Los Alamos
NATIONAL LABORATORY

Los Alamos National Laboratory
Overview and Capabilities

Kevin John

Applied Energy Programs Office

March 23, 2023

Western Tribal Carbon Management Technologies Strategies Forum

Los Alamos delivers national security solutions

- **We are dedicated to addressing complex national security issues and the world's most difficult challenges**
  - By applying multidisciplinary science, technology & engineering capabilities;
  - In unique experimental, computational, and nuclear facilities;
  - With an agile, responsive, and innovative workforce;
  - And by partnering with peer institutions for mission success

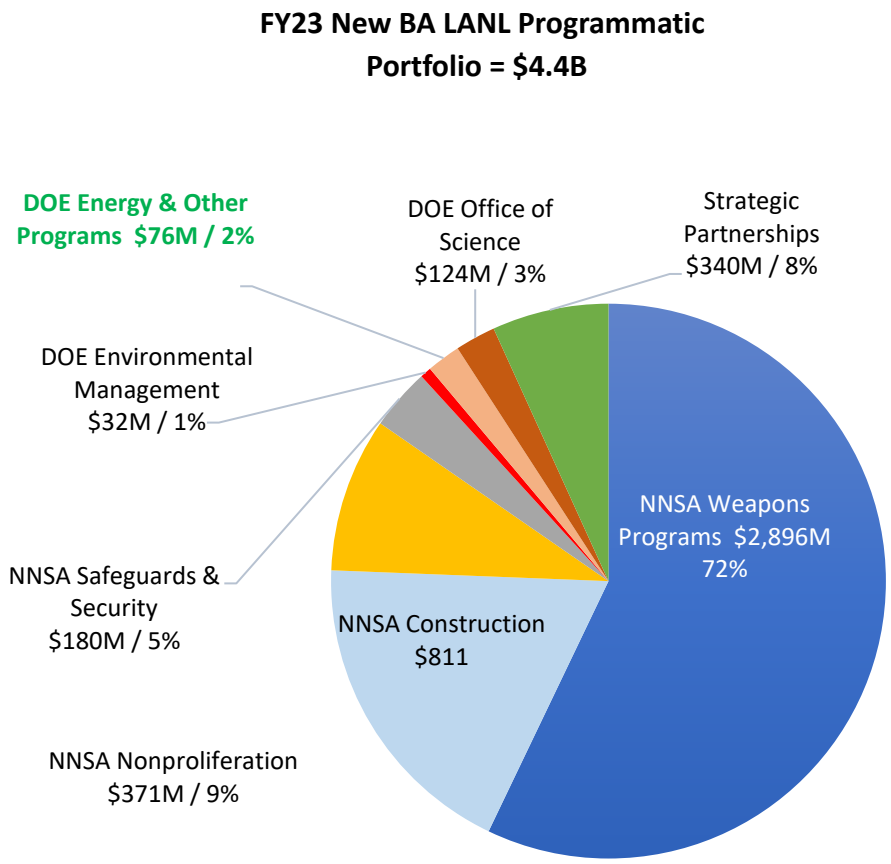
LANL Statistics

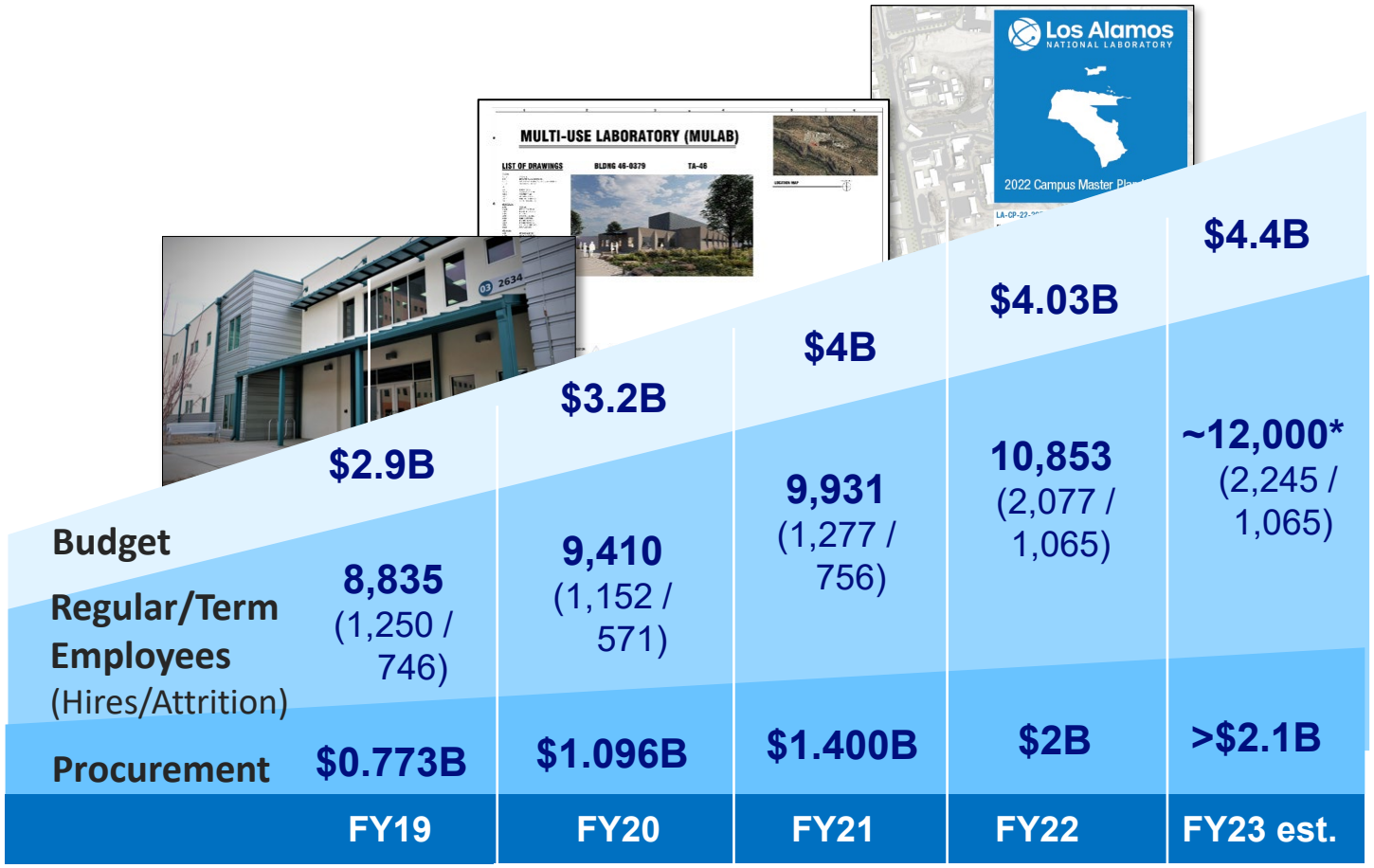
$4.4B budget
40 square miles, 47 technical areas
727 bldgs., 7.6M sq ft.
13 nuclear facilities
17,000 + workers
12,000 career employees
1,812 students, 468 postdocs
Employee average age: 42
67% male; 33% female 49% minorities
40.2% of employees are native New Mexicans

Significant increase in funding has driven hiring and procurement to record highs

Challenge now is to grow our capacity to keep pace with budget increases:

- Leasing, telework, updated infrastructure, and new construction are all critical



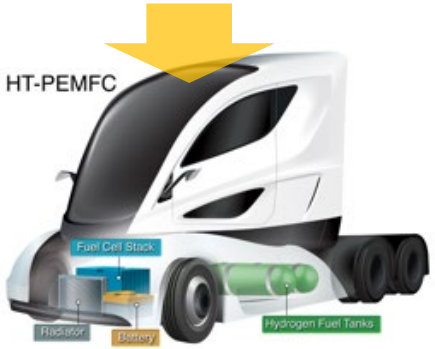


*Total FY23 estimated workforce: ~17,000

Why LANL for Clean Energy? For decades, our core-mission capabilities have helped DOE pioneer new solutions for energy – energy security is national security

Hydrogen for Transportation

Space Propulsion Systems
New energy systems based on hydrogen and nuclear



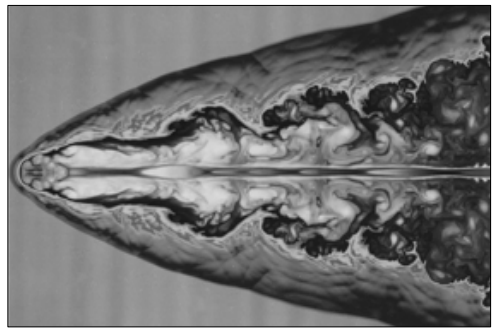
Hydrogen for Vehicles
Novel materials & devices; monitoring

Genomics & Bioinformatics

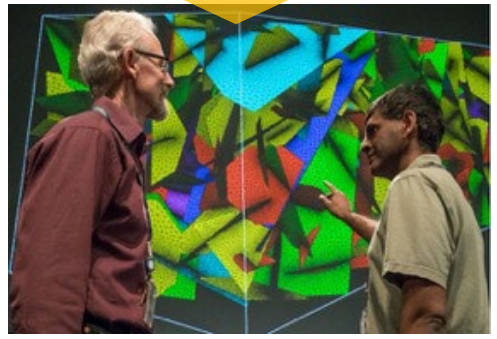
Radiation Effects; Human Genome
Genomics; flow cytometry; GenBank

Biofuels and Bioproducts (Biomanufacturing) Biosensors, computational biology

Virtual Learning for Complex Systems



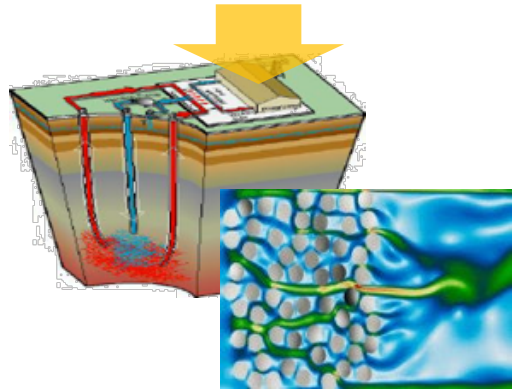
National Security Systems
Physics-based simulation



Complex Energy Systems
Discovery & exploration of new facilities, infrastructure, materials

Flow in Fractured Systems

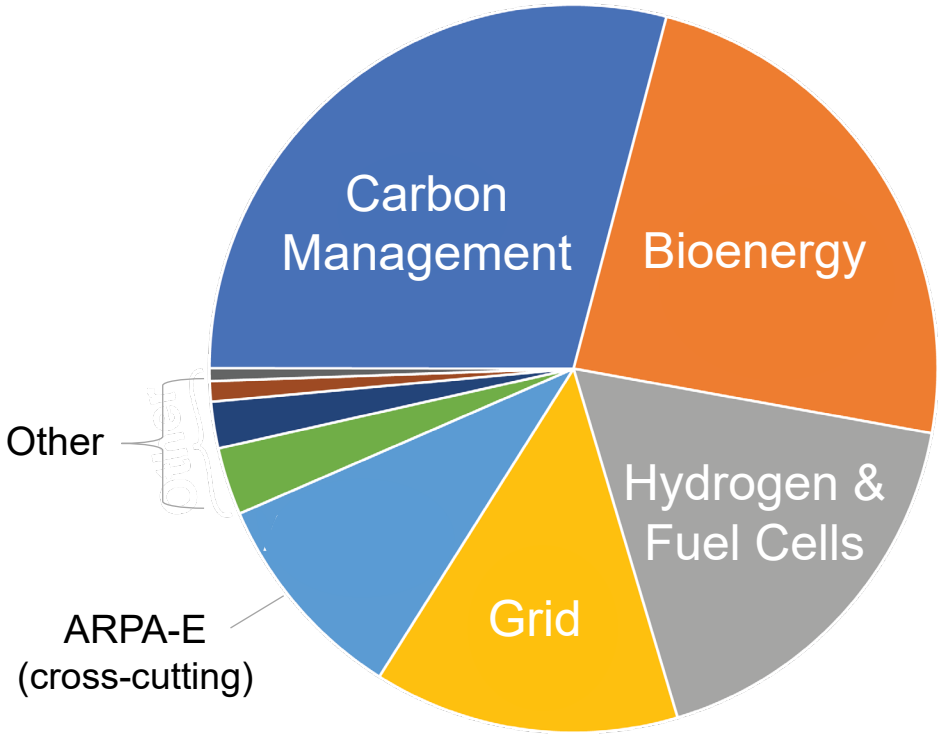
Containment & Nonproliferation
Physics-based simulation; wellbore integrity; monitoring



Engineered Subsurface Systems
Discovery & exploration of subsurface systems; “no leaks, no creaks”

Building on 40+ years of R&D in key areas of energy, Los Alamos is ready to accelerate deployment

Our applied energy portfolio is dominated by 4 key areas



~$40M/year

Technology Deployment

National energy targets

FACT SHEET: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies

On Day One, President Biden fulfilled his promise to rejoin the Paris Agreement and set a course for the United States to tackle the climate crisis at home and abroad, reaching net zero emissions economy-wide by no later than 2050. As part of re-entering the Paris Agreement, he

Subsurface Energy & Carbon Management Programs

Innovative tools and technologies to manage CO_2 capture, storage, and utilization

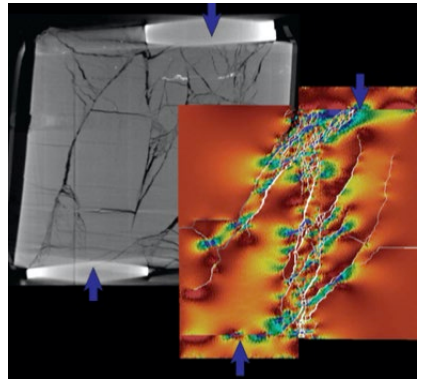
Historical Impacts

- The Los Alamos Hot Dry Rock Program proved that heat from the Earth could be harnessed for power, paving the way for modern-day geothermal work
- Understanding the subsurface for containment and monitoring of our own underground testing was key through the mid-90s
- As focus shifted to nonproliferation verification, new approaches were needed to detect and interpret smaller events

Los Alamos scientists examine a core sample taken from a depth of 13,700 feet at the Fenton Hill geothermal test site.

Current Challenges and Focus

- Today the Laboratory adapts these core capabilities to address challenges related to subsurface energy challenges, including
  - Enabling environmentally-prudent gas recovery from unconventional reservoirs
  - Ensuring wellbore integrity and eliminating fugitive methane leaks
  - Avoiding induced seismicity
  - Optimizing pipeline infrastructure for cost, performance, and resiliency
  - Capturing CO_2
  - Utilizing CO_2 in the Subsurface



Today we are leveraging our capabilities to accelerate the nation's transition to carbon-neutral energy systems.

Los Alamos Fuel Cell Program

Playing a critical role in the technical viability fuel cell stacks for fuel cell electric vehicles

Historical Impacts

- Longest running non-weapons program at Los Alamos (since 1977)
- First program to focus on fuel cells for transportation; today's DOE Fuel Cell Program grew out of the original Los Alamos program
- Major scientific breakthroughs at LANL in the 80s precipitated auto industry interest in fuel cell technology, leading to the LANL/GM Joint Development Center

Fuel cell vehicle developed at LANL in 1977, in response to the 2nd Oil Embargo.

Current Challenges and Focus

- Cost and durability remain the biggest barriers to commercialization
- Program is focused on obtaining fundamental understanding to enable "knowledge-based innovation," and subsequent materials and process development

Every Fuel Cell Vehicle on the road today relies on technology developed at Los Alamos.

Los Alamos Bioenergy Program

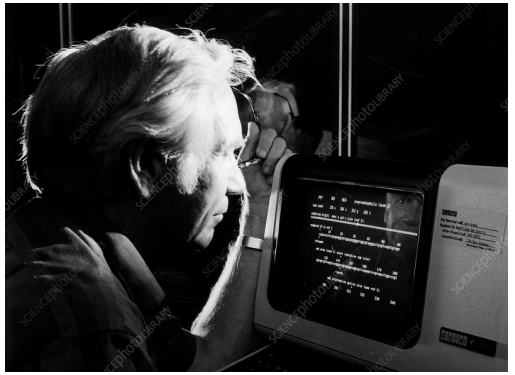
Utilizing biomass and waste resources for the production of biofuels and bioproducts

Historical Impacts

- Research in biosciences started as part of the Atomic Energy Commission's investigations on how radiation affects living organisms
- Genomics capabilities were key to the Human Genome Project
- Lead role in the National Alliance for Advanced Biofuels and Bioproducts (NAABB) consortium

Current Challenges and Focus

- Partnering with industry to develop and deploy technologies to produce fuels, products, and power from non-food sources of biomass and waste resources
- Los Alamos is active in all 5 areas of the DOE bioenergy program:
  - Advanced Algal Systems
  - Conversion Technologies
  - Data, Modeling, and Analysis
  - Feedstock Technologies
  - Systems Development and Integration



GenBank, NIH's publicly accessible genetic sequence database, was formed at Los Alamos National Laboratory.

Our expertise in genomics, developed over decades for our core mission, is now instrumental for the DOE bioenergy programs.

Electric Grid and Critical Infrastructure

Designing, controlling, and optimizing future energy systems

Historical Impacts

- Following the U.S. test-ban treaty, Los Alamos developed an advanced modeling and simulation capability to ensure the reliability of the U.S. nuclear arsenal
- This legacy has evolved into cutting-edge capabilities in modeling, simulation, and applied mathematics to inform scientific experimentation
- National Infrastructure Simulation & Analysis Center (NISAC) leverages these capabilities to monitor a broad selection of critical national infrastructures

Current Challenges and Focus

- Today the Laboratory applies its capabilities in physics, network science, algorithms, & applied math to develop more resilient energy systems, focusing on
  - Advanced Algorithms for Energy System Modeling and Computation
  - Resiliency in Infrastructure Systems
  - Interdependent and Interconnected Energy Systems
  - Analysis of Extreme Events and Threats to Infrastructure
  - Physics-Inspired Machine Learning and Data Analytics for Energy Systems

NISAC began as a collaboration between Los Alamos and Sandia National Laboratories in 1999.

The Laboratory is building on this expertise to contribute to the modernization of the nation's electric grid and critical infrastructure.

Los Alamos leads and partners in DOE energy consortia

Multi-institutional efforts critical to technology development and deployment

Office of Fossil Energy & Carbon Management

- National Risk Assessment Partnership
- Carbon Capture Simulation for Industry Impact
- Science-informed Machine-learning to Accelerate Real-Time Decisions
- Accelerating the Development of Extreme-Environment Materials

Hydrogen & Fuel Cell Technologies Office

- Million Mile Fuel Cell Truck
- Electrocatalysis Consortium
- Hydrogen from Next-generation Electrolyzers of Water

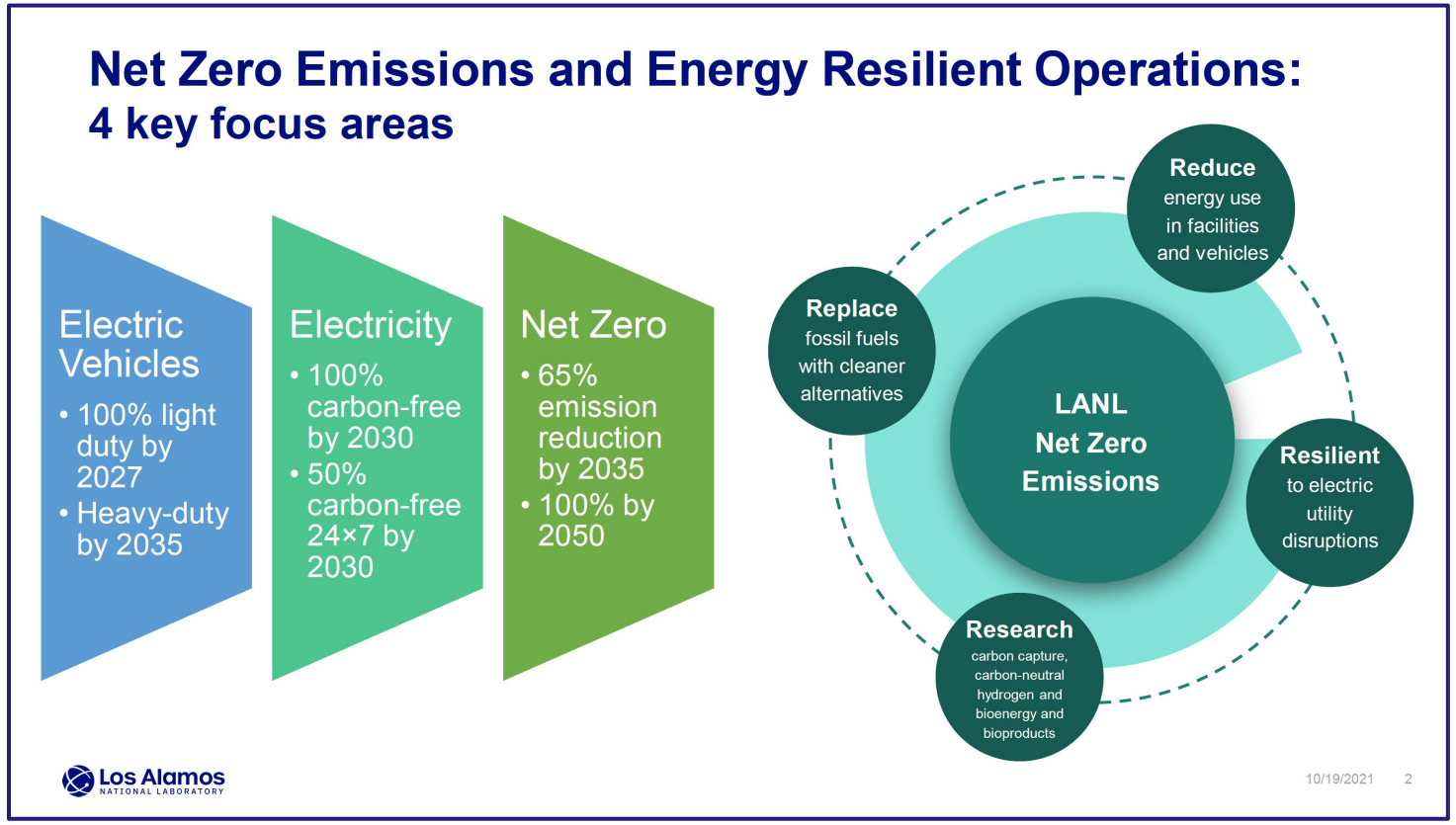
Office of Electricity

- Grid Modernization Laboratory Consortium
- North American Energy Resilience Model

Bioenergy Technologies Office

- Bio-Optimized Technologies to keep Thermoplastics out of Landfills and the Environment
- Co-Optimization of Fuels and Engines
- Chemical Catalysis for Bioenergy
- Feedstock Conversion Interface Consortium
- Development of Integrated Screening, Cultivar Optimization, and Verification Research

Our region has large facilities that can be leveraged as test beds to demonstrate technology deployment



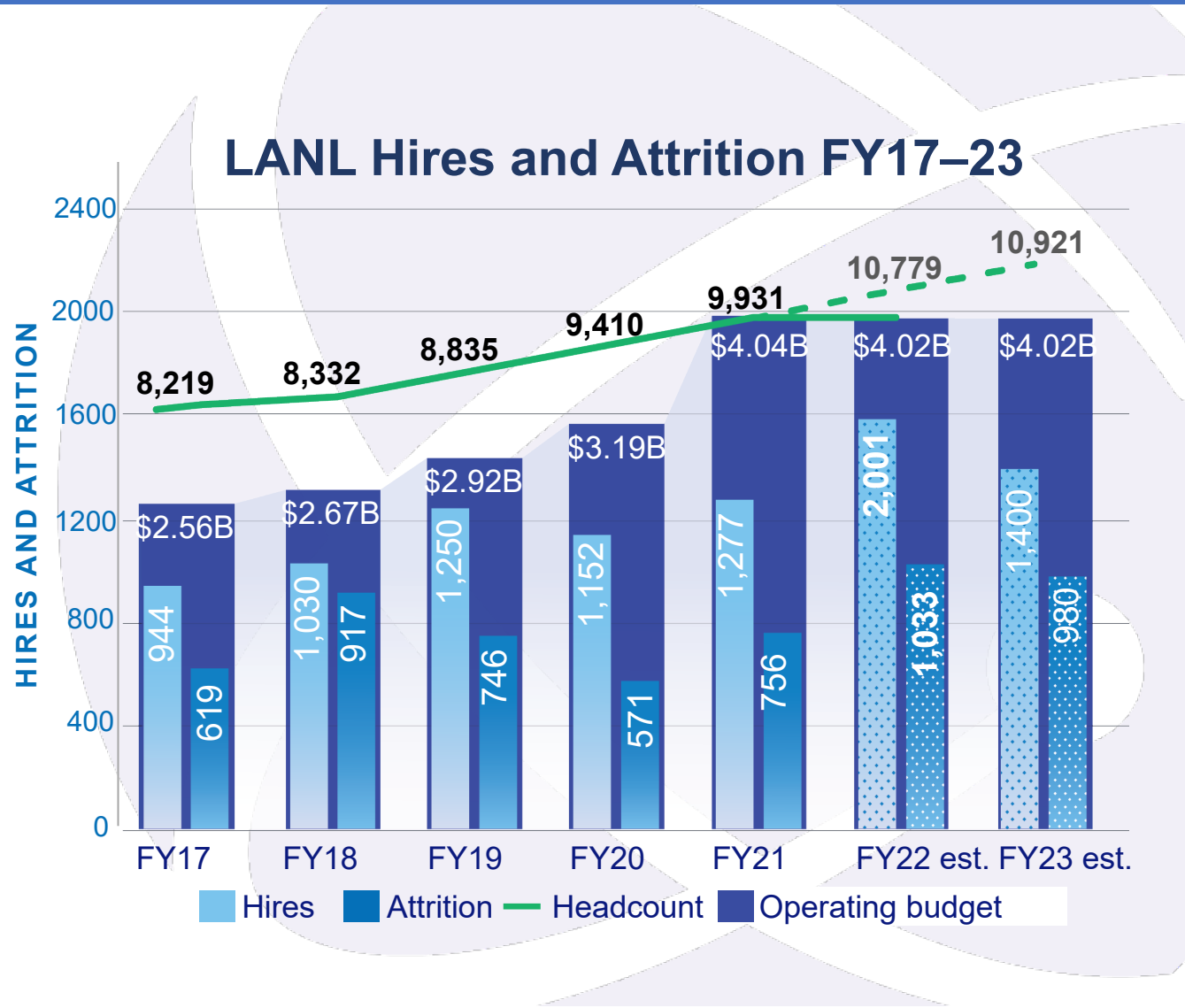
Using the Laboratory as a platform for scaling up what we've been doing at bench scale

Opportunities and Needs

- Improve and expand Laboratory infrastructure to support test beds
- Partnerships with regional communities and businesses for scaling up

Our Lab has grown by more than $1B in two years

- LANL has grown by **$1.48B and ~2,500 staff** in the 4+ years since Triad
- Based on year-to-date hiring, projected hires for FY22 is > 2,100
  - Net growth differs significantly from gross hiring
- Challenge now is to grow our capacity so we can keep pace with budget increases
  - Leasing, telework, updated infrastructure, and new construction are all critical to increasing our capacity



An updated Lab Agenda maps our evolving mission

- **Four Strategic Objectives direct the Laboratory**
  - Nuclear deterrent, threat reduction, technical leadership, and trustworthy operations
- **The Agenda positions us to execute on 13 Critical Outcomes in 5–10 years**
- **Purpose is to integrate functions and maximize effectiveness across LANL**
  - Agenda provides a framework for the decision-making that occurs at all levels
- **Every employee has a role in executing this plan**