

## What is CHP?

### **CHP: Efficient way to generate electricity and heat together:**

The definition of CHP or cogeneration implies that heat and electricity are produced simultaneously in one process. In CHP production intermediate fluids, either hot steam or exhaust gases, are used first in electricity generation after which the remaining heat is recovered and not emitted to the environment. If some part of the intermediate fluid or the remaining thermal energy is ejected to the environment without heat recovery, the portion of the electricity generation corresponding to this part is by default not CHP electricity.

In separate electricity generation the conversion efficiency is between 35-55%, but in cogeneration plants overall efficiencies as high as 80-90% can be achieved by using the remaining thermal energy to produce heat either for industrial processes or district heating. The energy savings potential of cogeneration is important in reducing CO<sub>2</sub> emissions, improving energy efficiency and reducing dependence on imported energy in New Jersey.

### **Combined Heat & Power – Benefits:**

CHP provides many benefits compared to separate heat and power production. These benefits include:

- Improved fuel efficiency (lower energy costs),
- Improved power quality and reliability,
- Improved energy cost predictability,
- Reduced emissions (per unit of useful output),
- Reduced grid congestion, transmission and distribution investment,
- Reduced ratepayer investments in new generation or T&D,
- Reduced system vulnerability to security risks,
- Shorter lead times with off-the-shelf modular technologies,
- No land-use impacts from power plant, transmission line footprints,
- No line losses,
- Optimizes scarce natural gas resources for better gas prices and supply,
- Supports new high-tech manufacturing and exporting industry,
- Supports competitive electric power industry structure.

### **The current natural gas-fired distributed energy resource technologies are:**

- Reciprocating engines
- Small industrial gas turbines (1 MW to 40 MW)
- Microturbines
- Small steam turbines
- Fuel Cells
- Sterling engines

## Applications and Markets for Gas-fired DG Technologies:

DG Technologies	Standby Power	Base Load Power Only	Demand Response Peaking	Customer Peak Shaving	Premium Power	Utility Grid Support	Combined Heat and Power	Applicable Market Sectors
<b>Reciprocating Engines</b> (50kW to 50 MW)	x	x	x	x	x	x	x	Commercial Buildings, Light Industrial, Utility Grid(larger units), Waste Fuels
<b>Gas Turbines</b> (500kW to 50 MW)		x		x	x	x	x	Large Commercial, Institutional, Industrial, Utility Grid, Waste Fuels
<b>Steam Turbines</b> (500kW to 100MW)		x			x		x	Institutional Buildings, Campuses, Industrial, Waste Fuels
<b>Micro Turbines</b> (30kW to 250kW)	x	x	x	x	x	x	x	Commercial Buildings, Light Industrial, Waste Fuels
<b>Fuel Cells</b> (5kW to 2 MW)		x			x	x	x	Residential, Commercial, Light Industrial

## Comparison of DG Technologies:

	Reciprocating Engines	Gas Turbine	Steam Turbine	Micro Turbine	Fuel Cells
<b>Technology Status</b>	Commercial	Commercial	Commercial	Early Entry	Early Entry/ Development
<b>Size(MW)</b>	0.01-5	0.5-50	0.05-50	0.03-0.25	0.005-2
<b>Electric Efficiency(HHV)</b>	30-37%	22-37%	5-15%	23-26%	30-46%
<b>Total CHP Efficiency(HHV)</b>	69-78%	65-72%	80%	61-67%	65-72%
<b>Power-Only Installed Cost(\$/kW)</b>	700-1000	600-1400	300-900	1500-2300	2800-4700
<b>CHP Installed Cost(\$/kW)</b>	900-1400	700-1900	300-900	1700-2600	3200-5500
<b>O&amp;M Cost(\$/kWh)</b>	0.008-0.018	0.004-0.01	<0.004	0.013-0.02	0.02-0.04
<b>Availability</b>	>96%	>98%	Near 100%	95%	90%
<b>Equipment Life(Years)</b>	20	20	>25	10	10
<b>Fuel Pressure(psi)</b>	1-65(may require fuel compressor)	100-500(may require fuel compressor)	N/A	55-90(may require fuel compressor)	0.5-45
<b>Fuels</b>	Natural Gas, Biogas, Liquid Fuels	Natural Gas, Biogas, Distillate Oil	All	Natural Gas, Biogas	Natural Gas, Hydrogen
<b>NOx Emissions(lb/MWh)</b>	0.2-6	0.8-2.4	Function of Boiler missions	0.5-1.25	<0.1
<b>Uses for Heat Recovery</b>	Hot Water, Low Pressure Steam, District Heating	Direct Heat, Hot Water, LP-HP Steam, District Heating	LP-HP Steam, District Heating	Hot Water, Low Pressure Steam, Direct Heat	Hot Water, Low Pressure Steam
<b>Thermal Output(Btu/kWh)</b>	3200-5600	3200-6800	1000-50000	4500-6500	1800-4200