

Combined Heat & Power: *Essential for a Clean Energy Standard*

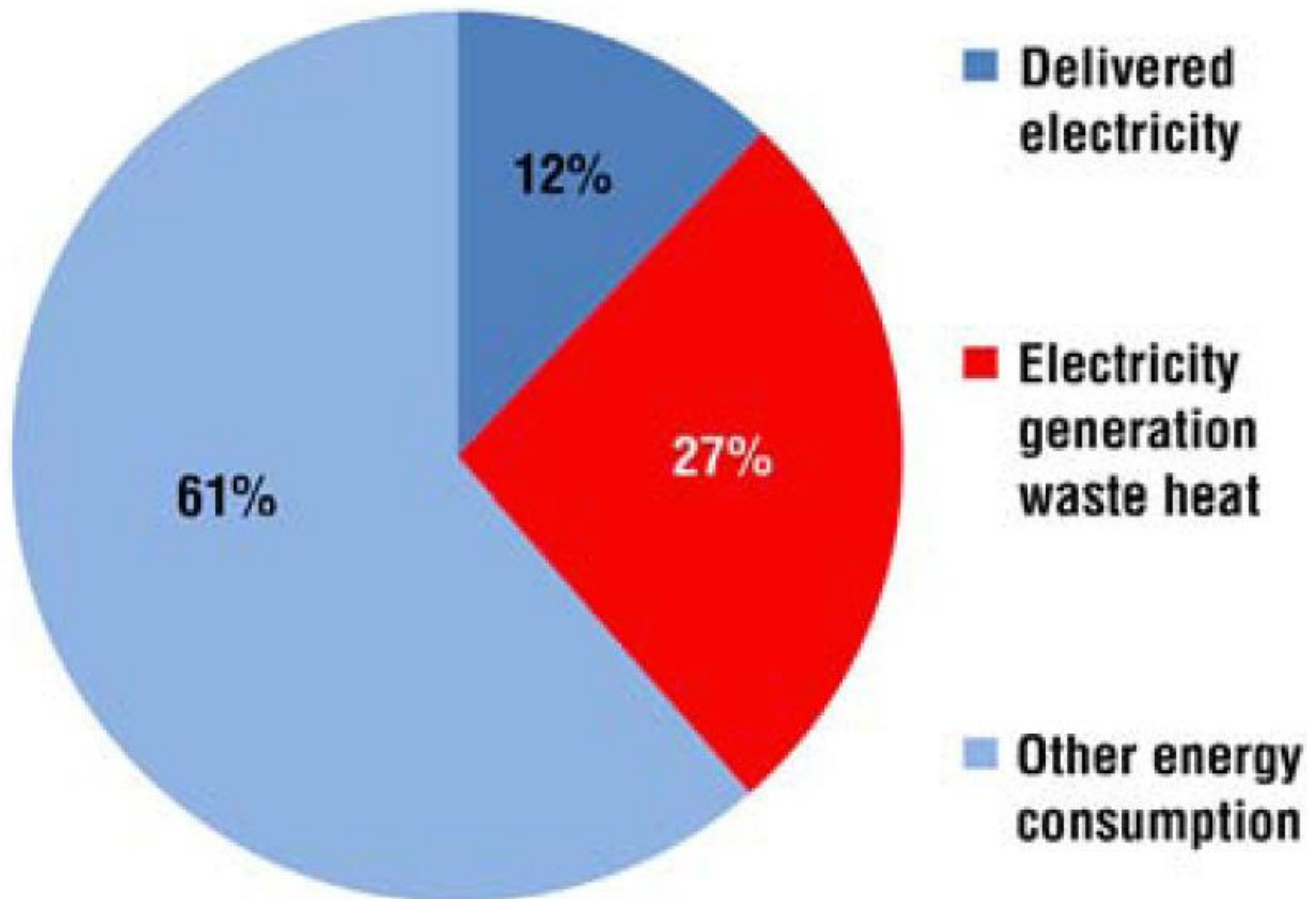


Agenda

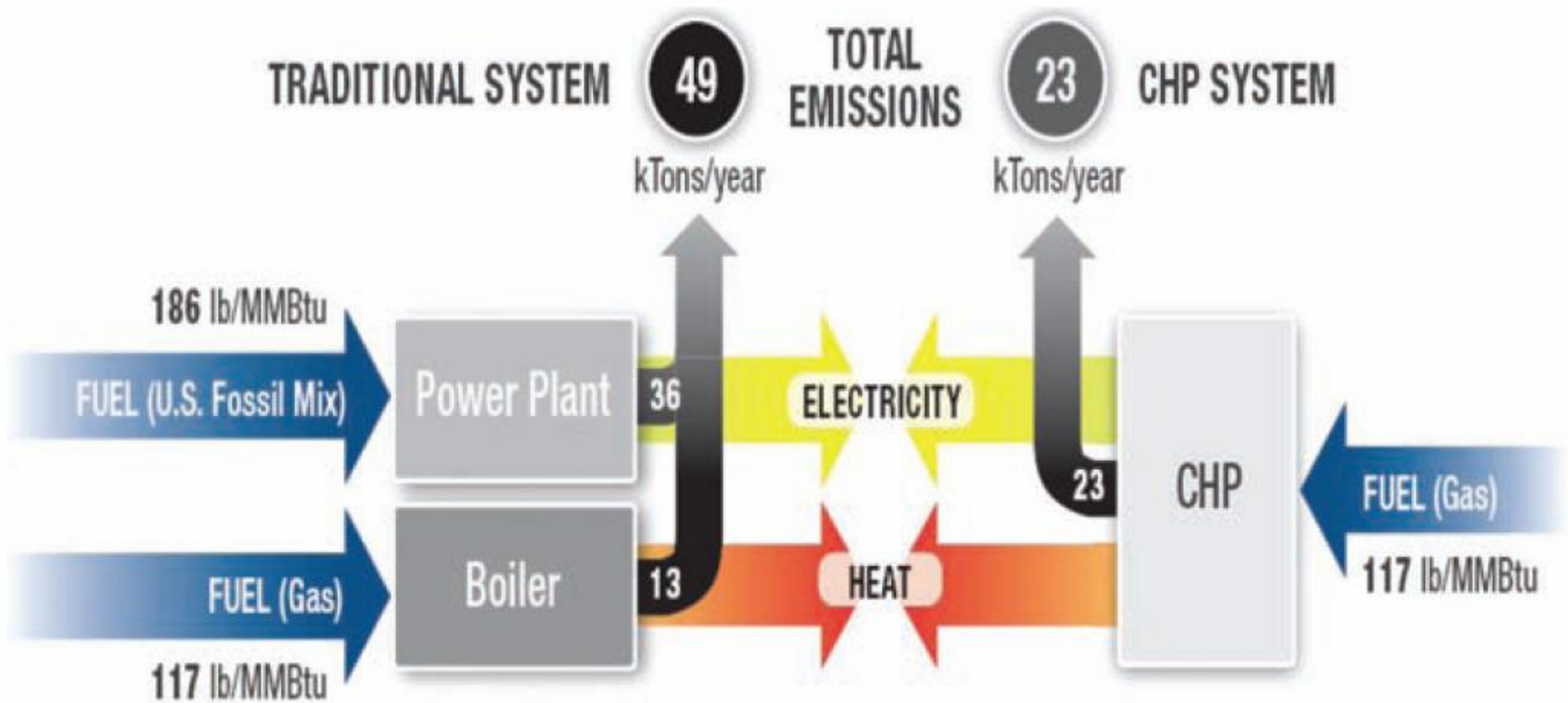
- Background
 - Combined Heat and Power
 - District Energy Systems
- Clean Energy Standard
 - How We Got Here
 - Analytical Framework
 - Results
 - Recommendations

Background

Electricity Generation Waste Heat as a Percentage of Total U.S. Primary Energy Consumption

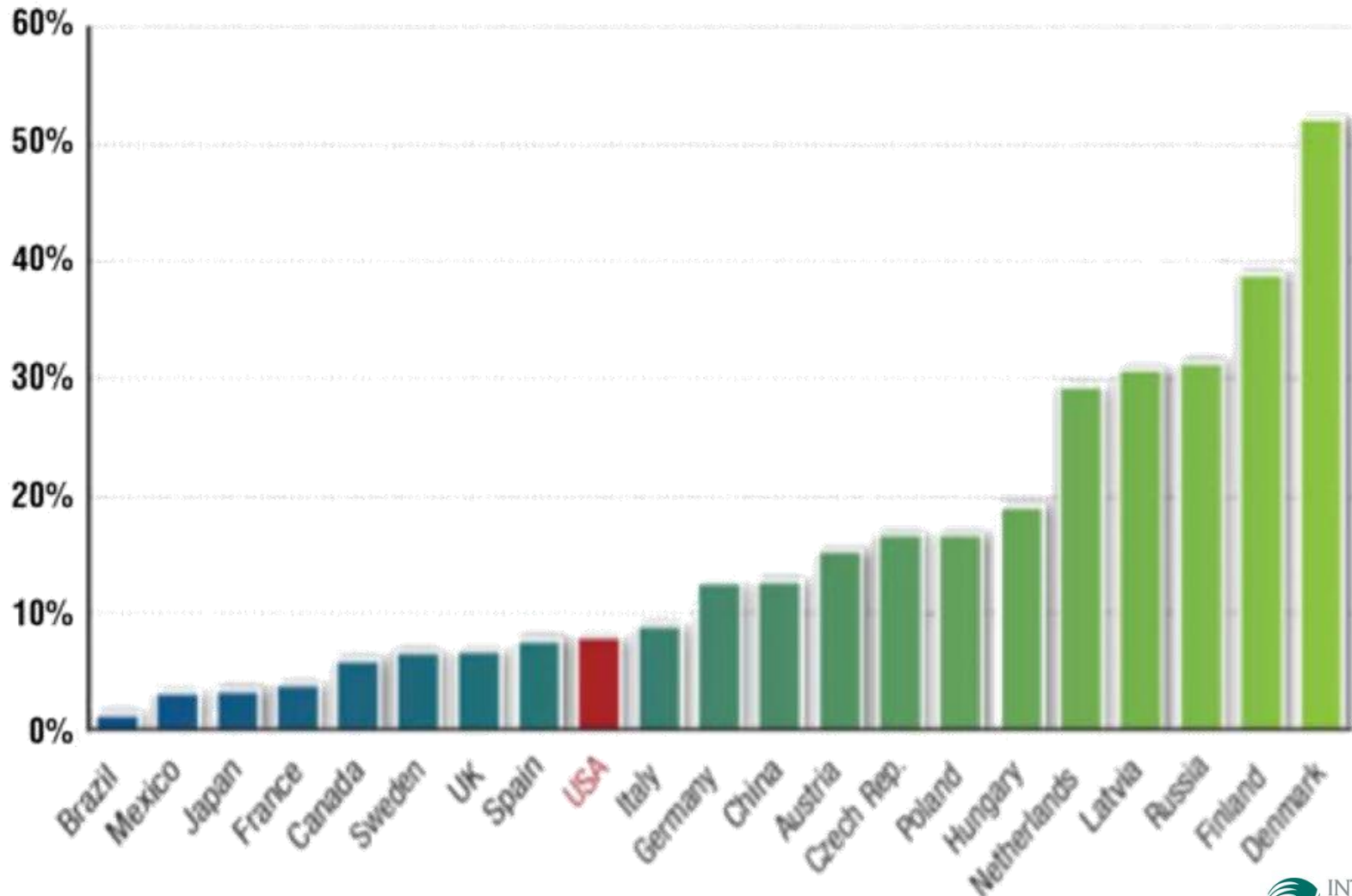


CHP Efficiency Conserves Fuel and Cuts Emissions

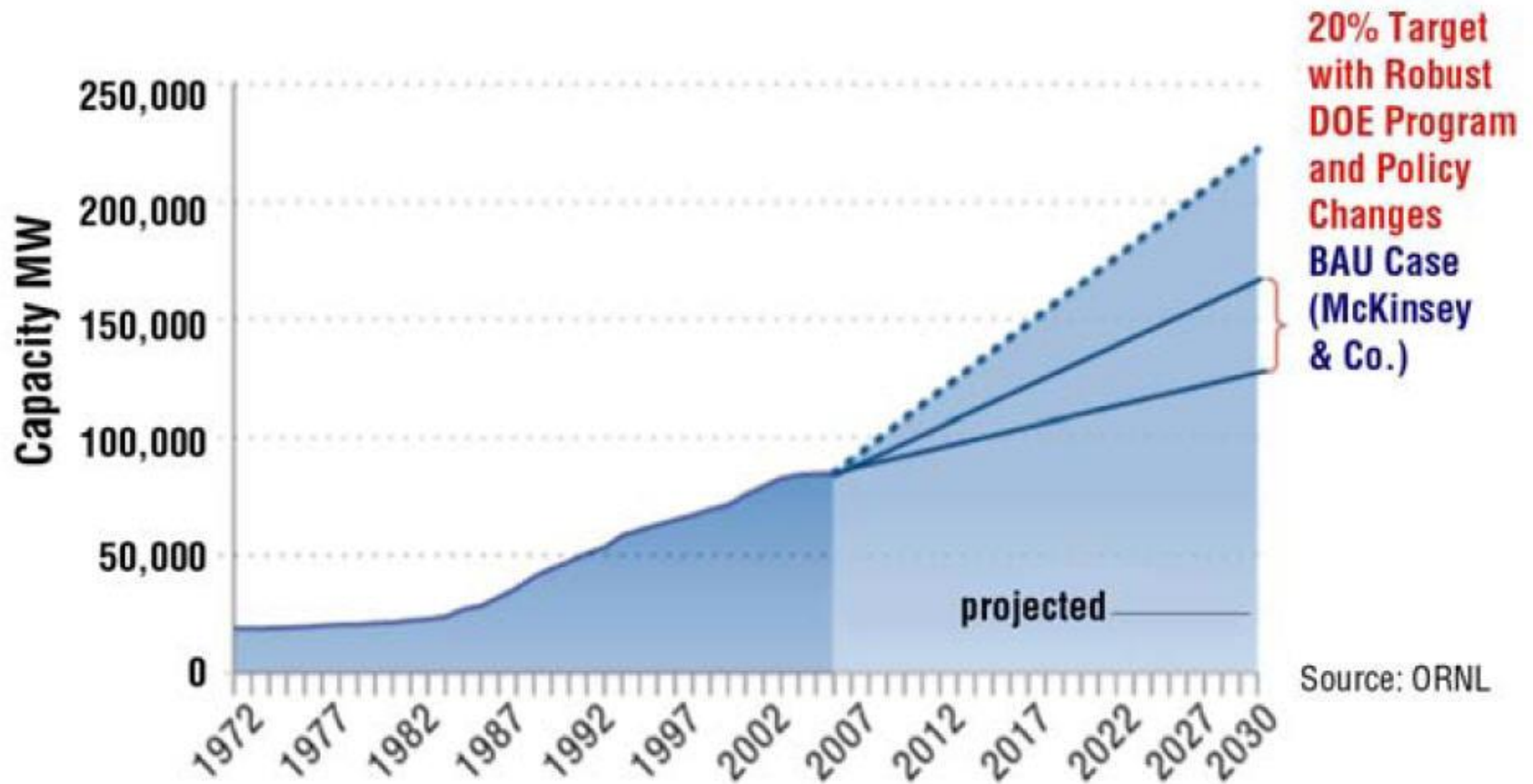


Country Percentage of Electricity Provided by CHP

CHP in a Global Context – 20% Capacity Goal is Reachable



Potential Growth for US CHP Capacity



Source: ORNL

Energy and Environmental Savings from CHP

	2006	2030
CHP Capacity	85 GW	241 GW
Annual Fuel Savings	1.9 quads	5.3 quads
Total Annual CO2 Reduction	248 MMT	848 MMT
Cars Taken Off Road (Equivalent)	45 million	154 million

Source: ORNL 2008

Clean Energy Standard

- Precedents
 - Renewable Energy Standard (RES)
 - Energy Efficiency Resource Standard (EERS)
 - RES + EERS
- Issues
 - Disparities between states relative to renewable sources
 - Renewable power generation costs
 - Capital cost per kW
 - Dispatchability
 - Utilization rate
 - Transmission Access
 - Efficiency
 - Establishing baseline
 - Additionality

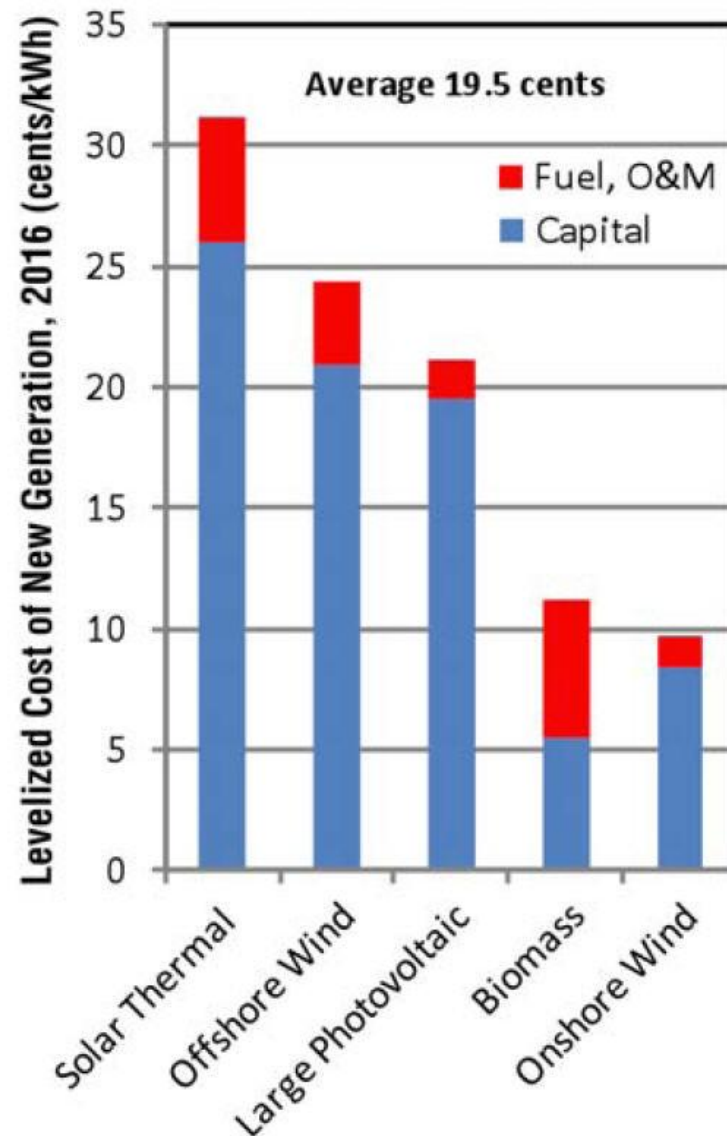
Clean Energy Standard

- Clean Energy Standard legislation
 - S. 1462, Sen. Bingaman (American Clean Energy Leadership Act, 2009)
 - Discussion draft, Sen. Graham (Clean Energy Act, 2009)
 - S. 3464, Sen. Lugar (Practical Energy and Climate Plan Act, 2010)
 - President Obama's proposal, 2011
 - Adds "efficient natural gas"
- Bingaman/Murkowski White Paper

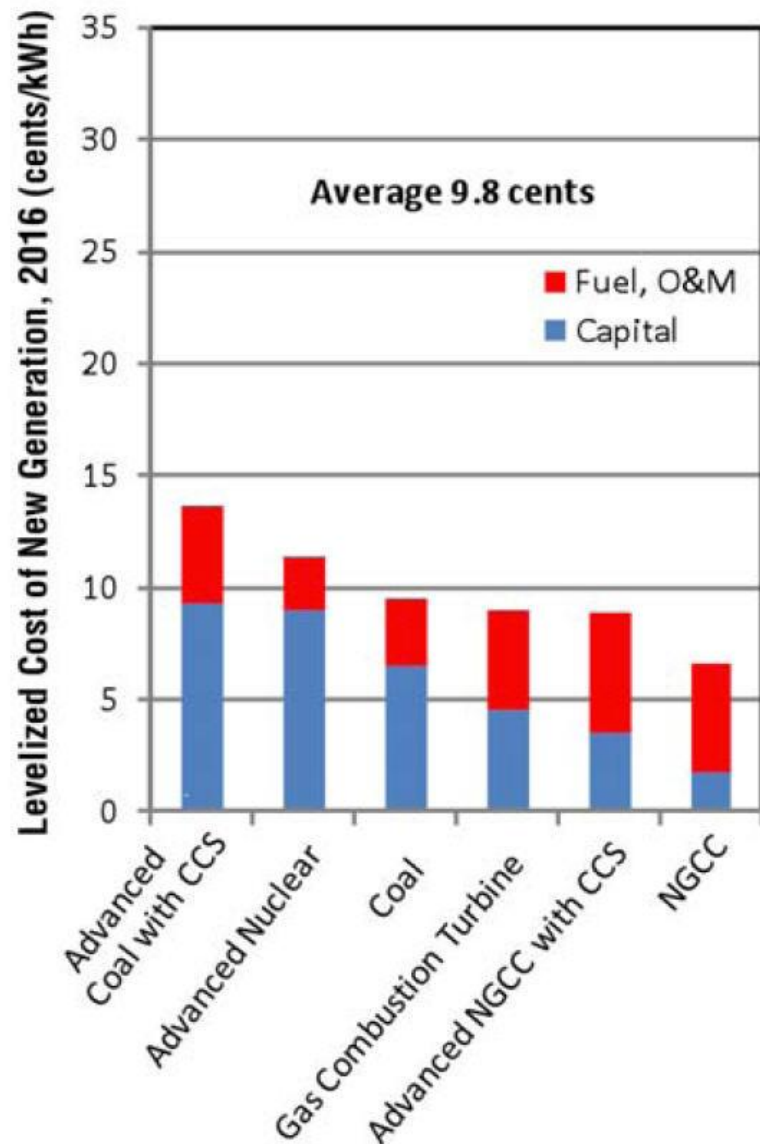
Analytical Framework

- Key data source
 - U.S. Energy Information Administration, “Levelized Cost of New Generation Resources in the Annual Energy Outlook 2011”, Dec. 2010.
- Levelized costs
 - Present value of life cycle costs
 - Capital
 - Financing
 - Fuel
 - Operation and maintenance
 - Utilization rate
 - Converted to equal annual payments in real \$

Results: Levelized Cost of New Renewable Power-Only Generation Resources On Line in 2016



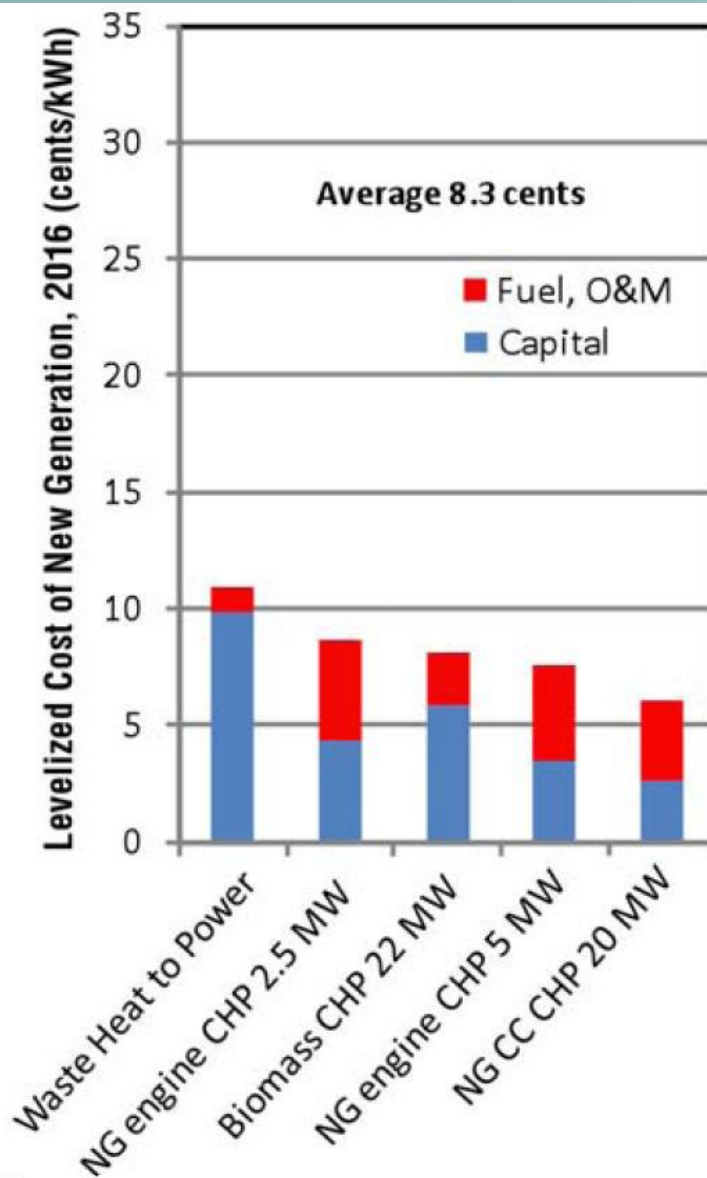
Levelized Cost of New Nonrenewable Power-Only Generation Resources On Line in 2016



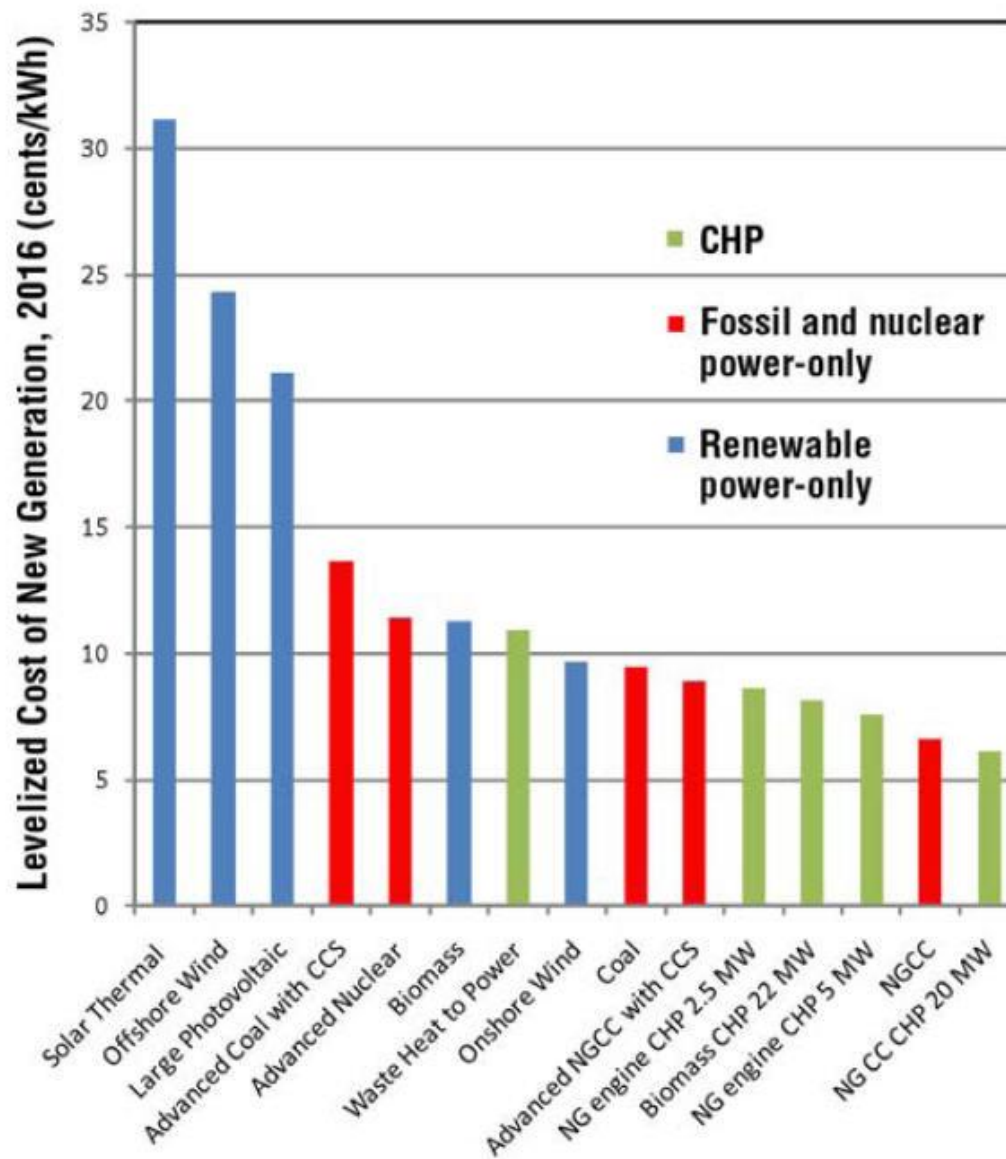
Levelized Cost of Fuels for Generation Resources On Line in 2016

	Levelized fuel cost (\$/MMBtu)
Natural gas	\$ 6.00
Coal	\$ 2.30
Nuclear	\$ 0.93
Biomass	\$ 2.62

Levelized Cost of New CHP Generation Resources On Line in 2016



Summary of Levelized Cost of Generation Resources On Line in 2016

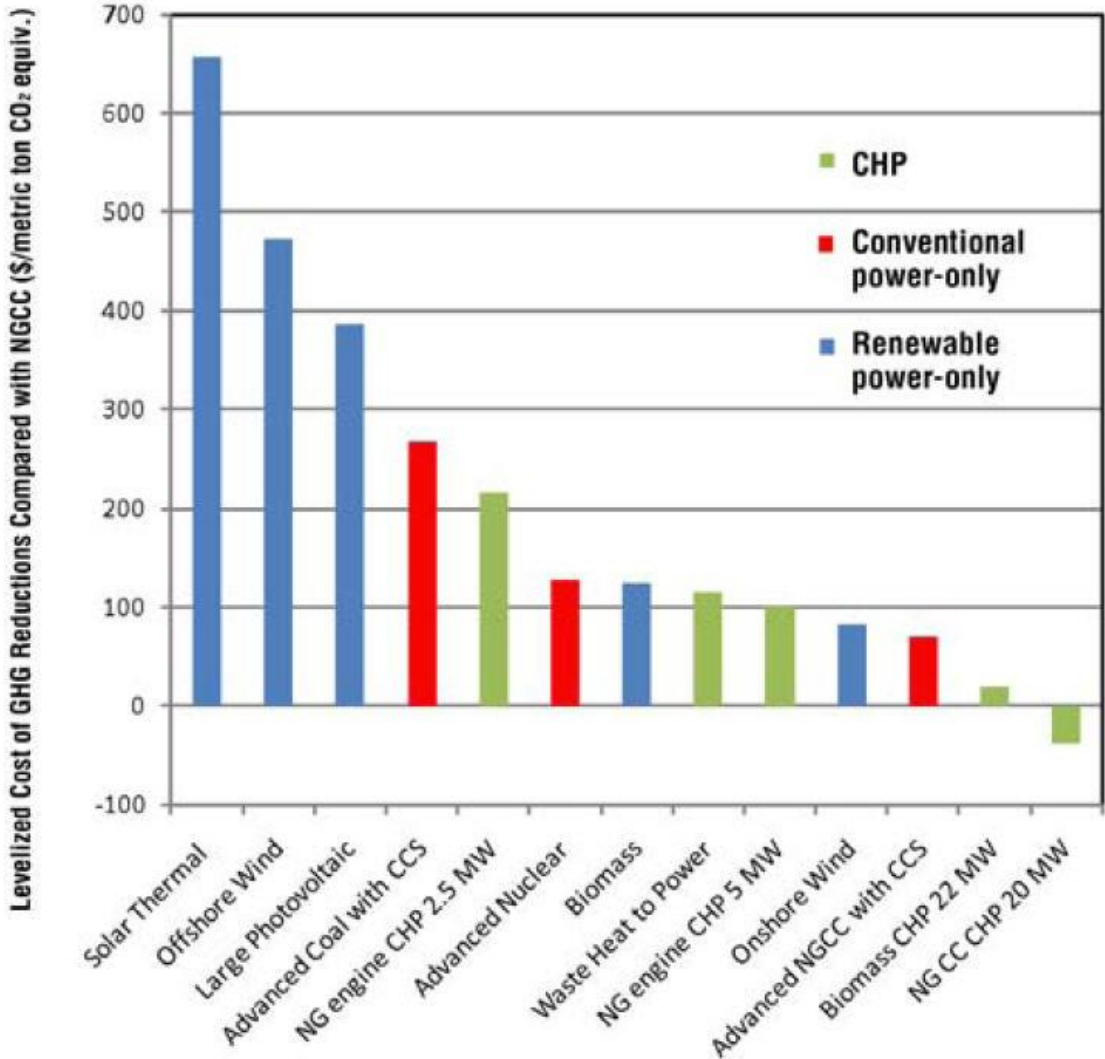


Fossil Fuel Consumption and Greenhouse Gas Emissions from a Range of Generation Resources

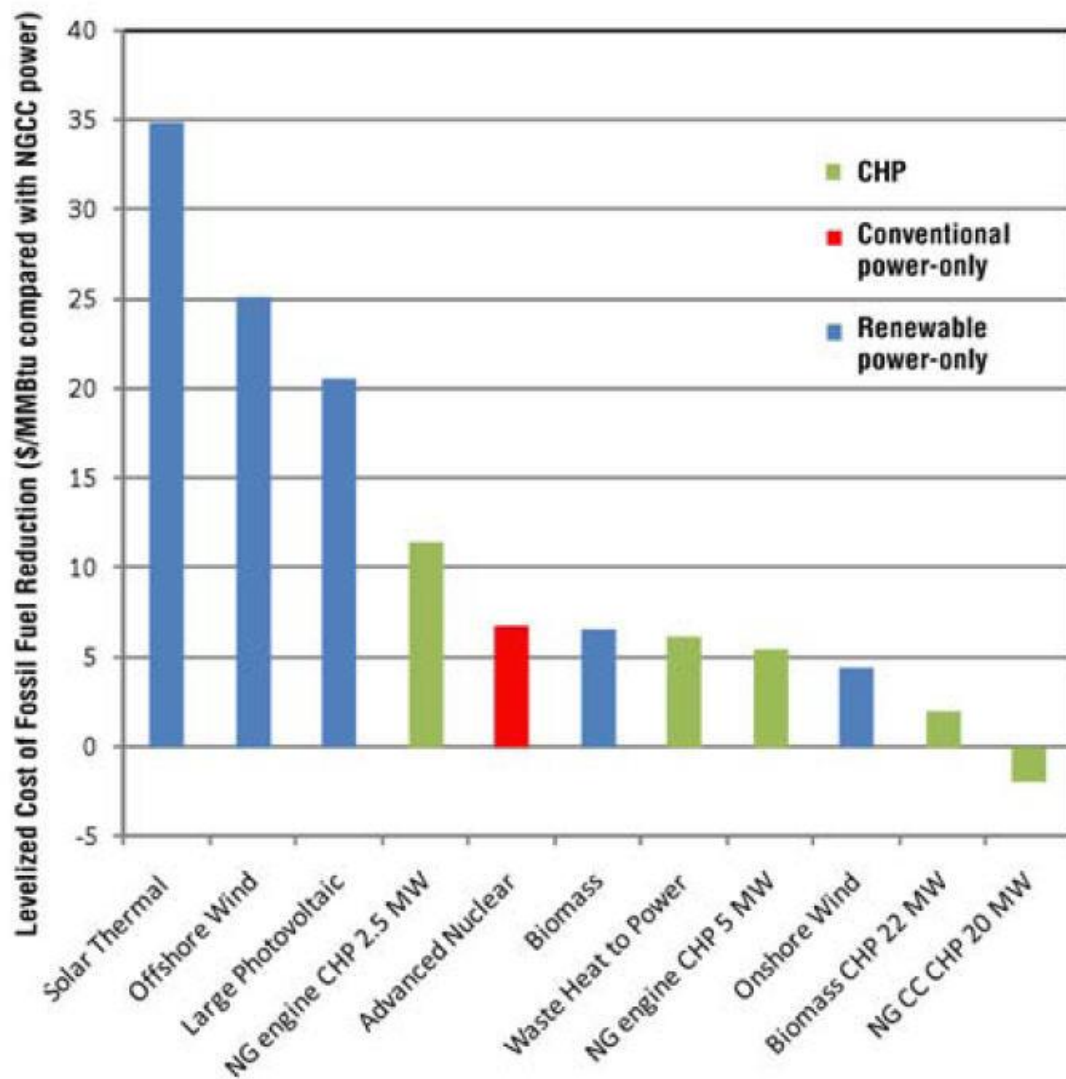
		Fossil fuel consumption (Btu/kWh)	GHG emissions (metric tons/MWH)
Fossil and Nuclear Power-only	Conventional Coal	8,784	0.82
	Conventional NGCC	6,967	0.37
	Nuclear	-	-
	Advanced Coal with CCS *	10,434	0.11
	Advanced NGCC with CCS *	7,521	0.04
Renewable power-only	Biomass	-	-
	Onshore Wind	-	-
	Offshore Wind	-	-
	Solar Thermal	-	-
	Large Photovoltaic	-	-
CHP	Waste heat to power	-	-
	Biomass CHP 22 MW	(767)	(0.43)
	NG engine CHP 2.5 MW	5,292	0.28
	NG engine CHP 5 MW	5,195	0.28
	NG CC CHP 20 MW	4,492	0.24

* Note: CCS is not a proven technology.

Levelized Cost of *Greenhouse Gas Reduction* Compared with Natural Gas Combined-Cycle On Line in 2016



Levelized Cost of *Fossil Fuel Reduction* Compared with Natural Gas Combined-Cycle On Line in 2016



Bottom Line

- Goal set by DOE by is achievable
 - 20% of power from CHP by 2030
 - Must address interconnection barriers
 - Must create economic incentive through CES
- The Opportunity
 - CHP could provide one third of CES resources targeted by President's proposal
 - Clean energy in all 50 states
 - Ratepayer savings over \$500 billion by 2035
 - Grid support by generating power at load

Recommendations

1. Include CHP in a CES
2. Take technology-neutral approach
 - Calculate credits based on the avoided primary energy consumption or greenhouse gas (GHG) reductions compared with
 - generation of electricity using a reference plant generating only power (for example, a natural gas combined-cycle plant); and
 - production of heat using a natural gas boiler.
3. Allow credits to be issued to entities other than electric utilities.

Questions?

- Please type your questions in box at lower right.
- Moderator will read and propose questions.



Thank you for attending.

Check www.districtenergy.org for webinar slides and streaming content.

Questions or comments to:

idea@districtenergy.org