



National Regulatory  
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## **Electric-to-Gas Substitution: What Should Regulators Do?**

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## Abstract

With concerns over global warming and energy sustainability increasing, policy options have broadened to include fuel switching, or as it more correctly termed, electric-to-gas substitution. Electric-to-gas substitution, as defined in this presentation, refers to the decision of small, generally residential consumers, to use natural gas rather than electricity for certain end-use applications. The decision can involve conversion from electricity to natural gas in an existing home or installation of gas-burning equipment in a new home. In each instance, the consumer must decide on the appliance or energy-using equipment she wants to purchase. End uses for which electric-to-gas substitution is common include space heating, water heating, cooking, and clothes drying.

This presentation highlights the recent NRRI paper of the same title. It starts with a question: Have market or regulatory barriers prevented or discouraged socially beneficial electric-to-gas substitution? Electric-to-gas substitution, more than anything else, involves consumer choice. In almost all energy and nonenergy markets in the U.S., even those heavily regulated on the supply side, the market is the primary institutional arrangement in which consumers to make decisions. Consumers' responses to the market determine what they buy and what benefits they receive from a purchase. An energy consumer's major concern is the capital equipment and energy costs she must incur to enjoy the level of heating comfort and other energy services she desires.

This presentation recommends that 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.

# Electric-to-Gas Substitution: What Should Regulators Do?

## I. Where are the benefits and costs of switching?

### A. Consumer's perspective

1. Energy services at issue here include cooling, space heating, water heating and clothes drying. How much service consumers desire depends upon such factors as climate, house size, fuel prices, and income.
2. The consumer tries to choose fuels that will provide service at least cost and satisfy other objectives (e.g., high service reliability and moderate price risk).
3. From the consumer's perspective, the cost-effectiveness of electric-to-gas substitution depends on several factors. They include: (1) for existing customers, conversion costs (e.g., electrical and plumbing work); (2) the cost of new natural gas connections or extension lines required; (3) the avoided cost of electricity (e.g., fuel and other operating costs, capital costs); and (4) the incremental cost of natural gas (e.g., purchased gas costs and any additional distribution costs).
4. The individual customer must consider initial costs (appliance costs and connection costs) and operating costs (mainly the cost of energy, which depends upon energy prices and the energy efficiency of appliances).

### B. Regulator's perspective

1. The regulator's perspective is broader than the individual consumer's. If the regulator's goal is to reduce total cost, she must consider several aspects.
2. Energy efficiency, which measures the ratio of energy output to energy input, can be measured from two perspectives:
  - a. At the consumption site, looking at the appliance alone, i.e., the amount of energy needed to run an appliance or equipment (e.g., cooling, space heat); and
  - b. The full fuel cycle, taking into account the production, transportation and distribution of energy.

3. If electric-to-gas substitution would lead to greater energy efficiency, however it is defined, that fact alone would not justify regulatory intervention. Most state commissions involved in promoting energy efficiency evaluate options using the Total Resource Cost (TRC) test.
4. Regulators should address whether to impute a value to the energy source with the higher energy efficiency from the perspective of a full fuel cycle. One argument is that imputing a value would be “double accounting” the benefits of higher energy efficiency.

**C. Environmental effects**

1. A study by the American Gas Foundation found that electric-to-gas substitution reduces air pollutants. The study assumed that the electricity generation avoided from electric-to-gas substitution would come from fossil fuel plants. It is assumed that these plants use either coal or natural gas, or both, as fuels.
2. The conclusion about emissions depends on the fuel mix used by the utility at issue.
  - a. If the power plants affected by electric-to-gas substitution have zero or extremely low emissions, such as wind, hydro, solar or nuclear, the environmental benefits of switching to gas are less, and may well be negative.
  - b. Electric end-use appliances also produce no carbon and other air pollutants, unlike natural gas appliances; this factor could be an issue in urban non-attainment areas.

**D. Effects on the utilities**

1. For electric utilities, a customer’s switch to gas means less electricity consumption per household, not fewer customers. For natural gas utilities, the same switch means higher gas consumption per customer or an increase in customers, or both.
2. The financial effects for both electric and gas utilities depend on:
  - a. The end-use energy services affected;
  - b. The change in revenues for both utilities, which depends to a significant degree on rate design; and
  - c. The change in avoided cost and incremental cost for both utilities, including any conversion inducements and other promotional costs

3. Two scenarios

a. (*Scenario #1: most efficient outcome*) The electric utility's peak demand falls and the gas utility's off-peak demand increases, as would occur when electric customers convert to natural gas air conditioners.

(1) Lower peak electric demand would reduce the requirements for new electric generating capacity.

(2) For electric utilities with uniform average-cost pricing, it also would tend to avoid costs greater than the lost revenues.

(3) For a gas utility building its load during off-peak periods, the increased capacity utilization would tend to lower its average cost per unit. Increasing off-peak demand also would tend to increase its earnings, both because of average-cost pricing (which tends to set prices above marginal cost during off-peak periods) and the recovery of fixed costs in the volumetric charge.

b. (*Scenario #2: more questionable outcome*) Electricity use would decrease and natural gas use would increase during cold winter mornings when space heating and water heating would likely be used.

(1) Switching from electric space and water heating to natural gas would tend to increase peak demands on the natural gas system, while having little or no effect on electric annual peak demands (which are due primarily to summer air conditioning).

(2) The electric utility would likely experience lower earnings, assuming that revenue declines would exceed the avoided cost (because in off-peak periods, average-cost rates exceed below-average costs).

(3) The gas utility, on the other hand, would likely enjoy higher earnings, for the opposite reasons.

**E. Comments on a recent industry study**

1. A study by the American Gas Foundation (AGF), *Direct Use of Natural Gas: Implications for Power Generation, Energy Efficiency, and Carbon Emissions*, cited different benefits from

small electricity consumers switching to natural gas for direct applications such as space and water heating. These benefits included reductions in:

- a. Energy consumption (in Btus), mostly from eliminating the high energy losses in producing and transmitting electricity;
  - b. Need for new generating facilities;
  - c. Energy costs incurred by end-use consumers; and
  - d. Carbon dioxide (CO<sub>2</sub>) emissions.
2. Limitations of study for policy-making
- a. It makes no assumptions as to whether consumers make rational decisions or whether market and regulatory impediments to electric-to-gas substitution exist.
  - b. It omits some real world costs that consumers would incur when switching, such as transaction costs and the inconvenience of switching fuels in an existing house.
  - c. The study is, therefore, unable to distinguish between reasonable and unreasonable consumer behavior.
  - d. It also did not measure the cost of regulatory intervention necessary to induce electric-to-gas substitution, such as the cost of promotional activities or of planning studies.

## **II. What market defects might affect the electric-to-gas substitution decision?**

- A. If all actors considered all cost factors rationally, and if price reflected all those factors, electric-to-gas substitution would occur to the extent it is economically efficient – no more and no less.**
- B. The field of behavioral economics asserts that the real world does not work that way. Here are examples of divergences from the ideal:**
  1. Consumers have imperfect information.
  2. Consumers' chief concern is the economic effect on themselves, not on others or on the environment.

3. Consumers overvalue present dollars and undervalue future benefits, resulting in insistence on payback periods that are shorter than are economically justified.
4. Inertia is a powerful force.
5. Even with information that a shift to natural gas will save money and help the environment, a customer might be more influenced by concern about gas price volatility, while also viewing the environmental benefit as trivial.
6. Inefficient rate designs induce consumers to make energy choices that do not reflect the full economic costs of producing and delivering energy.
7. Home builders choosing appliances tend to focus on the initial installation cost, not the life cycle cost.

### **III. What are the regulatory options?**

#### **A. Take no action**

1. Based on an assumption or finding that customer choices are rational, efficient, and consistent with the public interest
2. Based also on the absence of serious market distortions warranting regulatory intervention; or that correcting for those distortions would not pass a cost-benefit test
3. In other words, regulatory intervention should only occur if the distortions are serious and the cost of intervention is less than the benefits.

#### **B. Regulatory directives to the utilities**

1. Necessary conditions
  - a. Because of market imperfections, there are unexploited opportunities for cost-effective electric-to-gas substitution.
  - b. The utility's obligation to serve customers at the lowest feasible cost includes an obligation to help guide them toward actions that minimize the cost of energy services (e.g., the life-cycle cost of producing hot water in a home).



- c. Review any existing restrictions on promotional practices to determine if they deny customers the information necessary to effective choices.
- d. Grant rebates to residential customers who convert from electricity to natural gas for space heating and water heating, as long as electric-to-gas substitution passes a given cost-benefit test (such as the Total Resource Cost test).
- e. Require or authorize the gas utility to offer ratepayer-funded incentives to home builders to install gas appliances.
- f. Determine whether existing energy efficiency initiatives cause choice distortions.
- g. Recognize that if regulatory policy encourages customer departure from electric to gas utilities, electric utilities will experience under-recovery of fixed charges, requiring commission consideration of alternatives means of compensation.

**D. Regulatory caution: principles, risks and questions**

1. Principles

- a. Regulators should aim for that combination of market and regulatory influences most likely to produce economic efficiency.
- b. Regulators should re-examine that combination periodically, as facts change.
- c. Regulatory intervention is justified when market defects or customer behavior produces inefficient results that exceed the cost of intervention.
- d. For any given regulatory action, a commission must have sufficient commission staff resources and expertise to ensure effective design and implementation. Absent such resources and expertise, there is the risk of error.

2. Risks of regulatory intervention

- a. Regulation has benefits: the benefits are the removal of the economic efficiency losses associated with market defects and customer error.



- e. Do regulatory practices and policies distort electric-to-gas substitution decisions?
- f. What benefit-cost test should apply?
- g. What are the direct and indirect costs associated with executing the actions? Who would bear those costs?
- h. How and to what degree should regulators consider the non-monetized effects (e.g., energy efficiency and environmental) of consumer energy-choice decisions?
- i. Are the uncertainties in calculating the costs and benefits of electric-to-gas substitution too large to produce credible results?
- j. Are the relevant facts so location-specific so as to rule out categorical policies?
- k. What regulatory actions would best address each of the problems identified?
- l. Will the benefits of regulatory intervention exceed its costs? What are the risks associated with the proposed actions? Who bears those costs? Will the regulatory action distort competition?
- m. How should regulators evaluate the effectiveness of these interventions?
- n. Does the regulator have legal authority to execute those actions?