



U.S. DEPARTMENT OF
ENERGY

Update on Nuclear Energy Innovation

Nuclear Regulatory Commission Briefing
Office of Nuclear Energy

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U.S. Department of Energy

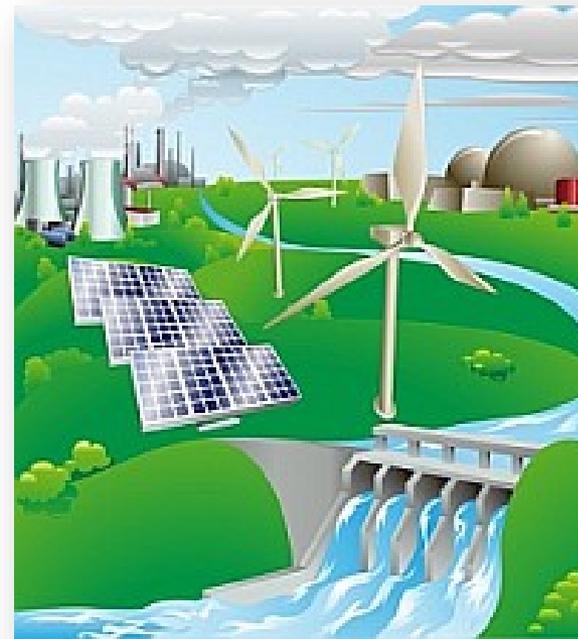
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Outline

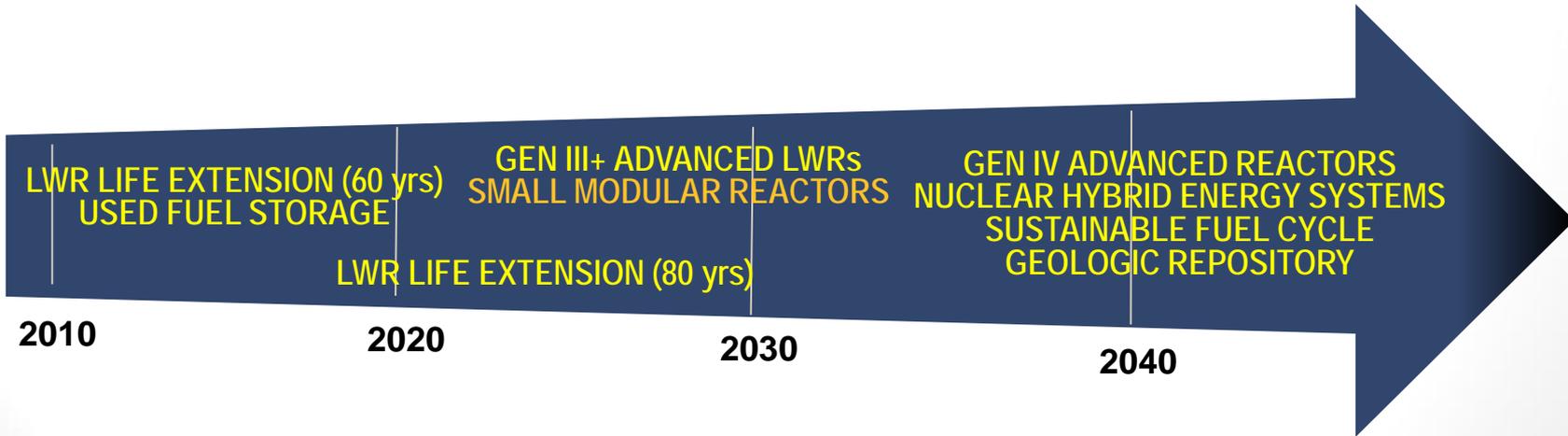
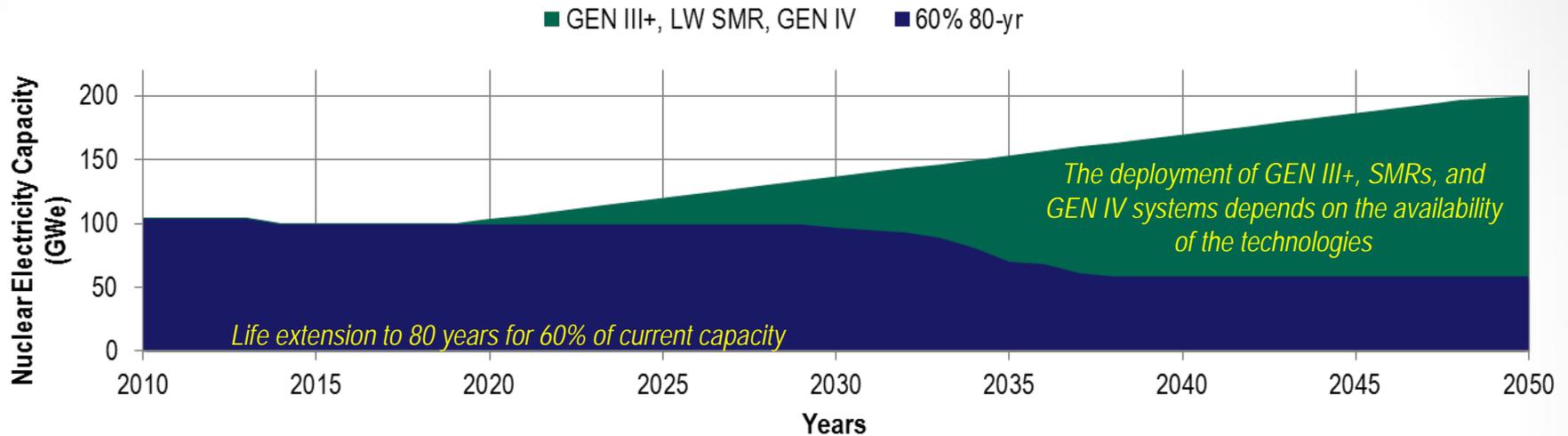
- Nuclear in a Clean Energy Future
- Gateway for Accelerated Innovation in Nuclear (GAIN)
- NE University Programs
- Nuclear Science User Facilities

A Clean Energy Future

- Achieving the vision of a clean energy future will require:
 - the continued long-term safe operation of the current fleet of commercial nuclear plants;
 - the commissioning of the next generation of Advanced LWRs currently under construction;
 - the deployment of new nuclear plants
 - Gen III+ Advanced LWRs
 - Small Modular Reactors
 - Gen IV Advanced Reactors
 - the utilization of nuclear in hybrid systems for non-traditional energy products;
 - a fundamental change in how nuclear technologies are perceived by the public; developed, licensed, and deployed by industry; and regulated by government
 - develop solutions for the long-term, sustainable management of our nation's spent nuclear fuel and high-level radioactive waste.



Nuclear Deployment & Clean Energy Goals



NE Support of US Industry Research and Development

Gateway for Accelerated Innovation in Nuclear (GAIN)

- Provides the nuclear community with access to the technical, regulatory, and financial support necessary to move advanced nuclear technologies toward commercialization while ensuring continued operation of the existing nuclear fleet.
- Integrates and facilitates efforts by private industry, universities and government researchers to test, develop and demonstrate advanced nuclear technologies.

Voucher Initiative

- DOE recently announced ~\$2 million in vouchers to assist small business applicants including entrepreneur-led start-ups seeking access to knowledge/capabilities available from DOE national labs so GAIN can support strong interest in nuclear energy by many new companies developing advanced nuclear energy technologies.

Energy Technology Commercialization Fund

- ~\$20 million allocation from DOE's applied RD&D and commercial application budget to pursue high impact commercialization activities. Established by Energy Policy Act of 2005. Provides matching funds with private partners to promote promising energy technologies for commercial purposes. (NE FY16 = \$4.3M)

SBIR/STTR

- NE provides over 3.4% of its applied RD&D funding annually to support small business research addressing focused NE mission areas. (NE FY17 est. \$13.6M)

Gateway for Accelerated Innovation in Nuclear



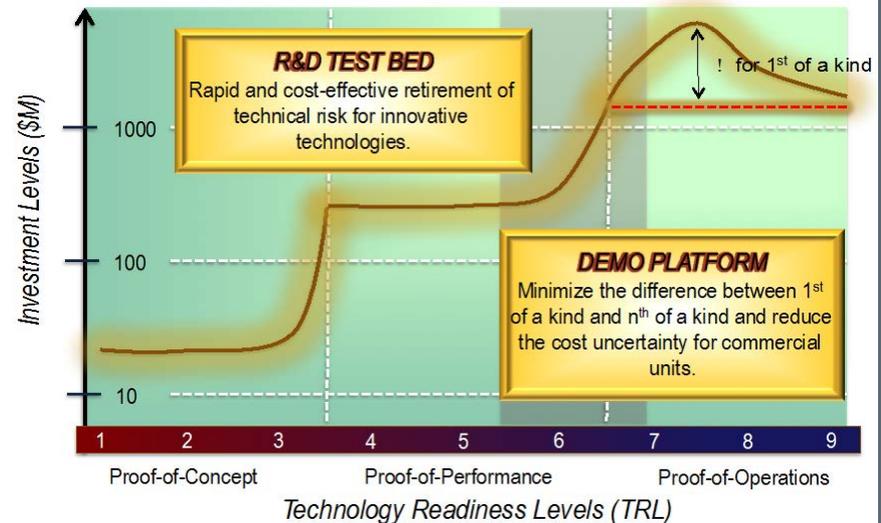
<i>Today's Challenges</i>	<i>DOE Response</i>	<i>GAIN Initiative</i>
<ul style="list-style-type: none"> • Time to market for nuclear technology is too long • Facilities needed to conduct RD&D activities are very expensive to develop and maintain • Facilities, expertise, materials, and historic data at government sites are not easily accessible to private sector • Technology readiness levels of innovative concepts vary and require different research and funding opportunities • Many technology developers require assistance working through the regulatory process for new nuclear technologies 	<ul style="list-style-type: none"> • Provide nuclear innovators and investors with a single point of access to the broad range of capabilities – people, facilities, materials, and data – across the DOE complex • Provide focused research opportunities and dedicated industry engagement • Expand cooperation with with the Nuclear Regulatory Commission (NRC) to assist technology developers through the regulatory process 	<ul style="list-style-type: none"> • Integrated institute headquartered at INL and managing a nationally-distributed test-bed and demonstration platform • Dedicated to accelerate commercial readiness of innovative concepts • Collaborative approach to addressing barriers <ul style="list-style-type: none"> ✓ Public-Private Partnerships ✓ Technology-Centered Industry Working Groups • Task-specific R&D to advance technology



GAIN – A Nuclear Energy Innovation Test Bed

- Builds on and expands the successful Nuclear Science User Facilities model
- Fosters the rapid and cost-effective maturation of technologies towards engineering-scale demonstration for innovative nuclear technologies
- Enables the use of existing capabilities at multiple institutions in an integrated and “fast and cost-effective” manner
- Offers a wide range of flexible and re-configurable capabilities to address multiple technology needs
 - Irradiation, PIE, thermal-hydraulic loops, process development/testing, component fabrication/testing, etc.
- Includes predictive modeling and simulation capabilities to reduce the number of tests needed to optimize designs
- Incorporates a knowledge and validation center to provide easy and efficient access to existing data and legacy knowledge

TRL	Research Capabilities
1 - 3	Nuclear Science User Facilities
4 - 7	Nuclear Energy Innovation Test Bed



A tailored approach to support technologies of varying TRLs

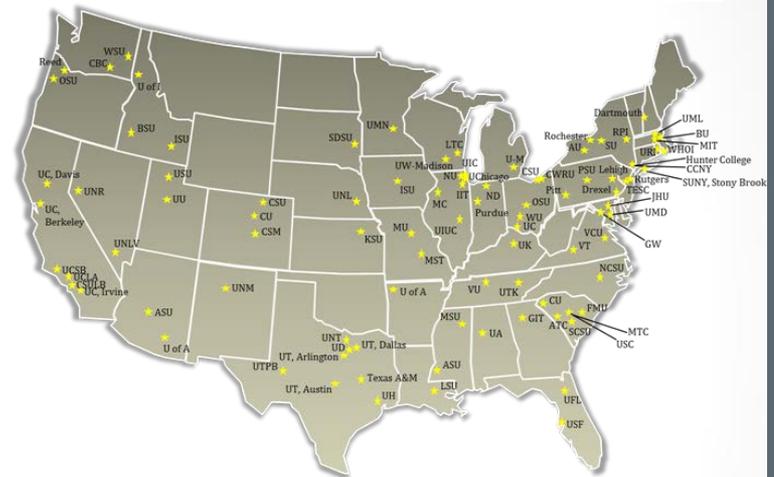
Initial Steps Towards Internationalizing GAIN

- DOE's Nuclear Science User Facilities (NSUF) is finalizing a CRADA with the Belgian Nuclear Research Centre (SCK-CEN) covering 4 near-term irradiation experiments in SCK-CEN's BR-2 test reactor.
- DOE is developing a MOU with the Belgian Nuclear Research Centre (SCK-CEN) to allow joint R&D access to the ATR in Idaho and the SCK-CEN's BR-2 test reactor.
- NE has asked our Nuclear Energy Advisory Committee (NEAC) to initiate a review of the availability of nuclear energy R&D capabilities internationally which could complement existing U.S. capabilities or bridge a gap in U.S. capabilities.

NE's University Programs

- Nuclear Energy University Program (NEUP)
 - NE designates up to 20 percent of the funds appropriated to its R&D programs to R&D and infrastructure projects awarded through an open, competitive solicitation process
- Integrated University Program (IUP)
 - NE provides graduate-level fellowships and undergraduate-level scholarships through an open, competitive solicitation process to support nuclear science and engineering education
- Research Reactor Infrastructure (RRI)
 - NE supports the continued operation of U.S. university research reactors by providing fuel services and maintenance of fuel fabrication equipment
- Traineeships
 - NE awards grants to competitively selected universities to train graduate level students in specific disciplines aligned with Department of Energy workforce needs

Since FY09, NEUP and IUP have awarded \$401 million to 104 schools in 39 states and the District of Columbia.



NEUP and IUP have a well established competitive process for awarding R&D, infrastructure, traineeships and scholarships /fellowships.

- FY2016 NEUP awards: 67 projects totaling \$61M for IRP, R&D, Infrastructure, and traineeship awards.
- FY2016 IUP awards: 57 scholarships and 33 fellowships, totaling \$5.0 M

Nuclear Science User Facilities (NSUF)

Provides the research community a means to conduct cutting-edge nuclear energy R&D by providing access to unique irradiation and post-irradiation examination capabilities, located at Idaho National Laboratory and various partner facilities.

- Reactor Facilities

- INL Advanced Test Reactor
- MIT Reactor
- North Carolina State University (NCSU) PULSTAR Reactor
- ORNL High Flux Isotope Reactor

- Beamline Facilities

- University of Wisconsin
- Illinois Institute of Technology
- University of Michigan
- NCSU PULSTAR Reactor

- Post Irradiation Examination

- Idaho National Laboratory (INL)
- North Carolina State University
- University of Wisconsin
- University of Michigan
- University of California Berkeley
- University of Nevada, Las Vegas
- Purdue University
- Pacific Northwest National Laboratory
- Oak Ridge National Laboratory (ORNL)
- Westinghouse

Summary

- Recognition of importance of nuclear – today and in the future – in meeting carbon reduction/climate goals
- Concern about financial viability of some currently operating plants, yet large carbon reduction benefits from keeping them running
- Increased interest in nuclear in some domestic and international markets
 - Gen III+
 - SMR technology
- Innovators, some utilities looking at advanced “Gen IV” nuclear as a way to move nuclear beyond electricity
 - Innovators need timely, affordable access to existing and new DOE capabilities