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Scenarios for Nuclear Energy Growth

Implications for Used Fuel Management

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Purpose

- **Provide range of possible used fuel generation scenarios**

- **Focus on 2050 time horizon**
  - 2030 too soon for effects to be seen
  - Beyond 2050 assumptions of reactor and fuel types increasingly speculative
  - Consider post-2050 impacts of pre-2050 deployments

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Approach

- **Three growth scenarios**
  - Low: All reactors operate to end of current licenses
    - *No new renewals, no new builds*
  - Medium: Maintain 20% share of electricity production
    - *All reactors in the current fleet operates for sixty years*
  - High: Nuclear grows to 50% share by 2050
- **Assumptions**
  - Electricity grows 1%/year through 2050
  - All new reactors resemble Gen III+ concepts
    - *Generic 1400 MWe capacity*
    - *New builds constrained to ramp up production*
  - Average burnup of 50 GWd/MTiHM (~20 MT/GWe-yr)

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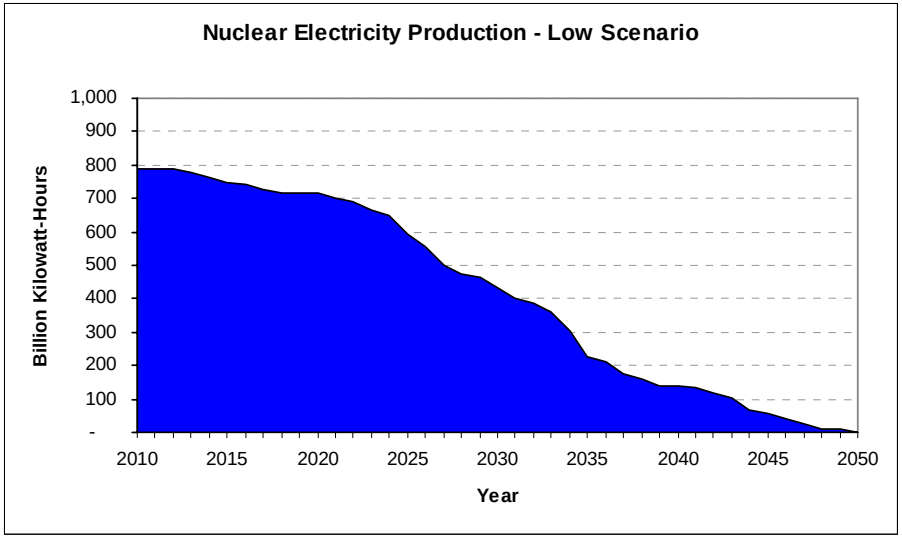
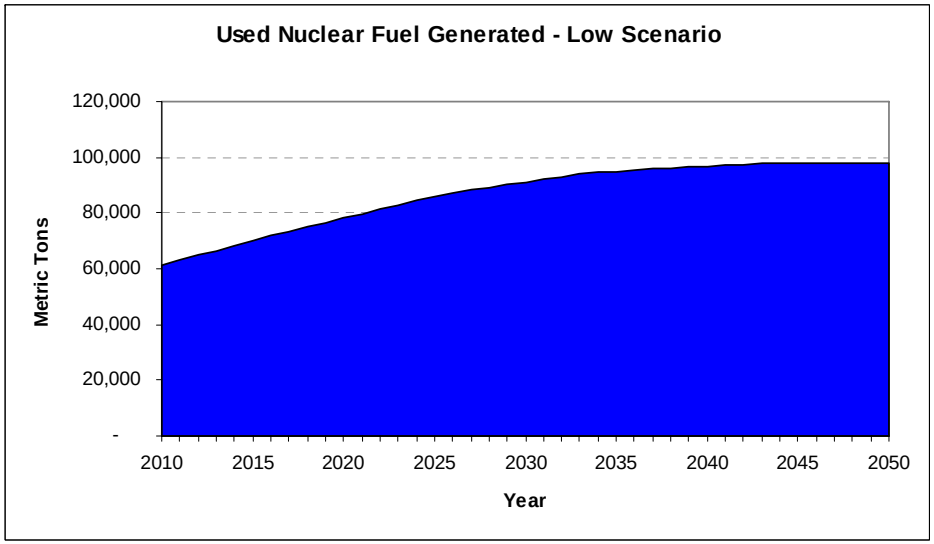
Low Growth Scenario



Nuclear electricity phased out by 2049

Almost 100,000 MT of used fuel generated



Current LWRs

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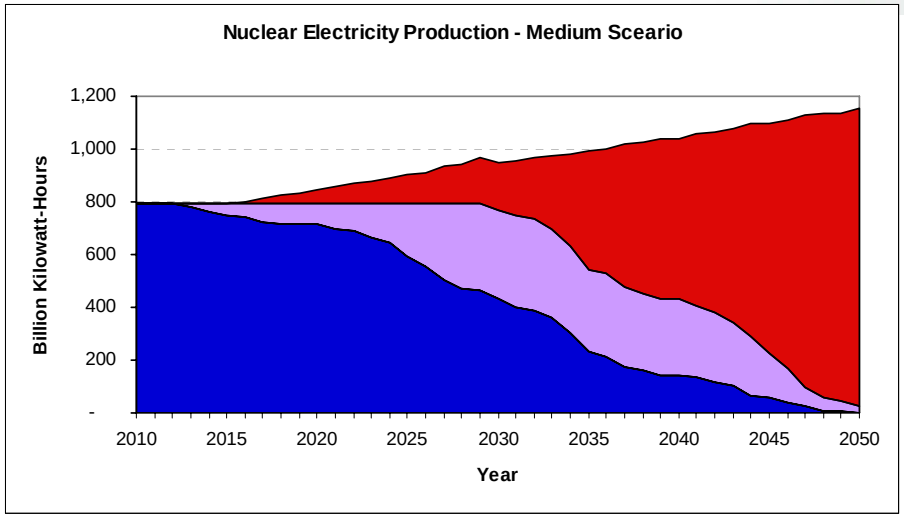
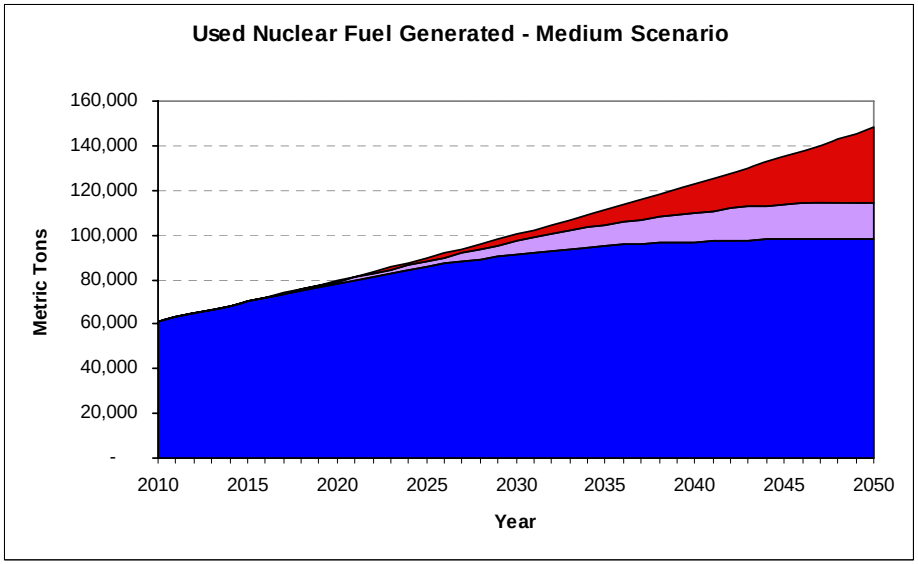
Medium Growth Scenario



Gen III+ Adv. LWRs
Assumed License Renewals
Current LWRs

Maintain 20% market share through 2050
- *146 GWe capacity - 105 (larger) reactors*
- *Average build rate about three reactors per year*

Most used fuel from current reactors by 2050



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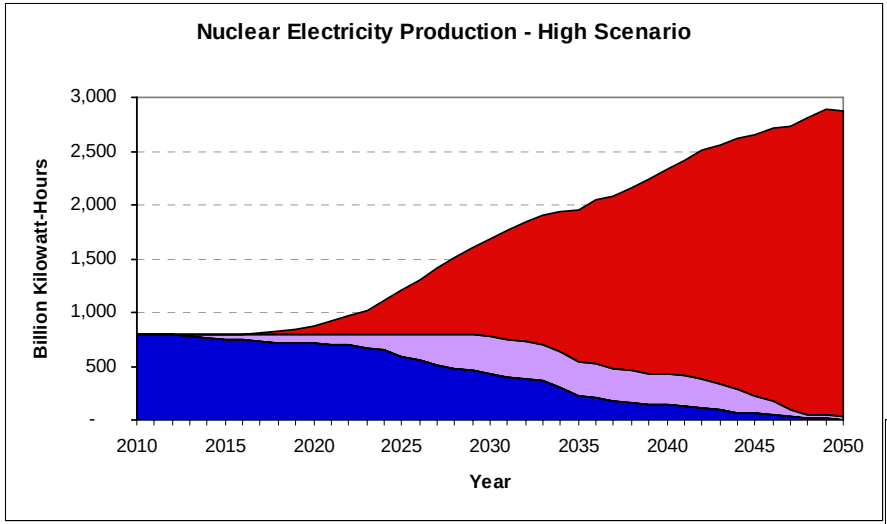
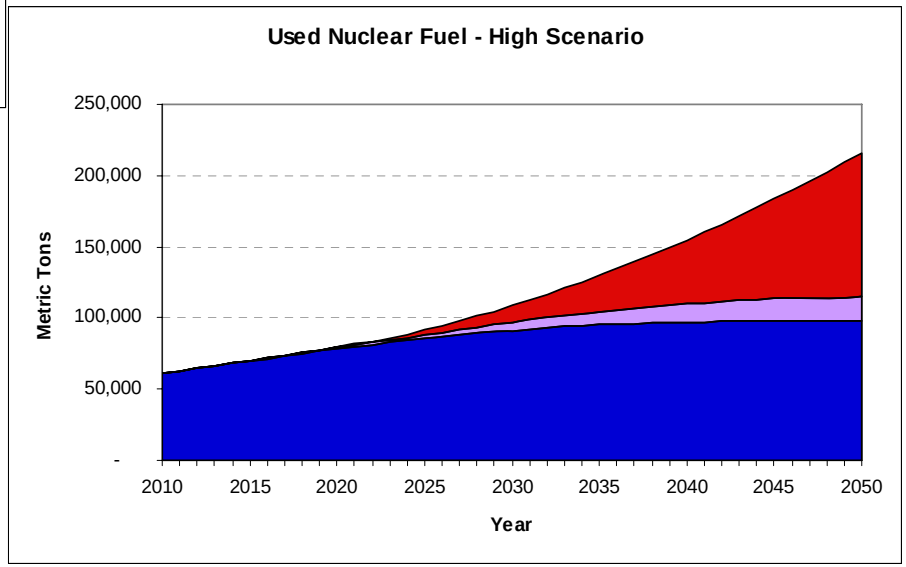
High Growth Scenario



50% share by 2050
- *365 GWe capacity (~260 reactors)*
- *Sustained build rate ~9 per year*

About as much used fuel from new builds as legacy reactors by 2050

Gen III+ Adv. LWRs
Assumed License Renewals
Current LWRs



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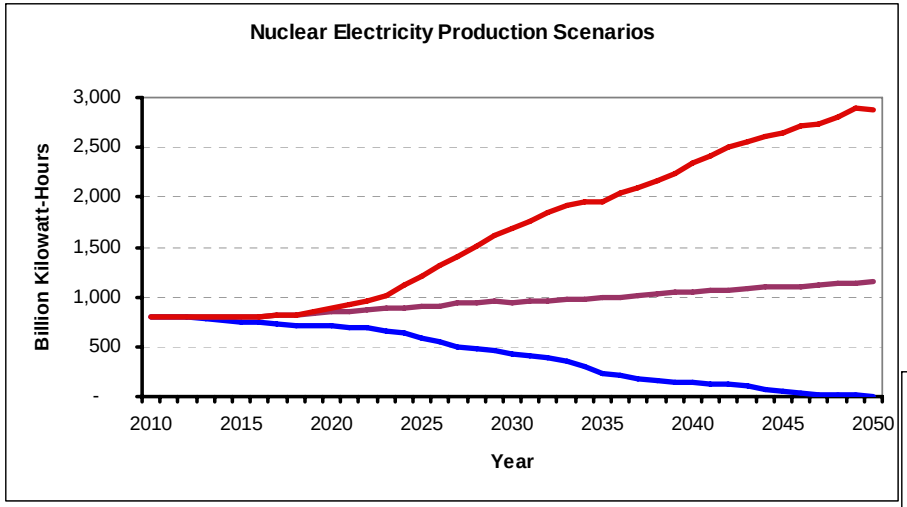
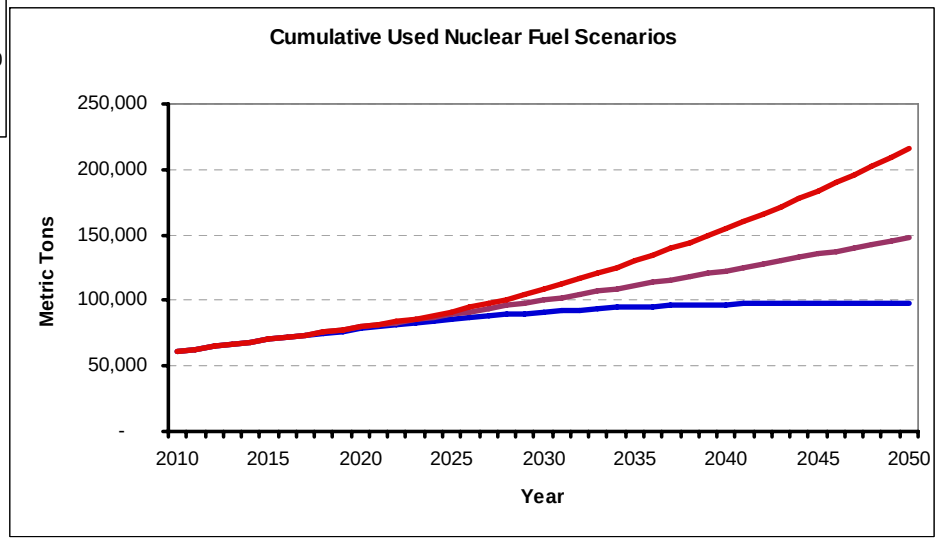
Scenarios



Range in electricity production much more dramatic than used fuel generation

Changes in cumulative impact take much longer for effects to be seen



High Growth Scenario
Medium Growth Scenario
Low Growth Scenario

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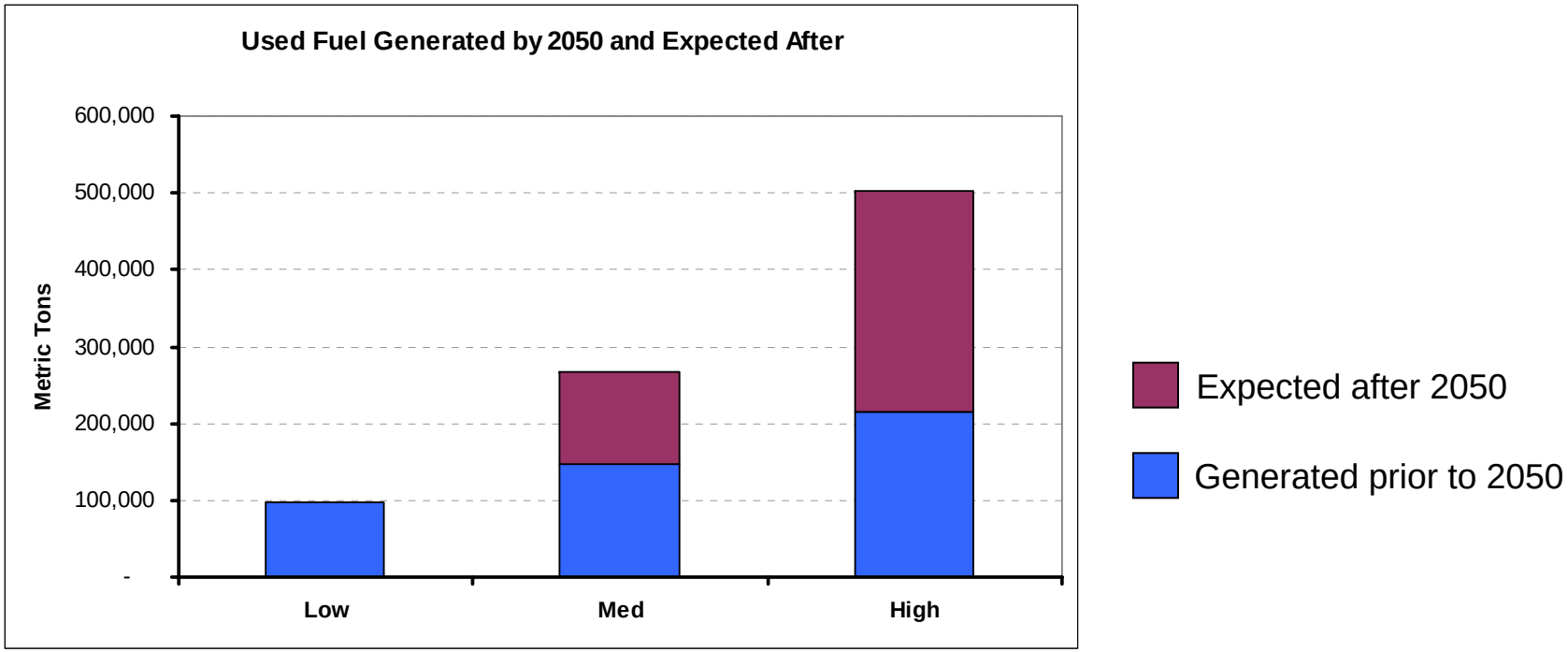
Beyond 2050

- **Expected Used Nuclear Fuel from reactors operating in 2050**
  - Assume they run for their full lifetime (taken to be 60 years)
  - Do not consider any additional new builds after 2050



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Final Observations

- Potentially wide range of used fuel projections that will need to be considered
- Even a low growth scenario implies ~100,000 metric tons
- Building new reactors in the coming decades will create expectations of used fuel generation beyond 2050
- New reactor concepts and fuel cycle management approaches could be notably different than the current system
- The amount of used fuel only one of the relevant attributes

Backup

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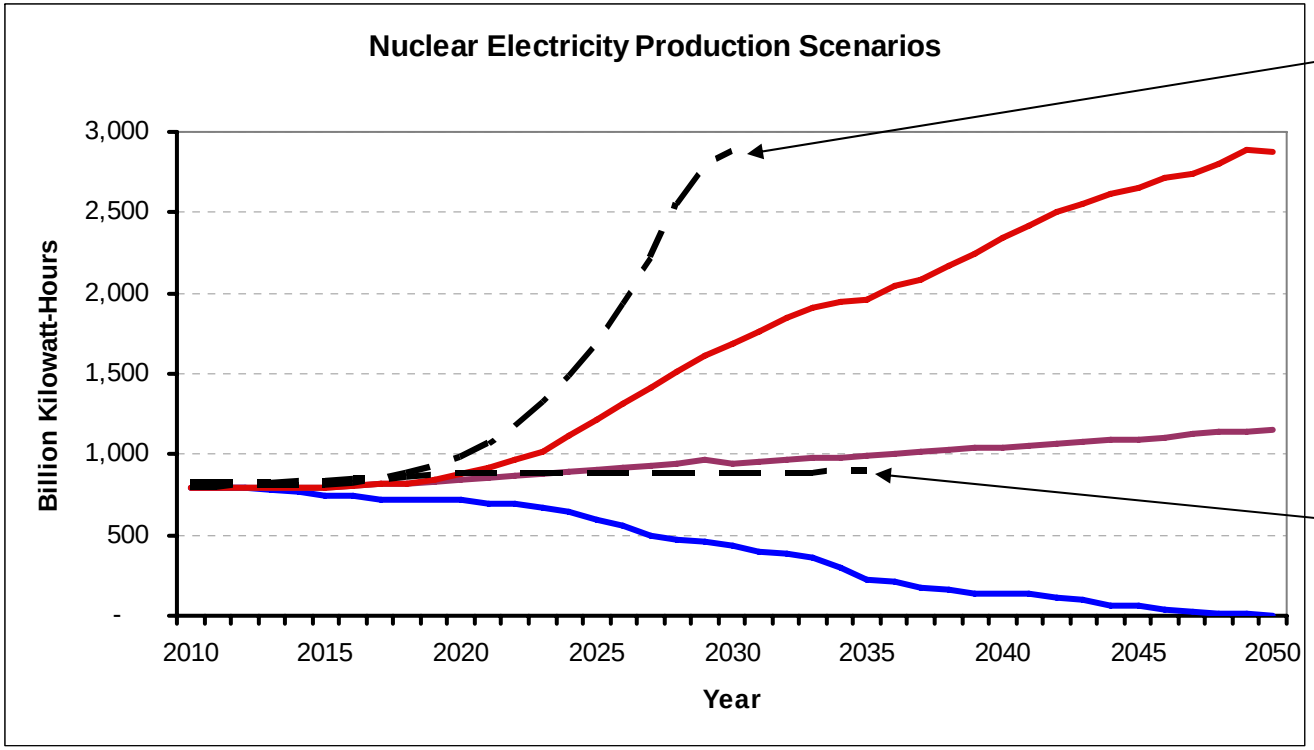
Scenario Comparison



EIA Climate Analysis 2008

EIA Ref. 2010

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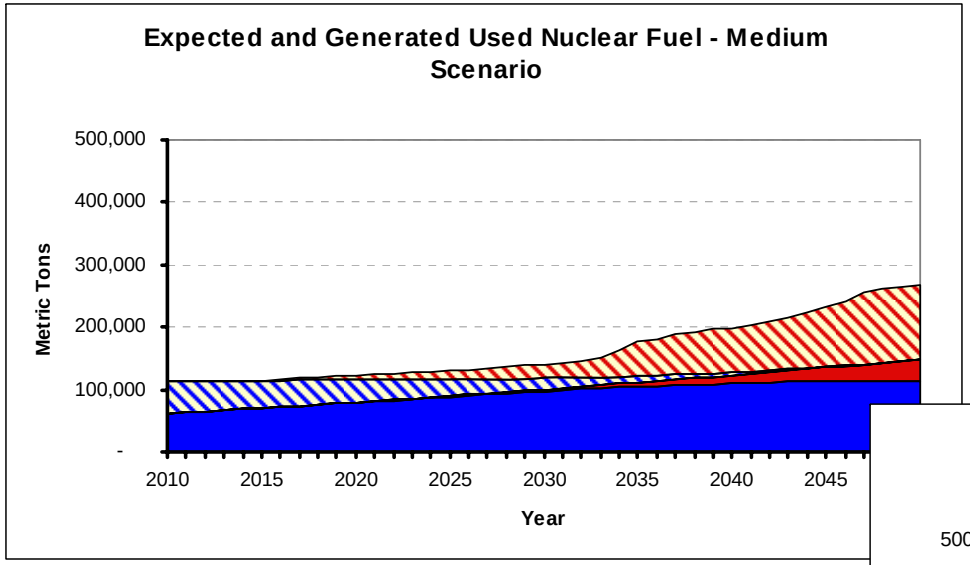
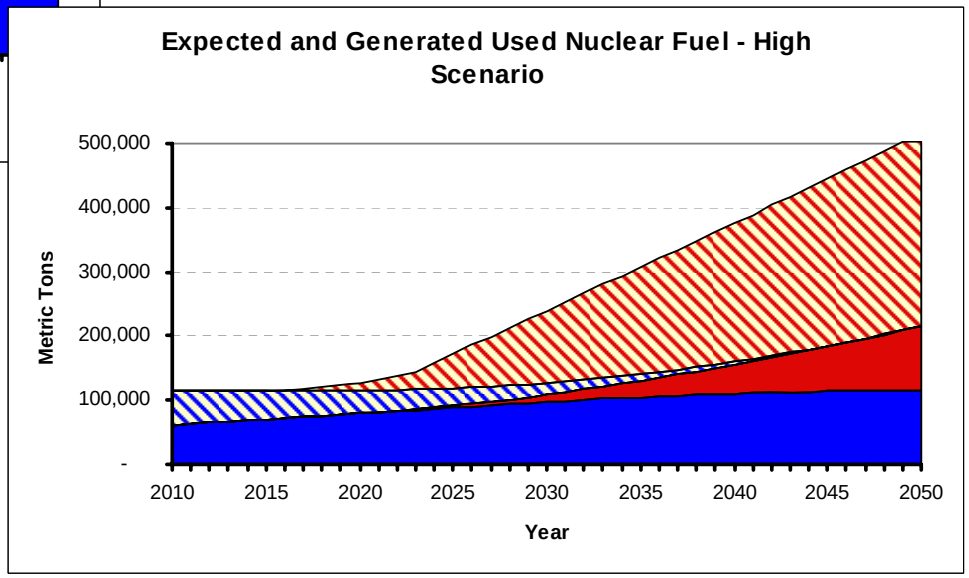
Generated and Expected Used Fuel – Medium and High Scenarios



Impact of new builds on used fuel generation really seen after 2050



- Used Fuel Still Expected from ALWRs
- Used Fuel Generated by ALWRs
- Used Fuel Still Expected from Current Fleet
- Used Fuel Generated by Current Fleet