



Combined Heat and Power – Current Status and Future Potential

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What Is Combined Heat and Power?

CHP is an *integrated energy system* that:

- Generates electrical and/or mechanical power
- Recovers waste heat for:
 - Space heating
 - Water heating
 - Space cooling
 - Dehumidification
- Is located at or near a factory or building that can use the energy output
- Can utilize a variety of technologies and fuels
- CHP is also known as *cogeneration*



CHP in the U.S. Represents a Variety of Fuels, Technologies, Sizes and Applications



Industrial



Institutional



Residential



Utility Scale



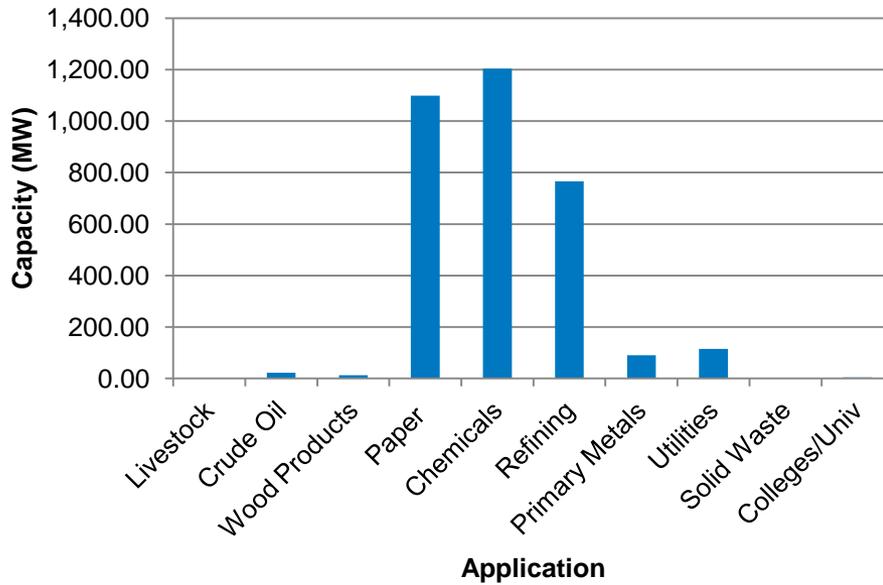
Commercial

What Are the Benefits of CHP?

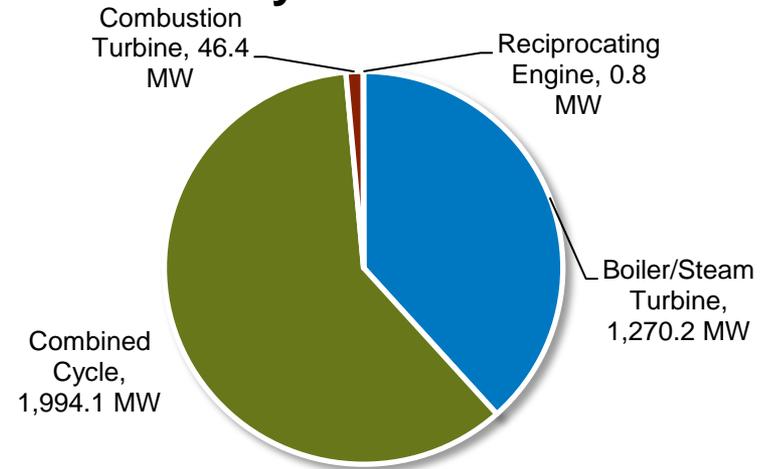
- CHP is more efficient than separate generation of electricity and thermal energy
- Higher efficiency translates to **lower operating cost**
- Higher efficiency **reduces emissions** of all pollutants, including CO₂, NO_x and SO₂
- CHP can **increase power reliability** and enhance power quality
- On-site electric generation **can help reduce grid congestion**

Existing CHP in Alabama (40 Sites, 3,312 MW)

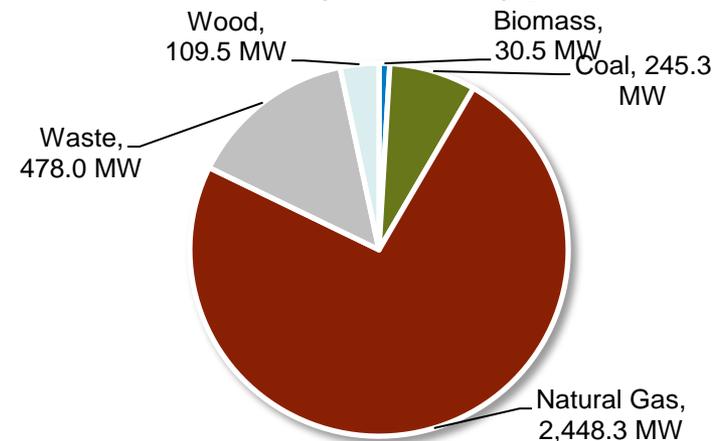
CHP by Application



CHP by Prime Mover



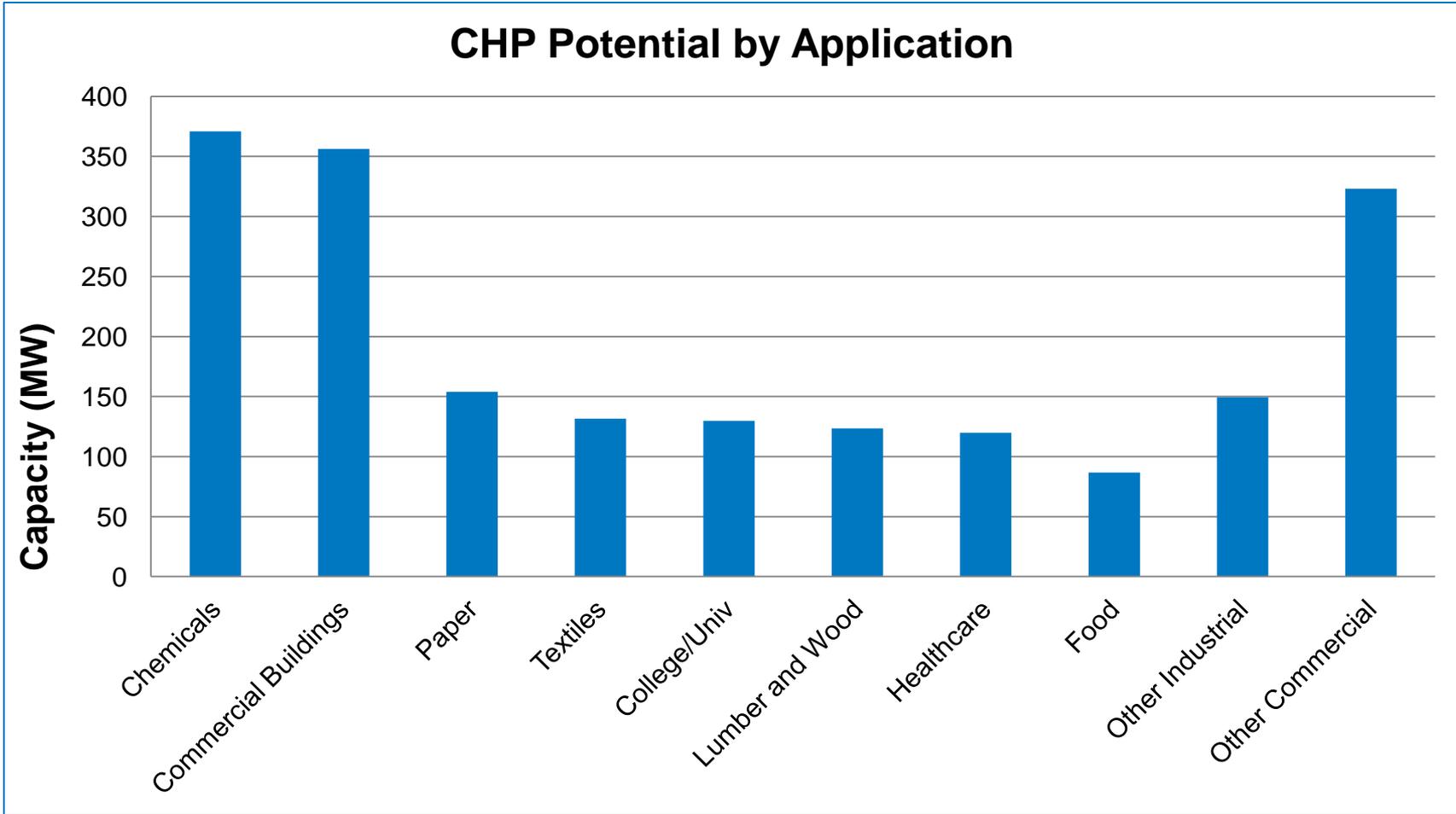
CHP by Fuel Type



Emerging Drivers for CHP

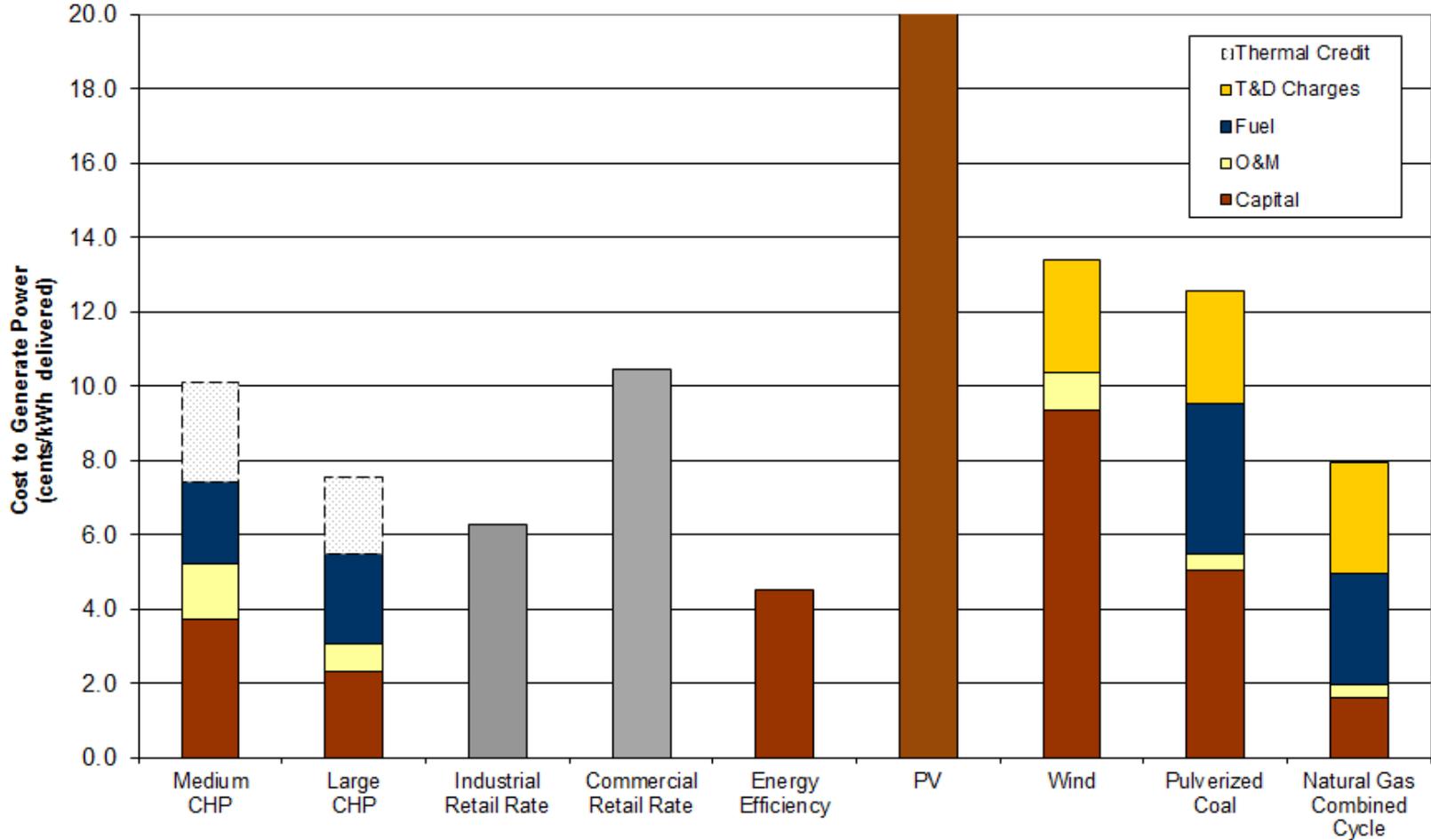
- Benefits of CHP recognized by Federal and State policymakers
 - *White House Executive Order: 40 GW by 2020*
 - *Increasing state interest (Ohio, Maryland, New Jersey, etc.)*
- Game changing outlook for natural gas supply and price in North America
- Opportunities created by environmental drivers
 - *ICI Boiler MACT*
 - *Pressures on utility coal and oil capacity*

CHP Technical Potential in Alabama (1,900 MW)



Natural Gas CHP Cost of Power in Alabama

Cost of Delivered Electricity - Alabama



ICI Boiler MACT (Major Source Rule)

- Standards for hazardous air pollutants from major sources: industrial, commercial and institutional boilers and process heaters
- Major source is a facility that emits:
 - 10 tpy or more of any single Hazardous Air Pollutant, or 25 tpy or more of total Hazardous Air Pollutants (HAPs)
- Emissions limits applicable to new and existing units > 10 MMBtu/hr
- Rule significantly impacts oil, coal, biomass, and process gas boilers
 - Emission limits must be met at all times except for start-up and shutdown periods
 - Controls are potentially required for Hg, PM, HCl, and CO
 - Also includes monitoring and reporting requirements
 - Limits are difficult (technically and economically) for oil and coal boilers (especially older units)

CHP as a Compliance Alternative

- Compliance with MACT limits will be expensive for many coal and oil users
- Many are considering converting to natural gas
 - Conversion for some oil units
 - New boilers for most coal units
- Some are considering moving to natural gas CHP
 - Potential for lower steam costs due to generating own power
 - Higher overall efficiency and reduced emissions
 - Higher capital costs, but partially offset by required compliance costs or new gas boiler costs

Boiler MACT Sites in Alabama

Total Affected Sites	41
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Fuel Type	# Boilers	Capacity (MMBtu/hr)	CHP Potential (MW)	CO2 Emissions Savings (000 MT)
Coal	16	6,347	634	4,247
Heavy Oil	10	1,483	148	871
Light Oil	3	704	0.7	206
Process Gas	4	480	0.5	142
<u>Biomass</u>	<u>49</u>	<u>13,823</u>	<u>1,383</u>	<u>9,255</u>
Total	82	22,836	2,166	14,721

- CHP potential based on average efficiency of affected boilers of 75%; Average annual load factor of 65%, and simple cycle gas turbine CHP performance (power to heat ratio = 0.7)
- GHG emissions savings based on 8000 operating hours for coal and 6000 hours for oil, with a CHP electric efficiency of 32%, and displacing average fossil fuel central station generation

DOE Boiler MACT Technical Assistance Program

- Provide “decision tree” analysis that provides comparative cost of compliance options for coal and/or oil fired boilers:
 - **Installing** control technologies on existing boilers
 - **Replacing** existing boilers with new natural gas boilers (coal only)
 - **Converting** existing boilers for operation on natural gas
 - Replacing existing boiler with a natural gas fueled combustion turbine **CHP system**

Questions?

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