

**NCASI Calculation Tool for Boiler  
MACT Output-Based Emission  
Limits – Overview and  
Compliance Approaches**

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# Output-Based Emission Limits

- Tables 1 and 2 in Subpart DDDDD include emission limits based upon boiler heat inputs, steam outputs and power generated
- Limits are applicable to HCl, Hg, filterable PM (TSM) and CO

# Why has EPA Included Output-Based Limits?

- Output-based limits are targeted at rewarding facilities which achieve greater energy efficiency through
  - Operating the boiler at higher efficiency
  - Operating combined heat and power units

# How did EPA Calculate the Output-Based Limits?

Output-Based Limit (lb/MMBtu steam)

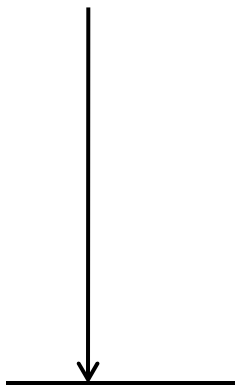
$$= \frac{\text{Input-Based Limit (lb/MMBtu heat input)}}{\text{Conversion Factor (MMBtu steam/MMBtu heat input)}}$$

# How did EPA Calculate the Output-Based Limits?

Output-Based Limit (lb/Mwh)

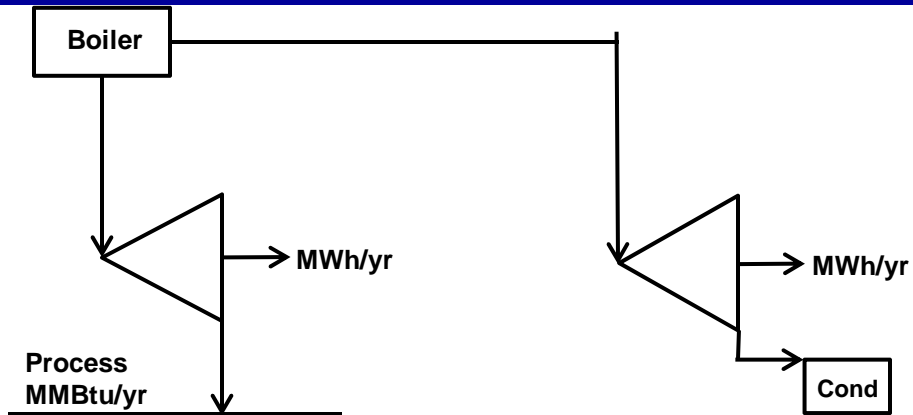
$$= \text{Input-Based MACT Limit (lb/MMBtu heat input)} \\ \times \text{heat rate (MMBtu/Mwh)}$$

# Boiler MACT Steam Output



§63.7575 Steam output means: (1)

For a boiler that produces steam for process or heating only (no power generation), the energy content in terms of MMBtu of the boiler steam output



§63.7575 Steam output means: (2)

For a boiler that cogenerates process steam and electricity (also known as combined heat and power (CHP)), the total energy output, which is the sum of the energy content of the steam exiting the turbine and sent to process in MMBtu and the energy of the electricity generated converted to MMBtu at a rate of 10 MMBtu/MWh

§63.7575 Steam output means: (3)

For a boiler that generates only electricity, the alternative output-based emission limits would be calculated using Equations 21 through 25.....

# How Would a Facility Determine the Output-Based Emission Limits for a Boiler with CHP?

- Measure the boiler steam output rate
- Calculate the effective steam output rate
- Multiply the emission limit in Tables 1 and 2 with the effective steam output rate

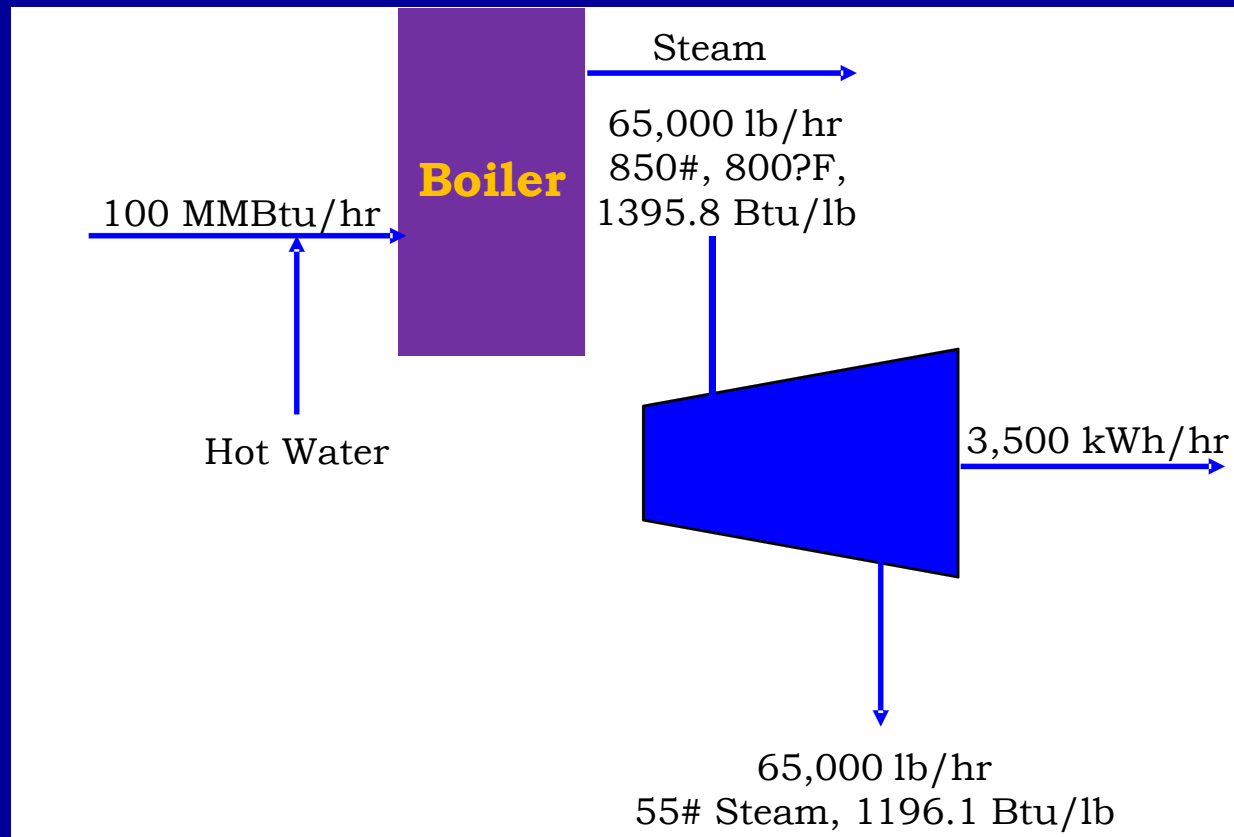
# How Does One Calculate the Effective Steam Output of a Boiler with CHP?

For boilers used to generate combined heat and power:

Effective Steam Output, Btu

$$= 10,000 \times \text{Kwh Generated} + \text{Energy Content of the Steam to the Process}$$

# Example Calculation for Wet-Biomass Stokers



Total Input = 100 MMBtu/hr

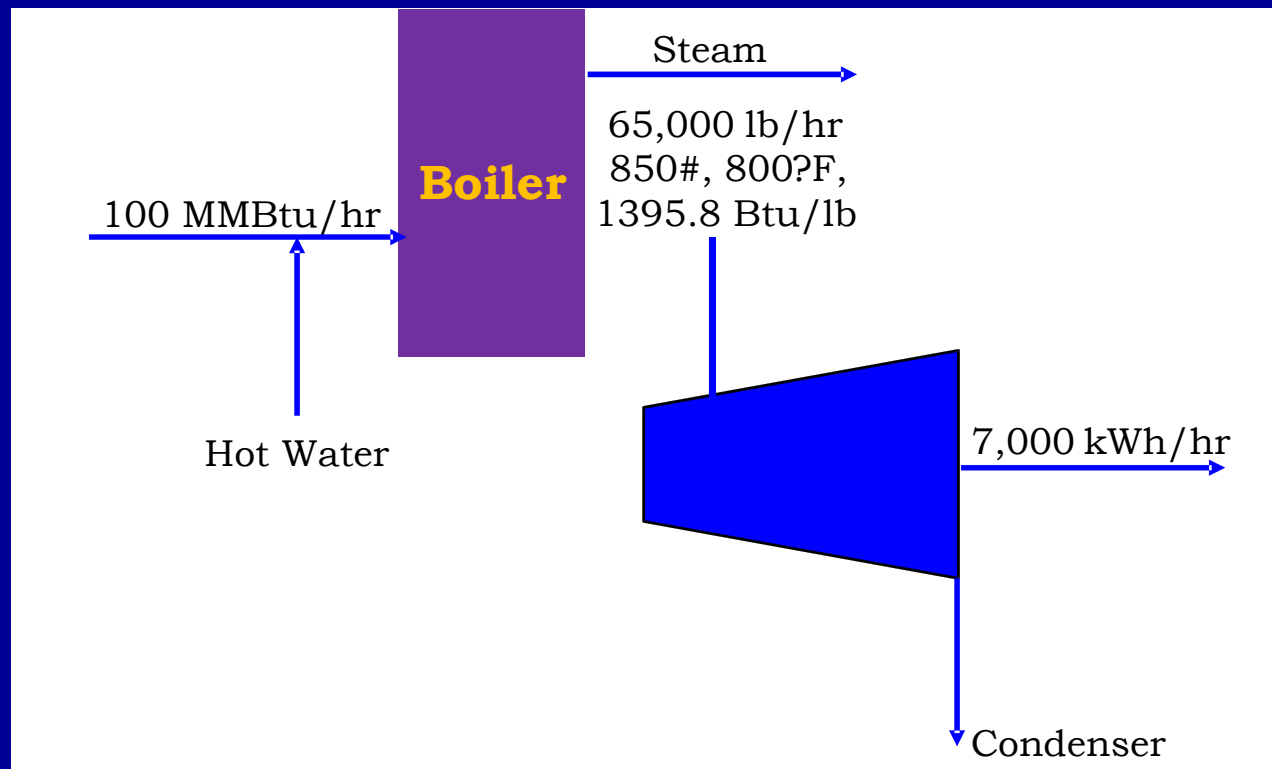
Steam Output = 91 MMBtu/hr =  $65,000 \times 1395.8 \div 10^6$

Effective Steam Output = 113 MMBtu/hr =  $(65,000 \times 1196.1 + 3,500 \times 10,000) \div 10^6$

# Output-Based Emission Limits for Wet-Biomass Stoker with CHP

	Input-based Emission Limit, lb/hr	Output-based Emission Limit, lb/hr
HCl	2.2	2.8
Hg	$5.7 \times 10^{-4}$	$7.2 \times 10^{-4}$
PM	3.7	4.9

# Example Calculation for Wet-Biomass Stokers Generating Power Only

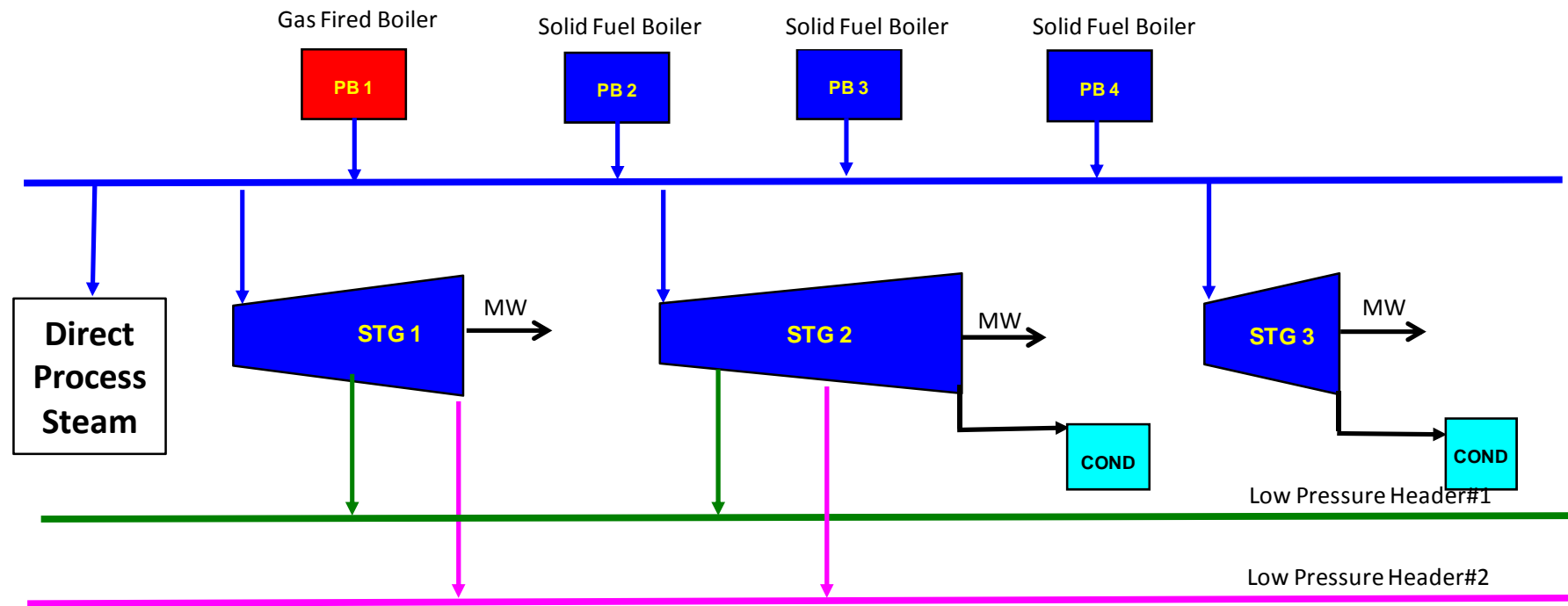


Total Input = 100 MMBtu/hr  
Power Produced = 7 Mwh

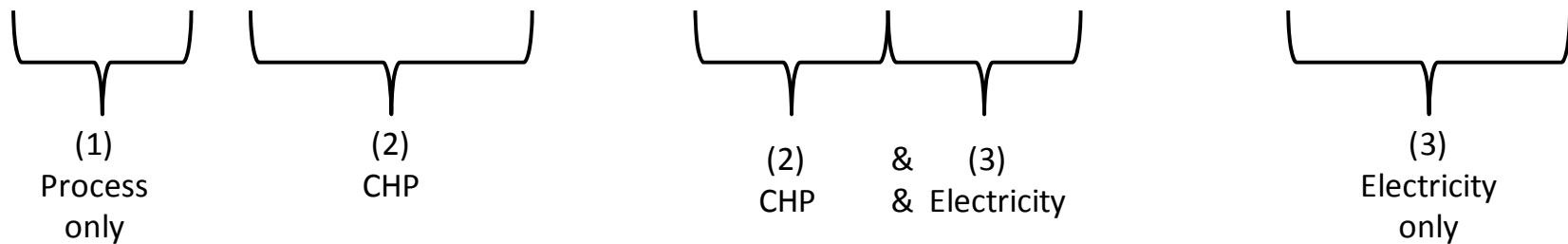
# Output-Based Emission Limits for Wet-Biomass Stoker Generating Power Only

	Input-based Emission Limit, lb/hr	Output-based Emission Limit, lb/hr
HCl	2.2	2.0
Hg	$5.7 \times 10^{-4}$	$5.1 \times 10^{-4}$
PM	3.7	3.6

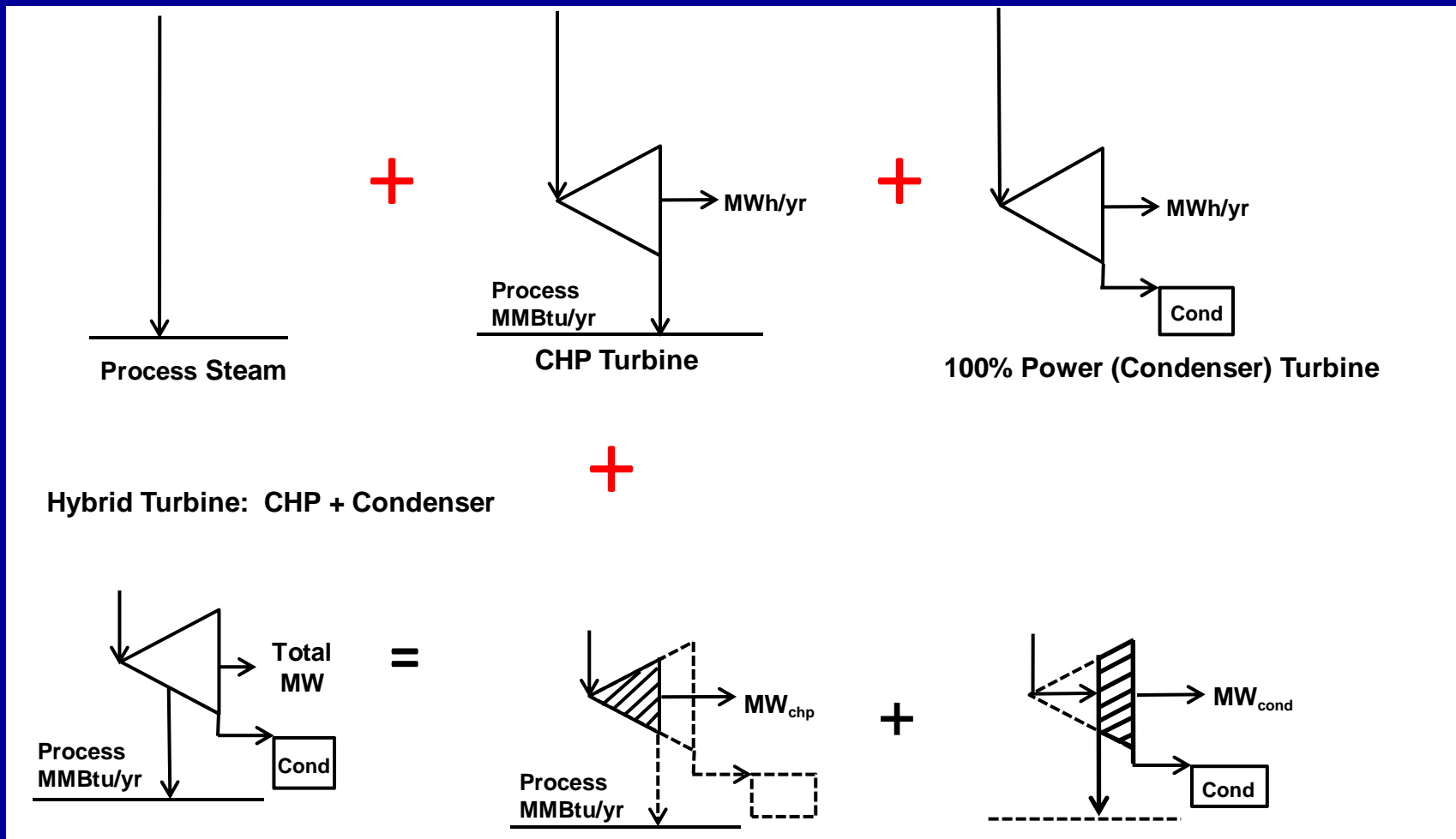
# Typical Power Island Scenario at Pulp & Paper Facilities



The "Steam Output" defined for this Power Island:



# Determination of Steam Output for Typical Power Island Scenario at Pulp & Paper Facilities



# Incorporating Output-Based Limits in Permits

- Establish boiler equivalent steam output
- Averaging time for the equivalency factor
- Continuous compliance parameters for the boilers