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Nuclear Energy

Activities to Support Advanced Reactor Development

Thomas J. O'Connor
Office of Advanced Reactor Technologies
Office of Nuclear Energy
U.S. Department of Energy

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Overview

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- **Mission:** Perform research to advance the state of reactor technology to improve its economic competitiveness and safety and advance nuclear power as a resource capable of meeting the Nation's energy, environmental, and national security needs
 - **Objectives:**
 - Develop technologies that can enable new concepts and designs to achieve greater levels of safety and resilience, flexibility of use, sustainability and construction or operational affordability.
 - Collaborate with industry to identify and conduct essential research to reduce technical risk associated with advanced reactor technologies.
 - Sustain essential technical expertise and capabilities within national laboratories, universities, and industry to perform needed research.
 - Collaborate with NRC and Standards Developing Organizations (SDO's) to address gaps in codes and standards to support advanced reactor designs



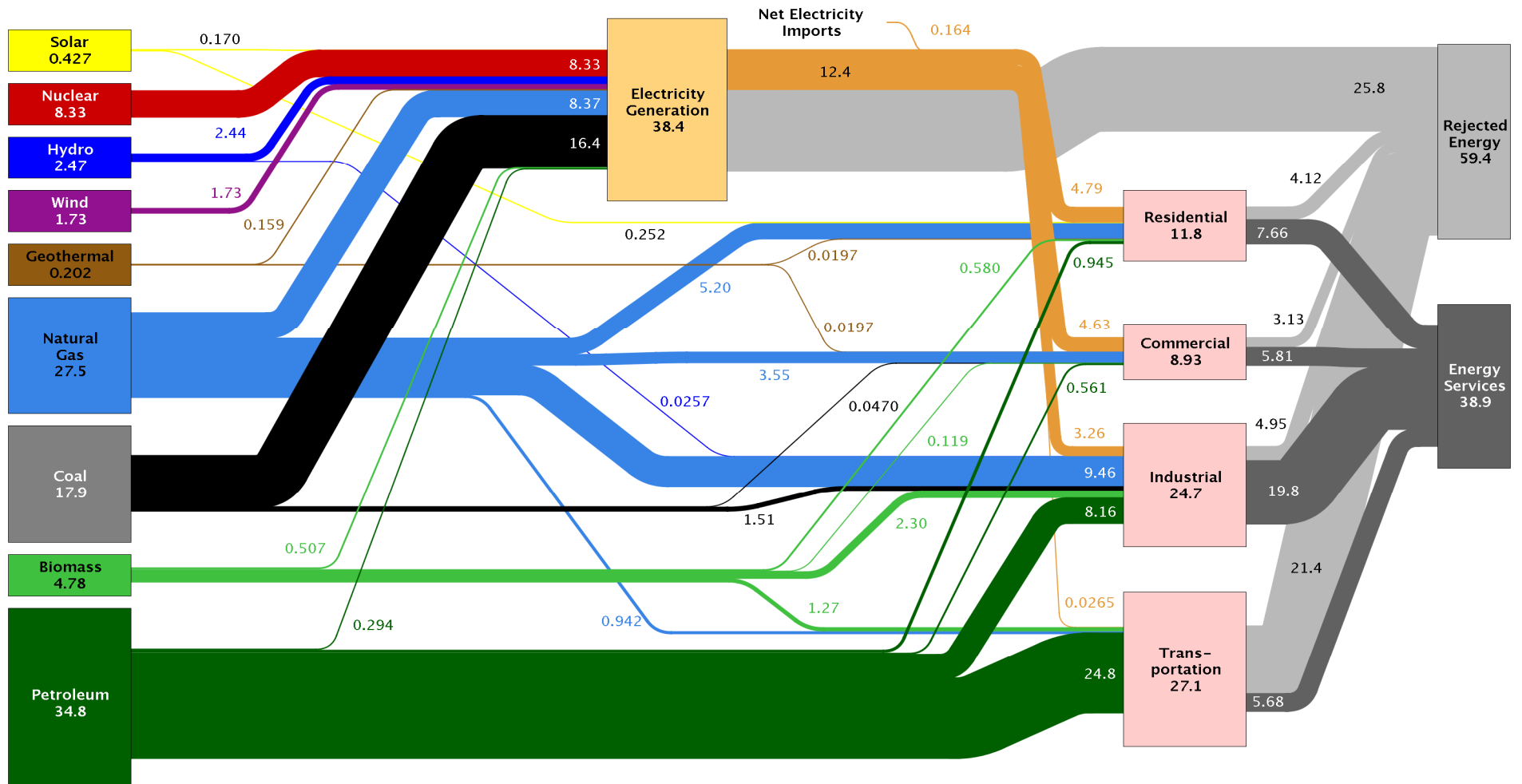
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Nuclear Energy Important Role US Electrical Generation

Estimated U.S. Energy Use in 2014: ~98.3 Quads

Lawrence Livermore
National Laboratory





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ART Technical Focus Areas

■ Fast Reactor Technologies:

- Mechanisms Engineering Test Laboratory (METL) for testing of small and intermediate scale components in liquid sodium
- Modernization of codes and knowledge preservation

■ High Temperature Reactor Technologies:

- Coated particle fuel development and nuclear grade graphite qualification
- High Temperature Test Facility at Oregon State University

■ Advanced Reactor Generic Technologies:

- Address design needs for advanced materials, including ASME code cases, energy conversion, decay heat removal systems and modeling methods

■ Advanced Reactor Regulatory Framework:

- Work with NRC to finalize advanced reactor design criteria and develop associated implementation guides

■ Advanced Reactor System Studies

- Hybrid Energy Studies with Energy Efficiency and Renewable Energy
- Advanced Test / Demonstration Reactor Planning Study



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Industry-Led R&D Collaborations

■ Technical Review Panel (TRP) Process to inform R&D decisions

- Facilitates greater engagement between DOE and industry.
- During 2012 and 2014 Technical Review Panel (TRP) identified R&D needs for viable advanced reactor concepts to inform DOE-NE R&D investment decisions.
- Funding Opportunity Announcements used to make industry led R&D awards.

■ Four awards were made in 2013 for a government cost share of \$3.5M.

- General Electric (SFR) - Electromagnetic Pumps
- General Atomics (GFR) - Silicon Carbide Bonding
- Gen4 Energy (LFR) - Lead Bismuth Natural Circulation
- Westinghouse (SFR) - Modeling and Validation of Sodium Plugging for Heat Exchangers

■ Five awards selections in 2014 for a government cost share of \$13M.

- AREVA (SFR/LFR) - Thermal hydraulic simulations for liquid metal fast reactors
- General Electric (SFR) – Probabilistic risk assessment methodologies
- General Atomics (GFR) - Fabrication and testing Silicon Carbide structures
- NGNP Alliance (HTGR) – Decay heat removal testing
- Westinghouse – (SFR) Thermo-acoustic sensors



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FY2015 Industry Collaboration

■ The FY15 Omnibus Spending Bill included the following:

\$12,500,000 is for the further development of two performance based advanced reactor concepts, of which \$7,500,000 is for industry-only competition of two performance-based advanced reactor concepts and \$5,000,000 is for the national laboratories selected to work with the awardees to perform the work required by the awardees to meet the goals of the awards.

■ Advanced Reactor Technology (2015) Funding Opportunity Announcement

- Released July 31, 2015, with proposals due October 5, 2015
- Complete selection process and make awards in CY15
- Looking to support a broad scope including such areas as R&D, design analysis, scale testing or licensing support to further development in the areas of safety, operations, and economics,
- Designed to support multi-year funding (up to \$100M, with 20% cost-share)



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Advanced Test/Demo Reactor Planning Study

■ FY15 Omnibus Spending Bill

“\$7,000,000 is for an advanced test/demonstration reactor planning study by the national laboratories, industry, and other relevant stakeholders of such a reactor in the U.S. The study will evaluate advanced reactor technology options, capabilities, and requirements within the context of national needs and public policy to support innovation in nuclear energy.”

■ Nuclear Energy Advisory Council (NEAC) providing study advice.

■ The objective of the study is to provide transparent, and defensible options to address need for, and technology of, a test and or demonstration reactor(s) to be built to support innovation and long term commercialization.

■ Recent Steps

- Workshop held in April with stakeholders to develop criteria and metrics
- Began the Technology Assessment evaluation in June

■ Revised schedule provides draft report in April 2016.



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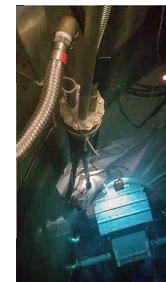
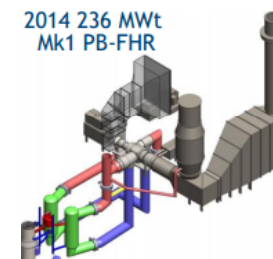
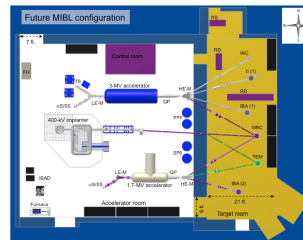
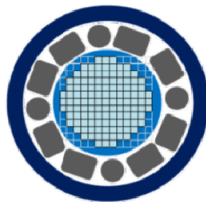
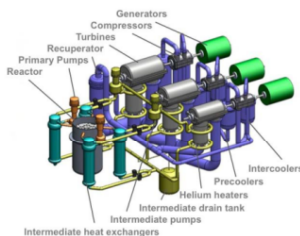
DOE Programs with Universities

■ DOE funds specific projects under the Nuclear Energy University Program (NEUP)

- Several projects each year are for R&D on advanced reactor related topics
 - Funded 18 projects (\$13.6M) in FY13
 - Funded 14 projects (\$10.4M) in FY14
 - Funded 13 projects (\$9.5M) in FY15

■ Integrated Research Projects are more extensive projects in support of advanced nuclear technologies

- High-Temperature Salt-Cooled Reactor for Power and Process Heat (2011, MIT, Wisconsin, UC Berkeley, \$7.5M)
- High Fidelity Ion Beam Simulation of High Dose Neutron Irradiation (2013, University of Michigan, \$5M)
- Integrated Approach to FHR Technology and Design Challenges (2014, MIT, \$5M and Georgia Tech, \$5M)





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International Collaborations

R&D work conducted with international partners through:

■ **Multi-lateral collaborations**

- Generation-IV SFR and VHTR System Arrangements
- IAEA and OECD coordinated research projects

■ **Bilateral collaborations on diverse topics with**

- China
- Russia
- France
- Japan
- Korea