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Title

Easing the Natural Gas Crisis: Reducing Natural Gas Prices Through Electricity Supply Diversification -- Testimony

Author
Wiser, Ryan

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Dr. Ryan Wiser
Scientist, Lawrence Berkeley National Laboratory

Mr. Chairman and Members of the Committee, I appreciate the opportunity to appear before you today. My name is Ryan Wiser, and I am a Scientist at Lawrence Berkeley National Laboratory (Berkeley Lab). Since 1995, I have conducted renewable energy research at Berkeley Lab; research that has been funded in large part by the U.S. Department of Energy.

I am here today to report on the findings of a recent study that I helped manage and conduct, a study titled *"Easing the Natural Gas Crisis: Reducing Natural Gas Prices Through Increased Deployment of Renewable Energy and Energy Efficiency."* This study explores the relationship between renewable generation and energy efficiency investments and natural gas prices. As I will describe, the report finds that by reducing natural gas demand, deployment of renewable energy and energy efficiency could put significant downward pressure on natural gas prices and thereby provide sizable consumer savings.

To be clear, I am here to report the results of this study, and not to take a specific policy position on the issues of diversity incentives or standards. Let me also note that my remarks are my own, and not those of Berkeley Lab or the U.S. Department of Energy.

The Current Situation with Natural Gas

I think we can all agree that we have seen a structural shift in the natural gas sector; a shift that has already led to more than a doubling of natural gas prices and an increase in price volatility.

From around $2 per mmBTU in the 1990s, average wellhead natural gas prices rose to $4.10 per mmBTU from 2000 through 2004, and $5.40 per mmBTU in 2004 alone. The 6-year NYMEX forward curve shows that the gas market expects prices at the Henry Hub to remain in the $5 to $8 per mmBTU range for at least the next six years, while the Energy Information Administration's (EIA) latest forecast projects that wellhead prices will average more than $5/mmBTU in the coming 20 years (all prices are reported in nominal dollars). Though both market and government forecasts of long-term gas prices have been notoriously inaccurate, we appear to be at a point where demand for natural gas is beginning to exceed our current ability to economically extract the fuel from domestic reserves.

At the same time, natural gas is a fuel with many positive attributes, and as a result its use in the residential, commercial, industrial, and power sectors is expected by the EIA and others to continue to increase. The power sector, especially, has been driving, and is projected to continue to drive, growth in natural gas demand. For example, from 1998 to the present, over 80% of the new generating capacity in the U.S. has been fueled with natural gas.

Correcting the present imbalance between natural gas supply and demand will clearly be a challenging task, and most would agree that a balanced energy policy must both expand the supply of, and reduce the demand for, natural gas. I commend this Committee for its leadership in exploring both sets of options, though for the remainder of these remarks I will be focusing on the potential benefits of demand-side measures.

Summary of the Berkeley Lab Study

With the recent run-up in natural gas prices, and the expected continuation of volatile and high prices for at least the mid-term future, a growing number of voices are calling for increased diversification of electricity supplies. Such diversification holds the prospect of *directly* reducing our dependence on a fuel whose costs are highly uncertain, thereby hedging the risk of natural gas price volatility and escalation. In addition, as I will describe in a moment, by reducing natural gas demand, increased diversification away from gas-fired generation can *indirectly* suppress natural gas prices.

Our report highlights the impact of increased deployment of renewable energy and energy efficiency on natural gas prices and consumer natural gas bills. A growing number of modeling studies conducted by government, non-profit, and private sector entities are showing that renewable energy and energy efficiency could significantly reduce natural gas prices and bills. *Our report summarizes these recent modeling studies and reviews the reasonableness of their findings in light of economic theory and other analyses.* (Though our report focuses on renewable energy and energy efficiency, other non-natural-gas resources would likely have a similar effect).

We find that, by displacing natural-gas-fired electricity generation, increased levels of renewable energy and energy efficiency will reduce demand for natural gas and thus put downward pressure on gas prices. These price reductions hold the prospect of providing consumers with significant natural gas bill savings. In fact, although we did not analyze in detail the electricity price impacts reported in the studies, the studies often show that any predicted increase in the price of electricity caused by greater use of renewable energy or energy efficiency is largely or completely offset by the predicted natural gas price savings. We conclude that policies to encourage fuel diversification within the electricity sector should consider the potentially beneficial cross-sector impact of that diversification on natural gas prices and bills.

Economic Theory

Our report confirms that the natural-gas-price reductions projected by earlier modeling studies are consistent with economic theory. Increased renewable energy and energy efficiency will cause an inward shift in the natural gas demand curve, leading to lower natural gas prices than would have been realized under the higher-demand conditions. Similar natural gas price reductions would likely result from increased use of other non-natural-gas energy sources that displace natural gas consumption (e.g., coal, nuclear).

The magnitude of the price reduction will depend on the amount by which natural gas consumption is reduced, as well the shape of the natural gas supply curve (measured by the inverse price elasticity of natural gas supply, or the percentage change in price caused by a one percent change in demand). Given the ability of natural gas supply and demand to adjust to altered prices over time, the price reduction is likely to be greater in the near term than over the longer term.

These reductions in gas prices benefit consumers by reducing fuel costs faced by electricity generators, and by reducing the price of natural gas delivered for direct use in the residential, commercial, industrial, and transportation sectors. According to economic theory, this benefit to consumers will, to some degree, come at the expense of natural gas producers. However, if policymakers are concerned about the impact of natural gas prices on consumers, or are concerned about the macroeconomic impacts of higher gas prices on overall economic activity, then policies to reduce gas demand might be considered appropriate. In addition, given anticipated future growth in imported natural gas, reducing natural gas prices may well enhance social welfare in the United States (because the gain to U.S. consumers comes, in part, at the expense of foreign producers).

Review of Previous Studies

The Berkeley Lab report reviews five different studies by the Energy Information Administration (EIA), six by the Union of Concerned Scientists (UCS), one by the Tellus Institute, and one by the American Council for an Energy-Efficient Economy (ACEEE) (see the References section for a full listing of these studies). In aggregate, these thirteen studies report results of twenty different modeling runs, which we review in our report. Most of the studies evaluate national renewables portfolio standard (RPS) proposals, though some evaluate state RPS policies and others also include energy efficiency investments. The vast majority of these studies rely on the National Energy Modeling System (NEMS), an energy model developed and operated by the EIA to provide long-term energy forecasts. Though these studies seek to evaluate a full range of economic impacts, the focus of the Berkeley Lab work is on the natural gas demand and price impacts.

As shown in our full report, these studies consistently find that renewable energy and energy efficiency deployment will reduce natural gas demand, thereby putting downward pressure on gas prices.

The level of demand and price reduction depends in large part on the level of renewable energy and energy efficiency deployment. Those studies that review the impact of more aggressive national renewable energy deployment efforts have found that such efforts could reduce demand for natural gas by as much as 3 to 4 quadrillion BTU (Quads) a year by 2020, or 10% of projected national gas consumption, with a mean reduction across studies of approximately 2 Quads (7%). Less aggressive levels of national deployment are found to reduce gas consumption by as much as 1.5 Quads, or 4% of total projected demand in 2020, with a mean reduction across studies of 0.7 Quads (2%).

At the higher end of the demand-reduction spectrum, the drop in demand is expected to lead to wellhead price reductions that can be as high as $0.5 per mmBTU (17% below projected wellhead prices in 2020), with a mean reduction across studies of $0.3 per mmBTU (10%). At the high end of this range, aggregate consumer gas savings in 2020 exceed $15 billion. Less aggressive levels of demand reduction are found to reduce gas prices by as much as $0.3 per mmBTU (13%), with a mean reduction across studies of around $0.15 per mmBTU (5%). (See Table 1, and Figures 1 and 2 in the Appendix). Note that, on the high end at least, these price reductions are similar in magnitude to those estimated to come from increased access to Alaskan gas and/or liquefied natural gas imports, as reported in recent studies by Stanford's Energy Modeling Forum and the National Commission on Energy Policy.

Another key source of variation among the studies' results lies in their assumptions about the shape of the natural gas supply curve. A quantitative measure of that shape is the long-term average inverse price elasticity of natural gas supply. Of the twenty modeling runs that we reviewed, thirteen show an average inverse price elasticity of natural gas supply in the range of 0.8 to 2. This means that each 1% reduction in national gas demand is expected to lead to a long-term average reduction in wellhead gas prices of 0.8% to 2%. Some studies predict even larger impacts, especially in the near term. In fact, of the remaining seven modeling runs, five show even more significant price reductions – up to a 4% price reduction for each 1% drop in demand. (See Figure 3, in the Appendix).

Overall, among those analyses that evaluate aggressive levels of national renewable energy development, nine of fifteen find that such deployment might provide natural gas bill savings in the range of $10 to $40 billion from 2003-2020 (on a national, net present value basis). These savings are often more than enough to offset any predicted increase in the price of electricity that is caused by greater use of renewable energy sources. (See Figure 4, in the Appendix).

Results from these studies further suggest that each megawatt-hour (MWh) of electricity generated from a renewable resource provides, on average, national consumer benefits (in the form of natural gas bill savings) that are typically in the range of $10 to $20/MWh. Even at the lower end of this range, these savings are significant relative to the current cost of supplying electricity from renewable resources, which averages perhaps $30 to $70 per MWh.

Benchmarking Our Results with Other Research

These consumer gas bill savings are clearly significant. But what level of confidence should be placed on these modeling results? After all, most of these results derive from a single energy model: NEMS. To answer this question, we sought to compare the results of the various modeling studies to each other, to the results of other national energy models, and to the empirical economics literature. We did this to test for model consistency over time, across models, and with economic theory.

The details of these comparisons can be found in the full report, but to summarize, we conclude that there remains significant uncertainty about the exact magnitude of the natural gas price reduction. However, we also find that each comparison provides reason to believe that the price-suppression effect is real, and that the studies reviewed above have characterized this effect within reason, given the state of current knowledge.

For example, four of six energy models (POEMS, CRA, E2020, MARKAL) used in a recent study by Stanford's Energy Modeling Forum show results consistent with those of the thirteen studies reported earlier, while the two outliers (NANGAS, NARG) display price-reduction impacts that are *greater* than those of the thirteen studies reported previously (See Table 2, in the Appendix). Meanwhile, the energy model from Energy and Environmental Analysis, Inc. (EEA), which was used by the National Petroleum Council and the National Commission on Energy Policy in their recent work, suggests that the long-term impact of demand reductions on natural gas prices will be at least double that reported earlier (i.e., a 1% decline in demand will result in a 4%+ drop in natural gas prices, compared to the 0.8-2% drop reported earlier).

While more work needs to be done on this topic, in the meantime, existing modeling results appear to be reasonable and should not be dismissed.

Conclusion

Elevated natural gas prices have emerged as a key energy-policy challenge for at least the early part of the 21st century. While our nation will continue to rely on natural gas, most agree that both supply-side and demand-side actions will likely be necessary to moderate prices. Focusing on just the demand side, our study has found that increased diversification of energy supplies should help to alleviate the threat of high natural gas prices over the short and long term, thereby reducing consumer natural gas bills.

The thirteen studies and twenty specific modeling analyses reviewed in our report consistently show that increased use of renewable energy and energy efficiency can begin to reduce natural gas prices. Our report is the first to demonstrate that these results are broadly consistent with economic theory, results from other national energy models, and limited empirical evidence.

Of course, these effects are not strictly limited to renewable energy and energy efficiency investments: any non-natural-gas resource that displaces gas use is expected to provide similar consumer benefits. In addition, a comprehensive analysis of the costs and benefits of policy efforts must consider other impacts as well, including impacts on electricity rates, national security, environmental outcomes, and economic development. Nonetheless, given present concerns about natural gas prices and the findings reported in this testimony, I believe it is prudent to carefully evaluate the cross-sector impacts of electricity-sector diversification policies on the natural gas market.

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Appendix

Table 1. Summary of Renewable Energy (RE) and Energy Efficiency (EE) Deployment Studies

Author	RPS/EE	Increase in U.S. RE Generation TWh (% of total generation)	Reduction in U.S. Gas Consumption Quads (%)	Gas Wellhead Price Reduction $/MMBtu (%)	Retail Electric Price Increase Cents/kWh (%)
EIA (1998)	10%-2010 (US)	336 (6.7%)	1.12 (3.4%)	0.34 (12.9%)	0.21 (3.6%)
EIA (1999)	7.5%-2020 (US)	186 (3.7%)	0.41 (1.3%)	0.19 (6.6%)	0.10 (1.7%)
EIA (2001)	10%-2020 (US)	335 (6.7%)	1.45 (4.0%)	0.27 (8.4%)	0.01 (0.2%)
EIA (2001)	20%-2020 (US)	800 (16.0%)	3.89 (10.8%)	0.56 (17.4%)	0.27 (4.3%)
EIA (2002a)	10%-2020 (US)	256 (5.1%)	0.72 (2.1%)	0.12 (3.7%)	0.09 (1.4%)
EIA (2002a)	20%-2020 (US)	372 (7.4%)	1.32 (3.8%)	0.22 (6.7%)	0.19 (2.9%)
EIA (2003)	10%-2020 (US)	135 (2.7%)	0.48 (1.4%)	0.00 (0.0%)	0.04 (0.6%)
UCS (2001)	20%-2020, & EE (US)	353 (7.0%)	10.54 (29.7%)	1.58 (50.8%)	0.17 (2.8%)
UCS (2002a)	10%-2020 (US)	355 (7.1%)	1.28 (3.6%)	0.32 (10.4%)	-0.18 (-2.9%)
UCS (2002a)	20%-2020 (US)	836 (16.7%)	3.21 (9.0%)	0.55 (17.9%)	0.19 (3.0%)
UCS (2002b)	10%-2020 (US)	165 (3.3%)	0.72 (2.1%)	0.05 (1.5%)	-0.07 (-1.1%)
UCS (2003)	10%-2020 (US)	185 (3.7%)	0.10 (0.3%)	0.14 (3.2%)	-0.14 (-2.0%)
UCS (2004a)	10%-2020 (US)	181 (3.6%)	0.49 (1.6%)	0.12 (3.1%)	-0.12 (-1.8%)
UCS (2004a)	20%-2020 (US)	653 (13.0%)	1.80 (5.8%)	0.07 (1.87%)	0.09 (1.3%)
UCS (2004b)	10%-2020 (US)	277 (5.5%)	0.62 (2.0%)	0.11 (2.6%)	-0.16 (-2.4%)
UCS (2004b)	20%-2010 (US)	647 (12.9%)	1.45 (4.7%)	0.27 (6.7%)	-0.19 (-2.9%)
Tellus (2002)	10%-2020 (RI)	31 (0.6%)	0.13 (0.4%)	0.00 (0.0%)	0.02 (0.1%)
Tellus (2002)	15%-2020 (RI)	89 (1.8%)	0.23 (0.7%)	0.01 (0.4%)	-0.05 (-0.3%)
Tellus, (2002)	20%-2020 (RI)	98 (2.0%)	0.28 (0.8%)	0.02 (0.8%)	-0.07 (-0.4%)
ACEEE (2003)	6.3%-2008, & EE (US)	NA	1.37 (5.4%)	0.74 (22.1%)	NA

Notes:

- The data for the ACEEE study are for 2008, the final year of that study's forecast. All other data are for 2020.
- All dollar figures are in constant 2000$.
- The increase in U.S. RE generation reflects the TWh and % increase *relative* to the reference case scenario for the year 2020. The % figures do not equate to the size of the RPS for a variety of reasons: 1) existing RE generation and new RE generation that comes on line in the reference case may also be eligible for the RPS, and 2) the RPS is not always achieved, given assumed cost caps in some studies.
- The reference case in most studies reflects an EIA Annual Energy Outlook (AEO) reference case, with some studies making adjustments based on more recent gas prices or altered renewable-technology assumptions. The one exception is UCS (2003), in which the reference case reflects a substantially higher gas-price environment than the relevant AEO reference case.
- The Tellus study models an RPS for Rhode Island, also including the impacts of the Massachusetts and Connecticut RPS policies. All the figures shown in this table for the Tellus study, as well as ACEEE (2003), are for the predicted national-level impacts of the regional policies that were evaluated.

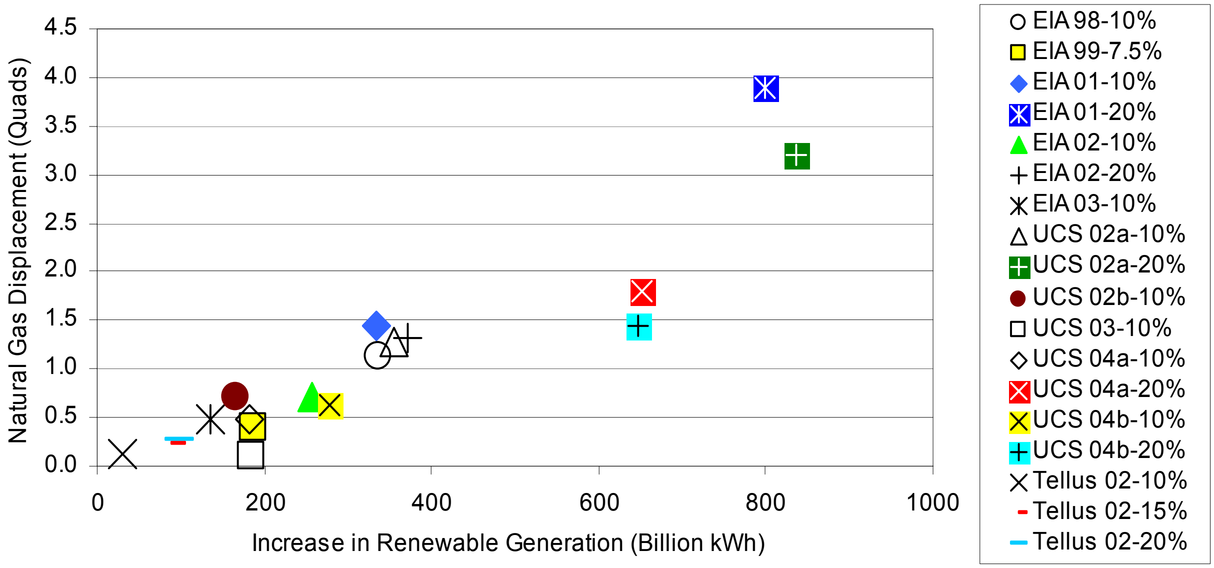


Figure 1. Forecasted Natural Gas Displacement in 2020, by Study and Modeling Run

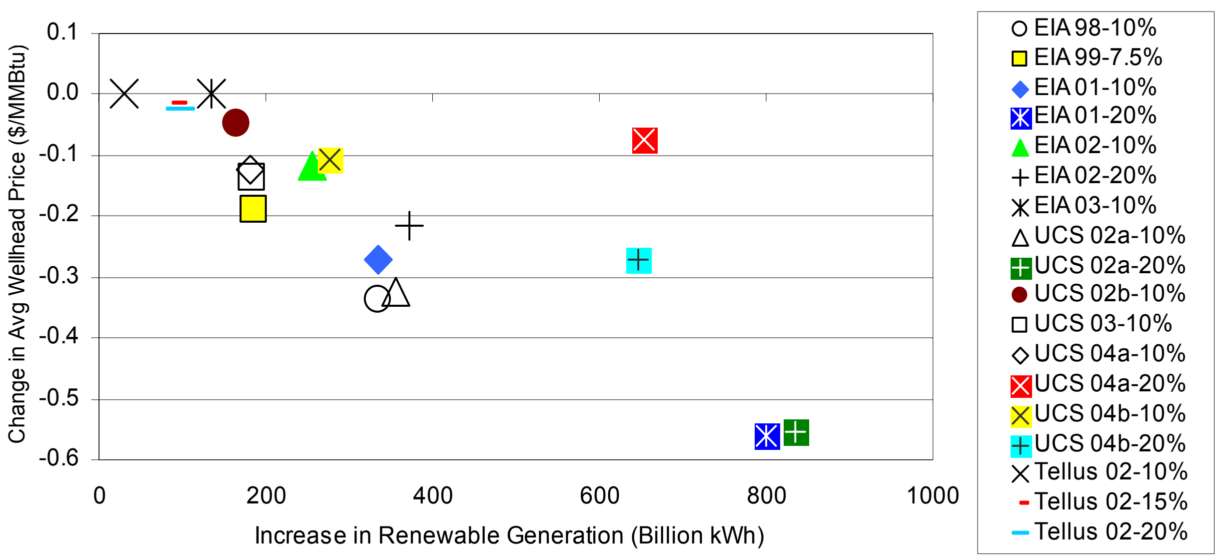
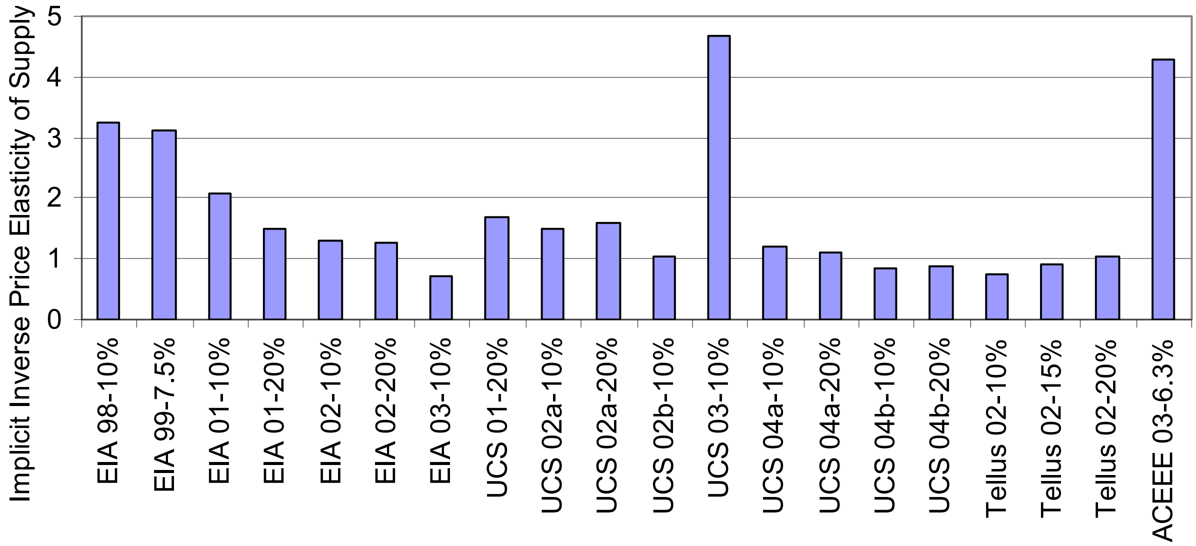


Figure 2. Forecasted Natural Gas Wellhead Price Reduction in 2020, by Study and Modeling Run



Note: inverse price elasticity of supply figures reported here are long-term averages, except for ACEEE (2003), in which the figure reported here is simply the average inverse elasticity for 2007 and 2008.

Figure 3. Average Inverse Price Elasticities of Supply, by Study and Modeling Run

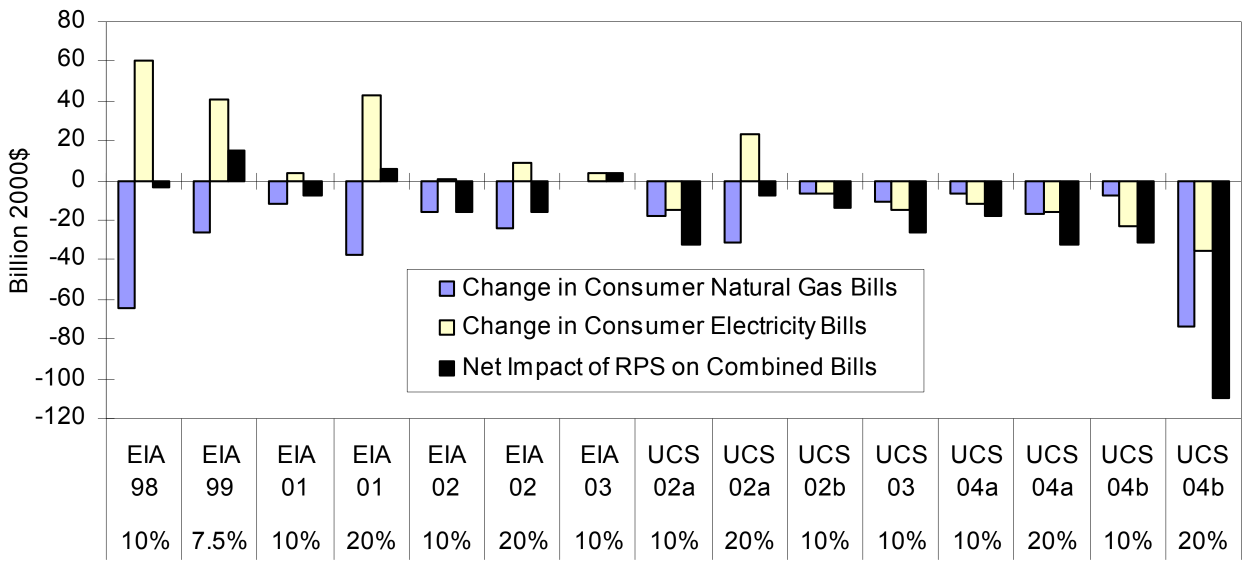


Figure 4. Net Present Value of National RPS Impacts on Natural Gas and Electricity Bills (2003-2020, 7% real discount rate)

Table 2. Implicit Inverse Elasticities in a Range of National Energy Models (EMF 2003)

Energy Model	Implicit Inverse Price Elasticity of Supply			
	2005	**2010**	**2015**	**2020**
NEMS	1.8	2.2	0.53	0.11
POEMS	2.4	1.8	2.5	1.8
CRA	3.5	2.5	1.1	0.9
NANGAS	5.4	7.0	7.6	5.1
E2020	1.5	1.0	1.0	0.7
MARKAL	na	2.0	na	2.1
NARG	8.7	12.4	5.6	2.4

NEMS (National Energy Modeling System); POEMS (Policy Office Electricity Modeling System), CRA (Charles River Associates), NANGAS (North American Natural Gas Analysis System), E2020 (Energy 2020), MARKAL (MARKet ALlocation), NARG (North American Regional Gas model)