ASIA AND THE PACIFIC POLICY SOCIETY CONFERENCE
MARCH 11 – 12, 2014

THE ENERGY TRILEMMA AND THE SMART GRID: IMPLICATIONS BEYOND THE U.S.

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AGENDA

1. Introductions: What is the Institute for Energy and the Environment?
2. What is the Energy Trilemma?
3. What is the Smart Grid?
4. Can the Smart Grid Address the Energy Trilemma?
5. Case Studies – Best Practices.
6. Conclusion.

1.1 VERMONT LAW SCHOOL INSTITUTE FOR ENERGY AND THE ENVIRONMENT

- Top Environmental Law Program in the United States.
- Institute offers Masters in Energy Law and Policy and LLM in Energy Law.
- Teaches 9 energy courses each year.
- Modeled on a consultancy firm; faculty, fellows, and research associates work on real life energy law and policy projects.
- Publications.

1.2 THE INSTITUTE'S MISSION

An enormous proportion of the world's environmental issues arise out of energy use…

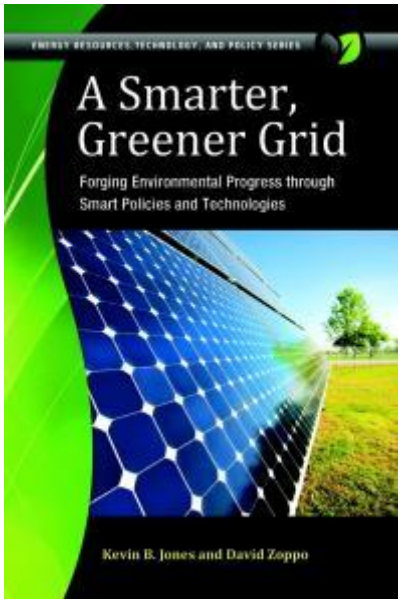
"Our mission is to have fewer greenhouse gas emissions in 50 years because of the work we do today; and in 100 years because of the work our students do tomorrow."

Professor Michael Dworkin, Director

1.3 THE INSTITUTE'S PROJECTS

- Smart Grid
- D.O.E. SunShot Plug & Play
- Energy Security and Justice
- Community Energy
- Arctic Oil and Gas
- Biomass

SunShot
U.S. Department of Energy



Institute for Energy and the Environment
VERMONT LAW SCHOOL

1.4 THE INSTITUTE'S PEOPLE

- Directed by Professor Michael Dworkin
- Dr. Benjamin Sovacool (Energy Security and Justice)
- Dr. Kevin Jones (Smart Grid)
- The "Energizers"/Research Associates

2.1 THE TRILEMMA

ECONOMIC CONCERNS

- Economic viability; Cost; Affordability.
- Asks: Is this a good investment? How will it impact on rates?

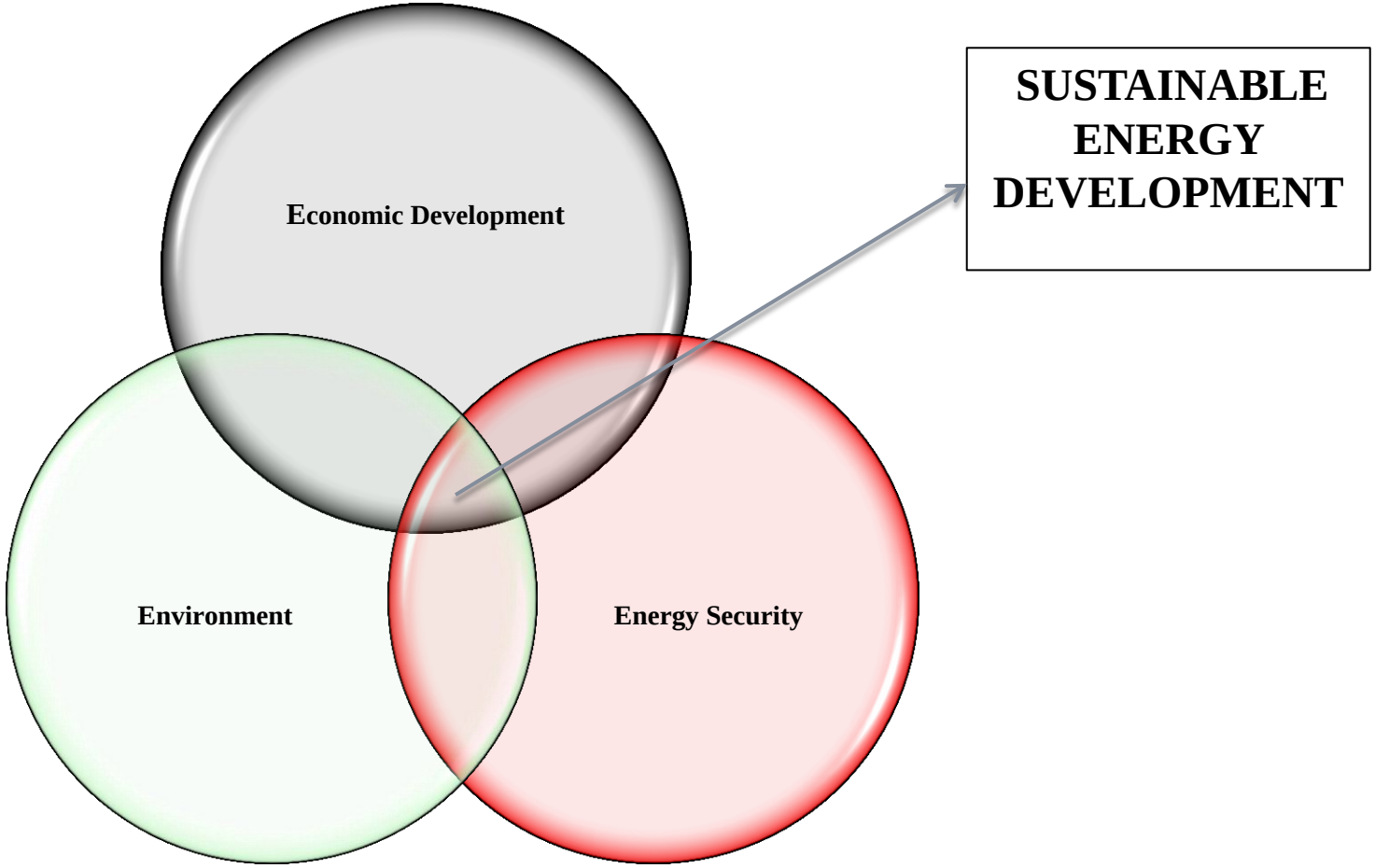
ENERGY SECURITY

- Security of Supply; Energy Independence; Reliability.
- Asks: Is there enough to meet demand? Is it reliable? Are we at the mercy of international politics?

ENVIRONMENTAL CONCERNS

- Burning of coal, natural gas, and oil for electricity and heat is the largest single source of global greenhouse gas emissions. (U.S. EPA)
- Asks: What impact will this have on the environment (climate change; physical destruction; aesthetics)?

2.3 THE ENERGY TRILEMMA



3.1 THE SMART GRID

WHAT IS THE ELECTRIC GRID?

- The electric grid is all the infrastructure that gets electricity from generation to end users.
  - Generation; transmission lines; substations; transformers; switches; distribution lines; wires…

Photo credit: Left and Centre Jeannie Oliver; Right Tom Adams.

3.2 THE SMART GRID

WHAT'S WRONG WITH WHAT WE'VE GOT?

- Our electricity infrastructure is getting old.
- Global energy demand is rising.
- What we have can't keep up with demand.
- If we can't reverse the upward trend for demand, we need to modernize what we have and/or build more. If we don't…

BLACKOUTS!

- INDIA JULY 2012: "Unprecedented grid failure" affecting 670 million people – more than half the country's population, or roughly 10 % of the world's population. (Gardiner Harris, Vikas Bajaj, New York Times 2012)
- SAN DIEGO 2011: A single blackout cost the region $97-118 million. Nationally, blackouts cost $150 million per year. (Di Savino, Scott, Reuters 2011)
- AUCKLAND 2006: 250,000 customers lost power costing approximately $70 million in GDP. (Concept Consulting Group 2008)
- Economic and energy security concern.

3.3 THE SMART GRID

WHAT IS THE SMART GRID?

"Much in the way that a 'smart' phone these days means a phone with a computer in it, smart grid means 'computerizing' the electric utility grid."

U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability.

U.S. DEPARTMENT OF ENERGY

3.4 THE SMART GRID

WHAT IS THE SMART GRID?

- Synonymous with communication. Lots of it!
- Encompasses a wide range of technologies, all designed to increase the multi-directional flows of information.
- Information identifies inefficiencies and faults.
- Information motivates demand response to reduce the stress on the grid – peak shifting; peak shaving; reduced demand.
- Enables integration of distributed generation.

4.1 THE SMART GRID AND THE TRILEMMA

"There is a pressing need to accelerate the development of low-carbon energy technologies in order to address the global challenges of energy security, climate change and economic growth."

International Energy Agency, *Smart Grid Roadmap 2012*

4.2 THE SMART GRID AND THE TRILEMMA

IS THE SMART GRID SMART ENERGY POLICY?

- E.U. says yes.
- U.S. says yes.
- South Korea says yes.
- Australia is exploring its options.
- New Zealand in 2012 said “not today, but probably tomorrow.” Today 395,000 smart meters installed, expect 1.2 million by April 2015.

4.3 SMART ECONOMIC POLICY

IS THE SMART GRID A GOOD INVESTMENT?

- Very expensive. Possibly the largest obstacle to fully implementing the smart grid.
- The Electric Power Research Institute in the U.S. estimates that fully implementing smart grid will cost between $1.3 and $2.0 trillion nationwide… But benefits will exceed costs by a factor of 3 or more.

4.4 SMART ECONOMIC POLICY

ECONOMIC BENEFITS

- Efficiency and peak shifting prolongs life of existing grid; delays costly investment in expanding grid.
- Avoid economic loss due to blackouts.
- Avoid meter reading costs. One U.S. utility expects to save $9 million per year on meter reading. (SMUD)
- Avoid electricity theft.

4.5 SMART ENERGY SECURITY

CAN THE SMART GRID RESOLVE ENERGY SECURITY ISSUES?

- Addresses reliability and resilience issues through efficiency and peak shifting/shaving and self healing mechanisms.
- Increased integration of distributed renewable energy → decentralized structure; energy independence.
- BUT cyber security issues need to be addressed.

4.6 SMART CLIMATE POLICY

CAN THE SMART GRID HELP US ADDRESS CLIMATE CHANGE?

- Pacific Northwest National Laboratory report expects that full implementation of a smart grid in the U.S. by 2030 could reduce energy consumption and carbon emissions by 12%.

Pacific Northwest National Laboratory (2010), *The Smart Grid: An Estimate of the Energy and CO2 Benefits.*

5.1 CASE STUDIES: LESSONS LEARNED

- We undertook six smart grid case studies representing a cross section of states, project type and size, regulatory environment, stakeholders, specific goals and concerns.

- 2 best practices emerged; both caution that technology alone, even smart technology, cannot resolve the trilemma without also addressing human concerns.

Project	State	Cost	Technology	Lessons Learned
Central Vermont Public Service "Smart Power." Part of statewide program, "eEnergy Vermont."	VT	$63 million. $69 million federal funding to VT utilities, of which CVP received $31 million.	Advance Metering Infrastructure ("AMI").	- Collaboration reduces regulatory barriers, enables cost sharing, ensures success. - Early and ongoing outreach accelerates customer acceptance, reduces confusion and skepticism, and ensures customers benefit from smart grid technology.
San Diego Gas & Electric.	CA	$3.5-3.6 billion. $5 million federal funding.	AMI; Programmable communicating thermostats; remote turn-on, turn-off device for residential meters; time of use rates	- Advanced customer education enhances customer acceptance.
Pecan Street Inc., Internet Demonstration Project	TX	$25 million. $10.4 million federal funding; a $350,000 private grant; $14 million investment by project partners.	AMI; smart water and smart irrigation systems; smart appliances; electric vehicles; rooftop solar; home energy storage; home energy networks. Uses internet for information sharing.	- Focus on customer experience; maximizing environmental impact; minimizing impact on utility revenue helps customers to understand "what's in it for me?"
Commonwealth Edison Smart Grid Innovation Corridor Pilot Project	IL	$800 million ($720m AMI, network, installation and vendor costs; $74m IT software and hardware integration; $6m additional operation and management; $2m miscellaneous). [	AMI; intelligent substations; integration of plug-in electric hybrid and all-electric vehicles; time of use rates.	- Real time pricing shifts peak loads. - Smart grid must be supported by clearly articulated state smart grid policies to achieve full benefits of smart grid. - Regulatory environment can hinder success: Cost allocation through rate recovery can be controversial; restrictions on advertising real time pricing hinders demand response potential.
Salt River Project	AZ	$114 million. $56.9 million federal funding.	AMI; smart grid backbone infrastructure (communications system); time of use rates.	- Smart grid backbone infrastructure (communications network) is essential to successful smart grids. - Time of use rates achieve customer satisfaction and end-use efficiency.
Sacramento Municipal Utility District, "Smart Sacramento"	CA	$308 million $127.5 million federal funding.	AMI; distribution automation; demand response; pricing study; cyber security.	- Value of customer engagement.

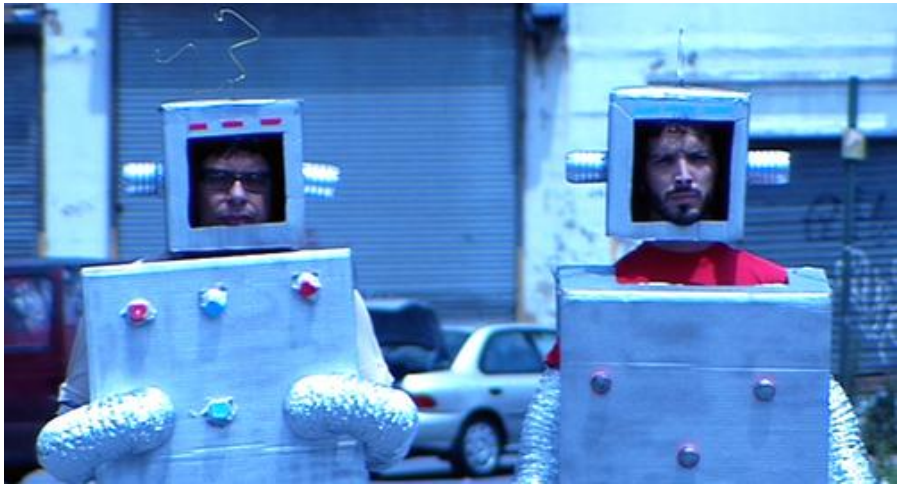
5.2 CUSTOMER COMMUNICATION

- Public misconception and/or ignorance about smart grid technologies can stall smart grid adoption and implementation.
- The smart grid is all about communication, yet many projects overlook the importance of *human* communication.

Technology must talk to the humans

HBO Flight of the Conchords,

"The Humans are Dead."



5.3 CUSTOMER COMMUNICATION

CALIFORNIA

- 2009 – "Is PG&E killing the smart grid?," "public relations disaster," "Bakersfield Effect" (Smart Grid Library)

AUSTRALIA

- Victoria mandatory smart meter rollout met with extreme negativity - temporary moratorium.
- Smart Grid, Smart City demonstration program, customer resistance "contributed to significant delays in rolling out the retail trial and, ultimately, the achievement of lower-than-expected numbers of customers participating."

5.4 CUSTOMER COMMUNICATION

BEST PRACTICES

- Engage early and often: before, during and after installation.
- Educate customers about the smart grid's benefits – societal and personal.
- Educate customers on how to use the technology.
- Address customers' concerns.

5.5 PRIVACY

A KEY CONCERN

- Smart technology increases the amount of information flowing out of a customer's home.
- Near real-time data on electricity usage transmitted using communication technologies.
- What can this data reveal about individuals?

5.6 PRIVACY

Smart meters may reveal occupants' **"daily schedules (including times when they are at or away from home or asleep), whether their homes are equipped with alarm systems, whether they own expensive electronic equipment such as plasma TVs, and whether they use certain types of medical equipment."**

U.S. Department of Energy, Data Access and Privacy Issues Related to Smart Grid Technologies (2010)

5.7 PRIVACY

BEST PRACTICES

- Develop robust privacy policies.
- Clarify from the outset:
  - what information is being collected;
  - who owns it;
  - who can see it;
  - who can use it; and
  - if information sharing is anticipated, to whom, for what purpose and under what conditions.
- Option to opt-out.

6. CONCLUSION

- Energy policy should be analyzed in terms of the energy trilemma.
- Smart grid technologies address each dimension of the trilemma: economic; energy security; environmental.
- But ultimately humans empower the smart grid to achieve its potential.
- Electricity end-users must be engaged and their concerns must be addressed.

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THANK YOU FOR YOUR ATTENTION