



Arizona State University (Tempe, Arizona)



Betsy Cantwell

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Area of Discussion: Water-Energy Nexus in the Southwest



COLORADO SCHOOL OF MINES



Western Area
Power Administration



THE UNIVERSITY of
NEW MEXICO



Utah State
University



NREL
NATIONAL RENEWABLE ENERGY LABORATORY



Southern Nevada
Water Authority

Major Takeaways: Arizona State University

Event Overview

- September 8, 2016: ASU hosted the Southwestern Regional Water-Energy Nexus Event in Tempe, AZ to address the water-energy megachallenge. Speakers and attendees included stakeholders from six states (AZ, CA, CO, NM, NV, and UT); 3 tribal entities (Gila River Indian Community, Fort Mojave Indian Tribe, and the Navajo Nation); 4 national labs (Lawrence Livermore, Los Alamos and Sandia National Labs, and the National Renewable Energy Laboratory); 2 utilities (Southern Nevada Water Authority and Western Power Administration); 7 universities (Arizona State University, New Mexico Tech, University of Arizona, University of California – Irvine, University of Colorado – Boulder, University of New Mexico, and Utah State University); as well as major industry leaders such as Coca Cola and Intel in addition to hydropower startup Natel Energy. Leaders from the U.S. Department of Energy attended and U.S. Senator Flake (R-AZ) prepared a welcome video.

Key Takeaways

- The greatest threat to southwestern regional sustainability is at the intersection of water and energy– the use of water in energy generation via coal, fracking/natural gas, hydropower, nuclear, biofuels, etc., and the use of energy for water – most notably represented by the energy being used to deliver water, especially for municipal use, agriculture, and irrigation across the region.
- The southwest regional ecosystem has everything needed to innovate at the water-energy nexus:
 - advanced technological expertise via our national labs and universities;
 - regulatory knowledge via our advanced partnerships with utilities and regulatory agencies; and
 - major industry centers with an interest in water-energy, especially for manufacturing.

Major Takeaways: Arizona State University (continued)

Key Takeaways (continued)

- Opportunities & Priorities
 - Wastewater and desalination are major R&D goal areas to address water supply challenges in the future
 - In addition to continued effort to use existing infrastructure more efficiently, evidenced-based reports indicate citizens in the region are willing to adjust troubling use trends to address demand changes in the future, but this must be done locally and in collaborative, community-based discussion
 - Integrated low water use-clean energy testbed opportunities should be leveraged to streamline the connection between ideation and market-readiness
 - Given advances in solar and related micro-grids, innovation in energy storage is critical to minimize the intermittency often associated with renewable energy deployment (including wind, solar, etc)
- Challenges
 - Industry is making progress in water-neutral use policies related to manufacturing, but progressive water and carbon programs are often isolated even within sustainability offices of the same company
 - Governance systems for utilities must evolve to support increasing decentralization; the boundaries that formerly governed utilities are no longer relevant for future needs
- Next Steps
 - Real change is possible at the municipal and tribal jurisdictional level
 - Regional participants are convening again around three important forward leaning steps: data sharing, shared technology development opportunities and regional testbed assets

Brown University
(Providence, Rhode Island)



Roundtable on
Clean Energy Technology and Mission Innovation Initiative
April 18, 2016

Major Takeaways: Brown University

Roundtable to share potential from Mission Innovation

Goal: Explore RI, New England / Northeast potential for a Regional Clean Energy Innovation Partnership

Key Takeaways:

- Significant ecosystem collaboration today:
 - Across universities
 - Connecting universities, entrepreneurs, industry, state agencies
 - Within single states, as well as across New England and Northeast region
- Deep regional assets in:
 - University research
 - Industry and ecosystem innovation programs and organizations
 - State support for clean energy
 - Common markets and industry sectors (details on next page)
- Ecosystem collaboration among the states:
 - Commerce RI, MassCEC, and NYSERDA collaborate today supporting cleantech startups, network of incubators, university / investor / industry network
- More analysis needed to confirm scale and focus of ecosystem and a Regional Innovation Partnership

April 18, 2016, Roundtable Attendees

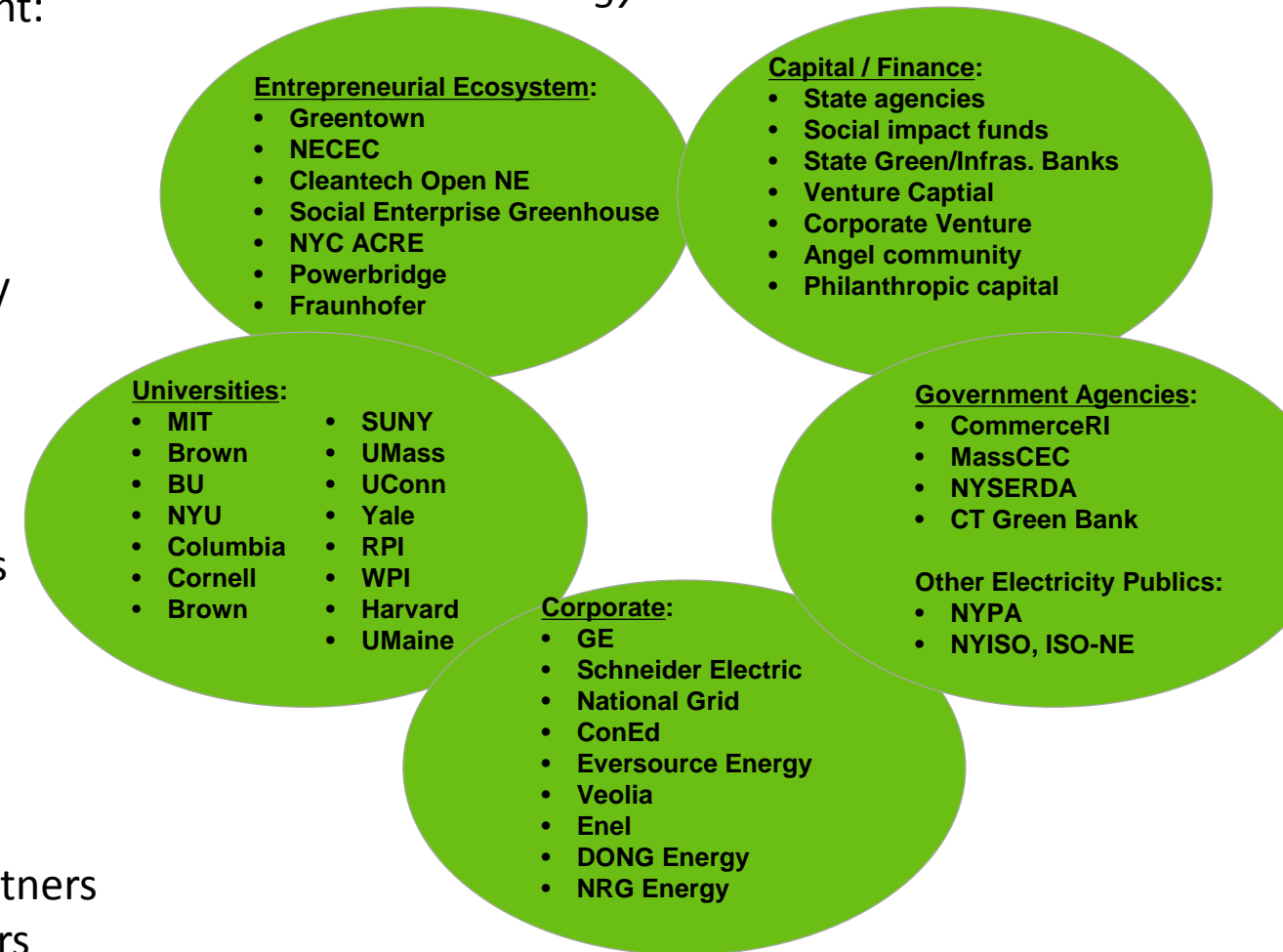
- DOE: Secretary Moniz, others from DOE
- RI Delegation: Senator Sheldon Whitehouse; Congressman Langevin; Congressman Cicilline
- Brown University (host):
 - Richard Locke, Provost; David Savitz, VP Research
 - Amy Carroll, Director of Research Development
 - Michael Miller and Rebecca Lorick, School of Engineering, Leading Edge tidal energy research project
- Other Universities:
 - Rob Stoner, Deputy Dir. for Science & Technology, MIT Energy Initiative
 - Mun Choi, UConn Provost
 - Dr. Gerry Sonnenfeld, University of Rhode Island VP Research
- RI Agencies:
 - Christine Smith, Director of Science Technology Advisory Council & Director of Innovation Programs at Commerce RI
 - Sam Marullo, Policy Advisor, Governor Raimondo's Office
 - Marion Gold, Director of RI Office of Energy Resources
 - Mark Huang, City of Providence, Economic Development Director
- Investors / Funders:
 - Thorne Sparkman and Rich Horan, Slater Technology Fund
 - Neil Steinberg, RI Foundation
- Industry / Innovation Ecosystem
 - Peter Rothstein, President, Northeast Clean Energy Council & NECEC Institute
 - Melissa Withers, Director of RevUp at Betaspring
 - Wendy Mackie, RI Composites Alliance
 - Tom Falcone, Tech Collective
- Corporate:
 - Tim Horan, President of National Grid, Rhode Island
 - Josh Brumberger, Utilidata
 - Jeff Gryzbowski, CEO, Deepwater Wind
 - Tim McDonald, SeaPotential
 - Chris Benzak, Managing Partner of Newport Biodiesel
 - Jessica Millar, Chief Technology Officer, vCharge
 - Jeff Flath, CEO, eNow
 - Paul Dunn, CEO, Enhanced Energy Group
 - Mark Hayward, RI District Director, Small Business Administration
 - Tim Burns, CEO, BioProcess Algae/BioProcessH2O

Major Takeaways: Brown University (continued)

Key Takeaways (continued)

- Sectors with regional opportunities for R&D, Demonstrations, Early-Adoption Customers, Deployment:
 - Offshore Clean Energy
 - Wind, Tidal, wave, ocean, river
 - Electricity System Modernization
 - Smart Buildings, Communities, Cities
 - DG, DR, Storage, Microgrids, Energy Efficiency
 - DER systems and business models
 - Advanced transportation & Infrastructure
 - EV vehicles and charging infrastructure
 - H2 vehicles and infrastructure
 - Autonomous vehicles & new business models
- Strong ecosystem & network of regional clean energy partners engaged in innovation from lab research to development, demonstration, deployment
(partial list in graphic)
- Challenges
 - Complex region and large number of potential partners
 - Planning efforts to confirm partners and key sectors needs further investigation
 - Partnership model to be determined

Partial List, Leading Regional Clean Energy Potential Partners



North Central and Intermountain West Region
(ND, SD, NE, KS, CO, MT, WY, UT, ID and discussions with NM)



Colorado Energy Research Collaboratory
Partners for Clean Energy

Maury Dobbie

Colorado Energy Research Collaboratory

Barbara Goodman

Executive Director / Institutional Planning, Integration & Development

National Renewable Energy Laboratory

Major Takeaways: Colorado Energy Research Collaboratory

Event Overview

The Sept 19 summit convened 167 individuals & approx. 30 on the live stream over a ten-state region (ND, SD, NE, KS, MT, ID, UT, CO, WY, NM) to acquire input and ideas from a wide variety of participants on topics including regional energy and innovation ecosystem strengths, opportunities and challenges; opportunities for regional public/private partnerships leading to pilot-scale commercial deployment; and understanding how public policy decisions influence achieving these goals.

The agenda included keynote sessions by former Colorado Governor Bill Ritter, current Colorado Governor John Hickenlooper and Dr. Lynn Orr from DOE. There were four topic areas discussed in pre-summit conference calls as well as concurrent breakout sessions. The topics included Grid and Storage; Food/Energy/Water; Energy/Climate and Renewable Sources. For more information: www.regionalsummit.org

Key Takeaways

Current Regional Innovation Ecosystem

This region incorporates 4 DOE national laboratories and dozens of other federal R&D facilities such as NOAA, NIST, NCAR, USDA labs, extension agencies, etc. The unique characteristics of the region include a large land area requiring a different approach to power transmission than in the more densely populated areas on the East and West coasts. The large reserves of fossil energy provides the motivation for production with the lowest possible environmental impact, and emphasizes the long term needs for CO₂ capture, sequestration and/or reuse. The region has significant capacity for biofuels, particularly advanced biofuels, but is challenged with a relatively arid environment that is water constrained in many regions. Cultivation of biofuels/biomass is challenged by the latitude variation of the region extending from the Mexican to Canadian borders.

Building a Broader Ecosystem

A large portion of the U.S. fossil and renewable energy resources reside in this region. The region has a low population density, extensive agriculture resources, large federal and tribal land footprints, and faces significant water challenges. In addition, other factors related to ecosystems, public policy, techno-economics, and human factors must be addressed as the region develops and implements a clean energy technology innovation strategy.

Major Takeaways: Colorado Energy Research Collaboratory (continued)

Key Takeaways (continued)

- Opportunities & Priorities

Commercial deployment of energy technologies is required to have impact at a large scale. The opportunities for collaboration between industry and research communities are critical in developing and deploying next generation energy innovations at a large scale in this region. Industrial scale up of clean energy technologies in the region is challenged by regulatory uncertainty around market signals on CO₂ emissions as well as incentive programs for renewable energy or CO₂ capture, sequestration or reuse programs. The research institutions in the region can be harnessed to stimulate the development of next generation energy products, but industry access to research institutions needs to be improved.

- Challenges

At the summit, participants discussed how the region can align anticipated research topics with state policies that become key drivers of deployment. Many of the states in the region have renewable portfolio standards, but these are primarily being fulfilled by build out of proven solar and wind technologies. The states could help to spur innovation by encouraging adoption of innovative new technologies for at least a portion of procurements to meet RPS goals. As it relates to improving industry participation, we will be forming an industry advisory group to further address this challenge.

- Next Steps

This region is rich in conventional energy resources, renewable energy resources, research and intellectual capacity, and a robust energy industry. The general consensus is that the four topics proposed are relevant and vital for the region. However, additional items for further consideration may include the role of energy efficiency, geopolitical, cultural, social and behavioral issues. The reports on the four breakout sessions contain many novel ideas around regional innovation. Using these comments, we plan to pursue future ways to partner by using our summit's data to craft a regional plan. At the summit, breakout groups were already deciding where they would host specific topic-area workshops so they could identify who the players should be in this regional multi-state endeavor. Researching best practices in the formation of a governance model, our goal is to create an effective organizational structure for our regional entity. We have already begun to create a 501(c)(3) organization that be used to form the North Central and Intermountain West regional partnership.

Purdue University (West Lafayette, Indiana)



Purdue President Mitchell Daniels welcoming Under Secretary Lynn Orr and other participants

In Association with
Argonne National
Laboratory

Pankaj Sharma

Managing Director, Energy Center, Discovery Park

Area of Expertise

Sustainable Energy Development

Major Takeaways: Purdue University

Event Overview

- 195 attendees; Midwestern States: IA, IL, IN, MI, MO, MN, OH, WI
- National Labs (ANL, AMES, SNL); Universities (PU, MN, MSU, ND, UIUC)
- Industry (Alcoa, Duke Energy, Energy Systems Network, Navitas, Enginuity Worldwide, GE, MISO, Whirlpool)
- Indiana State Government (Lieutenant Governor; Office of Energy Management; Indiana Geological Survey; Indiana Economic Development Corporation)
- Non-profits (Citizens Energy Group; Battery Innovation Center)
- USDA-ARS; Naval Surface Warfare Center, Crane, IN
- DOE (Office of Under Secretary, AMO)

Format: Key notes and five panels

1. Energy Storage *Plus Student Poster Session
2. Biomass/Synthetic Biology
3. Critical Materials/Advanced Manufacturing
4. Wind Energy/Grid Integration
5. Public Private Partnership



Mark Johnson, DOE Advanced Manufacturing Office and other panelists discussing energy storage challenges

Major Takeaways: Purdue University (continued)

Key Takeaways

- **Current Regional Innovation Ecosystem**
 - The Midwest has very strong research universities, national labs and industries focused on clean energy but there is no coordinated approach at the regional level to exploit abundant renewable resources (e.g. biomass, wind) and develop the talent pool of the future.
- **Building a Broader Ecosystem**
 - Efficient energy generation and utilization has both a regional and national basis. The time has come to address clean energy which is most appropriate for a given geographical area and for which solutions and living laboratories to test and prove the solutions, is best done on a regional basis. In our case, the pertinent region is IA, IL, IN, MI, MO, MN, OH, WI.
- **Opportunities & Priorities**
 - There is a compelling case to be made for a Midwest Regional Clean Energy Center whose scientific/engineering plus entrepreneurial expertise would address the bioeconomy, wind and solar energy, advanced materials and manufacturing, and energy storage technology. A partnership in the Midwest could act as a lens to focus regional activities on robust and internationally relevant solutions in clean energy.
- **Challenges**
 - It is important to speed up transfer from discovery to development to the market, and work with industry partners to define gaps and challenges before the translation process starts.
 - The challenges in carrying out the work under the auspices of a public/private partnership appear to be communication, intellectual property, and at times, differences in culture (i.e., timelines and expectations).
- **Next Steps**
 - Provide resources for each region for planning purposes to respond to future DOE RFPs for Regional Energy Innovation Centers.
 - These resources will allow: (1) a lead organizer of the forum to work with key stakeholders across the region to pull a team together; (2) engage a 501c.3; (3) hold workshops, meetings; (4) set a communication infrastructure (e.g. web site). This money is for planning purposes only and not for R&D.

University of California, Los Angeles
(Los Angeles, California)



Cassandra Rauser, PhD

Director, Sustainable LA Grand Challenge
UCLA Office of the Vice Chancellor for Research

Area of Expertise: Urban Sustainability

Major Takeaways: University of California, Los Angeles

Event Overview

- The Southern California Clean Energy Innovation Ecosystem Roundtable discussion brought together 28 leaders from academia, local and state government, utilities, a national laboratory, non-profit groups, and industry on May 10, 2016 at UCLA to discuss southern California's specific clean energy needs as the state and region transition to meet their ambitious climate and energy goals. Energy policy expert, J.R. DeShazo led the roundtable discussion that focused on identifying the region's immediate and long-term clean energy needs and challenges, and on laying the foundation for collaborations among the participants. During the panel, participants shared information on their area of expertise and regional energy role. The panel discussed increasing our renewable energy power, energy storage, grid modernization, distributed energy generation and storage, energy efficiency, and energy conservation in the region. After the panel, participants were given an opportunity to provide written responses to eight region-specific thought questions, and their responses were summarized in the final report.

Key Takeaways

- **Current Regional Innovation Ecosystem**
 - The panel agreed on the need for urgency, collaboration, and innovation. The state has played a leading role in moving the region towards clean energy through its mandates to produce 33% of energy from renewable sources by 2020, and 50% by 2030. Currently, there is only a loosely coordinated effort among key stakeholders and experts, and panelists agreed that the key to success is to collaborate regionally and develop a common vision.
- **Building a Broader Ecosystem**
 - A broader ecosystem must include academics and technology experts, government, utilities, national laboratories, non-government organizations, and industry representatives from across the southern California region. By focusing on southern California, we reduce a number of challenges related to governance and policy.

Major Takeaways: University of California, Los Angeles (continued)

Key Takeaways (continued)

- Opportunities & Priorities
 - Increase the amount of research and demonstration projects in the areas of cost effective utility and distributed solar and wind energy generation and storage; decarbonizing gas technologies, such as power to gas; renewable fuel generation; transportation electrification; grid modernization, integration, and security; and energy efficiency in buildings
 - Perform targeted feasibility assessments
 - Coordinate with regional cleantech incubators and organizations to connect clean energy investors with innovators
 - Develop a workforce and job opportunities related to clean energy innovation and deployment
 - Utilize southern California's different scale communities as test beds and demonstration sites
- Challenges
 - Aging infrastructure
 - The money and investment necessary for getting innovations to market and for scaled-up demonstrations
 - Governance, policy, and regulation; pricing strategies that don't allow and encourage emerging technologies to capture full benefits and revenues; federal and state subsidies; and IOUs vs. POUs
 - Community engagement and equitable solutions
 - The ports and major airports, and the transport of goods and services
- Next Steps
 - Coordinate discussions/workshops to develop a vision for the region and share expertise
 - Capitalize on existing efforts and programs in a more coordinated way

University of Delaware
(Newark, Delaware)



Dare to be first.



Charles Riordan

Deputy Provost for Research & Scholarship

Area of Expertise: Chemistry, Catalysis

Major Takeaways: University of Delaware

Event Overview

- The University of Delaware hosted a DOE Lab Day in May 2016, modeled after several DOE Lab Days on Capitol Hill
- Highlighted by a visit by Secretary Moniz.
- Nine DOE Labs participated in event via panel discussions and/or exhibits.
- Approximately 200 people attended from regional universities, large and small businesses and non profits.

*Sen. Chris Coons (DE), UD President Dennis Assanis
Sec. Ernest Moniz (left to right)*



Key Takeaways

Current Regional Innovation Ecosystem

- Delaware is going through fiscal challenges as well as the implications surrounding the DuPont-Dow merger and potential loss of technical talent. A mid-Atlantic regional ecosystem including the federal assets in the region (defense and bio) would enhance Delaware's existing capabilities and contribute to a economic development.

Building a Broader Ecosystem

- Delaware has a supportive State Government and Congressional delegation to help create a vibrant ecosystem. Combining the existing assets in renewable energy, composites materials for industry and military applications, chemical industry's catalysis expertise, and the bio/pharma centers in Maryland, Delaware, and New Jersey will require a regional approach and commitment for success.

Major Takeaways: University of Delaware (continued)

Key Takeaways (continued)

Opportunities & Priorities

- The DOE labs have programs and user facilities that provide collaboration opportunities for Delaware research and development entities, including training, employment and tech transfer.
- The various Manufacturing USA solicitations have provided new opportunities for Delaware organizations to collaborate with DOE labs and industrial organizations.

Challenges

- Delaware is a small state and has limited discretionary resources.

Next Steps

- Plans are underway to host a Materials Workshop in the Spring of 2017 that will include several DOE laboratories that will lead to new collaborations.
- The new President of the University of Delaware, Dennis Assanis, brings a broad background of the national labs and DOE research programs that will provide new opportunities for high level conversations.

University of Kentucky
(Lexington, Kentucky)



Rodney Andrews

*Associate Vice President for Research
and*

Director, University of Kentucky Center for Applied Energy Research

Area of Expertise: Energy policy and analysis; carbon materials; nanotube-polymer and nanotube-carbon composite materials; nanotube synthesis; carbon fiber formation; activated carbon materials; pitch chemistry and characterization

Major Takeaways: University of Kentucky

Event Overview

- The University of Kentucky hosted the nation's first Energy Innovation Regional Forum on April 21. It included 100 attendees from 11 U.S. states. In addition to keynote remarks from Energy Secretary Ernest Moniz and welcoming comments from UK President Eli Capilouto, the program featured panels on the following topics: Innovation, Combustion and CCS; New Value Creation from Coal; and Technology Innovation as a Driver for Regional Energy and Economic Development. The day also included a poster session featuring energy-related work from across the UK community.

Key Takeaways

- **Current Regional Innovation Ecosystem**
 - UK has a long, proud history of partnering with universities, industry, and non-government organizations across the region, nation and the world to solve the complex issues facing the energy industry. That tradition continues today.
 - UK CAER is well-positioned as a leader in developing technologies that utilize regional resources in an efficient and environmentally-sustainable manner. CAER researchers specialize in clean coal technology; beneficial re-use for coal ash and industrial waste; renewable fuels and chemicals; cost & reliability of power; and energy efficiency and security.
 - The current U.S. energy research and development ecosystem has encouraged investigators and institutions to focus on the same problems, regardless of geography, regional energy resources, and professional and institutional expertise.
- **Building a Broader Ecosystem**
 - The U.S. needs to change the innovation paradigm. We must innovate in ways that are appropriate to a region's resources and strengths. There is no "one size fits all" answer to ensuring a sustainable, reliable energy future in the United States. We must invest equally in new technologies regardless of fuel sources to remain internationally competitive in current and emerging markets.

Major Takeaways: University of Kentucky (continued)

Key Takeaways (continued)

- Opportunities & Priorities
 - Create a sustainable, consistent national research and development budget that invests in an “all-of-the-above” energy strategy. Regional partners can assist in this area by informing our policymakers, legislators, and key stakeholders of the importance of such policy.
 - Discovering breakthrough energy innovations will require long-term investment. Investment decisions should be managed by each region to ensure that regional partnerships can set priorities based on the particular needs and opportunities in each region. This will help region’s invest in their strengths and maximize their resources.
- Challenges
 - Successful regional energy innovation partnerships need to be two things that don’t necessarily “get along.” They need to be patient and nimble. We need to be patient in investing in technologies that we know hold great promise in the long-term (carbon capture and storage), and nimble enough to react and invest in new, emerging technologies.
 - Universities, institutes, and government agencies are not traditionally agile in their ability to react to market conditions. These regional organizations needs to develop processes and procedures that will allow them to react more quickly, while remaining patient with projects that need time to develop. The ability to make investment decisions regionally should help address these issues.
- Next Steps
 - Continue to partner and foster relationships with those that attended the Regional Energy Innovation Forum. At UK CAER, our work with organizations across the region and country continue to evolve and become central to the Center’s growth strategy.

THE UNIVERSITY OF NEW MEXICO

ALBUQUERQUE, NEW MEXICO



Vice President for Research Gabriel P. López

Area of Expertise: Materials Science & Engineering

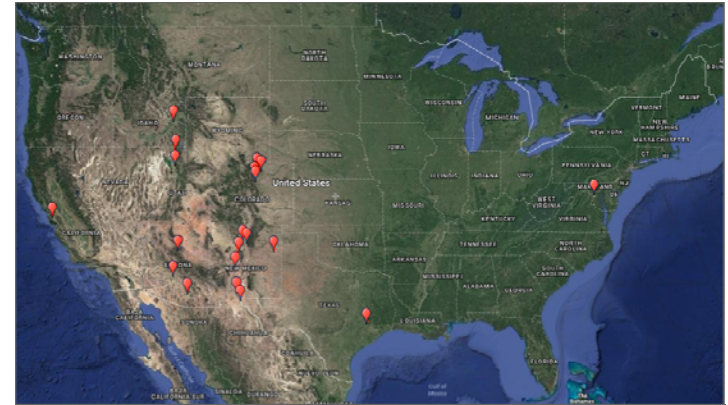
Major Takeaways: The University of New Mexico Forum

Forum Overview

- >136 participants from academia (70), national laboratories (25), industry (23), government (15), non-governmental organizations (3) and 5 panels of experts from all these sectors
- Southwest Mountain Region (NM, AZ, CO, UT, ID)
- Keynote comments by DOE Secretary Moniz, US Senators Udall and Heinrich
- Discussed revolutionary new approaches to clean energy production and utilization based on new materials technologies (hydrogen, photovoltaics, energy storage, advanced nuclear energy systems).

Key Takeaways

- Opportunities & Priorities
 - Transformative, disruptive technologies will be needed to allow Mission Innovation to succeed.
 - Materials research, development, translation and commercialization is the best technological opportunity in transformational clean energy.
- Current Regional Innovation Ecosystem
 - The Southwest Region is uniquely poised intellectually, technologically and geographically, is a national leader in materials research and development for energy applications and is an established hub for energy materials innovation and commercialization.



MATERIALS TECHNOLOGIES FOR CLEAN ENERGY



Hydrogen



Photovoltaics



Energy Storage



Advanced Nuclear
Energy Systems

The University of New Mexico: Key Takeaways (continued)

- Building a Broader Ecosystem
 - The Southwest Region demonstrates a strong presence of existing and well established public/private partnerships that can be leveraged and further enhanced.
- Challenges
 - Determining the promise of proposed technological advances will require linkage to economic models and climate modeling capability.
- Next Steps
 - Regional Summits & Workshops hosted by:
 - US Senator Heinrich's Energy Summit – Energy Storage Strategies for Industry & National Security
 - Sandia National Laboratories – New Mexico Regional Energy Storage & Grid Integration Workshop
 - Arizona State University – Water-Energy Nexus Event
 - Colorado Energy Research Collaboratory – North Central / Inter Mountain West Regional Clean Energy Innovation Summit
 - Innovate New Mexico – Technology Showcase
 - Los Alamos National Laboratory / New Mexico Consortium efforts in clean renewable bioenergy
 - Regional Stakeholders developing concept papers



University of Pittsburgh
Pittsburgh, Pennsylvania



Dr. Gregory Reed

Director, Center for Energy & The Energy GRID Institute

University of Pittsburgh

Area of Expertise: Electric power grid and energy technologies

Major Takeaways: University of Pittsburgh

Event Overview

- The University of Pittsburgh's Center for Energy hosted the U.S. Department of Energy Mission Innovation Workshop on Grid Modernization on Friday, June 24, 2016, at the Energy Innovation Center in Pittsburgh's Hill District. The workshop focused on modernizing the nation's vast and complex electric power delivery system. The keynote address was delivered by Dr. Franklin Orr, Under Secretary for Science and Energy
- Over 70 participants joined the full-day workshop, including representatives from academia, industry, utilities, government, nonprofit, and the private sector

Key Takeaways

- **Current Regional Innovation Ecosystem**
 - University of Pittsburgh's Energy Grid Research and Infrastructure Development (GRID) Institute - The GRID Institute will leverage public and private partnerships with new laboratory space at the Pittsburgh Energy Innovation Center to create a comprehensive solution center for industry, government, and community partners, while advancing research, development, demonstration, and deployment of evolving grid technologies and applications
 - The City of Pittsburgh has a MOU with the Department of Energy to establish Pittsburgh as a leader in 21st Century energy innovation
- **Building a Broader Ecosystem**
 - Representative of the broader regional ecosystem, the Tri-State University Energy Alliance (TrUE Alliance) was recently established between the University of Pittsburgh, Carnegie Mellon University, Case Western Reserve University, and West Virginia University to collaborate on regional energy-related research

Major Takeaways: University of Pittsburgh (continued)

Key Takeaways (continued)

- Opportunities & Priorities
 - The City of Pittsburgh has the opportunity in partnership with the DOE and the University of Pittsburgh to update existing district energy systems, deploy EV infrastructure, and integrate new technologies (e.g. microgrids and renewables)
 - The broader region has opportunities with unconventional oil and gas
- Challenges
 - Ageing grid infrastructure and a changing business model - the evolving role of utilities
 - How the grid can respond to customer demands, isolate disasters (natural or man-made), and integrate renewables
 - Grid modernization from a policy and regulatory perspective
 - Energy storage systems integration

Next Steps

- The Mid-Atlantic Region is well-suited as a hub for clean energy research and development in the area of grid modernization - relevant work is already underway as exemplified by the TrUE Alliance, the MOU between DOE and the City, the Pitt Energy GRID Institute, and the development of the EIC as a center for collaboration between industry, government, academia, and the public sector
- The region presents an opportunity to showcase modern grid technologies, leveraging local and existing assets. Within the Mid-Atlantic alone, clusters of research universities have come together to work on energy specific topics, major utility companies are testing innovative approaches to grid development, and industry partners are investing in the region

University of Tennessee, Knoxville (Knoxville, Tennessee)

Left to Right:

- 3D printed replica Shelby Cobra made at DOE's Manufacturing Demonstration Facility at ORNL
- AIME 3D printed house and vehicle additive manufacturing integrated energy system
- 3D printed tool (world record) for Boeing



Taylor Eighmy

Vice Chancellor, Research and Engagement

Area of Expertise: Government-University-Industry-National Lab Collaboration, Rapid Innovation, Tech to Market



Major Takeaways: University of Tennessee, Knoxville

Event Overview:

- May 23rd with 150 attendees from seven states (TN, AL, FL, GA, MS, NC, SC), with six panel discussions targeting industry, university, entrepreneurship and graduate education, technology and regional capabilities, and pathways to commercialization.

Key Takeaways:

- **Current Regional Innovation Ecosystem**
 - **Strong technology-based ecosystems** in (1) advanced manufacturing and automotive, aerospace and land-based turbine sectors, (2) grid stability, grid cyber security, scaled grid distribution, power electronics and regional energy suppliers, (3) biomaterials and carbon management strategies and industry, (4) nuclear energy, and (5) smart cities and the built environment.
 - **Accelerated Collaborations:** two DOE-AMO NNMI (IACMI for composites manufacturing, PowerAmerica for wide band gap power electronics); two DOE hubs (BESC for bioenergy and CASL for nuclear energy).
 - **National Laboratories** (ORNL in TN, SRNL in SC, Jefferson Lab in VA) including many **SC-supported specialized user facilities** (e.g., materials characterization, high performance computing, transportation, manufacturing, carbon fiber).
 - **Engaged Universities** with strong records of R&D, commercialization, and collaboration.
 - **Energy utilities** (e.g., TVA, EPRI, Southern, Duke, FPL, EPB) and **collaboratories** (e.g., NEI, EWI, SRI, RTI, ORAU).
 - **OEMs** (e.g., Boeing, Lockheed, GM, VW, BMW, Volvo, Honda, Nissan, Daimler, Mercedes Benz, GE, Siemens, MHI, Hitachi, Alstom, Mitsubishi, John Deere, Cummins, ABB, Westinghouse), **their supply chains** (e.g., Eastman, DuPont, BASF, PPG, Alcoa), and **SMEs** (e.g., Local Motors, Cincinnati Inc., Ingersoll, MVP, Techmer).
 - **Tech to Market:** Strong connectivity (e.g., Council on Competiveness, Brookings, Innovation Crossroads, Triangle Angel Partners, Nashville's 36/86 conference, Cleantech Open Southeast).
 - **International:** CRADAs and MOUs (e.g., ARCAM AB, Concept Laser GmbH, Boeing AMRCs, Fraunhofer).
- **Building a Broader Ecosystem:** Generally Southeastern (e.g., TN, IN, OH, PA, WV, KY, VA, NC, SC, GA, AL, FL, MS, LA)

Major Takeaways: University of Tennessee, Knoxville (continued)

Key Takeaways (continued):

- **Opportunities:**

- Excellent existing government-university-industry national lab collaborations to leverage.
- Supportive industries and their supply chains.
- Supportive State government.
- Supportive investment community and innovator (tech to market) ecosystems, NGOs.

- **Priorities (Clean Energy R&D Focus Areas):**

- *Advanced manufacturing* for light-weighting in the vehicles and transportation sector (**Vehicles and Transportation**).
- *Integrated grid management* and new *power electronics* (**Electricity Grid**).
- *Bio-derived fuels and Carbon Conversion* (**Bio-Based Fuels and Materials; CO₂ Capture, Utilization, Storage**)
- *Nuclear energy*, advanced manufacturing and materials (**Nuclear Energy**).
- *Sustainable smart communities* with net neutral energy and water consumption, resilient infrastructure (**Industry and Buildings; Energy Storage; Renewables**).

- **Challenges:**

- Need for improved business processes around speed of connecting industry to science & technology. Building upon existing models such as IACMI are essential for improving the speed of business.

- **Next Steps:**

- Directed strategic collaborations tied to regional innovation needs, workforce needs, and especially innovation accelerators and private/foundation/investment efforts in the clean energy technology space.

The University of Texas at Austin (Austin, Texas)



Jennifer Lyon Gardner, Ph.D.
Assistant Vice President for Research

Event Date: May 9, 2016

Major Takeaways: University of Texas at Austin

Event Overview

- Quadrennial Energy Review panels and Energy Innovation Roundtable discussion hosted at UT Austin on May 9, 2016; Participants included Honorable Secretary of Energy Ernest Moniz, DOE officials, and 45 stakeholders from industry, national laboratories, non-profits and academia

Key Takeaways

- Current Regional Innovation Ecosystem
 - Three areas of excellence within the Southwest region of the U.S. (SXSUUS):
 - (i) Oil and Gas; (ii) Clean Energy Entrepreneurship; (iii) Integrated Energy-Water Management
 - Vibrant entrepreneurial ecosystem:
 - Technology centers within states (TX, OK, NM)
 - Innovation hotbeds centered around national laboratories (Sandia, LANL), universities
 - Significant start-up activity and thriving energy industry
 - Leading university-industry partnerships (e.g., Advanced Energy Consortium, Gulf Coast Carbon Center, Next-Generation Photovoltaics I/UCRC)
- Building a Broader Ecosystem
 - Promotion of large-scale pilot studies leveraging expanses of rural land, ERCOT grid, large concentration of major manufacturing centers
 - Public-private partnerships to make use of data/resources available to different organizations and to manage regional energy portfolios

Major Takeaways: University of Texas at Austin (continued)

Key Takeaways (continued)

- Opportunities & Priorities

- TX, OK, NM have opportunities to increase solar and wind adoption due to sunny climates and high winds
- Opportunity to foster cross-border cooperation with Mexico as Mexico's energy markets shift
- Use of regional facilities (refineries, manufacturing centers) as testbeds for improving national natural gas infrastructure
- Opportunity to develop solutions in using the energy sector to improve the water sector and vice versa – of particular importance to SXSUUS owing to population growth + strained water supplies
- SXSUUS as a testbed for emerging technologies:
 - CO₂ management
 - Electrifying and deep decarbonization of transportation
 - Creating a hydrogen infrastructure; impact of hydrogen economy

- Challenges

- TX, OK, NM have water constraints due to long-term climatic conditions and nearer-term increasing populations
- Integration of resources from public and private sectors; management of extremely large datasets for decision support
- Investment in energy innovation impacted by changing market conditions

- Next Steps

- Innovation through regional partnerships (academia/industry/government) to accelerate the development and deployment of clean energy technologies
- Consider success of Texas Competitive Renewable Energy Zone (CREZ) as a useful test case that could inform discussions about expanding the nation's energy transmission infrastructure

Northwest Regional Clean Energy Innovation Workshop

University of Washington
Seattle, Washington



Michael B. Pomfret

Assistant Director

Clean Energy Institute

University of Washington

Area of Expertise: University-Industry Partnerships, Testbed Facilities

Major Takeaways: University of Washington Workshop

Event Overview

- 120 participants and speakers from Idaho, Montana, Oregon, and Washington
- Strong representation from Northwest Tribes, National Labs, Research Universities, Small and Medium Sized Enterprises, Cleantech Investors, Fortune 500 Tech & Industrial companies, Utilities, Policy Makers and Regulators.
- Panels explored the Research Ecosystem, Innovation in Large and Small Enterprises, Regional Policy & Investment
- Keynote talks by Secretary Moniz, Senator Cantwell, Governor Inslee, and Representative Kilmer

Key Takeaways

- **Current Northwest Regional Innovation Ecosystem : VERY PROMISING**
 - NW clean energy start-ups are getting exits to market; some NW states have dedicated clean energy public investment funds; regional coordination has resulted in the formation of Cascadia Cleantech Accelerator, a 501(c)(3).
 - Globals in the NW like Amazon, Boeing, Freightliner, GE Grid Solutions, Itron, McKinstry, Microsoft, Paccar, Schweitzer, SolarWorld, and others have know-how to launch market-leading or market-making energy & efficiency products & services.
 - Region is an “all of the above” testbed for deep decarbonization, and an energy gateway to Canada and Asia.
 - Invaluable experience in social/environmental issues of Energy-Water nexus from 8 decades of hydropower development.
- **Building a Broader Northwest Ecosystem: ROADMAPPING needed to ACCELERATE INNOVATION**
 - Ingredients for a supercharged ecosystem are present in the Northwest.
 - A regional roadmap with coordination of public and private funds, strategic partners, testbed facilities, researchers and students will enable next-level performance.

Major Takeaways: University of Washington Workshop (continued)

Key Takeaways (continued)

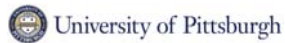
- NW Opportunity: Create the nation's premier "all of the above" deep decarbonization testbed
 - Currently about 75% of NW electricity generation has no carbon emissions.
 - Energy efficiency and renewables are expected to meet future growth in the region's electrical load.
 - NW science and technology strengths in materials, computing, large data analytics, system analysis supports deeper decarbonization of the grid, transportation, building, and industrial sectors.
 - Deeper decarb: RD&D partnerships using regional and national testbeds to expand deployment of small modular nuclear, wind, geothermal, marine energy, energy efficiency, and grid modernization hardware and software.
 - Deeper decarb: RD&D partnerships to accelerate biofuels, electrification, & lightweighting for aviation & vehicles
 - Deeper decarb: RD&D partnerships using regional & national testbeds to accelerate clean energy smart manufacturing
- NW Opportunity: Leverage the region's energy and trade integration with Canada and Asia to accelerate global progress.
- NW Challenge: Coordination & communication across the region to focus on highest impact areas.
- NW Priority: Strategy and funding that mobilizes the partnerships & facilities needed to transition high impact innovations from research to prototypes and scalable demonstration projects.
- Next Step: Develop a roadmap to strategically align regional assets with globally impactful goals & milestones in order to accelerate prototype development and technology demonstrations at scale.

Mid-Atlantic Region Energy Innovation Forum

hosted by West Virginia University

September 12, 2016

Morgantown, West Virginia



Brian Anderson

Director



Areas of Expertise: Sustainable Energy Portfolio Development, Academic-Industry-Government Partnerships

Major Takeaways: Mid-Atlantic Region Forum at West Virginia University

Event Overview

- 112 participants from 7 states (KY, OH, PA, VA, MD, NJ, WV) and DC from academia (32), national laboratories (8), industry (35), government (22), and non-governmental organizations (15).
- Keynotes from Secretary Moniz, Senator Joe Manchin, and Congressman David McKinley
- Regional cooperation panels:
 - Regional Challenges and Opportunities (NETL, CMU, Battelle, Benedum Foundation)
 - The Tri-State Governor's Regional Cooperation (WV, PA, OH)
- Topical Panels
 1. Innovation opportunities for fossil fuels in a future low carbon economy (ExxonMobil, Battelle, B&W, Siluria)
 2. Innovation opportunities in other clean energy technologies (GE, PPPL, SMLC, DOE NE)
 3. Policies Facilitating Sustainable Clean Energy Development (PJM, RFF, NRECA, Spilman Thomas & Battle)
 4. Regional Innovation Investment and Commercialization (InnovationWorks, HarbourVest Partners, DOE CFO)

Key Takeaways

- Current Regional Innovation Ecosystem
 - The Mid-Atlantic Region is a tale of two halves, fewer population but energy resources in the west and population density in the east. As such, there are currently two disconnected innovation ecosystems. WV, PA, and OH have created the Tri-State Coalition and the Pittsburgh/Cleveland/N. WV region has the Power of 32.
- Building a Broader Ecosystem
 - Coordinating across the entire 8 state region and multiple sub-regional efforts.

Major Takeaways: Mid-Atlantic Region Forum at WVU (continued)

Key Takeaways (continued)

- Opportunities

- Large (55 million ppl), diverse, energy-rich region with **engaged stakeholders from all sectors**

- Priority Innovation Focus Areas

- **Clean fossil**: advanced power cycles, fuel cells, CCUS, and increased natural gas utilization
 - NETL, Industry partners (i.e. B&W, ExxonMobil, Siluria, Battelle), and Universities strong in this area (OSU, UK, WVU, PSU, Princeton, VT, etc)
 - Strong state-level support and momentum in the industry, e.g. current infrastructure developments underway
- **Grid modernization** – smart grid and grid-scale electric storage (NEES EFRC, PJM, FirstEnergy, Exelon, AEP, NRG)
- **Energy Efficiency** – building and industrial efficiency (CBEI Hub, Energy4P32)
- **Nuclear Energy** – fission and fusion energy sciences (PPPL, WVU, Westinghouse, WastePD)
- **Advanced and Smart Manufacturing** (NNMIs: America Makes, IACMI, SMLC-CESMII)

- Challenges

- **Funding** for large-scale demonstration of technologies - CCUS, power cycles, NG conversion demonstrations cost \$100s of millions
- Diverse region and **broad priority focus** areas

- Next Steps

- **Five follow-on events** coordinated by the TrUE Alliance
 - **Grid**: EPIC Meeting Pittsburgh, 11/14-11/15; **Storage**: Center of Excellence in Ohio meeting on Energy Storage end of October in Cleveland;
 - **NG Utilization**: AIChE Natural Gas Utilization Workshop on November 1-3, 2016 in Morgantown and technical workshop Tri-State, November 30
 - **Efficiency**: CMU and Energy for the Power of 32
- PJM Interconnect will be working with WVU on **regional planning and innovation efforts**
- Coordinate with **sub-regional consortia** in developing a Mid-Atlantic Region Energy **Innovation Roadmap**

