Sargent & Lundy Webinar

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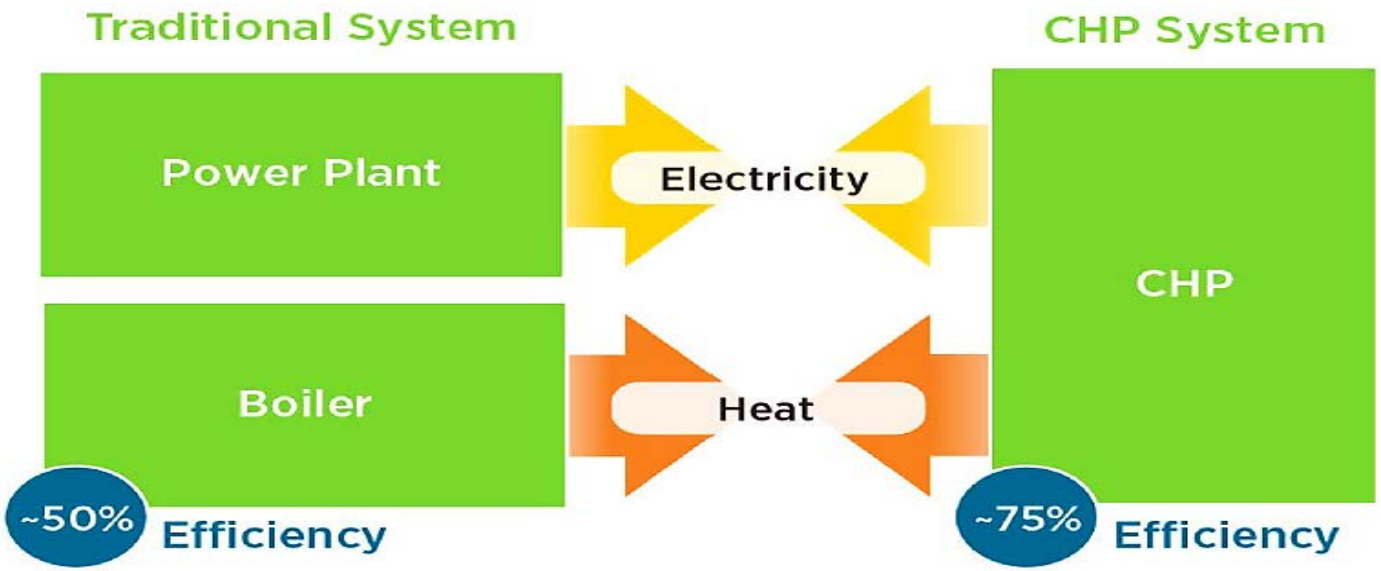
- Today's presentation will be available for download on S&L's website www.sargentlundy.com

What Role Can Combined Heat and Power Play in Meeting Your Industrial Energy Needs?

January 19, 2017

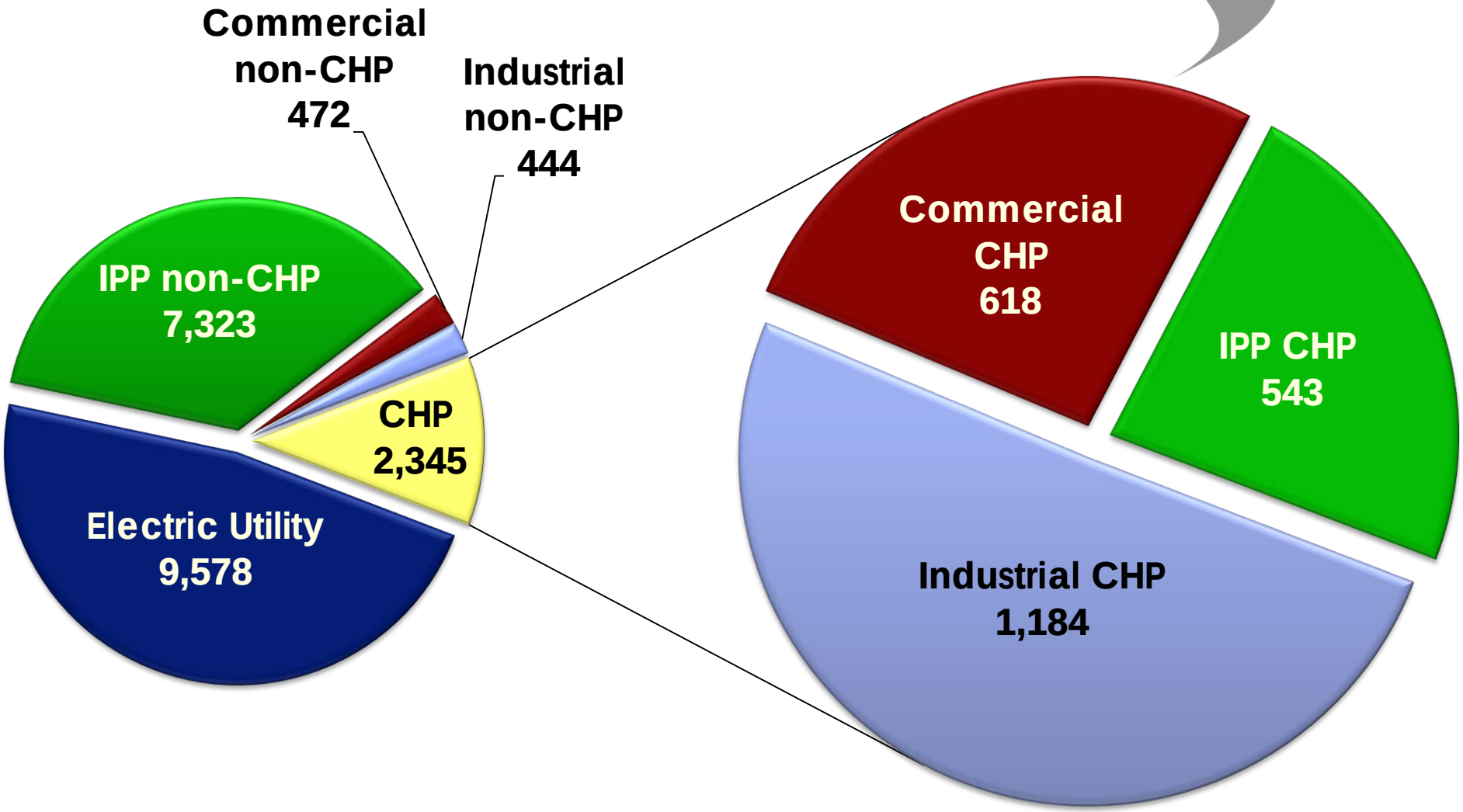
"…concurrent production of electricity or mechanical power and useful thermal energy…from a single source of energy"

Energy.gov, Office of Energy Efficiency & Renewable Energy



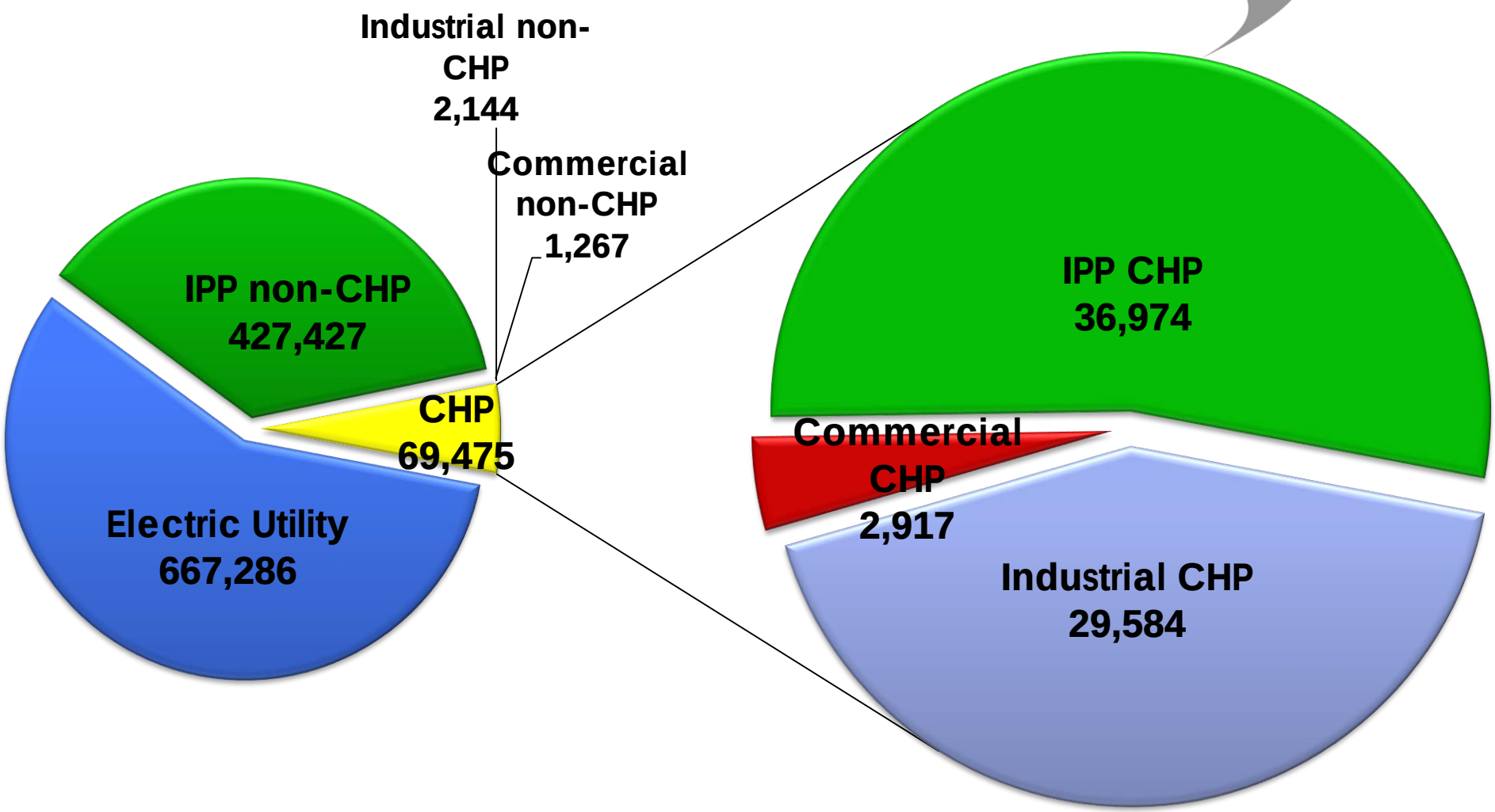
U.S. DOE CHP Deployment Program, 2016.

U.S. Market Share: Number of Units



Source: U.S. eia

U.S. Market Share: Capacity



Source: U.S. eia

Applications

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Industrial	Commercial	District Energy
Food Processing	Waste Water Treatment	Colleges & Universities
Chemicals	Hospitals	Downtown loops
Refining	Multifamily	Industrial complexes
Metal Manufacturing	Colleges & Universities	
Paper	Military Bases	

U.S. Installations by Fuel Type

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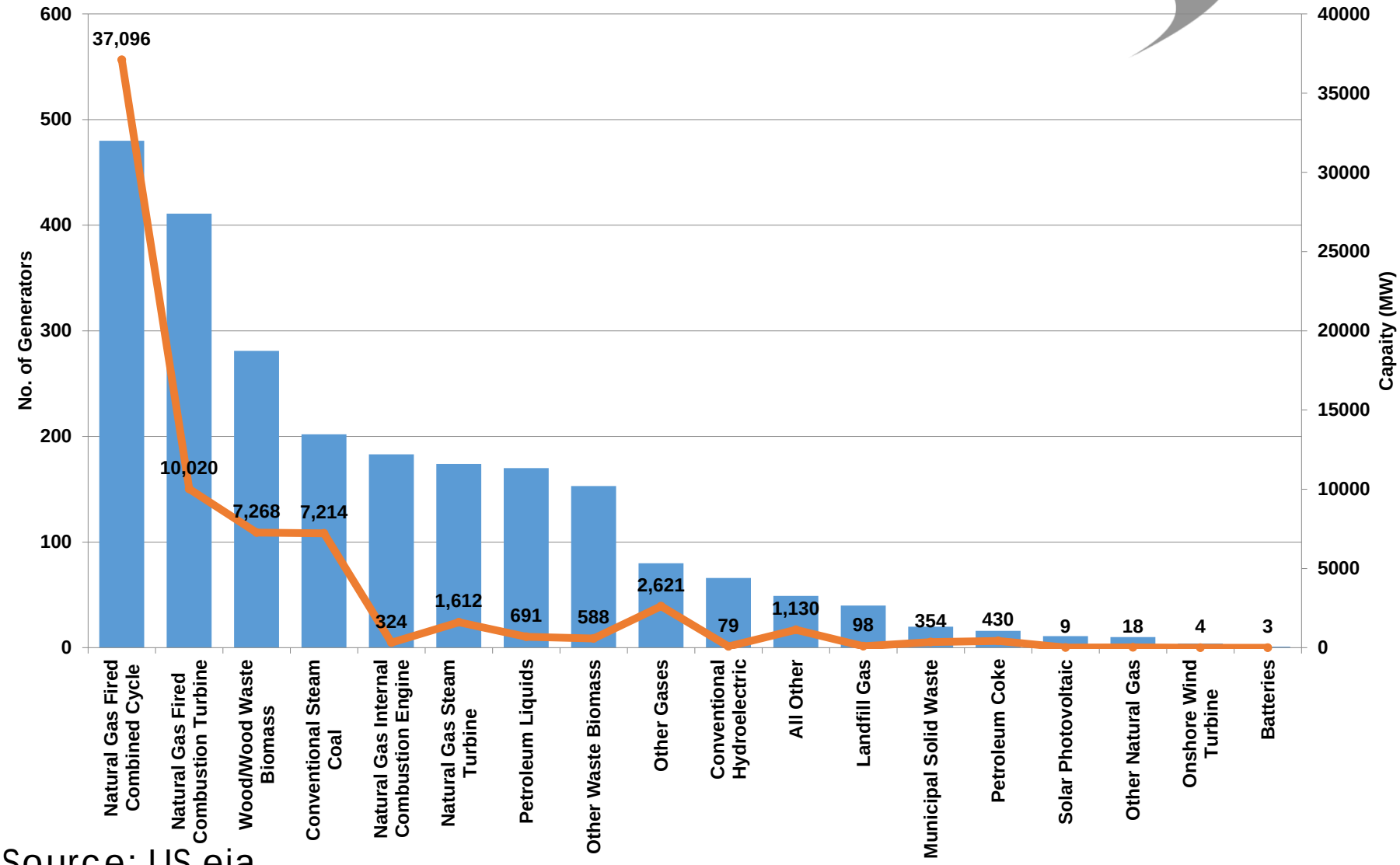

Source: US eia

Planned CHP's (Nationwide)

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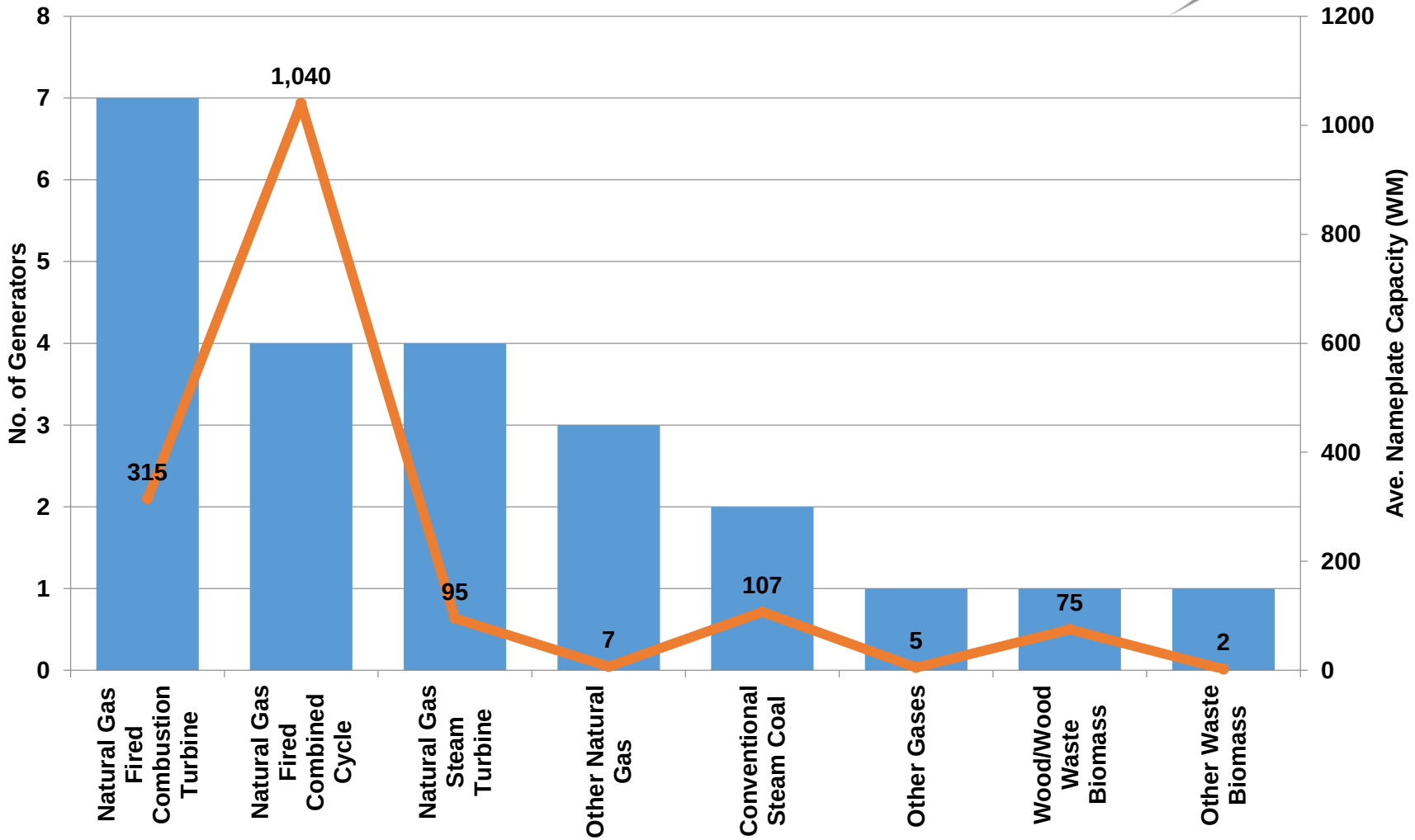
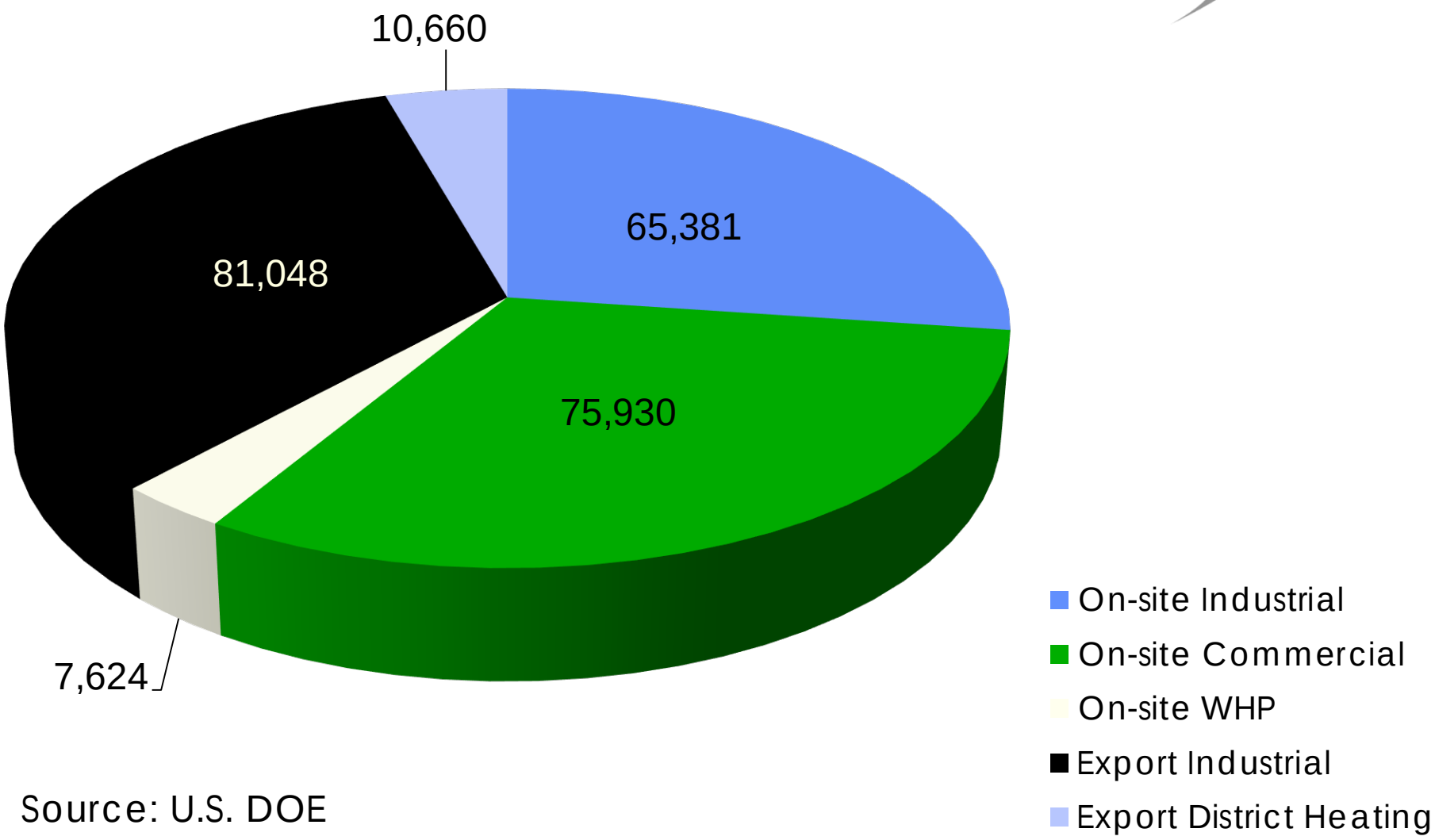


Source: US eia

U.S. CHP Potential



Source: U.S. DOE

Does it Make Sense to Consider?

Benefits

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- **Higher efficiency vs. conventional generation**
  - Less fuel per MWe
  - Lower emissions (GHG)
  - Lower water usage
- **Improved reliability**
  - Process steam
  - Heating/cooling
  - Quality electric power
- **Improved energy security**
- **Energy cost savings**
- **Multi-fuel capability**
- **Demand Response**

Obstacles

- Not core business of industry end-user
- Reluctance to make a long-term investment due to market uncertainties
- Payback periods beyond current company policy
- Complexity of permitting and siting

Energy Policy Act of 2005

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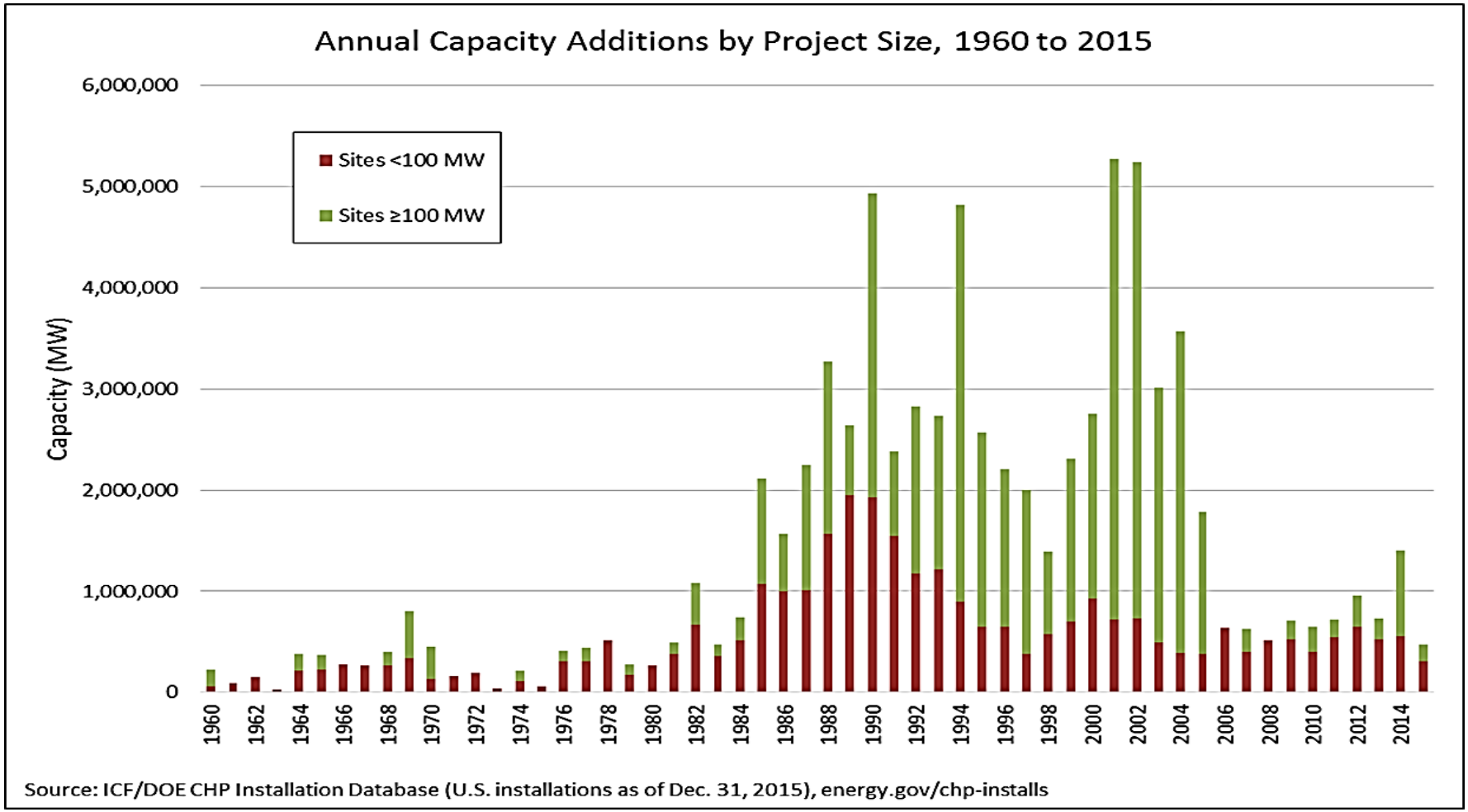
Eliminated PURPA "mandatory purchase"



Source: ICF CHP Installation Database, 2012

Approaches

- **Topping Cycle**
  Generate electricity first, then surplus used for thermal
- **Bottoming Cycle**
  Generate thermal energy first, then surplus used for electricity

Alternatives: Traditional

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Waste Heat Boilers	RICE	Microturbines	Gas Turbines
Dependent on WH temperature and mass flow	10 kW – 10 mW	30 – 330 kW	30 – 300+ mW
Steam quality sufficient for many process	Steam quality sufficient for many process	500 – 600ºF, hot water and low pressure steam	800 – 1,200ºF
Waste heat from process	Various gaseous and liquid fuels	Various gaseous and liquid fuels	Various gaseous and liquid fuels
Generally quiet	Acoustic enclosure building	Moderate	High energy fluids & high speed machinery
Limited ramp ranges, potentially complex metallurgy	Well-suited for part load operation	Significant loss of efficiency for part load operation	Significant loss of efficiency for part load operation

Industrial Green Initiative

- Corporate Goals
- State and Community Programs
- Community

Alternatives: Renewable

Solar PV	Wind
< 1 MW	< 1.5 MW
Light industrial & commercial	Light industrial & commercial
Sun	Wind
Quiet	Quiet
Dependent on weather conditions	Dependent on weather conditions

Battery Storage and CHP

- Current CHP model beneficial for concurrent consumption of electric power and heat
- Renewable Cogen facilities
- Electric power storage for non-coincidental thermal and electric power demand

CHP: Related Incentives & Policies

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Federal	
Interconnection Standards for Small Generators	Interconnection
USDA _ Rural Energy for America Program Loan Guarantees	Loan Program
USDA - Rural Energy for America Program (REAP) Grants	Grant Program
Modified Accelerated Cost-Recovery System (MACRS)	Corporate Depreciation
Business Energy Investment Tax Credit (ITC)	Corporate Tax Credit
Green Power Purchasing Goal for Federal Government	Green Power Purchasing
Indiana	
Interconnection Standards	Interconnection
Electric Efficiency Standard	Energy Efficient Resource Standard
Clean Energy Portfolio Standard	Renewable Portfolio Standard
City of Bloomington – Sustainable Development Incentives	Financial Incentive
Community Conservation Challenge	Grant Program

Clean Power Plan: Existing Units

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Some Units May Be Affected if They are:

- Fossil fuel fired
- Connected to utility/transmission grid > 25 MW
- Heat Input >250 mmBtu/hr

Clean Power Plan: New Units

- **New CHP units are not defined as affected units**
- **Plan suggests states include cogen in their SIPs**
- **CO_2 emissions calc. accounts for electrical and useful thermal energy**
- **Implications:**
  - CO_2 emissions lower than SIP limits can trade surplus allowances or emission reduction credits
  - Whether mass-based or rate based
  - Possible revenue stream
  - Smoother approval & permitting

Profile Slides

Combined Cycle CHP

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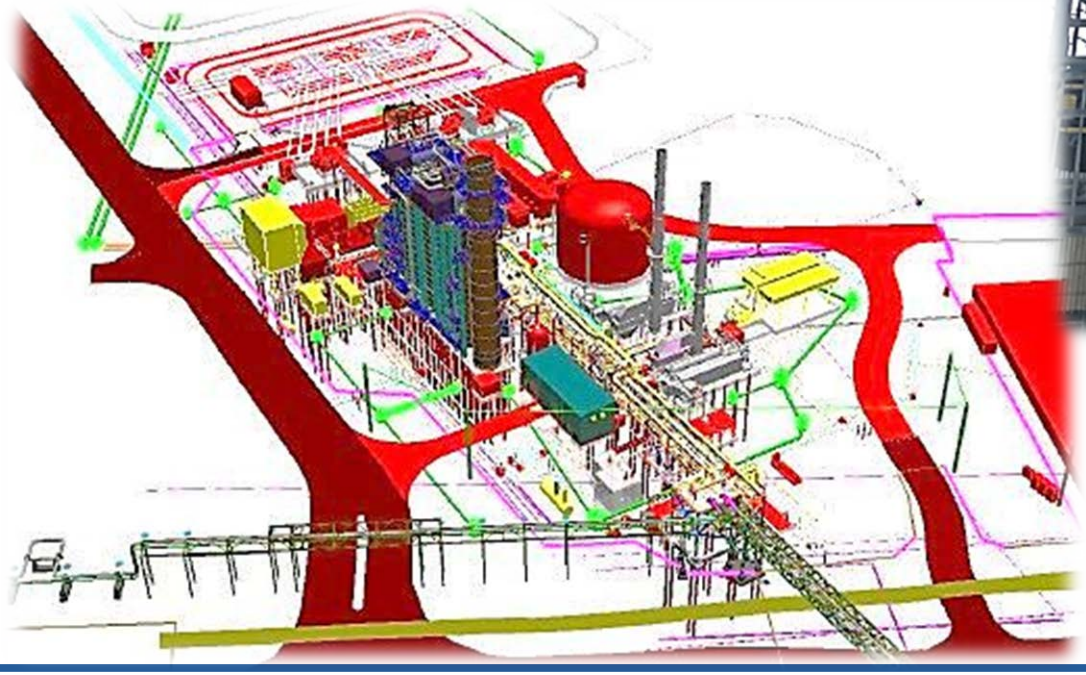
- EPC, Owners Engineer
- GE 7EA, 85 MW
- HRSG, 800,000 lb/hr steam
- (2) Aux Boilers, 200,000 lb/hr steam



Simple Cycle CHP

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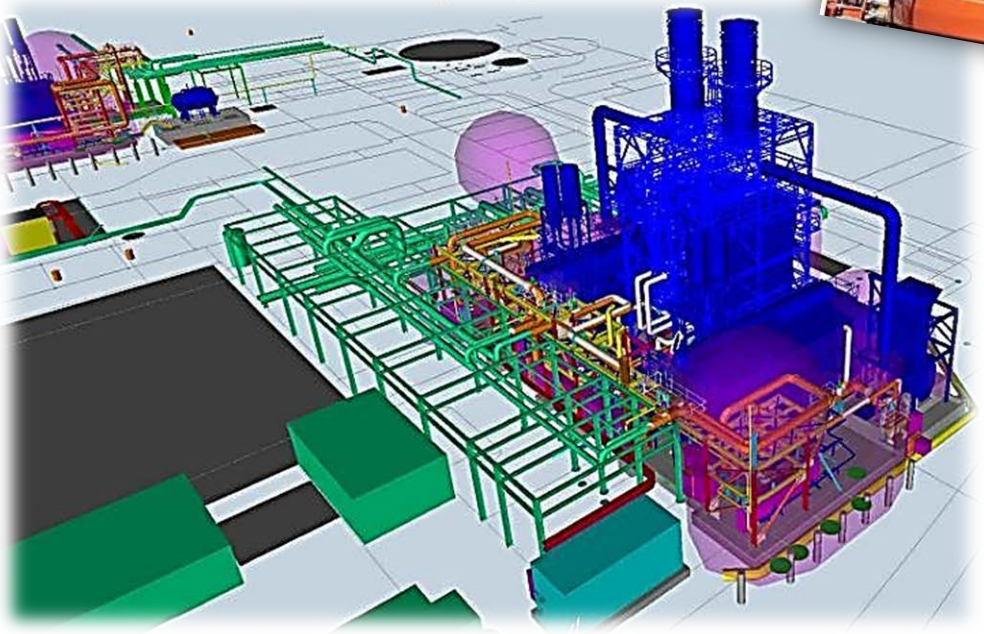
- (4) GE 7EAs
- (3) new boilers with SCRs
- Aux boiler replacement, EPC JV



If you have any questions concerning this webinar, please contact:

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