The Department of Energy's National Laboratory Complex

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From the Secretary's 2014 Strategic Plan

"We will strengthen Department and national missions through cross-cutting initiatives that leverage the science, technology and engineering capabilities in program offices and the DOE national laboratories."

- National laboratories solve important problems in fundamental science, energy, and national security.
- National laboratories steward vital scientific and engineering capabilities including technology transfer that are essential to our nation's continued science and technology primacy in a rapidly changing world.
- National laboratories design, build, and operate unique scientific instrumentation and facilities that serve tens of thousands of scientists and engineers from academia, government, and industry collaborating on solutions to pressing and complex problems.
- National laboratories promote innovation that advances U.S. economic competitiveness and contributes to our future prosperity.

Ernest Moniz, Secretary of Energy, March 2014

A special role as trusted advisors to problems of national interest

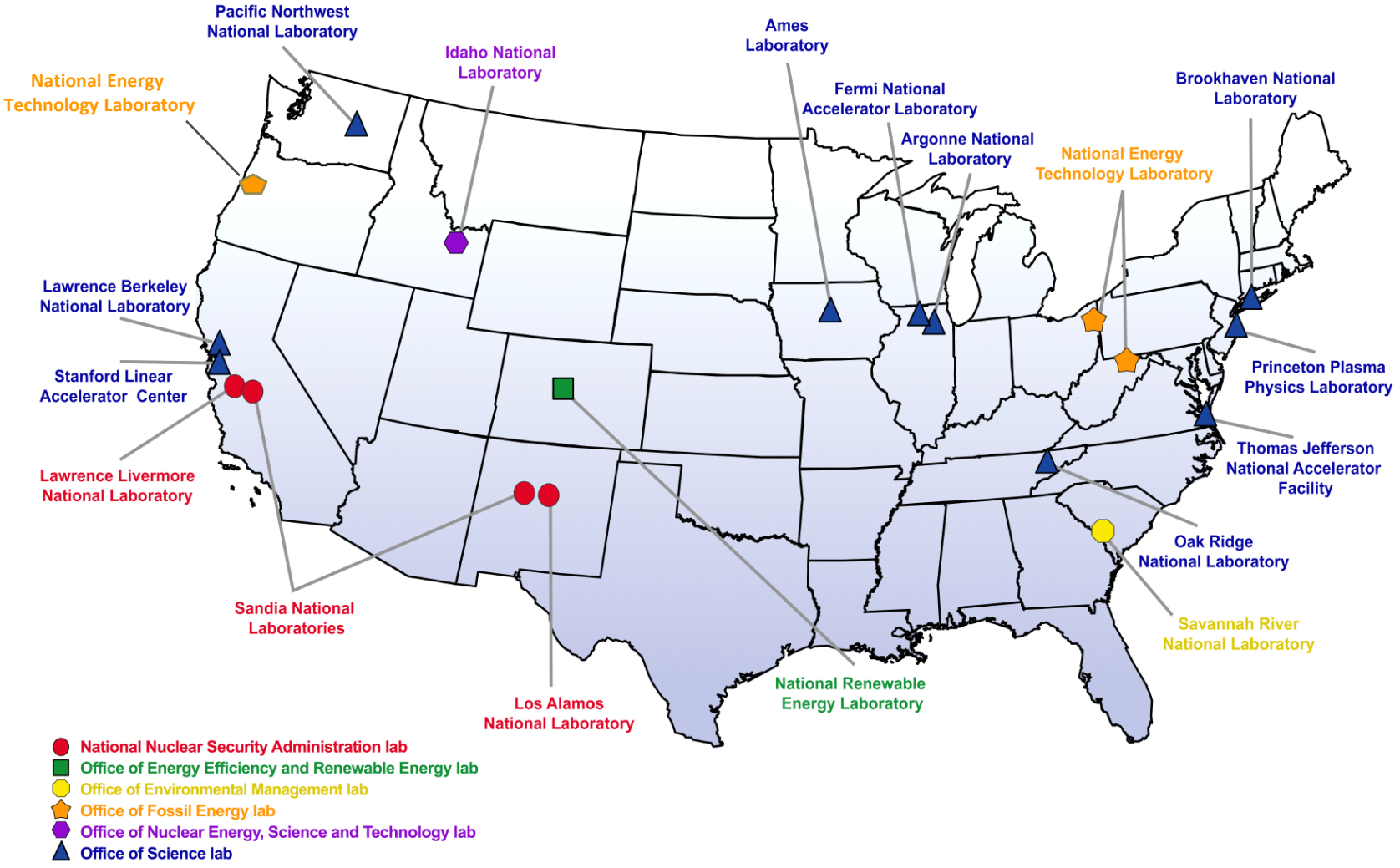
DOE Laboratories are places where

- basic science can be drawn into complex national missions.
- specific mission needs evolve in time, but the need for a deep bench of expertise does not.
- unique skills to develop, maintain and deliver them

DOE Laboratories are interdependent

- DOE programs draw from the core competencies across the DOE lab enterprise
- Lab to lab cooperation and competition; a historical construct still important today (eg computing)

The Department of Energy Laboratory Complex



Some basic terms related to labs:

- 16 or 17 DOE labs are Federally Funded R&D Centers
  - This defines the nature of their missions and what they do
- DOE maintains 16 of the 17 labs as GOCOs – Government owned and contractor operated.
  - Government turns to FFRDCs when we cannot find others to deliver on these national missions.
- DOE runs the FFRDCs under Management and Operations (M&O) contracts
  - This defines the contractual nature of the relationship between the government and the labs and how we conduct business together

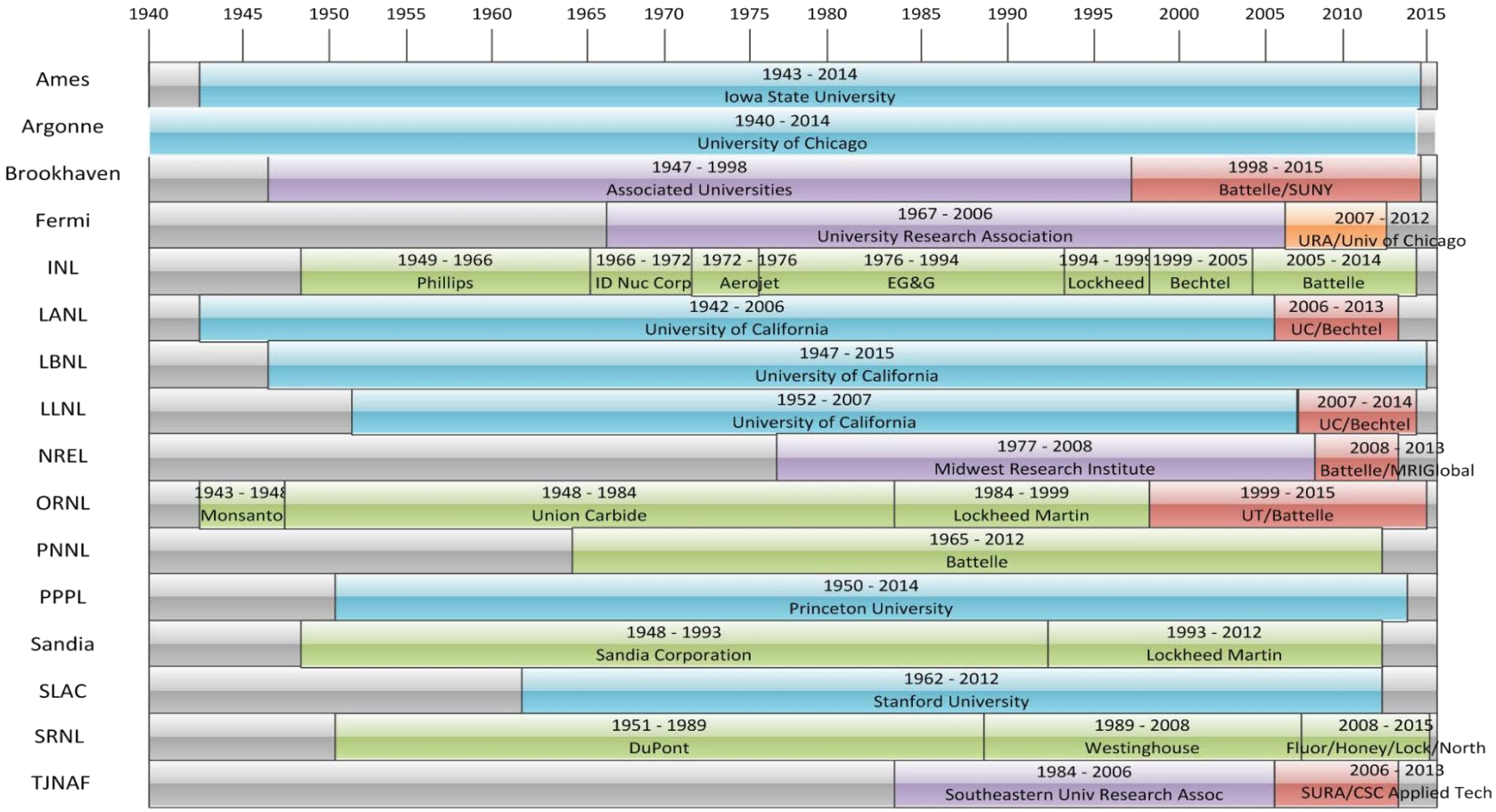
Some Details: Federally Funded R&D Centers (FFRDCs)

- FFRDC status identifies a laboratory or facility as a member of a group of unique organizations formed to assist the United States government in addressing specific long-term areas of considerable complexity.
- FFRDCs must: *(FAR § 35.017)*
  - *meet a special long-term government R&D need that cannot be met as effectively by the government or the private sector;*
  - *work in the public interest with objectivity and independence, and with full disclosure to the sponsoring agency;*
  - *operate as an autonomous organization or identifiable operating unit of a parent organization;*
  - *preserve familiarity with the needs of its sponsor(s) and retain a long-term relationship that attracts high quality personnel;*
  - *maintain currency in field(s) of expertise and provide a quick response capability.*
- Agencies have the ability to create and retire their FFRDCs.
- Should not be job-shops.

GOCOs & GOGOs

- GOCO (Government Owned/Contractor Operated) operated laboratories are owned by the Federal Government, but managed by contractors.
- Contractors may be individual universities, university consortia, private companies, or nonprofits. GOCO dates back to the original laboratories of the Manhattan Project.
- Most Federal laboratories are GOGOs (Government Owned/Government Operated); all but one of DOE's laboratories (NETL) are GOCOs.
- GOCO researchers are not Federal employees and have more freedom than GOGO scientists. GOCO employees can assert copyrights, consult with industry, and participate in start-ups based on technology developed at the laboratory.
- All FFRDCs are GOCOs, but not all GOCOs are FFRDCs.

Historic GOCO management



DOE's M&O Contracts

- DOE's FFRDCs operate under management and operating (M&O) contracts—a special Federal Acquisition Regulation (FAR) designation for GOCO facilities such as DOE's— which has additional provisions for addressing personal conflicts of interest.

- Has at its origin the character of work done through the Manhattan Engineer District, but the designation dates back to a Secretary of Energy memorandum (October 5, 1983) .

- M&O contracts are "an agreement under which the Government contracts for the operation, maintenance, or support, on its behalf, of a Government-owned or -controlled research, development, special production, or testing establishment wholly or principally devoted to one or more major programs of the contracting Federal agency." (FAR § 17.601)

- Requirements exist for the use of the M&O form of contract, including a close relationship with the contractor and the contractor's personnel in important areas. The work is closely related to the agency's mission and is of a long-term or continuing nature. (FAR § 17.604)

Characteristics of M&O Contracts

Atomic Energy Act of 1946 - captured basic principles of employing highly capable companies and educational institutions to carry out the actual performance of the agency's mission rather than civil servants.

1. Generally, the contractor assumes multi-program scientific and technical responsibilities and work under a broad statement of work.
2. The requirement is continuing with no foreseeable end.
3. The contractor is responsible for integration of scientific and technical and infrastructure functions.
4. The contractor performs the substantial portion of scientific and technical responsibilities with its own workforce.
5. The contractor's workforce is large, remaining at the site despite change of contractors. This results in the need for DOE to assume stewardship of employee relations and workplace labor conditions.
6. DOE oversees security, health, and safety at the site.
7. Work takes place at very large, Government-owned reservations and facilities.
8. DOE requires the successful offeror to form a corporate entity specifically for and dedicated to the performance of the DOE M&O contract. The contactor may accept work only directly from DOE or as allowed specifically under the M&O contract.

Science

THE Ames Laboratory
Creating Materials & Energy Solutions
U.S. DEPARTMENT OF ENERGY

Founded 1947 (1942)
8 acres, 12 buildings
210 staff
149 students

$34.7 M in FY12 DOE

Argonne NATIONAL LABORATORY

Founded 1946 (1942)
1,500 acres
99 buildings
3400 staff
812 students
979 post-docs
5,525 facility users

$731 M in FY12 DOE

BROOKHAVEN NATIONAL LABORATORY

Founded 1947
5,320 acres
302 buildings
2,989 staff
399 students
1,348 visiting scientists

$682 M in FY12 DOE

Fermilab

Founded 1967
6,800 acres
362 buildings
1,757 staff
32 visiting scientists
4,300 facility users

$414 M in FY12 DOE

BERKELEY LAB

Founded 1931
202 acres
97 buildings
3,395 staff
493 students
1,524 visiting scientists

$736 M in FY12 DOE

OAK RIDGE National Laboratory

Founded 1943
4,421 acres
196 buildings
4,368 staff
520 students
2,280 visiting scientists
3,115 facility users

$1,450 M in FY12 DOE funding

Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

Founded 1965
670 acres
95 buildings
3,922 staff
366 students
49 visiting scientists
2,400 facility users

$786 M in FY12 DOE funding

PPPL PRINCETON PLASMA PHYSICS LABORATORY

Founded 1961 (1951)
89 acres
34 buildings
414 staff
40 students
300 visiting scientists

$82.2 M in FY12 DOE funding

SLAC NATIONAL ACCELERATOR LABORATORY

Founded 1962
426 acres
151 buildings
1,684 staff
124 students
31 visiting scientists
3,411 facility users

$342 M in FY12 DOE funding

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Founded 1984
169 acres
83 buildings
759 staff
43 students
1,385 facility users

$172 M in FY12 DOE funding

Energy

Idaho National Laboratory

Founded 1975 (1949)
569,600 acres
327 buildings
3,460 staff
191 students
110 visiting scientists
3,600 facility users

$1,310 M in FY12 DOE funding

NETL

Founded 1999 (1910)
5 separate campuses
242 acres
114 buildings
1,359 staff
191 students
135 visiting scientists
80 postdocs

$713 M in FY12 DOE funding

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Founded 1977
2 campuses
632 acres
61 buildings
1,518 staff
65 students
69 postdocs
1,049 contractors/ flexible workforce

$267 M in FY12 DOE funding

Nuclear

Lawrence Livermore National Laboratory

Founded 1952
768 acres
684 buildings
5,855 staff
415 students
232 postdocs

$1,660 M in FY12 DOE funding

Los Alamos
NATIONAL LABORATORY
EST. 1943

Founded 1943
23,040 acres
1,280 buildings
6,794 staff
884 students
955 visiting scientists
399 postdocs
1,187 contractors/ flex workforce

$2,005 M in FY12 DOE funding

Sandia National Laboratories

Founded 1948 (1945)
6 campuses
14,168 acres
417 buildings
10,460 staff
540 students

$1,650 M in FY12 DOE funding

Env. Management

Savannah River National Laboratory™
OPERATED BY SAVANNAH RIVER NUCLEAR SOLUTIONS

Founded 1951
34 acres
80 buildings
932 staff

$34.0 M in FY12 DOE funding

Additional dimensions on how to think of the Laboratories

User Facilities: Laboratories design and operate one of a kind facilities whose main focus is to drive DOE mission needs in:

- Open science
  - broadly open internationally to best ideas based on merit
- Closed science
  - focused on developing science in disciplines that are not broadly published or are closely tied to national security missions and issues
  - Can involve international partners on targeted problems

Peer Review in unique disciplines

- Historically labs with non-overlapping missions were expected to work together; those with similar missions were asked to support peer review. (nb NAS)

Training and Education

User Facilities are key National Lab resources

- Federally sponsored research facilities ;
- Facility capabilities do not compete with an available private sector capability;
- Facilities are closely tied to expertise resident at that site;
- They come in two broad categories

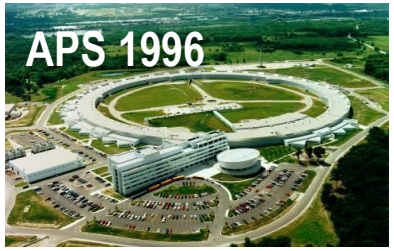
Open user facility source: http://science.energy.gov/~/media/_/pdf/user-facilities/Office_of_Science_User_Facility_Definition_Memo.pdf

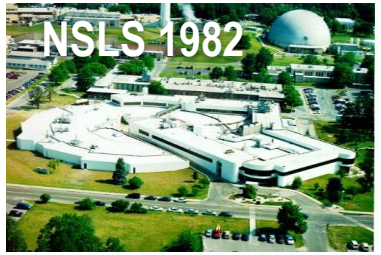
‘Open’ & ‘Closed’ User Facilities Serve Broad Constituencies

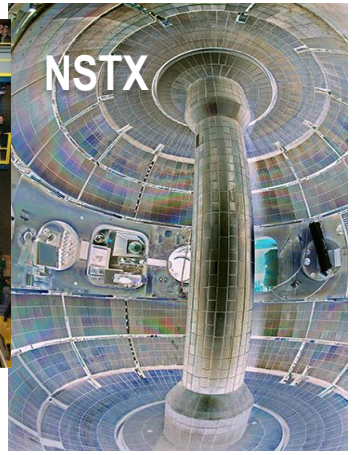
- An **‘open’** scientific user facility is a available for external use to advance scientific or technical knowledge under the following conditions:
  - The facility is open to all interested potential users without regard to nationality or institutional affiliation.
  - User fees are not charged for non-proprietary work if the user intends to publish the research results in the open literature. Full cost recovery is required for proprietary work. The facility provides resources sufficient for users to conduct work safely and efficiently.
  - The facility supports a formal user organization to represent the users and facilitate sharing of information, forming collaborations, and organizing research efforts among users.
  - Allocation of facility resources is determined by merit review of the proposed work;
- A **‘closed’** scientific or engineering user facility is available across the complex to address pressing national security questions including everything from basic science to manufacturing, production and aging issues.
  - Testbeds for large scale experiments
  - Includes foreign partners and work from other federal agencies
  - Prioritized and reviewed according to overall national security priorities and urgency

User Facilities serve a variety of scientific purposes

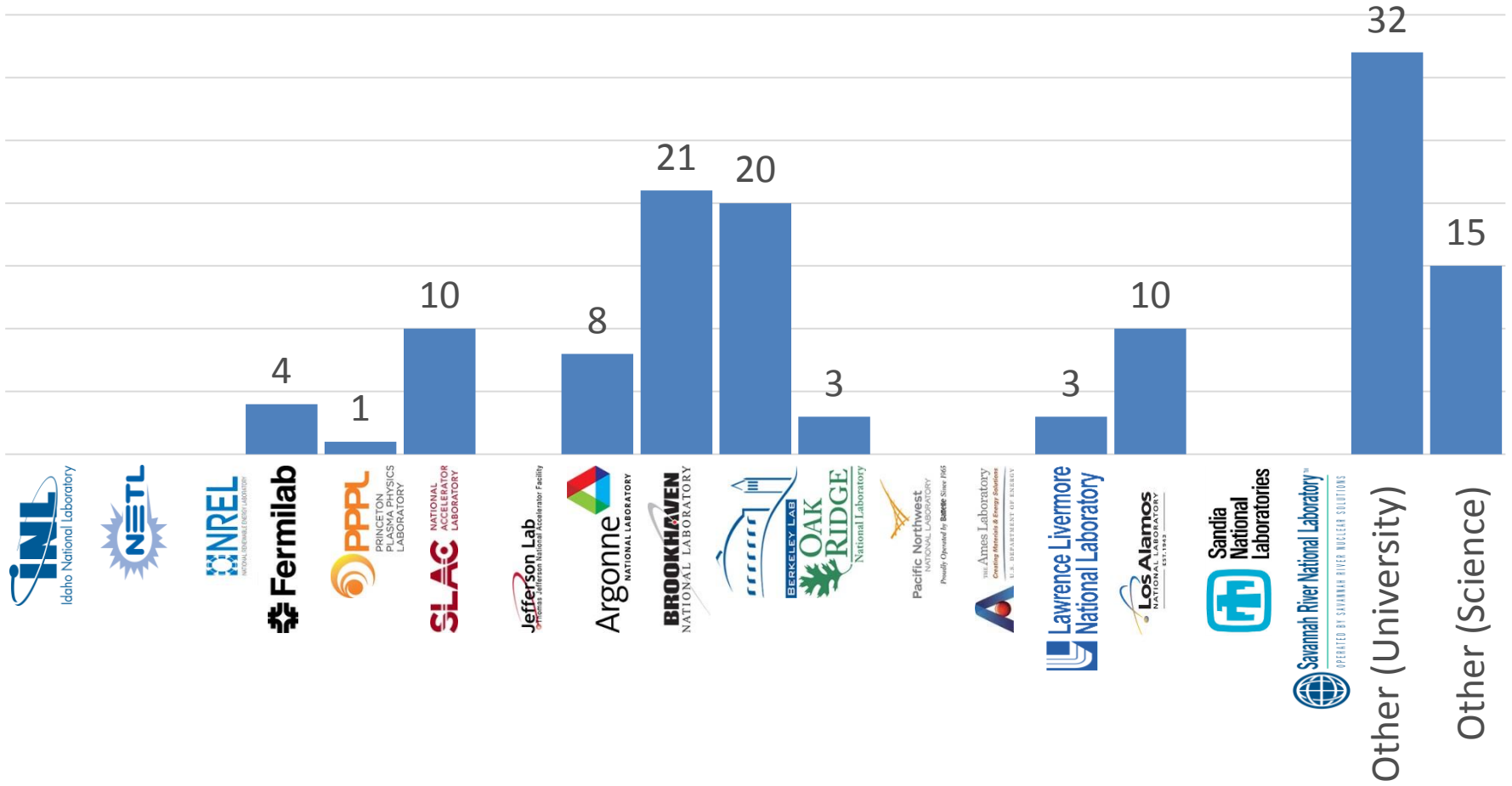
- Open User Facilities:
  - Five photon (light) sources
    - APS, ALS, NSLS, SSRL, LCLS
  - Three high-flux neutron sources
    - SNS, HFIR, Lujan
  - Three electron beam microcharacterization centers
    - EMCMR, NCEM, SHaRE
  - Five nanoscale science centers
    - CNMS, MF, CINT, CFN, CNM
  - Three high-performance computing facilities
    - NERSC, OLCF, ALCF
  - Several high-energy physics and nuclear physics facilities
    - Tevatron, CEBAF, RHIC, ATLAS, HRIBF
  - Multiple biological and environmental facilities
    - EMSL, JGI, ARM
  - Three fusion research facilities
    - DIII-D, Alcator C-Mod, NSTX







DOE's Nobel winners by Laboratory



‘Closed’ or more narrowly focused user facilities

- Hydrodynamic Testing & Radiography
  - DARHT, P-Rad, Confined Firing Facility
- High-Energy Density Physics
  - NIF, Z, Omega
- Test ranges
  - NNSS, INL, KTF, Tonopah
- High-explosive R,D, T&E
  - BEEF, HEAF
- Actinide Physics
  - U1a, PF-4, CMR, Superblock
- (Classified) High-performance computing facilities
  - Terascale Facility (LLNL) & Metropolis Center (LANL)
    - » Secret/Restricted Data facilities
  - NSCC (SNL)
    - » SCI computing facility
- Nuclear Physics & Neutrons
  - LANSCE, Lujan, WNR
- Fabrication and Production Design and Testing
  - Sigma, MSL
- Gas-guns & Flyer plates
  - JASPER, Large-Bore power gun, STAR, DICE
- Micro-electronics/mesoscale centers
  - MESA, CINT
- Environmental testing (‘shake, rattle & roll’)
  - Hermes, Saturn, ACRR, IBL
  - Sleds, thermal, shock, …
- DAF,…

DOE's national security missions rely on the entire Laboratory complex

National security missions of the DOE sites include the unique critical skills and capabilities beyond LLNL, LANL and SNL. Key work is conducted at:

- **Pacific Northwest National Lab**
- **Oak Ridge National Lab**
- **Argonne National Lab**
- **Idaho National Lab**
- **Brookhaven National Lab**
- **Savannah River Site**
- **Lawrence Berkeley National Laboratory**
- **New Brunswick Lab**

In addition:

- Inter-lab scientific collaboration in key areas (e.g.Computing)
- Cohesion in the complex strengthens NNSA labs' ability to engage in Peer Review in more specialized mission areas

DOE's open scientific and energy missions rely on national security sites as critical assets

- DOE science facilities at NNSA laboratories help draw talent into missions
  - Center for Integrated Nano-Technology
  - Lujan Neutron Science Center
  - Combustion Research Facility
  - Program for Climate Model Diagnosis and Intercomparison
  - …
- Cross fertilization of missions and labs plays an important role:
  - DOE Office of Science funds at NNSA labs is as important as LDRD in recruiting. Each dollar here has a hugely disproportionate impact on metrics: publications, postdocs,…
  - The nation needs to retain intellectual vitality in fields that do not see too much light of day.
- DOE Energy missions
  - From basic science, testing at scale to cyber security
- The genesis of many of the labs' strengths come from the nuclear weapons: microelectronics, climate, energy,…

DOE labs are campuses for classified work

For national security missions, labs emulate the free exchange of open science by:

- Fostering the exchange of ideas; the Q clearance
- Nurturing Innovation
- Cross-fertilizing across disciplines
- Providing multiple career paths behind the fence
- Enabling a culture of classified peer review
- Providing a stimulating environment to nurture students and postdocs
- Providing access to state-of-the-art computational and experimental facilities.

Labs are institutions of higher learning for national security ST&E

- Training in nuclear weapons science starts with the recruitment of a talented scientist followed by an extensive apprenticeship with mission teams with common goals.
- Cultivate and maintain the right expertise to be responsive to evolving national needs.

DOE Labs maintain and train experts to respond to national nuclear emergencies

Grounded in Mission - The missions foster responsiveness to broader nuclear security concerns:

- Joint Technical Operations Teams
- Foreign Intelligence Analysis
  - *Both real time and ongoing analysis of foreign threats, including DPRK, Iran, …*
- Provide training & exercises: IAEA, DHS, transportation…

Grounded in Capability - Breadth of expertise in ST&E enables a responsiveness to broader national needs:

- National Infrastructure Simulation and Analysis Center (NISAC)
  - *Source of national expertise to address critical infrastructure protection research and analysis*
- National Atmospheric Release Advisory Center (NARAC)
  - *Maps probable spread of hazardous material accidentally or intentionally released into the atmosphere*
- Urgent work in coordination with other federal agencies
- Field Intelligence Elements
- Training utilities in advanced cybersecurity techniques

Summary

- DOE relies on the laboratory complex as an enterprise
- Unique skills are developed and honed and adapted to changing priorities
- The vitality of the enterprise is fed through cross program use of the laboratories
- The Q clearance is an important DOE enterprise element which allows for multiple career paths, mobility, peer review and long-term success in missions
- DOE Laboratories are the places you turn to for complex problems that: are of critical national interest; are informed by a science-based understanding; require something to be built and deployed; are multi-disciplinary; require world-class user facilities.