BOOST ENERGY LABEL TAKE UP

Deliverable 2.2: Report summarising the environmental and economic benefits of the new labelling scheme

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

DOCUMENT DESCRIPTION

DOCUMENT TITLE	Environmental assessment
DOCUMENT ID	D2.2
DOCUMENT VERSION	V1.0
DOCUMENT TYPE	Report
DISSEMINATION LEVEL	Public
DUE DATE	June 30, 2020
SUBMISSION DATE	June 19, 2020
AUTHOR	SOFIES

HISTORY OF CHANGES

VERSION	DATE	CHANGE
1	June 19, 2020	
2	April 29, 2021	Reference added and text error corrected

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

Table of content

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

Summary

Regulation (EU) 2017/1369 aims to promote the uptake of more efficient energy-related products, and additional Commission Delegated Regulations (EU), which supplement Regulation (EU) 2017/1369, dictate the rescaling of energy labels. Unless properly managed, the rescaling of energy labels can create difficulties and confusion amongst all market actors, such as consumers, retailers and manufacturers.

The BELT project has the objective to facilitate the transition period informing and supporting all stakeholders, from manufacturers to consumers. In this context, this report examines the benefits of introducing the new energy labels at a European and country level, and also at the appliance performance and user level.

Washing machines, dishwashers, refrigerators, TVs, and lighting appliances, are the appliances in scope; while the countries considered here are Spain, Portugal, Italy, Belgium, and Slovenia (primary target countries), and Ireland, Greece, Croatia, and Lithuania (secondary target countries), and Europe as a whole.

For the purposes of determining the environmental and economic benefits of the introduction of the new labels, we have developed a tool that allows to refine the impact estimation based on the latest real market data and projections.

Initial results show the potential benefits of the introduction of the new energy labels in terms of both environmental and economic benefits, suggesting that thousands of tonnes of CO_2 emissions and billions of euros could be saved due to reductions in electricity consumption. This represents, however, a first attempt at estimating the environmental benefits of the BELT project and by the end of the project the impact on the adoption of the new labels will be reviewed and will be quantified using the latest available data.

At the same time, the results of this study contribute energy consumption and environmental data used in a Web tool, result of WP2.6, which is designed to help consumers understand the benefits of more energy efficient products on their environmental impact and running costs.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

1 Introduction

Regulation (EU) 2017/1369 aims to promote the uptake of more efficient energy-related products, repealing Directive 2010/30/EU and the first Directive 92/75/EEC. Additional Commission Delegated Regulations (EU), which supplement Regulation (EU) 2017/1369, dictate the rescaling of energy labels. Unless properly managed, the rescaling of energy labels can create difficulties and confusion amongst all market actors, such as consumers, retailers and manufacturers. Washing machines, dishwashers, refrigerators, TVs, and lighting appliances, which are placed on the market from the 1st of March 2021 onwards, must have the new labels.

The BELT project has the objective to facilitate the transition period informing and supporting all stakeholders, from manufacturers to consumers. In this context, it is important to understand the benefits of introducing the new energy labels at a European and country level, and the benefits of label at the appliance performance and user level.

The objectives of this task is to develop tools to assess the environmental and cost implications of the new energy labels at European and country level, and at the appliance and user level.

This task focuses on the following metrics to measure the impact of the introduction of the new labels:

- Expected energy consumption reductions
- Greenhouse gas emission reductions
- Particulates and Volatile Organic Compounds (VOCs) emissions reductions
- Economic cost savings

Since energy consumption reductions depend on many factors, this study modelled different scenarios of future sales per energy label category. At the same time, it is important to note that the benefits estimated in this study are both due to the introduction of the labels, but also due to investments in cleaner and renewable energies. In order to capture the impact of renewable energies, the modelling includes changing energy mixes according to different EU energy mix scenarios. The outputs of the work is collated in an excel file that allows the modelling of different scenario.

This task also provides the data necessary for consumers to understand the meaning of the new labels in terms of energy consumption, environmental impact, and energy consumption costs in the calculator available in a Web tool, result of WP2.6.

The study focused on both the primary target countries (Spain, Portugal, Italy, Belgium, and Slovenia), secondary target countries (Ireland, Greece, Croatia, and Lithuania), as well as Europe as a whole, and all five product categories have been considered (washing machines, dishwashers, fridges, lamps, and TVs).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

This report describes the data and methodology used to feed the tools developed in this task and gives a first estimation of the BELT project impact. These impact results will then be updated at a later stage of the project.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

2 Methodology

The impacts triggered by the project in terms of energy savings and CO_2 emissions reductions are calculated applying the following methodology:

- Sales data are used to calculate the waste generated based on the disposal pattern derived from the common methodology adopted by the European Commission for the estimation of WEEE generated methodology[1]. Stock is then calculated as the difference between cumulative sales per product label category and the cumulative disposal of products. When sales data was available per energy class, stock could also be estimated per energy class.

- The product of the average energy consumption and stock per year provides an estimate of the annual energy consumption, per country, per appliance. Energy consumption averages per appliance per energy label is determined considering market data and industry experts' opinion.

- Annual energy consumption is then translated into environmental impacts using LCA methodology designed to capture the impacts due to changes in energy demand (MJ primary energy); GHG emissions (CO_2, methane, etc.); and other air pollutants (particulate matters, VOCs, etc.).

Figure 1 illustrates the different steps in the calculation.

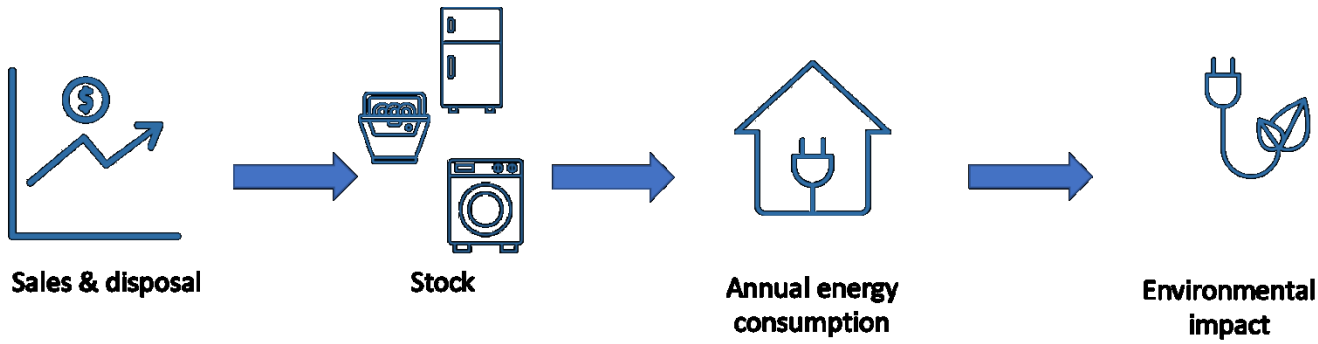

Figure 1: Methodology adopted

Estimation of energy saving potential is made by considering the current and future stock of appliances in the target countries and the breakdown by energy class. Breakdown per energy class was not available for each country so the breakdown obtained at EU level was assumed for each of the individual target countries.

[1] https://ec.europa.eu/environment/waste/weee/pdf/Final_Report_Art7_publication.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

3 Data

3.1 Main sources of data

3.1.1 Sales

Sales data for home appliances (washing machine, fridges, dishwasher) and breakdown per energy class were obtained from APPLIA at EU level.

Literature and market data obtained from industry experts were used for TVs and lamps.

Breakdown per target country was done according to the ratios available in the EU common Methodology dataset[2] (E-Tool EC) and considered constant. It was also assumed that the breakdown per energy class when available were similar from target countries to target country without more detailed information.

Projection of sales/current energy label shares were extrapolated from the current datasets to serve as baseline scenarios.

3.1.2 Energy consumption

The current energy consumption per energy class for the current energy labels were obtained from literature. In particular, studies by ENEA[3] and preparatory studies by the JRC[4,5] were deemed particularly relevant.

The expected energy consumption under the new labels was estimated based on the formulas found in the corresponding different regulations, detailed in Table 1, of which some key parameters were fixed based on literature, and through a review containing market data and advice from industry experts.

For the scenario during the project and to 2030, the following initial and conservative assumptions have been made: annual consumption, per energy class, is considered to be constant, while it will depend on improvements in efficiency of the appliances themselves and on the use given by consumers;

3.1.3 Energy mix

[2] EU Common Methodology dataset is available at: https://ec.europa.eu/environment/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee/implementation-weee_en ; and the report can is found at: https://ec.europa.eu/environment/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee/implementation-weee_en

3 Energy consumption estimations per appliance: https://www.efficienzaenergetica.enea.it/servizi-per/cittadini/interventi-di-efficienza-e-risparmio-energetico-nelle-abitazioni/etichetta-energetica/etichetta-energetica-apparecchi.html?filter_tag[0]=25

4 Boyano A., Moons H., Villanueva A., Graulich K., Rüdenauer I., Alborzi F., Hook I., Stamminger R., Follow-up for the preparatory study for Ecodesing and Energy Label for household dishwashers, EUR 28808 EN, doi:10.2760/0768

5 Boyano A., Espinosa, N., Villanueva A., Follow-up of the preparatory study for Ecodesign and Energy Label for household washing machines and household washer dryers, EUR 28807 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-73894-4, doi:10.2760/954441, JRC108583.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

The electricity mix for each of the primary and secondary target countries, as well as for the EU as a whole, was modelled using the latest EU Reference Scenario[6]. The EU Reference Scenario was selected as baseline energy mix supply for this study as its intended purpose is to provide a benchmark against which to compare new policies[7]. The selected scenario allows us to evaluate the impact of different degrees of adoption of the energy with the baseline electricity mix.

3.1.4 Environmental impacts

Emission data in terms of primary energy, GHG emissions and other pollutants emissions was obtained from the Ecoinvent v3.6[8] widely used among LCA practitioners due to its transparency and consistency by modelling in Simapro the energy mixes as described in the EU Reference Scenario.

The robust and well accepted impact assessment methods used in the study were: CML 2 baseline 2000, version 4.7, updated in 2016. The impact categories used were global warming potential (GWP100), implemented in the method according to IPCC2013, Primary energy, and Photochemical oxidation, linked to the creation of 'summer smog', and dependent mainly on emissions of carbon monoxide (CO), sulphur dioxide (SO2), nitrogen oxide (NO), ammonium and NMVOC (non-methane volatile organic compounds).[9] Additionally, the ILCD Particulate matter impact category was used to measure the benefits in terms of particulate matter emission reductions.

Table 1: Overview of main sources used

Type of data for the assessment	Main sources

Sales data	• Dishwashers
	  ○ APPLiA for the period 2008 – 2018
	  ○ Future sales estimations were obtained from VHK 2014.
	• Washing machines, Fridges
	  ○ up to 2019: E-Tool EC data for the period 2008 – 2018
	  ○ Future sales estimations were obtained from VHK 2014
	• Lamps
	  ○ E-Tool EC for 2008-2020
	  ○ Extrapolations from the dataset to 2030
	• TVs
	  ○ VHK 2014 sales data and projection for the period 2008 – 2030
	  ○ Country breakdown sales proportions from E-Tool EC

[6] https://ec.europa.eu/energy/sites/ener/files/documents/20160713%20draft_publication_REF2016_v13.pdf
[7] https://ec.europa.eu/energy/data-analysis/energy-modelling/eu-reference-scenario-2016_en
[8] https://www.ecoinvent.org/
[9] Green Delta 2016. LCIA methods - Impact assessment methods in Life Cycle Assessment and their impact categories. Accessed at: http://www.openlca.org/wp-content/uploads/2016/08/LCIA-METHODS-v.1.5.5.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

Breakdown per country	• E-Tool EC
Breakdown per energy class	• Washing machines, dishwashers, fridges: APPLiA for the period 2008 – 2018 • TVs: Topten, European commission • Lamps: no data found

Annual energy consumption for	• Washing machines
	  ○ Old energy labels – JRC 2017
	  ○ New energy labels – estimated
	• Dishwasher
	  ○ Old energy labels – ENEA
	  ○ New energy labels – estimated
	• Fridges
	  ○ Old energy labels – ENEA
	  ○ New energy labels – estimated
	• TVs
	  ○ Old energy labels – ENEA
	  ○ New energy labels – estimated
	• Lamps
	  ○ No information found

Estimation of stock	Study on collection rates of waste electrical and electronic equipment (WEEE), European Commission[10]
Electricity mix (current + projections)	Reference scenario: EU Reference Scenario 2016. Energy, transport and GHG emissions. Trends to 2050.
CO_2, primary energy and pollutants emission factors	Ecoinvent v3.6 database

Regulations	• Washing machines
	  ○ Old energy labels – Commission Delegated Regulation (EU) No 1061/2010
	  ○ New energy labels – Commission Delegated Regulation (EU) 2019/2014 of 11 March 2019
	• Dishwasher
	  ○ Old energy labels – Commission Delegated Regulation (EU) No 1059/2010
	  ○ New energy labels – Commission Delegated Regulation (EU) 2019/2017
	• Fridges
	  ○ New energy labels – Commission Delegated Regulation (EU) No 1060/2010
	• TVs
	  ○ New energy labels – Commission Regulation (EU) 2019/2021
	• Lamps
	  ○ Old energy labels – Commission Delegated Regulation (EU) No 874/2012

[10] https://ec.europa.eu/environment/waste/weee/pdf/Final_Report_Art7_publication.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

	○ New energy labels – Commission Delegated Regulation (EU) 2019/2015

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

3.2 Washing machines

3.2.1 Sales Data

Sales data for Europe and per target country was obtained from the E-Tool EC for the period 2008 – 2018. The data for the 2019 and 2020 was extrapolated following the trend of the previous years, and the sales for 2020 to 2030 were estimated using growth in sales obtained from VHK 2014. [11]

Past and future sales for washing machines are shown in Figure 2, where an irregular trend can be observed between the years 2008 and 2014, while the saturating future sales projection suggests that market may be reaching saturation.

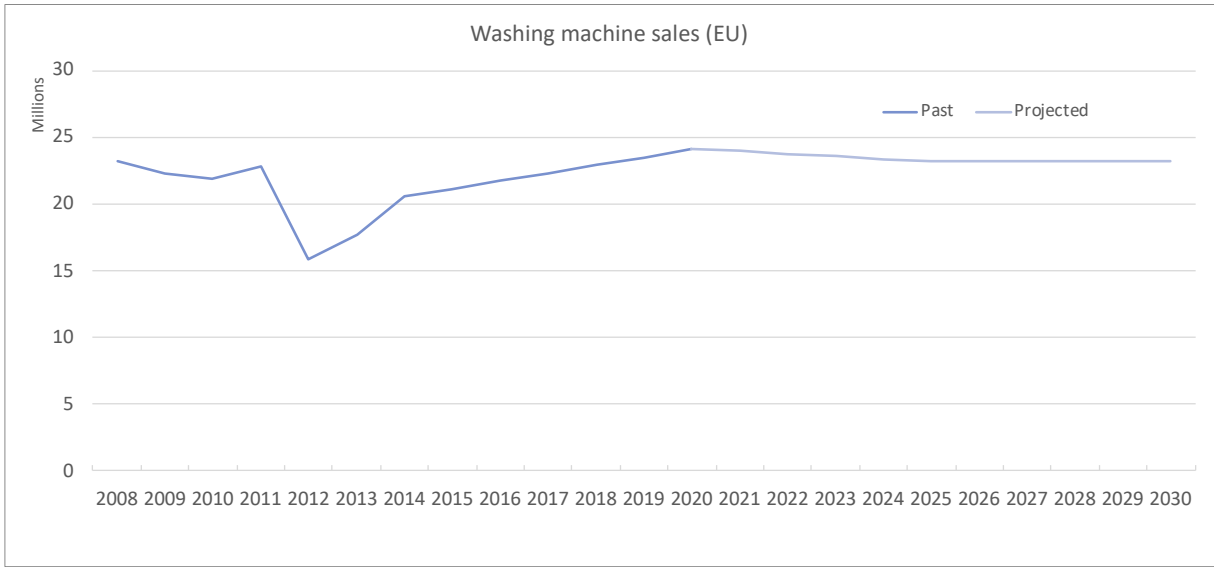

Figure 2 Sales – Washing machines

Sales per energy label category for Europe were obtained from APPLiA, as shown in Figure 3.

[11] Ecodesign Impact Accounting: Part 1 – Status Nov. 2013. Available at: https://ec.europa.eu/energy/sites/ener/files/documents/2014_06_ecodesign_ impact_accounting_part1.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

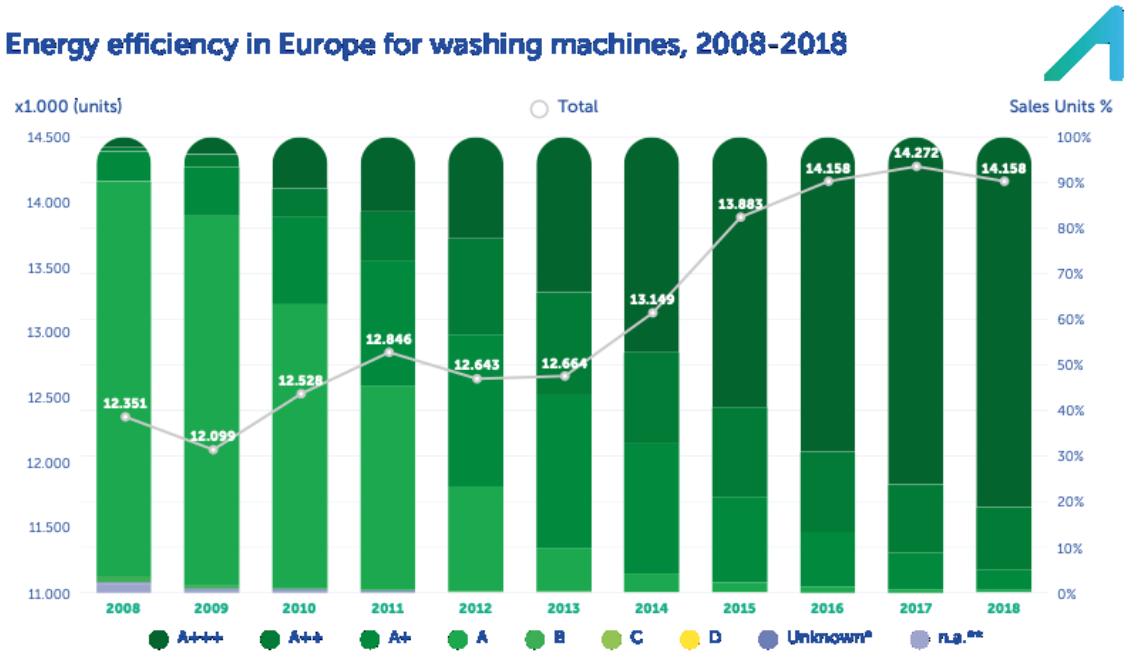

Figure 3 Share of sales per energy label class – Washing machines. Source: APPLiA 2020.[12]

Figure 3 shows how during the period 2008 – 2018 the energy efficiency of washing machines increased, and that by the year 2018 almost all products placed on market were of the top three energy efficiency categories. At the same time, this suggests that the energy label are not effectively using the entire range of categories to differentiate products according to their efficiency and a rescaling would be needed.

Note that the total sales number is different in this figure as it does not include all types of washing machines.

Future sales per energy label class for the reference scenario were obtained by extrapolating the 2016,17,18 trends of proportion sales per energy label class to 2030, Figure 4.

[12] APPLiA 2020. By the Numbers: The Home Appliance Industry in Europe, 2018 -2019. Accessible at: https://applia-europe.eu/statistical-report-2018-2019/files/applia-statistical-report-2019.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

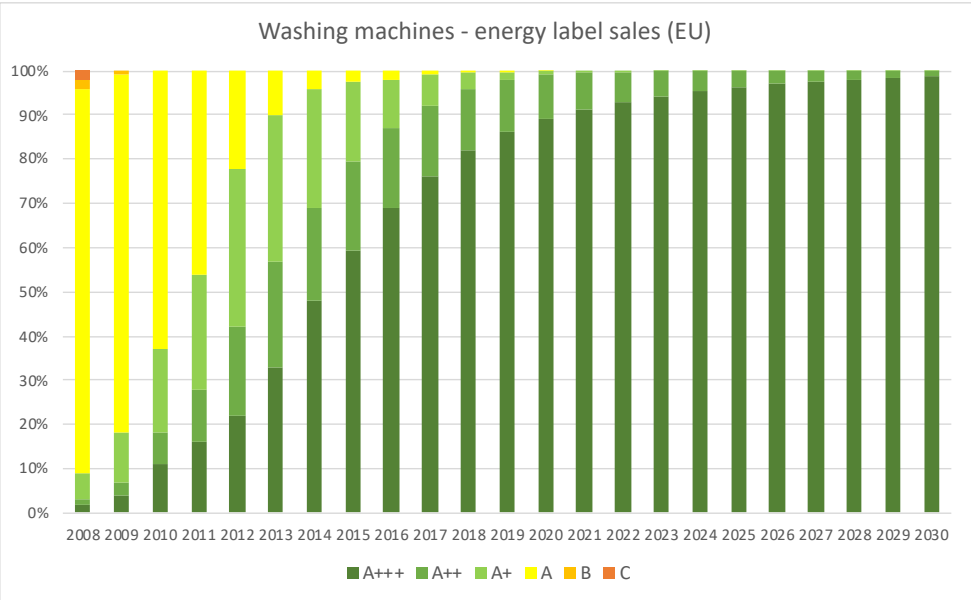

Figure 4: Share of sales per energy label class – Washing machines

3.2.2 Energy consumption

Energy consumption average per old label category were obtained from the 2017 JRC preparatory study.[13] These values were calculated assuming a rated capacity of 7 kg, and 220 cycles per year (as defined in the regulation for the yearly energy calculations).

Table 2: Old energy label energy consumption table – Washing machines[14]

	EEI Min	EEI Max	kWh/cycle Min	kWh/cycle Max	kWh/year Min	kWh/year Max	kWh/year Median
A+++		50		0.84		235	221*
A++	50	56	0.84	0.94	235	263	249
A+	56	63	0.94	1.06	263	295	279
A	63	71	1.06	1.19	295	333	314
B	71	80	1.19	1.34	333	375	354
C	80	90	1.34	1.51	375	422	399
D	90		1.51		422		436**

[13] Boyano A., Espinosa, N., Villanueva A., Follow-up of the preparatory study for Ecodesign and Energy Label for household washing machines and household washer dryers, EUR 28807 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-73894-4, doi:10.2760/954441, JRC108583.

14 Energy consumption values from Boyano et al., 2017

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

Under the new energy labels, energy consumption was estimated based on the EEI formula below, and the Standard cycle energy consumption (SCE formula below), as set out in the regulation:[15]

$$EEI_W = (E_W/SCE_W) \times 100$$

$$SCE_W = -0{,}0025 \times c^2 + 0{,}0846 \times c + 0{,}3920$$

Where E_w is the energy consumption of the household washing machine, c is the rated capacity of the washing machine in kg, and SCE_w is calculated in kWh per cycle.

The energy consumption per category was estimated by calculating the SCE_w for the average rated capacity of washing machines currently sold in Europe, and plugging in this value into formula the EEI formula. The rated capacity value used for the new label calculations was 7.2 kg, the current washing machines sales average capacity for Italy, Spain, Belgium and Portugal.[16] The slight increase in size reflects market trends.[17] The assumed number of cycles per year was 220, as defined in the regulation.

Table 3: New energy label energy consumption table – Washing machines

	EEI Min	EEI Max	kWh/cycle Min	kWh/cycle Max	kWh/year Min	kWh/year Max	kWh/year Median
A		52		0.47		104	96
B	52	60	0.47	0.55	104	120	112
C	60	69	0.55	0.63	120	138	129
D	69	80	0.63	0.73	138	160	149
E	80	91	0.73	0.83	160	182	171
F	91	102	0.83	0.93	182	204	193
G	102		0.93		204		215

3.3 Fridges

3.3.1 Sales Data

Sales data for Europe and per target country was obtained from the E-Tool EC for the period 2008 – 2018. The data for the 2019 and 2020 was extrapolated following the trend of the

15 Formulas extracted from COMMISSION DELEGATED REGULATION (EU) 2019/2014 of 11 March 2019
16 Data from GFK, reworked by market analysis department of Euroconsumers
17 Boyano Larriba, A., Cordella, M., Espinosa Martinez, M., Villanueva Krzyzaniak, A., Graulich, K., Rüdinauer, I., Alborzi, F., Hook, I. and Stamminger, R., Ecodesign and Energy Label for household washing machines and washer dryers, EUR 28809 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978- 92-79-74183-8, doi:10.2760/029939, JRC109033. Page 163.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

previous years, and the sales for 2020 to 2030 were estimated using growth in sales obtained from VHK 2014. [18]

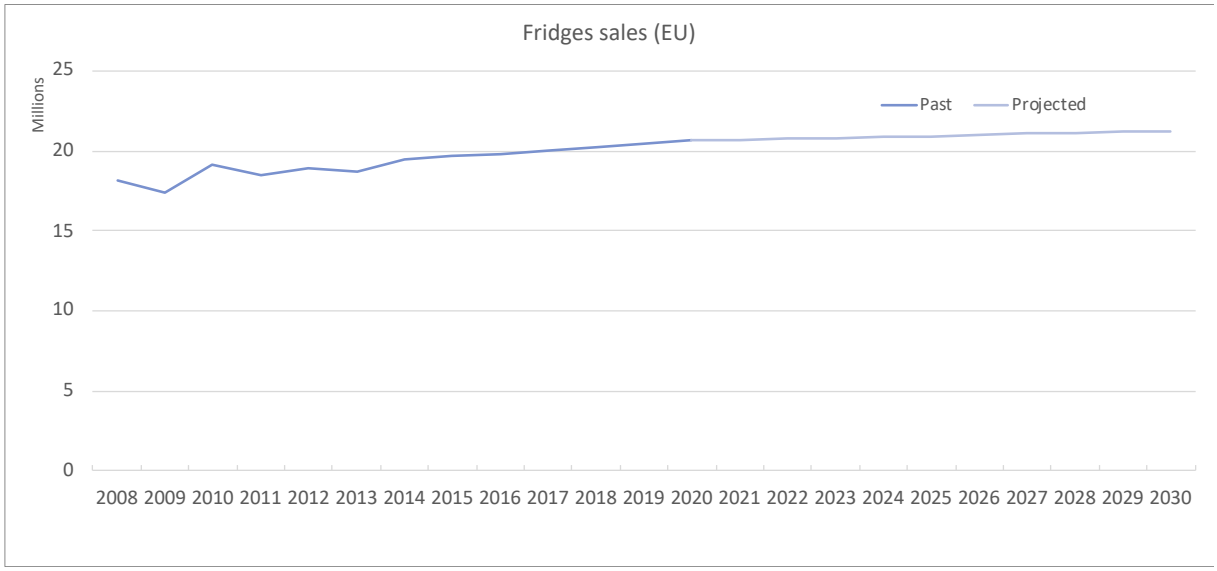

Figure 5: Fridge sales. Extrapolated 2020-2030

The trend in future fridge sales shown in Figure 5, obtained from VHK 2014, suggests a flattening of sales of fridges, suggesting a potential market saturation.

Sales per energy label category for Europe were obtained from APPLiA. It was assumed that the breakdown of sales per category remained equal across countries.

Figure 6 shows how during the period 2008 to 2018 the energy efficiency of products placed on the market increased, meaning that by 2018 almost all products were of categories A+++ and A++, and also suggesting that a rescaling of the labels was needed in order to effectively differentiate products on their efficiency. The trends were extrapolated to the year 2030 for the reference scenario, and can be seen in the figure below.

[18] Ecodesign Impact Accounting: Part 1 – Status Nov. 2013. Available at: https://ec.europa.eu/energy/sites/ener/files/documents/2014_06_ecodesign_ impact_accounting_part1.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

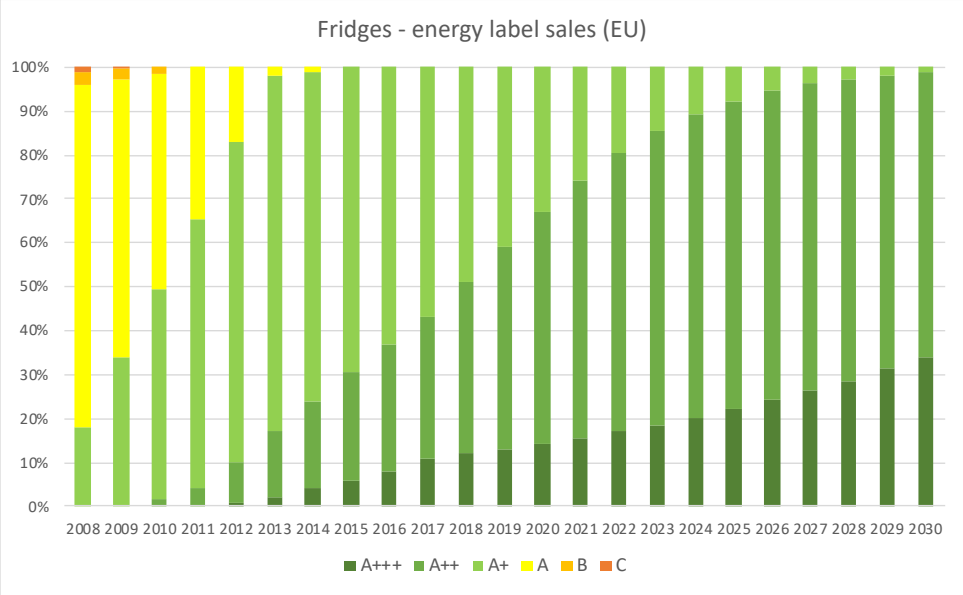

Figure 6: Fridge sales per energy label category. Data for 2008 to 2018 from APPLiA. Extrapolated 2019-2030

3.3.2 Energy consumption

Average energy consumption per energy label category in the old scheme was obtained from literature[19] :

Table 4 Old scheme energy label energy consumption table – Fridges. Source: ENEA.[20]

	EEI Min	EEI Max	kWh/year Min	kWh/year Max	kWh/year Median
A+++		22		138	105
A++	22	33	138	205	172
A+	33	42	206	274	240
A	42	55	275	343	309
B	55	75	344	468	406
C	75	95	469	593	531
D	95	110	594		656

[19] Energy consumption values per category for the old energy label from ENEA: Etichetta energetica per frigoriferi, frigocongelatori, congelatori e cantinette. Accessed on May 2020 from https://www.efficienzaenergetica.enea.it/servizi-per/cittadini/interventi-di-efficienza-e-risparmio-energetico-nelle-abitazioni/etichetta-energetica/etichetta-energetica-apparecchi/etichetta-energetica-per-frigoriferi-frigocongelatori-congelatori-e-cantinette.html

[20] Energy consumption values per category for the old energy label from ENEA: Etichetta energetica per frigoriferi, frigocongelatori, congelatori e cantinette. Accessed on May 2020 from https://www.efficienzaenergetica.enea.it/servizi-per/cittadini/interventi-di-efficienza-e-risparmio-energetico-nelle-abitazioni/etichetta-energetica/etichetta-energetica-apparecchi/etichetta-energetica-per-frigoriferi-frigocongelatori-congelatori-e-cantinette.html

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

The parameters set to estimate the above energy consumption values were a size of fridge of 300 litres, with a fresh food compartment of 200 litres, and frozen compartment of 100 litres.

The average energy consumption estimations under the new scheme can be seen in the table below:

Table 5: New energy label energy consumption table – Fridges

	EEI Min	EEI Max	kWh/year Min	kWh/year Max	kWh/year Median
A		42		101	90
B	42	51	101	123	112
C	51	64	123	154	138
D	64	80	154	193	173
E	80	100	193	241	217
F	100	125	241	301	271
G	125		301		331

The parameters set to calculate the energy consumption were a fridge of volume 292 litres, with fresh food compartment of 195 litres, and a freezer of 97 litres (values from industry expert, reflecting current sales averages). The type of fridge is a combi two door appliance. These parameters were calculated from average sales data from GSK reworked by the market analysis department of Euroconsumers.

The energy consumption was estimated based on the annual energy consumption formula defined in the Commission Delegated Regulation (EU) 2019/2016 of 11 March 2019:

$$SAE = C \times D \times \sum_{c=1}^{n} A_c \times B_c \times [V_c V] \times (N_c + V \times r_c \times M_c)$$

Where SAE is the standard annual energy consumption (kWh/year), V is the volume of the fridge, V_c volume of compartment, r_c, Nc, M_c and C are modelling parameters specific to each compartment; and A_c, B_c and D are compensation values defined in regulation.

3.4 Dishwashers

3.4.1 Sales Data

Sales data for dishwashers for Europe for the period 2008 – 2018 was obtained from APPLiA. Sales were extrapolated for the period 2019 – 2020, and growth rates from VHK 2014 were applied for the period 2020 – 2030. The steady increase in dishwasher sales during the period

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

reflects the fact that the penetration rate of washing machines is growing, and every year 0.67% more households in Europe benefit from a dishwasher.[21]

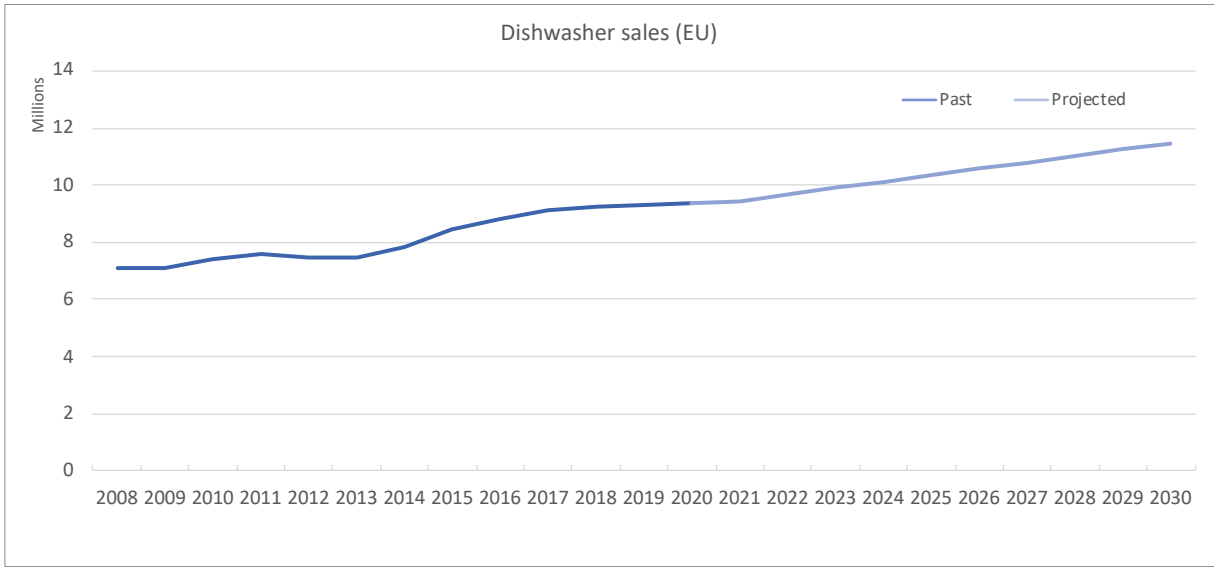

Figure 7: Sales – Dishwashers – EU

Sales per energy label category for Europe for the period 2008 – 2014 were obtained from APPLiA, and can be seen in the figure below.

[21] APPLiA 2017. What if all Europeans had a dishwasher? Accessed at https://www.applia-europe.eu/images/2017-03---DW-campaign-analysis.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

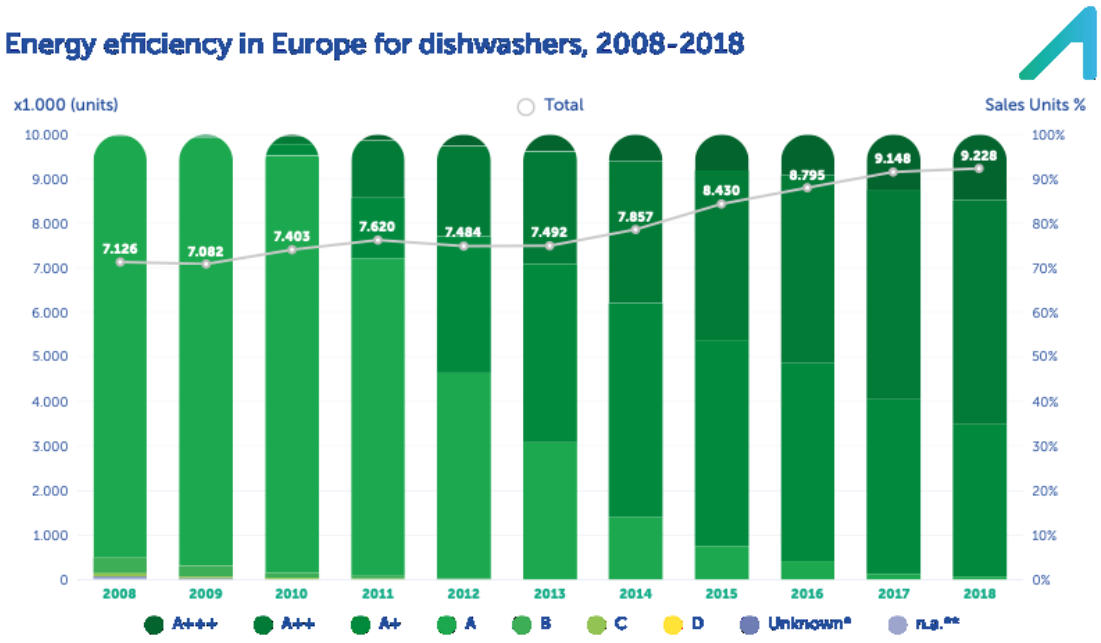

Figure 8: Sales per energy label category – Dishwashers – EU. Source: APPLiA 2020.[22]

Figure 8 shows how in the last few years all sales corresponded to products in the categories A+++, A++, and A+, indicating that the energy efficiency categories were not separating the products placed on market effectively.

The trend in sales per energy label category for the period 2008 – 2018 were extrapolated to 2030. The same proportion of sales per category was assumed across countries for the reference scenario.

[22] APPLiA 2020. By the Number: The Home Appliance Industry in Europe, 2018 -2019. Accessed at: https://applia-europe.eu/statistical-report-2018-2019/files/applia-statistical-report-2019.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

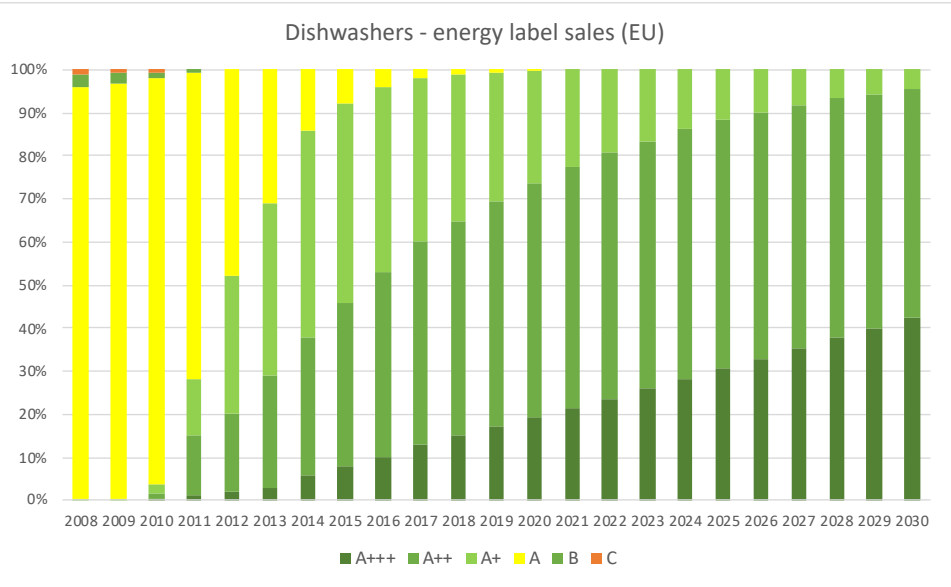

Figure 9: Sales per energy label category – Dishwashers, extrapolated 2019 -2030 – EU

3.4.2 Energy consumption

Average energy consumption values per energy label category under the old scheme were calculated using 12.9 as average number of place settings (sales average for Spain, Italy, Belgium and Portugal – calculated from data provided by industry expert), and a number of cycle per year of 280, as detailed in the regulation.

Table 6: Old energy label energy consumption table – Dishwashers

	EEI Min	EEI Max	kWh/cycle Min	kWh/cycle Max	kWh/year Min	kWh/year Max	kWh/year Median
A+++		50		0.84		235	221
A++	50	56	0.84	0.94	235	263	249
A+	56	63	0.94	1.06	263	295	279
A	63	71	1.06	1.19	295	333	314
B	71	80	1.19	1.34	333	375	354
C	80	90	1.34	1.51	375	422	399
D	90		1.51		422		436

The energy consumption for the new energy label categories was calculated based on the formula detailed on the Commission Delegated Regulation (EU) 2019/2017 of 11 March 2019.

$$EEI = (EPEC/SPEC) \times 100$$

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

Where, EPEC is the eco programme energy consumption (kWh/cycle), and SPEC is the standard programme energy consumption, calculated in kWh/cycle, and dependent on the number of place settings.

The new energy consumption average values per energy label category were calculated using the same parameters, 12.9 place settings,[23] and 280 cycles per year.

Table 7: New energy label energy consumption table – Dishwashers

	EEI Min	EEI Max	kWh/cycle Min	kWh/cycle Max	kWh/year Min	kWh/year Max	kWh/year Median
A		32		0.54		150	136
B	32	38	0.54	0.64	150	178	164
C	38	44	0.64	0.74	178	206	192
D	44	50	0.74	0.84	206	235	220
E	50	56	0.84	0.94	235	263	249
F	56	62	0.94	1.04	263	291	277
G	62		1.04		291		305

3.5 TVs

3.5.1 Sales Data

Sales data per countries and at European level from 2008 and 2030 were obtained from VHK 2014. The annual sales of televisions in the EU-27 are expected to grow at a steady rate between 2020 and 2030. This sector has seen technological changes such as the gradual switch across Europe from analogue to digital broadcast and the introduction of flat-screen, smaller-footprint and better performing televisions. Additionally, the proportion in sales of smart TVs is increasing rapidly in the coming decade.

[23] Parameter from data of GFK reworked by market analysis department of Euroconsumers.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

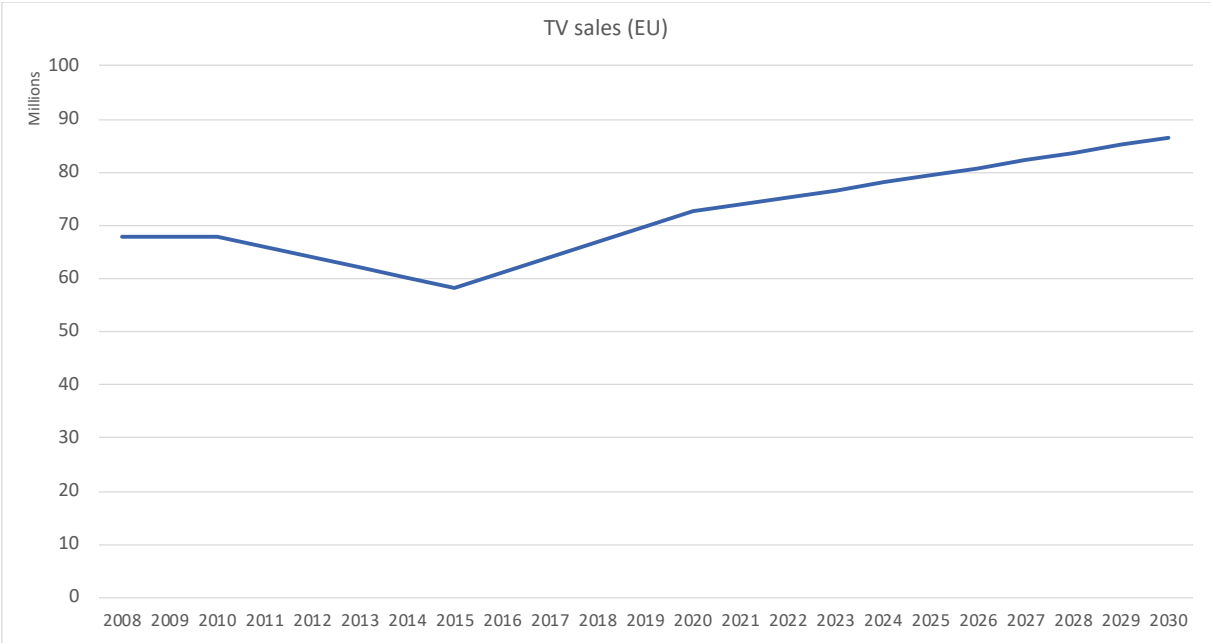

Figure 10: Sales – TVs – EU

To determine the share of the different energy labels, several data sources were used. The main one was a report from the European Commission which gave the energy labels share from 2013 to 2017[24]. In 2017 almost no televisions in classes below B were sold in the EU, with 86% of the TV in the A categories.

[24] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52019SC0354&from=EN

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

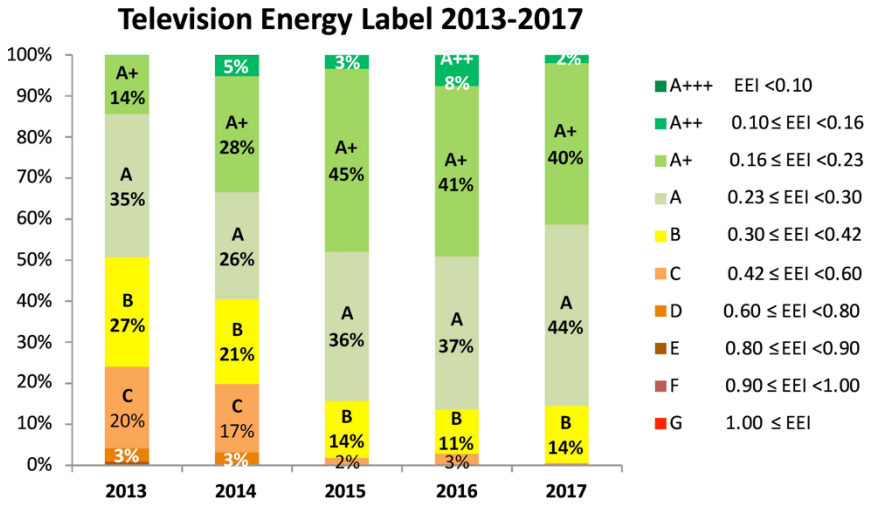

Figure 11: TV sales per energy class – 2013-2017

Additional data points were obtained from topten[25] and CLASP discussion paper on Ecodesign and energy labelling of electronic displays[26] to extrapolate the trends before 2013 and after 2017 for the baseline scenario (no new labelling scheme):

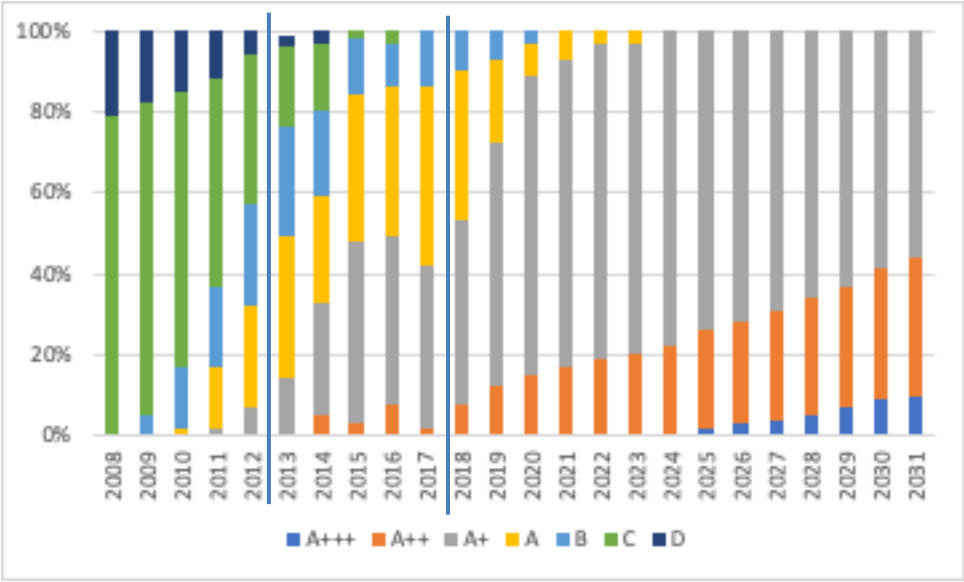

Figure 12: TV sales per energy class – extrapolated 2008-2030

[25] https://www.topten.eu/private/products/tvs
[26] https://c2e2.unepdtu.org/wp-content/uploads/sites/3/2016/04/2014-11-eu-electronic-displays-paper.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

3.5.2 Energy consumption

Energy consumption averaged per label category in the old scheme were taken from the literature.[27] These energy consumption values were calculated by ENEA, assuming 4 hours of use per day and 365 days of use a year (as defined in regulation for annual consumption), and a screen size of 102 cm diagonal, or 40''.

Table 8: Energy consumption averages per old label category

	EEI Min	EEI Max	W Min	W Max	kWh/year Min	kWh/year Max	kWh/year Median
A+++		0.10	-	21.23	-	31.00	26.50
A++	0.10	0.16	21.23	27.40	31.00	40.00	35.50
A+	0.16	0.23	34.25	47.95	50.00	70.00	60.00
A	0.23	0.30	48.63	63.01	71.00	92.00	81.50
B	0.30	0.42	63.70	88.36	93.00	129.00	111.00
C	0.42	0.60	89.04	127.40	130.00	186.00	158.00
D	0.60	0.80	127.40	169.18	186.00	247.00	216.50
E	0.80	0.90	169.86	190.41	248.00	278.00	263.00
F	0.90	1.00	191.10	211.64	279.00	309.00	294.00
G	1.00	-	212.33	-	310.00	-	325.00

For the new energy label scheme, energy consumption average under the new energy labels was estimated from the Energy Efficiency Index label formula, as expressed in the Corrigendum to Commission Delegated Regulation (EU) 2019/2013 of 11 March 2019:

$$EEI_{label} = \frac{(P_{measured} + 1)}{(3 \times [90 \times tanh(0,025 + 0,0035 \times (A - 11)) + 4] + 3) + corr_t}$$

Where A is the screen size (in dm^2), $P_{measured}$ the power consumption (in Watts), and corr is a correction factor to adjust for automatic brightness control (set as 'off' in our calculations to be conservative).

Based on market data and industry experts' opinion,[28] the average screen size based on sales data from Portugal, Spain, Italy, and Belgium, for the year 2019 was around 40''. With the

[27] Energy consumption values from ENEA - Etichetta energetica televisori, Servizi per I cittadini, Dipartamento Unita per l'efficienza Energetica. Accessed on May 2020 from https://www.efficienzaenergetica.enea.it/servizi-per/cittadini/interventi-di-efficienza-e-risparmio-energetico-nelle-abitazioni/etichetta-energetica/etichetta-energetica-apparecchi/etichetta-energetica-televisori.html

[28] Based on market data from GFK and reworked by market analysis department of Euroconsumers.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

assumptions of a use of 4 hours per day and 365 days a year, as defined in the regulation. the following average energy consumption per energy class are calculated:

Table 9: Energy consumption averages per new label category

	EEI Min	EEI Max	W Min	W Max	kWh/year Min	kWh/year Max	kWh/year Median
A		0.30		14.3		20.9	17.2
B	0.30	0.40	14.3	19.4	20.9	28.4	24.6
C	0.40	0.50	19.4	24.5	28.4	35.8	32.1
D	0.50	0.60	24.5	29.6	35.8	43.3	39.5
E	0.60	0.75	29.6	37.3	43.3	54.4	48.9
F	0.75	0.90	37.3	44.9	54.4	65.6	60.0
G	0.90		44.9		65.6		71.2

3.6 Lamps

3.6.1 Sales Data

Sales data per countries and at European level from 2008 and 2020 were based on the E-Tool EC, compiling Eurostat data until 2016. LED penetration rate has increased over the time and will still continue, hence the increasing trend over the longer term. The decline that can be observed between 2011-2013 is due to the non-replacement of conventional lamps[29] particularly incandescent.

[29] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC92971/jrc92971%20online.pdf

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

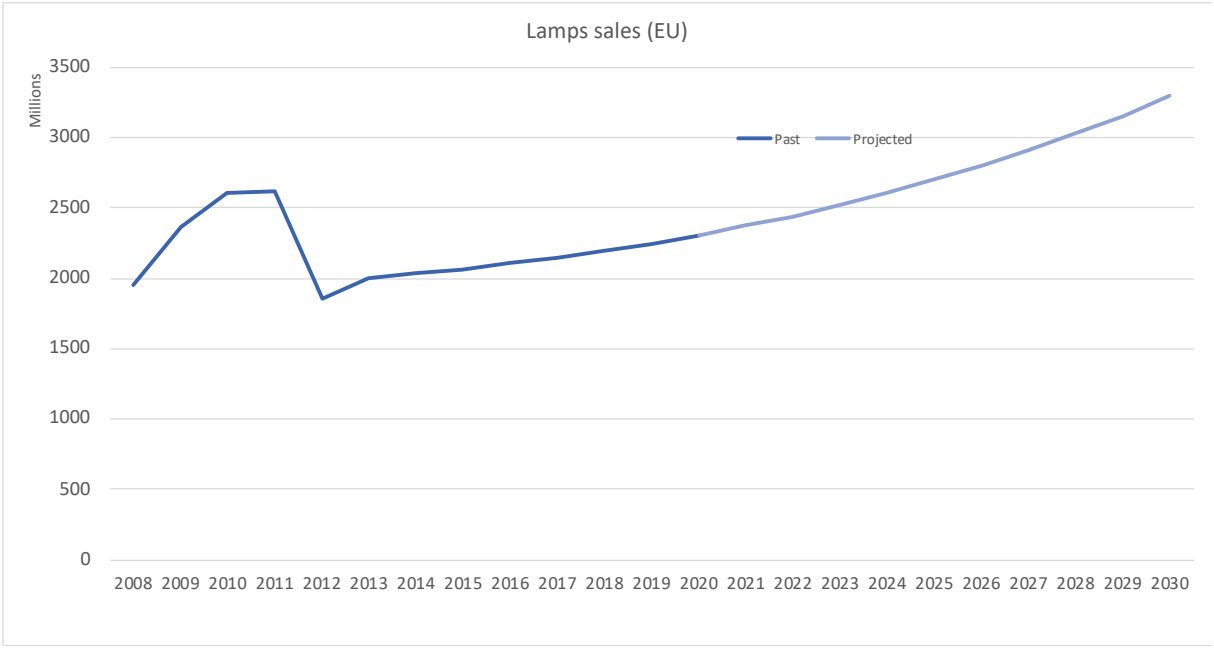

Figure 13: Sales – Lamps – EU

Breakdown per energy label category was not available. From the literature and no data could be obtained from industry associations. The

3.6.2 Energy consumption

For the web tool, energy consumption per energy label category under the new scheme was calculated using the equation detailed in the Commission Delegated Regulation (EU) 2019/2015 of 11 March 2019, and with parameters provided by industry experts from the market analysis department of Euroconsumers.

The energy consumption was calculated using the expression below:

$$\eta_{TM} = (\Phi_{use}/P_{on}) \times F_{TM}\ (lm/W).$$

Where η_{TM} is the total mains efficacy, ϕ_{use} is the lumen output, P_{on} is the power consumption (W), and F_{TM} is a factor dependent on light source type.

The parameters set for the calculation of the energy consumption per energy label category were average lumen output of 470 for lamps and 345 for spots, and a number of hours per use of 1000 per year.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

Table 10. Energy consumption for lamps (non-directional)

	EEI Min	EEI Max	W Min	W Max	kWh/year Min	kWh/year Max	kWh/year Median
A	210	-	-	1.19	-	1.19	1.11
B	185	210	1.19	1.35	1.19	1.35	1.27
C	160	185	1.35	1.56	1.35	1.56	1.46
D	135	160	1.56	1.85	1.56	1.85	1.71
E	110	135	1.85	2.27	1.85	2.27	2.06
F	85	110	2.27	2.94	2.27	2.94	2.61
G	-	85	2.94	-	2.94	-	3.28

Table 11. Energy consumption for spots (directional lighting)

	EEI Min	EEI Max	W Min	W Max	kWh/year Min	kWh/year Max	kWh/year Median
A	210	-		1.64		1.64	1.53
B	185	210	1.64	1.86	1.64	1.86	1.75
C	160	185	1.86	2.16	1.86	2.16	2.01
D	135	160	2.16	2.56	2.16	2.56	2.36
E	110	135	2.56	3.14	2.56	3.14	2.85
F	85	110	3.14	4.06	3.14	4.06	3.60
G	-	85	4.06		4.06		4.52

To estimate the savings of the project we considered average energy consumptions based on literature (VHK 2014).

	Energy consumption in TWh/year - Europe				
Type of lamp	2010	2015	2020	2025	2030
LFL Linear Fluorescent	313	343	334	325	311
CFL Compact Fluorescent	67	90	82	56	43
Tungsten	131	138	136	93	66
GLS General Lighting Service (Incandescent)	153	116	84	52	17
HID	188	170	151	142	142
LED	1	2	13	32	54
SP	151	132	112	92	76
Lighting controls & sb	43	37	31	26	21
Total lighting	**1047**	**1028**	**943**	**818**	**730**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

3.7 Details on environmental data for web tool

A web tool, result of WP2.6, was designed to help consumers understand the benefits of more energy efficient products on their environmental impact and running costs. Sofies contributed the calculations on energy consumption and associated costs and environmental impacts. Below the details on the overall approach, scope, data sources, and assumptions made, are presented.

3.7.1 Approach

The aim was to have a flexible tool that would allow consumers of different appliances in different European countries understand the implications of different labels on costs and environmental impact. Given the variability in the appliances, the values used are averages within categories, and emphasis was placed on simplification and user friendliness.

Your country	Belgium					
Capacity of the dishwasher	13	place settings				
Number of cycles per week	4					
Results						
	Annual energy consumptions (kWh per year)	Energy consumption per cycle (kWh per cycle)	Electricity costs (euros per year)	Associated CO_2 emsissions (kg per year)	Number of trees required to absorb the CO2	Km of driving a car equivalent
A	101	0.49	29	17	1.7	136
B	122	0.59	35	20	2.0	164
C	143	0.69	41	24	2.4	192
D	164	0.79	46	27	2.7	221
E	185	0.89	52	31	3.1	249
F	206	0.99	58	34	3.4	277
G	226	1.09	64	38	3.8	305

Figure 14. Example of user interface in Excel format. The tool allows the user to define the main parameters of the appliance, as well as the intensity of use and country, in order to obtain tailored impact data per energy label category.

3.7.2 Scope

The tool contains data for the appliances and countries in scope of the BELT project:
Primary and secondary target countries: Belgium, Croatia, Greece, Ireland, Italy, Lithuania, Portugal, Slovenia, and Spain.
Appliances: Dishwashers, Washing machines, Fridges, TVs, and Lamps.

3.7.3 Data sources

Energy consumption:
Energy efficiency parameters were obtained from the Commission Delegated Regulations:

- Washing machines – Commission Delegated Regulation (EU) 2019/2014 of 11 March 2019
- Dishwasher – Commission Delegated Regulation (EU) 2019/2017
- Fridges – Commission Delegated Regulation (EU) No 1060/2010
- TVs – Commission Regulation (EU) 2019/2021
- Lamps - Commission Delegated Regulation (EU) 2019/2015

Industry experts were consulted to obtain a better understanding of most frequent parameters in order to present the appropriate options to the tool users (e.g. dishwasher capacity, lamp intensities)

Estimation of costs and environmental impact:
Data on the cost per kWh consumed was obtained from Eurostat, accessed in May 2020 (see table 1 for more information).

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

Data on carbon emissions per kWh consumed was obtained from Carbon Footprint, 2019, 'Country specific electricity grid greenhouse gas emission factors' (see table 1 for details).

Data on emission from cars was obtained from European Environment Agency (122.4 g CO_2/km) corresponding to 2019, while the mass of CO_2 stored by growing trees was found at 'Plant for the planet', accessed May 2020 (10 kg CO_2/year).

Table 12. Costs and carbon dioxide emissions associated per kWh used in Web Tool

	EUR per kWh	kg CO2 per kWh
Belgium	0.2839	0.167
Croatia	0.1321	0.417
Greece	0.165	0.567
Ireland	0.2423	0.393
Italy	0.2301	0.327
Lithuania	0.1255	0.362
Portugal	0.2154	0.307
Slovenia	0.1634	0.335
Spain	0.2403	0.288

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

4 Results and discussion

To estimate the savings generated by the introduction of the new label scheme and in particularly of the BELT project, the reference scenario for each of the appliances, except for lamps, for which we didn't have data, was defined as the situation without the introduction of new label and by extrapolating the share per energy label compared to the trends that were available from APPLIA for fridges, dishwasher and washing machines and the literature for TVs (see part 3).

For the introduction of the new label scheme, the tool allows the user to define the percentage of sales per energy label category. This tool design will allow Sofies to update the results with actual product information and sales data as soon as the products under the new labelling scheme are introduced into the European Product Database for Energy Labelling (EPREL).[30] Therefore, it is important to interpret the results below as the best estimations with available data.

For the purpose of this report, we created future sales scenarios that resulted in average energy consumption of products put on market decrease at a rate of in between 2% and 3% per year (see Annex, section 6.2). These scenarios are examples of potential outcomes of the introduction of the new label, and will be updated by the end of the BELT project when real market sales data will be available.

Based on this data, the results obtained from the tool show the benefits of the introduction of the new labels for the appliances in the scope of this study (except lamps):

Table 13: Results at EU level for 4 appliances

Savings from 2021 until:	2021	2026	2031
GWh Primary Energy saved	608	17,380	54,167
ktonnes CO_2 saved	199	5,596	17,331
Tonnes air pollutants	17.6	515	1,658
Tonnes particulate matter	23.9	696	1,588
Million euros saved for consumers	100	2,967	9,749

With the BELT project aiming to reach 20 millions stakeholders in 9 target countries, covering together 30% of the total European population over the 3 years of the project, the impact for the BELT project could be estimated to be up to:

Table 14: Results for BELT for 4 appliances

Savings from 2021 until:	2021	2026	2031

[30] https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/product-database_en

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

GWh Primary Energy saved	182	5,214	16,250
ktonnes CO_2 saved	60.0	1,679	5,199
Tonnes air pollutants	5.28	154	497
Tonnes particulate matter	7.17	209	476
Million euros saved for consumers	30.2	890	2,924

Table 14: Results for BELT for 4 appliances shows the impact that the adoption of the new energy labels could have in the BELT target countries. It is important to note that these results do not assume that all consumers reached by the project are replacing their appliances, but instead, that the energy label keep on having the same effect on consumer choices, and the sales per energy category modelled can be found in Annex 6.2.

As shown in Table 13 and Table 14, the introduction of the new energy labels and expected corresponding increase in sales in more energy efficient products is expected to result in savings worth over 17 thousands of kilotonnes of CO_2 and billions of euros saved by consumers.

Putting these results in context, the 17,331 kt of CO2 saved amount to 3% of 2017 residential and commercial greenhouse gas emissions[31] (note that this includes all emissions and not only those corresponding to the appliances in focus here). Looking at individual appliances, for example dishwashers, for which scenarios the scenario was obtained to model the appliances in this study, the results are in the ballpark with the preparatory study findings, which reported on a range of scenarios with savings of up to 2.0 TWh/year for 2030,[32] compared with an estimated 1.2 TWh/year saved by 2031, in this study. There were some differences in the methods followed that would have influenced the results, for example, the preparatory study estimated the 'real' energy consumption, while this study used the energy consumption based on the energy consumption as calculated in the energy labels, which rely on the European harmonised test standards (EHTS). There have been reported differences between in energy consumption in EHTS and 'real world usage'.[33] Additionally, as mentioned previously, the scenarios developed for this report are designed to show how this tool can be utilised.

At the same time, the baseline scenario in this study was calculated assuming a continuing progression towards more efficient products, following the trend in the years 2016-2018, while the preparatory study assumed from 2020 appliances with category A+ and lower wouldn't be allowed in the market. While these factors can explain the differences in the estimations, and the assumption in the estimations carry a degree of uncertainty, both studies show how the

[31] Emission totals from EEA 2019. Total greenhouse gas emission trends and projections in Europe. Accessed at https://www.eea.europa.eu/data-and-maps/indicators/greenhouse-gas-emission-trends-6/assessment-3
[32] Boyano A., Moons H., Villanueva A., Graulich K., Rüdenauer I., Alborzi F., Hook I., Stamminger R., Follow-up for the preparatory study for Ecodesing and Energy Label for household dishwashers, EUR 28808 EN, doi:10.2760/0768
[33] CLASP, ECOS, EEB, and Topten.eu, 2017. Closing the 'reality gap' – ensuring a fair energy label for consumers

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

introduction of the new labels can save TWh worth of electricity every year, and save thousands of kilo tonnes of CO_2 emissions.

It is important to note that the BELT project may have other economic benefits, besides direct expenditure on electricity. For example, by being a central information reference point, BELT could help reduce the €7 million[34] that are estimated are annually in the EU on equipment energy performance regulatory compliance.

In conclusion, the additional value of the tool approach selected for this study is that the results can be updated, improved and refined by feeding the tool with real sales data broken down by energy according to the latest market developments. The flexibility of this approach is particularly important in the current Covid-19 pandemic, which is creating unprecedented economic instability and could impact appliance sales.[35]

[34] P. Waide et al. 2011 Enforcement of energy efficiency regulations for energy consuming equipment: findings from a new European study
[35] See for example https://technology.informa.com/622578/covid-19-lowers-expectations-for-home-appliances-during-2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

5 Conclusions

The main objectives of the tasks was to develop a tool that allowed to assess the environmental impact of the BELT project and more generally of the introduction of the new environmental label scheme. This tool based on the methodology and data described in this report is Excel-based.

The methodology used is based on stock estimation calculated using the apparent consumption methodology. The estimated stock is multiplied by energy consumption average to determine an annual consumption which is then translated into environmental impacts using emission factors from LCA methodology. Data was obtained from industry and industry associations when possible. However, for TVs and Lamps, data was gathered from literature and industry experts.

Initial results show the potential benefits of the introduction of the new energy labels in terms of both environmental and economic benefits, suggesting that thousands of tonnes of CO_2 emissions and billions of euros could be saved due to reductions in electricity consumption.

This represents, however, a first attempt at estimating the environmental benefits of the BELT project. The current results are based scenarios of sales per energy label category that will be validated and improved when the data on products under the new labelling scheme is added to the EPREL database, and when actual sales data becomes available.

The additional value of the tool approach selected for this study is that the results can be updated according to the latest market developments, in terms of energy consumption of products, total sales, and sales per energy label category. The added flexibility of this approach is particularly important in the current Covid-19 pandemic, which is creating unprecedented economic instability and could impact appliance sales.

By the end of the project the impact on the adoption will be reviewed and will be quantified using the tool developed to make sure that the impact is updated and closer to the reality.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

6 Annex

6.1 Appliance sales per country

6.1.1 Dishwashers[36]

	ESP	PRT	ITA	BEL	SVN	IRL	GRC	HRV	LTU	EU
2008	191,232	162,111	1,004,272	178,456	27,342	103,953	134,933	57,649	18,707	7,126,000
2009	185,258	136,446	918,769	199,488	22,971	79,625	101,337	43,119	7,976	7,082,000
2010	233,067	92,067	622,615	127,553	15,158	51,493	67,319	27,372	5,914	4,703,000
2011	579,284	118,713	872,031	230,372	26,863	79,549	116,801	52,466	7,047	7,620,000
2012	445,231	93,479	839,806	219,037	24,100	91,248	61,531	47,023	8,568	7,484,000
2013	467,494	98,446	761,406	195,725	17,744	77,794	58,466	44,143	6,284	7,492,000
2014	515,593	114,837	778,897	208,378	23,446	89,981	72,232	43,270	3,797	7,857,000
2015	553,194	123,211	835,701	223,574	25,156	96,543	77,500	46,425	4,074	8,430,000
2016	577,147	128,546	871,885	233,255	26,245	100,724	80,855	48,435	4,250	8,795,000

[36] Europe dishwasher data sales from GFK-APPLiA (2008 -2018), future sales from VHK2014, breakdown per country based on E-Tool EC.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

2017	600,311	133,706	906,879	242,617	27,298	104,766	84,101	50,379	4,421	9,148,000
2018	605,561	134,875	914,810	244,738	27,537	105,682	84,836	50,820	4,460	9,228,000
2019	610,857	136,054	922,810	246,879	27,778	106,607	85,578	51,264	4,499	9,308,700
2020	616,199	137,244	930,880	249,038	28,021	107,539	86,326	51,713	4,538	9,390,105
2021	620,562	138,216	937,472	250,801	28,219	108,300	86,938	52,079	4,570	9,456,600
2022	635,235	141,484	959,639	256,731	28,886	110,861	88,993	53,310	4,678	9,680,200
2023	649,908	144,752	981,805	262,662	29,553	113,422	91,049	54,542	4,786	9,903,800
2024	664,581	148,020	1,003,971	268,592	30,221	115,983	93,105	55,773	4,894	10,127,400
2025	679,255	151,288	1,026,138	274,522	30,888	118,543	95,160	57,005	5,002	10,351,000
2026	693,901	154,551	1,048,265	280,441	31,554	121,100	97,212	58,234	5,110	10,574,200
2027	708,548	157,813	1,070,391	286,361	32,220	123,656	99,264	59,463	5,218	10,797,400
2028	723,195	161,075	1,092,518	292,281	32,886	126,212	101,316	60,692	5,326	11,020,600
2029	737,842	164,337	1,114,645	298,200	33,552	128,768	103,368	61,921	5,434	11,243,800
2030	752,489	167,600	1,136,771	304,120	34,218	131,324	105,420	63,151	5,542	11,467,000

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

6.1.2 Washing machines[37]

	ESP	PRT	ITA	BEL	SVN	IRL	GRC	HRV	LTU	EU
2008	191,232	162,111	1,004,272	178,456	27,342	103,953	134,933	57,649	18,707	7,126,000
2009	185,258	136,446	918,769	199,488	22,971	79,625	101,337	43,119	7,976	7,082,000
2010	366,872	144,923	980,059	200,782	23,860	81,055	105,966	43,086	9,309	7,403,000
2011	579,284	118,713	872,031	230,372	26,863	79,549	116,801	52,466	7,047	7,620,000
2012	445,231	93,479	839,806	219,037	24,100	91,248	61,531	47,023	8,568	7,484,000
2013	467,494	98,446	761,406	195,725	17,744	77,794	58,466	44,143	6,284	7,492,000
2014	515,593	114,837	778,897	208,378	23,446	89,981	72,232	43,270	3,797	7,857,000
2015	553,194	123,211	835,701	223,574	25,156	96,543	77,500	46,425	4,074	8,430,000
2016	577,147	128,546	871,885	233,255	26,245	100,724	80,855	48,435	4,250	8,795,000
2017	600,311	133,706	906,879	242,617	27,298	104,766	84,101	50,379	4,421	9,148,000
2018	605,561	134,875	914,810	244,738	27,537	105,682	84,836	50,820	4,460	9,228,000
2019	610,857	136,054	922,810	246,879	27,778	106,607	85,578	51,264	4,499	9,308,700

[37] Europe washing machines sales data E-Tool EC. Future sales at Europe level from VHK2014 and breakdown per country from E-Tool EC.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

2020	616,199	137,244	930,880	249,038	28,021	107,539	86,326	51,713	4,538	9,390,105
2021	620,562	138,216	937,472	250,801	28,219	108,300	86,938	52,079	4,570	9,456,600
2022	635,235	141,484	959,639	256,731	28,886	110,861	88,993	53,310	4,678	9,680,200
2023	649,908	144,752	981,805	262,662	29,553	113,422	91,049	54,542	4,786	9,903,800
2024	664,581	148,020	1,003,971	268,592	30,221	115,983	93,105	55,773	4,894	10,127,400
2025	679,255	151,288	1,026,138	274,522	30,888	118,543	95,160	57,005	5,002	10,351,000
2026	693,901	154,551	1,048,265	280,441	31,554	121,100	97,212	58,234	5,110	10,574,200
2027	708,548	157,813	1,070,391	286,361	32,220	123,656	99,264	59,463	5,218	10,797,400
2028	723,195	161,075	1,092,518	292,281	32,886	126,212	101,316	60,692	5,326	11,020,600
2029	737,842	164,337	1,114,645	298,200	33,552	128,768	103,368	61,921	5,434	11,243,800
2030	752,489	167,600	1,136,771	304,120	34,218	131,324	105,420	63,151	5,542	11,467,000

6.1.3 Fridges[38]

	ESP	PRT	ITA	BEL	SVN	IRL	GRC	HRV	LTU	EU

[38] Europe fridge sales data E-Tool EC. Future sales at Europe level from VHK2014 and breakdown per country from E-Tool EC.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

2008	1,168,033	442,243	1,453,424	431,991	46,492	235,736	497,206	172,357	120,215	18,121,039
2009	950,176	380,749	856,752	400,304	48,166	177,963	534,168	123,771	78,613	17,396,970
2010	1,064,226	413,661	1,744,652	472,999	63,848	197,104	560,218	144,019	92,561	19,133,735
2011	958,564	334,015	1,597,349	482,970	66,179	162,509	296,748	131,825	80,321	18,433,226
2012	1,030,786	385,342	2,006,204	446,545	70,246	165,930	244,016	128,701	70,681	18,917,954
2013	1,079,811	378,151	1,977,094	446,622	59,865	186,255	291,003	125,446	62,786	18,739,166
2014	1,307,107	370,832	1,584,486	423,617	60,785	185,863	379,917	133,822	80,216	19,454,376
2015	1,319,907	374,463	1,600,002	427,765	61,380	187,683	383,637	135,133	81,001	19,644,885
2016	1,332,832	378,130	1,615,670	431,954	61,981	189,521	387,394	136,456	81,794	19,837,259
2017	1,345,884	381,833	1,631,492	436,184	62,588	191,377	391,188	137,792	82,595	20,031,517
2018	1,359,064	385,572	1,647,469	440,455	63,201	193,251	395,018	139,142	83,404	20,227,677
2019	1,372,373	389,348	1,663,602	444,768	63,820	195,144	398,887	140,504	84,221	20,425,758
2020	1,385,812	393,161	1,679,892	449,124	64,445	197,054	402,793	141,880	85,046	20,625,779
2021	1,390,032	394,358	1,685,009	450,492	64,641	197,655	404,020	142,312	85,305	20,688,599
2022	1,394,253	395,556	1,690,125	451,859	64,837	198,255	405,246	142,744	85,564	20,751,419

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

2023	1,398,474	396,753	1,695,242	453,227	65,034	198,855	406,473	143,177	85,823	20,814,238
2024	1,402,695	397,950	1,700,358	454,595	65,230	199,455	407,700	143,609	86,082	20,877,058
2025	1,406,915	399,148	1,705,475	455,963	65,426	200,055	408,927	144,041	86,341	20,939,877
2026	1,411,136	400,345	1,710,591	457,331	65,622	200,655	410,153	144,473	86,600	21,002,697
2027	1,415,357	401,543	1,715,707	458,699	65,819	201,256	411,380	144,905	86,859	21,065,517
2028	1,419,578	402,740	1,720,824	460,067	66,015	201,856	412,607	145,337	87,118	21,128,336
2029	1,423,798	403,938	1,725,940	461,435	66,211	202,456	413,834	145,769	87,377	21,191,156
2030	1,428,019	405,135	1,731,057	462,803	66,408	203,056	415,061	146,201	87,636	21,253,976

6.1.4 TVs

	ESP	PRT	ITA	BEL	SVN	IRL	GRC	HRV	LTU	EU
2008	3,738,692	606,034	3,998,830	742,301	60,883	363,459	721,864	171,146	214,862	34,952,677
2009	4,989,634	770,582	6,222,374	868,115	18,698	351,269	877,513	177,031	356,004	44,767,747
2010	5,990,562	990,857	7,787,831	1,004,622	107,164	371,868	856,019	263,635	352,346	52,777,172
2011	4,290,622	997,521	6,532,096	1,019,443	195,779	385,573	722,537	267,362	347,029	50,401,225

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

2012	3,352,199	948,495	5,573,046	858,566	164,314	333,331	631,880	287,592	366,580	43,656,638
2013	2,448,598	639,417	3,811,289	608,733	112,596	247,720	579,379	207,428	201,863	31,327,478
2014	2,353,479	598,900	3,551,095	602,996	112,704	242,956	554,108	187,776	39,344	29,741,811
2015	2,218,137	564,459	3,346,881	568,320	106,223	228,984	522,243	176,977	37,082	28,031,434
2016	2,090,577	531,998	3,154,410	535,637	100,114	215,816	492,210	166,800	34,949	26,419,416
2017	1,970,353	501,405	2,973,008	504,834	94,357	203,405	463,904	157,208	32,939	24,900,101
2018	1,857,043	472,570	2,802,037	475,802	88,931	191,707	437,226	148,167	31,045	23,468,159
2019	1,750,249	445,394	2,640,899	448,440	83,817	180,683	412,083	139,646	29,260	22,118,564
2020	1,649,597	419,780	2,489,028	422,651	78,997	170,292	388,385	131,616	27,577	20,846,580
2021	1,554,733	395,640	2,345,890	398,346	74,454	160,499	366,050	124,047	25,991	19,647,746
2022	1,465,324	372,887	2,210,984	375,438	70,172	151,269	344,999	116,913	24,496	18,517,853
2023	1,381,057	351,444	2,083,836	353,847	66,137	142,570	325,159	110,190	23,088	17,452,937
2024	1,301,636	331,233	1,963,999	333,498	62,333	134,371	306,460	103,853	21,760	16,449,262
2025	1,226,782	312,185	1,851,055	314,320	58,749	126,644	288,836	97,881	20,509	15,503,306
2026	1,156,233	294,232	1,744,605	296,244	55,370	119,361	272,226	92,252	19,329	14,611,750

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

2027	1,089,741	277,311	1,644,277	279,208	52,186	112,497	256,571	86,947	18,218	13,771,465
2028	1,027,072	261,364	1,549,719	263,151	49,185	106,027	241,816	81,947	17,170	12,979,502
2029	968,008	246,333	1,460,599	248,018	46,356	99,930	227,910	77,234	16,183	12,233,084
2030	912,340	232,167	1,376,603	233,755	43,691	94,183	214,803	72,792	15,252	11,529,589

6.1.5 Lamps

	ESP	PRT	ITA	BEL	SVN	IRL	GRC	HRV	LTU	EU
2008	153,755,079	40,416,526	157,289,264	46,512,748	6,930,905	11,358,550	42,976,414	9,105,375	6,335,806	1,947,220,562
2009	144,751,778	39,922,541	141,761,494	45,361,114	6,405,317	22,496,784	31,972,490	8,485,534	6,063,602	2,363,814,133
2010	178,045,612	38,161,952	238,593,002	59,565,640	6,376,146	15,612,255	38,537,124	8,832,611	6,514,911	2,606,413,016
2011	235,186,520	36,864,055	308,454,374	71,513,364	9,560,084	29,740,355	44,910,988	9,054,072	8,091,966	2,616,637,211
2012	163,846,328	33,677,489	187,873,519	39,631,168	6,873,870	17,871,556	37,996,267	11,233,825	8,096,732	1,852,729,582
2013	178,769,412	32,549,310	190,365,959	39,027,627	6,981,817	16,562,604	44,205,640	12,583,222	9,405,382	1,999,605,834
2014	176,908,470	37,000,255	193,451,619	42,362,744	7,123,807	16,384,104	46,055,445	12,830,541	10,049,458	2,034,092,418
2015	179,309,244	37,733,547	198,171,434	43,408,838	7,253,582	16,892,102	46,360,218	13,142,639	10,249,274	2,067,075,162

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

2016	182,122,770	38,556,500	203,385,301	44,549,501	7,399,975	17,443,185	46,770,860	13,490,702	10,475,167	2,104,701,129
2017	185,369,773	39,474,127	209,122,211	45,790,490	7,563,950	18,039,793	47,291,883	13,876,816	10,728,537	2,147,207,127
2018	189,072,817	40,491,855	215,413,538	47,138,007	7,746,553	18,684,553	47,928,263	14,303,235	11,010,898	2,194,850,481
2019	193,256,431	41,615,558	222,293,204	48,598,722	7,948,914	19,380,292	48,685,464	14,772,398	11,323,892	2,247,910,410
2020	197,947,245	42,851,584	229,797,854	50,179,811	8,172,254	20,130,053	49,569,475	15,286,939	11,669,294	2,306,689,514
2021	203,174,129	44,206,789	237,967,054	51,888,990	8,417,894	20,937,106	50,586,838	15,849,704	12,049,026	2,371,515,380
2022	208,968,353	45,688,575	246,843,497	53,734,554	8,687,259	21,804,969	51,744,689	16,463,762	12,465,163	2,442,742,306
2023	215,363,747	47,304,925	256,473,226	55,725,422	8,981,886	22,737,423	53,050,798	17,132,424	12,919,944	2,520,753,162
2024	222,396,891	49,064,451	266,905,876	57,871,177	9,303,434	23,738,529	54,513,613	17,859,261	13,415,786	2,605,961,391
2025	230,107,297	50,976,429	278,194,931	60,182,118	9,653,691	24,812,652	56,142,301	18,648,118	13,955,296	2,698,813,169
2026	238,537,628	53,050,858	290,398,003	62,669,310	10,034,582	25,964,477	57,946,806	19,503,140	14,541,282	2,799,789,718
2027	247,733,913	55,298,505	303,577,135	65,344,642	10,448,183	27,199,039	59,937,897	20,428,790	15,176,772	2,909,409,809
2028	257,745,798	57,730,962	317,799,116	68,220,886	10,896,731	28,521,742	62,127,230	21,429,872	15,865,025	3,028,232,445
2029	268,626,796	60,360,707	333,135,837	71,311,757	11,382,630	29,938,390	64,527,410	22,511,558	16,609,551	3,156,859,753
2030	280,434,575	63,201,167	349,664,654	74,631,993	11,908,472	31,455,210	67,152,055	23,679,413	17,414,129	3,295,940,088

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

6.2 Scenarios of sales per category

6.2.1 Washing machines

	A	B	C	D	E	F	G
2021	0%	0%	5%	25%	55%	10%	5%
2022	0%	2%	7%	27%	52%	9%	4%
2023	1%	3%	9%	29%	49%	7%	3%
2024	2%	5%	11%	31%	45%	5%	2%
2025	3%	6%	13%	33%	42%	3%	1%
2026	4%	8%	15%	35%	38%	1%	0%
2027	5%	9%	17%	36%	34%	0%	0%
2028	6%	11%	19%	36%	29%	0%	0%
2029	7%	12%	21%	36%	25%	0%	0%
2030	8%	14%	23%	36%	20%	0%	0%
2031	9%	15%	25%	36%	16%	0%	0%

6.2.2 Dishwasher

	A	B	C	D	E	F	G
2021	0%	2%	9%	25%	32%	28%	4%
2022	0%	3%	11%	27%	31%	26%	3%
2023	0%	3%	13%	29%	30%	23%	2%
2024	0%	4%	15%	31%	29%	21%	1%
2025	0%	4%	17%	33%	28%	18%	0%
2026	1%	5%	19%	34%	27%	16%	0%
2027	1%	5%	21%	34%	26%	13%	0%
2028	2%	6%	23%	35%	25%	11%	0%
2029	2%	6%	25%	35%	24%	8%	0%
2030	3%	7%	27%	36%	23%	6%	0%
2031	3%	7%	29%	36%	22%	3%	0%

6.2.3 Fridge

	A	B	C	D	E	F	G
2021	0%	10%	20%	44%	14%	7%	5%

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

2022	0%	12%	22%	43%	13%	6%	5%
2023	1%	13%	23%	41%	12%	6%	4%
2024	2%	15%	24%	40%	11%	5%	4%
2025	3%	16%	25%	39%	11%	4%	3%
2026	4%	18%	26%	37%	10%	3%	3%
2027	5%	19%	27%	36%	9%	3%	2%
2028	6%	21%	28%	34%	8%	2%	2%
2029	7%	22%	29%	33%	7%	1%	1%
2030	8%	24%	30%	32%	6%	0%	1%
2031	9%	25%	31%	30%	5%	0%	0%

6.2.4 TVs

	A	B	C	D	E	F	G
2021	0%	0%	5%	25%	55%	10%	5%
2022	0%	2%	7%	27%	52%	9%	4%
2023	1%	3%	9%	29%	49%	7%	3%
2024	2%	5%	11%	31%	45%	5%	2%
2025	3%	6%	13%	33%	42%	3%	1%
2026	4%	8%	15%	35%	38%	1%	0%
2027	5%	9%	17%	36%	34%	0%	0%
2028	6%	11%	19%	36%	29%	0%	0%
2029	7%	12%	21%	36%	25%	0%	0%
2030	8%	14%	23%	36%	20%	0%	0%
2031	9%	15%	25%	36%	16%	0%	0%

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

6.3 Electricity emission factors

Table 15. CO2 eq emissions and primary energy consumption (fossil fuels) per country for the reference scenario.[39]

	2020		2025		2030	
Country	CO2 content (kg CO2eq)	MJ Primary energy	CO2 content (kg CO2eq)	MJ Primary energy	CO2 content (kg CO2eq)	MJ Primary energy
EU - average	0.40	4.34	0.37	4.16	0.33	3.69
Italy	0.53	6.47	0.46	5.69	0.44	5.47
Spain	0.36	4.32	0.29	3.53	0.20	2.51
Portugal	0.22	2.87	0.16	2.30	0.10	1.41
Slovenia	0.42	3.51	0.38	3.30	0.37	3.53
Belgium	0.20	2.28	0.35	4.70	0.36	4.93
Greece	0.84	11.54	0.70	9.55	0.49	6.80
Ireland	0.41	5.07	0.39	5.14	0.36	4.99
Lithuania	0.45	7.50	0.50	8.26	0.15	2.42
Croatia	0.41	5.42	0.32	4.69	0.28	3.98

[39] Energy mix obtained from: Reference scenario: EU Reference Scenario 2016. Energy, transport and GHG emissions. Trends to 2050.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.

6.4 Electricity costs

Electricity prices considered for the calculations in the webtool are the 2019 prices found on Eurostat:

Table 16: Electricity prices[40]

	EUR per kWh
Belgium	0.2839
Croatia	0.1321
Greece	0.165
Ireland	0.2423
Italy	0.2301
Lithuania	0.1255
Portugal	0.2154
Slovenia	0.1634
Spain	0.2403

[40] https://ec.europa.eu/eurostat/statistics-explained/images/d/d9/Electricity_prices%2C_first_semester_of_2017-2019_%28EUR_per_kWh%29.png

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°847043. The information reported in this document reflect only the author's view and the European Commission is not responsible for any use that may be made of the information it contains.