# THE APPLICATION OF EXTENDED PRODUCT APPROACH (EPA) IN ECODESIGN MEASURES

## A CASE STUDY ON WATER PUMPS

# OUTLINE

1. Introduction
2. Methodology
3. Results and conclusions
4. Questions

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# INTRODUCTION

## ECODESIGN, EXTENDED PRODUCT APPROACH (EPA) AND CASE STUDY

# INTRODUCTION

**ECODESIGN**

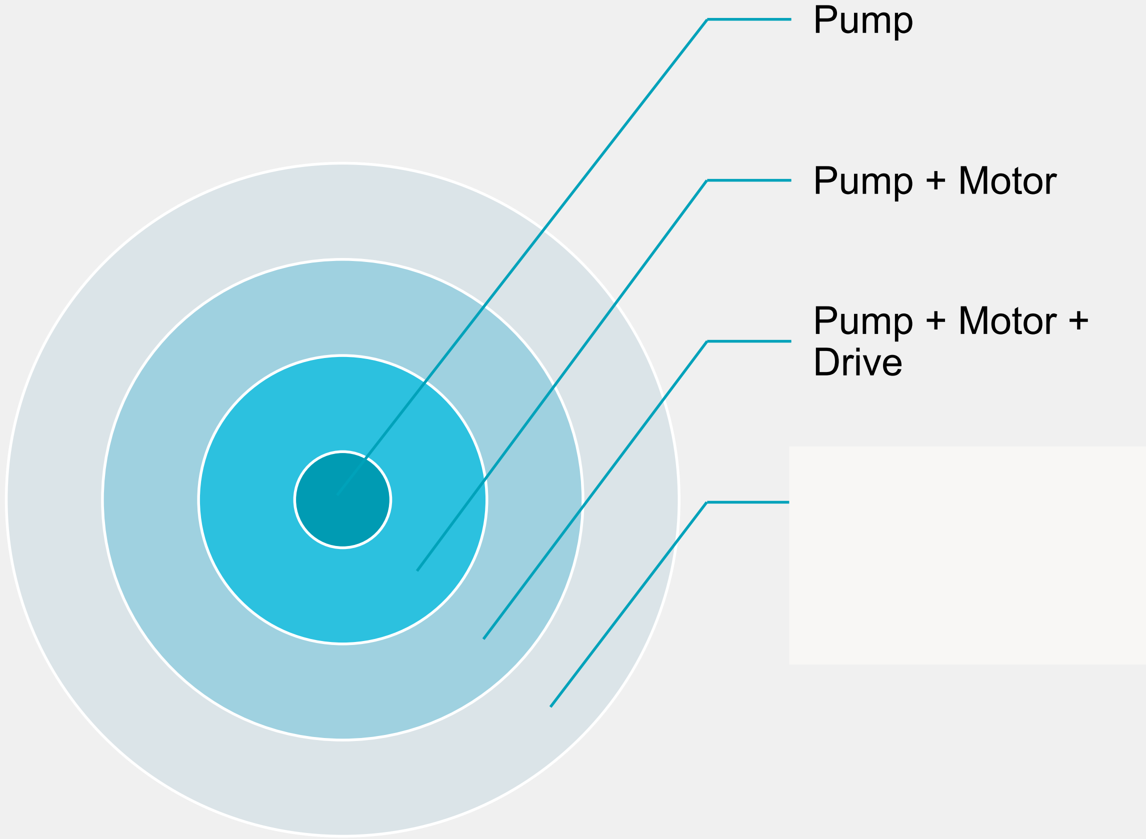
- Ecodesign: EU legislative framework functioning as tool for improving the energy (& non-energy) efficiency products

- Ecodesign removes worst performing products from the market by setting energy (& non-energy) requirements

- The requirements are set in product regulation: Commission Regulation (EU) 547/2012 is relevant for water pumps

# INTRODUCTION

## EXTENDED PRODUCT APPROACH (EPA) OF WATER PUMPS



# INTRODUCTION

## MOTOR SYSTEMS AND WATER PUMPS

- Motor systems: **47% global electricity consumption** (IEA, 2016)
- **Motor Driven Units (MDUs)** convert electrical power into rotational mechanical power
- An **optimised MDU with energy efficient individual components** matched together able to deliver important **energy savings** (IEA, 2016)
- IEA (2016): **governments** can **stimulate** development/adoption of **more energy efficient MDUs through MEPS**

- **Comission Ecodesign Regulation (EU) 547/2012** for water pumps is **under review**
- **2015 EU energy consumption: 225 TWh** (review study, 2016)
- **Potential annual energy savings EPA ~8 times + than** at **product level** (review study, 2016)
- **Key aspect: inclusion of the extended product in scope** (looked at in review study)
- **Other pumps not in current scope** have been assessed



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# AIMS OF CASE STUDY

**highlight** the **importance** of **applying EPA to MDUs**, using water pumps as case study

present the **challenges and opportunities** on **applying EPA** to water pumps

**highlight aspects** where **further work is needed** to achieve **larger energy savings** when applying EPA



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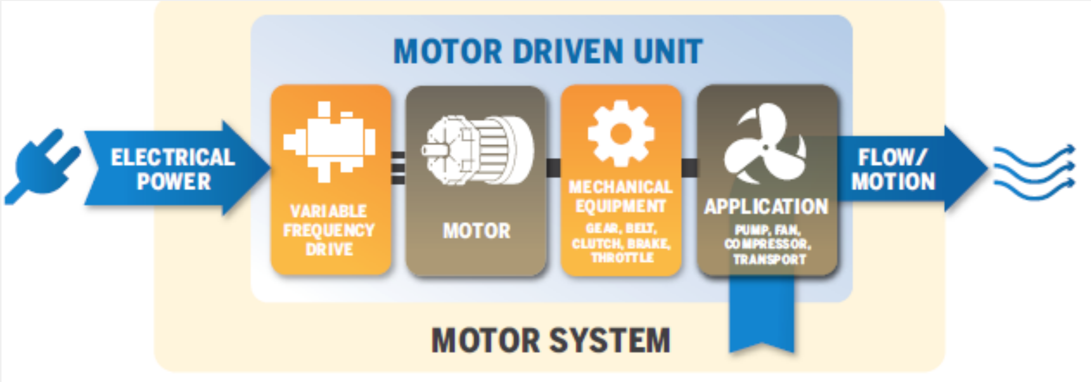
# METHODOLOGY

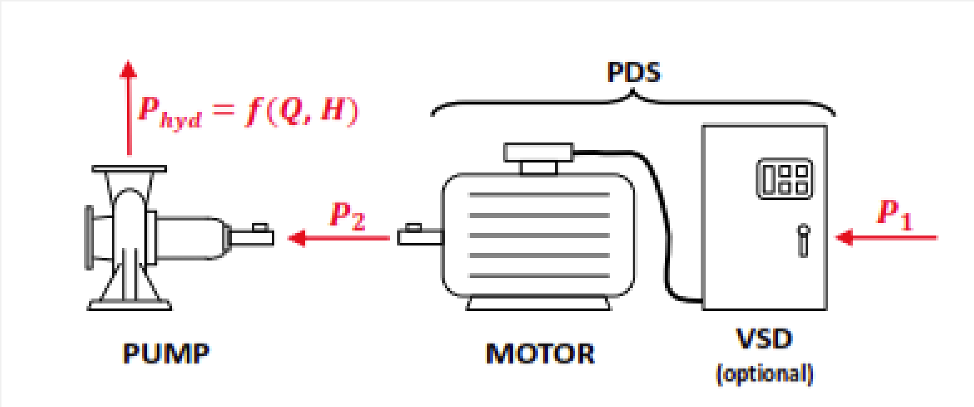
## PRODUCT SCOPE AND METRICS

# METHODOLOGY

## PRODUCT DEFINITION AND SCOPE




MDU




PUMP UNIT

# METRICS FOR EVALUATION OF ENERGY EFFICIENCY

## CONSIDERATIONS

- Must be a function of *energy consumption*
- Must consider energy consumption <u>as used</u> rather than at nominal load
- Water pumps deliver pressure that <u>exceed</u> the hydraulic requirements, when it operates at low flow rates
- This can be <u>avoided</u> with speed control – very important for part load energy consumption
- Variable Speed Drive (VSD) control the speed of the pump to reduce consumption in part load cases
- VSDs have internal losses

- **<u>Dilemma</u>**
- some water pumps operate near **constant** flow (*constant flow applications*)
- others have operate with large **variations** in flow rates (*variable flow applications*)
- In *constant* flow applications VSD is less useful and will in some cases increase energy consumption due to internal losses
- In *variable* flow applications VSD can significantly reduce energy consumption
- **The metric for energy efficiency have to reflect all situations**



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# METRICS FOR EVALUATION OF ENERGY EFFICIENCY

## ENERGY EFFICIENCY INDEX (EEI) AND REFERENCE POWER

- prEN 17038 defines the EEI for water pumps
- Based the regulation for circulators
- Usage of circulators are comparable with water pumps in variable flow applications, but not for other applications
- $P_{1,ref}$ is a reference power consumption
- Reference efficiency is defined in prEN 17038-2 for most clean water pump types

*- but not for submersible, waste water, and swimming pool pumps*

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

$$P_{1,ref} = \frac{P_{2,ref}}{\eta_{motor,ref}}$$

Efficiency class IE 3

$$P_{2,ref} = \frac{P_{hyd,ref}}{\eta_{PU,ref}}$$

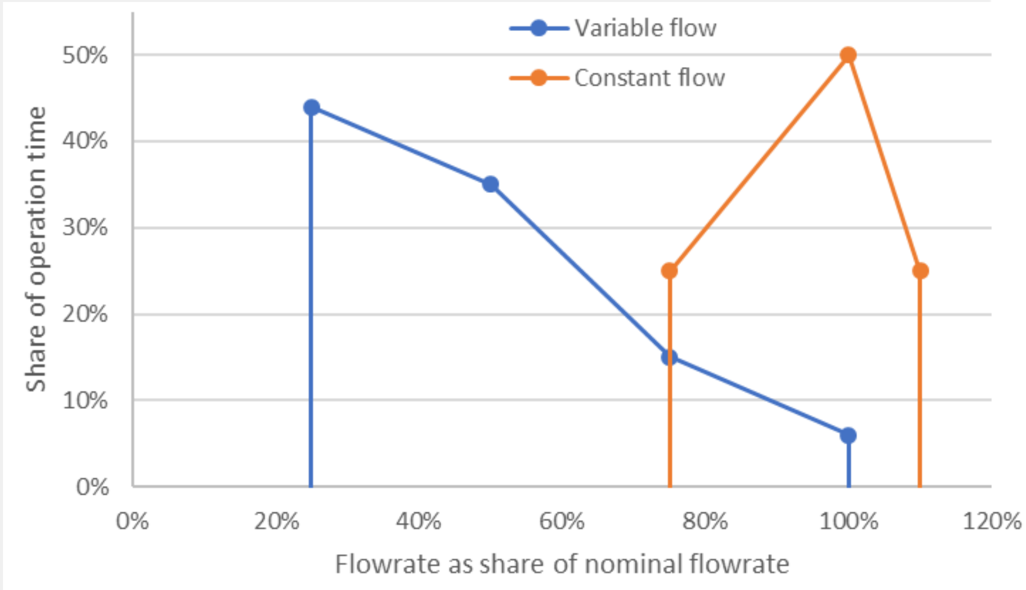
Nominal hydraulic power

Reference efficiency

# METRICS FOR EVALUATION OF ENERGY EFFICIENCY

## TIME-FLOW PROFILES AND AVERAGE ENERGY CONSUMPTION

- $P_{1,avg}$ is the weighted average of a number of predefined operation points, given with a *time-flow profile*
- The time-flow profile defines a number of flowrates and a time distribution
- For water pumps two time-flow profiles are defined, one for variable flow applications and one for constant flow application




$$P_{1,avg} = \sum_{i=1}^{i=N} \left( \frac{\Delta t_i}{100\%} \right) P_i$$

| Flow Q in % of Q100% | 25 | 50 | 75 | 100 |
|---|---|---|---|---|
| Time Δt in % of total operating time | 44 | 35 | 15 | 6 |

| Flow Q in % of Q100% | 75 | 100 | 110 |
|---|---|---|---|
| Time Δt in % of total operating time | 25 | 50 | 25 |

# RESULTS AND CONCLUSIONS

## APPLICATION OF EPA AND OVERALL ENERGY SAVINGS POTENTIAL

# APPLICATION OF EPA TO WATER PUMPS

## IDENTIFICATION OF IMPORTANT ASPECTS

| Pump type | Pump unit characteristics affecting energy consumption | System characteristics affecting pump unit's energy consumption |
|---|---|---|
| Clean water (end suction) | use VSD to regulate speed/flow in demand and reduce energy consumption | variable but measurable / harmonised |
| Clean water (multi-stage) | use VSD | variable but measurable / harmonised |
| Clean water (booster-sets) | use VSD<br>often includes multiple pumps in one pump unit | design customisation to control water pressure in open loops of buildings |
| Swimming pool pumps | may use VSD if possible to comply with hygienic level in the pool | physical treatment (filtration & circulation) and sanitation treatment (chemicals) - the relationship between these influences best practices for increasing energy savings |
| Wastewater pumps | peak flow rates and high contents of solids limiting the use of lower flow rates | end-users fear that lower flow rates can increase risk of clogging and thus don't see added value in using VSDs |



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# APPLICATION OF EPA TO WATER PUMPS

## BENEFITS FROM EPA – INCREASED USE OF VSD

- The potential energy savings, derives from increasing the use of VSD in variable flow applications
- There is a huge gap in the number of pumps with VSD and pumps in variable flow applications for clean water pumps
- The energy consumption can be reduced by 20-40% by using VSD in variable flow applications

| Water pump group | Share of pumps with VSD | Share pumps in variable flow applications | Share pumps in constant flow applications |
|---|---|---|---|
| Clean water end suction pumps | 4 – 30% | 30 – 90% | 10 – 70% |
| Clean water multistage pumps | 1 – 35% | 20 – 50% | 50 – 80% |
| Clean water booster-sets | 50% | 100% | 0% |
| Swimming pool pumps | 2.9% | 0% | 100% |
| Wastewater pumps | 5 – 20% | 5 – 20% | 80 – 95% |



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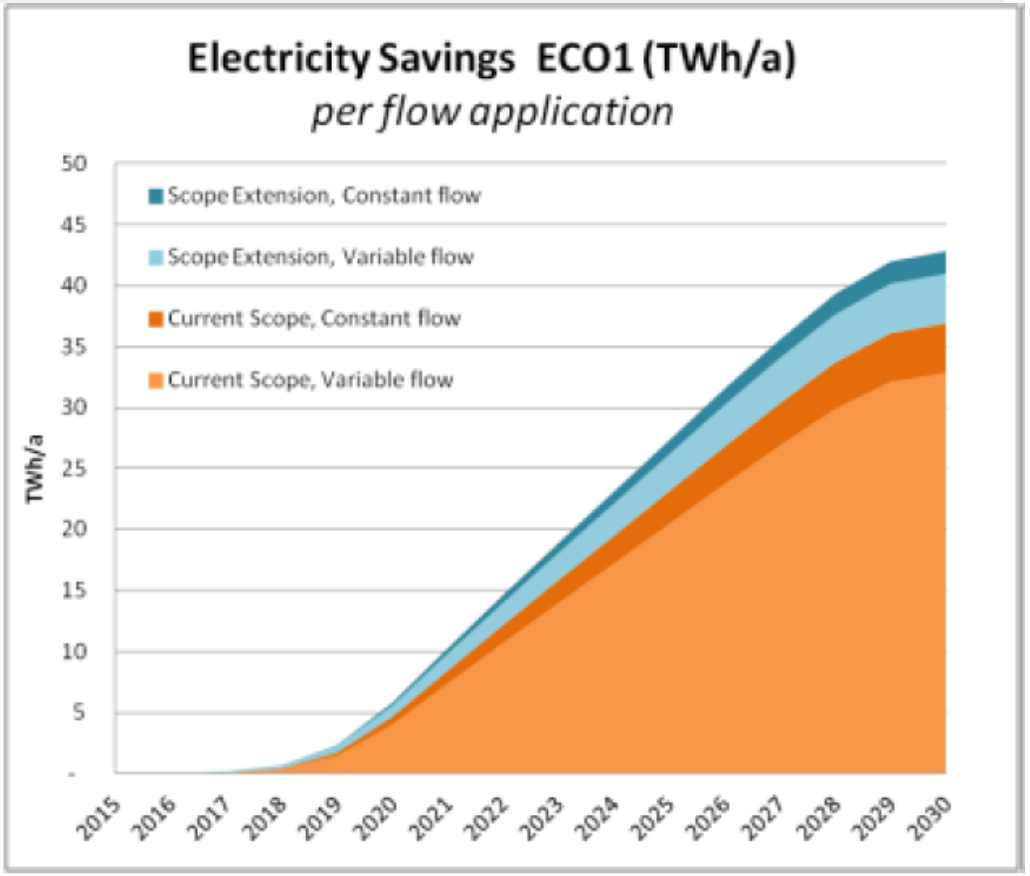
# RESULTS AND CONCLUSIONS

## APPLICATION OF EPA FOR ACHIEVING LARGER ENERGY SAVINGS

- Annual energy consumption for examined water pumps:
  - 225 TWh (2015)
  - 261 TWh (2030 projected, no action)
- Energy savings in 2030 (EPA)
  - 43 TWh (for all pumps)
  - 37 TWh (for variable flow pumps)
  - 6 TWh (for constant flow pumps)
  - 6 TWh from pumps not previous in scope (37 TWh from pumps already regulated)



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# CONCLUSIONS

**APPLICATION OF EPA FOR ACHIEVING LARGER ENERGY SAVINGS**

1. EPA is necessary for achieving the bulk of the energy savings
2. VSD is the key to lower energy consumption – this applies to other types of MDUs - compressors, fans etc.
3. The development of an industrial standard is necessary to create a suitable metric
4. Definition of categories and reference efficiencies takes time and requires a lot of cooperation with the industry – so far the metric is not in place for swimming pool pumps, waste water pumps, and submersible pumps
5. System aspect of MDUs are also very important for the energy consumption, and there is a huge potential for savings – but that is even more complicated to regulate

# QUESTIONS?

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