

Exhibit No.:	Renewables
Issues:	Richard Hasselman
Witness:	Missouri Department of
Sponsoring Party:	Natural Resources –
	Division of Energy
Type of Exhibit:	Rebuttal Testimony
Case No.:	EO-2011-0271

**REBUTTAL TESTIMONY  
OF  
RICHARD HASSELMAN**

**GDS ASSOCIATES, INC.**

**On behalf of the Missouri Department of Natural Resources  
Division of Energy**

**OCTOBER 28, 2011**

**BEFORE THE PUBLIC SERVICE COMMISSION  
OF THE STATE OF MISSOURI**

**UNION ELECTRIC COMPANY, d/b/a AMEREN MISSOURI**

**2011 UTILITY RESOURCE FILING  
PURSUANT TO 4 CSR 240 – CHAPTER 22**

**CASE NO. EO-2011-0271**

## I. INTRODUCTION

**Q. Please state your name, position and business address.**

A. My name is Richard Hasselman. I am a Project Manager at GDS Associates, Inc. ("GDS"). My business address is GDS Associates, Inc., 440 Science Dr., Suite 212, Madison, WI 53711.

**Q. Please describe GDS Associates.**

A. GDS Associates Inc. is a multi-service consulting and engineering firm formed in 1986 that now employs a staff of over 170 in five locations across the U.S. Our consultants are recognized leaders in their respective fields, dedicated to their clients and innovative in their approach to meeting unique challenges. Our broad range of expertise focuses on clients associated with, or affected by, electric, gas, water and wastewater utilities. The services that GDS offers include:

- energy efficiency, renewable energy and demand response planning, program design, implementation and evaluation;
- integrated resource planning;
- electric transmission and distribution system planning;
- wholesale and retail rate studies;
- and other planning and implementation projects for the electric and natural gas industries.

In addition, we offer information technology, market research, and statistical services to a diverse client base.

**Q. Please describe your educational background and professional experience.**

23 A. I received a Bachelor of Arts in Geography in 1994 from Radford University, with a  
24 concentration in Environmental Studies, and minors in Economics and Political Science.  
25 In 1998 I received a Master of Science degree in Land Resources from the University of  
26 Wisconsin-Madison, with a certificate in Energy Analysis and Policy. In 2008 I received  
27 a Master of Business Administration from the University of Wisconsin-Madison. I have  
28 worked in the energy business for approximately 14 years and have participated in  
29 projects ranging from market research, potential studies, program operations,  
30 measurement and verification, energy audits, feasibility studies, policy analysis, and  
31 scoping studies. In the area of renewable energy, I have completed feasibility studies  
32 across a wide variety of resources, including hydroelectric, solar electric, biomass, and  
33 wind projects.

34 Additional detail can be found in my resume, which is provided in Schedule A to this  
35 testimony.

36 **Q. On whose behalf are you testifying?**

37 A. I am testifying on behalf of the Missouri Department of Natural Resources (“MDNR”),  
38 an intervener in these proceedings.

39 **Q. What is the purpose of your rebuttal testimony?**

40 A. The purpose of my testimony is to reply to some of Ameren Missouri’s responses to GDS’s  
41 comments regarding its 2011 Integrated Resource Plan (IRP). These responses were provided by  
42 Ameren Missouri in its “Response to Comment’s of the Parties” (Response).<sup>1</sup> Specifically,  
43 my testimony addresses those deficiencies related to Ameren Missouri’s consideration of  
44 renewable energy resources in its IRP.

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<sup>1</sup> Ameren Missouri 2011 Integrated Resource Plan, EO-2011-0271, Response to Comments of the Parties.

45 In its comments, GDS explained that Ameren Missouri: (1) failed to meet the  
46 requirements of Stipulation and Agreement of Case EO-2007-0409; and (2) did not  
47 adequately consider Power Purchase Agreements (PPAs) as a method of renewable  
48 resource acquisition; (3) made unreasonable assumptions regarding the cost of energy  
49 from PPA based projects; (4) artificially constrained its consideration of smaller scale  
50 renewable energy projects; and (5) contorts the language of 4 CSR 240-22.040(1) to  
51 justify excluding “non-utility” scale PPAs.

52 **II. COMPLIANCE WITH STIPULATION AND AGREEMENT OF CASE EO-**  
53 **2007-0409**

54 **Q. Ameren Missouri claims in its Response to Comments of the Parties that its analysis**  
55 **of wind energy resources meets the requirements of Stipulation and Agreement of**  
56 **Case EO-2007-0409. Do you find its statement to be supported by the facts and the**  
57 **argument provide in its Response?**

58 A. No. In its Response, Ameren Missouri presents a number of arguments explaining why  
59 its wind analysis meets the Stipulation requirements; however, Ameren Missouri also  
60 explains how its analysis in fact differs from the requirements of the Stipulation while  
61 simultaneously claiming compliance. Additionally, there are several cases in which the  
62 chosen methods of complying with a specific Stipulation requirement were either  
63 inadequate or lead to vague results. The overall outcome of the Ameren Missouri analysis  
64 does not provide the information required by the Stipulation.

65 **Q. What does Stipulation and Agreement of Case EO-2007-0409 require of Ameren**  
66 **Missouri regarding its analysis of wind resources for purposes of its IRP?**

67 A. The Stipulation requires that Ameren Missouri provide the following in its next IRP as it  
68 regards its analysis of wind energy:<sup>2</sup>

- 69 • Demonstrate that its assumptions regarding capacity factors are consistent with  
70 the most recent data on capacity factors for the best commercially available wind  
71 sites;
- 72 • Demonstrate that its assumptions regarding the timing of transmission capacity  
73 upgrades, and the allocation of the costs associated with those upgrades, are based  
74 on the most recent system planning studies and currently effective transmission  
75 cost allocation principles;
- 76 • Present scenarios for acquiring wind resources that identify the region being  
77 considered utilizing multi-county areas, with a characterization of the wind  
78 resources available for each. To make a meaningful comparison of the regions  
79 under consideration, the information presented should include estimates at various  
80 turbine hub heights (e.g., 80, 100 or 120 meters, where practical) of wind density,  
81 transmission upgrades required and the levelized cost of energy per MWh under a  
82 Purchase Power Agreement and/or an ownership arrangement.

83 **Q. In its 2011 IRP and its Response did Ameren Missouri demonstrate that its**  
84 **assumptions regarding capacity factors are consistent with the most recent data on**  
85 **capacity factors for the best commercially available wind sites?**

86 A. Somewhat. Ameren Missouri's Response indicates that it assumed a capacity factor of  
87 37.5 percent for commercially available wind sites. Ameren Missouri cites a Berkeley  
88 Labs report that the average capacity factor for wind farm projects in the Heartland

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<sup>2</sup> JOINT FILING AND PARTIAL STIPULATION AND AGREEMENT, In re: Union Electric Company's  
2008 Utility Resource Filing pursuant to 4 CSR 240 – Chapter 22, Case No. EO-2007-0409, pp. 4-5.

89 region is approximately 33 percent, weighted by capacity. Ameren Missouri's  
90 assumption of 37.5 percent is certainly above the *average* capacity factor. However, the  
91 Berkeley Labs report does not differentiate between wind projects utilizing the older  
92 wind farm wind turbines or newer wind turbines or the wind regime in which those  
93 turbines are deployed. Nor does the Berkeley Labs report cited by Ameren Missouri  
94 illustrate the highest capacity factors available. Indeed, in Ameren Missouri's Response,  
95 it indicates a capacity factor range of 31.4 percent and 43.5 percent as the bounds of its  
96 own uncertainty range. Its own consideration of capacity factors exceeds the 37.5  
97 percent used in its analysis. The upper end of the capacity factor range is supported by an  
98 analysis by the National Renewable Energy Laboratory, which was included in Review  
99 of Ameren Missouri's 2011 Utility Resource Filing Pursuant to 4 CSR 240 – Chapter 22,  
100 (Case No. EO-2011-0271), Prepared for the Missouri Department of Natural Resources  
101 by GDS Associates, June 21, 2011.

102 **Q. What impact would a higher capacity factor have on project MWh costs?**

103 A. Wind energy projects are capital intensive and have a relatively high ratio of fixed costs  
104 as a percentage of overall energy cost drivers. All else held equal, higher capacity factors  
105 lead to lower per MWh costs.

106 **Q. In its analysis of wind energy, did Ameren Missouri demonstrate that its**  
107 **assumptions regarding the timing of transmission capacity upgrades, and the**  
108 **allocation of the costs associated with those upgrades, are based on the most recent**  
109 **system planning studies and currently effective transmission cost allocation**  
110 **principles?**

111 A. No. In fact, Ameren Missouri provided no analysis regarding how its planned  
112 transmission upgrades had any relation to its wind energy acquisition plans, other than  
113 that they were removing transmission barriers to wind development.<sup>3</sup> Indeed, in its  
114 Response, Ameren Missouri states “It is highly impractical to first develop a detailed  
115 transmission expansion plan over the 20 year planning horizon and then determine  
116 precisely how that plan will affect specific wind resources.”<sup>4</sup>

117 It is unclear how Ameren Missouri came to that conclusion. A relatively simple  
118 analysis can be performed that would overlay the existing and planned transmission  
119 system with publically available wind maps. Transmission proximity is a key criterion of  
120 successful wind farm developments, with transmission proximity sometimes resulting in  
121 favoring lower wind resources in exchange for transmission extension cost savings. By  
122 overlaying wind maps with existing and planned transmission, Ameren Missouri could  
123 have reasonably complied with the Stipulation, providing reasonable parameters around  
124 the potential wind resources proximate to the existing and planned transmission build-  
125 out. It is unclear why such an analysis was viewed as impractical. Ameren Missouri  
126 contends that a precise analysis is impossible; however, the Stipulation does not require a  
127 precise analysis.

128 **Q. Did Ameren Missouri present scenarios for acquiring wind resources that identify**  
129 **the region being considered utilizing multi-county areas, with a characterization of**  
130 **the wind resources available for each?**

131 A. Ameren Missouri’s initial IRP analysis, reiterated in its Response, indicates that it  
132 considered a *multi-state* region, that being the Upper Midwest region. Ameren Missouri

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<sup>3</sup> Ameren Missouri’s Response to Comment’s of the Parties, p. 63.

<sup>4</sup> Ameren Missouri’s Response to Comment’s of the Parties, p. 63.

133 does acknowledge that there are some areas with better wind resources than others, such  
134 as the Dakotas, Nebraska, and Kansas.<sup>5</sup> One could argue that multi-state regions are  
135 inclusive of multi-county regions; however, Ameren Missouri provides no comparisons  
136 between even state-based wind resources.

137 Wind farm developments using utility scale wind turbines can be located in single  
138 counties, though multi-county regions are reasonable for consideration, depending on  
139 transmission access, local geography, and the wind resource regime of the area. A  
140 statewide, much less a multi-state region, is simply not a meaningful geographic area  
141 upon which to base anything other than the most vague of wind development plans. That  
142 Ameren Missouri would be considering wind farm developments in the Midwest is a  
143 given – it is a Midwest based utility.

144 **Q. What methods might Ameren Missouri use to select multi-county regions for**  
145 **analyzing potential acquisitions of wind energy?**

146 A. At a very high level, Ameren Missouri could utilize a combination of wind maps and  
147 existing or planned transmission to identify multiple promising multi-county regions.  
148 The Stipulation does not specify the number or size of these regions. The wind maps  
149 would then allow for a relatively simple comparison of the wind resources available to  
150 each multi-county region. The analysis could also compare the likely capacity factors for  
151 current and future wind turbine designs that would correlate with transmission timing and  
152 how that transmission may or may not open up areas with better wind resources. Such  
153 an analysis is inherently high level, but appropriate for IRP efforts, and less vague than  
154 the analysis provided by Ameren Missouri. More detailed analyses would be needed  
155 once specific acquisition options are being considered.

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<sup>5</sup> Ameren Missouri's Response to Comment's of the Parties, pp. 62-63.



156 **Q. In its analysis of wind energy did Ameren Missouri include estimates at various**  
157 **turbine hub heights (e.g., 80, 100 or 120 meters, where practical) of wind density,**  
158 **transmission upgrades required and the levelized cost of energy per MWh under a**  
159 **Purchase Power Agreement and/or an ownership arrangement?**

160 A. Ameren Missouri did not specify specific hub heights and wind resources other than  
161 noting that hub heights of 80 meters are typical for much of the wind industry.<sup>6</sup> Newer  
162 utility scale turbine models are frequently coming with 100 meter towers or the option for  
163 100 meter towers. While towers over 100 meters are much less common, it is reasonable  
164 to expect that such towers will become more common, allowing access to better wind  
165 resources and larger rotor diameters, particularly for areas with wind resources that might  
166 be currently considered marginal for 80 meter towers. Turbines with larger rotors will  
167 perform with a higher capacity factor when compared to turbines with smaller rotors and  
168 the same generator size and wind resource.

169 Notwithstanding its other inadequacies in its compliance with the Stipulation,  
170 Ameren Missouri explains its lack of a robust analysis of various turbine hub heights by  
171 noting its concern with potentially greater hurdles to overcome with regard to permitting  
172 the larger towers that include local opposition due to visual appeal, FAA limitations at  
173 the higher hub heights, and even issues regarding potential bird and bat migratory path  
174 limitations.<sup>7</sup> While each of these issues can be a barrier to specific wind projects, the  
175 Stipulation does not discuss those factors in limiting the analysis. Further, the vague and  
176 incomplete analysis of wind energy that used multi-state regions makes such local  
177 considerations illogical as a basis for limiting the consideration of various hub heights in

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<sup>6</sup> Ameren Missouri's Response to Comment's of the Parties, p. 63.

<sup>7</sup> Ibid.

the regions being considered. Finally, these several issues are highly speculative even in a multi-county region. It is unclear that the population in a multi-county region could discern the visual impact difference between turbines of 80, 100, or 120 meter hub heights; specific wildlife impacts are a local phenomenon and require specific studies to determine likely impacts or mitigation strategies; and FAA issues are generally based on proximity to airport flight patterns or radar interference, with radar interference a technical issue being addressed by the wind industry. In short, using the potential barriers to wind farm development as a reason for not conducting a high level analysis of the wind resource at various hub heights suggests that Stipulation compliance is incomplete.

### **III. COMPLIANCE WITH 4 CSR 240-22-040(1) REGARDING POWER PURCHASE AGREEMENTS FOR RENEWABLE ENERGY RESOURCES AND NON-UTILITY SCALE RENEWABLE ENERGY SYSTEMS**

**Q. What does 4 CSR 240-22-040 (1) require for an IRP and IPPs?**

**A.** The rule is stated as follows:

“1) The analysis of supply-side resources shall begin with the identification of a variety of potential supply-side resource options which the utility can reasonably expect to develop and implement solely through its own resources or for which it will be a major participant. These options include new plants using existing generation technologies; new plants using new generation technologies; life extension and refurbishment at existing generating plants; enhancement of the emission controls at existing or new generating plants; purchased power from utility sources, cogenerators or independent power producers; efficiency improvements which reduce the utility’s own use of energy; and upgrading of the transmission and distribution systems to reduce power and energy losses...”

203                   The rule clearly states that independent power producers (IPPs) are an option to  
204           include.<sup>8</sup>

205   **Q.     In its 2011 IRP, did Ameren Missouri analyze the option of acquiring renewable**  
206           **resources via IPPs?**

207   A.     In the IRP and the Response, Ameren Missouri discussed IPPs and PPAs; however there  
208           are incongruous statements between the IRP and the Response, with the Response  
209           suggesting that IPPs and PPAs were not considered. In the Response, Ameren Missouri  
210           states that it had eliminated PPAs from consideration due to a general lack of information  
211           from past efforts or its trading organization.<sup>9</sup> Ameren Missouri explained its analysis  
212           process, noting that an RFI in 2008 did not elicit a response.<sup>10</sup> For the 2011 IRP, Ameren  
213           Missouri explained that it inquired at its trading organization regarding any awareness the  
214           trading organization had for developers seeking PPAs.<sup>11</sup> PPAs are the typical mechanism  
215           by which IPPs contract to sell electricity to utilities. According to Ameren Missouri, its  
216           trading organization did not indicate an awareness of any such interest. Further, Ameren  
217           Missouri suggests that any additional investigation or modeling would require specific  
218           projects and that no solicitations to support such analysis have been received. As a result,  
219           Ameren Missouri assumed that costs would be as estimated for an Ameren Missouri  
220           owned project, but also justified the elimination of PPAs for consideration in the IRP due  
221           to lack of a clear and specific opportunity. However, in the IRP, Ameren Missouri notes  
222           that it has power purchase agreements for 102 MW of wind<sup>12</sup> and reference unsolicited

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<sup>8</sup> Rules of Department of Economic Development, Division 240—Public Service Commission, Chapter 22—Electric Utility Resource Planning, p.15.

<sup>9</sup> Ameren Missouri's Response to Comment's of the Parties, p. 76.

<sup>10</sup> Ameren Missouri's Response to Comment's of the Parties, p. 76.

<sup>11</sup> Ameren Missouri's Response to Comment's of the Parties, p. 76.

<sup>12</sup> Ameren Missouri's 2011 Integrated Resource Plan, Chapter 5, p. 2.

proposals having been received.<sup>13</sup> It is unclear how the incongruous statements regarding PPAs as having been received in the past and simultaneously claiming no information regarding PPAs are reconciled or why the specific experiences are not being considered in some form for the IRP decisions.

**Q. In its 2011 IRP, did Ameren Missouri make reasonable assumptions regarding the cost of energy and capacity from PPA projects?**

A. Not necessarily. 4 CSR-240-040 (1) (E,F and G) requires capital costs per kW, as well as fixed and variable costs related to operations and maintenance, to be part of the analysis of supply side options.<sup>14</sup> As explained above, Ameren Missouri assumed that the costs of the projects were based on the full resource cost and that rates of return were based on Ameren Missouri's rates of return. Depending on the renewable resource in question, the full cost may or may not be the right consideration. Further, it is possible that through scale economies, lower per MWh and capacity costs might be possible with higher capacity wind resources through the purchase of wind energy from large wind developers. Finally, different organizations have different capital costs, some of which may be lower than Ameren Missouri's and could potentially be leveraged to benefit ratepayers.

In the case of large wind developers, these developers can often achieve significant economies of scale as its purchases of turbines and towers may cover multiple wind farms and hundreds of MW. In some cases, developments occurs based on speculation, with the developer simply selling into a wholesale market while PPAs are being sought.

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<sup>13</sup> Ameren Missouri's 2011 Integrated Resource Plan, Chapter 5, p. 6.

<sup>14</sup> Rules of Department of Economic Development, Division 240—Public Service Commission, Chapter 22—Electric Utility Resource Planning, p.15.

244 A single utility often does not purchase renewable energy in a volume sufficient to  
245 achieve the same scale economies that large developers can achieve. Whether or not this  
246 would be the case with Ameren Missouri is impossible to say as it has not conducted such  
247 an analysis nor does the 2011 IRP indicate plans to purchase renewable energy through  
248 PPAs.

249 In the case of smaller renewable energy purchases, PPAs can be entered into from  
250 developments of sub-MW or lower MW batches. These developments may occur from  
251 customer owned systems, such as a biogas system at an industrial or municipal  
252 wastewater plant, or through locally owned resources, such as with a community wind  
253 project. In the case of biogas systems, full costs may not be appropriate to consider as  
254 developments may leverage several other values that allow for an incremental cost to be  
255 considered by the developer, lowering the required per MWh amount from what would  
256 be required if the system had its full cost allocated to the sold MWh. Such situations may  
257 rely on non-energy benefits, such as regulatory compliance or an expansion plan that  
258 requires some level of management of effluent that can be converted to biogas and the  
259 biogas into electricity. Ameren Missouri did not consider the potential for non-energy  
260 benefits to leverage IPP investments.

261 In other cases, entities may have lower costs of capital. In the case of community  
262 wind, single digit or tens of MW developments can often be had through municipal or  
263 other community driven investments. In the case of municipalities, bonding or other  
264 financial mechanisms can be used to lower to cost of capital compared to Ameren  
265 Missouri's cost of capital or rate of return. So long as the project can be profitable,  
266 allowing for the project's cost of money, the project can be a good business opportunity.

Ameren Missouri did not consider this method of renewable energy development, though a great deal of literature is publically available and there are numerous examples of successful projects of this sort throughout the U.S.

As Ameren Missouri did not consider any alternative to its own ownership of renewable energy developments or that project MWh costs can leverage non-energy benefits, Ameren Missouri may have left a gap in its analysis of capital and energy costs for what could be a reasonable contributor to its renewable energy supply.

**Q. What reasons did Ameren Missouri provide for not taking a more in-depth look at PPAs and are those reasons appropriate?**

A. In its Response, Ameren Missouri seeks to claim that 4 CSR 240-22-040(1) specifically exempts Ameren Missouri from considering energy projects in which it does not implement solely through its own resources or as a major participant. Further, Ameren Missouri states that it “does not believe this requires utilities to consider developing projects that are of such small magnitude...”<sup>15</sup> However, 4 CSR 240-22-040(1) specifically states, in regards to the options to be considered under supply side resources, as including “...cogenerators or independent power producers...” It is unclear how Ameren Missouri can simultaneously claim compliance with 4 CSR 240-22-040(1) when it has explicitly rejected independent power producers.

**Q. In its 2011 IRP did Ameren Missouri unreasonably constrain its analysis of renewable energy options?**

A. Yes. Ameren Missouri limited its consideration of renewable energy resources to only those it considered to be “utility sized.” By limiting considerations to only utility sized

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<sup>15</sup> Ameren Missouri’s Response to Comment’s of the Parties, p. 66.

289 projects, Ameren Missouri effectively removed from consideration any customer sited  
290 projects, including those that it might be have been able to invest in. However, the  
291 summation of Ameren Missouri's logic for ignoring large portions of the potential  
292 renewable energy market, or for making gross assumptions that could have been  
293 investigated fairly simply, seems to be that it has no obligation to investigate any supply  
294 side resource unless it deems them to be of sufficient size to be worthy for its own direct  
295 investment. As noted in the above testimony, its analysis constrained the size  
296 consideration for renewable resources, disregarded IPPs and potential options that may  
297 result in costs lower than the costs modeled by Ameren Missouri for its own investment  
298 criteria, ignored the potential co-value benefits that might be leveraged from renewable  
299 energy projects to drive down per MWh costs, and appear to have made minimal efforts  
300 to determine whether IPPs are even a possibility for future renewable resource  
301 acquisitions. That other utilities around the U.S. have successfully procured renewable  
302 energy sources from not only its own resources, but also through IPPs, and "non-utility  
303 sized" projects, suggests that Ameren Missouri's planning efforts in its 2011 IRP were  
304 based on a general lack of awareness of otherwise well known options or were simply  
305 constrained through a series of assumptions that drove the outcome.

306 **Q. Does this complete your rebuttal testimony?**

307 **A.** Yes, it does.

***Resume of Richard Hasselman***  
**Senior Project Manager**

**GDS Associates, Inc.**  
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**EDUCATION:** University of Wisconsin Madison, 2008

Master of Business Administration

University of Wisconsin Madison 1995-1998

Degree: M.S. Land Resources, certificate in Energy Analysis and Policy

Thesis: *Photovoltaics and A Wisconsin Utility* – Modeled photovoltaic performance and compared results to a utility's demand profile.

Radford University, Radford Virginia, 1989-1994

Degree: B.A. Geography, concentration in Environmental Studies

Minors: Economics, Political Science, and Chemistry

**CERTIFICATIONS:** Certified Wind Site Assessor, Midwest Renewable Energy Association

Carbon Reduction Manager, Association of Energy Engineers

**WORK EXPERIENCE:**

**(2001 – present) GDS Associates – Project Manager**

**Renewable Energy** – Wind Lead for Wisconsin's Focus on Energy Program, overseeing and supporting other program sectors with wind energy market and technology assistance. Perform wind energy site evaluations for clients interested in small, medium, and utility scale wind turbines. Activities have included wind prospecting with developers, reverse engineering technical feasibility studies for due diligence efforts, and developing project financial pro formas. Also oversees the implementation of renewable energy technologies assigned to the agribusiness sector and conducts biogas program analyses with evaluation.

Specific areas of wind consulting experience include:



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**Senior Project Manager**

**GDS Associates, Inc.**  
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- Scoping studies for large geographic areas,
- Site specific feasibility studies
- Turbine model selection
- Modeling of specific wind turbine production
- Procurement assistance for wind energy development, including RFP development,
- Financial modeling including tax incentives and internal rate of return analysis.
- Measurement and verification of small wind systems,
- NABCEP site assessor certification exam resource guide committee,
- Improvement in site assessment protocols to increase accuracy,
- Interstate Turbine Advisory Council.

Specific areas of general renewable energy consulting experience include:

- Experience with RETScreen, PVWATTS, and other industry standard analytical tools,
- Developing GDS analytical tools,
- Supporting clients with the development of client specific analytical tools,
- Fundamental understanding of solar resource factors and modeling,
- Providing system output analyses for a variety of clients and technologies,
- Bioenergy resource and potential analysis,
- Biogas technical, financial, and market feasibility analysis,
- Knowledgeable regarding system component, sizing, design, and interconnection considerations,
- Analysis of financial considerations for project financial performance.

### **Potential Studies and Integrated Resource Plans**

Recent work includes supporting GDS on a potential study for the Vermont Dept. of Public Service. This work included renewable energy analyses, emerging efficiency technologies, potential modeling, and multiple scenario development. Integrated Resource Planning work has emphasized renewable energy planning, aligning with renewable portfolio standard compliance and least cost planning. Recent work includes IRP review for the Delaware Division of Public Advocate.

**Energy Efficiency Programs** – Help GDS design and manage the Focus on Energy Agriculture and Rural Business Program. This program delivers energy efficiency services to Wisconsin's agriculture and biofuels economy, helping improve energy utilization across diverse enterprises.

### **Other Experience**

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**Senior Project Manager**

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- The Wisconsin Department of Agriculture, Trade, and Consumer Protection: Part of the technical team to support the Governor's Consortium on Bio-based Industry.
- Field data collection including equipment installation, data retrieval, and analysis.
- GIS based analysis

**(1998–2001)                      Energy Center of Wisconsin – Project Manager**

Managed projects across a wide assortment of topic areas for the Evaluation and Market Research Department and worked collaboratively with multiple stakeholders to achieve successful outcomes.

**Key Accomplishments at the Energy Center of Wisconsin:**

**Appliance Sales Tracking** - Designed and managed the implementation of a bi-annual survey of Wisconsin homeowners.

**Residential Furnace and A/C Market Tracking** - Managed system of reporting furnace and air-conditioner sales. Worked with distributors to collect data reporting regional sales levels and trends in Wisconsin sales regions.

**WEB Low-Income Pilot Evaluations** - As part of an evaluation team, Richard designed data collection instruments, collected data, analyzed data, developed interview protocols, and conducted interviews for evaluations of five pilot low-income energy programs.

**WisconSUN** - Richard was a project manager for the WisconSUN program, and incentive program to encourage solar energy installations. Richard reviewed proposals, set incentive levels, and directed program policy.

**Wind Energy Awareness Materials** - Richard developed a series of fact sheets to educate the general public about wind energy. Richard also managed the development of a wind energy education website and multi-media CD-ROM.