

Statement of Qualifications for
Renewable Power

January 2021



Renewable Power

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1. Introduction

1.1 Why Hatch

For nearly 100 years, Hatch has been a world leader in renewable power; we have delivered professional engineering and technical services to renewable projects around the corner and around the globe.

As a multi-disciplinary firm, we have the bandwidth to support clients with multi-technology portfolios, including solar, wind, hydro, energy storage, microgrid, thermal, T&D, and nuclear. Developers, utilities, public and private companies, and financial institutions draw on our expertise.



Through technological improvements and declining cost, renewable power technology has been a disruptive force in the way that energy is produced and delivered worldwide. The push to drive down costs in order to make wind and solar more competitive and profitable has spurred innovation in all aspects of the industry, from technology and design to project delivery and financing. Experienced participants are confronted with a competitive landscape that is constantly changing, while new entrants are navigating a learning curve to understand how renewables can fit with their business.

The availability of incentives, the suitability of technologies, and the challenges associated with permitting differ greatly across, and often within, regions. Local knowledge is paramount, while a global view is necessary for monitoring trends and spotting opportunities **to improve efficiency and control costs. Add to that today's more stringent regulations and the need for social licenses to operate, and it's clear that thorough, sound, front-end project development is more vital than ever.**

1.2 Our Vision, Mission & Values

Our organization is passionately committed to the pursuit of a better world through positive change. We embrace your visions as our own and partner with you to develop better ideas that are smarter, more efficient, and innovative. Our global network of 9,000 professionals **work on the world's toughest challenges. Our experience spans over 150 countries around the world in the metals, energy, infrastructure, digital, and investments market sectors.**

OUR VISION

We are passionately committed to the pursuit of a **better world** through **POSITIVE CHANGE**

OUR MISSION

TOGETHER we create unprecedented outcomes for our clients by partnering with them to develop **better ideas.**



Our **exceptional, diverse teams** combine vast engineering and business knowledge, applying them to the **world's toughest challenges.**

We build practical **SOLUTIONS** that are **SAFE, INNOVATIVE,** & sustainable.

OUR VALUES

We believe in exceptional ideas delivered with exceptional service.

DOING OUR homework

INNOVATING all that we do

Engaging great people who make a difference

Acting like **OWNERS**

Encouraging a flat, connected organization

Achieving **No harm**

ENSURING **cost** effective, efficient **delivery**

Thinking globally, acting locally

Being unconditionally **HONEST**

nurturing long-term relationships

Living our commitments with **integrity**

We are employee-owned and independent—free to bring our best thinking to your business. Our exceptional, diverse teams combine vast engineering and business knowledge, working in partnership with our clients to develop market strategies, manage and optimize production, develop new game-changing technologies, and design and deliver complex capital projects.

We work closely with the communities in the 70 offices we operate from to ensure that our solutions optimize environmental protection, economic prosperity, social justice, and cultural vibrancy. We want their businesses, ecosystems, and communities to thrive, both now and into the future.



Our people are passionate about our corporate purpose and values. We believe in long-term relationships with our partners, and are committed to our clients' lasting success.

We are “entrepreneurs with a technical soul.”

2. Renewable Power

Hatch employs professionals who are leaders in their fields and take pride in the practical and innovative application of their skills, experience, and teamwork.



We are a trusted, value-added advisor to owners, investors, lenders, and insurers and we deliver our services through these key channels:

- Transaction and Advisory Services including independent and owner's engineering, lender's technical advisor, due diligence reviews, power purchase agreement assistance, contract negotiation
- Project Development Services including wind resource assessments, feasibility studies including financial analysis and capital cost estimates, geotechnical investigations, specialized expertise in turbine foundations for both onshore and offshore projects, environmental constraints analysis, environmental assessments, permitting to post-construction monitoring, regulatory and permitting, electrical systems including substations, interconnection design, transmission and distribution, submarine cables
- Operational Performance and Optimization Services including SCADA analytics, performance monitoring, troubleshooting, power curve analysis, condition monitoring, wake effect studies, root cause analysis, repowering evaluations, asset management, O&M strategy

Many of our individual services, practice areas, and expertise are brought forth within each of these channels. The following sections detail our expertise in these individual sectors.

2.1 **Independent Engineer / Lender's Technical Advisor**

In addition to being a delivery channel for many Hatch services, independent technical review **and lender's advisory services are a specialty on their own**. Hatch is differentiated as an IE supplier by our activity in projects, from concept, execution, and operation; this enables us to provide innovative and practical advice.

Hatch regularly supports financial services companies and other stakeholders in their due diligence of renewable power projects, and power projects in general. Our technology-agnostic support services in this area encompass the full spectrum of clients' independent engineering needs, typically including some or all of the following:

- Review of sites before, during, and after construction
 - Review of generator (or storage) technology, design and equipment selection
 - Review of civil, structural, geotechnical, electrical, SCADA, and communication engineering and designs
 - Resource assessments, energy yield assessments: pre-construction and operations-based estimates and uncertainty analysis (P75, P90, etc.).
 - Technical review of major contracts, e.g. construction, supply, PPA, Interconnection, service and maintenance
 - Project schedule review
 - Environmental and permitting review
 - Environmental hazard review
 - Financial model review
 - Capex and opex review
 - Useful life, life extension assessment
 - Long-term cost modeling, major maintenance account sufficiency assessment
 - Drawdown and completion certification
- Residual value, decommissioning cost estimates.

2.1.1 *Multi-Technology Portfolios*

As a leading engineering services provider across all power generation technologies, Hatch has the bandwidth and expertise to offer a one-stop shop for multi-technology portfolios. For example, Hatch recently provided IE services to several acquisitions, divestitures, or **refinancing's of portfolios that included wind power, hydropower, and solar power within the same transaction**, with each portfolio having projects in several countries or continents.

- Project Titan, Confidential Client – Hatch acted as sell-side IE, preparing IE reports for seven operational hydro facilities in British Columbia, six wind farms (2 in Ontario, 1 in Alberta, 2 in the US), and six solar photovoltaic (PV) facilities in Ontario with a total installed capacity of 342 MW and several projects under construction. In addition to project-by-project IE reviews, Hatch developed a portfolio-level energy yield assessment to assess possible hedges or geographic diversification effects.
- Pacific Hydro – Hatch performed a due diligence review of a number of Pacific Hydro’s energy generating assets for Banco Santander in Chile. Banco Santander had been retained by a confidential client to arrange and provide assistance in the potential acquisition process of these assets. For Hatch, the mandate consisted of a mix of wind and hydro Power assets in Australia, Chile and Brazil. Some of these energy projects were in operation and some were in the advanced development phase. The assets combined represented a total of 1534 MW.
- Project Athena, Confidential Client – Hatch acted as a buy-side IE for a major multinational infrastructure investor, preparing a Phase 1 review for an 800-MW portfolio consisting of several large (100-MW+) wind projects and a multitude of smaller hydropower projects in the US and Canada.

2.2 Solar Energy Production Estimates & Layout Design

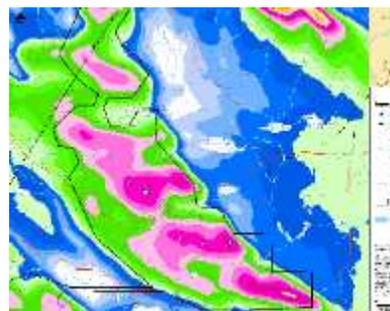
Hatch solar specialists provide system modeling and energy production estimates using industry recognized software programs, including PVsyst. We use solar resource data derived from publicly or commercially available sources or from on-site measurement using purpose-built equipment to minimize project risk associated with the resource. Our science-based approach can be applied to projects with unique conditions including excessive dust or snow. We have also developed a transparent uncertainty analysis approach that accounts for uncertainty in the solar resource, system losses, and other key project factors.

In projects where our scope of work includes design services, we combine preliminary layout design with initial equipment selection, constructability reviews, and value engineering to maximize return on investment for clients.

2.3 Wind Resource Assessment

Wind resource assessment is perhaps the most critical step in developing a successful wind power project. A detailed evaluation and quantification of the available wind energy guides the design and layout of the project, informs turbine selection and procurement, and enables accurate energy yield and financial projections.

Its ultimate success rests on the quality of the program’s assembled assets, including sound siting and measurement



techniques, trained staff, quality equipment, thorough data analysis tools and techniques, and the capability to understand and minimize the uncertainties in the estimate.

Key elements of our successful wind resource assessments include development of a wind monitoring campaign with appropriate site selection, in-house met tower installation or supervision for both tubular and lattice towers, data validation and quality assurance, understanding variability, energy modeling and layout optimization, and uncertainty evaluation. Hatch also conducts remote sensing campaigns using SODAR and LIDAR technology, either in concert with met masts or on their own. Where available, we also incorporate meteorological bureau information such as Environment Canada or NOAA.

A key differentiator in Hatch's wind resource assessments is our optimized wind data management database (WinDB) and our rigorous quality control protocol to ensure that each project gets started off on the right foot. WinDB is a secure online database service that manages the met data collected from a met tower. The database provides optimized data storage and efficient data processing. Users can view their tower statistics and quality-controlled data within a user-friendly interface.

2.4 Wind Energy Yield Forecasts and Operational Energy Yield Assessments

For pre-construction projects or operating projects, estimating the energy production potential accurately is critical to the valuation and bankability of wind projects.

2.4.1 Operational Energy Yield Assessments and Forecasting

For operating projects, Hatch regularly supplies assessment to predict the future energy yield of the project based on historical performance, availability corrections and long-term wind forecast adjustments. This assessment will typically include:

- Analysis of project revenue meter data to determine the historical production level of the project over the operational period;
- Review of monthly operating reports, against the revenue meter data, in order to verify historical production levels and quantify project availability and performance issues;
- Identification, comment on occurrences of availability and performance uncharacteristic of likely future operation;
- Derivation of availability and performance adjusted monthly production;
- Identification of suitable available sources of long-term reference data. Proposals identifying potential sources of ground-based reference data, or downscaled virtual reanalysis data (e.g. <5km resolution), in addition to freely available reanalysis, are sought.

- Customized correlation and extrapolation of availability and performance adjusted production data according to the long-term reference dataset to derive a central estimate of gross future energy generation for the project;
- Application of suitable future loss factors in order to derive P50 net production for the project in each year over a 30 year operational life;
- 12x24 estimation for net P50 production;
- Quantification of uncertainties and prediction of probability of exceedance values at P75 and P90 intervals.
- Reconciliation between current performance and P50 estimates

2.4.2 Pre-Construction Energy Yield Assessment

For unbuilt projects, Hatch will prepare a new wind resource assessment (WRA) and probabilistic forecast of energy yield, sweeping the variables that comprise the energy production prediction across their statistical range and developing predicted energy production forecast at 50% probability (P50), P75, P90 and P99 (or some other combination, at the choosing of the client) for periods of 1, 10, 20, and 30-years periods. This review will incorporate several years of met tower data (2013-2018) and seek to reconcile differences between historical (pre-construction) WRA forecasts and Hatch's estimate.

This assessment will provide a review of incoming wind energy, wind flow behavior, an overall site conditions assessment (that give rise to unique, challenging wind regimes, for example), and energy yield estimate with uncertainties. Factors such as terrain, shear, turbulence, air density, and turbine-to-turbine wake effects are included at this stage.

The Hatch team has an excellent command of the major wind energy assessment software, such as WaSP, Meteodyn, Windfarmer, etc, as well as some of its own proprietary tools. A detailed listing of Hatch WRA software capabilities can be provided.

Loss estimates are also incorporated at this stage, ranging from temporal factors such grid curtailment, bird/bat covenants, icing, restart sequences, and shadow flicker to long-term, permanent and non-permanent factors such as blade degradation, transmission losses, and equipment wear.

2.5 Electrical, System Studies & Interconnection Engineering

Hatch's electrical engineers have comprehensive experience with design and construction of low voltage, high voltage and DC electrical systems, and are able to provide complete electrical engineering design services and professional advice.

We are familiar with the challenges of remote sites and harsh climates, including conditions such as very high or low ambient temperature, dust, and non-uniform soil resistivity. Our design of grounding systems, cabling and equipment is informed by our understanding of how systems perform throughout their service life, whether in southern or northern climates.

Our services also include electrical system studies and interconnection design for developers, utilities, and transmission system operators, including load flow, short circuit, transient stability, harmonics, reactive compensation, low-voltage ride-through, protection coordination, communications, grounding, lightning protection, insulation coordination study and arc flash.

To quote one of our customers:

“Algonquin Power has been using Hatch’s electrical engineering services for developing various hydro-electric, wind and solar generation projects across Canada since 2007. The assignments included generation interconnection feasibility studies, reactive power assessment and voltage control studies, harmonic measurements and analysis, design of harmonic filters, protection and coordination studies, grounding grid analysis, and detailed design of collector systems and interconnection substations.

Algonquin has found that Hatch’s electrical engineers have provided superior technical, analytical and management capabilities. Their staff are very customer-focused, and their work product is always provided in a timely manner. Algonquin has very much appreciated Hatch’s ability to modify and cater its services to our specific needs, which vary significantly from project to project.”

– Homer Lensink, Director – Energy Projects, Algonquin Power Co.

2.6 Geotechnical Engineering

Hatch’s geotechnical engineers are recognized for their ability to identify and manage geotechnical risks associated with sites and construction. We provide feasibility-level geotechnical assessments and strategic siting advice for solar projects in early planning phases, as well as geotechnical investigations and detailed design of foundations. Our experts have been a trusted source of advice on pile design for solar projects developed in challenging conditions, supporting projects in locations as diverse as the Canadian Arctic to the Atacama Desert.

Both analytical techniques and numerical approaches are used, as appropriate, by the geotechnical team for input into engineering design. These techniques take into account uncertainties in data, level of acceptable risk, cost-effectiveness and construction considerations. Computer software packages are used to perform geotechnical analyses and design for different type of structures and under various loading conditions including earthquakes and hurricanes.

As evidence of its deep roots in **geotechnical engineering from hydropower projects**, Hatch’s Niagara Falls office maintains its own, sophisticated soil testing laboratory to run complete sample testing campaigns or audit the findings of third-party labs we collaborate with.

2.7 Civil & Structural Engineering

Many of our civil and structural engineers cultivate their skills and experience with local authorities on major capital projects like hydroelectric dams, bridges, pipelines, tunnels, and roads. In solar, our civil and structural services include:

- Grading, stormwater management, erosion and sediment control designs and reviews
- Access road design
- Traffic studies
- Structural capacity assessments and engineering for rooftop solar projects and carports.

2.8 Foundation Design

Hatch's foundation group is well known for providing expert services to assess difficult foundations and, in some cases, develop innovative remedial solutions for foundation designs (performed by others) that did not adequately account for project conditions. Hatch is known as the resource to turn to when serious foundation problems become apparent.

Hatch has performed technical evaluations and thorough investigations of foundation designs when issues such as tower swaying, tower fatigue or signs of tower stiffness occur. Hatch does 3D modeling of the foundation using ANSYS benchmark and can evaluate the harmonic response analyses under a single force to simulate vortex shedding action on the tower and foundation system. Hatch has been involved in the re-designing of tower anchor bolts and evaluating their fatigue life with several site visits to witness anchor bolt post-tensioning procedures.

2.9 Environmental Assessments & Approvals

During the feasibility and pre-feasibility phases, we complete Environmental Constraints Analyses to determine environmental considerations, constraints and opportunities to project sites. We undertake studies to gather relevant information for the Environmental Assessment including:

- Baseline environmental studies
- Physical, biological and socioeconomic impact assessments
- Mitigation planning/development
- Follow-up environmental monitoring programs
- Stakeholder consultation
- Noise assessment studies
- Equator Principles reviews

Hatch also provides environmental monitoring services during construction and operations to ensure project commitments and regulatory compliance are met.

2.10 Front-End and Detailed Engineering

Hatch provides complete design, engineering, cost estimation services and preparation of tender documents for both EPC- and EPCM-style contracts. We employ *Hatch's Project Lifecycle Process*, which requires each phase of major capital projects to be reviewed to **deliver successfully the required inputs for the subsequent phase. At the core of Hatch's culture is founder Dr. Gerald Hatch's philosophy of "Doing your homework."** We diligently work with the client in order to understand needs, constraints and opportunities unique to each project.

2.11 Construction & Project Management

As a group within a global EPCM firm, we leverage Hatch procurement, project controls, project management and construction resources to manage and execute multimillion-dollar projects delivering quality results on time and within budget.

Hatch has provided construction management services for renewable energy projects for nearly 100 years. **We have developed effective tools to allow us to manage our clients' projects safely and efficiently and in a manner that results in a clear understanding of roles and expectations of parties involved in the project.** Our knowledge and experience in renewable power allow us to ensure quality in construction and to provide value engineering by tailoring designs to the actual conditions encountered in solar projects. We also provide QA/QC, third-party reviews of construction projects, full-time construction monitoring, and commissioning oversight.

"Hatch has behaved as a true partner...and we will continue to rely on Hatch throughout the remainder of the project execution. I highly recommend them for project development services for ac and dc transmission projects."

– Rick Janega, President & CEO, Emera

2.12 Remediation and Operational Improvements

We provide unique engineering services to project owners, developers, EPC contractors, and vendors to solve challenges encountered during construction as well as commissioning and operations. These services include:

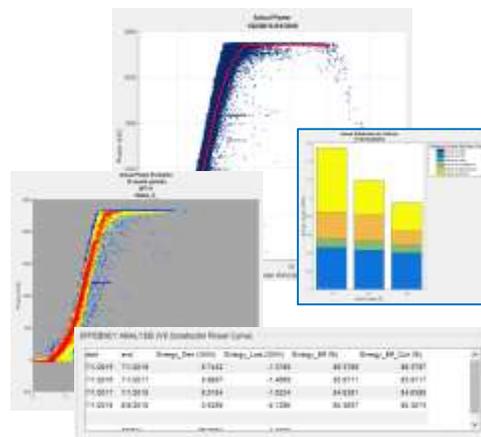
- Grounding gap analysis and re-verification.
- Validation and re-performance of short circuit, protections and controls, and arc flash studies.
- Racking failure and snow loading analysis.
- Pile design review and failure analysis.
- Code compliance review.
- Power quality analysis including measurements and analysis of harmonics, voltage flicker, unbalance, and sag/swell events against relevant IEEE and utility standards.

- Operational energy production analysis and comparison with PVsyst and financial model estimates.

2.13 Operational Performance Services

Once the facilities are producing power, operators can benefit from an expert and impartial eye on the operation of the turbines and plant. As the industry shifts from a development & construction focus to long-term operations, getting the most out of each assets has become the focus. Hatch provides the following services to help operators optimize the performance potential of their assets:

- Operations strategy reviews
 - Maintenance OPEX optimization
 - Sustaining CAPEX
 - Services supply strategy
- Wind turbine performance assessment, testing, and operational analysis to detect electrical loss, availability and perform power curve analysis
- SCADA analytics using tools developed in house to identify and quantify losses, incorrect settings, misalignments, inefficient operations, power curve degradation, unplanned curtailment events
 - Hatch has built its own custom software for managing and evaluating large operational data sets
- Hardware & software upgrade analysis, validation, and verification
- Condition assessment – turbines, blades, foundations, towers, and substations
- Lifecycle planning
- Repowering feasibility studies & project execution
- Environmental & noise monitoring
- Regulatory required inspections
- Arc flash studies



2.14 Root Cause Analysis

Accidents and equipment failures happen, unfortunately. **Hatch's core** renewable power team accesses the deep subject matter expertise across Hatch to bring specialists to complex problems such as transformer fires, inverter failures, explosions and other mishaps to provide forensic investigation services, including a fire investigation, lab analysis, simulations, research, production loss estimates, evidence management (and secure storage), and expert

witness services. We act on behalf of owners, insurers, lenders, and manufacturers to identify root causes of failures, and support them in the recovery, reconstruction, and restart of the asset.

3. Microgrids and Hybrid Power Systems (Wind, Solar, Diesel, Storage)

Industrial facilities and residential communities in remote locations with no access to power grids often rely on diesel generators for their energy supply; however, diesel fuel is expensive to supply and deliver to remote locations. Energy costs can be significantly reduced by incorporating renewable power sources, such as wind energy, to offset diesel fuel consumption.

Since we engineered and built our first microgrid in 1987, a captive power plant for a remote metal processing project in Indonesia, we have been keenly aware of the complexities of providing reliable, high quality power in remote environments, from as small as 1-MW to power a village or remote operations up to 100s of MW for off-grid, industrial facilities. Whether fully grid-isolated or capable of receiving intermittent grid power, we learned early on that we needed purpose-designed microgrid control systems to be able to supply our **customers' projects with stable power.**

Since those early days, renewables have entered the energy sector as both an opportunity to produce utility-scale power cleanly and economically, but also a challenge to integrate due to their intermittency. Since 2012, we have been heavily involved making these integrations happen. We start with desktop studies to retrofit existing diesel generation systems into microgrids with renewables and energy storage, and identify the required balance-of-plant equipment. As these projects advance, our role is typically to supply the integration engineering, ensuring that the generation technology are optimally matched to each other and function harmoniously with the load demands of the microgrid.

3.1 Hybrid Services from Concept to Commissioning

With offices on six continents, Hatch offers its clients high-quality services through all development phases of hybrid power projects:

- Conceptual and detailed economic assessment of hybrid power retrofits to existing generation assets
- Impact assessment on the operation, protection and control of existing systems
- Wind, solar resource assessments and bankable yield forecasts
- Optimal sizing and selection of wind and storage equipment
- Constructability assessments and balance-of-plant estimates
- Detailed integration study by modeling the system dynamics and evaluation of reliability and power quality
- Environmental impact assessment and permitting applications

- Engineering design, procurement and construction management.
- Complete microgrid and SCADA system design and programming

4. Energy Storage

Increasingly, grid operators are pushing the responsibility to supply firm supply capacity onto the PPA counterparty, a requirement that can be met with on-site or contracted energy storage (or another dispatchable asset). Identifying the optimal energy storage technology and configuration for your project that will perform appropriately for the desired lifetime at the estimated cost is not a simple matter.

Hatch can help you understand the financial and technical risks when evaluating energy storage as well as review the technical assumptions going into the financial models underpinning your investment.

Drawing on a wealth of experience, Hatch can quickly and thoroughly conduct technical due diligence on energy storage projects and evaluation, and even execute, energy storage integration to wind assets. Our technical experts work with all forms of energy storage, covering hydropower (pumped storage), mechanical (CAES - terrestrial and aquatic, flywheels, gravitational), thermal (molten salt), and electrochemical (Li-Ion, flow batteries, supercapacitors).



Whether for due diligence or development, our services typically entail the following activities and can apply to grid-connected, off-grid, or behind-the-meter storage applications:

- Characterization of how the energy storage is going to be used
- UPS-type utilization, fast response spinning reserves and ancillary service to ensure grid resiliency
- Power quality, frequency control to ensure grid stability
- Time-shifting or energy banking of generation for later use
- Technology viability review, including:

- Historical performance and safety track record in different climate conditions to validate the maturity of the technology
- Maintenance and service requirements, including supplier performance risk related to service and warranties.
- Review system sizing and multivariate optimization of project goals, e.g. revenue maximization, performance requirements, capital performance, and O&M cost minimization
- Evaluation of expected, useful service life and degradation assumptions
- Evaluation of round trip efficiency and energy lost from auxiliary loads (such as air conditioning, supplement heating, etc.)
- Charge and discharge rates, influence of temperature and other variables on performance
- Duty cycle limitations
- Lifetime evaluation based on intended utilization
- Fire suppression and noise
- Balance of plant: Project site, permit review, interconnection agreements.

4.1 Management System and Control Capabilities

- Capacity for the inverter to provide real and reactive power (respond to P & Q set points), close loop monitoring of grid frequency and voltage
- Evaluation of the energy storage management system
- Availability of remote control and monitoring capability, remote start and stop of the energy storage system
- Review user interface, data storage, graphics, data compatibility and export, IT security, and SCADA.

4.2 Purchase Contract, O&M, warranties

- Alignment of contractual elements to performance, O&M, and warranty goals
- Evaluate maintenance and operation conditions and costs over the lifetime of the energy storage; identifies spare part requirements
- Review of warranties, guarantees, exclusions and conditions
- Estimate the incremental cost needed to replace or augment components at the end of useful lifetime (when performance degrades below a threshold).

4.3 Factory and Site Accept Testing (FAT and SAT)

- Measure charging/discharging ramp rates and curves, roundtrip efficiency, energy storage power limits and capacity
- Measure duty cycles limits (and ability to disperse heat buildup); string monitoring

5. Selected Projects

The attached appendices contain representative experience examples, broken out into areas that are closely related to your requirements:

- Appendix A Representative Experience – Solar
- Appendix B Representative Experience – Energy Storage
- Appendix C Representative Experience – Hybrid Power and Microgrids
- Appendix D Representative Experience – Wind Power

In the following section, we have highlighted some of these projects in greater detail and would be please to provide you with more detail on any of the work in our portfolio.

Hatch has been working in wind power since 1980 when we completed a feasibility study for Niagara Mohawk Power in New York, USA. Since then, Hatch has worked on hundreds of projects, totaling more than 25,000 MW.

Hatch has worked on wind projects in Canada, USA, Mexico, Bahamas, Vietnam, Lesotho, Ghana, Senegal, Gabon, South Africa, Jamaica, Australia, the United Kingdom, Chile, Brazil and Argentina.

5.1 Western Lily Wind Project, Saskatchewan, Canada 2018 – 2019

Western Lily Wind Energy LP



The Western Lily wind project is in Grenfell, Saskatchewan, approximately 120-km east of Regina. The project consists of ten (10) Enercon E-92 wind turbine generators with hub height of 85m and a total installed capacity of 20-MW. The project interconnects with SaskPower at a substation that was built expressly for this project.

During the project’s development phase, Hatch performed owner’s engineering services and provided technical advice relating to electrical design work. Project designs were monitored for compliance with EPC contract documents and regulatory approvals. When the project entered construction, Hatch assisted the owner while turning over and accepting the various phases of the project. Construction planning documents were monitored for conformance to contracts and construction norms. Project communications were audited such that key decisions or key project data was traceable in the project records. No LTI incidents occurred under Hatch supervision during the execution phase of the project.

Hatch also performed lender’s engineering services such as site quality assurance services through site visits to witness key pre-commissioning activities, construction progress and to monitor that the design was done in accordance with applicable contractual documents. Hatch provided certificate approvals and prepared a project completion report. For the lender, based in Germany, Hatch was the eyes and ears in this transaction.

Hatch’s value added for the owner was the technical input on the design and offering the perspective of planning potential future needs of the project. Hatch was also tasked with independently monitoring the wind farm’s performance during early operations via SCADA-based health and performance review of all turbines.

Most of the project delivery was from Hatch’s Saskatoon office, whose structural and electrical engineers also participated in the design review and field work. Total consulting fees for the project were \$110,000 CAD.

Project Name:	Western Lily Wind	Equipment:	Enercon E-92
Size:	20 MW _{AC}	Value:	\$110,000 CAD
Location:	Grenfell, Saskatchewan, Canada	LTI under Hatch Supervision:	0
Role:	Owner’s Engineer		

5.2 Pennask and Shinish Wind Projects, British Columbia, Canada, 2015 – 2017

Zero Emission Energy Developments



Shinish and Pennask Wind Farms were among the first to be built under the BC’s Standard Offer Program and among the first wind projects to be built in the Okanagan Region of BC. The projects each have five (5) Senvion 3.2 turbines, for a total of 30 MW across both projects.

Hatch accompanied the developer of these projects from the very beginning in 2015. It started with site

selection and permitting for investigative use permits and license of occupation. Hatch completed the wind resource assessment campaign, starting with the met tower installation and the collection and analyses of meteorological data over several years. Hatch coordinated the environmental permitting process with a third-party consulting firm to prepare and submit the Development Plan, as required by the BC Ministry of Natural Resources and Lands (FLNRORD). Hatch prepared all the preliminary design work for the turbine layout including road design, electrical collector system and substation.

Hatch prepared the RFP for the EPC contractors and managed the bids to assist the client in selecting the contractor. Hatch facilitated negotiations with BCHydro with regards to the system impact studies prepared for the interconnection points.

Hatch acted as Owner’s Engineer for the project’s EPC contract and acted as technical advisor for the arc flash system modelling and protection study at the wind farms. Hatch worked with protection and control suppliers to implement a voltage control solution that meets stringent utilities requirements. There were no LTI incidents under Hatch supervision during the construction process.

The projects achieved commercial operational in early 2017, with a total Hatch consulting budget of \$475,000 CAD.

Project Name:	Pennask & Shinish Wind Projects	Equipment:	Senvion 3.2
Size:	30 MW _{AC}	Value:	\$475,000 CAD
Location:	Okanagan Region, British Columbia, Canada	LTI under Hatch Supervision:	0
Role:	Owner’s Engineer		

5.3 Raglan Hybrid Project, Northern Quebec, Canada 2014 – 2018

Glencore



Hatch was retained by Tugliq Energy and Glencore Raglan Mine to study and design the implementation of wind power at their mine to reduce diesel consumption and operating costs. Hatch developed preliminary designs for the facility, addressed any potential issues with respect to integration of the facility, analyzed the wind resource and estimated the wind power production. Hatch grid integration study lead to a 3-MW Enercon E-82 wind turbine with energy storage (Li-Ion battery, flywheel and hydrogen system) with a micro-grid controller as the optimal configuration for the site.

Hatch completed the designing, engineering, project management and commissioning of this system in 2014; since then, Hatch has been monitoring and optimizing the operation of the system. All Hatch supervised operations on site have had no LTIs to-date.

Hatch completed the integration study, grid stability analysis, interconnection study to the 25-kV transmission line and developed and installed the microgrid controller and designed-built the flywheel to ensure the grid stability.

As a part of the Raglan Mine project, Hatch was involved in screening and review of various **energy storage technologies in order to meet the specific needs of the mine’s microgrid.** As well, the energy storage systems were sized in order to ensure reliable power supply, including sufficient capacity to provide power during diesel generator ramp up.

In 2018, a second 3-MW wind turbine was added, along with an upgrade a larger capacity Li-Ion battery.

Hatch services for both phases comes to a total of \$2,700,000, including equipment supply for the HµGrid controller and associated support.

Project Name:	Raglan Hybrid Project	Equipment:	Enercon E-82
Size:	3 MW _{AC}	Value:	\$2,700,00 CAD
Location:	Raglan Mine, Quebec, Canada	LTI under Hatch Supervision:	0
Role:	Design Engineering & Consulting		

5.4 Bow Lake Wind Farm, Ontario, 2011 – 2015

Shongwish Nodin Kitagan GP Corp



The Bow Lake Wind Farm project was awarded 60-MW of FIT contracts and was constructed in two phases. The wind farm consists of 36 x 1.62-MW GE wind turbines and became operational in 2015.

Hatch provided due diligence for the owner and used **Hatch’s proprietary software to help mitigate constructability costs.**

In the pre-construction phase, Hatch conducted site visits to review points of interconnection, constructability and accessibility constraints.

Hatch was involved in the project from the very beginning with complete wind resource assessments performed throughout the measurement campaign from 2011 to 2014. Hatch was the independent engineer and reviewed all aspects of the project in order to secure

funding for the construction development phase of the project. This involved the review of geotechnical studies, electrical designs, wind turbine technology and site suitability, project construction costs and schedule, environmental review, assessment of potential energy yields, review of principal contracts and agreements, evaluation of projected operation expenditures and financial projections. Total Hatch services came to \$600,000 CAD.

Project Name:	Bow Lake Wind Farm	Equipment:	General Electric 1.6-100
Size:	60 MW _{AC}	Value:	\$600,00 CAD
Location:	Sault Saint Marie Ontario, Canada	LTI under Hatch Supervision:	0
Role:	Owner’s Engineer		

5.5 Amherst Island Wind Project, Ontario, 2009 – 2018

Algonquin Power / Windlectric Inc.



Hatch has a long history with the Amherst Island Wind Project, having supported the development and construction of it through numerous phases between 2009 and 2018.

Early efforts included the layout and performance the noise impact assessment for Algonquin Power’s facility, a 75-MW wind farm on an island in Ontario, Canada. The facility was the first in Canada to use Siemens SWT 2.3-113 wind turbine generators. In addition, a new submerged cable was required to transfer the electricity produced by the wind farm on the island to the point of interconnection, located onshore.

Hatch produced preliminary designs for the underground collector system and access roads, including the location of turnaround areas and crane pads based on manufacturer

specifications. Hatch also performed the wind resource assessment study and annual energy production estimation, including evaluation of energy production of different wind turbine models, as well as losses and uncertainty analyses.

Hatch also prepared the CIA/SIA applications required by Hydro-One and IESO (Independent Electricity System Operator) in Ontario.

Finally, Hatch served as the independent engineer and lender’s technical advisor for the project when financing was being secured for the construction phase and the project reached commercial operation in the summer of 2018. No LTIs occurred on Hatch supervised activities during the construction phase. During this phase, Hatch reviewed final project electrical designs, geotechnical studies, wind turbine technology and site suitability, telecommunications system, wind resource assessment, environmental and regulatory studies, principal contracts and agreements, construction schedule, financial model. Total Hatch services over the project development lifetime came to a total of \$400,000 CAD.

Project Name:	Amherst Island Wind Project	Equipment:	Seimens 2.3-113
Size:	75 MW _{AC}	Value:	\$400,000 CAD
Location:	Amherst Island, Ontario, Canada	LTI under Hatch Supervision:	0
Role:	Environmental & Technical Consulting, Lender’s Technical Advisor		

5.6 Grand Valley Wind Farm Project, Ontario, 2015 – 2016

Grand Valley 2 LP



The Grand Valley 3 wind project is in central Ontario near the village of Grand Valley. The project consists of 15 Siemens SWT-3.0-113 wind turbine generators with an installed capacity of 40 MW.

Hatch performed owner's engineering services and site quality assurance services for Veresen Inc. Hatch also provided a certificate of completion in compliance with the Ontario Power Authority's Feed-In Tariff Program. As part of the owner's engineering services, Hatch provided assistance with the turbine supply agreement.

During the project's design phase, Hatch provided technical review of the contractor submissions, including foundation and substation design reviews. When the project entered construction, Hatch provided site quality assurance services through site visits to witness key activities, including rebar placement, mass concrete pours, anchor bolt tensioning, turbine and substation walk-downs, static and dynamic commissioning steps, and product checks. During all Hatch supervised activities there were no LTIs or other recordable incidents. In addition, records audits were completed, and Hatch participated in commissioning activities.

Commercial operation was achieved one month early, and the project was completed \$3 million under budget. To avoid concrete shrinkage due to weather conditions, and to maintain schedule, some foundation pours began before daybreak; Hatch was in attendance to monitor the work.

During the owner's engineering review, Hatch determined that several of the foundation designs did not meet the criteria required by the OEM and CSA. Hatch did a technical evaluation of foundation stiffness of two shallow foundation designs. The work included building 3D finite element models of the two foundations, evaluating the geotechnical parameters including soil shear modulus and soil subgrade reaction values, investigating the rotational and horizontal stiffness criteria according to the wind turbine manufacturer and proposing several remedial measures for foundations that did not meet the stiffness criteria. Total Hatch fees for all of these services came to a total of \$620,000 CAD.

Project Name:	Grand Valley Wind Farm	Equipment:	Seimens SWT-3.0-113
Size:	40 MW _{AC}	Value:	\$620,000 CAD
Location:	Grand Valley, Ontario, Canada	LTI under Hatch Supervision:	0
Role:	Owner's Engineer		

5.7 St-Columban Wind Farm, Ontario , 2015 – 2016

BluEarth Renewables



The St. Columban Wind Project is in central Ontario near the village of St. Columban. The Project consists of 15 Siemens SWT 2.3-113 Wind Turbine Generators and an installed capacity of 33 MW. During construction, but prior to commissioning, incidences of tower sway associated with resonance were witnessed leading to a temporary safety shutdown.

Hatch provided Owners Engineering services for the duration of the project, including a mid-term expansion of scope to assist the client in investigating the root cause of the movement and to determine risk to personnel and to the life of the asset. An independent structural analysis was conducted; in addition, a novel approach to calculating foundation stiffness was developed.

Work included:

- Reviewing geotechnical data, including soil stability and water levels for the sites in question.
- Conducting a stability analysis on the foundation based on soil parameters provided in the original geotechnical report.
- Creating a 3D model in ANSYS of the foundation, tower, and soil system to model the dynamic behaviour under various conditions. Two model conditions were considered, one with a rigid foundation used to obtain the natural frequency and displacements of the tower; the second conditions looked at the overturning moment, and shear force at the top of the pedestal, as well as the natural frequency of the entire system.
- Reviewing calculations for the maximum tensile force on the anchor bolt due to axial load and bending moment was conducted to confirm the recommended post-tension force. The material of the bolts was tested to confirm chemical properties as well as ultimate tensile strength and yield strength

As part of the Owner's Engineer services, Hatch provided assistance with the Turbine Supply Agreement. Prior to construction, Hatch performed a transportation study including route assessment, fatal flaw identification, and turn studies to determine and assess any potential issues in the transport of the turbine components to site.

During the design phase of the project, Hatch provided technical review of the contractor submissions including foundation and substation design reviews. When the project entered construction, Hatch provided site quality assurance services through site visits to witness key activities, including rebar placement, mass concrete pours, anchor bolt tensioning, turbine

and substation walkdowns, static and dynamic commissioning steps and product checks. During these services the staff under Hatch supervision were free of any LTI incidents.

Hatch's total contract values over these services was \$520,000 CAD.

Project Name:	St. Columban Wind Farm	Equipment:	Seimens SWT-2.3-113
Size:	33 MW _{AC}	Value:	\$520,000 CAD
Location:	St. Columban, Ontario, Canada	LTI under Hatch Supervision:	0
Role:	Owner's Engineer		

5.8 Gahcho Kué Diamond Mine, North-West Territories, Canada, 2018-2021

De Beers



The Gahcho Kué site, located in the eastern region of the North-West Territories, is a diamond mine owned and operated by the De Beers group. The current power generation system is comprised of several generators consuming 12.5 ML of diesel per year. Hatch was retained by De Beers Canada to evaluate power generation alternatives to lower the carbon footprint and energy cost. The potential for wind

power generation, solar PV power generation, biological and geological carbon capture and sequestration (CCS), and waste heat recovery power generation (WHR) at the site were evaluated. The most promising technologies were found to be the wind and solar power generators due to the reduction of diesel consumption they offer.

The scope included the development of conceptual designs, energy generation profiles, CAPEX, and OPEX estimates, techno-economic optimization analyses, and preliminary logistics and construction plans for multiple variants of these technologies. The project is currently moving into procurement with Hatch in the **Owner's Engineer** role, and has single-axis tracking with bifacial PV modules as the primary candidate for on-site renewable generation. Hatch's total contracted services to date have a value of \$275,000 CAD.

Project Name:	Gahcho Kue Renewable Project	Equipment:	Single Axis Tracking & Bifacial PV Modules
Size:	2.5 MW _{AC}	Value:	\$275,000 CAD

Location:	Gahcho Kue, Northwest Territories, Canada	LTI under Hatch Supervision:	0
Role:	Consulting & Design Engineering		

5.9 Lightning Protection Technical Review, Prince Edward Island, Canada, 2018

Prince Edward Island Energy



Hatch's client required independent engineering support to review its blade lightning protection system (LPS) following a lightning strike, which resulted in a blade failure. Subject matter expertise combined with a systematic investigation led to a root cause for the LPS failure at the site. Hatch supported its client in its remediation effort as well as its dispute over cause and responsibility with the turbine OEM. As elements of this effort, Hatch conducted a full root cause investigation, manifested in several directions. Hatch fees for these services came to \$27,000 CAD.

Technical evaluation of:

- Existing inspection reports, maintenance logs, turbine supply agreement, service agreements and secondary agreements; commented on the prevalence of lightning strikes at the site, ground resistivity measurements/tests at the turbine locations

Reviewed lightning protection system:

- Operational status of the lightning protection systems at all turbine blades on the project; risk to other blades and turbines; benchmarked the lightning protection system design and specifications with industry standards.

Provided an independent loss evaluation:

- Turbine availability and energy production losses; extents of physical damages; remediation costs

Project Name:	Lightning Protection Technical Review	Equipment:	Acciona AW3000
Size:	30 MW _{AC}	Value:	\$27,000 CAD
Location:	Prince Edward Island, Canada	LTI under Hatch Supervision:	0
Role:	Independent Engineer		

5.10 Preliminary Engineering Services for Irma Wind Farm, Alberta, 2016 - 2017



The Irma Wind farm was a 90 MW under development eastern Alberta. Hatch was engaged early in the development process to support the developer through the geotechnical (including in-house geotechnical lab analysis at Hatch’s Niagara Falls laboratory) and preliminary engineering, through to developing an EPC bid package. Key Hatch deliverables included Preliminary engineering and cost estimate package, geotechnical campaign & preliminary foundation design, substation and collector system design utilizing Hatch’s own in-house optimization software.

Project Name:	Preliminary Engineering Services for Irma Wind Farm	Equipment:	Not selected at time of assignment.
Size:	90 MWAC	Value:	\$150,000 CAD
Location:	Wainwright, Alberta, Canada	LTI under Hatch Supervision:	0
Role:	Preliminary Engineering & Geotechnical Analysis		

5.11 Nanticoke Solar Farm, Ontario, Canada, 2018 – 2019

Ontario Power Generation



Hatch provided Owner’s Engineer services for Ontario Power Generation Inc. for its 44-MW ground mount solar project using fixed tilt racking, a portion of it built on the land of a decommissioned coal plant.

Hatch’s mandate was to conduct engineering design review of the EPC contractors’ detailed design drawings, design and execute a quality assurance plan for the duration of the project through commissioning and conduct as-built reviews.

In an earlier phase, Hatch carried out preliminary designs (system sizing and layout) and assisted OPG with bid preparation for the Ontario Governments Large Renewable Procurement (LRP), and site selection for the project. During the engineering design phase Hatch reviewed and commented on all detailed design drawings provided by the contractor; including civil, mechanical, electrical, and other.

Hatch designed a detailed quality assurance plan to execute during the construction phase of the project, conducting quality inspections of a percentage of all civil, mechanical, and electrical works; including Balance of Plant (BOP) and substation. A Hatch team acted as full-time, on-site **Owner's Representative during construction of the project** Hatch geotechnical expertise played a key role in determining risk of changes to design as a result of uncovered existing foundations and providing a due diligence review on behalf of the owner. There were no LTIs on Hatch supervised activities, and the total value of services provided was \$875,000 CAD.

Project Name:	Nanticoke Solar Farm	Equipment:	Fixed Tilt, Monofacial modules
Size:	44 MW_{AC}	Value:	\$475,000 CAD
Location:	Nanticoke, Ontario, Canada	LTI under Hatch Supervision:	0
Role:	Owner's Engineer		

5.12 **Owner's Engineer, Jaiba Solar Farm, Brazil, 2020**

Canadian Solar Developments

Hatch was **selected to be the Owner's Engineer** for **Canadian Solar's** Jaiba Solar farm in Brazil, a greenfield project with a capacity of 128 MW_{ac}.

Canadian Solar selected Hatch for its first self-developed solar project in Brazil due to its trust in Hatch from previous experience, **local staffing and expertise from Hatch's** Belo Horizonte office, and global bench of subject matter experts to ensure a successful project.

The project includes multiple phases of construction with a shared HV interconnection. **Hatch's scope as Owner's Engineer includes** design reviews, supplier coordination and management, review of Health, Safety, and Environmental plans from EPC contractor, and periodic on-site construction monitoring. The project is under construction at present and is expected to begin generation in early 2021.



Project Name:	Jaiba Solar Farm	Equipment:	Single-Axis Tracking & Bifacial Modules
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Size:	128 MW _{AC}	Value:	R\$ 835,000
Location:	Brazil	LTI under Hatch Supervision:	0
Role:	Owner's Engineer		

5.13 Boddentown 5-MW Solar Farm, Grand Cayman, Cayman Islands, 2017

CIBC First Caribbean



Hatch was engaged by CIBC First Caribbean to act as the Lender's Engineer for the 5-MW Bodden Town solar under development on Grand Cayman, the island's first utility-scale solar farm.

The project included a number of challenging design requirements, as it was located on a backfilled quarry representing a very difficult geotechnical basis as well as needing to be designed to resist Category 5 hurricane winds. The combination of these two elements led to the selection of the ballasted racking foundations as shown above.

Hatch's scope included design & energy model review through the development process, vendor & contractor assessment, as well as on-site progress & quality checks in support of the financial draw requests. During the construction and commissioning period no LTIs occurred under Hatch supervision. Hatch also provided support in interactions with the local utility, as they had not encountered a solar farm of this scale before. The project was successfully commissioned in 2017. Hatch services were valued at approximately \$110,000 CAD.

Project Name:	Cayman Solar	Equipment:	Fixed tilt racking, ballasted foundations, monofacial modules.
Size:	5 MW _{AC}	Value:	\$110,000 CAD
Location:	Boddentown, Grand Cayman, Cayman Islands	LTI under Hatch Supervision:	0
Role:	Lender's Engineer		

5.14 BluEarth Solar Portfolio, Alberta, Canada, 2020 - 2021

BluEarth Renewables



Hatch is engaged by BluEarth to act as the Owner’s Engineer for their portfolio of solar project under development in southern Alberta including the Burdett and Yellow Lake projects totaling over 100 MW. Hatch’s scope includes extensive design, construction documentation, and equipment review as well as support during the construction phase with periodic visits supporting schedule and quality review. The projects will be utilizing a combination of fixed and single axis tracking racking across the portfolio.

The first projects are currently under construction, with estimated completion of the portfolio in mid-2021. The current estimate for Hatch services is approximately \$450,000 CAD across the portfolio.

Project Name:	Blue Earth Renewable Portfolio	Equipment:	Fixed & single axis racking, monofacial modules.
Size:	100 MW _{AC}	Value:	\$450,000 CAD
Location:	Southern Alberta, Canada	LTI under Hatch Supervision:	0
Role:	Owner’s Engineer		

5.15 Great Bay Solar II, Independent **Engineer’s Review for Tax Equity**, USA, 2019-2020

Algonquin Power / Liberty Power



Hatch completed a pre-construction Independent Engineering review of a proposed 43-MW extension to an existing 75-MW solar project near the Chesapeake Bay, with the project utilizing both fixed tilt and single axis tracking over its multiple planned phases. Hatch’s report to Algonquin’s equity investors included reviews of site, equipment, engineering, interconnection with DPL/Exelon in PJM, major agreements, EPC contractor, energy forecast, schedule, operations plan, pro forma financial model, performance tests, and permitting.

Hatch also provided support in the development of a decommissioning cost estimate & project residual scrap value for this project and the sibling project Great Bay Solar I. Hatch’s consulting services value was approximately \$34,000 at the conclusion of the current scope.

Project Name:	Great Bay Solar II	Equipment:	Fixed & single axis racking, monofacial modules
Size:	43 MW _{AC}	Value:	\$34,000 USD
Location:	Maryland, USA	LTI under Hatch Supervision:	0
Role:	Independent Engineer		

5.16 **Owner's Engineer for Rainy River First Nations Solar Projects, Ontario Canada, 2014 - 2015**

Rainy River First Nations LP



Hatch was Owner's Engineer for three solar farms utilizing fixed tilt arrays with a total capacity of 25 MW_{ac}. Hatch worked on behalf of the owner from the planning phase of the project and contract negotiations through to commissioning and close-out, including technical contract specifications, EPC design reviews and on-site construction monitoring. Hatch's geotechnical experts assisted in overcoming geotechnical challenges due to severe frost conditions at the site utilizing custom designed helical piles. Hatch staff were on site full time for the nine month construction and commissioning period, and no staff under Hatch supervision suffered LTIs. The total consulting value was approximately \$1,500,000 CAD.

Project Name:	Rainy River Solar Farm	Equipment:	Fixed Tilt racking, monofacial modules.
Size:	25 MW _{AC}	Value:	\$1,500,000 CAD
Location:	Rainy River, Ontario, Canada	LTI under Hatch Supervision:	0
Role:	Owner's Engineer		

5.17 Peterborough Utilities Lender’s Engineering Services, Ontario, Canada, 2018-2019

Peterborough Utilities Inc.



Hatch was engaged in a Lender’s Engineering role to provide detailed review of the Peterborough Utilities renewable asset portfolio consisting of an existing solar facility, hydro assets, and fifteen ground mount solar projects under development.

The initial scope included the review of documentation, environmental compliance, power and energy production estimates, CAPEX, and OPEX for their existing and developing assets. Following the initial independent review Hatch was retained to act as lenders engineer for the duration of construction for the assets under development, acting in support of draw requests and providing review at substantial and final completion. There were no LTIs suffered by any staff under Hatch supervision over this period. The team conducted site visits upon draw requests and prepared detailed LE Reports for lenders. Total scope of services was valued at an estimated \$100,000 CAD.

Project Name:	Peterborough Utilities Lender’s Engineering Services	Equipment:	Fixed tilt racking, monofacial modules
Size:	7.5 MW _{AC}	Value:	\$100,000 CAD
Location:	Peterborough, Ontario, Canada	LTI under Hatch Supervision:	0
Role:	Lender’s Engineer		

5.18 **C.W. Bill Young Regional Reservoir Solar Options Study, Florida, USA, 2018**

Tampa Bay Water



Hatch was contracted to study multiple design and economic configurations for a solar PV system at the Tampa Bay Water’s C.W. Bill Young Regional Reservoir east of Tampa Bay, including different technologies, interconnections strategies, and ownership configurations. The scope of work involved the preparation of a conceptual design for each configuration including estimated CAPEX and OPEX, , energy production estimates for each configuration, and a financial assessment of each option based on the client’s inputs and typical financial practices.

Project Name:	C.W. Bill Young Regional Reservoir Options Study	Equipment:	Floating & ground based fixed tilt racking, monofacial modules.
Size:	1 - 4 MW _{AC}	Value:	\$55,000 USD
Location:	Tampa Bay, Florida, USA	LTI under Hatch Supervision:	0
Role:	Technical Consultant		

6. Sustainability, Quality, Health & Safety, **Indigenous Peoples' Policies**

6.1 Quality

Providing quality outcomes on projects is achieved through the careful application of a basic principle - **understanding client's** requirements and expectations and putting in place processes to ensure those requirements are met. Our employees address quality in all aspects of their work. They are committed to the **key principles of Hatch's quality policy and the importance of their personal role and contribution.**



The Hatch Quality Management System (HQMS) is a single integrated quality management system that will be used throughout the entire project cycle. The HQMS is compliant with the requirements of ISO 9001:2008 and is delivered on projects through the Hatch's Project Lifecycle Process (PLP). Hatch's PLP contains standardized procedures, functional guidelines and associated tools that the Hatch team needs to execute projects consistently from any location across the globe. It contains documentation for all functional groups and engineering disciplines. All Hatch offices around the world use the established HQMS to deliver scopes of work and to support clients with continuous improvement efforts and ensure that all our activities are carefully managed in accordance with quality-accredited processes. The deployment of HQMS has enabled Hatch to exceed client expectations and has contributed to our track record of achieving client satisfaction.

The project quality objectives are:

- Zero harm to people and the environment over the entire project lifecycle;
- Achieve specified project requirements, including performance and quality targets;
- Provide accurate deliverables to the required standards;
- Meet the project schedule and budget;
- Meet legal, statutory and regulatory requirements as applicable;
- **Comply with the project's quality management system;**
- Comply with contract requirements;
- Manage changes to scope, budget, schedule, and requirements; and
- Identify and resolve all quality incidents including nonconformities identified throughout the project lifecycle.

6.2 Health & Safety

The safety of our employees, visitors, and contractors is always top of mind. We recognize the importance of protecting the health and safety of our employees, clients, visitors and contractors. As a “One Hatch” team, we are committed to delivering the highest level of health and safety performance to achieve our goal of “No Harm” to people, as well as the communities and environments in which we work. Working together safely is a continuous journey and a cornerstone of The Hatch Way.

6.3 Sustainability

Sustainability requires the optimization of environmental, social, and economic outcomes. This ensures ecosystems are maintained, communities thrive, and society prospers, now and in the future. Sustainability is at the core of how we deliver value to our clients as a socially responsible company.

[Hatch's Mississauga offices are ISO 14001:2015 certified.](#)

6.4 Indigenous Peoples Policy

Our relationships with First Nations, Métis, Inuit, and Native Americans are based on the values of honesty, respect, and transparency. We understand that our ability to deliver successful projects on behalf of our clients is enhanced by our knowledge and understanding of the histories, cultures, protocols, values, aspirations, and governments of First Peoples across North America and Aboriginal communities around the world.



Rainy River First Nation Solar Farm – A Hatch Owner’s Engineering assignment

Appendix A

Representative Experience – Solar

Solar Power

Representative Experience

Project Name	Location	Years	Type of Energy	Client	Summary of Services
Solar Farm – Owner’s Engineer	Canada	2020	Solar PV	Hydro-Quebec	Hatch was engaged by Hydro-Quebec to act as the Owner’s engineer for its 10-MW solar farm under construction. The scope includes design and equipment review as well as site visits in support of progress and quality monitoring.
Confidential – Fire Investigation	Canada	2020	Solar PV	Confidential	Hatch was engaged to investigate and determine root cause for multiple similar fires at a utility-scale solar farm in Ontario. This scope includes, site investigation, laboratory assessment of failed components, and analysis of design elements that may have contributed to the events.
Jaiba I Solar – Owner’s Engineer	Brazil	2020	Solar PV	Canadian Solar	Hatch was engaged by Canadian Solar to act as the Owner’s engineer for its 128-MW solar farm under development in Brazil. The scope includes design and equipment review as well as site visits in support of progress and quality monitoring.
Burdett & Yellow Lake Owner’s Engineer	Alberta, Canada	2020	Solar PV	BluEarth	Hatch was selected by BluEarth to act as the Owner’s engineer for two solar farms, totalling 39-MW, under development in Alberta. The scope includes design and equipment review as well as periodic site visits in support of key construction milestones.
Great Bay Solar – Independent Engineering	Maryland, USA	2020	Solar PV	Algonquin / Liberty Power	Hatch was engaged as the independent engineer to provide independent certification of project substantial and final completion, as well as support in the development of decommissioning costs and salvage values.

Renewable Power



Due Diligence Technical Advisor for International Portfolio	North America, Asia, Australia	2019	PV	Confidential	Technical advisory supporting a portfolio due diligence assignment for a major investment firm. Scope included permitting, Interconnection, & schedule review for over a dozen projects in 4 major jurisdictions.
Lender's Engineer for Ground Mount Portfolio	Ontario, Canada	2018-2019	PV	Peterborough Utilities Inc.	Lender's Engineer for a 15-project solar portfolio, including a initial design review, and report followed by construction monitoring and drawdown certification.
Owner's Representative Nanticoke Solar	Ontario, Canada	2018 - 2019	PV	Nanticoke Solar LP	Hatch provided owner's engineer services for a 44-MW ground mount solar project on the land of a decommissioned coal plant. Services include supporting the owner through the detailed engineering and procurement phase of the project and providing on-site construction monitoring and reporting through project closeout.
IE Review of Small Rooftop PV Portfolio	Ontario, Canada	2018	PV	Eolectric Development Inc.	Independent review of operational generation data and forecasting of future performance in support of a potential portfolio acquisition.
Independent Review of Solar & Hydro Portfolio	Ontario, Canada	2018	PV & Hydro	Peterborough Utilities Inc.	Independent review of operational PV and hydrological assets including; permit status, generation history, equipment condition, and maintenance plans.
Peru Off-Grid Solar Bridge Monitoring	Peru	2017 - 2019	PV	Ergon Peru SAC	Independent Engineer, Environmental and Social consultant on the Peru Off-Grid project for rural microgrid installations. Part of the work involved the assessment of battery chemistry, vendors and choice of battery management systems including charging, discharging, equalization and replacement strategies to extend usable capacity over the duration of the project.
Independent Review of Combined PV & Thermal Assets	Chile	2017	PV & Thermal	Prime Energia	Independent review of operational thermal plant and newly constructed solar installation in the Atacama desert, including equipment, expected generation, and operational concerns.



Entropy Cayman Solar Independent Engineer	Cayman Islands	2016 - 2017	PV	CIBC FirstCaribbean International Bank	Independent Engineer for a 5-MW solar project, including a initial IE review and report followed by construction monitoring and drawdown certification.
Solar Project Fatal Flaw Review	Massachusetts, USA	2016	PV	NRG Renewables	Phase 1 fatal flaw review of a portfolio of ground mount solar projects being developed in Massachusetts.
IE Review of Rooftop PV Projects	Ontario, Canada	2016	PV	Orillia Power Corporation	Independent engineer for a portfolio of rooftop solar projects including pre-construction IE report (risk assessment of construction schedule, major equipment selections, structural/electrical engineering, and energy production estimate) and review of performance tests.
Consulting Services – 10-MW PV Project	Ontario, Canada	2016	PV	Fengate Real Estate Investments	Fatal flaw review for an operating 10-MW solar asset considering asset condition, environmental compliance, and energy yield assessment.
Technical specifications for EPC Contract	Chile	2016	PV	Regional Power Inc.	Development of technical EPC and O&M contract specifications for a portfolio of PV projects under development in the Atacama region of Chile.
Technical Due Diligence – PMGD Photovoltaic Project	Chile	2015	PV	Atacama Solar S.A.	Independent engineering services in support of financing of the 143-MW, including site review, engineering review, project participants, major agreements review, energy production estimate, permitting review and construction monitoring.
Energy Audit Technical Assistance Program	Jamaica	2016	PV	InterAmerican Development Bank	Independent review of the potential for solar power at various ground mount and rooftop sites in Jamaica including site review, energy yield analysis, and cost estimation.
Due Diligence	Centrales Fotovoltaica, Peru	2015	PV	Acciona Energia Chile Spa	Review a portfolio of projects of interest (60-MW in total) located in Arequipa, Perú, focused on reviewing the environmental conditions, the state of processing permits, the steps that projects must continue to operate from the point of normatively and the feasibility of connecting the point to the National Interconnected System (SEIN)

Ameresco, Phase B Independent Engineer Review	Ontario, Canada	2015	PV	Travelers Capital Corporation	Independent Engineer of an operating portfolio of rooftop solar assets, including past performance review, energy assessment and uncertainty analysis, site inspections, review of equipment suitability and warranties status.
Independent Engineer for 5-MW Solar Project	Ontario, Canada	2013–Ongoing	PV	Stonebridge Financial Corporation	Independent engineering services in support of financing of the 5 MW Alderville First Nation solar project, including construction monitoring for monthly draw requests, substantial and final completion certificates, and ongoing annual operations reviews.
Independent Engineering Services for SKIC10	California, USA	2015	PV	Algonquin Power Co.	Completed a pre-construction review of a 10 MW extension to a 20 MW solar project, including review of the site, equipment, engineering, interconnection, major agreements, EPC contractor selection, energy forecast and uncertainty analysis, schedule, operations plan, pro forma, performance testing, and permitting.
Yeager Airport Solar	W. Virginia, USA	2014–2015	PV	Yeager Airport	Completed detailed design and installer RFP for a 5.2 MW solar facility on three sites, including a parking garage and two airfield sites. The project is in collaboration with Hatch Mott MacDonald.
Owner's Engineer Solar Definition Phase	Ontario, Canada	2014–2015	PV	Ontario Power Generation Inc.	Providing owner's engineer services for a portfolio of ground mount solar projects, including environmental screening, layouts, energy production estimates, uncertainty modeling, equipment specifications, electrical interconnection design, and capital cost estimation.
Owner's Engineer for 20 MW Solar Farm	Jordan	2014	PV	AMP Solar Group Inc.	Provided Owner's Engineer for 20 MW solar project in Jordan, including preliminary engineering, bid specifications, and permitting.
Solar Power Options	Ontario, Canada	2014	PV	Thunder Bay Hydro	Reviewed options for acquisition and development of solar power projects, including cost estimates and financial models.

Renewable Power



Engineering review for 10 MW Solar Project	Ontario, Canada	2014	PV	Innergex Renewable Energy	Due diligence review for project under development, including site review, design and permit review, energy production estimate, and review of racking design.
Rooftop and Ground Mount Portfolio	Ontario, Canada	2014	PV	Orillia Power Corporation	Independent Engineer review of a rooftop and small ground mount solar portfolio including energy production estimates, equipment review, contract review and interconnection.
Review of Geotechnical Data for Solar Project	Ontario, Canada	2013–2014	PV	Fiera Axium Infrastructure	Reviewed geotechnical site data and piling design and engineering for four solar projects in Northwestern Ontario. Evaluated pile installation method and frost depth. Provided an independent report to the owner.
Technical and Environmental Assessment for Pampa Solar	Chile	2013–2014	PV	Terna Plus S.r.L.	Provided a fatal flaw analysis for two solar plants of approximately 200 MW (Pampa Solar Norte and Pampa Solar Sur) including an assessment of the technical and environmental aspects and risks that may affect the development during the construction and operation phases of the projects.
10 MW Solar Project	Ontario, Canada	2013	PV	Algonquin Power	Independent engineer review of a 10 MW solar PV project being developed in Ontario.
Owner's Engineer, 25MW Solar Project	Ontario, Canada	2013–2015	PV	Rainy River First Nations	Providing owner's engineer services for the construction of three solar farms located in northwestern Ontario, including development of technical contract specifications, review of EPC designs, and full-time, on-site construction monitoring.
Study of Solar PV Opportunities	Jamaica	2013–2014	PV	InterAmerican Development Bank	Visited and reviewed 26 candidate rooftop and ground mount sites for viability of installing solar PV systems at the University of West Indies, Mona Campus. Prepared a financial analysis for the selected portfolio.
Owner's Engineer, 10MW Solar Farm	Ontario, Canada	2013–2014	PV	Sunderland Solar Farm LP	Provided Owner's Engineer services , including EPC procurement support, design review, construction and commission monitoring, and energy production modeling.



Renewable Power



Touwsrivier CPV Power Plant No. 1	South Africa	2013	CPV	Soitec Solar	Provided Owner's Engineer services for the 36 MW CPV plant, including EPC design review, full time site construction progress and quality monitoring, plant nameplate capacity evaluation, commissioning assistance, and utility grid code compliance review services.
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Engineering Services to First Solar	South Africa	2013	PV	FSLR Development (SA)	Conducted fatal flaw and due diligence studies on a portfolio of seven PV projects being developed under the Department of Energy's REIPPP Programme. Recommended the projects considered to be most viable and best positioned to ensure successful connection to the national grid infrastructure.
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Technical Evaluation	Ontario, Canada	2013	PV	Canadian Solar Solutions Inc.	Reviewed inverter OEM submittals and system design with respect to inverter requirements for operating solar projects. Performed power quality analysis of the operating projects based on a measurements campaign.
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PV Project Review	Ontario, Canada	2013	PV	DIF Management Canada Ltd.	Conducted a review of supplied drawings, specifications, and documentation related to the PV facility.
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CSP Solar Farm	Chile	2013	CSP	SolarReserve LLC	Reviewed and updated construction costs for the implementation of a CSP solar farm in northern Chile.
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Review of Seven Solar Sites	Ontario, Canada	2013	PV	Rios Renovables Group	Provided an analysis of seven proposed PV projects and identified potential obstacles to their construction.
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Independent engineering services	Ontario, Canada	2013	PV	Potentia Solar Inc.	Independent engineering services provided in support of the potential acquisition of seven solar photovoltaic projects in Ontario with a total capacity of 57 MW AC.
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10 MW and 500 kW Solar Projects	Ontario, Canada	2012	PV	Spark Solar	Developed energy production estimates under multiple design scenarios for the client's proposed ground mount PV systems.
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2.5 MW Portfolio of Rooftop Projects	Ontario, Canada	2012	PV	Horizon Energy Solutions	Developed an energy production estimate for each of the sites in the client's portfolio, including shading and layout analysis.
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Appendix B

Representative Experience – Energy Storage

+ Energy Storage

Representative Experience

<p>2020 – Ongoing</p> <p>Utility Battery Feasibility Study</p> <p>Yukon, Canada</p> <p>H-362094</p>	<p>Yukon Energy Corporation</p> <p>Hatch is working with Yukon Energy to assess the potential benefits a utility scale battery can provide to their grid. As part of this study, the primary, secondary and tertiary use cases for the battery were identified. Based on the use cases, the preferred sizing and battery chemistry were proposed.</p> <p>Additionally, three potential sites were assessed to determine the benefits and challenges associated with each option.</p>
<p>2020-Ongoing</p> <p>Methodologies to Optimize the Value and Amount of Energy Storage: Economic and Technical Evaluation</p> <p>Canada</p> <p>H-362112</p>	<p>CEATI International Inc., Strategic Options for Integrating Emerging Technologies and Distributed Energy Interest Group</p> <p>Hatch is working with CEATI to support the development of a high level user friendly tool to evaluate the value of energy storage in various regulated and deregulated markets. As part of this study, Hatch’s team reviewed the existing and emerging opportunities for energy storage in both ISO and non-ISO markets. This information will be gathered to develop a high level methodology to estimate the potential value for energy storage in the market. Different scenarios and value stacking opportunities will be assessed.</p> <p>Additionally, sensitivity analysis on the impact of energy storage system sizing will be completed.</p>
<p>2020-Ongoing</p> <p>Energy Storage as a Transmission Asset</p> <p>Canada</p> <p>H-362017</p>	<p>CEATI International Inc., Power System Planning and Operations Interest Group</p> <p>Hatch is working with CEATI to complete a study assessing the opportunities and technical requirements for energy storage systems for transmission grid applications. As part of this assessment, Hatch’s team is reviewing the technical capabilities of commercially available storage technology as well as emerging technologies. Additionally, Hatch’s team reviewed the various transmission scale use cases. The technical capabilities of the commercial storage technologies were compared to the use case requirements.</p> <p>Opportunities for the storage technologies to improve were identified, to better meet the needs of the transmission grid.</p>

<p>2019-2020</p> <p>Battery Energy Storage System Procurement for 5 Remote Villages in Nunavik</p> <p>Quebec, Canada</p> <p>H-360935</p>	<p>Hydro Quebec</p> <p>Hatch is working with Hydro Quebec to support the procurement of 5 battery energy storage systems for remote first nations communities in the Nunavik Region. Hatch is working with Hydro Quebec to develop the performance and technical specifications for the battery, and the request for quotations.</p> <p>This project is part of a larger overall goal, in which Hydro Quebec will install energy storage + wind turbines to power these communities. Hydro Quebec is targeting diesel-off operation for these communities for prolonged periods.</p>
<p>2019-Ongoing</p> <p>Inuvik High Point Wind – Owner’s Engineer</p> <p>Northwest Territories, Canada</p> <p>H-360609</p>	<p>NT Energy</p> <p>Hatch was the Owner’s Engineer for the Inuvik High Point Wind Farm. This project integrates a 4 MW Wind turbine and a battery energy storage system with existing diesel generation that currently generates electricity for Inuvik. As part of this project, NTPC plans to operate diesel off overnight, with 100% of the power supplied by the wind turbine and the battery.</p> <p>Hatch supporting NTPC with the technical review of documents prepared by the EPC, support in the wind integration assessment and energy storage dispatch and usage. As the project proceeds, Hatch will support NTPC with procurement review, construction monitoring and commissioning review.</p>
<p>2019</p> <p>100% Renewable Energy for Chidliak Mine (Wind - Solar – Storage-Diesel Hybrid Microgrid)</p> <p>Northwest Territories, Canada</p> <p>H-359596</p>	<p>De Beers – Chidliak Mine</p> <p>De Beers is in the final design stages of the new Chidliak Mine in the Northwest Territories. As part of sustainability initiatives, De Beers has targeted 60-100% of the energy consumed by the mine should be generated from renewable resources. Hatch was retained to conduct a wide-ranging study investigating various opportunities to achieve these high renewable penetration.</p> <p>As part of the study, Hatch assessed the energy storage options required for the proposed microgrid. Due to the high renewable penetration targets, long duration energy storage is required.</p> <p>Hatch conducted a technology review and preliminary vendor assessment of both Lithium Ion Batteries and Flow Batteries. This included assessing the technology’s fit for the desired application, its readiness for deployment in the Arctic, and developing a preliminary cost estimate for deployment of the technology, including balance of plant indirect costs.</p>

<p>Phase 2: 2017 – 2019</p> <p>Detailed Engineering and Implementation of a 3 MW Wind Turbine and 3 MW Lithium Ion Battery for the Raglan Mine Microgrid</p> <p>Quebec, Canada</p> <p>H-355542</p>	<p>Tugliq Energy Co. & Glencore Raglan Mine</p> <p>Glencore’s Raglan nickel mine in northern Québec has added wind power and energy storage to reduce the high cost of diesel-based power generation. The project has 6 MW of wind power with 3 MW of battery to offset diesel costs with fast response battery and control systems to maximize the integration of wind power. Tugliq Energy Co. is the IPP (independent power producer) for the wind-storage system.</p> <p>Over a portfolio of projects for both Glencore and Tugliq, Hatch provided the following:</p> <ul style="list-style-type: none"> • Feasibility engineering for the new 3 MW wind turbine and 3 MW energy storage • Detailed Specification of the energy storage, Procurement (RFP and Vendor Selection) and commissioning of the storage systems • Design the operation and control strategy, programing and delivery of microgrid controller to provide fast response to reduce wind power variation and provide signals to the operator to change the diesel generator unit commitment.
<p>2018-2019</p> <p>Development of an Integrated Resource Plan and Supporting Cost of Service and Tariff Study for Montserrat’s Power and Water Sectors</p> <p>Montserrat</p> <p>H-358368</p>	<p>Caribbean Development Bank and Montserrat Utilities Limited</p> <p>The objectives of the study are wide ranging to prepare a detailed assessment of the country’s electric power and water sectors, both of which are served by MUL. As well, the study includes a review of operating costs by customer blocks (domestic, commercial, industrial), and the analysis of proposed tariff structures to distribute the costs equitably between customer classes.</p> <p>For the electricity sector, analysis focuses on the use of on-island resources, such as wind and solar, along with energy storage, in order to support the integration of the intermittent renewables with the grid.</p>
<p>2017-2019</p> <p>Hybrid Power System Design (Wind – Storage-Diesel)</p> <p>Yukon, Canada</p> <p>H-356247</p>	<p>Kluane Community Development Corporation</p> <p>Hatch is working with the Kluane Community Development Corporation to develop a business plan for the integration of wind and energy storage into the remote, diesel-powered grid.</p> <p>The business plan addressed wind turbine selection, system performance simulations with and without energy storage, project costs and financing, industry/market analysis, operations, financial modelling, risks and mitigation, and an implementation plan.</p> <p>Hatch is working directly with the Kluane First Nation development corporation to support this project development.</p>

<p>2018-2019</p> <p>Flow Battery Energy Storage Interconnection Feasibility</p> <p>Ontario, Canada</p> <p>H-357720</p>	<p>Lindsay Storage LP</p> <p>Technical Support and Balance of Plant Preliminary Engineering for a Flow Battery Energy Storage project. This project involves design of the electrical interconnection for the facility and balance of plant layout and site design. As part of this project, Hatch is providing technical reviews of the potential flow battery suppliers.</p>
<p>2018-2019</p> <p>Utility Battery Study, St. Vincent Electricity Services Ltd.</p> <p>Saint Vincent</p> <p>H-357499</p>	<p>Rocky Mountain Institute – Carbon War Room – Clinton Climate Initiative</p> <p>The goal of this study was to determine the optimal connection points for utility scale batteries on the Saint Vincent grid. This included power flow and dispatch modelling, as well as economic analysis to determine the optimal size and location for the BESSs. BESS locations were investigated for the current grid operation, as well as various planning cases for proposed renewable integration or additional thermal generation on the grid in the next 3 years.</p> <p>After the study has been completed, the first BESS for installation will be selected.</p>
<p>2018-2019</p> <p>Utility Battery Study, St. Lucia Electricity Services Ltd.</p> <p>Saint Lucia</p> <p>H-356974</p>	<p>Rocky Mountain Institute – Carbon War Room – Clinton Climate Initiative</p> <p>The goal of this study was to determine the optimal connection points for utility scale batteries on the Saint Lucia grid. This included power flow and dispatch modelling, as well as economic analysis to determine the optimal size and location for the BESSs. BESS locations were investigated for the current grid operation, as well as various planning cases for proposed renewable integration on the grid in the next 5 years.</p>
<p>2017-2018</p> <p>Solar and Battery Energy Storage Assessment for Northern Ontario Mine</p> <p>Canada</p> <p>H-356249</p>	<p>GoldCorp</p> <p>Technical and cost assessment of solar power farm combined with energy storage for a mine with a limited grid connection. The solar (1-3 MW) + battery energy storage system (1-3 MW) is planned to alleviate a near term energy gap and to displace a portion of the diesel power generation. Evaluation of reliability performance with respect to unplanned outages, environmental, health and safety performance as well as operating costs (by reducing diesel consumption and peak electricity cost related to the Ontario Global Adjustment Cost). Detailed project review to ensure that the business case is sound, and that the project plan can be implemented without major obstacles.</p>

<p>2017 - Ongoing</p> <p>Nassau Container Port Solar + Storage Minigrid & Energy Assessment</p> <p>Nassau, Bahamas</p> <p>H-352289</p>	<p>Arawak Port Development</p> <p>The initial assessment identified the potential of improved power supply and reliability through the installation of a solar + storage minigrid. The minigrid system will combine solar + energy storage to have increased resiliency to utility power outages. The project will reduce the carbon footprint of the port in an ecologically sensitive area of the Caribbean. Hatch continues to support the Arawak Port Development with engineering and feasibility studies for the proposed minigrid.</p>
<p>2017-2018</p> <p>Cannington Renewable Power + Energy Storage Feasibility Study & Project Cost Estimate</p> <p>Australia</p> <p>H-353406, H-355680</p>	<p>South 32</p> <p>Detailed wind power, solar power, and energy storage project cost estimate at scoping level for low to high wind power penetration (8, 12, 20 MW) to Cannington Mine. Characterization of different levels of solar PV and energy storage integration on the grid in order to maximize renewable penetration and minimize power costs. Detailed system simulations of diesel and natural gas dispatch along with solar PV and energy storage. Sizing of energy storage system to optimize spinning reserve and load shifting capabilities.</p>
<p>2017-2018</p> <p>Driland Microgrid Renewables + Energy Storage Engineering Study</p> <p>Canada</p> <p>H-355529</p>	<p>Enercon Canada Inc. & Wind Power Canada Inc.</p> <p>Evaluate the technical and economic feasibility of developing a grid connected microgrid system with energy storage and wind and solar generation. This study investigates the effects of the grid tied microgrid on the transmission network, operating by the Alberta Electric System Operator (AESO). As well, the battery chemistry and sizing will be determined in order to ensure that the 100% renewable microgrid supplies reliable and resilient power. The system is designed to operate in either grid tied or “islanded” mode. If the project is both economically and technically feasible, Hatch plans to work with the AESO to develop a demonstration project.</p>
<p>2018</p> <p>Electrical Hauling Truck Assessment for Underground Mines</p> <p>Canada</p> <p>H-356624</p>	<p>Goldcorp</p> <p>Hatch was retained to evaluate the technical feasibility and business case for underground electrical hauling trucks for 5 of Goldcorp’s mines in Northern Ontario and Quebec. The study involved validating OEM models, review of the required energy for ore hauling based on mine grading, review of battery performance, degradation and lifetime, and analysis of the CAPEX and OPEX of the electrical hauling truck (EHT).</p> <p>The EHT performance, CAPEX and OPEX were compared to a diesel hauling truck of similar payload to determine the potential savings associated with EHTs. In addition to reduction in diesel usage, the shift the EHTs will result in reduced ventilation requirements and costs for underground mines.</p>

<p>2018</p> <p>Compressed Air Energy Storage Market Assessment</p> <p>Canada</p> <p>H-352228</p>	<p>Tugliq Energie Co.</p> <p>Market analysis of available compressed air energy storage (CAES) technology to be deployed in a novel application as part of a remote microgrid in Arctic Canada. This study included identifying potential vendors of CAES systems and assessing the applicability of their CAES systems for the desired microgrid application.</p>
<p>2017-2018</p> <p>Alternate Power Generation Pre-Feasibility Study</p> <p>Northwest Territories, Canada</p> <p>H-355272</p>	<p>De Beers Canada Inc</p> <p>Alternative power prefeasibility study to evaluate the integrating of wind and solar generation to a mining diesel power plant, along with opportunities to use energy storage, waste heat recovery and carbon capture. Includes resource assessment, sizing options, cost estimates and project economics.</p>
<p>2017-2018</p> <p>Norman Wells Wind + Storage Integration Study</p> <p>Northwest Territories, Canada</p> <p>H-355879</p>	<p>Government of the Northwest Territories</p> <p>A feasibility study assessing the optimal sizing and configuration of wind power generation and energy storage technology for the Norman Wells community. This project will investigate both low and high wind power penetration into the existing power system, based on diesel generators.</p> <p>The study includes a review of the available storage technologies and the benefits they can bring to the microgrid to ensure stability and reliability. The study also reviews storage integration into the existing power system, cost estimates, sensitivity analyses and financial evaluations for the community.</p>
<p>2017</p> <p>Commercial BESS Integration</p> <p>Canada</p> <p>H-355287</p>	<p>Confidential Client</p> <p>Provision of integration engineering services to connect a battery energy storage system (BESS) (1-3 MW) to the electrical network of a commercial facility for peak shaving and load shifting applications. Includes the verification of the existing electrical network at the facility, design of the electrical interconnection point, and identification of any upgrades required to safely and effectively integrate the BESS.</p>

<p>2017</p> <p>GEMCO Solar PV Network + Energy Storage Study</p> <p>Australia</p> <p>H-352903</p>	<p>South 32</p> <p>Detailed High Solar PV integration Study at GEMCO Mine, up to 14 MW with the addition of a 4 MW/1.8 MWh battery energy storage system. The study included hybrid power operation and control strategy to manage the battery and solar system with the existing grid, solar assessment and detailed electrical analysis of the network. The battery system was studied to understand its contribution to spinning reserve and the potential for load shifting to reduce solar curtailment.</p>
<p>2017</p> <p>Peru Off-Grid Solar + Storage Project</p> <p>Peru</p> <p>H-354710</p>	<p>Ergon Peru S.A.C.</p> <p>Independent Engineer, Environmental and Social consultant on the Peru Off-Grid project for rural microgrid installations. Part of the work involved the assessment of battery chemistry, vendors and choice of battery management systems including charging, discharging, equalization and replacement strategies to extend usable capacity over the duration of the project.</p>
<p>2017</p> <p>Isolated Communities, Renewable Power Generation Feasibility Study</p> <p>Alberta, Canada</p> <p>H-353767</p>	<p>ATCO Electric Ltd.</p> <p>Feasibility study assessing the optimal sizing and configuration of renewable generation and energy storage technology at three (3) diesel powered remote communities in northern Alberta.</p> <p>The study included solar and wind resource assessments, diesel to propane conversion, optimization of high penetration hybrid configuration, energy storage selection and controls evaluation, cost estimates, sensitivity analyses and financial evaluations for each community.</p>
<p>2017</p> <p>Alternative Power Feasibility Study</p> <p>Democratic Republic of Congo</p> <p>H-351379</p>	<p>Kinsevere Primary Copper</p> <p>Feasibility study for alternative power options, including solar, wind, and storage for a remote mine in the Democratic Republic of Congo. Part of a broader study on the expansion of the mine, this study looked at a range of options to expand the mine's power supply and mitigate the production loss and downtime associated with a weak and unreliable grid power connection.</p>
<p>2016 –2017</p> <p>Grid Connection Study for Battery Energy Storage System</p> <p>Canada</p> <p>H-351197</p>	<p>NextEra Energy Canada Development and Acquisition Inc & Alberta Electric System Operator (AESO)</p> <p>The study investigates a proposed grid-tied battery energy storage system on the Alberta Electric System Operator (AESO) transmission system. The scope of work involves the preparation of Project Data Update Package for Stage 1 and 2, Connection Study, Facility Study, Cost Estimate for Upgrade facilities, and Connection Study proposal. These studies are to be carried out according to the AESO scope and guidelines as well as the applicable system reliability standards and requirement.</p>

<p>2016</p> <p>Conceptual and Prefeasibility Study for Hybrid Power System</p> <p>USA</p> <p>H-305423</p>	<p>Confidential Client</p> <p>Provided bid support for a 20 MW PV + 110 MWh storage system, intended to provide load shifting services to a municipal electrical utility. Services included cost estimates, sizing requirements, solar production estimates, battery storage estimates, and preliminary electrical system architecture and design.</p>
<p>2016</p> <p>Conceptual Study</p> <p>Bahamas</p> <p>H-344299</p>	<p>Interamerican Development Bank</p> <p>Preliminary Sizing and conceptual study costing for Energy storage used for the time-shifting of solar photovoltaic energy from the weekend to weekday times to reduce client energy demand for an industrial site in the Caribbean.</p> <p>This study involved a review of the available battery chemistries and suppliers to identify the optimal system to meet the use case requirements. As well, with the goal of reducing solar curtailment, the battery system was sized based on technical and economic constraints.</p>
<p>2016</p> <p>Borden Mine Power Supply Alternative Study</p> <p>Canada</p> <p>H-351877</p>	<p>Goldcorp</p> <p>A holistic approach was taken to review and identify potential alternative applicable for the site. The following alternative were analyzed: diesel, natural gas, propane generators, thermal heat recuperation, solar PV, Solar Thermal, biomass cogeneration, hybrid power combining wind, solar, energy storage and generators. Each alternative was reviewed and described with sufficient details to provide a CAPEX and OPEX estimate. The levelized cost of energy was estimated for each option.</p>
<p>2015-2016</p> <p>Red Rock Pumped Storage Project</p> <p>USA</p>	<p>Red Rock Power Corp.</p> <p>Hatch prepared the qualitative assessment of the potential benefits of the pumped storage project such as levelization of electricity price, provision of operating reserve, ancillary services (black-start, regulation, reactive support and voltage control), and capacity reserve, reduction of export during off-peak periods and import during peak periods, mitigation of transmission congestion, reduction of water spilling and system GHG emissions and improvement of system stability. In addition, Hatch performed an assessment of key issues regarding the project, including an initial assessment of geotechnical matters, an environmental assessment and obtaining of permits, approvals or other authorizations.</p>

<p>2014-2015</p> <p>Raglan Flywheel Energy Storage System</p> <p>Canada</p> <p>H-346870</p>	<p>Tugliq Energy Co.</p> <p>Design and supply of a skid mounted flywheel energy storage system. Included selection and coordination of vendors, electrical and controls integration of DC flywheel and grid-tied inverter, design, dynamic analysis and fabrication of skid, factory integration testing and site commissioning.</p>
<p>2013 –2016</p> <p>Development of a Utility Grade Controller for Remote Microgrids with High Penetration Renewable Generation</p> <p>Canada</p>	<p>Natural Resources Canada</p> <p>Grant funded development of a microgrid control system for hybrid power to manage diesel and renewable generators, energy storage and loads for the most economical operation of the grid while maintaining power quality (frequency and voltage) within required limits. In collaboration with University of Toronto, University of Waterloo, Hydro One and Kasabonika Lake First Nation.</p>
<p>2013-2015</p> <p>Hybrid Generation Options for Microgrid Project, Feasibility Study</p> <p>Gabon</p> <p>H-336241</p>	<p>Ministry of Oil, Energy and Hydraulic Resources of Gabon</p> <p>Feasibility study of a solar/wind/diesel hybrid plant with 400 kWh of energy storage (flow battery, Li-ion battery) to power an isolated microgrid. Hybrid generation to reduce fuel consumption by 50% compared to diesel only.</p>
<p>2013 – 2015</p> <p>Application of Composite Flywheels and Development of Control Platform for Integration of Renewable Energy in Remote Communities</p> <p>USA</p> <p>H-345153</p>	<p>Alaska Energy Authority</p> <p>This grant-funded project involved the following activities:</p> <ul style="list-style-type: none"> • Collection and analysis of village power system data • Dynamic and economic model of system demonstrating benefits of energy storage • Development of a fast response microgrid control system • Design and build of a grid tied flywheel energy storage system • System testing at UAF’s Power Systems Integration Lab

<p>Phase 1: 2012 – 2015</p> <p>Feasibility study and implementation of a 3 MW wind turbine with 3 energy storage systems at Raglan Mine</p> <p>Canada</p> <p>H-346545</p>	<p>Tugliq Energy Co. & Glencore Raglan Mine</p> <p>Implementation of a 3 MW wind turbine and energy storage systems (battery, flywheel, and hydrogen system) with a microgrid controller. Completed the conception, engineering, commissioning, and operation monitoring of the project.</p> <p>As a part of the Raglan Mine project, Hatch was involved in screening and review of various energy storage technologies in order to meet the specific needs of the mine’s microgrid. As well, the energy storage systems were sized in order to ensure reliable power supply, including sufficient capacity to provide power during diesel generator ramp up.</p> <p>The Hatch team also designed a rapid microgrid controller in order to accommodate instantaneous fluctuations in power supply and demand.</p> <p>The project is currently in its second phase, with additional wind power and energy storage being integrated into the microgrid.</p>
<p>2013 – 2014</p> <p>Dynamic System Modeling SmartCAES Project</p> <p>USA</p> <p>H-346366</p>	<p>Ronald J. O’Mara</p> <p>Development of a model for a 135 MW Dresser Rand Compressed Air Energy Storage System for the Gaelectric DS3 (Delivering a Secure Sustainable Electricity System) purposes in Ireland. The model was used to simulated and optimize the system’s response to grid regulations and conditions.</p>
<p>2013</p> <p>Wind-Hydrogen-Storage Pilot Feasibility Study</p> <p>Nunavik, QC, Canada</p>	<p>Glencore Raglan Mine</p> <p>Scoping, prefeasibility and feasibility of a 3.0 MW wind turbine at Raglan mine in combination with 600 kW of energy storages (fly-wheel, battery and hydrogen system) and micro-grid controller. The studies involved micrositing, estimate the energy production of the entire wind-hydrogen-storage system considering the energy losses from each technology and the combined operation with the diesel generators. The fuel reduction has been estimated as well as the number of reduction operation hours for the gensets. Detailed cost, logistic and financial model has been developed for this project.</p>

<p>2013</p> <p>Wind-Diesel Project for Kangiqsualujjuaq (Hydro Quebec)</p> <p>Canada</p> <p>H-338349</p>	<p>Enercon Canada Inc.</p> <p>Detailed integration study of wind generation (800 kW) and flywheel storage with existing Diesel plant (1975 kW) to demonstrate performance and plan its implementation executing the following tasks:</p> <ul style="list-style-type: none"> • technical description of the plant layout and all required components and modifications to the existing plant • estimate of the wind power production • description of the plant operation • estimate of the expected fuel consumption • description of the electrical protection system • description of the electrical controls system • demonstrate the dynamic electrical stability using a MATLAB system model • planning of the project implementation in terms of budget and schedule.
<p>2012</p> <p>Power Options Screening Study</p> <p>Canada</p> <p>H-342650</p>	<p>Glencore Raglan Mine</p> <p>Power generation technology screening for expansion of mining operations. Included a review of energy storage technologies and their potential applications at site.</p>
<p>2012</p> <p>Due Diligence</p> <p>Canada</p> <p>H-343864</p>	<p>TAQA</p> <p>Due diligence of energy storage company – manufacturer of Li-ion energy storage systems.</p>
<p>2012</p> <p>Precious Metals Recovery Project - Power Supply Options Study</p> <p>USA</p> <p>H-340940</p>	<p>Barrick Gold</p> <p>Design of a solar photovoltaic based islanded power supply integrated with a Li-ion battery and diesel generation to provide 80% average contribution of renewables.</p>

<p>2011-2012</p> <p>System Integrator Role for Electroveya BESS</p> <p>Canada</p> <p>H-339853</p>	<p>Electrovaya</p> <p>Integration of Utility Scale Lithium Ion Battery (300 k W/1.2 MWh) at two sites, one on the Hydro One Transmission Grid and on the Toronto Hydro Electric System Distribution System. This project involved the design of the interconnection and projections, as well as studies to determine the effect of the energy storage system on the grid (Transmission and Distribution, respectively).</p>
<p>2009 - 2011</p> <p>Wind Power Aggregation – Fatal Flaw Study</p> <p>Canada</p>	<p>Confidential Client</p> <p>The intent of the project was to contract with several thousand MWs of wind power projects spread over several western States and Provinces and through geographic diversity be able to deliver a high capacity factor, green product to the Nevada and California markets. In order to assess the ability to increase the “firmness” of the product, analysis of energy storage was included.</p> <p>This involved providing an overview of firming technologies available, including battery, pumped storage, compressed air energy storage, conventional gas turbines, etc.; the development of a firming analysis model; the assessment of the amount of firming capacity required; estimation of the fixed and variable costs of each firming technology; and determination of the annual costs to provide the required firming.</p>
<p>2010</p> <p>Optimal Performance Tool for Remote Grids</p> <p>Canada</p> <p>H-334576</p>	<p>Natural Resources Canada</p> <p>Hatch was contracted by NRCan to develop the tool. The tool can be used to analyze the cost/benefits, including fuel and GHG emission reduction, for developing and operating remote grid with diesel, wind, solar, small hydro, battery bank and other generation/storage resources. The tool enables grid planners to study several aspects including efficient control and monitoring of the diesel power plant through dispatch strategy to reduce fuel consumption and GHG emissions, improving the remote grid components efficiency and integrating demand side and demand response strategies. The tool also assists in determining the maximum penetration and use of renewables based intermittent generation, evaluating energy storage plants and analyzing generation cost including capital, fuel, O&M, emissions offset allowance and others.</p>

<p>2009</p> <p>Assessment of Pumped Storage Plants in Ontario</p> <p>Canada</p>	<p>Confidential Client</p> <p>An assessment was prepared of the benefits and costs of energy storage facilities in Ontario with the focus being on pumped storage hydro. The analysis looked at the market structures to estimate the costs of buying pumping power during low power costs periods and the price at which power generated by the facility could be sold during high load periods. Market price information gleaned from the Independent Electricity System Operator's statistics was a key input to this analysis.</p>
<p>2009</p> <p>Energy Pathways Project – Canadian National Power Grid</p> <p>Canada</p> <p>H-332572</p>	<p>Canadian Academy of Engineering</p> <p>Energy Pathways study of the National Power Grid. Hatch provided the project manager for this assignment as well as coordination of task force meetings, presentations to stakeholder groups and government agencies and preparation of reports. In addition, Hatch provided:</p> <ul style="list-style-type: none"> • Analysis of the existing electrical systems in Canada, plans for adding to these systems to meet load growth and retirements and the plans for strengthening connections between provinces. • A description of the current technology for high voltage, long distance transmission lines. This covers both AC and DC technologies. • An assessment of the current technology for energy storage systems. This assessment covers hydro pumped storage, compressed air energy storage, batteries and other developing technologies.

Appendix C
Representative Experience – Hybrid Power and
Microgrids

Hybrid Power

Representative Experience



Project Title	Client	Location	Scope of Work	Completion Date
Voisey's Bay Renewable Energy Project	Vale	Newfoundland and Labrador, Canada	Wind Power assessment that looked into optimizing the size of the Wind farm based on wind resource and site characteristics. The scope included site and equipment selection, project cost estimates, and considerations for site heat requirements.	2019
Hybrid Solar PV Preliminary Feasibility Study	TiZir/Eramet	Senegal	Hatch was contracted to conduct a prefeasibility study for the installation of solar PV, with the option for a battery energy storage system (BESS), at their mining operation in Senegal. Aiming to reduce HFO consumption by ~20%, the project assessed the integration of a BESS in conjunction with and as a separate entity from the Solar PV farm.	2019
Feasibility Study Central Remote Rural Electric, Solar, Gensets and Transmission lines	Somelec	Mauritania	Detailed Feasibility of 5 centralized greenfield hybrid power plant combining HFO genset, solar and battery to interconnect to 25 rural villages in Mauritania; work involved siting and sizing the plants, advance the engineering sufficient to prepare bid for EPC supplier, substation and transmission design.	2019
Solar and Battery Assessment in a Greenfield Lithium Mine	Eramet	Argentina	Evaluation of solar and battery storage integration in order to reduce natural gas power generation. Characterization of the impact of solar power on heat demand and steam requirements	2019

			to extract Lithium via evaporation process.	
High Renewable Power Penetration Study	South32	Australia	Detailed High penetration Solar PV integration Study at two of South 32 mines, up to 20 MW. Hybrid Power Operation and control strategy, Solar Assessment and detailed electrical analysis of the network. (H-355680)	2018
Norman Wells Wind Integration Study	Government of Northwest Territories	Northwest Territories, Canada	Integration study of wind power at low and high penetration levels on the Norman Wells electrical system. Energy modeling of diesel/wind/storage and grid/wind/storage scenarios with regard to grid and diesel outages and future implementation of carbon pricing on diesel fuel. (H-355879)	2018
Wind-Hybrid Prefeasibility Study	TMAC Resources	Nunavut, Canada	Conducted a wind monitoring campaign to quantify the resource. Assisted in preparing the prefeasibility report for the integration of wind power and energy storage into the site. Assessed the technology readiness and suitability of compressed air energy storage (CAES).	2018
Musselwhite Solar and Battery Assessment	Goldcorp	Ontario, Canada	Technical and cost assessment of solar power combined with energy storage to alleviate a near term energy gap and to displace current use and expected increase of diesel power generation.	2018
Meliadine Wind Power Project	Agnico Eagle	Nunavut, Canada	Identification of a feasible wind power project (size and location), evaluation of its development costs (including wind farm, interconnection, access roads) and operating costs. Estimation of the annual energy production along with the capacity for the	2018

			site to integrate the wind power to the mine grid.	
Renewable and Hybrid Options Study for Remote Mining Facility	De Beers	Northwest Territories, Canada	Identification of reliable and cost effective non-diesel power generation in order to reduce GHG emissions, including double-axis solar PV, wind turbines, Organic Rankine Cycle, and carbon sequestration alternatives. A techno-economic optimization was conducted to determine the optimal alternatives with respect to process heat demand and spinning reserve requirements. (H-355272)	2017
Conceptual Design for Rural Island Microgrid	Spark Power Corp.	Ontario, Canada	Feasibility of an islanded grid on the Rural Island that will be able to operate independently from the utilities grid. The island currently faces unreliable power from the grid due to a poor connection. In order to help eliminate the supply issues, the proposed project will be a microgrid system composed of a solar array, battery bank, and energy management system which will generate, store and manage the island's power.	2017
Energy Options Study	Confidential Client	Mongolia	Hybrid power simulation to determine the optimal sizing of wind, solar, and battery storage for a new mine in Mongolia. Modeling of four energy scenarios including high renewable penetration, peak thermal power efficiency, and 100MW of renewable capacity.	2017
GEMCO Solar PV Network Study	South32	Australia	Detailed High Solar PV integration Study at GEMCO Mine, up to 14 MW. Hybrid Power Operation and control strategy, Solar Assessment and detailed electrical analysis of the network. (H-352903)	2017

Cannington Wind Power Project Cost Estimate	South32	Australia	Detailed Wind Power and Energy Storage project cost estimate at scoping level for low to high wind power penetration (8, 12, 20 MW) to Cannington Mine. (H-353406)	2017
Peru Off Grid Solar Project	Ergon Peru S.A.C.	Peru	Independent Engineer, Environmental and Social consultant on the Peru Off-Grid project for rural microgrid installations. Part of the work involved the assessment of battery chemistry, vendors and choice of battery management systems including charging, discharging, equalization and replacement strategies to extend usable capacity over the duration of the project. (H-354710)	2017
Wind Power Integration Optimization	Oulliq Energy Corporation	Nunavut, Canada	Renewable integration study for a Wind/Diesel and Wind/Storage/Diesel power system at Iqaluit. Characterization of the optimal energy solution with respect to fuel cost savings, curtailment, spinning reserve requirements, and overall economic viability.	2017
Alternative Power Feasibility Study	MMG - Kinsevere Primary Copper	Katanga Province, DRC	Feasibility study for alternative power options, including solar, wind, and storage for a remote mine in the Democratic Republic of Congo. Part of a broader study on the expansion of the mine, this study looked at a range of options to expand the mine's power supply and mitigate the production loss and downtime associated with a weak and unreliable grid power connection. (H-351379)	2017
Isolated Renewable Feasibility Study	ATCO Electric	Alberta, Canada	Feasibility study assessing the optimal sizing and configuration of renewable generation and energy storage technology at three (3) diesel powered remote communities in northern Alberta.	2017

The study included solar and wind resource assessments, diesel to propane conversion, optimization of high penetration hybrid configuration, cost estimates, sensitivity analyses and financial evaluations for each community. (H-353767)

Sachs Harbour Wind Scoping Study	Government of Northwest Territories	Northwest Territories, Canada	The study aimed at identifying four (4) potential sites close to the community and assess the wind resource, the technology selection in arctic conditions, the environmental constraints and the economics to integrate wind power to the existing diesel powered isolated grid. (H-354025)	2017
Hybrid Power System (Wind – Diesel)	KCDC	Burwash Landing, Yukon	Hatch has completed a wind-diesel business plan for the Kluane Community Development Corporation. The business plan addressed wind turbine selection, system performance simulations, project costs and financing, industry / market analysis, operations, permits and approvals, land rights, financial modelling, environmental and community benefits, risks and mitigation, and an implementation plan.	2016
Robinson Crusoe Island Solar and Wind Optimization Study	ENEL	Chile	Optimization study of high penetration hybrid renewable power systems for a Chilean Island. Modeled the economic and technical potential of wind and solar power coupled with Li-Ion and flow batteries to reduce diesel consumption and minimize costs. Characterized the optimal storage control strategy and generator schedule that reduces diesel and operation costs, maintain the battery lifetime and ensure a robust solution for the grid stability.	2016

Prefeasibility study for the integration of 12 MW of wind power to a mine grid	Teck Alaska	Alaska, USA	Detailed study for the integration of a wind farm to a remote mining location. Includes technology and wind assessments, power management and control study, electrical and civil engineering, logistics and constructability studies, cost estimates. (H-349918)	2016
Prefeasibility of Taolagnaro Mine for Integration of Renewable Power	OIT Madagascar Minerals	Madagascar	Detailed study for the integration of a wind farm and solar power to Taolagnaro Mine. Includes technology and wind/solar assessments, power management and control study, electrical and civil engineering, logistics and constructability studies, cost estimates. (H-340671)	2015
Feasibility study of wind power sites in five communities in Labrador	Nalcor	Labrador, Canada	Wind project evaluation in five off-grid communities in Labrador, including potential site identification, complete wind monitoring campaign to evaluate the wind resource, wind-diesel project feasibility, and environmental assessment.	2015
Feasibility study and implementation of a 3 MW wind turbine with energy storage at Raglan Mine	Tugliq/Glencore mine Raglan	Quebec, Canada	Implementation of a 3 MW wind turbine of energy storage (battery, flywheel and Hydrogen System) with micro-grid controller. Completed the conception, Engineering, commissioning and operation monitoring of the project. (H-346545, H-346862, H-346870)	2015
Project evaluation of wind and solar project in Gabon	Minister of Energy of the Gabon Republic	Gabon	Identification of potential sites to deploy wind and solar projects in remote area, complete wind and solar monitoring campaign and resource assessment, feasibility study of wind-solar-diesel projects. (H-336241)	2015
Study and Implementation of	Glencore Raglan Mine	Québec, Canada	Glencore was interested in constructing a wind power plant	2014 and 2018

Wind Power and Energy Storage at Raglan mine			at one of their mine sites in Québec, Canada, with the goal of reducing diesel consumption and operating costs due to this consumption; Hatch developed conceptual study than the feasibility study and led the project implementation of 3 MW wind power in 2014 with energy storage and another 3 MW in 2018 with 3 MW Lithium Ion battery.	
Kangiqsualujjuaq Wind-Diesel Hybrid System	Enercon	Québec, Canada	Detailed integration study for a diesel plant retrofit with wind turbines and flywheel energy storage system. (H-338349)	2013
Hybrid solar study for Teck Resources	Teck Resources	British Columbia, Canada	Produced prefeasibility study involving site assessment, technology review and recommendation, interface specifications, evaluation of vendors' proposals, and technical inputs to the business case.	2013
Raglan Mine Power Options Screening	Xstrata Nickel	Québec, Canada	Performed a power generation technology screening for the expansion of the Raglan Mine. Five power generation technologies were reviewed and the retrofitting of the existing diesel generation at site was also investigated. For each of the selected technologies, the levelized cost of electricity (LCOE) was calculated and the major risks associated with implementing each technology were summarized. (H-342650)	2013
Bugwazi Mine Solar Photovoltaic Power Plant	African Barrick	Tanzania	Barrick is interested in constructing a 10 MW solar photovoltaic (PV) power plant at one of their mine sites in Tanzania with the goal of reducing diesel consumption and operating cost due to this consumption; Hatch developed preliminary designs for the facility, addressed any potential	2013

			issues with respect to integration of the facility, and supported the RFP process to procure the solar PV plant.	
Solar Photovoltaic Power Plant at Barrick Nevada mine	Barrick Gold	Nevada, USA	Barrick is interested in constructing a solar photovoltaic (PV) power plant at a remote process and storage facility with the goal of reducing diesel consumption and operating cost due to this consumption. Barrick has requested; Hatch developed preliminary designs for the facility, addressed any potential issues with respect to integration of the facility, and supported the RFP process to procure the solar PV plant.	2012
300 MW Solar Project	Element Power Chile Solar	Chile	Analyzed optimal economic operation of the projects based on marginal costs of energy for a horizon between 5 and 10 years. (H-341489)	2012
30 MW PV Project	Cennergi	South Africa	Provided Owner's Engineering services, including consulting on interconnection and PPA, and providing various technical inputs for bid. (H-340071)	2012
30 MW PV Plant	Exxaro	South Africa	Managed EPC contractor solicitation process, including providing technical inputs for the RFP documentation, evaluating responses, and making recommendations to the client. (H-339693)	2011
Remote Mining PV Application	Kinross	North Africa	Developed energy yield and cost/benefit analysis comparing alternative energy resources for a ground-mount site with a projected size of 20–40 MW, including integration with projected thermal gensets. (H-337777)	2011
Prefeasibility Analysis of Solar	Confidential	North Africa	Performed a comparative analysis of the levelized cost of	2011

Power for Off-Grid Installation			electricity for solar and existing power generation options; evaluated both solar PV and solar thermal technologies. (H-337777)	
Hybrid Solar/Combined Cycle Plant	Exxaro	South Africa	Produced conceptual study, including fuel and energy resource availability, system integration design, plant layout, cost estimates, and NPV analysis. (H-336537)	2010
Potential Use of Renewable Power at Decommissioned Mine Site	Barrick Gold	Chile	Produced conceptual study to evaluate feasibility of solar PV, wind, and other renewable energy sources, including energy production estimates; assessment of local infrastructure and interconnection potential; and derivation and assessment of economic aspects of each form of generation. (H-336306)	2010
250 MW Concentrating Solar Thermal Plant	Exxaro	South Africa	Produced prefeasibility study involving site assessment, technology review and recommendation, interface specification, evaluation of vendors' proposals, and technical inputs to the business case. (H-334725)	2010
250 MW Concentrating Solar Thermal Power Plant	Exxaro	South Africa	Investigated the business case and completion of the proposed plant's conceptual study . (H-334014)	2009
4 MW Solar Photovoltaic Plant Adjacent to Processing Facility	Metallurg Vanadium	United States	Provided preliminary engineering, site selection, environmental screening, energy yield, cost estimation, and economic evaluation. (H-333625)	2009
Integrated Solar and Combined Cycle Gas Turbine Project	Acquasol Infrastructure	Australia	Studied feasibility of a hybrid 150 MW gas turbine combined cycle and 30 MW concentrated solar power plant for a desalination facility. (H-327558)	2008
Solar Power Tower	Debswana	Botswana	Viability study for solar power tower (updraft chimney), evaluating technical and	2008

commercial considerations as well as potential symbiotic projects. (H-329165)

Electrical Power Generation Study	Debswana	Botswana	Evaluated technical and commercial aspects of distributed and centralized generation options (including solar thermal and photovoltaic) for projects from 10 to 100 MW. (H-329165)	2008
20 to 50 MW Hybrid Renewable Energy Project	Confidential	Dominican Republic	Studied technical, commercial, and financial viability of a renewable hybrid plant using various renewable energy resources. (P-15645)	2004
Backup Power for Lake Matano Regulation Structure	Inco	Indonesia	Assessed installation of a solar panel backup system for the diesel generator to provide emergency power for controls and alarm signals. (P-12235)	1997-1998

Appendix D

Representative Experience – Wind Power

Wind Power

Representative Experience

Years	Project/Client/Location	Capacity	Summary of Services
2020	LTA Services at EBR Wind Farm, CIBC syndicate, Quebec, Canada	25 MW	Construction monitoring, cost and schedule review, milestone reporting in support of the payment schedule, drawdown certificates, punchlist monitoring and other services as needed. Hatch previously conducted the IE review.
2020	IE Services, Glen Dhu Wind Farm, Capstone Infrastructure, Stonebridge Financial, Canada	60 MW	Hatch was engaged to review, opine on adequacy, and model its major maintenance reserve account for its 30- 2.0 MW Enercon E-82 turbines.
2020	Repowering Simulation at KEMONT Wind Farm, Kruger Energy, Canada	103 MW	Hatch was engaged by the owner to perform an energy production simulation to assess the impact of reblading 44 E-82 turbines with longer (E-92) blades and to identify suitable turbines within the farm for a pilot test.
2020	IE Services, Confidential Client, Canada	30 MW	Hatch was engaged by a sell-side client to conduct a review of 2 wind farms in Canada. The review included turbine inspections, SCADA turbine health assessment, power curve conformance assessment, P50 EYA update, operating costs, contract review, asset life extension opinion, performance improvement and optimization, and environmental compliance review.
2019	IE Services, Confidential Client, Canada	25 MW	Hatch was engaged to conduct a buy-side IE review of a portfolio of 4 wind farms in Ontario. The review included an operational energy yield assessment, turbine health review, OPEX, O&M contract review, and environmental review.
2019	Root Cause Assessment, Confidential Client, Mexico	2 MW	Hatch was engaged by an insurance company to act on its behalf to conduct a forensic root cause investigation of a wind turbine that had suffered irreparable damage due to fire.
2019-2020	LTA Services, Dune du Nord Wind Farm, Îles-de-la-Madeleine, Canada	6 MW	Construction monitoring, cost and schedule review, milestone reporting in support of the payment schedule, drawdown certificates, punchlist monitoring and other services as needed. Hatch previously conducted the IE review.
2019	Wind Monitoring Campaign Horen, AB Développement Électric Inc. (H-358824)	N/A	Hatch was selected to instrument a telecommunication tower in Alberta with wind monitoring equipment, collect the data for a year and perform a wind resource assessment.
2018-2019	Fire Incident Independent Review, RSA Global Speciality Lines (H-358677)	2 MW	Hatch was retained to conduct a Root Cause Analysis of a nacelle fire that took place in Nova Scotia. Hatch reviewed the turbinated SCADA data in addition to an on site investigation of the fire evidence. The team identified the equipment and fault which caused the fire within the nacelle, and determined the remaining work to be conducted.
2018	2019 AOP for Gosfield Brookfield BRP Canada Corp. (BBCC) (H-358669)	51 MW	Hatch was engaged to review the 2019 Annual Operating Plan for Gosfield Wind farm. This includes, annual energy generation, O&M

Years	Project/Client/Location	Capacity	Summary of Services
			plan and expenses, major maintenance works, planned capital expenditures.
2018	2019 AOP for Prince Brookfield Renewable Power Inc. (H-358667)	189 MW	Hatch acted as Owner's Engineer and provided design reviews, field technical services and environmental services for the two-phase development with a combined capacity of 189 MW, consisting of 126 GE 1.5-MW units.
2018-2019	IE Review - Dune du Nord Wind Project PARC ÉOLIEN DE LA DUNE-DU-NORD S.E.C (H-358485)	6.4 MW	Hatch has been requested by Parc Eolien de la Dune-du-Nord to independently review its proposed wind power generation project, located in the Îles-de-la-Madeleine, Quebec, for project financing purposes. It includes a review of the proposed equipment, site suitability, wind resource, engineering, costs and schedule. The mandate also includes on-site supervision during project construction.
2018	IE for Chatham and Port Alma Wind Farms, Kruger Energy (H-358305)	200MW	Hatch was retained by Kruger to undertake and Independent Engineer assessment of it's 200.6MW Port Alma and Chatham wind farms.
2018	Kemont Wind Farm Performance Review, Kruger Energy (H-358191)	100MW	Hatch was mandated by Kruger to complete a wind farm performance reconciliation and update a long-term energy production estimate for an underperforming wind farm.
2018-2019	IE Review – Project Titan Confidential Client H-357996	120MW	Hatch was engaged to perform an independent engineering evaluation of a generation portfolio including wind, hydro, and solar assets. This included comprehensive review of operational history and performance, forecasting future performance, reviewing operations strategies, and site inspections of assets to confirm condition.
2018-2019	Wind Power Feasibility at Northern Mine, Confidential Client (H-357973)	20 MW	The client engaged Hatch to determine the technical and economic feasibility of integrating 20 MW of wind power generation and energy storage at their facility. Hatch conducted a wind monitoring campaign and completed an assessment of wind farm feasibility at the mine site, including preliminary engineering, for multiple sizing and load cases in a remote arctic environment.
2018	BCH Wind Cost Report Update BC Hydro, British Columbia (H-357827)	N/A	BC Hydro engaged Hatch to update the Wind Project Cost Review Report previously completed in 2015. The objective of this update costs breakdown for CAPEX, OPEX and BoP taking into account the evolution of the market since 2015.
2018	IE Review of Comber Wind Farm Brookfield BRP Canada Corp. (BBCC) (H-357719)	165 MW	Hatch was engage an Independent Engineer (IE) for undertaking a technical assessment of the Comber Wind Farm, in view of an upcoming refinance. The Comber Wind Farm is located the Municipality of Chatham Kent. The review included a review of the facility's technical condition, regulatory compliance, and operations plan.

Years	Project/Client/Location	Capacity	Summary of Services
2018	Prince Wind Farm - Inspections Brookfield Renewable Power, Ontario (H-357299)	N/A	Hatch was retained by Brookfield Renewable to undertake inspection services of the wind turbines' anchor bolts, grout ring and pedestals at the Prince Wind Farms.
2018	LTA Services for a 20MW Wind Farm, Western Lily Wind Energy LP, Saskatchewan (H-357081)	20 MW	Hatch was engaged by Western Lily to provide Lender's Technical Advisor services for the Western Lily wind farm. These services included: design package review, construction monitoring, milestone reporting in support of the payment schedule, and other services as needed.
2018	Re-financing Assessment at Bow Lake Wind Farm, Shongwish Nodin Kitagan GP Corp., Ontario (H-356962)	58 MW	Evaluate long-term energy production forecast and operations and maintenance spending forecast, review financial model and contractual agreements, visit wind farm site and assess condition of the asset.
2018	Independent Review at Hermanville and Clear Springs Wind Farm, PEI Energy Corporation, Prince Edward Island (H-353878)	30 MW	Lightning protection system independent review, including blade damage root-cause analysis, design review, site visit, condition of the lightning protection system, warranty agreement review, availability and energy production losses estimates.
2017-2018	Norman Wells Wind Power Integration Study, Government of Northwest Territories (H-355879)	3 MW	Integration study of wind power at low and high penetration levels on the Norman Wells community electrical system. Energy modeling of diesel/wind/storage and grid/wind/storage scenarios with regard to grid and diesel outages and future implementation of carbon pricing on diesel fuel.
2017 (Ongoing)	Meliadine Mine, Agnico Eagle, Nunavut (H-355124)	10-40 MW	Wind power feasibility study to integrate high penetration wind generation to a mining diesel power plant. Includes complete monitoring campaign and resource assessment, integration to mine operations, storage sizing and impact on heat recuperation, carbon pricing calculations, project economics.
2017 (Ongoing)	Hope Bay Mine, Tugliq Energy, Nunavut	5 MW	Feasibility study to integrate wind power and energy storage technologies (lithium batteries and compressed air) to a mine diesel-based power plant. Wind resource assessment, site selection, economics, electrical preliminary design, technology review.
2017 (Ongoing)	Alternative Power Prefeasibility Study, DeBeers Canada, Gahcho Kue Mine, Northwest Territories (H-355272)	7 MW	Alternative power prefeasibility study to evaluate the integrating of wind and solar generation to a mining diesel power plant, along with opportunities to use energy storage, waste heat recovery and carbon capture. Includes resource assessment, sizing options, cost estimates and project economics.

Years	Project/Client/Location	Capacity	Summary of Services
2017	South Canoe Wind Farm, Oxford Frozen Foods, Nova Scotia (H-355626)	100 MW	Wind farm operational performance optimization services. Review of operations, maintenance, turbine performance, software upgrades, turbine settings and controls.
2017	Operational Assessment on 3 wind farms, Statkraft, Brazil (H-347918)	187 MW	Wind farm operational assessment for a client considering the acquisition of wind farms in Brazil.
2017	Isolated Renewable Feasibility Study, ATCO Electric, Alberta (H-353767)	0.5 MW	Feasibility study assessing the optimal sizing and configuration of renewable generation and energy storage technology at three (3) diesel-powered remote communities in northern Alberta. Study included wind and solar resource assessments, diesel to propane conversion, optimization of high penetration hybrid configuration, cost estimates, sensitivity analyses and financial evaluations for each community.
2017	RFP for a Virtual Wind Power Purchase Agreement, Confidential Corporate Client, USA	85 MW	Advise a corporate client on the best way to contract renewable power to power its facility. Organize the request for proposal process for a virtual power purchase agreement, prepare shortlist of proponents, participate to the selection of a wind energy supplier.
2017	Scoping Study, Confidential Client for a mine in Asia	100-400 MW	Wind resource assessment using mesoscale reanalysis wind data, wind capacity sizing including high penetration, cost estimate to evaluate the feasibility of a wind/diesel hybrid power plant to power a mine.
2017	Sachs Harbour Wind Scoping Study, Government of Northwest Territories, Canada (H-354025)	1 MW	The study aimed at identifying four (4) potential sites close to the community and assess the wind resource, the technology selection in arctic conditions, the environmental constraints and the economics to integrate wind power to the existing diesel powered isolated grid.
2017	South32, Cannington Wind Power Project Cost Estimate, Australia (H-353406)	8-20 MW	Detailed Wind Power and Energy Storage project cost estimate at scoping level for low to high wind power penetration (8, 12, 20 MW) to Cannington Mine
2016	Due Diligence at Kibby Wind Farm, Brookfield Renewables, Maine (H-352281)	140 MW	Evaluate long-term (40-yr) energy production forecast and operations and maintenance spending forecast, review financial model and contractual agreements, visit wind farm site and assess condition of the asset, environmental and regulatory review.

Years	Project/Client/Location	Capacity	Summary of Services
2015-2016	Wind power prefeasibility study for the integration of 12 MW of wind to the Red Dog Mine grid, Teck Alaska, Alaska (H-349918)	12 MW	Detailed study for the integration of a wind farm to a arctic remote mining location. Includes technology and wind assessments, power management and control study, electrical and civil preliminary engineering, logistics and constructability studies, cost estimates.
2016	Wind monitoring campaign and project development support for 4 wind farm sites, Zero Emissions Development, British-Columbia	4x 15 MW	Wind farm siting, meteorological mast installations, wind monitoring campaigns, wind resource assessments, permitting and assistance with standard offer program.
2016	Hybrid Power System (Wind – Diesel), KCDC, Burwash Landing, Yukon	-	Completion of a wind-diesel business plan for the Kluane Community Development Corporation. The business plan addressed wind turbine selection, system performance simulations, project costs and financing, industry / market analysis, operations, permits and approvals, land rights, financial modelling, environmental and community benefits, risks and mitigation, and an implementation plan.
2016	Lender's Engineer Services for Pennask wind farm and Shinish Creek wind farm, Instar AGF, British-Columbia	2x 15 MW	EPC Contract administration and submittal reviews, liaison with contractor, permanent met tower services
2016	Preliminary Engineering, Irma Wind Farm, Alberta (H-353140)	90 MW	Preliminary engineering and cost estimate, scope includes geotechnical campaign (Hatch led), preliminary foundation design, substation design and collector system design utilizing Hatch's own in-house optimization software.
2016	Robinson Crusoe Island Solar and Wind Optimization Study, ENEL, Chile	9 MW	Optimization study of high penetration hybrid renewable power systems for a Chilean Island. Modeled the economic and technical potential of wind and solar power coupled with Li-Ion and flow batteries to reduce diesel consumption and minimize costs.
2015	Complexo Eólico Chapadinha, Votorantim Energia (H-349986)	29 MW	Basic engineering for wind farm in Brazil, civil and electrical work
2015 (Ongoing)	Wind resource assessment, Feasibility study and implementation of a 3 MW wind turbine with energy storage at Raglan Mine, Nunavik, Quebec, Canada (H-346545, H-346862, H-346870)	3 MW	Installed wind measurement equipment (including Lidar) and monitored the meteorological data for the wind resource assessment. This was followed by the implementation of a 3 MW wind turbine and energy storage (battery, flywheel and Hydrogen System) with micro-grid controller. Completed the design, engineering, commissioning and operation monitoring of the project. The project demonstrates the use of wind to offset diesel costs and the use of various types of storage and fast response control systems to maximize the use of wind while minimizing grid disturbances due to wind variability, in this Arctic, remote location.



Years	Project/Client/Location	Capacity	Summary of Services
2015	Owner's Engineer Services for Grand Valley 3 Wind Project, Ontario, Canada (H-348823)	40 MW	Hatch reviewed the foundation, substation, and collector system design. Quality Assurance services, through site supervision, was provided during construction. Upon completion, Hatch assisted with turbine and substation walkdowns and commissioning procedures to provide a certificate of completion in compliance with OPA's FIT program.
2015	Owner's Engineer Services for Saint Columban Wind Project, Ontario, Canada (H-343072)	33 MW	Hatch conducted a transportation study and fatal flaw identification prior to construction. Review of foundation design was completed as well as Quality Assurance services, through site supervision, during construction. Upon completion Hatch assisted with turbine and substation walkdowns an commissioning procedures to provide a certificate of completion in compliance with OPA's FIT program.
2015	Owner's Engineer Services for Arnow Wind Project, Kincardine, Ontario, Canada (H-347716)	180 MW	Hatch's team brought a comprehensive understanding of all interfaces and phases of the project. These include wind resource, environmental requirements, electrical interconnection, geotechnical and structural aspects of turbine foundations, the Siemens turbine technology, and Hatch's efficient construction methodologies including winter construction, collector system design and electro/mechanical installation and commissioning.
2015	Meteorological Tower Installations and Wind Resource Evaluations, Zero Emissions Development, Five sites in British Columbia (H-200079)	5x 15 MW	Site screening process resulting in 45 potential wind farm locations in British-Columbia, environmental screening, wildlife management plan, installation of five (5) met towers, wind monitoring campaign, wind resource assessments, permitting, assistance with project development.
2014	South Kent Wind Project – Owner's Representative Services , Ontario (H-344773)	270 MW	Owner's representative during construction, monitoring technical and cost performance in this site than spanned an area over 80km from one end to the other.
2014	Bow Lake Wind Farm, Phase One, Environmental Site Assessment, Ontario, Canada (H-346847)	60 MW	Conducted a Phase One environmental site assessment (ESA) for an approximately 60 MW wind farm under construction in Algoma District, Ontario. The Phase One ESA was conducted in accordance with CSA Standard Z768-01 and O. Reg. 153/04.
2014	De-Icing System Evaluation, Servion Canada, Montréal, Québec	--	Work with Servion turbine manufacturer in the development of their wind turbine blade de-icing system. Evaluation of the potential impact of the de-icing system on the energy production output of a wind turbine.
2013	Wind Farm and Collector System, Ontario, Canada (H-343929)	154 MW	Design and construction support of 35 kV and 690 V underground AC collector system, including 230/3 5kV substation, turbine foundation design, ground grid design, transportation plan, road adjustments, access road design, ground grids, fiber optics (170+km) and construction support. Interface with ESA and other third party stakeholders.

Years	Project/Client/Location	Capacity	Summary of Services
2013	EcoEnergy Innovation Initiative, Ontario, Canada (H-343650)		Government funding to work on the development of a utility grade controller for remote micro-grids with high penetration of renewable power generation. Hatch will develop a commercially viable controller for the electricity distribution system in remote communities. The controller will manage hybrid power sources of both diesel and renewable generators (i.e., wind, solar) in remote communities as well as energy storage equipment for the most economical operation of the grid while maintaining power quality. The project also includes thorough feasibility and system planning studies which will be undertaken in collaboration with the Kasabonika Lake First Nation community.
2013	Amakhala, Cennergi, South Africa	134.4 MW	Independent wind resource assessment review.
2012	Niagara Region Wind Corporation Wind Farm Collector System, Niagara, Ontario, Canada (H-339580)	230 MW	Assist with the preliminary design of framing drawings. Develop a design build scope, budget and schedule for detailed engineering and construction.
2012	Phase One ESA, Chatham-Kent, Ontario, Canada (H-335936)	270 MW	Conducted a Phase One ESA for 167 properties associated with the proposed 270 MW South Kent Wind project located in the municipality of Chatham-Kent. The Phase One ESA was conducted in accordance with O.Reg. 153/04 and satisfied the requirements of CSA Standard Z768-01. Limited Phase Two ESA investigations were conducted at 12 properties.
2012	Canada Wind and Solar Assets, Teachers Insurance and Annuity Association of America (H-342694)	678.8 MW	Independent Engineering services for technical advisor for wind and solar assets under development and in operation
2012-2017	Amherst Island Wind Project, Algonquin Power Systems Inc., Ontario, Canada (H-340642, H-341551)	75 MW	Completed and in the process of completing numerous services including: technical specifications for turbine supply agreement, layout optimization, noise assessment, collection system and road design, wind resource assessment, technical specification for submarine cable, permitting, wind monitoring campaign including two Lidar and one met tower installations, independent engineer review
2012	Technocentre Éolien, Gaspésie, Québec, Canada (H-200087)	2x2 MW	Hatch was retained by TechnoCentre Éolien to act as the owners engineer for a project located in Rivière-Au-Renard, within the Gaspésie region, Québec, Canada. Hatch acted as the Owner's engineer , assisting with the design, procurement and installation of a 126-metre meteorological lattice tower, installed on public land in Gaspésie, Québec. Hatch provided project management services for all project deliverables including management of various sub-contractors to complete the site clearing, geotechnical study, access

Years	Project/Client/Location	Capacity	Summary of Services
			road to the site, foundation work, tower installation, instrumentation of the various sensors and tower commissioning.
2012	On-shore Wind/Transmission in Harsh Environments, Government of Newfoundland and Labrador, Newfoundland, Canada (H-341609)	--	Prepared documents on on-shore wind/ transmission in harsh environments, including the design and operation of turbines in cold conditions, icing on wind turbine blades, and transmission line anti-icing and de-icing
2012	Lingan Wind Farm, Enercon, Antigonish County, Nova Scotia, Canada (H-341446)	10 MW	Completed the turbine foundation and tower design for Enercon PCT E-82 E2 turbines. Monitoring of the foundation construction was also undertaken
2012	Fairmont, Enercon, Antigonish County, Nova Scotia, Canada (H-341448)	4.6 MW	Completed the turbine foundation and tower design for Enercon PCT E-82 E2 turbines. Monitoring of the foundation construction was also undertaken
2012	Wind Integration Study – Isolated Island, Nalcor Energy, Newfoundland, Canada (H-341742)	--	Completed a study to assess how much additional non-dispatchable wind generation can be added, economically and technically, to the Island of Newfoundland's power system
2012-2015	Coastal Labrador Wind Monitoring Program, Newfoundland and Labrador Hydro, Canada (H-340923)	--	Wind project evaluation in five off-grid communities in Labrador, including potential site identification, complete wind monitoring campaign to evaluate the wind resource, wind-diesel project feasibility, economic analysis and environmental assessment.
2012	Talinay wind Farm, Chile (H-339612)		Due diligence review of wind farm.
2011-2012	CORAM Wind Farm, Brookfield Renewable Power, Mojave, California	102 MW	Owner engineer work, review the quality of electrical work during and after project construction, including collection system, substation, transmission line, turbine wiring and grounding. Monitor design conformity, project schedule, quality control process, component deliveries, evaluate impact of deviations, review as-built drawings.
2011	Lesotho Highlands Power Project, Wind and Pumped Storage Study, Lesotho, South Africa (H-335915)	4,000 MW	Detailed evaluation of site selection for potential wind projects across the country. General overview of pumped storage operation including preliminary design considerations such as reservoir storage and plant head, calculation of the wind energy input based on the wind data obtained from a mesoscale study of the Lesotho system, with conversion into wind energy profiles according to standard wind turbine characteristics. Simulation of the generation and transmission system with exports of energy to the South African market, economic analysis of the wind-PSS system, and review of the purchase power agreement (PPA).

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2011	Cape Scott Phase 2, International Power Canada Inc., British Columbia, Canada (H-337868, H-341354, H-336353).	99 MW	Completed preliminary designs, specifications for balance of plant (BOP), a geotechnical investigation, interconnection support and EMTP studies.
2011	Niagara Region Wind Project, Niagara Region Wind Corporation (NRWC), Smithville, Ontario, Canada (H-337440)	230 MW	Environmental constraints assessment, winter environmental field work, interconnection studies, wind turbine technology review, wind resource assessment, two-year SODAR monitoring campaign
2011	Kent Breeze Wind Power Project, Suncor Energy Products Inc., Thamesville, Ontario, Canada (H-335806)	20 MW	EPCM for balance of plant, detailed engineering, on site construction management, safety audits, procurement and contract administration.
2011	Kruger Energy Chatham Wind Farm, Port Alma Wind Farm, Ontario, Canada (H-337821, H-339564, H-350610)	373 MW	Completed foundation design and review, fatigue analysis and finite element analysis, operational assessment for project re-financing, vortex generator performance assessment
2010–2015	Northland Power, Quebec, Canada (H-200058)	250 MW	Wind monitoring campaigns, project development work, wind resource assessments, public meetings, prepare bid documents on multiple wind farms in Quebec.
2010-2016	Department of Energy of the Gabon Republic, Renewable Energy Projects at National Parks, Gabon (H-336241)	150 MW	Assessed wind and solar resources at six national parks, including identification of potential sites, and conceptual and prefeasibility studies for the development of the renewable energy projects at the selected sites.
2010-2017	Five (5) Wind Farm Projects, Eolectrico, Mexico	300 MW	Wind monitoring campaigns (7 met towers), wind resource assessments, turbine layout optimisation, energy production estimates on 5 project sites across Mexico: Zacatecas, Esperanza, Dzemul, Telchac and Altamira.
2010–2017	Eolectric, Quebec, Canada	600 MW	Wind monitoring campaigns, project development work, wind resource assessments, various studies on multiple wind farm projects across Quebec.
2010	Dokie Wind Project, Dokie General Partnership, British Columbia, Canada (H-334443)	144 MW	Owner's Engineer services, including design review, quality monitoring, TSA related contract management, performance monitoring, schedule tracking, site construction monitoring
2010	Confidential Client, Ontario, Canada (H-334614)	—	Southern Ontario wind farm with GE 2.5-MW wind turbines; wind resource assessment, BOP design and procurement
2010	Wintering Hills Wind Farm, Suncor Energy Products Inc,	88 MW	EPCM for balance of plant utilizing 55 WTGs. Services included substation design, collection system design, road, pad and

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	Drumheller, Alberta, Canada (H-333826)		foundation design, SCADA system design, and construction and project management
2010	Gosfield Wind Power Project, Brookfield Renewable Power, Ontario, Canada (H-334666)	50 MW	Design review, site visits, inspections, and document control during construction phase
2010	South Kent Wind Project, Pattern Energy and Samsung Renewable Energy Inc. (H-335936)	270 MW	Renewable Energy Approval (REA) process and preliminary engineering required to secure REA and other permits and approvals
2009–2010	Great Lakes Offshore Wind (GLOW) Project, New York Power Authority, New York, USA (H-334966)	up to 500 MW per site	Initial interconnection studies for wind farm locations in Lakes Erie and Ontario. Completed order-of-magnitude cost estimates for the construction of offshore and on-shore electrical facilities to connect to the New York transmission system. Prepared list of permits to be obtained as well as environmental studies to be completed
2009–2010	International Power Canada (formerly AIM PowerGen), Ontario, Canada (H-334451)	—	Preparation of standard balance-of-plant contract sections and technical specifications for several Ontario FIT projects
2009–2010	Boralex B3 Wind Farm, Enercon, Ontario, Canada (H-334171)	20 MW	Construction inspection for 15 Enercon E82 wind turbines installed at the Boralex Gracey, Richardson and Naylor wind farms
2008–2010	Wind project in Niagara Region, Renewable Energy Limited, Ontario, Canada	200 MW	EPCM services for Niagara wind project located in Southern Ontario
2003–2010	Wind Energy Niagara, Public-Private Partnership between Rankin Construction and Regional Municipality of Niagara, Wainfleet, Ontario, Canada (P15253)	18 MW	Feasibility studies and environmental screening/review for a wind turbine installation near the north shore of Lake Erie. Support of Ontario renewable RFP bid. Owner's Engineer, wind resource assessment and modeling and noise assessment
2009	Aim PowerGen, Harrow, Ontario, Canada (H-334084)	4 x 10 MW	Site monitoring at four wind farm sites including civil/geotechnical foundation construction and substation installation
2009	Samsung Renewable Energy Project – Phase 1, Samsung C&T Corporation (H-332683)	240 MW	Engineering consulting services, balance of plant (BOP) design, geotechnical investigations, roads, foundation design, substation design. Optimization of layout designs to minimize BOP costs

Years	Project/Client/Location	Capacity	Summary of Services
2009	Skyway 127 Wind Energy Project, Premier Renewable Energy, Port Elgin, Ontario, Canada (H-333983)	100 MW	Balance-of-plant, engineering, cost estimating for 40 GE 1.5-MW turbines
2009	Gracey Wind Farm, Boralex, Chatham, Ontario, Canada (H-333931)	10 MW	Design of the foundations for the wind farm utilizing 5 Enercon E82 wind turbines
2009	Lake St. Clair Wind Farms, AIM PowerGen, Ontario, Canada (H-333861)	2 x 100 MW + 50 MW	Balance of plant contract documents as well as owner supplied equipment procurement services, contract preparation and administration of tendering for three wind farm projects
2009	Naylor Wind Farm, Enercon, Ontario, Canada (H-333755)	10 MW	Designed of foundations for a wind farm in South western Ontario utilizing 5 Enercon E82 wind turbines
2009	Confidential project, Weir Foulds, Canada (H-333112)	—	Engineering assistance to a legal team regarding wind farm development
2009	Wolfe Island, Wind Project, Kingston, Ontario, Canada (H-332897)	197.8 MW	Independent engineering review for certification of commercial operation for OPA
2009	Kent Breeze Wind Power Project, Thamesville, Ontario, Canada (H-332765)	20 MW	Wind resource assessment, flicker study, noise impact assessment, cost estimate, civil and electrical BOP engineering
2009	Ripley, Wind Farm, Enercon, Ontario, Canada (H-332748)	76 MW	Field witnessing of noise compliance tests to IEC 61400-11
2009	Renewable Energy Project, Samsung, Ontario, Canada (H-332683)	140 MW	Development engineering, project environmental, cost estimating and assistance with First Nations consultation for the project prior to award of contract by the Ontario Government
2009	Foundation Design and Review, Enercon, Canada (H-332316)	30 MW	Design of foundations for a wind farm utilizing 15 Enercon E82 wind turbines
2009	Harrow Wind Farm, AIM PowerGen, Harrow, Ontario, Canada (H-332093)	4 x 10 MW	Cost estimate for balance of plant for four wind farm projects
2009	Black Oak Wind Farm, Enfield Energy LLC, Ithaca, New York, USA (H-330267)	25 MW	Review wind resource data; optimize layout of wind turbines and electrical collector systems
2009	Wind Power at Auto Marine Terminal, Port Authority of	—	Met tower erection, feasibility study considering grid connection, geotech and infrastructure issues, and resource analyses leading to Board of Public Utilities grant application

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	New York & New Jersey, New Jersey, USA (H-327775)		
2009	Calama Wind Met Tower, Codelco Chile División Codelco Norte (DCN), Chile (H-330592)	—	Installation of a wind monitoring tower for data measurement and validation of a wind farm project in Calama, Chile
2009	Withrow Wind Farm, Public Utility District No. 1, Douglas County, Washington, USA (H-325738)	Up to 160 MW	Full design services including engineering, procurement and planned construction management. Wind data due diligence review, energy modeling, project layout and optimization, turbine modeling, BOP design
2008–2009	Calama Wind Farm, Codelco Chile División Codelco Norte (DCN), Chile (H-330592)	250 MW	Feasibility study, business model and environmental assessment for a proposed wind farm project in Calama, Chile
2008	Bailingmiao II Wind Farm, Mongolia, China (H-330346)	50 MW	Provision of technical advisory services, including project management and site inspection during construction, quality inspection during manufacture and review of contractors' designs for the 50-MW Phase II of the Bailingmiao Wind Farm.
2008	Bear Mountain Wind Project, AltaGas, Dawson Creek, British Columbia, Canada (H-324481)	102 MW	EPCM services for their Bear Mountain wind project located on a ridge just south of Dawson Creek, British Columbia
2008	Brookfield Power, USA	Various	Due diligence on a number of wind energy assets in the Pacific Northwest
2008	Magrath Wind Farm, Suncor, Alberta, Canada (H-328907)	30 MW	Review of the energy production from the Magrath wind farm independently for Suncor
2008	Merlin-Quinn Renewable Energy Project, Suncor, Alberta, Canada (H-329887)	100 MW	Cost estimating and layout support to Suncor for a 100-MW RES project in Southern Ontario
2008	Statia Grounding Study, Enercon, Nova Scotia, Canada (H-330367)	36 MW	Engineering for wind turbine grounding for the 36-MW Statia project in Nova Scotia
2008	Borex Inspection Services, Borex, Ontario, Canada (H-331163)	40 MW	Construction inspection services for the B1, B2 Borex Standard Offer projects in Southern Ontario
2008	Melancthon II Wind Farm, Canadian Hydro Developers, Ontario, Canada	80 MW	Independent engineer certification of commercial operation

Years	Project/Client/Location	Capacity	Summary of Services
	(H-331757)		
2008	Comber* & Gosfield** Wind Projects, Brookfield Renewable Power, Canada (H-331574)	*200 MW **50 MW	Environmental management plans for two RES III wind projects
2008	Comber* and Gosfield** EMPs, Brookfield Renewable Power (H-331573)	*200 MW **50 MW	Phase 1 Owner's Engineer services
2008	Port Alma Wind Project, Kruger Energy, Ontario, Canada (H-329938)	101.2 MW	Pre-commissioning field inspection of selected Siemens wind turbine installations
2008	Confidential (H-329493)	198 MW	Due diligence, review of project plan, schedule and estimated project costs
2008	Kingsbridge II Wind Farm, EPCOR, Ontario, Canada (H-329443)	158 MW	Wind turbine layout and energy assessment, noise assessment and cost estimate
2008	Wind Power Services, Florida Power and Light Energy, Ontario (H-329419)	50 MW	Technical review of transmission and related wind farm capacity
2008	Assessment of Standardization Risks in Wind and Ocean Power, Canadian Standards Association (H-329295)	--	Study to explore the risks in standardization of wind and ocean power in Canada
2008	Wind Farm East of Lake St. Clair, AIM PowerGen, Ontario, Canada (H-328641)	340 MW	Design engineering and cost estimates for three sites in Ontario, 40 to 150 MW each. Geotechnical drilling program and characterization.
2008	Environmental Assessment of Highgate Wind Farm, Saturn Power, Ontario, Canada (H-328628)	10 MW	Environmental assessment for Gesner wind farm, southern Ontario
2008	Electrical Study, Florida Power and Light Energy, Chicago, USA	--	Electrical assessment of transformer problems

Years	Project/Client/Location	Capacity	Summary of Services
2007-2014	Vents du Kempt Wind Farm, Vents du Kempt, Causapscal, Québec (H-200065)	100 MW	Design a 43-turbine wind farm layout, wind resource, energy and turbine suitability assessments, perform wind monitoring campaign with 10 met towers and 3 LIDAR units. LIDAR measurements for turbine power performance tests. Commissioned in 2014.
2007	Offshore Wind Farm, confidential client (H-328265)	300 MW	Technical review for an investment opportunity in a European offshore wind power project that is in the final planning stage of development including all onshore and offshore facilities
2007-2008	Hand Hills Wind Power Project, Nexen, Alberta, Canada (H-30371)	140 MW	Preliminary engineering and balance of plant cost estimate
2007-2008	Cultus, Frogmore, Mohawk and Byng Wind Farms, AIM Powergen, Ontario, Canada (H-327152)	4 x 10 MW	Contract preparation and bid negotiation for balance-of-plant and design-build contracts (H-325737). Field inspections during construction phase (H-327152)
2007-2008	Saturn Power, Ontario Canada	10 - 50 MW	Wind resource assessment and environmental fatal flaw analysis for up to five wind farms (Ontario Standard Offer)
2007-2008	Wind power prefeasibility and feasibility studies on brownfield sites in New Jersey	15 MW	Prefeasibility level assessment of wind power potential at selected sites in New Jersey
2007	FPLE; Various site	110 MW	Site evaluation, ranking of wind assessment and grid access
2007	Confidential project, Epcor	MW- confidential	Due diligence on potential wind farm purchase in Southern Alberta
2007	Offshore wind farm, confidential client (H-328265)	300 MW	Technical review for an investment opportunity in a European offshore wind power project that is in the final planning stage of development, including all onshore and offshore facilities
2007	Confidential/C-Free Power Corp. (H-328122)	200 MW	Owner's engineering services: engineering for completing the AESO applications for four wind sites
2007	Acciona Darlingford Pembina Hills	102 MW	Preliminary civil balance-of-plant design and cost estimating
2007	Acciona Amherst Aulac	30 MW 75 MW 50 MW	Preliminary civil balance-of-plant design and cost estimating

Years	Project/Client/Location	Capacity	Summary of Services
Lameque Wind			
2007	Site Prioritization Analysis, Pteragen Canada Inc., Ontario (H-325518)	~30 x 10 MW	Systematic comparison and prioritization of a multitude of sites in Ontario, all in a size range that would be eligible for the Standard Offer Program for wind power projects
2007	Due diligence, Proposed Wind Power Project, Confidential Client, China (H-327036)	49.5 MW	Review of feasibility study wind resource assessment and energy yield estimates
2007	Confidential Wind Turbine Manufacturer	--	Coordination of wind turbine certification for the Canadian market
2007	Nova Scotia Wind Integration Study, Nova Scotia Ministry of Energy	--	Assessment of the impacts of wind power integration on existing generation and transmission systems and reserve in the province of Nova Scotia
2007	Assessment of Potential Wind Power on Unguja Island, Zanzibar, Tanzania, Millennium Challenge Corporation, Washington DC.	20 MW	Prefeasibility level assessment of wind power potential at selected sites in Zanzibar and preliminary balance-of-plant cost estimate
2007	Gosfield*, Comber** and Coldwell*** Wind Projects, Brookfield Power, Ontario, Canada (H-325601)	*100 MW **150 MW ***100 MW	Preparation of civil technical specifications, solicitation of proposals from two EPC BOP contractors, review of layouts
2007	Manitoba Wind Projects, Invenergy Canada, Manitoba, Canada (H-325778)	300 MW	Preliminary interconnection studies for interconnecting up to 300 MW into the Manitoba system
2007	Confidential Client, Pacific Northwest US	30–200 MW	Site selection through to engineering including wind resource assessment, procurement and construction management; site confidential
2007	Confidential Studies, Northeast Coast	--	Three investigation studies to determine feasibility of coastal sites, locations not disclosed
2007	Site screening for potential wind farms, Pteragen Canada Ontario	--	Site prioritization study based on wind resource, interconnection and other considerations
2007	Sagamok Indian Reserve, Saulteaux Enterprises, Ontario	40 MW	Wind resource assessment, electrical interconnection and environmental fatal flaw analyses
2007	Kruger Energy, Québec	--	Tower design review for building permit application; Preliminary foundation design for wind farms in Québec

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2007	Wolfe Island Wind Farm, Canadian Hydro Developers Ltd., Ontario	--	Tower design review for Wolfe Island wind power project, Ontario
2006–2007	Wind Development Project Port Dover, Farms.com, Port Dover Ontario (H-324005)	10 MW	Monitoring of existing environment for bird and bat fall migration, and bird overwintering at the site of a proposed wind farm
2006–2007	Prince III Wind Project, Brookfield Power, Sault Ste. Marie, Ontario, Canada (H-323288)	10 MW	Environmental assessment addendum
2006–2007	Ripley Wind Farm, Suncor/Acciona, Ontario, Canada (H-017035)	76 MW	Project management services for Ripley Wind Power Project, including scheduling, cost control, quality and site management
2005–2007	Confidential Client	75 MW	EPCM services for the 75-MW proposed wind farm in Southern Alberta
2005–2007	Taber Wind Power Project, Enmax, Taber, Alberta, Canada	80 MW	EPCM services for Taber Wind Power Project, including scheduling, cost control, quality and procurement
2005–2007	Blood First Nations Band, Cardston, Alberta, Canada	30 MW	Preliminary services for a 30-MW wind farm grid application
2006	Wikwemikong Wind Farm, Wikwemikong Unceded Indian Reserve No26, Ontario, Canada (H- 324286)	8 to 26 MW	Feasibility studies and business plan for wind farms on Manitoulin Island at three potential sites
2006	Kingsbridge II Wind Farm, EPCOR, Ontario, Canada (H-323601)	158.7 MW	Owner's Engineer, overview of designs, design of foundations. Project delayed; restart in 2008
2006	Goulds-St. John's Wind Farm Engineering Study for NLH RFP, Anemos Energy, Newfoundland, Canada (H-323059)601	26 MW	Cost estimate, development planning and engineering feasibility including wind analysis, layout and electrical system design
2006	Windrush Wind Farm Cost Study, Windrush Energy, Ontario, Canada (H-322158)	39.6 MW	Cost estimates for two 19.8-MW wind farms
2006	Melancthon II Wind Project, Canadian Hydro Developers,	132 MW	As independent engineer reviewed project plan, energy yield estimate, construction costs and schedule for debt lender

Years	Project/Client/Location	Capacity	Summary of Services
	Inc., Ontario, Canada (H-322742)		
2006	Southpoint Wind/Southpoint Wind, Ontario, Canada	30 MW	Offshore wind farm foundation investigation and design, wind resource assessment and EA support
2006	Gilead Power/Gilead Power, Ontario, Canada (H-322366)	10 MW	Wind farm analysis, layouts allowing for expansion and capital cost estimating
2006	Foundation Design Review, Enercon, Ontario, Canada (H-323336)	2 MW	Independent review of foundation design for 2-MW turbine at Ripley, Ontario
2005-2007	Taber Wind Farm, Enmax, Taber, Alberta, Canada (H-024242)	80 MW	EPCM services for Taber wind power project, including scheduling, cost control, quality assurance and procurement.
2005-2006	Prince II Wind Farm, Brookfield/Brascan, Ontario, Canada (16969D0)	90 MW	Assisted Brascan in the submission of information to the Ministry of Environment for Ontario's RFP II for this winning project. Brascan's Owner's Engineer for the design and construction of this project , including Plan of Development, Environmental Management Plan and site inspection during construction
2005-2006	Kettles Hill Wind Energy Inc. Phase 1, Pincher Creek, Alberta, Canada (H-025059)	63 MW	EPCM services under way in 2005 for the Pincher Creek wind farm. Phase 1 and 2, 63 MW
2005-2006	Kingsbridge I Wind Farm, EPCOR, Ontario, Canada (16328)	39.6 MW	Owner's engineer to review electrical balance of plant design as well as geotechnical and civil engineering for 39.6-MW wind farm. Independent QA and site coordination of commissioning
2005-2006	Prince I Wind Farm, Brookfield/ Brascan, Ontario, Canada (16607D0)	99 MW	Project designs and contract documents as Owner's Engineer, as well as assisting Brascan with negotiations with EPC contract consortium and undertaking assessments and analyses leading to project optimization to reduce costs. The work also included a Plan of Development and Environmental Management Plan for MNR. Site inspections during construction
2005-2006	Confidential, Pincher Creek, Alberta, Canada	300 MW	Preliminary services for three 100-MW Pincher Creek wind farms. Grid application included
2005-2006	SaskPower, Rushlake, Saskatchewan, Canada	150 MW	Grounding and voltage regulation services for the 150-MW wind farm
2005	Confidential Client	68 MW	Lender's Engineer for a proposed wind farm in Ontario. Includes field inspection, condition assessment, maintenance review, capital expenditure planning, wind resource and energy yield analyses and environmental and other permitting issues review

Years	Project/Client/Location	Capacity	Summary of Services
2005	Suncor Energy, EHN Wind Power, Enbridge, Chin Chute, Alberta, Canada	30 MW	EPCM services kicked off in the first quarter of 2005 for the Chin Chute wind farm
2005	Green Breeze Inc., Ontario, Canada	10 MW	Wind resource analysis, electricity production estimates from wind resource simulations calculated from site measurements and long-term wind speed adjustment Noise analysis based on Ministry of Energy guidelines and international sound propagation. Development of capital cost for BOP
2005	Blue Highlands Wind Farms, Brookfield/Brascan, Ontario, Canada (16704D0)	49.5 MW	Project designs and contract documents as Owner's Engineer, as well as assisting Brascan with negotiations with EPC contract consortiums and undertaking assessments and analyses leading to project optimization for Owner's development of project costs
2005	Gosfield I/Gosfield II and Wolf Wind Farms, Brookfield/Brascan, Ontario, Canada (16704D0)	300 MW	Preliminary engineering, negotiations with EPC consortiums, and analyses of costs leading to Owner's decisions to bid (or not) under RFP II
2005	Confidential Client, Southern Alberta, Canada	150 MW	Engineering, design and cost estimate for a 138-kV/ 25-kV (150-MW) substation for a wind farm generation project. The work included application to the Transmission Administrator for substation interconnection approval
2005	Newfoundland Wind Generation Development Strategy, Dept. of Natural Resources, Energy Branch, Canada (16557)	--	Expert advice on development strategy for wind power in the province of Newfoundland accounting for wind resource, electrical grid, social, environmental and regulatory issues
2005	Suncor/EHN, Fort McLeod, Alberta, Canada	80 MW	Engineering, design, project management for this 138-kV/25-kV (80-MW) wind energy project. The work included application to the Transmission Administrator for substation interconnection approval. Project put on hold/alternate site chosen
2005	Wolfe Island Wind Farm, Canadian Hydro Developers (CHD), Ontario, Canada (16586)	N/A	Detail design for construction of a 17-km, 24.5-kV transmission line between wind farm and grid connection point
2005	Enbridge St. Leon Wind Farm	100 MW	Cost estimate for 100-MW wind farm at St. Leon, Manitoba
2005	St. Leon Wind Farm Substation Review, Vestas-American, Manitoba, Canada (16581)	100 MW	Review of substation design and pre-commissioning field inspection and witness testing of installation for 100-MW wind farm

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2005	Wind Farm, Seabreeze, British Columbia, Canada (16578)		Engineering study including transmission line routing, right-of-way and interconnection into BCTC grid for wind farm
2005	Wind and Hydro Assets Due Diligence, Canadian Hydro Developers (CHD), Alberta & Ontario, Canada (16559)		Field inspection, condition assessment, maintenance review, power and energy review for both hydro and wind (including wind resource analyses review) and capital expenditure planning for eight facilities in Alberta and five in Ontario including four wind facilities
2005	Wolfe Island Environmental Assessment (EA), Canadian Hydro Developers, Ontario, Canada (15762)	80 MW	Update of EA report for new owner including planning level engineering
2005	Mt. Copper Electrical Review, Vestas American, Murdochville, Quebec, Canada (16337)	35 MW	Troubleshooting of wind farm collection system experiencing conductor galloping, and general electrical design review
2005	Wind Farm, Confidential Client, Ontario, Canada (16149)	0 MW	Engineering for power collection system and interconnection study for a 90-MW wind farm and 180-MW steam plant
2005	Cabarete Wind Farm, CETURC, Dominican Republic (1564501)	20 MW	Site reconnaissance and wind monitoring instrumentation procurement for a up to 20-MW wind farm east of Puerto Plata. Wind resource analyses and power generation estimates from wind resource simulations calculated from site measurements and long-term wind speed adjustment and vertical extrapolation
2005	Proprietary Technology Development, Court Industries, St. Catharines, Ontario, Canada (NFO1010A009)		Development of design and manufacturing technology related to wind generating equipment
2004	Vestas-Canadian Wind Technology, Pincher Creek, Alberta, Canada	65 MW	Engineering, design and cost estimate for 4 CRCE (7.2 MW) and 31 WPPI (57.8 MW) 1.8 MW Vestas turbines. Work included transmission, substation, 25 kV underground distribution and SCADA wind energy generation project
2004	Magrath Wind Energy Project, Suncor/EHN/ Enbridge, Magrath, Alberta, Canada	30 MW	Engineering, design, construction project management (EPCM) for wind energy project 138-kV/25-kV 30 MW substation, 25-kV collection system and turbine bases. The work included application to the Transmission Administrator for substation interconnection approval. Commissioned in September 2004
2004	Wind Energy Project, Shell Canada, Confidential Site, Shell Canada Limited	80 MW	Engineering, design and cost estimate for a 138-kV/25-kV (80-MW) wind farm generation project. The work included application to the Transmission Administrator for substation interconnection approval

Years	Project/Client/Location	Capacity	Summary of Services
2004	Wind Energy Projects, Suncor/EHN, Various sites, Alberta, Canada		Cost estimates for several wind farm sizes and wind turbine size selection configurations. Wind farm sizes ranged from 30 MW to 65 MW. Costs evaluations included substation and wind farm collection systems
2004	Enbridge, Pincher Creek Alberta, Canada	30 MW	Preliminary design and cost estimate for a 30-MW wind energy project. Cost estimate included transmission interconnection, substation and 25-kV collection system
2004	Voltage Regulation, VESTAS, Alberta, Canada	--	Voltage regulation study to identify the best, cost effective wind farm voltage regulation solution to meet the AESO interconnection requirements for voltage regulation
2004	Wind Energy Projects, Shell Canada, Manitoba, Canada	--	Interconnection assessment and system access application to Manitoba Hydro for four-wind energy projects. Includes evaluating interconnection points and voltage levels to ensure line capacities meet the client's generation projects capabilities
2004	Schneider Power Inc, Providence Bay Wind Farm, Ontario, Canada	20 MW	Site design, capital cost, vendor selection and preliminary management, including collector design and construction review
2004	Ripley Wind Farm Generation, Suncor Energy Products Inc., Ontario, Canada (15879)	76 MW	System interconnection studies for connection of the proposed wind farm power station to the Independent Market Operator (IMO) grid at 230 kV
2004	Malahide Wind Farm Generation, Suncor Energy Products Inc., Calgary, Alberta, Canada (15879.01)	100 MW	System interconnection studies for connection of the proposed wind farm power station to the IMO grid at 115 kV
2004	Feasibility Study of Hybrid Renewable Energy Project, Confidential Client, Dominican Republic (15645)*	--	Study of technical, commercial and financial viability of 20- to 25-MW renewable energy plant involving wind and biomass energy resources. Wind resource modeling and analyses and long-term power generation estimates.
2004	Interconnection Studies for Restart of Bruce 'A' Units 1 and 2, Bruce Power, Tiverton, Ontario, Canada (15409)	--	Study and analysis of the IMO network model including several wind power projects
2004	Wind Hydro Cooperation Study, Manitoba Hydro, Manitoba, Canada	--	Evaluated various wind capacities proposed for integration into the system

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2003-2016	Le Plateau and Roncevaux Wind Farms, Invenergy LLC, Matapédia, Québec	175 MW	Wind monitoring campaign including 8 lattice and tubular met towers, including permanent met tower and site calibration measurements, radio, satellite and cellular data communications, sensor maintenance work, data collection, data quality control and reporting, met tower dismantlement.
2003-2010	Mont-Louis Wind Farm, Northland Power, Saint-Maxime-du-Mont-Louis, Québec (H-200059)	100 MW	Design 67-turbine layout in complex terrain, wind resource and turbine suitability assessments, wind monitoring campaign with 13 met towers and 1 SODAR, public meeting, BAPE hearing, landowner negotiations, permitting. Commissioned in 2010.
2003-2009	Jardin d'Éole Wind Farm , Northland Power, Saint-Ulric, Québec, (H-200060)	128 MW	Design and optimize an 85-turbine layout, design road layout, wind resource assessments, turbine suitability studies, wind monitoring campaign with 12 met towers and 2 SODAR units, negotiations with landowners and municipalities, bid document preparation, permitting, public meetings, expert testimony to reverse ruling from agricultural commission. Commissioned in 2009.
2003	Wind Turbine Foundation Review, Murdochville, Quebec, Vestas Canada (15601)	20 MW	Engineering review of foundation design on fractured rock using advanced computer models
2003	Financial Feasibility Evaluation Model, Toronto, Ontario, LZ Group†, Ontario	--	Provided a 'generic' financial model designed to evaluate small hydro and wind projects. The model incorporated the tax rates and incentive programs specific to projects located in Ontario
2003	3-MW Wind Turbine Project/Vestas American Wind Technology, Hitchland, North Texas, USA (P15301)	3 MW	Geotechnical, civil, and electrical layout engineering for a 3-MW wind turbine installation
2003	Pincher Creek Foundation Study/Vestas American Wind Technology, Pincher Creek, Alberta, Canada (P15173)	1.5 MW	Independent evaluation of the existing Pincher Creek V80 turbine foundation design to determine if the foundation is adequate to meet design loads
2003	V80-78 Meter Turbine/Vestas American Wind Technology, Bowling Green, Ohio, USA (P15138)	18 MW	Construction specifications and foundation design for two 2-MW wind turbines
2003	V47 Foundation Design/Vestas American Wind Technology, Hawaii, USA (P15063)	20 MW	Foundation design, including calculations, concrete and reinforcing bar detailing for sixteen V47 wind turbines

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2003	Foundation Design, V90 Wind Turbine/Vestas American Wind Technology, North Cape, Prince Edward Island, Canada (P15020)	3 MW	Geotechnical investigation to determine foundation conditions for a V90 3-MW wind turbine; preparation of foundation design specifications and construction drawings
2002	Wind Power Development, Wolfe Island, Ontario, Canada/Canadian Renewable Energy Corporation (P14413)	18 MW	Environmental screening of a proposed wind power development on Wolfe Island near Kingston, consisting of up to ten 1.8-MW turbines on each of three possible sites
2002	Wind Power Development, Huron-Kinloss Township, Ontario, Canada/Canadian Renewable Energy Corporation. (P14384)	18 MW	Environmental screening of a proposed wind farm, consisting of up to ten 1.8-MW wind turbines near the shore of Lake Huron
2001–2002	Renewable Energy Hybrid Power Plant/Canadian International Development Agency (CIDA) on behalf of Sandals Resorts International, Jamaica (P14049)	--	Feasibility study and preliminary environmental screening for providing Beaches Grande Sport and surrounding Sandals resorts in Ocho Rios with electricity from renewable resources, including wind, solar and biomass. Wind resource analyses and long-term power generation estimates from wind resource modeling.
2001	Niagara Region Wind Power Prefeasibility Study/ Regional Municipality of Niagara, Ontario (P13980)	10 MW	Assessment of the viability of wind generation on the Niagara Peninsula at a prefeasibility level.