INDUSTRIAL TECHNOLOGY INNOVATION ADVISORY COMMITTEE (ITIAC) MEETING MINUTES

Date and Time: January 16, 2025, 12:00 p.m. – 5:00 p.m. EST
Location: Virtual (ZoomGov), hosted by the U.S. Department of Energy's Industrial Efficiency 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; Mr. Jeffrey Rissman, Vice Chairperson; Dr. Sunday Abraham; Dr. Cathy Choi; Dr. Subodh Das; Ms. Elizabeth Dutrow; Dr. Neal Elliott; Ms. Anna Fendley; Dr. Comas Haynes; Dr. Joe Powell; Dr. Abigail Regitsky; Dr. Sridhar Seetharaman; Ms. Jolene Sheil; Ms. Sasha Stashwick

U.S. 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. David Borak

ITIAC Staff: Ms. Pamela de los Reyes; Ms. Caroline Dollinger; Ms. Simone Hill-Lee; Ms. Mahia Qureshi

Committee Members Not Attending: Dr. Sue Clark; Mr. Sergio Espinosa; Dr. Arun Majumdar; Dr. Akshay Sahni

Meeting Summary

The fifth meeting of the Industrial Technology Innovation Advisory Committee (ITIAC) was held January 16, 2025, virtually on ZoomGov, hosted by DOE's Industrial Efficiency and Decarbonization Office. ITIAC members reviewed and voted on a total of 30 recommendations that were submitted to the Chair Ms. Sharon Nolen and Vice Chair Mr. Jeffrey Rissman prior to the meeting. The ITIAC wished to publish these recommendations as a preliminary report after the meeting, with the intention of submitting a full Committee report to the Secretary of Energy in Fall 2025. Each recommendation was read aloud, followed by discussion and edits (as needed), and voted on by all members in attendance. 29 out of 30 recommendations were approved. Members also reviewed the recommended publications, introduction, and conclusion before voting on the preliminary report as a whole. The report was approved for publication.

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 ZoomGov platform. As described in the Federal Register Notice (89 FR 104121), members of the public were able register to provide oral comments and submit written statements to ITIAC@ee.doe.gov.

These meeting minutes include the final language from the approved recommendations, but omit the rationale, footnotes, and additional detail that were included in the draft preliminary report provided to the Committee. The "Discussion" under each recommendation below notes any changes between the final language shown in these minutes and the language from the draft report provided to the Committee before the meeting. The numbering of the recommendations corresponds to the numbering of approved recommendations. The recommendation that was not approved does not have a number in these minutes, in order to be consistent with the numbering in the final preliminary report.

Materials Provided to the Committee

- Draft "Preliminary Recommendations of the U.S. Department of Energy Industrial Technology Innovation Advisory Committee" report

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.

DFO Pritchard explained that the meeting will consist of members reviewing and voting on recommendations to be considered for inclusion in a preliminary report issued by the Committee. The preliminary report will serve as the basis for the full report that the Committee plans to deliver in Fall 2025. Dr. Pritchard also reviewed the voting process as this was the Committee's first time casting votes. A majority of the total Committee membership is required to approve a recommendation. With ITIAC's size of 18 members, the requirement for approval is 10 in favor (i.e., Yea votes). He also noted that members may abstain from voting for a recommendation due to conflict of interest or any other reason, and that only members who were present at the time of the vote were permitted to vote.

ITIAC Chairperson, Ms. Sharon Nolen, welcomed members and thanked them for proposing recommendations and submitting comments. She recognized ITIAC Vice Chairperson, Mr. Jeffrey Rissman, for his contributions in consolidating the recommendations submitted by Committee members for review during this meeting. She explained the review and voting process, in which Mr. Rissman would display the draft report on the screen and read each recommendation aloud. The accompanying rationale language will be included in the preliminary report but not read aloud during the meeting. Members may raise comments or concerns, and if modifications are needed to the recommendation, then ITIAC Vice Chairperson Rissman will make real-time revisions on the screenshare. The Committee will then vote on each recommendation using the "raise hand" function in Zoom.

ITIAC Recommendations: Review and Voting

Overarching DOE Strategy and Budget Recommendations

Budget Requests

Recommendation 1

In future budget requests, DOE should prioritize increases for the Industrial Efficiency and Decarbonization Office (IEDO), the Advanced Materials and Manufacturing Technologies Office (AMMTO), the Office of Clean Energy Demonstrations (OCED), and the Office of Manufacturing and Energy Supply Chains (MESC).

Discussion: None.

Vote: Approved

Voting results for Recommendation 1:

Present (14)			Not Present (4)
Yea (14)	Nay (0)	Abstention (0)	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			

Present (14)			Not Present (4)
Yea (14)	Nay (0)	Abstention (0)	
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Recommendation 2

Some offices fund technologies across multiple sectors and should receive budget increases specifically to support an increased focus on technologies, programs, and data collection and publication important for industrial decarbonization. These include the Advanced Research Projects Agency-Energy (ARPA-E), the Loan Programs Office (LPO), the Office of Technology Transitions (OTT), and the Bioenergy Technologies Office (BETO). The Energy Information Administration (EIA) should receive a budget increase to support improved industrial data collection and publication.

Discussion Highlights:

The language of this recommendation was modified during the meeting to specify support for data collection and publication.

Vote: Approved

Voting results for Recommendation 2:

Present (14)			Not Present (4)
Yea (14)	Nay (0)	Abstention (0)	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Technology and Program Prioritization

Recommendation 3

DOE should consider which subsectors have the greatest energy use and emissions when prioritizing support and crafting research, development, demonstration, and deployment (RDD&D) programs. The EIA Annual Energy Outlook provides data on which subsectors are the largest energy consumers today and future energy demand projections. DOE should also consider impacts such as national security, employment, the U.S. economy, and industrial competitiveness.

Discussion Highlights:

The language of this recommendation reflects modifications in response to comments from several members about the importance of additional priorities beyond energy use and emissions.

Vote: Approved

Voting results for Recommendation 3:

Present (14)			Not Present (4)
Yea (14)	**Nay (0)**	**Abstention (0)**	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Funding Opportunity Processes

Recommendation 4

DOE should create an open dialogue on what is making it hard for companies to respond to funding opportunities and to implement DOE funding. One way to do this is to expand the use of requests for information (RFIs) to solicit technological solution provider feedback, and to create a clear process to inform companies that submitted comments about how the agency has incorporated their feedback. Additionally, DOE should tailor funding opportunities to the needs of solution providers by leaning towards greater flexibility in funding opportunity design. Rather than articulating a defined/prescriptive set of technological parameters, DOE should articulate the specific problem it is seeking to address and welcome a wider range of solution providers to apply for funding. DOE should make funding opportunity information available more widely online, including on social media.

Discussion Highlights:

The language of this recommendation reflects modifications in response to members' feedback, including a suggestion to ensure that funding opportunities are more widely publicized.

Vote: Approved

Voting results for Recommendation 4:

Present (14)			Not Present (4)
Yea (14)	**Nay (0)**	**Abstention (0)**	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa

Present (14)			Not Present (4)
Yea (14)	Nay (0)	Abstention (0)	
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Improving Availability of Industrial Energy-Related Data

Recommendation 5

DOE should improve its collection and reporting of energy-related industrial sector data to support program prioritization and strategic planning both inside and outside of DOE. Specifically, DOE should improve EIA's Manufacturing Energy Consumption Survey4 by conducting it more frequently, reporting data with a shorter delay, and disaggregating more fuel types, industrial end uses, and manufacturing subsectors. DOE should begin providing regularly-updated, unit-level data on industrial equipment type, location, energy consumption, operating hours, and temperature, building on work done by researchers at two national laboratories. DOE should also create an Industry Annual Technology Baseline (ATB), like the existing Electricity and Transportation ATBs that includes data on the capital costs and energy efficiencies of both conventional and clean industrial technologies, such as boilers, heat pumps, furnaces, kilns, thermal batteries, etc.

Discussion: None

Vote: Approved

Voting results for Recommendation 5:

Present (14)			Not Present (4)
Yea (14)	Nay (0)	Abstention (0)	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			

Present (14)			Not Present (4)
Yea (14)	Nay (0)	Abstention (0)	
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Cross-Cutting Technologies and Opportunities Recommendations

Energy Efficiency

Recommendation 6

DOE should continue and expand its support for industrial energy efficiency technologies. Examples of key energy-efficient manufacturing technologies include waste heat recovery, net shape manufacturing, variable-frequency drives, high-temperature heat pumps, membranes for chemical separations, and product design alterations that enable the use of fewer or lower-energy manufacturing steps. DOE should continue to support and expand technical assistance for industrial efficiency and decarbonization, such as the Better Plants program, which provides valuable assistance to participating companies. Additionally, the Secretary should designate additional types of industrial equipment (such as industrial boilers, furnaces, kilns, precalciners, distillation columns, chemical reactors, heaters, dryers, etc.) as "covered equipment" using his/her authority under 42 U.S.C. § 6312. Then, DOE should issue minimum energy performance standards, test procedures, and labeling for each type of equipment so designated. Standard-setting bodies such as the American Society of Mechanical Engineers, the International Organization for Standardization, and ASTM International have developed standards for various types of industrial equipment. DOE should work with standard-setting organizations to write standards or incorporate existing standards into DOE's standards, test procedures, and labeling where appropriate.

Discussion Highlights:

This recommendation reflects minor editorial changes for clarification.

Vote: Approved

Voting results for Recommendation 6:

Present (14)			Not Present (4)
Yea (14)	Nay (0)	Abstention (0)	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Circular Economy and Material Efficiency

Recommendation 7

DOE should continue and expand its support for technologies that allow products to be produced with less material and domestically available materials. Additionally, DOE should publish high-quality technical guidance on how to design products for longevity and repairability.

Discussion Highlights:

The recommendation was modified in response to member comments to emphasize domestic sources of materials and reduce dependence on importation of these materials.

Vote: Approved

Voting results for Recommendation 7:

Present (14)			Not Present (4)
Yea (14)	**Nay (0)**	**Abstention (0)**	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Recommendation 8

DOE should continue and expand its support for technologies that facilitate the remanufacturing of products, reuse of parts and components, and recycling of materials. DOE should encourage the development of energy-saving recycling technologies, including mechanical and molecular approaches, and markets for recycled materials. DOE should require that claims about recycling technologies are clear, transparent, and accountable with third-party certifications.

Discussion: None

Vote: Approved

Voting results for Recommendation 8:

Present (14)			Not Present (4)
Yea (14)	**Nay (0)**	**Abstention (0)**	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni

Present (14)			Not Present (4)
Yea (14)	Nay (0)	Abstention (0)	
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Direct Electrification

Recommendation 9

DOE should prioritize support for direct electrification of industrial heating where it is technically feasible. Two technologies that can help overcome the cost gap between electricity and on-site fossil fuel combustion, and therefore are particularly important to commercialize, are high temperature industrial heat pumps and industrial thermal batteries. DOE should include industrial use of thermal batteries in electric grid-related research and programs, such as work by the Office of Electricity and ARPA-E's Grid Optimization Competition.

Discussion Highlights:

The recommendation reflects a modification made during the meeting in response to add on-site fossil fuel combustion when referencing the cost gap between electricity and fossil fuels.

Vote: Approved

Voting results for Recommendation 9:

Present (14)			Not Present (4)
Yea (14)	Nay (0)	Abstention (0)	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Clean Hydrogen

Recommendation 10

DOE should foster RDD&D and support demand-side technologies and incentives that motivate the use of clean hydrogen where it offers the lowest levelized cost of carbon emissions mitigation relative to alternative approaches. Applications where hydrogen may be the best fit include: (1) a replacement for fossil-derived hydrogen in applications where hydrogen is already used today, such as in the chemicals and refining industries; (2) a feedstock that enables the production of additional types of chemicals (e.g., methanol, olefins, aromatics) from non-fossil inputs; (3) a means of chemically reducing iron ore to metallic iron in the production of primary steel; (4) an indirect means of electrifying fuel-centric process heating needs where direct electrification is technically infeasible; and (5) as a clean energy storage mode for resilience in delivering electricity (e.g., via fuel cells) and low-NO_x combustion of hydrogen for process heating needs. DOE should support development of hydrogen infrastructure (e.g., LPO financing of hydrogen pipelines and storage) if the hydrogen serves these high-value end uses. DOE should continue and expand its support for hydrogen offtake.

Discussion Highlights:

- The numbered items in this recommendation do not reflect hierarchy or order of priority.
- This recommendation was modified to reflect suggestions from members, including the addition of low-NO_x combustion of hydrogen in relation to process heating needs. Another edit was made to specify support for hydrogen offtake. The rationale in the final report will expand on this point.
- Members also briefly mentioned that no pipelines for hydrogen transportation currently exist, but determined that a recommendation on this topic would be beyond DOE's scope.

Vote: Approved

Voting results for Recommendation 10:

Present (14)			Not Present (4)
Yea (14)	**Nay (0)**	**Abstention (0)**	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Carbon Capture, Utilization, and Storage

Recommendation Deferred. The proposed recommendation was a consolidation of multiple recommendations submitted by individual members. Although several Committee members are interested in addressing this topic, they collectively decided that additional discussions are needed to craft the recommendation language more clearly.

Discussion Highlights:

- Multiple members supported the addition of language mentioning electrification or CO_2 utilization, beneficial use, geologic sequestration, etc. to the recommendation or rationale.
- One member suggested that the recommendation consider industrial processes, such as biogenic and direct air capture CO_2 storage and utilization into products.
- Another member recommended that priority be given to projects that reduce the greenhouse gas footprint through carbon capture.
- Members differed on whether to mention specific subsectors in the recommendation; some members felt that specifying subsectors could be limiting.

Voting: Not approved.

Voting results of recommendation [not numbered in the January 2025 preliminary report]. Note: Prior to voting, **Chairperson Nolen** clarified that those who vote "nay" understand that this recommendation will be further discussed by the Committee about how to address the topic in the final report.

Present (14)			Not Present (4)
Yea (2)	**Nay (12)**	**Abstention (0)**	
Dr. Sunday Abraham	Dr. Cathy Choi		Dr. Sue Clark
Dr. Abigail Regitsky	Dr. Subodh Das		Mr. Sergio Espinosa
	Ms. Elizabeth Dutrow		Dr. Arun Majumdar
	Dr. Neal Elliott		Dr. Akshay Sahni
	Ms. Anna Fendley		
	Dr. Comas Haynes		
	Ms. Sharon Nolen		
	Dr. Joe Powell		
	Mr. Jeffrey Rissman		
	Dr. Sridhar Seetharaman		
	Ms. Jolene Sheil		
	Ms. Sasha Stashwick		

Non-CO_2 Greenhouse Gases

Recommendation 11

DOE should support technologies that cut industrial sources of nitrous oxide (N_2O) emissions, primarily nitric and adipic acid manufacturing, such as through thermal or catalytic decomposition of the N_2O. Similarly, DOE should support research and commercialization of climate-safe alternatives to common fluorinated gases (F-gases) used today as refrigerants, propellants, and electrical insulators, including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Hydrofluoroolefins (HFOs) are one possible option that would benefit from RDD&D to achieve cost reductions.

Discussion: None

Vote: Approved

Voting results for Recommendation 11:

Present (14)			Not Present (4)
Yea (14)	**Nay (0)**	**Abstention (0)**	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Industrial Subsectors Recommendations

Members noted that recommendations for some subsectors (e.g., aluminum, controlled environment agriculture, data centers) were not included in the draft report due to time constraints, but the Committee will discuss these subsectors for consideration in the full report.

Chemicals

Recommendation 12

DOE should establish a center of excellence for chemicals technology development and scale-up. The center of excellence may use digital and physical techniques to enable scale-up of complex multiphase reaction and separation systems with faster and more efficient solutions for the industry. It should also address polluting or harmful chemicals (e.g., per- and polyfluoroalkyl substances (PFAS), bisphenols, phthalates, brominated flame retardants, dioxins). Additionally, DOE should continue and expand work with the American Institute of Chemical Engineers (AIChE) Rapid Advancement in Process Intensification Deployment (RAPID) Institute and the Electrified Processes for Industry without Carbon (EPIXC) Institute to solve design challenges in scaling up chemicals industry process equipment that makes use of low-cost electricity. To date, the industry has not commercialized electrified reactors and separation equipment at scales exceeding 10 megawatts, which are needed for economic scale-up.

Discussion Highlights:

This recommendation reflects modifications made during the meeting in response to member feedback to be less prescriptive on specific technologies or techniques, while enabling industry to use more techniques to advance innovation through partnership and collaboration with DOE.

Vote: Approved

Voting results for Recommendation 12:

Present (14)			Not Present (4)
Yea (13)	**Nay (0)**	**Abstention (1)**	
Dr. Sunday Abraham		Dr. Sridhar Seetharaman	Dr. Sue Clark
Dr. Cathy Choi			Mr. Sergio Espinosa
Dr. Subodh Das			Dr. Arun Majumdar
Ms. Elizabeth Dutrow			Dr. Akshay Sahni
Dr. Neal Elliott			
Ms. Anna Fendley			
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Cement and Concrete

Recommendation 13

DOE should support the design and scale-up of technologies that increase the efficiency of cement plants and increase the purity of the CO_2 streams they produce, facilitating carbon capture. For example, electrified calciners allow more efficient use of energy (including variable renewable energy) while also producing pure CO_2 streams from limestone calcination. Oxy-firing of natural gas is another approach that enables more efficient CO_2 capture from concentrated streams.

Discussion Highlights:

The recommendation was modified slightly to characterize the specific technologies as examples, rather than the only technologies that should be considered.

Vote: Approved

Voting results for Recommendation 13:

Present (12)			Not Present (6)
Yea (12)	**Nay (0)**	**Abstention (0)**	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Ms. Elizabeth Dutrow
Dr. Subodh Das			Mr. Sergio Espinosa
Dr. Neal Elliott			Dr. Arun Majumdar
Ms. Anna Fendley			Dr. Akshay Sahni
Dr. Comas Haynes			Ms. Sasha Stashwick
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			

Iron and Steel

Recommendation 14

DOE should continue and expand its support for the following key approaches that hold promise for producing clean primary iron and steel: (1) technologies to reduce the cost of hydrogen – direct reduced iron (H_2-DRI) steelmaking, including the production of electrolytic H_2 and the energy efficiency, capital costs, and maintenance costs of H_2-DRI technology; (2) iron ore beneficiation (increasing the ore's iron content) and smelting to process lower-grade ores for use in DRI steelmaking; (3) molten oxide electrolysis of iron ore; (4) aqueous electrolysis of iron ore. Since these routes require electricity, DOE should conduct a study to map out and evaluate the economic viability of different solutions to meet the need for clean electricity 24/7 for the steel industry. The study should consider how grid electricity and on-site distributed energy (including a mixture of renewables and nuclear) could be optimally integrated with steel plants.

Discussion Highlights:

- The Committee plans to consider making a separate recommendation on secondary steel. Some members highlighted the U.S. steel industry's reliance on scrap and the need for better scrap utilization and sortation. Scrap can be considered secondary steel.
- Carbon capture is also a priority in the steel industry, and the Committee will continue discussing it as a recommendation of a cross-cutting technology and opportunity in the final report.

Vote: Approved

Voting results for Recommendation 14:

Present (11)			Not Present (7)
Yea (11)	**Nay (0)**	**Abstention (0)**	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Dr. Subodh Das
Dr. Neal Elliott			Ms. Elizabeth Dutrow
Ms. Anna Fendley			Mr. Sergio Espinosa
Dr. Comas Haynes			Dr. Arun Majumdar
Ms. Sharon Nolen			Dr. Akshay Sahni
Dr. Joe Powell			Ms. Sasha Stashwick
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			

Pulp and Paper

Recommendation 15

DOE should provide RDD&D assistance for companies to demonstrate how renewable energy can be incorporated into large-scale pulp and paper operations without adversely impacting costs and safety, focusing on technologies related to energy efficiency, electrification, thermal energy storage, and use of hydrogen. DOE should also facilitate the sharing of best practices across research partners and private firms.

Discussion: None

Vote: Approved

Voting results for Recommendation 15:

Present (11)			Not Present (7)
Yea (11)	**Nay (0)**	**Abstention (0)**	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Dr. Subodh Das
Dr. Neal Elliott			Ms. Elizabeth Dutrow
Ms. Anna Fendley			Mr. Sergio Espinosa
Dr. Comas Haynes			Dr. Arun Majumdar
Ms. Sharon Nolen			Dr. Akshay Sahni
Dr. Joe Powell			Ms. Sasha Stashwick
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			

Food and Beverage

Recommendation 16

DOE should work with partners including the RAPID Institute, the EPIXC Institute, and the Clean Energy Smart Manufacturing Innovation Institute (CESMII) to optimize direct electrical (non-steam) heating vs. use of traditional steam heat. This can reduce energy usage and costs but can affect food and beverage product quality due to changes in heat transfer rates and mechanisms

Discussion Highlights:

This recommendation was modified to reflect all relevant institutes.

Vote: Approved

Voting results for Recommendation 16:

Present (11)			Not Present (7)
Yea (10)	**Nay (0)**	**Abstention (1)**	
Dr. Sunday Abraham		Dr. Sridhar Seetharaman	Dr. Sue Clark
Dr. Cathy Choi			Dr. Subodh Das
Dr. Neal Elliott			Ms. Elizabeth Dutrow
Ms. Anna Fendley			Mr. Sergio Espinosa
Dr. Comas Haynes			Dr. Arun Majumdar
Ms. Sharon Nolen			Dr. Akshay Sahni
Dr. Joe Powell			Ms. Sasha Stashwick
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Ms. Jolene Sheil			

Overcoming Barriers Recommendations

Offtake of Cleanly-Produced Products

Recommendation 17

DOE should research specifications and standards for clean goods and materials in coordination with other federal agencies, participate fully in ongoing multilateral and multi-stakeholder efforts to align standards and methodologies related to the emissions intensity of production, and work with both producers and consumers to facilitate long-term offtake agreements for the purchase of clean goods. DOE should help industrial facilities develop clean hydrogen and zero-emission electricity and heat offtake agreements (by convening stakeholders, producing model agreements, etc.), perhaps supported by guaranteed offtake prices for clean heat as a service (e.g., via a contract for difference). DOE itself can also procure clean goods and energy, aligning these efforts with existing procurement programs across governments (e.g., the Federal Buy Clean Initiative, the Clean Energy Ministerial Industrial Deep Decarbonisation Initiative) and the private sector (e.g., the First Movers Coalition). For example, DOE should expand the Hydrogen Demand Initiative (H_2DI) to include other clean commodities, such as steel, cement/concrete, and chemicals.

Discussion Highlights:

This modification reflects minor edits for clarification.

Vote: Approved

Voting results for Recommendation 17:

Present (11)			Not Present (7)
Yea (11)	**Nay (0)**	**Abstention (0)**	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Dr. Subodh Das
Dr. Neal Elliott			Ms. Elizabeth Dutrow
Ms. Anna Fendley			Mr. Sergio Espinosa
Dr. Comas Haynes			Dr. Arun Majumdar
Ms. Sharon Nolen			Dr. Akshay Sahni
Dr. Joe Powell			Ms. Sasha Stashwick
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			

Electric Grid

Recommendation 18

DOE should work with Congress and leaders at the Federal Energy Regulatory Commission (FERC) to support reforms to electricity market rules at the state, regional, or federal level that allow flexible electrified technologies to access location- and time-specific electricity pricing available in wholesale markets.

Discussion: None

Vote: Approved

Voting results for Recommendation 18:

Present (11)			Not Present (7)
Yea (11)	Nay (0)	Abstention (0)	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Dr. Subodh Das
Dr. Neal Elliott			Ms. Elizabeth Dutrow
Ms. Anna Fendley			Mr. Sergio Espinosa
Dr. Comas Haynes			Dr. Arun Majumdar
Ms. Sharon Nolen			Dr. Akshay Sahni
Dr. Joe Powell			Ms. Sasha Stashwick
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			

Recommendation 19

DOE should conduct a study on the electric grid infrastructure and upgrades needed for industrial electrification (as well as other sources of demand, such as electric vehicles and data centers) that can serve as a resource to utilities, utility regulators, and industrial firms.

Discussion: None

Vote: Approved

Voting results for Recommendation 19:

Present (11)			Not Present (7)
Yea (11)	Nay (0)	Abstention (0)	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Dr. Subodh Das
Dr. Neal Elliott			Ms. Elizabeth Dutrow
Ms. Anna Fendley			Mr. Sergio Espinosa
Dr. Comas Haynes			Dr. Arun Majumdar
Ms. Sharon Nolen			Dr. Akshay Sahni
Dr. Joe Powell			Ms. Sasha Stashwick
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			

Recommendation 20

DOE should expand its efforts to facilitate expansion of high-voltage transmission as well as reconductoring of existing lines. DOE's efforts should include working with relevant agencies to streamline environmental review and permitting processes for transmission lines and exploring ways to streamline interconnection queue processes to facilitate rapid construction of clean generation that can be used for industrial facilities. DOE should also work to improve permitting of behind-the-meter electricity capacity upgrades at industrial facilities.

Discussion Highlights:

This recommendation was modified to reflect a suggestion for improved permitting of behind-the-meter electricity capacity upgrades at industrial facilities.

Vote: Approved

Voting results for Recommendation 20:

Present (12)			Not Present (6)
Yea (12)	Nay (0)	Abstention (0)	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Dr. Subodh Das
Dr. Neal Elliott			Ms. Elizabeth Dutrow
Ms. Anna Fendley			Mr. Sergio Espinosa
Dr. Comas Haynes			Dr. Arun Majumdar
Ms. Sharon Nolen			Dr. Akshay Sahni
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Recommendation 21

DOE should direct its electricity- and industry-related programs, national laboratories, and manufacturing institutes to pursue research, demonstration, and education about opportunities to optimize timing and utilization of electricity at industrial facilities. DOE should simultaneously encourage utilities and their regulators to implement smart grid technologies that can co-optimize generation and grid operations with these large customers to increase utilization of existing generation, transmission, and distribution assets, reducing the need for grid investments.

Discussion: None

Vote: Approved

Voting results for Recommendation 21:

Present (12)			Not Present (6)
Yea (12)	Nay (0)	Abstention (0)	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Dr. Subodh Das
Dr. Neal Elliott			Ms. Elizabeth Dutrow
Ms. Anna Fendley			Mr. Sergio Espinosa
Dr. Comas Haynes			Dr. Arun Majumdar
Ms. Sharon Nolen			Dr. Akshay Sahni
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Recommendation 22

DOE should support commercialization and deployment of clean firm generation (e.g., advanced nuclear, geothermal, fusion, long duration energy storage) at or co-located with industrial sites as an option to meet industries' increasing energy demands with clean, reliable power and/or heat. This should include focusing existing LPO financing tools on deploying clean firm generation at industrial sites (new and retrofit) and exploring implications of co-located or behind-the-meter clean generation solutions for grid reliability and pricing for other electricity buyers.

Discussion Highlights:

This recommendation was modified to reflect editorial suggestions from members.

Vote: Approved

Voting results for Recommendation 22:

Present (12)			Not Present (6)
Yea (12)	**Nay (0)**	**Abstention (0)**	
Dr. Sunday Abraham			Dr. Sue Clark
Dr. Cathy Choi			Dr. Subodh Das
Dr. Neal Elliott			Ms. Elizabeth Dutrow
Ms. Anna Fendley			Mr. Sergio Espinosa
Dr. Comas Haynes			Dr. Arun Majumdar
Ms. Sharon Nolen			Dr. Akshay Sahni
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Commercialization Support

Recommendation 23

ARPA-E should launch a dedicated program with funding and commercialization support for industrial technologies that could achieve large emissions reductions in the medium- to long- term, including, for example, alternative cement chemistries, alternative chemical and refinery feedstocks, and direct electrification of high-temperature heating of non-conductive materials (including electrification of cement kilns and chemical reactors). DOE should also expand the support available through its Seeding Critical Advances for Leading Energy technologies with Untapped Potential (SCALEUP) program for innovative industrial decarbonization technologies.

Discussion Highlights:

The rationale for the recommendation was revised in response to a member's comment to specify scenarios in which ARPA-E would be effective. For example, ARPA-E support would be effective when applied to technologies that have a path to commercialization but need support to overcome valleys of death, such as the examples listed in the recommendation.

Vote: Approved

Voting results for Recommendation 23:

Present (11)			Not Present (7)
Yea (11)	Nay (0)	Abstention (0)	
Dr. Cathy Choi			Dr. Sunday Abraham
Dr. Neal Elliott			Dr. Sue Clark
Ms. Anna Fendley			Dr. Subodh Das
Dr. Comas Haynes			Ms. Elizabeth Dutrow
Ms. Sharon Nolen			Mr. Sergio Espinosa
Dr. Joe Powell			Dr. Arun Majumdar
Dr. Abigail Regitsky			Dr. Akshay Sahni
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Recommendation 24

DOE should create a Fast Track program designed to help critical innovations rapidly advance along the commercialization pathway. This program should be technology-agnostic and milestone-based, provide dedicated technical and commercial support, and offer priority access to DOE resources (e.g., national laboratory facilities). The greatest gap a Fast Track program could fill at this time is pilot-scale demonstrations for key technologies moving toward commercialization.

Discussion: None

Vote: Approved

Voting results for Recommendation 24:

Present (11)			Not Present (7)
Yea (11)	Nay (0)	Abstention (0)	
Dr. Cathy Choi			Dr. Sunday Abraham
Dr. Neal Elliott			Dr. Sue Clark
Ms. Anna Fendley			Dr. Subodh Das
Dr. Comas Haynes			Ms. Elizabeth Dutrow
Ms. Sharon Nolen			Mr. Sergio Espinosa
Dr. Joe Powell			Dr. Arun Majumdar
Dr. Abigail Regitsky			Dr. Akshay Sahni
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Recommendation 25

DOE should conduct a study that identifies how to achieve successful technology adoption by companies when large-scale deployment of that technology does not yet exist and may not exist for a long time. The study should identify ways to mitigate risks posed by global events/conflicts, inflation, recessions, and other geopolitical and macroeconomic factors. The study should also review gaps in needs between innovators obtaining public-private partnerships with DOE offices working on technology deployment (including OCED, MESC, and LPO) to determine how solutions can bridge valleys of death.

Discussion Highlights:

The recommendation was modified in response to suggestions from members to focus the language on DOE deployment offices.

Vote: Approved

Voting results for Recommendation 25:

Present (11)			Not Present (7)
Yea (11)	**Nay (0)**	**Abstention (0)**	
Dr. Cathy Choi			Dr. Sunday Abraham
Dr. Neal Elliott			Dr. Sue Clark
Ms. Anna Fendley			Dr. Subodh Das
Dr. Comas Haynes			Ms. Elizabeth Dutrow
Ms. Sharon Nolen			Mr. Sergio Espinosa
Dr. Joe Powell			Dr. Arun Majumdar
Dr. Abigail Regitsky			Dr. Akshay Sahni
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Recommendation 26

DOE should more flexibly use its existing loan and funding authorities to better support industrial projects. DOE should enhance LPO's ability to finance industrial decarbonization projects by making it practical for LPO to issue smaller-value loans and broadening its investment portfolio to include innovative industrial technologies with long-term return potential to attract private investors but that cannot be supported solely by the private sector today. DOE should streamline the application process and due diligence period within LPO to reduce costs, redundancies, and burden on the applicant. DOE should consider expanding the use of flexible funding mechanisms, such as Partner Intermediary Agreements and Other Transaction Authorities, to increase market adoption for innovative solutions supporting industry and manufacturing.

Discussion: None

Vote: Approved

Voting results for Recommendation 26:

Present (11)			Not Present (7)
Yea (11)	**Nay (0)**	**Abstention (0)**	
Dr. Cathy Choi			Dr. Sunday Abraham
Dr. Neal Elliott			Dr. Sue Clark
Ms. Anna Fendley			Dr. Subodh Das
Dr. Comas Haynes			Ms. Elizabeth Dutrow
Ms. Sharon Nolen			Mr. Sergio Espinosa
Dr. Joe Powell			Dr. Arun Majumdar
Dr. Abigail Regitsky			Dr. Akshay Sahni
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			

Present (11)			Not Present (7)
Yea (11)	Nay (0)	Abstention (0)	
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Material Needs and Lifecycle Assessment

Recommendation 27

DOE should publish an assessment of the material needs to enable industrial decarbonization pathways, such as those identified in DOE's Pathways to Commercial Liftoff27 and Transformative Pathways28 reports, and the availability of those materials. The study should also discuss the emissions intensity of specific domestic and imported industrial materials using a methodology developed in cooperation with U.S. trading partners to ensure interoperability of approaches for determining emissions intensity.

Discussion: None

Vote: Approved

Voting results for Recommendation 27:

Present (11)			Not Present (7)
Yea (11)	Nay (0)	Abstention (0)	
Dr. Cathy Choi			Dr. Sunday Abraham
Dr. Neal Elliott			Dr. Sue Clark
Ms. Anna Fendley			Dr. Subodh Das
Dr. Comas Haynes			Ms. Elizabeth Dutrow
Ms. Sharon Nolen			Mr. Sergio Espinosa
Dr. Joe Powell			Dr. Arun Majumdar
Dr. Abigail Regitsky			Dr. Akshay Sahni
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Workforce and Social Considerations Recommendations

Workforce Development

Recommendation 28

DOE should increase efforts to complement existing workforce initiatives with decarbonization technical training modules (e.g., electrification technology in process heating curricula, energy efficiency practices in manufacturing technician training). This includes continued support for programs operated by MESC, such as the Industrial Training and Assessment Centers, which leverage best practices in workforce development to train participants for in-demand clean energy and manufacturing jobs by providing hands-on technical assistance to small- and medium-size manufacturers. Training should emphasize skills that are in demand by industrial firms and that support a transition to clean industrial energy sources and processes. When planning and developing training initiatives, DOE should formally partner with other agencies engaged in workforce training, particularly for skilled trades, such as the U.S. Department of Labor's apprenticeship initiatives and the U.S. Department of Commerce's workforce development initiatives around semiconductor manufacturing.

Discussion: None

Vote: Approved

Voting results for Recommendation 28:

Present (11)			Not Present (7)
Yea (10)	**Nay (0)**	**Abstention (1)**	
Dr. Cathy Choi		Dr. Comas Haynes	Dr. Sunday Abraham
Ms. Elizabeth Dutrow			Dr. Sue Clark
Dr. Neal Elliott			Dr. Subodh Das
Ms. Anna Fendley			Mr. Sergio Espinosa
Ms. Sharon Nolen			Dr. Arun Majumdar
Dr. Joe Powell			Dr. Akshay Sahni
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Community and Workforce Engagement

Recommendation 29

DOE should understand the impacts of projects it funds on local workforces and other community members, including economic and health benefits and risks. DOE should continue to require companies seeking public funding to develop and implement Community Benefit Plans and to proactively address perceived or actual impacts by engaging with the local community and workforce. DOE should continue to provide tools and resources to help applicants develop Community Benefit Plans.

Discussion Highlights:

The recommendation was revised to include feedback from members to reinforce priorities on understanding and addressing the impacts on local communities.

Vote: Approved

Voting results for Recommendation 29:

Present (11)			Not Present (6)
Yea (12)	**Nay (0)**	**Abstention (0)**	
Dr. Cathy Choi			Dr. Sunday Abraham
Ms. Elizabeth Dutrow			Dr. Sue Clark
Dr. Neal Elliott			Dr. Subodh Das
Ms. Anna Fendley			Mr. Sergio Espinosa
Dr. Comas Haynes			Dr. Arun Majumdar
Ms. Sharon Nolen			Dr. Akshay Sahni
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Overall Preliminary Report Review and Voting

ITIAC Chairperson Nolen summarized the results of voting to approve 29 recommendations. The Committee also reviewed the draft preliminary report's sections for the Introduction, Recommended Publications, and Conclusion and voted on the draft preliminary report overall.

Discussion Highlights:

- No members raised questions or concerns about the Introduction section.
- In the Recommended Publications section, some members noticed that some subsectors, e.g., controlled environment agriculture, have publications included but are not discussed in depth in the recommendations so far. Committee members expressed interest in considering these subsectors for the final report and agreed to the publications included on the list.
- The Conclusion section was modified with a minor edit to indicate DOE's continued leadership in its roles to support clean industry in the United States.

Vote: Approved

Voting results for the overall preliminary draft report:

Present (13)			Not Present (5)
Yea (13)	Nay (0)	Abstention (0)	
Dr. Cathy Choi			Dr. Sunday Abraham
Dr. Subodh Das			Dr. Sue Clark
Ms. Elizabeth Dutrow			Mr. Sergio Espinosa
Dr. Neal Elliott			Dr. Arun Majumdar
Ms. Anna Fendley			Dr. Akshay Sahni
Dr. Comas Haynes			
Ms. Sharon Nolen			
Dr. Joe Powell			
Dr. Abigail Regitsky			
Mr. Jeffrey Rissman			
Dr. Sridhar Seetharaman			
Ms. Jolene Sheil			
Ms. Sasha Stashwick			

Public Comments

ITIAC DFO Pritchard stated that no public comments were submitted prior to the meeting. Members of the public may send written statements to ITIAC@ee.doe.gov.

Closing Remarks

ITIAC Chairperson Nolen summarized the results of voting to approve 29 recommendations and to approve the overall preliminary report, including its introduction, recommended publications section, and conclusion. She thanked Committee members for submitting their recommendations and spotlighted ITIAC Vice Chair Rissman's role in consolidating and organizing the recommendations.

DFO Dr. Pritchard summarized next steps for the preliminary report. Now that the draft preliminary report was adopted and approved by the Committee, the report will be sent to the Secretary of Energy and

published as an official Committee document on the ITIAC webpage. DOE IEDO will also send an email notification to its stakeholder email list.

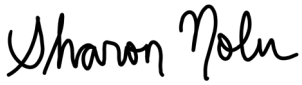
Adjournment

The fifth ITIAC meeting was adjourned at approximately 3:43 p.m. EST.

Respectfully submitted:

Zachary Pritchard
Designated Federal Officer

I hereby certify that these meeting minutes of the January 16, 2025, ITIAC meeting are true and correct to the best of my knowledge.



Sharon Nolen
Chairperson, Industrial Technology Innovation Advisory Committee