OAK RIDGE National Laboratory

Energy Science and Technology Directorate

Aug 24, 2023

Philip Bingham

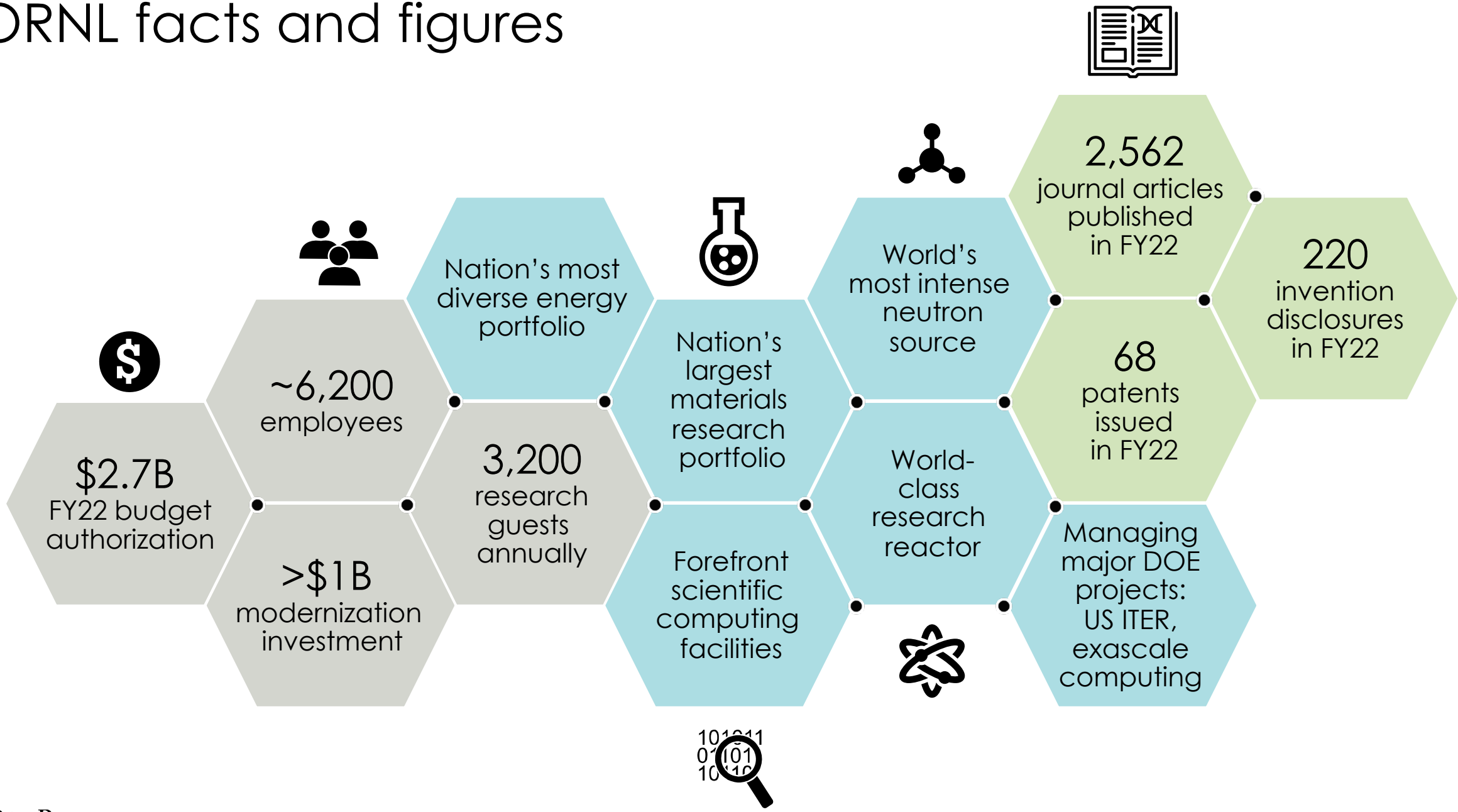
Director EEID (Electrification and Energy Infrastructures Division)

ORNL is managed by UT-Battelle, LLC for the US Department of Energy

U.S. DEPARTMENT OF ENERGY

Welcome to ORNL

ORNL facts and figures



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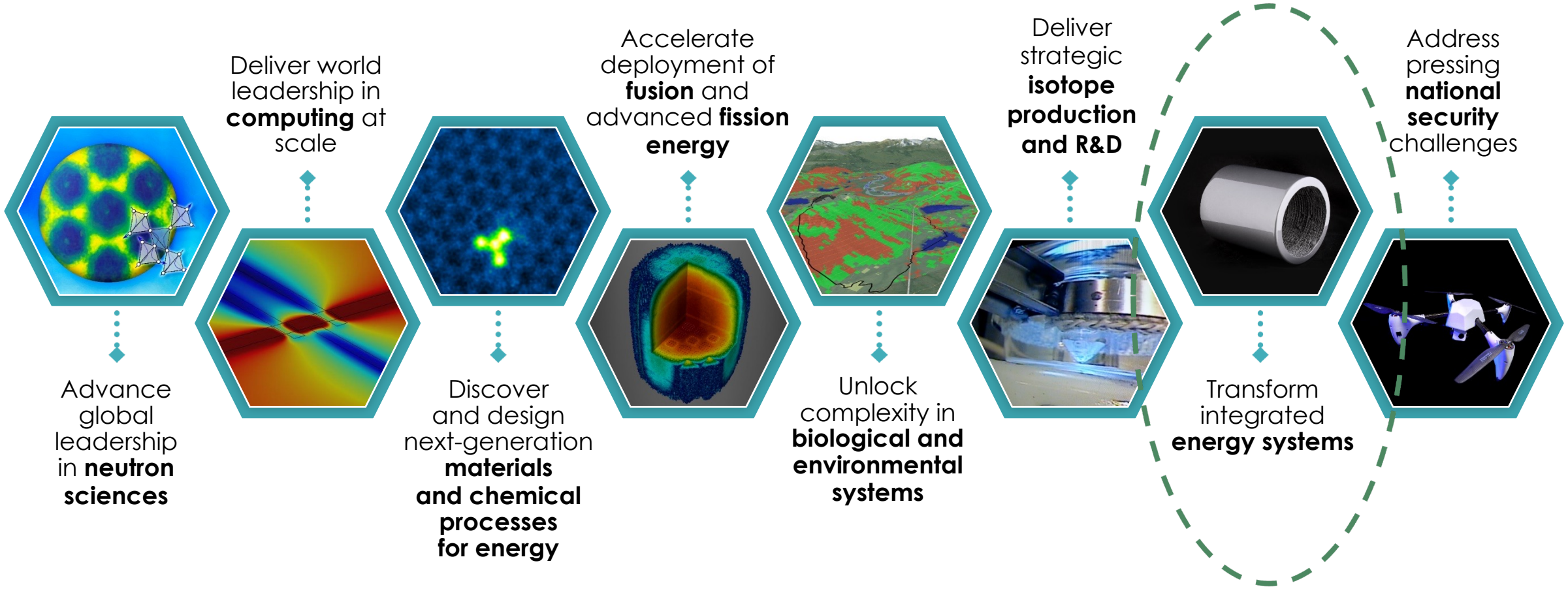
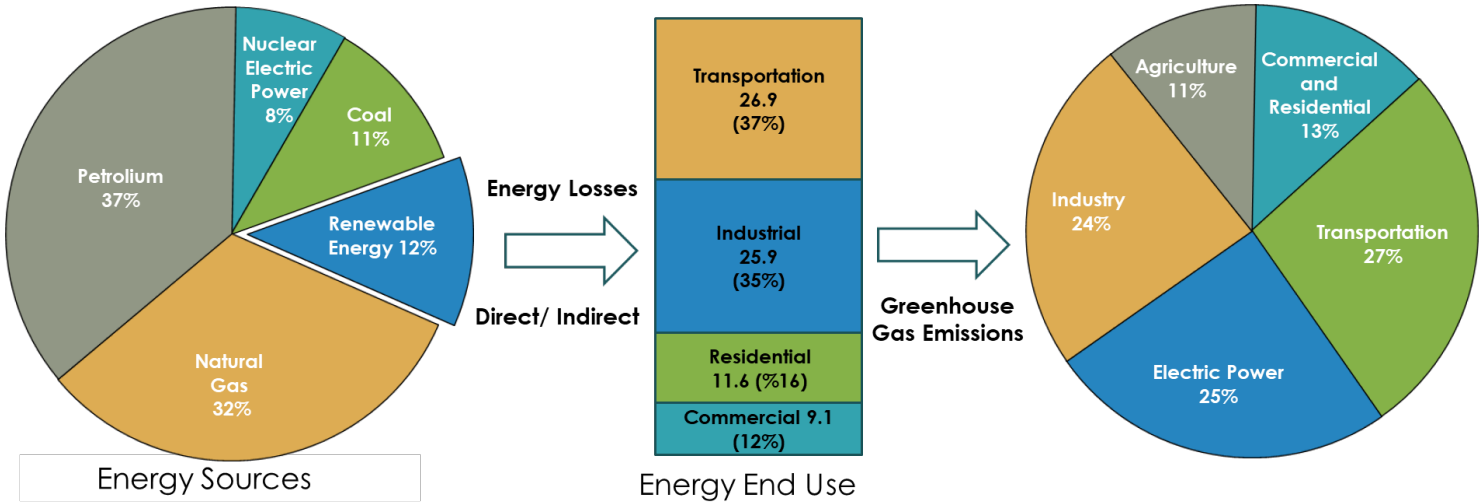
ORNL's major science and technology initiatives



ESTD Vision and Challenges

Vision

To lead transformational science and technology in enabling integrated, flexible, secure, and autonomous energy systems of the future, providing power and fuel originating from a variety of sources in a clean and seamless manner.



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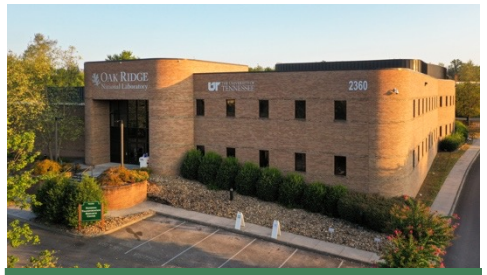
ESTD is home to five major collaborative/user facilities

Manufacturing Demonstration Facility

MDF houses integrated capabilities that drive the development of new materials, software, and systems for various advanced manufacturing technologies. MDF delivers manufacturing energy efficiency improvements and supports the secure production of clean energy products.



National Transportation Research Center

NTRC helps industry, academia, and other agencies accelerate the development and deployment of efficient and secure transportation technologies. Research focuses on electrification, emissions reduction, connected and autonomous vehicles, materials, and data and decision science for a decarbonized future.

Building Technologies Research and Integration Center

BTRIC delivers breakthroughs to improve the energy efficiency and environmental compatibility of residential and commercial buildings, focusing on building envelopes, equipment, building systems integration, energy storage, building-to-grid interactions, sensors, transactive controls, and modeling and simulation.

Carbon Fiber Technology Facility

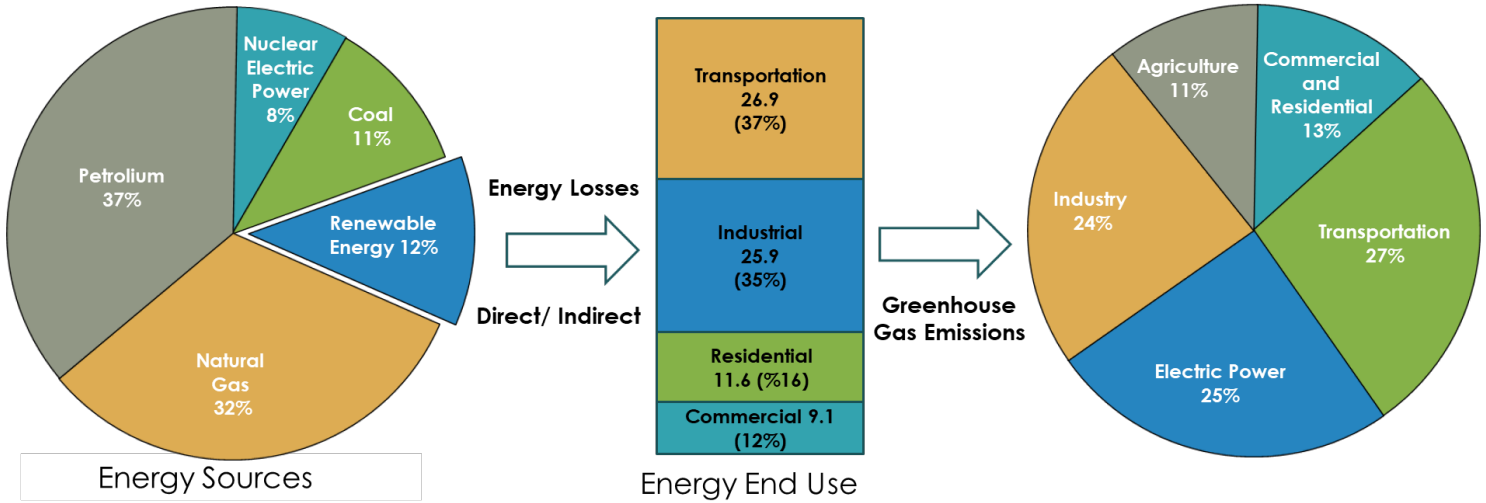
CFTF provides a platform for evaluating new processing technologies and identifying high-potential low-cost raw materials, including textile, lignin, polymer, and hydrocarbon-based precursors. Leveraging the CFTF's capabilities, ORNL is developing low-cost carbon fiber materials with desired structural properties and is co-optimizing feedstocks and processing conditions.

Grid Research Integration and Deployment Center

GRID-C delivers hardware and software solutions for the grid, including power electronics and battery innovations from concept to deployment, in support of decarbonizing the utility, buildings, and electric vehicle infrastructure sectors while advancing an integrated, secure, and resilient power grid.

Grid Transformation: Three key drivers

- **Decarbonization** - high penetration of renewable generation sources in the grid
- **Grid Security:** (natural and intentional) - flexible and adaptive to proactively mitigate threats
- **Changing Demand Patterns** - efficient electrified transportation and economic growth



Biden Administration goal to generate clean, domestic energy to achieve a carbon-free, pollution-free power sector by **2035–2050**

ORNL Sustainable Electricity Program - Overview

- Accelerate technology development to modernize the energy delivery system

- Translational R&D for higher TRL (>3) advanced solutions development for a secure and reliable energy grid future

Grid Modeling & Controls

- NAERM: Bulk power system & Natural Gas interdependency modeling threat-based modeling and analysis
- **Dynamic Modeling**
- Protection & Controls
- Grideye – Monitoring health of the U.S. Power Grid network

Grid Systems Integration

- Clean Energy/Renewable systems integration
- Solid state Power Substation
- Future microgrids operation
- Energy Storage
- Vehicle to grid integration(V2G)
- Buildings Integration(B2G)

Grid Security

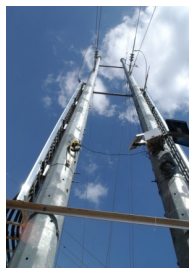
- Edge-to-utility cybersecurity framework
- Secure timing for grid
- Edge Detection of Grid Anomalies
- Grid Signature Library
- Quantum communications

Unique testing facilities

Secure Modern Grid

Distributed energy Communication & control

Supercomputing facility



PCAT facility

Future Strategic Directions(1-5 years)

- Capabilities (GRID-C and M&S) to accelerate (10-100X) design and development of sensors and distributed control systems to for utility-scale decarbonization and energy resilience
- Advanced power electronics interfaces and power flow control technologies and future grid architectures
- Distribution-level advanced sensing and federated architectures of DERs, PE and Edge computing
- National-scale infrastructure modeling – Adaptive DER Capacity, Transmission Planning, Extreme Event Modeling, Cyber-physical resilience, Situational Awareness
- Cybersecurity R&D and Grid Communications Modeling

Office of Electricity (OE) – Advanced Grid Modelling – Ali Ghassemian
Solar Energy Technology Office (SETO) – John Seuss

Discussion

Additional/Backup

Energy Science and Technology Directorate

Rick Raines, Interim Associate Laboratory Director

Stephanie Wilson, Executive Assistant

Matrix Support
Teddie Reagan: Business Manager
Amanda Tinson: Lead HR Business Partner
Jana Johnson: HR Business Partner
Doug Cross: Talent Acquisition Partner
Greg Cunningham: Communications
Jason Baert: Quality Manager
Mark Houston: Facilities and Operations

Directorate Support
Mike Twardy, Business Development Lead

Chief Operating Officer
Ron Ott

Energy Programs

- **S3- Infrastructure** — Edgar Lara-Curzio
- **Advanced Manufacturing** — Bill Peter
- **Buildings Technologies** — Melissa Lapsa
- **Sustainable Transportation** — Rich Davies
- **Electricity and Energy Reliability** — Madhu Chinthavali (Tom King)
- **Fossil Energy** — Edgar Lara-Curzio

Electrification and Energy Infrastructures Division
Philip Bingham, Director

- Grid Research Integration and Deployment Center

Buildings and Transportation Science Division
Robert Wagner, Director

- National Transportation Research Center
- Building Technologies Research and Integration Center

Manufacturing Science Division
Yarom Polsky, Director

- Manufacturing Demonstration Facility
- Carbon Fiber Technology Facility

ESTD's scientific research areas

Buildings and Transportation Science Division
Robert Wagner, Director

- **Propulsion Science Section** — Jim Szybist — 1
- **Vehicle and Mobility Systems Research Section** — Burak Ozpineci — 2
- **Building Technologies Research Section** — Kashif Nawaz — 3

Electrification and Energy Infrastructures Division
Philip Bingham, Director

- **Electrification Section** — Ilias Belharouak — 4
- **Energy Systems Integration, and Controls Section** — Madhu Chinthavali — 5
- **Energy Sensing, Analytics and Communications Section** — Ryan Kerekes (Acting) — 6

Manufacturing Science Division
Yarom Polsky, Director

- **Energy and Industrial Decarbonization Section** — Jim Parks — 7
- **Precision Manufacturing and Machining Section** — Scott Smith — 8
- **Secure and Digital Manufacturing Section** — Vincent Paquit — 9
- **Composites Science and Technology Section** — Vlastimil Kunc — 10

ESTD works with outside partners to deploy technology

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