Picking Up the Pace: Utilities and Innovation in a Carbon Constrained World

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About BPA
R&D Challenges Solved

• Operate a 230kV system over 780,000 km²
  
  Power System Analytical Tools
  BPA Load Flow Program
  BPA Transient Stability Program (EMTP)

• Exchange electricity seasonally with southern California
  
  Pacific HVDC Intertie - 1,400 km

About Variable Must-Run Resources
Challenge Scale

- Need lots of new must-run variable electricity generation
- Unique operational characteristics

Operations Impacts

Baseline

High Renewables

Wind energy curtailment

Largest hourly wind drop

National Renewable Energy Laboratories studies
R&D Challenges Solved

- Important to BPA
- Improved wind forecasting in PNW
- Operations real-time study improvements
- Important to others
- Turbine reliability
- Blade efficiency
R&D Still to Go

• Price points, Price points, Price points

• Energy Storage
  • Capacity / Capability / Cost (more materials science)
  • Integration to smart grid

• How to have end-use resources adopt performance characteristics (ride-through, voltage, etc) of generating resources.

Energy Efficiency as a Resource
EE Achievements

Regional Total (aMW)

Average Output of Two Grand Coulee Dams

Regional Achievements (Cumulative)
R&D Achievements
(& Needs)

• Hood River Conservation Project (c 1985)
  • Test consumer acceptance and performance of “extreme” home energy savings

• Super Efficient Refrigerator Program - Golden Carrot (c 1990-95)

• Self-diagnosing, self-correcting rooftop package HVAC (c ???)

• Much much more - see Technology Roadmap at www.bpa.gov/ti

About R&D
What’s Wrong with Spending 0.01%?

• Power sector “owns” about 40% of climate change issues
  • **R&D needs**: CO\textsuperscript{2} sequestration, energy efficiency, effective renewables and storage integration, & smart grid
• Power sector could “own” another 30% related to transportation (electric vehicles)
• Utterly new and more complicated grid operations coming - Smart Grid
Good R&D Practices

• Publicly articulated research interests and agenda (www.bpa.gov/ti)
• Portfolio concept across key dimensions
• Great project management including built-in kill decision points
• In-company integration addressing business needs

Doesn’t the Utility Industry Have an R&D Org?

• Yep - the Electric Power Research Institute (EPRI)
• Not yet as effective as it needs to be - do they use good R&D practices?
• Some - they have a portfolio and public research agenda. But no effective project kill decisions, and only good (not excellent) project management practices.

Some Research isn’t Collaborative
BPA’s Version

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<th>Value to Region</th>
<th>Commercial Risk</th>
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BPA Role in Technology Development

- BPA Leads
- EPRI, CEATI

Balancing Portfolio Issues

- Breakthrough
- Increment
- Reserve
- External
- Urgency

Trade-Off

R&D Investment Effectiveness

- $$$
- PMO
- Annual Review
- Built-in Kill
**Risk v Reward**

Expected Return

- **Free Lunch** (find these)
- **Don't Go Here**

Risk

- **Fair Game Line**

**Cycles**

- **Portfolio Summit** (Feb)
  - Review Portfolio
  - Prune >10%

- **Monitor Project Management**

- **Solicit New & Returning Projects**
  - Formal Technical Review

- **New Adopted Portfolio**

- **Recommend New Portfolio to TCI Council**
  - Present Case for Balance (Buckets)
Integration

Larry Bekkedahl, VP Tx Eng
Kathy Black, General Counsel
Dave Armstrong, Deputy CEO
Larry Buttress, VP IT, CIO
Jack Callahan, Energy Efficiency
Anita Decker, COO
Mark Gendron, VP Req Markets

John Haner, Tx Plan
Jeff Hildreth, Labs
Mark Jones, Hydro Ops
Elliot Mainzer, EVP Strategy
Terry Oliver, Chief TI Officer
Peter Raschio, Tx Tech Ops
Don Watkins, Tx WECC NERC

Executives & Experts Paneled as Peers

BPA Results
Ductless Heat Pumps

- Heat Pump technology assessment capability
- Installed more than 4,800 ductless heat pumps into homes in the Pacific Northwest
- Success resulted in expansion of program for small business applications
- Provides future savings to BPA

Value Delivered = $Millions in Least Cost Energy

Seismic

- Reduce the seismic acceleration by: 50% for 500 kV equipment; 30% for 230 kV and 115 kV equipment & 10% for 69 kV equipment
- Created tools for equipment designers to validate models of seismic mechanics & perform representative analysis and design approach

Value Delivered = $000 Millions Faster System Restoration
Conductor Shunt

- 20 mile Ross-Lexington upgrade
- Increased capacity with “splice shunts” instead of new wire
- Half outage time
- One BPA crew vs. multiple
- $4 million direct savings first application
- Multiple applications in progress and pending

Value Delivered = $Millions in First Cost Savings

Synchrophasors

- SCADA @ BPA = 2 seconds
- Synchrophasors = 60 / second (120 times faster)
- Now - sleuth grid issues (looking backward)
- Soon - control functions for reliability
- Mid-term - oscillation damping
- Long-term - additional Pacific Intertie throughput

Value Potential = $000 Millions in Additional Revenue
Operations Telecommunications

- Used for SCADA, etc
- Needs to be used for smart grid, synchrophasors, etc
- Current technology is reliable but low bandwidth and has many parts

Huge Bandwidth and Low Latency Operations Control Needs

Multi-Gigabit Ethernet Transport for Operations

Value Delivered = $Millions in First Cost multiples of that for operations savings
Plus critical bandwidth
Conclusions

• Threshold for essential R&D activity varies by industry
  - but is universally closer to 1% of revenues than
  0.01% of revenues

• Money is not enough -
  What are we trying to accomplish must be known -
  Clarity of Purpose
  Good choices require metrics - why is B more
  important than A? - Clarity of Choice
  “Management” requires systems - brownian motion
  does not good research make - Clarity of Systems

Disciplined R&D = $000 Millions in Value