Microgrids & Distributed Energy Is there a revolution in the making?

Council for Clean & Reliable Energy
transforming the way we think about power

WISE
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Thursday November 24
University of Waterloo
Federation Hall

Jatin Nathwani
Executive Director, WISE
CCRE Energy Leaders Roundtable
Hockley Valley Resort
April 07, 2017

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The coming energy revolution…..

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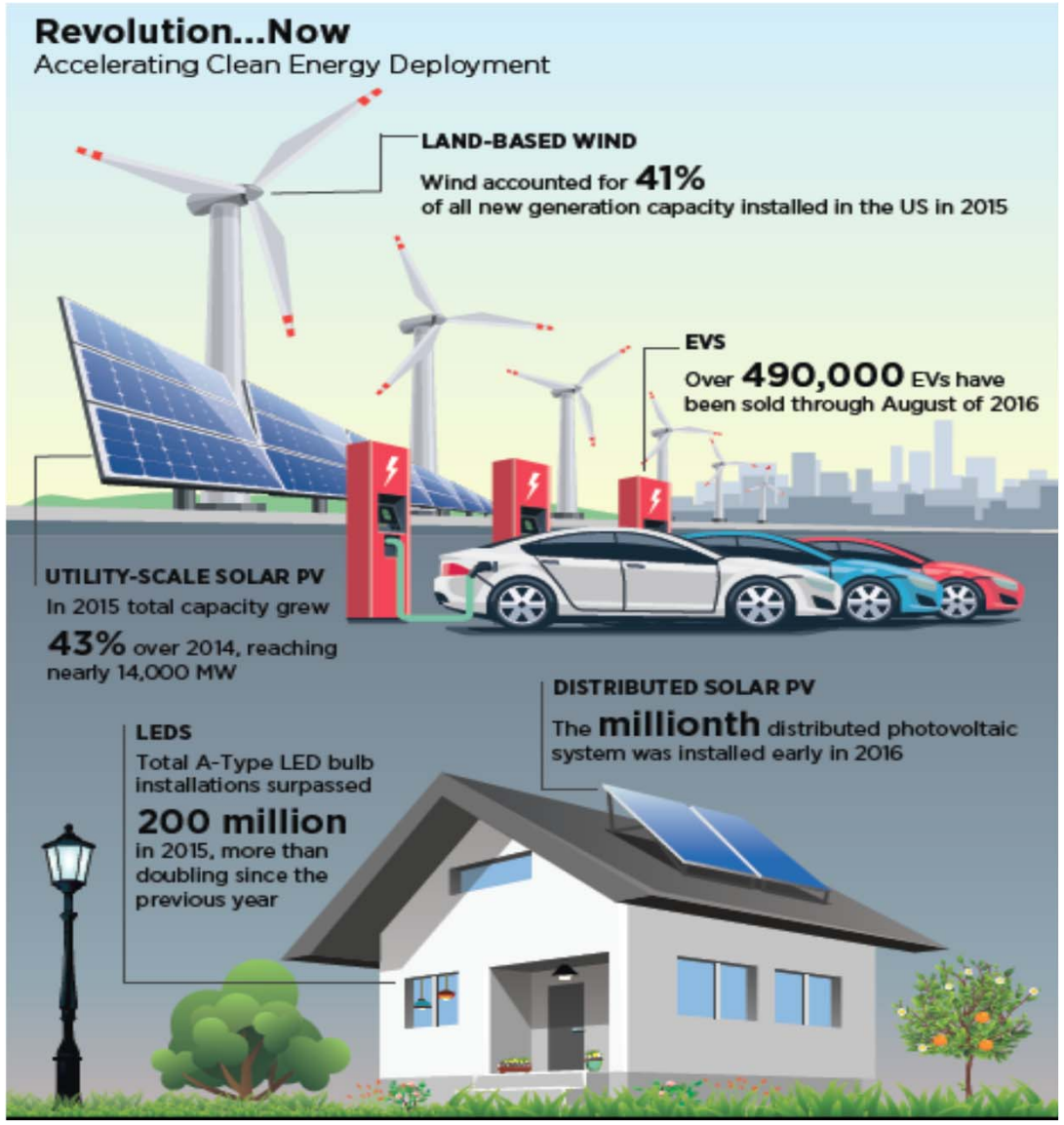
...will be led by innovators and accountants

Energy Revolution- Where?



Source: US DOE, 2016 'The Future Arrives for 5 Clean Energy Technologies

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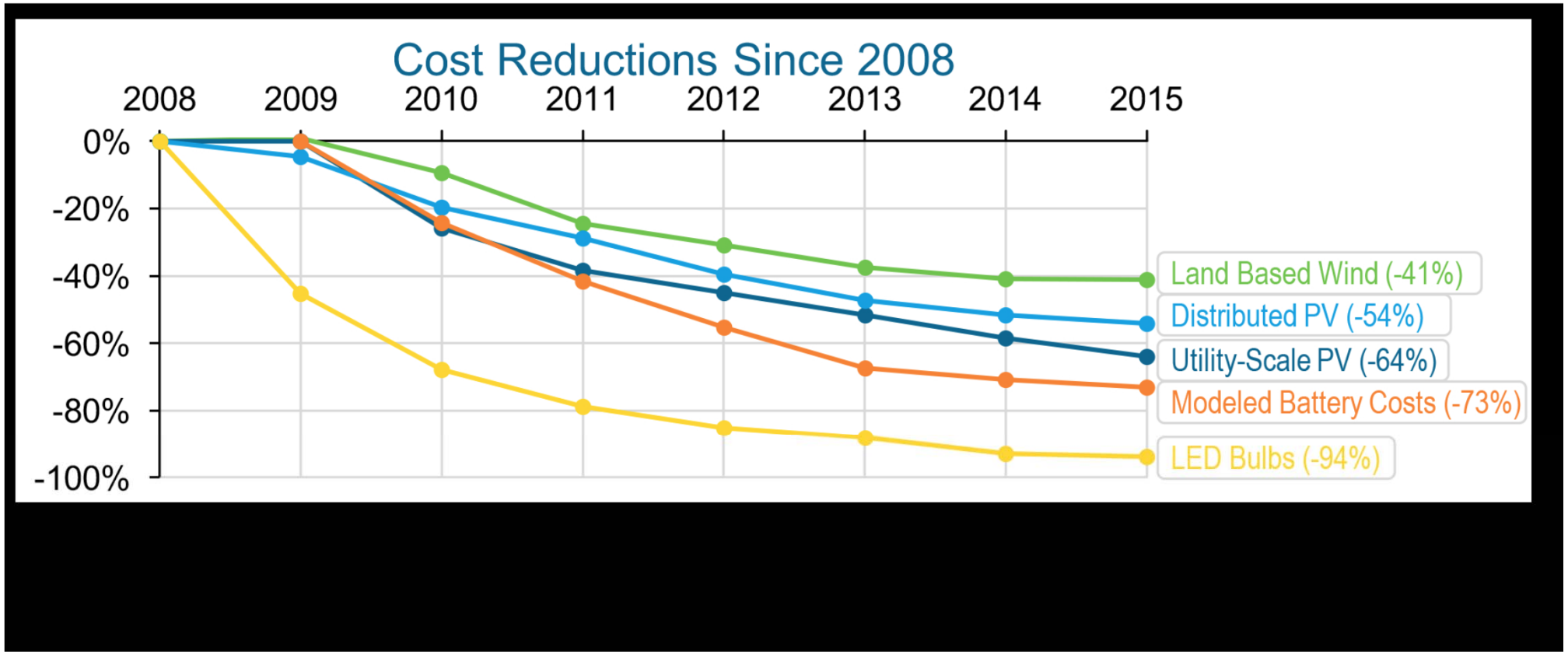
Future Arrives for 5 Energy Technologies



Source: USDOE 2016 'The Future Arrive for 5 Clean Energy Technologies
Notes: Land based wind costs derived from levelized cost of energy from representative wind sites from references [1]and [2] Distributed PV is average residential installed cost from reference [3] Utility-Scale PV is median installed cost for utility-scale PV systems from reference [4] Modeled battery costs are at high-volume production of battery systems, derived from DOE/UIS Advanced Battery Consortium PHEV Battery development projects LED bulbs are for A-typebulbs from reference [5]

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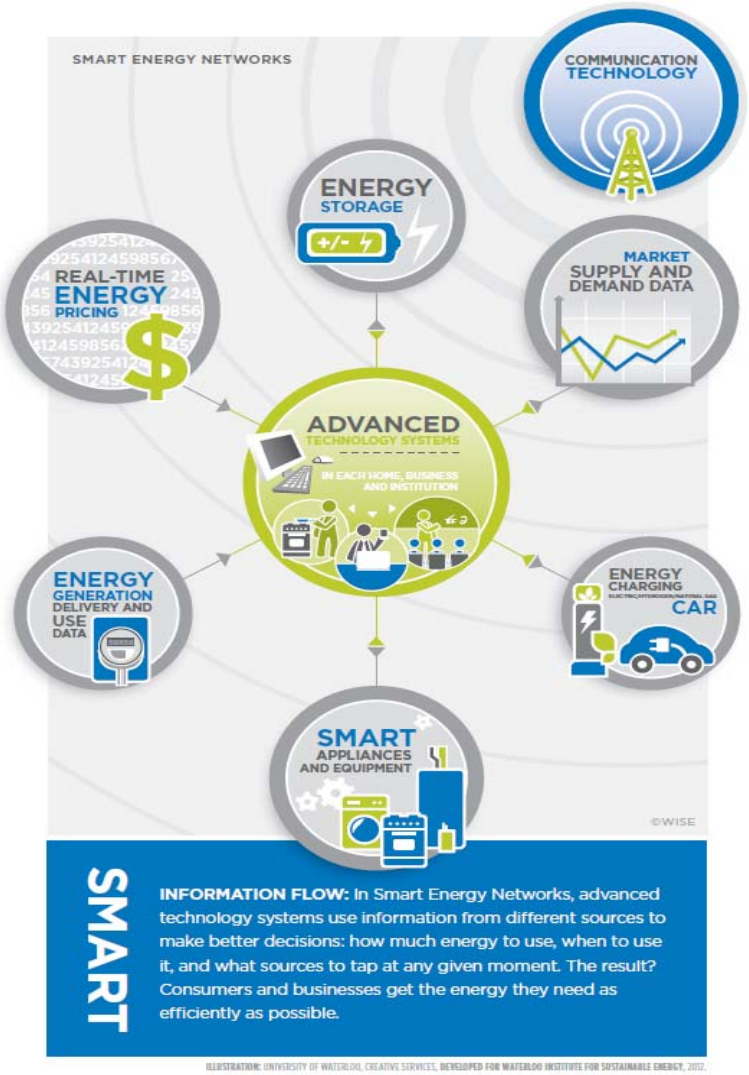
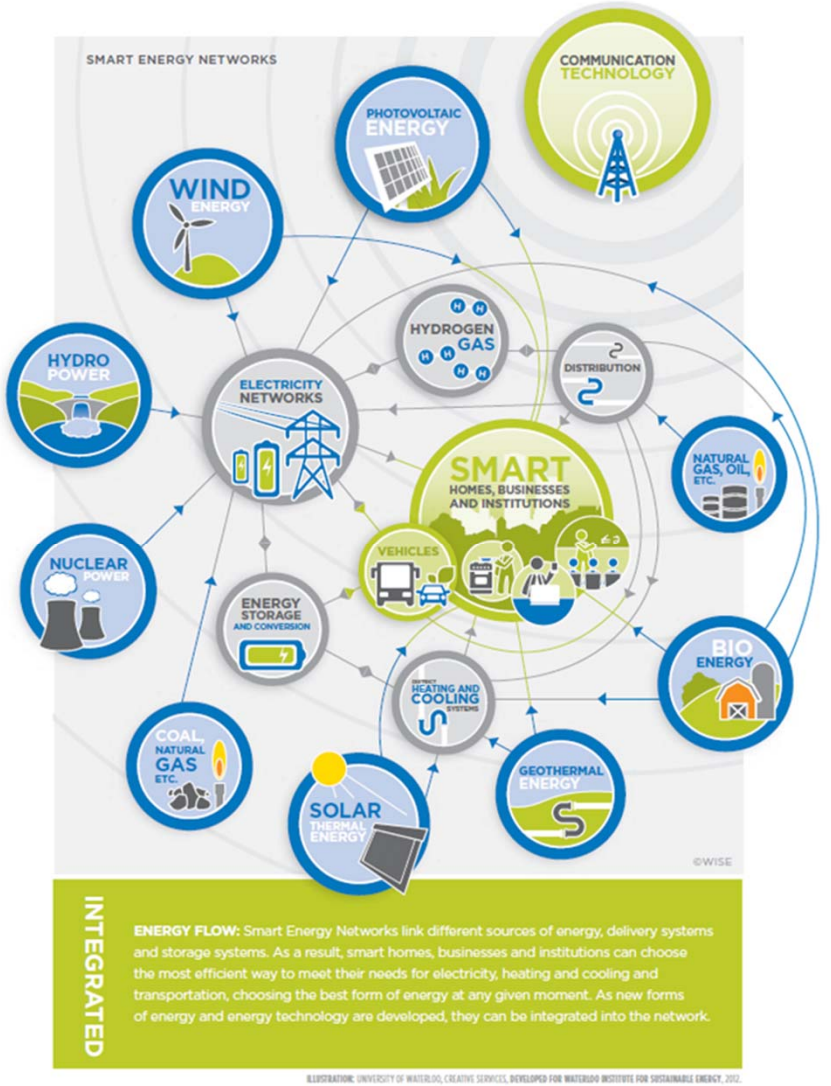
Smart Energy Networks





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Cars controlling the Grid?

Electric Vehicles Sell Power Back to the Grid

Delaware Test Fleet Makes Money by Serving as an Electricity Reserve

Balance of Power

The numbers behind the University of Delaware program using cars as a money-making reserve for the electric grid

Cars used	23 (19 all-electric Mini E's, 3 modified Scion xB's, 1 experimental Honda Accord plug-in hybrid)
What they do	Store or discharge electricity according to grid needs
Special equipment needed	Control board, $200-$300 per car
Power of car batteries	12 kilowatts per vehicle*
Minimum capacity needed for a grid "bank"	100 kilowatts/9 cars
Time connected to grid	24/7 except when being driven
Average daily driving time	About an hour per car
Monthly revenue per car from grid operator	About $150
Monthly electricity cost/car	About $40
Monthly profit	About $110 per car/$2,500 total

*For Minis and Scions. Honda power not disclosed.

Source: University of Delaware

The Wall Street Journal

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Solar Charging Stations for Electric Vehicles

2 kW EV Charging Station

10 kW EV Charging Station

30 kW EV Charging Shade Structure

300 kW EV Charging

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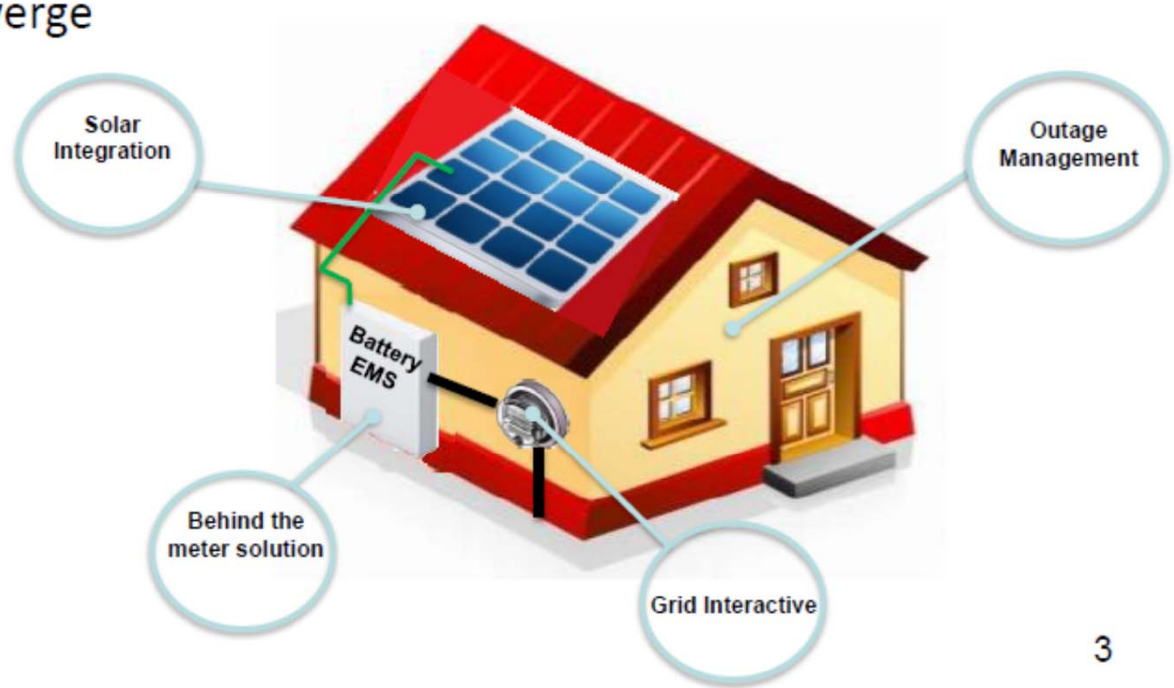
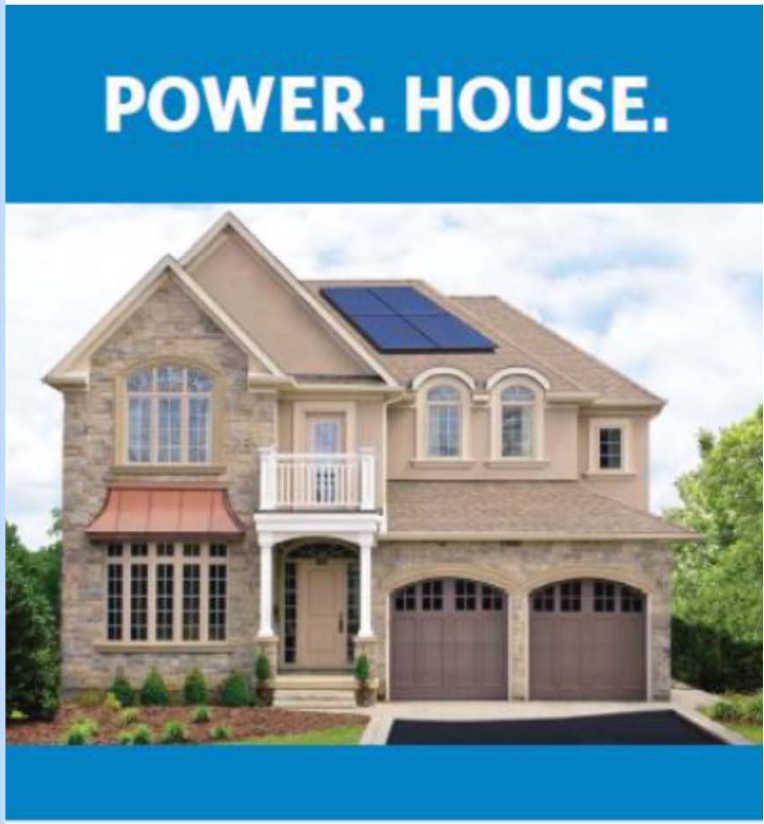
POWER.HOUSE VPP launched March 2016

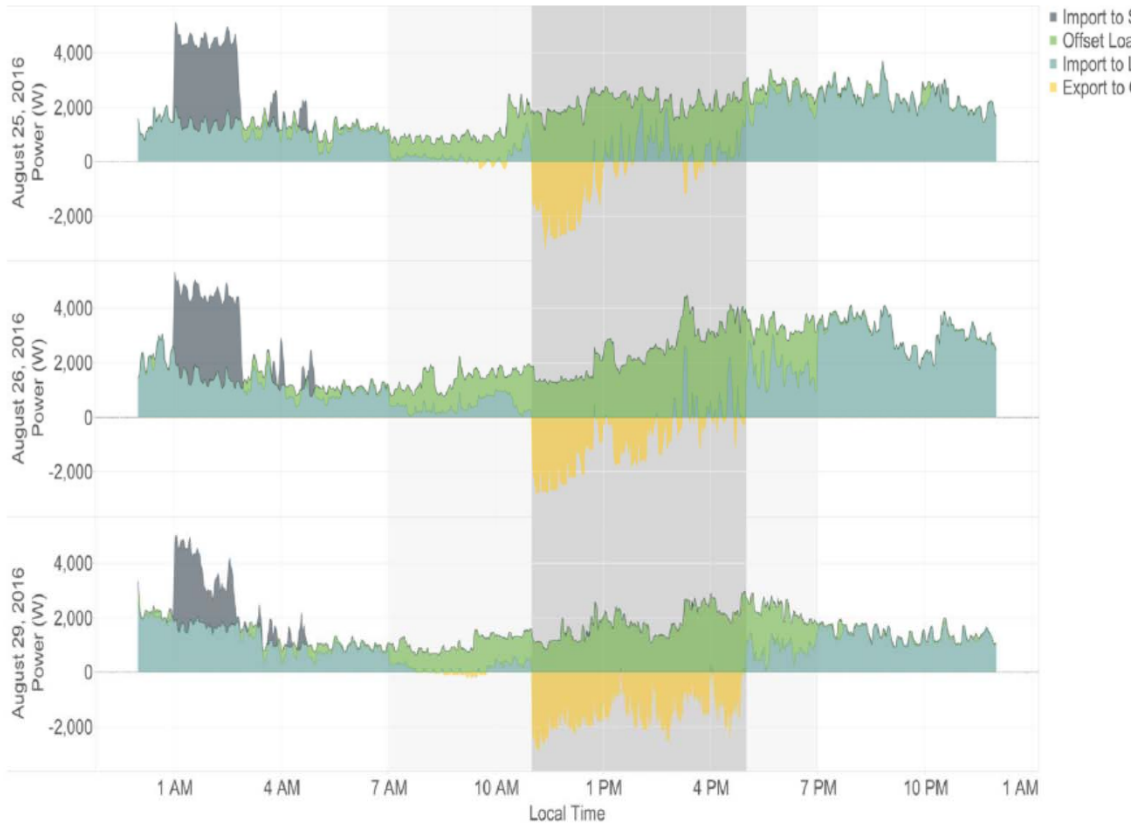
IESO Conservation Fund for 20 homes:

- 20 targeted homes in PowerStream territory
- 5 KW solar array; Sunverge unit- 6.8 KW/11.4KWH battery and EMS
- Aggregation of distributed assets to create a Virtual Power Plant
- Technology partner: Sunverge
- Installation partner: RBI

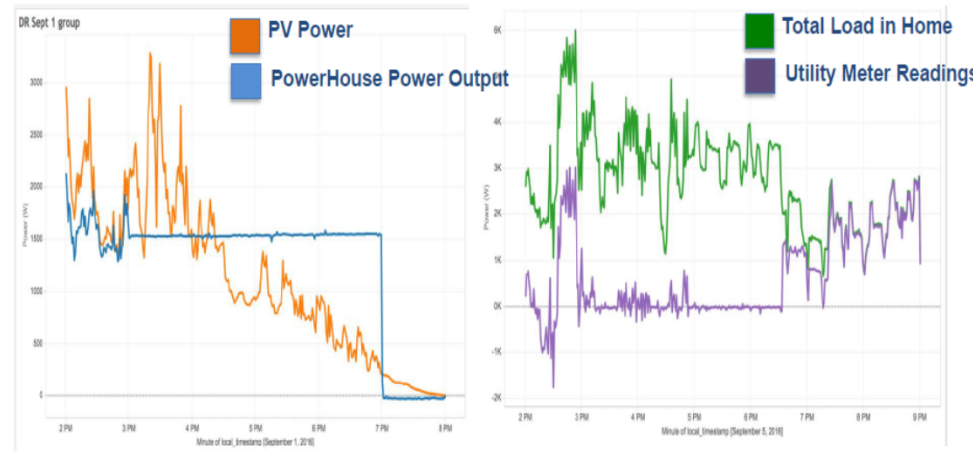




TOU Rate Management (using TOU arbitrage algorithm)



Demand Response Summary



- Graphs show average response of group of units
- Two different approaches to providing DR
- Left graph shows constant power output
- Right graph shows effort to minimize impact on grid (target = 0 kW utility meter readings)

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Thursday November 24
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Conference Program

8:30 am **Registration & Continental Breakfast**

9:30 am **Welcome**
Glen Wright, Chairman, Council for Clean & Reliable Energy (CCRE)
Jatin Nathwani, Executive Director, Waterloo Institute for Sustainable Energy (WISE); Member CCRE

9:45 am **Keynote Speaker**
Bruce Campbell, President and CEO, Independent Electricity System Operator

Innovation in Ontario's Electricity Sector

10:15 am **Break**

10:30 am **Panel 1: Technology and Disruptive Innovation**

Declining cost structure of distributed energy resources (solar, EVs and storage, microgrids) pose a challenge to the utility distribution network. Will prosumers proliferate? Is the state of technology mature enough for a massive exodus of customers and is there a real threat of stranded assets?

Moderator: **Jatin Nathwani**, Executive Director, WISE; Member, CCRE
Panelists: **Mark Henderson**, EVP, Asset Management and COO, PowerStream
Josipa Petrunic, Executive Director and CEO, Canadian Urban Transit Research and Innovation Consortium (CUTRIC)
Hartmut Schmeck, Professor of Applied Informatics, Karlsruhe Institute of Technology (KIT), University of Karlsruhe, Germany
David Teichroeb, Business Development, Emerging Technology, Enbridge Gas Distribution

Q&A Session: 45 minutes

12:00 pm **Lunch**

12:30 pm **Innovation Showcase, Networking & Industry-Academic Collaboration**

1:15 pm **Optional Lab Tours** (for Pre-registered Guests)
Lab 1: Fuel Cell and Green Energy Lab
Lab 2: Centre for Advanced Photovoltaic Devices

1:30 pm **Panel 2: Financing: Business Models; and, Regulatory Construct: Policy Alignment**

The traditional 'cost recovery' model for the electricity sector was designed and built for a one-way flow of energy technology. Technology is changing the texture of the system. Will distributed energy resources, high penetration of variable generation and ICT-enabled consumers undermine the existing business model of the distribution utilities?

Moderator: **David McFadden**, Counsel, Gowling WLG (Canada) LLP; Member, CCRE
Colin Andersen, Chair, Energy Council of Canada
Brian Poth, Partner, Power and Utilities, PricewaterhouseCoopers
Paul Murphy, Board Chair, Advanced Energy Centre
Vicky Sharpe, Corporate Director and founding President and CEO, Sustainable Development Technology Canada (SDTC)

Q&A Session: 45 minutes

3:00 pm **Wrap-Up and Closing Remarks**
David McFadden, **Jatin Nathwani** and **Glen Wright**

3:15-5:30pm **Reception, Innovation Showcase, Networking & Industry-Academic Collaboration**
Please join us for a Networking Reception

Optional Lab Tour 3:45 pm (for Pre-registered Guests)
Lab 2: Centre for Advanced Photovoltaic Devices

Thank you to our supporters

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