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An Evaluation of Water Usage and Related Institutional Influences on Three Electric Generating Capacity Expansion Alternatives for the Western United States

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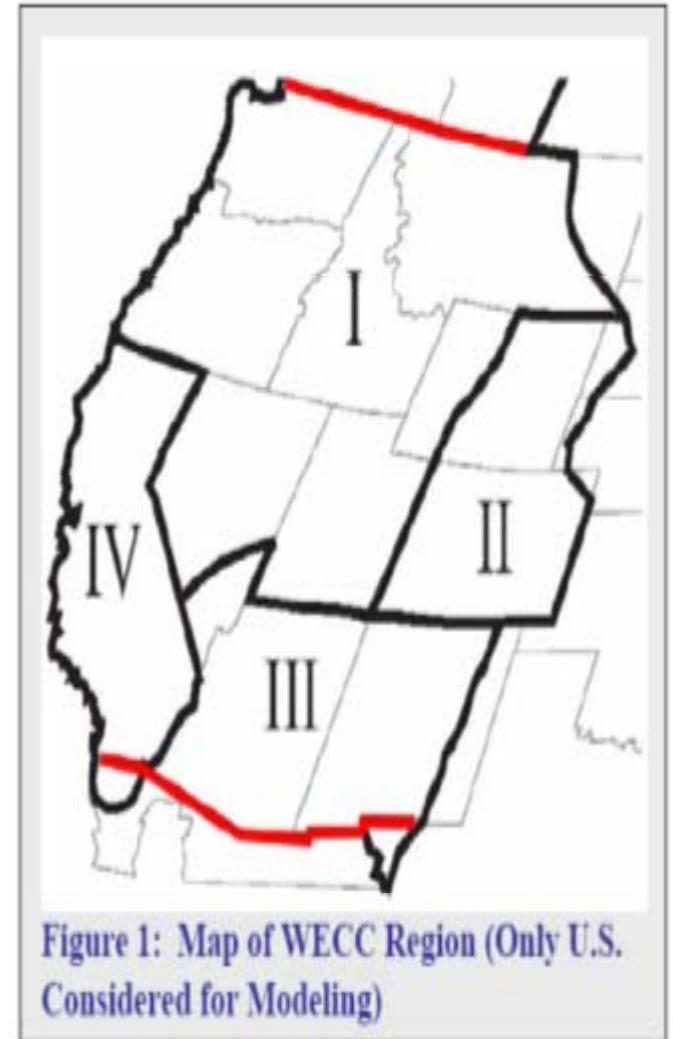
Project Overview

■ Objective:

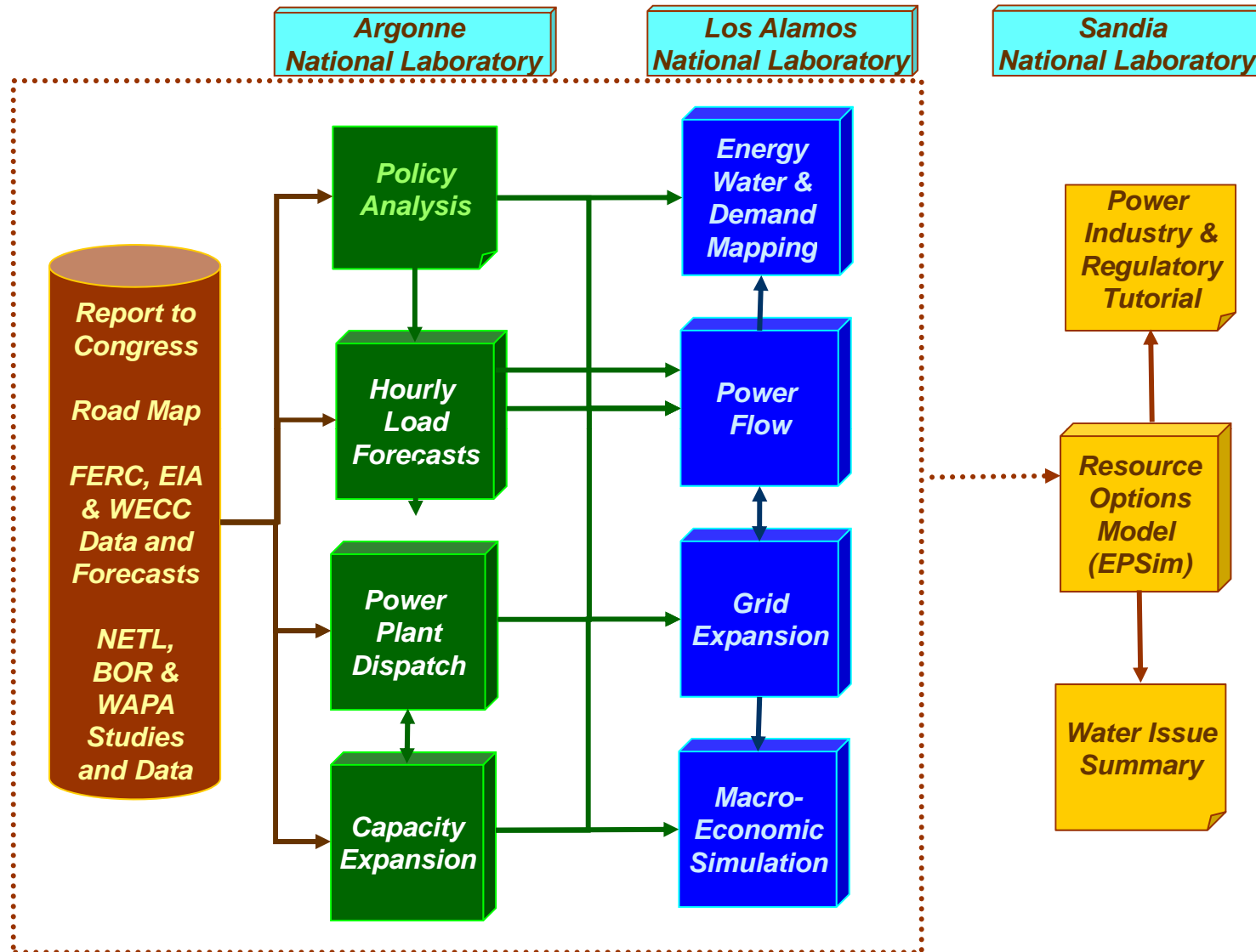
- Evaluate water demands and related institutional factors for electricity generation options for meeting future electricity requirements

■ Approach

- Develop 3 scenarios for meeting the expanding electricity demand from 2006 through 2025 in the states served by members of the Western Electricity Coordinating Council (WECC)
 - *Baseline Scenario*
 - *Renewable Energy Scenario*
 - *Nuclear Scenario*
- Project fresh water withdrawals, consumption & CO₂ emissions
- Identify institutional uncertainties/constraints



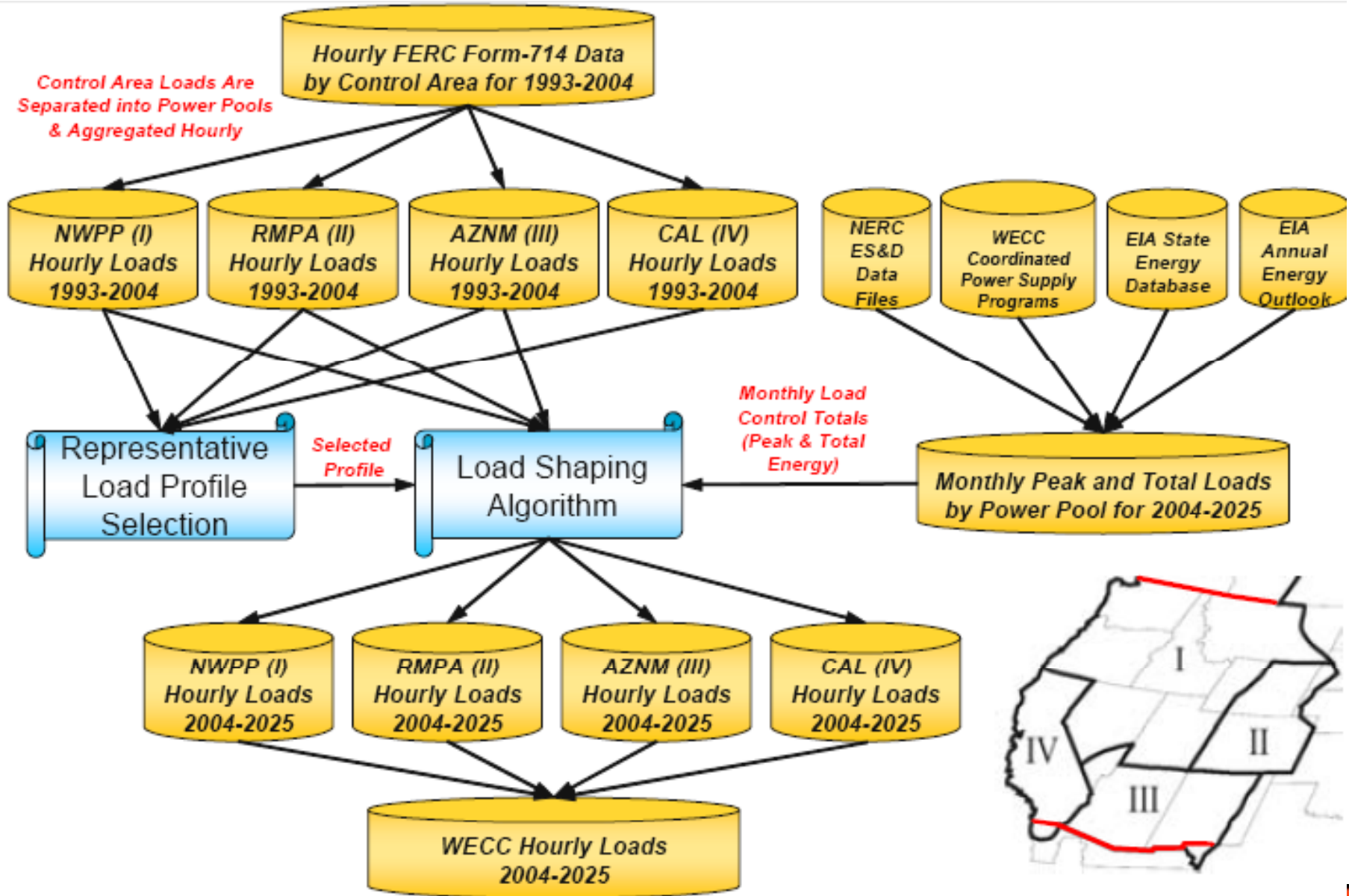
This Analysis Is Part of a Larger Integrated Analysis



Study Components

- Load forecasting, dispatch, water use and consumption
 - Forecast hourly loads and monthly load duration curves at the unit-level
 - Develop system expansion requirements
 - Calculate water use and consumption, other metrics
- Institutional Influences
 - Identify institutional influences (federal and state laws, regulations, and policies) with potential to affect the water and energy demands for energy facilities
 - Assess the potential for the identified institutional influences to change the validity of the assumptions for the each simulated scenario

Processing Hourly Loads



Thermal Power Plant Water Use Computation

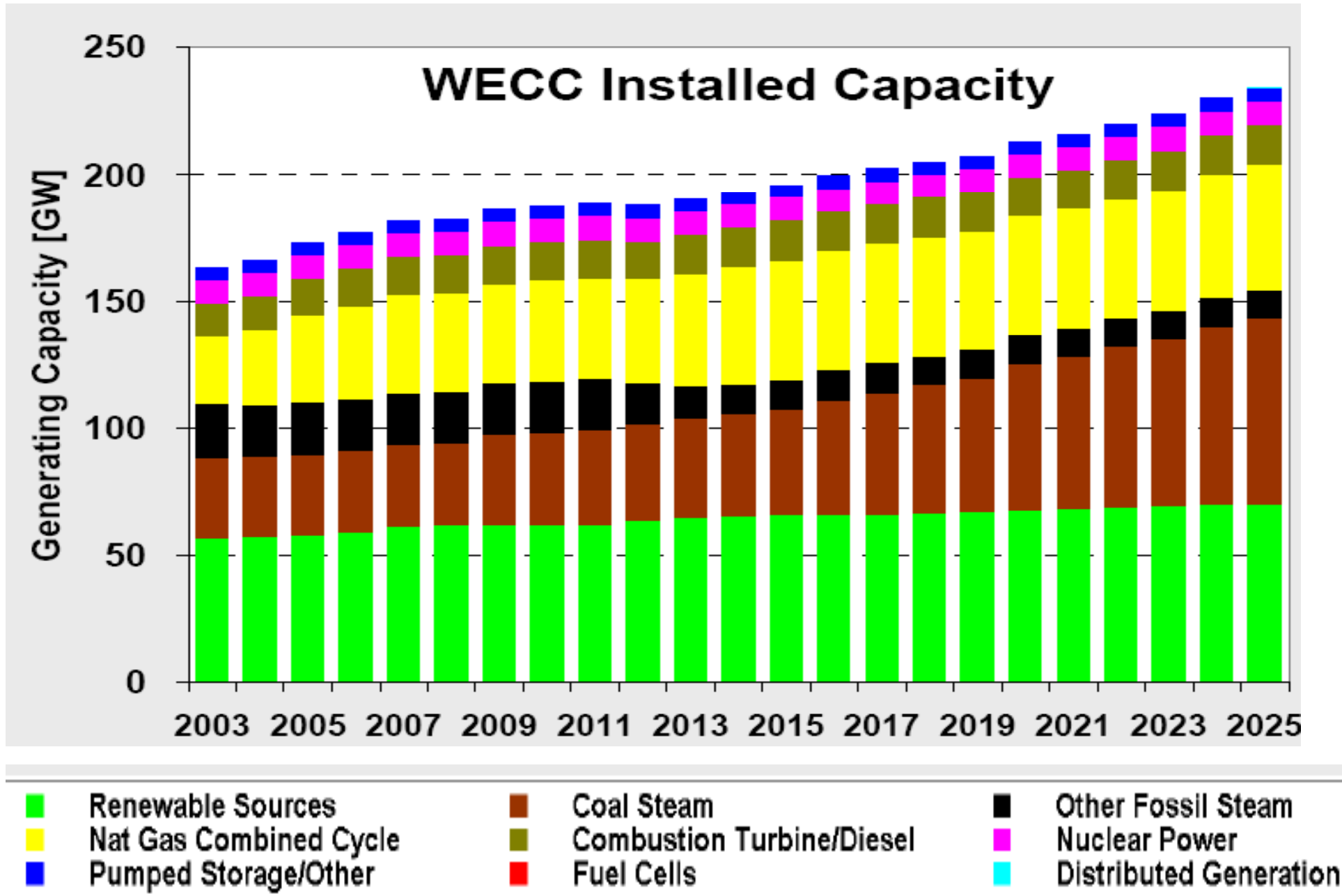
- Water consumption and withdrawal are based on water use factors and power plant energy production
- Water consumption factors is derived at the plant level from data contained in form EIA-767



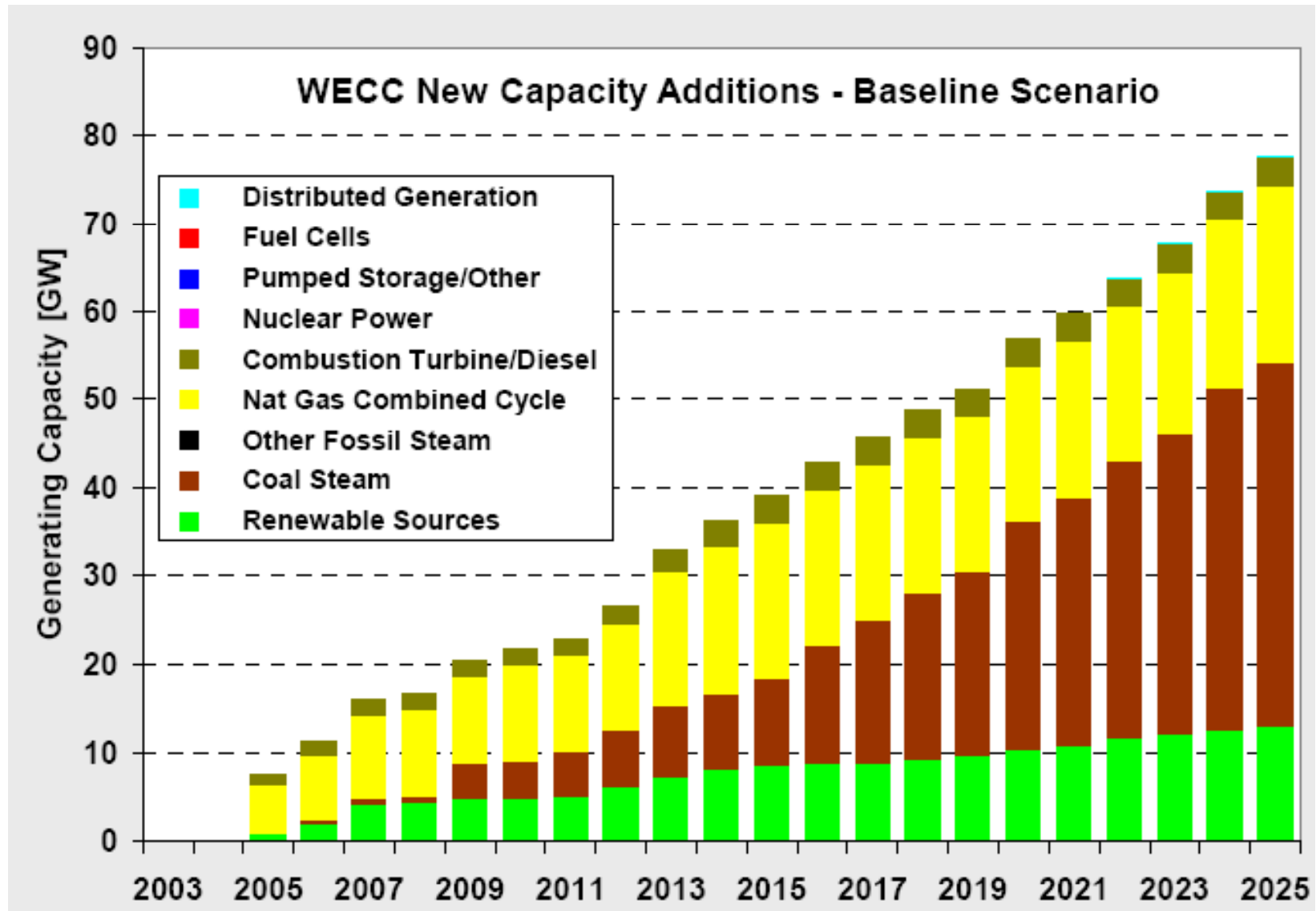
Baseline Case Scenario

2006 Annual Energy Outlook

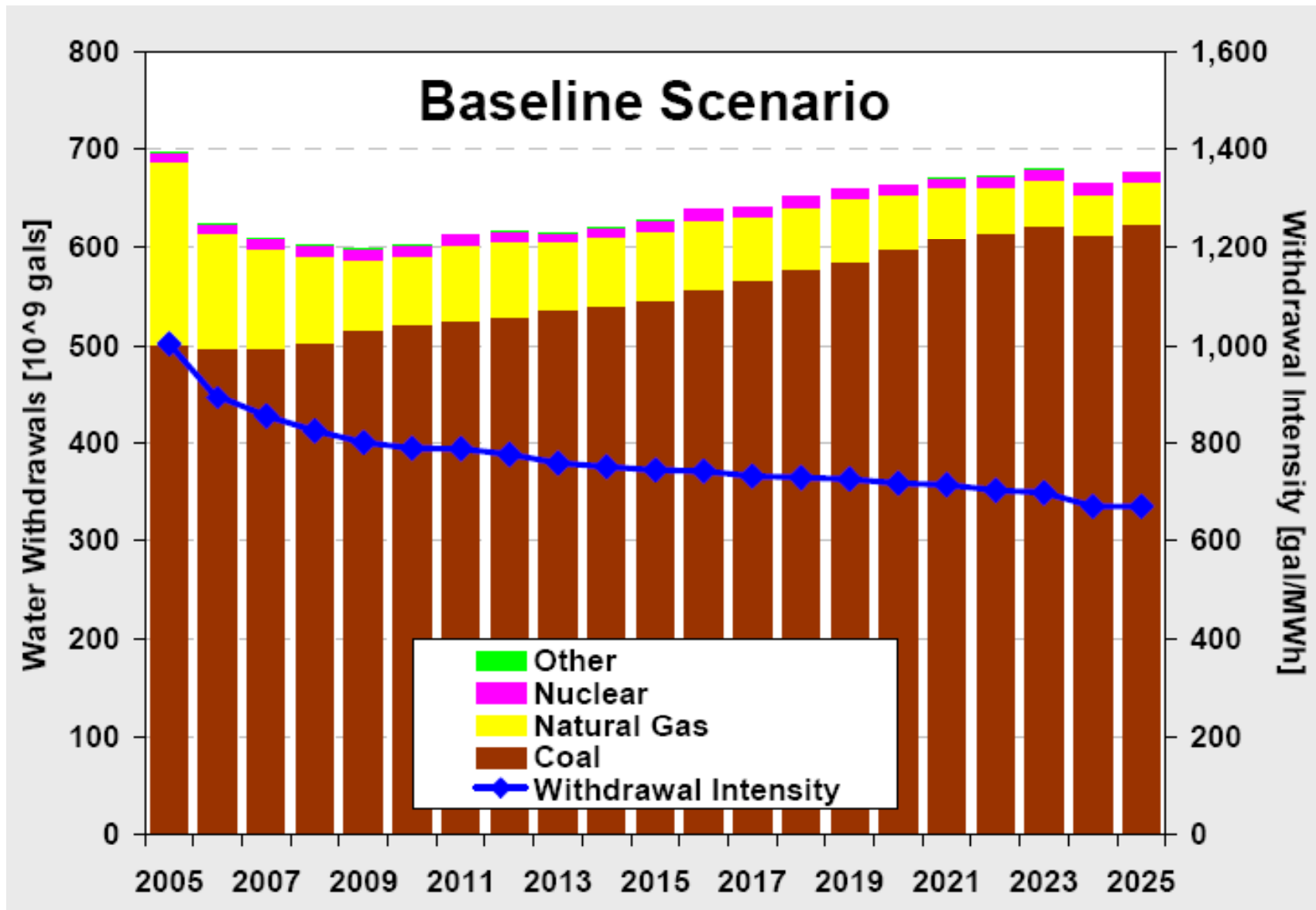
Total WECC Generating Capacity



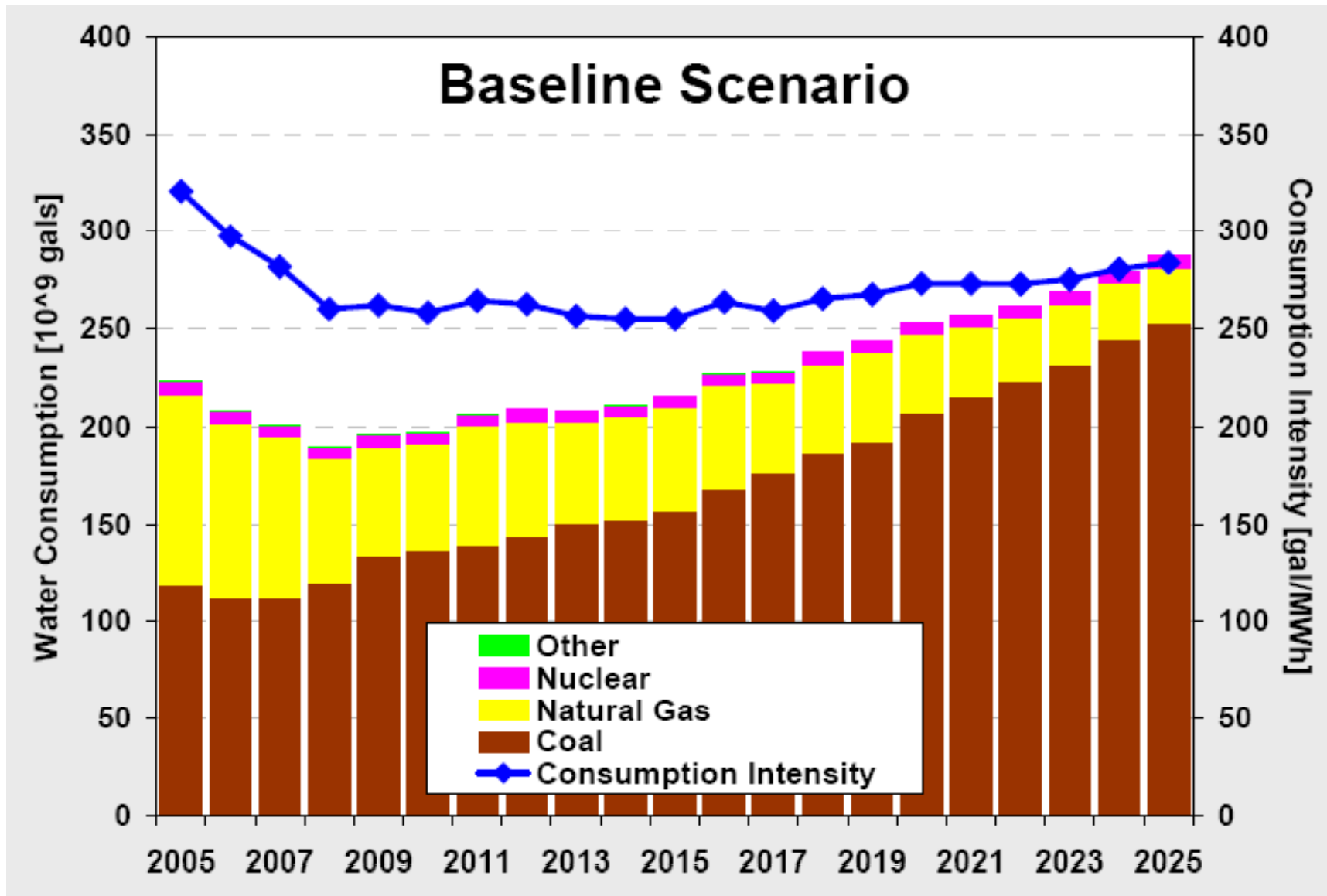
Baseline Case Cumulative Capacity Additions



Baseline Case Annual Water Withdrawal



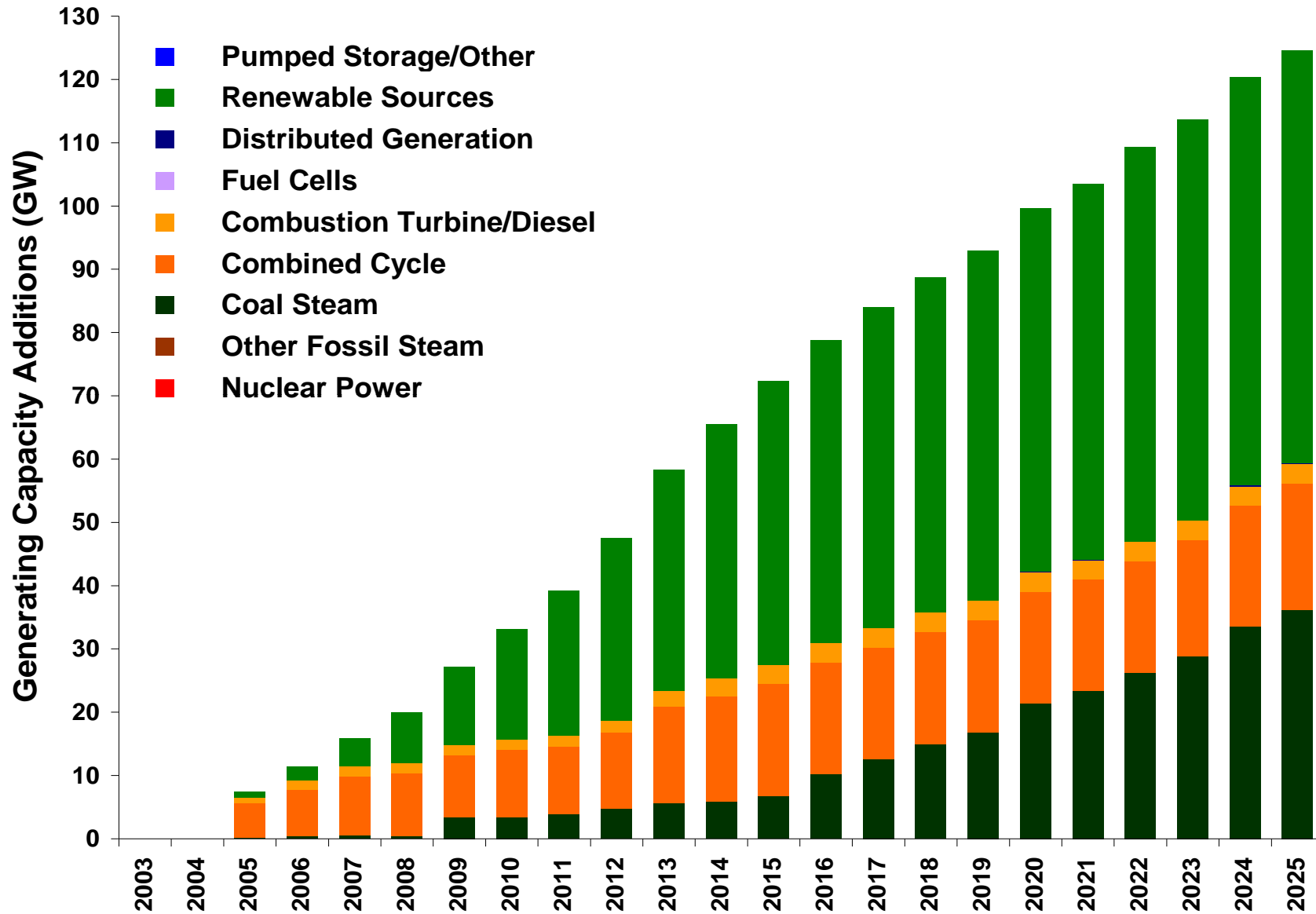
Baseline Case Annual Water Consumption



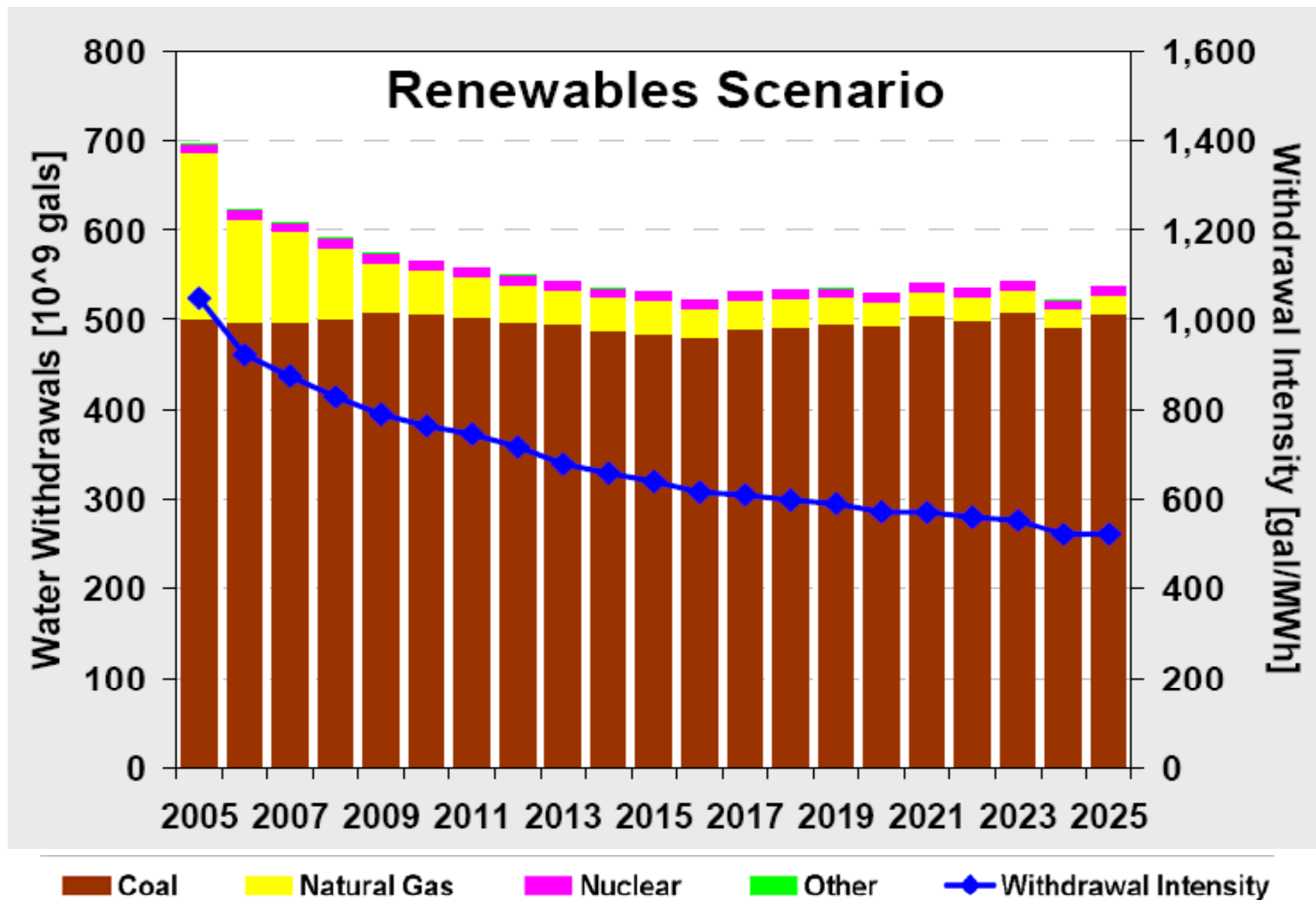
High Renewable Scenario
25% of Load Served by
Renewable Energy Sources
Primarily New Wind Turbines



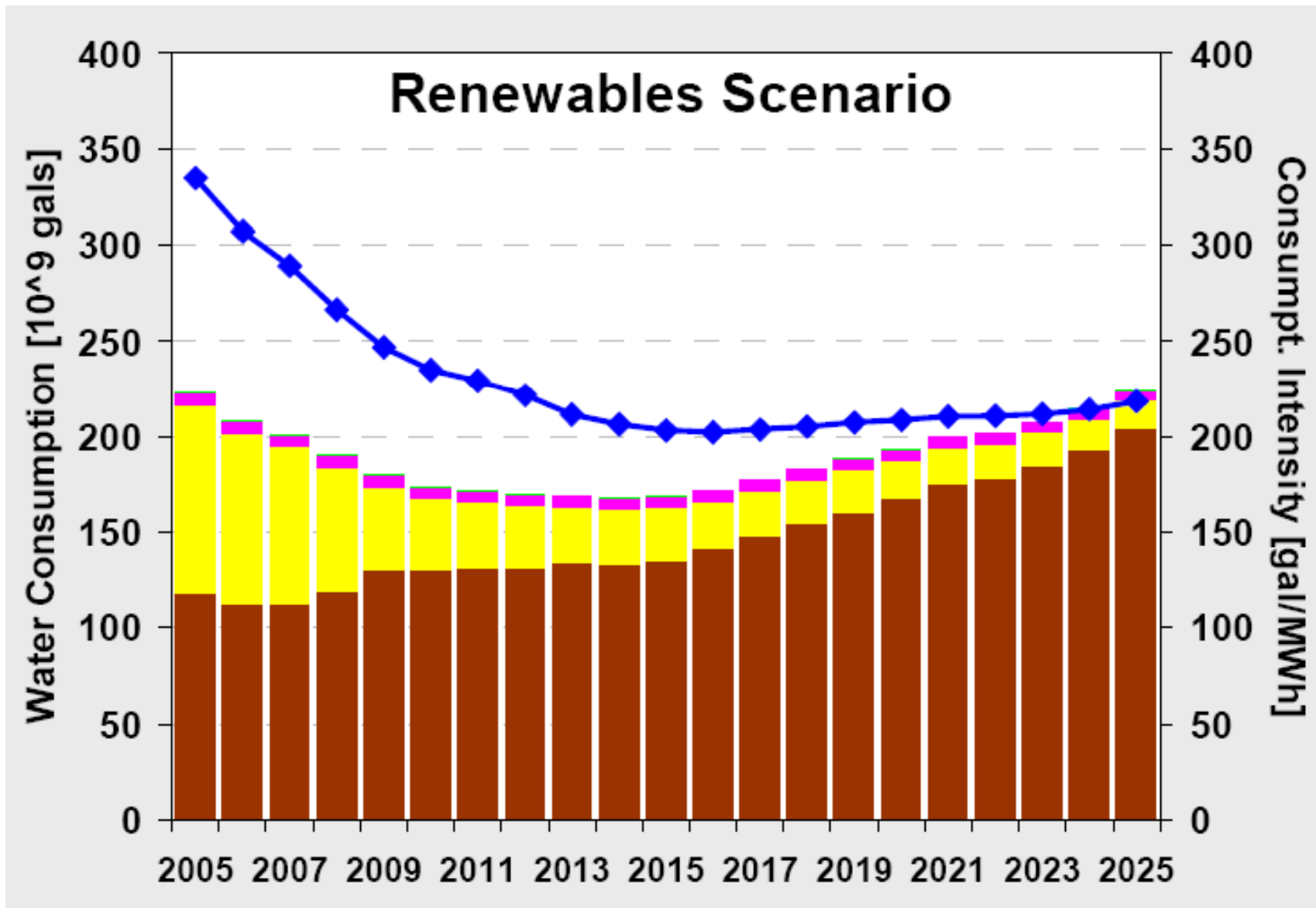
High Renewable Scenario Cumulative Capacity Additions



High Renewable Scenario Annual Water Withdrawal



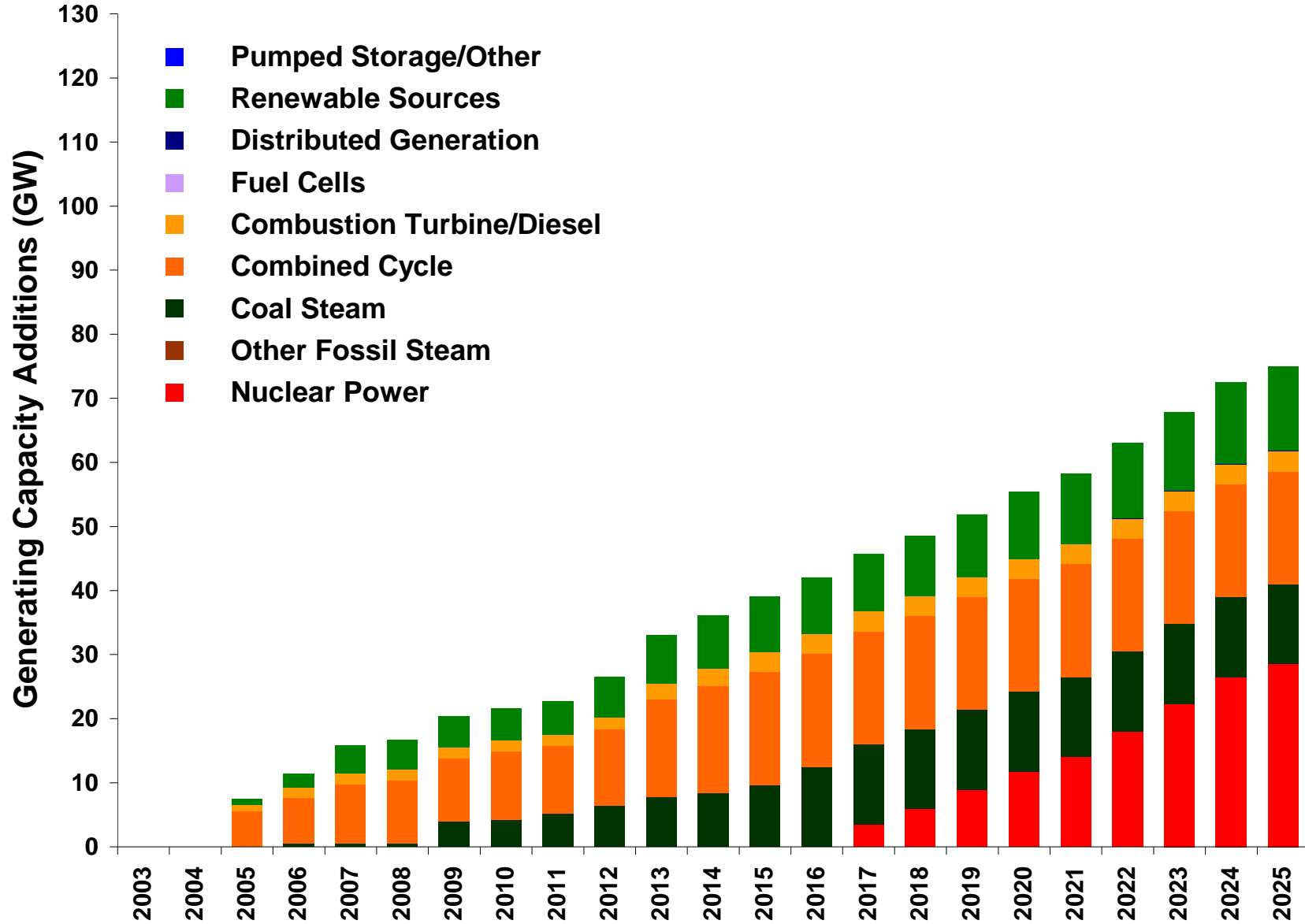
High Renewable Scenario Annual Water Consumption



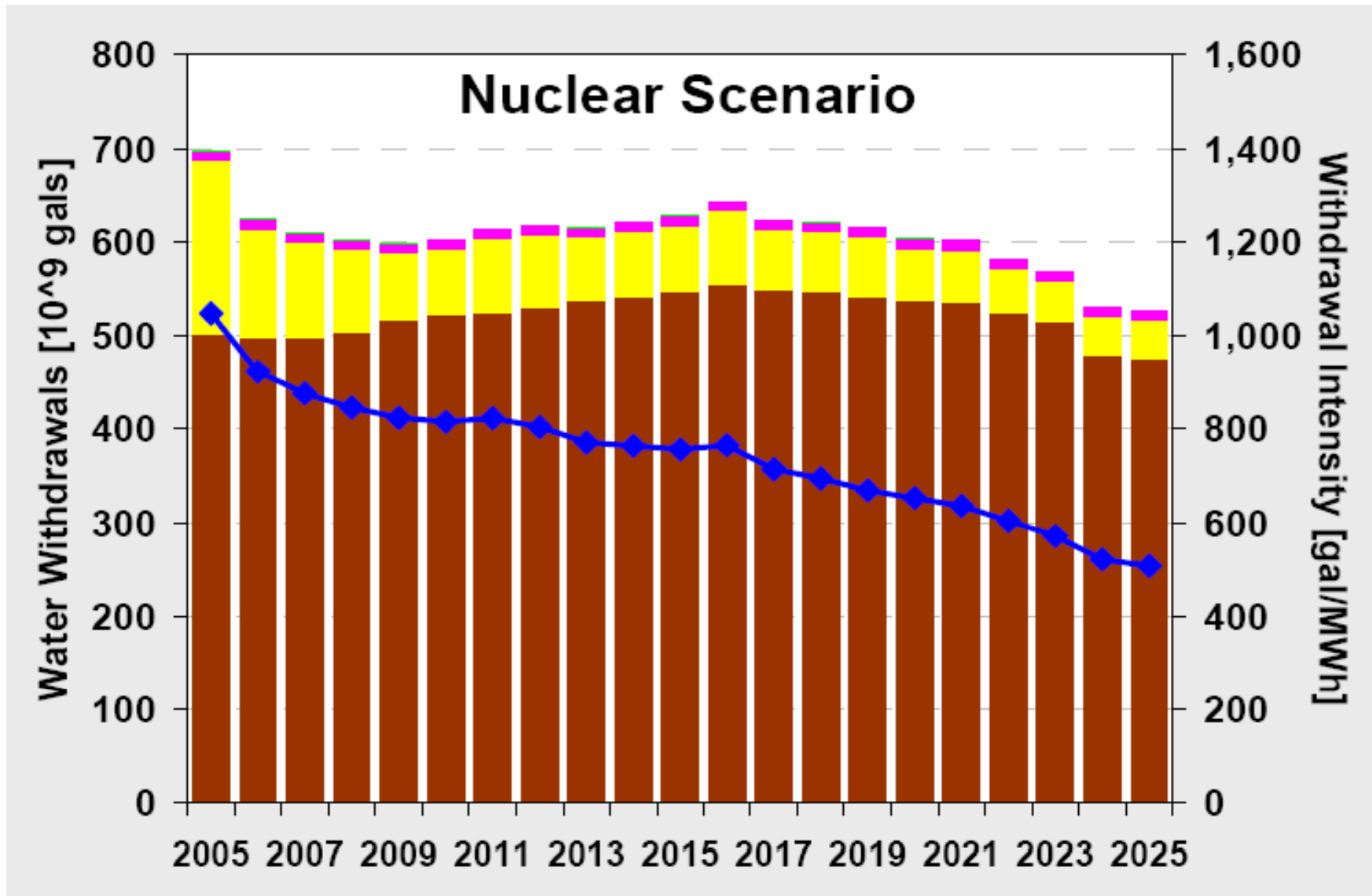
High Nuclear Scenario
50% of New Capacity Will
Eventually be Nuclear



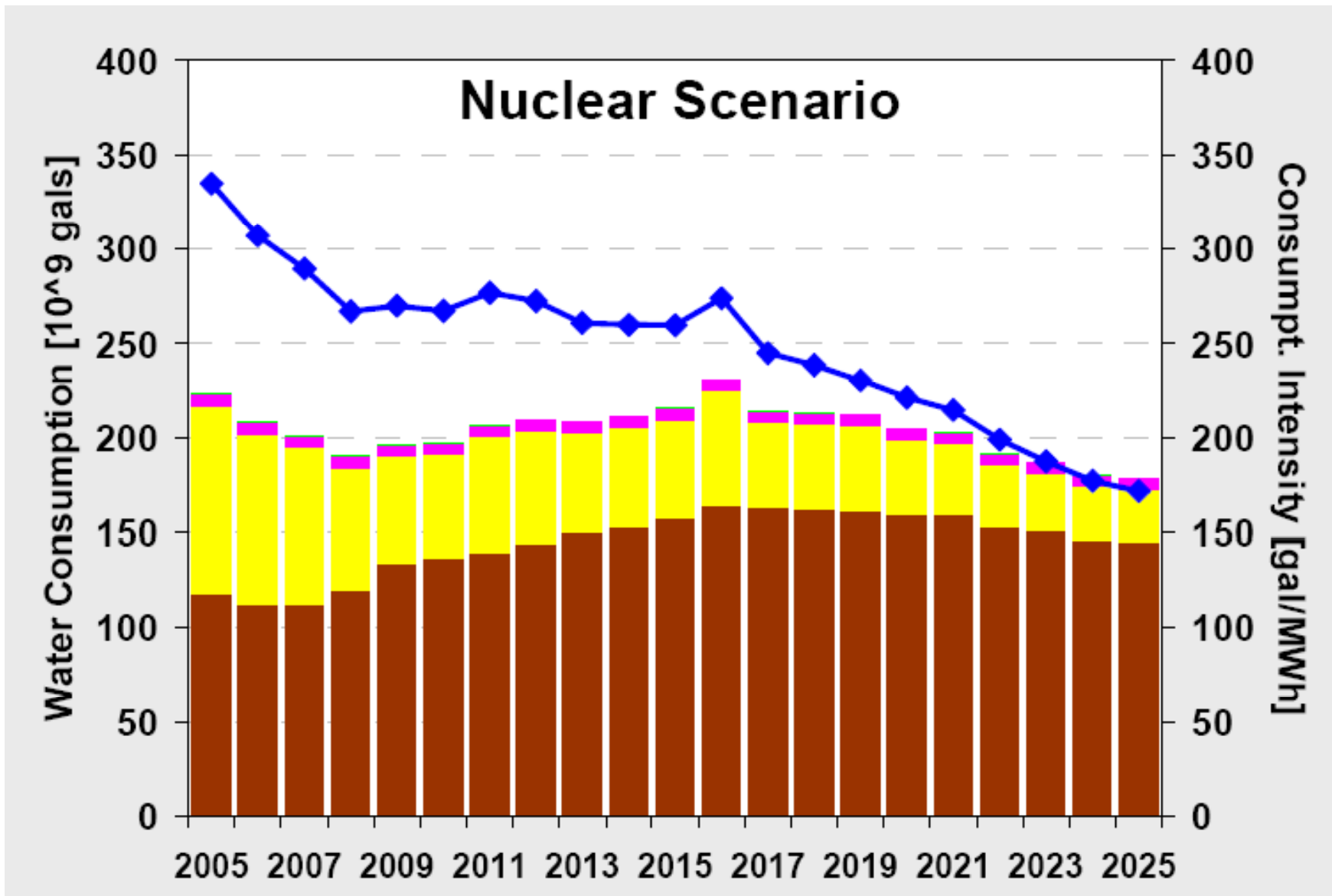
High Nuclear Scenario Cumulative Capacity Additions



High Nuclear Annual Water Withdrawal



High Nuclear Annual Water Consumption



Summary: Water Use

■ Base Case

- water withdrawal is expected to initially decline and then increase slightly through 2025
- water consumption is expected to significantly increase in the longer-term, but at a rate lower than load growth

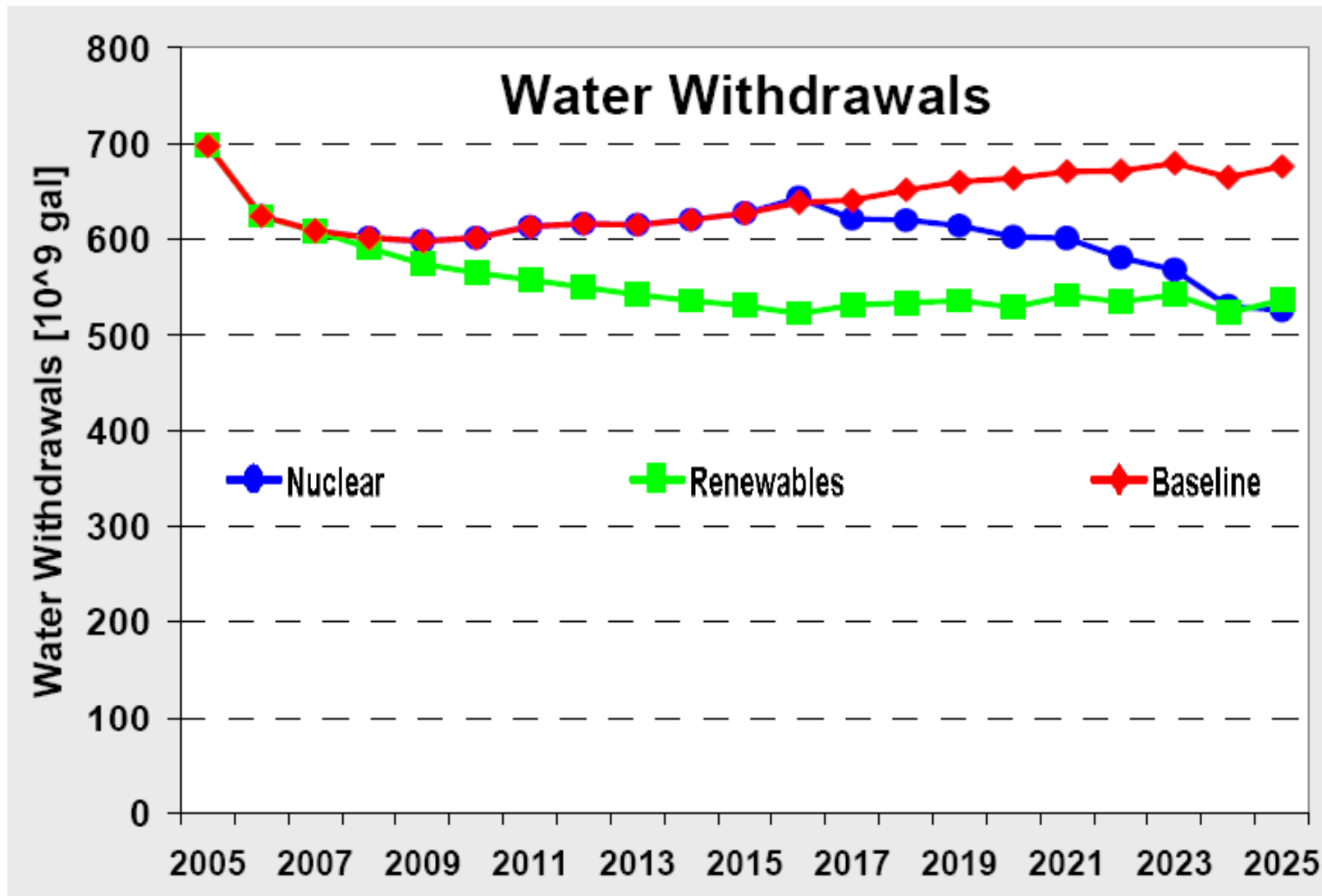
■ High Renewable Scenario

- wind generation displaces both coal and natural gas-fired generation to moderately reduce water use

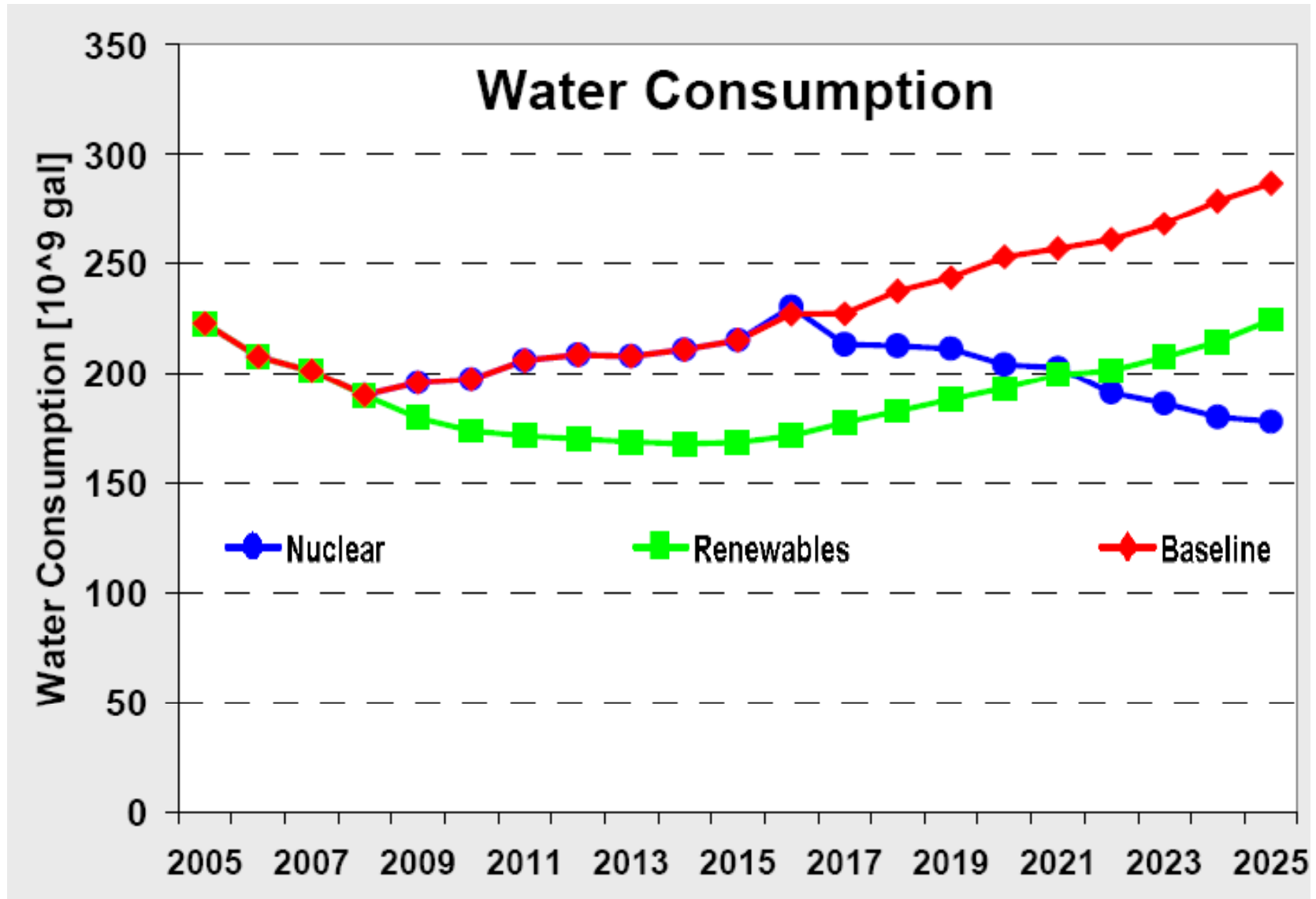
■ High Nuclear Scenario

- nuclear generation displaces base load coal generation resulting in a delayed, but more rapid reduction in water use
- This Scenario assumes that dry cooling will be required for all new nuclear plants (but not for new coal-fired plants)

Water Usage Comparison



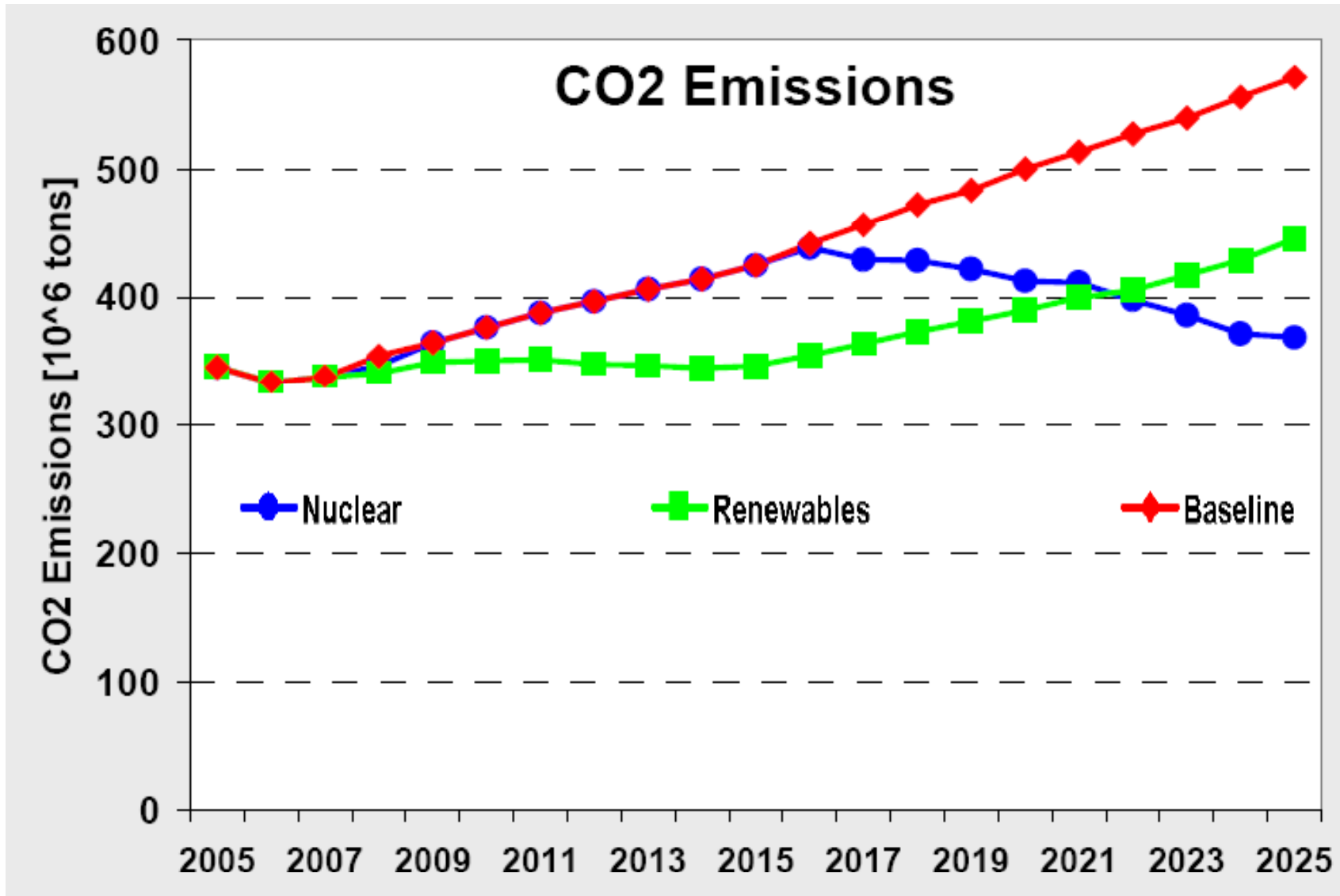
Water Consumption Comparison



Summary: CO₂ Emissions

- Increase at steady rate under Base Case due to increased generation
- Initial leveling under High Renewable Scenario increase in out-years due to increased generation
- Decrease in out-years of High Nuclear Scenario

CO₂ Emissions Comparison



Part II - Institutional Analysis

- Evaluated influences that would affect the water and energy demands of electricity generating facilities
- Evaluated relevant laws, regulations, and policies for each Expansion Scenario
- Categories of institutional influences
 - Controls on water supply and use
 - Controls that promote environmental protection and nuclear safety
 - Controls on electricity generation, transmission and sales

Water Supply and Use Influences

- Institutional influences that may affect the addition of capacity are accounted for in the assumptions for all scenarios
- Additional analysis would be needed to quantify other highly uncertain institutional influences that are not accounted for in the assumptions for any scenario:
 - Hydropower capacity impacts arising during FERC re-licensing of non-federal hydroelectric facilities
 - Capacity impacts from denials of water rights for energy projects
 - Water allocation impacts from settlements of tribal water rights claims and interstate water compact disputes



Environmental Protection Influences – Air Quality

- Compliance with mandatory Renewable Portfolio Standards is accounted for in all scenarios
- Compliance with the Clean Air Mercury Rule by coal-fired generating plants is accounted for in all scenarios
- Compliance with mandatory and voluntary CO₂ emissions limits
 - Baseline Scenario does not account for compliance
 - Nuclear Expansion Scenario assumes compliance will cause all new generating capacity after 2016 to be nuclear
 - Renewable Energy Expansion Scenario assumes compliance will provide additional incentives for adherence to renewable portfolio standards



Environmental Protection Influences – Cooling Water Intakes

- Compliance with Clean Water Act 316(b) requirements are not accounted for in the assumptions for any scenario
 - Impacts of compliance will differ among the scenarios, but may significantly change plant efficiencies and capital costs for both existing and new steam electric generating plants, which could affect simulation results for each scenario
 - Full implications will not be known until EPA responds to the remand of its Phase II Rule, which implements CWA 316(b)
 - According to Sept 8 article , EPA plans to publish a proposed revised rule in mid-2010



Nuclear Safety Influences

- Compliance with nuclear safety standards and licensing requirements is accounted for in all scenarios
 - The Baseline and Renewable Energy Expansion Scenarios assume that existing nuclear plants will comply with safety standards and that no new nuclear plants will operate before 2025
 - The Nuclear Expansion Scenario assumes that all new generating capacity after 2016 will be nuclear fueled.
 - *Simulation results for this scenario may be significantly altered if new plant licensing under 10 CFR 52, which is untested, takes longer than the assumed 10 years for each new plant.*
 - *Nuclear plants are likely to take longer to get approved and constructed than coal-fired plants*

Electricity Generation, Transmission , and Sales Influences

- Compliance with federal electric power industry regulations is accounted for in all scenarios
- The effects on transmission grids of state regulation of retail electric power markets is a developing area that is not accounted for in any scenario
 - Evaluation of the impact that state regulation of retail electric markets on the simulations in this study was beyond the scope

Institutional Analysis Summary

- Institutional influences with the greatest potential for impacts on the simulated scenarios include:
 - Cooling water intake regulations (CWA 316(b) Phase II Rule)
 - Limitations on emissions of greenhouse gases and mercury (CO₂ emission limits and Clean Air Mercury Rule)
 - Possible new CO₂ emission limits
 - New streamlined licensing requirements for nuclear plants (10 CFR 52)
- The impacts of other institutional influences on the outcomes of simulated scenarios appear to be either insignificant or indeterminate

For More Information on These Studies

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