Community Generation Working Group

AUC Distribution System Inquiry

Module One Technical Conference

Considerations in incorporating DERs into the distribution system

September 10, 2019

FNPA™ The Pathway to Powerful Opportunities™

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Presentation Overview

- Part 1: Joe Peters (Peters Energy Solutions)
- Part 2: Sarah Simmons (Power Advisory LLC)

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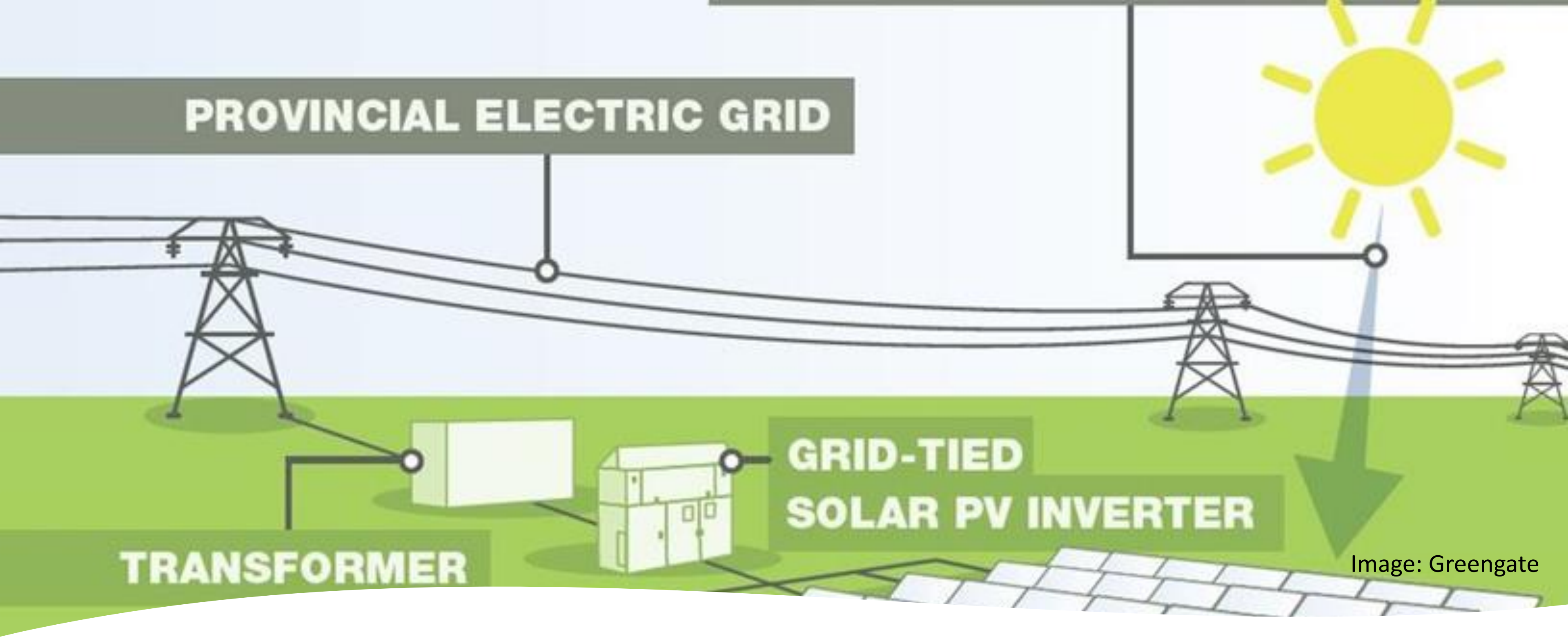


Image: Greengate

Distribution System Inquiry
Module One Technical Conference

Joe Peters, P.Eng.

September 10, 2019

Peters Energy
Solutions Inc.

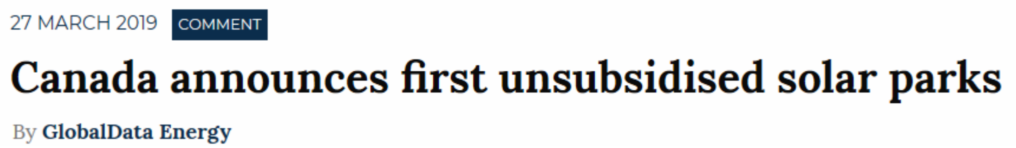
Presentation on behalf of CGWG

Solar in Alberta

Sunrise for Alberta's solar industry: Economics of commercial-scale projects increasingly make sense

Alberta's renewable energy sector has long been dominated by wind, but industry experts say a massive solar farm proposed for southern Alberta is proof of a coming sun-powered revolution.

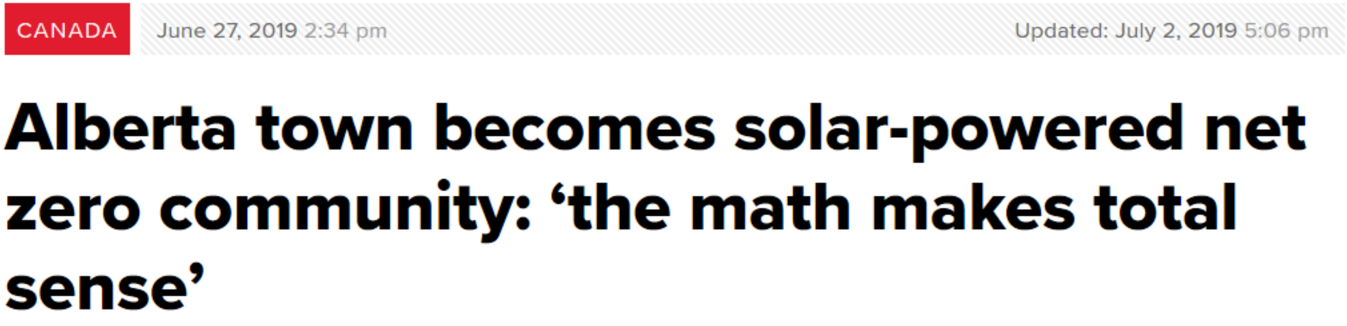
AMANDA STEPHENSON, CALGARY HERALD Updated: August 29, 2019



27 MARCH 2019 COMMENT

Canada announces first unsubsidised solar parks

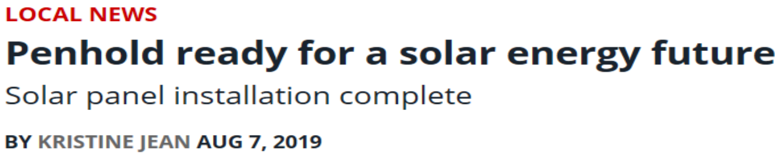
By **GlobalData Energy**



CANADA June 27, 2019 2:34 pm Updated: July 2, 2019 5:06 pm

Alberta town becomes solar-powered net zero community: 'the math makes total sense'

By Bob Weber The Canadian Press



LOCAL NEWS

Penhold ready for a solar energy future

Solar panel installation complete

BY KRISTINE JEAN AUG 7, 2019

Peters Energy Solutions Inc.

Solar is Competitive

“Is solar viable without subsidies?”

- Value in non-subsidized, market-driven solar
  - Supported in UCP Policy Document
- Large projects are commercially viable
  - 2 projects under construction now (46.5 MW)

Image: Solar Krafte Vauxhall Plant

Solar is Reliable

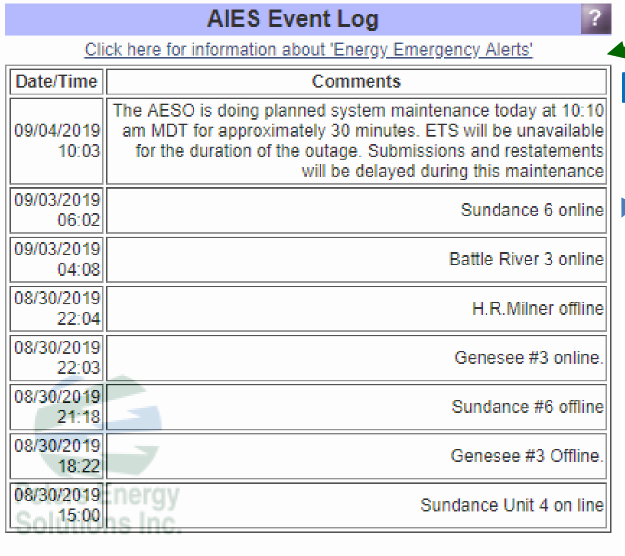
“Is solar is too intermittent?”

Reliability:

- Few moving parts
- Solar farm = collection of small (max 2.5 MW) generation plants
- Main intermittency = connecting distribution/transmission system

Variability:

- Position of sun = 100% predictable
- Cloud cover can be forecasted



AIES Event Log

Click here for information about 'Energy Emergency Alerts'

Date/Time	Comments
09/04/2019 10:03	The AESO is doing planned system maintenance today at 10:10 am MDT for approximately 30 minutes. ETS will be unavailable for the duration of the outage. Submissions and restatements will be delayed during this maintenance
09/03/2019 06:02	Sundance 6 online
09/03/2019 04:08	Battle River 3 online
08/30/2019 22:04	H.R.Milner offline
08/30/2019 22:03	Genesee #3 online.
08/30/2019 21:18	Sundance #6 offline
08/30/2019 18:22	Genesee #3 Offline.
08/30/2019 15:00	Sundance Unit 4 on line

Manageable impacts

Reliable

Variable

Intermittent

Solar is Variable

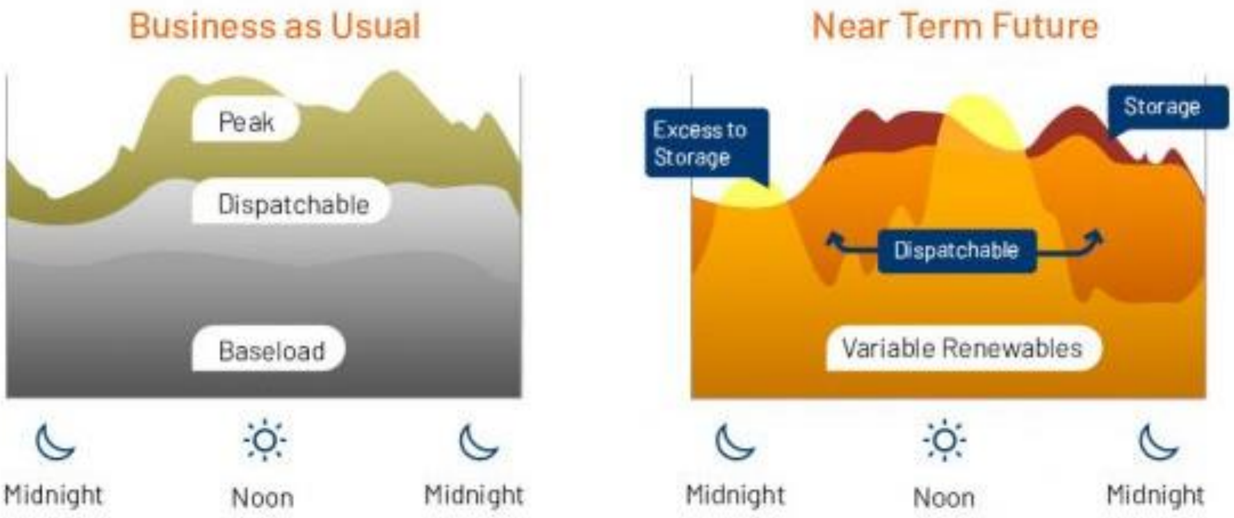
“Can the grid work with high solar penetration?”

Centralized Generation:

- Dispatch for offline generation
- Maintain baseload generation
- Plan for peak loads
- More predictable

Integrated Renewables:

- Smart-grid technologies
- Load management strategies
- Flexible, on-demand resources
- Control fluctuating loads



Source: International Solar Energy Society

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Solar is a Grid Complement

- Solar is a valuable part of the generation mix
  - Highly reliable, predictable & dispatchable
  - Correlates with high demand
  - Responsive to locational grid requirements

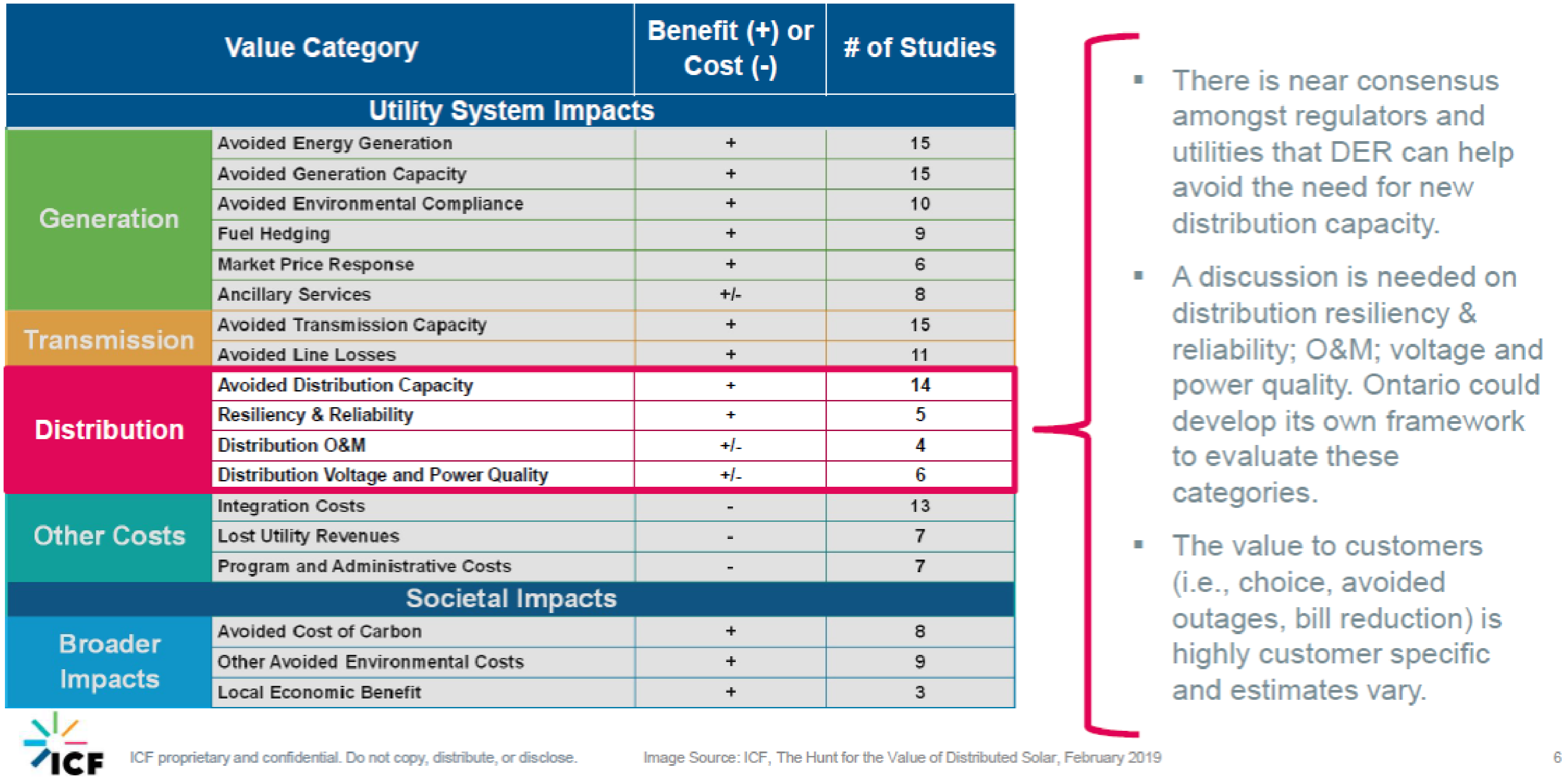
Image: Aura Power

Integration of Technology

- Integrate versus manage grid-edge technologies
    - Use flexible generation capacity
    - Incorporate as non-wire alternative
    - Provide ancillary grid services

Image: Aura Power

The Value of Distributed Solar



Value Category		Benefit (+) or Cost (-)	# of Studies
Utility System Impacts			
Generation	Avoided Energy Generation	+	15
	Avoided Generation Capacity	+	15
	Avoided Environmental Compliance	+	10
	Fuel Hedging	+	9
	Market Price Response	+	6
	Ancillary Services	+/-	8
Transmission	Avoided Transmission Capacity	+	15
	Avoided Line Losses	+	11
Distribution	Avoided Distribution Capacity	+	14
	Resiliency & Reliability	+	5
	Distribution O&M	+/-	4
	Distribution Voltage and Power Quality	+/-	6
Other Costs	Integration Costs	-	13
	Lost Utility Revenues	-	7
	Program and Administrative Costs	-	7
Societal Impacts			
Broader Impacts	Avoided Cost of Carbon	+	8
	Other Avoided Environmental Costs	+	9
	Local Economic Benefit	+	3

- There is near consensus amongst regulators and utilities that DER can help avoid the need for new distribution capacity.
- A discussion is needed on distribution resiliency & reliability; O&M; voltage and power quality. Ontario could develop its own framework to evaluate these categories.
- The value to customers (i.e., choice, avoided outages, bill reduction) is highly customer specific and estimates vary.

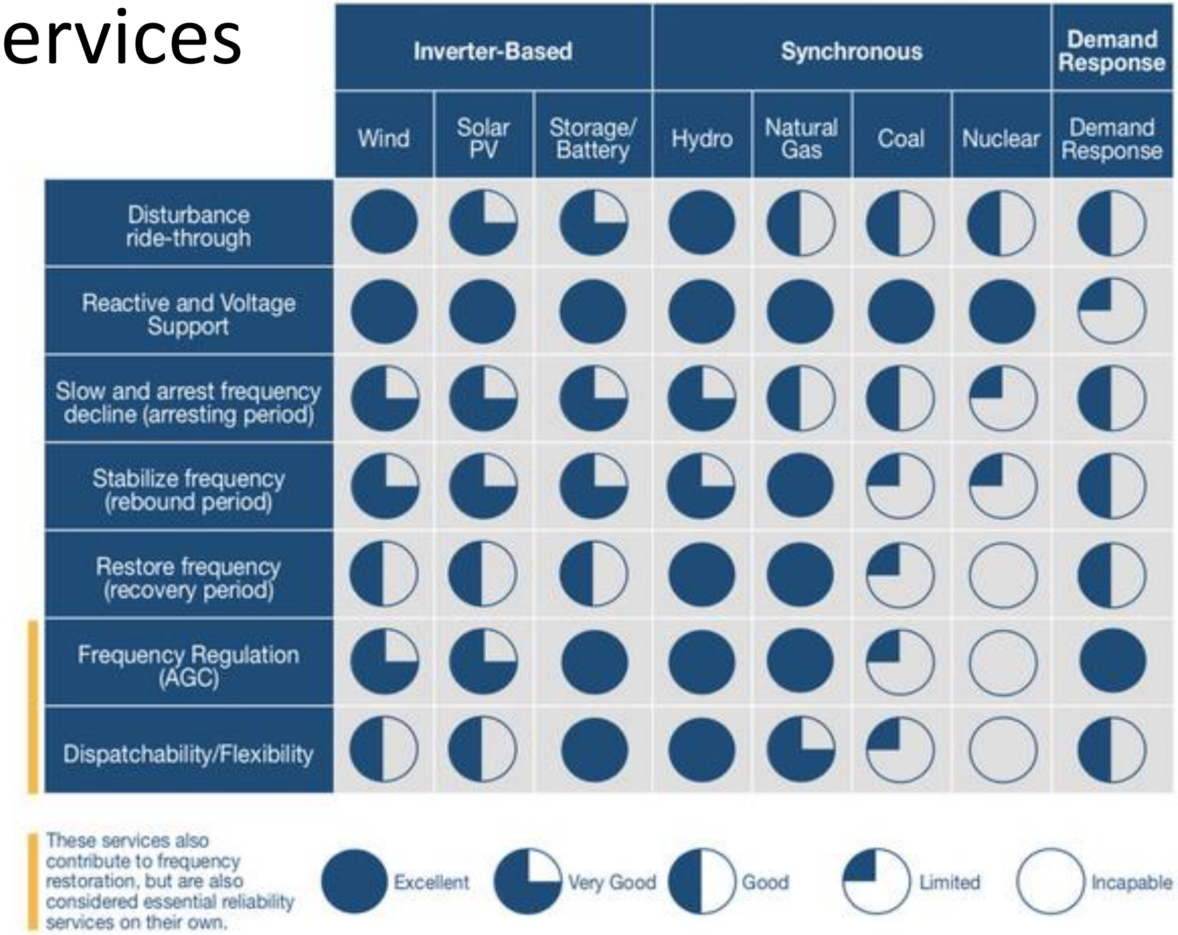
Image Source: ICF, The Hunt for the Value of Distributed Solar, February 2019

6

OEB. Case EB-2018-0287. Utility Renumeration. Retrieved from: https://www.oeb.ca/industry/policy-initiatives-and-consultations/utility-remuneration

Technology Comparison

Grid Services



	Inverter-Based			Synchronous				Demand Response
	Wind	Solar PV	Storage/ Battery	Hydro	Natural Gas	Coal	Nuclear	Demand Response
Disturbance ride-through	●	◕	◕	●	◑	◑	◑	◑
Reactive and Voltage Support	●	●	●	●	●	●	●	◔
Slow and arrest frequency decline (arresting period)	◕	◕	◕	◕	◑	◑	◔	◑
Stabilize frequency (rebound period)	◕	◕	◕	◕	●	◔	◔	◑
Restore frequency (recovery period)	◑	◑	◑	●	●	◔	○	◑
Frequency Regulation (AGC)	◕	◕	●	●	●	◔	○	●
Dispatchability/Flexibility	◑	◑	●	●	◕	◔	○	◑

These services also contribute to frequency restoration, but are also considered essential reliability services on their own.

● Excellent ◕ Very Good ◑ Good ◔ Limited ○ Incapable

Milligan, Michael. November 2018. Sources of Grid Reliability Services. The Electricity Journal, 31(9), 1-7.

Peters Energy Solutions Inc.

Innovation is Required

- E.G. Hail protection plus solar generation make this Sol Power / Okotoks Honda project successful
- Innovation is required to drive costs out and find the creative solutions
- Who is best positioned and incented to provide the innovation?

Image: Okotoks Honda

MG and small: Accessibility Required

- Recognition of value:
  - Hourly energy measurement and value
  - CO_2 value
    - Hourly
  - Credit for distribution/transmission value
  - Access to available grid support opportunity
    - Long-term opportunity

Distribution System Inquiry: Module One Technical Conference

Sarah Simmons
September 10, 2019

Power Advisory LLC

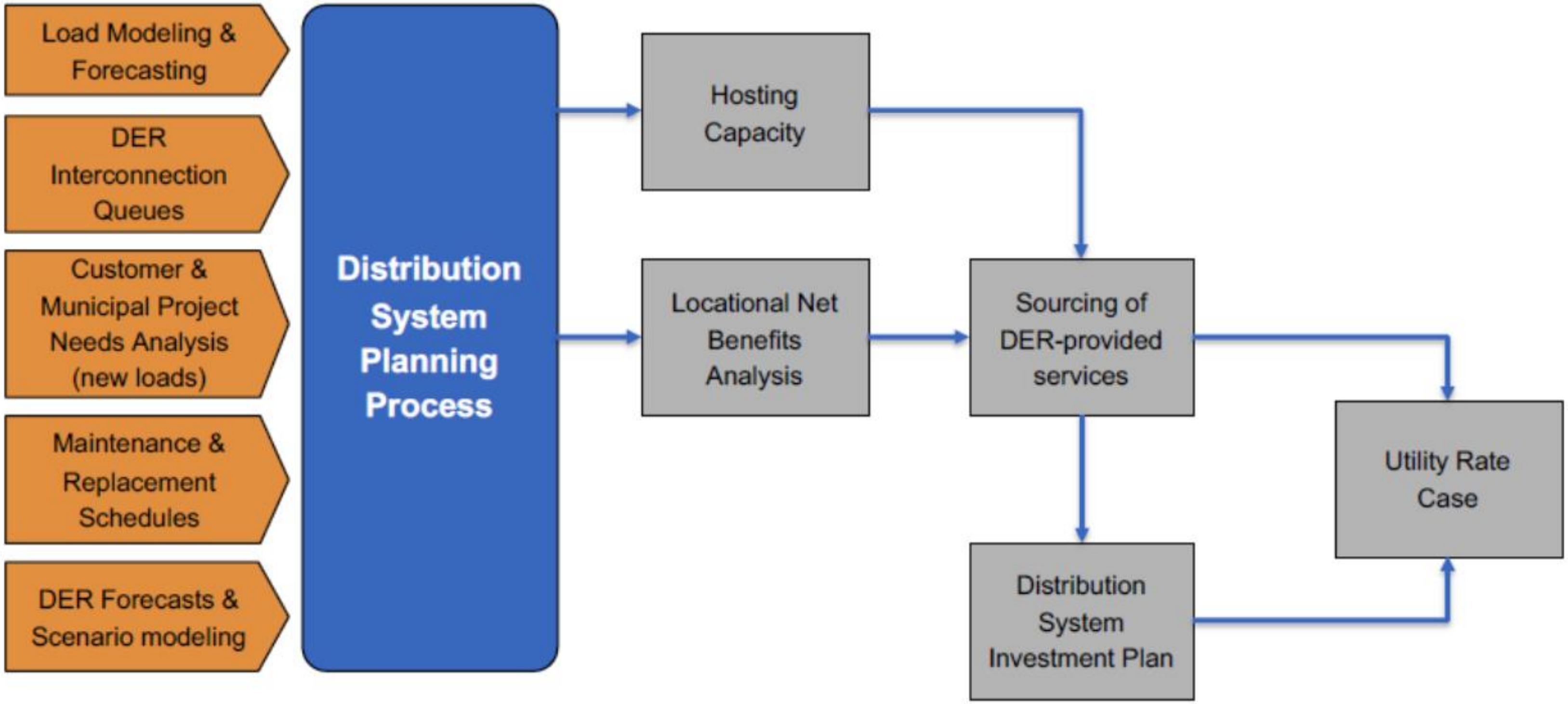
www.poweradvisoryllc.com

Presentation on behalf of CGWG

Best Practices for Distribution System Planning

- Framework outlined by the Advanced Energy Economy (AEE) in 2018:
  - Encourage DER to be sited in areas where it can be most beneficial to the grid
  - Make hosting capacity and non-wires solicitation information available to participants
  - Build appropriate transparency into the planning process (catalyst for innovation and private capital investment that complements utility investment)
  - Owners/operators of non-utility DERs that provide grid services should be provide appropriate information that allows the utility to optimize their value for the benefit of all customers

Best Practices for Distribution System Planning



Advanced Energy Economy. (2018, June 29). Distribution System Planning: Proactively Planning for More Distributed Assets at the Grid Edge. Retrieved from https://info.aee.net/21ces-issue-briefs

Non-Wires Alternative Case Studies

- In 2018, the Smart Electric Power Alliance, Peak Load Management Alliance and E4TheFuture published case studies from 10 leading U.S.-based NWA projects

- One project highlighted in CGWG IR responses – Boothbay Project / GridSolar
  - Intervened in 2008 rate case of Central Maine Power (CMP)
  - Original CMP expansion plans included 300-mile transmission upgrade ($1.5 Billion)
  - GridSolar predicted that CMP load growth estimate was too high / limited number of hours
  - Commission intervened and carved out a portion of the project for an NWA pilot
    - Energy efficiency, demand responses, solar, storage and back-up generation
  - Solar, operating passively downstream of the constrained area, resulted in additional capacity on transmission line
  - CMP took on role to provide dispatch instruction, while system was operated by Grid Solar
  - Pilot demonstrated reliability of NWA and cost savings ($12 Million)

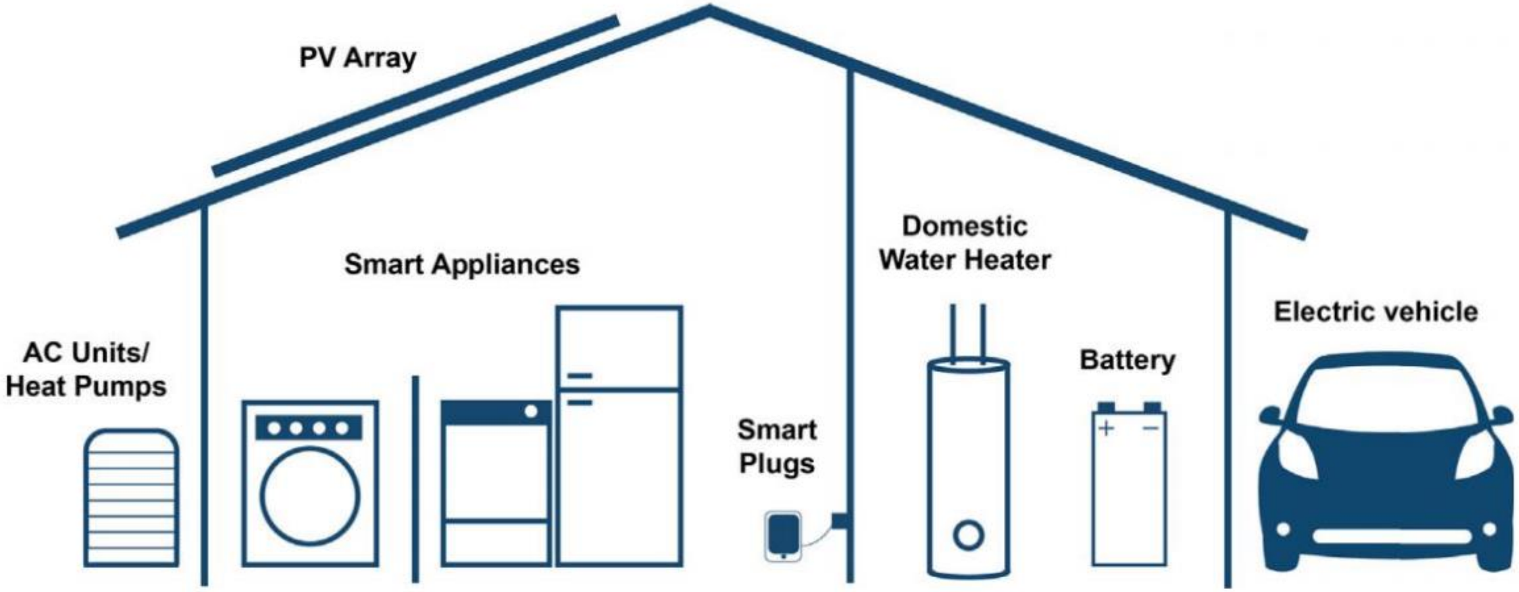
Lessons Learned from NWA Case Studies

- **Flexibility** – NWAs can be implemented in phases as load grows
- **Reliability** – NWAs can provide comparable reliability at lower costs compared to transmission construction projects
- **Cost savings** – NWAs can reduce stranded costs that may result from unnecessary infrastructure upgrades if forecasted load growth does not materialize; and
- **New approaches to revenue and incentives are needed** – a major hurdle for NWA projects is the traditional utility model of compensation (e.g., fixed rate of return on traditional capital investments)

Chew, B., Myers, E. H., Adolf, T., & Thomas, E. (2018, November). Non-Wires Alternatives: Case Studies From Leading U.S. Projects. Retrieved from https://sepapower.org/resource/non-wires-alternatives-case-studies-from-leading-u-s-projects/

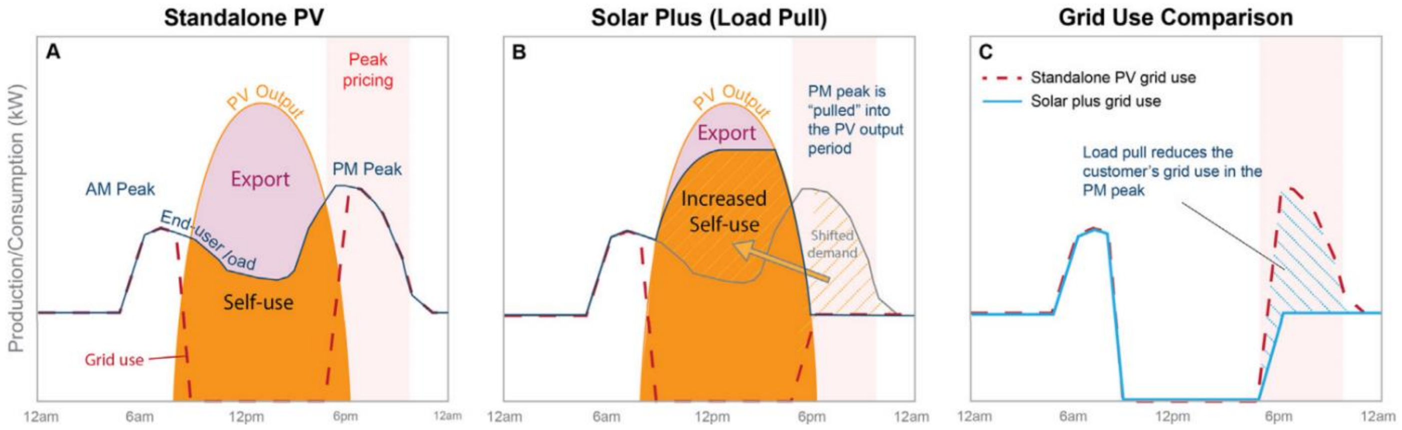
Value of solar and “solar plus” solutions

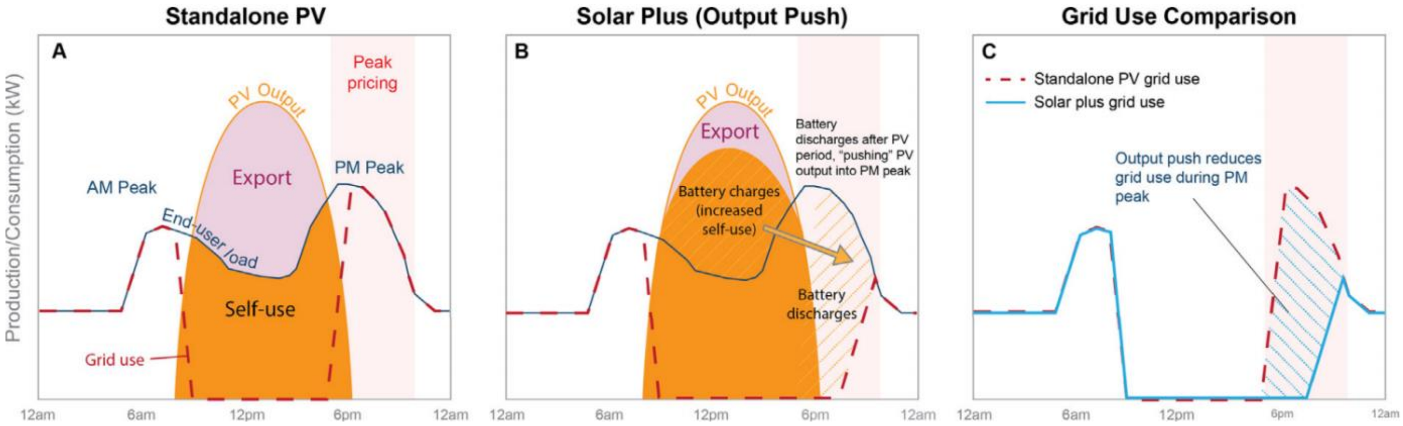
- The value of solar to the customer can be increased by controlling and temporally shifting electricity output using energy storage and other load control devices, an approach referred to as “solar plus”



O'Shaughnessya, E., Cutler, D., Ardani, K., & Margolis, R. (2018). Solar plus: A review of the end-user economics of solar PV integration with storage and load control in residential buildings. *Applied Energy*, 2165–2175. Retrieved from https://www.osti.gov/pages/servlets/purl/1417734

Load “push” vs. “load pull”





O'Shaughnessya, E., Cutler, D., Ardani, K., & Margolis, R. (2018). Solar plus: A review of the end-user economics of solar PV integration with storage and load control in residential buildings. *Applied Energy*, 2165–2175. Retrieved from https://www.osti.gov/pages/servlets/purl/1417734

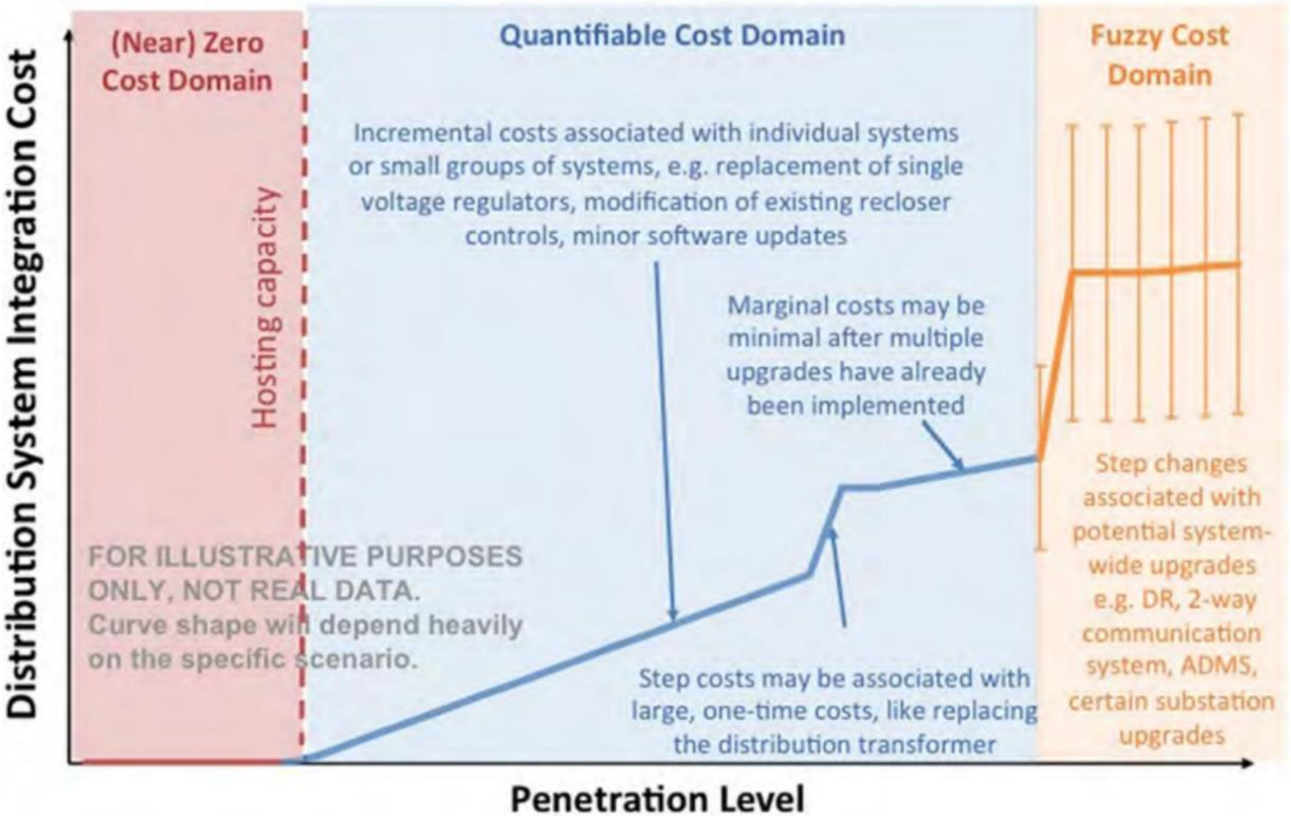
Customer benefits of “solar plus”

- O'Shaughnessya et al (2018) show that “solar plus” can increase on-site solar use and that these benefits can justify the incremental costs of “solar plus” devices for a variety of technologies (e.g., batteries, smart appliances, smart plugs, air conditioning units, hot water heating, electric vehicles), geographies, and customer load profiles.

- Customer benefit associated with “solar plus” is greatest when:
  - a) electricity output is sold to the grid at a lower value than the customer’s retail rate
  - b) time-of-use rates peak periods do not coincide with solar output
  - c) demand charge rates for load peaks do not coincide with solar output, and
  - d) electricity delivery charge rates are significant and/or vary with consumption

O'Shaughnessya, E., Cutler, D., Ardani, K., & Margolis, R. (2018). Solar plus: A review of the end-user economics of solar PV integration with storage and load control in residential buildings. *Applied Energy*, 2165–2175. Retrieved from https://www.osti.gov/pages/servlets/purl/1417734

Addressing integration costs



Horowitz, K. A., Palmintier, B., Mather, B., & Denholm, P. (2018). Distribution system costs associated with the deployment of photovoltaic. *Renewable and Sustainable Energy Reviews, 90*, 420-433. Retrieved from https://www.peakload.org/assets/resources/NREL%20PV%20Cost%20Paper%202018.pdf

Conclusion and next steps

- Enable new opportunities for Community Generation (including Co-ops and Indigenous power projects) as well as individual customers
- Find unsubsidized ways to enable, approve, simplify, facilitate and lower the cost and complexity for solar and solar+storage energy development
- Provide flexibility for solar and solar + storage as grid resources
- Realize benefits for all customers – reduced distribution system costs by displacing loads or by offering automated power factor and other support

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Conclusion and next steps

- The move to a grid with more distributed resources will require significant changes over time including:
  - rate structure and tariff reform
  - technology deployment and enablement across the grid
  - more granular metering data
    - Competitive opportunity
    - Time-based carbon value, energy value, wires value
    - Support policy initiatives
  - changes to utility planning practices
  - clarification of AESO rules
  - consideration of new revenue streams and services for utilities or third parties
  - enablement of NWAs via legislative, policy, and regulatory modernization

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- Thank you!
- Questions?

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