



*the Energy to Lead*

# End Use Solutions Update

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November 2010



gti<sup>®</sup>

# Key US Energy and Natural Gas Issues

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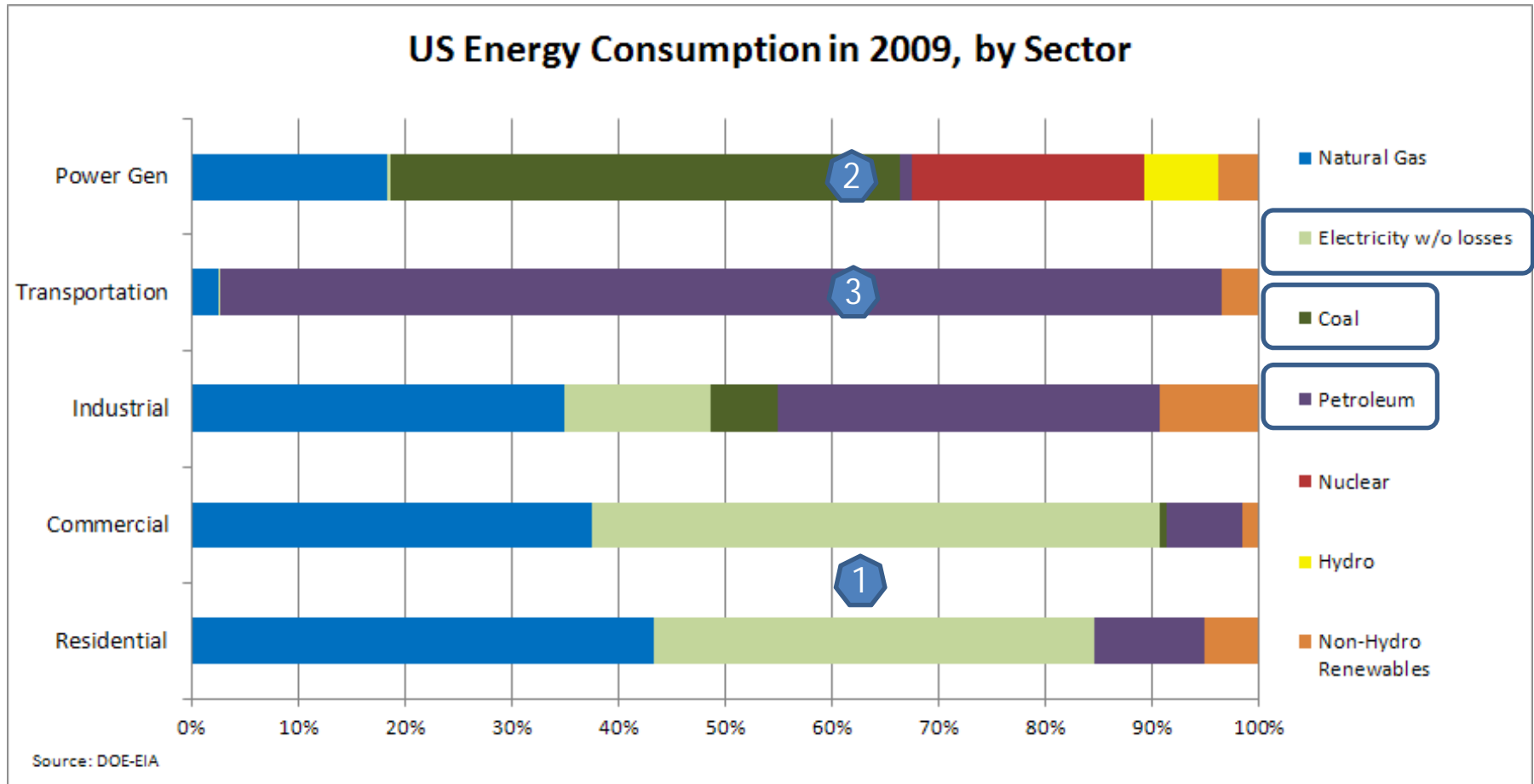
## Front Line Topics

1. Interplay of natural gas and electricity usage by residential and commercial customers
2. Natural gas use in power generation
3. Liquid fuel reliance (vehicles & stationary applications)

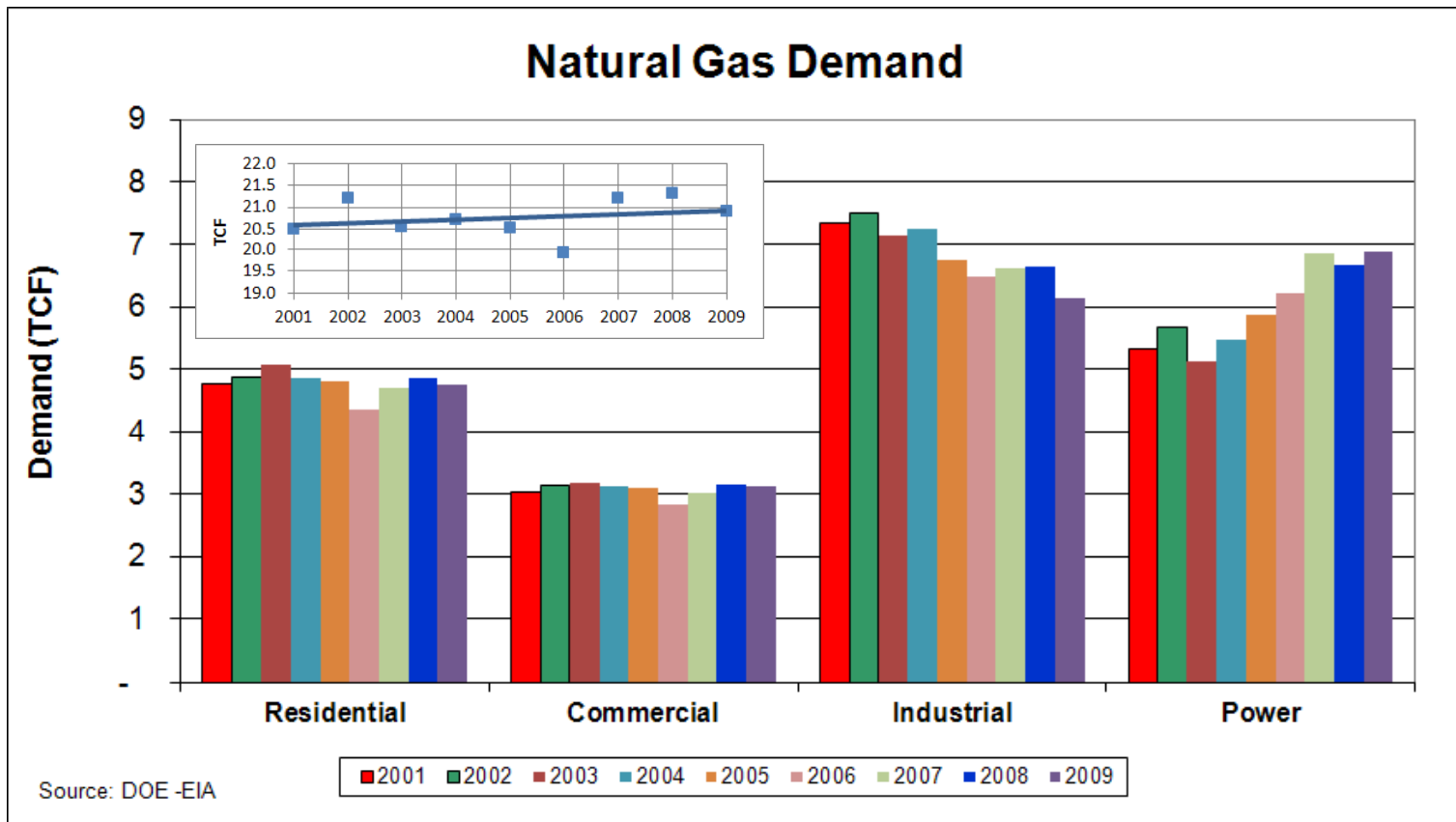
## Complementary Topics

1. Continued energy efficiency improvements
2. Carbon emission reduction
3. Expanded use of renewable energy

# US Energy & Natural Gas Usage



# Natural Gas Demand Trends



Total demand up slightly – driven by power generation.

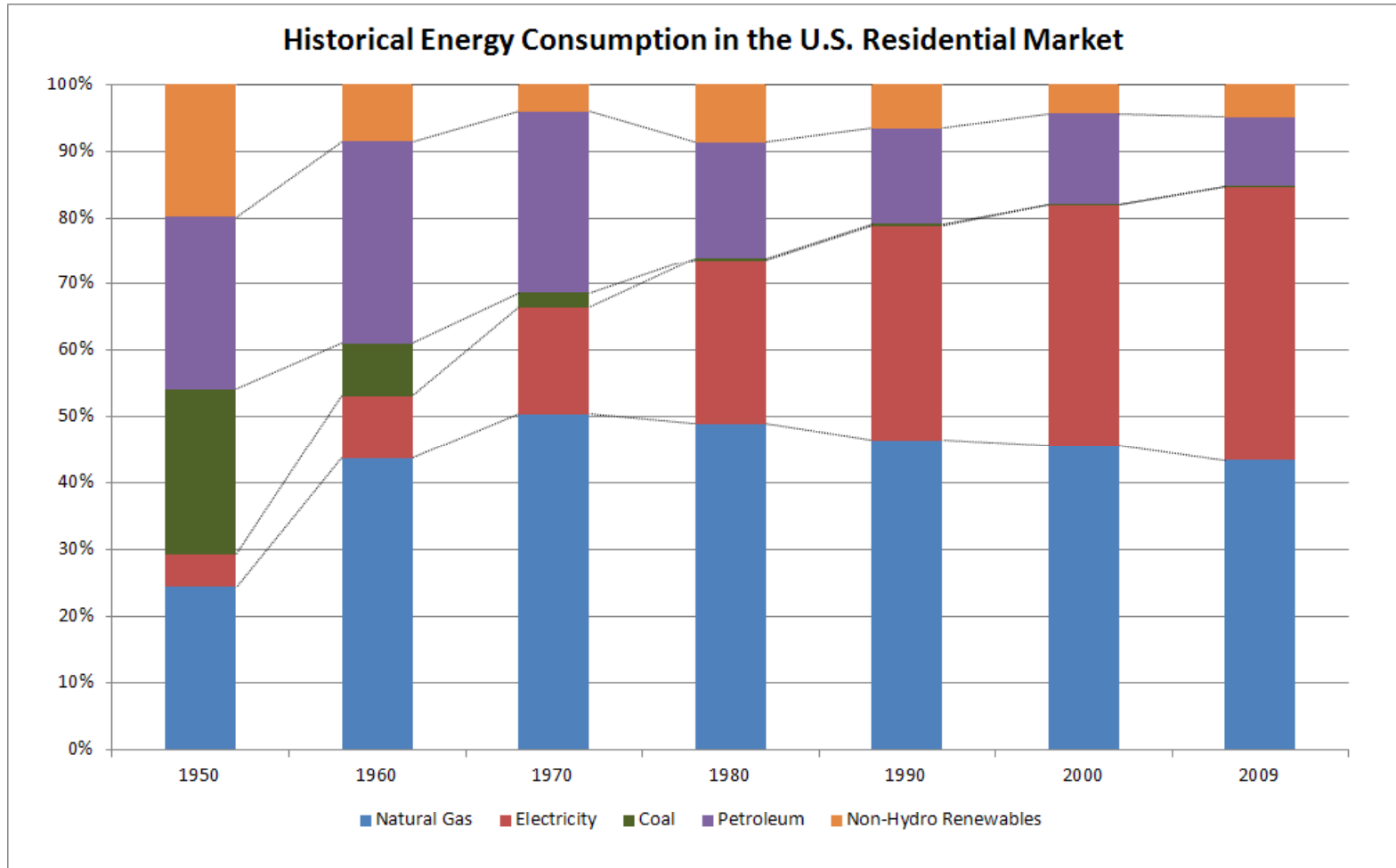
Signs of modest industrial rebound in 2010 – and continued power gen demand.

# Residential/Commercials Energy Customers

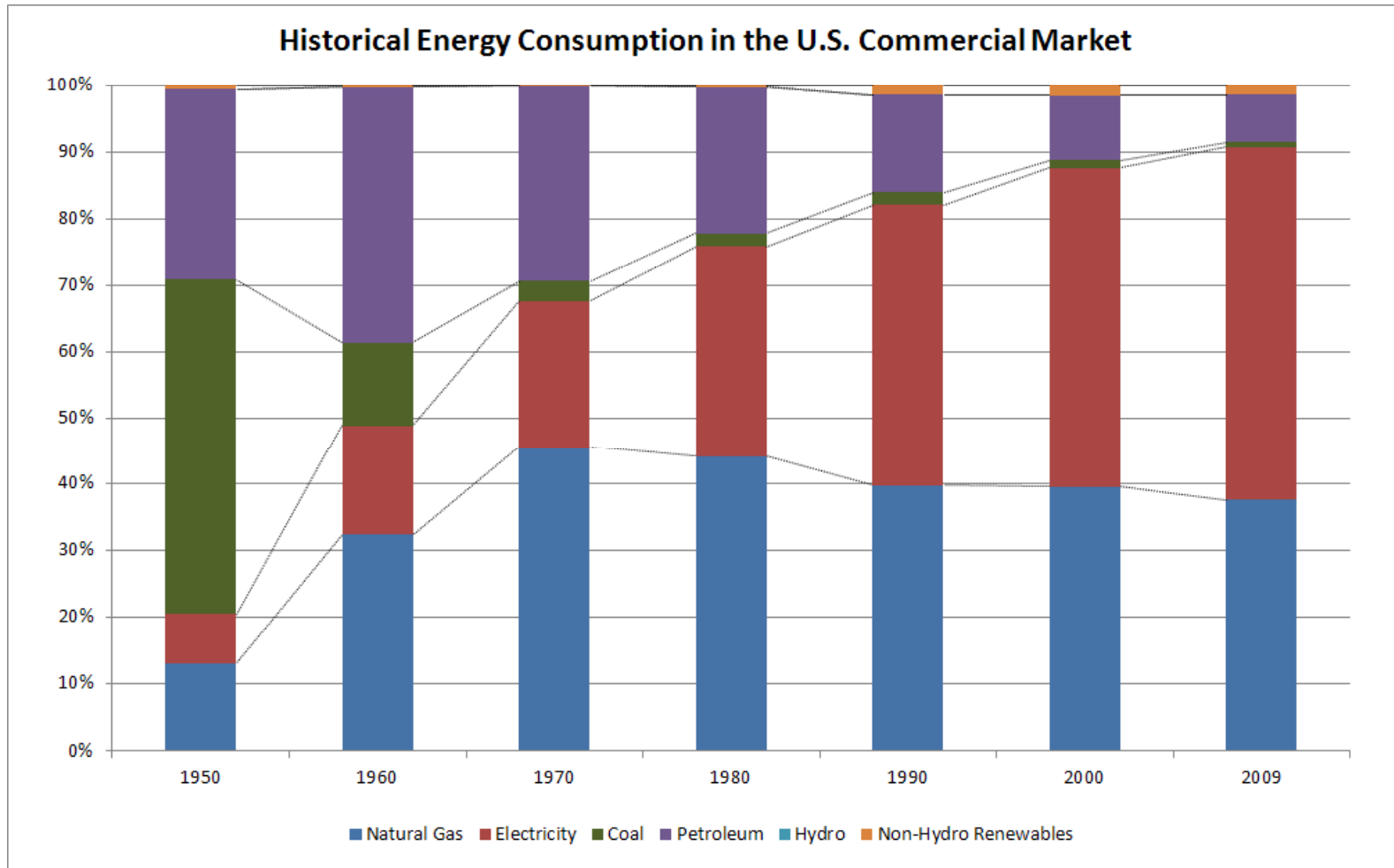
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- > Long-term res/com trends have led to dominant role for natural gas and electricity (80-90%)
  - Mainly driving out fuel oil use in recent years
  - Electricity growth has been ongoing since 1970
- > The interplay and future roles of res/com electricity and natural gas use is the defining issue in the buildings area
  - Impact on energy use and carbon emissions
    - > Role of source energy (or full-fuel-cycle analyses)

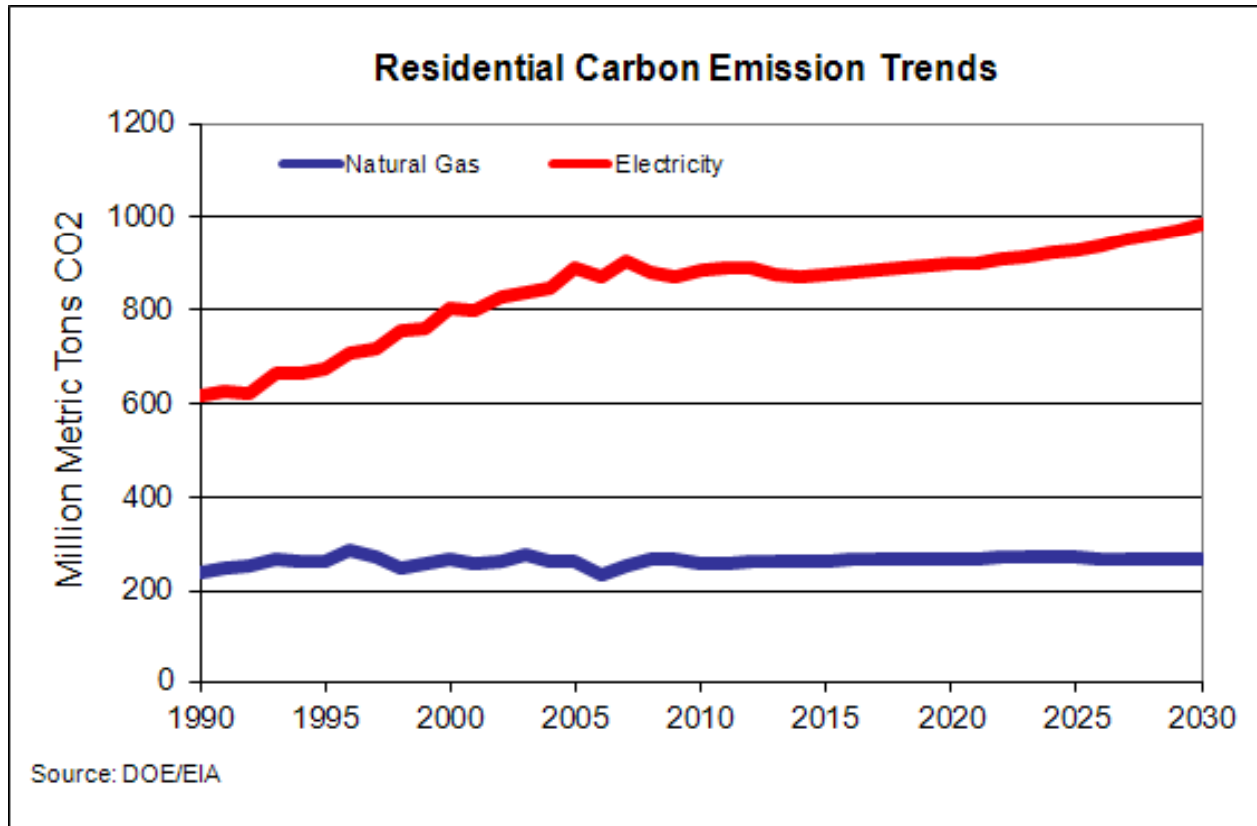
# Long-Term Trends In Residential Energy Use



# Long-Term Trends in Commercial Energy Use

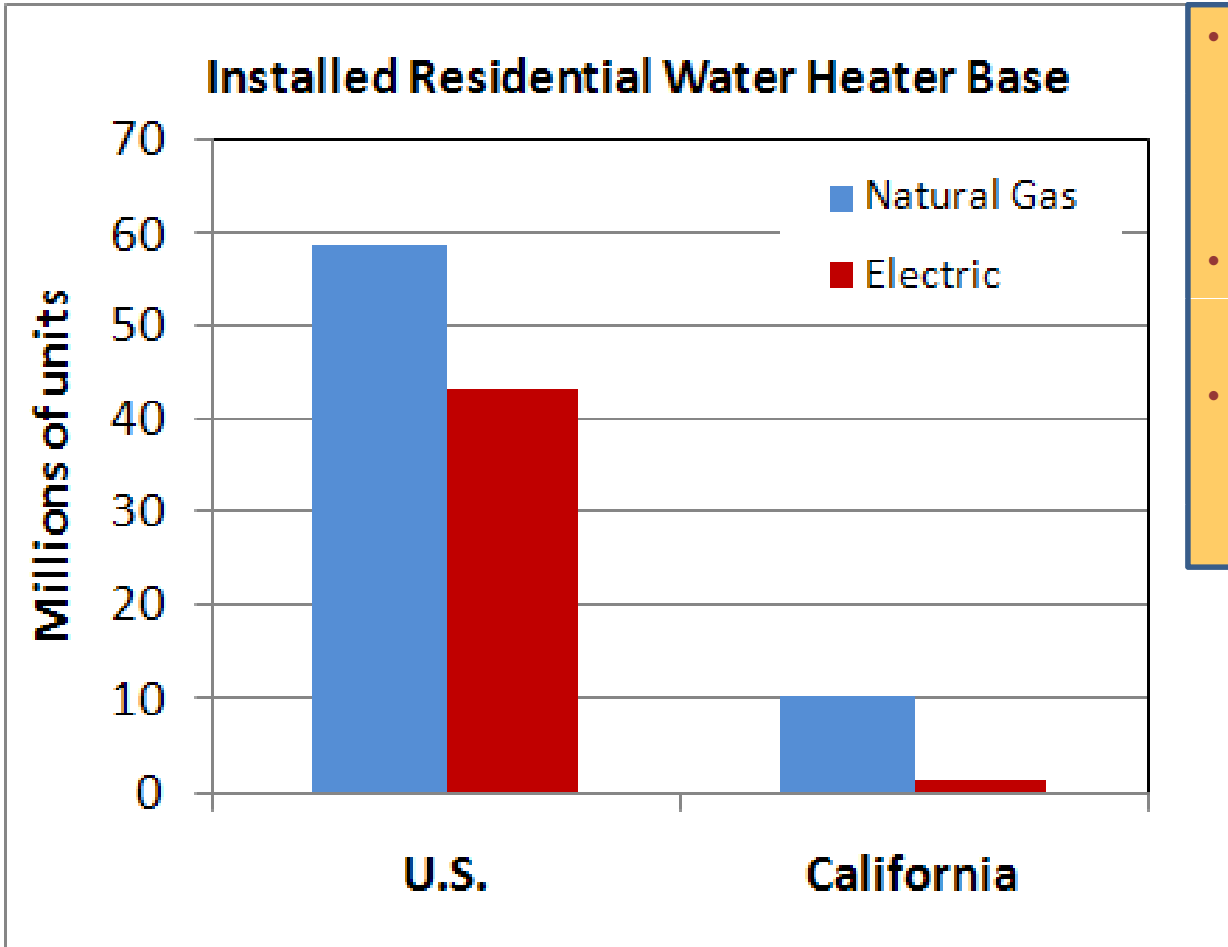


# Electric and Natural Gas Residential Carbon Emission Trends



Electricity usage is driving carbon emissions increases in the residential and commercial sectors

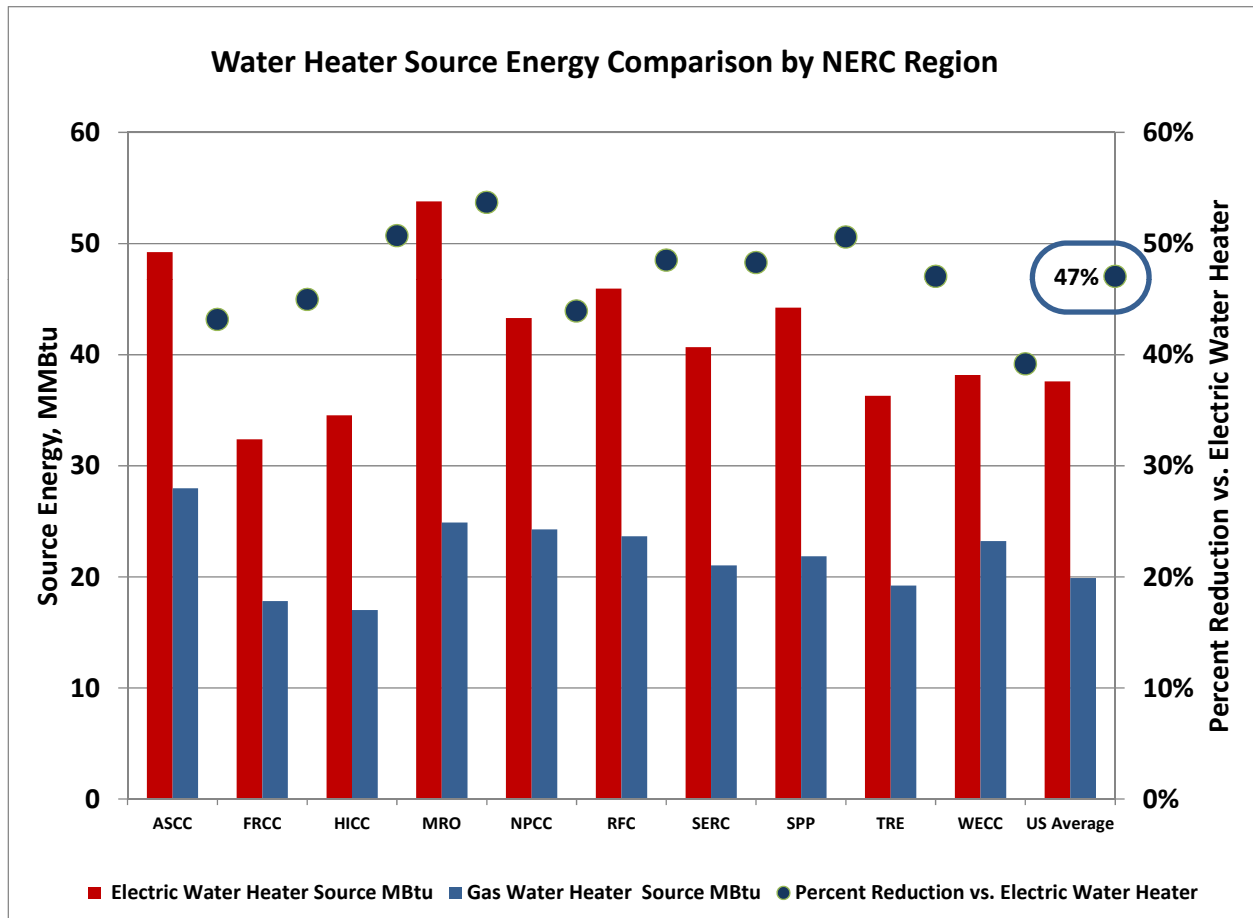
# Importance of Source Energy in Building Codes & Standards



- California's Title 24 building codes use source energy to drive homebuilder and consumer energy efficiency decision-making.
- Inhibits inefficient electric resistance water heating as matter of state policy.
- Drives efficient, direct natural gas use approaches.



# Potential 47% National Energy Savings (0.7 Quads) Using Source Energy for Residential Water Heating Codes



National impact if US residential-only water heating market reflected California:

- 0.7 Quads of primary energy savings

- 27 Million metric tons of carbon avoided

- 500 bcf greater gas demand

- 38 million more gas water heaters → higher volumes = lower costs to users

Benefits compound when looking at total Res/Com water and space heating uses

DOE NOPR on Source Energy (Full-Fuel-Cycle) issued 08/2010

# Source Energy Methodology in National Initiatives

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- > DOE Section 502(e) credit when source energy use declines but site energy use increases (amended October 1, 2004)
- > National Academy of Science full-fuel-cycle recommendations (May 15, 2009)
- > DOE Notice of Proposed Policymaking for adopting NAS full-fuel-cycle recommendations (August 20, 2010)
- > DOE request for info on National Energy Rating Program for Homes (June 8, 2010)

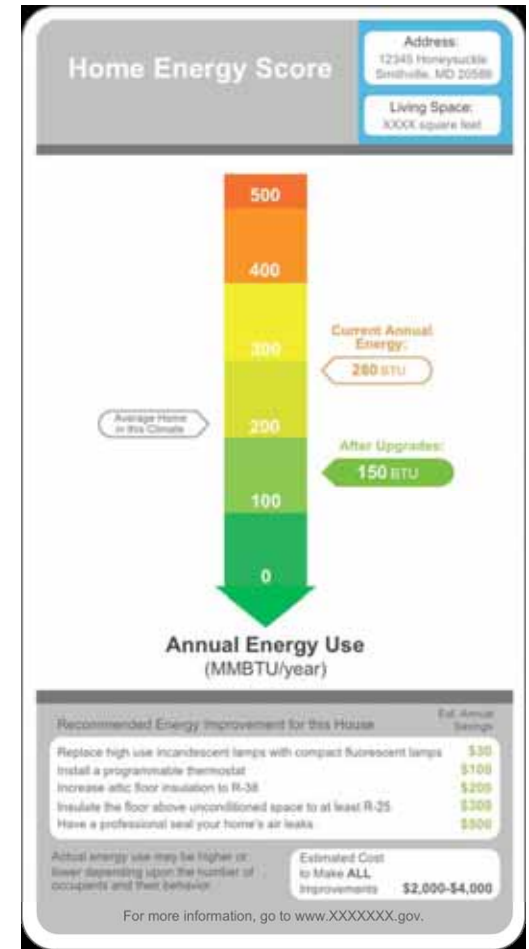
# DOE NOPP for Adopting Full-Fuel-Cycle Recommendations

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- > Full-fuel-cycle (FFC) measures of energy and greenhouse gas (GHG) emissions, rather than the primary energy measures it currently uses
  - Building from 2009 National Academy recommendation
- > GREET data for full-fuel-cycle metric
- > Collaborate with the Federal Trade Commission (FTC) to make FFC energy and GHG emissions data available to the public

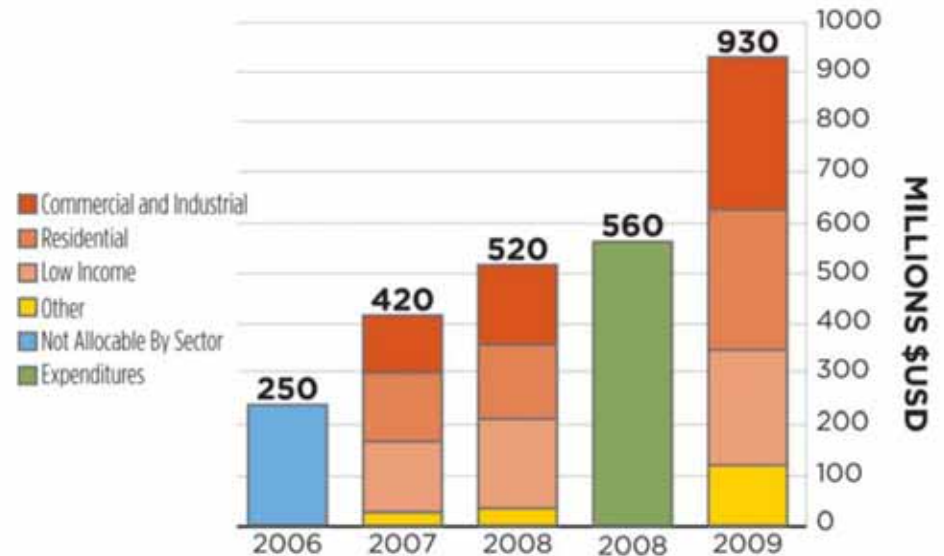
# National Energy Rating Program for Homes

- > Source energy metric for the program
  - National conversion factor
  - Potentially adjusted for home size and climate
- > Absolute numeric scale
- > National cost averages to prioritize improvements
- > Support GHG emission and cost information



# Natural Gas Energy Efficiency Programs

- > Gas utility EE programs experiencing significant growth
  - Likely over \$1 billion in 2010
- > Programs in various stages
  - Mature programs vs new programs
  - Working through “low hanging fruit”



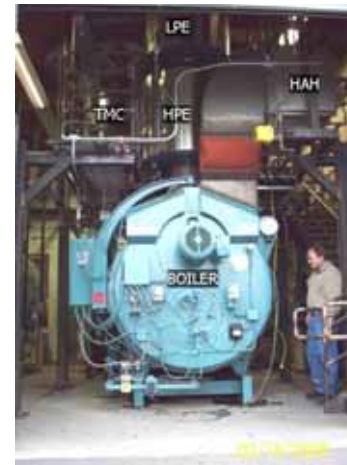
Source: CEE/AGA

# Possible Energy Technology Program Components

- > Market Analysis
- > Technology scanning & due diligence
- > Codes and Standards
  - Reducing implementation barriers
- > Field demonstrations
  - Validate performance and costs
- > Education and outreach
  - Seminars and workshops
  - Case studies
  - Website
  - White papers
- > Example Technologies/Products
  - **Advanced heat recovery systems for boilers and other equipment**
  - Gas heat pumps
  - Solar thermal hybrids
  - Micro CHP
  - Advanced building envelope systems
  - High efficiency commercial cooking equipment

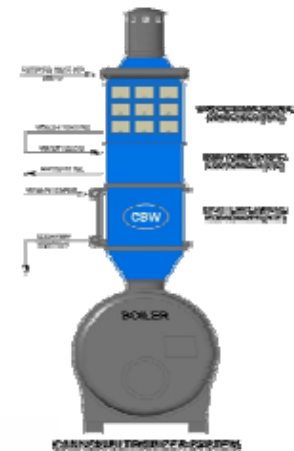
# Advanced Heat Recovery System for Commercial and Industrial Boilers

- > Specification Rubber (AL)
  - >15,000 hours of operation
  - ~19% reduction in fuel cost/GHG emissions
  - ~5% reduction in feed water
- > Clement Pappas (CA)
  - >10,000 hours of operation
  - ~15% reduction in fuel cost/GHG emissions
  - ~5% reduction in feed water
- > Baxter Thousand Oaks (CA)
  - >4000 hours of operation
  - ~15% reduction in fuel cost/GHG emissions
  - ~5% reduction in feed water
- > ORNL (TN)
  - 95% efficiency
  - 50% recovery of water vapor
- > City Brewing (PA)
  - Cannon's beta product launch site (09/2010)



# Advanced Heat Recovery System for Commercial and Industrial Boilers

- > Commercial launch of new technology underway by Cannon Boiler Works
- > Initial launch with standard unit sized to 400 boiler horsepower (BHP) ~ 14 MMBtu/hr
- > Future size range of 400 to 800 BHP, and finally 800 to 3000 BHP
- > Has the potential for substantial national energy efficiency savings



# DOE Buildings/Gas Industry Partnering

- > Expanding collaboration with DOE Buildings
  - Leverage gas industry funding
- > Six contracts awarded/signed
  - Two as a prime, four as a sub
  - \$1.5 million, with growth potential for 2011 (includes GTI Education project)
- > Key: new Building America prime contractor
  - PARR

U.S. Department of Energy - Energy Efficiency and Renewable Energy  
EERE News  
**DOE Announces \$30 Million for Energy-Efficient Housing Partnerships**  
July 20, 2010

The U.S. Department of Energy today announced 15 research and deployment partnerships to help dramatically improve the energy efficiency of American homes. These highly-qualified, multidisciplinary teams will receive a total of up to \$30 million for the initial eighteen months of the projects to deliver innovative energy efficiency strategies to the residential market and address barriers to bringing high-efficiency homes within reach for all Americans. A total of up to \$20 million per year will also be made available for the partnerships for three potential one-year extensions. These research and deployment partnerships will provide technical assistance to retrofit projects and will leverage industry expertise and funding to support DOE's energy efficiency retrofit programs. This effort will support the Department's [Retrofit Ramp-Up initiative](#), announced by Vice President Joe Biden in April, which brings communities, governments, private sector companies and non-profit organizations together to deliver energy-efficiency upgrades—or retrofits—to whole neighborhoods and cities.

"Home energy efficiency is one of the easiest, most immediate and most cost-effective ways to reduce carbon pollution and save money on energy bills, while creating new jobs," said Secretary of Energy Steven Chu. "By developing and using tools to reduce residential energy use, we will spur economic growth here in America and help homeowners make cost-cutting improvements in their homes."



# PARR Focus

## Midwest region, cold climate

1. Seven-state Midwest region with a Chicago “hub”
2. Systems and whole home solutions for cold climate
3. Targeting high potential building stock with opportunities for energy savings AND scalability



2.



3.



# PARR Partners

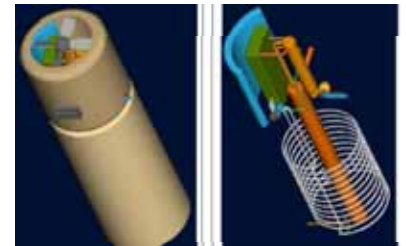
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## > Over 40 industry partners

- Manufacturers of building materials and equipment including:
  - > DuPont, Owens Corning, Carrier, Rinnai, AO Smith, Trane, Serious Materials
- Developers, contractors, and realtors including:
  - > DNR Construction, Checkmate Development, DNR Const, Solar Services
- Utilities, Agencies, and Programs including:
  - > ComEd, Columbia Gas of Ohio, PG&E, Vectren, CenterPoint, DTE Energy
- EE program implementers
- Government agencies including:
  - > City of Chicago, City of Champaign, IL DCEO, Indiana Energy Office, Iowa Energy Center, Michigan Bureau of Energy Systems, CMAP
- Neighborhood organizations and hybrid home owner associations
- Universities and others

# Other GTI DOE BTP-Funded Activities

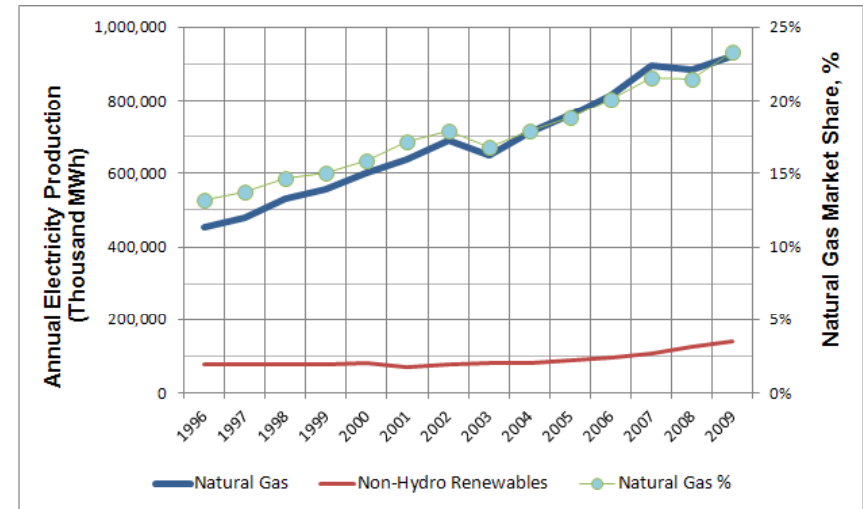
- > GTI currently testing integrated and “drop-in” electric HPWHs
  - Aid development of semi-empirical models by DOE, ORNL, sub to FSEC
  - Wide variety of operating conditions
- > Natural gas HPWH
  - Sub to Stone Mountain, other partners
  - Develop/test residential-scale natural gas HPWH (target: EF=1.5)
- > Test and develop supplemental dehumidifiers & enthalpy exchangers



# US Power Generation Market

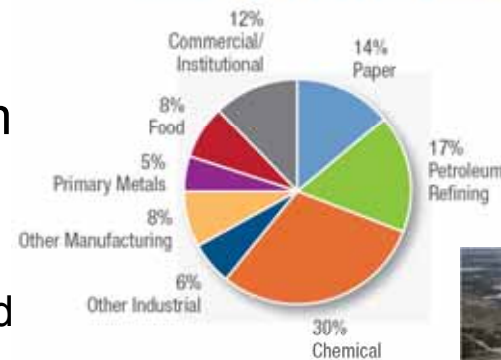
## > Growing role for natural gas and renewables

- High-efficiency **gas turbine combined-cycle** plants
  - > Low-carbon option with CCS
- Complemented by **combined heat and power (CHP)** system
- **Gas enables renewables**
  - > Fast response grid support for intermittent generators (solar, wind)
  - > Supplemental heat for solar thermal power plants
  - > Natural gas boost for bio-methane BTU content; pipeline infrastructure for delivery



**US Power Production**  
Steady natural gas growth from 13% in 1996 to current 23% in 2009

Existing CHP Capacity by Application



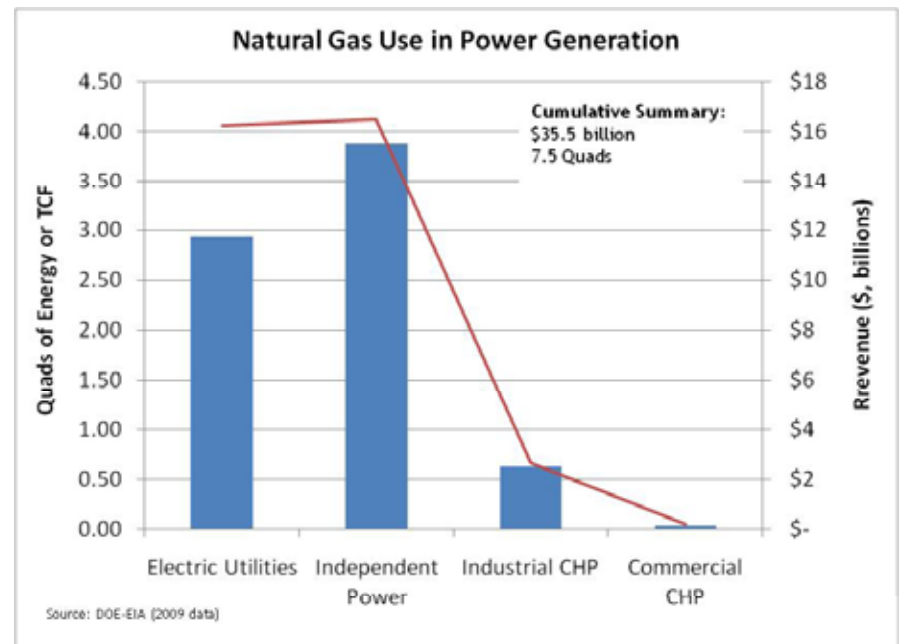
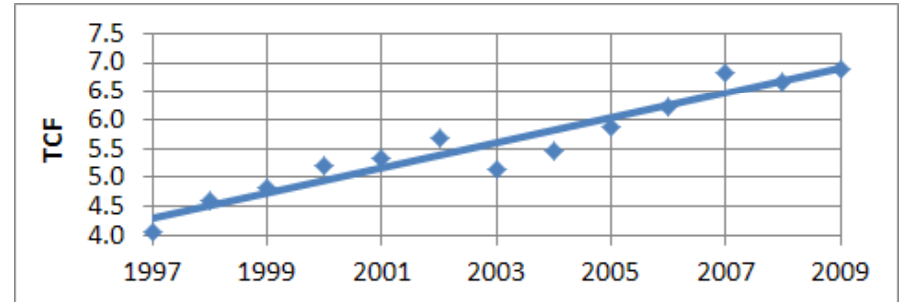
Source: EEA, Inc. CHP Installation Database.



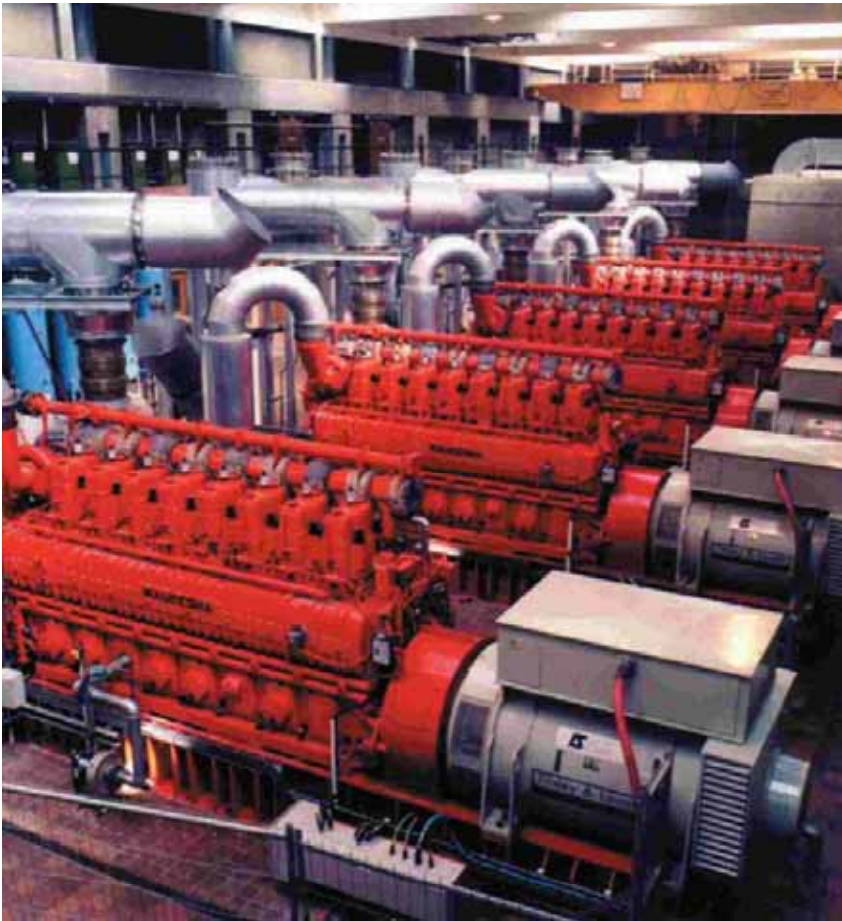
FPL Hybrid Solar Thermal and Gas Turbine Power Plant

# Natural Gas Use in Power Generation

- > Power generation key growth market for natural gas in past decade
- > Confluence of factors likely to continue trend (possibly accelerate)
  - Aging coal plants
  - Tight coal power margins with low natural gas prices
  - Increasing pressure on various environmental emissions (NO<sub>x</sub>, SO<sub>x</sub>, mercury, CO<sub>2</sub>)



# Expanding Role for CHP?

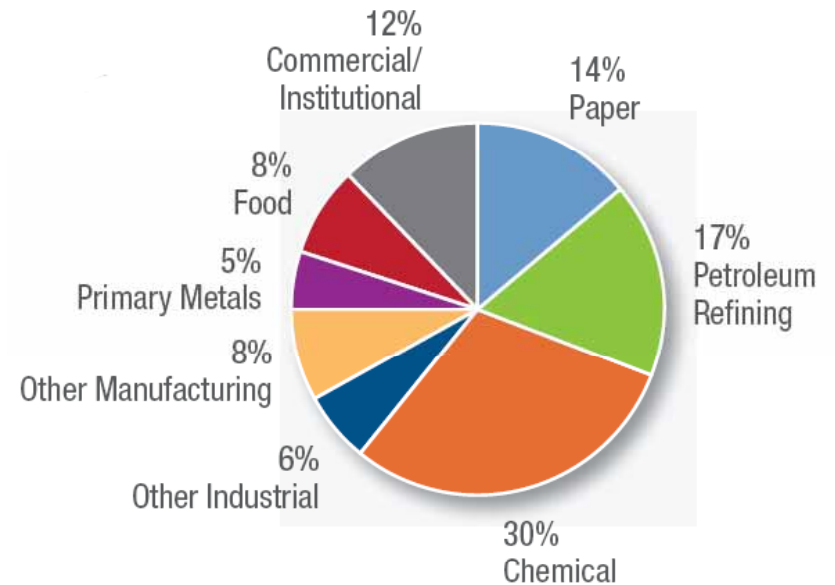


- > Coincidental Thermal and Electric Loads
- > Sufficient “Spark Spread”
- > Long Operating Hours
- > Central Heating and Cooling System
- > Minimal Electric Distribution Connections
- > Special Electrical, Cooling or Heating Needs

# Candidate Applications for CHP

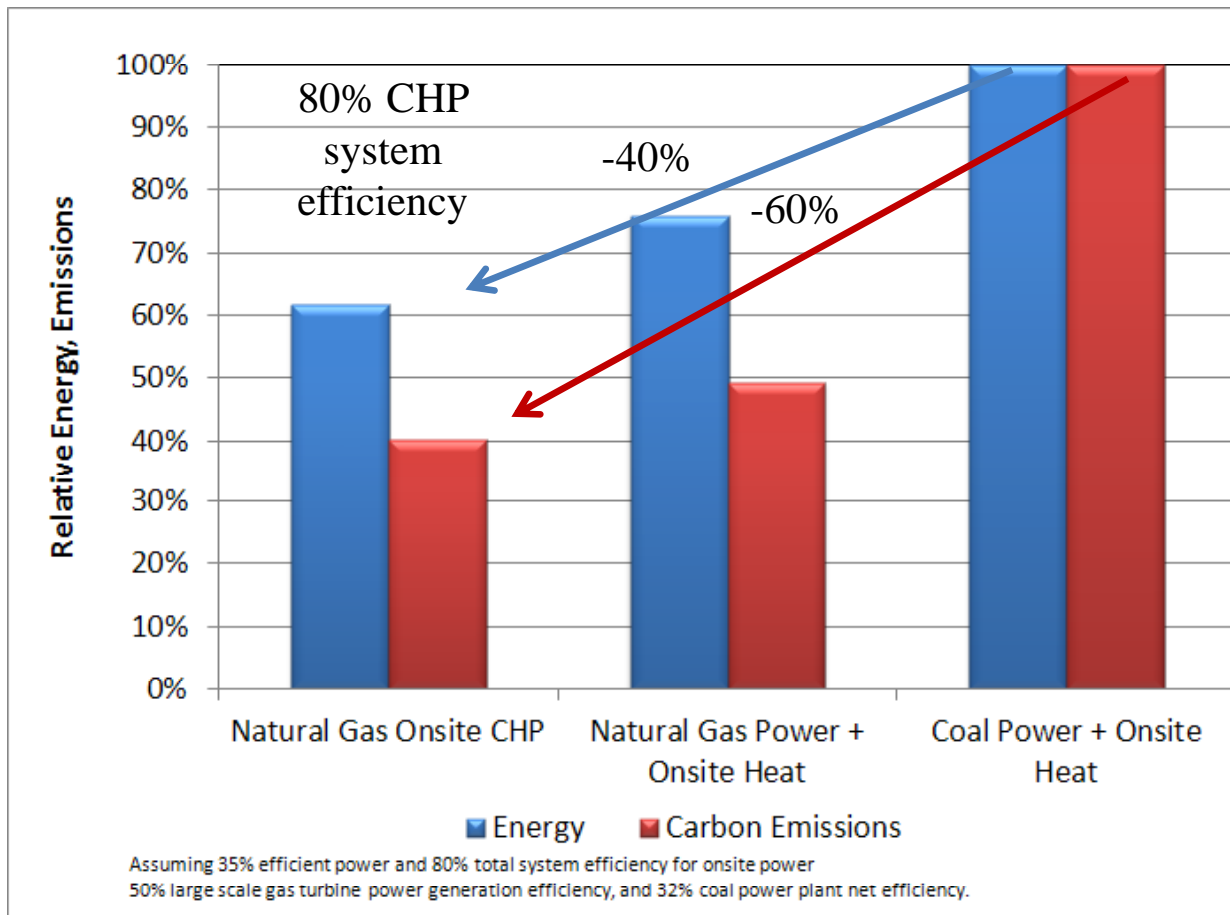
- > Hospitals
- > Colleges / Universities
- > High Schools
- > High Rise Hotels
- > Fitness Centers
- > Residential (multi and single family)
- > Food Processing
- > Paper / Lumber Mills
- > Chemical Plants
- > Metal Fabrication
- > Ethanol Plants
- > Landfill / Water Treatment Plants

Existing CHP Capacity by Application



Source: EEA, Inc. CHP Installation Database.

# Example Onsite Natural Gas Power CHP Energy and Carbon Benefits



- High-efficiency CHP holds potential for significant energy and carbon savings (40% on energy, 60% on carbon).
- Having a suitable host site important to achieving high system efficiency
- CHP growth (flat in recent years) can be enhanced by addressing barriers such as interconnection and onerous standby charges

# Gills Onions Overview



- > Nation's largest processor of fresh-cut onions
- > Advanced Energy Recovery System (AERS) uses 1.6 million lbs/wk of onion waste to produce 100% of facilities electric base load
  - 600 kW fuel cell CHP power plant
- > AERS reduces greenhouse gas emissions by up to 30,000 tons per year



### Gill's Onions: Proposed Energy Configuration

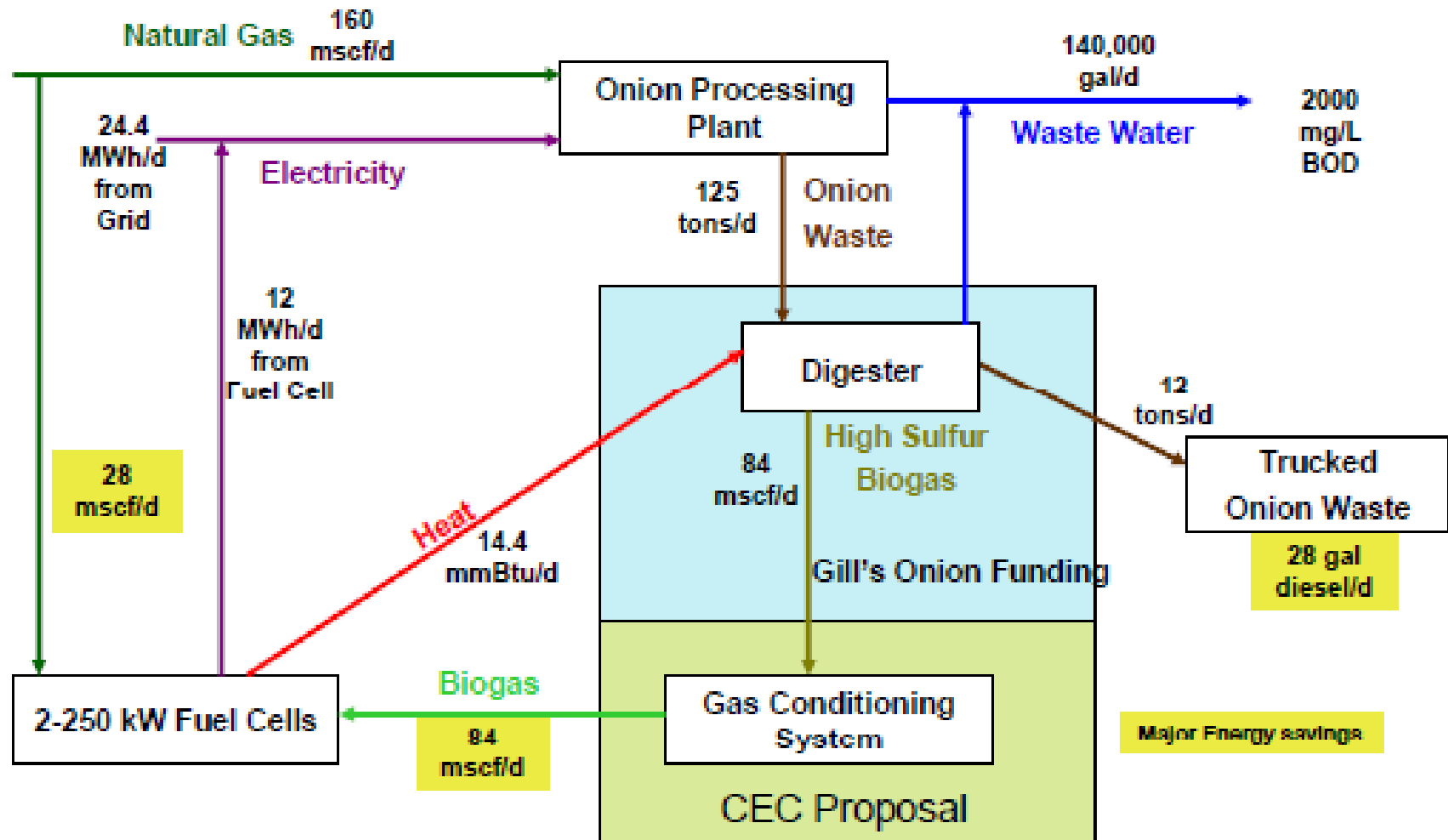


Figure 3: Proposed Energy Configuration

# Gills Onions Financial Savings



## > Selected System Costs

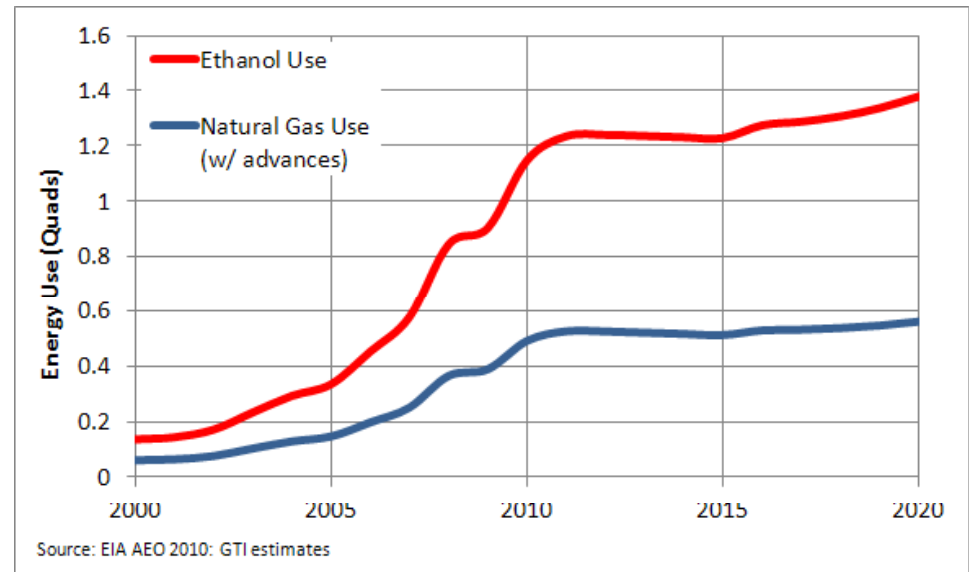
- Total Costs: \$9,500,000
- Grants/Incentives/Tax Credits: \$5,000,000
- Yearly Electricity Savings: \$700,000
- Yearly Waste-reduction Savings: \$400,000

## > Payback on Investment:

- ~ 6 years (with credits and incentives)
- ~12 years without

# Addressing Liquid Fuel Import Reliance

- > Expanding domestic natural gas supply opens potential for lowering imported liquid fuel reliance
  1. Ethanol production has been one route...natural gas has played a critical role
  2. Expanded use of NGVs
  3. Displacement of stationary heating oil/fuel oil in homes and businesses

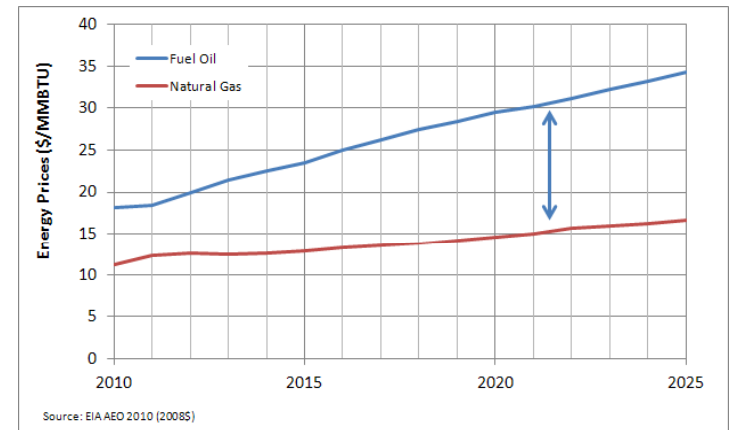


# Liquid Fuels

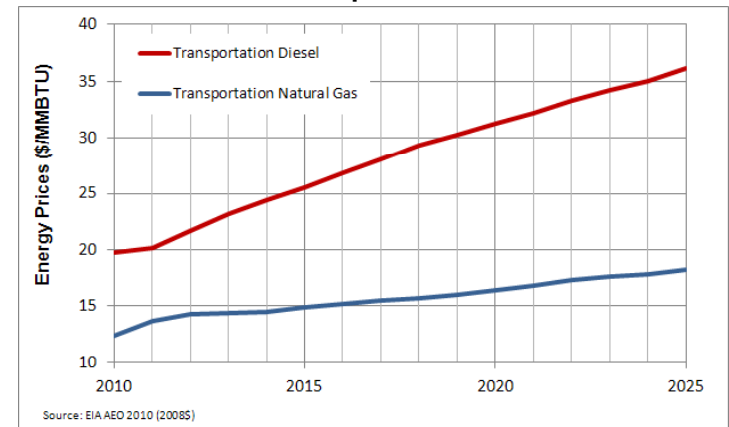


- > Transportation is a substantial energy market: 28 Quads
- > High imported crude oil and refined product use raises substantial energy security risk and large trade impact (\$400 billion+)
- > Attractive price spread between diesel/heating oil and natural gas can help shift demand over coming decade
  - Vehicles using diesel
  - Home, business, industrial, farm use exceeds 14 billion gallons
    - > Over 9 million homes
    - > Role for gas utilities?

### Residential



### Transportation



# Summary

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- > Key issues:
  - Role of natural gas and electricity in residential and commercial sector: importance of source energy and adoption into state/local building codes
  - Role of natural gas in power generation: confluence of factors poised to continue/accelerate gas use
    - > Opportunity to expand CHP. Barrier removal can help.
  - Natural gas can help reduce imported liquid fuel reliance: vehicles AND stationary
- > GTI is active in these areas – along with complementary topics of energy efficiency (including emerging technology deployment), carbon emission reduction, and expanded use of renewables