



Utility and Transmission Planning Services



Services, Qualifications, and Experience

- Integrated Resource Planning
- Power Supply Planning and Market Studies
- Transmission and Distribution Planning
- Interconnection and Grid Studies
- Grid Modernization Consulting



Challenges and Opportunities for Generation and Transmission Planning

Owners and developers of generation resources face a complicated planning environment in which both the potential costs and expected revenues of their investments are subject to risks and uncertainties as well as opportunities, including:

- ✦ Abundant supplies of low-cost natural gas that is displacing coal as the dominant fuel in many parts of the United States and in other parts of the world;
- ✦ Significant growth in renewable energy generation and associated integration issues as dispatchable generation and storage resources are used to compensate for variable output and duck-curve issues;
- ✦ The continued emergence of smart grid technologies, such as grid-scale battery energy storage, substation automation, synchrophasors, and others;
- ✦ Reduced load growth, if not flat demand for energy, driven in large part by growth in energy efficiency, demand response, and distributed energy resources (DERs) as well as economic factors;
- ✦ The continuing increase of rooftop solar and other forms of DERs along with the complex issues associated with how to appropriately determine the locational value of DERs;
- ✦ Concern about outages and reliability issues from cyber-security and terrorism events;
- ✦ Uncertain energy, capacity, and ancillary service revenues in competitive wholesale power markets; and
- ✦ Regulatory cost risk and uncertainty resulting from incidents like Fukushima, various ash pond failures, bankruptcies of large firms, and so forth.

One of the challenges for utility planners is to develop generation, energy storage, and transmission alternatives that create value for their company. Sophisticated planning tools and software are available to analyze alternative portfolios of generation assets; to conduct scenario analyses to understand how generation alternatives perform under stress conditions; and to assess downside risk of existing assets and determine how this risk can be mitigated by repowering assets, investing in life extension projects, or adding environmental controls. A key challenge to independent system operators (ISOs) that operate capacity markets is to develop administratively-determined demand curves and other mechanisms that provide adequate revenues to attract the capacity needed to ensure grid reliability.

An essential input to planning tools used by utility planners is good information on the cost and performance of generation and storage technologies. Sargent & Lundy is uniquely positioned to provide this information.

How Can Sargent & Lundy Help Address These Challenges?

Sargent & Lundy has extensive experience with generation, energy storage, and transmission and distribution (T&D) technologies gained from our projects and studies we have performed for clients across the United States and all over the world. This experience is embodied in internal databases and process guidelines containing information on the design, cost, and performance of turbines, boilers, emissions control equipment, reciprocating engines, solar photovoltaic (PV) power, wind power, hydropower, batteries, nuclear power—the full range of equipment and systems used today for electric generation, storage, and delivery—and in the capabilities of our staff's extensive knowledge and experience.

Many clients are leveraging Sargent & Lundy's capabilities and technology experience to support their resource planning studies and project development efforts. Utilities, merchant generators, transmission developers, and ISOs are relying on our knowledge to support the development of strategies, and our background gives us an invaluable perspective for supporting these clients' planning needs.

Typical planning assignments often include one or more of the following elements:

- **Power Supply Planning and Power Procurement Support.** Development of RFPs for utilities to procure new generation, energy storage, and T&D services. RFPs can be developed for specific technologies/fuels or can be "all source" RFPs to which developers can propose different types of solutions. We typically prepare an evaluation guide that adds credibility and weight to the outcome of the RFP; in our experience, this is particularly important when submitting procurement records to state public service commissions for approval/review. We can manage the RFP process by chairing regular meetings (often done by WebEx/teleconference), keeping detailed meeting minutes, maintaining action item lists, coordinating bidder Q&A, and so forth, as getting approval from state public service commissions for power procurements is facilitated by careful recordkeeping. We can prepare a detailed procurement record of the RFP, evaluation process, bid evaluations, and other steps.
- **Integrated Resource Plans (IRPs).** Our energy market and utility specialists, working with our technical writers and editors, prepare professional-quality IRPs and similar reports for utilities. We provide inputs into the resource planning modeling and, in some cases, run the resource planning models for our clients. We incorporate the results of this modeling in our IRPs, which are written with an appropriate level of detail while also being suitable and understandable for a non-technical audience.
- **Performance Estimates.** Development of performance estimates for each technology selected for evaluation. The parameters to be estimated often include 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 over time. 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.
- **Solar and Wind Resource Assessments.** Development of solar or wind resource assessments at potential project sites. Our project teams use a variety of data sources, including ground-based and satellite-derived data sets as well as on-site meteorological tower data and solar monitoring station data. We evaluate the quality of data sets in order to process the data appropriately and use the best combination of available information. As part of our resource assessments, we determine the long-term expected mean generation and the uncertainty in order to provide P75, P90, P95, and P99 generation estimates. Our clients benefit from the different reports and tools we provide, such as 12×24 diagrams and 8760 data sets, which help project owners, developers, lenders, and other stakeholders plan and make decisions. We use industry-recognized software for these assessments, such as PVsyst, Windographer, and Openwind®.

- ✦ **Capital Cost Estimates.** Estimation of overnight capital costs for each selected technology, including engineering, procurement, and construction (EPC) costs, owner's costs, and financing costs during construction. Monthly construction cash flow distributions and total construction duration, in months, is estimated for each technology.
- ✦ **O&M Cost Estimates.** Estimation of fixed and variable operations and maintenance (O&M) costs for each reference technology. Fixed costs are broken into major subcomponents, such as labor, materials, property taxes, and insurance. Variable costs are broken into subcomponents, such as major maintenance and consumables. We also develop decommissioning cost estimates.
- ✦ **Business Case Development and Risk Analysis.** Development of cost models and financial pro formas for generation, energy storage, and T&D technology alternatives. Evaluation of technical risks and financial risks by assessing the low and high values of cost and financial model inputs on the net present value (NPV) of alternatives. Qualitative assessment of the impacts and risks to operations, including the identification of fatal flaws.
- ✦ **Environmental Regulation Evaluation.** Review of the environmental regulations affecting the design and operation of a new stationary source of emissions in the area of interest to the client. This review includes an evaluation of environmental regulations, focusing primarily on air quality regulations, applicable to combustion-based generating technologies under consideration.
- ✦ **Screening Analysis.** Identifies feasible alternatives among various commercially available as well as emerging technologies that could be implemented in the 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., wind resource assessment or solar resource assessment).
- ✦ **Technology Assessments.** Evaluation of emerging or newer technologies, such as different types of battery energy storage systems, including location-specific assessments of the value of different technologies.

Sargent & Lundy's project teams provide the appropriate mix of skills necessary for each assignment. We are guided by our proven project management approach, our quality management program certified to the International Organization for Standardization ISO 9001:2015, and our project-specific work plans to meet each client's specific project needs.

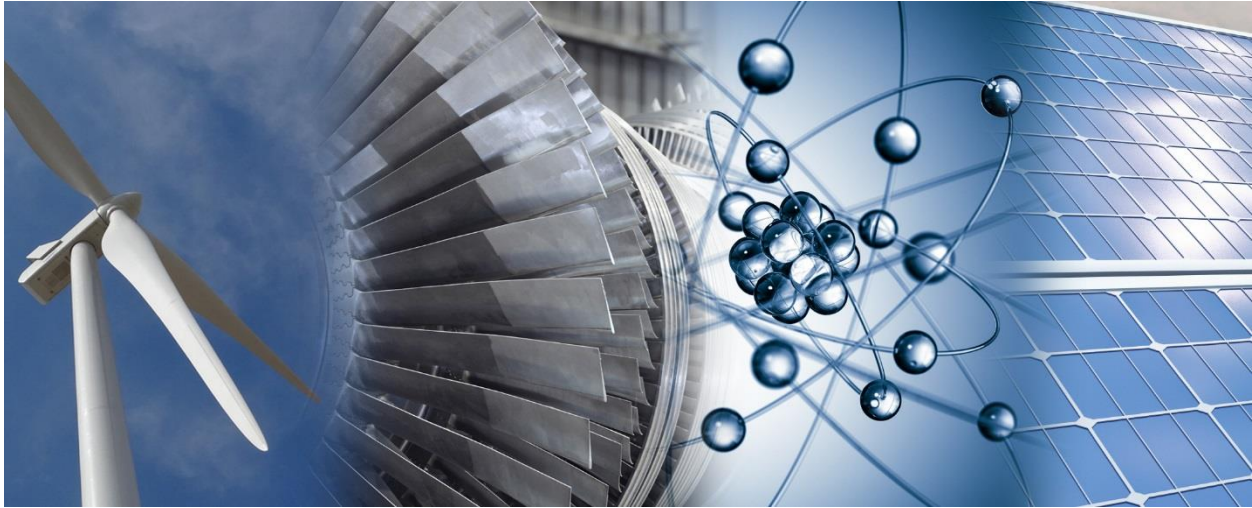
In addition to the utility planning services described above, Sargent & Lundy is also active in the following related tasks, studies, and services:

Interconnection and grid studies	Asset transaction support services
Asset valuations of power assets	Market studies
Remaining useful life assessments	Transmission congestion studies
Power supply planning	Grid modernization consulting
Demand side programs	Microgrid planning and design

A further overview of Sargent & Lundy's services can be viewed at www.sargentlundy.com.

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Recent Utility Planning Assignments

- ✦ **Confidential Midwestern Municipal Utility, 2017** | Sargent & Lundy performed a transmission and market planning study for a municipal utility located in the Midwestern U.S., including a detailed financial analysis of 24 different transmission and market options. The utility, which is located on a seam between two different 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** | Sargent & Lundy 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, we assessed an area of more than 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 in less than two months.
- ✦ **Public Service Electric & Gas (PSEG) Long Island, 2016–2017** | Sargent & Lundy provided technical writing and report preparation services to assist PSEG Long Island with the development of its IRP. We compiled relevant materials by conducting interviews with appropriate PSEG Long Island staff to develop a complete understanding of the IRP. We prepared an IRP report that clearly describes all processes, activities, and results and that follows a specified report structure, including the development of high-quality professional graphs, figures, and exhibits. We worked with PSEG Long Island staff through meetings and calls to further understand IRP issues, resolve concerns, clarify information, discuss the IRP development, and revise and edit the report.
- ✦ **PSEG Long Island, 2015–2017** | Sargent & Lundy is assisting PSEG Long Island in the evaluation and selection of bids for new resources on the South Fork of Long Island submitted under the terms of a June 2015 request for proposal (RFP) and in Western Nassau County under the terms of a January 2016 RFP. The assignments include development of evaluation models; handling of bid administration; screening for responsiveness of bids to RFP requirements; a quantitative and qualitative assessment of responsive proposals to identify semifinalists; detailed quantitative and qualitative technical, economic, and financial analyses of semifinalists; and formulation of recommendations for decision making. Sargent & Lundy conducts weekly meetings of a selection committee for each RFP and prepares meeting notes, develops presentation materials, and prepares a procurement memorandum and procurement record in accordance with New York State requirements.

- ✦ **ISO New England (ISO-NE), 2015** | Sargent & Lundy 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 physical operating and generator cost parameters estimates will be used by the ISO-NE's Internal Market Monitoring (IMM) department to benchmark the physical operating and generator cost parameters the IMM uses to estimate reference levels—the IMM's estimate of a competitive offer in the energy market. Sargent & Lundy 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** | Sargent & Lundy provided technical support to NYISO's Market Monitoring and Analysis group. Tasks included estimating going-forward costs of existing generation used in determining need for market power mitigation; estimating the cost of new entry for proposed projects used to determine need for buyer-side mitigation, and 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 and 2015** | Sargent & Lundy updated cost and performance estimates for gas, coal, nuclear, renewable, storage, and distributed generation technology alternatives to be evaluated in NIPSCO's IRP. Sargent & Lundy 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. Sargent & Lundy performed the same assignment in 2013 to support NIPSCO's 2014 IRP.
- ✦ **CPS Energy, 2008 and 2015** | Sargent & Lundy updated cost and performance data first prepared in 2008 for resource alternatives to be used in resource planning studies. Data was provided for the following technologies: simple- and combined-cycle combustion turbines, utility-scale solar PV plants, wind farms, and natural-gas-fired internal combustion engines. Data provided 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** | Sargent & Lundy 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. Sargent & Lundy 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. We prepared a dispatch study and report to assist MBLP to obtain approval from its board of directors.
- ✦ **Long Island Power Authority (LIPA), 2014** | Sargent & Lundy assisted LIPA with the evaluation and selection of bids for new generation, energy storage, and demand-response submitted under terms of a November 2013 RFP. The assignment included development of an evaluation model; handling of bid administration; screening for responsiveness of bids to RFP requirements; a quantitative and qualitative assessment of responsive proposals to identify a short list; detailed quantitative and qualitative technical, economic, and financial analyses of shortlisted bids; and formulation of recommendations for LIPA decision making.
- ✦ **Basin Electric Power Cooperative, 2014** | Sargent & Lundy prepared an overview of the costs and characteristics of nuclear generation options for consideration by Basin Electric's board members and management.
- ✦ **PacifiCorp, 2014** | Sargent & Lundy 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** | Sargent & Lundy supported The Brattle Group's review of PJM's "Variable Resource Requirement" (VRR) curve, which is an administratively-determined representation of a demand curve for capacity used in the PJM "Reliability Pricing Model" auction. Our role was to estimate (a) total gross overnight capital costs, including most owner's costs, all owner-furnished equipment, and all EPC balance-of-plant costs; (b) a capital drawdown schedule to be used in calculating interest during construction in the capital budgeting model; (c) first-year fixed O&M costs, including staffing, asset management, and other annual fixed costs; and (d) 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** | Sargent & Lundy supported The Brattle Group's development of ISO-NE's capacity demand curve proposal. We supported the selection of a reference technology, identified key assumptions required to estimate the cost and performance of the reference technology in New England, and developed cost and performance estimates for the reference technology in local regions of ISO-NE as necessary.
- ✦ **ACES, 2013** | Sargent & Lundy developed cost and performance information for new-build, natural-gas-fired generation options for use by ACES in supporting 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, we developed an approach for ACES' use in translating the cost estimates to other sites where ACES' members and customers are located.
- ✦ **NYISO; 2007, 2010, and 2013** | Sargent & Lundy 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. Our scope was to determine the localized, levelized embedded cost of peaking units in each New York Control Area (NYCA) locality and the rest of the state. We participated in monthly ICAP working group meetings to review assumptions; discussed work plans and technical approaches; and presented interim results and findings to working group representatives of generators, utilities, transmission owners, environmental groups, consumer advocates, and other special interests.
- ✦ **ISO-NE, 2013** | Sargent & Lundy partnered with The Brattle Group to estimate the "Offer Review Trigger Prices" used by ISO-NE as part of its market mitigation process. Our scope was to estimate capital and O&M costs for several technologies in New England states; including natural-gas-fired, simple- and combined-cycle plants; biomass; onshore and offshore wind; and solar PV technologies.
- ✦ **Confidential Client, 2013** | Sargent & Lundy supported The Brattle Group with an evaluation of the feasibility of supply options proposed in response to a RFP. The feasibility analysis identified supply options that could be placed in service for a stringent near-term commercial operation date (COD).
- ✦ **Ontario Power Authority, 2013** | Sargent & Lundy 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** | Sargent & Lundy 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** | Sargent & Lundy performed a generation asset assessment study to review the current condition of existing MECO generation facilities and the impact of the expected changes in usage resulting from increasing amounts of intermittent renewable resources. We assessed the units' remaining useful lives and performance given expected operational demands and proposed O&M adjustments to maximize performance and useful life of the units.

- ✦ **GenOn, 2012** | In support of GenOn's planning efforts, Sargent & Lundy developed an independent cost estimate of capital and O&M costs for simple- and combined-cycle power plant configurations that are used by PJM Interconnection as the basis for determining the "Cost of New Entry" (CONE). We prepared the estimates using PJM's equipment specifications to assist GenOn in determining 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** | Sargent & Lundy conducted an IRP study to provide the Grand Haven, MI, and Zeeland, MI, utilities with an integrated resource strategy, including equipment maintenance and replacement recommendations and cost estimates for the next 20 years. This provided a general road map for each utility to plan for significant equipment expenditures and capital investments as well as to identify the best means for meeting increased customer demand. Evaluated resource options included existing and new non-renewable generation and cogeneration facilities, renewable energy resources, energy conservation and demand reduction programs, and long-term power purchase agreements (PPAs) or shared ownership options in large economies-of-scale facilities.
- ✦ **NV Energy, 2011–2012** | Sargent & Lundy 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 were large-frame combustion turbines, aeroderivative combustion turbines, and combined-cycle plants using either frame or aeroderivative combustion turbine technology.
- ✦ **SaskPower, 2011** | Sargent & Lundy conducted an independent review of the integrated planning process within the Supply Planning area of SaskPower. The scope of the review included the basic methodology and process used to apply the reliability criterion; the frequency with which the supply plan is updated; the appropriateness of the types of data inputs used in the supply planning process; whether the supply plan is sufficiently documented; and a high-level evaluation of the suitability of the resources that SaskPower allocates to the supply planning process compared to other 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, staffing plan, capital and O&M cost estimates, mobilization plan, financial pro forma, and 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** | Sargent & Lundy 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. We 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. We also conducted a high-level economic feasibility analysis for the top technically viable projects. As part of

the renewable options study, we reviewed bids submitted to SMEPA in response to an RFP for renewable energy. This review included evaluating the economic and technical merits and feasibility of each bid.

- ✦ **New England Power Generators Association (NEPGA), 2010** | Sargent & Lundy 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** | Sargent & Lundy 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.

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