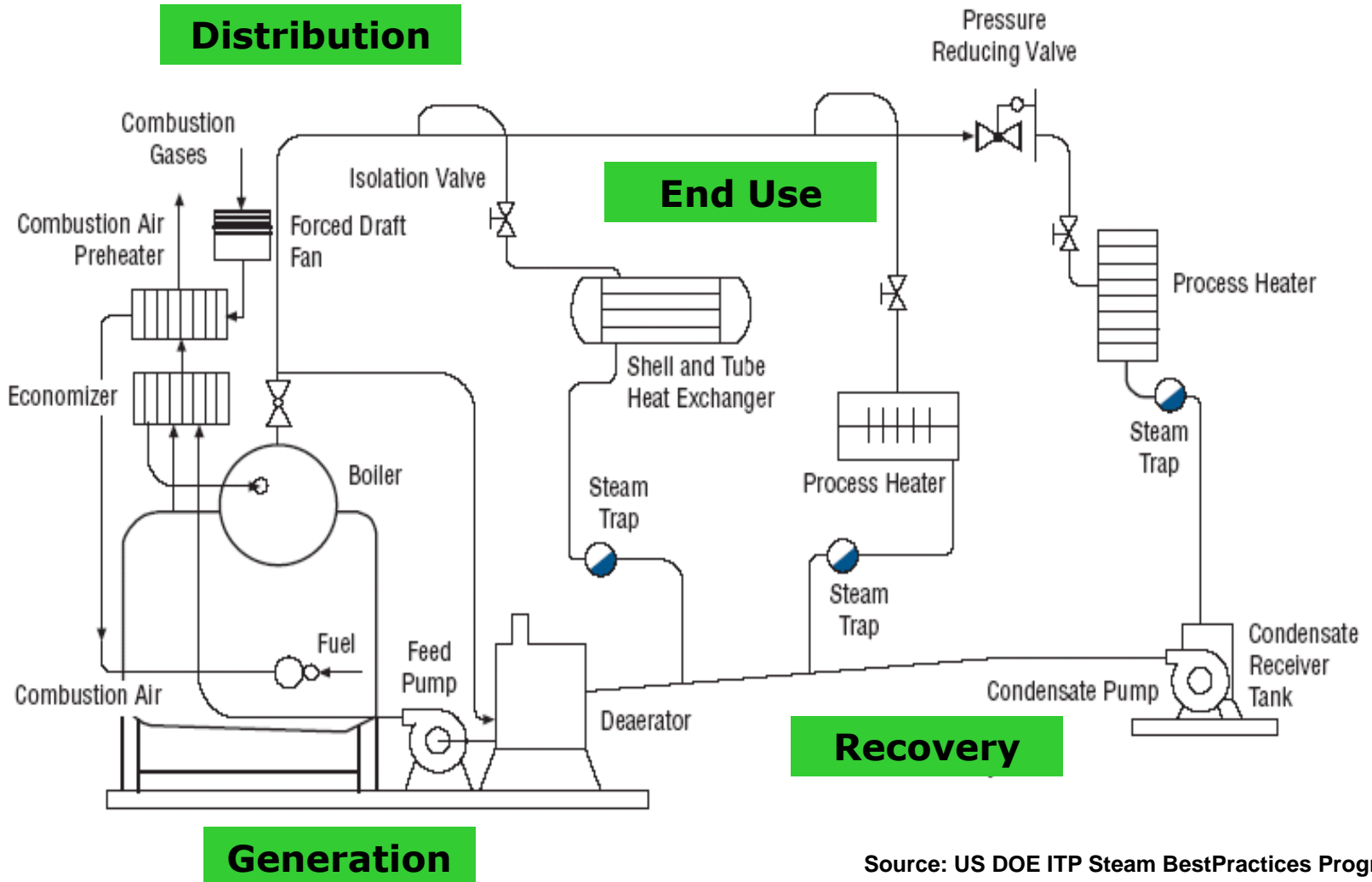


Generic Steam System



Source: US DOE ITP Steam BestPractices Program

Common BestPractices - 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

Common BestPractices - 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

Common BestPractices – 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

Common BestPractices - 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



Steam System Management Objective:

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

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



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>



US DOE's Steam System Scoping Tool

Office of Industrial Technologies

BestPractices
Energy Smart Technology for Today

Steam System Scoping Tool

Version 2.0.0

December 2002

United States Department of Energy

Click anywhere on this frame to begin the assessment.

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

Intended SSST Users

- ✓ Industrial manufacturers
 - Plant managers
 - Utility managers
 - Plant process engineers
- ✓ Can also be used by institutional, commercial steam users

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

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

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)

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

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



Section 2: Steam System Scoping Tool

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



SSST Scorecard – Results

SUMMARY OF STEAM SCOPING TOOL RESULTS		
	POSSIBLE SCORE	YOUR SCORE
STEAM SYSTEM PROFILING	90	78
STEAM SYSTEM OPERATING PRACTICES	140	104
BOILER PLANT OPERATING PRACTICES	80	33
DISTRIBUTION, END USE, RECOVERY OP. PRACTICES	30	16
TOTAL SCOPING TOOL QUESTIONNAIRE SCORE	340	231
TOTAL SCOPING TOOL QUESTIONNAIRE SCORE (%)		67.9%
Date That You Completed This Questionnaire		9/16/2011

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%
DISTRIBUTION, END USE, RECOVERY OP. PRACTICES	30	58%
TOTAL SCOPING TOOL QUESTIONNAIRE SCORE	340	222.0
TOTAL SCOPING TOOL QUESTIONNAIRE SCORE	100%	65%

✓ Allows for identifying potential improvement opportunities and focus areas

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%

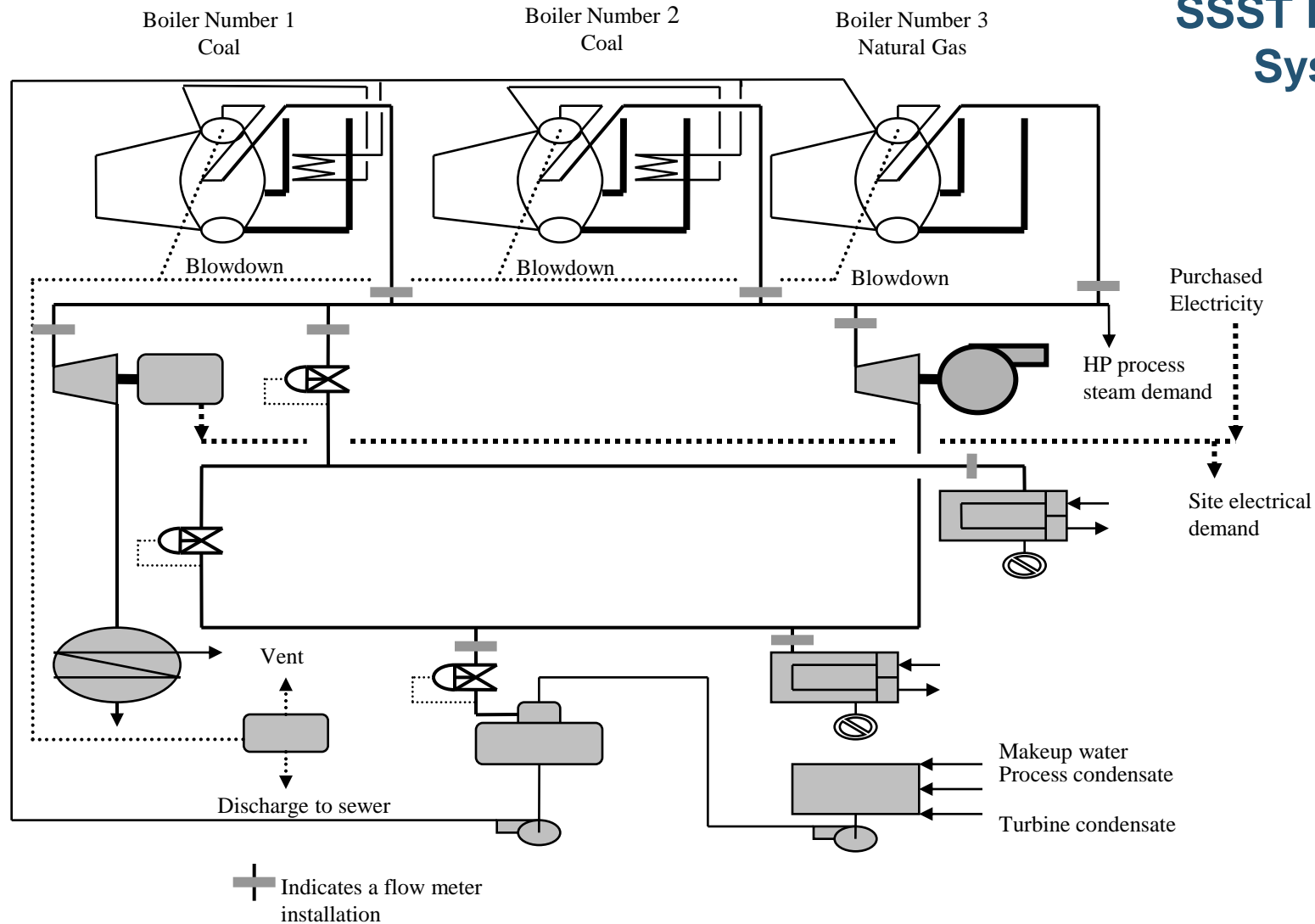
Interpreting Scores

- ✓ 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

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

SSST Example System



SSST Hands-On Exercise

- ✓ The plant (and steam system) operates 24 hours/day, 365 days/year;
- ✓ There are three boilers: 2 of them are Coal-fired, and the 3rd is Natural gas-fired
- ✓ The Coal-fired boilers are operated at base-load (fixed) whereas the Natural-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 and Natural 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
- ✓ Feedwater economizers are installed at the Coal-fired boilers only

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 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

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

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



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

6/6/2011



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

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		
LK1: 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 OPERATING PRACTICES SCORE	140	70

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 ←
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GENERATING DRY STEAM

DS1: Checking Boiler Steam Quality	10	10
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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

BOILER PLANT OPERATING PRACTICES SCORE	80	49
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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
RECOVER 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 ←
DISTRIBUTION, END USE, RECOVERY OP. PRACTICES SCORE	30	22

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

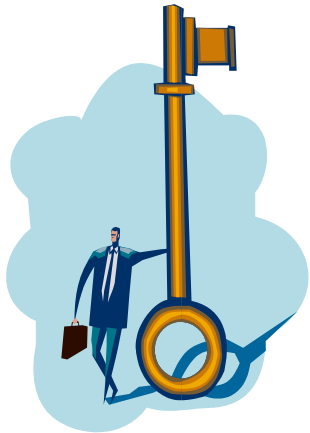
SSST Hands-on Exercise Next Steps

✓ 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



Key Points / Action Items

1. *Use a systematic approach (gap analysis, comparison to BestPractices) 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*

