U.S. DEPARTMENT of ENERGY | Office of Critical Minerals and Energy Innovation

Powering American Industry: Strategic Priorities from DOE's Industrial Technologies Office

Industrial Process Emerging Technologies (IPER) Workshop

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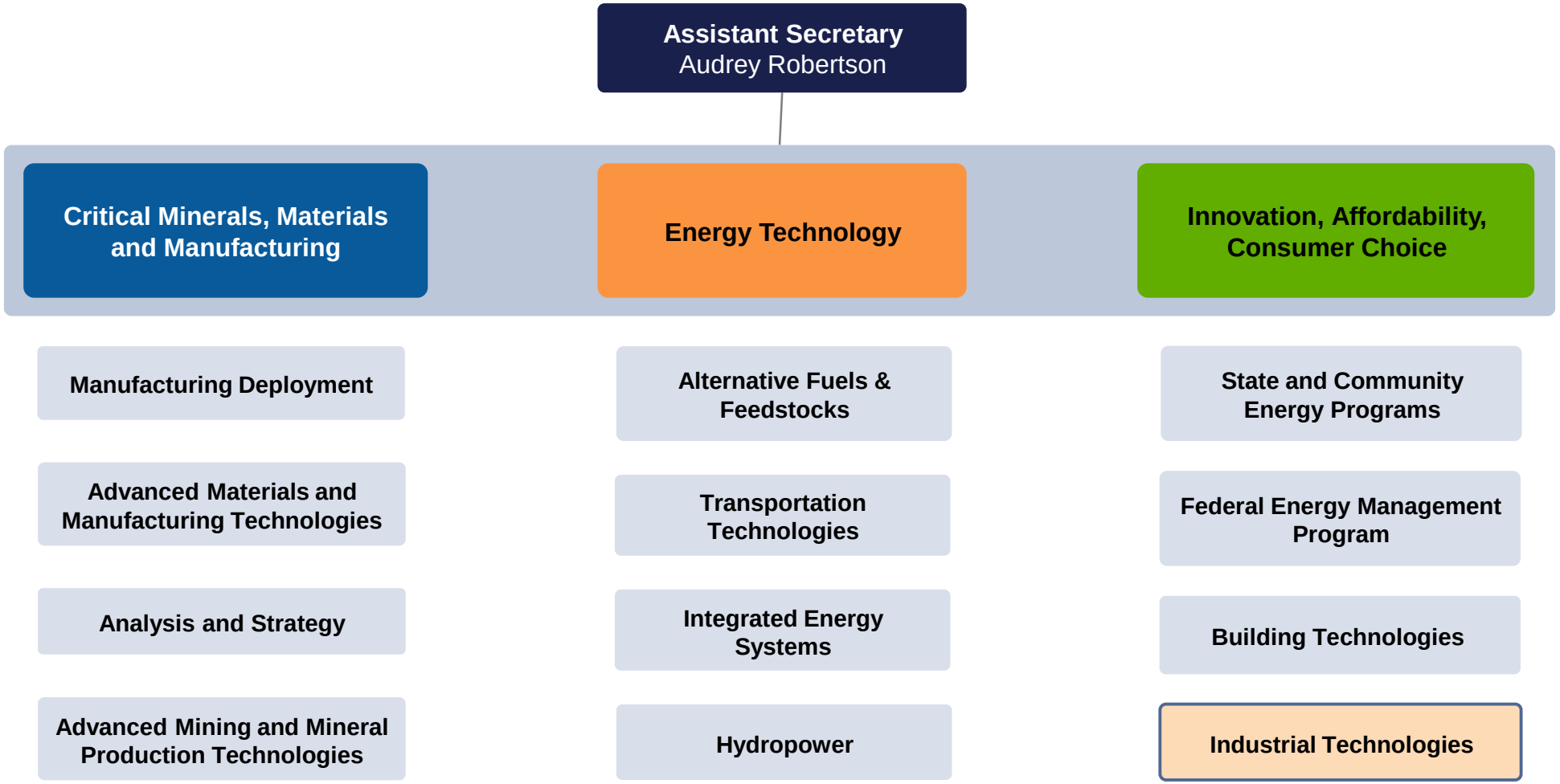


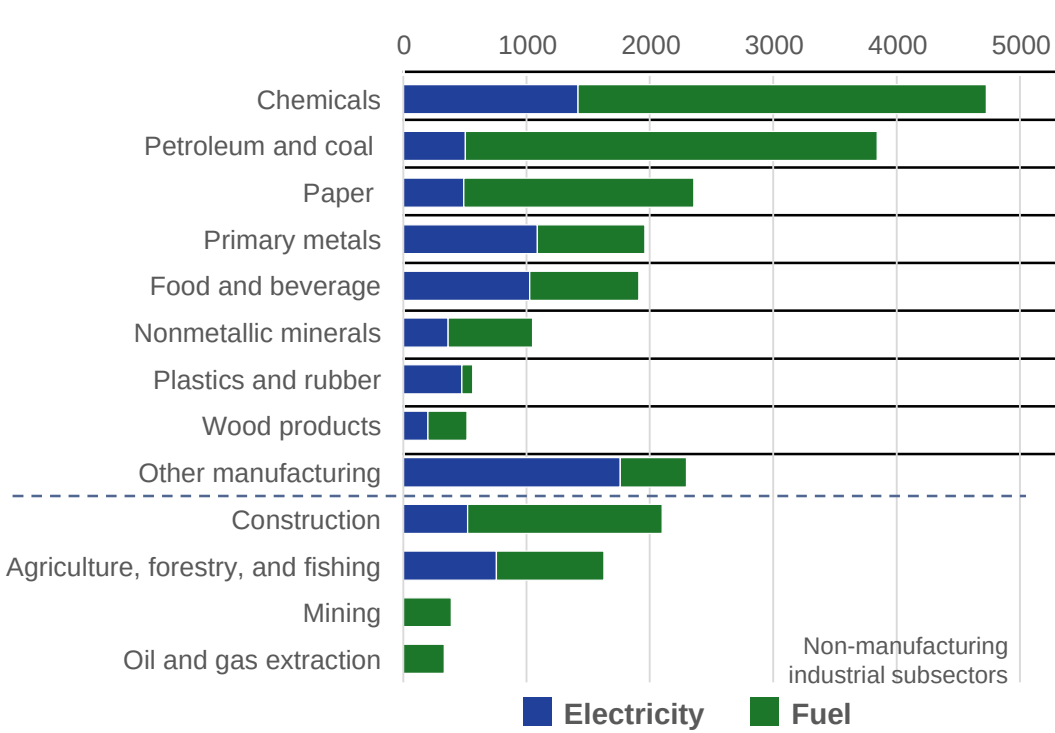
U.S. Industrial Sector: 27% of Total Energy Demand

CONTRIBUTES
$4.8 trillion to the U.S. economy annually [1]

CREATES
21.6 million jobs [2]

BOLSTERS
U.S. competitiveness in global markets

U.S. PRIMARY ENERGY CONSUMPTION, TRILLION BTU, 2021



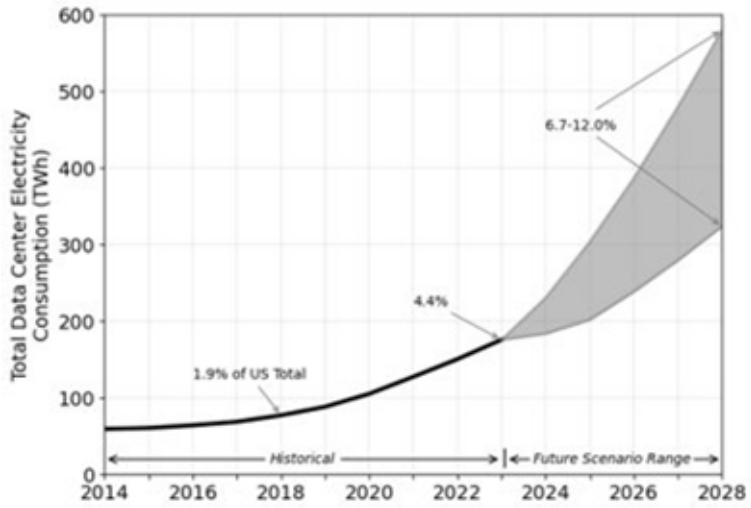
	Economic Value (2021, $ billion)	Employees (2021)
Chemicals	832.3	778,136
Petroleum and coal	610.3	100,428
Paper	198.3	330,425
Primary metals	280.8	317,946
Food and beverage	1,070.1	1,733,465
Nonmetallic minerals	144.2	384,716
Plastics and rubber	273.3	773,438
Wood products	154.8	398,867
Other manufacturing	2,515.5	6,388,556

Excludes feedstock (non-fuel) energy consumption. Energy data compiled from multiple EIA sources including Monthly Energy Review and Manufacturing Energy Consumption Survey; economic value and employee data from U.S. Census Bureau Annual Survey of Manufacturers, values for 2021.

Sources:
[1] Data for 2024 from Bureau of Economic Analysis Industry Economic Accounts Data, Value Added by Industry (sum of agriculture, forestry, fishing, and hunting; mining; construction; and manufacturing). Accessed October 2025.
[2] Data for May 2024 from U.S. Bureau of Labor Statistics, Occupational Employment and Wage Statistics [sum of NAICS sectors 11 (agriculture), 21 (mining), 23 (construction), and 31-33 (manufacturing)].
[3] National Association of Manufacturers. Facts About Manufacturing.

Growing Industrial Energy Demand:

U.S. Data Centers



Source: LBNL United States Data Center Energy Usage Report, 2024, https://doi.org/10.71468/P1WC7Q.

Electricity Use Estimates:

- Data centers consumed about 4.4% of total U.S. electricity in 2023
- Data center energy consumption is expected to consume approximately 6.7 to 12% of total U.S. electricity by 2028
- TOTAL U.S. Industrial electricity demand projected by EIA to increase between 3% and 38% by 2050

Data Center Electricity Use Over Time:

- **2014**: 58 TWh
- **2023**: 176 TWh
- **2028**: estimate: 325 to 580 TWh
- TOTAL 2022 U.S. Industrial Sector demand:
- ~1,025 TWh

ITO Activities Supporting Data Center Development:

Cross-Sector Technology R&D

- **Thermal Management:** immersion cooling systems; waste heat recovery and utilization
- **Energy Systems Integration:** combined cooling, heating, and power (CCHP); energy storage systems

Center of Expertise for Energy Efficiency in Data Centers (@ LBNL)

- Market analysis, tools, training, and technical expertise in efficient energy management

Onsite Energy Program

- Technical assistance, market analysis, and best practices to help industrial facilities, data centers, and other large energy users increase the adoption of onsite energy technologies

ITO's Mission

The U.S. Department of Energy's Industrial Technologies Office (ITO) accelerates the innovation and adoption of cost-effective technologies that position American industry to lead on the competitive stage in evolving domestic and global markets

Priorities

Strengthen the global competitiveness of the U.S. industrial sector by reducing costs and improving product value

Improve the reliability and security of American energy infrastructure by increasing the flexibility and responsiveness of industrial sector demand

Enable energy abundance and industrial growth by reducing the energy intensity of industrial processes and facilities

Secure American supply chains through technical innovation to onshore industrial excellence and ensure domestic availability of critical products

Technology Development Strategy

Energy-Intensive Industries

CHEMICALS: 22%
of U.S. Industrial Sector Energy Demand

FOOD & BEVERAGE: 10%

IRON & STEEL: 8%

FOREST PRODUCTS: 15%

CEMENT & CONCRETE: 2%

PETROLEUM REFINING: 19%

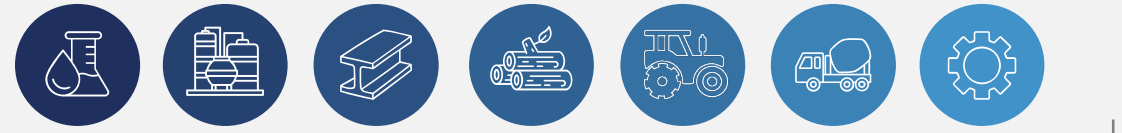
Support sector-specific R&D of industrial processes, materials, and products to accelerate innovative technologies for competitiveness and security of U.S. industrial supply chains in rapidly changing global markets

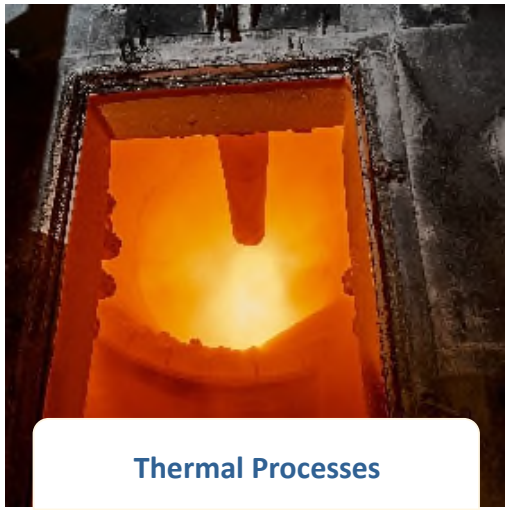
- Energy impact through full value chains
- Cost-effectiveness and competitive advantage for U.S. manufacturing
- Funding to de-risk technologies too risky for industry to fund themselves
- DOE vetting enables follow-on funding (VC, etc.)

Energy data compiled from multiple EIA sources including Monthly Energy Review and Manufacturing Energy Consumption Survey.

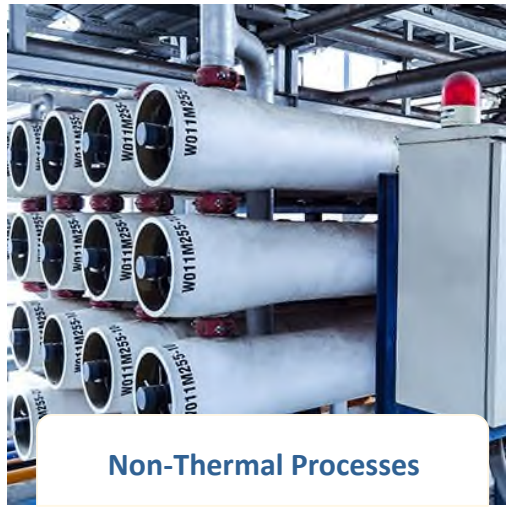
Technology Development Strategy

Cross-Sector Technologies





Thermal Processes



Non-Thermal Processes

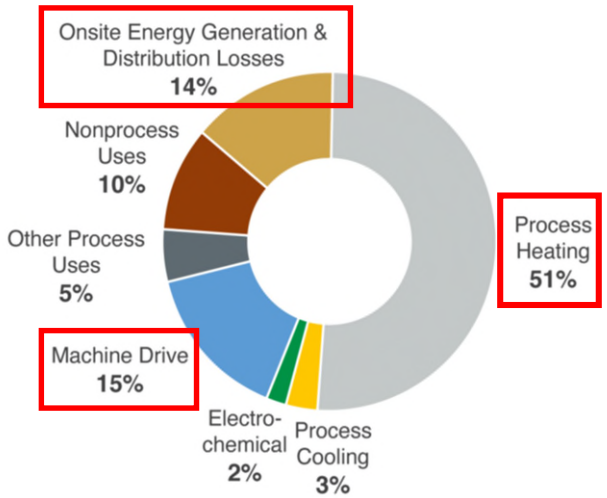
Grid Integration

Water-Energy Nexus

Cross-Sector Technologies R&D Drivers

Three process types account for 80% of onsite industrial energy consumption

- >7% of all energy use in the U.S. goes to industrial process heating; ~37% of that energy is lost as waste heat
- R&D focuses on technology development for the utilization of **innovative fuels and energy sources** for industrial processes and improved efficiency of non-thermal processes

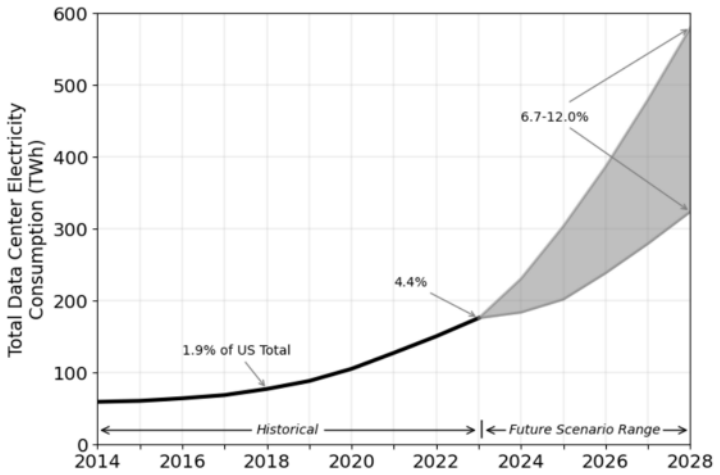


[1]Excludes non-fuel energy consumption

Source: Manufacturing Energy and Carbon Footprints, 2022

Addressing industrial load growth that will stress energy infrastructure is driven in the near-term by data centers

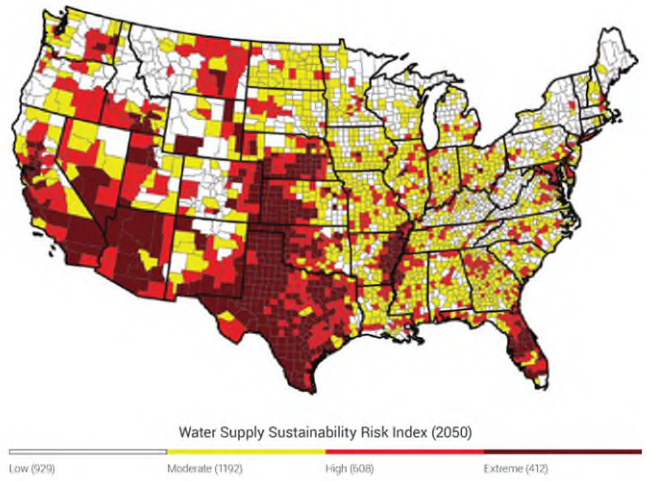
- Industrial **load integration for increased flexibility** with the grid including development of controls systems, energy storage (thermal and electrical)
- Includes a focus on data & analysis to advance understanding of industrial loads to allow sophisticated modeling



Source: LBNL US Data Center Energy Usage Report, 2024

Water stress is expanding, potentially increasing energy intensity of treatment

- Increasing **efficiency of wastewater treatment facilities**
- Ensuring a **secure supply of water resources** through developing technologies to utilize non-traditional water sources



Source: NRDC, Tetra Tech, 2010.

Strategies for Innovation in Process Heating

Alternative Sources of Heat

Strategy:
Strengthen manufacturing resilience by developing strategic options for process heating

Examples:
Geothermal, nuclear, hydrogen-natural gas blends, solar thermal, bio-based fuels, etc.

Electrotechnologies For Industrial Heating

Strategy:
Boost efficiency, productivity, and flexibility of thermal processes with electricity/hybrid inputs

Examples:
Resistive heating, high-efficiency process heating systems, microwave heating, induction heating, etc.

Low Thermal Budget Technologies

Strategy:
Develop new chemistries, processes, and technologies that can reduce heat demand

Examples:
Advanced separations, bio-based manufacturing, electrolysis, ultraviolet curing, etc.

Enabling technologies and systems: thermal energy storage, heat exchangers, materials, modeling/analytics, etc.

Technology Acceleration Strategy

Technical Assistance and Workforce Development

Public /private partnerships

to help manufacturers and industrial organizations set and achieve long-term energy intensity reduction goals

No-cost tools and resources

for manufacturers to improve efficiency and competitiveness

End-user support

to help manufacturers and industrial organizations set and achieve long-term energy intensity reduction goals

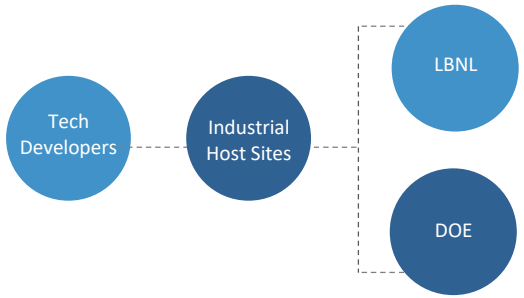
Education & training

for the current and future manufacturing workforce

ITV: Industrial Technology Validation

Awards of up to $400,000 to support technology developers and host sites in the assessment of emerging technologies that benefit operations, optimize performance, and improve competitiveness in the industrial sector.

ITV acts as a matchmaking and funding apparatus connecting technology developers and industrial host sites with Lawrence Berkeley National Lab (LBNL) and DOE to evaluate technologies under real-world operational conditions.



Program Details:

Technology developers provide the equipment or technology to be validated

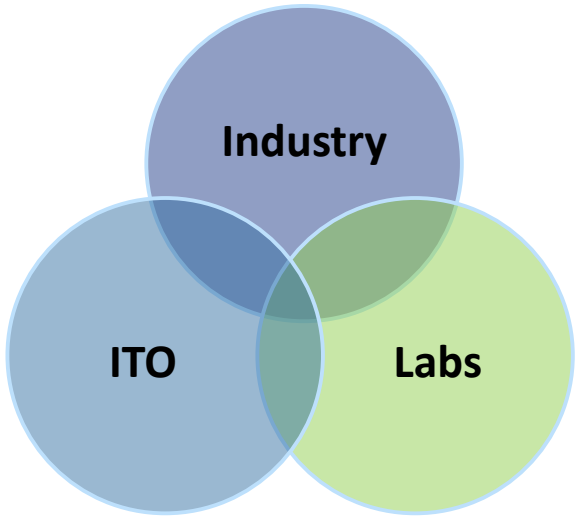
Host sites provide the facility where the installation will occur, manage the installation, and provide performance data from both the existing baseline system and the newly installed technology

Host sites and technology developers seeking project partners can provide their contact information on a public teaming partner list, accessible here

LBNL analyzes the data and produces a publicly available measurement and verification (M&V) report summarizing the technology's performance

Solicitation closed on January 29, selections anticipated in Spring 2026

ITO Lab Call



Lab Call Objectives	ITO Strategic Goals
1. Convene private-sector stakeholders, including technology developers, end-users, and trade groups	1. Unlock private capital and follow-on funding
2. Provide expedited, cost-effective access for industry and small businesses	2. Accelerate business formation and growth
3. Create tools and resources for industrial sites and workforce training	3. Create jobs in future-focused industries
4. Active participation of industry as partners, advisors, and users	4. Strengthen U.S. key sector competitiveness

16 Projects with a multi-year funding commitment of **$155 million** to expand lab capabilities that will drive process and technological innovation, reduce costs, and increase prosperity for American workers and consumers.

ITO Lab Call

7 Energy-Intensive Industry Projects

Oak Ridge National Laboratory	Center for Advanced Cement and Concrete Technologies
Lawrence Berkeley National Laboratory	The Food & Beverage Operational Optimization and Deployment Center (FOOD Center)
Lawrence Livermore National Laboratory	Solutions Center for Commercial Advancement of Large-scale Electrochemistry
Pacific Northwest National Laboratory	Advanced Catalytic Reactor Innovation for Scaleup (ACRIS) Center
Oak Ridge National Laboratory	Center for Research and Advancement of Forest Product Technologies
Idaho National Laboratory	National Library for Iron Ore and Scrap
National Laboratory of the Rockies	Incubator for Critical Steel Technologies: Tramp Element Removal Innovation (TERI)

9 Cross Sector Technologies Projects

Oak Ridge National Laboratory	Modular Testbed for High-Efficiency Thermomagnetic Processing
Oak Ridge National Laboratory	Center of Excellence for High-Efficiency Process Heating Systems
National Energy Technology Laboratory	Burner Laboratories to Advance Fuel UtiliZation for Thermal Energy (BLAZE)
National Laboratory of the Rockies	MEMBRANE Center
Sandia National Laboratories	Thermal Energy Storage Testbed (TESBed)
Lawrence Berkeley National Laboratory	Resource-secure Energy Flexibility (REFLEX): Powering a competitive future for U.S. Industry
Lawrence Livermore National Laboratory	Center for Industrial Modeling and Simulation (CIMS)
Lawrence Berkeley National Laboratory	Data Center Cooling Collaborative
Idaho National Laboratory	Testbed for Industrial and Manufacturing Users of Power and Heat (TRIUMPH)

Topic 1: Next Generation Cement and Concrete Materials

Center for Advanced Cement and Concrete Technologies

Description

The Center of Excellence for Advancement & Acceleration of Cement & Concrete Engineering Technologies. ACCENT is designed to **accelerate the development and adoption of next-generation cement and concrete** materials. It will engage industrial, academic, and workforce stakeholders through a **nationwide, rapid user-access model**. This integrated approach aims to accelerate industry innovation, support workforce development, and translate research into market-ready solutions for the cement and concrete industry, positioning the U.S. to reduce reliance on imported material as feedstock for the domestic construction industry.

Funding Amount
$20,000,000

Project Lead
Oak Ridge National Laboratory

Potential Impact:

- Uncover strong structure x properties correlations, establish new benchmarks and standards, develop a comprehensive database and modeling platform,
- Strengthen the workforce
- Position the U.S. to capture a major share of the $250B advanced construction market by 2033.
- Reduce cement imports, making the U.S. a global leader in construction solutions

Topic 11: Capabilities for Industrial Load Flexibility

Resource-secure Energy Flexibility (REFLEX): Powering a competitive future for U.S. Industry

Description

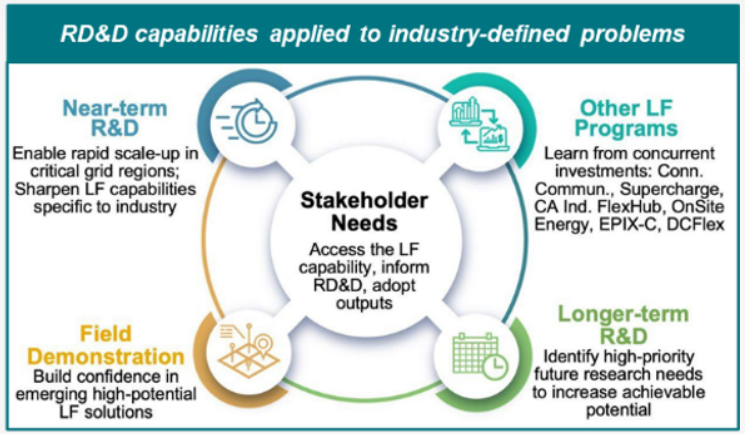
Resource-secure Energy Flexibility (REFLEX) will feature real-world load flexibility demonstration projects in multiple applications including data centers, food distribution, automotive manufacturing, and municipal water treatment, complemented by analysis of market potential and business case support tools. To enhance their capabilities, LBNL will engage a strong network of partners, including utilities, state and local stakeholders, technology and service providers, and industry.

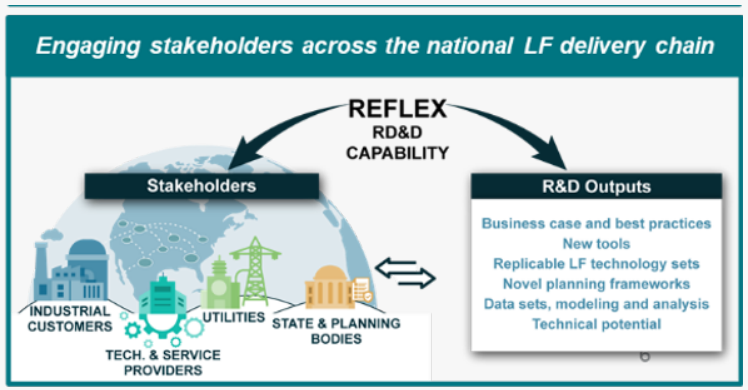
Funding Amount
$12,000,000

Project Lead
Lawrence Berkley National Lab

Potential Impact:

- 10 GW, 2.5x increase in nationally delivered LF within 5 years
- 3x increase in program participation via new programs and improved customer value
- 15% increase in program realization via new technology and increased automation





ITO Key Takeaways

ITO's programs offer opportunities to:

Improve the global competitiveness of foundational U.S. commodities through technology modernization

Improve the flexibility and reliability of industrial energy demand on both electricity and fuel infrastructure

Create new opportunities for U.S. business success through the development of new industrial processes

Advance energy affordability and reliability through innovation in efficiency for process technologies and facility-level integration

Thank you!

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Cross-sector Technologies Program Manager



Anne Hampson
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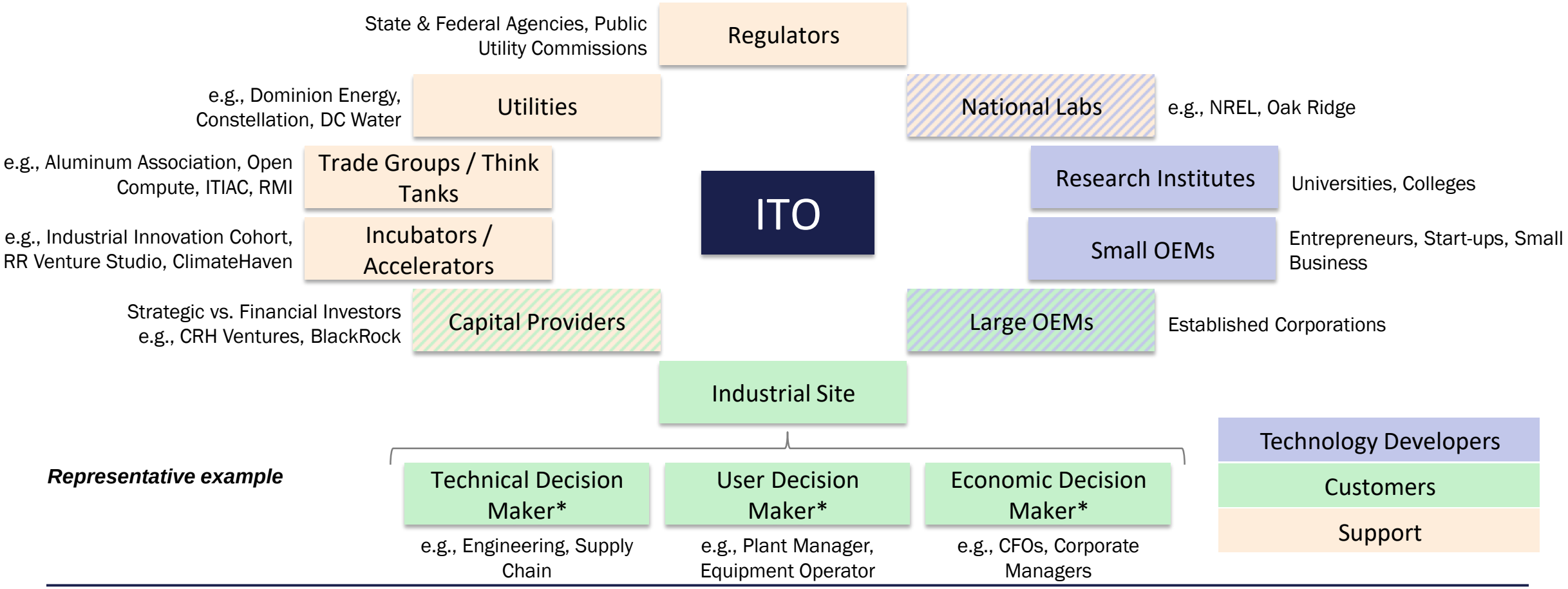
ITO's strategy is centered on engaging the *entire* industrial ecosystem.



Representative example

*Terminology is from the Miller Heiman Strategic Selling Process

Industry Sector Approach to Technology Development

ITO strategy transcends the plant boundaries, developing technologies that present meaningful market opportunities, including the impact of full supply chain and life cycle considerations