

Vacuum cleaners: Recommendations for policy design

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Summary

The regulations on Ecodesign and Energy Labelling for vacuum cleaners have been published in July 2013. Two different tiers of the regulation have banned vacuum cleaners with a power higher than 1600 watts and 900 watts in 2014 and 2017, respectively. They have led to considerable energy savings and have therefore been very welcomed. However, as highly improved technologies already exist on the market, a revision is much needed.

Topten's key policy recommendations are:

1. Topten is in favor of a **further power cap** of 600 watts for the upcoming review of the regulation.
2. The **formula** for the calculation of the **annual energy consumption** should be revised and include only parameters necessary for calculating the energy consumption.
3. **Testing measures** should be conducted at a **partly loaded** state. To enable the motor-life time test, which already requires testing with a partly loaded receptacle, "partly" should be defined in more detail.
4. The **scope** of the current regulation should be widened and include especially robot and battery-operated vacuum cleaners. If possible industrial, outdoor, central and wet vacuum cleaners should also be considered.
5. Labelling classes should be **rescaled from A to G** and sufficient classes should be left empty for technological development.

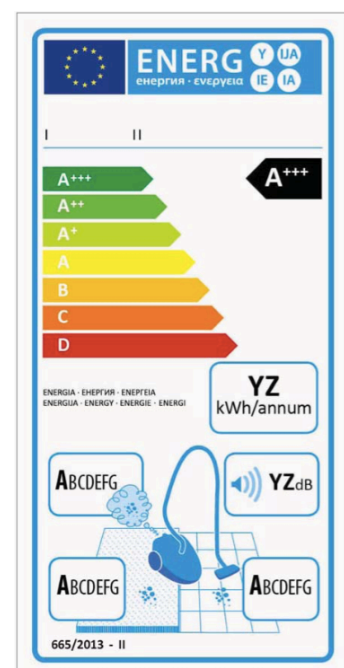
1. Vacuum cleaners: Ecodesign and Labelling regulation in force

In July 2013, the regulations on Energy Labelling and Ecodesign have been published in the Official Journal. Regulations cover both household and commercial, but not industrial, outdoor, central, wet, wet and dry, robot or battery-operated vacuum cleaners. 'Hybrid' vacuum cleaners that can be operated by electric mains or batteries are covered. Handhelds are not covered.

The introduction of an Energy Label and of Ecodesign requirements, especially of a power cap, have been very welcomed and led to successful technological improvements. Due to these improvements, a review of the current Ecodesign and Energy Labelling directive is needed.

The Energy Label's main information is based on the annual energy consumption (kWh/a). As shown in the table below, tier 2 has led to considerable changes. Since 1st September 2017, energy classes go from A+++ to D, allowing a maximum energy consumption of 43 kWh/year.

Today's best available technologies (also shown on www.topten.eu) reach the energy class A+ with a maximum energy



(Figure 1: Energy label, source: Energy Labelling Directive, 2013)

consumption of 22 kWh/year. As the best energy classes A++ and A+++ are not yet reached by any models, there is still room for improvement.

Energy efficiency	Max. kWh/year		
A+++	10	Shown on the Label for all models from 2017	
A++	16		
A+	22		BAT (Topten)
A	28		
B	34		
C	40		
D	46	Phase out 2017 (across class D)	
E	52		
F	58		
G	> 58		

(Table 1: Energy classes according to the Ecodesign and Energy labelling directive in force, source: Energy Labelling Directive, 2013)

As mentioned above, the Energy Label informs about the energy that a specific vacuum cleaner model consumes per year (kWh/a). The annual energy consumption AE is calculated as follows:

<p>$AE = 4 \cdot 87 \cdot 50 \cdot 0.001 \cdot ASE \cdot ((1 - 0.2) / (dpu - 0.2))$, where</p> <ul style="list-style-type: none"> - ASE is the specific energy consumption in Wh/m² that has been measured in the test - dpu is the dust pickup that has been measured in the test - 50 is the standard number of one-hour cleaning per year - 87 (m²) is the standard dwelling surface to be cleaned - 4 is the standard number of times that a vacuum cleaner passes over each point on the floor (two double strokes) - 0.001 is the conversion factor from Wh to kWh - 1 is the standard dust pick-up - 0.20 is the standard difference between dust pick-up after five and after two double strokes

(Table 2: Formula measuring the annual energy consumption (kWh/a) of vacuum cleaners, source: Energy Labelling Directive, 2013)

Unfortunately, the formula is not straightforward as it is not a real consumption formula. With the dpu (dust pickup, actual performance) in the denominator a parameter measuring the performance instead of the energy consumption is included. Hence, the formula assumes that a vacuum cleaner is used longer if its cleaning performance is lower, and will therefore have a higher energy consumption. It is however very unclear if people do really adjust their cleaning habits to the performance of the vacuum cleaner. In addition, the performance of the vacuum cleaner can be strongly influenced by the carpet type and the cleaning head that is used. All information related to the performance should therefore only be included in the testing of the dust removal. The energy efficiency formula should however be kept as simple as possible.

Ecodesign requirements

The Ecodesign regulation for vacuum cleaners No. 666/2013 applies since September 2014.

	Tier 1	Tier 2
	1 Sep 2014	1 Sep 2017
Max. annual energy consumption	62 kWh/year	43 kWh/year
Max. power	1600 W	900 W
Min. dust pickup on carpet	0.70	0.75
Min. dust pickup on hard floor	0.95	0.98
Max. dust re-emission (0.4-10 µm)	-	1%
Max. sound power level		80 dB(A)
Durability		40'000 hose oscillations; 500 hours operational motor lifetime

(Table 3: Ecodesign requirements according to tier 1 and tier 2, source: Ecodesign Directive, 2013)

Most requirements are not on the class thresholds, but cut through classes. One of the most effective (and at the same time simple) requirements from Topten's point of view is the power cap, which has limited the rated input power to a maximum of 1600 watts since 2014 and 900 watts since 2017. To continue the successful developments in the past Topten demands to further limit the input power of vacuum cleaners to 600 watts in the future.

Measurement standard

The current dust pickup measurements based on EN 60312-1:2017 are performed with new, empty receptacles. The performance of most vacuum cleaners however quickly declines with the receptacle becoming filled. Because in daily life the vacuum cleaner is virtually never empty, a measurement with partly filled receptacle would better reflect real-life usage conditions. Furthermore, the current empty dust pickup creates a bias between bagged and bagless vacuum cleaners, because the performance of the latter declines less with increasing dust filling.

The filling of the receptacle is also a critical issue for the durability test of the motor. For the motor life time test, testing with a loaded receptacle is required. However, as the European Commission has not defined the meaning of "loaded" in more detail (e.g. partly filled with a fixed amount, percentage etc.), measurements are still done with an empty receptacle (which goes against the regulation). In order to ensure technology neutral and real-life testing, Topten demands a clear definition of a "partly" loaded receptacle for the motor life time test.

To sum up, the revision of the current directive should:

- require testing the energy efficiency of a vacuum cleaner with a loaded receptacle.
- define "partly" loaded to enable the durability testing of the motor with a loaded receptacle, as it is already demanded in the current regulation.

2. Best available technology

Topten.eu shows the vacuum cleaners with lowest rated input power and good performance.

There are more than 60 vacuum cleaner models of different brands on topten.eu, all meeting the following selection criteria:

- Energy efficiency class A or better
- Cleaning performance class (carpet/hard floor): at least A/C, C/A or B/B
- Dust re-emission class A

The following table shows the five best models, according to Energy class and maximum input power, that are presented on topten.eu:

Brand	Miele	Kärcher	AEG	Miele	Miele
Model	Complete C3	VC 5	LX8-2-CR-A	Blizzard CX1	Compact C2
Type	With bag	Compact	Without bag	Without bag	With bag
Power (W)	550	500	500	550	550
Energy class	A+	A+	A+	A+	A+
Energy (kWh/y)	18.2	20	21.5	20	20.1
Cleaning class carpeted/ hard floor	C/A	C/A	B/A	C/A	B/A
Dust emission class	A	A	A	A	A
Noise level (db(A))	64	77	74	73	72

(Table 4: Most energy efficient vacuum cleaners, source: Topten.eu, last visit 30/09/2017.)

Tier 2 has led to considerable technological improvements and most of the best vacuum cleaners reach the power cap of 900 watts and the maximum annual energy consumption of 43 kWh, by far. As indicated in the table, at the moment, the best vacuum cleaner on Topten.eu has an annual energy consumption of only 20 kWh and a maximum input power of 500 watts. Continuous improvements are made and according to the information that Topten has, even better models will come on the market during the next months. To foster these positive technological developments, Topten asks for a further power cap of 600 watts in the future.

3. Topten policy recommendations

The implementation of the Ecodesign and Labelling regulations have reversed the trend to ever-higher power input in vacuum cleaners. Especially the **power cap is absolutely key**: As improved technologies exist and most vacuum cleaners are already well below the power cap of 900 watts, Topten recommends to further limit the power cap to 600 watts in the upcoming revision.

Next to this, the appropriateness of the calculation formula of the annual energy consumption should be checked in the next review process. Topten is **sceptical about the inclusion of the dust pickup into the calculation of the annual energy consumption**, because it is not related but complicates the declaration and compliance verification activities. The measurement of the dust pickup is complicated and the result can be strongly influenced by the carpet type and the cleaning head that is used. Topten therefore recommends using this value with caution.

Furthermore, the **dust pickup** should be established under conditions close to real-life usage. The most important point is that the measurement is not performed with an empty, but a **partly loaded receptacle**. The performance of most vacuum cleaners declines rapidly with dust load, and an empty vacuum cleaner does not reflect real usage conditions. It is furthermore key, that “partly” (e.g. half loaded, loaded with a certain amount or to a certain percentage of bag volume) loaded is clearly defined such that test methods can be developed and the motor life-time test can be performed with a partly loaded bag as required in the regulation.

In addition, the current Ecodesign and Labelling regulation does not include certain **types of vacuum cleaners** such as **robot or battery-operated** vacuum cleaners. As households

increasingly use those types of vacuum cleaners, it is highly recommended to broaden the scope of the current regulation and cover robot and battery-operated vacuum cleaners in the upcoming revision. In the future industrial, outdoor, central and wet vacuum cleaners should also be considered.

According to the revision of the Energy Labelling scheme, the labelling classes for vacuum cleaners should be **rescaled to A-G** in the upcoming revision, leaving the highest class empty for technological development.

5. References

- [COMMISSION DELEGATED REGULATION \(EU\) No 665/2013](#) of 3 May 2013 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of vacuum cleaners
- [COMMISSION REGULATION \(EU\) No 666/2013](#) of 8 July 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for vacuum cleaners
- [Website of Blue Angel on vacuum cleaners](#)
- [Website of Coolproducts on vacuum cleaner](#)
- [Website of Topten. Best products of Europe. Vacuum cleaners \(with bag\)](#)