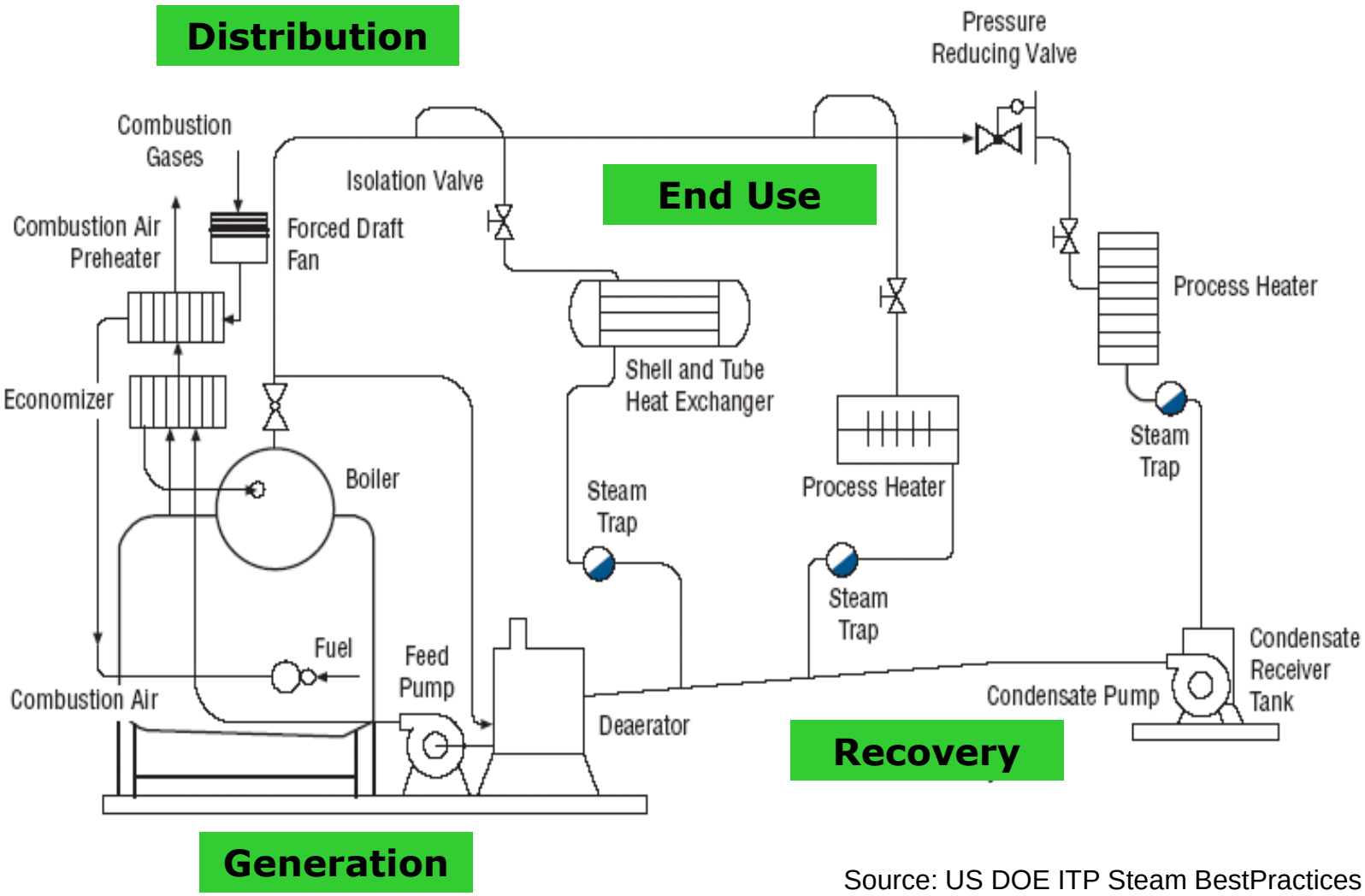
Section 2

Steam System Scoping Tool

Steam System Optimization Opportunities
Steam System Scoping Tool (SSST)
Hands-On Exercise on SSST

UNIDO 2012, all rights reserved

Generic Steam System



Source: US DOE ITP Steam BestPractices Program

UNIDO 2012, all rights reserved

Common Best Practices – Generation

- Minimize excess air
- Install heat recovery equipment
- Clean boiler heat transfer surfaces
- Improve water treatment to reduce boiler blowdown
- Recover energy from boiler blowdown
- Add/restore boiler refractory
- Minimize the number of operating boilers
- Optimize deaerator vent rate

Source: US DOE BestPractices Steam System Sourcebook

UNIDO 2012, all rights reserved

Common Best Practices – Distribution

- Repair steam leaks
- Minimize vented steam
- Ensure that steam system piping, valves, fittings and vessels are well insulated
- Isolate steam from unused lines
- Minimize flows through pressure reducing stations
- Reduce pressure drop in headers
- Drain condensate from steam headers

Source: US DOE BestPractices Steam System Sourcebook

UNIDO 2012, all rights reserved

Common Best Practices – End-Use

- Reduce steam usage by a process
  - Improving the efficiency of the process
  - Shifting steam demand to a waste heat source
- Reduce the steam pressure needed by process, especially in cogeneration systems
- Upgrade low pressure (or waste) steam to supply process demands
- Process integration leading to overall energy optimization of the plant

Source: US DOE BestPractices Steam System Sourcebook

UNIDO 2012, all rights reserved

Common Best Practices – Recovery

- Implement an effective steam-trap management and maintenance program
- Recover as much as possible of available condensate
- Recover condensate at the highest possible thermal energy
- Flash high-pressure condensate to make low-pressure steam

Source: US DOE BestPractices Steam System Sourcebook

UNIDO 2012, all rights reserved

Steam System Management Objective:

Minimize Steam Use,
Energy Losses, GHG Emissions And
Most Importantly
REDUCE STEAM SYSTEM OPERATING COSTS!!

UNIDO 2012, all rights reserved

US Steam Market Assessment Takeaways

- Fuel savings estimates – individual projects – **ranged from 0.6 percent to 5.2 percent**

- Estimated payback periods generally very attractive
  - Ranged from **2 to 34 months**
  - Most less than **2 years**

- Potential steam savings in target industries – **over 12 percent of fuel use**

UNIDO 2012, all rights reserved

Promising Areas To Achieve Steam Energy and Cost Savings?

Use US DOE Steam System Scoping Tool (SSST) For Initial Assessment

Download from:

http://www1.eere.energy.gov/industry/bestpractices/software.html

UNIDO 2012, all rights reserved

US DOE's Steam System Scoping Tool

UNIDO 2012, all rights reserved

US DOE Steam System Scoping Tool SSST

- SSST is a software-based questionnaire designed to enhance awareness of areas of steam system management
- Divided into typical steam system focus areas
- Provides the user a score that is indicative of management intensity and serves as a guide to useful information
- Tool to identify potential improvement opportunity areas
- Will NOT quantify the energy savings opportunities

UNIDO 2012, all rights reserved

Intended SSST Users

- Industrial manufacturers
  - Plant managers
  - Utility managers
  - Plant process engineers

- Can also be used by institutional, commercial steam users

UNIDO 2012, all rights reserved

Two SSST Formats Available

- Excel Spreadsheet (Version 1.0d)
  - Linking capability across plants
  - Spreadsheet – Look and Feel
  - Manual entry of scores
  - SI / Metric version available

- Visual Basic (Version 2.0.0)
  - Radio buttons – software package look and feel
  - Automatic entry of scores

UNIDO 2012, all rights reserved

SSST Organization

- Introduction
- Steam system basic data
- Steam system profiling
- Overall system operating practices
- Boiler plant operating practices
- Distribution, end use and recovery operating practices
- Summary results
- Next steps

UNIDO 2012, all rights reserved

Obtaining Data for SSST Input

- Sources of data:
  - Actual current measurements
  - Computerized or print copy historical records
  - Information on procedures from:
    - Plant engineer/utilities/maintenance manager(s)
    - Boiler operator

- 26 questions – expected time: 30 min (max)

UNIDO 2012, all rights reserved

Steps for Use of SSST

- Load program
- Open SSST by clicking on opening title screen
- Review SSST sections to identify needed input data
- Obtain input data
- Optionally complete steam system basic data section
- Insert answer choices into SSST sections

UNIDO 2012, all rights reserved

Steps for Use of SSST (Continued)

- On summary results screen note scores achieved in major tool sections
- Compare scores achieved with those for similar plants
- Identify and prioritize steam system improvement opportunities
- Utilize resources identified in “next steps” section for assistance in implementing steam system improvements

UNIDO 2012, all rights reserved

SSST Scorecard – Results

- What is the condition of your system?

Summary of results Scoping tool areas	Possible score	Typical score
Steam System Profiling	90	63%
Steam System Operating Practices	140	69%
Boiler Plant Operating Practices	80	63%
Total scoping tool questionnaire score	**340**	**222.0**
Total scoping tool questionnaire score	**100%**	**65%**

- Allows for identifying potential improvement opportunities and focus areas

Source: US DOE ITP Steam BestPractices Program

UNIDO 2012, all rights reserved

Interpreting Summary Results

- Total possible score: 340 points
- Average scores reported by 82 manufacturers:
  - Steam system profiling: 62%
  - Total steam system operating practices: 69%
  - Boiler plant operating practices: 62%
  - Steam distribution, end use and heat recovery practices: 58%
  - Overall average score reported: 65%

UNIDO 2012, all rights reserved

Interpreting Scores

- Notable variation in category scores
  - Best performance in category of total steam system operating practices (69%)
  - Poorest performance in category of steam distribution, end use and heat recovery practices (58%)
  - Modest scores overall indicate substantial opportunity for steam system improvement
  - SSST can be used to trend improvements

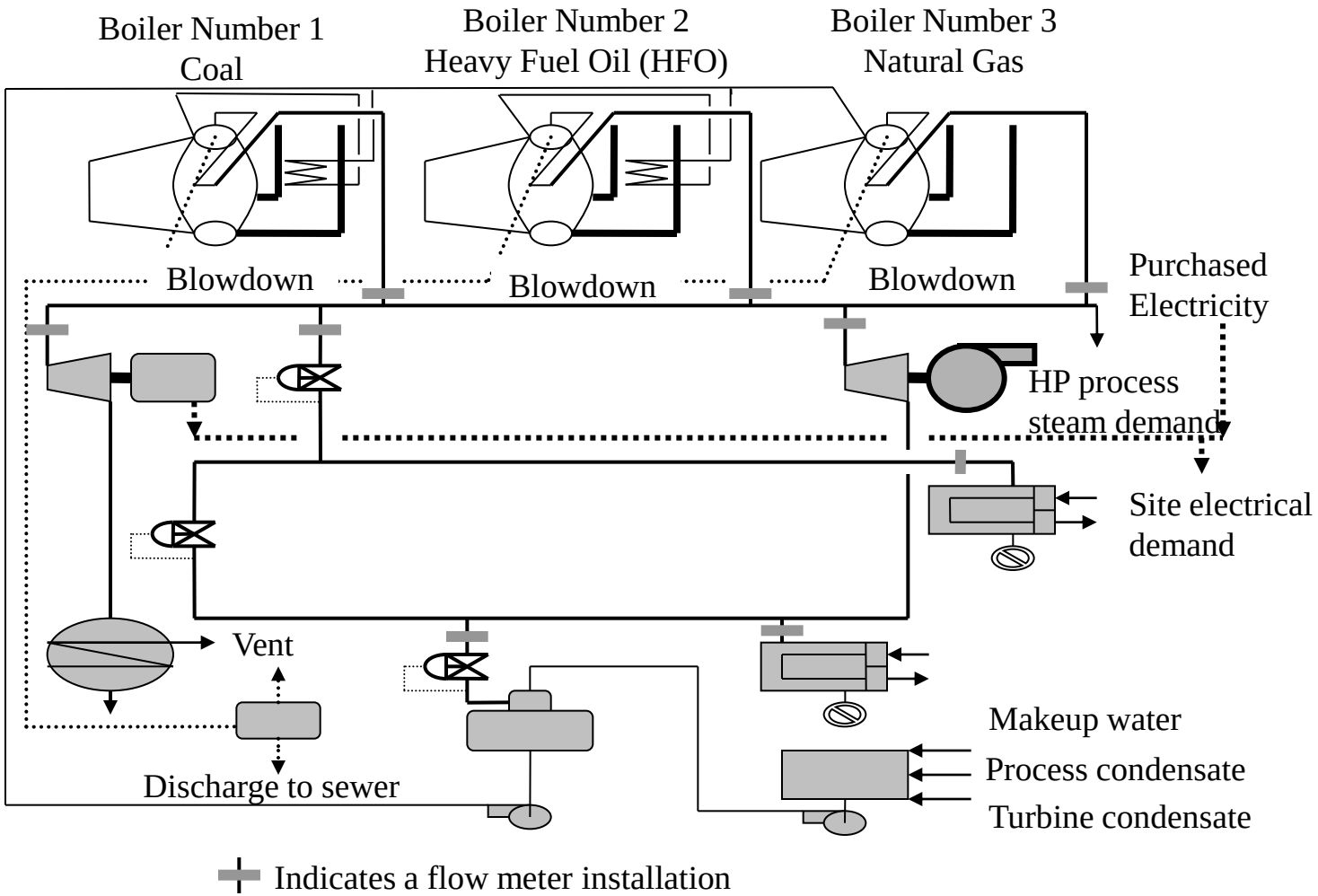
UNIDO 2012, all rights reserved

SSST Hands-On Exercise

- You have been tasked with a steam system assessment at a pulp and paper mill
- The plant Utilities Manager & Utilities Engineer are available to provide information to you about the plant
- Open SSST and input available plant data
- Identify missing data and determine appropriate plant source for this data
- List possible steam system improvement opportunities that you would like to investigate

UNIDO 2012, all rights reserved

SSST Example System



UNIDO 2012, all rights reserved

SSST Hands-On Exercise

- The plant (and steam system) operates 24 hours/day, 365 days/year;
- There are three boilers: Coal-fired, HFO-fired and Natural gas-fired
- The coal-fired and HFO-fired boilers are operated at base-load (fixed) whereas the methane-gas boiler responds to load variations
- Typical average loads correspond to ~65-70% of total available capacity
- Boiler instrumentation is limited to header pressure and boiler steam output
- Monthly boiler fuel (coal, HFO and methane gas) costs are tracked but not related to steam or product production rates
- Boiler combustion efficiency is measured on a semi-annual basis using portable instrumentation.
- Fireside heat transfer surfaces are normally found to be clean
- Waterside surfaces have had to be cleaned about every three years
- A feedwater economizer exists on the coal-fired and the HFO boiler

UNIDO 2012, all rights reserved

SSST Hands-on Exercise

- Blowdown for all boilers is done manually by the operators based on TDS and conductivity measurements taken once during the day
- An outside contractor provides boiler water treatment services based on monthly visits to the plant
- There are have been no problems with the regulation of boiler pressure, water levels or steam quality
- There is uncertainty about the number of steam traps in the plant; traps have not been surveyed for some time due to reduction in maintenance staff; but traps are checked and repaired/replaced if production is affected
- Steam system components are inspected and serviced as needed only when process operators report problems
- Condensate recovery averages 50% based on make-up water amounts

UNIDO 2012, all rights reserved

SSST Hands-on Exercise

- During a walk-through inspection of the plant the following observations were made:
  - Within the utilities areas, most of the steam distribution piping and system components seemed well insulated
  - There were several lengths of steam pipe and valves with modest amounts of missing insulation in the rest of the plant
- No evidence of water hammer was detected
- No leak management program at the plant and several minor steam leaks are observed

UNIDO 2012, all rights reserved

SSST Hands-on Exercise Instructions

- For the plant information presented, provide data input to the SSST and arrive at scores for each SSST section and the summary listing
- For all questions for which input data is unavailable or insufficient, specify how you would obtain the needed information during your plant visit
- Based on your SSST analysis results, develop a list of priority actions to achieve energy conservation in the example plant

UNIDO 2012, all rights reserved

SSST Hands-on Exercise Results

- Summary of steam scoping tool results

	Possible Score	Your Score
Steam System Profiling	90	36
Steam system Operating Practices	140	70
Boiler Plant operating Practices	80	49
Distribution, End Use, Recovery OP, Practices	30	22
Total Scoping Tool Questionnaire Score	340	177
Total Scoping Tool Questionnaire Score (%)		**52.1%**
Date that you completed this questionnaire		**6/3/2012**

UNIDO 2012, all rights reserved

SSST Hands-on Exercise Results

- Scoping tool questions

	Possible Score	Your Score
1. Steam System Profiling		
Steam Costs		
SC1: Measure Fuel Cost To Generate Steam	10	5
SC2: Trend Fuel Cost to Generate Steam	10	5
Steam/Product Benchmarks		
BM1: Measure Steam/Product Benchmarks	10	0
BM2: Trend Steam/Product Benchmarks	10	0
Steam System Measurements		
MS1: Measure/Record Steam System Critical Energy Parameters	30	21
MS2: intensity Of Measuring Steam Flows	20	5
Steam System Profiling Score	**90**	**36**

UNIDO 2012, all rights reserved

SSST Hands-on Exercise Results

2. Steam System Operating Practices		
Steam Trap Maintenance		
ST1: Steam Trap Maintenance Practices	40	8
Water Treatment Program		
WT1: Water Treatment – Ensuring Function	10	5
WT2: Cleaning Boiler Fireside/Waterside Deposits	10	5
WT3: Measuring Boiler TDS, Top/Bottom Blowdown Rates	10	5
System Insulation		
IN1: Insulation – Boiler Plant	10	10
IN2: Insulation – Distribution/End Use/Recovery	20	14
Steam Leaks		
KL1: Steam Leaks – Severity	10	8
Water Hammer		
WH1: Water Hammer – How Often	10	10
Maintaining Effective Steam System Operations		
MN1: Inspecting Important Steam Plant Equipment	20	5
Steam System Operation Practices Score	**140**	**70**

UNIDO 2012, all rights reserved

SSST Hands-on Exercise Results

3. Boiler Plant Operating Practices		
Boiler Efficiency		
BE1: Measuring Boiler Efficiency – How Often	10	5
BE2: Flue Gas Temperature, O2, CO Measurement	15	9
BE3: Controlling Boiler Excess Air	10	7
Heat Recovery Equipment		
HR1: Boiler Heat Recovery Equipment	15	3
Generating Dry Steam		
DS1: Checking Boiler Steam Quality	10	10
General Boiler Operation		
GB1: Automatic Boiler Blowdown Control	5	0
GB2: Frequency Of Boiler High/Low Level Alarms	10	10
GB3: Frequency Of Boiler Steam/Pressure Fluctuations	5	5
Steam System Operation Practices Score	**140**	**70**

UNIDO 2012, all rights reserved

SSST Hands-on Exercise Results

4. Steam Distribution, End Use, Recovery Operating Practices		
Minimize Steam Flow Through PRVs		
PR1: Options For Reducing Steam Pressure	10	10
Recovery And Utilize Available Condensate		
CR1: Recovering And Utilizing Available Condensate	10	6
Use High-Pressure Condensate To Make Low-Pressure Steam		
FS1: Recovering And Utilizing Available Flash Steam	10	6
Steam System Operation Practices Score	**140**	**70**

UNIDO 2012, all rights reserved

SSST Hands-on Exercise Next Steps

- Steam system profiling
  - Calculate steam costs & trend
  - Correlate steam costs with production and benchmark

- Steam System Operating Practices
  - Incorporate Steam Trap Management Program
  - Investigate steam system insulation in the plant
  - Investigate causes for water-side fouling issues
  - Evaluate the need for periodic inspection of steam system equipment

UNIDO 2012, all rights reserved

SSST Hands-on Exercise Next Steps

- Boiler Plant Operating Practices
  - Calculate and trend individual boiler and overall plant steam generation efficiency & trend
  - Investigate excess air control equipment and in-situ measuring equipment
  - Investigate feedwater economizer
  - Investigate blowdown thermal energy recovery
  - Improve boiler blowdown control

- Distribution, End-Use & Recovery
  - Back-pressure turbine optimization
  - Improve condensate return & flash steam recovery

UNIDO 2012, all rights reserved

Key Points / Action Items

1. *Use a systematic approach (gap analysis, comparison to Best Practices) to identify potential energy saving opportunities that may exist in steam systems*
2. *The US DOE's Steam System Scoping Tool (SSST) can be used to identify these improvement opportunities*
3. *It is available "free" from the web and in two versions*
4. *The SSST can also be used as an intake questionnaire to collect preliminary plant level information*
5. *It contains 26 questions and shouldn't take more than 30 minutes to complete*

UNIDO 2012, all rights reserved