

**STATE OF NEW HAMPSHIRE  
BEFORE THE  
PUBLIC UTILITIES COMMISSION**

Docket No. DE 17-189

Alectra Energy Solutions, Inc.  
Overview of Residential Storage Benefits for Electric Distribution Companies

**DIRECT TESTIMONY**

**OF**

**VIKRAM SINGH**

February 9, 2018

THIS PAGE INTENTIONALLY LEFT BLANK

1 **I. INTRODUCTION AND QUALIFICATIONS**

2 **Q. Please state your full name, business address, and position.**

3 A. My name is Vikram Singh and my business address is 161 Cityview Blvd, Vaughan,  
4 Ontario, Canada. I am a Manager on the Advanced Planning team at Alectra Utilities  
5 (“Alectra”), which is a municipally owned distribution utility servicing over 1 million  
6 customers in Ontario. In this capacity I am responsible for providing services to the  
7 company related to identifying new technologies and business models that could be  
8 leveraged by the utility to foster growth and adapt to changing market conditions.

9 **Q. Please describe your educational background and training.**

10 A. I graduated from Concordia University in 2002 with a Bachelor of Engineering degree. I  
11 received a Master’s of Business Administration from Institut Européen d’Administration  
12 des Affaires (INSEAD) in Paris, France in 2009.

13 **Q. Please describe your professional background.**

14 A. I joined Alectra in April of 2015. Prior to my employment at Alectra, I was employed as  
15 a Director of Business Development at Advanced Green Innovations (AGI) – a  
16 technology fund focused on renewable energy technologies. Prior to AGI I was a  
17 Business Development Manager at Stirling Energy Solutions, a manufacturer of utility  
18 scale concentrated solar power (CSP) modules based on concentrator dish and stirling  
19 cycle engine technology.

1 **Q. Have you previously testified before the New Hampshire Public Utilities**  
2 **Commission (“the Commission”)?**

3 A. No, I have not.

4 **II. PURPOSE OF TESTIMONY**

5 **Q. What is the purpose of your testimony?**

6 A. The purpose of my testimony is to share Alectra’s views and experiences in evaluating  
7 customer sited residential storage as a utility asset. I will be commenting on the benefits  
8 and challenges of using such a technology for both customers and grid operators alike.

9 **III. RESIDENTIAL STORAGE BENEFITS**

10 **Q. Please describe any recent experience you may have with projects related to**  
11 **residential energy storage being leveraged as a utility asset.**

12 A. In 2015, Alectra launched a pilot program called “Power.House”. The POWER.HOUSE  
13 pilot represented Alectra’s first demonstration of the value of a Virtual Power Plant – an  
14 aggregate fleet of 20 distributed energy resources (DERs) located at customer homes that  
15 could be autonomously controlled through intelligent software to simulate a single, larger  
16 generating facility.

17 The technology being used was a combination of rooftop solar PV (between 5kW per  
18 site) and a lithium-ion battery installed “behind the meter” at the home of each  
19 participating customer. Customers benefit through load displacement, leading to bill  
20 reduction and reduced exposure to costly peak rates. They also receive clean, renewable  
21 energy that is not subject to the classic intermittency issues that typically limit the value

1 of solar power. In addition, customers are not only be able to use their systems while  
2 grid connected, they are also able to leverage the system in the case of an outage,  
3 benefitting from increased reliability at all times of the day using a combination of stored  
4 and generated solar energy.

5 From a utility perspective, leveraging carbon-free generating resources and fast-  
6 responding storage assets can play a pivotal role in several grid supporting functions.  
7 These resources can be used to reduce peak system loads, regulate frequency, and even  
8 defer capital costs associated with substation construction that would result from load  
9 growth or capacity constraints.

10 **Q. What are the types of grid services that storage can provide? What, specifically,**  
11 **makes storage an ideal choice for these services?**

12 A. Alectra has performed an analysis of the potential grid services that storage can deliver,  
13 and mapped these services to DER grid service categories that Lawrence Berkley  
14 National Labs and EPRI have jointly identified in a recent study. A table summarizing  
15 these use cases is provided below. In addition, the specific technical capability that  
16 energy storage systems are equipped with to fulfill each use case is also provided.

| Grid Service Use case                  | EPRI/Berkeley Category   | EPRI Function   | ESS Technical Capability  |
|--|--|---|---|
| Regulation                             | Safety, Reliability, System Stability  | Real Power Smoothing  | Push or pull power immediately  |
| Voltage Support                        | Safety, Reliability, System Stability  | Volt-VAR, Volt-Watt   | Push or pull power according to configured thresholds   |
| Operating Reserve                      | Safety, Reliability, System Stability  | Price Driven Actions  | Push or pull power at a scheduled time; Push or pull power upon receiving a trigger signal                |
| Peak Load Reduction                    | Safety, Reliability, System Stability; Quality                                   | Peak Power Limiting, Price Driven Actions   | Push or pull power at a scheduled time  |
| PV Smoothing and Renewable Integration | Safety, Reliability, System Stability; System and Equipment Constraints; Quality | Real Power Smoothing; Maximum generation limit; Peak power limiting function                              | Push or pull power according to configured thresholds; Push or pull power upon receiving a trigger signal |
| Demand Response                        | Safety, Reliability, System Stability  | Price Driven Actions  | Push or pull power at a scheduled time; Push or pull power upon receiving a trigger signal                |
| Consumer Use Cases - Bill Savings      | Economics & Value  | Price Driven Actions; Coordinated charge/discharge management; Direct battery charge / discharge function | Push or pull power at a scheduled time (rate management)  |
| Backup Power                           | Safety, Reliability, System Stability; System and Equipment Constraints          | Connect/ disconnect function  | Automatically disconnect from grid and supply power to critical/UPS loads                                 |
| Maximize PV Self-Consumption           | Safety, Reliability, System Stability; System and Equipment Constraints; Quality | Maximum generation limit; Peak power limiting; price driven actions                                       | Predict PV and load profiles to automatically push/pull power to achieve goals                            |
| Demand Charge Reduction                | Economics & Value  | Peak power limiting; price driven actions   | Automatically push/pull power to achieve demand reduction goals   |
| Ramping (esp. end of day ramp)         | Safety, Reliability, System Stability  | Real power smoothing function   | Push or pull power at a scheduled time; Push or pull power upon receiving a trigger signal                |

1 **Q. What technical advantages does residential storage provide over other technologies**  
2 **that may be used for the same purpose?**

3 A. Residential storage has a number of unique capabilities. Namely:

4 • **Performance:** Battery chemistry found in today's energy storage devices are  
5 extremely fast responding and have a high level of operational flexibility. In  
6 addition, batteries require very little ramp-up time, unlike fossil generators or  
7 turbines. As a result, they can be used either for grid services that require very quick  
8 response times, such as frequency regulation, or for standard grid support functions  
9 like capacity relief. They also can be leveraged as loads or generators. This allows  
10 them to either source or sink power depending on the needs of the grid. These high  
11 performance characteristics of batteries make them extremely flexible to operate and  
12 amenable to any number of grid services, as opposed to building purpose-built  
13 solutions that risk becoming stranded assets should the needs of the grid change.

14 • **Scalability:** Utilizing smaller, distributed resources allows a central operator to scale  
15 installed capacity according to market dynamics. This allows generation to grow in  
16 proportion to load requirements, and allows network planners to adjust capacity  
17 according to variances in actual load growth. This helps to provide more measured  
18 investments in capacity that are tied to actual market conditions.

- 1       • **Locational Benefit:** Once again, due to their distributed nature, residential storage  
2       can be collocated at specific nodes or along specific feeders in the network to deliver  
3       value where it is needed the most. This allows utilities to avoid oversizing  
4       centralized equipment in order to solve issues that present themselves at the “edge” of  
5       the grid (i.e. closer to loads).

6       **Q. What specific benefit streams do you see residential storage delivering to grid**  
7       **operators?**

8       A. There are a number of immediate and future values streams that storage can potentially  
9       deliver for utility benefit. They are:

- 10      • **Capital Deferral:** The ability to defer capital investments in distribution  
11      infrastructure to meet load growth requirements provides utilities with the financial  
12      returns associated with the time value of money. The longer the deferral period that  
13      embedded storage can provide the larger the capital deferral value. In order to  
14      capture this benefit, system-wide load forecasting has to be a key function of the  
15      distribution system operator – as it will be imperative in determining when to  
16      dispatch the assets.

- 17      • **Customer Engagement:** Residential storage allows for a much greater level of  
18      interaction and engagement with the customer. It provides unique features (such as  
19      site level resiliency), as well as added engagement features such as real-time visibility  
20      into household loads and local generation. These features have been extremely  
21      attractive to Power.House customers.



1       • **Demand Charge Reduction:** Coordinating dispatch of an aggregate fleet of storage  
2       assets allows operators to reduce demand charges assessed by the transmission  
3       system operator. This results in system wide savings that get socialized among the  
4       entire rate base.

5       • **Planning Flexibility:** Given the flexible and scalable nature of storage, it also  
6       provides an effective hedge against potential variances in actual load growth patterns.  
7       Operators are able to deploy localized generation that could act as an insurance policy  
8       should, for example, system demand decrease unexpectedly. This would prevent the  
9       need to build large centralized assets that may become underutilized.

10    **Q. What are some of the challenges of deploying such a technology?**

11    A. The notion of deploying a Virtual Power Plant (VPP) of residential storage for grid  
12    balancing is new and unproven. While battery technology is fairly mature and has  
13    proven to be quite reliable, many risks remain involving the uncertainty around their  
14    integration into standard grid operating and planning processes. Some specific examples  
15    of such challenges are described below:

16    • **Colocation Risk:** As many of the features of residential storage are dependent on  
17    providing locational value, there is always a risk of being unable to enroll enough  
18    customers within a required service area to deliver adequate capacity for a specific  
19    locational need.

- 1       • **IT/OT Integration:** Developing an understanding of how to dispatch storage assets  
2           and what type of additional services they can provide is essential for system operators  
3           if they are to take full advantage of the technology's potential. As such,  
4           understanding how to incorporate the control functions of a VPP into the utility's  
5           existing control architecture is a challenge utilities must be prepared to overcome.
  
- 6       • **Technology Risk:** Once again, using an unproven technology comes with certain  
7           risks. Especially considering that residential storage typically relies on customer  
8           internet for its communications architecture, there are a number of technical  
9           challenges that must be quantified before a large scale rollout of these assets can be  
10          deemed reliable enough to replace traditional utility assets.

11       Each of the above risks represents a compelling reason why utilities should pursue pilot  
12       projects in order to better understand what role energy storage could play in their future  
13       operational portfolio. Controlling a federated group of assets versus a centralized  
14       generating resource is a distinct departure from typical utility operations; however with  
15       an increase in DER penetration being fueled by lower storage pricing it is a change that  
16       we feel utilities must embrace if they are to be prepared to adapt to new market realities.

17   **Q.    What is the advantage of utility ownership vs. a third party aggregator or customer-**  
18   **owned model?**

19   **A.**    Distribution System Operators have direct responsibility for the planning, operation,  
20           maintenance, billing, and customer service functions required to manage an electric grid.  
21           This provides them with an inherent level of technical competency and internal

1 infrastructure that is ideally suited to managing a VPP. It also provides them with  
2 extremely detailed visibility into the locational benefit that storage can provide to both  
3 participants and non-participants alike. Allowing utilities the flexibility to integrate these  
4 assets into the grid where they can provide the most benefit is both economically and  
5 operationally efficient, and provides customers with access to more lucrative revenue  
6 streams than simply energy savings or time-of-use arbitrage. Utilities can also leverage  
7 value streams by coordinating benefits for the transmission network, and by participating  
8 in wholesale market activity. Incorporating this functionality into the utility's existing  
9 planning and operations activities is a natural fit, and allows for energy storage assets to  
10 be fairly valued according the aggregate benefit they deliver to the entire grid.

11 **IV. CONCLUSION**

12 **Q. Does this conclude your testimony?**

13 **A.** Yes it does.