

# Idaho National Laboratory Plan

**Mark Peters**

*Laboratory Director  
Idaho National Laboratory*



# *INL Maturing as a Multi-program National Laboratory*



Research and Education Campus (REC) – before and after

# *Three Pillars of Simultaneous Excellence Shape the Future of INL as a Research, Development, Demonstration, and Deployment (RDD&D) National Laboratory*



# *Our Vision and Mission Position INL to Be Relevant to Tomorrow's Energy Future*

## **INL Vision**

INL will change the world's energy future and secure our critical infrastructure.

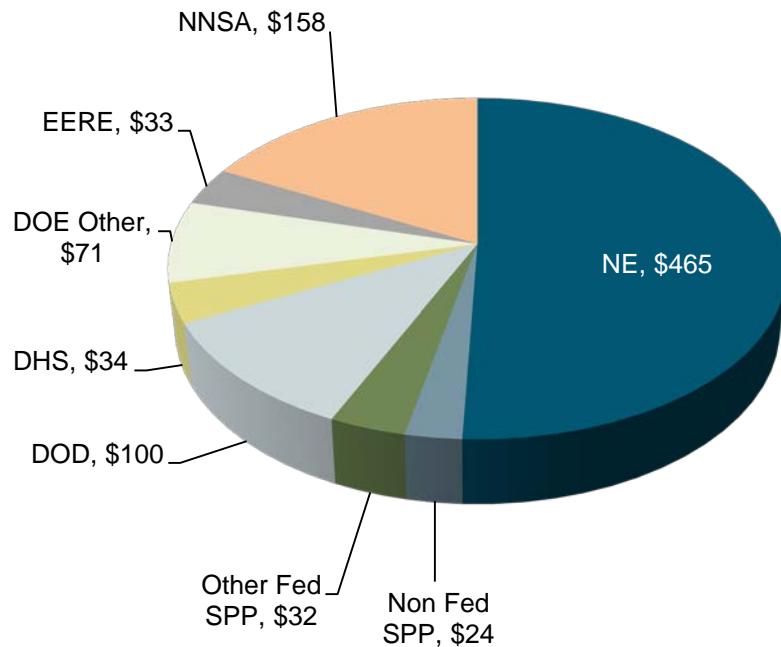
## **INL Mission**

Discover, demonstrate, and secure innovative nuclear energy solutions, other clean energy options, and critical infrastructure.



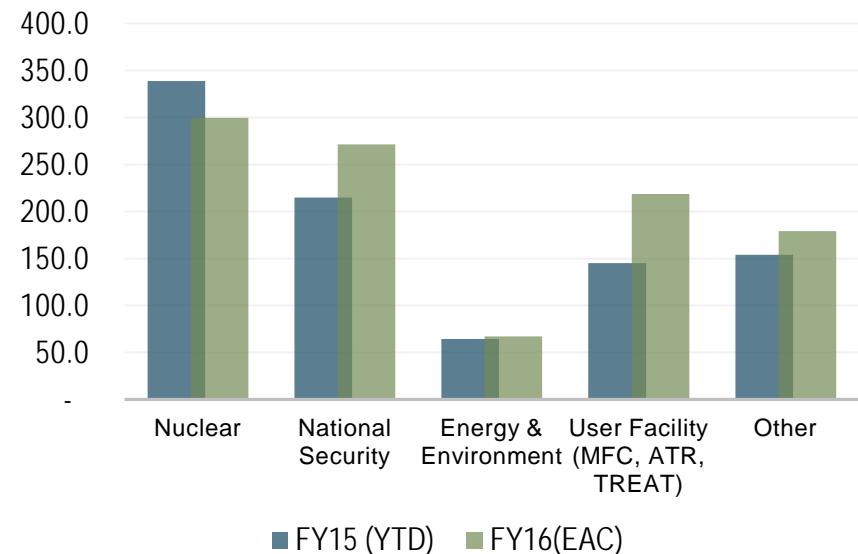
# *INL's FY15 Business Volume Shows Diversity of Funding – We Realized Growth in FY16*

FY15 Business Volume by Customer (\$M)



FY15 Actual (\$917.4M)

FY16 Projected (\$1035M)

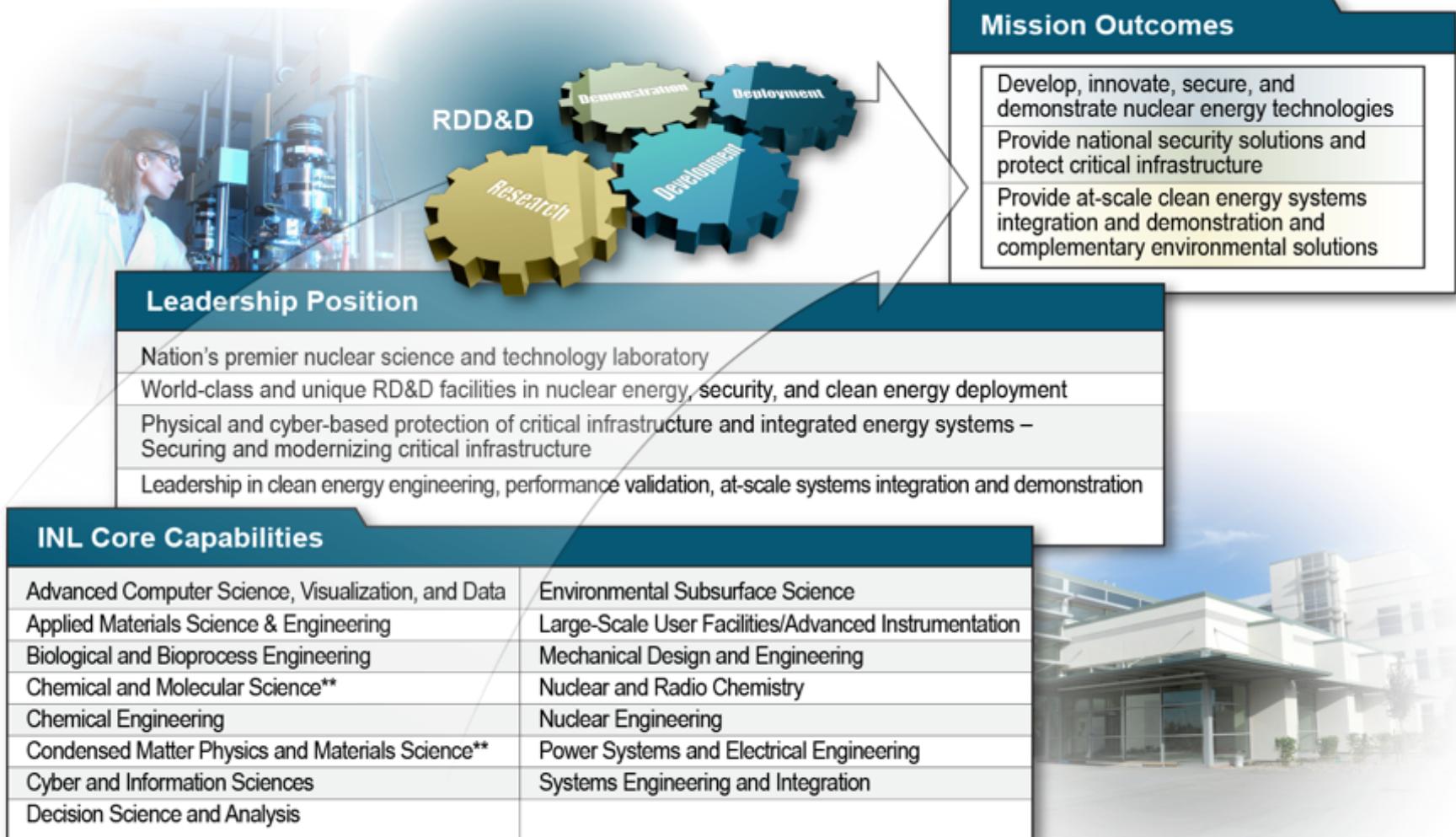


# ***Strategy to Achieve Our Vision and Mission***

- **Focus on grand challenges to meet energy, climate, national security goals**
- **Build world-class scientific and engineering talent pool**
- **Sustain strategic partnerships**
- **Steward world-class RDD&D infrastructure**



# Core Capabilities Lay Foundation For Mission Outcomes



**Leadership Position**

- Nation's premier nuclear science and technology laboratory
- World-class and unique RD&D facilities in nuclear energy, security, and clean energy deployment
- Physical and cyber-based protection of critical infrastructure and integrated energy systems – Securing and modernizing critical infrastructure
- Leadership in clean energy engineering, performance validation, at-scale systems integration and demonstration

**INL Core Capabilities**

Advanced Computer Science, Visualization, and Data	Environmental Subsurface Science
Applied Materials Science & Engineering	Large-Scale User Facilities/Advanced Instrumentation
Biological and Bioprocess Engineering	Mechanical Design and Engineering
Chemical and Molecular Science**	Nuclear and Radio Chemistry
Chemical Engineering	Nuclear Engineering
Condensed Matter Physics and Materials Science**	Power Systems and Electrical Engineering
Cyber and Information Sciences	Systems Engineering and Integration
Decision Science and Analysis	

**Mission Outcomes**

- Develop, innovate, secure, and demonstrate nuclear energy technologies
- Provide national security solutions and protect critical infrastructure
- Provide at-scale clean energy systems integration and demonstration and complementary environmental solutions

# *Enabling Science and Innovation through Partnerships and Collaboration*

Enhance core capabilities, talent, S&T infrastructure, programs, and partnerships

Nuclear energy  
competitiveness  
and leadership



Integrated nuclear fuel  
cycle solutions



Regional clean  
energy systems



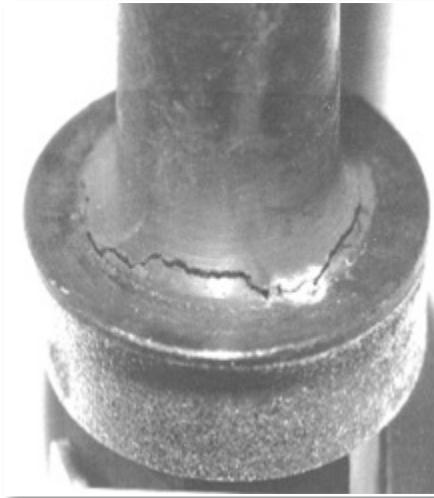
Cyber & physical  
security organized  
around Cybercore  
Integration Center



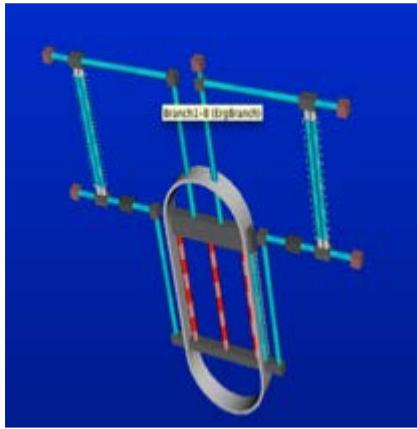
Research, Development, Demonstration, and Deployment

# LWR Sustainability

- Materials aging and degradation
- Risk-informed safety margin characterization
- Advanced instrumentation, information, and control systems technologies
- Reactor safety technologies



*Materials aging and degradation*



*Interactive 3D view of the plant – RELAP-7 example*



*Human systems lab, virtual control room*



# LW Small Modular Reactors

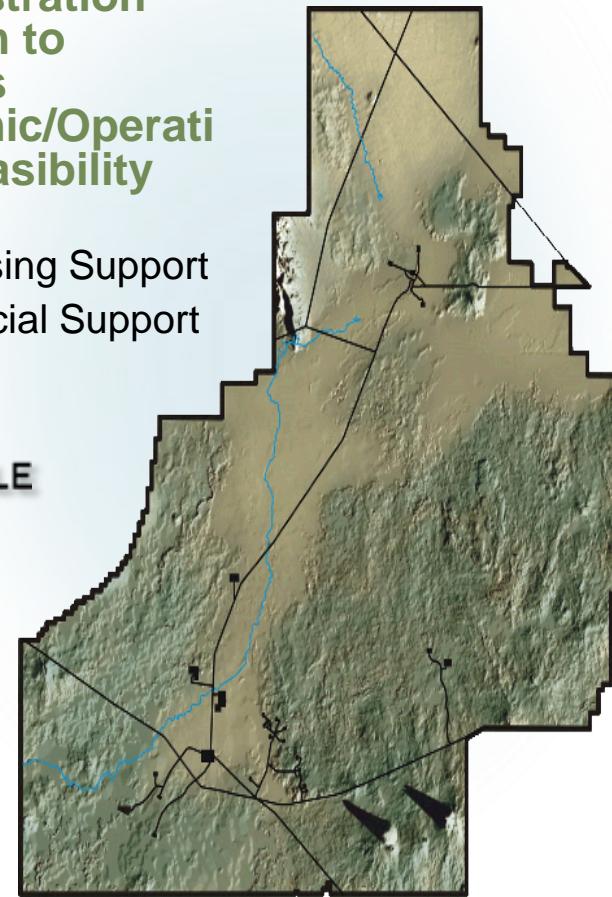
## NuScale Collaboration

- Supporting NuScale with systems integration and design reviews for remote handling and maintenance of modular reactor systems and providing RELAP to complete design documents for the NRC.
- NuScale executed a paid in full, perpetual license for RELAP5-3D for use, sub license, and customization.



Demonstration Platform to Address Economic/Operational Feasibility

- Site
- Licensing Support
- Financial Support



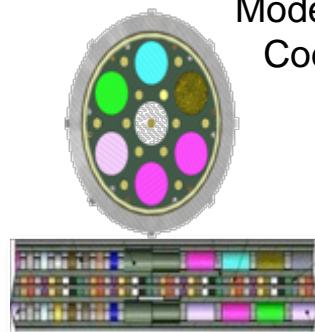
# HTGR Technology Development and Fuel Qualification



High Temperature **Materials**  
Characterization, Testing, and  
Codification

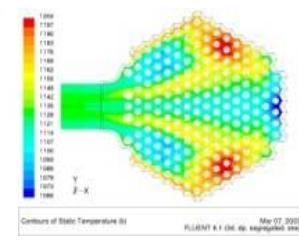
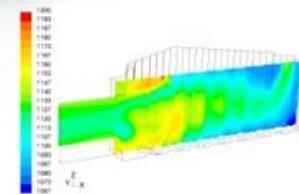


**Graphite**  
Characterization,  
Irradiation Testing,  
Modeling and  
Codification

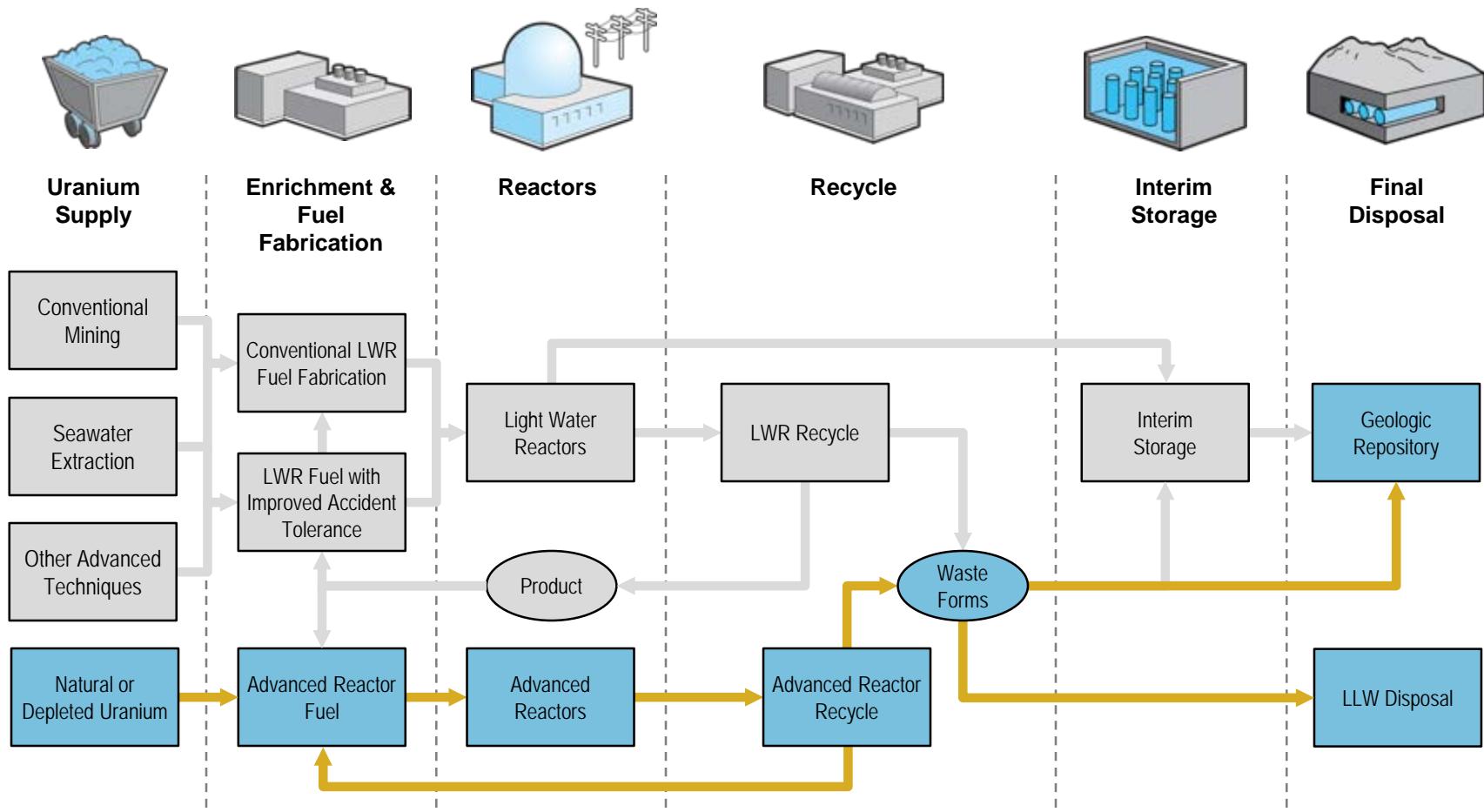


**Fuel** Fabrication,  
Irradiation, and Safety  
Testing

**Design and Safety  
Methods**  
Development and  
Validation



# Future Fuel Cycles Should Align with Advanced Reactor Development and Deployment and Could Incorporate Recycling



# ***Gateway for Accelerated Innovation in Nuclear (GAIN)***



***Removing barriers to a cleaner, safer nuclear energy source***



In parallel, create private-public partnership and funding approach, engage industry on technology needs and focus advanced reactor R&D on common technology needs, innovative designs, and reducing cost of advanced nuclear energy systems.

# Center for Advanced Energy Studies (CAES)

## Collaborative Energy Research

**Explore:** Energy & Environmental Research

**Educate:** Energy & Environmental Education

**Engage:** Apply Knowledge to Industry

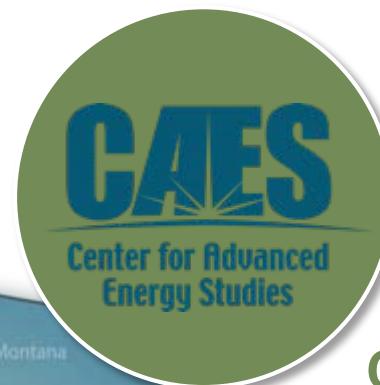
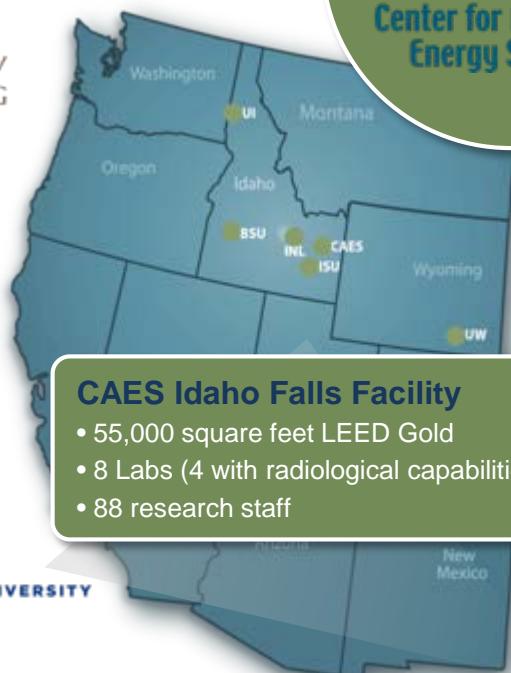
**Enable:** Energy Transitions and Economic Development



University of Idaho

Idaho State  
UNIVERSITY

**B** BOISE STATE UNIVERSITY



## Core Capabilities

- Energy Systems Design and Analyses
- Nuclear Science and Engineering
- Materials Science and Engineering
- Environmental and Resource Sustainability
- Carbon Engineering
- Geological Systems and Applications
- Policy

## CAES by the Numbers

In the past 6 years:

**\$131.8 M**

Research and development funding and equipment acquired

**3754**

Number of students supported by CAES-related projects

**1051**

Number of publications, presentations, and proceedings CAES researchers produced

# *Developing an International Strategy*

- **INL will position itself to be more of an international leader**
  - Working with IAEA, GIF, NEA
  - Continuing ongoing projects with Japan, Korea, France
  - Developing new collaborations
- **Change the way we do business, align with GAIN**
  - Public/Private partnerships
  - International visitors and staff exchanges
- **Become recognized as a focal point for international nuclear energy S&T programs**

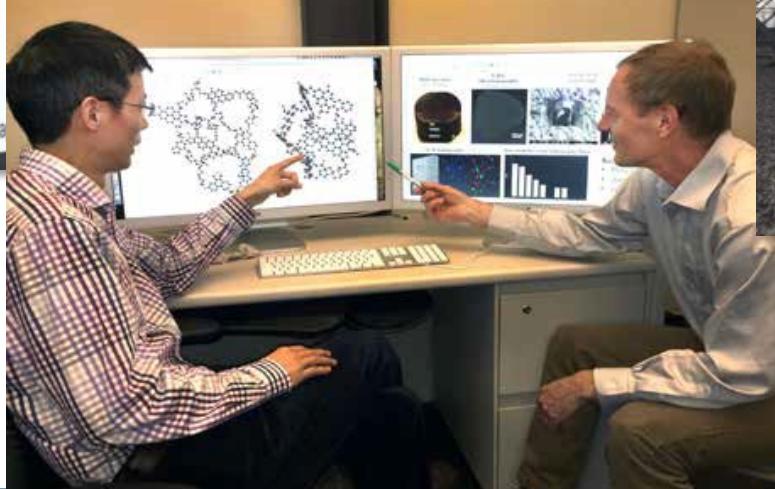
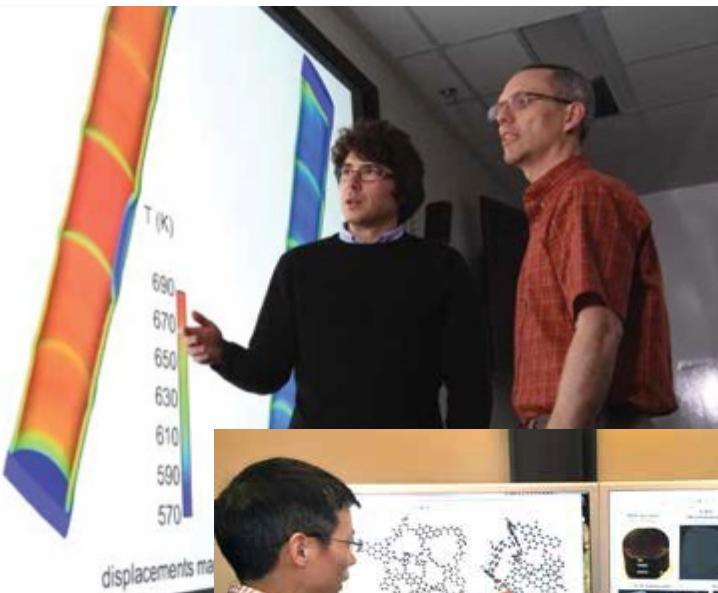


U.S. - Japan TMI-2 Knowledge Transfer Meeting



KJRR Experiment Loading into ATR

# Laboratory Directed Research and Development (LDRD)



# FY17 LDRD Investments are Aligned to Critical Outcomes and will Build S&T Pipeline

FY17 Initiatives	Objective, R&D Areas
Advancing Nuclear Energy	<ul style="list-style-type: none"> <li>• Deliver the Gateway for Accelerated Innovation in Nuclear (GAIN), enable the first-of-kind small modular reactor, advance computational and experimental capabilities</li> <li>• R&amp;D areas:               <ul style="list-style-type: none"> <li>– Fuels and materials, transient testing, fuel cycle material recovery, advanced manufacturing techniques, probabilistic risk assessment, enhancing INL reactors and distinctive experimental facilities</li> <li>– Blue Sky – support innovative ideas in advancing nuclear energy</li> </ul> </li> </ul>
Regional Clean Energy Development	<ul style="list-style-type: none"> <li>• Advance clean energy and environmental systems at scale, accelerate technology deployment through regional innovation and demonstration</li> <li>• R&amp;D areas:               <ul style="list-style-type: none"> <li>– Environmental sustainability, clean energy technology and systems deployment, next-gen transportation, sustainable and efficient manufacturing processes</li> <li>– Blue Sky – support innovative ideas in clean energy development and deployment</li> </ul> </li> </ul>
Critical Infrastructure Protection	<ul style="list-style-type: none"> <li>• Deliver cyber-physical innovations solving urgent national challenges in control systems and infrastructure security, centered on Cybercore Integration Center</li> <li>• R&amp;D areas:               <ul style="list-style-type: none"> <li>– Control systems cyber security, nuclear nonproliferation, defense and intelligent systems, advanced materials, threat analysis</li> <li>– Blue Sky – support innovative ideas in security</li> </ul> </li> </ul>
Russell Heath Postdoctoral Fellowship	<ul style="list-style-type: none"> <li>• Select candidates with highest potential and offer competitive fellowship award, benefits, research environment, mentoring, and training to achieve success at INL</li> </ul>

# *Plan to Grow LDRD/Program Development Over Next 5 Years*

	FY2017	FY2018	FY2019	FY2020	FY2021
Proposed budget (\$M)	\$32	\$36	\$42	\$46	\$49
Estimated operating and capital lab budget (excluding AARA and construction, \$M)	\$1,038	\$1,063	\$1,143	\$1,177	\$1,235
LDRD as a % of Laboratory budget	3.1%	3.4%	3.7%	3.9%	4.0%

## **INL will realize:**

- Growth in impact of programs and commitment to advance energy security, address climate change goals, and grow the economy
- Increased role in nuclear energy, clean energy systems, critical infrastructure protection - nationally and globally
- Strengthen science and engineering staff pipeline

FY15: \$28M, 3.1%  
FY16: \$30M, 2.9%

MOOSE Multiphysics Object Oriented Simulation Environment



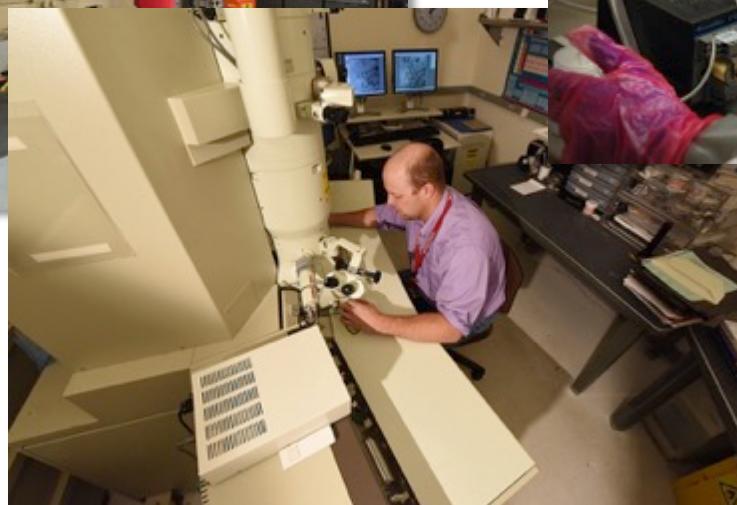
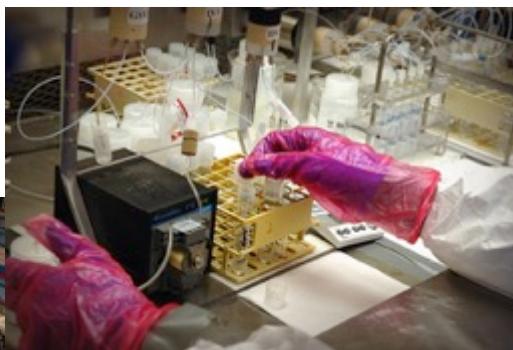
Switchable Polarity Solvent Forward Osmosis



Wireless Spectrum Communications



# Strategic Partnership Projects (SPP) and Industry Engagement

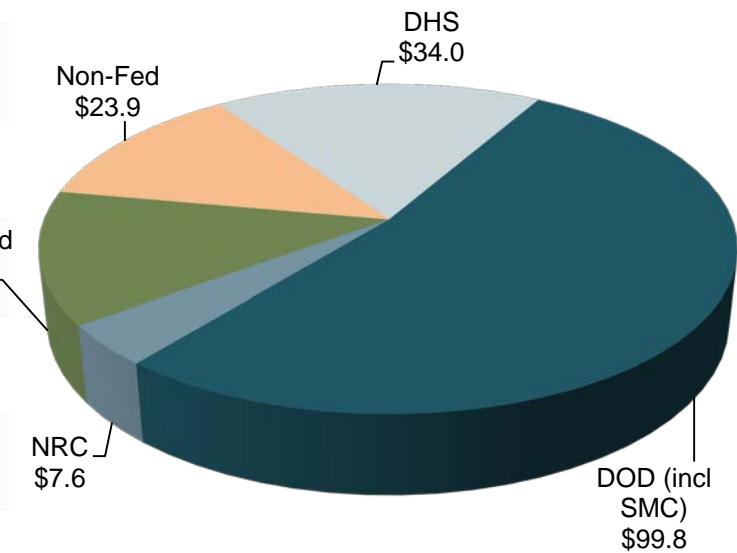


# **SPP Represented 21% of FY15 Costs Distributed Across All INL Mission Areas**

## ***SPP builds multiple core capabilities***

Applied Materials Science and Engineering	DOD, EPRI, Terrapower, KJRR
Cyber and Information Sciences	DHS, DOD
Decision Science and Analysis	DOD, NASA, Canadian Nuclear Safety Commission, NuScale
Mechanical Design and Engineering	DOD, IC, KAERI
Nuclear and Radio Chemistry	NASA, DHS
Nuclear Engineering	NASA, KJRR, X-Energy, NuScale
Power Systems and Electrical Engineering	DHS, DOD, Florida Power and Light, Southern California Edison
System Engineering and Integration	DHS, DOD

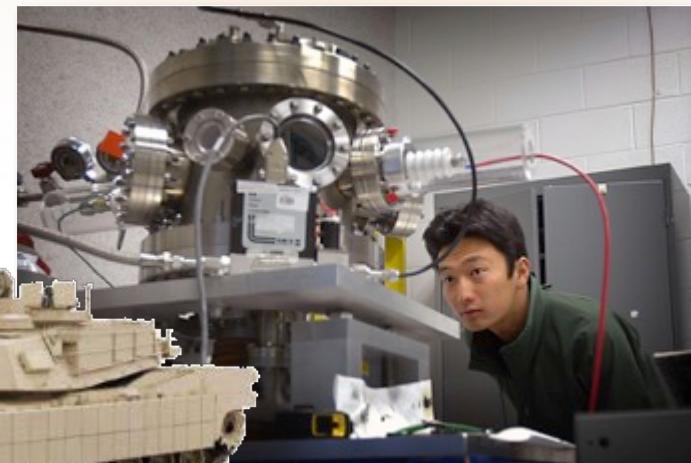
## ***FY15 SPP (\$M) by Customer***



- SPP is 18% without DHS
- Single largest customer (DOD SMC) is 28% of SPP

# ***INL SPP Strategy to Accelerate Deployment of Our Innovation to Market Impact***

- Complementary and enhanced core capabilities and encourages science and innovation
- Balanced portfolio to effectively manage impacts to changes in funding profiles
- Capabilities delivered through use of personnel and infrastructure with incidental use of subcontracted resources
- Enhanced business processes and systems that improve efficiency and are scalable to support increased SPP volume

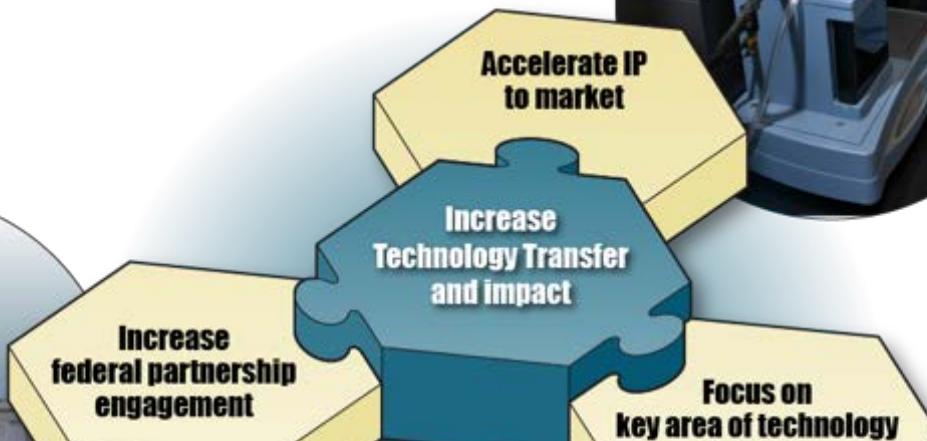


# Working Hand-in-hand With Industry

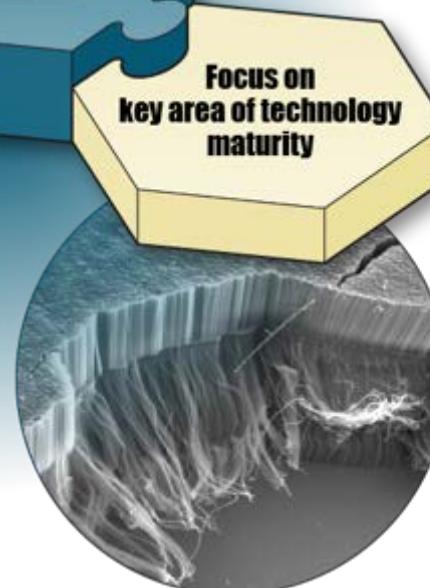
**Increasing the pace of technology to marketplace and fostering economic development**



**DOE impact initiatives**  
Lab Corps, SBV, Technology Commercialization Fund with matching funds from industry



Technology  
Maturation, venture  
capital, SBV



Nuclear modeling and simulation,  
nuclear cyber, wireless  
communications, nuclear  
nonproliferation, biomass  
processing, advanced  
manufacturing

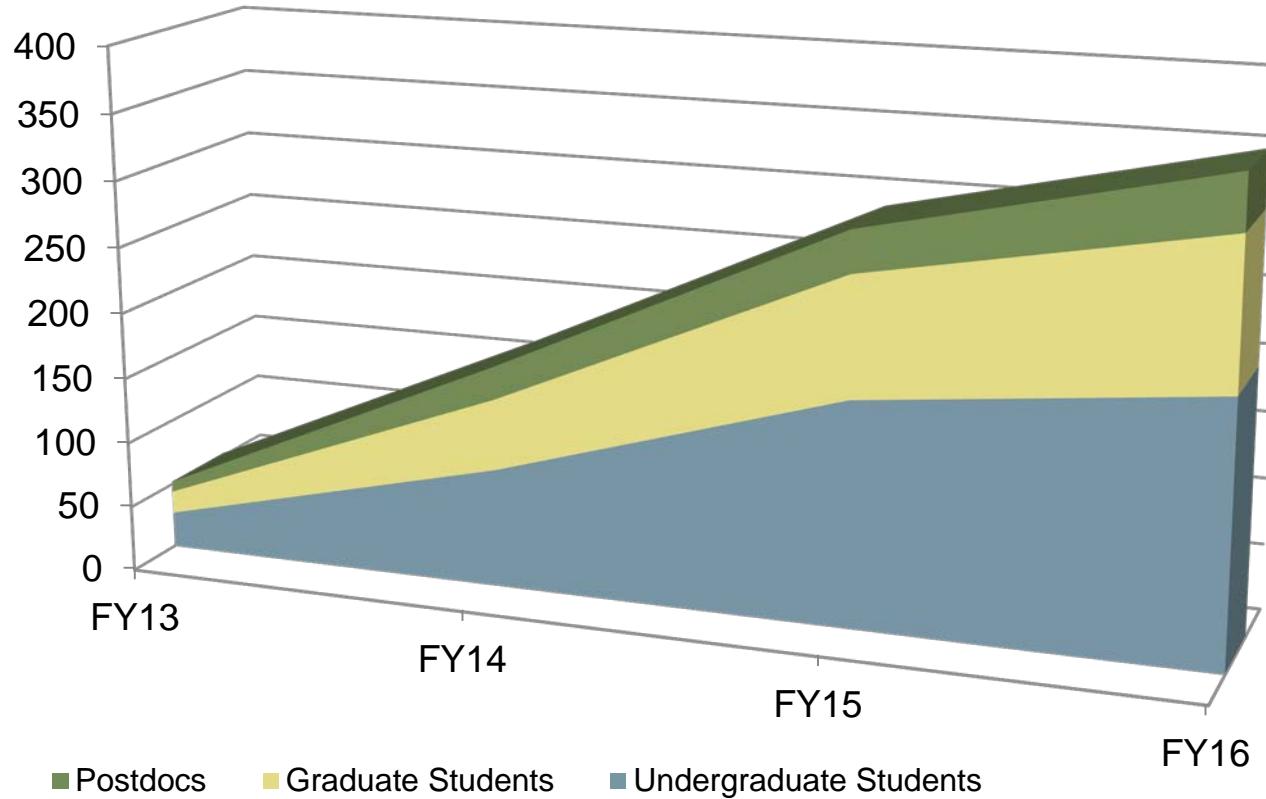
# Human Capital



# *Initiatives to Increase Talent Attraction and Engagement*

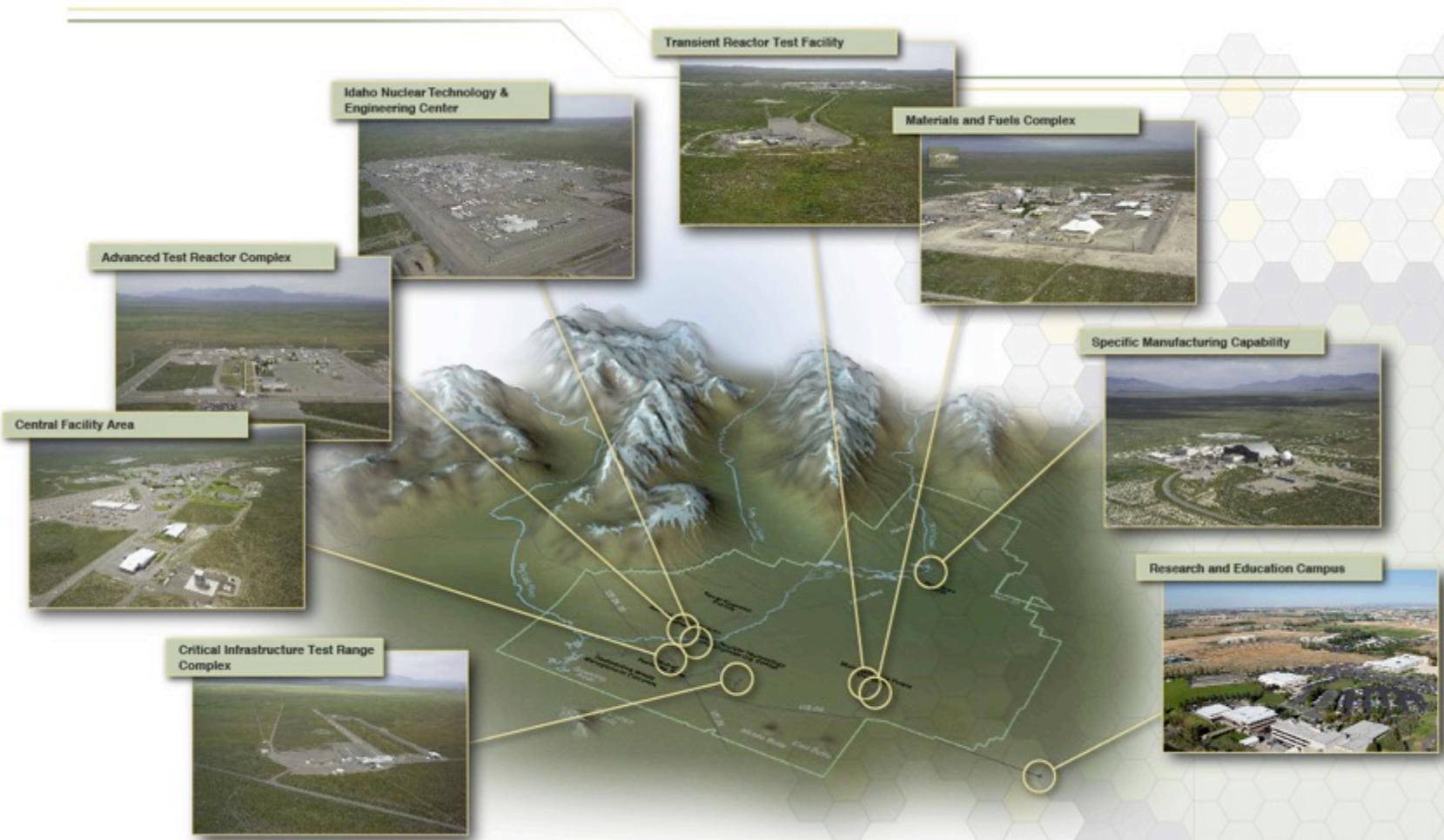
- Increased pace of hiring
- Partnering with universities, community colleges, and technical colleges
- Increased recruiting capability
  - Recruiting and staffing team has doubled in past two years
- Launched new *INL.gov* career page and implementing new applicant tracking system
- Revamped and launched new hire orientation
- Increasing emphasis on diversity and inclusion – both recruiting and workplace
  - Partnered with Professional Diversity Network to increase reach to under-represented candidates
  - Creating a culture of development and inclusion
  - Inclusion and Implicit Bias Interruption training provided across INL
- Strengthening our competitive compensation market position
  - Revamp of our job classification system to more closely match market data

# *INL Building Pipeline Programs*

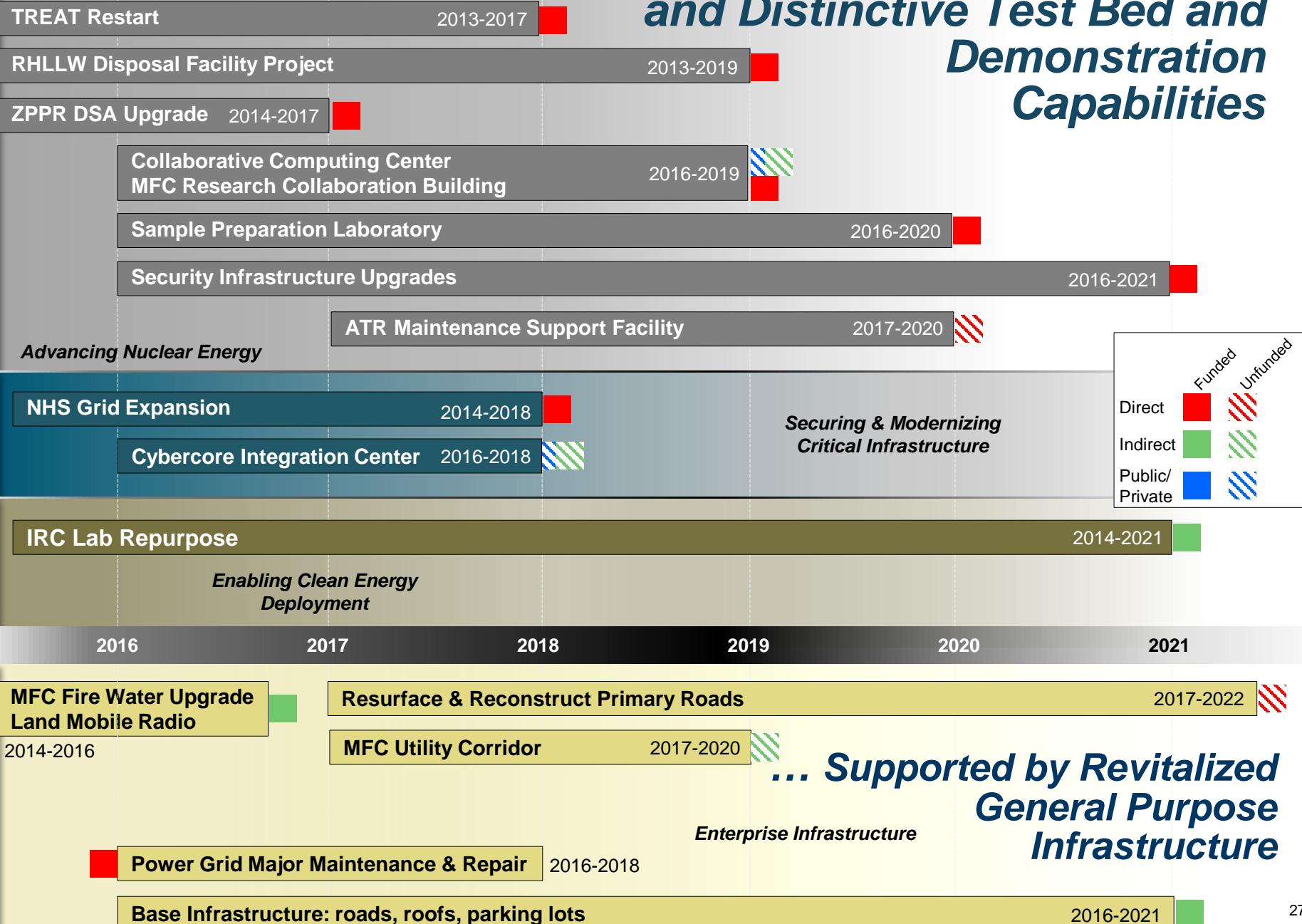


- Postdoc hiring has increased since FY13 across all mission areas
- Internship program feeds pipeline
- Need to increase conversion of interns to regular hires

# Infrastructure/ Mission Readiness

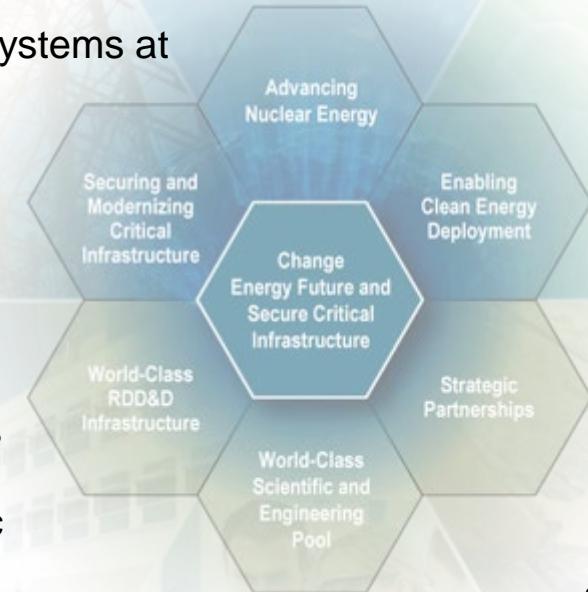


# Infrastructure Strategy: New, Sustained and Distinctive Test Bed and Demonstration Capabilities



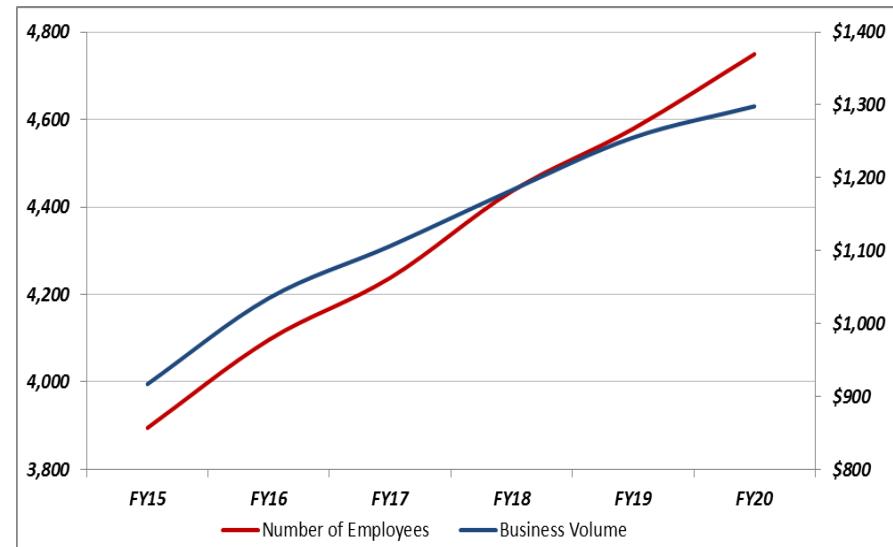
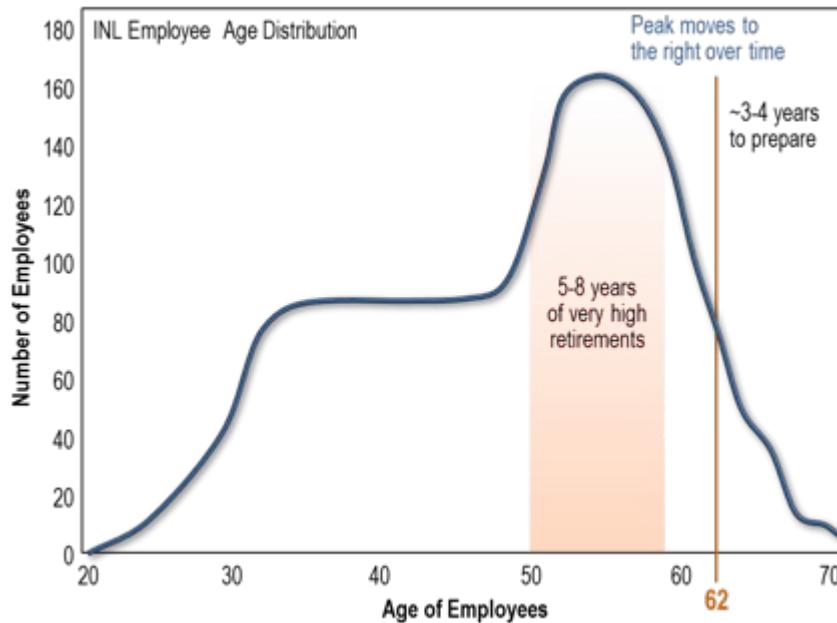
# ***INL Has an Important Mission and a Grand Vision, our Sound Strategic Plan Will Help us Reach our Goals***

- Enhance and build our broad core capabilities to deliver our mission and achieve our vision
- Focus on critical outcomes
  - Ensure GAIN success by expanding testbed capabilities at MFC and ATR, serve as a demonstration platform in partnership with industry
  - Partner with industry to deliver a domestic first-of-a-kind SMR and continue to pave way for innovative advanced reactors and future fuel cycles
  - Advance and demonstrate clean energy and environmental systems at scale through regional innovation and demonstration
  - Develop cyber-physical innovation capabilities, advance cyber-science and engineering, and establish Cybercore Integration Center
- Achieve excellence in safety, security, and operations
  - Develop our talent pipeline
  - Cultivate positive and enduring partnerships at all levels with industry, national laboratories, universities, policymakers
  - Operate reliably, efficiently, and effectively – protect environment, ensure safety and health of staff, visitors, public





# *The Perfect Storm – Talent Pipeline Need is Imperative to INL Future Success*



- Those eligible to retire is growing as Laboratory is growing
- National STEM hiring crisis
- Local competition for talent
- Educational curriculum may not match hiring need

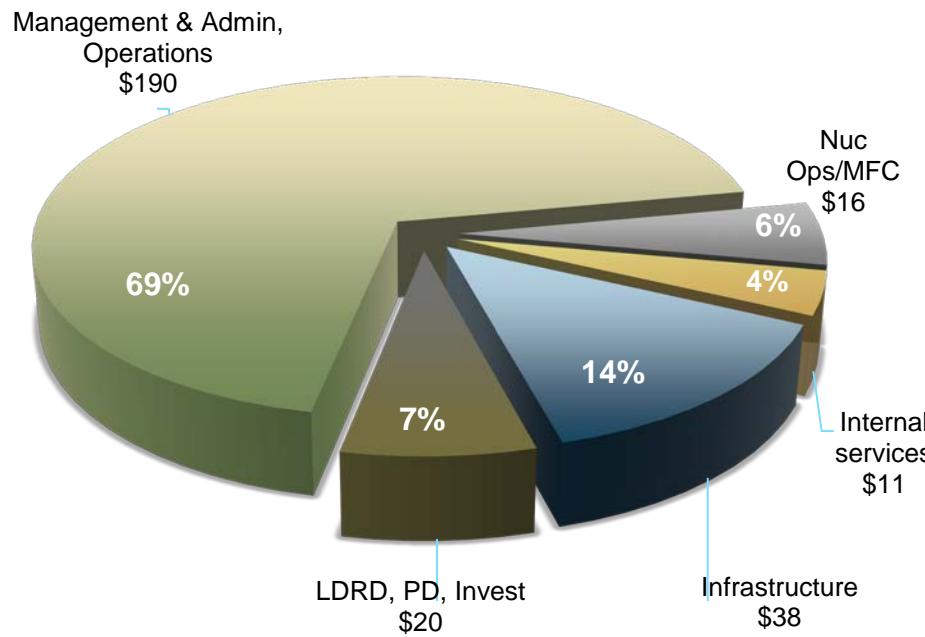
# Cost of Doing Business



# ***INL Has Transformed How The Lab Invests Its Indirect Resources***

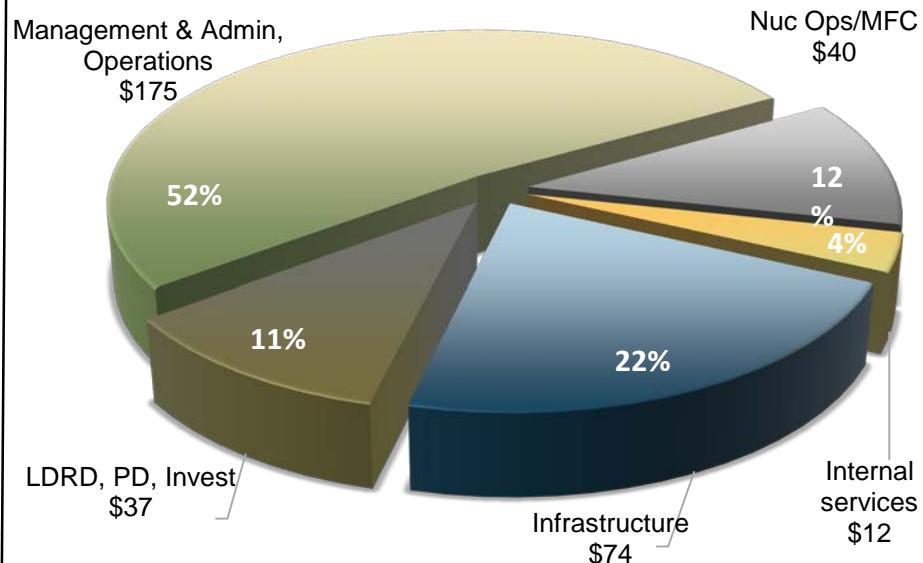
Reduced management, administration, and operations; focus on nuclear operations and infrastructure; increased investments in LDRD and other capabilities

**FY07 Total (\$276M)**



**37.3% of business volume**

**FY15 Total (\$339M)**  
22.8% growth from FY07



**37.0% of business volume**

# Plans to Improve Performance

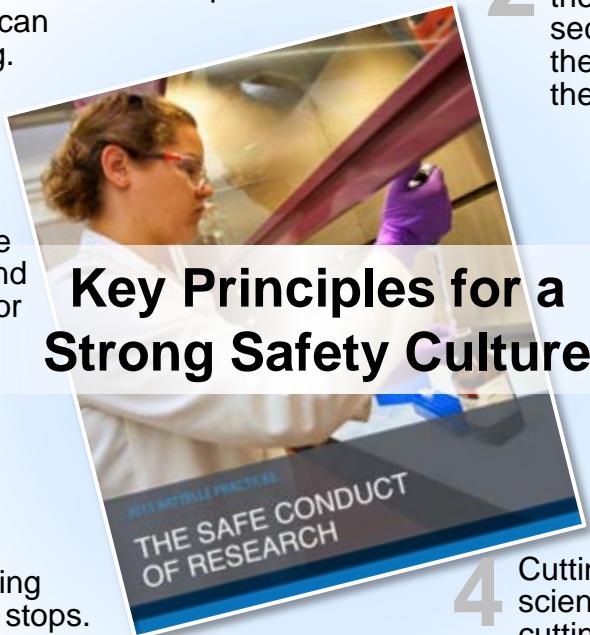


# ***INL's Risk Register Identifies Key Enterprise Risks we are Managing***

Enterprise risks	Assessment of performance	Actions for improvement
Safety	Reverse recent trends	Focus on safety culture and behaviors, Safe Conduct of Research, Lab Director Safety Council
Security	Rapidly evolving and increasing cyber threat	Implement MFA, industrial control cyber security program, modernize boundary protection technology, upgrade aging infrastructure
Budget and funding	Indirect affordability insufficient to address infrastructure needs	R&D Capability Management Model
Scientific and technical reputation	Better understand scientific impact of our work, be able to provide metrics-based evidence to support our claimed leadership positions	Initiative to measure research productivity
Maintaining and upgrading infrastructure	Critical ATR, MFC capabilities are aging	Improve reliability of existing capabilities, while ensuring continued delivery of mission
People	Increasing retirement rate, growing lab programs, STEM hiring crises, competition for talent, mismatch of educational curriculum	Initiatives to increase talent attraction and engagement, partnership solution, local and regional initiatives

# Safety and Security as a Vital Focus

**8** A healthy respect is maintained for what can go wrong.



## Key Principles for a Strong Safety Culture

**7** Hazards are identified and evaluated for every task, every time.

**6** Learning never stops.

**1** Everyone is personally responsible for ensuring safe operations.

**2** Leaders value the safety and security legacy they create in their discipline.

**3** Staff raise safety concerns because trust permeates the organization.

**4** Cutting-edge science requires cutting-edge safety and security.

**5** A questioning attitude is cultivated.

**INL values the safety and security of our employees and protection of our assets and the environment.**



*Employees doing things right for the right reasons, even when no one else is looking*