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To: William R. Lloyd, Esq.; Pennsylvania Office of Small Business Advocate
From: Bob Knecht; Industrial Economics, Incorporated ("IEc")
RE: Comments on Fuel Switching Cost-Benefit Analysis
Date: March 11, 2010

Background

On January 7, 2010, Ms. Karen Moury, Executive Director, Pennsylvania Public Utility Commission ("Commission"), circulated an e-mail regarding a meeting held by the Fuel Switching Working Group held on January 6, 2010. The e-mail indicated that the Commission is considering whether fuel switching programs should be included as part of the energy efficiency and conservation ("EE&C") programs of the Pennsylvania electric distribution companies ("EDCs"). The e-mail further indicated that the Working Group believed that cost-benefit analysis of fuel switching programs would be useful to the Commission in making its evaluation. A committee ("Committee") of the Working Group was tasked to develop cost-benefit evaluations for five specific fuel switching programs.[1]

On January 26, 2010, Ms. Moury circulated what I understand to be the work product of the Committee. It included a January 25, 2010 letter from Mark Morrow, Esq. of UGI Utilities, Inc., to Ms. Moury; five undated MS Word summaries of the fuel switching programs evaluated; and nine MS Excel spreadsheets purportedly presenting the analysis prepared by the Committee.

OSBA requested that I provide comments on these materials. On February 11, 2010, I provided comments to the OSBA. Those comments were primarily general and methodological, and were based on an abbreviated review.[2] A detailed analysis of the specific numbers used by the Committee was deemed to be unwarranted for that assignment.

Subsequent to that memo, I reviewed the comments submitted by the other parties, I reviewed reply comments by Mark Morrow, and I participated in a conference call with the other parties. This memo updates my February 11 memo to incorporate this additional review.

Comments

1. **Perspective**

The Committee's memo begins with a perspective that electric generation involves substantial process energy losses. As a factual matter, this assertion is certainly true for fossil fuel and other thermal generating stations. The thermal efficiency (the ratio of useful electric energy out to thermal energy in) of a coal-fired generating station is generally less than 35 percent, and a combined cycle natural gas facility may achieve 50 percent. In

[1] A copy of Ms. Moury's explanatory e-mail is attached to the end of this memo.

[2] Mr. Morrow's letter invited Working Group participants to submit questions to Mr. Paul Raab, who prepared the analyses. I was unable to take advantage of this option within the scope of my assignment.

addition, some electric energy is lost in the transmission and distribution systems. (Natural gas is also both consumed and lost in the transmission and distribution processes.)

As an economic matter, these losses are irrelevant. Coal, nuclear, and wind energy resources cannot directly run air conditioners, water heaters, dryers, or home heating furnaces. In a cost-benefit analysis, the issue is incremental cost. For fuel switching from electric to gas, the correct comparison is whether the incremental cost of installing and using gas-fired equipment is less than the incremental costs associated with the electric equipment.

It can, of course, be argued that the use of natural gas imposes lower environmental externality costs on society than electric supply, and that these costs are not reflected in prices. For certain forms of electricity generation, this assertion may very well be true. However, Act 129 specifies the use of a total resource cost ("TRC") test for evaluating the economic efficiency of EE&C programs that does not consider environmental or other externality costs.

Mr. Morrow observes that a fuel-switching program must meet a threshold test of being an energy efficiency measure. Mr. Morrow's point is well-taken, but I am not qualified to comment on the legal standard. Moreover, I did not identify any analysis of overall energy savings in the materials provided by the Committee. Based on my limited review of the spreadsheets provided, no energy reduction analysis was included in the program tests. To the extent that Mr. Morrow's legal point is correct, there may be value in adding a lifecycle energy savings analysis for each program.

2. Incentives

The Committee's cover letter goes on to comment on program incentives for fuel-switching programs and the free-rider problem. A free-rider problem exists when customers are given incentives to participate in a utility-sponsored energy efficiency program when they would have made the same energy efficiency improvements without the incentives. The Committee opines that, the higher the incentives are as a percentage of program measure, the less likely is the free rider problem. I can neither agree nor disagree. Program incentives are set by program designers, and may very well be based on a rigorous analysis of the level of incentive necessary to obtain participation. However, other parties have expressed concerns that free-ridership is an issue, as many customers are converting to gas without any incentives. (See First Energy companies' comments at 3 and 5.)

On the other hand, because utilities can recover the costs of incentives from other ratepayers (and, under Act 129, face penalties if they do not get sufficient customers to participate), the incentives may simply all be set too high. Or the incentives may be targeted at programs that are the most cost-effective, in order to ensure that mandated energy reduction targets are met, despite the fact that customers are more likely to participate in the most effective programs without incentives.

More importantly, for the TRC test, the level of incentives is irrelevant. The incentive is an economic transfer from ratepayers who do not participate in the EE&C programs to those customers who do. The net TRC test cost of the incentive is zero.

The Committee prepared its analysis assuming that the incentive for residential programs equals 100 percent of the ratepayer cost of the conversion. The Committee appears to argue that because this incentive is set high, the free-rider problem is minimized. This argument is logically backward. Setting a high incentive does not mean there are no free riders. A high incentive may possibly be necessary if customers are not making economically efficient conversions from electric to gas with lower incentives. However, the Committee offers no evidence that more modest incentives would not be equally effective.

Setting incentives that high will (a) almost guarantee that free rider problems exist, because the incentives are likely set higher than they need to be to induce conversion, (b) create a large negative impact on non-participating ratepayers, and (c) make the fuel switching programs look quite attractive for participants relative to other options.

Since the analysis submitted by the Committee is prepared for a single customer, I think the issue of the incentive should be dropped. This will focus the comparison on the economics of the comparison, rather than who is paying for it. Such an approach would be consistent with the TRC test mandated by Act 129.

3. Alternatives Analyzed

As I understand it, the objective of this analysis is to inform the debate as to whether fuel switching programs should be components of EDCs' EE&C plans. It therefore would seem appropriate to prepare an analysis of the relative economic efficiency of fuel switching programs with other EDC EE&C options. If the fuel switching options are materially more economically attractive than other EE&C programs, an economic case can be made to include them in the EE&C plans.[3]

For the most part, the documentation from the Committee does not directly state what options the cost-benefit analyses are intended to compare.[4] However, in his reply comments, Mr. Morrow confirms that the examples presented are generally based on a comparison of standard efficiency gas appliances with standard efficiency electric appliances.

With Mr. Morrow's clarification, I conclude that the analysis is not useful as submitted. Specifically, the analysis presented by the Committee considers the cost of a standard efficiency electric appliance to be a *savings* associated with installing a standard efficiency gas appliance. I do not believe this is the relevant comparison. If a straight fuel-switching analysis is performed, it would be much more reasonable to consider the cost of a standard

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[3] I cannot comment on the legal requirements of Act 129. However, from a lay perspective, Act 129 mandates a reduction in electricity consumption, and does not impose a similar mandate on gas consumption. Moreover, energy efficiency gains typically involve the substitution of capital and labor for energy, wherein customers purchase new, more efficient and more expensive equipment to reduce energy costs. Finally, Act 129 mandates that an economic test be used to evaluate the programs. Because both substitution and energy efficiency are integral components of Act 129, a credible economic argument can be made that substitution to an alternative fuel is not inconsistent with the legislation.

[4] Mr. Morrow's letter indicates that the Micro-CHP program is compared to a standard efficiency furnace.

efficiency electric appliance to be a sunk cost, and therefore excluded from the analysis. A customer simply switching to gas would get little value from the existing appliance. (Citizen Power offers a similar conclusion, at 1.)

In the alternative, the Committee could consider comparing a high efficiency replacement gas appliance with a high efficiency replacement electric appliance. This comparison would be the type of comparison that a customer would make when a replacement appliance is required. In this case, the incremental cost of both the gas and electric appliance are relevant. In my view, such an analysis would better inform the debate, as it could show the advantages/disadvantages of gas relative to electric in comparison to actual analysis being performed by EDCs in their EE&C plans.

I recommend that the Working Group provide a clear explanation as to what options are being compared in the cost-benefit analysis. To the extent that standard efficiency options are compared, I recommend that the cost of standard efficiency electric appliances be considered sunk. I also recommend that the economics of the fuel switching option be (a) based on the adoption of high efficiency gas equipment, and (b) be compared to the next best all electric option. Furthermore, the comparison should be clear about what is assumed with respect to avoided electric equipment costs.

4. Alternative Benefits Tests

Rather than only providing the TRC test results (which is the metric mandated by Act 129), the Committee offers five other tests. For the most part, I do not believe that these tests provide useful information for evaluating fuel switching. They also appear to contain a variety of assumption and calculation errors.

Participant Test: This test compares the benefits and costs to the participant. The result of this type of analysis seems obvious without the need for a test, particularly with the incentive assumption used by the Committee. If a heavily-subsidized program is not economically attractive to the participant who receives the subsidy, it is most unlikely that the program will be economic on a TRC test basis.

Rate Impact Test: The impact of a fuel switching program on rates is not easy to calculate. By definition, fuel switching will reduce electric consumption and increase gas consumption. From the perspective of electric ratepayers, near-term rates will increase to (a) accommodate lost distribution revenue related to the downturn in consumption, and (b) pay for the incentives. Gas ratepayers may see a near-term rate decrease related to increased distribution revenues, if incremental distribution costs are not incurred. The Committee's analysis appears to address this complexity by assuming most of the problems away. The Committee does not appear to distinguish between marginal rates (i.e., the energy-related charges in utilities' tariffs) and marginal costs (i.e., the actual variable cost associated with utility supply). With these assumptions, the rate impact test should simply boil down to the cost of the incentive program, because marginal costs and marginal rates would offset. However, the Committee appears to have excluded increased marginal cost that the gas utility would incur as a result of the program, for reasons I do not understand and are not explained.

In general, I believe a rate impact test has some merit for evaluating actual EE&C programs. Many of these programs are economically efficient in aggregate (under the TRC

test), but involve significant transfers from non-participating ratepayers to participating ratepayers. However, for EE&C programs, the General Assembly did not require a rate impact test. Some protection for non-participating ratepayers is embodied in the provision that the EE&C program costs cannot exceed 2.0 percent of EDC annual revenues, although EDCs have virtually no incentive to keep total program costs below that cap.

Because I recommend that the incentive effect be excluded from this analysis, there is no particular value to including a rate impact test in this analysis. Furthermore, while a rate impact test may have merit, I do not believe that the version presented by the Committee is sufficiently accurate to add value.

Program Administrator Test: The program administrator test appears to be similar to the TRC except that it excludes costs borne directly by plan participants. I see little reason for ignoring the cost impact on plan participants when evaluating whether fuel switching is a reasonable conservation program. It is like looking at half of the economic equation.

Primary Fuel Utility Test: This test purportedly measures the impact on the EDC, comparing avoided costs to the incentive costs of the program. For example, Mr. Morrow says that this test when applied to water heaters "suggests that the costs incurred by EDC customers as a result of the proposed incentive will be greatly outweighed by the energy cost savings." Based on my interpretation of the analysis presented by the Committee, I do not believe Mr. Morrow's interpretation is correct. This test appears to demonstrate that when a customer is paid to convert to gas, the reduction in electric costs experienced by the EDC is greater than the cost of paying the customer to convert. This test appears to ignore the impact on EDC revenues, the impacts on the NGDC, and the impacts on the ratepayers. Based on my understanding, I see no relevance to this test.

Alternate Fuel Utility Cost Test: This test appears to simply measure the increased costs incurred by the gas utility. It also ignores revenue changes, impacts on the EDC and impacts on all ratepayers. As with the Primary Fuel Utility Test, I see no relevance to this test.

5. Analytical Assumptions

As noted earlier, I have not reviewed the analysis in detail. However, I make the following notes based on my limited review.

At least for the hot water heater and dryer analyses, the Committee appears to use 13.6 cents per kWh for electric service (both marginal rate and marginal cost), and $9.03 per mmbtu for natural gas in 2010. No citations support these values that I found in my limited review. Moreover, it appears that the electric rate increases by 135% in inflation-adjusted terms over 15 years, while the gas rate increases by 48%. (This differential appears to be related to an extraordinary jump in electric costs between 2019 and 2020, which is unexplained.) I am unsure why such a divergence between electric and gas rates is assumed.

Also, the Committee assumes that the cost of capital for both a utility and a customer are the same, at 9.0 percent nominal or 5.8 percent real. Neither assumption appears to be reasonable. Marginal utility costs of capital are likely to be below that figure, while marginal small business costs of capital are likely to be higher.

Summary

1. Philosophically, I believe that consideration of high-efficiency gas appliances as an alternative to electric appliances can have a place in an EE&C program. Act 129 mandates that the economic evaluation of options be based on the TRC test. The TRC test considers incremental actual costs, and it ignores offsetting transfers (e.g., the incentive paid by EDC ratepayers to participating customers). It should serve as the basis for evaluating fuel switching options. In addition, there may be merit in presenting specific information about overall energy savings based on lifecycle analyses, if an energy efficiency legal hurdle must be passed.

2. To the extent that the Commission does permit fuel switching as an option within EE&C plans, I do not believe that the Commission should either encourage or discourage fuel switching. Instead, each specific fuel switching proposal should compete against the other potential EE&C programs considered by the EDC. The competition should be based on the TRC test result for the fuel switching proposal in comparison to the TRC test results for each of the other potential EE&C programs.

3. Unless and until the legislature mandates some kind of social welfare test, neither the btus of fuel consumed nor the tons of carbon emitted are relevant to the analysis, except to the extent they are already reflected in incremental costs. Cost-benefit analyses should be based on actual costs and benefits, consistent with the TRC methodology.

4. In the TRC test, incentives are irrelevant, and I suggest that they be dropped from this analysis. Moreover, by setting the incentives at 100 percent of the participant's cost, the Committee's analysis may be inflammatory and counter-productive. To the extent that the Commission allows fuel switching programs, incentives should be established in the same way other EE&C program incentives are established. Preferably, these incentives would be limited to those necessary to get customers to participate.

5. I believe that the analysis would be more credible if cost-benefit comparisons were made between (economically efficient) high-efficiency options, not standard efficiency options. However, if the Committee determines that a standard-efficiency comparison will inform the debate, I recommend that the costs of standard efficiency electric equipment be considered sunk in the analysis.

6. The various tests posited by the Committee other than the TRC test do not appear to add value to the debate.

7. The parameters used in the analysis provided thus far are simplistic and appear to contain significant and unexplained biases in favor of the fuel switching option. Other participants have questioned certain assumptions (e.g., West Penn Power comments at 3). To inform the debate, the assumptions, parameters and risk factors should be clearly stated.

Recommendation to OSBA

The analysis available thus far from the Committee is not of sufficient quality and detail for me to conclude that fuel switching options should necessarily be part of an EDC's EE&C program.

However, as fuel switching is occurring without formal EE&C programs and without incentives, fuel-switching may very well represent a low-cost option for achieving the electricity

reductions mandated by Act 129. That is, if the economics are good enough for customers to switch from electric to gas with no incentives, additional electric reductions may be achievable with relatively modest incentives. Incorporating programs that require lower incentive costs could potentially reduce the inequitable socialization of costs inherent in the EDCs' EE&C plans. Assuming that fuel switching is determined to be a legal option for achieving Act 129 goals, I therefore recommend that the OSBA support EDC consideration of fuel switching options on a case-by-case basis, along with the other programs considered by the EDCs as part of their ongoing review of their EE&C plans.

Industrial Economics, Incorporated
2067 Massachusetts Avenue
Cambridge, MA 02140 USA
617.354.0074 | 617.354.0463 fax
www.indecon.com