Panel #2

1:30 p.m. to 3:45 p.m.
Kerrick Johnson, VP of Strategy and Communication, Vermont Electric Company

Evolve or Die - What are the Top 3 Ways in which Utilities, Grids and Business Models must Evolve?
Kerrick Johnson’s Panel

Sam Aronson
Past Director, Brookhaven National Lab., APS President

Micah Kotch
Director, NY Prize & Strategic Innovation NYSERDA

Champlain Landry
Manager, Smart Grid Innovation Hydro Québec

Luigi Michi
Head of Strategy & Development Terna, Italy

Ron Ambrosio
Distinguished Engineer, IBM Research
Poll Question

Which will be extinct first?

- The grid as we know it
- Utilities as we know them
- Fossil fuels
- A/C grids
"I need someone well versed in the art of torture—do you know PowerPoint?"
Communications critical

Statewide Infrastructure

- eEnergy VT smart grid
- Fiber optic network
- Radio system
Renewable Energy Standard & Energy Transformation

**Tier 1 Renewable RPS** – 55% of annual retail electric sales must come from renewable energy beginning January 1, 2017; must increase by 4% every three years until reaching 75% after January 1, 2032.

**Tier 2 Renewable DG** – 1% of sales from new, in-state, renewable DG projects 5 MW or less beginning in 2017 and that percentage must increase until reaching 10% percent on January 1, 2032. This requirement can also count toward Tier 1.

**Tier 3 Energy Transformation Projects** – 2% of sales must come from additional distributed renewable energy, ETPs or a combination of the two, beginning January 1, 2017, must increase each year until it reaches 12% on January 1, 2032. For municipals with fewer than 6,000 customers, date delayed until 2019 with a 2% requirement increasing annually to 10% by 2032. **ETPs must achieve a net reduction of a customer’s fossil fuel consumption and a net reduction in GHG emissions attributable to that consumption.**
Implementation

- National focus on major state policy revisions
  - New York
  - California
  - Massachusetts

- **GMP Philosophy:** Prove out the system and let policy and regulation follow
‘Culture eats strategy for breakfast’
- Peter Drucker
This year’s planning context is more volatile than ever and demands a different kind of thinking.
VELCO-IBM
Vermont Weather Analytics Center
“Whatever you can do, or dream you can do, begin it. Boldness has genius, power and magic in it. Begin it now.”

– William H. Murray
And now as we embrace change:

“Our great new adventure.”
prototyping remote communities of tomorrow

bringing sustainable energy, water, and IT solutions to off-grid communities

Core Institutions
Turkana Basin Institute
Stony Brook University
How using Turkana Basin Institute (TBI) in Kenya as a “living Laboratory”

www.turkanabasin.org
TBI is a destination for human origins study

- the history of humankind is written in the rocks of Africa
- located in Turkana, the least developed county in Kenya
Turkana Basin Institute today

In less than 10 years, TBI has successfully established two off-grid research facilities. Both sites offer abundant renewable energy resources: solar, biomass, wind and geothermal.
TBI helps local capability building

with Richard Leakey in 2013
TBI has small solar, energy storage and water purification capabilities, but inadequate to host a population of 100 people year round.
Economic Development

- e-TBI aims to stimulate entrepreneurship, enable local businesses, empower women, and facilitate investment by financial institutions
- project demonstrations (e.g., construction, manufacturing, transportation) enabled by access to energy, clean water, IT will enhance regional capabilities

The e-TBI project will promote solutions that are culturally and regionally appropriate, and economically feasible....
Considerations for next steps

• Technology suite
  – Resource survey
  – Interoperability

• Business Model
  – Needs survey
  – Sustainability

• Partnerships
  – In-country NGO, advocate(s)/business partner(s), political support
  – Research institutions, industry, foundations, government agencies, professional societies
Current and Potential e-TBI Partners

- **University:**
  - Stony Brook University ✔
  - Kenyatta University (MOU) ✔
  - Peking University (in discussion)
  - Beijing University of Chemical Technology (in discussion)
  - Jomo Kenyatta University of Agriculture & Technology

- **International and Government Agency:**
  - Brookhaven National Laboratory ✔
  - USAID (Power Africa) ✔
  - World Bank

- **Society and Foundation**
  - IEEE (Community Solutions Initiative) ✔
  - German Society for International Cooperation (ProSolar) ✔

- **Industry:**
  - Sinopec, Africa Oil
  - IBM-Africa, India and China ✔
  - Facebook, Google
  - Electratherm
Sustainability: Considerations

• Maintaining a narrow focus on a few interventions in a single region
  – Different regions will require different technology suites; what is really being tested is the building of sustainable solutions to economic development

• Put a lot of upfront effort into social, cultural and political assessments of the target region
  – This will require local surveying of the target population conducted by people who are themselves local. (Local NGOs, most likely.)

• Base the implementation on local industry
  – Business people who have a stake in the success of the interventions (new or bigger markets for example) are the basis for sustainability. Local banks and other sources of credit are vital to expansion of commercial activity

• Build a sustainable workforce through appropriate educational opportunities
  – Focus the education on those people in the target region with plans for new/expanded businesses and activities supported by the planned interventions, as well as people who will maintain and improve the interventions
    – Business and technical skills

• Build in significant analysis of the performance of the target population compared to other populations serving as control groups
Impact to Africa

- over 600 million people in sub-Saharan Africa do not have electricity
- Africa’s population is projected to grow from 1 billion people now to over 3.5 billion by the end of this century

The e-TBI project may present a simple but effective solution that offers everlasting impact...
e-TBI project

• demonstrate integrated systems to provide affordable and sustainable energy, water and IT solutions by international scientific groups

• solutions can lead to economic development opportunities for off-grid communities around the world

An integrated, systems-based approach that provides sustainable solutions...
offers safe drinking water for the locals

The recent discovery of commercially viable oil and gas reserves may transform the region in five years …
REV Demonstration Projects

Micah Kotch
Director, NY Prize - Strategic Advisor for Innovation
NYSERDA

June 18, 2015
Landscape Evolution

Greater Level

Tech Capability and DER Adoption

Lower Level

Monopoly Functions

Competitive Functions

Regulatory Environment

Reduce Disincentives

Create Incentives

Enable New Value Creation
Economic Burden on Customers

Over the past ten years, we spent $17 billion to maintain our electric power grid. We predict that number to jump to $30 billion over the next decade.

$17B vs. $30B
Economic Burden on Customers

The rate of capacity utilization of our electric power grid is:

54%
Technology as an Opportunity

Private sector innovation is creating new opportunities for greater deployment of clean, flexible, and efficient energy solutions.
BUSINESS MODELS NOT SCIENCE EXPERIMENTS
Objectives of REV Demonstration Projects

Guide regulatory change
Inform development of DSP functionality
Measure customer response
Guide effective DER implementation
Evaluation Criteria & Selection Process

DPS Staff will review:

- Whether proposal embodies the principals defined in 12.12.14 ‘Resolution on Demonstration Projects’ order and PSC Track 1 Order issued 2.26.15
- Utility’s proposed deferral or other cost recovery mechanism
- Utility’s proposed performance incentive
- Expected system benefits
Get in Touch with Us

Submit ideas online at

www.nyserda.ny.gov/revdemos

Micah.kotch@nyserda.ny.gov

Twitter: #REV4NY   @cleantechnyc
Evolve or Die
The load will be an active part of the grid

- No longer in a load following scenario (Less interest for generation to provide only power and no energy)
- Traditional « load » could island, have reverse power flow or be net zero: Fundamentally changing the business model.
- Customers want new services that can enable new opportunities for the utility to balance more dynamically offer and demand.
- The load has unpredictable behaviors (prosumers), reacting to different signals, ultimately they can decide to disconnect from the grid
Utility planning and management will evolve from a deterministic world towards a statistical approach

- Most inputs of the electric grid, contain a significant amount of uncertainty that forces utilities to build security margins to maintain safe operations.
  - Renewable generation (wind, solar, ...)
  - Demand
  - Markets
  - Equipment failures, ...
- These margins simply add up when you stack them together and eventually causes inefficiencies
- Network planning and management, will gain from having explicit uncertainties, that can be optimised, rather than simply operating with larger security margins
When the « Power System » OPF is no longer enough: You need optimisation of complex systems

- Traditional power system optimisation of mature networks is reaching its limit
- The grid is a complex integrated system of systems
- Major gains will come from the global grid optimisation rather than optimisation process by process.
- New advanced analytic methods, coming from other fields, will need to be adapted to our industry.
The ubiquitous power electronics:
They are here to stay!

- They put the traditional network at risk, by reducing inertia
  - No spinning steel or cast iron
- They bring controllability to the grid
  - SVC’s, HVDC, FACTs
- They enable most types of renewable
  - Solar and wind
- They are a key to flexibility
  - Integration of storage
- Enabling energy sharing on large distances
  - 6000 MW on 1000’s of km in China to decarbonise our energy grid

Fundamental enabler of our vision of the
Modern Electric Network
Smarter Energy Research Institute
Third Annual Conference

Special Session #2: “Evolve or Die: What are the Top 3 Ways in Which Utilities, Grids and Business Models Must Evolve?”

Yorktown Heights, NY
June 18th, 2015
Terna’s activities - Overview

**Terna is...**
- ...the largest independent Transmission System Operator (TSO) in Europe
- ...the owner of the Italian High Voltage Transmission Grid
- ...listed on the Italian Stock Exchange since 2004

**Our Grid**
- \( \sim 63,900 \text{Km} \) HV lines
- 25 interconnections\(^1\)
- 491 substations

**Electricity Market\(^2\)**
- \( 309 \text{TWh} \) energy demand
- \( 51.5 \text{GW} \) highest peak of demand (12\(^{th}\) June 2014)
- \( 125 \text{GW} \) installed capacity\(^3\)

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\(^1\) 2014 provisional figures - Italy
\(^2\) 2013 Statistical data on electricity in Italy
\(^3\) 21 owned by Terna + 3 merchant lines operated (but not owned) by Terna + 1 (Italy-Malta) owned by Enemalta

NOTE: double circuit transmission lines are accounted twice
**SERI - Third Annual Conference**
**Italian current energy framework**

1. **Post crisis demand drop**
   - TWh/year
   - Back to 2002 level
   - * 2014 Provisional data

2. **Booming in RES**
   - * 17x
   - * 2014 Provisional data

3. **Huge overcapacity**
   - ~ 1,5x
   - ~ 2,3x

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1. Source: 2015 National Development Plan (PV and Wind)
2. Source: Statistical data on electricity in Italy (2014 Provisional data)
SERI - Third Annual Conference

TSO Role

NEEDS

- Grid **safety**, **adequacy** and **quality**
- Crucial **ancillary services** management
- **Coordination with distributors** *(system overview and management)*
- Coordination with **neighboring countries**

ACTIONS

- New initiatives aimed at ensuring:
  - system **resources integration**
  - **supply** and **availability** of ancillary services
  - **quality**, **resilience** and **safety** of the Grid
  - coordination and **mutual assistance** among **neighboring TSOs**
The world is changing…

NEW FEATURES:

- **Phase Shift Transformers (PST):** to manage flows on critical interconnection
- **Synch compensators:** to ensure voltage quality
- **Storage systems:** to deal with local service needs

New “traders” and consumers

Development of energy efficiency services and active management of the demand

The huge growth of Distributed Generation (DG) - mainly photovoltaic - makes essential the coordination between TSOs and local distributors (DSOs)

Over 500,000 plants (60TWh more than 30GW*)

NEW FEATURES:

- System operators coordination: TSO-DSO load management programs
- Smart Meters
  Residential load management
- Autoproducers
- Development of «energy islands» producers/consumers scheme

The emerging new technologies requires TSOs to leverage and integrate them granting the grid to have a “Backbone role”
Possible 5 years evolution

Roadmap for a possible and sustainable evolution of the electrical system

3 WAYS TO EVOLVE TO PURSUE SIMULTANEOUSLY

- To identify and select on a merit order basis «untapped» resources for dispatching services (grid reinforcements, PST, compensators, local storage systems, active demand,..)

- To ensure a strong coordination with local distributors aimed at optimal resources utilization

- To enhance the supervisor/monitor system’s role in order to address a consistent capacity development
Evolve or Die: There really is an up side

Ron Ambrosio
Distinguished Engineer
Chief Technology Officer, IBM Smarter Energy Research
Embrace Distributed Energy Resources (DER)

- They can be a valuable operational and business asset
  - This statement applies to all parts of the electricity delivery chain, not just Distribution
    - Intermittent bulk supply integration can be facilitated by responsive DER assets
    - Transmission constraints and balancing can leverage DER assets
    - Distribution can improve reliability, engage customers, coordinate 3rd parties, develop products
    - Aggregators and Energy Service Providers can provide market-based ancillary services
    - Customers can benefit from new offerings and maximize the value of their DER investments

- ... but left uncoordinated they will become an additional source of uncertainty
Expose hidden or untapped value in the system

- Don’t wait for new regulatory and business models to be imposed
  - Understand the implications of emerging technology and policy evolution
    - This is an important aspect of dealing with uncertainty
  - It’s not a matter of if there will be change; it’s a matter of when
    - What new business and operational models will best meet your objectives?
    - What technologies are required to implement those models?
    - What policy and regulatory changes would enable those models?
    - What are the potential policy benefits supported by those models?

- Example: Transactive Energy designs can expose, quantify and leverage value
  - Business and operational objectives and constraints can be assigned value
  - That value can be location, time and situation dependent
  - Transactive systems establish the “plumbing” to implement value-based controls and/or services
Poll Question

When will the US achieve 100% clean energy?

- 2050
- 2070
- 2090
- Never
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Ron Ambrosio
Distinguished Engineer, IBM Research
What fascinated me the most at this conference was:

- The criticality of utility R&D
- The global similarity of challenges to utilities
- How much Ron Ambrosio resembles the Mike McLintock character on Veep
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Should the U.S. enact a national carbon tax?

☐ Yes

☐ No
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Ron Ambrosio  
Distinguished Engineer, IBM Research
Poll Question

The top way in which utilities, grids and business models will evolve are: