KILPATRICK TOWNSEND

Research Triangle Cleantech Cluster

Insight Sharing Session: Energy Storage and Microgrid Technologies – Emerging Opportunities

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October 20, 2014

Insight Sharing Session: Research Triangle Cleantech Cluster
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I. ELECTRIC SECTOR IN TRANSITION

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Introduction – Electric Sector in Transition

- Electric Sector
  - 100 year old architecture and technologies
  - Relies heavily on old coal burning power plants
  - Industry is fragmented
  - Industry regulatory structure leads to slow adoption of new technologies
- Electric Sector Transformation in Full Swing
  - Increasing renewables penetration
  - Digitization of the Grid
  - Increased emphasis on Grid Security and Grid Resiliency
    - Cybersecurity Challenges
    - Hurricane Sandy and extreme weather

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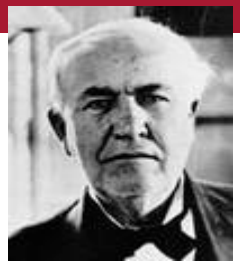
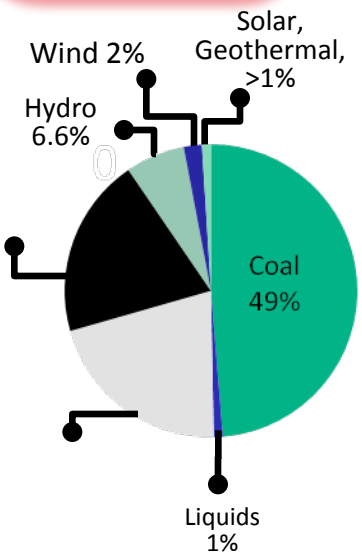
Our Current Electric System, Technologies, and Architecture are 100 Years Old



Edison Would Recognize Most of the System

Central Power Stations	Alternating Current High Voltage Transmission Lines	Distribution Companies	End Users
	• Transmission congestion and constraints • Need more transmission for renewables	• 3,100 Utilities • Southern Co. serves 4.4M customers • Altamaha EMC rural electric co-op serves 19,648 customers in Lyons, GA	• 100% availability • Lowest ¢/kWh • Unaware of potential of smart grid

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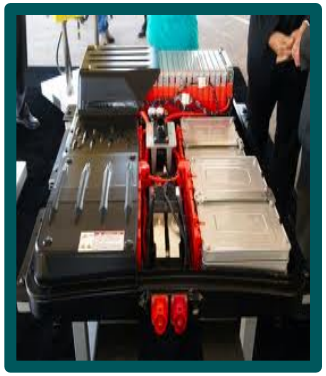
A Green and Sustainable 21st Century Electric System Will Have Many of the Following Features….



Renewable Generation

Battery Storage as Generation

Robust Transmission Capacity

Smart Transmission

Utility Scale Storage

Smart Storage

Smart Grid

Distributed Generation

Microgrids

Roof Top Solar

Battery Storage

Electric & Plug-In Hybrid Vehicles

Smart Consumers

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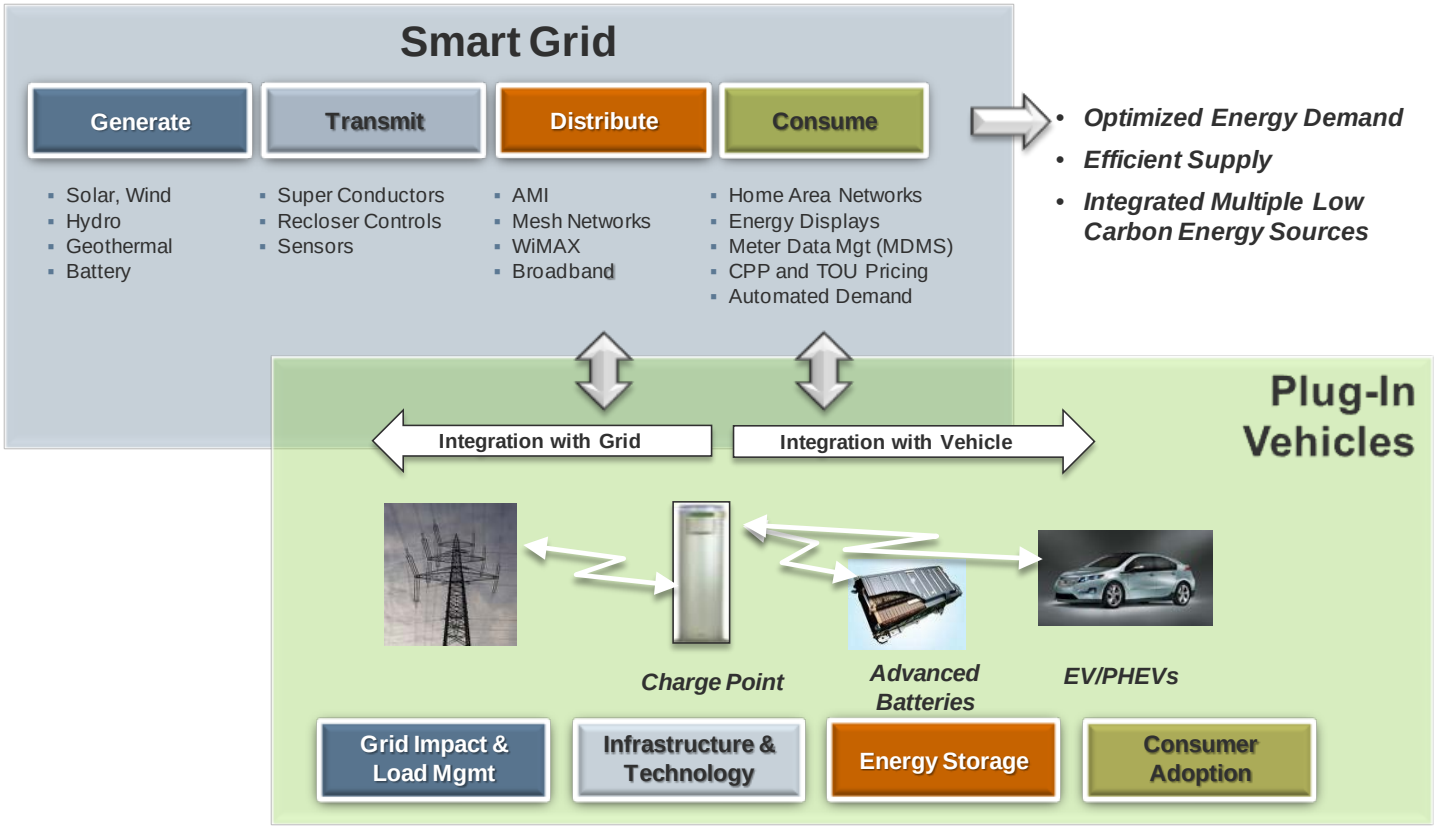
IT IS ALL CONNECTED . . .
Cross Industry/Horizontal Relationships Can Speed Change
Electric Vehicles Will Depend on Smart Grid Technology,
And in Turn Increase its Value

Smart Grid Technology Will Enable the "Smart Charging" Needed to Support Electric Vehicles, for example:

- Peak Load Management to deal with the "5PM Surge" when every one returns home and plugs in
- Consumer information to incentivize off -peak charging at night



The systems integration and IT challenges are enormous when we consider the end-to-end requirements of the electric grid

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II. REGULATIONS AND TECHNOLOGY DRIVING ELECTRIC SECTOR'S TRANSITION

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EPA Regulation Section 111(d) Is Designed to Allow States to Flexibly Develop and Implement GHG Reductions from Existing Sources

- June 1, 2015 – EPA to finalize Existing Source Performance Standards (ESPS)
  - June 30, 2016 – States to submit implementation plans
  - June 30, 2017 – States submitting single-state implementation plans may request a 1-year extension
  - June 30, 2018 – States submitting multi-state implementation plans may request a 2-year extension
- The proposal guidelines are expected to reduce total power sector carbon emissions 30% from 2005 levels by 2030 through setting of individual emissions targets for each state.
- The EPA determined the best system of emission reduction ("BSER") to include four categories("building blocks") of carbon emission-reduction measures:
  - Improving efficiency at individual coal-fired units,
  - Increasing use of existing natural gas units in place of higher-emitting coal-fired units,
  - Generating electricity with low-and zero-carbon units, such as renewable or nuclear energy facilities, and
  - **Implementing demand-side energy efficiency policies and programs**

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Regulations and Technology Driving the Electric Sector's Transition

- Utilities and Public Utility Commissions – "The Gordian Knot"
  - 50 State PUCs + Federal Energy Regulatory Commission (FERC)
  - Historically regulation has properly focused on reliability and cost
  - Fragmented and slow regulatory structure slows innovation
  - Need regulatory innovation to allow for roll-out of
    - Smart Grid
    - Utility Scale Battery Storage
    - New services and business models
- What is New Here?
  - State PUCs are gaining more experience in evaluating energy efficiency programs
- How does this Relate to EPA Section 111(d)
  - As the value of customer-side programs rise in the context of CO2 compliance, States should expect to see more opportunities for cost-effective energy efficiency – and can use ratemaking tools to create incentives for utilities and others to pursue these measures

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States are Developing Their Implementation Plans

- Initial plans focus on fuel switching, heat rate improvements and related generation efforts
- States are also commencing pilots in the distributed generation, microgrids and energy storage to both improve GHG emissions and to improve grid resiliency
- For example, New York is aggressively supporting microgrids and energy storage to strengthen the grid following Hurricane Sandy.
  - In highly-populated and dense areas, such as New York City, energy storage technologies have to provide on-site small-footprint storage solutions.
- One such example of an adaptive energy storage technology was launched on April 23, 2014 by the New York City's Metropolitan Transit Authority, which is one the largest single energy users in the US.
  - Technology uses CellCube vanadium flow batteries.
    - CellCube is a commercial technology available worldwide, with more than 60 systems currently in operation. It is manufactured by Gildemeister and distributed in the US by American Vanadium.
    - CellCube is a modular flow battery technology that can deliver anywhere from 10 kW to multi-MWs for long durations.
- NY's Enhanced Load Incentive Program allows building owners, building managers, and third-party developers, who are Con Edison customers, apply for incentives for energy efficiency and demand management projects that are completed prior to June 1, 2016.
  - Incentive provided by both NYSERDA and Con Edison.
  - Battery storage projects will receive $2,100/kW (up from the current $600/kW), thermal storage will receive $2,600/kW (up from the current $600/kW), and demand response projects will receive $800/kW (up from the current $200/kW).
  - Bonus incentives are provided for large projects over 500 kW.

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Investments and Deployment of New Technologies Also Driving Transformation

Department of Energy Office of Electricity Delivery and Energy Reliability – Recovery Act	$ Millions
Smart Grid Investment Grant Program; ≤3 years	$3,400
Smart Grid Demonstrations; 3-5 years	$615
Interoperability Framework Development by NIST	$10
Resource Assessment and Interconnection-Level Transmission Analysis and Planning	$80
State Electricity Regulators Assistance	$50
Enhancing State Government Energy Assurance Capabilities and Planning for Smart Grid Resiliency	$55
Workforce Development	$100

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Federal Government is also Supporting Deployment of Microgrids and Energy Storage

- Case studies for projects in California using Federal funds:
  - On September 8, 2014, DOE announced more than $8 million for microgrid projects to support the development of advanced microgrid technologies and to help cities and towns better prepare for electricity disruptions.
    - Among the 7 awardees, the University of California, Irvine will develop and test a generic microgrid controller intended to be readily adapted to manage a range of microgrid systems. With the California Independent System Operator Corporation providing technical advice, this project is expected to pave the way for the development of open source industry standards.
    - Each awardee received approximately $1.2 million in DOE grant funds.
    - Each microgrid is less than 10 MW.

- On September 28, 2014, California's Tehachapi Energy Storage Project opened.
    - This is the largest batter energy storage project to date in North America with 32 MWh of storage capacity.
    - The funding was provided by both DOE funds under the American Recovery and Reinvestment Act of 2009 and Southern California Edison Company funds, who built the project.

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III. MICROGRIDS

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Microgrids – The Emerging Opportunity

- Definition
- Evolution from public support to private finance
- Utility business model, disruption business model, transformation enabler
- Work in progress
  - Technology
  - Policy
  - Transaction Promises
  - Finance
- Commercialization

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Microgrid Case Study

- Remote customer within service territory needs electricity
- Challenging to reasonably recover traditional needed generation, distribution & transmission investment
- Utility evaluates microgrid as solution
  - ROI from regulated market
  - ROI from competitive market

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Developing Microgrid Opportunities

- Partnerships, Alliances & Joint Ventures
  - No actor or sector is in position to execute solo
- Regulators
  - Aware, gathering information, conclusions not formed
- Financing opportunities
  - Project Finance
  - Operating Company
  - Yieldco
- Challenges
  - Combination of technologies
  - Contracted asset vs. merchant
  - Warranty
  - Interconnection
  - Autonomy (islanding & blackstart)

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IV. ENERGY STORAGE

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Energy Storage -- Where Does the Industry Stand Today?

- Leading Load Serving Entities in California have small pilot projects up and running.
  - SCE/ PG&E/ SDG&E piloting small projects with diverse technologies and diverse uses.
- Each has issued RFPs and contract awards are winding their way through bidding, evaluation and approval by CPUC.
- Targeted levels of deployment are shown on the next slide

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Energy Storage -- California CPUC Requirements

Energy Storage Procurement Targets

Storage Grid Domain Point of Interconnection	2014	2016	2018	2020	Total
Southern California Edison					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal SCE	**90**	**120**	**160**	**210**	**580**
Pacific Gas & Electric					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal PG&E	**90**	**120**	**160**	**210**	**580**
San Diego Gas & Electric					
Transmission	10	15	22	33	80
Distribution	7	10	15	23	55
Customer	3	5	8	14	30
Subtotal SDG&E	**20**	**30**	**45**	**70**	**165**
Total – all 3 Utilities	**200**	**270**	**365**	**490**	**1,325**

Source: Energy Storage, North America

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Energy Storage -- Where Does the Industry Stand Today?

- Procurements outside of California are just beginning:
  - In October 2013, the Long Island Power Authority issued an RFP seeking proposals for 150 MW of energy storage. Proposals were due in March 2014.
  - In March 2014, although it has no immediate need, the Kauai Cooperative issued an RFP for standalone or renewable paired energy storage to address anticipated daytime over-generation and variability of PV solar projects.
  - In July 2014, the Oregon Department of Energy issued a "Comment Opportunity" to aid in scoping potential energy storage procurement.
  - In September 2014, the Ontario Power Authority issued a Draft RFQ for 50 MW of energy storage, with submittals of qualification due on October 2, 2014.

Source: Energy Storage, North America

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Energy Storage
Key Challenges and Road Blocks - Technologies

- New Technologies
  - Must meet Electric Sector Five 9's reliability
  - Little long-term performance experience
  - Costs uncertain

- Multiple Technologies
  - High-power flywheels
  - Li-Ion battery
  - Lead-acid battery
  - Compressed air energy storage

- Multiple Uses Make Valuations By PUCs Difficult

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Energy Storage

Key Challenges and Road Blocks – Multiple Uses

STORAGE GRID DOMAIN (Grid Interconnection Point)	REGULATORY FUNCTION	USE-CASE EXAMPLES
Transmission-Connected	Generation/Market	Co-Located Energy Storage Concentrated Solar Power, Wind + Energy Storage, Gas Fired Generation + Thermal Energy Storage
		Stand-Alone Energy Storage Ancillary Services, Peaker, Load-Following
	Transmission Reliability (FERC)	Voltage Support
Distribution-Connected	Distribution Reliability	Substation Energy Storage (Deferral)
	Generation/Market	Distributed Generation + Energy Storage
	Dual-Use (Reliability & Market)	Distributed Peaker
Behind-The-Meter	Customer Sited Storage	Bill Mgt/Permanent Load Shifting, Power Quality, Electric Vehicle Charging

Source: Energy Storage, North America

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Energy Storage – Next One to Three Years

- The next one-two years will be a period of pilots/testing/transitions
  - California is going through its first cycle of RFPs
  - These pilots will set benchmarks and verify the value creation of various energy storage technologies
  - Value validations will lead to CPUC approvals for rate basing of some battery/energy storage technologies for particular uses
  - Once benchmarks and values are confirmed, scaling will begin based on the approved technologies, use and commercial models

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How Will the Emerging Technologies and Implementation of Federal and State Regulations Shape Opportunities for Battery/ Energy Storage

- Parallel opportunities will be developing in the commercial and industrial sectors
  - Energy Storage suppliers and buyers have greater flexibility to enter into innovative commercial solutions
  - Data centers and large energy users will lead the way in being early adopters of battery/energy storage technologies to:
    - Shave peak usage
    - Improve energy security
    - Improve resiliency
    - Ring fence from ups and downs of the local grid

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V. TYING IT TOGETHER – DOE LOAN PROGRAM FUNDING OPPORTUNITY

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Tying it Together – DOE Loan Program Funding Opportunity – Loan Guarantees for Renewable Energy and Efficient Energy Projects

****DOE would like to receive microgrid and energy storage loan applications ****

For a project to be eligible under Section 1703 REEE, it:

- Must be located in the United States.
- Must use one of the following technologies: renewable energy systems; efficient electrical generation, transmission, and distribution; or efficient end-use energy technologies.
- Need to demonstrate significant GHG emissions reductions – use a Lifecycle Analysis Report.
- Must be new and unique technology, i.e. not three (3) or more identical technologies running commercially in the U.S. – foreign commercial projects are not counted against this limit, with a site in the U.S.
- Catalytic technologies are encouraged.
- Must demonstrate a reasonable likelihood of repayment.

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Tying it Together – DOE Loan Program Funding Opportunity

Anatomy of a DOE Loan Guarantee --

- Suite of Technology/Finance/Integration Partners Needed
  - Host site or utility
  - Technology suppliers (solar/battery storage/grid integration and control)
  - Financing model and approach (Equity Sponsor)
  - Legal and Regulatory Team
- DOE looks for experienced developers with well-structured projects
  - DOE credit underwriting modeled after investment bank/commercial bank approach
  - Track record of developing greenfield projects
  - Technology tested
  - Buy-in and commitment of all Team Members
  - Sufficient equity funding including reserves and contingencies
- Getting Started –
  - Identify the specific value proposition that your company brings to the Project
  - Identify and partner with companies who bring the complementary skills
  - Develop a replicable template so that the DOE Project catalyzes a series of Projects

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THANK YOU

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