Trainer Instructions: Fuels and Combustion

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Title	**FUELS AND COMBUSTION**
Objective	To obtain an understanding of fuels and combustion, including the types of fuels and their characteristics, how to assess efficiency of fuel combustion and the main areas for energy conservation.
Minimum duration and approach	▪ 1.5 session (2 hours), including the quiz and workshop exercise ▪ Recommended approach: spend a maximum of 1 hour and 15 minutes on the PowerPoint presentation. If more than 20 minutes are left, participants can complete the quiz themselves first before discussing the answers. If little time is left, go through the quiz as a group (10 minutes). The workshop exercise is relatively long and should therefore be completed (30 minutes) and discussed (15 minutes) in a separate session. In the agenda, the workshop exercise for fuels and combustion is placed in the same session as the boilers workshop exercise. ▪ Presentation: 47 slides ▪ Textbook chapter: 24 pages
Contents	▪ Introduction ▪ Types of fuels ▪ Assessment of fuel combustion ▪ Energy efficiency opportunities
Assessment of participants	▪ 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, where participants are asked the following: *Calculate the stoichiometric (kg) amount of air required for the complete combustion of 1 kg liquid fuel with the following properties:* - *Carbon (C) 85.9% by weight* - *Hydrogen (H): 12%* - *Oxygen (O2): 0.7%* - *Nitrogen (N): 0.5%* - *Sulphur (S): 0.5%* - *Moisture (H2O): 0.35%* - *Ash: 0.05%* - *Total: 100%* *The gross calorific value (GCV) of the liquid fuel is 10200 kCal/kg.*

	Participants can make use of the example of stoichometric air calculations (section 3.2 in the textbook) to solve this question. If participants have difficulties getting started, it may be helpful to provide them the needed steps: - *Write down what you already know and assumptions* - *Write the combustion reactions based on 100 kg of fuel* - *Calculate the O2 required for complete combustion of 100 kg of fuel using combustion reactions (1), (2) and (3)* - *Calculate the air required to provide the additional O_2 for complete combustion of 1 kg fuel*
Other comments	▪ It is important to present this session before the sessions on thermal equipment (boilers, steam, furnaces, cogeneration, and waste heat recovery) because many of the terms and definitions explained here will be used later. ▪ The most important part of fuels and combustion is "Assessment of fuel combustion". The best way for participants to understand this is by carrying out a calculation. It is strongly recommended to include the workshop exercise for fuels and combustion. ▪ If time is limited, it is recommended to spend less time on the types of fuels section (e.g. by going through the fuel properties only briefly or by explaining fuel properties for liquid fuels, but skip the explanation for solid fuels (coal)). ▪ 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.