



U.S. Nuclear Waste Technical Review Board

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# **Nuclear Waste Assessment System for Technical Evaluation (NUWASTE): Status and Initial Results**

Presented to:  
**BRC Reactor & Fuel Cycle Technology Subcommittee**

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# The Board's Role

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- Conduct an independent and ongoing evaluation of the technical activities undertaken by the Secretary of Energy in managing:
  - High-level radioactive waste (HLW)
  - Commercial, research, and defense-related spent nuclear fuel (SNF)
- Report its findings to Congress and the Secretary of Energy at least twice per year.
- The Board's statutory responsibility is unchanged by the status of the Yucca Mountain repository program, though the DOE activities the Board reviews in future will necessarily be different.



# About the Board

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- The 11-person Board was created in the 1987 amendments to the Nuclear Waste Policy Act.
- Members are nominated by the National Academy of Sciences and appointed by the President to four-year terms.
- The Board is an independent agency in the Executive Branch, **not** part of the Department of Energy (DOE).
- The Board typically holds 2 or 3 public meetings each year, plus smaller topical meetings and fact-finding trips.



# Board Priority Tasks

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- Analyze the impact of new SNF and HLW management options being considered by DOE (NUWASTE).
- Consider options for dealing with “stranded” SNF and HLW.
- Identify technical issues involving very long term storage.
- Characterize waste management programs and derive lessons learned based on SNF and HLW experiences in the U.S. and abroad.
- Perform technical review of other activities conducted by DOE-NE and DOE-EM under the NWPA.



# NUWASTE Objectives

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- Understand the impacts of potential fuel cycle initiatives on the generation and management of SNF and HLW.
- Create ability to vary system parameters to represent different scenarios that DOE may consider.
- Explore opportunities to balance potentially conflicting waste management criteria:
  - Surface dry storage volume
  - Number of waste packages generated
  - Mass of natural uranium used
  - Introduction of new waste streams
  - Proliferation risk
  - Relative dose to the public
  - Relative cost (construction, operating, decommissioning)



# NUWASTE Features

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- Projects types, volumes and locations of SNF, HLW and other wastes
- Includes entire U.S. program – not focused on theoretical waste streams or specific fuel cycle facilities
- Currently includes LWR program using existing technologies
- Evaluates the impact of alternative SNF management options:
  - Dry surface storage
  - Reprocessing/recycling
  - Direct repository disposal
- Considers nuclear electricity generating capacity alternatives:
  - Present nuclear power plants only
  - Present plus planned nuclear power plants
  - New nuclear power plants as needed to maintain present generating capacity
- Allows selection of a variety of fuel fabrication options:
  - New uranium fuel
  - Recycled uranium fuel
  - MOX fuel



# Other Factors Considered

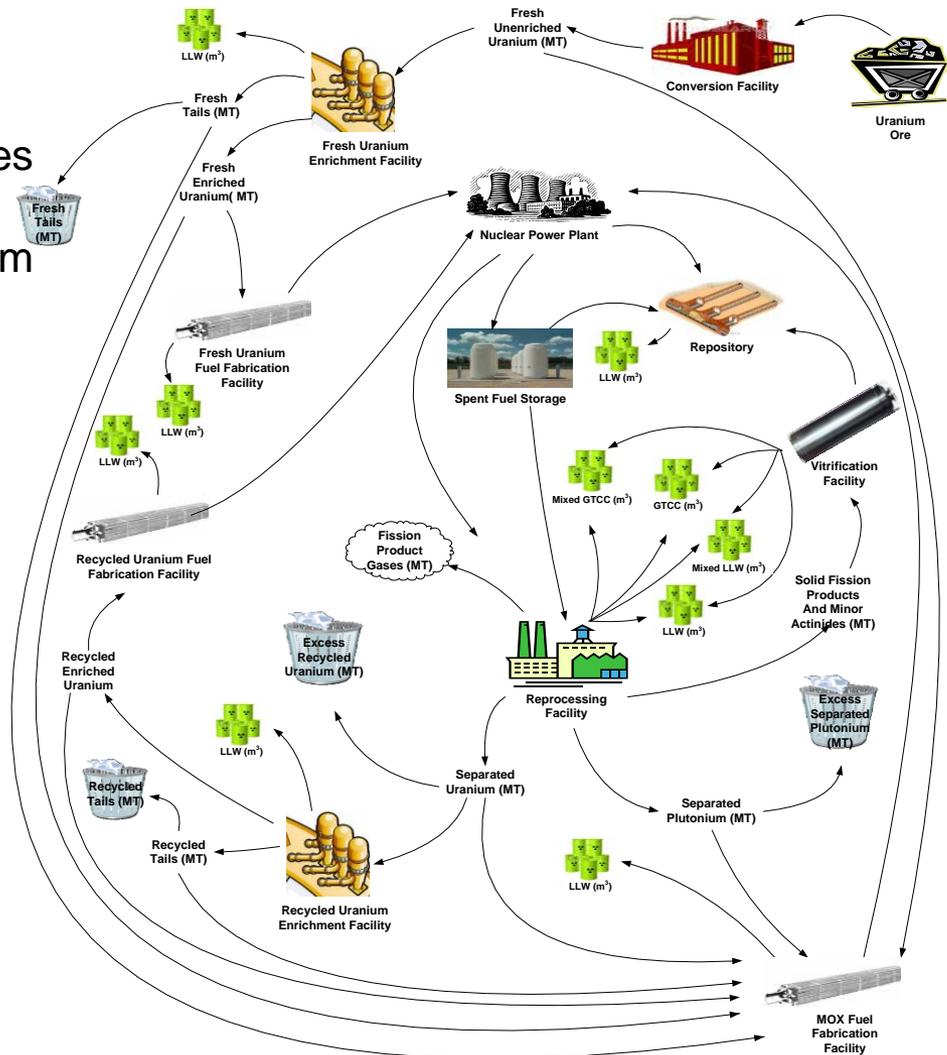
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- Facility availability
  - Start date
  - Operating period
  - Capacity
- PWR/BWR burn-up (GWd/MT)
- Fuel age ranges, and order of selection, for disposal and reprocessing
- Applying importance weights to various criteria
- Length of evaluation period



# NUWASTE Process Operations & Material Flow

- Waste streams generated
  - Fission products and minor actinides
  - Fuel assembly components
  - Tails from new and recycled uranium
  - Low-level waste
  - Greater than Class C waste
  - Transuranic waste
- Facilities required
  - Recycled uranium enrichment
  - Recycled fuel fabrication
  - Spent fuel storage
  - Reprocessing
  - Vitrification
  - Repository for CSNF and HLW
  - Repositories for other wastes
- Transportation logistics



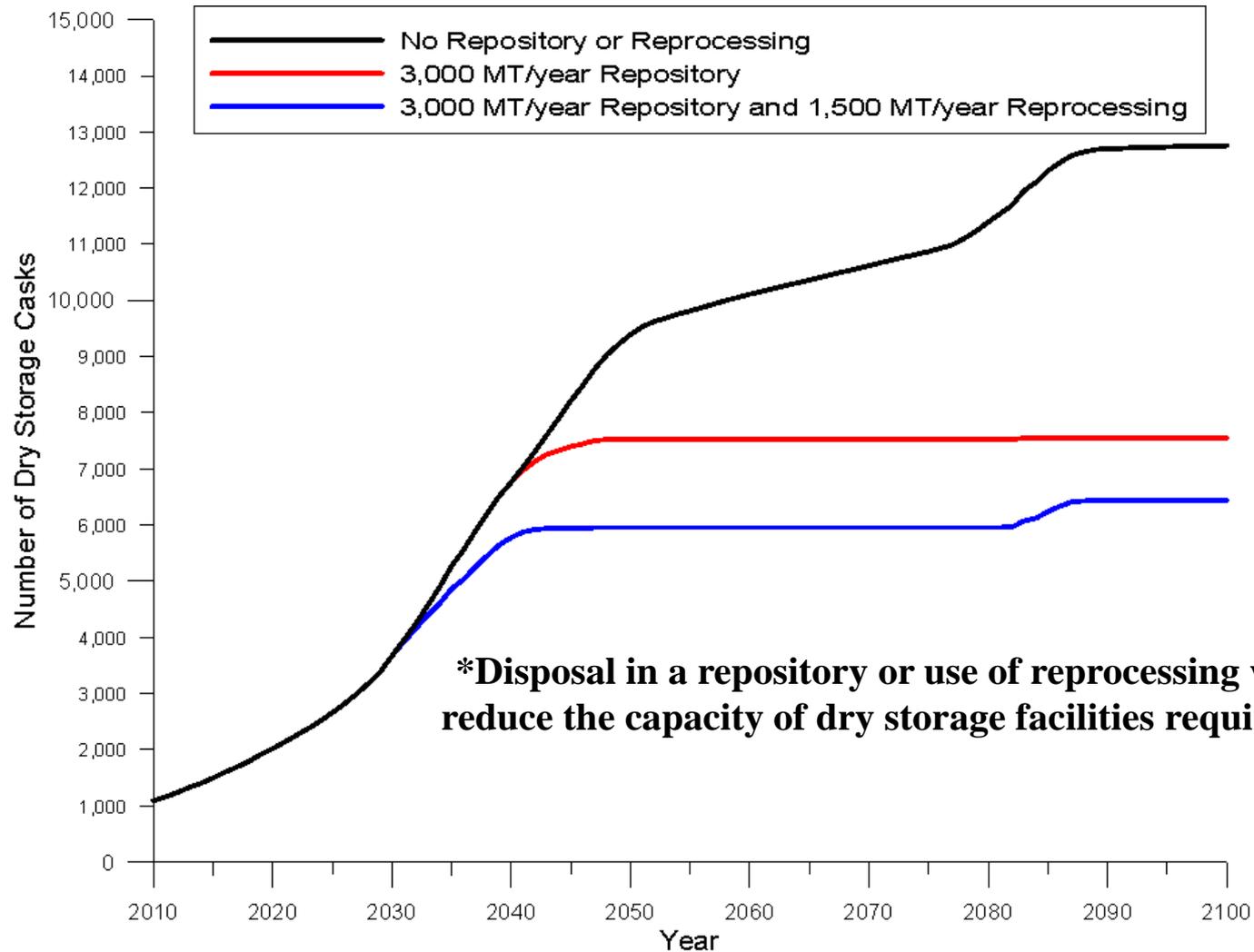
# Scenarios Presented Today

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- Waste Stream
  - Existing plus 28 plants that have submitted license applications to the NRC
  - All plants operate for 60 years
  - 40 GWd/ton for assemblies discharged prior to 2010 and 60 GWd/ton burnup for assemblies discharged in 2010 and beyond
- Scenarios
  - Scenario 1: Long-Term Storage Only
    - No repository
    - No reprocessing facility
  - Scenario 2: Direct Disposal of SNF
    - Repository starts in 2040 with a capacity of 3,000 MT/year
    - No reprocessing facility
  - Scenario 3: Recycle of Uranium and Plutonium (Once)
    - Repository starts in 2040 with a capacity of 3,000 MT/year
    - Reprocessing starts in 2030 with a capacity of 1,500 MT/year
    - All separated uranium and plutonium recycled within one year



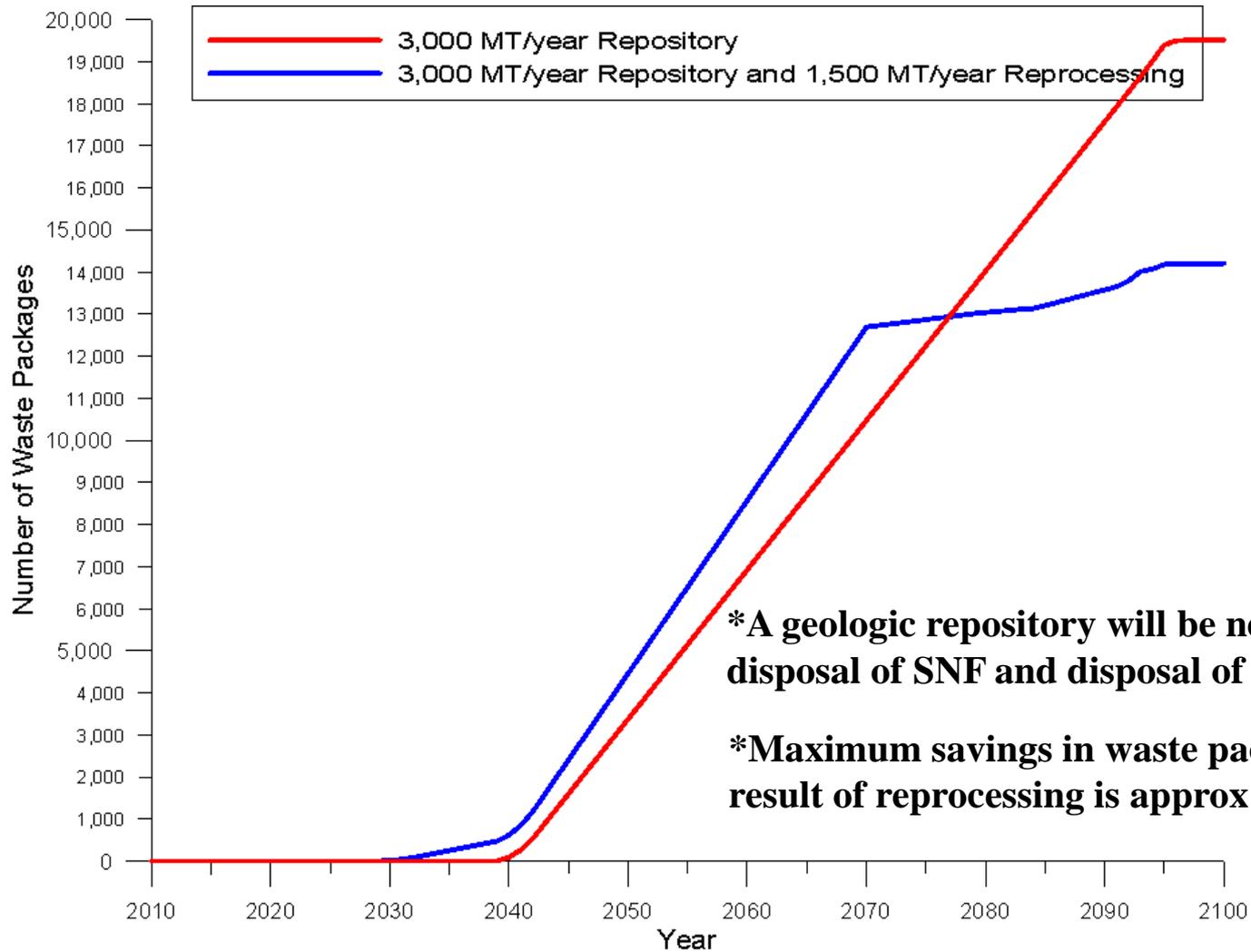
# Number of Dry Storage Casks Required



**\*Disposal in a repository or use of reprocessing would each reduce the capacity of dry storage facilities required for SNF**



# Number of Waste Packages Required

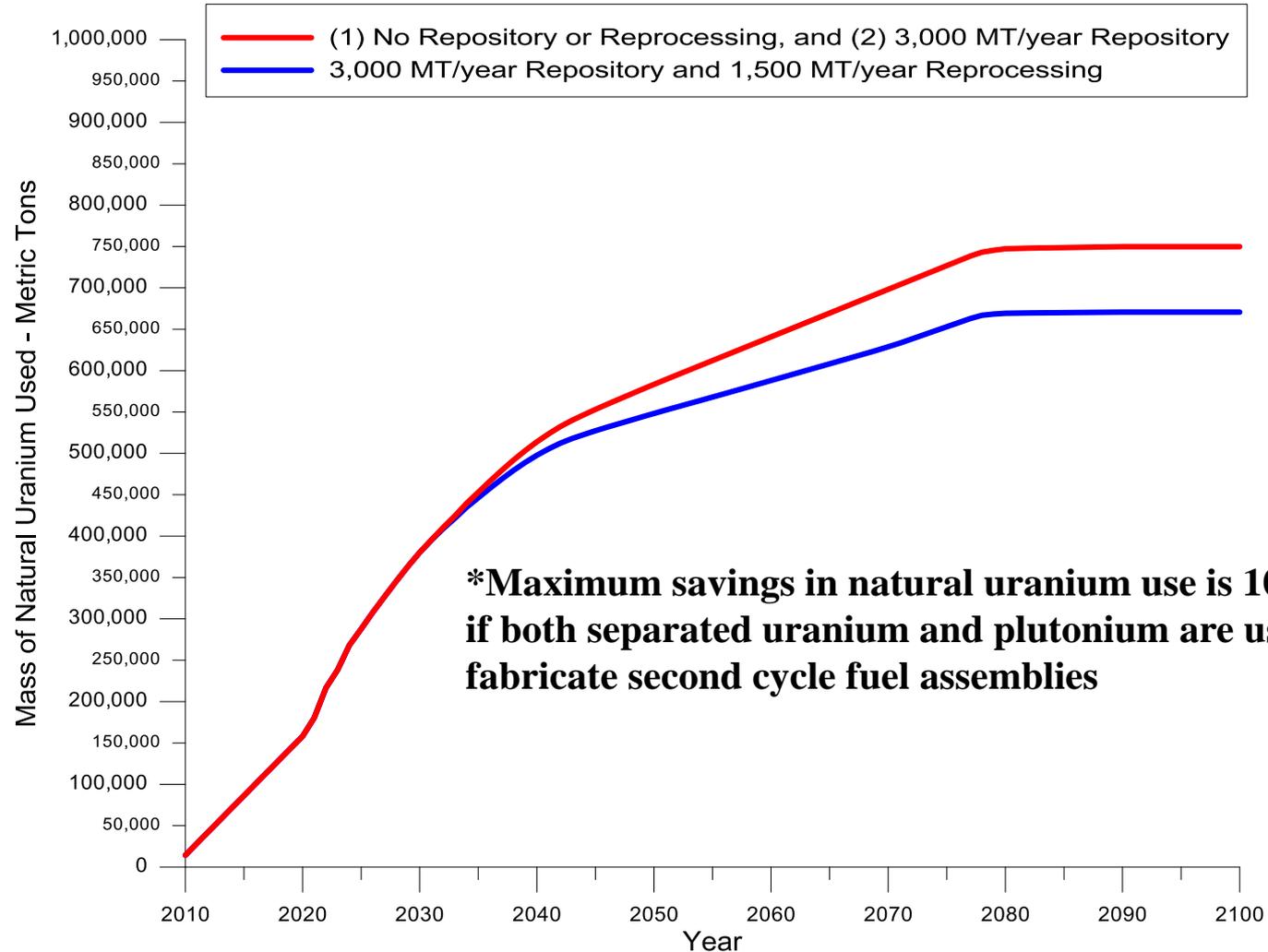


**\*A geologic repository will be needed for direct disposal of SNF and disposal of vitrified HLW**

**\*Maximum savings in waste packages as a result of reprocessing is approx 25%**



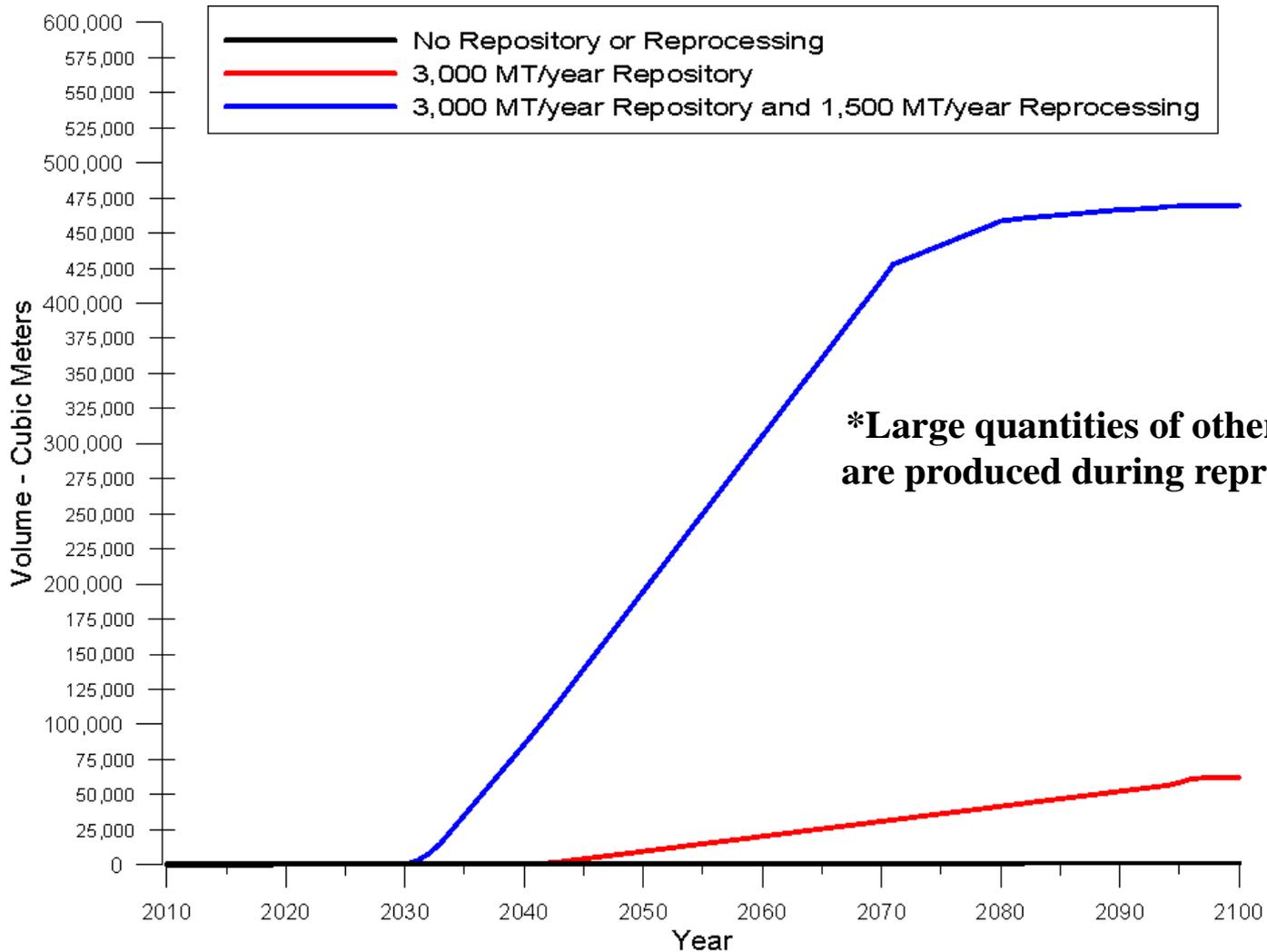
# Natural Uranium Usage



**\*Maximum savings in natural uranium use is 10-15% if both separated uranium and plutonium are used to fabricate second cycle fuel assemblies**



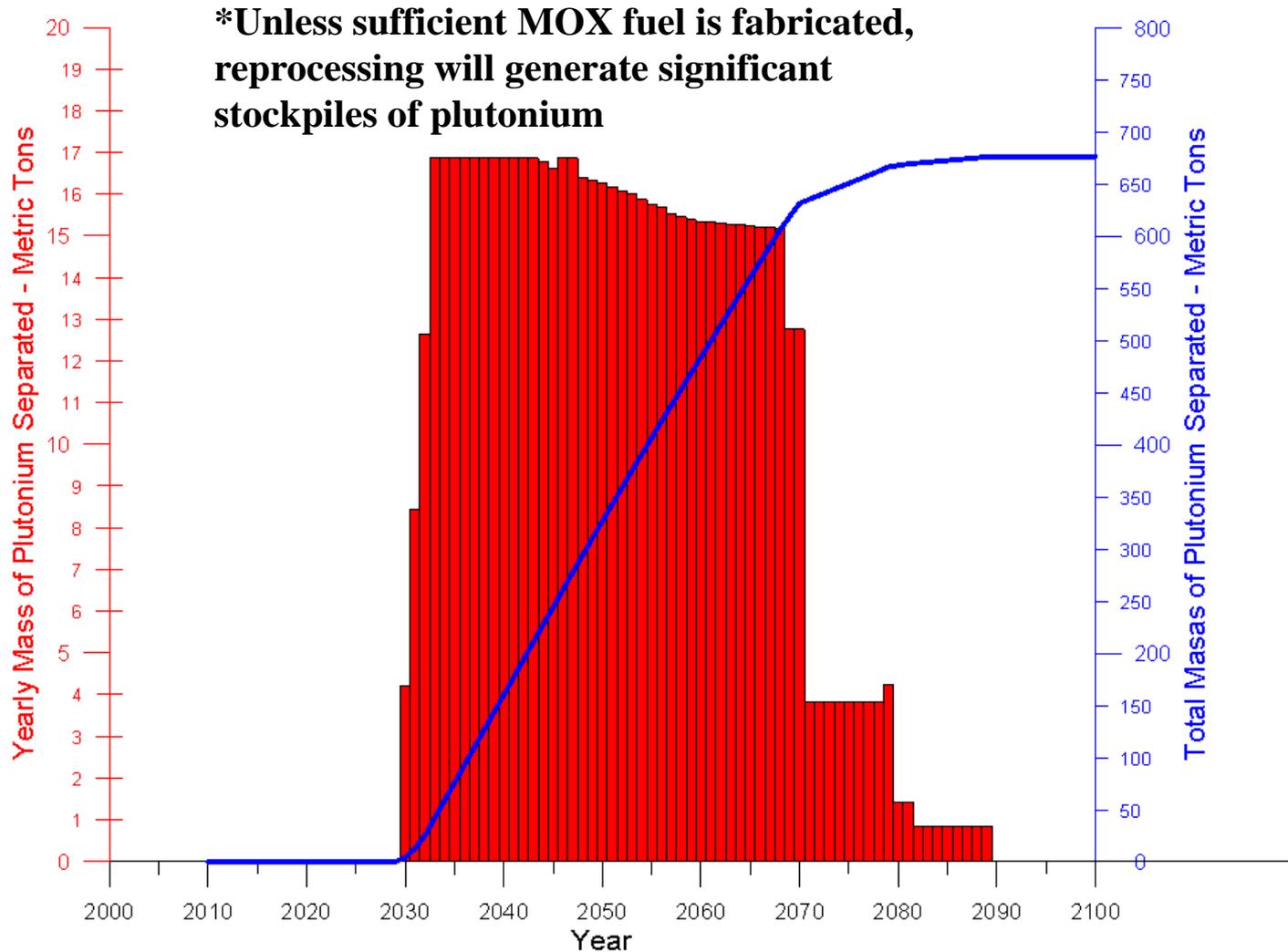
# Quantity of LLW and GTCC Waste Generated



**\*Large quantities of other wastes are produced during reprocessing**



# Quantity of Plutonium Separated



# Overarching Observations

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- NUWASTE can help understand the impacts of potential fuel cycle initiatives on the generation and management of SNF and HLW.
- A variety of waste management criteria warrant consideration.
- Under all likely scenarios, a geologic repository will be needed for disposal of both SNF and vitrified HLW.
- Significant delays in opening a repository will substantially increase the quantity of SNF in dry storage, potentially in at least 33 states.
- The analyses completed to date have not identified any major advantages from reprocessing, in terms of either reduction in repository volume required for disposal of SNF and HLW or in uranium demand.



# NUWASTE – Ongoing Activities

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- Communicate results to Congress, DOE, BRC and other interested parties.
- Include additional functionality
  - relative facility construction, operating and decommissioning costs
  - relative dose to the public
- Identify and evaluate additional scenarios.
- Extend NUWASTE capabilities
  - away from reactor central storage facility/facilities
  - processing of DOE SNF, disposal of all DOE HLW
  - transportation equipment/facility characteristics and logistics
  - small modular reactors
  - advanced (Gen III and IV) reactor designs, fast reactors

