



Embassy of Australia
Washington, D.C. **Canada**



EMBASSY OF DENMARK
Washington D.C.

Global Energy Solutions Summit, March 28-29, 2019, Washington, DC

The National Governors Association in collaboration with the Embassy of Australia, Embassy of Canada and the Embassy of Denmark hosted this Summit to help governors gather ideas from countries that are leading in the deployment of three emerging energy technologies: offshore wind, energy storage, and carbon capture, utilization and storage. For each technology, the Summit examined innovative activities and policies to foster deployment and development internationally and in the U.S.

DAY 1: OFFSHORE WIND & ENERGY STORAGE

Welcome & Opening Remarks

Ethan Zindler, Head of Americas Bloomberg New Energy Finance: We've come a long way regarding the technology for offshore wind.

- We will need all of these technologies [to reduce emissions].
- Several billion dollars a year will need to be spent to ensure that this sector [offshore wind] will be at scale.
- In what is disruptive to the status quo, the U.S. is seeing solar and battery projects get built that are economically competitive with natural gas.
- We don't want to get distracted with the technologies of the future and disregard the technologies of today.

Sue Gander, Division Director, Energy, Infrastructure & Environment Division, National Governors Association: With a growing number of states advancing very ambitious clean energy goals, this conversation is very timely.

Lone Dencker Wisborg, Ambassador of Denmark: We do not have much in the way of natural resources, but one thing we do have is wind.

- Today, wind power is supplying almost forty-five percent of Danish electricity demand, while Denmark maintains one of the lowest levels of power disruptions in Europe.
- It has taken Denmark almost three decades to develop our offshore wind industry to where we have it today. Hopefully, U.S. states can reap the same benefits faster by learning from international partners.

State of the Offshore Wind Market

Ned Lamont, Governor, State of Connecticut: Our administration is committed to mitigating environmental concerns and you can look at the wind project off New London Coast as an example of what we're doing in our state.

- Wind power is the right and smart thing to do. It can make Connecticut the wind power capitol of the North East coast and offer thousands of jobs in the process.

"My goal in Connecticut is to make sure we have a diversified set of energy. Offshore wind is going to be a huge part of that." – **Governor Ned Lamont, State of Connecticut**

Morten Baek, Permanent Secretary, Danish Ministry of Energy, Utilities & Climate: Denmark has realized that green energy is secure energy. A green energy future makes pure sense for so many reasons: Security of supply, energy economics, and growth and climate.

- 1 GW of offshore wind yields 8,200 jobs. We will need training centers to get the know-how transferred.
- Transmission is paramount in this process. As we revisit the development of this industry, we have also recognized the importance of flexibility in bringing projects online.
- Speaking specifically to European advancement, the countries in the North Sea will need to cooperate and have uniform standards for maritime, spatial, technology, finance.
- Cooperation will lead to sharing of best practices to deploy offshore wind and will help ensure affordable prices.

Alicia Barton, President & CEO, New York State Energy Research & Development Authority (NYSERDA): As we look at offshore wind in NY, we are pleased with the level of competition for 800 MW solicitation, but there is still work to do. NY is concerned about infrastructure & transmission constraints.

- Our goal of 9,000 MW of offshore wind by 2035 would represent 30% of the state load – this is a huge transformation in our energy sector.
- The \$200 million in support for offshore wind industry infrastructure has affirmed our mission to make New York an offshore wind hub.
- We hope to have lease options in NY by the end of 2019, we emphasize that we would like the leasing process to move faster and have maintained a strong working relationship with BOEM to achieve this.
- Will see offshore wind as one of the most cost competitive resources on the east coast in the future.
- Every time a new contract is launched in one state, it's good for all states

Thomas Brostrom, CEO, Orsted U.S. Offshore Wind: If you want to get to 100% renewable energy, you have to have offshore wind.

- With ambitious state targets and investments of \$70 billion investment expected in offshore wind to meet these targets, the number one thing the industry needs is visibility.
- In the past 3 or 4 years alone, costs have been reduced by 60%-70% - still a technology that is advancing and there's still room for improvement.
- U.S. has hit the timing almost perfectly piggybacking on what's happened in Denmark.

Walter Cruickshank, Acting Director, Bureau of Ocean Energy Management, U.S. Department of the Interior: The U.S. and Denmark have similar interests in the consideration of offshore wind development – this is evidenced in the MOU we signed.

- The administration supports a diverse mix of resources for our domestic energy portfolio and is committed to streamlining permitting and providing flexibility to industry where appropriate. This flexibility includes the option to submit a Construction and Operations Plan that describes a reasonable range of project designs, otherwise known as a project design envelope.
- As of now, we oversee 15 active commercial wind energy leases on the U.S. outer continental shelf (OCS), with much of the activity located in the Northeast.
- The U.S. can leverage our significant experience and lessons learned from the oil and gas industry and apply it to the emerging offshore wind industry.
- Wind on the OCS offshore CA will require floating technology. Given other onshore options, e.g., solar, it will be one of a menu of possibilities for new electricity generation.

Advancing Offshore Wind Through Regional Collaboration

Morten Baek, Permanent Secretary, Danish Ministry of Energy, Utilities & Climate: Offshore wind development in the North Sea will provide 20% of Europe's electricity by 2040.

- Four specific areas of cooperation among ten North Sea countries: maritime spatial planning, offshore grids and infrastructure, tenders and finance as well as joint standards and rules. With the aim to expand the deployment of offshore wind power, while bringing down costs.
- Linking the countries through offshore wind energy infrastructure will create jobs and economic growth throughout the region.
- EU has taken additional steps to develop an internal market for electricity so it can move freely across borders; this helps ensure affordable prices.
- 90% of offshore capacity is currently in Europe. U.S. states will represent an important part of the growth in offshore wind development. We look forward to strengthening transatlantic ties.

What Does it Take to Unlock the U.S. Market for Offshore Wind?

Tom Kiernan: Goldman Sachs has estimated cost declines that could continue in the future for offshore wind.

- We estimate between 15 to 20 GW of offshore wind being developed between now and 2030.
- From an agency perspective, BOEM, DOI, and FERC have all been doing a great job with leases and policy issues. The capital will come if there are steady federal and state policies (such as the 2015 federal extension of tax credit that added clarity for the industry).
- Offshore wind needs to be branded to the public for what it is: opportunities for growth and jobs, even for the oil and gas offshore industry who are enthusiastic to learn how to apply skills and expand their expertise.

Jason Folsom, US National Sales Director, MHI Vestas Offshore Wind:

- We want this (offshore wind) to be an American industry because it's an industry that has massive ancillary benefits.
- With every doubling of capacity, we see a 10%-12% price reduction.
- Looking at policies, offshore wind needs an ITC/PTC equivalent that worked well for onshore wind and gives offshore a pathway to being cost competitive.

"What's obvious is that states are going to compete, and governors are going to compete in the offshore wind energy space. The federal government needs to play a role with both the competition and the collaboration and make sure state voices are heard." – **Tom Kiernan, President & CEO, American Wind Energy Association**

"Offshore wind is a clear economic development driver. We need to continue to focus on expanding past borders in Europe and ensure that offshore wind is baseload power." – **Jason Folsom, US National Sales Director, MHI Vestas Offshore Wind**

Sara Bluhm Gibson, Director, Office of Clean Energy, New Jersey Board of Public Utilities: Governor Murphy's transition to 100% clean energy has solidified New Jersey as a leader for offshore wind development.

- States can follow NJ's example of recognizing where there is expertise, for example Rutgers University's wind mapping tools.

Annie Hawkins, President, Representative from Offshore Development Alliance: There are many diverse viewpoints among

fishing industry; there's been an evolution in the channels of communication.

- There's a need for cooperation among states when it comes to dealing with fishing industry concerns.

Rob Gramlich, Founder & President, Grid Strategies LLC:

There traditionally hasn't been an appetite for large-scale transmission projects, but that's starting to change; RTOs can be doing more to plan for transmission projects.

- Offshore wind has higher capacity factors and higher capacity value.

Future of the Offshore Wind Market Keynote

"The Trump administration's all-of-the-above approach to energy development includes offshore wind and other renewable technologies." – **Joe Balash, Assistant Secretary for Land & Minerals Management, U.S. Department of the Interior**

Workforce Development for Emerging Energy Tech

Angela Navarro, Deputy Secretary of Commerce & Trade, State of Virginia:

We, like many other states, have in-demand certification programs along with scholarships that will provide 100% funding for pathways in welding, data security, or cybersecurity

- Offshore wind will be very significant most jobs will be in the Hampton Roads region; our major focus is on diversifying the economy

"Our major focus is on diversifying the economy. Offshore wind will be very significant when we look at the direct jobs impact of this industry." – **Angela Navarro, Deputy Secretary of Commerce & Trade, Virginia**

Cory Channon, Assistant Director of Construction Sector Operations, International Brotherhood of Boilermakers: In an effort to get career programs off the ground, word of mouth is always great, along with open houses and trade shows. We are trying to move down the average age of our membership.

- We are proud that our programs offer ways for women and indigenous groups to build their futures.

Mary Sotos, Deputy Commissioner, Department of Energy & Environmental Protection, Connecticut: The state has a lot of clean energy job opportunities, especially involving solar. Just 200 MW of offshore wind development will equal the current number of solar industry jobs in the state.

- We have a long list of programs that have been successful, but we are still working to break down barriers to underrepresented groups.

State of the Energy Storage Market

Betty Watson, Senior Manager of Energy Policy, Tesla Energy: A high amount of storage is being deployed in CA due to drivers such as procurement targets and the Aliso Canyon natural gas leak.

- A large IOU had to look at what it would take to replace 3 gas peaking plants and heard back that storage, plus transmission, would be a solution.
- We've seen a great success for second life uses of batteries: they have a high cycling ability and are useful for providing backup power in someone's home.
- Tesla/South Australia case study: this is the project we talk about the most that involved a 129 MWh capacity battery installed in 100 days. AEMO has a report on the project and its performance. The batteries were able to respond very quickly to ramping up or down.

"Storage technology is proven and ready to be deployed at scale."

Betty Watson, Tesla Energy

John Perry, Coordinator General, State of Tasmania: Tasmania is about 92% renewable energy now and will be at about 100% by 2022.

- We see a big opportunity in the pumped hydro sphere.

Sarah Vorpahl, Senior Energy Policy Specialist, Washington State Department of Commerce: Washington State has a 100 percent clean energy goal in works.

- Washington has not had capacity constraints due its reliance on large hydropower systems, but with climate impacts this could be a potential issue in the future (due to a loss of snowpack).
- Energy storage work in Washington is being supported via the State's Clean Energy Fund, which is a \$40 million pot of funding.
- Pacific Northwest National Laboratory (PNNL) research on value of storage and DER shows how siting and size is important.
- A tool developed to value energy storage in Washington State was able to show the importance of size of storage – real-time analysis that showed the actual performance of batteries.

Ray Hohenstein, Market Applications Director, Fluence: Storage is competing and winning side by side with natural gas plants in AZ.

- Never assume you know what the price of storage will be – allow the industry to show you what it can do.
- We need to think about designing an electricity system that meets underlying needs.

Keynote on Energy Storage

John Zahurancik, Chief Operating Officer, Fluence: Fluence is the global leader in utility-scale energy storage; 760+ total MW; 70+ projects; 17 countries; 11+ years.

- The duck curve is coming faster and bigger in the U.S. than we thought, a very similar picture is forming in Australia.
- The Australia Energy Market Operator (AEMO) first integrated system plan showed a need for storage: In the future, frequency control & ancillary services (FCAS) needs in Australia will be very different. Ramp rates will also become a lot higher, making storage a "must have" in the next 5 to 7 years.
- Mix of price volatility and grid congestion in Australia, which storage is well suited to address.
- Recent U.S. wins for storage: FERC 2017 policy statement on storage was a win for multi-use applications. CAISO selection of storage as part of regional transmission plan was a win for 2018.

State & International Perspectives on Energy Storage

Kevin Moriarty, Executive Chairman, 1414 Degrees: thermal storage molten silicon; very large-scale storage at a very low price – silicon is the 2nd most plentiful element in earth's crust; pure silicon melts at 1414 Celsius.

- 50% of world's energy consumption goes towards heat production. Thermal storage can deliver 80 to 90% efficiency; it can work around the clock and has an indefinite lifetime
- Distributed storage to displace gas will yield a stronger grid with a higher utilization factor.

Scott Bordenkircher, Director, Technology Innovation & Integration, Arizona Public Service Company: APS is the state's largest IOU; serves 11 of AZ's 15 counties. The peak is around 7,300 MW when it is 120/115 degrees and we're using every single bit of the system.

- Storage deployment is driven by solar production. AZ is #2 in solar production in the U.S. – trying to shock absorb intermittent load is creating that space for storage.
 - Punkin Center project: looked at cost of replacing the line – storage ended up being economically better and provided ancillary services – eliminated a whole lot of line losses; energy storage system won the day based on its merits. This project demonstrated power reliability and provided additional benefits at a lower cost than that of a transmission line.
 - Mandates may have been necessary to get storage kick started – get storage into IRP is a much better approach for individual states.
- **Dr. Imre Gyuk, Director of Energy Storage Research in the Office of Electricity, U.S. Department of Energy:** We need all kinds of storage, compressed air, thermal storage with ice to replace air conditioning; there are many technologies and they all come in handy.
- Examples of DOE's international work on energy storage: international energy storage database, reliability work with Canada, work with Denmark; we're interested in international collaboration.
 - Considerable dealings with different countries where most of the storage comes from: Japan, Korea, China, Singapore; we'll continue with this international collaboration.

Day 2: CARBON CAPTURE, UTILIZATION & STORAGE (CCUS)

Welcome & Opening Keynote

"There is huge potential for carbon capture and storage around the world and Saskatchewan can be a global model." –**Rachel McCormick, Counsellor & Head, Energy & Environment Section, Embassy of Canada**

Bronwyn Eyre, Minister of Energy & Resources, Saskatchewan

- Saskatchewan is very proud to be a leader in CCUS and has much to share involving lessons learned.
- CCUS is vital to solving one of the great challenges' governments face – how to handle emissions while sustaining economic growth.
- Past MOU on CCS between Saskatchewan, and MT, ND, and WY reflects a mutual interest in reducing emissions.

State of the CCUS Market

Samantha McCulloch, Head CCUS Unit, International Energy Agency: Samantha McCulloch, Head CCUS Unit, International Energy Agency: IEA analysis (Global Energy & CO₂ Status Report) shows an increase in energy demand driven by strong economic growth globally; almost 70% of the increase in energy demand in 2018 was met by fossil fuels, mainly natural gas.

- Coal use accounts for largest share of CO₂ emissions; majority of coal fired generation capacity is found in Asia.

Trude Sundset, CEO, Gassnova: Gassnova is a state enterprise owned by the Norwegian government. Gassnova's latest project is focused on injecting CO₂ offshore – very important knowledge for capturing CCS large scale.

- Gassnova has supported over 500 research projects on CCS and has also support international projects and work with large scale demonstration projects.
- We want to develop an infrastructure for transportation and storage so can capture CO₂ and know where to send it. We see a lot of other interest from other European countries such as Sweden.

- CCU can probably account for 5% CO₂ reductions needed, and CCS/storage can account for 95% of what you need to meet climate goals.

"The market for carbon capture, utilization, and storage technologies – which avert GHG emissions – is growing in the U.S. and Europe."

Panel on the State of the CCUS Market

Sarah Forbes, Scientist, Office of Fossil Energy, U.S. Department of Energy: Regarding CCS in the U.S., DOE's research program on CCS has been around since the late 1990's.

- U.S. demonstration projects include Petra Nova in Texas for enhanced oil recovery, Valero in Port Arthur TX, and Archer Daniels Midland in IL. The CO₂ captured in the Petra Nova and Valero projects is used for EOR whereas the ADM project stores the CO₂ deep underground.
- Since the 1970's CO₂ has been used in the U.S. for enhanced oil recovery (EOR).
- DOE did small scale injections at first, then pilot and large pilot scale and now have full scale demonstrations (>1M tons per year) in the U.S.
- DOE loan guarantee office has \$8.5 million available for CCS projects.
- 45Q has been in place since 2008, it was extended and improved in 2018. There are some aspects of 45Q that stakeholders would like to have clarified.
- National Petroleum Council, federal advisory committee to U.S. DOE, is currently conducting a CCUS study.

John Harju, Vice President for Strategic Partnerships, University of North Dakota's Energy & Environmental Research Center: There's a team of about 200 people working on capture and storage solutions at the Univ. of North Dakota.

- Project Tundra is a modest size Midwestern cooperative project that includes storage and an EOR component.
- North Dakota has various incentives in place to encourage CCUS such as an EOR incentive for CO₂ injection.
- The State has sales tax exemptions for CCS.
- There's a pore space clarification bill in ND.
- The State has a liability trust fund, and long-term liability management is a key focus point.
- There's a need to monetize CO₂; there's a need to turn it into a commodity for storage, for application, etc.
- Early stage research on CCUS is underfunded.

Rob Niven, CEO, CarbonCure: CarbonCure is using CO₂ to make cement and reducing costs and emissions in the process. This is happening across Canada and the U.S. Carbon Cure is a Canadian company with 132 projects in the U.S.

- Carbon Cure integrates CO₂ into concrete production as another feedstock material
- Last May, Carbon Cure received Breakthrough Energy Initiatives funding
- Worldwide there's at least one concrete plant every 45 minutes from where every human is located
- Examples of HI and AL CCU projects in cement plants and effective legislation in HI requiring the use of CO₂ concrete in state building construction.

Case Study on the Boundary Dam Project

Beth Hardy, VP Strategy & Stakeholder Relations, International CCS Knowledge Center: Boundary Dam is the World's 1st Integrated Large-Scale Post-Combustion CCS Facility. Boundary Dam is CCS on a coal-fired power plant that's been operating since 2014.

- Boundary Dam has a projected 90% capture rate & 30 yr. life extension. The initial investment for this project was approximately \$1.5 billion CDN.
- At Boundary Dam, CO₂ is used for EOR or sequestered at Aquistore.
- CCS at Boundary Dam Power Station allows for the production of over 110 MW of clean, base-load electricity.
- Boundary Dam has captured & stored over 2 Mt since it began operation.
- "Real world" considerations for using CCS are important. We must COLLABORATE and not just talk about collaborating.
- Almost all IPCC 1.5°C pathway scenarios include CCS.

State & International Perspectives on CCUS

Shannon Angielski, Executive Director, Carbon Utilization Research Council (CURC): The CURC is made up of industry across the entire supply chain.

- Senators Capito and Whitehouse, as well as Senators Heitkamp and Barrasso, advanced 45Q – this is a good example of bipartisanship.
- 45Q is a game changer there are so many projects in development due to this tax credit: it is a two-pronged approach to help reduce costs and includes R&D and then deployment incentives.

Adam Schafer, Policy Director, Office of Montana Governor Steve Bullock

- Montana has helped support WY's CCS test center; also want to highlight the MOU between MT, WY & Saskatchewan on advancing CCS.

Brad Crabtree, Vice President, Carbon Management, Great Plains Institute (GPI)

- GPI is the leader of the carbon capture coalition; this initiative was launched in 2015.
- The Carbon Capture Coalition looks at several questions such as how do you make carbon capture projects financially viable?
 - How do you build-out the infrastructure?
 - How do you create a national panel on infrastructure?
 - What are the federal policies needed to help advance this technology?

Jason Lanclos, Director, Technology Assessment Division, Louisiana State Energy Office

- A 2009 bill on storage - liabilities move to state after 10 years; we're going to dust off this legislation for this session.
- Louisiana is setting up one stop shop for permitting for injection — applied for primacy from EPA.
- Regarding LNG terminals in Louisiana, there's one in place and 10 on the books.

Keynote on the Future of CCUS

Dr. S. Julio Friedmann, Senior Research Scholar, Center for Global Energy Policy, Columbia University:

Mitigation: CCS is required to achieve the goal of limiting temperature rise to 2°C (IPCC, IEA, UNEP).

- *18 operating CCS plants operating worldwide currently, storing ~30 Mtons CO₂ each year; estimated storage worldwide: ~10 trillion tons*
- Additional mitigation: CO₂ removal (CDR) is required to achieve a 1.5°C temperature rise goal and is critically important for heavy industry & "hard to mitigate" sections.
- We expect dramatic cost reductions within 5-7 years for CCS.
- The world, especially North America, has plenty of storage potential 2.5-21.8 trillion tons (median ~8.5 T tons)
- BC-based Carbon Engineering is commercializing direct air capture technology that could be game-changing
- We should focus on creating markets for carbon products and services, and policy options are required for market design and scaling:
 - *Policies to spur investment*
 - Tax credits (45Q, ITC & PTC, bonus depreciation, economic activity zones)
 - Other financial incentives (private activity bonds, MLP)
 - *Policies to spur markets*
 - Procurements (e.g., low-C building materials)
 - Clean Energy Standards & Low-C Fuel Standards
 - Critical infrastructure investments
 - Carbon tax/cap & trade
 - *Policies to spur innovation*
 - RD&D investment (Mission Innovation)
 - Loan-program office
 - Life-cycle assessments & performance standards

For more information about the Global Energy Solutions Summit, please contact:

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