	12.62%	2391	2040	6.05%	
4 - 10	841	12.60%	2470	3600	13.69%	5200	120	16.46%	2491	4561	13.53%	
10 - 30	606	9.08%	3269	3707	14.09%	5200	340	46.64%	3000	4653	13.80%	
30 - 70	2370	35.51%	5063	5483	20.84%	5700	177	24.28%	4000	8030	23.82%	
70 - 130	346	5.18%	5063	4488	17.06%	4700	0	0.00%	0	4834	14.34%	
130 - 500	1384	20.74%	5063	8207	31.20%	5700	0	0.00%	0	9591	28.45%	
total	**6674**	**19.80%**	**4375**	**26306**	**78.04%**	**5328**	**729**	**2.16%**	**3082**	**33709**	**1**	**5091**

VENTILATION												
	NAF 15			NAF 24			NAF 28			cons.	%	
motor ratings kW	IAA			Basic chemistry			Mechanical					
	GWh	%	time	GWh	%	time	GWh	%	time	GWh		
0.75 - 4	1320	16.89%	8390	226	1.89%	5100	1240	12.71%	2941	2786	9.44%	
4 – 10	986	12.62%	3583	630	5.28%	6100	1601	16.41%	3248	3217	10.91%	
10 – 30	709	9.07%	5063	270	2.26%	6500	4583	46.99%	5632	5562	18.86%	
30 – 70	2776	35.52%	5063	2300	19.28%	6600	2330	23.89%	8568	7406	25.11%	
70 – 130	406	5.20%	5063	3832	32.12%	7600	0	0.00%	0	4238	14.37%	
130 – 500	1618	20.70%	5063	4671	39.16%	7100	0	0.00%	0	6289	21.32%	
total	**7815**	**26.49%**	**5438**	**11929**	**40.44%**	**7060**	**9754**	**33.07%**	**5600**	**29498**	**1**	**6148**

42 Based on ADEME-ATEEE calculation sheet prepared for calculating the deemed savings for the energy saving certificate programme.

COMPRESSORS												
	NAF 15			NAF 24			NAF 28			total	**%**	
motor ratings kW	IAA			Basic chemistry			Mechanical					
	GWh	%	time	GWh	%	time	GWh	%	time	GWh		
0.75 - 4	1004	16.90%	1878	25	0.28%	3700	1162	12.71%	1800	2191	9.15%	
4 - 10	747	12.58%	5063	106	1.20%	2700	1502	16.42%	2000	2355	9.84%	
10 - 30	542	9.12%	5063	338	3.82%	4600	4299	47.01%	3730	5179	21.63%	
30 - 70	2110	35.52%	8453	1271	14.35%	4700	2182	23.86%	4050	5563	23.24%	
70 - 130	307	5.17%	5063	1823	20.58%	5300	0	0.00%	0	2130	8.90%	
130 - 500	1230	20.71%	4147	5293	59.77%	6100	0	0.00%	0	6523	27.25%	
total	**5940**	**24.81%**	**5539**	**8856**	**36.99%**	**5630**	**9145**	**38.20%**	**3277**	**23941**	**1**	**4709**

ANNEX B2 Additional information on Case application commercial buildings; Heating

Reference Baseline energy consumption for heating and hot water

Baseline annual energy consumption indicator by type of building or branch (kWh/m²)

Branch	Sub-branch	Heating + domestic hot water (kWh/m²)		Heating (kWh/m²)		Domestic hot water (kWh/m²)	
		Natural gas	Electricity	Natural gas	Electricity	Natural gas	Electricity
Offices	*Overall*	**184**	**116**	**177**	**106**	**7**	**9**
	<1,000m²	198	121	191	111	7	10
	>=1,000m²	170	111	163	102	6	9
Education	*Overall*	**120**	**108**	**108**	**69**	**12**	**39**
	Primary	174	157	157	101	17	56
	Secondary	96	86	86	55	9	31
	Higher - Research	140	127	127	81	14	45
Healthcare	*Overall*	**174**	**153**	**134**	**97**	**41**	**56**
	Public hospitals	193	169	148	107	45	62
	Clinics	152	134	117	85	35	49
	Remainder	164	144	126	91	38	53
Shops	*Overall*	**152**	**104**	**142**	**77**	**10**	**27**
	Hypermarkets						
	Small shops	**278**	**154**	**260**	**115**	**18**	**40**
	Large stores						
Cafés, hotels and restaurants	*Overall*	**274**	**123**	**220**	**84**	**54**	**39**
	Restaurants	304	129	244	88	60	41
	Bars	218	68	175	46	43	22
	Hotels	253	123	203	84	50	39

ANNEX C: Case application of Demand Response: Tempo tariff, critical peak pricing

Introduction

Demand response (DR) refers to the reduction of customer energy usage at times of peak usage in order to help address system reliability, reflect market conditions and pricing, and support infrastructure optimization or deferral. Demand response programs may include dynamic pricing/tariffs, price-responsive demand bidding, contractually obligated and voluntary curtailment, and direct load control/cycling.

The information on Demand Response products is collected to relating impacts of DR projects to those for energy savings. For this reason the information is organised as following. We start with general information on the DR project and relations with other DR initiatives (section 1 and 2). Then we present information to be related to energy savings calculations: input data, baseline definition and key parameters considered, and savings calculations (section 3-5). Next is information on changes in the load shape and benefits in sections 6-8. We end with sources and documentation.

1. The DR initiative "Tempo Tariff"

This Demand Response program carried out in France is related with Critical Peak Pricing (CPP) and is known as "Tempo" or "Tempo Tariff". Tempo was precedence by the "peak days step back" project (EJP) that started already in 1982 and had a high tariff for critical days (maximum 18 hours and maximum 22 days between November 1 and March 31).

Tempo is a product designed for small consumers, every day the utility presents on its website the tariff for energy the next day with a colour: red (high tariff), white (medium high) or blue(cheaper). Figure 1 present an example. The colour is based on the production and demand estimated for the day ahead.

The colour is also sent to each home on a box at 8 pm day ahead and the consumers can be also informed by e-mail or SMS. In addition to a colour, each day also has normal and off-peak periods, which produces six different tariffs. There is a maximum of 22 red days and 43 white days in a year. The red days are kept for between November 1 and March 31 and occur between Monday and Friday, never at a weekend or on public holidays.

There are four different versions of Option Tempo, depending on the metering, communications and load control equipment installed at the customer's premises:

1. Standard Tempo - The customer has only an electronic interval meter
2. Dual Energy Tempo - The customer's space-heating boiler can be switched from one energy source to another
3. Thermostat Tempo - The customer has load control equipment which is able to adjust space heating and water heating loads according to the electricity price.
4. Comfort Tempo - The customer has a sophisticated energy controller.

Figure 1: Example of the Tempo prices for 3 days July 2012

This service was tested during the period 1989-1992 for 800 customers and introduced to more customers until 1995 when this tariff was offered to all customers. In 2003 about 300,000 residential customers and more then 100,000 small business customers had chosen Tempo.
In July 2009, EDF discontinued the Tempo tariff for new customers and for customers who are on the tariff at their current residence and then move house. So the Tempo tariff no longer available for new customers. This change is related to the fact that the Tempo tariff was designed specifically for the situation where EDF was a monopolistic generator and retail supplier of electricity. In the new, open electricity market the network use of system charge does not vary between seasons; and the value of peak load reduction is not reflected in spot prices for energy which are less volatile than the marginal costs of supply.

Over time the electricity tariffs changed and with those also the tariff for the 3 different collared days. Figure 2 and 3 present tariffs for the year 2005 and 2010. It shows that will for the blue and white days the tariffs increased by about 3 c€/kWh, those for the red days increased by about 6 c€ for the 6 red hours night and even 16c€ for the 18 hours day.

Figure 2: Tempo electricity tariff June 2005

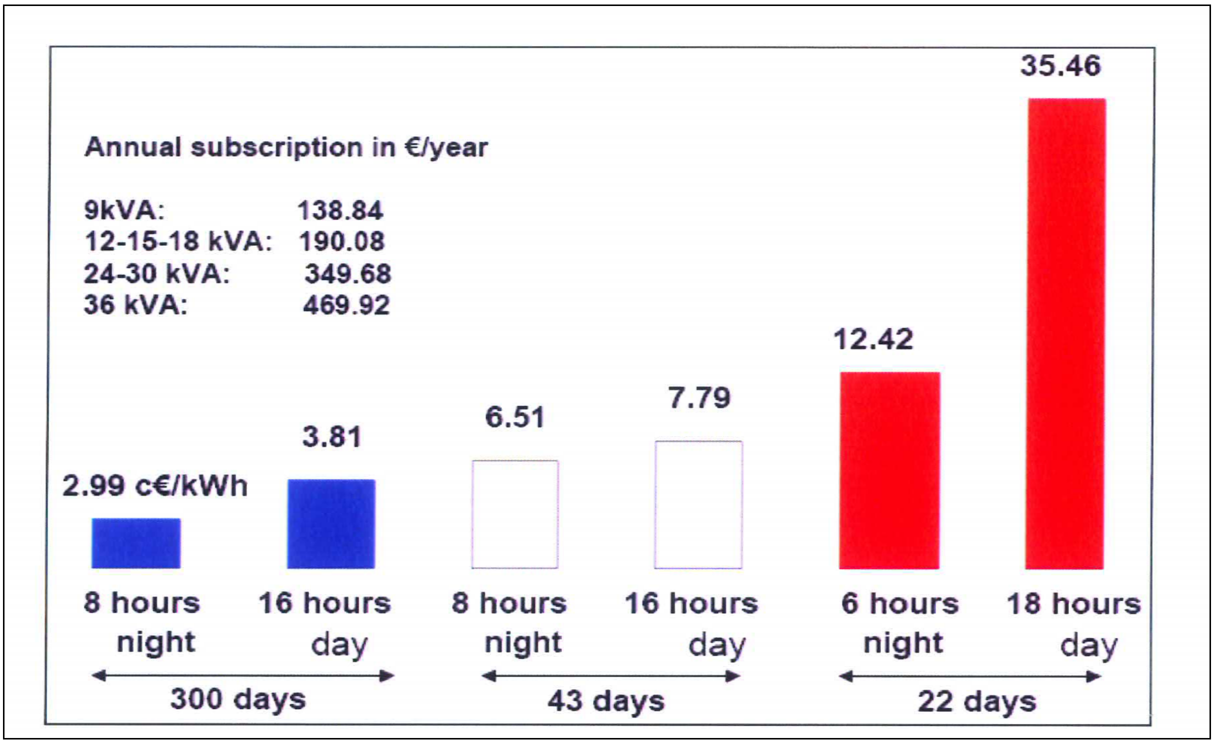
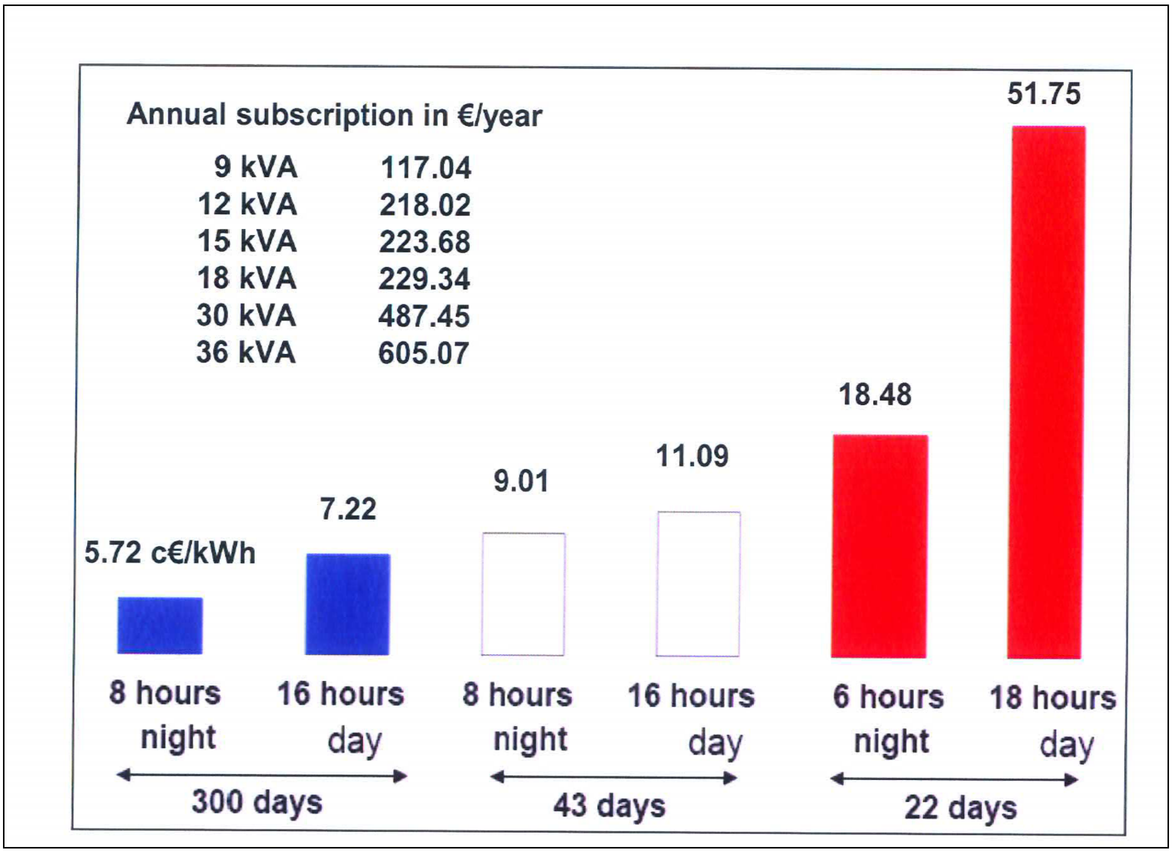


Figure 3: Tempo electricity tariff August 2010



2. Related DR initiatives

There are no other DR initiatives related to critical peak pricing known in France, for small and medium consumers, based on the information from IEA DSM Tasks 15 and 19, as well from an internet search.

The internet search indicated that there are some recent developments for Demand Response. E.g. a project at end of 2011 by Energy Pool in Brittany allows the largest energy consumers in the agribusiness sector to free up close to 20 MW reserve capacity. This reserve capacity can be mobilized within half an hour at peak times. Another example is that early 2012 Energy Pool has in France a reserve consumption capacity to offer around 1000 MW, and it could go up to 1500 MW by the end of that year.

3. Input data

There is no input data used for estimating energy savings.

The only input data is the estimation of energy to be consumed the day ahead that the utility and the grid operator estimate, based on the forecast congestion and demand of electricity. There is no information provided by consumers in this sense.

4. Baseline definition and key parameters considered

For Tempo, baselines were established adding up different baselines from 800 consumers participating in the experiment in the early 1990s.

Price variation initiatives like Tempo are highly weather-related, so the response is entirely dependent on the weather. For this a figure (see figure 4) is available (from the experimental period) on the average daily power demand and the daily temperature.

5. Savings calculation

There is no information available on the electricity savings.

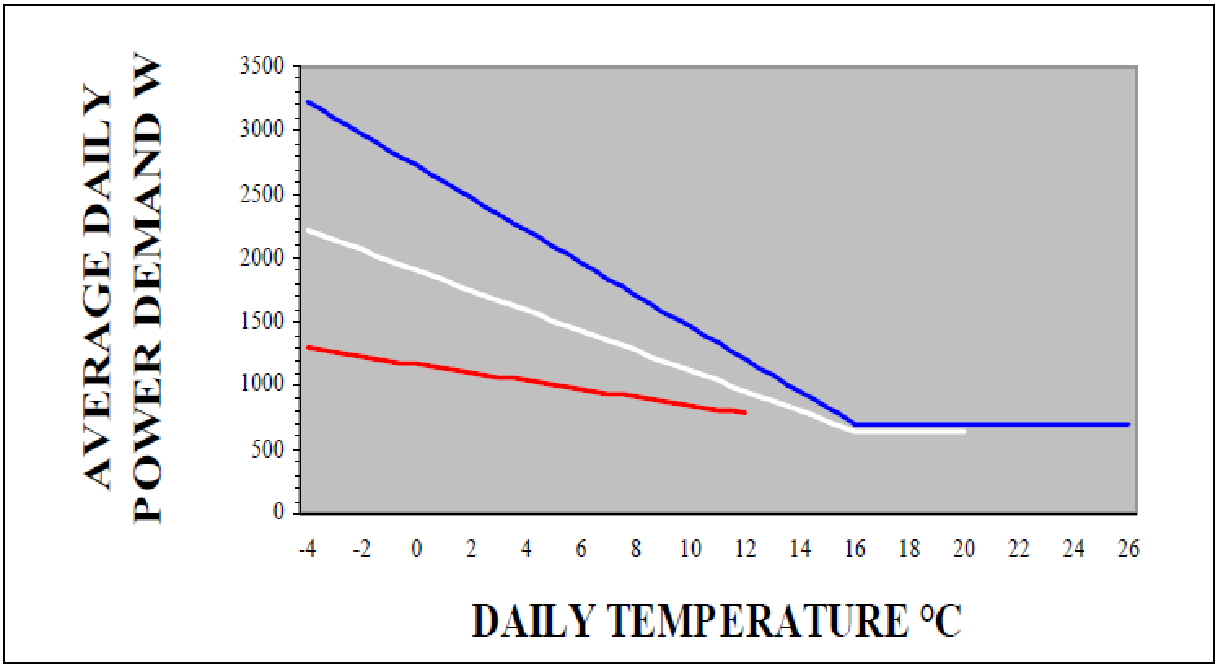
There is only information on changes during the pilot (1989-1992). Compared with blue days, the Tempo tariff has led to a reduction in electricity consumption of 15% on white days and 45% on red days, on average 1 kW per customer.

6. Load shape impact

Load reduction was measured using interval meters.

As an example, in 2008, a red day offered about 400 MW of curtailment. EDF estimates that on average, residential consumers decrease their consumptions in peak hours by 50 % and by 25 % in off-peak hours. A part of the consumption is shifted to off-peak hours. The curtailment volume is twice higher in houses with electrical heating than in houses without electrical heating (In percentage, the consumption decreases by 37% instead of 30% because the house with electrical heating consume more, so the difference in percentage is lower).

Figure 4: Tempo costumers power demand versus outdoor temperature



7. Benefits to participants

Tempo customers have saved 10% on average on their electricity bill, was concluded from the introduction in the period 1993-1995. No updated information is available, although also during the roll out after 1995 by early 2000s consumers indicated that they chosen Tempo in order to reduce the electricity bill.
During the introduction about 90% of the customers were satisfied with the tariff while during the roll out customers continued to be rather happy with the tariff.

Less than 20% of electricity customers in France have chosen Tempo. It seems Tempo customers have very particular customer profiles and are interested in managing their energy use. They are prepared to constrain their lifestyles to make comparatively small financial savings relative to their incomes.

Even though no Tempo customers were paying more for electricity than with the other rate, EDF had about 3 percent of people who, after the first season, wanted to drop off the program. Despite the fact that they have been getting some savings, they thought it was not worth the hassle. There is a kind of threshold under which the people don't want to bother, even if they don't have much to do.

8. Other benefits

There are not other additional benefits described in this demand response initiative.

9. Sources and documentation

EDF, *Electricé, prix de l''electricité, Tempo, EDF*, 12 juilet 2012
http://particuliers.edf.com/abonnement-et-contrat/les-prix/les-prix-de-l-electricite/option-tempo/la-couleur-du-jour-2585.html

Faruqui, Ahmad and Sergici, Sanem, *Household response to dynamic pricing of electricity. A survey of the experimental evidence*, January 2009 http://www.science.smith.edu/~jcardell/Readings/uGrid/House%20DemandResp%20Experience.pdf

Giroud, Denise, *The tempo Tariff,* EFFLOCOM workshop 10 June 2004,
http://www.sintef.no/project/Efflocom/EDF.pdf
International Energy Agency, Empowering Customer Choice in Electricity Markets, Paris 2011,
http://www.iea.org/papers/2011/Empower.pdf

IEA-DSM Task XV, P 106, *The tempo TARIFF. EDF,* October 2008
http://www.ieadsm.org/TaskXVNetworkDrivenDSMCaseStudiesDatabase.aspx

IEA DSM Task XVIII, *Project description DSM-FR02, Tempo Electricity Tariff*, November 2010,
http://www.ieadsm.org/TaskXVIIIDSMProjectsDatabase.aspx

Kärkkäinen, Seppo *Pricing models and mechanisms for the promotion of demand side integration.* Corentin Evens, 2009

Neuralenergy, *Tempo Tariff – France*, status Thursday, September 9, 2009,
http://www.neuralenergy.info/2009/07/france.html

Press release: Energy Pool helps Brittany to manage electricity consumption with a demand response capacity close to 20 MW, February 2012, http://www2.schneider-electric.com/documents/press-releases/en/shared/2012/02/20120201_CP_CapaciteBretagne_EN.pdf

ANNEX D: Review of existing energy savings calculation standards in France

Country:	France
Report number	1
Report title	Energy savings by standardised operation for energy saving certificates
Year	Updated every year
link	http://www.developpement-durable.gouv.fr/Les-Fiches-d-operations.html
Highlights/summary	Prepared for the energy saving obligation/white certificate scheme in France
Sector	Households, services and to a lesser extent transport and industry
Technologies (max 15)	Various technologies and equipment ranging from building envelops, heating appliances and lighting
Baseline approach	Depends on the situation market average for electrical appliance and lighting; stock average for other operations
Default energy or savings values	Default energy savings values for standardised operations (presently around 180)
GHG emissions	Not evaluated
Comment:	Publicly available are only discounted life time saving More detailed calculation sheet with assumptions sued in terms of annual savings not publicly available. Some have been translated for the project.

Country:	France
Report number	2
Report title	Impact assessment of energy audits funded by ADEME in 2000 and 2001 by external consultant (Evaluation de l' impact des études d'aides à la décision subventionnées par l'ADEME en 2000-2001)
Year	2003
link	Internal document (ADEME)
Highlights/summary	ADEME awards grants to carry out technical and financial audits (3 types of audits : pre-diagnosis, diagnosis, feasibility study) to identify actions of energy management and environment protection.
Sector	Industry; building
Technologies (max 15)	
Baseline approach	Probably before situation (no explanation on how energy / CO_2 savings have been calculated)
Default energy or savings values	No
GHG emissions	Yes
Comment:	For industry, CO_2 savings are 1 650 tonnes of CO_2 / 100 enterprises with Financial grants For buildings, for 100 buildings (60% pre-diagnosis and 40% diagnosis) = 1 200 MWh saved = 194 t CO_2 saved Ratio toe saved per audit used by ADEME to measure every year the savings from audit subsidies

Country:	France
Report number	3
Report title	National evaluation of mobility plans for companies (Plan de déplacement entreprises PDE in French only)
Year	July 2005
link	Internal document (ADEME)
Highlights/summary	Between 2001 and 2005, 158 mobility plans for companies have been implemented, of which 20 have been evaluated.
Sector	Industry
Technologies (max 15)	Solutions chosen for the mobility plan: bicycles (22%), grant / subsidies for transport (21%), car sharing (19%), improvement in public transport access (11%), clean vehicles (8%)
Baseline approach	Probably before situation (no explanation on how energy / CO_2 savings have been calculated)
Default energy or savings values	No
GHG emissions	Yes
Comment	Around 0-315 t CO_2 saved per year and project

Country:	France
Report number	4
Report title	Evaluation of the National Wood fuel Programme over 2000-2006 (in French only)
Year	2007
link	Internal document (ADEME)
Highlights/summary	End of 2006, 1800 collective and industrial boilers have been installed with subsidies from ADEME.
Sector	Tertiary/industry/Residential
Technologies (max 15)	Wood boilers
Baseline approach	
Default energy or savings values	
GHG emissions	Yes
Comment	Savings estimated at around 320 ktoe/year and 800 kt CO_2

Country:	France
Report number	5
Report title	Evaluation of the network of energy info sites (Espaces Info »Energies)
Year	March 2006
link	Internal document (ADEME)
Highlights/summary	The Energy info network provide citizens with information and practical advice at the local level on all issues related to sustainable development
Sector	All, but mainly targeted to households
Technologies (max 15)	Advices provided by ADEME. Most of requests concern on : space heating system change (30%), solar water heaters (30%), thermal insulation and photovoltaic.
Baseline approach	No data on quantitative energy savings
Default energy or savings values	No data on quantitative energy savings
GHG emissions	No
Comment	

Country:	France
Report number	6
Report title	School mobility (Eco mobilité scolaire in french)
Year	Evaluation for the period : February 2007-october 2008
link	ADEME
Highlights/summary	End of 2008, 1350 school mobility plans were in function in France. The objective of such programme is to encourage pupils/students to go to school by bike or on foot
Sector	
Technologies (max 15)	Soft modes (walk, bus).
Baseline approach	No evaluation impact in term of energy saved
Default energy or savings values	No evaluation impact in term of energy saved
GHG emissions	No
Comment	

Country:	France
Report number	7
Report title	Law MLLE of March 29, 2009 defining the contribution of buildings occupants to the energy saving resulting from energy efficiency investments by the owner; Decree of 24 November 2009 specifying the methods for measuring the savings
Year	2010- onwards
link	http://www.legifrance.gouv.fr/affichTexte.do;jsessionid=?cidTexte=JORFTEXT00002132744
Highlights/summary	Law MLLE of March 29, 2009 provides for the participation of the tenant to the energy saving resulting from energy efficiency investments by the owner. The owner can ask the tenant to pay back a portion of the monetary savings resulting from the investment. The Decree of 24 November 2009 specifies the modalities for the evaluation of the energy savings. The contribution is fixed and not subject to revision. It is up to 50% of the estimated monthly monetary energy savings (in €) after the completion of work. These estimates are made using the method of calculating th-C-E ex (Decree of 8 August 2008), or with the method used for the diagnosis of energy performance (DPE) corrected with the actual consumption in the case of a private owner.
Sector	Household (rented dwellings)
Technologies (max 15)	Heating; retrofitting
Baseline approach	Consumption before
Default energy or savings values	None
GHG emissions	No
Comment	

Country:	France
Report number	8
Report title	Public-private partnership contract in high schools
Year	2010-2030
link	
Highlights/summary	This public-private partnership contract covers the design, financing, construction and exploitation of energy equipment of 14 high schools in Region Alsace. Concluded for 20 years between the Region and Cofely (GDF Suez), this contract will reduce the energy consumption of all buildings by 35% and emissions of greenhouse gases by 65% (avoiding the emission of 90 kt of CO_2 over the duration of the contract). Investments of €30million will be made in 2010-2011
Sector	Public schools
Technologies (max 15)	biomass boiler, heating and ventilation, photovoltaic panels, regulation of heating, insulation of buildings and replacement of windows.
Baseline approach	Not known The Region will pay Cofely an annual rent of 3.5 million €, which will take into account repayment of investment and interests, maintenance (0.9 M€ / year), and supply of wood for biomass boiler (0.15 M€ / year). If the savings are lower than stated in the contract, Cofely will pay for the difference.
Default energy or savings values	Not known
GHG emissions	Reduction of GHG emissions by 65% (avoiding the emission of 90 kt of CO_2 over the duration of the contract).
Comment	