



222 S. Hamilton, Madison, WI 53703

June 2, 2014

Ms. Sandra Paske
Secretary to the Public Service Commission
P.O. Box 7854
Madison, WI 53707-7854

Re: Docket No. 1-IC-480 RENEW Wisconsin Supplement to its Application for Intervenor Compensation to Participate in Docket No. 6690-UR-123)

Proposal from Synapse Energy Economics

Dear Ms. Paske:

In its intervenor compensation application submitted in Docket No. 1-IC-480 on May 21, 2014 (PSC REF#: 204803)(IC Application), RENEW Wisconsin noted its intent to supplement its initial application on the issue of parallel generation rates. This letter and accompanying proposal supplements and completes RENEW's IC Application.

In its rate design testimony filed May 15, 2014, Wisconsin Public Service Corporation proposes to continue its practice compensating parallel generators at rates that we believe do not represent the utility's actual avoided costs.

The issue of parallel generation rates is of critical importance to RENEW members. The combination of energy-only pricing and the withdrawal of special buyback rates for specific renewable generation systems has effectively limited installation activity to renewable energy systems eligible for net metering service.

Other businesses and investors in Wisconsin would build distributed generation (renewable and natural gas cogeneration), creating local jobs and keeping ratepayer dollars in Wisconsin, with fair feed-in rates. When appropriately set at the true avoided costs, such programs have no ratepayer impacts—creating a clear policy win for the state economy and ratepayers. However, the current practices of using LMPs and MISO capacity rates do not provide a fair (or legal) avoided cost rate because the LMP and capacity market prices do not represent the utility's actual avoided costs. Rather, at most, it represents what the utility is willing to sell energy or capacity for, not what it costs to provide that energy or capacity. It appears from public documents that WPS is selling energy at a loss in the MISO market. This means ratepayers are

picking up the difference between the true cost of generation and the MISO clearing price. Avoided cost rates must include all of the avoided costs of generation—including those that the utility chooses to shift from MISO payments to ratepayers. Additionally, all generation provided to WPS' system both avoids transmission and decreases WPS' transmission bills from ATC, yet not all PG tariff rates appropriately reflect those avoided costs.

In its proposal to RENEW, Synapse Energy Economics defines several key tasks necessary to determine whether distributed generators are being fairly and adequately compensated for the electricity delivered to the WPSC's distribution system. These include a review of current contracts for energy and capacity as well as a critique of the company's model and model inputs used in calculating avoided costs.

Based on its review of WPSC's rate designs in this proceeding, Synapse submitted a budget of \$39,020 for its proposal. This amount is reasonable given the technical complexity of calculating a utility's avoided costs. Attached to this letter is a Synapse's proposal specifying its workplan, project team, relevant experience (including resumes), and budget.

With the inclusion of this proposal RENEW's total intervenor compensation request for this proceeding is:

Table 1

Synapse Energy Economics (Expert Witness - Parallel Generation)	\$39,020
RENEW Wisconsin (Expert Witness – Net Metering, Administration)	\$ 6,400
Legal Expenses (McGillivray, Westerberg and Bender)	\$20,355
Total	\$65,775

Table 1 above replaces the table on the first page of Appendix B of RENEW's initial IC Application.

Please let us know if you have any questions or need any additional information. Thank you for your consideration of RENEW's application.

Thank you for your consideration.

Sincerely,



Michael Vickerman
Program and Policy Director

Proposal to Examine Avoided Costs of Distributed Generation in Wisconsin

TO: DAVID BENDER, MCGILLIVRAY, WESTERBERG & BENDER, LLC
FROM: PATRICK LUCKOW, ASSOCIATE, 617-453-7052, pluckow@synapse-energy.com
DATE: MAY 30, 2014
RE: AVOIDED COSTS OF DISTRIBUTED GENERATION IN WISCONSIN

Background

RENEW Wisconsin requires technical consulting services to support its work in Docket 6690-UR-123, focusing primarily on the methodology used to determine avoided costs of electricity generated using distributed generation (DG) technologies, such as solar PV, within the Wisconsin Public Service Company (WPS) territory. As utilities like WPS seek new restrictions on net-metered distributed generation systems, it is critical that the costs that are avoided by the utility as a result of having these DG systems in their service territories are being fairly and adequately represented in the rate paid to those customers.

Synapse Energy Economics, Inc. (Synapse) proposes to provide expert testimony for the August 13, 2014 direct testimony and September 8, 2014 surrebuttal testimony deadlines to assist RENEW Wisconsin in this matter. In addition to technical assistance and testimony, Synapse will provide discovery support and support related to the evidentiary hearing. One witness will be available to attend the September 10, 2014 hearing in Madison, WI.

Once retained, Synapse will hold a teleconference with RENEW Wisconsin to review and discuss the scope of work as a first step in carrying out this effort. We will discuss key methodological issues, review milestones, agree on deliverables, and identify the specific information needed from the utilities or other parties.

Scope of Work

Project Management

Patrick Luckow will serve as Synapse's project manager for this work. He will be the primary liaison with RENEW Wisconsin for this project, and will be responsible for developing a clear work plan, overseeing the project team, and ensuring that deliverables are provided on schedule and to the satisfaction of

RENEW Wisconsin. Our understanding is that David Bender of McGillivray, Westerberg & Bender, LLC, will serve as the primary point of contact for RENEW Wisconsin for this project.

Synapse places a strong emphasis on project management practices. We believe it is essential to:

- **Communicate regularly.** Mr. Luckow will provide RENEW Wisconsin with project status updates on a regular basis, as needed.
- **Identify key assumptions, technical methodologies, and deliverable outlines early in the project,** to the extent possible. Synapse proposes to work with RENEW Wisconsin to determine a process and a schedule for approving these critical components as part of a project kickoff call.
- **Thoroughly review our work.** We will use an internal peer-review system to ensure that our analyses are highly defensible, and we ask our clients to consolidate their edits into one document to streamline the feedback process and avoid opportunities for confusion.
- **Be flexible and responsive to changes as they arise.** We understand that project needs often evolve, for a variety of reasons. With your approval, we will adapt our approach to meet the changing needs of your project.

Task 1: Technical Assistance and Written Testimony for August 13 Direct Testimony

Synapse proposes to review all relevant testimony filed by WPS in this docket; review relevant filings from other parties, including staff and other intervenors; review WPS's current contracts for energy and capacity; review the transmission tariff and how avoided costs for transmission are calculated; and examine the models and inputs used to generate locational marginal prices (LMPs). Synapse will also draft appropriate discovery in response to this testimony.

Finally, Synapse will submit expert testimony in support of an avoided cost rate methodology that is fair, reasonable, and as transparent as possible. Synapse expert Patrick Luckow's testimony will focus on major costs the utility system avoids as a result of distributed generation resources within the context of PURPA, including—to the extent possible given existing data—the following:

- Avoided energy costs
- Avoided generating capacity costs
- Supply-induced price effects
- Avoided capital costs associated with transmission and distribution
- Avoided line losses
- Avoided RPS compliance costs
- Avoided costs of complying with air emission and water regulations not incorporated within other avoided costs
- Avoided fuel hedging costs
- Avoided non-energy costs (e.g., resource savings from reduced water use)

Mr. Luckow's testimony will include an in-depth review of the company's modeling of key factors that impact the calculation of the avoided cost rate, such as LMPs and generation sources' variable costs. Mr.



Luckow will review the reasonableness of the inputs, outputs, and the application of the company's models.

Should other categories of significant avoided costs be proposed by other participants in the course of the docket, Synapse will address those costs in our analysis or testimony as well.

Key Meetings & Deliverables

- Draft testimony will be provided to RENEW Wisconsin on or before Wednesday, August 6, and finalized testimony on or before Wednesday, August 13

Task 2: Technical Assistance and Written Testimony for September 8 Surrebuttal

Synapse proposes to summarize any relevant contentious issues from the additional testimony of other parties, and to present this summary in a teleconference with RENEW Wisconsin, if desired. In addition, Mr. Luckow will draft expert surrebuttal testimony in support of an avoided cost rate methodology that is fair, reasonable, and as transparent as possible.

Key Meetings & Deliverables

- Draft surrebuttal testimony will be provided to RENEW Wisconsin on or before Tuesday, September 2, and finalized surrebuttal testimony on or before Monday, September 8

Task 3: Appear Before the Wisconsin Public Service Commission at September 10 Evidentiary Hearing

Synapse proposes to provide one expert witnesses to appear before the Wisconsin Public Service Commission for direct testimony and cross examination. Mr. Luckow will address avoided costs broadly and will critique the current methodology for calculating avoided costs. He will also focus on the company's modeling of LMPs as well as other factors that impact the determination of avoided costs for distributed generation.

Synapse will also provide technical assistance to RENEW Wisconsin in preparation for the evidentiary hearing. This includes both hearing preparation time on-site immediately preceding the hearing date and assistance in preparing for cross examination, if necessary.

Key Meetings & Deliverables

- In-person meetings between RENEW Wisconsin and Synapse in Madison, WI on or very near the date of the evidentiary hearing
- Attend evidentiary hearing on September 10

Task 4: Post-Hearing Brief

Synapse will assist RENEW Wisconsin by attending a post-hearing brief via teleconference to ensure uniform understanding of key aspects of testimony.



Key Meetings & Deliverables

- A mutually agreeable date and time for this meeting will be determined at a later date

Services Not Included in Scope

Numerous additional issues may arise during this project. We are happy to discuss expansion in the scope of work described here, with corresponding changes in the budget. Note that our proposed scope of work includes technical assistance and expert testimony of one witness who will review and critique the company's model and model inputs—but does not include the procurement of a model license or the re-running of the company's modeling. The current budget includes time spent crafting recommendations on how the Commission should calculate avoided costs; however, it does not include the time and budget for Synapse to execute those calculations. The current budget also does not include time that may be necessary for depositions or rounds of testimony that go beyond the surrebuttal phase identified in the prehearing conference memorandum dated May 15, 2014.

Milestone Schedule

Our expected timeline for the project is as follows:

Date	Milestone
Friday, June 6 (proposed)	Kickoff meeting
Tues., July 8	Call with RENEW WI to discuss contentious issues from pre-filed testimony
Wed., August 6	Draft direct testimony sent to RENEW WI
Mon., August 11	Comments from RENEW WI regarding direct testimony received by Synapse
Wed., August 13	Final direct testimony sent to RENEW WI
Mon., August 18	Call with RENEW WI to discuss contentious issues and surrebuttal strategy
Tues., September 2	Draft surrebuttal testimony sent to RENEW WI
Thurs., September 4	Comments from RENEW WI regarding surrebuttal testimony received by Synapse
Mon., September 8	Final rebuttal testimony sent to RENEW
Tues., September 9	Meet with RENEW WI
Wed., September 10	Attend evidentiary hearing
TBD	Call with RENEW WI regarding post-hearing brief

RENEW Wisconsin acknowledges that meeting the deliverable target dates is contingent upon timely completion of review and comments by the client. Our proposed budget for this project assumes one round of consolidated comments from the client on each draft deliverable and specified calls/meetings, consistent with the table above.



RENEW Wisconsin will immediately advise Synapse as soon as it becomes aware of any developments that may delay completion of scheduled deliverables, including any requested changes to the scope of work requested by RENEW Wisconsin. Synapse will work with RENEW Wisconsin to adjust the deliverable target dates accordingly.

Project Team

Patrick Luckow will serve as the Synapse project manager and primary expert witness for this work. Mr. Luckow performs modeling analyses of electric power systems using industry-standard models to evaluate long-term energy plans and the environmental and economic impacts of policy/regulatory initiatives. He has substantial experience reviewing and critiquing utility modeling runs, assumptions, and output files.

The personnel for our team will also include:

- Max Chang, principal associate
- Bob Fagan, principal associate
- Dr. Tommy Vitolo, associate
- Sarah Jackson, associate
- Sarah Kushner, communications assistant

These team members have experience analyzing net metering, distributed generation costs and benefits, and avoided costs in a range of contexts and jurisdictions, including projects for the Alliance for Solar Choice in North Carolina, the Avoided Energy Supply Component Study Group in New England, and the Massachusetts Departments of Energy Resources and Environmental Protection.

Our team is ready to begin work immediately, and has sufficient time available throughout the project timeframe to conduct the scope of work discussed in this proposal.

Brief bios for each team member are provided below. Resumes for all proposed team members are attached at Appendix A.

Patrick Luckow, Associate

Patrick Luckow performs modeling analyses of electric power systems using industry-standard models to evaluate long-term energy plans and the environmental and economic impacts of policy/regulatory initiatives. His recent work at Synapse includes modeling the market price impacts of adding high levels of wind resources in PJM; modeling the New England electric system to calculate avoided costs associated with energy efficiency programs; modeling the cost and emission impacts associated with transmission and renewable energy additions in New England; and using the ReEDS model to analyze several national clean energy futures for the Energy Foundation. As part of an ongoing integrated resource planning docket in Hawaii, Mr. Luckow has reviewed utilities' Strategist modeling runs and output files to assess and compare resource scenarios that would allow the islands to meet aggressive renewable energy targets. Prior to joining Synapse, Mr. Luckow worked as a scientist at the Joint Global



Change Research Institute in College Park, Maryland. In this position, he evaluated the long-term implications of potential climate policies, both internationally and in the U.S., across a range of energy and electricity models. Mr. Luckow holds a Master of Science in Mechanical Engineering from the University of Maryland.

Max Chang, Principal Associate

Max Chang provides economic analysis of technologies and policies, performs electricity policy modeling, evaluates distribution system infrastructure, and evaluates air emissions of electricity generation. He has filed expert testimony in Massachusetts and New Jersey regarding energy efficiency plans and program costs, and has presented or testified on a range of issues before the United States District Court, Vermont Public Service Board, and the Maine Public Service Commission. Mr. Chang regularly analyzes reliability metrics and infrastructure issues in utility rates cases, and examines the benefits and costs of energy efficiency measures and programs for the U.S. Environmental Protection Agency and consumer advocate clients. Since 2011, he has played a central role in managing and coauthoring the biennial *Avoided Energy Supply Costs in New England* study, which is a key reference used by New England energy efficiency program administrators. He has also examined the benefits and costs of energy efficiency measures and programs for the U.S. Environmental Protection Agency and consumer advocate clients, and has authored several reports examining the costs and risks associated with proposed nuclear power plants in the U.S.

Bob Fagan, Principal Associate

Bob Fagan, a principal associate at Synapse Energy Economics, is a mechanical engineer and energy economics analyst who has analyzed energy industry issues for more than 25 years. His activities focus on many aspects of the electric power industry, in particular:

- Economic and technical analysis of electric supply and delivery systems
- Wholesale and retail electricity provision
- Energy and capacity market structures
- Renewable resource alternatives, including on-shore and off-shore wind and solar PV
- Assessment and implementation of energy efficiency and demand response alternatives

Mr. Fagan is expert in the complexities of, and the interrelationships between, the technical and economic dimensions of the electric power industry in the United States and Canada. His areas of focus include: wholesale energy and capacity provision under market-based and regulated structures; transmission use pricing, encompassing congestion management, losses, LMP, and alternatives; financial and physical transmission rights; and transmission asset pricing (e.g., embedded cost recovery tariffs).

His experience includes in-depth knowledge of physical transmission network characteristics; related generation dispatch/system operation functions; technical and economic attributes of generation resources; RTO and ISO tariff and market rules structures and operation; and FERC regulatory policies and initiatives, including those pertaining to RTO and ISO development and evolution. Mr. Fagan is also



expert in the assessment of technical and economic dimensions of wind and solar power integration into utility power systems, and in utility demand side management and demand response impacts on the power system.

Mr. Fagan holds an MA from Boston University in energy and environmental studies and a BS from Clarkson University in mechanical engineering. He has completed additional course work in wind integration, solar engineering, regulatory and legal aspects of electric power systems, building controls, cogeneration, lighting design, and mechanical and aerospace engineering.

Tommy Vitolo, PhD, Associate

Tommy Vitolo is an associate at Synapse. He earned his PhD in systems engineering from Boston University, and has more than seven years of professional experience as a consultant, researcher, and analyst. Since joining Synapse in 2011, Dr. Vitolo has focused on utility resource planning, variable resource integration, avoided costs, and other issues that typically involve statistical analysis, computer simulation modeling, and stochastic processes. He has filed expert testimony in Missouri related to utility integrated resource planning, and has reviewed and critiqued the numerical analysis, modeling, and decision strategies of integrated resource plans and certificates of public convenience and necessity submitted by utilities located in Kansas, Missouri, New Mexico, Georgia, Kentucky, Nebraska, and Colorado. He is currently leading a project for The Alliance for Solar Choice examining assumptions and methodologies for calculating the costs and benefits of solar PV in North Carolina. Before joining Synapse, Dr. Vitolo worked at the Massachusetts Institute of Technology's Lincoln Laboratory, where he designed algorithms and implemented software to create network topologies for orbital, aerial, land-based, and nautical vehicles.

Sarah Jackson, Associate

Sarah Jackson brings a background in environmental policy and consensus-building to Synapse's work. Formerly of Earthjustice, she has more than 10 years of experience analyzing federal and state regulations, policies, and environmental planning documents. Ms. Jackson applies this experience at Synapse to evaluate the impacts of policies and regulations on the electric sector, the costs and impacts of electricity production options, and the environmental compliance assumptions used by utilities in major regulatory filings. She has supported the development of expert witness testimony in several cases analyzing proposed and historical coal-plant investments, including cases in Indiana, Oregon, Wyoming, Utah, Kentucky, Louisiana, and Michigan. Ms. Jackson also specializes in electricity market rules, trends, and analysis. A significant part of her job is providing ongoing monitoring and advocacy services for Synapse's New England Power Pool (NEPOOL) clients. As part of this work, she maintains Synapse's end user and alternative resource sector clients' interests at ISO-New England stakeholder meetings, assists clients in navigating RTO market rules, and develops reports examining key market issues. She holds a Master of Environmental Law and Policy from Vermont Law School.

Sarah Kushner, Communications Assistant

Sarah Kushner provides editorial, coordination, and formatting assistance for Synapse proposals, reports, presentations, and other work products. Prior to joining Synapse, Ms. Kushner served as the managing editor of The World & I Online, an online educational database for K-12 students, where she



compiled and edited academic articles in the areas of natural science, current events, history, global cultures, and the arts. She also worked as an editorial intern at Island Press, an environmental book publisher in Washington, DC. Ms. Kushner holds a Bachelor of Science in Journalism from Boston University.

Relevant Experience

Synapse has extensive experience providing expert services to support our clients' involvement in regulatory cases and other forums analyzing avoided costs, net metering, distributed generation, and related assumptions and methodologies. The following project descriptions represent a sample of our ongoing and recent work that is related to RENEW Wisconsin's current need.

Mississippi Net Metering Study

Client: Mississippi Public Service Commission

Synapse is assisting the Mississippi Public Service Commission (PSC) in Docket No. 2011-AD-2, a proceeding opened to develop and implement net metering and implementation standards for Mississippi. Synapse will conduct a comprehensive cost-benefit analysis for net metering and interconnection in Mississippi, to help the PSC make an informed decision regarding the costs and benefits and assist it in developing appropriate policies for the state. Synapse will assess both the direct and indirect costs and benefits of net metering and interconnection—whether under a net metering and interconnection or alternative policy scenario—and will consider and quantify both energy-related and non-energy costs and benefits. Project ongoing.

North Carolina Valuing Distributed Generation

Client: The Alliance for Solar Choice

Synapse is developing testimony on behalf of The Alliance for Solar Choice supporting a fair and reasonable methodology and assumptions for calculating the costs and benefits of solar PV in North Carolina. Our analysis will focus on major costs the utility system avoids as a result of solar PV within the context of PURPA, including avoided energy costs, avoided generating capacity costs, price suppression, and other major categories of avoided costs. Project ongoing.

Avoided Costs of Global Warming Solutions Act Compliance

Clients: Massachusetts Departments of Energy Resources and Environmental Protection

Synapse developed pre-filed direct testimony for the Massachusetts Departments of Energy Resources and Environmental Protection related to the cost of Global Warming Solutions Act (GWSA) compliance avoided by energy efficiency programs in Massachusetts. Project ongoing.

Analysis of Avoided Costs in Mississippi

Client: American Council for an Energy-Efficient Economy

Synapse provided support to ACEEE in its development of a Mississippi energy efficiency potential study. Synapse provided analysis of wholesale electricity supply prices for the reference case, high-level estimates of avoided electric energy and capacity costs, and projections of electricity supply prices under a clean energy policy case. Project completed January 2014.



2013 Avoided Energy Supply Cost Study

Client: Avoided-Energy-Supply-Component Study Group

Synapse and a team of subcontractors developed projections of marginal energy supply costs that would be avoided due to reductions in electricity, natural gas, and other fuels resulting from energy efficiency programs offered to customers. The 2013 AESC study was sponsored by a group representing all of the major electric and gas utilities in New England as well as efficiency program administrators, energy offices, regulators, and advocates. Synapse conducted prior AESC studies in 2007, 2009, and 2011. The report provides projections of avoided costs of electricity and natural gas by year from 2014 through 2028 with extrapolated values for another 15 years. In addition to projecting the costs of energy and capacity avoided directly by program participants, the report provides estimates of the Demand Reduction Induced Price Effect (DRIPE) of efficiency programs on wholesale market prices for electric energy, electric capacity, and natural gas. The report also provides a projection of non-embedded environmental costs associated with emissions of CO₂. Project completed in 2013. Report available at: <http://www.synapse-energy.com/Downloads/SynapseReport.2013-07.AESC.AESC-2013.13-029-Report.pdf>.

State Efficiency and Clean Energy Plans

Client: American Council for an Energy-Efficient Economy

Synapse assisted ACEEE with their clean energy plans for several U.S. states by developing avoided cost values as well as fuel costs and utility investments. Synapse assisted in the development of clean energy plans for North Carolina, South Carolina, Virginia, Ohio, Pennsylvania, Missouri, and Arkansas. The energy future reports can be found on the ACEEE website. Project completed March 2013.

Distributed Generation Study in New York

Client: New York State Energy Research and Development Authority

Together with the Pace Energy Project, Synapse provided NYSERDA with analyses regarding distributed generation (DG) and combined heat and power (CHP) in New York. This project comprised three major phases. First, Synapse estimated the price benefits of incorporating DG/CHP in New York utility systems, conducting a gap analysis of what would be necessary to realize the benefits and summarizing available options, drawing on case studies of quantifiable DG/CHP benefits. Second, Synapse and Pace investigated the implications and impact of DG/CHP rules and regulations in New York (with an emphasis on decoupling) on the development of these resources. Finally, Synapse and Pace examined three models illuminating policy options to encourage DG (utility DG model, DG development zone model, and refined RFP model) from various perspectives, including the level and overall cost of DG/CHP development in New York. Project completed in 2011. Full report available at: <http://www.synapse-energy.com/Downloads/SynapseReport.2011-02.NYSERDA.DG-Benefits-and-Case-Studies.07-081.pdf>.

Analysis of a Massachusetts Clean Energy Performance Standard

Client: Massachusetts Clean Energy Center, Massachusetts Department of Environmental Protection, Massachusetts Department of Energy Resources, Massachusetts Department of Public Utilities

Synapse conducted a research study and modeling to inform the Massachusetts Clean Energy Center and its partners about the policy options, effectiveness, costs and benefits, and regulatory or legislative avenues for implementation of a proposed Clean Energy Standard. The team investigated advantages



and disadvantages of various approaches that could be taken to implement a Standard to reduce greenhouse gas emissions from the electric sector; estimated costs and emissions reductions that could be achieved from various designs and stringency levels for Standards; detailed the approach, successes, and difficulties of other Standards; and determined how a Standard might interact with existing renewable energy and emission policies. Project completed in 2013.

Review of Ameren IL Revised AMI Plan

Client: Illinois Attorney General

The Attorney General of Illinois retained Synapse to examine and testify as to whether the Ameren Illinois Revised AMI Plan meets the cost-beneficial standard under Section 16-108.6(c) of the IL Energy Infrastructure and Modernization Act. Project completed in 2013. Testimony available at:

<http://www.synapse-energy.com/Downloads/SynapseTestimony.2012-08.IL-AG.Ameren-Revised-AMI-Plan.12-058.pdf>.

Energy Efficiency in Rhode Island

Client: Rhode Island Division of Public Utilities and Carriers

Synapse is representing the Rhode Island Division of Public Utilities and Carriers in a collaborative process to oversee and provide input concerning energy efficiency programs offered by National Grid, the state's primary electric utility. This work encompasses all aspects of energy efficiency program design and implementation, including efficiency measure assessment, program delivery options, program budgeting, cost-benefit analyses, utility performance incentives, and other relevant regulatory policies. Project ongoing.

Long Island Clean Energy Vision

Client: Renewable Energy Long Island

Synapse prepared a report detailing the potential for using energy efficiency and renewable resources to meet all of the electricity demand on Long Island by 2022. The report assessed the potential for energy efficiency, demand response, distributed generation, solar thermal, photovoltaics, land-based wind, off-shore wind, and hydro power. Project completed July 2012.

Budget

Our proposed budget for this project is \$39,020. This is a good faith time-and-materials estimate based upon our current understanding of the requirements to complete the project. However, there are several factors that could impact the level of effort required, including changes in scope, availability of source materials, communication requirements, or other factors. If for any reason we anticipate that the level of effort required will exceed the estimated budget, Synapse will inform RENEW Wisconsin as soon as reasonably possible, so that RENEW Wisconsin and Synapse can discuss an appropriate modification to the scope and/or budget.

The hourly billing rates for our project team are as follows:

- Patrick Luckow, associate: \$155/hour



- Max Chang, principal associate: \$175/hour
- Bob Fagan, principal associate: \$220/hour
- Dr. Tommy Vitolo, associate: \$155/hour
- Sarah Jackson, associate: \$155/hour
- Sarah Kushner, communications assistant: \$125/hour

The table below presents our estimated labor hours and labor cost per task. In keeping with our standard business practices, RENEW Wisconsin will only be invoiced for actual effort expended and actual expenses.



Task \ Project Team	Luckow	Chang	Fagan	Vitolo	Jackson	Kuschner	Total
Billing Rate per hour	\$155	\$175	\$220	\$155	\$155	\$125	
Task 1: Technical Assistance and Written Testimony for August 13 Direct Testimony							
Review of company filing, testimony, exhibits	8	2		2			12
Promulgate discovery to company	6	4	2	2	2		16
Review of discovery responses, analysis, workbooks	12	8	4	4	4		32
Review of computer modeling	20		4	4			28
Prepare written direct testimony	24	8		4	4	4	44
Cross-discovery, respond to discovery	8	2		2	2		14
Task 2: Technical Assistance and Written Testimony for September 8 Surrebuttal Testimony							
Prepare written rebuttal testimony	16	4		2	2	2	26
Review company's and intervenors' rebuttal testimony	6	4					10
Task 3: Appear Before the Wisconsin Public Service Commission at September 10 Evidentiary Hearing							
Prep for hearing / assist with cross / travel to hearings	20	4	2	4	2	4	36
Appear at hearings	8						8
Task 4: Assist with Post-Hearing Brief							
Review of / assistance with post-hearing brief	8	2					10
Total Hours	136	38	12	24	16	10	236
Labor	\$21,080	\$6,650	\$2,640	\$3,720	\$2,480	\$1,250	\$ 37,820
Travel Expenses (one witness to Wisconsin)	\$1,200						\$ 1,200
Total Budget							\$39,020



Appendix A: Project Team Resumes

On the following pages, we provide resumes for each member of the proposed project team:

- Patrick Luckow, associate
- Max Chang, principal associate
- Bob Fagan, principal associate
- Dr. Tommy Vitolo, associate
- Sarah Jackson, associate
- Sarah Kushner, communications assistant



Patrick Luckow, Associate

Synapse Energy Economics | 485 Massachusetts Avenue, Suite 2 | Cambridge, MA 02139 | 617-4537052
pluckow@synapse-energy.com

PROFESSIONAL EXPERIENCE

Synapse Energy Economics Inc., Cambridge, MA. *Associate*, May 2012 – present.

Provides consulting services, conducts research, and performs analysis of energy investments. Calibrates, runs, and modifies industry-standard economic models to evaluate long-term energy plans, and the environmental and economic impacts of policy/regulatory initiatives.

Joint Global Change Research Institute, College Park, MD. *Scientist*, 2009 – 2011.

Evaluated the long-term implications of potential climate policies, both internationally and in the US, across a range of energy and electricity models. Modeled large-scale biomass use in the global energy system. Led a team studying global wind energy resources and their interaction in the Institute's integrated assessment model. Utilized updated global wind supply curves to help understand both onshore and offshore wind deployment, and issues associated with transmission requirements, intermittency, and technology costs.

DaimlerChrysler, Auburn Hills, MI. *Stress Lab & Durability Development Intern*, 2007.

Completed load and vibration data acquisition and analysis on various Chrysler vehicles, and contributed to the development of an improved generic body vibration profile.

Northrop Grumman, Rolling Meadows, IL. *Defensive Systems Division Co-op*, 2005 – 2007.

Designed new enclosures and mounting structures for electronic components, silenced existing enclosures, and conducted thermal testing of complete systems.

EDUCATION

University of Maryland, College Park, MD

Master of Science in Mechanical Engineering, 2009.

Northwestern University, Evanston, IL

Bachelor of Science in Mechanical Engineering, 2007.

PUBLICATIONS

Luckow, P., E. A. Stanton, B. Biewald, S. Fields, S. Jackson, J. Fisher, F. Ackerman. 2014. *CO₂ Price Report, Spring 2014: Includes 2013 CO₂ Price Forecast*. Synapse Energy Economics.

Luckow, P., E. A. Stanton, B. Biewald, J. Fisher, F. Ackerman, E. Hausman. 2013. *2013 Carbon Dioxide Price Forecast*. Synapse Energy Economics.

Hornby, R., P. Chernick, D. White, J. Rosenkranz, R. Denhardt, E. A. Stanton, J. Gifford, B. Grace, M. Chang, P. Luckow, T. Vitolo, P. Knight, B. Griffiths, B. Biewald. 2013. *Avoided Energy Supply Costs in New England: 2013 Report*. Synapse Energy Economics for Avoided-Energy-Supply-Component (AESC) Study Group.

Ackerman, F., T. Comings, P. Luckow. 2013. *A Review of Consumer Benefits from a Corporate Average Fuel Economy (CAFE) Standards*. Synapse Energy Economics for Consumers Union.

Fagan, R., P. Luckow, D. White, R. Wilson. 2013. *The Net Benefits of Increased Wind Power in PJM*. Synapse Energy Economics for Energy Future Coalition.

Wilson, R., P. Luckow, B. Biewald, F. Ackerman, E. Hausman. 2012. *2012 Carbon Dioxide Price Forecast*. Synapse Energy Economics.

Biewald, B., T. Vitolo, P. Luckow. 2012. *Comments Regarding KCP&L's 2012 IRP Filing*. Sierra Club and Synapse Energy Economics.

Zhou, Y., P. Luckow, S.J. Smith, and L.E. Clarke. 2012. "Evaluation of Global Onshore Wind Energy Potential and Generation Costs." *Environmental Science & Technology* 46 (14):7857–7864, doi:10.1021/es204706m.

Dooley, J., P. Luckow, M.A. Wise. 2012. *Algal Biodiesel Production in GCAM: Initial Parameterization and Discussion of Potential Model Development Areas*. College Park, MD: Joint Global Change Research Institute and Pacific Northwest National Laboratory.

Edmonds, J., P. Luckow, K. Calvin, M.A. Wise, J.J. Dooley, P. Kyle, S. Kim, P. Patel, and L.E. Clarke. 2013. "Can radiative forcing be limited to 2.6 Wm⁻² without negative emissions from bioenergy AND CO₂ capture and storage?" *Climatic Change* 118 (1): 29–43, doi:10.1007/s10584-012-0678-z.

Luckow, P., M.A. Wise, J.J. Dooley, S.H. Kim. 2010. "Large-scale utilization of biomass energy and carbon dioxide capture and storage in the transport and electricity sectors under stringent CO₂ concentration limit scenarios." *International Journal of Greenhouse Gas Control* 4 (5): 865–877, doi:10.1016/j.ijggc.2010.06.002.

Luckow, P., M.A. Wise, J.J. Dooley. 2013. "Deployment of CCS Technologies across the Load Curve for a Competitive Electricity Market as a Function of CO₂ Emissions Permit Prices." Paper presentation at the 10th International Conference on Greenhouse Gas Control Technologies in Amsterdam, September 19 – 23, 2010.

Luckow, P., A. Bar-Cohen, P. Rodgers, and J. Cevallos. 2010. "Energy Efficient Polymers for Gas-Liquid Heat Exchangers" *Journal of Energy Resources Technology* 132 (2): 021001, doi:10.1115/1.4001568.

Luckow, P., A. Bar-Cohen, and P. Rodgers. 2009. "Minimum Mass Polymer Seawater Heat Exchanger for LNG Applications." *Journal of Thermal Science and Engineering Applications* 1 (3): 031009, doi:10.1115/1.4001239.

Luckow, P., A. Bar-Cohen, P. Rodgers, and J. Cevallos. 2008. "Energy Efficient Polymers for Gas-Liquid Heat Exchangers." Presentation at the ASME 2nd International Conference on Energy Sustainability in Jacksonville, FL, August 10 – 14, 2008.

TESTIMONY

Hawaii Public Utilities Commission (Docket No. 2012-0185): Direct testimony and exhibits regarding the proposed Aina Koa Pono Biofuel Project. On behalf of the State of Hawaii Division of Consumer Advocacy. March 2013.

Resume dated November 2013

Maximilian Chang, Principal Associate

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mchang@synapse-energy.com

PROFESSIONAL EXPERIENCE

Synapse Energy Economics Inc, Cambridge, MA. *Principal Associate*, 2013 – present, *Associate*, 2008 – 2013.

Consults and provides analysis of technologies and policies, electric policy modeling, evaluation of air emissions of electricity generation, and other topics including energy efficiency, consumer advocacy, environmental compliance, and technology strategy within the energy industry. Conducts analysis in utility rate-cases focusing on reliability metrics and infrastructure issues and analyzes the benefits and costs of electric and natural gas energy efficiency measures and programs.

Environmental Health and Engineering, Newton, MA. *Senior Scientist*, 2001 – 2008.

Managed complex EPA-mandated abatement projects involving polychlorinated biphenyls (PCBs) in building-related materials. Provided green building assessment services for new and existing construction projects. Communicated and interpreted environmental data for clients and building occupants. Initiated and implemented web-based health and safety awareness training system used by laboratories and property management companies.

The Penobscot Group, Inc., Boston, MA. *Analyst*, 1994 – 2000.

Authored investment reports on Real Estate Investment Trusts (REITs) for buy-side research boutique. Advised institutional clients on REIT investment strategies and real estate asset exchanges for public equity transactions. Wrote and edited monthly publications of statistical and graphical comparison of coverage universe.

Harvard University Extension School, Cambridge, MA. *Teaching Assistant*, 1995 – 2002.

Teaching Assistant for Environmental Management I and Ocean Environments.

Brigham and Women's Hospital, Boston, MA. *Cancer Laboratory Technician*, 1992 – 1994.

Studied the biological mechanism of tumor eradication in mouse and human models. Organized and performed immunotherapy experiments for experimental cancer therapy. Analyzed and authored results in peer-reviewed scientific journals.

EDUCATION

Harvard University, Cambridge, MA

Master of Science in Environmental Science and Engineering, 2000

Cornell University, Ithaca, NY

Bachelor of Arts in Biology and Classics, 1992

REPORTS

White, D. E., M. Chang, B. Biewald. 2013. *State Energy Efficiency Embedded in Annual Energy Outlook Forecasts: 2013 Update*. Synapse Energy Economics for US Environmental Protection Agency.

Hornby, R., P. Chernick, D. White, J. Rosenkranz, R. Denhardt, E. Stanton, J. Glifford, B. Grace, M. Chang, P. Luckow, T. Vitolo, P. Knight, B. Griffiths, B. Biewald. 2013. *Avoided Energy Supply Costs in New England: 2013 Report*. Synapse Energy Economics for Avoided-Energy-Supply-Component (AESC) Study Group.

Koplow, D., M. Chang. 2013. *Vogtle 3 and 4 Conditional Loan Guarantee: Review of Documents Pertaining to Department of Energy Conditional Loan Guarantees for Vogtle 3 & 4*. Synapse Energy Economics and Earth Track.

Chang, M., D. White, E. Hausman. 2012. *Risks to Ratepayers: An Examination of the Proposed William States Lee III Nuclear Generation Station, and the Implications of "Early Cost Recovery" Legislation*. Synapse Energy Economics for Consumers Against Rate Hikes.

Fagan, R., M. Chang, P. Knight, M. Schultz, T. Comings, E. Hausman, R. Wilson. 2012. *The Potential Rate Effects of Wind Energy and Transmission in the Midwest ISO Region*. Synapse Energy Economics for Energy Future Coalition.

Chang, M., D. White, P. Knight, B. Biewald. 2012. *Energy Benefits Resulting from the Investment of 2010 RGGI Auction Revenues in Energy Efficiency*. Synapse Energy Economics for Regulatory Assistance Project.

Chang, M., D. White, E. Hausman, N. Hughes, B. Biewald. 2011. *Big Risks, Better Alternatives: An Examination of Two Nuclear Energy Projects in the US*. Synapse Energy Economics for Union of Concerned Scientists.

Hornby, R., P. Chernick, C. Swanson, D. White, J. Gifford, M. Chang, N. Hughes, M. Wittenstein, R. Wilson, B. Biewald. 2011. *Avoided Energy Supply Costs in New England: 2011 Report*. Synapse Energy Economics for Avoided-Energy-Supply-Component (AESC) Study Group.

Chang, M., D. White, L. Johnston, B. Biewald. 2010. *Electricity Energy Efficiency Benefits of RGGI Proceeds: An Initial Analysis*. Synapse Energy Economics for Regulatory Assistance Project.

Fisher, J., J. Levy, P. Kirshen, R. Wilson, M. Chang, J. Kallay, C. James. 2010. *Co-Benefits of Energy Efficiency and Renewable Energy in Utah*. Synapse Energy Economics for the State of Utah Energy Office.

Napoleon, A., W. Steinhurst, M. Chang, K. Takahashi, R. Fagan. 2010. *Assessing the Multiple Benefits of Clean Energy: A Resource for States*. Synapse Energy Economics for US Environmental Protection Agency.

Hornby, R., P. Chernick, C. Swanson, D. White, I. Goodman, B. Grace, B. Biewald, C. James, B. Warfield, J. Gifford, M. Chang. 2009. *Avoided Energy Supply Costs in New England: 2009 Report*. Synapse Energy Economics for Avoided-Energy-Supply-Component (AESC) Study Group.

Biewald, B., D. White, J. Fisher, M. Chang, L. Johnston. 2009. Incorporating Carbon Dioxide Emissions Reductions in Benefit Calculations for Energy Efficiency: Comments on the Department of Energy's Methodology for Analysis of the Proposed Lighting Standard. Synapse Energy Economics for New York State Attorney General.

ABSTRACTS

Koehler, D., M. Chang. 1999 "Search and Disclosure: Corporate Environmental Reports." *Environment* 41 (2): 3.

Makoto, N., P. S. Goedegebuure, U. L. Burger, M. Chang, T. J. Eberlein. 1995. "Successful adoptive immunotherapy (AIT) is dependent on the infiltration of host CD8+ and CD4+ T cells into tumor." *Surgical Forum* 66:528–531.

Burger, U.L., M. Chang, P. S. Goedegebuure, T. J. Eberlein. 1994. "Changes in host T-cell concentrations but not in donor TIL concentrations at the tumor site following adoptive immunotherapy." *Surgical Forum* 45 (0): 513–515.

Burger, U.L., M. Chang, S. L. Adams, D. D. Schoof, T. J. Eberlein. 1993. "The role of CD4+ and CD8+ T-cells during TIL+ rIL-2 treatment in cancer immunotherapy." *Surgical Forum* 64:467–469.

Zuber, M., D. L. Leonard-Vidal, A. L. Rubinstein, A. F. Massaro, M. Chang, D. D. Schoof, T. J. Eberlein. 1990. "In vivo efficacy of murine tumor-infiltrating lymphocytes (TIL) reactivated by anti-CD3." *Journal of Cancer Research and Clinical Oncology* 116; A3.112.28.

Eberlein, T.J., A. F. Massaro, S. Jung, A. L. Rubinstein, U. L. Burger, M. Chang, D. D. Schoof. 1989. "Cyclophosphamide (Cy) immunosuppression potentiates tumor-infiltrating lymphocytes (TIL) therapy in the mouse." Proceedings Annual Meeting: American Association Cancer Research. A30.A1472.

TESTIMONY

State of Maine Public Utilities Commission (Docket 2012-00449): Testimony regarding the Request for Approval of Review of Second Triennial Plan Pertaining to Efficiency Maine Trust. On behalf of the Maine Efficiency Trust. January 8, 2013.

Resume dated April 2014

Robert M. Fagan, Principal Associate

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rfagan@synapse-energy.com

SUMMARY

Mechanical engineer and energy economics analyst with over 25 years of experience in the energy industry. Activities focused primarily on electric power industry issues, especially economic and technical analysis of transmission, wholesale electricity markets, renewable resource alternatives and assessment and implementation of demand-side alternatives.

In-depth understanding of the complexities of, and the interrelationships between, the technical and economic dimensions of the electric power industry in the US and Canada, including the following areas of expertise:

- Wholesale energy and capacity provision under market-based and regulated structures; the extent of competitiveness of such structures.
- Potential for and operational effects of wind and solar power integration into utility systems; modeling of such effects.
- Transmission use pricing, encompassing congestion management, losses, LMP and alternatives, financial and physical transmission rights; and transmission asset pricing (embedded cost recovery tariffs).
- Physical transmission network characteristics; related generation dispatch/system operation functions; and technical and economic attributes of generation resources.
- RTO and ISO tariff and market rules structures and operation.
- FERC regulatory policies and initiatives, including those pertaining to RTO and ISO development and evolution.
- Demand-side management, including program implementation and evaluation; and load response presence in wholesale markets.
- Building energy end-use characteristics, and energy-efficient technology options.
- Fundamentals of electric distribution systems and substation layout and operation.
- Energy modeling (spreadsheet-based tools, industry standard tools for production cost and resource expansion, building energy analysis, understanding of power flow simulation fundamentals).
- State and provincial level regulatory policies and practices, including retail service and standard offer pricing structures.

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- Gas industry fundamentals including regulatory and market structures, and physical infrastructure.

PROFESSIONAL EXPERIENCE

Synapse Energy Economics, Inc., Cambridge, MA. *Principal Associate*, 2004 – Present.

Responsibilities include consulting on issues of energy economics, analysis of electricity utility planning, operation, and regulation, including issues of transmission, generation, and demand-side management. Provide expert witness testimony on various wholesale and retail electricity industry issues. Specific project experience includes the following:

- Analysis of PJM and MISO wind integration and related transmission planning and resource adequacy issues.
- Analysis of California renewable energy integration issues, local and system capacity requirements, and related long-term procurement policies.
- Analysis of Nova Scotia resource policies including effects of potential new hydroelectric supplies from Newfoundland; analysis of new transmission supplies of Maritimes area energy into the New England region.
- Analysis of Eastern Interconnection Planning Collaborative processes, including modeling structure and inputs assumptions for demand, supply and transmission resources. Expanded analyses of the results of the EIPC Phase II Report on transmission and resource expansion.
- Analysis of need for transmission facilities in Maine, Ontario, Pennsylvania, Virginia, Minnesota.
- Ongoing analysis of wholesale and retail energy and capacity market issues in New Jersey, including assessment of BGS supply alternatives and demand response options.
- Analysis of PJM transmission-related issues, including cost allocation, need for new facilities and PJM's economic modeling of new transmission effects on PJM energy market.
- Ongoing analysis of utility-sponsored energy efficiency programs in Rhode Island as part of the Rhode Island DSM Collaborative; and ongoing analysis of the energy efficiency programs of New Jersey Clean Energy Program (CEP) and various utility-sponsored efficiency programs (RGGI programs).
- Analysis of California renewable integration issues for achieving 33% renewable energy penetration by 2020, especially modeling constructs and input assumptions.
- Analysis of proposals in Maine for utility companies to withdraw from the ISO-NE RTO.
- Analysis of utility planning and demand-side management issues in Delaware.

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- Analysis of effect of increasing the system benefits charge (SBC) in Maine to increase procurement of energy efficiency and DSM resources; analysis of impact of DSM on transmission and distribution reinforcement need.
 - Evaluation of wind energy potential and economics, related transmission issues, and resource planning in Minnesota, Iowa, Indiana, and Missouri; in particular in relation to alternatives to newly proposed coal-fired power plants in MN, IA and IN.
 - Analysis of need for newly proposed transmission in Pennsylvania and Ontario.
 - Evaluation of wind energy “firming” premium in BC Hydro Energy Call in British Columbia.
 - Evaluation of pollutant emission reduction plans and the introduction of an open access transmission tariff in Nova Scotia.
 - Evaluation of the merger of Duke and Cinergy with respect to Indiana ratepayer impacts.
 - Review of the termination of a Joint Generation Dispatch Agreement between sister companies of Cinergy.
 - Assessment of the potential for an interstate transfer of a DSM resource between the desert southwest and California, and the transmission system impacts associated with the resource.
 - Analysis of various transmission system and market power issues associated with the proposed Exelon-PSEG merger.
 - Assessment of market power and transmission issues associated with the proposed use of an auction mechanism to supply standard offer power to ComEd native load customers.
 - Review and analysis of the impacts of a proposed second 345 kV tie to New Brunswick from Maine on northern Maine customers.

Tabors Caramanis & Associates, Cambridge, MA. *Senior Associate*, 1996 – 2004.

- Provided expert witness testimony on transmission issues in Ontario and Alberta.
- Supported FERC-filed testimony of Dr. Tabors in numerous dockets, addressing various electric transmission and wholesale market issues.
- Analyzed transmission pricing and access policies, and electric industry restructuring proposals in US and Canadian jurisdictions including Ontario, Alberta, PJM, New York, New England, California, ERCOT, and the Midwest. Evaluated and offered alternatives for congestion management methods and wholesale electric market design.
- Attended RTO/ISO meetings, and monitored and reported on continuing developments in the New England and PJM electricity markets. Consulted on New England FTR auction and ARR allocation schemes.

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- Evaluated all facets of Ontario and Alberta wholesale market development and evolution since 1997. Offered congestion management, transmission, cross-border interchange, and energy and capacity market design options. Directly participated in the Ontario Market Design Committee process. Served on the Ontario Wholesale Market Design technical panel.
 - Member of TCA GE MAPS modeling team in LMP price forecasting projects.
 - Assessed different aspects of the broad competitive market development themes presented in the US FERC's SMD NOPR and the application of FERC's Order 2000 on RTO development.
 - Reviewed utility merger savings benchmarks, evaluated status of utility generation market power, and provided technical support underlying the analysis of competitive wholesale electricity markets in major US regions.
 - Conducted life-cycle utility cost analyses for proposed new and renovated residential housing at US military bases. Compared life-cycle utility cost options for large educational and medical campuses.
 - Evaluated innovative DSM competitive procurement program utilizing performance-based contracting.

Charles River Associates, Boston, MA. *Associate*, 1992 – 1996.

Developed DSM competitive procurement RFPs and evaluation plans, and performed DSM process and impact evaluations. Conducted quantitative studies examining electric utility mergers; and examined generation capacity concentration and transmission interconnections throughout the US. Analyzed natural gas and petroleum industry economic issues; and provided regulatory testimony support to CRA staff in proceedings before the US FERC and various state utility regulatory commissions.

Rhode Islanders Saving Energy, Providence, RI. *Senior Commercial/Industrial Energy Specialist*, 1987 – 1992.

Performed site visits, analyzed end-use energy consumption and calculated energy-efficiency improvement potential in approximately 1,000 commercial, industrial, and institutional buildings throughout Rhode Island, including assessment of lighting, HVAC, hot water, building shell, refrigeration and industrial process systems. Recommended and assisted in implementation of energy efficiency measures, and coordinated customer participation in utility DSM program efforts.

Fairchild Weston Systems, Inc., Syosset, NY. *Facilities Engineer*, 1985 – 1986.

Designed space renovations; managed capital improvement projects; and supervised contractors in implementation of facility upgrades.

Narragansett Electric Company, Providence RI. *Supervisor of Operations and Maintenance*, 1981 – 1984.

Directed electricians in operation, maintenance, and repair of high-voltage transmission and distribution substation equipment.

EDUCATION

Boston University, Boston, MA

Master of Arts in Energy and Environmental Studies – Resource Economics, Ecological Economics, Econometric Modeling, 1992

Clarkson University, Potsdam, NY

Bachelor of Science in Mechanical Engineering – Thermal Sciences, 1981

ADDITIONAL EDUCATION

- **Utility Wind Integration Group**: Short Course on Integration and Interconnection of Wind Power Plants into Electric Power Systems, 2006
- **University of Texas at Austin**: Short course in Regulatory and Legal Aspects of Electric Power Systems, 1998
- **Illuminating Engineering Society**: courses in lighting design, 1989
- **Worcester Polytechnic Institute and Northeastern University**: Coursework in Solar Engineering; Building System Controls; and Cogeneration, 1984, 1988 – 1989
- **Polytechnic Institute of New York**: Graduate coursework in Mechanical and Aerospace Engineering, 1985 – 1986

REPORTS AND PAPERS

Fagan, R., J. Fisher, B. Biewald. 2013. *An Expanded Analysis of the Costs and Benefits of Base Case and Carbon Reduction Scenarios in the EIPC Process*. Synapse Energy Economics for the Sustainable FERC Project.

Fagan, R., P. Luckow, D. White, R. Wilson. 2013. *The Net Benefits of Increased Wind Power in PJM*. Synapse Energy Economics for the Energy Future Coalition.

Hornby, R., R. Fagan, D. White, J. Rosenkranz, P. Knight, R. Wilson. 2012. *Potential Impacts of Replacing Retiring Coal Capacity in the Midwest Independent System Operator (MISO) Region with Natural Gas or Wind Capacity*. Synapse Energy Economics for the National Association of Regulatory Utility Commissioners.

Fagan, R., M. Chang, P. Knight, M. Schultz, T. Comings, E. Hausman, R. Wilson. 2012. *The Potential Rate Effects of Wind Energy and Transmission in the Midwest ISO Region*. Synapse Energy Economics for the Energy Future Coalition.

Woolf, T., M. Wittenstein, R. Fagan. 2011. *Indian Point Energy Center Nuclear Plant Retirement Analysis*. Synapse Energy Economics for the Natural Resources Defense Council (NRDC) and Riverkeeper.

Napoleon, A., W. Steinhurst, M. Chang, K. Takahashi, R. Fagan. 2010. *Assessing the Multiple Benefits of Clean Energy: A Resource for States*. US Environmental Protection Agency with research and editorial

support from Stratus Consulting, Synapse Energy Economics, Summit Blue, Energy and Environmental Economics, Inc., Demand Research LLC, Abt Associates, Inc., and ICF International.

Peterson, P., E. Hausman, R. Fagan, V. Sabodash. 2009. *Synapse Report and Ohio Comments in Case No. 09-09-EL-COI, "The Value of Continued Participation in RTOs."* Synapse Energy Economics for Ohio Consumers' Counsel.

Hornby, R., J. Loiter, P. Mosenthal, T. Franks, R. Fagan and D. White. 2008. *Review of AmerenUE February 2008 Integrated Resource Plan.* Synapse Energy Economics for the Missouri Department of Natural Resources.

Hausman, E., R. Fagan, D. White, K. Takahashi, A. Napoleon. 2007. *LMP Electricity Markets: Market Operations, Market Power, and Value for Consumer.* Synapse Energy Economics for the American Public Power Association.

Fagan, R., T. Woolf, W. Steinhurst, B. Biewald. 2006. "Interstate Transfer of a DSM Resource: New Mexico DSM as an Alternative to Power from Mohave Generating Station." Proceedings and presentation at 2006 American Council for Energy Efficient Economy (ACEEE) Summer Study on Energy Efficiency in Buildings Conference, August 2006.

Fagan, R., R. Tabors, A. Zobian, N. Rao, R. Hornby. 1999. *Tariff Structure for an Independent Transmission Company.* Tabors Caramanis & Associates Working Paper 101-1099-0241.

Fagan, R. 1996. *The Market for Power in New England: The Competitive Implications of Restructuring.* Tabors Caramanis & Associates and Charles River Associates for the Office of the Attorney General, Commonwealth of Massachusetts.

Fagan, R., D. Gokhale, D. Levy, P. Spinney, G. Watkins. 1995. "Estimating DSM Impacts for Large Commercial and Industrial Electricity Users." Proceedings and presentation at The Seventh International Energy Program Evaluation Conference in Chicago, IL, August 1995.

Fagan, R., P. Spinney. 1995. *Demand-side Management Information Systems (DSMIS) Overview.* Charles River Associates for Electric Power Research Institute. Technical Report TR-104707.

Fagan, R., P. Spinney. 1994. *Northeast Utilities Energy Conscious Construction Program (Comprehensive Area): Level I and Level II Impact Evaluation Reports.* Charles River Associates, Energy Investments (Abbe Bjorklund) for Northeast Utilities.

PRESENTATIONS

Fagan, R., R. Tabors. 2003. "SMD and RTO West: Where are the Benefits for Alberta?" Keynote paper prepared for the 9th Annual Conference of the Independent Power Producers Society of Alberta, March 2003.

Fagan, R. 1999. "A Progressive Transmission Tariff Regime: The Impact of Net Billing". Presentation at the Independent Power Producer Society of Ontario Annual Conference, November 1999.

Fagan, R. 1999. "Transmission Congestion Pricing Within and Around Ontario." Presentation at the Canadian Transmission Restructuring Infocast Conference in Toronto, June 1999.

Fagan, R. 1998. "The Restructured Ontario Electricity Generation Market and Stranded Costs." Presentation to the Ontario Ministry of Energy and Environment on behalf of Enron Capital and Trade Resources Canada Corp., February 1998.

Fagan, R. 1998. "Alberta Legislated Hedges Briefing Note." Presentation to the Alberta Department of Energy on behalf of Enron Capital and Trade Resources Canada, January 1998.

Fagan, R. 1997. "Generation Market Power in New England: Overall and on the Margin." Presentation at Infocast Conference: New Developments in Northeast and Mid-Atlantic Wholesale Power Markets in Boston, MA, June 1997.

Spinney, P., J. Pelozo, R. Fagan presented. 1993. "The Role of Trade Allies in C&I DSM Programs: A New Focus for Program Evaluation." Charles River Associates and Wisconsin Electric Power Corp presentation at the Sixth International Energy Evaluation Conference in Chicago, IL, August 1993.

TESTIMONY

California Public Utilities Commission (Docket No. RM.12-03-014): Reply and rebuttal testimony on the topic of local reliability impacts of a potential long-term outage at the San Onofre Nuclear Power Station (SONGS) in Track 4 of the Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans. On behalf of the California Office of Ratepayer Advocate. September 30, 2013 and October 14, 2013.

Nova Scotia Utility and Review Board (Matter No. M05419): Direct examination regarding the report *Economic Analysis of Maritime Link and Alternatives: Complying with Nova Scotia's Greenhouse Gas Regulations, Renewable Energy Standard, and Other Regulations in a Least-Cost Manner for Nova Scotia Power Ratepayers* jointly authored with Rachel Wilson, Nehal Divekar, David White, Kenji. Takahashi, and Tommy Vitolo. In the Matter of The Maritime Link Act and In the Matter of An Application by NSP MARITIME LINK INCORPORATED for the approval of the Maritime Link Project. On behalf of Board Counsel to the Nova Scotia Utility and Review Board. June 5, 2013.

Prince Edward Island Regulatory and Appeals Commission (Docket UE30402): Jointly filed expert report with Nehal Divekar analyzing the Proposed Ottawa Street – Bedeque 138 kV Transmission Line Project in the matter of Summerside Electric's Application for the Approval of Transmission Services connecting Summerside Electric's Ottawa Street substation to Maritime Electric Company Limited's Bedeque substation. On behalf of the City of Summerside. November 5, 2012.

California Public Utilities Commission (Docket No. RM.12-03-014): Direct and reply testimony regarding the long-term local capacity procurement requirements for the three California investor-owned utilities in Track 1 of the Order Instituting Rulemaking to Integrate and Refine Procurement Policies and

Consider Long-Term Procurement Plans. On behalf of the California Office of Ratepayer Advocate. June 25, 2012 and July 23, 2012.

California Public Utilities Commission (Docket No. A.11-05-023): Supplemental testimony regarding the long-term resource adequacy and resource procurement requirements for the San Diego region in the Application of San Diego Gas & Electric Company (U 902 3) for Authority to Enter into Purchase Power Tolling Agreements with Escondido Energy Center, Pio Pico Energy Center, and Quail Brush Power. On behalf of the California Office of Ratepayer Advocate. May 18, 2012.

New Jersey Board of Public Utilities (Docket No. GO11070399): Direct testimony in the matter of the petition of Pivotal Utility Holdings, Inc. D/B/A Elizabethtown Gas for authority to extend the term of energy efficiency programs with certain modifications and approval of associated cost recovery. On behalf of New Jersey Division of Rate Counsel. December 16, 2011.

New Jersey Board of Public Utilities (Docket No. EO11050309): Direct testimony regarding aspects of the Board's inquiry into capacity and transmission interconnection issues. October 14, 2011.

New Jersey Board of Public Utilities (Docket Nos. GR10100761 and ER10100762): Certification before the Board regarding system benefits charge (SBC) rates associated with gas generation in the matter of a generic stakeholder proceeding to consider prospective standards for gas distribution utility rate discounts and associated contract terms. On behalf of New Jersey Division of Rate Counsel. January 28, 2011.

New Jersey Board of Public Utilities (Docket No. ER10040287): Direct testimony regarding Basic Generation Service (BGS) procurement plan for service beginning June 1, 2011. On behalf of New Jersey Division of Rate Advocate. September 2010.

State of Maine Public Utilities Commission (Docket 2008-255): Direct and surrebuttal testimony regarding the non-transmission alternatives analysis conducted on behalf of Central Maine Power in the Application of Central Maine Power Company and Public Service of New Hampshire for a Certificate of Public Convenience and Necessity for the Maine Power Reliability Program Consisting of the Construction of Approximately 350 Miles of 345 and 115 kV Transmission Lines, a \$1.55 billion transmission enhancement project. On behalf of the Maine Office of the Public Advocate. January 12, 2009 and February 2, 2010.

Virginia State Corporation Commission (CASE NO. PUE-2009-00043): Direct testimony regarding the need for modeling DSM resources as part of the PJM RTEP planning processes in the Application of Potomac-Appalachian Transmission Highline (PATH) Allegheny Transmission Corporation for CPCN to construct facilities: 765 kV proposed transmission line through Loudoun, Frederick, and Clarke Counties. On behalf of Sierra Club. October 23, 2009.

Pennsylvania Public Utility Commission (Docket number A-2009-2082652): Direct and surrebuttal testimony regarding the need for additional modeling for the proposed Susquehanna-Roseland 500 kv transmission line in portions of Luckawanna, Luzerne, Monroe, Pike, and Wayne counties to include load

forecasts, energy efficiency resources, and demand response resources. On behalf of the Pennsylvania Office of Consumer Advocate. June 30, 2009 and August 24, 2009.

Delaware Public Service Commission (Docket No. 07-20): Filed the expert report *Review of Delmarva Power & Light Company's Integrated Resource Plan* jointly authored with Alice Napoleon, William Steinhurst, David White, and Kenji Takahashi In the Matter of Integrated Resource Planning for the Provision of Standard Offer Service by Delmarva Power & Light Company Under 26 DEL. C. §1007 (c) & (d). On behalf of the Staff of Delaware Public Service Commission. April 2, 2009.

New Jersey Board of Public Utilities (Docket No. ER08050310): Direct testimony filed jointly with Bruce Biewald on aspects of the Basic Generation Service (BGS) procurement plan for service beginning June 1, 2009. On behalf of the New Jersey Division of the Ratepayer Advocate. September 29, 2008.

Wisconsin Public Service Commission (Docket 6680-CE-170): Direct and surrebuttal testimony in the matter of the alternative energy options available with wind power, and the effect of the MISO RTO in helping provide capacity and energy to the Wisconsin area reliably without needed the proposed coal plant in the CPCN application by Wisconsin Power and Light for construction of a 300 MW coal plant. On behalf of Clean Wisconsin. August 11, 2008 and September 15, 2008.

Ontario Energy Board (Docket EB-2007-0707): Direct testimony regarding issues associated with the planned levels of procurement of demand response, combined heat and power, and NUG resources as part of Ontario Power Authority's long-term integrated planning process in the Examination and Critique of Demand Response and Combined Heat and Power Aspects of the Ontario Power Authority's Integrated Power System Plan and Procurement Process. On behalf of Pollution Probe. August 1, 2008.

Ontario Energy Board (Docket EB-2007-0050): Direct and supplemental testimony filed jointly with Peter Lanzalotta regarding issues of congestion (locked-in energy) modeling, need, and series compensation and generation rejection alternatives to the proposed line of in the matter of Hydro One Networks Inc.'s application to construct a new 500 kV transmission line between the Bruce Power complex and the town of Milton, Ontario. On behalf of Pollution Probe. April 18, 2008 and May 15, 2008.

Federal Energy Regulatory Commission (Dockets ER06-456, ER06-954, ER06-1271, ER07-424, EL07-57, ER06-880, et al.): Direct and rebuttal testimony addressing merchant transmission cost allocation issues on PJM Regional Transmission Expansion Plan (RTEP) Cost Allocation issues. On behalf of the New Jersey Division of the Ratepayer Advocate. January 23, 2008 and April 16, 2008.

State of Maine Public Utilities Commission (Docket No. 2006-487): Pre-file and surrebuttal testimony on the ability of DSM and distributed generation potential to reduce local supply area reinforcement needs in the matter of the Analysis of Central Maine Power Company Petition for a Certificate of Public Convenience and Necessity to Build a 115 kV Transmission Line between Saco and Old Orchard Beach. On behalf of Maine Office of the Public Advocate. February 27, 2007 and January 10, 2008.

Minnesota Public Utilities Commission (OAH No. 12-2500-17037-2 and OAH No. 12-2500-17038-2; and MPUC Dkt. Nos. CN-05-619 and TR-05-1275): Supplemental testimony and supplemental rebuttal testimony on applicants' estimates of DSM savings in the Certificate of Need proceeding for the Big Stone II coal-fired power plant proposal In the Matter of the Application by Otter Tail Power Company and Others for Certification of Transmission Facilities in Western Minnesota and In the Matter of the Application to the Minnesota Public Utilities Commission for a Route Permit for the Big Stone Transmission Project in Western Minnesota. On behalf of Fresh Energy, Izaak Walton League of America – Midwest Office, Wind on the Wires, Union of Concerned Scientists, Minnesota Center for Environmental Advocacy. December 8, 2006 and December 21, 2007.

Pennsylvania Public Utility Commission (Docket Nos. A-110172 *et al.*): Direct testimony on the effect of demand-side management on the need for a transmission line and the level of consideration of potential carbon regulation on PJM's analysis of need for the TrAIL transmission line. On behalf of . October 31, 2007.

Iowa Public Utilities Board (Docket No. GCU-07-01): Direct testimony regarding wind energy assessment in Interstate Power and Light's resource plans and its relationship to a proposed coal plant in Iowa. On behalf of Iowa Office of the Consumer Advocate. October 21, 2007.

New Jersey Board of Public Utilities (Docket No. EO07040278): Direct testimony on certain aspects of PSE&G's proposal to use ratepayer funding to finance a solar photovoltaic panel initiative in support of the State's solar RPS. September 21, 2007.

Indiana Utility Regulatory Commission (Cause No. 43114): Direct testimony on the topic of a proposed Duke – Vectren IGCC coal plant and wind power potential in Indiana. On behalf of Citizens Action Coalition of Indiana. May 14, 2007.

British Columbia Utilities Commission: Pre-filed evidence regarding the "firming premium" associated with 2006 Call energy, liquidated damages provisions, and wind integration studies In the Matter of BC Hydro 2006 Integrated Electricity Plan and Long Term Acquisition Plan. On behalf of the Sierra Club (BC Chapter), Sustainable Energy Association of BC, and Peace Valley Environment Association. October 10, 2006.

Maine Joint Legislative Committee on Utilities, Energy and Transportation (LD 1931): Testimony regarding the costs and benefits of increasing the system benefits charge to increase the level of energy efficiency installations by Efficiency Maine before in support of an Act to Encourage Energy Efficiency. On behalf of the Maine Natural Resources Council and Environmental Defense. February 9, 2006.

Nova Scotia Utility and Review Board: Direct testimony and supplemental evidence regarding the approval of the installation of a flue gas desulphurization system at Nova Scotia Power Inc.'s Lingan station and a review of alternatives to comply with provincial emission regulations In The Matter of an Application by Nova Scotia Power Inc. for Approval of Air Emissions Strategy Capital Projects and The

Public Utilities Act, R.S.N.S., 1989, c. 380, as amended. On behalf of Nova Scotia Utility and Review Board Staff. January 30, 2006.

New Jersey Board of Public Utilities (BPU Docket EM05020106): Joint direct and surrebuttal testimony with Bruce Biewald and David Schlissel regarding the Joint Petition Of Public Service Electric and Gas Company And Exelon Corporation For Approval of a Change in Control Of Public Service Electric and Gas Company And Related Authorizations. On behalf of New Jersey Division of the Ratepayer Advocate. November 14, 2005 and December 27, 2005.

Indiana Utility Regulatory Commission (Cause No. 42873): Direct testimony addressing the proposed Duke – Cinergy merger. On behalf of Citizens Action Coalition of Indiana. November 8, 2005.

Indiana Utility Regulatory Commission (Causes No. 38707 FAC 61S1, 41954, and 42359-S1): Responsive testimony addressing a proposed Settlement Agreement between PSI and other parties in respect of issues surrounding the Joint Generation Dispatch Agreement in place between PSI and CG&E. On behalf of Citizens Action Coalition of Indiana. August 31, 2005.

Illinois Commerce Commission (Dockets 05-0160, 05-0161, 05-0162): Direct and rebuttal testimony addressing wholesale market aspects of Ameren’s proposed competitive procurement auction (CPA). On behalf of Illinois Citizens Utility Board. June 15, 2005 and August 10, 2005.

Illinois Commerce Commission (Docket 05-0159): Direct and rebuttal testimony addressing wholesale market aspects of Commonwealth Edison’s proposed BUS (Basic Utility Service) competitive auction procurement. On behalf of Illinois Citizens Utility Board and Cook County State’s Attorney’s Office. June 8, 2005 and August 3, 2005.

State of Maine Public Utilities Commission (Docket No. 2005-17): Joint testimony with David Schlissel and Peter Lanzalotta regarding an Analysis of Eastern Maine Electric Cooperative, Inc.’s Petition for a Finding of Public Convenience and Necessity to Purchase 15 MW of Transmission Capacity from New Brunswick Power and for Related Approvals. On behalf of Maine Office of the Public Advocate. July 19, 2005.

Indiana Utility Regulatory Commission (Cause No. 38707 FAC 61S1): Direct testimony in a Fuel Adjustment Clause (FAC) proceeding concerning the pricing aspects and merits of continuation of the Joint Generation Dispatch Agreement in place between PSI and CG&E, and related issues of PSI lost revenues from inter-company energy pricing policies. On behalf of Citizens Action Coalition of Indiana. May 23, 2005.

Indiana Utility Regulatory Commission (Cause No. 41954): Direct testimony concerning the pricing aspects and merits of continuation of the Joint Generation Dispatch Agreement in place between PSI and CG&E. On behalf of Citizens Action Coalition of Indiana. April 21, 2005.

State of Maine Public Utilities Commission (Docket No. 2004-538): Joint testimony with David Schlissel and Peter Lanzalotta regarding an Analysis of Maine Public Service Company Request for a Certificate of

Public Convenience and Necessity to Purchase 35 MW of Transmission Capacity from New Brunswick Power. On behalf of Maine Office of the Public Advocate. April 14, 2005.

Nova Scotia Utility and Review Board (Order 888 OATT): Testimony regarding various aspects of OATTs and FERC's *pro forma* In The Matter of an Application by Nova Scotia Power Inc. for Approval of an Open Access Transmission Tariff (OATT). On behalf of the Nova Scotia Utility Review Board Staff. April 5, 2005.

Texas Public Utilities Commission (Docket No. 30485): Testimony regarding excess mitigation credits associated with CenterPoint's stranded cost recovery in the Application of CenterPoint Energy Houston Electric, LLC. for a Financing Order. On behalf of the Gulf Coast Coalition of Cities. January 7, 2005.

Ontario Energy Board (RP-2002-0120): Filed testimony and reply comments reviewing the Transmission System Code (TSC) and Related Matters, Detailed Submission to the Ontario Energy Board in Response To Phase I Questions Concerning the Transmission System Code and Related Matters. On behalf of TransAlta Corporation. October 31, 2002 and November 21, 2002.

Alberta Energy and Utilities Board (Application No. 2000135): Filed joint testimony with Dr. Richard D. Tabors in the matter of the Transmission Administrator's 2001 Phase I and Phase II General Rate Application pertaining to Supply Transmission Service charge proposals. On behalf of Alberta Buyers Coalition. March 28, 2001.

Ontario Energy Board (RP-1999-0044): Testimony critiquing Ontario Hydro Networks Company's Transmission Tariff Proposal and Proposal for Alternative Rate Design. On behalf of the Independent Power Producer's Society of Ontario. January 17, 2000.

Massachusetts Department of Public Utilities (Docket # DPU 95-2/3-CC-I): Filed a report (Fagan R., G. Watkins. 1995. *Sampling Issues in Estimating DSM Savings: An Issue Paper for Commonwealth Electric*. Charles River Associates). On behalf of COM/Electric System. April 1995.

Massachusetts Department of Public Utilities (Docket # DPU 95-2/3-CC-I): Filed initial and updated reports (Fagan R., P. Spinney, G. Watkins. 1994. *Impact Evaluation of Commonwealth Electric's Customized Rebate Program*. Charles River Associates. Updated April 1996). April 1994 and April 1995.

Resume dated April 2014

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PROFESSIONAL EXPERIENCE

Synapse Energy Economics Inc., Cambridge, MA. *Associate*, 2011 – present.

Performs consulting, conducts research, and assists in writing testimony and reports on a wide range of issues relating to electric utilities, energy efficiency, electricity transmission and generation, consumer advocacy, environmental policy and compliance, and air emissions.

Jointown Group Co., Ltd., Wuhan, China. *System Engineer Intern*, Summer 2007.

Developed and implemented a modified (s,S) inventory management scheme for over 20,000 warehoused pharmaceutical products, resulting in more orders filled, lower carrying costs, and a reduction in the frequency of product expiration.

MIT Lincoln Laboratory, Division 6, Group 65, Lexington, MA. *Research Assistant*, 2003 – 2006.

Designed algorithm and implemented software to create autonomous wireless point-to-point topologies for aerial, land-based, and nautical vehicles as part of an Optical & RF Combined Link Experiment (ORCLE) funded by Defense Advanced Research Projects Agency (DARPA).

EDUCATION

Boston University, Boston, MA

Doctor of Philosophy in System Engineering, 2011. Developed algorithms to discover degree constrained minimum spanning trees in sparsely connected graphs.

Dublin City University, Dublin, Ireland

Master of Science in Financial and Industrial Mathematics, 2001. Researched partial differential equations modeling fluid flow over an erodible bed.

North Carolina State University, Raleigh, North Carolina

Bachelor of Science in Applied Mathematics, 2000. *Summa Cum Laude*.

Bachelor of Science in Computer Science, 1999. *Summa Cum Laude*.

Bachelor of Science in Economics, 1998. *Summa Cum Laude*.

ADDITIONAL EXPERIENCE

TEACHING

- Graduate Teaching Fellow, Boston University College of Engineering. *Introduction to Engineering Computation*, 2009
- Guest Lecturer, Boston University Department of Systems Engineering, *Case Studies in Inventory Management*, 2007-2008
- Guest Lecturer, Boston University Department of Systems Engineering, Solving Linear Programs with CPLEX, 2003-2008

GOVERNMENT SERVICE

- *Constable*, Brookline, MA, 2010 – present
- *Town Meeting Member*, Brookline, MA, 2007 – present
- *Bicycle Advisory Committee Member*, Brookline, MA, 2007 – present.

OTHER INFORMATION

FELLOWSHIPS AND SCHOLARSHIPS

- National Science Foundation IGERT Fellowship, 2006 – 2008
- National Science Foundation GK-12 Fellowship, 2002 – 2003
- Mitchell Scholarship, 2000 – 2001
- Park Scholarship, 1996 – 2000

ADDITIONAL SKILLS

- Computer Applications: Microsoft Office, LaTeX
- Programming: Fortran, C, C++, perl, MATLAB, CPLEX

AFFILIATIONS

- Center for Computation Science, Boston University, 2006 – 2010
- Center for Information and Systems Engineering, Boston University, 2002 – 2010

PUBLICATIONS

Vitolo, T., J. Daniel. 2013. *Improving the Analysis of the Martin Drake Power Plant: How HDR's Study of Alternatives Related to Martin Drake's Future Can Be Improved*. Synapse Energy Economics for Sierra Club.

Vitolo, T., P. Luckow, J. Daniel. 2013. *Comments Regarding the Missouri 2013 IRP Updates of KCP&L and GMO*. Synapse Energy Economics for Earthjustice.

Hornby, R., P. Chernick, D. White, J. Rosenkranz, R. Denhardt, E. A. Stanton, J. Gifford, B. Grace, M. Chang, P. Luckow, T. Vitolo, P. Knight, B. Griffiths, B. Biewald. 2013. *Avoided Energy Supply Costs in New England: 2013 Report*. Synapse Energy Economics for the Avoided-Energy-Supply-Component (AESC) Study Group.

Stanton, E. A., T. Comings, K. Takahashi, P. Knight, T. Vitolo, E. Hausman. 2013. *Economic Impacts of the NRDC Carbon Standard*. Synapse Energy Economics for the Natural Resources Defense Council (NRDC).

Vitolo, T., G. Keith, B. Biewald, T. Comings, E. Hausman, P. Knight. 2013. *Meeting Load with a Resource Mix Beyond Business as Usual: A regional examination of the hourly system operations and reliability implications for the United States electric power system with coal phased out and high penetrations of efficiency and renewable generating resources*. Synapse Energy Economics for Civil Society Institute.

Stanton, E. A., F. Ackerman, T. Comings, P. Knight, T. Vitolo, E. Hausman. 2013. *Will LNG Exports Benefit the United States Economy?* Synapse Energy Economics for Sierra Club.

Ackerman, F., T. Vitolo, E. A. Stanton, G. Keith. 2013. *Not-so-smart ALEC: Inside the attacks on renewable energy*. Synapse Energy Economics for Civil Society Institute.

Woolf, T., M. Whited, T. Vitolo, K. Takahashi, D. White. 2012. *Indian Point Replacement Analysis: A Clean Energy Roadmap: A Proposal for Replacing the Nuclear Plant with Clean, Sustainable Energy Resources*. Synapse Energy Economics for Natural Resources Defence Council (NRDC).

Hornby, R., D. White, T. Vitolo, T. Comings, K. Takahashi. 2012. *Potential Impacts of a Renewable and Energy Efficiency Portfolio Standard in Kentucky*. Synapse Energy Economics for Mountain Association for Community Economic Development and Kentucky Sustainable Energy Alliance.

Keith, G., B. Biewald, E. Hausman., K. Takahashi, T. Vitolo, T. Comings, P. Knight. 2011. *Toward a Sustainable Future for the U.S. Power Sector: Beyond Business as Usual 2011*. Synapse Energy Economics for Civil Society Institute.

PRESENTATIONS AND POSTER SESSIONS

Vitolo, T. 2013. "How Big an Issue is Intermittency? Integrating Renewables into a Reliable, Low-Carbon Energy Grid," Presentation for Civil Society Institute webinar, April 17, 2013.

Vitolo, T. 2009. "RPS in the USA: The Present Impact and Future Possibilities of Renewable Portfolio Standards in America." Presentation at Boston University Energy Club Seminar Series.

Vitolo, T. 2007. "An ILP Approach to Spanning Tree Problems on Incomplete Graphs with Heterogeneous Degree Constraints." Presentation at INFORMS Annual Meeting.

Vitolo T., J. Hu., L. Servi, V. Mehta. 2005. "Topology Formulation Algorithms for Wireless Networks with Reconfigurable Directional Links." Proceedings of the IEEE Military Communications Conference, October 2005.

Vitolo, T. 2004. "Topology Design and Traffic Routing for Wireless Networks with Node-Based Topological Constraints." Presentation at Boston University CISE Seminar Series.

TESTIMONY

Missouri Public Service Commission (Case No. EO-2011-0271): Rebuttal testimony Regarding Union Electric Company D/B/A Ameren Missouri. On behalf of the Missouri Office of Public Counsel. October 28, 2011.

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PROFESSIONAL EXPERIENCE

Synapse Energy Economics Inc, Cambridge, MA. Associate, September 2011 – present.

Analyze economic and environmental implications of renewable portfolio standards and clean energy policy scenarios. Investigate electricity market price trends and fluctuations. Maintain our end user and alternative resource sector clients' interests at ISO-NE and PJM stakeholder meetings. Assist clients in navigating RTO market rules, especially regarding reliability assessments for coal-fired power plants and participation of energy efficiency and distributed generation in wholesale capacity markets.

Earthjustice, Oakland, CA. Research and Policy Analyst, 2005 – 2011.

Analyzed federal, state, and local regulations, policies, and environmental planning documents in support of clean air and climate change campaigns. Drafted substantial comment letters on priority issues, often leading to significant policy changes. Advocated at public hearings critiquing proposed policies or regulatory actions. Developed and maintained strong relationships with federal, state, and local agency staff, client groups, community and grassroots groups, technical and scientific experts, and key media contacts. Developed factual basis for and evaluated environmental significance of lawsuits to advance clean air and climate change campaigns

Central Valley Air Quality Coalition, Central Valley, CA.

Chair, Watchdog Committee, 2007 – 2011.

Analyzed and prioritized federal, state, and local regulatory and legislative activities affecting air quality in California's polluted Central Valley. Managed and coordinated with technical consultants on complex regional air pollution clean-up plans. Educated and mobilized committee members and affected communities, empowering them to participate on priority issues. Developed and facilitated technical trainings and educational events for coalition members and citizens.

Steering Committee Member, 2005 – 2011.

Managed and set policy priorities for a diverse coalition of more than 75 community, public health, faith, environmental, and environmental justice organizations and individuals working for clean air in California's Central Valley. Helped develop Strategic Plan for advancing policy priorities and making coalition more effective.

Kopelman & Paige, P.C., Boston, MA. Land Use Paralegal, 2003 – 2005

Performed legal research on subjects such as wetlands protection, coastal management, legality of municipal bylaws, and validity of comprehensive permits in support of Land Use department.

Reviewed and prepared administrative records, briefs, litigation status reports, and other legal documents.

Governor's Office of Energy and Community Services, Concord, NH. *Energy Program Intern*, 2001

Assisted in the research and organizational stages of drafting a State Energy Plan. Participated in the initial implementation of the Energy, Environmental & Economic Integration Project. Special projects relating to energy efficiency and renewable energy.

EDUCATION

Vermont Law School, South Royalton, VT

Master of Environmental Law and Policy, 2003

Mount Holyoke College, South Hadley, MA

Bachelor of Arts in English and Environmental Studies, 2001

PUBLICATIONS

Luckow, P., E. A. Stanton, B. Biewald, S. Fields, S. Jackson, J. Fisher, F. Ackerman. 2014. *CO₂ Price Report, Spring 2014: Includes 2013 CO₂ Price Forecast*. Synapse Energy Economics.

Keith, G., S. Jackson, J. Daniel, K. Takahashi. 2014. *Idaho's Electricity Sources: Current Sources and Future Potential*. Synapse Energy Economics for the Idaho Conservation League.

Ackerman, F., S. Jackson, S. Fields. 2014. *Sustainable Development for the Navajo Nation: Replacing the Navajo Generating Station with Renewable Energy*. Synapse Energy Economics for Chorus Foundation.

Stanton, E.A., J. Daniel, F. Ackerman, S. Jackson. 2013. *Review of EPA's June 2013 Steam Electric Effluent Limitations and Guidelines (40 CFR Part 423)*. Synapse Energy Economics for Earthjustice, Environmental Integrity Project, and Sierra Club.

Jackson, S., P. Peterson, D. Hurley, T. Woolf. 2013. *Forecasting Distributed Generation Resources in New England: Distributed Generation Must Be Properly Accounted for in Regional System Planning*. Synapse Energy Economics for E4 Group.

Whited, M., D. White, S. Jackson, P. Knight, E.A. Stanton. 2013. *Declining Markets for Montana Coal*. Synapse Energy Economics for Northern Plains Resource Council.

Keith, G., S. Jackson, A. Napoleon, T. Comings, J. Ramey. 2012. *The Hidden Costs of Electricity: Comparing the Hidden Costs of Power Generation Fuels*. Synapse Energy Economics for Civil Society Institute.

Fisher, J., S. Jackson, B. Biewald. 2012. *The Carbon Footprint of Electricity from Biomass: A Review of the Current State of Science and Policy*. Synapse Energy Economics.

Peterson, P., D. Hurley, S. Jackson, M. Schultz. 2012. *The Road to Better System Planning: ISO-New England's Revised Energy Efficiency Forecast*. Synapse Energy Economics for Connecticut Office of Consumer Counsel.

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PROFESSIONAL EXPERIENCE

Synapse Energy Economics, Inc., Cambridge, MA. *Communications Assistant*, June 2013 – present.

Provide editorial, coordination, and formatting assistance for Synapse proposals, reports, presentations, and other work products. Produce and edit content for Synapse's website, e-newsletter, and social media pages.

The World & I Online, Washington, DC. *Managing Editor*, September 2012 – May 2013.

Served as the managing editor of an online educational database for K-12 students. Compiled and edited academic articles from staff and freelancers in the areas of natural science, current events, history, global cultures, and the arts. Wrote headlines, coordinated art research, and created supplementary materials for classrooms. Drafted letters for national marketing campaigns targeting K-12 schools.

Island Press, Washington, DC. *Editorial Intern*, October 2012 – May 2013.

Provided editorial support to associate and senior editors at an environmental book publisher. Reviewed and evaluated book proposals on the topics of conservation biology, resource management, and urban planning. Proofread manuscripts and ePublications. Solicited peer reviews and back cover quotes, processed contracts, and tracked projects in title management database.

Rollinglobe Media, Boston, MA. *Destination Reviewer*, January 2012 – May 2012.

European Vibe Magazine, Madrid, Spain. *Staff Writer*, September 2012 – December 2012.

EDUCATION

Boston University, Boston, MA

Bachelor of Science in Journalism, 2012

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