IN THE PUBLIC UTILITIES COMMISSION OF OHIO

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In the Matter of the Application of Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company for Authority to Provide for a Standard Service Offer Pursuant to R.C. 4928.143 in the Form of an Electric Security Plan.	:	Case No. 14-1297-EL-SSO

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DEPOSITION

of Lawrence J. Makovich, Ph.D. taken before me, Carolyn D. Ross, Registered Professional Reporter, and a Notary Public in and for the State of Ohio, at the offices of FirstEnergy Corporation, 76 South Main Street, Akron, Ohio, on Wednesday, May 27, 2015, at 9:00 a.m.

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APPEARANCES:

FirstEnergy Corp.
By Mr. James W. Burk
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On behalf of the Applicants.

Bruce E. Weston, Ohio Consumers' Counsel
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On behalf of the Residential Consumers of Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company.

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On behalf of the Sierra Club.

Bricker & Eckler, LLP
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On behalf of the NOPEC.

IGS Energy
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On behalf of the IGS Energy.

APPEARANCES: (Continued)

Vorys, Sater, Seymour & Pease, LLP
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On behalf of RESA, EPSA, and the PJM Power Providers Group.

Carpenter Lipps & Leland LLP
By Ms. Rebecca Hussey (via speakerphone)
and Ms. Kimberly W. Bojko (via speakerphone)
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On behalf of the Ohio Manufacturers' Association Energy Group.

Environmental Law & Policy Center
By Ms. Madeline Fleisher (via speakerphone)
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On behalf of the Environmental Law & Policy Center.

ALSO PRESENT:

Mr. Ryan O'Rourke, PUCO Staff.

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Wednesday Morning Session,
May 27, 2015.

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LAWRENCE J. MAKOVICH, Ph.D.,
being by me first duly sworn, as hereinafter certified, deposes and says as follows:

CROSS-EXAMINATION

BY MR. SOULES:

Q. Good morning, Dr. Makovich.

A. Good morning.

Q. My name is Michael Soules, and I'm representing Sierra Club in this proceeding.

Could you please state your name for the record?

A. My name is Lawrence J. Makovich.

Q. Thank you. What is your business address, Dr. Makovich?

A. My business address is 55 Cambridge Parkway, Cambridge, Massachusetts.

Q. Okay. And you're employed by IHS Energy; is that correct?

A. I'm employed by, yes, IHS.

Q. Thank you. And what is your current position with IHS?

A. I am a vice-president at IHS.

Q. Okay. And you've been serving in your current position since 2004; is that correct?

A. Yes. IHS purchased CERA, and that's when I began working for IHS.

Q. Thank you. Can you describe generally what your current job responsibilities are?

A. I conduct research into the electric power business and share that research with IHS clients.

Q. Okay. Any other job responsibilities?

A. Some management responsibilities, as well I have a small team, as well as work with others in the company on broader research initiatives, including some of the events that we put on.

Q. Okay. Thank you.

Who at IHS do you report to?

A. Atul Arya, A-r-y-a.

MR. KUTIK: Want to spell -- excuse me, why don't you spell the first name.

THE WITNESS: A-t-u-l.

MR. KUTIK: Michael, I'm sorry, since I was asking him to spell the name, we didn't get your question.

MR. SOULES: Okay. No. Thank you, David.

BY MR. SOULES:

Q. Dr. Makovich, does anyone report to you?

A. Yes.

Q. And how many people report to you?

A. I have two people.

Q. And what are their job responsibilities?

A. To support our team's research efforts.

Q. Okay. Thank you.

Now, in your professional career, you've testified before the US Congress several times; is that correct?

A. Yes.

Q. And if we could turn to Attachment LM-1, which is a copy of your curriculum vitae. Please let me know when you have that ready.

A. Yeah.

Q. Great. So on the final page of that attachment, there's a heading entitled "Testimony." Beneath that there are five entries. Do you see that?

A. Yes.

Q. And three of those entries refer to

Congressional committee hearings from 2001, correct?

A. Yes.

Q. Have you testified before the US Congress on any occasion other than those three committee hearings?

A. No.

Q. Okay. Now, earlier this year you testified before a committee of the Michigan House of Representatives, correct?

A. Yes.

Q. And the subject of your testimony was retail open access policy, correct?

A. Yes.

Q. Okay. And generally speaking, what were your conclusions about retail open access policy?

A. That the proposal to reform the process there had merit.

Q. And why did it have merit?

A. The partial retail open access creates an unfair cost distribution in the power sector.

Q. Okay. And so the proposal that was before the Michigan House would address that problem?

A. Yes.

Q. Okay. When you appeared before the

Michigan House of Representatives committee, were you representing another organization besides IHS?

A. No.

Q. Okay. Were you testifying solely on your own behalf?

A. Yes.

Q. And did the Michigan legislature compensate you for your appearance before the committee?

A. No.

Q. Have you testified before a state legislature on any other occasion other than this committee hearing in Michigan?

A. No.

Q. Dr. Makovich, have you ever testified in a court case?

A. Yes.

Q. Okay. What case -- court case?

A. There were some court cases regarding the tax basis of power plants.

Q. And what court were those cases in?

A. One was in Michigan and one was in New York.

Q. And were these state court proceedings?

A. Yes.

Q. And in the Michigan proceeding, on whose behalf did you testify?

A. It was the Midland Cogeneration Venture.

Q. And do you recall approximately when that court case was going on?

A. I do not remember.

Q. Okay. Do you remember what the subject of your testimony was?

A. Yes.

Q. And what was that?

A. In regard to the discounted cash flow of the Midland Cogeneration Venture.

Q. Did you have your deposition taken in that case?

A. No.

Q. And then you also referenced a New York state case; is that correct?

A. Yes.

Q. And on whose behalf did you testify in that proceeding?

A. I'm not -- I don't remember.

Q. Okay. Do you remember approximately when that case was ongoing?

A. Again, it was quite a while ago; so I don't remember the date.

Q. Okay. Did you have your deposition taken for that case?

A. No.

Q. Do you remember the name of either the Michigan case or the New York case?

A. The ownership of the plants in New York had changed a number of times. I believe it was Dynegy that owned the plants, but I would have to check that.

Q. Okay. Thank you.

Apart from the Michigan case and the New York case, have you testified in any court cases?

A. Those are the two.

Q. Okay. Thank you.

Now, you previously testified before the North Carolina Public Service Commission; is that correct?

A. Yes.

Q. And that was in July of 2014, correct?

A. Yes.

Q. And on whose behalf did you provide testimony in that proceeding?

A. Duke Energy.

Q. Did you have your deposition taken in that proceeding?

A. No.

Q. Okay. Apart from this North Carolina proceeding, have you ever provided written testimony to a state public utility commission or public service commission?

A. No.

Q. Okay. And apart from the North Carolina proceeding, have you ever provided live testimony to a state public utility commission or public service commission?

A. No.

Q. Okay. Thank you.

So let's just talk about your testimony here. Now, in this case you're testifying on behalf of the Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company; is that correct?

A. Yes.

Q. And if I refer to those three utilities collectively as the companies, will you understand what I mean?

A. Yes.

Q. Great. And for your testimony in this case, did IHS contract directly with the companies?

A. Yes.

Q. Okay. So the contract is with the Ohio Edison Company, The Cleveland Electric Illuminating Company, and The Toledo Edison Company?

A. I have not seen the contract; so I am not familiar with exactly what the language is.

Q. Okay. Did somebody else at IHS handle the contract?

A. Yes.

Q. Have you -- apart from any conversations with counsel, have you communicated with anyone who is employed by any of the companies?

A. I'm not sure which -- could you rephrase that question?

Q. Yes. Have you spoken to anyone who is employed by the companies?

A. I've had a long-standing, ongoing relationship with these FirstEnergy companies; so I have communicated with people at FirstEnergy.

Q. Okay. Are there particular people within the FirstEnergy companies that you regularly

communicate with?

A. Yes.

Q. And who are those people?

A. Lauren Quam.

Q. Okay. Anyone else besides Lauren Quam?

A. Well, I have had discussions with a number of people in these companies through time.

Q. Okay. So does IHS have a consulting agreement with the FirstEnergy companies outside of your work in this case?

A. No.

Q. Has IHS Energy previously had consulting agreements with FirstEnergy companies?

A. I'm -- I'm not aware of the complete history of IHS and FirstEnergy on the consulting side of the business.

Q. Okay. In the communications that you've had with employees of the FirstEnergy companies, is that just because you're both in the same -- you know, you're both dealing with utility issues or was there a business relationship?

A. There's a business relationship.

Q. Okay. What was the nature of that business relationship?

A. FirstEnergy is a retainer client of IHS.

Q. What types of services does IHS provide FirstEnergy?

A. As a retainer client, they are entitled to access the research we do in the electric power sector.

Q. Okay. Are there any other services that you're aware of that IHS provides FirstEnergy?

A. Yes.

Q. And what are those services?

A. We have provided presentations at the request of FirstEnergy.

Q. Presentations to FirstEnergy or presentations to other entities?

A. Presentations to FirstEnergy.

Q. Okay. Apart from that, are there any other services that IHS provides FirstEnergy?

A. No.

Q. Thank you. Did anyone at IHS assist you with your testimony for this proceeding?

A. Yes.

Q. And what type of assistance did they provide?

A. Assembling some of the graphics, and I

have coauthors on the report attached as LM-2.

Q. Okay. Apart from LM-2 and the assistance with the graphics, did anyone at IHS assist you with your testimony?

A. No.

Q. Dr. Makovich, if I refer to the Public Utilities Commission of Ohio simply as the Commission, will you understand what I mean?

A. Yes.

Q. Okay. And you're familiar with the Economic Stability Program that the companies had proposed for Commission approval, correct?

A. Yes.

Q. And the Economic Stability Program includes the companies' proposed Retail Rate Stability Rider, correct?

A. Yes.

Q. And if I refer to that proposed rider as Rider RRS, will you understand what I mean?

A. Yes.

Q. Does the Economic Stability Program include any components other than Rider RRS?

A. I do not know.

Q. All right. Are you aware of the

proposed agreement under which FirstEnergy Solutions worked --

THE COURT REPORTER: I'm sorry, I need you to repeat that.

MR. KUTIK: You need to restate it. The court reporter didn't get your question.

BY MR. SOULES:

Q. Okay. Thank you.

Are you aware of the proposed agreement under which FirstEnergy Solutions would sell its capacity, energy, and ancillary services from generating plants to the company?

A. I'm sorry, repeat the question.

MR. SOULES: Could we have the question reread back?

(Record read back as requested.)

THE WITNESS: Yes.

BY MR. SOULES:

Q. Okay. And do you know which generating plants are the subject of this proposed agreement between the companies and FirstEnergy Solutions?

A. Yes.

Q. And what plants are the subject of the agreement?

A. It involves the Davis-Besse nuclear power station, the WH Sammis coal-fired power plant, and it also involves two generating plants owned and operated by the Ohio Valley Electric Corporation, of which FirstEnergy has a share of the output.

Q. And are those two -- those two additional plants the Kyger Creek and Clifty Creek plant?

A. I believe so, yes.

MR. SOULES: Has somebody just joined the deposition?

MR. SETTINERI: Yes. This is Mike Settineri with the law firm of Vorys, Sater, Seymour & Pease on behalf of the P3 Power Providers organization and EPSA and RESA.

MR. SOULES: Good morning. Sounds like someone needs to put their phone on -- okay. Thank you.

BY MR. SOULES:

Q. Dr. Makovich, do you know how FirstEnergy Solutions would be compensated under this proposed agreement?

A. Yes.

Q. And how will FirstEnergy Solutions be

compensated?

A. Under a 15-year contractual payment.

Q. Can you elaborate on that 15-year contractual payment?

A. I'm not familiar with the actual terms and conditions of the long-term contract arrangement.

Q. Okay. Do you know what return on equity FirstEnergy Solutions would receive for its plants under the proposed agreement?

A. No.

Q. Do you know whether the companies in FirstEnergy Solutions had executed a final contract for this proposed agreement?

A. No.

Q. And are you offering any opinions in this proceeding about this proposed agreement?

MR. KUTIK: Objection.

THE WITNESS: I'm sorry, would you repeat the question?

BY MR. SOULES:

Q. Sure. Are you offering any opinion in this proceeding about this proposed agreement?

A. Yes.

Q. And what opinion are you offering?

A. My opinion is that this is a way to address a problem in the revenue stream for these baseload power plants.

Q. And what are you -- what are you relying on in support of that?

A. Research into the value of power supply diversity and the missing money problem.

Q. Okay. Dr. Makovich, have you reviewed the term sheet that relates to this proposed agreement?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: I have already told you I've not seen the contract.

BY MR. SOULES:

Q. Okay. So you're not offering any opinions regarding the specific terms of the proposed agreement; is that correct?

A. That's correct.

Q. Thank you. Now, in this proceeding, you have offered certain opinions about the Economic Stability Program, correct?

A. Yes.

Q. Okay. Could we turn to Page 3 of your

written testimony?

A. Okay.

Q. Okay. Starting on Line 4 it states, I'm quoting, "The Economic Stability Program will produce benefits for retail consumers because it will prevent the Plants from retiring before it is economic to do so. It makes economic sense for Ohio policy makers and the Public Utilities Commission of Ohio (the 'Commission') to protect power supply diversity in Ohio over the long-term by approving the Companies' Economic Stability Program."

That's your testimony, correct?

A. Yes.

Q. And the reference to the plants on page -- or, I'm sorry, the reference to the plants on Line 5 is referring to the WH Sammis plant and the Davis-Besse plant, correct?

A. Yes.

Q. Okay. And are the benefits for retail consumers referenced in this portion of your testimony the same benefits that you describe on Pages 12 to 16 of your testimony?

MR. KUTIK: Objection.

THE WITNESS: The benefits that I've

described on Pages 12 through 16, yes.

BY MR. SOULES:

Q. Okay. And are the benefits described on Pages 12 to 16 the only benefits that you're referring to here?

A. There may be additional benefits.

Q. Okay. Can you identify those additional benefits?

A. I believe in my -- in my testimony, I do refer to other analysis that's been done with regard to employment and economic impacts.

Q. And, Dr. Makovich, are you referring to Page 12, Line 17 through 19?

MR. KUTIK: Objection.

THE WITNESS: Yes.

BY MR. SOULES:

Q. Okay. So understanding that that's inclusive of the benefits described on Pages 12 through 16, are there other benefits for retail consumers that you're referring to?

A. There may be.

Q. Okay. Can you identify them?

A. Well, there are changes that are likely to occur in the power business which may create

additional benefits from these plants.

Q. And what changes are you referring to?

A. Regulatory rule changes.

Q. Can you describe those regulatory rule changes?

A. Well, they can cover lots of different regulations that can change in the future.

Q. Okay. Let's set aside the potential benefits for a minute. Apart from that potential benefit and the benefits described on Pages 12 to 16, are there other benefits for retail consumers that you're referring to on Page 3?

A. I have included testimony with regard to some of the benefits. I have not testified that this is an exhaustive list of the benefits that these plants can provide.

Q. Okay. Going back to the regulatory rule changes you referenced a moment ago.

A. Yes.

Q. Can you give me some examples of those?

A. One example would be that within the next several months, we expect the EPA to issue its final rule on its Clean Power Plan that's going to require state implementation plans to be developed.

Q. And that change relates to the Economic Stability Program in what fashion?

A. The carbon footprint of these plants will have to be part of the state implementation plan.

Q. And that carbon footprint would provide a benefit for retail consumers?

A. Without the final rule, I cannot tell you what the costs or benefits will be other than there's a possibility that these plants will produce additional benefits beyond what I've testified to.

Q. Okay. And sitting here today, can you identify any other benefits for retail consumers that are not described on Pages 12 to 16 of your testimony?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: As I said, I have not testified that this is an exhaustive list of the benefits.

BY MR. SOULES:

Q. So you cannot identify any other benefits to retail consumers sitting here today, correct?

MR. KUTIK: Objection, mischaracterizes his testimony.

THE WITNESS: Would you reread the question, please?

(Record read back as requested.)

THE WITNESS: No, that's not correct.

BY MR. SOULES:

Q. Okay. Can you please identify those benefits?

MR. KUTIK: Objection. He already has; so I object, asked and answered.

BY MR. SOULES:

Q. Apart from the one potential benefit we've already discussed, can you identify any other benefits for retail consumers that are not referenced on Pages 12 to 16 of your testimony?

MR. KUTIK: Well, that also mischaracterizes his testimony, but you can answer it again.

THE WITNESS: I have said that there are additional benefits that these plants may provide to retail customers. I have not focused my testimony on all of the benefits that these plants can provide, but I've focused my testimony on some of the benefits

that they provide.

BY MR. SOULES:

Q. Have you performed any analyses to identify other benefits for retail consumers that's not described in your testimony?

THE WITNESS: I'm sorry, could you reread that question?

(Record read back as requested.)

THE WITNESS: Can you rephrase that question?

BY MR. SOULES:

Q. Sure. So for your testimony in this proceeding, did you consider benefits for retail consumers that would result from the Economic Stability Program?

A. I focused my testimony on some of the benefits that I see from the Economic Stability Program. I've not testified that this is an exhaustive list of the benefits that these power plants can provide.

Q. And were there analyses relating to benefits for retail consumers which are not described in your testimony that you performed but did not discuss in your testimony?

A. Can you rephrase that question?

Q. Sure. Sure. So when you were considering the potential benefits for retail consumers related to the Economic Stability Program, did you perform a set of analyses related to a category of benefits that are not discussed here at all?

A. No.

Q. Okay. Could we turn to Page 12 of your written testimony?

A. Yes.

Q. Okay. Starting on Line 8, there's a sentence that reads, "I discuss it here in my testimony to appropriately inform the discussion on how the Plants at issue in this case can be exceptional assets from an operations perspective but nevertheless be financially challenged."

That's your testimony, correct?

A. Yes.

Q. What makes a generating unit an exceptional asset from an operations perspective?

A. It is part of a cost-effective generation mix.

Q. Are there specific characteristics that

a unit must have to be an exceptional unit?

A. Can you repeat that question?

Q. Yes. Are there specific characteristics that a generating unit must have to be an exceptional asset from an operations perspective?

A. The characteristics I refer to regard the unit being part of a cost-effective generation mix.

Q. What do you mean by "part of a cost-effective generation mix"?

A. I testified that the lowest-cost way to provide customers with the electricity they need when they want it involves a mix of peaking, cycling, and baseload plants in a generating portfolio.

Q. And are there any other specific characteristics that a unit must have to be an exceptional asset?

A. Yes.

Q. What characteristics are those?

A. Well, all units have parameters with regard to cost and performance. Meeting those parameters is something that's necessary for a cost-effective generation mix.

MR. OLIKER: I'm sorry. I apologize.

Could I have his answer from three questions ago read back?

(Record read back as requested.)

MR. OLIKER: Thank you.

MR. SOULES: I'm sorry, could I have the last question read back?

(Record read back as requested.)

BY MR. SOULES:

Q. Dr. Makovich, which parameters specifically are you referring to?

A. Well, for example, availability.

Q. Any other parameters?

A. Yes.

Q. Could you please list those parameters?

A. For example, the efficiency of turning fuel into electricity.

Q. Any other parameters?

A. Yes.

Q. Okay. And what parameters?

A. That operation and maintenance expenses are within the expected range.

Q. Any other parameters?

A. Yes.

Q. Okay. What parameters?

A. Well, there are numerous parameters from an engineering and economic standpoint that describe power plants, and these are all the things that are involved in putting together a cost-effective mix.

Q. Okay. Are there any nuclear generating units currently operating in the United States that are not exceptional assets from an operations perspective?

A. I don't have the current data in front of me with regard to the distribution of nuclear plant performance.

Q. Okay. And are you aware of any coal-fired generating units currently operating in the United States that are not exceptional assets from an operations perspective?

A. Similarly, I don't have plant-specific information on coal unit cost and performance in front of me here to be able to provide you an answer.

Q. Okay. And is it your opinion that the Sammis plant is an exceptional asset from an operations perspective?

A. Yes.

Q. And why do you believe that Sammis is an exceptional asset from an operations perspective?

A. The testimony of Don Moul.

Q. And are you referring to Mr. Moul's direct testimony?

A. Yes.

Q. Okay. Are there any other reasons why you believe that Sammis is an exceptional asset from an operations perspective?

A. No.

Q. Okay. So your opinion is based entirely upon the direct testimony of Donald Moul; is that correct?

A. Yes.

Q. Okay. Are you offering any independent opinions in this case regarding the Sammis plant's operational characteristics?

MR. KUTIK: Objection.

THE WITNESS: No.

BY MR. SOULES:

Q. And is it your opinion that the Davis-Besse plant is an exceptional asset from an operations perspective?

A. Yes.

Q. And do you believe that Davis-Besse is an exceptional asset from an operations perspective?

A. Based on the testimony of Don Moul.

Q. Okay. Are there any other reasons why you believe that Davis-Besse is an exceptional asset from an operations perspective?

THE WITNESS: Would you repeat that question?

(Record read back as requested.)

THE WITNESS: No.

BY MR. SOULES:

Q. Okay. So you are relying entirely on the direct testimony of Donald Moul for that opinion, correct?

A. Yes.

Q. Okay. If we could look again at Page 12, starting at Line 13 it states, "The Economic Stability Program is a reasonable effort to address the missing money problem by compensating the Plants for system benefits that are not explicitly compensated for in the marketplace. One of those benefits is supply diversity, including the system reliability and price stability benefits provided by coal and nuclear baseload plants with on-site fuel supply."

That's your testimony, correct?

A. Yes.

Q. Are you offering an opinion in this proceeding about the reliability of the Davis-Besse plant?

THE WITNESS: Could you read that back, please?

(Record read back as requested.)

THE WITNESS: Read it again, please.

(Record read back as requested.)

THE WITNESS: Yes.

BY MR. SOULES:

Q. And what opinion are you offering?

A. That Davis-Besse is part of the cost-effective generation mix.

Q. Can you explain how that relates to the reliability of the plant?

A. As I previously testified, that the cost and performance of plants are a necessary condition for them to be part of the cost-effective portfolio.

Q. Are you relying on any other witness's testimony for that opinion?

A. I'm sorry, can you rephrase the question?

Q. Sure. You testified that Davis-Besse is

part of a cost-effective generation mix, correct?

A. Yes.

Q. Are you relying on another witness's testimony in support of that?

A. I've already said that I'm relying on Don Moul's assessment.

Q. Did you review any specific data relating to the reliability of the Davis-Besse plant?

A. No.

Q. Did you review any other documents related to the reliability of the Davis-Besse plant?

A. No.

Q. And are you offering an opinion in this proceeding about the reliability of the Sammis plant?

A. Yes.

Q. And what opinion are you offering?

A. That it's currently part of a cost-effective generating portfolio.

Q. And are you relying in part on Donald Moul's direct testimony for that opinion?

A. Yes.

Q. Is there anything else you're relying on for that opinion?

A. No.

Q. And you haven't reviewed any specific data about the Sammis plant's reliability, correct?

A. Yes.

Q. Yes, that's correct?

A. Yes.

Q. And you've not reviewed any other documents specifically relating to the Sammis plant's reliability, correct?

A. Yes.

Q. Do you have an opinion as to whether some of the generating units of the Sammis plant are more reliable than others?

A. No.

Q. Okay.

MR. SOULES: I'm sorry, did somebody just join the deposition?

MR. KUTIK: Let's go off the record.

(Discussion held off the record.)

MR. KUTIK: Let's go back on the record.

MR. SOULES: Okay. Hopefully that won't happen again.

BY MR. SOULES:

Q. Dr. Makovich, are you aware of problems the railroad industry has recently experienced in

transporting Powder River Basin coal to midwest coal plants?

MR. KUTIK: Objection, assumes facts.

THE WITNESS: Can you rephrase the question, please?

BY MR. SOULES:

Q. Sure. Do you have any knowledge as to whether the railroad industry has had difficulty transporting Powder River Basin coal to midwest coal plants?

MR. KUTIK: Objection.

THE WITNESS: If your question is has that ever happened, the answer would be, yes, there are constraints in most every infrastructure delivery system at some point in time.

BY MR. SOULES:

Q. Do you have any knowledge about whether there have been greater-than-normal problems in the last year or two?

MR. KUTIK: Objection.

THE WITNESS: Can you rephrase that question?

BY MR. SOULES:

Q. Yes. And so I believe you answered my

earlier question in terms of has that ever been -- have there ever been problems transporting Powder River Basin coal to midwest coal plants.

My question is: Are you aware of any problems within the last year or two in transporting Powder River Basin coal to midwest coal plants?

MR. KUTIK: Well, I'll state -- I'll state my objection again, and I'll have an additional objection that it mischaracterizes his testimony.

Go ahead. You can answer.

THE WITNESS: I have not included in my testimony anything about specific constraints that did or did not exist in the delivery of Powder River Basin coal.

BY MR. SOULES:

Q. Okay. You're not offering any opinions in this case about the effect any transportation constraints might have on the Sammis plant's reliability, correct?

MR. KUTIK: Objection, assumes facts, assumes there are constraints, assumes that the Powder River Basin coal problems regarding the midwest plants includes Sammis, which there's been no evidence of. He can answer.

MR. SOULES: And I would please ask, Mr. Kutik, if you could avoid --

MR. KUTIK: No, no. I'm making an objection. When you ask an absurd and totally improper question, I can make my objection on the record. If you don't like it, it's too bad.

MR. SOULES: Can we please have the question reread?

(Record read back as requested.)

THE WITNESS: No, it's not correct.

BY MR. SOULES:

Q. Why is that not correct?

A. In LM-2, on Page 11, I discuss the general problem that delivered fuel prices for power generation have inherent uncertainties.

Q. Have you offered any opinion beyond what's referenced in Attachment LM-2?

MR. KUTIK: Objection.

THE WITNESS: Yes.

BY MR. SOULES:

Q. Okay. And what opinion?

A. On Page 13 of my supplemental testimony, I discuss on Line 20 -- beginning on Line 20 that power generation technologies have different

performance risks.

Q. Okay. Thank you.

Getting back, and without inquiring as to what the content of this would be, have you performed any analysis of coal transportation to the Sammis plant specifically?

A. No.

Q. Okay. Thank you.

If we could go back to Page 12 of your testimony. Starting on Line 22 it states, "The Economic Stability Program addresses the missing money problem and prevents uneconomic retirements of cycling and baseload power plants that would move the generation portfolio toward a more expensive fuel and technology mix."

That's your testimony, correct?

A. Yes.

Q. Okay. Is it your understanding that some of the generating units at issue in this case are cycling units?

A. I'm not sure about the units that they've got partial ownership in. My understanding is Sammis and Davis-Besse would be best characterized as baseload units.

Q. And would all seven generating units at the Sammis plant be best characterized as baseload units?

A. I've not done a specific analysis of the units at Sammis.

Q. Okay. So why would it be a concern that cycling units might retire?

A. As I've testified, the most cost-effective way to give customers the electricity they want when they want it is to have the cost-effective mix of peaking, cycling, and baseload units. If you don't have that mix, you're not going to have as cost effective a power supply portfolio.

Q. Hypothetically speaking, if a cycling unit retired and was replaced by another cycling unit, would that pose a problem?

MR. KUTIK: Objection.

THE WITNESS: As I testified on Page 41 of LM-2 that, "There is no single fuel or technology of choice for power generation, and all forms of power production have economic, environmental, and reliability impacts."

So what the most economic replacement would be would depend on what the current generating

mix looks like.
BY MR. SOULES:
Q. Okay. Are there any particular characteristics about the cycling unit currently in existence today that make them a more optimal part of a generation mix as opposed to a cycling unit that might replace them?
MR. KUTIK: Objection.
THE WITNESS: I'm not sure I understand your question. Can you rephrase it, please?
BY MR. SOULES:
Q. Sure. So our country's generation portfolio currently includes a number of cycling units, correct?
A. Yes.
Q. Is there anything particular about the characteristics of those units that make them more optimal than a cycling unit that would replace them?
MR. KUTIK: Objection.
THE WITNESS: Yeah. I don't understand what you mean by "more optimal."
BY MR. SOULES:
Q. Let's scratch that, and we'll move on.
Could we take a look at Page 13 of your

written testimony?

A. Yes.

Q. Okay. Thank you.

So starting on Line 3 it states, "These power plants have capacity costs in excess of combustion turbine, but they have a lower overall power supply cost because the expected value of the fuel savings compared to a combustion turbine are more than enough to pay for the higher upfront capacity costs. Thus, some of the additional capacity costs over and above combustion turbine costs in a power supply portfolio are cost-effective investments in production cost efficiency."

Is that your testimony?

A. Yes.

Q. Okay. When you're referring to these power plants on Line 3, are you referring specifically to Sammis and Davis-Besse?

A. No.

Q. And you're referring to cycling and baseload power plants generally?

A. Yes.

Q. Okay. And combustion turbine references in this portion of your testimony are referring to

natural gas simple-cycle combustion turbine; is that correct?

A. It could also involve a liquid fuel combustion turbine.

Q. Okay. But you're not referring to combined-cycle plants, correct?

A. A combined-cycle plant involves a combustion turbine plus a heat recovery steam generator.

Q. So when you refer to combustion turbine in this portion of your testimony, what are you referring to?

A. I'm referring to the combustion turbine technology.

Q. Including combined-cycle plant?

A. No. I referred to combined-cycle plants as an example of a technology with a higher upfront cost, but lower production cost compared to the combustion turbine alone.

MR. SOULES: I'm sorry, could we have that last answer read back?

(Record read back as requested.)

BY MR. SOULES:

Q. Okay. Thank you.

In this portion of your testimony, though, you're comparing cycling and baseload power plants to combustion turbine specifically.

MR. KUTIK: Did you get the question? Michael, why don't we try to repeat that question, please.

MR. SOULES: Sure. Can you guys hear me any better now?

MR. KUTIK: Slightly, yes.

MR. SOULES: Okay. I'll try to speak up.

BY MR. SOULES:

Q. In this portion of your testimony, you're comparing cycling and baseload power plants to combustion turbines specifically, correct?

A. I'm comparing all three technologies to each other.

Q. Okay. Are you considering combined-cycle plants in this comparison?

MR. KUTIK: Objection.

THE WITNESS: Natural gas-fired, combined-cycle power plants are one of several technologies that can be part of a cost-effective generation mix.

BY MR. SOULES:

Q. Okay. Let's take a look at Page 15 of your testimony.

A. Yes.

Q. Okay. Starting on Line 18 it states, "Ohio must face the conundrum that the Plants are both economic (because the cost of continued operation is below the cost of closing the Plants and replacing them with the lowest-cost source of equivalent power supply) and at risk of retirement (because market compensation is chronically below their average total cost)."

Is that your testimony?

A. Yes.

Q. Okay. So it's your opinion that the Sammis and Davis-Besse plants are economic because the cost of continued operations is below the cost of closing the plant and replacing them with the lowest-cost source of equivalent power supply, correct?

A. Yes.

Q. Okay. I'd like to spend a few minutes talking about this opinion.

In developing this opinion, did you

analyze the expected cost of continuing to operate the Sammis plant?

A. As I've previously testified, I relied on Don Moul's testimony.

Q. I believe when we were talking about Mr. Moul's testimony, we were discussing another portion of your testimony, and I'm wondering about this specific opinion.

Did you analyze -- did you specifically analyze the expected cost of continuing to operate the Sammis plant?

A. I've already answered that question. I have relied on Don Moul's testimony in that regard.

Q. Okay. When you're referring to Don Moul's testimony, you mean his direct testimony?

A. Yes.

Q. Okay. And not his supplemental testimony?

A. I am relying on his direct testimony.

Q. Okay. Are you relying on any other witness's testimony for your opinion that the Sammis plant is economic?

A. No.

Q. Are you relying on any projections of

the Sammis plant's future costs and revenues for your opinion that the Sammis plant is economic?

A. I believe I've already answered that question. I've relied on Don Moul's testimony in this regard.

Q. Okay. In preparing your testimony for this proceeding, did you review any projections of Sammis's future costs and revenue?

A. Would you repeat that question, please?

MR. SOULES: Could we have the question reread?

(Record read back as requested.)

THE WITNESS: Yes.

BY MR. SOULES:

Q. In what years did those projections cover?

A. I'm referring to Don Moul's testimony with regard to the economics of these plants going forward.

Q. Okay. Apart from any projection that might be in Mr. Moul's testimony, you didn't review any projections of Sammis's future costs and revenue; is that correct?

A. I've testified that I've relied on the

assessments in Don Moul's testimony.

Q. And you're not relying on anything other than Mr. Moul's testimony for your opinion that the Sammis plant is economic; is that correct?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: I believe I've already answered that question, that I'm relying on Don Moul's testimony in that regard.

BY MR. SOULES:

Q. Okay. Looking again at Page 15, Lines 19 to 21, you refer to "...the cost of closing the Plants and replacing them with the lowest-cost source of equivalent power supply..." Do you see where it states that?

A. Yes.

Q. It's a little unclear to me whether you're referring here to one category of costs or two categories. Is the cost of closing an existing power plant a separate cost that you consider when determining whether the plant is economic?

A. I'm sorry, I don't think I understand your question. Can you rephrase it?

Q. Sure. So when you were -- in general

when you're trying to determine whether a power plant is economic, you consider the cost of continued operations as part of that assessment, correct?

A. Yes.

Q. And you also consider the cost of replacing that plant with the lowest-cost source of equivalent power supply, correct?

A. Yes.

Q. And I'm wondering if there's a third category of cost that you consider, which is the cost of closing the existing plant?

A. The costs that I'm discussing here are the going-forward costs of the existing plant.

Q. So -- and I'm not -- I'm asking this in general, not with respect to Sammis or Davis-Besse. When you're determining whether a plant is economic, do you assess what the costs would be of closing the plant?

A. Would you repeat that question, please?

MR. SOULES: Could we have the question reread?

(Record read back as requested.)

THE WITNESS: What I've talked about is the economic test, which involves comparing the

going-forward costs of a plant with the cost to replace it. That's the economic test that I have discussed.

BY MR. SOULES:

Q. Okay. So the economic test essentially involved comparing two categories of costs; is that correct?

A. I'm not sure what you mean by "categories."

Q. The economic tests involved comparing two costs, the cost of going forward and the cost of replacement; is that accurate?

A. Yes.

Q. Okay. Thank you.

Could we -- let's talk for a few minutes about the costs of replacing -- I'm sorry. Scratch that.

It's your opinion that the Davis-Besse plant is economic, correct?

A. As I've already testified, I relied on Don Moul's testimony in this regard.

Q. Okay. That applies with respect to your opinion about both Davis Bessie and Sammis, correct?

A. Yes.

Q. Okay. With respect to the cost of replacing Sammis and Davis-Besse with the lowest-cost source of equivalent power supply, do you know what type of resource is the lowest-cost source of equivalent power supply for Sammis and Davis-Besse?

A. I have not done an assessment, as I said, of the specifics of the Davis-Besse and Sammis plants. I've testified to the value of fuel and technology diversity and power supply.

Q. So you're not offering an opinion in this case about what type of resource specifically would be the lowest-cost source of equivalent power supply for Sammis and Davis-Besse?

MR. KUTIK: May I have the question read, please?

(Record read back as requested.)

THE WITNESS: My testimony is that the missing money problem creates the probability that cost-effective baseload plants will close down and be replaced by more costly peaking and cycling plants.

BY MR. SOULES:

Q. Okay. So you've not performed any client-specific analysis for the Sammis plant, correct?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: My testimony is that I've relied on Don Moul's testimony in that regard.

BY MR. SOULES:

Q. Okay. Have you considered whether a subset of the Sammis unit could be retired without requiring an equivalent power supply?

A. I've already testified that I've not done a specific analysis of Sammis or Davis-Besse, and I've relied on Don Moul's testimony in that regard.

Q. Okay. Let's go back to Page 15 again, Lines 18 to 22. It's your opinion that the Sammis plant is at risk of retirement, correct?

A. Yes.

Q. And what information did you rely on in developing that opinion?

A. My assessment of the consequences of the missing money problem in the PJM power market.

Q. Is there any other information that you are relying on for that opinion?

A. Yes.

Q. And what information is that?

A. On Page 29 of LM-2, I discuss some similar examples to the Davis-Besse plant, including the Kewaunee nuclear plant and the Vermont Yankee nuclear plant.

Q. So I was inquiring about the Sammis plant, not the Davis-Besse plant. Is there any other information that you're relying on for your opinions that the Sammis plant is at risk of retirement?

A. My previous answer is still applicable. There are other examples of baseload plants that are closing down before it's economic to do so because of the missing money problem in the energy marketplace.

Q. Okay. Thank you.

Is there anything else that you're relying on for your opinion that the Sammis plant is at risk of retirement?

A. Yes.

Q. And what is that?

A. The direct testimony of Don Moul.

Q. Okay. Anything else?

A. No.

Q. Okay. Based on what you know today, how great is the risk that Sammis will retire in the next three to five years?

A. As I previously testified, I'm relying on the assessment of Don Moul in that regard who says on Line 17 of his direct testimony, on Page 2, Line 17, "The economic viability of the Plants is in doubt." He goes on further on Line 21 to say, "...the Plants may not survive to see these better days."

Q. Okay. Do you think it's more likely than not that Sammis will retire in the next three to five years if the Economic Stability Program is not approved?

A. I have not put a probability on the retirement of these plants.

Q. Okay. Do you have an opinion as to whether some of the Sammis units are at greater risk of retirement than other units?

A. I've already testified that I've not done a specific analysis of Sammis, and I've relied on the testimony of Don Moul in that regard.

Q. Okay. Have you communicated with anyone employed by FirstEnergy Solutions or the companies about the Sammis plant's potential retirement?

A. Can you rephrase that question?

Q. Yeah. Can you tell me what confused you

about that question?

A. Well, it could be broadly interpreted. If I've discussed the missing money problem, since it has a direct bearing on the plant, without mentioning the plant, you know, that could be considered a discussion of the issue that affects the plant.

Q. Okay. Thank you.

Have you communicated with anyone employed by FirstEnergy Solutions or the companies that specifically referenced the Sammis plant's potential retirement?

MR. KUTIK: Objection.

THE WITNESS: Yeah. I've already testified that I've been engaged here to talk about the value of fuel diversity as it applies to the potential loss of Sammis and Davis-Besse.

BY MR. SOULES:

Q. Have you verbally communicated with anyone employed by FirstEnergy Solutions or the companies about whether the Sammis plant specifically might retire?

MR. KUTIK: Objection.

THE WITNESS: My testimony, as I understand it, has been read by people at

FirstEnergy, and my testimony does discuss the potential for Sammis and Davis-Besse to retire.

BY MR. SOULES:

Q. Have you had an oral conversation?

A. I'm sorry?

MR. KUTIK: I'm sorry, what was the question?

THE WITNESS: I didn't hear that.

BY MR. SOULES:

Q. Have you had a verbal conversation with anyone employed by FirstEnergy Solutions or the companies about the Sammis plant potential retirement?

MR. KUTIK: Objection.

THE WITNESS: Yes.

BY MR. SOULES:

Q. And are you relying on that conversation in any way for your opinion that the Sammis plant is at risk of retirement?

A. I believe I've already testified, I'm relying on the testimony of Don Moul in that regard.

Q. And Mr. Moul's testimony is written testimony, right?

A. Yes.

Q. And I was inquiring about verbal conversations.

MR. KUTIK: Well, he's answered your questions, Counsel. Why don't you move on. In fact, it's -- we've been going at this an hour-and-a-half. Why don't we take a break. Let's go off --

MR. OLIKER: Dave, before we go on a break, can I just follow up and see what the order is right now, because I may have a conflict around lunch, though I doubt it will be my turn by then.

MR. KUTIK: First let's be off the record.

(Discussion held off the record.)

(Recess taken.)

(Record read back as requested.)

BY MR. SOULES:

Q. Dr. Makovich, do you know what factors FirstEnergy Solutions Corp. would consider in deciding whether to retire the Sammis plant?

A. I'm not sure what you mean by "what factors."

Q. If the owner of a generating unit were considering the retirement of that unit, they would look at certain factors or criteria in deciding that,

right?

A. Yes.

Q. That's the way in which I'm referring to factors. Does that clarify?

A. Not really. I'm not sure what you're asking.

Q. Do you know what type of information FirstEnergy Solutions would consider in deciding whether to retire the Sammis plant?

A. I have not been privy to any of the internal discussions by the companies with regard to this retirement assessment.

Q. Okay. And you don't know what time horizon FirstEnergy Solutions would consider in deciding whether to retire the Sammis plant; is that correct?

A. As I've just testified, I've not been privy to any of their internal discussions in that regard.

Q. Okay. Let's assume hypothetically the Economic Stability Program were not approved by the Commission. In that circumstance, do you think that the Sammis plant's market compensation will remain below its average total costs for the foreseeable

future?

MR. KUTIK: Objection.

THE WITNESS: As I testified, I'm relying on the assessment of Don Moul in that regard.

BY MR. SOULES:

Q. And that includes your testimony that market compensation for the Sammis plant is chronically below its average total cost?

A. I'm sorry. Where are you referring to that?

Q. I'm looking at Page 15, Lines 21 to 22.

A. And, I'm sorry, your question is what?

Q. My question was: If the Economic Stability Program were not approved by the Commission, do you think that the Sammis plant's market compensation will remain below its average total costs for the foreseeable future?

A. I believe there's a probability that that will be the case.

Q. And that's based upon the testimony -- the direct testimony of Mr. Moul, correct?

A. Yes.

Q. Okay. If that were the case, would that mean that FirstEnergy Solutions would earn a higher

profit by retiring the Sammis plant rather than continuing to operate it?

MR. KUTIK: Objection.

THE WITNESS: I've done no assessment of the financial pro formas of any of these options that you're discussing here.

BY MR. SOULES:

Q. Okay. But speaking in general terms, if you had a -- if you hypothetically had a generating unit whose market compensation were chronically below its average total costs, would the owner of the unit earn a higher profit by closing the unit rather than continuing to operate it?

MR. KUTIK: Objection, incomplete hypothetical.

THE WITNESS: The hypothetical that you've posed, you haven't told me anything about the market itself; so it's very difficult to answer that question.

BY MR. SOULES:

Q. And what would you need to know about the market itself to determine whether the unit owner would earn more money by closing the unit?

A. There's a whole host of things I would

need to know about the costs of the owner's options, as well as the level and volatility of the prices we're talking about in this electricity market that you're referring to.

Q. If you had -- if you hypothetically had a situation where for the entire foreseeable future the unit's market compensation would remain below its average total costs, would it make financial sense for the owner to retire the unit?

MR. KUTIK: Objection.

THE WITNESS: The -- the -- I've testified that the economic test here is a comparison of the going-forward costs to the replacement cost. I haven't testified with regard to the profitability of -- of an owner's two options here of closure and replacement.

BY MR. SOULES:

Q. Okay. Is it your opinion that there -- that the right -- from an economic perspective, a retirement -- scratch that.

Is it possible to have an economic generating unit that is economic, but is also financially unprofitable?

MR. KUTIK: Objection.

THE WITNESS: Yes.

BY MR. SOULES:

Q. Okay. So the interest of the unit owner can average from what would be economically efficient; is that correct?

A. I'm not sure what you mean by the interest of the owner.

Q. The generating unit profit margin does not necessarily sync up perfectly with what is economically efficient; is that correct?

MR. KUTIK: Objection.

THE WITNESS: Again, the term "sync up perfectly" is not clear what you mean.

BY MR. SOULES:

Q. Okay. Why don't we move on.

Dr. Makovich, have you reviewed the direct testimony of the companies' witness, Jay Ruberto?

A. No, I have not.

Q. Okay. Have you reviewed the direct testimony of companies' witness, Jason Lisowski?

A. No, I have not.

Q. Have you reviewed the direct testimony of companies' witness, Judah Rose?

A. No.

Q. If we could look at the bottom of Page 15 of your written testimony. Starting on Line 23 it states, "Indeed, with PJM capacity and energy cash flows increase in future years to cover the costs of a diverse power supply portfolio, then customers will be further benefited from the Economic Stability Program in place."

That's your testimony, correct?

A. Yes.

Q. What is the basis for your belief that PJM energy cash flows will increase in future years?

A. I didn't testify that that was my belief. What I'm saying is if that were to happen, then the customers would benefit further.

Q. Okay. So when you say "when PJM capacity and energy cash flows," you really mean if PJM capacity and energy cash flows increase in future years, then customers would benefit further?

A. That's what I mean, that if the energy -- the capacity and energy cash flows increase in future years, then customers would benefit further.

Q. Okay. But you're not offering any

specific opinion that energy or capacity cash flows will increase in future years?

A. That's right.

Q. Dr. Makovich, do you recall earlier when we were discussing the Clifty Creek and Kyger Creek plants?

A. I believe we mentioned that they were part of this Economic Stability Program.

Q. Right, right. Okay. Thank you.

These two plants are often referred to as the Ohio Valley Electric Corporation, or OVEC, plants. If I refer to the plants collectively as the OVEC plants, would you understand what I mean?

A. I'm sorry, I didn't hear that. If you refer to them as what?

Q. If I refer to these plants collectively as the OVEC plants, will you understand what I mean?

A. Yes.

Q. Okay. Are you offering any opinions in this case regarding the operational characteristics of the OVEC plants?

A. No.

MR. KUTIK: Objection.

BY MR. SOULES:

Q. Are you offering any opinions in this proceeding as to whether the OVEC plants are economic?

MR. KUTIK: Objection.

THE WITNESS: As I've said, I've relied on Don Moul's testimony in that regard.

BY MR. SOULES:

Q. Okay. And any opinion -- do you have any opinion -- scratch that.

Are you offering any opinion about the OVEC plants' cost of continued operation?

A. As I said, I am relying on Don Moul's testimony in that regard.

Q. Okay. And is it the same case as to whether the OVEC plants might be at risk of retirement, any opinion you have would be described in the direct testimony of Mr. Moul?

A. I've relied on Mr. Moul's testimony in that regard.

Q. Okay. And nothing beyond Mr. Moul's testimony?

A. I think I've already answered that I've relied on his testimony.

Q. Okay. Let's talk a bit about the

broader issue of supply diversity, plant retirement. If we could take a look at Page 4 of your written testimony.

A. Yes.

Q. Okay. Starting on Line 13 it reads, "Without a surplus of generating capacity, it is economic to retire a power plant when the cost of continued operation exceeds the cost of closing the plant and replacing it with the lowest cost source of equivalent power supply."

That's your testimony, correct?

A. Yes.

Q. And this subject is essentially providing a formula for determining whether it's economic to retire a power plant, is that a fair characterization?

A. I've described when it is economic to retire a power plant under a given set of conditions.

Q. And what -- what are those given set of conditions?

A. As I mentioned here on Line 13 of Page 4, that one of the conditions is we don't have a surplus of generating capacity.

Q. So if you had an electrical grid with a

surplus of generating capacity, it might be economic to retire the power plant even if these conditions are not met?

A. Yes.

Q. Okay. Looking down a little further, Line 18, there is a reference to environmental impact management. Do you see where it says that?

A. Yes.

Q. Could you define what you mean by "environmental impact management"?

A. All forms of electric generation have an environmental impact, and this is something that power suppliers have to manage.

Q. Did you describe environmental impact as a system benefit; is that accurate?

MR. KUTIK: Objection.

THE WITNESS: Can you reread the question, please?

(Record read back as requested.)

THE WITNESS: No.

BY MR. SOULES:

Q. Why is that not accurate?

A. I described environmental impact management as a system benefit.

Q. Right, okay. I think I misspoke. Thank you.

If we could look at the bottom of Page 14 and top of Page 15 of your written testimony.

A. Yes.

Q. Okay. Starting on Line 22 on Page 14 it reads, "The Plants involve fixed costs to fund greater power production efficiency, and provide production cost risk management and technology, performance risk management, as well as provide environmental impact management."

Is that your testimony?

A. Yes.

Q. So is it your opinion that the Sammis and Davis-Besse plants provide environmental impact management?

A. It is my testimony that some of the investments in these plants do provide environmental impact management.

Q. And which investments are you referring to?

A. Environmental control investments.

Q. Are there any other ways in which the Sammis plant provides environmental impact

management?

A. Yes.

Q. In what way?

A. That an environmental profile is a function of the cost-effective generation portfolio of which it's a part.

MR. SOULES: I'm sorry, could we have that last answer read back?

(Record read back as requested.)

BY MR. SOULES:

Q. What do you mean by "environmental profile"?

A. I'm talking about the environmental impacts.

Q. Both positive and negative impacts?

MR. KUTIK: Objection.

THE WITNESS: I -- I haven't divided impacts into positives and negatives. As I've testified, all sources of power supply have an environmental impact.

BY MR. SOULES:

Q. And environmental impact management is a type of system benefit, correct?

A. Yes.

Q. What are you relying on in support of your opinion regarding the Sammis plant's environmental impact management?

A. I'm not sure I understand your question.

Q. Did you -- did you review any documents -- well, scratch that.

I believe you stated that the Sammis plant provides environmental impact management, correct?

A. Yes.

Q. And what information are you relying on for that conclusion?

A. Well, as I told you, it's part of the cost-effective generation mix, and all of the technologies in that mix have an environmental impact that needs to be managed.

Q. Did you review any specific information about the Sammis plant's environmental controls?

A. I have not.

Q. Have you reviewed any specific information about the pollutant emissions from the Sammis plant?

A. I'm sorry. I didn't hear that question.

Q. Have you reviewed any specific

information about the pollutant emissions from the Sammis plant?

A. As I've testified, I've not done specific analysis of the Sammis plant.

Q. Okay. Thank you.

Let's turn back to Page 4 of your written testimony.

A. Yes.

Q. Starting on Line 19 it states, "Wind and solar resources are not realistic substitutes because they are not equivalent power supply sources in meeting power customer demands."

Is that your testimony?

A. Yes.

Q. Why don't wind resources qualify as an equivalent power supply source?

A. These technologies are not direct substitutes for the conventional generating resources that provide baseload electric supply.

Q. And when you refer to conventional generation resources, are you referring specifically to coal and nuclear resources?

A. Those would be included, but it's not exclusively those.

Q. Okay. Would you include natural gas as a conventional generation resource?

A. That's a fuel.

Q. How would you consider a natural gas combined-cycle plant?

MR. KUTIK: So the question again is?

BY MR. SOULES:

Q. Would you consider a natural gas combined-cycle plant to be a conventional generation resource?

A. Yes.

Q. Are there any circumstances in which a wind resource could qualify as an equivalent power supply source?

A. Equivalent to what?

Q. Equivalent to a conventional generation resource.

A. Yeah. Can you rephrase your question? I'm not sure what you're trying to ask here.

Q. Sure. So I believe you've testified that wind resources do not qualify as an equivalent power supply source comparable to conventional generation resource, correct?

A. What I've testified is that to give

people the electricity they want when they want it with a cost-effective portfolio of fuels and technologies, that may or may not include wind and solar resources.

Q. Okay. Wind and solar resources are not realistic substitutes for conventional generation resources, right?

A. Well, what I've testified to is in a cost-effective generation mix, you need the peaking, cycling, and baseload units. In that cost-effective mix, wind and solar resources are not a substitute for the conventional technologies in those roles.

Q. Okay. Can demand reduction initiatives such as demand response or energy efficiency program serve as a realistic substitute?

A. Those are resources that are on the demand side of the marketplace as opposed to what I'm talking about here with the supply side.

Q. Okay. Thank you.

Are you offering any opinions in this case as to whether the OVEC plant provides environmental impact management?

A. I -- I've already answered the question that all types of power supply have an environmental

impact, which would include those plants.

Q. Okay. Are you providing any specific opinions about the environmental impact management that those plants would provide?

A. As I've testified, I've not done a specific analysis of those particular plants.

Q. Okay. And you've not specifically analyzed any cost risk management benefits that the OVEC plants might provide?

A. As I've testified, I've relied on Don Moul's testimony in that regard.

Q. Okay. And have you relied on Mr. Moul's testimony for any opinions about the OVEC plants' potential technology performance risk management services?

MR. KUTIK: May I have the question read, please?

(Record read back as requested.)

MR. KUTIK: Objection.

THE WITNESS: Can you read it back to me, please?

(Record read back as requested.)

THE WITNESS: Yes.

BY MR. SOULES:

Q. And nothing besides Mr. Moul's testimony?

MR. KUTIK: Objection.

THE WITNESS: As I've said, I've relied on Don Moul's testimony in this regard.

BY MR. SOULES:

Q. Have you relied on Mr. Moul's testimony for any opinions about whether the OVEC plants provide production efficiency benefits?

A. Yes.

Q. And have you relied on Mr. Moul's testimony for any opinion about whether the OVEC plants provide grid location benefits?

A. Yes.

Q. Okay. Are you offering any opinions in this case as to whether the Davis-Besse plant provides grid location benefits?

A. As I've said, I relied on Don Moul's testimony in that regard.

Q. And you haven't specifically analyzed whatever grid implications retirement of the Davis-Besse plant might have?

A. As I've testified, I've not done specific analyses of these plants.

Q. Okay. Dr. Makovich, you recently performed a study that looked at the value of diversity in our country's power supply portfolio, correct?

A. Yes.

Q. And that's the study that's attached as LM-2 to your testimony?

A. Yes.

Q. Okay. And in that study, you compared the country's current power supply portfolio to a hypothetical less diverse portfolio, correct?

A. Yes.

Q. And based on that comparison, you found that the current national portfolio lowers the cost of electricity by more than $93 million a year; is that correct?

A. That was for a timeframe of analysis from 2010 through 2012.

Q. Okay. The national portfolio that you considered had a generation mix that was approximately 40 percent coal, 20 percent nuclear, 27 percent gas, and less than 5 percent wind and solar; is that correct?

A. Can you -- are you talking about a

capacity mix or a generation mix?

Q. I was talking about generation mix.

A. Can you repeat the question there?

Q. Sure. The national portfolio that you considered in this analysis had a generation mix that was approximately 40 percent coal, 20 percent nuclear, 27 percent gas, and less than 5 percent wind and solar; is that accurate?

A. Yes.

Q. And the hypothetical less diverse portfolio had a generation mix that was approximately 74 percent natural gas and 22.5 percent wind and solar; is that correct?

A. On Page 5 of LM-2, I've described the reduced diversity case where wind and solar make up about one-third of installed capacity and 22.5 percent of generation; hydro decreases from 6.6 to 5.3 in the capacity mix and represents 3.8 percent of generation; natural gas-fired power plants account for the remaining 61.7 percent of installed capacity and 73.7 percent of generation.

Q. Okay. And the reduced diversity case includes no generation of coal or nuclear resources, correct?

A. Yes.

Q. Do you have any knowledge about the current generation mix within PJM?

A. Yes. I have a general knowledge.

Q. Do you know if PJM's current generation mix has a higher percentage of coal and nuclear than the national generation mix?

A. Before I would testify to that, I'd want to check the numbers.

Q. Okay. Do you have a general sense of whether PJM's generation mix is representative of the national generation?

A. As I said, without the data in front of me, I can't compare and contrast the PJM mix to the national average.

Q. Okay. Do you have any knowledge about the current generation mix in Ohio?

A. Yes. I have a general knowledge.

Q. Okay. What knowledge do you have about Ohio's generation mix?

A. Well, we're talking about some of the plants in that mix right now. So it is a portfolio that does include nuclear and coal assets, as well as some natural gas assets, as well as some renewable

power supply assets.

Q. Okay. And am I assuming correctly that you don't have the numbers of Ohio's current generation mix at your fingertips?

A. Yes.

Q. Okay. Do you think it's likely that coal-fired power will be eliminated from PJM's generation mix within the next five years?

A. Within the next how many years?

Q. Five years.

A. No.

Q. How about within the next 10 years?

A. I'm sorry, what's the -- the question is?

Q. Do you think it's likely that coal-fired power will be eliminated from PJM's generation mix within the next 10 years?

A. If you mean completely eliminated, I'd say the probability is low that that would happen.

Q. Okay. Do you think it's likely that coal-fired power will be completely eliminated from PJM's generation mix within the next 20 years?

A. It's difficult to assess the probability of the generation mix that far out with regard to

coal, particularly because of pending environmental regulations.

Q. Okay. Do you think it's likely that nuclear power will be eliminated from PJM's generation mix within the next five years?

A. Similarly, I think that's a low probability.

Q. And how about within the next 10 years?

A. Again, as we get out into these longer terms, it's difficult to assess, you know, the probabilities of this -- of this generation mix.

Q. Okay. Do you think that the reduced diversity case presented in LM-2 is a likely outcome within the next 10 years?

A. Yes, for some regional power systems.

Q. But not nationally?

A. As I've talked about it in this, power systems tend to be regional, and that directionally -- I think we're seeing a move directionally towards the reduced diversity case. In some regions, we are already close.

Q. Okay. But not within PJM, correct?

A. No.

MR. KUTIK: Objection.

BY MR. SOULES:

Q. I'm sorry, did you say no?

A. I said no.

Q. Okay. Thank you.

Dr. Makovich, have you evaluated what the optimal mix of generation sources for PJM would be from a supply diversity perspective?

A. No.

Q. In your opinion, can an electrical grid have power supply diversity without coal resources?

MR. KUTIK: Could I have the question read, please?

(Record read back as requested.)

THE WITNESS: Yes.

BY MR. SOULES:

Q. And in your opinion, can a grid have power supply diversity without nuclear resources?

A. Yes.

Q. And can a grid have power supply diversity without either coal or nuclear resources?

A. Well, by "power supply diversity" in my answers, I'm simply saying that you can have more than one type of power supply. What my study was about was cost-effective diversity, which is a

different issue.

Q. Okay. Can an electrical grid have cost-effective diversity without coal resources?

A. I'd have to analyze the specific grid. My study started off with the mix that we have in place, which includes a significant slice for coal.

Q. Okay. Let's talk a little bit more about the missing money problem. If we could turn to Page 6 of your written testimony.

A. Yes.

Q. Okay. Starting on Line 10 it states, "There are two root causes of the missing money problem. First, power generation technologies have inherent characteristics that prevent electric energy markets from delivering prices high enough to balance demand and supply in the long run."

That's your testimony, correct?

A. Yes.

Q. Okay. And let's consider this first group for a minute here. In looking on Page 7 --

A. Yes.

Q. -- starting on Line 12 it states, "Some power production technologies have cost characteristics similar to Dupuit's bridges with

relatively large upfront costs and relatively low (or virtually no) marginal costs."

That's your testimony, correct?

A. Yes.

Q. And I apologize if I mispronounced the Dupuit's thing.

MR. KUTIK: That's the way we pronounce it.

MR. SOULES: Good.

BY MR. SOULES:

Q. Now, your testimony specifically cites to wind and solar technology. Are there other power generation technologies that contribute to the missing money problem?

A. Yes.

MR. KUTIK: Object.

BY MR. SOULES:

Q. Which technologies are those?

A. As I've testified on Line 15 of Page 7, "More generally, the technologies employed to cost-effectively generate electricity do not have the incremental cost characteristics needed to produce a textbook market outcome in which prices keep demand and supply in long-run balance."

Q. And the technologies employed to cost-effectively generate electricity are from which technologies specifically?

A. Here I'm referring to the technologies that make up a cost-effective generating portfolio, which are the peaking, cycling, and baseload technologies we've been discussing.

Q. So does that mean that baseload technology contributes to the first root cause of the missing money problem?

MR. KUTIK: Objection.

THE WITNESS: Yes.

BY MR. SOULES:

Q. And cycling technologies, likewise, contribute to the first root cause of the missing money problem?

A. As I've testified, it's the cost characteristics of these technologies that are the root cause of the first dimension of this problem.

Q. Okay. Thank you.

If we could turn to the bottom of Page 10 of your written testimony. I'm specifically looking at Page 10, Line 10, through Page 11, Line 2. So if you want a minute to skim that, please do so.

A. I've got Page 10 in front of me.

Q. Okay. Is it your opinion that PJM's existing capacity market eliminates the first root cause of the missing money problem?

A. I'm sorry. I didn't hear the question.

Q. Is it your opinion that PJM's existing capacity market eliminates the first root cause of the missing money problem?

A. I testified that it addresses the inherent dimension of the missing money problem; I did not testify that it eliminates it.

Q. And do you think that the current capacity market does not fully eliminate the first root cause of the missing money problem?

A. It is not clear to me that it has fully addressed the first dimension of the missing money problem.

Q. Okay. If PJM modified the capacity market so that generating units received higher cash flows by providing capacity, would -- could that eliminate the first root cause of the missing money problem?

THE WITNESS: Can you read that question back, please?

(Record read back as requested.)

MR. KUTIK: Objection.

THE WITNESS: Yeah. I've not testified here as to what kinds of evolutionary reforms in PJM might provide improvements.

BY MR. SOULES:

Q. Okay. And you're not offering any opinions in this case about PJM's proposed capacity performance proposal that is filed with FERC?

A. I have not included a discussion of the proposed changes to the PJM capacity market.

Q. Okay. And it's your opinion that PJM's existing capacity market does not address the second root cause of the missing money problem; is that correct?

A. It -- my testimony is it largely does not address the second dimension of the missing money problem.

Q. Okay. While we're looking at Pages 10 and 11, if we could look at Page 11, starting on Line 9.

A. Okay.

Q. It reads, "Current market conditions illustrate this cost recovery shortfall, with the

current market providing approximately $48 per megawatt hour to a replacement power plant requiring approximately $55 per megawatt hour to cover its annual levelized costs."

That's your testimony, correct?

A. Yes.

Q. And the $55-per-megawatt-hour figure is based in part on your estimate that upfront capital costs would run at around $1,400 per kilowatt; is that correct?

A. Yes.

Q. Is that $1,400 figure expressed in 2015 dollars?

A. These would be current dollars.

Q. Okay. And is that a capital cost estimate for a combined-cycle power plant specifically?

MR. KUTIK: I'm sorry. Can you read the question?

(Record read back as requested.)

THE WITNESS: Yes.

BY MR. SOULES:

Q. Okay. And how did IHS calculate that $1,400 figure?

A. As I said on Line 13 of Page 11, this reflects some internal metrics that we use in our research.

Q. And can you describe what the source of those internal metrics are? If we need to process to a confidential portion later, that's fine.

MR. KUTIK: Well, if Dr. Makovich is going to be talking about things that are proprietary to IHS, I'm not sure that having a confidential session solves that problem, but let's cross that bridge when we come to it. Go ahead.

THE WITNESS: Yes. This upfront cost reflects the information we gain from our interaction with our clients.

BY MR. SOULES:

Q. Can you describe in general terms what information sources IHS relies on to develop that figure?

MR. KUTIK: Objection, asked and answered. Go ahead.

THE WITNESS: As I've said, we have a large number of clients interested in our assessments of the power marketplace. Through our interactions, we gain information with regard to costs.

BY MR. SOULES:

Q. And those interactions provide the sole basis for the $1,400 figure?

A. No.

Q. Okay. What else formed the $1,400 figure?

A. Well, there are other available information with regard to upfront capital costs.

Q. And what available information would that be?

A. Well, for example, you know, the Energy Information Association provides information about the costs of a combined-cycle plant.

Q. Did you review that information in performing the calculation shown on Page 11 of your testimony?

A. I'm aware of it.

Q. Okay. Did you personally take any steps to verify the reasonableness of the $1,400-per-kilowatt figure?

A. Yes.

Q. What steps did you take?

A. The example I've provided here is an estimate that errs on the low side. It is lower than

what we typically tell clients we expect the annualized levelized cost to be, and it's lower, for example, than the Energy Information Association's annual energy outlook in 2014 that put this not at $55 a megawatt hour, but instead at $77.9.

Q. So correct me if I'm wrong, but those sound like steps you may have taken to verify the reasonableness for the $55-per-megawatt figure; is that accurate?

A. That's what I've just said.

Q. Okay. So talking about the $1,400-per-kilowatt figure specifically, did you take any steps to verify the reasonableness of that number?

A. As I've said, it is a function of interactions we have with people in the marketplace that are developing power lines.

Q. And is it your opinion that that figure is accurate?

A. As I just testified, it's my opinion that it would be on the low side.

Q. Okay. Take a look at Page 12 of your written testimony. Just let me know when you're there.

A. Page 12, yes.

Q. Starting on Line 2 it states, "...market payments of approximately $48 per megawatt hour are coming up about 12 percent short of covering the replacement costs of a baseload power plant."

That's your testimony, correct?

A. Yes.

Q. Given this cost recovery shortfall, it would not make financial sense for a new combined-cycle power plant to be built within PJM, correct?

A. I did not testify to that.

Q. Do you think it -- do you think it makes financial sense for a new combined-cycle power plant to be built within PJM?

A. It may in a cycling mode, but not a baseload mode.

Q. And why that qualification?

A. The decision to develop a power plant is a function of the expected utilization rate. It may be the case that it would make sense to build a natural gas combined-cycle plant in a cycling mode, but not in a baseload mode.

Q. Are you aware of whether there are new

combined-cycle plants currently being developed within PJM?

A. Yes, there are.

Q. Are those combined-cycle plants designed to operate in a cycling mode?

A. I do not have information on the specific expectations of the development plans of these plants.

Q. Okay. But it would be your opinion that if there was a combined-cycle plant currently being developed, it would not make financial sense if it was designed to operate in a baseload mode, correct?

A. I -- I did not say that.

Q. Okay. Why am I wrong? What's wrong about that statement?

A. What I've provided here is an example of some generic costs that were on the low side. As you look at specific power plant projects, they differ quite a bit with regard to their costs compared to what might be typical or generic. So I cannot, without looking at a specific power plant, opine on what the economics involve.

Q. When you say what the economics involve, you mean whether or not it would make financial sense

to build it --

A. Yes.

Q. -- correct?

Okay. Let's turn back to Page 6. Please let me know when you're there.

A. Yes. I'm on Page 6.

Q. Okay. Starting on Line 12 it states, "Second, environmental regulations imposed on power supply created the unintended consequence of further suppressing electric energy market prices."

Is that your testimony?

A. Yes.

Q. Okay. And then on Pages 8 and 9 of your written testimony, you elaborate on this point by discussing how environmental policies contribute to the missing money problem; is that correct?

A. On Page 8 and 9, yes.

Q. Okay. And --

A. With the -- what I'm talking about on Page 8 and 9 are cash flows as opposed to just the revenue stream.

Q. I'm sorry, can you explain the difference between cash flows and the revenue stream that you're referring to?

A. Yes.

Q. Okay. Please -- please do.

A. When I talk about prices being suppressed, your revenue stream is lower because the revenue stream is price times quantity. If the -- as I've testified here, the imposition of renewables also effects the cost side and the cash flow being revenues less costs.

Q. Okay. Got it. Thank you.

And on Page 8 -- we've been discussing the environmental policies. On Page 8, Line 11 to 12, you reference subsidies and the imposition of mandates for renewable power generation shares, correct?

A. Yes.

Q. And these types of environmental policies contribute to the missing money problem, correct?

A. Yes.

Q. Are there other types of environmental policies that contribute to the missing money problem?

MR. KUTIK: Objection.

THE WITNESS: There may be.

BY MR. SOULES:

Q. Can you identify any other environmental policies?

A. Yes.

Q. Okay. Please identify the policies.

A. Well, for example, there are some market rules that require taking the renewable output even if it would be less expensive to curtail it.

Q. Okay. Can you identify any other environmental policies that contribute to the missing money problem?

A. There are others. My testimony doesn't provide an exhaustive list.

Q. Okay. Does federal regulation of carbon dioxide contribute to the missing money problem?

A. I'm sorry, can you repeat that question?

Q. Sure. Does federal regulation of carbon dioxide contribute to the missing money problem?

A. Can you rephrase the question? What federal policies are you referring to?

Q. Sure. Why don't I -- let's scratch that.

Does any state or federal regulation of carbon dioxide contribute to the missing money

problem?

A. Again, I'd need to know what specific policy you're referring to.

Q. Okay. Move on.

Does EPA's regulation of other air pollutants such as mercury or sulfur dioxide contribute to the missing money problem?

A. I have not had any reason to expect that they do.

Q. Okay. How about environmental policies that apply to the handling and disposal of radioactive material, would those policies contribute to the missing money problem?

A. It's not something that I've assessed. I don't have any reason to expect they would, but it's not something that I can think of a connection.

Q. Okay. Thank you.

If we could look at Page 9 of your written testimony.

A. Yes.

Q. Thank you. Starting on Line 5 it reads, "It is important to note, however, that renewable mandates and renewable supply are only part of the missing money problem. There are other

contributors."

Is that your testimony?

A. Yes.

Q. And when you refer to "other contributors," what are you referring to?

A. I've been involved in discussions with people regarding other factors that are suppressing energy prices.

Q. What factors are those?

A. Well, for example, there is a concern that some of the processes that are followed to create a security-constrained economic dispatch and calculate uplift payments are a contributing factor to missing money.

Q. Okay. Are there other factors --

A. Yes.

Q. -- that you're aware of?

Okay. I'm sorry. Could you please describe those factors?

A. Well, what I -- I haven't provided testimony here regarding a comprehensive list of all factors that can suppress energy prices.

Q. Okay. Just to clarify, when you're referring to other contributors on Line 6 and 7, are

you referring to other contributors to the second root cause of the missing money problem?

A. Yes.

Q. Okay. But not other contributors to the first root cause of the missing money problem?

A. I did not provide a comprehensive list of all of the factors that could contribute to the first dimension, either.

Q. Can you describe any of the other factors that contribute to the first dimension?

A. Yes.

Q. Okay. Please do.

A. For example, a subsidized program for demand-side management has the potential to suppress capacity prices.

Q. And that would fall under the first root cause of the missing money problem?

A. It could be a contributor to that first dimension of the missing money problem.

Q. Okay. While we're looking at Page 9, let's take a look at Figure 1 of your direct testimony. This is the figure that's entitled "Key Results from Selected Wind Energy Integration Cost Studies."

A. Yes.

Q. Did you prepare this figure?

A. This figure came from a research paper done by Brooks and others in 2003.

Q. Do you know what the title -- I'm sorry. What's the -- Brooks's full name?

A. I don't have that in front of me.

Q. Are you referring to the first source listed at the bottom of the figure?

A. The source there, Brooks et al., in 2003.

Q. Okay. But this figure also includes other data points as well, correct?

A. No. This figure came from the book -- the Brooks research.

Q. And that was in 2003?

A. Yes.

Q. Can you explain to me why the list of sources include references to items that post date 2003?

A. As I said, I have to -- I don't have the direct cite for Brooks as far as the year of the report. I can get that for you, but I don't have it here in front of me.

Q. No. I appreciate that. My confusion is this figure appears to cite to reports -- a number of reports, the most recent of which appears to be from 2010 if I'm reading the source correctly.

A. Yes, yeah. So Brooks -- yeah, I'm sorry, the --

MR. KUTIK: Let him ask a question. Let him ask a question. Go ahead.

THE WITNESS: Okay.

BY MR. SOULES:

Q. I wondered if you could please explain that apparent discrepancy.

A. I believe that, for example, the 2003 refers to that Xcel study. The Brooks study -- I'll have to get the exact cite for you and the date. Brooks was the one that collected all these studies and put them together in this kind of a graphic.

Q. Okay. And then you reproduced that graphic in your testimony here?

A. Yes.

Q. Okay. Did you review the underlying studies that are represented in the data points in this graphic?

A. I have looked at some of these

integration studies in the past.

Q. Okay. And is Brooks an employee of IHS?

A. No.

Q. Okay. Was this figure reproduced in an IHS report at a later date?

A. Yes.

Q. Before -- and when was it reproduced?

A. I'd have to check the date and exact publication.

MR. SOULES: David, would it be possible to get that data publication after this deposition?

MR. KUTIK: We will take your request under advisement.

MR. SOULES: Okay. Thank you.

Could we take maybe a five-minute break? I think I'm pretty close to being done, but just wanted to review, you know.

MR. KUTIK: Okay. Very good.

(Recess taken.)

BY MR. SOULES:

Q. I have just a couple more questions. Should be just a few minutes here.

Dr. Makovich, could we take a look at Page 11 of your written testimony?

A. Yes.

Q. For the calculations that you provided in this portion of your testimony, did you create any workpapers?

A. Yes.

Q. And those workpapers reflect the calculation, et cetera, that fed into this estimate?

A. Yes.

Q. Okay. Are you aware of whether those workpapers have been provided to other parties in this case?

A. I don't believe they have.

Q. Okay. Did you create workpapers for any of the other analyses that you performed for this testimony?

A. This is the -- I think this is the only calculation I've got in the testimony. I did provide Figure 2, which is a graphic of data.

Q. And that -- that figure and the data underlying it are also part of your workpapers associated with this testimony?

MR. KUTIK: Objection. Go ahead.

THE WITNESS: I didn't hear the question.

BY MR. SOULES:

Q. I -- I asked if the data underlying Figure 2 is also part of the workpaper associated with your testimony for this case?

A. Oh, I'm not sure what you mean by "workpaper," but there's data behind Figure 2.

Q. Okay. That data is graphically represented in Figure 2?

A. Yes.

Q. Okay. Did you create any other workpapers -- scratch that.

Did you -- apart from what we've just discussed, have you created any workpapers associated with your testimony in this case?

A. I believe what we've talked about is the extent of my workpapers that I prepared in -- for this testimony.

Q. Okay. And you've -- apart from whatever modeling you performed for Attachment LM-2, you performed no economic modeling in preparing your testimony for this case; is that correct?

THE WITNESS: Can you repeat the question?

(Record read back as requested.)

THE WITNESS: All of the analysis for LM-2 was prepared before I was engaged to provide testimony.

BY MR. SOULES:

Q. And did you perform any economic modeling apart from that modeling in LM-2?

A. Yes.

Q. And what modeling did you perform?

A. What we just discussed on Page 11.

Q. Did you perform any other modeling for this case apart from what we described on page -- what we discussed on Page 11?

A. No.

Q. Okay. Those are my questions, Dr. Makovich. Thank you for your time, and I'm finished.

MR. KUTIK: Okay. Thank you.

Let me go through the parties that I have listed here, the counsel. Ryan O'Rourke, do you have any -- do you have any questions?

MR. O'ROURKE: No questions.

MR. KUTIK: All right. Rebecca Hussey, do you have questions at this time?

MS. HUSSEY: Just a few questions. I do

have another brief call, though. I thought we were waiting until after lunch to do the remaining questions.

MR. KUTIK: Well, I was trying to get through at least a couple of the ones with shorter time lines.

Dylan, are you prepared to go at this time?

MR. BORCHERS: I actually no longer have any questions.

MR. KUTIK: Okay. Thank you.

Larry Sauer.

MR. SAUER: David.

MR. KUTIK: Are you prepared to go at this time?

MR. SAUER: Yeah, I can. I've got a few questions.

MR. KUTIK: Okay. Thank you. Why don't you go ahead then.

MR. SAUER: Thank you.

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CROSS-EXAMINATION

BY MR. SAUER:

Q. Dr. Makovich, my name's Larry Sauer.

I'm representing the office of the Ohio Consumers' Counsel.

If you could turn to Page 4 of your testimony, Lines 13 to 15.

A. Yes.

Q. When you're discussing that, sir, are you talking about over what period of time? Is it a long-run analysis?

A. What do you mean by "long-run analysis"?

Q. Well, your statement is, "Without a surplus of generating capacity, it is economic to retire a power plant when the cost of continued operation exceeds the cost of closing the plant and replacing it with the lowest cost source of equivalent power supply."

Trying to understand if that analysis takes place over a short run or a long run, or could it be both?

A. Well, the timeframe here involves the life of the assets being considered.

Q. So that would be long run then?

A. Yes. To the extent that long run means that all of the ver- -- all of the inputs here on the replacement costs are avoidable, then I'd say it's

best to characterize this as a long-run assessment.

Q. Okay. I'm sorry if this is a repeat of what Mr. Soules had asked you. On Lines 19 and 20 you're talking about, "Wind and solar resources are not realistic substitutes..."

Did I hear you say that the natural gas combined-cycle unit would be a realistic substitute as an equivalent power supply source?

A. Yes.

Q. Thank you. There were some questions on Page 5 regarding your analysis pertaining to the current diversified portfolio of US power supplies. I think the questions were something along the lines of is it realistic that there would be no meaningful coal generation in Ohio in the next 10 years. Did you say you didn't have an answer for that?

A. My testimony was that I have not put a probability on that.

Q. Okay. And that was the same with nuclear as well?

A. Yes.

Q. And the -- the purchase power arrangement in this case is a 15-year term. Do you understand that?

A. Yes.

Q. What would be your understanding of the purchase power arrangement if there was -- if the Sammis plant was no longer generating power due to a retirement?

MR. KUTIK: May I have the question read, please?

(Record read back as requested.)

THE WITNESS: As I've testified, I don't have any knowledge of the specific terms and conditions of the contract.

BY MR. SAUER:

Q. Okay. If the Sammis plant were to be retired during the 15-year term of the purchase power arrangement and replaced with a natural gas combined -- a combined-cycle natural gas facility, would -- I'm sorry. Strike that question.

In your analysis of the US diversified power supply, did you -- did you look at the diversification of Ohio's power supply?

A. As I testified, the analysis was done for the existing supply at an interconnection level.

Q. What factors were you considering, or how did you arrive at the $93 billion number that

appears on Line 8 on Page 5 of your testimony?

MR. KUTIK: Objection.

THE WITNESS: Can you rephrase the question as to what you mean by "factors"?

BY MR. SAUER:

Q. You state that "...the current diversified portfolio of US power supply lowers the cost of generating electricity by more than $93 billion per year compared to a less diverse portfolio..."

How do you arrive at the $93 billion number?

A. By quantifying the counterfactual and looking at the difference.

Q. And what are the counterfactuals that you're looking at?

A. What the United States would have looked like in 2010, '11 and '12 with the less diverse power generation portfolio.

Q. Would you consider the US power supply to be less diverse if the Sammis plant would be retired and be replaced by a natural gas combined-cycle unit?

A. My testimony is that the objective of

the study was not to maximize diversity, but it was to assess the cost effectiveness of the existing generation mix.

Q. Could you do that analysis on an individual plant-by-plant basis?

A. Yes.

Q. And did you do any such analysis in preparation of this case?

A. No.

Q. When -- if you could turn to Page 10 of your testimony.

A. Yes.

Q. I'm looking at the statement on Page 5 -- Lines 5 and 6, it says, "...the price suppression from renewable power mandates causes the price to clear at a negative level within the PJM system, as shown in Figure 2."

I guess what I'm asking is you show a negative 55 megawatt hour minimum. Was that over the 11 hours you're talking about, the negative hours?

A. No.

Q. Does the figure show that during this period of time, is this a -- is this a full 13 months or is it a 12-month chart on Figure 2?

A. It's a 12-month chart.

Q. Okay. And for that 12-month period, are you saying that there were 11 hours that were negative?

A. Yes.

Q. And the lowest negative figure was at negative 55?

A. Dollars per megawatt hour, yes.

Q. Uh-huh. And that that is caused by renewable power mandates?

A. Yes.

Q. And that's the only factor that's driving that?

MR. KUTIK: Objection.

THE WITNESS: The renewable -- my testimony is the renewable power mandates are the primary cause of these negative prices.

BY MR. SAUER:

Q. What could the other causes of the negative pricing --

A. In a -- in a power system with lots of hydro in a very wet year, we might be able to create a situation like this. That's an example.

Q. Any other examples that you can think

of?

A. Not offhand.

Q. Okay. Thank you, Dr. Makovich. That's all the questions I have for you today.

MR. KUTIK: Okay. Let's go off the record.

(Discussion held off the record.)

(Luncheon recess.)

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Wednesday Afternoon Session,
May 27, 2015.

- - -

MR. KUTIK: Rebecca, are you ready to go?

MS. HUSSEY: I am.

MR. KUTIK: Let's go back on the record.

MS. HUSSEY: Thank you.

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CROSS-EXAMINATION

BY MS. HUSSEY:

Q. Dr. Makovich, could you please turn to Page 3, Line 4 to 5 of your testimony?

A. Yes.

Q. And I'm summarizing, but there you testified of the Economic Stability Program, among other things, will prevent the plant from retiring before it's economic to do so; is that correct?

A. Yes.

Q. Okay. To your understanding, who will make the choice about whether the plants that are implicated by the Economic Stability Plan will be retired?

THE WITNESS: Would you read that

question back, please?

(Record read back as requested.)

THE WITNESS: That would be the plant owners.

BY MS. HUSSEY:

Q. Okay. And different places throughout your testimony -- I guess, please refer to Page 3, Line 17. We're talking about effective -- or excuse me, efficient power supply. So on Page 3, Line 17, could you tell me what you mean by "efficient power supply"?

A. Yes.

Q. Could you please do so?

A. As I've testified, the objective is to provide electricity customers with the power that they want when they want it with a cost-effective mix of peaking, cycling, and baseload technologies.

Q. Okay. And two lines further down on Line 19, you refer to cost-effective power supply portfolio.

A. Yes.

Q. Please tell me what you mean by "cost effective."

A. It's a power supply portfolio where the

economic tradeoffs between peaking, cycling, and baseload plants have been made appropriately.

Q. Okay. In different places throughout your testimony, and would that be attached to your testimony as LM-2, you refer to fuel diversity or fuel supply diversity. Could you share with me what your definition of diversity is?

MR. KUTIK: Objection.

THE WITNESS: Well, the simple explanation is not to have all your eggs in one basket.

BY MS. HUSSEY:

Q. Okay. And could you maybe elaborate a little bit about exactly what you mean by that?

A. The study we performed showed that it was valuable to have the existing mix of generating technologies and fuels in US power supply compared to a less diverse mix.

Q. And a less diverse mix that you're referring to was presented in your reduced diversity case; is that correct?

A. Yes.

Q. Okay. And I have a clarification with regard to a response that you gave to Mr. Soules

earlier about fuel supply diversity. So in LM-2, as we just discussed, you and your team advanced a reduced diversity case in which no coal or nuclear generation was included; is that correct?

THE WITNESS: Could you read that back for me?

THE COURT REPORTER: I was going to ask her to repeat that question. I think she broke up.

MR. KUTIK: Could you repeat the question, please?

BY MS. HUSSEY:

Q. Sure. In LM-2 you and your team advanced a reduced diversity case in which no coal or nuclear generation was included; is that accurate?

MR. KUTIK: I'm sorry, what were the first couple words of that? I really didn't hear that.

(Record read back as requested.)

MR. KUTIK: Is that what you said?

BY MS. HUSSEY:

Q. Advanced a reduced diversity case.

A. I believe I previously testified about the nature of the reduced diversity case by reading its description from Page 5 of LM-2.

Q. Okay. And summarizing, in the reduced diversity case, no coal or nuclear generation was included, correct?

A. Yes.

Q. Okay. And I believe you also testified earlier that you do not believe that coal or nuclear generation will be entirely eliminated as fuel supply sources for at least the next 10 years; is that accurate?

A. No. I said that I hadn't put a probability on the next 10 years.

Q. Okay. And was that specifically with regard to the PJM zone?

A. I don't remember the exact nature of the question, whether it was PJM or whether it was the entire United States.

Q. Okay. I thought, and please correct me, I thought that you had said that you didn't put a probability on the next 20 years, but that at 10 years you believe that there would still be coal or nuclear generation as a fuel supply source in the PJM zone.

MR. KUTIK: Well, his testimony is what it is. So what is your question?

MS. HUSSEY: I'm trying to clarify.

MR. KUTIK: Well, that's not a question; you just made a statement.

MS. HUSSEY: I asked him if it was accurate.

MR. KUTIK: Well, I'll object, mischaracterizes his testimony. Go ahead.

THE WITNESS: Could you repeat your question, please?

BY MS. HUSSEY:

Q. Sure. Okay. From what I understood from your testimony earlier, I believe that you did not -- you said that you don't believe coal or nuclear generation will be entirely eliminated as fuel supply sources in PJM for at least the next 10 years; is that correct, or no?

A. I did not assign a probability to it, but I think there's a low probability that we -- of no nuc and coal in 10 years.

Q. Okay. Thank you.

And so I believe you also testified that the reduced diversity case has a lower level of probability in the PJM zone; is that correct?

MR. KUTIK: Objection.

THE WITNESS: Yeah. I -- I'm not sure what you're referring to there.

BY MS. HUSSEY:

Q. Okay. It's my understanding that the PJM zone, excuse me, as a reduced diversity case, it consists of a fuel supply diversity where no nuclear or coal-fired generation appears; is that correct?

A. That's part of the reduced diversity case, yes.

Q. Okay. And I believe you just told me that you did not -- that there was a low probability that in the next 10 years coal and nuclear generation would be entirely eliminated in fuel supply sources in PJM, correct?

A. Yes.

Q. Okay. So then the 25 percent increase in retail power prices that your team calculated under the reduced diversity case would not apply in PJM?

A. I did not testify to that, no.

Q. I'm asking you that now.

MR. KUTIK: Well, he's given you the answer, it's no.

BY MS. HUSSEY:

Q. Okay. And if there is going to be coal and nuclear power supply in PJM in the next 10 years, would a 25 percent increase in retail power prices still stand for the PJM zone?

A. On Page 36 of LM-2, I've included graphics that show the progression one might expect as you move from the current mix to the reduced diversity case.

Q. Okay. And given those graphics and given what you know about PJM, what would be representative then of PJM?

A. As I've testified, the assessments were done on an interconnection level; so I did not specifically analyze PJM on its own.

Q. Okay. So in correlation then, the 25 percent increase that you've predicted in resale power prices doesn't necessarily represent PJM on its own?

A. That is an aggregate number for the United States.

Q. Okay. Thank you.

You also referred to the missing money problem throughout your testimony in LM-2. I wondered, in your estimation, how long has the

missing money problem been ongoing in the context of competitive power markets?

A. In my estimation, it's been there from the very start.

Q. If you could turn to Page 15, Line 22.

A. Yes.

Q. You refer to an efficient market test. Could you please explain what you mean by "efficient market test"?

A. Yes.

Q. Okay. Would you please go ahead and do so.

A. The comparison that we've provided with regard to the going-forward costs of an existing plant and the cost to replace that plant with the lowest-cost source of equivalent power supply.

Q. You referred to wind and solar technology on Page 7 of your testimony. In your estimation, do wind and solar generation technologies add value to the power system?

MR. KUTIK: Objection.

THE WITNESS: Where in particular on Page 7 are you referring?

BY MS. HUSSEY:

Q. You generally refer to wind and solar technologies on Lines 13 and 14 and in other places throughout your testimony. I wondered broadly if wind and solar generation technologies, in your opinion, add value to the power system?

MR. KUTIK: Objection.

THE WITNESS: On Line 13 and 14, I was not providing an assessment of the value of wind and solar technologies. I was providing an example of technologies with low or virtually zero marginal costs in a competitive situation.

BY MS. HUSSEY:

Q. Okay. Perhaps I was confused. If you could just set the reference to 13 -- Line 14 -- 13 and 14 or 14 and 15, and just generally answer for me whether you believe wind and solar technologies add value to the power system?

MR. KUTIK: Objection.

THE WITNESS: It would depend on the characteristics of the power system.

BY MS. HUSSEY:

Q. Okay. In the PJM zone as it currently stands, do you believe that wind and solar generation technologies add value?

MR. KUTIK: Objection.

THE WITNESS: I've not performed this assessment to be able to tell you whether they add value or not.

BY MS. HUSSEY:

Q. Okay. On Page 12, Line 9, you make reference to exceptional assets.

A. Yes.

Q. And I wondered in your estimation if any generation assets other than coal or nuclear generating units would qualify as exceptional assets.

A. Yes.

Q. Okay. And what type of assets would those be?

A. As I said, the objective of giving customers the electricity they want when they want it requires a mix of peaking, cycling, and baseload units, and these units need to be running at -- and meeting the cost and performance characteristics.

Q. Okay. So if those qualifications are met, is it your opinion that any type of generating asset might qualify as an exceptional asset?

A. No.

Q. Okay. Could you explain why not?

A. Some generating assets, regardless of how well they run, would not be part of a cost-effective power supply portfolio.

Q. And that's based upon what?

A. It would be based upon the cost and performance characteristics of the technology.

Q. Okay. Thank you very much.

MR. KUTIK: Okay. Joe Oliker, are you on the phone?

MR. OLIKER: Dave, I'm on the phone, but if there's somebody else that is ready to go, I would prefer to go that way.

MR. KUTIK: All right. Madeline Fleisher.

MS. FLEISHER: Yes, I can go.

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CROSS-EXAMINATION

BY MS. FLEISHER:

Q. Mr. Makovich, my name is Madeline Fleisher. I represent the Environmental Law & Policy Center. I hope you can hear me okay.

A. Yes.

Q. Great. So is it your opinion that all plant closures in PJM are due to the missing money

problem?

A. No.

Q. And what other causes could there be for plant closures within PJM?

A. As I've testified, there are cases where the going-forward costs exceed the replacement costs, in which case it would be an economic retirement.

Q. And can you determine for the Sammis and Davis-Besse and OVEC plants which category this would fall into?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: Based on the testimony of Don Moul, these plants are economic to continue to operate.

BY MS. FLEISHER:

Q. And what's your understanding of what Mr. Moul identified as the least cost alternative supply?

A. My understanding is the future market price projection was at a level to cover the cost of new entry.

Q. Are you -- which market price projection are you referring to there?

A. Don Moul's direct testimony, Page 2, Line 20. It begins on Line 20 where he refers to Witness Rose's forecast that market prices for energy and capacity will increase over time.

Q. Pardon. I just want to pull that up to make sure we're in the same place.

And so you're just basing it on that portion of Mr. Moul's testimony?

A. No.

Q. What other portions are you basing your conclusion on?

A. Page 5 of Don Moul's direct testimony, beginning on Line 4, he says: Specifically, these units satisfy important policy goals of fuel diversity and promoting baseload units with significant on-site fuel capacity.

Q. And how does that relate to the question of the going-forward costs of these plants versus the cost of alternative supply?

MR. KUTIK: Objection.

THE WITNESS: The alternative supply will affect fuel diversity and on-site fuel supply.

BY MS. FLEISHER:

Q. I guess I'm a little confused here. I

was asking you about which portions of Mr. Moul's testimony you relied upon to conclude that the going-forward costs of the -- that the Sammis, Davis-Besse, and OVEC plants are greater than the cost of alternative supply. I guess can you explain to me how this portion on Page 5 relates to that?

A. Further down on Page 5, Line 12, Don Moul testifies, "Retirement of the Plants could also mean that customers are forced to pay significantly more for energy, for transmission upgrades...and eventually for the construction of new baseload plants through higher capacity costs."

Q. Okay. So just to make sure I'm understanding you correctly, you're saying that you relied on Mr. Moul's references to potential transmission costs and costs for construction of new baseload plants?

A. I've testified I relied on that section that I read to you on Page 5 of Don Moul's direct testimony.

Q. Okay. Do you know if Mr. Moul considered in his analysis the potential for demand-side resources to decrease the cost required for either -- well, let's start with transmission

upgrades?

A. I cannot speak for Don Moul and what he did or did not include.

Q. Okay. And in firm, do you know if Mr. Moul considered the potential for demand-side resources to address the cost for the construction of new baseload plants referenced in his testimony here?

A. Again, that's a question that's appropriate for -- for Don Moul.

Q. Okay. Let's turn -- can we turn to Page 9 of your direct testimony, Figure 1.

A. Yes.

Q. And I guess just an aside for a moment. Are you aware that PJM conducted a study issued in 2014 looking at renewable integration costs?

A. I'm aware that PJM has done integration studies for renewables. I can't testify specifically to the dates.

Q. Okay. Just without referencing any specific date, is there a reason you didn't include the PJM studies that exist in your analysis here?

A. As I've testified, this analysis was conducted by Brooks, and it's compilations of studies that Brooks had collected.

Q. Okay. And you didn't independently look at any other study?

A. I've testified that I have looked at integration studies in the past.

Q. Okay. And is there a reason you didn't -- you relied solely on the Brooks study here?

A. Yes.

MR. KUTIK: Objection. Go ahead.

BY MS. FLEISHER:

Q. Please answer.

A. It's an example of a collection of studies showing positive integration costs for wind.

Q. And do you believe that this figure, I guess I'll call it, necessarily reflects integration costs for renewables in PJM?

A. I have no reason to expect that PJM is much different.

Q. Okay. But you didn't look at that PJM -- PJM studies to compare?

MR. KUTIK: Objection, mischaracterizes his testimony. Go ahead.

THE WITNESS: As I've testified, in the past, I have looked at integration studies from different power systems.

BY MS. FLEISHER:

Q. For purposes of this testimony in this case, did you compare the existing PJM renewable integration study to the studies referenced in this figure?

A. No.

Q. Okay. And can we turn back to Page 4 of your testimony, Line 13 through 15. It's been read before, but, "Without a surplus of generating capacity, it is economic to retire a power plant when the cost of continued operation exceeds the cost of closing the plant and replacing it with the lowest cost source of equivalent power supply."

Do you know whether there's a surplus of generating capacity in PJM currently?

A. I -- I don't have the PJM reserve margins in front of me to tell you the degree of reserve margin in PJM right now.

Q. Okay. Did you -- I guess just to -- did you look at the question in preparing this testimony of whether PJM has a surplus of generating capacity?

A. My understanding of PJM is that we do not have a serious problem of surplus-generating capacity.

Q. What does serious problem mean?

A. Meaning that it would alter this statement as being applicable.

Q. Okay. And the -- I'm trying not to repeat what others have done. Can we go to Page 36 in exhibit -- Attachment LM-2 to your testimony?

A. Yes.

Q. I'm looking at Figure 25, and to paraphrase, I believe you described this to Ms. Hussey as showing the progression from a base case to your load diversity case of the average wholesale power price; is that correct?

A. Yes.

Q. And do you have any basis for assuming that it's a linear progression?

MR. KUTIK: Objection.

THE WITNESS: Yeah, I have no basis to assume it's not.

BY MS. FLEISHER:

Q. Okay. Do you have any basis for assuming it is?

A. It's not an assumption. What I'm trying to show is moving away from a cost-effective generation mix is a matter of degree.

Q. Okay. I guess I'm trying to flesh that out a little bit. Does that mean, you know, if you're -- sorry. Let me pick out a couple points here.

So you're not saying that, you know, any particular point on this -- one of these lines, that that is, in fact, the quantitative degree of the effect on wholesale prices?

A. I'm not sure. Can you rephrase your question?

Q. Sure, I guess. So if you look at, you know, let's say on the X axis, there's the 10 standard deviation hash mark. You follow that out to the -- on the East line, then that -- the East line, that would be, I'm estimating here, about an average wholesale price of $45 per megawatt hour.

Does your analysis in this report indicate that that would, in fact, be the wholesale price at that mix of diversity?

A. What the graphic shows is that the value of the current diversity in power supply will change as you move towards the less diverse case, and it will change more for some regions than others, and that the loss of the value is a matter of degree

given the direction we're moving in.

Q. Okay. But your analysis doesn't address the magnitude of that case?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: I did not say that.

BY MS. FLEISHER:

Q. Now, have you -- getting back to the missing money problem, have you done any analysis of preferred policy solutions for addressing the missing money problem?

MR. KUTIK: Objection.

THE WITNESS: Can you read back that question?

(Record read back as requested.)

THE WITNESS: I'm not sure what you mean by "preferred."

BY MS. FLEISHER:

Q. Or have you offered any recommended policy solutions as part of your work with IHS to address the missing money problem?

A. Yes.

Q. Can you describe what that solution or those solutions are?

A. In Attachment LM-1, under my Selected Publications, in October of 2014 what's listed as No. 2 was a report on "Bridging the Missing Money Gap: Assessing alternative approaches," which we looked at the different approaches to addressing this problem.

Q. And since I don't have that report in front of me, can you offer a brief description of what alternative approaches you endorsed in that report?

A. The report evaluated 13 different approaches and broke the approaches into the group of eight that could work under the right circumstances, and the remaining five were not likely to work well under any circumstances.

Q. And of the eight that you believed would work under the right circumstances, do you believe any of those would be applicable to PJM?

A. Yes.

Q. Can you describe what those are?

A. PJM employs a formal-forward capacity market, which was one of the eight, and this proposal for a long-term contract is also one of the eight that can work.

Q. Are there any others?

A. Yes.

Q. Can you describe them, please?

A. Well, the report goes through in exhaustive detail all 13 ranging from, as I mentioned, the capacity markets to the contracts, as well as others.

Q. Apologies, I don't mean to cut you off. I was looking for whether, besides the formal capacity market and the proposal for a long-term contract, there were any approaches that you -- that the report recommended that would be appropriate for PJM.

A. I did not make specific recommendations in the report for PJM.

Q. Okay. Were there any that -- other approaches besides a forward capacity market and a long-term contract that were recommended in general?

A. As I said, there were eight that we deemed had a high probability of being able to address the missing money problem under the right conditions.

Q. Okay. So that's two. What were the other six?

A. I don't have the report in front of me here, but it included things like administratively set capacity payments, administratively set energy price adders, economic withholding. Again, without this in front of me here, I don't want to presume I can give you all 13 accurately.

Q. I can only ask you to do your best. Okay. So I have now five; capacity market, long-term contract, administratively set capacity payments, administratively set energy price adders, economic withholding. Can you remember any of the other three from the list of eight recommended approaches?

A. I just -- at this time I cannot remember.

Q. Okay. And do you know, has that report been produced to any of the parties in discovery?

A. I do not know.

Q. Okay. Do you happen to know if it's publicly available?

A. It's not publicly available.

Q. Okay. Of the recommended approaches you recall, do you know if any of them are being considered for implementation in PJM?

A. Well, as I have testified, PJM has a

formal-forward capacity market, which is one of the approaches to address one dimension of the missing money problem.

Q. And do you know whether PJM is considering any other approaches?

A. I cannot speak for PJM.

Q. Give me one second. I'm just trying to find a particular reference in your testimony. Okay. Here we are. On Page 12 of your testimony when you -- Lines 7 to 8 you say, "The missing money problem is a problem left for PJM and other markets to sort through and attempt to correct."

When you say that, what do you believe is the right approach for PJM to take to this issue that you've identified?

A. The purpose of our study in the missing money was to find the problem in its two dimensions and discuss the approaches that people take.

Q. Okay. And are you aware that the utility, American Electric Power, has proposed a power purchase agreement similar to FirstEnergy for approval by the Public Utilities Commission of Ohio?

MR. KUTIK: Objection.

THE WITNESS: Yes.

BY MS. FLEISHER:

Q. Do you believe both PPAs would be necessary to address the missing money problem? Let's leave it there.

MR. KUTIK: Objection.

THE WITNESS: I would need more information to answer your question.

BY MS. FLEISHER:

Q. Okay. What other information would you need?

A. I'd need to know what power plants we're talking about, for example.

Q. Okay. And you would need information on the costs and cost effectiveness of power plants, for example?

A. No. What I said is I need to know what the plants are and what type they are.

Q. Okay. And is that, in effect, the relevance to the supply diversity issue you discussed?

A. Supply diversity would be one thing to consider, as well as the role; peaking, baseload, or cycling.

Q. Is there a limit to the number of

megawatts or amount of coal and nuclear generation that would be needed through a PPA to provide the supply diversity benefit you've described?

A. I don't believe there's an absolute limit.

Q. Is there a minimum amount?

A. A minimum amount of what?

Q. Of -- of -- amount of -- let's talk about coal for a minute. Is there a minimum amount of coal generation that would be needed to provide the supply diversity benefit you've discussed?

A. I have not provided testimony regarding any minimum shares.

Q. So given a particular proposal such as this one, how would you determine whether that proposal is needed to support supply diversity?

THE WITNESS: Can you read that question back, please?

(Record read back as requested.)

MR. KUTIK: Objection, asked and answered.

THE WITNESS: The study we conducted established that there's considerable value to the existing portfolio -- diverse portfolio of power

supply, and that current trends are moving us to lose that.

BY MS. FLEISHER:

Q. And when you say "the existing portfolio," you mean the national generation mix that you exhibit in your study?

A. No.

Q. What do you mean?

A. That -- I'm talking about the existing diversity in power supply portfolios in the regional US power markets.

Q. Okay. How does your study show the region for -- let's back up a second. When you say "regional," you mean region such as PJM?

A. Yes.

Q. Okay. And where does your study describe the benefits of the PJM generation mix?

A. The study I conducted was done at an interconnection level, and demonstrated an approach to quantify the current value of diversity.

Q. Did you apply that approach to PJM?

A. As I previously testified, I have not done a specific analysis of PJM.

Q. And to get back to the question I was

asking you before: Given your study, how would you apply that approach to determine how much diversity you need to retain to get the benefits that you discussed?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: As I said, I have not conducted a specific study to recommend a particular generation mix.

BY MS. FLEISHER:

Q. I guess I'm saying how would you conduct that study -- how would you apply your study to determine an appropriate generation mix for a region?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: The study demonstrated an approach to quantifying the current value of power supply diversity by analyzing the counterfactual over a historic timeframe.

BY MS. FLEISHER:

Q. And does your approach enable analyzing the counterfactual other than your reduced diversity case?

MR. KUTIK: Objection.

THE WITNESS: Someone could devise a different counterfactual and analyze it in a similar way.

BY MS. FLEISHER:

Q. Okay. Wait a second. I think I'm almost done here, but I just want to see if I have a couple more questions.

(Pause.)

If we can just turn -- just another question or two here -- Page 19 of Attachment LM-2 directly under the heading "Diversity: The substitution effect," it reads, "A varied portfolio mitigates power production cost risk because fuel diversity provides the flexibility to substitute one source of power for another in response to relative fuel price changes."

Do I understand correctly that there is value in flexibility available to switch between different types of power supply?

A. Yes.

Q. And might that -- do I understand correctly that flexibility would be useful if, for instance, the cost of a particular type of generation rose?

A. I'd have to have more information to answer that question.

Q. If the price of coal generation were to rise in response to EPA regulation of carbon dioxide, would there be value in being able to switch to other types of generation?

A. That's a hypothetical that -- I don't know what other conditions exist.

Q. Okay. All else being equal, if that were the hypothetical condition?

A. All else being equal to what base?

Q. To current-day generation in PJM.

A. So what's the question?

Q. Is there value to preserving the flexibility between different types of generation -- to switch between different types of generation in PJM?

A. I believe my testimony is clear that a varied portfolio of fuels and technologies provides the opportunity to take advantage of relative fuel cost changes.

Q. Okay. But just to go back to the actual statement, to substitute one source of power for another or provide the flexibility to substitute one

source of power for another; is that correct?

MR. KUTIK: May I have the question read?

THE WITNESS: Yeah. Can we read the question back?

(Record read back as requested.)

MR. KUTIK: I object.

THE WITNESS: Can you restate that question, please?

BY MS. FLEISHER:

Q. Sure. So you have referred the first part saying that -- of that saying a varied portfolio mitigates power production off grid -- actually, scratch that.

I guess I was just looking for your confirmation that the -- the value you're identifying here in terms of the substitution effect is the ability to actually substitute and the flexibility to substitute between alternative generation resources; is that correct?

A. What I've talked about here was the ability to substitute one source of power for another in response to relative fuel price changes.

Q. Okay. And would the proposed PPA affect

that flexibility?

A. Yes.

Q. How so?

A. By having diverse sources of power supply, you have the capability of changing utilization response to relative fuel price changes.

Q. Okay. Just one last question, which is: You believe that the goal within PJM should be to maintain the current generation mix?

A. That's not my testimony.

Q. So you don't believe it's necessary to maintain the current generation mix within PJM?

A. I didn't testify to that, either.

Q. Have you considered whether it's necessary to maintain the current generation mix within PJM?

A. My testimony is that one needs to consider the value of fuel and technology diversity in the existing mix in assessing changes.

Q. Okay. That's all I have. Thank you.

MR. KUTIK: Okay. Mike Settineri.

MR. SETTINERI: Just for the record, because I jumped on a little late, I'll just make sure we have an official notice of appearance.

Michael Settineri with the law firm of Vorys, Sater, Seymour & Pease on behalf of the PJM Power Providers Group, Electric Power Supply Association, and the Retail Energy Supply Association.

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CROSS-EXAMINATION

BY MR. SETTINERI:

Q. Good afternoon, Dr. Makovich. One minor detail I assume: Is it appropriate to call you Dr. Makovich?

A. Yes.

Q. Okay. Just making sure. Sometimes people prefer not to.

I was looking at Attachment LM-1, and just a quick question: How many times have you testified before Congress?

A. Three times.

Q. And those are the dates listed on Attachment LM-1, correct?

A. Yes.

Q. Okay. Thank you.

I'm going to jump around a little bit here, but I'll try to move along. Let me ask you this question: If we assume that FES is not going to

retire the plant -- and when I say "FES," I'm referencing FirstEnergy Solutions.

If we assume FES is not going to retire the plants, regarding whether the ESP is approved, is there any reason to implement the ESP program, in your opinion?

MR. KUTIK: Objection.

THE WITNESS: The -- well, as I said, I've relied on Don Moul's testimony in this regard, which is that I can't assume they're not going to retire the plant.

BY MR. SETTINERI:

Q. Are you done answering?

A. Yes.

Q. Okay. And I'm going to go back, though, because I am asking you a hypothetical: If the plants do not retire, regardless whether the ESP is approved -- let me rephrase that.

Again, assuming FES is not going to retire the plants, regardless whether the ESP is approved, is there any reason to implement the ESP program?

MR. KUTIK: Objection.

THE WITNESS: There may be.

BY MR. SETTINERI:

Q. And what would that reason or reasons be?

A. Well, my testimony isn't about this hypothetical case where it's not going to be retired and an assessment of that, the benefits of this contract in that case. I'm assessing what I've been asked to look at, which is that there is a possibility here of retirement.

Q. And I understand that, Dr. Makovich. But I'm not asking you what you are testifying to here with that question. I'm asking you: Based on that assumption that I gave you, is there any reason to implement the ESP program, and you indicated that there would be a reason.

So my follow-up question to you then is: What is that reason?

A. I said there may be a reason.

Q. And, again, what would that reason be?

A. I can only give you an example and not an exhaustive list of reasons.

Q. Well, let's start with the first one. What would the reason be?

A. If such a contract were in place and

natural gas prices went on another upward cycle, then the benefit of that would accrue to the customers.

Q. And how would that benefit accrue to the customers?

A. If a runup in gas prices created a dramatic runup in the wholesale price of electricity, this contract would protect customers from that price volatility.

Q. And for those retail customers that may have long-term contracts -- when I say "long-term," let's say up to three-year contracts for retail energy supplies -- would they receive that protection or that benefit?

A. It would depend on the terms and conditions of those contracts.

Q. Any other reasons to implement the ESP program if FES is not going to retire the plant regardless whether the ESP is approved?

A. As I said, there may be.

Q. And you gave me one. Any others that come to mind?

A. As I said, I haven't thought through your hypothetical to be able to give you a comprehensive list of the reasons.

Q. Let's go to Page 6 of your testimony. The first question on the top of the page, "What is the 'missing money' problem?" I just want to ensure that I fully understand that answer.

Looking at Line 10 and 11, you indicate, "There are two root causes of the missing money problem." First, and I'm going to paraphrase, is that certain technologies have inherent characteristics that prevent markets from delivering prices high enough to balance demand supply.

Are you referencing there the -- that prices are generally too low to generate new investments in the power markets?

A. What I'm referencing is that in an energy-only power market, there will be a shortfall and a resource adequacy problem.

Q. So the first root cause relate to investments?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: I said the root cause of the first dimension comes from the inherent characteristics of the technologies used to provide electricity.

BY MR. SETTINERI:

Q. And I don't understand that; so I'll have to ask it a different way I guess.

You say here, "First, power generation technologies have inherent characteristics..." What are those inherent characteristics?

A. I provided the example of the extreme case of -- of wind and solar that are technologies that have zero marginal costs. As a result, in a competitive market you'll have a price that clears at zero.

Q. And how does that impact other power generation technologies?

A. The reason I provided the example is if you had a marketplace with those kinds of technologies, it would fail to provide investment and supply.

Q. Okay. And when you say "fail to provide investment and supply," taking that in two steps, when you say the word "investment," are you referring to the construction of new generation facilities?

A. In the example that we are discussing that I provided on Page 7 where the technologies are wind and solar, if the price clears at zero there's

no incentive to invest.

Q. And, again, when you say "invest," though, I just want to understand is it someone investing in buying a facility?

A. I'm talking about there would be a failure to provide an adequate economic signal for investment.

Q. Well, again, what do you mean by "invest?" Is it relating to the construction facility, or an equity investor, or coming in and buying a new asset?

A. I'm talking about deploying capital in the productive resources for power supply.

Q. Does that include construction of a new facility?

A. It includes the construction of any facilities.

Q. That's what I was trying to get to. I appreciate it.

Now, later on in your testimony you referenced the PJM capacity markets at Page 10, Line 15 and 16.

A. Yes.

Q. You state in Line 16, "This addresses

the inherent dimension of the missing money problem..."

The inherent dimension that you're referencing there, does that relate back to the investment -- into the energy infrastructure and market that we just discussed?

A. What we discussed was deploying capital for power production facilities.

Q. Again, does that reference the inherent dimension of the missing money problem? Does that relate to that deploying of capital?

A. Yes.

Q. Okay. And so what I'm trying to understand here is you note that the PJM capacity markets address that issue. What I'm going to try to understand is how -- how does the PJM capacity market address that inherent dimension of the missing money problems?

A. It closes the cost recovery gap from the inherent dimension.

Q. Okay. Does it eliminate the issue of the inherent dimension of the missing money problem?

A. As I previously testified, it is not clear that it fully closes the gap in PJM.

Q. Why do you say it's not clear?

A. Well, it -- as I'm saying, as I look at the data, there is some uncertainty as to whether it's fully closing the gap.

Q. What data are you looking at?

A. When I look at the market clearing prices for energy and capacity in PJM.

Q. What does that data tell you when you just look at a clearing price?

A. The rest of Page 11, I work through what it tells me as it looks like there's still a shortfall for baseload generation.

Q. And you say at Page 12, top of Page 12, Line 3 and 4, I'm going to paraphrase it, the shortfall has been chronic in PJM for over a decade; is that correct?

A. Yes.

Q. Okay. What has been the impact of this shortfall over the last decade?

A. The impact has been on the generation mix and --

Q. How has that mix changed over the last decade?

MR. KUTIK: He hadn't finished his

answer; so go ahead and finish.

BY MR. SETTINERI:

Q. Go ahead, Dr. Makovich.

A. And the impact has been to drive continued evolution of market rules.

Q. When you say "evolution of market rules," are you referring to PJM rules?

A. Yes.

Q. Let me ask the -- have you reviewed specifically how the missing money problem, as you frame it, has impacted the Sammis and Davis-Besse plants?

A. No.

Q. Why not?

A. As I previously testified, I've been asked to testify to the value of power supply diversity. And in attaching the study, I've said that one of the threats to that value is the missing money problem.

Q. Is it fair to say generally that your testimony is at a policy level versus a plant-specific level?

A. I'm not sure what you mean by those terms.

Q. Well, I can reframe it a little simpler in the sense that is it fair to say that your testimony is a high-level presentation of the missing money problem, but not a detailed application of the missing money problem to the Davis-Besse and Sammis plants?

MR. KUTIK: Objection.

THE WITNESS: Yeah. That's not how I've characterized my testimony.

BY MR. SETTINERI:

Q. Well, how do you characterize it then?

MR. KUTIK: Objection, asked and answered. Tell him again.

THE WITNESS: I've been asked to testify with regard to the value of fuel and technology diversity and power supply.

BY MR. SETTINERI:

Q. Is that within the state of Ohio?

A. I wasn't asked to focus it on any specific geography.

Q. And likewise, you did not focus on any specific plants, correct?

A. As I said, that the study was done in looking at the current value of fuel and technology

diversity in the US on an interconnection level.

Q. And I understand that was your study.

MR. KUTIK: I'm sorry. I'm sorry. I'm sorry. Had you finished your answer?

THE WITNESS: Yeah.

MR. KUTIK: Okay. All right. Go ahead.

BY MR. SETTINERI:

Q. And I'm talking not about your study that was attached to your testimony, but the actual testimony itself.

A. I'm sorry. What's the question?

MR. SETTINERI: Why don't the court reporter, can you read back the second-to-last question I asked, please?

(Record read back as requested.)

MR. SETTINERI: Thank you.

BY MR. SETTINERI:

Q. So likewise, you didn't focus on any specific plants in your written testimony, correct?

A. My written testimony mentions the plants of the Davis-Besse and Sammis plants.

Q. But I'm trying to just understand this. You didn't do any analysis of the operation of the plants, correct?

A. I did not do an analysis of the operation of those plants.

Q. Did you do any analysis, financial or otherwise, of the plants?

A. As I've testified, I relied on Don Moul's testimony in that regard.

Q. Okay. That's not what I asked you. I'm asking a simple yes-or-no question. I'd like to know: Did you do a financial analysis in regards to plants?

You referenced Mr. Moul's testimony, but that didn't answer my question of whether you did an analysis. That's all I want to know.

MR. KUTIK: Well, we'll agree to disagree; so I'll object to your question as asked and answered.

BY MR. SETTINERI:

Q. You can go ahead and answer.

MR. KUTIK: If you feel you've answered the question, you can tell him that. Go ahead.

THE WITNESS: The question of fuel diversity and the missing money problem is something that applies to the Davis-Besse and Sammis power plants, which is what I've said in my testimony.

BY MR. SETTINERI:

Q. And that's good, because it's one of the questions I have.

Okay. How is it impacting the Sammis and Davis plants?

A. My testimony is that renewable power mandates have suppressed the cash flows for baseload power plants, and both these plants are baseload power plants.

Q. Let's go to Page 3. A couple quick questions for you there, Dr. Makovich.

Page 5 -- I'm sorry, Page 3, Line 5, we'll start with -- let's read the whole sentence, Line 4 you state, "The Economic Stability Program will produce benefits for retail customers because it will prevent the Plants from retiring before it is economic to do so."

Are you certain that the ESP will prevent the plants from retiring?

A. I've relied on the testimony of Don Moul in that regard.

Q. Okay. So your testimony here is simply -- is based on Mr. Moul's testimony that the ESP is needed to prevent the plants retiring, is that

a fair characterization?

MR. KUTIK: Objection.

THE WITNESS: I don't think Don Moul said they would necessarily retire.

BY MR. SETTINERI:

Q. And just for the record, you don't have -- do you have an opinion on whether these plants will retire?

A. As I said, I've testified, they are at risk of retiring.

Q. I know you state that, but -- okay. Let me -- I hate to do this, but on what do you base your opinion that the plants may retire?

A. On the testimony of Don Moul in that regard.

Q. And my follow-up question is: Do you have an opinion, separate from any opinion by Mr. Moul, that either the Sammis or Davis plants will retire?

A. I have not made an assessment to assign probabilities to that.

Q. Looking at Line 8, Page 3, you -- there's a sentence that starts with, "The probability exists that these baseload plants will retire

prematurely..." and the sentence continues.

I believe earlier you mentioned that you had not done any probability analysis that the plants will retire prematurely. If that is the case, what do you mean by "the probability exists"?

A. I mean that there is a chance that these baseload plants will retire prematurely because the value of fuel diversity is not being properly compensated by power market cash flows and thus properly internalized in current power plant decision making.

Q. Again, you didn't do any specific analysis of the Davis and Sammis plant, so on what do you base that statement?

A. As I previously testified, there are other examples of similar plants where this has happened.

Q. And other basis for that statement?

A. Yes.

Q. What are those?

A. The chronic problem of missing money in energy market revenue streams.

Q. And when you say "the chronic problem," I believe it was of missing revenue -- energy

revenue. Does that directly apply to the Davis-Besse and Sammis plants?

MR. KUTIK: Objection.

THE WITNESS: Yes.

BY MR. SETTINERI:

Q. Okay. Let me ask you this: For a generation fleet owner like FirstEnergy Solutions, what other options are available to address the missing money problem? And I recognized previously you had mentioned there was a list of 13, and I believe you could only remember six of the 13. Do you recall that testimony previously?

A. Yes.

Q. Okay. Is one option that will be available to a generation fleet owner is to seek tax breaks?

A. That was not one of the 13 I assessed.

Q. Okay. Have you considered -- are you aware that Ohio has a personal property tax on generating facilities?

A. I'm aware that states have -- generally have taxes on the value of power plants. I'm not familiar specifically with the Ohio provisions.

Q. Have you ever considered whether

targeted tax breaks could be used to address the missing money problem for a specific unit?

A. The -- the -- I have not assessed the use of tax breaks as a remedy.

Q. And just to double-check, was that -- do you recall if tax breaks were discussed in your article about Bridging the Missing Money Gap: Assessing alternative approaches?

MR. KUTIK: Objection, asked and answered. Go ahead and tell him again.

THE WITNESS: Yes. In the discussions of the approaches that people are currently using to address this, we don't have an approach which is tax breaks -- property tax breaks.

BY MR. SETTINERI:

Q. Okay. Are you done answering?

A. Yes.

Q. Okay. Thank you. Let me ask this question: What can a generation fleet owner do to address the missing money problem within -- let me rephrase that and ask this question: Can a generation fleet owner address the missing money problem by maintaining a diverse generation fleet?

A. No.

Q. And why not?

A. The missing money problem derives from a market intervention, not the generating mix of a supplier.

Q. Would that diversity, though -- well, in terms of managing fuel costs, would that allow the generation -- provide the generation fleet owner with a -- considered a hedge against price spikes in one fuel resource versus another?

MR. KUTIK: Objection.

THE WITNESS: I don't consider what you described an approach to addressing the missing money problem.

BY MR. SETTINERI:

Q. Okay. Have you reviewed FirstEnergy Solutions' generation fleet makeup?

A. I'm generally aware of it.

Q. Okay. And how did you become generally aware of it?

A. I've worked with FirstEnergy over many years.

Q. What is the nature of your work you've done for FirstEnergy?

MR. KUTIK: Objection, asked and

answered.

THE WITNESS: As I've previously testified, FirstEnergy's been a retainer client of IHS.

BY MR. SETTINERI:

Q. All right. Thank you.

Have you -- to prepare -- to write your testimony, did you review any of FirstEnergy Solutions' financial statements?

A. No.

Q. Do you have an understanding of the financial position of FirstEnergy Solutions?

A. I do not have specific information on their financial position.

Q. Okay. And previously there was some questions about communicating directly with FirstEnergy Solutions' personnel. I don't know if the record's real clear on that; so I'll ask the question.

Have you communicated directly with any FirstEnergy Solutions personnel about the ESP?

A. Yes.

Q. And who did you communicate with?

A. Jim Lang.

Q. Anyone else?

A. No.

Q. Okay. Let me ask you this question: To address the missing money problem, do you believe that all baseload plants should be included in programs like ESP?

A. No.

Q. Okay. Well, why not?

A. There are some baseload plants that are economic to retire.

Q. Okay. Let me ask you this question: Given -- correct me if I'm wrong, but I believe you mentioned that the PJM capacity markets have narrowed the gap on the inherent root cause. If you removed the imposed dimension of the missing money problem, would the Davis-Besse and Sammis plants still be exposed to a missing money problem?

MR. KUTIK: Objection.

THE WITNESS: As I've testified, there can be other factors that could cause a missing money problem. My testimony focuses on the impact of the renewables' mandates.

MR. SETTINERI: And, I'm sorry, could I ask the court reporter, I couldn't hear you on that

last part of your answer.

MR. KUTIK: Read the answer.

(Record read back as requested.)

MR. KUTIK: Let's go off the record for a second.

(Discussion held off the record.)

(Recess taken.)

BY MR. SETTINERI:

Q. Real quick, Dr. Makovich, what information did you review to prepare for your -- to prepare your direct testimony in this case?

A. Well, as I've testified, I reviewed Don Moul's direct testimony.

Q. And any other documents that you reviewed?

A. The Value of US Power Supply Diversity report that I've attached as LM-2.

Q. Any others besides those two documents?

A. Yes. I have included data on the power prices that cleared at the AEP/Dayton hub. It's included as Figure 2.

Q. Okay. And I'm just trying to run through, capture everything. Anything else that you reviewed to prepare your testimony?

A. I think that covers it.

Q. Okay. And just so I'm clear, are you aware that Mr. Moul submitted both direct testimony and supplemental testimony in this proceeding?

A. I am aware that he has filed supplemental testimony.

Q. And did you review the supplemental testimony?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: I have not.

BY MR. SETTINERI:

Q. Thank you. A few remaining questions here.

Page 4, really you don't even have to look at it, I'm wondering, have you ever been involved in a decision to retire a power plant?

MR. KUTIK: Objection.

THE WITNESS: Yeah. What do you mean by "involved"?

BY MR. SETTINERI:

Q. Have you had any involvement whatsoever in a decision to retire a power plant?

A. Yes.

Q. Okay. And how many power plants have you been involved in regarding decisions to retire a plant?

A. I don't know the number.

Q. Over 10?

A. Your question was rather broad. I provide information regarding the business landscape in power to a wide variety of people who use information to make decisions.

Q. Okay. And is that what you mean by -- or when I asked you the question about being involved in decisions, would that constitute your involvement?

A. Yes.

Q. Okay. Thank you. Just so I understand, do you -- would you consider a combined-cycle natural gas-fired generation plant to be a baseload plant in certain instances?

A. It is a technology that's capable of that role in a portfolio.

Q. And under what circumstance would that technology be capable of being a baseload unit?

A. Well, the circumstances -- I'm not sure. Can you rephrase the question?

Q. Yeah. Number one, what I'm trying to

understand is whether you consider a natural gas-fired combined-cycle plant to be a baseload plant. And I understand that certain instances -- I think you clarified that as to certain instances.

So what I'm trying to understand is under what circumstances -- let's say under what operational circumstances would you consider a natural gas-fired combined-cycle power plant to be a baseload unit?

MR. KUTIK: Objection.

THE WITNESS: I'd consider it baseload if it ran at a high utilization rate to serve loads that are seen a high percentage of the time.

BY MR. SETTINERI:

Q. Okay. So essentially -- okay. Are there any units in the FirstEnergy Solutions fleet that are not being impacted by the missing money problem?

A. As I said, I haven't done a specific analysis of the FirstEnergy fleet.

Q. Turning to Page 16, Line 12 and 13.

MR. KUTIK: I'm sorry. What page?

MR. SETTINERI: Page 16.

MR. KUTIK: Thank you.

MR. SETTINERI: Line 11 through 14.

THE WITNESS: Yes.

BY MR. SETTINERI:

Q. The very last sentence where it starts with, "I would expect that, all else equal, the retirement of Sammis and Davis-Besse in combination with thousands of megawatts of other coal-fired generation in Ohio and elsewhere would result in retail power prices in Ohio that are higher and more volatile than would otherwise occur."

Do you see that sentence?

A. Yes.

Q. On what is that sentence based?

A. The sentence is based on my assessment that renewables are depressing the energy market cash flows and disproportionately affecting baseload units.

Q. One last question: How long have you been studying the missing money problem?

A. For decades.

Q. And I notice on LM-1, it looks like you started writing a number of articles starting in 2013 through 2014. Assuming that's correct, that you wrote on this issue in the last few years, what

created your interest in writing an article on this issue?

A. Well, our business involves providing research on the power sector to clients, and this is part of that research.

Q. Have you seen a renewed -- or have you seen an -- a heightened interest in the missing money problem since 2013 from your clients?

A. I'm not sure if I'd use the term "heightened." What I would say is the missing money problem remains an issue on people's minds.

Q. Well, thank you, Dr. Makovich. I have no further questions. Thank you.

MR. KUTIK: Are we done?

MR. OLIKER: My turn?

MR. KUTIK: Is it?

MR. OLIKER: I'm ready to go if the witness is ready to continue.

MR. KUTIK: Okay. Let's go.

- - -

CROSS-EXAMINATION

BY MR. OLIKER:

Q. Dr. Makovich, good afternoon. My name is Joe Oliker. I represent IGS Energy. Are you okay

to continue?

A. Yes.

Q. Okay. Just a few questions for you today. I'll try not to repeat anything, but I apologize, hitting cleanup, it's hard to avoid.

For purposes of our discussion today, and I think you've been asked this before, would you understand if I referred to the Ohio Edison Company, The Toledo Edison Company, and Cleveland Electric Illuminating Company as the companies?

A. Yes.

Q. And FirstEnergy Solutions Corp. will be FES, okay?

A. Yes.

Q. And Clifty Creek and Kyger Creek collectively will be referred to as the OVEC plant.

A. Yes.

Q. Okay. Could you turn to Page 3 of your testimony, please?

A. Yes.

Q. And I understand we've talked just a little bit, but I'm still not sure I understand your answer. You're talking about -- you say, "The Economic Stability Program will produce benefits for

retail customers because it will prevent the Plants from retiring before it is economic to do so."

When you say "economic" in this sentence, you're referring to the comparison of going-forward costs to closure costs plus replacement costs, correct?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: I am comparing the costs of going-forward costs to the cost of replacement.

BY MR. OLIKER:

Q. Okay.

A. Yes.

Q. We'll come back to that in a second.

Now, from a high level, would you say that your testimony takes issue with the --

MR. KUTIK: You have to say it again, Joe. Someone was moving papers around, we couldn't hear you.

BY MR. OLIKER:

Q. Sure thing.

Dr. Makovich, from a high level, would you agree that your testimony takes issue with the amount of compensation that is available to the FES

plants through the PJM capacity market?

A. No.

Q. Would you please explain why that's not true?

A. My testimony is the problem resides in the missing money in the energy market revenue stream.

Q. Do you believe there are any flaws in the capacity market?

MR. KUTIK: Objection.

THE WITNESS: Can you restate the question?

BY MR. OLIKER:

Q. What part of my question don't you understand?

A. What you mean by "flaws."

Q. If you could change the PJM capacity market, would you, and how would you change it?

MR. KUTIK: Objection.

THE WITNESS: I've not made any recommendations here regarding how I would change the PJM capacity market.

BY MR. OLIKER:

Q. Let me state it differently: Would you

agree that the missing money problem is a product of a revenue shortfall?

A. Yes.

Q. And would you agree that when you're determining the amount of revenue in the equation, you're considering all revenue available to a point?

A. Yes.

Q. And capacity revenue is a component of that revenue?

A. Yes.

Q. For purposes of your missing money problem, you would agree that the amount of capacity revenue that is available to the FES plants is a component?

A. Yes.

Q. Okay. Dr. Makovich, I'm sorry if you already answered this, but have you evaluated whether there is currently a surplus of capacity in PJM?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: I've already testified that I do not see a serious surplus capacity problem in PJM.

BY MR. OLIKER:

Q. Thank you for that answer, Dr. Makovich, but I'm not -- I don't think that answers my question. You mentioned a serious capacity surplus. My question is is there a capacity surplus at all?

MR. KUTIK: Objection, asked and answered. If you feel you've answered the question, you can say so.

THE WITNESS: I feel I've answered the question.

BY MR. OLIKER:

Q. Is there a difference between serious capacity surplus and a capacity surplus?

A. Yes.

Q. And could you please explain whether there is a capacity surplus in PJM -- or, let me step back.

Could you explain the difference between a serious capacity surplus and a capacity surplus?

MR. KUTIK: Asked and answered, I object.

THE WITNESS: A capacity surplus is typically measured with a loss of load probability assessment or reserve margin measure, and there could be trivial differences from the target that do not

amount to a serious surplus of capacity.

BY MR. OLIKER:

Q. Would you define a serious surplus capacity, please?

A. Yes. For example, the US as a whole reached a reserve margin of over 40 percent decades ago, which was generally considered a serious surplus of capacity.

Q. And could you please explain what level of an installed reserve margin with a gaining of a surplus of -- a serious surplus of capacity?

A. In this testimony, I've not created a distinction and a line on reserve margins or loss of load probability to distinguish. I'm simply saying my testimony is that there's not a serious surplus of capacity in PJM.

Q. And when you state that, "Without a surplus of generating capacity, it is economic to retire a power plant when the cost of...closing the plant and replacing it with the lowest cost source of equivalent power supply," in that sentence, are you referring to serious surplus or just a surplus?

A. A serious surplus.

Q. And would you agree that when you're

talking about the economic rationality of closing a power plant, your testimony is not evaluating the metrics that FirstEnergy Solutions will consider?

MR. KUTIK: Can I have the question read, please?

(Record read back as requested.)

THE WITNESS: My testimony is I'm not privy to the discussions internally with regard to plant closures for the companies.

BY MR. OLIKER:

Q. Dr. Makovich, do you have an opinion of the metrics that a rational owner of a power plant would consider in closing it?

A. Let me -- can you rephrase the question? I'm not exactly sure what you're asking me for.

Q. What part of my question don't you understand, and I'll try --

THE WITNESS: Can you read the question back, please?

(Record read back as requested.)

THE WITNESS: In general, they're going to be evaluating the costs and benefits of continued operation versus closure.

BY MR. OLIKER:

Q. Okay. Let's try to drill it down maybe a little more. If a plant produces market-based revenue in excess of its marginal cost of operation, will the owner retire it?

MR. KUTIK: Objection.

THE WITNESS: I'm not sure what you mean by "market-based revenue."

BY MR. OLIKER:

Q. Take out the market. Let's try that again.

If a power plant produces revenue in excess of its marginal cost of operation, will the owner retire it?

A. It's possible he could decide to.

Q. Can you explain why it's possible that they would retire it?

A. It may be that they faced going-forward costs that the -- this cash flow wouldn't support.

Q. Okay. Then let's try the question again. Let's assume that the going-forward costs of operating a plant are less than the revenues that that plant will produce. Would you agree that the power plant owner would not retire it?

THE WITNESS: Can you read that question

back, please?

(Record read back as requested.)

THE WITNESS: I'm sorry, slow down again. Go ahead, read it again.

(Record read back as requested.)

THE WITNESS: Not necessarily.

BY MR. OLIKER:

Q. And why is that?

A. This is a decision being made under uncertainty, and there would be uncertainty with regard to the going-forward costs and the revenue streams.

Q. Okay. Let's -- Dr. Makovich, thank you for that answer. Let's ask this as a hypothetical now. I'm going to take out some of the variables.

Let's assume that the going-forward costs of the plant are certain, and let's assume the revenues of the plant are certain, the going-forward costs are less than the revenues, would you agree that in this hypothetical the plant owner will not retire it?

MR. KUTIK: Objection.

THE WITNESS: My expectation would be that they would not retire.

BY MR. OLIKER:

Q. Thank you.

Let's talk about -- assuming that a plant owner does retire -- retire, plant closure costs can be significant, correct?

A. Yes.

Q. And that's another one of the things that a plant owner will consider when they're making their decision, right?

A. Possibly.

Q. Do you agree that nuclear decommissioning costs are very significant?

A. It would depend on the plant.

Q. Have you evaluated the closing costs of either the OVEC plants, Sammis, or Davis-Besse?

A. No.

Q. Do you know whether FES would be able to recover plant closure costs from customers in Ohio?

A. No.

Q. Assuming they could not recover those closure costs from customers in Ohio, do you agree that they would definitely consider them in making the decision to close the plant?

A. Again, as I've testified, I'm not privy

to their decision process.

Q. Okay. I apologize for jumping around, but you attached an analysis to your testimony. I think it's Figure ES-1. I'll try to help you out with that page number. It is on, I believe, Page 5 of Attachment LM-2. Let me know when you're there, Dr. Makovich.

A. Page 5 of LM-2, yes.

Q. This figure, ES-1, says "US generation mix." And I apologize if you've already said this, but is this installed capacity or is this energy --

MR. KUTIK: Objection, asked and answered.

BY MR. OLIKER:

Q. -- or something else?

MR. KUTIK: Asked and answered. Go ahead.

THE WITNESS: This is generation energy.

BY MR. OLIKER:

Q. Okay. So I think that's all.

If you can jump to Figure 14, which is on Page 22. Does that explain why there are different -- this pie chart looks different?

MR. KUTIK: Objection.

BY MR. OLIKER:

Q. Is that installed capacity?

A. Figure 14, as the title suggests, is the installed capacity.

Q. Thank you. I wanted to make sure of that.

Talking about this study, The Value of US Power Supply Diversity, this is largely a discussion of what happens if coal, nuclear, oil, and hydro disappears, correct?

MR. KUTIK: Objection.

THE WITNESS: No.

BY MR. OLIKER:

Q. Can you explain why that's not true?

A. The reduced diversity case reflects the trend of less hydro, but it doesn't eliminate hydro.

Q. Thank you for that clarification.

But if we evaluate, am I correct there is a base case and then there's the reduced case, correct?

A. The base case is what actually happened between 2010 and 2012.

Q. Okay. And would you agree that if -- scratch that.

A. Sorry, I didn't catch that.

Q. Sorry, Dr. Makovich. I'm trying to make sure I don't reask other people's questions.

Dr. Makovich, does your analysis in LM-2 model anything in between the reduced case and the base case?

A. No.

Q. And have you evaluated the impact of Davis-Besse, Sammis, and the OVEC plants retiring on the fuel mix in PJM?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: I've testified that I've not done a specific analysis of these plants.

BY MR. OLIKER:

Q. Okay. And have you evaluated what the impact on power prices would be if Davis-Bessie, Sammis, and the OVEC plants were to retire?

A. As I said, my testimony does not involve specific analyses of these plants.

Q. Okay. On Page 7 of LM-2, you mentioned the Razor Model. What does the Razor Model do?

A. The Razor Model simulates the supply and demand in a regional power market -- the interaction

of supply and demand in a regional power market.

Q. And does it predict power prices?

A. Yes.

Q. Energy prices or capacity energy prices?

A. Energy prices.

Q. How about capacity prices?

MR. KUTIK: Objection.

THE WITNESS: I've testified it analyzes the production costs, the energy prices.

BY MR. OLIKER:

Q. Okay. Have you used or has IHS used the Razor Model to forecast power prices in PJM over the next 15 years?

A. We may have.

Q. Would you have been involved in that forecast?

A. Other people at IHS may have used it for that purpose. I've not been involved in a forecast using it for PJM.

Q. And do you know the results of any forecast of power prices over the next 10 years or 15 years in PJM using the Razor Model?

THE WITNESS: I'm sorry, could you repeat that question?

(Record read back as requested.)

THE WITNESS: No.

BY MR. OLIKER:

Q. Okay. Now, could you please turn to LM-2? I believe it's Page 47. I'd like you to focus on the bottom paragraph. You indicate, "Based on the LDC, in this example baseload generation was modeled at 52.5 percent of capacity and was composed of equal parts gas, coal, and nuclear capacity."

First, in this statement, what do you mean by baseload generation?

A. The generation that's being utilized to meet power demands that are present with the highest percentage of time.

Q. And could you explain what the 52.5 percent number is?

A. The 52.5 percent is the amount of capacity that was made up of the gas, coal, and nuclear technologies. To be specific, I believe that's of a combined-cycle; gas, coal, and nuclear technologies.

Q. That was my next question. I think you just clarified. Simple-cycle combustion turbines are not included in this definition of gas?

A. Yes.

Q. Would you consider 52.5 percent baseload composed of equal parts coal, nuclear, and gas as a diverse generation mix?

A. In this assessment, it was being compared to an all-gas generation portfolio; so I would consider it to be more diverse than the all-gas generation portfolio.

Q. Would your answer be the same if we weren't comparing it to an all-gas portfolio?

A. Well, diversity is a matter of degree. Since it's made up of more than one source of supply, there is diversity.

Q. Okay. Do you consider a power supply that is 40 percent gas, combined cycle, 30 percent coal, 15 percent nuclear, 5 percent hydro, and 10 percent renewable to be a cost-effective diverse fuel mix?

MR. KUTIK: Objection. That would depend on the conditions in that power system.

BY MR. OLIKER:

Q. What about PJM?

A. As I said, I have not done a PJM-specific analysis for this testimony.

Q. Do you believe that natural gas combined-cycled power plants --

MR. KUTIK: You need to repeat that, Joe.

BY MR. OLIKER:

Q. Sure. Do you believe that natural gas combined-cycle power plants cause volatile energy prices?

MR. KUTIK: Objection.

THE WITNESS: No.

BY MR. OLIKER:

Q. Could you explain -- I'm happy that you disagree with me. Could you explain why?

A. It's the volatility of the fuel input price that creates the volatility in the wholesale price.

Q. Do you agree that if a natural gas combined-cycle power plant has firm transportation, you will have less volatile fuel?

MR. KUTIK: Objection.

THE WITNESS: That's not necessarily the case.

BY MR. OLIKER:

Q. Why is that?

A. People can buy firm transportation without firming up the commodity price.

Q. Would you agree it reduces volatility?

MR. KUTIK: Objection.

THE WITNESS: I've not testified to that, no.

BY MR. OLIKER:

Q. Do you agree that if a natural gas combined-cycle power plant has firm transportation and hedges its natural gas contract, it will not have volatile cost of production?

MR. KUTIK: Objection.

THE WITNESS: No.

BY MR. OLIKER:

Q. Why is that?

A. Because the cost of production is going to depend on the delivered cost of gas, and that's -- the hedge is simply a financial instrument to offset the volatility or to manage the volatility.

Q. Yeah. I understand where we -- where we looked past each other. Let's try this one more time, Dr. Makovich.

Would you agree that if a natural gas combined-cycle power plant has firm transportation

and contracts for natural gas on a long-term basis, it will not have a volatile cost of production?

A. Well, the cost of production can include other factors. What I do believe, it would be less volatile than buying that gas on the spot market.

Q. Okay. And would you agree that if a natural gas-fired power plant has dual fuel capability, it will have a less volatile cost of production?

MR. KUTIK: Objection.

THE WITNESS: It would depend on the characteristics of that dual fuel capability as to how much it would affect the cost of production.

BY MR. OLIKER:

Q. What characteristics would it depend on, Dr. Makovich?

A. I'm aware of limits that have been mandated about hours of operation when plants switch to a liquid fuel.

Q. Referring to diesel generator rules?

A. That would fall under that.

Q. How about oil?

MR. KUTIK: Hold on a second. Let's go off the record for a second.

(Discussion held off the record.)

MR. KUTIK: Could you read the last question, please?

(Record read back as requested.)

THE WITNESS: What about oil?

MR. KUTIK: Read the last two questions, please.

(Record read back as requested.)

MR. KUTIK: Do you understand the question at this point, Dr. Makovich?

THE WITNESS: I'm not sure I understand the question. Can you rephrase the question?

BY MR. OLIKER:

Q. What types of dual fuel capability do you know about?

A. There are gas-fired power plants that can also run on liquid fuels, and that would include, but not exclusively, diesel.

Q. What other ones?

A. There's No. 2 fuel oil.

Q. Any others?

A. Kerosene.

Q. When -- in the fuel diversity analysis that you have included in your testimony when you

refer to oil generation, what type of oil generation are you talking about?

A. It includes all the types of oil generation we've just talked about.

Q. Okay. Are you familiar with the PJM capacity performance proposal?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: I am familiar with it, yes.

BY MR. OLIKER:

Q. Do you agree that if it is approved as proposed, it would allow combined-cycle power plants to include the price of firm transportation or dual fuel capability in offers in the capacity market?

A. Yeah. Without reviewing the latest version, I really can't testify as to what it can or cannot do.

Q. What was the latest version you have reviewed?

A. It was a version submitted to FERC months ago.

Q. Assuming that the capacity performance proposal allowed combined-cycle generators to include

the cost of firm transportation in their offers, would you agree that that will have a tendency to reduce volatility in the PJM capacity energy market?

A. I've already testified that that wouldn't necessarily be the case.

Q. Could you explain that, please?

A. As I said, that the volatility is primarily associated with the commodity price of gas, not the transportation charge.

Q. Do you agree that the commodity price spikes occur as a result of a lack of infrastructure?

MR. KUTIK: Objection.

THE WITNESS: That is a contributing factor.

BY MR. OLIKER:

Q. And do you agree that those concerns are not present in the summer?

A. I did not testify to that.

Q. Is your answer no?

A. I certainly have seen evidence that deliverability constraints exist in the winter, but I cannot at this point in time tell you if they do not exist at all in the summer.

Q. Do you agree that there is a robust

pipeline expansion development occurring within the PJM footprint right now?

MR. KUTIK: Objection.

THE WITNESS: Yeah. I don't know what you mean by "robust."

BY MR. OLIKER:

Q. Would you agree that there are pipelines that are continuing to be developed in PJM right now?

A. I'm aware that there is pipeline development going on within the PJM.

Q. On Page 6 at LM-2, you talk about natural gas issues during the polar vortex and forced outage rates, correct?

A. Let's see, I don't think it's -- Page 6, did you say?

Q. Of Attachment LM-2.

MR. KUTIK: Do you want to refer him to a specific text?

BY MR. OLIKER:

Q. Yeah. "These recent events demonstrated that natural gas deliverability remains a risk and natural gas prices continue to be hard to predict."

MR. KUTIK: Where?

MR. OLIKER: Under cycle.

MR. KUTIK: Where are you on Page 6? Sorry.

BY MR. OLIKER:

Q. Yeah. Sure. I'm on Page 6, it's the second full paragraph at the bottom. I just wanted you to look at that for context for my next question.

MR. KUTIK: Do you know where he's referring? Because I don't.

THE WITNESS: I believe it's here where it starts with "However."

MR. KUTIK: Okay.

BY MR. OLIKER:

Q. It's the paragraph that starts with, "The shale gas revolution..."

A. Yes.

Q. And from a high level, you're talking about natural gas issues during the polar vortex. But my question is: Have you evaluated the issues that coal-fired power plants experienced during the polar vortex?

A. I'm generally aware of some of the challenges.

Q. Would you agree that general plant failures during the polar vortex were responsible for

twice the number of forced outages and natural gas fuel delivery problems?

MR. KUTIK: Objection.

BY MR. OLIKER:

Q. If you know.

A. I'm sorry, repeat the question.

Q. Would you agree that general plant failures during the polar vortex were responsible for twice the number of forced outages and natural gas delivery costs?

MR. KUTIK: Objection.

THE WITNESS: I can't testify to that, whether that's true or false.

BY MR. OLIKER:

Q. Is that because you don't know?

A. I'd have to look at the data to testify to that.

Q. Have you seen that data?

A. I have looked at reports regarding what happened during the polar vortex in PJM.

Q. Okay. And would you agree that the winter of 2014-2015 actually saw higher peak loads and colder weather than the polar vortex?

A. Again, without having the data in front

of me, I can't -- I can't confirm or deny these comparisons.

Q. Okay. Let me come at it differently. Would you agree that this past winter was very similar to the prior winter from a weather perspective?

MR. KUTIK: Objection.

THE WITNESS: Again, the weather's a very complex phenomena, and it's more than just an average temperature comparison. So without doing an analysis of the weather stress this past winter versus the previous winter, I really can't testify to one being more or less severe than the other.

BY MR. OLIKER:

Q. Do you know if the peak load during this past winter of 2014-2015 was greater than the peak load in the polar vortex?

A. As I said, I don't have any of that data in front of me to be able to testify to that.

Q. Okay. And that's okay. Would you agree that price spikes during the polar vortex were significantly higher than the pricing that was experienced during this past winter, and that is on energy?

A. Again, I'm aware that there were some significant price spikes both this past winter and the previous. I don't have the data in front of me to be able to compare and contrast the degree of those.

Q. Have you ever reviewed it?

A. Yes. I have looked at the data.

Q. When?

A. Well, in fact, the -- on Page 10 of my testimony, when it shows the AEP Dayton wholesale power prices, you can see the winter price spikes there in January.

Q. And looking -- and we're talking about Figure 2, correct?

A. Yes.

Q. So do you agree that prices were spiking to less than $100 in January?

MR. KUTIK: Objection.

THE WITNESS: No. What I'm showing here is that we had some wholesale hourly prices that were above $1,500 per megawatt hour.

BY MR. OLIKER:

Q. And you're referring to January 2014, correct?

A. That's right.

Q. And if you look down at the other end of your graph, would you agree that the prices January of '15 and December were probably less than $100 a megawatt hour?

MR. KUTIK: Objection, mischaracterizes the testimony. Go ahead.

THE WITNESS: The graphic does not include data for January of 2015.

BY MR. OLIKER:

Q. Okay. I thought you pointed me to this figure as to when you were reviewing pricing from this past winter. Is that not correct?

A. I thought your question was do I ever review price data -- winter price data.

Q. And have you -- have you reviewed winter price data from the winter of 2014-2015?

A. Yes. I have looked at it.

Q. When did you look at that data?

A. I don't remember the exact dates that I've looked at it, but it is data that I have looked at.

Q. Have you reviewed any of PJM or FERC's reports on performance of generating assets during

the 2014-2015 winter?

A. I may have seen sections from that analysis. I cannot remember specifically what I have and have not looked at in that regard.

Q. Okay. I apologize for jumping around, but I wanted to touch on something I think you said to Mr. Soules.

Did you mention to Mr. Soules that the Davis-Besse, Sammis, and OVEC plants may be part of this -- of the State of Ohio's implementation of the federal Clean Power Plan?

MR. KUTIK: Objection.

THE WITNESS: I believe my testimony was they would be -- they could be affected by it.

BY MR. OLIKER:

Q. I just want to be clear: Do you -- would they be affected by it or would they be part of the State's implementation plan?

A. My testimony was that we do not have the final rules from the EPA; so we don't know what the implementation plans are going to ultimately look like, but that these plants as part of the generation mix could be affected.

MR. OLIKER: I'm sorry. Could the court

reporter indicate, did he say affected or effective?

MR. KUTIK: Affected.

THE WITNESS: Affected.

MR. OLIKER: Thank you.

MR. KUTIK: All right. Let's go off the record.

(Discussion held off the record.)

(Recess taken.)

BY MR. OLIKER:

Q. Looking at Page 11 in your testimony --

A. Yes.

Q. -- I have a few questions about this. Is this the portion of your testimony that you indicated to Mr. Soules that there are workpapers?

A. Yes.

Q. Are those going to be provided?

MR. KUTIK: The witness has them with him as requested by the notice.

MR. OLIKER: Okay. But they haven't been distributed to the parties?

MR. KUTIK: We responded to the notice.

BY MR. OLIKER:

Q. We can walk through it. Am I correct that you are using as a reference of natural gas

combined-cycle power plant?

A. Yes.

Q. And so if I take your $1,400 a kilowatt and I had a 1,000-megawatt power plant, that would cost $1.4 billion?

MR. KUTIK: I think that's a question.

THE WITNESS: Is that a question?

MR. KUTIK: Yes.

THE WITNESS: Oh.

MR. KUTIK: You can tell him if his math is right.

THE WITNESS: So go ahead. What is your question?

BY MR. OLIKER:

Q. I guess is my math right?

First -- let's try it differently. This $1,400-per-kilowatt number, is this tied to a specific size power plant?

A. It would be a combined-cycle gas plant at scale.

Q. What does that mean? What does "at scale" mean?

A. I think you're talking about a 300 megawatt or bigger kind of power plant.

Q. Would it apply to a 1,000-megawatt plant?

A. Yes.

Q. So the way the math would work is a 1,000-megawatt combined-cycle power plant would cost $1.4 billion in upfront capital costs, correct?

A. Well, that's not the calculation I made, but go ahead.

Q. First is -- can you tell me if a 1,000-megawatt combined-cycle power plant would require $1.4 billion in upfront capital costs?

A. Yeah. I haven't testified to the construction of a 1,000-megawatt combined-cycle natural gas plant; so I'm not sure what you're asking me to do here.

Q. What are you testifying to then? I'm sorry.

A. Well, I -- I used the $1,400 per kW as an upfront capital cost of a baseload natural gas-fired combined-cycle plant at scale.

Q. Well, I guess my question is: If we wanted to know the upfront total capital costs, would we multiply the $1,400 per kilowatt times the nameplate capacity?

A. Yes.

Q. So going back to my initial question, it would cost $1.4 billion in upfront capital costs to build a 1,000-megawatt combined-cycle power plant?

A. Okay.

Q. Is that a yes?

A. Yes.

Q. When you say with an annual levelized carrying charge rate of 14 percent the annual fixed cost would be $196 per kilowatt, is that merely 14 percent of 1,400?

A. Yes.

Q. What type of depreciation schedule are you using?

A. These plants are typically depreciated over a 25 or 30-year kind of timeframe.

Q. Have you reviewed any other studies or projections regarding the upfront capital costs of building a combined-cycle power plant?

A. Yes.

Q. What studies have you reviewed?

A. I've already testified that I've looked at the Energy Information Association's Annual Energy Outlook in 2014 that did a levelized cost of energy

analysis for a natural gas-fired combined-cycle plant, and came up with $77.9 per megawatt hour.

Q. Okay. How about on a kilowatt basis, dollars per kilowatt, have you reviewed any studies that make that analysis?

A. There must be an underlying assumption for that in the EIA report, but I don't have it in front of me.

Q. Have you reviewed the analysis performed by the Brattle Group?

MR. KUTIK: Objection.

THE WITNESS: I'm not sure what analysis you're referring to.

BY MR. OLIKER:

Q. I'm referring to -- do you know what the Brattle Group is?

A. Yes, I do.

Q. Do you agree that they perform analysis for PJM Interconnection from time to time?

A. They may.

Q. Have you reviewed any of the analysis of the upfront capital costs relating to a combined-cycle power plant that the Brattle Group has performed for PJM?

A. No, I have not.

Q. Have you reviewed any of the analysis the Brattle Group has done with respect to the upfront capital costs of a combined-cycle power plant?

A. Yes.

Q. Would you agree that their number is lower than $1,400 per kW?

A. I cannot tell you how it compares to the $1,400 number.

Q. Would you agree that their analysis indicates that a combustion turbine costs less than $1,000 per kW?

A. Again, I cannot --

Q. Do you know?

A. I cannot verify that for you.

Q. Going back to the missing money issue you identify, I'd like to ask you a hypothetical. Assume for a second that the Ohio Commission approves the Economic Stability Program, and Davis-Besse and Sammis otherwise would have been retired, all else being equal in the PJM market, would you agree that the Commission's actions would actually increase the missing money problem for all other plants in PJM by

depressing capacity and energy prices?

A. No.

Q. Why is that?

A. I don't understand your connection there. I don't understand the logic of your hypothetical.

Q. What part of the logic don't you understand?

A. I don't understand why it's going to increase a capacity price.

Q. I think you might have missed the part of my hypothetical. Let's try it one more time.

Let me know if you don't understand anything along the way, and I'll try to clarify it. But for purposes of this hypothetical, assume the Commission approves the Economic Stability Program, and Davis-Besse and Sammis otherwise would have retired, and then all else -- all else equal in the PJM market, would you agree that the Commission's actions would increase the missing money problem for all other plants in PJM by depressing capacity and energy prices?

A. No.

Q. Why is that?

A. If these plants are retired in your hypothetical, I'm assuming that they're going to be replaced by gas plants and it's going to make things more expensive in the energy dispatch that the energy price will be higher.

Q. Did you hear the part of my hypothetical where I said all else being equal?

A. So you're not replacing -- well, to keep reliability equal, you'd have to replace it.

Q. I'm talking about -- let me ask it very simply: If the Commission issues an order that ultimately depresses capacity prices and energy prices in PJM, would you agree that that order will have the tendency to increase the missing money problem for all other market participants?

MR. KUTIK: Objection.

THE WITNESS: Yeah. I'm not sure I understand your hypothetical. What kind of order are they going to issue that's depressing the energy and capacity markets?

BY MR. OLIKER:

Q. That doesn't matter for purposes of this hypothetical, Dr. Makovich.

MR. KUTIK: Well, apparently it matters

for purposes of his answer; so don't argue with the witness. Just ask another question, please.

BY MR. OLIKER:

Q. Dr. Makovich, do you believe that the missing money problem prevalent throughout PJM Interconnection?

THE WITNESS: Would you read that back, please?

(Record read back as requested.)

MR. KUTIK: I'm sorry, is your question is it prevalent?

BY MR. OLIKER:

Q. Yes.

A. My testimony is that the inherent problem was prevalent in PJM, which is why PJM has a capacity market. My testimony is also that renewable mandates are a common feature within PJM, and they depress energy prices disproportionally in the off-peak period.

Q. Dr. Makovich, if you take 3,000 megawatts out of the PJM capacity and energy market, and you don't replace it with anything, do you believe it will impact the price of energy and capacity?

A. Yes.

Q. So would you agree that if the price of energy and capacity goes up, the missing money problem for other plants in PJM is smaller, all else being equal?

A. All else being equal.

Q. Is that a yes?

A. Well, it would depend on the distribution of those price increases.

Q. Let's look at it this way: Would you agree that there are independent power producers in the state of Ohio that are not affiliated with utilities?

A. Would I agree that they exist?

Q. Yes.

A. Yes.

Q. Would you agree that if Davis-Besse and Sammis close, all else being equal, the missing money problem for independent power producers in Ohio gets smaller?

MR. KUTIK: Objection.

THE WITNESS: As I've testified, it would depend on the impact -- what hourly prices are impacted. I don't expect they're all going to be

impacted evenly.

BY MR. OLIKER:

Q. Assume they're all --

A. It's not a question.

MR. KUTIK: She needs to be able to get the question --

THE WITNESS: I'm sorry.

MR. KUTIK: -- so that she could have it on the record. So, Joe, you need to state your question again.

BY MR. OLIKER:

Q. Okay. Let's assume those plants all have the same dispatch costs and they're all at the same hub.

A. So what's the question?

Q. That retiring Davis-Besse and Sammis decreases the missing money problem for other independent power producers in the state of Ohio at the same hub, assuming they're all the same dispatch cost?

A. No.

Q. Why is that?

MR. KUTIK: Objection, asked and answered. Tell him again.

THE WITNESS: Would you read the question back, please?

(Record read back as requested.)

THE WITNESS: My answer is no.

BY MR. OLIKER:

Q. My question was why?

MR. KUTIK: Which you answered before; so tell him the same answer.

THE WITNESS: You've held all else equal, and you've reduced the power supply. I don't see why that's going to make the missing money problem worse.

BY MR. OLIKER:

Q. I said it will make it better. It will make the missing money problem shrink. Do you agree with that statement?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: Yeah. I'm confused about what question you've asked me here.

BY MR. OLIKER:

Q. Okay. Repeat what you think I asked you, and then I can let you know if that's the case.

MR. KUTIK: No. That's not the way it's

going to happen. Ask him a question.

MR. OLIKER: Let's have the court reporter read back my original question.

(Record read back as requested.)

BY MR. OLIKER:

Q. I think you've heard in that question, I said it decreases the missing money problem.

A. Right. And my answer is no.

Q. Now I'm still waiting to hear why.

MR. KUTIK: Objection. He's answered that question, but tell him again.

THE WITNESS: It would depend on what hours the prices change.

BY MR. OLIKER:

Q. Okay. So to add one more layer, the plants are running in the hours where the prices increase. Now do you agree with me?

A. Well, it's a different question.

Q. Everything else is the same, Dr. Makovich.

MR. KUTIK: No, it isn't. You just asked him a different question. So don't argue with the witness, please.

THE WITNESS: So my answer was not all

the merchant generating plants would have a reduced missing money problem, because some of them wouldn't be running in the hours when prices go up.

BY MR. OLIKER:

Q. Okay. And then just to close the loop on that, assuming that they're all running, the prices go up, then the missing money problem gets smaller --

MR. KUTIK: Objection.

BY MR. OLIKER:

Q. -- correct?

MR. KUTIK: Objection, incomplete hypothetical. Go ahead.

THE WITNESS: Again, the hypothetical is a bit difficult to understand, because removing that supply is going to change the dispatch of these existing plants. So it's difficult for me to predict what their cash flow is going to look like.

BY MR. OLIKER:

Q. Maybe I can ask this at a different angle.

Dr. Makovich, would you agree that if the Commission approves the Economic Stability Program, it could be harmful to other independent

power producers in Ohio?

MR. KUTIK: Objection.

THE WITNESS: Not necessarily.

BY MR. OLIKER:

Q. Do you agree that it could be?

MR. KUTIK: Objection.

THE WITNESS: I have no reason to believe it's going to be damaging.

BY MR. OLIKER:

Q. Would you agree that if they do not have a similar purchase power agreement to that which has been proposed by FirstEnergy, they may be at a competitive disadvantage?

MR. KUTIK: Objection.

THE WITNESS: That's not necessarily the case.

BY MR. OLIKER:

Q. Then why does FirstEnergy need one?

A. There's a difference --

MR. KUTIK: Objection. Go ahead.

THE WITNESS: Okay. There's a difference between a baseload power plant like we're talking about here with Davis-Besse and Sammis where renewables are depressing the energy price

disproportionately in the off-peak hours. What effects that won't effect a merchant generator running a combustion turbine during a peaking period.

BY MR. OLIKER:

Q. Thank you for that clarification. Now I can artfully ask my question.

Would you agree that it is possible that the Economic Stability Program, if approved, will be harmful to baseload power plants owned by independent power producers in Ohio?

MR. KUTIK: Objection.

THE WITNESS: I -- I don't believe it would be harmful.

BY MR. OLIKER:

Q. Do you believe they would be competitively disadvantaged?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: As I said, I don't see why they would be.

BY MR. OLIKER:

Q. Isn't it the case that those power plants would have to compete against other renewables in PJM, as well as FirstEnergy Solutions' plants that

are guaranteed cost recovery?

MR. KUTIK: Objection.

THE WITNESS: No.

BY MR. OLIKER:

Q. Why is that not true?

A. Because they're all going to continue to compete on the basis of their incremental costs of production in the energy market.

Q. Okay. Page 13 of your testimony, you had that coal and nuclear have higher capacity costs than combustion turbine and lower variable costs than a combustion turbine, correct?

A. Yes.

Q. And then you indicate that the lower variable costs are more than enough to pay for the higher upfront capacity costs. In these statements, are you claiming that the combination of capacity and energy payments necessary to support a coal or a nuclear plant is lower than a combustion turbine?

A. No.

Q. Can you clarify what you mean then, please?

A. What I'm talking about here is that a cost-effective generation mix is made up of peaking,

cycling, and baseload plants, and that the proportions are governed by these tradeoffs.

Q. Okay. Turning to LM-2, Page 17. Let me try to get to you an exact paragraph cite. Okay. This is -- I'm sorry, it's a mega paragraph; so it might not be that helpful to tell you that. It's the largest one, but I'm focusing on the sentence that starts with, "As Table 1 shows..."

It says, "As Table 1 shows, the 2013 dispatch cost to produce electricity at the typical US natural gas-fired power plant equivalent to the dispatch cost at the typical US coal-fired power plant with a delivered natural gas price of $3.35 per MMBtu..."

My question is: In this statement, are you referring to combined-cycle power plants?

A. Yes.

Q. So this does not apply to a simple-cycled power plant?

A. That's right.

Q. And in this statement, is a typical coal plant a subcritical coal plant or a supercritical coal plant?

A. I don't remember.

Q. Is there anything you could look at that would refresh your memory?

A. Not with me here.

Q. Does -- you would agree that IHS projects the price of natural gas in the future, correct?

A. Yes.

Q. Have you reviewed any of IHS's future projections --

A. Yes.

Q. -- of natural gas prices?

Sorry, I didn't mean to talk over you. Was that a yes?

A. Yes.

Q. And is that proprietary information?

A. Yes.

Q. Without giving any answers, are you able to -- do you know the future projections of natural gas prices that IHS has come up with with specificity?

A. I cannot recite for you right now what our natural gas price forecast is.

Q. Do you know from a high level?

A. Yes.

Q. And when I say that, please don't give numbers within the 50 cent range for each five years.

MR. KUTIK: Objection.

THE WITNESS: No. I don't have the numbers in front of me that I will -- would testify to within. I can give you a high level, but not the specific numbers and times.

BY MR. OLIKER:

Q. And, I'm sorry, by high level, how granular do you mean?

A. IHS produces gas price forecasts within a scenario framework. So there are three scenarios that produce a range of gas prices for planning purposes.

Q. Have you reviewed the projections of natural gas prices that Witness Judah Rose provided in this proceeding?

MR. KUTIK: Objection.

THE WITNESS: I have not.

BY MR. OLIKER:

Q. Have you reviewed any of ICF International projections of natural gas prices?

A. I have seen their projections at different points in time.

Q. How recently?

A. I've seen comparisons. I can't tell you where and when I had seen them.

Q. Fair enough. Going back to the $3.35 per MMBtu, would you agree that natural gas combined-cycle power plants are currently competing or beating most coal plants?

MR. KUTIK: Objection.

THE WITNESS: No.

BY MR. OLIKER:

Q. Why is that?

A. They compete. But if by beating you mean there's no coal-fired generation, then I think the facts are that we do see coal-fired generation.

Q. Okay. So stated differently, would you agree that natural gas combined-cycle power plants are currently operating as baseload generation?

A. In some cases, but not all cases.

Q. And there are coal-fired power plants that are on the margin?

A. Yes.

Q. Earlier we talked a little bit about natural gas pipeline development. Have you read a report released by the Department of Energy in

February of 2015 titled, "Natural Gas Infrastructure Implications of Increased Demand from the Electric Power Sector"?

A. No.

Q. Okay. In your testimony, you indicate that the Economic Stability Plan is not a subsidy. What is your definition of a subsidy?

A. In that particular case, I'm defining a subsidy as a payment that's distorting an efficient market result.

Q. So is it your testimony that the payment in this instance puts these power plants on a level playing field?

A. That's not what I testified to.

Q. You tell me why that's not -- why that's not what you testified to.

A. I think the term "level playing field" is vague.

Q. Do you agree that subsidy is an out-of-market form of compensation?

A. I provided you my definition of subsidy for the statement that I've made.

Q. Do you agree with the definition I just provided as well?

THE WITNESS: Can you repeat his definition, please?

BY MR. OLIKER:

Q. I'll just ask it again, Dr. Makovich. Would you agree that a subsidy is an out-of-market form of compensation?

A. Not necessarily.

Q. But can it be?

MR. KUTIK: Objection.

THE WITNESS: I believe there are -- that the term subsidy could be defined in different ways by different people.

BY MR. OLIKER:

Q. So you would agree that a subsidy could be defined as an out-of-market compensation?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: I've testified that I believe people could have different definitions for the term subsidy.

BY MR. OLIKER:

Q. Would you agree that a baseload power plant in Ohio that is owned by an independent power producer would consider the Economic Stability

Program a subsidy?

MR. KUTIK: Objection, calls for speculation.

THE WITNESS: As I've just testified, it would depend on how they define subsidies themselves.

BY MR. OLIKER:

Q. Do you agree that the Economic Stability Program will allow Davis-Besse, Sammis, if approved, to avoid the difficult retirement decisions that other independent power producers that own base generation in Ohio will have to consider?

MR. KUTIK: Objection.

THE WITNESS: Yeah. The question requires me to speculate about the conditions and decision parameters of people that I'm not privy to their decision process.

BY MR. OLIKER:

Q. Do you agree that guaranteed cost recovery for a power plant allows the plant owner to operate that facility in a way differently than someone that has to live solely by market-based revenues?

MR. KUTIK: Objection.

THE WITNESS: Not necessarily.

BY MR. OLIKER:

Q. Why not?

A. Well, in the case that we're talking about here, it's only a fraction of total cost recovery.

Q. What do you mean, "it's only a fraction of total cost recovery," Dr. Makovich?

A. There is still cost recovery that depends on market revenue streams.

Q. Do you understand how the Economic Stability Program works, Dr. Makovich?

A. I have testified that I have a general understanding, but I do not have the specific terms and conditions of the proposed contract.

MR. OLIKER: If I could just have two or three minutes, I may be done.

(Discussion held off the record.)

MR. KUTIK: Let's go back on the record.

BY MR. OLIKER:

Q. Dr. Makovich, are you familiar with the general evaluation process that a power plant undergoes when it's considering a new capital project?

MR. KUTIK: Objection.

THE WITNESS: Your question is quite general. Can you rephrase it?

BY MR. OLIKER:

Q. Let's do -- are you familiar with the Clean Power Plan?

A. I'm sorry, was the question am I familiar? Yes, I'm familiar.

Q. So you know about the four building blocks, correct?

A. Yes.

Q. Do you agree that Building Block 1 is heat rate improvement?

A. Yes.

Q. Okay. Do you agree that the decision to implement heat rate improvements may be a product of evaluation of the cost of those improvements relative to the revenues that will be received?

A. As I've testified, a capital decision would involve an assessment of the costs and benefits.

Q. Okay. Do you agree that if one market participant is guaranteed to recover the cost of a heat rate improvement and another market participant must make its decision based upon the market revenues

that will be available, the former market participant will have a competitive advantage?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: Not necessarily.

BY MR. OLIKER:

Q. Why is that?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: Again, without knowledge of specifics with regard to these power plants, I can't tell you what the impact is going to be.

BY MR. OLIKER:

Q. Do you agree that if one party has a guaranteed cost recovery and the other party does not, the first party with guaranteed cost recovery has less risk?

MR. KUTIK: Objection.

THE WITNESS: Not necessarily.

BY MR. OLIKER:

Q. Why not?

A. There are multiple sources of risk.

Q. Risk of -- for purposes of this question, I'm referring to the risk of investment

recovery.

MR. KUTIK: Objection.

THE WITNESS: I'm not sure, but can you restate the question, please?

BY MR. OLIKER:

Q. Let's go back to your previous answer. What are the different risks that the owner would face?

A. With regard to what?

Q. You had indicated, I believe, that there are different kinds of risks. What type of risks were you indicating in your answer?

A. You had asked me a question about two different power plants where some aspect of cost recovery was different, and you did not specify any of the other parameters of risk, and asked me if one would necessarily be less risky than the other, and I can't answer that question for you.

Q. Okay. Fair enough, Dr. Makovich.

Let's use the old parameters: All else being equal, one power plant is guaranteed cost recovery for heat rate improvement capital expenditures and another power plant is not, do you agree that the risk is much less for the company and

the power plant that has guaranteed cost recovery?

A. Not necessarily.

MR. KUTIK: Objection.

BY MR. OLIKER:

Q. Okay. I hope you heard me say all else being equal.

A. I did.

Q. Why was that not necessarily true?

A. It would depend on the characteristics of our starting position.

Q. And as I said, all else being equal.

MR. KUTIK: Well, he's answered that question. So what's your next question?

MR. OLIKER: Answer -- the answer indicated that the starting positions are not the same, and that variable has been taken out of the equation.

MR. KUTIK: No. That's not what he said.

BY MR. OLIKER:

Q. Dr. Makovich, can you please clarify your answer?

A. I said all else being equal, which means we've got a base situation that hasn't changed other

than the one thing you mentioned.

Q. Is that your answer, Dr. Makovich?

A. Yes.

Q. This may be the last hypothetical. Dr. Makovich, assume for a second that there are four power plants that are identical to the power plants that are the subject of FirstEnergy's application. They're located on plots of land that are directly next door each of those power plants, almost like having a twin. Would you agree that if the Economic Stability Plan is approved, the FirstEnergy Solutions power plants will have the competitive advantage?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: No.

BY MR. OLIKER:

Q. Why is that?

MR. KUTIK: Asked and answered.

THE WITNESS: I've already said, they're going to be -- they're going to continue to compete in the energy market on the basis of their incremental generating costs.

BY MR. OLIKER:

Q. Do you disagree that those plants would

face a risk of retirement that the FirstEnergy Solutions plants would not?

MR. KUTIK: Objection, asked and answered.

THE WITNESS: We've got similar locations and similar plants, but ownership structures, financial structures could be different in this hypothetical. So I can't tell you how they would each fare.

BY MR. OLIKER:

Q. So you're saying because there's a chance the FirstEnergy plants -- the FirstEnergy Solutions plants won't close, there's a chance that those ones will not, either?

THE WITNESS: Can you read that back to me?

(Record read back as requested.)

MR. KUTIK: Objection.

THE WITNESS: Yeah. That's not my testimony.

BY MR. OLIKER:

Q. Is it your testimony that the Economic Stability Program does not provide a benefit to FirstEnergy Solutions?

A. I did not testify to that.

Q. And going back to your rationality, the economic rationale for retiring a power plant, is your analysis the traditional framework used in an integrated resource planning process?

A. Not necessarily.

Q. Is it the process used in a regulated environment?

A. Not necessarily.

Q. This may be a little off of this subject. I'm curious regarding your testimony in Michigan. Would it be any different if the Michigan transmission owners were all members of PJM Interconnection?

MR. KUTIK: Would what be different?

MR. OLIKER: His testimony.

MR. KUTIK: Which testimony?

BY MR. OLIKER:

Q. Dr. Makovich, you submitted testimony recently in Michigan, correct?

A. Yes.

Q. Would there be any aspect of your testimony you would have changed if Michigan was entirely located within PJM?

MR. KUTIK: Objection. Now you really are getting far afield; so I hope you're done.

MR. OLIKER: Very close, David.

MR. KUTIK: Well, you said it was 15 minutes over an hour ago; so we should be done, like, now. But go ahead and answer that question.

THE WITNESS: The testimony in Michigan had to do with the conditions in Michigan which involved partial retail choice in the MISO market with a small piece in the southwest corner of Michigan being in PJM.

BY MR. OLIKER:

Q. My question is: If all of Michigan was in PJM, would your testimony have looked different?

A. Yes.

Q. And how so?

A. In the way the capacity market would be expected to work.

Q. Therefore, you believe the problems experienced in Michigan would be smaller --

MR. KUTIK: Objection.

BY MR. OLIKER:

Q. -- right?

A. I did not testify to that. I've not

done a quantification of the impacts under the hypothetical you've presented.

MR. OLIKER: David, this is my last question.

BY MR. OLIKER:

Q. Dr. Makovich, you do not believe that retail choice leads to a lack of diversification of supply, correct?

MR. KUTIK: May I have the question read, please?

(Record read back as requested.)

THE WITNESS: I have not testified that retail choice in any form is affecting the diversity in PJM. I'm not sure the linkage that you're asking me about here.

BY MR. OLIKER:

Q. Sorry, I hoped we were done, but I'll try to refine it. Competition itself doesn't lead to a lack of diversity of generation, correct?

MR. KUTIK: Objection, incomplete hypothetical.

THE WITNESS: Yeah. I'm -- I'm confused about your question about retail competition and power supply.

BY MR. OLIKER:

Q. Well, I tried to ask it broader of wholesale competition, Dr. Makovich. You're not testifying that wholesale competition or retail competition erode fuel diversity, correct?

MR. KUTIK: Objection.

THE WITNESS: I have not testified that competition erodes fuel diversity.

MR. OLIKER: Okay. Thank you. That's all the questions I have, Dr. Makovich. I appreciate your time.

MR. KUTIK: Okay. We will read the transcript, and at this point we are off the record.

(Thereupon, the deposition concluded at 4:45 p.m. Signature not waived.)

- - -

State of Ohio :
: SS:
County of :

I, Lawrence J. Makovich, Ph.D., do hereby certify that I have read the foregoing transcript of my deposition given on Wednesday, May 27, 2015; that together with the correction page attached hereto noting changes in form or substance, if any, it is true and correct.

Lawrence J Makovich

Lawrence J. Makovich, Ph.D.

I do hereby certify that the foregoing transcript of the deposition of Lawrence J. Makovich, Ph.D. was submitted to the witness for reading and signing; that after he had stated to the undersigned Notary Public that he had read and examined his deposition, he signed the same in my presence on the 8th day of June, 2015.

Lauren Koch

Notary Public

LAUREN M. KOCH
Notary Public
COMMONWEALTH OF MASSACHUSETTS
My Commission Expires
October 31, 2019

My commission expires October 31, 2019.

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ERRATA SHEET

Please do not write on the transcript. Any changes in form or substance you desire to make should be entered upon this sheet.

TO THE REPORTER:

I have read the entire transcript of my deposition taken on the 27 **day of** May, 2015, **or the same has been read to me. I request that the following changes be entered upon the record for the reasons indicated. I have signed my name to the signature page and authorize you to attach the same to the original transcript.**

Page	Line	Change	Reason
51	9	"and" to "in"	clarification
62	4	"average" to "diverge"	clarification
96	16	"of a" to "of having a"	clarification
106	23	"Ver" to "variables"	clarification
217	1	"What" to "These"	clarification
217	2	delete "That"	clarification

Date June 8, 2015 **Signature:** Laurence J Makovich

CERTIFICATE

State of Ohio :
: SS:
County of Muskingum :

I, Carolyn D. Ross, Registered Professional Reporter and Notary Public in and for the State of Ohio, duly commissioned and qualified, certify that the within named Lawrence J. Makovich, Ph.D. was by me duly sworn to testify to the whole truth in the cause aforesaid; that the testimony was taken down by me in stenotype in the presence of said witness, afterwards transcribed upon a computer; that the foregoing is a true and correct transcript of the testimony given by said witness taken at the time and place in the foregoing caption specified and completed without adjournment.

I certify that I am not a relative, employee, or attorney of any of the parties hereto, or of any attorney or counsel employed by the parties, or financially interested in the action.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my seal of office at Columbus, Ohio, on this 29th day of May, 2015.

Carolyn Ross

Carolyn D. Ross,
Registered Profession
Reporter and Notary
Public in and for the
State of Ohio.

My commission expires April 3, 2019.

(CDR-78541)

Summary: Deposition (Public) of Lawrence J. Makovich electronically filed by Mr. Tony G. Mendoza on behalf of Sierra Club