Environmental and Economic Benefits of CHP

Understanding the Environmental and Economic Benefits of Combined Heat and Power (CHP)

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Outline

- Fundamental Principles of CHP
- History of CHP, US and Globally
- Environmental Benefits of CHP
- Economics of CHP
- Example CHP Plants

Fundamental Principles of CHP

On-Site Power - Definition

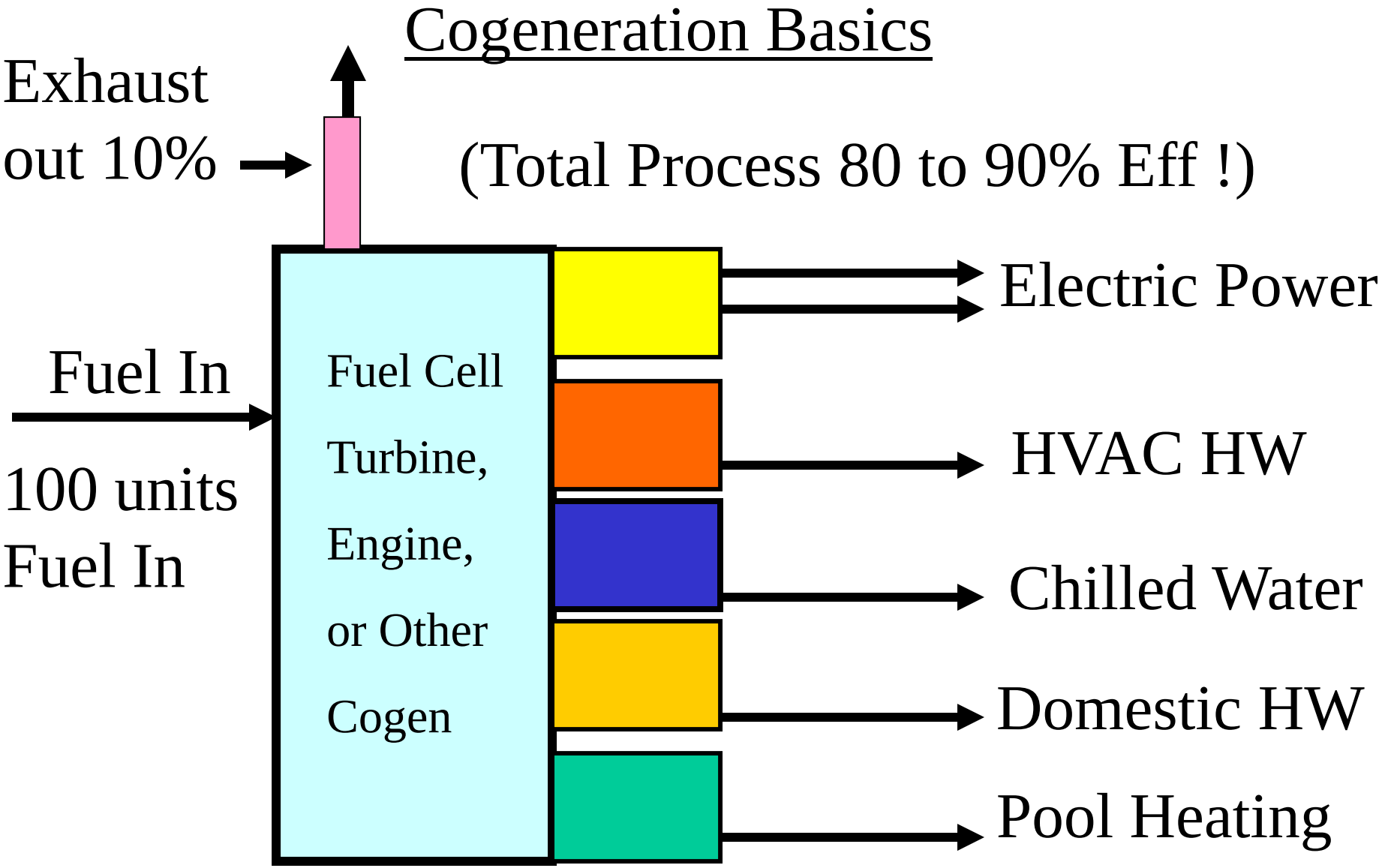
Any equipment that produces power on-site on the property of an institution, business or residence for which the primary power and waste heat is to be used. Generally “inside the fence”. May be grid connected as well.

May also wheel power to wholesale market .

Types of On-Site CHP Power

- Sizes from 30 kW to 5,000 kW + higher
- Natural Gas engines
- Gas Expansion Microturbines
- Large Gas expansion turbines
- Fuel cells, 10 kW to 1,000’s of kW
- Induction or Synchronous plants
- Steam Turbines

Cogeneration Basics



80 to 90 Fuel Units Used Total

Nat Gas Engine

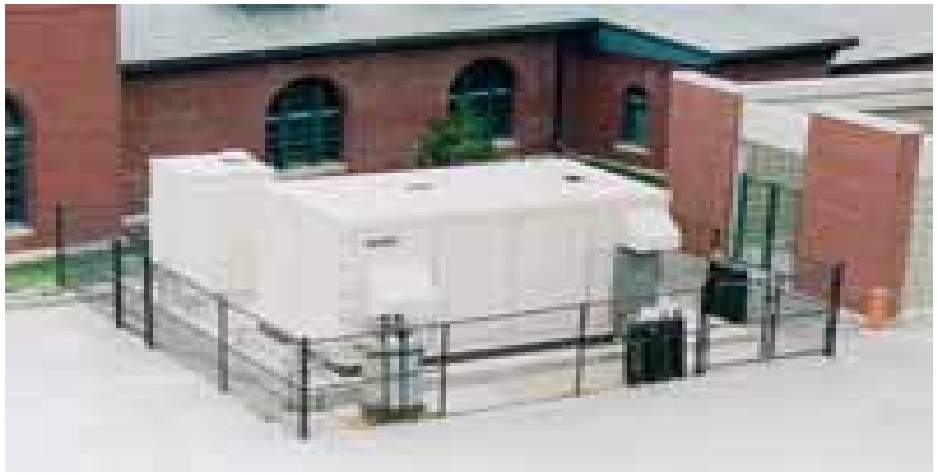
- Common in NYS
- 75 kW to 750 kW
- Often multiple units

Micro-Turbine

- Several in beta sites
- Ingersol Rand pictured

Nat Gas Fuel Cell

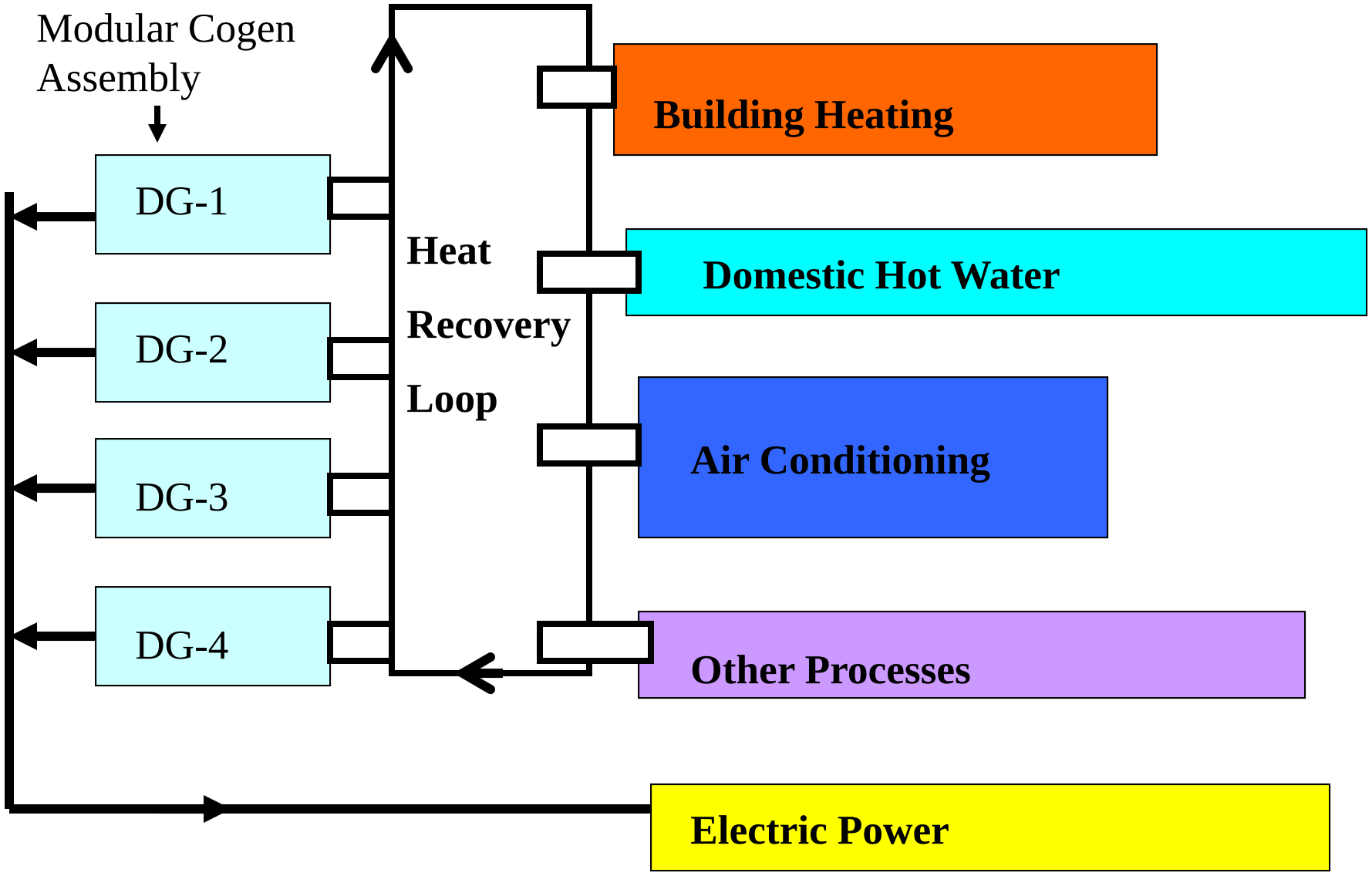
Boces - Syracuse, NY



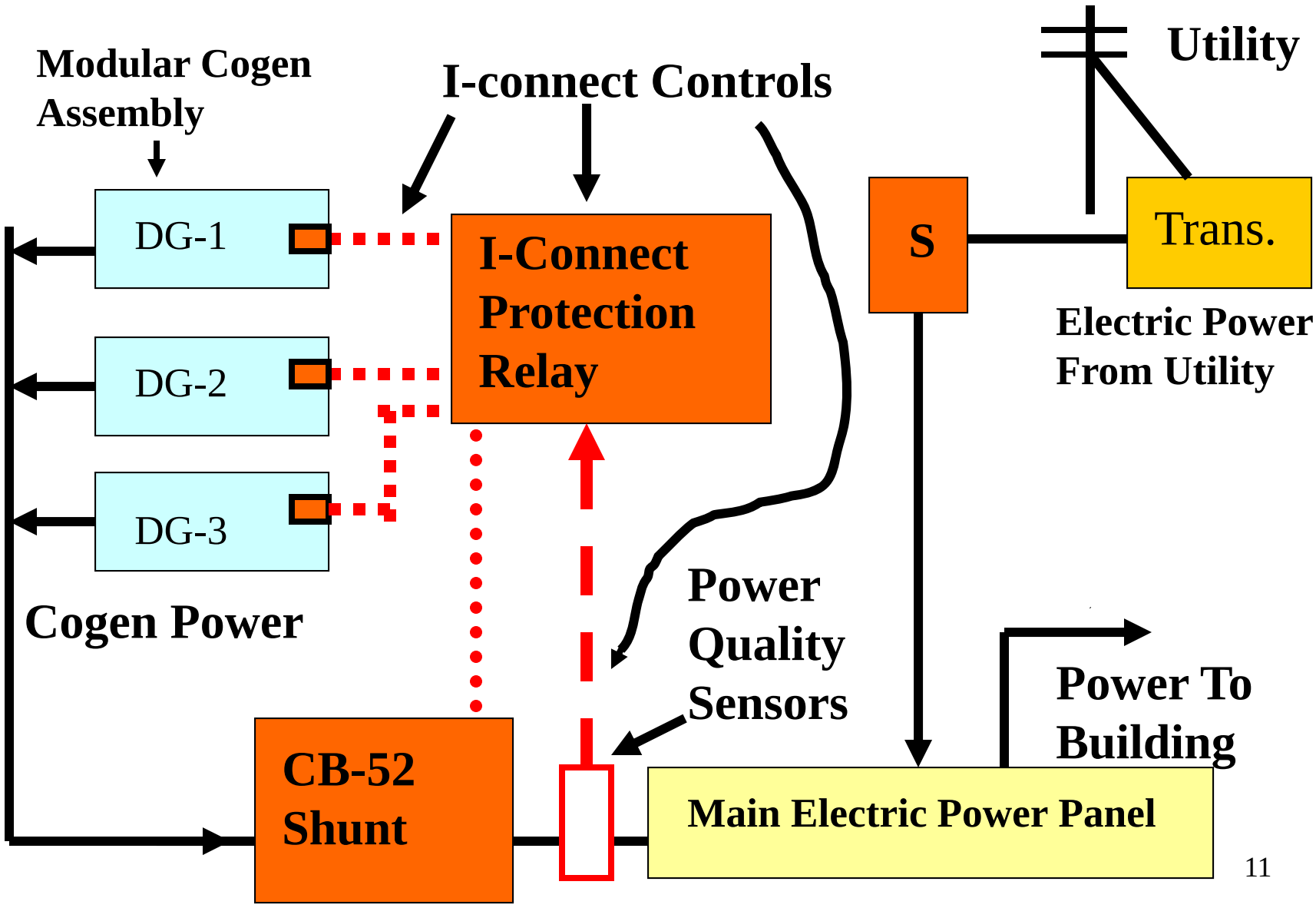
Methane Waste Plant

- Small 2-10 kW systems
- Medium 100 kW + size

Typical CHP Plant Layout



Interconnect – What is it ?



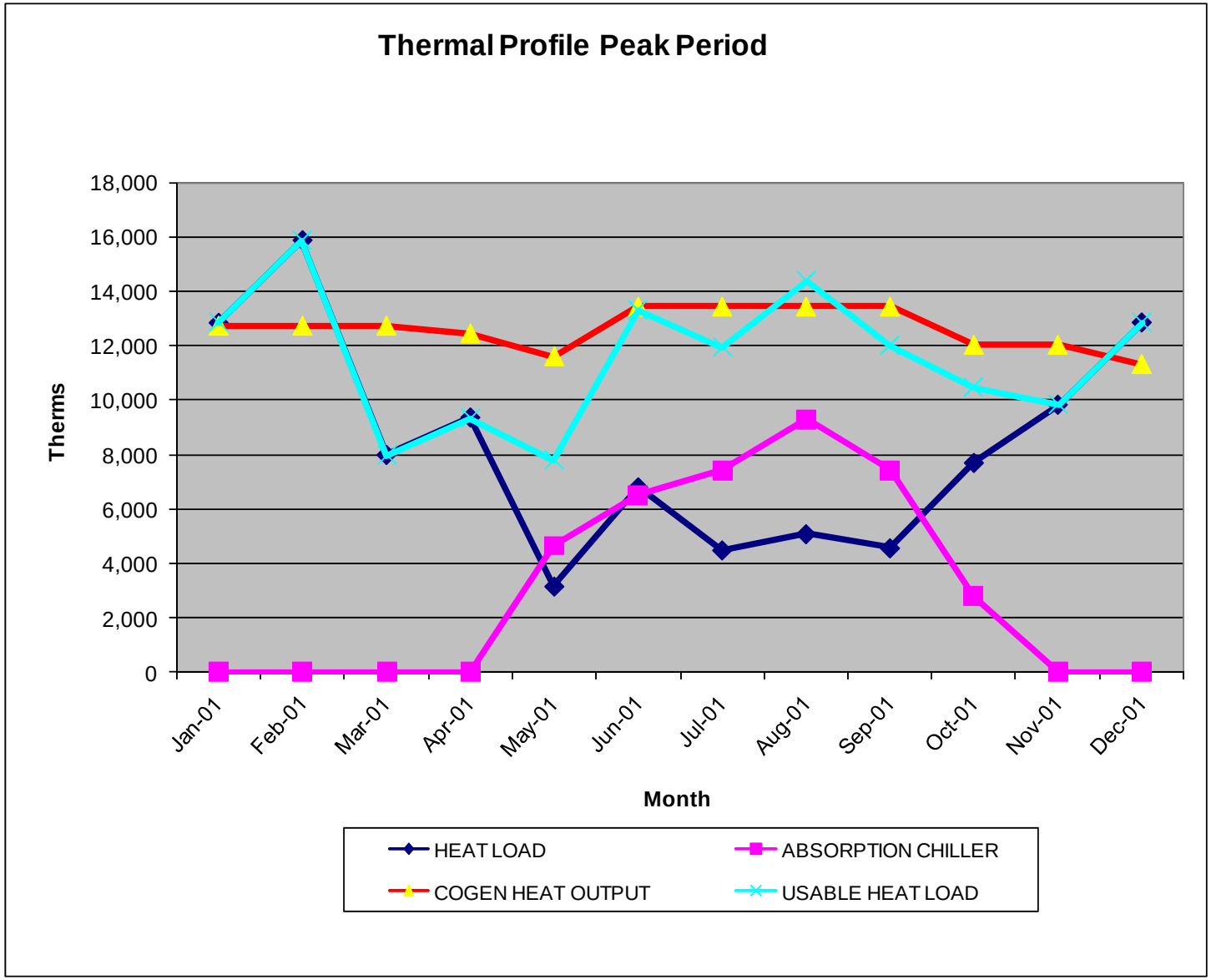
Interconnection Relay Panel

- Microprocessor based relay logic panel

CHP Analysis

- Existing electric annual profile
- Electric daily/weekly profile
- CHP plant sizing based on profile
- Existing thermal use, annual, daily
- Proper CHP plant size requires a balance of serving both electric and thermal needs.
- Not necessary to meet max of each, depends on site issues and utility tariffs.

Thermal Goal of CHP



History of CHP

History in US

- CHP Plants were popular at turn of the century, large commercial buildings and hotels, NYC, Chicago.
- Waned during age of “big utility” power distribution, 1920 to 1975
- New technologies , micro scale devices, environmental increasing today
- About 5% of total US Power

History in Europe

- More common since 1950's
- Europe produces about 11% total power with CHP
- Includes very large plants > 10,000 kw and small plants 100 to 2,000 kw
- Active market presently
- Denmark – 27% power is CHP
- Strong in Germany, other technical states

Asia, Japan CHP

- Active Market – Environmental and Economic Drivers
- Japan - Largest “Home” market for CHP, over 50,000 installations. Micro CHP
- Government energy policies favorable to CHP, clean energy.
- Strongest nation wide CHP growth.

Is it This Easy ?

- Japanese Add 1 Kw Nat Gas CHP Unit

Environmental Benefits of CHP

Environmental Advantages of CHP Plants

- Greater efficiency 60 to 90% (Vs 35% Utility)
- No Ozone depleting refrigerants
- Reduced air emissions
- Virtually no wastewater emissions/effects
- Low Noise
- Normally not visible
- No plant shutdown waste
- Modular, on-site, accurate sizing

Equivalent Energy Use Profiles
Standard Building Plant VS Cogen
Using Therms Fuel as Baseline

System Item	Standard Heat Plant	Standard Cooling	CHP Plant Heat/Cool
Boilers	6.5	0	0
Chillers		3.2	Non Ozone depleting
Electric Utility	8.7 (75 Kw)	8.7 (75 Kw)	(75 Kw)
CHP Cogen			8.7
Total Energy	15.36	11.9	8.7

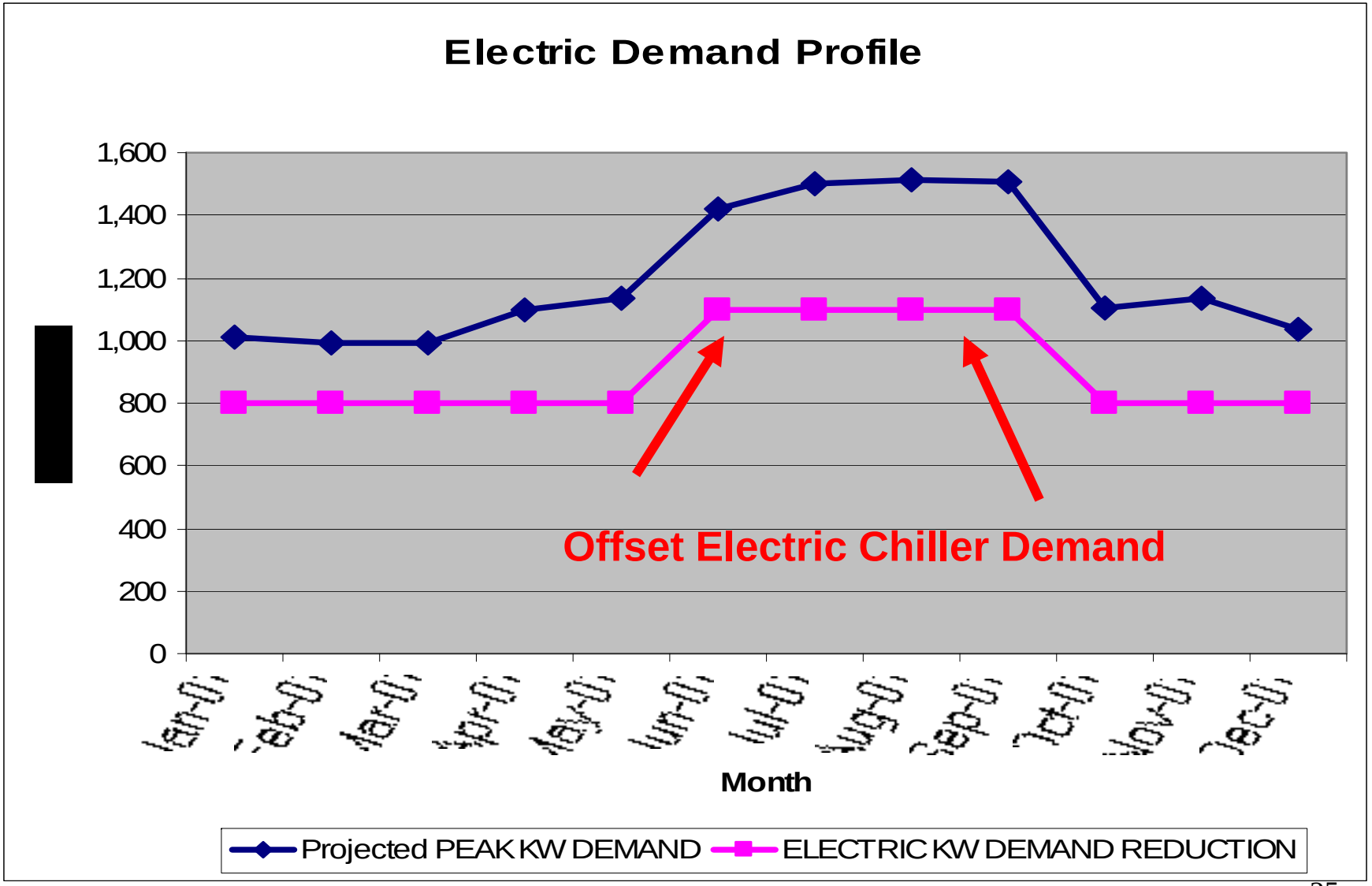
Absorber Air Conditioning

- Small to Large Chiller Plants
- Flexible Location, Just Get Hot Water
- Uses Waste Heat From Plant
- Little Electric Use
- Cleanest Available Refrigerant
- Complete Elimination of Ozone Depleting
- Good for Low Temp Chilled H2O

Reduction of Ozone

- Waste heat from CHP plant used to drive **Absorption air conditioning**. Does not use electricity and eliminates use of ozone depleting refrigerants and hazards.

Electric Effect With Absorber



LEED® CREDITS

Energy & Atmosphere Credit 1 – Optimize Energy Performance

- **Reduce design energy cost compared to the energy cost budget for regulated energy components described in ASHRAE 90.1-2007.**
- Demonstrate reduced design energy cost by a whole building simulation using the Energy Cost Budget Method.
- **CHP can help to achieve up to 19 LEED Points !**

New Buildings (% energy cost savings vs. ASHRAE 90.1-2007 baseline)	Existing Buildings (% energy cost savings vs. ASHRAE 90.1-2007 baseline)	Points
14	10	2
18	14	4
22	18	6
26	22	8
30	26	10
34	30	12
38	34	14
42	38	16
46	42	18
48	44	19 (max)

For LEED 2009 New Construction and Major Renovation

CHP - What You Can Expect:

- Plant sized based on proper balance of CHP plant to thermal load.
- Electric bill reduction 35 to 95 %.
- NET Gas increase 10 to 40 %.
- Cost to produce power $ .04 to $ .09/kwh.
- Simple paybacks 3 to 5 years, right site.
- Financial aid in certain regions may be significant $500,000 to $ 1,000,000.

Benefits of CHP to Owners/Ratepayers

- Energy reduction and cost $$ savings
- Reduced environmental cost and liability
- More competitive services/products
- Jobs retained and savings to customers
- Improved Power Quality
- Power backup during utility outages
- Leverage savings to finance infrastructure improvements
- Long plant life, flexible power needs

Implementation Methods and Financing Options:

- Turnkey owned by others – power sale agreement.
- Bids, owned by owner – with stipulated cost of construction.
- Owner financed: Operating lease, tax advantages, separate owner owned LLC's etc.
- Grant programs, rebates, incentives – can be a big factor.
- Federal Tax Incentives from 10% to 30% of CHP System cost.

Example CHP Plants

Harbec Plastics

25 by 30 Kw Microturbines and 250 Kw Windturbine

Delta Sonic Auto Care

Off Grid Power Plant

Total electric capacity = 300 kW

Total heat output = 1,500 MBH

Rochester Airport

Two by 750 Kw Units

Clifton Springs Hospital and Clinic

Total electric capacity = 375 kW

Total heat output = 2,500 MBH

Main System in C-Tainer Package

Redhook Green Power LLC

1,000 kW electric capacity, heating, cooling, domestic HW

Winner - Municipal Art Society NYC Masterworks Award

Geneva General Hospital

Total electric capacity = 375 kW

Total heat output = 2,500 MBH

Questions and Discussion

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