

**INDUSTRIAL TECHNOLOGY INNOVATION ADVISORY COMMITTEE (ITIAC)
MEETING MINUTES**

Date and Time: August 28, 2024, 12 p.m. – 5 p.m. EDT
Location: Virtual (Zoom), hosted by DOE Industrial Energy and Decarbonization Office (IEDO)
Purpose: Industrial Technology Innovation Advisory Committee (ITIAC) Meeting

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Participants

Committee Members: (*in attendance*) Ms. Sharon Nolen, Chairperson; Dr. Sunday Abraham; Dr. Cathy Choi; Dr. Sue Clark; Dr. Subodh Das; Ms. Betsy Dutrow; Dr. Neal Elliott; Mr. Sergio Espinosa; Dr. Comas Haynes; Dr. Eric Masanet; Dr. Joe Powell; Dr. Abigail Regitsky; Mr. Jeffrey Rissman; Dr. Sridhar Seetharaman; Ms. Jolene Sheil; Ms. Sasha Stashwick

Department of Energy (DOE) Participants: ITIAC Designated Federal Officer (DFO) Dr. Zachary Pritchard; Alternate Designated Federal Officer (ADFO) Dr. Celina Harris; Mr. Joe Cresko; Mr. Leo Marchetti; Dr. Avi Shultz

ITIAC Staff: Pamela de los Reyes; Caroline Dollinger; Simone Hill-Lee; Dr. Brian Ray; Kenta Shimizu

Committee Members Not Attending: Ms. Anna Fendley; Dr. Arun Majumdar; Dr. Akshay Sahni

Meeting Summary

The third meeting of the Industrial Technology Innovation Advisory Committee (ITIAC) was held August 28, 2024, virtually on Zoom. An overview of the progress and content of the *Pathways to U.S. Industrial Transformation* vision study was presented by the DOE Industrial Efficiency and Decarbonization Office (IEDO).

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 53069), members of the public were able register to provide oral statements and submit written statements to ITIAC@ee.doe.gov.

Materials Provided to the Committee

- [Agenda](#)
- Mural board Q&A document
- [Meeting presentation slides](#)

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

Welcome and Opening Remarks

ITIAC Designated Federal Officer (DFO) Dr. Zach Pritchard opened the ITIAC meeting at approximately 2 p.m. EDT.

ITIAC Chairperson Ms. Sharon Nolen welcomed everyone to the meeting and gave a brief overview of the meeting agenda and indicated that no public comments were received for this meeting. She introduced Mr. Joe Cresko, Chief Engineer for IEDO to brief ITIAC about the *Pathways to U.S. Industrial Transformation* report currently under development.

Pathways to U.S. Industrial Transformation

Mr. Cresko gave an overview of the work underway within DOE to reduce industrial emissions and to move toward deep decarbonization by the middle of the 21st century. He began with an overview of the pillars for decarbonization defined in the [Industrial Decarbonization Roadmap](#) (“Roadmap”) and the viable pathways to reducing emissions and forecasting impacts of decarbonization activities. Industrial emissions make up 30% of the energy related greenhouse gas (GHG) emissions in the United States. If no changes to processes and energy use are made, emissions could increase 17% by 2050.

The *Industrial Decarbonization Roadmap* identified four key pillars for decarbonization to help stakeholders assess and forecast impacts of changes in energy efficiency, industrial electrification, low-carbon fuels, and carbon capture. The *Roadmap* focused on five industries, iron and steel, chemicals, food and beverage, petroleum refining, and cement as a starting point to understand the emissions and how to make changes. The focus is expanding going forward to include more industrial sectors and to consider both energy related and non-energy related emissions, e.g., chemical process emissions, as non-energy related emissions make up a larger percentage of total industrial emissions.

The industrial sector is a major driver of the U.S. economy, accounting for 11% of U.S. gross domestic product and ~11 million jobs. DOE has developed the *Pathways to Commercial Liftoff* (“Liftoff”) reports to identify technologies and processes for the industrial sector to reach decarbonization goals in the shorter term. Investment needed for viable, emerging technologies for the eight industrial sectors identified in the Inflation Reduction Act (IRA)¹ is approximately \$1 trillion, and nearly two-thirds of the innovations needed to decarbonization by mid-century are not yet commercially ready or viable.

The strategy across DOE and particularly within IEDO is to advance applied research phase and move technologies to a point where they can be technically and economically viable for commercial deployment. IEDO focuses efforts in three programs: Energy- and Emissions-Intensive Industries, Cross-Sector Technologies, and Technical Assistance and Workforce Development. Within these programs, IEDO has rolled out funding opportunities totaling approximately \$500 million to date.

Mr. Cresko outlined the challenges and barriers to driving technologies toward viability for demonstration and ultimately commercial deployment. Challenges exist not only in electrifying or improving processes within a manufacturing plant but also in the supply chain and infrastructure. Overcoming infrastructure inadequacy, operations and structural limitations, and inefficient information flows are critical to integrating new processes and technologies. Two elements that have become critical issues within all of DOE’s work are ensuring equitable transitions and protecting the underrepresented workforce and communities in transitioning to a clean energy economy.

Decarbonization pathways cannot be a single solution across all sectors, or even within a single sector across geographical locations. DOE’s goal is to build a framework within the *Pathways to U.S. Industrial Transformation* (“*Pathways*”) effort that is flexible and can be adapted to specific needs. As the study and report move forward, additional subsector assessments, technology assessments, and underlying models for forecasting will be explored. An important part of the study is the timing and prioritization of deployment of technologies.

Mr. Cresko paused for any questions from the ITIAC members.

Dr. Neal Elliott noted that the *Pathways* work is much appreciated and asked how coordination among DOE offices is functioning.

- **Mr. Cresko** noted that there are a lot of players involved in the decarbonization work, and DOE has a decarbonization joint strategy team (JST) to bring the offices together as well as an Industrial Decarbonization Science and Energy Technology Team that is focusing on target areas such as thermal management. Through these mechanisms, the offices can collaborate on funding opportunities and initiatives as well as analytical work. The collaboration is bringing all the work of the different offices into the *Pathways* development. Elements of the impacts and evaluation criteria in adopting new technologies and process must be considered beyond the manufacturing

¹ H.R.53760-0 Inflation Reduction Act of 2022, <https://www.irs.gov/inflation-reduction-act-of-2022>.

plant, including environmental pollutants and health impacts, energy costs and infrastructure, workforce training and high-quality jobs, deployment costs, and materials and supply chain impacts and costs. Solving issues and industrial impacts must include an understanding of the whole system interactions.

Mr. Cresko compared the *Roadmap* and the *Pathways* vision study content and direction. The *Pathways* work will include the following:

- Identify cost effective and industry specific strategic pathways.
- Address the technological, economic, societal, and environmental health impacts associated with the scale and pace of an industrial transformation.
- Present the strategies, targeted pathways that are identified through the range of opportunities investigated, and associated metrics and targets to overcome the challenges and barriers to get to decarbonization.

DOE sees this as a robust start to being able to map out where the country needs to go to transform the industrial sector by mid-century. The *Pathways* report will use decision trees as representations of the forecast models leading to targeted case studies and are expected to evolve as better data is collected.

Mr. Cresko introduced Dr. Brian Ray for discussion of the *Pathways* models.

Dr. Brian Ray, Principal Energy Analyst with Energetics supporting IEDO, followed up on Mr. Cresko's overview with a deeper dive into the *Pathways* vision study. The *Pathways* work includes two approaches to data analysis: one model forecasts by production route and the other model is unit and process specific. Long term, the models will help inform DOE industrial decarbonization, but short term the models are looking at annual forecasts of production volumes and energy intensities by subsector.

The *Pathways* workshop held in May 2024 and the following request for information (RFI) resulted in significant feedback which helped focus the resolution and assumptions that went into the initial modeling. The feedback helped expand the approach and focus in on subsector specific data.

Dr. Ray reviewed the modeling approach in more detail, discussing the sensitivities and variables that define the model features and functionalities, including technology readiness level (TRL), demand, electricity supply, and consistency. The modeling is expanding around the advanced scenarios for multiple pathways to a net zero future. He also described how the *Pathways* modeling fits in with other decarbonization modeling with respect to scope and timescale. Some other offices models have also informed the approach and data in the *Pathways* model, i.e., the National Renewable Energy Laboratory's (NREL's) GreenHEART, Fuels and Industry Integrated Optimization (FINITO), and Regional Energy Deployment System (ReEDS) models.

Dr. Ray paused for questions.

Chairperson Nolen noted that there were some questions on the Mural board.

- **DFO Dr. Pritchard** suggested that clarification questions would be appropriate at this point and hold the Mural board questions until the end.

Ms. Betsy Dutrow stated she and Dr. Elliott had been involved in the Energy Modeling Forum (EMF) 37 study² and asked if the *Pathways* work follows that analysis.

- **Dr. Ray** concurred that EMF 37 results informed the data used to make assumptions for the *Pathways* work.

Dr. Ray continued his discussion with a list of sensitivities included in the modeling to help identify potential pathways. The input from the RFI and the workshop and internal review was filtered into eight categories, four of which are applicable across all industrial sectors and align with the *Roadmap* pillars. The remaining four categories are sector specific with solutions varying from industry to industry. He shared some examples of applications in the different categories.

Dr. Ray provided high level examples of analysis within two industrial subsectors. He described the modeling and inputs, clarifying the types of data used for the model and how it compares with other types of models in varying industries. He provided preliminary takeaways for iron and steel production and emissions using feedback from industry and the model forecasting. Food and beverage industry was also evaluated and preliminary results for emissions and subsector-specific sensitivities were shared for both industries.

DFO Dr. Pritchard noted that there may be more questions on the Mural board than time left in the meeting to address them, but the questions will be addressed following the close of the session.

Chairperson Nolen invited any questions relating to clarification of anything presented can be asked first, followed by the Mural board questions.

Discussion Highlights

Dr. Elliott asked about primary data challenges that may be affecting the scenarios being considered, for example, the quality of data on actual process thermal requirements. He stated concern that the data reflects delivered thermal quality not required thermal quality, which can be significantly different and can affect the pathway choices, assumptions, and may distort the analysis results.

- **Dr. Ray** agreed that it is a risk that the data is not fully representative and it is acknowledged at a subsector level the deep analysis of process resolution is still lacking and analysis is mindful of where the demands can match what is truly delivered.

Dr. Sunday Abraham asked if cost analysis will be considered in the future.

- **Dr. Ray** stated that cost is not directly part of the calculation within the spreadsheet model, but cost is considered as part of the modeling framework and part of the results discussion.

Chairperson Nolen asked if models will be available at some point to companies to modify assumptions to be more appropriate to particular situations.

- **Mr. Cresko** stated that sharing the models is one of the goals. The *Roadmap* has tables of assumptions, but for the *Pathways* report, the goal is to make the inputs, assumptions, and models available. Deeper sectoral assessments and their models are planned to be shared for stakeholders to use, refine and apply to different assumptions. The goal is to estimate impacts at a national scale and be transparent with the base analysis.

² The EMF 37 study was initiated to help model builders and model users better understand the potential role of electrification in economy-wide decarbonization pathways in important economic sectors—transportation, buildings, and industry. Stanford University, Stanford Engineering Energy Modeling Forum, <https://emf.stanford.edu/emf-37-deep-decarbonization-high-electrification-scenarios-north-america>

Chairperson Nolen noted there were several questions on the Mural board that asked for clarification on the statement that 60% of technologies are not commercially available and how to bridge the gap between where companies are and where they want to be. Further questions asked if the technology that is available is being fully utilized.

- **Mr. Cresko** agreed that those are some of the most important questions. Some companies may choose to wait until a better solution is available, which is not encouraged; but there are also concerns about adopting intermediate technology that may not meet needs. He noted that the demonstration projects funded by the Office of Clean Energy Demonstrations (OCED) will raise the level of confidence in large investment areas, for example in the Heidelberg cement facility in Indiana where they are revamping the entire plant with a new kiln and carbon capture, utilization, and storage system and taking advantage of federal funding. The available technologies are not fully utilized, however, and it is not clear what is driving the corporate decision-making process.

Chairperson Nolen summarized another group of questions from the Mural board regarding the cost of electricity as opposed to the cost of fossil fuels and whether DOE has an approach to reducing electricity costs for individual buyers to drive electrification.

- **Dr. Ray** stated that question is a policy issue, but a simplistic look at electricity and natural gas prices in different scenarios and locations may be able to equalize the costs.
- **Mr. Cresko** said it is a policy discussion but it is also a broader question to include offices other than IEDO. There are workforce development tools and regional experts to help industry to assess energy use and plan efficiencies to reduce costs.
- **Dr. Ray** added that the Office of Electricity and national labs are modeling scenarios to achieve cost ratios of better than 2:1 electricity to natural gas.

Chairperson Nolen noted there are several questions related to modeling and consideration of factors such as job creation, number of jobs, job quality, healthcare costs due to emissions, subsidy policies such as the IRA, and how non-technical issues are handled.

- **Mr. Cresko** noted the models do not directly calculate impacts on jobs at this time. DOE does have input/output models that do try to calculate job impacts that are available. The *Pathways* report will not quantitatively address job impacts, though qualitative discussion will be included.
- **Dr. Ray** commented that the IRA in its current policy is included in how sensitivities are defined.

Chairperson Nolen asked another question from the Mural board regarding whether there is a way to look at what technologies other countries who may be ahead of the United States are implementing and to incorporate those results in the *Pathways* modeling.

- **Dr. Ray** confirmed that the *Pathways* work integrates results and data from other countries' innovations and cited an electrowinning study³ from Europe. He also noted that the lack of data in low-TRL technology is a challenge to modeling.

Dr. Abigail Regitsky asked how DOE plans to improve IEDO programs through the *Pathways* study and how current research may be linked to the modeling and guidance to inform DOE decisions and programming in the near future with regard to low-TRL technology.

³ Development of new methodologies for industrial CO₂-free steel production by electrowinning, <https://www.siderwin-spire.eu/>.

- **Mr. Cresko** responded that DOE is establishing a framework to be iterative in analysis of technologies and pathways that does not presume that solutions or opportunities that are currently high potential are static. While each office has its own multi-year program plan (MYPP), the goal is to provide overarching guidance on revising analysis and improving model development over time to give better insights to inform the types of investments an office may make to drive technology performance, drive down cost, etc. DOE is also in the early stage of developing a multi-year analysis plan under the tiered multi-office framework which includes multiple programs working on focused research and filtering to a whole office perspective. The *Pathways* study will directly inform IEDO activity but also will be a good resource for DOE to defend investments and research and development activity.
- **Dr. Ray stated** that lower TRLs are harder to represent, and they are not in the model because it is hard to get the data. These models will continue to evolve as technology progresses and data becomes available. Sensitivities may be run in both directions to begin to define the scope of the potential of the lower-TRL technologies.

Chairperson Nolen thanked Dr. Ray and Dr. Cresko for their presentations. She reminded the members that as noted in the first ITIAC meeting, the Committee has the responsibility to not only produce a report but also to provide comments on current DOE work. She thanked DOE for giving the Committee insight into this work and the opportunity to comment while it is in progress.

Chairperson Nolen noted the Committee is trying to get subcommittee meetings on a regular cadence on members calendars. She stated she felt the subcommittees were making good progress and moving in the right direction.

DFO Dr. Pritchard stated that there is a poll for the presentation topics for the next in-person meeting, and one of the potential topics is in regard to the 60% of technologies not yet commercially available as stated in the *Liftoff* reports. He also reiterated that no request for public comment were submitted prior to the meeting, but members of public are invited to submit written statements to ITIAC@ee.doe.gov

Committee Action Items

- Respond to subcommittee meeting date polls.
- Subcommittee on Report Outline meeting is scheduled for August 29, 2024.
- Respond to poll for presentation topics at the next in-person meeting (October 29–30, 2024).

Adjournment

The third meeting of the Industrial Technology Innovation Advisory Committee was adjourned at approximately 4 p.m. EDT.

Respectfully submitted:

Zachary Pritchard
Designated Federal Officer

I hereby certify that these meeting minutes of the August 28, 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
Chairperson, Industrial Technology Innovation Advisory Committee