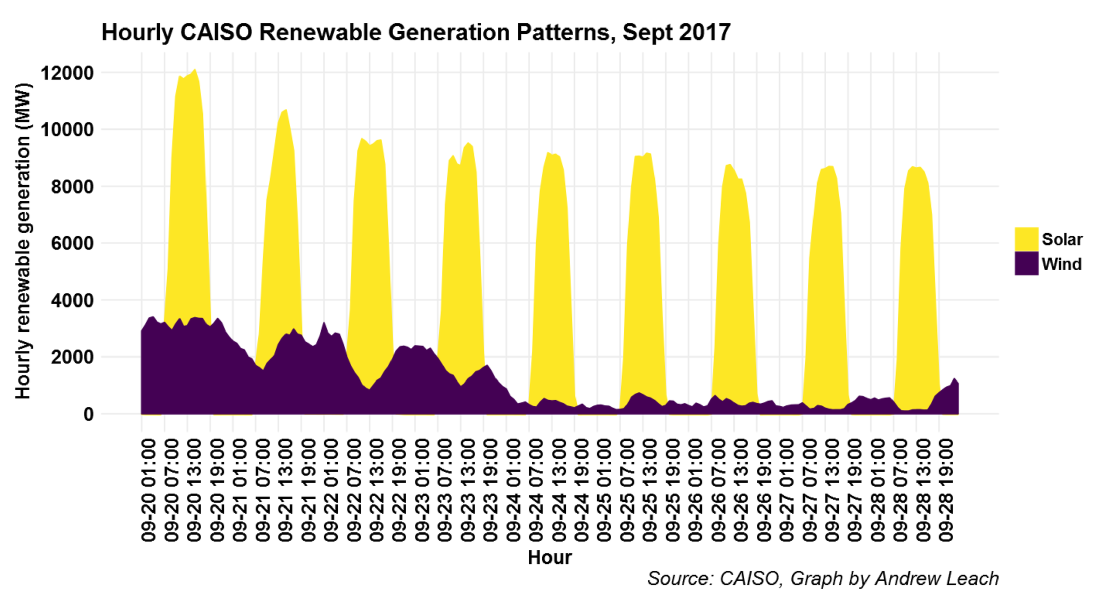
Economic Policy and the Future Electricity Grid

Andrew Leach

BACKGROUND

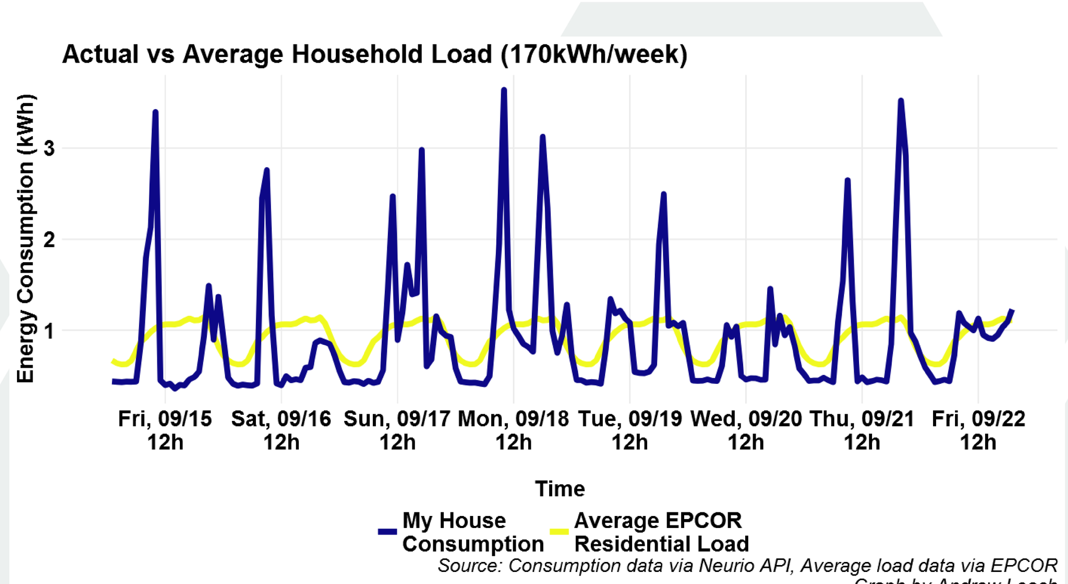
As renewable energy grows in importance and becomes more cost-effective, it will create a niche for energy storage. Without storage, we have a hard time displacing the energy we generate from wind and solar power from the time the sun shines or the wind blows to the times we use energy. No matter how cheap that generation may be, if it can't be stored, it's not worth as much to us. The goal of this series of projects is to examine the policies which would enable energy storage on our grid, the barriers to adoption, and the most likely utility advocates for storage.



SHORT-TERM OBJECTIVES

Residential Energy Storage

As more people install solar power systems on their homes, it will be important to understand how the current policies affecting their electricity bills will encourage them to deploy storage and the degree to which these changes will allow for meaningful load re-shaping at the municipal level. As the graph below shows, individual residential loads vary a lot from the average, and so the policy incentives will need to be tailored to residential and commercial decision-making.



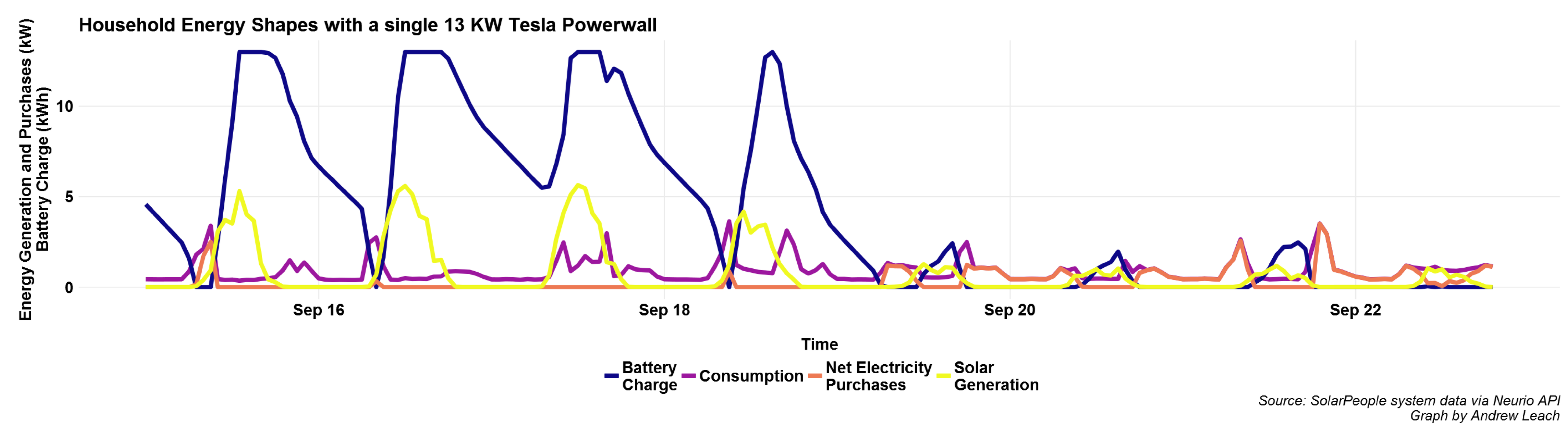
PROJECT OVERVIEW

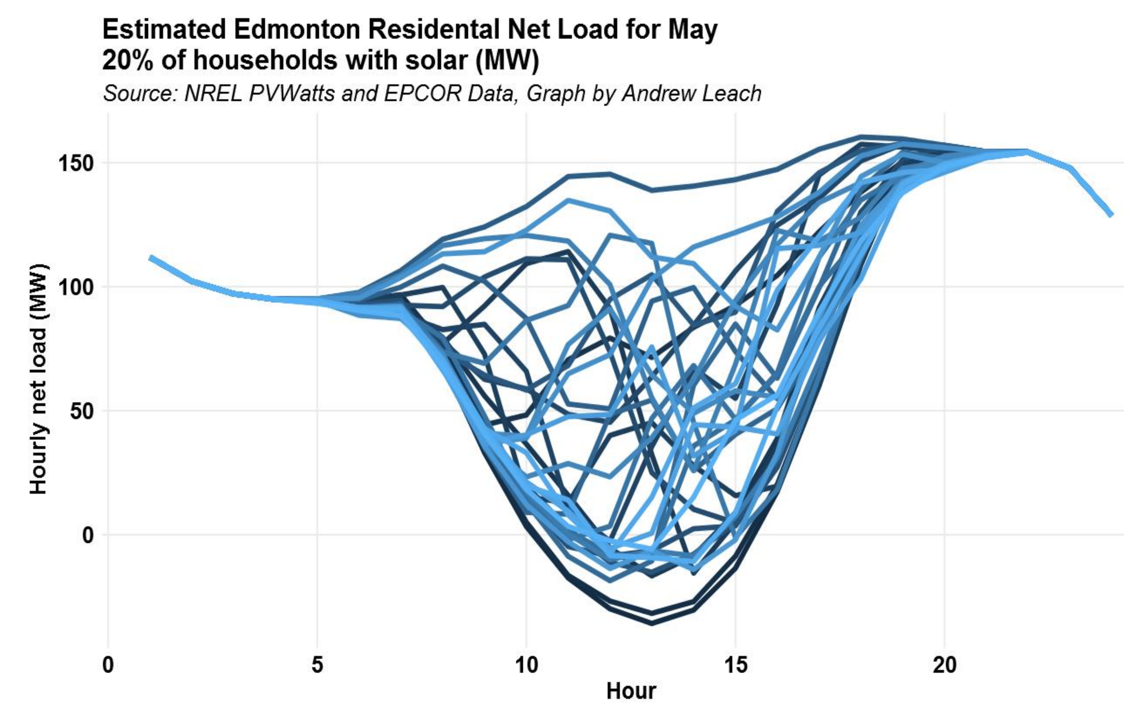
The goal of this project is to examine the interface between economics, policy, renewable energy supply and energy storage. Our initial goals include modeling of residential-level energy storage decisions and their relationships to grid-level management considerations. This will provide us with a meaningful basis on which to expand our consideration to broader grid-level deployment of energy storage.

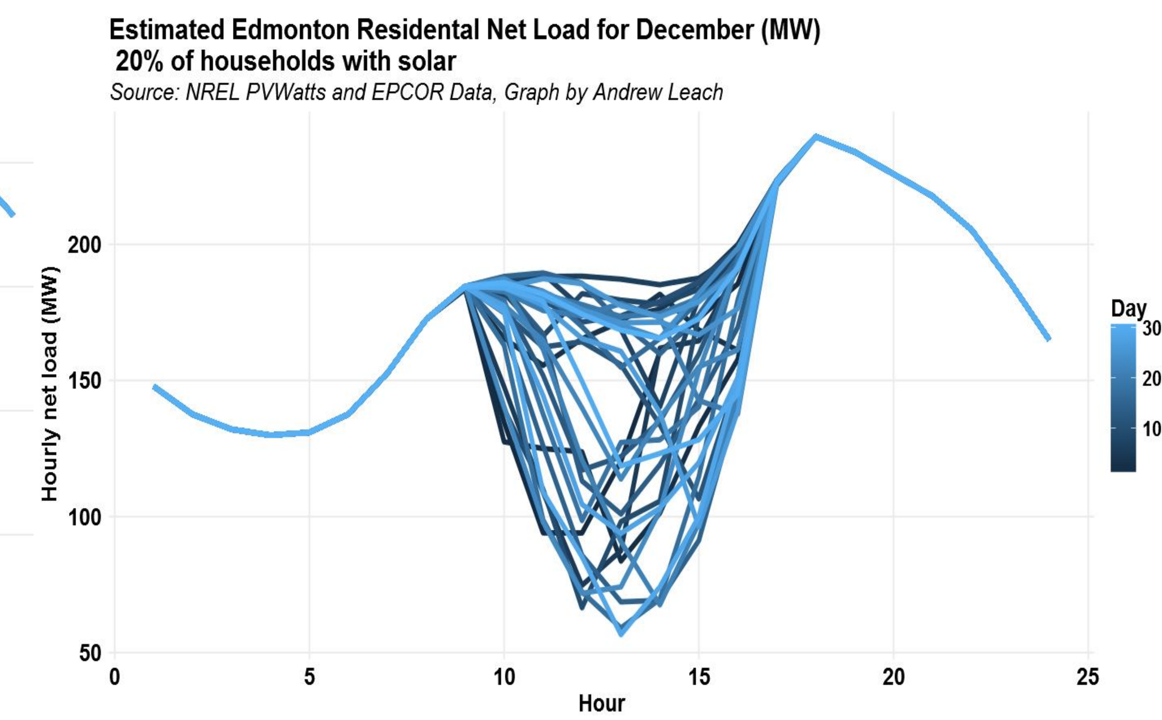
Below, there are three graphics which illustrate some of our challenges.

The first shows the hypothetical role of a battery (a single Tesla Powerwall) in a residential solar power system. While the battery does allow significant load-shaping, and does reduce the total draw of power from the grid, it does not change the peak demand from what it would otherwise have been after a few rainy days.

The second set of graphs shows hypothetical modeling of solar penetration into the residential grid in Edmonton. Even at 20% of rooftops, there are significant changes in peak out-flows of power, with Edmonton becoming a net generator in some periods. More challenging is the within-city load ramps seen in particular in December and their day-to-day variability.







THEME OVERVIEW

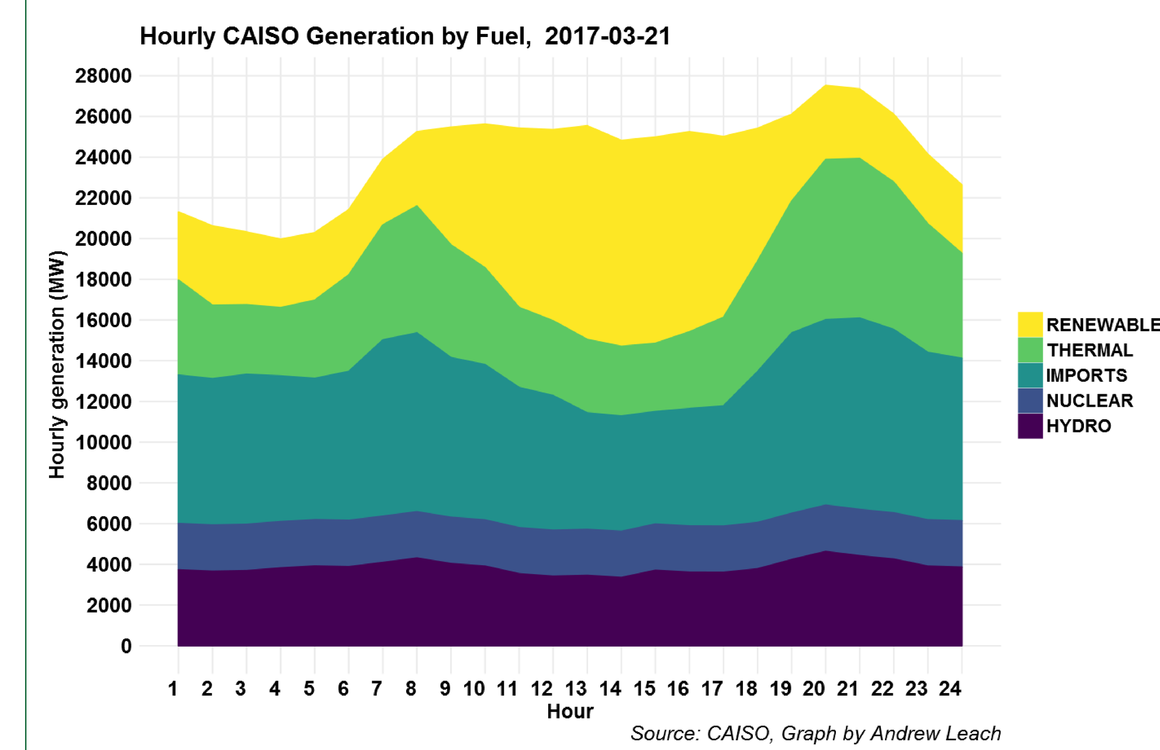
Grids and Storage

New technologies enable us to exploit renewable energy resources, but truly harnessing their energy requires the ability to control and adapt to the complex interaction between multiple sources and users. Smart grid technology will enable systems that can adapt to the variation in supply that is common from renewable sources, while new storage technologies will make it possible to retain energy generated at during peak times to be withheld for later use. Developing hybrid grids that can accommodate both AC and DC power, accommodating distributed generation, and effectively interfacing with legacy grid systems will be essential to our energy future.

EXPECTED OUTCOMES

Grid-wide analysis

We expect that our Alberta-wide, hourly-resolution electricity model, once fully developed and tested, will enable us to assess grid-scale options for energy storage in Alberta. Our primary focus will remain on the economics of energy storage as we seek to understand the interplay between energy storage and payment mechanisms for generation, capacity, ancillary services, transmission, demand response, and distribution services. Storage is unique in that it can have a role as both source and sink of electricity, can provide voltage regulation and other ancillary services, and can serve as a substitute for new transmission or generation.



EXTERNAL PARTNERS

The project is still in development, but early opportunities for collaboration have already presented themselves with companies engaged in the renewable energy and utility space in Alberta.

Capital Power

ALTALINK
A BERKSHIRE HATHAWAY ENERGY COMPANY

EPCOR

SOLAS
ENERGY CONSULTING

UNIVERSITY OF ALBERTA
FUTURE ENERGY SYSTEMS

CANADA FIRST
RESEARCH EXCELLENCE FUND

This research has been undertaken thanks in part to funding from the Canada First Research Excellence Fund.