CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Air Emission Benefits of CHP

Air Innovations Conference

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Combined Heat and Power

- Combined Heat and Power is the generation of electricity and heat sequentially from the same heat input
- CHP is a proven strategy for increasing the efficiency for electric and thermal generation
  - 77 GW of existing CHP in U.S.
  - approximately 10% of total U.S. electric generation
- Advantages
  - CHP is more efficient than separate generation of electricity and heat
  - CHP can replace older, high emitting emission sources that would otherwise not be upgraded or retired
  - CHP is applicable to all fuels and prime mover technologies

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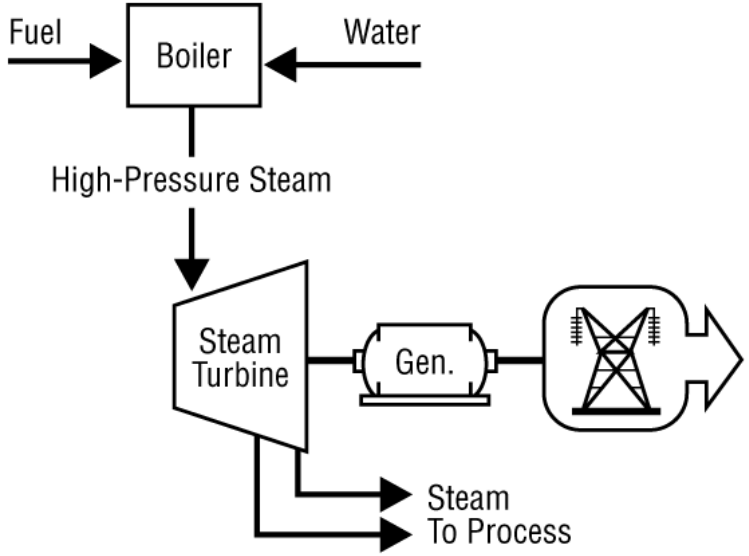
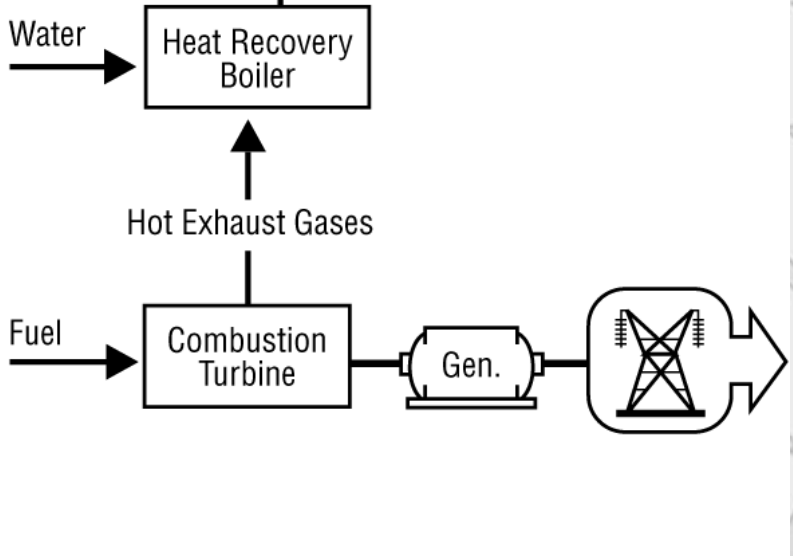
Typical CHP Systems

Steam Boiler/Steam Turbine:



Gas Turbine or Engine/Heat Recovery Unit:



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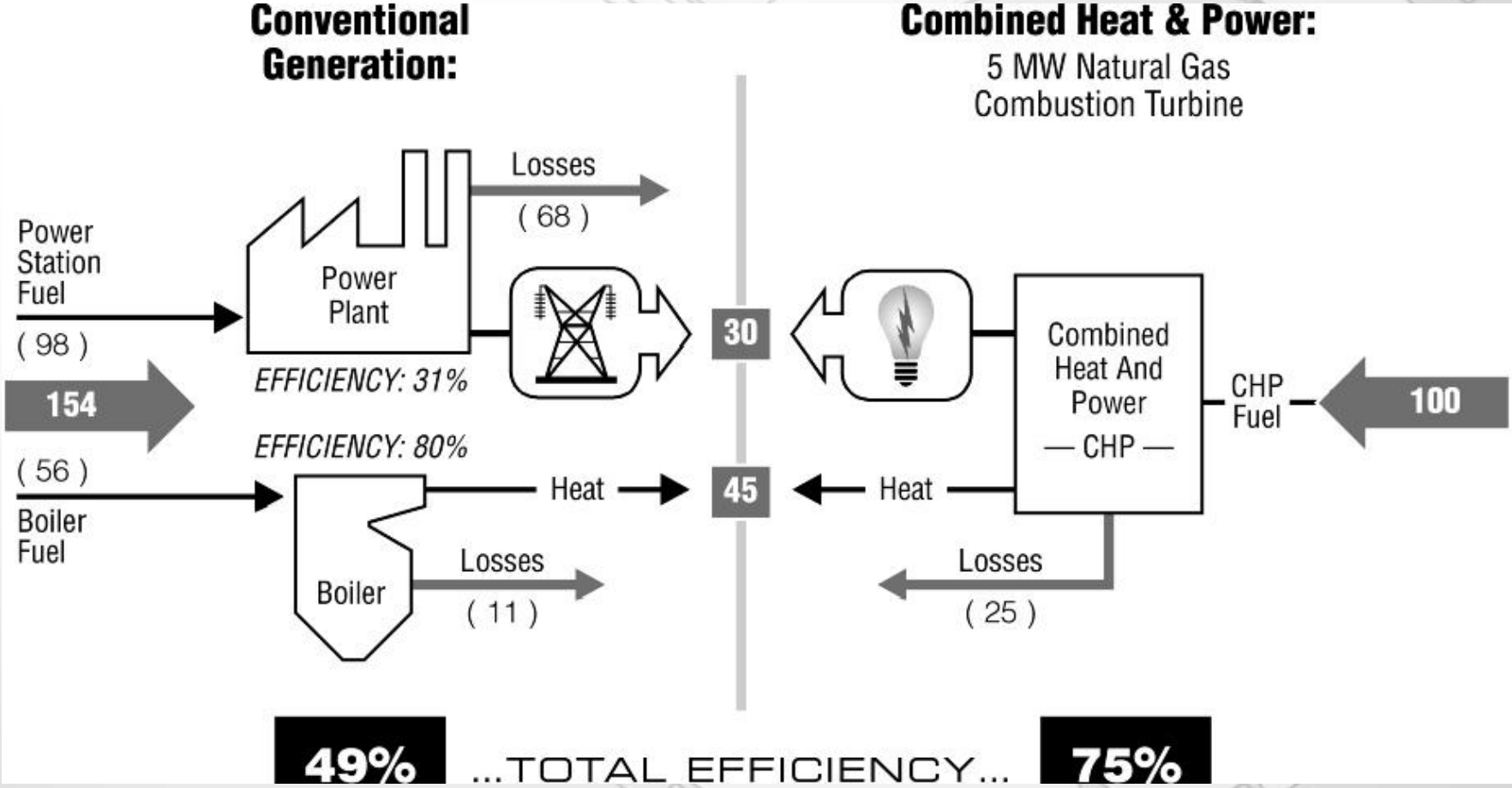
Efficiency Advantages of CHP



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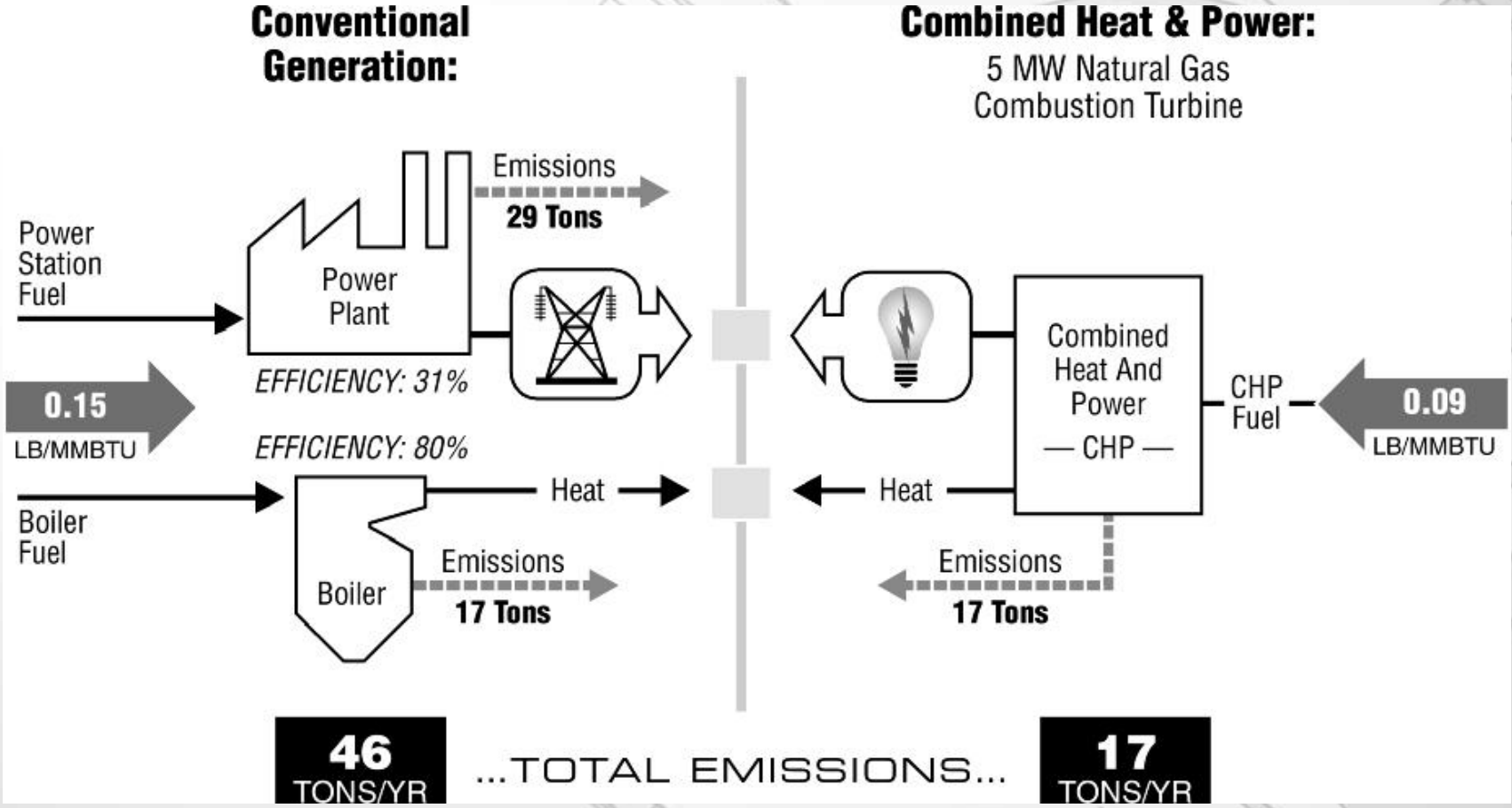
Environmental Benefits of CHP



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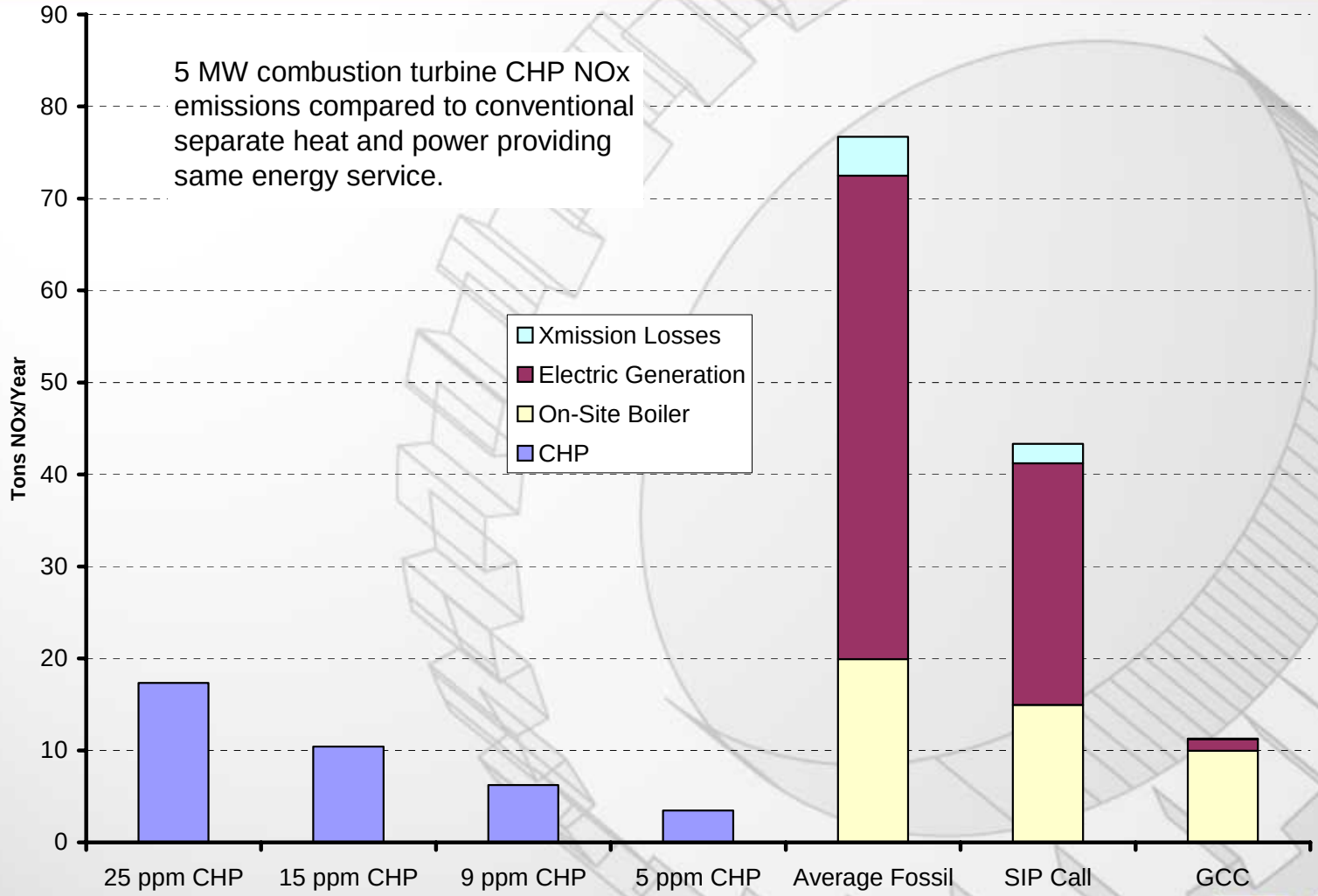
CHP Emission Comparisons



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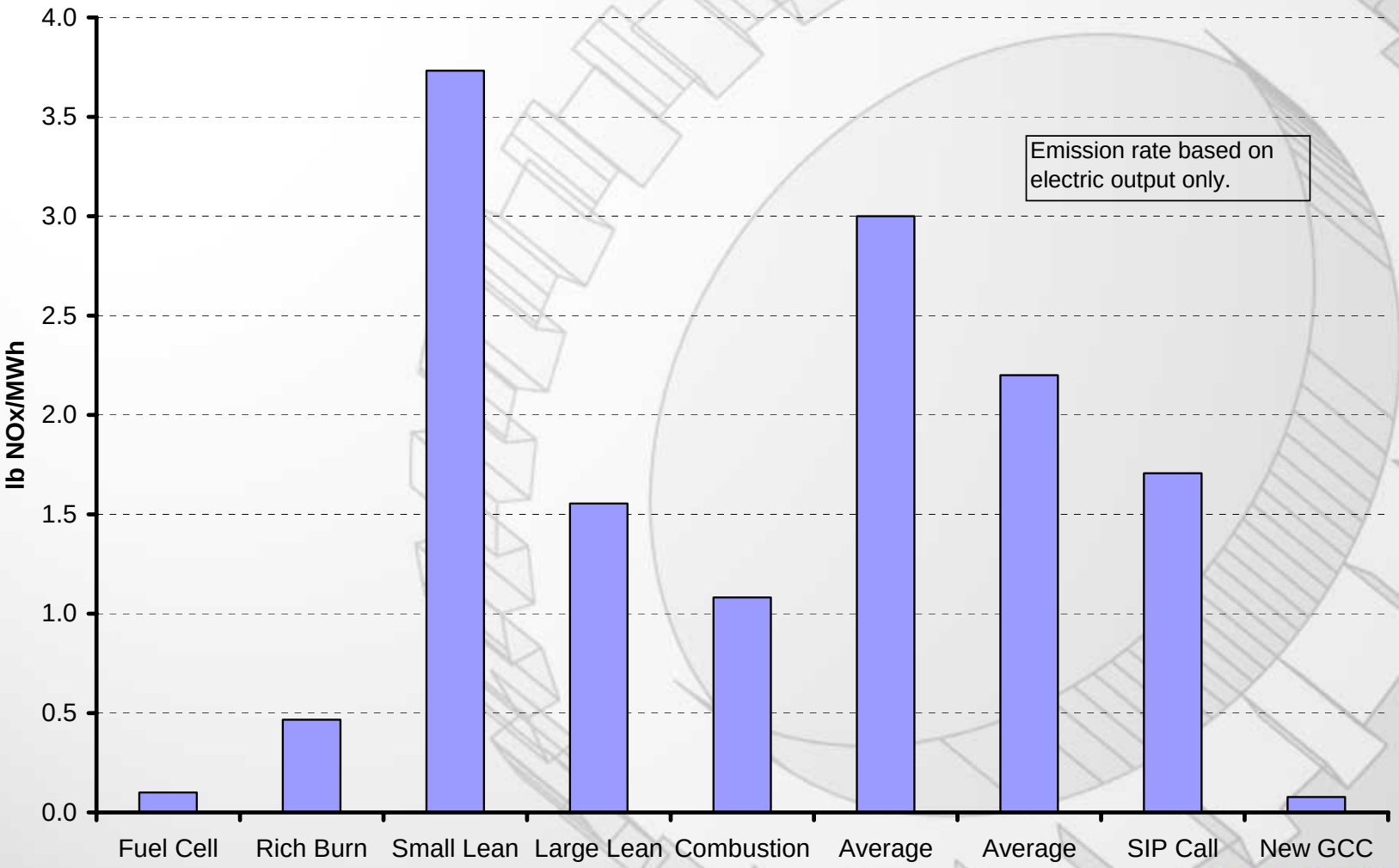
Prime Mover NO_x Emissions



Data Sources: EEA, U.S. EPA, DOE

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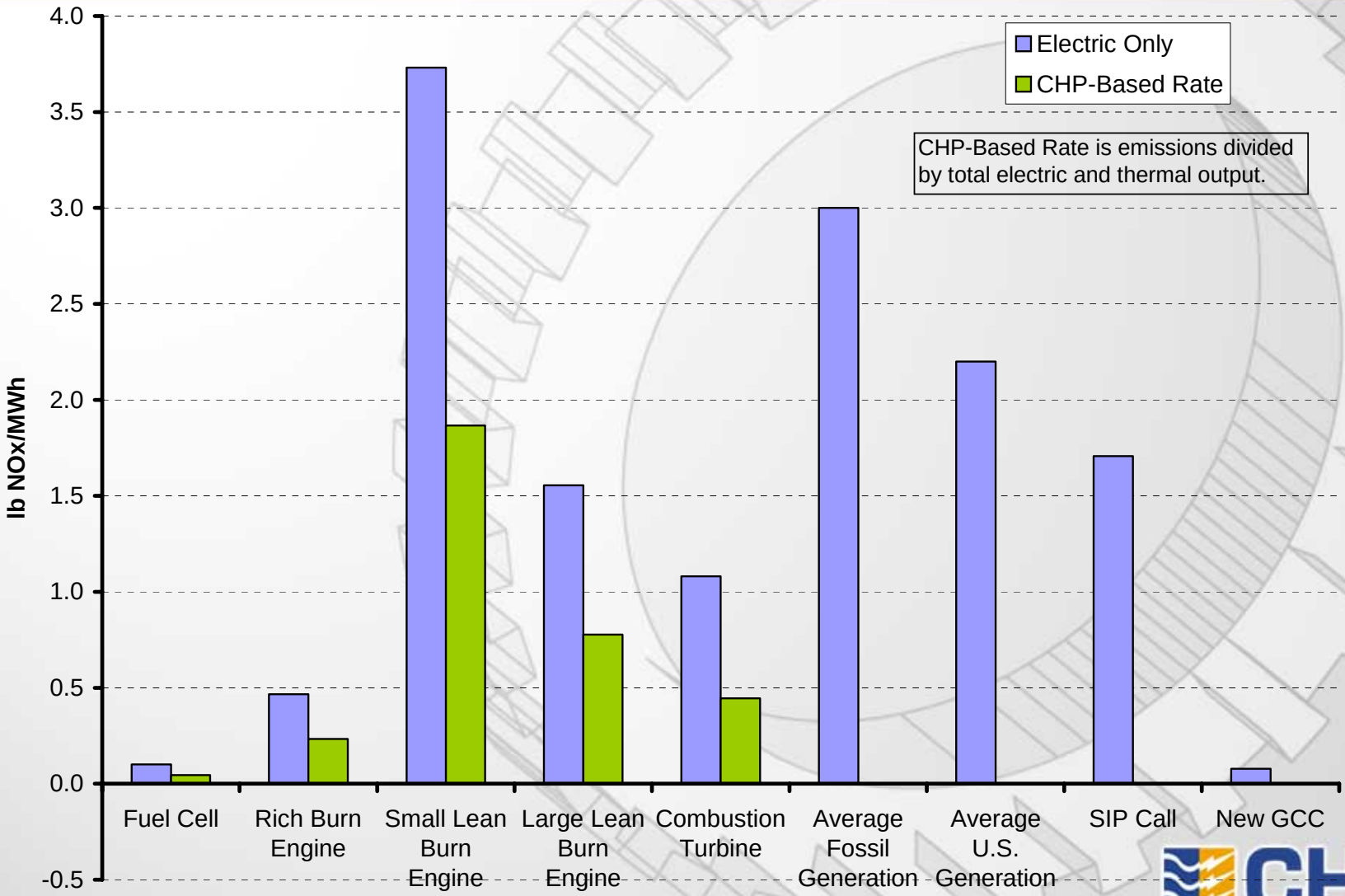
NO_x Emissions Based on *Total* CHP Output



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Example Opportunities for CHP

- Hospitals, universities, prisons, other "campus" facilities
- Medium size industries with thermal loads
- Casinos, resorts, hotels, nursing homes.
- Wastewater treatment plants, biomass facilities
- District energy facilities

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Case Study: Hotel/Casino

- 6 x 0.8 MW reciprocating gas engine with advanced emission controls
  - 0.28 g/bhp-hr (0.89 lb/MWh) NO_x and CO
- Provides electricity and hot water
- 34% reduction in energy consumption
- 45 tons/yr NO_x reduction (79 percent)
- 51 tons/yr SO_2 reduction (100 percent)
- 17,370 tons CO_2 reduction (52 percent)

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Case Study: Refinery

- Gas combined cycle in Houston non-attainment area
- 546 MW, 3.1 MM lb steam capacity
- 40% reduction in energy consumption
- 6,240 tons/yr NO_x reduction (96 percent)
- 6,050 tons/yr SO_2 reduction (100 percent)
- 2.1 MM tons/yr CO_2 reduction (52 percent)

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EPA CHP Partnership

- Established in 2001.
- To assist deployment of environmentally beneficial CHP projects.
- To provide services and tools for states and industry to assist project development and market transformation.
- Accomplishments to date: 2,000 MW of CHP capacity (20+ projects).

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EPA CHP Partnership Services to States

- Assist with market assessments, education, outreach, technical information.
- Developed a handbook on permitting of CHP on an output basis:
  - *Output-Based Regulation: A Handbook for Regulators*
  - Available for download at www.epa.gov/cleanenergy

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State and Local EPA CHP Partners

- Wisconsin Division of Energy
- Minnesota State Energy Office
- San Diego Regional Energy Office
- Ohio Office Energy Efficiency
- Illinois Department of Commerce
- NYSERDA
- Indiana Department of Commerce
- Illinois Environmental Protection Agency
- Iowa Department of Natural Resources
- City of Chicago
- Delaware

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Current Example State Actions

- NYSERDA, San Diego REO, NJ BPU pursuing CHP incentive programs.
- WI - Looking at replacing cyclone boilers and promoting biomass CHP.
- IL EPA and IA DNR focusing on CHP in ethanol plants.
- TX - Established permitting on output basis.

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For Further Information

Contact:

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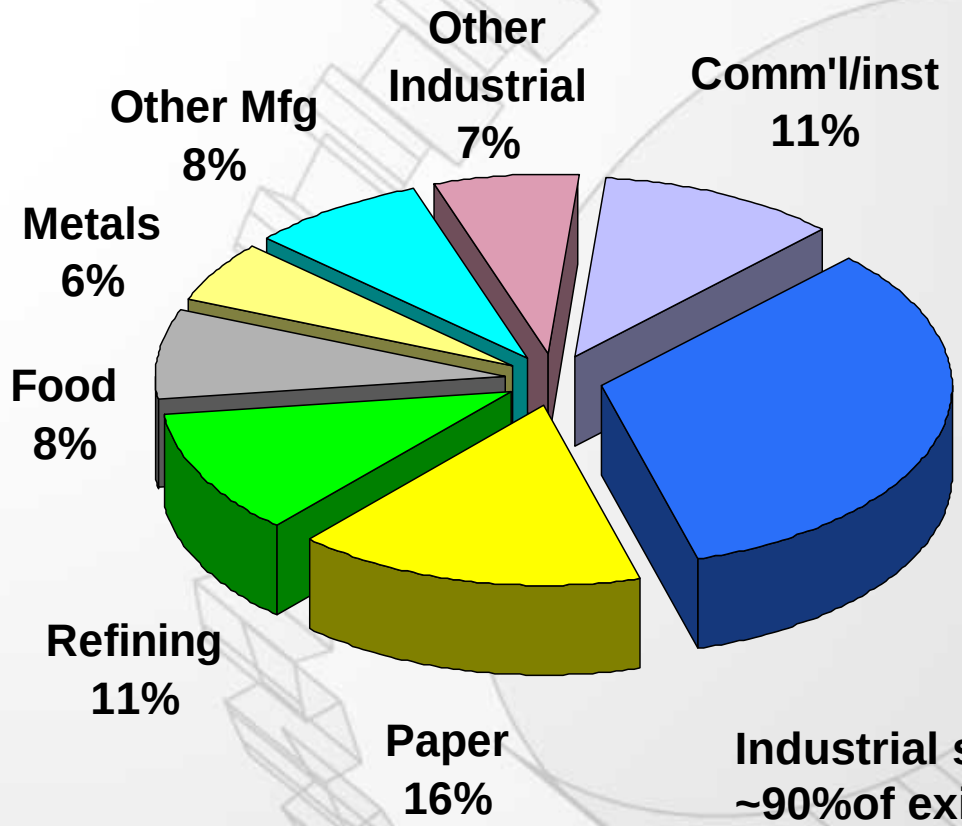
Appendix – Additional Information on CHP

Sectors, Fuels, Technology, Costs,Emissions

CHP is Well Demonstrated



Industrial sites represent ~90%of existing CHP

77,100 MW at 2,719 sites in 2003

Average capacity is 28 MW

Source: EEA

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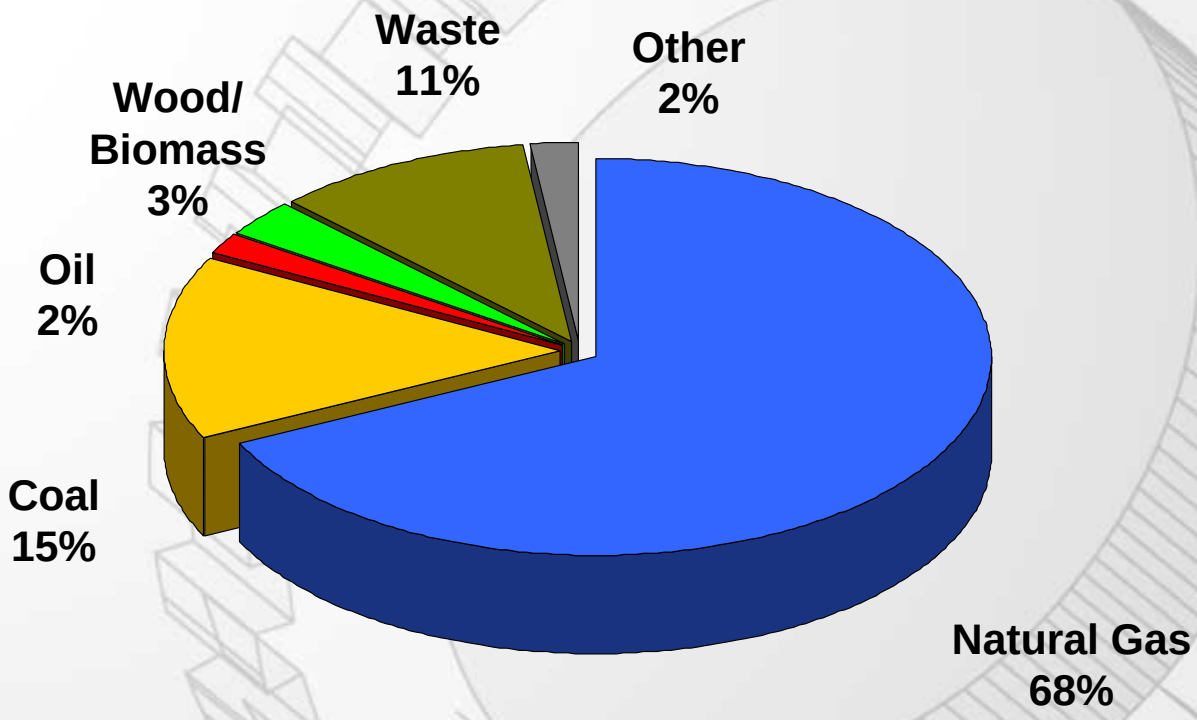
CHP Fuel Distribution



Source: EEA

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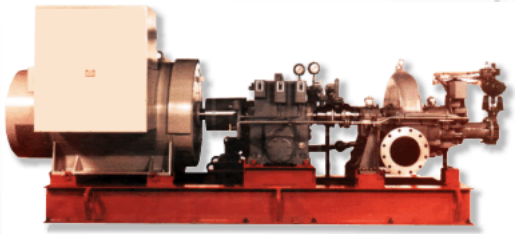
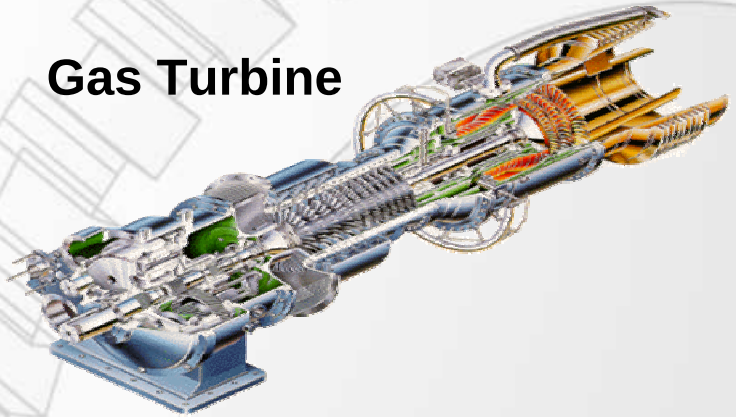
Typical CHP Technology Options

Steam Turbine



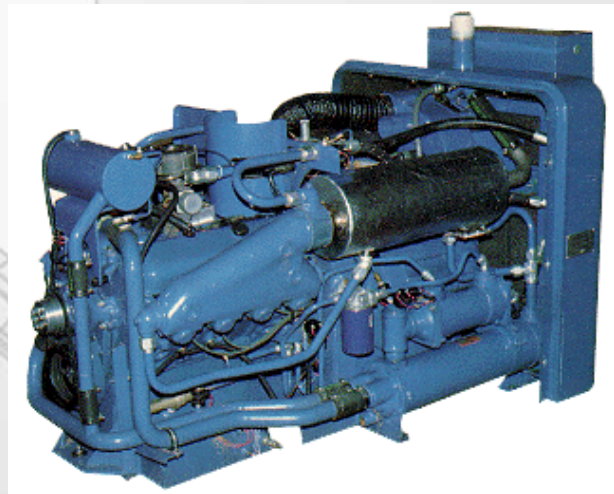
Gas Turbine



Microturbine

Fuel Cell

Reciprocating Engine



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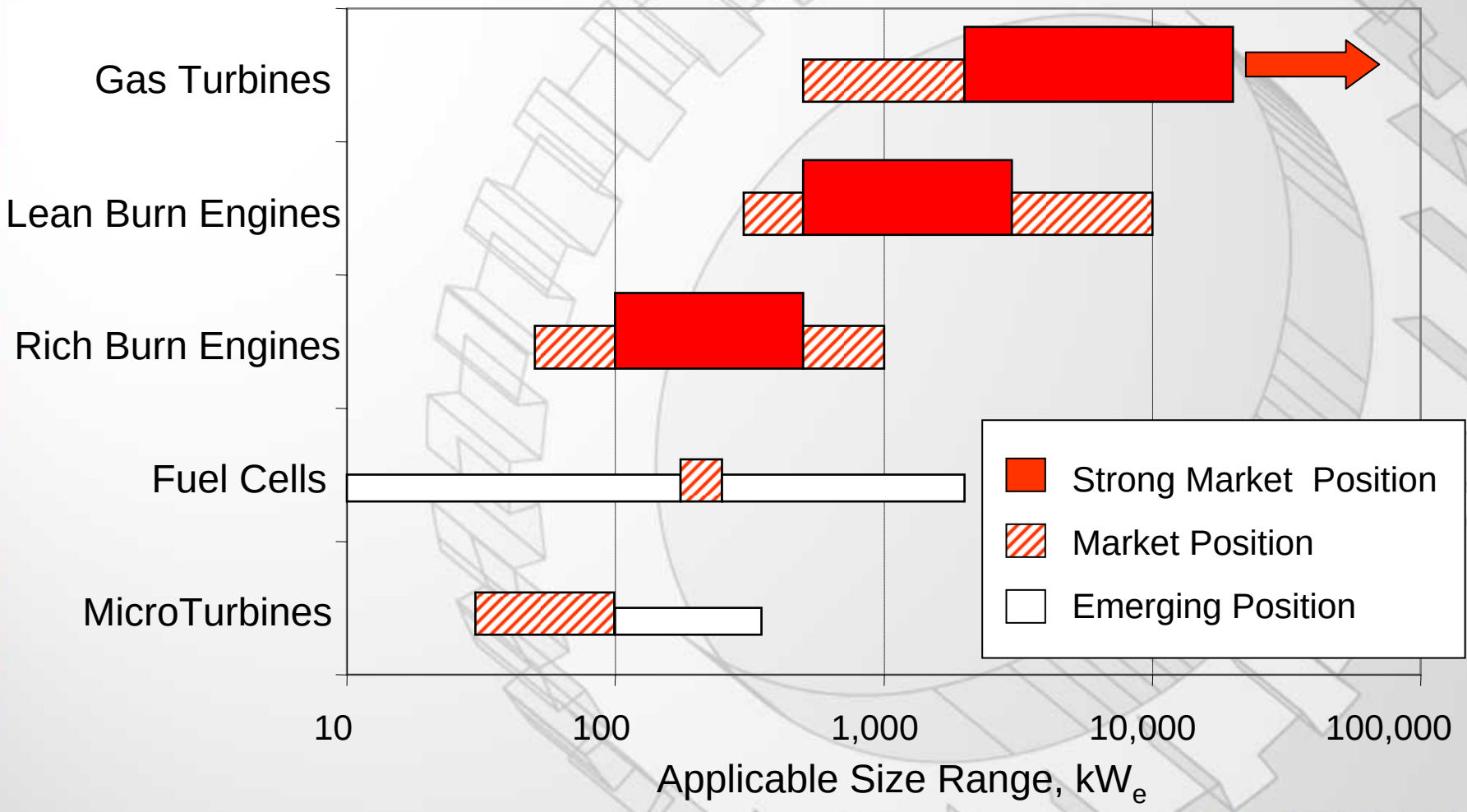
Technology vs Size Coverage



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How do the Technologies Compare?

	Status	*Size*	*Efficiency (%)*	*Installed Costs ($/kW)*	*O&M Costs ($/kWh)*
Reciprocating Engine	Commercial	30 kW - 6 MW	28 - 38	500 - 1400	0.007-0.02
Industrial Gas Turbine	Commercial	500 kW - 20 MW	22 - 40	600 - 1500	0.003-0.008
Microturbines	Early Entry	25 kW - 300 kW	20 - 28	800 - 1400	0.003-0.01
Fuel Cells	1996 - 2010	3kW - 3MW	36 - 60+	2000 - 8000	0.005-0.010

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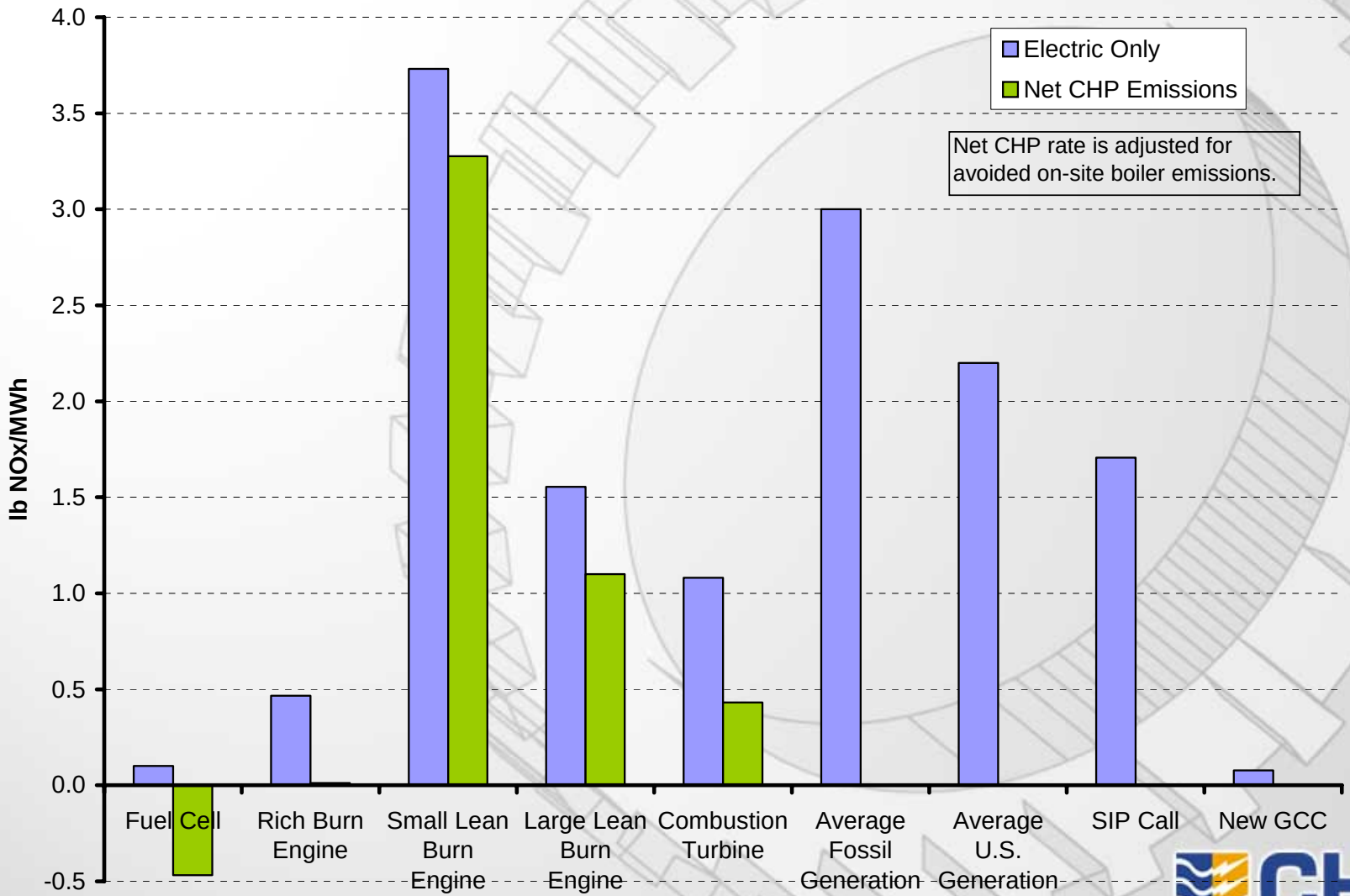
CHP Replacing On-Site Boiler Emissions



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