Partnering with the National Laboratories

Presented to
Technology Deployment Day: Better Plants Conference

Mike Paulus
March 15, 2017
Why does the US government invest in research and development?

“Without scientific progress, no amount of achievement in other directions can insure our health, prosperity, and security as a nation in the modern world.”

Vannevar Bush
Science – The Endless Frontier (1945)
These priorities are reflected in today’s R&D budgets
DOE has 21 National Laboratories and Facilities with Broad Expertise:

- Pacific Northwest
- Idaho
- Lawrence Berkeley
- Stanford
- Lawrence Livermore
- Nevada NSS
- National Renewable Energy Lab
- Kansas City Plant
- Fermi Lab
- Argonne
- Ames
- National Energy Technology Lab
- Brookhaven
- Princeton
- Thomas Jefferson
- Y12
- Oak Ridge
- Savannah River
- Pantex
- Sandia
- Los Alamos
- Weapons Science Cleanup Energy
Where do the National Laboratories fit?

Bridging the Valley of Death – The Role of Test Beds for Advanced Nuclear Reactors. Source: Todd Allen, Idaho National Laboratory, & Jessica Lovering, Breakthrough Institute.
Some National Laboratory game changers

Nuclear power plants provided 10.9 percent of the world's electricity production in 2012. In 2014, 13 countries relied on nuclear energy to supply at least one-quarter of their total electricity.

Approximately 50 million nuclear medicine procedures are performed each year worldwide. BNL developed the Tc-99m generator and FDG.

Since the end of World War II, nuclear deterrence has been a cornerstone of the United States defense strategy.
Some National Laboratory game changers

National laboratories (SNL, LANL, LLNL, NETL) contributed to shale gas technology that significantly improved US energy independence.

National laboratories are drivers of new wind energy technologies.

Argonne National Lab’s battery cathode design powers the Chevy Volt.

The Ames Lab lead-free solder alloy is the world wide market leader.
Some National Laboratory game changers

Fermilab designed the first proton accelerator for cancer treatment.

PNNL millimeter wave airport screening devices enhance airport security. More than 1300 systems have been deployed worldwide.

ORNL was an early leader in the use of ion implantation for semiconductor processing and artificial joint surface treatment.
Often returns on R&D investment take time and can come in unexpected forms.

- **1988**: "giant magnetoresistive effect" (GMR) is discovered, creating the field of spintronics. Basic research foundation: DOE funding for thin-film metallic multilayers.
- **1990**: Development of the lithium-ion battery. Basic research foundation: DOE funding for Electrochemistry.
- **1988**: Thin film transistor LCD displays emerge. Basic research foundation: NIH, NSF, DoD fund liquid crystal research.
- **1960–70s**: Very Large Scale Integration (VLSI) system and circuit design pioneered. Basic research foundation: IBM, DARPA funding.
- **1965**: The “Fast Fourier transform” revolutionizes the field of signal processing. Basic research foundation: Army Research Office funding.
There are a variety of mechanisms for working with the National Laboratories:

- Cooperative Research and Development Agreements
- Strategic Partnership Projects
- Agreements for Commercializing Technologies
- Technology Assistance Programs
- User Agreements
- Technology Licenses
We have 4 mechanisms to collaborate with these assets:

- **Cooperative R&D Agreements**
- **Strategic Partnerships Projects and ACT**
- **Technology Licenses**
- **User facilities**

<table>
<thead>
<tr>
<th></th>
<th>Active CRADAs</th>
<th>Active NF-SPP agreements</th>
<th>Active patent licenses</th>
<th>Active copyright licenses</th>
<th>2014 inventions</th>
<th>2014 User Facility users</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2014</strong></td>
<td>709</td>
<td>2,667</td>
<td>1,443</td>
<td>2,621</td>
<td>1,580</td>
<td>26,403</td>
</tr>
</tbody>
</table>
Cooperative Research & Development Agreement (CRADA)

A CRADA is…

- An agreement between ORNL and private sector partner(s) to conduct specified research or development activities consistent with the mission of the lab.
- Each party provides personnel, services, facilities, equipment, intellectual property or other resources (intense collaboration).

Funding Mechanisms:

- 100% Funds-In by the Participant. Participant funds ORNL’s portion of the project. No DOE funding involved.
- DOE funds ORNL’s portion of the project.* Participant provides both funds-in and in-kind contributions.
- DOE funds ORNL’s portion of the project.* Participant provides in-kind contribution.

*Subject to availability of funds. DOE funds ORNL through appropriation.
Example CRADA: Local Motors

CRADA on rapid automotive design and innovation using large-scale polymer additive manufacturing

- Demonstrate lightweighting of systems and subsystems
- Develop tools for additive and subtractive manufacturing
- Explore innovative assembly approaches

Demonstration:
3D printing of an entire vehicle at International Manufacturing Technology Show in Chicago

January 2014

September 2014
Strategic Projects Program (SPP)

- A Strategic Projects Program is:
  - Performance of work for non-federal entities by contractor personnel
  - Utilization of DOE resources that is not directly funded by appropriations

- SPP is appropriate when:
  - ORNL is performing the research with minimal collaboration with sponsor

- A Materials & Services Order Form is:
  - A simplified SPP agreement
  - An agreement supporting non-R&D projects
  - An agreement with minimum terms and conditions
  - A one-page agreement (front & back)
  - Quick and easy to use
Five-year project deploys a broad array of sensor technologies and data analytics to enhance worldwide agricultural sustainability
Intellectual Property License

• A License is:
  – A contract enabling a partner to make, use or sell ORNL intellectual property
  – Associated with patent(s) (granted or pending) or other ORNL IP
  – Associated with defined field(s) of use
  – Exclusive or Non-Exclusive

• Payment typically includes
  – Patent cost reimbursement
  – Execution fee (in some cases equity in lieu of cash may be negotiated)
  – Royalty fees

• Options may also be executed, which provide partners with an exclusive right to negotiate a license for a defined period of time
Example License: Vertimass LLC

2014 License

Vertimass, LLC

2015 – DOE Awards Vertimass a grant to develop the technology

ORNL has developed a process to upgrade ethanol to gasoline, jet fuel and other high value products

2016 – ORNL and Vertimass are negotiating a CRADA
User Agreement

A User Agreement is

• A mechanism for private industry or academia to conduct research at the contractor’s DOE-designated user facilities

• An agreement (proprietary or non-proprietary) stipulating terms and conditions, including disposition of intellectual property

• An agreement under which the partner directs the activity, within framework of agreement

Types of User Agreements:

• Nonproprietary: funded by DOE program and/or cost-recovery from User

• Proprietary: cost-recovery required for all users

• Pre-competitive: allows collaboration; currently available for only a few facilities
Example User Agreement: BMI Aerodynamic Truck Design

- High performance computing reduced simulation times from days to hours
- New design could save $5B in fuel costs per year
- BMI awarded Heavy Duty Trucking Magazine top 20 design award
Recent Initiatives
The mission of the SBV Pilot is to significantly increase the industrial impact of DOE national labs on the U.S. clean energy sector.

Goals

- Increase small business accessibility to lab capabilities and lab awareness of needs
- Accelerate commercialization timelines for EERE technologies
- Align lab practices with private sector business cycle timelines

Award Size: $50,000-$300,000

Period of Performance: 12 months

Cost Share Requirement: 20%

Details available at www.SBV.org
ORNL REVV! and Technology Assistance

- Funded by a grant from the State of Tennessee
- Provides Tennessee Manufacturing Companies with access to ORNL and The University of Tennessee
- 5-page Proposals are competitively selected by a ORNL/UT committee
- Companies must currently manufacture a product
- Companies must employ a minimum of 10 employees in Tennessee or have made a firm commitment to do so

Jeff Cornett  865-241-3807

Technology Assistance Program

Available to any US Small Business that has licensed an ORNL technology

- Intended to assist in the transfer of technology from ORNL to the small business
- Maximum of 120 hours of effort; typically completed in 3 months
- Funded by royalty receipts
- Available on a first-come first-serve basis
- Requires a simple contract with statement of work and budget

Mike Paulus  865-574-1051
**Technical Collaborations Program**

**The MDF Model**

<table>
<thead>
<tr>
<th><strong>Explore</strong></th>
<th><strong>Engage</strong></th>
<th><strong>Execute</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Opportunity for industry to discover and apply new manufacturing technologies</td>
<td>• Work with MDF staff to develop scope of work</td>
<td>• Simplified on-line application</td>
</tr>
</tbody>
</table>

**Additive Manufacturing**
Drawing on its close ties with industry and world-leading capabilities in materials development, characterization, and processing, ORNL is creating an unmatched environment for breakthroughs in both metal and polymer additive manufacturing, or 3D printing.

**Carbon Fiber and Composites**
New manufacturing processes for low-cost precursor development technologies hold the key to reducing carbon fiber cost for energy applications. Similarly, innovative performance-focused materials and processes can potentially drive significant performance improvements for national security applications.

[www.ornl.gov/manufacturing](http://www.ornl.gov/manufacturing)
Oak Ridge National Laboratory: Science and technology for innovation