Sargent & Lundy

Renewable Energy

Qualifications and Experience

Wind Power | Solar PV | Concentrating Solar Power | Alternative Fuels, Recycling, & Biomass | Geothermal | Hydroelectric | Energy Storage | Hybrid Power Plants & Microgrids

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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 energy with expertise in grid modernization, renewable energy, energy storage, nuclear power, and fossil fuels. Sargent & Lundy delivers comprehensive project services—from consulting, design, and implementation to construction management, commissioning, and operations/maintenance—with an emphasis on quality and safety. The firm serves public and private sector clients in the power and energy, gas distribution, industrial, and government sectors.

Sargent & Lundy's staff of over 2,000 people enables the firm to conduct projects around the globe. We serve the worldwide power markets through our headquarters in Chicago, Illinois, and numerous satellite offices in various locations in the United States (in Arizona, California, Delaware, Maryland, New Jersey, North Carolina, Tennessee, and Washington), as well as through international and joint venture offices in Canada, India, Saudi Arabia, and the UAE. In addition, we have strategic partners in South America and Africa supporting our project activities in these regions. We offer state-of-the-art facilities and resources throughout our organization.

1891
founding year

125+
years leading the industry

500+
power generation clients

100+
transmission & distribution clients

400+
consulting clients

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Wind Power

Since the early 2000s, Sargent & Lundy has provided services to the wind power industry. We provide a wide range of services for wind project developers, contractors, owners, lenders, and investors, including:

- Full Plant Design
- Site Screenings
- Project Feasibility Studies
- Wind Resource Assessments
- Independent Engineering
- Interconnection Planning
- Conceptual Engineering
- Contract Development
- Detailed Engineering
- Design Reviews
- Construction Monitoring
- Commissioning
- Operations and Maintenance Support

We have experience with a variety of wind turbine generators, including models from Acciona, Clipper, Enercon GmbH, GE, Goldwind, Kenersys, Mitsubishi, Nordex, Senvion, Siemens Gamesa, Sinovel, Suzlon, and Vestas.

We participate in the AWEA Offshore Wind Working Group and the AWEA Wind Power O&M Working Group. We also actively participate in the IEEE Wind Plant Collector Design Working Group.

The following recent projects provide an overview of Sargent & Lundy's wind energy experience.

Sargent & Lundy participated in and was actively involved in the American Society of Civil Engineers (ASCE) / American Wind Energy Association (AWEA) committee that prepared a US code for the design of wind turbine foundations.

Due Diligence and Independent Engineering

Selected Recent Project Experience

ARES Energy Investors

- 2018–Present | Texas, United States | Performed a full independent engineering due diligence for a partial repower of three wind facilities:
  - 60 MW | Silver Star
  - 145 MW | Sherbino Mesa II
  - 225 MW | Trinity Hills

Apex Clean Energy Management

2018 | Performed an independent engineering review of P&H wind turbine foundation design at the 249-MW Chapman Ranch Wind Project.

Blattner Energy

- 2018 | Independent engineering review and post-processing of raw instrument data for the Trent Mesa Wind Energy Center.
- 2018 | Independent engineering review and post-processing of raw instrument data for the Desert Sky Wind Farm.
- 2018 | Data processing and analysis of wind turbine foundation data from operating wind turbines to support wind turbine partial repowering.

BP Wind Energy

2018 | Performed an independent engineering review of the Flat Ridge 1 Wind Farm to support repowering.

Confidential Clients

- 2018–2019 | Texas | Independent engineering due diligence review for a partial repower of a 122-MW, 53 turbine wind project and a partial repower of a 161-MW, 70 turbine wind project.
- 2018–2019 | Performed an independent engineering review of a single wind project in the United States to support repowering. Sargent & Lundy's scope included site inspections and desktop reviews of the foundations, electrical systems, and tower sections.
- 2018–2019 | Pennsylvania, United States | Provided full scope of independent engineering services for a wind project in support of tax equity.
- 2018–2019 | New Hampshire, United States | Provided full scope of independent engineering services for a wind project in support of tax equity.

- 2018–2019 | Hawaii, United States | Owner's engineering reviews and support of a new wind project. Sargent & Lundy's scope of review incudes review and negotiation of key project agreements such as the turbine supply agreement, BOP EPC agreement, and O&M agreement.
- 2018 | Texas, United States | Provided due diligence services for a wind project in support of acquisition.
- 2018 | New Mexico, United States | Independent review of a wind resource assessment and operations and maintenance contracting.
- 2018 | Colorado, United States | Independent engineering review and assessment of the wind project's interconnection request feasibility study.
- 2018 | Illinois, United States | Independent engineering review and assessment of costs associated with a wind project's substation upgrades.
- 2018 | Independent engineering evaluations to support tax equity investment for 12 greenfield wind projects. Sargent & Lundy's scope included assessment of the wind turbine foundations, electric BOP design, and construction review.
- 2018 | Independent engineering evaluations to support tax equity investment for five repowered wind projects. Sargent & Lundy's scope included a full analysis of the wind turbine foundations, foundation inspections, tower inspections, and electric BOP design and construction review.
- 2018 | Independent engineering evaluations to support tax equity investment of a fully repowered wind project. Sargent & Lundy's scope included assessment of the wind turbine foundations, electrical BOP, commercial agreements, and O&M cost projections.

E.ON Climate & Renewables

2018 | 201 MW | Texas, United States | Sargent & Lundy performed a detailed decommissioning cost estimate for the Stella Wind Farm on behalf of the project owner and property owner.

Fagen, Inc.

- 2018 | Iowa, United States | Performed an independent engineering third-party foundation design review for the Saratoga Wind Farm.
- 2018 | Independent engineering review of Palmers Creek Wind Farm. Also performed independent engineering review of the RUTE foundation design.

GlidePath Advanced Energy

- 2018 | Due diligence reviews of seven operating wind projects in support of asset acquisition.
- 2018 | Provided due diligence reviews in support of asset acquisition of 10 wind projects.

IC Power

2018 | Reviewed the foundation design for the Agua Clara Wind Farm in the Dominican Republic.

JBS Energy Solutions LLC

2018 | Independent engineering review of P&H tensionless pier shear reinforcement at the Kimball Wind Farm.

Leeward Renewable Energy

- 2019 | 76 MW | Illinois, United States | Provided an independent engineering opinion on a third-party arc flash risk assessment for the Mendota Hills Wind Farm. Also provided an opinion on the aspects of a switchgear cabinet installation.
- 2018–2019 | 76 MW | Illinois, United States | Conducted an independent engineering due diligence review for a full repower of the Mendota Hills Wind Farm. Also conducted decommissioning analyses. Currently providing construction monitoring services.
- 2018 | 37.5 MW | Texas, United States
    - Performed a wind turbine foundation review for possible update at Sweetwater 1 Wind Farm.
    - Independent due diligence for a partial repower of the Sweetwater I Wind Farm. Sargent & Lundy's scope included foundation review, electrical BOP, condition assessment, wind energy assessment, and O&M cost assessment.

Mitsui & Co., LTD.

2018 | 60 MW | Argentina | Independent engineering reviews and turbine foundation evaluation for the Vientos los Hercules wind project.

NextEra Energy Resources, LLC

- 2018–2019 | 160 MW | Nebraska, United States | Performed independent engineering evaluation and completion verification reviews of the Sholes Wind Energy Portfolio to support tax equity investment. Sargent & Lundy's scope included review of BOP design and construction, interconnection facilities, and project contracts as well as construction completion verifications.
- 2018 | Performed independent engineering due diligence reviews of the following wind projects:
    - 454 MW Total | Horse Hollow I (230 MW) and Horse Hollow III (224 MW) Wind Energy Centers
    - 513 MW Total | Capricorn Ridge I, III, and IV Wind Energy Centers
    - 114 MW | Callahan Divide Wind Energy Center
    - 90 MW | Red Canyon Wind Energy Center
- 2018 | United States | Performed independent engineering evaluation and completion verification reviews of several greenfield wind projects to support tax equity investment. Sargent & Lundy's scope included review of BOP design and construction, interconnection facilities, and project contracts. Also verified construction completion. The sites included:

  - 51 MW | Casa Mesa Wind Energy Center
  - 80 MW Total | Texas & Oklahoma | Lorenzo Wind Energy Center, Wildcat Ranch Wind Farm, Armadillo Flats, and Pegasus Wind Farm
  - 607 MW Total | Kansas, Iowa & Oklahoma | Pratt Wind Energy Center, Heartland Divide Wind, Minco IV Wind Energy Center, and Minco V Wind Energy Center
  - 400 MW Total | Texas | Torrecillas Wind (300 MW) and Blue Summit II (100 MW) Wind Energy Centers
- 2018 | 555 MW Total | Texas | Performed an independent engineering review of three wind projects to supporting repowering: Indian Mesa Wind Energy Center (100 MW), Woodward Mountain Wind Energy Center (177 MW), and King Mountain Wind Energy Center (278 MW).
- 2018 | 465 MW Total | New Mexico, North Dakota & Oklahoma, United States | Performed an independent engineering review of four wind projects to support repowering and tax equity investment of Elk City II (101 MW, Oklahoma); Langdon Wind I (119 MW) and Langdon Wind II (41 MW) Energy Centers (North Dakota); and New Mexico Wind (204 MW, New Mexico). The scope included a full analysis of the wind turbine foundations, foundation inspections, and electric BOP design.
- 2018 | 99 MW | Oklahoma, United States | Performed an independent engineering review of the proposed 2019 operating budget for the Breckinridge Wind Farm.

Patrick & Henderson

2018–2019 | Post-processing of wind turbine tower and foundation sensor data for the wind turbines at Desert Sky Wind Farm, Trent Mesa Wind Farm, Snyder Wind, and Auwahi Wind.

Rute Foundation Systems

- 2018 | Review of several new foundation designs:
  - Rute foundation design
  - Rute BXG 90% foundation design package
  - Rute TG foundation

Third Planet Windpower

2018 | 100 MW | Texas, United States | Independent engineering electrical and structural design reviews of the Loraine Windpark.

U.S. International Development Finance Corporation

2018 | 50 MW | Lender’s Technical Advisor for the Master Green Wind project.

Additional Project Experience

AES

2008–2009 | Pennsylvania, United States | Independent engineering review to support raising third-party capital for the Armenia Mountain Wind Project. The facility uses GE 1.5sle wind turbine generators. Sargent & Lundy performed complete technical review of the project, which included the wind resource assessment, project financial statement, turbine foundations, power collection system, SCADA system, and key project contracts.

Avangrid Renewables (formerly Iberdrola Renewables)

2008–2009 | Independent engineering review of the Aeolus VI portfolio of five wind projects owned by Iberdrola Renewables.

BBVA Securities

2010–2012 | Nova Scotia, Canada | Independent engineering review to support financing for the Glen Dhu Wind Project. The facility uses Enercon E-82 2.3 MW wind turbines. Sargent & Lundy performed a technical review of project, which included the project financial statement, wind resource assessment, wind turbine technology and suitability, wind turbine foundations, power collection system, SCADA system, interconnection and grid congestion, and key project contracts.

Blattner Energy

- 2007–2019 | United States | Independent engineering reviews and evaluations of wind turbine foundation designs for more than 60 projects. Select sites and locations listed below.
    - California | North Sky River (162 MW)
    - Colorado | Limon Wind (200 MW)
    - Iowa | Heartland Divide (104 MW); Story County (150 MW)
    - Kansas | Pratt Wind (244 MW)
    - Michigan | Pheasant Run (75 MW)
    - Nebraska | Sholes Wind (160 MW); Steele Flats (75 MW)
    - New Mexico | Casa Mesa (51 MW)
    - North Dakota | Ashtabula Wind (149 MW); Brady Wind (150 MW)
    - Oklahoma | Armadillo Flats (248 MW); Minco IV (130 MW); Minco V (220 MW)
    - Texas | Wildcat Ranch (151 MW); Pegasus Wind; Capricorn Ridge Wind; Lorenzo Wind; Palo Duro; Desert Sky Wind Farm; Trent Mesa Wind Farm

BP Wind Energy

- 2017–2018 | 430 MW Total | Conducted an independent engineering review of the Sherbino Mesa II, Trinity Hills, and Silver Star wind projects in support of asset sale and potential repowering. Sargent & Lundy's scope included site inspections and desktop reviews of the foundations, electrical systems, and tower sections. The projects consist of 172 turbines.
- 2010 | Idaho, United States | Independent engineering review to support raising third-party capital for Goshen II Wind Project. Facility uses GE 1.5xle wind turbine generators. Sargent & Lundy performed technical review of project, including project financial statement, wind turbine technology and suitability, wind turbine foundations, power collection system, SCADA system, interconnection and grid congestion, and key project contracts.

Confidential Clients

- 2017–2018 | Independent engineering evaluations to support planning for the repowering of three wind projects. Sargent & Lundy's scope included a full analysis of the wind turbine foundations, foundation inspections, tower inspections, wind resource assessment, turbine suitability review, contracts review, and electric BOP design and construction review.
- 2017 | Independent engineering evaluations to support tax equity investment for two repowered wind projects. Sargent & Lundy's scope included a full analysis of the wind turbine foundations, foundation inspections, tower inspections, wind resource assessment, turbine suitability review, contracts review, and electric BOP design and construction review.
- 2017 | United States | Acquisition due diligence. Performed technical and financial due diligence of 11 development-stage wind power projects.
- 2017 | Central United States | Acquisition due diligence. Performed an assessment of future O&M expenses at two wind projects.
- 2016–2017 | Texas, United States | Independent engineering review to support tax equity investment of two wind projects being repowered.
- 2016 | Hawaii, United States | Asset acquisition due diligence services to support the client's evaluation of a wind power. Sargent & Lundy evaluated the wind resource, wind turbine selection, project feasibility, and economics, and provided bid model inputs.
- 2011–2012 | Canada | Asset acquisition due diligence services to support the client's evaluation of investing in a wind power project. Sargent & Lundy performed a technical review of the project, which included the project financial statement, wind turbine technology and suitability, project construction plan and schedule, interconnection and grid congestion, and key project contracts.

ContourGlobal

- 2016–2019 | 114 MW | Peru | Independent engineering O&M budget review of the Inka wind project.
- 2014–2015 | 114 MW | Peru | Independent engineering review of the Inka wind project to support bond offering. Sargent & Lundy performed a technical review of the project, which included the project financial statement, wind resource assessment, wind turbine technology and suitability, wind turbine foundations, power collection system, SCADA system, interconnection, and key project contracts.

EDF Renewable Energy

- 2010 | Washington, United States | Independent review of commercial operation completion for the Linden Wind Energy Project.
- 2009 | Washington, United States | Independent engineering review of the wind turbine foundation design for the Linden Wind Energy Project. The project uses P&H-type foundations for REpower 2-MW wind turbines.

E.ON Climate & Renewables

2011–2014 | Wind project financial modeling support.

Exelon

2010 | 700 MW | Technical due diligence services to support the acquisition of a portfolio of 36 operating wind projects. Sargent & Lundy's scope included a fatal flaw analysis, a review of operating performance, a design review, and the provision of technical and financial input into the financial model used to develop the acquisition bid.

Fagen, Inc.

2009–2019 | Independent reviews and evaluations of wind project electrical and foundation designs for more than 20projects.

GE Energy Financial Services

- 2017 | Independent engineering evaluations to support tax equity investment for 12 repowered wind projects. Sargent & Lundy's scope included a full analysis of the wind turbine foundations, foundation inspections, tower inspections, and electric BOP design and construction review.
- 2014–2015 | Texas, United States | Independent engineering review of Capital Dynamic's Briscoe Wind Project to support financing.
- 2014 | Texas, United States | Construction monitoring review of Pattern Energy's Panhandle Wind Project to support financing.

- 2013 | Texas, United States | Independent engineering review of Pattern Energy's Panhandle Wind Project to support financing.
- International Finance Corporation & European Bank for Reconstruction and Development
- 2012–2013 | 142.5 MW | Turkey | Independent engineering review of the Bares Wind Project to support financing. Sargent & Lundy's scope included reviews of project financial projections, contracts, wind turbine selection, designs and the construction plan and schedule. Sargent & Lundy monitored construction progress and start-up on behalf of the project lenders.

International Finance Corporation

- 2011–Present | Turkey | Served as the Lender's Technical Engineer for three WPPs. Sargent & Lundy's scope included due diligence, construction monitoring, and ongoing operations monitoring of the projects. The projects use Siemens SWT-2.3-101 wind turbine generators:
  - 143 MW | Balıkesir | Balıkesir WPP | 454 GWh annual generation
  - 30 MW | Mahmudiye | Çanakkale WPP | 77 GWh annual generation
  - 39 MW | Mersin Province | Dağpazarı WPP | 90 GWh annual generation
- 2009–2010 | Turkey | Independent engineering review of a wind energy project to support project financing. The facility uses Siemens SWT-2.3-101 wind turbine generators. Sargent & Lundy's review included the project financial statement, wind resource assessment, wind turbine technology and suitability, wind turbine foundations, power collection system, SCADA system, interconnection and grid congestion, and key project contracts.

Macquarie Capital

2015 | Northwestern Illinois, United States | Independent engineering review of Big Sky Wind Project as Lender's Technical Advisor to support financing of project.

NextEra Energy Resources

- 2017 | 46 MW | California, United States | Independent engineering evaluation to support tax equity investment for the greenfield Golden Hills North Wind. The scope included a full analysis of the wind turbine foundations, foundation inspections, tower inspections, and electrical BOP design and construction review.
- 2017 & 2018 | 99 MW & 120 MW | Arizona & Pennsylvania, United States | Reviewed the proposed and baseline annual O&M budget for the Canyon Wind Portfolio, which consists of the Perrin Ranch Wind Energy Center (99 MW, Arizona) and the Tuscola Bay Wind Energy Center (120 MW, Pennsylvania).
- 2013–2018 | Independent engineering services for several O&M budget reviews for operating wind projects to support loan agreement obligations.

- 2017 | Independent engineering evaluations of ten repowered wind projects to support tax equity investment. Sargent & Lundy's scope included a full analysis of the wind turbine foundations, foundation inspections, tower inspections, and electrical BOP design and construction review.
- 2016 | 99 MW & 201 MW | Missouri & North Dakota, United States | Independent engineering evaluation and completion verification of the Oliver III Wind Project (99 MW) in North Dakota and the Osborn Wind Project (201 MW) in Missouri to support tax equity investment. Sargent & Lundy's scope included review of BOP design and construction, interconnection facilities, and project contracts, as well as verification of construction completion.
- 2016 | 200 MW & 250 MW | Oklahoma & Texas, United States | Independent engineering evaluation and completion verification of the Rush Springs Wind Project (250 MW) in Oklahoma and the Javelina II Wind Project (200 MW) in Texas to support tax equity investment. Sargent & Lundy's scope included review of BOP design and construction, interconnection facilities, and project contracts, as well as verification of construction completion.
- 2015 | 150 MW | Colorado, United States | Independent engineering evaluation and completion verification of the Carousel Wind Project to support tax equity investment. Sargent & Lundy's scope included review of wind turbine technology, BOP design and construction, SCADA systems, project contracts, and construction completion verification.
- 2015 | 250 MW | Texas, United States | Independent engineering evaluation of the Javelina Wind Project to support tax equity investment. Sargent & Lundy's scope included review of BOP design and construction, SCADA systems, project contracts, and construction progress.
- 2015 | 98 MW | Oklahoma, United States | Independent engineering evaluation and completion verification of the Breckinridge Wind Project to support tax equity investment. Sargent & Lundy's scope included review of wind turbine technology, BOP design and construction, SCADA systems, project contracts, and construction completion verification.
- 2014 | Colorado, United States | Independent engineering evaluation of the Limon III Wind Project to support project financing. Sargent & Lundy's scope included review of BOP design and construction, SCADA systems, and project contracts.
- 2014 | Oklahoma, United States | Independent engineering evaluation of the Mammoth Plains Wind Project to support project financing. Sargent & Lundy's scope included review of BOP design and construction, SCADA systems, and project contracts.
- 2014 | 199 MW & 250 MW | Independent engineering evaluation of the Seiling I (199 MW) and II Palo Duro (250 MW) wind projects to support project financing. Sargent & Lundy's scope included review of BOP design and construction, SCADA systems, and project contracts.
- 2013 | 162 MW | California, United States | Independent engineering evaluation of the North Sky River Wind Project to support project financing. Sargent & Lundy's scope included review of BOP design and construction, SCADA systems, and project contracts.
- 2013 | 161 MW | Oklahoma, United States | Independent engineering evaluation of the Pioneer Plains Wind Portfolio, consisting of two wind energy projects to support project financing. Sargent

& Lundy's scope included review of BOP design and construction, SCADA systems, and project contracts.

- 2012–2013 | 220 MW Total | Arizona & Michigan, United States | Independent engineering evaluation of two wind energy projects to support project financing. Sargent & Lundy's scope included review of the financial model, wind turbine technology, BOP design and construction, SCADA systems, project contracts, plant O&M, and construction monitoring.
- 2012 | 400 MW Total | Colorado, United States | Independent engineering evaluation of two wind energy projects to support project financing. Sargent & Lundy's scope included review of the financial model, wind turbine technology, BOP design and construction, SCADA systems, project contracts, plant O&M, and construction monitoring.
- 2011 | Over 1,000 MW | California, Oklahoma & Texas, United States | Independent engineering review of seven wind projects to support financing. The plants use GE and Siemens wind turbines. Sargent & Lundy's scope for each facility included review of the financial model, turbine technology, BOP design and construction, SCADA systems, project contracts, and plant O&M.
- 2009–2010 | Midwestern United States | Independent engineering review of the Mountain Prairie and Peace Garden portfolios to support financing of four wind energy plants. The facilities use GE 1.5-MW and Siemens 2.3-MW wind turbine generators. Sargent & Lundy's scope for each facility included review of the foundations, power collection and SCADA systems, and BOP EPC contracts.
- 2008–2009 | Midwestern United States | Independent engineering review of the Heartland I and II portfolios to support raising third-party capital for five wind energy plants. The facilities use GE 1.5sle wind turbine generators. Sargent & Lundy's scope for each facility included review of the foundations, power collection and SCADA systems, and BOP EPC contracts.
- 2008 | Eastern Canada | Independent engineering review of wind turbine foundations at two wind energy plants. Facilities use Vestas 78-meter HH 1.8-MW wind turbine generators.
- 2007 | Midwestern & Rockies Regions, United States | Independent engineering review of the Northern Frontier portfolio to support raising third-party capital for five wind energy plants. The facilities use GE 1.5 and Siemens 2.3e wind turbine generators. Sargent & Lundy's scope for each facility included review of the foundations, power collection and SCADA systems, and BOP EPC contracts.

Patrick & Henderson

2007–2018 | Independent reviews and evaluations of wind turbine foundation designs for more than 12 projects.

Standard Bank of South Africa

- 2011–2014 | Independent engineering review of MetroWind Van Stadens Wind Farm, which is being developed under the South African Renewable Energy Independent Power Producer Program. Sargent & Lundy's scope included pre-construction due diligence and construction monitoring.
- 2011–2012 | Independent engineering reviews of several proposed wind energy projects. Provided Lender's Technical Advisor services to support project development and bidding into the South African Renewable Energy Independent Power Producer Program.

SunEdison / TerraForm Power

- 2014 | Hawaii & Maine, United States | Asset acquisition due diligence of four wind projects—three in Maine and one in Hawaii—to support the client's acquisition of First Wind.
- 2012–2013 | Independent engineering review of wind turbine foundation designs on three projects, including complex geotechnical and foundation issues.

U.S. International Development Finance Corporation (formerly Overseas Private Investment Corporation)

- 2014–2019 | 36 MW | Jamaica | Independent engineering review as Lender's Technical Advisor to support financing of a wind project. Sargent & Lundy performed a technical review of the project, which included the project financial statement, wind resource assessment, wind turbine technology and suitability, wind turbine foundations, power collection system, SCADA system, interconnection, key project contracts, construction monitoring, and operations monitoring.
- 2013–2019 | 150 MW Total | Pakistan | Independent engineering review as Lender's Technical Advisor to support financing of three 50 MW wind projects. Sargent & Lundy performed a technical review of the projects, which included the project financial statement, wind resource assessment, wind turbine technology and suitability, wind turbine foundations, power collection system, SCADA system, interconnection, key project contracts, construction monitoring, and operations monitoring.
- 2013–2014 | 114 MW | Peru | Independent engineering review as Lender's Technical Advisor to support financing of a wind project. Sargent & Lundy performed a technical review of the project, which included the project financial statement, wind resource assessment, wind turbine technology and suitability, wind turbine foundations, power collection system, SCADA system, interconnection, and key project contracts.
- 2011 | 5 MW | Caribbean | Independent engineering review as Lender's Technical Advisor to support financing for a wind project on an island in the Caribbean. Sargent & Lundy performed a technical review of the project, which included the project financial statement, wind resource assessment, wind turbine technology and suitability, wind turbine foundations, power collection system, SCADA system, interconnection, and key project contracts.

Xcel Energy

- 2013 | Evaluated, scored, and ranked 64 proposals that were submitted to Xcel Energy seeking funding from their Renewable Development Fund. The technologies involved included ground and rooftop solar PV, utility-scale wind, small wind, biomass and biogas, anaerobic digestion, battery storage, fuel cells, and hydrogen production.

Owner's Engineer and Technical Advisor

Selected Recent Project Experience

AES

- 2019–Present | 28 MW | Hawaii, United States | Providing Owner's Engineer services related to the development, engineering, and construction of the Na Pua Makani Wind Project. These services include design engineering reviews, commercial agreement technical support, and field support.
- 2018 | 28 MW | Hawaii, United States | Sargent & Lundy provided technical reviews of the key project agreements including the EPC Agreement, O&M Agreement, and Turbine Supply Agreement.

ConEd Development

2018 | South Dakota, United States | Verification of construction completion for two wind projects.

Confidential Clients

- 2019 | Sargent & Lundy is providing support to the European Bank for Reconstruction and Development (EBRD) and the Ministry of Energy of a country in eastern Europe in developing new renewable energy resources (wind and solar PV). The work scope includes evaluating and selecting sites for future renewable generation, developing a detailed framework for a competitive bidding process (auction), developing auction rules, recommending institutional and financial arrangements to support the bids selected during the competitive bidding process, and advising on the financial and technical considerations associated with the auctions. In addition, Sargent & Lundy is responsible for evaluating the different bids that submit into the auction, responding to bidders' questions, and narrowing the total number of bidders down to a short list of possible bids.
- 2018–Present | United States | Performed project siting on behalf of a client looking to develop a wind project. Sargent & Lundy's scope included exploring various options across the United States and adhering to a set of parameters outlined by the client.
- 2018 | Southwestern United States | Advised client who will assume ownership of wind project under a build-transfer arrangement on several aspects of the project development including: wind resource and turbine layout; and O&M contract arrangements.
- 2018 | Performed wind project O&M cost and performance benchmarking study for large U.S. wind owner-operator.
- 2018 | Performed wind project O&M cost and performance benchmarking study for large U.S. wind owner-operator.

Additional Project Experience

American Capital Energy & Infrastructure

2014–2016 | 150 MW | Senegal | Owner's engineer to support the development of the Taiba Wind Project.

BBVA Securities

2010 | Nova Scotia, Canada | Developed a pro forma financial model for the project lenders to support financing for the Glen Dhu Wind Project.

BP Wind Energy

- 2009 | Consulting and BOP design review services to support development and implementation of the Titan 1 wind energy project.
- 2008–2009 | Construction consulting services to support development and implementation of the Fowler Ridge wind energy project.
- 2008 | Consulting and BOP design review services to support development and implementation of the Flat Ridge wind energy project.

City of New Ulm

2008–2009 | Minnesota, United States | Coordination and management of the development of a small wind energy project, including feasibility studies, contract development, and wind turbine selection.

Confidential Clients

- 2015 | Central United States | Sargent & Lundy performed a site screening, site evaluation, and wind resource study. Sargent & Lundy studied approximately 20 sites located in 4 states. In addition to the wind resource, Sargent & Lundy evaluated environmental restrictions, land availability, civil engineering considerations, and other relevant site selection matters.
- 2015–2018 | Performed numerous wind project decommissioning projects for various clients. Services included preparing decommissioning plans, decommissioning cost estimates, environmental review, and decommissioning field oversight.
- 2015 | Kenya | Wind resource assessment and site evaluation for a wind project.
- 2012 | Caribbean | Site selection and wind resource evaluation for a 30-MW wind project.
- 2012 | Central America | Cost estimating, scheduling, and project planning services to a client for a 30 MW wind project.
- 2011 | Midwestern United States | Site selection and project feasibility study for a 2-MW wind project for a municipal utility. Sargent & Lundy evaluated suitable wind turbine models, estimated annual energy production, and developed project development plans.

Energía Eólica de Honduras, S.A.

2009 | 100.5 MW | Honduras | Consulting services to support development and implementation of a wind project. Sargent & Lundy provided review of the client's draft BOP agreement and developed exhibits for the agreement, including the contractor's scope of work, technical specifications for all BOP components and systems, and completion criteria for all major systems and stages of construction.

E.ON Climate & Renewables

- 2008–2009 | Geotechnical and structural design consulting to guide the client in selecting the optimal wind turbine foundation type for the Stony Creek wind energy project.
- 2008 | Consulting and BOP design review services to support development and implementation of the Panther Creek, Inadale, and Pyron wind energy projects.

Gestamp Wind North America

2009 | Midwestern United States | Supplied interconnection advisory services and prepared interconnection request forms, including wind turbine technical information and a one-line diagram, for the client's project under development.

Half Moon Power

2008–2009 | Midwestern United States | Consulting services to support the development and implementation of multiple projects. Sargent & Lundy's services included conceptual project siting and layout, and the preparation of interconnection requests.

Lincoln Clean Energy

- 2017 | 500 MW Total | Texas, United States | Decommissioning cost estimate of two wind projects.
- 2017 | 250 MW | Texas, United States | Owner's engineering services to support operational readiness, including developing O&M procedures, for a wind project.

Mainstream Renewable Power

2010 | Illinois, United States | Consulting and owner's engineering services to support the development and implementation of a wind project. Sargent & Lundy provided advisory services for negotiation of the interconnection agreement and performed the transmission power flow study.

NextEra Energy Resources

2015–2018 | Wind turbine foundation design assessments and analysis for five operating wind projects to support repowering and life extensions.

PSEG Long Island

2017 | Assisted client with the evaluation and selection of bids submitted under terms of RFPs for the South Fork "Reforming the Energy Vision" project, which includes offshore wind. Developed evaluation models; handled bid administration; performed quantitative and qualitative technical, economic, and financial analyses of bids; and provided recommendations for stakeholder decision-making.

REpower USA (now Senvion)

2008 | Washington, United States | Review and evaluation of the wind turbine foundation design for Phase 1 of the Windy Point Wind Project. The project uses P&H type foundation design.

Third Planet Windpower

2008–2009 | 100 MW | Consulting services to assist the client with EPC contractor oversight during construction and with evaluating non-conformances at the Loraine Windpark project.

Conceptual Design and Studies

Selected Recent Project Experience

Acciona Energy USA Global

2018–2019 | Texas, United States | Conducted a design review on the wind turbine foundation for the Palmas Altas Wind Farm.

Apex Clean Energy

- 2019 | Northeastern United States | Engineering and design services for wind turbine foundations for a large wind farm being planned in the northeastern U.S.
- 2019 | 297 MW | Ohio, United States | Engineering and design services for 345/34.5-kV collector substation, 34.5-kV collection system, and 345-kV transmission line for the Emerson Creek Wind Farm.
- 2018–2019 | 302 MW | Illinois, United States | Engineering and design services for 345/34.5-kV collector substation and the 34.5-kV collection system for the Lincoln Land Wind Farm.

Avangrid Renewables

2018–2019 | Illinois, United States | Prepared a 30% design package for bidding purposes for the 34.5-kV collection system, 34.5-kV collection substation, and 138-kV transmission line for the Midland Wind Farm.

Calpine

2019 | 124 MW | New York, United States | Engineering and design services for 115/34.5-kV collector substation, 115-kV interconnection switchyard, and 115-kV transmission line tap for the Bluestone Wind Farm.

Invenergy

2019 | 208 MW | Engineering and design services for 115 interconnection switchyard upgrades for the Canisteo Wind Farm.

NextEra Energy Resources

- 2018–2021 | 44 MW | Pennsylvania, United States | Engineering and design services for 34.5-kV 15-mile overhead collection lines for the Waymart II Wind Farm.
- 2018–2019 | 250 MW | Oklahoma, United States | Engineering and design services for 345/34.5-kV collector substation and 30-mile 345-kV transmission line for the Skeleton Creek Wind Farm.
- 2018–2020 | 600 MW | Kansas, United States | Engineering and design services for 345/34.5-kV collector substation and 80-mile 345-kV transmission lines for the Soldier Creek Wind Farm.

- 2018–2020 | 200 MW | Texas, United States | Engineering and design services for 345/34.5-kV collector substation and 20-mile 345-kV transmission lines for the Hubbard Wind Farm.

UKA North American

2018–2019 | Illinois, United States | Prepared a 30% design package for bidding purposes for the 34.5-kV collection system, 34.5-kV collection substation, and 138-kV transmission line for the Midland Wind Farm.

Additional Project Experience

Acciona Energy USA Global

2008 | 100 MW | Engineering and design services for the 100-MW Ecogrove Project 138/34-kV collector substation, as a subcontractor to the Morse Group. Sargent & Lundy also provided engineering and design upgrades at six remote-end substations to support the interconnection and provided commissioning, testing, and quality control services for the collector substation and 138-kV interconnect transmission line.

American Capital Energy & Infrastructure

2014 | Senegal | Performed a renewable energy integration assessment for the Senegal (country wide) electric grid to assist the client with their evaluation of a wind power project acquisition.

Avangrid Renewables (formerly Iberdrola Renewables)

2009 | 200 MW | Engineering, design, commissioning, testing and quality inspection services for the 345-kV interconnection substation of the Cayuga Ridge Wind Farm, as a subcontractor to Meade Electric.

BP Wind Energy

- 2010–2011 | 147.5 MW | Texas, United States | Engineering and design services for one 138/34.5-kV collector substation, one 138-kV junction substation, 138-kV transmission line, and 34.5-kV collection system for the Sherbino Mesa II Wind Project.
- 2010–2011 | 225 MW | Texas, United States | Engineering and design services for one 345/34.5-kV collector substation, 345-kV transmission line, and 34.5-kV collection system for the Trinity Hills Wind Project.
- 2010 | 200 MW | Oregon, United States | Engineering and design services for one 230/34.5-kV collector substation, 230-kV transmission line, and 34.5-kV collection system for the Golden Hills Wind Power Project.
- 2009–2010 | 100 MW | Illinois, United States | Engineering and design services for one 138/34.5-kV collector substation, 138-kV transmission line, and 34.5-kV collection system for the Ford Ridge Wind Farm.
- 2009 | Central United States | Transmission power flow study to support operation of the client's wind energy project.

- 2008–2009 | Pennsylvania & Virginia, United States | Development of conceptual one-line diagrams and data required for the system impact and feasibility studies for five wind projects.

Confidential Clients

- 2009 | Conceptual design and study for integrating energy storage with the client's wind energy project.
- 2006–2007 | Wisconsin, United States | Engineering and design of interconnection facilities and substations for three new wind power projects.

Cherokee Nation

2008 | Review and assessment of a wind energy project feasibility white paper.

EDP Renewables

- 2015–2016 | 78.8 MW | New York, United States | Engineering and design services for 115/34.5-kV collector substation, 115-kV transmission line, and 34.5-kV collection system for the Arkwright Summit Wind Farm.
- 2015–2016 | 250 MW | Texas, United States | Engineering and design services for 345/34.5-kV collector substation, 345-kV transmission line, and 34.5-kV collection system for the Hidalgo Wind Farm.
- 2015 | 77.7 MW | New York, United States | Engineering and design services for 115/34.5-kV collector substation and 34.5-kV collection system for the Jericho Rise Wind Farm.
- 2015 | Engineering and design services for modification of collector substation and 34.5-kV collection system for a new project under development.
- 2008–2010 | 600 MW | Indiana, United States | Engineering and design services for three 345/34.5-kV collector substations, 345-kV transmission line, and 34.5-kV collection system for the Meadow Lake Wind Farm.
- 2008–2010 | 300 MW | Illinois, United States | Engineering and design services for one 345-kV interconnection switchyard, two 345/34.5-kV collector substations, 345-kV transmission line, and 34.5-kV collector system for the Top Crop Wind Farm.
- 2007–2009 | 300 MW | Iowa, United States | Engineering and design services for two 345/34.5-kV collector substations and 345-kV transmission line for the Pioneer Prairie Wind Farm.
- 2007 | 99 MW | Calumet County, Wisconsin, United States | Facility study for of wind generation.
- 2005–2007 | 397 MW | Illinois, United States | Engineering and design services for one 345-kV interconnection switchyard, two 345/34.5-kV collector substations, and 345-kV transmission line for the Twin Groves Wind Farm. Sargent & Lundy's scope also included support to Horizon Wind Energy for procurement of project materials and equipment.

Electric Power Research Institute

2010, 2015–2018 | Global | Provided EPRI with updates to the EPRI Wind Power Technology Guide. This included development of cost and performance data for sites in the U.S. and several international locations. LCOE calculations and sensitivities were conducted.

Enel Green Power North America

2017–2018 | 250-MW | Illinois, United States | Engineering and design services for the 345-kV interconnection switchyard for the HillTopper Wind Farm.

Gamesa Energy

2010 | United States | Investigation and assessment of electrical failure at the Gamesa wind power project; issued findings and recommendations to correct the issue and prevent reoccurrence.

Goldwind USA

2011–2012 | 108 MW | Illinois, United States | Engineering and design services for 138/34.5-kV collector substation and 138-kV interconnection switchyard for the 108-MW Shady Oaks Wind Farm.

Maui Electric Company

2013 | Performed a renewable energy integration assessment to assist the client with their efforts to expand the use of wind and solar power while maintaining reliability requirements.

NextEra Energy Resources

- 2017–2020 | 300 MW | North Dakota, United States | Engineering and design services for 115/34.5-kV and 230/34.5-kV collector substation and a 15-mile 115-kV and 10-mile 230-kV transmission lines for the Emmons-Logan Wind Farm.
- 2017–2018 | 100 MW | Iowa, United States | Engineering and design services for 161/34.5-kV collector substation and 20-mile, 161-kV transmission line for the Heartland-Divide Wind Farm.
- 2017–2020 | 200 MW | Minnesota, United States | Engineering and design services for 345/34.5-kV collector substation and 35-mile, 345-kV transmission line for the Dodge County Wind Farm.
- 2016–2017 | 150 MW | Michigan, United States | Engineering and design services for five-mile, 345-kV transmission line for the Huron Wind Farm.
- 2016–2018 | 200 MW | Kansas, United States | Engineering and design services for 20-mile, 345-kV transmission line for the Pratt Wind Farm.
- 2016–2020 | 100 MW | New York, United States | Engineering and design services for 115/34.5-kV collector substation; 20-mile, 115-kV transmission line; and 34.5-kV collection system for the Eight Point Wind Farm.

- 2016–2017 | 100 MW | West Virginia, United States | Engineering and design services for 15-mile 138-kV transmission line for the Mt. Storm Wind Farm.
- 2015–2016 | 150 MW | South Dakota, United States | Engineering and design services for 5-mile 230-kV transmission line for the Oliver III Wind Farm.
- 2015–2016 | 200 MW | Kansas, United States | Engineering and design services for 60-mile 345 kV transmission line for the Ninnescah Wind Farm.
- 2015–2016 | 250 MW | Oklahoma, United States | Engineering and design services for 20-mile 345-kV transmission line for the Rush Springs Wind Farm.
- 2015–2016 | 200 MW | South Dakota, United States | Engineering and design services for 40-mile 230-kV transmission line for the Crowned Ridge Wind Farm.
- 2014 | 200 MW | Texas, United States | Engineering and design services for 30-mile 345-kV transmission line for the Javelina Wind Farm.
- 2014 | 199 MW | Kansas, United States | Engineering and design services for 38-mile 230-kV transmission line for the Cedar Bluff Wind Farm.
- 2014 | 150 MW | Colorado, United States | Engineering and design services for 7-mile 230-kV transmission line for the Carousel Wind Farm.
- 2014 | 99 MW | Oklahoma, United States | Engineering and design services for 12-mile 138-kV transmission line for the Breckenridge Wind Farm.
- 2013 | 200 MW | Oklahoma, United States | Engineering and design services for 5-mile 345-kV transmission line for the Mammoth Plains Wind Farm.

Noble Environmental Power

2008–2009 | 350 MW | Texas, United States | Preparation of conceptual one-line diagrams and general arrangement drawings; support of client in discussions with transmission system operator for a wind park.

NRG

2010–2011 | 450 MW | Conceptual engineering services for the landfall and underground portions of the 230-kV transmission interconnection for the offshore Mid-Atlantic Wind Park, including route evaluation, landfall and duct bank engineering, and permitting support. The transmission line design had two circuits, each serving half of the wind project. The client did not proceed with the project.

Xcel Energy

- 2016 | 100 MW | Minnesota, United States | Engineering and design services for the 34.5-kV interconnection substation expansion (Chanarambie substation) for the Stone Ray Wind Farm.
- 2016 | 200 MW | Minnesota, United States | Engineering and design services for the 345-kV interconnection substation (Hawks Nest Lake Substation) and modification of the 345-kV interconnect transmission line for the Red Pine Wind Farm.

- 2015 | 150 MW | North Dakota, United States | Engineering and design services for the 230-kV interconnection substation (Peace Garden Substation) and modification of the 230-kV interconnect transmission line for the Border Wind Farm.

Construction Monitoring/Management

Selected Recent Project Experience

Acciona Energy USA Global

2018–2019 | Texas | Conducted construction monitoring for the Palmas Altas Wind Farm.

AES

2019–Present | 28 MW | Hawaii, United States | Providing construction management and owner's engineer services to support the development, engineering, and construction of the Na Pua Makani Wind Project. These services include on-site field support, design engineering reviews, and commercial agreement technical support.

Altamont Winds

2019–Present | 58 MW | California, United States | Providing construction management and owner's engineer services to support the development, engineering, and construction of the Summit Wind Project.

Additional Project Experience

AES

2009 | Pennsylvania, United States | Independent construction oversight on behalf of the project lenders to support financing for the Armenia Mountain Wind Project. The facility uses GE 1.5sle wind turbine generators.

Avangrid Renewables (formerly Iberdrola Renewables)

- 2009 | Commissioning, testing, and quality inspection services for the 345-kV interconnection substation of the Iberdrola Cayuga Ridge Wind Farm, as a subcontractor to Meade Electric.
- 2009 | Development of operating procedures for the Cayuga Ridge Wind Farm interconnection substation for the interconnecting utility.

BBVA

2010–2011 | Nova Scotia, Canada | Independent construction oversight on behalf of the project lenders to support financing for the Glen Dhu Wind Project.

BP Wind Energy

- 2010 | 124.5-MW | Idaho, United States | Independent construction oversight on behalf of the project lenders to support financing for the Goshen II Wind Project.
- 2009 | 199.5 MW | Indiana, United States | Commissioning services for the Fowler Ridge II Wind Project.

- 2008 | 301.3-MW | Indiana, United States | Onsite construction management and commissioning services for the Fowler Ridge Wind Project.
- 2008 | 520.4-MW | Kansas, United States | Onsite construction management for the Flat Ridge Wind Project.

CG Power

2011 | Idaho, United States | Independent construction oversight of the Power County Wind Farm.

ContourGlobal

2013–2014 | 114 MW | Peru | Independent construction oversight of a wind project on behalf of bond financing arrangers.

Eco Energy/Acciona

2008 | Commissioning, testing, and quality inspection services for the 138-kV transmission line and the 138/34.5-kV substation of the Acciona Eco Energy Wind Farm, as a subcontractor to Morse Electric.

EDP Renewables

- 2007–2008 | Commissioning services for substations of the Pioneer Prairie Phases 1 and 2.
- 2007–2008 | Construction management and electrical testing and commissioning for the substation and transmission for the Twin Groves Phases 1 and 2.
- 2007–2008 | Development of operating procedures for the Twin Groves interconnection substation and the Twin Groves I collector substation.
- 2007–2008 | Construction management services for the interconnection substation at the Top Crop Phase I.
- 2008–2009 | Development of operating procedures for the Top Crop Phases I and II interconnection and collector substations.
- 2007–2008 | Commissioning services for the collector substation at the Meadow Lake Phase I.
- 2009 | Development of operating procedures for the Meadow Lake Phase I collector substation.

NextEra Energy Resources

- 2017–2018 | Independent construction oversight of numerous wind projects during repowering.
- 2012 | Michigan, United States | Independent construction oversight on behalf of project lenders to support financing of the Tuscola Bay Wind Project.

Third Planet Windpower

- 2010 | 100 MW | Texas, United States | Independent certification of the Loraine Windpark Phase I Project Completion project.
- 2008–2009 | 100 MW | Texas, United States | Onsite construction management and commissioning services for the Loraine Windpark project.

U.S. International Development Finance Corporation (formerly Overseas Private Investment Corporation)

- 2016–2018 | 50 MW | Lender's Technical Advisor for construction monitoring for the Hawa Wind Project.
- 2017–2019 | 50 MW | Pakistan | Performed construction monitoring for the Jhimpir Wind Project.
- 2015–2016 | 36 MW | Jamaica | Independent construction monitoring of a wind project.
- 2015–2016 | 50 MW | Pakistan | Independent construction monitoring of the Master Wind Project.

Operations and Maintenance Support and Services

Selected Recent Project Experience

Patrick & Henderson

2018–2019 | Post-processing of wind turbine tower and foundation sensor data for the wind turbines at Desert Sky Wind Farm, Trent Mesa Wind Farm, Snyder Wind, and Auwahi Wind.

Confidential Client

2018 | O&M cost and performance analysis of a large data set from 78 operating wind projects with over 142 operating years of information. Identified patterns and trends about O&M costs, with respect to project age, project size, O&M approach, turbine OEM, location, and other factors.

Herling Construction Inc.

2018 | Illinois & Texas, United States | Performed a wind turbine generator decommissioning analysis for the Gulf Wind Farm (Texas) and Mendota Hills (Illinois).

Additional Project Experience

Confidential Clients

- 2017 | 350 MW | Kansas, United States | Operations and maintenance projections on two wind projects (200 MW and 150 MW).
- 2015–2018 | Performed numerous wind project decommissioning projects for various clients. Services included preparing decommissioning plans, decommissioning cost estimates, and decommissioning field oversight.
- 2015–2016 | West Virginia, United States | Independent engineering review of wind turbine foundations at an operating wind power project to assess potential remediation options.
- 2015 | Pennsylvania, United States | Independent engineering review of wind turbine foundations at an operating wind power project to assess potential remediation options.
- 2015 | Midwestern United States | Independent engineering review of wind turbine foundations at an operating wind project. Sargent & Lundy performed design calculations to assess the suitability of the original design.
- 2011 | Western United States | Third-party failure analysis of wind turbine blade failures for a project.
- 2010 | Western United States | Third-party failure analysis of a wind turbine gearbox failure for a project.
- 2010 | Engaged by an investment firm to perform technical due diligence on a wind O&M services company that the client was seeking to acquire. Sargent & Lundy evaluated the target firm's

vibration monitoring technology and provided assessments and recommendations to the client on the effectiveness and market potential of the technology.

- 2009–2010 | Technical consulting services to the client to support their negotiations with a wind turbine supplier to resolve a serial defect with critical wind turbine components.

BP Wind Energy

- 2011–2018 | 124.5 MW | Idaho | Independent engineering annual O&M assessment and budget review for the Goshen II Wind Project.
- 2010 | Engaged to develop a wind turbine foundation inspection guideline for our client's O&M personnel to use during their annual inspections and maintenance. The guidelines were developed based on Sargent & Lundy's extensive knowledge and experience with the design and operating considerations for wind turbine foundations.

Enel Green Power North America

2010 | New York, United States | Technical advisory and independent engineering services to Enel Green Power North America to review and assess the causes of a wind turbine collapse. One 1.5-MW wind turbine collapsed at Enel's wind project after 10 years of operation. Sargent & Lundy also provided design input for the revised foundation design and remediation plan. We also performed independent engineering reviews of the revised design.

Lincoln Clean Energy LLC

2017 | Texas, United States | Performed decommissioning cost studies for the Willow Springs Wind Farm and Dermott Wind Farm.

NextEra Energy Resources

2010 | Independent engineering review of the Langdon Wind Project plant performance, turbine reliability, and O&M procedures and practices on behalf of the project lenders. Assessed the need for O&M budget and maintenance reserve adjustments based on the initial two years of plant performance.

U.S. International Development Finance Corporation (formerly Overseas Private Investment Corporation)

2017–2019 | 50 MW | Pakistan | Operations monitoring of the Master Wind Project.

Offshore Wind

Selected Recent Project Experience

Confidential Clients

2018 | 400 to 800 MW | New York & New Jersey, United States | Competitor analysis for offshore wind projects.

Equinor

2018–2019 | New York, United States | Performed system reliability impact study (SRIS) to support client's bid in response to the New York offshore wind solicitation.

Additional Project Experience

Electric Power Research Institute

2010; 2015–2019 | Provided EPRI with updates to the EPRI Wind Power Technology Guide. This included providing capital cost estimates, O&M cost estimates, and performance data for sites in the United States and several international locations for both onshore and offshore wind. LCOE calculations and sensitivities were conducted.

PSEG Long Island

- 2017–2019 | 90-MW | Sargent & Lundy is monitoring the project development of the South Fork Offshore Wind Project, on behalf of the power purchaser. Our monitoring role will continue throughout construction and commissioning.
- 2015–2017 | 90 MW | Sargent & Lundy provided consulting services to support the selection and development of a planned offshore wind project. We reviewed the technical and economic feasibility of the offshore wind project and helped our client negotiate a PPA with the wind project developer. Sargent & Lundy is monitoring the project development and will monitor the project construction.

NRG

2010–2011 | 450 MW | Conceptual engineering services for the landfall and underground portions of the 230-kV transmission interconnection for the offshore Mid-Atlantic Wind Park, including route evaluation, landfall and duct bank engineering, and support of permitting. The transmission line design had two circuits, each serving half of the wind project. The client did not proceed with the project.

Solar Power

Sargent & Lundy has significant solar project experience and is on the forefront of new solar technologies and applications, such as bifacial PV modules and integration of solar and battery energy storage. Sargent & Lundy was the BOP engineer for the design of the SEGS VIII, IX, and X facilities in the late 1980s and has been active in the development of solar energy ever since. Sargent & Lundy is active in the renewable energy generation market and is currently providing owner's engineering, technical due diligence, and conceptual design of solar energy generation for our clients.

Selected Sargent & Lundy solar experience is provided within.

Due Diligence & Independent Engineering

Selected Recent Project Experience

ACWA Power / Project Lenders

2018–2019 | United Arab Emirates | Lender's Technical Advisor for the DEWA 700-MW CSP project. The project consists of a 100-MW central tower unit with molten salt storage and three 200-MW parabolic trough units with molten salt storage. Services include independent technical due diligence and presentations on technology in support of project financing.

American Electric Power

- 2018 | Nevada, United States | Performed an end-of-warranty inspection for the Boulder II Project. Work included reviewing the general arrangements for the project to develop a site-specific inspection plan with the intent of reasonably identifying EPC warranty items based on visual observation.
- 2018 | Utah, United States | Performed an end-of-warranty inspection for the Pavant III Project. Work included reviewing the general arrangements for the project to develop a site-specific inspection plan with the intent of reasonably identifying EPC warranty items based on visual observation.

BELECTRIC GmbH

2018 | North Carolina, United States | Provided due diligence services for solar projects.

Borrego Solar

2019 | Illinois, United States | PV Interconnection Support. Sargent & Lundy provided interconnection support for four 2-MW PV projects. As a part of our support we reviewed the Lottery Combined Study Reports issued by ComEd to assess the proposed costs and identify potential areas where the scope of upgrades may be reduced.

Community Power Group

2019 | Illinois, United States | Sargent & Lundy provided services to support an interconnection application for a PV project.

Confidential Clients

- 2020 | Provided a Level 5 cost estimation of a PV project considering an EPCM project structure. The cost estimate was broken down into the cost for various contractor specific tasks.
- 2020 | Provided a Level 4 cost estimation of a PV project in development based on layout drawings and site-specific material totals. The estimation used a parametric model to utilize material quantities and installation hours and rates for specific components.

- 2018 | Asset evaluation of seven projects for potential acquisition. Projects included one wind project, one CSP, and five solar PVs.
- 2018 | California, United States | Prepared CAISO interconnection applications and supplemental technical requirements for four 100+ MW solar PV and battery energy storage projects.
- 2018 | North Carolina, United States | Due diligence review of four solar PV projects in North Carolina to support client's potential acquisition. Prepared cost estimates and optimized layouts as part of LCOE analysis.

Domtar Paper Company

2019 | Sargent & Lundy performed a preliminary screening to assess the feasibility of wind and solar generation at three paper mill locations. As a part of our assessment we used PVsyst software to produce PV energy yield assessments for each location. EPC capital cost estimates were also provided.

Leeward Renewable Energy

2019–2020 | Sargent & Lundy has been providing independent engineering support throughout the interconnection application process included PV layout, yield, single line diagrams, and CAD drawings.

SolarReserve / Project Lenders

2018 | Australia | Lender's Technical Advisor for SolarReserve's 135-MW CSP project with molten salt storage being developed. Services include independent technical due diligence in support of project financing.

Silk Road Fund

2018 | United Arab Emirates | Providing support for potential asset investment in a 700-MW CSP project. Services include independent technical due diligence and presentations on technology and projects.

Additional Project Experience

Confidential Clients

- 2017–2019 | Chile | Independent technical due diligence and construction monitoring of a project in Chile, which consists of a 110-MW tower-technology electric power generation thermosolar plant with thermal storage capacity and 100-MW single-axis tracking PV plant.
- 2017–2018 | Jordan & United Arab Emirates | Due diligence review of four ground- and roof-mounted solar PV projects and one energy efficiency project on commercial properties to support client's potential acquisition.
- 2017 | California, United States | Independent engineering due diligence review of a 150-MW solar thermal power facility using a molten-salt power tower.
- 2015 | South Africa | Due diligence review of an operating 40-MW ground-mounted solar PV project to support client's potential acquisition.

- 2013 | Arizona, United States | Independent engineering review of the root-cause analyses and corrective actions related to the failures of padmount transformers at a PV solar power plant in Arizona.

Inter-American Development Bank

- 2015–2016 | Chile | Independent engineer for the Atacama 110-MW concentrating solar tower project with molten salt storage. Services include independent technical due diligence and construction monitoring.
- 2015 & 2017 | Chile | Independent engineer for a 100-MW solar PV project with single-axis tracking. Services include independent due diligence assessment and construction monitoring.

International Finance Corporation

2014–2015 | Philippines | Independent engineer for a 70-MW portfolio of three solar PV projects financed by the IFC. Services include independent solar energy yield assessment, technical due diligence in support of funding, and construction monitoring.

Macquarie Capital

2013 | Georgia, United States | Independent engineer for a 30-MW PV solar project constructed by Silicon Ranch. Services include independent technical due diligence, in support of funding, and construction monitoring.

Overseas Private Investment Corporation

- 2017–2019 | Jordan | Independent engineer for a 50-MW solar PV project. Services include independent solar energy yield assessment, technical due diligence in support of funding, construction monitoring, and performance testing oversight.
- 2017–2019 | India | Independent engineer for a 100-MW solar PV project and a 50-MW solar PV project. Services include independent solar energy yield assessment, technical due diligence in support of funding, construction monitoring, and performance testing oversight.
- 2016–2019 | El Salvador | Independent engineer for a portfolio of 100-MW solar PV projects. Services include independent solar energy yield assessment, technical due diligence in support of funding, construction monitoring, and performance testing oversight.
- 2015–2019 | El Salvador | Independent engineer for nine solar PV projects totaling approximately 40 MW. Services include independent solar energy yield assessment, technical due diligence in support of funding, construction monitoring, and performance testing oversight.
- 2014–2016 | Jamaica | Independent engineer for a 20-MW solar PV project that was financed by OPIC and the IFC. Services include independent solar energy yield assessment, technical due diligence in support of funding, and construction monitoring.
- 2013–2017 | Tanzania | Independent engineer for a 5-MW solar PV project being financed by OPIC. Services include technical due diligence in support of funding and construction monitoring.

SolarReserve / Project Lenders

- 2012–2018 | Africa | Independent engineering services for the 100-MW Redstone Solar Thermal Power project.
- 2013–2014 | Independent engineering services for the Limestone Concentrating Solar Power project.

Standard Bank & International Finance Corporation

2011–2017 | South Africa | Independent engineer for the Redstone CSP Solar Energy Project. Redstone is a 100 MW molten salt solar tower project with 12 hours of storage. Services included independent technical due diligence in support of funding by the consortium of lenders.

Standard Bank of South Africa

- 2011–2012 | South Africa | Independent engineering reviews of proposed solar PV projects; provide lender's technical advisory services to support project development and bidding into the South African Renewable Energy Independent Power Producer Program.
- 2011 | Independent engineering for a 75-MW PV solar project. Services include independent technical due diligence in support of funding and construction monitoring.
- 2011 | South Africa | Independent engineering for a 50-MW PV solar project. Services include independent technical due diligence, in support of funding, and construction monitoring.

SunEdison / TerraForm Power

2015 | Canada | Asset acquisition due diligence of two solar PV projects to support the client's potential acquisition.

United States Department of Energy

- 2010–2019 | Tonopah Solar Project | Nevada, United States | Independent engineer for the Tonopah Solar Project. Tonopah is a 100-MW molten salt solar tower project with 10 hours of storage. Services include independent technical due diligence, in support of funding by the DOE, construction monitoring, and operations monitoring.
- 2010–2019 | California, United States | Mojave Solar Project | Independent engineer for the Mojave Solar Project. Mojave is a 250-MW parabolic trough solar project. Services include independent technical due diligence, in support of funding by the DOE, construction monitoring, and operations monitoring.
- 2010–2011 | California, United States | Rice Solar Project | Independent engineer for the Rice Solar Project. Rice is a 150-MW molten salt solar tower project with four hours of storage. Services include independent technical due diligence in support of funding by the DOE.

PV Site Evaluation, Solar Resource, & Energy Production Assessment

Selected Recent Project Experience

Confidential Clients

- 2020 | New York | Sargent & Lundy developed tools to assist with the site selection of future PV project locations. These tools allowed the client to filter through 100+ sites ranging in size from 8 MW to 300 MW. The selection process included comparing their civil feasibility, ease of interconnection, PV performance, and site-specific costs.
- 2019 | Abu Dhabi | Sargent & Lundy provided bid support for a leading developer/IPP for the recent 1.5-GW solar project tender. Sargent & Lundy performed an independent energy yield assessment, based on a single-axis tracking project using bifacial solar modules. Sargent & Lundy considered solar field layout optimization opportunities and the integration of battery energy storage.
- 2018–2019 | Northern Africa | Technical review and assessment of solar resource and energy production estimates proposed within Solar PV IPP tenders for numerous bidders of a 200-MW project.
- 2018 | Caribbean | Developed conceptual layout and energy estimates for an 8-MW solar PV project being developed on a Caribbean island. Sargent & Lundy evaluated fixed-tilt and single-axis tracking configurations as well as thin-film and crystalline PV module options, and we prepared cost estimates.

BayWa r.e. USA

2018 | Michigan, United States | Performed a siting study for 2-MW and 10-MW solar PV plants.

Additional Project Experience

Confidential Clients

- 2017 | California, United States | Conceptual cost estimates and average service life estimate for a portfolio of solar PV generation sites.
- 2016 | Central United States | Developed conceptual layout and energy estimates for 20-MW solar PV project being developed near a U.S. military base. Sargent & Lundy evaluated fixed tilt and single axis tracking configurations, as well as thin film and crystalline PV module options.
- 2016 | California, United States | Developed conceptual layout and energy estimates for 60-MW solar PV project being developed in central California. Sargent & Lundy evaluated fixed tilt and single axis tracking configurations, as well as thin film and crystalline PV module options.

- 2016 | Central United States Developed conceptual layout and energy estimates for 20-MW solar PV project being developed adjacent to coal fired power plant. Sargent & Lundy evaluated fixed tilt and single axis tracking configurations, as well as thin film and crystalline PV module options.
- 2015 | Central United States | Sargent & Lundy performed a site screening and site evaluation study client. Sargent & Lundy studied approximately 50 sites located in 6 states. In addition to the solar resource, Sargent & Lundy evaluated environmental restrictions, land availability, civil engineering considerations, and other relevant site selection matters.

International Finance Corporation

- 2014 | Philippines | Performed an independent solar resource and energy production assessment of three solar PV projects (70 MW in total) to support project financing.

Macquarie Capital

- 2013 | Georgia, United States | Performed an independent solar resource and energy production assessment of a 30-MW solar PV project to support project financing.

Overseas Private Investment Corporation

- 2016–2019 | El Salvador | Performed independent solar resource and energy production assessments of a 100-MW solar PV project to support project financing.
- 2015–2019 | El Salvador | Performed independent solar resource and energy production assessments of nine solar PV projects located to support project financing. The projects together total approximately 40 MW.
- 2014–2016 | Jamaica | Performed independent solar resource and energy production assessment of a 20-MW solar PV project to support project financing.
- 2013–2014 | Tanzania | Performed an independent solar resource and energy production assessment of a 5-MW solar PV project to support project financing.

SunEdison / TerraForm Power

2015 | Canada | Performed independent solar resource and energy production assessment of two operating solar PV projects to support the client's potential acquisition.

Vistra Energy

2017–2018 | Texas, United States | Performed energy yield studies as part of an evaluation to add battery energy storage to the existing 180-MW Upton 2 Solar Project. Also provided battery technology advisory, cost estimates, preliminary electrical design, and other owner's engineering support.

CSP Site Evaluation, Solar Resource, and Energy Production Assessments

Selected Recent Project Experience

ACWA Power

2018–2019 | United Arab Emirates | Served as the Lenders' Technical Advisor for a 700-MW CSP project.

Additional Project Experience

Abengoa | 2015–Present

Chile | Atacama 110-MW Molten Salt Tower Project with 10 hours of storage

Performed an independent technical assessment of the solar resource and performance model (energy yield) for the project lenders in support of financial close.

DEWA Mohammed bin Rashid Al Maktoum

Solar Park Project | Phase IV | Two CSP units rated at 100 MW. One unit uses molten salt power tower technology and the other a proven CSP technology. Sargent & Lundy performed an independent review of the project's solar resource assessment and developed a solar performance and production model submitted with the client's bid.

SolarReserve

- Tonopah, Nevada, United States | Crescent Dunes 100-MW Molten Salt Tower Project with 10 hours of storage
    - Performed an independent technical assessment of the solar resource and performance model (energy yield) for the project lenders in support of financial close.
- California, United States | Rice 100-MW Molten Salt Tower Project with 10 hours of storage
    - Performed an independent technical assessment of the solar resource and performance model (energy yield) for the project lenders in support of financial close.
- Chile | Copiapó 110-MW Molten Salt Tower Project with 10 hours of storage
- Performed an independent technical assessment of the solar resource and performance model (energy yield) and third-party independent certification for submittal of the bid by SolarReserve.
- South Africa | Redstone 100-MW Molten Salt Tower Project with 10 hours of storage developed by ACWA and SolarReserve
    - Performed an independent technical assessment of the solar resource and performance model (energy yield) for the project lenders in support of financial close.

Conceptual and Detailed Design

Selected Recent Project Experience

Confidential Client

2018 | Caribbean | Developed conceptual layout, design, and energy estimates for an 8-MW solar PV project being developed on an island in the Caribbean. Sargent & Lundy evaluated fixed-tilt and single-axis tracking configurations as well as thin film and crystalline PV module options.

NextEra Energy Resources / Florida Power & Light

Florida, United States | Engineering and design services for new greenfield solar collection substations.

- 2020–2021
  - 230/34.5-kV solar collection substation for the 75-MW Delmonte North Solar Farm
- 2019–2020
  - 230/34.5-kV solar collection substation for the 75-MW Harmony Solar Farm
  - 230/34.5-kV solar collection substation for the 75-MW Taylor Creek Solar Farm
- 2018–2020
  - 500/34.5-kV solar collection substation for the 75-MW Ghost Orchard Solar Farm
  - 230/34.5-kV solar collection substation for the 75-MW Leno Solar Farm
  - 230/34.5-kV solar collection substation for the 75-MW Nubbin Solar Farm
  - 230/34.5-kV solar collection substation for the 75-MW Crawford Solar Farm
  - 115/34.5-kV solar collection substation for the 75-MW Plum Solar Farm
  - 115/34.5-kV solar collection substation for the 75-MW Moccasin Solar Farm
- 2017–2018
  - 138/34.5-kV solar collection substation for the 75-MW Krome Solar Farm
- 2016–2018
  - 138/34.5-kV solar collection substation for the 75 MW Interstate Solar Farm
- 2016–2017
  - 230/34.5-kV solar collection substation for the 75 MW Indian River Solar Farm
  - 230/34.5-kV solar collection substation for the 75 MW Loggerhead Solar Farm
  - 138/34.5-kV solar collection substation for the 75 MW Hammock Solar Farm

Additional Project Experience

Confidential Clients

- 2016 | Central United States | Developed conceptual layout, design, and energy estimates for 20-MW solar PV project being developed in conjunction with thermal power plant. Sargent & Lundy evaluated two different sites, and fixed tilt and single axis tracking configurations, as well as thin film and crystalline PV module options.
- 2016 | Central United States | Developed conceptual layout, design, and energy estimates for 20-MW solar PV project being developed adjacent to coal fired power plant. Sargent & Lundy evaluated fixed tilt and single axis tracking configurations, as well as thin film and crystalline PV module options.

First Solar

- 2017–2018 | California, United States | Engineering and design services for the new 150-MW North Rosamond solar PV project.
- 2017–2018 | California, United States | Engineering and design services for the new 100-MW Willow Springs solar PV project.

United States Department of Energy / Solar Dynamics

2017 | Southwest United States | Developed the comprehensive conceptual design for a 250-MW dispatchable solar plant. The conceptual design for a molten salt power tower includes a detailed conceptual design (preliminary drawings and technical specification), performance, cost, and schedule.

Xcel Energy

2016 | Minnesota, United States | Engineering and design services for modification of the 115-kV interconnection substation for the 62-MW Marshall Solar Farm.

Owner's Engineer and Technical Advisor

Selected Recent Project Experience

Confidential Clients

- 2020 | Michigan, United States | Provided technical advisory support for layout optimization and support throughout the interconnection process. Scope of work included optimized yield for the site based on inverter location, row spacing, module tilt, and road widths throughout the site. Sargent & Lundy also provided single line diagrams and CAD layout drawings for the interconnection application.
- 2019 | Texas, United States | Provided owner's engineering services to support conceptual layout design optimization, tracker technology selection, and EPC bid solicitation for a 400-MW project.
- 2019 | Sargent & Lundy is providing technical advisory services to the European Bank for Reconstruction and Development (EBRD) and the Ministry of Energy of a country in eastern Europe in developing new renewable energy resources (wind and solar PV). The work scope includes evaluating and selecting sites for future renewable generation, developing a detailed framework for a competitive bidding process (auction), developing auction rules, recommending institutional and financial arrangements to support the bids selected during the competitive bidding process, and advising on the financial and technical considerations associated with the auctions. In addition, Sargent & Lundy is responsible for evaluating the different bids that submit into the auction, responding to bidders' questions, and narrowing the total number of bidders down to a shortlist of possible bids.
- 2018–Present | Northern Africa | Sargent & Lundy is currently providing technical advisory services to the European Bank for Reconstruction and Development (EBRD) and a large utility in Northern Africa for new solar (200 MW) and wind projects. Current work scope focuses on implementation support for a Solar PV IPP tender. Key activities include further implementation support covering tender clarification, bid evaluation, selection of and negotiation with shortlisted bidders, award of the project to the preferred bidder, and finalization and execution of the project documentation with the preferred bidder. Our technical review includes an evaluation of plant design, yield assessment, main equipment suitability, equipment warranties, experience of EPC and O&M contractors, and overall schedule.
- 2018 | United States | Prepared a solar PV project technical specification for a utility-scale project.
- 2018–2019 | Midwestern United States | Providing owner's engineering support for a 100-MW+ solar PV project. Sargent & Lundy is currently managing the interconnection application process.
- 2018 | California, United States | Prepared MISO interconnection applications for four separate solar and battery storage projects between 100 MW and 200 MW.
- 2018 | Mexico | Serving as owner's engineer for a 100-MW solar PV project. Sargent & Lundy personnel will be deployed to the site during the construction and commissioning phases.

- 2018 | Michigan, United States | Performed site identification and site evaluation study for 20 solar projects. Each project is 2 MW in capacity. Used geographic information system tools to perform the study. Managed the interconnection application process.

Mitsui Mitre Calera Solar S.A.P.

2018–2019 | Served as the Owner's Engineer for the Mitsui Calera Solar PV project.

Swift Current Energy

2019 | Illinois & Arkansas, United States | Prepared PJM and MISO interconnection applications for three separate solar projects and two wind projects between 200 MW and 600 MW.

Additional Project Experience

Agrifos Fertilizer

2009 | Renewable Energy Feasibility Study | Texas, United States | Review and assessment of various renewable energy generation options that could be used at a site in southeastern Texas. Solar thermal and solar PV technologies were investigated. Performance, cost, and incentives were evaluated for the various technologies at the site.

Alstom

2015 | Israel | Developed the technical specification and review of bids for the tower structure for the 100-MW Ashalim molten salt power tower project.

Arizona Electric Power Cooperative

2007 | Functional specification for a gas turbine solar inlet chiller system for the Apache Station.

BP America, Inc.

2007–2008; 2011 | Assisted the client in developing their solar renewable strategy. The strategy included evaluation of solar trough and tower technologies, including current costs and potential cost reductions.

California Solar Ranch, LLC

2016 | Reviewed the technical performance of and conducted a cost study for a hybrid solar plant.

Confidential Clients

- 2017–2018 | Southern United States | Performed technical study and conceptual design for integration of battery energy storage into an existing solar PV project.
- 2016 | Central United States | Developed conceptual layout and energy estimates for 20-MW solar PV project being developed adjacent to coal-fired power plant. Sargent & Lundy evaluated fixed tilt and single axis tracking configurations, as well as thin film and crystalline PV module options.

- 2016 | United States | Conducted a decommissioning study, including cost estimates and environmental review, for dismantlement and scrap of various sites including wind projects and solar PV arrays.
- 2013 | South Africa | Performed a pre-feasibility study for a 30-MW solar PV facility. The scope included a solar resource evaluation, conceptual design, generation projection, interconnection review, and overall risk analysis.
- 2011 | California | Project and technical due diligence review for the client who was looking to invest in the Blythe CSP parabolic trough plant.
- 2011 | India | Developed the conceptual design for a parabolic trough plant. The conceptual design included a review of technology; a solar resource assessment and projection; a conceptual design including solar field size, HTF system, and power block; and conceptual design drawings including solar field layout, heat balance, electrical one line, control block diagram, and water balance.
- 2011 | Developed the detailed design for the solar field and HTF system. The solar field design included foundations. The HTF system design included a complete design package for purchase, installation, and commissioning.
- 2010 & 2011 | Southwestern United States | Project and technology due diligence reviews of solar thermal project(s). The reviews included both technology and general project risk.
- 2010 | Technical due diligence of a solar technology supplier.
- 2009–2011 | Technical due diligence review of eSolar direct steam power tower technology.
- 2008–2011 | Technical due diligence review of SolarReserve molten salt power tower technology.
- 2008 | Issued a consolidated report on the current status of CSP technology. The information included the current market, participants, active projects and developers, current costs, cost reduction potential, and discussion of emerging technologies.
- 2008 | Technical due diligence of the current three solar distributed power tower technologies being developed in the United States. Reviewed the design concept and implementation strategy for each of the technologies.
- 2007–2009 | Due diligence review of a solar technology supplier (SkyFuels) for an investment group and developer.
- 2007 & 2008 | Southwestern United States | Owner’s engineering for the development of two 180-MW solar parabolic trough power plants.
- 2007 | Due diligence review of concentrating PV systems. Developed a conceptual cost estimate for installation of large-scale projects.
- 2006 | Feasibility review of Ausra’s linear Fresnel technology proposed for a 180 MW plant.
- 2006, 2009, & 2010 | Feasibility review of the Brightsource direct steam power tower technology proposed for large-scale solar plant.

CPS Energy

2011 | Texas, United States | Engineering services for a technical review and construction monitoring of three 10-MW PV solar projects.

CMS Generation

2000–2001 | A technology survey and analysis investigation of commercially available renewable energy technologies, which included solar thermal and solar PV technologies.

Duke Energy Generation Services

2007 | Evaluation of solar trough and tower technologies, including current costs and potential cost reductions.

Electric Power Research Institute

- 2013–2019 | Global | Provided EPRI with updates to the EPRI Solar PV Technology Guide and the Solar Thermal Technology Guide. This included development of cost and performance data for sites in the United States and several international sites. LCOE calculations and sensitivities were conducted.
- 2017 | Provided EPRI with a PV solar project decommissioning guide.
- 2009 & 2010 | Provided EPRI with plant descriptions, estimated cost, and associated technical information on solar thermal and PV electric power generation technologies. The information included current status and potential projections for development and/or commercialization activities over the next 5 to 15 years. Issues and activities associated with renewable power generation technologies, as they relate to planning, engineering, and project development, were discussed.

Entegra Power Group

2009 | Gila River Solar Feasibility Study | Analysis of the use of both parabolic trough and PV technologies at the existing Gila River power plant site. The parabolic trough CSP configuration investigated for the Gila River plant was based on integration with the existing combined-cycle configuration. The PV configuration was based on non-tracking thin-film PV panels. The analysis included capital costs, O&M costs, water usage, land requirements, staffing, achievable performance, and technology maturity.

Florida Power and Light

Florida Power and Light, as one of the principal owners, engaged Sargent & Lundy to perform an independent due diligence review of the SEGS facilities. Services included:

- 2005 | A due diligence review of the SEGS III VII for a project refinancing, including a condition assessment, reviews of O&M practices and budgets, plant performance, financial projections, and status of permitting and licensing compliance.

- 1998 | A due diligence review of SEGS VIII and IX for a project refinancing, including a condition assessment, reviews of O&M practices and budgets, plant performance, financial projections, and status of permitting and licensing compliance.

Goldman Sachs

2006 | Southwestern United States | Engineering services for the development of a large-scale (600 MW) parabolic trough plant. Services included conceptual design and conceptual cost estimate.

HIRCO

2010 | Feasibility of Solar Power at Existing Site | Engineering services for the feasibility of parabolic trough technology at an existing site in India, as well as an analysis of expected project costs, taking local factors into consideration.

Intermountain Power Agency

2009 & 2010 | Feasibility of Solar Power at Existing Site | Utah, United States | Engineering services for the feasibility of various solar technologies (tower, trough, and PV) at an existing site.

Iberdrola

2008 | Southwestern United States | Conceptual design for 100-, 250-, and 500-MW parabolic trough power plants. A high-level capital cost estimate and estimate of O&M costs were developed.

InterGen

2008 | A feasibility study of a solar retrofit for a 501F 1x1 combined-cycle unit. The CSP technologies addressed were parabolic trough, power tower, and compact linear Fresnel receiver. The relevant advantages and disadvantages of each type of system were identified. Evaluation areas included steam conditions achievable, technology maturity, comparative capital and O&M costs, and equipment availability.

LUZ Solar Partners

- 1997 | Since the original operation of the units, Sargent & Lundy has provided engineering support to the operating companies to improve the efficiency and reliability of the plant. For example, we designed the piping system for added condensate storage tanks, bypasses for the HTF heaters, and provided a study of variable-frequency drives, a structural design review, and assistance with turbine blade repairs.
- 1988 | Harper Lake, California, United States | Sargent & Lundy participated in the original design of the SEGS VIII and IX—two 80-MW parabolic trough units. The units have gas-fired HTF heaters, a hybrid design that was considered the lowest-cost and latest technology. Initial operation was in December 1989. Sargent & Lundy performed the design of the power block, balance-of-plant, and interface with solar field. Our efforts included the design of SEGS X, for which construction was started but not completed.

Maui Electric Company

2013 | Performed a renewable energy integration assessment to assist the client with their efforts to expand the use of wind and solar power while maintaining reliability requirements.

Mesa del Sol

2008 | Southwestern United States | High-level capital cost estimate and O&M costs for a 100-MW solar parabolic trough plant.

Mitsui & Co., Ltd.

2007 | Comprehensive technology survey and analysis of commercially available solar thermal and solar PV technology.

National Rural Electric Cooperative Association

2005 & 2006 | The National Rural Electric Cooperative Association engaged Sargent & Lundy to assess renewable energy options to enhance combustion turbine performance. Our scope included a technical and financial analysis of combustion turbine enhancement using solar parabolic troughs and absorption cooling of inlet air. The final deliverable included a comprehensive report and working economic model.

Sempra

- 2009 | Feasibility Study for Batteries in Large-Scale PV Plants | Southwestern United States | Engineering services for the feasibility and selection of large-scale battery systems for a 50-MW thin-film PV plant. The study included a review of available battery technology, maturity of the technology, capital and O&M costs, and methodology to size the battery and determine optimum battery type based on technology and cost.
- 2007 & 2009 | Parabolic Trough Solar Plant | Southwestern United States | Engineering services for the development of a large-scale parabolic trough plant. The services included conceptual design of the entire plant (solar and thermal), conceptual cost estimate, EPC specifications, technical input for permitting (emissions and transmission), schedules, and additional support as required.

SkyFuels

2010 & 2011 | Independent technical review of the SkyTrough parabolic solar collector. Services consisted of a review of the design, comparative product cost assessment, and performance assessment. Sargent & Lundy evaluated the prototype testing conducted on the SkyTrough collector and provided an independent review and opinion of the test results.

Solar Chimney Projects

1996 | Gujarat & Rajasthan, India | Sargent & Lundy, through our joint venture in India, L&T-S&L, was involved in three proposed solar chimney projects in India: a 5-MW project in Gujarat and 200-MW projects in Rajasthan and Gujarat. We advised the state governments on the proposed projects. This effort included a technical, economic, and design feasibility report, and coordination with the developers.

SolarReserve

2014 | Chile | Performed an independent technical assessment of the solar resource and performance model (energy yield) and third-party independent certification for submittal of the bid by SolarReserve for the Copiapó 110-MW molten salt tower project with 10 hours of storage.

Southern California Edison

- 2008 | Study of potential uses of the Mohave Site. Services included developing a conceptual design and cost estimates for a parabolic trough solar plant, power tower, and integrated solar combined cycle plant.
- 2005 | Southern California Edison engaged Sargent & Lundy to study alternate and complementary generation to potentially replace 885 MW of generation at the Mohave Power Plant. The study included a feasibility analysis of renewable energy: CSP (parabolic trough, power tower, Sterling dish/engine, and PVs), wind, geothermal, and biomass.

Total/Abengoa

- 2008 | United Arab Emirates | Bid support for a solar thermal power plant. The services included independent technical verification that the EPC contract proposal for the bid complied with the requirements identified in the RFP, including the PPA. Sargent & Lundy also provided technical assistance in preparing a competitive bid and identifying technical risks.
- 2007 & 2008 | Spain | A technical evaluation of bids for receiver tubes and mirrors for a parabolic trough project

Toyota Tsusho Corporation

2011 | Comprehensive technology survey and analysis of commercially available solar thermal and solar PV technology.

U.S. DOE

- 2008 & 2009 | NREL & Sandia | Updated the Sargent & Lundy Report, “Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts” dated May 2003, for DOE and Sandia to include parabolic trough, molten salt power towers, direct steam power towers, and dish technology. Issued the draft report for industry review in April 2009.
- 2003 | DOE & NREL | This study for the DOE and NREL involved an assessment of the potential for developing CSP technology as an electric generating technology over the subsequent 10–20

years. We analyzed industry projections for technology improvement, progress of research and development, plant scale-up and economies of scale, economies of learning resulting from increased deployment, cost-reduction potential, and other factors. The study considered possible improvements in efficiency, tax credits, O&M cost, and total cost of produced electricity. This work provided Sargent & Lundy with an extensive network of contacts in the solar thermal industry, including persons in government, research organizations, and equipment manufacturers. The analyses considered a variety of sensitivity studies, including impacts of owners' cost of capital (e.g., investor-owned utilities versus other types of utilities that have lower financing costs).

Vistra Energy

2017–2018 | Texas, United States | Provided owner's engineering services to support adding battery energy storage to the existing 180-MW Upton 2 Solar Project; services included battery technology advisory, cost estimates, preliminary electrical design, and other owner's engineering support.

The World Bank

1999 | Mexico | Comisión Federal De Electricidad (CFE) received funding from the Global Environmental Facility (GEF) of the World Bank for the solar portion of an integrated solar combined-cycle system thermal power generation project planned in Mexico. The World Bank engaged Sargent & Lundy to assess the plant feasibility based on a change in how the project was being contracted and because of technical changes. Our scope included summarization of current CSP technology development and experience; appraisal of the technical soundness of the CFE-proposed design and its status in terms of technological progress; a review of technological arrangement alternatives; an assessment of incremental costs and the economic feasibility of the CFE-proposed design; and an evaluation of technological performance risk, cash-flow risk, project financial return risk, developer financial return risk, and policy risk for the project. Our work included a review of the solar field (insolation, field configuration, and geotechnical) and the combined-cycle plant. The combined-cycle analysis included an evaluation of the absorption chillers, powered by solar generated steam, that were used for cooling the combustion turbine inlet air to maintain a constant 10°C inlet air temperature.

Alternative Fuels, Recycling, and Biomass

Sargent & Lundy's involvement in the alternative fuels industry includes feasibility studies, fuel supply assessments, evaluations of technology options, siting evaluations, identification of "target" emission rates for air permitting activities, layouts, cost estimating, and other conceptual design activities. Our project development work has included providing conceptual design with the ability of burning biomass. This work has also involved investigating optional equipment layouts based on information gathered from steam generator suppliers, material handling vendors, and air quality control vendors to assure our clients that new or existing coal-fired units could also be able to fire biomass in sufficient quantities to impact CO2 emissions. In addition, we have investigated WTE projects and alternative fuels co-firing in existing units as well as new unit designs.

Selected Recent Projects

B&W Vølund

- 2019–Present | Jakarta, Indonesia | Sunter WTE Plant (two units) | Industrial Waste | Detailed structural engineering and design for steel structure to support the boiler, economizer, the combustion grate, air ducts, piping, and all related equipment within the boiler island. Scope included connection design for high-seismic location.
- 2017–Present | Providing technical advisory services for various WTE projects.

Babcock & Wilcox Company

- 2017–Present | Black Bin Waste and Biomass | Engineering oversite and technical advisory services, including:
    - Detailed cost analysis;

- Advisory services on potential construction partners;
- Engineering site support and in-office coordination assistance of B&W's design;
- Plant design risk mitigation/optimization;
- Detailed electrical design;
- Mechanical and structural design oversight;
- Document control services for ongoing projects;
- Technical support for government interfaces;
- Schedule analysis, development, and support (at site and in office); and
- Site construction scheduling.

Confidential Client

2018–2019 | 36 MW | Hawaii, United States | Independent engineer for potential investment in a wood-fired biomass project being developed. Services included technical and financial due diligence in support of a tax-equity investment evaluation, including an in-depth assessment of the boiler design.

Covanta Energy LLC

- 2017–Present | Two separate facilities located at one site, sharing a common wall on refuse receiving areas, with boilers at each feeding the respective TGs. Condition assessments focused on fire protection of older WTE power plants. Performed a walkdown of facilities, interviewed operating and maintenance staff, and observed operations. Provided technical recommendations to improve fire safety, considering housekeeping, facility design, latest industry practices, and current codes and standards.
  - H-Power: Boilers 1 and 2 Turbine Generator 1 | RDF | Hawaii, United States
  - H-Power: Boiler 3 Turbine Generator 2 | Mass Burn

Cube Mas Energy

2017–2019 | Georgia, United States | Performed an independent engineering review of the methodology used in estimating operating expenses for two LFG projects.

Korea Electric Power Company

2018 | Georgia, United States | Technical advisory services for two biomass projects.

NOVI Energy

2010–Present | Virginia, United States | Owner's engineer technical support for project start-up activities through EPC award for the brownfield development of a nominal 50-MW boiler facility. Scope includes development of a feasibility study to assess technology, fuel, interconnection, environmental, and site characteristics. Sargent & Lundy was retained to support permit applications, the PJM interconnection

application, development of EPC specifications, EPC bid evaluations, and guidance for economic incentives. Sargent & Lundy performed detailed design in civil/structural areas outside of the power block and general owner's engineering support during project implementation. We supported the owner's application for the Department of Treasury's 1603 ARRA Grant funding, providing detailed cost estimate breakdowns and general grant application guidance.

Additional Projects

Antilles Energy Cooperative

2009 | Lower Somerset Renewable Energy Facility | Owner's engineer support for project start-up activities for the conversion of an existing generating facility from fuel oil to a biomass feedstock of poultry litter and agricultural feed. Feedstock processing included gasification for combustion, liquefaction to liquid biofuel products, and associated process stream cleanup. Sargent & Lundy assisted in developing the project's commercial structure, defining the plant's division of responsibilities and preliminary permit scoping, and generating an integrated project schedule.

Associated Electric Cooperative Inc.

2010 | Missouri, United States | Evaluated biomass co-firing options at five existing coal-fired units, ranging in size from 175 MW to 715 MW and using pulverized coal and cyclone technologies. Scope included fuel analysis, co-firing technology options for both boiler types, performance calculations, material handling design considerations, emissions and permitting impacts, economic analysis, and implementation schedule analysis.

Biomass Products, LLC

2010–2011 | Illinois, United States | Owner's engineer support for obtaining transmission services for the proposed 25-MW Rock Falls biomass power plant. Scope included consultation regarding a proposal to the regional transmission authority and an analysis of the historical locational marginal pricing to assist in determining bid pricing. Analysis included identification and assessment of transmission service alternatives for delivery into regional transmission territories.

Buena Vista Biomass Project

2010–2012 | California, United States | Lender's engineer support of financing the conversion of the brownfield, 18-MW Buena Vista biomass project in Northern California. The scope included an initial evaluation of the technical and commercial basis for the project and subsequent periodic reviews and approvals of contractor invoices and change orders. Site visits and regular project team communications included to maintain adequate level of insight into project progress.

City of Ames, Iowa

2015–2016 | Iowa, United States | City of Ames Steam Electric Plant Units 1 & 2 | RDF | Boiler conversion from coal and RDF to gas, coal, and RDF combustion. Project included elimination of main control board

to distributed control system and relocation of BOP programmable logic controller-controlled systems to plant distributed control system, including RDF system.

City of Escanaba & Wisconsin Public Power, Inc.

2006–2008 | Escanaba, Michigan, United States |Siting and project feasibility study for new solid fuel generating unit of up to 300 MW and jointly owned and operated by the City of Escanaba and Wisconsin Public Power, Inc. The fuel considered was a blend of coal and petroleum coke, with up to 8% heat input provided by wood chips.

City of New Ulm

2007–2009 | Minnesota, United States | Evaluation of converting an existing 10-MW stoker, currently firing natural gas, to burn coal and biomass. Scope included material handling options, boiler performance, and air emission estimates.

CLECo

2007 | Rodemacher Unit 3 | A feasibility study of 2x330-MW CFB boilers under construction to burn biomass. Sargent & Lundy's evaluation included environmental considerations, performance assessments, and economic analyses based on a 2010 service date. We also reviewed the quantity and type of biomass near the site.

Cleveland-Cliffs Northshore Mining

2008–2009 | Silver Bay | Evaluated co-firing up to 25% biomass (heat input) from a product line called Renewafuel, owned by the parent company. Evaluated methods of burning the fuel, as defined by the Renewafuel specifications, in Unit 2 at the Silver Bay Unit 2 boiler. (Renewafuel proprietary fuels are a blend of renewable feedstock and can be sized for boiler- or furnace specific applications. Densified and custom-sized pellets allow immediate use in most existing solid fuel systems, with minimal capital improvements. The densified biofuel is consistent in size, heat value, and moisture content, so it is easier to store and use than raw biofuels.)

Sargent & Lundy also reviewed installation of new burners dedicated to the biomass fuel alone. We reviewed several standalone combustion options (e.g., Dutch ovens, gasifiers), which minimized the impact to the existing mills and burners. All options reviewed included evaluation of a new material handling system.

We also evaluated unit performance impacts and estimated changes to SO_2, NO_X, PM, Hg, and CO_2 emissions. We estimated capital expenditures, O&M costs, and completed an overall plant economic evaluation, including projected cash flow.

Confidential Clients

- 2011 | Midwestern United States | Phase 1 engineering study and report for utilizing waste fuel to be delivered to existing sites for gasifying the biomass material and using low-Btu fuel in existing boilers to offset the use of coal firing.

- 2010–2011 | West (Mountain) United States | Biomass fuel supply and co-firing (up to 10% by heat input) study. Initially, a fuel supply investigation was conducted to determine the types of fuel readily available, the quantities and sustainability of each, and the suitable delivery concepts to the station. A technical assessment was also performed to determine the method(s) of co-firing the fuels that may be readily found near the station. Material handling concepts were presented based on viable fuel alternatives identified in the fuel assessment evaluation.
- 2009–2010 | Midwestern (East North Central) United States | In conjunction with a re-powering study, Sargent & Lundy evaluated the conversion of two existing PC-fired boilers to burn biomass with a percentage of refuse-engineered fuel. Deliverables included site arrangement drawings, a cost estimate, a completely new biomass material handling system layout and flow diagrams, a fuel alternatives assessment, a conversion technology assessment (co-firing or switching to 100% biomass), a performance optimization, a project schedule, and emissions estimates for permitting input.
- 2009–Present | Midwestern (East North Central) United States | Biomass conversion of two existing PC-fired boilers to burn biomass with a percentage of refuse-engineered fuel. Deliverables include site arrangement drawings, a cost estimate, a complete new biomass material handling system layout and flow diagrams, a fuel alternatives assessment, a conversion technology assessment (co-firing or switching to 100% biomass), a performance optimization, a project schedule, and an emission estimates for permitting input.
- 2009–2010 | Pacific West United States | Biomass conversion study for large coal-fired unit, including evaluating co-firing from 10%–100% biomass. The report provided layouts, estimated costs, estimated emissions, and an evaluation of a new biomass material handling system (wood chips, grasses, pellets, and torrified biomass) and fuel supply for type and quantity available.
- 2009–2010 | South Atlantic United States | Biomass conversion study for two older PC-fired boilers to burn 100% biomass, including material handling layout integration with an existing system. More than 15 material handling options were under consideration, involving various degrees of long-term and short-term storage, rail and truck delivery, and assessment of additional truck traffic. Deliverables included estimated cost, boiler technology selection (stoker vs. bubbling fluidized bed [BFB], or standalone gasifier), and emissions and unit performance projections, and emission estimates. Also developed a detailed conversion scope and inputs to the air permit application.
- 2009–2010 | Midwest (West South Central) United States | A biomass conversion study for two large coal-fired units, which included evaluating co-firing from 10% biomass. The report included material handling layouts, estimated costs, estimated emissions, and evaluations of the material handling system preparation equipment costs (wood chips, grasses, pellets, and torrified biomass) and the fuel supply for type and quantity available.
- 2009–2010 | Midwest (West North Central) United States | Independent engineer assessment of an operating biomass unit with a single boiler and steam turbine. The assessment included reviews of fuel supply, system performance, environmental compliance, operations, staffing, and PPA and FSAs. Fuel consists of 100% biomass from multiple sources, including wood, harvest, and poultry project byproducts.

- 2008–2009 | Existing CFB Unit. Study of material handling issues associated with receiving and unloading wood chips at the site and conveying to the boiler. Target biomass fuel consumption was ~20% on a yearly average basis, maximum of 40%, by heat input of wood chips.
- 2007 | British Columbia, Canada | Conceptual design of the power block, including material handling layouts for a nominal 200-MW greenfield CFB unit, with the capability of firing up to 40% wood chips. The wood source considered for the study was the Pine Bark Beetle Kill affecting forests in British Columbia. Layouts were prepared for wood truck unloading, storage, reclaim, and preparation to feed an existing CFB boiler. Sargent & Lundy supported the air permit application on behalf of the client. Our scope included developing performance values, such as heat rate, emissions, waste quantities, and water consumption, along with estimated bus bar costs.

Corval-Ryan J.V. LLC

- 2011 | Indiana, United States | Peru Station | RDF | RDF conversion feasibility study
- 2011 | Indiana, United States | Whitewater Station | RDF | RDF conversion feasibility study

Credit Suisse First Boston

2007 | Malaysia | Aokam Perdana Timber Complex | Technical evaluation and feasibility for the sale of a 10 MW wood waste power plant. Included review of the process, high-level condition assessment of the equipment, and review of the O&M and production capability.

Dairyland Power Cooperative

2009–2011 | Wisconsin, United States | Evaluation of the availability of various biomass fuels for use at multiple stations in the client's fleet; also considered combustion alternatives applicable to each unit. Technologies included modifications to support several co-firing options; boiler conversions to stoker/BFB; and external combustion alternatives, such as Dutch ovens and full and partial gasifiers producing syngas. Different material handling options were identified for each of these firing options due to the different sizing requirements of the technologies. The study identified estimated quantities of each biomass type within reasonable distance from each site. Additional scope includes developing a test burn for several biomass fuel types and selecting the candidate unit for testing, as well as identifying fuel suppliers and temporary material handling equipment required for the test burn.

ecoPower Generation LLC

2009–2010 | 50-MW Biomass Facility | Owner's engineer technical support for project start-up activities for the greenfield development of a nominal 50 MW fluidized bed boiler facility to burn wood waste from a local Kentucky lumber industry and forestry. Scope included technology assessment and selection; conceptual design; technical support to the permitting process; site planning, including material handling unloading storage and reclaim operations; and permit support and consultation for economic feasibility.

Entergy

2008 | Little Gypsy | Feasibility study of CFB boilers (2x330 MW each) to repower an existing steam turbine fired on biomass. The evaluation included environmental considerations, performance assessments, and economic analyses based on a 2010 service date. We also reviewed the quantity and type of biomass near the site.

Indiana Inland Steel Company

1989 | East Chicago, Indiana, United States | Assessed condition of powerhouse system and components and identified and evaluated alternatives for upgrading powerhouse. Alternatives included burning process waste, paper, and wood currently being recycled.

International Finance Corporation

2014–2019 | 70 MW | Philippines | Independent engineer for a 70-MW portfolio of three biomass projects being financed by the IFC. Services included technical due diligence in support of funding and construction monitoring.

Kauai Island Utility Cooperative

2011 | Hawaii, United States | A high-level feasibility review of installing a new boiler to replace an existing oil-fired package-type boiler in order to combust biomass at the Port Allen Station (S1). Options considered were to reuse the existing stream turbine generator, replace the steam turbine and reuse the existing generator and auxiliaries, or replace the entire steam turbine generator.

MidAmerican Energy

2008 | System-wide Biomass Evaluation | Evaluated the availability of various biomass fuels for use at several coal-fired stations in the client's fleet. The study involved assessment of boiler operations, air quality control equipment, and material handling and the impact onsite space requirements. Sargent & Lundy also studied sensitivity of providing up 10% biomass fuel to each unit. We estimated emissions with the different types of fuels studied, including SO_2, NO_X, PM, Hg, and CO_2, and provided economic analysis of the capital expenditures, O&M expenses, delta fuel costs, and sensitivity on the value of CO2 credits.

A separate study reviewed the technologies available for a 100% biomass-fired steam generator supplying a separate steam supply, including the appropriate material handling system, which is different from that used to prepare the fuel for direct injection into the boiler. The approximate size was 30–35 MW, including stokers, CFB boilers, and small gasification units.

Minnesota Power

- 2001 | Laskin Station | Studied the addition of a new boiler to an existing site and the repowering of existing steam turbines, including 70% Powder River Basin and 30% wood chips, and integration of a new material handling system with the existing coal yard.

- 1997 | Rainy Station | Condition and cost evaluation of the Blandin Paper Mill cogeneration and hydroelectric facility. Evaluated the existing facility condition (four wood waste/coal boilers, two turbines, 27-MW total; two hydroelectric turbines, 1 MW total) and performed a valuation in terms of potential sale value (capital value vs. revenue for an assumed rate of return) and remaining life value. Also evaluated potential partial replacement/expansion of the facility by integrating a variety of technology options: CFB, CT/HRSG, gas-fired boilers, and/or wood waste/coal stoker boilers.
- 1985–1987 | Hibbard Station | Conceptual design, feasibility study, and detailed design for converting Units 3 and 4 to burn wood and coal on a traveling grate stoker spreader. Scope encompassed engineering, procurement, and onsite engineering liaison during construction to convert oil-fired boilers, originally designed to burn coal, to fire on wood and coal and to provide a steam supply to a paper mill a half-mile away. Early studies established the feasibility of converting two of the units but dictated an ambitious 24-month schedule from authorization to completion. The boilers required extensive modifications to convert to traveling grate spreader stokers for efficiently firing the new fuel and meeting the paper mill's steam requirements.

Mitsui & Co. Ltd

2003 | Thailand | Developed technical and EPC contract information for the client to submit an offer for a 3x100 MW project using coal and biomass with CFB technology. Sargent & Lundy’s scope included development of general arrangements, performance calculations, emission evaluations, site environmental parameters, single-line diagrams, costs estimates, scheduling, and functional plant and system descriptions, such as water supply and treatment.

NRG

2010–2011 | Waste-to-Energy Facility | Sargent & Lundy developed the conceptual design for a WTE facility using the AlterNRG (Westinghouse Plasma) gasification technology to produce syngas. We prepared design criteria for the plant; developed an emission profile for submittal of permits; prepared general arrangement drawings; and developed a plant cost estimate.

Scimitar Global Markets

2015, 2017 | Ireland and United States | Carried out the valuation of one biomass project in Ireland and one biomass project in Nevada, United States. Both projects designed to be 48 MW in capacity and to use a gasification process utilizing a combination of RDF, construction waste, tires, and other biomass fuels.

Southern Illinois Power Cooperative

2000–2003 | Marion Station Units 1–3 | Engineering and design to support the repowering of units that were originally commissioned in 1963. Existing steam turbines remained intact while the existing steam generators were retired and replaced with a single 120-MW circulating fluidized steam generator capable of burning coal refuse, petroleum coke, wood refuse, and tire-derived fuel.

South Mississippi Electric Power Association

2009–2010 | Study of various renewable energy options potentially available to serve load requirements of South Mississippi Electric Power Association's (SMEPA's) member cooperatives. Performed an evaluation of biomass fuel alternatives, including review of potential renewable energy legislation; an investigation of renewable fuel sources and technologies; and a feasibility study on the use of potentially viable renewable fuels at existing SMEPA generating units, including integration of biomass handling with existing facilities. Technologies included modifications to support several co-firing options; boiler conversions to stoker/BFB; and external combustion alternatives, such as Dutch ovens and full and partial gasifiers producing syngas. We also performed an economic evaluation of these renewable project alternatives.

Tondu Corporation

2008 | Filer City | Evaluated NO_X control options for two ~30-MW (each) stoker boilers. The boilers co-fired biomass (wood chips).

Upper Peninsula Power Company

2003–2004 | A siting and technology screening study for the use of wood waste. Sargent & Lundy evaluated the best locations on the transmission system, identifying the generation technology and capacity options to be used as the basis for the site evaluations and in developing the conceptual designs and cost estimates. Options centered on steam generating units capable of burning a mix of wood waste and Powder River Basin coal.

Landfill Gas (LFG) Projects

Sargent & Lundy has been actively involved in numerous LFG projects, including the following explored below.

Selected Recent Projects

Cube Mas Energy

2017–2019 | Georgia, United States | Performed an independent engineering review of the methodology used in estimating operating expenses for two LFG projects.

Additional Projects

Arrow Canyon LFG Project

- 2003 | Nevada, United States | Sargent & Lundy was retained by Reliant Resources, Inc., to investigate the use of LFG at its proposed Arrow Canyon combined-cycle facility. The following production options were evaluated:
  - Compression and treatment of LFG for use as a supplemental fuel in the Siemens-Westinghouse combustion turbines.
  - Compression and treatment of LFG for use in the combined-cycle burners.

- An independent steam boiler/steam turbine facility for electrical generation.
- Steam boilers fueled by LFG integrated with the combined-cycle boilers and steam turbines.
- Internal combustion engines with and without heat recovery.
- Gas turbines with and without heat recovery.

The above options were evaluated in terms of plant performance, maintenance, reliability, and cost.

Dairyland Power LFG Project

2004 | Sargent & Lundy was retained by Dairyland to evaluate the costs associated with potential LFG to energy projects to be constructed at two different landfill sites within the Dairyland service territory. The scope of the study included (a) estimates of LFG production and evaluation of generation technology options, sizing and performance; (b) range estimates for capital costs and for O&M costs; and (c) development of a project pro forma that estimated the annual revenue requirements derived from electric energy sales needed to provide a reasonable rate of return. The pro forma calculated annual income based on fixed and variable operating costs, debt service, taxes, insurance and general administrative costs.

Dallas Clean Energy—McCommas Bluff LFG Facility

2010–2011 | Sargent & Lundy performed a due diligence review for the purposes of bond financing of the proposed project to improve existing wellfield infrastructure and to expand processing capacity from 9.8 million standard cubic feet per day to 14.8 million standard cubic feet per day. Our analysis included a wellfield and processing facility technology assessment, economic analysis of the project pro forma, validation of LFG recovery projections, forward renewable gas pricing analysis, and impact assessment of environmental regulations.

E/S Energy Solutions

- 2005 | Texas, United States | McCommas Bluff Landfill Gas Facility | Performed due diligence reviews for E/S Energy Solutions on two alternatives for the McCommas Bluff LFG facility.
  - LFG to High-Btu Gas Conversion Project (4.0 Million Cubic Feet/Day) | The previous LFG to high-Btu gas conversion project had been underperforming in capacity factor and availability. Sargent & Lundy performed a due diligence review of E/S Solutions' plans to improve the performance and availability of the facility. Areas of potential improvement or upgrades included reliability of the LFG flow from the landfill, LFG purification, maintenance program, and selected equipment replacement or upgrading.
  - LFG Engine Project (14 x 1.75-MW Reciprocating Engines) | Sargent & Lundy reviewed an alternate plan to install LFG engines to use the McCommas Bluff LFG. Proposals were reviewed for the engine supply and installation work, and engine maintenance. Sargent & Lundy reviewed the LFG flow capability from the landfill to support a multiple engine project over the long term and the proposed LFG purification strategy.

Electric Power Research Institute LFG Industry Report

2007 | Sargent & Lundy was retained by EPRI to prepare an assessment of the LFG industry in 2009. As part of EPRI's Technical Assessment Guide (TAG®) program, Sargent & Lundy prepared the LFG section in the renewable energy module entitled "Renewable Power Generation Technologies – Current Status, Cost & Performance and Future Trends."

Exelon Fairless Hills LFG Generating Station Project

2003–2008 | Fairless Hills was purchased by Exelon from U.S. Steel in 1997. The boiler plant was being used to support the steel production at the site. The boilers burned off-gas product with a heat content ranging from 100–200 Btu. Fairless Hills was converted to burn LFG in 1997 when it was purchased by Exelon Corporation. At that point, Exelon converted Boilers 4 and 5 from burning off-gas to burning LFG with a heat content of approximately 500–600 Btu. Exelon has a long-term contract with Waste Management Corp. to supply LFG to the facility. Boiler 6 still burns natural gas as a peaking boiler.

- There are two turbines and three boilers with each turbine producing roughly 30 MW. One boiler usually supports one turbine, but the LFG flow will increase such that two turbines and two boilers will need to be online at all times.
- Since 2003, Exelon has invested approximately $8–$12 million each year to support this facility. Sargent & Lundy was involved with and supported turbine inspections/overhauls, boiler studies, and outages to support the dual unit operation. In addition to the boiler and turbine work, Sargent & Lundy has also been involved with all their BOP improvement services. The following summarizes some of the projects Sargent & Lundy has performed at Fairless:
- Boiler 4 and 5 Outages: Scope of work specifications, contractor evaluations, and recommendations
- Turbine 2: Scope of work specifications, contractor evaluations, and recommendations
- Boiler 6 study on the scope and cost to convert to LFG
- Installation of a revenue LFG flow meter interfaced with Waste Management Corp.
- Replacement of the low-temperature and high-temperature air heaters on Boiler 4.
- Conceptual design, detailed design, and follow-on work associated with adding a new water treatment plant; downsized from the old facility.
- Modified BOP systems

Florida Power & Light LFG Project

2004 | Johnson, Rhode Island | Sargent & Lundy was retained by SCS Engineers to investigate the utilization of LFG at Florida Power & Light's Johnston, Rhode Island, combined-cycle plant, which is located adjacent to the Rhode Island Resource Recovery Corporation landfill. The Johnston combined-cycle plant consisted of two Westinghouse W501FD combustion turbines, including supplemental burners in the heat recovery steam generators. The facility did not possess an auxiliary boiler or any other gas burning components. Sargent & Lundy, in conjunction with Earth Tech Solid Waste Services, evaluated the impact

of both treated as well as untreated LFG in terms of performance issues (e.g., power output, heat rate, and emissions), maintenance issues (e.g., wash frequencies, maintenance cycles, and warranty issues), HRSG performance issues (e.g., duct burners and SCR catalyst), and the feasibility and economics associated with various LFG cleaning technologies.

Jacksonville Electric Authority

2003 | LFG Project | Sargent & Lundy was retained by Jacksonville Electric Authority to evaluate and solve a significant corrosion problem associated with the BOP piping on the reciprocating engine skids firing LFG. The problem was caused by inadequate treatment of the LFG.

Richland & Anderson County LFG Projects

2004–2006 | South Carolina, United States | Sargent & Lundy was the owner's engineer for the design and installation of two power generation LFG facilities. The client negotiated the rights to take LFG currently being flared from existing landfills and installed Solar Taurus 60 combustion-turbine-based power generation facilities at both sites. The solar equipment and the LFG conditioning skids were reviewed by Sargent & Lundy and purchased by the client.

Sargent & Lundy's scope included the review of client prepared specifications for various LFG system components and associated prefabricated buildings, and review of the vendor design drawings and direct vendor interface. In addition, we provided engineering support for all BOP systems and structures, including assisting with the final site general arrangement, development of an installation package for all the plant equipment, integration of the fuel system components, and reviews of vendor data.

Geothermal

Examples of Sargent & Lundy's active involvement in geothermal energy projects are summarized below.

Selected Recent Project Experience

Mitsui & Co., Ltd.

2019 | Conducted a geothermal energy market and application feasibility study. Scope included technical and market analysis on geothermal heat pumps, direct-use geothermal, and geothermal power to determine the most cost-effective method for generation and selling of geothermal heat.

Additional Project Experience

CMS Generation

2001 | Technology survey and analysis investigation of commercially available renewable energy technologies for CMS Generation (Michigan) to incorporate into their long-term power generation strategic plan. The renewable energy technologies surveyed included geothermal power.

Confidential Clients

- 2008 | Southwestern United States | Environmental reviews for 10 geothermal generating plants.
- 2008 | Study for additional generation adjacent to an existing facility. This included noncombustible renewable energy and geothermal.
- 2007 | Central America | Technical support on two geothermal projects. This included evaluation of failure modes on new and operating turbines, reviewing manufacturer's root cause analysis results, and formulating independent recommendations on addressing reliability issues.

Electric Research Power Institute

2010 | Updates to the geothermal sections of the EPRI Technology Assessment Guide

Enel Green Power North America, Inc.

2013 | Utah, United States | Independent engineering assessment of the Cove Fort Geothermal Project in southern Utah to provide a completion certification report in accordance with application requirements of the United States Treasury American Recovery and Reinvestment Act of 2009 (ARRA) Payments for Specified Energy Property in Lieu of Tax Credits Section 1603. Sargent & Lundy performed a site visit and reviewed project design documents and agreements. The project was completed by Enel Green Power North America, Inc., a branch of the Italian utility Enel SpA, with Ormat Technologies, Inc., as the EPC contractor and major equipment provider.

Inversiones Energeticas S.A. DE C.V.

2007–2010 | El Salvador | Berlin Unit 3 is a 44-MW geothermal power plant in the Usulutan province in eastern El Salvador. The plant is a direct injection geothermal plant, and the steam turbine is designed for steam conditions of 160°C and 8 bar at the inlet. During inspections of the steam turbine, cracks were discovered by the owner in the last stage blades. Sargent & Lundy provided engineering services to identify the root cause of the cracks and to evaluate potential solutions. We worked with the owner and the steam turbine manufacturer to identify and implement modifications. We also participated in steam turbine inspections to verify the success of the modifications.

PacifiCorp

2005 | Services associated with well bearing cooling water issues, BR 6 brine pump repairs, derating, and a controls system upgrade for the Blundell Geothermal Plant.

Southern California Edison

2005 | Study of alternative/complementary generation resources for the Mohave power plant. Our study included a feasibility analysis of renewable energy, including geothermal.

Hydroelectric

Sargent & Lundy has provided extensive engineering and consulting services for hydroelectric power projects worldwide. Recent hydroelectric power consulting and engineering service engagements are summarized below.

Selected Recent Project Experience

Confidential Client

2018 | Pakistan | Lender's technical, environmental, and social advisor for the potential financing of a new 90-MW hydroelectric project.

ContourGlobal

2018 | Peru | Conducted a due diligence review of Santander Hydro.

International Finance Corporation and other lenders, including: West LB, Akbank, & European Investment Bank (Project owner: Enerjisa Enerji Uretim A.S.)

2011–Present | 1,000+ MW | Turkey | Lender's engineering, including preconstruction due diligence and environmental review; construction and performance test monitoring; monitoring during startup; and operations monitoring. Sargent & Lundy has performed more than 70 construction monitoring and operations monitoring site visits.

- Adana, Göksu Tributary (Seyhan River)
- Köprü HEPP | 156 MW nominal capacity; 198 GWh annual generation
- Kuşaklı HEPP | 20 MW nominal capacity; 22 GWh annual generation

- Menge HEPP | 89 MW nominal capacity; 88 GWh annual generation
- Yamanlı II HEPP | 82 MW nominal capacity; 120 GWh annual generation
- Adana, Zamantı & Göksu Tributaries (Seyhan River)
- Kavşakbendi HEPP | 191 MW nominal capacity; 496 GWh annual generation
- Artvin (Çoruh River)
- Arkun HEPP | 245 MW nominal capacity; 540 GWh annual generation
- Kahramanmaraş, Göksun Tributary (Ceyhan River)
- Dağdelen HEPP | 8 MW nominal capacity; 23 GWh annual generation
- Hacınınoğlu HEPP | 142 MW nominal capacity; 304 GWh annual generation
- Kandil HEPP | 208 MW nominal capacity | 304 GWh annual generation
- Sarıgüzel HEPP | 102 MW nominal capacity; 243 GWh annual generation
- Trabzon, Ögene & Haldizen (Şerah) Rivers
- Çambaşı HEPP | 44 MW nominal capacity; 132 GWh annual generation

Hydro Fraser

2018 | Performed a due diligence review for Hydro Fraser.

Hydro Quebec

2018 | Performed a due diligence review of three small hydro projects.

Kallpa Generacion S.A.

2018 | Conducted a dam fissure evaluation of the Cerro del Aguila hydroelectric power plant.

Kaukauna Utilities

2018 | Advisory services to support client's potential acquisition of a small operating hydroelectric project.

Master Hydro (Pvt.) Limited

2018 | Technical and E&S due diligence for the Arkari Gol Hydroelectric Power Plant.

Additional Project Experience

American Electric Power

2015 | Ohio, United States | Independent engineering review of a small hydroelectric project.

Comisión Ejecutiva del Río Lempa (CEL)

2005–2007 | El Salvador | 180-MW hydroelectric plant. Sargent & Lundy performed owner's engineering services for a generator re-wind and other changes to increase two generators' power output by approximately 20%.

Confidential Clients

- 2016 | Peru | Asset acquisition due diligence services for two hydroelectric projects.
- 2016 | Canada | Technical consulting services for arbitration support for three hydroelectric projects.
- 2016 | Midwestern United States | Technical support and prepared EPC specification for the upgrade (from 3 MW to 12 MW) of a small hydroelectric project.

ContourGlobal

- 2017 | Armenia | Independent technical and environmental due diligence for the Vorotan Cascade project consisting of three HEPPs across four reservoirs situated on and adjacent to the Vorotan River in the southeastern part of Armenia. The three power plants have a total installed electrical capacity of 404 MW. Additional annual monitoring was requested as well.
- 2016 | Peru and Central America | Asset acquisition due diligence of three hydroelectric power plants, two in Peru and one in Central America, to support client.

Enerjisa Enerji Uretim A.S.

2017 | Seyhan River Basin, Turkey | Served as the Lender's Technical Advisor for the Doğançay HEPP project. Performed a technical review in cooperation with its partner, Fichtner GmbH & Co. KG. Also prepared a review of the environmental and social aspects of the projects. This review was designed to verify the project's compliance with the Equator Principles and the IFC's Performance Standards. The installed capacity of the powerhouse is 64 MW, which results in a power generation of about 168.98 GWh per year.

European Bank for Reconstruction and Development

2013 | Turkey | Served as the Lender's Technical Advisor and provided due diligence services for the Alpaslan II dam and HEPP project located on the Murat River in Turkey.

Inter-American Development Bank

2006 | Ecuador | Abanico 15-MW run-of-river hydroelectric project. Provided lender's engineering services, including preconstruction due diligence.

Kaukauna Utilities

- 2017 | Wisconsin, United States | Owner's engineer bid reviews to support relicensing of two existing small hydroelectric power plants.
- 2015 | Wisconsin, United States | Owner's engineer bid review to support relicensing of an existing small hydroelectric power plant.

Overseas Private Investment Corporation & International Finance Corporation

- 2013–2014 & 2016–2017 | Independent engineering review as Lender's Technical Advisor to support financing of acquisition and refurbishment of a hydroelectric project in Armenia. Sargent & Lundy performed a technical review of the project, including project financial statement, hydrological studies, refurbishment plan, interconnection, and key project contracts.

Total Fina Elf

2000 | Argentina | Piedra del Aguila 1,400-MW hydroelectric project. Provided a due diligence review for potential acquisition.

West LB

2004–2007 | Mexico | El Cajon 750-MW hydroelectric project. Sargent & Lundy performed lender's engineering services, including preconstruction due diligence and environmental review; construction and performance test monitoring; and monitoring during startup.

Energy Storage

Sargent & Lundy has been actively involved in numerous energy storage projects that have used a variety of technologies, including batteries, compressed air, and pumped hydropower. Energy storage is a major issue with renewable generation: intermittent fuel availability creates challenges aligning generation with demand. Sargent & Lundy has assessed and designed systems for energy supply, grid stability, and other applications. Below is a summary of our experience.

Selected Recent Project Experience

Able Grid

2019–2020 | Texas, United States | Providing Owner's Engineering Services for a new 100 MW/100-MWh of battery energy storage.

Confidential Clients

- 2019 | Eastern United States | Providing Owner's Engineering Services and performed technical feasibility study for large east coast utility to support the addition of up to 300 MW/1200 MWh of battery energy storage to their system.
- 2018–2019 | Pennsylvania, United States | Independent engineering due diligence in support of acquisition of two battery energy storage systems. Sargent & Lundy's scope includes reviews of technical, BOP, and HVAC elements. The work also includes a condition assessment and an O&M and performance review.
- 2018–2019 | Eastern United States | Performed technical feasibility study for large east coast utility to support the addition of battery energy storage to their system. Studied adding battery storage to existing solar projects and thermal power plants.

- 2018–2019 | Western United States | Providing Owner's Engineering Services and performed technical feasibility study for large west coast utility to support the addition of up to 40MW/160MWh of battery energy storage to their system.
- 2018–2019 | Western United States | Providing Owner's Engineering Services and performed technical feasibility study for sizing of three battery energy storage projects, 5MW/20MWhr, 10MW/40MWhr, 20MW/80MWhr utilizing existing interconnections to the grid.
- 2018–2019 | Central United States | Owner's Engineering Services for the integration of 1600 MW/6400 MWhr BESS Facilities at existing gas turbine generation facilities.

Tesla

- 2019–2020 | California, United States | Providing detailed design services for the 184-MW/736-MWh battery energy storage project for PG&E at the Moss Landing Substation Facility.
- 2019 | Illinois, United States | Providing detailed design services for the 2-MW/4-MWh battery energy storage project for ComEd.

Vistra Energy

2018–2020 | California, United States | Provided owner's engineering services to support the development of a new battery energy storage project at the Moss Landing Power Plant site. The proposed project is 300 MW / 1,200 MWh, which would be the largest battery energy storage project in the world.

Additional Project Experience

CAES—Norton

2004 | Owner's engineering services, including development of CAES conceptual design.

Confidential Clients

- 2017–2018 | United States | Performed technical study and conceptual design for integration of battery energy storage into six existing power generation projects, including one solar PV project and five gas plants.
- 2016 | Performed due diligence for a private equity client seeking to invest in a battery manufacturing company. Sargent & Lundy evaluated the technical performance of the battery company's novel metal-air battery technology and reviewed the company's financial projections. Sargent & Lundy also performed a valuation of the company.
- 2016 | Performed market study and financial evaluation of adding a battery energy system to an existing wind project in the PJM region. Sargent & Lundy assessed the new PJM capacity performance market to evaluate the battery system economics.

- 2016 | California, United States | Performed a technical feasibility study and conceptual design for integrating battery energy storage into the San Francisco Bay Area Rapid Transit electrical system.
- 2015–2017 | Northeastern United States | Owner's engineering bid evaluation services for six energy storage projects. Sargent & Lundy supported technical Q&A and negotiations with bidders. In addition, Sargent & Lundy supported the offtaker to negotiate the power supply contract.
- 2013 & 2015 | Midwestern United States | Provided cost and performance estimates to a utility for battery storage and pumped storage systems to support client's resource planning activities.
- 2013–2014 | Northeastern United States | Bid reviews of more than a dozen energy storage proposals on behalf of a utility client.
- 2009–2011 | Engineering services for several energy storage projects totaling in excess of 60 MW, including conceptual studies, conceptual design, detailed design, construction oversight, and interconnection studies. The objectives of the projects were to provide services, such as grid stability and power plant ancillary services, and enhance wind facilities' operation.
- 2009 | Southwestern United States | Study and development of a plan, including conceptual design, to integrate 10 MW of battery storage with the client's utility scale solar PV project.

Electric Power Research Institute

1998 | Study and preparation of a technical report (EPRI Report TR-111691, "Compressed Air Energy Storage with Humidification – An Economic Evaluation") on compressed air energy storage with humidification. This project encompassed technology evaluation and financial modeling; preliminary system design, including layout drawings and conceptual equipment arrangements; capital cost estimates for this technology and competing technologies; market price study for electricity; fuel cost estimates; and development of pro formas for each technology.

Lockheed Martin

- 2019 | Illinois, United States | Providing detailed design services for the 2MW/4MWh battery energy storage project for ComEd.
- 2019 | Illinois, United States | Providing detailed design services for the 2MW/4MWh battery energy storage project for ComEd.

NextEra Energy Resources, LLC

- 2019 | Oklahoma, United States | Engineering services and equipment procurement support for Rush Spring 10-MW Battery Energy Project.
- 2016 | Maine, United States | Engineering services and equipment procurement support for Casco Bay 16-MW Battery Energy Project.
- 2016 | Arizona, United States | Engineering services and equipment procurement support for Pima 10-MW Battery Energy Project.

- 2016 | Florida, United States | Engineering services and equipment procurement support for Southwest 1.5-MW Battery Energy Project.
- 2016 | Florida, United States | Engineering services and equipment procurement support for Florida Bay 1.5-MW Battery Energy Project
- 2015 | Northeastern United States | Independent engineering services for two energy storage projects.
- 2015 | Pennsylvania, United States | Engineering services and equipment procurement support for Meyersdale 18-MW Battery Energy Project. The project is co-located with a wind power project.
- 2015 | Pennsylvania, United States | Engineering services and equipment procurement support for Green Mountain 10-MW Battery Energy Project.

PacifiCorp

2005 | Owner's engineering services, including development of CAES conceptual design.

U.S. DOE, EPRI, Public Service Company of Indiana, Westinghouse Electric Company

1982 | Three-year study of CAES and preparation of a report (EPRI Report EM 2351, "Compressed Air Energy Storage Preliminary Design and Site Development Program in an Aquifer"), including project coordination, power system studies, geotechnical review and design, site study and selection, turbine design, BOP design, cost estimating, schedule preparation, licensing assessment, and environmental impact study.

Vistra Energy

2018–2019 | Texas, United States | Provided owner's engineering services for a 9.9-MW/42-MWh Battery Energy Storage Project that was added to an existing 180-MW Solar Facility.

Hybrid Power Plants & Microgrids

Sargent & Lundy has extensive experience with hybrid power plants, including the planning and design of these complex projects.

Selected Recent Project Experience

Confidential Clients

- 2020 | Mongolia | Provided technical advisory support for a client considering multiple 500+ MW hybrid solar plus wind power plants with supplemental grid support to provide consistent power to a mine. Scope included review of technical and commercial concept proposals as well as guidance in next steps of the development process.
- 2019 | Midwest, United States | Study of diesel generator-based microgrid at existing casino integrated to existing solar PV field.
- 2018–2019 | Eastern United States | Performed technical feasibility study for large east coast utility to support the addition of battery energy storage to their system. Studied adding battery storage to existing solar projects and thermal power plants.
- 2018–2019 | Texas, United States | Provided owner's engineering services to support conceptual layout design optimization, tracker technology selection, and EPC bid solicitation for 400-MW solar and battery storage project.

ComEd

- 2019 | Illinois, United States | Providing detailed design services for the 2-MW/4-MWh battery energy storage portion of the ComEd Bronzeville Community Microgrid.

- 2019 | Illinois, United States | Providing detailed design services for integration of existing solar and wind distributed energy resources using ComEd's Distributed Energy Resource Management System (DERMS)

Additional Project Experience

Agrifos Fertilizer

2009–2010 | Houston, Texas, United States | Prepared a study of onsite renewable energy alternatives for an industrial company located in the Houston area. The evaluation included solar PV, solar thermal, and wind power.

American Capital Energy & Infrastructure

2014 | Senegal | Performed a renewable energy integration assessment for the Senegal (country wide) electric grid to assist the client with their evaluation of a wind power project acquisition. As part of the study, Sargent & Lundy assessed the existing generators on the system and their reserve capabilities.

CMS Generation

2000 | Performed a technology survey and analysis investigation of commercially available renewable energy technologies for CMS Generation (Michigan) to incorporate into their long-term power generation strategic plan. The renewable energy technologies surveyed included wind power, biomass, geothermal, solar thermal, and solar PV.

City of Ames

2004 | Iowa | Developed of a recommended resource plan that identified the generation resources required to meet the forecast electricity needs of Ames Electric Services' customers through 2025. The resource options included renewable energy resources that would be appropriate for the Green Choice program, primarily biomass and wind along with efficient, low-emission generating technologies like natural gas or other fuels.

Confidential Clients

- 2016 | California, United States | Provided development support, conceptual design, and owner's engineering services for planned 120-MW hybrid power plant using solar PV and thermal generation.
- 2013 & 2015 | Northeastern United States | Managed power supply planning process for a utility client. Reviewed and evaluated more than 50 power supply and load reduction bids. The bids included technologies such as combustion turbines, reciprocating engines, energy storage, microgrids, and demand side projects.

InterGen

2008 | A feasibility study of a solar retrofit for a 501F 1x1 combined-cycle unit. The CSP technologies addressed were parabolic trough, power tower, and compact linear Fresnel receiver. The relevant advantages and disadvantages of each type of system were identified. Evaluation areas included steam conditions achievable, technology maturity, comparative capital and O&M costs, and equipment availability.

Maui Electric Company

2013 | Performed a renewable energy integration assessment to assist the client with their efforts to expand the use of wind and solar power while maintaining reliability requirements.

NIPSCO

2013 & 2015 | Provided cost and performance estimates for various power generation and energy storage systems to support client's resource planning activities.

San Diego Gas & Electric

2003 | Consulting support and services to San Diego Gas & Electric for new power supply resources, including renewable generation, fossil generation, and demand-side resources; provided consulting support through the evaluation of options, contract negotiation, and utility commission filings for PPAs and turnkey plant purchases.

Southern California Edison

2005 | Prepared a study of alternatives for replacement or to complement the share of electrical capacity generation of Southern California Edison's ownership share of the 1,580-MW Mohave generating station, in response to a California Public Utilities Commission (CPUC) order. The evaluation included solar, wind, other renewables, demand side management and energy efficiency, integrated solar combined-cycle, and combined-cycle natural gas.

Unilever

2008–2009 | California, United States | Performed a study of energy usage, boiler replacement options, and onsite renewable energy alternatives for Unilever's industrial facility in Southern California. The evaluation included combined heat and power, solar PV, and energy efficiency.

Value Recovery Holding

- 2017 | Developed modeling tool for integration and optimization of backup generators for microgrids.
- 2015–2016 | Reviewed sizing and conceptual design of microgrid planned for installation at a U.S. Army base. The project included solar PV, liquid fuel engines, and battery energy storage.

Vistra Energy

2017–2018 | Texas, United States | Provided owner's engineering services to support adding battery energy storage to the existing 180-MW Upton 2 Solar Project; services included battery technology advisory, cost estimates, preliminary electrical design, and other owner's engineering support.

Selected Sargent & Lundy Renewable Energy Publications and Presentations

- "Battery Storage News: Utility Scale Development," panel discussion moderated by M. Thibodeau, The 5th Annual Powering Africa Summit, Miami, Florida, February 25–27, 2019
- "Energy Assessment & Independent Engineering Review for Wind Project Partial Repower," authored by E. Soderlund (Sargent & Lundy) and J. O'Connor (ArcVera Renewables), presented by D. Jolivet (Sargent & Lundy) and J. O'Connor, EUCI Conference, San Diego, California, February 2019.
- "Be Specific: Determination of Site-Specific Engineering Parameters for Wind Turbine Foundations," presented and authored by E. Soderlund, AWEA WINDPOWER Conference, Chicago, Illinois, May 2018.
- "Developing Wind Project Capital & Operating Cost Forecasts: A Benchmarking Approach," presented and authored by S. Noonan, AWEA WINDPOWER Conference, Chicago, Illinois, May 2018.
- "Performance Anxiety: Wind Power Project Performance Guarantees," presented and authored by A. Coologeorgen, AWEA WINDPOWER Conference, Chicago, Illinois, May 2018.
- "Staying Grounded: Grounding Transformers vs High-Speed Ground Switches," presented and authored by B. Connaghan, AWEA WINDPOWER Conference, Chicago, Illinois, May 2018.
- "Subsynchronous Resonance in Doubly-Fed Induction Generator Based Wind Farms," presented and authored by H.A. Mohammadpour, AWEA WINDPOWER Conference, Chicago, Illinois, May 2018.
- "Wind Project Partial Repowering: Key Considerations and Insights," presented and authored by E. DeCristofaro, AWEA WINDPOWER Conference, Chicago, Illinois, May 2018.
- "Wind Turbine Foundation Fatigue: Causes, Symptoms, and Treatment," presented and authored by E. Soderlund, AWEA WINDPOWER Conference, Anaheim, California, May 2017.
- "FACTS: Devices for Dynamic Reactive Power Compensation in Wind Farms," presented and authored by P. Wiczkowski, AWEA WINDPOWER Conference, Anaheim, California, May 2017.
- "Repowering: Renewing Renewable Energy," presented and authored by A. Coologeorgen, AWEA WINDPOWER Conference, Anaheim, California, May 2017.
- "Constructing a Plan for Successful Construction," presented and authored by A. Friedman, AWEA WINDPOWER Conference, Anaheim, California, May 2017.
- "Support Your Wind Turbines: Choosing the Optimum Foundation System," presented and authored by E. Soderlund, AWEA WINDPOWER Conference, New Orleans, Louisiana, May 2016.

- "Wind Farms Without Borders: Top 5 Best Practices When Building in Developing Markets," presented and authored by T. Kantarek and E. Soderlund, AWEA WINDPOWER Conference, Orlando, Florida, May 2015.
- "Contracting Strategies and Lessons Learned on International Wind Projects," presented and authored by M. Thibodeau, AWEA WINDPOWER Conference, Orlando, Florida, May 2015.
- "Everything You Always Wanted to Know About Wind Power Purchase Agreements," presented and authored by G. Rainey and T. Kantarek, AWEA WINDPOWER Conference, Las Vegas, Nevada, May 2014.
- "Middle East and African Renewable Energy Markets: Impacts and Opportunities," presented and authored by M. Thibodeau, AWEA WINDPOWER Conference, Las Vegas, Nevada, May 2014.
- "What's in the Future for Clean Tech," M. Thibodeau (invited panel member), Global Midwest Alliance Conference, Chicago, Illinois, September 2013.
- "Wind Plant O&M: Different Approaches, Risks, and Trade-Offs," presented and authored by M. Thibodeau, AWEA WINDPOWER Conference, Chicago, Illinois, May 2013.
- "Capacitor Bank Control in Wind Farm Substations," presented and authored by J. Kotal, D. O'Reilly, L. Raue, AWEA WINDPOWER Conference, Chicago, Illinois, May 2013.
- "Selection Considerations for Switchgear, Outdoor Circuit Breakers, and Gas Insulated Substations," presented and authored by D. O'Reilly, M. Braet, AWEA WINDPOWER Conference, Chicago, Illinois, May 2013.
- "Renewable Energy and Integrated Resource Planning for Utilities," presented by P. Geenen, co-author M. Thibodeau, Solar Power-Gen Conference, San Diego, California, February 2012.
- "Integrated Resource Planning for Utilities," presented and authored by M. Thibodeau, AWEA WINDPOWER Conference, Atlanta, Georgia, June 2012.
- "Renewable Energy and Integrated Resource Planning for Utilities," presented and authored by M. Thibodeau, Electric Power Conference, Baltimore, Maryland, May 2012.
- "Wind Turbine Structures & Foundations – Past Present & Future," presented and authored by S. Hagen, S. Fang, University of Illinois' 13th Annual Structural Engineering Conference, Champaign, Illinois, April 2012.
- "Construction Quality Control – Lessons Learned," presented and authored by D. Sleezer, AWEA WINDPOWER Conference, Dallas, Texas, May 2010.
- "Wind Energy Project Financing Challenges," presented and authored by M. Thibodeau, Energy & Environment Conference, Phoenix, Arizona, February 2010.
- "Integration of Battery Storage with Solar PV Plants," presented and authored by J. Patino, Energy & Environment Conference, Phoenix, Arizona, February 2010.
- "Electric Energy's Low Carbon Future and the Tough Choices Required," presented by M. Thibodeau, co-authors K. Davis, J. Bero, S. Hagen, Electric Power Conference, Rosemont, Illinois, May 2009.

- "Codes and Standards for Wind Turbine Foundations: An Overview and Future Outlook," presented and authored by T. Vazquez, AWEA WINDPOWER Conference, Chicago, Illinois, May 2009.
- "Cost Estimates for Utility-Scale Renewable Energy Projects," presented and authored by S. Hagen, American Association of Cost Engineers regional meeting, Chicago, Illinois, October 2008.
- "Grid Interconnection of the Largest Wind Farm East of the Mississippi," presented and authored by D. O'Reilly, AWEA WINDPOWER Conference, Houston, Texas, June 2008.
- "Optimizing Wind Farm Design for Profitability," presented and authored by S. Hagen with AWS Truewind, AWEA WINDPOWER Conference, Houston, Texas, June 2008.
- "Municipal Utility Small Wind Projects: Challenges And Benefits – A Municipal Perspective – New Ulm, Minnesota," presented and authored by S. Hagen with New Ulm Public Utility, AWEA WINDPOWER Conference, Houston, Texas, June 2008.
- "Assessment of Concentrating Solar Power Technology Cost and Performance Forecasts," authored and presented by R. Charles, K. Davis, and J. Smith, Electric Power Conference, April 2005.
- "Assessment of Parabolic Trough and Tower Solar Technology Cost and Performance Forecasts," R. Charles and J. Smith, Golden, Colorado: National Renewable Energy Laboratory, October 2003, Report No. NREL/SR-550-34440

  (To read the full text, please visit the following: http://www.nrel.gov/docs/fy04osti/34440.pdf).

These and other papers are available upon request.

Acronyms and Abbreviations

Acronym or Abbreviation	Definition
AWEA	American Wind Energy Association
BESS	battery energy storage system
BOP	balance of plant
CAES	compressed air energy storage
CFB	circulating fluidized bed
CO_2	carbon dioxide
CSP	concentrating solar power
CT	combustion turbine
DEWA	Dubai Electricity and Water Authority [United Arab Emirates]
DOE	[United States] Department of Energy
E&S	environmental & social
EPC	engineering, procurement, and construction
EPRI	Electric Power Research Institute
GE	General Electric
GW | GWh	gigawatt(s) | gigawatt hour(s)
HEPP	hydroelectric power plant
HH	hub height
Hg	mercury
HRSG	heat recovery steam generator
HTF	heat transfer fluid
IFC	International Finance Corporation
IPP	independent power producer
kV	kilovolt
LCOE	levelized cost of electricity
LFG	landfill gas
MW | MWh	megawatt(s) | megawatt hour(s)

Acronym or Abbreviation	Definition
NO_X	nitrogen oxide
NREL	National Renewable Energy Laboratory [U.S. Department of Energy]
O&M	operations and maintenance
OPIC	Overseas Private Investment Corporation
P&H	Patrick & Henderson
PC	pulverized coal
PM	particulate matter
PPA	power purchase agreement
PV	photovoltaic
RDF	refuse-derived fuel
RFP	Request for Proposal
SCADA	supervisory control and data acquisition
SO_2	sulfur dioxide
WTE	waste-to-energy