STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

VERIFIED PETITION OF SOUTHERN INDIANA GAS AND ELECTRIC COMPANY D/B/A VECTREN ENERGY DELIVERY OF INDIANA, INC. REQUESTING THE INDIANA UTILITY REGULATORY COMMISSION TO APPROVE CERTAIN DEMAND SIDE MANAGEMENT PROGRAMS AND GRANT COMPANY AUTHORITY TO RECOVER COSTS, INCLUDING PROGRAM COSTS, INCENTIVES AND LOST MARGINS, ASSOCIATED WITH THE DEMAND SIDE MANAGEMENT PROGRAMS VIA THE COMPANY'S DEMAND SIDE MANAGEMENT ADJUSTMENT	**)**	**CAUSE NO. 44927**

DIRECT TESTIMONY AND EXHIBITS OF ELIZABETH A. STANTON, PHD, ON BEHALF OF CITIZENS ACTION COALITION OF INDIANA, INC.

Direct Testimony of Elizabeth A. Stanton, PhD
On Behalf of Citizens Action Coalition of Indiana, Inc.
Cause No. 44927
July 26, 2017

I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Elizabeth A. Stanton. I am the Director and Senior Economist of the Applied Economics Clinic, a non-profit consulting group housed at Tufts University.

Q. Please describe the Applied Economics Clinic.

A. The Applied Economics Clinic provides expert testimony, analysis, modeling, policy briefs, and reports to public interest groups on the topics of environment, consumer protection, and equity. The Clinic also serves to train the next generation of expert technical witnesses and analysts by providing applied, on-the-job training to graduate students in related fields and working proactively to support diversity among both student workers and professional staff. The Applied Economics Clinic began operations in February 2017.

Q. Please describe your professional background and experience.

A. I am a researcher and analyst with more than 16 years of professional experience as a political and environmental economist. I have authored more than 120 reports, policy studies, white papers, journal articles, and book chapters on topics related to energy, the economy, and the environment.

In my previous position as a principal economist at Synapse Energy Economics, I led studies examining environmental regulation, cost-benefit

analyses, and the economics of energy efficiency and renewable energy. I have submitted expert testimony and comments in Illinois, Vermont, New Hampshire, Massachusetts, and several federal dockets. My recent work includes extensive analysis of the EPA's proposed Clean Power Plan, critiquing the analyses used to support a flawed valuation method for nuclear power plants, developing testimony on Global Warming Solutions Act (GWSA) compliance for the Massachusetts Departments of Energy Resources and Environmental Protection, and analysis of the need for new gas pipelines in New England and the U.S. Southeast.

Prior to joining Synapse, I was a senior economist with the Stockholm Environment Institute's (SEI) Climate Economics Group, where I was responsible for leading the organization's work on the Consumption-Based Emissions Inventory (CBEI) model and on water issues and climate change in the western United States. While at SEI, I led domestic and international studies commissioned by the United Nations Development Programme, Friends of the Earth-U.K., and Environmental Defense.

My articles have been published in Ecological Economics, Renewable Climatic Change, Environmental and Resource Economics, Environmental Science & Technology, and other journals. I have also published books, including *Climate Change and Global Equity* (Anthem Press, 2014) and *Climate Economics: The State of the Art* (Routledge, 2013), which I co-wrote with Frank Ackerman. I am also coauthor of *Environment for the People* (Political Economy Research Institute, 2005, with James K. Boyce) and co-editor of *Reclaiming*

Nature: Worldwide Strategies for Building Natural Assets (Anthem Press, 2007, with Boyce and Sunita Narain).

I earned my Ph.D. in economics at the University of Massachusetts-Amherst, and have taught economics at Tufts University, the University of Massachusetts-Amherst, and the College of New Rochelle, among others.

My professional resume is attached as Attachment EAS-1.

Q. Have you testified previously before the Indiana Utility Regulatory Commission ("Commission" or "IURC")?

A. Yes. I have submitted pre-filed testimony in the currently pending Cause Nos. 43955 DSM 4 (Duke 2018-2020 DSM) and 44872 (NIPSCO CCR).

Q. On whose behalf are you testifying?

A. I am testifying on behalf of Citizens Actions Coalition of Indiana, Inc. ("CAC").

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to provide my expert opinion as to whether or not Southern Indiana Gas & Electric Company's dba Vectren Energy Delivery's ("Vectren" or "the Company") 2017-2019 energy efficiency plan meets the definition of "energy efficiency goals" and is reasonable under Indiana Senate Enrolled Act 412 (2015), which has been codified under Ind. Code § 8-1-8.5-10. I have concluded Vectren's plan should be rejected as unreasonable. It is my opinion that Vectren's 2016 IRP, including Vectren Witness Stevie's inputs provided for the IRP, does not provide an optimal balance of energy resources that "can only result[] from a well-developed and reasoned IRP that evaluates the appropriate balance of new supply-side and demand-side resources taking account

of risks and uncertainty." Cause No. 43955 DSM 3, Final Order at 45; *see also* Final Order, Cause No. 44634 at 34.

Q. Are you submitting any attachments?

A. Yes. Attachment EAS-2 is an update to the report written by myself and CAC Witness Anna Sommer, which was previously submitted to the Commission through the Vectren IRP stakeholder process on April 17, 2017.[1] This document is now completely public. Our report comments on a 2015 working paper by Richard Stevie entitled "Energy Efficiency Program Costs, Program Size, and Market Penetration"[2] and debunks his claim that there is evidence of "higher energy efficiency market penetration leading to higher efficiency costs."[3] Instead, we show that there is no reliable evidence to support such a claim and that "[i]mplementing Stevie's suggestions would lead utilities to the selection of less energy efficiency than is optimal."[4]

Q. Please summarize your conclusions and recommendations.

A. Vectren's 2016 IRP, specifically as it relates to DSM cost projections, depends heavily on an analysis performed by Vectren Witness Stevie. Vectren Witness Stevie's projected increase in future energy efficiency costs is based on faulty data, an incorrect interpretation of statistical results, and a deeply flawed application of those results to predicted costs.

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[1] The original submission can be found here as Attachment A: http://www.in.gov/iurc/files/Vectren%202016%20IRP--Public%20Comments%20by%20CAC%20et%20al--4-17-17.pdf.
[2] Petitioner's Exhibit No. 2, Attachment RGS-2.
[3] Attachment EAS-2 at 1.
[4] *Id.*

Because Vectren's 2016 IRP depends so heavily on Vectren Witness Stevie's flawed cost projections, Vectren cannot demonstrate that its 2016 IRP arrives at an optimal balance that "can only result[] from a well-developed and reasoned IRP that evaluates the appropriate balance of new supply-side and demand-side resources taking account of risks and uncertainty" pursuant to Ind. Code § 8-1-8.5-10(c). Cause No. 43955 DSM 3, Final Order at 45; *see also* Final Order, Cause No. 44634 at 34. I recommend against using these findings as they are inadequate and unreasonable,[5] given that (as Vectren Witness Stevie acknowledges) no useable prediction of the impact of efficiency market penetration on program costs exists. Instead, I suggest that the correct assumption to use in IRP modeling is that inflation-adjusted efficiency costs remain constant (in real, inflation-adjusted terms) over time.

[5] Ind. Code 8-1-8.5-10(j) states that under the overall reasonableness evaluation of a Plan, the Commission must consider, among other items, "Comments provided by customers, customer representatives, the office of utility consumer counselor, and other stakeholders concerning the adequacy and reasonableness of the plan, including alternative or additional means to achieve energy efficiency in the electricity supplier's service territory" and "The electricity supplier's current integrated resource plan and the underlying resource assessment."

II. FAILURES AND LIMITATIONS IN VECTREN'S 2016 IRP DUE TO VECTREN WITNESS STEVIE'S UNDERLYING DSM COST ASSUMPTIONS.

Q. Have you reviewed the testimony of Richard Stevie marked as Petitioner's Exhibit 2?

A. Yes, I have reviewed Vectren Witness Stevie's testimony and attachments.

Q. On pages 13-17 of Petitioner's Exhibit 2, Vectren Witness Stevie explains Vectren's rationale for limiting incremental energy savings to 2 percent of eligible retail sales per year. Please summarize this rationale.

A. Vectren Witness Stevie states that—based on various studies of energy efficiency potential—Vectren chose 40 percent of eligible retail sales for additional cumulative efficiency savings (starting in 2018) as the total amount of DSM available or possible to then be an input into Vectren's 2016 IRP. He offered that 2 percent of eligible retail sales per year, starting in 2018, adds up to 40 percent of eligible retail sales in total over 20 years:

> *Vectren South chose to make up to 2% of eligible retail sales as DSM resource options available for selection in the IRP process for each year beginning in 2018. This represents almost 40% of eligible retail sales, far above estimates of even technical market potential.)*[6]

Q. Do you agree with Vectren's rationale for limiting incremental energy savings to 2 percent of eligible retail sales per year, as described by Witness Stevie?

[6] Petitioner's Exhibit 2 at 17.

A. No. The way in which Vectren slowly adds 2 percent per year to eventually reach the 40 percent maximum is unreasonable, and Vectren Witness Stevie's testimony presents no reasoning behind this slow pace of adoption as an input into Vectren's 2016 IRP. Two percent incremental savings per year is not the only way to add up to 40 percent additional cumulative savings over time. If Vectren believes that an additional 40 percent cumulative energy efficiency savings is available and that energy efficiency has the potential to lower customer costs (in comparison to generation alternatives), then I can see no reason for slowly adding 2 percent per year to eventually reach the 40 percent maximum.

Logically, Vectren should offer as much energy efficiency into its IRP as it can each and every year, with the goal of reaching and exceeding 40 percent efficiency savings (and getting maximum cost savings to customers) as quickly as is feasible. By spreading out the 40 percent efficiency savings equally over the twenty years, Vectren has created an annual ceiling and an artificial, equal division of savings by year. If there is some other rationale for limiting incremental efficiency savings to 2 percent per year in this three-year plan, Vectren Witness Stevie fails to describe or explain it.

Q. Does CAC have an alternative proposal to using savings to judge consistency between the IRP and DSM plans?

A. Yes. Please see the testimony of CAC Witness Sommer, who describes an alternative method to reconcile IRP and DSM plan savings using the IRP results to help inform the cost-effectiveness screening that occurs within the DSM plan. I

submitted the same proposal in the currently pending case docketed as Cause No. 43955 DSM 4.

Q. Witness Stevie provides Vectren South with a forecast of future energy efficiency prices. Does Vectren Witness Stevie explain his rationale and methodology for this forecast?

A. Yes.

Q. Does the current energy efficiency literature provide guidance on how energy efficiency prices will change over time as the size of energy efficiency programs (their "market penetration") increases?

A. I agree with Vectren Witness Stevie that the current literature does not provide such guidance:

> *The energy efficiency literature does not provide adequate guidance.*[7]

Q. In the absence of such guidance, what methodology does Witness Stevie utilize in the energy efficiency cost projections used by Vectren in its 2018-2020 DSM Plan at issue here?

A. Vectren Witness Stevie created his own, new, un-vetted methodology:

> *Based upon my research into this issue, I provided Vectren South with a methodology to estimate how the cost to achieve an increment of EE could change as the cumulative EE market penetration rises.*[8]

Q. Vectren Witness Stevie concludes that "The study found that EE program costs per kWh increase as the cumulative penetration of EE increases, as

[7] Petitioner's Exhibit 2 at 18.
[8] Petitioner's Exhibit 2 at 19.

measured by the percent of retail sales."[9] and escalates Vectren's projected energy efficiency costs over time on this basis. Do you agree with his conclusion?

A. No. I do not agree that Vectren Witness Stevie's study provides evidence that energy efficiency program costs per kWh increase as cumulative savings as a percentage of sales increase.

Further, I disagree both with the methodology used by Witness Stevie in his 2015 study[10] and with his application of that 2015 study's results to Vectren's efficiency cost projections.

Q. Vectren Witness Stevie says that "The primary focus of the research [in his 2015 study] was to examine if and to what extent the program cost of EE changes as the available supply (i.e., retail sales) of EE is consumed through implementation of EE programs."[11] Does Witness Stevie's 2015 working paper[12] succeed in its purpose?

A. No. While Vectren Witness Stevie's 2015 analysis examines the relationship between efficiency cost and cumulative savings, it does not provide new or usable information and is not an appropriate source for determining expected future efficiency costs for Vectren.

Q. What critiques do you have of Witness Stevie's 2015 analysis?

[9] Petitioner's Exhibit 2 at 19.
[10] Petitioner's Exhibit 2, Attachment RGS-2.
[11] Petitioner's Exhibit 2 at 19.
[12] Petitioner's Exhibit 2, Attachment RGS-2.

A. In my attached report which updates the one previously submitted to the Commission through the IRP stakeholder process, I make the following four critiques of Vectren Witness Stevie's analysis:

(1) his analysis is not replicable (a fundamental expectation of any such analysis);

(2) he has used incorrect data, and correcting his data changes his results;

(3) correcting his data also renders his results statistically insignificant (that is, not discernable from happenstance); and

(4) his analysis is not robust (his data are of low quality, and removing inaccurate entries changes the results).[13]

Q. Please explain your first critique: Witness Stevie's analysis is not replicable.

A. Vectren Witness Stevie's analysis employs a regression methodology. This is a common, well-understood methodology—so much so that given the same data and basic description of a regression, anyone with statistical or econometric expertise should be able to replicate the results of an analysis exactly. If a regression cannot be replicated, it must be because either the data have been recorded incorrectly or described incorrectly, and/or the regression methodology itself was described incorrectly.

Witness Stevie creates two regression models—one using 2012-only data and one using data reported from 2010-2012—and reports that his data for both models are taken from energy efficiency cost and performance reported in Energy Information Administration (EIA) Form 861. I was able to replicate Witness

[13] Attachment EAS-2.

Stevie's 2012-only (Model 2) regression exactly using the data he provides in his supporting spreadsheets.[14]

I was not, however, able to replicate the results of his 2010-2012 (Model 1) regression, even though I was using data provided by Witness Stevie and the same data specifications used to exactly match the 2012-only regression. I can only conclude that either the data provided by Witness Stevie was not the data used to arrive at his findings, or his description of his 2010-2012 regression was incomplete or inaccurate (see Table 2 below). I would describe the differences between my replications and Witness Stevie's findings as small but troubling.

Q. **Please explain your second critique: Witness Stevie's analysis uses incorrect data, resulting in incorrect findings.**

A. Vectren Witness Stevie provides both (1) sources for his data (in Petitioner's Exhibit No.2, Attachment RGS-2) and (2) the data themselves in CAC Exhibit 1, Attachment EAS-3.

In attempting to replicate his regression results using the actual data he provided—as described in my reply to the previous question—I also checked to see if the data that he provided matched the data sources that he cited. I found that many of Witness Stevie's data points do not match the public sources of data that he provided, as shown in Table 1:

[14] Attachment EAS-3 consists of two spreadsheets provided by Vectren Witness Stevie.

Table 1. Percentage of erroneous data entries in Stevie data

	% non-match		
	2010	2011	2012
Program Costs ($)	65%	27%	4%
Current Year Savings (kWh)	67%	27%	8%
Cumulative Savings (kWh)	65%	24%	6%
Total Revenue ($)	0%	0%	0%
Total Sales (kWh)	31%	31%	31%

Given these differences between the data provided and the actual source data, I reran the regressions described in Vectren Witness Stevie's analysis with the corrected data. I found that changing these data to match the public sources of data that he provided changes the results of the analysis, as compared in Table 2. ("Original" is Witness Stevie's reported regression results. "Replication" is my attempt to match his results using his data; "Replic_State" and "Replic_Year" are two different versions of my replication attempts, differentiated by the type of dummy variable.[15] "Public Data" is the correct public data cited by Stevie. "Clean Data" is a subset of these Public Data, as discussed below.)

[15] Witness Stevie appears to have assigned "dummy variables" to differentiate results by state. I attempted regression replications that differentiate results by state and, separately, by data year.

Table 2. Comparison of regression results

Model 1						
Results		Original	Replic_State	Replic_Year	Public Data	Clean Data
Number of Observations		153	153	153	153	105
Adjusted R^2		0.76	0.76	0.73	0.19	0.57
Coeff.	(Constant)	-17.82	-18.62	14.72***	1.55	12.92***
	LOG (UR)	2.44	2.15	-	2.92	1.06
	LOG (EE/kWh)	0.61***	0.61***	0.56***	-0.74	0.43*
	LOG (CUMEE/kWh)	0.28**	0.28**	0.28***	0.72	0.39
	LOG (REV*CPI_I/kWh)	-11.98	-11.99	-0.08	-0.21	0.24
Model 2						
Results		Original	Replication		Public Data	Clean Data
Number of Observations		49	49		51	46
Adjusted R^2		0.54	0.54		0.08	0.57
Coeff.	(Constant)	12.02***	12.02***		3.22	12.1***
	LOG (EE/kWh)	0.00	0.00		-0.76*	0.36
	LOG (CUMEE/kWh)	0.90***	0.90***		0.52	0.61*
	LOG (REV/kWh)	-0.84	-0.84		-1.93	-1.16

***P ≤ 0.001 ; **P ≤ 0.01 ; *P ≤ 0.05

The adjusted R-squared values estimate the overall statistical significance of the regression (how good of a "fit" the results are to the data). The coefficients ("coeff.") in Table 1 are Stevie's main regression result and can be interpreted as for every 1 percent change in Variable X expect a β percent change in Stevie dependent variable, energy efficiency program costs. For example, using the "Original" results from Stevie's Model 1 would suggest that every 1 percent change in cumulative efficiency savings was associated with a 0.28 percent change in program costs. The asterisks (noted in the footnote to the table as different "P-values") are indications of the statistical significance of each variable; the more asterisks the better job the coefficient is doing to represent the relationship between the variables. No asterisk or one asterisk suggest that the coefficient does not do a good job of representing relationships between variables.

I compared the Original results, reported by Witness Stevie, to the Public Data results, which use the methodology reported by Witness Stevie but replaces his flawed data with the correct public data. The Public Data results:

- Have much lower "Adjusted R^2," indicating a lower overall statistical significance for these regressions than that reported by Witness Stevie. This means that less import should be assigned to these findings because the patterns identified by Witness Stevie are difficult to discern from happenstance.
- Have different elasticities (or coefficients) than those estimated by Witness Stevie for the unemployment rate (UR), percent of incremental energy efficiency savings (EE/kWh), percent of cumulative energy efficiency savings (CUMEE/kWh), and electricity price (REV/kWh). The coefficients from Stevie's regressions are what is used in Vectren's efficiency program cost projections, and correcting his underlying data changes these results.

Q. **Please explain your third critique: Witness Stevie's analysis uses incorrect data, resulting in findings that are reported as statistically significant but, in fact, are not.**

A. Using corrected data to run Witness Stevie's regressions changed not only the findings but the significance of those findings. Statistical significance can be thought of as the degree of confidence that should be placed in regression findings. As shown above in Table 2, correcting Witness Stevie's data lowers the level of significance for his explanatory variables (meaning that less confidence can be

placed in his results). When the correct data are used for Witness Stevie's regressions, which are then plugged into project Vectren's energy efficiency costs in its 2016 IRP, it flips Stevie's result on its head. Rather than saying there is a significant impact in change of cumulative savings on program costs as proclaimed by Witness Stevie, the regression performed with the correct data suggest that no such relationship exists. Based on these corrected regression results, there is no evidence for greater market penetration resulting in higher efficiency costs.

Witness Stevie's main variable of interest, cumulative energy efficiency savings, is statistically insignificant when either Model 1 or Model 2 is performed with corrected data. This means that had Witness Stevie used the correct public data, he could not have concluded that there was a meaningful relationship between efficiency program costs and market penetration, which completely undermines the energy efficiency cost projections he developed for Vectren's 2016 IRP.

Q. Please explain your fourth critique: Witness Stevie's analysis is not robust.

A. I took one further step in assessing the quality of Witness Stevie's regression results: I evaluated the underlying data (from the original public sources) for quality. Specifically, I rejected data points with the following characteristics with the goal of examining how sensitive these regression results are to small changes in the underlying data:

- I eliminated data points with $0 or $1 (that is, one dollar) recorded as their efficiency costs.

- I eliminated data points for which incremental savings were recorded as higher than cumulative savings, or where cumulative savings were recorded as shrinking precipitously over time.

Overall, these eliminations reduced that number of data points in Model 1 from 153 to 105 and in Model 2 from 51 to 46. I reran the regressions described in Witness Stevie's analysis with the corrected (from public sources) and "Clean Data" (with poor quality data points removed), which changed the results of the analysis, as shown in Table 2 above. It improved the overall significance of the regression and changed the values (and in some cases signs) of the coefficients, but did little to improve the statistical significance of individual variables. Vectren Witness Stevie's analysis is not robust: Its results depend on the inclusion of faulty data.

Q. Given these methodological issues, do you recommend the use of Witness Stevie's analysis in utility planning?

A. I do not. The analysis needs significant additional refinement to be used as a source of assumptions for public policy decisions. Furthermore, Vectren Witness Stevie's results rely on a data set that is so small as to call into question the value of regression as a methodology here.

Q. Based on your rerunning of Witness Stevie's regressions using improved data as described in Attachment EAS-2, what can you suggest regarding Witness Stevie's findings and their use in efficiency cost forecasting?

A. My regression analysis was limited to attempts to replicate Witness Stevie's results and examination of the sensitivity of his results to data corrections. In my

opinion, Witness Stevie's findings, taken together with my own explorations of his findings, do not amount to evidence sufficient for use in utility planning decisions.

Q. If Witness Stevie's regression results were replicable, based on both correct data and on high-quality data, would you then support their use in forecasting Vectren's energy efficiency costs?

A. No, I would not. In addition to finding fault with the data and methodology of Witness Stevie's underlying regression analysis, I cannot support the methodology used by Witness Stevie to apply his regression findings to predictions of Vectren's expected future efficiency costs. Even if Stevie's regression analysis had produced a robust estimation of the expected quantitative relationship between cumulative savings and program costs, the way in which it is applied to cost projections appears to include several errors that impact the predicted costs.

Q. What errors have you identified in Witness Stevie's application of his regression findings to efficiency cost projections?

A. I have identified four main errors in Witness Stevie's application of his regression findings to efficiency cost projections (provided to CAC as Base DSM Modeling File—Confidtial.xlsx and included in this submission as CAC Exhibit 1, Attachment EAS-4-Confidential):

(1) the basis for his efficiency cost growth factors are artificially inflated;

(2) he uses his regression results selectively, ignoring certain findings;

(3) his 2017 efficiency costs are erroneously based on expected cumulative savings in 2036; and

(4) he confuses the effects of changes over time with the effects of differing policy choices within a single year.

Q. Please explain your first critique: the basis for Witness Stevie's efficiency cost growth factor is artificially inflated.

A. The coefficients for cumulative energy efficiency savings identified by Witness Stevie in his regression analysis are interpreted as "elasticities", meaning that they can be interpreted as follows: a 1 percent change in cumulative energy efficiency savings is assumed to result in an X percent change in program costs, where X is the reported coefficient from the statistical model. So, for example, according to Witness Stevie's cost growth factor methodology and assuming his Model 1 were correct, a 1 percent increase in cumulative energy efficiency savings would increase program costs by 0.28 percent. Witness Stevie has performed a regression on three years of data (Model 1: 2010-2012) to estimate this coefficient. He then repeats this regression on a subset (just one year) of these same data (Model 2: 2012 only) and identifies a second, higher, coefficient. Finally, Stevie averages the two coefficients together to get his result.

This methodology is non-standard and, frankly, rather surprising. I can think of no justification for it. This is like finding that the preliminary result for years A, B, and C is zero (0), but the result for year A alone is ten (10), and concluding from that, therefore, the correct result for A, B, and C is somehow the average of zero and ten: five (5).

ABC = 0

A = 10

Therefore: ABC = 5

Witness Stevie's methodology is not sound. In Vectren's DSM plan, it doubles the rate of efficiency program cost growth used by Vectren as an input into the 2016 IRP.

Q. Please explain your second critique: Witness Stevie uses his regression results selectively, ignoring certain findings.

A. Cumulative energy efficiency savings were not the only variable for which Vectren Witness Stevie reported a statistically significant relationship to program costs, but cumulative energy efficiency savings were the only variable that Stevie applied to these efficiency cost growth predictions. Witness Stevie finds a significant relationship between incremental efficiency savings and program costs in his Model 1, and he finds a significant relationship between electricity prices and program costs in both Model 1 and Model 2. In both models, he finds that higher electricity prices are associated with lower program costs, but he does not apply this finding to his projected program costs. The cumulative savings finding is "cherry picked" from among the larger regression and other coefficients.

Electricity prices are expected to rise in Indiana over time. My calculations suggested that including this effect on a forecasted growth of electric rates ranging from 0.7 percent per year[16] to 3.2 percent per year[17] results in a

[16] Petitioner's Exhibit 1, Attachment RHH-1 (Vectren 2016 IRP Attachment 4.1) at 95.

decrease in the incremental change in program costs of 4 to 20 percentage points in each year averaged across Witness Stevie's two models. Put into context, just this countervailing effect would reduce Witness Stevie's 0.6 percent increase in efficiency costs due for each 1.0 percent increase in market saturation down to 0.40 to 0.56 percent, without any consideration of the other errors in Witness Stevie's analysis. I can think of no justification for excluding the expected effect of changing electricity prices on program costs from Witness Stevie's projected efficiency costs.

Q. Please explain your third critique: Witness Stevie's 2016 efficiency costs are erroneously based on expected cumulative savings in 2036.

A. Witness Stevie applies a different growth rate and starts from a different cost assumption for savings between 1 and 2 percent of eligible sales. For example, he projects that the first 0.25 percent of savings would cost $0.03322 per kWh in 2016, while the fifth block with savings from 1 to 1.25 percent would cost $0.07811 per kWh in 2016. The $0.07811 per kWh cost is based on his assumed level of savings and costs in 2036 and not on 2016 values.

He compounds this same error by calculating 2016 energy efficiency prices and costs from this growth rate by again using the 2036 efficiency price (that is, he makes the same error twice in his calculations). I can think of no justification for this methodology. Witness Stevie has based 2016 energy efficiency cost growth rates and efficiency costs on the growth rates and costs

[17] 2016 Residential Bill Survey. Available at: http://www.in.gov/iurc/files/2016_Residential_Bill_Survey_Presentation.pdf

reached after an additional 19 percent cumulative savings have been added in 2036. The effect of this error is that the efficiency price per kWh for the fifth block of savings put into the 2016 IRP is more than double that of the fourth block of savings.

Q. Please explain your fourth critique: Witness Stevie confuses the effects of changes over time with the effects of differing policy choices within a single year.

A. Even if Witness Stevie's model results were accurate and applied properly to the Vectren system, he is forecasting year-to-year changes in cost as the *annual* cumulative sum of energy efficiency increases. Despite this, he also applies his results to intra-annual changes in savings. So the *cost per unit of energy saved*, not just the total cost of the program, increases as savings increase.

For example, if Vectren deployed programs that achieved 1.50% savings in any given year Stevie assumes that those savings would cost more per unit of energy saved than if Vectren deployed a program that saved 1.25%. There is no logical basis for extrapolating his regression results to such effects because he estimates the relationship between market penetration and program costs from year to year—not the relationship between incremental annual savings and program costs within the same year. I can think of no justification for this methodology.

Q. Given the critiques that you have presented of Witness Stevie's regression analysis and its application, can you recommend the use of these findings in predicting the future cost of energy efficiency?

A. No. I do not recommend using either Witness Stevie's regression results or his method of applying regression results to efficiency cost projections—whether used singly or together. The flaws in the Witness Stevie analysis are serious and, in my opinion, entirely undermine Vectren's 2016 IRP and its usefulness in guiding DSM decisions.

Q. Vectren states that "While they assert that "they are aware of no reliable evidence for higher energy efficiency market penetration leading to higher efficiency costs" (Environmentalists Comments, p. 35), Vectren South's own historical experience is that adoption of energy efficiency measures become more expensive once market saturation occurs. This result is logical—more work, and thus more cost, is required to capture the attention of those consumers who have not already taken advantage of energy efficiency measures that have been available for several years. Those consumers are either not initially interested (and require increased marketing to reach) or require an increased incentive to adopt the energy efficiency measure."(Vectren reply, p.19) Does Vectren assertion amount to evidence for the assumption that higher market penetration results in higher program costs?

A. No. Analysis is the way in which historical experience is quantified and introduced as evidence. Vectren South has not provided any analysis regarding its historical experience of the relationship be efficiency market penetration and program costs. Instead, they offer the assertion—without evidence—that such a relationship exists. If evidence of the asserted relationship exists and is made

available to stakeholders, I will review and comment on it. Such an analysis must control for factors that influence cost like the exclusion of opt-out customers and the quality of program implementation.

III. CONCLUSION AND RECOMMENDATIONS.

Q. Please summarize your recommendations.

A. Vectren's 2016 IRP, specifically as it relates to DSM cost projections, depends heavily on an analysis performed by Vectren Witness Stevie. Vectren Witness Stevie's projected increase in future energy efficiency costs is based on faulty data, an incorrect interpretation of statistical results, and a deeply flawed application of those results to predicted costs.

Because Vectren's 2016 IRP depends so heavily on Vectren Witness Stevie's flawed cost projections, Vectren cannot demonstrate that its 2016 IRP arrives at an optimal balance that "can only result[] from a well-developed and reasoned IRP that evaluates the appropriate balance of new supply-side and demand-side resources taking account of risks and uncertainty" pursuant to Ind. Code § 8-1-8.5-10(c). Cause No. 43955 DSM 3, Final Order at 45; *see also* Final Order, Cause No. 44634 at 34. I recommend against using these findings as they are inadequate and unreasonable,[18] given that (as Vectren Witness Stevie

[18] Ind. Code 8-1-8.5-10(j) states that under the overall reasonableness evaluation of a Plan, the Commission must consider, among other items, "Comments provided by customers, customer representatives, the office of utility consumer counselor, and other stakeholders concerning the adequacy and reasonableness of the plan, including

acknowledges) no useable prediction of the impact of efficiency market penetration on program costs exists. Instead, I suggest that the correct assumption to use in IRP modeling is that inflation-adjusted efficiency costs remain constant over time.

Q. Does this conclude your testimony?

A. Yes.

alternative or additional means to achieve energy efficiency in the electricity supplier's service territory" and "The electricity supplier's current integrated resource plan and the underlying resource assessment."