Attachment IV

UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

New York Independent System Operator, Inc. **Docket No. ER21-___-000**

AFFIDAVIT OF MATTHEW E. LIND AND KIERAN MCINERNEY

I. Qualifications

A. Matthew Lind

1. My name is Matthew E. Lind. I am a Director leading the Resource Planning & Market Assessments Business at 1898 & Co., part of Burns & McDonnell Engineering Company, Inc. (BMCD). BMCD has been in business since 1898, serving multiple industries, including the electric power industry. BMCD is a family of companies made up of more than 7,600 engineers, architects, construction professionals, scientists, consultants and entrepreneurs with more than 40 offices across the country and throughout the world and world headquarters located in Kansas City, Missouri. My business address is 9400 Ward Parkway, Kansas City, Missouri 64114.

2. I have been with BMCD for 16 years since 2004. As Director of the Resource Planning & Market Assessments Business, I oversee the related business development, marketing, staff training and project execution for the Business Unit. This Business Unit specializes in development of economic models and analyses associated with generation and transmission planning serving municipal, cooperative, investor-owned utilities, independent generation and transmission developers, and regional transmission organizations. Projects range from integrated resource planning, new resource procurement evaluation, economic transmission planning, demand-side management, asset retirement, transmission congestion impacts, and other economic planning decisions. I have led or supported client engagements in markets across the United States and some international markets working directly with market operators, market participants and developers of power infrastructure. I have supported development of work product and submitted testimony to multiple state regulatory commissions on matters related to both generation and transmission assets.

3. I hold a M.B.A. in Finance from the University of Missouri-Kansas City and a B.S. in Industrial Engineering from Iowa State University. I am a registered Professional Engineer in the state of Kansas. My curriculum vitae is attached as Exhibit A.

B. Kieran McInerney

4. My name is Kieran McInerney. I am a Senior Engineer and Project Manager at BMCD, located at 9400 Ward Parkway Kansas City, Missouri 64114.

5. I have been with BMCD since September 2013. During that period, I have worked on wide range of planning studies and development projects related to electrical energy production and storage in various areas, including New York State. Prior to working for BMCD, I worked for URS Corporation (acquired by AECOM in 2014), Johnson Controls, and York International (acquired by Johnson Controls in 2005).

6. I hold a B.S. in Mechanical Engineering from Marquette University. I am a registered Professional Engineer in the state of Colorado. My curriculum vitae is attached as Exhibit B.

II. Purpose and Summary of Affidavit

7. Section 5.14.1.2.2 of the New York Independent System Operator, Inc. (NYISO) Market Administration and Control Area Services Tariff (Services Tariff) requires the NYISO to conduct a comprehensive review of the ICAP Demand Curves every four years.[1] An independent consultant assists with conducting the periodic reviews. In order to develop recommended ICAP Demand Curve parameters, the independent consultant develops the initial assumptions and analysis, and reviews these with the NYISO and stakeholders through a stakeholder process. This process culminates in the filing with the Federal Energy Regulatory Commission (FERC or Commission) of the ICAP Demand Curves approved by the NYISO Board of Directors. This process is commonly referred to as the ICAP Demand Curve reset (DCR).

8. Analysis Group, Inc. (AGI) was hired as the independent consultant for review of the ICAP Demand Curves to be used starting in the 2021/2022 Capability Year. AGI worked with BMCD to complete the tariff-required periodic review process (together, AGI and BMCD are referred to in this Affidavit as the "Independent Consultant").

9. This affidavit addresses four topics. First, we provide an overview of BMCD's role in the 2021-2025 DCR, which is described more fully in the accompanying *Affidavit of Paul J. Hibbard, Dr. Todd Schatzki, Charles Wu, and Christopher Llop* (AGI Affidavit).[2] Second, we provide an overview of the technology screening criteria and technology advancements related to power generating technology considered as part of the screening process. Third, we describe the methodology used for estimating costs for technologies meeting the screening criteria. Finally, we address certain key issues which impacted our basis for conceptual plant designs and the resulting cost estimates, all of which are described more fully in Section II and Appendix A of the

[1] Capitalized terms that are not specifically defined in this Affidavit shall have the meaning set forth in the filing letter to which this Affidavit is attached or, if not defined therein, the meaning set forth in the Services Tariff.

[2] The AGI Affidavit is included as Attachment III of the filing that includes this Affidavit.

Final Report completed by AGI and BMCD for the 2021-2025 DCR dated September 9, 2020 (Final Report).[3] The Final Report is attached as Exhibit E to the accompanying AGI Affidavit.

III. Overview of Role and Methodology

10. As more fully described in Section II of the Final Report and the AGI Affidavit, BMCD's role was to select peaking plant technology options to be evaluated for each ICAP Demand Curve and to develop the representative design (including site requirements, zone/location considerations and emission controls), cost and performance information for each option in Load Zones C, F, G (Dutchess County), G (Rockland County), J, and K.

11. To comply with the Service Tariff requirements and applicable FERC precedent regarding peaking plant technology selection matters, BMCD utilized the following screening criteria for technology selection:

    - Standard generating facility technology – available to most market participants;
    - Mature market technology – operating experience as a commercial power plant;
    - Unit characteristics that can be economically dispatched;
    - Ability to cycle and provide energy and/or ancillary services;
    - Whether the technology can be practically constructed in a particular location; and
    - Ability to meet applicable environmental and other operating requirements and regulations.

12. BMCD determined that the following peaking technologies satisfy the screening criteria:
    - Aeroderivative Combustion Turbines
        - General Electric (GE) LM6000
        - GE LMS100
        - Siemens SGT-A65 (formerly Rolls Royce Trent 60)
        - Siemens SGT-A45
        - Mitsubishi Hitachi Power Systems (MHPS) Pratt & Whitney (P&W) FT4000
    - Frame Combustion Turbines
        - GE 7HA.02
        - Siemens SGT6-9000HL
        - MHPS 501JAC
        - Siemens SGT6-8000H
        - MHPS 501GAC

[3] Hibbard, Schatzki, Wu, Llop, Lind, McInerney, and Villarreal, *Independent Consultant Study to Establish New York ICAP Demand Curve Parameters for the 2021/2022 through 2024/2025 Capability Years - Final Report*, September 9, 2020 (hereafter, the Final Report or Independent Consultant Report).

- GE 7FA.05
- Siemens SGT6-5000F

- Reciprocating Internal Combustion Engines (RICE) are generally competitive with aeroderivative gas turbines, but the initial screening and results of prior DCRs indicate that RICE technology was not likely to be the lowest fixed cost alternative. Accordingly, BMCD did not evaluate RICE technology for the 2021-2025 DCR.

13. Based on the screening criteria and considerations presented above, BMCD identified representative technologies for each of the following types: (1) aeroderivative turbines; (2) F class frame turbines; and (3) H class frame turbines. Options were selected for the 200 MW size range for the aeroderivative and F class units, consistent with previous DCR studies. Given the larger capacity of advanced class units currently offered by manufacturers, the H class unit studied was sized around 350 MW. The representative technologies selected for further evaluation and development of detailed cost estimates are as follows:

    - Aeroderivative peaking plant option: Three Siemens SGT-A65 units
    - F class frame turbine peaking plant option: One GE 7F.05 unit
    - H class frame turbine peaking plant option: One GE 7HA.02 unit

    For the last reset, the H class frame turbine was evaluated for informational purposes due to its then lack of commercial operating experience in a simple cycle configuration. Since the completion of the last reset, the H class frame turbine has achieved commercial operation in a simple cycle configuration. For example, the Canal 3 unit in Sandwich, Massachusetts commenced commercial operation in June 2019. This facility consists of a single GE 7HA.02 unit equipped with selective catalytic reduction (SCR) emissions controls operating in a simple cycle configuration.

    The DCR study also includes the following battery energy storage systems (BESS), based on lithium-ion battery technology, for comparison to traditional simple cycle gas-fired turbine technologies:

    - 200 MW, 4-hour (800 MWh stored energy) lithium-ion
    - 200 MW, 6-hour (1,200 MWh stored energy) lithium-ion
    - 200 MW, 8-hour (1,600 MWh stored energy) lithium-ion

14. The capital investment costs include the installed cost of the plant, owner's costs, and financing costs during construction. The installed cost estimate is based on a developer entering into an engineer, procure, construct (EPC) contract for project execution. Owner's cost estimates include the electric and gas interconnection facilities, owner development and management activities, fuel inventory (applicable for fossil plant options with dual fuel capability), builder's risk insurance, and an additional contingency.

15. The capital cost estimates are based on BMCD's experience as an EPC contractor, engineering design firm, and consultant in the power generation and energy storage industries. BMCD has recent project execution experience, consulting experience, and/or proposal experience on simple cycle, combined cycle, and energy storage projects in New York, including New York City. Gas turbine costs are based on budgetary estimates from the respective original equipment manufacturer (OEM). Other equipment and material quantities and costs are based on recent BMCD project costs, designs, and proposals for simple cycle, combined cycle, and energy storage projects. For BESS options, the battery pricing was based on recent BMCD EPC proposals for storage projects and Owner's Engineering experience on large utility scale storage projects. Labor costs are based on man-hour durations within each craft multiplied by the respective labor rates. Costs are based on the EPC contractor self-executing the steel, piping, and equipment scopes. All other craft scopes are assumed to be subcontracted. Construction craft base pay and supplemental (fringe) benefits were obtained from the RSMeans Labor Rates for the Construction Industry (RSMeans) for the nearest municipality to each Load Zone evaluated as part of the 2021-2025 DCR. Burdened labor rates were developed by adding Federal Insurance Contributions Act (FICA) tax, state and federal unemployment taxes, general liability insurance, and workmen's compensation insurance. All-in wage rates were developed by adding allowances for small tools, supervision, construction equipment, and subcontractor overhead and profit. Work is assumed to be performed on a 50-hour work week by qualified union craft labor available in the respective area. Direct installation labor man-hours for the base cost estimates are for an ideal location and must be adjusted for locations where productivity is reduced due to a variety of factors, including, but not limited to, weather, union rules, construction parking and laydown space limitations. Based on BMCD experience, man-hours were multiplied by a labor productivity factor for each Load Zone evaluated.

16. Owner's costs include allowances for items such as development activities, project management oversight, Owner's Engineer, legal fees, financing fees, emission reduction credits (ERCs), fuel inventories, builder's risk insurance, and additional contingency. Owner development, oversight, permitting, and management related activities are duration-based, with assumptions for personnel cost for the Owner and/or consultants, plus expenses. As applicable, electrical interconnection, gas interconnection, and water supply costs are included. Allowances are included for spare parts, legal fees, and area development concessions that often arise as part of project permitting/siting. Applicable ERC price assumptions for nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in each location are based on discussions with emissions brokers familiar with the current ERC market in New York.

17. Construction financing costs were developed from indicative project schedules.

18. Fixed operations and maintenance (O&M) costs were developed using BMCD's proprietary tools that generate cost estimates for plant staff labor, routine maintenance, training, laboratory expenses, safety equipment, building and grounds

maintenance, administrative and general costs, plus variable O&M. Where applicable, variable O&M costs include routine equipment maintenance, makeup water, water treatment, water disposal, ammonia (if SCR emissions controls are included in the peaking plant design), SCR catalyst replacements (if applicable), carbon monoxide (CO) catalyst replacements (if applicable), and other consumables not including fuel.

19. The site leasing costs are equal to the annual lease rate ($/acre-year) multiplied by the land requirement in acres. BMCD reviewed market transactions, property tax values and stakeholder-provided feedback in assessing the leasing cost assumptions. In addition to this review, BMCD considered quoted values obtained through discussions with various property owners in the potential acquisition of land for similar use. As further described in Section IV.C, particularly in New York City, this resulted in a wide range of observed values. Using values approved for the 2017-2021 DCR, escalated to $2020 using the cumulative change in the Gross Domestic Product (GDP) implicit price deflator (Q1 2015-Q1 2020) arrived at values that were within the observed range of leasing costs identified by BMCD's review indicating that the use of an escalation approach resulted in reasonable values for purposes of this study.

20. Section II of the Final Report contains additional information regarding BMCD's work as described above. Appendix A of the Final Report provides additional detail on the total capital investments, fixed and variable O&M costs, and performance data.

IV. Key Issues

21. BMCD addresses certain key issues raised by stakeholders during the DCR below. Specifically, BMCD provides additional information regarding the following matters: (1) the assumptions regarding inclusion of SCR emissions control technology for the various locations studied as part of the 2021-2025 DCR; (2) the assumed natural gas interconnection costs for the recommended peaking plants; (3) the assumed land lease cost for New York City; and (4) Owner's cost estimates for the recommended peaking plants.

A. Application of SCR Emission Controls for simple cycle GE 7HA.02 units

22. Candidate fossil peaking plant technologies would be required to obtain an air permit from the New York State Department of Environmental Conservation (NYSDEC). The air permit will require the new source to meet various Federal and New York State requirements. These requirements, among others, include New Source Performance Standards (NSPS), New Source Review (NSR), National Emission Standards for Hazardous Air Pollutants (NESHAP) and those specified in the New York State Codes, Rules, and Regulations (NYCRR).

23. NSPS Subpart KKKK is technology specific and does not vary based on the installation location. Subpart KKKK requires combustion turbines with heat inputs greater than 850 MMBtu/hour to limit NOx emissions to less than 15 ppm while

firing natural gas and to less than 42 ppm while firing liquid fuels (*e.g.*, ultra-low sulfur diesel (ULSD)). These standards apply to all the combustion turbine options with heat inputs greater than 850 MMBtu/hr, including the GE 7HA.02 units.

24. As further described in Section II of the Final Report, the conceptual designs and cost estimates developed by BMCD included two model variations for the GE 7HA.02 gas turbine.

25. The base model 7HA.02 emits 25ppm NOx, which would require SCR emissions controls to comply with Subpart KKKK. However, GE also offers a version of the 7HA.02 unit tuned to emit 15 ppm NOx, which would not require SCR emissions controls to satisfy Subpart KKKK. There is an approximate 5% reduction in power output for this alternative model, which is captured in the performance estimates.

26. In addition to NSPS, new units will be subject to the New Source Review (NSR) program established by the U.S. Environmental Protection Agency (EPA), which considers the impacts to the air quality in the vicinity of the emission source. If a project site is located in an area where a criteria pollutant's concentration is below its respective National Ambient Air Quality Standard (NAAQS), then the area is in "attainment" for that pollutant. An area where a criteria pollutant's ambient concentration is above its NAAQS is classified as a "nonattainment" area, and there are multiple levels of nonattainment (*i.e.*, moderate vs. severe). The NSR program is split into two permitting pathways/regimes: Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review (NNSR). PSD applies to new units within attainment areas. NNSR applies to new units located within nonattainment areas.

27. In order to improve a nonattainment area's air quality, the NNSR permitting pathway has more stringent permitting thresholds and requires stricter permitting analyses. In an attainment area, a source that would qualify for a PSD permit would need to perform a Best Available Control Technology (BACT) analysis, which reviews control technologies that have been installed on similar units for applicability to the new source. BACT analyses allow for the evaluation of cost feasibility when determining the control technology required. On the other hand, in a nonattainment area, a source applying for a permit under NNSR review is required to go through a Lowest Achievable Emission Rate (LAER) analysis, which does not take cost into consideration when determining applicable control technologies and thus typically has much more stringent control requirements.

    The PSD major source threshold for new simple combustion turbines is 250 tons/year. However, as further described below, the applicable threshold for areas otherwise designated as attainment areas in New York (*e.g.*, Load Zones C, F, and G (Dutchess County)) is 100 tons/year because New York is within the Ozone Transport Region (OTR). The annual emissions are typically based on the potential to emit (PTE) at 8,760 hours/year of operation. If a new source is determined to be a major

PSD source, then PSD review would be performed for any pollutant that exceeds the applicable thresholds.

28. However, it is possible to "synthetically limit" a unit's operating profile to maintain emissions for applicable pollutants below the PSD thresholds (both the major source threshold and the Significant Emissions Rates (SER) threshold). By synthetically limiting the PTE, the facility will become a "synthetic minor source," requiring less strict permitting analyses. For example, a BACT analysis would not be required as a part of a federal synthetic minor permitting application.

29. Based on BMCD's prior experience and professional judgment, absent application of a synthetic operating limit, BMCD expects that in order for a new unit in New York State to meet the BACT standard, SCR emissions controls would be required for NO_X control and an oxidation catalyst would be required for CO and/or VOC control.

30. NNSR only applies to the pollutants for which a given area is classified as in nonattainment. The current nonattainment areas classified as Severe include the New York City Metropolitan Area[4] and the Lower Orange County Metropolitan Area.[5] These areas are nonattainment for the eight-hour ozone National Ambient Air Quality Standard (NAAQS). The major source thresholds in these areas are 25 tons/year for NO_X and VOC.

31. The remaining areas in the State are classified as either Marginal, Moderate or in the Ozone Transport Region (OTR). The major source thresholds in these areas are 100 tons/year for NO_X and 50 tons/year for VOC.

32. NNSR major sources located in nonattainment areas for ozone are required to install LAER technology. LAER is an emission rate that has been achieved or is achievable for a defined source and does not consider cost-effectiveness. Based on BMCD's prior experience and professional judgment, SCR emissions control systems for NO_X emissions and an oxidation catalyst for VOC emissions are expected LAER technologies for combustion turbine facilities subject to NNSR.

33. Similar to the PSD permitting process, a synthetic limit (e.g., application of an annual operating hours cap/limit) could be applied to a new source or facility, which would bring the annual PTE below the thresholds mentioned above. Since the facility would no longer be subject to NNSR, the LAER analysis would no longer be required.

34. The GE 7HA.02 peaking plant technology option with a 25 ppm NO_x emissions rate would already require the installation of SCR emissions controls per the NSPS Subpart KKKK limits. When using the maximum annual run hours limitation for simple cycle units for compliance with the NSPS TTTT regulation (3,066 hours), the

[4] The New York City Metropolitan Area includes both New York City and Long Island.

[5] The Lower Orange County Metropolitan Area includes the Load Zone G (Rockland County) location evaluated as part of the 2021-2025 DCR.

GE 7HA.02 with 15 ppm NO_x emissions would require SCR emissions controls as a part of NNSR analyses requiring LAER in all locations evaluated, regardless of nonattainment status of areas of each location.

35. In addition to the "maximum-hour" compliance analysis summarized above, BMCD also analyzed limiting the annual hours of operation to reduce emissions below the NNSR threshold, which would remove the requirement to perform a LAER analysis. The approximate annual operating hours restriction to eliminate the need to perform BACT or LAER (as applicable) for the GE 7HA.02 unit with 15 ppm NO_x emissions are listed as follows:

    - Load Zones C, F, and G (Dutchess County):
        - 1,060 hours if only using natural gas fuel
        - 312 hours if only using ULSD
    - Load Zones G (Rockland County), J, and K:
        - 260 hours if only using natural gas fuel
        - 78 hours if only using ULSD

B. Natural Gas Interconnection Costs

36. Gas interconnection cost estimates are based on BMCD's experience with gas laterals and publicly available information on pipeline projects recently planned or completed in or near New York. Recent gas lateral projects in New York and Connecticut suggest that 5 miles is a reasonable assumption for gas pipeline lateral length in all Load Zones, except Load Zone J. BMCD developed costs reflecting an average gas lateral length of one mile in Load Zone J and five miles in all other Load Zones, with a 12-inch diameter pipeline for the 3x Siemens SGT-A65 and GE 7F.05 options and 16-inch diameter pipeline for the GE 7HA.02 options. In all Load Zones except Load Zone J, estimates are based on $250,000 per inch diameter per mile to represent total installed cost. The average cost for a metering and regulation station was estimated at $3.5 million in all Load Zones except Load Zone J. It is reasonable to expect that the gas interconnection for Load Zone J would be shorter than the five mile length estimated for all other locations, but the difficulty of installing a pipeline in New York City would likely offset any savings from a shorter distance. This would result in an installed pipeline cost greater than the unit costs considered for all other locations. BMCD believes that a non-site-specific allowance for Load Zone J of $20 million for a one mile 12-inch or 16-inch diameter interconnect to a local natural gas distribution company (LDC) system plus a metering station is reasonable to account for the increased costs expected for gas interconnection within New York City.

37. Certain stakeholders contend that the assumed gas interconnection cost is understated, especially for the lower Hudson Valley, based on recent project experience in this area. BMCD considered stakeholder provided information, publicly available cost information for projects in or near New York, and confidential information related to BMCD's project experience in New York. The list of projects considered includes the following:

- CPV Valley Millennium pipeline
- National Fuel Gas Northern Access Project
- Constitution Pipeline
- PennEast Pipeline
- National Fuel Gas FM100
- Bayonne Lateral Delivery Project

Public cost information often does not include detailed breakdowns, but commonly the numbers are intended to be all-in views of project costs, including development, engineering, procurement, and construction costs. While the scopes/specific characteristics and information sources of these projects differ, BMCD sought to normalize the scopes in ways that are consistent with the level of effort for planning studies:

- Efforts were made to exclude non-linear equipment/construction items such as compressor stations and metering and regulation equipment.
- Consistent with typical industry practices for cost studies similar to the DCR, the linear portions were reviewed in terms of cost per inch diameter per mile.

The range of costs identified was approximately $100,000/in/mile to $500,000/in/mile, including consideration of the specific projects noted above. CPV Valley Millennium pipeline represented the highest unit cost. The Bayonne Lateral represented the lowest unit cost. The high variability of these unit costs is evidence of the significant variation from one project to the next, and it highlights the challenge of assigning a single number to a generic pipeline project. The approximate average of the linear costs identified was $260,000/in/mile. If the highest and lowest unit costs are removed from consideration, the approximate average drops slightly to $240,000/in/mile. BMCD assumed an allowance of $250,000/in/mile for the all-in lateral costs in the final DCR report. Given the range of costs identified, our recommended value is a reasonable assumption for a generic, hypothetical peaking plant. The metering and regulation portion of the gas interconnection cost remains at $3.5 million for Load Zones C, F, G, and K. Due to the variability of costs identified, BMCD elected to maintain the same costs for the pipeline allowance across Load Zones C, F, G, and K.

C. Land Lease Costs in Load Zone J

38. As part of determining the annual land lease cost assumption in Load Zone J, BMCD reviewed several different data points including property tax values, stakeholder-provided appraisals of utility property in New York City, and other market transaction data. Property tax values were identified for nine sites adjacent to existing power plants within Load Zone J. Stakeholder-provided feedback included property appraisal reports for existing generation and/or industrial sites within Load Zone J. Other public and private market transaction data included the observation of a recent

purchase of a waterfront parking lot in Astoria and values quoted through BMCD's discussions with various property owners in the potential acquisition of land for similar use.

39. For data points where only property value was implied based on assessed value for property tax purposes or a market sales transaction, the value was converted to a $/Acre value and multiplied by 5.5% to determine an estimated annual lease payment expressed as $/Acre-year. The range of values observed by BMCD's assessment are summarized in the table below.

Description	Property Value ($/Acre)	Annual Lease ($/Acre-year)
Low end observed property value range	$182,752	$10,051
Average of Property Tax Values for Sites Adjacent to Existing Generation Facilities	$3,264,359	$160,712
Assumed Cost for the 2021-2025 DCR	$4,909,091	$270,000
Average of Stakeholder Provided Property Assessments	$11,736,518	$645,509
High end observed property value range	$18,181,818	$1,000,000

40. BMCD found that property values and associated leasing cost for property within New York City have a wide range of potential values and are highly dependent on site specific factors and conditions. Using the land leasing cost value for New York City that was approved in the 2017-2021 DCR, escalated to $2020 using the cumulative change in the Gross Domestic Product (GDP) implicit price deflator (Q1 2015-Q1 2020), produced an estimated lease cost value of $270,000/acre-year. This value was within the observed range of annual leasing costs identified by BMCD's review indicating that the use of an escalation approach resulted in a reasonable value for purposes of the 2021-2025 DCR. Notably, the assumed land lease cost of $270,000/acre-year falls within a range between the average value determined based on the property tax values of sites adjacent to existing power plants ($160,712/acre-year) and the appraisal values for specific sites in New York City provided by certain stakeholders ($645,509/acre-year).

D. Owner's Costs Estimates

41. During the DCR, certain stakeholders placed particular focus on line-by-line comparisons of estimated items related to Owner's development costs developed by BMCD for this DCR with the cost estimates developed by a different engineering and design firm for the 2017-2021 DCR.

42. Development costs are difficult to define and quantify for a generic/hypothetical project because they can vary significantly in the field due to project scope, location, general regulatory environment, and Owner/developer processes, among other items. Because the cost estimates for both the 2017-2021 DCR and the 2021-2025 DCR

were generated for the same purpose (*i.e.*, providing cost estimates for a hypothetical peaking plant at various generic site locations throughout New York), it is reasonable that the overall scope, underlying assumptions, and results of the estimates would be similar. However, the estimates were compiled by two different consultants whose internal estimating methodologies may not be (and need not be) the same.

43. For generic/hypothetical projects, especially when the estimates were prepared by different consultants, it is likely more illustrative to compare larger cost categories than to engage in line-by-line scrutiny. Both BMCD and the firm used in the 2017-2021 DCR provided information that is consistent with industry norms for studies of this type, but differences in internal methodology and organization of information will produce results that may not appear similar for direct comparisons of specific line items. As such, attempting to conduct a line-by-line comparison is likely to produce inadvertently misleading results.

44. For example, the following represent certain of the differences readily identified by BMCD (but are not intended to represent an exhaustive lists of all differences between the estimates developed by BMCD and the those developed for the 2017-2021 DCR) between its cost estimates for this DCR and the estimates developed for the 2017-2021 DCR:

    - The Owner's cost estimate developed for the 2017-2021 DCR does not appear to be tailored to any specific scope of work. Instead, as set forth in the independent consultant's final report for the 2017-2021, the Owner's cost estimate was generically based on specified percentages of the total EPC cost.
    - BMCD developed separate estimates for both electric and gas interconnection for the hypothetical peaking plants as part of its Owner's cost estimates. BMCD was unable to identify whether the Owner's cost estimates for the 2017-2021 DCR were intended to cover the generation project alone, or if they also include certain allowances or scope components for the gas and/or electrical interconnection.
    - Owner's cost line items for Owner personnel and development related activities developed by BMCD for this DCR are generally intended to cover the generation facility, and are based on allowances for a generic schedule, an assumed quantity of full-time-equivalent (FTE) personnel, and an hourly cost assumption. Lateral cost line items (*e.g.*, gas and electric interconnection) are generally intended as all-in costs that include development, engineering, procurement, and construction elements.
    - The components of the Owner's costs developed by BMCD for this DCR include items not provided or not broken out in the estimates developed for the 2017-2021 DCR, such as an Owner's contingency that is separate from the contingency included in the EPC estimate.

45. In response to concerns raised by certain stakeholders, BMCD conducted a comparative analysis of cost estimates developed for the 2017-2021 DCR to the estimates developed by BMCD for this DCR. For purposes of this analysis, BMCD utilized the cost estimates for dual fuel GE 7HA.02 unit equipped with SCR emissions controls and located at a generic site in Load Zone G (Dutchess County). Effort was made to align the line items for each estimate to the extent practicable. Two things were evident in the comparison:

    - There was rarely consensus between the two estimates when viewing specific line items. This is likely due to the differences in the categorization of cost items and methodology used by BMCD and the engineering design firm used in the 2017-2021 DCR.
    - When looking at the totality of project execution related items and the totality of Owner related items, both sets of costs were substantially similar (approximately 1% different when considering escalation of the estimates from the 2017-2021 DCR). This demonstrates that contrary to contentions by certain stakeholders, BMCD's cost estimates for this DCR appropriately accounted for all relevant cost components and established reasonable values for such costs.

The table below provides the results of BMCD's analysis.

Zone G-Dutchess County	2016 Report	2016 Escalated	2020 Report	% Dif.
Equipment (see note 1)	$127,188,000	$138,660,851	$129,664,906	
Spare Parts	Moved to Owner's Costs	Moved to Owner's Costs	In Owner's Costs	
Construction Labor and Materials	$80,495,000	$87,755,961	$63,184,048	
Switchyard	$3,774,000	$4,114,429	$10,250,000	
Electrical Interconnection and Deliverability	$23,050,000	$25,129,199	$11,000,000	
Gas Interconnection and Reinforcement	$15,600,000	$17,007,181	$23,500,000	
Site Prep	$4,748,000	$5,176,288	Included in Construction Line Above	
Engineering & Design	$6,280,000	$6,846,480	Included in Other EPC	
Construction Mgmt / Fiel Engr	$3,583,000	$3,906,201	Included in Other EPC	
Startup & Training	$3,400,000	$3,706,693	Included in Other EPC	
Testing	$0	$0	Labor in EPC, Consumables Listed Below	
Contingency	$16,461,000	$17,945,846	Included in Other EPC	
Other EPC Cost in 2020 DCR (see note 2)	N/A	N/A	$64,282,985	
Construction Power and Water	Not Explicitly Broken Out	Not Explicitly Broken Out	$550,000	
Startup/Testing (Fuel & Consumables)	$1,325,000	$1,444,520	$4,500,000	
Site Security	Not Explicitly Broken Out	Not Explicitly Broken Out	$580,000	
Builder's Risk Insurance	Not Explicitly Broken Out	Not Explicitly Broken Out	$1,160,000	
Project Execution Items (2016 Methodology)	**$285,904,000**	**$311,693,651**	**$308,671,938**	**1.0%**
Permitting	$2,852,000	$3,109,261	$1,000,000	
Legal	$2,852,000	$3,109,261	$1,000,000	
Owner's Project Mgmt & Misc. Engr. (see note 3)	$4,279,000	$4,664,982	$2,420,000	
Social Justice	$570,000	$621,416	$500,000	
Owner's Development Costs (see note 4)	$8,557,000	$9,328,875	$370,000	
Financing Fees	$5,705,000	$6,219,613	See AFUDC Below	
Studies (Fin, Env, Market, Interconnect)	$1,426,000	$1,554,631	Not Explicitly Broken Out	
Emission Reduction Credits	$0	$0	$70,000	
System Deliverability Upgrade Costs	$0	$0	$0	
Owner's Operational Personnel Prior to COD	Not Explicitly Broken Out	Not Explicitly Broken Out	$440,000	
Owner's Contingency	Not Explicitly Broken Out	Not Explicitly Broken Out	$16,430,000	
AFUDC - EPC Portion	$19,866,000	$21,657,990	$18,564,786	
AFUDC - Non EPC Portion	$1,920,000	$2,093,191	$6,318,222	
Working Capital and Non-Fuel Inventories (include	$3,517,000	$3,834,247	$6,500,000	
Fuel Inventory	$4,453,000	$4,854,678	$7,240,000	
Owner's Cost Items (2016 Methodology)	**$55,997,000**	**$61,048,147**	**$60,853,008**	**0.3%**
Total Capital Investment	**$341,901,000**	**$372,741,797**	**$369,524,946**	**0.9%**

Notes
1. Equipment in 2020 DCR includes gas turbine and materials lines added together
2. "Other" EPC line item in 2020 DCR includes design engineering, const. mgmt, G&A, field engineering, startup, training, warranty, surety, fee, and EPC contingency
3. In the 2020 DCR, this adds up the Owner PM, Owner's engineer, and Owner startup/commissioning personnel
4. Lateral costs included in 2020 DCR (shown in Project Execution Section) are intended to reflect all-in pricing
5. The total cost for the 2016 DCR lines matches the 2016 report. In this comparison, "spare parts" was moved to the "Working Capital" line in the Owner's costs and "Fuel oil testing" was moved from the Owner's Costs into the "Startup Testing Fuel/Consumables" italicized line item in the Project Costs.

V. Conclusion

46. BMCD's role in this DCR was to assist AGI with: (1) the selection of peaking plant technology options to be evaluated for each ICAP Demand Curve; and (2) developing the necessary design information (including site requirements, zone/location considerations and emission controls), cost estimates, and performance information for each option in Load Zones C, F, G (Dutchess County), G (Rockland County), J, and K.

47. In this role, we identified and evaluated technologies and selected potential technologies to serve as the peaking plant for each ICAP Demand Curve. For each selected option, we developed capital costs, operating costs, operating parameters, and considered applicable siting and environmental permitting requirements. We also

considered how the peaking plant could be practically constructed within each location, and how a potential developer would evaluate various design capabilities and environmental control technologies when making investment decisions in consideration of project development and operational risk, and opportunities for revenues over the economic life of the project.

48. BMCD's work products are presented in Section II and Appendix A of the Final Report.

49. This concludes our affidavit.

Respectfully submitted,

/s/ Matthew E. Lind
Matthew E. Lind, P.E.
Director of the Resource Planning & Market Assessments Business
Burns & McDonnell Engineering Company, Inc.

/s/ Kieran McInerney
Kieran McInerney, P.E.
Senior Engineer and Project Manager
Burns & McDonnell Engineering Company, Inc.

Exhibit A

Matthew Lind, PE

Business Lead – Resource Planning & Market Assessments

Matthew is the Director of Resource Planning & Market Assessments at 1898 & Co., part of Burns & McDonnell. He is responsible for market evaluations and strategic system planning studies requiring regulatory, engineering, and/or financial analyses consulting. Matthew has a diverse background of experience using sophisticated economic models to provide decision-making analysis to investor-owned utility, regional transmission organization, cooperative, and municipal utility clients as well as independent developers of transmission and generation projects. Matthew has managed studies in multiple North American and international organized markets including:

- New York ISO
- PJM Interconnection
- MISO
- Southwest Power Pool
- ERCOT
- WestConnect
- CAISO
- Ontario IESO
- Puerto Rico
- Australia

Matthew's study experience includes evaluations and expert witness testimony related to integrated resource planning, competitive transmission planning, transmission congestion, strategic asset management, asset valuation/due diligence reviews, demand side management, feasibility evaluations, and project development. The following is a selection of recent projects that Matthew has managed:

Education

B.S. / Industrial Engineering
MBA / Finance

Registrations

- Professional Engineer (KS)

16 years with 1898 & Co.
16 years of experience

Visit my **LinkedIn** profile.

PROJECT EXPERIENCE

Integrated Resource Plan / Central Electric Power Cooperative, Inc.

South Carolina / 2020

Matthew supported a project team in the development of an integrated resource plan for Central Electric Power Cooperative, Inc. who provides service to 20 different member cooperative throughout the state of South Carolina. The IRP was developed as a result of the passage of South Carolina's Energy Freedom Act (Act 62) compelling utilities to develop an IRP and consider alternative futures with higher levels of renewable energy and energy efficiency. 1898 & Co. collaborated with Central's planning staff in the development of its first ever IRP through the use of Capacity Expansion portfolio optimization software.

All Sources RFP Administration & Evaluation / Vectren Energy Delivery
MISO Market / 2019-2020

Project manager supporting the design and development of an All-Sources RFP seeking to procure capacity and energy products capable of delivering 10 MW up to 700 MW of capacity and energy to Vectren. All bids were evaluated for both quantitative and qualitative factors and scored relative to similar technology types for purposes of evaluating within the portfolio development of Vectren's 2019/2020 integrated resource plan. Bids were independently evaluated for both reliability and congestion/deliverability concerns prior to making short list recommendations.

Demand Curve Reset / New York ISO
NYISO / 2019-2020

Matthew managed a project team consisting of technical and environmental engineers supporting the development of a study used as the basis to set the NYISO's ICAP Demand Curves for the four Capability Years beginning with the summer 2021 period. This included the determination of Gross CONE values less revenues obtained through energy and ancillary services for representative simple cycle, combined cycle, and battery energy storage systems. The development of the demand curves included monthly presentations to a public stakeholder working group and a report to be filed with the FERC in 2020.

Portfolio Optimization & Bid Evaluation Support / Confidential Client
Southeast / 2019-2020

Matthew provided strategic oversight and advisory support on our project team supporting a cooperative utility that was considering potential purchase transactions which considered comprehensive decisions and consideration for long term power supply and associated transmission impacts. The study first provided pre-bid analysis to understand what decisions may yield operational or other savings and then validated bid details in the middle of a pre-defined commercial bid window. This study utilized Strategist for portfolio optimization, PROMOD security constrained economic dispatch to inform financial and rate impact modeling and steady state power flow modeling to inform transmission reliability impacts.

Southeast Market Study / Confidential Client
Southeast / 2019

Project manager on the study of customer cost, unit viability and reliability impacts associated with various market scenarios within the southeast. This study utilized PROMOD security constrained economic dispatch and steady state power flow modeling to inform the analysis. Generator utilization, unit profitability, and adjusted production cost were key elements compared across market scenarios that considered an expanded day ahead market footprint. Key sensitivities such as fuel price, load growth, and renewable energy source penetration were analyzed compared to a reference set of assumptions. Results were presented to clients' corporate officers and documented in a final report.

Energy Storage Deployment Economic Study / Confidential Client
MISO Market / 2019

Project manager for a project developing benefit scenarios in which energy storage solutions could be compared on a large and small scale. Benefits defined within select scenarios included resource adequacy, market efficiency, and reliability. Energy storage project configurations were varied based on the targeted benefit looking at large and small-scale lithium-ion applications and large scale advanced compressed air energy storage applications. Comparative costs and policy discussions around each technology were included in a final report to be shared with state regulators and policymakers.

LMP Impacts Study / Confidential Client
MISO Market / 2019

Matthew provided support developing regional locational marginal price (LMP) forecasts looking out 15 years, considering changing future regional conditions including plant retirements, new renewable builds, and altered transmission facilities including both AC and HVDC facilities. The impacts to load and generator LMPs were reported based on the changing future conditions. LMPs were forecasted through the use of PROMOD and security constrained economic dispatch modeling.

SPP 2019 ITP Transmission Project Development Support / Confidential Client
Southwest Power Pool Market / 2019

Project manager for a utility client in support of developing proposed transmission projects to be submitted in SPP's 2019 ITP regional transmission expansion plan and Order 1000 process. Proposed transmission and non-wires alternative projects were analyzed and developed to address reliability, public policy, or economic needs as identified as part of SPP's ITP assessment. The study considered projects across multiple futures and included analysis developed through multiple software platforms including PSS/E and PROMOD Nodal software. Project types considered included both AC and HVDC transmission and battery energy storage systems.

Puerto Rico Economic & Disaster Recovery Plan: Power Infrastructure Assessment / Rand Corporation

Puerto Rico / 2018-2019

Matthew was one of 4 principle authors developing a comprehensive report prepared for the Homeland Security Operational Analysis Center (HSOAC), FEMA, and the Rand Corporation focused on all facets of the power system infrastructure in Puerto Rico. This report discussed the impacts associated with the hurricanes Irma and Maria that struck the island in 2017. Scenarios contemplating rebuilding the generation, transmission, distribution, and customer interfacing infrastructure were discussed and an estimated cost was provided. These served as a road map to inform future spending of disaster recovery funds.

PJM 2018/19 RTEP Long Term Proposal Window Support / Confidential Client

PJM Interconnection Market / 2018-2019

Project manager for a team of system planners and engineers to support a transmission company in the collaborative development of proposed transmission projects to be submitted in PJM's 2018/19 RTEP Long Term proposal window. Matthew coordinated all activities in collaboration with the client throughout the window including the development of transmission and battery storage solutions and evaluation of solutions for competitiveness. Project development within this window focused on market efficiency needs and were evaluated for both economic and reliability benefits using licensed software including PROMOD, PSS/E and TARA.

SPP 2019 ITP Resource Plan Phase 2 Support / Southwest Power Pool

Southwest Power Pool Market / 2018

Project manager for a project team developing the resource expansion plan to be used in reliability and economic models associated with Southwest Power Pool's 2019 Integrated Transmission Plan. Resource plans were developed for the entire SPP footprint based on stakeholder feedback associated with future load growth and generator retirements for three different future scenarios. Each scenario had differing policy goals associated with renewable integration. Resource plans were developed using Strategist and results were communicated through SPP's stakeholder working group for final approval.

Expert Witness Support – Certificate of Public Convenience and Necessity Cause No. 45052 / Vectren Corporation

MISO Market / 2017-2018

Matthew served as one of 14 expert witnesses providing testimony in support of Vectren's Certificate of Public Convenience and Necessity (CPCN) filed with the state regulatory commission to build an approximately $850M generating facility. His analysis and testimony was provided to support Vectren's decision to self-build new generation capacity in replacement of existing unit retirements including the evaluation of competitive project bids received through an RFP process.

Energy Storage Feasibility Assessment / Confidential Client

Southeast / 2018

Project manager for a team evaluating the business case of an energy storage solution mitigating a substation transformer overload. The energy storage solution was developed such that it could be evaluated and compared against deferred or avoided transmission and/or distribution upgrades. An economic comparison was performed looking at the energy storage solution compared to transmission and distribution upgrades on a net present value basis.

CAISO 2017/18 TPP Submission Window Support / Confidential Client

CAISO Market / 2017-2018

Project manager for a team that supported the evaluation and development of transmission projects which were submitted to CAISO during the Phase 2 Request Window as part of its Transmission Planning Process for the 2017/18 planning cycle. Transmission solutions were developed to address reliability needs as identified by CAISO and were

analyzed for steady state reliability performance using PSLF. Transmission solutions were additionally analyzed for economic and policy-related production cost benefits using GridView. Benefit-cost ratios following CAISO calculation methodology and various other metrics were reported to communicate the multiple benefits provided by the transmission solutions as submitted.

Expert Witness Support – DSM Program Spending and Approval Cause No. 44927 / Vectren Corporation

MISO Market / 2017

Matthew served as an expert witness providing testimony in support of Vectren's proposed DSM program and associated spending filed with the state regulatory commission. His analysis and testimony was provided to support Vectren's decision to implement energy efficiency programs on a three year forward basis for up to 1 percent of eligible customer sales. Testimony was provided to support IRP analysis and energy efficiency program decisions.

PJM 2016/17 RTEP Long Term Proposal Window Support / Confidential Client

PJM Interconnection Market / 2016-2017

Project manager for a team of system planners and engineers to support a transmission company in the collaborative development of proposed transmission projects to be submitted in PJM's 2016/17 RTEP Long Term proposal window. Matthew coordinated all activities in collaboration with the client throughout the window including the development of transmission and battery storage solutions, evaluation of solutions for competitiveness and development of formal project proposals which include engineering, routing and permitting detail which were submitted to PJM for independent evaluation. Project development within this window focused on market efficiency needs and were evaluated for both economic and reliability benefits using licensed software including PROMOD, PSS/E and TARA. Multiple bids were submitted.

Pacific Gas & Electric 2016 Energy Storage Request for Offers Window Support / Confidential Client

CAISO Market / 2016-2017

Pursuant to California Assembly Bill 2514, PG&E is required to solicit bids for transmission, distribution, and behind the meter connected energy storage projects. Matthew provided support for a third-party developer in the feasibility evaluation associated with energy storage projects to be submitted into PG&E's bid window. The feasibility evaluations were responsible for targeting viable locations with beneficial applications for reliability and resource adequacy benefits for PG&E and/or the third-party battery operator.

CAISO 2016/17 TPP Submission Window Support / Confidential Client

CAISO Market / 2016

Project manager in the development and evaluation of transmission projects which were submitted to CAISO during the Phase 2 Request Window as part of its Transmission Planning Process for the 2016/17 planning cycle. Transmission solutions including transmission and battery storage were developed to address reliability needs as identified by CAISO and were analyzed for steady state reliability performance using PSLF. Multiple projects were submitted for evaluation by CAISO and included a summary of planning performance and estimated costs related to the project.

PJM 2016 RTEP Proposal Window #3 Support / Confidential Client

PJM Interconnection Market / 2016

Project manager in PJM's 2016 RTEP proposal window related to short term reliability issues. Matthew provided management and direction on planning, project evaluation, and proposal development of transmission solutions within PJM's Order 1000 process. Transmission solutions were developed to address reliability needs as identified by PJM and were analyzed for steady state reliability performance using PSS/E and TARA. He also supported the strategic decision-making associated with identifying evaluated transmission solutions to be submitted to PJM within the proposal window.

SPP 2017 ITP10 Staff Augmentation / Southwest Power Pool

Southwest Power Pool Market / 2016-2017

Project manager for an independent study supporting the Southwest Power Pool's Economic Planning team. The project support was provided as staff augmentation and supported updates associated with the regional Integrated Transmission Plan Year 10 (ITP10) modeling. Model updates were incorporated, and reliability and economic transmission needs were identified and compared against a

prior version. This supported SPP staff in transmission project portfolio recommendations as part of their 2017 ITP10.

PJM 2016 RTEP Proposal Window #2 Support / Confidential Client

PJM Interconnection Market / 2016

Project manager for PJM's 2016 RTEP proposal window related to short term reliability issues. Matthew provided management and direction on planning, project evaluation, and proposal development of transmission solutions within PJM's Order 1000 process. Transmission solutions were developed to address reliability needs as identified by PJM and were analyzed for steady state reliability performance using PSS/E and TARA. He also supported the strategic decision-making associated with identifying evaluated transmission solutions to be submitted to PJM within the proposal window.

Alternative Technology Solution Planning / Smart Wires

South Australia / 2016

Project manager for supporting the evaluation of a market efficiency solution utilizing Smart Wires technology to support the integration of renewable generation and facilitate cost effective energy imports. The evaluation considered steady state comparison of solutions utilizing PSS/E comparing multiple dispatch and transfer scenarios. Results were presented to the transmission owner for consideration and submission to the regional market studies.

Alternative Technology Solution Planning / Smart Wires

MISO Market / 2016

Project manager for a project which considered the development of an alternative transmission reliability solution utilizing Smart Wires technology. This included a steady state evaluation and comparison of solutions using PSS/E. The Smart Wires solution was ultimately selected in lieu of the previously approved transmission solution.

Unregulated Generation and Transmission Development Support / Confidential Clients

Puerto Rico / 2016-2017

Provided expert witness testimony and strategic consulting related to the development of a comprehensive generation and transmission solution by a third-party utility consortium. He advised both generation and transmission strategy throughout the course of the project.

Integrated Resource Plan Regulatory Filing Support / Vectren Corporation

Indiana / 2016

Project manager who worked collaboratively with client's staff to develop long range resource plans in the framework of a public utility commission-filed Integrated Resource Plan. Matthew provided strategic and planning support in a variety of analysis applications and public meeting presentations. The analysis included consideration of both supply and demand-side options using the Strategist and PROMOD IV production cost modeling software. The IRP process included several public meetings and development of a regulatory filing report.

SPP 2017 ITP10 Transmission Project Development Support / Confidential Client

Southwest Power Pool Market / 2016

Project manager for a utility client in support of developing proposed transmission projects to be submitted in SPP's 2017 ITP10 regional transmission expansion plan and Order 1000 process. Proposed transmission projects were analyzed and developed to address reliability, public policy, or economic needs as identified as part of SPP's 2017 ITP10 assessment. The study considered projects across multiple futures and included analysis developed through multiple software platforms including PSS/E and PROMOD Nodal software.

PJM 2016 RTEP Proposal Window #1 Support / Confidential Client

PJM Interconnection Market / 2016

Project manager for PJM's 2016 RTEP proposal window related to short term reliability issues. Matthew provided management and direction on planning, project evaluation, and proposal development of transmission solutions within PJM's Order 1000 process. Transmission solutions were developed to address reliability needs as identified by PJM and were analyzed for steady state reliability performance using PSS/E and TARA. He also supported the strategic decision-making associated with identifying evaluated transmission solutions to be submitted to PJM within the proposal window.

Western New York Public Policy Transmission Need Project Solicitation Support / Confidential Client

NYISO Market / 2015

Project manager for a team supporting the development and evaluation of proposed transmission projects that address the public policy transmission needs identified by the New York ISO (NYSO). The study included analysis of combined generation and transmission solutions. Both AC and DC transmission solutions were evaluated and compared to sufficiency criteria as defined by the NYISO. The study provided analysis through multiple software platforms including PSS/E and TARA.

Michigan Peninsula Transmission Connection Study / Confidential Client

Michigan / 2015

Project manager supporting the development and evaluation of proposed transmission projects that connect transmission facilities in the Lower and Upper Peninsulas of Michigan. The study was needed to support recommendations to a state approved Board responsible for reviewing potential transmission project options and associated project costs and benefits. The study included analysis of both AC and DC transmission solutions evaluating solution performance related to thermal and voltage violations, transfer capability, generation deliverability, resource adequacy, adverse impacts, and economic benefits. The study provided analysis through multiple software platforms including PSS/E, TARA, and PROMOD Nodal software.

Strategic Corporate Planning / Confidential Client

MISO Market / 2015

Project manager supporting strategic corporate planning initiatives related to future power supply investment decisions. This support included analysis that considered both aggressive customer-side initiatives as well as new conventional power supply as compared to costs associated with operation of the existing generation fleet while meeting future regulations including coal combustion residuals (CCR), effluent limitation guidelines (ELG), and the Clean Power Plan (CPP). A comparison of various power supply portfolios was studied using PROMOD and evaluated for multiple benefits including customer cost, shareholder return, and regulatory compliance.

RFP Design and Development Support / Minnesota Power

Minnesota / 2015

Project manager for strategic consulting through participation and leading a client steering committee dedicated to the development of an RFP for a combined cycle facility to be available in the early 2020 timeframe. The RFP and bid evaluation factors stipulated within the RFP were developed with design parameters related to reliability and plant availability in mind. The RFP process was designed to create a fair and open process in which to compare Minnesota Power's self-build generation alternative to other similar market offerings and garner approval from the public utility commission.

Integrated Resource Plan Regulatory Filing Support / Minnesota Power

Minnesota / 2015

Project manager working collaboratively with Minnesota Power's planning staff to develop a long range resource plan. The study provided strategic and planning support in a variety of analysis applications considering long term operation and shut down alternatives for existing power supply as well as new supply and demand side alternatives. The analysis considered various scenarios related to future regulatory and other uncertainties using the Strategist production cost modeling software. The IRP was filed with and approved by the Minnesota Public Utility Commission (Docket No. E015/RP-15-690).

SPP 2016 ITPNT (Near Term) Transmission Project Development Support / Confidential Client

Southwest Power Pool Market / 2015

Project manager supporting a utility in developing proposed transmission projects to be submitted in SPP's 2016 ITPNT regional transmission expansion plan. Proposed transmission projects were analyzed and developed to address reliability needs as identified by SPP. The study considered projects across multiple futures and included analysis developed through PSS/E and TARA power flow modeling software.

PJM 2015 RTEP Proposal Window #1 Support / Confidential Client

PJM Interconnection Market / 2015

Project manager for a team of system planners and engineers to support a utility in developing proposed transmission projects to be submitted in PJM's 2015 RTEP proposal window related to short term reliability issues. Transmission solutions were developed to address reliability needs as identified by PJM and were analyzed for steady state reliability performance using PSS/E and TARA. Matthew also supported the strategic decision-making associated with identifying evaluated transmission solutions to be submitted to PJM within the proposal window.

Great Northern Transmission Line Certificate of Need Filing Support / Minnesota Power

Minnesota / 2015

Project manager working collaboratively with Minnesota Power's planning staff to evaluate and quantify the customer benefits associated with ownership of a proposed 500kV transmission line. The analysis included consideration of generation alternatives versus the new transmission and associated access to Canadian markets and energy. The environmental attributes associated with the generation mix procured as a result of the new transmission line were also considered. The Certificate of Need was filed with and approved by the Minnesota Public Utility Commission (Docket No. E015/CN-12-1163).

Ongoing Resource Planning and Software Consulting / Minnesota Power

Minnesota / 2011-2015

Matthew has provided ongoing consulting support to Minnesota Power's Resource Planning Department on a variety of analyses topics. The primary focus of Matthew's support includes economic evaluation of detailed production cost modeling, resource expansion, environmental compliance, and strategic long-range planning. Most of his support is related to regulatory filings. Analyses are typically developed comparing PVRR and annual cash flow comparisons.

PJM 2014/15 RTEP Proposal Window Support / Confidential Client

PJM Interconnection Market / 2014-2015

Project manager for a team of system planners to support a transmission company in developing proposed transmission projects to be submitted in PJM's 2014/15 RTEP project proposal windows. This support included two 30-day proposal windows focused on short term reliability issues and a third long term (120 day) proposal window focused on reliability and market efficiency issues. Transmission solutions were developed to address reliability or market efficiency needs as identified by PJM. Reliability projects were analyzed for steady state reliability performance using PSS/E and TARA. Market efficiency projects where studied using PROMOD Nodal software and evaluated on a benefit to cost ratio basis with benefits calculated according to PJM protocol. Matthew also supported the strategic decision-making associated with identifying evaluated transmission solutions to be submitted to PJM within the proposal window.

ERCOT Regional Planning Group Studies / Confidential Client

ERCOT Market / 2014-2015

Project manager for a study looking at potential transmission expansion options in West Texas to be submitted as part of ERCOT's Regional Planning Group (RPG). The study considered the development of transmission projects to address reliability issues associated with increased load from oil and gas production and increased generation from renewable energy projects. Various software programs were used for the analysis and evaluation of transmission solutions including PSS MUST and PSS\E.

Integrated Resource Plan / Pedernales Electric Cooperative

Texas / 2014-2015

Project manager for a long-range integrated resource plan for Pedernales Electric Cooperative, the largest electric distribution cooperative in the United States. The analysis considered various power supply and customer demand side options supplementing a partial requirements energy contract under varying scenarios. The analysis helped the utility's short-term and long-term energy purchase strategy, distributed energy resource deployment, and market coincident peak demand management. The study deliverables included a final report and multiple Board presentations.

Value of Solar Tariff Analysis / Minnesota Power

Minnesota / 2014

Provided consulting support to Minnesota Power's Resource Planning Department in regard to an approved methodology for calculating a uniform value of solar (VOS)

tariff. Consulting support included developing or consolidating all components necessary to calculate the VOS as prescribed. The study also provided information to support Minnesota Power in recommendations for change regarding the appropriate methodology and assumptions basis for a VOS tariff applied to Minnesota Power's customers. The study ultimately helped Minnesota Power calculate their VOS and provided a detailed overview of the inputs required to calculate all of the components that make up the tariff rate as prescribed.

SPP 2015 ITP10 Transmission Project Development Support / Confidential Client

Southwest Power Pool Market / 2014

Project manager supporting a utility client in developing proposed transmission projects to be submitted in SPP's 2015 ITP10 regional transmission expansion plan. Proposed transmission projects were analyzed and developed to address reliability, public policy, or economic needs as identified as part of SPP's 2015 ITP10 assessment. The study considered projects across multiple futures and included analysis developed through multiple software platforms including PSS/E and PROMOD Nodal software.

Integrated Resource Plan Regulatory Filing Support / Vectren Corporation

Indiana / 2014

Project manager who worked collaboratively with client's staff to develop long range resource plans in the framework of a public utility commission-filed Integrated Resource Plan. Matthew provided strategic and planning support in a variety of analysis applications and public meeting presentations. The analysis included consideration of both supply and demand-side options using the Strategist and PROMOD IV production cost modeling software. The IRP process included several public meetings and development of a regulatory filing report.

MATS Compliance Regulatory Filing Expert Witness Testimony Support / Vectren Corporation

Indiana / 2014

Provided expert witness testimony support on behalf of Vectren Corporation to the Indiana Utility Regulatory Commission related to filing Cause No. 44446. His testimony supported the client's capital investment decision regarding compliance for the Mercury and Air Toxics Standards (MATS). The utility's investment decision was ultimately supported and approved by the IURC.

High Priority Incremental Load Study / Southwest Power Pool

Arkansas / 2013-2014

Project manager in support of a special study commissioned by Southwest Power Pool and its Members. The purpose of the study was to evaluate reliability and economic transmission expansion projects to support incremental load growth related to oil and natural gas drilling and exploration. The study considered a range of load scenarios over multiple years and included analysis developed through multiple software platforms including PSS/E and PROMOD Nodal software.

Environmental Compliance Resource Planning and Regulatory Consulting / Arizona Electric Power Cooperative

Southwest / 2013-2014

Project manager that supported a generation and transmission cooperative client in the southwest. The analysis supported regulatory filings and provided the foundational basis for long range capital planning decisions at existing assets. The analysis involved long range investment decisions of multiple operating configurations and included multiple project stakeholders. The study was filed with the Arizona Corporation Commission (Docket No. E-01773A-12-0305).

Integrated Resource Plan Regulatory Filing Support / Minnesota Power

Minnesota / 2013

Project manager supporting the development and documentation of an integrated resource plan regulatory filing. This project included strong collaboration with client's staff throughout all aspects of the study including base and sensitivity assumption development, scenario development for risk analysis, modeling and summarizing benefits and costs associated with various resource plans. Matthew provided strategic and planning support in a variety of analysis applications including consideration of both supply and demand-side options using Strategist, an industry standard production cost modeling software program. The IRP was filed with and approved by the Minnesota Public Utility Commission (Docket No. E015/RP-13-53).

Wind Farm Congestion and LMP Forecasting / Nordex-USA, Inc.

Southwest Power Pool Market / 2013

Project manager for a project that predicted medium and long-term LMP projections and generation curtailment for a potential wind farm and several potential off takers in the Southwest Power Pool. The analysis was based on long range models using PROMOD Nodal that included future transmission projects and generation as included in regional transmission organization transmission expansion plans. Study assumptions were primarily based on SPP planning assumptions and models. Upon completion of the Study, our team prepared a formal report with conclusions that was used in support of marketing the potential wind farm project.

Due Diligence Economic Evaluation Support / Perennial Power Holdings, Inc.

Multiple Locations / 2013

Provided economic analysis for a developer / investment client in support of generation asset purchase / acquisition due diligence activities. The analysis consisted of review and development of long-range project pro formas representing predicted cash flows. Project markets included PJM and ERCOT. Detailed spreadsheet summaries for evaluation purpose were developed representing an income statement and statement of cash flows. NPV and IRR were key metrics used for project comparison.

Generation Expansion and Long-Range Transmission Study / Southwest Power Pool

Arkansas / 2012-2013

Provided software expertise and analysis support to Southwest Power Pool's Economic Planning group to determine long range generation expansion plans throughout the eastern interconnect with a focus on the SPP footprint. The expansion plans were used in the ITP20 transmission assessment to analyze the benefits of future transmission projects using security constrained unit commitment and economic dispatch with PROMOD Nodal software.

Generation Fleet LMP Forecasting / Alliant Energy

Iowa / 2012

Project manager for a project that developed medium and long-term LMP forecasts at specific nodes for an investor-owned utility that operates within the MISO transmission system. The analysis used security constrained economic dispatch to provide information assisting in the determination of estimated economic benefit for various existing and potential generation assets. The long range LMP forecasts included future transmission projects and generation as outlined in regional transmission organization transmission expansion plans and was based on MISO transmission models. The analysis was performed using PROMOD Nodal software.

Baseload Diversification Study Regulatory Filing / Ottertail Power Company

Minnesota / 2012

Worked collaboratively with client's staff to develop long range resource plans in the framework of a public utility commission-ordered Baseload Diversification Study. Matthew provided strategic and planning support in a variety of analysis applications. The primary focus of the study was to consider the benefit to utility ratepayers of fuel diversification over a long-range study period. The analysis considered new build alternatives as well as several environmental retrofit configurations at existing generation assets under defined future environmental regulatory scenarios using Strategist. The Baseload Diversification Study was filed with and approved by the Minnesota Public Utilities Commission (Docket No. E017/RP-10-623).

Generation Asset Valuation Study / CPS Energy

Texas / 2012

Aided with near-term resource planning regarding capital project spending for a municipal utility in Texas. The focus of the study was to develop economic analysis and unit valuation for justification of long-range plant expenditures related to improved reliability and unit availability. Matthew helped analyze various long-range scenarios through use of the Strategist production cost modeling software.

Baseload Diversification Study Regulatory Filing / Minnesota Power

Minnesota / 2011-2012

Project manager who worked collaboratively with client's staff to develop long range resource plans in the framework of a public utility commission-ordered Baseload Diversification Study. Matthew provided strategic and planning support in a variety of analysis applications. The primary focus of the study was to consider the benefit to

utility ratepayers of fuel diversification over a long-range study period. The analysis considered new build alternatives as well as the potential retirement of existing generation assets under a variety of environmental regulatory scenarios using Strategist. The Baseload Diversification Study was filed with the Minnesota Public Utilities Commission (Docket No. E015/RP-09-1088).

Long Range Transmission Study Staff Augmentation / Southwest Power Pool

Arkansas / 2011

Matthew served as supplemental staffing to Southwest Power Pool's Economic Planning group to provide support in the evaluation of long-range high voltage transmission projects for their ITP10 transmission expansion plan. The analysis considered the benefits of reduced congestion, reduced losses, and increased reliability against the potential project costs using security constrained unit commitment and economic dispatch with PROMOD Nodal software.

Joint Planning & Operations Study / Sunflower Electric Power Corp. & Golden Spread Electric Cooperative

Kansas & Texas / 2011

Project manager for a long-term resource planning study with two cooperatives in the lower Midwest. Matthew provided planning support to both utilities to quantify potential benefits of a virtual integration. The analysis considered new build alternatives as well as transmission consideration for integrated operations using the Strategist and PROMOD IV production cost modeling software.

Generation Asset Retirement and New Technology Evaluation Update / Austin Utilities

Minnesota / 2011

Project manager for a long-term economic feasibility study for a municipal utility in the upper Midwest. The analysis included development of long-range pro formas that considered the integration of simple cycle generation against wind production at an existing node. The analysis helped the utility's short-term resource planning and decision making regarding the existing generation facility and consideration of power development alternatives.

Integrated Resource Planning / Lafayette Utilities System

Louisiana / 2011

Supported integrated resource planning and analysis with a large municipal utility in the Southeast. The analysis included various unit retirements options as well as new build and re-power of existing resources under various environmental compliance scenarios. The analysis helped the utility's short-term and long-term resource planning and decision making around the impact to the existing generation fleet from potential future environmental regulations.

Resource Purchase Evaluation Study / Kansas Power Pool

Kansas / 2011

Project manager for a planning study for multiple municipalities in the Midwest. Matthew helped analyze the economic impact of pursuing joint ownership of a generation resource versus smaller individual based projects for various generation technologies using the Strategist production cost modeling software. Economic and feasibility screening analysis was provided over a study period of 20 years.

Integrated Resource Plan and Regulatory Filing Support / Wyoming Municipal Power Agency

Wyoming / 2011

Project manager for an integrated resource planning study for a municipal power agency in the Mountain west. The IRP was prepared pursuant to the requirements of Federal Register Notice 10 CFR Part 905 in support of submittal to the Western Area Power Administration as a purchaser of federal power. The analysis included consideration of both supply and demand-side options using the Strategist and PROMOD IV production cost modeling software. The IRP process included several public webinars and public involvement. The IRP was submitted to and approved by the Western Area Power Administration.

Integrated Resource Planning / Minnesota Power

Minnesota / 2010-2011

Supported integrated resource planning and analysis with an investor-owned utility in the upper Midwest. His assistance included benchmarking production cost

modeling output based on previous analysis and support of long-range integrated resource planning analysis. The analysis included various unit retirements options as well as new build and power purchase alternatives. The analysis helped the utility's short-term and long-term resource planning and decision making around the least cost plan compared to alternatives reducing the utilities coal-based generation.

Generation Asset Retirement Review / Westar Energy

Kansas / 2010

Performed a 10-year economic analysis for an investor-owned utility in the Midwest considering various levels of capital investments required under different environmental regulatory scenarios. The study analyzed potential retirement dates of older resources within the utility's fleet as well as fuel switching to natural gas or installing pollution controls equipment to comply with expected environmental regulations. The study provided mid-range planning direction while balancing retirement considerations as well as the potential new capital investment required in future environmental regulations. Use of Strategist and PROMOD IV software was used in the study.

Generation Asset Retirement and New Technology Evaluation / Otter Tail Power Co.

Minnesota / 2010

Performed a long-term economic analysis for an investor-owned utility in the upper Midwest for various generation alternatives at an existing power station using PROMOD IV. The analysis included various repower scenarios including fuel switching to natural gas or installing pollution controls equipment to comply with expected environmental regulations. The analysis helped the utility's short-term and long-term resource planning and decision making around the existing generation facility.

Demand Side Management Study / Sunflower Electric Power Corp.

Kansas / 2010

Project manager for the study of demand side management options to reduce a client's native peak load through demand response or direct load control programs. The options considered included residential A/C and electric hot water heater, irrigation, and oil well load control. The load control programs were evaluated over a 20-year study period and various future scenarios were evaluated to determine the robustness of the study results.

Demand Side Management and Long-Term Power Supply Planning / Manitowoc Public Utilities

Wisconsin / 2010

Provided long term integrated resource planning assistance for a municipal utility in the Upper Midwest. He helped analyze the benefit/cost ratios for multiple conservation and peak reduction demand side management programs in the residential sector. The benefit/cost ratio screening analysis was provided over the life of the programs. A review of the client's modeled supply side analysis was also performed, along with assistance integrating the supply and demand side analysis.

Preliminary Joint Resource Planning Study / Kansas Municipal Utilities

Kansas / 2010

Provided long term planning assistance for multiple municipalities in the Midwest. He helped analyze the economic cost impact of pursuing larger joint ownership generation resources or smaller individual based projects for various generation technologies ranging from gas-fired peaking to baseload options through PROMOD IV and Strategist production cost modeling software. Economic and feasibility screening analysis was provided over a study period of 20 years.

Renewable Energy Resources Alternatives Study / Great Lakes Utilities

Wisconsin / 2010

Provided long term resource planning assistance regarding state and federal regulatory requirements for a client in the Upper Midwest. He helped analyze the feasibility and economic cost impact of building various renewable energy generation projects including biomass, wind, solar, and low impact hydro options. Economic and feasibility screening analysis was provided over the life of the projects.

Generation Asset Retirement and New Technology Evaluation / Austin Utilities

Minnesota / 2010

Provided a long-term economic feasibility study for a municipal utility in the upper Midwest for various generation

alternatives at an existing power station. The analysis included a comparison of resource production costs compared to forecasted long-term fuel and wholesale market energy prices over a 20-year period. The analysis helped the utility's short-term resource planning and decision making regarding the existing generation facility.

Asset Valuation Study / Corn Belt Power Cooperative

Iowa / 2010

Project manager for a project that provided the estimated fair market value of multiple generation and transmission distribution assets for a power cooperative in the Midwest. The present and future worth of the assets was forecasted using the income and reproduction cost approaches over a 20-year period. The assets' fair market value was used to assist in negotiations for fair compensation after the termination of power pooling contracts.

Generation Resource Planning / Sunflower Electric Power Corp.

Kansas / 2008-2010

Provided long term planning assistance for a generation and transmission cooperative in the Midwest. He helped analyze the economic cost impact of building various generation technologies ranging from gas-fired peaking to baseload options through Strategist, a resource optimization and production cost modeling program. Economic and feasibility screening analysis was provided over a study period of 20 years.

Gas Generation Technology Assessment / Fayetteville Public Works Commission

North Carolina / 2009

Provided a long-term economic feasibility study for various generation alternatives for a municipal utility in the Mid-Atlantic region. The analysis included forecasting long-term fuel and wholesale market energy prices over a 20-year period and comparing the economic benefits of generation alternatives to market-based energy. The analysis helped the utility's short-term resource planning and decision making.

Rate Impact Analysis / Corn Belt Power Cooperative

Iowa / 2009

Assisted a Midwest client with analyzing economic impact to its members under several different potential future conditions through the use of PROMOD IV hourly dispatch model. Rate analysis included scenarios where the client became a Class A ratepayer of another cooperative or continued standalone operations and remained independent. Analyses included operational and regulatory risks.

Generation Asset Retirement Study / CPS Energy

Texas / 2008

Aided with near-term resource retirement planning for a municipal utility in Texas. He helped analyze various long-range scenarios through use of the Strategist production cost modeling software. Scenarios were modeled to mirror expected conditions as well as bias the advantages of existing resources studied for retirement consideration. Along with long-range integrated production cost-planning, Matthew helped develop a spreadsheet tool that the client could use to monitor future conditions and make high level resource retirement decisions.

Fair Market Valuation Assessment / Prairie Power, Inc.

Illinois / 2008

Provided an estimate of the fair market value of several units in the client's generating fleet by forecasting the present worth of future cash flows based on expected and forecast maintenance, production costs, and other fixed and regulatory costs over a nine-year period. The assets' fair market value was used to aid in negotiations with member cooperatives considering cancellation of their wholesale power supply contracts.

Generation Resource Planning / Dairyland Power Cooperative

Wisconsin / 2008

Provided long term planning assistance for a client in the upper Midwest. He helped analyze the economic cost impact of building various generation technologies ranging from gas-fired peaking to baseload options using Strategist software. Economic and feasibility screening analysis was provided over a study period of 20 years and sensitivity analyses related to load growth, carbon regulation scenarios, and commodity prices were performed.

Demand Side Management Program Training and Analysis / Dominion Resources Services, Inc.

Virginia / 2008

Aided with long term power supply planning for a municipal utility in the Midwest. He helped analyze various scenarios ranging from contract purchase power pricing to the addition of self-built generating options including wind and repowering existing gas-fired peaking resource options through spreadsheet production cost modeling analysis. Economic and feasibility screening analysis was provided over a study period of 20 years.

Production Cost Modeling / South Mississippi Electric Power Association

Mississippi / 2007-2009

Provided resource planning assistance for client by modeling multiple supply and demand management alternatives including baseload, intermediate, peaking, and renewable resources. He provided economic screening analysis of the best alternatives identified through production cost modeling using Strategist and PROMOD IV software. Also reviewed sensitivity to cost estimates, fuel and other assumptions to evaluate both near term and long-term issues.

Power Supply Planning / Rochester Public Utilities

Minnesota / 2007-2008

Aided with long term planning for a client in the upper Midwest. He helped analyze various scenarios ranging from contract purchase power pricing to the addition of self-built generating options including wind to meet state mandated renewable portfolio standards and gas-fired peaking resource options through hourly production cost modeling using PROMOD IV software. Economic and feasibility screening analysis was provided over a study period of 25 years.

Siting Studies / Southwest Public Power Resources Group

Southwest / 2007

Provided assistance with comprehensive strategic siting services that involved identifying suitable locations throughout the Southwest for a large coal-fired facility as well as natural gas-fired resources including combined and a simple cycle combustion turbine facility. Services provided include site identification and selection, management of environmental review, economic and technical screening analyses, and site recommendations.

Integrated Resource Planning / City of Columbia

Columbia, Missouri / 2007

Provided comprehensive resource planning assistance with supply and demand-side alternatives for a municipal utility in the Midwest. He developed a production cost model of existing resources and tested the economic feasibility of adding demand management programs, baseload, intermediate, peaking, and renewable resources to meet client's projected energy demand growth using Strategist and PROMOD IV software. Also reviewed sensitivity to cost estimates, fuel and other assumptions of the optimal alternatives having both near term and long-term generation implications.

Power Supply Study / Midwest Energy, Inc.

Kansas / 2007

Aided with ongoing future supply options for client by modeling various generation and contract capacity alternatives. Feasibility of alternatives was analyzed based on the hourly production costs determined through use of PROMOD IV software. Analysis provided over near term, five-year study period.

Avoided Cost Study / Corn Belt Power Cooperative

Iowa / 2006-2008

Assisted client with contract planning for a wind generation resource by establishing the utility's hourly avoided cost over a one-year period. He determined the avoided cost by modeling the hourly production cost of the client's generation portfolio using PROMOD IV planning software. The resulting avoided cost was used to determine an appropriate energy price for a wind generation contract.

Power Supply Study / Corn Belt Power Cooperative

Iowa / 2006

Aided with updating a previous resource expansion plan for Corn Belt Power Cooperative. He helped analyze the addition of wind, gas, and coal-based resource options through hourly production cost modeling using PROMOD IV. Reviewed sensitivities to cost estimates, fuel and other

assumptions and analyzed both near term and long-term issues.

Peaking Review Study / Fayetteville Public Works Commission
North Carolina / 2006

Provided assistance with the review of best generation alternatives to meet load demand above the utility's contract rate of delivery from the market. The review was done by modeling the client's system using PROMOD IV software to analyze a variety of simple cycle and combined cycle generation alternatives and identifying trade-offs between start costs and operating efficiencies.

Coal-Fired Power Plant Siting Study / Arkansas Electric Cooperative Corp.
Arkansas / 2006

Assisted with the strategic evaluation of locating a coal-fired power plant site in Arkansas. He aided with site identification, mapping, environmental review, technology assessment, and economic analysis of options.

Solid Fuel-Fired Power Plant Feasibility Study / Old Dominion Electric Cooperative
Mid-Atlantic Region / 2006

Assisted a client with strategic site evaluation for locating a coal-fired power plant in the mid-Atlantic region of the east coast. He aided with site identification and evaluation, mapping, environmental review, economic analysis, and technology assessment.

Coal-Fired Cost Estimate / Progress Energy
North Carolina/Florida / 2006

Project manager tasked with providing performance and cost estimates for a baseload and intermediate power projects located in North Carolina and Florida. The project provided estimates for plant performance and costs including capital investment, fixed and variable operation and maintenance expenses.

Siting Study and Technology Assessment / Arizona Public Service
Arizona/New Mexico / 2005-2006

Assisted APS with a strategic siting evaluation study that involved locating a large, multi-unit coal-fired facility in the Southwest. Services provided include site identification and selection, transmission analysis management, environmental review, and technology assessment.

Siting Studies / Westar Energy, Inc.
Kansas / 2005-2006

Assisted Westar with strategic siting services that involved locating both a large, multi-unit coal-fired facility and a simple cycle combustion turbine peaking facility in Eastern Kansas. Services provided include site identification and selection, and management of environmental review and technology assessment.

Baseload Feasibility Study / Wisconsin Public Power, Inc. and Madison Gas & Electric Co.
Wisconsin / 2005

Assisted with a feasibility study for locating a multi-unit, solid fuel-fired generation facility in Wisconsin. The study included site identification and selection, environmental review, and technology assessment.

Due Diligence Evaluation / Old Dominion Electric Cooperative
Virginia / 2004

Assisted the client with an asset due diligence study of a simple cycle peaking power plant on the east coast. He reviewed much of the material agreements as well as operational data to assist the client in the bidding process. A summary report of this due diligence was also prepared.

Joint Baseload Feasibility Study / Wisconsin Public Service and Wisconsin Power & Light
Wisconsin / 2004

Assisted with a siting study of a coal-fired generation station located in Wisconsin. The siting study involved mapping assessment, infrastructure assessment, environmental analysis, and field verification of the mapping and infrastructure results.

Coal-Fired Power Plant Siting Study / Ameren UE
Missouri / 2004

Assisted in a strategic siting evaluation for a potential coal-fired generation station located in Missouri. The siting

study consisted of detailed analysis of land availability, fuel delivery and transmission infrastructure, water resources and availability, and environmental impacts of the potential coal-fired power plant.

Exhibit B

KIERAN MCINERNEY, PE, CEM

Project Development Manager – Energy Storage and Generation

As a project manager and consultant on Burns & McDonnell's Energy Storage Team, Mr. McInerney has experience in energy storage, generation, and demand side energy management. His duties include project management, technical feasibility, economic analysis, conceptual design, cost estimating, and strategic planning related to the development of energy storage and generation projects, as well as resource planning. He is also skilled in energy program management and strategic demand side management.

EDUCATION

- BS, Mechanical Engineering, Marquette University, 2003

REGISTRATIONS

- Professional Engineer (Colorado)
- Certified Energy Manager (CEM), Association of Energy Engineers

AWARDS/PUBLICATIONS

- Federal Energy and Water Management Award, U.S. Department of Energy, 2013
- Publications (See Section Below)

SPECIALTIES

- Project Development
  - Energy Storage
  - Renewables
  - Gas/liquid fueled
- Project Management
- Feasibility and Technology Studies
- Economic Evaluation
- Energy Storage System Modeling
- Capital and O&M Cost Estimating
- Strategic Planning

7 YEARS WITH BURNS & MCDONNELL

17 YEARS OF EXPERIENCE

Microgrid Feasibility Assessment | Confidential Utility

June 2020 – September 2020

Project Manager for a microgrid feasibility assessment for a geographically isolated distribution system in California using solar and storage technologies. The microgrid was intended to increase renewable energy on the system, reduce reliance on purchased power, and support the utility's customers during a potential Public Safety Power Shutoff (PSPS) event. Responsibilities included system modeling, storage technology evaluation, conceptual engineering, capital cost estimates, and O&M cost estimates.

Energy Storage Use Case Analysis | Confidential Utility

May 2020 – July 2020

Technical Lead for an energy storage use case economic analysis. The study identified and analyzed multiple use cases for energy storage at an existing generating facility in Kentucky, including behind-the-meter (BTM) and front-of-meter (FOM) options. Developed an economic model to determine net present value of the battery facility based on capital cost, O&M costs, demand charge savings for BTM applications, revenue potential for FOM applications, charging costs, and unique site constraints.

Solar Plus Storage Project Development | Confidential IPP

May 2020 – June 2020

Technical Lead for engineering support of two solar plus storage developments in Georgia. Responsibilities included system modeling and conceptual design for a solar smoothing application. The model shapes the system to maintain desired ramp rates at the point of interconnection based on the PV output, battery size, state of charge, and cycling constraints, and system losses.

KIERAN MCINERNEY, PE, CEM

(continued)

Solar Plus Storage Project Development | Confidential Utility

May 2020 – June 2020

Technical Lead for engineering support of three solar plus storage sites in Texas. Responsibilities included system modeling to shape the system output based on locational marginal pricing, PV output, POI interconnection limits, state of charge, system losses, and cycling constraints.

Generation and Storage Technology Assessment for Demand Curve Reset | NYISO

December 2019 – November 2020

Technical Lead for peaking generation and energy storage inputs to the 2021-2025 NYISO Demand Curve Reset (DCR). The DCR study involved evaluating performance, capital cost, and O&M cost information for lithium-ion storage, simple cycle gas turbine, and combined cycle technologies in New York. Responsibilities included stakeholder engagement, report development, capital cost estimate, O&M cost estimate, and performance estimate activities.

Energy Storage Feasibility Study | Confidential Utility

November 2019 – March 2019

Project Manager for an energy storage feasibility study in South Carolina. The study identifies use cases, system sizing, costs, and risks for a non-wires alternative to transmission system upgrades. Responsibilities include project management, use case development, system sizing, storage technology evaluation, conceptual engineering, capital cost estimates, and O&M cost estimates.

Lithium-ion Battery Product Consultation | Confidential OEM

December 2019 – January 2020

Consultant on a team supporting a lithium-ion battery OEM as they establish and/or update design guidelines, installation manuals, and O&M manuals. The primary focus of Burns & McDonnell's support was consultation on fire safety in product and system designs. Mr. McInerney' s responsibilities included research and consultation on fire safety designs in building-based and containerized applications.

Generation and Storage Technology Assessment | Duke Energy

October 2019 – February 2020

Project Manager for a generic unit assessment study evaluating multiple energy storage technologies, distributed generation technologies, and utility scale generation technologies including simple cycle, reciprocating engine, combined cycle, landfill gas, wind, solar. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Lithium-ion Project Development | Confidential IPP

November 2019 – December 2019

Project Manager for engineering support of a 10MW / 40MWh lithium-ion project development in New York. Responsibilities included project management and support for environmental studies, conceptual system design, and capital cost estimates.

KIERAN MCINERNEY, PE, CEM
(continued)

Flow Battery Project Development | Confidential OEM
September 2019 – October 2019

Development Lead supporting a 20MW / 100MWh flow battery proposal for development in Pennsylvania. The initiative included product development and balance of plant design activities with a flow battery OEM. Responsibilities included project management and support for design, capital cost estimate, and O&M cost estimates.

Lithium-ion Project Development | Confidential IPP
November 2019

Development Consultant for a 200MW / 800MWh lithium-ion development in California. Responsibilities included system modeling and conceptual design support.

Lithium-ion Project Development | Confidential IPP
October 2019 – November 2019

Development Consultant for a 50MW / 200MWh lithium-ion development in Hawaii. Responsibilities included system modeling and HVAC sizing support.

Owner's Engineer for Lithium-ion Procurement | Confidential IPP
October 2019 – November 2019

Consultant for an Owner's Engineering project for an IPP procuring turnkey lithium-ion systems for multiple sites (approx. 1GWh total). Responsibilities included proposal reviews and life cycle cost evaluations.

Flow Battery and PV Project Development | Confidential Utility
August 2019 – October 2019

Development Lead for a microgrid development on a geographically isolated distribution system in California. The purpose of the microgrid is to support the utility's critical customers during a potential Public Safety Power Shutoff (PSPS) event. Responsibilities included system modeling, storage technology evaluation, conceptual engineering, capital cost estimates, and O&M cost estimates.

Flow Battery and PV Project Development | Confidential OEM
August 2019 – November 2019

Development Lead supporting development of flow battery and PV integration at manufacturing site. Systems would be integrated with existing onsite wind turbine and demand response initiatives. The initiative included product development and balance of plant design support with a flow battery OEM. Responsibilities included project management, economic evaluation, technology evaluation, conceptual engineering, and capital cost estimate activities.

Energy Storage Development | Confidential IPP
September 2018 – January 2020

Development Lead supporting IPP's development of a multi-GWh energy storage project site including lithium ion and flow battery technologies. Responsibilities include strategic planning and technical support for permit applications, project scoping, technology selection, site layout, and capital cost estimates.

KIERAN MCINERNEY, PE, CEM
(continued)

Energy Storage and Solar Study | Confidential IPP
April 2019 – July 2019

Technical Lead for the evaluation of a 70 MW solar plus 35 MW / 140 MWh storage development in California. The goal of the study was to compare the cost and performance of AC vs. DC connected systems and distributed vs. centralized systems. Responsibilities included modeling the PV and BESS performance while providing support for capital cost and conceptual design activities.

Flow Battery Product Development Support | Confidential OEM
August 2018 – March 2019

Project Manager for an EPC consulting study for a confidential flow battery manufacturer. The goal of the study was to support the manufacturer's efforts in commercializing its product through evaluation of balance of plant design/construction options. Mr. McInerney led a diverse team to provide technical and capital cost input on electrolyte storage designs, balance of plant systems, and construction/manufacturing strategies.

Generation and Storage Technology Assessment | Duke Energy
October 2018 – February 2019

Project Manager for a generic unit assessment study evaluating multiple energy storage technologies, distributed generation technologies, and utility scale generation technologies including simple cycle, reciprocating engine, combined cycle, landfill gas, wind, solar. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Renewable Energy and Storage Technology Assessment | PacifiCorp
August 2018 – September 2018

Energy Storage Lead for a storage and renewable energy technology assessment to support resource planning for a Western USA utility. Responsibilities included capital cost estimation, O&M cost estimation, and performance estimation for multiple storage technology options including lithium ion and flow battery technologies of varying capacities and locations.

Energy Storage and Generation Project Development | Confidential IPP
February 2018 – June 2018

Development Project Manager for a project development involving 50 MW / 200 MWh of energy storage, 20 MW fuel cell, and 50 MW natural gas generation options. Responsibilities included project management and support for technology evaluation, conceptual engineering, and capital cost estimate.

Generation Project Developments | Confidential Utility
July 2017 – July 2019

Project Manager for two generation development projects for the same client, each including solar PV and reciprocating engine technologies on military installations. Responsibilities include project management and consulting for site selection, technology evaluation, conceptual engineering, capital cost estimates, O&M cost estimates, permitting activities, and specification development.

KIERAN MCINERNEY, PE, CEM

(continued)

Microgrid Feasibility Study | Confidential Utility

January 2018 – April 2018

Project Manager for a microgrid feasibility study for a geographically isolated distribution system, including generation units with multiple fuels plus PV and energy storage systems. System electrical upgrades and controls were also included in the study. Responsibilities included project management and consulting for technology evaluation, performance, conceptual engineering, capital cost estimates, and O&M cost estimates.

Generation and Storage Technology Assessment | Duke Energy

October 2017 – February 2018

Project Manager for a generic unit assessment study evaluating simple cycle, reciprocating engine, combined cycle, nuclear, landfill gas, wind, solar, and battery storage technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Generation Project Development | Confidential Utility

September 2017 – November 2017

Development Engineer for a reciprocating engine development project. Responsibilities included support for project definition, engine technology selection, capital cost estimates, and O&M cost estimates.

Plant Life Assessment | Confidential Utility

July 2017 – September 2017

Project Manager for a life of plant assessment at a coal-fired generation facility. Responsibilities included project management, technical evaluation, economic analysis, and compliance review to support client's planning and budget objectives.

Generation Project Development | Confidential Utility

March 2017 – August 2017

Project Manager for a reciprocating engine development project. Responsibilities include project management and consulting for technology assessment, conceptual engineering, feasibility studies, capital cost estimates, O&M cost estimates, life cycle cost analyses, schedule development, and ongoing support for project development.

Generation Project Development | WEC Energy Group / UMERC

March 2016 – February 2017

Project Manager for two reciprocating engine development projects for Upper Michigan Energy Resources (UMERC), totaling 180 MW. Responsibilities included project management and consulting for technology assessment, conceptual engineering, specification development, generation technology selection, capital cost estimates, O&M cost estimates, life cycle cost analyses, schedule development, project definition, and support for O&M service agreement negotiations.

KIERAN MCINERNEY, PE, CEM

(continued)

Generation and Storage Technology Assessment | Tucson Electric Power

January 2017 – February 2017

Project Manager for a technology assessment study evaluating simple cycle, reciprocating engine, combined cycle, wind, solar, and battery storage technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Generation Feasibility Study | Confidential Utility

August 2016 – January 2017

Project Manager for a reciprocating engine feasibility study. Responsibilities included project management, feasibility studies, site selection studies, conceptual design, capital cost estimate support, and O&M cost evaluation.

Generation and Storage Technology Assessment | Duke Energy

November 2016 – February 2016

Project Manager for a generic unit assessment study evaluating simple cycle, reciprocating engine, combined cycle, nuclear, landfill gas, wind, solar, and battery storage technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Generation and Storage Technology Assessment | Basin Electric Power Cooperative

January 2017 – February 2017

Project Manager for a generic unit assessment study evaluating simple cycle, reciprocating engine, combined cycle, coal, nuclear, wind, solar, and battery storage technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Generation Technology Assessment | Oklahoma Gas & Electric

July 2016 – November 2016

Project Manager for a generic unit assessment study evaluating simple cycle, combined cycle, and reciprocating engine technologies for greenfield and brownfield applications. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Generation Project Development | Confidential IPP

March 2016 – May 2016

Technical Lead for development of a reciprocating engine generating station. Responsibilities included feasibility studies, technology selection, capital cost estimate support, and O&M cost evaluation.

Generation and Storage Technology Assessment | Duke Energy

January 2016 – April 2016

Project Manager for a generic unit assessment study evaluating simple cycle, combined cycle, coal, fuel cell, landfill gas, wind, solar, compressed air storage, and battery storage technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

KIERAN MCINERNEY, PE, CEM

(continued)

Generation and Storage Technology Assessment | Basin Electric Power Cooperative

January 2016 – April 2016

Project Manager for a generic unit assessment study evaluating simple cycle, reciprocating engines, combined cycle, coal, nuclear, wind, solar, and battery storage technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Generation and Storage Technology Assessment | Old Dominion Electric Cooperative

October 2015 – February 2016

Project Manager for a generic unit assessment study evaluating simple cycle, reciprocating engines, combined cycle, coal, landfill gas, wind, solar, hydroelectric, fuel cell, and battery storage technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Heat Rate Improvement Study | Confidential Utility

July 2015 – December 2015

Development Lead for a heat rate improvement study at a coal-fired generation facility. Responsibilities included technical evaluation, economic analysis, and compliance review for potential heat rate improvement technologies.

Generation Technology Assessment | Confidential Client

August 2015 – October 2015

Technical Lead for a generic unit assessment study evaluating simple cycle, combined cycle, and reciprocating engine technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Generation Technology Assessment | Central Electric Power Cooperative

July 2015 – October 2015

Technical Lead for a generic unit assessment study evaluating reciprocating engine and simple cycle gas turbine generation options for peak shaving. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Generation Project Development | Rochester Public Utilities

June 2015 – August 2015

Development Lead for a technology selection project including reciprocating engines and simple cycle gas turbines. Responsibilities included targeted technology assessment and capital budget development.

Generation Technology Assessment | Midwest Energy

July 2015 – September 2015

Technical Lead for a generic unit assessment study evaluating simple cycle, combined cycle, and reciprocating engine technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

KIERAN MCINERNEY, PE, CEM

(continued)

Plant Decommissioning Study | Confidential Client

April 2015 – May 2015

Development Lead for a power plant decommissioning study that encompassed the client's entire generation portfolio. Responsibilities included system analysis, logistics, and cost estimation.

Generation Technology Assessment | South Mississippi Electric Power Association

April 2015 – July 2015

Technical Lead for a generic unit assessment study evaluating simple cycle, combined cycle, and reciprocating engine technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Generation and Storage Technology Assessment | Duke Energy

January 2015 – April 2015

Development Manager for a generic unit assessment study evaluating simple cycle, reciprocating engines, combined cycle, coal, biomass, wind, solar, and battery storage technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, and performance estimation.

Generation and Storage Technology Assessment | Public Services Enterprise Group

November 2014 - January 2015

Technical Lead for a generic unit assessment study evaluating simple cycle, combined cycle, reciprocating engine, wind, solar, and battery storage technologies. Responsibilities included technical report, capital cost estimation, O&M cost estimation, performance estimation, and conceptual design.

Heat Rate Improvement Study | Confidential Utility

August 2014 – November 2014

Development Engineer for a heat rate improvement study at a coal-fired generation facility. Responsibilities included technical evaluation, economic analysis, and compliance review for potential heat rate improvement technologies.

Project Definition Report | Confidential Utility

May 2014 – October 2014

Development Engineer for an EPC project definition report of a simple cycle generation facility and a combined cycle generation facility. Responsibilities included project definition, specification development, performance evaluation, and cost estimating.

Boiler Fuel Conversion Analysis | Kansas City Power & Light Company

March 2014 – February 2015

Mechanical Lead for a boiler fuel conversion analysis at two existing coal-fired generation facilities. Responsibilities include technical evaluation, economic analysis, strategic planning, and conceptual design for converting coal-fired boilers to consume alternative fuels.

KIERAN MCINERNEY, PE, CEM

(continued)

Generation Technology Assessment | Duke Energy

January – April 2014

Development Manager for a technical assessment study evaluating simple cycle, reciprocating engines, combined cycle, integrated gasification combined cycle (IGCC), pulverized coal, biomass, wind, and solar generation technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, performance estimation, and conceptual design.

Emissions Controls Technology Assessment | Basin Electric Power Cooperative

October 2013 – April 2014

Development Engineer for a financial and technical evaluation of emissions control solutions for existing coal-fired boilers. Responsibilities include technical evaluation, economic analysis, strategic planning, and conceptual design for implementing NOx reduction technology.

Combined Cycle Development | Confidential Utility

November 2013 – January 2014

Development Engineer for an EPC capital cost estimate of a 1x1 natural gas combined cycle facility. Responsibilities included project definition, system evaluation, specification review, and capital cost estimation.

Generation and Storage Technology Assessment | Vectren Corporation

September 2013 – October 2013

Development Engineer for a technical assessment study evaluating simple cycle, reciprocating engines, combined cycle, IGCC, pulverized coal, biomass, wind, and solar generation technologies, plus energy storage technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, performance estimation, and conceptual design.

Generation and Storage Technology Assessment | Louisville Gas & Electric Company and Kentucky Utilities Company

September 2013 – October 2013

Development Engineer for a technical assessment study evaluating simple cycle, reciprocating engines, combined cycle, IGCC, pulverized coal, biomass, wind, and solar generation technologies, plus energy storage technologies. Responsibilities included project definition, capital cost estimation, O&M cost estimation, performance estimation, and conceptual design.

Energy Program Support | United States Coast Guard*

April 2010 – September 2013

Technical Lead and Project Engineer for the development and implementation of a holistic energy management program. Worked directly with the Coast Guard Energy Management Office Chief to provide technical support for the energy program, from the headquarters level to the site level. Activities included energy and water utility data analyses, energy data gap analyses, renewable energy feasibility studies, and development of an enterprise-wide utility data management solution, including procurement and implementation consulting. [+]

[+]Received a 2013 Federal Energy and Water Management Award from the U.S. Department of Energy for contributions to the U.S. Coast Guard enterprise-wide utility data management system.

KIERAN MCINERNEY, PE, CEM
(continued)

Net Zero Energy Implementation Plan | United States Air Force Academy*
April 2012 – October 2012

Project Manager and Technical Lead for the development of a plan to guide the Air Force Academy toward its net zero energy goal. The plan is based on a three-tiered net zero approach: culture/behavior, energy efficiency, and renewable energy generation. Included with the plan is a custom spreadsheet tool to perform dynamic projections of future energy consumption monitor progress toward net zero goals.

Energy Master Plan | U.S. Marine Corps Mountain Warfare Training Center*
October 2011 – April 2012

Project Manager and Technical Lead for the development of an energy master plan that received an EXCEPTIONAL ACASS rating from the Naval Facilities Engineering Command Southwest. The plan focuses on strategies to meet federally mandated energy and water reduction/sustainability targets, as well as identifying areas to improve energy security and reliability. Tasks included coordination with key facility personnel, energy and water utility data analyses, prioritization of conservation measures, renewable energy screening, GHG emissions analysis, and creation of an integrative and sustainable plan.

Energy Program Support | United States Air Force 21st Space Wing*
October 2011 – September 2012

Project Manager and Technical Lead for energy program support. Led the development of the Dynamic Energy Implementation Plan for the 21st Space Wing, which includes 6 geographically separate bases. The plan and associated spreadsheet tool monitor progress toward energy management goals. Future energy consumption is projected based on utility data and expected outcomes of planned energy projects and capital development projects. The project received an EXCEPTIONAL ACASS rating.

Energy Master Plan | U.S. Marine Corps Recruit Depot*
October 2010 – September 2011

Technical Lead for the development of an energy master plan that received an EXCEPTIONAL ACASS rating from the Naval Facilities Engineering Command Southwest. The plan focuses on strategies to meet federally mandated energy and water reduction/sustainability targets and prioritizing existing conservation opportunities. Tasks included coordination with key facility personnel, energy and water utility data analyses, prioritization of conservation measures, renewable energy screening, greenhouse gas emissions analysis, and creation of an integrative and sustainable energy master plan.

Energy Efficiency Project Plans | Puerto Rico Department of State and Governor's Pavilion*
March 2011 – May 2012

Technical Lead for the development of energy master plans for two government complexes in San Juan, Puerto Rico. Tasks included analyses of current energy usage, energy audits, technical and financial analyses of energy conservation measures, renewable energy feasibility studies, and strategic planning measures for implementation of short, mid, and long-term energy project solutions.

KIERAN MCINERNEY, PE, CEM

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Energy Master Plan | U.S. Army Fort A.P. Hill*

April 2010 – June 2010

Project Engineer for the development of an energy master plan for the Fort A.P. Hill U.S. Army facility. Developed energy master plan that included short, mid, and long-term energy management activities. The plan focused on meeting federally mandated reductions and maximizing cost savings/payback for the facility. Tasks included coordination with key facility personnel, development of energy/water conservations measures, renewable energy screening, and creation of an integrative and sustainable energy master plan.

HVAC Systems Projects*

2003 – 2009

As a manufacturer's representative for an industry-leading equipment and controls provider, Mr. McInerney provided custom HVAC solutions from design phase through sales, installation, and warranty phases. Projects spanned commercial, education, government, healthcare, industrial, and high-rise residential markets. Clients included contractors, engineers, and property owners/developers.

**denotes experience prior to joining Burns & McDonnell*

Publications and Presentations:

"Long-Duration Energy Storage – What's Available?", Webinar for Burns & McDonnell's "Energy on Demand" Series, April 2020. Co-presented with Tisha Scroggin-Wicker.

"Flow Batteries: Energy Storage Option for a Variety of Uses", Power Magazine, March 2, 2020. Co-authored with Tisha Scroggin-Wicker.

"Flow Batteries Offer Utilities Another Energy Storage Option", White Paper, Burns & McDonnell, March 2020. Co-authored with Tisha Scroggin Wicker.

"A Power Ballad: Winds of Change Coming for Gas Generation?", Power Engineering Magazine, August 2018

"Reciprocating Engine Market Trends", presented to Electric Power Research Institute (EPRI): RICE Interest Group, November 2017.

"Schofield Generating Station Highlights Value of Reciprocating Engines", Power Engineering Magazine, August 2017.

"Reciprocating Engine Generator Technology", Power Engineering Magazine, June 2017. Co-authored with Brian Elwell.