

# New Developments in Sustainable Energy: Boston University & Beyond

Peter Fox-Penner, PhD

Director, Institute for Sustainable Energy

Professor of Practice, Questrom School of Business

Presented at the *Executive MBA Luncheon*

October 1, 2016

[www.bu.edu/ise](http://www.bu.edu/ise)

# There's a lot going on in sustainable energy...



At BU



In Boston & the Northeast



Worldwide

# Sustainable Energy at BU



Earth & Environmental  
Sustainability MBA  
Concentration



Earth & Environment  
Department, CAS



Pardee Center for the  
Study of the Longer-  
Range Future



*sustainability@BU*



Engineering Research



Urban Studies



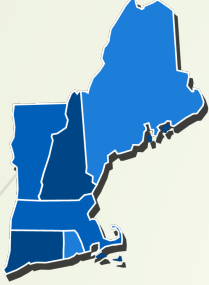
Pardee School of  
Global Studies



Institute for Sustainable Energy

...and much more

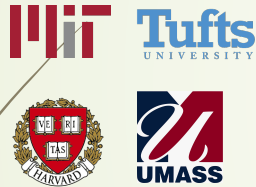
# Boston is a Green Tech Hub



New England  
Cities are  
Climate Leaders



States are leading too



World Class Energy  
Research



**GREENTOWNLABS**

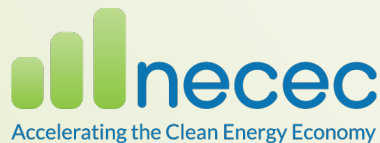
Large clean tech  
financing and incubator



GE Energy Global HQ

**nationalgrid**

Forward-leaning utilities

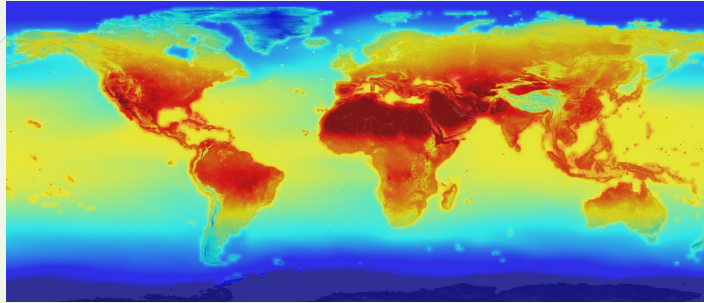


Huge Clean Tech  
NGO Community



# What's Motivating All This Activity?

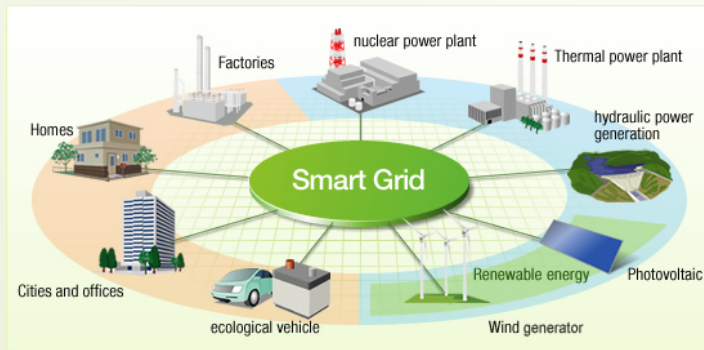
# Change Drivers



Global Climate Change



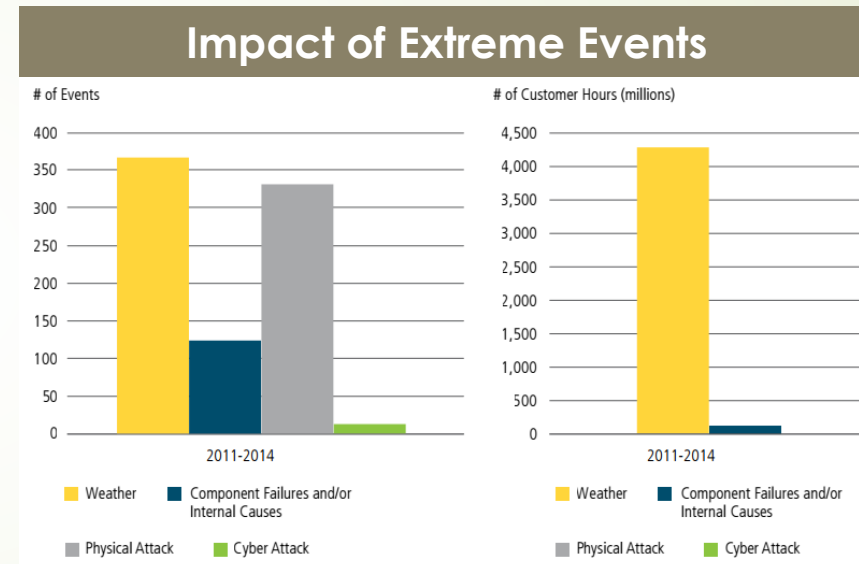
New Energy Technologies



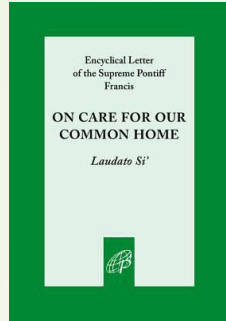
Digitalization of the Power System: The “Smart Grid”

# Impacts of Climate Change Have Begun

- Utilities adapting to climate-driven damage :
  - Extreme weather incidents have increased tenfold since 1992
  - Costs of weather-related power outages \$107 million - \$202 billion from 2008 - 2012
  - Droughts in 2011 covered 2/3 of the U.S. stressing several utilities



# New Voices, New Actions



Christians “must forcefully reject the notion that our being created in God’s image and given dominion over the earth justifies absolute domination over other creatures.”  
“What is at stake is our dignity.”



“The low-carbon economy is a >\$600 billion/year market”

“...a watershed year for the low-carbon economy.”



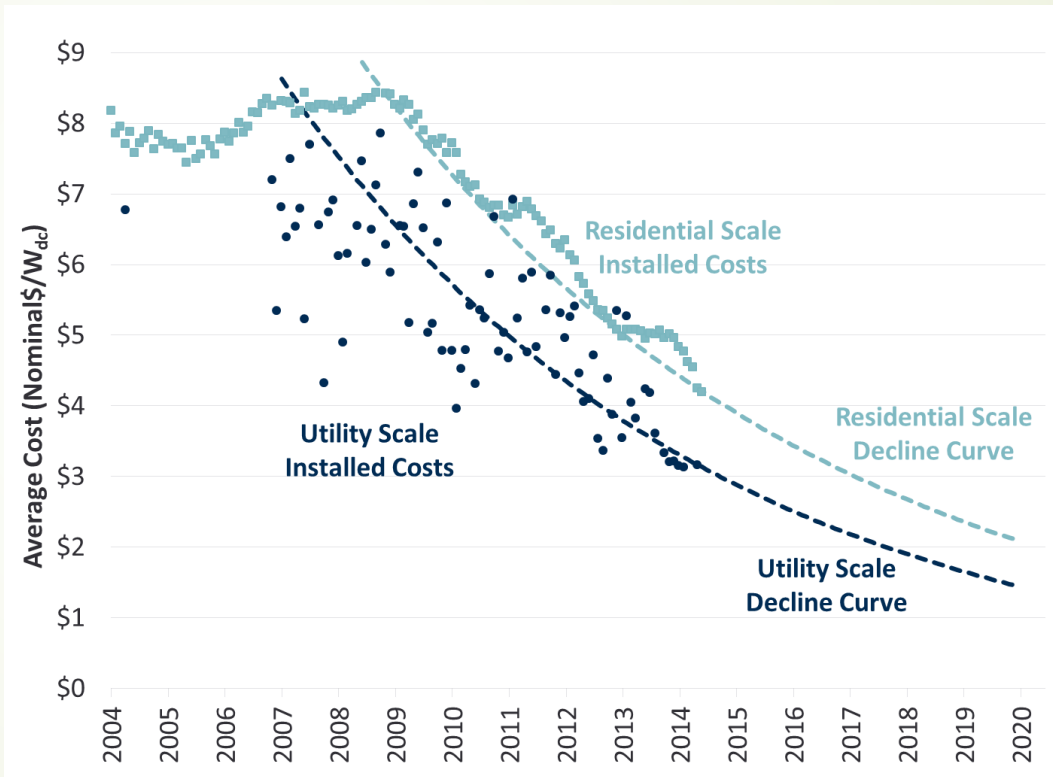
Paris Climate Accord, 2015-16



# Solar Power: Costs Coming Down

- Technological advances have driven module costs down and third party financing expands the residential market for roof top solar
- Brattle found in 2014 utility-scale solar was about half as expensive on a per MW basis compared to residential rooftop solar systems (\$83/MWh for utility vs. \$167/MWh for residential)

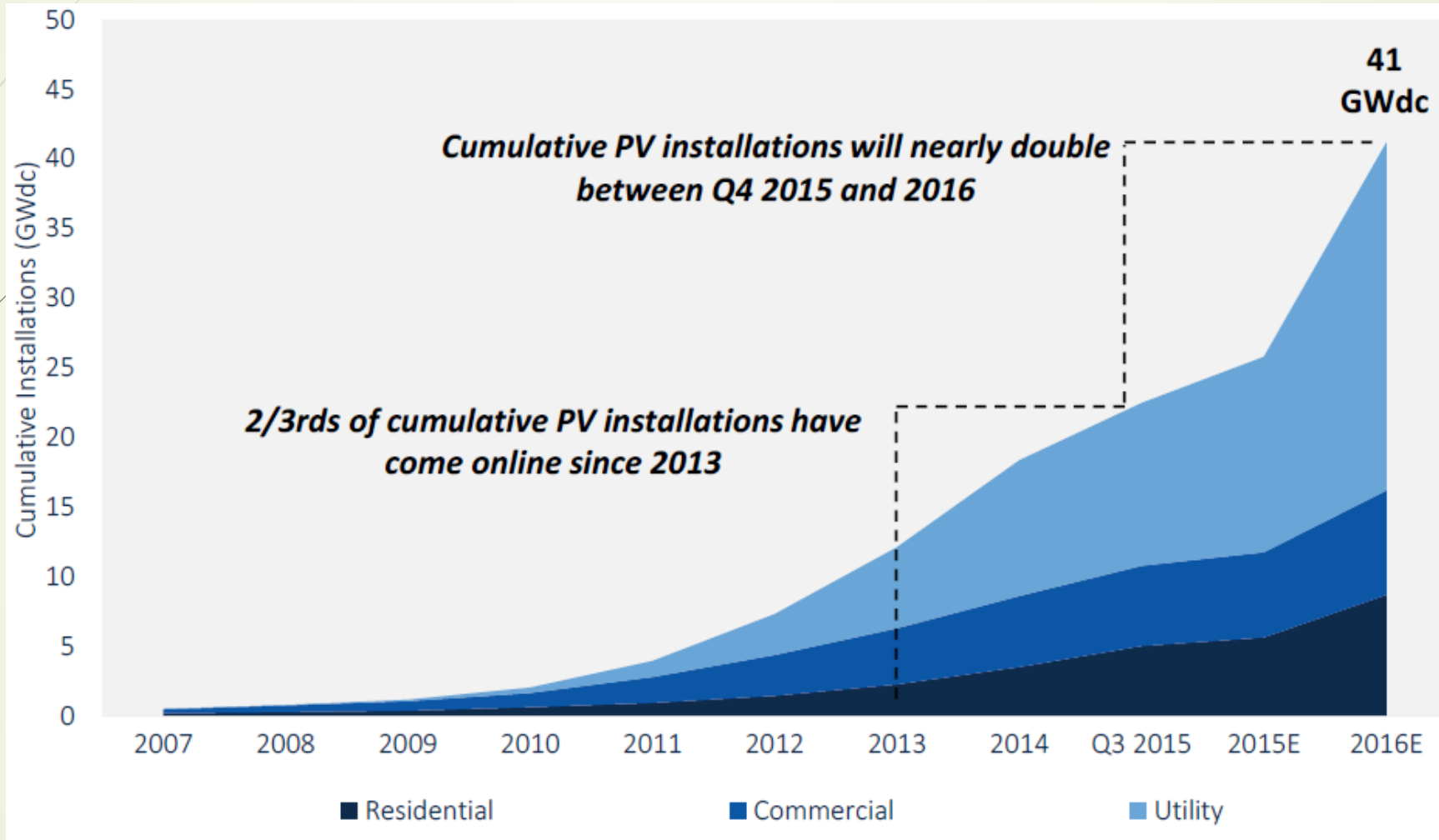
## Forecasted Residential and Utility Scale Prices



Source: Open PV Project, NREL (<https://openpv.nrel.gov/>)

Note: Total installed costs, before incentives. Rooftop defined as 0-10 kW, Utility-Scale defined as >1 MW.

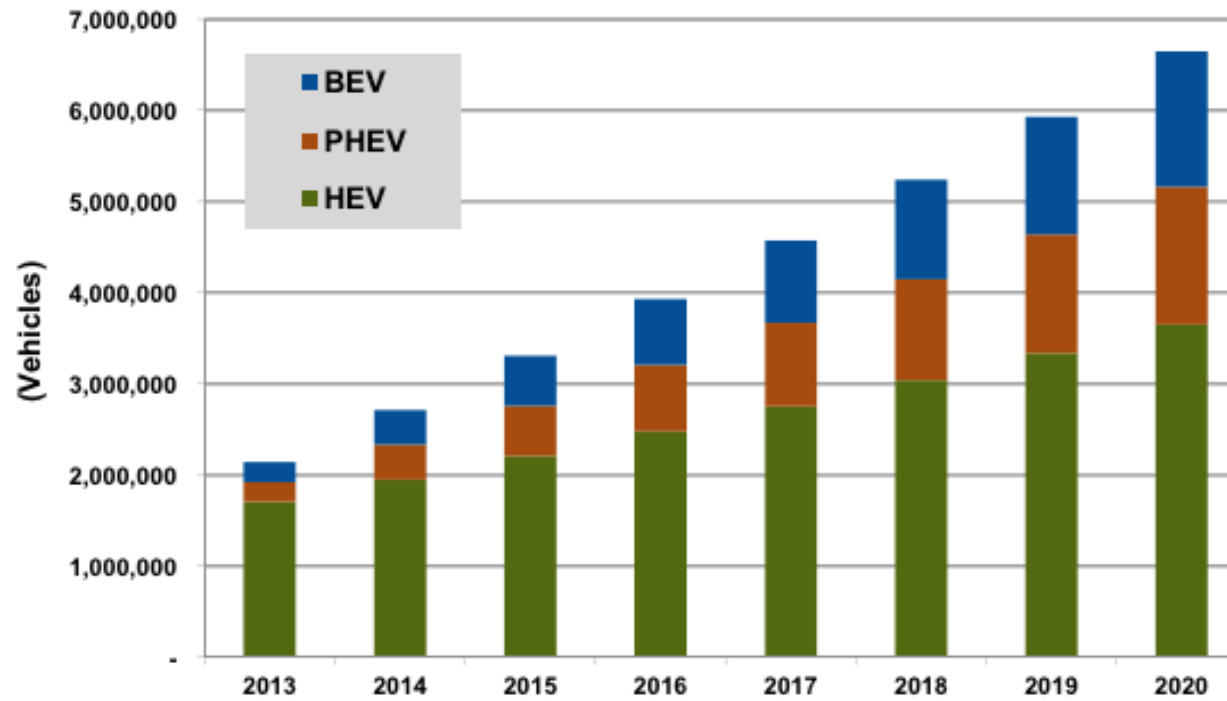
## ...and Installations Booming



Source: "US Solar Market Insight Executive Summary" December 2015, page 5.

# Electric Vehicles and Storage

Chart 1.1 Annual Light Duty Electric Vehicle Sales by Drivetrain, World Markets: 2013-2020

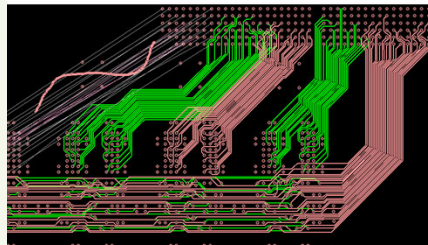


(Source: Navigant Research)

Source: "Electric Vehicle Market Forecasts." Navigant Research, Q3 2013



# The Smart Grid



Digital Control of Homes

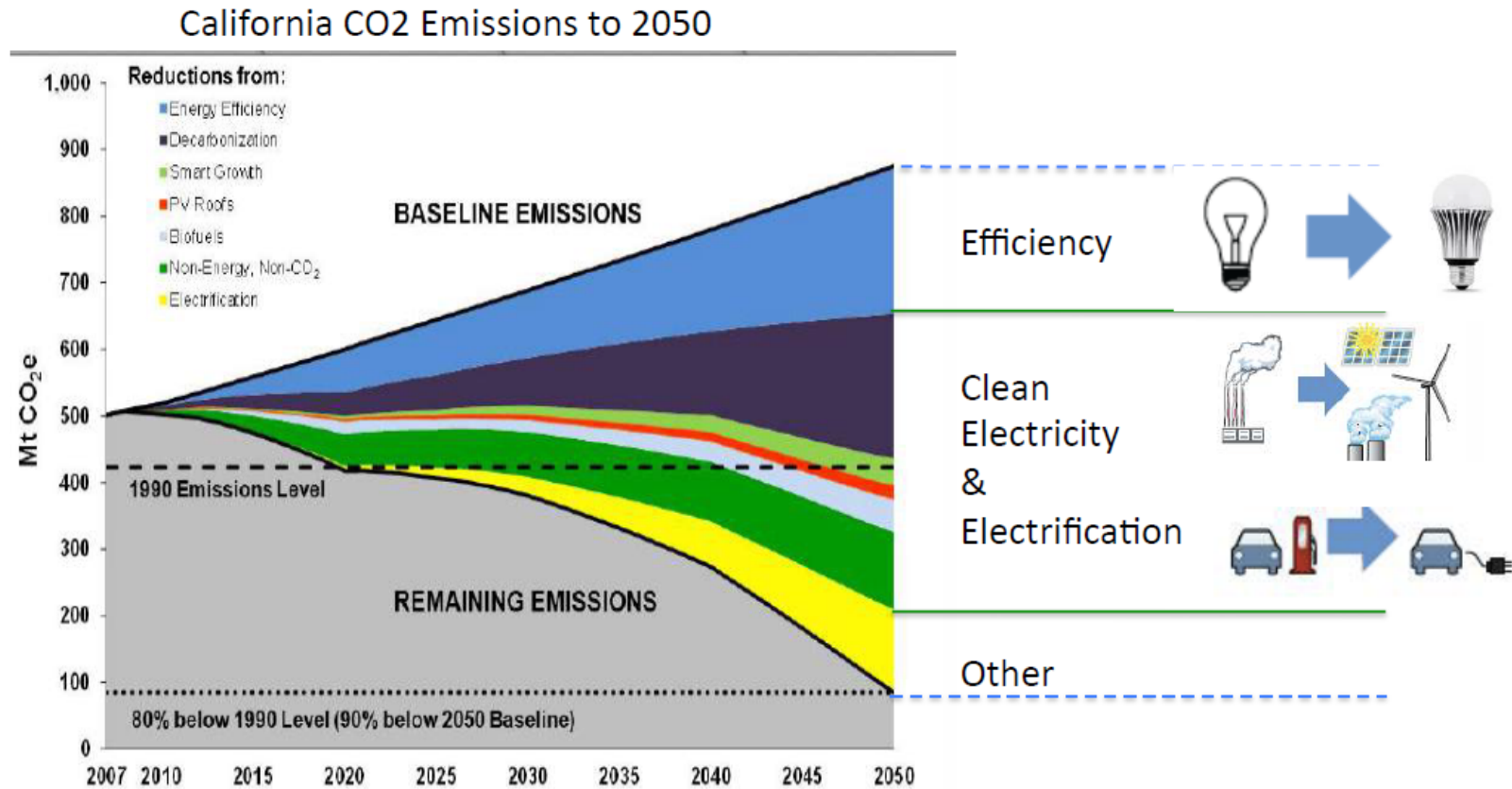
Automatic Grid Rerouting

Remote Customer Analytics

DER markets



# Picture the Sustainable Energy Future

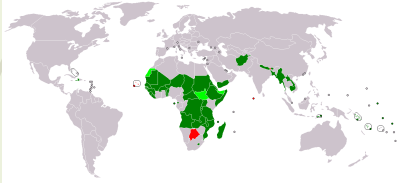


Source: "The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity," published online Nov. 24, 2013 in Science Express.  
<http://newscenter.lbl.gov/news-releases/2011/11/24/ca-emissions-2050/>

# BU Institute for Sustainable Energy



Carbon-Free Boston



Sub-National Climate Finance of Least-Developed Countries



Industry Council



Electric Vehicle Adoption in China



Electric Utility of the Future



Events, Seminars, Etc.



Thank You