

The Future for LDCs

What changes will determine the future for Electricity LDCs and How soon will changes be upon us?

Dan McGillivray, Ph.D.

Council for Clean & Reliable Electricity

October 15, 2014



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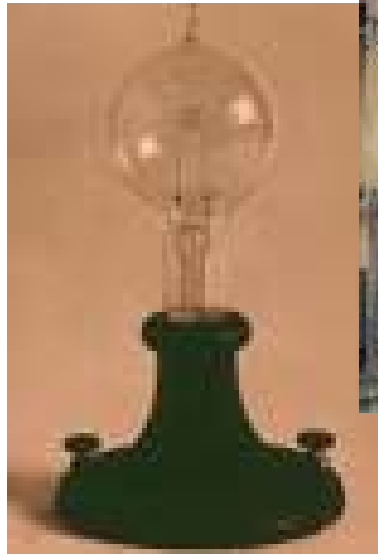
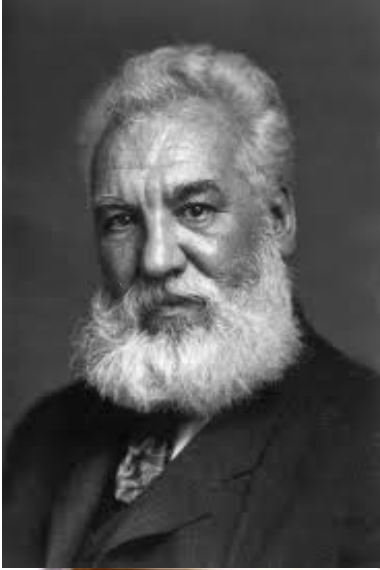
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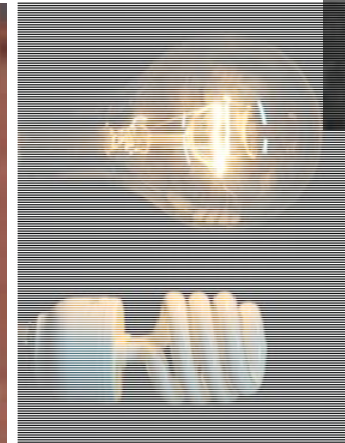
Hypothesis

The pace of energy technology development is accelerating, particularly in the areas of solar PV and battery storage, which are reaching grid parity, making the electrical grid optional for many consumers, reducing the revenues received by utilities and threatening to strand billions of dollars of energy assets.





Innovation



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Jeremy Rifkin sees a global economy in which the marginal costs of producing some goods is lowered to zero...

We are witnessing the emergence of the third industrial revolution:

The 1st industrial revolution was driven in part by coal and the locomotive.

The 2nd ... by electricity and trucks.

The 3rd ... by the Internet, renewable energy and the exponential growth in digital sensors, moving, tracking and transporting goods.



Globe & Mail, June 24, 2014

In Ontario, the power grid frequently has a surplus of electricity ... such that wind and solar producers push the price of electricity into negative territory.



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1 The accelerating pace of change ...



2 ... and exponential growth in computing power ...

Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years

COMPUTER RANKINGS

By calculations per second per \$1,000



Analytical engine
Never fully built, Charles Babbage's invention was designed to solve computational and logical problems



Colossus
The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II



UNIVAC I
The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.



Apple II
At a price of \$1,298, the compact machine was one of the first massively popular personal computers



Power Mac G4
The first personal computer to deliver more than 1 billion floating-point operations per second

3 ... will lead to the Singularity

10²⁶ ← 2045 Surpasses brainpower equivalent to that of all human brains combined

10²⁰ ← Surpasses brainpower of human in 2023

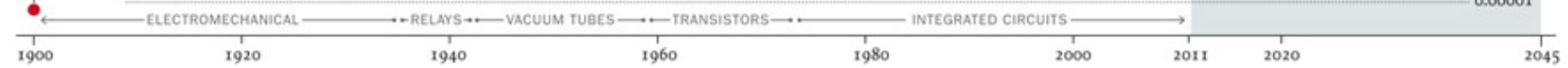
10¹⁵ ←

10,000,000,000 ← Surpasses brainpower of mouse in 2015

100,000 ←

1 ←

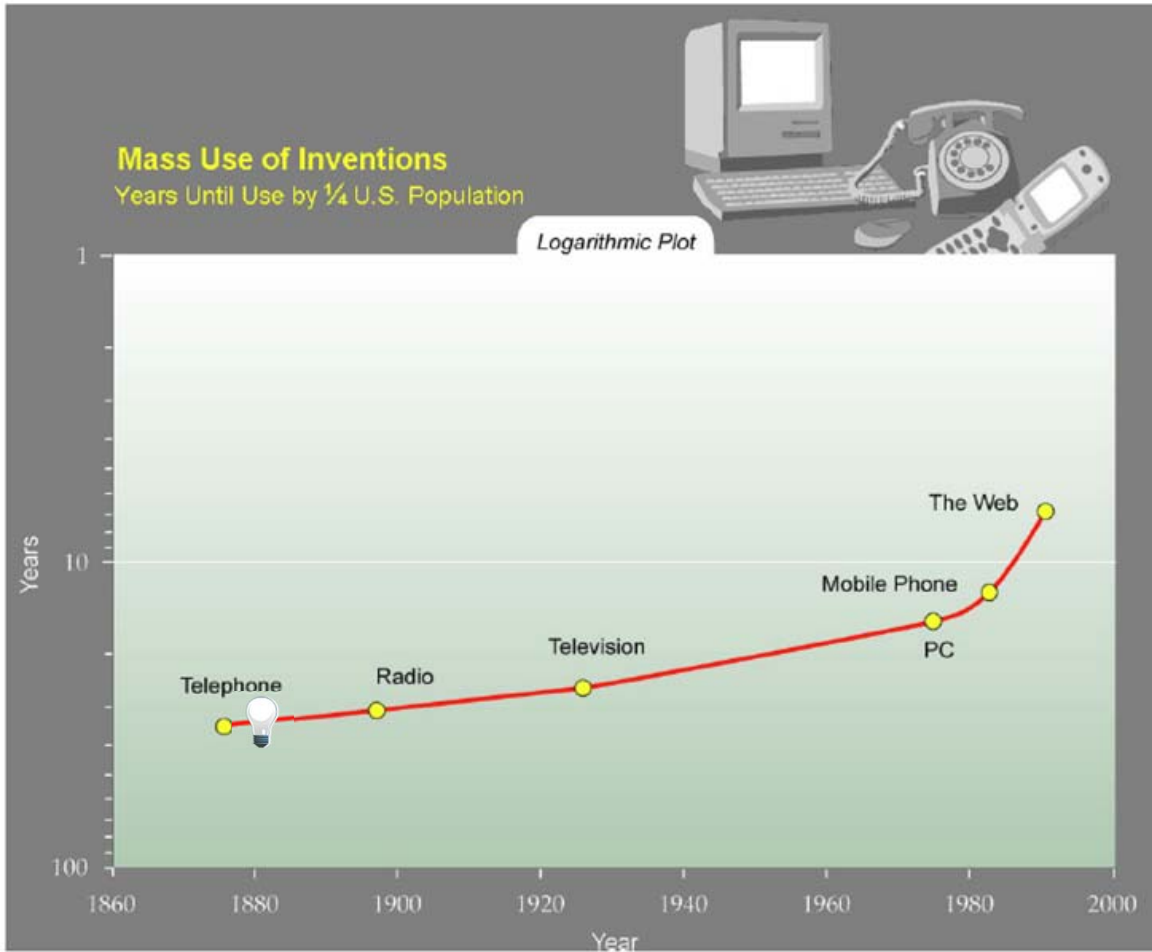
0.00001 ←



Price performance of computing (Calculations / sec / \$1000)

Time: February 2011

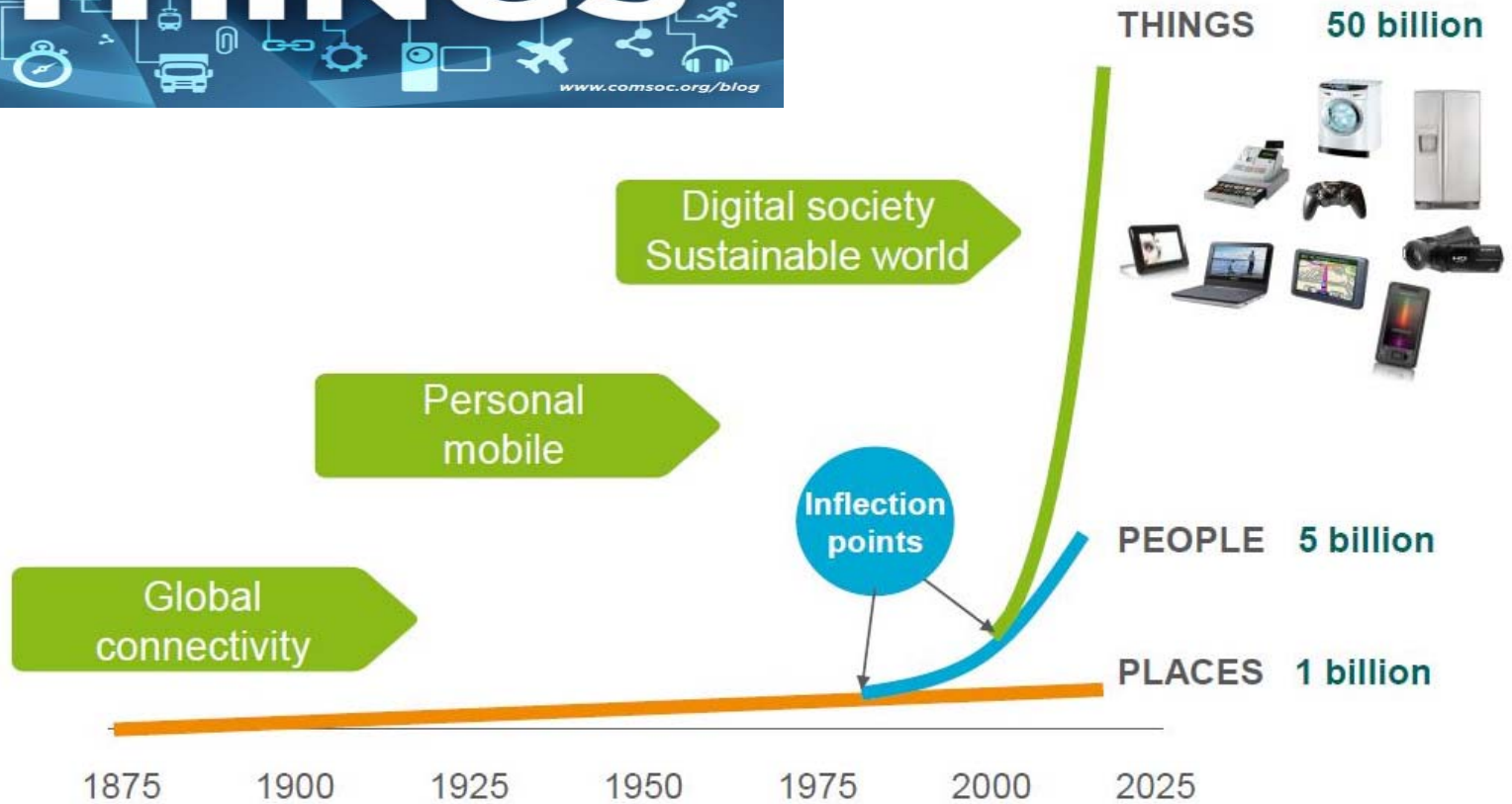
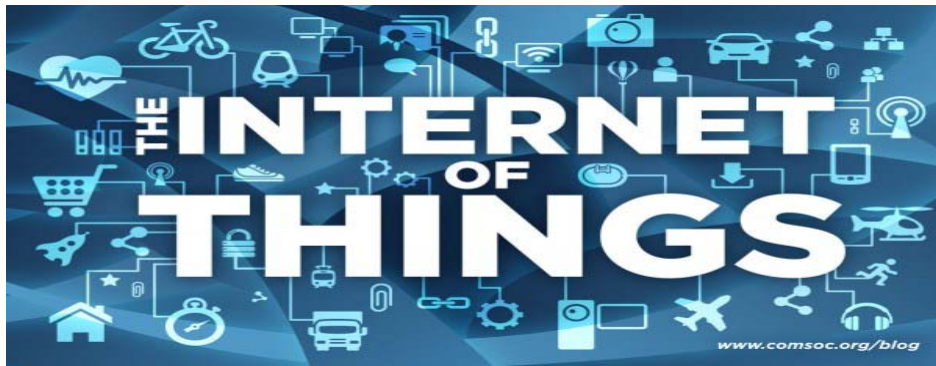
Mass Use of Inventions

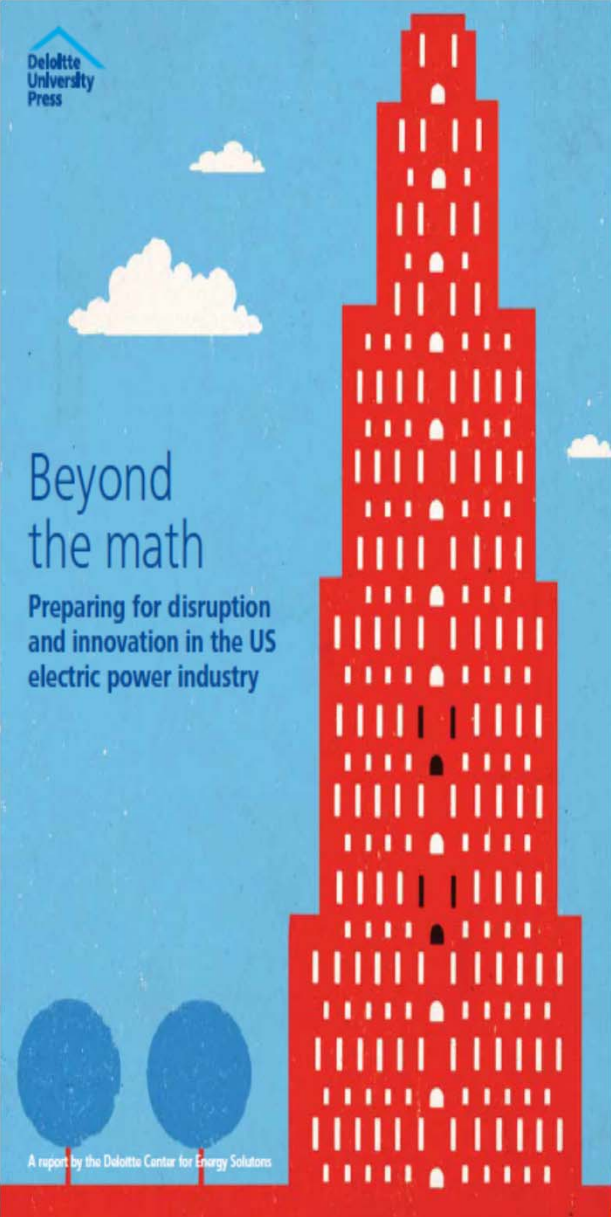


The overall rate of adopting new technologies, parallels the rate of technology progress. It is currently doubling every decade.

Kray Kurzweil, 2005: *THE SINGULARITY IS NEAR: When Humans Transcend Biology*, Viking Press.







Beyond
the math

Preparing for disruption
and innovation in the US
electric power industry

A report by the Deloitte Center for Energy Solutions

Gregory Aliff, 2013: Energy & Resources, Deloitte LLP

- ❖ The electric power industry could soon be facing the most disruptive period of change since the commercialization of electricity in the 19th century.
- ❖ Distributed renewable generation, demand side management technologies and energy storage technologies are breaking the traditional boundaries between LDC and customer.
- ❖ The customer is being enabled to produce, conserve, shift and store energy.



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Five Dimensions Controlling Velocity of Change

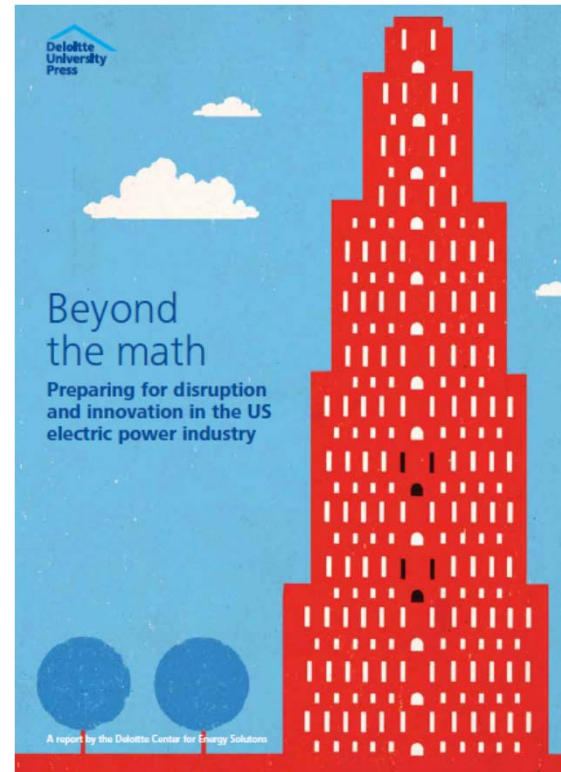
Demand

Technology

Regulations

Alternatives

Competition

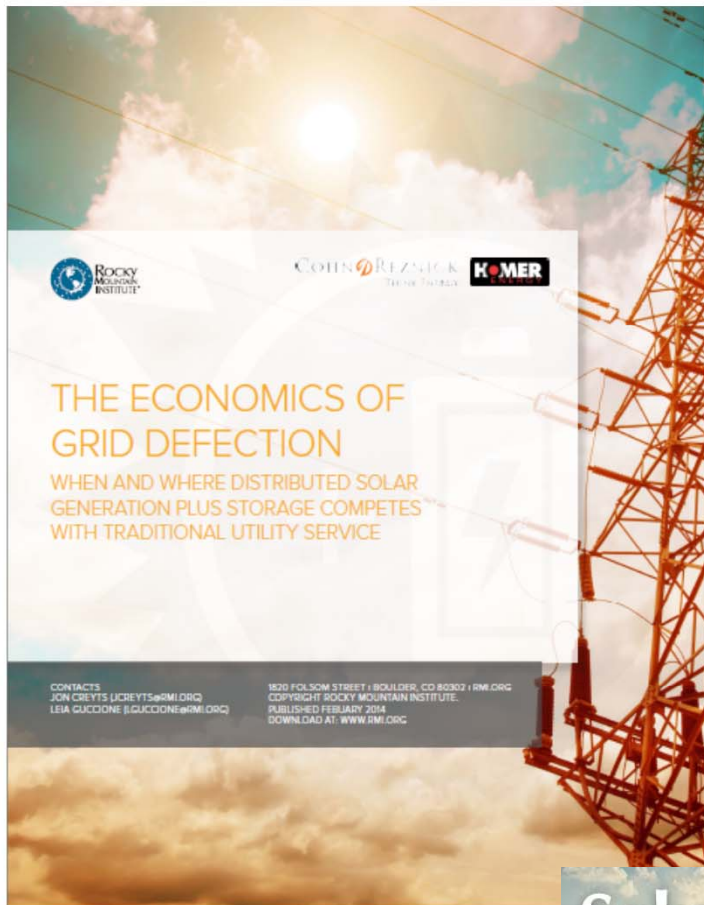


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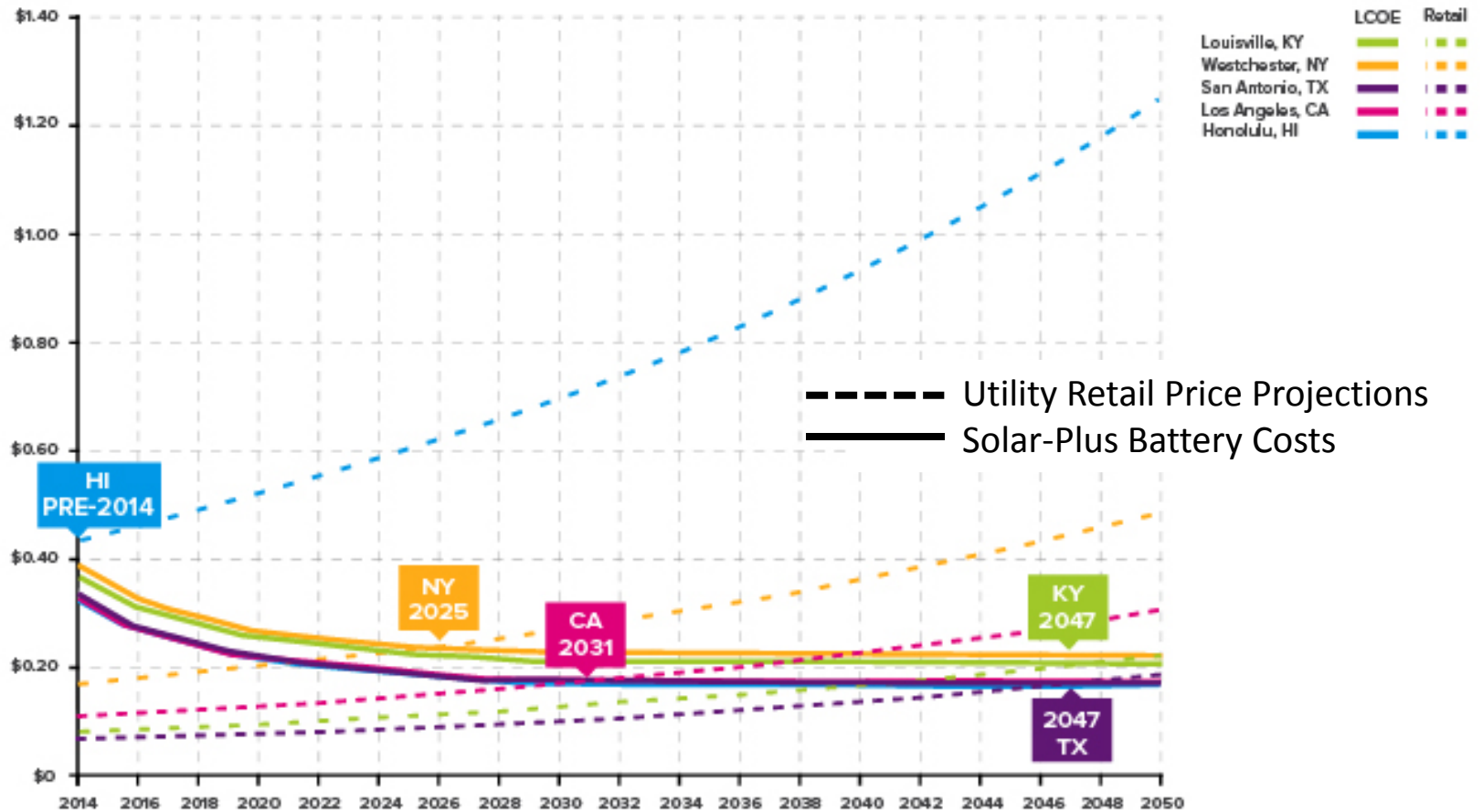
Rocky Mountain Institute, February 2014:

- Will the Electricity Grid Become Optional?
- Report identifies when and where solar-plus-battery systems could enable affordable customer defection from utilities.
- Grid parity exists today in Hawaii for commercial customers, and will rapidly expand to reach residential customers as early as 2022.

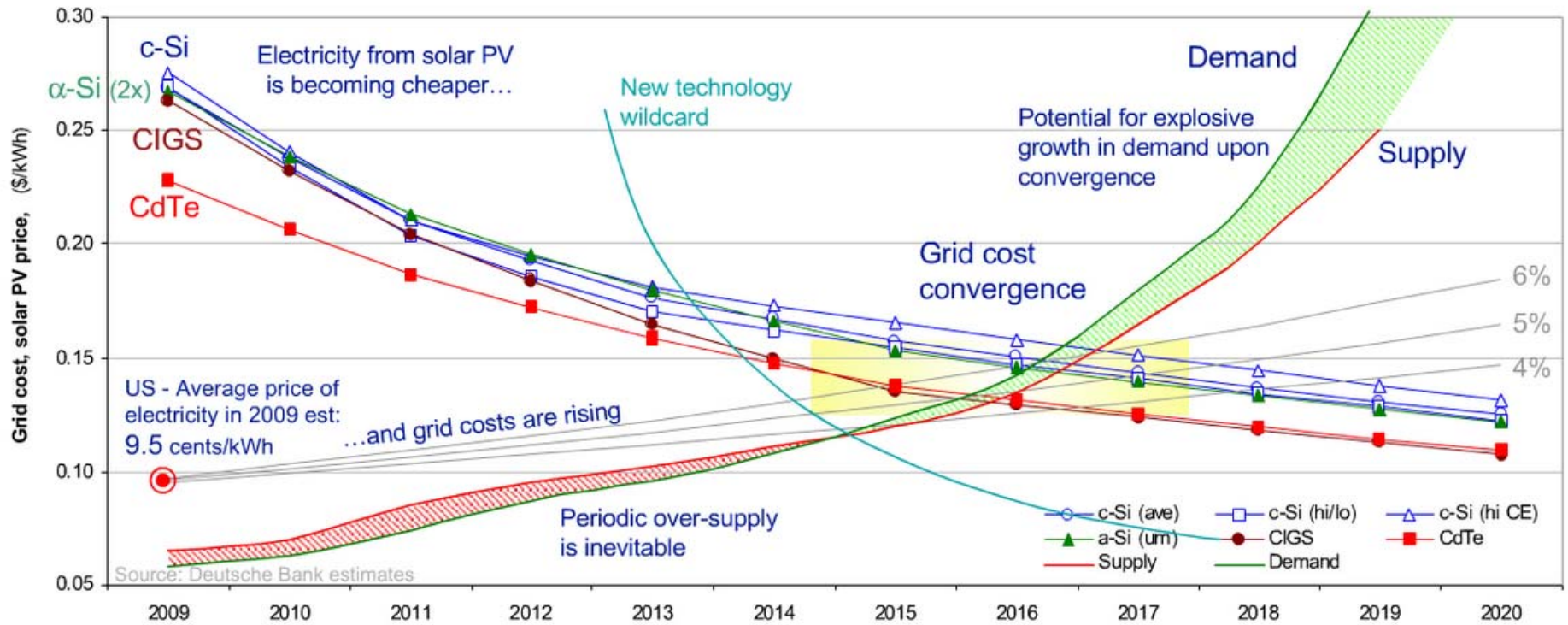


Rocky Mountain Institute, February 2014:

SOLAR-PLUS-BATTERY LEVELIZED COST OF ELECTRICITY (LCOE)
 VS. UTILITY RETAIL PRICE PROJECTIONS
 COMMERCIAL - BASE CASE (Y-AXIS \$/MWh)



Solar PV industry – long-term outlook



Source: Stephen O'Rourke, 2009: Deutsche Bank Securities



NRG Energy Inc. of New Jersey buys Toronto based residential roof-top solar installer Pure Energies Group Inc.

Richard Blackwell, Globe and Mail, October 3, 2014

Why?



- Solar systems more cost effective
- Innovative financing (LIC Bylaws)
- In 10 US states solar power @ grid parity; 10 more in 2 years
- In Ontario, we have seen a dramatic increase in rooftop solar due to the FIT.

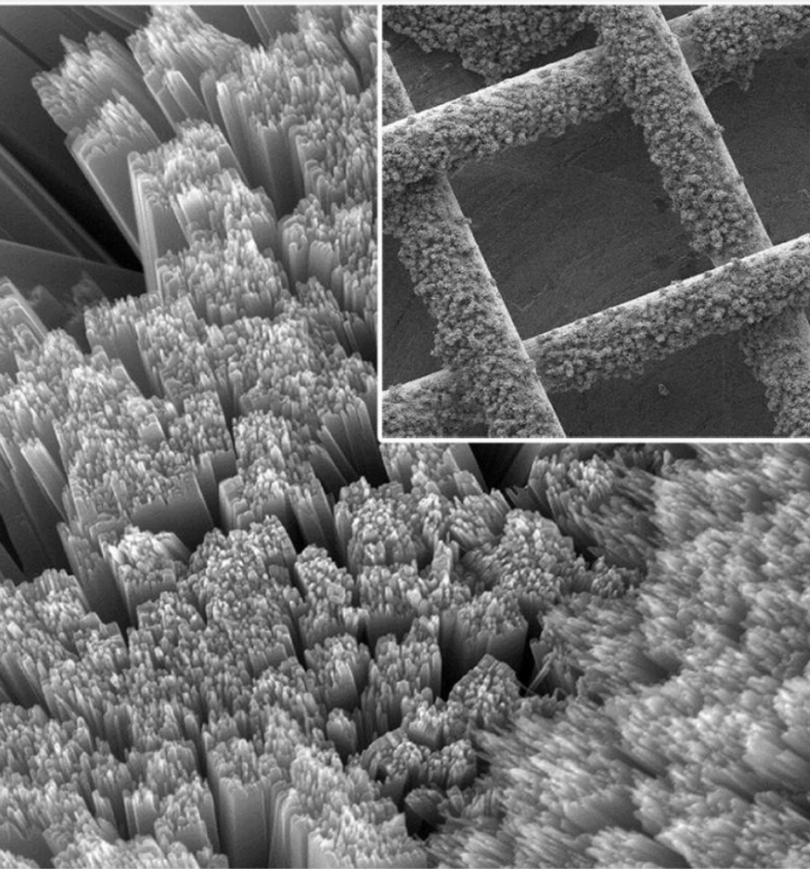


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World's first solar battery runs on light and air

BREAKTHROUGH



Researchers at the Ohio State University have invented a solar battery -- a combination solar cell and battery -- which recharges itself using air and light. The design required a solar panel which captured light, but admitted air to the battery. Here, scanning electron microscope images show the solution: nanometer-sized rods of titanium dioxide (larger image) which cover the surface of a piece of titanium gauze (inset). The holes in the gauze are approximately 200 micrometers across, allowing air to enter the battery while the rods gather light.

Credit: Yiying Wu, The Ohio State University.

Read more at: <http://phys.org/news/2014-10-solar-cell-power-world-battery.html#jCp>

October 3, 2014: Nature Communications

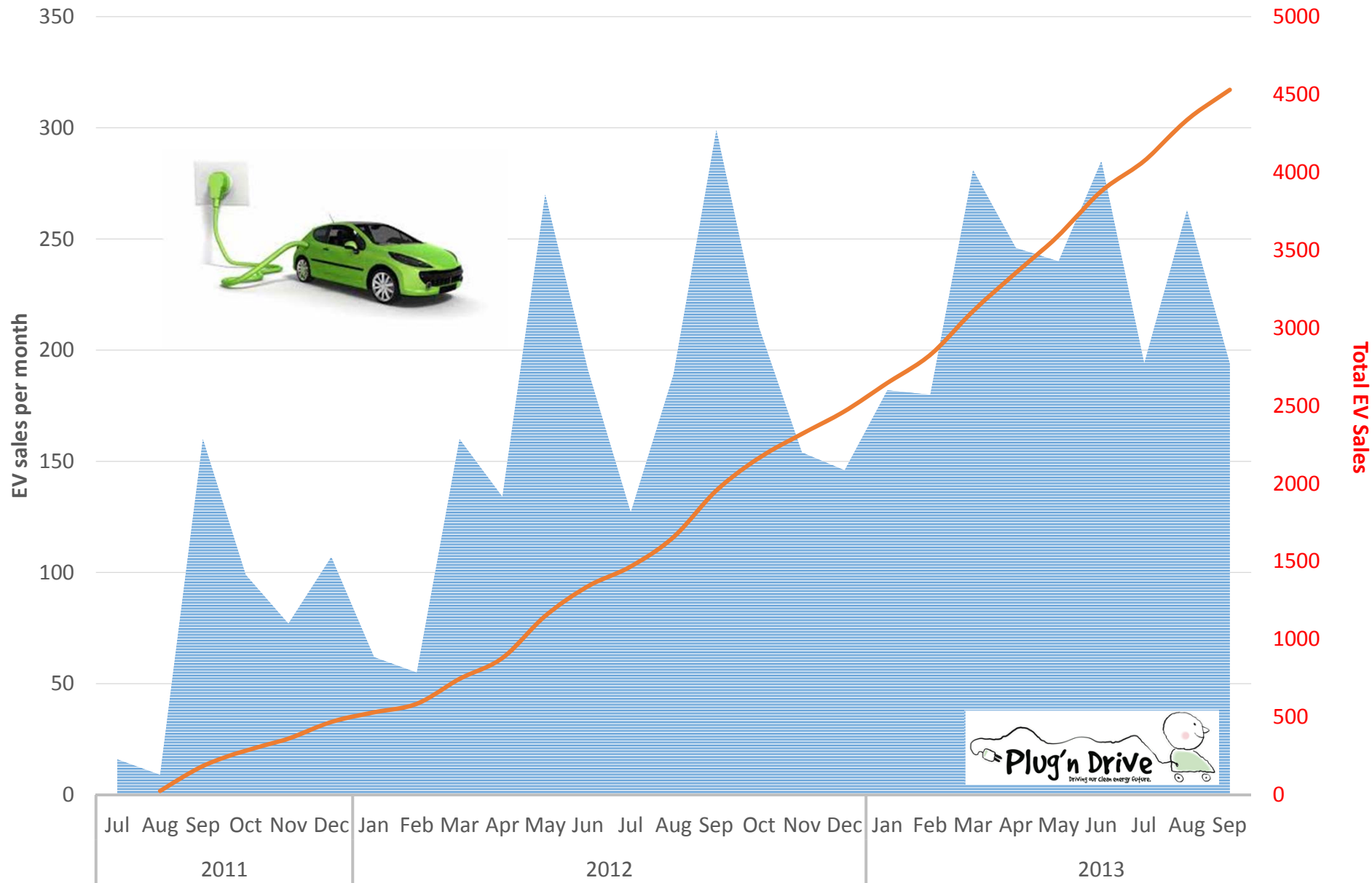


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CANADIAN EV SALES BY MONTH

SOURCE: GOODCARBADCAR.NET



2011

2012

2013



Conclusion

- The pace of energy technology development is accelerating.
- Solar PV and battery storage are reaching grid parity.
- The velocity of change will be controlled by market demand, technological innovation, alternatives to the grid, the regulators ability to regulate, & competition from new entrants to the market.
- The electrical grid could become optional for many consumers, reducing the revenues received by utilities and threatening to strand billions of dollars of energy assets.
- The pace of change will be altered by at least two forces: **reliability** and **electric vehicles**, both of which may act to slow down or speed up grid defection.





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