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Managing the Transition to Climate Stabilization

Richard Richels, EPRI

Thomas Rutherford, ETH Zurich

Geoffrey Blanford, EPRI

Leon Clarke, JGCRI

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Goal of this Study

To examine the relationship between the long-term climate goal and near-term policies.

- Long-term stabilization targets
- Policy Design
  - Coalition membership
  - Emissions reduction timetables
- Technology availability

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MERGE 5.5 Model Overview

- Top-down economic model
- Intertemporal optimization through 2150
- Nine regions (USA, Western Europe, China, India, etc.)
- Process model of energy sector technology:
  - Electric Generation
  - Non-Electric Energy
- Prices of each GHG determined endogenously (no GWPs)
- Capable of representing a variety of greenhouse gas control scenarios
- Captures economy-wide impact of carbon policy

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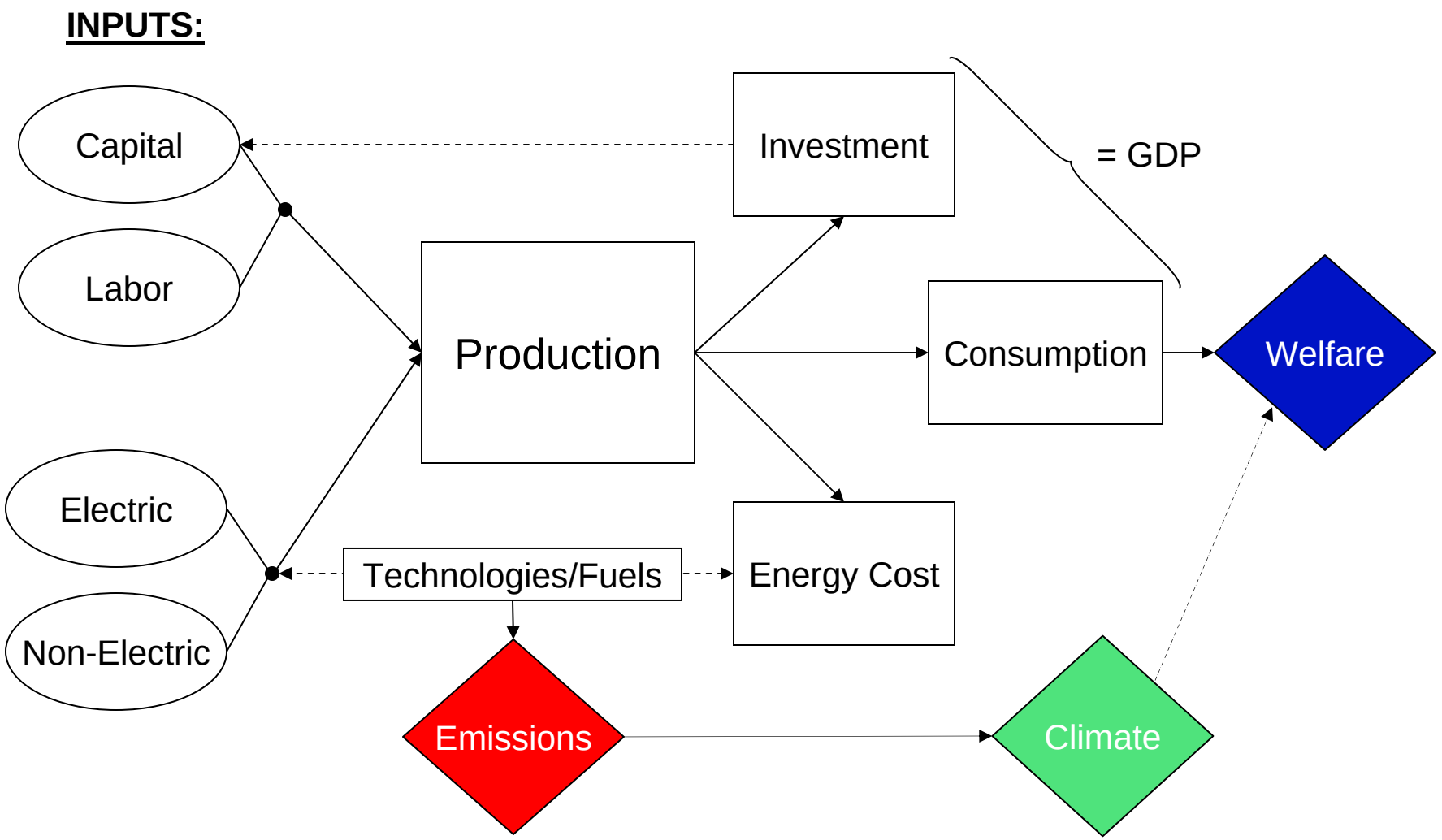
Structure of MERGE Model



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Overview of MERGE 5.5

- Intertemporal optimization model with 200 year timeframe
- Each region maximizes its own utility
- Prices of each GHG determined endogenously, i.e. no GWPs
- Top down model of economic growth and trade
- Process model of energy sector, with **new additions**:
  - CCS Technologies
    - Existing plants
    - New plants
  - Considers market *and* nonmarket costs of nuclear power

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Focus on Two Radiative Forcing Constraints

U.S. CCSP Stabilization Level	Long-Term Radiative Forcing Limit (Wm^{-2} relative to pre-industrial)	Approximate 2100 CO_2 Limit (ppmv)
Level 4	6.7	750
Level 3	5.8	650
Level 2	**4.7**	**550**
Level 1	**3.4**	**450**

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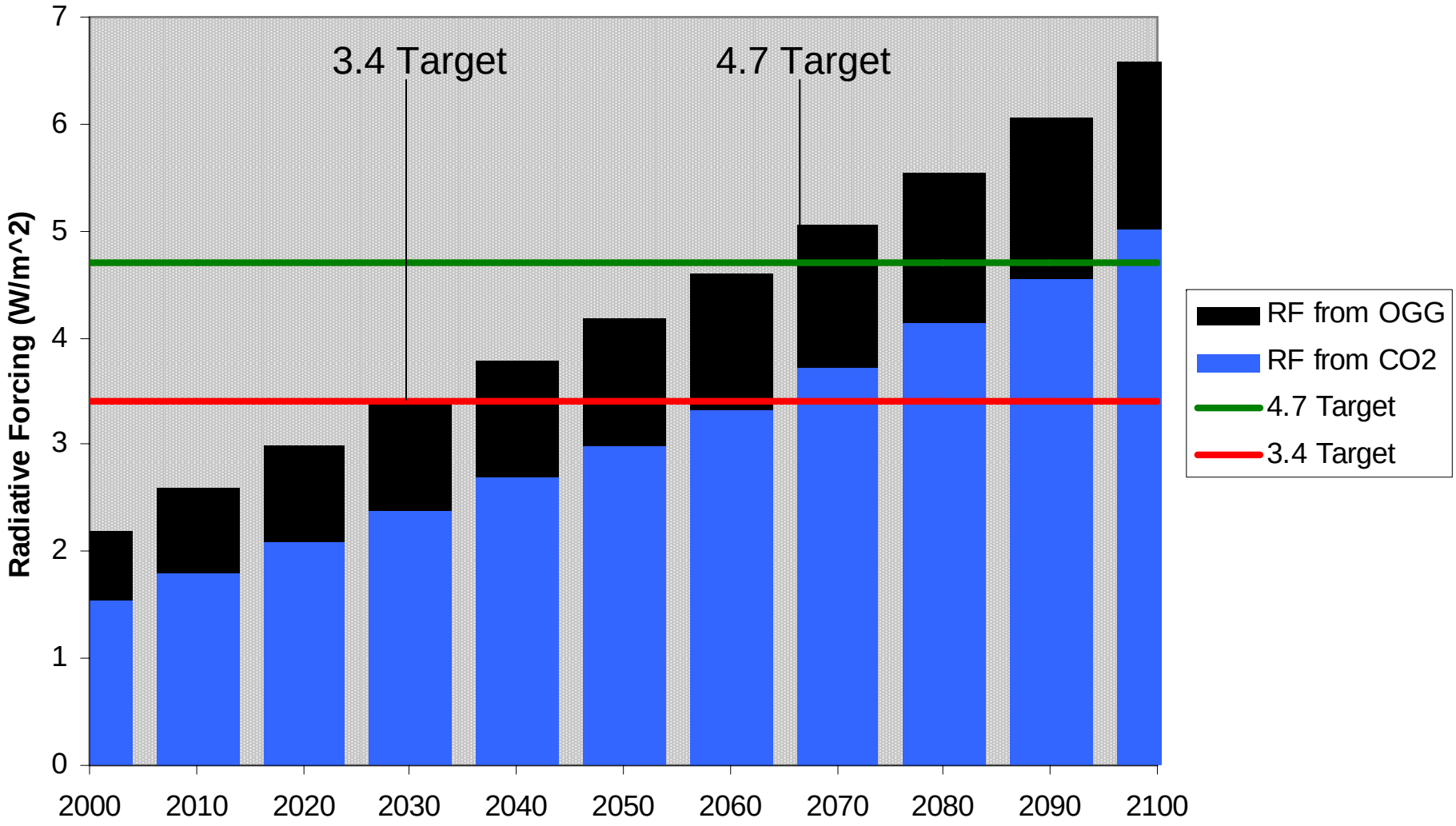
Reference Case Radiative Forcing



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Two Policy Scenarios

- "First Best" (1B):

  When and where flexibility

- "Third Best" (3B):

  Additional "Transition Constraints" Through 2050:

  - Near-term reduction timetables for Annex B countries
  - Non-Annex B does not participate

3B Designed to Reflect Realistic Policies

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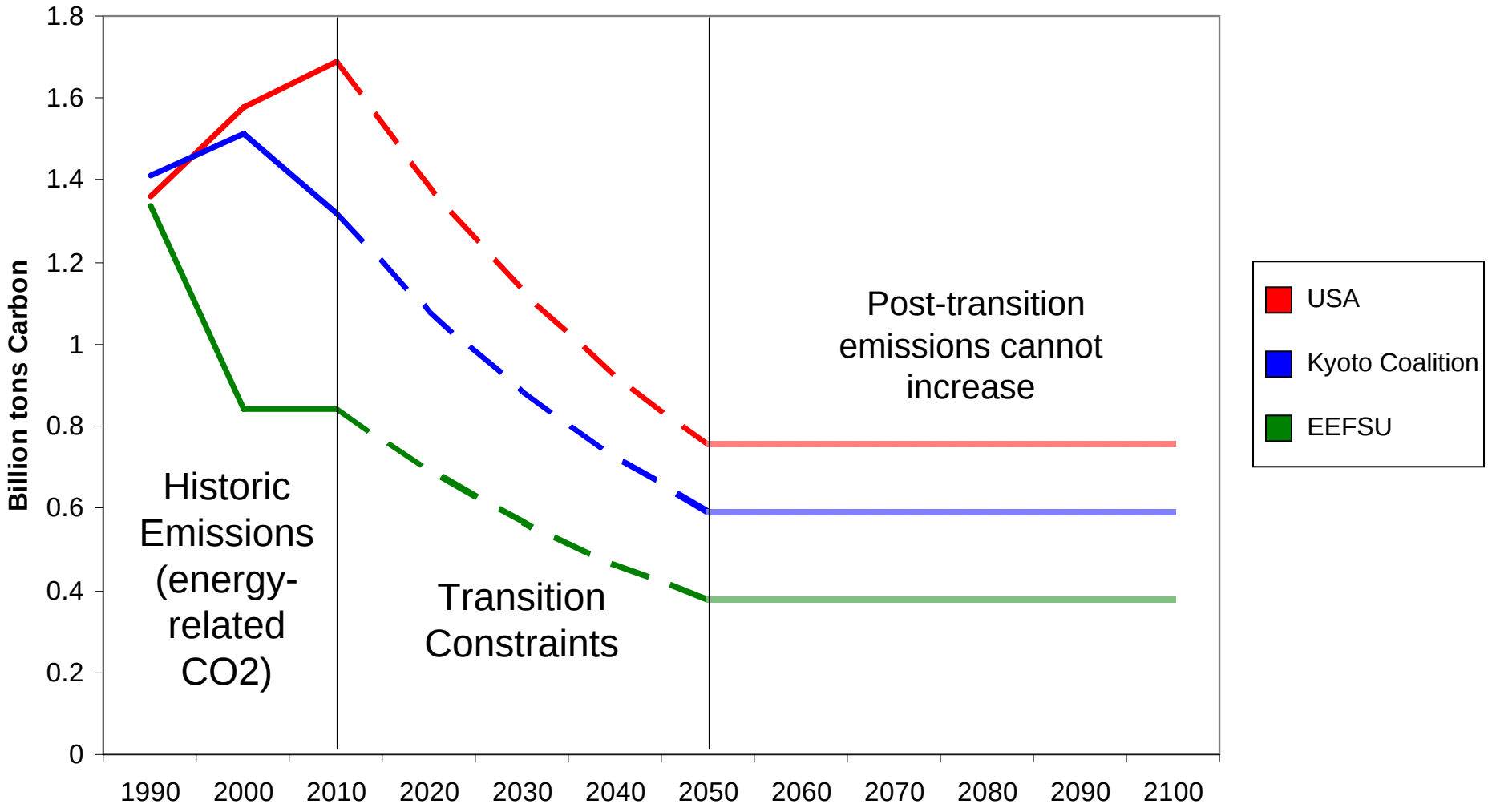
3B Transition Constraints for Annex B



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Two Technology Scenarios

- "Optimistic":

  All technologies available

- "Pessimistic":

  New nuclear and carbon capture and sequestration (CCS) are not available in electric sector

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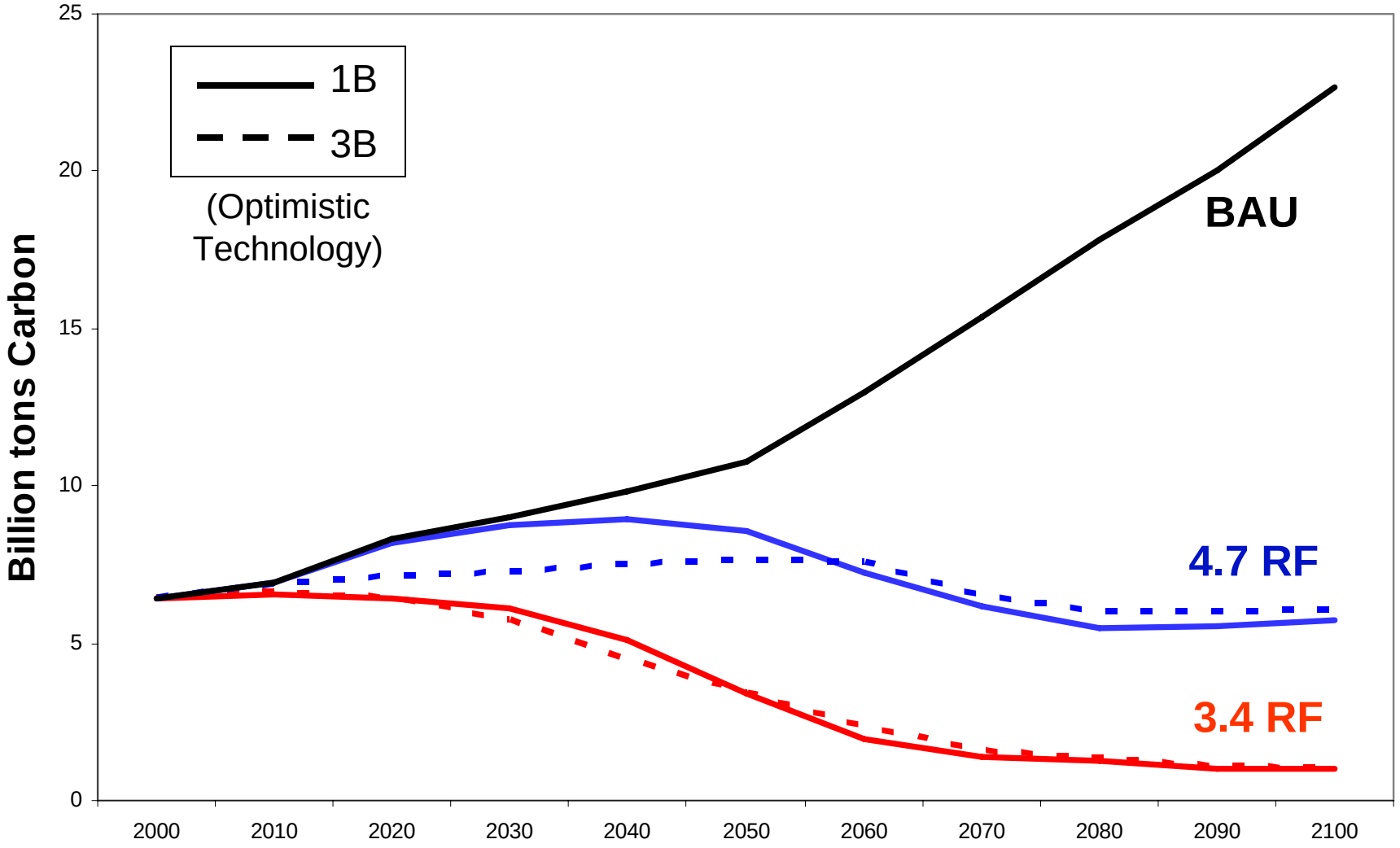
Global Energy-Related CO2 Emissions



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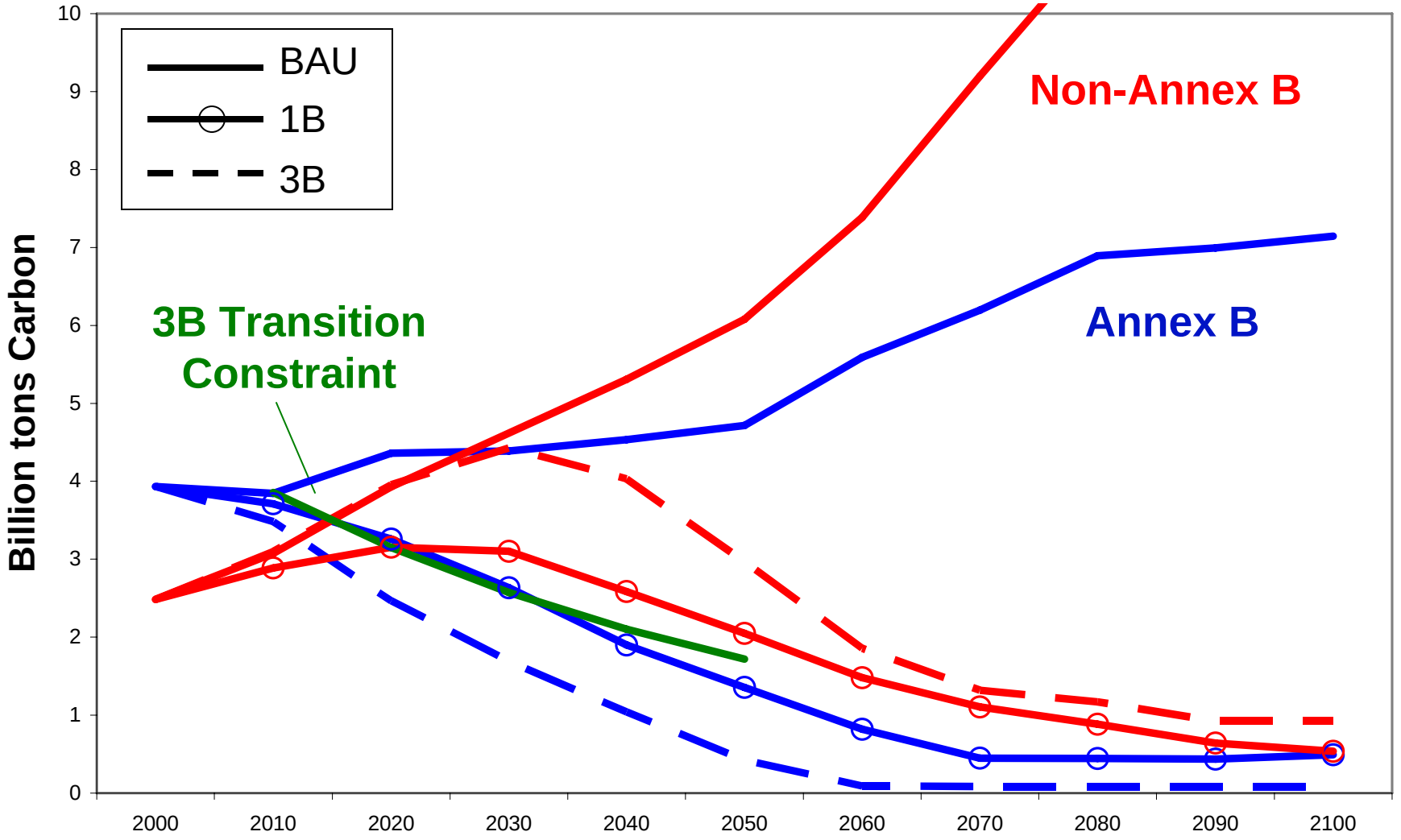
Emissions by Region with 3.4 RF Target



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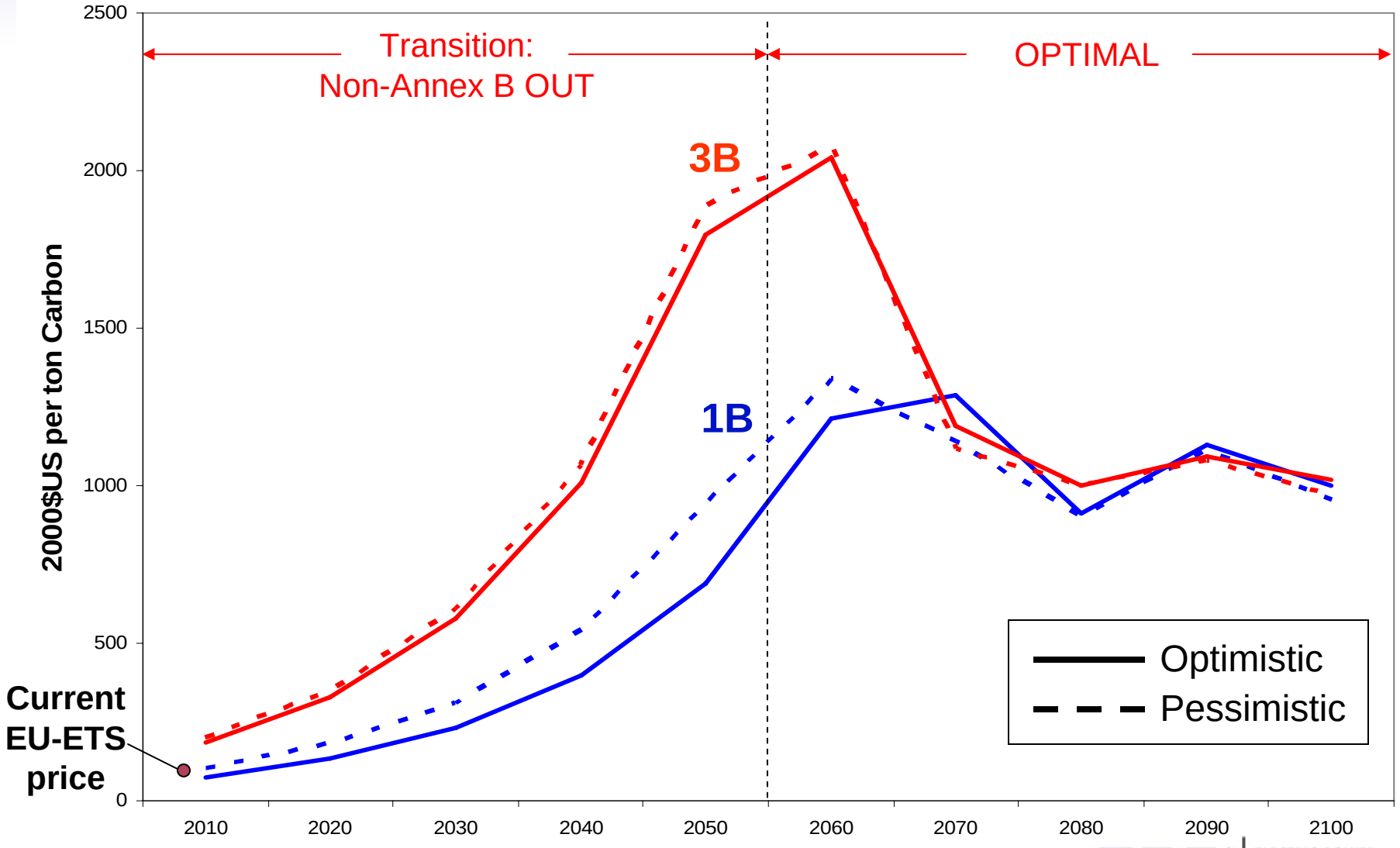
Annex B Carbon Price with 3.4 RF Target



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3.4 RF Target Storyline

- Transition constraints on Annex B are *not* binding
- 3B policy costs are higher because Non-Annex B is out
- Carbon price rises quickly, driven by immediacy of target

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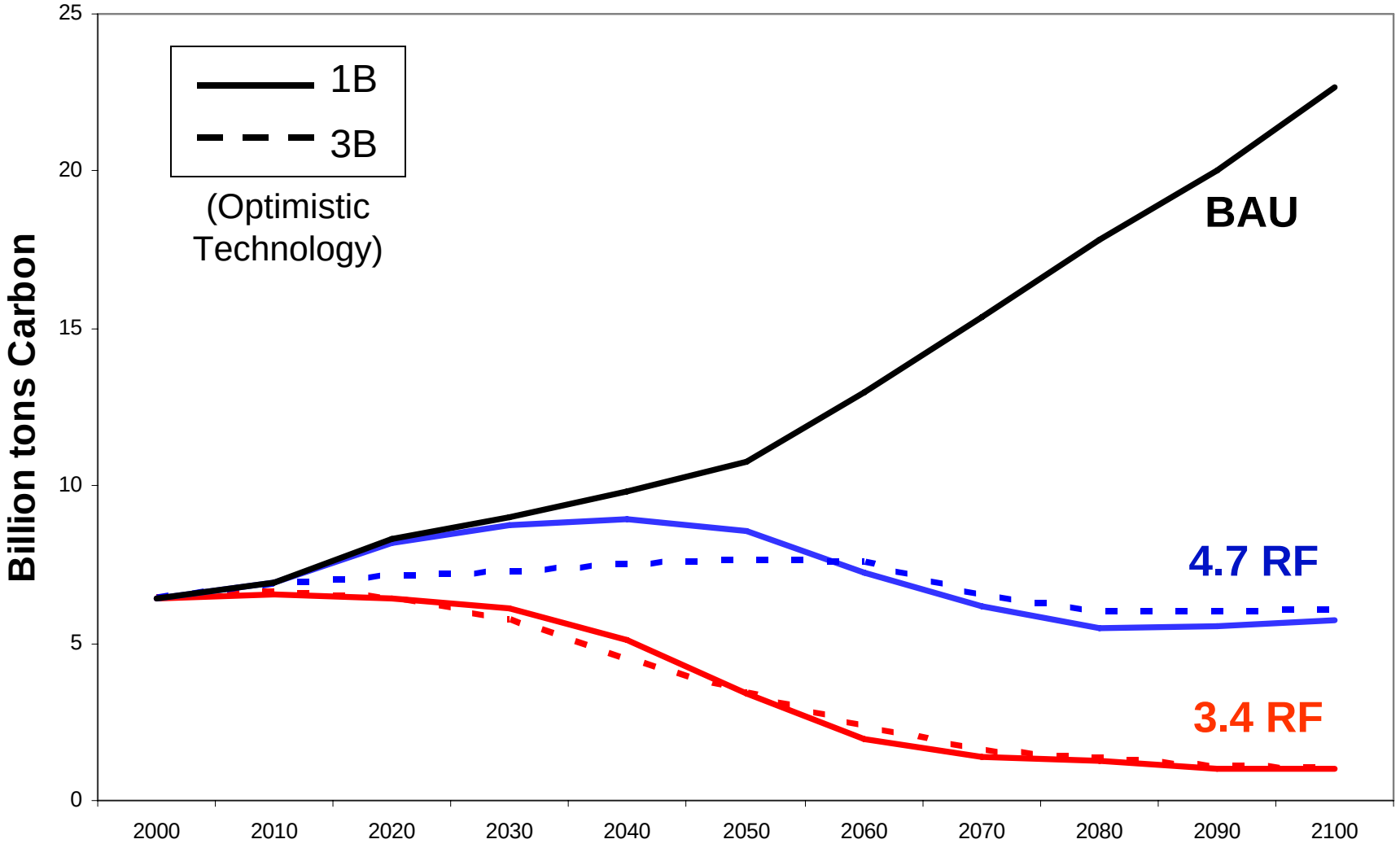
Global Carbon Emissions



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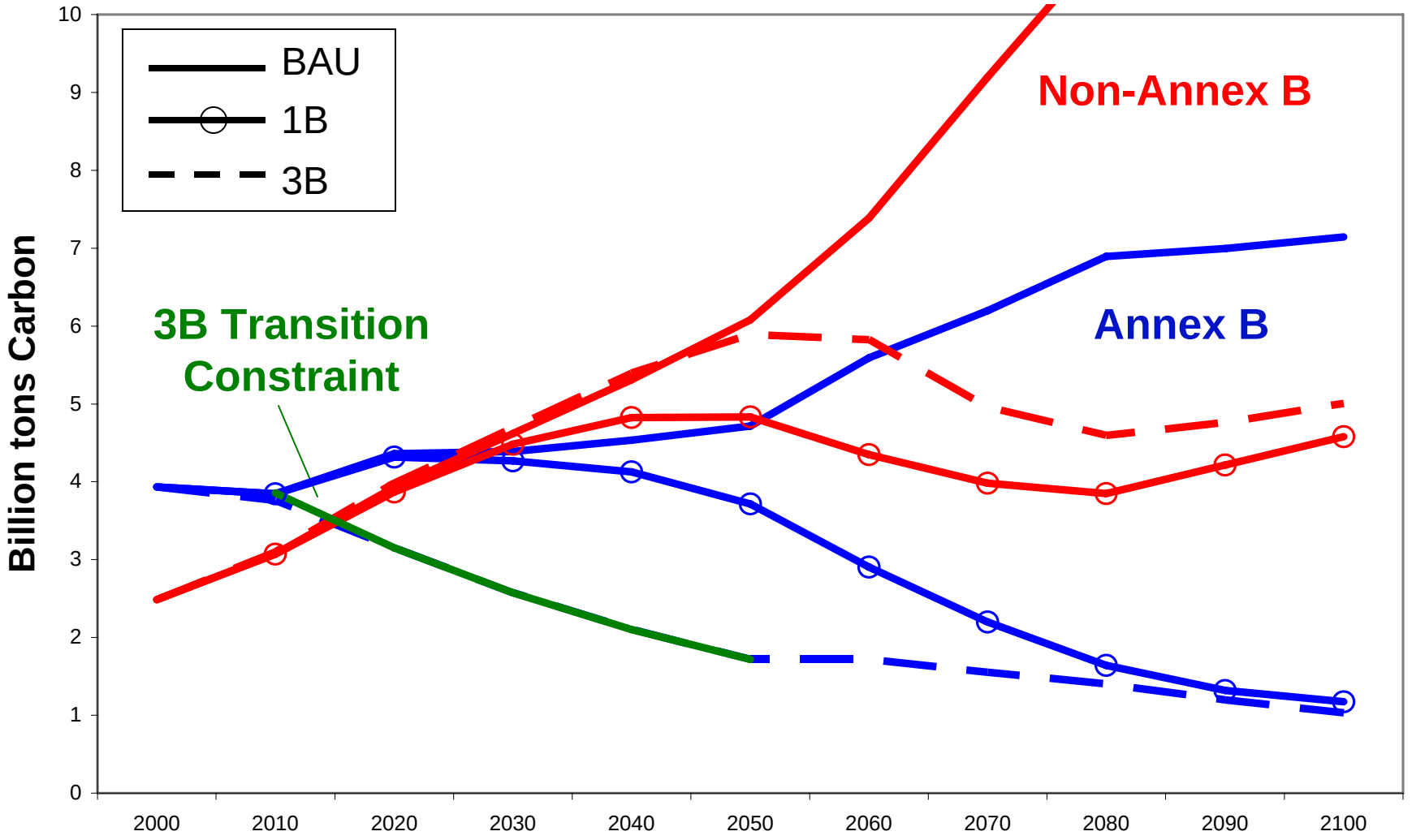
Emissions by Region with 4.7 RF Target



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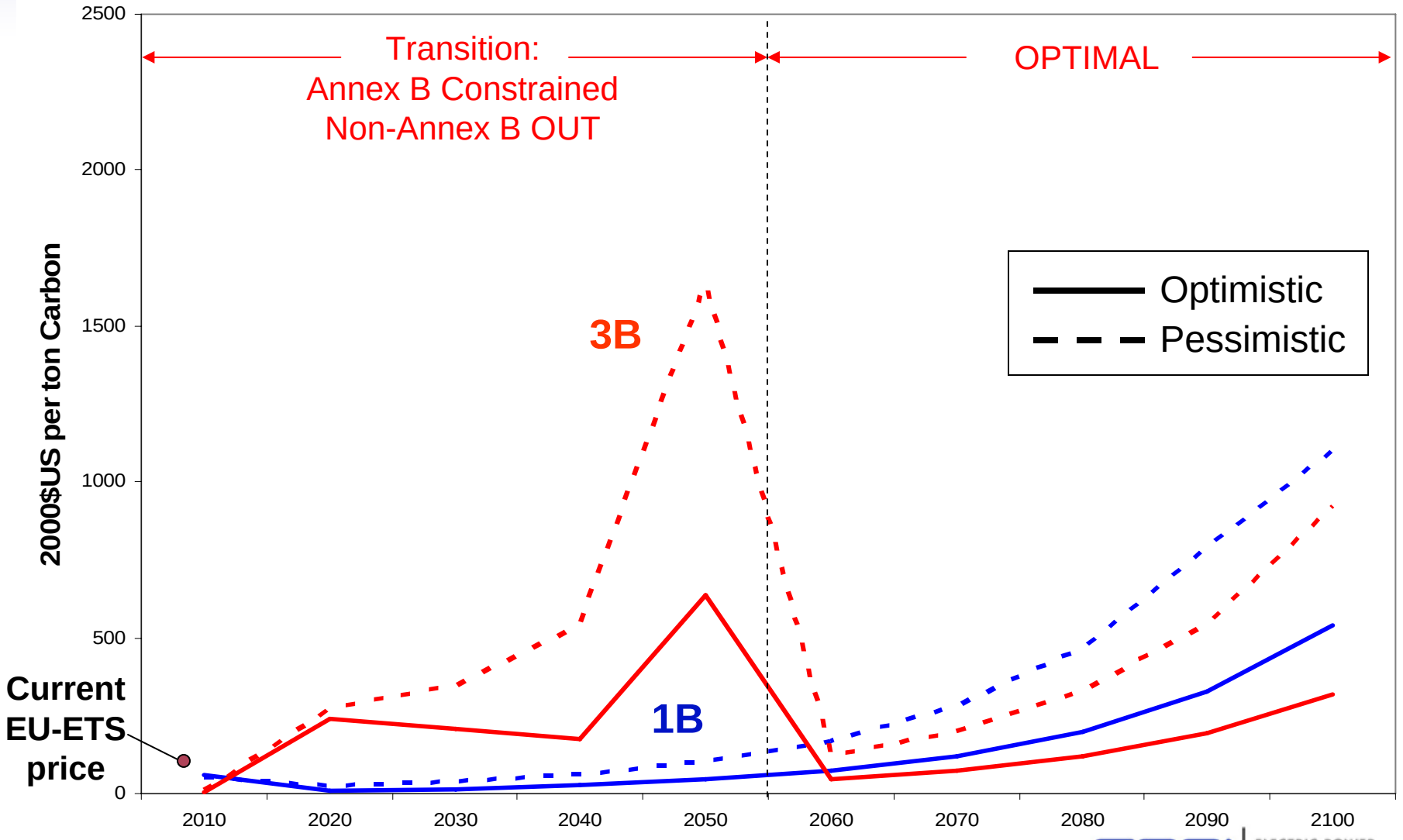
Annex B Carbon Price with 4.7 RF Target



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4.7 RF Target Storyline

- Transition constraints on Annex B are binding
- 3B policy costs are higher because Annex B *over*-abates and because Non-Annex B is out
- Carbon price rises slowly in 1B, but quickly in 3B to satisfy transition constraints

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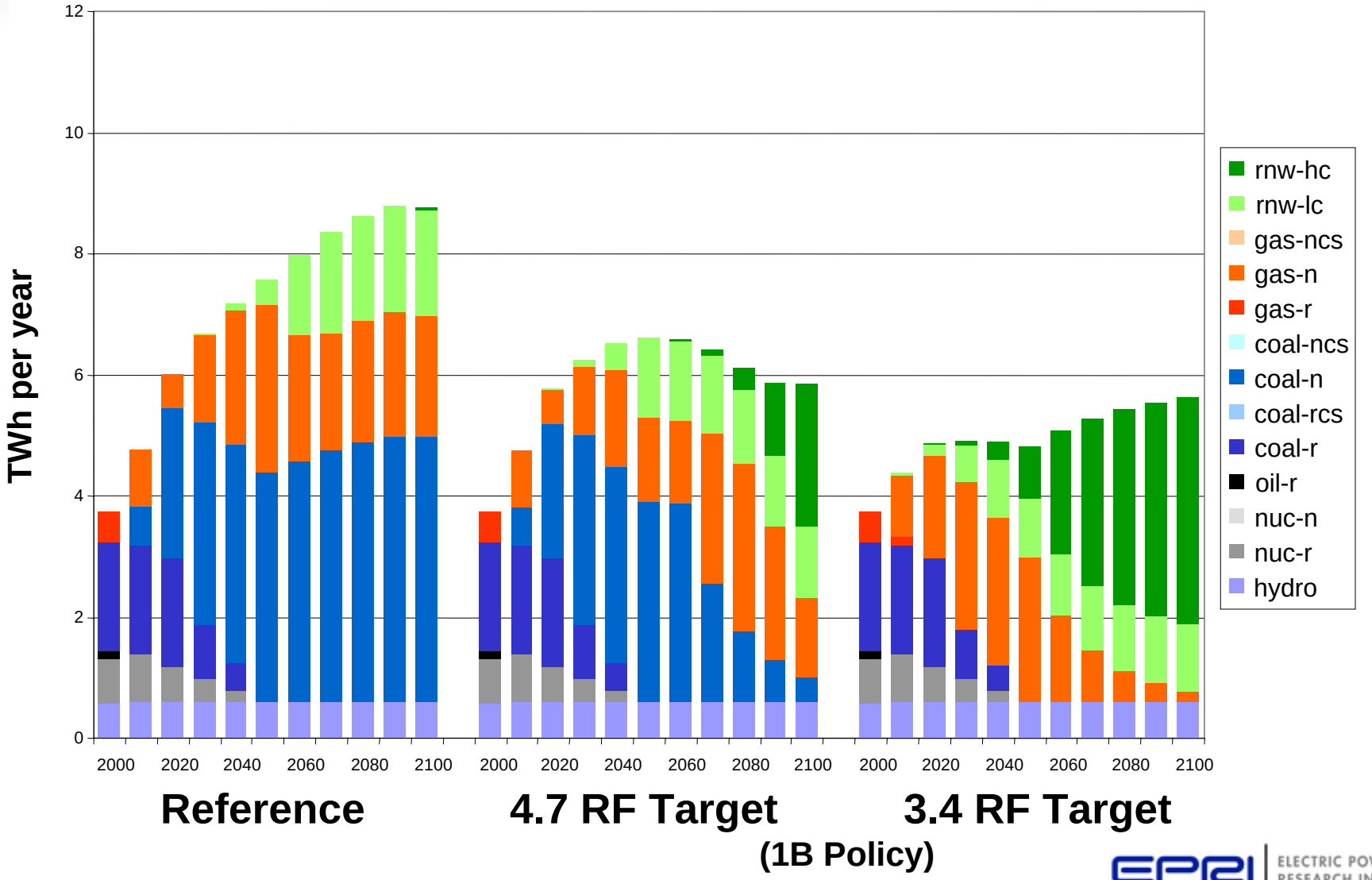
U.S. Electric Generation, Pessimistic Technology



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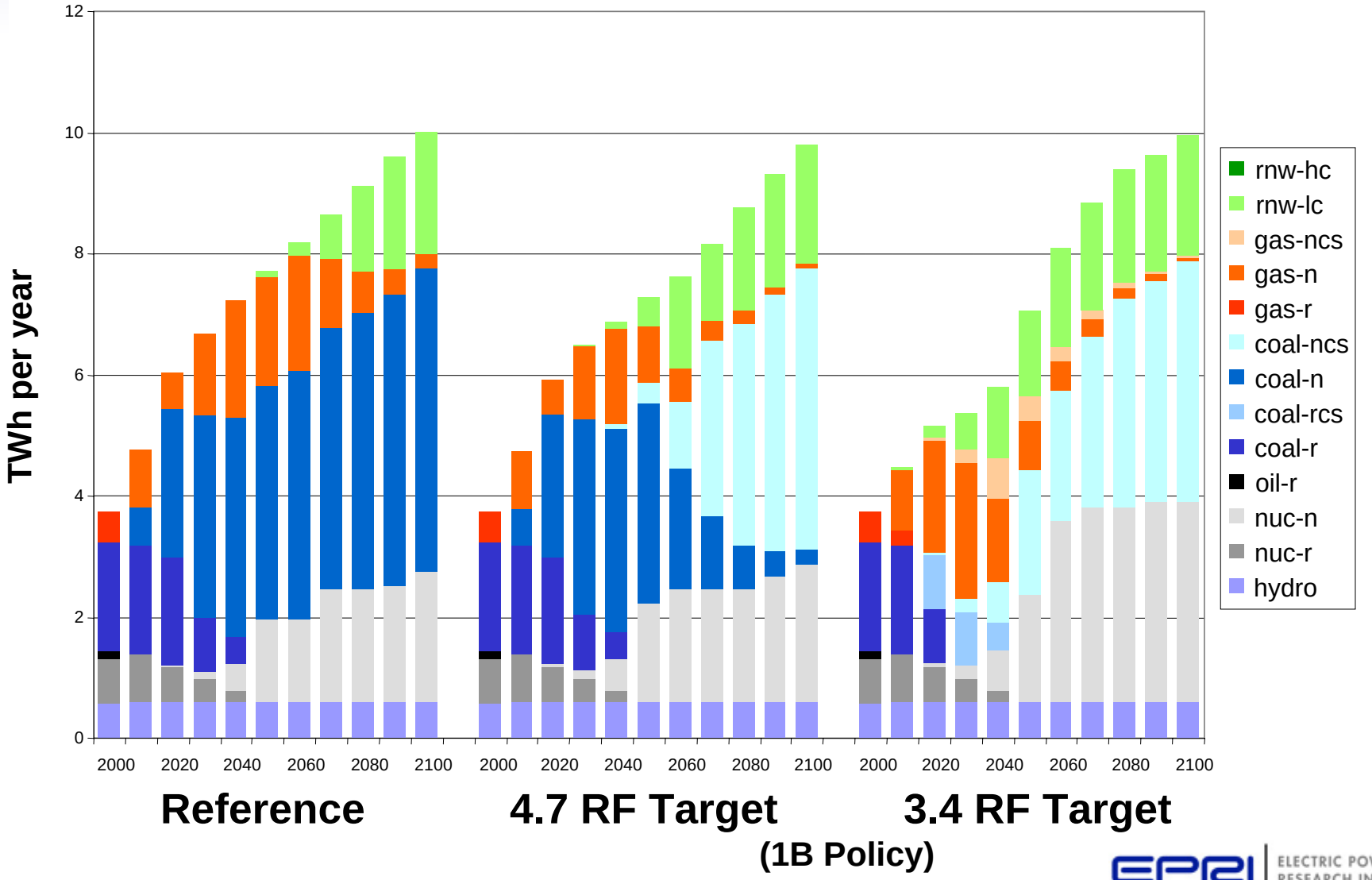
U.S. Electric Generation, Optimistic Technology



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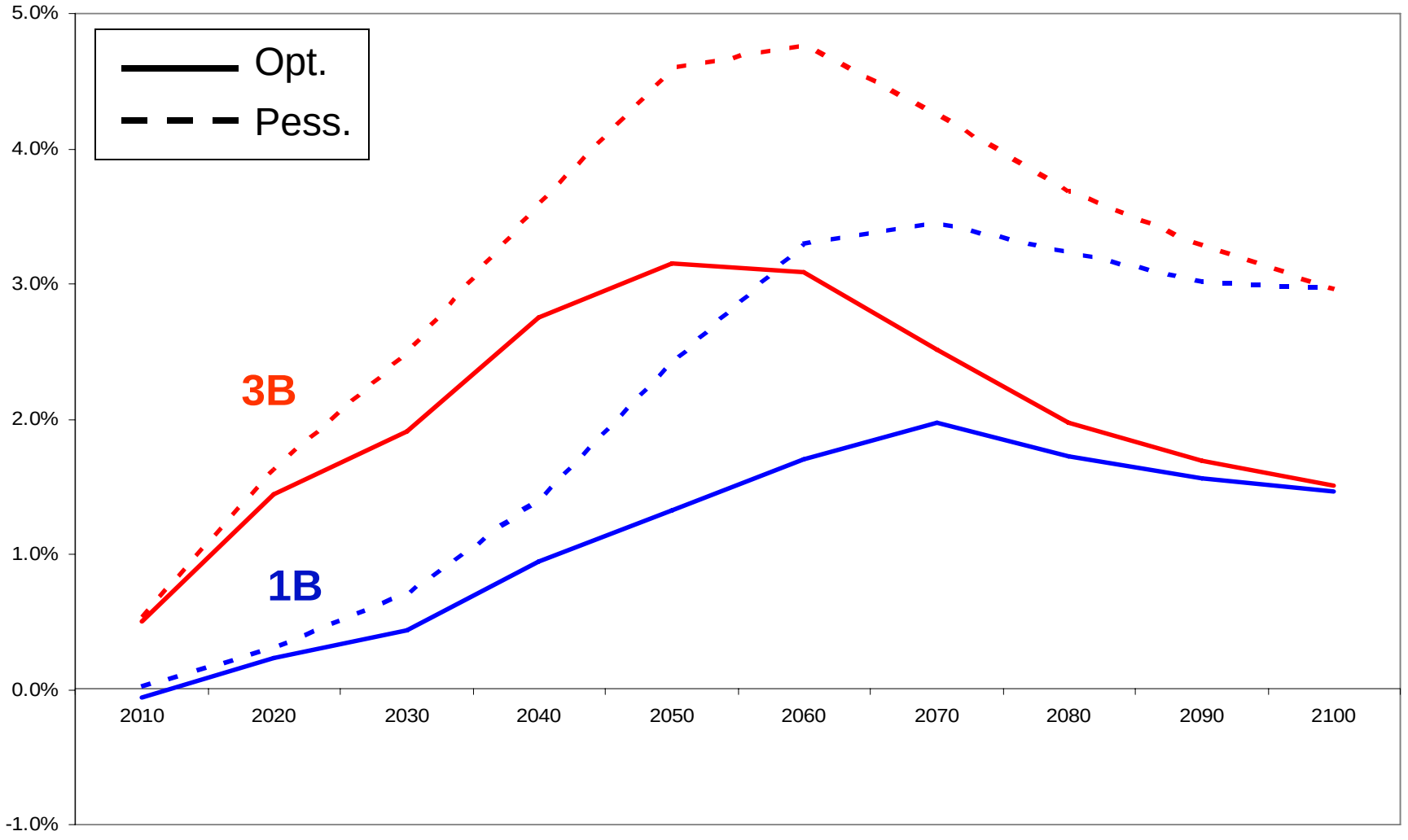
USA GDP Loss from Reference with 3.4 RF Target



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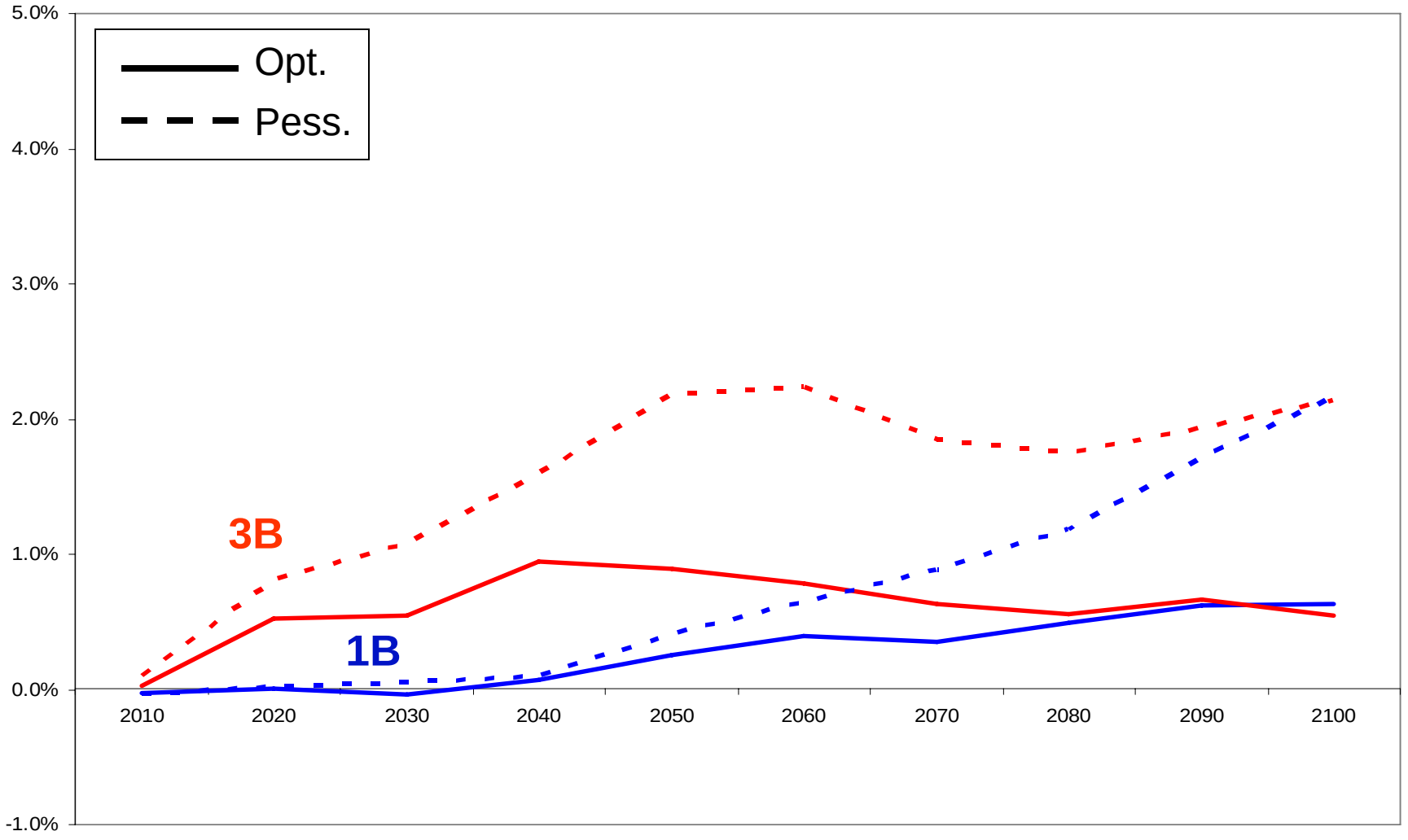
U.S. GDP Loss from Reference with 4.7 RF Target



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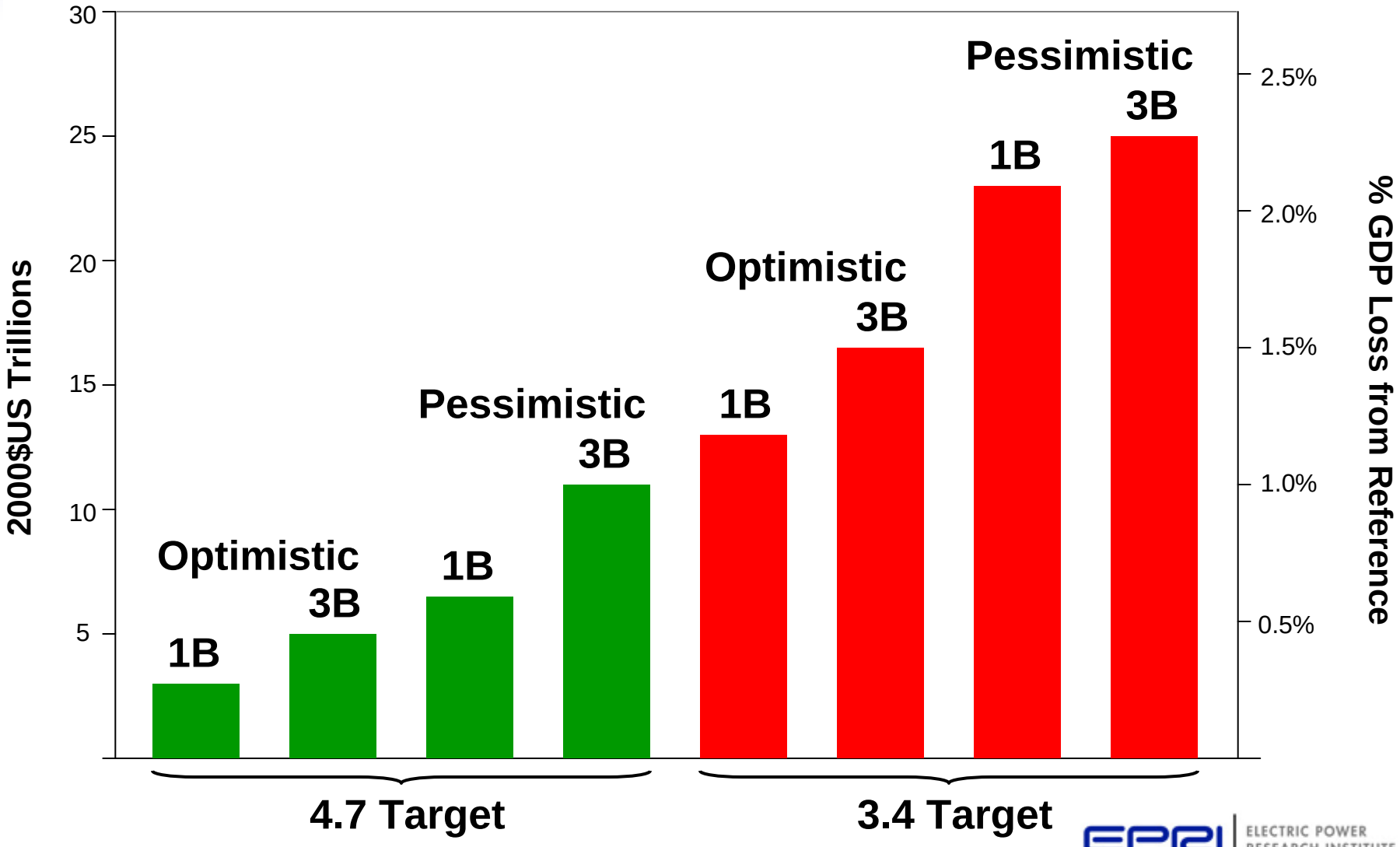
Global Discounted Sum of Economic Cost

At 5% through 2200



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Insights from These Scenarios

- Target has greatest impact on stabilization cost
- Technology plays increasingly important role in managing cost
- Transition policy choice has smallest effect on overall cost, possibly large effect on cost distribution

Paper Available on AEI-Brookings website:

www.aei-brookings.org

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Effect of Technology

- 3.4 RF Target: Technology does not have strong effect *at the margin* because backstop and conservation are required in both optimistic and pessimistic case
- 4.7 RF Target: Technology *does* have strong effect at the margin
- In both cases, technology impacts inframarginal costs of abatement

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“Second Best” Policies

- Replace exogenous transition constraints with When Flexibility within Annex B
- Annex B chooses an optimal emissions path to achieve forcing level in 2050 equivalent to 3B scenario
- Non-Annex B remains outside coalition
- Long-term stabilization target still applies

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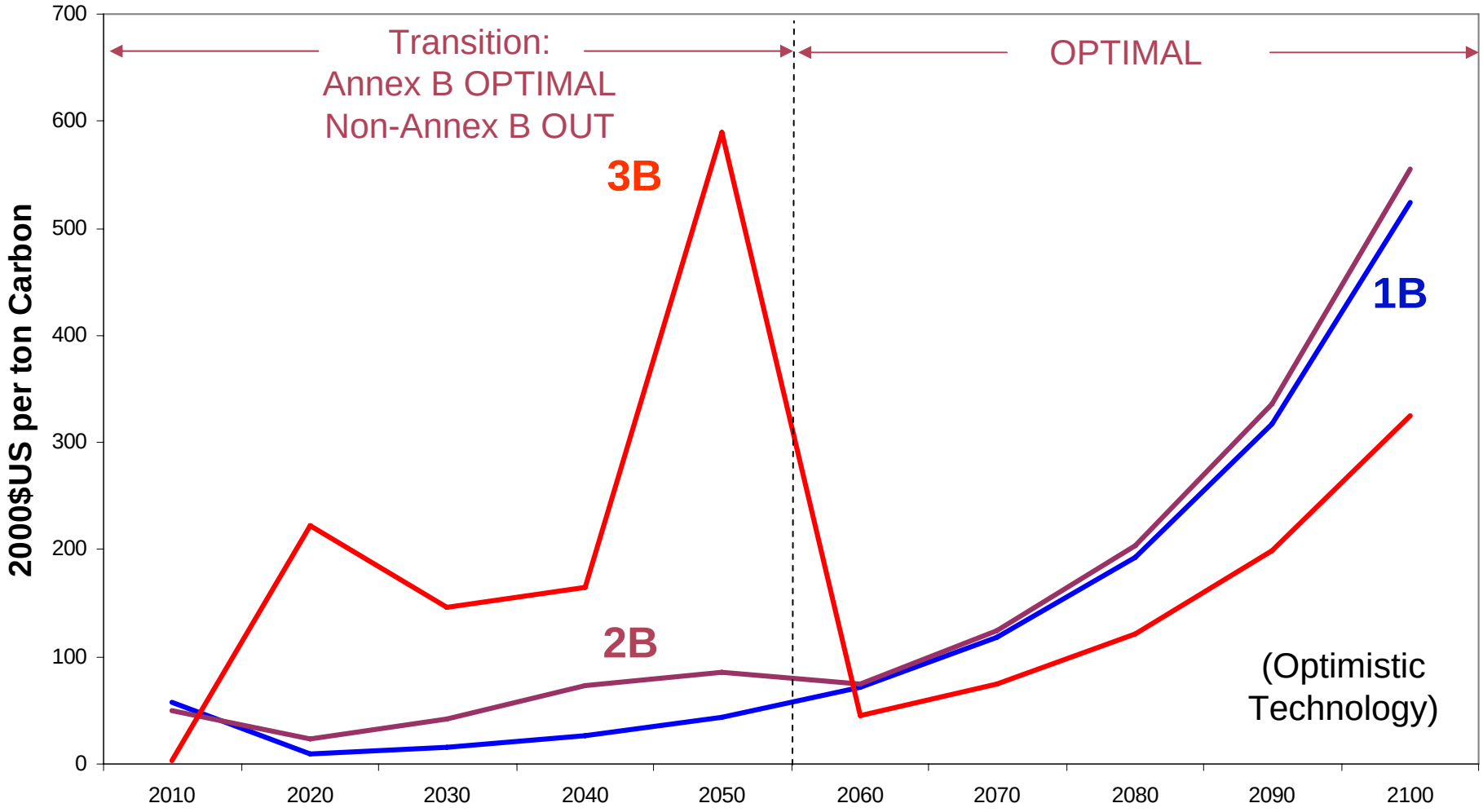
Annex B Carbon Price with 4.7 RF Target



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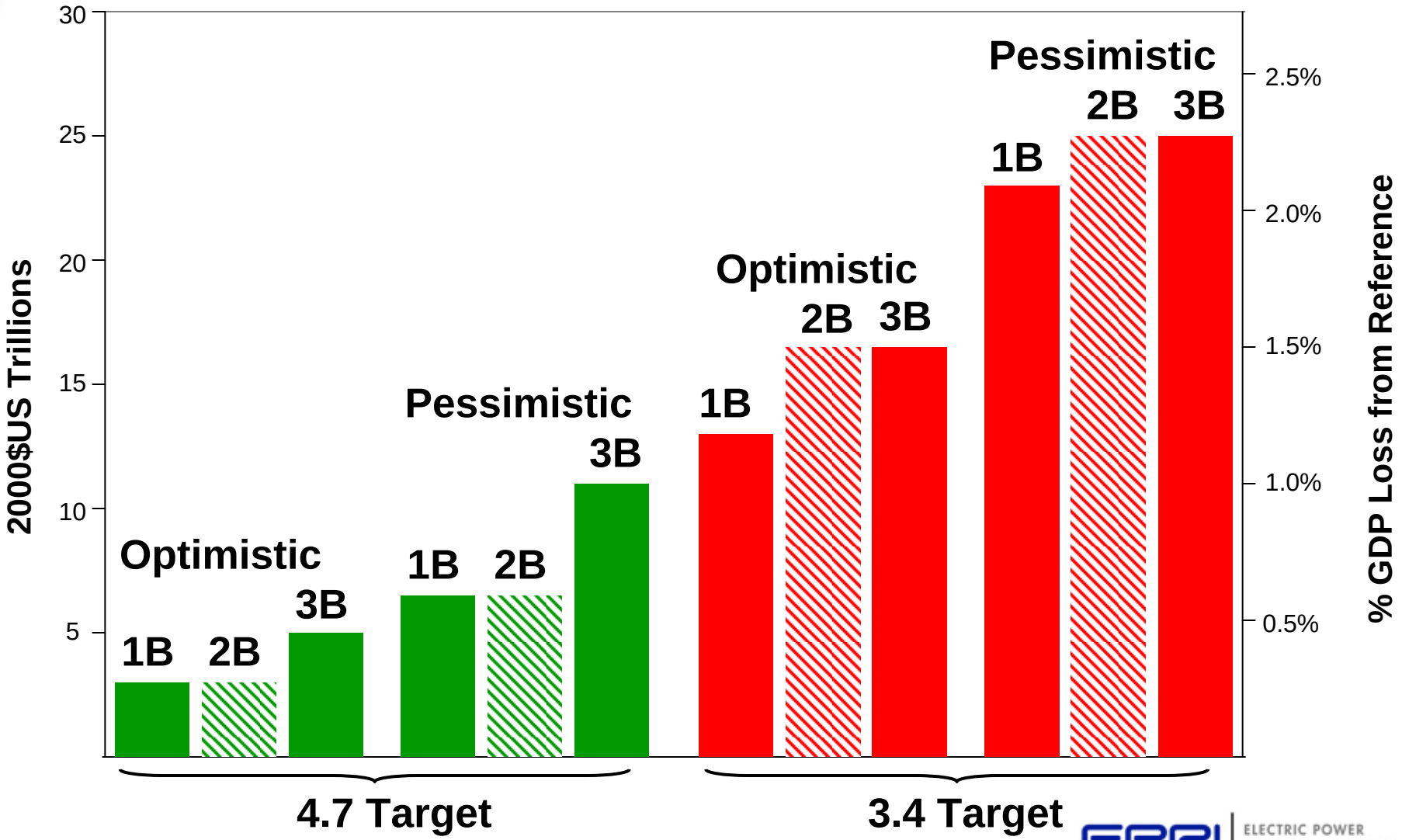

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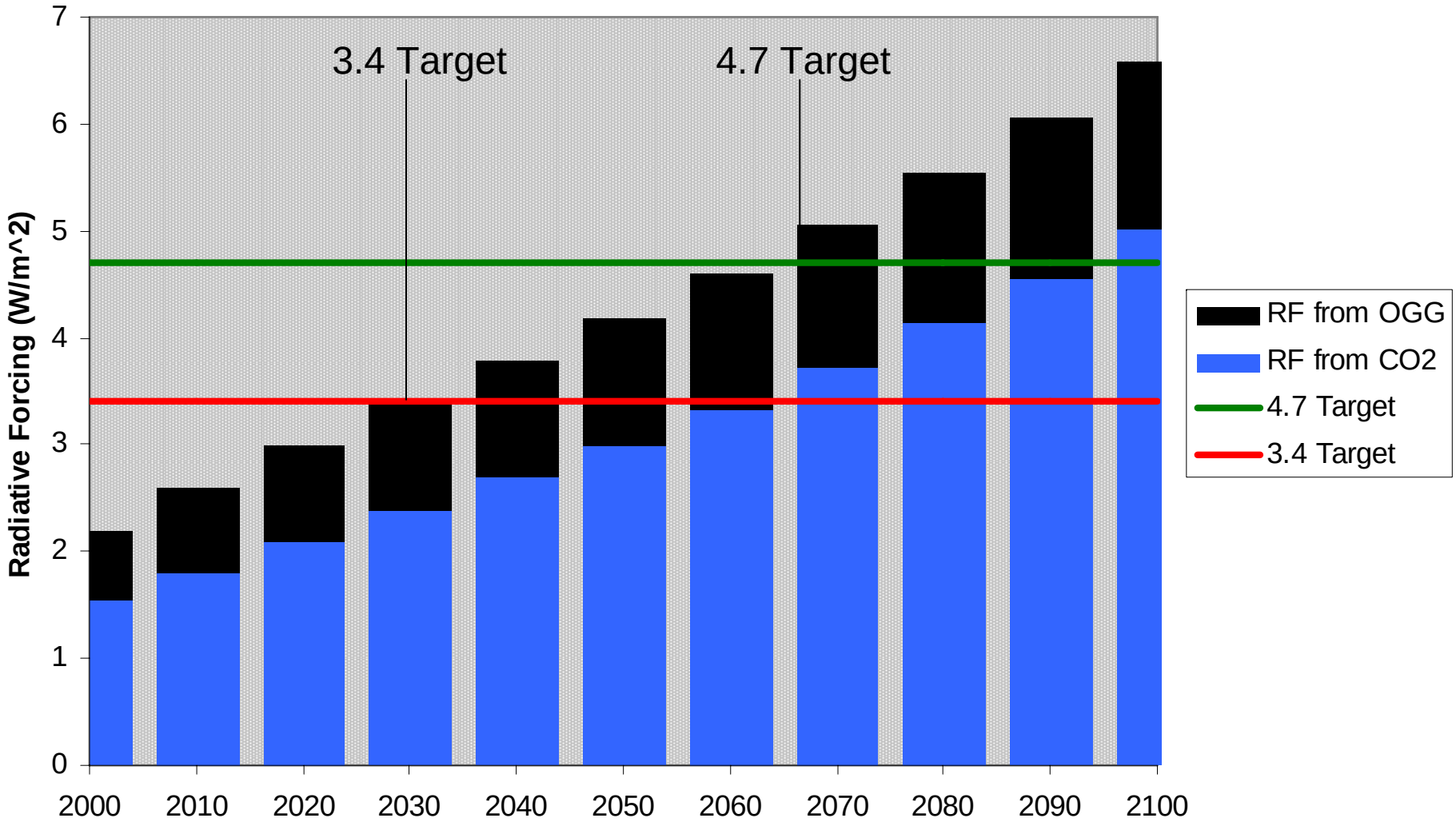
Reference Case Radiative Forcing



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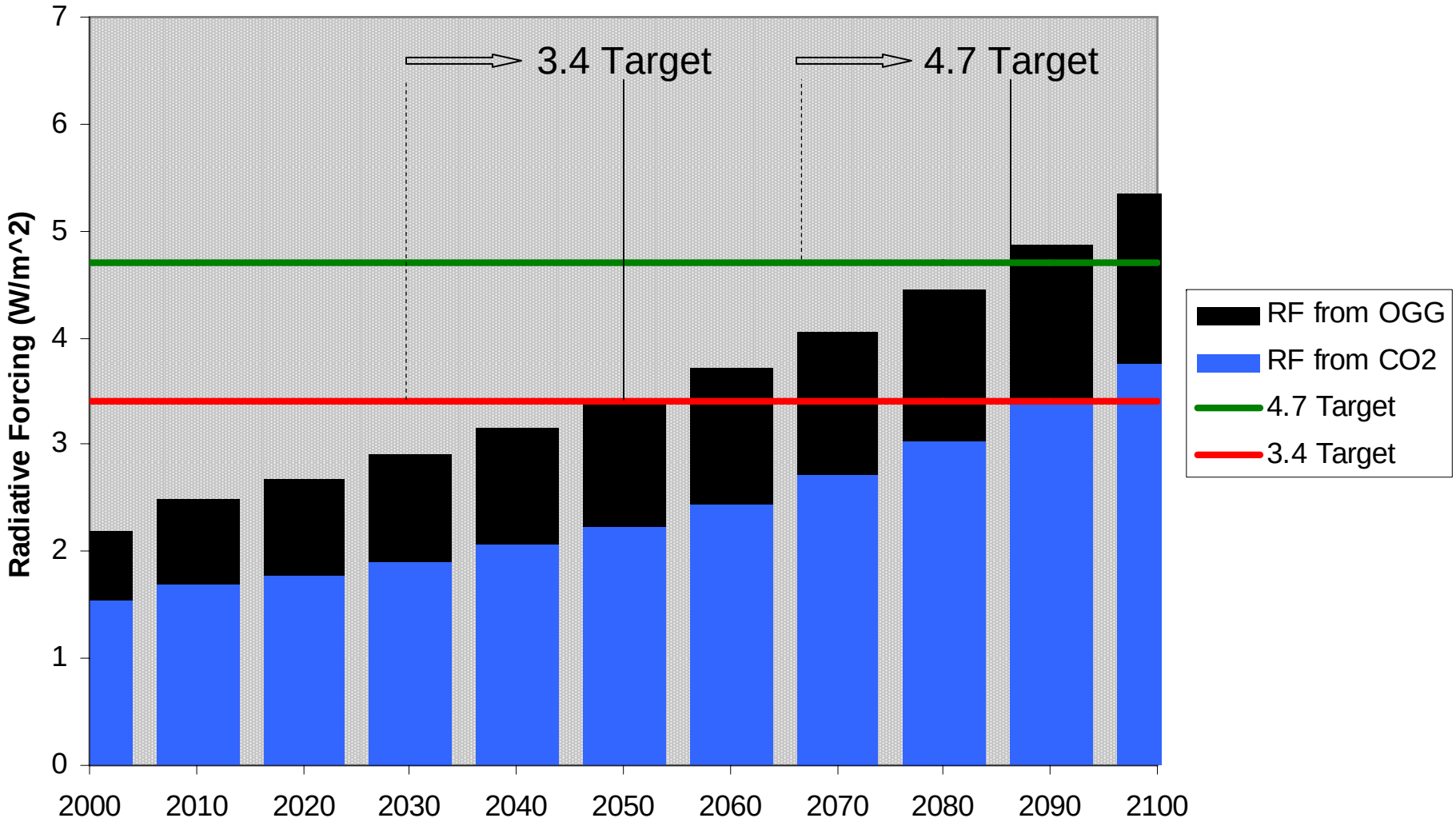
Reference *without* Annex B Emissions



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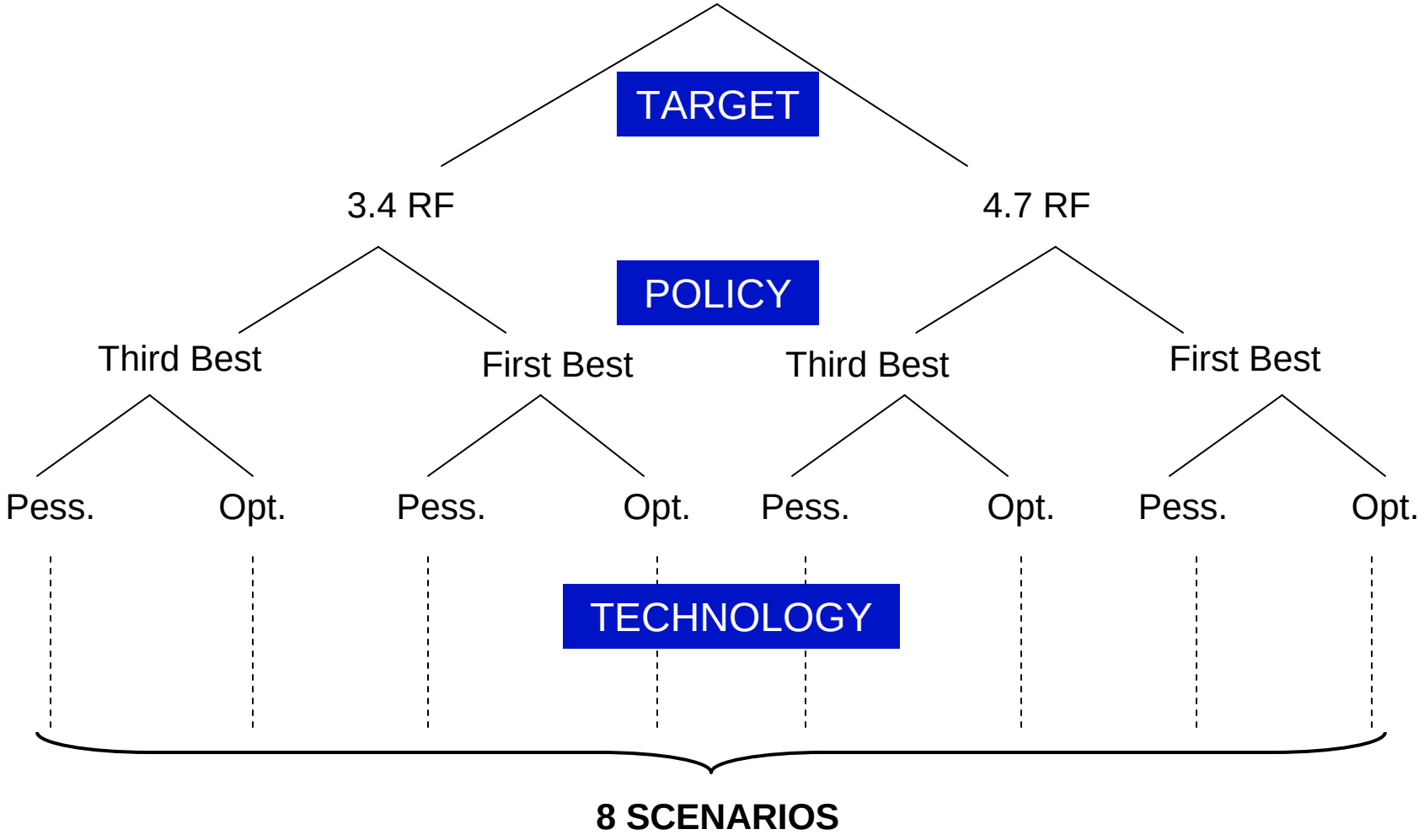
Scenario Design



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