Electric-to-Gas Fuel Switching

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Introduction

- Encouraging the usage of natural gas where it is a viable substitute for electricity and converting loads currently served by electricity to natural gas will improve the efficiency with which energy is consumed.
- Encouraging the usage of natural gas where it is a viable substitute for electricity and converting loads currently served by electricity to natural gas will reduce electricity usage and could become an important component of an electric utilities overall energy efficiency strategy.
- Encouraging the usage of natural gas where it is a viable substitute for electricity and converting loads currently served by electricity to natural gas will reduce CO2 emissions and could become an important component of an electric utilities overall energy efficiency strategy .

Introduction

- Costello Paper Suggests Three Key Issues
  - Do market barriers or imperfections, or regulatory obstacles, prevent utility customers from making rational and socially desirable decisions?
  - Regulatory intervention in consumer markets should pass some cost-benefit test. There should be evidence of market problems (defined by consumers making poor choices for themselves) serious enough to justify the cost of such intervention.
  - The regulator can compare both forms of regulatory intervention – intervention to encourage energy efficiency and intervention to encourage electricity-to-gas switching – to arrive at the most cost-effective solutions.
- I Suggest and Discuss a Fourth:
  - How do regulatory interventions for the purpose of promoting electric efficiency lead to market problems and regulatory-induced poor consumer choices?

Market Barriers

- Market defects that affect the fuel selection decision (Costello, pages 8-10):
  - Imperfect information
  - Externalities not fully reflected in price
  - High discount rates
  - Inertia
  - Future price concerns
  - Inefficient rate designs
  - Split incentive problem (Builders versus homeowners, landlords versus renters)
- Costello Conclusion: "Although this list is long, it is a mistake to consider all of these factors as impediments to market performance." (Costello, page 10)

Market Barriers

- Barriers that affect the fuel selection decision (National Action Plan for Energy Efficiency, page 1-9):
  - Market barriers (such as the split incentive problem)
  - Customer barriers (such as imperfect information)
  - Public policy barriers (such as inefficient rate designs)
  - Utility, state and region planning barriers (supply side resources not consistently evaluated with demand side resources)
  - Energy efficiency program barriers (such as imperfect information)
- NAPEE Conclusion: "As a nation, we are passing up…savings by substantially under investing in energy efficiency…The current underinvestment in energy efficiency is due to a number of well-recognized barriers." (NAPEE, page 1-9)

Market Barriers

- Do market barriers or imperfections, or regulatory obstacles, prevent utility customers from making rational and socially desirable decisions?
  - Regulators have overwhelmingly decided that the answer to this question is "Yes." Utilities in 48 States engage in end-use market intervention for the purpose of encouraging different energy usage decisions than would be made absent the intervention. (Source: ACEEE 2008 Energy Efficiency Scorecard)
  - Legislators are also affirmatively weighing in on this issue, with 19 states imposing energy efficiency resource standards as of March 2009 and 3 other states considering such standards (Source: ACEEE 2009 State Energy Efficiency Resource Standard Summary)

Market Barriers

- Do market barriers or imperfections, or regulatory obstacles, prevent utility customers from making rational and socially desirable decisions?
  - Natural Gas Utilities have never advocated that electric utilities be required to engage in market interventions for the purpose of fuel switching in the absence of Commission- or Legislatively- mandated interventions in end use energy markets. If such interventions are going to be required for energy efficiency purposes, <u>all</u> options that achieve greater energy efficiency should be considered and, if cost-effective relative to other interventions, should be pursued. This is only fair to ratepayers who fund these activities.

The Case For Natural Gas

- Is market intervention for this purpose even worthwhile? Can the direct use of natural gas to provide the end-use service be more efficient than the indirect use of natural gas to produce electricity to provide the end-use service ?

The Case for Natural Gas

- Converting electric end uses to natural gas can provide significant improvements in energy efficiency.
  - [B]ased on their site energy consumption, an electric storage water heater might operate with 90 percent efficiency and a natural gas water heater with 70 percent efficiency. But for the electric storage water heater, energy losses of about 70 to 75 percent occur in acquiring the primary fuel and in the generation, transmission, and distribution of the electricity, yielding an overall energy efficiency for the electric storage water heater of about 0.30 X 0.90, or 27 percent. This figure is much lower than the gas-fired storage water heater's overall energy efficiency of about 0.91 X 0.70, or 64 percent, when full-fuel-cycle energy consumption is the measure employed. The National Academies, Review of Site (Point-of-Use) and Full-Fuel-Cycle Measurement Approaches to DOE/EERE Building Appliance Energy-Efficiency Standards, May 15, 2009.

The Case for Natural Gas

- Converting electric end uses to natural gas can provide significant emissions reductions.
  - "Optimizing *how* the U.S. uses energy has the potential to reduce carbon dioxide (CO_2) emissions by 375-565 million metric tons/yr." This strategy would bring the "net CO_2 levels for natural gas end-use and the natural gas industry to 15% lower than the 1990 levels, well beyond the Kyoto Accord goals (5% lower than 1990 levels)." Source: Gas Technology Institute, <u>A Lower-Cost Option for Substantial for Substantial Carbon Dioxide Emission Reductions in the U.S.</u>, January 2008, page 1.

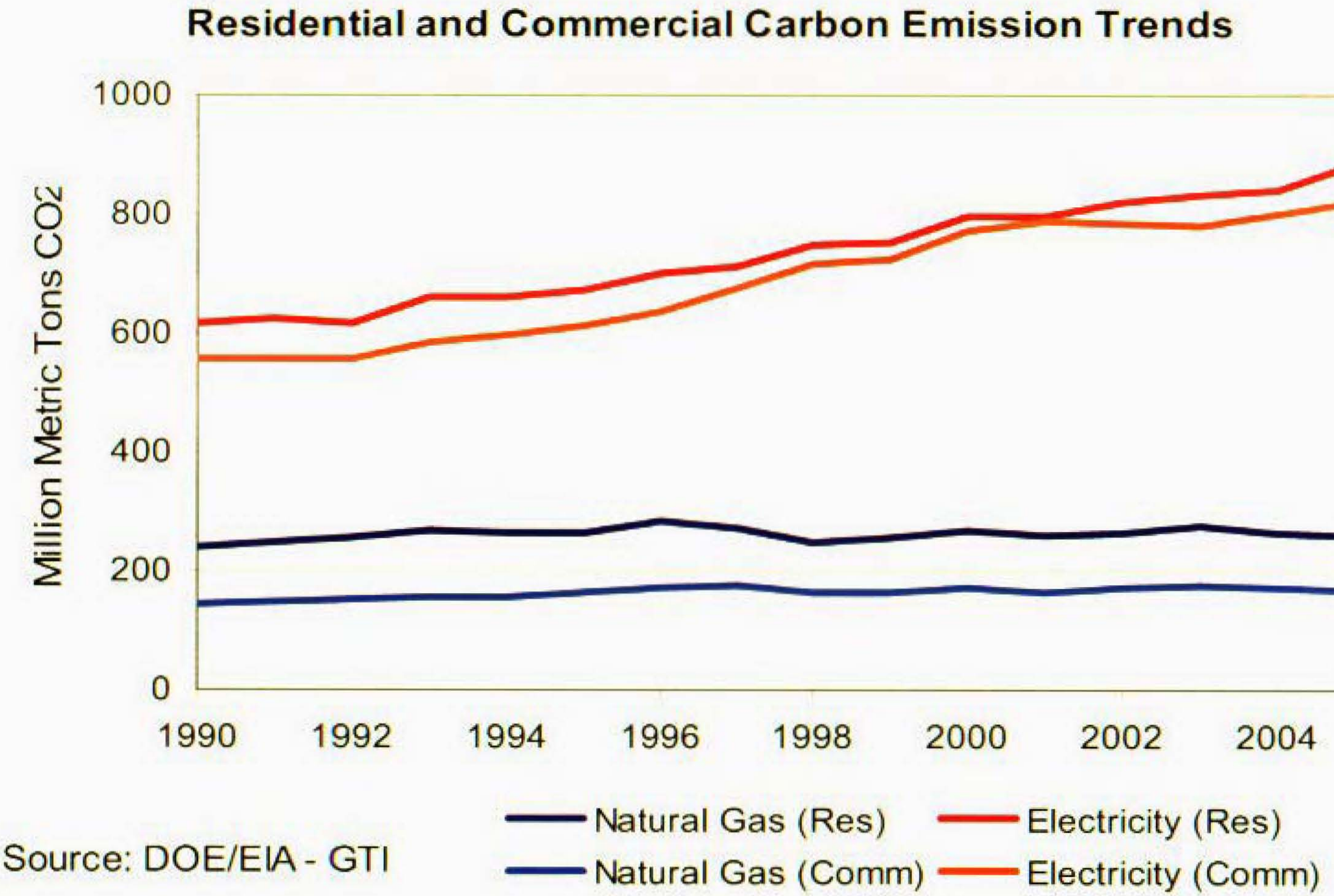
The Case for Natural Gas

Energy End-Use Sector Sources of U.S. Carbon Dioxide Emissions, 1990-2005

Sector	Million Metric Tons Carbon Dioxide 1990	Million Metric Tons Carbon Dioxide 2005	*Percent Change* 1990-2005	*Percent Change* 2004-2005
Residential	953.7	1,253.8	*31.5%*	*3.3%*
Commercial	780.7	1,050.6	*34.6%*	*1.6%*
Industrial	1,683.6	1,682.3	*-0.1%*	*-3.1%*
Transportation	1,566.8	1,958.6	*25.0%*	*1.0%*

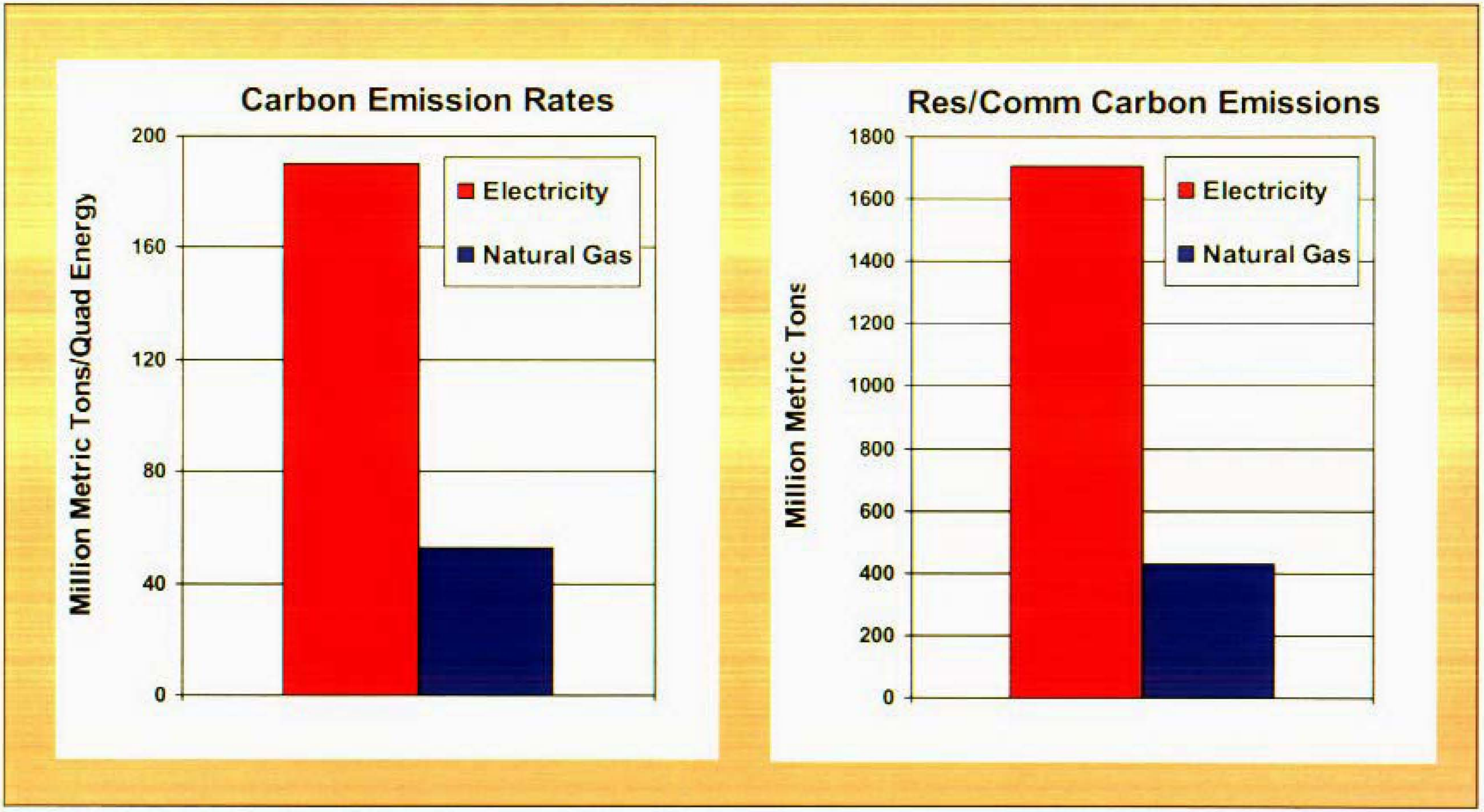
Note: Electric power sector emissions are distributed across sectors.

The Case for Natural Gas



Source: DOE/EIA - GTI

The Case for Natural Gas



Composite data for residential and commercial sectors compiled by GTI from DOE EIA AEO 2007 (2005 data)

The Case for Natural Gas

Total Energy Efficiency Carbon Dioxide Emissions for New Homes[1] (lbs of CO_2 per Average Household Energy Use[2])		
	1,500 SQ. FT.	**3,000 SQ. FT.**
Natural Gas	**7,423**	**10,583**
Oil	**13,095**	**15,198**
Electricity[3]:		
Coal-Based	17,560	22,828
Oil-Based	582	757
Natural Gas-Based	1,561	2,029
Total Electricity	**19,703**	**25,614**
[1] Based on hypothetical fuel generating mix.		
[2] Excludes energy use for cooling and base electric requirements.		
[3] For existing generating capacity only.		

The Case for Natural Gas

- Electric position: "The potential for saving energy and reducing CO_2 emissions by expanding end-use applications of electricity is significant. For all three sectors combined, the *cumulative* Technical Potential for energy savings is 71.7 quadrillion BTUs and the *cumulative* Technical Potential for CO_2 reductions is 4,400 million metric tons between 2009 and 2030." "The Potential to Reduce CO_2 Emission by Expanding End-Use Applications of Electricity" Electric Power Research Institute, March 6, 2009.

The Case for Natural Gas

- Response: Regulators and Ratepayers should welcome the opportunity for a dialogue on these important issues:
  - If market interventions are to be mandated, then all technologies, including exotic electric technologies, geothermal heat pumps, and natural gas equipment should be considered as potential energy efficiency options.
  - Energy efficiency market interventions should provide incentives for all appropriate technologies based on the benefits that those technologies provide to the system. No technology, either electric or natural gas, should be given preferential treatment.
  - The efficiencies of future technologies for space and water heating are not known at this time. However, given existing technologies, the direct use of natural gas can provide a significant improvement in energy efficiency in the economy.

Benefit Cost Tests

- Fuel Switching market interventions should be required to pass a Total Resource Cost (TRC) Test or whatever test the Commission or legislature deems appropriate for determining the cost-effectiveness of any market intervention. (Costello, page 4)
- If the Rate Impact Measure (RIM) Test is also required, fuel switching market interventions should be required to pass this test as well. However, fuel switching market interventions are more likely to pass a RIM Test than are single fuel interventions. (Costello, page 6)

Benefit Cost Tests

- Fuel switching market interventions over-whelmingly pass a Total Resource Cost (TRC) Test.
  - I have demonstrated this repeatedly in analysis I have performed for clients in the District of Columbia, Kansas, Maryland, Oklahoma, Pennsylvania and Virginia.
  - The analysis is consistently ignored, even though identical assumptions are used to demonstrate cost-effectiveness of fuel switching programs.
  - Conclusion: Ratepayer money is not being efficiently spent.

Benefit Cost Tests

- If the Rate Impact Measure (RIM) Test is also required, fuel switching market interventions should be required to pass this test as well.
  - Fuel switching market interventions are more likely to pass a RIM Test than are single fuel interventions.
  - Since the marginal cost of electricity is generally greater than the average embedded cost, load decreases on the electric system generally translate into rate reductions.
  - Since the marginal cost of delivered natural gas is generally less than the average embedded cost, load increases on the natural gas system generally translate into rate reductions.
  - This analysis is also ignored, even though these results imply that greater levels of efficiency spending could be undertaken with less rate impact.
  - Conclusion: Ratepayers are being forced to pay higher rates than necessary because fuel switching programs are not adopted.

Benefit Cost Tests

- A source-versus-site analysis should not be used to determine cost-effectiveness, only to determine whether any intervention is likely to lead to a more energy efficient outcome.
- EPA's national energy performance ratings evaluate the performance of buildings that use all types of energy. To compare this diverse set of commercial buildings equitably, the ratings must express the consumption of each type of energy in a single common unit. EPA has determined that ***source energy*** is the most equitable unit of evaluation. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, thereby enabling a complete assessment of energy efficiency in a building. ENERGY STAR Performance Ratings Methodology for Incorporating Source Energy Use December, 2007.

Benefit Cost Tests

- Criticism: "Calculating the energy reduction from switching would require knowing what generating units would run less, a fact that changes hourly." Costello, page 4.

- Response:

  - Calculating the energy reduction from any mandated market intervention requires knowing what generating units would run less. Nevertheless, this fact has not prevented Commissions and Legislatures from mandating the expenditure of billions of dollars of ratepayer funds to achieve changes in the running of those units.

  - Environmental Effects - The fuels that have less environmental impact (wind, hydro, solar, nuclear) are not normally on the margin and are therefore not normally backed off in an energy efficiency or fuel-switching context. They are also the resources with the lowest operating costs. In an economic dispatch, these units are not normally backed off in response to lower loads.

Unintended Consequences

- Incentives that are provided by electric utilities to entities that do not have natural gas service currently or potentially available to them for the purpose of encouraging the installation of "efficient heating and cooling appliances" have the great potential to increase electricity at the expense of natural gas and to increase overall energy usage.
- Any natural gas to electricity fuel switching that occurs as a result of DSM incentive payments is likely to result in the increased consumption of electricity, in direct conflict with Energy Efficiency Performance Standards.

Unintended Consequences

- Simple economics dictates that incentives paid to encourage the purchase of higher efficiency appliances of a particular fuel type must lower the life cycle costs of appliances of that fuel type and will impact the fuel selection decision.
- This occurs as a result of the simple economics of life cycle costs:

$$LC_i = CC_i + OC_{i,1}/(1+r)^0 + \ldots + OC_{i,n}/(1+r)^{(n-1)}$$

Unintended Consequences

Rationale for DSM Incentive Payments			
	Standard Efficiency Appliance	High Efficiency Appliance	High Efficiency Appliance With Rebate
Up-Front Cost	$ 1,000	$ 1,500	$ 1,250
Annual Operating Costs	$ 500	$ 450	$ 450
Appliance Lifetime (Years)	15	15	15
Discount Rate	10%	10%	10%
Life-Cycle Cost	$ 5,183	$ 5,265	$ 5,015

Unintended Consequences

Impact of DSM Incentive Payments on the Fuel Selection Decision			
	High Efficiency Electrical Appliance	High Efficiency Electrical Appliance With Rebate	Gas Appliance
Up-Front Cost	$ 1,500	$ 1,250	$ 2,500
Annual Operating Costs	$ 450	$ 450	$ 320
Appliance Lifetime (Years)	15	15	15
Discount Rate	10%	10%	10%
Life-Cycle Cost	$ 5,265	$ 5,015	$ 5,177

Unintended Consequences

- Even programs that are touted as "fuel-neutral," such as the Energy Star® program, will likely have fuel selection consequences:

  "[I]t is often cheaper to build a house meeting the electric-heating criteria for Energy Star than for the gas heating criteria." Alan Meier, The Future Of Energy Star And Other Voluntary Energy Efficiency Programs, Proceedings of the ECEEE 2003 Summer Study – Time to Turn Down Energy Demand, 2003, page 677.

Conclusion

- Costello's concerns with the AGF Study suggest the following approach to examining the appropriateness of fuel switching (Costello, page 7):
  - Must evaluate fuel-switching on a utility-specific basis. Agree.
  - Must determine whether and to what extent institutional barriers prevent what appears to be rational consumer decision-making. Agree, but this determination has already been made at the national level (see NAPEE) and at the State level (See, for example Act 129 in PA and Empower MD in MD) and at the utility level (See numerous Commission orders requiring end use market interventions).
  - Must accurately account for appliance efficiencies. Agree, but this is a determination that must be made by state regulatory authorities in the context of cost-effectiveness evaluations of all market interventions.
  - Must accurately reflect the avoided cost. Agree, but this this is also a determination that must be made by state regulatory authorities in the context of the cost-effectiveness evaluations of all market interventions.
  - Must make the appropriate comparisons between electric and gas options. Agree, but similar to current market interventions, compare incremental (new) appliances to existing generation.