

Trainer Instructions: Boilers and Thermic Fluid Heaters

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Title	BOILERS AND THERMIC FLUID HEATERS
Objective	To obtain an understanding of boilers and thermic fluid heaters, including types of boilers, how to assess their performance and the main areas for energy conservation.
Minimum duration and approach	<ul style="list-style-type: none"> ▪ 1.5 sessions (2 hours), including the quiz and workshop exercise ▪ Recommended approach: spend 1 session (1.5 hours) on the PowerPoint presentation. It is unlikely that much time is left at the end of this session, therefore it is recommended to go through the quiz as a group (10 minutes). Participants should spend 30 minutes on completing the workshop exercise and it takes about 15 minutes to go through the solution. In the agenda the workshop exercise for fuels and combustion is placed in the same session as the boilers workshop exercise. ▪ Presentation: 54 slides ▪ Textbook chapter: 42 pages
Contents	<ul style="list-style-type: none"> ▪ Introduction ▪ Types of boilers ▪ Assessment of boiler ▪ Energy efficiency opportunities
Assessment of participants	<ul style="list-style-type: none"> ▪ Pose questions during the presentation. Some suggested questions are included in the trainer notes underneath each slide, for example “What type of boilers do you know” should be asked before the types of boilers are explained. ▪ Take the quiz with 10 multiple choice questions. ▪ Carry out the workshop exercise. Participants can be asked the following: <p><i>A company is considering replacing an oil-fired boiler of 10 tons per hour with a coal-fired boiler of the same capacity. With the help of the data provided, calculate the following:</i></p> <ol style="list-style-type: none"> 1. Annual oil consumption in tons per year 2. Annual coal consumption in tons per year 3. Annual fuel cost savings in million US\$ <p><i>The following data is given:</i></p> <ul style="list-style-type: none"> - Heat content of steam 660 kCal/kg - Feed water inlet temperature 600 °C - Daily operating hours 24 - Number of days / year 300 - Efficiency of oil-fired boiler 82%

	<ul style="list-style-type: none"> - <i>Efficiency of coal-fired boiler 72%</i> - <i>Cost of oil US\$ 300/ton</i> - <i>Cost of coal US\$ 45/ton</i> - <i>GCV of oil 10,000 kCal/kg</i> - <i>GCV of coal 4,200 kCal/kg</i> <p>If participants have difficulties completing the exercise, it may be helpful to give them the four calculations they should make to determine the annual oil and coal consumption:</p> <ol style="list-style-type: none"> a. <i>Boiler operation hours</i> b. <i>Annual steam production</i> c. <i>Energy (Q) required to produce the amount of steam calculated under (b)</i> d. <i>Amount of coal or oil required by multiplying the energy Q by the GCV of coal or oil</i> <p>Participants should not have difficulties to calculate the annual fuel cost savings so there is no need to give them formulae for question 3.</p>
<p>Other comments</p>	<ul style="list-style-type: none"> ▪ Case study options from www.energyefficiencyasia.org or other sources can be included in this session as illustrations of how other companies reduce energy consumption and costs. ▪ If the workshop exercise for fuel and combustion is not combined with the boiler workshop exercise, then there will be time left at the end of the second session. There are several possibilities to use the remaining time: <ul style="list-style-type: none"> - Explain the monitoring instruments that typically are used in determining boiler performance: combustion analyzer, thermocouple and infrared thermometer. See the session “Monitoring Equipment” for more details. This option may be particularly useful if the course does not include a specific session on monitoring equipment. - Explain cogeneration under “Energy Efficiency Opportunities” during the boiler session, as cogeneration is based on combined heat (steam) and power generation. This is especially useful if the course does not include the cogeneration session. See the session on “Cogeneration” for more details.