This project has received funding from the European Union's H2020 Coordination Support Action under Grant Agreement No. 894356.

Best Practice	MOTOR REPLACEMENT	PUMP-04
Application	Optimisation of Pumping Systems	
SME sector	Industrial	
SME Sub-sector	All	
Technical description	In many industrial sites, pumps are driven by old electric motors. The analysis of Topmotors, with more than 4,000 motors, revealed that 56% of these are already running almost twice if their life expectancy. This suggest there is barely any continuous improvement process for replacing old, mostly oversized, and inefficient motors systems. In total, less than 20% of all motors are equipped with Variable Speed Drive (VSD). Most of the motors that are equipped with a VSD is younger than 15 years. VFD would probably be suitable for up to 50% of all drives with huge efficiency potentials.	
Recommendation for optimisation	The effect of a lower frequency is extremely important in small motors. The performance of asynchronous machines drop-down since 50% of nominal speed is reached. Synchronous motors (PM in particular) are much more efficient in this respect. Although this effect is somewhat less pronounced with large motors, variable speed with low-speed working ranges is a valid reason to change existing motors for synchronous technology. Today, IE4 or IE5 motors can improve efficiency by 5% or more compared to older motors. In frequent low speed working situations, a synchronous motor will offer higher efficiency.	
Technical considerations	The average load factor is about 0.8 for pumps with constant flow. It is reduced to around 0.6 for pumps with variable flow but no frequency converter and about 0.4 for variable flows and frequency converter. The positive effect of a regulated system is obvious.	

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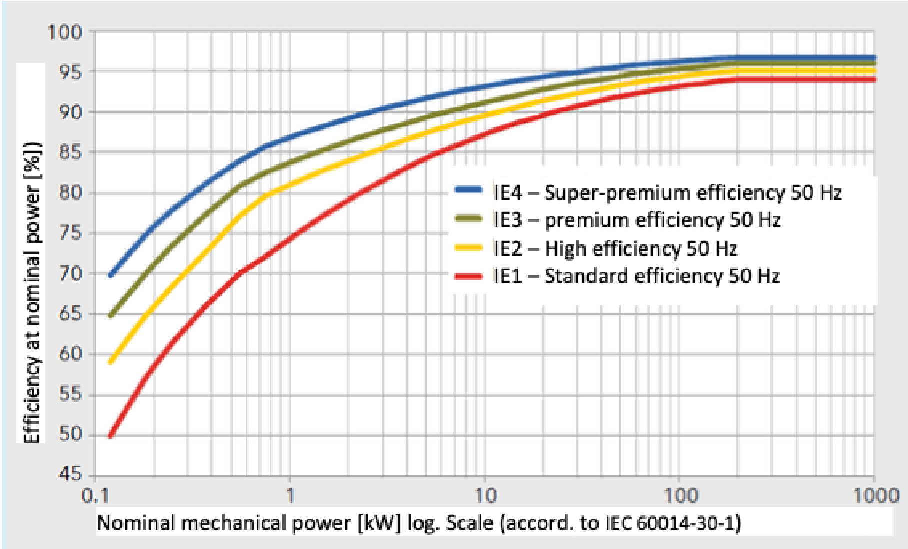
<table>
<tr><td>Schemes and diagrams</td><td>

Efficiency classes of motors according to IEC 60014-30-1</td></tr>
<tr><td>Economics</td><td>The average cost of replacing a pump motor varies between 180 and 1,300 EUR</td></tr>
<tr><td>Energy savings</td><td>Minimum yearly operating time (hours/year) for profitable anticipated motor replacement:
<table>
<tr><td></td><td>1.1 kW</td><td>11 kW</td><td>110 kW</td></tr>
<tr><td>Intervention</td><td colspan="3">Annual operating time for the convenience of the intervention</td></tr>
<tr><td>IE0 -> IE4</td><td>(+25% efficiency)
1500 hours</td><td>(+9.5% efficiency)
4000 hours</td><td>(+4.5% efficiency)
5500 hours</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>IE2 -> IE4</td><td>(+7% efficiency)
7000 hours</td><td>(+4.5% efficiency)
8700 hours</td><td>(+2% efficiency)
(Payback 6 years)</td></tr>
</table></td></tr>
<tr><td>Economic savings</td><td>Up to 25%</td></tr>
<tr><td>Average Payback Time</td><td>3-6 years</td></tr>
<tr><td>Emissions</td><td>This measure does not involve further emissions.</td></tr>
<tr><td>Environmental benefits</td><td>Reduced CO_2 emissions due to a reduction in electricity needs.</td></tr>
<tr><td>Main NEBs

(Multiple benefits)</td><td>☒ Environmental benefits
☐ Increased productivity
☐ Work environment/ Health/Safety
☐ Increased competitiveness
☐ Maintenance</td></tr>
</table>

Replicability	Medium In the context of pumping system optimizations, motor replacement is rarely the action that leads to the best savings.
Related measures	• PUMP-01: Reduction of running time for pumps - Switch off motors when not needed • PUMP-02: Adapt the offer to real needs • PUMP-03: Optimised control of pumps • PUMP-05: Coupling replacement • PUMP-06: Pump replacement
Case study	Addition of a frequency converter and new synchronous motors, pumping plant, pharmaceutical company (Switzerland, 2019) • Initial Situation: in a large industrial plant (Pharma), a group of 3 pumps circulates cooling tower water to users. 2 pumps operate, the third one is the back-up. The flow rate is constant. The problem is that the flow is throttled in a permanently semi-closed valve. This means unnecessary high pressure and pump operating in non-ideal efficiency zone. The associated losses are significant. • Description of the optimisation: considering that the pump efficiency is high in the operating area linked to the valve full open, we have chosen an optimisation measure based on the addition of a frequency converter and new synchronous motors. The efficiency of the pump stays optimal and the synchronous motor guaranty an excellent efficiency at reduced speed. • Implementation costs: 30,000 EUR • Payback Time: less than 2 years
References	New motortechnologies https://www.topmotors.ch/de Planair SA, 2014

This Best Practice was developed by the Impawatt Project (GA No. 785041) and adapted for the GEAR@SME Project (GA No. 894356)