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Energy Efficiency & Conservation

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Efficiency and Conservation

A Penny Saved is a Penny Earned – Ben Franklin, 300.
A Btu Saved is a Btu Mined!

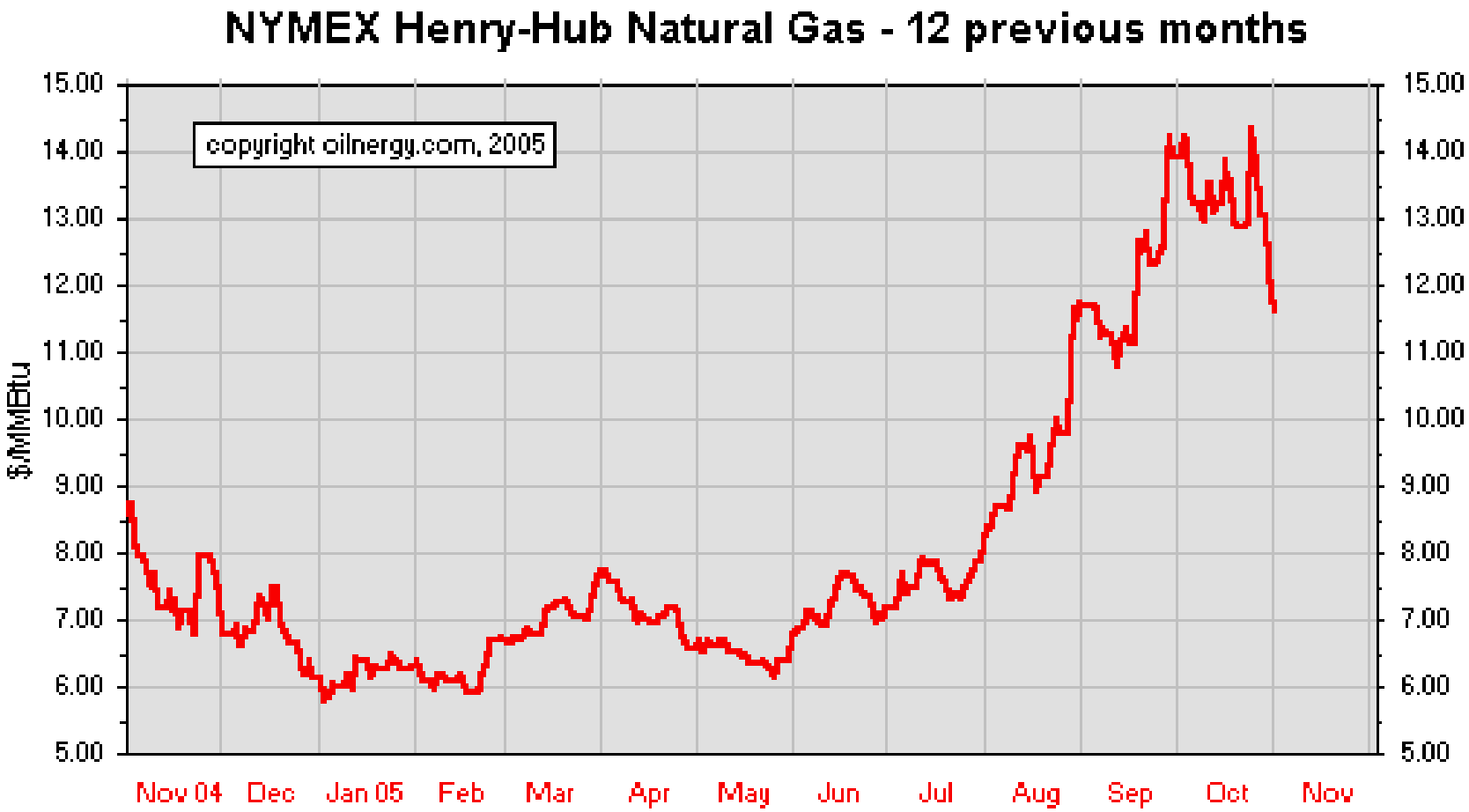
*** Conservation and Efficiency should thus be natural.**
*** Saved Btu could cost more than a bought Btu**

Technology and Efficiency

Technology has helped improve Energy Efficiency Over the years

Better SFC, Better MPH for cars
More efficient power plants
Newer aircraft have better fuel efficiency,
747 vs 787

Do we need a reason to conserve?



Source – DOE EERE

Where to Conserve?

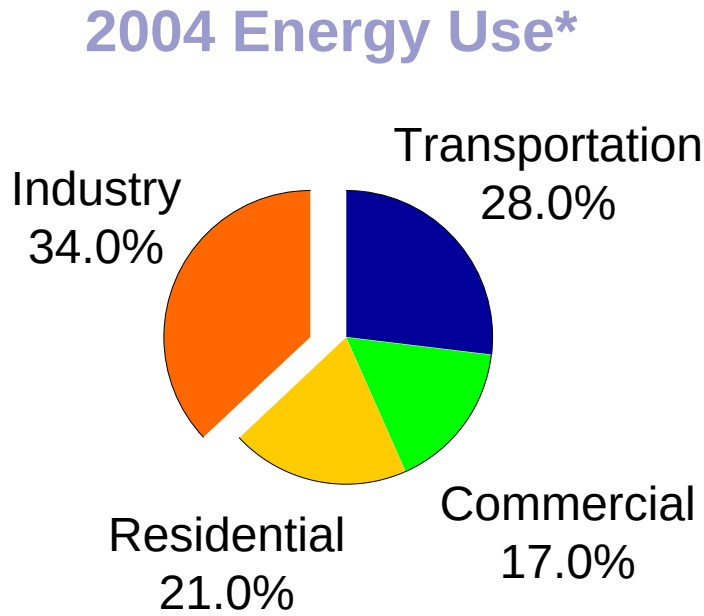
Industry, Residential, Commercial, Transportation ?

Industry uses

- **1/3 of U.S. energy**
- **More than 40% of U.S. natural gas**
- **~28% of U.S. electricity**

Transportation

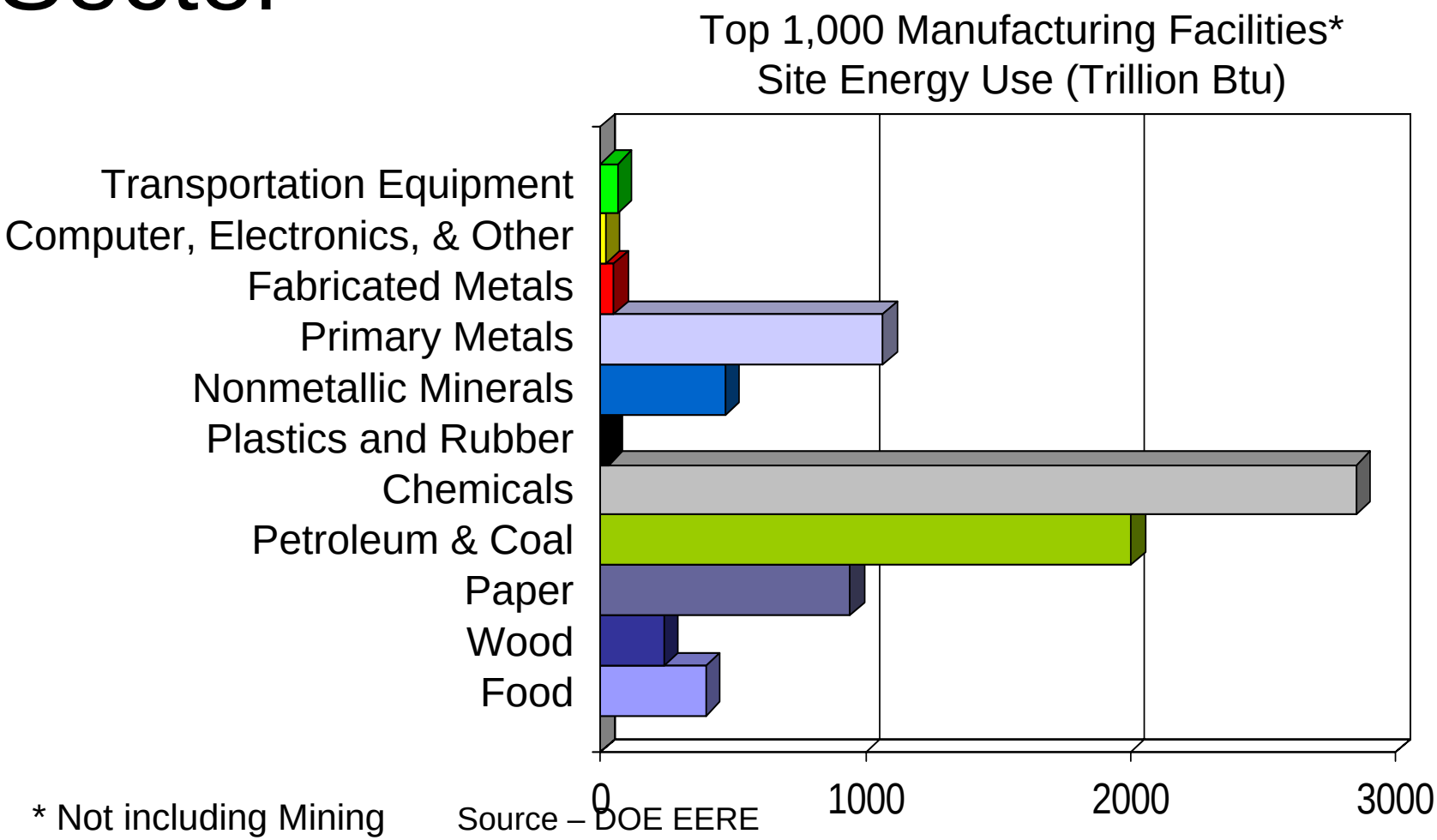
- **Needs fluid fuels**
- **Currently Import sensitive**



*Includes electricity losses

Source: DOE/EIA Monthly Energy Review 2004 (preliminary) from EERE

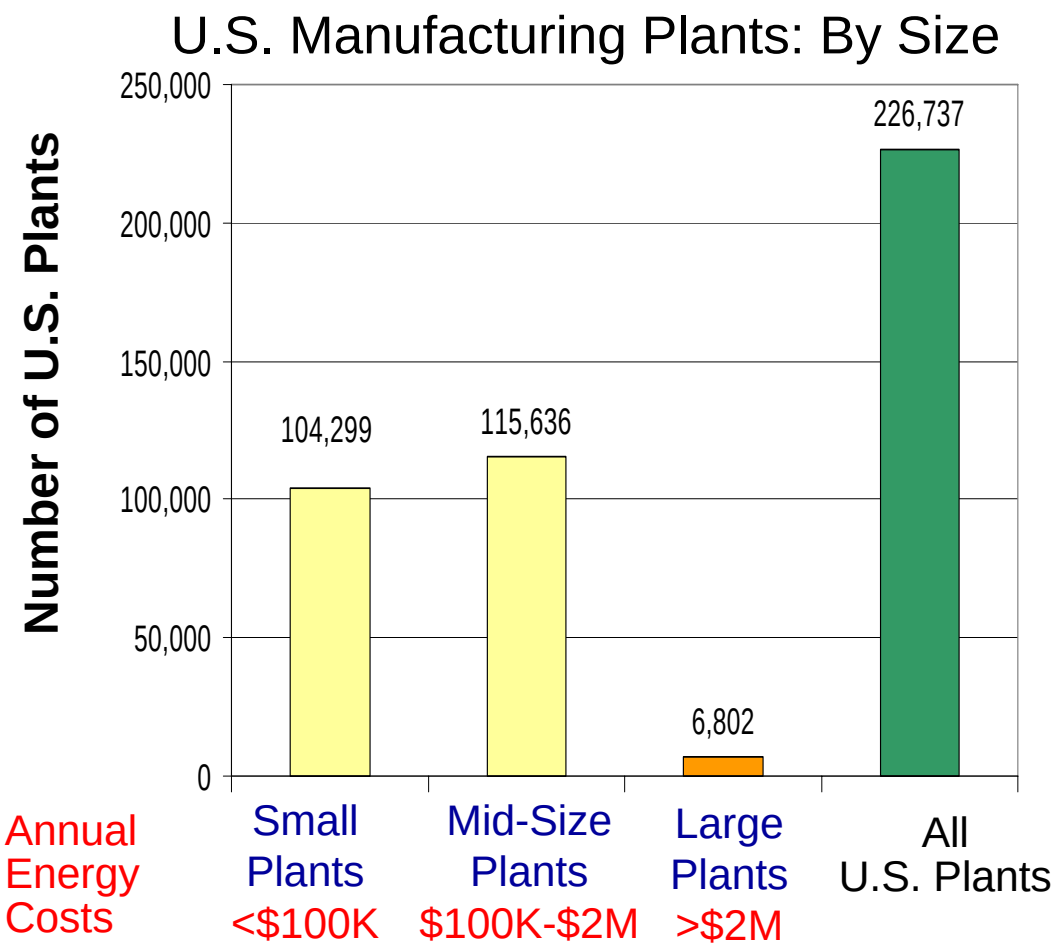
Energy Use - Large Plants by Sector

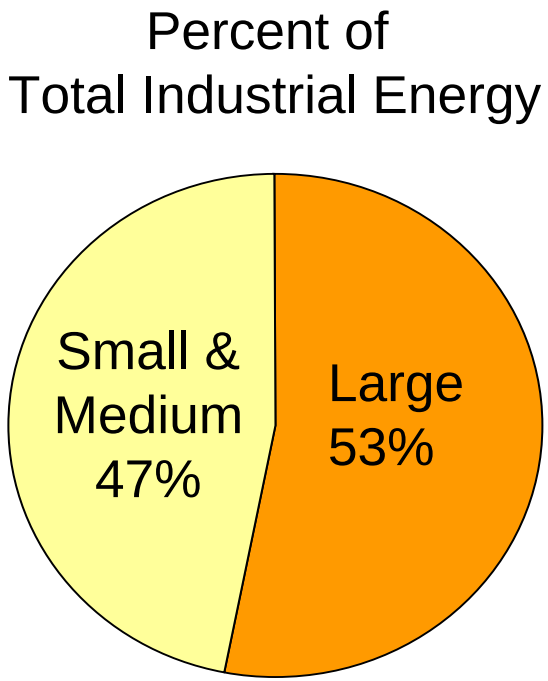


* Not including Mining

Source – DOE EERE

Relatively Few Plants Use the Most Energy





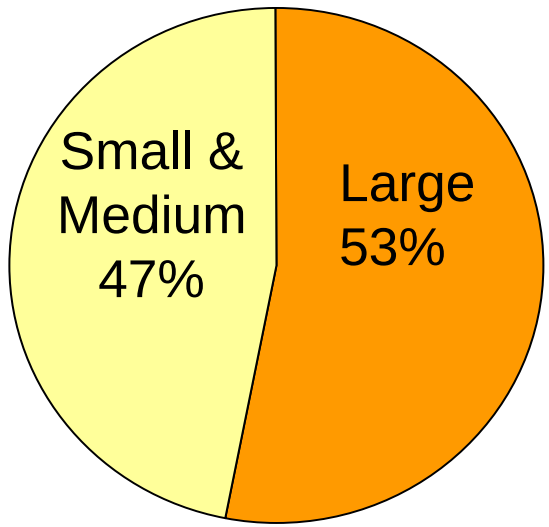
1998 EIA MECS – DOE EERE

DoE Programs for Energy Savings

Industrial Assessment Center (IAC) Program for small/medium plants

Save Energy Now Initiative of Industrial Technologies Program (ITP) for large plants – 200 to start with in 2006

Percent of
Total Industrial Energy



1998 EIA MECS – DOE EERE

Save Energy Now: A New DoE Initiative

- **Plants must apply for an Energy Savings Assessment (ESA)**
- **Conduct 200 energy savings assessments of the most energy-intensive U.S. plants**
- **Work with partners to create awareness and find energy savings solutions**
- **Disseminate energy savings information & tools to 50,000 plants to help reduce natural gas and electricity use.**

IAC Program for small/medium size plants

- **Lack internal expertise to energy analysis**
- **Could use DOE “Best Practices” for energy savings**
- **Need energy savings and $$**
- **We shall discuss the methods pertaining to energy savings in the context of IAC**

The Lehigh IAC

in the Department of Mechanical Engineering & Mechanics.

Director:

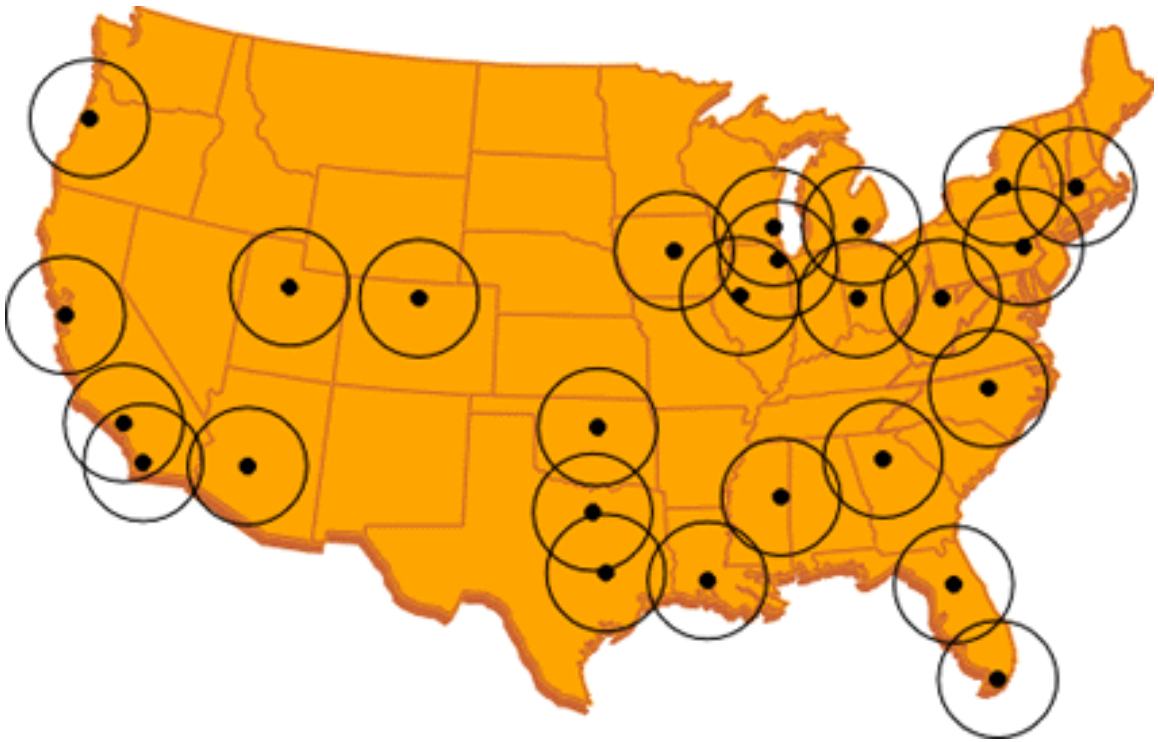
Prof. Sudhakar Neti

Associate Director:

Prof. Alp Oztekin

National Organization

- **26 DoE IAC centers at various universities**
- **The collective database is a strength**
- **Implementation database is proof**



Energy Assessment Process

- **Pre-plant visit Planning**
- **Plant Visit -- listen to plant personnel, quantify plant parameters**
- **Post plant visit process – Report**
- **Follow up for implementation**
- **Follow up for implementation**
- **More follow up ……**

Criteria for Success

- **Use ideas the <u>plant subscribes to</u>** ←
- **Total Energy Savings**
- **Annual Cost Savings**
- **Implementation cost must be low**
- **Payback Period (two years or under)**
- **Financial Strength of the Plant**
- **Financial strength……**

Data must be verifiable, complete

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ARC No.	Description	Type of AR	Annual Savings	Total Annual Cost Savings ($)	Implementation Cost ($)
AR 1 2.3415.2	Install a Combined Heat and Power System	Electricity Demand	9,984,000 kWh 19,200 kW	$564,465	$1,440,000
AR 2 2.4232.2	Install Low Pressure Blower for the tank agitation	Electricity Demand	786,081 kWh 504 kW	$38,827	$9,500
AR 3 2.3131.1	Stagger Start the Electric Motors to Reduce Peak Electric Demand	Demand	1,919 kW	$16,161	$2,500
AR 4 2.2445.1	Recover Condensate Heat Loss	Natural Gas Water Waste	2,169 MMBtu 1 million gal 1 million gal	$13,784	$37,000
AR 5 2.1116.2	Adjust Air-Fuel Ratio of Boilers	Natural Gas	1,911 MMBtu	$9,210	$1,110
AR 6 2.7261.3	Install Set Back Timers on Thermostats Controlling Office Heating	Electricity	147,503 kWh	$6,490	$1,925
AR 7 2.4221.2	Use Outside Air for Compressor Intake	Electricity Demand	70,526 kWh 120 kW	$4,111	$1,500
AR 8 2.6218.2	Turn off Equipment when not in Use	Electricity	92,170 kWh	$4,055	$350
AR 9 2.2514.1	Cover Heated Pickling Tank	Natural Gas	591 MMBtu	$2,850	$2,274
AR10 2.4236.2	Repair Air Leaks in Compressed Air Lines	Electricity Demand	48,804 kWh 67 kW	$2,712	$200
AR 11 3.6124.3	Install a waste oil Heater	Natural Gas Waste	283 MMBtu 2,272 gal waste oil	$1,823	$3,000
Total	--------	------	------	**$664,488**	**$1,499,359**

ENERGY Savings in…

- Electrical Energy
  - kWh and kW Savings
- Natural Gas
- Fuel Oil (#2, #4, etc.)
- Coal

Assessment Areas

- Energy usage (electricity bills, fuel consumption)
- Energy intensive equipment (electrical motors, compressors)
- Processes and equipment (boilers, combustion sys, heat exchangers and cooling towers, chillers)
- Buildings and plant areas (insulation, lighting, HVAC)
- Production process

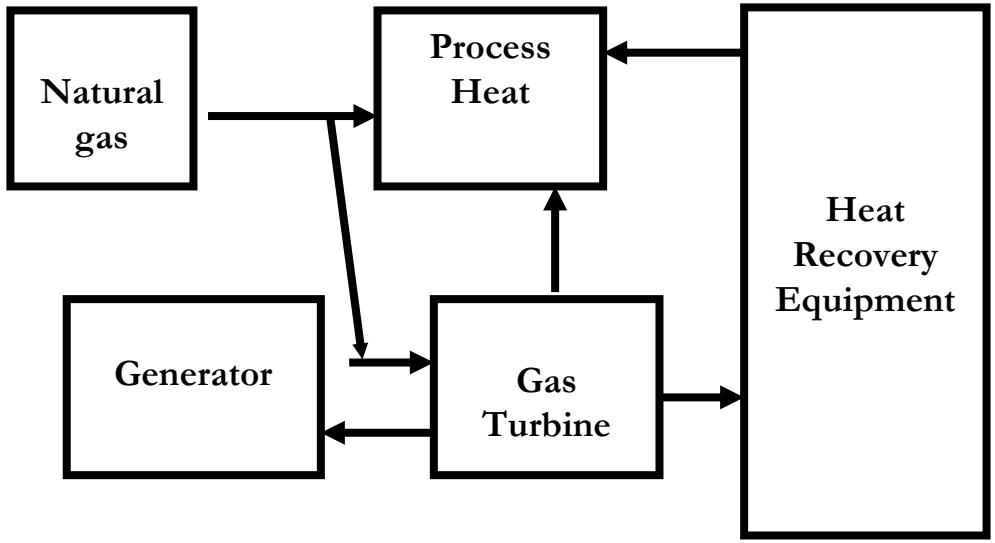
Steam System Recommendations

- Boiler combustion diagnostics – Excess air %
- Reduce steam Pressure, Temperature set Points
- Steam Leaks
- Steam Trap Leaks
- Use correct size boiler

Compressed Air Recommendations

- Size compressor for full load operation
- Estimating true plant air demand
- Control Strategies for multiple compressors
- Operational – pressure too high
- Maintenance – leaks, etc.

CHP – Combined Heat & Power



Electricity - $ 0.064/KWh, $ 8.42 / kW, Gas - $12/ MMBtu

Equipment	Power (kW)	Cost per KW	Implementation Cost ($)	Operating Hours per year	Annual Cost Savings ($)	Payback (years)
Gas Turbine	1,600	$900	1,440,000	6,240	364,465	~ 4
IC Engine	1,600	$1,200	1,920,000	6,240	415,098	~ 5

Important Suggestions

Consider viable renewable energy sources

TURN OFF EQUIPMENT WHEN NOT IN USE !

Turn off motors, lights, Set back thermostats, etc.

Turn off equipment with appropriate automation

Summary

Do we need to conserve?

Programs for energy savings.

Methodologies for energy savings.

Discussion

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