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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

COMMISSION REGULATION (EU) .../... laying down ecodesign requirements for household washing machines and household washer-dryers pursuant to Directive 2009/125/EC of the European Parliament and of the Council, amending Commission Regulation (EC) No 1275/2008

and repealing Commission Regulation (EU) No 1015/2010

and

COMMISSION DELEGATED REGULATION (EU) .../... supplementing Regulation (EU) 2017/1369 of the European Parliament and of the Council with regard to energy labelling of household washing machines and household washer-dryers

and repealing Commission Delegated Regulation (EU) No 1061/2010 and Commission Directive 96/60/EC

{C(2019) 1804 final} - {C(2019) 2124 final} - {SEC(2019) 337 final} - {SWD(2019) 351 final}

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This report commits only the Commission's services involved in its preparation and does not prejudge the final form of any decision to be taken by the Commission

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

This impact assessment relates to the review of Commission Regulation (EC) No 1015/2010[1] on ecodesign requirements for household washing machines, Commission Delegated Regulation (EU) No 1060/2010[2] on energy labelling of household washing machines and Directive 96/60/EC on Energy Labelling of household washer dryers[3].

1.1. Benefits of Ecodesign and Energy Labelling

Ecodesign and Energy Labelling are **recognised globally** as one of the most effective policy tools in the area of energy efficiency. They are central to making Europe more energy efficient, contributing in particular to the 'Energy Union Framework Strategy'[4], and to the priority of a 'Deeper and fairer internal market' with a strengthened industrial base'[5]. Firstly, this legislative framework pushes industry to improve the energy efficiency of products and removes the worst-performing ones from the market. Secondly, it helps consumers and companies to reduce their energy bills. In the industrial and services sectors, this results in support to competitiveness and innovation. Thirdly, it ensures that manufacturers and importers responsible for placing products on the European Union (EU) market only have to comply with a single EU-wide set of rules.

It is estimated that by 2020, Ecodesign and Energy Labelling regulations will deliver around 175 Mtoe (i.e. about 2035 TWh) of energy savings per year in primary energy in comparison to if there were no measures in place. This is roughly equivalent to Italy's energy consumption in 2010, close to half the EU 20 % energy efficiency target by 2020 and about 11 % of the expected EU primary energy consumption in 2020[6].

The average household will invest in more expensive and efficient products, but in return saves about € 500 annually on its energy bills by 2020. Although the cost for industry, service and wholesale and retail sectors will increase, it will result in EUR 55 billion per year of extra revenue by 2020.

This legislative framework benefits from **broad support** from European industries, consumers, environmental non-governmental organisations (NGOs) and Member States (MSs), because of its positive effects on innovation, increased information for consumers and lower costs, as well as environmental benefits.

Household washing machines represent an important component of the consumption of domestic electricity. They have been subject to EU energy labelling measures since 1994 and minimum energy efficiency requirements since 2010. Similarly, household washer dryers have been subject to EU Energy labelling measures since 1996.

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1 OJ L 293, 11.11.2010, p. 21–30
[2] OJ L 314, 30.11.2010, p. 17–46 (
[3] OJ L 266, 18.10.1996, p. 1–27
[4] Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee, The Committee Of The Regions And The European Investment Bank - A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy. COM(2015) 080 final., Brussels, 25.2.2015 (Energy Union Framework Strategy)
[5] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Upgrading the Single Market: more opportunities for people and business COM(2015) 550 final. 28 October 2015. (Deeper and fairer internal market)
[6] Ecodesign impact accounting – Overview report for the European Commission DG Energy, VHK December 2016

1.2. Legal framework

In the EU, the **Ecodesign Framework Directive**[7] sets a framework requiring manufacturers of energy-related products to improve the environmental performance of their products by meeting minimum energy efficiency requirements, as well as other environmental criteria such as water consumption, emission levels or minimum durability of certain components before they can place their products on the market.

The **Energy Labelling Framework Regulation**[8] complements the Ecodesign Framework Directive by enabling end-consumers to identify the better-performing energy-related products, via an A-G/green-to-red scale. The Regulation sets out the general rules for rescaling the existing A+ to A+++ labels:

- Class A shall be empty at the moment of introduction of the label, and the estimated time within which a majority of the models falls into that class is at least 10 years;
- Where technology is expected to develop more rapidly, classes A and B shall be empty when introducing the label;
- Moreover, the A to G steps of the classification shall correspond to significant energy and cost savings and appropriate product differentiation from the customer's perspective.

In general, the boundaries of the label scale are defined by the performance of products on the market incorporating 'Best Available Technology' (BAT) and the minimum requirement under Ecodesign for those products. Subsequently, the bandwidth of the classes is determined so as to keep the same effort to move from one class to the next one. For specific product groups this may however be different to take into account appropriate product differentiation.

The BAT is determined following the MEErP methodology, and is based on purely technical grounds, i.e. the product on the market with the lowest environmental impact, while ensuring that other functional requirements (e.g. performance, quality, durability) are equivalent to the base case.

The EU Energy Label is recognised and used by 85% of Europeans[9].

The legislative framework builds upon the **combined effect** of the two aforementioned pieces of legislation. See Figure 1 for a visualisation of this effect.

[7] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of Ecodesign requirements for energy-related products. OJ L 285, 31.10.2009, p. 10 (Ecodesign Framework Directive)

[8] Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017 setting a framework for Energy Labelling and repealing Directive 2010/30/EU. OJ L 198, 28.7.2017, p. 1 (Energy Labelling Framework Regulation)

[9] Study on the impact of the energy label – and potential changes to it – on consumer understanding and on purchase decisions - . LE London Economics and IPSOS, October 2014

Figure 1: Synergetic effect Ecodesign and Energy Labelling

The Ecodesign framework Directive and the Energy Labelling framework Regulation are implemented through product-specific implementing and delegated regulations. To be covered, the energy-related products must (i) represent a significant volume of sales (indicatively more than 200000 units a year), (ii) have a significant environmental impact within the EU and (iii) represent a significant energy improvement potential without increasing the cost excessively, see also Article 15.2 of the Ecodesign Framework Directive.

As an alternative to the mandatory Ecodesign requirements, voluntary agreements or other self-regulation measures can be presented by the industry sector(s) concerned (see also Article 17 of the Ecodesign Framework Directive). If certain criteria are met, the Commission formally recognises these voluntary agreements[10]. The benefits include quicker and more cost-effective implementation, which can be more flexible and easier to adapt to technological developments and market sensitivities. For more details about the legal framework, including a full list of Ecodesign and Energy Labelling measures, see Annex 11.

Household washing machines are currently regulated by Commission Ecodesign Regulation (EC) No 1015/2010[11] and Commission Delegated Energy Labelling Regulation (EU) No 1061/2010[12] and household washer dryers are regulated by Directive 96/60/EC[13]. An overview of existing policies, legislations and standards affecting household washing machines and household washer dryers in the EU and outside is given in Annex 12.

1.3. Legal context of the reviews

Article 7 of the **Ecodesign Regulation for household washing machines and similarly** Article 7 of the **Energy Labelling Regulations for household washing machines**

[10] Commission Recommendation (EU) 2016/2125 of 30 November 2016 on guidelines for self-regulation measures concluded by industry under Directive 2009/125/EC of the European Parliament and of the Council; OJ L 329, 3.12.2016, p.109

[11] Commission Regulation (EU) No 1015/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for household washing machines

[12] Commission Delegated Regulation (EU) No 1061/2010 of 28 September 2010 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of household washing machines

[13] Commission Directive 96/60/EC of 19 September 1996 implementing Council Directive 92/75/EEC with regard to energy labelling of household combined washer-driers

requires the regulations to be reviewed in the light of technological progress no later than four years after their entry into force. This review should in particular assess the verification tolerances, the opportunity of setting requirements on rinsing and spin-drying efficiency and the potential for hot water inlet.

Finally, in August 2017, the new Energy Labelling framework Regulation (EU) 2017/1369 entered into force, repealing Directive 2010/30/EU[14]. Under the repealed Directive, energy labels were allowed to include A+ to A+++ classes to address the overpopulation of the top classes. Over time, due to technological development, also the A+ to A+++ classes became overpopulated, thereby reducing the effectiveness of the labels significantly. To resolve this, the new framework regulation requires a rescaling of existing energy labels, back to the original A to G scale. Article 11 of the Energy Labelling framework Regulation lists 5 priority product groups for which new delegated acts with rescaled energy labels must be adopted at the latest on 2 November 2018. Household washing machine is one of the priority product groups.

1.4. Political Context

Several new policy initiatives indicate that Ecodesign and Energy Labelling policies are relevant in a broader political context. The main ones are the **Energy Union Framework Strategy**, which calls for a sustainable, low-carbon and climate-friendly economy, the **Paris Agreement**[15], which calls for a renewed effort in carbon emission abatement, the **Gothenburg Protocol**[16], which aims at controlling air pollution, the **Circular Economy Initiative**[17], which amongst others stresses the need to include reparability, recyclability and durability in Ecodesign, the **Emissions Trading Scheme** (ETS)[18], aiming at cost-effective greenhouse gas (GHG) emissions reductions and indirectly affected by the energy consumption of the products in the scope of Ecodesign and Energy Labelling policies, and the **Energy Security Strategy**[19], which sets out a strategy to ensure a stable and abundant supply of energy.

Moreover, the **Ecodesign working plan 2016-2019**[20] also includes the review of both regulations, requiring in particular examining how aspects relevant to the circular economy can be assessed and taken on board. This is in line with the Circular Economy Initiative[21], which concluded that product design is a key in achieving the goals, as it can

[14] 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. OJ L 153, 18.6.2010, p. 1.

[15] Global agreement in response to climate change of 2015 (Paris Agreement)

[16] Protocol to abate acidification, eutrophication and ground-level ozone of 1999 (Gothenburg Protocol)

[17] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Closing The Loop - An EU Action Plan For The Circular Economy (Circular Economy Initiative)

[18] https://ec.europa.eu/clima/policies/ets_en (ETS)

[19] Communication of the commission to the European Parliament and the Council European Security Strategy. COM(2014) 0330 final.

[20] Communication from the Commission Ecodesign Working Plan. COM(2016) 773 final, Brussels, 30 November 2016. (Ecodesign Working Plan 2016-2019)

[21] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Closing The Loop - An EU Action Plan For The Circular Economy (Circular Economy Initiative)

have significant impacts across the product life cycle (e.g. in making a product more durable, easier to repair, reuse or recycle).

1.5. Need to act

The need to act is driven by the following main considerations:

Cost effective increases in energy efficiency and the level of protection of the environment:

Manufacturers and consumers stand to benefit from the fact that there are still cost effective energy and water savings to be achieved in washing machines and washer-dryers, even if these savings are modest in view of EU 2030 energy and climate targets. By way of illustration, electricity savings due to the existing requirements on these products were expected to be 1.5 TWh per year in 2020 and are now estimated to be around 2 TWh per year. This represent a contribution of 0.14% to the EU target on energy efficiency by 2030.

Other policy objectives:

Several other EU policy objectives require to look beyond the technical revisions mentioned in the review article of the existing regulations, e.g.:

- renewed effort in carbon emission abatement through the Paris climate agreement;
- the EU Circular Economy action plan aiming at improving the durability, reparability, recyclability of products;
- the Better Regulation policy aiming at more efficient and effective legislation;
- the need to address possible circumvention of testing standards;
- renewed energy efficiency targets..

Rescaling of energy labels

The new Energy Labelling framework Regulation requires the Commission to rescale the existing labels for five priority product groups, including washing machines and washer-dryers, by 2 November 2018 at the latest, to remove the A+ to A+++ classes.

Effectiveness of Ecodesign and Energy Labelling measures

Where regulatory measures in Ecodesign and Energy Labelling are no longer effective, or no longer as effective as expected, they need to be revised (or potentially withdrawn). This may happen as a result of technological progress, consumers' choices or market evolutions. In particular, the filling up of the top classes means that the label is no longer effective. If there is still a significant difference in energy efficiency of products remaining on the market, a label will still bring added value in terms of guiding consumers to more efficient products.

2. PROBLEM DEFINITION

2.1. How the problems are defined

The review of the Ecodesign and Energy Labelling for washing machines and washer-dryers started in 2015 and several studies were conducted for this purpose, as described in Annex 1. These studies evaluated the impact of the current legislation, as reported in

Annex 4; they also looked at the evolution of the sector (technological and economic evolution) and at stakeholders' views. Results from the studies have been used directly as input to the analysis model of Annex 6.

The results of the review are summarised in the follow-up study published in 2017 and cover the following issues:

- Energy label classes: most washing machines already exceed the minimum level of the highest energy class A+++ in the current scale;
- Range of programmes: washing machines offer a broad range of programmes and not all programmes are optimised on energy efficiency to the same extent;
- Use of standard programmes: standard programmes, which are used in the measurement of energy efficiency and are optimised on this aspect, are only rarely used by consumers;
- Programme duration: standard programmes have generally a longer duration than non-standard ones, while consumers are reluctant to use programmes lasting more than 3 hours;
- Loading of machines: the average load of washing machines in actual conditions of use is much lower than the capacity of the machines and lower than in tests;
- Technical innovation: further energy savings could be achieved by technical improvements in both washing machines and washer-dryers, generally with a low impact on life cycle costs;
- Durability: an increased proportion of washing machines have to be replaced in the first 5 years of use, with an impact on the average lifetime of appliances;
- Rinsing performance: the current measurement method is not sufficiently reproducible, but an alternative measurement method is under development;
- Spin-drying efficiency: the current requirements seem appropriate but may need to be adapted in case of change in testing programmes;
- Hot water inlet: the use of hot water inlets could lead to additional energy savings but depend on other equipments than the washing machine itself;
- Verification tolerances: the current tolerances seem appropriate but would need to be adapted in case of change in testing programmes.

The problems defined in this section and the policy options defined in Section 5 build on the results of the review study and on the comments from stakeholders on these results.

2.2. Problem 1: Outdated energy efficiency requirements

The problem:

The current Ecodesign requirements for washing machines no longer capture cost-effective energy savings, and the current energy label no longer allows consumers to effectively differentiate sufficiently between the appliances on the market.

The last revision of Ecodesign requirements, in Regulation 1015/2010, has set minimum energy efficiency requirements at an EEI-limit of 59, which entered into force in 2013 for all household washing machines with a rated capacity equal or higher than 4kg. As a

consequence, today there are only three energy efficiency classes available (A+/ A++/ A+++) for most models of washing machines, and four for the smaller ones. Appliances of lower performance are excluded from entering in the single market.

The small number of Energy Label classes led to the classification of many models in the top Energy Label classes ("Energy Label congestion")[22] and to poor differentiation of the performance of dishwasher models on the market. Furthermore, the "A+", "A++" and "A+++" classes introduced by the Energy Labelling framework Directive (Directive 2010/30/EU) have been shown to be less effective in persuading consumers to buy more efficient products than the A to G scale[23].

Consumers do not easily understand the differences between A+, A++ and A+++ and purchase A+ class washing machines without realising that these are the lower performing appliances currently on the market. Consumer surveys reveal that energy consumption is one of the main criteria in consumer purchase decisions. However, as consumers do not differentiate sufficiently between appliances on the market, they are less likely to pay more upfront, i.e., at the moment of purchase, for the latest technology lower energy-using appliances.

The poor differentiation of models on the market has detrimental effect for both high-performing and low-performing products. For the best performing products, the lack of differentiation is an obstacle to the introduction of innovative or high end technology that is used in washing machines and washer-dryers. The review study identified that further energy savings are possible and can become economical for consumers, but the existing measures (8 and 18 years old respectively for washing machines and washer-dryers) are not able to unlock this potential. For the less performing products, there is no incentive to invest in energy efficiency as the products are already in an energy class perceived as good; there is instead an incentive for manufacturers and retailers to compete on price.

The driver of the problem:

Problem driver 1.1: Technological progress

Technological progress for household washing machines keeps evolving thereby improving energy efficiency. In Regulation 1015/2010, the indicative energy consumption benchmarks for the best available technology (BAT) were in the range of 0.85 kWh/cycle to 1.2 kWh/cycle for washing machines between 5 kg and 8 kg of rated capacity. Today, the energy consumption of the BAT models on the market have an energy consumption of 0.55 kWh/cycle for a 6 kg washing machine, 0.44 kWh/cycle for 8 kg washing machine or even 0.35 kWh/cycle for a 9 kg washing machine

[22] Label congestion has also resulted in manufacturers and importers attaching "unofficial" labels to the best energy-saving washing machines, from "A+++ -10%" to "A+++ -30%" (in each case, the minus representing less energy use than the regulated "A+++" performance level).

[23] Commission Staff Working Document Impact Assessment Accompanying the document Proposal for a Regulation of the European Parliament and of the Council setting a framework for energy efficiency labelling and repealing Directive 2010/30/EU. SWD(2015) 0139 final, Brussels, 15.7.2015. (Impact Assessment Energy Labelling Regulation)

(corresponding to an EEI=14.8) according to EU Topten (April 2018)[24] which is an improvement of roughly 55%.

The highest energy efficiency class is populated by a very high proportion of available models. About **45% of the washing machines** models were labelled in the highest class already in 2015. By 2016 the success of the label led to a situation that a large proportion of household washing machines (>50%) carried the same highest energy efficiency label A+++.

Concerning washer-dryers, the distribution of energy efficiency classes has shifted dramatically from 1997 to 2013 towards the higher energy efficiency classes. In 2014 about 50% of washer-dryers were already labelled with class A and the majority of the rest was labelled as class B.

2.3. Problem 2: Consumers do not use the most efficient programmes

Consumers often do not use the most energy efficient washing programmes, mainly because they can be very long. As these are the programmes that the Ecodesign requirements are tested against, and the label is therefore based upon, this puts in question the effectiveness of the Ecodesign and Energy Label measures. Figure 2 shows the use frequency of washing programmes, based on a survey made by the University of Bonn in 2011 in 11 European countries.

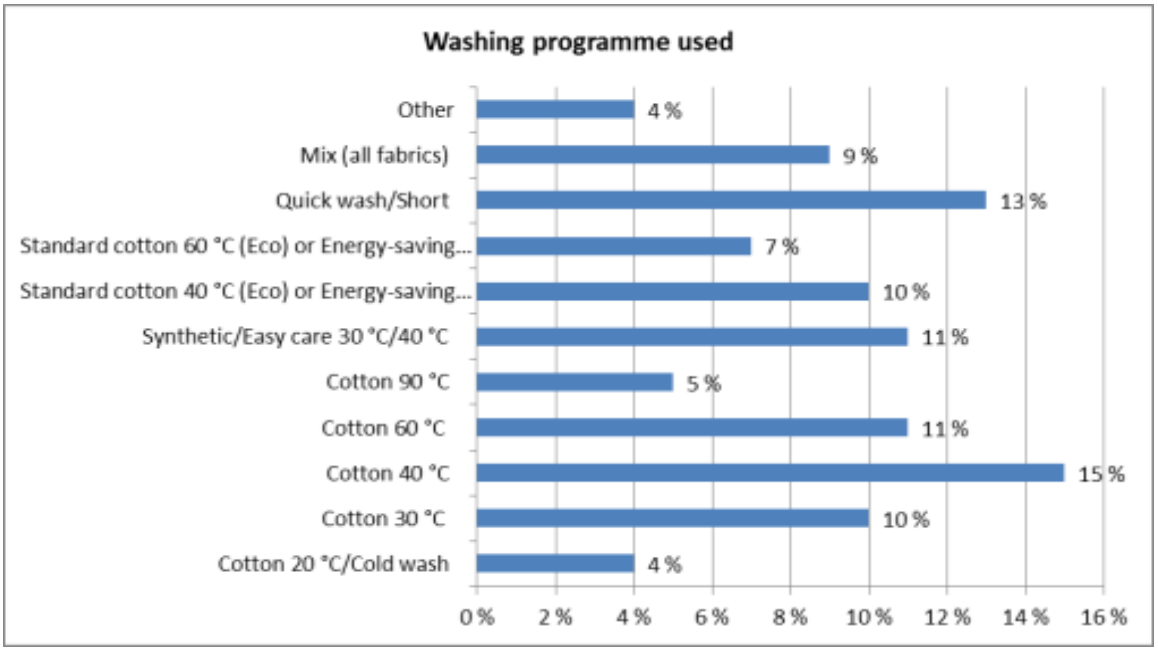

Figure 2: Washing programmes used (Alborzi et al. 2015)

The two "standard cotton programmes (40°C and 60°C)", which are the programmes used to test the energy performance of the washing machine, only make up 17% of the programmes used. These programmes were optimised by manufacturers for energy efficiency in order to meet the minimum requirements and/or to reach a good

[24] http://www.topten.eu/english/household/washing-machines/8kg-3.html

classification on the energy label, but other characteristics of these programmes (such as duration, temperature or rinsing) do not meet the preference of consumers. **The consequence of this under-use of regulated programmes is that the energy savings** permitted in theory by the Regulation **are not realised in practice**.

Problem driver 2.1 – Testing programmes are too long for consumers

The existing energy efficiency tests and calculations do not or no longer properly account for the real-life performance of washing machines and washer dryers. This is primarily because the duration of the regulated programmes is too long for most consumers and this lengthy duration is largely due to the energy efficiency test.

The current Ecodesign Regulation does not regulate the duration of the washing programme (for both washing machines and washer-dryers) but does specify that for the calculation of the energy consumption and other parameters, the standard cotton programmes at 40 °C and 60 °C shall be used. As longer programmes are in general more energy-efficient, the standard programmes last typically longer than other comparable programmes[25] (the 'normal 60 °C cotton programme' takes 2 to 3 hours whereas the 'standard cotton 60 °C programme' runs for 3 to 5 hours). However, a user survey conducted in 2015 revealed that consumers are very reluctant to use programmes which are longer than 3 hours. As a consequence, consumers do not benefit from the energy efficiency shown on the label.

Despite this relation between energy efficiency and long programme durations, the Review study found that high energy efficiency and relatively short programme times are not necessarily mutually exclusive: Topten[26] lists washing machines with short 'standard programmes' of 2 to 3 hours in which there are A+++ models.

Problem driver 2.2 – Tests do not reflect real conditions of use and encourage a trend to bigger appliances

Consumer research shows that the average loading is only 3.3 kg per cycle for the cotton programmes, which is far lower than the maximum load conditions of most machines on the market. It is also lower than the average of 5 kg load used for testing the energy efficiency requirements under the Regulations. Additionally, there is a trend towards manufacturing and offering machines with increasing rated capacities, even if this does not fit consumers' needs. This trend may be explained by the better energy efficiency classification that they achieve *but* the high gains (from the lower energy and water consumption per kg of laundry) would be only captured if the machines were fully loaded, which on average is not the case.

Problem driver 2.3 – The perception of insufficient rinsing, often reported by consumers, may also lead to under-use of the most efficient programmes

[25]The standard programmes are designed with improved energy efficiency but at the expense of reducing the washing temperature and partially increasing mechanical action while prolonging the programme duration.
[26] Review study section 2.2.6.3 (see the following report), evidence regarding trends towards longer cycle durations: http://susproc.jrc.ec.europa.eu/Washing_machines_and_washer_dryers/docs/JRC108604_20171117_wash_prepstudy(6).pdf

Rinsing is one of the typical phases of a washing cycle together with main wash and spinning. The main programmes use 2 to 4 rinsing phases each with different water levels and duration. Pre-rinsing can be offered as an additional option. It is generally considered that a minimum of two rinses is necessary.

Rinsing performance is a functional reference parameter of washing programmes that consumes energy and takes time and that can be negatively influenced when manufacturers optimise the energy and water consumption of the testing programme.

The perception of insufficient rinsing in the standard programme may therefore also contribute to the under-use of that programme. Some Member States and Consumers associations are in favour of setting a minimum performance level as insufficient rinsing could contribute to allergic reactions. A minimum rinsing performance could not be included in the current Regulation 1015/2010 because at that time there was no method for measuring the rinsing performance that was sufficiently reproducible and replicable, but rinsing was included in the revision clause for assessment in the review study.

Problem 3: Poor "circular economy" performance

The problem:

The current Ecodesign and Energy Labelling Regulations lack requirements that contribute to Circular Economy objectives, such as for durability, reparability, and recyclability. The existing requirements focus mainly on energy efficiency improvements as the most significant environmental impact during the life-cycle of household washing machines. However, washing machines and washer-dryers, like many other products, can be significantly improved in terms of circular economy aspects, which could be progressively achieved through Ecodesign measures.

The main indicator of this poor performance is that of durability. The **average lifetime of washing machines and washer-dryers** has reduced to 12.5 years from approximately 15 years in recent decades[27] and this is no more justified by the expected energy efficiency gains offered by new models, which do not outweigh the impacts of disposal nor the economic cost to consumer expenditure. Tecchio et al. (2016) have shown that a washing machine has to be at least 28% more energy-efficient to serve as an efficient voluntary replacement, i.e. not to replace a completely broken-down machine. The trade-off between energy efficiency and durability is further analysed in Section 6.2.7.1.

Furthermore, Consumer and Environment NGOs (see Annex 3 and the review study 2017) have noted the following trends over time, both for washing machines and other "white goods":

- An increase in the proportion of early product failures (<5 years),
- Increased complaints by consumers that repair is not as feasible and beneficial as it should be,

[27] Prakash, S. Dehoust G., Gsell M., Schleicher T., Stamminger R. (2016) Einfluss der Nutzungsdauer von Produkten auf ihre Umweltwirkung: Schaffung einer Informationsgrundlage und Entwicklung von Strategien gegen "Obsoleszenz" [Influence of the service life of products in terms of their environmental impact: Establishing an information base and developing policies against "obsolescence"]

- More resources are lost at product end of life, owing to the difficulties encountered by professional recyclers to separate and recycle materials.

Problem driver 3.1: availability and cost of spare parts and their delivery.

Currently no measures exist which regulate the availability of spare parts for washing machines and washer-dryers or their delivery. The Review study suggests that a minimum availability of those spare parts that fail most frequently (see Annex 7.3) would be useful, also after production of the model ends. If spare parts are available, it is often not clear to end-users where to order them and how to replace them. In some cases it is technically unfeasible to replace certain broken parts, because they cannot be removed without damaging other parts, or because they are permanently fixed to other parts, meaning that replacing the broken part would require the replacement of a significant larger part of the appliance. Additionally, the cost of spare parts and the cost of repair services (including travel and labour time) are often high in comparison with the purchase price of a new appliance[28]. Consequently, in case of problems that occur after the expiry of the legal guarantee, defective appliances are often not repaired at all but instead are replaced by new ones.

Another important issue is the time for delivery of the spare parts - a reasonable maximum time limit is needed to ensure that consumers are not discouraged due to the waiting time.

Problem driver 3.2: Access to repair and maintenance information

There is sub-optimal information available both to individuals and to professional repair services to easily identify the cause of problems and carry out repairs on washing machines and washer dryers. The Review study shows that this is especially the case for independent repairers, i.e. professional repairers other than those under a contractual relationship, or "authorised", by Original Equipment Manufacturers (OEMs). No measures currently exist regulating the availability of repair and maintenance information for washing machines and washer-dryers and their access to independent repairers.

For example, disassembly procedures and sometimes diagnosis software are essential prerequisites for repairs and are generally not available to independent repairers. This was confirmed through the feedback received from repair and end-of-life operators during and after the December 2017 Consultation Forum.

Difficult access to information impacts on the competitiveness of independent as compared to authorised repairers, while more competition in repair activities could potentially reduce the cost of repair, making it more attractive to consumers compared to replacement with a new appliance[29]. The current situation is likely to result in fewer appliances being repaired than would be economically, socially and environmentally beneficial, causing sub-optimal use of resources and avoidable costs for consumers.

[28] The after-sales service hourly rate may cost 70€. If the spare part (a new motor) costs 200€, including only one hour of service labour costs then the total cost of replacing the motor may be 270€, representing approximately 50% of the purchase price of a new appliance according to consumer association magazine "Quel Choisir?". See more information in Annex 7.

[29] It should be acknowledged that new appliances, although costing more, usually incorporate new or up-to-date functionalities, which may be attractive to consumers. In addition, the new product is accompanied by at least the EU-wide minimum legal guarantee of 2 years.

Problem driver 3.3: Incomplete information on the end-of-life of appliances

The review study noted that if recyclers are given insufficient and/ or poor quality information related to the recycling and disposal of washing machines and washer dryers, there is a reduction in efficiency in terms of material recovery, which then increases the cost of these treatments (See Annex 3). This may be linked to several causes, such as a lack of standardised methods or insufficient and not easily understandable information (e.g. dismantling at end of life, including exploded diagrams, what valuable materials such as Critical Raw Materials might be contained therein, etc.).

The Waste Electrical and Electronic Equipment Directive (WEEE Directive)[30] establishes a list of parts that must be easily dismantled by recyclers, using commonly available and non-proprietary tools. Integrating those parts relevant for washing machines and washer-dryers into the Ecodesign Regulation would facilitate the efficient implementation of this requirement already at design stage, in complement to the enforcement of the Directive by Member States in relation to waste management.

2.4. General market failures

In addition to the product specific problem drivers described in Section 2.3, some general market failures have been identified:

Asymmetrical information - Without up to date energy efficiency requirements and energy labels, economic actors (both business and individual consumers) will not choose the product that is the most cost-effective over the product's life-time. This is because economic actors are limited by the information they have, their knowledge about products, and the finite amount of time they have to make a decision.

Split incentives – Without up to date energy efficiency requirements, manufacturers lack incentives to invest in new technologies and consumers lack the guarantee that the products will be cost-effective over their life-time. This is especially important for a certain group of consumers, in particular those in a landlord-tenant situations, in where the landlord buys the appliance and the tenant pays the energy bill.

Environmental externalities – The price of the products does not reflect the real environmental costs to society in terms of resources used from raw materials and production processes, waste management and missed opportunities for a more circular economy. Hence, without setting requirements that will improve Circular Economy aspects of the product, the different actors in the life cycle of the appliance will not be incentivised to improve these aspects of the product.

2.5. Who is affected?

2.5.1. Household washing machine and washer dryer appliances' manufacturers and retailers

For the **manufacturing industry and retail sectors**, the Energy Label class rating is one of the main market drivers. It is an important quality feature that allows industry and

[30] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)

importing actors to distinguish themselves via a well-recognised and trusted label representing features associated with quality and innovation. **Important manufacturers** with EU production facilities are Bosch Siemen Home appliances (BSH), Electrolux, Samsung, LG, Miele, Brandt and Whirlpool. The European industry association is APPLiA (formerly known as CECED). These end-product manufacturers assemble and produce components that are used in the production. Almost all manufacturers are large companies. SME manufacturing companies are only present in niche markets, such as washing machine equipped with heat-pumps, e.g. the SME V-Zug.

European manufacturers are mostly affected by the outdated energy efficiency requirements and by the resulting difficulty in introducing new energy-efficient technologies on the market. The evolution to a situation of competition on price-only, rather than on both technology performance and price, would have a negative effect on their competitiveness.

The total employment in the household washing machines and household washer dryers sector is estimated at close to 90 000 jobs of which around 65% are in the retail sector. The EU 2015 annual market value for household washing machines and household washer dryers is estimated close to 6.2 billion Euros (including VAT and levies), of which almost 3.0 billion Euros is derived from industry revenues (manufacturers sales), 2.05 billion Euros in retail, and just over 1.2 billion Euros in taxes, levies etc. Other studies, such as Deloitte 2016[31], mention that over half of the value (54%) of EU annual sales of related white goods relate to products that are imported from outside of the EU.

In the traditional **retail sector**, the position of larger retail chains such as Metro (Media Markt), Carrefour, etc. is increasing. Internet sales exist, but the growth rate is not higher than for the other distribution channels of this product group.

2.5.2. Repair industry

This industry consists mainly of SMEs that act locally, either as individual organisations, or as "authorised" repair entities that have a contractual relationship with OEMs/ retailers[32]. Activities in this sector are likely to benefit from better availability of spare parts and better access to maintenance and repair information. Ecodesign requirements on repair would facilitate better conditions for repair activities, and would help to ensure that consumers have affordable and fast repair options. Additionally, access to maintenance and repair information fosters greater competition in this sector, as conditions under which independent repairers operate, as compared to OEM-authorised repairers, would start to level out. This would be expected to cause the costs of repair to decrease, in line with reducing the technician's time at the consumer's home when analysing breakdowns, via the technician having access to better product repair information.

[31] Deloitte (2016) Study on socioeconomic impacts of increased reparability: final report. Prepared for the European Commission DG ENV. Available at: https://publications.europa.eu/en/publication-detail/-/publication/c6865b39-2628-11e6-86d0-01aa75ed71a1/language-en

[32] This contractual relationship gives the sub-contracting repair/ maintenance organisation the "badge" of being an approved supplier of the main manufacturer or retailer, but – especially with the former – often requires the sub-contractor to sign up to various manufacturer/ retailer training sessions per year at a cost, and also sometimes the obligation to carry several thousand Euros worth of original spare parts in repair vans, or at the repair organisation's base.

2.5.3. Recycling industry

Recycling companies are situated all over EU. Some of the bigger recyclers are situated in Netherlands and Belgium as well as in UK and France. The recycling industry is represented by the European Recycling Industries Confederation (EURIC). The recycling industry is likely to benefit from Ecodesign requirements at the end of life of appliances, e.g. better identification of refrigerating gases (in case of the heat-pump technology) and easier dismantling of electric and electronic components.

2.5.4. Consumers

For **consumers,** the EU Energy Label offers a unique opportunity to make an informed choice regarding which products offer the best environmental and energy performance, allowing them to save money in the long-run. Ecodesign requirements safeguard consumers from the least-performing products. Additionally, fair-priced spare parts and their prompt availability would improve the reparability of household washing machine and washer dryers and would help to ensure that consumers could have their appliances repaired, even after the final production date of a particular model. This would help extend product lifetime and save consumers expense on purchasing a replacement model.

Consumers are represented by the Bureau Européen des Unions de Consommateurs (BEUC), and the European Association for the Co-ordination of Consumer Representation in Standardisation (ANEC).

2.5.5. Society as a whole

For society as a whole, ambitious policies in the area of energy efficiency are important tools to mitigate climate change. Effective and efficient Energy Labelling and Ecodesign regulations contribute to achieving goals set in the Paris Agreement and they help achieve the EU 2030 climate goal.

Environmental organisations are represented by the European Environmental Citizens Organisation for Standardisation (ECOS), the European Environment Bureau (EEB), TopTen, the Collaborative Labelling and Appliance Standards Program (CLASP).

For EU and Member State policy-makers, more effective and efficient Energy Label and Ecodesign regulations mean that these policies will make additional contributions to achieving policy goals regarding the single market, energy efficiency, environmental protection, technological innovation, energy security of supply, carbon emission abatement and furthering the aims of the "Circular Economy", thus saving resources.

3. WHY SHOULD THE EU ACT?

3.1. Legal basis

The legal basis for acting at EU level through the Ecodesign framework Directive and the Energy Labelling framework Regulation is Article 114 and Article 194 of the Treaty on European Union and the Treaty on the Functioning of the European Union (TFEU)[33] respectively. Article 114 relates to the "the establishment and functioning of the internal

[33] Consolidated version of the Treaty on the Functioning of the European Union. OJ C 326, 26.10.2012, p. 47 (TFEU)

market", while Article 194 gives, amongst others, the EU the objective "in the context of the establishment and functioning of the internal market and with regard for the need to preserve and improve the environment" to "ensure security of energy supply in the Union" and "promote energy efficiency and energy saving and the development of new and renewable forms of energy".

The Ecodesign Framework Directive and Energy Labelling Framework Regulation include a built-in proportionality and significance test. For the Ecodesign Framework Directive, Articles 15(1) and 15(2) state that a product should be covered by an Ecodesign or a self-regulating measure if the following conditions are met:

- The product should represent a significant volume of sales (indicatively, more than 200 000 units a year);
- The product should have a significant environmental impact within the EU;
- The product should present a significant potential for improvement without entailing excessive costs, while taking into account:
    - an absence of other relevant Community legislation or failure of market forces to address the issue properly,
    - a wide disparity in environmental performance of products with equivalent functionality;

The procedure for preparing such measures is described in Article 15(3). In addition, the criteria of Article 15(5) should be met:

- No significant negative impacts on user functionality of the product;
- No significant negative impacts on health, safety and environment
- No significant negative impacts on affordability and life cycle costs
- No significant negative impacts on industry's competitiveness (including SMEs see Annex 2).

The Energy Labelling Framework Regulation includes similar criteria for products covered by an energy label:

- The product group should have significant potential for saving energy and where relevant, other resources;
- Models with equivalent functionality should differ significantly in the relevant performance levels within the product group;
- There should be no significant negative impact as regards the affordability and the life cycle cost of the product group;
- The introduction of energy labelling requirements for a product group should not have a significant negative impact on the functionality of the product during use.

During the review process (Review study 2017), it was established that household washing machines and household washer dryers as a product group fulfil the above eligibility criteria.

3.2. Subsidiarity: Necessity for EU action

Action at EU level gives end-users the guarantee that they buy an energy and resource efficient product and provides them with harmonised information no matter in which MS

they purchase their product. This is becoming even more relevant as the (cross-border) online trade increases. With Ecodesign and Energy Labelling at EU level, energy and resource efficient products are promoted in all MSs, creating a larger market and hence greater incentives for the industry to develop them.

It is essential to ensure a level playing field for manufacturers and dealers in terms of requirements to be met before placing an appliance on the market (under Ecodesign) and in terms of the information supplied to customers for sale across the EU internal market (under both Ecodesign and Energy Labelling). For this reason EU-wide legally binding rules are necessary.

Market surveillance is carried out by the Market Surveillance Authorities (MSAs) appointed by Member States. In order to be effective, the market surveillance effort must be uniform across the EU to support the internal market and incentivise businesses to invest resources in designing, making and selling energy efficient products.

Finally, Regulation (EU) 2017/1369 requires the Commission to update the current energy labelling regulations for washing machines and washer dryers, in particular as regards rescaling the label to A to G classes and removing the A+ to A+++ classes.

3.3. Subsidiarity: Added value of EU action

There is clear added value in requiring minimum energy and resource efficiency levels and energy label class limits at EU-level. Without harmonised requirements at EU level, MSs would have to lay down national product-specific minimum requirements in the framework of their environmental and energy policies. This would undermine the free movement of products and the level playing field for retailers across different Member States. Before the existing Ecodesign and energy label measures were implemented at EU level, this was in fact the case for many products.

4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1. General objectives

Following the legal basis in the TFEU, the general objectives are to:

1. Facilitate **free circulation** of efficient household washing machines and washer dryers within the internal market;
2. Promote **competitiveness** of the EU household washing machines and washer dryers industry through the creation or expansion of the EU internal market for sustainable products;
3. Promote the **energy efficiency** of household washing machines and washer dryers as a contribution to the European Commission's objective to reduce energy consumption by at least 30 % and domestic greenhouse gas (GHG) emissions by 40 % by 2030; implement the energy efficiency first principle established in the Commission Communication on Energy Union Framework Strategy; and
4. Increase **energy security** in the EU and reduce energy dependency through a decrease in energy consumption of household washing machines and washer dryers.

There are several synergies between these objectives: reducing electricity consumption (by increasing the energy efficiency) leads to lower carbon, acidifying and other emissions to air; tackling the problem at EU level enhances efficiency and effectiveness of the measure and, following the Ecodesign Working Plan 2016-2019, Ecodesign and Energy Labelling measures also contribute to the objectives of the Circular Economy Action Plan to facilitate the transition towards a more resource efficient and circular economy in the EU.

4.2. Specific objectives

The specific objectives to be pursued by policy options are to correct the problems and underpinning drivers identified in Section 2, namely to:

1. Redefine the regulated programmes and testing to better reflect the preferences and use patterns of consumers;
2. Update the energy efficiency requirements and the energy label in line with technological developments and the revised Energy Labelling framework Regulation, to achieve cost-efficient savings of energy and other resources;
3. Contribute towards a circular economy in the EU by supporting longer-lasting products, among others by facilitating their repair, and by increasing their recyclability at the end of life.

These objectives will drive investments and innovations in a sustainable manner, increase monetary savings for the consumer, contribute to the Energy Union Framework Strategy and the Paris Agreement, contribute to the Circular Economy Initiative and strengthen the competitiveness of EU industry.

5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

The procedure for identifying policy options follows from the Better Regulation Toolbox[34]. Specific measures in the policy options are the result of a combination of initiatives mentioned in the Review study 2017, the evaluation in Annex 4, the Inception Impact Assessment[35], and inspiration taken from the Ecodesign Framework Directive and the Energy Labelling framework Regulation.

In view of the issues identified in Section 2, the need to change the test programmes for washing machines was progressively recognised during the review study and shared by most stakeholders. The test programme(s) should better reflect the expectations of consumers, in particular as regards its duration, so that consumers chose energy-efficient programmes more often. The policy options were identified to address this need in particular, combined with the necessary update of the energy label to re-instate an appropriate differentiation between models, a new calculation of the energy efficiency index to limit or reverse the trend towards bigger capacity machines and new Ecodesign measures to improve the reparability and recyclability of appliances.

[34] https://ec.europa.eu/info/sites/info/files/file_import/better-regulation-toolbox-17_en_0.pdf (Better Regulation Toolbox)

[35] Inception Impact Assessment (IIA) "Regulatory measures on the review of Ecodesign requirements for household washing machines and household washer dryers" and Inception Impact Assessment "Regulatory measure on the reviews of Energy Labelling for household washing machines and household washer dryers"

5.1. Issues not subject to assessment

During the review study and subsequent stakeholders consultations, several issues were the object of a large consensus between stakeholders. They are not re-discussed in detail in this report. These issues are the following:

- **Inclusion of washer-dryers in the scope of both Ecodesign and Energy Label measures**:
  Washer-dryers are currently covered by Commission Directive 96/60/EC on energy labelling; they were excluded from the scope of Commission Regulation 1015/2010 on Ecodesign measures on washing machines, but recital (5) indicates that they should be addressed in another implementing measure;
  There is consensus in particular on the fact that the washing cycle of a washer-dryer is comparable in all aspects to a washing machine and should be the object of the same regulatory measures, including eco-design measures; in this report, washer-dryers are considered together with washing machines as regards their washing cycle, while separate options are defined and assessed to address their specific features;

- **Non-inclusion of Ecodesign measure on spinning and drying efficiency:**
  The conclusion of the review study on spinning and drying efficiency is largely consensual; the approach followed in the current Regulation is therefore maintained: the measurement of the spinning and of the drying efficiency are covered by the Energy Labelling Regulation without minimum requirements under Ecodesign; and

- **Non-inclusion of requirements on hot water inlet:**
  The review study concluded that hot water inlets could be a source of energy savings, but their energy efficiency depends on other equipment in the household such as the water heating system, the length and insulation of water pipes, etc. It does not seem appropriate to set eco-design requirements in this situation. This conclusion was not questioned in stakeholders consultation and this measure was therefore not integrated in proposed options.

In addition to the issues described above and to the measures integrated in the options assessed, some measures were considered as *de minimis* changes to the current Ecodesign and Energy Labelling regulations on washing machines. This corresponds to highly technical changes or changes with negligible impacts, for which it does not seem possible or proportional to propose several options for assessment. They are however implicitly included in the different options, except for the baseline, and will be integrated into the preferred option. Further information on these measures and assessment of their impacts can be found in Annex 9.

These measures concern:

- the eco-design requirement on water consumption
- a new eco-design requirement on rinsing efficiency
- Low-power modes
- Acoustic airborne noise emissions classes
- Changes to the energy label

Finally, some issues were assessed in the review study or suggested by stakeholders but they were not considered mature enough to be included in the options assessed here or as *de minimis* changes. They are reported here as 'options discarded at an early stage' in Section 5.6 and/or will be integrated in the review clause in the revised Regulations. These issues concern:

- The possibility to introduce an Ecodesign requirement for a minimum service lifetime, requested in particular by environmental NGOs;
- The possibility to introduce an Ecodesign requirement for filters extracting microplastics from the water outlet, requested by several Member States and environmental NGOs;
- The inclusion of information on circular economy aspects, such as the expected service lifetime or a score on reparability, onto the Energy Label, as suggested by a recent report of the European Parliament[36] and several stakeholders during the review study.

5.2. Policy options subject to assessment

Table 1 outlines the policy options for washing machines and Table 2 the policy options for washer dryers.

Policy options for washing machines	**Name**	**Short name**	**Description**
POWM 1	Baseline	BAU	No further action, the household washing machines regulations currently in place remain unchanged
POWM 2	Minimum temperature 35°C in the laundry core	POWM 2 (MT35)	a. Ecodesign requirement based on a test programme with a **minimum temperature** in the laundry core (35°C), b. A-G energy label based on new test and **rescaled**
POWM 3	Time cap 3h for half and quarter loads and information of the full load added on the energy label	POWM 3 (TC3h)	a. **Ecodesign requirements based on a test programme limited to 3 hours** at half and quarter loadings b. **Duration of the test washing cycle** at full load added on the label, c. A-G label based on new test and **rescaled**
POWM 4	Limited durations of the cycle proportional to the capacity	POWM 4 (PTC)	a. **Ecodesign requirements based on a test programme limited in time** with the limit proportional to the capacity, b. A-G energy label based on new test and **rescaled**
POWM 5	Ecodesign requirements on material efficiency	POWM 5 (ME)	New Ecodesign requirements on **material efficiency** , to be combined with the requirements of POWM 1 to 4, related to: a. End-of-life of appliances b. Spare parts availability and delivery c. Repair and maintenance information

Table 1: Policy options for household washing machines

[36] [add reference]

In order to analyse the impact of the different possible combinations of Ecodesign requirement on the temperature or duration and the effect of energy efficiency requirements, two scenarios were considered for each of the POWM 2 to 4:

- **Scenario T1** (Tier 1) keep the same level of strictness of the current Ecodesign energy efficiency requirements. Scenario T1 focusses on the energy savings that can be realised via changes in the testing programme, with a view to make it more attractive to consumers and used more often.
- **Scenario T1&T2** (Tier 1 followed by Tier 2) considers an increase in stringency of the Ecodesign energy efficiency requirements but with a belated entry into force in 2024, called Tier 2. (Tier 2 results in phasing out the least efficient machines, i.e. those falling into classes G and F). The time between Tier 1 and Tier 2 should allow manufacturers to implement new technologies and continue to decrease the energy and resource consumption of washing machines under the new testing conditions.

The Ecodesign measures included in options POWM 2, 3 and 4 would apply to the testing programmes[37], even if they might indirectly have an impact on the other washing programmes. In comparison with the current Regulations, options POWM 2 to POWM 4 imply the use of one testing programme only (corresponding approximately to the current 'cotton 40°C') instead of the present two ('standard cotton 40°C' and 'standard cotton 60°C'). The new testing regime tests three different loadings (at full capacity, half and a quarter of full capacity) instead of the two loadings (solely at full and half capacity) in the current tests. The reasons for these changes, common to all options assessed, are explained in Annex 9.

Additionally, Options POWM 2 to 4 consider that the washing performance should be for each loading higher than 1.03[38]. This requirement is stricter than the current one where only the average washing performance of the testing programmes should be higher than 1.03. This change also reflect consumers' expectations.

Under POWM 2 to 4, the re-scaled **Energy Label** is to be introduced in **April 2021,** with a proportional sequence of Energy bandwidths, in which every better class limit represents an EEI improvement value of approximately 8%, compared with the value of the previous class. This follows the general approach to define the energy classes for the Energy Label (see Section 1.2).

Washer-dryers are characterised by being used both as washing machines and as washer-dryers. According to the review study, a washer-dryer is used solely as a washing machine in approximately 37% of the cases (in which cases the drying function is not utilised). Technically, it should be noted that the washing cycle of a washer-dryer is comparable in all aspects to a washing machine. For this reason, the options for washing machines are applied unchanged to the washing cycle in washer-dryers.
Additionally, in order to regulate the use of these machines also as washer-dryers, the following policy options have been considered.

[37] The test or testing programmes, also called regulated programmes, are the programmes used, with specific loadings of textile, to test the appliances and calculate their Energy Efficiency Index, which is also used in the Energy Labelling measures to classify the appliances in energy classes.
[38] This figure being measured against the washing performance of the cotton 60 °C programme in the reference washing machine, according to International Standard IEC60456.

Policy options for washer dryers	Name	Short name	Description
POWD 1	Baseline	BAU	No further action, the household washer dryer Directive currently in place remains unchanged
POWD 2	Combination of low ambition Ecodesign requirements and Energy Labelling	ED +EL (T1)	a. Low ambition Ecodesign requirements implemented in one Tier b. A-G energy updated label
POWD 3	Combination of moderate Ecodesign requirements and Energy Labelling	ED+EL (T1&T2)	a. Moderate Ecodesign requirements implemented in two Tiers b. A-G energy updated label
POWD 4	Combination of additional Ecodesign requirements on material efficiency	ME	New ecodesign requirements on material efficiency, to be combined with the requirements of POWD 1 to 3, related to: a. Spare parts availability and delivery b. Repair and maintenance information c. End-of-life of appliances

Table 2: Policy options for household washer dryers

The specific Ecodesign requirements and Energy Labelling discussed in the options POWD 2 and POWD 3 would apply only to the "wash & dry" programme, which is a combined washing and drying cycle and is the most suitable programme for specific Ecodesign requirements on washer-dryers, as explained in Annex 9. Option POWD 4 on material efficiency contains the same measures as Option POWM 5 for washing machines and both options will be assessed together.

5.3. What is the baseline from which options are assessed?

In the baseline, the current Ecodesign and Energy Labelling Regulations and all other relevant EU-level policies and measures are assumed to continue.

According to the Energy Labelling framework Regulation, products have to be registered in a new product database ("EPREL[39]") from 1 January 2019 onwards, for all models placed on the market after 1 January 2019; and by 30 June 2019 for models placed on the market between 1 August 2017 and 1 January 2019. This applies to washing machines and to washer-dryers and should therefore be part of the baseline. The cost of this measure is however considered together with the options assessed and it is reported with the cost of the preferred option (see Annex 10).

In the BAU scenario, the efficiency of all washing machines or washer dryers is assumed to continue the trend observed in recent years[40]; i.e. improvement is expected to be slow and to remain close to the existing minimum requirements because of the suboptimal market development (i.e. the absence of, or limited competition on technology, and no push and pull effect by regulation).

[39] European Products Registration database for Energy Labelling

[40] It is important to note that "BAU" in this sense does not mean 'freezing at one moment' the current technologies and the state of play of the market (models offered and sales share). Rather, it means that the pace of progress and technology trends will continue "as is".

Annex 5.1 describes how the situation will evolve in a baseline scenario in terms of resource savings including energy, circular economy and scope.

5.4. Description of the policy options for household washing machines

The policy options for washing machines regarding their performance that are described in this section have been selected from a list including eight possible alternatives. The analysis to reduce the number of policy options related to energy efficiency is based on the electricity consumption of an average household washing machine. Further details are presented in Annex 6.1 and Annex 9.6. Additionally, different policy options regarding material efficiency requirements that are proposed to be applied complementary to the energy efficiency measures are considered.

5.4.1. Policy option for washing machines POWM 1 - -No changes - BAU 2015

POWM 1 forms the baseline for the impact assessment and is described in Section 5.1.

5.4.2. Policy option for washing machines POWM 2 - -Minimum temperature 35°C in the laundry core

POWM 2 consists of imposing a minimum temperature of 35°C in the laundry core for a minimum duration of 5 minutes, combined with the minimum washing efficiency and energy efficiency requirements. This measure would allow a single requirement for all washing machines to be set, regardless of their capacity.

Temperature in the laundry core is one of the most important parameters influencing the washing efficiency and the energy consumption in a washing cycle. Additionally, this is one of the parameters that most impacts the duration of the cycles (the higher the temperature the shorter the programme duration)[41] and consequently the acceptance of the most energy-efficient programmes by consumers.

The procedure to test temperatures at the laundry core is being elaborated by the dedicated standardisation group and should be available, at least as a transitional method, at the time of the entry into force of the measures.

Stakeholders' views. In previous analysis (see Annex 9.6.3) two temperatures were considered: 30°C, based on the review study and discussed at the Consultation Forum meeting, and 35°C, identified by experts after the Consultation Forum as a possibly preferable alternative and retained in POWM 2.

Opinions of stakeholders are split on this option: environmental NGOs and consumers organisations are in general favourable (but would like a requirement closer to the nominal temperature of programmes for consumers), some Member States have expressed a negative opinion and industry stakeholders don’t have an agreed opinion on

[41] Washing processes are ruled by the so-called "Sinner's Circle". The Sinner’s Circle theory shows that the washing effect results from the interplay between **cleaning agents, temperature, washing time and mechanical effects**. Taking into account that the cleaning agents are fixed by the test standard and that the mechanical effects result from the drum design, ecodesign requirements can influence the washing efficiency (already required), temperature or washing time; a decrease in the washing time would need to be compensated by an increase in the temperature of the wash, and vice-versa. The derived energy and water consumption result from the interaction of these four parameters.

this option, despite some individual companies are in favour of this approach, in particular in comparison with a requirements fixing a maximum duration.

5.4.3. Policy option for washing machines POWM 3 -- Time cap of 3 hours for half and quarter load, and information of the duration of the full load added in the Energy Label

POWM 3 would limit the duration of the testing programme for the half and quarter loadings, with the aim of making it more attractive for consumers as these are the loadings mainly used according to the consumers' survey (average loading is around 3.3 kg/cycle). It would leave unregulated the duration of the full load programme. The choice of 3 hours appeared as the only possible compromise (at half load) between consumers' expectations in terms of duration and the possible increase in temperature. For the full load, preliminary calculations show that it was not possible to fix a single maximum duration for all machines of different capacities. Displaying the information of the duration of the full load cycle on the label will nevertheless trigger competition between manufacturers and act as an incentive to keep this duration as short as possible.

Stakeholders' views: At the Consultation Forum meeting, some Member States and the consumer associations were in favour of limiting the duration of washing programmes (in combination with the requirement on temperature for consumers); industry stakeholders are opposed to time limitations but the sector association APPLiA recommended displaying information on the programme duration on the energy label. Some companies raised concerns that a time cap, if it is fixed too short, could result in the temperature exceeding 40^{o}C in larger machines with the risk of damage to textiles.

5.4.4. Policy option for washing machines POWM 4 -- Limited duration of the washing cycle proportional to the washing machine capacity.

POWM 4 consists of linking the time-cap on the testing programme to the capacity of the appliance. In comparison with POWM 3, POWM 4 takes better into consideration the influence of the washing machine capacity on the duration of washing programmes. The restriction on the duration has been analysed for full, half and quarter loadings. The limit for the duration for the full loading (i.e. the rated capacity) is given by the equation:

$$t_{cap} = 137\ min + \ capacity\ (in\ kg) * \ 10.2\ min$$

And the limit for the duration for half and quarter loading is given by the following equation:

$$t_{cap} = 132\ min + \ capacity\ (in\ kg) * 6\ min$$

This alternative gives incentives to the manufacturers to not only optimise the energy consumed by the heating system but also to optimise the energy consumed by the motor. It is expected that both will have a positive effect on the energy consumed in the test programme and also in other washing programmes.

Consumer surveys show that the duration of the cycle is one of the main parameters for selecting the programme: consumers' acceptance increases when the programme duration

decreases. The review study consumers survey[42] shows that consumers' acceptance reached 42% when the programme duration was 2 hours but dropped to 13% when the programme duration increased up to 5 hours. Further information can be found in Annex 9.2.

Stakeholders' views: this option could not be commented by all stakeholders as it emerged late during the impact assessment process as a possible compromise between technical feasibility, the policy objective of a more realistic test programme and the diverging views of stakeholders on the other options. Preliminary feedback from industry stakeholders indicate however that the opposition to time limitations would also apply to this option, albeit with possible nuances depending on companies.

5.5. Description of the policy options for household washer dryers

5.5.1. Policy option for washer dryers POWD 1 - No changes - BAU 2015

Option POWD 1 forms the baseline for the impact assessment as described in Section 5.3.

5.5.2. Policy options for washer dryers POWD 2 and POWD 3 - Minimum requirements on energy efficiency and energy labelling update

POWD 2 and POWD 3 consist of implementing a minimum energy efficiency index (EEI) for the testing programme ("wash & dry" cycle) to ensure that washer dryers are optimised on energy efficiency for this programme by manufacturers, benefitting to both the continuous and the interrupted processes, which are covered by this programme.

Based on the repartition of energy consumption of models on the market (see Annex 6.2.1), two options are considered for the Ecodesign minimum energy efficiency index:

- under POWD 2, an EEI limit of 110 (considered to be of low ambition) would enter into force in April 2021
- under POWD 3, a first Tier with an EEI limit of 110 would enter into force in April 2021 and a second Tier with an EEI limit of 90 (18% more ambitious than Tier 1, considered of moderate ambition) would enter into force in April 2024, removing from the market those appliances rated until then in class G and class F.

The wash & dry cycle includes a washing cycle followed by a drying cycle for the same loading. For the assessment of this option, the washing cycle was considered to follow the requirements of POWM 4 for the washing machines, i.e. a restriction on the duration of the washing process depending on the washing capacity; the wash & dry cycle was considered to follow the international standard IEC 62512[43] and achieve a 'cupboard dry' moisture level in textiles at the end of the cycle.

[42] Figure 3.33 in 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

[43] IEC 62512: 2012 Electric clothes washer-dryers for household use – Methods for measuring the performance.

Additionally, the Energy Label established by the Commission Directive 96/60/EC would be updated with a full scale of seven energy classes ranging from A to G, in line with the new Energy Labelling framework Regulation.

Stakeholders' views: Stakeholders agreed on using the wash & dry cycle as testing programme for the washer dryers but no consensus was agreed on how to reduce the testing efforts for this product. No views on the Ecodesign requirements were expressed.

5.5.3. Policy options POWM 5 for washing machines and POWD 4 for washer dryers -- Ecodesign requirements on material efficiency

To address the problem of poor "circular economy" performance presented in Section 2, several measures are considered under policy options POWM 5 and POWD 4. They should be considered as additional (not alternative) to the measures presented in the previous options and they should ultimately be combined with the preferred options, respectively for washing machines and for washer dryers.

The measures considered here were identified during the review study, based on the different studies and initiatives on this field summarised in Annex 7. They relate to the following aspects:

a. End-of-life of appliances
b. Spare parts availability and delivery
c. Repair and maintenance information

Under (a), two measures are considered: the marking of refrigerating gases in case of the use of a heat-pump (as per the F-gas Regulation)[44] and the safe removal of key electric and electronic components (as per Article 8(2) of the "WEEE" Directive[45]). Building on the Directive Annex 7, the key components for washing machines and washer-dryers include:

- Printed circuit boards (larger than 10 cm^2);
- Electrolyte capacitors containing substances of concern (height > 25 mm, diameter > 25 mm or proportionately similar volume);
- Liquid crystal displays (larger than 100 cm^2);
- Batteries;
- Heat pumps.

These measures implement the WEEE legislation already in force – except for heat pump, which is not mentioned as such in the Directive Annex 7. However, since Annex VII to the WEEE Directive includes **a minimum** list of substances and components to be removed from WEEE, components such as heat pumps which may have similar technical characteristics with components listed in Annex VII should be removed for the WEEE as well for the achievement of the objectives of these measures. The measures should also be seen in relation with the platform of exchange of information[46] between producers and recyclers, established in implementation of the WEEE Directive. The inclusion of these

[44] Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006
[45] Directive 2012/19/EU on Waste Electric and Electronic Equipment
[46] https://i4r-platform.eu/

measures in the Ecodesign Regulation would facilitate their implementation by clarifying the role of producers and of Market Surveillance Authorities, without changing the nature of existing obligations. Their cost is therefore considered as negligible for economic actors.

Under (b), the measures assessed would require those spare parts essential for the functioning of the appliance to remain available for a minimum period of time of 7 years after the removal of a model from the market and a maximum delivery time of 3 weeks. This is complemented by a requirement for easy access to and disassembly, for the purpose of repair, of a list of components compiled from the information available (see Annex 7.3).

These measures reflect the current practice, as least for the major brands represented on the market, which offer the same or better conditions for the provision of spare parts. They aim therefore at creating a level-playing field by setting the same minimum conditions for all producers and importers and establishing the basis for the controls of Market Surveillance Authorities and for possible complaints of consumers and repairers in case of failure to meet the requirements. Their additional cost is also considered as negligible in comparison with the current obligations and practice.

Under (c), the measure would require access to Repair and Maintenance Information (to be listed in the Regulation) by professional repairers, with the possibility of proportional fees.

This measure reflect also the practice of major brands as concerns authorised repairers. The access of independent repairers would be new for part of the information concerned, for example the access to digital codes for diagnosis and reprogramming. In order to avoid possible risks regarding intellectual property and liability issues expressed by stakeholders, conditions are imposed on independent repairers to declare that they have the appropriate skills (as covered by national legislation and possible registration) and liability insurance. Checking these conditions represent an extra cost, of administrative nature, for those manufacturers willing to check the access of independent repairers.

This access should also be seen in relation with competition rules: in EU competition law, some vertical arrangements that impose restrictions on the supply of spare parts by their manufacturers to third parties have such a potential for being anticompetitive that they do not benefit from the so-called ‘block exemption regulation' (Regulation EC/330/2010). The objectives pursued with the Ecodesign requirements on making available spare parts and repair information equally to independent repairers and repairers under contract of manufacturers are therefore consistent with those of EU competition law.

Stakeholders’ views: the measures on circular economy were supported by environmental NGOs and consumer associations, and by associations or representatives of recyclers and of repairers in the Consultation Forum. Representatives of manufacturers are not favourable to the measures under (b), for which they would prefer simple declarations without minimum requirements, and opposed to the measure under (c) because of the risks on intellectual property and on liability and quality issues, which in their view risk impacting their reputation. Member States have diverging views or have not expressed an opinion.

The responses to the Open Public Consultation (see Annex 2) have confirmed the importance of material efficiency requirements for stakeholders: Some 63% of the participants were in favour of including Ecodesign requirements on reparability and durability, and 65% of respondents considered that this information should be on Energy Labels (which is not considered at this stage).

Regarding the reparability of products, participants valued mostly as "very important" to "important" (in the range 62%-68%) each of the following: a warranty, the availability of spare parts, and a complete manual for repair and maintenance. The delivery time of spare parts was rated as 56% "very important" to "important".

5.6. Options discarded at an early stage

5.6.1. Voluntary agreement by the industry for the household washing machines and household washer dryers

Voluntary Agreements (VA) are to be given priority, subject to certain regulatory efficiency provisions, according to the framework provisions of the 2009 Ecodesign Directive. However, no VA proposal has been made by any industry sector active in this market. Minimum mandatory requirements are already in force for this product; therefore, if they were to be substituted by a VA, there could arguably be a risk of free-riders, if the VA were not signed up to – and complied with by - all actors present on the market. Hence, this option is discarded from any further analysis.

5.6.2. Mandatory Energy Labelling scheme only for household washing machines and household washer dryers

This option would consider the use of Energy Labels according to the Energy Labelling Regulation No 2017/1369, and the withdrawal of the requirements under the Ecodesign Directive. A labelling scheme (as "pull-effect") alone would be much less effective than the setting of this policy together with minimum Ecodesign energy efficiency requirements. The mandatory Energy Label makes the relative efficiency of products transparent to consumers, and thus gives incentives to manufacturers to compete on energy efficiency of products. However, Energy Labelling alone cannot achieve the withdrawal of inefficient products from the market, which is the strong point of Ecodesign measures. Energy Labelling alone might allow products with lower energy efficiency than permitted today to re-enter the market (the so-called "race to the bottom"); these products could then compete on cheap purchase price alone (rather than the complete Life Cycle Cost).

The effectiveness of Energy Labelling alone would have to rely heavily on consumers' understanding of the Energy Label, in order to make informed decisions. However, consumers may not always choose the most efficient washing machine or washer dryer model for several reasons, such as split incentives or asymmetrical information. Consumers may often base their purchase decisions on purchase price only, and on other factors, such as availability in the shop or warehouse, rather than on the long-term optimal life cycle costs and relative environmental impact of the product to be chosen.

For all the reasons given above, and because no stakeholder has expressed support for this option, this option was discarded.

5.6.3. Ecodesign requirement for a minimum service lifetime for household washing machines and household washer-dryers

An additional requirement for a minimum service lifetime for household washing machines and washer-dryers was considered but it was discarded during the impact assessment. The question of durability of washing machines was studied by the JRC and a report published in 2017[47] but the assessment of a proposed endurance test was not positive at this stage.

A new series of generic standards covering Ecodesign requirements related to material efficiency aspects is being developed via the Mandate 543 of EC (2015). These standards could help provide more clarity as to what is covered by durability and how this can be tested efficiently and accurately. The inclusion of durability requirements, not considered here, could be revisited in the next revision of the regulation.

6. WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

6.1. Methodological considerations and key assumptions

This section describes for each scenario the associated environmental, economic and social impacts on manufacturers, retailers, consumers and general environment as compared to the baseline (scenario BAU 2015). The analytical methods used to determine the impacts of POWM 2 to POWM 4 for washing machines and for POWD 2 and POWD 3 for washer dryers are described in detail in Annex 6. The material efficiency requirements introduced in POWM 5 or POWD 4 for washing machines and washer dryers respectively are assessed qualitatively based on the information summarised in Annex 7.

With the adoption of the Ecodesign Working Plan 2016-2019 in November 2016, the Commission committed for the first time explicitly to systematically exploring resource efficiency requirements in Ecodesign. As a result, the methodological basis for the inclusion of such requirements is not yet fully developed; there are no well-established and accepted methodologies in place to identify these requirements in the context of mandatory legislation.

Therefore, the 'circular economy' requirements that are proposed here are based mainly on stakeholder input, existing studies and evidence of product failure (e.g. on spare parts), and focus on measures that can be relatively easily implemented. As such, they can be considered a starting point that can subsequently be complemented or refined when the methodological tools are available.

There is also a lack of methodologies to quantify the costs and benefits of such criteria in the context of the least life cycle cost (LLCC) calculations applied for energy efficiency in Ecodesign, in particular as regards the assessment of trade-offs.

Although a fully quantified impact assessment of such requirements has not been possible at this stage, a qualitative impact assessment was made, based on inputs taken from technical, scientific and policy-making literature, and nascent evidence from other

[47] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC107722/kjna28759enn.pdf

similar product groups. This forms the basis of an assessment, which can be refined over time and be supplemented with actual quantitative data collected via the monitoring and the evaluations. These data will also serve at the time of the next revisions of the product regulations.

To support improvements in the methodological framework, the Commission mandated CEN/CENELEC to develop standards for material efficiency under Ecodesign and a first set of horizontal standards is expected next year. These will be integrated in the MEErP methodology as appropriate. A broader update of the MEErP is foreseen in 2019, in particular to see how circular economy aspects could be better integrated in preparatory and review studies, including the LLCC calculations.

The key assumptions used in this impact assessment are as follows:

The quantitative results presented in this section are the outcome of two models. The first one simulates the performance of the machines and the second one simulates the impacts due to the implementation of several measures. Due to this fact and to the changes to the testing programme (affecting the relevance of existing data as a basis for simulation), the uncertainty of the results can be significant. In order to assess the influence of the most relevant assumptions considered in both models several sensitivity analyses have been performed and summarized in Annex 6.

6.2. Environmental impacts

6.2.1. Electricity consumption for washing machines

The estimation of the energy consumption (i.e. electricity) per product placed on the market is described in Annex 9.5 and the outputs are shown in Annex 9.6.1. Table 3 shows the EU final energy consumption of the total population of household washing machines for the different scenarios in 2015, 2020, 2025 and 2030 and Table 4 shows the EU cumulative total savings over these time periods compared to the BAU (2015).

Electricity consumption (TWh/year)	**POWM 1 (BAU)**	**POWM 2**		**POWM 3**		**POWM 4**	
		T1	T1&T2	T1	T1&T2	T1	T1&T2
2015	29.30	29.30	29.30	29.30	29.30	29.30	29.30
2020	26.59	30.79	27.18	27.11	27.59	26.67	25.78
2025	26.56	30.68	25.59	25.53	26.29	25.7	24.32
2030	25.92	29.96	24.73	23.87	24.74	24.77	23.32

Table 3: EU final energy consumption for scenarios POWM 1 to POWM 4

Electricity cumulative savings (TWh)	**POWM 2**		**POWM 3**		**POWM 4**	
	T1	T1&T2	T1	T1&T2	T1	T1&T2
2015	0.00	0.00	0.00	0.00	0.00	0.00
2015-2020	-14.60	-1.88	-1.81	-3.13	-2.85	2.43
2020-2025	-25.49	1.18	1.25	-2.59	2.05	8.98
2025-2030	-24.99	5.59	8.40	3.30	5.46	13.63

Table 4: EU energy savings for scenarios POWM 2 to POWM 4 in comparison to scenario POWM1 (BAU)

The new test requirements and rescaling of Energy Label introduce a perturbation into the model for 2020, which is shown by the differences in the values between 2015 and 2020. The model, however, becomes stable in the years subsequent to 2020.

Furthermore, the average lifetime of washing machines is 12.5 years, which means that it will take some time before the whole stock of products has changed. As such, the differences in 2030 are more relevant for the comparison of options.

Scenario POWM 4 (T1&T2) shows the highest energy saving (2.60 TWh/year) in 2030 in comparison to the BAU (2015) scenario, as well as the highest cumulative energy savings (13.63 TWh over the period).

6.2.2. Electricity consumption for household washer dryers

For all scenarios the overall energy consumption of washer-dryers in the EU 28 decreases between 2015 and 2030. This is due to the decrease in the energy consumption attributed to individual machines, even if the stock is expected to slightly i ncrease in coming years. New machines will replace old machines from the stock, increasing the energy efficiency of the overall stock.

The maximum energy saving is expected for scenario ED+EL (T1&T2) with energy savings of 0.47 TWh/year in 2030 in comparison to the BAU (2015). It can be seen that the implementation of both Ecodesign minimum requirements on the energy consumption as well as an update of the Energy Label have the most beneficial effect.

Electricity consumption (TWh/year)	**POWD 1 BAU**	**POWD 2 ED+EL (T1)**	**POWD 3 ED+EL (T1&T2)**
2015	8.54	8.54	8.54
2020	7.70	8.54	8.04
2025	7.39	7.37	7.31
2030	7.70	7.41	7.24

Table 5. Estimated electricity consumption of the WD stock under actual use for scenarios BAU, ED+EL for the options T1 and T1&T2

Electricity cumulative savings (TWh)	**POWD 2 - ED+EL (T1)**	**POWM 3 - ED+EL (T1&T2)**
2015	0.00	0.00
2015-2020	-3.21	-1.24
2020-2025	-1.71	-0.82
2025-2030	0.89	1.47

Table 6. Estimated cumulative electricity savings of the WD stock for scenarios ED+EL for the options T1 and T1&T2 in comparison to the BAU scenario

6.2.3. Greenhouse gas emissions for household washing machines

One of the main environmental emission impacts is the greenhouse gas (GHG) emissions from electricity consumption during the use phase. As described in Annex 9.5.4, the trends in scenarios for GHG emissions are similar to the energy consumption trends. However, the main difference is that the absolute savings over time are higher due to continuous decrease of specific GHG emissions per kWh electricity. The decrease of specific GHG is attributed to the increased use of renewable energy sources in EU electricity production and the shift toward cleaner fossil fuels such as natural gas. In that sense, Table 7 shows the expected GHG-emissions of the total population of household washing machines for the different scenarios and Table 8 shows the cumulative GHG

savings for those scenarios. The scenario POWM 4 (T1&T2) provides the highest GHG emission savings reaching almost 1 million tonnes $CO_{2\ eq}$/year in 2030 in comparison to the BAU scenario.

GHG emissions (million tCO_{2eq}/year)	**POWM 1 BAU**	**POWM 2**		**POWM 3**		**POWM 4**	
		T1	T1&T2	T1	T1&T2	T1	T1&T2
2015	11.57	11.91	11.57	11.57	11.59	11.91	11.57
2020	10.10	11.70	10.33	10.30	10.48	10.13	9.80
2025	9.56	11.04	9.21	9.19	9.46	9.25	8.76
2030	8.81	10.19	8.41	8.12	8.41	8.42	7.93

Table 7. Estimated total GHG emissions at EU level of the stock of WMs under the conditions of scenarios BAU, POWM2, POWM 3 and POWM 4 for the options T1 and T1&T2.

GHG emissions cumulative savings (million tCO_{2eq})	**POWM 2**		**POWM 3**		**POWM 4**	
	T1	T1&T2	T1	T1&T2	T1	T1&T2
2015	0	0	0	0	0	0
2015-2020	-5.61	-0.72	-0.69	-1.20	-1.12	0.93
2020-2025	-9.43	0.41	0.44	-0.98	0.74	3.30
2025-2030	-8.75	1.96	2.93	1.14	1.91	4.77

Table 8. Estimated cumulative GHG savings at EU level of the stock of WMs for scenarios POWM2, POWM 3 and POWM 4 for the options T1 and T1&T2 in comparison to scenario BAU.

6.2.4. Greenhouse gas emissions for household washer dryers

The GHG emissions are - as commented on above - directly linked to the energy consumption. Table 9 shows a decrease of $CO_{2\ eq}$ emissions in all scenarios, and Table 10 shows the cumulative GHG savings over selected time intervals for all scenarios. Scenario ED+EL (T1&T2) provides the highest GHG emissions savings, reaching 0.16 million tonnes $CO_{2\ eq}$ in 2030 in comparison to the BAU scenario. The cumulative savings of scenario ED+EL (T1&T2) reach 0.52 million tonnes $CO_{2e\ q}$ by 2030.

GHG emissions (million tCO_{2eq}/year)	**POWD 1 BAU**	**POWD 2 ED+EL (T1)**	**POWD 3 ED+EL (T1&T2)**
2015	3.38	3.38	3.38
2020	2.92	3.33	3.05
2025	2.66	2.66	2.63
2030	2.65	1.84	2.49

Table 9 Estimated GHG emissions of the stock of WD under the actual use for scenarios BAU, ED+EL for the options T1 and T1&T2.

GHG cumulative savings (million tCO_{2eq})	**POWD 2 - ED+EL (T1)**	**POWD 3 - ED+EL (T1&T2)**
2015	0	0
2015-2020	-1.33	-0.49
2020-2025	-0.64	-0.31
2025-2030	0.32	0.52

Table 10 Estimated cumulative GHG savings of the stock of WD for scenario ED+EL for the options T1 and T1&T2 in comparison to the BAU scenario.

6.2.5. Water consumption for household washing machines

Table 11 shows the estimated total water consumption for the scenarios considered in this impact assessment and Table 12 shows the cumulative water savings in comparison to the scenario BAU. All scenarios lead to water consumption lower than the BAU scenario, as it is expected that less water will be used during the washing process in combination with better mechanical effect. The highest water savings are obtained in the scenario POWM 3 (T1&T2) and the scenario POWM 4 (T1&T2). The cumulative water savings compared to the BAU scenario reaches 11 878 million m^3 and 11 567 million m^3, respectively, over the total period 2015-2030 for scenarios POWM 3 (T1&T2) and POWM 4 (T1&T2).

Water consumption (million m^3/year)	**POWM 1 BAU**	**POWM 2**		**POWM 3**		**POWM 4**	
		T1	**T1&T2**	**T1**	**T1&T2**	**T1**	**T1&T2**
2015	2250	2250	2250	2250	2250	2250	2250
2020	1923	1676	1299	1586	1245	1627	1273
2025	1719	1563	1083	1477	1049	1523	1063

Table 11. Estimated total water consumption at EU level of the stock of WMs under actual use conditions for scenarios BAU, POWM 2, POWM 3 and POWM 4, for the options T1 and T1&T2

Cumulative water savings (million m^3)	**POWM 2**		**POWM 3**		**POWM 4**	
	T1	**T1&T2**	**T1**	**T1&T2**	**T1**	**T1&T2**
2015	0	0	0	0	0	0
2015-2020	1993.71	3610.18	2267.88	3779.30	2151.83	3695.15
2020-2025	1175.89	3827.48	1692.89	4067.55	1438.52	3952.05
2025-2030	807.24	3788.70	1358.67	4031.50	1030.01	3920.20

Table 12. Estimated cumulative water savings at EU level of the stock of WMs for scenarios POWM 2, POWM 3 and POWM 4, for the options T1 and T1&T2 in comparison to scenario POWM 1 (BAU)

6.2.6. Water consumption for household washer dryers

The water consumption is expected to decrease in comparison to the BAU scenario in both scenarios. Scenario ED+EL (T1&T2) provides water savings of approx. 44 million m^3/year in the year 2030, and cumulative water savings of 2198 million m^3 in year 2030 in comparison to the BAU scenario

Water consumption (million m^3/year)	**POWD 1 BAU**	**POWD 2 ED+EL (T1)**	**POWD 3 ED+EL (T1&T2)**
2015	161	161	161
2020	139	107.26	95.72
2030	131	89.38	86.90

Table 13. Estimate of the water consumption WD stock under the actual use for scenarios BAU, ED+EL for the options T1 and T1&T2.

Cumulative water savings (million	**POWD 2 ED+EL (T1)**	**POWD 3 ED+EL (T1&T2)**

m^3)		
2015	0	0
2015-2020	1058.34	993.19
2020-2025	1708.89	1641.11
2025-2030	2283.14	2198.70

Table 14. Estimate cumulative water savings of WD stock for scenarios ED+EL for the options T1 and T1&T2 in comparison to the BAU scenario.

Estimated water consumption values have an uncertainty of ± 20%. However, the introduction of a minimum requirement on water consumption will avoid excessive water consumption (see Annex 9.6.5)

6.2.7. Environmental impacts of material efficiency requirements

6.2.7.1. Energy consumption, greenhouse gas emissions and water savings

The impact of longer product lifetimes on energy consumption, greenhouse gas emissions and water savings has been generally considered to be negative, as replacement machines are expected to be more efficient than older machines being replaced. However, the increase of efficiency of washing machines is no longer improving as rapidly as in the past. A recent study[48] found that extending the operational lifetime of the product actually results generally in an environmental benefit, depending on the selected environmental impact category. In the case of the Global Warming Potential (GWP) the environmental benefit is 2.5% for per additional year; a newer product would have to be 28% better than the old one to be preferable. In the case of abiotic depletion potential (e.g. mineral raw materials), extending the service lifetime of the machine is a better option until the new product is 70% more energy efficient. Based on the average performance of models in 2018 and 2030, it is expected that new models will be just 12.5% more energy efficient than current ones**.** This gives a clear advantage to longer operational lifetimes of products as regards environmental impacts.

6.2.7.2 Resources used in production

Longer product lifetime means fewer requirements for new machines per year, reducing the environmental impacts associated with production (energy, water and material use). A recent study[49] shows that while the manufacturing process itself has comparatively low impact, the materials used in a washing machine or washer dryer cause environmental impacts, most notably abiotic depletion, ecotoxicity and freshwater eutrophication. The level of impact of course depends on the amount of certain materials used in the washing machine or washer dryer and the potential reduction of this impact due to repair depends on the amount of product life saved, but the impact will always be positive.

[48] Ardente, F. & Talens Peirò, L. (2015). Environmental Footprint and Material Efficiency Support for Product Policy: Report on benefits and impacts/costs of options for different potential material efficiency requirements for Dishwashers. Available at http://publications.jrc.ec.europa.eu/repository/bitstream/JRC95187/lb-na-27200-en-n.pdf .
[49] Ardente, F. & Talens Peirò, L. (2015). Environmental Footprint and Material Efficiency Support for Product Policy: Report on benefits and impacts/costs of options for different potential material efficiency requirements for Dishwashers. Available at http://publications.jrc.ec.europa.eu/repository/bitstream/JRC95187/lb-na-27200-en-n.pdf .

6.2.7.3. Recycling and depollution at end-of-life

The improvement in disassembly at the end-of-life phase as a consequence of the proposed measures is expected to make recycling and depolluting easier, providing a large positive environmental effect by making available recycled materials (particularly steel and copper) that can replace virgin materials.

6.3. Economic impacts

6.3.1. Business impacts for household washing machines and household washer dryers

To achieve energy, carbon, water and resource savings, industry has to invest. As such, the cost of the investment will be fully or partially translate to higher purchase prices of the appliances which can affect consumer expenditure. Consequently, the acquisition cost for consumers may increase as a consequence of the policy options but also decrease later as a consequence of the learning effect[50] (see also section 9.5.2.). The combination of both effects on the revenues for the industry and the retail sector is indicated in Table 15 for household washing machines and in Table 16 for household washer dryers.

		POWM 1	POWM 2		POWM 3		POWM 4	
			T1	T1&T2	T1	T1&T2	T1	T1&T2
Manufacturer	2015	1.55	1.55	1.55	1.55	1.55	1.55	1.55
	2020	1.43	1.399	1.40	1.41	1.51	1.33	1.76
	2025	1.45	1.44	1.44	1.55	1.56	1.37	1.81
Retailer	2015	4.14	4.14	4.14	4.14	4.14	4.14	4.14
	2020	3.82	3.74	3.74	3.76	4.05	3.57	4.20
	2025	3.89	3.85	3.85	3.87	4.16	3.67	4.83
	2030	5.18	5.12	5.12	5.15	5.54	4.88	6.43
Total	2015	5.69	5.69	5.69	5.69	5.69	5.69	5.69
	2020	5.25	5.14	5.14	5.167	5.56	4.90	5.96
	2025	5.34	5.29	5.29	5.42	5.72	5.04	6.64
	2030	7.12	7.04	7.04	7.07	7.61	6.709	8.83
Difference 2015 to 2030		25%	24%	24%	24%	34%	18%	55%

Table 15. Overview of the business revenue per scenario for household washing machines, in billion Euro2015

The policy options POWM 2 (T1&T2), POWM 3 (T1&T2) and POWM 4 (T1&T2) will have impacts on business due to the models that will have to be removed from the market when the second tier of requirements enters into force. Tier 2 in comparison with T1 sets the energy efficiency requirement approximately 15-18% higher depending on the policy option. Tier 2 will remove from the market in 2024, 12%, 8% and 5 % of the models for scenarios POWM 2, POWM 3 and POWM4 respectively. The industry has therefore 3 years to adapt the models to the Ecodesign requirements of Tier 2. Keeping in mind the number of models to be adapted, this time frame is considered to be feasible.

[50] "Learning effect" meaning the reduction in price due to the increase in demand, and thus economies of scale regarding production.

		POWD 1	POWD 2 ED+EL (T1)	POWD 3 ED+EL (T1&T2)
Manufacturer	2015	145.5	145.5	145.5
	2020	136.8	138.8	138.8
	2025	146.4	148.6	148.6
	2030	204.8	207.8	207.8
Retailer	2015	389.0	389.0	389.0
	2020	366.0	371.3	371.3
	2025	391.6	397.4	397.4
	2030	547.7	555.7	555.7
Total	2015	534.5	534.5	534.5
	2020	502.8	510.2	510.2
	2025	538.1	545.9	545.9
	2030	752.5	763.5	763.5
Difference from 2015 to 2030		41%	43%	43%

Table 16. Overview of the business revenue per scenario for household washer dryers, in million Euro2015

POWD 2 and POWD 3 have the same (small but positive) impacts on business due to the updating of the Energy Label. Under POWD 3, approximately 5% models are expected to be removed from the market when Tier 2 comes into force in 2024, but this has no additional impact on business revenue in the simulation.

Other impacts on business such as on innovation, research and development, competitiveness and trade, stranded assets and intellectual property have been further analysed in Annex 8.3. No relevant impacts have been found regarding the intellectual property rights of the manufacturers or regarding possible stranded assets. In addition, investments due to the current regulation are expected to be financially depreciated already in the manufacturers accounts.

6.3.1.1. Business impacts of material efficiency requirements

The material efficiency requirements will impact different business sectors differently. Effects are foreseen for the following sectors:

Effects on manufacturers

An unavoidable impact of achieving the policy goal of longer product lifetimes is a corresponding decrease in the number of new products sold, which negatively impacts manufacturers. The expected increase of repairs (after expiry of the legal guarantee) would offset this to a certain extent. The precise extent of this offsetting will vary, depending on the profit margins of manufacturers on spare parts and provided repair services. Some studies indicate a very large variation in the rates charged for spare parts and repair services between different manufacturers and even the same manufacturers in

different Member States[51]. The overall impact on manufacturers is expected to be neutral to negative.

Effects on retailers

Retailers who act only as intermediaries between manufacturers and consumers could be expected to be negatively impacted by lower annual sales volumes due to longer product lifetimes. This would be compensated in part by the expected corresponding increase in the market for spare parts, which retailers can also profit from. Also, given the fact that the market for washer-dryers is not saturated, the effects on sales would be expected to be lower. The overall impact on retailers is expected to be neutral to slightly negative.

Effects on independent repair businesses

One objective of the material efficiency measures is to improve the competitiveness of independent repairers and facilitate a more open playing field in repair activities. The impacts of proposed measures on these businesses, mostly SMEs[52], is expected to be very positive. Increases of 15%-20% of repairs were observed after the consumption law came into force in France[53].

Measures requiring availability of spare parts and access to repair information should help independent repairers to overcome barriers currently limiting their capability to compete in a fair way, widening the range of products which they could repair. This is expected to greatly outweigh the potential negative effect of lower profit margins due to more competition between repair services. Also the lower costs for repair are expected to drive up the overall demand for repairs, as studies show that consumers currently cite (perceived) high costs as the main reason to not repair but replace appliances. Overall the impact on repair businesses is expected to be very positive.

Effect on reuse operators/second-hand retailers

Longer product lifetimes would have an evident positive impact on second-hand retailers. Better and cheaper repair options would in particular benefit businesses that combine repair and second-hand sale of appliances. Overall, the effects of proposed measures on second-hand retailers are expected to be very positive.

Effect on recycling businesses

Longer product lifetime could mean less availability of discarded machines to recyclers, which would be a negative impact. However, the requirements for disassembly will facilitate extraction of valuable materials from discarded devices and make it easier to depollute materials. This will cause a strong positive effect in the long term (from the moment devices marketed under this regulation reach recycling facilities). Improved extractability of the key components due to better disassembly will increase the recovery rate of copper and precious metals such as gold, palladium and silver, with an estimated

[51] See Annex 6, Section 6.2.2
[52] On average, repair companies employ 2.5 persons, and thus It is expected that most would be micro-enterprises
[53] The Consumption Law of 17 March 2014, effective as of March 2015, has placed an obligation on product retailers to inform the customer about how long spare parts will be available for the products in the market.

yearly potential economic benefit of 6.3-6.6 million euros[54] (similar results are expected for the washing machine and washer dryer sector). The overall impact on recycling businesses is expected to be very positive.

6.3.2. User expenditure

User expenditure consists of acquisition costs, maintenance/repair and running costs (including detergent, electricity and water costs). The running costs due to the consumption of detergents were estimated at EUR 44.1 per year and the repair costs at EUR 45 per year for both appliances and are the same for all scenarios. Purchase price, energy and water costs differ due the influence of the eco-design requirements and the energy label. The future electricity prices and energy mix were modelled by using the PRIMES 2016 model. The estimated consumer expenditure for household washing machines is shown in Table 17 and for household washer dryers is shown in Table 18.

		POWM 2		POWM 3		POWM 4	
	POWM 1	T1	T1&T2	T1	T1&T2	T1	T1&T2
2015	30.94	30.94	30.94	30.94	30.94	30.94	30.94
2020	29.57	29.32	26.72	28.05	27.04	27.88	27.77
2025	31.11	31.37	27.35	29.50	27.85	29.52	28.43
2030	37.37	37.79	33.09	35.27	33.43	35.63	34.57

Table 17. Consumer expenditure in billions of Euros$_{2015}$ for all scenarios for washing machines

	POWD 1 BAU	POWD 2 ED+EL (T1)	POWD 3 ED+EL (T1&T2)
2015	3.06	3.06	3.06
2020	3.05	3.60	3.32
2025	3.33	3.49	3.46
2030	3.65	3.66	3.61

Table 18. Consumer expenditure in billions of Euros$_{2015}$ for all scenarios for washer dryers

Counting together the impacts of both acquisition and running costs the trends in overall consumer expenditure is increasing for the *household washing machines*. In the BAU scenario, consumer expenditure reaches EUR 37 billion in 2030, being an increase of 20 % between the expenditure in 2015 and 2030. The total user expenditures indicated for all scenarios are in the same order of magnitude, even if there are differences in the average purchase price of each alternative that are compensated by the differences in the costs of the utilities.

The increasing consumer expenditure for *household washer dryers* is shown in Table 4 This is because in the coming years not only the purchase price of the household washer

[54] Ardente, F. & Talens Peirò, L. (2015). Environmental Footprint and Material Efficiency Support for Product Policy: Report on benefits and impacts/costs of options for different potential material efficiency requirements for Dishwashers. Available at http://publications.jrc.ec.europa.eu/repository/bitstream/JRC95187/lb-na-27200-en-n.pdf .

dryers but also the number of machines are expected to increase. POWD 3 results in lower user expenditure in comparison to the BAU scenario.

Longer product lifetimes would have an evident positive effect on consumer expenditure (i.e. less expenditure). Material efficiency requirements may facilitate this effect especially if they cause the repair costs to lower below the threshold that consumers are willing to spend on repair (estimated to be around 30% of the price of a new product).

Stakeholder views – No comments were made on the user expenditure.

6.3.3. Administrative burden

The administrative burden of new measures under the Energy Labelling Framework Regulation was calculated in the Impact Assessment for the Energy Labelling Framework Regulation. The costs for household washing machine and household washer dryer appliances are summarised in Table 19.

Administrative burden (thousand euros)	**one-off**	**annual**	**BAU**
For the first 6 months provide a second label and supply extra labels on request to dealers	2700		-
Dealers re-labelling around 2.5% of products on stock/display or on the internet	450		-
Database, supplier costs		494.22	-
Database, EU budget	494.22	49.42	-
Joint support actions, EU budget (e.g. EEPLIANT)		33	x
Support joint surveillance actions (Horizon2020)		60	x
External laboratory costs (SMEs)		66	x
Market surveillance, Member State costs		330	x
Total business-as-usual (BAU)	**-**	**489**	
Total new costs of measures	**3642.22**	**543.64**	

Table 19: Summary of administrative burden in thousand euros for both appliances (Impact Assessment Energy Labelling Regulation)

The above-mentioned table considers no additional administrative burden for industry. More details to be found in Annex 8.3.

Stakeholder views – No comments were made on the administrative burden.

6.4. Social impacts

6.4.1. Product cost and affordability

The acquisition cost for various scenarios are given in Table 20 for household washing machines and Table 21 for household washer dryers.

		POWM 2		**POWM 3**		**POWM 4**	
	POWM 1	**T1**	**T1&T2**	**T1**	**T1&T2**	**T1**	**T1&T2**
2015	370	370	370	370	370	370	370

2020	382	371.4	371.4	373.1	402.0	356.2	469.5
2025	391	374.5	374.5	376.2	405.1	359.2	473.0
2030	401	374.6	374.7	376.4	405.2	359.3	473 .2

Table 20. Purchase price for household washing machines in Euro$_{2015}$

	POWD 1	POWD 2 ED+EL (T1)	POWM 3 ED+EL (T1&T2)
2015	888.78	888.78	888.78
2020	889.43	902.42	902.42
2025	889.49	902.48	902.48
2030	888.36	901.33	901.33

Table 21. Estimated purchase price for household washer dryers in Euro$_{2015}$

The impacts for the different scenarios on the product purchase prices shows a difference of up to 27% in 2030 in comparison to the BAU scenario. This increase in the purchase price is however compensated by the savings in the utilities and the increasing prices of the utilities in the coming years. The net savings of the consumers for each of the options can be observed in Section 7.

The risk that consumers would postpone the purchase of a new washing machine exists. However this behaviour was not observed with the introduction of the current Regulations, therefore it is not considered here.

For household washer dryers, the impacts of the different scenarios on the product purchase prices and therefore in its affordability are shown in Table 21. The increase in price is observed in all the scenarios; this can be explained partly by the uptake of new technologies such as heat pumps. Heat pumps in washer dryers is at present one of the most energy efficiency technologies on the market and it is expected to be taken up more rapidly than for other appliances such as washing machines or dishwashers because of the substantial energy savings that this technology can bring in the drying process[55]. Additionally, as shown in the Review study 2017, washer dryers equipped with a heat pump show a simple payback time (SPP) that is smaller than its average lifetime, indicating that the investment is recovered

The parameters regarding the savings in the utilities and the corresponding increase in the purchase price are worth considering for most of consumers. However, there are cases where the purchaser (e.g. the landlord) is not the one paying the energy and water bills (e.g. tenant), or where the purchaser buys the appliance as a "quick fix" for an apartment that s/he plans to leave after a short while leaving the appliances behind. In those cases, the economic considerations for the purchaser may be different. The likelihood of this happening is higher in the case of household washing machines than

[55] Tumble dryers equipped with heat pumps entered into the market around 20 years ago, showing a fast penetration ratio. The tumble dryers equipped with heat pumps have the advantages of using a lower temperature to dry the load and therefore using less energy, offering better protection for the clothes and being less noisy.

in the case of household washer-dryers as the latter is considered as a relatively luxury product[56].

Improved reparability of appliances may also have a positive impact on their affordability by developing the second-hand market of repaired appliances.

6.4.2. Health, safety and functionality aspects

There are no specific health and safety aspects related to the measures analysed. There are no known negative impacts from using more efficient appliances as prescribed by the policy options.

The measures of material efficiency proposed would be beneficial to the safety and health of workers in the repair as well as the recycling businesses, as requirements in these two scenarios include providing information on – and action regarding - easier and safer access to components containing hazardous substances.

6.4.3. Employment

The EU employment impact is estimated from the increase in revenue and turnover per employee. For a proper understanding it is important to define the boundaries. In this impact assessment:

- only direct jobs in the production and distribution chain are considered, i.e. including OEM suppliers and business services but excluding the indirect employment effect of employees in the production and distribution chain buying/renting houses, doing their shopping, paying taxes, etc
- it is assumed that the increase in revenue leads to an increase in the number of jobs, but in this case, where employment is declining (see section 6.3), it can also be understood as retaining jobs that otherwise would be lost;
- the total number of direct jobs considered, however, it needs to be taken into account that approximately 50% of the OEM-jobs and 20% of the retailer –job is created/retained outside the EU through imports of components and other services;
- no employment effect is calculated for maintenance and repair industry, although positive effects on these sectors are expected due to the implementation of material efficiency requirements.

Even if it is not intuitive that higher product prices help the industry sectors involved and lead to higher employment, in the impact assessment study carried out for the current regulation, the link between business revenues and the number of employees was checked against annual reports from individual companies. In the impact assessment report for this revision, we assumed that these dynamics did not change.

Table 22 gives an overview of the employment impact according to these rules for the manufacturing and retail sector for household washing machines.

[56] Those household appliances with a saturated market are considered as non-luxury products. This is the case of washing machines that have a stock penetration close to 92% while the stock penetration of the washer-dryers is approximately 4%

		POWM 1	POWM 2		POWM 3		POWM 4	
			T1	T1&T2	T1	T1&T2	T1	T1&T2
Manufacturer	2015	8.24	8.24	8.24	8.24	8.24	8.24	8.24
	2020	7.59	7.44	7.44	7.48	8.06	7.1	9.35
	2030	10.3	10.19	10.19	10.2	11.02	9.71	12.79
Retailer	2015	69.01	69.01	69.01	69.01	69.01	69.01	69.01
	2020	63.62	62.38	62.38	62.68	67.52	59.47	78.38
	2030	86.29	85.37	85.37	85.79	92.33	81.39	107.18
Total	2015	77.25	77.25	77.25	77.25	77.25	77.25	77.25
	2020	71.21	69.82	69.82	70.16	75.57	66.56	87.74
	2030	96.59	95.56	95.56	95.99	103.35	91.1	119.98

Table 22. Estimated number of employees (in '000 jobs) for all scenarios for washing machines at EU-28 level

Table 23 provides an overview of the employment impact for the manufacturing and retail sector for *household washer dryers*. In that sense considering that the sales are not affected by the implementation of the eco-design requirements, the scenario ED+EL (T1&T2) provide a slight increase in the total number of jobs in 2030.

		POWD 1	POWD 2 ED+EL (T1)	POWD 3 ED+EL (T1&T2)
Manufacturer	2015	0.77	0.77	0.77
	2020	0.73	0.74	0.74
	2025	0.78	0.79	0.79
	2030	1.09	1.11	1.11
Retailer	2015	6.48	6.48	6.48
	2020	6.19	6.19	6.19
	2025	6.53	6.62	6.62
	2030	9.13	9.26	9.26
Total	2015	7.26	7.26	7.26
	2020	6.92	6.93	6.93
	2025	7.31	7.41	7.41
	2030	10.22	10.37	10.37

Table 23. Overview of the jobs per scenario for household washer dryers, in thousand jobs

As regards material efficiency, a number of studies contain useful information on the social impacts of making available spare parts and repair information:

- According to a horizontal study across various household products by Deloitte[57], positive social impacts for EU employment are expected due to the material efficiency requirements. As in the case of the economic impacts, there might be

[57] Deloitte 2016 – see footnote 37

some reductions on the projected increase of jobs in the manufacturing sector - part of which will occur outside the EU. However, the creation of a significant amount of jobs in the repair sector would correspond to the development of quality jobs, largely in SMEs and smaller companies, mostly in the EU.

- In 2011, the 'social economy' accounted for 11 million jobs in the EU, an amount that represented around 11% of total employment[58]. It should be noted that social enterprises operate mainly in the second-hand market for products, whereas repair activities have a smaller share in the sector, but have an increased development trend (e.g. repair cafés). An increase in reparability could therefore promote growth of the second-hand market of appliances. Such a prospect is expected to benefit low-income households, because low-cost and good-quality products would become more affordable[59].

7. HOW DO THE OPTIONS COMPARE?

7.1. Summary of the impacts

The quantitative impact analysis was performed on the basis of scenarios for the baseline (BAU) and for three alternative options for household washing machines and two options for household washer dryers. The main results for these options are summarised in Tables 24 and 25. It shows the estimated annual impacts in 2030 (in terms of energy savings, greenhouse gas emissions, end-user expenditure, revenues and jobs) for household washing machines and household washer-dryers.

		POWM 2		POWM 3		POWM 4	
		T1	T1&T2	T1	T1&T2	T1	T1&T2
Electricity savings	TWh/yr	-4.36	0.60	1.60	0.59	0.84	**2.01**
CO_{2eq} reduction	million tonne	-1.4848	0.2020	0.5454	0.2020	0.2929	**0.6868**
Water savings	million m^3	135	645	237	**696**	165	667
Extra purchase cost	billion EUR_{2015}	0.00	-0.55	-0.51	0.09	**-0.91**	1.45
Energy costs savings		-1.29	0.38	0.66	0.38	0.37	**0.83**
Water cost savings		0.79	3.82	1.4	**4.12**	0.98	3.95
Net cost savings		-0.50	4.75	2.57	**4.41**	2.26	3.33
Industry revenue	billion EUR_{2015}	0.09	0.09	0.09	-0.32	-0.50	**0.40**
Retailer revenue		0.24	0.24	0.24	0.66	0.00	**0.71**
Manufacturer employment	thousands of jobs	0.49	0.49	0.49	1.29	0.00	**3.09**
Retailer employment		1.01	4.01	4.41	10.91	0.01	**25.79**

Table 24. Overview main annual impacts in year 2030 compared to the POWM 1 of the options for household washing machines. Best values in Bold

		POWD 2	POWD 3
Electricity savings	TWh/yr	0.29	**0.47**
CO_{2eq} reduction	million tonne	0.1010	**0.1616**
Water savings	million m^3	41.62	**44.1**
Extra purchase cost	billion EUR_{2015}	-0.01	**-0.01**

[58] Deloitte 2016 – see footnote 37
[59] O'Connell et al (2012) Evaluating the sustainability potential of a white goods refurbishment program.

Energy costs savings		0.09	**0.15**
Water cost savings		0.25	**0.26**
Net cost savings		0.33	**0.40**
Industry revenue	billion EUR_{2015}	0.00	**0.00**
Retailer revenue		0.01	**0.01**
Manufacturer employment	thousands of jobs	0.02	**0.02**
Retailer employment		0.13	**0.13**

Table 25. Overview main annual impacts in year 2030 compared to the PODW 1 of the options for household washer dryers. Best values in Bold

For material efficiency aspects, while it was not possible to quantify the impacts in the same detailed fashion as for the other requirements, Table 26 summarises the qualitative assessment made of the different measures proposed.

Impact categories	**Assessment**		
	End-of-life of appliances	Spare parts availability and delivery	Repair and maintenance information
Environmental impacts	+	**++**	**++**
a. energy consumption	=	+	+
b. greenhouse gas emissions reduction	=	+	+
c. water consumption	=	+	+
d. resource used in production	+	+	+
e. improved recycling and depollution	**++**	+	++
Economic impacts	=	+	+
a. Impact on manufacturers	=	=/-	=
b. Impact on retailers	=	=/-	=/-
c. Impact on independent repair businesses	=	++	++
d. Impact on reuse operators/second-hand retailers	+	++	++
e. impact on recycling businesses	++	=	=
f. User expenditure	=	+	+
Social impacts	=	+	+
a. affordability and product cost	=	=	=
b. employment in the EU	+	+	+
c. health and safety aspects	+	=	+

Table 26. Evaluation of potential impacts from enhanced material efficiency (greater reparability) requirements on the following categories (qualitative assessment: + means positive effect (e.g. lower costs), - means negative effect (eg more energy consumption), = means no or negligible effect

7.2. Market Surveillance

All proposed policy options would be subject to Article 15(8) of the Ecodesign Framework Directive, as well as Article 8(1) and (3) of Energy Labelling Framework Regulation, which requires that MSAs can verify the conformity of a product with all regulatory requirements.

The cost for market surveillance organised by MSs is the same for all options, i.e. EUR 330 000 annually, see Section 6.3.3

Stakeholder views – APPLiA and other industry associations have emphasised the importance of securing a sufficient level of market surveillance to ensure that only compliant products are placed on the market. In this respect, they call for increased enforcement by MSAs**.**

7.3. Assessment in view of Article 15(5) of the Ecodesign Framework Directive

Pursuant to Article 15(5) of the Ecodesign Framework Directive, future implementing measures should fulfil a number of criteria, see Section 6. An assessment of the options in view of these criteria can be seen in Table 27. It summarizes the impacts described in Section 6.

Significant impacts as stipulated in Art 15 of the Ecodesign Directive	**PO WM 1**	**Household washing machines**						**Household washer dryers**			**Material Efficiency requirements**		
		POWM 2		**POWM 3**		**POWM 4**		**POWD 1 BAU**	**POWD 2 T1**	**POWD 3 T1&T2**	End-of-life of appliances	Spare parts availability and delivery	Repair and maintenance information
		T1	**T1&T2**	**T1**	**T1&T2**	**T1**	**T1&T2**						
No significant negative impacts on the functionality of the product from the perspective of the user	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Health, safety and environment shall not be adversely affected	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
No significant negative impact on consumers in particular as regards affordability and life-cycle costs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
No significant negative impacts on industry's competitiveness	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Setting of an eco-design requirement shall not have the consequence of imposing proprietary technology on manufacturers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Impose no excessive administrative burden on manufacturers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Table 27. Evaluation of policy options in terms of their impacts compared to the baseline

7.4. Assessment in view of the objectives

An assessment of the options in view the objectives in Section 4, on the basis of Table 28.

Significant impacts as stipulated in Art 15 of the Ecodesign Directive	**POWM 1**	**Household washing machines**						**Household washer dryers**			**Material Efficiency requirements**		
		POWM 2		**POWM 3**		**POWM 4**							
		T1	**T1&T2**	**T1**	**T1&T2**	**T1**	**T1&T2**	**POWD 1 BAU**	**POWD 2 T1**	**POWD 3 T1&T2**	End-of-life of appliances	Spare parts availability and delivery	Repair and maintenance information
General objectives													
1. Ensure free circulation of efficient products within the internal market	0	+	+	+	+	+	+	0	+	+	0	+	+
2. Promote competitiveness of the household washing machines and washer dryers through the creation of expansion of the EU internal market for sustainable products	0	+	+	+	+	+	+	0	+	+	0	+	+
3. Promote the energy efficiency of household washing machines and washer dryers as contribution to the EU's objective to reduce energy consumption by 30% and domestic GHG emissions by 40% by 2030; and	0	+	++	+	++	+	++	0	+	++	0	0	0
4. Increase the security of energy supply in the Union through a reduction in energy consumption of household	0	+	++	+	++	+	++	0	+	++	0	0	0

washing machines and washer dryers.													
Specific objectives													
1. Redefine the regulated programmes and testing to better reflect the preferences and use patterns of consumers;	0	+	+	+	+	+	+	0	+	+	0	0	0
2. Update the energy efficiency requirements and the energy label in line with technological developments and the revised Energy Labelling framework Regulation, to achieve cost-efficient savings of energy and other resources;	0	+	++	+	++	+	++	0	+	++	+	+	+
3. Contribute towards a circular economy in the EU by supporting longer-lasting products, among others by facilitating their repair, and by increasing their recyclability at the end of life.	0	0	0	0	0	0	0	0	0	0	++	++	++

Table 28. Score of impacts against objectives (see section 4)

Legend: -=small negative impacts --= large negative impact, 0= no change; + = limited improvement; ++= significant improvement

8. PREFERRED OPTION

The comparison of options presented in Section 7 should be interpreted with prudence, including for quantitative assessments. The assessment of options POWM2 to POWM4 rely on simulations, as the change of test programme did not make it possible to use the data available on the performance of machines on the market, which is measured using the current test programmes. The figures summarised in Table 24 are therefore very dependent on the assumptions made for the simulations. They give nevertheless enough useful indications to compare the different options.

A first conclusion, valid for both washing machines and washer-dryers, is that options with two Tiers lead to better results than options with one Tier. The reinforcement of the minimum energy requirement after 3 years is obviously an important element in the provision of the savings expected.

Among the options with two Tiers, **two options present good results in terms of environmental and economic impacts and could be considered as preferred option: POWM 3 (T1+T2) – "Time cap 3h for half and quarter load and information on the full load on the energy label" – and POWM 4 (T1+T2) – "limited duration of the cycle proportional to the capacity".**

Between these two options, it seems that POWM 4 (T1+T2) presents the best combination of savings and benefits for stakeholders, based on Table 24: POWM4 is the best option for electricity savings, CO2 reduction, industry and retailer revenue and employment. POWM3 is the best option for water savings and net cost savings for consumers. In the comparison, it should be noted that POWM4 still provides important savings to consumers, while POWM3 would lead to a negative result on industry revenue and to only half the number of job creations of POWM4.

The preferred option for washing machines is therefore a combination of POWM 4 (T1 + T2) – "Proportional Time Cap with Tier 1 and subsequent Tier 2" and **POWM 5** for material efficiency requirements. This preferred option fulfils the criteria in Article 15(5) of the Ecodesign Regulation and Article 16(2) of the Energy Label Regulation, see Section 3.1 and will achieve the objectives as set out in Section 4 in the best way, see section 7.4.

By 2030, **POWM 4 (T1&T2)** together with **POWM 5** will results in the following

- Electricity savings of 2.01 TWh/year, water savings of 667 million m^3/year and GHG emission abatement of 0.68 $MtCO_2eq$/year; this represents a contribution of 0.14% to the EU target on energy efficiency by 2030 and 0.06% to the EU target on CO_2 emissions reduction by 2030.
- EUR 6.75 billion savings of annual end-user expenditures are expected. Extra business revenue of EUR 1.1 billion per year, which translates into ca 3 090 additional jobs in the EU manufacturing sector and 27 790 in the retail sector in comparison to the BAU scenario.
- ensuring EU industry's competitiveness and leading role as high-quality manufacturers

- promoting innovation and medium term cost reduction for more efficient household washing machine and washer dryers.

The energy label bandwidths corresponding to this combination and Tiers are shown in the following table.

Energy Label bandwidth	Ecodesign requirements (Tiers)
A ≤ 52 52 < B ≤ 60 60 < C ≤ 69 69 < D ≤ 80 80 < E ≤ 91 91 < F ≤ 105 105 < G	Tier 1: 105 in April 2021 Tier 2: 91 in April 2024

The preferred option for washer-dryers is a combination of POWM 4 for the washing process, POWD 3 – Ecodesign + Energy Label (T1&T2) for the combined "wash & dry" and POWD 4 for the requirements on material efficiency. It fulfils the criteria in Article 15(5) of the Ecodesign Regulation and Article 16(2) of the Energy Label Regulation, see Section 3.1 and will achieve the objectives as set out in Section 4 in the best way, see section 7.4.

By 2030, **this preferred option for washer-dryers** will results in the following

- Electricity savings of 0.47 TWh/year, water consumption of 44 million m^3/year and GHG emission abatement of 0.1616 million tCO_2eq/year; this represents a contribution of 0.03% to the EU target on energy efficiency by 2030 and 0.01% to the EU target on CO_2 emissions reduction by 2030.
- EUR 400 million savings of annual end-user expenditures are expected. Extra business revenue of EUR 10 million per year, which translates into ca 20 additional jobs in the EU manufacturing sector and 150 in the retail sector in comparison to the BAU scenario.
- ensuring EU industry's competitiveness and leading role as high-quality manufacturers
- promoting innovation and medium term cost reduction for more efficient household washing machine and washer dryers
- Higher revenues and profits for independent companies (such as SMEs) working in the field of reparation and refurbishment of products.

The energy label bandwidths corresponding to this combination and Tiers are shown in the following table.

Energy Label bandwidth	Ecodesign requirements (Tiers)
A ≤ 37 37 < B ≤ 48 48 < C ≤ 63 63 < D ≤ 76 76 < E ≤ 88 88 < F ≤ 100 100 < G	Tier 1: 105 in April 2021 Tier 2: 88 in April 2024

8.1. REFIT (simplification and improved efficiency)

This section describes how the preferred option is expected to improve the efficiency of the existing measures.

The POWM 4 (T1&T2) and POWD 3 will reduce the total consumer expenditure as compared to the respective baselines. The consumer expenditure includes the acquisition cost and the energy and water cost. The acquisition cost and the energy and water prices will be higher, but the total cost for energy and water will decrease as compared to the respective baselines (due to the gain in efficiency). In addition, these policy options will improve industry's revenues.

There is a one-off cost linked to the application of the new Energy Labelling Framework Regulation. For suppliers, a cost of EUR 2.7 million, for providing two labels (one according to the current Regulations and one according to the new measure) during 4 months. For dealers, a cost of EUR 0.45 million for relabelling 2.5% of their products on display. This cost is not included in Table, because it is a one-off cost, which will not have an impact anymore in 2030.

Table 29 and 30 give an overview of the increments in cost and as compared to the baseline.

	2030	**Comment**
Acquisition costs (EUR billion) Energy costs (EUR billion) Water costs (EUR billion) Consumer expenditure (EUR billion)	1.45 -0.83 -3.95 -3.30	The additional acquisition cost is more than compensated by the overall consumer expenditure decrease
Industry revenue (EUR billion) Retail revenue (EUR billion)	0.40 0.71	There is an increase in revenue for industry and retail sectors

Table 29: Increment in costs, revenue and administrative burden of the preferred option for household washing machines

	2030	**Comment**
Acquisition costs (EUR billion) Energy costs (EUR billion) Water costs (EUR billion) Consumer expenditure (EUR billion)	0.01 -0.15 -0.26 -0.40	The additional acquisition cost is more than compensated by the overall consumer expenditure decrease
Industry revenue (EUR billion) Retail revenue (EUR billion)	0.00 0.01	There is a minor increase in retail revenue

Table 30: Increment in costs, revenue and administrative burden of the preferred option for household washer dryers

9. HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

The main monitoring element will be the tests carried out to verify compliance with the Ecodesign and energy labelling requirements. This monitoring should be done by MSAs to ensure that requirements are met. The main indicator for evaluating the impact of potential Ecodesign and energy labelling regulations is the achievement of a market improvement towards household washing machines and household washer dryers with a smaller environmental impact. An analysis of the products on the market (sales figures, performance, etc.) will determine if the shift towards more resource efficient products has happened as estimated, in particular based on the following sub-indicators, which reflect the general and specific objectives:

- Reduction of the electricity consumption and related GHG emissions of household washing machines and household washer dryers;
- Increasing the economic savings for European consumers;
- Safeguarding the competitiveness of the European household washing machines and household washer dryers industries and the full value chain;
- Improving the regulatory effectiveness and efficiency of the regulation;
- Compliance with energy efficiency requirements, i.e. maximum EEI for the different product categories;
- Compliance with material efficiency requirements
    - spare part availability/delivery time,
    - disassembly of key-components,
    - access to repair and maintenance information;
- Compliance of those products that were potentially excluded due to loopholes.

The evaluation should therefore assess these sub-indicators.