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Yearly Appliance Energy Cost Indication

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Approach, methodology and data per country

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CHAPTER 1: PRODUCT COVERAGE

1.1 Methodology

For the selection of products, the project team considered all appliances which are covered by the Directive on energy labelling. The Directive 92/75/EEC¹ and the corresponding implementing Directives cover the following products (hereafter “old label products”):

- Refrigerators, freezers and their combinations;
- Washing machines, dryers and their combinations;
- Dishwashers;
- Ovens;
- Electrical lamps and luminaires;
- Tumble dryers;
- Air-conditioning appliances.

The Directive 2010/30/EU² which amends the Directive 92/75/EEC was adopted in May 2010. On the date of writing, Delegated Regulations were adopted for the following products (hereafter “new label products”):

- Refrigerators, freezers, their combinations and wine storage appliances;
- Washing machines, dryers and their combinations;
- Dishwashers;
- Televisions;
- Tumble Dryers;
- Electrical lamps and luminaires;
- Air-conditioning appliances.

Overall, the number of old label products sold in shops is gradually decreasing and will be less significant for their coverage by future YAECI action³. For this reason only the new label products are covered by the YAECI energy indicator as

¹ Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances

² Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products

³ According to the Come On Labels project the current share of old label products is currently 40% in 13 EU countries (in 330 shops in total). The share of new label products increased from 40-50 % in winter of 2011 to approximately 60% in the fall of 2012.

the inclusion of both categories would impose an unnecessary effort on data collection from the manufacturers. Nevertheless, a methodology which associates the old and new energy labels has been developed for assisting the retailers, in case they prefer to display the energy indicators in all of their products.

The combined washer dryers is the only exception in which an old label product is included since no new energy label has yet been developed for this product category. Ovens and light bulbs and tubes, which are covered by the EU Directives on energy labels, are not included in the selection for the reasons provided below.

Products which are not covered by the EU Directive on energy labelling have not been selected to bear the energy indicator in this stage of the YAECI project because this would impose difficulties in establishing commonly accepted methodology and/or in collecting the necessary data from the manufacturers. This data-gathering difficulty was experienced in the Dutch EnergieWeter⁴ project which attempted to include computers, laptops and computer monitors. Computers, laptops and computer monitors which can be labelled according to the EU Energy Star Program and registered in the EU Energy Star database within the framework of the Agreement between the Government of the US and the European Community (EU)⁵ have an unambiguous yearly energy consumption figure and are therefore ready to be included the EnergieWeter program and the YAECI project.

Some aspects related to specific product categories which were considered during the selection process are explained below.

► Refrigerators, freezers and their combination, washing machines and dishwashers

The potential impact of displaying an energy indicator on wine refrigerators, which are covered by the new Directive on energy labelling, is expected to be insignificant in all countries due to their relatively low sales (both in terms of units and power capacity). For this reason, wine refrigerators have been excluded from the scope of products covered in this study.

► Tumble dryers and combined washer dryers

Tumble dryers and combined washer dryers have been excluded from the YAECI selection in countries with warmer climates. In addition, according to available market data, in some New Member States (including CZ, RO and SI), the market penetration of this type of products is generally much lower compared to the western European countries (e.g. FR and NL). However, the market trends show that the market penetration is increasing rapidly and therefore their inclusion was considered in CZ, CR, RO and SI as well.

The new Delegated Regulation on tumble dryers was published very recently and it will become mandatory for all tumble dryers, which are placed on the market after May 2013. For this reason, only new label tumble dryers are included the

⁴ Website of the EnergieWeter initiative: <http://www.energieweter.nl/>

⁵ Website of the EU Energy Star program: <http://www.eu-energystar.org>

database which will be developed by the project team to provide data on running costs to the retailers. Nevertheless, a methodology which associates the new and old label for tumble dryers has been developed as well to assist the retailers until no more old label products will be sold.

► Ovens

The use of electric ovens is generally higher compared to gas ovens but their share of overall household electricity consumption, is relatively low. In the EU, the market penetration of electric ovens will continue to rise but this will not have any significant impact on the electricity consumption, since the current share of electric ovens is already very high.

Nevertheless, ovens have been excluded for the scope of product covered in this study due to the likelihood of similar difficulties that were experienced in the EnergieWeter initiative. The main difficulties relate to the estimation of the usage patterns which seem to differ considerably not only between different countries but also between households within the same country.

► Air-conditioners

The use of air-conditioners in the residential sector is increasing in all EU countries, regardless of the local weather conditions. However, in the short-term the impact of this product will remain rather insignificant in countries with cold climates, because the main driver of the air-conditioners market is the cooling demand (regardless of the fact that some air-conditioners can be used for heating as well).

The new and old energy labels for air-conditioners cannot be correlated because they are based on different classifications and standards. For this reason, no methodology has been developed for old label air-conditioners.

► Electrical lamps and luminaires

Usually, the retailers who trade white goods and televisions also sell light bulbs. Nevertheless, this product category has considerably different characteristics compared to other products covered by the EU legislation on energy labelling, limiting the impact of their potential inclusion. Most significantly, due to the small size of light bulbs and their packaging, the energy indicator might not be noticed by the consumers. A specific light bulb can be replaced by different types of lamps depending on the required spectral quality and intensity of light, thus making the comparison difficult. In addition, conventional incandescent lamps have been phased-out and therefore the savings from within the most energy efficient products are not considered to be very significant. Halogen lamps are less efficient by approximately 40% compared to compact fluorescent lamps (CFL). However, halogen lamps will be phased-out from the market as well.

1.2 Product selection

Table 1 shows the selection of products which is mainly based on the market penetration and trends of different products in each country and also the product-specific aspects outlined in section 1.1. Due to their large market

penetration, the refrigerators and freezers, the washing machines, the dishwashers and the televisions are covered by all countries. The inclusion of washer dryers, tumble dryers and air-conditioners is excluded in some countries due to their low market uptake. For the reasons explained in the previous section, ovens and light bulbs have been excluded from the scope of analysis performed in this study.

The table also shows which labels are taken into account in the development of the YAECI database of running costs. The combined washer dryers is the only old label product which is included in the database since the new label for this product has not been published yet.

Table 1: Final proposed selection

Product	AT	CZ	CR	DE	ES	FR	MT	NL	PT	RO	SI	Old label	New label
Refrigerators and freezers*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Washing machines	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Dishwashers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Televisions	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Combined washer dryers		✓	✓			✓		✓				✓	✓**
Tumble dryers	✓	✓	✓	✓		✓		✓			✓		✓
Air-conditioners			✓		✓	✓	✓		✓	✓	✓		✓

* Including built-in freezers and excluding wine – refrigerators

** Not published yet

CHAPTER 2: DEFINITION OF THE ENERGY INDICATOR

2.1. Examination of options

The term “energy indicator” refers to a substantial element of the running cost which will be displayed either within the price tag of the products or separately. The aim of the energy indicator is to provide to the consumers an estimate of the running cost of products. This information is not included in the EU energy labels. The information which is currently displayed in the EU energy labels can assist the consumers to estimate their potential energy savings from more efficient products but not in monetary terms. This poses a risk that the information which is provided in the EU energy label (i.e. energy class and energy consumption) may not encourage consumers to purchase the most performing products.

For the development of YAEI energy indicator, the project team assessed different options covering the following 4 aspects:

- definition of the time frame of the indicator;
- selection of a common or a diverse approach between the participating countries;
- definition of potential presentation standards for energy indicator;
- adding supplementary information.

The selection of the approach for each of these aspects is described below.

► **The time frame of the indicator**

The running cost of products can be calculated on an annual basis or for longer periods (e.g. 5 or 10 years). The project team assessed the option of displaying the running cost of products over their lifetime. In this option, the average lifetime for each product category would be based on a common source of information. Potential sources considered, include the base cases from the Ecodesign preparatory studies which were carried out in the context of the Ecodesign Directive⁶. These base cases serve as a reliable source since they have been developed in consultation with the manufacturers. However, this option was abandoned due to the possibly significant differences between the actual lifetimes of products and the possible opposition by retailers and manufacturers on using one average value for all products.

For this reason, the project team selected the option of displaying the annual running cost which will be mandatory for all participating retailers and all products. This approach has already been applied in a real situation (under the EnergieWeter initiative) which gives it additional credibility. Nevertheless, the retailers will be encouraged to display the running cost for longer periods without

⁶ Directive 2009/125/EC of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products, recast of Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products

associating those periods with the lifetime of the respective products. The annual cost savings might appear insignificant and therefore the provision of the running costs for a longer period will further encourage the consumers to purchase energy efficient products.

► Common or diverse approach

The potential benefits of setting either a common or a diverse approach were assessed. Under a diverse approach each country would be free to decide on the time frame of the energy indicator whereas under a common approach, this aspect would be same for all countries. The main advantages of having different types of energy indicators are presented below:

- there are potential difficulties in the harmonisation of one single approach due to national specificities;
- different types of indicators would give the opportunity to assess different options during the evaluation phase of YAECI;
- the adaptation of the time frame on the national characteristics could add credibility to the energy indicator at the national level;
- a flexible approach would allow an adaptation of the indicator according to the marketing strategies of the retailers.

The benefits of a common and unified approach include the following:

- due to cross-border sales (e.g. in web shops), a single timeframe is favourable. The cross-border sales have already a significant share and will further increase in the future;
- a common approach would allow consumers to understand the label when shopping abroad (e.g. a French consumer who is familiar with the energy indicator through retailers in France would also be able to understand the respective indicator in Germany).

Based on the consideration of all aspects mentioned above, a mixed approach has been selected. The common aspect in the mixed approach is the annual energy costs as the substantial element of the running cost of the products which is mandatory in all countries and shops and for all products. Certain flexibility will be allowed to other aspects and specifically the display of supplementary information (i.e. the cost of water and/or energy during several years, up to 10 years).

► Context and appearance

The context of the energy indicator will be based on EnergieWeter approach. Similar to the Dutch initiative, the YAECI energy indicator will follow the following principles:

- the energy indicator will be presented in the form of the statement "Energy cost per year is € X" (written in national languages);

- in shops, the energy indicator must be set on the price tag (preferable on the last line) and for online sales the indicator will be presented in the product specification;
- the use of the YAEI logo is encouraged but not mandatory;
- the YAEI logo may be used in different forms (i.e. in colour or in black and white);
- the YAEI logo can be displayed on the price tags of the products and on separate tags

This approach is preferred because of its acceptance by the retailers and also as its effectiveness has already been tested and applied in real life situations under the EnergieWeter initiative.

The project team also examined the possibility of setting uniform design principles for retailers who choose to use a separate tag to display the energy indicator. Such characteristics would contribute in the establishment of a common identity and would highlight the European dimension of the project. This approach would follow the rationale of the EU energy label which establishes certain principles to ensure recognisability and acceptability in all Member States. Such characteristics could include:

- standard colours and fonts;
- a minimum size and standard proportions.

Concerning the content of the label (e.g. text and logos) this could be developed, based on the following standards:

- set the YAEI logo on the left side and retailers logo on the right side (if retailers ask for this option);
- the annual running cost of the product in large fonts and secondary information in smaller font (e.g. the electricity price and the website of the project);
- name and flag of the country.

Despite the benefits of setting common design principles, several difficulties could arise on the realisation of this approach. A key difficulty identified is the possible incompatibility with the design principles and the relevant equipment used by the retailers for printing similar items (e.g. price tags). In addition, the resources provided under YAEI would not be adequate to cover additional costs that would be incurred, thus this option was abandoned.

► Use of supplementary information

The project team examined the possibility of including additional aspects of the running cost which could be used as supplementary information of the energy indicator. For this reason, the significance of the share of water consumption to the total running cost was analysed. The inclusion of water consumption was considered as it is one of the key elements included in the EU energy label and is largely related with the environmental impact of products. The products that

would be affected by the inclusion of water consumption are the washing machines, dishwashers and washer dryers. Table 2, shows an estimate of costs that was carried out by the project team, for Austria, Malta and Portugal.

Table 2: Weight of water consumption in washing machines and dishwashers

Countries	Share of water cost in the annual total running cost		Comments
	Washing machines	Dishwashers	
Austria	40- 50%	n.a.	Water cost = €3.00 per m ³
Malta	40 - 54 %	11 - 20 %	Water cost = €3.04 per m ³ based on a national avg. consumption of 55m ³ per person/year
Portugal	28 - 42%	7- 13 %	Water cost = €1.28 per m ³ based on a national avg. consumption of 120 m ³ /year

Depending on the specific models used for the estimation of the weight of water ranges between 28%-54% for washing machines and 7%-20% for dishwashers. The washing machines models used in the calculations for Malta and Portugal were the same but not for Austria where different models were applied.

Concerning washer-dryers, according to an estimate based on the performance of 4 units sold in France, the share of water cost ranges between 21%-39%. The share of water consumption is significant in this product category because most washer-dryers have a condensation-based drying function which uses cold water to cool down the drying process. In fact, the lower value (21%) of the range above, refers to an air-vented appliance whereas the share of water consumption in the other three models which use water in the drying process, ranges between 33%-39%.

At least for the washing machines and washer dryers (especially the water-cooled units) the cost of water represents a significant share of total cost. Although the weight of water consumption is not as significant in dishwashers, it would still be reasonable to include the cost of water, to ensure consistency on the overall approach.

Overall, the benefits of including the cost of water consumption in the YAEI project are the following:

- water represents a significant share of the total running cost for some products (e.g. in washing machines the share ranges 28%-54%);
- the water cost is included in other similar initiatives (e.g. in France);

- the water consumption is included in the EU energy label.

Following are the main disadvantages of including water consumption:

- potential difficulties might arise in defining a representative average cost for the water consumption (e.g. differences between municipalities/ regions and at different levels of consumption);
- the inclusion of water might cause difficulties for the evaluation of the YAECI action since this will be largely based on the share of products per energy class.

Regarding the differences in water prices per region and/or per level of consumptions, in Malta the prices vary between €3-€3.5/m³ and in Portugal between €0.1 and €4.8/m³.

Differences might also exist in the water pricing system at the local level. For example, for most dwellings in the UK, the water consumption is not metered. In addition, in some municipalities in France, only the total water consumption of a building is metered and the cost is shared between the different apartments based on the size of each dwelling (regardless of the actual consumption). In such situations, there are no cost incentives for the consumers to reduce their water consumption and therefore the inclusion of water cost in the YAECI indicator would possibly have no effect.

Therefore, although the water consumption represents a significant share in the total running cost of certain product categories, it also poses several challenges which relate mainly to the definition of a representative average water price. For this reason, the display of the cost of water consumption is not mandatory in the YAECI action but its inclusion will be supported by YAECI if this is requested by the retailers.

2.2. Approach on the energy indicator

Based on the analysis of different options for the definition of the energy indicator the mandatory principles that should be followed by all retailers are the following:

- the annual running cost must be displayed in all shops and products;
- the annual running cost will be presented in the form of the statement "Energy cost per year is € X".

Non-mandatory, but desirable principles are the following:

- the energy running cost for a different (numeral) number of years (e.g. 5 or 10 years) may also be displayed as supplementary information;
- the additional energy indicator will then be presented in the form of the statement "Energy cost per (Y) years is € Z" (written in national languages)

- retailers may display the YAEI logo in the tags which will include the energy indicator.

Other optional elements are the following:

- retailers may include the running cost for water consumption calculated based on the methodology provided by YAEI;
- the annual water consumption cost will be presented in the form of the statement "Water cost per year is € P";
- the water consumption cost for a different (numeral) number of years (e.g. 5 or 10 years) may also be displayed as supplementary information;
- the additional water indicator will then be presented in the form of the statement "Water cost per (Q) years is € R" (written in national languages);
- When a multi-annual energy indicator and a multi-annual water consumption are used simultaneously the timeframe for both indicators have to be the same to avoid confusion.

CHAPTER 3: METHODOLOGY FOR THE CALCULATION OF THE RUNNING COSTS

This chapter describes the methodology for the calculation of the annual running costs for products selected in chapter 1. For all product groups which are displayed with the old and new EU energy label, two different formulas have been developed (except for air-conditioners).

The development of the YAECI database takes into account only the methodologies referring to the new energy label (except for combined washer dryers for which only the old energy label exists). The methodologies for these products will be embedded in the YAECI database (see section 3.1). All other methodologies have been developed to assist the retailers to make their own estimates, in case they wish to also display the running costs of products using the old energy label (see section 3.2).

Where applicable, the methodology includes also formulas for the calculation of the annual cost of water consumption. The retailers will not be required to display the annual cost of water consumption and the calculation method is provided as an optional element.

In all cases the participating retailers will be required to display the annual cost of energy consumption (the "energy indicator"). The retailers are encouraged to also display the running costs for different periods of time (e.g. 5 and 10 years) but this will be optional. If retailers wish to communicate the energy cost and/or water consumption cost for periods longer than one year they should use the following formula: $AEC_{n\text{year}} = n \times AEC$ for energy and $AWC_n = n \times AWC$ Where:

AEC = Annual energy cost and

AWC = Annual water consumption cost

n = number of years

The data on energy and water prices and the usage patterns of single and double duct air-conditioners are described in Chapter 4.

3.1. Methodologies embedded in the YAECI database

- ▶ **Refrigerators, freezers and combined units (displayed with the new energy label)**

Both the new and the old energy labels indicate the annual energy consumption. In both labels the energy consumption is calculated based on similar standards⁷. The formula for the calculation of the annual running cost is the following:

⁷ EN 153- Methods of measuring the energy consumption of electric mains operated household refrigerators, frozen food storage cabinets food freezers and their combinations, together with associated characteristics

ARC= AEc x EP

Where:

ARC= Annual running cost

AEC= Annual energy consumption per kWh according to the label

EP= Electricity price per KWh

► Washing machines (displayed with the new energy label)

The new energy label shows the weighted annual energy consumption which is calculated at 220 cycles per year and takes into account the energy consumption of the following programmes:

- standard 60 °C cotton programme at full load (Et,60);
- standard 60 °C cotton programme at partial load (Et,60½);
- standard 40 °C cotton programme at partial load (Et,40½).

The weighted annual consumption of washing machines also takes into consideration the weighted powers in "off- mode" (P0) and in "left-on mode" (P1).

The formula for the calculation of the annual cost of energy and water consumption of washing machines is the following:

AEC= AEc x EP
AWC= Awc x WP
ARC*= AEC+ AWC

Where:

ARC= Annual running cost

AEC= Annual energy cost

AWC= Annual water cost

AEC= Annual energy consumption per kWh according to the label

EP= Electricity price per KWh

Awc = Annual Water consumption (L)

WP= Water price per L

*this parameter will not be included in the YAECI database or displayed by the retailers

► Dishwashers (displayed with the new energy label)

The annual energy consumption of dishwashers is provided in the new energy label. This is calculated based on 280 standard cleaning cycles using cold water fill and the low power modes.

As in the case of washing machines the new energy label for dishwashers also takes into consideration P0 and P1. The formula for the calculation of the annual cost of energy and water consumption of dishwashers is the following:

AEC= AEc x EP
AWC= Awc x WP
ARC*= AEC+ AWC

Where:

ARC= Annual running cost

AEC= Annual energy cost

AWC= Annual water cost

AEC= Annual energy consumption per kWh according to the label

EP= Electricity price per KWh

AWc = Annual Water consumption

WP= Water price per L

* this parameter will not be included in the YAECI database or displayed by the retailers

► **Televisions**

All televisions which were placed on the market after March 2012 should be displayed with the new energy label. Currently there are still some unlabeled televisions on the market but this number is gradually decreasing.

The energy label for the televisions indicates the annual energy consumption and therefore the formula for the calculation of the annual running cost is straightforward:

ARC= AEC x EP

Where:

ARC= Annual running cost

AEC= Annual energy consumption per kWh according to the label

EP= Electricity price per KWh

► **Combined washer dryers**

At the time of preparation of this report, the combined washer dryers were covered only by the old energy label. In relation to the energy consumption, the energy label includes the following information:

- energy consumption per complete operating cycle (washing, spinning and drying) using standard 60 °C cotton cycle with a full capacity wash load and a "dry cotton" drying cycle;
- energy consumption per washing cycle (washing and spinning only) using standard 60 °C cotton cycle.

The energy label also shows the capacity (in kg of cotton) for both the washing and drying functions. The main aspects in the operation of washer dryers which needs to be taken into account for the calculation of the annual running cost are the following:

- consumers do not always use the drying function;
- the drying capacity does not often match the washing capacity and is normally smaller;

For this reason, the calculation of annual energy consumption of washer dryers is relatively more complex compared to other product groups. Consumers might be required to use the drying function more than once for a single load of washing. Alternatively, consumers might prefer to wash loads which match the (normally

smaller) drying capacity. There is no information on these specific usage patterns.

The methodology for the estimation of the annual energy consumption is based on the EnergieWeter methodology, but it has been slightly modified for simplification and to be consistent with the new energy labels of washing machines and tumble dryers. The following assumptions have been applied:

- According to energy labels for washing machines and tumble dryers, on average the consumers use the washing machine 220 times per year and the tumble dryers 160 times per year. The ecodesign study on tumble dryers⁸ suggests the average load of tumble dryers is 3.4 kg for machines with a capacity of 6 kg. Similarly, for washing machines the average load is estimated at 3.4 kg for machines with a capacity of 5.4 kg. Consequently it is estimated that in total 750 kg of clothes are being loaded (220×3.4) either for washing only or for washing and drying. Under these assumptions it is estimated that the weight of the clothes that are loaded in the wash and dry function is 550 kg (160×3.4). Energieweter assumes that the drying function is loaded at its full capacity and estimates 110 drying cycles at loads of 5 kg. In this context it is assumed that total weight of clothes in the wash/dry function is 550 kg. Therefore, the total number of the wash-only cycles is 58 (200 kg, 3,4 kg in each cycle).
- Several washer dryers are equipped with a load indicator which allows a lower consumption in the washing function at loads which are lower than the washing capacity. In Energieweter the overall effect is estimated at 87% which corresponds to actual energy consumption compared to the energy consumption which is included in the label.
- Based on findings of the ecodesign study on washing machines it is estimated that the 40 °C programme is the most commonly used (63%) followed by the 60 °C programme (37%). According to the same study the energy consumption of the 40 °C programmes correspond to the 72% of the energy consumption of the 60 °C programme.
- The energy consumption of the drying function always corresponds to the energy consumption which is stated in the energy label. This is based on the assumption that consumers use the drying function at its full capacity since this is normally lower than the washing capacity.

⁸ PricewaterhouseCoopers (2009), Ecodesign of Laundry Dryers Preparatory studies for Ecodesign requirements of Energy-using-Products (EuP) – Lot 16, available at:

http://www.ebpg.bam.de/de/ebpg_medien/tren16/016_studyf_09-03_complete.pdf

Based on these assumptions, the formula of the estimation of the annual cost of energy and water consumption of washer dryers is as follows:

$$\text{AEC} = [(160 \times 5.4/\text{Cd} \times \text{Ew,d}) + (58 \times 5.4/\text{Cw} \times (\text{Ew} \times 37\% + \text{Ew} \times 72\% \times 63\%) \times 87\%)] * \text{EP}$$

$$\text{AWC} = [(160 \times \text{Wt}) + (58 \times \text{Ww})] \times \text{WP}$$

$$\text{ARC*} = \text{AEC} + \text{AWC}$$

Where:

ARC = Annual running cost

AEC = Annual energy cost

AWC = Annual water cost

Cd = Capacity in the drying function according to the energy label in kg

Cw = Capacity in the washing function according to the energy label in kg

Ew,d = Energy consumption per cycle in the washing/ drying function in kWh

Ew = Energy consumption in the washing only function in kWh

EP = Electricity price per kWh

Wt = Total water consumption per cycle in L according to the energy label

Ww = Water consumption per cycle in L in washing and spinning functions according to the product fiche

WP = Water price per L

* this parameter will not be included in the YAECI database or displayed by the retailers

► **Tumble Dryers (displayed with the new energy label)**

The new energy label on tumble dryers was adopted very recently and will become mandatory for all products placed on the market from May 2013. The new energy label indicates the weighted annual energy consumption which is estimated at 160 cycles per year by taking into account the energy consumption of the standard cotton programme at full and partial loads (Edry and $\text{Edry}_{1/2}$). In addition to the air-vented and condenser tumble dryers, the new energy label also covers gas-fired appliances. This type of tumble dryers is out of the scope of the YAECI project.

The formula for the calculation of the annual running costs of the air-vented and condenser tumble dryers which are be displayed with the new energy label is the following:

$$\text{ARC} = \text{AEc} \times \text{EP}$$

Where:

ARC = Annual running cost

AEc = Annual energy consumption per kWh according to the label

EP = Electricity price per kWh

► Air-conditioners (displayed with the new energy label)

The old label cannot be associated with the new energy label which becomes mandatory in January 2013. For this reason only products displayed with the new energy label will be taken into account.

The new Delegated Regulation on air-conditioners covers the following types:

- Single and multi split;
- Single duct;
- Double duct.

There are three main types of single and multi split air-conditioners according to which the information provided in the energy label varies. Particularly the specific types and the information provided is as following:

- Reversible air-conditioners – annual energy consumption in kWh per year for cooling and heating. For the heating function, 3 different values are given, for 3 different geographical zones.
- Heating-only air-conditioners - annual energy consumption for 3 different geographical zones.
- Cooling-only air-conditioners – annual energy consumption.

Similarly for the single and double duct air-conditioners, depending on the specific type, the information on energy consumption might refer to heating-only, cooling-only or to both heating and cooling functions. A key difference of the single and double duct air-conditioners compared to the single and multi splits is that the hourly energy consumption is indicated. In addition, for the heating function a single value is given instead of 3 zonal values.

The formula for the estimation of the annual energy running cost for split and multi split air-conditioners is the following:

$$\text{ARC} = (\text{AEc,h,x} + \text{AEc,c}) \times \text{EP}$$

Where:

ARC= Annual running cost

AEc,h,x = Annual energy consumption in the heating function per kWh according to the label, in the respective heating season

AEc,c = Annual energy consumption in the cooling function per kWh according to the label

EP= Electricity price per KWh

For the single and double duct air-conditioners the formula is as follows:

$$\text{ARC} = [(\text{HEc,h} \times \text{HUh}) + (\text{HEc,c} \times \text{HUC})] \times \text{EP}$$

Where:

ARC= Annual running cost

HEc,h = Hourly energy consumption in the heating function according to the label

HEc,c = Hourly energy consumption in the cooling function according to the label

HUh = Annual hours of use in the heating function, defined by partners
HUC = Annual hours of use in the cooling function , defined by partners
EP= Electricity price per KWh

3.2. Methodologies not embedded in the YAEI database

- ▶ **Refrigerators, freezers and combined units (displayed with the old energy label)**

The formula for the calculation of the annual running cost for refrigerators displayed with the old energy label is the same with the old label products:

$$\text{ARC} = \text{AEC} \times \text{EP}$$

Where:

ARC= Annual running cost

AEC= Annual energy consumption per kWh according to the label

EP= Electricity price per KWh

- ▶ **Washing machines (displayed with the old energy label)**

The old label shows only the Et,60, whereas under the new Delegated Regulation the product fiche also indicates the energy consumptions of the standard cotton cycles at Et,60½ and Et,40½.

In the EnergieWeter initiative the two labels are associated based on the average energy consumption per cycle. In the case of Netherlands the following values are considered. These values might vary slightly between countries but since they are used only to compare Et, 60 with Et,60½ and Et,40½ they are considered as representative for all Member States.

Table 3: Average consumption of washing machines per cycles at different temperatures and loads

Temperature	Energy consumption per cycle at full load	Energy consumption per cycle at half-full load
60 degrees	1.03 kWh	0.73 kWh
40 degrees	0.54 kWh	0.43 kWh

In the new energy label the weighted energy consumption (Et) is calculated as follows:

$$\text{Et} = [3 \times \text{Et},60 + 2 \times \text{Et},60,1/2 + 2 \times \text{Et},401/2]/7$$

In EnergieWeter the association of the two labels is carried out by applying the following formula:

$$\text{Et} = (3y + 2 * 0.73/1.03 y + 2 * 0.43/1.03y)/7 = 0.75 y$$

Where:

$y = Et_{60}$ in the old energy label.

To fully associate the two labels, EnergieWeter also adds the average consumption of P_l and P_o . By also taking into account that the new energy label considers 220 cycles per year, the annual energy consumption is calculated as follows:

$$AEc = 220 * 0.75 y + APc = 165 y + APc$$

Where:

AEc = Annual energy consumption

APc = Annual energy consumption in "off-mode" and "left-on mode"

In the Delegated Regulation APc is calculated based on the following formula:

$$\frac{\left[P_o \times \frac{525\,600 - (T_t \times 220)}{2} + P_l \times \frac{525\,600 - (T_t \times 220)}{2} \right]}{60 \times 1\,000}$$

Where:

P_o = weighted power in "off – mode"

P_l = weighted power in the "left-on mode"

T_t = weighted programme time

The values and the associated assumptions which are applied in the formula above are the following:

- $P_o = 1W$ - the minimum requirement for equipments in any off-mode condition as set by the Regulation on the ecodesign requirement for standby and off mode power consumption⁹ (Ecodesign Regulation).
- $P_l = 2W$ - the minimum requirement for equipments in any off-mode condition under the Ecodesign Regulation. This value applies on "power consumption of equipment in any condition providing only information or status display, or providing only a combination of reactivation function and information or status display".
- $T_t = 120$ minutes- the average programme time per cycle for washing machines. The base-case in the ecodesign study on washing machines¹⁰ considers a shorter average programme duration (approximately 95 minutes). The latest value is taken into account since it is considered as more representative at the EU level.

By applying these values in the formula above it is estimated that $APc = 13$ kWh.

⁹Regulation No 1275/2008 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment, available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:339:0045:0052:en:PDF>

¹⁰ ISIS (2007), Preparatory Studies for Eco-design Requirements of EuPs, LOT 14: Domestic Washing Machines & Dishwashers

From January 2013 onwards, the Ecodesign requirements will be lowered to 0.5 W for the “off-mode” and 1 W for the standby mode. However, this will not affect the YAECI action since the products covered by this requirement will be displayed with the new energy label.

Based on the analysis above, the harmonised formula for the estimation of the annual cost of energy and water consumption of the washing machines which are displayed with the old energy label is the following:

$$\text{AEC} = (165 \times Et,60 + 13) \times EP$$

$$\text{AWC} = 165 \times Wt \times WP$$

$$\text{ARC}^* = \text{AEC} + \text{AWC}$$

Where:

ARC= Annual running cost

AEC= Annual energy cost

AWC= Annual water cost

Et,60= Energy consumption per cycle at 60 °C (kWh) according to the label

EP= Electricity price per KWh

Wt = Water consumption per cycle in L

WP= Water price per L

* this parameter will not be included in the YAECI database or displayed by the retailers

► Dishwashers (displayed with the old energy label)

Compared to washing machines, in dishwashers, the association of the new and the old label is considerably simpler, since only one function is taken into account. By applying an approach similar to the estimation of the annual energy consumption of washing machines, which are displayed with the old energy label, the calculation for dishwasher can be carried out by applying the following formula:

$$AEc = 280 \times Et + APc$$

Where:

Et= Energy consumption per cycle in kWh

APc= Annual energy consumption in “off-mode” and “left-on mode”

For the calculation of the APc the same assumptions are applied as for the estimation of the APc of the washing machines. In the context of the present study the same duration of the cycle (Tt) is considered as in the base case of the ecodesign study on dishwashers¹¹ which is approximately 75 minutes (instead of 90 minutes which is the average in the Netherlands according to EnergieWeter). By applying these values is estimated that the APc of dishwashers is also approximately 13 kWh.

¹¹ ISIS (2007), Preparatory Studies for Eco-design Requirements of EuPs, LOT 14: Domestic Washing Machines

& Dishwashers

Based on this analysis the formula for the calculation of the annual energy and water consumption costs for dishwashers which are displayed with the old energy label is the following:

$$\text{AEC} = (280 \times E_t + 13) \times EP$$

$$\text{AWC} = 280 \times W_t \times WP$$

$$\text{ARC*} = \text{AEC} + \text{AWC}$$

Where:

ARC= Annual running cost

AEC= Annual energy cost

AWC= Annual water cost

E_t = Energy consumption per cycle (kWh) according to the label

EP= Electricity price per KWh

W_t = Water consumption per cycle in L

WP= Water price per L

* this parameter will not be included in the YAEI database or displayed by the retailers

► Tumble dryers (displayed with the old energy label)

The old energy label displays the weighted energy consumption per cycle in two types of tumble dryers, the condensed and air-vented models.

In the EnergieWeter the following formula is applied for the estimation of the annual energy cost:

$$\text{ARC} = (155 \times 5/Cd \times E_t \times 78\%) \times EP$$

Where:

ARC= Annual running cost

Cd= Capacity of cotton in kg as per the label

E_t = Energy consumption per cycle (kWh) as per the label

EP= Electricity price

In this formula, the following assumptions are taken into account:

- On average a tumble dryer is used 155 times per year;
- The average load is 3.4 kg for a tumble dryer with maximum capacity of 5 kg. Based on this assumption it is estimated that on average tumble dryers consume 78% of the energy consumption which is indicated in the energy label. This ratio is applied to all machines regardless of their capacities.

In light of the new energy label described earlier, this formula needs to be modified and harmonised with the approach specified in the new Delegated Regulation.

There are two main differences between the two labels:

- the old label indicates the energy consumption per cycle in full load whereas the new label weights the annual energy consumption at full and partial loads ($Edry$ and $Edry^{1/2}$);
- the new energy label also takes into account the energy consumption in "off mode" and "left on mode".

The bridging of these two differences can be accomplished by following an approach similar to the methodology which is applied for the association of the new and the old energy labels of washing machines.

The energy consumption in the new energy label is estimated by applying the following formula:

$$Et = (3 \times Edry + 4 \times Edry^{1/2})/7$$

According to the ecodesign study on tumble dryers¹² the energy consumption per cycle of a tumble dryer is reduced at smaller loads. Based on estimates provided in this study it is assumed that at partial load a tumble drier requires 60% of energy compared to a full load. Consequently the formula above can be written as:

$$Et = (3 \times Edry + 4 \times 60\% \times Edry)/7 = 0.77 \times Edry$$

By considering an annual use of 160 cycles (as defined in the new energy label) and the energy consumption in "off-mode" and "left-on mode" the formula is the following:

$$AEc = 123 \times Edry + APc$$

AEc = Annual energy consumption

APc = Annual energy consumption in "off-mode" and "left-on mode" (P_0 and P_1)

In the new energy label, the APc is calculated by applying the same formula as for washing machines. For the definition of P_0 and P_1 , the same parameters of the Ecodesign Regulation are taken into account. In the Base-case of the ecodesign study on tumble dryers, the average programme time per cycle (T_t) for air-vented and condensed tumble dryers with a load of 3.4 kg is estimated respectively at 71 and 59 minutes¹³. By applying these parameters in the formula, the APc for both types of products, is estimated at approximately 13 kWh.

Consequently the harmonised formula for the tumble dryers displayed with the old energy label is as follows:

$$\text{ARC} = (123 \times Edry + 13) \times EP$$

Where:

ARC = Annual running cost

$Edry$ = Energy consumption per standard cycle (kWh) according to the label

EP = Electricity price per KWh

¹² PricewaterhouseCoopers (2009), Ecodesign of Laundry Dryers Preparatory studies for Ecodesign requirements of Energy-using-Products (EuP) – Lot 16, available at: http://www.ebpg.bam.de/de/ebpg_medien/tren16/016_studyf_09-03_complete.pdf

¹³ These values represent the averages of front and top loading models

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CHAPTER 4: DEFINITION OF DATA PER COUNTRY

The calculation of the running cost is based on data which is mostly provided by the EU energy label, but certain parameters are defined by the project team. Specifically, the following data needs to be defined:

- energy prices per country;
- water prices per country (optional);
- usage patterns of single and double-duct air-conditioners (applicable in CR, ES, FR, MT, PT, RO and SI).

The data for each of these categories and their sources are described in the sections below.

4.1. Energy prices per country

Table 4 shows the household energy prices in all countries represented in YAEI. Most of these prices come from Eurostat and they refer to the first semester of 2012 and will be updated at the beginning of the YAEI action. These prices entail the following characteristics:

- they are charged in direct current (DC) bands for annual consumptions between 2,500 and 5,000 kWh;
- they include all taxes (including VAT).

As indicated in Table 4, the electricity prices in Spain, the Netherlands and Romania are estimated based on national sources.

Table 4: Energy prices per country¹⁴

Country	Energy price €/KWh	Source
AT	0.1975	Eurostat
CR	0.1398 (1.0454 kn)	Estimate
CZ	0.1497 (3.7700 CZK)	Eurostat
DE	0.2595	Eurostat
ES	0.2250	Estimate ¹⁵
FR	0.1412	Eurostat
MT	0.1700	Eurostat

¹⁴ Eurostat data are taken from table: domestic consumers - half-yearly prices - new methodology from 2007 onwards (nrg_pc_204), average of the first semester of 2012 <http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/database#>

¹⁵ At the time of preparation of this report, the Eurostat data for Spain, were flagged as "provisional"

Country	Energy price €/KWh	Source
NL	0.2200	Milieu Centraal ¹⁶
PT	0.1993	Eurostat
RO	0.1160 (0.5230 lei)	Enel ¹⁷
SI	0.1542	Eurostat

The project team also examined the possibility of obtaining data from national sources (e.g. statistical offices, energy agencies) and for this purpose information was collected as well from such sources. Although national authorities and statistical offices often provide more up-to-date data, Eurostat was selected as the most appropriate source, due to the differences that exist between countries in the definition of characteristics which relate to the electricity prices (e.g. corresponding bands and inclusion of taxes). In this context, the use of data from Eurostat can ensure consistency throughout the whole duration of YAECI.

4.2. Water prices

The inclusion of the cost of water consumption as a supplementary information to the energy indicator is optional. The inclusion will be based on the height of water prices at the national, regional or local levels and on the preferences of the participating retailers. Table 5 shows the average water prices per m³ in 7 countries covered by YAECI. These prices are either provided by national statistical sources (CZ and FR) or they have been estimated based on average prices from various suppliers. In addition, these estimates entail the following three aspects:

- the prices correspond to an annual consumption of approximately 120 m³/year;
- they reflect costs of both water supply and sewage;
- any extreme cases (i.e. particularly high or low prices in certain regions) have been excluded.

Table 5: Water price per m³

Country	Water price €/m ³	Source
CR	1.52 (11.33 kn)	Estimate
CZ	2.92 (73.44 CZK)	CZSO
FR	1.73	INSEE
MT	3.20	Estimate

¹⁶ <http://www.milieucentraal.nl/themas/energie-besparen/energielprijzen>

¹⁷ <http://www.enel.ro>

Country	Water price €/m³	Source
PT	1.28	Estimate
RO	1.29 (5.86 lei)	Estimate
SI	0.66	Estimate

4.3. Usage patterns of air-conditioners

The new Energy label on single and multi-split air-conditioners provide the annual energy consumption for both heating and cooling functions. However, for single and double duct units, the information on energy consumption is provided on an hourly basis.

The preparatory study on the environmental performance of residential room conditioning appliances¹⁸ provides an estimate of the annual use of single-duct air-conditioners. According to this study, in the EU, the annual use of single-duct air-conditioners is estimated at 311 hours per year. This amount of hours corresponds to the duration when the compressor is on. This figure is therefore relevant for the EU energy label as the Delegated Regulation on the energy labelling of air-conditioners¹⁹ refers to “on mode” energy consumption for display in the energy label. In addition the preparatory study provided the basis for the development of the EU energy indicator on air-conditioners. It is assumed that this estimate corresponds also to the double-duct air-conditioners.

Due to the lack of data at national level, the usage patterns of air-conditioners are estimated based on the Cooling Degree Days (CDD). Table 6, shows the usage patterns in the cooling function of single and double duct air-conditioners, for each country in which the YAECI energy indicator will be displayed.

Table 6: Usage pattern in the cooling function²⁰

Country	Cooling Degree Days (base 18°)	Usage pattern in the cooling function
CR	455	374
ES	808	665
FR	180	148
MT	1445	1188

¹⁸ Armines et al (2009), Preparatory study on the environmental performance of residential room conditioning appliances (airco and ventilation)

¹⁹ Commission Delegated Regulation (EU) No 626/2011 of 4 May 2011 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of air-conditioners

²⁰ The Cooling Degree Days are taken from Wheeler D. (2012), Energy+ Country Performance Ratings 2001–2010 – Working Paper 301, available at: <http://www.cgdev.org/content/publications/detail/1426349>

Country	Cooling Degree Days (base 18°)	Usage pattern in the cooling function
PT	509	419
RO	461	379
SI	413	340
EU 27	378	311

No data is available on the usage patterns of single and double duct air-conditioners in the heating function. The estimate of these usage patterns are based on the usage patterns of the portable electric fan heaters which share similar characteristics as portable air-conditioners. Particularly, both products are portable, they cover a relatively small floor area, they use air as a media for heating and they are often used as a secondary source of space heating. The preparatory study²¹ on local room heating, estimates that in the EU the usage pattern of the portable electric fan heaters is 324 hours per year. Table 7, shows the usage patterns at national level which are estimated based on the approach which was applied for the estimation of the usage pattern in the cooling function. The heating Degree Days (HDD) are used instead of the CDD.

Table 7: Usage pattern in the heating function²²

Country	Heating Degree Days (base 18°)	Annual hours in the heating function
CR	2316	244
ES	1686	178
FR	2340	246
MT	499	53
PT	1166	123
RO	2773	292
SI	2774	292
EU 27	3076	324

²¹ BIO Intelligence Service (2012) Preparatory Studies for Ecodesign Requirements of EuPs (III), ENER Lot 20 – Local Room Heating Products - Task 5: Definition of Base-Cases. http://www.ecoheater.org/lot20/open_docs/BIO_EuP_Lot20_Task_5_Final%20Report.pdf

²² Heating Degree Days are taken from Eurostat, table Heating degree-days by NUTS 2 regions - annual data (nrg_esdgr_a),

<http://epp.eurostat.ec.europa.eu/portal/page/portal/energy/data/database#>

ANNEX 1: SUMMARY OF PARAMETERS AND DATA COLLECTION METHODS

The table below summarises the parameters from the formulas which need to be defined for all products and labels which have been selected. This table also serves as an input in WP3 and specifically it defines which information will be requested by the manufacturers.

Table 8: Summary of parameters and data collection methods

Product	Parameters	Source	Method of collection	Countries concerned
Refrigerators and freezers (displayed with the new energy label)	Annual energy consumption (AEc)	Point IV of the new energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	
Refrigerators and freezers (displayed with the old energy label)	Annual energy consumption (AEc)	Point V of the old energy label	Optional element - Calculated by the retailers	
Washing machines (displayed with the new energy label)	Annual energy consumption (AEc)	Point IV of the new energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	All
	Annual water consumption (AWc)	Point V of the new energy label	Optional element- Inserted by manufacturers in the database for each model, which is placed in shops.	
Washing machines (displayed with the old energy label)	Energy consumption per cycle at 60 °C (Et60)	Point V of the old energy label	Optional element - Calculated by the retailers	
	Water consumption per cycle	Point X of the old energy label	Optional element - Calculated by the retailers	
Dishwashers (displayed with the new energy label)	Annual energy consumption (AEc)	Point IV of the new energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	

Product	Parameters	Source	Method of collection	Countries concerned
	Annual water consumption (AWc)	Point V of the new energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	
Dishwashers (displayed with the old energy label)	Energy consumption per standard cycle (Et)	Point V of the old energy label	Optional element - Calculated by the retailers	
	Water consumption per cycle	Point IX of the old energy label	Optional element - Calculated by the retailers	
Televisions	Annual energy consumption (AEc)	Point V of the energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	
Washer dryers	Ew,d= Energy consumption per cycle in the washing/ drying function in kWh	Point V of the energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	CZ, CR, FR, NL
	Ew= Energy consumption in the washing only function in kWh	Point VI of the energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	
	Cw= Capacity in the washing function according to the energy label in kg	Point IX of the energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	
	Cd= Capacity in the drying function according to the energy label in kg	Point X of the energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	

Product	Parameters	Source	Method of collection	Countries concerned
	Water consumption per cycle	Point XI of the old energy label	Optional element- Inserted by manufacturers in the database for each model, which is placed in shops.	
	Ww= Water consumption per cycle in L in washing and spinning functions according to the product fiche	Point 13 of the energy fiche	Optional element- Inserted by manufacturers in the database for each model, which is placed in shops.	
Tumble dryers (displayed with the new energy label)	Annual energy consumption (AEc)	Point IV of the new energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	AT, CZ, CR, DE, FR, NL, SI
Tumble dryers (displayed with the old energy label)	Energy consumption per standard cycle (Et)	Point V of the old energy label	Calculated by the retailers	
Air-conditioners (displayed with the new energy label) – single and multi split	Annual energy consumption in the heating function per kWh according to the label, in the respective heating season (AEc,h,x)	Point IX or VI of the new energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	
	Annual energy consumption in the cooling function per kWh according to the label (AEc,c)	VI of the new energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	CR, ES, FR, MT, PT, RO, SI
Air-conditioners (displayed with the new energy label) – single and double duct	Hourly energy consumption in the heating function according to the label (HEc,h)	VI of the new energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	

Product	Parameters	Source	Method of collection	Countries concerned
	Hourly energy consumption in the heating function according to the label (HEc,c)	VI of the of the new energy label	Inserted by manufacturers in the database for each model, which is placed in shops.	
	Annual hours of use in the heating function (HUh)	Studies and/or expert opinion	Defined by the partners	
	Annual hours of use in the cooling function (HUC)	Studies and/or expert opinion	Defined by the partners	

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YAECI - Yearly Appliance Energy Cost Indication

www.appliance-energy-costs.eu