STATE OF IOWA
BEFORE THE IOWA UTILITIES BOARD

IN RE: INTERSTATE POWER AND LIGHT COMPANY	))))))	DOCKET NO. RPU-2017-0001

REBUTTAL TESTIMONY
OF
PAUL CHERNICK

On Behalf of

Environmental Law & Policy Center, Iowa Environmental Council,
Natural Resources Defense Council, Vote Solar, and Solar Energy Industries Association

Resource Insight, Inc.

September 8, 2017

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I. INTRODUCTION

Q: Are you the same Paul Chernick who filed direct testimony in this proceeding?

A: Yes.

Q: What is the subject of your testimony?

A: I respond to the rebuttal testimony of Interstate Power and Light (IPL) witness David Vognsen. Specifically, I address the following topics:

- Mr. Vognsen's failure to substantively respond to my critique of IPL's proposed demand-rate pilots.
- Additional data from Mr. Vognsen's reply testimony that undermines his rate-design proposals.
- IPL's failure to provide even the most fundamental data necessary to develop a residential or small-commercial demand rate.
- Apparent errors in IPL's discussion regarding line losses.

II. VOGNSEN REPLY TESTIMONY

A. Failure to Respond to my Critique

Q: What did Mr. Vognsen say about your testimony, in his rebuttal testimony?

A: The only substantive reference to my direct testimony is the following:

> Mr. Chernick provides no IPL-specific cost or load data to support any of his conclusions regarding demand rates. Mr. Chernick seems to be arguing against the Board rules pertaining to ratemaking in which generation, transmission, and distribution cost allocations are on a demand basis as previously mentioned in this testimony. Mr. Chernick has chosen to ignore the data that supports IPL's CCS and rate designs as well as the impact that customer load factors have on costs. In general, EI, through its witnesses Chernick and

> Rábago, provides no data or cost support for any of its claims or criticisms. (IPL Exhibit Vognsen Rebuttal at 46)[1]

I see two points in Mr. Vognsen's response. First, he seems to be under the impression that my direct testimony argued "against the Board rules pertaining to ratemaking in which generation, transmission, and distribution cost allocations are on a demand basis." Second, Mr. Vognsen asserts that I have not provided "IPL-specific cost or load data to support any of [my] conclusions regarding demand rates." Both these points are incorrect and misleading.

Q: Did you dispute the Board rules pertaining to allocating costs on a demand basis, as Mr. Vognsen asserts?

A: No. I do not know how he reached that conclusion. My direct testimony did not argue with any portion of IPL's cost allocation, let alone with the Board's underlying rules.[2] In fact, my direct included an entire sub-section (IV.D) explaining that allocation of costs on class demand does not require that those costs be collected through demand charges. In fact, time-of-use energy rates can more accurately reflect the demand-related costs than would the legacy demand-charge that Mr. Vognsen proposes. My direct testimony is more supportive of recovery of demand-related costs from usage at the times of high loads than is Mr. Vognsen's misguided demand-charge proposal.

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[1] Mr. Vognsen repeatedly refers to me as "Mr. Chemick." In quoting from his Rebuttal Testimony, I have corrected those errors.

[2] Mr. Vognsen did not cite to specific rules, and I have not attempted to determine what rules he might have in mind.

Q: Did you cite any "IPL-specific cost or load data" to support your conclusions?

A: Yes. I discussed the timing of the loads that drive IPL's generation and transmission costs, at pages 15–19 of my direct testimony.

Q: Have you requested that IPL provide additional "IPL-specific cost or load data" that would be relevant to the value of demand charges?

A: Yes. I asked IPL for IPL-specific cost and load data, and was told that IPL did not have, or would not provide, that data, as in the following examples:

- IPL declined to provide the date and time of the annual peak MISO, MISO LRZ 3 (Iowa) or Interstate Power and Light. (IPL Response to EI DR 73, attached as Ex. PC-4)
- IPL failed to reconcile the three different estimates of non-coincident peak loads by class in three different IPL documents. (IPL Response to EI DR 81, attached as Ex. PC-5)
- IPL was not able to reconcile the sales values provided in IPL Response to IBEC DR 4c with those used elsewhere in this docket. (IPL Response to EI DR 83, attached as Ex. PC-6)
- IPL was not able to provide any workpapers showing how the load shapes for the load-research strata were computed and aggregated. (IPL Response to EI DR 80c, attached as Ex. PC-7)[3]

[3] IPL does not use the common consumption-based strata, which insure that the load research accurately measures and reflects the load shapes of all groups of customers, which in the case of residential customers might range from small apartments using less than 300 kWh/month to large single-family homes using over 2,000 kWh/month. Instead, IPL uses five bins: four representing the

- IPL was unable to print, export, or otherwise provide the hourly load shapes of the customers metered in the load-research sample. (IPL Response to EI DR 80e, f, attached as Ex. PC-7)
- IPL does not know when its substations or feeders peak, so it cannot determine what sort of load shifts would increase or decrease need for distribution upgrades. "IPL has limited data on its distribution substations and feeders, which is one of the major drivers for its grid modernization effort. IPL knows the time of the coincident peak on its system for 2016 as 1700 hours on July 21, 2016. The non-coincident peak is known for a few circuits only for dates but not times." (IPL Response to EI DR 90b, c, attached as Ex. PC-9)

Q: Has Mr. Vognsen provided any "IPL-specific cost or load data" that demonstrates that demand charges would encourage customers to take actions that would reduce system costs, or otherwise benefit IPL's customers as a whole?

A: No. His rebuttal is entirely data-free on these topics. He does not even speculate on the ways in which customer load shapes would change in response to demand charges, let alone provide any evidence that those changes are likely.

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combinations of customers using more or less than 1,000 kWh/month in the summer, and those using more or less than 700 kWh/month in the winter. (Attachment A to EI DR 80, attached as Ex. PC-8), plus one for the 24 customers using more than 8,000 kwh/month. It is not clear whether IPL has accurately modeled the usage pattern of the class.

Q: In response to EI DR 99a, attached as Ex. PC-10, Mr. Vognsen asserts that "Demand rates have been proven to improve customer class load factors. IPL's load research reports demonstrate that the rate classes with demand rates have better overall load factors than the classes that do not have demand rates." Is his assertion correct?

A: No. It is hardly surprising that shopping malls, hospitals, and factories have higher load factors than residential and small general-service customers. That is a function of their hours of operation and the composition of their end uses. Mr. Vognsen does not demonstrate that demand charges produce higher load factors on class peak or on system peak, even compared to flat energy rate, and certainly not compared to time-of-use energy rates.

The data provided in IPL's response to IBEC DR 4 (Attachment 4C), attached as Ex. PC-11, show that the residential monthly load factor on system peak varies from 44% in September to 102% in October. Table S 1 shows that the load factors for the classes without demand meters sometimes exceed those of classes with demand meters, depending on weather and customer operations.

Table S 1: Class Load Factors on System Peak, by Month

	Res	GS	LGS	LV	Bulk
January	70%	94%	93%	89%	96%
February	60%	90%	90%	91%	102%
March	67%	70%	79%	98%	91%
April	86%	55%	80%	97%	101%
May	62%	63%	83%	90%	113%
June	59%	62%	84%	96%	99%
July	46%	64%	100%	104%	97%
August	55%	59%	81%	120%	104%
September	44%	56%	82%	99%	99%
October	102%	61%	74%	95%	95%
November	64%	90%	90%	99%	112%
December	68%	90%	90%	90%	93%

Q: How important is data in determining whether demand charges are likely to have any benefit to IPL customers as a whole?

A: Since IPL cannot provide much data on customer load shapes, it is fortunate that the Board does not need much data to understand that the demand charges will encourage customers to shift load off their individual peaks, into other hours, which may be the peak hours (or other important high-load hours) for the generation system and for the transmission lines and distribution equipment that serve the customer's area. If IPL tells customers they can reduce their bills by shifting loads off their individual monthly peak, regardless of where they shift loads, customers are likely to make those shifts.

As Mr. Vognsen says:

> This optional rate is designed to encourage customers to not only control their demand, but utilize energy more efficiently. IPL believes that, similar to IPL time-of-use rates, customers will adapt their behavior to demand rates in the pilots to save on their electric bills. Naturally, IPL will provide customer support, tools, and education in support of the optional tariffs by providing customers information about how demand rates work and how the customer can take advantage of them. (Vognsen Rebuttal p. 45)

So Mr. Vognsen expects customers on the pilot demand rate to shift load in response to the demand charge, and that IPL and the pilot participants would expend considerable effort and expense to achieve that shift. Participants would have no incentive to shift usage out of hours that impose high costs on the system, unless those hours were likely to represent the customer's monthly maximum demand. Businesses that usually see a surge of load in the early morning, as their air conditioning comes on and employees turn on lights and other equipment, would have an incentive to delay the start-up of some equipment to later in the day, when it may contribute more to the system peak and T&D equipment overloads. A restaurant that experiences its maximum load in the evening may move some air conditioning, ice-making, oven heating, and other loads into the late afternoon, onto the system and T&D peaks. Residential customers who would normally experience their maximum loads in the evening could cut their demand-charge by setting their air conditioning to come on at 4 or 5 PM, on the summer peaks.

Mr. Vognsen does not present any evidence regarding the timing of the individual customer peaks, and IPL indicated that it does not know how to retrieve that information. (Ex. PC-7) As I noted in my direct testimony, IPL has no plans to monitor the changes in customer load shapes in response to demand charges, so IPL may be no wiser about customer load shapes or the effects of demand charges after the pilots than it is now.

The limited load data that IPL provides in Attachment IBEC 4c shows that many customers do not reach their individual maximum loads at the class or system peak hours, so there is considerable opportunity for customers to reduce their demand billing by shifting load onto higher-cost hours. For example, in August 2016, IPL estimates that the residential class had individual maximum loads totaling 2,019 MW, but the class maximum demand was 995 MW and the class contribution to the system peak was 870 MW. For general service, the estimated August 2016 sum of customers maximum demands was 1,005 MW, the class peak was 555 MW, and the contribution to system peak was 531 MW. Unfortunately, IPL cannot provide any greater detail on customer load data.

Q: Does Mr. Vognsen's rebuttal testimony demonstrate that the demand-charge pilots are likely to have any benefit, or that any of your explanation of the shortcomings of demand charges are incorrect?

A: No. He does not refute my explanation of the flaws of demand charges, or the inefficient price signals they give to customers.

Q: Has IPL explained what it hopes to accomplish with the demand charges?

A: No. IPL was unable to answer any of the following questions about the purpose of the demand-charge pilot (IPL Response to EI DR 99a, b, c, attached as Ex. PC-10):

- Does IPL hope to reduce demands in certain hours of certain months, and if so, which ones?
- Does IPL hope to reduce IPL's load coincident with the MISO peak load, the LRZ-3 peak load, or something other hour critical to the generation and/or transmission system?
- Does IPL hope to reduce peak loads on transmission lines, substations, feeders, line transformers, or other equipment?

Strangely enough, even though a pilot program is an experiment or test, by definition, IPL denied that the demand-charge pilots were experimental. (IPL Response to EI DR 99a, attached as Ex. PC-10).

B. IPL's Estimates of Line Losses

Q: Does Mr. Vognsen demonstrate that Mr. Rábago is incorrect in stating that line losses fall as loads fall?

A: No. The only information that IPL has provided regarding its line-loss computations are the response to EI DR 84, attached as Ex. PC-12, and Vognsen's Reply Schedule N. These documents are identical and thus share the same two problems.

First, IPL fails to provide a comprehensible description of its derivation of line losses. These two documents show estimates of peak distribution line losses, in percent and in MW, and average energy line losses in percent and in MWh, for four levels of equipment (distribution substation transformers, primary distribution lines, line transformers and secondary lines). The amount of the losses (in MW and MWh) are said to be "calculated," apparently from the percentages. The loss percentages appear to be stated as a percentage of total load (not the load on the particular level of equipment), although that is difficult to determine, since IPL does not define what the percentages mean and some of the values are rounded off to just two significant figures. Engineering computations of line losses would be based on the load on each level of equipment, which would vary for two reasons:

- The losses on the equipment closer to generation result in less power flowing through the equipment closer to the customers.
- Not all customers are served through utility-owned transformers and secondary lines.

Hence, taken at face value, these documents indicate that IPL estimated losses as a percentage of load at the transmission level, without an engineering analysis of the load on the various types of equipment. This is curious, at best.

Second, both documents indicate that the energy losses were estimated using a loss factor computation, in which the average losses in MW over the load curve are estimated as peak losses in MW multiplied by a loss factor:

$$\text{Loss factor} = a \times \text{LF} + (1 - a) \times \text{LF}^2$$

IPL estimates the empirical *a* factor as 0.1, and does not state the load factor it used.[4] Since IPL provides the peak and energy (annual MWh) values for its analysis, we can compute the load factor as:

$$12{,}824{,}338 \div (2{,}436 \times 8{,}760) = 60.1\%$$

Hence, the loss factor would be:

$$0.1 \times 0.601 + 0.9 \times 0.6012 = 38.51\%.$$

Applying this loss factor to the estimated total peak losses of 74.41 MW would produce average losses of 28.7 MW, or 251,000 MWh over the 8760 hours of the year, about 63% of the energy losses that IPL claims. These energy losses would be a bit less than 2% of the total energy, not the 3.09% that IPL reports. This result would support Mr. Rábago's observation that percentage losses increase with load and decrease if load is decreased.

[4] I have seen somewhat higher values of *a* in other examples (e.g., 0.15), but the exact value depends on the load shape and will vary among utilities or other applications.

Q: Is Mr. Vognsen correct in any of his statements about line losses?

A: He is correct that losses in the transformer cores (so-called "iron" losses, even though transformer cores are now alloys designed to minimize losses) are fixed with respect to load. In addition, transformers have a lot of copper windings on the primary side to magnetize the core and on the secondary side to be energized by the core's magnetic field.

Those copper windings—along with mostly aluminum conductors in primary feeders, secondary lines, and service drops (collectively called "copper" losses)—experience line losses in proportion to the square of the power flowing through them. This is among the most elementary concepts of electrical engineering.[5] That load-squared relationship is embedded in, and dominates, Mr. Vognsen's loss-factor equation. Yet Mr. Vognsen asserts that "[t[he copper losses actually decrease as loading on the transformers increase." (Vognsen Rebuttal at 32) This claim is incorrect. Conductor losses (in the transformers, the wires and cables, and other equipment) not only increase as loading increases, they increase much faster than load.

Q: Does this conclude your rebuttal testimony?

A: Yes.

[5] The energy lost as current flows through a conductor equals the current × the voltage drop along the conductor. The voltage drop, by Ohm's law, equals the current × the resistance. So the losses equal resistance times current squared (I^2R).

STATE OF MASSACHUSETTS)
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COUNTY OF MIDDLESEX)

I, Paul Chernick, being first duly sworn on oath, state that I am the same Paul Chernick identified in the testimony being filed with this affidavit, that I have caused the testimony and exhibits to be prepared and am familiar with its contents, and that the testimony and exhibits is true and correct to the best of my knowledge and belief as of the date of this affidavit.

/s/ Paul Chernick

Paul Chernick

Subscribed and sworn to before me this 8th of September, 2017.

/s/ Dianne J. DeMarco

Notary Public in and for the State of Massachusetts