OCC Exhibit _____

BEFORE
THE PUBLIC UTILITIES COMMISSION OF OHIO

In the Matter of the 2018 Long-Term Forecast Report on behalf of Ohio Power Company and Related Matters.	)))	Case No. 18-0501-EL-FOR
In the Matter of the Application Seeking Approval of Ohio Power Company's Proposal to Enter into Renewable Energy Purchase Agreements for Inclusion in the Renewable Generation Rider.	)))))	Case No. 18-1392-EL-RDR
In the Matter of the Application of Ohio Power Company to Amend its Tariffs.	))	Case No. 18-1393-EL-ATA

DIRECT TESTIMONY
OF
NOAH DORMADY

On Behalf of
The Office of the Ohio Consumers' Counsel
65 East State Street, 7th Floor
Columbus, Ohio 43215

January 2, 2019

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I. INTRODUCTION

Q1. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A1. My name is Noah C. Dormady. My address is 1810 College Rd., Columbus Ohio, 43210.

Q2. BY WHOM ARE YOU EMPLOYED AND WHAT IS YOUR CURRENT POSITION?

A2. I am employed by The Ohio State University. I am an Assistant Professor of Public Policy. My teaching and research areas are 1) energy and environmental economics and policy, and 2) the economics of resilience to terrorism and natural hazards. Public policy is a field of study that deals with the applications of economics and other disciplinary tools to inform applied societal issues.

Q3. WOULD YOU PLEASE DESCRIBE YOUR EDUCATIONAL AND PROFESSIONAL BACKGROUND?

A3. Yes. I earned a Ph.D. in Public Policy, Planning and Development from the Price School of Public Policy at the University of Southern California in 2012. I have published in peer-reviewed scholarly journals on the subject of energy and environmental economics, public policy, and resilience. I am the co-recipient of the first REMI Economic Analysis Award, in 2012, from Regional Economic Models Inc. ("REMI"), the maker of a leading economic impact analysis and forecasting software. I am a Co-Principal Investigator of a U.S. Department of

Homeland Security ("DHS") National Center of Excellence, the Critical Infrastructure Resilience Institute. I have received competitive research funding from federal, state, non-governmental organization (NGO), and private sources, and have conducted economic research for several states and regions. My survey-based economic research has been funded by both the National Science Foundation and DHS, including two large-area economic resilience surveys of firms affected by Superstorm Sandy and Hurricane Harvey. I continue to publish in leading peer-reviewed journals on topics of relevance to public policy and economic analysis, including the use of survey methods for economic measurement. Prior to working at The Ohio State University, I worked at the U.S. DHS Center for Risk and the Economic Analysis of Terrorism Events. A current CV is provided as Attachment ND-1.

Q4. HAVE YOU PREVIOUSLY SUBMITTED TESTIMONY IN ANY REGULATORY PROCEEDING?

A4. Yes. I have submitted testimony before the Public Utilities Commission of Ohio ("PUCO" or "Commission") in Case No. 14-1693-EL-RDR.

Q5. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A5. In these proceedings, Ohio Power Company ("AEP Ohio") seeks to establish that there is a need for 900 MW of generic renewable projects and a specific need for 400 MW of solar projects. In defining need, AEP Ohio has offered its opinion that its customers want renewable power, and that customers desiring green power

helps establish the need for that power. But, as explained by OCC Witness Lesser, under Ohio law, the word "need" in this context means whether power plants are needed to serve the electricity requirements of customers. In this regard, AEP Ohio's definition of need is inconsistent with Ohio law.[1] In support of its definition of need, AEP Ohio relies upon a survey of its customers to assert that they want renewable power and are willing to pay extra money for it. In assessing the survey, I am not accepting any premise that the survey presents information applicable to the meaning of need under Ohio law. Indeed, the survey does not present information applicable to the meaning of need where need is about whether power plants (and other resources) are able to meet the electricity requirements of customers.

AEP Ohio retained the services of an external consultant, Navigant Consulting, Inc. ("Navigant"), to develop, administer, and analyze a survey of AEP Ohio's customers to gauge their willingness-to-pay[2] for, and support, renewable power. I am testifying on behalf of the Office of the Ohio Consumers' Counsel ("OCC") to provide an independent and objective assessment of Navigant's Customer Survey ("Survey"), including the methodology and results.

[1] R.C. 4928.143(B)(2)(c).

[2] "Willingness-to-pay" is a term that economists and public policy analysts often use synonymously with demand, as in supply and demand.

II. OVERALL RELIABILITY ASSESSMENT

Q6. ARE THE NAVIGANT CUSTOMER SURVEY RESULTS RELIABLE?

A6. No. The Survey was poorly designed. It is biased in multiple ways. It is designed to support a particular policy conclusion—namely that AEP Ohio customers are eager to support development of the proposed renewable projects and would overwhelmingly welcome paying higher electricity bills to support their development. The Survey has many inherent biases, including (as described in detail below) Framing Bias, Hypothetical Bias, Social Desirability Bias, and likely has Selection Bias. The Survey's underlying approach to estimating customers' willingness to pay for renewable installations has long been acknowledged by experts to result in biased estimates. The methodology utilized is known to result in survey estimates that greatly diverge from what customers are actually willing to pay. There is no evidence that the Survey designers took these biases into consideration or attempted to mitigate them.

Consequently, I recommend that the PUCO not use the survey results for making policy decisions in these proceedings related to whether there is a need for renewables, as AEP Ohio witness Allen recommends. The survey's findings are unlikely to accurately represent AEP Ohio customers' true attitudes, preferences, and especially willingness to pay for renewable energy.

III. BRIEF SUMMARY OF NAVIGANT SURVEY FINDINGS AND METHODOLOGY

Q7. CAN YOU PROVIDE A BRIEF SUMMARY OF THE NAVIGANT SURVEY?

A7. Yes. The Navigant survey (AEP Ohio Exhibit TH-1) is titled *AEP Ohio Voice of the Customer: Attitudes and Expectations for Renewable Energy* (the "Customer Survey" or "Survey"). The Survey is an online platform survey designed and administered by Navigant. It was administered between 8/14/2018 and 8/24/2018 to electricity customers within the AEP Ohio service territory. The Survey was administered separately to three customer groups: 1) Percentage of Income Payment Plan ("PIPP") residential customers, 2) non-PIPP residential customers, and 3) small commercial and industrial ("C&I") customers. Navigant defined C&I customers as those who use less than 1 million kWh per year.

The stated purpose of the Survey was to gauge customers' interests and opinions regarding renewable energy in Ohio. Additionally, the most important aspect of the Survey is that it purports to estimate customers' willingness-to-pay for additional renewable energy generation.

Q8. WHAT APPROACHES ARE THERE TO DETERMINING A CUSTOMER'S WILLINGNESS-TO-PAY?

A8. There are two main approaches utilized by professional economists and related researchers for measuring willingness-to-pay—"Stated Preference" and

"Revealed Preference." Under the Stated Preference approach, survey respondents are asked to simply state their preferences or willingness-to-pay for a good or service. In contrast, under the Revealed Preference approach, researchers analyze people's actual actions to determine what choices they make in real life.

Q9. WHICH APPROACH—STATED PREFERENCE OR REVEALED PREFERENCE—IS MORE RELIABLE?

A9. There's an easy way to think about the difference between the Stated Preference and Revealed Preference approaches. The Stated Preference approach analyzes what people *say* they will do, while the Revealed Preference Approach analyzes what people *actually* do. And importantly, these are often not the same.

Revealed preference studies are almost always more reliable because stated preference studies suffer from many types of bias (discussed in detail below). Stated preference studies tend to grossly inflate true willingness-to-pay and misrepresent true behavior and attitudes of the population of study. If given the option between revealed and stated preference, a reasonable researcher would nearly always choose a revealed preference approach because it provides observations of actual behavior in the context of study rather than hypothetical assertions of persons who may or may not be representative of the context of study.

Consider the following simple example. A restaurant chain is considering offering a higher tier menu of wine options for its customers. It could hire a third-party survey firm to survey households in the area and ask them if they dined at the restaurant and if they would be willing to pay more for a higher tier of wine. The restaurant owners would have obvious concerns, such as whether the survey firm accurately sampled customers who tend to be their customers, and whether respondents provided accurate responses, before investing in the new product offering. Alternatively, if they had access to data from a similar chain of restaurants that informed them of actual customer behavior that is representative of their own customer base, they would clearly choose the actual data. The actual data (i.e., revealed preference) shows what customers in a similar environment actually did, rather than what potential customers would hypothetically do.

Q10. WHICH APPROACH DID NAVIGANT USE IN THE AEP OHIO CUSTOMER SURVEY?

A10. The Survey uses the Stated Preference approach.

The Survey attempted to estimate willingness-to-pay by an unusual Stated Preference approach. Respondents were asked to respond to a hypothetical statement with a simple dichotomous response (I would support paying/I would not support paying). The statement asked respondents the following: "*If this renewable initiative resulted in an increase of X per month on your electricity bill, would you support paying that amount?*" The "X" additional cost per month was

a random variable populated internally by the Qualtrics software, with range given by $0.50-$1.25 for residential customers and with range given by 1%-2% for small C&I customers. Depending upon their response, a subsequent question was asked that increased (incremented) or decreased (decremented) the randomly-selected X-value for respondents who stated in support, or not in support, respectively. The increments and decrements were $0.25 and $0.50 for residential customers, and 0.25% and 0.5% for small C&I customers. Thus, the willingness-to-pay survey instrument used a randomized two-part approach to estimate the highest or lowest dollar value a customer would be willing to pay for the proposed 900 MW renewable installations.

At its core, the Survey estimated willingness-to-pay by asking customers to state their agreement or disagreement with a hypothetical, non-committal statement. The statement did not directly ask respondents if they would pay, or if they would agree to pay, an amount for renewables. Rather, the statement asked if they would "support" paying that amount. In other words, the survey instrument utilized methodology that resulted in biased estimates, with a hypothetical instrument that was ambiguous regarding from whom the actual payment would be remitted. Accordingly, the Survey is unreliable.

Q11. DID THE CUSTOMER SURVEY INCLUDE SUFFICIENTLY DETAILED INFORMATION ABOUT ITS METHODOLOGY?

A11. No. The Survey omits some important technical methodological details. It omits details such as coding methodology (i.e., how data was coded/evaluated), sampling approach (i.e., who was invited and who was excluded), and content framing (i.e., language used to invite respondents and frame the survey). These details are important because methodology matters.

The methods used can affect the outcome and may unduly affect policy decisions relying upon and trusting that outcome. If the data were coded without reliability checks in place, there would be no way to effectively rely upon the coded responses. If the sampling approach systematically restricted some respondents over others, the estimates could be biased. If the survey language observed by respondents was framed in a way to encourage one set of responses over another, this could also bias the results. Omission of these key details is not consistent with generally-accepted practices for conducting economic survey research.

Details regarding sampling methodology are almost completely excluded from the Customer Survey (Exhibit TH-1) and its sponsoring testimony (provided by AEP Ohio witnesses Fry and Horner). The Survey does not provide details relating to how PIPP or non-PIPP customers were identified, where those customers were located, what industries the small C&I customers came from, or other relevant demographic or descriptive details. These are necessary for evaluating whether

the Survey's findings are representative of AEP Ohio's customer base as a whole. Without such details, the Survey has not been demonstrated to be reliable and it should not be trusted.

Some of these details were later provided through discovery. Through discovery, I learned that the Survey authors (Navigant) took no steps to address sampling bias.[3] They also made no effort to obtain a representative sample (in terms of industrial classification) from small C&I customers,[4] and they made no effort to ensure that their responses were geographically representative.[5] And, for their qualitative coding for the open-ended responses, they made no effort to include coding reliability checks.[6]

IV. ASSESSMENT OF BIAS IN THE NAVIGANT CUSTOMER SURVEY

Q12. WHAT IS THE DIFFERENCE BETWEEN "BIAS" AND "ERROR" IN A CUSTOMER SURVEY?

A12. "Bias" and "error" is not the same thing. Error is generally benign and exists in all research and analysis, even the most carefully-conducted and designed research with textbook-perfect conditions in place. Error is unavoidable, but a properly designed survey takes steps to minimize it. Most importantly, error does not

[3] *See* AEP Ohio's response to OCC INT-08-077, attached hereto as Attachment ND-02.

[4] *See* AEP Ohio's response to OCC INT-08-080, attached hereto as Attachment ND-03.

[5] *See* AEP Ohio's response to OCC INT-08-082, attached hereto as Attachment ND-04.

[6] *See* AEP Ohio's response to OCC INT-08-086, attached hereto as Attachment ND-05.

change the ultimate conclusions of statistical results—ups and downs cancel each other out and the average finding is left unchanged. In technical terms, error affects the variance, but has no effect on the mean (or average).

Bias, on the other hand, is error in a consistent direction. Bias is not benign. Bias is unfavorable and can result in the survey's unreliability. Bias can occur in survey research when a study is designed or administered in such a way as to introduce error that consistently results in one outcome over another. A biased survey leads to conclusions that are not representative of the respondents' true beliefs because it is skewed in one direction. In technical terms, bias affects the mean.

Q13. ARE THERE DIFFERENT TYPES OF BIAS THAT CAN AFFECT SURVEY RESULTS?

A13. Yes. There are several types of bias, described below, which can be endogenous and/or exogenous. Exogenous forms of bias generally result from external factors that skew statistical error in one direction. An example would be a survey of American voters regarding attitudes about radical terrorism administered within 72 hours after a major terrorism event. Whereas the survey instrument could have been designed and sampled perfectly, its results would obviously be unreliable in assessing voter attitudes under normal circumstances.

Endogenous forms of bias, on the other hand, occur when the survey design or implementation (or both), either by commission or omission, lead to bias that is

independent of external conditions. In other words, the results would be inherently unreliable because its biases are "baked in." The Survey has endogenous, or "baked in," bias. That is unfavorable and results in unreliability.

Q14. IN WHAT WAYS CAN THE DESIGN OF A SURVEY CAUSE IT TO BE BIASED?

A14. Bias can be endogenously manifested in a survey like the AEP Ohio Customer Survey in several ways. The sampling approach can be designed in special ways to include or exclude respondents who are more likely to hold a particular set of opinions or beliefs. This is known as "selection bias."

Survey wording can be designed to elicit or skew responses in a particular way. This is known as "framing bias."

And because the subject matter (i.e., renewable energy) involves a pro-social (i.e., promoting social acceptance) issue, another type of bias resulting from a sociological effect can occur, whereby respondents misrepresent their true beliefs, and instead say what they believe "they should say." This is known as "social desirability bias."

And when estimating willingness-to-pay, the actual question instrument can fail to produce reliable estimates because of the absence of an actual commitment to pay the amount stated. This is known as "hypothetical bias."

Q15. DOES THE AEP OHIO CUSTOMER SURVEY INCLUDE THESE TYPES OF INHERENT BIASES?

A15. Yes. The Survey clearly suffers from framing bias, hypothetical bias, and social desirability bias. And, it very likely suffers from selection bias. Accordingly, the Survey is unreliable.

Q16. DID THE SURVEY IDENTIFY EFFORTS BY NAVIGANT TO REDUCE POTENTIAL BIAS IN THE SURVEY?

A16. The Survey and accompanying testimony of AEP Ohio witness Horner identify two efforts made by Navigant to mitigate what they identified as potential biases. The first is by acquiring a statistically-significant sample size. The second is by developing two versions of a particular survey question (described below) and randomly selecting which version respondents observed.

Q17. WERE NAVIGANT'S EFFORTS TO REDUCE BIAS ADEQUATE?

A17. No. Both of these efforts are insufficient (and inappropriate) to mitigate the types of bias I have identified. First, a sufficiently-large sample size is important for obtaining a statistically-robust sample. But large sample sizes only address error, not bias. A large sample can be just as biased as a small sample if, for example, the questions asked are skewed in one direction. Thus, Navigant's claim that a large sample size mitigates bias is not accurate.

Second, the random selection of a question that is worded two different ways is an interesting approach, but it is selectively applied to only one "question"—and that question has nothing to do with the ultimate willingness-to-pay estimate. The questions that were randomly assigned (respondents saw either question numbers 11 or 12) pertain to competing versions of customer preference for higher bills versus renewable energy. This is insufficient because these are altogether different survey questions that come after the actual willingness-to-pay questions (questions 6 through 9). Randomizing the order of questions 11 and 12 does nothing to mitigate bias in the willingness-to-pay questions.

In short, by relying on these steps alone (sample size and a single randomized question ordering), the designers of the Survey did not take appropriate actions to mitigate more serious issues of bias.

Q18. WHAT BIASES ARE PRESENT IN THE SURVEY, AND WHAT IS THE LIKELY CONSEQUENCE?

A18. As mentioned above, the Survey suffers from at least four main types of bias: 1) Framing Bias, 2) Social Desirability Bias, 3) Hypothetical Bias, and 4) Selection Bias.

Q19. HOW DID FRAMING BIAS AFFECT THE RELIABILITY OF THE SURVEY?

A19. Framing bias is a change in behavior that is driven by the manner in which information is presented. When the presentation of an ostensibly scientific instrument (e.g., a survey) is suggestive in its wording, it can influence the outcome measures of that instrument (i.e., responses). The same question, asked two different ways, can result in drastically different responses. This framing bias "pollutes" the objectivity of a survey.

In the AEP Ohio Customer Survey, the willingness-to-pay questions (questions numbers 6-9) are immediately preceded by survey questions that (i) solely highlight the potential benefits of additional renewable energy and not the potential costs, and (ii) identify AEP Ohio—not the customers responding to the survey—as the funding source for proposed renewables. The question asks: "How important is it to you that *AEP Ohio provide*…" [emphasis added]. The likely consequence of both would be to inflate the willingness-to-pay estimate. Relatedly, the willingness-to-pay questions were ambiguously worded. These questions did not ask the respondents what they would be willing to pay, as a direct question. Instead, they asked customers if they would "support" paying. That phrasing likely caused some customers to believe that the renewables projects would be funded by others. This is especially true, given the framing concern just identified in which the question wording identified the provider as

AEP Ohio. Thus, it is likely that a material number of respondents thought that they were simply providing a statement of support for the expenditures of others.

Additionally, the location and structure of the preceding question (question number 3) that asks respondents what they perceive to be the most important benefits of renewables is designed less to elicit opinions about preferences and more to place those benefits in the immediate memory of respondents. In other words, the design appears to be aimed at ensuring that immediately before respondents answer the willingness-to-pay questions, they are reminded of all of the potential benefits of renewable energy. This is endogenous bias (i.e., by design)—the aim of the question is more about informing and persuading the respondent than eliciting the respondents' opinions.

Q20. DO STATED PREFERENCE SURVEYS SUFFER FROM THE HYPOTHETICAL BIAS?

A20. Yes. Hypothetical bias is a consequence of the fact that the Customer Survey is a non-committal, hypothetical instrument that does not actually require paying the funds that the respondent indicated a willingness-to-pay.

This is a long-standing problem in economic valuation. It is a fundamental issue for economists as it pertains to the measurement of willingness-to-pay.

There is considerable academic literature devoted to the application of measuring willingness-to-pay, specifically related to environmental amenities where actual economic decision data (e.g., consumption data) is not available.[7] This has been most robustly applied to valuing environmental amenities for purposes of cost-benefit analysis (CBA) in environmental impact assessment litigation (e.g., National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) cases). In many environmental impact assessment cases, economists have been called upon to estimate the economic value of non-market environmental amenities such as clean water, bison populations, biodiversity, etc. In many early cases, Stated Preference methods like the one used in the AEP Ohio Customer Survey, such as Contingent Valuation Methods (CVM) instruments, were used. Since then, economic research has consistently found that hypothetical bias causes inflated willingness-to-pay estimates.[8]

Q21. CAN HYPOTHETICAL BIAS BE ELIMINATED OR MITIGATED SUBSTANTIALLY FROM A SURVEY?

A21. In response to the long-history acknowledging hypothetical bias in stated preference surveys, several methods have been developed to measure and correct

[7] See Loomis, J. B. 2014. 2013 WAEA keynote address: Strategies for overcoming hypothetical bias in stated preference surveys. *Journal of Agricultural and Resource Economics*, 34-46. In his Keynote address, Loomis provides a thoughtful summary of this literature, and highlights numerous issues in stated preference surveys including hypothetical bias.

[8] See Loomis, J. 2011. What to know about hypothetical bias in stated preference valuation studies. *Journal of Economic Surveys, 25*(2): 363-370. There, Loomis reviews two meta analyses (a meta-analysis is a study of studies) that have found that hypothetical bias results in inflated willingness-to-pay estimates of between 260 and 300 percent.

for hypothetical bias in both the academic literature and in applications such as environmental impact litigation. But none of these methods were employed by Navigant in the Voice of the Consumer survey.

One method is to inform the respondent about the issue of hypothetical bias. Under this approach, the people answering the survey are, up front, simply asked to respond as though they really had to pay. Other methods have tried to emphasize for the respondents the importance, or consequentiality, of the survey as their reported values would be used to make costly, societally-important policy decisions. These approaches have generally been found to reduce the hypothetical bias, but not eliminate it. Researchers have tested this in the laboratory or in field experiments in what are called "choice experiments" by using what has been called "cheap talk" scripts. These scripts emphasize the issue that some respondents tend to lie or overstate estimates or emphasize the social impacts of their responses.

A related direct method has relied upon the use of oaths. In these experiments, randomly selected subjects are asked to sign an oath swearing that they will in fact provide honest willingness-to-pay estimates. Even then, these methods have been met with mixed results in actually addressing the bias.

More broadly than just an application to hypothetical bias, an entire subfield of game theory, known as "mechanism design," has gained prominence in the past

30 years or so that has worked to more adequately address these biased instruments in measuring Demand (i.e., willingness-to-pay), as well as in measuring other fundamental economic concepts such as utility. Mechanism design involves the use of alternative commitment mechanisms designed to elicit more accurate estimates from respondents/subjects. Mechanisms, such as the Becker-DeGroot-Marshak (BDM) mechanism, have been long-studied for improvements over simple stated preference approaches. These mechanisms enforce a financial penalty on the subject to try to re-align the incentives of the respondent to be more compatible (consistent) with the true willingness-to-pay. For this reason, these are known as "incentive compatible" mechanisms, or more colloquially as "truth telling" mechanisms.

All of these approaches have been identified to address at least some degree of hypothetical bias. But while these approaches may *reduce* the hypothetical bias, none of the approaches, even after almost six decades of research, have fully addressed it. The point to take away from this is that there are entire subfields of research devoted to addressing issues associated with hypothetical bias, and none of the corrections or lessons learned from any of this have been incorporated into the AEP Ohio Customer Survey.

Q22. DOES THE AEP OHIO CUSTOMER SURVEY EMPLOY ANY METHODS FOR REDUCING OR MITIGATING THE HYPOTHETICAL BIAS?

A22. No. While none of the approaches I described above are perfect at eliminating the hypothetical bias, it is crucial for any willingness-to-pay survey to employ at least *some* method of reducing or adjusting for hypothetical bias. The AEP Ohio Customer Survey utilized *none* of these approaches (nor any others) to correct for hypothetical bias.

Two and a half decades ago, the National Oceanic and Atmospheric Administration (NOAA) addressed the issue of economic valuation in the context of natural resource damage assessments. In discussing the issue of Contingent Valuation Method (CVM) Stated Preference methods, they stated "hypothetical markets tend to overstate willingness to pay for private as well as public goods. The same bias must be expected to occur in CVM studies"[9] Since that time, it has been well-established that simply asking respondents to state their willingness-to-pay without any commitment mechanism results in estimates that are not reliable and should not be used for informing policy decisions. But this is exactly how the Survey for AEP Ohio was designed. It is inconsistent with standard research practices and thus is not reliable.

[9] National Oceanic and Atmospheric Administration (NOAA). 1993. Natural resource damage assessment: Proposed rules. *Federal Register 58*: 4601-14 (pg. 4610).

Q23. DOES SOCIAL DESIRABILITY BIAS ALSO AFFECT THE RELIABILITY OF THE AEP OHIO CUSTOMER SURVEY?

A23. Yes. Social desirability bias results when respondents misrepresent themselves and instead report what they perceive they "should be saying." Psychology and behavioral economic research refers to the issue as "cognitive dissonance"—emotional discomfort that results when someone anticipates perceived social tension due to disagreement, such as disagreements over policy issues. It can adversely affect the reliability of economic estimates of willingness-to-pay.

Unlike the first two types of bias, social desirability bias does not directly result from the design of the survey but is instead due to typical respondent behaviors. However, that does not absolve the surveyor of the responsibility for being aware of the issue and for taking proactive steps to mitigate it through responsible survey design.

Social desirability bias affects the accuracy of valuing environmental and sustainability-related goods and services such as green energy and sustainable development through surveys. Because the issue has been so pronounced in the context of green energy and sustainable development,[10] there is a pronounced

[10] See: Roxas, B., Lindsay, V. 2011. Social desirability bias in survey research on sustainable development in small firms: an exploratory analysis of survey mode effect. *Business Strategy and the Environment, 21:* 223-235. And, see: Pagiaslis, A., Krontalis, A. 2014. Green consumption behavior antecedents: Environmental concern, knowledge, and beliefs. *Psychology and Marketing, 31*(5): 335-348.

concern that respondents reported inflated values because it involves a pro-social policy issue.

Q24. IS IT POSSIBLE THAT CUSTOMERS RESPONDING TO THE SURVEY INTENTIONALLY OVERSTATED THEIR WILLINGNESS-TO-PAY IN ORDER TO INFLUENCE THE RESULTS?

A24. Yes. Survey results can also be skewed by respondents themselves. This occurs as a separate, but related type of bias known as "strategic bias." It occurs when respondents themselves over-inflate their willingness-to-pay because they knowingly seek to support their own desired policy outcome (in this case, development of renewable energy). This is another related concern that should have been addressed with some forethought by the survey researchers at Navigant.

As an example, a well-received paper by Carson and Groves (2007)[11] found that people often have an incentive to "over pledge" because they perceive that doing so will more likely influence development of a public good that they prefer. An example is a respondent who inflates their willingness-to-pay response on a survey designed to inform a local government regarding parks department budgetary allocations. If the respondent would like to see a new park developed and believes that providing a high willingness-to-pay response will make it more

[11] Carson, R. T., & Groves, T. (2007). Incentive and informational properties of preference questions. *Environmental and Resource Economics*, *37*(1), 181-210.

likely that their local government will develop the park, they possess an incentive to inflate their response. And because the survey is anonymous, there is no commitment mechanism to enforce accurate reporting. This type of strategic bias further leads to biased, over-inflated willingness-to-pay results.

Q25. WHAT EVIDENCE IS THERE THAT STRATEGIC BIAS IMPACTED THE AEP OHIO CUSTOMER SURVEY?

A25. The text of the survey invitation email[12] sent to respondents suggests the presence of strategic bias. The second sentence of the body of the email invitation told respondents that their input was being sought "to inform our strategy." This language provides a direct connection between the respondents' responses and capital investment decisions relating to renewable energy—as a matter of fact, it uses the very same root word ("strategy") as the name of the type of bias it reflects. Respondents were thus informed that there was a direct connection between their responses and a possible renewable investment by AEP Ohio.

Q26. WHAT IS YOUR CONCLUSION REGARDING THE IMPACT OF SOCIAL DESIRABILITY BIAS AND STRATEGIC BIAS ON THE CUSTOMER SURVEY?

A26. As I have just identified, social desirability bias not only inflates willingness-to-pay. Some respondents that are in fact unwilling to pay anything will respond that they are willing to pay some amount. And some respondents who are in fact

[12] *See* AEP Ohio's response to OCC RPD-03-010, attached hereto as Attachment ND-06.

willing to pay some amount will respond that they are willing to pay a higher amount. In some instances, customers may deliberately inflate their response to willingness-to-pay questions to achieve their desired result. Combined with the framing issues, is it very likely that both types of social desirability bias are present in the Survey and led to inflated estimates. Accordingly, the Survey is unreliable.

Q27. IS THERE POTENTIAL SELECTION BIAS PRESENT IN THE AEP OHIO CUSTOMER SURVEY?

A27. Yes. The goal of any survey is to determine the actual actions or true beliefs of a given population of people. Not every person in the population takes part in the survey. Instead, the surveyor chooses a smaller set of people, and those people's responses are deemed to be representative of the larger population. But this only works if the smaller set of people is randomly chosen and accurately represents the larger population.

Selection bias results when the process of selecting survey respondents is done in a way that violates the properties of randomization so that the ultimate research findings are not representative of the larger population. If the method of collecting samples—in this case responses from survey respondents—is distorted in a way that leads to a particular outcome that will make the ultimate results unreliable.

Through my review of the Survey (AEP Ohio Exhibit TH-1), I was concerned that these types of selection biases are present. My review of discovery responses raised a red flag for me regarding selection bias in the residential portion of the Survey. Through discovery (see OCC INT 08-077, attached hereto as Attachment ND-02), I learned that the random selection of residential and small C&I customers was not performed by Navigant—ostensibly a neutral third party conducting objective research. In that response, the authors of the Survey clarify that the randomization was actually performed by AEP Ohio and after that, email addresses were provided to Navigant. Because of the importance of developing a randomized, generalizable sample in survey research, this is a highly unusual procedure. Typically, respondents would be randomly selected by the third-party survey firm so that the reliability and objectivity of the randomization process is not called into question. That was not performed in the case of the Survey. Navigant apparently made no effort to determine whether AEP Ohio "cherry picked" customers that it wanted to be surveyed.[13] Again, the Survey results should not be trusted.

Relatedly, even if the sample is objectively randomized, it is generally good form to stratify the sample. This means that the sample of people responding to the survey should reflect the entire population as it pertains to things like income, age, population density, firm size, industrial classification, etc. In the absence of stratification, a random sample can generate a result that does not accurately

[13] *See* Attachment ND-07 (AEP Ohio's response to IGS INT-04.9).

portray the true willingness-to-pay of consumers. For example, if 25% of AEP Ohio Customers are over the age of 60, but only 10% of survey respondents fell within that age range, the survey results would be skewed and might not accurately represent the entire population.

Through discovery (see OCC INT 08-077, attached hereto as Attachment ND-02), Navigant confirmed that no attempts to stratify were made. And, through additional discovery (see OCC INT 08-077 and 08-080, attached hereto as Attachments ND-02 and 03) Navigant also confirmed that it made no attempts to verify the generalizability of these strata after the survey data was collected, even though they had in their possession measures of several strata. For example, survey question number 16 asks residential customers to provide their household income, and survey question number 17 asks C&I customers to provide an (albeit non-standard[14]) industrial classification. Navigant apparently made no attempt after the fact to analyze this data after the survey was collected, to verify that the responses received were in the same general proportion as the population at large. Any reasonable researcher would take this step to allay selection bias concerns. Because of the above-mentioned selection bias issues, this provides additional confirmation that the Survey results are not trustworthy.

[14] There are generally two standard industrial classifications used in the U.S.; the North American Industrial Classification System (NAICS) or the Standard Industrial Classification (SIC) code system.

Q28. DID YOU IDENTIFY ANY OTHER TYPES OF BIAS IN THE SURVEY?

A28. Yes. There is coding bias. In addition to the quantitative metrics of the Survey that attempted to estimate willingness-to-pay, the Survey also included some questions (numbers 5 and 9) allowing open-ended responses. Because review of open-ended responses is defined by a high degree of subjectivity, it is generally good form to evaluate these responses in a more objective manner than that performed by Navigant. Through discovery (see OCC INT 08-086, attached hereto as Attachment ND-05), I learned that only a single researcher personally reviewed the entirety of the survey responses and conducted the "coding" of those responses. This is not consistent with standard good form practices for qualitative coding. As a result, we cannot have confidence that if another person were to review the responses that they would not come to an altogether different set of conclusions regarding consumer interests and preferences for renewables.

There are generally two well-established ways to perform a qualitative coding analysis. One is by using a qualitative coding software platform, such as NVivo, that processes all qualitative responses the same way using an algorithm that is disclosed to reviewers. These platforms take the subjectivity (the human element) out of the process with an algorithm. Another approach is to use multiple human coders (at least two or three) via an objective process. This process involves randomizing the responses and ensuring that the coders only have access to the qualitative text strings and not the rest of the respondent's survey responses, names or identities. The process involves randomized duplication of a portion of

the same exact responses, so that the coders are asked to review, at random, the same responses on different occasions. In this way, comparison between coders can yield a measure of coder accuracy, known as Inter-Coder Reliability. And, because coders reviewed some of the same responses at different points, a measure of accuracy internal to each coder can be taken, known as Intra-Coder Reliability. Through discovery (see OCC INT 08-086, attached hereto as Attachment ND-05) I learned that no such method was utilized by Navigant, and they were unable to provide a measure of Inter- or Intra-coder Reliability. This raises additional concerns about the trustworthiness of the Survey.

V. CONCLUSION

Q29. DOES THIS CONCLUDE YOUR WRITTEN TESTIMONY?

A29. Yes, it does. However, I reserve the right to incorporate new information that may subsequently become available through outstanding discovery or otherwise.

CERTIFICATE OF SERVICE

It is hereby certified that a true copy of the Direct Testimony of Noah Dormady on Behalf of the Office of the Ohio Consumers' Counsel was served upon the persons listed below via electronic transmission this 2nd day of January 2019.

/s/ Christopher Healey
Christopher Healey
Assistant Consumers' Counsel

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EDUCATION

Ph.D., *Public Policy, Planning and Development* 2012
Price School of Public Policy
University of Southern California (USC)
Winner: *Henry Reining Jr. Award for Best Dissertation in Public Policy*

M.A., *Political Science* 2006
University of California, Riverside

B.A., *Political Science (Cum Laude)* 2004
University of California, Riverside

APPOINTMENTS

Assistant Professor (tenure-track) 2012—
John Glenn College of Public Affairs
The Ohio State University

Fellow 2016—
Center for Risk and the Economic Analysis of Terrorism Events (CREATE)
U.S. Dept. of Homeland Security (DHS) National Center of Excellence
University of Southern California (USC)

Faculty Affiliate and Co-PI 2016—
Critical Infrastructure Resilience Institute (CIRI)
U.S. Dept. of Homeland Security (DHS) National Center of Excellence
University of Illinois, Urbana-Champaign

Associated Faculty 2012—
Battelle Center for Science and Technology Policy
The Ohio State University

Associate/Adjunct Faculty 2008
Department of Political Science
Chaffey College

Associate/Adjunct Faculty 2008
Department of Political Science
Mt. San Jacinto College

Staff Member 2004—2008
United States Senate
Office of U.S. Senator Barbara Boxer

RESEARCH FIELDS

Energy & Environmental Policy; Economic Resilience; Energy Markets; Deregulation; Emissions Markets; Auctions & Strategic Behavior; Economics of Disasters; Risk & Decision Analysis

JOURNAL ARTICLES
(EXCLUDES SECURITY-RESTRICTED PAPERS)

Dormady, N., Hoyt, M. Roa-Henriquez, A. & Welch, W. Forthcoming. Who Pays for Retail Electric Deregulation?: Evidence of Cross-Subsidization from Complete Bill Data. *The Energy Journal, xx(x):* x-xx.

Dormady, N. & Healy, P.J. Forthcoming. The Consignment Mechanism in Carbon Markets: A Laboratory Investigation. *Journal of Commodity Markets, xx(x):* x-xx.

Dormady, N. Roa-Henriquez, A. & Rose, A. Forthcoming. Economic Resilience of the Firm: A Production Theory Approach. *International Journal of Production Economics, xx(x):* x-xx.

Dormady, N., Jiang, Z. & Hoyt, M. Forthcoming. Do Markets Make Good Commissioners: A Quasi-Experimental Analysis of Retail Electric Restructuring in Ohio. *Journal of Public Policy, xx(x)*: x-xx.

Dormady, N., & Ellis, R. 2018. Energy-Transport Sector Interdependence in Extreme Events: The Case of a Hurricane Event in Boston. *Current Sustainable/Renewable Energy Reports*, Special Issue: Energy Markets. 1-13.

Young, K., Greenbaum, R. & **Dormady, N**. 2017. Sex, Gender and Disasters: Experimental Evidence on the Decision to Invest in Resilience. *International Journal of Disaster Risk Reduction, 24*: 439-450.

Dormady, N. 2017. Having Your Cake and Eating it, Too: Ohio's Proposals to Re-Regulate through Power Purchase Agreements. *The Electricity Journal, 30*(5): 42-46.

Dormady, N. 2016. Carbon Auction Revenue and Market Power: An Experimental Analysis. *Energies, 9*(11): Article No. 897.

Dormady, N. & Englander, A.G. 2016. Carbon Allowances and the Demand for Offsets: A Comprehensive Assessment of Imperfect Substitutes. *Journal of Public Policy, 36*(1): 139-167.

Wei, D., **Dormady, N.** & Rose, A. 2015. Development of Reduced-Form Models to Evaluate Macroeconomic Impacts of Greenhouse Gas Mitigation. *Journal of Sustainable Energy Engineering, 2*(4): 377-397.

Dormady, N. 2014. Carbon Auctions, Energy Markets & Market Power: An Experimental Analysis. *Energy Economics, 44*: 468-482.

Dormady, N., Szelazek, T. & Rose, A. 2014. The Potential Impact of an Anthrax Attack on Real Estate Prices and Foreclosures in Seattle. *Risk Analysis, 34*(1): 187-201.

Dormady, N. 2013. Market Power in Cap-and-Trade Auctions: A Monte Carlo Approach. *Energy Policy, 62*: 788-797.

Dormady, N. 2013. The Political Economy of Collaborative Organization. *Administration & Society, 45*(6): 748-772.

Rose, A., Wei, D. & **Dormady, N.** 2011. Macroeconomic Assessment of the Pennsylvania Climate Action Plan. *Regional Science Policy and Practice, 3*(4): 357-379.

Winner: Economic Analysis Award, Regional Economic Models Inc. (REMI), 2012

Rose, A., & **Dormady, N.** 2011. A Meta-Analysis of the Economic Impacts of Climate Change Policy in the United States. *The Energy Journal, 32*(2): 143-166.

BOOK CHAPTERS

Dormady, N., Rose, A., Rosoff, H. & Roa-Henriquez, A. Forthcoming. Estimating the Cost-Effectiveness of Resilience to Disasters: Survey Instrument Design & Refinement of Primary Data. In, Ruth, M., & Reisemann, S.G. (Eds). *Handbook on Resilience of Socio-Technical Systems*. Cheltenham: Edward Elgar.

Rose, A., & **Dormady, N.** Forthcoming. Dynamic Economic Resilience & Economic Recovery: A Focus on Investment. In, Trump, B. D., Florin, M.V., & Linkov, I. (Eds.). IRGC Resource Guide on Resilience (vol. 2): Domains of resilience for complex interconnected systems. Lausanne, CH: EPFL International Risk Governance Center.

PAPERS IN PROGRESS

Dormady, N. Greenbaum, R. & Young, K. Resilience Decisions of the Firm: An Experimental Analysis of Dynamic Decision-Making in Repeated Disasters. (in preparation)

Dormady, N., Jones, D., Roe, B., & Rub, G. An Intersection of Privatization and Public Utility Regulation: The Long-Term Concession Agreement for Ohio State University's Energy Utility System. (in preparation)

Dormady, N., Rose, A., Roa-Henriquez, A. The Cost-Effectiveness of Static Economic Resilience Actions. (in preparation)

Dormady, N., Greenbaum, R., & Young, K. The Value of Information on Resilience Decision Making in Repeated Disaster Environments. (in preparation)

Young, K., Greenbaum, R., & **Dormady, N.** Experimental Evidence of the Effects of Gender and Group Dynamics on Firm-Level Resilience Decisions. (in preparation)

Dormady, N. Convergence Bidding in Deregulated Electricity Markets. (in preparation)

TEXTBOOK PROJECT

Dormady, N. *Public Policy Analysis for the 21st Century.* Undergraduate textbook for BA/BS programs in Public Affairs, Public Policy, and related fields.

RECENT GRANTS

National Science Foundation (NSF). 2018-2019. *Research Experiences for Undergraduates (REU).* $8k. (PIs: **Dormady, N.**)

National Science Foundation (NSF). 2016-2019. *A Novel Dynamically-Coupled Storm Surge Hazard-Infrastructure Model for Effective Real-Time Risk-Informed Decision Making.* $487k. (PIs: Shafieezadeh, A., **Dormady, N.** & Kubatko, E.).

Department of Homeland Security (DHS). 2017-2018. *Measuring Business and Economic Resilience in Disasters.* $190k. (PIs: Rose, A., **Dormady, N.** & Rosoff, H.).

Department of Homeland Security (DHS). 2017-2018. *Resilience Governance for Infrastructure Dependencies and Interdependencies.* $175k. (PIs: Flynn, S., Holdeman, E., Ruth, M, Stephens, J., Ellis, R., White, R. & **N. Dormady**).

Department of Homeland Security (DHS). 2016-2018. *Analyzing and Measuring Economic Resilience to Disasters.* $250k. (PIs: Rose, A., **Dormady, N.** & Rosoff, H.).

Department of Homeland Security (DHS). 2016-2017. *Resilience Governance.* $400k. (PIs: Flynn, S., Ruth, M. & **Dormady, N.**).

Office of Energy and Environment, The Ohio State University. 2016-2017. *Energy and Water Infrastructure Planning Under Extreme Events.* Sustainable, Resilient Economy (SRE) Seed Grant. $35k. (PIs: Bayraksan, G., Conejo Navarro, A., Sioshansi, R., **Dormady, N.** & Greenbaum, R.).

National Science Foundation (NSF). 2014-2017. *An Integrated Approach to Measuring Dynamic Economic Resilience Following Disasters.* $493k. (PIs: Rose, A., Tierney, K. & **Dormady, N.**).

National Center for the Middle Market. 2014-2015. *An Experimental Analysis of Middle Market Resilience: Gender, Frequency & Information.* $68k. (PIs: **Dormady, N.** & Greenbaum, R.).

REPORTS & POLICY BRIEFS

Dormady, N., Jiang, Z. & Hoyt, M. Why Ohio's Retail Electric Deregulation Has Been Bad for Households and Why Re-Regulation Would Be Even Worse. *John Glenn College of Public Affairs Policy Brief.* March, 2017.

Rose, A. & **Dormady, N.** Israeli-Palestinian Land Swap Auction Model, Final Report. *RAND Intelligence Policy Center*. Santa Monica, CA. January, 2014.

Roberto, C. & **Dormady, N.** The Costs of Inefficiency: Ignoring Ohio's Energy Efficiency Potential. *John Glenn School of Public Affairs Policy Brief*. March, 2013.

Rose, A., & **Dormady, N.** Three-State Regression Analysis of the Macroeconomic Impacts of Climate Mitigation Options: Report to the State of Maryland. *The Center for Climate Strategies.* August, 2011.

Rose, A., Szelazek, T. & **Dormady, N.** Economic Analysis of the Consequences of a Potential Anthrax Terrorist Attack in the Pacific Northwest: Business Income Losses and Real Estate Price Declines. *Center for Risk and the Economic Analysis of Terrorism Events (CREATE)*, University of Southern California. Final Report to the United States Department of Homeland Security. August, 2011.

Rose, A. et al. Aggregate and Distributional Impacts of AB32 on the California Economy: Alternative Allocation Strategies for Cap and Trade. *The Next 10 Foundation.* December, 2010.

Rose, A. et al. Impacts of Comprehensive Climate and Energy Policy Options on the U.S. Economy. *The Center for Climate Strategies.* July, 2010.

Rose, A. & **Dormady, N.** Global Economic Impacts of an International Climate Change Treaty. *CENTRA Technologies National Security Impacts of a Prospective Climate Change Treaty Workshop*. Washington, D.C., 2010.

Rose, A., et al. Southern Regional Economic Assessment of Climate Policy Options and Review of Economic Studies of Climate Policy: A White Paper Report. Prepared for The Southern Governors' Association. *The Center for Climate Strategies*. October, 2009.

SELECTED CONFERENCE PAPERS

Who Pays for Retail Electric Deregulation?: Evidence of Cross-Subsidization from Complete Bill Data (with Hoyt, M., Roa-Henriquez, A., & Welch, W.). *Western Regional Science Association*. Pasadena, CA., February, 2018.

A Multi-Party Auction Model for Land Exchanges. *Regional Science Academy*. Los Angeles, CA., February, 2018.

Who Pays for Retail Electric Deregulation?: Evidence of Cross-Subsidization from Complete Bill Data (with Hoyt, M., Roa-Henriquez, A., & Welch, W.). *American Economic Association*. Philadelphia, PA., January, 2018.

Who Pays for Retail Electric Deregulation?: Evidence of Cross-Subsidization from Complete Bill Data (with Hoyt, M., Roa-Henriquez, A., & Welch, W.). *International Association for Energy Economics*. Houston, TX., November, 2017.

Resilience Decisions of the Firm: An Experimental Analysis of Dynamic Decision-Making in Repeated Disasters (with Greenbaum, R., & Young, K.). *Association for Public Policy Analysis and Management.* Chicago, IL., November, 2017.

Do Markets Make Good Commissioners?: A Quasi-Experimental Analysis of Retail Electric Deregulation In Ohio (with Jiang, Z. & Hoyt, M.). *Midwest Public Affairs Conference.* Columbus, OH., June, 2016.

An Experimental Analysis of Middle Market Resilience: Gender, Frequency and Information (with Young, K. & Greenbaum, R.). *Association of Public Policy Analysis and Management*. Miami, FL., November, 2015.

Pollution Permit Consignment Auctions: Theory and Experiments (with Healy, P.J.). *Polish-American Science and Technology Association.* Columbus, OH., May, 2015.

Pollution Permit Consignment Auctions: Theory and Experiments (with Healy, P.J.), *American Economic Association.* Boston, MA., January, 2015.

Pollution Permit Consignment Auctions: Theory and Experiments (with Healy, P.J.), *International Association for Energy Economics.* New York, June, 2014.

Emissions Markets, Power Markets and Market Power: An Experimental Approach, *Association of Environmental and Resource Economists: Western Economic Association International.* San Francisco, CA., June– July, 2012.

Emissions Markets, Power Markets and Market Power: Regulatory Mechanisms and Policy Approaches, *Association for Environmental Studies and Sciences.* Santa Clara, CA., 2012.

Anthrax Outbreak in Downtown Seattle: A Spatial and Longitudinal Assessment of Terrorism's Impact on Real Estate Prices, *Second International Conference on Integrated Disaster Risk Management.* Los Angeles, CA., July, 2011.

Market Power in Cap and Trade Auctions: A Monte Carlo Approach, *Western Economics Association International.* San Diego, CA., July, 2011.

The Exercise of Market Power in Contemporary Transferable Property Rights Markets, *Southern Political Science Association.* Atlanta, GA., January, 2010.

Global Economic Impacts of an International Climate Change Treaty. (with Rose, A.), *CENTRA Technologies National Security Impacts of a Prospective Climate Change Treaty Workshop.* Washington, D.C., 2010.

Climate Change Mitigation Policy and Energy Markets: Cooperation and Competition in Integrating Renewables into Deregulated Markets (with Maggioni, E.), *Forging Closer Ties: Transatlantic Relations, Climate and Energy.* Freie University Berlin, (Germany), 2009.

EXPERT TESTIMONY

Before the Public Utilities Commission of Ohio, Pre-filed Written Direct Testimony on Dayton Power and Light Co.'s Electric Security Plan (Case No. 16-0395-EL-SSO), Columbus, Ohio, September 18, 2016.

Before the Public Utilities Commission of Ohio, Hearing on Ohio Power Company's Stipulation Agreement to Enter into an Affiliate Power Purchase Agreement (Case No. 14-1693-EL-RDR), Columbus, Ohio, January 8, 2016.

Before the Public Utilities Commission of Ohio, Pre-filed Written Direct Testimony on Ohio Power Company's Stipulation Agreement to Enter into an Affiliate Power Purchase Agreement (Case No. 14-1693-EL-RDR), Columbus, Ohio, December 28, 2015.

Before the Public Utilities Commission of Ohio, Hearing on Ohio Power Company's Application to Enter into an Affiliate Power Purchase Agreement (Case No. 14-1693-EL-RDR), Columbus, Ohio, October 2, 2015.

Before the Public Utilities Commission of Ohio, Pre-filed Written Direct Testimony on Ohio Power Company's Application to Enter into an Affiliate Power Purchase Agreement (Case No. 14-1693-EL-RDR), Columbus, Ohio, September 11, 2015.

INVITED PRESENTATIONS & EXPERT INTERVIEWS

Powering Tomorrow: Energy Infrastructure Challenges. Building Resilient Communities in a Changing Climate Forum. Ohio State University. May, 2018.

A Multi-Party Auction Model for Land Exchanges. Regional Science Academy. Los Angeles, CA. February, 2018.

Understanding the Clean Power Plan's Impact in Ohio. NPR-WOSU. All Sides with Ann Fisher. February, 2016.

Dialogue: Can Ohio Meet the Clean Power Plan. John Glenn School of Public Affairs Dialogue Policy Forum Series, The Ohio State University, February, 2016.

Markets and Regulation: COMPAS Conference. The Ohio State University, January, 2016.

Dialogue: Ohio's Algae Crisis. John Glenn School of Public Affairs Dialogue Policy Forum Series. The Ohio State University, April, 2015.

Carbon Allowances and the Demand for Offsets: A Comprehensive Assessment of Imperfect Substitutes. John Glenn School of Public Affairs Seminar Series, The Ohio State University, March, 2015.

Pollution Permit Consignment Auctions: Theory and Experiments. Knowlton School of Architecture Seminar Series, The Ohio State University, February, 2015.

Climate Change, Public Policy and the Economy. (Keynote Panelist) American Lung Association, Columbus Public Health, Ohio Sea Grant, Byrd Polar Research Center, *et al.,* Climate Explorations Series. *A Matter of Dollars and Sense: Climate Change, Carbon Standards and Public Health*, October, 2014

Pollution Permit Consignment Auctions: Theory and Experiments. John Glenn School of Public Affairs Seminar Series, The Ohio State University, December, 2013.

Energy and the Environment. Battelle Center for Science and Technology Policy, The Ohio State University, January, 2013.

Emissions Markets, Power Markets, and Market Power: An Experimental Approach. The Ohio State University, Department of Agricultural, Environmental and Development Economics (AEDE), Seminar Series, November, 2012.

Energy and Environmental Policy: An Introduction. John Glenn School of Public Affairs, The Ohio State University, Guest lecture, October, 2012.

Anthrax Outbreak in Downtown Seattle: A Spatial and Longitudinal Assessment of Terrorism's Impact on Real Estate Prices. USC Center for Risk and the Economic Analysis of Terrorism Events (CREATE) Fall Seminar Series, October, 2011.

Transferable Property Rights Markets (Cap and Trade). School of Policy, Planning and Development (SPPD), University of Southern California, November, 2010.

California's Perspective on Progressive Electricity and Feed-In Tariffs. University of Meunster, (Germany), August, 2010.

Succeeding on the PhD Qualifying Examination. School of Policy, Planning and Development (SPPD), University of Southern California, May, 2010.

Climate Change Mitigation Policy and Energy Markets: Cooperation and Competition in Integrating Renewables into Deregulated Markets (with E. Maggioni). Forging Closer Ties: Transatlantic Relations, Climate and Energy, Freie University Berlin, (Germany), November–December, 2009.

TEACHING FIELDS

Public Policy Analysis; Public Sector Economics; Risk & Decision Analysis; Energy Policy; Environmental Policy; Graduate Capstone (Thesis)

TEACHING
(D) Course Developed
(T) Course Taught
(R) Course Revised

The Ohio State University
Graduate Courses:
Public Sector Economics & Applied Policy Analysis Capstone (Public Affairs 7920) (D, T)
Energy and Environmental Policy Capstone (Public Affairs 7910) (D, T)
Graduate Capstone Research Paper (Public Affairs 7900) (T)
Public Sector Economics (Public Affairs 6030) (T)
Risk & Decision Analysis (Public Affairs/City & Regional Planning 5880) (D, T)
Environmental & Energy Policy (Public Affairs 5800) (D, T)

Undergraduate Courses:
Environmental & Energy Policy (Public Affairs 5800) (D, T)
Policy Evaluation (Public Affairs 4000) (D)
Public Policy Analysis (Public Affairs 3000) (D, T, R)

Chaffey College
Undergraduate Courses:
American Government (Political Science 1) (T)

Mt. San Jacinto College
Undergraduate Courses:
American Government (Political Science 100) (T)

SOFTWARE

Pollution Permit Consignment Auction Human Experiment Software
Utility: Zurich Toolbox for Readymade Economics Experiments (Z-TREE) application for conducting Coasian auction market experiments utilizing a consignment mechanism.

Oligopsony 1.0
Utility: Windows-based (C# .NET 3.0) stochastic Monte Carlo simulation environment for simulating market power in uniform price auctions.

Simultaneous Energy-Emissions Market Experiment Software
Utility: Zurich Toolbox for Readymade Economics Experiments (Z-TREE) application for conducting energy-emissions market experiments, Control and Experimental Treatments.

AWARDS

Economic Analysis of Award (National) 2012
(Inaugural Recipient of Annual Award)
Regional Economic Models Inc. (REMI)

Henry Reining Jr. Award, Best Dissertation in Public Policy 2012
University of Southern California (USC)

Excellence in Publication Award 2012
University of Southern California (USC)

OLDER RESEARCH FUNDING SOURCES

John Randolph & Dora Haynes Foundation; The Southern Governors' Association; The Center for Climate Strategies; The Pennsylvania Department of Environmental Protection; The Next 10 Foundation; The University of Southern California; The University of California; U.S. Communications Agency; The RAND Corporation

PEER-REVIEW, REFEREE & EXTERNAL ADVISORY

Referee/Panel Review:

Canadian Journal of Economics; Earthquake Spectra; Eastern European Economics; Economic Modelling; Economics of Disasters & Climate Change; Energy Economics; The Energy Journal; Energy Policy; Journal of Public Policy; Journal of Public Administration Research & Theory; The National Science Foundation (NSF); Oxford Press; Risk Analysis; Journal of Regional Science; Norton Press; Science and Public Policy

Guest Editor:

Natural Hazards Review

Advisory Reviewer:

Maritime Security Center: A U.S. Department of Homeland Security National Center of Excellence

RECENT MEDIA COVERAGE

Cleveland Plain Dealer (Print/Online)—Cleveland, Ohio (2017, 2015)
Columbus Dispatch (Print/Online)—Columbus, Ohio (2015)
Gannett News Service (Print/Online)
Govplan.com (Online)—National (2017)
Midwest Energy News (Online)—Midwest U.S. (2018, 2017, 2016)
NBC News (Online)—National (2014)
NBC News (Television)—Columbus, Ohio (2014)
NPR-WOSU (Radio)—Ohio (2016)
Ohio Citizen Action (Online)—Ohio (2017)
Press & Sun Bulletin (Print/Online)—New York State (2017)
S&P Global (Online)—National (2017)
Seattle PI (Print/Online)—Seattle, Washington (2013)
TBS eFM (Radio)—National (Korea) (2015)
The Regulatory Review (Online)—National (2017)
UtilityDive (Online)—National (2018; 2017)

UNIVERSITY COMMITTEE SERVICE

University level:

1. Energy Management Faculty Advisory Committee (2014; 2015; 2016; 2017)
2. Sustainability Curriculum Committee (2014; 2015; 2016)

College level:

1. Faculty Search Committee (2016; 2017)
2. Graduate Studies Committee (2017; 2018; 2019)
3. Budget & Strategic Planning (2018; 2019)
4. Rewards & Recognition Committee (2017; 2018)
5. Curriculum Development Committee: Program Evaluation and Public Policy Analysis (2013)
6. Robert Backoff Research Award Committee (2012; 2013; 2014; 2015; 2016; 2018)
7. (Ad hoc) Appointment, Promotion & Tenure (APT) Review (2014; 2015)
8. Search Committee for School of Environment and Natural Resources, Ohio State University (2014; 2015)
9. Masters Examination Review Committee (2014; 2016; 2017)
10. Discovery Themes Research Advisory Committee (2014; 2015)
11. Wellness Committee (2018; 2019)

OHIO POWER COMPANY'S RESPONSE TO THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S DISCOVERY REQUEST PUCO CASE NOS. 18-501-EL-FOR, 18-1392-EL-RDR AND 18-1393-EL-ATA EIGHTH SET

INTERROGATORY

OCC-INT-08-077 Please provide a description of the sampling methodology utilized to conduct the Voice of the Customer ("VOC") survey? Please include a description of the random stratification methodology utilized, including any stratification by industrial classification, socioeconomic status, racial/ethnic identification.
a) Please provide a description of the methodology utilized for determining the businesses and households that would not receive an invitation to participate in the VOC survey.
b) Please provide a description of the methodology utilized to improve inclusiveness of respondents without access to a computer or internet connection.

RESPONSE

The survey involved three customer groups: residential non-PIPP customers, residential PIPP customers, and small C&I customers. No further stratification was done within these groups as part of the sampling methodology.
a) Invitations were sent to AEP Ohio customers with email addresses. Customers where AEP Ohio does not have an email address did not receive an invitation to participate. Customers that were not randomly selected by AEP Ohio did not receive an invitation to participate.
b) No such methodology was utilized.

See also the Company's response to IGS-INT-4.9.

Prepared by: Trina Horner

OHIO POWER COMPANY'S RESPONSE TO THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S DISCOVERY REQUEST PUCO CASE NOS. 18-501-EL-FOR, 18-1392-EL-RDR AND 18-1393-EL-ATA EIGHTH SET

INTERROGATORY

OCC-INT-08-080 Please provide an industrial sector classification breakdown summary of the responses to VOC survey question 17 pertaining to organizational industry for C&I respondents.

RESPONSE

Navigant does not have and is therefore unable to provide an industrial sector classification breakdown summary of the responses to VOC survey question 17.

Prepared by: Trina Horner

OHIO POWER COMPANY'S RESPONSE TO THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S DISCOVERY REQUEST PUCO CASE NOS. 18-501-EL-FOR, 18-1392-EL-RDR AND 18-1393-EL-ATA EIGHTH SET

INTERROGATORY

OCC-INT-08-082 Please provide a regional breakdown (by zip code) of PIPP and non-PIPP customers both surveyed and sampled (i.e, invited but survey not completed).

RESPONSE

For customers sampled and surveyed, Navigant does not have locational information for the specific individuals or accounts, nor did the survey include a question to determine the zip code of customers surveyed.

Prepared by: Trina Horner

OHIO POWER COMPANY'S RESPONSE TO THE OFFICE OF THE OHIO CONSUMERS' COUNSEL'S DISCOVERY REQUEST PUCO CASE NOS. 18-501-EL-FOR, 18-1392-EL-RDR AND 18-1393-EL-ATA EIGHTH SET

INTERROGATORY

OCC-INT-08-086 Please describe the methodology utilized in the VOC survey to evaluate the qualitative (i.e., open-ended) responses? Please address methodology utilized to ensure inter- and intra-coder reliability.
a) Was a qualitative text coding platform, such as Nvivo, utilized? If so, please describe the methodology utilized to program the software.
b) If the coding was performed by human coders, please provide the number of coders utilized, and inter- and intra-coder reliability scores/metrics as an accuracy percentage.

RESPONSE

A single individual reviewed and evaluated all open-ended responses. The individual reviewed each comment and categorized the comment as either supportive, opposed, neutral, or mixed/unclear. The individual further organized the comments to identify the top themes represented by each of the four comment categories.

a. No.

b. A single individual reviewed and evaluated all open-ended responses.

Prepared by: Trina Horner

RESIDENTIAL INVITE

An AEP Company

BOUNDLESS ENERGY℠

Subject Line: AEP Ohio Requests Your Valuable Feedback on Utility-Sourced Renewable Generation
Sender: AEP Ohio

Dear Valued Customer:

AEP Ohio is looking to make investments to increase the percentage of electricity from wind and solar. We are seeking input from our customers regarding utility-sourced renewable generation to inform our strategy.

Please click on the link below to share your anonymous feedback through a brief online survey:
Take the Survey <link>

Or copy and paste the URL below into your internet browser:
www link

The survey will take approximately 5 minutes to complete. If you cannot complete the survey all at one time or you accidentally exit the survey mid-course, you can resume the survey where you left off by clicking on the link from this email or hitting the back button.

Thank you in advance for taking the time to share your feedback!

Sincerely,
Julie Sloat
President and Chief Operating Officer
AEP Ohio

Follow the link to opt out of future emails:
Click here to unsubscribe <unsubscribe link>

SMALL C&I INVITE

An AEP Company

BOUNDLESS ENERGY℠

Subject Line: AEP Ohio Requests Your Valuable Feedback on Utility-Sourced Renewable Generation
Sender: AEP Ohio

Dear Valued Customer:

AEP Ohio is looking to make investments to increase the percentage of electricity from wind and solar. We are seeking input from our customers regarding utility-sourced renewable generation to inform our strategy.

Please click on the link below to share your anonymous feedback through a brief online survey:
Take the Survey <link>

Or copy and paste the URL below into your internet browser:
www link

The survey will take approximately 5 minutes to complete. If you cannot complete the survey all at one time or you accidentally exit the survey mid-course, you can resume the survey where you left off by clicking on the link from this email or hitting the back button.

This survey is being administered by Navigant on behalf of AEP Ohio. If you have questions or difficulty with the survey, please contact Jane Hummer at 303-728-2506 or jane.hummer@navigant.com.

Thank you in advance for taking the time to share your feedback!

Sincerely,
Julie Sloat
President and Chief Operating Officer
AEP Ohio

REMINDER EMAIL TEXT

Subject Line: Reminder: AEP Ohio Requests Your Valuable Feedback on Utility-Sourced Renewable Generation
Sender: AEP Ohio

Dear Valued Customer:

AEP Ohio is looking to make investments to increase the percentage of electricity from wind and solar. We are seeking input from our customers regarding utility-sourced renewable generation to inform our strategy.

Please click on the link below to share your anonymous feedback through a brief online survey:
Take the Survey <link>

Or copy and paste the URL below into your internet browser:
www link

The survey will take approximately 5 minutes to complete. If you cannot complete the survey all at one time or you accidentally exit the survey mid-course, you can resume the survey where you left off by clicking on the link from this email or hitting the back button.

Thank you in advance for taking the time to share your feedback! If you have already completed the survey, please disregard this message.

Sincerely,

Julie Sloat
President and Chief Operating Officer
AEP Ohio

**OHIO POWER COMPANY'S RESPONSE TO
INTERSTATE GAS SUPPLY'S
DISCOVERY REQUEST
PUCO CASE NO. 18-501-EL-FOR, 18-1392-EL-RDR, AND 18-1393-EL-ATA
FOURTH SET**

INTERROGATORY

IGS-INT-04.9 Regarding the Navigant Study, at TH-1, P 15 of 41, it is stated that Navigant worked with AEP to randomly select 120,000 residential customers to participate in the survey. Regarding this statement:
a. Identify what steps were taken to randomly select 120,000 customers.
b. Identify whether the sample included customers of all ages and genders
c. Identify whether AEP has an e-mail address for all customers.
d. Identify whether the absence of an e-mail address excluded a customer's ability to participate.
e. Identify whether the survey included customers from all areas of AEP's service territory.
f. Identify whether the survey included customers taking service from a competitive retail electric service provider.
g. Identify the percent of customers that responded that receive competitive retail electric service from AEP under the standard service offer.

RESPONSE

a. Navigant requested that AEP Ohio randomly select 120,000 customers and that random selection was performed by AEP Ohio.
b. The pool of customers who were sampled and invited to take the survey were randomly selected from AEP Ohio customers with email addresses. Navigant does not know the specific individuals or accounts who responded to the survey. The demographic questions at the end of the appendix included a question for age range (Question 14) but there was no question to identify gender.
c. AEP Ohio does not have email addresses for all customers.
d. The absence of an e-mail address excluded a customer's ability to participate.
e. The pool of customers who were sampled and invited to take the survey were randomly selected from AEP Ohio customers with email addresses. Navigant does not know the specific individuals or accounts who responded to the survey or their location.
f. Navigant cannot confirm which customers received or took the survey. It is possible that customers taking service from a competitive retail electric service provider took the survey as such customers were not excluded from the survey.
g. This is unknown. Navigant does not know the specific individuals or accounts who responded to the survey and the survey did not include a question to determine whether a respondent is taking service from a competitive retail provider.

Prepared by: Trina Horner

Summary: Testimony Direct Testimony of Noah Dormady on Behalf of the Office of the Ohio Consumers' Counsel electronically filed by Ms. Deb J. Bingham on behalf of Healey, Christopher Mr.