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Energy Efficiency and a Cleaner Energy Perspective for India

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Energy Conservation | Environment | Process Efficiency

This presentation will focus on

- The power scenario in India
- Policy and initiatives at the country level
  - Clean energy
  - Energy Efficiency initiatives
- The Energy Efficiency business at Forbes Marshall

Power Scenario in India

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Installed Generation Capacity (As on 31-07-10)

All India	Thermal				Nuclear	Hydro	Renewable (RES)	Grand Total
	Coal	Gas	Diesel	Total				
MW (,000s)	87	17	1.2	105	4.6	37	16.4	163
%	53	10	1	64	3	23	10	100.0

RES -Renewable Energy Sources includes Small Hydro Project(SHP), Biomass Gas(BG), Biomass Power(BP), Urban & Industrial waste Power(U&I), and Wind Energy.

All India Thermal PLF (%)

2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11 (upto July 10)
72.2	72.7	74.8	73.6	76.8	78.6	77.2	77.48	74.93

Source: Central Electricity Authority

Annual per capita consumption of Electricity

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Year	Per capita consumption (KWh) (as per U.N. methodology)
2002-03	566.69
2003-04	592.00
2004-05	612.50
2005-06	631.50
2006-07	671.89
2007-08	717.13
2008-09	733.54

The per capita power consumption in India has grown 30% in 6 years, but it is still less than 20% that of China, and less than 5% that of US

Source: Central Electricity Authority

- It is clear that supply will increase substantially to meet:
  - The existing gap between energy supply and demand
  - The growth in future demand that India's economic growth will require

…….and there's yet another problem

T & D losses in Power

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Transmission & Distribution (or is it Theft & Dacoity?) losses in India

Year	T & D Losses
2002-03	33%
2003-04	33%
2004-05	31%
2005-06	30%
2006-07	29%
2007-08	27%
2008-09	25%

Source: Central Electricity Authority

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Therefore, the great need for energy efficiency and energy conservation

India – Green Initiatives

- Green House Gas emission monitoring
- Renewable Energy initiative
- Energy Efficiency initiatives / incentives for industry

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Green House Gas (GHG) Emission

India's GHG Scenario

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- India total GDP in 2008 - US$1.2 trillion
  - 12th in the world
- India - 4th largest GHG emitter in the world and accounts for 8% of global emission
- Indian GHG emissions are projected to increase by almost three times from1990 levels by 2020
- India's recent international commitment of reducing its GHG emission intensity of GDP by 20-25% from 2005 levels by 2020
- National Action Plan on Climate Change released by Prime Minister on 30th June 2008

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Our vision is to create a prosperous, but not wasteful society, an economy that is self sustaining in terms of its ability to unleash the creative energies of our people and is mindful of our responsibility to both present and future generation

- Prime Minister Manmohan Singh, in National Climate Change Policy June 30, 2008

India’s 8 Missions to address climate change

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1. National Solar Mission
2. National Mission on Enhanced Energy Efficiency
3. National Mission on Sustainable Habitat
4. National Water Mission
5. National Mission for Sustaining the Himalayan Ecosystem
6. National Mission for a Green India
7. National Mission for Sustainable Agriculture
8. National Mission on Strategic Knowledge for Climate Change

Key policies and actions

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- Energy Conservation Act, 2001
- Reforming energy markets (Electricity Act 2005, Tariff policy 2003, Petroleum & Natural Gas Regulatory Board Act, 2006, etc.)
- Ethanol Blending of Gasoline - Mandates 5% blending of ethanol with gasoline since 1 January 2003 in 9 states & 4 union territories
- New and Renewable Energy Policy 2005 – To promote dependency on sustainable green energy source

Key policies and actions

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- Rural electrification policy 2006 – Promoting renewable power where grid connectivity is not possible
- Bio diesel purchase policy - Mandates bio diesel procurement
- Energy conservation building code
- Bachat Lamp Yojana – Replacing incandescents by CFLs
- 50,000 MW hydroelectric Initiative – 162 Hydel projects identified

Renewable Energy – Electric Power Generation

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- Wind
- Solar
  - Target 20,000 MW by 2022
- Bio Mass
- Small Hydro (< 25 MW)

Renewable Energy - Incentives

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- No common policy, but some combination of:
  - Corporate Income tax exemptions: for 5 – 10 years
  - Concessional Customs and Excise duty exemptions on capital equipment procurements
  - Low interest loans
  - For solar: direct financial incentives

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Energy Efficiency

Energy Efficiency

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- Energy Conservation Bill introduced in 2000 and Act enacted in September 2001
- The National Mission on Enhanced Energy Efficiency Launched in Aug 2009.
  - Targets:
    - To reduce Specific Energy Consumed (Energy Consumed / Output of firm) in large energy intensive consumers.
    - Trading mechanism in Energy Certificates - ~ Rs 750 billion ($16 billion) of transactions by 2015
- Key aspects of the Mission
  - Perform Achieve and Trade (PAT) scheme
  - Market Transformation for Energy Efficiency
  - Financing of Energy Efficiency Projects
  - Power Sector Technology Strategy

Energy Efficiency

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- PAT (Perform Achieve and Trade) Scheme Objective:
  Market based mechanism for enhancing energy efficiency in “Designated Consumers”
  - Three phases of the scheme:
    - Goal setting for the individual Designated Consumers
    - Reduction phase
    - Trading phase
  - Consumers exceeding targets would get tradable energy certificates
  - Consumers failing to achieve targets would compensate by buying certificates

Energy Efficiency

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- Market transformation for Energy Efficiency
  - (Accelerated shift to use of energy efficient products)

  – Standards and Labeling
  – Development of public entity procurement policy
  – Tech program for replacement of inefficient equipment
  – Development of energy conservation building code
  – Promotion of Energy Service Companies (ESCos)
  – Capacity building and Information Dissemination

Energy Efficiency

- Financing of energy efficiency projects
  - Tax exemptions for the profits made from energy efficient projects by ESCos + VC Funds / Reduction of VAT taxes for energy efficient equipment.
  - Partial Risk Guarantee fund:
    - this fund will provide commercial banks with partial coverage of risk exposure against loans made for energy efficiency projects.
  - Venture Capital fund:
    - which will support manufacturing of energy efficient products and energy efficiency services.

Energy Efficiency

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- Power Sector Technology Strategy
  - (Aimed at enhancing energy efficiency in power plants)

- Finance for enhancing energy efficiency in power plants
- Adopt energy efficient generation technologies in new plants, including installation of supercritical boilers
- Enhance energy efficiency in existing power plants
- Roadmap for IGCC (Integrated Gasification with Combined Cycle) demonstration plants
- Development of know-how for advanced super-critical boilers
- Road map for fuel shift toward cleaner fuels

Some Forbes Marshall Focus Areas

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- Improvements by way of better efficiency and reduced downtime through better power plant maintenance

- Energy (Thermal + Electric Power) from Waste Fuels (Bio Mass)

- Minimizing energy waste by improving energy usage practices in process plants

Efficiency of power generation

- Total efficiency of power generation in thermal power plants:
  - a function of boiler efficiency, conversion efficiency of the steam turbine, and losses in the thermodynamic cycle.

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Input: Fuel

- Oil
- Coal
- Gas
- Biofuels

Output:

Steam that drives turbines

The Case for Efficiency

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- 64% of India's electricity comes from Thermal Power plants
- ~ 65% of India's Green House Gases are caused by Power Generation
- So, making power plants better can greatly impact the environment

Operational efficiency is affected by…

- Forced outings (FO)
- Planned Shutdowns (PS)
- Availability of the Power plant = 100 - (FO+PS)
  - ~ 80% for Indian Power plants.
- Two major causes of shutdowns are related to corrosion and vibration effects.

Making Power Plants Better – Corrosion effects

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- Monitoring beyond the boiler…..
  - Corrosion effects and deposition on turbine blades plays major role in destabilizing power plants
    - Over 50% of unplanned shutdowns are due to inadequate analysis/control of impurities and resulting corrosion
    - Reduces both efficiency of power generation and life of the power plant
  - Maintaining water & steam quality at ultrapure levels is therefore key
  - A good water quality management system is therefore essential for any power plant running on steam.

Making Power Plants Better – Vibration effects

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- Monitoring beyond the boiler…..
  - Vibration monitoring of:
    - Critical Machinery – Turbine & Generator
    - Other Essential Machinery – Boiler Feed Pumps, Cooling Water Pumps, Condensate Extraction Pumps, Fans, Motors
    - Balance of Plant – Cooling Tower fan, Press Air Fan, Make up water pump, Raw water pump, Coal Handling Crushers, Compressors

Making Power Plants Better – Vibration effects

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- Monitoring beyond the boiler…..
  - Vibration monitoring
    - Monitor trends to detect anomalies / abnormalities
    - Diagnose the causes from the data
  - Timely detection allows for corrective action before critical damage occurs, and enables planned rather than forced shut downs.

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Decentralized Energy Generation

+

Energy from Waste Fuels

De-centralized IPPs & CHPs

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- Because of losses in distribution, de-centralized Integrated Power Plants (IPP) & Combined Heat and Power Plants (CHP) instead of single standalone power plants offer a solution.

- The Benefits:
  - Usage of fuels (including waste fuels) based on local availability
  - Control on Generation relative to demand
  - Lower Maintenance and Operating Costs
  - Eliminates setting up separate utilities for process heating needs

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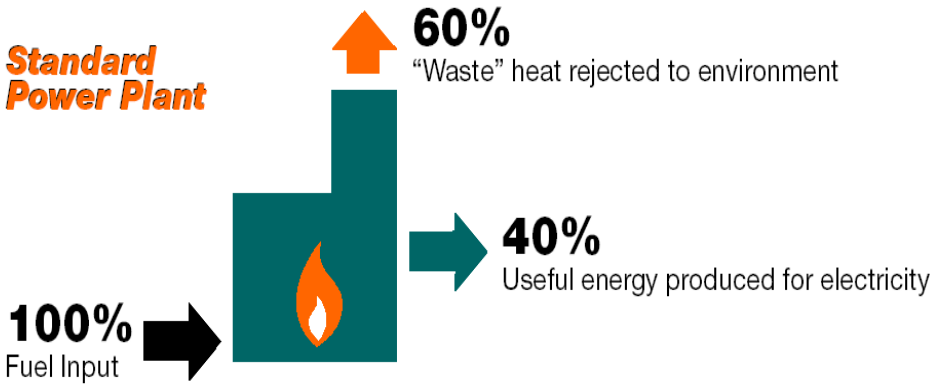
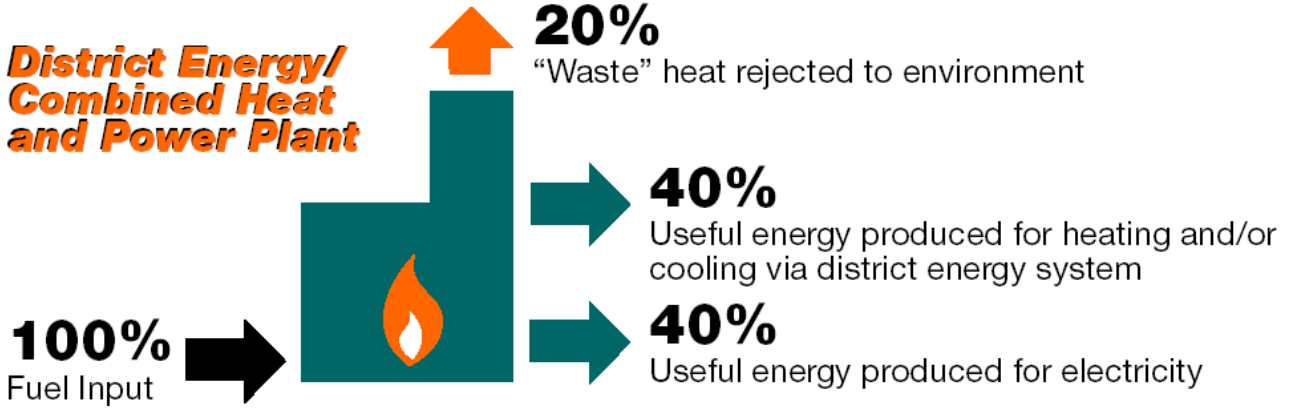
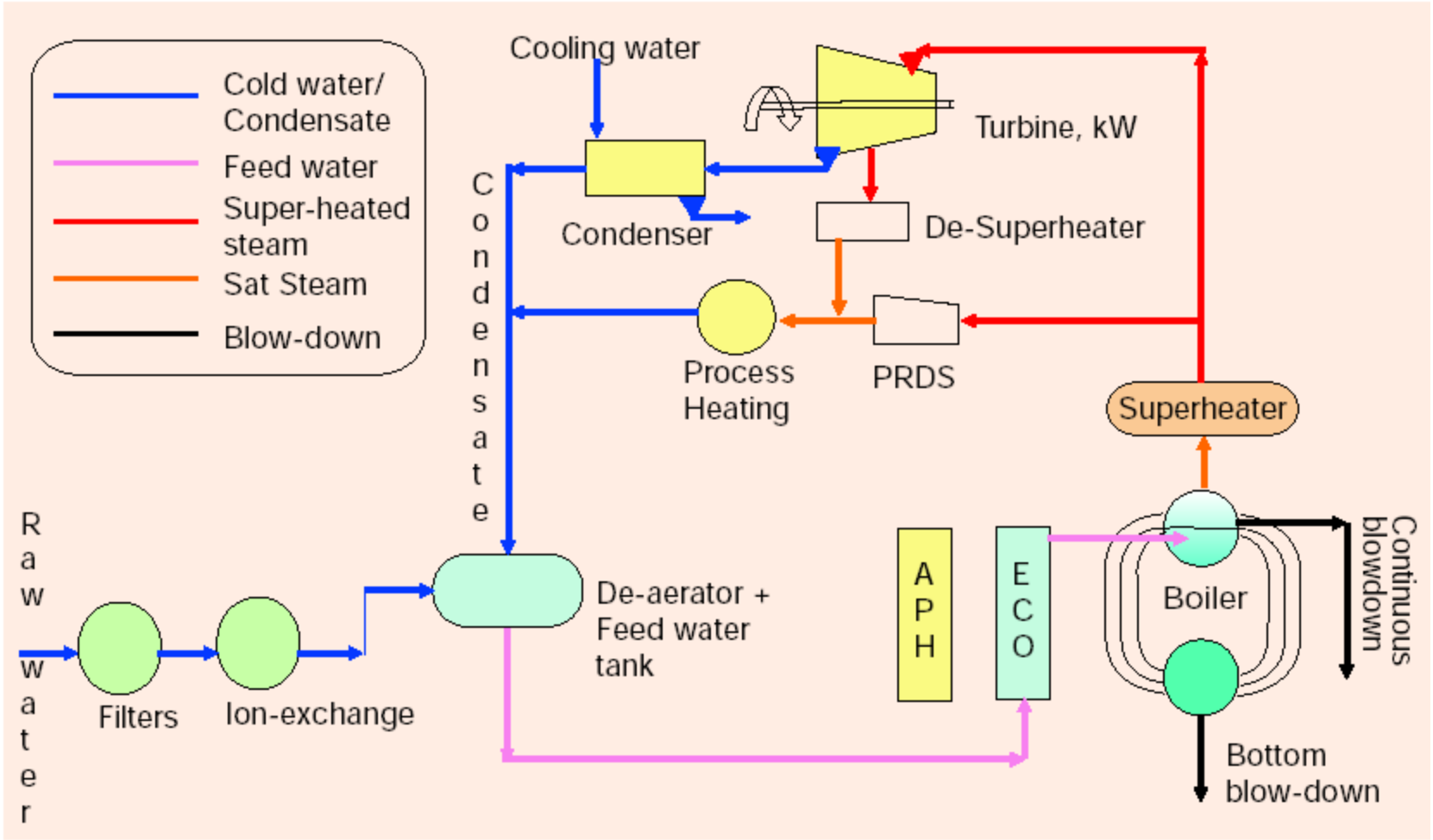




Cogeneration

Typical Cogeneration Plant Layout



“Tomorrow’s” Power Sector

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De-Centralized – CHPs

Fuel Source Shift

A shift to locally available… Biomass

Waste to Energy !

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Industrial By-Products

- Spent grain in Breweries, Coffee processing waste.
- Spent wash in Distilleries.
- De-inking sludge in Paper Industry.
- Bleaching earth (Spent Earth) from Solvent extraction in Edible Oil Refinery plants.
- Empty Fruit Bunches and Kernel in Palm Oil Industry.
- Jatropa, Tyre waste etc.

Some Concerns for the use of Biomass

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- Repeatability of supply of a particular biomass not guaranteed.
- Biomass Supply Chain is unorganized.
- Combustion Technology for different Biomasses vary.
- Critical issues like high moisture and low ash fusion temperatures reduce the availability of a power plant.
- Low bulk density of fuel leading to high transportation and handling costs.
- Suitable technologies for mechanized handling of biomass.

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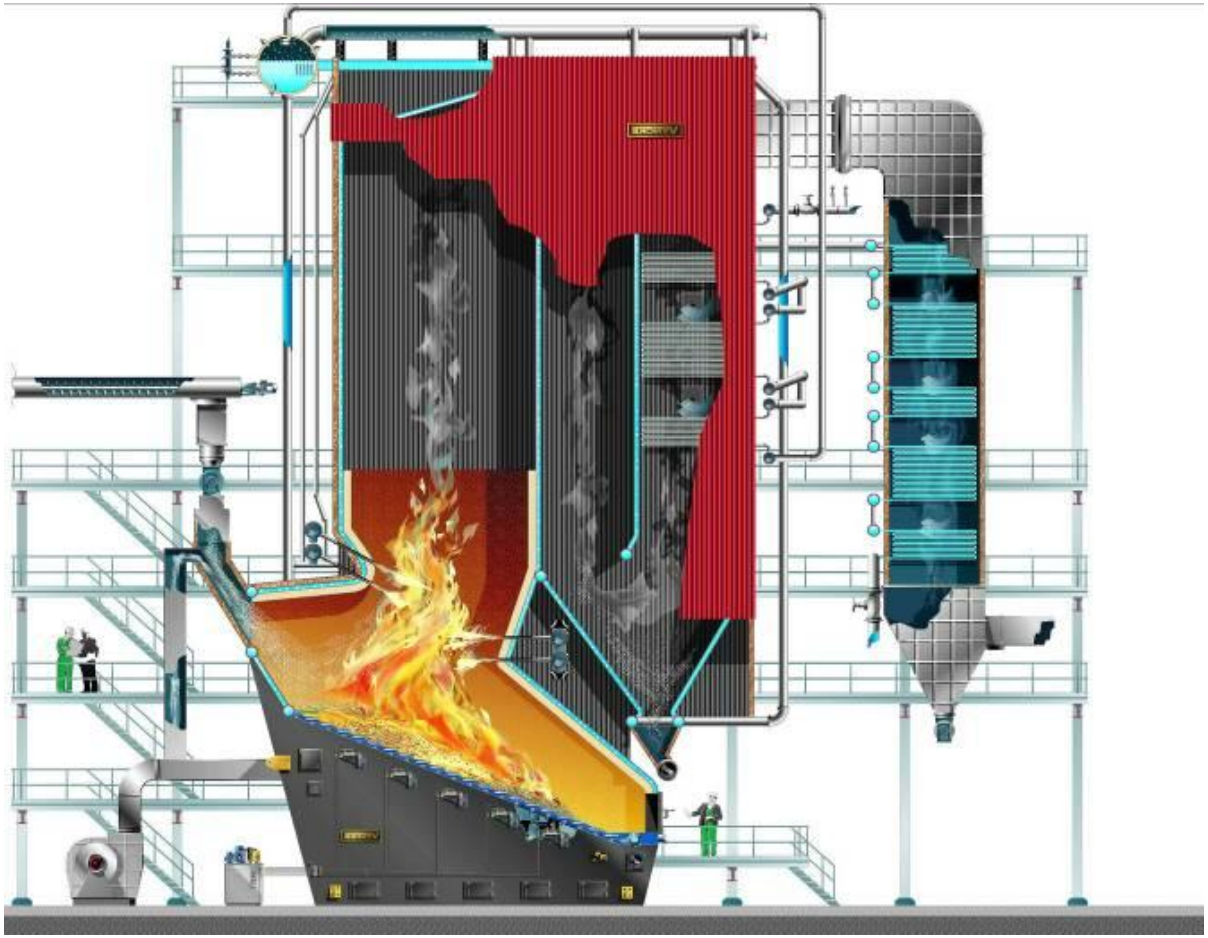
- Mini-Power Plants – 0.5 Mwe and above



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- Dynamically Water Cooled Step Grates …..

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and finally,

the great need for better energy conservation in process plants

Energy Conservation - From Fashion Statement to Reality

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- There always was:
  - Great need, great interest, and great potential for energy savings
  - But also a big gap in interest and what is actually achieved

- Now, moving from Energy Conservation as “fashion statement” to reality:
  - Helped greatly by the volatility in fuel prices
  - Estimated potential for savings in India for process steam alone is over US$ 1.3 B, based on the installed capacity of process steam usage

An efficient Steam & Condensate Loop

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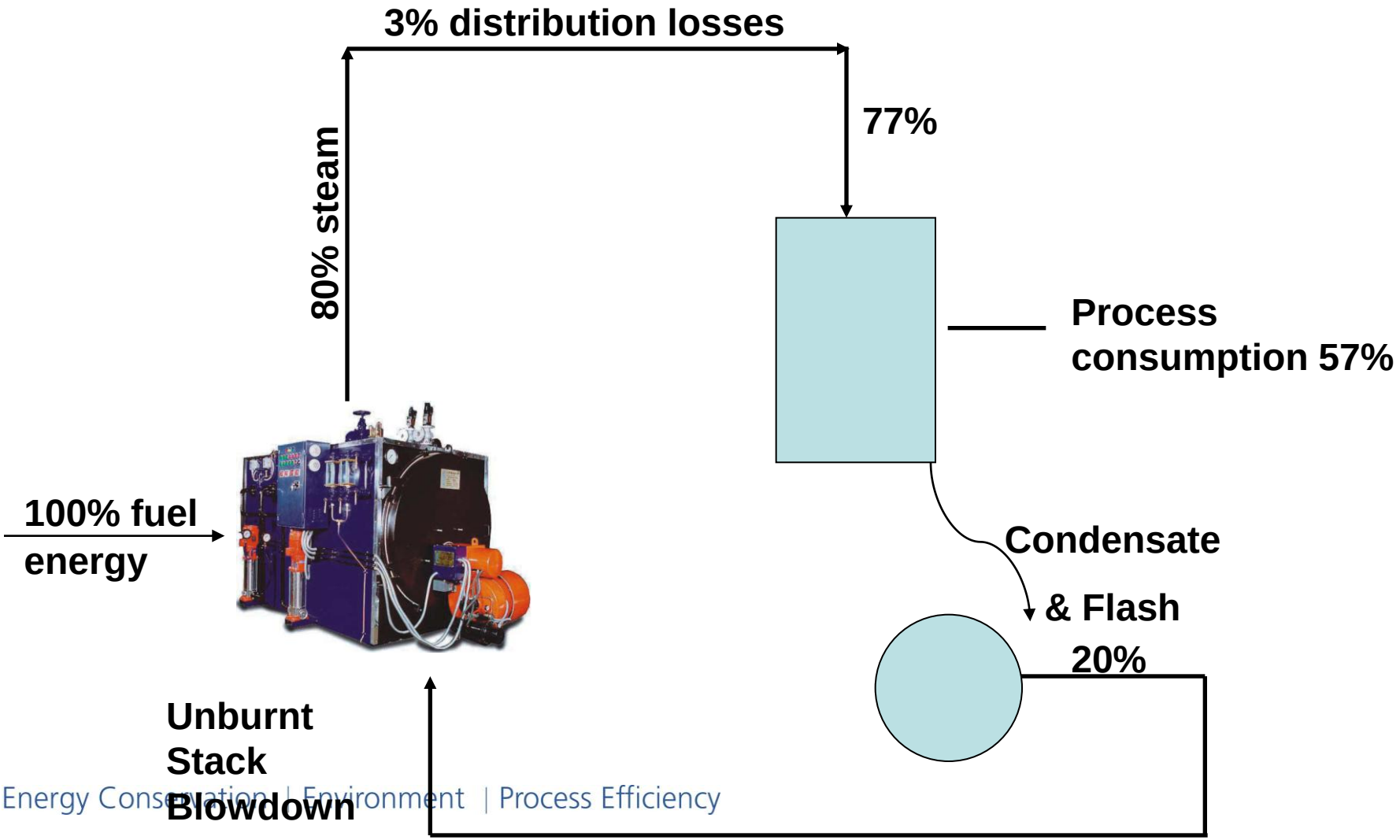

Critical Elements of Energy Efficiency & Steam Systems

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How efficient is the Boiler?
Direct, Indirect, Ideal efficiency

- The substantial gap in efficiency is due to either incorrect feed water temperatures, oversized boilers and improper combustion control

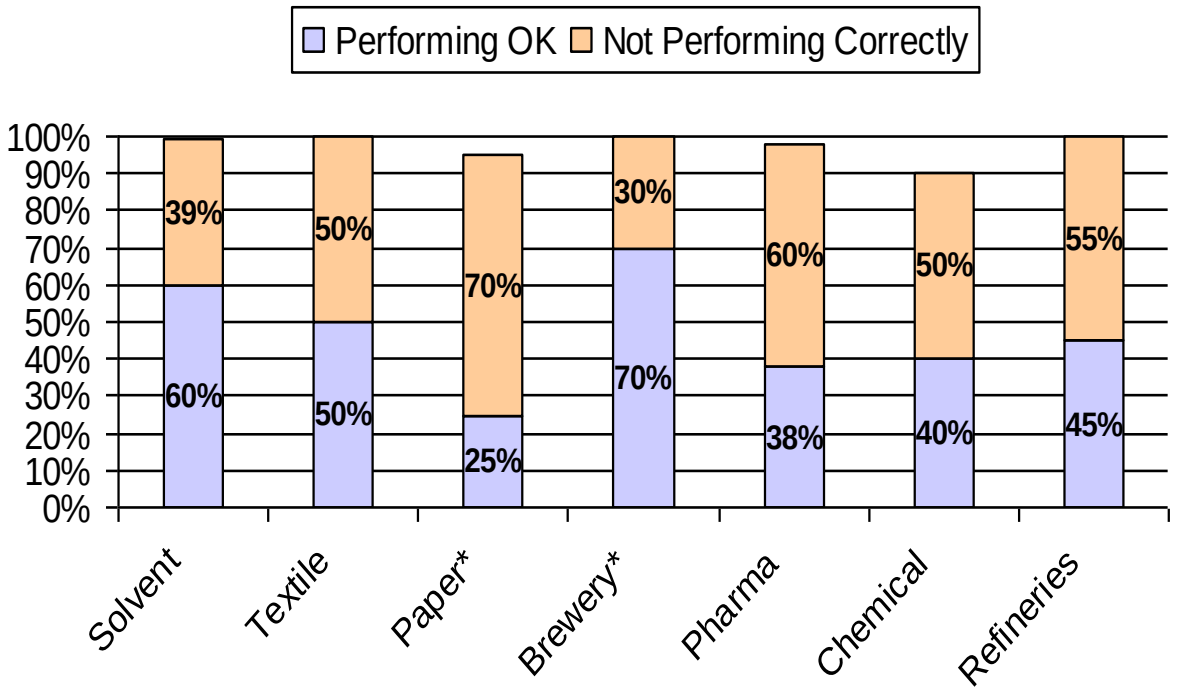
How much condensate is being returned?

- In reality, we found that less than half of 90+ plants surveyed returned more than half of their recoverable condensate

How many “leaking” process steam traps?

- For every X unit of energy leaked through a steam trap, 1.75 X energy is consumed in the boiler (1/0.57)
- Our survey found that between 30 and 70% of process steam traps are wrong in some way - selection, maintenance, operation

Process Traps – Actual Findings



Industry	Remarks
SEP	Trap Selection & design of CRS
Textile	Trap Selection + group trapping issues
Paper	System design; Operating practices.
Brewery	Bottle washer stalling of traps
Pharma	Selection of traps; Multiple Utility
Chemical	Balance not known
Refineries	27% failed + no trap locations

Learnings from these mundane areas of boiler efficiency, condensate recovery, and steam traps

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- Much more is possible to achieve in energy conservation - there are huge opportunities. 20%+ in energy savings between these three areas
- Ensure perceptions match reality - get the hard data on actual operations on a continuous real-time basis - diagnosis is critical
- See investment in equipment as step 1 - and only step 1 (Buying a high efficiency boiler ≠ high efficiency)
- The operation and maintenance of the equipment is even more important

The Mundane gives Big savings

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Plants # / Specific fuel consumption	Routine Plants	Plants with correct Process Trapping and Condensate Recovery	Plants with correct Process Trapping, Condensate Recovery, Flash Steam Recovery & on-line diagnosis of Boiler Efficiency
Rice Bran Kg Husk/ton	**142**	**100**	**80**
Soya Kg Husk/ton	**88**	**66**	**47**

Getting specific about conservation potential

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- Our experience suggests that the average well-managed plant in India can save 10 – 25% of its steam fuel bill

- Survey of the steam process heating systems of 97 firms:
  - In 2003: Textiles, Paper, Tyres, Breweries, Pharmaceuticals and Hotels
    - Savings potential for steam ranged from 22% to 64%
  - In 2005 and 2007:
    - Tyres 22%, Breweries 25%, Paper 44%, Textiles 54% and Hotels 64%

- These figures compare the average with the best firm operating under the same conditions, with the same fuel, with the same raw materials

Our Benchmarking findings of Specific Fuel Consumption

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Industry	Units	Best	Average	Worst
Brewery	FO Lit/KL Beer	44	58	75
Tyre	FO Kg/Ton Finished Tyre	162	210	353
Textile	Coal Kg/ 1,000 Mts	168	390	666
Paper*	Coal Kg/Ton Paper	230	408	574
SEP Soya	Coal Ton / Ton Seed Crushed	47	70	93
SEP Rice Bran	Husk Ton / Ton Seed Crushed	100	115	124
Beverage	KL Beverage / KL Fuel (FO)	189	107	76
Coil Type Boilers	Steam: Fuel Ratio	10	7.5	6
Smoke Tube Boilers	Steam: Fuel Ratio	15	12.5	10

Making Conservation happen:
it's all about managing implementation

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- Need an effective management structure
  - Committed top management to drive savings
  - Imaginative process and plant engineers and managers to propose the right schemes
  - Effective maintenance technicians to sustain savings
- Permanent Savings:
  - Audits for Diagnosis as step one
  - Implementation as step two - and focus on savings, not just working products
  - The hard work of day-to-day perfect operation
- But, if done it can make a significant difference – both economically and for the environment!

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Thank you