The application of extended product approach (EPA) in ecodesign measures – a case study on water pumps

Larisa Maya Altamira
Viegand & Maagoe
Nr. Farimagsgade 37
1364, Copenhagen K
Denmark
lmd@viegandmaagoe.dk

Ulrik Vølcker Andersen
Viegand & Maagoe
Nr. Farimagsgade 37
1364, Copenhagen K
Denmark
uva@viegandmaagoe.dk

Keywords

standardisation, energy saving technologies, system analysis, harmonisation, extended product approach, motor driven units

Abstract

The application of the Extended Product Approach (EPA) in energy efficiency measures for energy related products (ErP) has long been discussed as one of the methodological approaches that can maximize energy saving potentials for ErPs. However, the EPA has so far only been applied to very few products at regulatory level. This paper presents the results of a review study of the ecodesign requirements for water pumps used in buildings and industrial processes, which is one of the priority product groups in ecodesign measures. When using EPA at regulatory level it is important to define the scope, which in this case it was the 'pump unit', i.e. the pump and the electric motor (and a drive, which is optional). Thereafter, a methodology for testing and calculation of energy efficiency requirements for the pump units in the current regulation (i.e. clean water pumps) was developed. The yearly energy savings potential from applying this methodology to these pump units was calculated as 37–40 TWh by 2030, but the greatest challenge was to extend this methodology to other pump units not in the regulation (i.e. swimming pool pumps and wastewater pumps). This is because the calculation of the energy efficiency in the EPA methodology is based on flow-time profiles so far only standardised for clean water pumps. In order to define them, it is important to characterise the hydraulic behaviour of the pumps in the systems they operate, both at a constant or varying flow demand. So far until now there is not much common knowledge of system aspects for swimming pool and wastewater pumps at varying flow demand. Because of this lack of common knowledge, some assumptions were made for these pump units which resulted in small potential energy savings. More effort is thus needed in defining suitable usage strategies and quantifying system aspects for swimming pool and wastewater pumps, so that an energy efficiency methodology at EPA level can be developed which incentivizes the application of variable flow so more potential savings can be achieved.

Introduction

The approach where a product is regarded in several levels from a product level (e.g. a pump) to an extended product/system level (e.g. a pump in a water supply system) is called extended product and systems approach (Kemna, R. 2011). This is illustrated in Figure 1. When looking at the possibilities to increase the energy efficiency of a pump, the boundaries can be minimised even further looking only at a key component (e.g. the impeller[1]), or maximised looking at the whole water supply unit.

In any case, it is important to look at the application of the product when defining energy efficiency measures else it would be of no gain to increase the efficiency of the product but would negatively affect the function of the system and/or increase the energy consumption in another part of the system. However, it is complex to go beyond the product approach when defining and implementing energy efficiency policy measures. The

1. In China, regulation for clean water pumps considers only one individual component, the impeller of a pump.

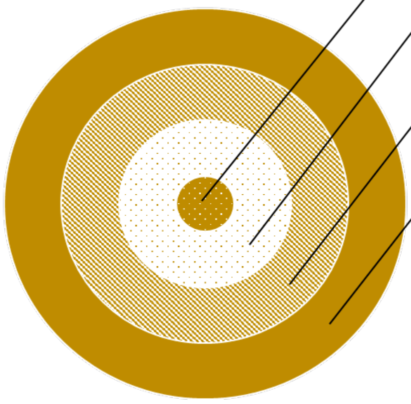

Figure 1. Example of a product and its levels from a product to a system approach (adapted from MEErP 2011 (Kemna, R. 2011)).

more products, sub-assemblies and components are covered under an energy efficiency regulation, the more difficult is to establish standards to harmonise the efficiency calculation as well as to enforce the regulation. For example, according to a later report by the International Energy Agency (International Energy Agency 2016), many countries find it easier to define and implement individual regulations for pumps, fans and compressors above 5 kW, while regulations for a motor driven unit (MDU)[2] offer the potential for greater energy savings. This same study estimated a global annual energy consumption of pumps, fans and compressors of 6,560 TWh, and according to the recent review study on water pumps (Viegand Maagøe and Van Holsteijn en Kemna B.V. 2016), the annual energy consumption of water pumps in the EU was 225 TWh in 2015.

Already in 2008, the preparatory study Lot 11 on water pumps (AEA Energy & Environment 2008) indicated that three out of the four key areas in which end-users should focus to reduce the energy consumption of a pump are related to how it is fitted to operate within the system. Lot 11 highlighted that optimal pump selection, pump sizing and operating pressures as well as ensuring adequate controls, can lead to energy savings of up to 34 %. This fits to the findings from the International Energy Agency (International Energy Agency 2016), which say that a MDU with energy efficient individual products matched together to meet the required task is able to deliver energy savings of 20 % to 30 % (referring mostly to fans, pumps and compressors).

In spite of the identified potential energy savings and the importance of the extended product approach, its application has been barely applied at a regulatory level. In the EU, this has only been implemented for glandless standalone circulators and circulators integrated in products.

According to the International Energy Agency (International Energy Agency 2016), one of the starting barriers for achieving larger energy savings for pumps, fans and compressors is the lack of harmonisation when using terminology and definitions for MDUs across regions. This brings difficulties when attempting to develop standards and regulations which are the fundament to quantify energy efficiency. The differences are mainly related to:

- Definition and Scope of MDUs – i.e. **Product definitions and Scope**
- The determination of energy efficiency for MDUs – i.e. **Metrics**
- The approach to bind the different components and products together in the extended product, incl. but not limited to the definition of default values and reference test values – i.e. **Methodology**

In this way, the role of international standards is very important for the harmonisation of these aspects. When international standards exist, a uniform criteria is implemented for trade and enforcement. However, these aspects cannot be applied the same way to some products due to different system considerations and thus there are limitations on the scope of the standards. Although ecodesign does not regulate systems, it is important to consider system characteristics when defining the product and the scope of a MDU (e.g. swimming pool pumps and wastewater pumps). This will be discussed in more detail in the methodology section.

CASE STUDY

In the context of the application of the extended product approach (EPA) for MDUs, the review study of the Commission Regulation (EU) No 547/2012 defining ecodesign requirements for water pumps (Viegand Maagøe and Van Holsteijn en Kemna B.V. 2016) had, as one of the main goals, to try incorporating EPA in the ecodesign requirements. Currently, the ecodesign requirements are expressed as a 'Minimum Efficiency Index (MEI)', and it applies solely to the pump focusing on hydraulic efficiency at product level. Furthermore, another goal of this review study was to extend the scope to include other water pumps assessed in previous preparatory studies (BIO Deloitte and Atkins 2014) but which are not covered by Minimum Energy Performance Standards (MEPS) in the EU. It was thus also investigated whether EPA could be applicable to the water pumps in the extended scope. In order to focus the effort of investigating the energy savings potential at EPA level, the scope was, during the course of the review study, narrowed down to clean water pumps, swimming pool pumps and wastewater pumps.

The pumps under study were:

1. Clean water pumps, specifically:
   a. End suction pumps, used for water supply applications in residential and industrial buildings and in industrial processes, covering three product types: end suction own bearing (ESOB), end suction closed coupled (ESCC) and end suction closed coupled inline (ESCCi) pumps.
   b. Multistage pumps, used mainly for water supply applications in residential and industrial buildings, covering three product types: vertical multistage (MS-V), horizontal multistage (MS-H) and submersible multistage (MSS) pumps.

2. A motor driven unit (MDU) is an extended product that converts electrical power into rotational mechanical power and may consist of the following individual components: variable speed drive, electric motor, mechanical equipment (gear, belt, clutch, brake, throttle) and a driven application (pump, fan, compressor, transport).

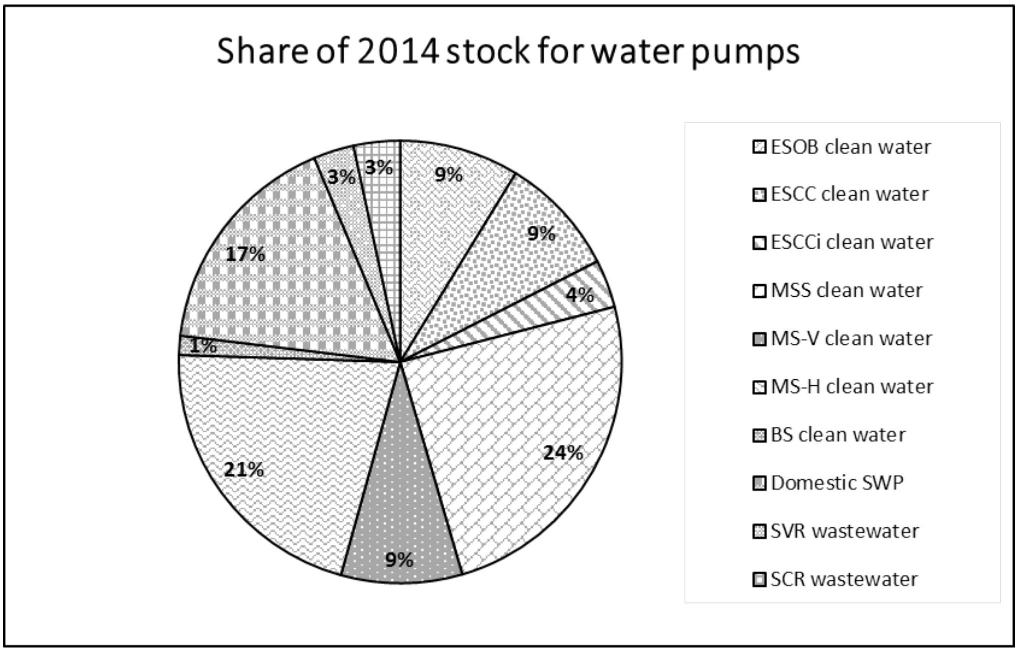

Figure 2. Share of installed base stock for water pumps in scope of review study (2014 figures).

c. Booster-sets (BS), mainly sold as extended product and used for water supply applications in residential buildings (mainly apartment buildings).

2. Domestic swimming pool pumps (SWP) which are small pump units comprising of a motor, pump and controls sold as extended product and used in small swimming pools where the pumps can operate with maximum rated power that can be drawn from domestic mains outlet.

3. Wastewater pumps, specifically:

   d. Centrifugal submersible radial vortex (SVR) pumps used for municipal and industrial wastewater transport and treatment.

   e. Centrifugal submersible channel radial (SCR) pumps used for municipal and industrial wastewater transport and treatment.

The installed base stock of these pumps in the EU was calculated as 26,8 million in 2014, and it is predicted to grow to 30 million pumps by 2020 and 34.3 million pumps by 2030. The share of each pump type based on the available sales data for 2014 is shown in Figure 2. Here it can be seen that clean water pumps represent about 75 % of the installed base stock, and from the rest, 17 % are domestic swimming pool pumps.

The purpose of this paper is to highlight the importance of applying the EPA to MDUs, using water pumps as case study. Furthermore, this paper also presents the challenges and opportunities on applying this methodology to water pumps not in current ecodesign regulation, and highlights the aspects where further work is needed in order to achieve higher energy savings when applying the EPA, compared to the savings presented herein.

Methodology

The methodology section is split into two parts. The first part describes how the EPA was tailored so it could be applicable to water pumps, particularly in relation to the aspects highlighted previously: (i) product definition and scope, and, (ii) methodology and metrics. These concepts form the EPA methodology. The second part describes the challenges and opportunities encountered during the review study to apply the EPA.

PART 1: DEVELOPMENT OF EPA METHODOLOGY FOR WATER PUMPS

Product definition and scope

An extended product (e.g. a MDU) is a product that goes beyond the product itself and the boundaries are set so additional components or products are covered which have a direct and/or indirect influence on the product's electricity consumption.

A MDU consists of four individual products or components: (i) variable speed drives (VSD), if available, (ii) electric motor, (iii) mechanical components (e.g. gears, belts, breaks and clutches), if necessary, and (iv) the pump, fan or compressor. See Figure 3 for a schematic representation of a MDU driven by a pump (i.e. a pump unit). The mechanical components are not indicated in the figure but can be added if required to improve the hydraulic performance of a MDU. Both the electric motor and the pump, fan or compressor are always part of a MDU, whilst the VSD and the mechanical equipment are optional.

In the case of rotodynamic pumps, an international standard[3] has been developed which defines the scope, methodology and metrics for qualifying and verifying water pump units (i.e.

3. prEN 17038-1 Pumps – Methods of qualification and verification of the Energy Efficiency Index for rotodynamic pumps units – Part 1: General requirements and procedures for testing and calculation of energy efficiency index (EEI) and prEN 17038-2 Pumps – Methods of qualification and verification of the Energy Efficiency Index for rotodynamic pump units – Part 2: Testing and calculation of Energy Efficiency Index (EEI).

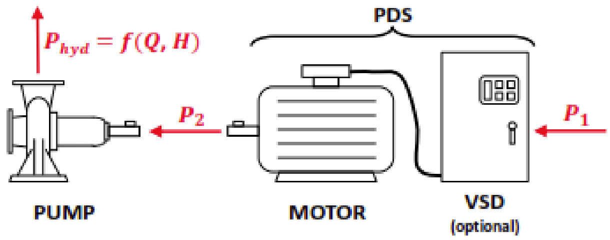

Figure 3. Schematic representation of a MDU, which is a pump unit in this figure (Europump 2014).

an example of a MDU) to be compared through a single energy efficiency indicator.

The pump unit consists of one or several pumps and one or several electric motors. The parts of the pump units can be placed on the market separately and later assembled into a pump unit or as a single product. When placed on the market as a single unit they are either placed:

- With a terminal box which only enables to operate the pump unit at constant motor stator frequency and thereby (nearly) constant rotational speed, or,
- With a variable speed drive (VSD), that enables to operate the pump unit at variable rotational speed depending on a varying demand of flow rate and/or discharge or differential pressure.

P_1 represents the electrical power into the pump unit, P_2 the shaft power transmitted from the shaft to the impeller of the pump, and P_{hyd} is the hydraulic power (which is a function of flow and head) that has until now been the focus for measuring energy efficiency of water pumps, as it includes the internal losses of the pump. However, the electric power input P_1 covers the shaft power P_2, and additionally the internal power losses of the electric motor. The PDS is the power drive system which is basically what delivers the shaft power (P_2) into the pump. When the pump unit operates at constant rotational speed, the PDS is basically only the terminal box containing the electric motor.

Methodology and metrics

To apply the EPA, the metric for evaluating the energy efficiency performance is the Energy Efficiency Index (EEI). The EEI is defined so that it considers the energy use of the pump unit under normal load conditions rather than at nominal load, which is divided by a reference power:

$$EEI = \frac{P_{1,avg}}{P_{1,ref}}$$

The methodology for calculating the EEI values are described in detail in the draft for the standard[3].

Water pumps are treated differently depending on the application. Some pumps are used in applications where the flowrate is always close to maximum flow rate (constant flow application) and some pumps are used in applications where the flowrate is varying with lower flowrates for most of the operation time (variable flow applications). The distinguishing between the two types of application is important when considering the usage of VSD. Using VSD can reduce the energy consumption of a pump significantly when it operates at low flowrates, but it has little impact at flowrates near nominal flow. For these reasons, there are two separate EEI values, one for constant flow applications and one for variable flow applications.

The difference between the two EEI definitions is the $P_{1,avg}$ which is the average power consumption under normal load conditions. The normal load conditions are described as a time-flow profile, which defines a number of flowrates and the share of time the pump is operating at each flowrate. For constant flow applications, the weighted average of the electric power input $P_{1,avg}$ is calculated by the sum of the electrical energy at three flow-time points (partial, nominal and over load).

For variable flow applications, this is calculated by, not only summing the electrical energy at the pre-defined flow-time points, but by adjusting the actual pressure values to the reference pressure control curve values. Furthermore, the flow-time points are four (25 %, 50 %, 75 % and 100 %) considering there is no overload.

PART 2: APPLICATION OF EPA METHODOLOGY TO WATER PUMPS

The definitions, scope, methodology and metrics presented in Part 1 were used during the review study of eco-design requirements for water pumps (i.e. the case study). Their application was a test of the newly developed standards[3], since they were developed before and in parallel to the review study. Regular communication with the stakeholders that were part of the working group (TC 197 W1) was essential to get input on the concepts and for providing them input back on their application.

Because of technical differences, the application of the concepts in the standard could not be done the same way for the three pump unit groups in scope. Clean water pump units were used as starting point: end suction first (ESOB, ESCC and ESCCi), and multistage after (MS-V, MS-H, MSS and BS). Swimming pool pump units (SWP) and wastewater pump units (SVR and SCR) were not used to test the EPA methodology because of fundamental technical differences which are discussed later in this section. The challenges and opportunities found on applying the developed EPA methodology separately to the different pump unit types are presented in the sections below.

Factors were identified that affect the pump units' energy efficiency and that are related to how the pumps operate in the system they are used. In particular, factors that can be controlled by the user at an extended product level (i.e. pump unit = pump + motor (+ VSD)). Some of these factors are relevant for all of the pumps and others are only relevant to certain types. Overall, the factors are:

- Differences in pump's operating load characteristics to what they have originally been designed for.
- Wear of pump's components, in particular the impeller, bearings and seals.
- Correct selection of pump according to system characteristics: i.e. size, duty point, flow rate and pressure and type of fluid they are meant to pump.
- Operation time: Meaning how many hours/day and days/year the pump is meant to operate (i.e. the product service lifetime).

- Control method: Meaning the type of system applied to control the pump flow and/or pressure. This can be throttling, bypassing or a simple on/off timer to pump constant flow, or a VSD that adjusts the flow.

Differences in pump's operating load characteristics

The typical efficiency of rotodynamic pumps as installed is usually different to the nominal or catalogue's efficiency at the pumps' best efficiency point (BEP). Designers will specify slightly more flow or head of a pump to what originally calculated allowing for any operational difference in system characteristics from what is planned. This means that the average pump will work in a lower efficiency to what is specified as BEP, and hence below its nominal rated efficiency. However, the EPA methodology corrects for this difference by incorporating the actual part-load, Best Efficiency Point (BEP) and overload of the pump units in the calculation method, as described in part 1 of this section.

Wear of pump's components

The energy efficiency of pumps is not constant over its lifetime. Usually the energy efficiency is reduced as the pump wears down. Proper maintenance can keep the pump running at higher efficiency at longer periods, but the pump will in any case be worn down eventually.

The other factors were assessed individually for each pump unit type since they affect differently their efficiencies. The findings from these assessments are presented in the results and discussion section.

Results and discussion

APPLICATION OF EPA METHODOLOGY TO THE DIFFERENT PUMP UNIT TYPES

Potential energy savings of clean water pumps applying EPA

For variable flow applications, maximum EEI values were proposed considering that significant energy savings can be only achieved by using VSD. For this reason, the strategy was to set the requirements ensuring that VSD are required for complying with the requirements.

The proposed EEI limits are shown in Table 1, and it is expected that these limits will result in 20–40 % of the pumps currently on the market being phased out. These are primarily pumps in constant flow applications, so only pumps with VSD will be allowed. 5 % worst performing pumps with VSD will be also phased out.

Since booster-sets are not comparable to other pump categories, it was not possible to calculate any meaningful EEI-values. Even though booster-sets are by default designed to operate best with at least one VSD, the EPA methodology cannot be applied directly since the flow-time profile differs to that of the other clean water pumps. This is because these pump units are designed to operate at many more partial loads. Because the flow-time profile is different, a separate calculation method for $P_{1,avg}$ needs to be developed. However, since these pump units best operate with VSDs and the flow-time profile has already been characterised, it is possible to set ecodesign requirements now considering the phase out of booster-sets without VSD in the future. When a separate calculation method for $P_{1,avg}$ is ready, it will be possible to apply the already developed EPA methodology for multi-stage clean water pumps and also define an EEI limit that will ensure that only booster-sets with VSD can comply with the regulation.

Potential energy savings of swimming pool pumps and wastewater pumps applying EPA

Swimming pool pump units are currently operated at constant flow in the EU. This is because of hygienic requirements, where the pump unit needs to keep a minimum turnover rate for the filtration system of the swimming pool. Else, the water quality is affected and this cannot be compensated by adding more chlorine and/or other chemicals (i.e the so-called sanitation system) because of restrictions of the use of chemicals in the EU. This crucial interaction between the filtration and the sanitation system is different in other parts of the world (e.g. Australia and USA), according to claims from stakeholders. In these places, the turnover rate by the pump unit is longer, which is compensated by the addition of more chemicals. Thus more work is done by the sanitation system than the by the filtration system. Because of these limitations, limited energy efficiency policy measures were defined under a EPA for these pump units. The fact that swimming pool pumps are built similarly to end-suction clear water pumps, allowed to set EEI levels based on those set for clean water pumps. However, it was considered that swimming pool pumps need additional considerations (e.g. clogging cycle of the filter, use of chemicals, backwashing process) beyond the pump unit in order to increase their use of VSDs and thus switching to a higher degree of variable flow applications. So the EEI levels set for swimming pool pumps were much less ambitious than those set for end-suction clean water pumps. By setting these levels it is expected that about 25% of the worst performing swimming pool pumps in the EU market in terms of energy efficiency are removed by 2030.

A similar case it is observed for submersible centrifugal wastewater pumps where no potential energy savings were identified from switching more wastewater pump units to variable flow applications. To achieve this, it is necessary that additional considerations beyond the pump unit are observed which can incentivise the use of VSDs and consequently switch to more variable flow applications. These considerations were mostly identified around the potential risk for clogging at the impeller of the pump, when the wastewater presents either high

Table 1. Proposed EEI limits for clean water pumps.

Application	ESOB, ESCC and ESCCi	MS-V up to 25 bar	MS-V 25 to 40 bar	MS-H up to 25 bar	MS-H 25 to 40 bar	MSS
Variable flow	0.62	0.52	0.51	0.65	0.63	0.68
Constant flow	0.988	0.98	0.94	1.19	1.06	1.14

concentrations of suspended solids and/or suspended solids of great sizes (e.g. clothes, bottles, household objects). However, some technologies exist where impellers have self-cleaning characteristics and/or processes at different flow speeds which allow the pump units to operate at lower speeds/flows. These are, though, not widely applied yet in the EU, and thus the share of variable flow applications is still very limited. It was found that many wastewater treatment facilities operators are still doubtful about the effectiveness of these solutions as it seems to be a conservative market[4]. The potential energy savings measures identified were solely based in improving the hydraulic efficiency of the pumps, which is not EPA based. This was done because there is no existing calculation methodology of $P_{1,avg}$ for these pumps. Furthermore, as long as it is not possible to define the flow and quality of the wastewater to be used for testing that is close to real life, the differences in efficiency may be too big so the actual savings will differ to what calculated during testing. Due to the difficulties on characterizing wastewater quantitatively a more simplified characterisation approach must be developed for wastewater pumps applications. This will allow the definition of a flow-time profile which is suitable for operating the different types of wastewater.

Table 2 shows a summary of the main findings concerning the most important aspects that affect energy consumption and efficiency at pump unit level and in some cases at system level.

OVERALL ENERGY SAVINGS POTENTIAL

The current energy consumption of all the pumps in the review study (i.e. the case study) was calculated as 225 TWh/a in 2015, based on the investigations of the market and data provided by industry. Of this, 166 TWh/a is from pumps currently in scope of the regulation (i.e. end-suction and some multi-stage clean water pumps), and 59 TWh/a is from pumps not covered by the regulation (i.e. some multi-stage clean water pumps, swimming pool pumps and wastewater pumps). If no action is taken, meaning that no changes take place in current regulation, the predicted total annual energy consumption will be 253 TWh/a in 2025 and 261 TWh/a in 2030.

The use of VSDs in variable flow applications is the major opportunity for energy savings. By assuming that implementing EEI requirements at EPA level will happen by increasing the use of VSDs, the potential energy savings were calculated as 27–31 TWh/a in 2025 and 43–48 TWh/a in 2030. The ranges are from implementing three policy measures (Eco 1, Eco 2 and Eco 3) from the least to the most ambitious.

For swimming pool pumps, rather unambitious EEI levels were defined (as explained previously), and for wastewater pumps, EEI levels could not be defined due to the lack of harmonised flow-time profiles. Furthermore, no agreement currently exists in the EU, concerning whether it is possible to use swimming pool pump units in variable flow. For wastewater pump units, the application of newer technologies is not yet realized and it is therefore generally thought that variable flow applications are and will be very limited for these pumps.[5]

An overview of the savings can be seen in Figure 4. Most of the savings came from applying EPA to pumps currently in the scope of the regulation (see Figure 4 and Figure 5), based on the premises that these pumps have the highest potential to shift to variable flow applications using VSDs and that a methodology for calculation EEIs already exists.

Conclusions and recommendations

The application of the EPA for the water pumps already in the existing ecodesign regulation is estimated to lead to energy savings of 37–40 TWh/a per 2030, which are substantially larger than what previously estimated for the existing regulation (i.e. 3,3 TWh/a). The larger energy savings are primarily from including the use of VSD. Since the VSD is not a part of a water pump itself, the approach of the existing regulation (product approach) can't accomplish these savings, but an extended product approach where the entire MDU (i.e. the pump unit) is considered in the energy efficiency evaluation. The metric for evaluating energy efficiency in an EPA is EEI. A methodology for calculating EEI for water pumps has been introduced.

An important difference between the EPA for water pumps and the EPA for other products (e.g. circulators), is that similar water pumps are used in a range of different applications (i.e. constant and variable flow applications). In order to integrate this when calculating the EEI, the requirements have been differentiated for water pumps for variable flow applications and pumps for constant flow applications.

The considerations for establishing EEI requirements for swimming pool and wastewater pumps are different to those for clean water pumps. The harmonisation of aspects related to product definition and scope is necessary before intending to develop the methodology and the metrics, since during this exercise one identifies the aspects at the system level that affect those at the extended product level regarding energy efficiency. During the review study it was attempted to apply the EPA methodology for clean water pumps to swimming pool pumps and to wastewater pumps but it was soon realized that the lack of harmonisation of scope and of flow-time profiles presented a barrier. The definition of flow-time profiles depends on system aspects (described in Table 2) which have been described throughout this paper, and these must be further investigated to adapt the existing EPA methodology. Finally, for defining these profiles it is necessary to counter balance the potential benefits of switching the pump units to a higher utilisation at variable flow with the negative effects (e.g. increased weight of the sanitation system of the swimming pool, potential clogging of the impellers of the wastewater pumps). A quantitative assessment is needed, which was not performed at this stage due to lack of data.

This paper also shows that it is necessary to perform an analysis of the system(s) where the extended product operates at, in order to identify the system aspects that affect the operation and the energy efficiency of the extended product. It is recommended to do this separately for each product group (e.g. for clean water pump units, swimming pool pump units and wastewater pump units separately), when defining energy efficiency metrics for energy related product under the EPA umbrella. This should be considered, since the application of EPA on energy efficiency policy measures may imply much

4. Personal communication from interviews to wastewater pump manufacturers and utilities at IFAT fair: http://www.ifat.de/trade-fair/visitors/.

5. Table 2, existing EPA methodology, multistage pumps: A separate sub-working groups within the CEN TC 197 Working Group 1 will be formed to develop a separate methodology.

Table 2. Overview of the results from assessing the implementation of EPA to water pumps in scope of the review study.

Water pump group	Operational time (hours/ year)	Share pumps with VSD	Share pumps in variable flow applications	Share pumps in constant flow applications	Existing EPA methodology	Pump unit characteristics affecting energy efficiency	System characteristics affecting energy efficiency
End suction pumps (ESOB, ESCC, ESCCi)	2,250–5,000	4–30 %	30–90 %	10–70 %	Yes	Use of VSD to regulate speed and flow in demand and thus reduce energy consumption	Not relevant
Multistage pumps (MSS, MS-V, MS-H)	2,250–5,000	1–35 %	20–50 %	50–80 %	Partially: not a complete calculation method for $P_{1,ref}$ for MS-V, no C-value for MS-H and no-existing method for MSS		Not relevant
Booster-sets (BS)	2,000	50 %	100 %	0 %	Partially: different flow-time profile	Often includes multiple pumps in one unit.	Defined primarily according to its application to control pressure in open loops inside buildings.
Swimming pool pumps (SWP)	1,540	2.9 %	0 %	100 %	No	In USA and Australia VSDs are more prevalent which help achieving large energy savings by regulating the flow rate of the pumps instead of simply using on/off control.	Swimming pools have 2 treatment systems: physical treatment (filtration & circulation) and sanitation treatment (chemicals). The relationship between the filtration and sanitation systems determines potential for energy savings,
Wastewater pumps (SVR, SCR)	1,000–2,000	5–20 %	5–20 %	80–95 %	No	End-users fear pumps will not cope well with peak flow rates and high contents of solids, thus the application of VSDs and variable flow is still limited in the EU.	There is a vital trade off with the ability to pass solids and resist clogging or ragging. The ability to resist wear is also crucial for wastewater pumps. End users traditionally accept this efficiency penalty as long as the pumps do not regularly block and fail.

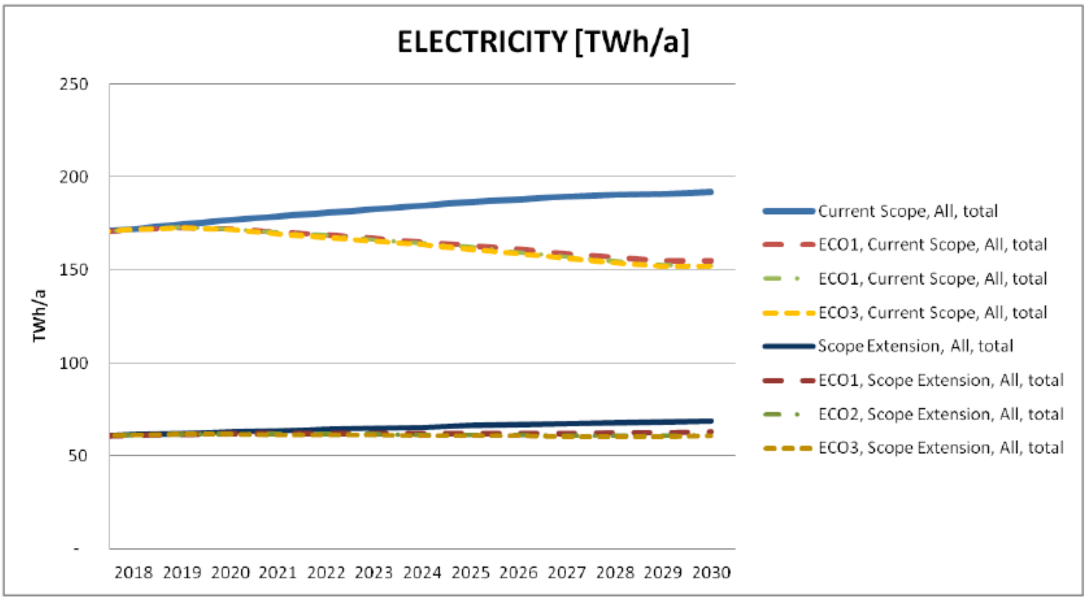

Figure 4. Electricity consumption of pumps in scope (blue lines) and potential reduction from the three energy savings policy options (ECO1, ECO2 and ECO3).

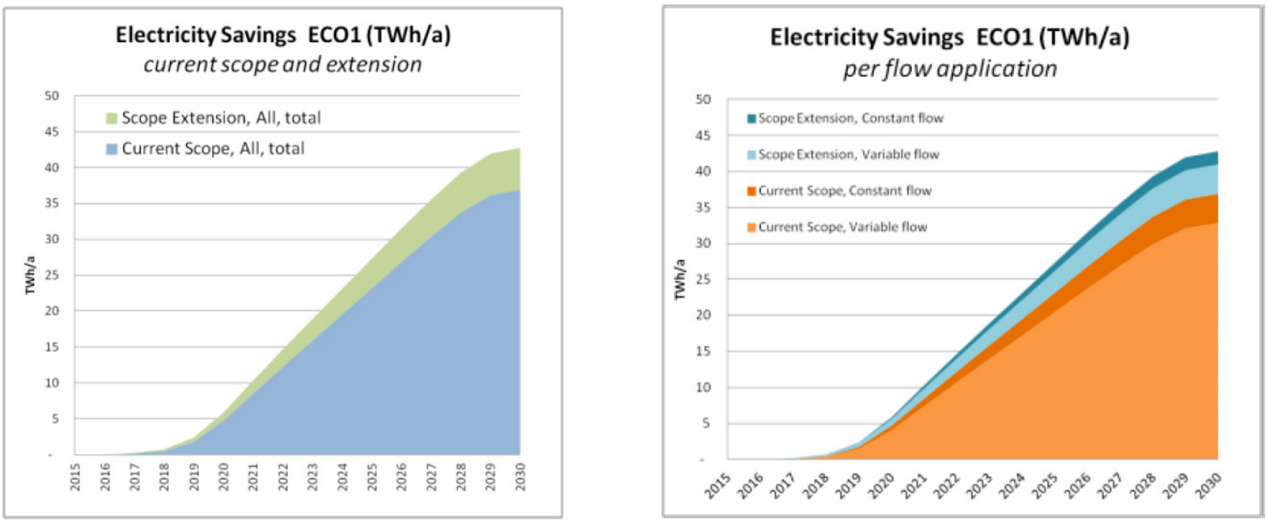

Figure 5. Energy savings potential from implementing the least ambitious policy measure (ECO 1) and from constant and variable flow applications under an EPA.

larger savings than those based on product approach, as this case study showed. Thus, it is worth to reassess the application of EPA for important product groups, such as MDUs. This case study showed that it is possible to apply ecodesign measures to extended products, as long as the scope definition is properly done. The definition of the scope brings light into the potential barriers and opportunities of regulating the extended product, and it is necessary to do so to evaluate whether it is realistic to harmonise scope and definitions for a certain extended product group, but also to foresee whether the potential energy savings are worth the effort of this harmonisation.

References

AEA Energy & Environment (2008) Lot 11 – Water Pumps (in commercial buildings, drinking water pumping, food industry, agriculture). ED Number 02287. Issue Number 6. AEA Energy & Environment. April 2008.

BIO Deloitte and Atkins (2014) Preparatory studies ENER Lot 28 – Pumps for Private and Public Wastewater and for Fluids with High Solids Content and ENER Lot 29 – Pumps for Private and Public Swimming Pools, Ponds, Fountains, and Aquariums (and clean water pumps larger than those regulated under ENER Lot 11). BIO Deloitte and Atkins. March and April 2014.

Europump (2014) EXTENDED PRODUCT APPROACH FOR PUMPS. A Europump Guide. 27 October 2014.

Kemna, R. (2011) Methodology for Ecodesign of Energy-related Products – MEErP 2011. Methodology report – Part 1: Methods. Brussels/Delft. 28 November 2011.

International Energy Agency (2016) Policy guidelines for motor driven units (MDUs). Part 1: Analysis of standards and regulations for pumps, fans and compressors. Energy efficient end-use equipment – International Energy Agency. October 2016.

Viegand Maagøe and Van Holsteijn en Kemna B.V. (2016) Ecodesign pump review. Study of Commission Regulation (EU) No. 547/2012 incorporating the preparatory studies on 'Lot 28' and 'Lot 29' (Pumps). Draft final report (to be published soon at: http://www.ecopumpreview.eu/documents.htm). Viegand Maagøe (VM) and Van Holsteijn en Kemna B.V. (VHK). July 2016.