Partnering Opportunities at ORNL

Mike Paulus

Director, Partnerships

February 5, 2024

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

Welcome to ORNL

ORNL facts and figures

>$1B
modernization investment

$2.78B
FY23 budget authorization

>6,500
employees

Nation's most diverse energy portfolio

3,600
research guests annually

Nation's largest materials research portfolio

World-class research reactor

World's most intense neutron source

Managing major DOE projects: US ITER, exascale computing

8
DOE user facilities

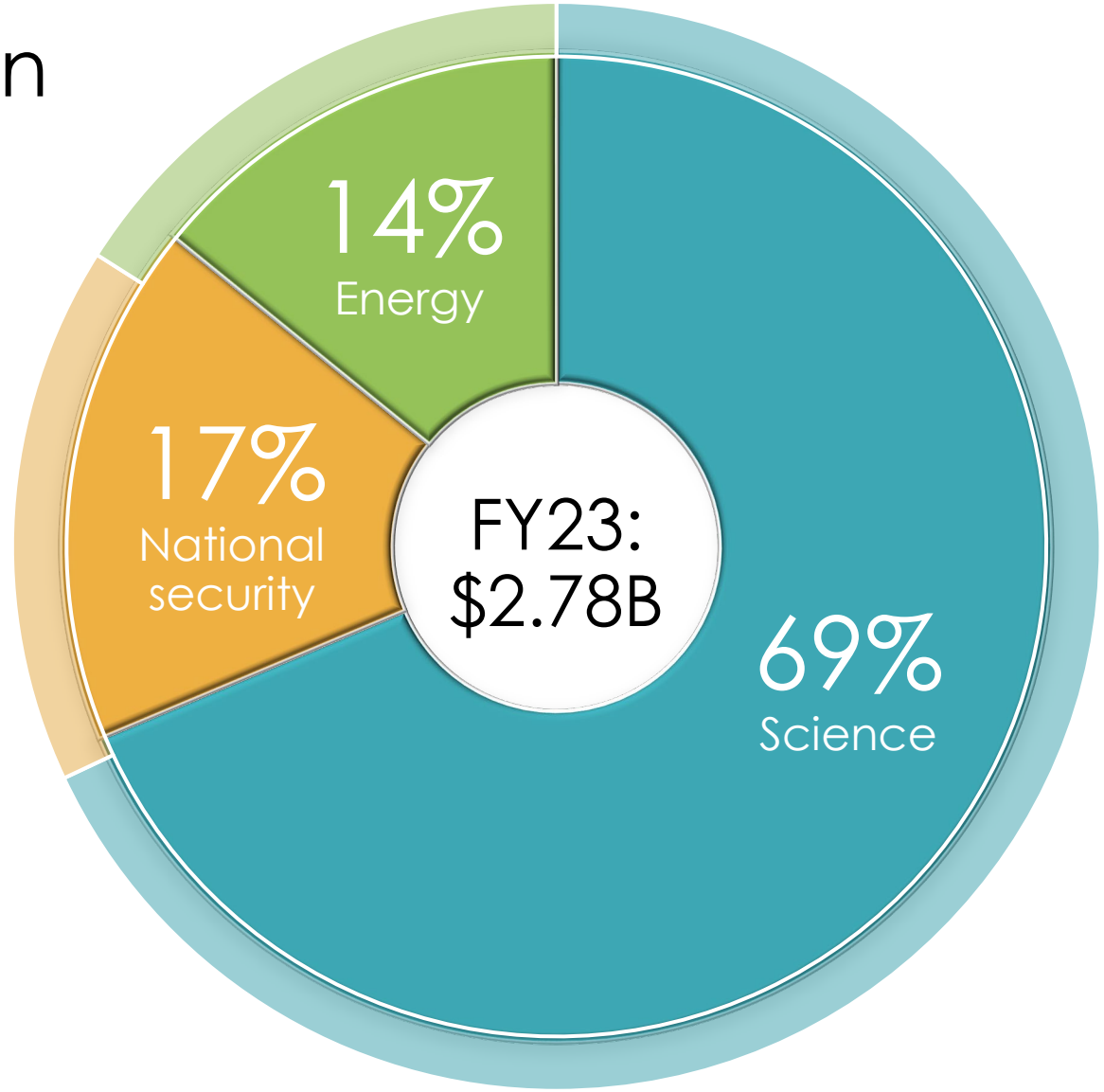
>2,600
journal articles published in FY23

#1
fastest computer in the world

291
invention disclosures in FY23

84
patents issued in FY23

Funding by DOE Mission



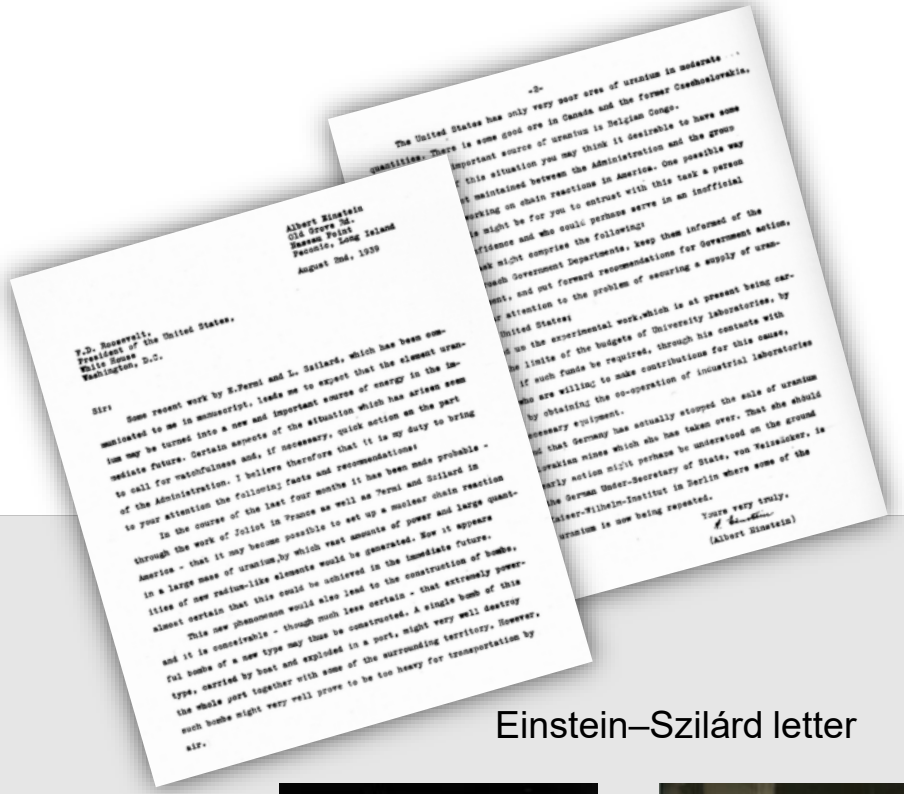
Open slide master to edit

Clinton Laboratories, 1943

Mission: Produce gram quantities of plutonium for chemical and engineering research

- Construct the world's first continuously operated nuclear reactor
- Develop chemical processing techniques to separate plutonium from irradiated fuel

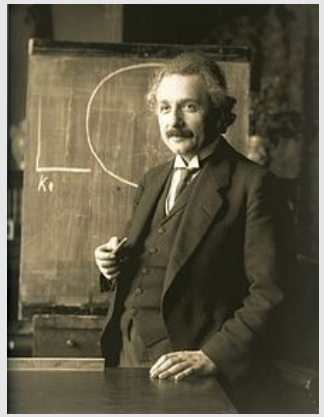
Manhattan Project origins



Einstein–Szilárd letter

President Roosevelt

Sen. Kenneth McKellar

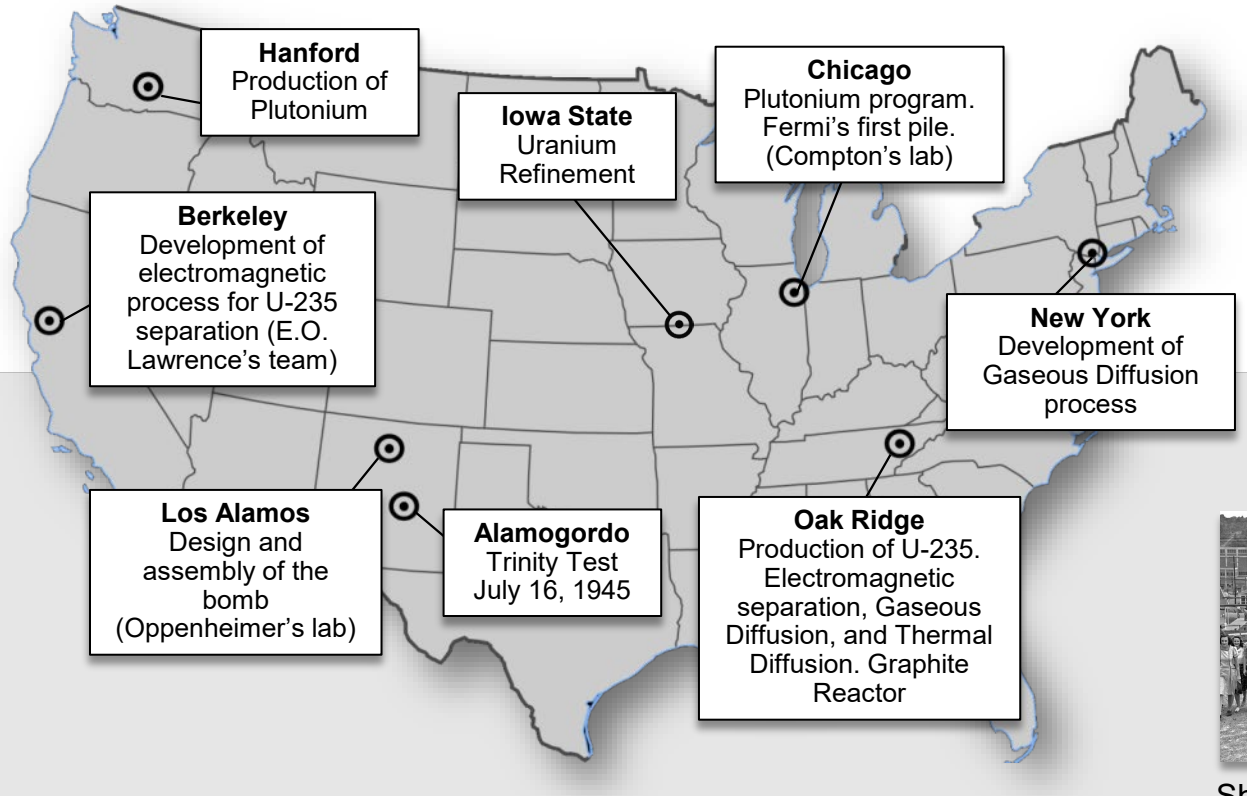


"Mr. President…Where in Tennessee do you want me to hide ($2B)?"

Manhattan Project: 4 years, $2B, 130,000 employees at peak

Hanford B-Reactor

Manhattan Engineering District



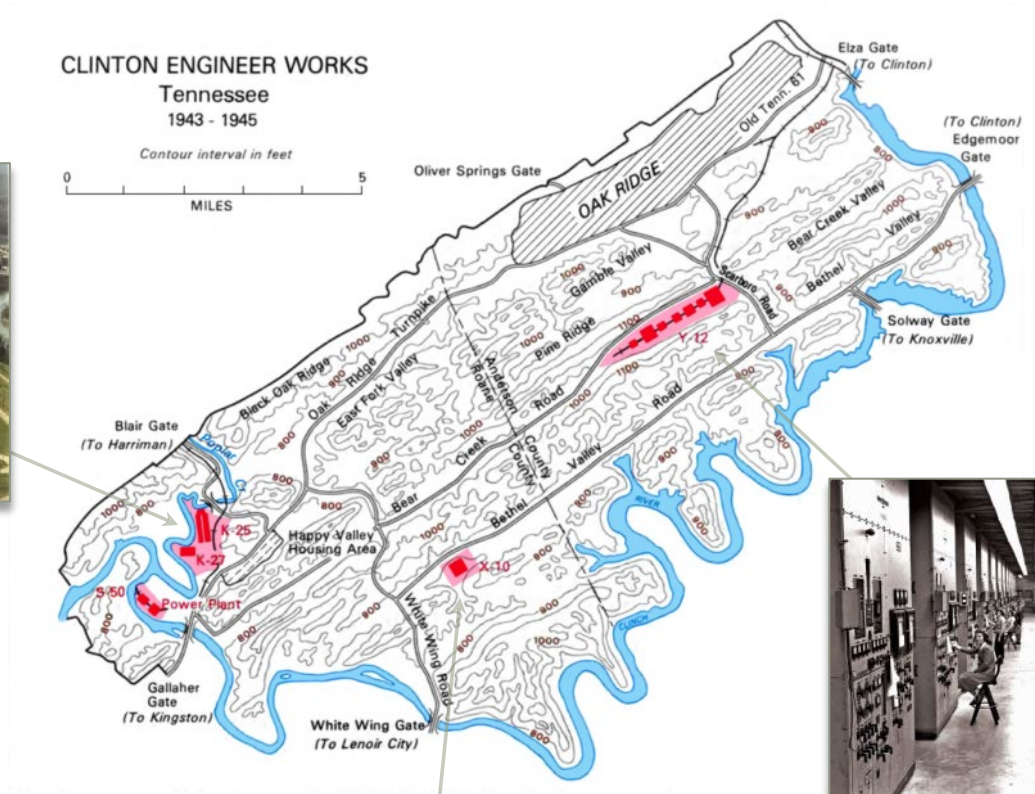
270 Broadway, first Manhattan Engineering District Headquarters

Los Alamos site

Shift change at the Oak Ridge Y-12 uranium enrichment facility

The Oak Ridge sites employed 82,000 people in May 1945

K-25 Gaseous Diffusion Plant



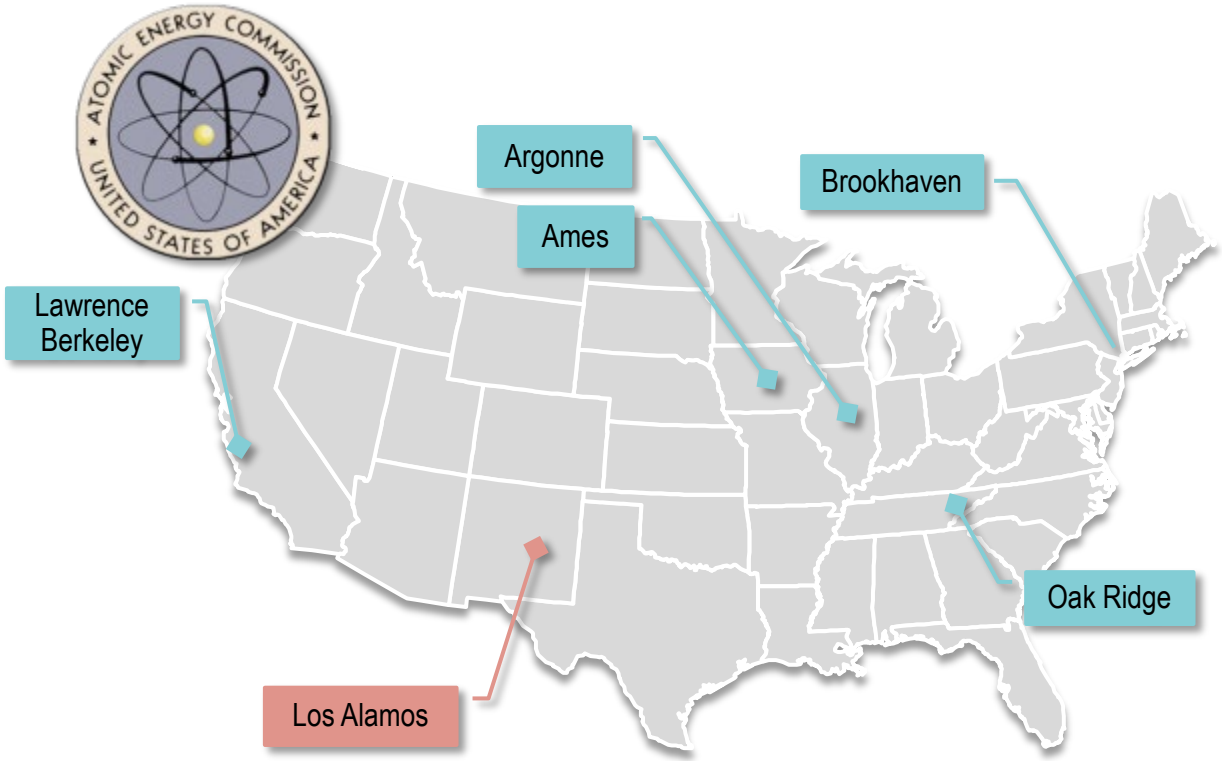
Y-12 Calutron
Electromagnetic
Separation Facility

X-10 Graphite
Reactor

OAK RIDGE National Laboratory

Open slide master to edit

Following World War II, the Manhattan Project facilities evolved into the national laboratories



President Harry Truman signing the Atomic Energy Act on August 1, 1946

- **Capitalize on the extraordinary scientific and technical capabilities assembled for the war effort**
- **Continue nuclear R&D with a focus on peaceful use**
- **Conduct unclassified fundamental research on a scale beyond the reach of a single university or industry**

Open slide master to edit

Today ORNL is part of the DOE National Laboratory System

Open slide master to edit

ORNL delivers translational research for national priorities

We apply our signature strengths to the most compelling S&T challenges

Lead the world in **neutron sciences**

Transform integrated **energy systems** to accelerate decarbonization

Deliver **exascale computing** from system to ecosystem

Unlock complexity in **biological and environmental systems**

Discover and design next-gen **materials and chemical processes for clean energy**

Provide strategic **isotope R&D and production**

Accelerate deployment of **fusion** and advanced **fission energy**

Address pressing **national security** challenges

Discovery science

Develop and deploy

Open slide master to edit

DOE funding is increasingly attached to partnerships

> "Now it's time to deploy, deploy, deploy!"
>
> - Secretary of Energy Jennifer Granholm

- DOE funding for demonstration and deployment is largely going to industry, who then partners with ORNL
- ORNL must have efficient partnering processes to compete for these funding opportunities

Business Sensitive

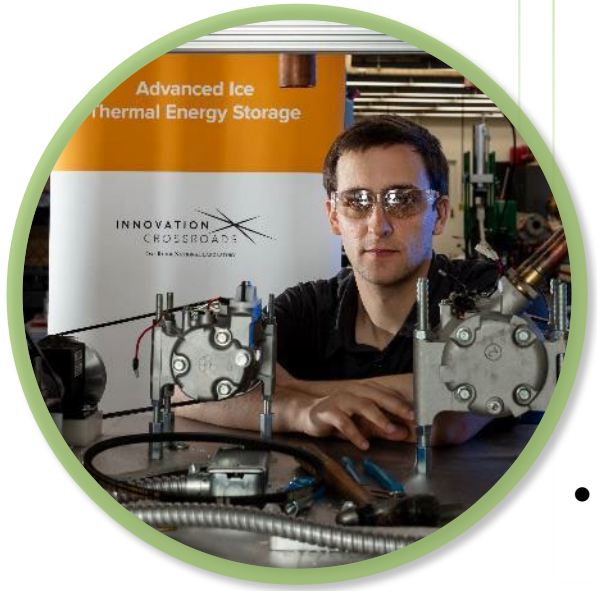
Partnerships are vital to accelerating technology transition and engaging with industry and universities

Partnerships Office

- Cooperative R&D agreements (CRADAs)
- Strategic partnership projects
- Technology licensing
- Entrepreneurship

Industry and economic development partnerships

- Regional industry recruiting and cluster development
- State and local economic development partnerships



Education and university partnerships

- Research and educational experiences
  - UT-ORNL Bredesen Center
  - GEM fellowship program
  - Graduate Opportunities (GO!) program
  - Internships
  - Science education and workforce development programs (through ORISE)
- Postdoctoral program

OAK RIDGE National Laboratory
Open slide master to edit

There are a variety of mechanisms for working with the National Laboratories

- Cooperative Research and Development Agreements
- Strategic Partnership Projects
- Agreements for Commercializing Technologies
- User Agreements
- Technology Licenses

https://www.ornl.gov/sites/default/files/2019-02/TTWG_Partnering_Guide.pdf

Oak Ridge National Laboratory
Open slide master to edit

What are SPPs and CRADAs?

SPPs and CRADAs enable ORNL to work with entities other than DOE and DHS

Strategic Partnership Project (SPP)	**Cooperative Research and Development Agreement (CRADA)**
ORNL performs work for a non-DOE sponsor	ORNL collaborates with one or more non-federal participants
Only ORNL has tasks in SOW	Both ORNL and participant have tasks in SOW
Sponsor funds 100% of work	• Participant funds 100% of its contribution • Either Federal Government or participant funds ORNL contribution
If sponsor is a US entity using non-federal funds, it can take title to ORNL inventions	Participant has an option to exclusively license ORNL inventions in a pre-negotiated field of use
If sponsor is a US entity using non-federal funds, it can treat generated data as proprietary	Participant can protect data for (typically) up to five years

OAK RIDGE National Laboratory
Open slide master to edit

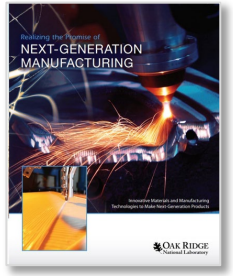
Licensing Opportunities at ORNL

Technologies Available for Licensing

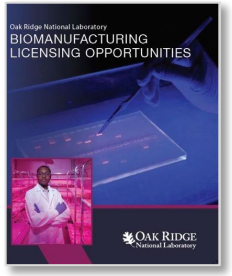
Analytical Instrumentation View Portfolio	Chemicals View Portfolio	COVID-19 View Portfolio
Detectors and Sensors View Portfolio	Energy and Utilities View Portfolio	Healthcare and Biology View Portfolio
IT and Communications View Portfolio	Manufacturing View Portfolio	Materials View Portfolio
Security and Defense View Portfolio	Transportation View Portfolio	All Technologies View Portfolio

https://www.ornl.gov/technology-transfer

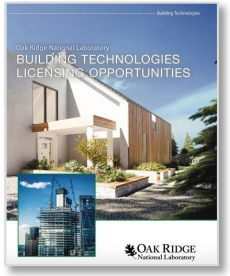
Featured Portfolios



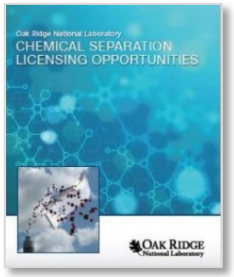
Advanced Manufacturing



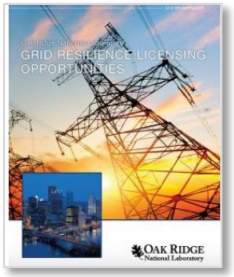
Biomanufacturing



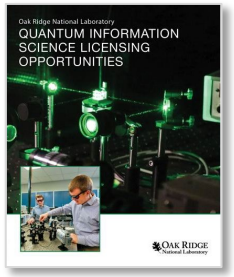
Building Technologies



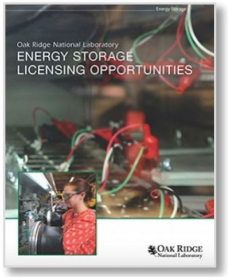
Chemical Separation Technologies



Grid Modernization



Quantum Information Science



Storage Technologies

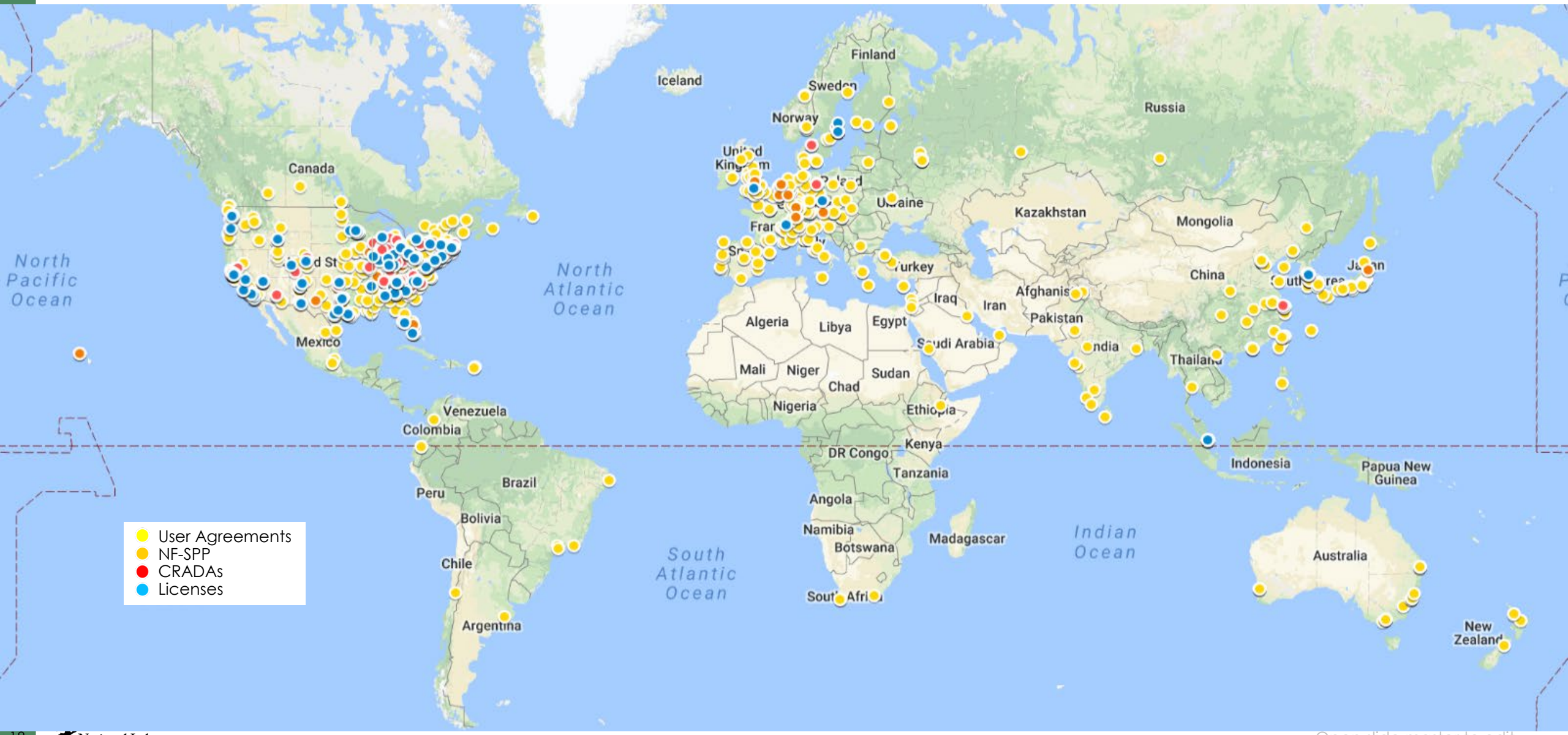
Open slide master to edit

Typical license terms

- Exclusivity / non-exclusivity
- License execution fee
- Annual minimum royalties
- Running royalties
- Equity
- Patent cost reimbursement
- Commercialization plan
- US manufacturing

Open slide master to edit

ORNL has a worldwide footprint

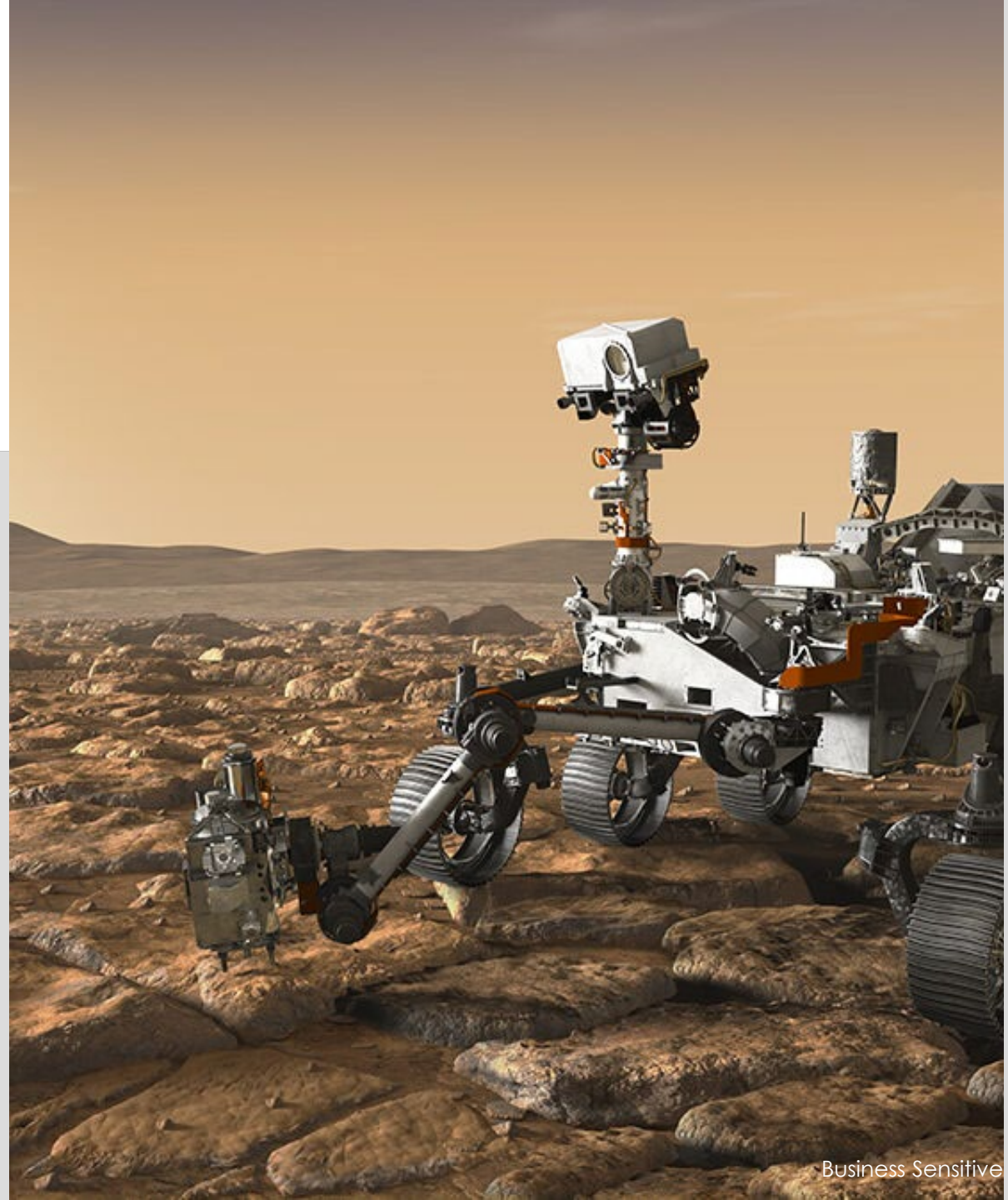


Open slide master to edit

NASA:
Example federal SPP

Dozens of projects conducted including:

- 30 years of data on arctic ecosystems, biomass, carbon cycle, climate, fire, hydrology and cryosphere, land use and human dimensions, soils, and vegetation and forests to inform NASA's Earth Observing System Data and Information System
- 3D-printed heat shield
- Radioisotope power systems needed for deep space exploration such as Mars rover missions
- Materials testing for the Parker Solar Probe

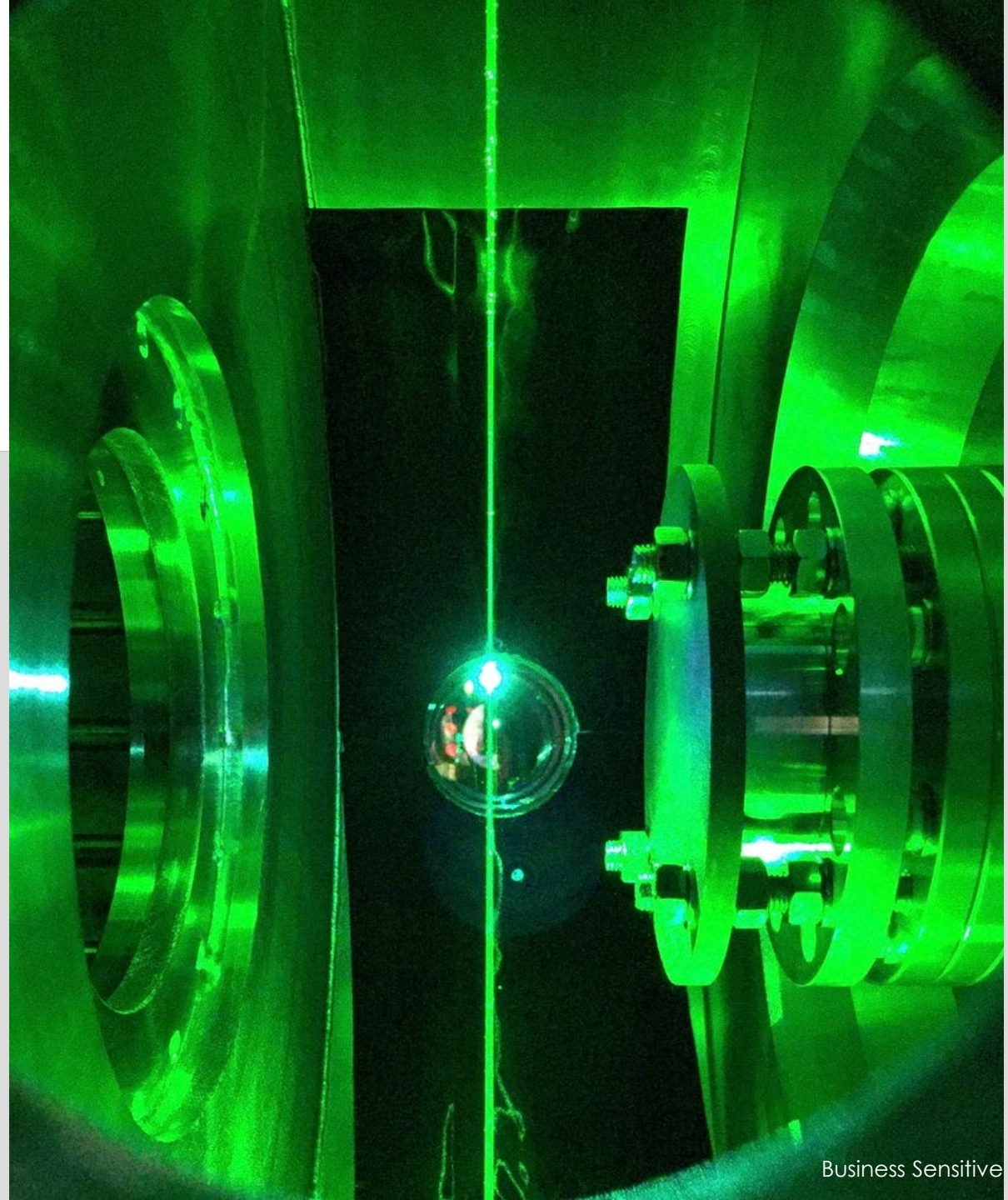


Business Sensitive

Fusion industry: Example non-federal SPPs

Milestone-Based Fusion Development Program

- Commonwealth Fusion Systems - Commercial fusion power on a decadal timescale with the compact, high-field ARC power plant
- Princeton Stellarators - Stellarator fusion pilot plant enabled by array of planar shaping coils
- Realta Fusion - The high-field axisymmetric mirror on a faster path to fusion energy
- Tokamak Energy - ST-E1 preliminary design review for a fusion pilot plant
- Type One Energy - The high-field stellarator path to commercial fusion energy
- Xcimer Energy - IFE pilot plant with a low-cost, high-energy excimer driver and HYLIFE concept



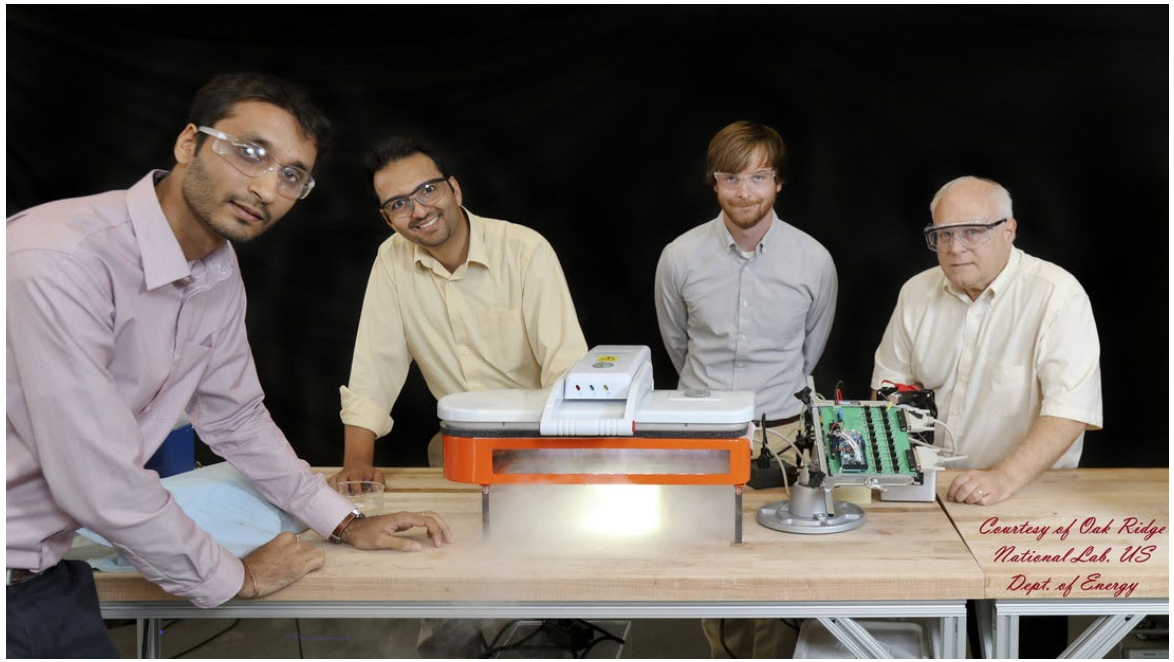
Business Sensitive

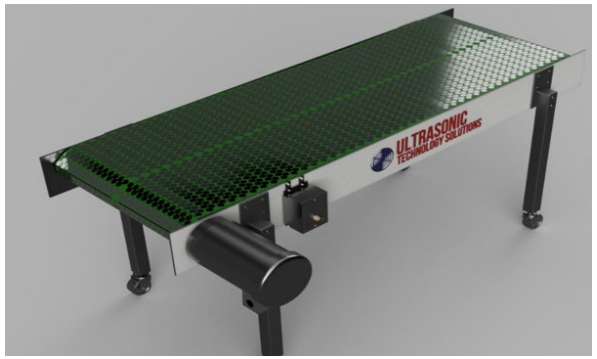
Westinghouse Air Brake Technologies Corporation: Example CRADA

- Valued at $8M, began in FY22, runs for 4 years
- Develop and implement low-carbon fuels in locomotive engines for the decarbonization of the rail industry
- Partners include Argonne National Laboratory and Convergent Science

Business Sensitive

ULTRASONIC TECHNOLOGY SOLUTIONS





- October 2014: DOE project funded under Building Energy Efficiency Frontiers and Incubator Technologies (BENEFIT)
  - CRADA with General Electric Appliances
- November 2014: Invention disclosed "Clothes Dryer Using Ultrasound Phenomena"
- May 2016: PCT patent application filed
- September 2018: Exclusive license executed with Ultrasonic Technology Solutions (UTC)
  - PI has an approved outside activity
- 2019: UTC participates in DOE Energy I-Corps
- 2020: PI takes entrepreneurial leave to focus on UTC full time

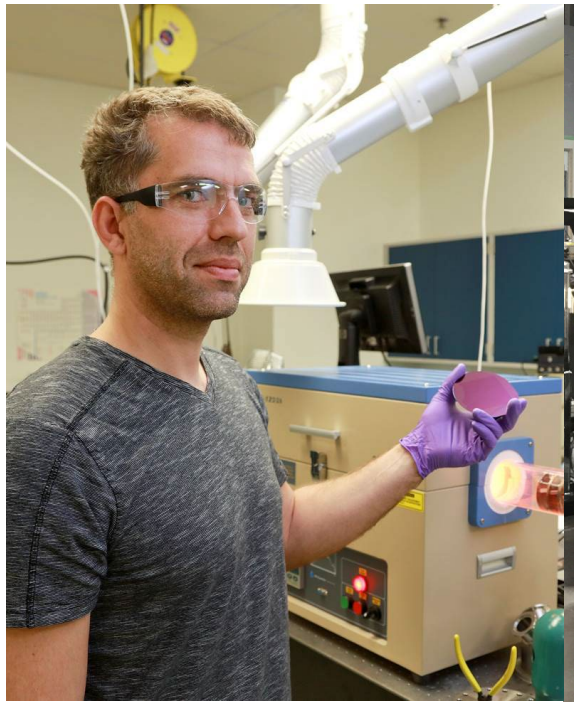
SCIEX

The Power of Precision

- 2002 – present: multiple CRADAs to develop new mass spectrometry technologies
- 2009: option to license ORNL technology
- 2009: option converted to exclusive license
- 2016: new technology licensed to Sciex
- 2020: Sciex launches Exho MS, a cutting-edge mass spectroscopy system incorporating ORNL technologies

Open slide master to edit

GENERAL GRAPHENE



- 2013: ORNL developed a low-cost graphene production technology
- 2014: General Graphene exclusive licensed ORNL technology

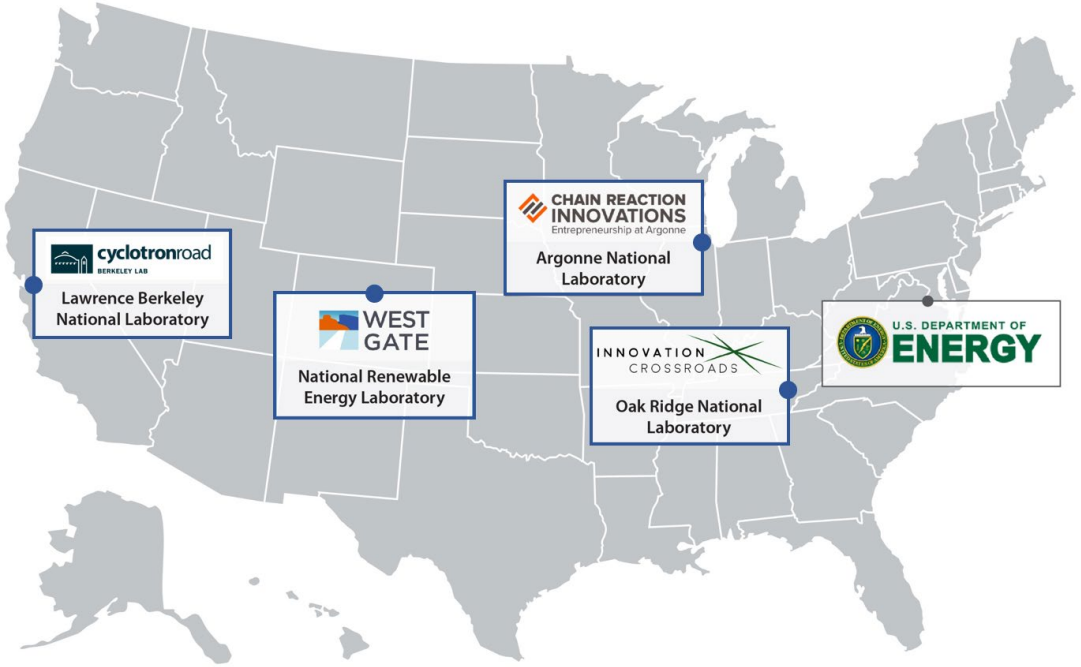
- 2015: ORNL secured a $3.6M ARPA-E grant in collaboration with General Graphene, New Mexico State University and ITN Energy Systems, Inc.
- 2018: ORNL lead researcher joined General Graphene on entrepreneurial leave
- 2018 - 2019: ~$35M raised
- 2019: 3rd generation prototype operational; first roll-to-roll graphene production achieved
- ~20 employees in Knoxville facility
- 2021: planned product launch

MVP
MAGNUM VENUS PRODUCTS

- 2013: MVP and ORNL begin informal collaboration
- 2015: MVP relocates headquarters to Knoxville, TN
- 2016: ORNL and MVP enter first CRADA
- 2019: ORNL and MVP enter a second CRADA to develop a large area thermoset 3D printer
- 2020: MVP licenses two technologies
- 2020: Product launched; first commercial unit installed at ORNL MDF

ORNL LEEP Node: Innovation Crossroads

The Lab-Embedded Entrepreneurship Program (LEEP) is a fellowship that connects entrepreneurs with world-leading scientists and facilities at US Department of Energy national laboratories. LEEP accelerates the deployment of transformative energy technologies that address climate change and other challenges, while also creating jobs, promoting domestic manufacturing, and providing benefits to disadvantaged communities.

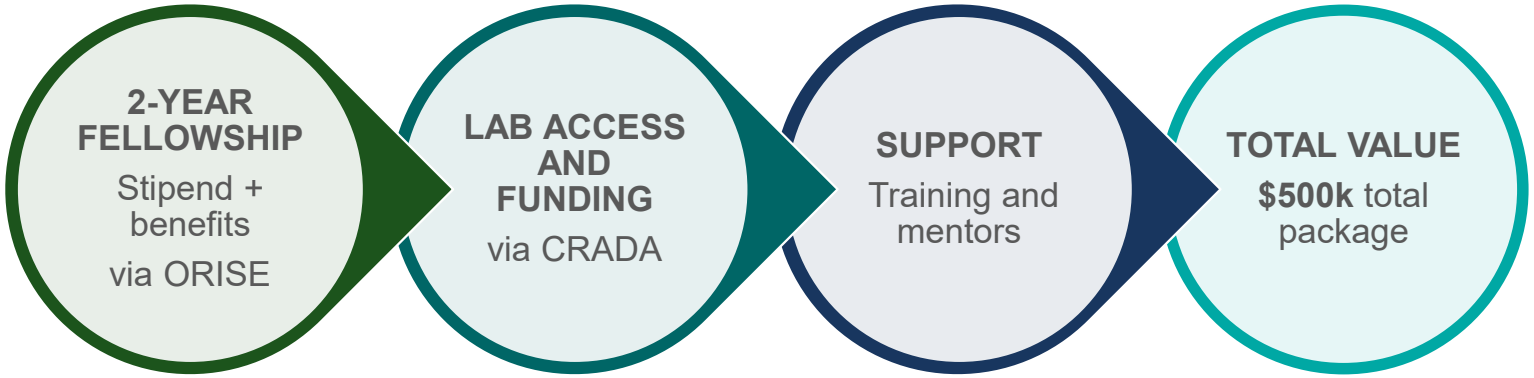


Vision:

- **Recruit** the best energy and advanced manufacturing innovators
- **Leverage** expert mentorship and world-class facilities at national labs on a win-win basis
- **Position** people and technology for market

OAK RIDGE National Laboratory
Business Sensitive

World Class Support for Startups



Program Sponsors:

- U.S. Department of Energy's
  - Advanced Materials and Manufacturing Technologies Office
  - Building Technologies Office
  - Office of Electricity
  - Office of Science Advanced Scientific Computing Research program
- Tennessee Valley Authority
- Oak Ridge National Laboratory

OAK RIDGE National Laboratory
Open sli Business Sensitive

Driving Impact by Embedding Entrepreneurs at ORNL

INNOVATION CROSSROADS

38
startups supported

$74.4 million
in non-dilutive funding received

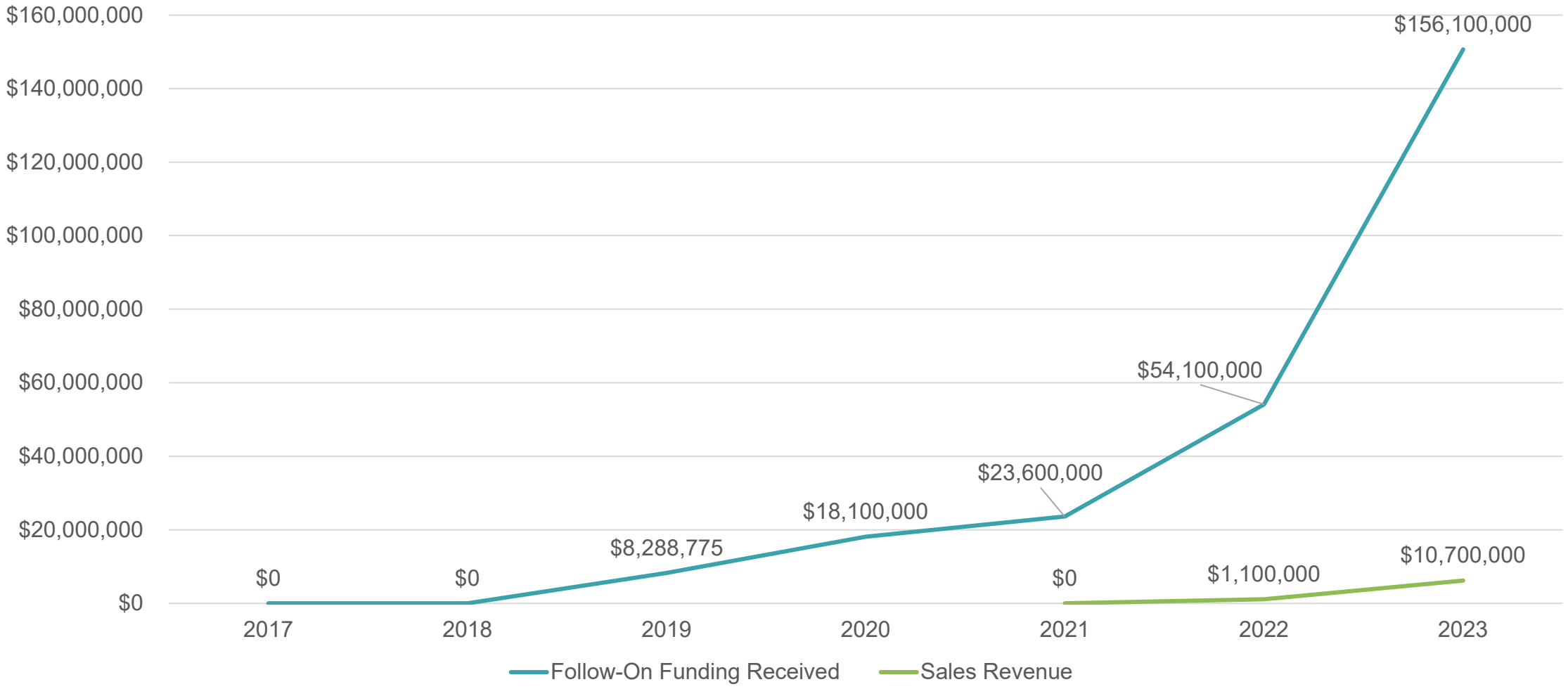
200
jobs created

$81.7 million
venture funding raised

16
startups with sales

$10.7 million
in sales revenue

Innovator Follow-On Funding Received & Sales Revenue



Oak Ridge National Laboratory

Open slide master to edit

Discussion

We solve problems and protect people
We are ONE ORNL
We debate with purpose, passion and respect
We build new materials atom by atom