Utility-Scale Distributed Solar Generation Projects:
Why The Aurora Project is Historic and Transformative for the Solar Energy Industry
Executive Summary

In March 2013, the Minnesota Public Utilities Commission (MN PUC) determined that Minnesota-based utility Xcel Energy was in need of up to 500 megawatts (MW) of additional capacity to meet its projected demand requirements for the 2017-2019 timeframe. In response, the MN PUC ordered Xcel to undergo a Competitive Resource Acquisition Process. In this type of process, interested bidders, including Xcel Energy, submit proposals directly to the MN PUC, and the Commission is charged with deciding which of the proposals should be developed. In April 2013, five parties submitted proposals, including several natural gas combustion turbines, a natural gas combined-cycle turbine expansion, short term capacity credits and the Aurora Utility-Scale Distributed Solar Project: a 100 MW solar project from Geronimo Energy that would be built on up to 24 separate sites of 2 MW to 10 MW and interconnect directly into Xcel Energy’s distribution system. In a hearing process, an Administrative Law Judge (ALJ) made a historic recommendation that the MN PUC require Xcel to adopt the distributed solar project over and above the other bids. Upholding the judge’s recommendation, the MN PUC ruled on March 26, 2014 in favor of the distributed solar project and ordered the utility to begin the process of negotiating a Power Purchase Agreement (PPA) with Geronimo for their Aurora Utility-Scale Distributed Solar Project. This landmark decision by the MN PUC not only changed the solar industry, but it also opened doors for the broader energy industry. This white paper will discuss utility-scale distributed solar generation, the competitive advantages of utility-scale distributed solar projects, the short and long-term benefits that utility-scale distributed solar projects offer, and the Aurora Utility-Scale Distributed Solar Project as a case study.
Background

**SOLAR CAPACITY**

While many believe variable resources such as wind and solar are only energy resources, solar can also supply a reliable source of capacity. For summer peaking utilities and Regional Transmission Organizations (RTOS), maximum production of solar energy is highly correlated to system peak loads. This results in a high percentage of solar nameplate capacity being accreditable for use in meeting reliability requirements and reserve sharing obligations. The alternative is that solar energy generated at peak can be netted against peak energy and demand requirements, reducing both the utility’s peak load and the need for demand resources and associated reserves.

The National Renewable Energy Laboratory (NREL) has collected solar irradiance information for decades. This data provides solar developers and their financing entities with reliable datasets upon which they can base their financial projections of a project. Unlike wind energy, whose resource is extremely site specific, solar resource is fairly uniform and predictable across a region. Using NREL data, along with RTO solar capacity accreditation methodologies, Geronimo can design solar systems that can provide high levels of accredited capacity in most utilities’ service territories.

For the Aurora Utility-Scale Distributed Solar Project proposal, the project team studied the three previous years of output at the St. John’s Solar Project (a 400 kilowatt (kW) single-axis tracking project located in Collegeville, MN) and determined that energy generation in June, July and August over the most typical hours of the Midcontinent Independent System Operator’s (MISO) coincident peak averaged 71% of nameplate capacity. This performance, if applied to a similarly situated 100 MW (AC) facility, results in either 71 MW of accredited capacity or a 71 MW reduction to peak load.

Utility-Scale Distributed Solar Generation

**WHAT IS UTILITY-SCALE DISTRIBUTED SOLAR GENERATION?**

Utility-Scale Distributed Solar Generation (UDSG) is the placement of load-matched utility scale solar facilities that interconnect directly to, or near, distribution substations throughout a utility’s service territory. Distributed solar sites are strategically selected based on proximity to substations, size, land characteristics and permitting constraints. UDSG offers the best of both small-scale, residential solar installations and large-scale, utility solar installations: since each site is small and strategically located, transmission availability is never a concern, and with UDSG’s economies of scale, customers also capture considerable cost savings.

**HOW AND WHY DOES UTILITY-SCALE DISTRIBUTED SOLAR GENERATION WORK?**

UDSG provides local electricity generation at a larger, more cost-effective scale than individual residential solar installations. Load-matched solar facilities are installed in close proximity to local distribution substations, avoiding transmission and its associated upgrade costs and line losses, and utilizing easy-to-execute distribution level interconnections. To optimize output, each location is carefully selected based on land availability and site quality.
UDSG provides a measure of reliable capacity, which means the project is available to meet peak loads. UDSG delivers a utility-scale, clean, renewable generation resource that is cost-competitive with natural gas peaking alternatives. Geronimo works with utilities throughout the development process and manages all aspects of the process, including:

• Developing a strategic plan based on the utility’s long range resource plans.
• Determining sizing needs, both overall and for each site.
• Identifying and targeting multiple solar facility site locations based on substation locations and current load.
• Securing land rights for the selected sites.
• Assisting utility community relations representatives with public relations throughout the development process.
• Permitting the project and obtaining the necessary approvals.
• Identifying and selecting the best technology and equipment for the project.
• Bidding the project out to the industry’s top construction companies.
• Securing a construction team and managing the construction process.

UTILITY-SCALE DISTRIBUTED SOLAR GENERATION: BENEFITS FOR UTILITIES

Distributed solar projects provide many benefits to system operators, utilities and ratepayers. These benefits include a reduction in line loss, an increase in transmission capacity, a decrease in the potential for total source failure, and a higher level of reliability and security through geographic and resource diversity. In addition, solar energy provides environmental benefits that can assist a utility in meeting its emission reduction or renewable energy requirements.

Reduction in Line Loss = Increased Savings

Traditionally, line loss occurs when electrons travel long distances and when power is stepped up and down in voltage during the delivery process. Utility-Scale Distributed Solar Projects are unique from traditional large-scale utility generation facilities in that they interconnect a set of geographically dispersed solar facilities directly to utility distribution substations. In doing so, the solar facilities are able to deliver power and capacity to utility customers without utilization of the high voltage transmission system. This method of delivery reduces line loss and has a significant economic impact because the utility no longer pays for power that will never be delivered. As an example, the Aurora Utility-Scale Distributed Solar Project eliminates approximately 50% of the losses (or 4-6% of generated energy) associated with the delivery process by delivering power directly to the local community.

BEFORE: Electricity is carried from a power plant to the city over long distance. As a result of the distance the electricity must travel, there is 10% line loss.

AFTER: By replacing the power plant and large transmission lines with small distribution centers that are located closer to the city, the electricity has a smaller distance to travel, which reduces line loss to a maximum of 5%.
Increased Transmission Capacity = No Additional Cost

Because Utility-Scale Distributed Solar Generation Projects connect directly to, or near, substations, these projects have the added benefit of reducing usage of the transmission system. From an overall grid perspective, system operators see an increase in transmission capacity due to the fact that the load it had previously served to the local community has decreased. This “negative load effect” frees up capacity on the transmission system and increases overall grid resilience in the short-term. In the long-term, it reduces the need to expand transmission systems because more load can be served with the existing system. Finally, by connecting directly to distribution substations, no additional transmission service is necessary, and utilities do not incur any additional cost.

Decreased Source Failure = Increased Reliability and Security

Large generating facilities offer advantages in the form of economies of scale. However, they also have the disadvantage of being a potential single point of failure. A utility-scale distributed solar project with multiple locations increases grid reliability and alleviates the fear of a single point of failure.

Distributed solar projects are less prone to disruptions to the grid and a total loss of generating capabilities: if a weather or technical issue is affecting a particular solar facility, the other sites will still operate. Conversely, if a large power plant goes down for weather or technical issues, grid operators are faced with the challenge of replacing upwards of hundreds of megawatts of capacity on the system. In fact, this single point of failure scenario became reality during the winter of 2013 - 2014. In what the media coined as the “Polar Vortex,” several large facilities were inoperable due to harsh weather and unavailability of natural gas supplies. Some coal plants actually froze and were completely inoperable. This resulted in near brownout conditions in several locations throughout the country. Utilities and system operators scrambled to replace capacity that had been lost due to single point failure.
By decreasing the risk of single point failure, utility-scale distributed solar projects not only increase the grid’s reliability, but they also help protect national security. A growing national security threat stems from the Unites States of America’s reliance on large power generating facilities. As many articles have alluded to, disruptions to key points within our grid can result in catastrophic failure of the grid. By providing geographically dispersed solar facilities, distributed solar projects help defray threats to the nation’s grid and power supply.

**BEFORE:** Electricity is carried from a power plant to the city over long distance. If the power lines break, you have 100% loss.

**AFTER:** Electricity is carried from multiple distributed solar facilities into the city from a shorter distance. If a power line breaks, there is no single point of failure, and you have a maximum of 5% loss.

The Aurora Utility-Scale Distributed Solar Project

**AURORA’S DESIGN**

The Aurora Utility-Scale Distributed Solar Project (Aurora) was designed as an innovative approach to meet a portion of Xcel’s stated capacity and energy needs for 2017-2019, to help meet Xcel Energy’s peak capacity obligations in the MISO Planning Reserve Sharing Pool, and to provide Xcel up to 200,000 megawatt hours (MWh) of primarily on-peak energy each year. It is a project that has not only captured the attention of international media and energy experts, but has also blazed a trail for new ways for utilities to diversify their energy portfolio.

Aurora consists of distributed photovoltaic power plants located on up to 24 sites that are located near an Xcel Energy distribution substations. These distributed solar facilities range in size from 2 MW to 10 MW and will utilize linear axis tracking devices to maximize availability during Xcel Energy’s MISO coincident peak. In total, the Aurora Utility-Scale Distributed Solar Project will consist of up to 100 MW of alternating current (AC) distributed solar capacity.

Aurora has been designed with an increased DC to AC inverter ratio in order to maximize output and therefore increase the available peak capacity rating. Use of a linear axis tracking system will further increase output over the MISO coincident peak. Aurora will provide an estimated accredited capacity of 71 MW for its 100 MW AC plant.

Each of the solar facilities will interconnect directly to the utility’s distribution feeders or distribution substations across Minnesota and will provide energy and capacity for the local distribution network. Distribution facilities will be a short distance (approximately 0.5 to 3 miles) away from each solar facility, making efficient use of existing distribution equipment. By sizing each solar facility on an individual basis, Aurora can offset approximately 20 to 40 percent of the existing peak load, depending upon the load profile of each respective substation.
Aurora’s primary components include a nominal 300 watt photovoltaic module mounted on a linear axis tracking system and a centralized inverter. The tracking system foundations will utilize a driven pier and are not expected to require concrete. The balance of the remaining plant components include electrical cables, conduit, step up transformers and metering equipment. The solar facilities will be fenced and seeded in a low growth seed mix to reduce run-off from existing conditions and improve water quality.

**AURORA’S COMPETITIVE ADVANTAGE**

The Aurora Utility-Scale Distributed Solar Project was compared against several natural gas combustion turbine and a combined cycle projects in a competitive process before the MN PUC. In comparing the costs and benefits of the various generating options, Aurora was determined to have the lowest overall levelized cost of energy. In addition, when considering benefits associated with reduced line losses, avoided transmission, zero fuel costs and zero emissions, the project was also the lowest cost alternative when modeled in the Strategist production cost model.

Aurora’s unique utility-scale distributed solar generation design offers several key benefits. Distributed solar generation offers the distinct advantage of interconnecting smaller, separate generators, while providing economies of scale to drive down capital costs. Additionally, Aurora’s design offers distinct benefits, such as:

- Fixed costs over the life of the project
- Reduction in line loss
- An increase in reliability
- Enhancement and ease of interconnection
- Capacity and energy to meet on-peak customer needs
- Increased control and oversight of facilities
- Reduced risk of system failures
- Geographic diversification of generation assets
- Solar Renewable Energy Credits, which offer rights to environmental, social and other non-power qualities
- UDSG projects have no air emissions, displace pollutants emitted by fossil fuel-fired generating resources, offer minimal environmental impacts and use zero water during operation

One of the key advantages of the Aurora Utility-Scale Distributed Solar Project is the ability for the utility to have a single Power Purchase Agreement (PPA) for several distributed facilities across its service territory. A single PPA provides off-takers with several benefits:

1. Financial assurance
2. Product uniformity
3. Administrative ease

In addition, the solar facilities are managed by a single entity and can share maintenance and spare parts inventory.
Aurora provides an additional advantage in that it will supply Renewable Energy Credits ("RECs") to Xcel Energy, which Xcel can use to meet its Solar Energy Standards, Renewable Energy Standards or other environmental requirements. Xcel Energy also has the option to market the Solar Renewable Energy Credits ("S-RECs") to other utilities that need to meet solar-specific requirements in Minnesota or other states.

**AURORA: TIMELINE OF KEY EVENTS**

**March, 2013:**
The Minnesota Public Utilities Commission (MN PUC) concludes that Xcel Energy needs up to 500 MW of additional capacity to meet its demand requirements in the 2017-2019 timeframe. Through an order from the MN PUC a Request for Proposal (RFP) is issued through a Competitive Resource Acquisition Process.

**April, 2013:**
Interested parties, including Xcel Energy, submit their proposals to fulfill the identified need. The proposals included: Geronimo’s Aurora Utility-Scale Distributed Solar Project, several natural gas combustion turbine proposals, a natural gas combined-cycle proposal and a proposal for short-term capacity credits.

**November - December, 2013:**
Each proposal is separately evaluated by an Administrative Law Judge (ALJ) through a process involving expert testimony, rebuttals and briefs.

**December 31, 2013:**
The ALJ rules that “the greatest value to Minnesota and Xcel’s ratepayers is drawn from selecting Geronimo’s solar energy proposal.”

**March 2014:**
The MN PUC directs Xcel to negotiate a contract with Geronimo, finding that Aurora Utility-Scale Distributed Solar Project is in the public interest, is the most environmentally beneficial, and is cost-effective.

**AURORA: HISTORY IN THE MAKING**

Aurora was a “first” in the United States for two key reasons. Primarily, solar had never previously competed directly with natural gas in a competitive resource acquisition process. Additionally, the rulings made in favor of Aurora by both the Administrative Law Judge and the MN PUC mark the first time that solar has competed and won based on economic value and not purely on environmental benefit.
Beyond Aurora: Replication of the Distributed Solar Model

The Aurora Utility-Scale Distributed Solar Project can be replicated in nearly any region of the United States. However, each ISO provides a unique capacity accreditation and market mechanism to balance its generation needs. For instance, some ISOs may peak at different hours of the day, shifting the time for peak capacity needs. Additionally, the market mechanism for contracting capacity may be done through auctions, long-term contracts or regulated by a governmental body. Each scenario requires careful planning to assure that the distributed model created meets the needs of the specific ISO. Geronimo has the expertise and experience to work with any ISO on the distributed solar generation model.

Conclusion

By strategically locating solar facilities throughout a utility’s territory, Utility-Scale Distributed Solar Generation offers several key benefits to utilities and ratepayers. These include: reduced line loss, increased savings, increased transmission capacity, decreased source failure, and increased reliability and security. As the nation’s largest distributed solar project, the Aurora Utility-Scale Distributed Solar Project proves that solar energy is cost-competitive with natural gas peaking energy sources and is the most beneficial for both the utility and its ratepayers.

About Geronimo Energy

Geronimo is a premiere energy development firm in the Midwest. Geronimo is creative and flexible, offering solutions for all different types of electrical utilities. Founded with deep roots in agriculture with understanding & respect for farming principals, Geronimo ensures that each of our projects benefit the local area for generations to come.

Headquartered in Minneapolis, Minnesota with satellite offices throughout the Midwest, Geronimo has successfully developed and built over 240 megawatts (MW) of wind and solar energy and has been awarded over 1,000 MW of wind and solar power purchase agreements for delivery in 2015 & 2016. The Geronimo team is fully staffed with competencies in marketing, wind and solar resource assessment, wind and solar development, land acquisition, real estate & title services, environmental permitting, energy policy, finance, accounting, and sales.

Geronimo Energy has extensive solar development experience in areas such as oversight, engineering and project management. Geronimo delivers large-scale solar projects and offers on-site/ near-site installations, as well as off-site installations located in more efficient, lower cost geographical locations. Recently, Geronimo was awarded a Power Purchase Agreement (PPA) from Xcel Energy for the largest solar project in the state of Minnesota, the 100 MW Aurora Utility-Scale Distributed Solar Project, which is slated for construction in 2016. Geronimo’s ability to deliver solar energy with market-leading cost, creative solutions, and efficiency is due to our top-notch team of renewable energy development professionals, who together, have a combined experience in over 100 commercial and utility-scale solar projects throughout 16 states in the United States.
Geronimo is the only developer that has the experience to offer end-to-end development consulting. Geronimo manages all aspects of:

- Strategic planning
- Site analysis and acquisition
- Permitting
- Technology analysis and selection
- Management of engineering procurement and construction of the project
- Community and public relations
- Regulatory coordination

Geronimo’s Executive Solar Development Team

**Nathan Franzen**, Director of Solar

For the Aurora project, Nathan managed project origination and development as well as the technical design parameters required to meet the capacity obligations of the Competitive Resource Acquisition Process. This iterative process required extensive coordination with Geronimo’s regulatory and strategic planning staff as the project progressed from conceptual design to final site selection and technical design.

Nathan Franzen came to Geronimo in January of 2013 to initiate its solar development practice. Previously, he was the Director of Solar Energy at Westwood Professional Services where he lead the development and creation of its commercial and utility-scale solar engineering division. His experience comprises of oversight and project management of over 100 commercial and utility-scale solar projects in 16 states, including overseeing project development, interconnection studies, engineering, and construction services.

Nathan has a Masters of Urban and Regional Planning from the Hubert H. Humphrey School of Public Affairs in Minneapolis and actively promotes renewable energy policy and regulatory framework at the local and national level.

**Betsy Engelking**, Vice President, Policy and Strategy

Betsy Engelking joined Geronimo Energy as Vice President in January 2012 and currently leads the Company’s policy efforts. Betsy developed the regulatory strategy for the Aurora Project and provided expert testimony in the PUC process. She also collaborated with a number of legislators and advocates to achieve passage of the 2013 Minnesota Solar Energy legislation. Previously, Betsy was Director of Resource Planning for Xcel Energy, where she developed and implemented long-range power supply plans, including compliance with Xcel’s wide-ranging renewable energy requirements. She has also held positions with Great River Energy and the Minnesota Public Utilities Commission.

With more than 25 years of experience in the energy industry, Betsy’s expertise in energy policy, renewable energy, resource planning, utility rates and regulation, and energy markets are invaluable to Geronimo. Since the beginning of her career, Betsy has worked both regionally and nationally to promote the advancement of wind energy and other renewables through participation with the National Association of Regulatory Utility Commissioners (NARUC), the National Wind Coordinating Committee (NWCC), the Great Plains Institute’s Power the Plains collaborative, and through an active role in state and national policy development. Betsy holds an MBA in finance and economics from the Carlson School of Management at the University of Minnesota.