SURVEY RESULTS

JANSEN
Combustion and Boiler Technologies, Inc.

Boiler Needs Survey
Responses Forest Products Industry

This survey was conducted in 2003 to collect, summarize, and document commonly experienced challenges and projected future needs of large industrial boilers in the Forest Products Industry.

For questions and inquiries, please contact:

Jansen Combustion and Boiler Technologies, Inc.
Kirkland, WA, USA.
www.jansenboiler.com
425.825.0500, Ext. 111

Boiler Needs Survey
Forest Products Industries Responses

JANSEN Combustion and Boiler Technologies, Inc.

General Comments / Assumptions

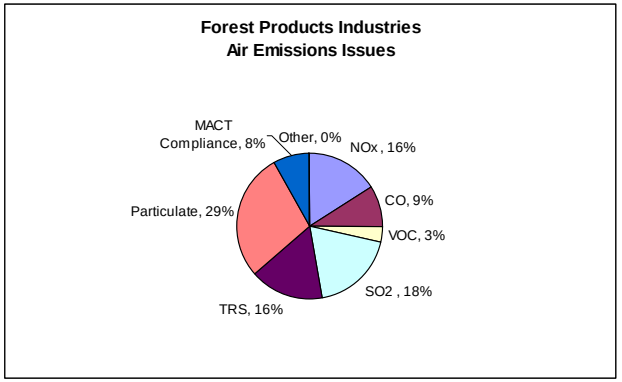
- 42 total mills responded
- If no response given for a question
  - It was counted as a “no” if that choice was offered
  - It was not counted (no response) if “no” was not a choice offered

Boiler Needs Survey
Forest Products Industries Responses

JANSEN Combustion and Boiler Technologies, Inc.

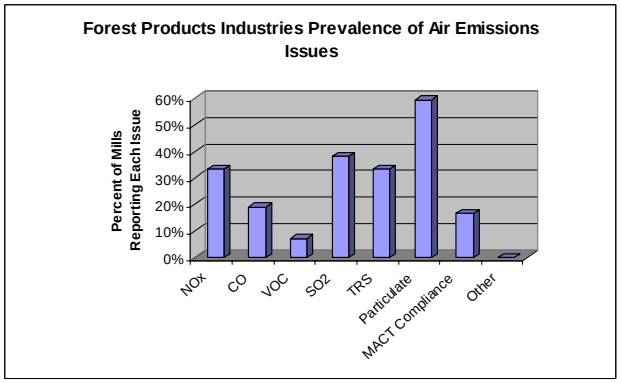
Pie Charts:

- Multiple answers to a single question from any respondent were each counted as an additional response (e.g. if each of 42 respondents checked 3 of the choices offered to a given question, a total of 126 responses was used as denominator to calculate percentage response to each choice offered
  - In example at right, 16% of total responses were for NOx as an air emissions issue

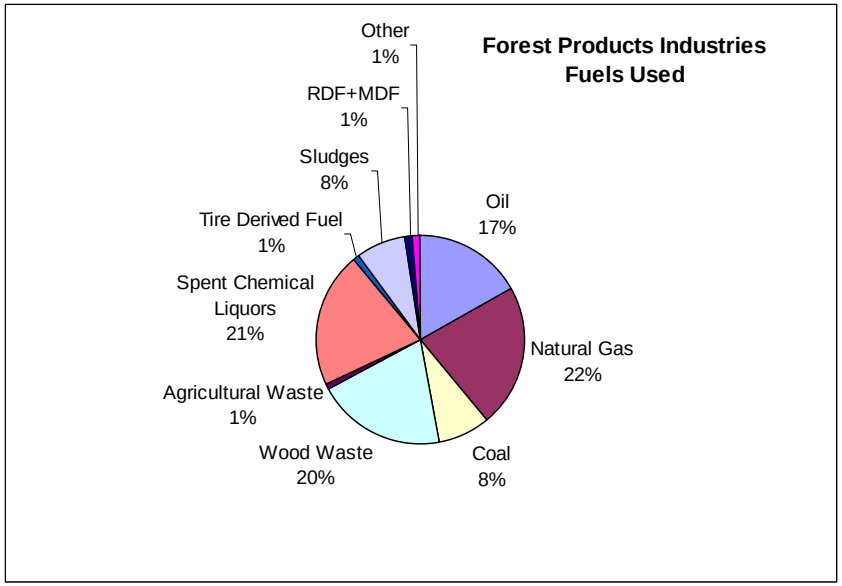


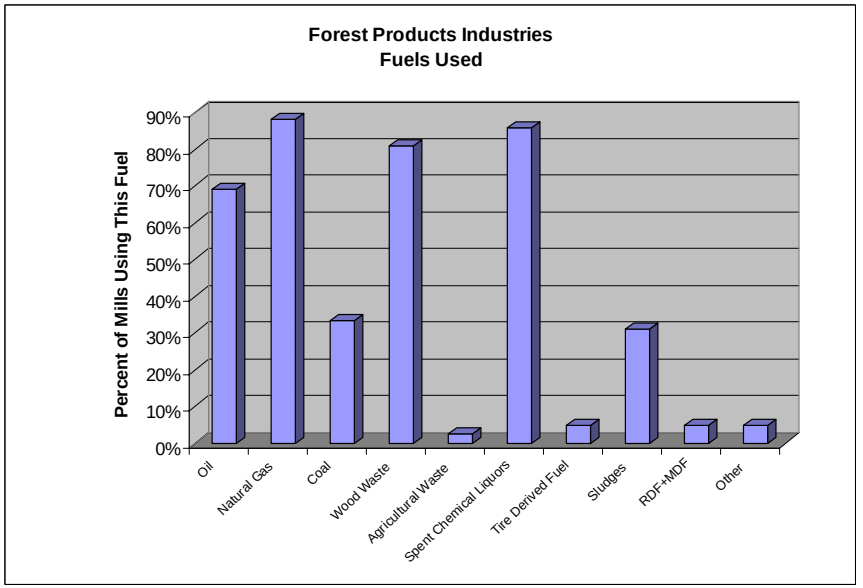
Bar Charts:

- Reflect percent of the mills which responded positively for any given issue
  - In example at right, ~30% of mills responding reported NOx as an air emissions issue
  - Percentages don't necessarily add to 100%



Boiler Needs Survey
Forest Products Industries Responses

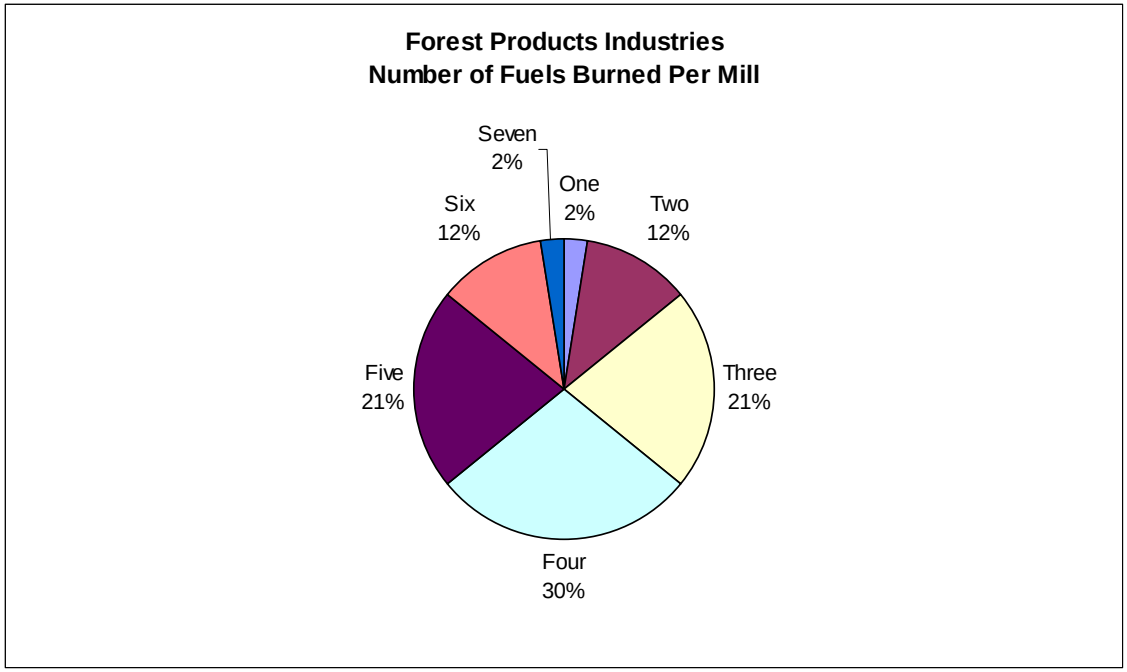




Question 1: What fuels do you burn?

- "Other" includes fuel pallets, CDF (combustible derived fuel, boxes, pallets, etc.),

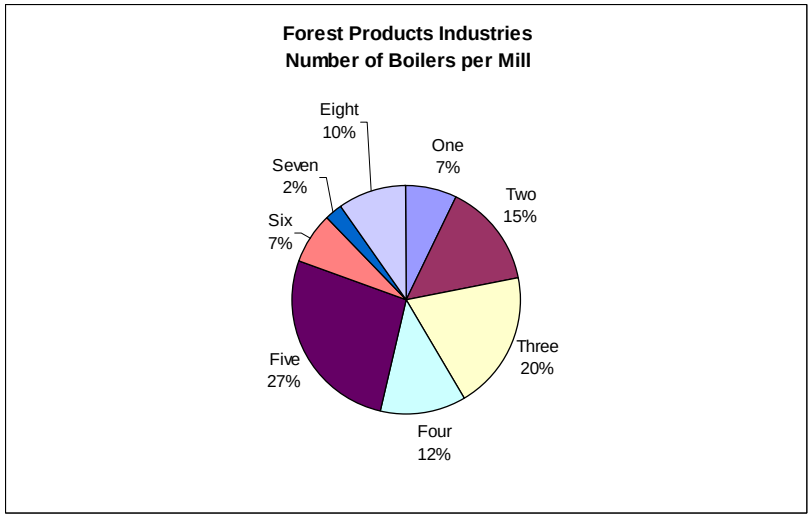
Boiler Needs Survey
Forest Products Industries Responses

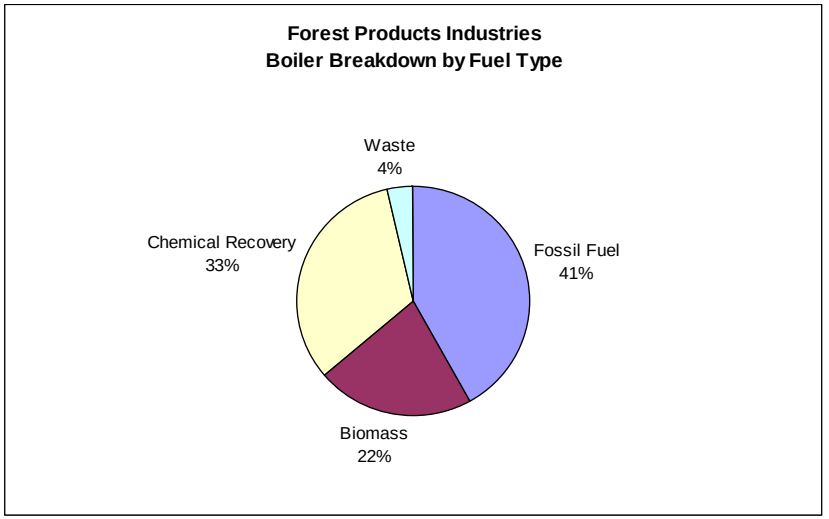


Question 1 (continued): What fuels do you burn?

- Most mills burn at least 3 fuel types
- Majority of mills burn 3-5 fuel types

Boiler Needs Survey
Forest Products Industries Responses

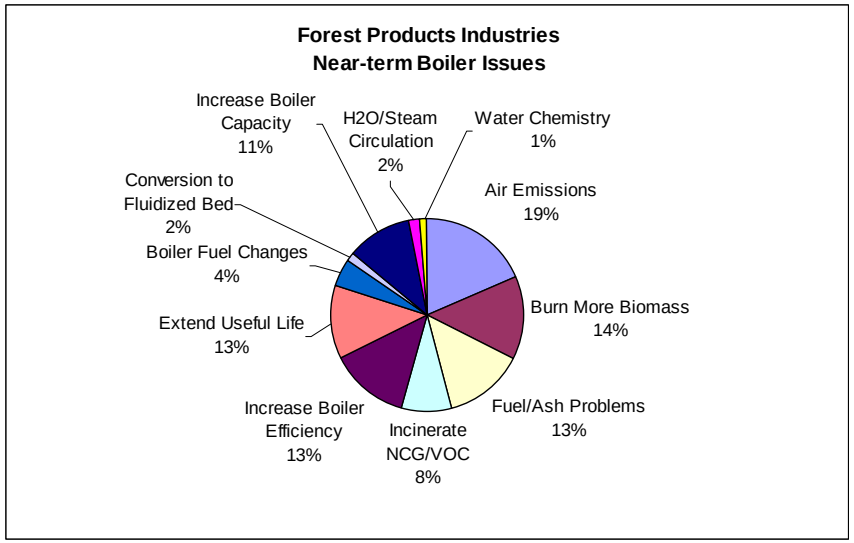


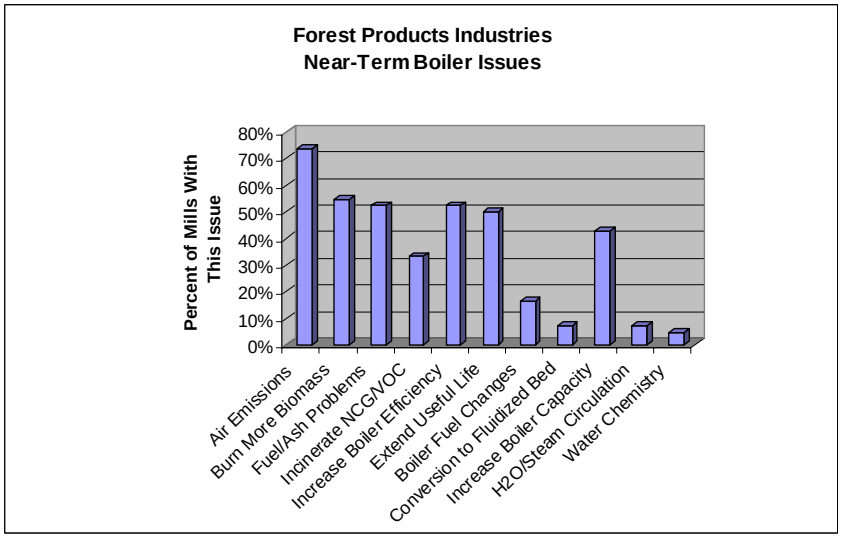


Question 2: How many boilers do you oversee?

- Average number of boilers per plant is ~ 4

Boiler Needs Survey
Forest Products Industries Responses

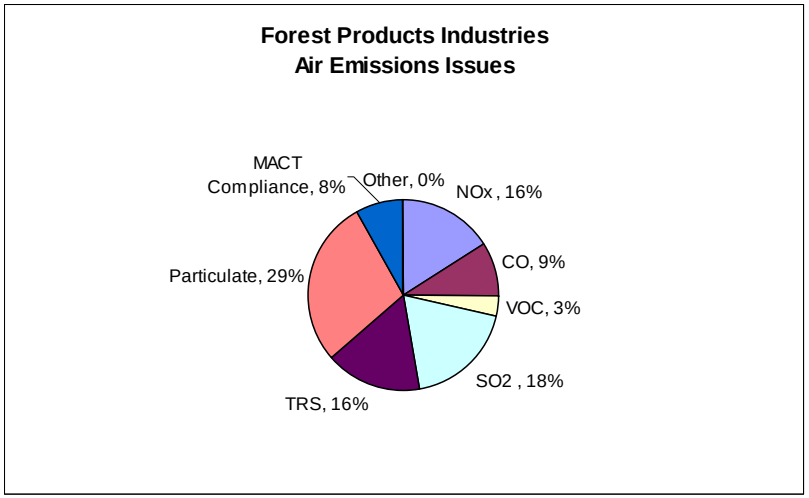


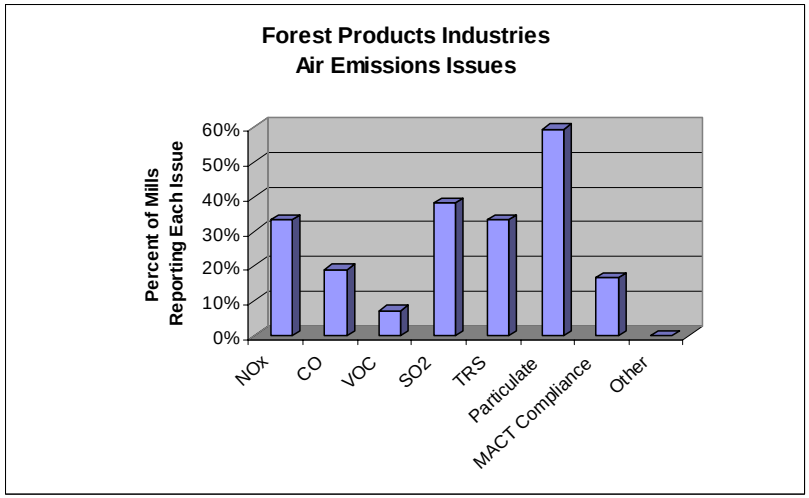


Question 3: What issues are you facing with these boilers in the near future?

- Air emissions is clearly the top issue facing this industry in the near future

Boiler Needs Survey
Forest Products Industries Responses

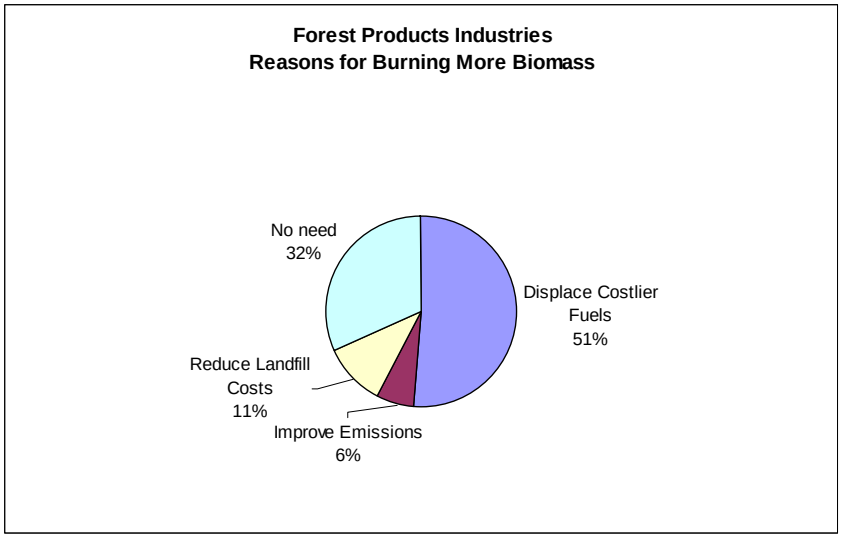


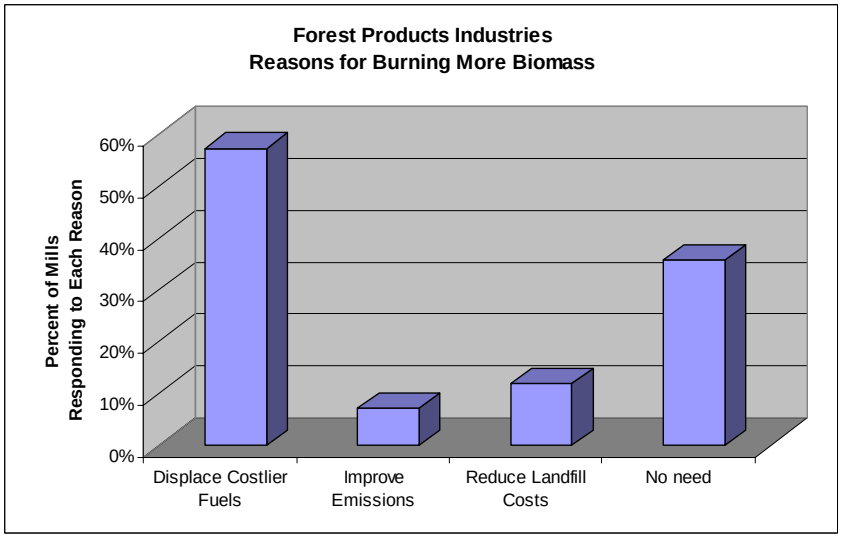


Question 4: What are the specific air emissions issues?

- HCL compliance called out by 1 respondent
- Average response had ~2 entries
- Five of 42 respondents had no air emissions issues
- Common answer was “NOx and particulate”

Boiler Needs Survey
Forest Products Industries Responses

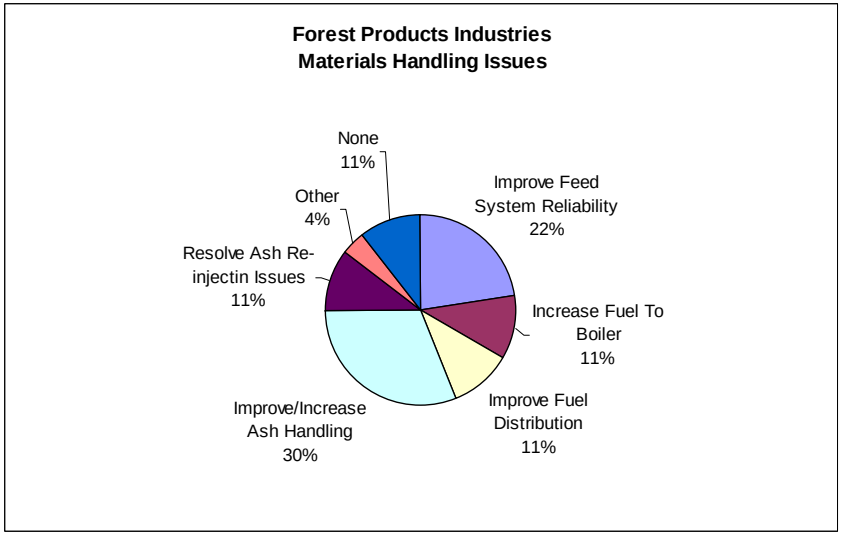


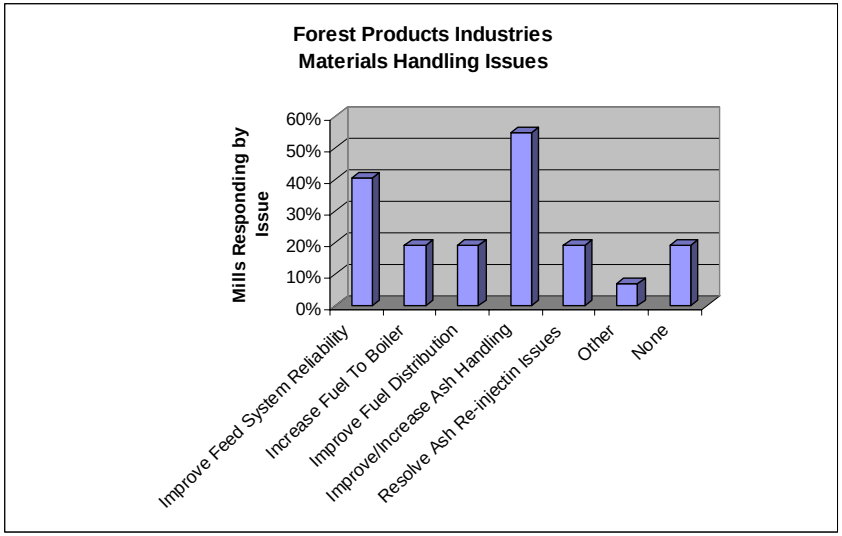


Question 5: If you would like to burn more biomass or waste fuel, what is the reason why?

- Six entries not filled in counted as “No need”
- Six multiple entries
- Reduction of landfill costs does not appear to be a strong need
- Average reasons given per mill ~1

Boiler Needs Survey
Forest Products Industries Responses

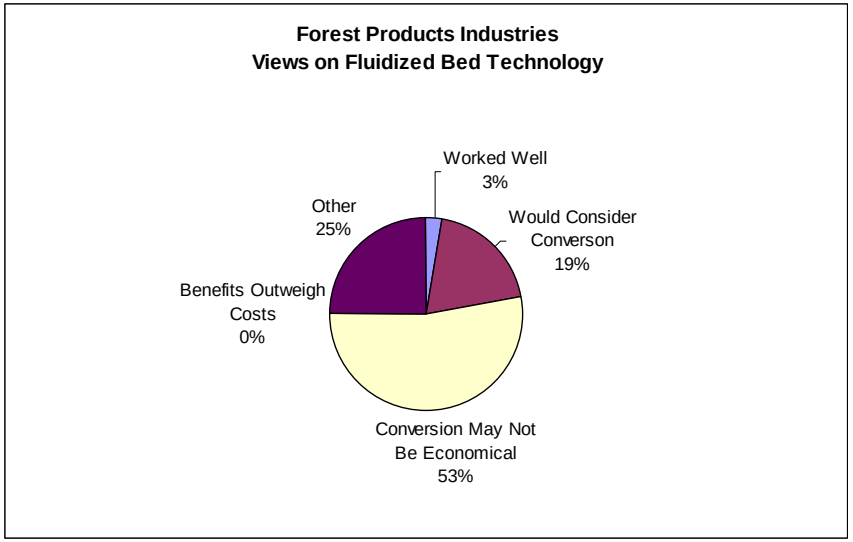


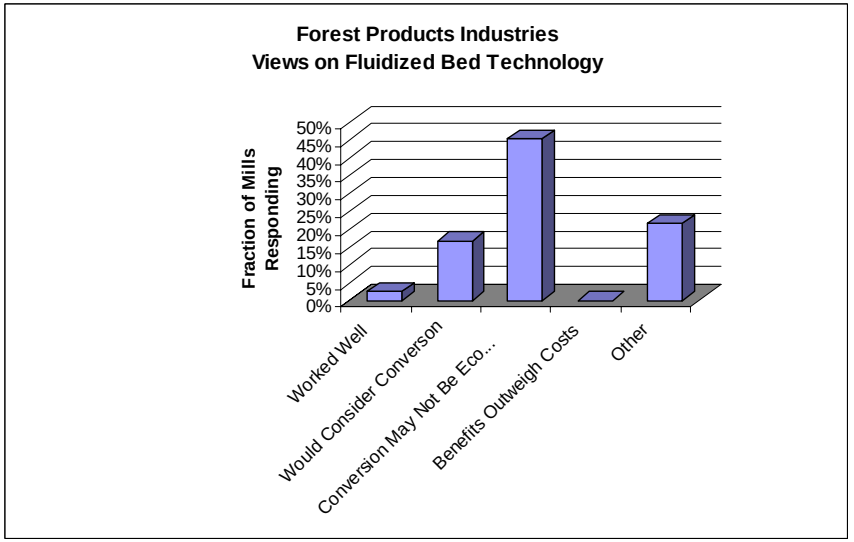


Question 6: Do you need to address materials handling issues (i.e. fuel and/or ash)?

- Three entries not filled in counted as “None”
- Average issues per mill ~1.8
- Three “other” entries: Increase boiler capacity, fires in ash handling equipment, recovery unit precipitator conveyors

Boiler Needs Survey
Forest Products Industries Responses

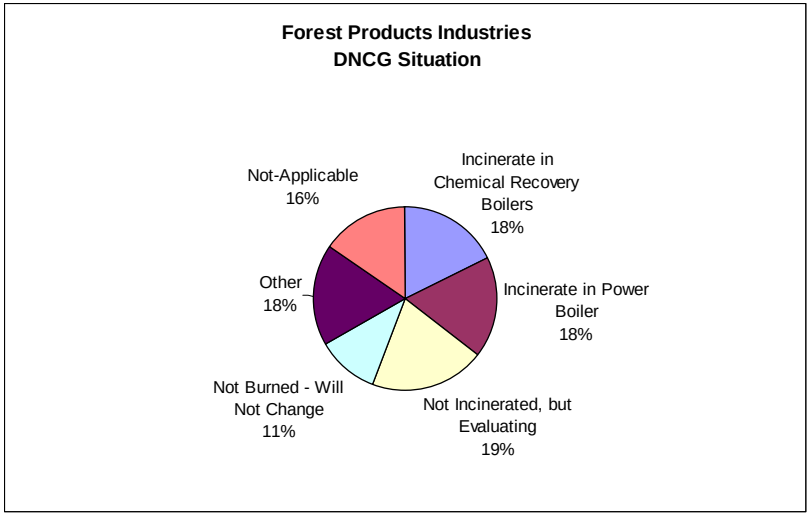


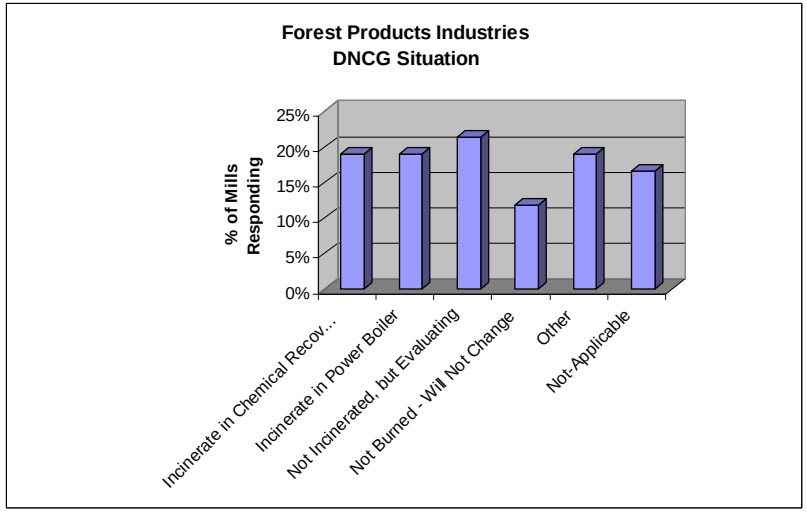


Question 7: How do you comment on fluidized bed technology?

- 9 responded as “other”: “not currently in our plans”, “if older units retired, would consider this for replacement”, “no experience with it”, “not familiar”, “our main fuel source would not support a fluidized bed boiler”, “N/A” (2), “uncertain”, “it has a place, particularly for sludge. Would consider for new boiler, cannot justify for retrofit”
- 71% response rate (12 mills with no response)
- Average responses per mill: ~0.85
- Skepticism among mill operators; substantial education of market required, if economical

Boiler Needs Survey
Forest Products Industries Responses

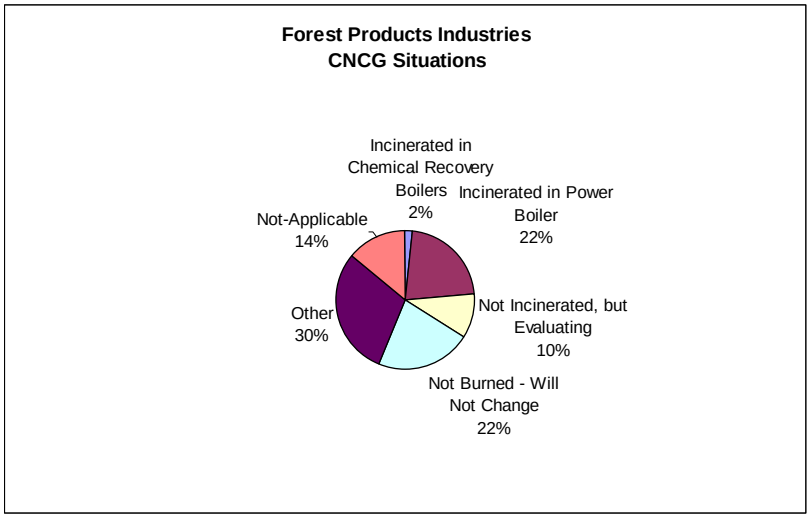


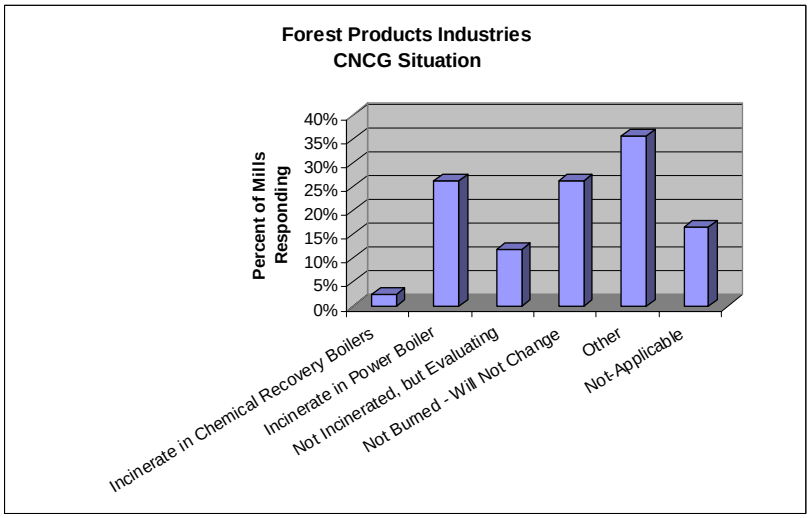


Question 8a: What best applies to your situation regarding disposal of Dilute Non-Condensable Gases (DNCG) in the boilers?

- "Other" responses included: "IQS", "DMT & SCMT vents only burned in recoveries", "incinerator", "kiln" (3), "RTO – need to re-look at burn HVLC in bark boiler"
- 3 "no response" counted as "not applicable"
- DNCG situation evenly divided among options

Boiler Needs Survey
Forest Products Industries Responses

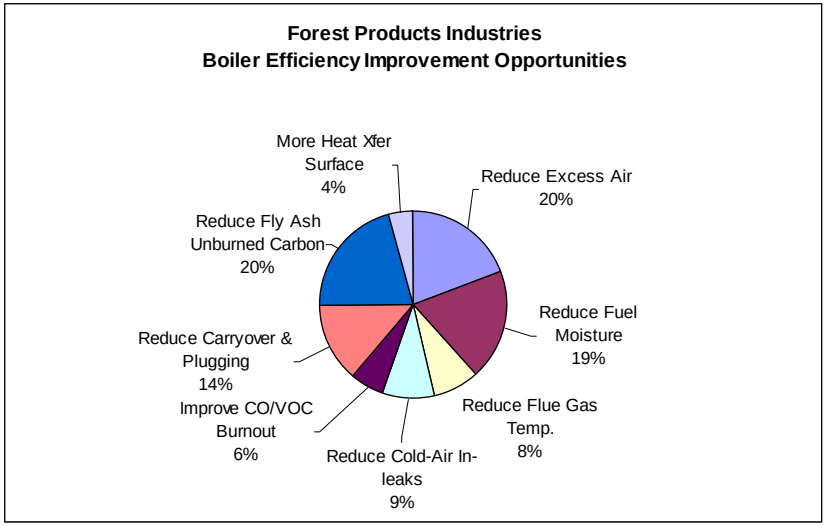


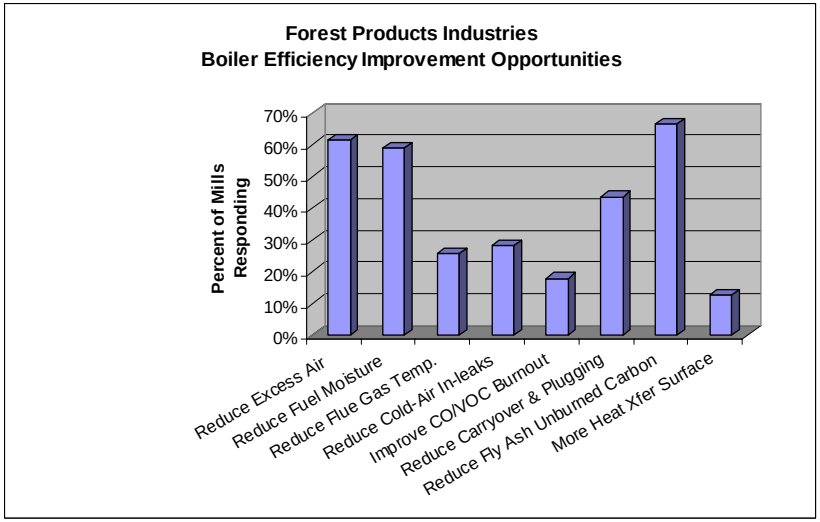


Question 8b: What best applies to your situation regarding disposal of Concentrated Non-Condensable Gases (CNCG) in the boilers?

- "Other" responses included: "lime kiln" (11), "IQS", "NCG incinerator" (4)
- 4 "no response" counted as "not applicable"

Boiler Needs Survey
Forest Products Industries Responses

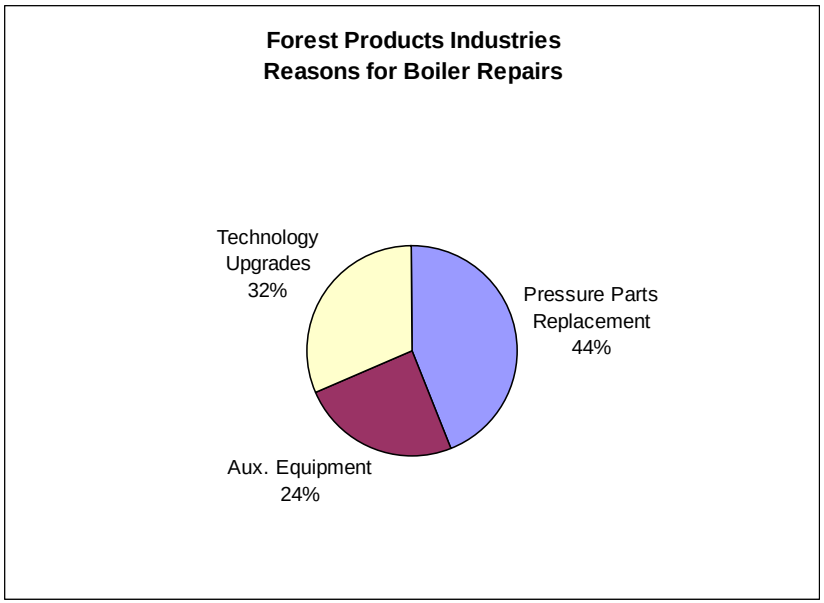


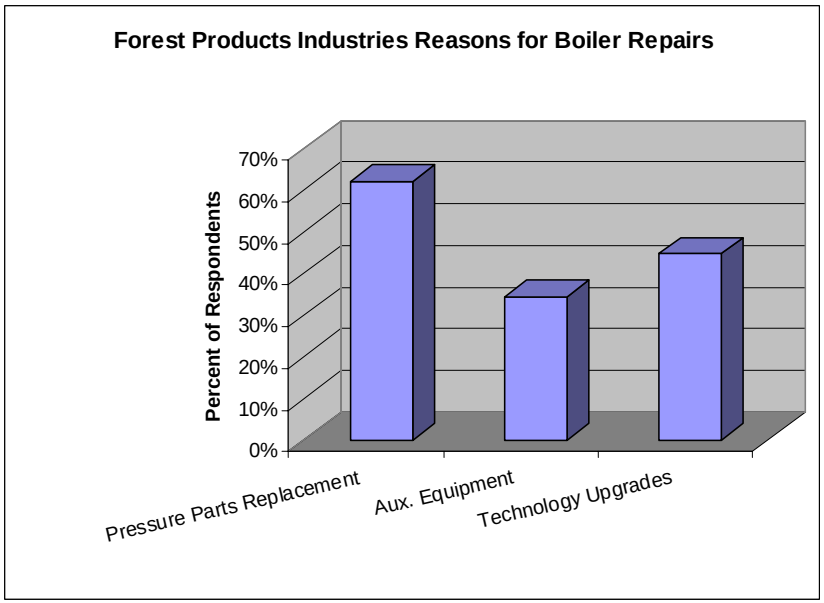


Question 9: Are opportunities available to improve boiler efficiency? In what way?

- Average issues per mill ~3
- 3 “no response” not counted
- One mill added “Increase % solids in recovery boiler”

Boiler Needs Survey
Forest Products Industries Responses

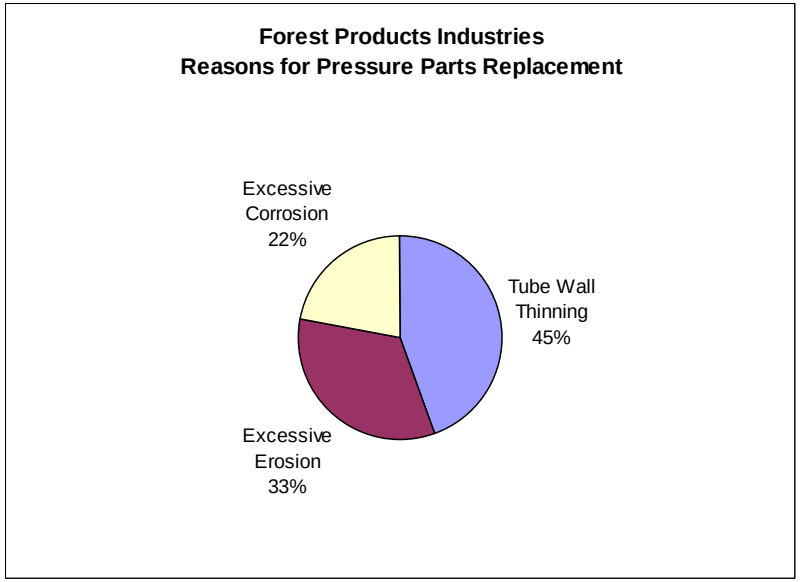


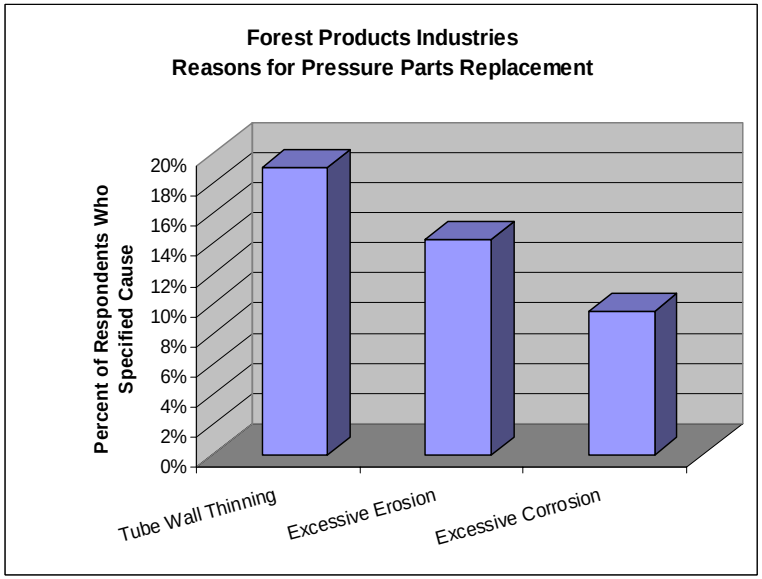


Question 10a: Are any of the boilers in need of significant maintenance repairs or upgrades?

- Response rate: 69% (29 of 42)
- 9 of 29 respondents noted more than one reason for boiler repairs
- Only 3 of 42 respondents noted boiler age
- 1 No response
- Other causes for repair noted: “RB Nose”, “primary air ports”, “economizer leaks”

Boiler Needs Survey
Forest Products Industries Responses

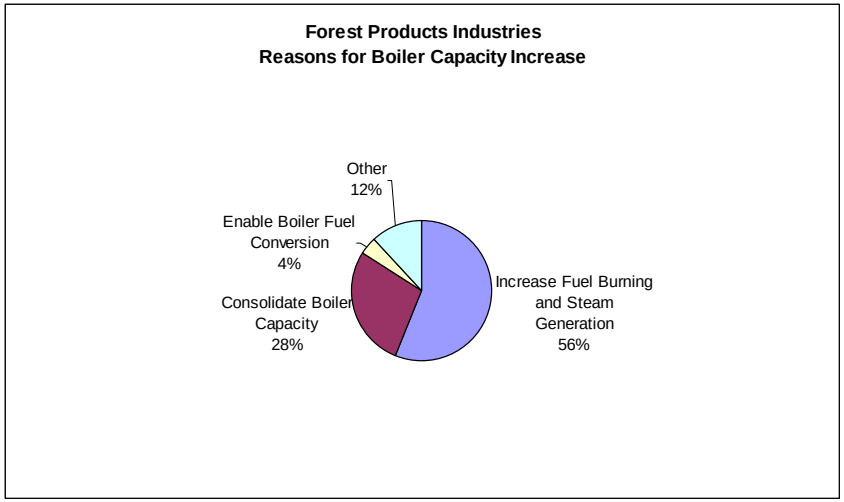


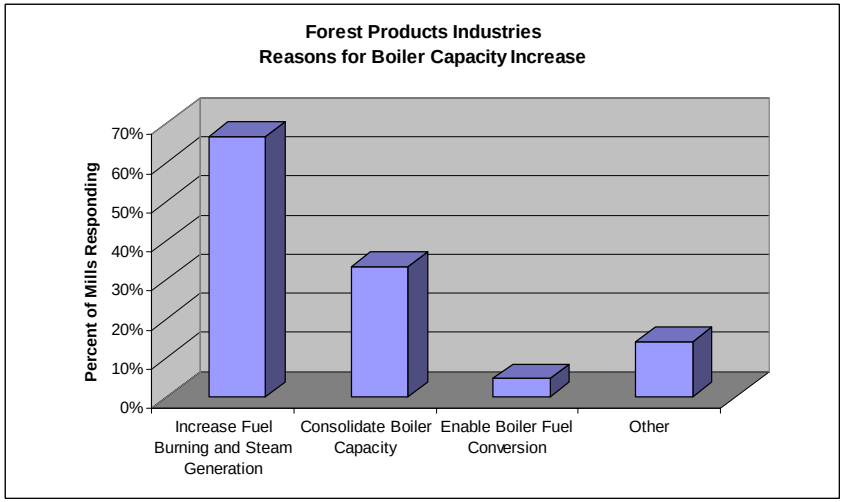


Question 10b: Are any of the boilers in need of significant maintenance repairs or upgrades? Results for mills reporting need for pressure parts replacement.

- Response rate: 43%--18 of 42 respondents reported need for pressure parts replacement.
- Only 3 of 42 respondents noted boiler age.
- 3 of 29 identified pressure parts replacement but gave no specific reason.
- 4 noted more than one reason for replacement.

Boiler Needs Survey
Forest Products Industries Responses





Question 11: Would you like to significantly increase boiler capacity, and for what reason?

- Response rate low: 50% (21/42)
- Two no-responses added “No!”
- “Other” responses include:” to supply steam for a paper machine re-start (was moth-balled)”, “marginal increase in burning capacity”
- 4 or 21 responses with multiple entries

Boiler Needs Survey
Forest Products Industries Responses

JANSEN Combustion and Boiler Technologies, Inc.

Question 12: In order of priority, what are the current operating challenges with your boilers?

Response rate: 35/42 (83%)

- 1st priorities
  - Age (2 of 4)
  - Improve reliability & capacity of wood waste boiler
  - In recovery boiler must increase as-fired liquor solid from 65 to 70%
  - Hog fuel handling / ash handling
  - Recovery boilers: maximum uptime with minimum water wash, best security practices
  - Power boilers: fuel optimizer for lowest cost, maximum uptime
  - Maintain low emissions of carryover on recovery boiler (to stack)
  - High maintenance
  - Water side cleanliness
  - Combustion control on power boiler needs some adjustment
  - Maintenance costs
  - Wood/bark fired boiler, reduce PM & NOx emissions with better distribution of overfire air & updated controls
  - Replacement of old 1960 vintage hog fuel boiler
  - Reliability
  - Excessive carbon in ash
  - Meet air emission target
  - Ash carryover to ash system
  - Overheating multiclone hoppers @ high rates of bark burning (co-fired boiler)
  - Recovery boiler particulates

Boiler Needs Survey
Forest Products Industries Responses

JANSEN Combustion and Boiler Technologies, Inc.

Question 12 (continued): In order of priority, what are the current operating challenges with your boilers?

1st priorities (continued)

- Recovery boiler particulates
- Increased steam demand beyond rated capacities by 45%
- Low solids on recovery boilers
- Reduce or minimize water/chemical carryover out of the steam drum
- Availability of sufficient quantity of waste wood fuel
- Ash removal
- Offset natural gas with bark by getting more out of bark boiler
- Recovery low order conversion
- Reliability of pressure parts
- Getting more out of recovery boiler
- Optimize header control
- Replacing tubes in recovery boiler
- Reliability of wood waste steam boiler. Grate system a maintenance nightmare. This hampers drive to produce more steam from wood waste.
- Increase recovery boiler capacity
- Reliability of operation (i.e. reduce unplanned downtime)
- Generating bark pluggage and lower furnace air port corrosion in boiler B (?)
- Power boiler efficiency

Boiler Needs Survey
Forest Products Industries Responses

JANSEN Combustion and Boiler Technologies, Inc.

Question 12(continued): In order of priority, what are the current operating challenges with your boilers?

- 2nd priorities
  - Burning in suspension/carryover
  - Get some capacity creep out of 2 recovery boilers – particulate emissions / precipitators will be major issue with both boilers
  - Tubes plugging in steam boiler when burning oil with fuel additive
  - Recovery boiler maximum operating rate (40% over MCR)
  - Maintain high availability of bark boiler (steam production with refuse)
  - Generator bank erosion/corrosion
  - Low reliability
  - Max steaming rate on recovery boiler
  - Fuel flexibility
  - Natural gas: NOx reduction
  - Cost/# steam
  - Opacity
  - Increase capacity (fuel/steam)
  - Decrease need to co-fire fossil fuels
  - Increase wear of ID fan rotor with high rate of bark burning

Boiler Needs Survey
Forest Products Industries Responses

JANSEN Combustion and Boiler Technologies, Inc.

Question 12(continued): In order of priority, what are the current operating challenges with your boilers?

- 2nd priorities (continued)
  - Power boiler SO2
  - NOx & CO emissions from heavily N-bound fuels
  - Maximize grate fuel to replace fossil fuels
  - Pluggage of recovery boilers, liquor systems, cascades, etc.
  - Steam coil air heater reliability
  - Reliability
  - Lower boiler grate and ash handling upgrades
  - Unstable operation
  - Getting more waste fuel in waste fuel boiler consistently
  - Balance steam/electric load
  - OFA on bark boiler
  - Reducing emissions from old (cascade) recovery boiler – without spending lots of capital on low-order conversion
  - Increase off season bark burning
  - Cost of operation (i.e. maximizing generation using low cost fuels)
  - Increased bark burning in biomass boiler
  - Combustion stability and reduction efficiency for recovery boilers

Boiler Needs Survey
Forest Products Industries Responses

JANSEN Combustion and Boiler Technologies, Inc.

Question 12(continued): In order of priority, what are the current operating challenges with your boilers?

- 3rd and lower priorities
  - Hot ash
  - Inconsistent fuel quality/feed to boiler
  - Reduce natural gas firing
  - Cracking of tubes within recovery boiler
  - Maintain natural gas consumption to minimum
  - Tube leaks (old boilers/dirty water side)
  - Bark boiler fuel efficiency
  - Boiler pluggage
  - Storage of offline boilers
  - Ease of operation
  - Reduce outlet gas temps
  - Improve combustion stability
  - Reduce excess air
  - Turn down on both recovery boilers
  - High fuel, operating, and maintenance costs
  - Minimize gas
  - Need to produce ~50 T/hr more steam for possible paper machine restart
  - Reduce carryover bark fines & ash
  - Reduce oil use
  - Environmental (i.e. managing solid fuels quality to meet permits)
  - Secondary treatment sludge burning in biomass boiler

Boiler Needs Survey
Forest Products Industries Responses

JANSEN Combustion and Boiler Technologies, Inc.

Question 13: What future operating/permit challenges are you anticipating for your boilers?

Response rate: 28/42 (67%)

- 1st priority
  - Fluidized bed technology
  - NO_x
  - Steaming rate increased to meet production needs
  - Operating recovery boilers at their MCR in the safest manner
  - Operating power boilers safely at their minimum cost
  - NO_x emissions for coal
  - Expect TRS & particulate permits to decrease
  - Lower NO_x limits / NO_x control
  - Idaho Tier II permit in 2004 for hog fuel boilers
  - Upgrade / consolidation / retirement
  - Opacity
  - Build a new recovery boiler
  - SO2 – would like to burn cheaper coal with high sulfur content
  - Presently evaluating MACT implications
  - Future SO2 emission regulations may impact bunker C firing (change fuels or install NaOH scrubber)
  - NO_x and CO compliance
  - Any major work on boilers - even tube (in-kind) replacements – can trigger a PSD review

Boiler Needs Survey
Forest Products Industries Responses

JANSEN Combustion and Boiler Technologies, Inc.

Question 13 (continued): What future operating/permit challenges are you anticipating for your boilers?

2nd priority

- ESP capacity
- Convert recovery boiler to bark boiler
- Replacing waste fuel boiler wet scrubber with precipitator to get lower emissions
- MACT – not yet clear
- NO_x on gas boiler
- Recovery boiler capacity increase
- Replace oil boiler w/ biomass boiler
- NO_x limits
- NO_x and SO_x for power boilers
- Alternate fuels
- Burn high salt hog – haze issues
- New particulate limits
- Upgrade burners
- NO_x & particulate on combination boiler
- Electrostatic precipitator improvement
- Determining proper time to acid clean units w/ good DWD data & inspection (?), after long lag time since last cleaning
- Effect of Kyoto protocol (in Canada)