Trainer Instructions: Pumps and Pumping Systems

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<table>
<tr><td>Title</td><td>PUMPS AND PUMPING SYSTEMS</td></tr>
<tr><td>Objective</td><td>To obtain an understanding of pumps and pumping systems, including the types of pumps, how to assess their performance and the main areas for energy conservation.</td></tr>
<tr><td>Minimum duration and approach</td><td>▪ 1.5 session (2 hours), including the quiz and workshop exercise
▪ Recommended approach: spend about an hour on the PowerPoint presentation. Depending on time left, either go through the quiz as a group (10 minutes), or ask each participant to do the quiz on their own and discuss the answers as a group (20 minutes). The workshop exercise takes 20 minutes to complete and 10 minutes to discuss. This will most likely need to be done in a separate session. In the agenda, the workshop exercise for pumps is combined with the workshop exercise for fans in one session.
▪ Presentation: 40 slides
▪ Textbook chapter: 19 pages</td></tr>
<tr><td>Contents</td><td>▪ Introduction
▪ Types of pumps
▪ Assessment of pumps
▪ Energy efficiency opportunities</td></tr>
<tr><td>Assessment of participants</td><td>▪ Pose questions during the presentation. Some suggested questions are included in the trainer notes underneath each slide.
▪ Take the quiz with 10 multiple choice questions.
▪ Carry out the workshop exercise. Participants can be asked the following:

In a large paper plant the design and measured operating parameters for a clear water pump are the following:

<table>
<tr><th>Parameter</th><th>Design</th><th>Operating</th></tr>
<tr><td>Flow Q (m3/hr)</td><td>800</td><td>550</td></tr>
<tr><td>Head H (m WC)</td><td>55</td><td>24</td></tr>
<tr><td>Power P (kW)</td><td>160</td><td>124</td></tr>
<tr><td>RPM</td><td>1485</td><td>1485</td></tr>
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The required water flow rate varies from 500 m³/h to 700 m³/h. For this reason, the pump flow rate has been reduced by partially closing the delivery valve. Motor efficiency is 93%.</td></tr>
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	Calculate the following: 1. *Calculate the operating efficiency.* 2. *Explain what would be the best option to obtain the required flow rate variation.* 3. *Calculate the power savings if the options suggested under question 2 would reduce the flow rate of the pump is 550 m³/h.* If participants have difficulties completing the exercise, or if time is limited, give them the formulae to be used in the calculations: - *Efficiency of the pump = Q x H x g* *According to affinity laws:* - *Relationship flow rate Q and RPM: $Q_1/Q_2 = N_1/N_2$* - *Relationship head H and RPM: $H_1/H_2 = (N_1/N_2)^2$* - *Relationship power P and RPM: $P_1/P_2 = (N_1/N_2)^3$*
Other comments	▪ Case study options from www.energyefficiencyasia.org or other sources could be included in this session as illustrations of how other companies reduce energy consumption and costs. ▪ Fans use motors. Therefore it is recommended to place this session on the agenda after the session on electric motors. ▪ In the agenda, one session is allocated for completing the workshop exercise for fans and blowers and for pumps and pumping systems.