

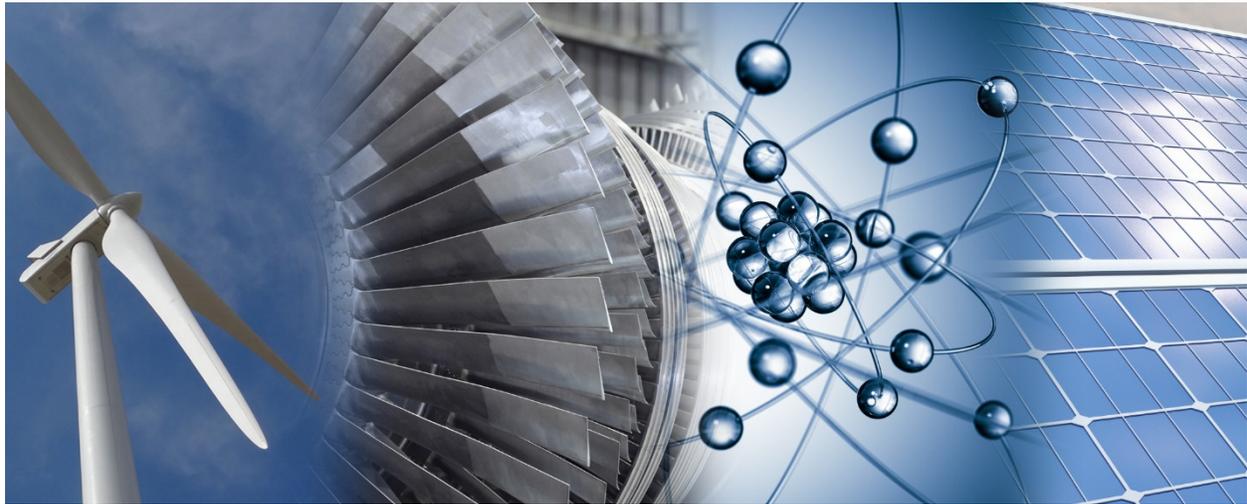
The logo for Sargent & Lundy, featuring a stylized grey 'S' shape that curves from the top right towards the bottom left.

Sargent & Lundy

Planning and Advisory Services

Services, Qualifications, and Experience

Integrated Resource Planning | Power Supply Planning |
Power Procurement Management | Production Cost Modeling and
Market Studies | Transmission and Distribution Planning |
Interconnection and Grid Studies | Grid Modernization Consulting |
Power System Master Planning | Oil and Gas Infrastructure
Master Planning | Hydrogen Infrastructure Planning | Net Zero Carbon
and High Renewable Planning | Carbon Capture and Storage Planning



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About Sargent & Lundy

Sargent & Lundy is one of the oldest and most experienced full-service architect-engineering firms in the world. Founded in 1891, the firm is a global leader in power and infrastructure with expertise in all forms of electric power generation; power transmission and distribution; renewable energy; grid modernization; energy storage; oil and natural gas infrastructure; energy consulting; physical and cyber-security; industrial facilities and heavy infrastructure; and government services. Sargent & Lundy's power generation experience includes natural gas-fired, nuclear power, wind, solar, coal-fired, oil-fired power plants, among others. The firm delivers comprehensive project services—from consulting, design, and implementation to construction management, commissioning and operations/maintenance—with an emphasis on quality and safety. Sargent & Lundy serves public and private sector clients in the power and energy, government, natural gas distribution, industrial, mining, and other heavy industrial sectors.

1891

founding year

130

years leading the industry

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Challenges and Opportunities for Utilities and Power Industry Organizations

Utilities, independent power producers, government energy agencies, and other infrastructure companies face a complicated planning environment in which both the potential costs and expected revenues of their investments are subject to risks, uncertainties, and opportunities including:

- Abundant supplies of low-cost natural gas that displaced coal as the dominant fuel source in many parts of the United States and the world;
- Significant growth in renewable energy driven by performance improvements, cost reductions, and incentives/rebates;
- The continued emergence of smart grid technologies such as distribution automation, advanced metering infrastructure, distributed energy resources (DERs), and others;
- Reduced load growth, if not flat demand for energy, driven by energy efficiency, demand response, DERs, and economic factors;
- The potential for significant load growth in the future from electrification of the transportation, industrial, and other sectors;
- Increasing number of states and countries with 100% renewable energy or carbon free power generation targets and laws;
- The increased use of battery energy storage systems and hybrid generation projects;
- Concern over outages and reliability issues from cyber-security, storms, and terrorism;
- Uncertain energy, capacity, and ancillary service revenues in competitive wholesale power markets; and
- Regulatory cost risk and uncertainty from stranded assets, carbon pricing, utility bankruptcies, project cancellation, environmental concerns, etc.

The challenge for utility planners is to develop generation, energy storage, and transmission and distribution (T&D) alternatives that create value for their company while managing risk. This requires accurate and up-to-date information on the cost and performance of generation and storage technologies. As for independent system operators (ISOs), their key challenge is the development of administered demand curves and other mechanisms to attract the capacity needed for grid reliability. Regardless, these challenges require essential, verified input for the comprehensive analysis of current and future generation portfolios.

How Sargent & Lundy Can Help

Sargent & Lundy (S&L) has invaluable experience with today's toughest power challenges thanks to projects and studies performed for clients across the globe. This experience is primarily captured in S&L's database, storing information on the design, cost, and performance of the full range of equipment used for today's electric generation, storage, and delivery systems. Additionally, S&L has a critical advantage in the experience of its capable and knowledgeable personnel.

Clients are leveraging S&L's experience to support their planning and project development efforts. Utilities, merchant generators, transmission developers, and ISOs alike rely on S&L's expertise and unparalleled perspective to support their most sensitive strategies. S&L's typical planning assignments often include one or more of the following elements:

- **Performance Estimates.** S&L's performance estimates include parameters such as capacity and heat rate (at specified ambient conditions), equivalent forced outage rate (EFOR), equivalent availability factor (EAF), ramp rate, fuel consumed during startup, and emissions rates for both "new and clean" conditions and with degradation. For renewable technologies, parameters include solar or wind resource assessments, capacity factor, EFOR, and EAF. For storage technologies, parameters include cycle efficiency, peak discharge time, and ramp rates.
- **Capital Cost Estimates.** S&L estimates capital costs for each selected technology, including engineering, procurement, and construction (EPC) costs; owner's costs; and financing costs during construction. These estimates also account for monthly construction, cash flow distributions, and total construction duration (in months).
- **Operations and Maintenance (O&M) Cost Estimates.** For each reference technology, S&L breaks down the estimation of fixed and variable O&M costs into subcomponents like labor, materials, property taxes, and insurance. S&L also breaks down costs for maintenance, consumables, and decommissioning.
- **Electric System Master Planning.** S&L evaluates the current state of utility systems and infrastructure to define a desired future state for clients, such as net zero carbon emissions. This ranges from high-level strategic plans to detailed roadmaps. S&L considers high renewable penetration levels, reliability, customer experience/engagement, DER interconnections, grid investment efficiency, greenhouse gas reduction requirements, the electrification of sectors like transportation, the use of hydrogen as a fuel or for energy storage, resilience, physical and cyber security needs, and other relevant factors. The presentations and reports are used by utility executives, regulatory bodies, and other key stakeholders.
- **Power Supply Planning and Power Procurement Support.** This includes the development of requests for proposal (RFPs) on behalf of utilities to procure new generation, energy storage systems, and T&D services. RFPs can be for specific technologies and fuels, but S&L also develops "all source" RFPs to which developers can propose multiple solutions. S&L typically prepares an evaluation guide to add credibility and weight to the outcome of the RFP; this is particularly important when submitting procurement records to state public service commissions for approval and review. S&L can manage the RFP process by chairing regular meetings (often done

by WebEx/teleconference), keeping detailed records, maintaining action items, coordinating bidder Q&A, and finalizing commission approval. Examples of data managed include a detailed procurement record of the RFP, evaluation process, and bid evaluations.

- **Energy Storage Planning and Implementation.** S&L is a leader in the energy storage sector, having completed more than 100 projects, studies, and other engagements. We have extensive experience with energy storage technologies, business models, contracting structures, procurement, project design, EPC selection and management, independent engineering, and O&M support.
- **Natural Gas and Fuel System Master Planning.** Low-cost natural gas has altered the generation mix worldwide. S&L utilizes its experience with pipelines, compression stations, natural-gas-fired generation, liquified natural gas facilities, and other related infrastructure to develop fuel system master plans for clients.
- **Integrated Resource Plans (IRPs).** S&L's specialists, in collaboration with technical editors, prepare professional-quality IRPs and similar reports for utilities. This includes current and forecasted cost and performance inputs, economic dispatch modeling, and long-term capacity expansion modeling that provides the analytical results necessary for a comprehensive IRP. S&L considers potential future scenarios, client preferences, and regulatory requirements to identify how a utility can reliably meet the future electric needs of its customers. Perhaps most importantly, IRPs are written with an appropriate level of detail while remaining suitable for a non-technical audience.
- **Grid Studies and Market Modeling.** S&L performs a variety of power system studies and market modeling, including balanced and unbalanced load flow; contingency analysis; dynamic studies; transient analysis; production cost modeling and capacity expansion studies; DER impact analysis; transfer analysis; and others. We use powerful software such as PSSE, PSLF, DSA Tools, Plexos, Promod, Capacity Expansion, ASPEN Oneliner, ETAP, EMTP, TARA, CYMDIST, PSCAD, CYMCAP, CDEGS, Matlab/Simulink, and Homer.
- **T&D Planning.** S&L develops transmission, distribution, and storage system plans to help clients deploy reliability investments that preserve the utility's ability to serve peak load, maintain system performance, and operate safely. The plans consider improvements and changes to the utility's risk modeling, internal planning studies, required reliability improvements, non-wires alternatives, and needed modernization initiatives. The key quantitative/financial element of S&L's work often involves updates to financial risk models for T&D assets. These models systematically and efficiently identify assets that require capital improvements and upgrades. Ultimately, S&L helps utilities reach their internal goals with respect to safety, reliability, modernization, and economic development through efficient and effective capital investment.
- **Interconnection Application Support and Management.** S&L manages the interconnection application process for many clients, for all types of power generation and energy storage projects. We prepare the complete interconnection application package, including all required system and grid models. S&L provides ongoing support during the study process and interconnection agreement negotiations.

- **Solar and Wind Resource Assessments.** S&L develops solar or wind resource assessments at potential project sites using a variety of data sources. This includes ground-based and satellite-derived data sets as well as on-site meteorological tower and solar monitoring station data. As part of the resource assessment, S&L determines the long-term expected mean generation and its uncertainty to provide P75, P90, P95, and P99 generation estimates. Clients also benefit from different reports and tools including 12×24 diagrams and 8760 data sets for final decision-making. All assessments use industry-recognized software such as PVsyst, Helioscope, Windographer, and Openwind®.
- **Business Case Development and Risk Analysis.** This includes cost models and financial pro formas for generation, energy storage, and T&D technology alternatives. S&L also performs evaluations of technical and financial risks by assessing the low and high values of cost and financial model inputs on the net present value (NPV) of alternatives. There's also a qualitative assessment of the impacts and risks to operations, including the identification of fatal flaws.
- **Environmental Regulation and Permitting Evaluations.** In a client's area of interest, S&L reviews the environmental regulations and permitting requirements affecting the design, construction, and operation of a new project or facility. For renewable energy projects, we consider appropriate siting of projects to account for noise, visual impact, drainage, and other factors. For combustion-based generating technologies, this includes an evaluation of air emission limits and water resource issues.
- **Screening Analysis.** The S&L team identifies feasible alternatives among commercially available and emerging technologies that could be implemented in a client's service area. When a screening analysis addresses renewable energy technologies, it often includes an assessment of the availability of renewable resources in the client's region (e.g., a wind or solar resource assessment).
- **Technology Assessments.** Finally, S&L evaluates emerging or newer technologies including long-duration energy storage systems, carbon capture and storage systems, and large-scale hydrogen projects. Reviews include location-specific assessments of the value of these technologies.

S&L's project teams possess an appropriate mix of skills necessary for each assignment. They are guided by a proven project management approach, a quality management program certified to the International Organization for Standardization ISO 9001:2015, and project-specific work plans dedicated to meeting each client's needs.

In addition to the utility planning services described above, S&L is also active in the following tasks, studies, and services:

- Interconnection and Grid Studies
- Asset Valuations of Power Assets
- Remaining Useful Life Assessments
- Power Supply Planning
- Demand Side Programs
- Asset Transaction Support Services
- Market Studies
- Transmission Congestion Studies
- Grid Modernization Consulting
- Microgrid Planning and Design

An overview of S&L's services can be found at www.sargentlundy.com.

Selected Recent Planning and Advisory Assignments

- **PJM Interconnection (PJM)** | 2020 | S&L collaborated with The Brattle Group to analyze the gross avoidable costs rates (ACRs) for several types of existing generation including single-unit nuclear, multi-unit nuclear, coal, gas-fired combined-cycle, gas-fired combustion turbines, onshore wind, utility-scale solar PV, and behind-the-meter diesel generators. Our analysis helped PJM implement the December 2019 FERC order to expand the application of its Minimum Offer Price Review (MOPR) in its forward capacity market.
- **New York Independent System Operator (NYISO)** | 2020–2021 | S&L provided current costs and anticipated capacity factors for solar, wind, and similar resource types that meet NYISO's definition of intermittent power resources or represents a resource type with limited ability to control their output. This analysis is supporting NYISO's assessment of renewable energy technologies in various regional zones of their operating system. S&L is providing ongoing support for specific project evaluations.
- **PSEG Long Island** | 2020–2021 | S&L is supporting PSEG Long Island in their 2020 Energy Storage RFI and RFP process. S&L's scope includes structuring contracting options, preparation of RFI/RFP document, managing the entire RFI/RFP process, qualitative and quantitative bid evaluations, and support during project selection and contract negotiations.
- **Confidential Midwestern Municipal Utility** | 2020 | S&L performed a system planning and financial analysis associated with the future of a coal-fired power plant. The analysis consisted of developing a production cost model of the municipal utility's energy system and an associated net present value (NPV) analysis to evaluate various retirement and replacement scenarios for the coal-fired power plant. All scenarios analyzed covered a 20-year time horizon into the future. S&L used the resource planning software PLEXOS for the production cost modeling for this analysis. The production cost model was used to both to determine the optimal timing of the potential retirement of the coal-fired power plant and to assess the financial impact of different energy generation and purchase options that the utility could pursue in the future. Outputs of the production cost model were used to develop the NPV analysis.
- **CPS Energy** | 2020 | S&L worked with CPS Energy in Texas to help develop an economic analysis to assess several different scenarios related to the long-term plan for an existing coal asset. The analysis provided an impartial assessment of least-cost portfolio options for the CPS Energy, with consideration of the full value stream and risks of each replacement resource option. Portfolios analyzed included different options related to the future of the coal asset, the potential addition of new combined cycle units, and an increase in renewable generation and battery storage. The analysis captures the market dynamics of the surrounding integrated energy market and translate these into economic framework for resource selection.

- **Puerto Rico Electric Power Authority (PREPA), 2018–2021** | Since early 2018, S&L has provided a wide range of services to PREPA including condition assessments; energy procurement and RFP support; capital and O&M project planning; fuel conversion studies and contracting support; natural gas/LNG infrastructure planning and design; T&D roadmaps and designs; project scoping for FEMA; solar project implementation support; new combined cycle generation planning and design; environmental compliance studies and support; repair vs. replace studies; and depreciation studies and other financial support services. Natural gas and LNG-related services include the development of a natural gas master plan for the island, feasibility studies and economic evaluations of new natural gas business models, conceptual design of LNG import facilities and pipelines, pipeline routing studies, and gas storage and transportation planning.
- **Various Confidential Hydrogen Projects** | 2019–2021 | S&L is performing a number of projects involving hydrogen, such as: a hydrogen market cost; a pilot combustion turbine project using a blend of hydrogen and natural gas; several nuclear power plant hydrogen production projects using electrolysis; and independent technical evaluation of a proprietary new hydrogen combustion technology.
- **New York Independent System Operator (NYISO)** | 2020 | S&L provided engineering support to the NYISO as part of the buyer-side mitigation process to determine the Unit Net Cost of New Entry of renewable energy projects seeking to become Installed Capacity Suppliers. This analysis helps NYISO to identify low bidders that might be outside a feasible project implementation cost level.
- **Confidential IPP** | 2020 | S&L supported the client's development of a compliant and optimized proposal for a long-term BOOT proposal for the utilities systems for an off-grid development in Saudi Arabia. S&L ran PLEXOS to determine optimum generation mix scenarios containing primarily renewable resources and battery energy storage systems. Generation source options included solar PV, solar CSP, wind, and restricted use of reciprocating engines running biodiesel. Analysis was also performed to assess the load-shifting and thermal storage opportunities related to operation of a district cooling plant and a seawater desalination plant. Finally, S&L performed network analysis studies on the planned high voltage network to ensure electrical functionality of the mini-grid system, as proposed.
- **Indianapolis Power & Light Company (IPL), 2019–2021** | S&L managed and administered an All-Source RFP for IPL to obtain new supply-side electric capacity resources. S&L led the RFP process and services included the complete preparation of the RFP package, analysis and review of the proposed power purchase and build-transfer contracts,



Indianapolis Power & Light Company All-Source Request for Proposals

Indianapolis Power & Light Company (IPL) has issued an all-source request for proposals (RFP) to competitively procure approximately 200 MW of unforced capacity (UCAP) by the 2023-2024 MISO Planning Year. Proposed resources must be capable of delivering capacity to the MISO Local Resource Zone (LRZ) 6. Resource options may include transfer of new or existing assets, power purchase agreements (PPAs), and demand-side management opportunities.

Bid submissions are due by 5 p.m. CT, February 28, 2020. Information sessions will be held on Thursday, January 2 and on Tuesday, January 7. Sargent & Lundy will act as an independent third-party consultant on behalf of IPL to execute the RFP and evaluate proposals. Additional information is available online at IPLpower.com/RFP. For additional information regarding the process, please contact Sargent & Lundy directly at IPL-ASRFP@sargentlundy.com.

interfacing with bidders through the process, development of both qualitative and quantitative bid evaluation methodologies, administration of the RFP process, bid evaluations from technical and economic perspectives, and bid and contract negotiation support. S&L is also providing expert testimony to support regulatory approval.

- **Northern Indiana Public Service Company (NIPSCO) | 2019–2020** | S&L is preparing a business case report for NIPSCO to support the utility’s filing to the Indiana Utility Regulatory Commission to address the replacement of aging T&D infrastructure and grid modernization investments over a seven-year period. S&L is also preparing project scoping documents and cost estimates while maintaining a detailed database of the projects to facilitate planning and regulatory filings.
- **United States Energy Information Administration (EIA) | 2019** | S&L performed a study for the EIA on the cost and performance of 25 different power generation and energy storage technology cases and issued a report, *Capital Cost Study: Cost and Performance Estimates for New Utility-Scale Electric Power Generating Technologies*. The technologies included in the report are: onshore wind, offshore wind, solar PV, concentrating solar, coal, reciprocating engines, simple cycle combustion turbines, combined cycle combustion turbines, fuel cells, nuclear (advanced and small modular reactors), biomass, geothermal, hydroelectric, and battery energy storage. The report includes estimates of capital costs, O&M costs, emissions, heat rate, and other data. The report was issued in 2019, and it was publicly released by the EIA in 2020: https://www.eia.gov/analysis/studies/powerplants/capitalcost/pdf/capital_cost_AEO2020.pdf
- **Confidential Renewable Energy IPP | 2019–2020** | S&L managed the interconnection application process for more than 40 solar, wind, and battery storage projects being developed across the U.S. S&L prepared the complete interconnection application packages including system model development and managed technical discussions with the ISOs and transmission owners during the study process.
- **European Bank for Reconstruction and Development & Egyptian Electricity Transmission Company | 2019–2021** | S&L currently supports the European Bank for Reconstruction and Development (EBRD) and the Egyptian Electricity Transmission Company (EETC) for solar and wind projects in Egypt. S&L has teamed with Synergy Consulting and Baker McKenzie for technical, financial, and legal advisory services over a four-year period. S&L is serving as the technical advisor. During this engagement, S&L supports the EETC’s procurement of power from solar PV projects, concentrating solar power projects, and wind power projects. S&L is preparing and reviewing RFP packages, conducting bid evaluations, and providing advisory services for the structuring of future EETC tenders, among other tasks. As part of this engagement, S&L worked on the planned 200 MW Kom Ombo solar photovoltaic (PV) project, one of several large solar PV projects planned for development in Egypt under an independent power producer (IPP) model.
- **Electric Power Research Institute | 2013–2020** | S&L has supported EPRI with more than 25 system planning studies related to the cost and performance aspects of various generating technologies, including, solar PV, concentrated solar, onshore and offshore wind, gas turbine, and reciprocating engines. Cost and performance inputs developed by S&L include capital costs, operating costs, performance characteristics, generation forecasts, and emissions data. Our work

was utilized as input for EPRI's TAGWEB database and their Solar PV and Wind Technology Guides, among other purposes.

- **Confidential Great Lakes Region Utility** | 2019 | For a large utility in the MISO regional transmission organization, S&L evaluated a proposed transmission system upgrade against alternatives such as new generation, other transmission level projects, and a combination of transmission and distribution system upgrades. This included numerous power flow simulations using PSS/E software, prepared cost estimates, and cost efficiency assessments.
- **Arizona Electric Power Cooperative, Inc.** | 2019 | S&L provided detailed capital cost, O&M cost, and performance estimates for different candidate resource types including simple cycle frame-type gas turbine, aeroderivative gas turbine, reciprocal internal combustion engine, and combined cycle gas turbine projects. S&L's deliverables were provided as input for the client's long-term resource planning.
- **Equinor** | 2019 | S&L performed a system reliability impact study (SRIS) to support client's bid in response to the NYSERDA offshore wind solicitation. As part of the SRIS study, S&L evaluated multiple interconnection point options in NYISO Zone J (NYC) and Zone K (Long Island) with respect to the reliability impact to the NYISO transmission system.
- **Alberta Electric System Operator (AESO)** | 2018–2019 | S&L collaborated with the Brattle Group to estimate the Cost of New Entry (CONE) in Alberta for new merchant generation resources. The CONE and Net CONE are used to determine the AESO's administratively-set demand curve for capacity for the new centralized three-year-forward capacity market with a first commitment period of November 2021 to October 2022. S&L specialists also provided testimony in hearings with AESO.
- **Confidential Offshore Wind Developer/Owner/Operator** | 2018–2019 | S&L performed a competitor analysis for a leading offshore wind developer for the New York and New Jersey markets. S&L developed potential plant configurations, energy estimates, cost estimates, interconnection arrangements and costs, and O&M cost estimates to inform and advise the client's bidding strategy for the offshore wind solicitations.
- **United States Energy Information Administration (EIA)** | 2017–2018 | S&L performed a study for the EIA on the cost of operating and maintaining various types of power plants. As part of the study, S&L compiled and analyzed over 15,000 data points (operating years). The report was issued in 2018, and it was publicly released by the EIA in 2019: https://www.eia.gov/analysis/studies/powerplants/generationcost/pdf/full_report.pdf
- **Confidential Midwestern Municipal Utility** | 2018 | S&L performed an engineering and economic evaluation of the client's electric power system with respect to a potential shutdown of a major generation asset. The engineering evaluation included reviews of the capital expenditure plans, fixed and variable O&M numbers, and various performance metrics such as availability, forced outages, and heat rates, all of which were used as inputs to the economic model. The economic evaluation calculated breakdowns of various energy production costs such as market purchases/sales, fuel costs, variable O&M costs, and other fixed costs under multiple scenarios involving the generation asset retirement and a new power purchase agreement (PPA).

- **PJM Interconnection (PJM) | 2017–2018** | S&L collaborated with the Brattle Group to evaluate reference technology options and update the corresponding CONE and Net CONE values. The S&L team estimated (i) total gross overnight capital costs, including most owner's costs, all owner-furnished equipment, and all EPC balance-of-plant costs; (ii) a capital drawdown schedule to be used in calculating interest during construction in the capital budgeting model; (iii) first-year fixed O&M costs, including staffing, asset management, and other annual fixed costs; and (iv) performance data relevant for calculating cost of new entry and net energy revenues, including plant heat rate and summer capacity rating. S&L specialists supported PJM's filing of revisions to its Variable Resource Requirements (VRR) curves and CONE values to FERC.
- **Confidential Midwestern Municipal Utility | 2017** | S&L performed a transmission and market planning study for a municipal utility located in the Midwestern United States. This included a detailed financial analysis of 24 different transmission and market options. The utility, located on a seam between two regional transmission organizations (RTOs), is facing the upcoming expiration of their existing transmission arrangement and needed guidance on future planning.
- **Confidential Great Lakes Region Utility | 2017** | S&L performed a geographic information system (GIS)-based site screening and evaluation study for a new natural-gas-fired, combined cycle power plant. Using a multitude of mapping layers, such as natural gas pipelines, high-voltage transmission lines, sensitive environmental areas, and others, S&L assessed an area of over 20 million acres and identified approximately 30 potential sites for a new power plant that met the client's parameters. The entire study was completed within two months.
- **Public Service Electric & Gas (PSEG) Long Island | 2016–2017** | S&L provided technical writing and report preparation services to assist PSEG Long Island with the development of its IRP. The support team compiled materials by conducting interviews with appropriate PSEG Long Island staff to develop a complete understanding of the IRP. The resulting report astutely described all processes, activities, and results under the specified structure, including the development of high-quality professional graphs, figures, and exhibits. S&L worked with PSEG Long Island staff through meetings and calls to further understand IRP issues, resolve concerns, clarify information, discuss the IRP development, and edit the report.
- **PSEG Long Island | 2015–2017** | S&L also supported PSEG Long Island in the evaluation and selection of bids for new resources submitted under two RFPs. Assignments included (i) the development of evaluation models; (ii) the handling of bid administration; (iii) a screening for responsiveness of bids to RFP requirements; (iv) a quantitative and qualitative assessment of responsive proposals to identify semifinalists; (v) a detailed quantitative and qualitative technical, economic, and financial analysis of semifinalists; and (vi) the formulation of recommendations for decision-making. S&L conducted weekly meetings of a selection committee for each RFP and prepared meeting notes, developed presentation materials, and prepared a procurement memorandum and record in accordance with New York State requirements.
- **ISO New England (ISO-NE) | 2015** | S&L prepared estimates of physical operating parameters and fixed and variable generator cost parameters for several categories of fossil-fueled generating units currently existing in the ISO-NE footprint. The parameter estimates will be used by the ISO-NE's Internal Market Monitoring (IMM) department to benchmark the physical operating and

generator cost parameters used to estimate reference levels (the IMM's estimate of a competitive offer in the energy market). S&L also developed a cost development reference guide to provide direction to resource owners on how to collect, develop, and validate their physical operating and generator cost parameters for submission to the IMM.

- **New York ISO (NYISO) | 2007–2016** | S&L provided technical support to NYISO's Market Monitoring and Analysis group. This included (i) estimating the going-forward costs of existing generation to determine the need for market power mitigation; (ii) estimating the cost of new entry for proposed projects to determine need for buyer-side mitigation; and (iii) assisting with development of a technical assessment process supporting a determination of whether a generator could transfer interconnection service rights when proposing to repower a generating unit.
- **NIPSCO | 2013 & 2015** | S&L updated cost and performance estimates for gas, coal, nuclear, renewable, storage, and distributed generation technology alternatives to be evaluated in NIPSCO's IRP. S&L prepared a technical assessment report that outlines the methodology and results. The report was included in NIPSCO's submittal of its IRP to the Indiana Public Service Commission in 2016. S&L performed the same assignment in 2013 to support NIPSCO's 2014 IRP.
- **CPS Energy | 2008 & 2015** | S&L updated cost and performance data first prepared in 2008 for resource alternatives to be used in resource planning studies. The data applied to technologies for (i) simple- and combined-cycle combustion turbines; (ii) utility-scale solar PV plants; (iii) wind farms; and (iv) natural-gas-fired internal combustion engines. S&L's data support included overnight capital costs for greenfield and brownfield sites, construction payment curves, fixed and variable O&M, and performance assumptions (heat rate, emissions rates, capacity factor, outage rates, minimum capacity, startup fuel, and ramp rates).
- **Marquette Board of Light & Power (MBLP) | 2015** | S&L analyzed the need for additional generation in MBLP's service area. MBLP cannot obtain firm transmission import capacity and relies on two older coal units and one oil-fired combustion turbine to meet its needs. S&L analyzed reliability risks and recommended the addition of gas-fired reciprocating engines to improve system reliability, increase fuel diversity, reduce emissions, and improve system heat rate. S&L's team also prepared a dispatch study and report to help MBLP obtain approval from its board of directors.
- **Long Island Power Authority (LIPA) | 2014** | S&L assisted LIPA with the evaluation and selection of bids for new generation, energy storage, and demand-response submitted under the terms of a November 2013 RFP. The assignment included (i) the development of an evaluation model; (ii) the handling of bid administration; (iii) a screening for responsiveness of bids to RFP requirements; (iv) a quantitative and qualitative assessment of responsive proposals to identify a short list; (v) detailed quantitative and qualitative technical, economic, and financial analyses of shortlisted bids; and (vi) the formulation of recommendations for LIPA decision-making.
- **Basin Electric Power Cooperative | 2014** | S&L prepared an overview of the costs and characteristics of nuclear generation options for consideration by Basin Electric's board members and management.

- **PacifiCorp** | 2014 | S&L examined the economics, performance, and development of the commercial viability of small modular reactors (SMRs). The scope of the review included licensure and regulatory issues, an overview of three SMR technologies, ongoing design improvements to SMR technology, and an assessment of the stage of technical, commercial, and regulatory development of SMRs.
- **PJM Interconnection (PJM)** | 2013–2014 | S&L supported The Brattle Group’s review of PJM’s “Variable Resource Requirement” (VRR) curve, an administratively-determined representation of a demand curve for capacity used in the PJM “Reliability Pricing Model” auction. S&L estimated (i) total gross overnight capital costs, including most owner’s costs, all owner-furnished equipment, and all EPC balance-of-plant costs; (ii) a capital drawdown schedule to be used in calculating interest during construction in the capital budgeting model; (iii) first-year fixed O&M costs, including staffing, asset management, and other annual fixed costs; and (iv) performance data relevant for calculating cost of new entry and net energy revenues, including plant heat rate and summer capacity rating.
- **ISO-NE** | 2013–2014 | S&L supported the Brattle Group’s development of ISO-NE’s capacity demand curve proposal, supporting the selection of a reference technology, identifying key assumptions to estimate its cost and performance, and developing estimates from those assumptions in local regions of ISO-NE.
- **ACES** | 2013 | S&L developed cost and performance information for new-build, natural-gas-fired generation options for use by ACES in supporting the development of mid- to long-term power supply strategies with its members and customers. In addition to developing assumptions and estimating the cost and performance of each option for an assumed Midwest U.S. location, S&L developed an approach for translating the cost estimates to other sites where ACES’ members and customers are located.
- **NYISO** | 2007, 2010, & 2013 | S&L partnered with National Economic Research Associates (NERA) to develop the parameters used as the basis to reset the NYISO “Installed Capacity” (ICAP) demand curves for the upcoming three capability years. This required the determination of the localized, levelized embedded cost of peaking units in each New York Control Area (NYCA) locality and the rest of the state. S&L (i) participated in monthly ICAP working group meetings to review assumptions; (ii) discussed work plans and technical approaches; and (iii) presented interim results and findings to working group representatives of generators, utilities, transmission owners, environmental groups, consumer advocates, and other special interest groups.
- **ISO-NE** | 2013 | S&L partnered with the Brattle Group to estimate the “Offer Review Trigger Prices” used by ISO-NE as part of its market mitigation process, including (i) capital and O&M costs for several technologies in New England states; (ii) natural-gas-fired, simple- and combined-cycle plants; (iii) biomass; (iv) onshore and offshore wind; and (v) solar PV technologies.
- **Confidential Client** | 2013 | S&L supported the Brattle Group with a feasibility evaluation for supply options proposed in response to an RFP. The analysis identified supply options that could be placed in service for a stringent near-term commercial operation date (COD).

- **Ontario Power Authority** | 2013 | S&L partnered with NERA to develop a cost and performance estimate for a simple-cycle, natural-gas-fired frame combustion turbine unit in the Southwest Greater Toronto Area (GTA) in the province of Ontario, Canada.
- **Confidential Client, 2013** | S&L evaluated the costs and risks associated with firing a proposed combined-cycle plant with natural gas only (i.e., without providing for backup fuel capability using distillate fuels).
- **Maui Electric Company (MECO)** | 2012–2013 | S&L performed a generation asset assessment study to review the current condition of existing MECO generation facilities and the impact of expected usage changes from intermittent renewable resources. The project team assessed the units' remaining useful lives and performance under expected operational demands and proposed O&M adjustments.
- **GenOn** | 2012 | In support of GenOn's planning efforts, S&L developed an independent cost estimate of capital and O&M costs for simple- and combined-cycle power plant configurations used by PJM Interconnection as the basis for determining the CONE. Under PJM's equipment specifications, S&L estimates allowed GenOn to determine how to respond to PJM's proposed CONE for upcoming years.
- **Grand Haven Board of Light and Power, Zeeland Department of Public Utilities** | 2011–2012 | S&L conducted an IRP study to provide the Grand Haven, MI, and Zeeland, MI, utilities with an integrated resource strategy. This included cost estimates and recommendations for equipment maintenance and replacement for the next 20 years. The study provided a general roadmap for each utility to plan for significant equipment expenditures and capital investments while identifying the best means for meeting increased customer demand. Evaluated resource options included (i) existing and new non-renewable generation and cogeneration facilities; (ii) renewable energy resources; (iii) energy conservation and demand reduction programs; and (iv) long-term PPAs or shared ownership options in large economies-of-scale facilities.
- **NV Energy** | 2011–2012 | S&L identified natural-gas-fired generation expansion options at five southern Nevada generating stations for NV Energy. The brownfield study includes an analysis of each site, taking into consideration all suitable natural-gas-fired generation options based on each site's specific characteristics. Preliminary permitting timelines were developed for each case. The study described the best fit natural-gas-fired technology considering fuel availability, regulatory permitting, environmental requirements, land status, and capital cost. The natural-gas-fired generation options considered large-frame combustion turbines, aeroderivative combustion turbines, and combined-cycle plants using either frame or aeroderivative combustion turbine technology.
- **SaskPower** | 2011 | S&L independently reviewed the integrated process of SaskPower's supply planning. The scope of the review included (i) the basic methodology and process used to apply the reliability criterion; (ii) the frequency with which the supply plan is updated; (iii) the appropriateness of the types of data inputs used in the supply planning process; (iv) whether the supply plan is sufficiently documented; and (v) a high-level evaluation of the suitability of the resources that SaskPower allocates to the supply planning process compared to similar utility groups.

- **MidAmerican Energy** | 2010–2011 | Sargent & Lundy developed a business plan for a fleet of generating plants based on small modular nuclear reactor technology. The plan included an assessment of the regulatory framework, a proposed organizational structure, the staffing plan, capital and O&M cost estimates, a mobilization plan, a financial pro forma, and a risk analysis. The business model formed the foundation for MidAmerican’s report to the Iowa legislature entitled “Iowa Nuclear Feasibility Assessment in a Carbon-Constrained Environment.”
- **Tennessee Valley Authority (TVA)** | 2010 | Sargent & Lundy prepared the need for power analysis and energy alternatives chapters for TVA’s IRP: final “Supplemental Environmental Impact Statement for Bellefonte Nuclear Plant Unit 1” and draft “Supplemental Environmental Impact Statement for Relicensing of Sequoyah Nuclear Plant.”
- **South Mississippi Electric Power Association (SMEPA)** | 2009–2010 | S&L conducted a high-level technical evaluation of renewable fuel technology integration into existing SMEPA generation facilities. The evaluation included reviewing the availability of resources (both locally and regionally) and incorporated potential greenfield and brownfield site options based on fuel source location. S&L provided recommendations on the top two most technically and economically feasible options to integrate renewable fuel technology into existing SMEPA infrastructure through direct-firing or separate-firing equipment. Additionally, S&L conducted a high-level economic feasibility analysis for the top technically viable projects. Finally, as part of the renewable options study, S&L reviewed bids submitted to SMEPA in response to an RFP for renewable energy. This review included the economic and technical merits of each bid.
- **New England Power Generators Association (NEPGA)** | 2010 | S&L estimated the localized, levelized embedded cost of one peaking unit technology in two ISO-NE locations in support of a NEPGA filing with the Federal Energy Regulatory Commission.
- **PSEG** | 2009–2014 | S&L prepared the need-for-power analysis and energy-alternatives analysis for PSEG’s “Early Site Permit” application for a new nuclear plant site in New Jersey. The need-for-power study analyzed the need for new base load generation within the Eastern Middle Atlantic Area Council region of PJM.