



U.S. DEPARTMENT OF  
**ENERGY**

# Update on Nuclear Reactor RD&D Program

*Nuclear Regulatory Commission Briefing*

**Office of Nuclear Energy**

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U.S. Department of Energy

June 20, 2016

# Nuclear Energy – Sustainably Clean Power

*“To meet our emissions reduction targets and avoid the worst effects of climate change, we need to dramatically reduce power sector emissions. Switching from coal to natural gas is already reducing the U.S. carbon footprint, but it’s not enough to get the deep CO<sub>2</sub> cuts envisioned in the President’s Climate Action Plan. Reducing emissions by 80% will likely require the complete decarbonization of the power sector....”*

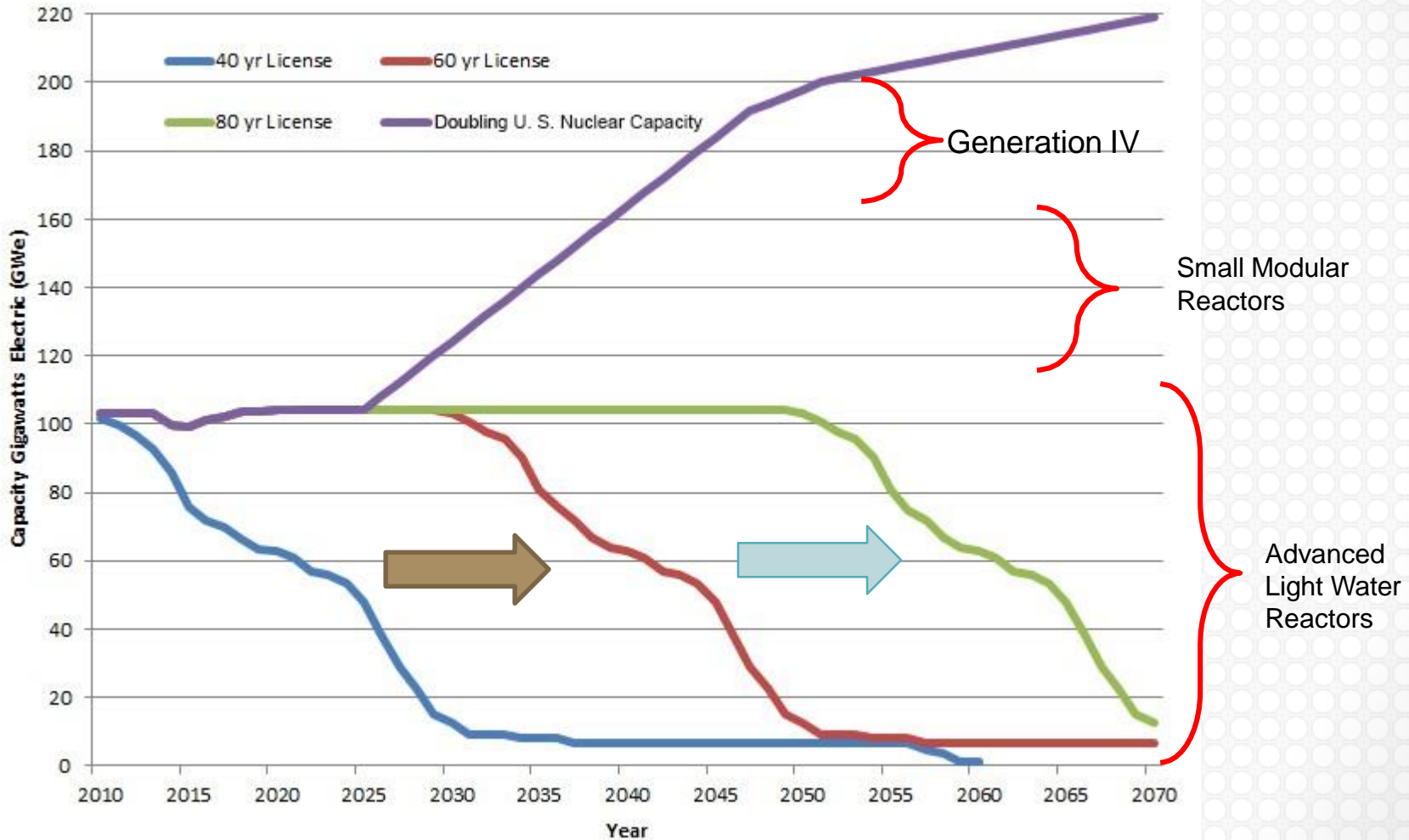


Secretary Moniz  
COP21, Paris 2015

*We know **nuclear can provide 24-hour baseload power**, because it already does. Worldwide, nuclear power produces more energy than hydro, solar, wind, and geothermal power combined.*

*The bottom line is that to achieve the pace and scale of worldwide carbon reductions needed to avoid climate change, **nuclear must play a role.**”*

# Nuclear Power Capacity needed to meet Clean Power Goals



# Light Water Reactor Sustainability (LWRS) Program

- LWRS Program Goal
  - Develop fundamental scientific basis to allow continued long-term safe operation of existing LWRs (beyond 60 years) and their long-term economic viability
- LWRS focus areas
  - Materials Aging and Degradation
  - Advanced Instrumentation and Controls
  - Risk-Informed Safety Margin Characterization
  - Systems analysis of emerging issues
  - Reactor Safety Technologies
- Coordination with NRC and EPRI has and will continue to be needed for success
- Data from LWRS program will support the recently announced plants seeking Subsequent License Renewal



*Nine Mile Point ~ Courtesy Constellation Energy*

# Accelerating SMR Deployment

## *SMR Licensing Technical Support Program*

- Initiated in FY12 / A 6-year, \$452M program
- Mission
  - Accelerate the deployment of SMRs by supporting certification and licensing for U.S.-based SMR projects through cost-shared cooperative agreements with industry partners
    - Design Certification of NuScale SMR
    - Site Permitting and Licensing for Tennessee Valley Authority (TVA) and Utah Associated Municipal Power Systems (UAMPS)
  - Resolve generic SMR issues to improve the potential for commercialization, such as:
    - User requirements for SMRs
    - Technical analyses to address licensing concerns
    - Economic and Market analysis
    - Siting studies



# SMR Program Status

- NuScale
  - Design Certification Application (DCA) Design Freeze completed at end of May 2016 - Next Steps:
    - Complete the final design review for the reactor module
    - Complete final Thermal-Hydraulic testing runs and reports
    - Finalizing DCA for December 2016 submission
- TVA Siting
  - Submitted Early Site Permit Application to NRC May 12, 2016 - Next steps: NRC acceptance review and review schedule development
  - TVA to begin technology selection activities in Fall 2016 followed by commencement of COLA development
- NuScale/UAMPS Siting
  - Site use agreement for a site on the INL reservation
  - Final stages of Site Selection (4 candidate sites on INL reservation; Site Selection report completed)
  - UAMPS Decision to Proceed to be made in August 2016

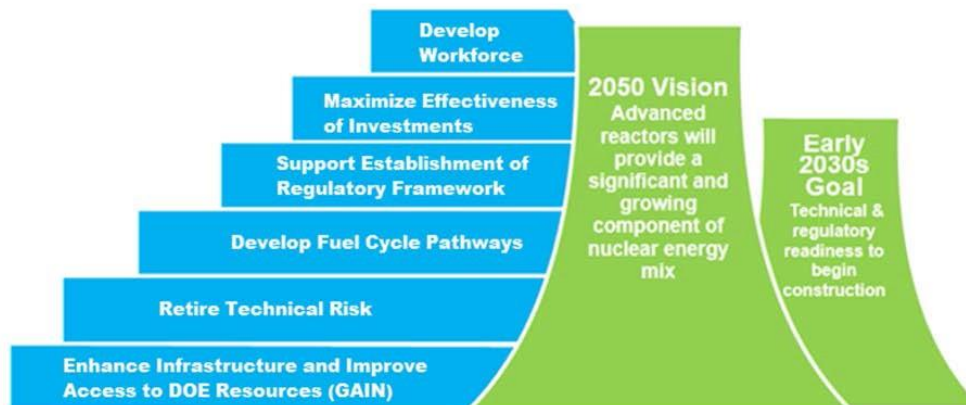


# Support for SMR Commercialization

- NE identifying options for SMR commercialization beyond the LTS program
- Under consideration:
  - Support for Design Finalization for most mature SMR designs
  - Continue to build customer base by supporting additional COLAs
  - Further development of manufacturing technologies that would be important to the SMR manufacturing enterprise.
  - Supporting the development of alternative SMR applications, such as non-electrical uses and nuclear/renewable hybrid energy systems
- NE working closely with NEI and industry partners to understand market dynamics
- Workshop June 22-23, 2016 to solicit feedback from stakeholders

# Vision and Strategy for Advanced Reactors

- To meet the challenge, DOE has developed a *Vision and Strategy for the Development and Deployment of Advanced Reactors* (<http://energy.gov/ne/downloads/draft-vision-and-strategy-development-and-deployment-advanced-reactors>)
  - The 2050 vision is for advanced reactors to be a significant part of the nuclear energy mix, and the goal is to have at least 2 concepts ready for deployment in the early 2030's
- DOE Vision and Strategy document is well aligned with those from NRC and NEI



Vision and Strategy for Advanced Reactors



# Advanced Test and Demonstration Reactor Study

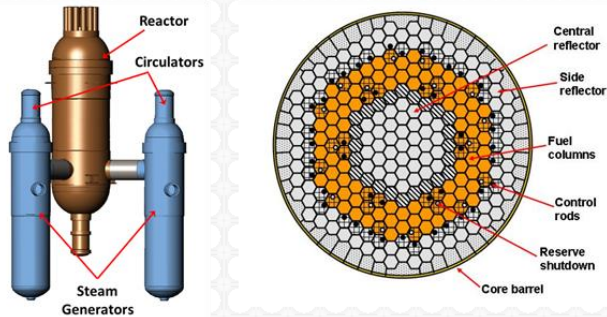
- Test Reactor – Irradiation Services:
  - Primarily for R&D
  - Provides appropriate environment
  - Must support development of advanced reactors
- Demonstration Reactors – Technology Validation
  - Demonstrate integrated reactor technology
  - Demonstrate transient performance
  - Provides flexibility to swap out components
  - Provides feedback on design, construction and operations

# Strategic Objectives

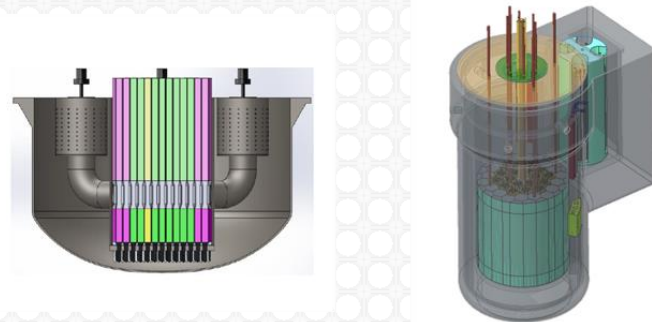
- **Demonstration Reactors:** fundamental mission is to provide efficient, reliable electricity production without carbon emissions
  1. Deploy a **high temperature process heat application** for industrial applications and electricity demonstration using an advanced reactor system to illustrate the potential that nuclear energy has in reducing the carbon footprint in the US industrial sector
  2. Demonstrate **actinide management** to extend natural resource utilization and reduce the burden of nuclear waste for future generations
  3. Deploy a **small scale demonstration reactor for a less mature reactor technology** with the goal of increasing the technology readiness level of the overall system for the longer term
- Irradiation Test Reactor: Built upon a reliable platform
  4. Provide an **irradiation test reactor** to support development and qualification of fuels, materials and other important components (e.g. control rods, instrumentation) of both thermal and fast neutron-based Generation IV advanced reactor systems

# Preliminary Options

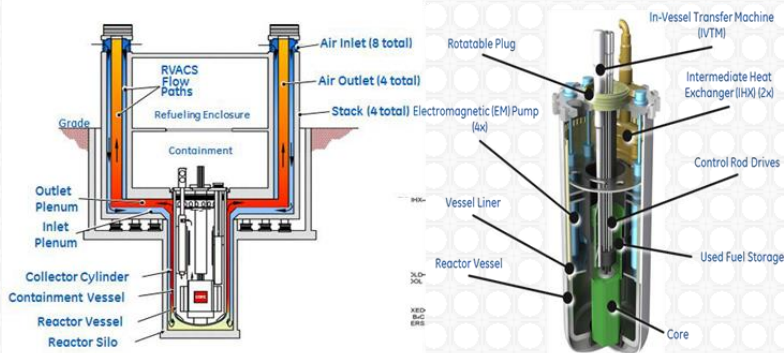
Strategic Objective 1: Process heat demonstration – modular HTGR



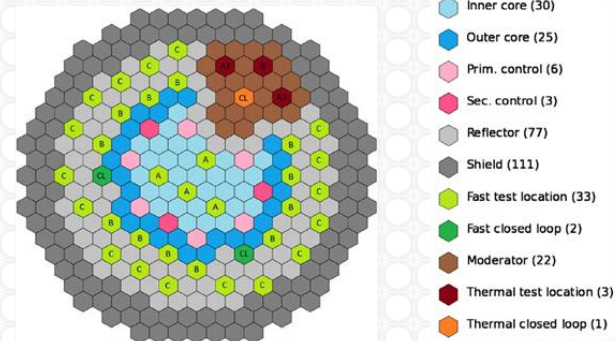
Strategic Objective 3: Demonstrating a Less Mature Technology – FHR or LFR



Strategic Objective 2: Resource Utilization and Waste Management – SFR



Strategic Objective 4: Test Reactor to Provide Neutrons – Sodium-cooled Fast Test Reactor



# Summary

- Nuclear power must be a major source of our energy production to meet our clean energy goals
- Continue the safe and reliable operation of the current fleet
- Deploy SMRs in mid-2020's
- Develop advanced reactor technologies (Generation IV) for deployment in the early 2030's

