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

HPC for Industrial Technologies

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Industrial Technologies Office

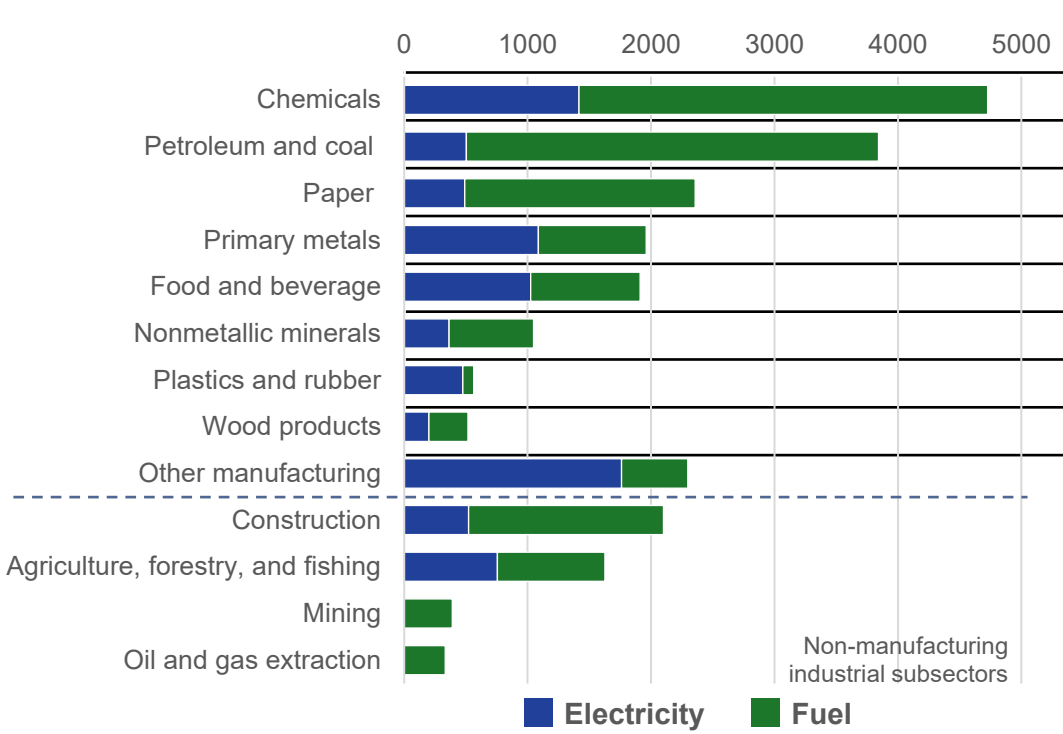
U.S. Industrial Sector: 27% of Total Energy Demand

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, 2018



	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

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 Manufactures, values for 2021.

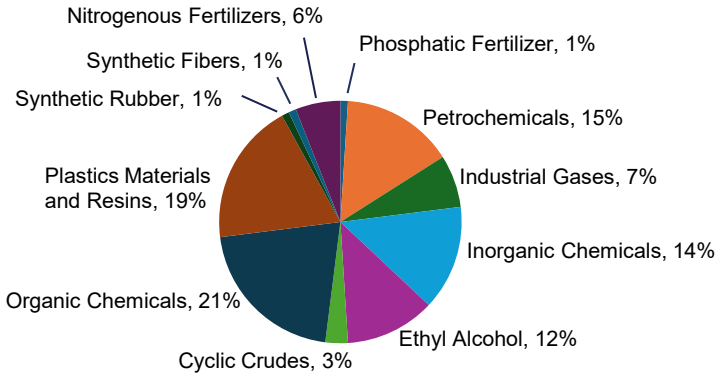
Sources:
[1] Data for 2024 from Bureau of Economic Analysis Industry Economic Accounts Data, Value Added by Industry (sum of agriculture, forestry, fishing, and hunting; mining; construction; and manufacturing). Accessed October 2025.
[2] Data for May 2024 from U.S. Bureau of Labor Statistics, Occupational 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.

Challenge of Industrial Sector: No “Silver Bullet” Solutions for Industry

- Large variations in products and processes
- Wide distribution in process heat demands
- Energy needed for many uses

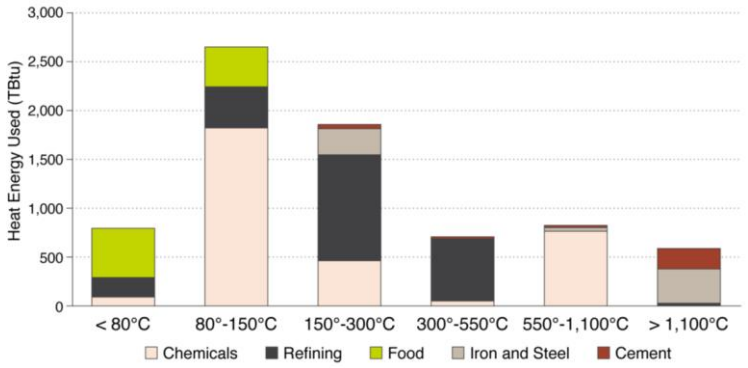
Products

U.S. Chemical Industry Primary Energy Use by NAICS Class



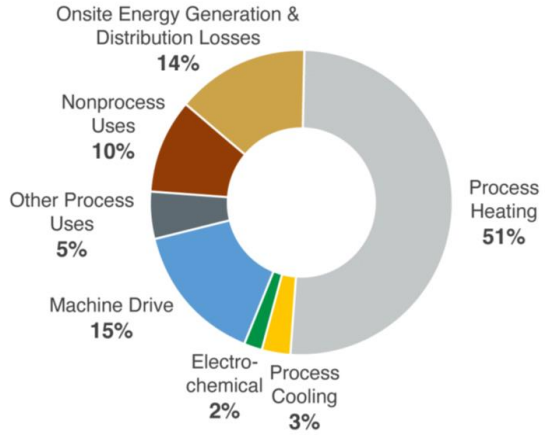
2018 Manufacturing Energy and Carbon (MECS) Primary Energy Use. Excludes Pharmaceuticals & Medicines (NAICS 3254)

Distribution of Process Heat by Temperature



Distribution of process heat by U.S. manufacturing subsector and temperature range (2014). Data source: https://dx.doi.org/10.7799/1570008.

Onsite Energy Use



Onsite energy use at U.S. manufacturing facilities (2018). Data source: Manufacturing Energy Footprint: All Manufacturing

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

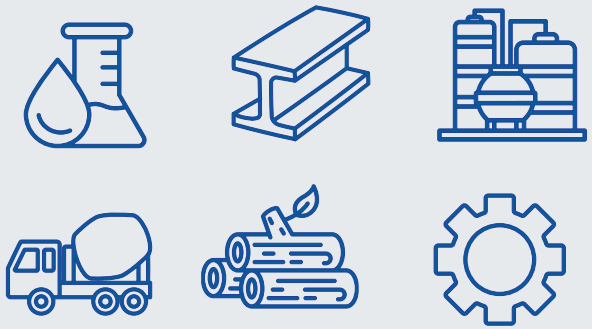
Enable energy abundance and industrial growth by reducing the energy intensity of industrial processes and facilities

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

ITO Program Structure

Energy Intensive Industries

Sector specific R&D of industrial processes, materials, and products



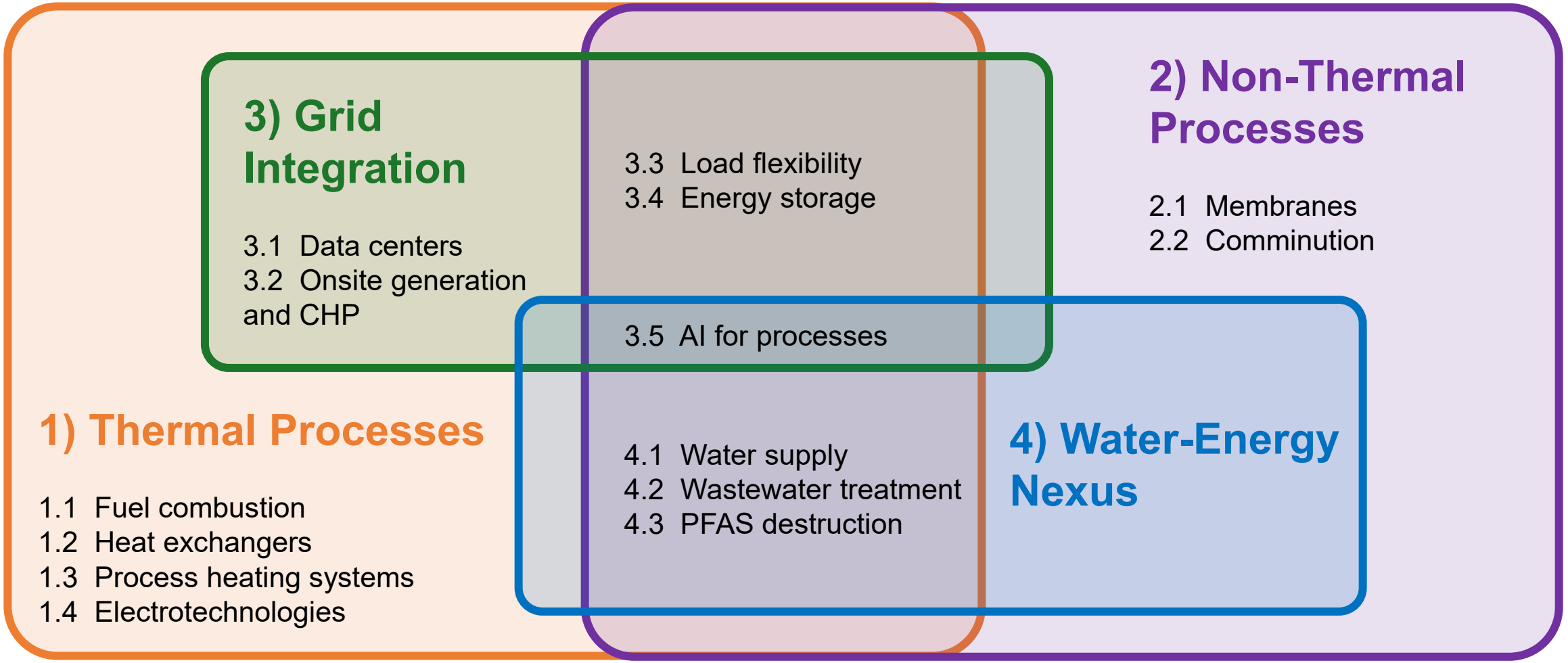
Cross-Sector Technologies

R&D in component, system, and process technologies that address challenges common across multiple industrial subsectors

Technical Assistance and Workforce Development

Accelerating technology adoption through technical assistance, partnerships, and workforce development.

Cross-Sector Technologies (CST) Program Structure



Crosscutting Activities, including HPC

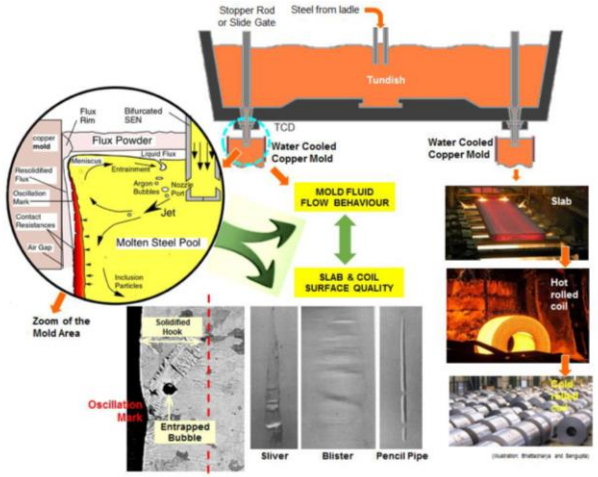
Emerging Technologies

HPC Highlights

ITO Awards $1.2M for HPC Projects from Spring 2024 solicitation:

ArcelorMittal

Real-time defect prediction and control in continuous casting of steel slabs via AI and HPC to improve productivity and reduce production costs and waste.

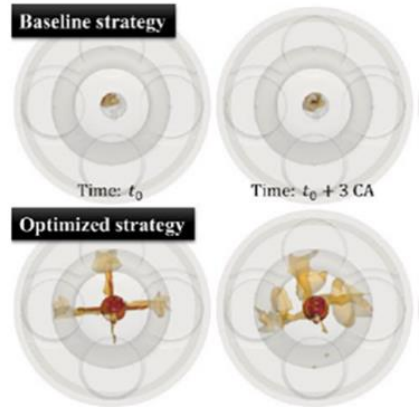


Various Past Project Successes:

M2X

Argonne NATIONAL LABORATORY

Expanding the stable operating range of a combustion system by optimizing its design and operating conditions through digital twinning and HPC to efficiently and reliably convert wellhead gas into valuable products, supporting domestic energy production and energy exports.



ITO Collaborations for Industrial Computing

Center for Industrial Modeling and Simulation – *ITO*
Direct engagement with key industrial sectors to identify high-impact applications and gaps in national lab capabilities/resources

RD&D Solicitations – *ITO*
Modeling & simulation as part of technology/process development

HPC4Mfg – *ITO & AMMTO*
National lab-industry partnerships using HPC expertise and resources to advance high-impact technologies

Office of Advanced Scientific Computing – *SC*
Fundamental algorithm and code development for HPC and AI/ML

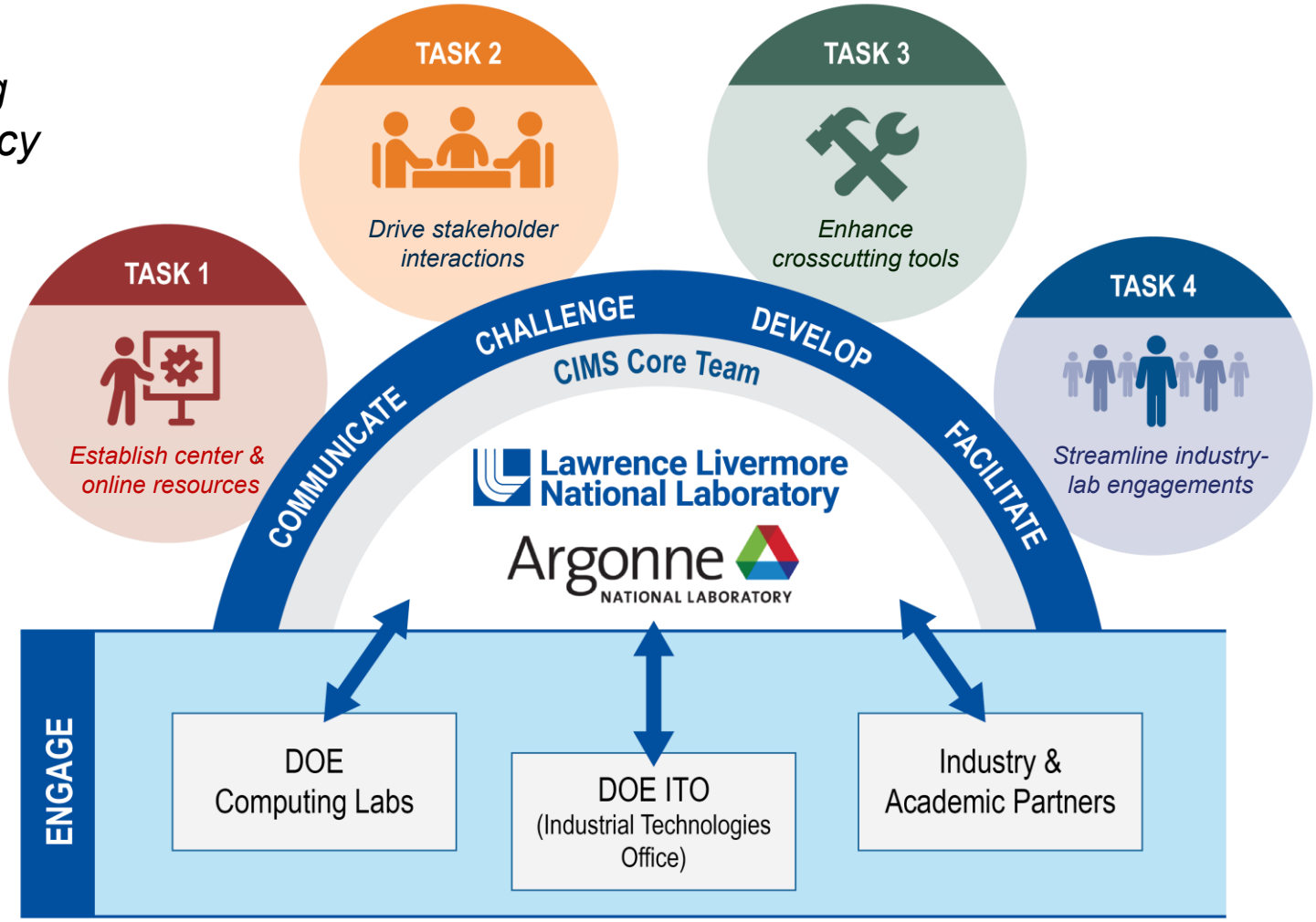
Genesis Mission – *DOE-wide*
AI tools built on LLMs & foundation models to address challenges for fundamental science and energy technologies

Center for Industrial Modeling and Simulation (CIMS)

*CIMS aims to **accelerate adoption** of computing tools and resources to improve industrial efficiency and competitiveness.*

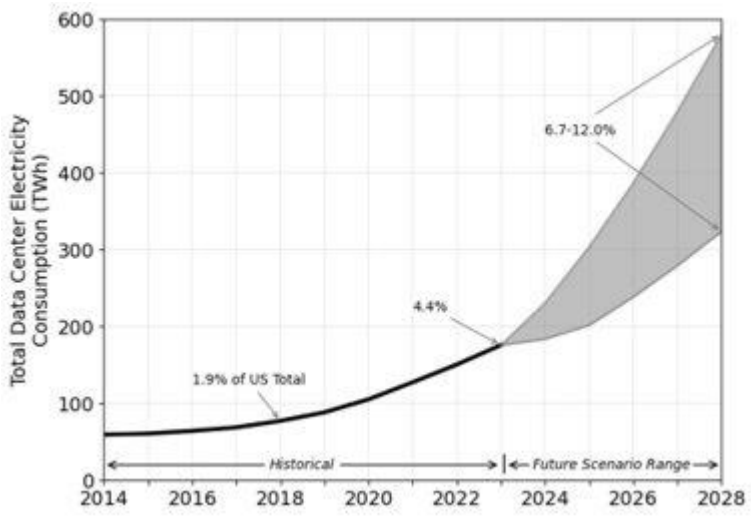
*We will assemble consulting experts in **physics-based modeling, AI/ML, & process modeling** across each ITO technology domain to:*

- Perform outreach and education
- Identify emerging challenges and solutions
- Develop adaptive computational & AI/ML capabilities
- Serve as a resource to match labs and industry



Growing Industrial Energy Demand:
U.S. Data Centers

Results from ITO-Funded LBNL Study



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

Energy for AI efforts underway

- Maintaining U.S. leadership in AI innovation—including through the rapid development of data center infrastructure—is a key national and economic security priority. If macro-level energy challenges are not addressed, the workaround solutions will lead to increased costs for ratepayers and data centers will increasingly move their operations overseas.
- In response, ITO is developing **E4AI (Energy for AI)**, a public-private partnership that will be a national convening of data center operators and developers, utilities, technology providers, and government agencies, supported by the national labs.
- We will focus on these key priorities to achieve long-term impacts:

Increase speed to connect	Improve grid stability	Support technology pipeline
Data center developers and utilities are armed with information and strategies to streamline the interconnection process for new large load requests.	Data center owners make informed decisions about the best onsite generation and storage options for their business and serve as grid-interactive assets during peak load periods.	New data center builds can come online within 18 months of completed plans, using the latest and most efficient technologies and without supply chain bottlenecks.

Industrial Technologies Office (ITO) Data Center Activities

Industry Engagement

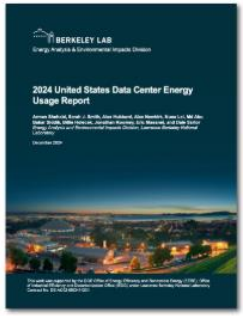
Through the **Better Buildings, Better Plants** program, ITO partners with data centers that seek to make their operations more efficient.

Through the **Onsite Energy** program, the TAPs perform technology screenings for data centers.

ITO is developing a new public-private partnership with the data center industry called **Energy for AI (E4AI)**, a national convening of data center operators and developers, utilities, technology providers, and government agencies to address the industry's biggest energy challenges.

Analysis

ITO's collaboration with the Center of Expertise for Data Center Energy at LBNL resulted in the **2024 US Data Center Energy Usage Report** and a **Data Center Load Flexibility Workshop** with industry.



Data center electricity consumption is expected to represent approximately 6.7 to 12% of total U.S. electricity consumption by 2028.[1]

More frequent updates to the US Data Center Energy Usage Report are on the horizon!

Technology R&D

ITO established new capabilities with LBNL through the **FY25 Lab Call** that will drive process and technological innovation with direct impact on data centers:

Data Center Cooling Collaborative (DC Cool): will form a data center cooling testbed network that can meet varied and evolving cooling technology needs; provide reliable, flexible, standardized user test facilities; and reduce the time and cost to bring new technologies to market.

Resource-secure Energy Flexibility (REFLEX): will develop and demonstrate innovative approaches for harnessing load flexibility as a strategy to cut operational costs and support rapid growth in industrial electricity usage with existing grid resources.

[1]Shehabi, Arman, et al. "2024 United States Data Center Energy Usage Report." December 2024.

Future Directions

HPC4Mfg

- HPC4EI NOI released October 23, 2025

Center for Industrial Modeling and Simulation

- Launch CIMS in Spring/Summer 2026
- Recruit national lab and industry partners, industrial advisory board
- Publish initial index of industrially relevant computing capabilities and codes at the labs
- Initial focus areas: iron/steel, chemicals, electroheating, combustion

Genesis Mission

- Fast-moving, with frequent announcements – stay up to date at https://genesis.energy.gov/

Thank You!

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