Trainer Instructions: Steam Distribution and Utilization

From: Energizing Cleaner Production – a Guide for Trainers, UNEP/InWEnt, 2007

Title	**STEAM DISTRIBUTION AND UTILIZATION**
Objective	To obtain an understanding of steam distribution and utilization, including characteristics of steam, the components of a steam distribution system, how to assess the performance of steam distribution systems and the main areas for energy conservation.
Minimum duration and approach	▪ 2 session (3 hrs), including the quiz and workshop exercise ▪ Recommended approach: spend the first session to go through the introduction and explanation of steam distribution and components. Spend the first 45 minutes of the second session on the assessment of steam systems and energy efficiency opportunities. Give participants 30 minutes to complete the quiz and workshop exercise, and leave 15 minutes to go through the answers. ▪ Presentation: 79 slides ▪ Textbook chapter: 68 pages
Contents	▪ Introduction ▪ Steam distribution system ▪ Assessment of the steam distribution system ▪ 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: *A paper plant has an extensive steam network. The steam is generated at a pressure of 10 bar and the condensate is not recovered. The plant management is planning to generate flash steam (from the condensate) for use as low pressure process steam and to recover as much steam condensate as practical.* *With the help of the data provided, calculate the following:* *1. Quantity of flash steam generated (kg)* *2. Annual savings from flash steam recovery in US$/year* *3. Annual savings from flash steam recovery and condensate recovery in US$/year* *The following data is provided:* - *Total enthalpy of steam at 10 bars: 672 kCal/kg*

	- *Condensate quantity: 1000 kg/hr* - *Condensate pressure: 10 bar* - *Cost of steam: US$ 25/ton* - *Annual operating hours: 8000* - *Low pressure process steam pressure: 2 bar (Flash steam pressure)* - *Sensible heat of condensate at 10 bar: 187.1 kCal/kg* - *Sensible heat of condensate at 2 bar: 134.4 kCal/kg* - *Latent heat of steam at 2 bar: 517.5 kCal/kg* - *Boiler efficiency: 82%* - *Fuel used in boiler : Furnace oil* - *GCV of Furnace oil: 10,200 kCal/kg* - *Specific gravity of furnace oil: 0.92* - *Condensate temp. when recovered: 95^0C* - *Make-up water temperature: 35^0C* - *Cost of furnace oil : US$ 350/kiloliter* *The following equation is given:* *Flash steam generation potential condensate (%) = $(S_1-S_2/L) X 100$* *Where,* *S_1 = Sensible heat of condensate at high pressure* *S_2 = Sensible heat of condensate at low pressure* *L = latent heat of steam at low pressure* Participants should not have difficulties in completing this workshop exercise as both the formula and the steps are provided in advance.
Other comments	▪ This is the longest but also one of the most important sessions, as steam generation, distribution and use is one of the highest costs for companies. It also has the greatest potential for savings through energy efficiency. It is strongly recommended to spend two full sessions on this topic. ▪ It is important to take a break after the explanation of the steam distribution system and its components because it covers a lot of information. Without a break, there is a risk that participants will not take in the information on how to improve the energy efficiency of steam systems. ▪ 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.