



Cause No. 43114 and 43114-S1  
Rebuttal Testimony of John Thompson  
On behalf of Intervenors CATF and IWF

1 Q. ON PAGE 8 LINES 21-29 OF HIS TESTIMONY, MR. BIEWALD ALSO  
2 STATES THAT THE PROPOSED EDWARDSPORT PLANT WOULD  
3 INCREASE THE COMPANIES' RISK EXPOSURE RELATED TO COAL  
4 PARTICULARLY WITH RESPECT TO ANNUAL COAL USE AND  
5 CARBON DIOXIDE EMISSIONS. DO YOU AGREE WITH THOSE  
6 CLAIMS?

7 No. People can love or hate coal depending upon their point of view, but the  
8 fact is coal is quite abundant and readily available in Indiana, indeed right in the  
9 vicinity of the proposed plant. I can't conceive how it could be claimed that the risk  
10 of coal supply interruption or cost fluctuations could ever, during the useful life of the  
11 proposed plant, be greater than the risk of a supply interruption or cost fluctuations  
12 for any other fossil fuel source.

13 To the extent Mr. Biewald could claim any risk exposure related to coal, it  
14 must be risk arising from future environmental regulations. However, as I already  
15 stated, for an IGCC plant those risks are manageable, because of the flexibility of the  
16 technology and the extremely small environmental footprint.

17 I particularly disagree with respect to the risk of complying with future carbon  
18 dioxide restrictions. I believe the opposite is true. The proposed Edwardsport IGCC  
19 plant can more economically capture carbon dioxide than other coal technologies,  
20 indeed either more economically or as economically as natural gas. The proposed  
21 Edwardsport IGCC plant, especially if it begins partial carbon dioxide capture as  
22 described in the direct testimony submitted by IWF and CATF, can reduce the risks  
23 to the companies of carbon dioxide regulation.

1 **Q. WHY DO YOU SAY THAT THE PROPOSED EDWARDSPORT IGCC**  
2 **PLANT CAN REDUCE DUKE AND VECTREN'S CARBON DIOXIDE**  
3 **RISKS?**

4 A. As other intervenors have pointed out, the issue of reducing carbon emissions is not  
5 merely capturing carbon dioxide before it is released into the atmosphere. The issue  
6 also involves disposing of the carbon dioxide so it cannot enter the atmosphere.

7 While there are some commercial uses for carbon dioxide, including enhanced oil  
8 recovery, disposal of carbon dioxide on the scale necessary to address the  
9 environmental threat it poses will require geologic storage (also known as  
10 sequestration).

11 Mr. Biewald testifies that Vectren's projected 2007 generation mix is 96%  
12 coal<sup>1</sup> while Duke's is 96.8%<sup>2</sup>. He also testifies that even if the IGCC plant were not  
13 built and the capacity shortfall was met with a new natural gas plant, the system in  
14 2016 for Duke and Vectren still relies on coal for more than 92.2% and 94% of the  
15 generation mix respectively.<sup>3</sup>

16 The data presented by Mr. Biewald, in my opinion, underscores the need for a  
17 real storage option for the Duke and Vectren systems. With or without the IGCC  
18 plant, the two systems have high reliance on coal, meaning that with or without the  
19 IGCC plant, in a carbon constrained future they will have to capture and store huge  
20 quantities of carbon dioxide.

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<sup>1</sup> Direct Testimony of Bruce Biewald, page 20, Figure 7

<sup>2</sup> Ibid, Figure 14, page 31.

<sup>3</sup> Ibid, Figure 16 page 33 and Figure 9 page 21.

1 Right now, with or without the IGCC plant, those two issues—(i) capturing  
2 carbon dioxide from the flue gas of conventional coal, oil, and natural gas plants and  
3 (ii) storing commercial quantities of captured carbon dioxide—present substantial  
4 risk to Duke and Vectren in a carbon constrained future. They will have to address  
5 both of those issues.

6 **Q. HOW COULD THEY ADDRESS THOSE ISSUES?**

7 Certainly it would not make sense to build another conventional coal plant or  
8 natural gas plant for the purpose of learning how to deal with the issue of capturing  
9 carbon dioxide from flue gas. Both systems already have plenty of existing facilities  
10 emitting carbon dioxide in flue gas on which to test that technology. The technical  
11 and economic challenges of post-combustion capture on a conventional coal plant  
12 will be daunting by themselves without simultaneously addressing the issues of  
13 carbon dioxide storage.

14 The Edwardsport IGCC plant, with partial carbon capture, not only would  
15 provide an opportunity to satisfy a capacity need in a way that reduces pollutants such  
16 as NO<sub>x</sub>, SO<sub>2</sub> and mercury, it would also provide its owners with the opportunity to  
17 meet and address the issues involved in disposing of commercial quantities of  
18 captured carbon dioxide, both through EOR operations and by geologic storage in  
19 deep saline formations. The Edwardsport plant with partial carbon capture would  
20 allow them to address carbon storage in way that benefits their entire power plant

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1 fleet. The Edwardsport IGCC plant, with partial carbon capture, would also provide  
2 them with valuable and practical operational experience with carbon capture  
3 technology.

4 **Q. HOW WOULD THE EDWARDSPORT PLANT WITH PARTIAL CARBON**  
5 **CAPTURE ALLOW DUKE AND VECTREN TO ADDRESS THE ISSUES OF**  
6 **CARBON STORAGE OR DISPOSAL?**

7 The 700,000+ tons of carbon dioxide that would be captured annually with  
8 partial carbon capture at the Edwardsport IGCC plant would provide Duke and  
9 Vectren with commercial quantities of carbon dioxide to use in locating and  
10 developing suitable sites and opportunities for both enhanced oil recovery (EOR) and  
11 saline aquifer storage. The valuable knowledge and experience gained from dealing  
12 with the issues of disposing of 700,000+ tons of carbon dioxide would greatly  
13 mitigate the future risk those companies face when they could be required to capture  
14 and dispose of many times that quantity of carbon dioxide.

15 Thus, from my perspective, if the proposed IGCC plant is not built, these  
16 companies are simply left with the same risk they presently have with respect to  
17 future carbon constraints, and no real way to develop the knowledge and experience  
18 necessary to mitigate that risk in any meaningful way. If the proposed IGCC plant is  
19 built, with partial carbon capture, that risk will be mitigated, because these companies  
20 will gain valuable knowledge and experience required to address a significant

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1 element of that risk, namely the disposal of commercial quantities of captured carbon  
2 dioxide.

3 **Q. WOULD EXPERIENCE AND KNOWLEDGE GAINED FROM DISPOSING**  
4 **OF CARBON DIOXIDE CAPTURED AT THE PROPOSED EDWARDSPORT**  
5 **PLANT BE APPLICABLE TO THE OTHER FACILITIES OF DUKE AND**  
6 **VECTREN?**

7 A. Yes. Thompson Rebuttal Testimony Exhibit 1 is a map prepared under my direction  
8 which shows the coal plants in the Duke/Vectren system in relation to the likely  
9 Illinois Basin oil fields and saline aquifers with CO2 storage potential. The map  
10 shows that virtually all of the coal plants in the systems of the two companies are  
11 located in close proximity to potential saline aquifers or EOR opportunities.  
12 Developing Edwardsport as an IGCC plant with partial capture opens the door to a  
13 new option for mitigating the carbon risks for Duke and Vectren's customers, namely  
14 addressing the issues of carbon dioxide storage.

15 Indeed, with time, money and effort, carbon dioxide storage may become the  
16 primary method for Duke and Vectren to comply with the constraints in a carbon  
17 dioxide-regulated world.

18 In the absence of the Edwardsport plant with partial capture, addressing the  
19 issues involved with carbon storage at commercial scale, will, for both Duke and  
20 Vectren and for Indiana in general, proceed with measures that are slower, piecemeal  
21 and indirect. The Edwardsport proposal, in effect, creates a "real option" that has  
22 significant value for mitigating potential future carbon dioxide costs. These

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1 mitigation benefits that come from advancing the deployment of sequestration extend  
2 across many sectors in Indiana. The power sector in Indiana produces roughly 100  
3 million tons of carbon dioxide each year, and the industrial sector produces roughly  
4 50 million tons of carbon dioxide each year.

5 **Q. YOU USED THE TERM "REAL OPTION" IN YOUR LAST ANSWER.**  
6 **WHAT DID YOU MEAN BY THAT TERM?**

7 A. I was describing a term used in valuing options. The term "real option" is perhaps 30  
8 years old in that context. A "real option" is the ability, but not the requirement, to  
9 undertake an action, normally an investment.

10 What I meant was that right now, there is no reasonably available quantity of  
11 carbon dioxide to use in developing the actual ability to use carbon dioxide in EOR  
12 operations, or to inject carbon dioxide into deep saline formations.

13 Building the proposed Edwardsport IGCC plant with partial carbon capture  
14 would provide the needed commercial quantities of carbon dioxide, giving Duke and  
15 Vectren the "real option," meaning the real ability for geologic disposal of  
16 commercial quantities of captured carbon dioxide. Having that real option sooner  
17 rather than later will be an important advantage when it comes time to deal with  
18 future carbon constraints.

19 Today, we have decades of experience in exploring and investigating  
20 underground geologic formations, finding formations that will trap a gas, drilling  
21 deep wells, injecting gases and fluids into wells, and monitoring for migration or

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1       escape. The feasibility of deep saline storage of carbon dioxide has been  
2       demonstrated at test sites around the world. It is a question now of applying that  
3       knowledge, together with the commercially available technology to capture CO2  
4       emissions, into an integrated project that both captures CO2 and injects the CO2 into  
5       suitable geologic formations.

6               By addressing and solving the issues of geologic disposal of captured carbon  
7       dioxide, Duke and Vectren will acquire the real option of geologic disposal of carbon  
8       captured from their other conventional coal plants in the future. Given the risk those  
9       companies face, the acquisition of such a real option has real value in my opinion.  
10       Indeed, the experience gained from the geologic disposal of commercial quantities of  
11       carbon captured by an IGCC plant at Edwardsport could open the real option of  
12       geologic disposal of captured dioxide to other portions of Indiana's power and  
13       industrial sector.

14       **Q. IS THERE ANY OTHER WAY IN WHICH AN IGCC PLANT AT**  
15       **EDWARDSPORT COULD BE CONSIDERED TO PROVIDE "REAL**  
16       **OPTIONS" FOR DUKE AND VECTREN?**

17               Yes. The term "real options" is closely associated with a type of investment  
18       analytics called Real Options Analysis. In an options analysis, an investment isn't  
19       viewed simply as a single build/no build decision, but potentially as a series of  
20       continuation/abandonment decisions over time. The power of options analysis over  
21       more static analytical tools to value investments results when the investing



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1 environment is characterized by high uncertainty (such as future carbon dioxide  
2 regulations) and volatility (such as future fuel or electricity prices).

3 While the decision to initially construct an IGCC plant is certainly a yes or no  
4 decision, the ability of the plant to respond to carbon regulations through roughly  
5 20%, 50% and 90% levels are significant options that are unavailable today with  
6 conventional coal plant technology. All things being equal, I believe a Real Options  
7 Analysis would be more likely to find a higher value to an IGCC plant than a static  
8 NPV analysis.

9 By ordering partial capture and storage at the Edwardsport plant, the IURC  
10 creates an option that benefits Vectren and Duke customers for the reasons I have  
11 already explained. That should be reason enough to justify partial capture and storage  
12 at the proposed Edwardsport plant.

13 However, beyond those benefits, there are also potential state-wide benefits.  
14 When carbon regulations come, they won't impact just the proposed plant in this  
15 present Cause. They will impact every power plant and probably every sector of  
16 Indiana's economy. Unfortunately, those larger state-wide benefits are societal in  
17 nature, and likely wouldn't be captured in standard modeling, including dynamic  
18 probabilistic analyses such as ROA. The fact that such benefits aren't captured in  
19 econometric models does not mean, however, either that those larger societal benefits  
20 are not real or that they should not be considered in a public interest analysis.

1 Q. MR. BIEWALD TESTIFIED THAT NOT BUILDING THE IGCC PLANT AT  
2 EDWARDSPOINT WOULD REDUCE THE CARBON DIOXIDE EMISSIONS  
3 OF BOTH THE VECTREN AND DUKE SYSTEMS. DO YOU AGREE?

4 A. No, I do not agree. As I described earlier in my rebuttal testimony, the issue is not  
5 that simple. Mr. Biewald's charts show that carbon dioxide emissions rise with or  
6 without an IGCC plant for Duke relative to historic levels.<sup>4</sup> The risk faced by Duke  
7 and other Indiana utilities and industry is that future carbon regulations would require  
8 cuts in carbon dioxide to levels that are well below historic levels. Given Duke and  
9 Vectren's, indeed Indiana's, present reliance on coal for power generation, the only  
10 ways to reduce carbon dioxide emissions to well below historic levels are: (i) capture  
11 and store carbon dioxide from coal burning plants, (ii) replace existing coal burning  
12 plants with lower or non-carbon producing power plants, (iii) reduce energy  
13 consumption. I would respectfully suggest that it would require the use of all three of  
14 those ways to attain cuts in carbon dioxide emissions in Indiana. Any strategy for  
15 reducing carbon emissions that attempts to rely on less than all three options would  
16 pose greater risks to the economy and citizens of Indiana.

17 Energy conservation measures are being implemented. People may disagree  
18 on whether more energy conservation measures could or should be undertaken or  
19 encouraged, the methods for doing so, and who should bear the costs, but they cannot  
20 disagree that energy conservation is a real option both available and in use right now.

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<sup>4</sup> Direct Testimony of Bruce Biewald, page 35, Figure 18.

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1 Lower or non-carbon producing power sources can, and are, being built.  
2 Again, people may disagree on whether more lower or non-carbon producing power  
3 sources should be built, but it remains a real option both available and in use right  
4 now.

5 The same cannot be said of the option of capturing and sequestering carbon  
6 dioxide. Until commercial quantities of carbon dioxide are captured and used to  
7 develop the actual ability to sequester carbon dioxide, Duke and Vectren, indeed  
8 Indiana, will lack capturing and sequestering carbon dioxide as a real option to  
9 address future constraints on carbon emissions.

10 That is why building the proposed Edwardsport plant and using it to advance  
11 carbon storage through partial capture are so vitally important, not only to Duke and  
12 Vectren, but to the entire state of Indiana.

13 **Q. DOES MR. BIEWALD IDENTIFY CARBON STORAGE, EITHER BY USE IN**  
14 **EOR OPERATIONS OR BY DEEP SALINE SEQUESTRATION, AS AN**  
15 **OPTION TO MITIGATE THE RISKS OF FUTURE CARBON DIOXIDE**  
16 **REGULATIONS?**

17 A. No, Mr. Biewald omits that option from consideration. On page 7 of his  
18 testimony, lines 13 through 26, Mr. Biewald is questioned about resource options. In  
19 response, he opines that Duke and Vectren shareholders and customers are exposed to  
20 significant risks due to the risks of future carbon regulations and the large reliance of  
21 both systems on coal. On page 7, beginning on line 29 and continuing through line  
22 20 of page 8, he identifies only two of the options I listed earlier, namely natural gas

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1 and renewable generating resources (which fall into the option I identified as lower or  
2 non-carbon producing power plants) and energy efficiency (which falls into the  
3 option I identified as reduced energy consumption), as ways to address future carbon  
4 risks. Mr. Biewald ignores the option of capturing and storing carbon dioxide.

5 **Q. WHAT IS THE RESULT OF MR. BIEWALD'S OMISSION OF CAPTURE**  
6 **AND STORAGE AS AN OPTION FOR ADDRESSING FUTURE CARBON**  
7 **RISKS?**

8 A. It is a significant flaw in his analysis, which distorts the reality that an IGCC plant at  
9 Edwardsport, with partial carbon capture implemented, would actually reduce the risk  
10 of future carbon constraints by adding a real option for mitigating those risks.

11 **Q. IS CARBON STORAGE OMITTED FROM THE RECOMMENDATIONS OF**  
12 **MAJOR STUDIES THAT SEEK TO PREVENT GLOBAL WARMING BY**  
13 **REDUCING CARBON EMISSIONS?**

14 A. No. Carbon storage is one of the main solutions proposed for addressing global  
15 warming. For example, it is a key part of the MIT Future of Coal study and IPCC  
16 reports that are referenced in the CAC testimony. Generally, the major studies  
17 advocated a mix of energy efficiency, renewables, nuclear, natural gas, and coal with  
18 storage as key technologies for the power sector. That mix conforms to options I  
19 listed earlier.

20 Those studies confirm what I stated. There is no one solution that can solve  
21 all of the problem of cutting carbon emissions to an acceptable level. It will require a  
22 mix of solutions. Certainly, geographic regions that lack the geology for storage

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1       won't pursue that particular option. Indiana, however, is not one of those regions. To  
2       the contrary, Indiana has excellent carbon dioxide geologic storage potential. There  
3       is no good reason to exclude that option from the available options to reduce carbon  
4       emissions in Indiana, and any analysis, such as Mr. Beirwald's, that does so, should  
5       not be relied upon.

6       **Q. MR. BIEWALD IDENTIFIES NATURAL GAS AS AN ALTERNATIVE TO**  
7       **THE EDWARDSPOINT IGCC PLANT THAT WOULD EMIT LESS CARBON**  
8       **DIOXIDE. DO YOU AGREE?**

9       A. I certainly agree that natural gas is a very clean fossil fuel, and that a combustion  
10       turbine or combined cycle plant without any carbon capture implemented would emit  
11       less carbon dioxide than an IGCC coal plant without any carbon capture  
12       implemented.

13               However, in scenarios where both natural gas and IGCC plants are required to  
14       capture carbon dioxide, the emission rates of carbon dioxide are quite similar. In  
15       other words, with carbon capture implemented at both plants, a natural gas plant  
16       would not necessarily emit less carbon dioxide than an IGCC coal plant.

17               What is important is the level of carbon dioxide reduction that will be needed  
18       over the rest of this century to prevent climate change. To achieve the needed  
19       reductions in carbon dioxide emissions, carbon capture and storage will need to be  
20       deployed not only on coal plants, but fossil-fueled power plants of all types, including

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1 natural gas. The carbon dioxide captured from these coal and natural gas plants will  
2 have to be isolated from the atmosphere. That means storage must be deployed.

3 As stated earlier, the Edwardsport IGCC plant, with partial capture, would  
4 make a key contribution toward adding geologic carbon storage as a real option to  
5 address the future risk of carbon constraints. That is important and beneficial for  
6 Duke and Vectren and their ratepayers. It is also important and beneficial for the  
7 citizens of Indiana. Indeed, it is important and beneficial beyond Indiana.

8 The Edwardsport project, as I noted in my direct testimony, has global  
9 significance. Emissions must be reduced around the world, and especially in the  
10 United States and rapidly developing economies of China and India. China and India,  
11 like Indiana, have large reserves of coal but relatively little natural gas. Those  
12 countries intend to develop their coal reserves fully. It is important that any climate  
13 solution be mindful of China and India, because China will soon surpass the United  
14 States in carbon dioxide emissions, and India may follow in the coming years. In my  
15 opinion, building one more natural gas plant in Indiana will, not only do absolutely  
16 nothing to advance option of carbon capture and storage for Duke and Vectren or for  
17 Indiana, but will also have absolutely no impact on the power plant construction  
18 planning in China and India.

19 However, building an IGCC plant at Edwardsport, particularly one with  
20 partial carbon capture, may influence not only power plant plans in Indiana and other  
21 parts of the United States, but also important far away places like China and India.

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- 1 That was one of the reasons why, in my direct testimony, I stated that the
- 2 Edwardsport plant has global significance.

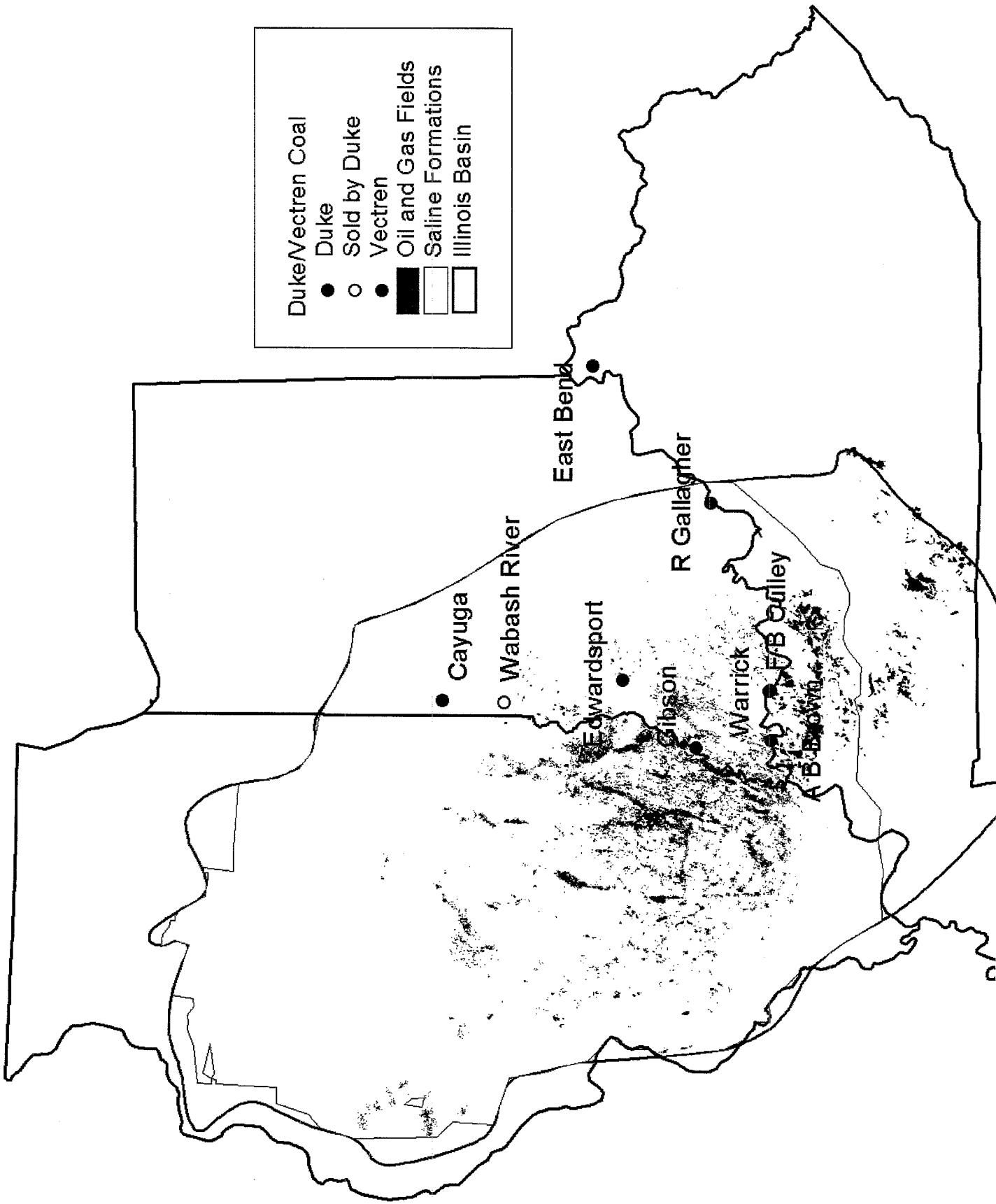
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Exhibit Thompson 1

Map Showing Carbon Storage Potential in Relation to Duke/Vectren Plants

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CERTIFICATE OF SERVICE

Service of the foregoing was made by placing a copy of the same into the United States

Mail, first class postage prepaid, this 31st day of May, 2007, addressed to:

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