Oak Ridge National Laboratory

Presented to the
Better Plants Technology Deployment Day

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Oak Ridge National Laboratory evolved from the Manhattan Project

The Clinton Pile was the world’s first continuously operated nuclear reactor

Chemical processing techniques were developed to separate plutonium from irradiated fuel
ORNL innovations have had billion dollar impacts

- **PUREX:** Basis for nuclear fuel reprocessing techniques used worldwide
- **Lab-on-a-chip:** Caliper sold for $600M in 2011
- **Cesium extraction:** Basis for $1.3B waste processing facility at Savannah River
- **Reactor life extension:** $20B cost avoidance
- **Advanced alloys:** Chrome-moly steel in widespread use
- **Cryopreservation of mouse embryos:** Frozen embryo transfer for livestock reproduction
- **Ion implantation:** Technology for integrated circuits and medical implants
- **Centrifuge technology:** Basis for vaccine purification and US enrichment industry
- **Instrumentation:** >$1B in products and spinoffs from ORTEC and TENNELEC
- **Reactor technology:** Concept and technology development for light water, high temperature, and molten salt reactors

**1940s**

- **Radioisotopes:** Multibillion dollar industry (>100 million procedures per year)

**1960s**

**1980s**

**2000s**
Today, ORNL is a leading science and energy laboratory

- 4,750 employees
- $1.5B budget
- $750M modernization investment
- 3,200 research guests annually
- Nation’s largest materials research portfolio
- Nation’s most diverse energy portfolio
- Forefront scientific computing facilities
- World-class research reactor
- World’s most intense neutron source
- 2,203 journal articles published in CY16
- Managing major DOE projects: US ITER, exascale computing
- 185 invention disclosures in FY16
- 83 patents issued in FY16
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ORNL R&D programs address DOE missions and national needs (FY16 business volume, $k)

- Science SPP $139,300
- Science $736M
- Energy SPP $17,788
- Energy $245M
- National Security $306M
- Capital/Construction $117,481
- Energy $245M
- Capital/construction $117M
- Total $1.408B

- Security SPP $92,515
- DHS $19,632
- DoD and FBI $34,072
- Y-12 $4,950
- NNSA $154,903
- EM Cleanup $3,330
- EERE/OE $128,913
- Fossil Energy $4,494
- Nuclear Energy $93,875
- Energy SPP $17,788
- Other Office of Science $38,130
- Advanced Computing $96,109
- Other DOE $34,017
- Fusion $21,493
- Nuclear Physics $21,014
- Basic Energy Sciences $307,882
- Biological/Environmental Research $78,471
ORNL’s mission

Deliver scientific discoveries and technical breakthroughs that will accelerate the development and deployment of solutions in clean energy and global security, and in doing so create economic opportunity for the nation.

Signature strengths

- Computational science and engineering
- Materials science and engineering
- Neutron science and technology
- Nuclear science and technology
Our core capabilities position us to tackle compelling science and technology challenges

- Advance ORNL’s science and Innovation culture
- Accelerate the discovery and design of new materials for energy
- Advance the science and impact of neutrons
- Scale computing and data analytics to exascale and beyond for science and energy
- Advance the scientific basis for breakthrough nuclear technologies and systems
- Advance understanding of complexity in biological and environmental systems
- Deliver science and technology to address complex security challenges
- Discover and develop sustainable and secure integrated energy systems
- Accelerate deployment of DOE IP and engagement with industry and universities
Our staff continue to deliver national impacts

<table>
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<tr>
<th>Buildings</th>
<th>Transportation</th>
<th>Manufacturing</th>
<th>Electricity</th>
<th>Bioenergy</th>
<th>Climate and environment</th>
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<tbody>
<tr>
<td>Partnerships with industry to develop high-efficiency appliances</td>
<td>Atomic-level imaging of catalysts</td>
<td>Guinness Book of World Records: Largest solid 3D printed item</td>
<td>&gt;25 grid modernization projects</td>
<td>Leading proposal for new Center for Bioenergy Innovation</td>
<td>Understanding climate change and planning for its impacts</td>
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<td>Low global warming potential (GWP) refrigerants</td>
<td>High-efficiency wireless charging for electric vehicles</td>
<td>Developing Wide and High Additive Manufacturing (WHAM)</td>
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<td>Billion-Ton Report</td>
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ORNL’s distinctive facilities bring thousands of R&D partners to Tennessee each year.
Partnerships are vital to accelerating technology transition and engaging with industry and universities

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<th>Technology transfer</th>
<th>Industry and economic development partnerships</th>
<th>Graduate education and university partnerships</th>
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<tr>
<td>Technology Innovation Program (royalty-funded technology maturation)</td>
<td>R&amp;D partnerships</td>
<td>Graduate education:</td>
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<td>Technology licensing</td>
<td>Regional industry recruiting and cluster development</td>
<td>– UT-ORNL Bredesen Center: 145 students</td>
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<td>Intellectual property management</td>
<td>State and local economic development partnerships</td>
<td>– Graduate Opportunities (GO!) program: 53 students from 11 universities</td>
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<td>Strategic Partnership Projects</td>
<td>Institute for Advanced Composite Materials Innovation (IACMI)</td>
<td>– DOE Office of Science Graduate Student Research program: 11 students</td>
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<tr>
<td>Cooperative R&amp;D Agreements (CRADAs)</td>
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<td>~260 joint faculty appointments</td>
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Strengthening the regional innovation ecosystem

- Small business vouchers
- Technology licenses
- Strategic Partnership Projects
- Cooperative R&D agreements

- Carbon fiber
- Additive manufacturing
- Automotive

- Deploying an industry cluster strategy to build regional competitive advantage

- Contributing to state and local economic development initiatives

- Making our resources available to industry partners

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Thank you