

Regulation and Integration of Solar PV into Electricity Markets

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BACKGROUND

Solar PV capacity expansion in electricity markets has been growing at a rapid pace. This is driven primarily by the reduction in solar panel costs. The (unsubsidized) levelized cost of energy for large utility-scale solar PV, which represents the cost of generating a unit of electricity (in \$/MWh), has declined nearly 85% since 2009. The costs of solar PV are expected to continue to decline. This puts the unsubsidized levelized cost of energy from utility-scale PV at or below natural gas generation in some jurisdictions.

Despite this progress, substantial barriers and market structure issues remain which impede the deployment of solar PV.

We analyze questions related to:

- (i) The design of compensation policies for solar PV output;
- (ii) The design and performance of innovative regulatory models to motivate utilities to adopt solar PV onto their network; and
- (iii) Rooftop solar panel market structure and firms' abilities to exercise market power.

PROJECT OVERVIEW

Solar Photovoltaics (PV) will be an essential component of the electricity portfolio of the future. Solar PV costs have declined substantially and installed capacity has grown rapidly. For example, in the United States in 2015 and 2016, solar and wind generation capacity accounted for over 60% of all new capacity investments. Nearly half of these investments were in solar PV capacity. This growth has been driven in large part by the exponential decline in the cost of generating electricity from solar PV.

Despite this progress, there are numerous barriers to the adoption and integration of solar into electricity markets:

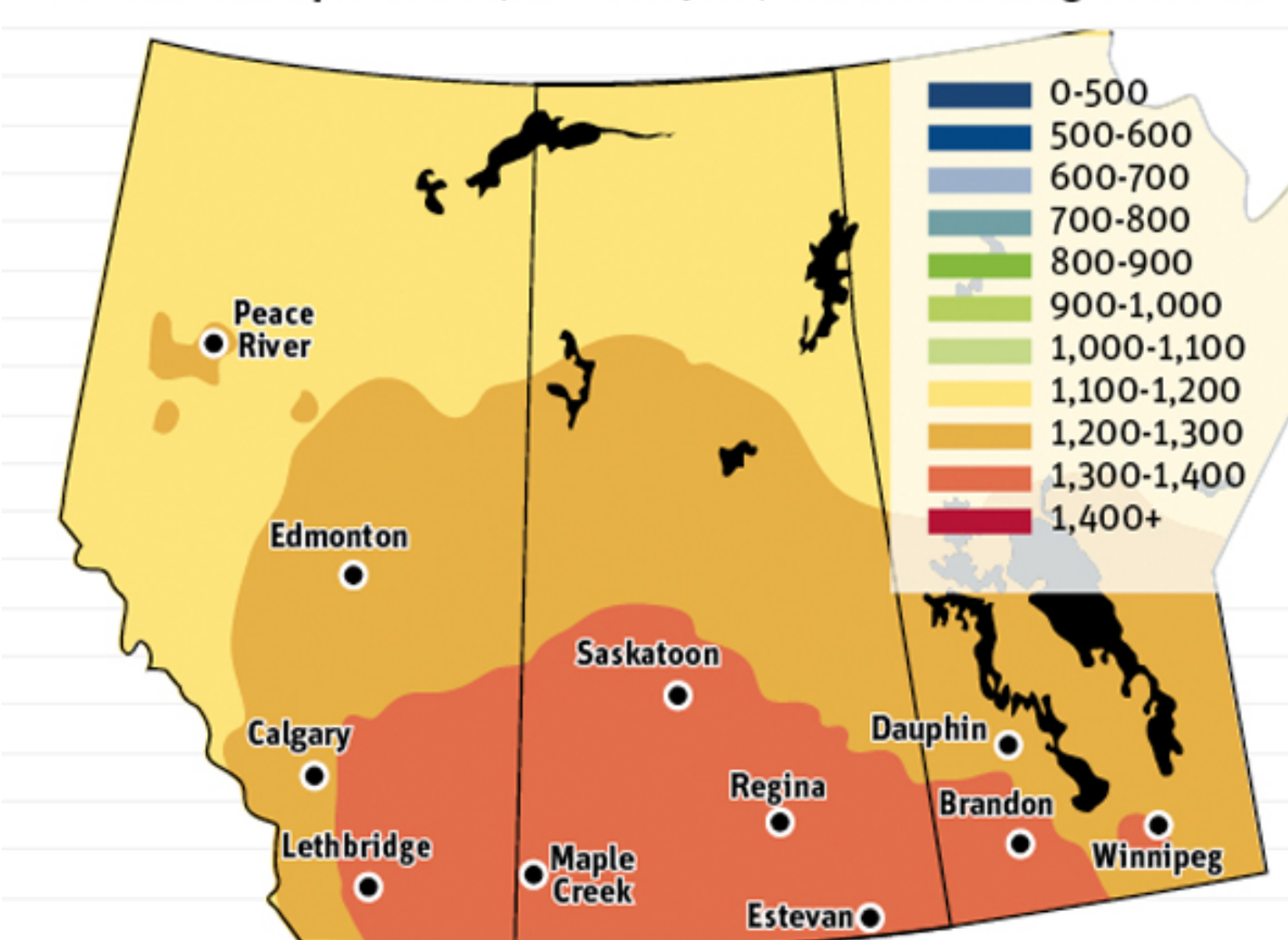
1. A fundamental issue with solar is its intermittency;
2. Existing regulatory models provide limited incentives for utilities to actively adopt and integrate solar into their power systems;
3. There has been considerable controversy over how solar should be compensated for its output; and
4. There are growing concerns over firms' abilities to exercise market power in the provision of solar panels.

The objective of our research program is to analyze the impacts of existing policies and regulations, and to consider alternative mechanisms to alleviate these barriers. We will analyze the performance of existing compensation policies, design alternative market mechanisms that take advantage of various instruments such as demand response and storage technologies to alleviate the issues associated with intermittency, and design new regulatory models that motivate utilities to actively integrate solar into their networks. Lastly, we will establish models to analyze the nature of competition in solar PV markets.



Source: Solar Energy Society of Alberta

Annual solar potential (kW hours/kW) for south-facing structures



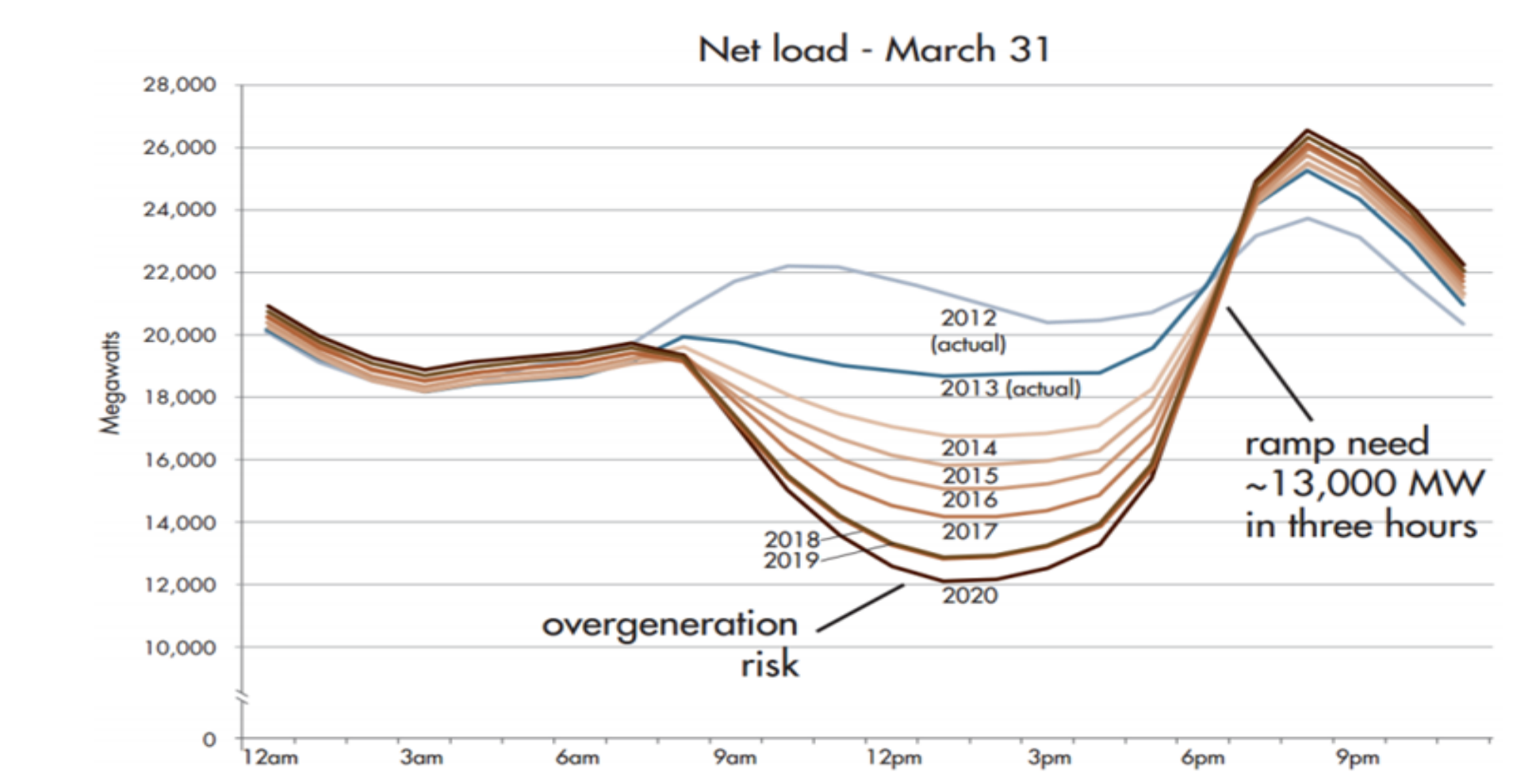
Source: Natural Resources Canada | WP GRAPHIC

EXPECTED OUTCOMES

We anticipate establishing several research publications in top peer-reviewed journals in the field of energy economics and policy. This research will contribute to the growing dialogue over how to integrate and regulate solar PV in electricity markets, and the nature of competition in the provision of rooftop solar panels.

Our work will also involve substantial policy outreach with the Alberta government and electricity industry. Further, we are currently pursuing collaborations with international government agencies related to issues of the integration and deployment of renewables in the electricity sector.

We expect to hold a conference in spring 2018, discussing issues related to the integration of renewables in the electricity sector, inviting leading academic researchers in the area of energy policy. In addition, we will hold an annual workshop on issues related to future energy systems and the integration of renewables in the power sector.



Source: CAISO (2013)

SHORT-TERM OBJECTIVES

In the short-term, we will establish several research projects that address the following important policy-relevant questions which will lead to increased deployment of solar PV:

1. Designing policies to motivate regulated utilities to actively adopt solar PV and other distributed technologies. This requires establishing policies to redesign the utility business model and facilitate the "Utility of the Future".
2. Establish a modeling framework to analyze market structure and spatial competition in the distributed solar market. We will subsequently analyze the impact of regional policies on the nature of market competition.

THEME OVERVIEW

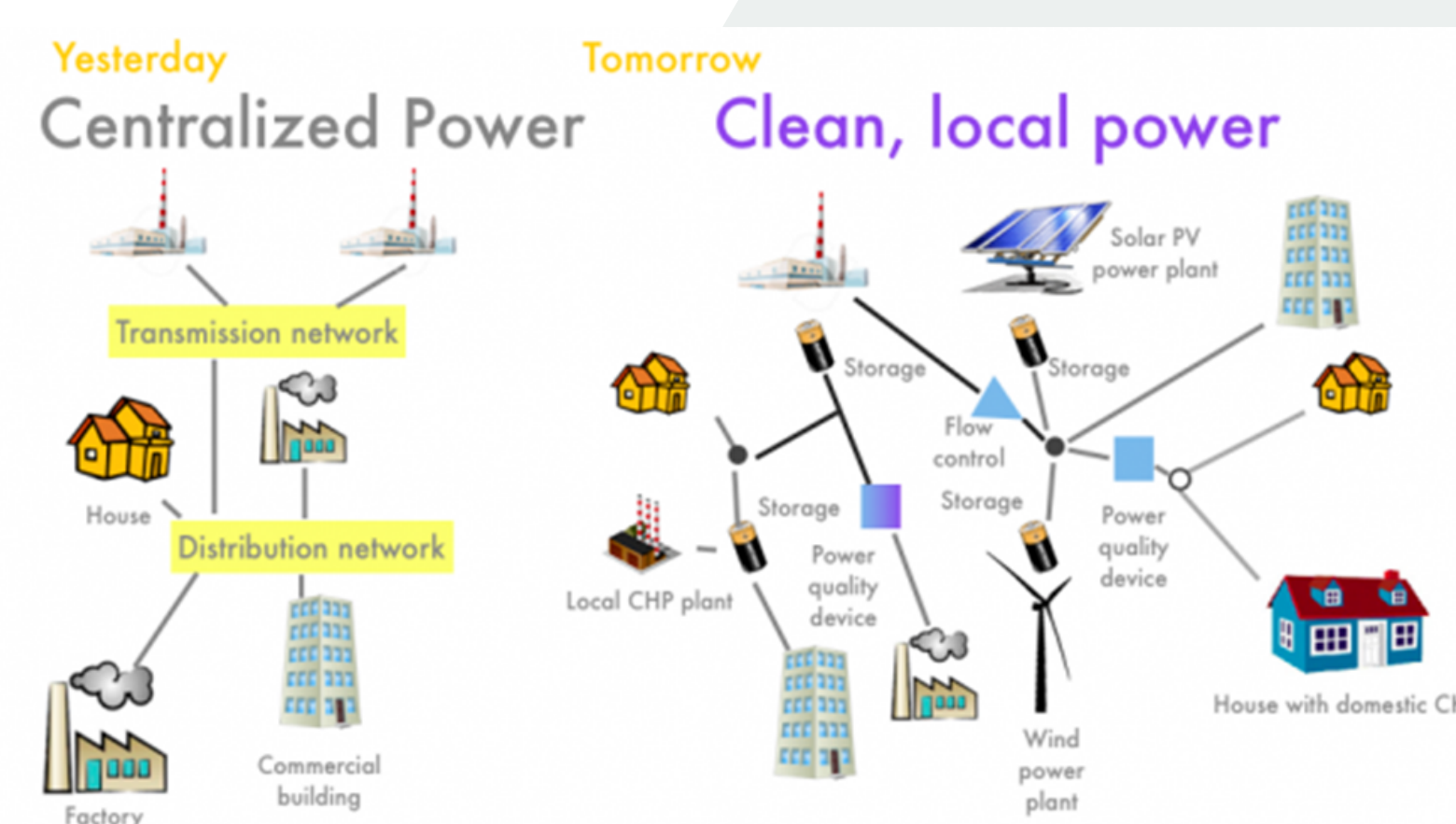
Solar

The sun powers the entire world, providing warmth, light, and sustenance for countless forms of life. Technologies have made it possible to use some of the sun's energy to produce electricity and fuels, but new refinements may allow us to diversify the ways in which solar energy can be generated, stored, and utilized. By identifying lower-cost materials for use in the construction of solar cells, finding new catalysts to enable different types of production, identifying more efficient methods for market integration, and considering the possibility of solar-derived hydrogen fuels, it may be possible to develop vast energy resources from the most abundant source in our lives.

EXTERNAL PARTNERS

We are actively pursuing research partnerships with numerous Canadian government agencies such as the Alberta Market Surveillance Administrator, Alberta Electric System Operator, and the Alberta Department of Energy.

We also anticipate collaborating with researchers from Waseda University's Research Institute for Environmental Economics and Management (RIEEM), University of Hawaii's Economic Research Organization (HERO), and the University of Florida's Public Utility Research Center (PURC).



Source: Institute for Local Self-Reliance

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