

Introduction to Steam and Heat Systems



Energy Efficiency Network Meeting

Holiday Inn

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AGI
ENERGY
SERVICE CENTRE



AGI
Association of
Ghana Industries



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Many industrial operations and heating applications require the use of steam and heat systems

In this presentation, will talk about;

- Heat Systems Definition and Importance
- Heat Systems Types and Components
- Energy Efficiency in Heating Systems
- Introduction – Steam Systems
- Typical Industrial Use of Steam
- Energy Efficiency in Steam Generation and Distribution
- Energy Efficiency in Steam Distribution

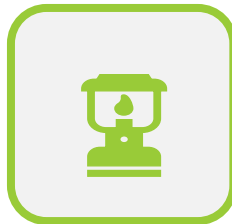


Heating Systems Definition and Importance

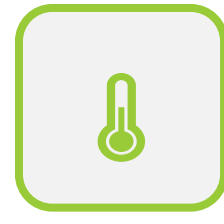
- Heat is associated with the transfer of thermal energy from one object or substance to another due to temperature differences
- A heating system is equipment and components designed to provide an enclosed space, such as a building or a room with heat.
- Heat systems are integral to numerous industrial processes, from manufacturing to food processing.
- They enable precise temperature control, ensuring product quality and safety.



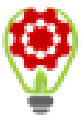
Heat



Heat source



Temperature



The Need for Energy Efficiency and Sustainability

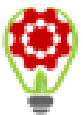
Heating systems are major contributors to greenhouse gas emissions, which drive climate change.

- Energy-efficient systems and sustainable practices reduce emissions, mitigating environmental harm
- Energy-efficient heating systems lower energy bills, saving industries and businesses money in the long run. Heat recovery systems can also reduce operational costs in various industries.
- Energy-efficient heating and heat recovery systems help reduce an individual's or organization's carbon footprint, contributing to global efforts to combat climate change
- Rapid advancements in heating and heat recovery technology have made energy-efficient solutions more accessible and cost-effective
- Heat recovery systems capture and repurpose waste heat, reducing the need for additional energy inputs and conserving resources

Source: ecomatcher.com



Reducing carbon footprint



Heat Systems Types and Components

Some common Heat Systems:



Furnace



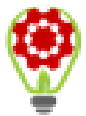
Boiler



Heat Pump



Space Heater



Heating Systems Types and Components Cont'd.

Some Components of Heat Systems;

- Boiler Shell, Combustion Chamber or Furnace, Heat Exchanger, Steam Circulation System Feedwater System, Burner.
- **Safety and Control Devices:** Pressure Relief Valve, Temperature and Pressure Gauges Water Level Controls

Source: dieselship.com



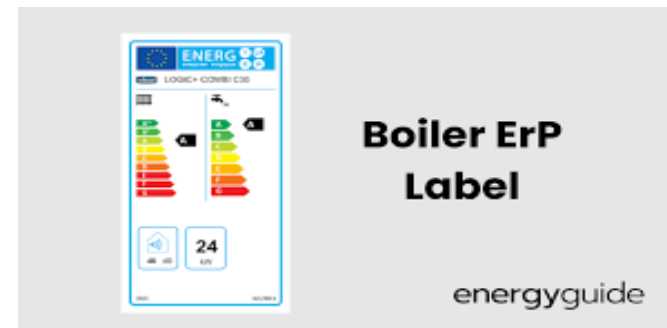
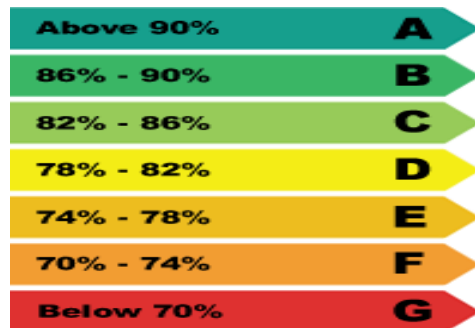
Boiler Plant



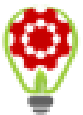
Energy Efficiency in Heating Systems.

Energy Efficiency Ratings

- The most common rating for boilers is the Annual Fuel Utilization Efficiency (AFUE) for gas-fired boilers and the Thermal Efficiency (TE) for oil-fired boilers.
- You'll often see it on the little yellow "Energy Guide" tag on the side of a furnace or HVAC system.
- Heating Seasonal Performance Factor: It is a rating only for heat pumps, which move heat from a colder space into a warmer space



Source: SEDBUK , gasboilerforums.com



Energy Efficiency in Heating Systems Cont'd.

Strategies for Enhancing Efficiency in Heat Systems

- Regular Maintenance
- Upgrade to High-Efficiency Equipment
- Upgrade Insulation
- Heat Recovery Systems
- Efficient Ductwork



Maintenance



Insulation Upgrade



Energy Efficiency in Heating Systems Cont'd.

Benefits of Energy-Efficient Heating Systems.



Lower Energy Bills



Reduced Environmental Impact



Increased Competitiveness



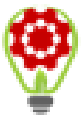
Reduced Maintenance Costs



Compliance with Regulations



Energy Independence



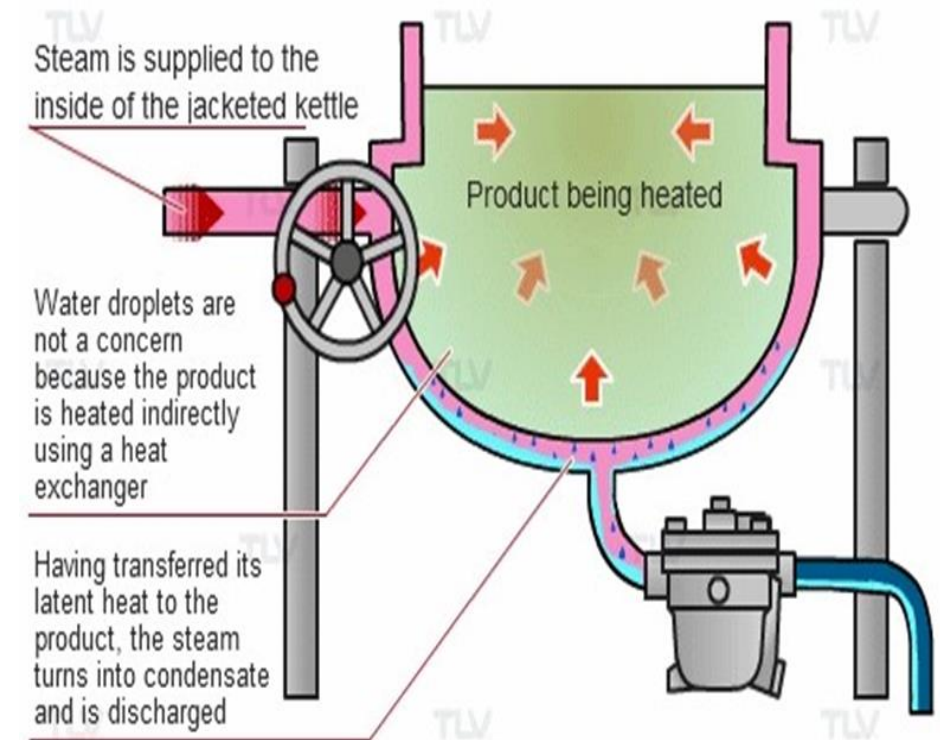
Steam Systems

Introduction – Steam Systems

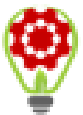
Steam is water in its gaseous phase. Steam is generated in boilers and then distributed.

Why Steam?

- It is very efficient as a heat source and cost-effective in distributing to point-of-use.
- Very flexible for different heat requirements.
- The technologies and applications are proven at different scales.



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Typical Industrial Use of Steam

- Propulsion and Drive (Power generation)
- Cleaning (Food & beverage, Pharmaceuticals)
- Moisturisation (Agro-allied, Paper)
- Pasteurisation (Breweries, Food & beverage, Sugar refining)



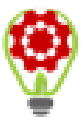
Steam Power Plant



Cleaning

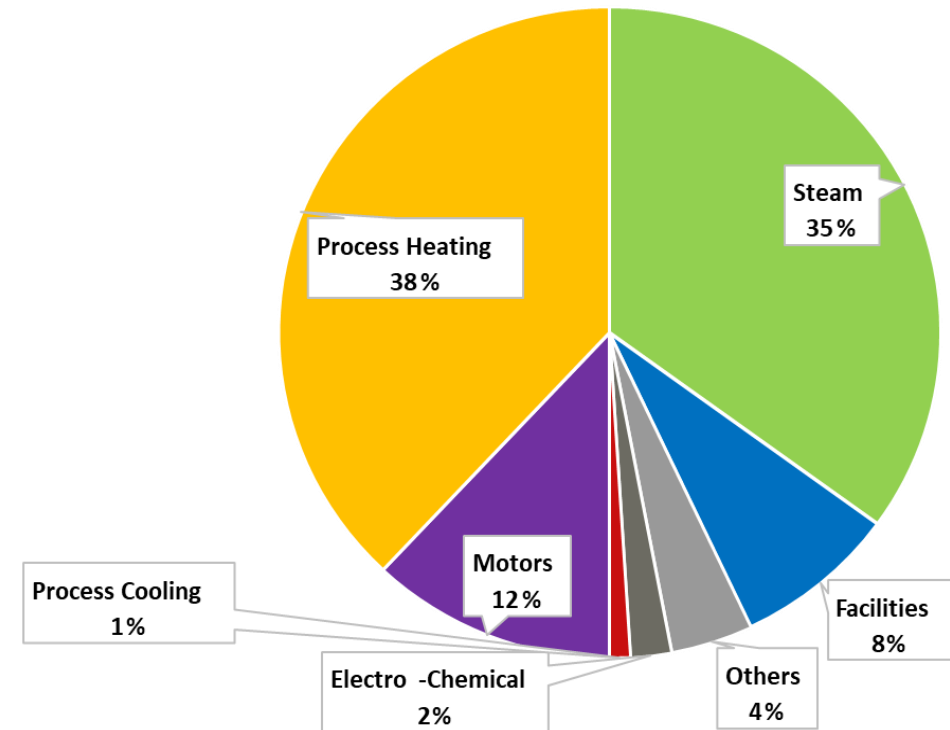


Pasteurisation



Steam Consumption in Industries

- Steam production accounts for around 35% of energy consumption in Industries



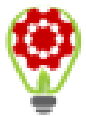
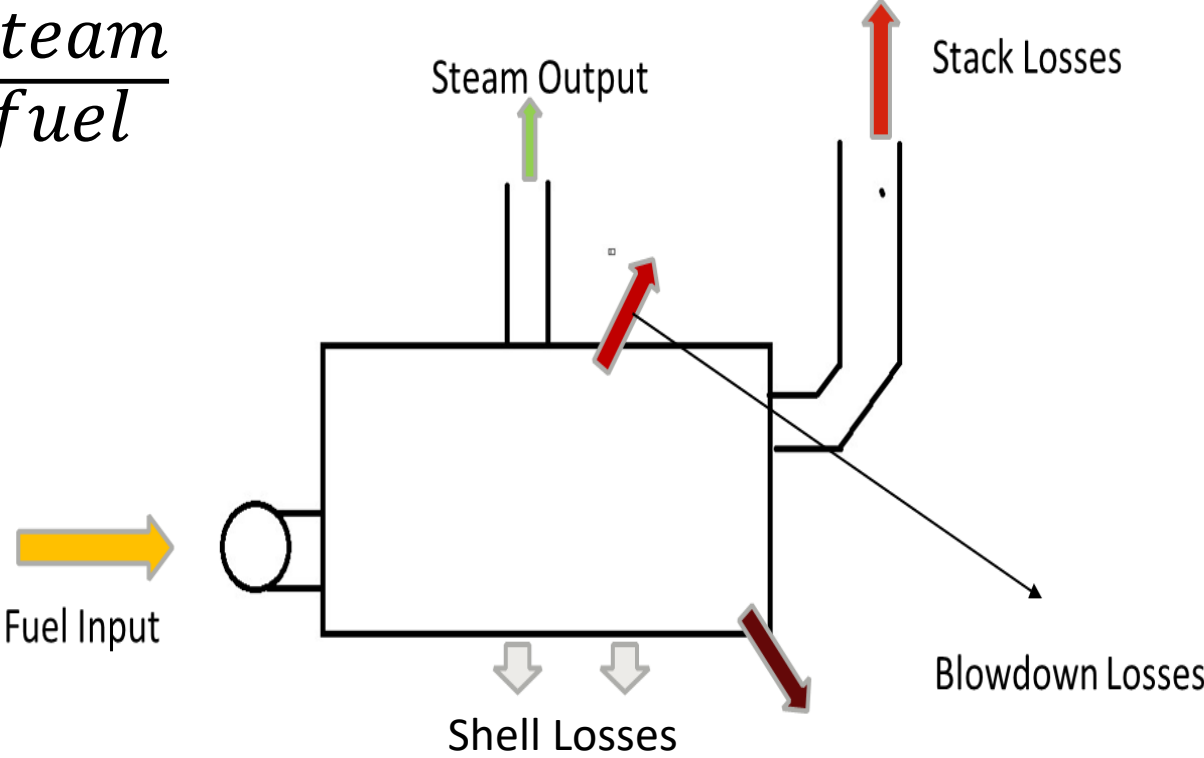
Typical energy consumption in industries.

Source: DOE/EIA Monthly energy review (2004)



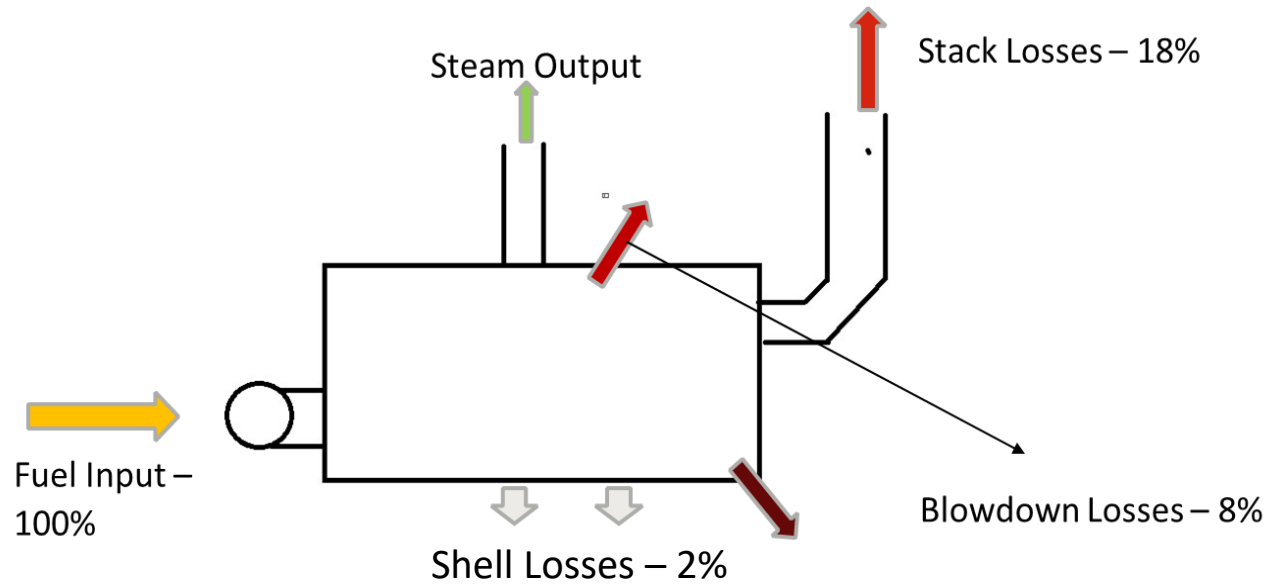
Energy Efficiency in Steam Generation

$$\text{Efficiency} = \frac{\text{Output Energy in Steam}}{\text{Input Energy in fuel}}$$



Energy Efficiency in Steam Generation cont'd.

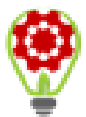
$$\text{Efficiency} = \frac{\text{Output Energy in Steam}}{\text{Input Energy in fuel}}$$



Stack loss

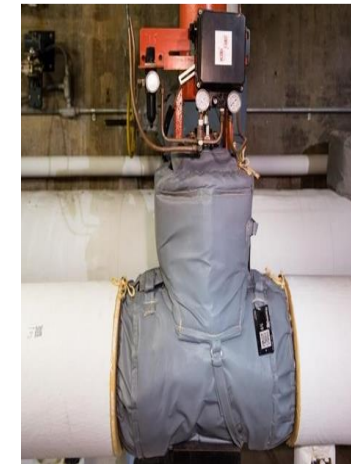


Blowdown loss



Energy Efficiency in Steam Distribution

- Proper System Design: Insulate steam pipes to prevent heat loss during distribution
- Insulation: Properly size pipes, valves, and other components to match the load requirements;
 - 0.7kWh of thermal energy is lost per meter of unlagged piping.
 - @8,400hrs per year operations, you loose GHs10,114/year per meter of unlagged piping
- Steam Traps: Install and maintain steam traps to remove condensate efficiently
- Pressure Reduction: Reducing pressure when higher pressure is not required can save energy.
- Condensate Recovery: Implement a condensate recovery system to capture and reuse condensate from steam processes.



Unlagged Valves contribute to energy loss in steam distribution



Steam and Condensate Leaks

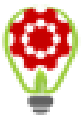
- Steam traps
- Valves
- Pumps
- Heat exchangers



Steam Leak at the valve



Steam leak at the steam trap



Optimizing Energy Use With Heat Recovery

- Integrate Economizers to utilize energy lost at the stack
- integrating Economizer -3% in fuel savings for Non-condensing units
- Utilize energy lost at blowdown to increase boiler feedwater temperature
- Utilizing blowdown heat in boiler feedwater improves system efficiency by 1%

Improve condensate recovery to 75% – 90%

Improve Condensate recovery – 3% fuel savings

Boiler Feedwater economizer



Blowdown Heat exchanger



Condensate recovery tank



Source: dieselship.com



Energy Saving Areas For Steam Systems

- Minimize excess air
- Clean Boiler heat transfer surface
- Recover energy from blowdown
- Install heat recovery at the stack
- Repair steam & condensate leaks
- Check the steam pressure control

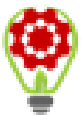
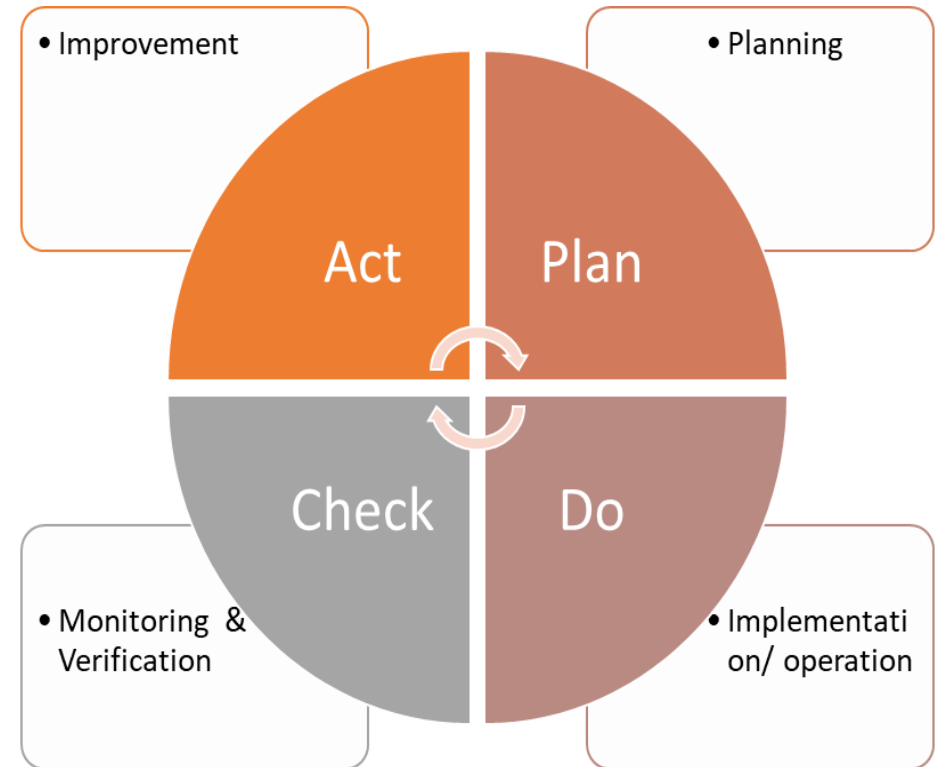


Repair Works



Energy Saving Areas For Steam Systems cont'd.

- Isolate steam from unused lines
- Match pressure needed to generate pressure
- Integrate an Energy Management to monitor specific energy consumption
- Utilize other waste heat sources in your facilities such as from power plants, furnaces, etc.



Conclusion

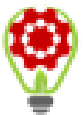
Summary

Steam and heat systems play pivotal roles in numerous aspects of our modern world, serving a wide range of industrial applications.

Steam and Heat systems are fundamental to the efficient transfer of heat energy.

Takeaway

Proper maintenance and safety protocols are essential for the safe and efficient operation of steam and heat systems. Regular inspections, water treatment, and safety devices are critical components of system upkeep.





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Thank you