Industrial Technologies Program

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Areas Covered in this Webinar

- Industrial sector energy consumption characteristics
- Market barriers to industrial energy efficiency
- Energy-saving technologies for the industrial sector
- Industrial efficiency program design and delivery
- Providing assessments to industrial energy consumers
- Benefits of assessments

Speakers

- John Nicol, SAIC/Wisconsin Focus On Energy
- Nels Andersen, Franklin Energy
- Chris Goff, Southern California Gas Company

Sponsors

- DOE Industrial Technologies Program
- American Public Power Association, Demonstration of Energy-Efficient Developments
- Western Area Power Administration

Opportunities for Cost-Effective Energy Efficiency In the Industrial Sector

John Nicol, PE
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January 13th, 2010

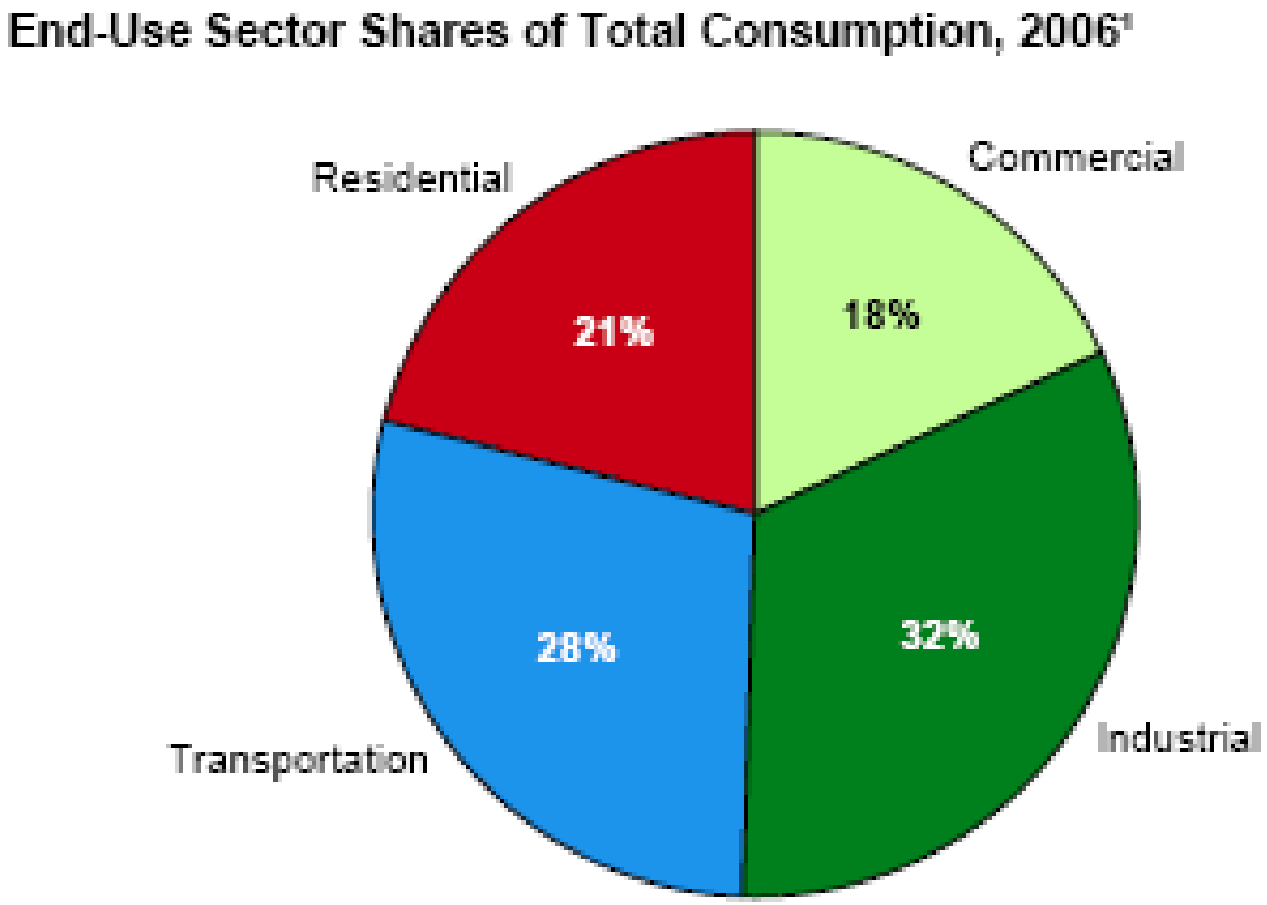
Session Agenda

- Speaker's Expertise and Perspective
- Overview of Industrial Energy Use
- Program Opportunities
- Market and Program Barriers
- Program Strategies
- Program Trends and Resources

My Perspective

- 25+ years promoting energy efficiency in commercial and industrial facilities
- Directed Wisconsin's Focus on Energy industrial program since the start in 2001
- This year I oversee a $18 million dollar budget to achieve 97,000 MWH, 17 MW and 6,800,000 therms industrial savings
- During the last 9 years we have tried many approaches to maximize program energy savings within Industry

US Energy Consumption (EIA)



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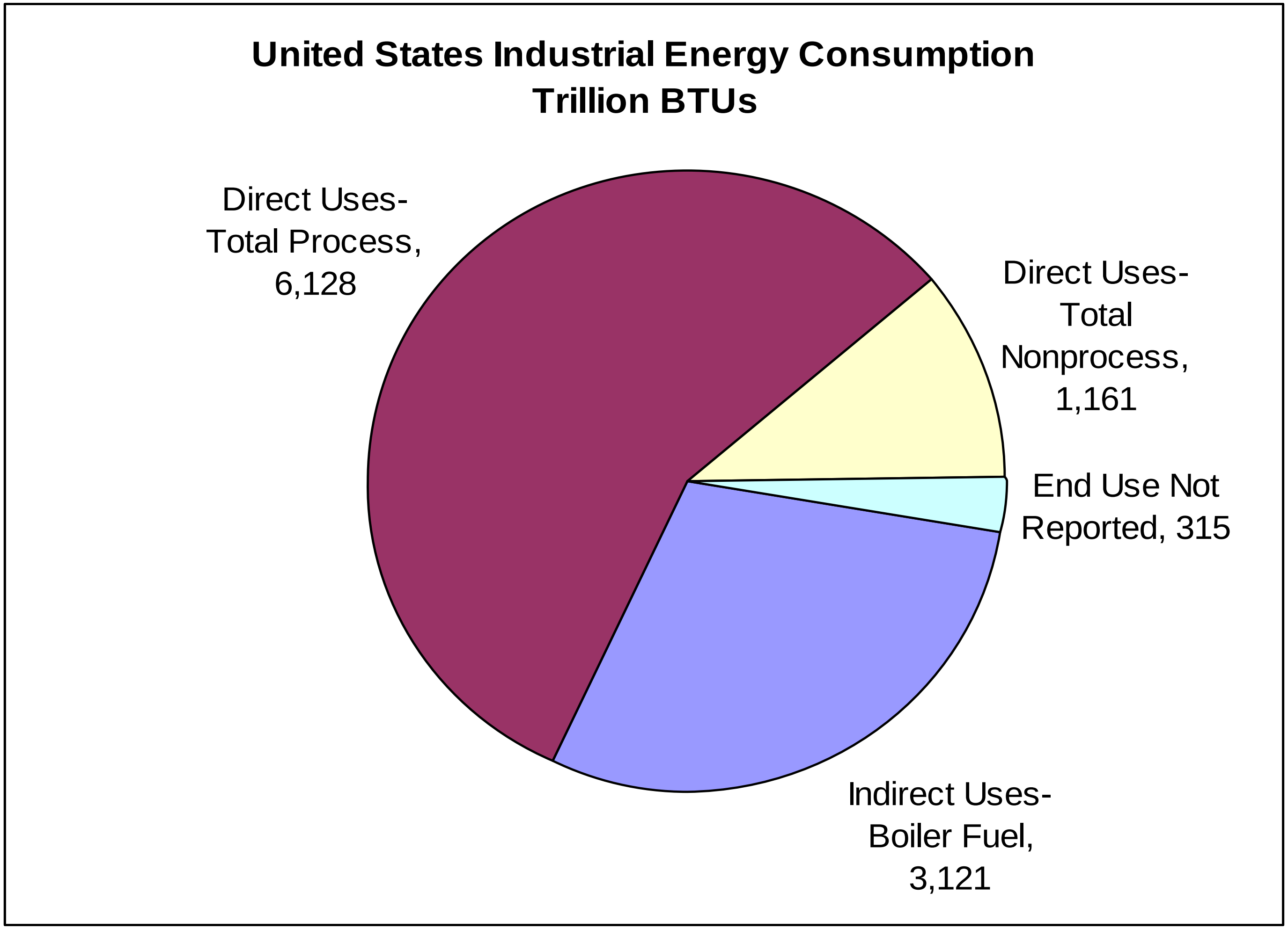
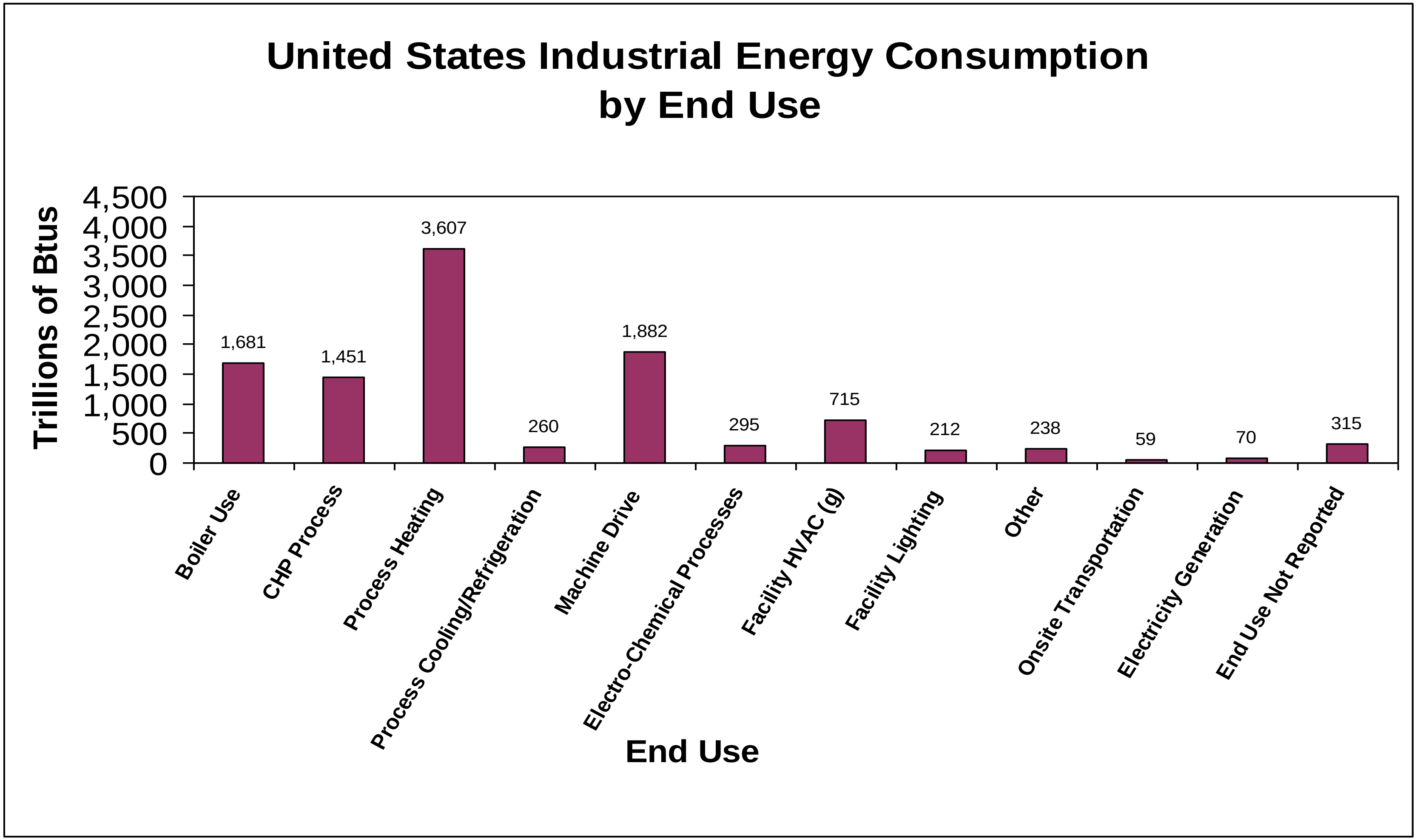
How do Industries Use Energy?



2002 Energy Consumption by Manufacturers--Data Tables, Energy Information Agency, USDOE, 2002

More Refined Breakout of Use



2002 Energy Consumption by Manufacturers--Data Tables, Energy Information Agency, USDOE, 2002

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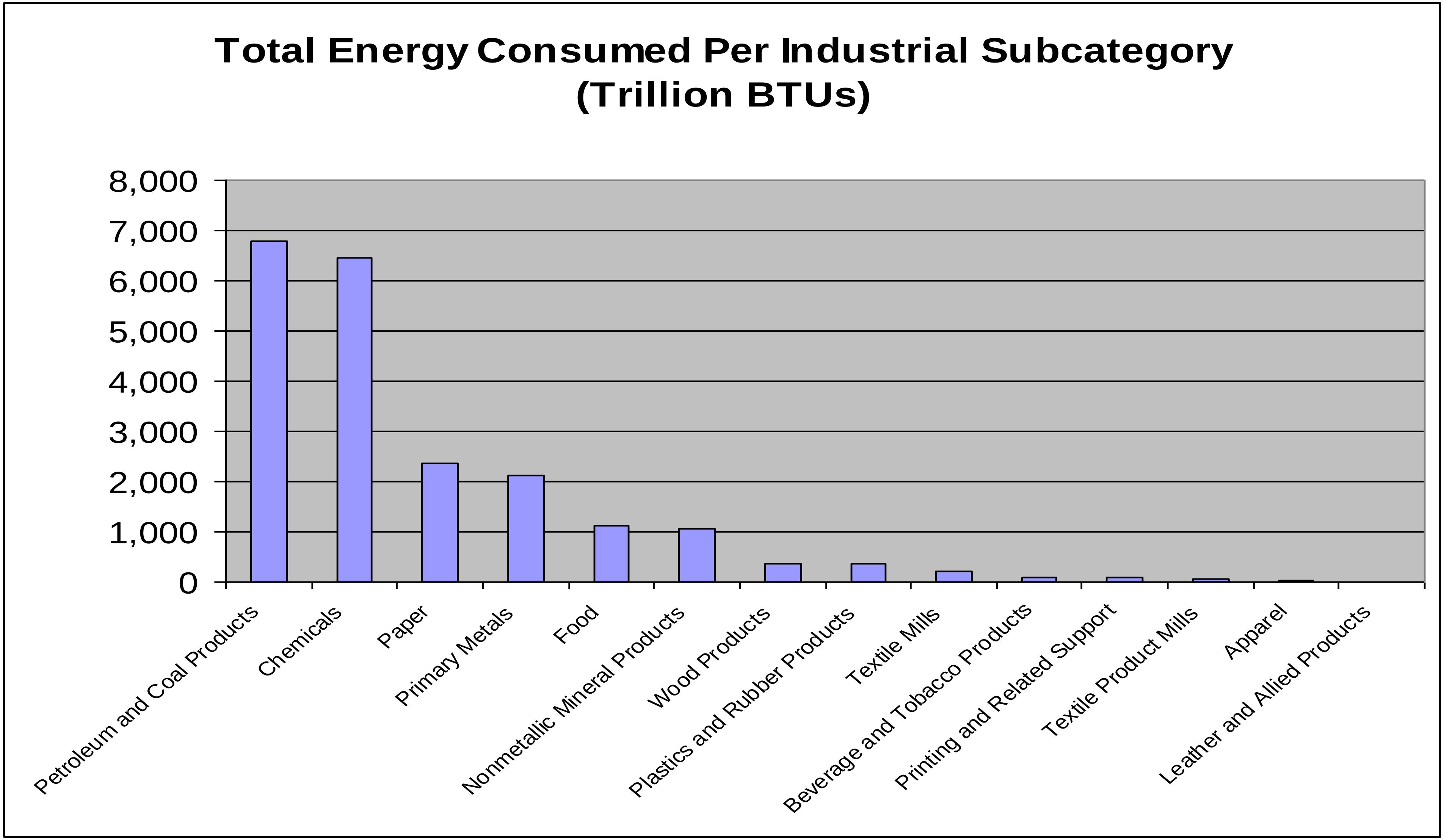
Who is Using the Most Energy?



EIA Database

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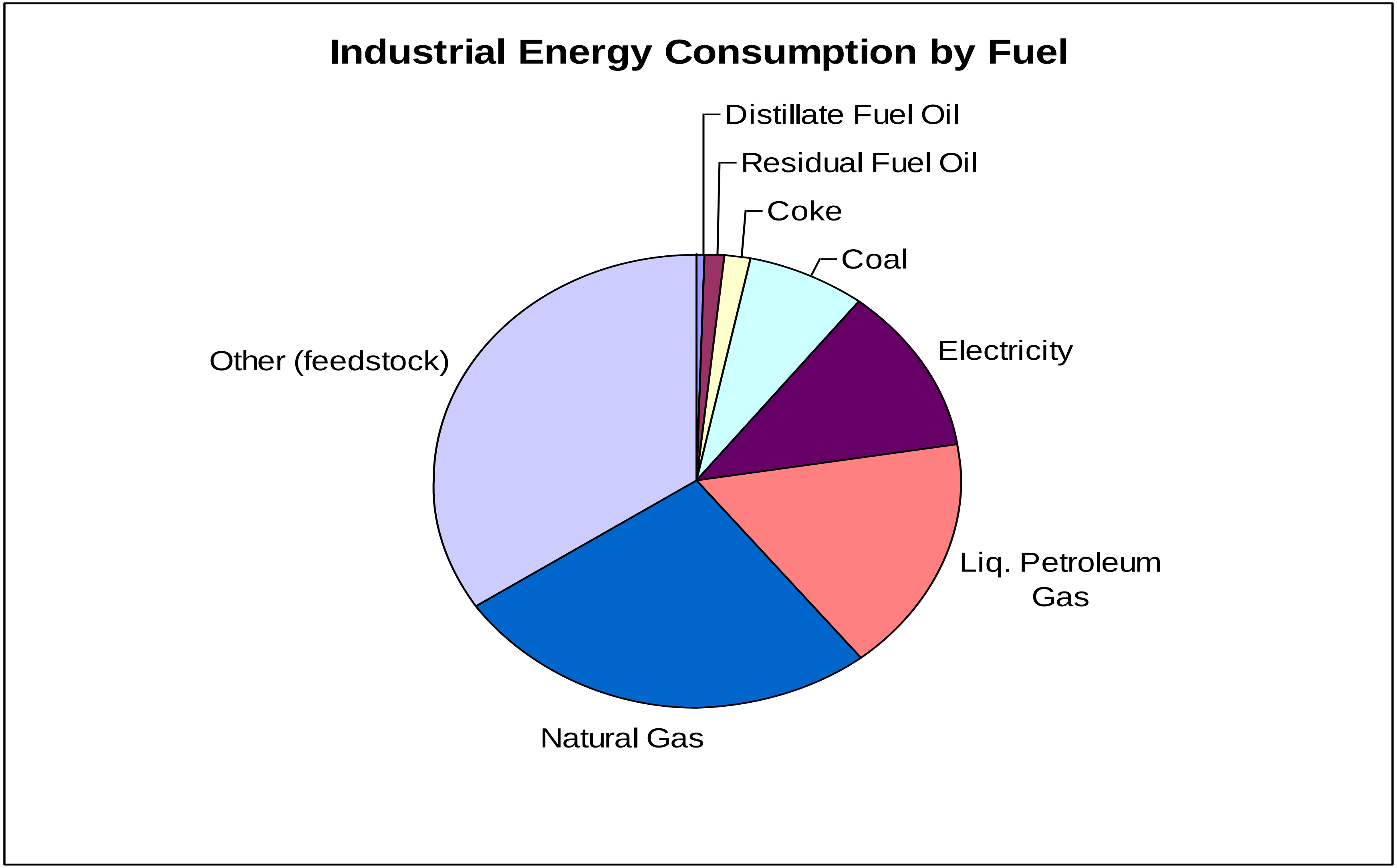
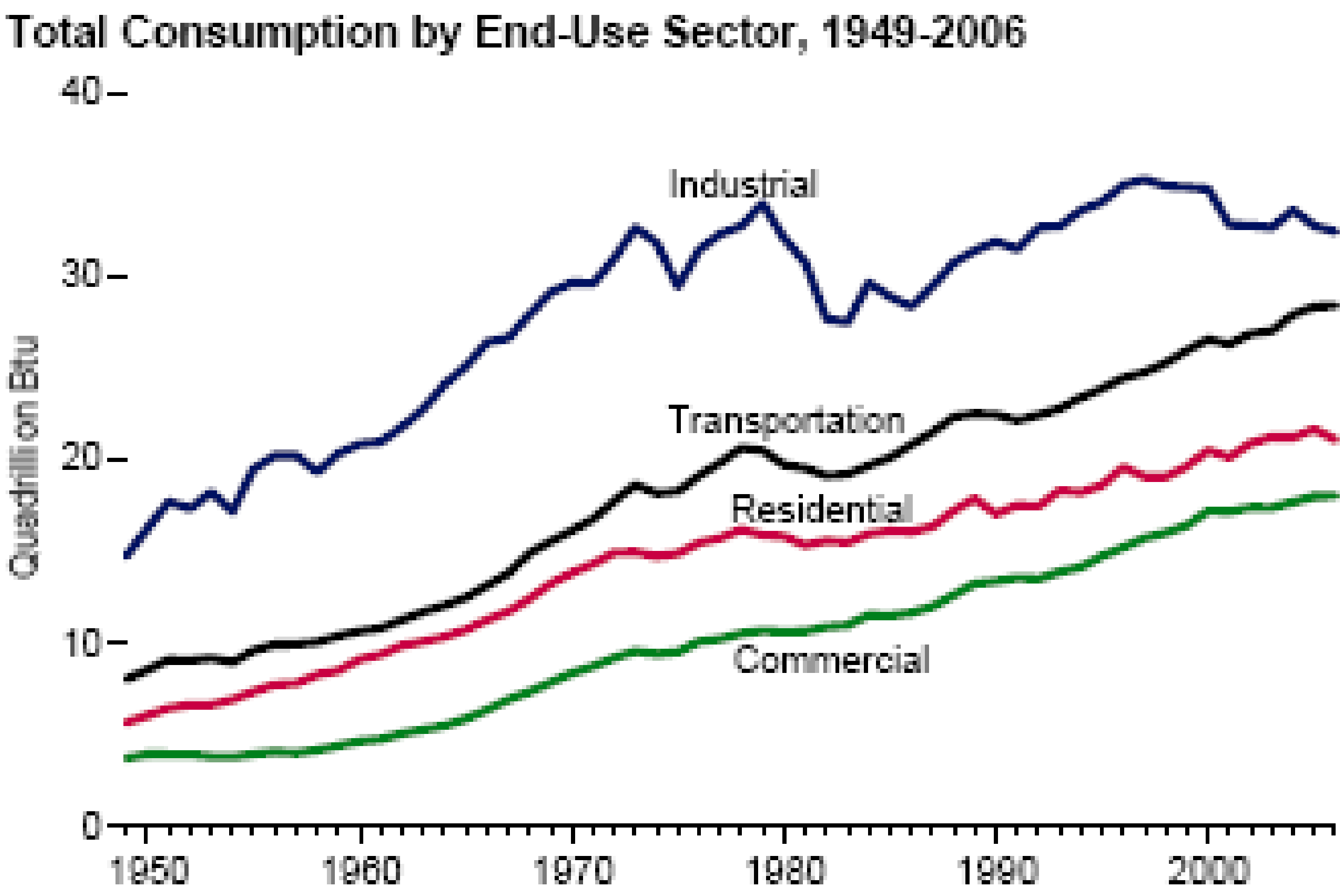
What are the Fuels Used by Industry?



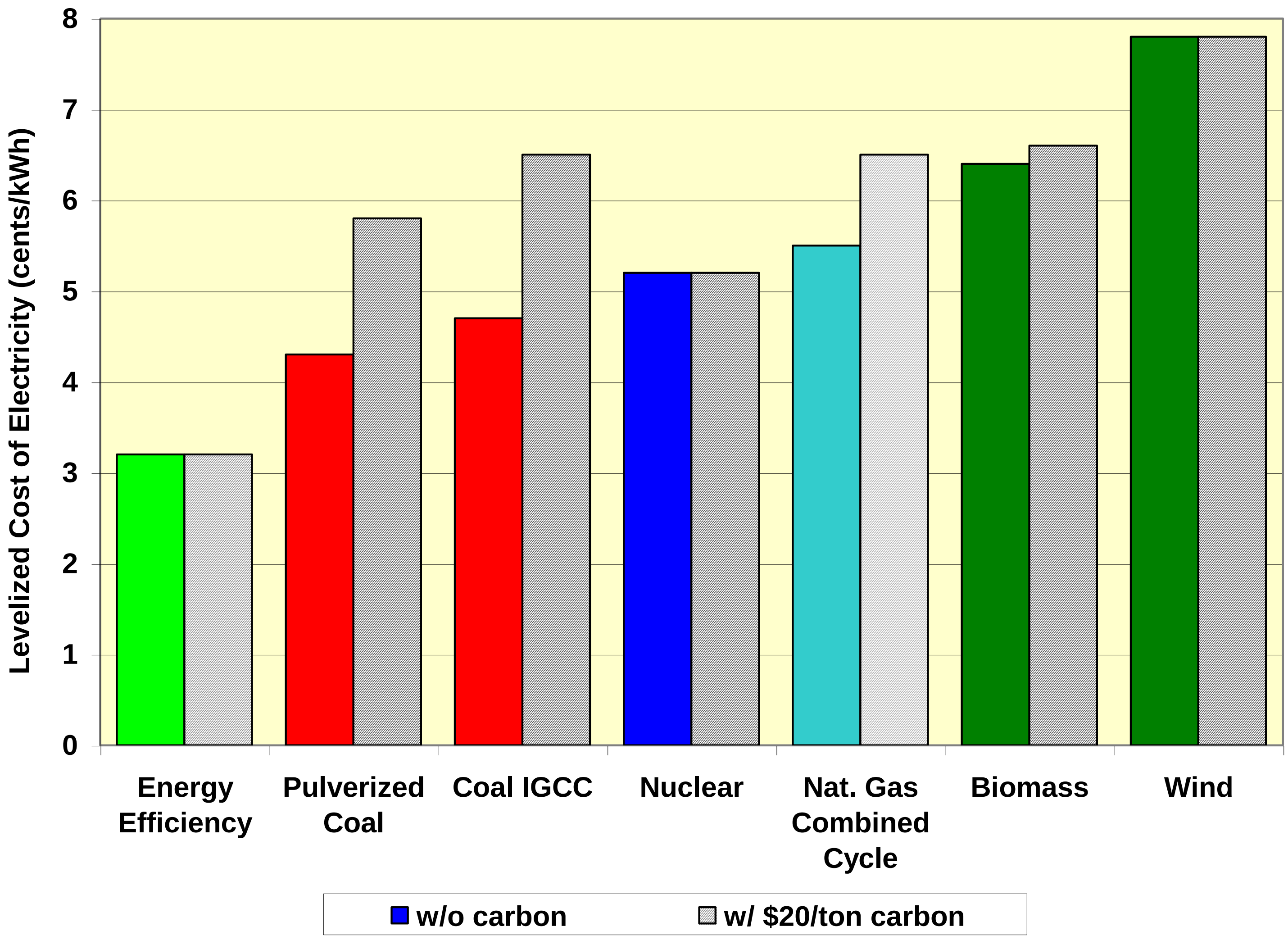
EIA Database

Historical Energy Use



Cost of Electricity Resources

(Source: ACEEE 2006 & EPRI 2006)



Common Systems Energy Use

- **Steam Systems (>80% of gas use for most facilities)**
- **Compressed Air Systems (10% of electric)**
- **Pumping Systems (15% of electric)**
- **Fan Systems (12% of electric)**
- **Lighting Systems (8% of electric)**
- **Process Heat (can be large use)**

Common System Opportunities

- **Steam Systems - 10 to 20% savings from failed steam traps, blowdown heat recovery, linkage-less burner controls, stack economizers**
- **Compressed Air Systems - 10 to 50% savings from repairing leaks, centralized control, reduce pressure, variable speed controls**
- **Fan and Pumping Systems – up to 40% savings from using variable speed controls instead of vanes or valves**
- **Lighting Systems – up to 50% savings from using high bay fluorescent fixtures**
- **Process Heating – up to 80% savings from recovering waste heat. This is a significant opportunity in some industries.**

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Best Practice Story – Mercury Marine

- **<u>Centralized compressed air system</u>**
  - **9.2 million kWh saved**
  - **1.1 MW**
  - **135,000 therms**
  - **6,900 tons CO2**

  - **$1,850,000 project cost**
  - **$541,000 energy savings**
  - **$60,000 water savings**
  - **$100,000 inventory savings**

- **2.6 year payback**

Emerging Technology Opportunities

- **Examples**
  - **Drying/Separation**
    - **Membrane Technology (up to 55% savings)**
  - **Process Heating/Melting**
    - **Stack melters (up to 40% savings)**
  - **Gasification (up to 100% savings)**
    - **Pulp and Paper, Petroleum Refineries**
  - **New Motor/Control Technologies (up to 60% savings)**
  - **Combined Heat and Power (CHP) or Cogeneration (very large potential savings)**

Emerging Technology Story – Nestle USA

- **Condensing stack economizer**
  - **142,000 therms**
  - **826 tons CO2**
  - **$340,000 project cost**
  - **$111,000 energy savings**
- **2.7 year payback**

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Potential Saving from Emerging Technologies

Technology	Industrial Sector	2025 Technical Savings Potential (TBtu)	2025 Assumed Penetration (%)	2025 Achievable Savings (TBtu)
Near net shape casting	Iron and Steel	400	40%	160
Membrane	Food Chemicals Wastewater	167 317 225	30% 30% 70%	50 95 158
Gasification	Pulp and Paper Petroleum Refining	1,153	40%	461
Motor Systems	Cross cutting	2,288	30%	686
Cogeneration	Cross cutting	3,333	30%	1,000
TOTAL		**7,883**		**2,610**

Source: US EIA - 2004

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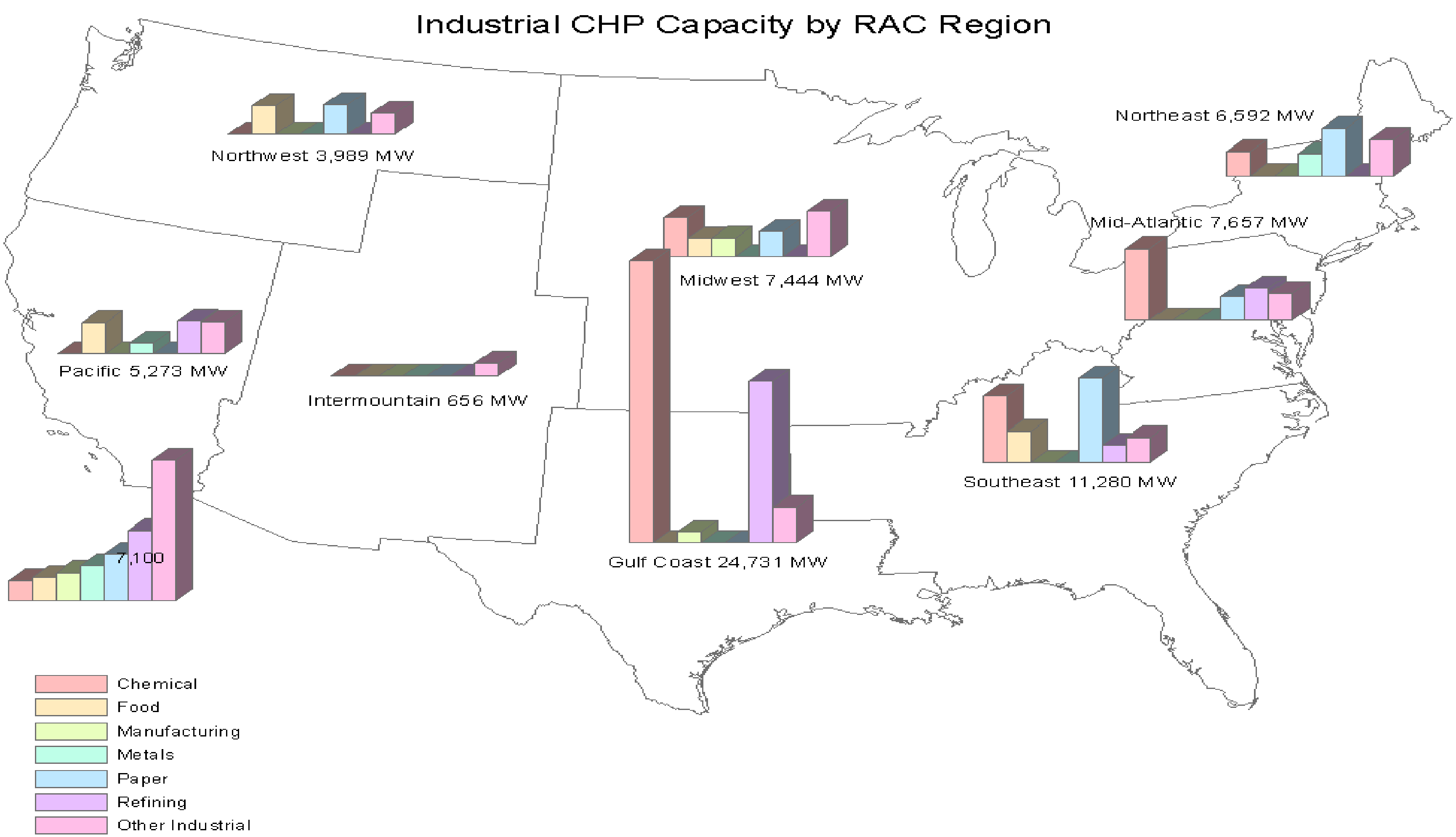
Cogeneration or Combined Heat and Power (CHP)

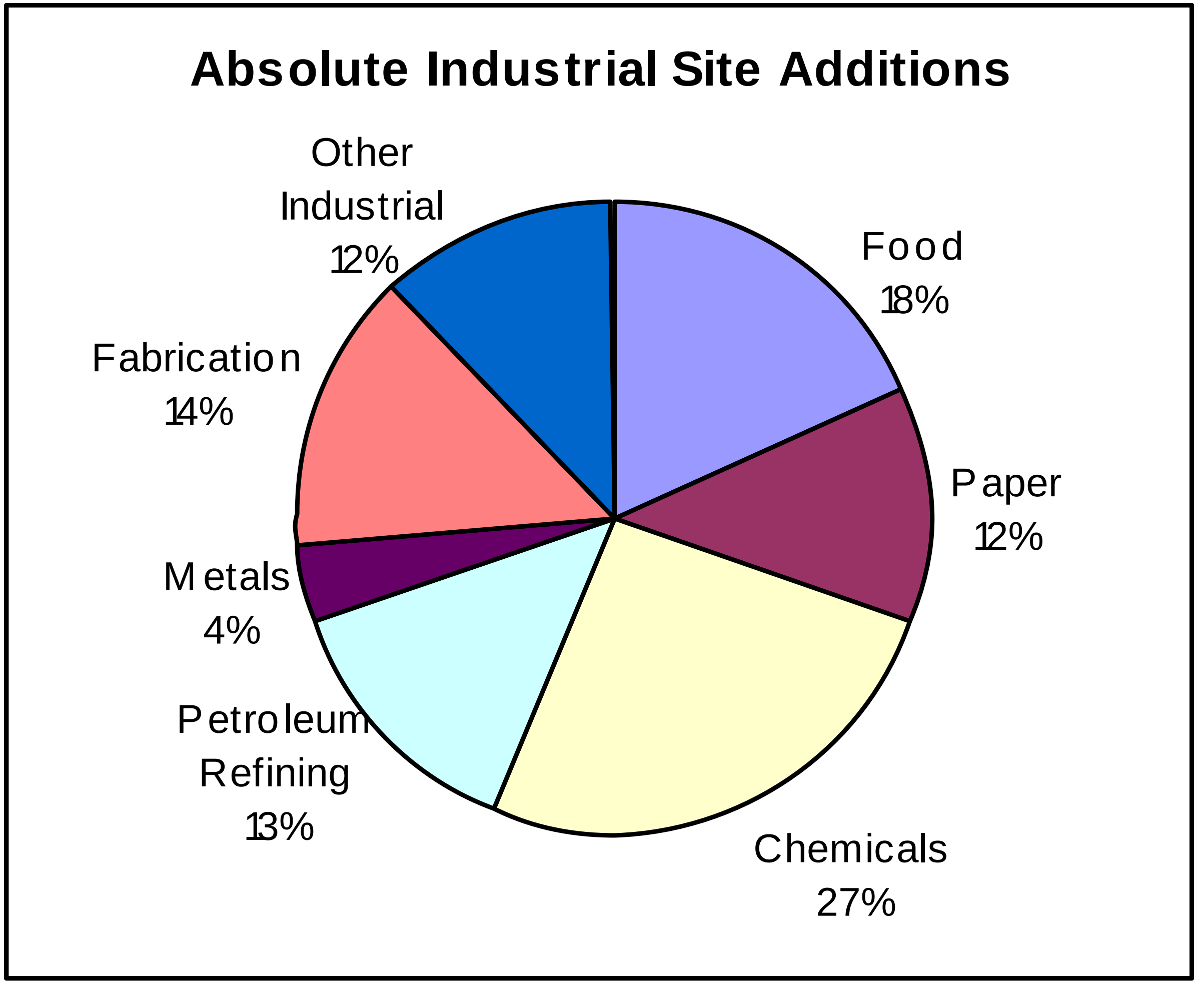
- Produces both power and usable heat
- Typical power generation is 35% efficient while CHP can be 70%
- One of the largest industrial efficiency opportunities
- Is distributed within the electric grid so reduces transmission requirements and losses
- 80,000 MW of industrial capacity today

Industrial CHP Capacity by Region



EEA Database

Industrial CHP Additions From 2000-2005 (17,082 MW)



EEA Database

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Market Barriers to Efficiency

- Payback is too long (> 1 year or >2 years)
- Energy is small part of overall costs and not seen as core business
- Limited staff time to focus on energy
- Do not trust energy savings will actually occur
- Energy costs are paid out of operation budget, not linked to capital budget
- No commitment from upper management and culture does not support efficiency investments

Program Barriers to Efficiency

- **Industrial energy use is relatively complex**
- **Many industries already have technical expertise**
- **Large variety of processes and applications**
- **Most energy use is for the process that is “sacred”**
- **Large variety of different sub-market cultures and approaches to energy management**

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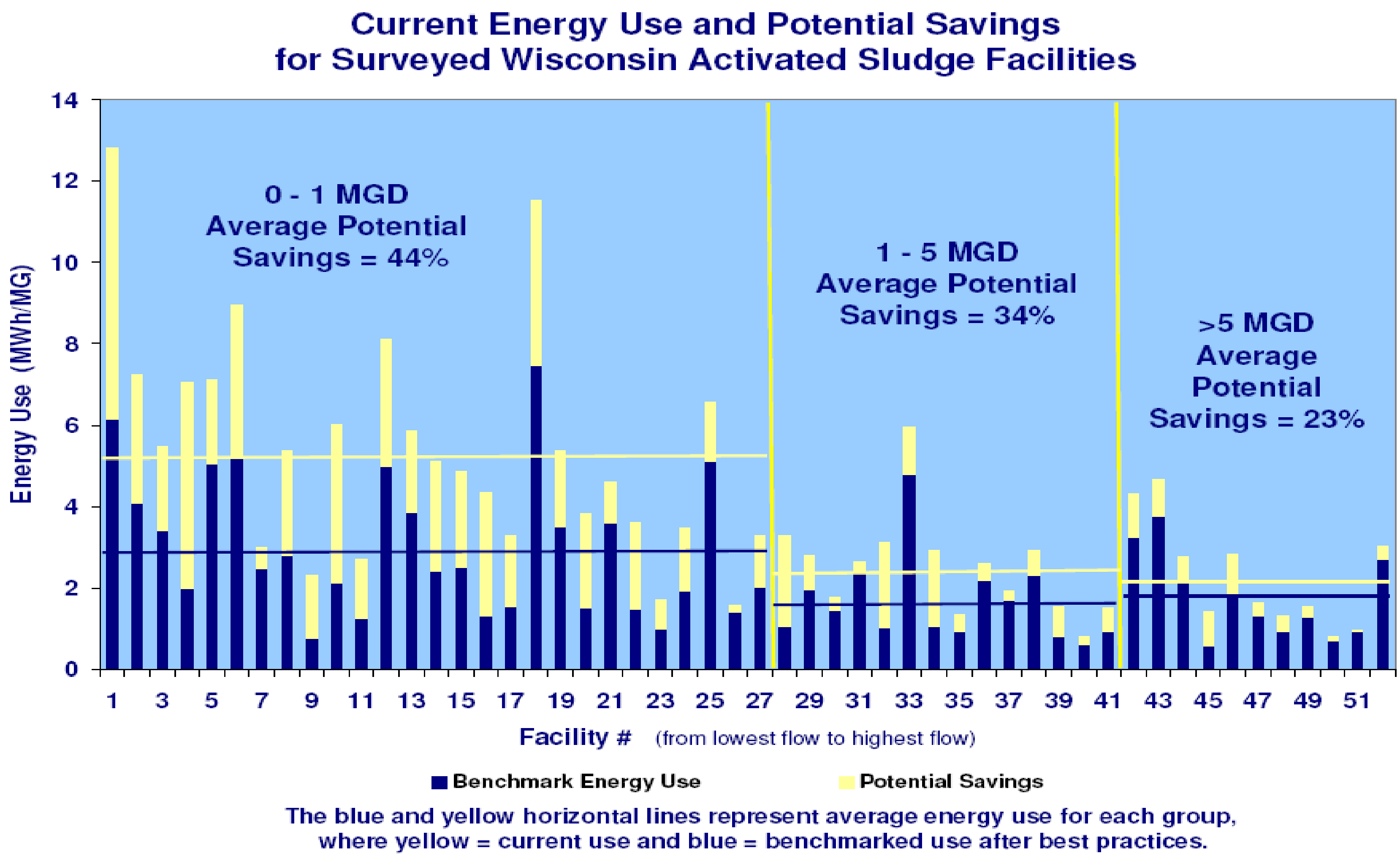
Common Program Strategies

- Higher level engineering and technical support for project support
- Energy Team and Energy Management Plan support
  - One-2-Five
  - Practical Energy Management
- Custom incentives and Study grants (50%)
- Engaging higher level executives in commitments
- Developing an ally network
- Education and training – best practices and emerging technologies

Innovative Program Strategies

- **Cluster expert teams**
  - targeted process support
  - talk the language – Best Practice Guidebooks
  - understand the needs of the industry cluster
  - engage industry cluster feedback
  - use cluster association networks
- **Flexible custom incentives**
  - large enough to impact project decision cost effectively
  - "sweet spot" – incentives for 1.5 to 4 year payback and max 30% of costs
  - competitive custom grants
  - Targeted prescriptive process incentives
- **Staffing grants to overcome barrier of limited staff time to manage energy projects**
- **Project financing through shared savings**
- **Benchmarking cluster facilities**

Wastewater Examples



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Program Resources

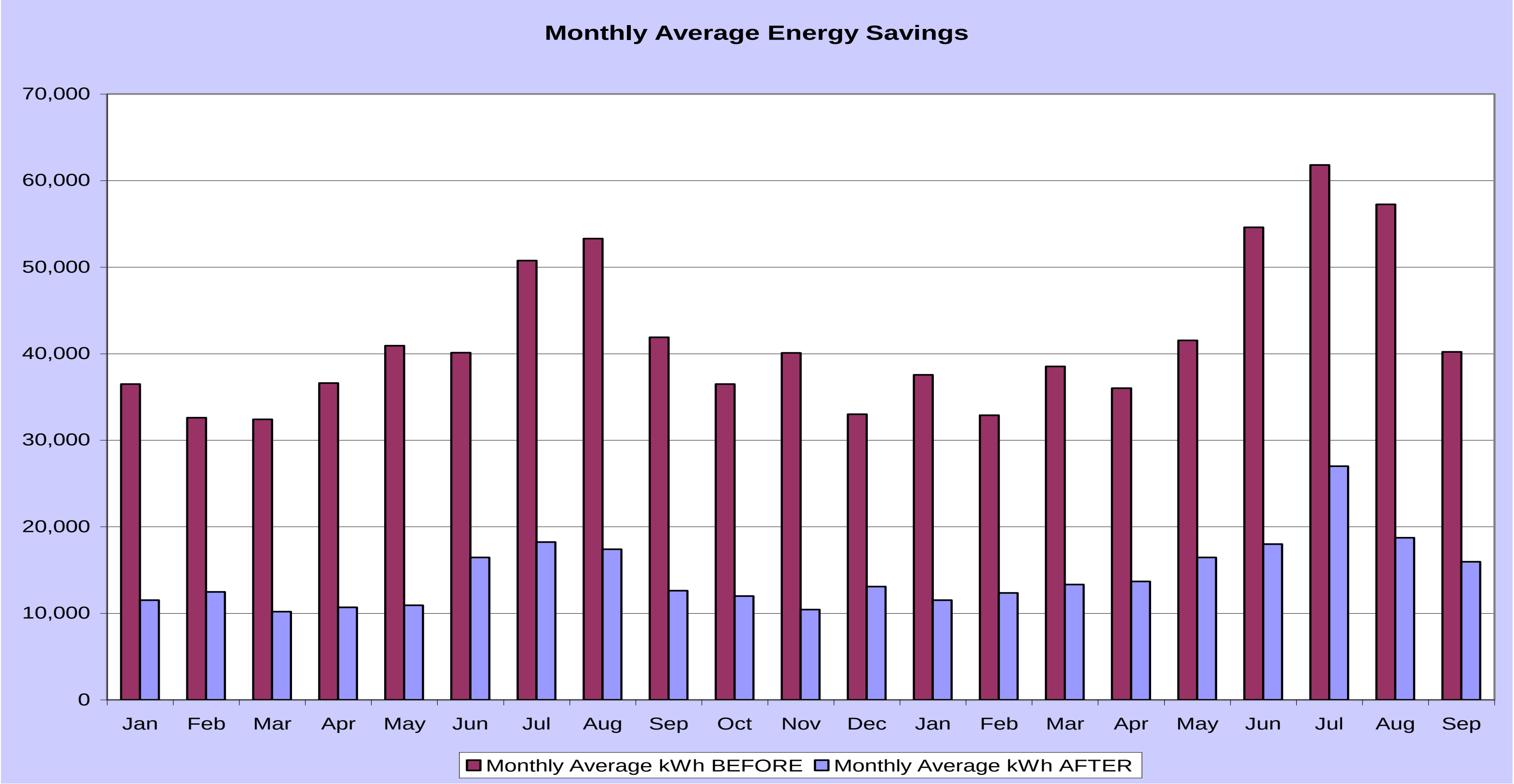
- DOE “Save Energy Now” program
  - DOE qualified experts
  - No cost to facility
  - Steam, process heating, pumps, fans, and compressed air
- DOE Save Energy Now Leaders
  - Companies commit to 25% energy intensity reduction over 10 years
- DOE Superior Energy Performance
- Pump Systems Matter
- Energy Star materials and benchmarking
- CEE, ACEEE and AESP industrial committees

Program and Market Trends

- Programs maturing to offer more targeted technical assistance
- Integrating more closely with national DOE and EPA efforts
- Industries have become more receptive to energy efficiency as an important part of doing business and even survival
- Program allies better understanding and using programs to make sales since new program start-ups across additional states

The Potential is There and Real

Northern Moraine Wastewater Facility



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Basics of Energy Efficiency Programs

General Open Session

January 13, 2010

Nels Andersen
Franklin Energy Service
Vice President, Engineering

Experience. Delivery. Results.

Franklin Energy

Goals for this presentation

- How do we determine what the utility clients need?
- What are the mechanisms employed to deliver programs?
- What are some conservation program best practices?

Determining Client Needs

- Understanding the market to be served
- Role of evaluation
- Determining program effectiveness

Understand the Market

- Begin with the market in mind
- What markets do you want to serve?
- How well do those markets understand energy efficiency?
- Does a well-developed trade ally network exist?
- Review successful approaches by other utilities or states

Role of Evaluation/Determining Program Effectiveness

- Are you achieving your stated goals?
- Create a collaborative atmosphere between utility, administration, and evaluation
- Understand the resource cost tests and which are applicable to your goals

Mechanisms for program delivery

- Prescriptive
- Custom
- RFP (Request for Proposal)
- Guaranteed Savings and Performance Contracting/Shared Savings
- Trade Ally networks
- Customer field services

Prescriptive Overview

- Common, well understood technologies
- Fixed incentive on a $/fixture, $/hp, $/ton, etc. basis
- Deemed savings – variables are few, well understood, and easily quantified
- Volume of potential installations are significant
- Typically inexpensive to administer on a cost per energy unit basis

Custom Overview

- Measures that aren't covered by prescriptive
- Incentives on a dollar per energy unit basis
- Supported by engineering calculations
- Due diligence typically performed on all projects
- Typically more expensive administratively than prescriptive

RFP Overview

- Specialized type of custom program
- Generally for large commercial and industrial customers and unique projects
- Customer bid – OR
- Trade Ally bids (contracts) to deliver a set amount of savings for a specified cost
- Usually more expensive than custom

Guaranteed Savings and Performance Contracting/Shared Savings

- Specialized type of custom program
- Savings are verified
- Incentives are based upon the verified savings
- PC/SS – savings are guaranteed by the trade ally and project cost is financed out of the cash flow from savings
- Similar administrative cost as RFP

Trade Ally Networks

- Cost effective way to leverage marketing and customer contacts
- Properly trained trade allies bring projects from their customers to the program
- Use a registration process

Customer Field Services

- Education and awareness programs
- Leverage third-party tools (e.g. Energy Star Benchmarking, One-2-Five®, etc.)
- Energy Efficiency Training
- Customer site surveys

Best Practices

- Have clearly defined program goals and objectives
- Implement a robust program planning process
- Adapt to technology changes and market conditions
- Deliver integrated programs
- Perform quality control and verification
- Maintain stable sources of program funding

Best Practices on the web

- Itron Portfolio Best Practices Report
- http://www.eebestpractices.com/pdf/Portfolio_BP_Report.pdf
- Itron Energy Efficiency Best Practices: What's New?
- http://www.eebestpractices.com/pdf/whatsnew.pdf
- EPA Energy Efficiency Program Best Practices
- http://www.epa.gov/RDEE/documents/napee/napee_chap6.pdf

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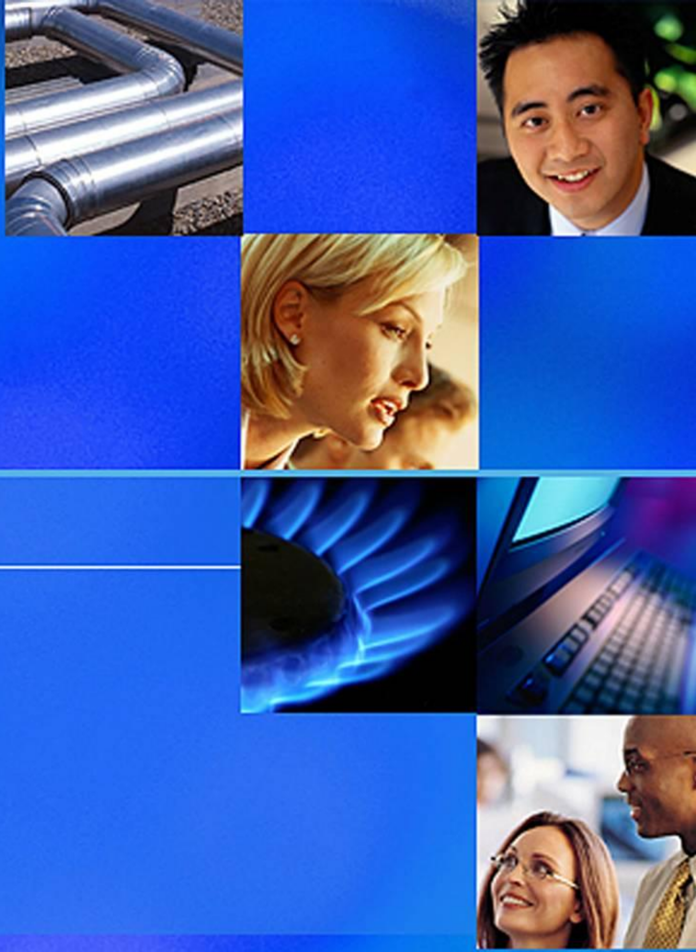

Energy Assessments – Our Experience

Southern California Gas Company

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Discussion & Objectives:

1. Why did Southern California Gas Company (SoCalGas®) develop an assessment program
2. How did we structure our program
3. Partnering with the California Energy Commission (CEC) and the U.S. Department of Energy (DOE)
4. Customer experience with our assessments
5. Utility benefits from assessments
6. More info about SoCalGas' Assessment Program

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Why did SoCalGas develop an Assessment Program

- The California energy crisis of 2000 – 2001 hit our Industrial customers hard. Many left the State
- Customers faced engineering staff reductions
- Customers knew there might be EE opportunities, but needed help finding the opportunities and quantifying the savings
- The Gas Company had increasing *mandatory* energy savings goals to meet
- The Gas Company also needed better engineering analysis for our EE Incentive Program applications
- #1 reason: Customers asked us for help

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Assessment Program Structure

What was needed:

- Very high quality assessments
- Sophisticated engineering models, i.e. SSAT, PHAST, SCG tools
- Comprehensive
- Accurate – good enough to base an EE Incentive payment on

- energy savings must be defendable

Assessment Program Structure

- Structured almost identical to a D.O.E. Assessment

Process:

- We visit the plant
- Review the process with plant personnel
- Make critical process measurements and recording of data –

- *Measurement* means *accuracy*

  Our motto (per Lord Kelvin):

  "You can't quantify what you don't measure"

- We also train plant personnel how to measure, record and use analysis tools

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Assessment Program Structure

For the Assessment analysis:

- Use SoCalGas tools (software and measurement) and protocols for energy efficiency assessments
- Use U.S. DOE's SSAT and PHAST models

The customer receives a report that maps out:

- No cost, low cost and investment grade measures and maintenance actions
- Associated energy savings and GHG reductions
- Available Incentives and Rebates for measures
- Production impact

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The Gas Company's Energy Efficiency Tools

Load Balance Tool

*Annual gas use **before** implementation of measure (therms/yr)*

Score Card Tool

Qualitative rank of energy efficiency opportunities

Thermal Oxidizer Tool

Furnaces & Ovens Tool

Heat Recovery Tool

Excess Air Tool

Like to Like Tool
(equipment replacement)

*Annual gas use **after** implementation of measure (therms/yr)*

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SoCalGas Load Balance Tool

Load Balance Results

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1. Account Information

Gas Customer:	ABC Company
Billing Account ID No.:	1.11111E+12

2. Gas Use

Value (therms/yr):	900,000
Source:	Actual monthly billing records

3. Gas Equipment

Description	*Equipment Type*	*Equipment Use*	*Qty*	*Connected Load (MBtu/hr)*	*Op Time (hrs/yr)*	*Load Factor*	*Gas Use (therms/yr)*
HP hot water boilers	BOILER	HEATING HUMAN COM.	2	15,000	4,043	0.332	402,959
Bldg 1 process	BOILER	HOT WTR.-COMF. & CLN	1	5,000	8,760	0.249	109,135
Assembly line #1	SPACE HEATER	HUMAN COMFORT-GAS	4	4,000	3,369	0.266	143,274
Assembly line #2	SPACE HEATER	HUMAN COMFORT-GAS	2	3,500	3,369	0.266	62,682
Process #3	WATER HEATER	HOT WTR.-COMF. & CLN	1	4,000	8,760	0.332	116,410
Acme #1	WATER HEATER	HOT WATER-HUMAN COM.	1	2,000	5,054	0.266	26,864
Acme #2	WATER HEATER	HOT WATER-HUMAN COM.	1	2,500	5,054	0.266	33,580
Food service equip	KITCHEN	COOKING-GAS	1	800	1,534	0.415	5,097
							900,001

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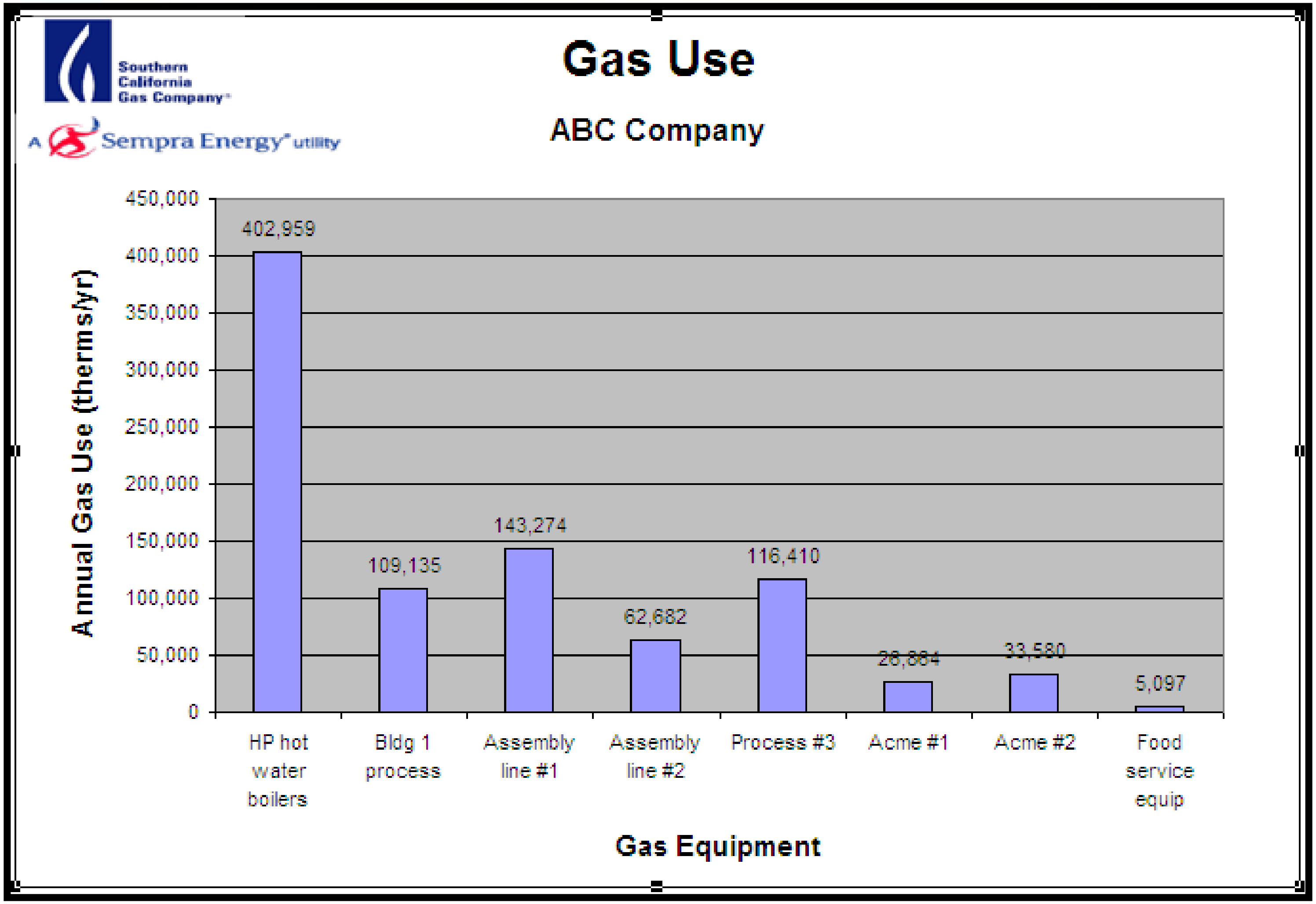
Load Balance Tool Bar Graph



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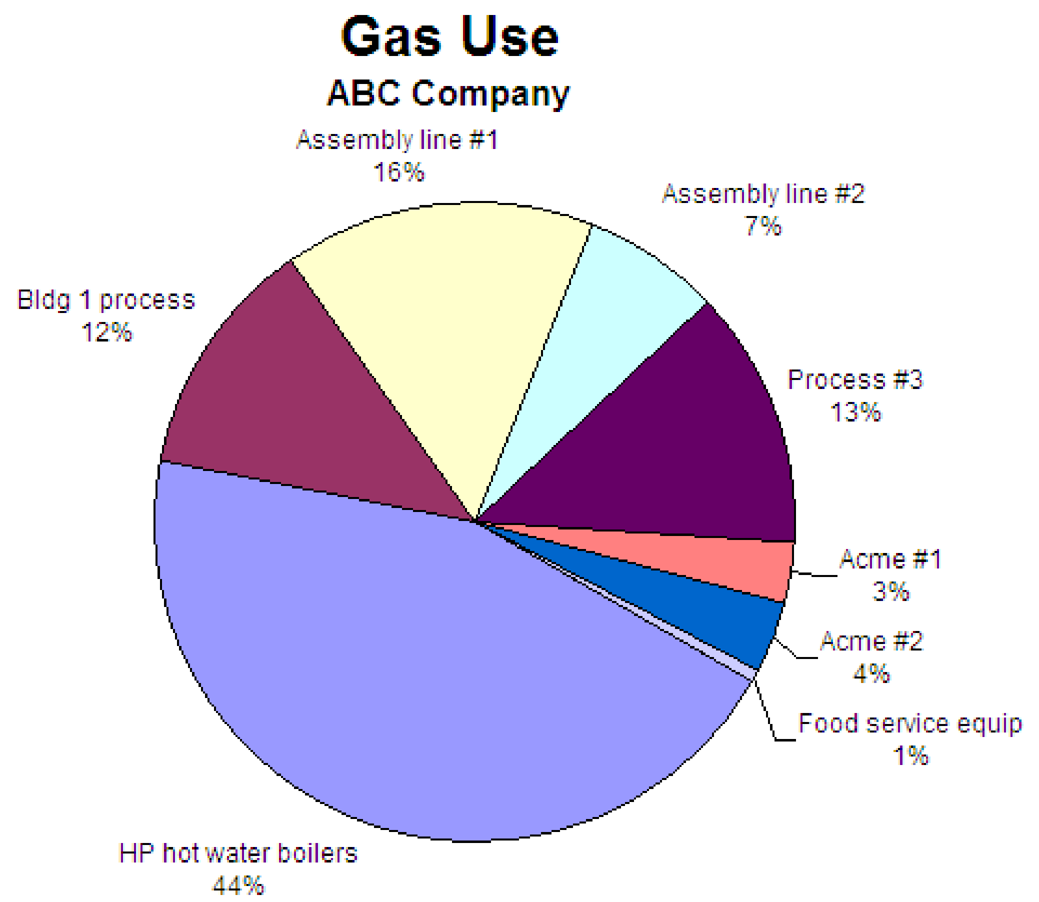
Load Balance Tool Pie Graph



SoCalGas Calculator Tool

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Gas Savings Calculation

Excess Air

Approach for Excess Air Reduction (select one)

- (●) Calculate Gas Savings for Power Burner or Combustion Air Damper
- ( ) Repair furnace leaks for induced draft system
- ( ) Repair furnace leaks for stack draft system

Parameter	Scenario: Baseline	Scenario: Efficiency Measure
Equipment Load and Annual Use Inputs		
1. Connected load (MBtuh)	2,000	
2. Operating time (hrs/yr)	7,200	
3. Load Factor	65%	
4. Equivalent full load hours (hrs/yr)	4,680	
5. Annual Gas Use (therms/yr)	93,600	
Temperature and % Oxygen Inputs		
6. Flue gas temperature (F)	325	280
7. Oxygen (O_2) in flue gas (%, dry)	5.0%	2.5%
8. Combustion air temperature (F)	80	80
Gas Savings for Power Burner or Combustion Air Damper		
9. Excess air (%)	29.4%	12.5%
10. Annual gas use (therms/yr)	93,600	91,380
11. Gas savings (%)	2.4%	
12. Gas savings (therms/year)	**2,220**	
CO2 Reduction (lbs/year)	**25,970**	
Cost Savings from Power Burner or Combustion Air Damper		
13. Gas rate ($/therm)	$0.950	
14. Annual cost savings ($/year)	**$2,109**	

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Assessment Report Summary Table

Energy Conservation Measure (ECM) Summary Table					
ECM description	Energy savings potential	Investment category	Incentive/Rebate		CO_2 Reduction
Operation and Maintenance (O&M) ECM's					
Repair steam leaks in header and distribution lines	12,444 th/yr	Low cost	No		145,595 lbs/yr
Short term ECM's					
Insulate 59' of 8" steam line	7,953 th/yr	Low cost	Yes		93,050 lbs/yr
Insulate 27' of 6" steam line	2,846 th/yr	Low cost	Yes		33,298 lbs/yr
Insulate shell of Continental boiler	25.8 $th/yr \bullet ft^2$	Low cost	Yes		302 $lbs/yr \cdot ft^2$
Insulate Kewanee exhaust flue to economizer	2,064 th/yr	Low cost	Yes		24,149 lbs/yr
Install automatic boiler blowdown system	396 th/yr	Low cost	Yes		4,633 lbs/yr
Install boiler blowdown heat recovery heat exchanger to preheat boiler make up water	10,234 th/yr	Higher cost	Yes		119,738 lbs/yr
Medium term ECM's					
Reduce boiler blowdown by installing a Reverse Osmosis system	50,034 th/yr	Higher cost	Yes		585,398 lbs/yr
Consider installing an economizer on the Continental boiler	16,675 th/yr	Higher cost	Yes		195,098 lbs/yr
Long term ECM's					
Investigate installation of a HP boiler with a steam turbine generation unit to reduce electric demand	3,096 MW-hr/yr	Higher cost			232,360 lbs/yr (net)

CEC and U.S. DOE involvement

- The Gas Company worked closely with U.S. Dept. of Energy Experts and Calif. Energy Commission Engineers doing Industrial Assessments
- CEC also gave strong support for integrated assessments (i.e. gas, water, electric)
- The U.S. DOE top consultants provide both technical training and software training to our Engineers and Account Executives
- Our results have been very good – customers and audits have confirmed that our recommendations are solid and energy savings numbers are accurate

Why customers request Assessments

- Know there is opportunity but need help getting started
- Lack resources to dedicate to assessment work
- Need Utility engineering expertise to help identify measures and **quantify savings**
- Would like assistance in mapping out a short term and long term energy efficiency plan
- Would like us to review project proposals and collaborate with their consultants and vendors

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Customer Benefits from Assessments

- Helps them identify opportunities for efficiency improvement
- Helps them get a better understanding of their operations
- Helps them map out a long term energy efficiency plan
- Gives plant personnel needed support to make improvements
- Helps them quantify:
  - Cost savings benefits
  - Production benefits
  - Emissions benefits (NOx, CO_2)

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Utility Benefits from Assessments

- Assessments enhance your connection with customers
  - You can’t do assessments from a desk!
- Helps you understand the needs of your customers
  - Production issues? Emissions issues? Provide solutions!
- It sharpens your analysis and engineering skills.
- You get a little bit better with each assessment you do
- Keeps your customer base viable

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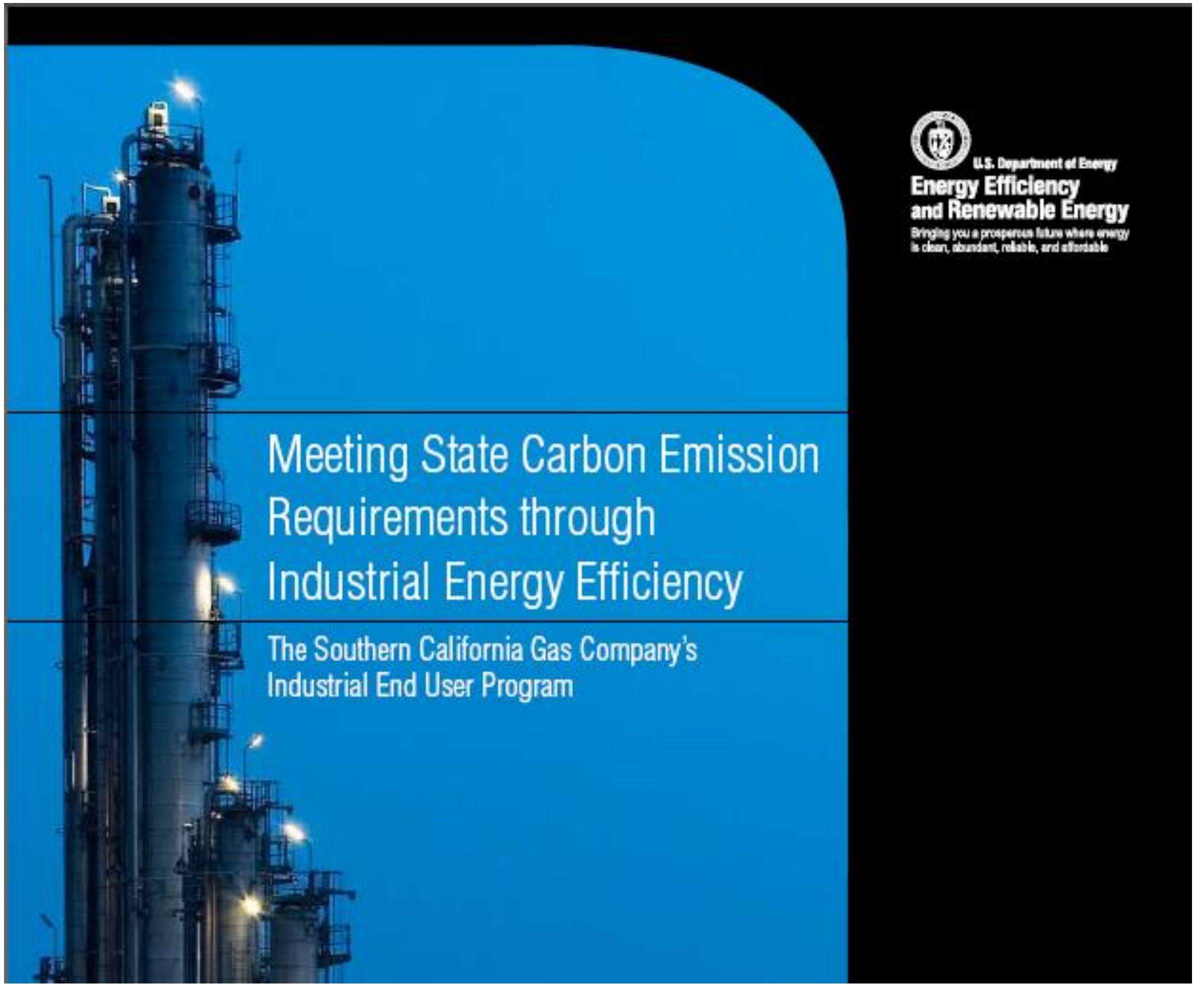
Assessment Results

- Assessments have enabled customers to reduce costs, reduce their emissions *and* increase production
- Customers use the assessments by SoCalGas to justify projects both internally and for incentive funding
- Customers were able to modify process steps and save energy
- Customers gained a better understanding of their process and used that information to make improvements
- Most customers took actions recommended by assessment reports, The Gas Company got EE savings credit
- Assessments helped customers map out an energy/production action plan

For more information

- For more information on SoCalGas' Assessment Activities, go to:

http://www1.eere.energy.gov/industry/saveenergynow/pdfs/socalgasco_casestudy.pdf



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For More Information

DOE Industrial Technologies Program (ITP) Utility Partnerships

www.eere.energy.gov/industry/utilities

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American Public Power Association (APPA)

Demonstration of Energy-Efficient Developments (DEED)

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Questions?