Summary Minutes of the

U.S. Department of Energy (DOE)
Secretary of Energy Advisory Board
Public Meeting

Committee Members:	Present: Vicki Hollub, Chair; Norman R. Augustine; David Lockwood; Pedro Pizarro; Samantha Ravich; Scott Campbell: Marvin Fertel; Ankur Jain; Kay Coles James; Sean McGarvey; Thomas Rosenbaum; Bill Samuels; Michael Whatley Absent: Richard Mies, Vice Chair; David Dewhurst, Daniel Yergin
Date and Time:	October 2, 2019, 1:00 PM – 3:52 CDT
Location:	Drake Hotel, Chicago, IL. (Parkside Room)
Purpose:	Secretary of Energy Advisory Board (SEAB) Meeting
SEAB Staff:	Kurt Heckman, Designated Federal Officer, Allison Mills, Deputy Director, Office of Boards and Councils
DOE Speakers:	Secretary Rick Perry; Deputy Secretary Dan Brouillette; Under Secretary of Energy Mark Menezes; Under Secretary for Science Paul Dabbar; Principal Deputy Administrator National Nuclear Security Administration, Dr. William Bookless
Invited Presenter:	Chief Technology Officer of the United States Michael Kratsios

Meeting Summary

This Secretary of Energy Advisory Meeting was the second SEAB meeting convened under Secretary Rick Perry. SEAB members heard briefings from Secretary Rick Perry; Deputy Secretary Dan Brouillette; Chief Technology Officer of the United States Michael Kratsios; Under Secretary of Energy Mark Menezes; Under Secretary for Science Paul Dabbar; and Principal Deputy Administrator of the National Nuclear Security Administration Dr. William Bookless. SEAB members and DOE staff held brief discussions on the charge topics of Artificial Intelligence and Innovation and their associated working group. The meeting adjourned after an opportunity for public comment.

Public Meeting

Secretary Rick Perry: Secretary Perry welcomed SEAB Chair Vicki Hollub and new members, thanking the new members for agreeing to serve. He also thanked DOE staff who helped organize the meeting. The following is an abridged summary of his statements.

This is one of the most exciting times in DOE history. The market's understated reaction to the recent drone attack in Saudi Arabia shows that Saudi Arabia is no longer the leader in energy—America is. The United States is now producing more oil and natural gas than ever; progress continues on coal

production; America is second in the world in solar energy, and a leader in the pursuit of cleaner energy. The United States is ahead of the signatories of the Paris Accord on clean energy, and that the country has proven it can develop both clean energy generation and economic benefits while still protecting the environment.

America is in the midst of a clean energy revolution due to cleaner coal plants and a nuclear energy revival due to the rise of new technologies like small, modular reactors. Innovation is key to the country's economic future under President Trump. The United States exports natural gas to 36 countries on five continents as a result of innovation, and that the United States will use energy as a tool of liberation, not subjugation. However, the DOE and the nation cannot rest on their laurels; we must continue to advance energy, economic, and national security. Innovation must permeate the DOE, and that's why he asked the SEAB to set up an Innovation Working group to help ensure DOE's leadership in innovation.

Furthermore, the Secretary recently stood up a special office of artificial intelligence (AI) to focus DOE priorities and strategies on AI and to coordinate federal efforts in AI innovation, delivery, and adoption. AI will strengthen national security and cybersecurity, increase energy efficiency, enhance grid resiliency, predict earthquakes, increase crop yields, and optimize transportation. The stakes have never been higher: the world is in a race for AI supremacy, and other countries have different ideas about the way the world should work. The United States needs to win because America has a fundamental respect for dignity and human freedom.

Thanks to the SEAB for their choice to come and serve their country in this role and for all they will do for the DOE, the United States, and the world.

Designated Federal Officer Kurt Heckman: Mr. Heckman thanked the SEAB Members and the DOE Staff for attending the meeting. He then reviewed the meeting's agenda.

SEAB Chair Vicki Hollub: Chairwoman Hollub thanked SEAB members for coming and Secretary Perry for his inspirational opening statements. She said she was excited about his challenge. She then welcomed new SEAB members, noting that they will add value to an already-strong team, and introduced Deputy Secretary Dan Brouillette.

Deputy Secretary Dan Brouillette: The Deputy Secretary thanked the Chair and echoed that he supports what Secretary Perry just described. He noted that everyone at DOE counts on the advice of this Advisory Board on the important issues of the day and thanked everyone for agreeing to serve. The following is an abridged summary of his statements.

The stakes are high around the world regarding energy, whether in the world of artificial intelligence or in energy markets around the world. And that's why the steps the United States has taken in liquefied natural gas (LNG) exports are crucial and have resulted in dramatic changes. By the end of next year, export capacity is expected to grow by 150% over 2018 levels, and U.S. LNG is now being exported to five continents and the 36 countries the U.S. exports to, 18 of those countries were added since the beginning of this Administration. This is critical to our allies around the world. DOE argues that it is important that Europe not become overly dependent on a single supplier of natural gas; when a country is overly dependent on a single provider, it puts that country and its constituents at risk. The President has been clear that it makes no sense for the U.S. to pay for the security of Europe from adversaries like Russia, while Europe makes itself dependent on Russian provided energy. Diversification is important, and the U.S. can provide it.

According to EIA, American crude production will reach 14 million barrels per day by 2021, LNG production will reach 111 billion cubic feet per day by 2040. DOE authorized nearly 35 billion cfd of LNG exports from 14 large-scale export projects in several states. Five projects, in particular, are currently

operating and their export capacity is over 7 billion cubic feet per day. Many facilities are switching from import facilities to export facilities under this Administration.

This matters. It matters in Europe, for the reasons I explained, but it also matters elsewhere. DOE is a contributor to "day-one" planning in countries like Venezuela. That work entails efforts being undertaken by our National Laboratories, including analyzing their grid and infrastructure and putting together plans that might be of assistance when organizing and prioritizing the work that needs to be done in the energy sector. There has been a dramatic reduction in the number of barrels of oil that Venezuela produces each day -- oil the global market needs. United States oil production is important for global stability and can shield the U.S. economy from market disruption. The U.S. government will also continue to pursue a maximum pressure campaign against Iran and will with allies like Iraq to lessen dependence on Iran for their electricity and other resource needs. DOE is also supporting the Administration in their negotiations with the Democratic People's Republic of Korea (DPRK).

Switching to the budget, Congress passed a continuing resolution to fund the DOE through November 21, 2019. DOE has been engaged with Congress and hopes to see operations funded through FY2020 soon. There has been strong support for DOE throughout the process. A recent House bill provides more than DOE requested for environmental cleanup, but these increases have come at the expense of the NNSA weapons program. We hope to see this adjusted. The Senate bill provides for an increase to the proposed budget to the NNSA and more money across the board, generally.

In particular, there is strong support for AI in both Congressional chambers. The Senate funded a new AI office within DOE, and we are very pleased with that step. In September, DOE made its first FY 2021 budget requests to the Office of Management and Budget (OMB) on time; expects the OMB budget to be submitted to Congress sometime in early February. DOE is pleased with the process they have undertaken internally – taking NNSA's practice of developing 5-year look ahead budget plans and applying it to the entire Department. Our hope is to bring continuity and stability to the programs.

Chief Technology Officer of the United States Michael Kratsios

The Chief Technology Officer (CTO) thanked everyone in attendance. The following is an abridge summary of his statements.

The high-level technology strategy of the United States revolves around American exceptionalism, the power of the American worker, and fair trade practices abroad. The President is focused on the idea that "we must lead the world in emerging technologies", because doing so is important to American quality of life and to national security. The core areas of the White House technology focus being AI, quantum computing, 5G, and advanced transportation.

The Administration wants to maximize the benefit of federal dollars to R&D. The United States benefits from R&D conducted by the federal government, private sector, and academia (unlike government-driven efforts in, e.g., China). So what is the government's role in advancing RD alongside of the private sector and academia? In one example, the federal government, has five of the top 10 supercomputers in the world, and of those, four are at DOE national labs. These capabilities can help empower not only the government's internal research, but also R&D done in industry and academia. This is government working well and empowering. There are other similar stories elsewhere in the government and the White House desires to coordinate that activity to maximize efficiency.

The federal government can drive innovation and research through funding graduate students through grants, fellowships, and similar resources and by optimizing retraining and reskilling programs to support the development of American workers in areas of critical need. The President also asked the private sector to support the "Pledge to the American Worker" by committing to retrain or reskill some number of workers in the next 5 years; over 300 companies signed on.

Concerning removing regulatory barriers, there are technologies that are "born free" versus those that are "born in captivity." Those born free (e.g. the internet), need to stay free; these support dramatic growth. Those born in captivity (e.g. drones) require innovators to obtain permissions, which may result in stagnation. He wants to ensure continued American leadership through public / private partnership with the DOE. The amount of work being done at the national labs is incredible and empowering to the American industry.

Note: at the end of CTO Kratsios' presentation there were several questions from the SEAB.

Under Secretary of Energy Mark W. Menezes

The Under Secretary thanked everyone for attending, and recognized new members. He stated that he was thrilled to work with Secretary Perry and his infectious enthusiasm, the Deputy as an effective COO and Under Secretary Dabbar. He also thanked the CTO for his remarks and enthusiasm. The following is an abridged summary of his statements.

The DOE believes "in innovation, not regulation." The DOE wants to bring together three national research programs: bring together the applied laboratories and programs in greater collaboration to break down silos in government offices. Specifically, he wants more integrated energy systems analysis, modeling and optimization, systems engineering, and development and testing in specific areas. The first area is carbon capture and utilization. The goal is to improve the technologies and bring down the costs at different phases of the carbon lifecycle.

The other key area is thermal storage (heat) in manufacturing, power generation, thermal heat exchange and other applications where heat energy is a driving component.

The third area is hydrogen energy storage and utilization. To drive hydrogen as a fuel.

DOE also needs to elevate the national capability on critical materials and water recycling.

Finally grid resiliency throughout the lifecycle with security and cybersecurity.

The Under Secretary's second idea is in energy efficiency. The goal is to develop a circular energy economy initiative with R&D associated with new materials, advanced biology and AI. People are still creating products that do not have an end-of-life plan, thereby leaving problems for future generations. The global demand for plastic will continue to increase, which replaces the use of wood, steel and glass that consume much more energy to produce. However; many plastics are designed to be used only once. Nonetheless, we know how to break it down with organisms and enzymes to reuse plastics.

The Under Secretary also expressed support for a collaborative grid modernization initiative. There is a call for funding opportunities to modernize the electrical grid through collaboration with the key offices across the DOE and applied lab complex.

He closed by restating the driving forces of innovation without regulation and by collaboration within the DOE.

Under Secretary for Science Paul Dabbar

The Under Secretary stated that it was great to meet with everyone and that he is extremely lucky to work for Secretary Perry and Deputy Secretary Brouillette. The following is an abridged summary of his statements.

The DOE is the inheritor of the Manhattan Project and everything has come from that. The DOE has significant support from Congress in terms of budget that Congress has broad faith in the DOE missions, and that DOE has the highest support ever for research and innovation in the history of this country.

There are six leader areas for innovation: AI, quantum technology, sustainable energy, genomics, advanced mobility and space exploration.

Regarding the DOE execution of environmental cleanup, there have been significant advances; the DOE finished cleaning up a vitrification facility in New York and tore it down on time and on budget; finished a mission in Idaho; cleaned up and cleared out the last existing plutonium reactor from the Cold

War ahead of schedule and under budget, which is a rare feat. We are currently standing up three new nuclear facilities all at once in Savannah River, Idaho and Hanford Washington.

In the science mission, DOE is making advances in AI and machine learning, biosecurity, microelectronics innovation, the national isotope strategy, and quantum information science. In addition to its existing quantum information systems efforts, the DOE is part of the National Quantum Initiative with the NSF and NIST.

DOE asked Congress to pass a bill on utility-scale energy storage. This is a near doubling in battery storage investments focusing on next generation (non-lithium ion) batteries where we are looking for 3 to 5 times improvement which could result in 800 to 1000 mile ranges on electric cars. Other important areas include rare earth mineral separations, critical materials and polymer upcycling.

Computation and data infrastructure is also important. Here we are collaborating with the National Institutes of Health (NIH) on modeling life system.

We are also focusing on increasing the fusion program. While the DOE continues to be a world leader in fusion, the commercial space for fusion is seeing something entirely new. Several commercial companies are moving forward with aggressive plans to build and deploy fusion based power generation within a few years. DOE is working to help with programs that might parallel the NASA COTS program which provided incentive for commercial companies to overcome engineering hurtles and produce a commercially viable space transportation. The goal in fusion would be to help fusion companies produce ten to one energy production through nuclear fusion technology.

Science funds research at every one of the labs, not just the science labs with all time high budgets. The challenge now is executing from a people point of view.

Finally commercialization is a major component of Science's mission. Here we are striving to get scientific content out the door. Here we have the challenge of letting people know of our existence and what we do. Then we strive to streamline the process of working with us. This conference (xLab) is one way we can introduce more organizations to the science portfolio of the DOE and the opportunities we provide.

Principal Deputy Administrator of the National Nuclear Security Administration Dr. William Bookless

The Principal Deputy Administrator thanked the SEAB and stated that the DOE values the advice from SEAB and takes it to heart. The following is an abridged summary of his statements.

The NNSA has three main mission spaces:

1. the nation's nuclear weapons stockpile, from cradle to grave cooperating with the DoD,
2. the defense and nuclear the nonproliferation community, train inspectors, and prepare to respond to any nuclear-related emergency in America or abroad, and
3. the design and delivery of naval nuclear propulsion systems.

The NNSA partners with academia, the DOD, and other parts of the DOE. The NNSA is the largest single funder at Pacific Northwest National Laboratory which is a science lab. Also, the NNSA funded the research of two of this year's Nobel Prize winners in high energy physics.

The NNSA is facing challenges in three main areas:

(1) The NNSA is in the process of updating the entire U.S. nuclear weapons stockpile. DoD is updating every delivery system, nuclear command and control systems, and the DOE is updating warheads associated with those—over the next 15 years.

(2) A personnel crisis is approaching: 41,000 people are working on the NNSA mission today, and since March 2019, the NNSA has added more than 4,700 new employees; however, the NNSA needs to add an additional 20,000 by 2025. Currently, 20% of the NNSA workforce is eligible to retire, and by 2025 that number will increase to 40%.

(3) Regarding infrastructure, 30% of the NNSA's facilities date back to the Manhattan Project. More than 30 projects are past mission need approval to update this aging infrastructure. This is

billions of dollars in investment.

Unfortunately, many NNSA projects have no industrial base, e.g. pit production. That's why the NNSA needs to sustain and create new expertise as it goes forward. Much of America's expertise in the 1980 and 90s is gone due to retirement of skilled personnel. Fortunately many capabilities were well built and have aged gracefully. But we need to reestablish our development capabilities, because in the 1980s and 1990s, when funding was tight and a Cold War peace dividend was expected, the federal government made a calculated decision to prioritize the scientific knowledge-base behind the NNSA, rather than maintain its production capability. To reestablish that production base is estimated to be over $36 billion in the next thirty years. In response, the NNSA included the labs, plants, and sites into the integrated development of the 2020 budget submission to collectively start to reestablish the production base.

Since March of this year, the NNSA has supported more than 300 nonproliferation activities. These included training first responders in Minnesota, conducting tabletop exercises in Maine that included observers from Japan, and supporting cooperative activities across the nation.

More than 100 reactors in the world have been either decommissioned or modified to use low-enriched uranium as a result of NNSA efforts to reduce the proliferation threat.

The NNSA has ongoing collaborations between national labs to support AI and exascale computing where the NNSA wants to use AI for nonproliferation and its stockpile caretaking duties. He would like to better utilize advanced manufacturing resources to more efficiently and effectively produce the materials the NNSA needs, and to design materials to purpose.

The work of the NNSA will continue to build a strong security posture.

Board Member Discussion/Comments/Questions

The SEAB had open discussion regarding the Secretary's charge related to Artificial Intelligence. They discussed that a working group for AI has been organized and will be led by Dr. Samantha Ravich and Dr. Thomas Rosenbaum. The first working group meeting would be on the following day in the afternoon.

The SEAB had open discussion regarding the Secretary's charge related to Innovation. They discussed that a working group for AI has been organized and will be led by Pedro Pizarro and Ankur Jain. The first working group meeting would be on the following day in the morning.

The discussions were diverse but pointed out that both AI and general innovation should be studied for implementation at three levels:

1. In the Department of Energy as an operating enterprise in all of its functions.
2. In the Mission Space of the Department of Energy
3. In the culture and society of the United States based on discovery in the DOE and the national laboratory complex.

Public Comment Period

There were no requests for public comment.

Meeting Adjourned

Meeting adjourned at 3:52 PM CDT

Respectfully Submitted:
Kurt Heckman
Designated Federal Officer

I hereby certify that these minutes of the March 5, 2019, SEAB meeting are true and correct to the best of my knowledge.

Vicki Hollub
Chair, Secretary of Energy Advisory Board