

INDUSTRIAL TECHNOLOGY INNOVATION ADVISORY COMMITTEE (ITIAC) MEETING MINUTES

Date and Time: March 21, 2024, 9 am – 5 pm EDT, March 22 2024, 9 am – 1 pm EDT
Location: U.S. Department of Energy Headquarters, 1000 Independence Ave SW,
Washington, DC 20024
Purpose: Industrial Technology Innovation Advisory Committee (ITIAC) meeting

Table of Contents

Participants.....	2
Meeting Summary.....	2
Materials Provided to the Committee	2
March 21, 2024	3
1. Day 1 Welcome and Opening Remarks	3
2. Innovation Pipeline for Industrial Decarbonization– followed by Q&A.....	3
3. Brief Welcoming Remarks – Christopher Davis, Chief of Staff, Office of the Secretary	4
4. DOE Industrial Decarbonization Strategy – followed by Q&A	5
5. DOE Industrial Efficiency and Decarbonization Office overview	7
6. Technologies for Industrial Emissions Reduction Development (TIEReD) Program lightning talks 9	
7. Demonstration and Deployment Lightning Talks – followed by Q&A.....	11
March 22, 2024	13
8. Day 2 Welcome and opening remarks	13
9. Committee discussion on statute, charter, and report	13
10. Public Comments	18
11. Closing Remarks	18
12. Adjournment	18

Participants

Committee Members: (in attendance) Ms. Sharon Nolen, Chair; Dr. Cathy Choi; Dr. Sue Clark; Dr. Subodh Das; Ms. Betsy Dutrow; Dr. Neal Elliott; Ms. Anna Fendley; Dr. Comas Haynes; Dr. Arun Majumdar (*Remote*); Dr. Eric Masanet; Dr. Joe Powell (*Remote*); Dr. Abigail Regitsky; Mr. Jeffrey Rissman; Dr. Akshay Sahni; Dr. Sridhar Seetharaman; Ms. Jolene Sheil (*Remote*); Ms. Sasha Stashwick

Department of Energy (DOE) Presenters and Participants: (includes virtual presenters)

Dr. Emmeline Kao, ITIAC Designated Federal Officer; Dr. Zachary Pritchard; Dr. Avi Shultz; Joe Cresko; Dr. Celina Harris; Meegan Kelly; Dr. Paul Majsztrik; Arpita Bhattacharyya; Christopher Davis; Dr. Lisa Guay; Sam Goldman; Kelly Visconti; Dr. Diana Bauer; Dr. Kamala Raghavan; Tomas Green; Dr. Gayle Bentley; Dr. Gail McLean; Sarah Forbes; Jason Marcinkoski; Dr. Chris Vandervort; Andrew Dawson

ITIAC Staff: Cameron Bordinat; Pamela de los Reyes; Caroline Dollinger

Meeting Summary

The first meeting of the [Industrial Technology Innovation Advisory Committee](#) (ITIAC) was held on March 21 and March 22, 2024 at the U.S. Department of Energy (DOE) headquarters in Washington, DC. On the first day, offices and programs across U.S. Department of Energy gave presentations to the Committee about their technology research and development (R&D) portfolios, analyses, and initiatives to decarbonize and reduce industrial emissions. The presentations provided the Committee with context to determine how to undertake work to fulfill the ITIAC Charter and develop a report. On Day 2, the Committee reviewed its Charter, discussed a preliminary outline for its report, and formed subcommittees according to topics of importance to the Committee. The Committee plans to hold two more meetings in 2024 to report progress from the subcommittees.

In accordance with the provisions of Public Law 92-463, the meeting was open to the public. Members of the public were invited to attend virtually via the Zoom platform. As described in the [Federal Register Notice \(89 FR 15561\)](#), members of the public were able register to provide oral statements and submit written statements by contacting ITIAC@ee.doe.gov.

Materials Provided to the Committee

- [Agenda](#)
- Presenter bios and slide decks
- List of acronyms
- ITIAC Charter
- [42 U.S. Code § 17113](#)
- [42 U.S. Code § 17114](#)
- Draft outline of ITIAC report and subcommittees
- Mural brainstorming commentary
- [Energy Earthshots – U.S. Department of Energy Industrial Heat Shot™ Fact sheet](#)
- [Energy Earthshots – U.S. Department of Energy Clean Fuels & Products Shot™ Fact sheet](#)
- [U.S. Department of Energy Industrial Technology Joint Strategy Fact sheet](#)

Materials provided to the Committee are available on the [ITIAC website](#).

March 21, 2024

1. Day 1 Welcome and Opening Remarks

Dr. Zach Pritchard, Incoming ITIAC Designated Federal Officer (DFO) & Technology Manager, Industrial Efficiency and Decarbonization Office (IEDO), Ms. Sharon Nolen, ITIAC Chair, and Dr. Avi Shultz, Director, IEDO

The Designated Federal Official, Dr. Zach Pritchard, commenced the Industrial Technology Innovation Advisory Committee (ITIAC) meeting at 9:00 p.m. Eastern Daylight Time (EDT). Chairperson Ms. Sharon Nolen welcomed ITIAC members both in-person and on the webinar. The full Committee then provided introductions, including Dr. Pritchard and Dr. Shultz. No public comments were presented.

Presentation summaries and highlights of the discussions that followed are provided below.

2. Innovation Pipeline for Industrial Decarbonization– followed by Q&A

Moderator: Dr. Avi Shultz, Director, IEDO

Industrial Decarbonization Innovation Strategy

- Dr. Avi Shultz, Director, IEDO

Dr. Shultz welcomed and thanked members for their time and commitment towards this federal advisory committee and to DOE's industrial decarbonization goals. He informed members that he will deliver remarks on the Industrial Decarbonization Innovation Strategy on Dr. Carolyn Snyder's behalf. He reviewed DOE's innovation pipeline for industrial decarbonization, such as the Industrial Decarbonization Roadmap, Commercial Liftoff Reports, the Industrial Heat and Clean Fuels Earth Shot, and IEDO's Clean Energy Manufacturing Institute.

Industrial Decarbonization Commercialization & Deployment Strategy

- Arpita Bhattacharyya, Senior Advisor and Chief Climate Officer, Loan Programs Office (LPO)

Ms. Bhattacharyya welcomed and introduced herself to ITIAC members. She reviewed the roles that DOE program offices contribute towards the public-private partnership that supports research, development, demonstration, and deployment (RDD&D), enabling DOE to act as a catalyst to excel technologies towards deployment. She emphasized the importance of this collaborative effort with ITIAC in providing guidance to offices on emerging industrial decarbonization technologies.

Discussion Highlights

- Dr. Cathy Choi inquired about the definition of ready for scale.
 - Ms. Bhattacharyya stated that these can be 10–30-year loans, depending on the technology.
- Dr. Subodh Das asked if there was any way to provide the Committee with this information.
 - Dr. Shultz informed him that there is information in the handouts on TIEReD. There is a clearing house on information the DOE website energy.gov with information on all the program offices that was discussed.
- Dr. Arun Majumdar posed questions regarding the process within and across DOE and other agencies. He stated that coordinating with the Treasury and the White House has traditionally resulted in a lot of paperwork. He asked how the team is planning on streamlining that process both internally and externally to DOE to get the capital out. He also sought clarification regarding any mismatches

between the processing of proposals within DOE offices and getting the dollars out or if there are some pockets of excellence or best practices that can be copied across.

- Ms. Bhattacharyya acknowledged the burden of the timeline and noted that there have been improvements to the pipeline between LPO Treasury and OMB and that it is continuously improved upon. She stated that the Undersecretary Office has done a lot of work to streamline the process. She included that one area that they are trying to improve upon is sorting where different technologies belong.
- Ms. Sharon Nolen asked about the \$300 billion dollars per year that is needed from industrial investments in addition to DOE funding that was mentioned and inquired about a breakdown by year or industry.
 - Ms. Bhattacharyya responded by saying that the \$300 billion is for all of climate funding. She said that the idea is that, especially when talking about GHG emissions, it's a calculation broken down dollar by dollar, not by sector. She said that she can follow up on a potential sector-by-sector breakdown.
- Dr. Akshay Sahni inquired about the experience over the last three years by asking what are the top two or three things that are working well with the partnership and what opportunities could make opportunities stronger.
 - Dr. Shultz stated that for technical offices, the requirement of partnerships of interdisciplinary teams for the funded projects has been a huge model of success.
 - Dr. Akshay Sahni followed up with inquiring about how opportunities could be improved.
 - Dr. Shultz expressed that huge strides have been made to overcome valleys of death but there are still gaps that the level of investment isn't quite adequate to overcome the full scale of the problem.
 - Ms. Bhattacharyya also noted that when thinking of an example like low-carbon cement, who would be the off taker for that and what does that coordination look like. She expressed interest in gathering the members' opinions on this topic.
- Dr. Abigail Regitsky asked if the information on coordination will be disseminated. She also asked what flexibility would be required to allow shuffling projects around to the appropriate program areas.
 - Dr. Shultz explained that there's not much flexibility due to statute requirements for procurement. However, there is huge internal coordination between the different programs. For example, IEDO shares expertise across its departments and includes individuals for reviews and consensus panels across the various offices.
 - Ms. Bhattacharyya added that this topic is currently being addressed as they have been working very closely with General Counsel to determine what pieces can be shared across programs.

3. Brief Welcoming Remarks – Christopher Davis, Chief of Staff, Office of the Secretary

Mr. Davis discussed the importance of today's timing, in which the DOE can shape the trajectory of U.S. manufacturing through the RDD&D taking place in the different offices, paired with legislative support from the Bipartisan Infrastructure Law and Inflation Reduction Act. He stressed the significance of thinking through the commercialization of technologies and the financial markets they can invest in to meet the pace of industrialization decarbonization needed in the United States. He encouraged the Committee to think about how DOE focuses beyond business-as-usual and how to build on success to accelerate decarbonization.

4. DOE Industrial Decarbonization Strategy – followed by Q&A

Moderator: Dr. Zach Pritchard, ITIAC DFO (pending) & Technology Manager, IEDO

Industrial Decarbonization Roadmap and Continuing Analysis

- Dr. Avi Shultz, Director, IEDO
- Joe Cresko, Chief Engineer, IEDO

Mr. Cresko presented the contextual background of industrial energy and emissions, including an overview of available DOE resources and IEDO analysis methodologies and tools. He also spoke to the DOE Industrial Decarbonization Roadmap, in which he emphasized the importance in investing in the Roadmap's pillars, pathways, and technologies.

Industrial Heat Shot

- Joe Cresko, Chief Engineer, IEDO

Mr. Cresko provided an overview of the Energy Earthshots Portfolio. He spoke in detail about the Industrial Heat Shot's identified drivers and the pathways, and how current investments drive toward the Shot's target of 85% reduction of CO₂ emissions by 2035.

Clean Fuels & Products Shot

- Dr. Lisa Guay, AAAS Fellow, Bioenergy Technologies Office (BETO)

Dr. Guay presented the Clean Fuels and Product Earthshot, aimed at developing cost-effective fuels and products from sustainable carbon sources to achieve greater than 85% lowers net GHG emissions by 2035. She described the Shot's pillars and core research areas, along with a summary of the Shot's action timeline.

Liftoff Reports

- Sam Goldman, Policy Advisor, LPO

Mr. Goldman presented the Pathways to Commercial Liftoff reports, aimed at catalyzing commercialization and deployment of technologies between the public and private sectors. He shared cross-sector and sector-level insights of the Industrial Decarbonization ("Cross-Cut") and Low-Carbon Cement Liftoff reports.

Cross-DOE Collaboration

- Dr. Avi Shultz, Director, IEDO
- Kelly Visconti, Office of Manufacturing and Energy Supply Chains (MESC)

Dr. Shultz and Ms. Visconti presented on the DOE Coordination on Industrial Emissions Reduction. Dr. Shultz summarized the DOE technology landscape and the strategic framework shared among DOE offices. He explained how the TIEReD Program leads this coordination effort, ensuring that programs within each technology office address the drivers and pillars of the Industrial Heat and Clean Fuels and Products Shot. Ms. Visconti shared insights on the Industrial Technologies Joint Strategy team, made up of over 10 offices across DOE, and charted to develop a strategy, coordinate internally, and engage externally to address energy efficiency and decarbonization technologies that reduce emissions and increase competitiveness of the US industrial sector in a net zero economy.

Discussion Highlights

- Dr. Akshay Sahni commented on how the Industrial Decarbonization Report and Liftoff Report are some of the most comprehensive and well-done reports he has encountered. He asked what the governance or decision making will look like to ensure the “right eggs and right baskets” are selected and how the newly formed team help to get there.
 - Mr. Cresko expressed the importance of the analytical foundation that is used to help guide decisions at the technology office level. He also said that this is representative of the offices and the way they work closely together.
- Dr. Cathy Choi asked why the roadmaps do not emphasize recycling, reducing, or reusing?
 - Mr. Cresko stated that the roadmap does have the resource efficiency pathway that exists for low-carbon fuels and feedstocks, and energy sources. Although recycling is not featured prominently in the roadmap, it is an important driver and will be more visible in future work.
- Dr. Cathy Choi challenged a notion that technology innovation must be transformational and cannot be achieved incrementally. She said this can be challenging because industry typically develops products incrementally due to the life cycle of existing assets in the heavy-duty space. She added that this is not only a transformation of accepting new technologies, but also a business transformation.
 - Mr. Cresko agreed to some extent. He said one way to interpret this is by taking the use of efficiency pillar and dialing up the practical minimum energy intensities for every major material and commodity used, which would lead to a third of the way to emissions reductions. He said perhaps this is a charge to be as innovative as possible, leading to new business practices.
 - Ms. Visconti added that this is a “yes and” situation. She said that today’s tools will not achieve net zero, and that we need to build plants differently within 30 years. There is a need to innovate and push for the future and to do everything in the incremental stages.
 - Dr. Cathy Choi commented by saying that that was a great way to put it because in industry, people are waiting to get to net zero, as opposed to getting the slide path for net zero.
- Ms. Anna Fendley added to Dr. Choi’s point about incremental vs. transformational change and inquired about how DOE is thinking about the potential economic disruption from such transformation. She asked that with technology development and where DOE is putting its money, how does that factor in.
 - Dr. Shultz answered that there are a few ways DOE has been attempting to address this in their strategy. He said one way is trying to understand the implications better, which was not fully explored in the Decarbonization Roadmap. The other way is to ensure that they are baking those considerations into every stage of technology development. For example, IEDO is developing public best practices for community benefit plans (CBP) and just released a [website](#) for applicants to understand what it means to meaningfully engage in a CBP.
 - Ms. Visconti responded by saying that the Committee has an opportunity to be intentional about the transition. For example, DOE has a program supporting coal transition communities to help communities that have been hollowed out because of the transition with the closing of coal plants.
- Mr. Jeff Rissman thanked the presenters for their incredible work. He remarked that many different types of industrial equipment don’t have standards assigned yet and suggested that creating the first ever standards for equipment could create demand and overcome market virtualization challenges. He asked if the presenters had thoughts on coordinating with the Standards Office and to develop industrial equipment standards.
 - Dr. Shultz replied by saying that the DOE’s work on standards (e.g., appliance standards) is circumscribed by legislation and authorized by Congress. DOE does not have that regulatory

authority for industrial applications. However, DOE plays a role in analytical support to help industry develop standards, coming from the programs and strategic analysis work to help provide the analytical foundation for industry-led standard development.

- Dr. Comas Haynes asked whether the Liffort Reports' examination of technology viability factored in increased revenue in addition to cost.
 - Mr. Goldman responded that for modeling purposes in the report, it is really the cost baseline. Incremental revenue from tax credits is factored in. He said that the study tries to include some interest, for example a 30% more expensive product and how it can support a premium market. It is challenging but not unprecedented for these to be done i.e., in Europe. They assess the viability of some markets to absorb these premium costs.
 - Mr. Cresko added that the industry is in a big experiment now. There are many investments into new initiatives. Takeaways can be learned from federal procurement for categories like steel, glass, cement, and concrete in a few years that are going to give more insight and answers to questions like this.

5. DOE Industrial Efficiency and Decarbonization Office overview

Moderator: Joe Cresko, Chief Engineer, IEDO

IEDO Overview

- Dr. Avi Shultz, Director, IEDO

Dr. Shultz presented IEDO's scope and goal of decarbonizing the industrial sector without de-industrialization by strengthening and accelerating the growth of the manufacturing sector, while decreasing total CO2 emissions and maintaining an energy, environmental, and economic justice (EEEJ) focus throughout its programs. He highlighted the systemic barriers of industrial decarbonization and the landscape of needed RD&D investments to overcome these barriers, including a snapshot of IEDO funded projects and resources that help address some of these barriers.

Energy- and Emissions-Intensive Industries (EEII) subprogram

- Dr. Paul Majsztrik, Program Manager, IEDO

Dr. Majsztrik presented EEII's mission and strategy, providing insight into the motivation and sector-specific approach employed to address the unique functions, challenges and solutions for the assorted sectors. He also provided an overview of two ongoing EEII funded projects that address the chemical and cement and concrete industries. He concluded with information on the FY24 EEII FOA for applied RD&D to decarbonize the heavy industry.

Cross-Sector Technologies (CST) subprogram

- Dr. Zach Pritchard, Technology Manager, IEDO

Dr. Pritchard presented on behalf of Isaac Chan, CST Program Manager, who was unable to join. He outlined CST's key themes, program areas, and gave insight into why a cross-sector approach is needed in the RD&D landscape. He highlighted CST priorities that support the pathways of the Industrial Heat Shot and CST approaches that overlap with EEEJ goals. He recapped CST's recent investments and its current FY24 Cross-Technologies FOA to accelerate the innovation, cross-sector technologies required to decarbonize industry.

Tech Assistance and Workforce Development (TAWD) subprogram – followed by Q&A

- Meegan Kelly, Technology Manager, IEDO

Ms. Kelly presented on behalf of Anne Hampson, Tech Assistance and Workforce Development Program Manager, who was unable to join. She explained the need for technical assistance from manufacturers and TAWD's ability to assist with technology deployment at scale via coordination with other programs. She provided an overview of TAWD's core programs, key initiatives, analysis and stakeholder engagement. She also spotlighted examples of EEEJ within TAWD's portfolio.

Discussion Highlights

- Dr. Eric Masanet asked what is needed to supercharge efficiency savings and whether new programmatic elements capture this, or if any new barriers have been identified. He remarked on the enormous amount of efficiency potential left, and that all potential should be tapped.
 - Ms. Kelly responded saying that low hanging fruit should be continuously prioritized because the energy efficiency space has not captured all of it.
 - Dr. Eric Masanet rephrased his question and asked what is new and what is Ms. Kelly most excited about regarding new gains.
 - Ms. Kelly replied that workforce efforts within TAWD is enhancing training for more kinds of facilities that are participating in the Better Plants program, bootcamps, and in-plant trainings. Savings opportunities are included in the curriculum.
 - Dr. Shultz added that looking at the timescales, IEDO programs have to look further fields ahead. He said that TAWD is positioned to help facilities capture near-term efficiency gains—whereas in the RD&D portfolio, energy efficiency is engaged from the very beginning of technology scoping.
 - Mr. Cresko added that issues of efficiency are hard but fundamental. He said there may be more low hanging fruit, but some of the higher fruit is bigger and hard to shake.
- Ms. Betsy Dutrow alluded to TAWD's energy intensity work and commented that there is still a lot out there that hasn't been touched, for example rolling out more chemical sectors. She said that there is always more to be done.
- Dr. Neal Elliott asked if there is something new in the efficiency space and if there is another level of efficiency that can be attempted to be reached.
 - Mr. Cresko mentioned that data centers are a challenge, and utilities are acknowledging this. Data centers grew rapidly and were inefficient. Now that they are more efficient, system issues need to be addressed.
 - Dr. Shultz agreed and noted that there is huge untapped potential for industrial load flexibility.
- Dr. Sridhar Seetharaman stated that most energy in plants is recovered, so electricity may increase in demand. He asked how the national labs and the High Performance Computing (HPC) resources play into the office's work.
 - Dr. Schultz responded by saying yes, national labs have a critical role in IEDO's portfolio and are the backbone of a large portion of the technical assistance and R&D work. He added that HPC is a growing priority for DOE.
 - Dr. Pritchard replied that HPC resources have a role. Compared to the Advanced Materials and Manufacturing Technologies Office's (AMMTO) side of the HPC portfolio, there is a lot less awareness of what HPC can solve and the opportunity that's there. However, IEDO is addressing this challenge.

- Ms. Sasha Stashwick said that she's aware of LPO's outreach to states and asked if DOE is considering states as convening potential public cohorts of facilities as adopters of some of these prospective technologies.
 - Dr. Shultz agreed and noted that that one of IEDO's strategies is turning its very public TAWD stakeholder engagement function into a gateway that informs technology development for the broader office.
 - Ms. Kelly added that for the last two years, the National Association of State Energy Officials (NASEO) has funded a state industrial working group. She said that this has been an important way for DOE and other federal agencies, such as NIST and EPA, to share what's available.
- Ms. Anna Fendley inquired about how knowledge from workers sought and collected. She characterized input from workers as distinct from the engineers' perspectives. She asked onsite programs collect this input, and if not, how it could become routinely incorporated.
 - Dr. Shultz replied R&D project teams require industry partners. He said that this is why pilot scale demonstrations are conducted, that's the point of working with partners to do commercial scale demonstrations because there is a lot of technical risk still in the project when it hasn't hit the factory floor.
 - Ms. Kelly mentioned that TAWD ensures that workers and stakeholders are at the table when they design resources. TAWD is developing a collaborative that will work with 3–5 organizations that are addressing workforce development. They want to scale up what they are already doing well.
 - Mr. Cresko added that there is a strong focus on workforce development within the Manufacturing Innovation Institute.

6. Technologies for Industrial Emissions Reduction Development (TIEReD) Program lightning talks

Moderator: Dr. Zach Pritchard, ITIAC DFO (pending) & Technology Manager, IEDO

EERE Offices – followed by Q&A

- Dr. Diana Bauer, Deputy Director, Advanced Materials and Manufacturing Technologies Office (AMMTO)

Dr. Bauer presented AMMTO's vision and mission statement. She outlined AMMTO's focus areas, including platform manufacturing technologies, advanced materials, and workforce. She provided examples of AMMTO programs and prizes that support clean energy manufacturing.

- Dr. Kamala Raghavan, Technology Manager, Solar Energy Technologies Office (SETO)

Dr. Raghavan spoke about concentrating solar-thermal technologies for industrial process heat. She delivered an overview of concentrating solar-thermal power (CSP), including SETO's priority research areas for CSP. She also mentioned the various thermally driven industrial processes that CSP can support, along with two project examples.

- Tomas Green, Hydrogen and Fuel Cell Technologies Office (HFTO)

Mr. Green presented on HFTO's involvement in industrial decarbonization. He shared HFTO's vision diagram depicting how hydrogen can play in the economy. He provided an overview of current iron and steel and transportation projects, along with the associated project goals and potential impact.

- Dr. Gayle Bentley, Technology Manager, Bioenergy Technologies Office (BETO)

Dr. Bentley presented on the decarbonization priorities lead by BETO. She emphasized that BETO develops technologies to produce fuels and chemicals from renewable resources, primarily biomass. She shared BETO's strategic goals and framework, including insight into BETO's focus areas and ongoing funded projects.

Discussion Highlights

- Mr. Jeff Rissman stated that there are disagreements about how large bioenergy can be scaled up before negative environmental consequences set in. He asked if BETO has estimated for how far sustainable bioenergy can be pushed before incurring these impacts.
 - Dr. Bentley responded that [BETO's 2023 Billion-Ton Report](#) was recently released. It contains an extensive study of available biomass and waste resources, looking at the availability, demand, and future projections. National lab partners contributed to this analysis.
- Dr. Comas Haynes asked who is keeping tally on the sources of these fuels, including the transportation and utilization and generation.
 - Mr. Green replied that the HFTO invested in the GREET model and uses a life cycle assessment of carbon intensity of hydrogen. He said it looks at how clean hydrogen has a strict requirement of what can be considered clean.
 - Dr. Bentley added that BETO also invests in GREET and other life assessment tools. She mentioned that a lot of life assessment tools are limited to cradle-to-gate rather than cradle-to-grave. She explained that the [BOTTLE™](#) consortium takes consideration for lasting environmental impacts and extended producer responsibility.
- Dr. Eric Masanet asked HFTO about its efforts to blend hydrogen into existing natural gas infrastructure and where this would make sense for industry. For example, would it be certain locations, industry clusters, or would it be better just to electrify. He asked how hydrogen can be used as a stop gap for industrial heat through blending.
 - Mr. Green replied that in the strategy and National Roadmap, high processes temperatures of over 553 Celsius were identified. He said that IEDO's analysis in the Industrial Decarbonization Roadmap was leveraged to work out how much energy is used by heat category, by range, and heat value. He added that there are opportunities when electrification is hard for technologies, however he said that the goal is to not displace something that would be beneficially electrified high with hydrogen for the sake of it being relevant, there should be a strategic advantage.

Other DOE Offices – followed by Q&A

- Dr. Gail McLean, Chemical Sciences, Geosciences, and Biosciences Division Director, Office of Science

Dr. McLean presented the industrial decarbonization research taking place in the Office of Science. She provided an overview of the Office's mission and research portfolio. She highlighted a few Energy Earthshot Research Centers (EERCs) Awards and Science Foundations Awards that are relevant to industrial decarbonization and funded of the Office of Science.

- Sarah Forbes, Acting Director, Office of Carbon Management Technologies, Office of Fossil Energy and Carbon Management (FECM)

Ms. Forbes delivered remarks on the five R&D divisions within the FECM. She shared a few milestone projects and a snapshot of the growth of carbon storage projects, stating that it is a busy time for the carbon management space. She recapped FECM's budget history and provided a summary of the major program areas within the different divisions.

- Jason Marcinkoski, Program Manager, Office of Nuclear Energy (NE)

Mr. Marcinkoski presented nuclear integrated energy systems supporting the transportation and industry sector. He provided an overview of the capabilities and the future landscape of nuclear energy systems. He spoke about the overall decarbonization potential of the U.S. through a nuclear lens. He concluded with insight on the organizational pillars of NE and a recap of the first of kind nuclear-H₂ production demonstration projects.

- Dr. Chris Vandervort, Technology-to-Market Advisor, Advanced Research Projects Agency-Energy (ARPA-E)

Dr. Vandervort presented ARPA-E FLExible Carbon Capture and Storage (FLECCS) Program and industrial heat initiatives. He offered insight into ARPA-E's history, mission, and program cycle. He summarized ARPA-E's 2023 impact indicators and technology initiatives. Lastly, he highlighted ARPA-E's Innovation Summit, taking place on May 22-24 in Dallas, Texas.

Discussion: No Committee members asked questions.

7. Demonstration and Deployment Lightning Talks – followed by Q&A

Moderator: Dr. Zach Pritchard, ITIAC DFO (pending) & Technology Manager, IEDO

- Kelly Visconti, Office of Manufacturing Energy and Supply Chains (MESC)

Ms. Visconti presented MESC's purpose, mission, and vision. She highlighted that MESC is focused on the "how" of the energy transition and that MESC's investment activities are backed by robust analytical modeling through its core functions. She summarized a few key programs, including relevant projects and funding examples.

- Andrew Dawson, Office of Clean Energy Demonstrations (OCED)

Mr. Dawson presented on OCED and its industrial demonstrations. He spotlighted OCED's mission and focus to be a technology agnostic office addressing the challenges of the energy transition and commercial scale demonstrations. He reviewed a few selected OCED programs, along with areas of interests and priorities for the Industrial Demonstrations Program.

Discussion Highlights

- Dr. Cathy Choi stated that she hears a lot about meeting climate goals. She said that part of the challenge is that many industries have a large fleet of an existing asset base that still have useful life

(e.g., trucks, rail, existing power generation, fleet of assets etc.). If these industries cannot address their current fleets, then it's a bow wave going into 2050. She asked if either of the offices address this.

- Mr. Dawson replied that a large emphasis of OCED's Industrial Program is on retrofits e.g., how to make the existing assets last longer. He said that there is a lot of effort going on. He added that the Industrial Program is looking at working within existing facilities.
- Ms. Visconti responded that the indirect way MESC supports this is through transportation related funding opportunities to build out the EV supply chain, including a range of options. She said that MESC does not directly fund companies to get new fleets, but they are helping to build the supply chain, so they are available and at cost. She added that to her best knowledge, transportation related emissions are not being addressed within any DOE programs.
- Mr. Dawson commented that there is a joint DOE and Department of Transportation (DOT) group that examines a lot of transportation issues.
- Dr. Eric Masanet directed his question to MESC regarding the matching funds for the ICE Program. He asked if MESC is tracking the technologies that are selected for matching and wondered if there are patterns in the types of technologies that companies choose to pursue that can help to better understand barriers around certain technologies.
 - Ms. Visconti replied that MESC is nine months into the program and has selected about 70-80 projects. She said that the database is still being built and that the analytics haven't been completed yet, but it is in the plan to track technology trends. The projects range from very small efficiency programs to rooftop solar.

March 22, 2024

8. Day 2 Welcome and opening remarks

Dr. Zach Pritchard, ITIAC Designated Federal Officer (DFO) (pending) & Technology Manager, IEDO

Ms. Sharon Nolen, ITIAC Chair

Dr. Pritchard and Ms. Nolen delivered opening remarks on the second and final day of the ITIAC meeting. Ms. Nolen welcomed Committee member Dr. Joe Powell, who joined virtually and was unable to join on the first day of the meeting. She delivered a high-level summary of the prior day's proceedings and emphasized that Day 2 will focus on planning and initiating Committee work. She added that, although the DOE's Office of Energy Efficiency and Renewable Energy furnishes primary support for the Committee, ITIAC should also look across DOE as it undertakes its work. Dr. Pritchard added that Committee members may request support from federal staff and for contractor support resources.

9. Committee discussion on statute, charter, and report

ITIAC Duties and Planning, Dr. Zach Pritchard

Dr. Pritchard briefed committee members on the goal of the day's agenda and summarized ITIAC duties and technology focus areas. He highlighted the Committee Charter as a guiding resource on ITIAC roles and responsibilities.

A key outcome of the discussion was the formation and population of various subcommittees to support the development and synthesis of ITIAC recommendations to the Secretary of Energy. The Committee used Mural to brainstorm ideas and track questions to address. Inputs to the Mural helped the members identify themes and to propose subcommittees. Members then self-assigned themselves as leads or participants on subcommittees as desired. The following table reflects general agreement on the subcommittee structure and self-assignments.

Subcommittee Rosters							
	Report Outlining	Industrial Sectors	Cross-Cutting Technologies & Opportunities	Barriers	Workforce & Social Considerations	Economic Competitiveness	DOE Current Work & Gaps Assessment
Subcommittee Lead(s):	Sharon Nolen	Subodh Das	Eric Masanet	Cathy Choi	Anna Fendley	Akshay Sahni	Jeffrey Rissman Sasha Stashwick
Participants	Neal Elliott Eric Masanet Abigail Regitsky Jeffrey Rissman Akshay Sahni Sridhar Seetharaman	Betsy Dutrow Eric Masanet Joe Powell Sridhar Seetharaman Jolene Sheil	Neal Elliott Comas Haynes Sharon Nolen Jeffrey Rissman Sridhar Seetharaman Jolene Sheil	Sue Clark Betsy Dutrow Neal Elliott Eric Masanet Abigail Regitsky Sasha Stashwick	Sue Clark Comas Haynes Abigail Regitsky Sridhar Seetharaman	Subodh Das Neal Elliott Anna Fendley Abigail Regitsky	Cathy Choi Sue Clark Comas Haynes Eric Masanet Abigail Regitsky Sridhar Seetharaman

- Report Outlining
 - Ms. Nolen suggested a separate subcommittee focus on drafting the outline for the report and that she lead this subcommittee. Many ITIAC members agreed.
- Industrial Sectors
 - This standing subcommittee will determine which industries will be addressed.
 - Further subcommittees could be formed to address specific sectors in more detail.
- Cross-cutting Technologies & Opportunities
 - Infrastructure
 - Electrification
 - AI

- Energy efficiency, material efficiency, circular economy considerations
 - Use of fuels
- Barriers
 - Adoption
 - Access to clean power.
 - Pilot to demonstration to deployment
 - Technology, i.e., where R&D can help
 - Infrastructure, permitting, and policy support
 - Financing: market demand (via policy or private sector) – long-term offtake of clean goods
 - Electricity cost
 - Examine IAC and Better Plants data for insight on barriers
- Workforce and Social Considerations
 - Workforce adequacy
 - Training
 - Job opportunities
- Economic Competitiveness
 - International trade or provenance tracking.
 - Industrial technology exports.
 - Alignment between global governments and entities, such that U.S. competitiveness could be improved to drive scale.
 - Supply chain resilience.
- DOE Current Work & Gaps Assessment
 - DOE effectiveness / DOE enablement for goals
 - DOE access to data across offices (data generated by various programs and modeling tools, but currently fragmented)
 - Structure as an information collection for the full committee on these issues
 - What are the authorities beyond technologies that affect DOE's effectiveness (internal barriers)
 - This may be the section that synthesizes most of the reports' recommendations

Discussion Highlights on Subcommittee Formation

- Subcommittee meetings do not have the same requirements as full Committee meetings, but subcommittee meetings and outcomes must be reported to the full committee. He added that a subcommittee meeting with more than 50% of the committee members would constitute a full Committee meeting. It may be helpful to think of some subcommittees as needing only a few meetings, while others might be longer term subcommittees.
- Ms. Sharon Nolen credited Ms. Sasha Stashwick for outlining the vision for subcommittees that ended up being list of subcommittees that the Committee agreed upon.
- Ms. Nolen asked for feedback on the draft timeline, including a tentative schedule to meet in person twice a year and then meeting virtually during the three months in between. It would be good to schedule a virtual meeting in mid-summer 2024 to hear updates from subcommittees and hold another in-person meeting in the September/Fall timeframe. This would put the Committee on an 18-month schedule to issue its report.
 - Several members expressed agreement with this proposal. No one expressed disagreements.
 - After the Committee sends its report to DOE, then DOE has 60 days to comment on it before it goes to Congress. DOE does not intend to edit it.

- After the first report is finished, there is a three-year period before the next one is due. The Committee must meet twice a year during the three-year period and can decide on what to do in the meantime.

Additional Discussion Highlights on ITIAC Charter and Authorizing Statute

Some member comments have been consolidated or reordered and that these highlights are not meant to be a transcript.

- Dr. Sue Clark asked about the strategic plan that ITIAC is to develop, i.e., what the difference is between the Committee's strategic plan versus IEDO's strategic plans, and how should that be balanced.
 - Dr. Pritchard responded that the Committee is encouraged to use existing DOE resources as a starting point. The Committee may express points of agreement, or recommend changes. He said that the Committee has a lot of flexibility to decide how to interpret these things and where to focus.
 - Dr. Shultz suggested that if the Committee is satisfied with IEDO's strategy, then they may indicate that in their report. Replicating the work is not necessary. However, if the Committee identifies gaps in DOE's strategy, then they should indicate those gaps.
 - Dr. Pritchard added that the strategic plan does not have to be its own stand-alone production, rather it can be a part of the report and evaluation.
- Dr. Neal Elliott made remarks about the state of industrial programs when the Energy Act of 2020 was drafted. He added that the audience for this committee is not just DOE but Congress as well. He reflected on DOE's presentations from Day 1 and said that other factors could have material impacts on the success of DOE's industrial decarbonization efforts, such as infrastructure issues with electric adequacy.
- Dr. Cathy Choi sought confirmation if the 85% emissions reduction goal by 2035 applied to the Industrial Emissions Reductions Technology Development Program referenced in the ITIAC Charter.
 - Dr. Pritchard clarified that this goal is specifically for Earthshot.
 - Dr. Neal Elliott added that the legislation was written in a specific time when the United States was experiencing deindustrialization of its economy and supply chain disruptions due to international trading issues.
- Dr. Sue Clark asked for clarification about Committee charter, which specifies that ITIAC reports to the Secretary of Energy but sends a report to Congress. Dr. Pritchard clarified that the Committee's report will go to the Secretary of Energy, and after 60 days, it will go to Congress.

Additional Discussion Points on DOE Programs, Reports, or Informational Needs

Some discussion points are summarized as follows and reflect comments throughout the session, grouped where appropriate, and not necessarily in sequential order. Many of these points contributed to the determination of the subcommittees.

- Mr. Jeff Rissman expressed concern about duplicating recommendations from DOE's Liftoff Reports, which already identify promising technologies in individual sectors. He asked if it would be useful for the Committee to provide guidelines for helping DOE with selecting technologies in each program, or suggest reallocation of various office budgets. Dr. Shultz responded that the Committee may decide what it would find useful for the report.
- Ms. Anna Fendley noted that the Committee should avoid getting bogged down in debating one technology versus another. She recommended focusing on how DOE will be able or unable to

accomplish the goals set out. She agreed with Dr. Elliott's suggestions and added that the Committee should also consider what current DOE policies or practices are working well and which ones are not. She also asked how much offices are really talking to each other and thinks that more cross pollination may be possible.

- Dr. Sridhar Seetharaman commented that opportunities in OCED, MESC, and LPO that did not exist before also bear accompanying risks, emphasizing that the risk of investing in the wrong thing is enormous. It would be helpful to understand how selections are made, why certain projects are selected over others, how progress is tracked, and how to determine if it is performing the way it should.
- Dr. Eric Masanet asked if any IEDO reports already examined barriers of technology that the Committee could learn from.
 - A report on barriers to uptake for efficiency was published 5-6 years ago. IEDO is also conducting further analysis related to the Industrial Decarbonization Roadmap, and the Committee will have access to input from the Roadmap workshop to be held on May 14-15, 2024.
 - IAC data and Better Plants data could offer insight on barriers, as well as DOE's ability to understand the barriers and to gather data on them.
- Dr. Abigail Regitsky expressed that it would be beneficial to gain a better understanding of big programs, as well as IEDO programs, such as the Industrial Decarb Roadmaps and Commercial Liftoff, and understanding how those fit together. She mentioned that there are overlapping technologies and abatement potentials, and it would be beneficial to know if they do or do not match and why. Understanding how the funding has mapped across those things is a way to start identifying gaps, she added. Her second point included ensuring these technologies are globally cost competitive, including in developing economies.
- Dr. Sue Clark commented that the industrial decarbonization problem is too big for DOE to address by itself. The Department of Commerce thinks about industrial topics in terms of economic development. While keeping a focus on DOE, the Committee might want to think about how to facilitate perspectives from other agencies across the government.
- Dr. Sridhar Seetharaman asked if there are critical capabilities or networks that should be considered or created when thinking about utilizing the national labs. Further, he asked if that recommendation would be useful from DOE's point of view.
- Dr. Abigail Regitsky expressed that the Committee can draw on past DOE analysis to identify gaps. She said that the section on DOE current work and gaps will contain the "meatier" parts of the report.

Additional Discussion Points on ITIAC Report Outline and Content

Members initially considered a report outline draft that aligned with the structure of the Industrial Decarbonization Roadmap. While many members agreed with the initial outline, others made recommendations to expand and restructure the outline. Ultimately, the Committee decided to form a subcommittee devoted to refining the report outline. Discussion points are summarized as follows and reflect comments throughout the session, grouped where appropriate, and not necessarily in sequential order. Many of these points also contributed to the determination of the subcommittees.

- Dr. Abigail Regitsky asked how much the Committee should include within the report that is more currently under DOE authority that DOE has the ability to change and improve, versus what DOE does not have the authority to act upon unless Congress grants that authority. She stated that she believes both should be included and could be helpful for guiding Congress. Many members agreed.

- Dr. Neal Elliott views the Committee as having two audiences: one within DOE and Congress. The Committee should decide what it views as priorities, such as allocations for DOE, and what are the statutory recommendations.
- Dr. Comas Haynes recommended that sectors should be looked at independently, as well as how sectors feed into one another. Look for opportunities to see what should be prioritized. Sectors can't be independent silos, there is too much cross pollination to lose out on.
- Dr. Eric Masanet inquired about demand reduction. He mentioned that it was discussed on Day 1 as an important wedge and not nearly fully tapped into in the U.S. and that might ripple into things like building standards, design practices, knowledge sharing etc. He asked if that is within the purview of the Committee. Dr. Shultz replied that implementation of technologies is in scope, and recommendations can be made on analysis.
- Ms. Betsy Dutrow commented that given recent developments like the Inflation Reduction Act, the Committee should think broadly about the changes that these policies are bringing and to anticipate these changes in the Committee's outputs. She also expressed support for ideas in the report that address technology adoption.
- Dr. Akshay Sahni recommended that it may be more effective to focus on a few technologies that can have an impact on economic competitiveness instead of trying to address all possibilities.
- Dr. Eric Masanet added to this point, and that it would be helpful to have a rubric, e.g., X megatons of savings that could be deployed by a certain timeframe where the U.S. is uniquely poised to fill strategic gaps. He said that this approach would better support decision making.
- Similarly on the policy side, Ms. Sasha Stashwick observed that there is opportunity to consolidate some durable political recommendations. If the Committee can identify mega opportunities, they can have a transformational impact even if only some of them are implemented.
- Dr. Joe Powell offered comments about how to categorize refining. The roadmap treats refining as a category, but he suggested that this report cover it under "fuels" because refining will be replaced by hydrogen and synthetic fuels. Dr. Neal Elliott later added that the Committee weigh in on the feedstock issue within petroleum refining and look at it as fully integrated within the organic chemical hydrocarbon industry.
- Ms. Nolen replied that the Committee has a lot of latitude in choosing how to organize its recommendations and which sectors to emphasize.
- Akshay Sahni agreed with the initial outline and suggestions for addressing competitiveness. He recommended that the Committee focus the "competitiveness" aspect on achieving economic competitiveness in a decarbonized society. This would be cross-cutting across all the initiatives.
- Dr. Cathy Choi suggested for the outline to be structured around research, development, demonstration, commercial application, impacts on technology economic competitiveness, impacts on industrial technology exports, and emissions reductions. She said this would frame the report outline around the Committee's purpose.
- Mr. Jeff Rissman agreed with Cathy's comments, including U.S. technological leadership aspect. He asked where the intersection is with that goal and what DOE is doing to address it, such as IP licensing to help with technology diffusion.
- Dr. Sridhar Seetharaman noted that there is a workforce implication that needs to be addressed, such as the consequence of a workforce reduction in a decarbonized society.
- Dr. Arun Majumdar raised a comment from Day 1 regarding how DOE is doing internally. He said it would be worth it for the Committee to address that. There are lots of pockets of excellence within DOE, but it would be helpful for the Secretary and Congress to know if there is coordination. He added that a question one may ask is what DOE's role is and if it is providing this convening role of

funding and enabling technology to enable multiple sectors and to convene the community. Dr. Sue Clark concurred and added that it can't be assumed that all the big programs will be integrated together, and that the Committee should begin assessing how DOE is doing and make suggestions on how to facilitate them.

- Ms. Anna Fendley commented that since the goal is about competitiveness and workforce, there should be a part of the report that addresses social and economic issues.
- Several members agreed that economic competitiveness should be its own section in the report, and that social impact should also be addressed.
- Ms. Sasha Stashwick stated that the Committee has the opportunity for the report to be different and complimentary compared to a replicated DOE report. She said focusing on DOE's potential impact on climate, competitiveness, workforce, non-CO2 pollution impact, and organizing other technologies and markets in a way that could go even further than additional funding and authority.
- Ms. Betsy Dutrow expressed that the report should address industry receptivity to new technology adoption. Dr. Comas Haynes agreed and suggested finding a way to facilitate candid, non-threatening feedback from industry about their pain points as first adopters.
- Dr. Eric Masanet suggested presenting barriers upfront rather than discussing subsector specific areas and cross cutting barriers, such as framing the barriers of technology adoption as key challenges and unpacking what is specific to each sector. He also suggested including a framing level discussion of the historical context of how the innovations and efficiency of today were achieved.
- Dr. Abigail Regitsky proposed if individuals have the subject matter expertise, there could be an optional meeting on sectors to help reference the Roadmap and Liftoff Reports and to determine what information to add to the specific sector or cross-cutting technologies.
- Dr. Akshay Sahni highlighted the importance of being as granular as possible. He said if it is very high level, one cannot action something. He added that there could be high level sections but pinpointing actions for certain technologies and industries need to be included.
- Dr. Eric Masanet brought attention to the upstream and downstream effects of industrial sector changes. He said it's important to recognize in the report the way the sectors evolve and could have strong benefits upstream, such as less mining, and downstream, such as new materials. He added this could be captured in a subcommittee's lifecycle effects or roll it into a charge.

10. Public Comments

None submitted. In the Federal Register Notice announcing this meeting, there were instructions for members of the public to contact the ITIAC team if they wished to deliver oral statements during this meeting. No requests were received. If anyone listening online would like to send a statement, they send an email to ITIAC@ee.doe.gov.

11. Closing Remarks

- Regarding next steps, Ms. Nolen stated that subcommittees can begin meeting while the report outline is being finalized. She stated that she will chair the outline of the report and will be convening that group together. When the Committee meets again in three months, subcommittees should have an outline ready to share, she added.
- Ms. Nolen thanked members for their contributions and insights and adjourned the meeting.

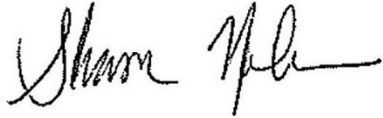
12. Adjournment

The meeting adjourned at 12:34 pm EDT.

Respectfully Submitted:

Emmeline Kao
Designated Federal Officer

I hereby certify that these meeting minutes of the March 21-22, 2024, ITIAC meeting are true and correct to the best of my knowledge.

A handwritten signature in black ink, appearing to read "Sharon Nolen", with a stylized flourish at the end.

Sharon Nolen
Chair, Industrial Technology Innovation Advisory Committee