Preparatory Studies for Ecodesign Requirements of EuPs (III)

ENER Lot 20 – Local Room Heating Products – Task 3: Consumer behaviour and local infrastructure

European Commission, DG ENER
25 June 2012

European Commission

Developed by: bio Intelligence Service

Document information

CLIENT	European Commission, DG ENER
CONTRACT NUMBER	TREN/D3/91-2007-Lot 20-SI2.519986
REPORT TITLE	ENER Lot 20 – Local Room Heating Products Task 3: Consumer behaviour and local infrastructure
REPORT SUB-TITLE	Final report
PROJECT NAME	Preparatory Studies for Ecodesign Requirements of EuPs (III)
PROJECT CODE	EUP20
PROJECT TEAM	BIO Intelligence Service & TÜV Rheinland
DATE	25 June 2012
AUTHORS	Mr. Shailendra Mudgal, BIO Intelligence Service Dr. Adrian Tan, BIO Intelligence Service Mr. Sandeep Pahal, BIO Intelligence Service Ms. Mary Ann Kong, 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

ACKNOWLEDGEMENTS

TÜV Rheinland contributed to the first version of this report. Several stakeholders and experts have also contributed with many valuable comments during the course of the study.

Please cite this publication as:
BIO Intelligence Service (2012) Preparatory Studies for Ecodesign Requirements of EuPs (III), ENER Lot 20 – Local Room Heating Products - Task 3: Consumer behaviour and local infrastructure. Prepared for the European Commission, DG ENER.

Photo credit: cover @ Per Ola Wiberg

Table of Contents

List of Tables

List of Figures

Task 3: Consumer behaviour and local infrastructure

This chapter presents an assessment on the influence that consumer behaviour and local infrastructure have on the use of local room heating products during particular phases of their life cycle (notably the use and end-of-life phase). To some extent, product design can be used to influence a consumer's behaviour so as to influence the environmental impacts and the energy efficiency associated with the product use. This section also identifies barriers and restrictions to possible Ecodesign measures due to social, cultural or infrastructural factors. A second aim is to quantify relevant user parameters that influence the environmental impact during product life that are different from the standard test conditions as described in Task 1. Further, analysing real life use conditions of products in comparison with standard test conditions will provide a more accurate picture of the real energy use.

3.1 Consumer behaviour

This section looks at how consumer behaviour affects the real life environmental impacts of local room heating products in the use and end-of-life phase. Information on how real-life efficiencies of local room heating products differ from those tested in standard conditions and to quantify user defined parameters will also be provided. Assessment of the impact of consumer behaviour on real life efficiency and environmental impacts of local room heating products needs to take into account the following parameters:

- Factors that influence purchasing decisions
- Installation requirements
- Frequency and characteristic of use
- Real life efficiency, such as load efficiency (real load vs. nominal capacity), temperature- and/or timer settings; quality and consumption of auxiliary inputs; power management enabling-rate and other user settings, repair and maintenance practice (frequency, spare parts, transportation and other impact parameters)
- End-of-life behaviour

As the scope of products in this study includes both residential and non-residential heating, the customer and end-user is not always the same. Consumer behaviour in homes is different from those in the commercial, public and industrial sectors. In the following sub-sections a distinction will be made between consumers in the residential heating market and those in the non-residential heating market.

In the residential market the customer (the person who pays) is often also the end-user in the case of homeowners and for most portable appliances. In the case of renting and social housing, the end-user does not necessarily have an influence in which heating system is purchased, but does have to pay for its running costs.

3.1.1 Factors influencing purchase decisions

The purchase of a heating system is the first step by which consumer behaviour can have an effect on the products covered by the Lot 20 preparatory study. Appliance functionality is usually the primary factor influencing the purchase decision of the consumer. Purchasing price is also an important factor influencing consumers and is discussed in further detail in Task 2. Other factors such as heating costs, energy infrastructure, and design are also important and are discussed in further detail below for heating appliances used in residential and non-residential buildings.

Stakeholder responses to questionnaires prepared for this task indicate the main factors influencing the consumer purchase decision for local room heating products are as per following:

- Building type
- Thermal comfort
- Functionality
- Energy savings and environmental performance
- Economic factors
- Energy infrastructure
- Design/aesthetics
- Health and safety aspects
- Advice from manufacturers, energy suppliers, specifiers, installers, etc.

Building type

Buildings' characteristics (such as insulation, ceiling height, needs for ventilation, use of the building) determines the heating requirement. In that way, building type is a very important factor influencing purchase decision, especially for non-residential applications where the choice of heating technology depends on the specific building uses. Radiant heating is more suitable for spaces with high ceilings and high ventilation or drafts. Radiant heating is also suitable for large areas where heating is only needed in specific places (zones). However, for buildings with high needs of ventilation, the solution of using a warm air heating system may be preferred to radiant solutions.

Besides this, the choice of heating system can be limited in existing buildings due to the absence of suitable flue for flued gas and oil heating products will influence the choice of heating system. For buildings that are rented, the owner of the building may have preferences of what type of heating system can be installed. Local and national building regulations may also determine the choice of heating systems.

Thermal comfort

For customers in the residential market (such as homeowners) who also use the appliances they buy themselves, thermal comfort is the main criteria driving the market for installed direct heating in homes. Thermal comfort from residential end-user's point of view includes aspects such as:

- Air temperature
- Mean radiant temperature
- Heat inertia of the heating appliance especially for poorly insulated houses
- Air quality (air between 40% to 60% of local humidity grade and no air movement superior to 0.2 m/s)
- Level of temperature homogeneity in the room
- Quick heat ramp up (usually less than 2 hours to go from 15.5°C to 19°C)[1]

For commercial and industrial applications, thermal comfort beyond work environment regulation is not a major concern. Especially in large non-domestic spaces such as workshops, warehouses and sport halls, thermal comfort is needed only in the areas used regularly by people. In these buildings, the heat transfer from the heating source to the zone of required thermal comfort is a key parameter in the choice of heating system.

Functionality

Local room heating products used in residential buildings can serve as either the primary or secondary/complimentary heating source. These heating products can boost the temperature of rooms used by individuals who are sensitive to cold, especially elderly persons, without overheating the entire house. In residential buildings these products are sometimes purchased as an alternative to central heating, when the main heating system is inadequate or when central heating is too costly to install or operate.

Energy savings and environmental performance

In many cases, consumers purchase portable local room heating products to compensate for issues related to wastage of energy in their homes, such as a poorly maintained furnace, inadequate insulation, and missing caulk around windows or damaged weather stripping around doors.

Residential end-users are often not aware of the difference in energy efficiency among competing products and fuel types due to the absence of energy efficiency labels for these products. For commercial and industrial customers energy savings (proportional with economic savings) are often the main criteria for choosing heating systems. Other environmental aspects are rarely of any concern.

[1] The UK Government's Standard Assessment Procedure (SAP) for Energy Rating of Dwellings,(part of the UK national methodology for calculation of the energy performance of buildings) specifies the 'Responsiveness' of various heating systems in its calculation methodology.

Economic factors

Findings of Task 2 indicate that sales of some local room heating products, such as fixed electric radiators, are increasing due to the rise in running cost for space heating. Local room heating products are seen as a low cost alternative to central heating, when only small heating demand is required. For customers that do not use the appliance themselves or just use it temporarily, the selling price of the heater can become the most important purchase criteria. In general, electric heaters are cheaper to buy compared to other sources of heat, but may be more expensive to operate, because electricity is typically more expensive per unit of heat energy produced than gas or liquid fuel. This should however be weighted with the energy efficiency of the different appliances.

An industry stakeholder from the UK states that the type of fuel selected for residential heating applications depends largely on the fuels already available at the property where consumers live. Residential end-users usually lack information on the cost to operate their equipment over the product's lifetime. However, for non-residential heating applications, the choice of fuel type is only finalised after a selection of the main features and a comparison is done on the various cost options against their budget.

Energy infrastructure

The choice of heating system is sometimes limited by the availability of a public supply of gas or electricity. For buildings not connected to gas mains, it is possible to have a LPG storage tank installed or use cylinder gas. This is however represents an additional investment or commitment to LPG supply. Customers tend to choose the energy sources that are already readily available to them.

Design/aesthetics

Local room heating products are not only purchased to heat up a room but are also often seen as a decorative piece in homes by consumers. In particular for direct heating appliances used in residential buildings, besides the principal heating function of the appliance, other factors like aesthetic pleasure and design are also important criteria. For example, fireplaces may sometimes be chosen because of their decorative appearance and ambiance rather than for the heat they generate.

For non-residential applications and indirect heating appliances, aesthetic issues are less important (indirect heating appliances such as centralised heating systems are not usually openly displayed in places such as living rooms, bedrooms, etc.). Other qualities such as heat output, temperature control, ease of use and noise are characteristics that are tested by consumer associations such as "consumer reports" to rate and recommend certain local room heating products[2].

Health and safety aspects

Heating appliances sold on the EU market have to meet strict health and safety criteria. Indeed, health and safety aspects are strictly controlled by standards mentioned in Task 1. However, their

[2] Consumer reports website: www.consumerreports.org/cro/appliances/heating-cooling-and-air/space-heaters/index.htm, Accessed: 13/12/2010

improper installation or use may cause fires or degradation of indoor air quality. As an example, low temperature heating has the health advantage that it does not burn the dust. A recent study on consumer behaviour and fire safety found that fire caused by human behaviour occurs more often than caused by technical failure[3]. The use of heating appliances is one of the causes of fatal domestic fires: 3% in the Netherlands, 5.8% in Sweden and 8% in London. The study does not specify which type of heating appliance is the cause of fires, but mentions that in New Zealand, except for one, all fires caused by heating between 1997 and 2003 started in electrical heaters. In the USA, 73% of all fatal heating fires were caused by stationary or portable space heaters. The frequent use of space heaters causes a higher risk of fire than central heating[4]. The most common factor for heating fires are a lack of cleaning (60% of all heating fires) and putting combustibles too close to the heat source (28% of the fires, 36% of the fatalities)[5]. There is no evidence that local room heating products in Europe have caused any health or safety incidents. There are however cases of electric portable (mostly imported) heaters that are called back each year by distributors due to product defaults and non-compliance.[6] Therefore, safety and its perception among end users also plays a role during customers' (particularly those with children in residential applications) buying decision of these heating products.

- **Advice from retailers, manufacturers, energy suppliers, specifiers, installers, etc.**

Depending on the sales channel of local room heating products, different heating professionals will try and influence consumers on their choice of heating system. See Figure 3-1 for an example of actors that are implicated in the process of choosing a heating system.

For portable heating products that can be bought off the shelf in DIY stores, the retailers have a large influence through their advice to consumers on which products to choose. For installed systems more actors in the professional network come to play, when a new heating system is about to be installed. For new buildings the building contractors will often contract professional heating (or HVAC) consultants to advise and specify the system. This is done based on information on the building, its heating requirements, the owner's or occupier's preferences and product information from heating equipment manufacturers. In existing buildings the owner or occupier may simply ask an installer to plan and specify the heating system, or also contract a heating (HVAC) specialist for larger and complex systems. No matter what the process is, it is important that the right information on the products and building are used to ensure the heating system is suitable for the purposes and dimensioned correctly.

[3] Austrian Ministry for Labour, Social Affairs and Consumer Protection (2009) Consumer fire safety: European statistics and potential fire safety measures [Available online: www.verbraucherrat.at/download/firesafetyconsumer.pdf]

[4] Office of the Deputy Prime Minister (2006) Fires in the Home: findings from the 2004/05. Survey of English Housing. National Statistics.

[5] Austrian Ministry for Labour, Social Affairs and Consumer Protection (2009) Consumer fire safety: European statistics and potential fire safety measures [Available online: www.verbraucherrat.at/download/firesafetyconsumer.pdf]

[6] Que Choisir 486, November 2010.

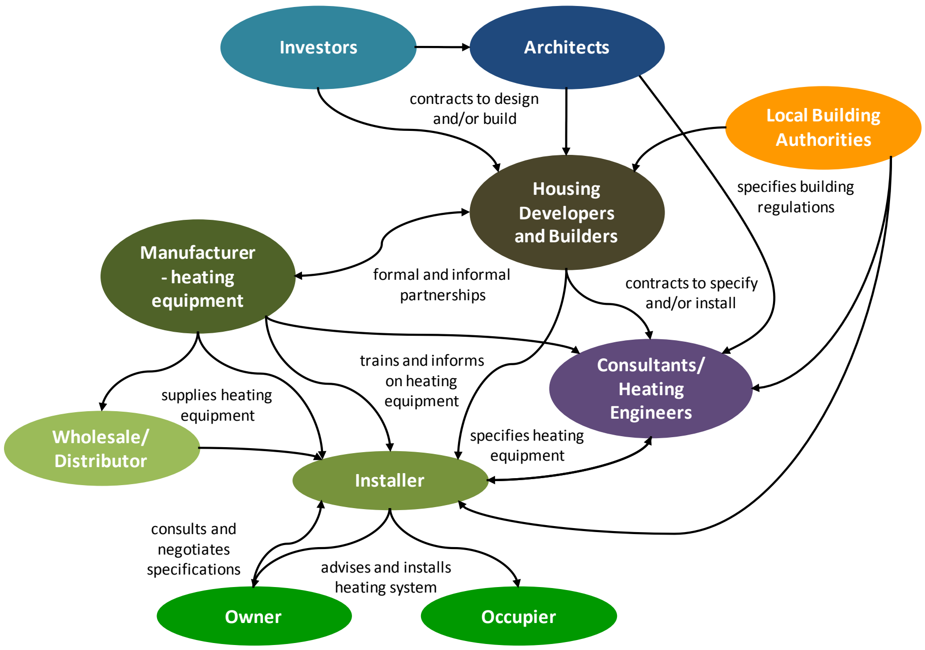

Figure 3-1: An example (not generic) of what actors are involved in the specification of installed heating equipment[7]

3.1.2 Installation requirements

Installation requirements for local room heating products may vary across their applications in the residential and non-residential buildings. Safety precautions are of particular concern regarding the installation and use of certain local room heaters. Fire experts and manufacturers offer safety advice to ensure that consumers properly install and safely use the products as intended. Examples of such advice include[8]:

- Do not cover convectors and radiant heaters with clothes. Only towel heaters are designed to dry clothes and towels.
- Do not leave an electric heater unattended while it's plugged in. Heaters should be place on a level, flat surface where children and pets cannot reach it- and should never be put in a child's room. Use a heater on a tabletop only when specified by the manufacturer. If placed on furniture, it could fall and be damaged.
- Do not use a space heater in a damp or wet area unless it's designed for outdoor use or in bathrooms. Moisture could damage it.
- Keep combustible materials such as clothes, furniture, bedding, and curtains at least a metre from the front of the heater and away from its sides and rear. Do not use a heater near paint, gas cans, or matches. Keep the air intake and outlet clear.

[7] After Banks, N.W. (2000) The UK Domestic Heating Industry – Actors, Networks and Theories. Appendix C to Lower Carbon Futures for European Households. Environmental Change Institute, Ecofys and ISR.

[8] www.consumerreports.org/cro/appliances/heating-cooling-and-air/space-heaters/space-heater-buying-advice/space-heater-getting-started/space-heater-getting-started.htm

- Run the electric cord on top of rugs or carpeting so that even if you step over it without abrading it underfoot. Plugging another electrical device into the same outlet or extension cord as the heater could cause overheating.
- For liquid-fuelled heaters, only the approved fuels should be used. For example, gasoline should never be used in kerosene room heaters.

Gas heaters can be vented or unvented ("vent free"). Unvented units should only be used in rooms that are sufficiently ventilated, as they introduce unwanted combustion products into the living space, including nitrogen oxides, carbon monoxide, and water vapour. Vented units are designed to be permanently located next to an outside wall or chimney, so that the flue gas vent can be installed through a ceiling or directly through the wall to the outside.

For gas room heaters at the EU level, the Gas Appliance Directive (2009/142/EEC[9]) addresses the design and installation of fuel gas systems and gas-fired appliances through requirements that emphasise performance (see Task 1 for more information). This code covers unvented and vented gas room heaters. As most gas space heaters require venting, professional installation is recommended. Installed (wall mounted) room heaters shall be attached to a non-combustible wall surface. Radiant (infrared) type space heaters also have recommended clearances from the sides and rear as well as in front. Task 1 provides more detailed information on standards and legislations that govern the installation requirements for certain local room heating products.

3.1.3 Frequency and characteristic of use

Consumer behaviour in the use phase of direct heating equipment greatly influences energy efficiency and environmental impacts. Therefore, understanding how consumers use local room heating products and the factors that influence frequency and characteristics of use is important to determine real life use conditions and the extent to which consumer behaviour influences possible environmental impacts in the use phase of local room heating products.

Calculation of frequency of use

In past preparatory studies on heating products such as ENER Lot 1 on boilers the frequency of use of these specific heating appliances are calculated based on various approaches and parameters that could also be relevant in the case of Lot 20 products. For boilers in the context of the ENER Lot 1 preparatory study, the following parameters affecting the frequency and characteristics of use of these appliances were identified:

- Climate conditions
- Appliance type and function
- Building type and heating demand
- Demographic conditions

[9] To undertake a codification of this directive, the Commission has made a proposal for a Directive of the European Parliament and of the Council relating to appliances burning gaseous fuels (Codified version), COM(2007) 633 - COD 2007/0225

Similar to Lot 1 products, the above parameters also affect the characteristics of use of Lot 20 products and are further discussed below. In addition, to some extent demographic factors also affect use patterns of local room heating products and will also be discussed briefly.

- **Climate conditions**

In general, the use patterns of a heating system exhibit a large degree of sensitivity to weather. In other words, local conditions and infrastructure play a big role on the use of the local room heating products by consumers. Energy consumption and end-user patterns of local room heating products will depend on the nature of the building envelope (e.g. materials used for construction, air-tightness, etc.). Heat will be lost and gained depending on levels of insulation, ventilation and solar radiation. The usage patterns of heaters are largely determined by users' perceptions of a comfortable indoor living environment. Climatic conditions and user preferences for indoor air temperature are the main factors in determining the frequency and the characteristics of use (temperature and timer settings) of local room heating products. In the EU, available long-term measurements of indoor preferred residential temperatures give the level of 18°C in United Kingdom, 20°C in Ireland, and 21-22°C in Sweden. In South-East Europe, substantially reduced indoor temperatures have been a reality during the recent years for the poorest part of the population with respect to affordability. According to the World Health Organization, the optimum indoor temperature for good health is between 18 and 24°C[10], with night temperatures lower.

The calculation of Heating Degree Days (HDD) and the length of the heating season are important indicators that can be used to help estimate the frequency of use of local room heating products based on climatic conditions. HDD is an indication of the heat demand based on outdoor temperatures. HDD is calculated by summing the difference between the mean outdoor temperature (Tm) and the base temperature (for each outdoor temperature) multiplied by the number of days it occurs over a year:

The greater the number of HDD, the more the heating system must work in order to keep the inside environment comfortable. In practice this is measured as the number of days the outdoor temperature is under a certain a base temperature, which is the outside temperature above which a building needs no heating. This base temperature differs from one building to the other as it is mainly depending on its insulation quality. Eurostat defines the average minimum temperature for when heating is needed at 15°C.[11] Figure 3-2 shows the average HDD for EU-27 over the period 1980-2004, weighted by dwelling stock. Due to the large climatic differences between MS, the frequency and characteristics of use are likely to vary considerably across the EU.

According to the recently published report on "The European Environment State and Outlook 2010", HDD have declined in almost all European countries since 2004. Climate change has lead to an increase in mean land surface temperature and winter temperatures in Europe are

[10] EuroHeatCool, 2006, "The European Heat Market"
[11] Eurostat: http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/nrg_esdgr_esms.htm

increasing more rapidly than summer ones[12]. Therefore, despite a short term increase in 2008 and 2009, heat demand still remained below the 1980–2004 mean.

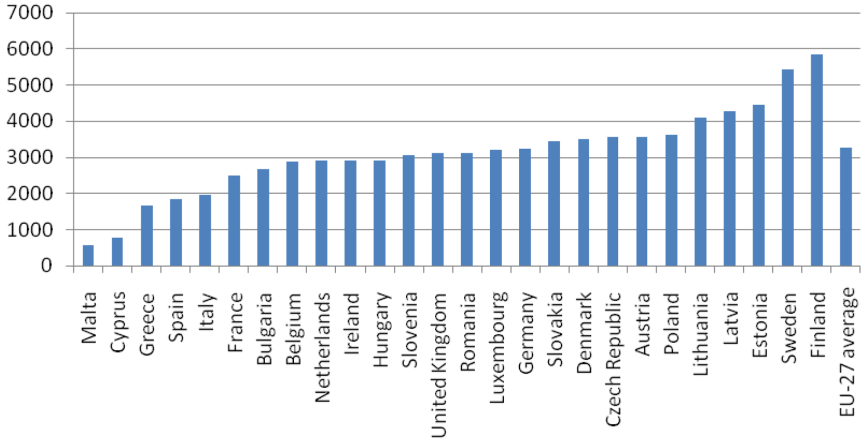

Figure 3-2: The mean HDD over the period 1980-2004 for EU-27[13]

Figure 3-3 shows that current heat demand in Europe is below its long-term average (defined as 1980–2004). Warmer winter days (and thus decreasing HDD) will be an important aspect to consider for later tasks.

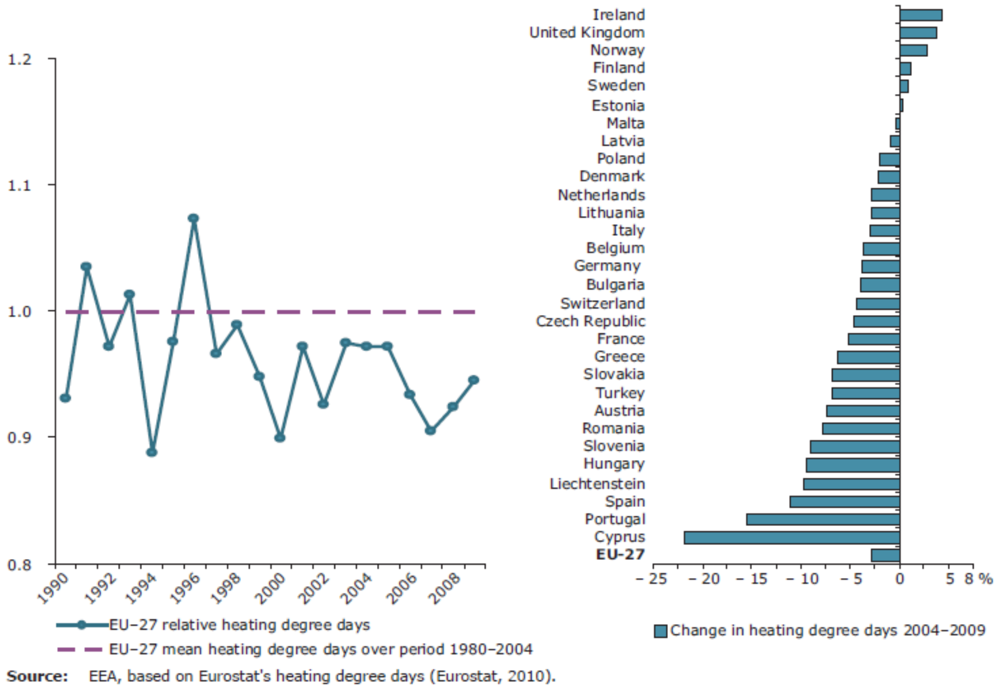

Figure 3-3: Change in HDD as fraction of EU-27 mean heating days (left) and change in HDD 2004–2009 (right)[14]

[12] EEA (2010) The European Environment State and Outlook 2010: Thematic Assessment, Mitigating Climate Change, www.eea.europa.eu/soer/europe/mitigating-climate-change/at_download/file

[13] Eurostat data

[14] EEA (2010) The European Environment State and Outlook 2010: Thematic Assessment, Mitigating Climate Change. www.eea.europa.eu/soer/europe/mitigating-climate-change/at_download/file

Table 3-1: Average heating season (in months) for EU-27 based on average HDD from 1980-2004*

Member State	Mean heating degree-days over period 1980 - 2004	Heating season in months	Number of days in heating season	Grouped by heating season average	Average number of days per group	Average duration in months of heating season per group
Finland (FI)	5 849	10.8	323	Group 1	288	9.6
Sweden (SE)	5 444	10.2	306			
Estonia (EE)	4 445	8.8	265			
Latvia (LV)	4 265	8.6	257			
Lithuania (LT)	4 094	8.3	250	Group 2	214	7.1
Poland (PL)	3 616	7.7	231			
Austria (AT)	3 574	7.6	229			
Czech Republic (CZ)	3 571	7.6	229			
Denmark (DK)	3 503	7.5	226			
Slovakia (SK)	3 453	7.5	224			
EU-27 average**	**3 254**	**7.2**	**216**			
Germany (DE)	3 239	7.2	215			
Luxembourg (LU)	3 210	7.1	214			
Romania (RO)	3 129	7.0	211			
United Kingdom (UK)	3 115	7.0	210			
Slovenia (SI)	3 053	6.9	208			
Hungary (HU)	2 922	6.7	202			
Ireland (IE)	2 906	6.7	202			
Netherlands (NL)	2 902	6.7	201			
Belgium (BE)	2 872	6.7	200			
Bulgaria (BG)	2 687	6.4	193			
France (FR)	2 483	6.1	184			
Italy (IT)	1 970	5.4	163	Group 3	138	4.6
Spain (ES)	1 842	5.3	158			
Greece (GR)	1 663	5.0	151			
Portugal (PT)	1 282	4.5	135			
Cyprus (CY)	782	3.8	114			
Malta (MT)	560	3.5	105			

* weighted by dwelling stock
** this table does not relate to Air Curtains, data for the them is provided separately, see Task 5.

Table 3-1 regroups the HDD averages across MS by average heating season and number of heating days per group[15].

Appliance type and function

The type of local room heating product in question may also be important in terms of frequency and characteristics of its use. At least three major applications[16] of local room heating products were identified:

- Primary residential heating
- Primary non-residential heating
- Secondary heating

Each application has different use patterns. Primary heating is used for several hours a day during the heating season. Heaters used for secondary heating may only be used irregularly and only for a few hours at a time. Heaters used as primary heating may benefit from automatic controls, while heaters used as booster heat are typically manually controlled. Manually controlled appliances may require more frequent operator intervention, whereas in the case of automatic appliances, more dynamic temperature controls are often adjusted automatically according to the outside temperature. In addition, aspects such as an estimation of the share of secondary appliances, as well as their typical frequency of use, need to be made. This is because installed local room heating appliances are generally assumed to operate continuously during the heating season, whereas portable local room heating appliances such as electric portable fan heaters are mainly used as a secondary heat source and may not be operating frequently[17]. Therefore, whether or not the local room heating product is used as primary or secondary heating source will influence frequency and characterisation of use.

Building type and heating demand

The JRC Study[18] on "*Environmental Improvement Potentials of Residential Buildings (IMPRO-Building)*" published in 2008 classifies the residential building types in EU into following three categories:

- **Single-family houses:** It includes individual houses that are inhabited by one or two families. Also terraced houses are assigned to this group. This group represents 53% of the existing EU-25 building stock.

---

[15] The three climatic zones are defined as proposed in the JRC Study to develop Ecolabel and Green Public Procurement for Buildings:
- Cold zone : HDD > 4200°C.day
- Moderate zone : 2200°C.day < HDD < 4200°C.day
- Warm zone : HDD < 2200°C.days

[16] Evidentially there are numerous ways of using local room heating products. These are but three archetypical applications.

[17] BIO et al. (2009) Preparatory Studies for Eco-design Requirements of EuPs (II), Lot 15 Solid fuel small combustion installations, Task 3: Consumer behaviour and local infrastructure, [Available online: www.ecosolidfuel.org/docs/BIO_EuP_Lot%2015_Task3_v3_200906.pdf]

[18] Source: http://ftp.jrc.es/EURdoc/JRC46667.pdf

- **Multi-family houses**: It contains more than two dwellings in the house. It is considered that buildings with fewer than 9 stories are regarded as multi-family buildings. This group represents 37% of the existing EU-25 building stock.
- **High-rise buildings**: were defined as buildings that are higher than 8 storeys and represent 10% of the existing EU-25 building stock.

The above classification of residential buildings also helps to takes into account their distribution into three main zones in Europe that roughly represent three climate zones according to heating degree days (HDD).

For non-domestic buildings that use decentralised heating systems the heat demand depends on the specific application. The industry associations EURO-AIR and ELVHIS provide some examples[19]:

- **Factories**: Buildings with high ceilings and large volumes with material traffic between inside and outside. Often these buildings have additional heat sources from machinery and processing equipment. Unless the factory employs several work shifts, the buildings are not heated during the night, weekends or holidays.
- **Warehouses and logistic buildings**: buildings that are mainly heated at low temperatures, sometimes only to maintain a frost free environment. Some areas may however require higher temperature. Large volumes of materials enter and leave the building.
- **Sports halls and churches**: Buildings that are generally only used temporarily and often only partially. They require heating systems that can heat up areas quickly and are able to only heat individual areas.
- **Retail buildings (e.g. supermarkets, show rooms, car dealers, etc.):** These spaces are not used at night or on holidays and therefore do not need to be heated during this time.
- **Workshops:** These buildings are only heated when used. When the door or gate is closed the temperature in the space has to be re-established quickly.
- **Airplane hangars**: Hangars are large and high buildings that generally have one side that opens entirely. When the door or gate is closed the temperature in the space has to be re-established quickly.
- **Greenhouses and buildings used for animal production**: These spaces need to be kept at a steady temperature level. The heating system has to be able to offset sudden temperature changes, e.g. from rain.
- **Steel or material storage**: Steel has to be stored at 1 – 2 °C higher than the ambient air temperature (even in summer) to avoid corrosive condensation.

[19] EURO-AIR / ELVHIS (2010) Common position paper to ErP Directive.

A key factor to ensuring energy efficiency is that the heating system is well-suited to the building and its heating demand. For example, a heater for a small workshop will probably not be the best choice for a warehouse with a high ceiling. The design and planning of a heating system need to take into consideration the individual requirements. This is often ensured through qualified engineers that specify the heating system for customers in cooperation with manufacturers' guidelines and specifications.

There are several different approaches to calculating the heat demand of buildings and indoor spaces. Sophisticated energy simulation models and standards such as EN 15316 do exist, but require specific information about the building, climate conditions, operation modes, etc. For the purposes of this study, a simplified approach to calculating the annual heating requirement is used:

Hours of operation

Q_h [kWh]: energy requirement for heating (also called heating demand)

HL [W/°C]: heat losses[20]

Dh {°C h}: heating degree hours

A [m^2]: room heated area

T_s [°C]: set temperature

ΔT [°C]: average ambient temperature

12.33 [W°/C] is a heat loss through the walls for a 10.33 m^2 room[21]

1000 [$W.kW^{-1}$]: conversion factor from kW to W

The hours of operation can be expressed as the product of average amount days in heating season in the EU by the heating duration per day.

The method described above was used as a reference for all local room heaters in the product scope of Lot 20 study except air curtains. Calculation of energy requirement for air curtains is performed separately due to their specific functionality. For the Base-Cases (Task 5), the final values used to determine the annual heat demand was agreed upon with the stakeholders.

Demographic factors

To some extent housing family size and age of occupants also affect the use pattern of residential local room heating products. Occupant behaviour, such as individual levels of thermal comfort and hours of occupancy will also affect energy consumption and the use of local room heaters. Some local room heating appliances contain thermostats. The energy consumption of these

[20] The parameter is provided by stakeholders (CECED) and transferred to the standard room area for residential and non-residential heaters used in the present study

[21] Source: stakeholder's inputs (CECED)

appliances can be expected to depend on the surrounding indoor temperatures and also rates of heat exchange between the appliance in question and its microenvironment.

The role of age has been the focus of several studies that estimate space heating consumption. Empirical studies have been carried out in Japan, Norway and USA confirms the positive correlation between residential consumption for space heating and age of household's members[22]. Simply put, more energy is needed for space heating as the household head becomes older. Elderly persons prefer higher room temperatures and in general tend to stay at home more than younger persons.

Some studies have also looked into household size as a variable for energy consumption for home heating. It is estimated that household family size is a positive and significant parameter of the choice of dwelling size, which in turn affects households' demand for space heating[23]. Study findings show that particular household composition, such as the existence of a baby as a family member significantly and positively affects the amount of energy consumed for space heating.

So far, not much detailed information on the above aspects regarding the use patterns of local room heating products could be identified. Nevertheless, stock data on local room heating products and climate information have been identified which can be used in the estimations on frequency and characteristics of use. In case of absence of all needed information, estimations based on certain assumptions can be made in order to calculate frequency and characteristic of use.

In ENER Lot 15 (solid fuel small combustion installations (SCI)) study, two main approaches were used to make such estimates. The first is the bottom-up approach, whereby use patterns and technical specifications of an SCI (per appliance) were modelled based on data and/or assumptions. A top-down approach was also used, whereby the total direct energy consumption of solid fuel in the residential sector was split among the different appliances according to their stock and weighing factors. Possible approaches to determine the best estimates for frequency and use of local room heating products can be further analysed based on stakeholder's inputs.

Currently, available data include:

- Stock data on the breakdown of different local room heating products by Member State (provided in Task 2)
- Climate information, specifying space heating demands for EU MS and relationship between outside temperate and hours that room heaters are used (data from Australian study).
- Energy consumption per appliance and per year (kWh/year)
- Some preliminary estimates on the hours per day that local room heating products are used for certain regions in EU-27

[22] Sardianou, Eleni (2008) Estimating space heating determinants: An analysis of Greek households
[23] Sardianou, Eleni (2008) Estimating space heating determinants: An analysis of Greek households

3.1.4 Real life efficiency

As explained in the earlier sections, the real life energy efficiency of local room heating products is influenced by many different factors. This section presents the differences between the efficiency of local room heaters in standard test conditions as compared to the real life conditions in which these products are operated. The influence on environmental impacts of these products associated with user parameters is also discussed in this section.

Before analysing the factors that contribute to real life efficiency, one must first define efficiency for heating products. Electric heaters function by Joule Effect which means that all the electrical energy is transformed to heat. With oil and gas heaters, efficiency can relate to combustion efficiency, thermal efficiency or Annual Fuel Utilisation Efficiency (AFUE). All of these can vary considerably. Efficiency in this study will be defined in the subsequent tasks. In this section, only the factors that affect efficiency are discussed. The influence of each of the following listed factors is different depending whether it is residential or non-residential heating.

3.1.4.1 Installation and location of the appliance

As stated by many test standards, gas-based local room heaters must be installed in a well-ventilated, draft free room with a specified ambient temperature (e.g. 20°C ± 5°C). Other ambient temperatures for testing are acceptable provided that the test results are not affected.[24]

Installing convective heating appliances under windows appears to be beneficial for user comfort, but this practice does not appear to increase consumption. Local room heaters are occasionally found to be located too close to combustible materials or with flue gas channels of incorrect dimensions. They have also been found to be installed in narrow spaces or very high positions[25].

Gas fired radiant heaters are always installed "overhead", installation heights starting at 3,5 m up to 20 m or even more. Positioning and angling of the appliances effects heat distribution and energy efficiency.

Manufacturers of local room heating appliances provide instructions to end-users concerning proper installation of these products and the distances to be kept from surrounding walls and other objects. Test standards require the appliances to be installed according to these instructions. In the opinion of some stakeholders, not all end-users follow the manufacturer's instructions on installation and mounting. Improper installation can have major adverse influences on energy efficiency as an incorrect installed heater can be restricted in heat transfer, convective heat flow and maintenance accessibility. If industrial units are mounted above the recommended mounting height this can affect the overall system heating efficiency.

3.1.4.2 Fuel characteristics

For gas and liquid fuel appliances, test standards specify requirements concerning the type and composition of the fuel that is used. For example, gas-fired heaters have to be supplied with

[24] EN 613 - Independent gas-fired convection heaters, chapter 7 – Test methods

[25] Stakeholders response to the ENER Lot 20 questionnaire

gases that have to match specific parameters and characteristics. The fuel characteristics have an impact on the efficiency of the heater as they directly influence the quality of overall combustion.

3.1.4.3 Flue gas

For oil and gas local room heaters, the flue pipe system may affect the overall heating efficiency of the appliance. Heaters that use a flue gas system to carry the exhaust gas to the outside of the dwelling, need to follow specific technical requirements and instructions for the design and maintenance of the flue pipe system. The real life situation may differ from these test requirements. In some Member States these flue gas systems are required to be inspected by technical organisations regularly due to safety concerns associated with such devices.

3.1.4.4 Average frequency of use

As mentioned earlier in this section, climate conditions have a major impact on the frequency of use, which in simple words means that the colder it gets, the more often heating devices are used. Regarding the user depending factors, the frequency of appliance strongly depends on:

- The location of the appliance
- The temperature requirement inside the room for thermal comfort
- The main purpose of the device
- The installed power of heating devices inside the house

For example portable electric fan heaters are often used for very short periods (e.g. in unheated bathrooms), while oil-filled column heaters are used for longer periods. Radiant heaters such as infrared/visibly glowing heaters are often used for shorter heating periods, because they provide heating very quickly and do not need time to warm up. In a study conducted by a consumer organisation at the pan French level[26] suggests that portable fan heaters (both electric and gas fuel based) are used for secondary heating in France and have an average use time of 1 hour per day over a period of four months in a year.

The following conditions were assumed to represent EU-27 for primary heating:

- residential heating: 8 hrs at 20°C and 16 hrs at 15.5 °C [27]
- non-residential heating: 8 hrs at 18°C and 16 hrs at 14°C

For secondary heating, the heater operation duration was estimated as presented in the following table.

[26] Que Choisir 486, November 2010.

[27] As recommended in the standard EN 12831

Table 3-2: Time duration for which local room heaters are used for secondary heating in MS with similar climate conditions

Country group	Annual heating time duration for secondary heating		Source
	Hours per day (during heating season)	Days per year (duration of heating season)	
Group 1 (FI, SE, EE, LV)	3	288	CECED
Group 2 (LT, PL, AT, CZ, DK, SK, DE, LU, RO, UK, SI, HU, IE, NL, BE, BG, FR)	3	214	CECED
Group 3 (IT, ES, GR, PT, CY, MT)	1	138	CECED
EU-27 average	**1.5**	**216**	**CECED**

The numbers presented for primary and secondary heating are broad averages as the individual use patterns of these heaters by consumers may be very different. As an example, due to limited time for heating up, the average time of operation of a storage heater is much smaller than the one of direct heating appliances. To compensate this and provide the same total amount of heat to the room, they thus need to have about three times higher capacity, as it was shown in the Table 2-8 from Task 2.

3.1.4.5 Operating power and temperature settings

Operating power is a parameter that, among others, influences the time needed to heat up an area. As end-users are typically able to configure the power settings of their room heater, they may use the highest possible power settings to speed up the heating process in a cold room. If not controlled regularly, or not used with temperature settings, the device then runs without interruption at full load, which can cause overheating of the room and higher heat losses to the environment. However, a correct setting of the space heaters by integrated or external thermostat is more common.

3.1.4.6 Repair and maintenance practices

Repair and maintenance practices advised by the manufacturer, including recommended inspection are important actions, which the consumer needs to undertake to ensure the effective functioning and sustained operating life of local room heating products. For electric space heaters, there is no need for other maintenance than removing dust with a damp cloth, broom and/or vacuum cleaner.[28] Installed gas and oil heaters are subject to annual service checks, but most portable heaters are not. Operating and installation manuals for local room heating

[28] GIFAM (2004) Tout savoir pour bien choisir son chauffage. Les advantages du chauffage électrique de qualité. Groupement Interprofessionel des Fabricants d'appareils d'équipment menager.

products are almost always provided with the appliance and also include information on troubleshooting and where to find spare parts.

Many manufacturers also provide limited warranties for up to one or two years on local room heaters. Manufacturers stipulate certain conditions. Any warranty considerations are contingent upon correct installation. For most installed heating products, self-installation is prohibited and will invalidate the product warranty. Most warranties cover replacement parts due to defective materials and workmanship. Some online websites[29] also exist that assist consumers in repairing certain types of local room heating products. In terms of repair practices, depending on cost of repair and cost of a new local room heating appliance, consumers may dispose of the broken appliance rather than attempting to repair it.

3.1.4.7 Best practices in the use phase

This section discusses best practices in product usage related to how consumer behaviour can minimise the energy losses in the usage of local room heating products. The end-user behaviour has a significant impact on the energy consumption. Best practices in sustainable product use include regular maintenance, abiding by specific safety measures, choosing a thermostatically controlled heater (since they avoid the energy waste of overheating a room) and choosing heaters that correspond to the room's size and to the scope of desired heating.

A number of governmental agencies and organisations[30] provide recommendations for smart use of local room heating products and "energy-saving tips" to end-users of such products. Such strategies to reduce the energy use aim at reducing the amount of heating needed which can be achieved through better equipment settings and through the reduction of heat loses. To use heater most energy efficiently, it is recommended to match the type of local room heater with the type of room and use patterns it has. For example:

- For rooms in constant use, it is better to have the heaters functioning at **constant power ratings**. Underfloor heating systems provide even distribution of heat, which can enable the overall temperature to be lowered by 2°C compared to radiators.
- For rooms that need to be **heated quickly** (e.g. bathrooms, workshops, and seldom-used areas), a convection heater with a fan, or a radiant heater, is best. However, underfloor heaters are also often used in rooms where people are barefooted, e.g. the bathroom.

[29] Such as: http://homerepair.about.com/od/heatingcoolingrepair/ss/elec_htr_repair_2.htm

[30] Such as:

- the Energy Saving Trust in the UK (www.energysavingtrust.org.uk/Easy-ways-to-stop-wasting-energy)
- DirectGov in the UK (www.direct.gov.uk/en/Environmentandgreenerliving/Energyandwatersaving/Energyandwaterefficiencyinyourhome/DG_064374),
- ADEME in France (www.ecocitoyens.ademe.fr/mon-habitation/bien-gerer/chauffage-climatisation)
- GoEnergi in Denmark (www.goenergi.dk/forbruger/produkter/varmeanlaeg/gode-raad)

- For **spot heating**, a radiant heater is the most efficient choice if it is only meant to be used for a few hours and if the person remains within the line of sight of the heater[31]. Radiant heaters provide warmth almost instantly to objects.

According to a manufacturer, it is also recommended to not heat rooms excessively and lower the indoor temperature in rooms that are not used frequently, e.g. down to 16°C, instead of to 18°C. By lowering the indoor temperature with 1°C, it is possible to reduce energy consumption with 7%.

Other factors that make local room heating products the more energy efficient include[32]:

- Avoiding room heaters that do not have automatic temperature control as it will have to be monitored constantly and turned on or off depending on the temperature of the room.
- Relative humidity[33] in dwellings is also an important factor to consider. A dry house with 20% relative humidity will need a higher temperature to feel as warm as a home with medium humidity of 60%. This is because the body is giving up heat by the process of evaporation. The lower the relative humidity the faster the body gives up this heat as the higher moisture of the body evaporates to the atmosphere.

3.1.5 End-of-Life behaviour

The end-of-life behaviour of consumers concerning local room heating products is important to consider ensuring that the environmental impacts of Lot 20 products are considered across their entire life cycle. Aspects of actual consumer behaviour regarding end-of-life includes aspects such as:

- Economical product life (actual time to disposal);
- Percentage of recycling, re-use and disposal;
- Estimated second hand use, fraction of total and estimated second product life (in practice);
- Best Practice in product end-of-life.

3.1.5.1 Economic product life

The lifetime of the appliances is of interest in this study as a key parameter in assessing the Life Cycle Costs of the appliances in the later stages of the study (Tasks 5 and 7). Lifetime can also be used to estimate the stock data based on sales. In the context of this study, the focus is on 'active lifetime', i.e. the time in service. Most local room heating appliances have few moving parts (except in the case of fan assisted heaters) and are made of durable materials due to safety reasons. Hence, their wear is generally low and their lifetimes are long. Parameters that have the

[31] US Department of Energy's Online Consumer's Guide on Portable Heaters, www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12600

[32] Source: Buy Energy Efficient Organisation, www.buyenergyefficient.org/energyefficientspaceheater.html

[33] Relative humidity is the percent of water vapour in the air at a specific humidity.

greatest influence on the lifetime of appliances are quality of material, frequency of use, and maintenance. Average economical product life is the length of time during which the space heater may be put to profitable use. This is usually less than its technical life (time until which a space heater functions sustaining minimum acceptable performance criteria). Product economic life may vary across products and Member States and is highly depending on how the appliance was used (e.g. a local room heater that was used continuously and never turned off vs. a local room heater that was used from time to time, intermittently), so should be seen with caution. However, some preliminary estimates on average economic product life are presented in

Table 3-3, which are based on discussions and interviews with industry stakeholders.

Although fixed heaters have a long life (at least 20 years) some users might replace them due to aesthetic reasons (if they are out of fashion). Similarly concerning the lifetime of portable fan heaters, a study conducted by a consumer organisation at the pan European level[34] showed that most of the tested fan heaters worked flawlessly for 720 hours, i.e. 6.3 years (one hour per day, 4 months per year). Safety parameters remained unchanged after 720 hours.

The domestic appliance industry association, CECED, claims that the economic lifetime of installed radiant heaters is usually very close to the technical lifetime. The need for change due to aesthetics requirements may bring down the economic lifetime below the technical life, in case of the availability of many different designs of the products, but normally products are replaced when they break down.

CECED and some manufacturers also point out that underfloor heating systems that are embedded in the concrete slab have an especially long life. The cables built in the floor have no moving parts and are not in contact with oxygen or sunlight, so their technical lifetime is at least 40 years. Besides, as it is needed to destroy the concrete slab to change the heating system, figures for economic life and technical life very often matched. For thermostats, however, a realistic lifetime is 20 years.

[34] Que Choisir 486, November 2010.

Table 3-3: Average product life time of residential local room heaters

Main category	Type of appliance	Average product life (in years)		Source
		Economic life	Technical life	
Fixed electric heaters[35]	Convector panel heaters	12	20	Manufacturers
	Radiators	20	30	Manufacturers
	Fan heaters (electric fireplaces)	6	10	Estimate
	Fan heaters (fixed fan heater)	12	15	CECED
	Radiant panel heaters	12	20	Manufacturers
	Ceramic heaters	12	20	Estimate
	Visibly glowing radiant heaters	12	20	Estimate
	Storage heaters (static)	20	30	CECED
	Storage heaters (dynamic)	20	30	CECED
	Underfloor heating	40	40	Manufacturers
	Towel heaters for bathrooms	15	20	Estimate
Portable electric heaters	Convector panel heaters	12	15	CECED
	Radiators	12	15	Manufacturers
	Fan heaters	12	15	CECED
	Radiant panel heaters	12	15	Manufacturers
	Ceramic heaters	12	15	Estimate
	Visibly glowing radiant heaters	12	15	Estimate
Gas heaters	Flued gas heater	20	30	Manufacturers
	Flued gas fire	20	30	Manufacturers
	Flueless gas	20	30	HHIC
Liquid fuel heaters	Kerosene heater	10	15	Estimate
	Gel fire	10	15	Estimate

Table 3-4: Average product life time of non-residential local room heaters

[35] In an observation made by a manufacturer, the technical lifetime of installed electric heaters may be very different when the product is sold through the Do-It-Yourself (DIY) channel (5 to 10 years) as compared to when it is sold through the professional distribution channel (15 years or more). The same manufacturer pointed out that the technical lifetime of these heaters is directly related to the price and quality of the products.

Main category	Type of appliance	Average product life (in years)		Source
		Economic life	Technical life	
Warm air heaters	Electric warm air heaters	20	20	Estimate
	Gas-fired warm air heaters	15	20	Manufacturers
	Oil-fired warm air heaters	20	20	Manufacturers
Radiant heaters	Electric radiant cassettes	20	20	Estimate
	Gas-fired radiant heaters (luminous)	15	30	Manufacturers
	Gas-fired radiant heaters (tube)	15	20	Manufacturers
Air curtains[36]	Electric air curtains	10	20	Manufacturers
	Heated water based air curtains	10	20	Manufacturers
	Heat pump based air curtains	10	20	Manufacturers

In summary, replacement of direct heating appliances is rarely due to technical failure of the appliance, but rather to the wish of the user to install a better performing appliance or change the interior design, for example during a house renovation. In that case, replacement is driven by the (fuel) market and possible environmental/energy policies, more than it is because of defects in existing appliances.

3.1.5.2 *Recycling, re-use and disposal options*

This section provides information on some of the end-of-life options for local room heating products. At the Member States level, under the WEEE Directive manufacturers must contribute to the collection and recycling of end-of life product through a collection system at the time of their replacement. For example, according to one of the manufacturers, in France since 2006 the eco-organisation has set up mechanisms to collect and recycle electric heaters when they are replaced. Through this scheme more than 500 000 electric heaters were collected and recycled in France in 2009, showing an increase of more than 50% compared to 2008.

- **Recycling**

Many local room heating appliances are made of metals such as steel or cast iron. In the current market situation, they have a positive value as a scrap metal at end-of-life. However, in practice, the installer of the new heating appliances or system takes back the old appliance without any charge. Thus, the revenue at the end-of-life goes to the installer rather than to the consumer, who nevertheless benefits as he does not need to worry about the transport of the heavy and bulky appliance.

- **Reuse**

[36] One of the manufacturers of industrial unit heaters and air curtains pointed out that they expect the economic life of these products to be very similar to the technical life.

With the exception of a few decorative appliances, there is a very small second hand market for local room heaters. One industry stakeholder quoted that the percentage of Lot 20 products having a second life is very low – between 3-5%. Another stakeholder commented that for certain local room heating products, which have particular aesthetic value (e.g. electric fireplaces), second-hand markets may exist. The re-use of waste oil in space heaters has also been observed in many parts of the world. Agricultural, commercial, industrial, institutional and municipal facilities use waste oil to fuel space heaters. Waste oil is combustible and, because it is often contaminated with heavy metals, gasoline, chlorinated solvents and other hazardous constituents, it is also classified as a "toxic" waste. For these reasons, proper management is essential. For example since 1973, waste oil from space heaters have been considered a hazardous waste and regulations have been set up that require safe handling of waste oil by those who generate, accumulate, transport, treat, recycle, dispose or burn it. The Waste Framework Directive[37] specifies that the management of waste oil should follow the priority order of the waste hierarchy, where recycling comes before incineration and disposal.

- **Disposal**

In terms of disposal options for local room heating products, the EU introduced in 2005 new legislation to deal with Waste from Electrical and Electronic Equipment (WEEE). The purpose of this legislation is to ensure that old electrical and electronic equipment is recycled or reused rather than disposed in landfill sites. Another aim of the legislation is to encourage better design of electrical and electronic products to ensure that they can be recycled easily and more efficiently. Electric room heaters fall under the scope of the WEEE directive (category 1) under large household appliances (electric heating appliances, electric radiators, other large appliances for heating rooms). However, product recycling varies depending of the country. The requirements put the responsibility on the producer and state that:

"the rate of recovery shall be increased to a minimum of 80% by an average weight per appliance, and component, material and substance reuse and recycling shall be increased to a minimum of 75% by an average weight per appliance;"

The latest data from EUROSTAT indicates that 1.7 million tonnes of large household appliances were collected in 2008[38]. Of the amount of large household appliances that were collected, 81 % went to reuse and recycling and 17 161 tonnes (approximately 1%) of collected large household appliances are re-used as a whole appliance. Further analysis and data collection is needed to estimate the share that local room heating products account for within large household appliances.

3.1.5.3 Best practice in end-of-life behaviour

Ensuring that local room heating products are properly collected through the WEEE Directive for further re-use, recovery, or recycling is a best practice in end-of-life behaviour. However, household involvement is vital to the success of recycling initiatives as these rely on the willingness of individuals to change current behaviours and participate. This is especially the case

[37] Waste Framework Directive (2008/98/EC)

[38] Eurostat WEEE data, epp.eurostat.ec.europa.eu/portal/page/portal/waste/data/wastestreams/weee

for those products and materials that pose a greater challenge when recycling, whether due to a lack of awareness, or the product type[39]. A UK study provides some insight into household consumer attitudes and activities concerning the management of WEEE in the UK. Findings of the study indicate that current WEEE recycling and collection schemes are largely reliant on consumers making the effort to dispose of items responsibly, which can be difficult if infrastructure is sparse and information lacking.

In order to encourage best practice in consumers to recycle their local room heating products (e.g. by taking them to designated treatment sites or calling appropriate services for pick-up), adequate local infrastructure to enable easy and simple actions is primordial to help empower people to participate in more sustainable waste management practices. In addition to adequate local infrastructure, consumers must also be aware of why they need to change their behaviour. Therefore, raising and maintaining public awareness about the importance of properly disposing of local room heating products is also necessary.

3.2 Local Infrastructure

The aim of this section is to identify and describe barriers and opportunities relating to local infrastructural factors. This task deals with the differences between theory and practice, which is very important for the success of ecodesign. The benefit of technology only persists if the product is properly used. Therefore the influence of consumers and the influence that local infrastructures factors have on the product are crucial to consider when analysing the success of new technologies, marketing strategies, etc. This section also looks at the barriers that may hinder users/consumers to purchase or use Lot 20 products in a more environmentally-sound manner.

3.2.1 Local infrastructure factors

Local room heating products interact to a great extent with their surroundings as their main functions are to control and maintain temperature in the room where they are used. Space heating and cooling of buildings is generally assumed to be one of the most climate sensitive end-uses of energy. Local room heating products are very strongly influenced by ambient conditions (temperature and draughts) which in turn are dependent on the user behaviour, e.g. the duration and frequency of the use of room heaters, the temperature at which the room heater is set (depending on the user's temperature preference) and the placement of the heater. In addition, some local room heating products such as gas and liquid fuel heaters must be properly ventilated. Besides the requirement for ventilation for certain types of local room heaters, they are in general independent devices that only need to be connected to a fuel source (electricity, gas, liquid fuel) to function. Considering the specificity of local room heating

[39] Darby, Lauren and Louise Obara (2005) Household recycling behaviour and attitudes towards the disposal of small electrical and electronic equipment, [Available online: 2004aix.meng.auth.gr/pruwe/dhmosieuseis/household_recycling_behaviour_EEE.pdf]

products, other factors in addition to outside temperature affecting an individual household's room heating energy consumption include housing infrastructure conditions such as:

- House construction type
- Age
- Nature of the building shell materials
- Window style and size
- House floor plan area
- Number of rooms (e.g. several small rooms may necessitate the purchase and use of more than one room heater)
- Solar gains
- Shading
- Level of insulation in ceilings, walls and floors[40]

Other factors related with local infrastructure that affect the use of local room heating products include:

- **Energy aspects:** includes electricity reliability, electricity tariffs, special local tariffs influencing consumer behaviour (night-tariffs, progressive tariffs, etc.);
- **Availability of installation and maintenance services**, e.g. availability and level of know-how/training of installers. Lack of qualified craftsmen (installers and chimney sweepers) can be detrimental for both market development and environmental performances of appliances;
- **Installation guides for good practice**: Not only are the provision of these documents important, but users should also carefully read and follow safety and operating instructions to ensure most safe and efficient use;
- **Building regulations and codes** (e.g. restriction on the use of certain local room heaters due to fire hazards and safety measures – for example in university dorms the use of certain space heaters such as gas or liquid fuelled room heaters are prohibited);
- **Inadequate or absence of a primary heating source** (e.g. a centralised heating system)
- **Fuel supply:** There are wide differences between MS. Shifts towards more environmentally-friendly fuels or technologies may be hindered due to convenience reasons and the negative environmental impacts associated with transporting fuels.
- **Fuel quality:** Constant and adequate quality of fuel are important, either for gas or liquid fuels.

[40] CSIRO (2001) NatHERS (Nationwide House Energy Rating Schemes). CSIRO, Division of Building and Construction Engineering.

- **Quality of information given to consumers:** lack of knowledge or lack of independent reliable information on products, and on their energy and environmental performance
- **Local regulations**: in areas where district heating system is installed, local room heating products may be forbidden. Local regulations may also impose limitations for air pollution concerns (e.g. forbidding all gas or liquid fuel installations independent of their performance);

Depending on specific Member States, different energy sources are used for local room heating products. For example, gas, oil, and electricity are the energy sources for over 90% of heating systems, though there is variation between countries. Other country specific factors such as special local tariffs that influence consumer behaviour (night-tariffs, progressive tariffs, etc.) exist in the UK. 'Economy 7' is the name of a tariff provided by United Kingdom electricity suppliers that uses base load generation to provide cheap night-time electricity. Houses using the Economy 7 tariff require a special electricity meter which provides two different readings - one for the day period and one for the night period. The night (off-peak) period lasts for seven hours, hence the name. The wiring in the house does not need to be altered. The night storage heaters are on the ordinary circuit, but only switch on when the night rate is activated. Any electrical appliance in use during this period therefore runs at a lower rate of billing set to start using a timing device.

3.2.2 Barriers to ecodesign

In practice, many barriers to ecodesign exist not just from the demand/consumer side but also from the supply side. For example, investment-related questions may be directly involved: often the more energy-efficient the product is; the more expensive the purchase price. Supply side actors may also not incorporate life cycle thinking when setting purchase price as buyers and product distributors are not in charge of the system operation afterwards and thus do not pay the final electricity bill. Other possible barriers towards ecodesign could be:

- **Preference for stabilised technologies:** technology changes often generate a temporary increase in breakdown rates due to a necessary learning period.
- **Fear of complexity:** in recent years, electrical appliances have increased in technological complexity, with new product innovations and ever shortening product life expectancy[41]. Technology within consumer appliances and electronics is a dynamic and fast-moving field and continually advancements in technology related to more energy efficient local room heating products could bar consumers from purchasing them due to fear of complex functioning and use.
- **Safety:** Safety is a primary factor for consumers when deciding whether not to purchase a specific local room heater, therefore any advancements in ecodesign

[41] Darby, Lauren and Louise Obara (2005) Household recycling behaviour and attitudes towards the disposal of small electrical and electronic equipment

of Lot 20 products need to specifically take the safety aspect of local room heaters into account.

- **Lack of knowledge:** e.g. relevant information is not available to local room heater manufacturers concerning new energy standards; relevant information is not available on energy efficient products in stores; etc.)
- **Cost factors**: many consumers may opt for a cheapest model (if given a choice), though very rarely aware of the energy consumed by local room heating products during its lifetime. Fuel and electricity prices also affect not only the level of household consumption for space heating but also households' choice of the type of local room heater to buy.
- **Compatibility and liability issues**: depends to a great extent by the services required by the end-user.
- **Design and convenience:** e.g. use of power management or shutting off devices seems too time consuming for users; new energy efficient models do not meet the aesthetic taste of consumers.
- **Rebound effects:** even though the sold devices are more energy efficient, overall more energy is consumed due to higher ownership rates or due to increased use of the product because of its "energy-efficient" status.[42]

3.3 Conclusions

Task 3 has addressed consumer behaviour and local infrastructure issues associated with local room heating products. The findings indicate that some of the major factors that influence the purchase and selection of certain types of local room heating products include heating demand (based on building type and use), purchase price in relation to heating costs, functionality (primary vs. secondary heating), and design (e.g. purchase of the local room heater more as a decorative piece rather than a heating device). In general, the installation requirements of local room heating products, notably electric local room heaters are simpler than that of other heating products such as solid fuel combustion installations or centralised heating systems. In case of certain local room heaters that use liquid or gas fuel, special installation concerning ventilation can be required.

In terms of frequency and characteristics of use, climatic conditions, appliance function and type, and building type and heating demand were identified as the principal facts that influence the frequency and way that consumers operate local room heating products. Outside temperatures and whether the room heater is used as a primary or secondary heating source determine at what temperature settings and the duration local room heating products are used. For commercial and industrial applications, the heating demand is individual and has very specific requirements. Other aspects such as the age and size of the building can also influence the use of Lot 20

[42] One stakeholder noted that the 'rebound effect' mentioned should not be confused with the difference between increased energy consumption and the aspect that people can now afford to heat their houses properly. Before, they might not have been able to afford to heat their houses efficiently.

products. Further quantitative information regarding frequency and characteristics of use will be provided following further discussions with industry experts and stakeholders.

Regarding end-of-life behaviour, little information was identified on the reuse of local room heating products, with the exception of used oil, which is frequently reused in space heaters. In the EU, disposal and recycling options of local room heating products is regulated by the WEEE Directive to encourage that the end-of-life material from these products are re-used, recycled, or recovered.

Local infrastructure factors also influence the use of local room heating products. Aspects include:

- housing infrastructure conditions (i.e. number of rooms, quality of insulation, size of windows, type of housing structure, etc.);
- electricity reliability and costs;
- availability of installation and maintenance services;
- building regulations and codes (e.g. restriction on the use of certain local room heaters due to fire hazards and safety measures – for example in university dorms the use of certain space heaters such as gas or liquid fuelled room heaters are prohibited);
- fuel quality and availability; and,
- the quality of information given to consumers.

Finally, a number of barriers to Ecodesign measures and developments have also been identified. These include an absence of life-cycle thinking across the supply chain, fear of complex technologies by consumers, safety issues, cost factors, rebound effects and design issues.

25 June 2012

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