Widespread Urban Solar: the role of aggregators in Calgary

Authored by Edison Alvarez | Supervised by Dr. Derek Olmstead, University of Calgary, and Michael Wenig, Big Spruce Law

Problem / Question

What business models and regulatory frameworks can support the aggregation of Distributed Energy Resources (DERs) in Calgary, with a focus on urban solar photovoltaic systems?

Abstract

- This research examines the potential of energy aggregators in integrating Distributed Energy Resources (DERs) into Alberta's electricity grid, with a focus on urban solar photovoltaic systems. It analyzes the regulatory landscape and revenue opportunities for DERs, finding that geographically widespread aggregation models common in other regions are not feasible under Alberta's current regulations. However, business models like retailers' micro-generation rates offer viable pathways for DERs to generate more revenue. The study highlights the untapped potential for expanding DER participation in various markets and recommends policy changes to support the aggregation of dispersed DERs and their involvement in ancillary services. It also emphasizes the need to optimize incentive allocation across technologies and ensure market signals promote efficient DER use within the distribution network

Literature Review

- The literature review examines the electricity grid's structure and the role of DERs, particularly in Alberta. It highlights the benefits and trends of DERs, such as reduced transmission losses, increased resilience, and lower generation costs, with a focus on solar photovoltaic (PV) systems in urban areas. The review explores international examples of DER aggregation in Europe, the United States, and Australia, where aggregators play a significant role in managing DERs to enhance their value in electricity markets. In Europe, business models allow aggregators to operate across vast geographic areas, managing assets like solar panels and batteries. In the U.S., Federal Energy Regulatory Commission (FERC) orders enable DERs to participate in regional markets. Australia's virtual power plant (VPP) model facilitates DER aggregation for market participation. The review also identifies challenges in Alberta's regulatory environment, where DER aggregation is limited, and compares this to more flexible frameworks elsewhere.

Methods

Step 1

Legal and Regulatory Analysis

Step 2

Market Opportunities Exploration

Step 3

Current Case Studies

Legal Analysis

Asset	Aggregation Restrictions	Opportunities
Micro-Generators	Limited to sites under the same ownership and connected to a single distribution system feeder. Energy generated is primarily for self-use, with excess sold to the grid. Aggregation across multiple sites is restricted.	Allows excess energy to be sold, and large micro-generators can negotiate rates with retailers, offering some flexibility.
Small-Scale Generators	Aggregation is permitted but limited to generators connected to the same collector bus. Generation units must not exceed the distribution system's hosting capacity.	Can directly participate in the electricity market by aggregating multiple small units, increasing market access.
Batteries	Distribution Facility Owners (DFOs) can own batteries only with AUC approval under specific conditions, such as public interest or lack of market competition. Aggregation of batteries with DERs is limited by geographic proximity.	Private owners can install batteries to provide ancillary services and engage in energy arbitrage, increasing DER value.

Market Opportunities

- **Energy Market Participation**: Small-scale generators can directly sell electricity into the power pool, but aggregation of multiple small units is needed to maximize market access and operational efficiency. Micro-generators can optimize energy value through flexible pricing, though participation is limited to excess energy sales.
- **Ancillary Services**: Aggregation of DERs, particularly when combined with energy storage systems, is essential for providing ancillary services like operating reserves and frequency response, enhancing grid reliability and generating additional revenue.
- **Carbon Markets**: Solar PV projects can generate carbon offsets under Alberta's TIER regulation, and aggregation of smaller projects is crucial to reduce administrative costs and make participation in carbon markets more economically viable.

Case Studies

- **Case Study 1: Micro-Generation Rate**
- Under the micro-generation regulations prosumers (households or small businesses with solar PV systems) to generate electricity for their use and sell any excess back to the grid. The Micro-Generation Rate offers two pricing options: a high and a low rate, which prosumers can switch between based on their expected electricity generation and consumption.
- The micro-generation rate model significantly increases the value of electricity generated by solar PV systems. Prosumers can achieve higher returns by selling excess electricity during peak production periods. Retailers can optimize the pricing based on their interaction with the grid. The model's success results in increasing both the revenues of prosumers and retailers.

- **Case Study 2: Rooftop renting**
- This model involves leasing underutilized spaces for solar installations, such as commercial rooftops or parking lots. The space owner leases it to a solar energy company, which installs and operates a solar system. The energy generated is sold to the grid or through power purchase agreements (PPAs).

  The leasing model faces financial challenges in Alberta, where low electricity prices limit profitability. The study found that, with current electricity prices, leasing underutilized spaces is generally only profitable with financial incentives or significant reductions in solar installation costs. While projects in years with higher-than-average pool prices could be profitable, average prices over the past decade rendered most projects unviable. PPAs and declining solar costs could help improve this model's financial performance in the future.

Conclusion

- The study concludes that Alberta's current regulatory framework significantly restricts the potential for DER aggregation, particularly for geographically dispersed assets. While models like the micro-generation rate benefit prosumers and retailers, broader aggregation models, as seen in Europe and the U.S., are not feasible under Alberta's existing laws. Policy reforms are necessary to unlock the full potential of DERs, enable city-wide aggregation, and allow DERs to participate more actively in ancillary services and energy markets. The findings suggest that a provincial strategy, led by the Alberta Electric System Operator (AESO) or the Alberta Utilities Commission (AUC), is needed to facilitate the aggregation of DERs and to integrate them into Alberta's grid more effectively. Implementing these changes could significantly increase DER deployment, contribute to grid stability, and promote the adoption of clean energy in urban areas like Calgary.

References

- Hydro and Electric Energy Act, RSA 2000, c H-16
- Micro-generation Regulation, Alta Reg 27/2008.
- Small Scale Generation Regulation, Alta Reg 194/2018.