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Memorandum

To: Bob Finkelstein, TURN

From: Gayatri Schilberg, Senior Economist, JBS Energy, Inc.

Date: 6/12/2012

Re: Overall Evaluation of Perfect Power Institute's "Investing in Grid Modernization"

As requested I am giving a quick review to the study by Perfect Power Institute (PPI), which ostensibly shows that Grid Modernization would provide benefits to consumers that exceed the investment cost by a factor of 3 or more. Based on my overview of the benefit calculations,[1] it appears that the benefits are grossly overstated and quite unrealistic, and the conclusion is therefore completely false and misleading. Major reasons are that 1) for half of the alleged benefits, the costs to achieve are not included but rather are assumed, 2) the calculations of some benefits are questionable, and 3) the reliability solutions experienced by a small municipal utility have only limited relevance to larger utilities with diverse service territories. Furthermore the validity of the assumptions made by PPI is likely to vary considerably depending on the type of utility and climate zone. Thus readers should be very cautious in expecting that the benefits claimed in the PPI study could be obtained cost-effectively if at all. I discuss several issues below, although there are many more details that could be addressed in a more comprehensive review.

A. Costs to Achieve are Not Included

1. Assumptions

PPI based the analysis on huge assumptions (p. 14 open markets for retail electricity and consumer choice, price transparency and access to dynamic pricing enabled by advanced metering, availability of real-time usage data, net metering as well as aggregation of customer meters, ancillary services payments). No costs were included

[1] Time prevented an examination of costs, with one exception discussed below.

to achieve these market features – rather the features were assumed to already exist.[2] In actuality, creating these market and data structures and features entails a huge investment, not the least of which is significant IT expenditure to administer accurately and securely huge volumes of data. Were such structures to be created, much of the benefit attributed by PPI to the "grid modernization" would instead already have been counted as a benefit of creating these features, to be weighed against their costs: market restructuring, advanced metering, real-time data and pricing, ancillary service payments. PPI counts benefits without the accompanying costs to achieve.

2. Savings due to Energy Efficiency

One of the largest components of "waste" is building consumption, that PPI claims can be remedied by conservation (p. 10). While this may be true, there is no link between the solution recommended, grid modernization, and the problem, leaky buildings and inefficient appliances. Grid modernization has nothing to do with energy efficiency and may even be detrimental to it in some cases.[3] One can advance energy efficiency through codes, standards and utility programs without spending on "smart grid," as California and other states have been doing for decades. The benefit of increased building efficiency should not be attributed to grid modernization unless the latter includes programs and costs associated with tightening the building envelopes and improving and replacing appliances. No such costs or programs have been included so there is no reason to include this large $90 billion benefit, equivalent to 60% of all energy lost in buildings (both commercial and residential), as the result of grid modernization (p.11). Even if building energy efficiency is economically cost-effective (and we believe that large amounts of efficiency are cost-effective), significant expenditures would be required to obtain this benefit.

3. Generation Efficiency

PPI notes that US fossil generation is roughly 35 percent efficient (p.30). With no substantiation, PPI expects that with customer choice, there will be a 50 percent improvement in efficiency, to 53% across the whole generation fleet, again accompanied by no cost to achieve this result. Furthermore it is not even clear how such a result would be technically achievable. It is quite a leap to think that customer choice, even if a significant portion of customers chose a 100% renewable supply, would result in the

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[2] I am reminded of the following joke: " A physicist, a chemist and an economist are stranded on an island, with nothing to eat. A can of soup washes ashore. The physicist says, "Let's smash the can open with a rock." The chemist says, "Let's build a fire and heat the can first." The economist says, "Let's assume that we have a can-opener..."

[3] See for example the discussion of how air conditioner efficiency and demand response are at least partially substitutes for each other in: TURNs' Opening Comments on Policy Issues on Time-Variant Pricing and Residential Rate Design, March 30, 2012 in A.10-08-005, p.43 (available at http://docs.cpuc.ca.gov/efile/RESP/163358.pdf).

massive transformation of the entire national stock of fossil-based generation! The savings of $200/year per household is completely without foundation, and not credible. (As discussed above, the costs to achieve customer choice, which underlies the assumption of generator efficiency, have not been included in this study either).

4. Ancillary Services

PPI estimates that customers could receive $140 per year per household due to providing electricity and ancillary services (p.24). Based on California experience, huge telemetry costs are necessary in order to provide the response necessary for ancillary services to the grid. These costs far exceed the potential benefit from revenue for residential and small business users. Any revenue that is obtained from providing energy services (demand response, etc.) is barely enough to compensate the customer for discomfort and the hassle factor of making behavioral changes. Furthermore, care must be taken that any benefit attributed to selling energy does not double count the benefits from demand response (peak reduction) programs and dynamic pricing.

5. Emission Reduction Credits

PPI's calculation of emission reduction credits contains the same problems as discussed above because costs are not included (creation of market in emissions, improvements in building and generation efficiencies). Thus the reduction in energy consumption upon which this calculation is founded has no basis.

B. Calculation of Benefits

Calculation of most benefits by PPI is done at an overall level with broad assumptions. Some assumptions, however, seem incorrect or inaccurate.

1. Savings from Dynamic Pricing

PPI expects annual benefits of $110 per household per year (p. 24) from dynamic pricing and peak shifting. The calculation by PPI of the benefit from dynamic pricing is questionable. The possibility to reduce peak load by 20% (p. 27) does not result in the reduction of electric bills by an equivalent percentage, because peak rates last for only a few hours per day (for TOU rates) or per month (for peak-time rates). PPI jumps from a result of 25% cost savings for a commercial customer with real-time rates (p. 27), to the assumption of a 10% cost savings for residential customers which is completely unsubstantiated. A result by Borenstein expects real time pricing to offer little reduction in overall energy use, and impact less than 5% of the energy bill (which is only about half of the electricity bill), with a significant cost to achieve for residential customers.[4]

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[4] NBER Reporter: Research Summary 2009 Number 1, Borenstein, S. "Electricity Pricing That Reflects Its Real-Time Cost."

By changing the rate design to dynamic rates, there will be winners and losers. It is not logical to expect all residential customers to be 10% winners on average,[5] and it is not reasonable to expect that all will respond to prices and realize benefits.[6] Furthermore the volatility of dynamic pricing can cause increased customer bills during peak months, possibly resulting in increased arrearages for low-income customers.

2. Participation

PPI asserts that "Consumers and innovators will respond to dynamic pricing signals, ancillary service payments and net metering for fair value and the new ability to easily interconnect and participate in electricity markets." (p. 23). This hope is not substantiated. For residential customers especially, electricity is not an end-use in itself but rather a means to an end. Thus customers are not that eager to monitor and respond to changes in electricity price if their comfort and end-uses are adversely impacted. Furthermore the amount of financial savings that is generally possible from dynamic rates is only a few dollars per month.[7] The majority of customers are simply too busy or disinterested to respond to these rates.

3. Avoided rate increases

Rates increase for many reasons – not only due to infrastructure spending. It is not reasonable to take as a benefit all avoided rate increases (p. 25).

C. Limitations of the Small Municipal Utility Example

1. A Contained Utility Service Territory

PPI discusses the reliability benefits obtained by Naperville, a small municipal utility (p. 12) serving a population of 141,200 in 38 square miles.[8] The methods used to improve reliability in that contained service area (undergrounding, redundancy, and switching) are very expensive ($1-2 million per mile for undergrounding).[9] These methods cannot

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[5] Winners will generally have a load shape that is more favorable than the class average.

[6] In a pilot by Pacific Gas & Electric company where customers could volunteer for the SmartRate program (where rates were higher during peak periods on peak days and lower during other times), 11% of volunteers who were covered by bill protection in 2011 were worse off under the dynamic rate. Freeman, Sullivan & Co., "2011 Ex Post Load Impact Evaluation of Pacific Gas and Electric Company's Residential Time-Based Pricing," (SmartRate and TOU) Draft, March 22, 2012, p. 40.

[7] Ibid, p. 39-40.

[8] http://www.naperville.il.us/demographics.aspx

[9] We note that undergrounding and redundancy are design elements that have been available for a long time and do not require implementation of a Smart Grid. Conversely, switching and other

reasonably be extended to utilities with more diverse service territories, especially rural areas with long spans that would be expensive to treat. Thus the promise of improving reliability by 50% (p. 32) is completely unsubstantiated and probably unattainable at a reasonable cost for larger utilities.

2. Undergrounding

PPI alleges that undergrounding can dramatically improve reliability (p. 22). As with so many things, there is both good news and bad news with this technology and overall it is not a panacea for reliability. Utilities in California underground new developments, and also have a program to underground certain lines for aesthetic reasons. San Diego Gas & Electric Company, which has 55% of its system underground, has found that outages caused by overhead sources are reduced by undergrounding (for example wind, trees), but once an outage occurs, it takes far longer to locate and repair the cable fault. Edison and PG&E found that underground (UG) cable generally has a shorter life than overhead. Furthermore early designs of UG cable[10] proved to be faulty, requiring early and expensive replacement of entire vintages of cable. Thus costs and possible reliability benefits must be carefully weighed, as California experience has not shown that undergrounding provides a cost-effective reliability net benefit.

3. Reliability from SmartGrid

TURN's analysis of PG&E's proposed Smart Grid improvements (particularly FLISR[11]) showed a potential for 14.9% improvement in SAIDI if the technology were concentrated in the poorly-performing circuit group.[12] Outside this group of problem circuits, the reliability improvement would be significantly lower.

A 50% overall improvement in a given utility's system SAIDI is questionable and highly unlikely at reasonable cost.

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elements of Smart Grid improvements can be done on the overhead system without expensive undergrounding.

[10] XLPE unjacketed cable.

[11] Fault Location Isolation and System Restoration. These devices operate automatically based on preprogrammed responses to specific events.

[12] TURN found that installing FLISR on PG&E's 400 worst-performing circuits would result in a system-wide 14.9% SAIDI improvement. See Direct Testimony of William B. Marcus and Gayatri M. Schilberg in A.08-05-023, dated July 17, 2009.

D. Summary of Benefits

PPI alleges $1200 per household/year in benefits from grid modernization. We have found $575 of these benefits[13] are not at all justified because no costs to achieve have been included. The $220 of dynamic pricing benefits and $400 of reliability benefits are grossly overestimated and only a small fraction is even achievable or likely. $150 of benefits due to avoided new capacity costs and reduced transmission and distribution losses we have not examined. We have also not examined PPI's costs of grid modernization, but the conclusion that the benefits are 3 to 4 times the cost is clearly not supported.

E. Results must be Interpreted on an Individual Basis

Many assumptions that PPI include do not necessarily hold true in various parts of the country. Each jurisdiction would need to assess the estimated savings and benefits based on their actual conditions, rather than those informing this report. For example, I compare the report's statements with California's experience:

- PPI bases conservation on 10% bill savings for customers who consume 11,000 kWh per year. In California, average use is around 7000 kWh. California's building and appliance standards already deliver a significant portion of the benefits that PPI attributes to Smart Grid – demonstrating that Smart Grid has little to do with efficiency.
- PPI quotes US average SAIDI as 240 minutes (p.31). For California utilities the SAIDI is much lower, 60-90 minutes, despite a significant number of rural customers. Incremental reliability improvements are harder and more expensive to obtain.
- On-peak prices are quoted as high as $200/mWh (p. 26). In California at present on-peak prices show little volatility, and are generally below 10 cents/kWh.[14] Thus expected gains from dynamic pricing will be minimal and difficult to realize.
- While it is true that in some areas the residential peak is later than the system peak (p. 27), supporting the view that residential customers could benefit somewhat from time-differentiated pricing, that situation varies by climate zone. In many areas, the residential AC load contributes significantly to the system

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[13] Benefit categories 6.1.1 (electricity consumption savings), 6.1.4 (improved generation efficiencies), 6.3.1 (revenue for providing electricity and ancillary services) and 6.3.2 (emission reduction credits).

[14] Robert Levin, DRA, "Time-Variant Pricing for California's Small Electric Consumers, May 2011, p. 20-21.

peak. Furthermore, the system peak in California (and other parts of the country) has been getting later as residential air conditioner saturation has been increasing. The trend could accelerate if more customers install behind-the-meter photovoltaic systems where energy production falls off after 5:00 pm.

F. Other Inaccuracies

1. Current Regulatory Environment

The authors allege that "the current regulatory environment does not account for the indirect or direct costs of outages, thereby limiting investment that could eliminate waste associated with power interruptions." (p. 12). This statement is false. In assessing distribution reliability during rate cases in California and other jurisdictions, additional distribution improvements and programs are weighed against their costs, to make sure that ratepayers derive sufficient benefit (in terms of reduced outages and lower maintenance) to equal the cost. "Benefits" of reduced outages are calculated both in terms of lost output and productivity (for commercial), willingness to pay or accept payment (for residential) as well as inconvenience cost.[15] Worker safety programs are implemented to reduce worker injuries and deaths. It is incorrect to maintain that these costs to society and the economy are not recognized in the current regulatory framework.

2. Costs

In general we do not intend to comment on the grid modernization costs. However having had experience in five regulatory cases in California where smart meters were requested, we note that PPI's cost of smart meters, at $20 per household per year for 8 years (p. 16 and 23), is vastly underestimated. Including the costs of installation, communications and back office support systems (to read the meters and administer bills), Southern California Edison was approved for twice that amount .[16] We have not investigated if the other costs have been so significantly underestimated.

The other point that must be made is that estimates related to the smart grid often understate the long-term cost of computer systems used to implement them. Given that these systems must be periodically "refreshed"– at even shorter intervals than the smart grid investments themselves-- computer systems are now becoming a significant source

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[15] See, for example, Freeman, Sullivan, &Co., "2005 Value of Service Study for Pacific Gas & Electric Company, December 14, 2005, filed in PG&E's 2007 General Rate Case.

[16] D.08-09-039, p. 16, SCE was approved $1.634 billion for AMI for its almost 5 million customers.

of burgeoning rate increases. Ongoing and careful vigilance is required to keep utilities from overspending in this area.[17]

[17] See, for example, Northwatch, Submission to Ontario Energy Board Regarding "Renewed Regulatory Framework for Electricity" (Consolidated dockets EB 2010-0377 *et al.*) April, 2012, pp. 13-15.