

**BEFORE
THE KENTUCKY PUBLIC SERVICE COMMISSION**

**In the Matter of the Consideration of the New Federal Standards
of the Energy Independence and Security Act of 2007**

Case No. 2008-00408

Testimony of
ROBERT J. CAMFIELD

January 12, 2009

2 **Q. Please state your name, title, and business address.**

3 A. My name is Robert J. Camfield. I serve in the capacity of Vice President for
4 Christensen Associates Energy Consulting LLC (“CAEC”), a wholly owned
5 subsidiary of Laurits R. Christensen Associates, Inc. My business address is
6 4610 University Avenue, Madison, Wisconsin, 53705.

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8 **Q. On whose behalf are you testifying?**

9 A. I am testifying on behalf of East Kentucky Power Cooperative, Inc. (“EKPC”)
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11 **Q. What is the scope of your testimony?**

12 A. EKPC has engaged CAEC to describe EKPC’s view and position on various
13 provisions of the Energy Independence and Security Act 2007 (“EISA 2007”).
14 The purpose of my testimony is to present to the Kentucky Public Service
15 Commission (“Commission”) EKPC’s perspective regarding EISA 2007, and
16 to assist the Commission in its deliberation of the issues identified in its Order
17 of November 13, 2008. The specific provisions of EISA 2007 that I focus on
18 include two new standards that are incorporated into the Public Utilities
19 Regulatory Policies Act of 1978 (“PURPA”) and one non-PURPA standard.

20 These are as follows:

- 21 • Consideration of smart grid Investments.
- 22 • smart grid Information.
- 23 • Incentives for recovery, use, and prevention of industrial waste energy.

1 **Q. What qualifies you to present testimony on the topics that you identify**
2 **above?**

3 A. I am an energy economist and my experience focuses mainly on wholesale
4 electricity markets, cost analysis and valuation, and regulatory economics.
5 The scope of my professional work includes asset valuation and cost of
6 capital, transmission pricing, electricity demand and load forecasting, cost
7 assessment, and wholesale contracts and negotiation. For major service
8 providers, I have assessed the benefits and costs of transmission expansion
9 plans, and prepared demand-side resource strategies that involve industrial
10 waste heat. I have served on forecast review committees, expert panels on
11 wholesale market design, and regional forecast groups.

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13 My clients include electric utilities, cooperatives, consumer advocacy groups,
14 regulatory agencies, municipalities, industrial customers of electric utilities,
15 law firms, commodity traders, electric industry associations, transmission
16 companies, generation companies, RTOs, distribution companies, and
17 industry research groups. I have testified and made appearances on behalf of
18 clients in evidentiary proceedings and other formal regulatory settings on a
19 range of topics including transmission congestion, corporate performance,
20 cost of capital and rate of return, cost escalation, power supply contracts, load
21 and energy forecasting, marginal costs and cost allocation, tariff design and
22 utility rate phase-in plans, cost benchmarking, and generation supply plans.

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24 My previous assignments include the assessment of demand-side strategies
25 and the management of electric and gas rate cases, contract terms for

1 renewable resources, power supply solicitations, and electricity market
2 restructuring in Central Europe. I have initiated or been involved in several
3 innovations including two-part tariffs for transmission services, web-based
4 self-designing retail electric products, marginal cost-based cost allocation
5 methods, and the development of principles for efficient pricing of
6 distribution services. I have served as a member of the economics committee
7 of the National Association of Regulatory Utility Commissioners and on an
8 advisory panel for EPRI. I have published reports, chapters in technical
9 books, and articles in noted journals such as *The Electricity Journal*, *IEEE*
10 *Transactions on Power Systems*, and the *Council on Large Electric Systems*. I
11 served as Program Director of the Edison Electric Institute's *Market Design*
12 *and Transmission Pricing School* 1999-2008. I have held the position of chief
13 economist for a regulatory agency, and system economist for a large,
14 integrated electric service provider. I hold a masters degree in economics
15 from Western Michigan University, and I am a graduate of Interlochen Arts
16 Academy.

17
18 **Q. Please summarize the conclusions of your review of the EISA 2007**
19 **standards and criteria, and recommendations regarding EIA Section**
20 **1307(a)(16) referred to as smart grid Investments?**

21 A. I recommend that the Commission not adopt a formal smart grid regulatory
22 review standard, as proposed. As an alternative, I would recommend that the
23 Commission consider establishing a collaborative process with the utilities
24 and other stakeholders to monitor smart grid developments, to identify
25 promising new technologies and concepts, and to potentially engage in pilot

1 programs on a voluntary basis that appear to offer net benefits. For this
2 discussion, positive net benefits refers to the condition where the prospective
3 cost savings for generation and transmission services are greater than the costs
4 of the technology including implementation, and the costs associated with the
5 risks and uncertainty of future net benefits.

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7 I believe there are several reasons favoring this alternative. First, smart grid
8 technologies and information systems consist of five major categories
9 including Sensing and Measuring, Advanced Control Methods, and Improved
10 Interfaces and Decision Support. The full envelope of smart grid technologies
11 discussed below are largely complementary to, rather than substitution for,
12 conventional power system equipment and facilities. Going forward,
13 conventional technologies will likely remain the central expenditure of power
14 delivery including transmission and distribution. Hence, a formal regulatory
15 review involving technology selection that implies technology substitution
16 possibilities is not necessarily applicable.

17

18 Second, power delivery facilities, as with generation, are indivisible in
19 capability and expenditure. This means that ongoing expansion of capacity
20 occurs in rather lumpy increments and, as a consequence, it is unlikely that
21 many opportunities where smart grid technologies substitute for conventional
22 technologies exist, although a known, working smart grid technology may
23 delay the deployment of a major conventional technology. As I mention, the
24 nature of smart grid investments are informational with a focus operations.

1 This is inherently more complementary to conventional technologies, than
2 substitutes.

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4 Third, evidence suggests that the Commission's current policy of monitoring
5 industry developments and voluntary adoption is working satisfactorily. The
6 smart grid envelope includes an array of electronic technologies, information
7 systems, and concepts that, as a whole, may potentially offer at some point
8 substantial benefits in the form of lower electric bills and improved reliability
9 for retail consumers. As these technologies reach fruition, EKPC and member
10 systems incorporate them into power delivery as necessary and appropriate.

11 As an example, EKPC and its members along with customers are putting forth
12 efficient market-based pricing programs that will utilize interval meters.

13

14 Fourth, smart grid technologies geared to reliability and, in particular, real-
15 time operations will increasingly need to operate across electric utility service
16 providers to realize effectiveness. In turn, such interoperability will require
17 regional solutions that will assuredly involve the various organization that,
18 together, comprise the Energy Reliability Organization (ERO). In short, smart
19 grid to a substantial extent will be regional in nature. In short, the net benefits
20 to local smart grid investments will likely be manifested outside the host
21 utilities territory.

22

1 Fifth, the burden of demonstrating, within formal regulatory processes before
2 the Commission, that occasional small scale investments in smart grid
3 technologies and concepts of one type or another provide net benefits is
4 substantial, for both the Commission and utilities.

5
6 Sixth, high resource costs, substantial siting limitations, and an increasingly
7 larger array of substitute possibilities available to consumers present utilities
8 with strong incentives to minimize total costs. As a result of the incentives
9 that are inherently present within today's energy markets with rising costs and
10 increasing range of potential substitutes, the Commission can be assured that
11 Smart grid technologies which provide positive net benefits will be adopted
12 by service providers where appropriate.

13

14 **Q. As you have discussed Section 1307(a)(17), smart grid Information, calls**
15 **for the Commission to consider requiring electric utilities to make**
16 **available, where practicable, time-based wholesale market price**
17 **information to retail consumers. What is your perspective and**
18 **recommendation regarding smart grid Information?**

19 A. The EISA 2007 provision of time-based price information, as contained in
20 Section 1307(a)(17), recognizes that the economic costs of power systems in
21 the short term can vary greatly according to time and location. This follows
22 from two key properties of power systems. First, electricity cannot be readily
23 stored, such that inventories cannot be used dampen the variation in marginal
24 costs over time. Second, the pattern of power flows within transmission

1 network follow physical laws. Accordingly, economic costs and wholesale
2 market prices can be highly differentiated among network locations. This
3 means that substantial cost savings and overall gains in market efficiency can
4 potentially be realized through marginal cost-based pricing programs,
5 including real time pricing and critical peak pricing, where load decreases
6 during high load and high cost periods can obtain major cost savings and
7 mitigate the need for capacity. To this end, EKPC and its member systems are
8 initiating a real time pricing pilot program, and have implemented a Direct
9 Load Control program. These programs provide retail consumers with
10 economic cost information for EKPC. These programs mitigate high costs
11 associated with near-term conditions, and incorporate relevant information
12 regarding economic cost and tight supply-demand balance. The programs
13 obtain market efficiency on the appropriate costs and conditions. In contrast,
14 wholesale market data is removed from the local markets served by EKPC.
15 Indeed, wholesale market prices, to a large extent, are driven by variation in
16 electricity demand of the Eastern markets, and may be much different in level
17 and variation of local economic costs. As a result, wholesale market
18 information may be highly inaccurate, if not misleading, vis-vis the costs of
19 the incumbent service provider, which is the relevant information. Second, it
20 is burdensome to consumers to receive information that is not relevant to
21 them, and it is also burdensome to service providers to present this
22 information. Therefore, I recommend that the Commission not adopt the
23 proposed Smart grid Information standard.

24

1 **Q. Would you please summarize briefly the provisions of EISA 2007 that**
2 **pertain to smart grid, with a focus on smart grid technologies?**

3 A. Yes. A quick summary of the provisions that are important in this proceeding
4 can be found in Appendix B of the Commission’s Order in Case No. 2008-
5 00408. One provision concerns the investment decisions of PURPA-covered
6 utilities: “Each state shall consider requiring, prior to undertaking investments
7 in non-advanced grid technologies, that an electric utility of the state
8 demonstrate to the state that the electric utility considered an investment in a
9 qualified smart grid system based on appropriate factors...” A second
10 provision requires that “All electricity purchasers shall be provided direct
11 access... to information from their electricity provider such as:
12 prices...usage... (and) sources” of electricity. Information is to be provided
13 “to the extent practicable”, according to EISA 2007. The underlying text for
14 these provisions can be found in Sections 1307(a)(16) and (17).

15
16 **Q. Does the EISA 2007 provide a definition of the term “smart grid”?**

17 A. Yes, Section 1301 of the EISA 2007 offers a set of ten points that provide a
18 definition of what the smart grid term encompasses. The definition consists of
19 *actions* by which the grid can be modernized, rather than *technologies* that can
20 be used to make the grid smart. Without enumerating them here, these actions
21 can be characterized as improving the control of grid operations in both the
22 energy supply and delivery and in end use efficiency by customers. Related
23 actions include development of uniform technology standards and reducing
24 barriers to adoption of new technologies, practices and services.

25

1 **Q. Is this a definition that is used universally?**

2 A. Not entirely, although it is well recognized. Some in the industry think about
3 the smart grid chiefly from the perspective of grid monitoring and
4 management. Others focus on the customer end, sometimes inappropriately
5 equating smart metering with the smart grid. Smart metering is, of course, just
6 one possible component of the smart grid.

7

8 **Q. If the Commission is to review investments in the smart grid by PURPA-**
9 **covered utilities, is there a reference for what constitute smart grid**
10 **technologies, either in EISA 2007 or elsewhere?**

11 A. EISA 2007 does not appear to be precise but it did create a smart grid Advisory
12 Committee and Task Force to facilitate such definition. Under the auspices of
13 the U.S. Department of Energy, the National Energy Technology Laboratory
14 (“NETL”) has begun a “Modern Grid Initiative” that has issued documents
15 providing information on smart grid technology.

16

17 **Q. How is this information categorized?**

18 A. The NETL classifies smart grid technologies into five categories. These areas
19 are 1) Integrated Communications, 2) Sensing and Measuring, 3) Advanced
20 Components, 4) Advanced Control Methods, and 5) Improved Interfaces and
21 Decision Support. The NETL sets out its classification in its paper “A Systems
22 View of the Modern Grid”, which includes appendices on these categories.

23

24 **Q. How does NETL characterize Integrated Communications?**

1 A. Integrated communications connects suppliers and users of electricity in a
2 national and rapid network. A key supporting element is uniform standards for
3 use by users, vendors and operators. NETL identifies one component of the
4 grid, substation automation, that aspires to the concept, thanks to a set of
5 standards developed by the International Electrotechnical Commission (IEC).
6 In contrast, no such standards exist for the user side in the areas of automated
7 meter reading or demand response or in distribution automation. Technologies
8 of interest include broadband over power line, wireless technologies (of which
9 NETL identifies nine types) and other technologies, notably Internet2, the next
10 generation of Internet communication and Fiber to the Home (“FTTH”).

11

12 **Q. What constitute smart grid technologies in the Sensing and Measurement**
13 **Category?**

14 A. These technologies record power flows or power information at all stages of
15 the electricity supply process. These include customer metering, wide-area
16 monitoring systems and dynamic line rating technology for the transmission
17 grid. (This last area includes measurement of line sag and current-carrying
18 capacity.) Also included in this category are advanced protection systems that
19 serve to conduct fault testing, for example. At the customer end, technologies
20 relate to residential customer networks and advanced metering are included.

21

22 **Q. What does the term “Advanced Components” encompass?**

23 A. This technology area includes such fields as power electronic devices such as
24 static VAR compensators, superconductivity technology, distributed generation,
25 distributed storage devices and complex systems such as micro grids.

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Q. What is included in “Advanced Control” methods?

A. This area consists of a set of distributed intelligent agents to manage power, analytical tools consisting of computer hardware and software for information processing and operational applications such as outage management.

Q. Lastly, how does NETL describe “Improved Interfaces and Decision Support”?

A. This category, with the acronym IIDS, includes technologies that improve grid “visualization” and decision support. These can include software and controls that provide information to decision makers charged with system management. The theme of this technology area appears to be information synthesis.

Q. How would you characterize the development state of these various technologies?

A. Generally, it appears that for all categories, the technologies are at uneven stages of development, with some being in their infancy and rapid change occurring in some areas and little development in others. In one case the NETL laments the absence of funding in some areas of transmission grid information technology.

That smart grid technologies, at least with the exception of interval metering, is largely developmental is evidenced by Section 1304(b)(4) where the law states “...The Secretary shall establish a smart grid regional demonstration initiative...” and again in Section 1305(a) where the law states “...The

1 Director of the National Institute of Standards and Technology shall have
2 primary responsibility to coordinate the development of a framework that
3 includes protocols and model standards for information management to achieve
4 interoperability...”

5

6 **Q. What do you infer from the state of the technology at present, for**
7 **purposes of evaluating how the Commission should proceed?**

8 A. Smart grid technologies are undergoing rapid advance. Investment in new
9 technologies during times of rapid technological and institutional change
10 harbor comparatively high risks associated with potential net benefits. An
11 investment of latest technology complementing conventional technology may
12 appear to offer positive net benefits. However, it may also be the case that the
13 technology in question could be superseded by an improved technology in the
14 not too distant future. Alternatively, the technology might appear promising
15 but unproven.

16

17 In brief, it is unusually difficult to gauge, after the fact, whether or not benefits
18 outweigh the costs, where the benefits are based on the expected value of the
19 potential outcomes. Results may not be available for several years. Even then,
20 utilities and regulators would seemingly need to construct the counter factual
21 case of what the outcome, measured as total system costs, would have been
22 under conventional technologies. While the utility must evaluate such issues
23 on a regular basis, it would be difficult to accurately gauge results in a
24 systematic, consistent and timely review by regulators.

25

1 **Q. Would you please provide the Commission with EKPC's perspective on**
2 **industrial waste heat?**

3 A. Yes. Industrial waste heat refers to investment actions and technologies that
4 capture heat produced by industrial manufacturing processes to generate
5 electricity. As a general rule, the industrial sectors that utilize energy most
6 intensively are also the sectors with the greatest potential for waste heat
7 capture. These industries include chemicals, food process, petroleum, forecast
8 products, and primary and secondary metals. It is commonly recognized that,
9 because of inherent thermal inefficiencies, only a modest share of the energy
10 input is utilized within the industrial process. The remainder is lost to the
11 atmosphere and, for years, industries have attempted to capture and recycle
12 heat. This involves a number of well known technologies such as mechanical
13 and thermal compression, condensing economizers, heat pumps, and
14 cogeneration for electricity. Nationally, a longstanding successful application
15 is the combined heat and power facilities on university campuses. Also,
16 pumping stations of pipelines can be attractive sites for waste heat capture for
17 electricity generation.

18
19 Generally speaking, the recapture of heat for electricity generation is focused
20 on the use of hot exhaust gases where temperatures may be in excess of 700
21 degrees. My experience demonstrates that economically attractive applications
22 of waste heat capture for power generation are highly specific to the host
23 technology and site characteristics. The commercial arrangements underlying
24 waste heat capture for electricity can vary. Technology vendors may be the
25 investors that install the facility at the host site and claim the electricity output,

1 which is then is sold to the incumbent electric utility or within wholesale
2 electricity markets. The host is compensated for its heat input to the process.

3

4 EKPC encourages industrial waste heat recapture for electric power generation
5 and, in fact, has a cogeneration tariff in place. Consequently, EKPC does not
6 recommend the adoption of the proposed industrial waste heat standard. EKPC
7 may be well positioned to assist the State of Kentucky identify potential waste
8 heat sites in its service territory.

9

10 **Q. Does this conclude your testimony?**

11 A. Yes, it does.