



U.S. DEPARTMENT OF
ENERGY

Nuclear Energy

Nuclear Energy Research and Development Roadmap

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Nuclear Energy Roadmap - Purpose

- Roadmap provides guideposts to help ensure nuclear energy remains a compelling and viable energy option for the U.S.
- Nuclear energy imperatives were developed to focus resources on national objectives for clean energy, economic prosperity, and national security.
- Contribution of nuclear power to U.S. energy mix must increase significantly to meet these aggressive objectives.
- NE Roadmap outlines an integrated approach to meet objectives.
 - Roadmap was developed in cooperation with the national laboratories.
- Roadmap also addresses transformation of NE RD&D programs to a more science-based approach.



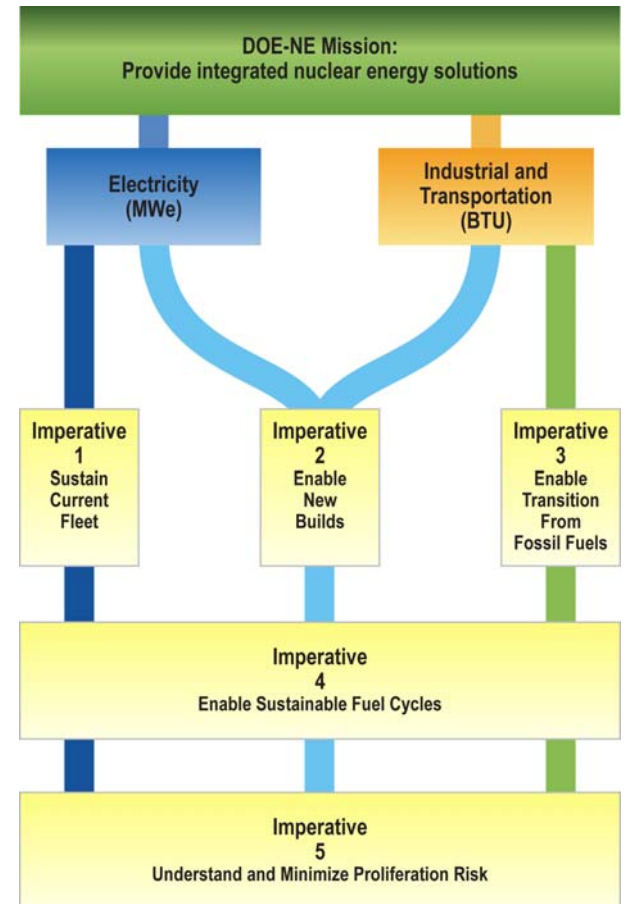
Roadmap Structure

- **EXECUTIVE SUMMARY**
- **1. INTRODUCTION**
- **2. BACKGROUND**
- **3. MISSION AND GOALS OF THE OFFICE OF NUCLEAR ENERGY**
 - **3.1. The Office of Nuclear Energy Mission**
 - **3.2. Five Nuclear Energy Imperatives and the Role of NE in Achieving Them**
- **4. AN INTEGRATED NUCLEAR ENERGY ROADMAP**
 - **4.1. Imperative 1: Extend life, improve performance, and maintain safety of the current fleet**
 - **4.2. Imperative 2: Enable New Builds for Electricity Production and Improve the Affordability of Nuclear Power**
 - **4.3. Imperative 3: Enable a Transition Away from Fossil Fuels by Producing Process Heat for Use in the Transportation and Industrial Sectors**
 - **4.4. Imperative 4: Enable Sustainable Fuel Cycles**
 - **4.5. Imperative 5: Assure proliferation risk is not an obstacle to nuclear power deployment**
- **5. RD&D APPROACH**
 - **5.1. Solution-Driven, Goal-Oriented, Science Based Approach to Nuclear Energy Development**
 - **5.2. Enabling Technologies**
 - **5.3. RD&D Facilities and Infrastructure Requirements**
 - **5.4. Interfaces and Coordination**
- **6. SUMMARY AND CONCLUSIONS**



Nuclear Energy Imperatives

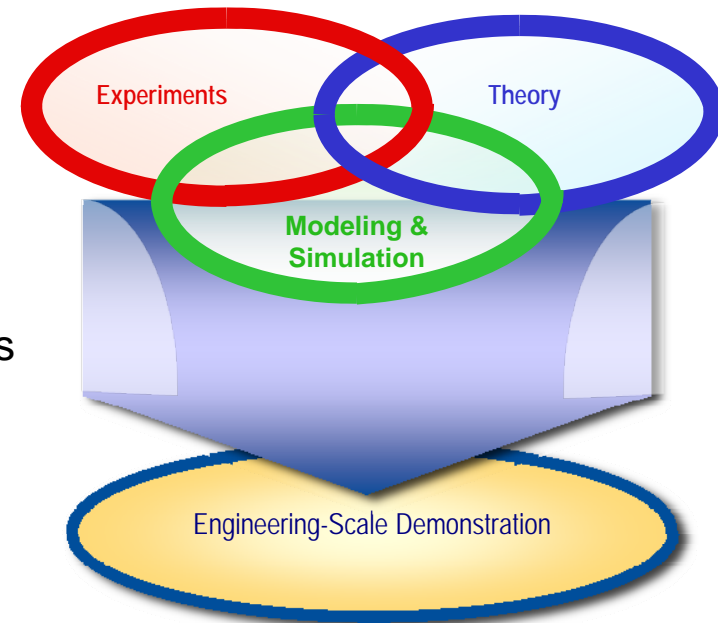
- **Extend life, improve performance, and sustain health and safety of the current fleet**
- **Enable new builds for electricity production and improve the affordability of nuclear energy**
- **Enable transition away from fossil fuels by producing process heat for use in the transportation and industrial sectors**
- **Enable sustainable fuel cycles**
- **Understand and minimize proliferation risk**





Science Based Approach to Nuclear Energy Development

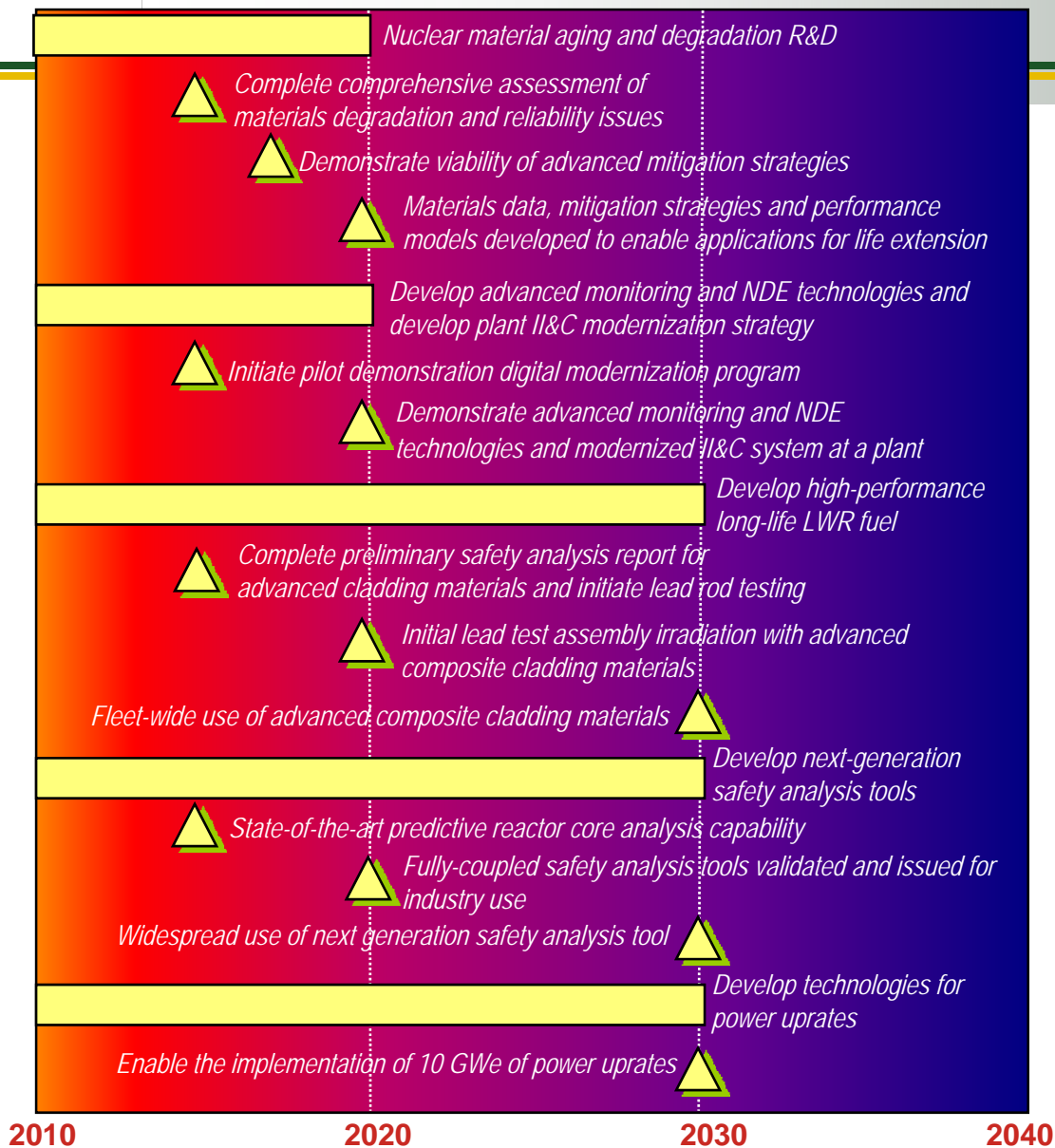
- **Experiments** – Physical tests done to develop understanding of single effects or integrated system behaviors.
- **Theory** – Creation of models (i.e. theories) of physical behaviors based on understanding of fundamental scientific principals and/or experimental observations.
- **Modeling and Simulation** – Use of computational models to develop scientific understanding of the physical behaviors of systems. Also used to apply scientific understanding to predict the behavior of complex physical systems.
- **Demonstrations** – New technologies, regulatory frameworks, and business models integrated into first-of-kind system demonstrations that provide top-level validation of integrated system technical and financial performance .





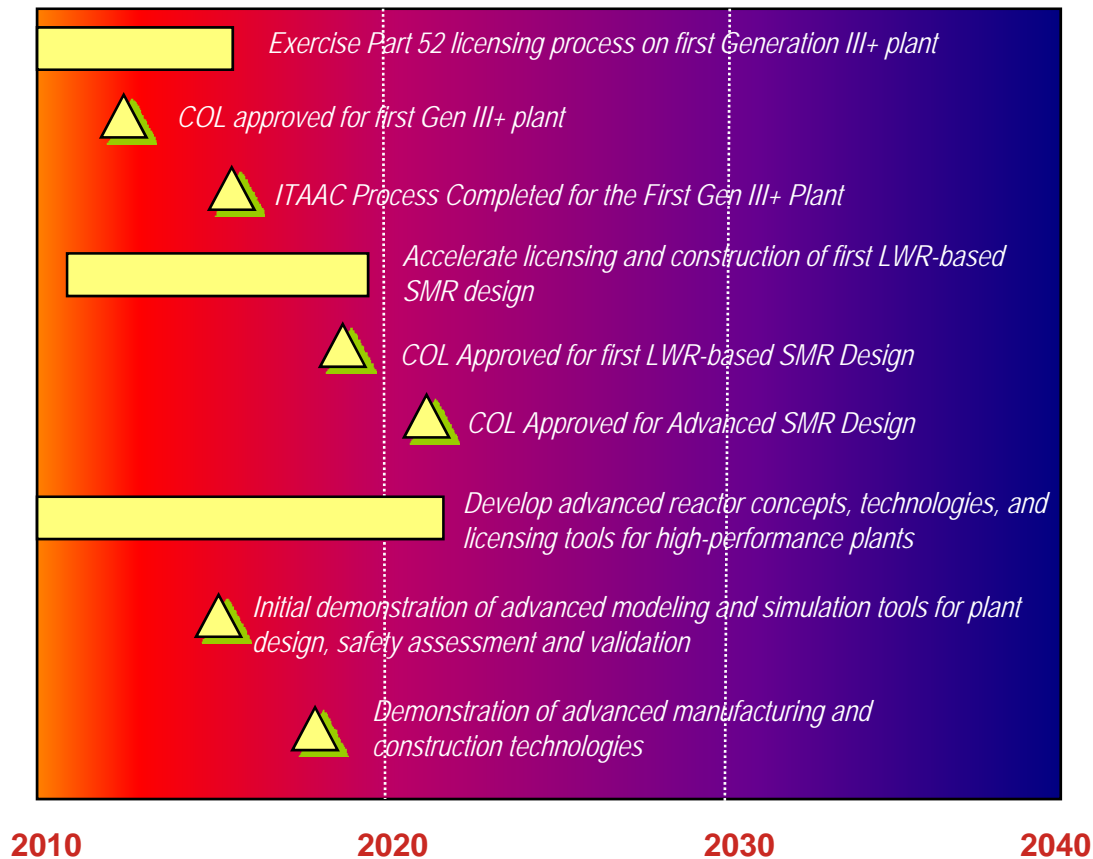
Imperative 1 Milestones

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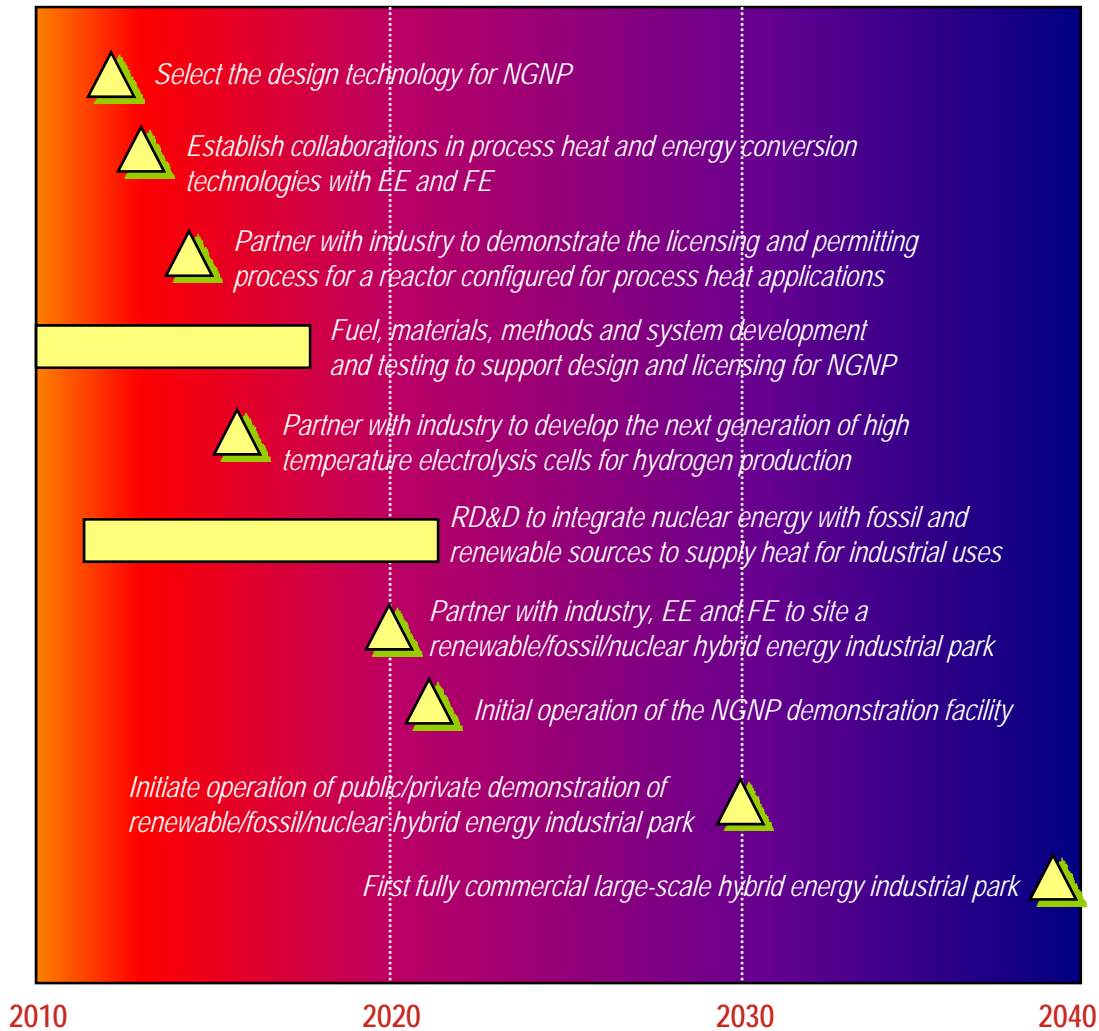


Imperative 2 Milestones



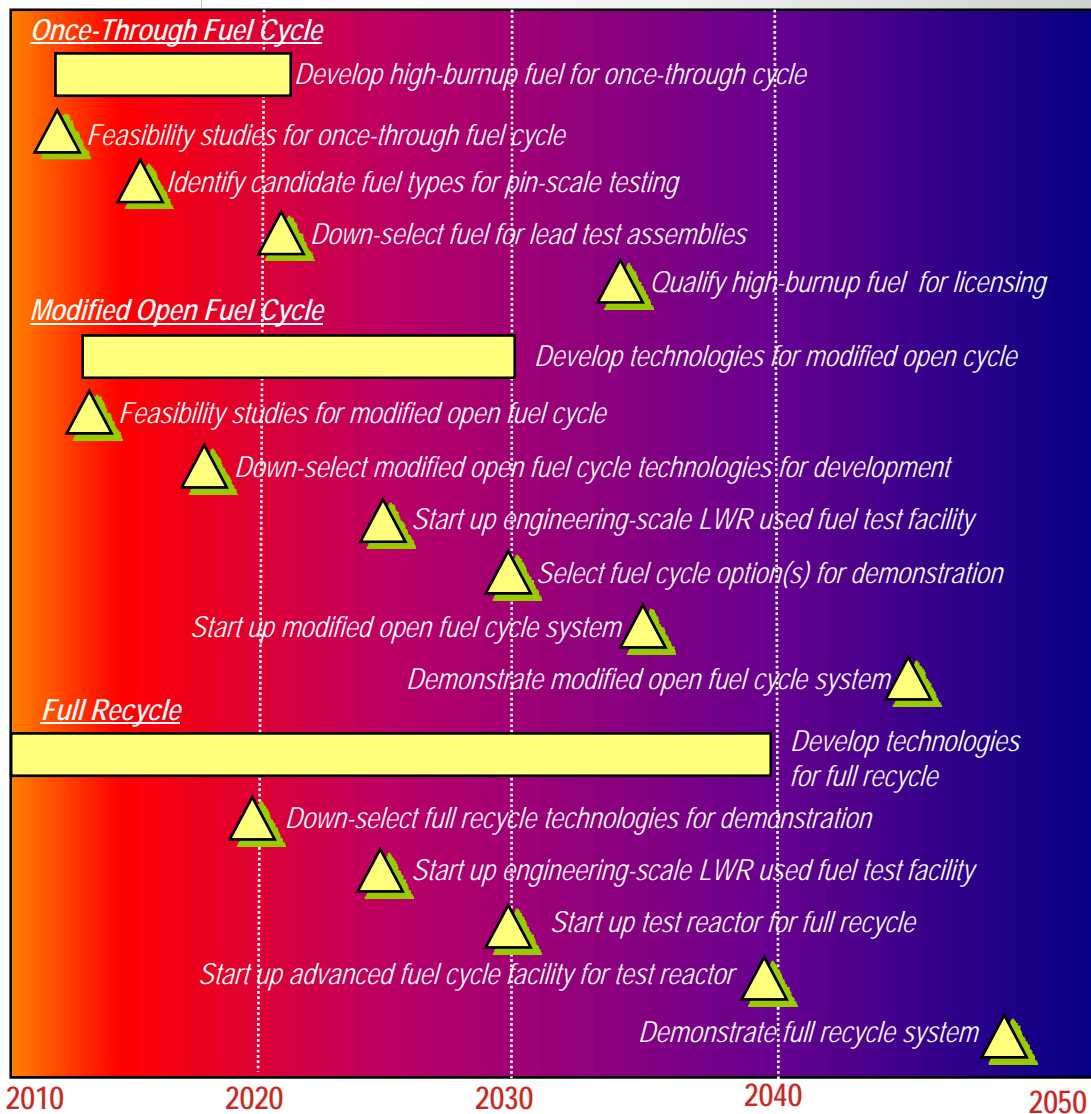


Imperative 3 Milestones



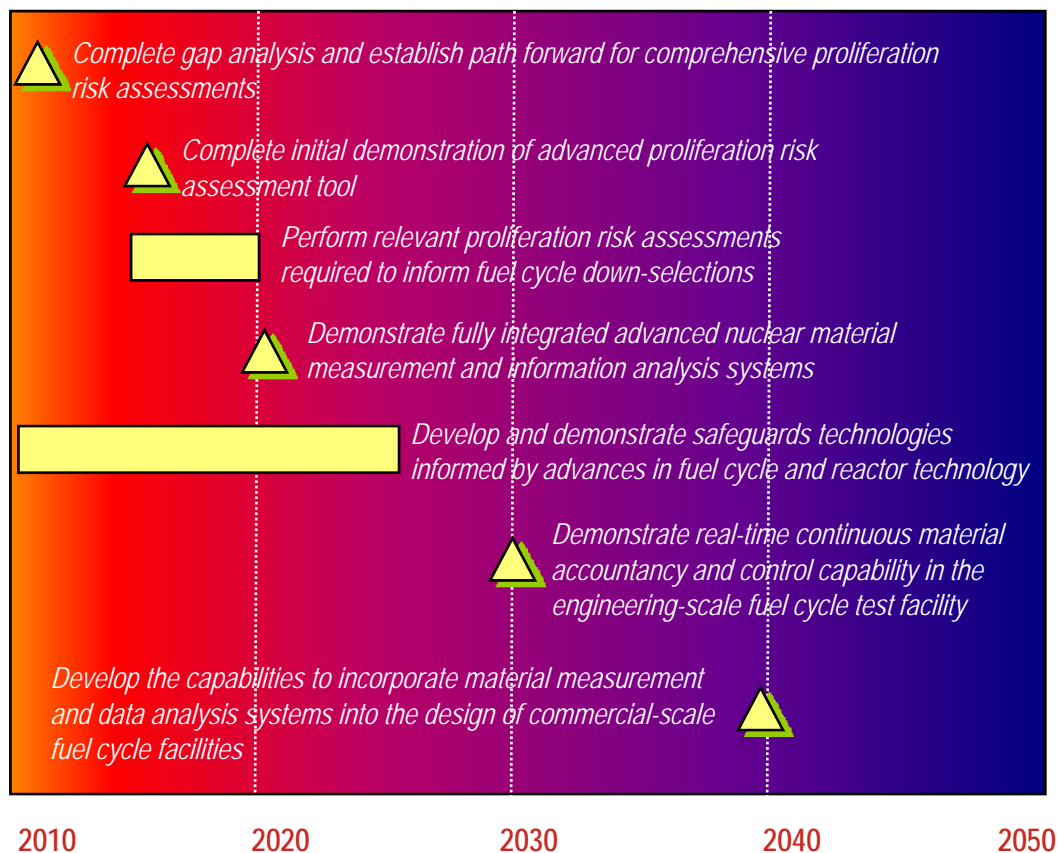


Imperative 4 Milestones





Imperative 5 Milestones





Integrated Milestones

#) Imperative

3) Enable Transition from Fossil Fuels

2) Enable new builds

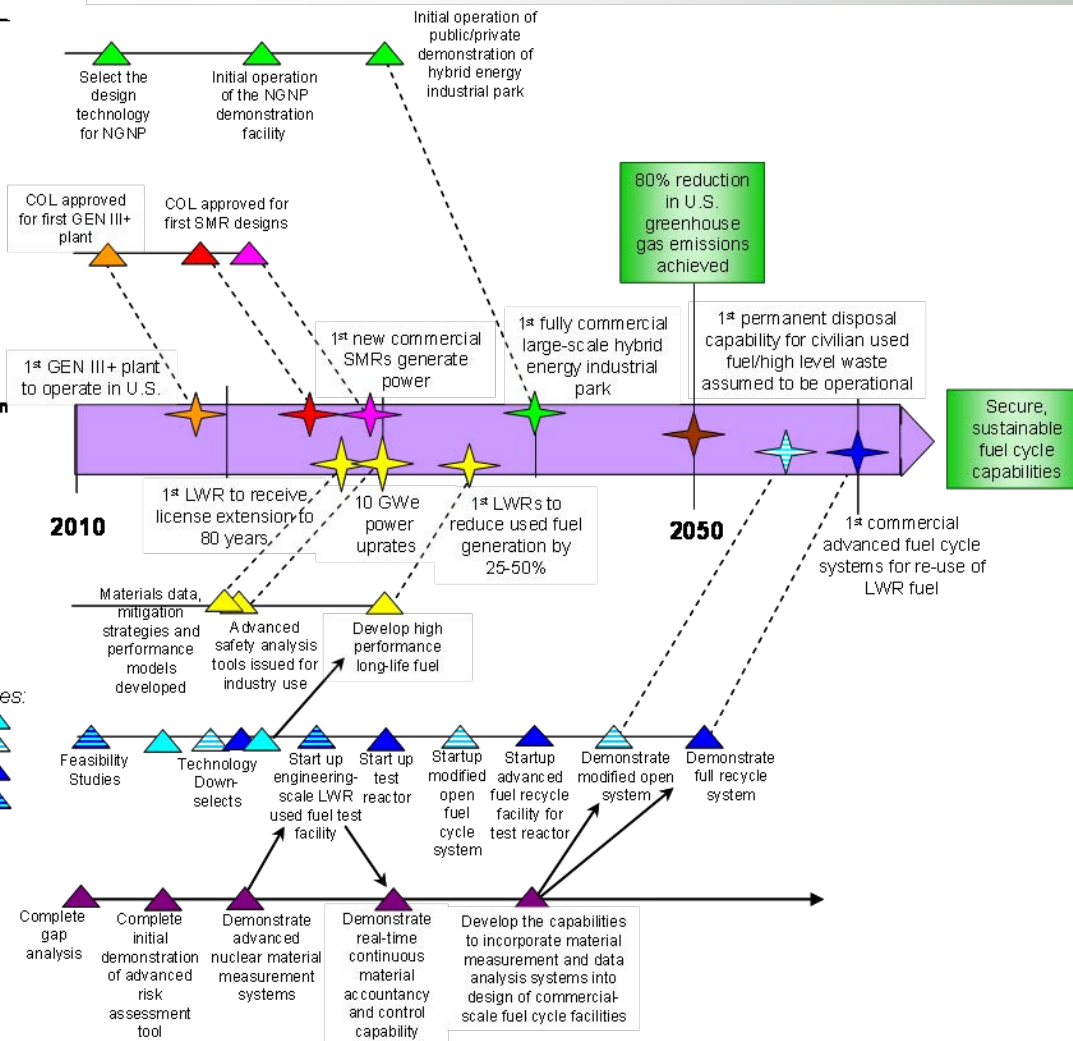
U.S. Nuclear Energy System (stars indicate potential future achievements; possible "firsts")

1) Sustain Current Fleet

4) Enable sustainable fuel cycles:

- A) Once-through options
- B) Modified open options
- C) Full recycle options
- Combined milestone

5) Understand and Minimize Proliferation Risk





Research Areas

Mission

Provide
Integrated
Nuclear
Energy
Solutions

Impacts

MWe

BTUs

Imperatives

Sustain
Current Fleet

Enable New Builds

Enable Reduced
Fossil Fuel Use

Implement
Sustainable Fuel
Cycles

Manage
Proliferation Risk

Enabling Technologies

- Structural Materials
- Nuclear Fuels
- Reactor and Fuel Cycle Systems
- Instrumentation and Controls
- Power Conversion Systems
- Process Heat Transport Systems
- Dry Heat Rejection
- Separations Processes
- Waste Forms
- Risk Assessment Methods
- U & Th Fuel Resources
- Manufacturing S&T
- Computational Modeling & Simulation



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Interfaces

■ Department of Energy

- National Nuclear Security Administration
- Office of Civilian Radioactive Waste Management
- Office of Environmental Management
- Office of Science
- Office of Fossil Energy
- Office of Energy Efficiency and Renewable Energy

■ Other Government

- Nuclear Regulatory Commission
- State Department

■ Nuclear Industry

■ Universities

■ International Partners

- Country-to-Country
- Multilateral



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Next Steps

- **Report to Congress**

- **Imperative Implementation Plans**
 - Detailed description of the research program
 - Schedule of milestones
 - Program management plan

- **FY 2011 Budget**