Preparatory Studies for Ecodesign Requirements of EuPs (III)

ENER Lot 20 – Local Room Heating Products
Task 8: Scenario, policy, impact and sensitivity analysis

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AUTHORS

Mr. Shailendra Mudgal, BIO Intelligence Service
Dr. Adrian Tan, BIO Intelligence Service
Mr. Sandeep Pahal, BIO Intelligence Service
Mr. Alvaro de Prado Trigo, BIO Intelligence Service

KEY CONTACTS

Shailendra Mudgal
+ 33 (0) 1 53 90 11 80
sm@biois.com

Adrian Tan
+ 33 (0) 1 53 90 11 80
adrian.tan@biois.com

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Task 8: Scenario, policy, impact and sensitivity analysis

8.1 Introduction

This task summarises the outcomes of all previous tasks. It looks at suitable policy means to achieve the potential implementing Least Life Cycle Cost (LLCC) as a minimum and Best Available Technology (BAT) as a promotional target, using legislative or voluntary agreements, labelling and promotion. It draws up scenarios for the period 2010-2030 quantifying the improvements that can be achieved with respect to a Business-as-Usual (BAU) scenario and compares the outcomes on EU energy targets.

Besides, an estimate of the impact on consumers (purchasing power, societal costs) and industry (employment, profitability, competitiveness, investment level, etc.) is also presented. In addition, an analysis of which significant impacts may have to be measured under possible implementing measures and what measurement methods would need to be developed or adapted is provided. Finally, a sensitivity analysis of the main parameters is performed to ensure the robustness of the outcomes.

Note that the preliminary policy discussions are the opinions of the consultants and do not reflect the views of the European Commission.

8.2 Policy analysis

In this section on policy analysis, policy options are identified considering the outcomes of all previous tasks. They are based on the definition of the product, according to Task 1 and modified/ confirmed by the other tasks. Specific recommendations to the residential and non-residential application of local room heaters covered by the Lot 20 study are detailed in the following sub-sections.

8.2.1 Caveat

Some of the options considered in this section require the conversion of electricity into primary energy. For that purpose, the conversion factor of 2.5 used is derived from Annex II of the Energy Service Directive (2006/32/EC), reflecting the estimated 40% average EU generation efficiency. This factor is also used in other EuP preparatory studies including the DG ENER Lot 1 study on boilers and the proposed implementing measures.

Please note that all other primary energy consumption values presented in this study (Task 5, Task 7 and in the other sections of Task 8) were calculated using the EcoReport tool, as required by the European Commission to undertake the cost and environmental impact analysis in Ecodesign preparatory studies.

8.2.2 Scope and product definitions

This preparatory study examined a very wide range of local room heating products. In Task 1 local room heating products were defined as decentralised space heating stand-alone devices that convert electricity, gaseous or liquid fuels directly into heat and then emits it to provide heat indoors (heat is generated in the same space where it is distributed and emitted). It is therefore proposed to use the same definition for any legislative texts. The definition is:

Local room heating products are defined as de-centralised space heating stand alone devices that convert electricity, gaseous or liquid fuels directly into heat and then distribute it to provide heat indoors. These devices can be portable or installed in the building

This section further attempts to provide recommendations for product definitions and classifications that could be used in future legislative texts. An obvious distinction to be made is the energy source and the manner in which heat is generated. The following is proposed:

Heaters that generate heat using:

- Liquid or gaseous fossil or biomass fuels (solid fuels are not part of the scope)
- The Joule effect in electric heating elements

While it is straightforward to establish product definitions on functionality and energy source, it is more challenging determining an appropriate classification for capacity ranges and related application areas. To analyse the different local room heating products, this study has made a distinction between heaters for residential and non-residential spaces, even though there is not clear distinction between capacity ranges. Although test standards use the terms 'domestic', 'household' and 'non-domestic', there is nothing that prevents a heater for domestic use to be used in industrial and commercial spaces. However, as a practical approach and with respect to gas fired air heaters and boilers, it would seem reasonable to propose the following capacity ranges for liquid and gas-fired heaters:

- ≤ 12 kW (mostly residential, but also non-residential heaters)
- > 12 kW and ≤ 70 kW (mostly non-residential heaters)
- > 70 kW and ≤ 300 kW (only non-residential heaters)

It will be discussed later on in this report whether it is necessary to define different requirements for each of these capacity ranges or the same value can be used for all capacities.

The definitions of those heaters for which MEPS are recommended in this report are presented below.

- **Gas and liquid fuel residential local room heaters (≤ 12 kW)**
  - **Flued gas heaters**

Flued gas heaters means a local room space heater that generate heat by combustion of natural gas or liquefied gas (e.g. LPG), are available in both open combustion and closed combustion types, are installed in the building and are connected to a flue system, with the purpose to transport all formed flue gases to the outside of the building.

▷ **Flued gas fires**

Flued gas fires means a local room space heater that generates heat by combustion of natural gas or liquefied gas (e.g. LPG), contains flame tubes for decorative flames effects, are available in both open combustion and closed combustion types, are installed in the building and are connected to a flue system, with the purpose to transport all formed flue gases to the outside of the building.

▷ **Flueless gas heaters**

Flueless gas heaters means a local room space heater that generates heat by combustion of natural gas or liquefied gas (e.g. LPG), can be installed (to any gas connection point) or can also be used as portable space heaters with bottled fuel supply and all combustion gases are released directly into the heated space .

▷ **Liquid/gel fireplaces**

Liquid/gel fireplaces means a local room space heater that generates heat by combustion of liquid or ethanol gel fuel (including ethanol of biological origin), and is equipped with a burner and fuel container; are available as fixed fireplace inserts and portable devices; a liquid fireplace provides a decorative flame and all combustion gases are released directly into the heated space.

▶ **Non-residential local room heaters (> 12 kW and ≤ 300 kW)**

▷ **Warm air unit heaters**

Warm air unit heaters contain gas or oil burners, or use resistive electric heating to generate heat. They can be designed as unflued or flued appliances. The generated heat is transferred to the heated space by convection using an axial fan. Direct-fired warm air unit heaters have no flue and the heat generation by combustion takes place directly in the air stream circulating in the heated space. Indirect-fired warm air unit heaters are flued, the fuel is burned and the hot flue gas is passed through a heat exchanger. A fan draws in the surrounding air and passes it over the heat exchanger. The heat is transferred from the flue gas to the ventilation air. The hot flue gas is extracted to the outside either by natural or induced draught.

EN 13842 defines warm air unit heaters as appliance designed to provide space heating from a central source by distributed heated air, by means of an air moving device, either through ducting or directly into the heated space. The appliance may consist of the following components:

- Burner
- Combustion chamber
- Heat exchanger
- Fan with drive motor
- Housing (casing)
- Air control device

Enhanced Capital Allowance (ECA)[1] scheme defines warm air heaters as equipment that are specifically designed to provide space heating by using the heat generated by a burner to raise the air temperature in the space(s) being heated, and optimising controllers that ensure warm air heating systems operate in an efficient manner.

▷ **Gas radiant heaters**

ECA[2] defines gas radiant heaters as products that are specifically designed to heat people or objects in the space below them by infrared radiation without heating the surrounding air directly, and optimising controllers that ensure radiant heating systems operate in an efficient manner.

Gas radiant luminous heaters are appliances intended for installation at a height above head level which is designed to heat the space beneath by radiation and in which the heat is produced by means of burning the fuel at or near the outer surface of a material such as a ceramic plaque or gauze, or by means of an atmospheric burner heating a gauze or similar material

Gas radiant tube heaters are appliances intended for installation above head level which is designed to heat the space beneath by radiation by means of a tube or tubes, heated by the internal passage of combustion products.

▶ **Exhaust system**

Combustion air supply and evacuation of flue gases (out of the heated space) for all residential/non-residential gas/liquid fuel-fired heaters can be classified into 3 types (as per the national and European installation guidelines in force):

- Type A – combustion air taken from the room, flue gases evacuated indirectly together with air of the room (according EN 13410).
- Type B – combustion air taken from the heated space, flue gases evacuated directly by pipe system with roof or wall terminal.
- Type C – combustion air taken from outside by air pipe, flue gases evacuated directly by pipe system with roof or wall terminal.

During this preparatory study, several energy-using products that are closely related to 'local room space heaters' were identified:

- **Air curtains**: The functionality of air curtains is different from local room space heaters. These were however analysed in this preparatory study and policy options are discussed in section 8.2.3.
- **Sauna heaters**: Although similar to local room space heaters, they have very specific uses and operate at indoor temperatures much higher than other space heaters. Sauna heaters were considered in the Ecodesign Working Plan but their savings potential was estimated to be limited. Sauna heaters are proposed to be

[1] http://etl.decc.gov.uk/NR/rdonlyres/86B5F1DA-A029-49C1-B836-86DD2E2730D5/0/11_RWAH_Warm_Air_Heating_Equipment.pdf

[2] http://etl.decc.gov.uk/NR/rdonlyres/EDE50F89-BFC7-41B8-922B-29798E2133AA/0/11_RWAH_Radiant_Heating_Equipment.pdf

outside of the scope for policy measures now, but this could be subject of review at a later stage.

- **Outdoor (patio/terrace) heaters**: These products have received much attention in the energy efficiency debate. Some of the radiant space heaters (electric and gas) used for outdoor heating are almost identical to the heaters considered in this study. Outdoor heaters serve a different functionality than indoor heaters and are therefore out of scope. At present (besides blankets and jackets), there are no alternative products or technologies to fulfil the functionality of outdoor heaters. Due to the way the products are produced, it is possible that manufacturers would have to abide to any Ecodesign measures for indoor heaters, if their product is capable of being installed both indoors and outdoors.
- **Decorative heaters**: No distinction is made between 'decorative' and 'non-decorative' heaters in this study. Decorative heaters will be included within the scope of the policy options. The safety aspects of ethanol-fired heaters have been scrutinised by the European Commission (including air quality emissions)[3], but besides general safety requirement no energy efficiency measures were proposed.
- **Incandescent light bulbs sold as heating devices**: The European Commission is currently investigating the marketing of incandescent light bulbs as an electric heater. Incandescent light bulbs do provide significant amounts of heat, but are not designed to be able to control and emit heat in an efficient way. If incandescent light bulbs were allowed to be sold legally in the EU as heating devices, policy options for minimum energy efficiency requirements for electric heaters could be considered. Electric heaters designed for space heating are close to 100% efficient, an incandescent light bulb is only "95% efficient".
- **Air-based central heating products**: Some of the larger (industrial) warm air heaters investigated in this study are similar to the central heating products that use hot air to distribute heat. The difference being whether the heater is connected to a duct system to distribute the heat in a large space or several spaces in a building. As manufacturers cannot know in advance whether their local room space heater will be installed as central heating, it is not possible to make a distinction. Instead, the policy options in this study are aligned with the policy options suggested for ENER Lot 21, which deals with central heating products that use hot air to distribute heat
- **Combination heaters**: Some manufacturers offer local room heating products that are able to also heat water for space (central) heating or sanitary use. This is a special additional function of a limited number of local room heaters. These heaters are proposed not to be included in the scope of policy options as they are only a niche market.

[3] European Commission (2011) Ethanol Stoves. State of Play & Possible Way Forward. DG Health and Consumer Protection.

- **Solid fuel direct heating appliances**: The ENER Lot 15 Ecodesign preparatory study analysed solid fuel direct heating products such as fireplaces and stoves. Policy options for these products were proposed. With the definition of space heaters and energy sources, no overlaps with this study and policy options were identified.

The policy measures proposed in this document are closely related to other potential policy measures on space heating, as explained in Task 1 report of this preparatory study. Other products that share the same functionality (i.e. space heating) as the products in the scope of this document are the following:

- Of these product groups, ENER Lot 21 shares part of the scope of products covered in this document (i.e. non-residential warm air heaters).
- The policy recommendations presented in this document are aligned with the recommendations for warm air heaters in ENER Lot 21.
- Central Warm Air Heaters covered in ENER Lot 21 study are proposed to be included within the regulation issued under this study for decentralised warm air heaters. This split, although not consistent from the point of view of functionality, is more logical from the point of view of product development. Centralised and decentralised warm air heaters share the same technical principles even if their application might be different.

Table 1: Ecodesign preparatory studies with products related to the scope of the products covered in this study

Product	Ecodesign preparatory study	Ecodesign regulation (if any)
Reversible air conditioners >12 kW cooling capacity	ENTR Lot 6	-
Reversible air conditioners <12 kW cooling capacity	ENER Lot 10	Regulation 206/2012
Central water-based space heating	ENER lot 1	-
Central heating products that use hot air to distribute heat	ENER Lot 21	-
Solid fuel combustion installations	ENER Lot 15	-

8.2.3 Specific Ecodesign requirements

The Ecodesign requirements discussed hereafter are proposed in a provisional timetable following the common practice in past Ecodesign studies and their regulation:

- **First tier**: 2015 or two years after the approval of the proposed implementing measures
- **Second tier**: 2017 or four years after the approval of the proposed implementing measures

- **Third tier** (optional): special requirements

The implementation of Ecodesign requirements in the form of tiers takes into account the time for revision of standards and the availability of new technologies. It also enables to keep the most ambitious targets as a final goal and gives a clear signal to industry regarding the direction in which the market should be heading.

8.2.3.1 Minimum Energy Performance Standards (MEPS)

MEPS may be a relevant option to remove the least efficient appliances from the market. The following discusses possible MEPS that could be set for both residential and non-residential applications of these heaters.

8.2.3.1.1 Residential local room heaters

- **Gas and liquid fuel local room heaters (≤ 12 kW)**

The current test and measurement standards for gas and liquid fuel fired space heaters only allows to set energy efficiency requirements based on thermal efficiency. As stated in Task 4, a need for standardised measurement and calculation methods for the seasonal efficiency of these heaters was identified.

It was already assessed that as flueless gas and liquid fuel local room heaters (including decorative ethanol fires) release all the heat they produce in to the space to be heated, Ecodesign requirements are not appropriate. However, ensuring correct installation, use and proper ventilation of the space, where flueless heaters are used, could result in significant energy savings.

The standards used for the measurement of thermal efficiency of residential gas and liquid fuel local room heaters are presented in Table 2.

Table 2: Standards for the measurement of thermal efficiency of residential gas and liquid fuel local room heaters

Type of appliance	Relevant standard	Description
Gas-fired flued gas heaters/fires	EN 613	Independent gas-fired convection heaters
	EN 1266	Independent gas-fired convection heaters incorporating a fan to assist transportation of combustion air and/or flue gases
	EN 13278	Open fronted gas-fired independent space heaters
	BS 7977-1	Specification for safety and rational use of energy of domestic gas appliances. Radiant/convectors
	EN 509	Decorative fuel-effect gas appliances
Flueless heaters	EN 14829	Independent gas-fired flueless space heaters for nominal heat input not exceeding 6 kW

	EN 449	Specification for dedicated liquefied petroleum gas appliances - Domestic flueless space heaters (including diffusive catalytic combustion heaters)

The design improvement options analysed showed that there is potential to set minimum energy performance standards for flued gas and liquid fuel local room heaters. Table 3 presents the proposed MEPS for these heaters for residential use.

Table 3: Proposed MEPS for flued gas and liquid fuel local room heaters ≤ 12 kW

	Minimum thermal efficiency (gross calorific value[4]) [%]	
	Tier 1: 2015	**Tier 2: 2017**
Gas and liquid fuel local room heaters (flued heater/fire)	45%	60%

Flued gas and liquid fuel local room heaters have similar technical characteristics and functioning. Although, the combustion process and the burner are different, their thermal efficiencies are similar.

The use of electric ignition system and a mechanical draft for combustion air supply can reduce annual energy consumption by around 2% and 3%, respectively. These energy savings should be incorporated in the MEPS when a standardised measurement and calculation method for the seasonal efficiency of these heaters is developed.

- **Electric local room heaters (≤ 12 kW)**

The Article 15, paragraph 2(c) of the Ecodesign Directive[5] recommends that a product shall be covered by implementing measures only if it presents significant potential for improvement in terms of environmental impacts.

Electric resistance heaters use the Joule effect to generate heat. This means that all electric heaters have heat generation efficiency close to 100%. There is however small differences in the efficiency of electric local room heaters and their uses. The main design improvement options that lead to reduced environmental impacts and least life cycle costs for electric space heaters are related to room temperature controls (these controls are not always part of the product, but the extended product).

Due to the large stock and sales volume of electric local room heating products, their environmental impact at EU level is high; as a consequence, small improvements in their energy efficiency can lead to high energy savings.

[4] A conversion factor of 0.901 was used to convert Net Calorific Value (NCV) into Gross Calorific Value (GCV). This factor is based on the draft SAP 2012 report (Table D 2.1 on page 51) published by UK's DECC (Department of Energy and Climate Change).

[5] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:285:0010:0035:en:PDF

As electric local room heaters generate heat using the Joule effect, their energy performance is fixed. In consequence if MEPS are proposed, these should be based on the use of controls for electric local room heating products. The approach used for proposing these MEPS should be in line with any energy labelling proposals.

No specific MEPS related to electric local room heaters are proposed in this report.

8.2.3.1.2 Non-residential local room heaters (> 12 kW and ≤ 300 kW)

- **Decentralised warm air heaters**

For non-residential warm air heaters, two alternatives for energy efficiency requirements are proposed:

- Alternative 1: MEPS on overall seasonal energy efficiency in primary energy
- Alternative 2: MEPS on thermal efficiency based on Gross Calorific Value (GCV)

The overall seasonal energy efficiency ($\eta_{product,overalll,seasonal}$) in primary energy is calculated as follows:

$$\eta_{product,overalll,seasonal} = \eta_{gen,on,seasonal} \times \eta_{em,th}$$

$$\eta_{gen,on,seasonal} = 0.2 \times \eta_{th,Q\_max} \pm 0.8 \times \eta_{th,Q\_min}$$

$$\eta_{em,thr} = 1 - 0.00978 \times spec.airthrow[W/m^3h]$$

Where,

η_{th,Q_max}	*is the thermal efficiency (based on GCV) at maximum heat input*
η_{th,Q_min}	*is the thermal efficiency (based on GCV) at minimum heat input*
$\eta_{gen,on,seasonal}$	*is the annual seasonal thermal efficiency (based on GCV)*
$\eta_{em,thr}$	*is the seasonal specific air throw efficiency*[6]

The proposed MEPS on overall seasonal energy for decentralised non-residential warm air heaters are presented in Table 4. These MEPS are based on the analysis of Base-Cases and improvement options performed in Tasks 5, 6 and 7 of this preparatory study.

An example of calculation of overall seasonal energy efficiency using the above equation is presented below for a condensing type warm air heater with following characteristics:

- *Thermal efficiency (based on GCV) at maximum heat input: 92.7%*
- *Thermal efficiency (based on GCV) at maximum heat input: 92.7%*
- *Specific air throw rate: 5 W/m³/hour*

[6] The specific air throw is assessed as air volume blown by the heater (m³/h at 15 K temperature rise per kW heat in performance). The influence of seasonal variation of heat load on the specific air throw rate is calculated as per following: *Seasonal specific air throw = 0.2 x Specific air throw rate* $_{maximum\ input}$ + *0.8 x Specific air throw rate* $_{minimum\ input}$

Calculations:

The annual seasonal thermal efficiency (based on GCV)	*= (0.2*92.7 + 0.8*92.7)%*
	= 92.7%
The seasonal specific air throw efficiency	*= 1 – (0.00978*5)*
	= 0.9511
Overall seasonal energy efficiency	*= 92.7 * 0.9511%*
	= 88.2%

Therefore, the above condensing warm air heater type will meet both the tiers of MEPS requirements on overall seasonal efficiency.

Table 4: Proposed MEPS for warm air heaters (alternative 1)

	Minimum overall seasonal efficiency4	
	Tier 1: 2015	**Tier 2: 2017**
Gas and oil warm air heaters	73%	84%

Alternatively, while an appropriate standard for annual efficiency is developed, the Minimum Energy Performance Standards can be established in terms of net gross thermal efficiency tested following the standard EN 621[7]/EN 1020[8]/EN 1196[9]. The MEPS are proposed in two steps (see Table 5) following the efficiency values of the Base-Cases selected in Task 5 and the outcomes of the ENER Lot 21 preparatory study.

Table 5: Proposed MEPS for warm air heaters (alternative 2)

	Minimum thermal efficiency based on GCV4 [%]	
	Tier 1: 2015	**Tier 2: 2017**
Gas and oil warm air heaters	82%	90%

As mentioned, it is the aim to have the proposal for Ecodesign measures for decentralised non-residential warm air heaters that is aligned with central warm air heaters covered in ENER Lot 21.

- **Gas radiant (luminous and tube) heaters**

For non-residential gas radiant heaters, two alternatives for energy efficiency requirements are proposed:

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[7] Non-domestic gas-fired forced convection air heaters for space heating not exceeding a net heat input of 300 kW, without a fan to assist transportation of combustion air and/or combustion products

[8] Non-domestic forced convection gas-fired air heaters for space heating not exceeding a net heat input of 300 kW incorporating a fan to assist transportation of combustion air or combustion products

[9] Domestic and non-domestic gas-fired air heaters - Supplementary requirements for condensing air heaters

- Alternative 1: MEPS on overall seasonal energy efficiency in primary energy
- Alternative 2: MEPS on radiant factor

The overall seasonal energy efficiency ($\eta_{product,overalll,seasonal}$) in primary energy is calculated as follows:

$$\eta_{product,overalll,seasonal} = \eta_{gen,on,seasonal} \times \eta_{gen,ctr} \times \eta_{em,RF}$$

Where,

$\eta_{gen,on,seas}$	*is the seasonal thermal efficiency*
$\eta_{gen,ctr}$	*is the efficiency of power control*[10]
$\eta_{em,RF}$	*is the heat emission performance of radiant heaters and can exceed values > 1.0*

The seasonal thermal efficiency for luminous radiant heaters for use in reference commercial and industrial buildings is a fixed value at maximum heat input calculated for the reference building according to EN 15316-4-8. Based on this, TC 180 proposed a value of 86.4% (based on GCV) for the seasonal thermal efficiency for luminous radiant heaters.

For radiant tube heaters, the seasonal thermal efficiency is calculated as:

$$\eta_{gen,on,seasonal} = 0.2 \times \eta_{th,Q\_\max} \pm 0.8 \times \eta_{th,Q\_\min}$$

Where,

$\eta_{th,Q\_\max}$	*is the thermal efficiency (based on GCV) at maximum heat input*
$\eta_{th,Q\_\min}$	*is the thermal efficiency (based on GCV) at minimum heat input*

The heat emission performance of radiant luminous and tube heaters is calculated as:

$$\eta_{em,RF} = \frac{0.94125}{f_{Radiant}}$$

Where,

$f_{Radiant}$	*is a factor to describe the influence of overhead radiant heating systems in non-domestic premises. The lower the value is, the higher are the energy savings by radiant heating systems. This is described in the Part 5 of DIN 18599:2011 standard (page 49, formula number 39)*

[10] Efficiency of power control influences the ability of heaters to meet the actual heat demand of the building during the annual heating period and to avoid additional energy losses of the building by temporary or local overheating. The value of this efficiency varies with the choice of power control for the burner as following:

1) 1 stage power control (on/off heater): 94%
2) 2 stage power control (heater with two burners): 96%
3) Modulating power control (heaters using modulating burners): 99%

The $f_{Radiant}$ in turn is calculated as[11]:

Where,

RF *is radiant factor of radiant luminous or radiant tube heaters is defined according to EN 416-2 resp. EN 419-2 standards*

The proposed MEPS on overall seasonal energy for gas radiant heaters are presented in Table 6. These MEPS are based on the analysis of Base-Cases and improvement options performed in Tasks 5, 6 and 7 of this preparatory study.

Table 6: Proposed MEPS for gas radiant heaters (alternative 1)

	Minimum overall seasonal efficiency4	
	Tier 1: 2015	**Tier 2: 2017**
Gas luminous radiant heaters	82%	89%
Gas radiant tube heaters	78%	83%

Alternatively, while an appropriate standard for annual efficiency is developed, the Minimum Energy Performance Standards can be established in terms of radiant factor tested following the standard EN 416-2[12] and EN 419-2[13]. The MEPS are proposed in two steps as shown in Table 7.

Table 7: Proposed MEPS for gas radiant heaters (alternative 2)

	Minimum radiant factor	
	Tier 1: 2015	**Tier 2: 2017**
Gas luminous radiant heaters	0.60	0.65

[11] The origin of the simplified formula for the calculation of $f_{Radiant}$ presented here is DIN V 18599-5 Revision 2011:

$$f_{Radiant} = \frac{0.36}{RF + 0.2} + 0.37 \times \left(\frac{70}{pH}\right)^{0.12} \times \left(\frac{10}{hR}\right)^{0.15} + 0.1$$

pH: Is the specific heat load of the heating system, calculated as heat input per net floor area of the building, limited to between 30 and 250 W/m². This is described in the Part 5 of DIN 18599:2011 standard (page 49, formula number 39)

hR: is the ceiling height of the non-domestic building, limited between 4 and 25 meters. This is described in the Part 5 of DIN 18599:2011 standard (page 49, formula number 39)

The $f_{Radiant}$ calculation formula presented in this report assumes that the radiant heater is installed in a reference building (pH = 80 W/m² and hR = 10 m)

[12] Single-burner gas-fired overhead radiant tube heaters for non-domestic use - Part 2: Rational use of energy

[13] Non-domestic gas-fired overhead luminous radiant heaters - Part 2: Rational use of energy

Gas radiant tube heaters	0.57	0.60

- **Air curtains**

The ISO 27327-1 standard defines the effectiveness of an air curtain as the percentage reduction of the heat loss through the door opening in comparison to a situation without an air curtain.

The main design improvement options that lead to reduced environmental impacts and least life cycle costs for air curtains are related to controls. The analysis of improvement options in Task 7 showed that the use of controls such as controlled air stream technology and self-regulating controls can improve the effectiveness of air curtains.

The fan is a minor part compared to the total energy consumed by air curtains. The MEPS for fans used in air curtains are already covered by the Commission Regulation 327/2011[14].

The requirements on heat generation performance of air curtains are already covered under various Ecodesign studies as presented below:

- Air curtains using hot water from hot water boiler (including heat pumps) as heat source: as required by DG ENER Lot 1 study
- Air curtains using heat from heat pumps as heat source: as required by DG ENER Lot 10 or ENTR Lot 6 studies
- Air curtains using heat from the warm air heaters as the heat source: as required by DG ENER Lot 20 study for the warm air unit heaters
- The heat generation efficiency of air curtains using electric heaters is close to 100%, similar to the residential local room electric heaters: as required by this study (ENER Lot 20)

Therefore no MEPS are suggested for air curtains at this moment as this requires the development of a standard which specifies a methodology to assess their effectiveness.

8.2.3.2 Energy Labelling

8.2.3.2.3 Residential local room heaters (≤ 12 kW)

This section will consider how energy labelling could be established for residential local room heaters in the EU.

Energy labelling can be an effective tool to aid consumers to make better purchasing choices related to the energy efficiency of products. Energy labels work by differentiating products with equivalent functionality on the market into different energy classes. According to the Energy Labelling Directive (2010/30/EU), labelling of energy-related products should represent significant potential for energy savings and having a wide disparity in performance levels with equivalent functionality. The challenge with proposing an energy label for residential local room heaters is that a comparison of different energy sources and applications must be made. Even

[14] Implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for fans driven by motors with an electric input power between 125 W and 500 kW.

though the energy mix varies across the EU, an EU energy label would have to be based on primary energy in order to be comparable. According to Directive 2006/32/EC, the current primary energy conversion factor is currently set at 2.5 in the EU.

The general idea of the energy label is to provide consumers with relevant information that will influence their choice in favour of products which consume less energy. Besides thermal efficiency based on primary energy, the influence of controls is used to distinguish the best heaters from the rest.[15]

The proposed approach is based on seasonal efficiency for all residential heaters using different energy sources.

Please note that this is only a proposal prepared for discussion. Any decision regarding an energy labelling for residential local room heaters will be taken by the European Commission.

In this approach the seasonal energy efficiency (based in GCV) is used to distinguish energy classes with a range from A to G. To be consistent with Lot 1 on space heaters and Lot 2 on water heaters correction factors are used to relate possible energy losses or energy savings that are not covered by the active mode energy efficiency.

This approach is in line with previously proposed EC labelling measures for appliances working with electricity or gas, and offer a common labelling scheme where electricity consumptions are converted into primary energy using a conversion factor of 2.5..

Seasonal energy efficiency of local room heater

The seasonal local space heater energy efficiency η_s is defined as:

$$\eta_s = \eta_{son} - \sum F(i)$$

Where:

- η_{son} — *is the active mode energy efficiency, expressed in % and based on GCV*
- *F(i)* — *are correction factors calculated according to table x, and expressed in %.*

Active mode energy efficiency

The active mode energy efficiency η_{son} is equal to:

- For gaseous and liquid fuel fired room heaters is the energy efficiency while providing the rated output power, based on the GCV of the fuels, in %.
- For all electric heaters: η_{son}=40%

The corrections used are close to real life effects (10% - 15% reduction of energy consumption).

[15] The project team did consider distinguishing convection heaters and radiant heaters. Some stakeholders claimed that radiant heaters could reduce energy consumption up to 18-24% as a result of reducing the air temperature in the room. Energy calculations for building regulations in some Member States do provide different energy consumption values depending on the type of heater (also in relation to the height and insulation of the room). However, in typical small rooms that are reasonably insulated there is not much difference between radiant and convection heaters. It is also difficult to clearly define radiant heaters from convectors as many local room heaters provide a mixture of both.

An energy labelling scheme could be developed based on the active mode energy efficiency corrected by the use of controls. The proposed scale is based on the scale used in ENER Lot 1, space heaters.

Table 8: Suggested energy efficiency thresholds (only provided as an example)

Energy class	Seasonal efficiency
A	$\eta_{son} \geq 90$
B	$82 \leq \eta_{son} < 90$
C	$75 \leq \eta_{son} < 82$
D	$37 \leq \eta_{son} < 75$
E	$34 \leq \eta_{son} < 37$
F	$30 \leq \eta_{son} < 34$
G	$\eta_{son} < 30$

In the following tables correction factor values for the use of controls are provided. These values are provided only as an example.

Table 9: Suggested correction factor for capacity control (provided as an example)

F(1)	Correction value
Correction on capacity control	- 5%
For fuel fired heaters and electric heaters except electric storage heaters	
1 single stage output	+ 0%
2 two-stage output	+ 2.5%
3 variable output	+ 5%
Electric storage heaters	
1 output by convection only	+ 0%
2 forced draft output, not variable	+ 2.5%
3 forced draft output variable to input from other equipment	+ 5%

Table 10: Suggested correction factor for temperature control (provided as an example)

F(2)	Correction value

F(2)	Correction value
Correction on temperature control	- 5%
1 manual control of room temp (includes remote control)	+ 0%
2 on/off room thermostat, placed at distance	+ 1%
3 automatic thermostatic, placed at distance	+ 1.5%
4 modular. room thermostat, placed at distance (only if F(1) is "variable output" or "forced draft variable")	+ 2.5%
5 other types of thermostatic control, placed at distance	+ 2%
6. if either option 1 to 5 is combined with a programmable timer an additional correction applies	+ 2.5%
7 if the unit provides additional control at a distance through TCP (internet protocol) an additional correction applies	+ 2.5%

Table 11: Suggested correction factor for auxiliary electricity use (provided as an example)

F(3)
Correction on auxiliary electricity use
Fuel fired heaters only: $F(3)=2.5*(0.2*el_{max}+0.8*el_{min}+1.3*P_{sb})/(0.2*P_{nom}+0.8*P_{pl})$

Table 12: Suggested correction factor for ignition losses (provided as an example)

F(4)	Correction value
Correction on ignition losses (fuel fired heaters only)	
if ignition burner present	- 1%
2 no ignition burner	+ 0%
Or alternatively $F(4)=0.5*P_{ign}/P_{rated}$ where $P_{ign}=0$ if no pilot flame	

8.2.3.2.4 Non-residential local room heaters (> 12 kW and ≤ 300 kW)

No energy labelling requirements are proposed for the non-residential heaters (which include warm air unit heaters, gas radiant luminous and tube heaters and air curtains). The market of non-residential heaters requires heating, ventilation and air conditioning (HVAC) professionals. Energy labelling is an effective policy tool for the consumer market to help consumers make the right choice of best performing product. However, energy labelling would not be effective as professional HVAC engineers and designers are capable of correctly dimensioning and designing central heating systems if they are provided with the relevant information from manufacturers.

8.2.3.3 Potential air quality requirements

Air quality is a key environmental issue, especially in densely populated areas. The combustion processes of some heating products such as residential gas heaters/fires, non-residential warm air heaters or non-residential gas radiant heaters have direct emissions during the use phase, which could contribute to poor ambient air quality. The implementation of emission limit values (ELV) of NO_x and other air pollutants for heating products with direct emissions could therefore be considered.

Little information has been found on emissions of local room heaters covered in this study due to the lack of standardised data. Manufacturers claim that although NO_x emissions are tested for heaters, they are very dependent on local conditions and fuel quality. The environmental impacts of emissions to air assessed in Task 5 of this preparatory study are based on generic life cycle inventories rather than real test data from manufacturers, so they can only be seen as a rough indication of the life cycle impacts.

There exist testing methods and standards for gas and oil boilers to measure NO_x emissions. These can be extended to most of the local room heaters, but currently these are not covered in the standard. It is therefore proposed to align any recommendations for NO_x ELV with ENER Lot 1 as burners used in most of the local room heaters are similar to the burners used in boilers, although the heating medium and heat exchangers are different.

For luminous heaters, the level of NO_x emissions is limited by the basic design of the combustion system. Chemical reaction at or in the radiant surface (which also acts as the heat exchanger) keeps combustion temperatures low and hence NO_x emissions are very low (under 50 mg/kWh). No option for further reduction was identified for luminous radiant heaters.

For radiant tube heaters, the level of NO_x emissions (150 – 200 mg/kWh) is also limited by the design of the combustion system inside the radiant tube (which also acts as the heat exchanger). A long flame and high combustion temperatures are needed for good radiant and energy efficiency. Reducing NO_x emissions further (e.g. by decreasing the flame length) will result in decreasing the efficiency of the product.

Following the proposal of Ecodesign regulation for boilers preparatory study, the ELV for local room heating products are presented in Table 13.

Table 13: Proposed ELV of nitrogen oxides for local room heaters

Type of heater	mg/kWh fuel input in terms of *Gross Calorific Value*[16]
	Tier 1: 2015
Residential gas heaters/fires (both flueless and flued)	70
Residential liquid fuel fired heaters/fires (both flueless and flued)	120
Warm air heaters using gaseous fuels	70
Warm air heaters using liquid fuels	120

Regarding CO, HC, particulate matter and other pollutants it has not been possible to establish ELV due to the lack of data. A standardisation mandate for the development of appropriate test standards for air emissions could be proposed, as it could help establish the emissions related with air-based heating products. Nevertheless, the harmonisation of the different regulations regarding pollutant air emissions is a key issue. The proposal of implementing measures for central heating boilers does not include other ELV than for NO_x. If ELV have to be set for CO, HC and particular matter, these should include all heating products fired by fuel.

8.2.3.4 *Potential noise requirements*

Noise levels for the local room heaters covered in this study are insignificant. Therefore, it is not recommended to set any noise emission requirements for local room heaters. It is however recommended that manufacturers should provide the noise levels (as specified in the relevant standards[17]) in the brochures /catalogues of the local room heaters placed by them on the EU market.

8.2.3.5 *Potential waste/recycling requirements*

Electric space heaters for residential purposes (other than electric underfloor heaters[18]) are currently covered by the WEEE Directive. This is thought to be the most effective policy instrument to increase the recycling and recovery of materials of residential space heaters. No other policy options are suggested here, besides strengthening the general implementation of WEEE in Member States and setting more ambitious the recycling targets.

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[16] Some stakeholders expressed their concerns about establishing ELV in relation to fuel input instead of heat output capacity. When heating capacity is used as a reference, the efficiency of the heat generation should be taken into account. However, the ELV proposed follow the current standardised testing methods for NO_x emissions in boilers, which can be applied to local room heaters.

[17] For example, noise levels for warm air heaters, gas radiant luminous heaters and gas radiant tube heaters are specified in standards EN 1020, EN 419 and EN 416, respectively.

[18] These heaters presently are considered as Construction and Demolition Waste (CDW)

In order to increase the material efficiency and promote recycling, it is recommended to include the obligation for manufacturers/installers to have a take-back system for non-residential heaters and residential electric underfloor heating and gas/liquid fuel fired heaters at the end of their life.

Alternatively, the scope of WEEE Directive can be revised and extended in order to include non-residential heaters, gas/liquid fuel fired residential heaters and electric underfloor heaters. However, in the opinion of some of the stakeholders, these types of products would not fulfil the criteria to be included within the scope of the WEEE Directive. Large equipment are not part of household waste (as EEE are) and are considered construction waste. Nevertheless, these products contain some valuable materials such as copper and aluminium. Therefore the current practice is that they are collected and the materials recovered.

8.2.3.6 Indicative benchmarks

Indicative benchmarks are non-binding for manufacturers but could support product innovation and development prior to any other policy options. Indicative benchmarks for Ecodesign requirements can serve as guidelines for other policy measures such as Green Public Procurement and financial incentives. The greatest energy saving design improvement option identified in Task 7 is a good candidate for indicative benchmark.

8.2.3.6.5 Residential local room heaters (≤ 12 kW)

In the case of gas and liquid independent space heater, an indicative benchmark would be a heater/fire having a net thermal efficiency of minimum 72% (based on GCV).

For electric independent space heaters an indicative benchmark would be a heater (excluding electric storage heaters) using room temperature controls (including a PI thermostat, programmable set-back thermostat and sensors for open window and absence detection). For electric storage heaters, a dynamic storage heater would be an indicative benchmark.

8.2.3.6.6 Non-residential local room heaters (> 12 kW and ≤ 300 kW)[19]

For warm air unit heaters, an indicative benchmark could be a condensing type heater (with net thermal efficiency of 94.5% based on GCV) using electric ignition device, mechanical draft for supply of combustion air, a specific air throw of <= 5 W/m³/h and using room temperature controls (including a PI thermostat and automatic programmable with optimisation).

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[19] It must be noted that for non-residential heaters, the additional energy savings can primarily be realised by:

a. Choosing the best heating system for the particular building (size, height, specific heat demand, inner construction structure, possible inner shelf installations, etc.) and its use (ventilation demands, air infiltration, inner heat sources, temporally limited use, locally limited use, etc.)

b. Determination of the most appropriate heating design taking into account system components like room temperature control, additional destratification fans, additional heat exchanger for flue gases, etc.

TC 180 WG 4 recommended that these additional improvement options and energy savings on system level should be considered at the EPBD level. To realise these options additional information and qualification of professional planners, consultants and architects could be helpful.

For radiant tube heaters an indicative benchmark could be a heater with radiant factor greater than 0.65 (in 2015) and radiant factor greater than 0.70 in 2017.

For radiant luminous heaters an indicative benchmark could be a heater with radiant factor greater than 0.65 (in 2015) and radiant factor greater than 0.75 in 2017.

In case of air curtains an indicative benchmark would be an air curtain using air stream technology and self-regulating controls.

8.2.4 Other elements

8.2.4.1 Information requirements

The analysis of improvement options for most of the local room heaters showed potential for room temperature controls to reduce energy consumption. It should be noted that room temperature controls are not always part of the product. One of the key factors to ensure energy efficient non-residential heaters is the correct dimensioning, design and installation of the specific heating system in a building. Manufacturers should provide relevant information to encourage efficient use of these heaters. This could be done by ensuring that consumers are provided with information on the proper use of these heaters. It is therefore recommended to set requirements of minimum information that the manufacturers should provide to designers/installers.

This information could be provided both as booklets that are given to consumers with the purchase of the appliance as well as general awareness campaigns on how to heat homes in an energy efficient manner. In case of the non-residential fixed heaters, the information should be directed at installers and support them in correct installation and setting of room control systems. The various information requirements for the different local room heaters covered in ENER Lot 20 study are summaries in Table 14.

Table 14: Summary of information requirements for the different local room heaters covered in ENER Lot 20 study[20]

Information requirement	Units	Residential heaters		Non-residential heaters		
		Gas/liquid fuel-fired heaters	Electric heaters	Warm air heaters	Gas radiant heaters	Air curtains
Rated heat output* (both full load and part load)	kW	✓	✓	✓	✓	✓
Thermal efficiency based on GCV (both full load and part load)	%	✓		✓	✓	

[20] An example of information requirements for non-residential warm air unit heaters is presented in Annex A of this report.

Information requirement	Units	Residential heaters		Non-residential heaters		
		Gas/liquid fuel-fired heaters	Electric heaters	Warm air heaters	Gas radiant heaters	Air curtains
Seasonal efficiency in primary energy	%	✓				
Overall seasonal efficiency in primary energy	%			✓	✓	
Radiant factor	-				✓	
Auxiliary electricity consumption (both full load and part load)	kW	✓	✓	✓	✓	✓
Standby power consumption	W	✓	✓	✓	✓	✓
Ignition burner power consumption	kW	✓		✓	✓	
Emission of nitrogen oxides (NO_x)	mg/kWh	✓		✓	✓	
Noise levels	dB	✓	✓	✓	✓	✓
Type of controller (bimetallic/P/PI/PID, programmable set back, presence detection, open window detection, automatic door activation, etc.)	-	✓	✓	✓	✓	✓
Air velocity uniformity	%					✓

** In case of electric storage heaters, rated heat input should instead be provided*

8.2.4.2 Standardisation mandates

The following needs for standardised measurement and calculation methods have been identified:

- Standard for residential electric heaters for the determination of their seasonal efficiency taking into account the associated aspects related to the use of the appliances and aspects such as the possible energy savings by using advanced controls such as thermostat control (PI regulator), programmable timers for setback control, presence detection and open window detection sensors. The working group WG 12 ("Electric room heating appliances") of the Technical Committee CLC/TC 59X is presently working on the revision of current standards

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to take into account the performance and comfort of different electric room heating appliances including underfloor heating equipment[21]. This work should lead to a methodology in which electric direct heating space heaters can be compared.

- Standard for residential fuel-fired (gas/LPG/oil) heaters/fires (both flued and flueless) for the determination of their seasonal efficiency and pollutant emissions to air (NO_x, PM, CO, HC).
- Standard for the determination of overall seasonal energy performance of gas/oil/electric warm air heaters and gas-fired radiant luminous and tube heaters. CEN/TC180 recently started working on a methodology for calculating overall seasonal performance of decentralised gas warm air heaters[22].
- Standard for the determination of seasonal energy performance of air curtains. At the time of drafting this report, ISO 27327 is however still under development. The Part 3 of this standard is currently being developed by ISO/TC 117 WG 9 which should lead to a methodology to measure the effectiveness of air curtains.

The technical working groups identified in the standardisation bodies for the different product groups are the following:

- Gas warm air heaters: CEN/TC 180 - Decentralised gas heating (as mentioned some decentralised heaters can be connected to a duct)
- Oil warm air heaters: CEN/TC 47 - Atomising oil burners and their components - Function - Safety - Testing
- Electric heaters: CENELEC/TC 59x - Performance of household and similar electrical appliances
- Residential fuel-fired (gas/LPG) heaters: CEN/TC 62 - Independent gas-fired space heaters
- Air curtains: ISO/TC 117 WG 9- Air curtain units

[21] Following standards are being updated by CENELEC TC 59X WG 12: prEN 50559 for electric underfloor heaters, prEN 60531 for electric storage heaters and prEN 60675 for all other electric heaters.

[22] TC 180 has provided a timeline for the revision of the corresponding standards for the non-domestic decentralised gas heaters as per following:

a. Registration of work item: by May 2012
b. Elaboration and translation of draft standards: by January 2013
c. Processing and public enquiry: by July 2013
d. Adaptation of comments (including translation): by October 2013
e. Processing and final vote: by March 2014
f. Approving final draft and publishing: by July 2014

8.2.5 Summary of policy options

In the previous sections, various policy options to reduce the environmental impacts of local room heaters have been discussed which include: energy efficiency, air emissions, noise levels, and material consumption and waste production. The alternatives to the policy options discussed are "self regulation" or "no EU action".

- "Self regulation" is an available option foreseen by the Ecodesign Directive as an alternative to mandatory implementing measures. Industry in this case would be responsible for proposing feasible improvement measures for the products in the market.
- "No EU action" is an option if the market, energy consumption or saving potential of the products examined are not significant enough to justify an implementing measure.

For residential heaters, in particular the electric heaters the improvement potential per product is not huge, but the total savings potential (see section 8.3) could be important to justify the establishment of implementing measures, either by self regulation or by mandatory regulation issued by the Commission. So far, the manufacturers have not started any voluntary agreement procedures, even though the European companies are actively involved in the Ecodesign regulatory process and in R&D.

For non-residential heaters, "self regulation" would be a feasible option if the industry was organised and involved in the Ecodesign process. However, these products are not very spread in the EU and the manufacturers are small players, mostly focused on regional markets. According to the findings of this preparatory study, the energy consumption of non-residential heaters is relatively high, the improvement potential of each product is significant and the total potential savings could be important. This issue will be analysed in the following section.

8.3 Scenario analysis

Based on the policy options proposed in the previous section, different scenarios are drawn up to illustrate quantitatively the improvements that could be achieved. The implementation of different sets of improvement options at EU level by 2035 is compared to baseline scenarios (reference scenarios).

An Excel tool was used to calculate the impacts of different scenarios (2011-2035). The tool relies on the following assumptions:

- The scenarios are modelled on a discrete annual basis to match the available data.
- Sales and stock forecasts detailed in Task 2 were used as input.
- Primary energy consumption was judged to be the most relevant and representative indicator to be modelled using the tool and to allow comparing environmental benefits with other Ecodesign Lots. The tool calculates the expenditure in Euros and primary energy in GJ related to local room heaters,

under different policy scenarios. The primary energy results are not limited to the use phase, but take into account the energy required over the whole lifetime (including the manufacturing, distribution and end-of-life phases). These primary energy consumptions are based on the results of the Task 7.

- Energy consumption is allocated uniformly over the lifetime of the product although in theory this is only true for the use phase. Given the relatively low shares of other life cycle phases in energy consumption (see Task 5), this assumption is considered reasonable in order to carry out the analysis - a more "realistic" modelling would not make a significant difference to the overall results.
- Expenditure measures the yearly value of the entire market. It consists of the money spent to buy the product (purchase price), taken into account at the time of purchase, and the operating costs (energy, water, maintenance and repair), which are spread over the lifetime of the machine.

In the following subsections, five scenarios are described:

- **Business-as-usual (BaU) scenario:** reflects the natural evolution of the market assuming no further changes in performance of the products if no new policy is adopted.
- **Pragmatic BaU scenario:** is a more realistic representation of the current market situation of the local room heaters. It assumes that since 2011, the sales of local room heaters are comprised of a mix of Base-Cases and products incorporating the design improvement options.
- **Policy recommendation scenario:** only concerns the EU market of those local room heaters types for which MEPS are proposed in the previous sections (BC 1, BC 2, BC 7, BC 8a and BC 8b)
- **Least Life-Cycle Cost (LLCC) scenario**: assumes that the LLCC options for all product categories are implemented from 2015
- **Best Available Technology (BAT) scenario**: assumes that the LLCC options from 2015 and BAT options from 2017 onwards are implemented for all product categories

Scenarios are compared to the 'BAU' and 'Pragmatic BaU' scenarios in order to estimate the overall potential of the improvement options. Most of the description in the sections below refers to 2035 for comparison.

8.3.1 BaU scenario

In the BAU scenario, the Base-Cases remain the only products sold on the market over the outlook period. No improvement options are introduced to the market. In this scenario, it is consequently assumed that there is no incremental process of product improvement. This scenario together with 'Pragmatic BaU scenario' is used as a baseline in order to compare the results with those of the 'Policy recommendation', 'BAT' and 'LLCC' scenarios.

► Residential local room heaters (≤ 12 kW)

The figures below show the breakdown by Base-Case of energy consumption, expenditure and GHG emissions over the period 2011-2035 for residential local room heaters in the BaU scenario. BC 4 has the highest share for all three of them.

Figure 1: Residential heaters Base-Case share (in %) of total energy consumption over the period 2011-2035 in BaU scenario

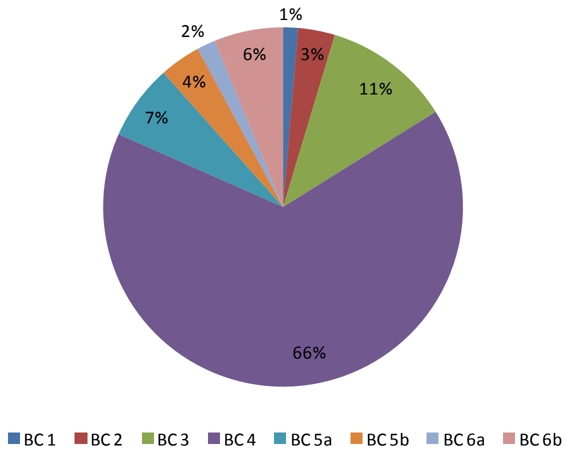


Figure 2: Residential heaters Base-Case share (in %) of total expenditure over the period 2011-2035 in BaU scenario

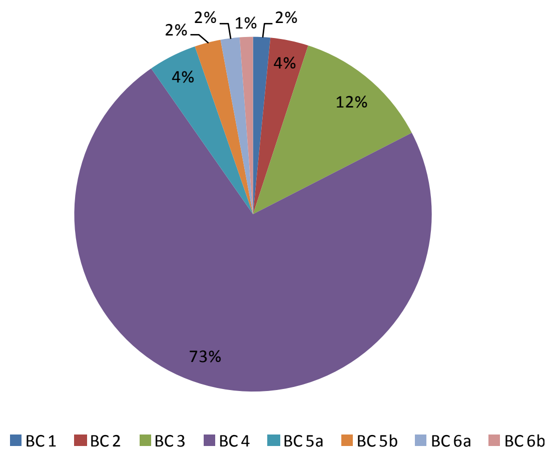
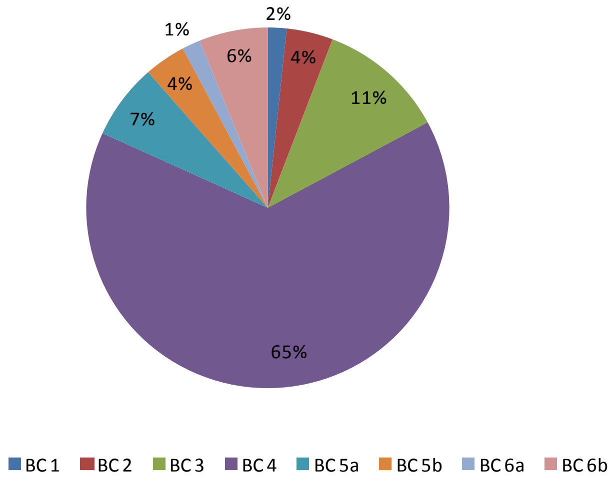


Figure 3: Residential heaters Base-Case share (in %) of total GHG emissions over the period 2011-2035 in BaU scenario



In 2035, residential local room heaters covered in this study would require 519 TWh of primary energy, and total consumption over the period 2011-2035 would be 12 976 TWh. They will result in 83 Mt CO_2 eq of GHG emissions in 2035 and total emissions of 2 068 Mt CO_2 eq over the period 2011-2035. Regarding expenditure, €21.2 billion is projected to be spent on these residential local room heaters in 2035, and the market is projected to represent a cumulative €554 billion over the period 2011-2035.

- **Non-residential local room heaters (> 12 kW and ≤ 300 kW)**

The figures below show the breakdown by Base-Case of energy consumption, expenditure and GHG emissions over the period 2011-2035 for non-residential local room heaters in the BaU scenario. BC 7 has the highest share for all three of them.

Figure 4: Non-residential heaters Base-Case share (in %) of total energy consumption over the period 2011-2035 in BaU scenario

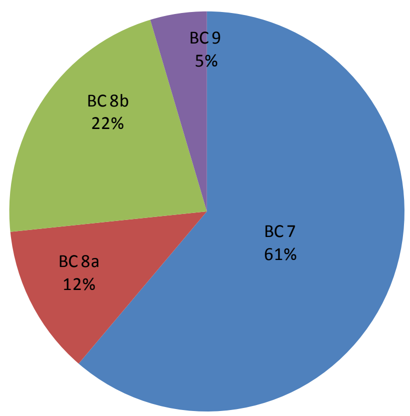


Figure 5: Non-residential heaters Base-Case share (in %) of total expenditure over the period 2011-2035 in BaU scenario

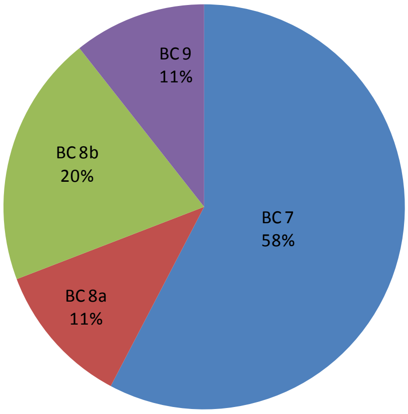
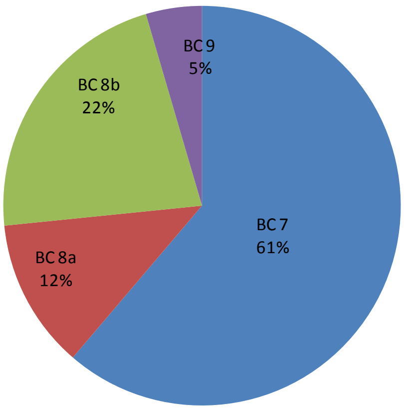


Figure 6: Non-residential heaters Base-Case share (in %) of total GHG emissions over the period 2011-2035 in BaU scenario



In 2035, non-residential local room heaters covered in this study would require 80 TWh of primary energy, and total consumption over the period 2011-2035 would be around 2 000 TWh. They will result in 16 Mt CO_2 eq GHG emissions in 2035 and total emissions of around 400 Mt CO_2 eq over the period of 2011-2035. Regarding expenditure, €2.1 billion is projected to be spent on these non-residential local room heaters in 2035, and the market is projected to represent a cumulative €54 billion over the period 2011-2035.

8.3.2 Pragmatic BaU scenario

The pragmatic BaU scenario assumes that the sales of local room heaters since 2011 are comprised of a mix of Base-Cases and products incorporating some of the design improvement options. The 2011 onwards sales of local room heaters in this scenario are presented below:

- BC 1 sales: 100% BC 1 (same as BaU)
- BC 2 sales: 90% BC 2 and 10% Balanced flue gas fires

- BC 3 sales: 50% BC 3 and 50% Portable fan heaters having a bi-metallic controller
- BC 4 sales: 50% BC 4 and 50% Convector fixed heaters having a PI controller
- BC 5a sales: 50% BC 5a and 50% Static storage heaters having an automatic electro-mechanical charge controller
- BC 5b sales: 50% BC 5b and 50% Dynamic storage heaters having an automatic electronic charge control and thermostat output control
- BC 6a sales: 50% BC 6a and 50% Underfloor heaters (primary heating) having a PI controller
- BC 6b sales: 50% BC 6b and 50% Underfloor heaters (secondary heating) having a PI controller
- BC 7 sales: 50% BC 7 and 50% warm air unit heaters with a net thermal efficiency (based on NCV) of 98%
- BC 8a sales: 50% BC 8a and 50% luminous radiant heaters with a radiant factor > 0.65
- BC 8b sales: 50% BC 8b and 50% radiant tube heaters with a radiant factor > 0.60
- BC 9 sales: 50% BC 9 and 50% air curtains sold with self regulating controls

This scenario is used as another baseline in order to compare the results with those of the 'Policy recommendation', 'BAT' and 'LLCC' scenarios.

Residential local room heaters (≤ 12 kW)

The figures below show the breakdown by Base-Case of energy consumption, expenditure and GHG emissions over the period 2011-2035 for residential local room heaters in the Pragmatic BaU scenario. BC 4 has the highest share for all three of them.

Figure 7: Residential heaters Base-Case share (in %) of total energy consumption over the period 2011-2035 in Pragmatic BaU scenario

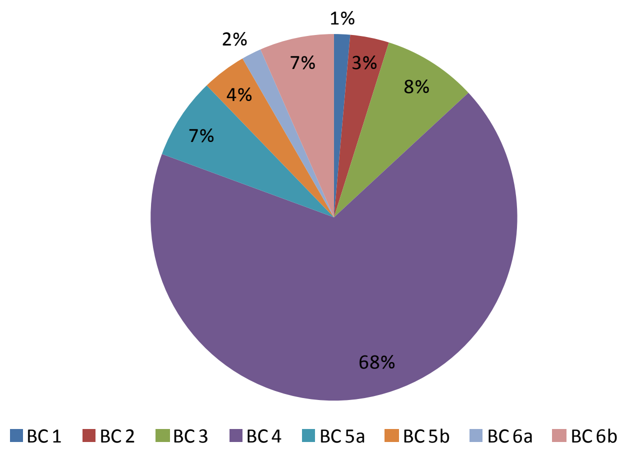


Figure 8: Residential heaters Base-Case share (in %) of total expenditure over the period 2011-2035 in Pragmatic BaU scenario

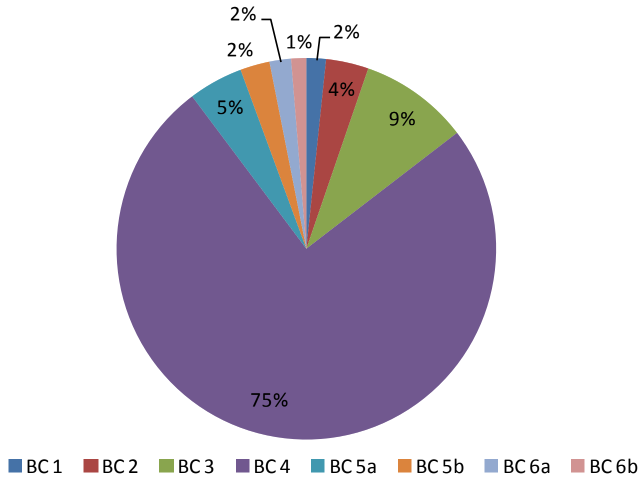
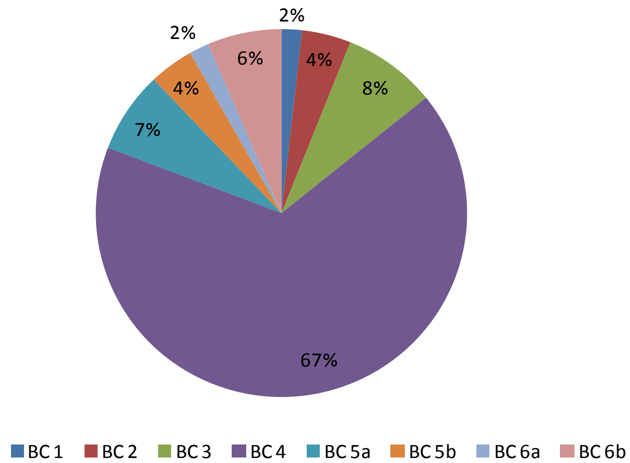


Figure 9: Residential heaters Base-Case share (in %) of total GHG emissions over the period 2011-2035 in Pragmatic BaU scenario



In 2035, residential local room heaters covered in this study would require 479 TWh of primary energy, and total consumption over the period 2011-2035 would be 12 190 TWh. They will result in 76 Mt CO_2 eq GHG emissions in 2035 and total emissions of 1 944 Mt CO_2 eq over the period of 2011-2035. Regarding expenditure, €20.6 billion is projected to be spent on these residential local room heaters in 2035, and the market is projected to represent a cumulative €522 billion over the period 2011-2035.

- **Non-residential local room heaters (> 12 kW and ≤ 300 kW)**

The figures below show the breakdown by Base-Case of energy consumption, expenditure and GHG emissions over the period 2011-2035 for non-residential local room heaters in the Pragmatic BaU scenario. BC 7 has the highest share for all three of them.

Figure 10: Non-residential heaters Base-Case share (in %) of total energy consumption over the period 2011-2035 in Pragmatic BaU scenario

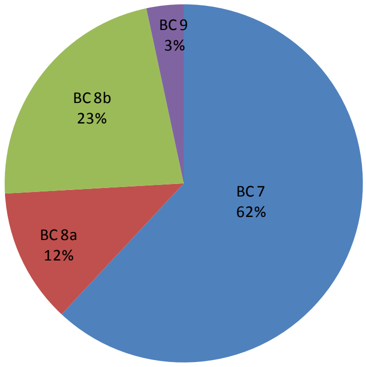


Figure 11: Non-residential heaters Base-Case share (in %) of total expenditure over the period 2011-2035 in Pragmatic BaU scenario

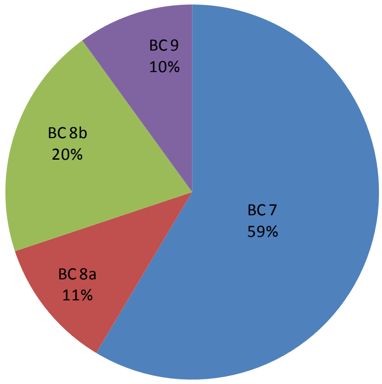
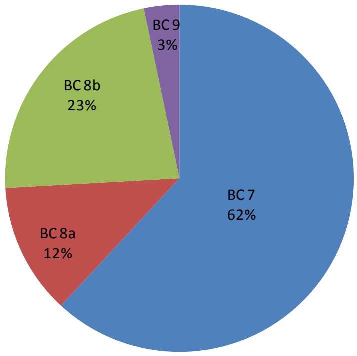


Figure 12: Non-residential heaters Base-Case share (in %) of total GHG emissions over the period 2011-2035 in Pragmatic BaU scenario



In 2035, non-residential local room heaters covered in this study would require 74 TWh of primary energy, and total consumption over the period 2011-2035 would be around 1 900 TWh. They will result in 15 Mt CO_2 eq GHG emissions in 2035 and total emissions of around 380 Mt CO_2 eq over the period of 2011-2035. Regarding expenditure, €2.1 billion is projected to be spent on these non-residential local room heaters in 2035, and the market is projected to represent a cumulative €53.6 billion over the period 2011-2035.

8.3.3 Policy recommendation scenario

This scenario only concerns the heaters types for which MEPS are proposed in the previous sections (BC 1, BC 2, BC 7, BC 8a and BC 8b). The "Policy recommendation scenario" considers that from 2015 onwards Tier 1 requirements as described earlier are implemented and from 2017 Tier 2 requirements are implemented for the concerned heaters. This scenario best represents the potential savings that can be realised for local room heaters through the MEPS proposed in this report.

Table 15: Summary of the different MEPS and tier levels for the concerned Base-Cases for the 'Policy recommendation scenario'

Heater type	MEPS based on	MEPS	
		Tier 1: 2015	Tier 2: 2017
BC 1 and BC 2 (Residential gas/liquid flued heaters/fires)	Based on GCV [%]	45%	60%
BC 7 (Non-residential gas and oil warm air heaters)		82%	90%
BC 8a (Non-residential gas luminous radiant heaters)	Radiant factor	0.60	0.65
BC 8b (Non-residential gas radiant tube heaters)		0.57	0.60

The figures below show the breakdown by Base-Case of energy consumption, expenditure and GHG emissions over the period 2011-2035 for local room heaters in the 'Policy recommendation' scenario. BC 2 and BC 7 have the highest share of impacts for all three of them.

Figure 13: Local room heaters Base-Case share (in %) of total energy consumption over the period 2011-2035 in Policy recommendation scenario

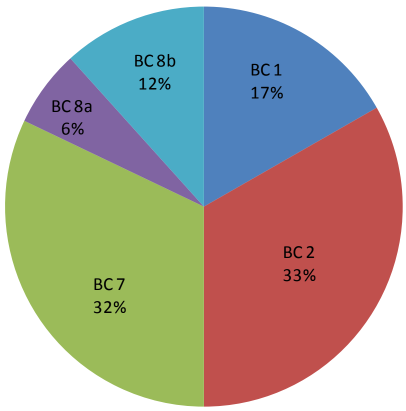


Figure 14: Local room heaters Base-Case share (in %) of total expenditure over the period 2011-2035 in Policy recommendation scenario

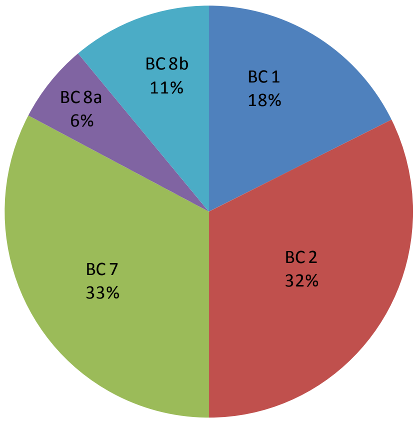
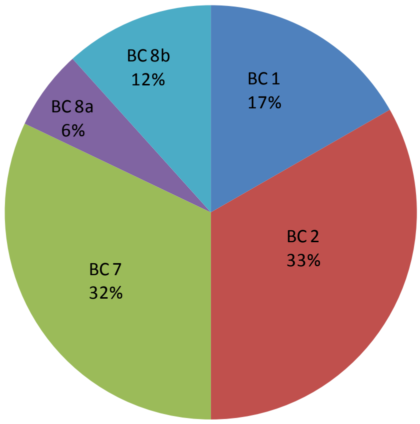


Figure 15: Local room heaters Base-Case share (in %) of total GHG emissions over the period 2011-2035 in Policy recommendation scenario



In 2035, local room heaters covered by this scenario would require 97 TWh of primary energy, and total consumption over the period 2011-2035 would be 2 342 TWh. They will result in 17 Mt CO_2 eq GHG emissions in 2035 and total emissions of 465 Mt CO_2 eq over the period of 2011-2035. Regarding expenditure, €2.8 billion is projected to be spent on these local room heaters in 2035, and the market is projected to represent a cumulative €76 billion over the period 2011-2035.

Table 16: Summary of total energy consumption, GHG emissions and expenditure savings in Policy recommendation scenario compared with BaU scenario in years 2020, 2025 and 2035 for concerned Base-Cases (BC 1, BC 2, BC 7, BC 8a and BC 8b)

Environmental impact indicator	BaU scenario consumption of the concerned heaters	Savings compared to BaU scenario (in different years)		
		2020	2025	2035
Primary energy (TWh)	100	3.3	7.8	16.7
GHG emissions (GWP Mt eq. CO2)	20	0.7	1.6	3.3
Expenditure (€ million)	3 023	-176	-49	205

Table 17: Summary of total energy consumption, GHG emissions and expenditure savings in 'Policy recommendation' scenario compared with 'Pragmatic BaU' scenario in years 2020, 2025 and 2035 for concerned Base-Cases (BC 1, BC 2, BC 7, BC 8a and BC 8b)

Environmental impact indicator	Savings compared to 'Pragmatic BaU' scenario (in different years)		
	2020	2025	2035
Primary energy (TWh)	1.1	4.3	11.3
GHG emissions (GWP Mt eq. CO2)	0.2	0.9	2.3
Expenditure (€ million)	-151	-53	158

8.3.4 LLCC scenario

The LLCC scenario considers that the LLCC improvement option as described in Task 7 is implemented for each Base-Case. From 2015, all products sold include these LLCC options and no more Base-Cases are sold (the market shift takes place from one year to the next).

- **Residential local room heaters (≤ 12 kW)**

The figures below show the breakdown by Base-Case of energy consumption, expenditure and GHG emissions over the period 2011-2035 for residential local room heaters in the LLCC scenario. BC 4 has the highest share for all three of them.

Figure 16: Residential heaters Base-Case share (in %) of total energy consumption over the period 2011-2035 in LLCC scenario

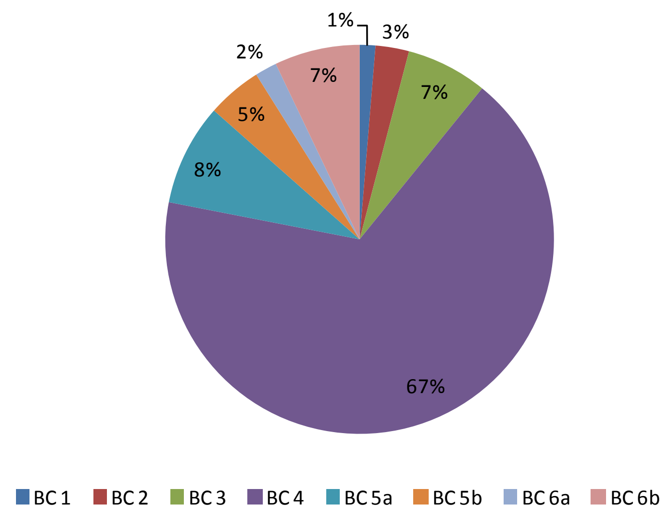


Figure 17: Residential heaters Base-Case share (in %) of total expenditure over the period 2011-2035 in LLCC scenario

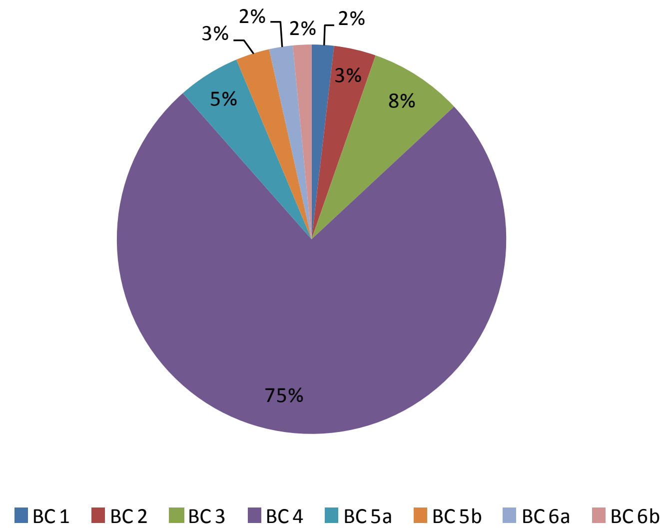
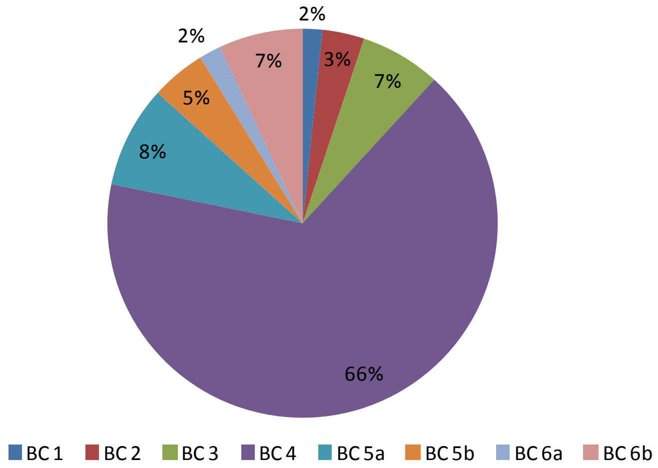


Figure 18: Residential heaters Base-Case share (in %) of total GHG emissions over the period 2011-2035 in LLCC scenario



In 2035, residential local room heaters covered in this study would require 346 TWh of primary energy, and total consumption over the period 2011-2035 would be around 10 300 TWh. They will result in 55 Mt CO_2 eq GHG emissions in 2035 and total emissions of 1 640 Mt CO_2 eq over the period of 2011-2035. Regarding expenditure, €16.1 billion is projected to be spent on these residential local room heaters in 2035, and the market is projected to represent a cumulative €465 billion over the period 2011-2035.

Table 18: Summary of total energy consumption, GHG emissions and expenditure savings in 'LLCC scenario' compared with 'BaU scenario' in years 2020, 2025 and 2035 for residential Base-Cases (BC 1 to BC 6b)

Environmental impact indicator	BaU scenario consumption	Savings compared to 'BaU scenario' (in different years)		
		2020	2025	2035
Primary energy (TWh)	519	91.3	163.6	173
GHG emissions (GWP Mt CO_2 eq.)	83	14.5	26.1	28
Expenditure (€ million)	22 151	2 769	5 737	6 060

Table 19: Summary of total energy consumption, GHG emissions and expenditure savings in 'LLCC scenario' compared with 'Pragmatic BaU scenario' in years 2020, 2025 and 2035 for residential Base-Cases (BC 1 to BC 6b)

Environmental impact indicator	Savings compared to 'Pragmatic BaU scenario' (in different years)		
	2020	2025	2035
Primary energy (TWh)	52.8	124.6	134
GHG emissions (GWP Mt eq. CO_2)	8.5	19.9	22
Expenditure (€ million)	1 202	4 155	4 459

- **Non-residential local room heaters (> 12 kW and ≤ 300 kW)**

The figures below show the breakdown by Base-Case of energy consumption, expenditure and GHG emissions over the period 2011-2035 for non-residential local room heaters in the LLCC scenario. BC 7 has the highest share impacts for all three of them.

Figure 19: Non-residential heaters Base-Case share (in %) of total energy consumption over the period 2011-2035 in LLCC scenario

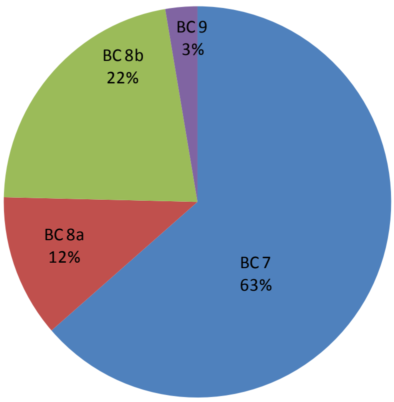


Figure 20: Non-residential heaters Base-Case share (in %) of total expenditure over the period 2011-2035 in LLCC scenario

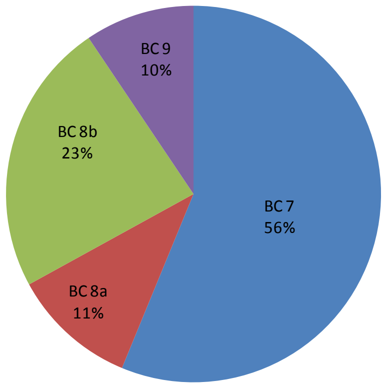
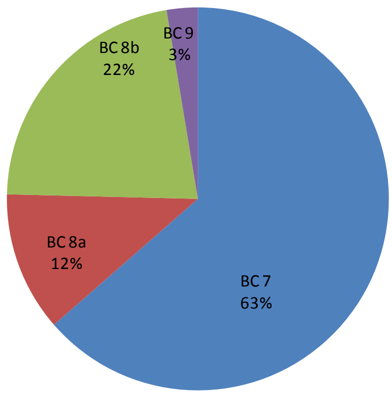


Figure 21: Non-residential heaters Base-Case share (in %) of total GHG emissions over the period 2011-2035 in LLCC scenario



In 2035, non-residential local room heaters covered in this study would require 56 TWh of primary energy, and total consumption over the period 2011-2035 would be 1 726 TWh. They will result in 11 Mt CO_2 eq GHG emissions in 2035 and total emissions of 396 Mt CO_2 eq over the period of 2011-2035. Regarding expenditure, €1.8 billion is projected to be spent on these non-residential local room heaters in 2035, and the market is projected to represent a cumulative €52.3 billion over the period 2011-2035.

Table 20: Summary of total energy consumption, GHG emissions and expenditure savings in 'LLCC scenario' compared with 'BaU scenario' in years 2020, 2025 and 2035 for non-residential Base-Cases (BC 7 to BC 9)

Environmental impact indicator	BaU scenario consumption	Savings compared to 'BaU scenario' (in different years)		
		2020	2025	2035
Primary energy (TWh)	80	7.2	13.5	24
GHG emissions (GWP Mt CO_2 eq.)	16	1.4	2.7	5
Expenditure (€ millions)	2 140	-68.5	67.6	296

Table 21: Summary of total energy consumption, GHG emissions and expenditure savings in 'LLCC scenario' compared with 'Pragmatic BaU scenario' in years 2020, 2025 and 2035 for non-residential Base-Cases (BC 7 to BC 9)

Environmental impact indicator	Savings compared to 'Pragmatic BaU scenario' (in different years)		
	2020	2025	2035
Primary energy (TWh)	3.9	9.2	18
GHG emissions (GWP Mt CO_2 eq.)	0.8	1.8	4
Expenditure (€ million)	-54.6	58.6	252

8.3.5 BAT scenario

The BAT scenario considers that from 2015 onwards LLCC options as described in Task 7 are implemented and from 2017 BAT (improvement option leading to greatest energy savings) is implemented for all product categories (the market shift takes place from one year to the next). This represents the best case scenario and is included in the present analysis only for comparative purposes in order to assess the maximum saving potential achievable over the period 2015-2035 compared to the two scenarios presented earlier.

- **Residential local room heaters (≤ 12 kW)**

The figures below show the breakdown by Base-Case of energy consumption, expenditure and GHG emissions over the period 2011-2035 for residential local room heaters in the BAT scenario. BC 4 has the highest share for all three of them.

Figure 22: Residential heaters Base-Case share (in %) of total energy consumption over the period 2011-2035 in BAT scenario

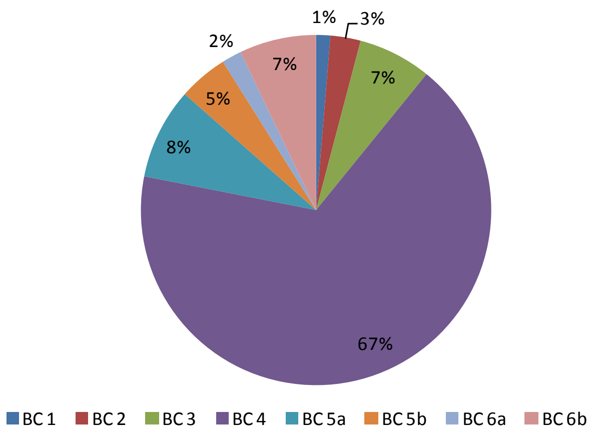


Figure 23: Residential heaters Base-Case share (in %) of total expenditure over the period 2011-2035 in BAT scenario

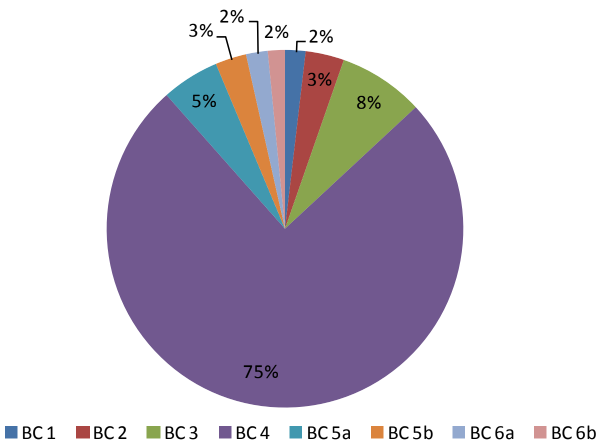
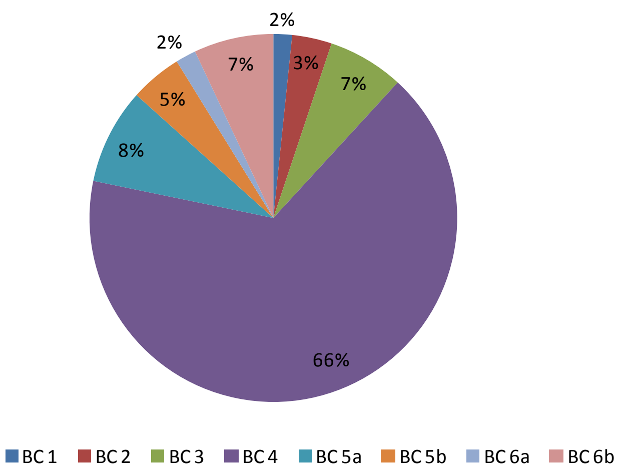


Figure 24: Residential heaters Base-Case share (in %) of total GHG emissions over the period 2011-2035 in BAT scenario



In 2035, residential local room heaters covered in this study would require 346 TWh of primary energy, and total consumption over the period 2011-2035 would be 10 300 TWh. They will result in 55 Mt CO_2 eq GHG emissions in 2035 and total emissions of 1 640 Mt CO_2 eq over the period of 2011-2035. Regarding expenditure, €16.1 billion is projected to be spent on these residential local room heaters in 2035, and the market is projected to represent a cumulative €465 billion over the period 2011-2035.

Table 22: Summary of total energy consumption, GHG emissions and expenditure savings in 'BAT scenario' compared with 'BaU scenario' in years 2020, 2025 and 2035 for residential Base-Cases (BC 1 to BC 6b)

Environmental impact indicator	BaU scenario consumption	Savings compared to 'BaU scenario' (in different years)		
		2020	2025	2035
Primary energy (TWh)	519	91	164	173
GHG emissions (GWP Mt CO2 eq.)	83	14.6	26.1	28
Expenditure (€ million)	22 151	2 761	5 731	6 059

Table 23: Summary of total energy consumption, GHG emissions and expenditure savings in 'BAT scenario' compared with 'Pragmatic BaU scenario' in years 2020, 2025 and 2035 for residential Base-Cases (BC 1 to BC 6b)

Environmental impact indicator	Savings compared to 'Pragmatic BaU scenario' (in different years)		
	2020	2025	2035
Primary energy (TWh)	53	125	134
GHG emissions (GWP Mt CO2 eq.)	8.5	20	21.7
Expenditure (€ million)	1 194	4 149	4 458

- **Non-residential local room heaters (> 12 kW and ≤ 300 kW)**

The figures below show the breakdown by Base-Case of energy consumption, expenditure and GHG emissions over the period 2011-2035 for non-residential local room heaters in the BAT scenario. BC 7 has the highest share for all three of them.

Figure 25: Non-residential heaters Base-Case share (in %) of total energy consumption over the period 2011-2035 in BAT scenario

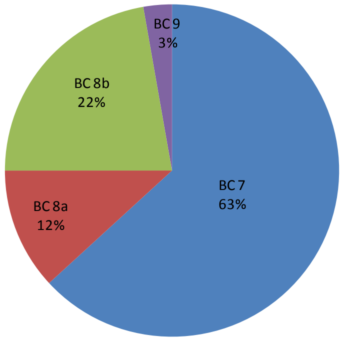


Figure 26: Non-residential heaters Base-Case share (in %) of total expenditure over the period 2011-2035 in BAT scenario

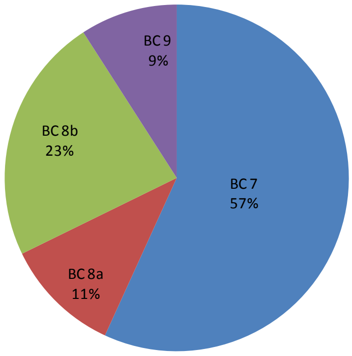
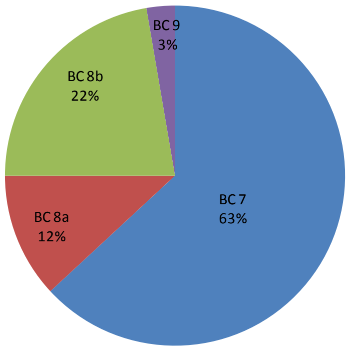


Figure 27: Non-residential heaters Base-Case share (in %) of total GHG emissions over the period 2011-2035 in BAT scenario



In 2035, non-residential local room heaters covered in this study would require 51 TWh of primary energy, and total consumption over the period 2011-2035 would be 1 678 TWh. They will result in 10 Mt CO_2 eq of GHG emissions in 2035 and total emissions of 333 Mt CO_2 eq over the period of 2011-2035. Regarding expenditure, €1.9 billion is projected to be spent on these non-residential local room heaters in 2035, and the market is projected to represent a cumulative €54.4 billion over the period 2011-2035.

Table 24: Summary of total energy consumption, GHG emissions and expenditure savings in 'BAT scenario' compared with 'BaU scenario' in years 2020, 2025 and 2035 for non-residential Base-Cases (BC 7 to BC 9)

Environmental impact indicator	BaU scenario consumption	Savings compared to 'BaU scenario' (in different years)		
		2020	2025	2035
Primary energy (TWh)	80	8.1	15.8	29.1
GHG emissions (GWP Mt CO_2 eq.)	16	1.6	3.1	5.8
Expenditure (€ million)	2 140	-214	-47	241

Table 25: Summary of total energy consumption, GHG emissions and expenditure savings in 'BAT scenario' compared with 'Pragmatic BaU scenario' in years 2020, 2025 and 2035 for non-residential Base-Cases (BC 7 to BC 9)

Environmental impact indicator	Savings compared to 'Pragmatic BaU scenario' (in different years)		
	2020	2025	2035
Primary energy (TWh)	4.8	11.4	23.1
GHG emissions (GWP Mt CO_2 eq.)	0.9	2.3	4.6
Expenditure (€ million)	-200	-57	198

8.3.6 Summary of scenarios

This section presents a summary of the results of each Base-Case in terms of energy consumption, GHG emissions and consumer expenditure for all scenarios in years 2020, 2025 and 2035. It can be seen that for some Base-Cases the same scenarios can be more effective in reducing the energy consumption, GHG emissions and consumers expenditure over the years from others.

Table 26: Summary of energy consumption for residential Base-Cases 1- 6b in all scenarios (TWh)

Years	BC 1	BC 2	BC 3	BC 4	BC 5a	BC 5b	BC 6a	BC 6b
BaU[23]								
	6.9	17.19	59.6	340.0	35.3	19.2	8.6	32.3
Pragmatic BaU								
2020	6.9	16.82	35.7	326.5	35.0	19.1	8.5	32.0
2025	6.9	16.62	35.7	326.4	34.9	19.0	8.5	31.9
2030	6.9	16.41	35.7	326.4	34.8	18.9	8.5	31.9
Policy Option								
2020	6.9	15.45	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
2025	6.9	13.09	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
2030	6.9	10.72	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
LLCC								
2020	6.0	13.80	30.9	285.4	35.0	19.0	7.7	29.8
2025	5.1	10.40	10.7	241.4	34.8	18.7	6.9	27.4
2030	4.2	7.01	10.7	241.4	34.6	18.4	6.9	27.4
BAT								
2020	6.0	13.80	30.9	285.4	35.0	19.0	7.7	29.8
2025	5.1	10.40	10.7	241.4	34.6	18.7	6.9	27.4
2030	4.2	7.01	10.7	241.4	34.3	18.4	6.9	27.4

Table 27: Summary of energy consumption for non-residential Base-Cases 7- 9 in all scenarios (TWh)

Years	BC 7	BC 8a	BC 8b	BC 9
BaU[23]				
	49.0	9.7	17.6	3.7
Practical BaU				
2011	49.0	9.7	17.6	3.7
2020	47.7	9.4	17.3	2.3
2030	46.2	9.0	17.0	2.3
Policy Option				
2011	49.0	9.7	17.6	N.A.
2020	48.0	9.4	17.3	N.A.
2030	45.1	8.6	16.7	N.A.

[23] For the BaU scenario only yearly consumption of each Base-Case is presented as it is assumed that Base-Case is the only product sold in the market with only replacement sales.

Years	BC 7	BC 8a	BC 8b	BC 9
LLCC				
2011	49.0	9.7	17.6	3.7
2020	45.9	8.8	16.1	1.8
2030	39.9	6.9	13.3	0.9
BAT				
2011	49.0	9.7	17.6	3.7
2020	45.3	8.7	16.0	1.8
2030	37.0	6.6	12.8	0.9

Table 28: Summary of GHG emissions for residential Base-Cases 1- 6b in all scenarios (mt CO2 equivalent)

Years	BC 1	BC 2	BC 3	BC 4	BC 5a	BC 5b	BC 6a	BC 6b
BaU[23]								
	1.38	3.43	9.38	53.47	5.60	3.06	1.35	5.07
Pragmatic BaU								
2020	1.38	3.35	5.63	51.34	5.56	3.03	1.34	5.02
2025	1.38	3.31	5.63	51.34	5.54	3.02	1.34	5.02
2030	1.38	3.27	5.63	51.34	5.53	3.01	1.34	5.02
Policy Option								
2020	1.38	3.08	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
2025	1.38	2.61	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
2030	1.38	2.14	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
LLCC								
2020	1.20	2.75	4.87	44.89	5.56	3.02	1.21	4.69
2025	1.02	2.07	1.69	37.97	5.52	2.97	1.08	4.31
2030	0.84	1.40	1.69	37.97	5.49	2.93	1.08	4.31
BAT								
2020	1.20	2.75	4.87	44.89	5.55	3.02	1.21	4.69
2025	1.02	2.07	1.69	37.97	5.50	2.97	1.08	4.31

Years	BC 1	BC 2	BC 3	BC 4	BC 5a	BC 5b	BC 6a	BC 6b
2030	0.84	1.40	1.69	37.97	5.45	2.93	1.08	4.31

Table 29: Summary of GHG emissions for non-residential Base-Cases 7-9 in all scenarios (mt CO2 equivalent)

Years	BC 7	BC 8a	BC 8b	BC 9
BaU[23]				
	9.70	1.93	3.50	0.72
Practical BaU				
2020	9.45	1.86	3.44	0.45
2025	9.30	1.83	3.41	0.45
2030	9.16	1.79	3.38	0.45
Policy Option				
2011	9.51	1.86	3.44	N.A.
2020	9.22	1.79	3.38	N.A.
2030	8.94	1.72	3.31	N.A.
LLCC				
2020	9.11	1.74	3.21	0.36
2025	8.51	1.56	2.92	0.18
2030	7.92	1.37	2.63	0.18
BAT				
2020	8.98	1.73	3.19	0.36
2025	8.16	1.52	2.87	0.18
2030	7.34	1.31	2.55	0.18

Table 30: Summary of expenditure for residential Base-Cases 1- 6b in all scenarios (million Euros)

Years	BC 1	BC 2	BC 3	BC 4	BC 5a	BC 5b	BC 6a	BC 6b
BaU[23]								
	346	765	2,752	16,143	973	525	383	265
Pragmatic BaU								
2020	346	759	1,748	15,588	970	524	381	267
2025	346	752	1,748	15,586	967	522	381	267
2030	346	743	1,748	15,586	961	518	381	267
Policy Option								

Years	BC 1	BC 2	BC 3	BC 4	BC 5a	BC 5b	BC 6a	BC 6b
2020	395	781	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
2025	395	699	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
2030	395	617	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
LLCC								
2020	375	744	1,576	14,520	971	529	372	294
2025	344	626	716	12,607	965	522	348	286
2030	313	508	716	12,607	959	516	348	286
BAT								
2020	375	744	1,576	14,520	980	529	372	294
2025	344	626	716	12,607	971	522	348	286
2030	313	508	716	12,607	963	516	348	286

Table 31: Summary of expenditure for non-residential Base-Cases 7-9 in all scenarios (million Euros)

Years	BC 7	BC 8a	BC 8b	BC 9
BaU[23]				
	1,234	246	432	228
Practical BaU				
2020	1,266	245	433	210
2025	1,250	241	430	210
2030	1,235	237	426	210
Policy Option				
2020	1,332	250	440	N.A.
2025	1,301	242	434	N.A.
2030	1,239	228	420	N.A.
LLCC				
2020	1,297	255	444	211
2025	1,232	235	413	192
2030	1,168	214	381	192
BAT				
2020	1,403	275	463	211
2025	1,315	251	428	192

Years	BC 7	BC 8a	BC 8b	BC 9
2030	1,227	228	393	192

8.3.7 Comparison of scenarios

This comparison is made in terms of energy consumption, GHG emissions and consumer expenditure. As expected, the BAT scenario enables the largest primary energy savings (both annually and over the period 2011-2035) while the LLCC scenario results in the smallest annual expenditure.

- **Residential local room heaters (≤ 12 kW)**

Figure 28**Erreur ! Source du renvoi introuvable.** to **Erreur ! Source du renvoi introuvable.**Figure 33 presents the comparison of energy consumption for each of the residential Base-Cases (BC 1 to BC 6b) for the five different scenarios: BaU, Pragmatic BaU, Policy recommendation, LLCC and BAT. As no MEPS were proposed for BC 1-BC 6b, therefore, no 'Policy recommendation' scenario is analysed for them. For some of the Base-Cases, the LLCC and BAT scenarios are superimposed in the figures (whenever the BAT and LLCC option is the same).

Figure 28 : Comparison of the total energy consumption (in TWh) for the four scenarios over the period 2011-2035 for BC 1[24]

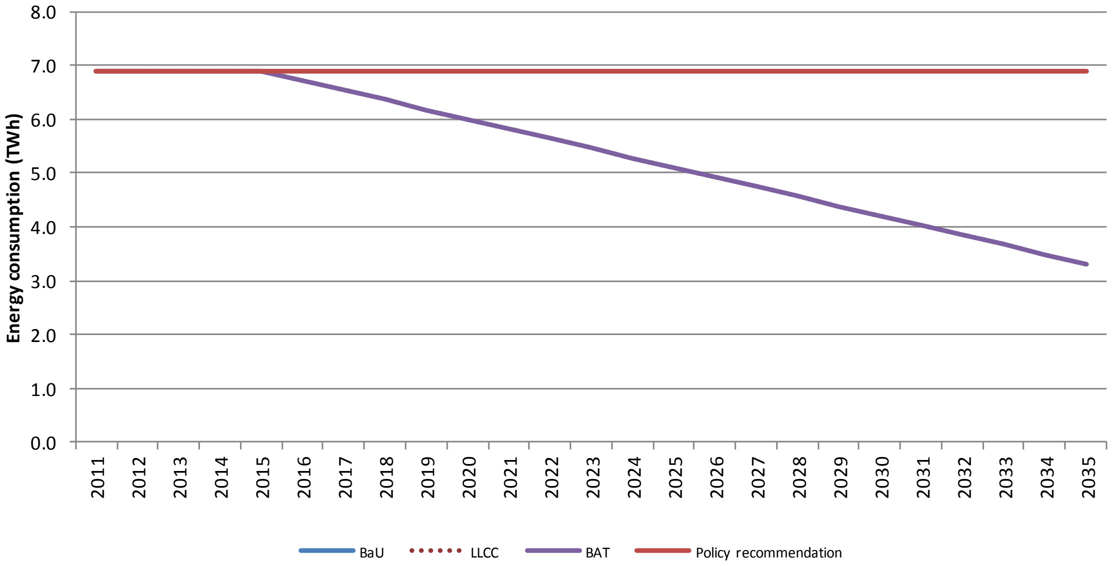
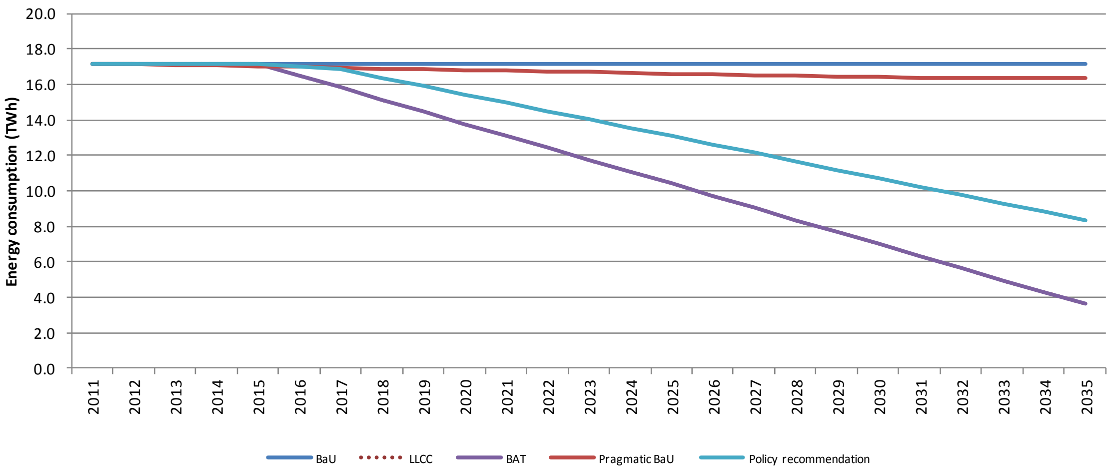


Figure 29: Comparison of the total energy consumption (in TWh) for the five scenarios over the period 2011-2035 for BC 2



[24] The 'Policy recommendation' scenario curve for BC 1 overlaps with the 'BaU' scenario curve. This is so because the thermal efficiency value considered for BC 1 is of the same order as the Tier 2 MEPS proposal under the 'Policy recommendation' scenario.

Figure 30: Comparison of the total energy consumption (in TWh) for the four scenarios over the period 2011-2035 for BC 3

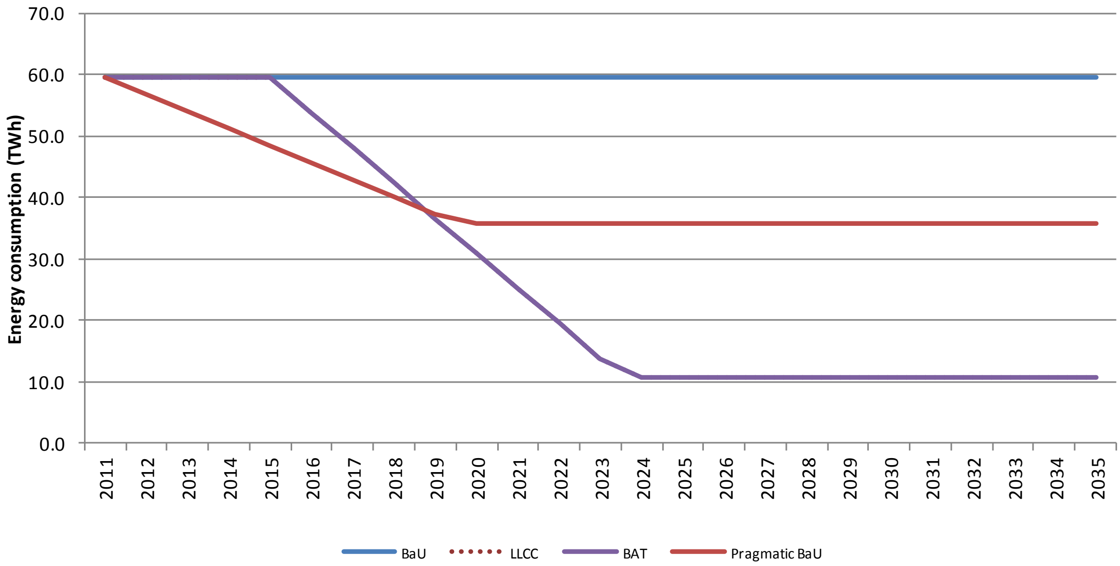


Figure 31: Comparison of the total energy consumption (in TWh) for the four scenarios over the period 2011-2035 for BC 4

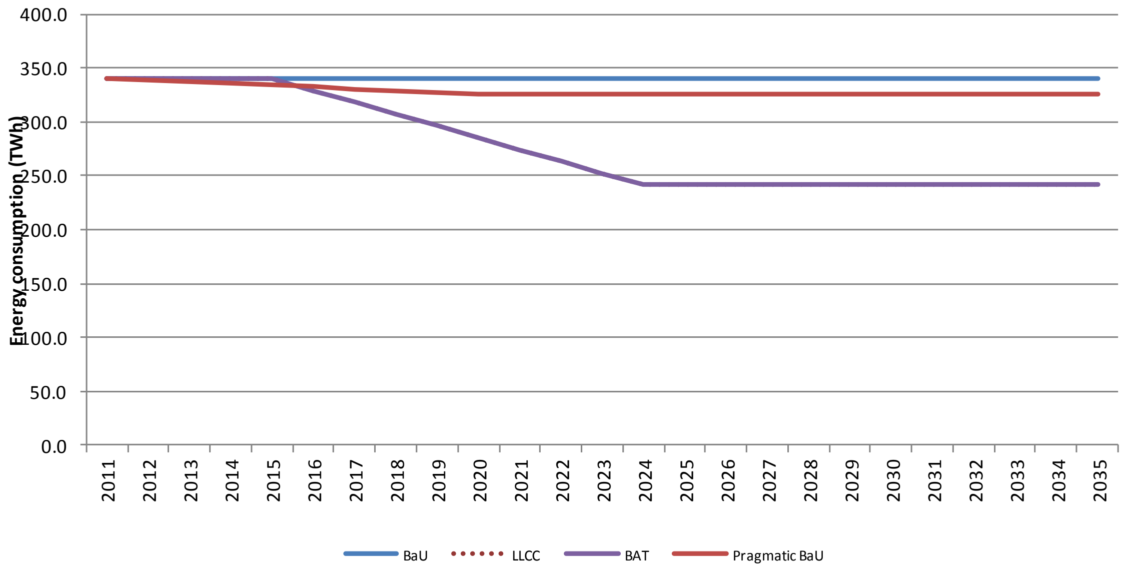


Figure 32: Comparison of the total energy consumption (in TWh) for the four scenarios over the period 2011-2035 for BC 5a

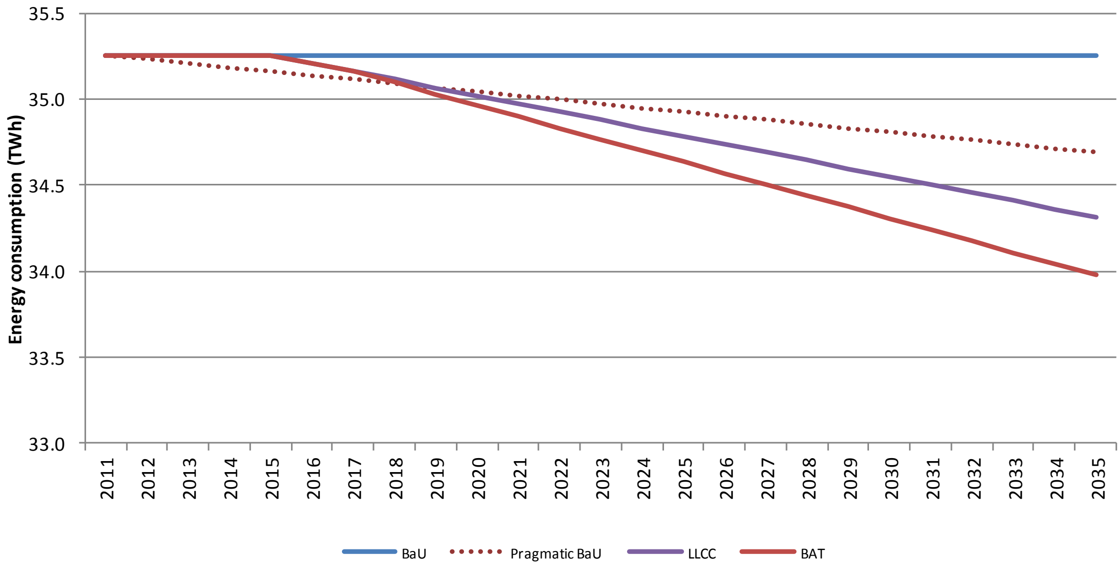


Figure 33: Comparison of the total energy consumption (in TWh) for the four scenarios over the period 2011-2035 for BC 5b

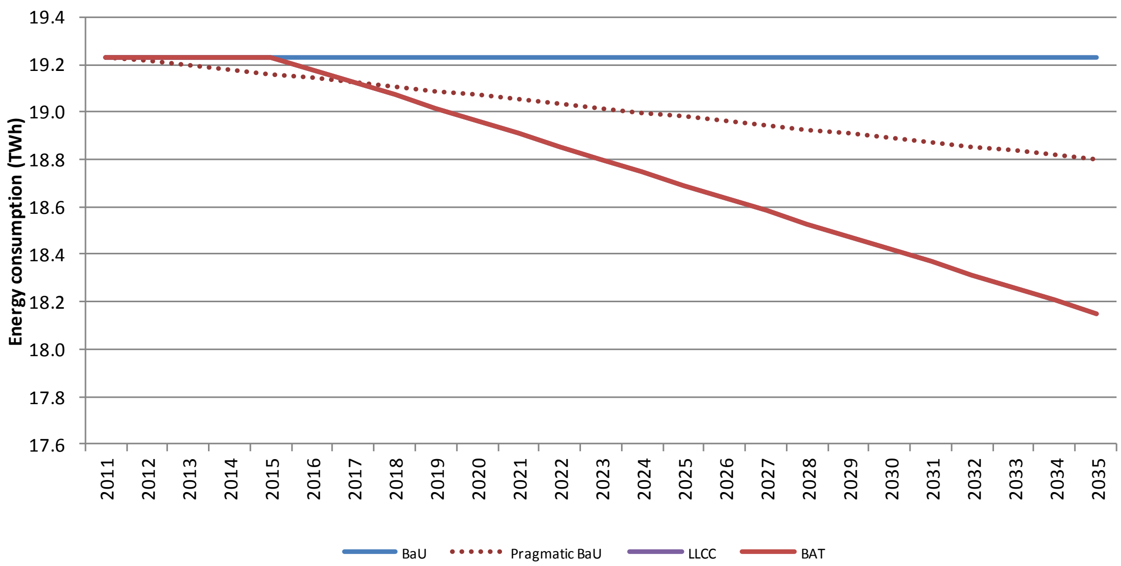


Figure 34: Comparison of the total energy consumption (in TWh) for the four scenarios over the period 2011-2035 for BC 6a

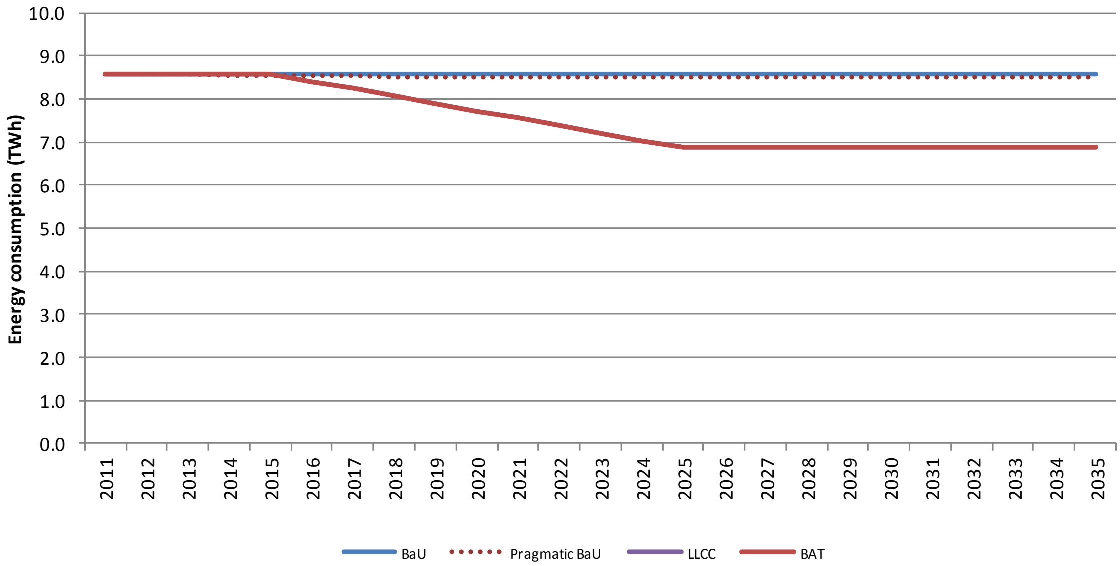


Figure 35: Comparison of the total energy consumption (in TWh) for the four scenarios over the period 2011-2035 for BC 6b

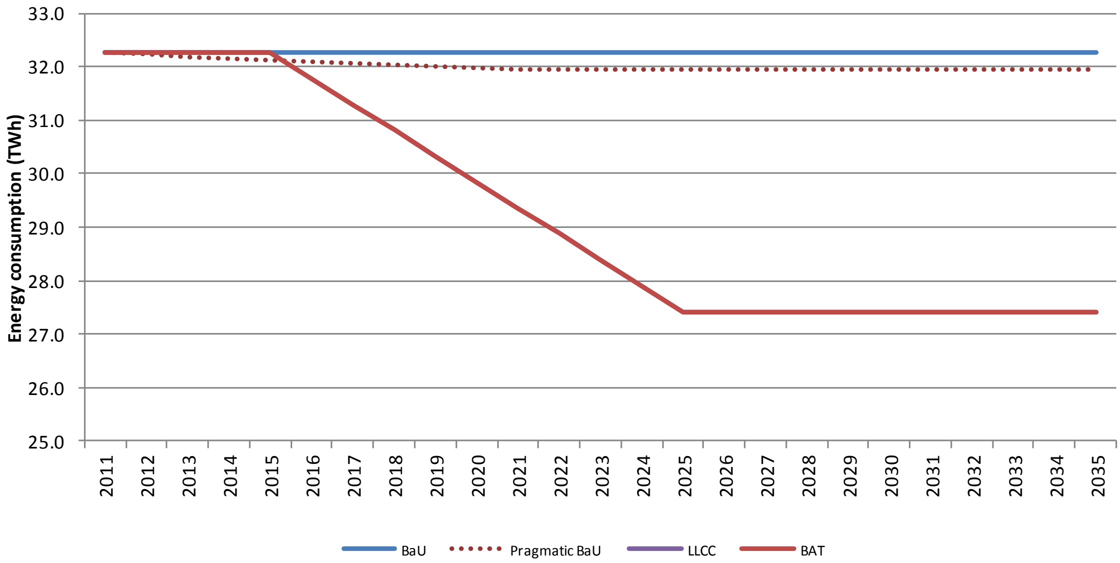


Figure 34 to Figure 43 presents the comparison of GHG emissions for each of the residential Base- Cases (BC 1 to BC 6b) for the five different scenarios: BaU, Pragmatic BaU, Policy recommendation, LLCC and BAT. As no MEPS were proposed for BC 1-BC 6b, therefore, no 'Policy recommendation' scenario is analysed for them. For some of the Base-Cases, the LLCC and BAT scenarios are superimposed in the figures (whenever the BAT and LLCC option is the same).

Figure 36: Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the four scenarios over the period 2011-2035 for BC 1

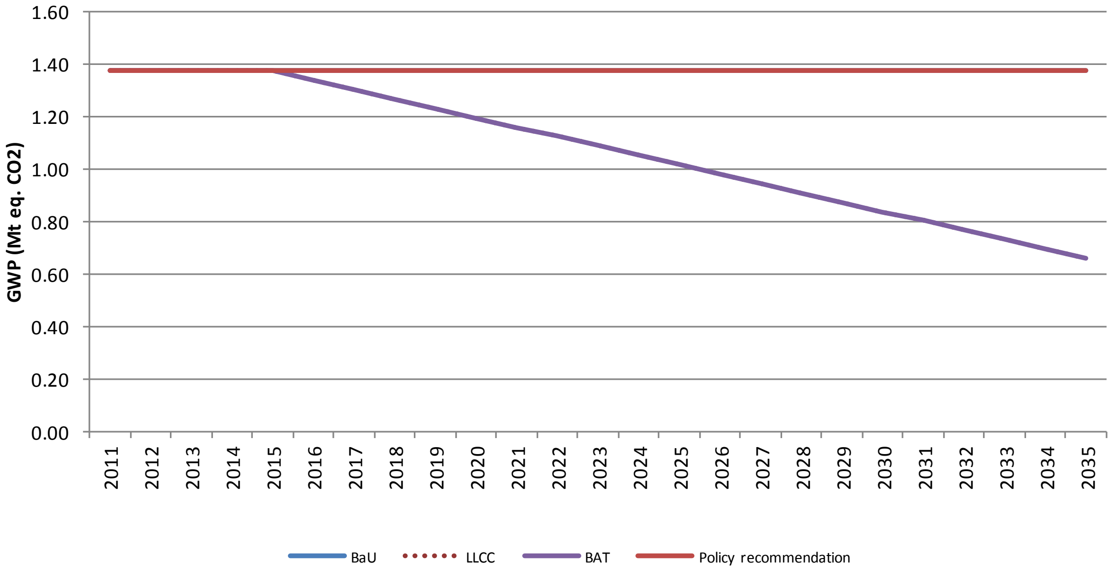


Figure 37: Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the five scenarios over the period 2011-2035 for BC 2

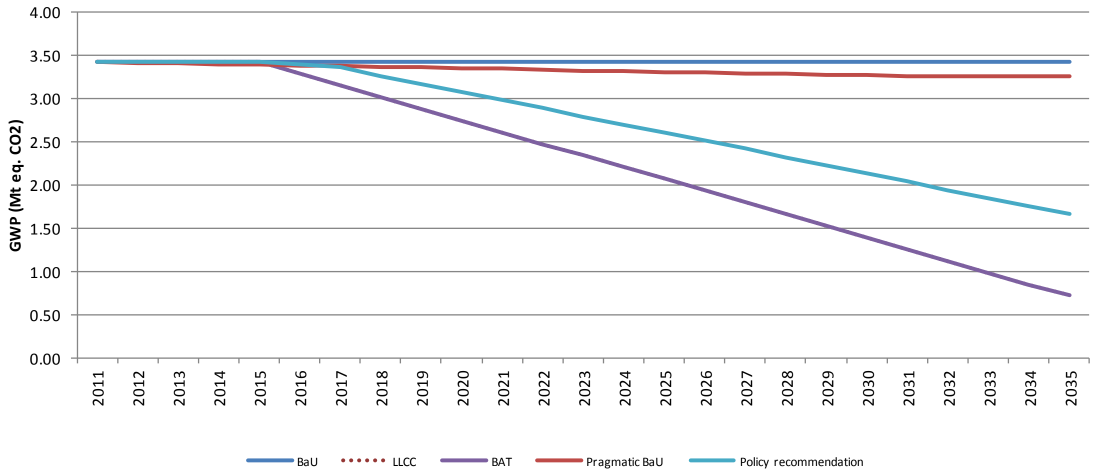


Figure 38: Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the four scenarios over the period 2011-2035 for BC 3

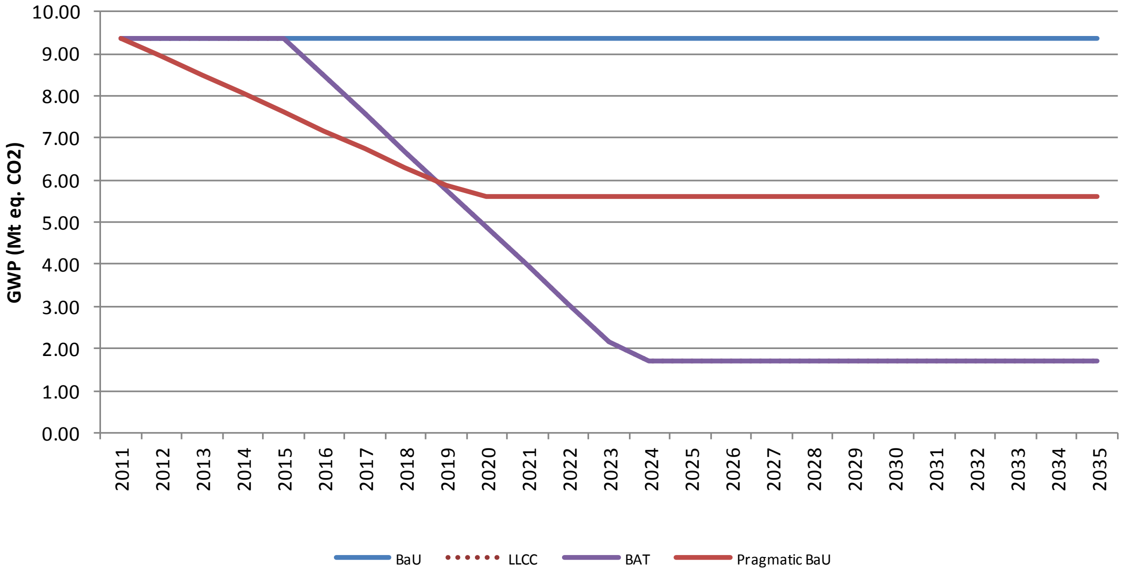


Figure 39: Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the four scenarios over the period 2011-2035 for BC 4

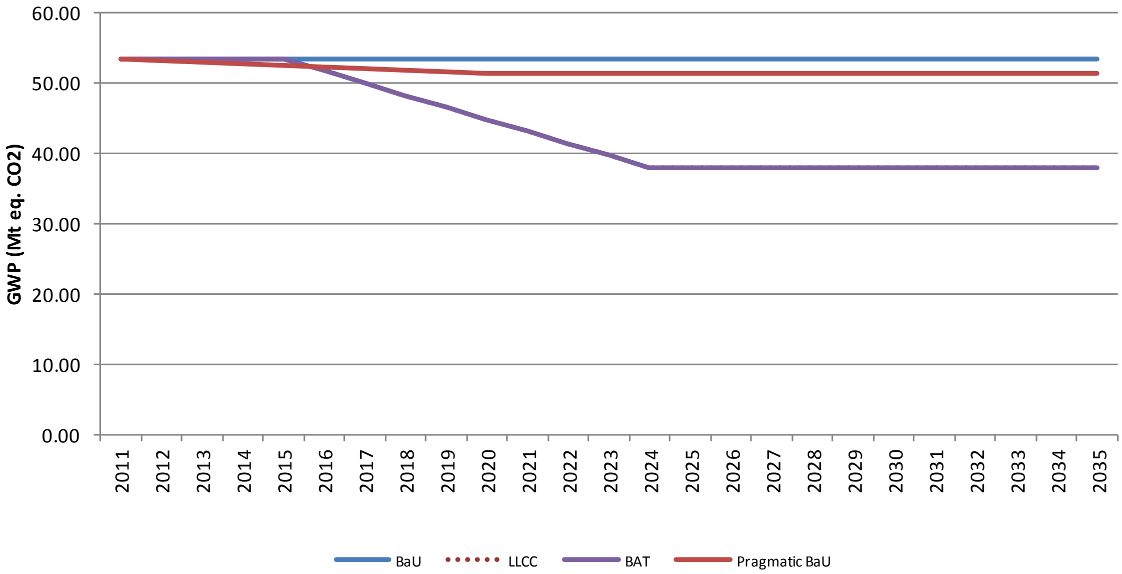


Figure 40 Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the four scenarios over the period 2011-2035 for BC 5a

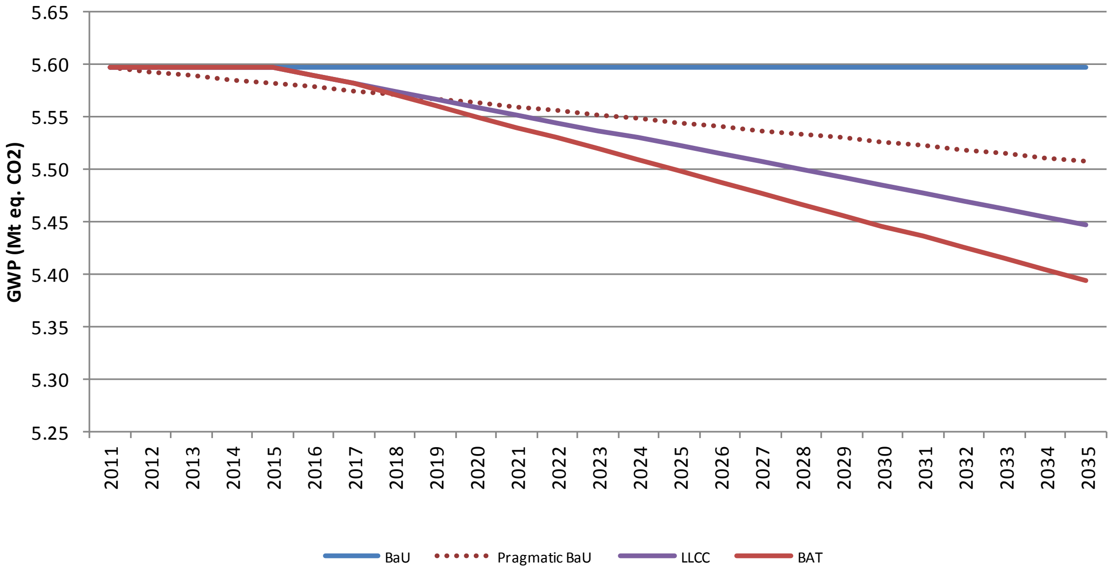


Figure 41: Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the four scenarios over the period 2011-2035 for BC 5b

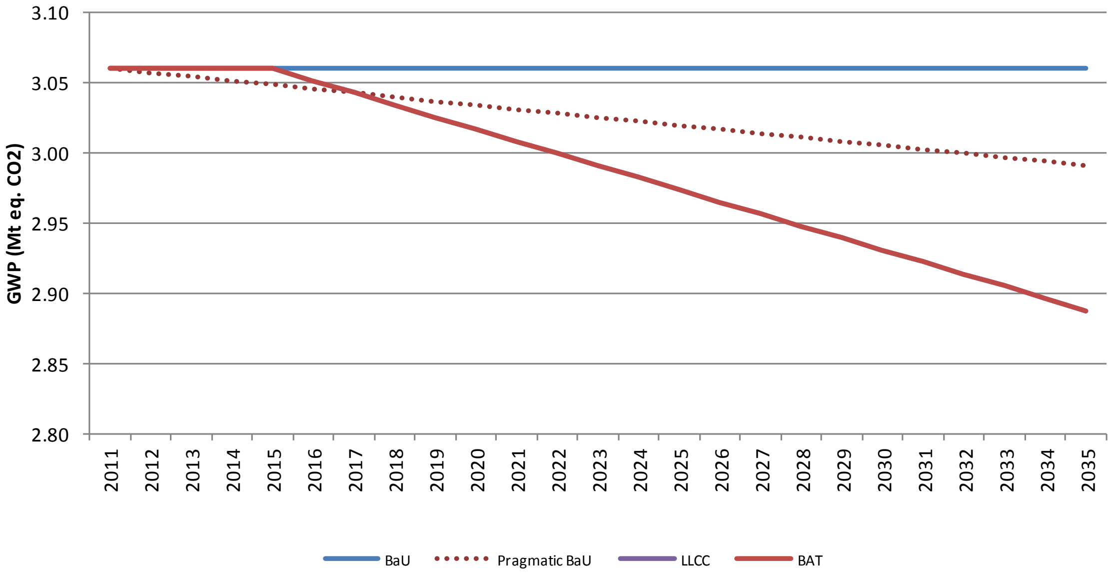


Figure 42: Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the four scenarios over the period 2011-2035 for BC 6a

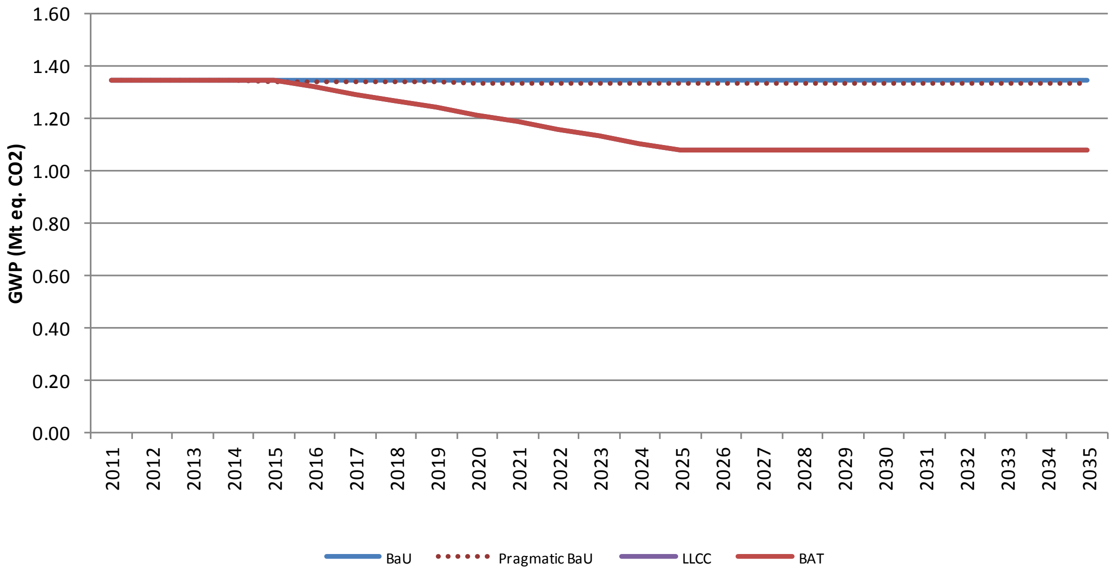


Figure 43: Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the four scenarios over the period 2011-2035 for BC 6b

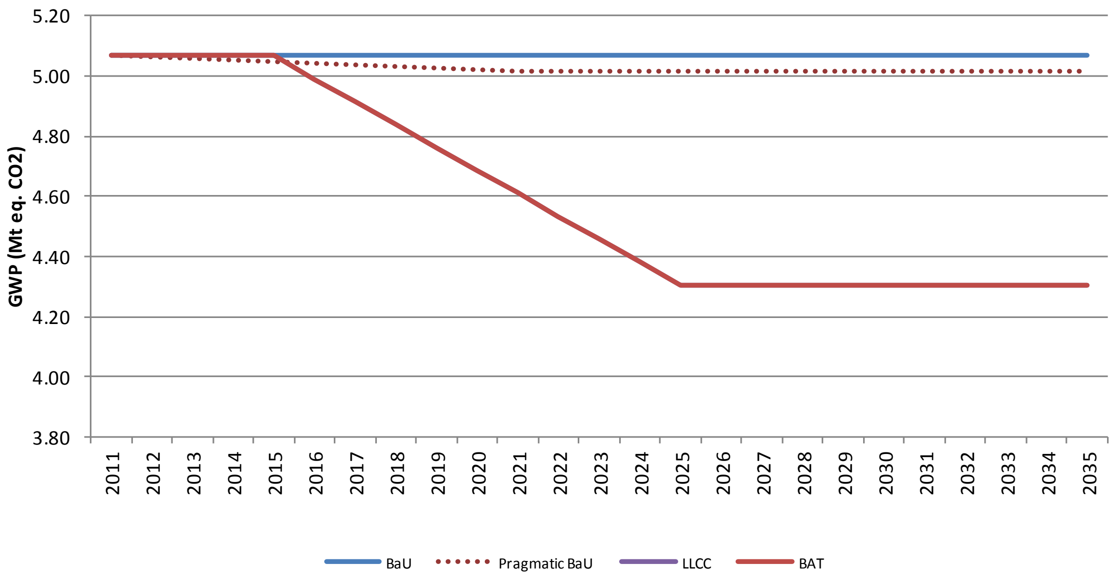


Figure 44 to Figure 51 presents the comparison of overall expenditure for each of the residential Base-Cases (BC 1 to BC 6b) for the five different scenarios: BaU, Pragmatic BaU, Policy recommendation, LLCC and BAT. As no MEPS were proposed for BC 1-BC 6b, therefore, no 'Policy recommendation' scenario is analysed for them. For some of the Base-Cases, the LLCC and BAT scenarios are superimposed in the figures (whenever the BAT and LLCC option is the same).

Figure 44: Comparison of the total expenditure (in million Euros) for the four scenarios over the period 2011-2035 for BC 1

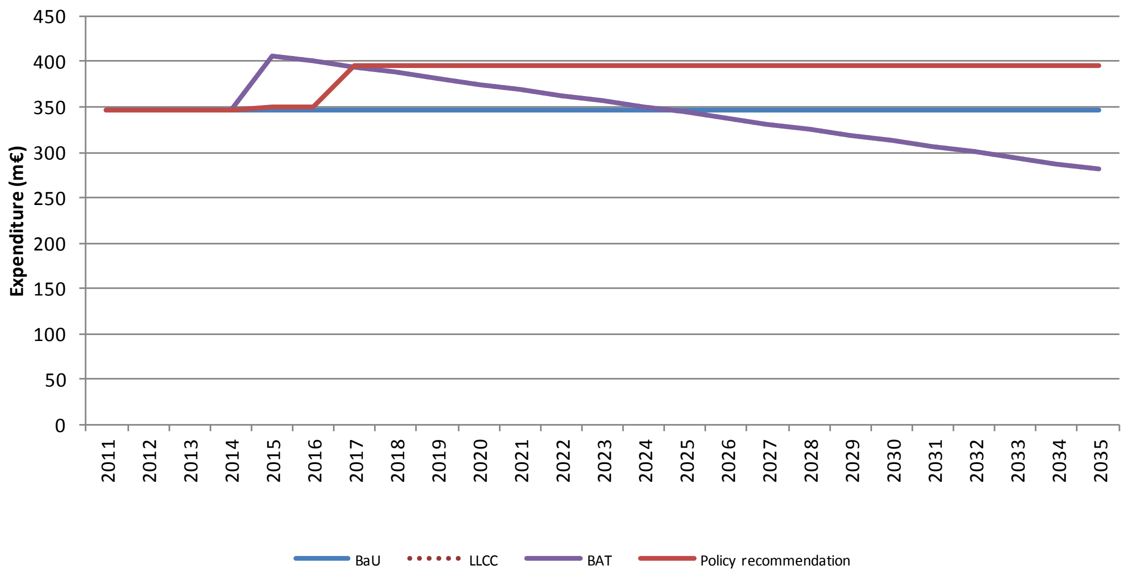


Figure 45: Comparison of the total expenditure (in million Euros) for the five scenarios over the period 2011-2035 for BC 2

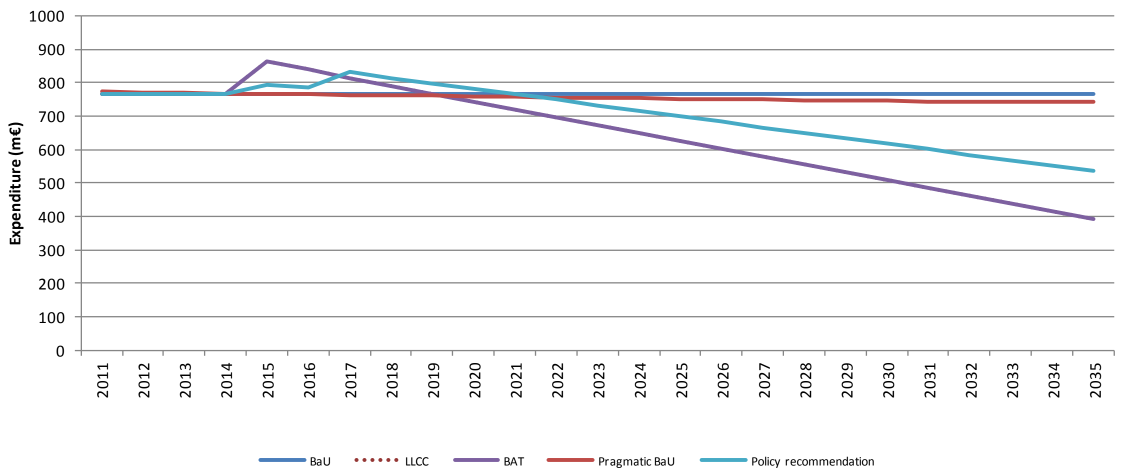


Figure 46: Comparison of the total expenditure (in million Euros) for the four scenarios over the period 2011-2035 for BC 3

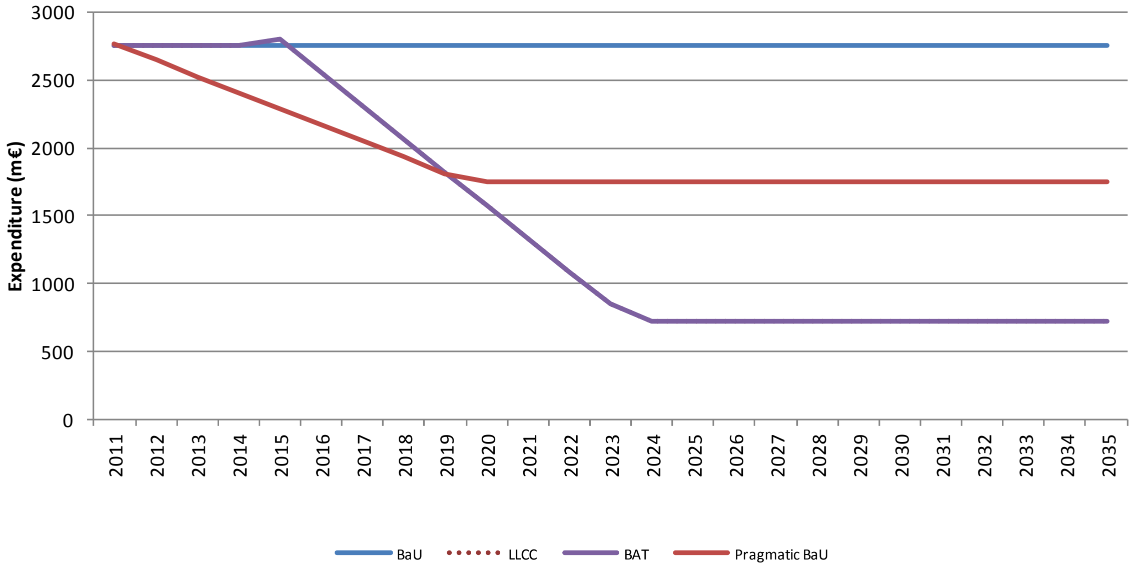


Figure 47: Comparison of the total expenditure (in million Euros) for the four scenarios over the period 2011-2035 for BC 4

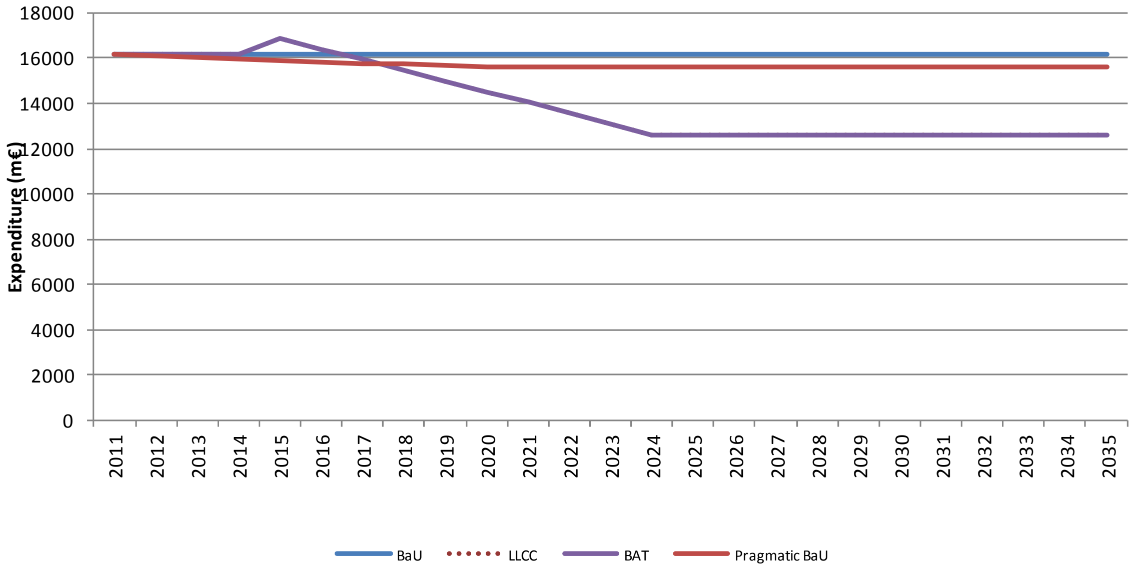


Figure 48: Comparison of the total expenditure (in million Euros) for the four scenarios over the period 2011-2035 for BC 5a

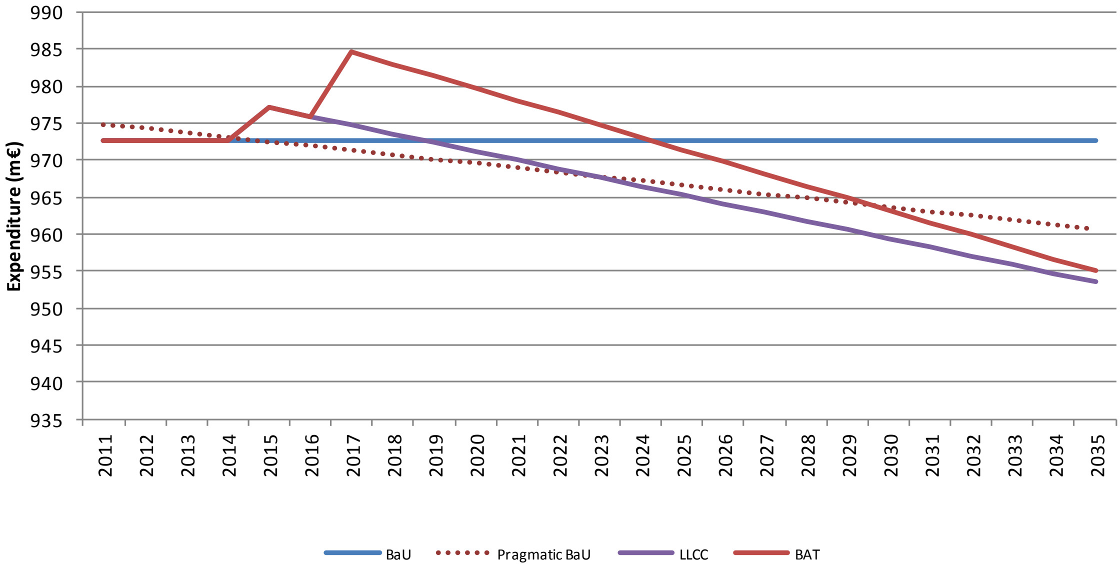


Figure 49: Comparison of the total expenditure (in million Euros) for the four scenarios over the period 2011-2035 for BC 5b

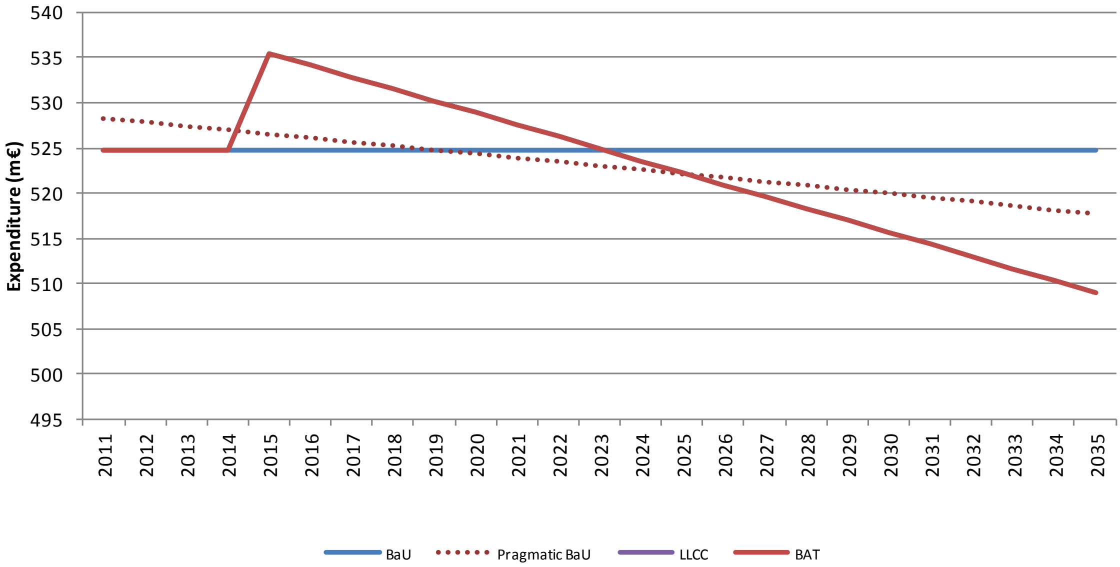


Figure 50: Comparison of the total expenditure (in million Euros) for the four scenarios over the period 2011-2035 for BC 6a

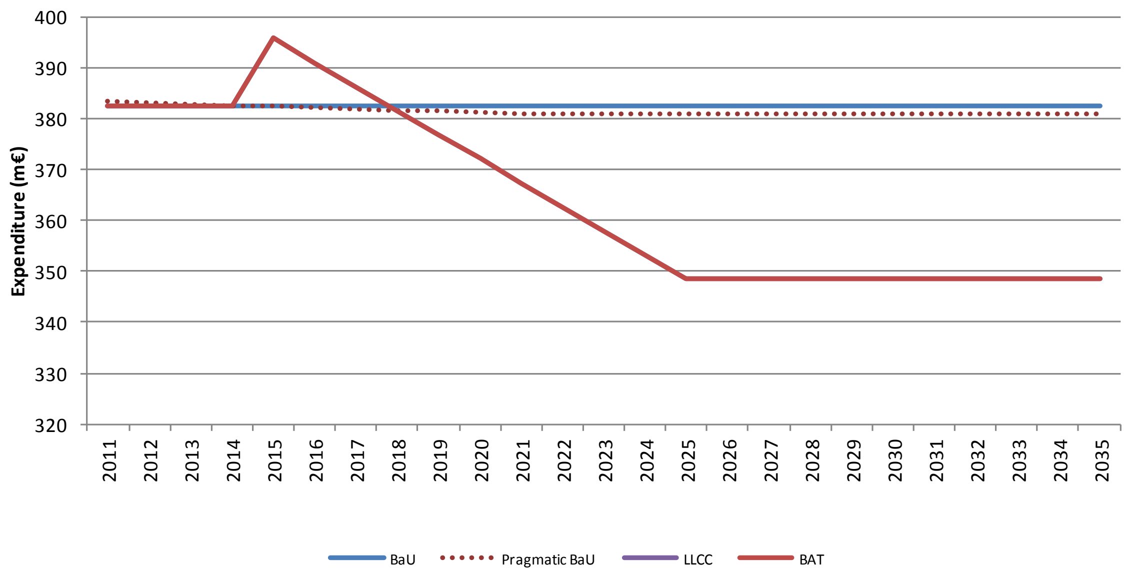
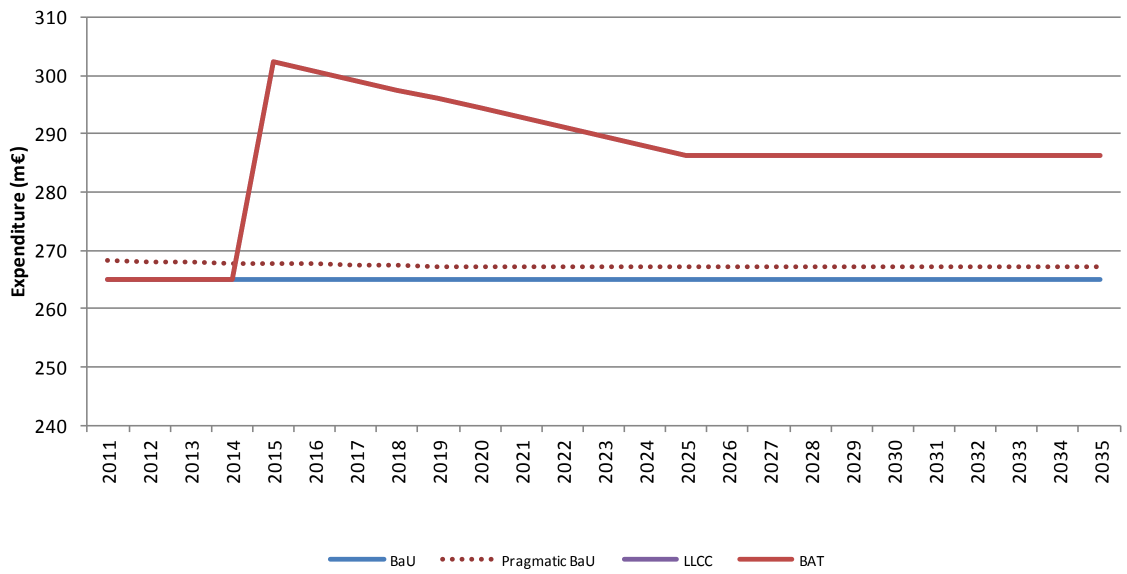


Figure 51: Comparison of the total expenditure (in million Euros) for the four scenarios over the period 2011-2035 for BC 6b



- **Non-residential local room heaters (> 12 kW and ≤ 300 kW)**

Figure 52 to Figure 55 presents the comparison of overall energy consumption for the non-residential Base-Cases (BC 7 to BC 9) for the five different scenarios: BaU, Pragmatic BaU, Policy recommendation, LLCC and BAT. As no MEPS were proposed for BC 9, therefore, no 'Policy recommendation' scenario is analysed for it. For some of the Base-Cases, the LLCC and BAT scenarios are superimposed in the figures (whenever the BAT and LLCC option is the same).

Figure 52: Comparison of the total energy consumption (in TWh) for the five scenarios over the period 2011-2035 for BC 7

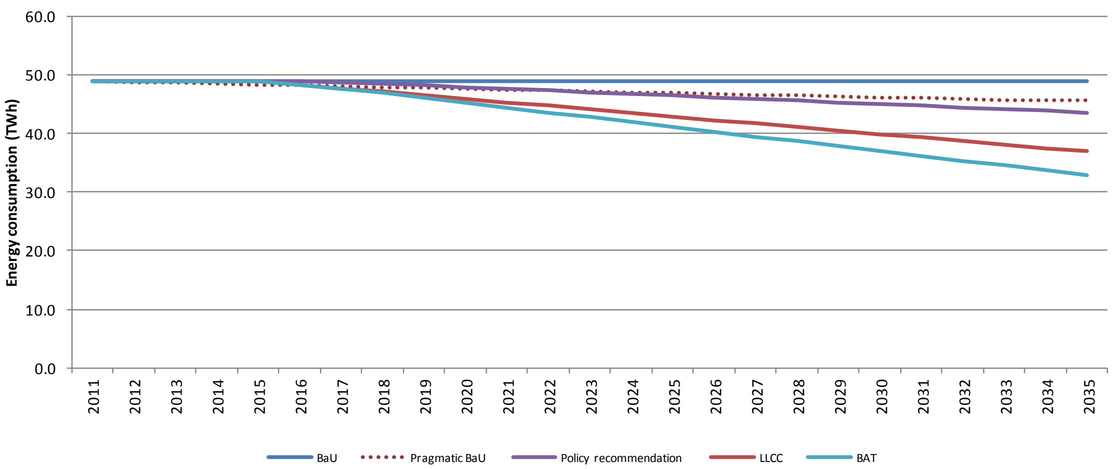


Figure 53: Comparison of the total energy consumption (in TWh) for the five scenarios over the period 2011-2035 for BC 8a

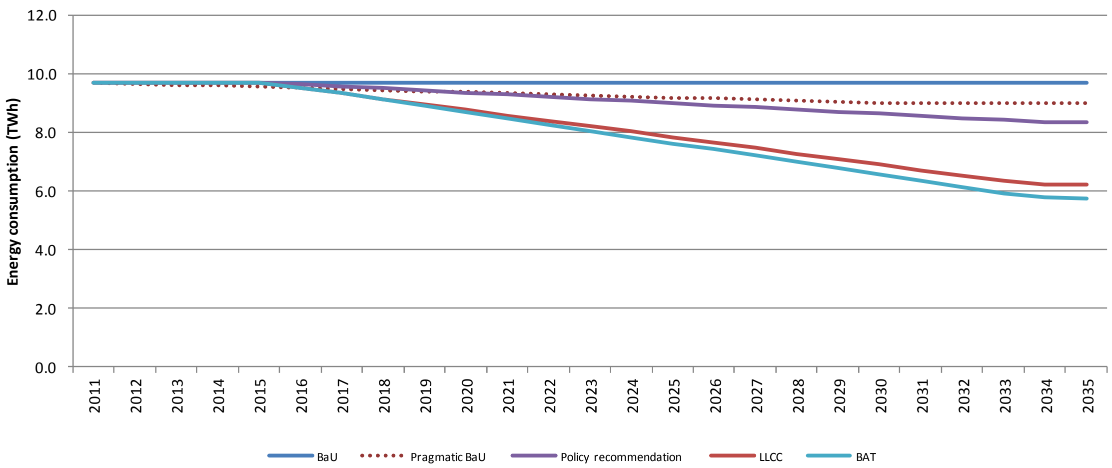


Figure 54: Comparison of the total energy consumption (in TWh) for the five scenarios over the period 2011-2035 for BC 8b

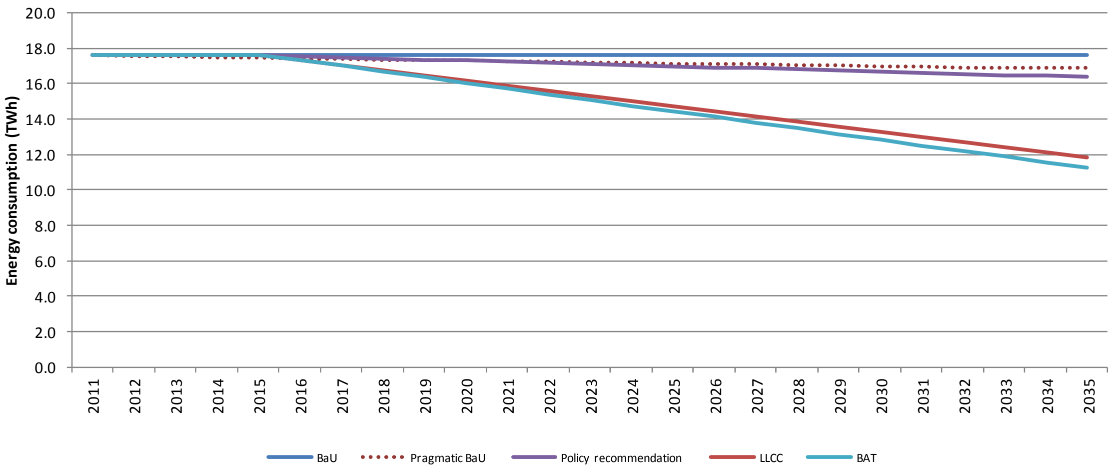


Figure 55: Comparison of the total energy consumption (in TWh) for the four scenarios over the period 2011-2035 for BC 9

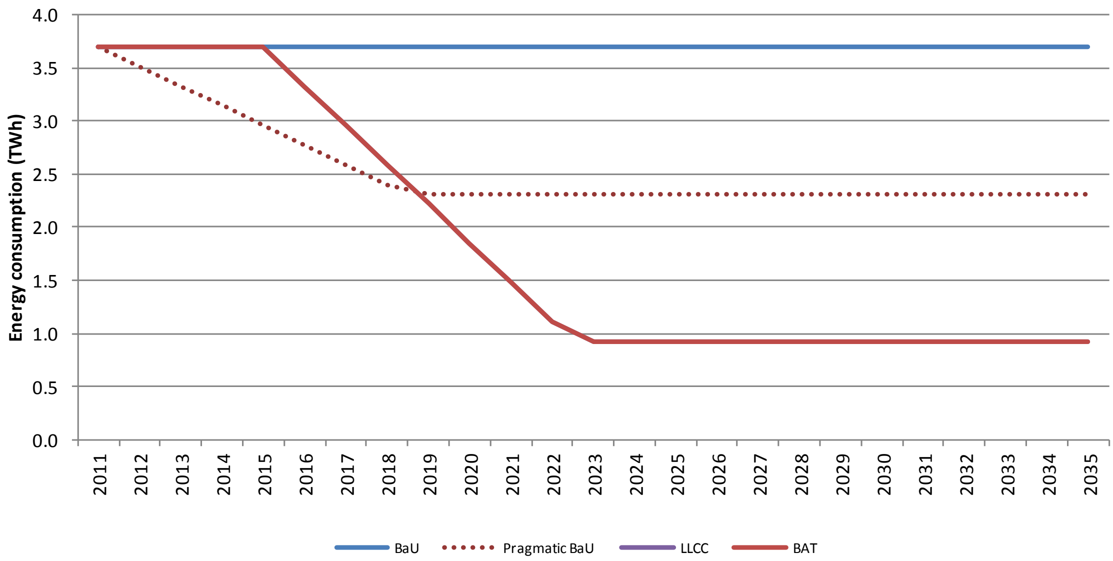


Figure 56 to Figure 59 presents the comparison of total GHG emissions for the non-residential Base-Cases (BC 7 to BC 9) for the three different scenarios: BaU, LLCC and BAT.

Figure 56: Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the five scenarios over the period 2011-2035 for BC 7

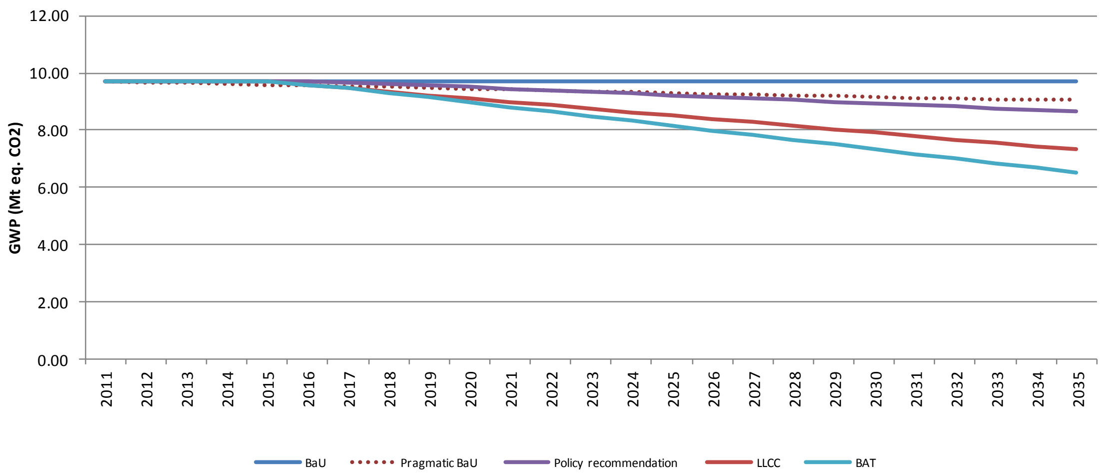


Figure 57: Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the five scenarios over the period 2011-2035 for BC 8a

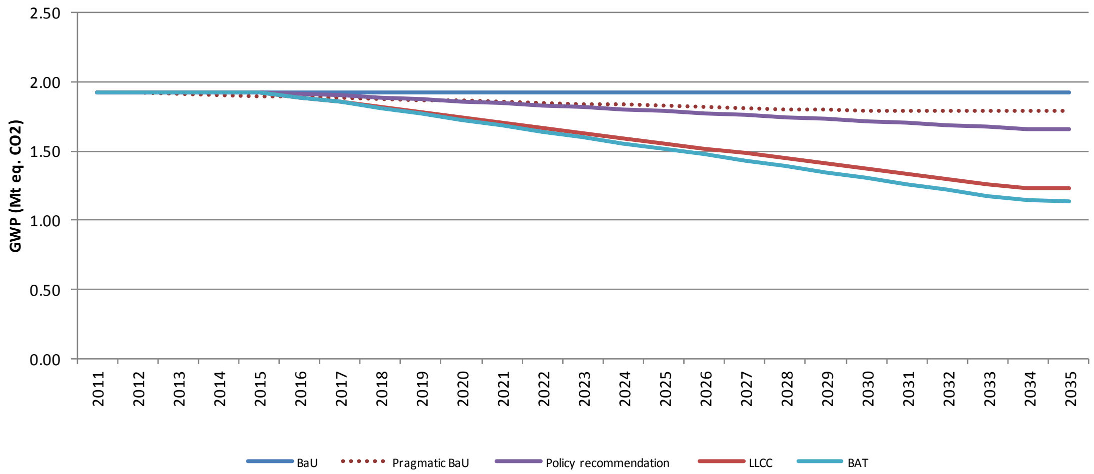


Figure 58: Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the five scenarios over the period 2011-2035 for BC 8b

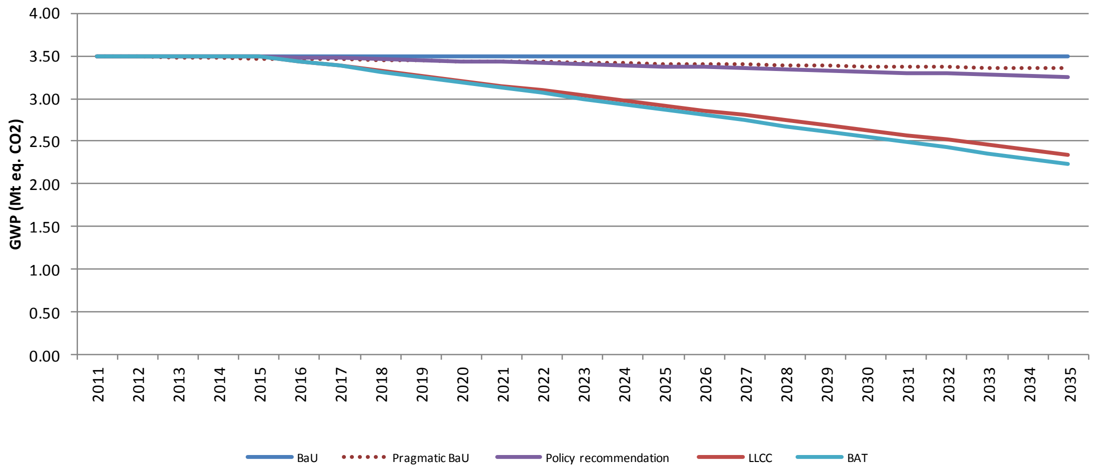


Figure 59: Comparison of the total GHG emissions (in million tonnes CO2 equivalent) for the four scenarios over the period 2011-2035 for BC 9

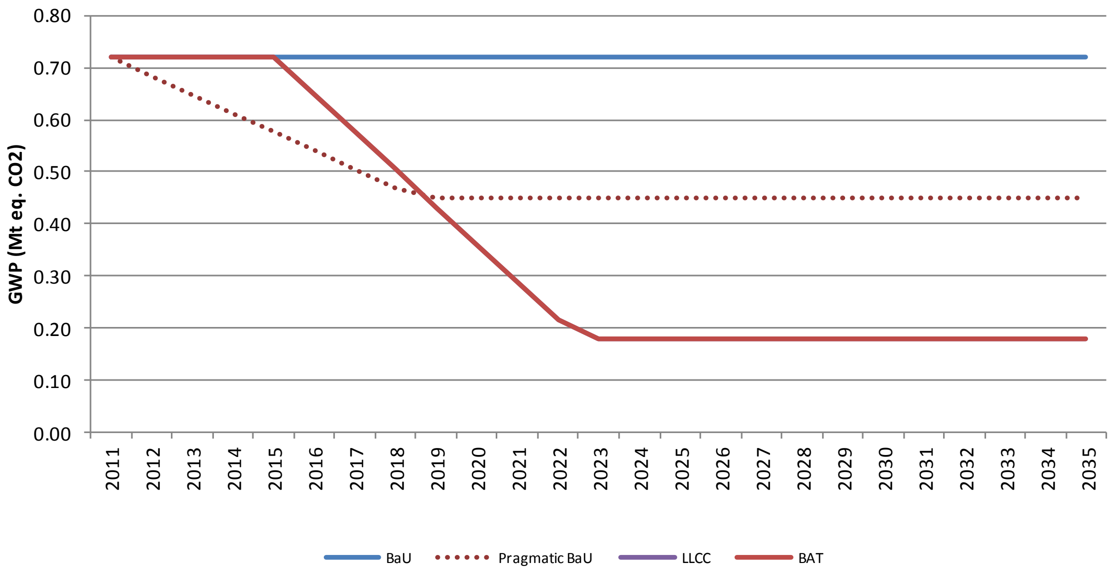


Figure 60 to Figure 63 presents the comparison of total expenditure for the non-residential Base-Cases (BC 7 to BC 9) for the five different scenarios: BaU, Pragmatic BaU, Policy recommendation, LLCC and BAT. As no MEPS were proposed for BC 9, therefore, no 'Policy recommendation' scenario is analysed for it. For some of the Base-Cases, the LLCC and BAT scenarios are superimposed in the figures (whenever the BAT and LLCC option is the same).

Figure 60: Comparison of the total expenditure (in million Euros) for the five scenarios over the period 2011-2035 for BC 7

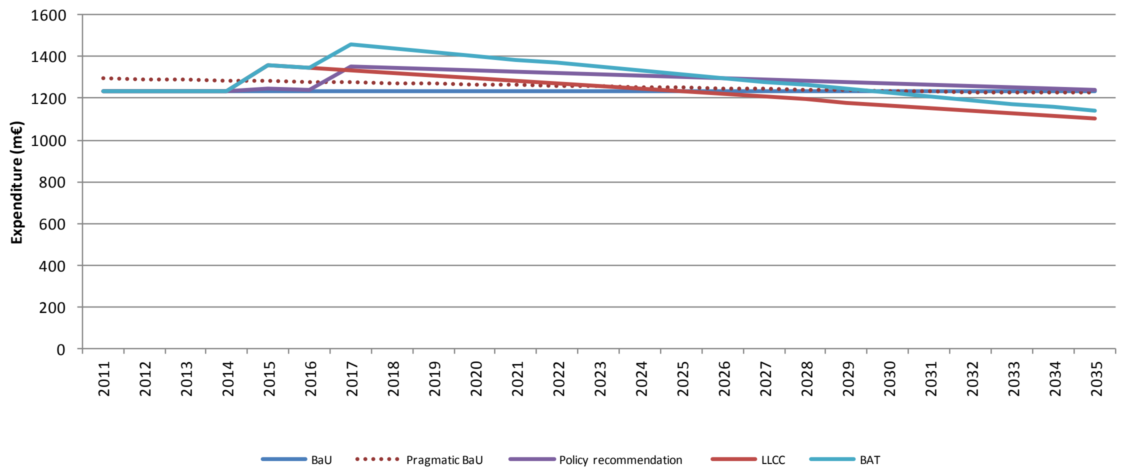


Figure 61: Comparison of the total expenditure (in million Euros) for the five scenarios over the period 2011-2035 for BC 8a

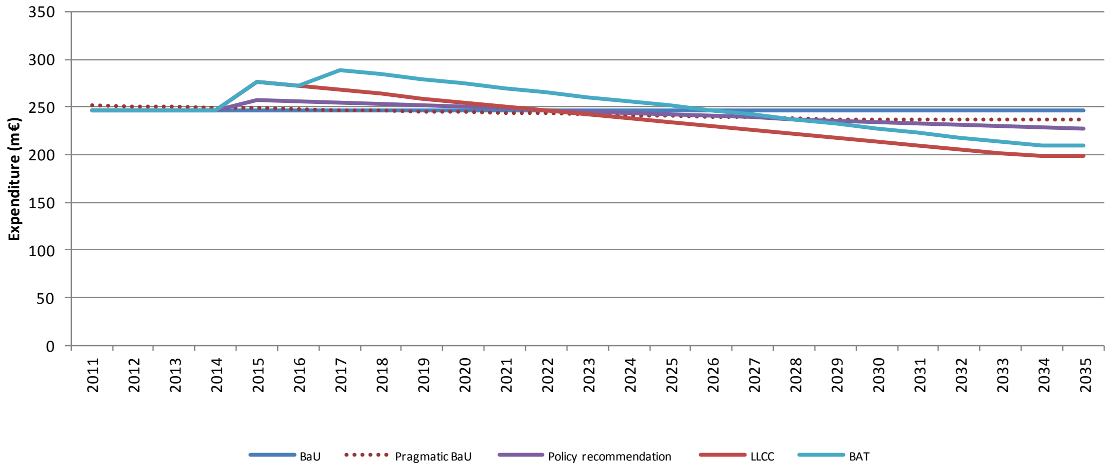


Figure 62: Comparison of the total expenditure (in million Euros) for the five scenarios over the period 2011-2035 for BC 8b

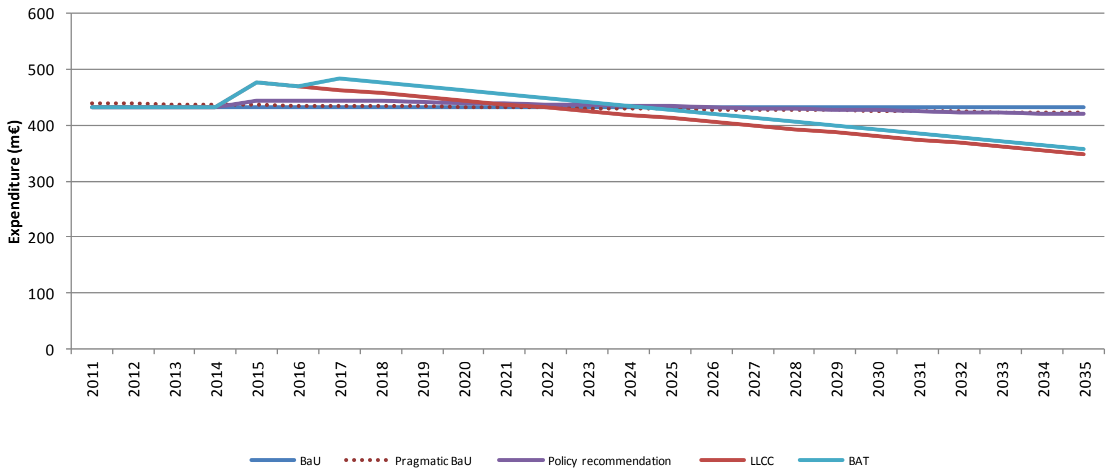
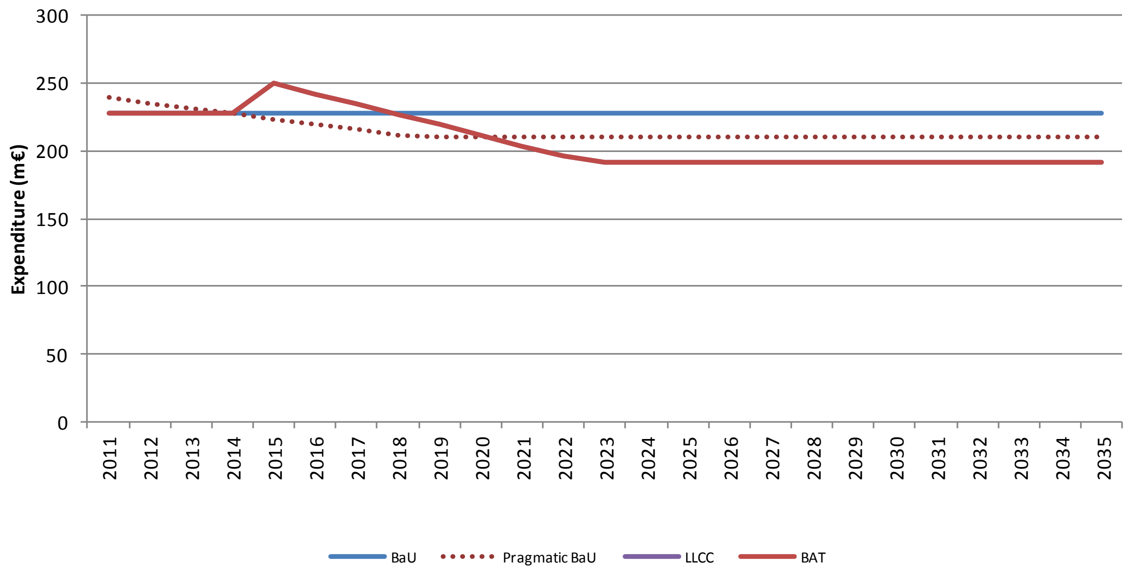


Figure 63: Comparison of the total expenditure (in million Euros) for the four scenarios over the period 2011-2035 for BC 9



8.4 Impact analysis

The Ecodesign requirements should not entail excessive costs nor undermine the competitiveness of European enterprises and should not have a significant negative impact on consumers or other users. In this section, the following impacts are assessed:

- Impacts on manufacturers and competition
- Monetary impacts
- Impacts on consumers
- Impacts on innovation and development
- Social impacts

8.4.1 Impacts on manufacturers and competition

All the technologies described in this study and considered as improvement options in the scenarios are already available on the market. As a result, the implementation of MEPS is technically achievable although it would require an economical effort from the manufacturers.

The timeline to implement standards should take into account the sufficient time to adapt the correct products and production lines. This redesign time varies depending on the type of change to be achieved. It has been estimated that between 12 and 24 months are needed to implement any of the improvement options presented within the study.

Most of the non-residential EU manufacturers claim to produce high efficient products, therefore, the implementation of minimum performance standards is not expected to significantly hamper their economic development and competitiveness in the EU.

Although the generic economic data presented in Task 2 refer to broad product categories which are not specifically relevant to those examined in this study, they can give a rough economic overview of the sector in the EU. From the PRODCOM data presented in Task 2, it can be concluded that the external trade of local room heating products is relatively small. The biggest share of the sales of these products in the EU is also for the EU market.

The market of residential heaters is divided among a few international groups and a number of small and medium European manufacturers that design and manufacture their products in the EU. Some share of small electric products is imported from Asia (mainly China). The market of non-residential heaters is smaller and shared between several European companies. These products are manufactured within the EU and remain mostly in a domestic market, highly influenced by the national characteristics of the heating sector and the existing infrastructures for fuel supply.

8.4.2 Monetary impacts

The possible implementation of MEPS for non-residential applications could require manufacturers to invest more in technology and product development or in adapting their production to offer the more efficient products. Compared to the usual development investments made every year, any additional investment required by the Ecodesign requirements is thought to be limited.

In the case of any additional costs, these could be passed on to customers, but the life cycle costs would actually benefit them in the long term, although it would require more capital to purchase the more efficient products.

8.4.3 Impacts on consumers

For the improvement options presented, the functional unit and the quality of service given by the improved product remains the same as the Base-Case (this is a necessary condition to make a relevant comparative LCA).

There should be no trade-off in terms of heating function (e.g. reduced thermal comfort), as a result of the increased energy efficiency.

8.4.4 Impacts on innovation and development

BNATs and current technological research in independent space heaters were not very examined in detail in this study due to a lack of data. Such information is obviously very sensitive for manufacturers and it is understandable that they may not be willing to disclose what they are working on.

The proposed MEPS can be seen as an opportunity for manufacturers to search for innovative and efficient technological solutions. As mentioned, it seems that with the current trend of research and development activities in EU manufacturing firms, it thought to be feasible for manufacturers to meet the proposed requirements.

8.4.5 Social impacts (employment)

Most EU manufacturers of local room heaters have their production plants within the EU. Upgrading or changing production lines in the EU is often viewed as an opportunity to decide whether to relocate. If performance standards were set, they are not thought to have a detrimental impact on the number of jobs or the well-being of the EU manufacturers' employees. In addition, the improvement options presented do not require any specific material that might be difficult to obtain within the EU so that the supply chain would not be unduly affected nor EU industries disadvantaged.

8.5 Sensitivity analysis

The robustness of the outcomes of the study depends on the underlying assumptions. These assumptions have been explicitly mentioned at the relevant steps of the study. In this section, the sensitivity of the environmental and economic results to the most critical parameters and assumptions is tested. The sensitivity analysis is carried out and discussed for each of the Base-Cases for the parameters mentioned hereunder:

- Product price
- Product lifetime
- Annual energy (electricity/natural gas) consumption
- Energy (electricity/natural gas) tariff
- Discount rate
- Product stock (in year 2008)

Parameters such as energy price, product purchase price and discount rate have a direct influence on the LCC calculations of the base-cases and their improvement options (but not on the environmental impacts of the products) while others (annual energy consumption and lifetime) will influence both the environmental impacts of the products and the LCC through operating costs.

8.5.1 Assumptions related to the product lifetime

Average lifetimes are used in the EcoReport tool to assess environmental and LCC over the whole life cycle of the Base-Cases. However, some products can have a shorter or a longer lifetime. Such extreme values, are considered for two scenarios (presented below) used in this sensitivity analysis to assess the impact of this parameter on the LCC of the Base-Cases and their energy consumption during the use phase.

Variation in product lifetime (in years):

- An increase of 40% (upper limit)
- A decrease of 20% (lower limit)

Figure 64 to Figure 87 show the influence of the product lifetime on the total energy consumption (TEC) and life-cycle costs of the different Base-Cases and associated improvement options. For all situations, despite the expected variations in absolute values, the ranking of the different improvement options remains the same whether the minimum or maximum parameter is used.

Figure 64: Sensitivity to product lifetime for Base-Case 1's Life Cycle Cost

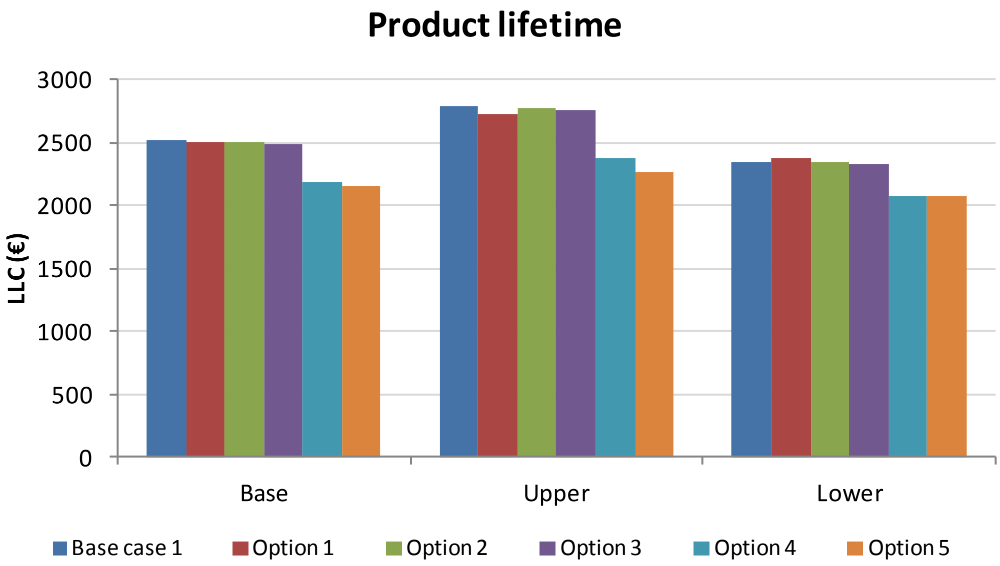


Figure 65: Sensitivity to product lifetime for Base-Case 1's TEC[25]

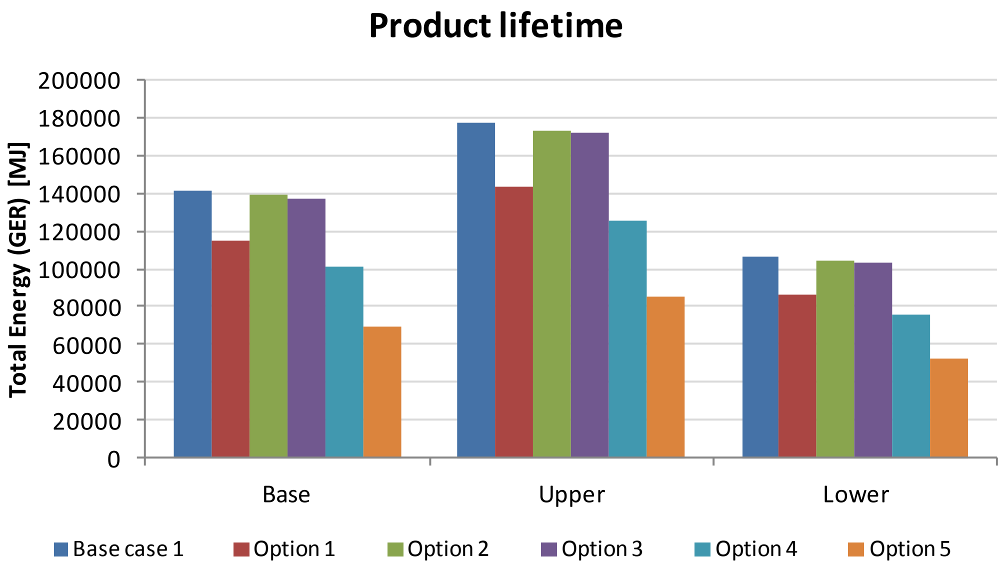
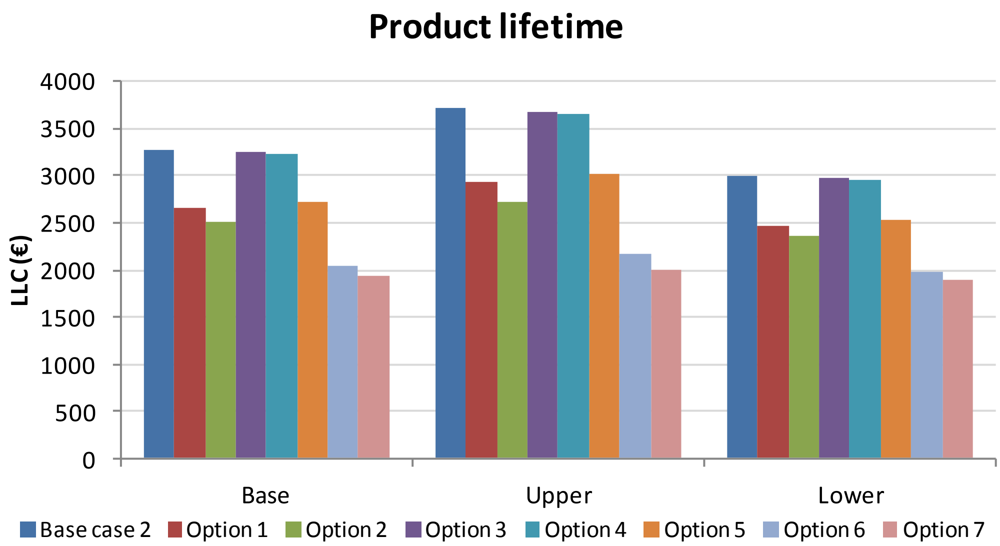


Figure 66: Sensitivity to product lifetime for Base-Case 2's Life Cycle Cost



[25] TEC: Total Energy Consumption over the life cycle of the Base-Case

Figure 67: Sensitivity to product lifetime for Base-Case 2's TEC

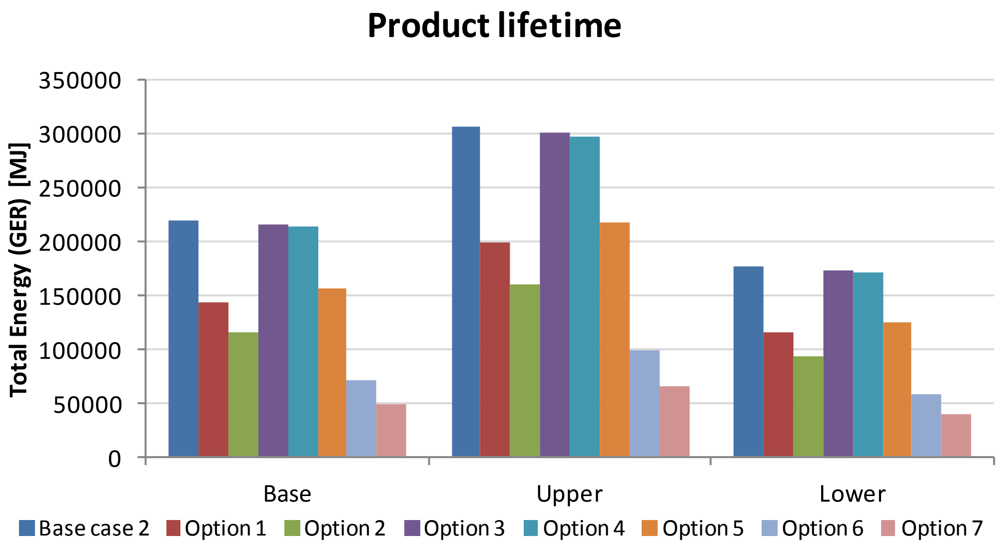


Figure 68: Sensitivity to product lifetime for Base-Case 3's Life Cycle Cost

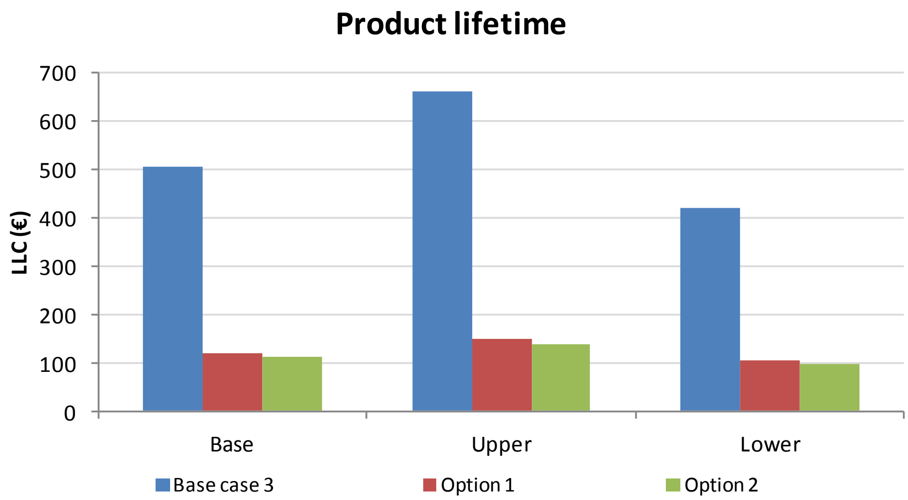


Figure 69: Sensitivity to product lifetime for Base-Case 3's TEC

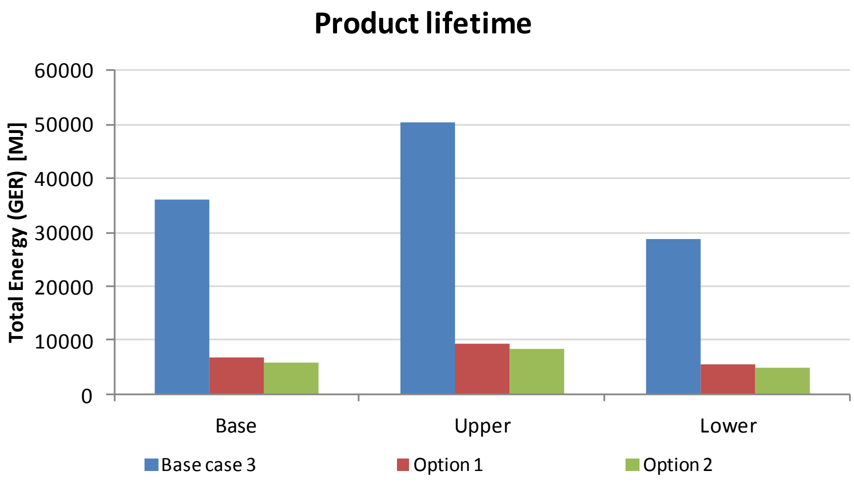


Figure 70: Sensitivity to product lifetime for Base-Case 4's Life Cycle Cost

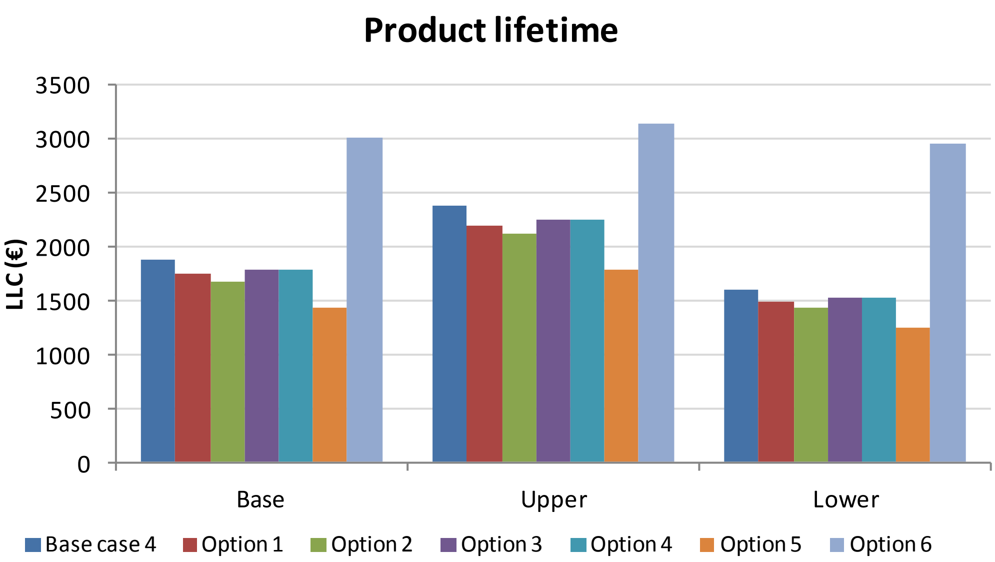


Figure 71: Sensitivity to product lifetime for Base-Case 4's TEC

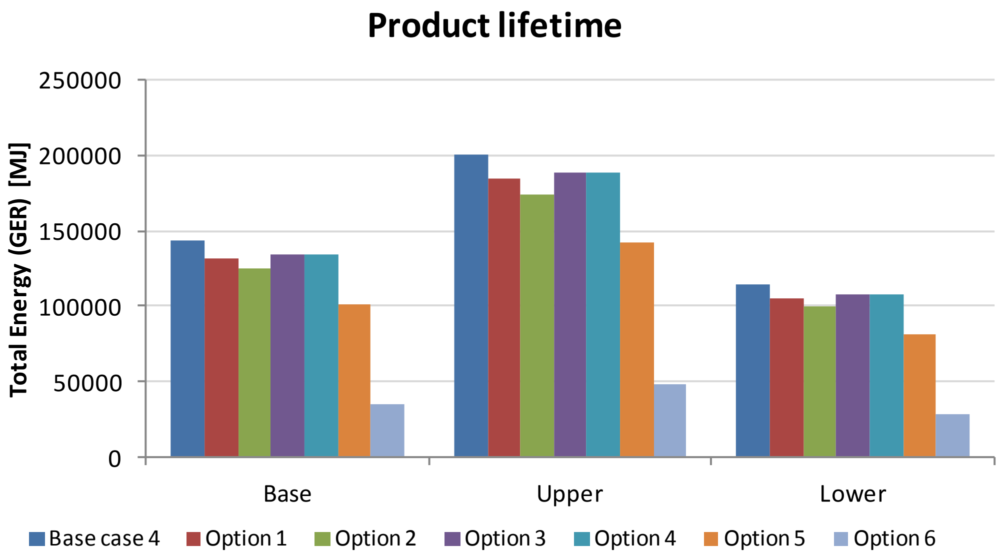


Figure 72: Sensitivity to product lifetime for Base-Case 5a's Life Cycle Cost

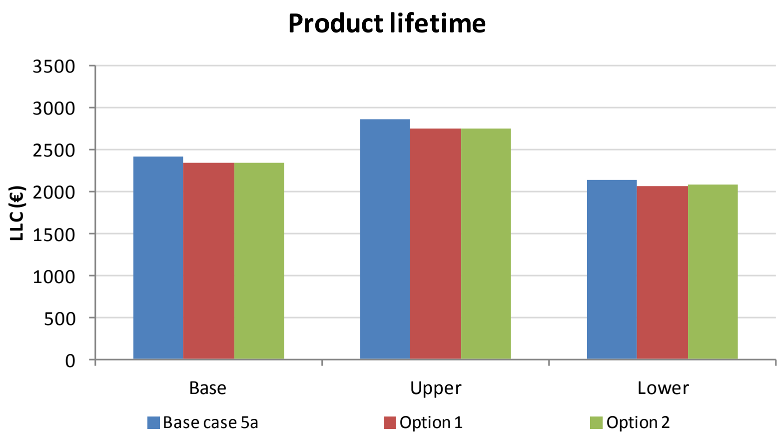


Figure 73: Sensitivity to product lifetime for Base-Case 5a's TEC

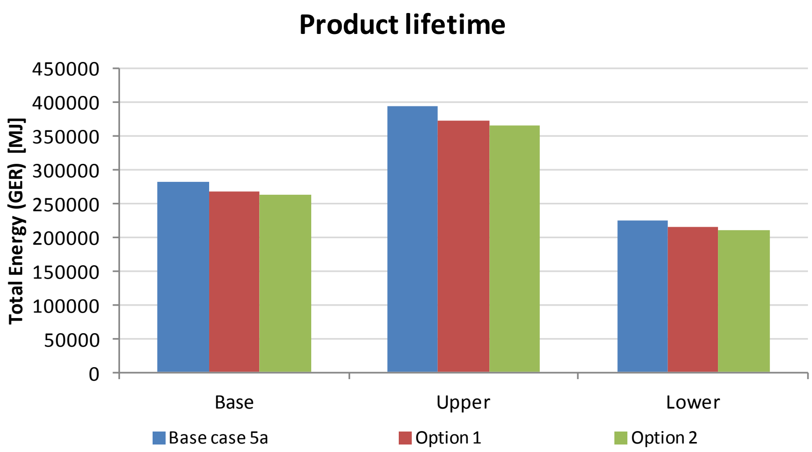


Figure 74: Sensitivity to product lifetime for Base-Case 5b's Life Cycle Cost

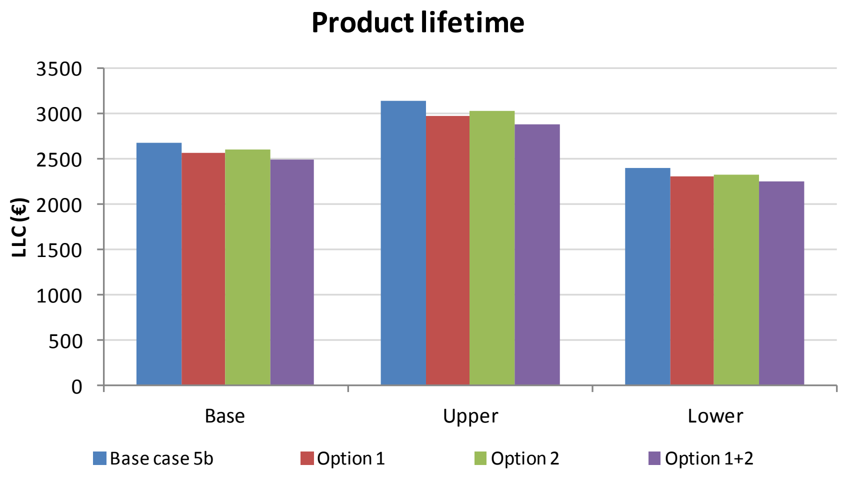


Figure 75: Sensitivity to product lifetime for Base-Case 5b's TEC

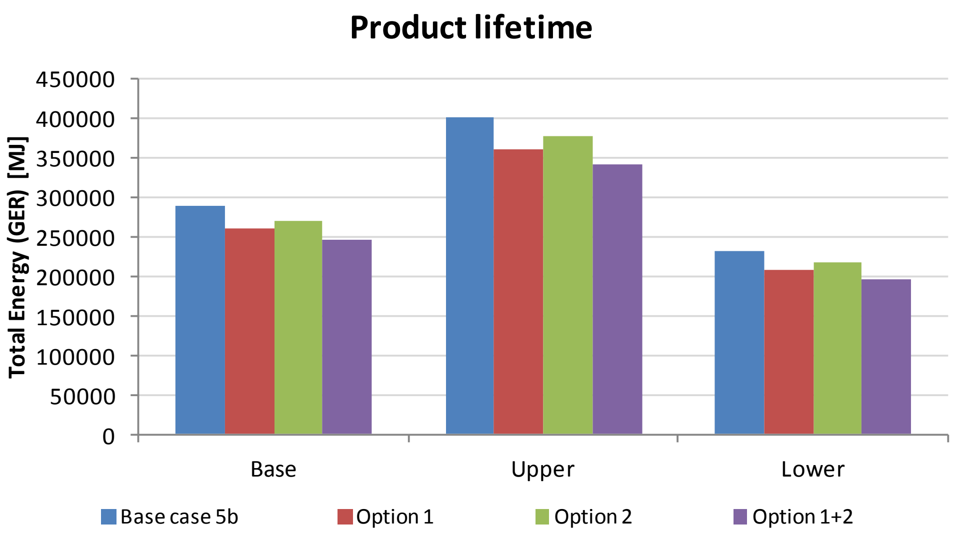


Figure 76: Sensitivity to product lifetime for Base-Case 6a's Life Cycle Cost

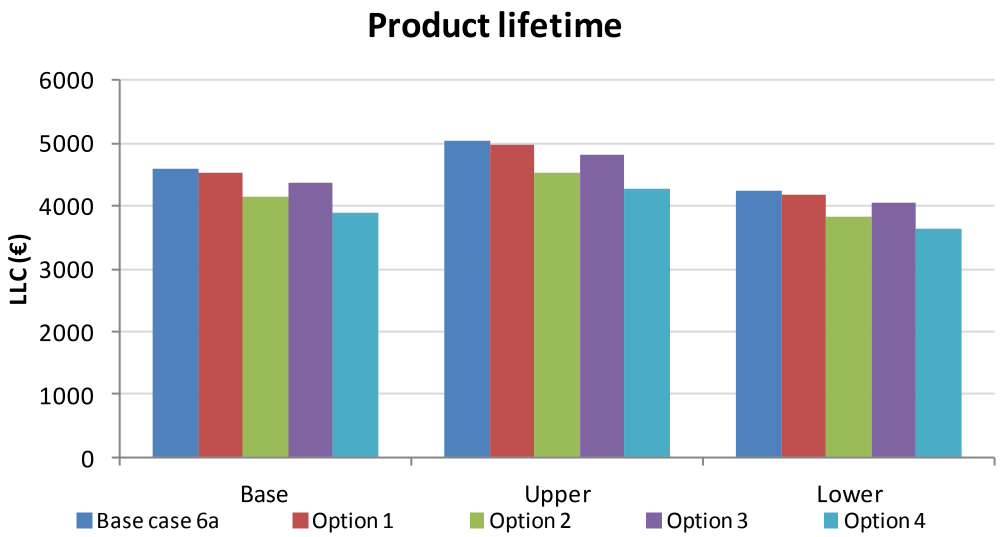


Figure 77: Sensitivity to product lifetime for Base-Case 6a's TEC

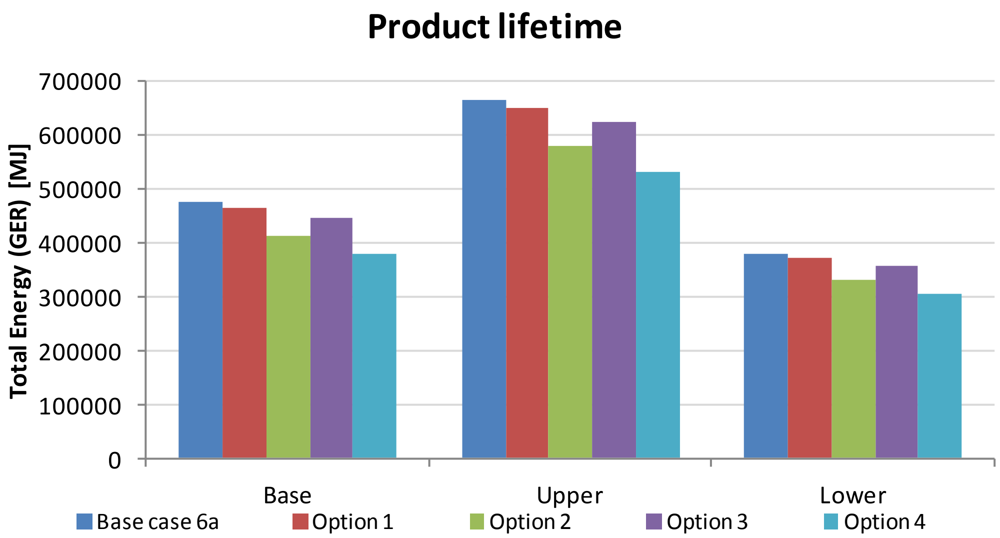


Figure 78: Sensitivity to product lifetime for Base-Case 6b's Life Cycle Cost

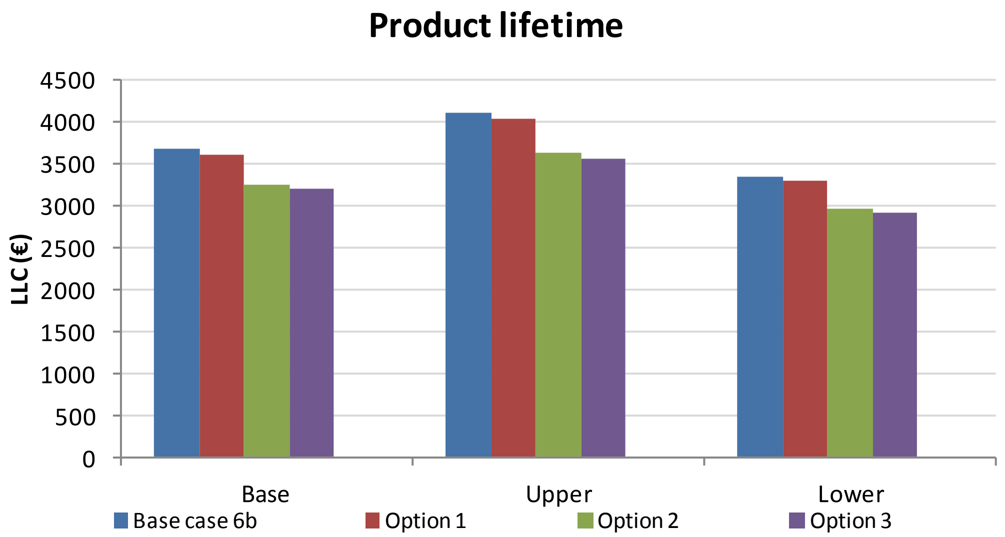


Figure 79: Sensitivity to product lifetime for Base-Case 6b's TEC

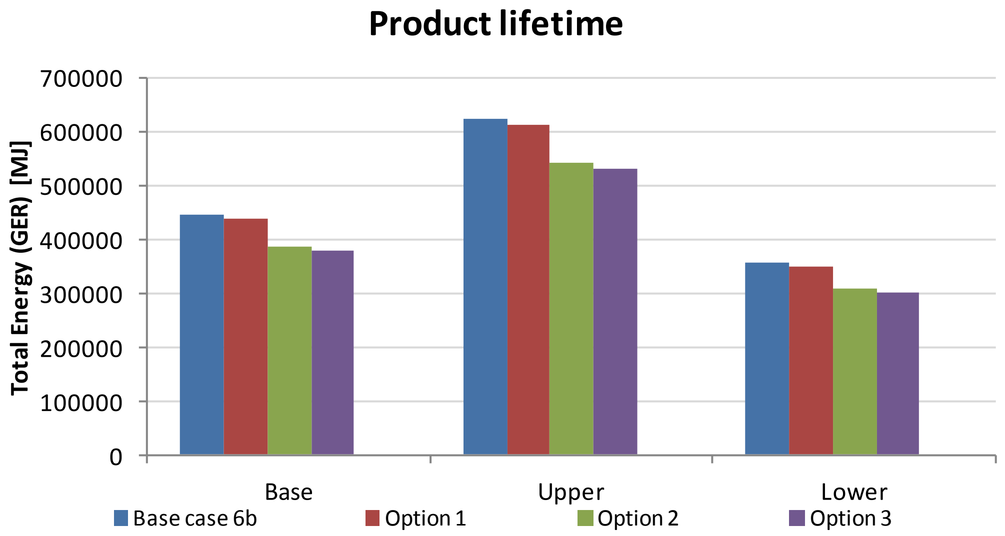


Figure 80: Sensitivity to product lifetime for Base-Case 7's Life Cycle Cost

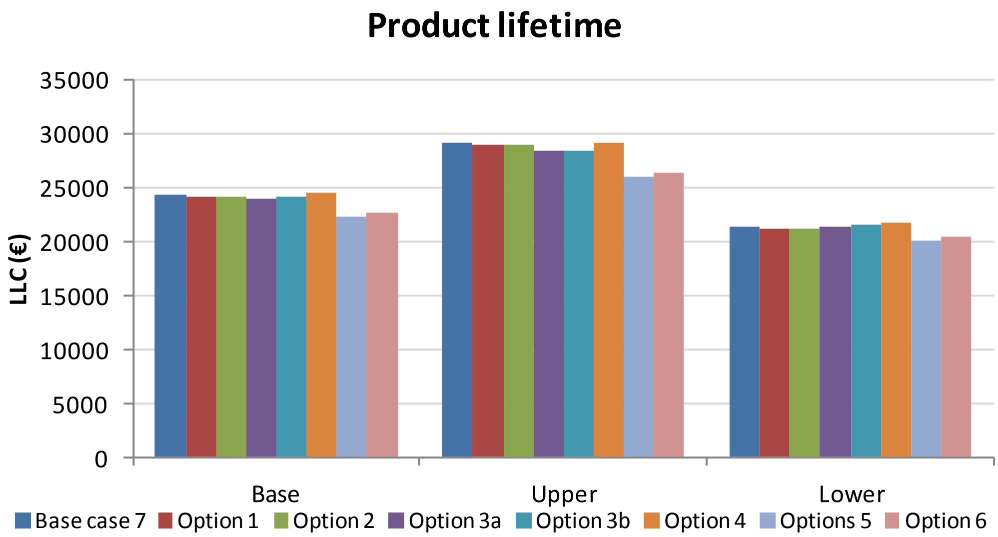


Figure 81: Sensitivity to product lifetime for Base-Case 7's TEC

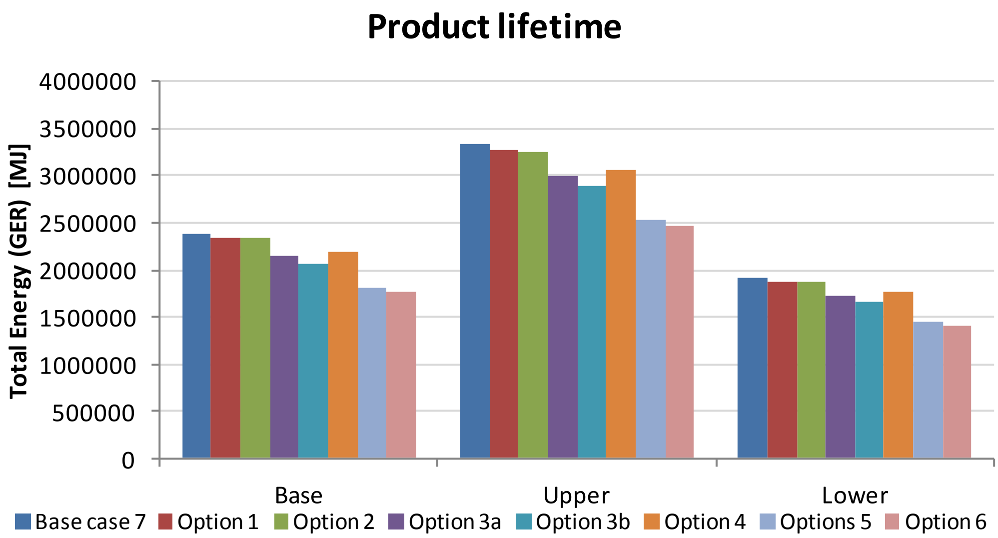


Figure 82: Sensitivity to product lifetime for Base-Case 8a's Life Cycle Cost

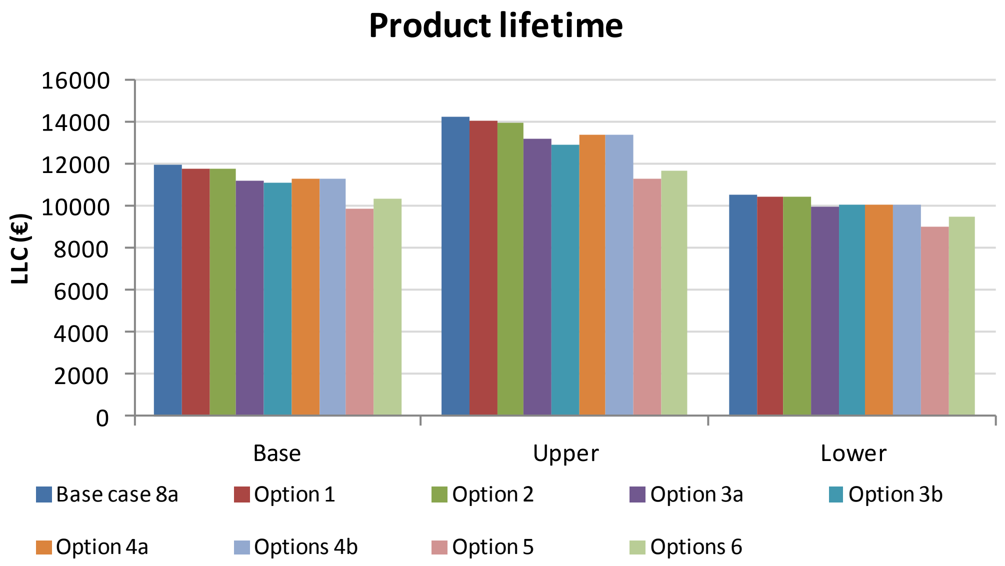


Figure 83: Sensitivity to product lifetime for Base-Case 8a's TEC

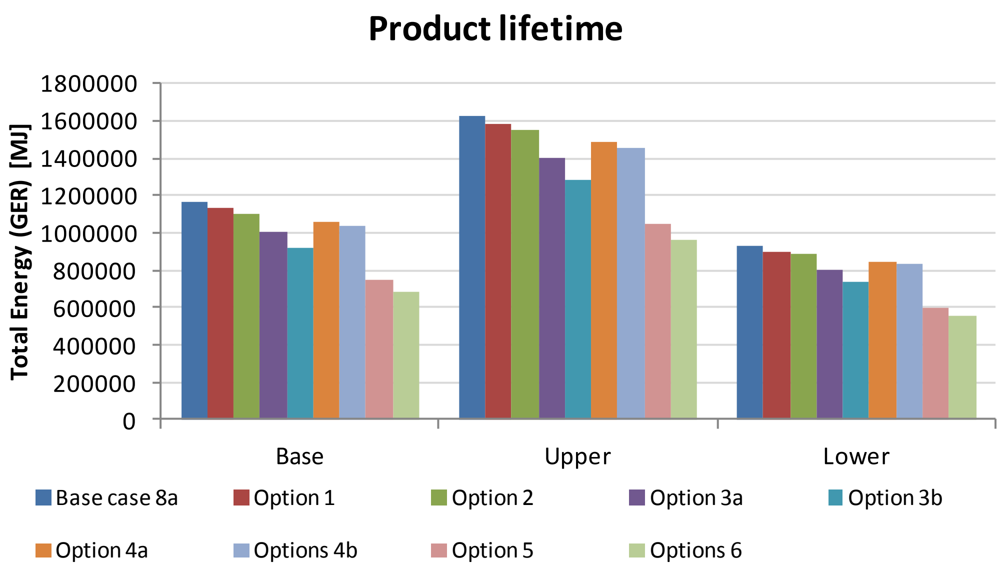


Figure 84: Sensitivity to product lifetime for Base-Case 8b's Life Cycle Cost

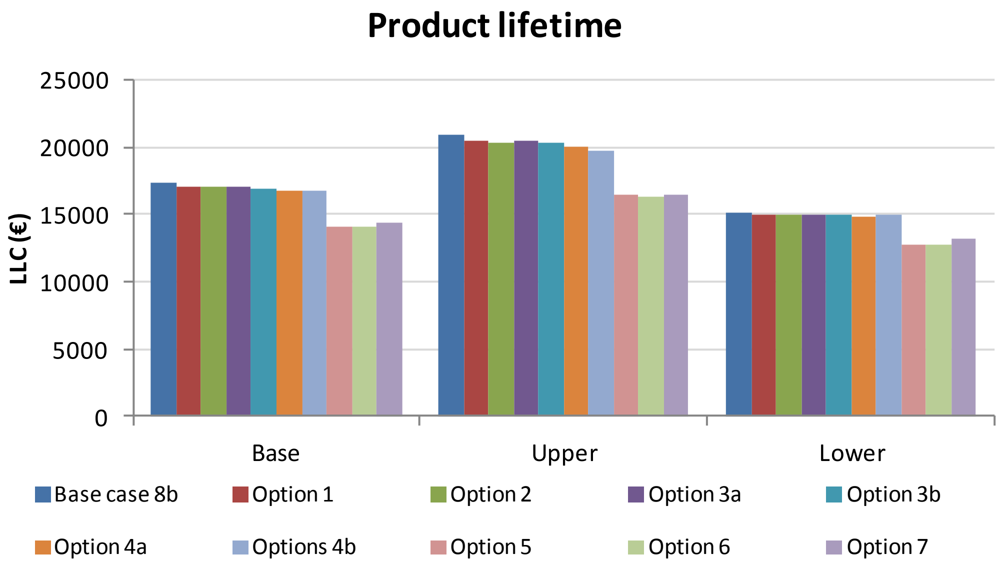


Figure 85: Sensitivity to product lifetime for Base-Case 8b's TEC

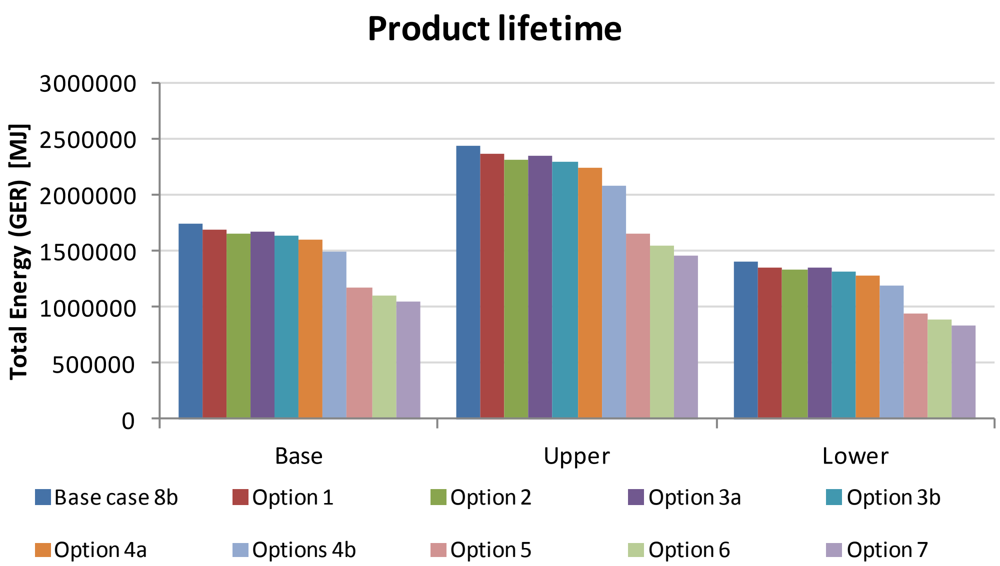


Figure 86: Sensitivity to product lifetime for Base-Case 9's Life Cycle Cost

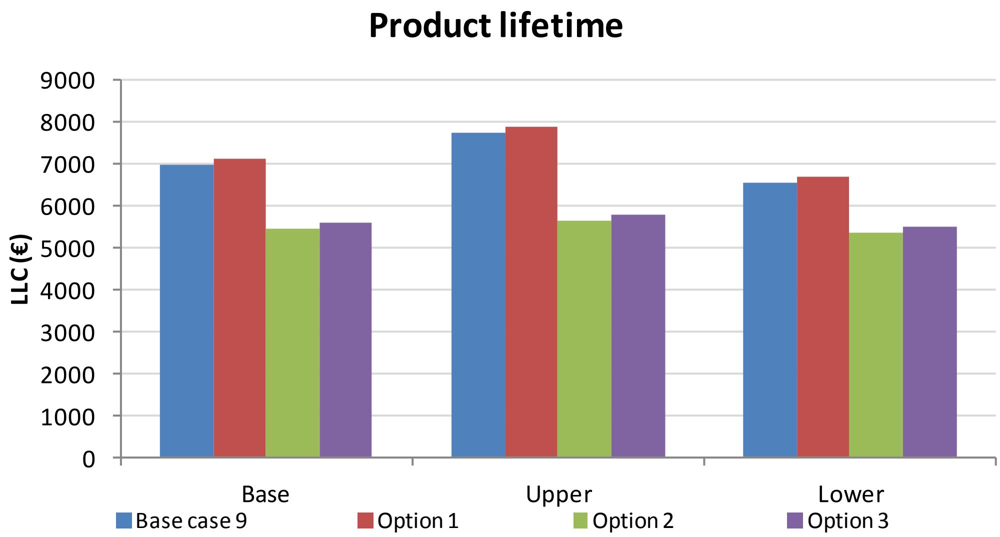
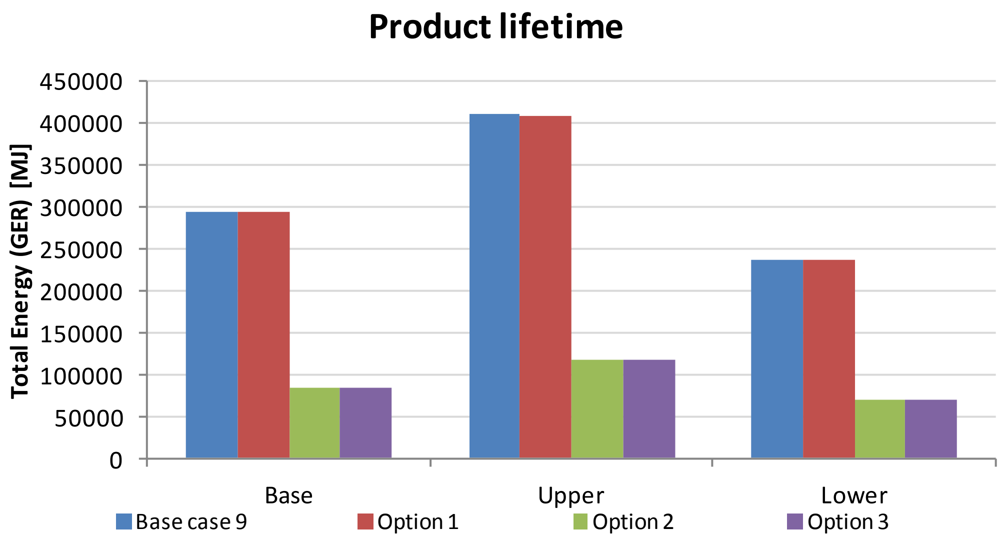


Figure 87: Sensitivity to product lifetime for Base-Case 9's TEC



8.5.2 Assumptions related to the product price

The ranges of local room heaters covered by each of the product groups (Base-Cases) are very wide. Local room heaters with a variety of characteristics, applications and different purchase prices exist on the EU market.

Therefore, compared to the product price defined for Base-Cases, two scenarios are defined, to take into account the fact that on the one hand, the price may be underestimated and on the other that it is overestimated.

Variation in product price:

- An increase of 40% (upper limit)
- A decrease of 20% (lower limit)

Figure 88 to Figure 102 show the influence of the product price on the total energy consumption (TEC) and life-cycle costs of the different base-cases and associated improvement options. For all situations, despite the expected variations in absolute values, the ranking of the different improvement options remains the same whether the minimum or maximum parameter is used.

Figure 88: Sensitivity to product price for Base-Case 1's Life Cycle Cost

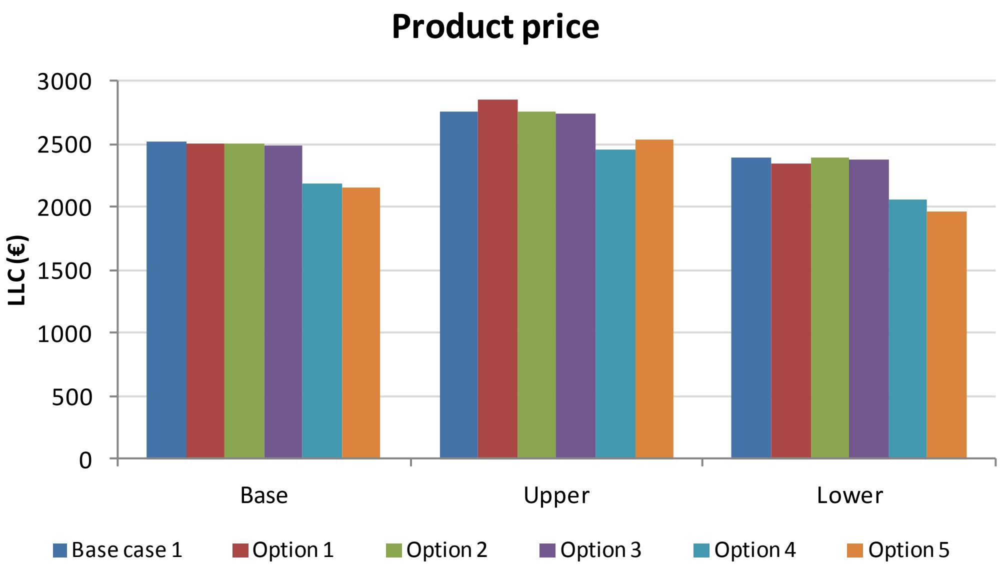


Figure 89: Sensitivity to product price for Base-Case 2's Life Cycle Cost

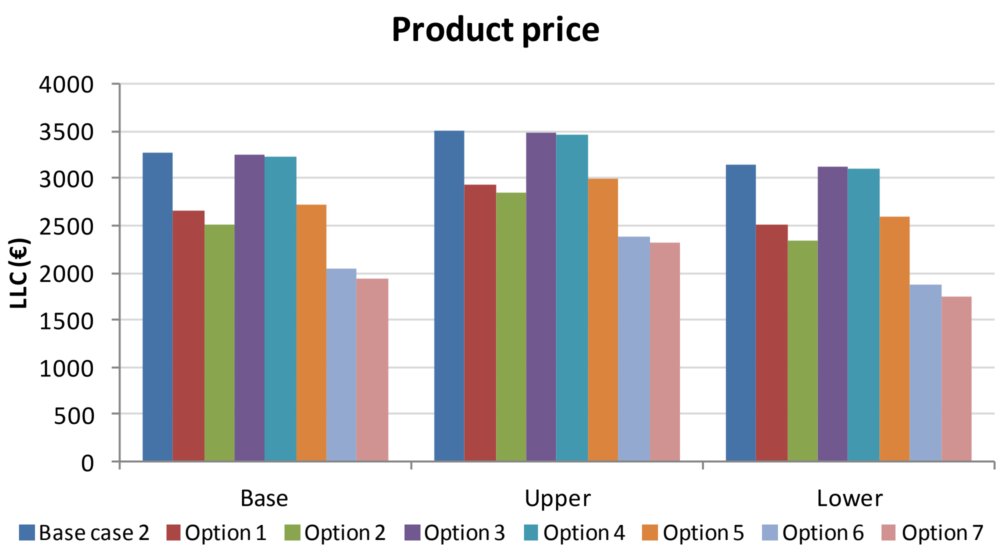


Figure 90: Sensitivity to product price for Base-Case 3's Life Cycle Cost

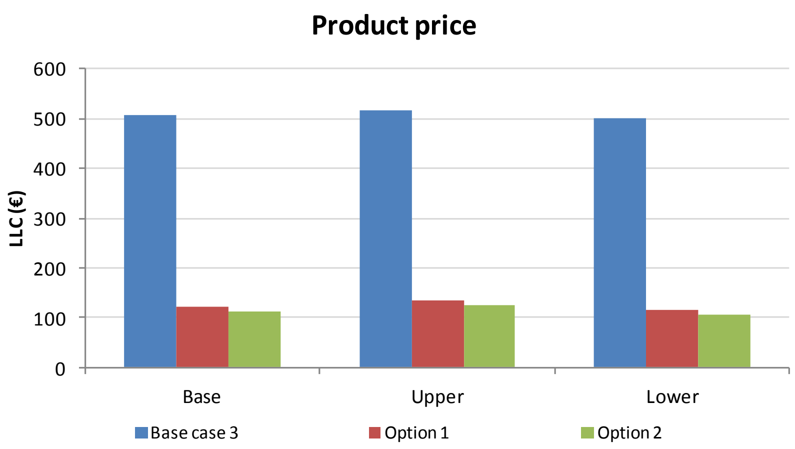


Figure 91: Sensitivity to product price for Base-Case 3's TEC

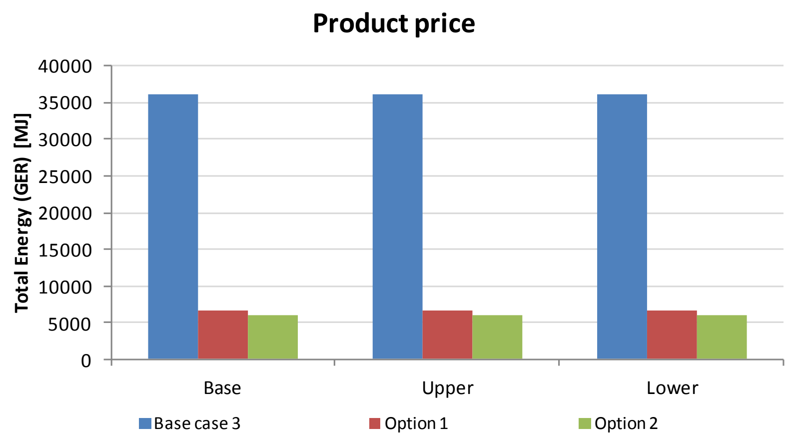


Figure 92: Sensitivity to product price for Base-Case 4's Life Cycle Cost

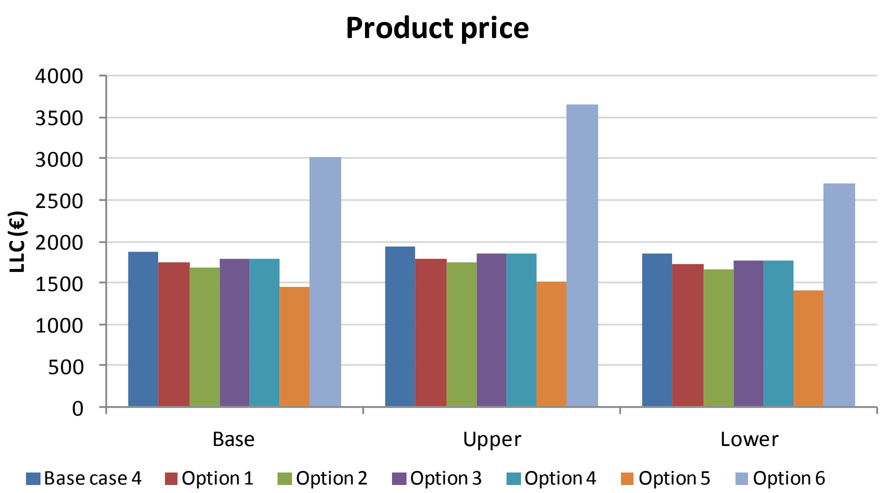


Figure 93: Sensitivity to product price for Base-Case 5a's Life Cycle Cost

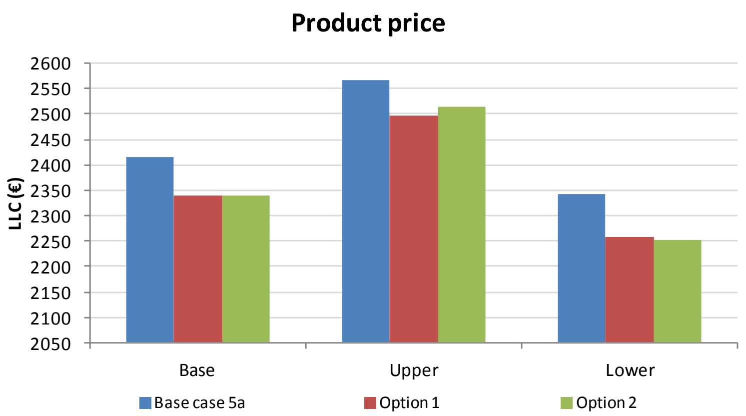


Figure 94: Sensitivity to product price for Base-Case 5a's TEC

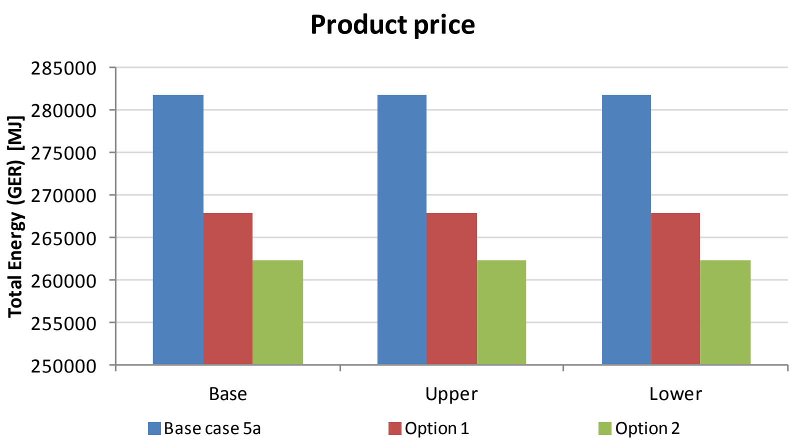


Figure 95: Sensitivity to product price for Base-Case 5b's Life Cycle Cost

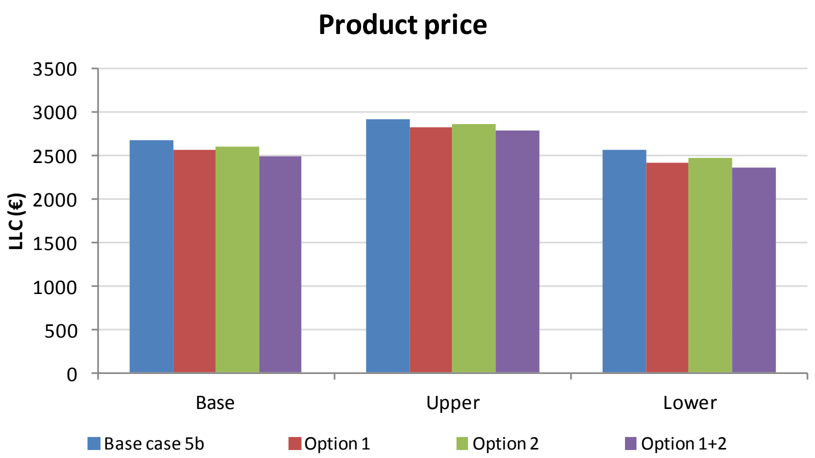


Figure 96: Sensitivity to product price for Base-Case 5b's TEC

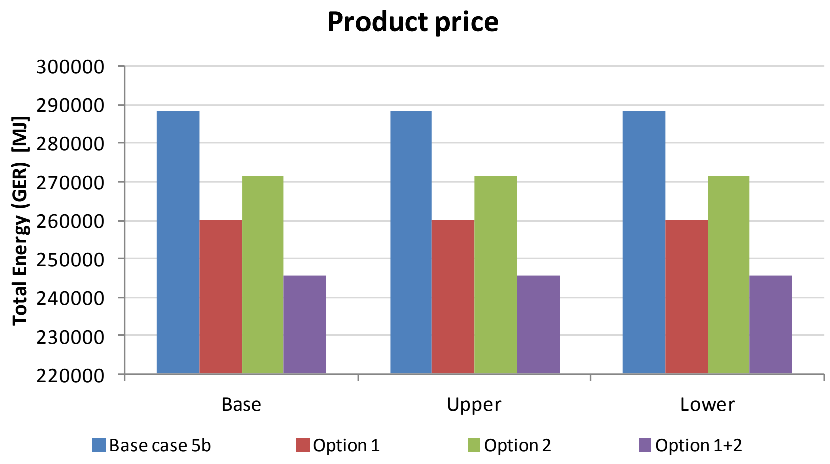


Figure 97: Sensitivity to product price for Base-Case 6a's Life Cycle Cost

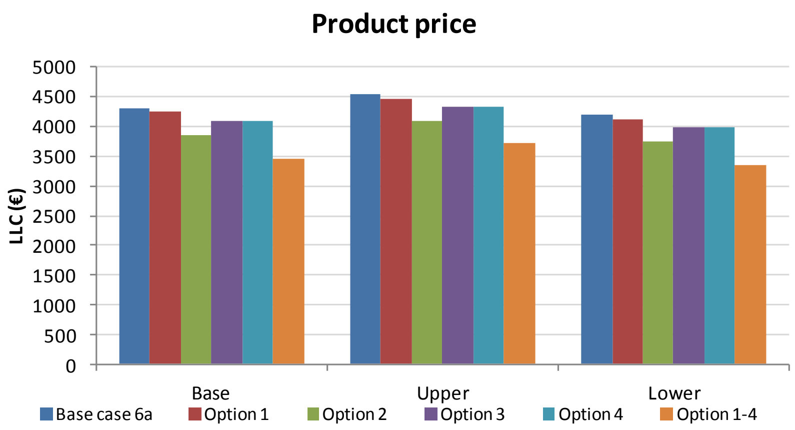


Figure 98: Sensitivity to product price for Base-Case 6b's Life Cycle Cost

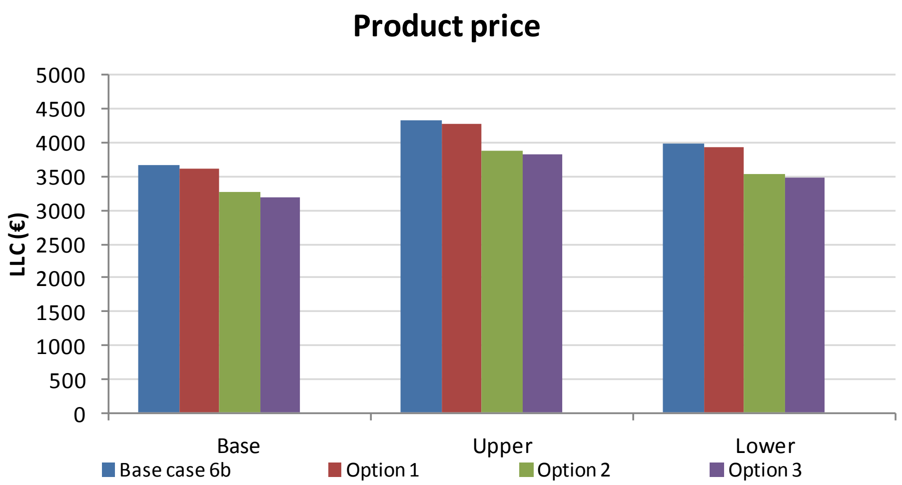


Figure 99: Sensitivity to product price for Base-Case 7's Life Cycle Cost

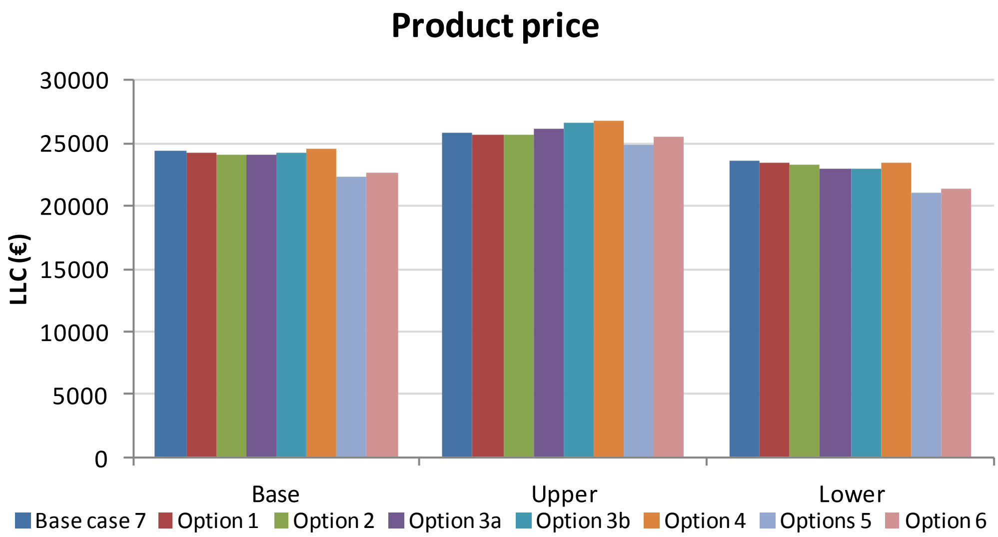


Figure 100: Sensitivity to product price for Base-Case 8a's Life Cycle Cost

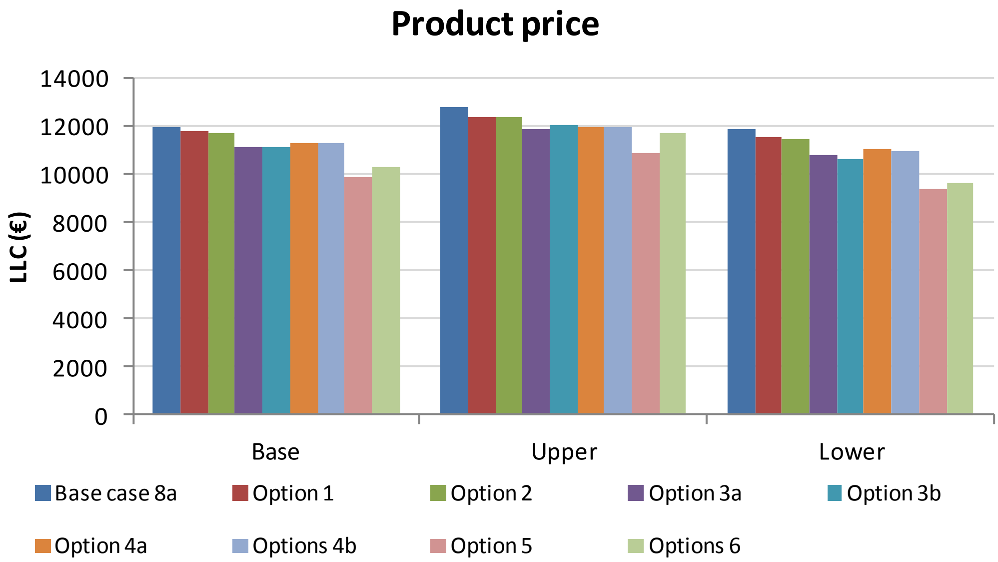


Figure 101: Sensitivity to product price for Base-Case 8b's Life Cycle Cost

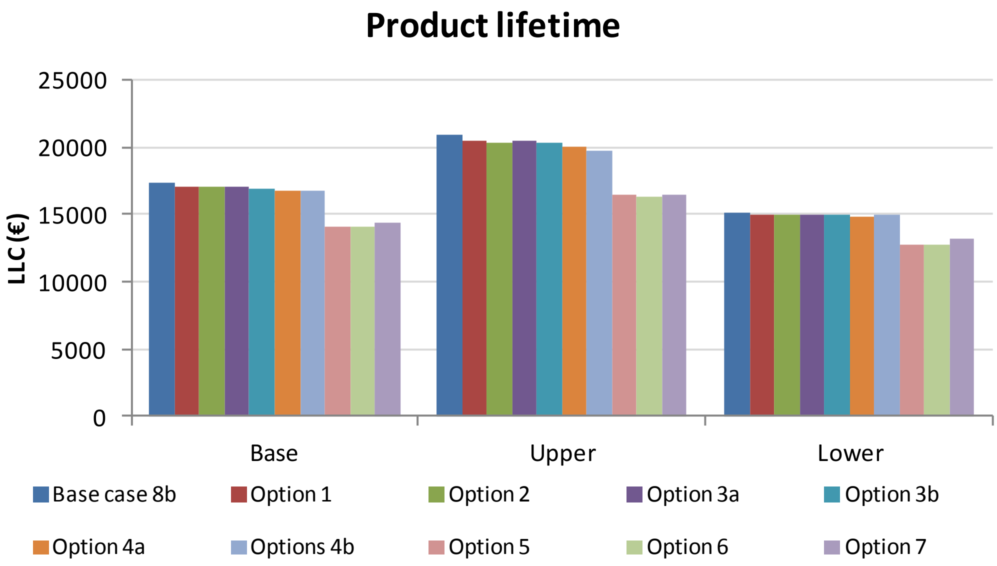
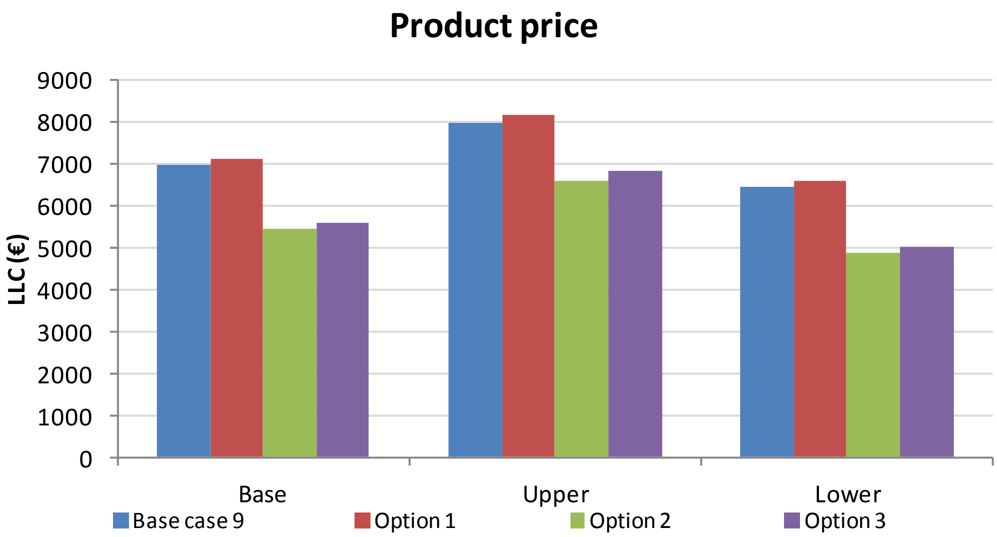


Figure 102: Sensitivity to product price for Base-Case 9's Life Cycle Cost



8.5.3 Assumptions related to the energy (electricity/NG) tariff

For all Base-Cases and their improvement options, an average EU-27 energy price was used[26]. However, the variation of energy prices across Member States in EU could lead to different LCC

[26] Based on the data from Eurostat following prices were used: for residential heaters other than storage heaters EU-27 electricity tariff of €0.163/kWh and for storage heaters electricity price of €0.109/kWh. For non-residential heaters, an electricity tariff of €0.156 was used. Natural gas tariff of €15.6/GJ was used for residential heaters and €11.58/GJ for non-residential heaters.

for the Base-Cases and their improvement options. Such extreme values are considered for the scenarios presented below:

Variation in energy (electricity) tariff:

- An increase of 60% (upper limit)
- A decrease of 50% (lower limit)

Variation in energy (natural gas) tariff for residential heaters:

- An increase of 70% (upper limit)
- A decrease of 50% (lower limit)

Variation in energy (natural gas) tariff for non-residential heaters:

- An increase of 55% (upper limit)
- A decrease of 15% (lower limit)

Figure 103 to Figure 117 show the influence of the product lifetime on the total energy consumption (TEC) and life-cycle costs of the different base-cases and associated improvement options. For all situations, despite the expected variations in absolute values, the ranking of the different improvement options remains the same whether the minimum or maximum parameter is used.

Figure 103: Sensitivity to gas rate for Base-Case 1's Life Cycle Cost

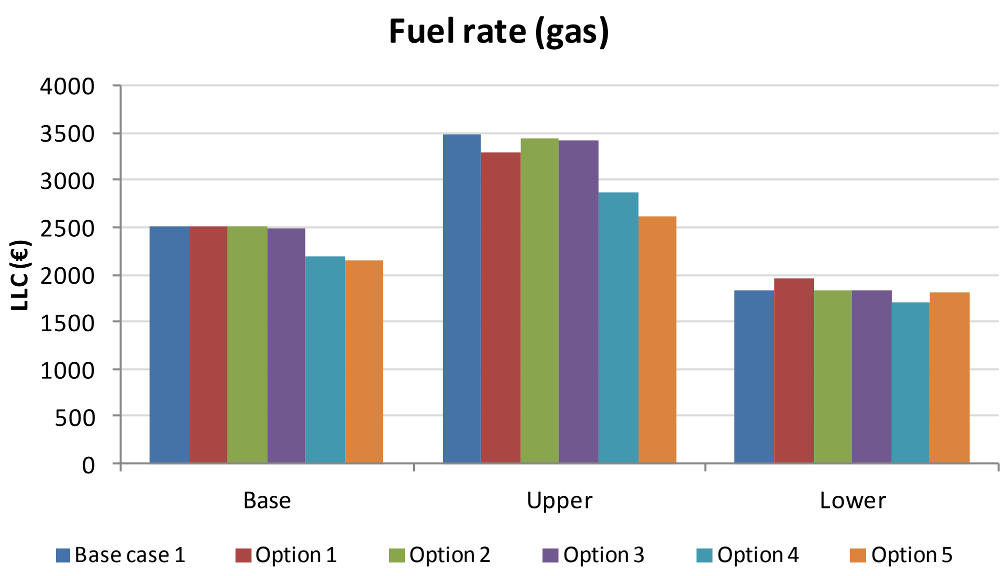


Figure 104: Sensitivity to gas rate for Base-Case 2's Life Cycle Cost

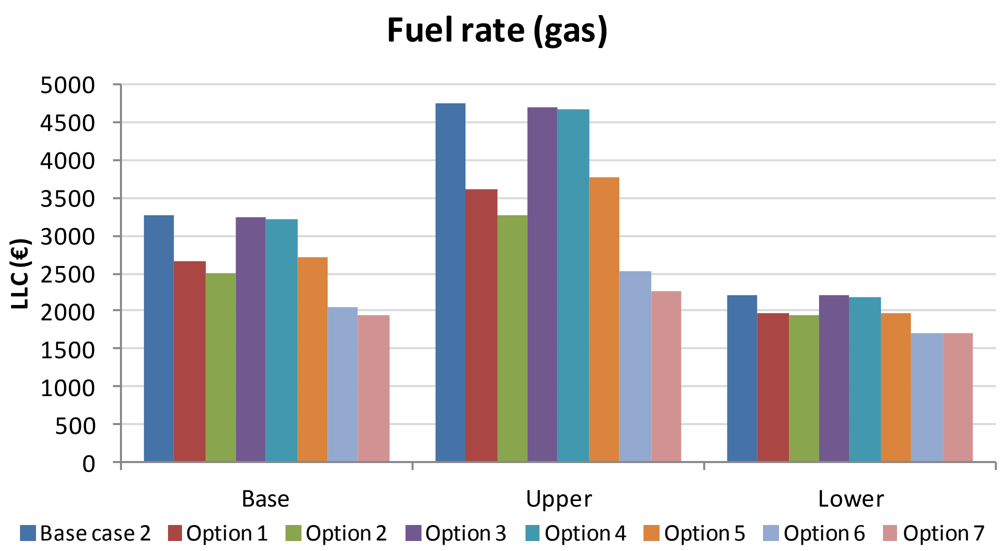


Figure 105: Sensitivity to electricity rate for Base-Case 3's Life Cycle Cost

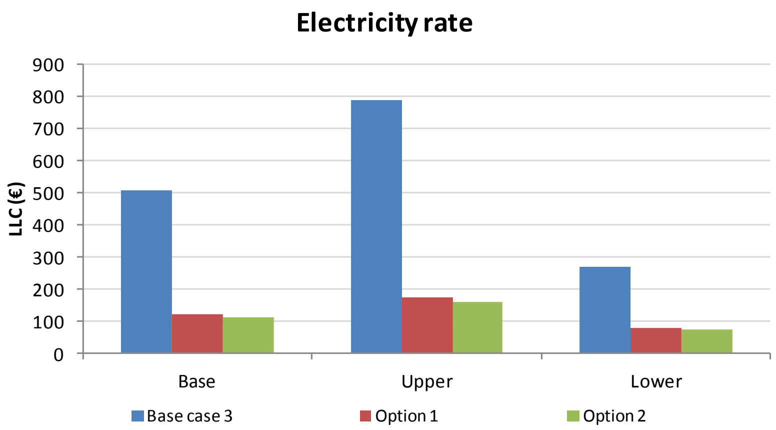


Figure 106: Sensitivity to electricity rate for Base-Case 3's TEC

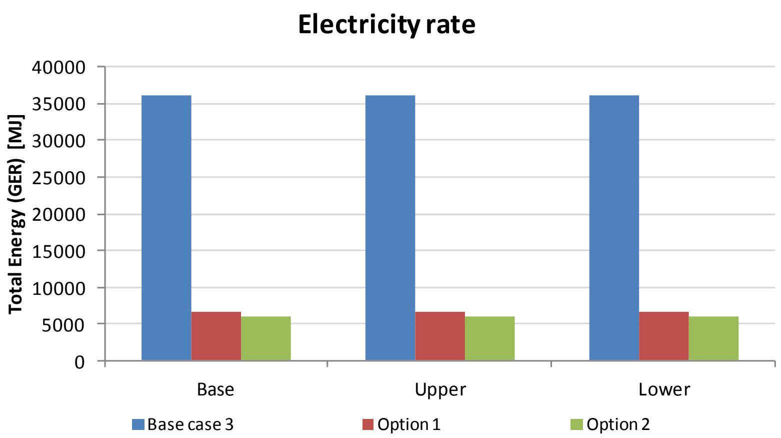


Figure 107: Sensitivity to electricity rate for Base-Case 4's Life Cycle Cost

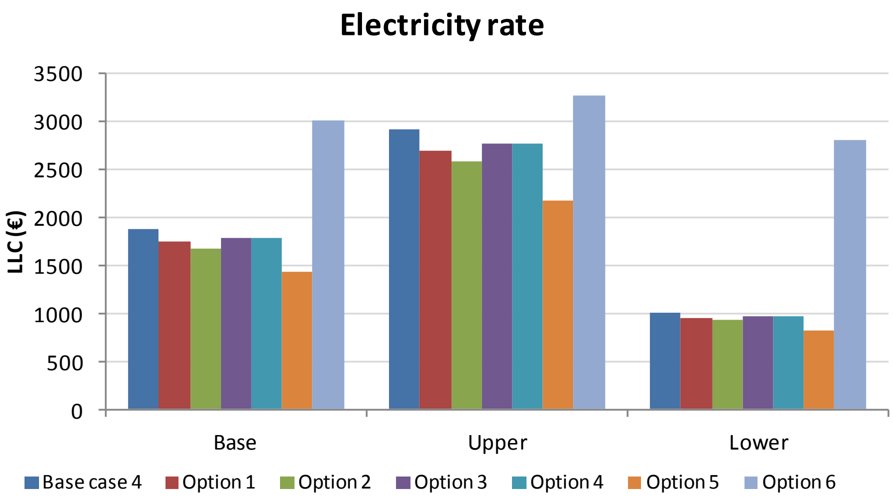


Figure 108: Sensitivity to electricity rate for Base-Case 5a's Life Cycle Cost

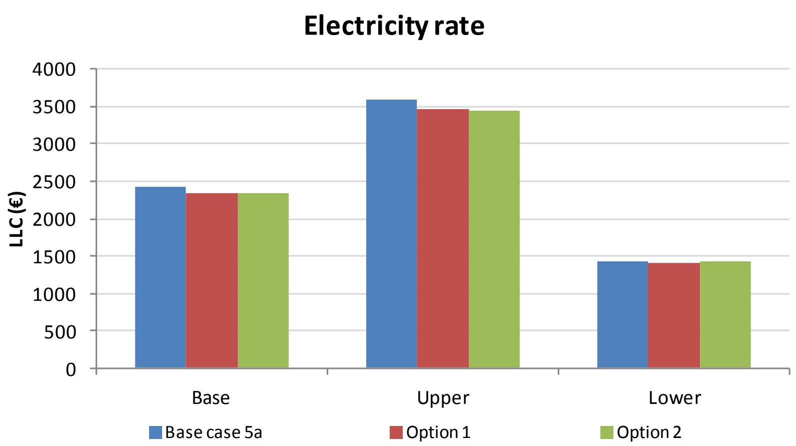


Figure 109: Sensitivity to electricity rate for Base-Case 5a's TEC

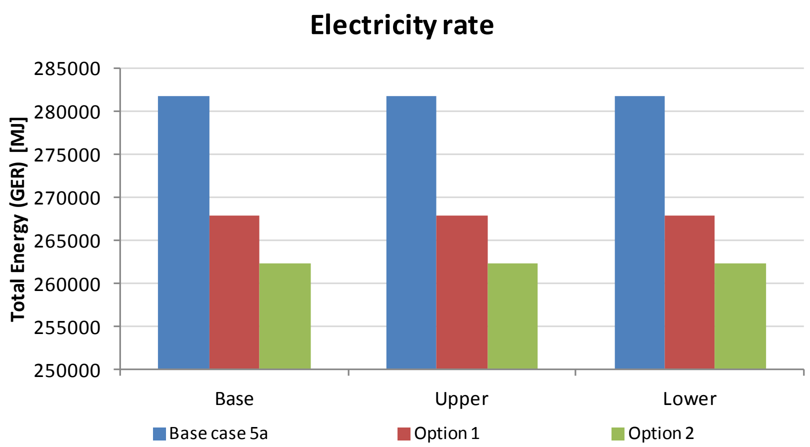


Figure 110: Sensitivity to electricity rate for Base-Case 5b's Life Cycle Cost

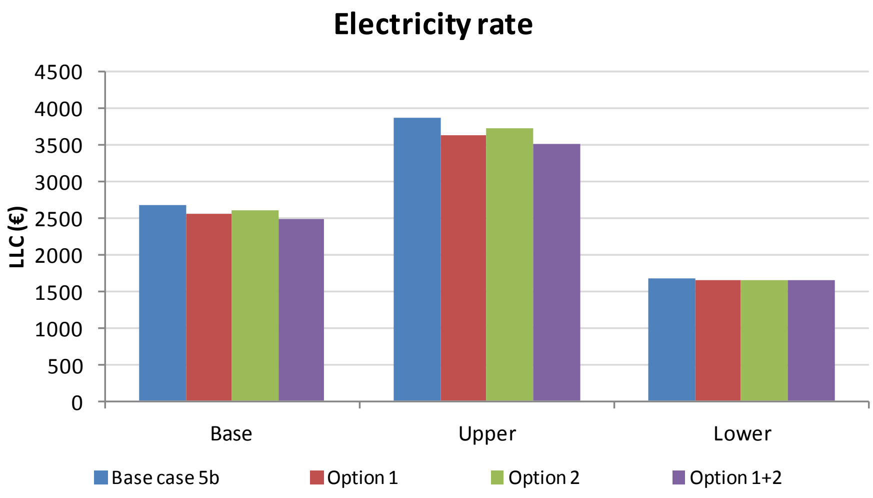


Figure 111: Sensitivity to electricity rate for Base-Case 5b's TEC

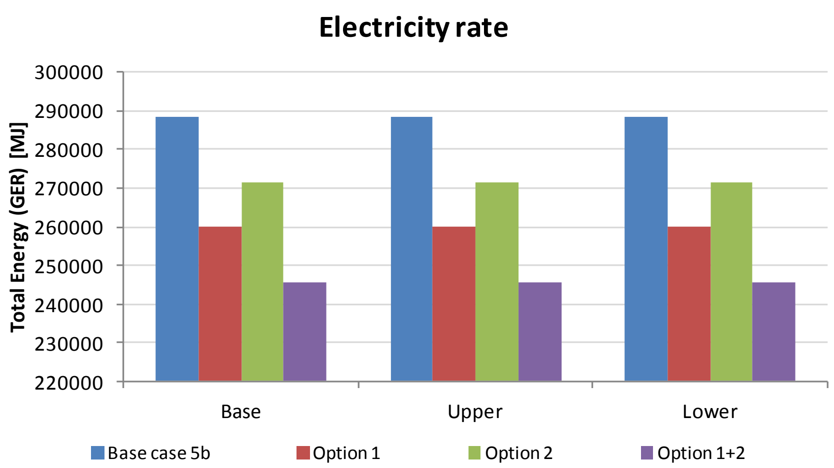


Figure 112: Sensitivity to electricity rate for Base-Case 6a's Life Cycle Cost

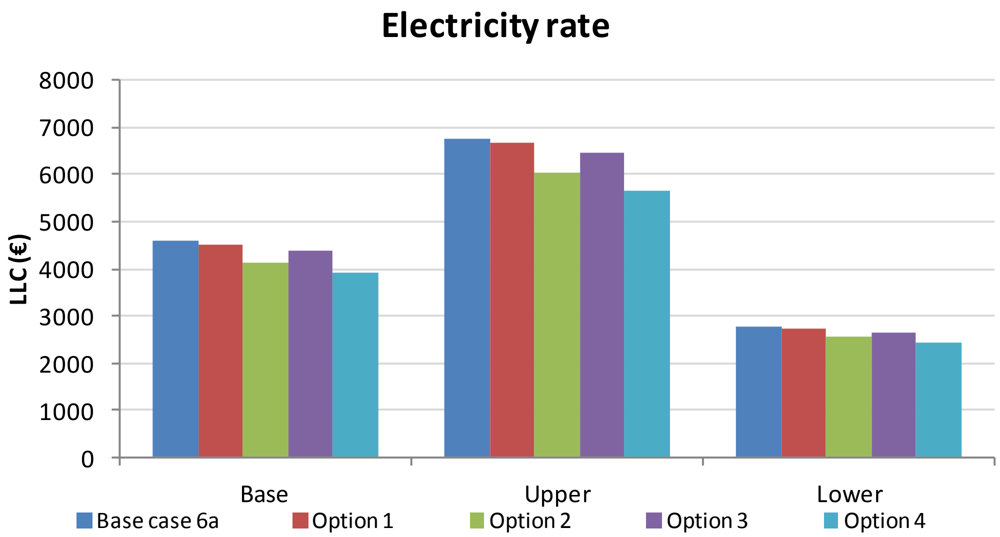


Figure 113: Sensitivity to electricity rate for Base-Case 6b's Life Cycle Cost

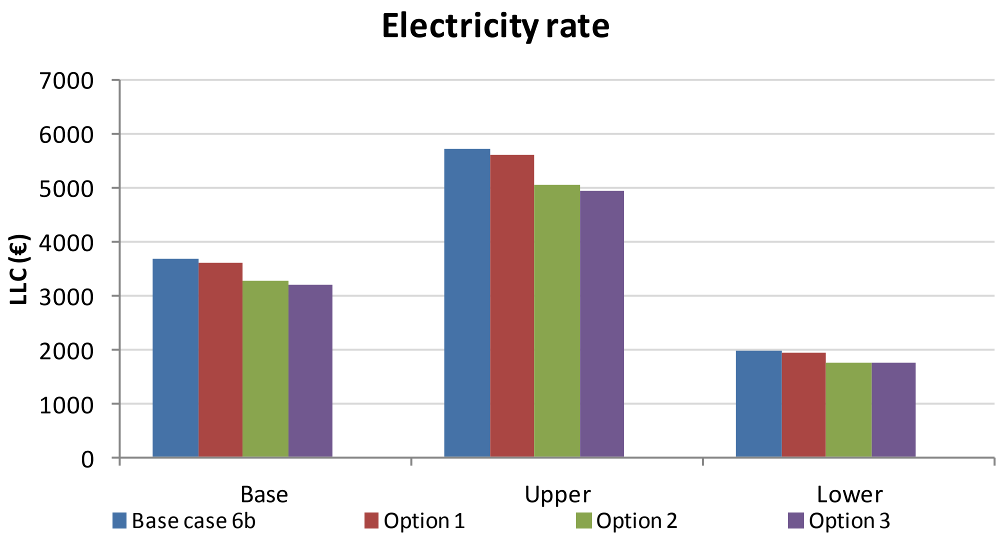


Figure 114: Sensitivity to gas rate for Base-Case 7's Life Cycle Cost

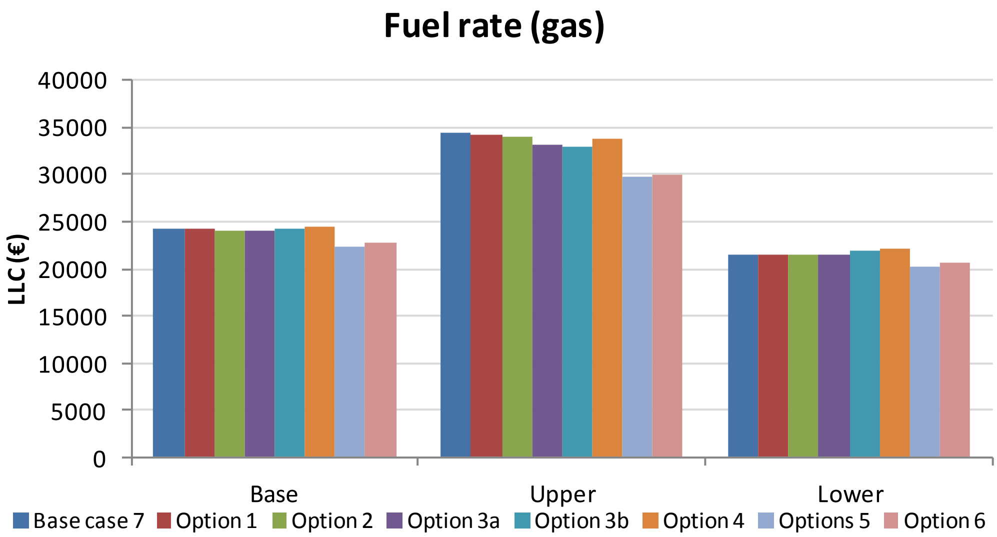


Figure 115: Sensitivity to gas rate for Base-Case 8a's Life Cycle Cost

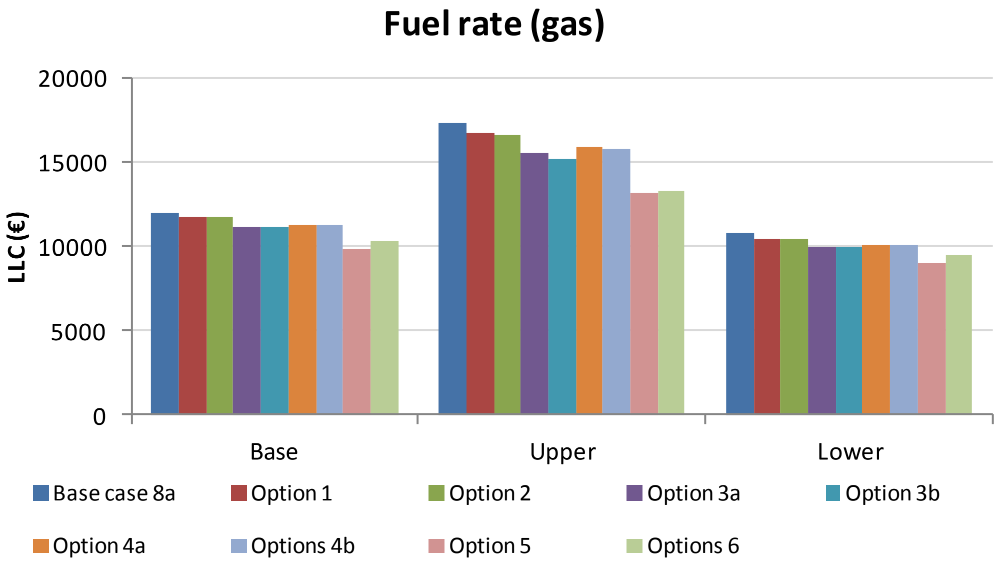


Figure 116: Sensitivity to gas rate for Base-Case 8b's Life Cycle Cost

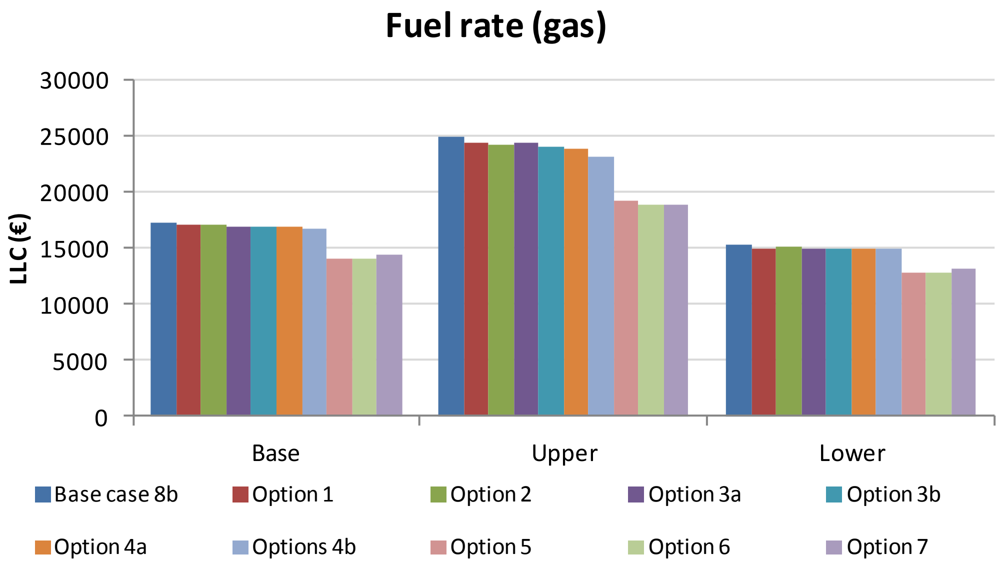
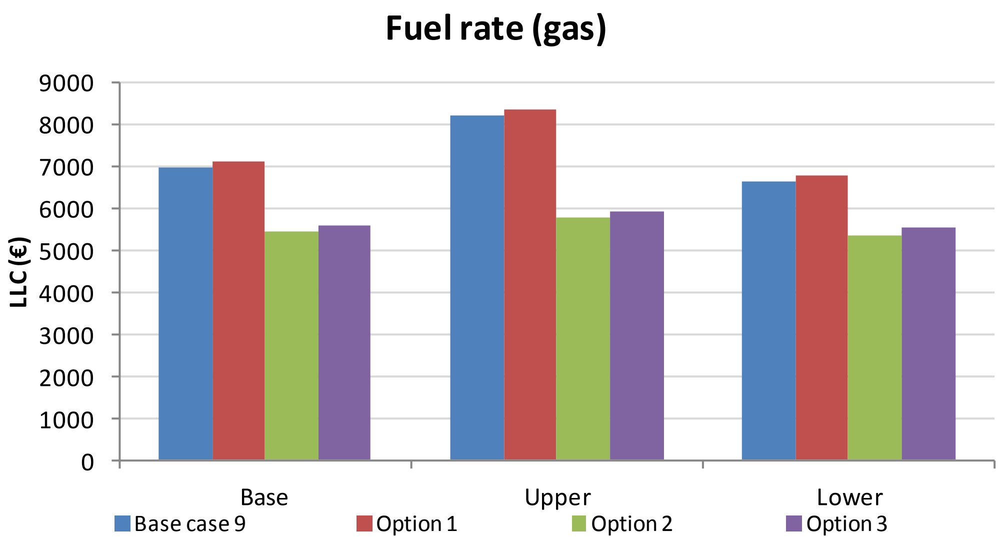


Figure 117: Sensitivity to fuel rate for Base-Case 9's Life Cycle Cost



8.5.4 Assumptions related to the discount rate

In a manner similar to the energy prices, the discount rate (interest minus inflation rate) influences the LCC calculation. Higher and lower values than the one used in Tasks 5 & 7 are employed to assess the impact of this parameter.

Variation in discount rate:

- An increase of 50% (upper limit)
- A decrease of 50% (lower limit)

Figure 118 to Figure 130 show the influence of the product price on the total energy consumption (TEC) and life-cycle costs of the different Base-Cases and associated improvement options. For all situations, despite the expected variations in absolute values, the ranking of the different improvement options remains the same whether the minimum or maximum parameter is used.

Figure 118: Sensitivity to discount rate for Base-Case 1's Life Cycle Cost

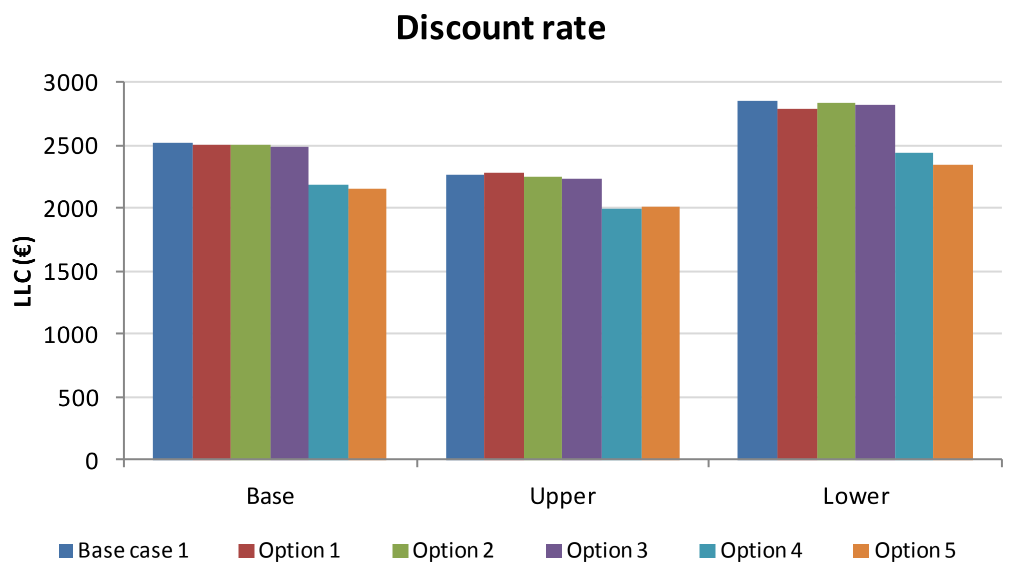


Figure 119: Sensitivity to discount rate for Base-Case 2's Life Cycle Cost

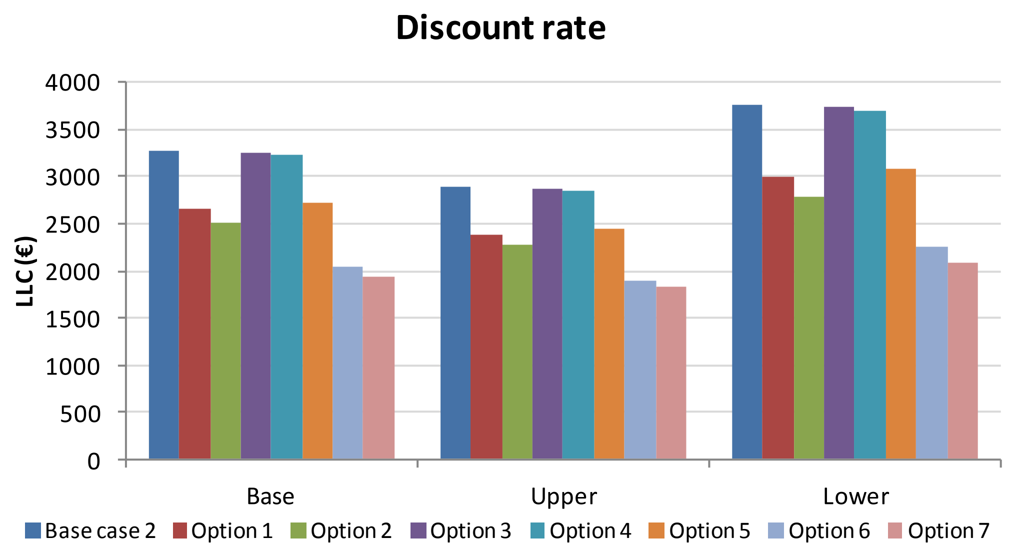


Figure 120: Sensitivity to discount rate for Base-Case 3's Life Cycle Cost

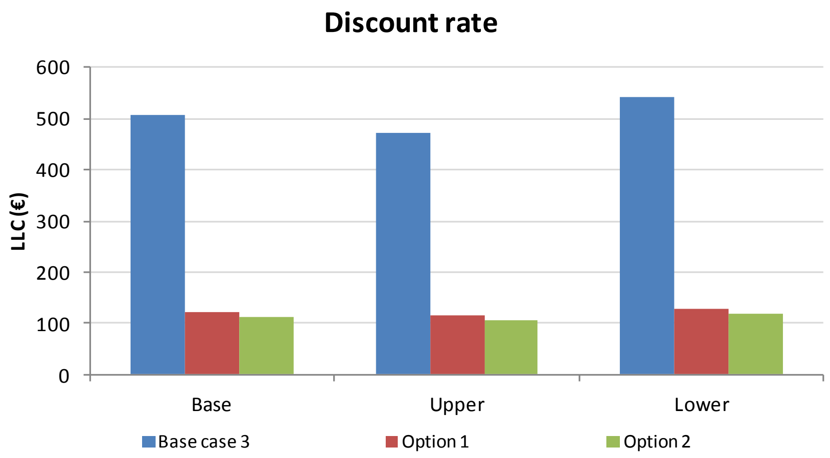


Figure 121: Sensitivity to discount rate for Base-Case 3's TEC

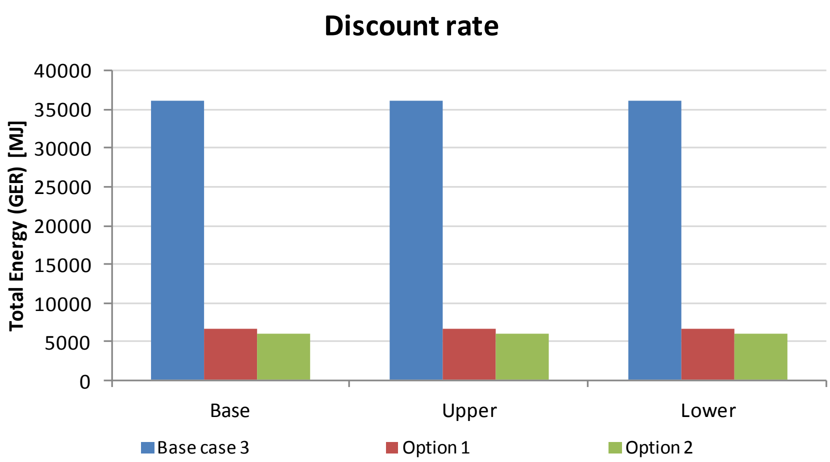


Figure 122: Sensitivity to discount rate for Base-Case 4's Life Cycle Cost

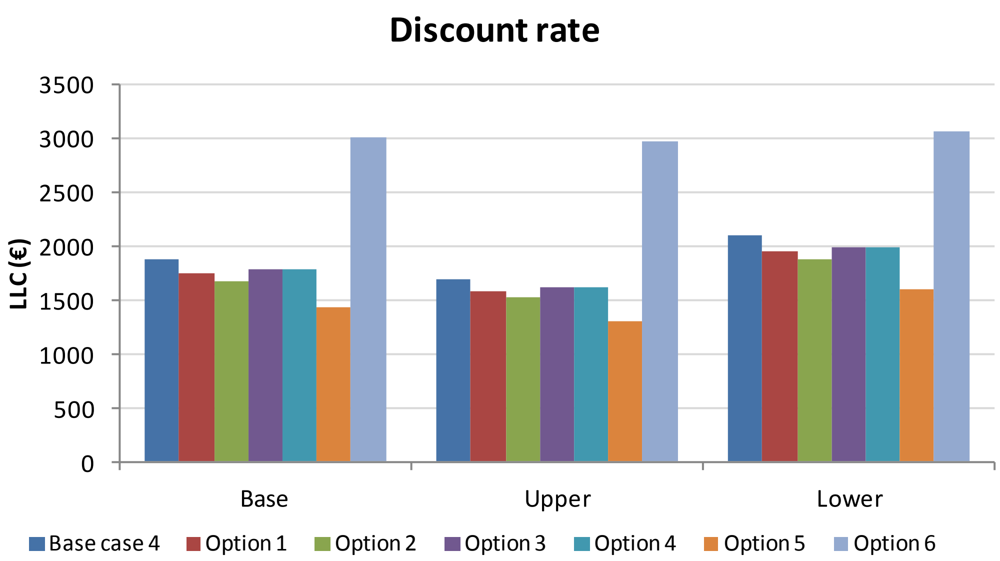


Figure 123: Sensitivity to discount rate for Base-Case 5a's Life Cycle Cost

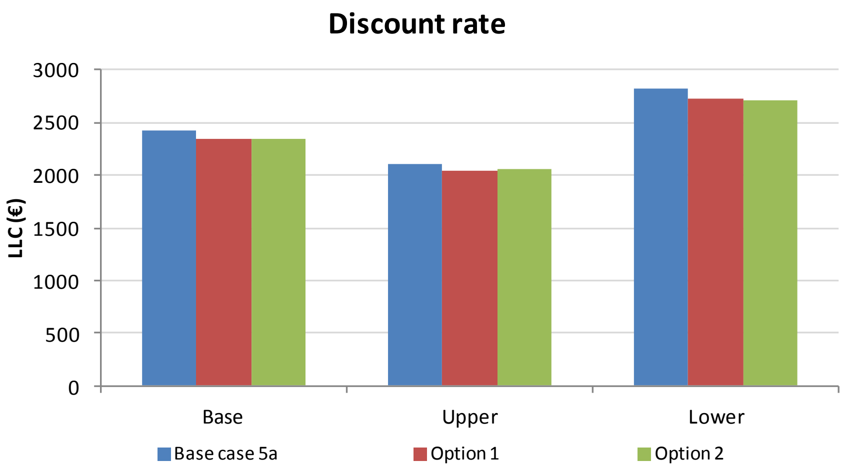


Figure 124: Sensitivity to discount rate for Base-Case 5b's Life Cycle Cost

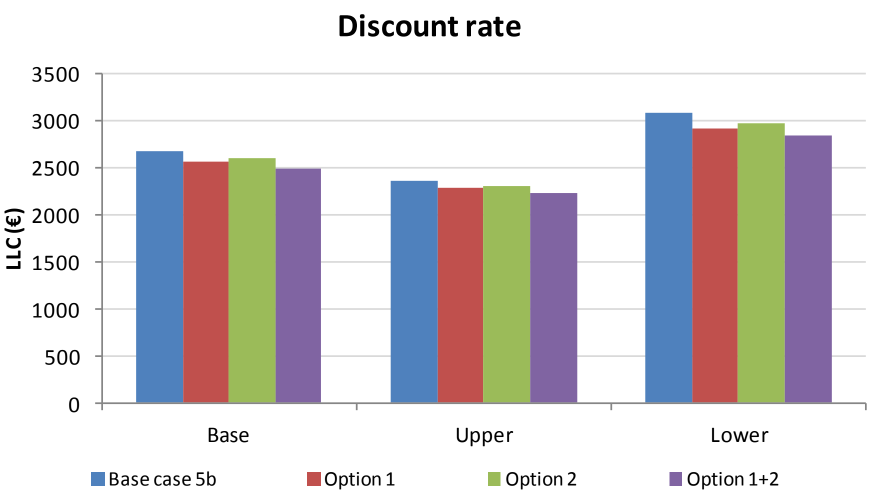


Figure 125: Sensitivity to discount rate for Base-Case 6a's Life Cycle Cost

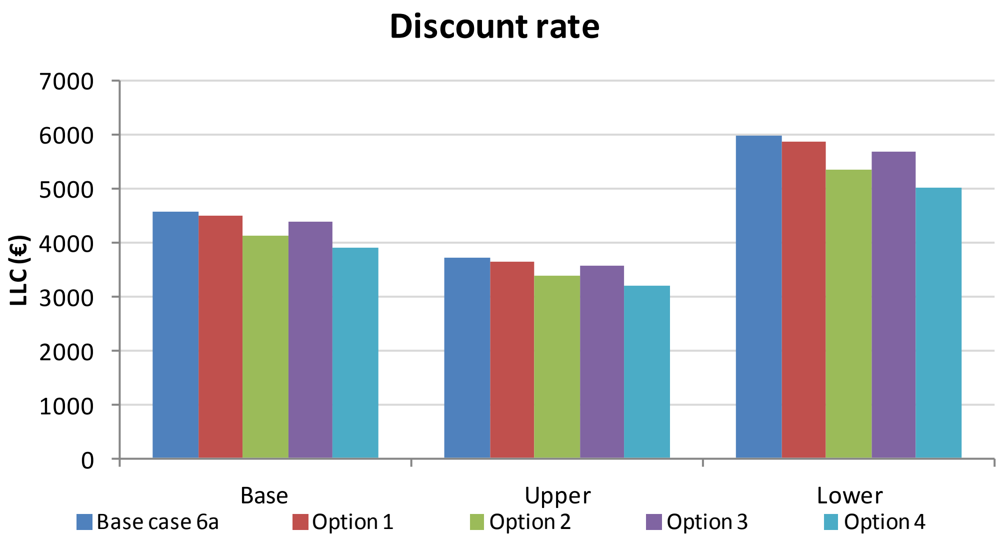


Figure 126: Sensitivity to discount rate for Base-Case 6b's Life Cycle Cost

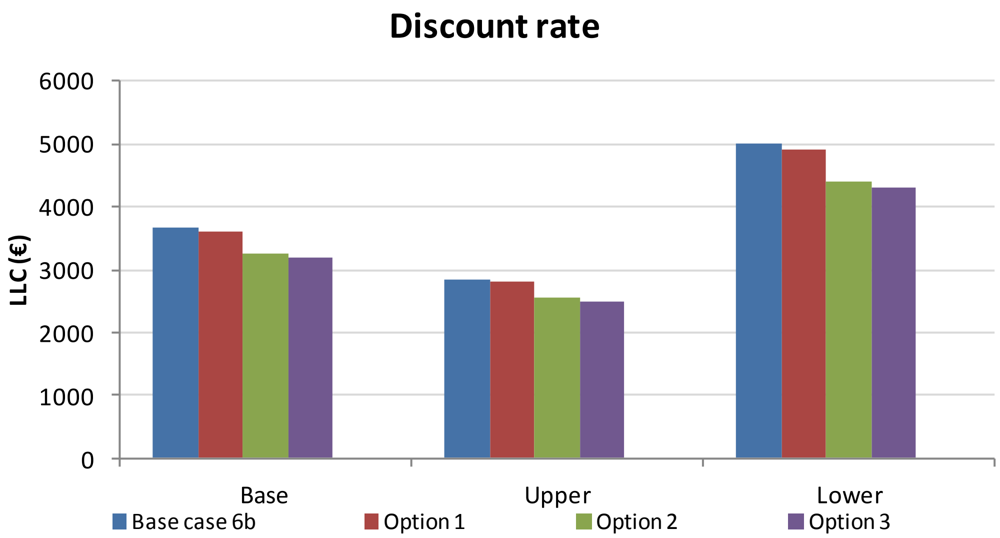


Figure 127: Sensitivity to discount rate for Base-Case 7's Life Cycle Cost

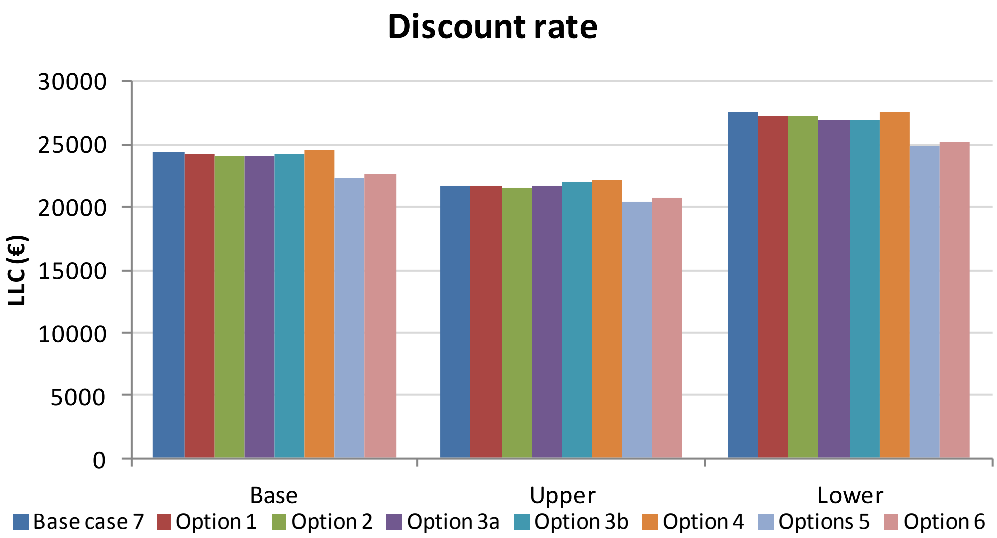


Figure 128: Sensitivity to discount rate for Base-Case 8a's Life Cycle Cost

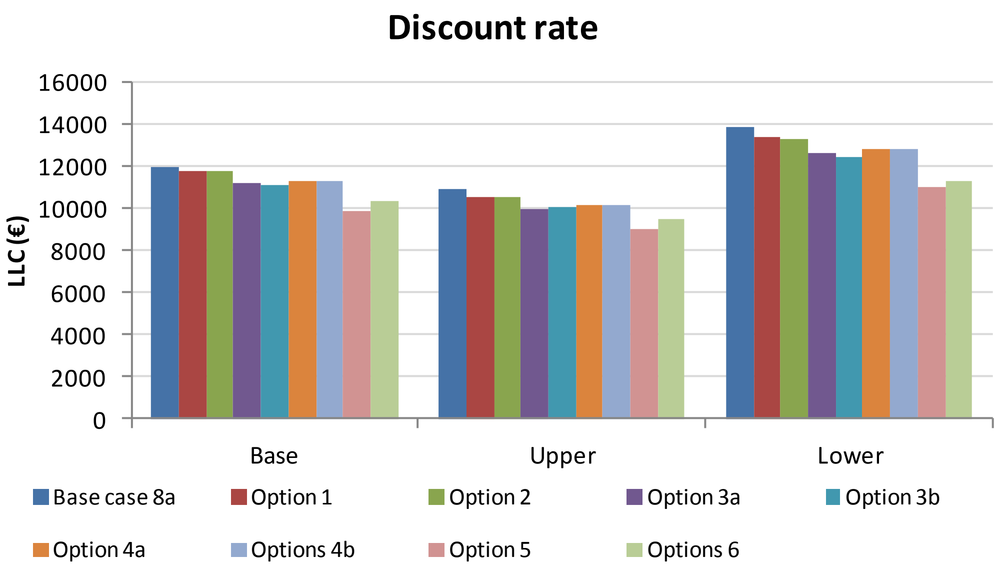


Figure 129: Sensitivity to discount rate for Base-Case 8b's Life Cycle Cost

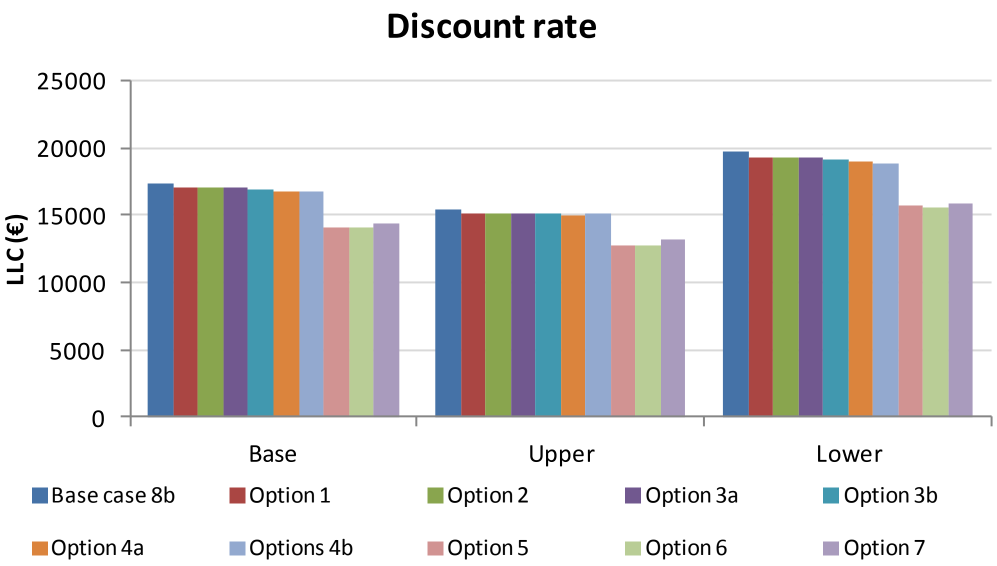
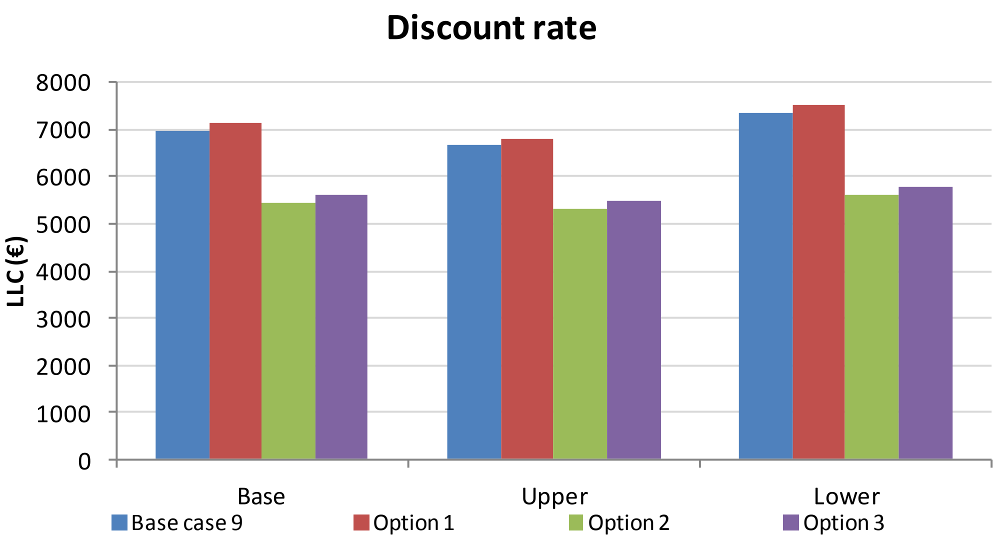


Figure 130: Sensitivity to discount rate for Base-Case 9's Life Cycle Cost



8.5.5 Assumptions related to the energy consumption (kWh/year)

As for all energy-using products, energy consumption is considered as a major impact. In Task 5, average energy consumptions were defined for all Base-Cases based on the inputs provided by stakeholders. Nevertheless, as the type of heaters covered by each of the Base-Cases is very diverse, it is worthwhile carrying out a sensitivity analysis on this parameter.

Variation in annual energy consumption:

- An increase of 25% (upper limit)
- A decrease of 25% (lower limit)

Figure 131 to Figure 154 show the influence of the annual energy consumption on the TEC and life-cycle costs of the different Base-Cases and associated improvement options. For all situations, despite the expected variations in absolute values, the ranking of the different improvement options remains the same whether the minimum or maximum parameter is used.

Figure 131: Sensitivity to energy consumption for Base-Case 1's Life Cycle Cost

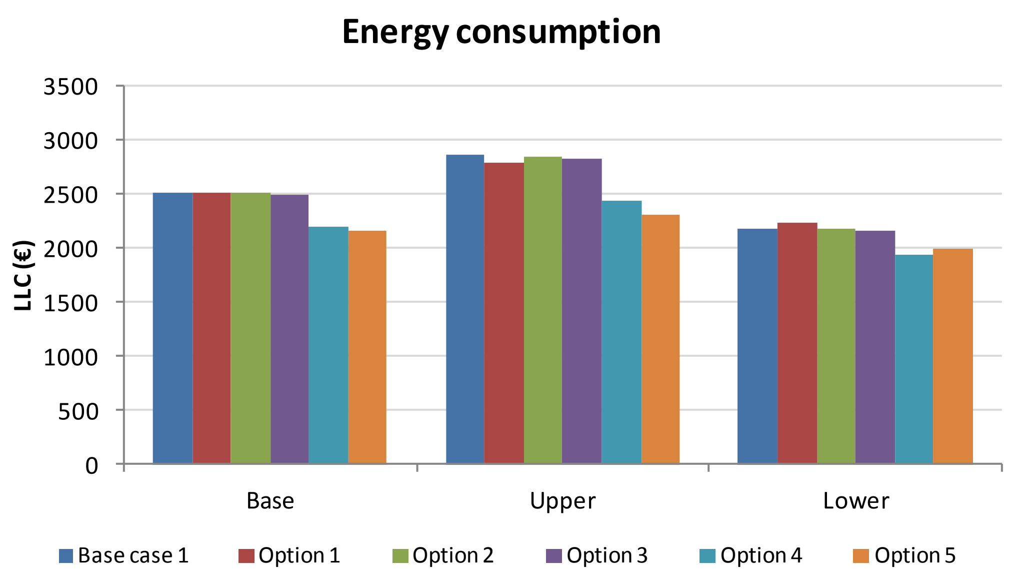


Figure 132: Sensitivity to energy consumption for Base-Case 1's TEC

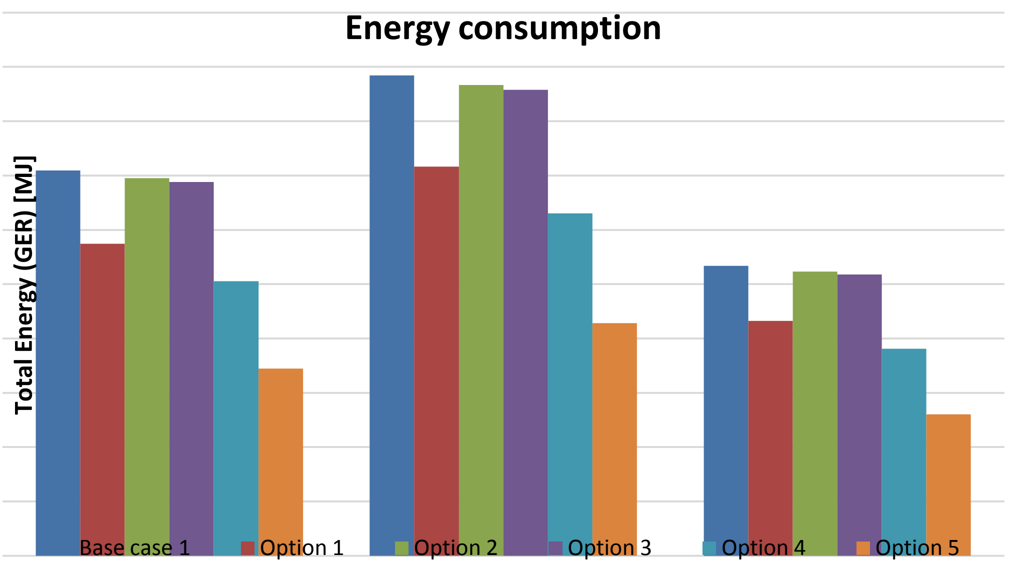


Figure 133: Sensitivity to energy consumption for Base-Case 2's Life Cycle Cost

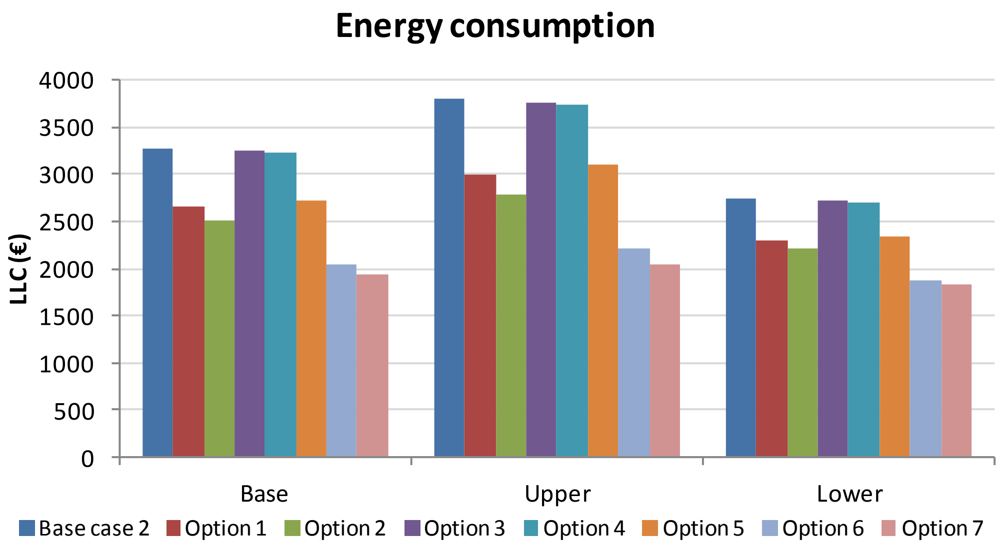


Figure 134: Sensitivity to energy consumption for Base-Case 2's TEC

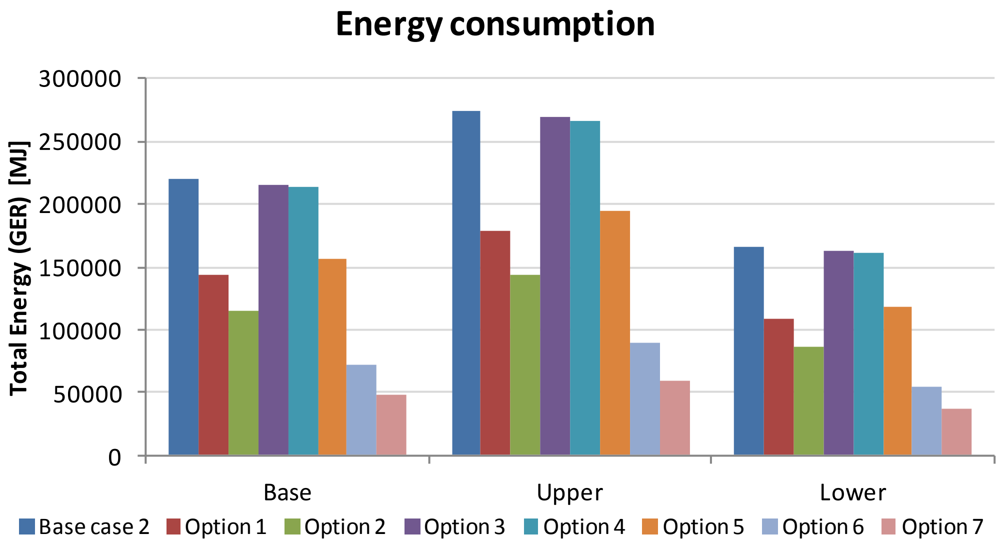


Figure 135: Sensitivity to energy consumption for Base-Case 3's Life Cycle Cost

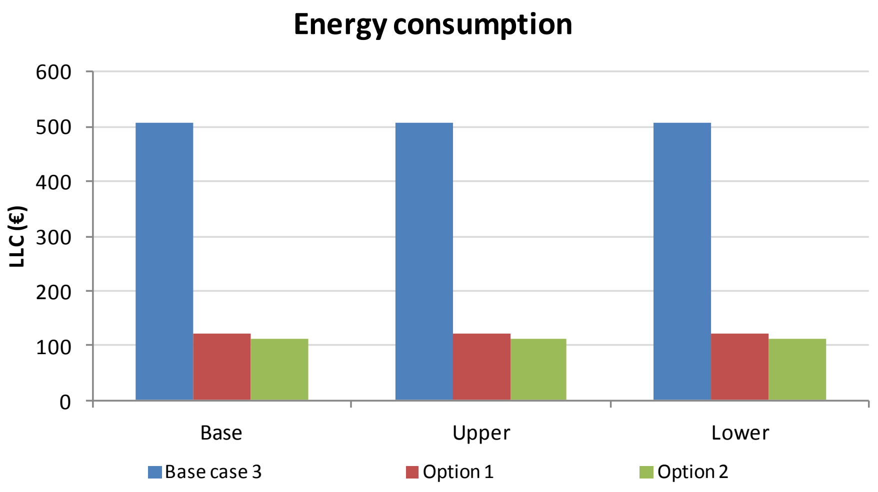


Figure 136: Sensitivity to energy consumption for Base-Case 3's TEC

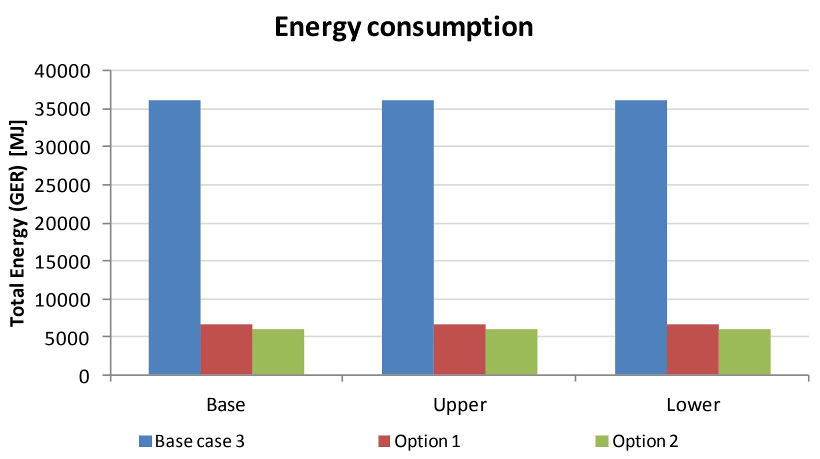


Figure 137: Sensitivity to energy consumption for Base-Case 4's Life Cycle Cost

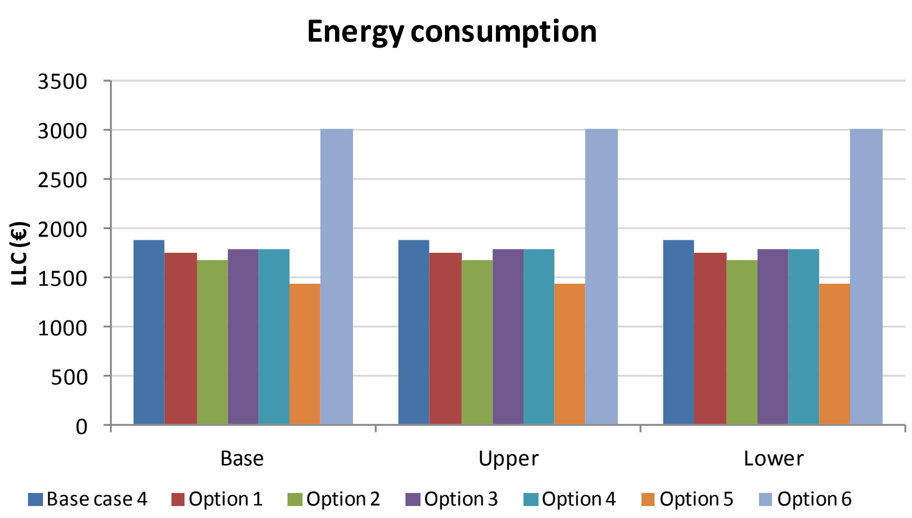


Figure 138: Sensitivity to energy consumption for Base-Case 4's TEC

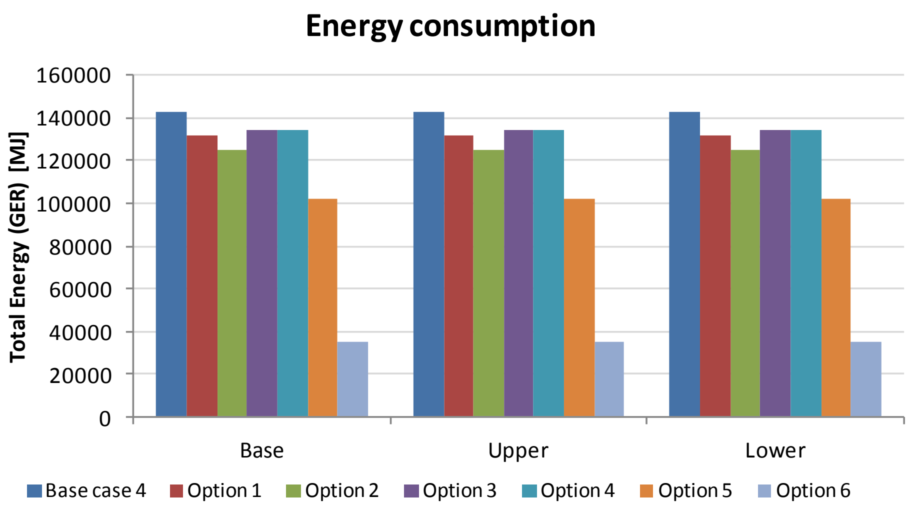


Figure 139: Sensitivity to energy consumption for Base-Case 5a's Life Cycle Cost

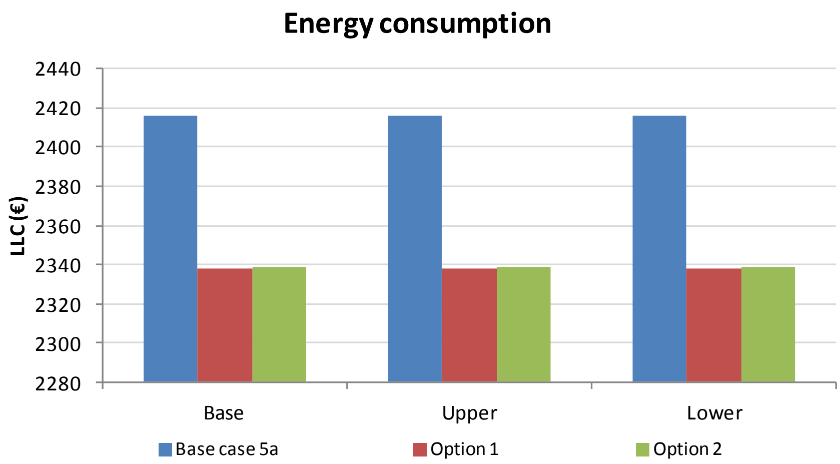


Figure 140: Sensitivity to energy consumption for Base-Case 5a's TEC

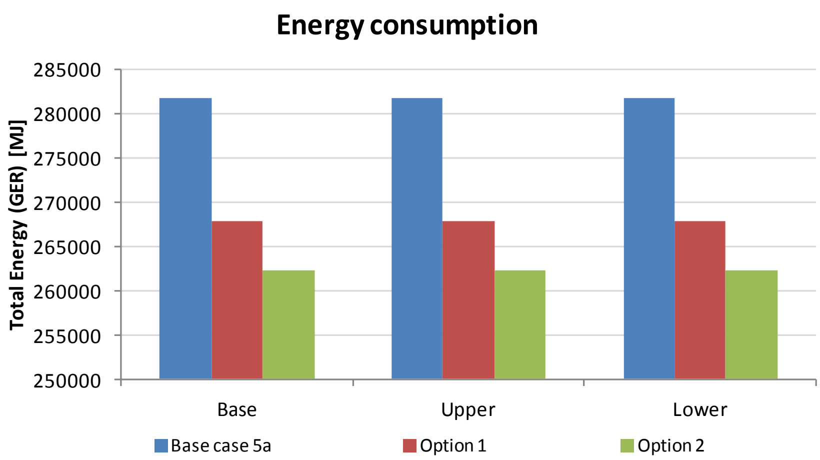


Figure 141: Sensitivity to energy consumption for Base-Case 5b's Life Cycle Cost

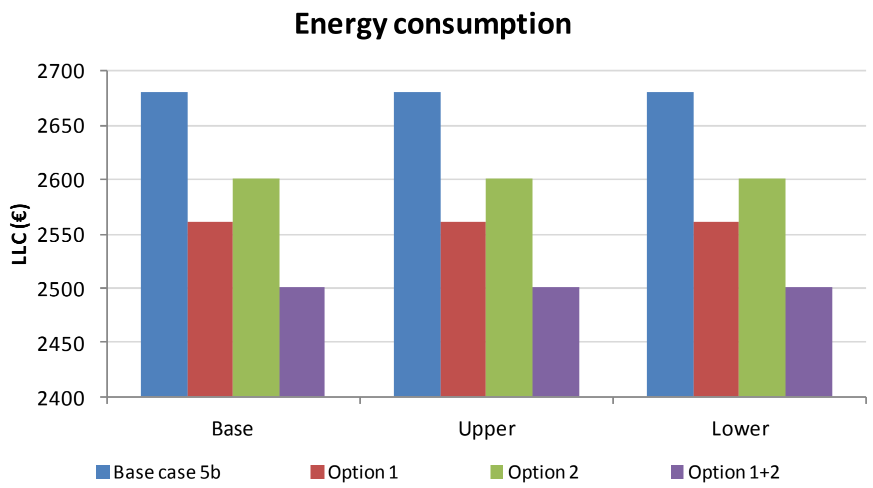


Figure 142: Sensitivity to energy consumption for Base-Case 5b's TEC

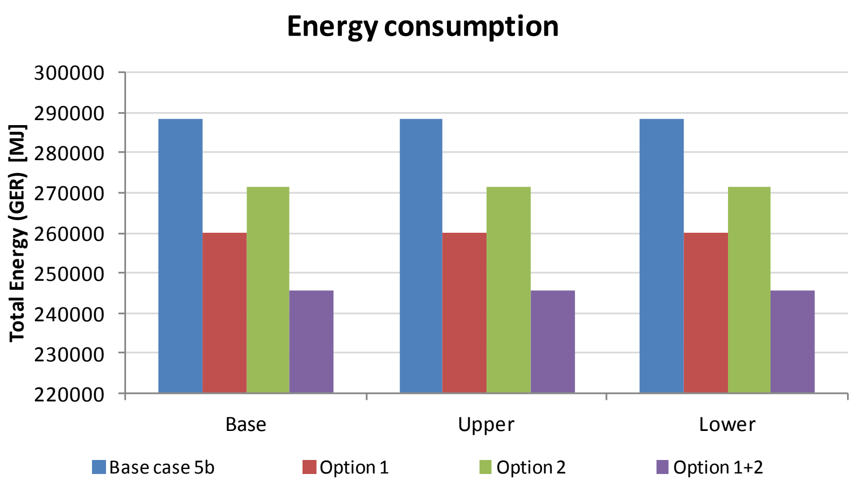


Figure 143: Sensitivity to energy consumption for Base-Case 6a's Life Cycle Cost

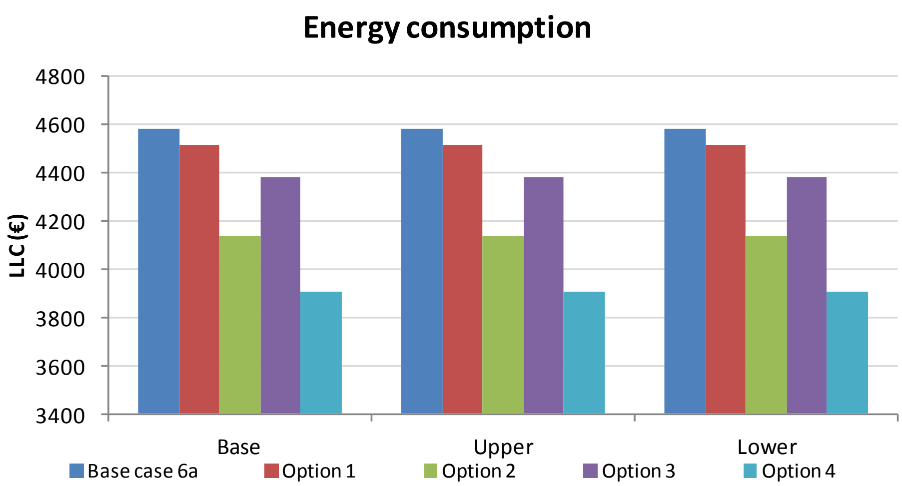


Figure 144: Sensitivity to energy consumption for Base-Case 6a's TEC

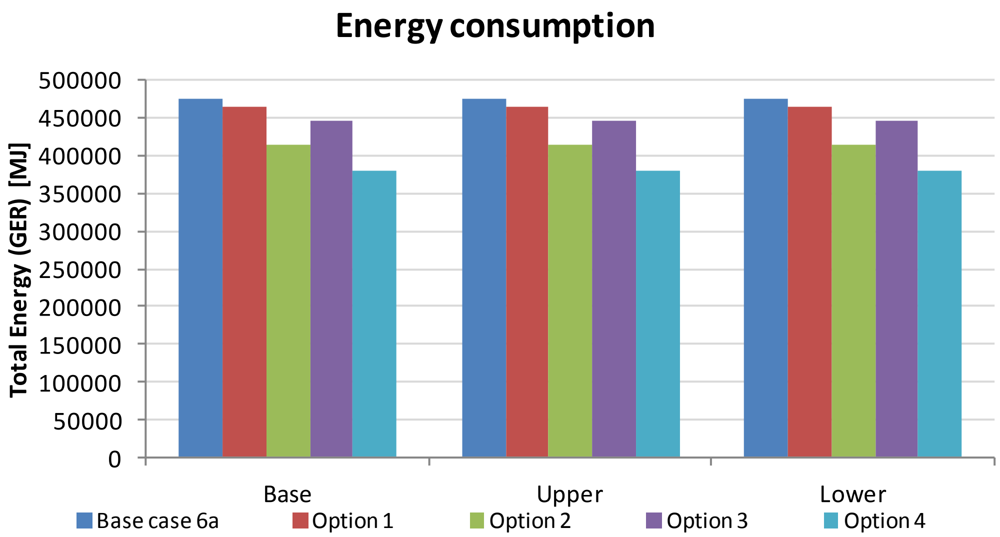


Figure 145: Sensitivity to energy consumption for Base-Case 6b's Life Cycle Cost

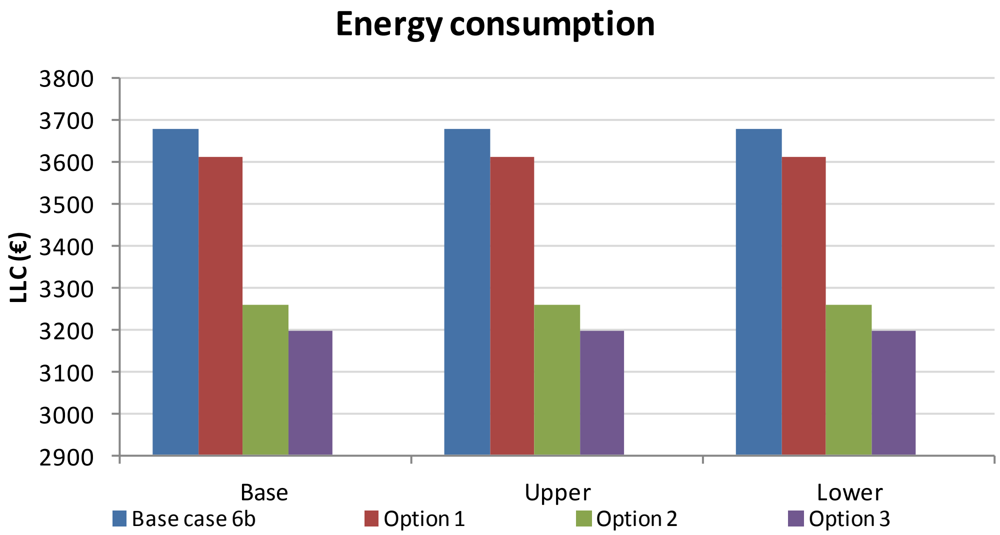


Figure 146: Sensitivity to energy consumption for Base-Case 6b's TEC

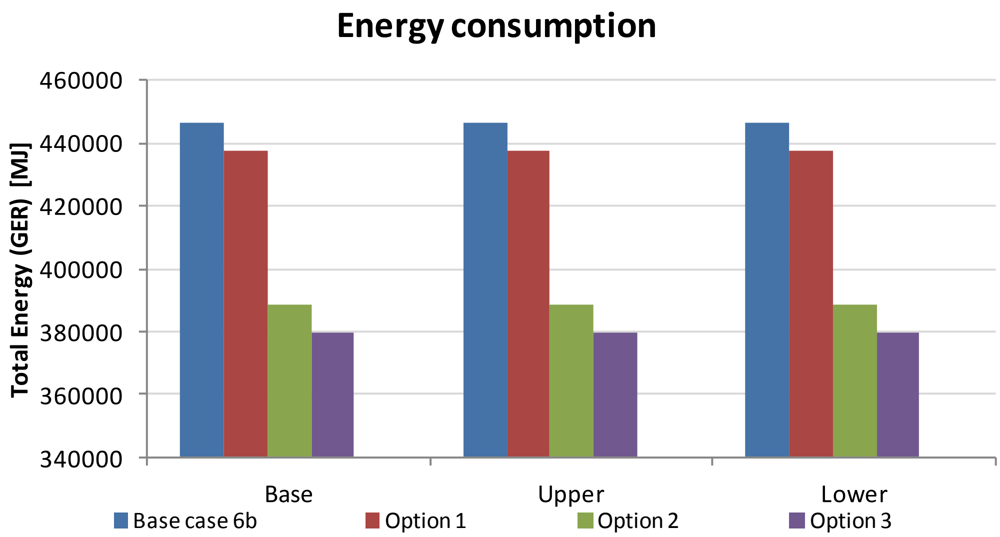


Figure 147: Sensitivity to energy consumption for Base-Case 7's Life Cycle Cost

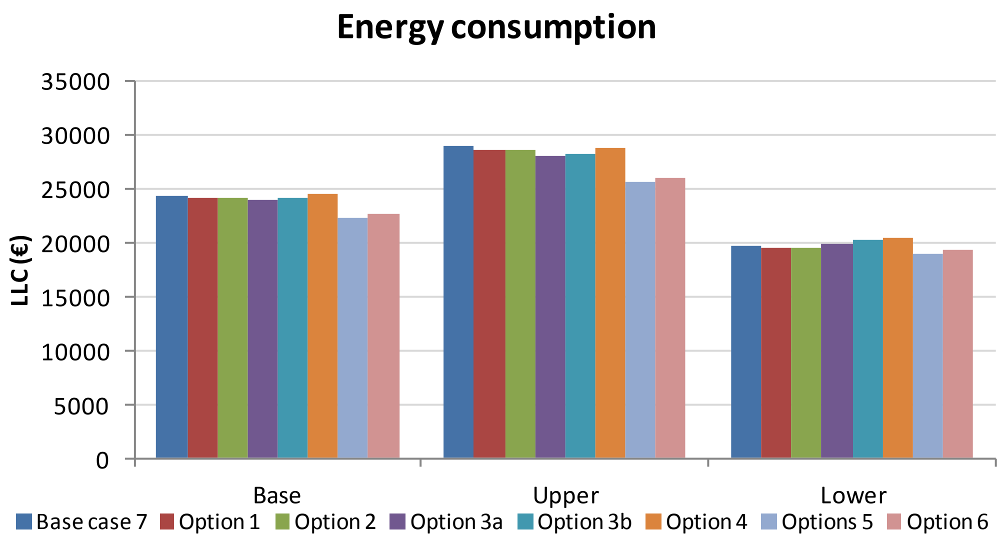


Figure 148: Sensitivity to energy consumption for Base-Case 7's TEC

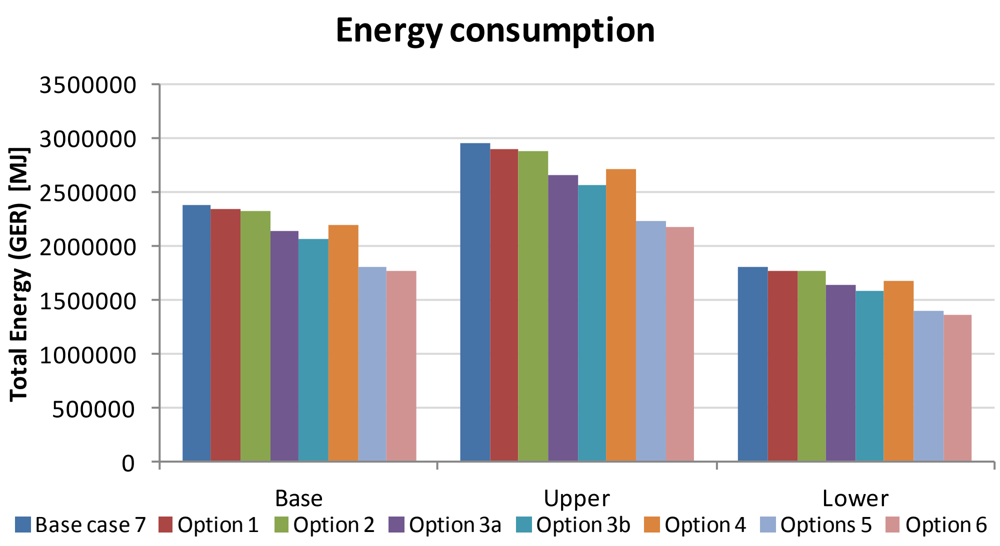


Figure 149: Sensitivity to energy consumption for Base-Case 8a's Life Cycle Cost

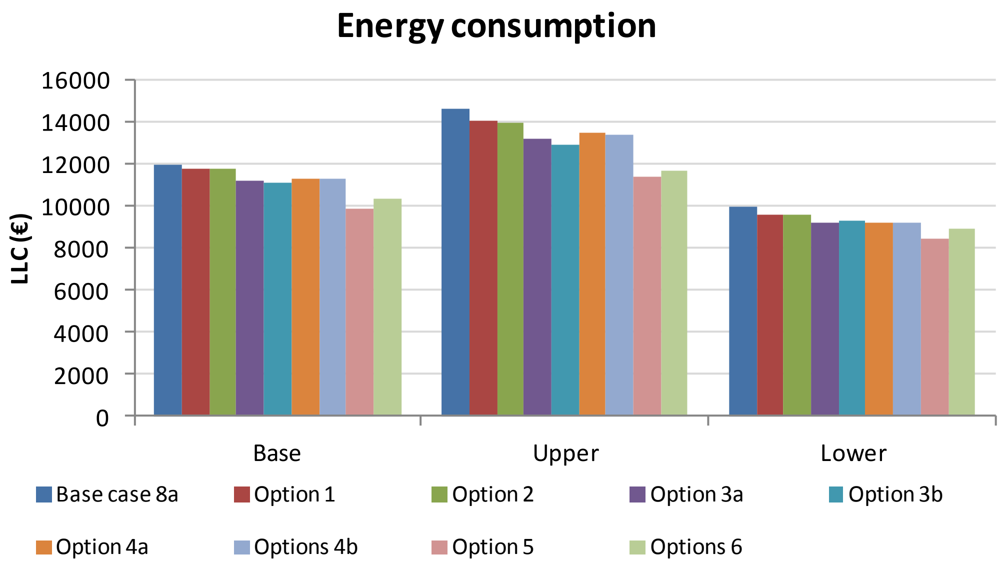


Figure 150: Sensitivity to energy consumption for Base-Case 8a's TEC

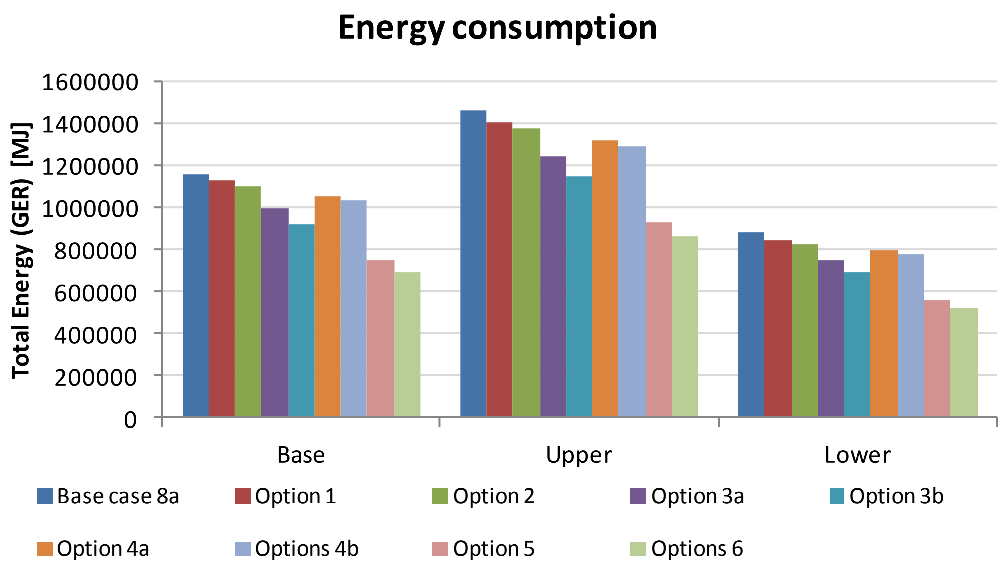


Figure 151: Sensitivity to energy consumption for Base-Case 8b's Life Cycle Cost

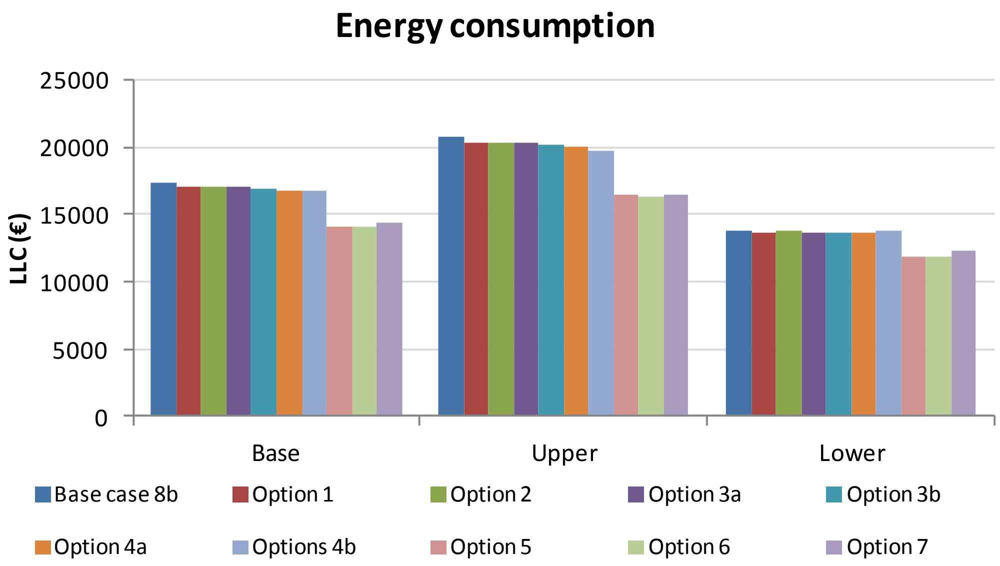


Figure 152: Sensitivity to energy consumption for Base-Case 8b's TEC

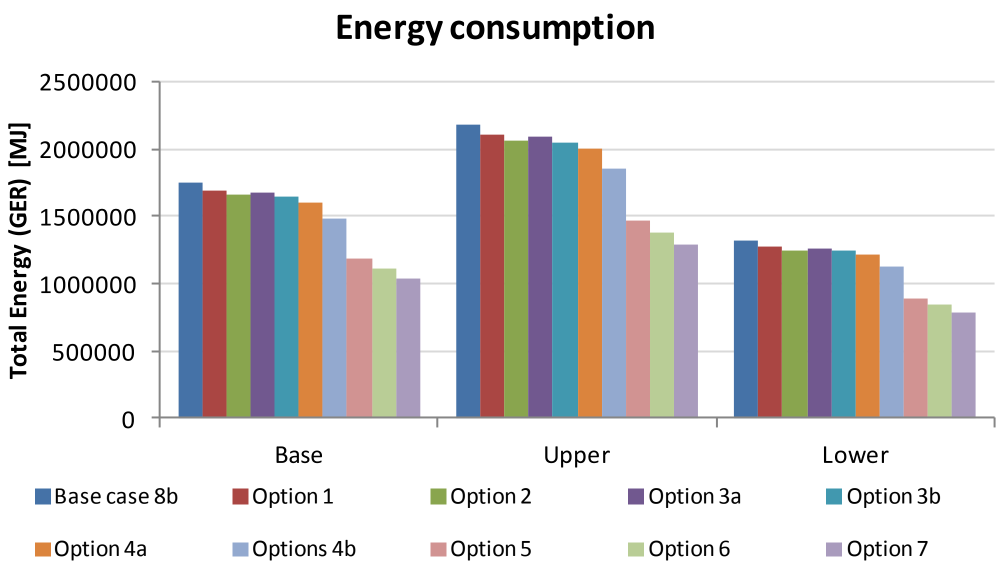


Figure 153: Sensitivity to energy consumption for Base-Case 9's Life Cycle Cost

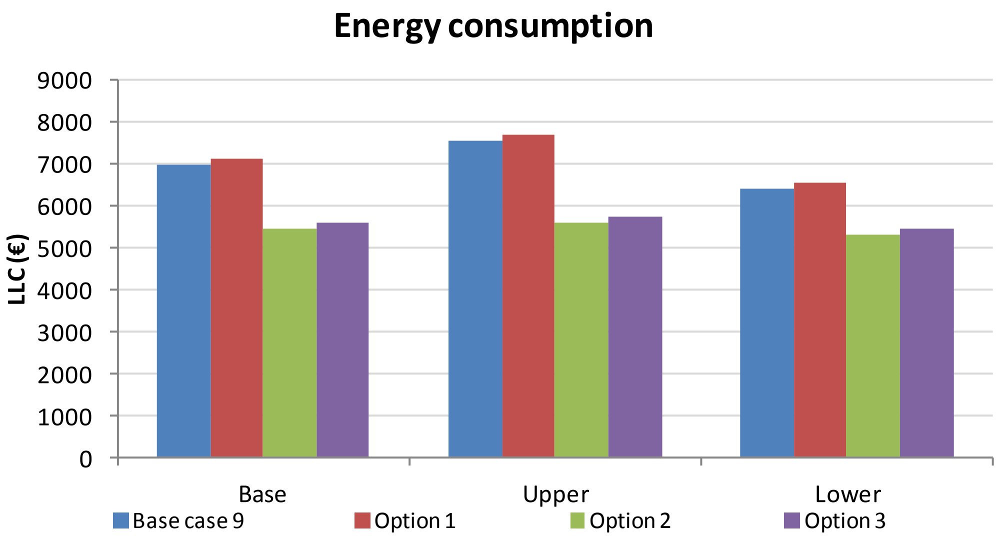
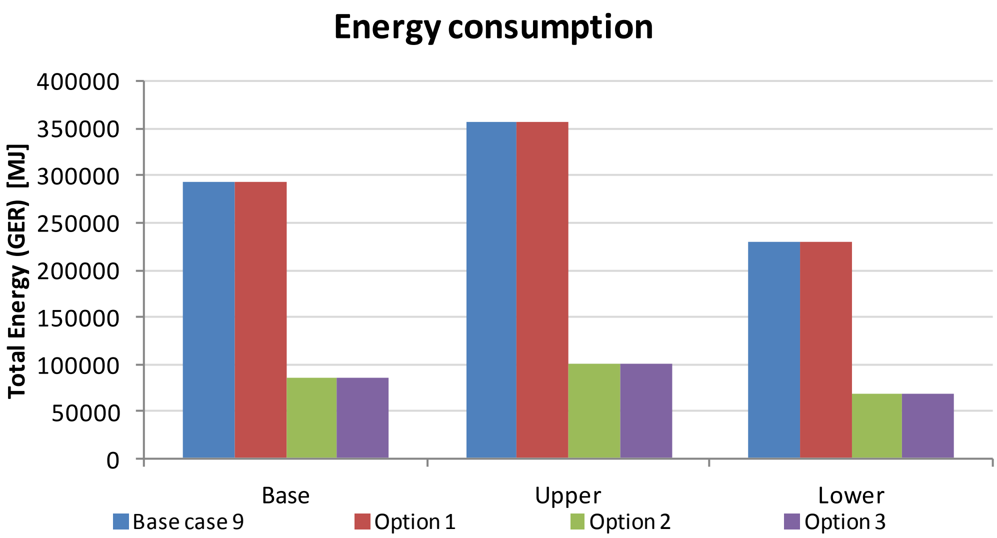


Figure 154: Sensitivity to energy consumption for Base-Case 9's TEC



8.5.6 Assumptions related to the product stocks

Estimating the stock of local room heaters in EU was not an easy task due to the fragmented nature of the market and also limited availability of corresponding market data.

In Task 2, stock data for 2008 was defined based on available information and inputs provided by stakeholders. These values were used in Task 5 to assess energy consumption (and other environmental impacts) at EU level. However, the accuracy of these stock data is quite limited and a sensitivity analysis on this parameter is therefore desirable.

Variation in stock:

- An increase of 20%
- A decrease of 20%

Figure 155: Sensitivity to stock of BC 1 – BC 6 TEC in EU

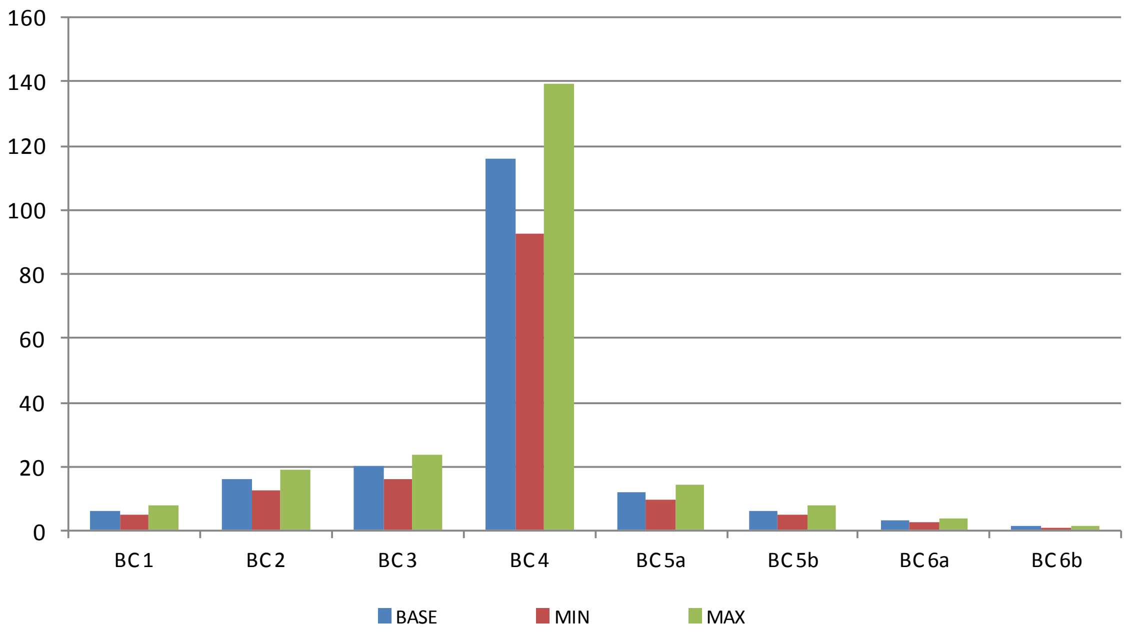
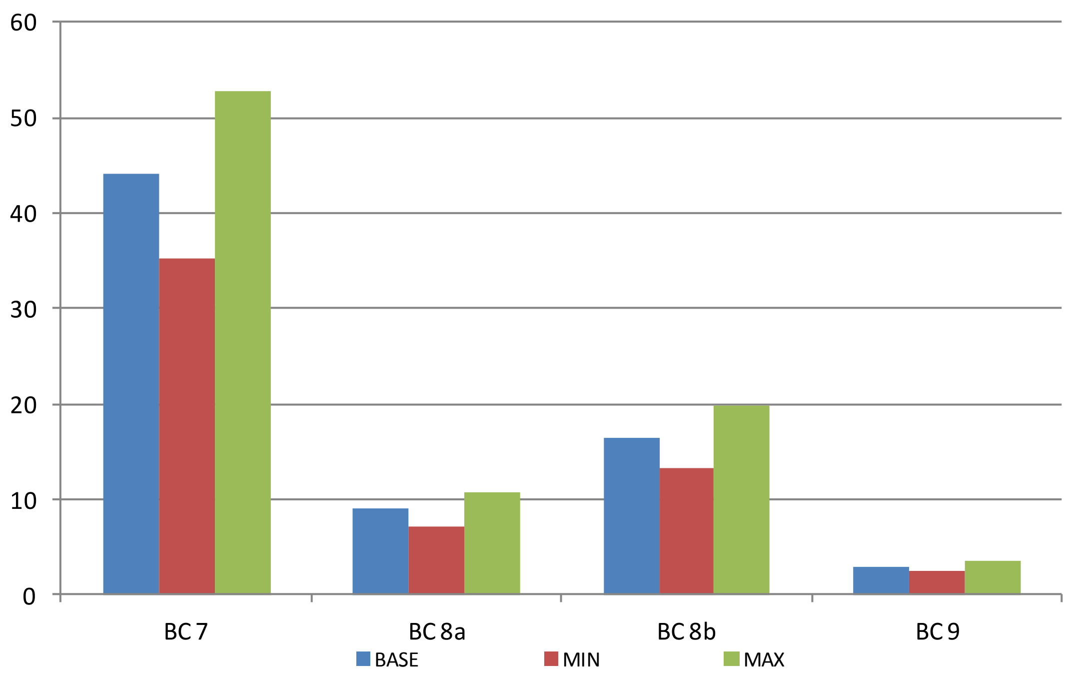


Figure 156: Sensitivity to stock of BC 7 – BC 9 TEC in EU



Stock has a direct impact on all environmental impacts so that a 20% increase in stock increases all impacts by the same percentage.

8.5.7 Conclusion of the sensitivity analysis

When varying the input data on 6 parameters: energy price, discount rate, product purchase price, product lifetime, product stock in EU and annual energy consumption, the ranking of the Base-Case and the different improvement options / scenarios is almost not affected for the 9 different Base-Cases. For all situations, the LLCC remains the same option that was already identified in Task 7. This observation strengthens the reliability of the outcomes presented in previous tasks.

8.6 Conclusions

This Task brings together the findings of the previous tasks of the preparatory study for Ecodesign requirements of local room heaters (electric, gas and liquid fuel). It looked at the possibility to propose suitable requirements for local room heaters examined in this study to achieve significant environmental improvements.

The study showed that there was scope to set Minimum Energy Performance Standards (MEPS) for residential gas/liquid fuel flued heater/fires, and non-residential warm air and radiant heaters. Most of the design improvements for electric heaters for residential use are related to controls (often the extended product) and not the product itself as the Joule effect is almost 100% efficient. Scenarios representing the implementation of policy recommendation (BC 1, BC 2, BC 7, BC 8a and BC 8b), least life cycle costs (LLCC) and Best-Available-Technologies (BAT) in the EU were projected over the period 2011-2035 to quantify the improvements that can be achieved with respect to the 'BAU' and 'Pragmatic BaU' scenarios. As non-residential heating products require professional engineers and technicians to dimension and design the systems, relevant product information requirements were thought to be more effective than simplified energy labels. Two approaches were proposed for a combined energy label forr all the residential heaters using different energy sources.

Besides energy efficiency requirements, policy options for waste/recycling requirements were considered. The residential heaters (other than underfloor electric heaters) are currently covered by the WEEE Directive but not the non-residential heaters. Therefore, it is recommended to include the obligation for manufacturers/installers to have a take-back system for these remaining heater types. Air quality emissions for residential gas/liquid fuel flued heater/fires and non-residential warm air heaters were also proposed.

As the non-residential warm air heaters considered in this study can also be used to provide central air heating, therefore the measures related to the warm air heaters proposed in this study are aligned with the ones proposed in ENER Lot 21 study.

The likely economic and social impacts of the policy options were briefly described. Finally, a sensitivity analysis was performed to assess the main assumptions used in the study and it was concluded that the findings remain robust and reliable.

8.7 Annex A

8.7.1 Further inputs on information requirements

An example of information requirements for non-residential warm air unit heaters is presented below.

Information to identify the model(s) to which the information relates to:							
Indication if the heater is a condensing or low temperature heater:							
Indication if the heater is a cogeneration space heater: yes/no If yes, indication if cogeneration space heater is equipped with a supplementary heater: yes/no							
Item	**Symbol**	**Value**	**Unit**	**Item**	**Symbol**	**Value**	**Unit**
Rated heat output	*Prated*	x,x	kW	**Annual energy efficiency in primary energy**	η_{annual}	x,x	%
Useful heat output				Useful efficiency			
At rated heat output	P_4	x,x	kW	At rated heat output	η_4	x,x	%
At 30 % of rated heat output	P_1	x,x	kW	At 30 % of rated heat output	η_1	x,x	%
Auxiliary electricity consumption				Other items			
At full load	*elmax*	x,x	kW	Standby heat loss	P_{stby}	x,x	kW
At part load	*elmin*	x,x	kW	Ignition burner power consumption	P_{ign}	x,x	kW
In standby mode	P_{SB}	x,x	kW	Emissions of nitrogen oxides	*NOx*	x	mg/kWh
Contact details	Name and address of the manufacturer or of its authorised representative.						

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20-22 Villa Deshayes
75014 Paris
+ 33 (0) 1 53 90 11 80
biois.com