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Managing the Transition to Climate Stabilization

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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
- Near-term transition constraints
- Coalition membership
- Technology availability

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

Electricity Generation Technologies in MERGE 5.5

Technology	Description
HYDRO	Hydroelectric
NUC-R	Remaining initial nuclear
GAS-R	Remaining initial gas-fired
OIL-R	Remaining initial oil-fired
COAL-R	Remaining initial coal-fired
NUC-N	New nuclear
GAS-N	Advanced combined-cycle
COAL-N	Pulverized coal without CO_2 recovery
RNW-LC	Low-cost carbon-free technologies (quantity constrained)
RNW-HC	High-cost carbon-free technologies (unlimited quantity)
GAS-NCS	**New gas with carbon capture and sequestration**
COAL-NCS	**New coal with carbon capture and sequestration**
COAL-RCS	**Remaining coal with carbon capture and sequestration**

Non-electric Energy Supplies in MERGE 5.5

Technology	Description
CLDU	Coal – direct uses
OILNON	Oil (10 cost categories)
GASNON	Gas (10 cost categories)
BFUEL	Biofuels (ethanol, biodiesel, etc.)
SYNF	Synfuels (coal to liquids)
RNW-NE	Non-electric high-cost carbon-free technologies (unlimited quantity)

Reference Case Relies Heavily on Synfuels

CAVEAT:

THIS IS *NOT* A COST BENEFIT ANALYSIS

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So when I say there is no "free lunch", I am <u>not</u> saying it is not a lunch worth buying!

USCCSP Study Design

- Three integrated assessment modeling teams
  - MIT – IGSM
  - Stanford/EPRI – MERGE
  - PNNL – MiniCAM

- Stabilize total radiative forcing from CO_2, N_2O, CH_4, HFCs, PFCs, and SF_6

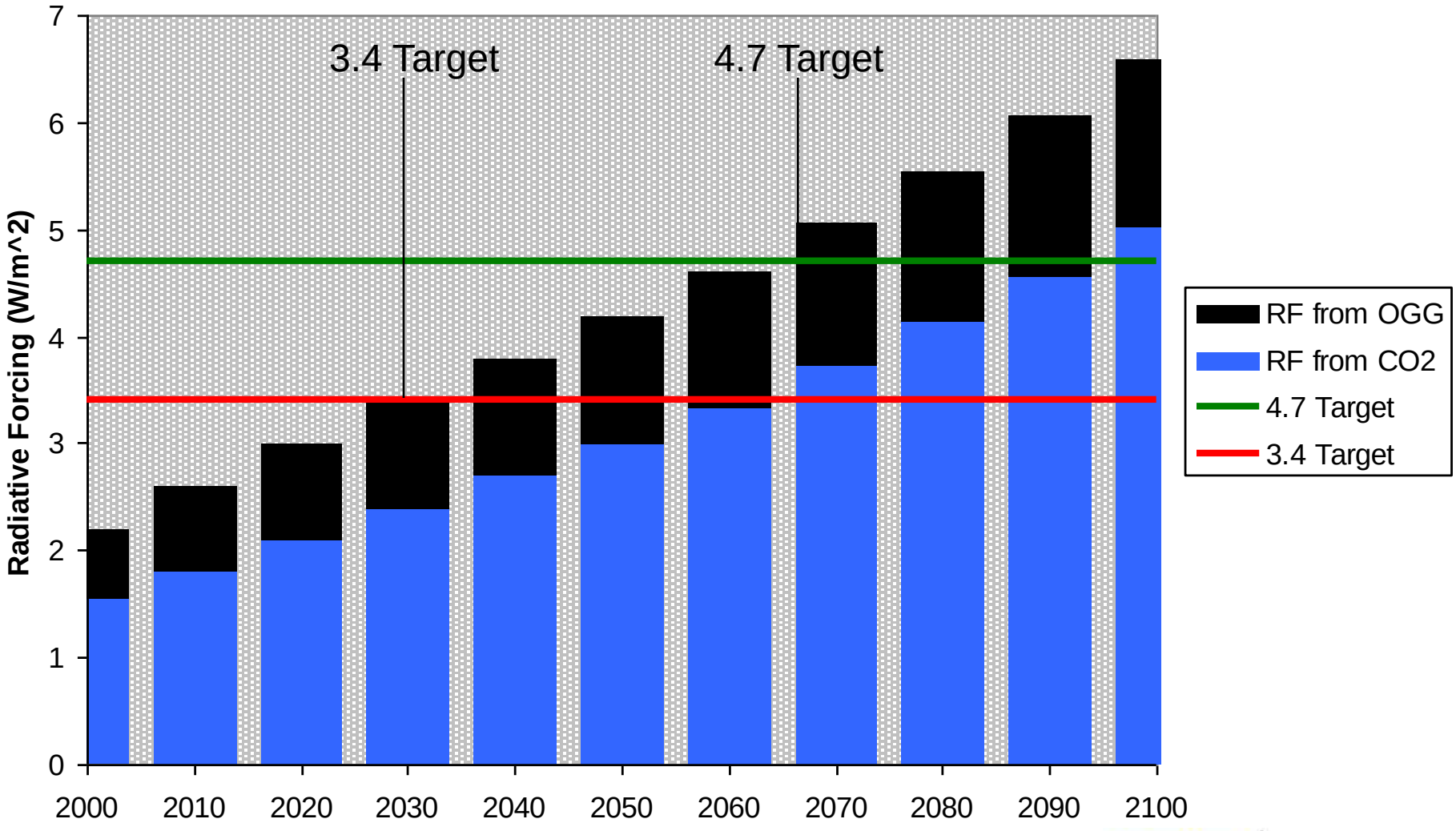
- Four stabilization scenarios roughly consistent with 450 ppmv through 750 ppmv CO_2, along with one reference case.

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

Focus on Two Radiative Forcing Constraints

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**

Reference Case Radiative Forcing



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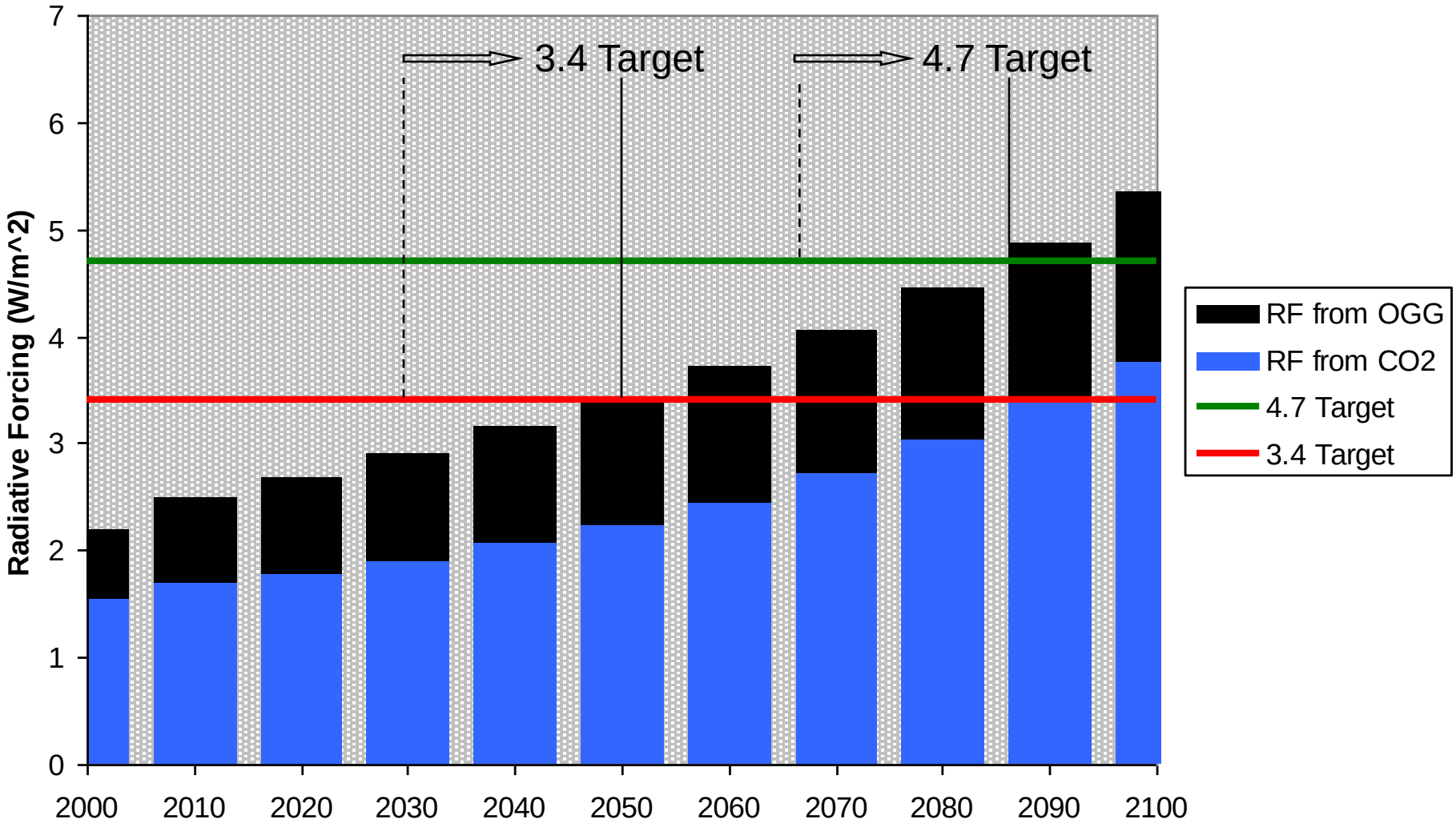
Reference *without* Annex B Emissions



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Two Policy Scenarios

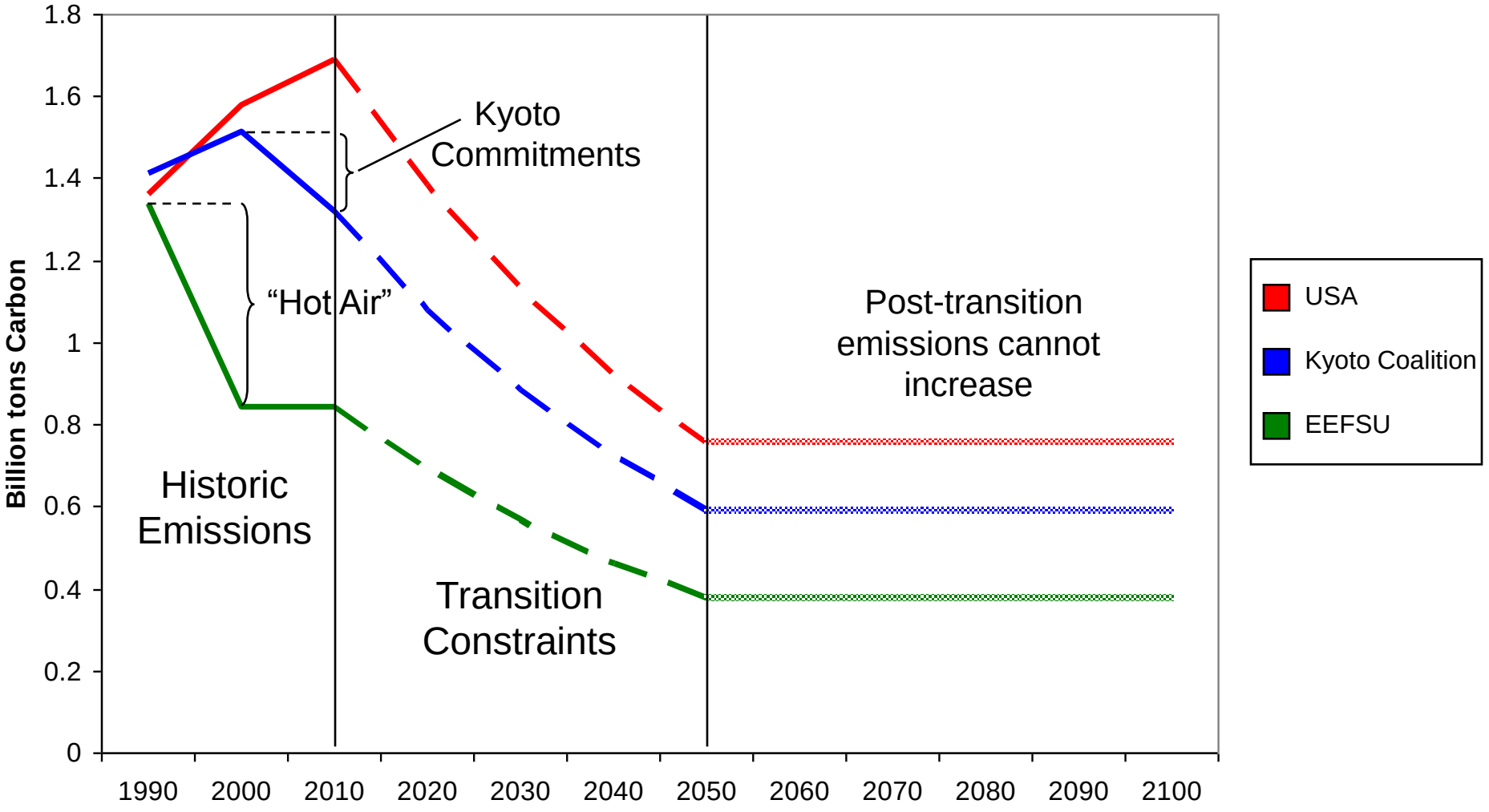
- "First Best" (1B):

  When and where flexibility

- "Third Best" (3B):

  Near-term transition constraints on Annex B countries
  Non-Annex B does not participate until post-2050

Transition (3B) Specified



Two Technology Scenarios

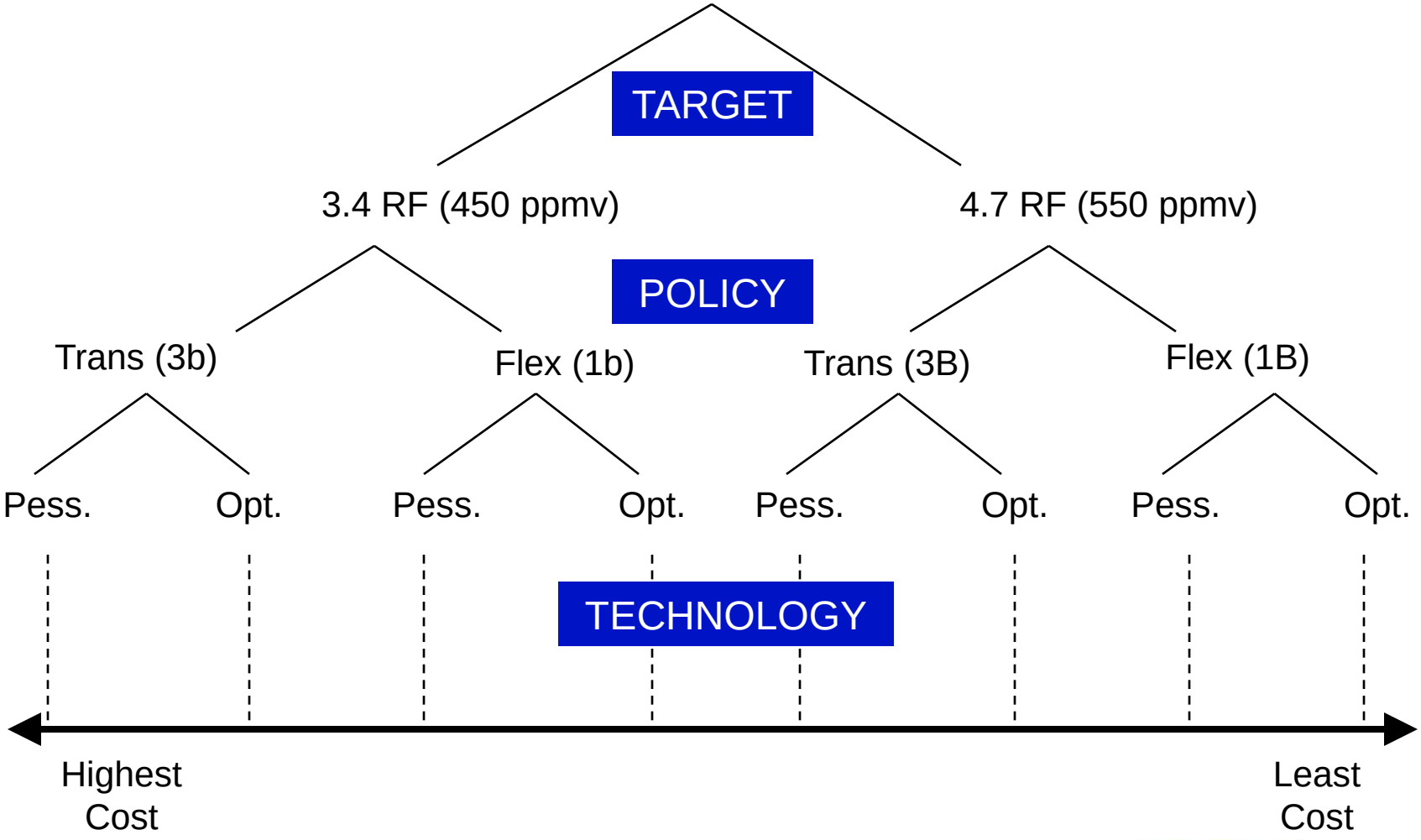
- "Optimistic":

  All technologies available

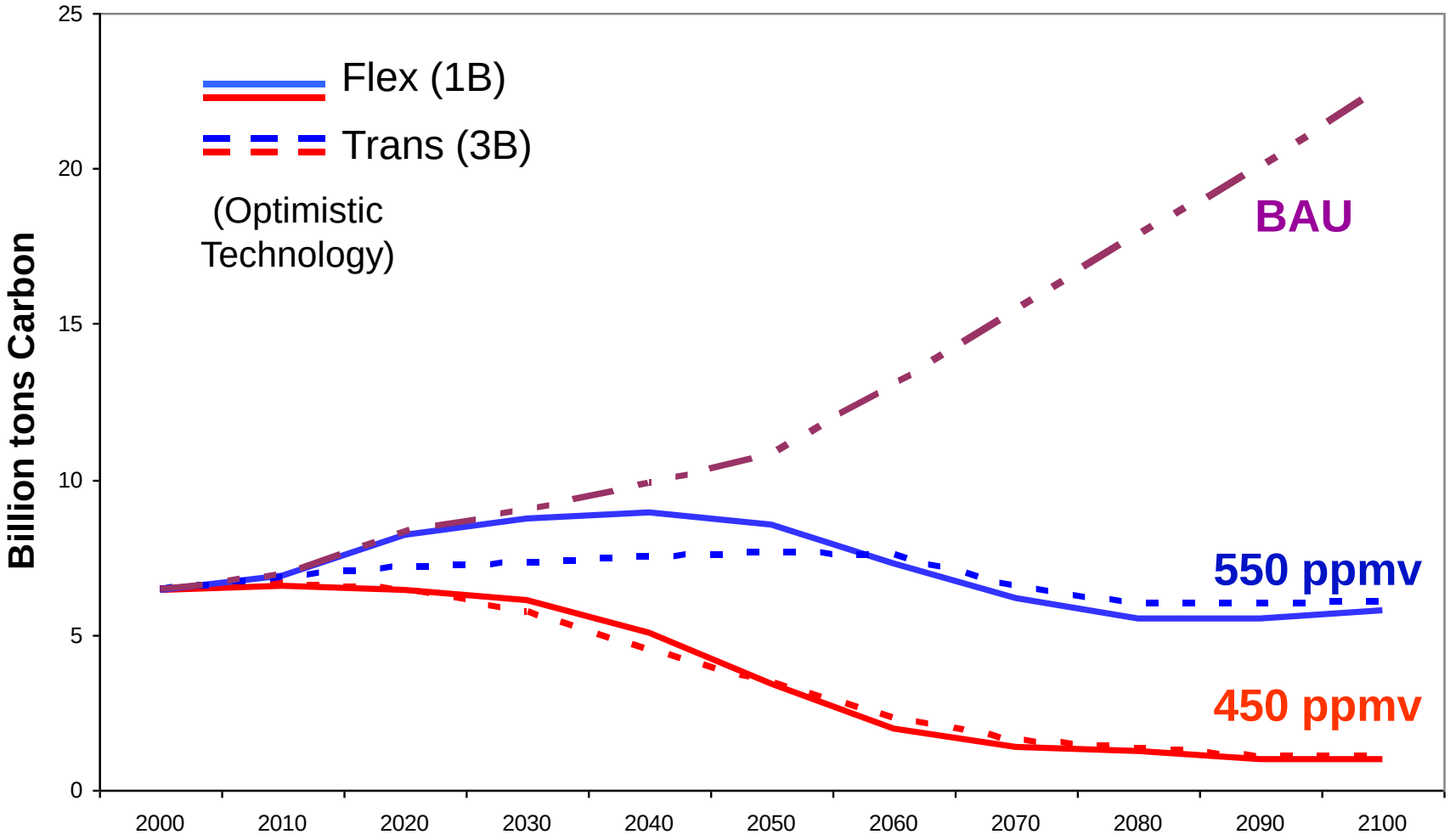
- "Pessimistic":

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

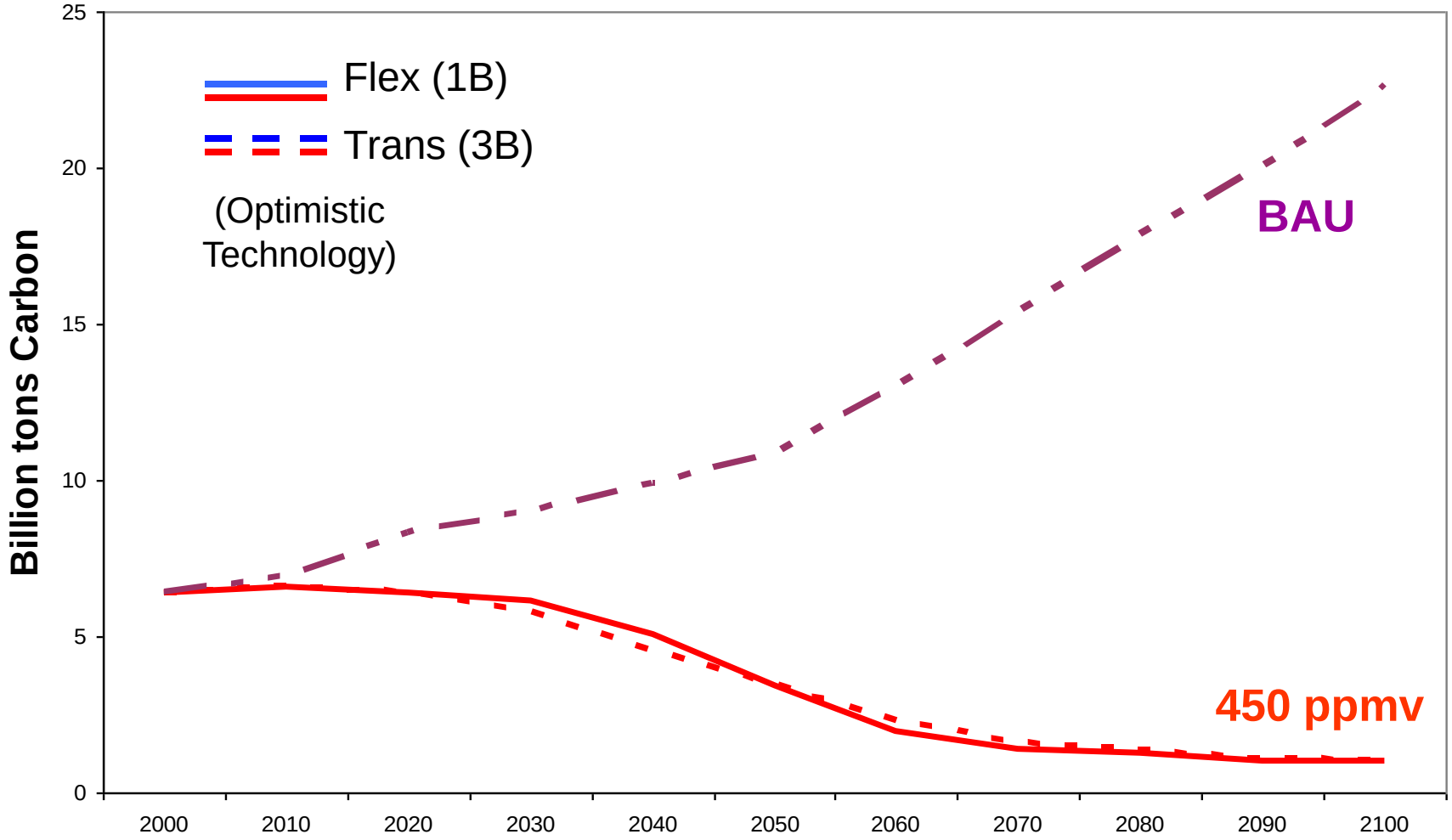
Scenario Design



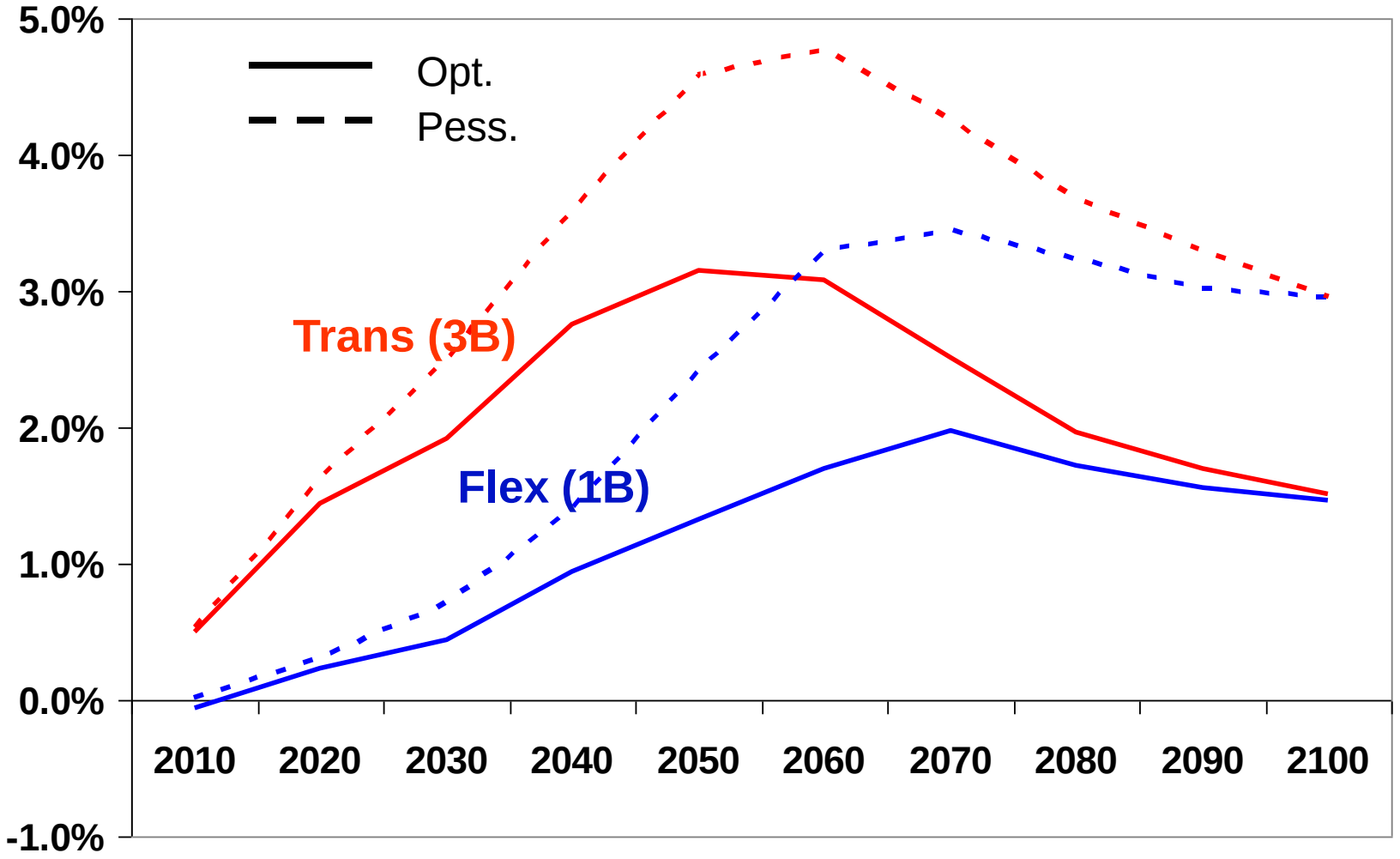
Global Carbon Emissions



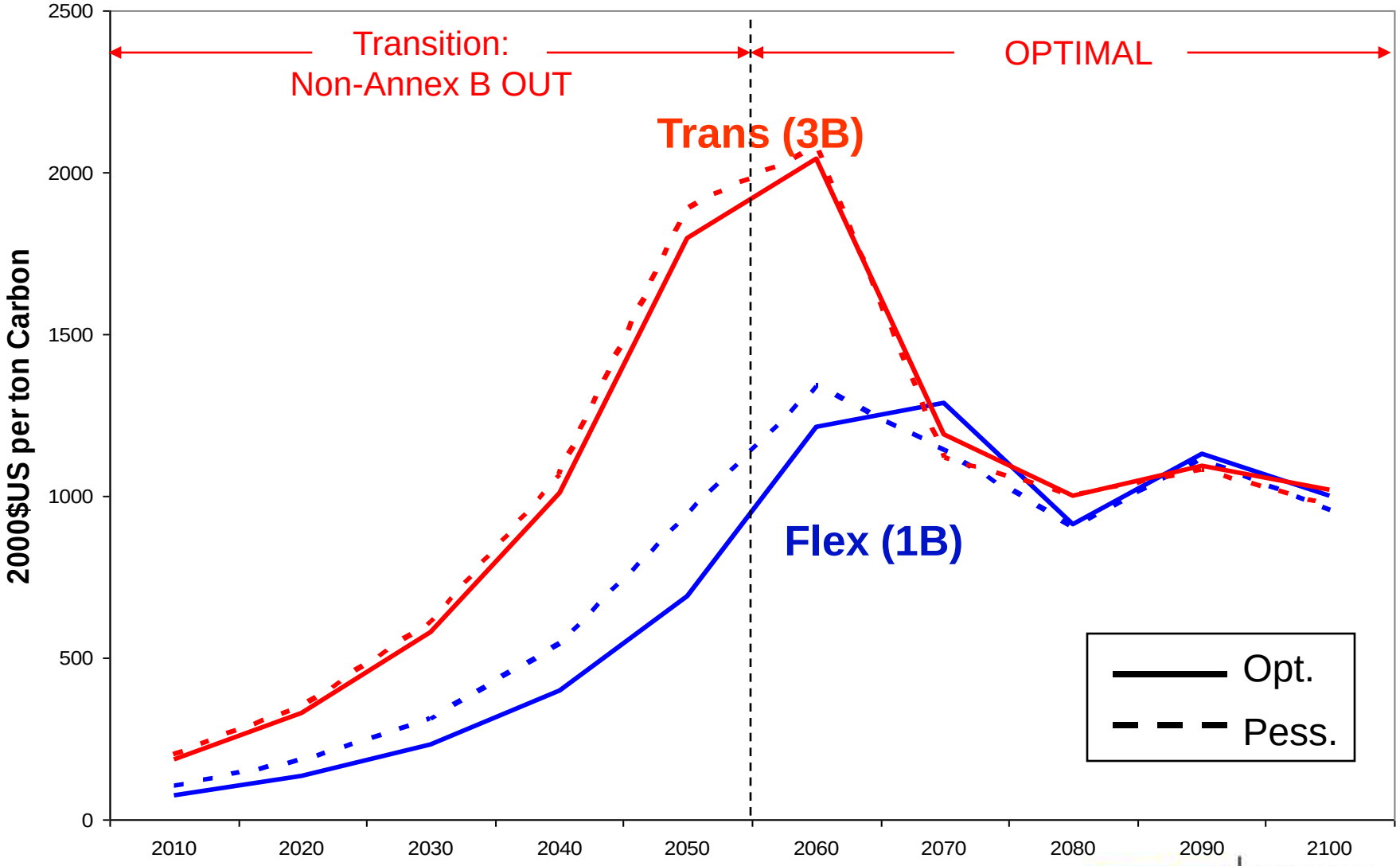
450 ppmv – Transition Constraints on Annex B Not Binding



Trans Costs are Higher Because Non Annex B Countries are Out



Technology does not have Strong Effect at Margin



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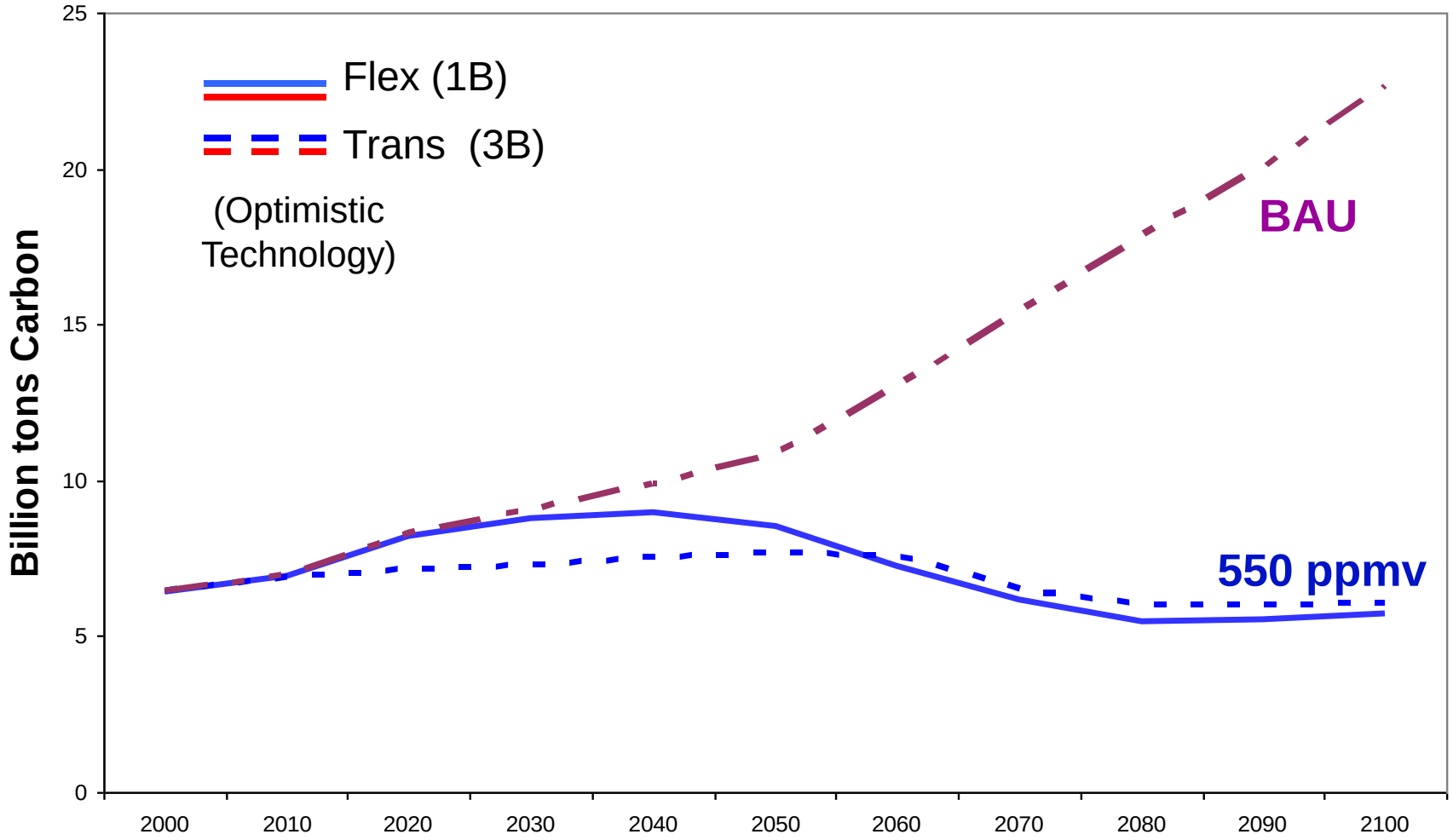
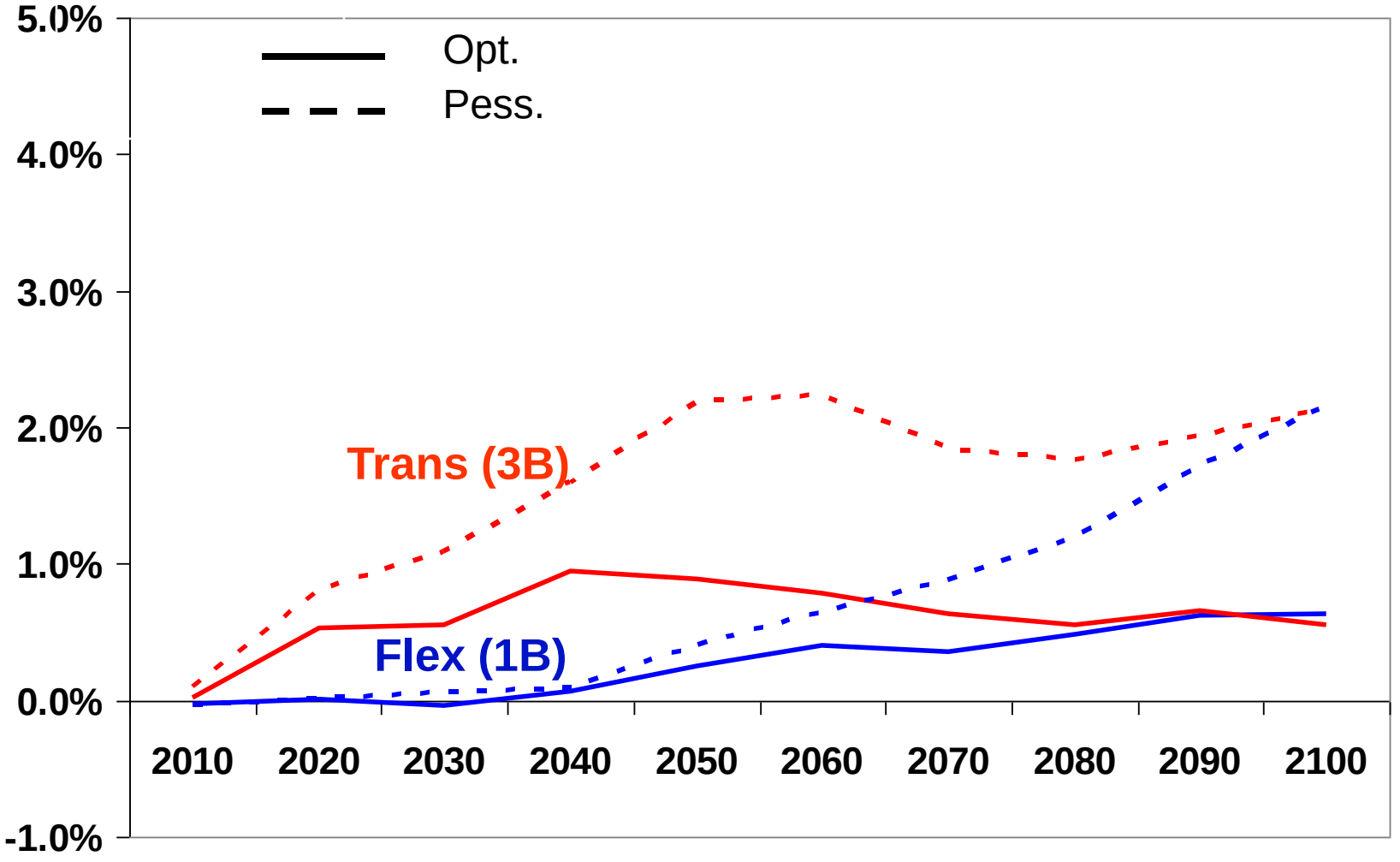
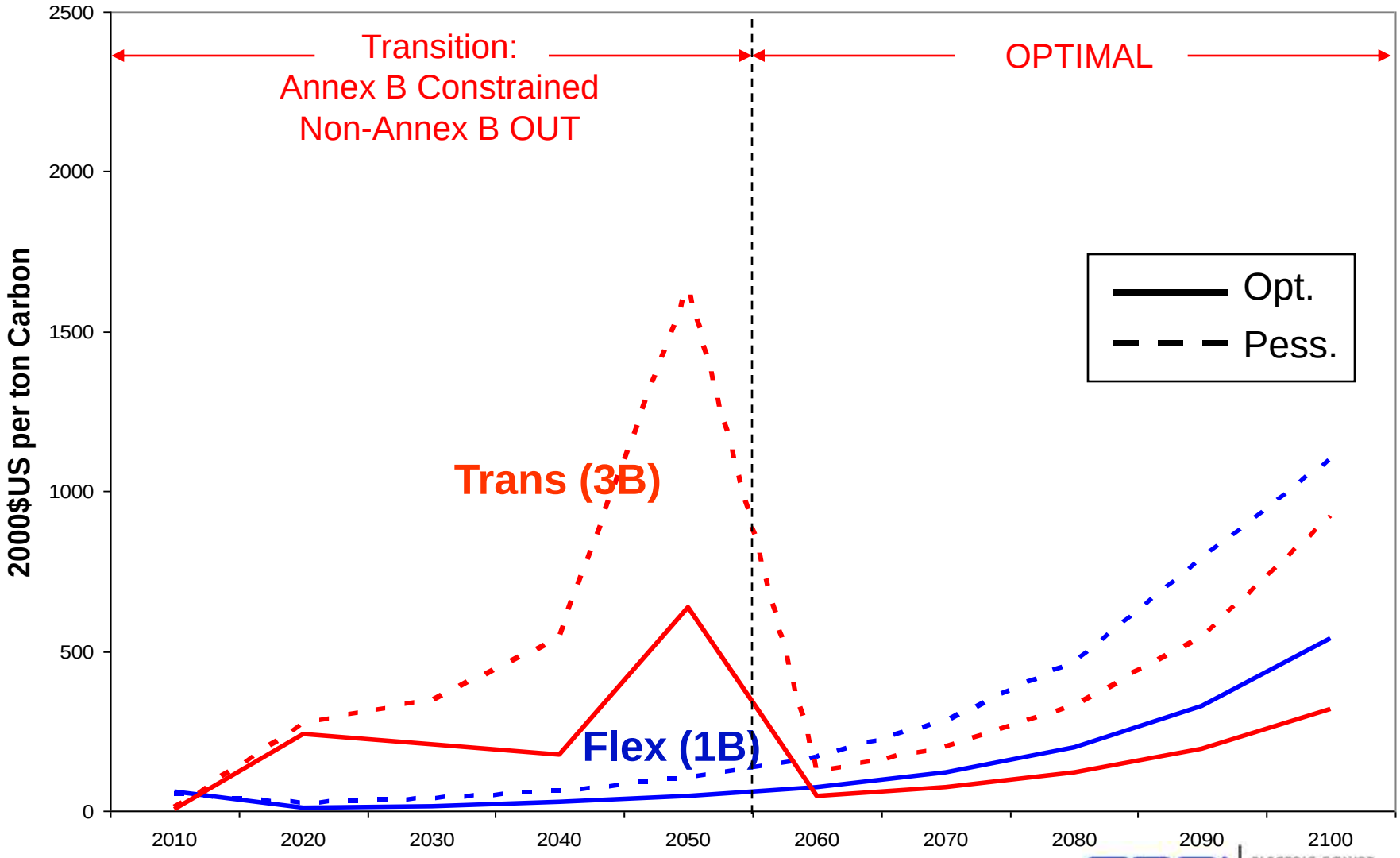
550 ppmv – Transition Constraints on Annex B Binding



Trans Costs are Higher Because Annex B Over-abates and Non-Annex B is Out



Technology has Strong Effect at Margin



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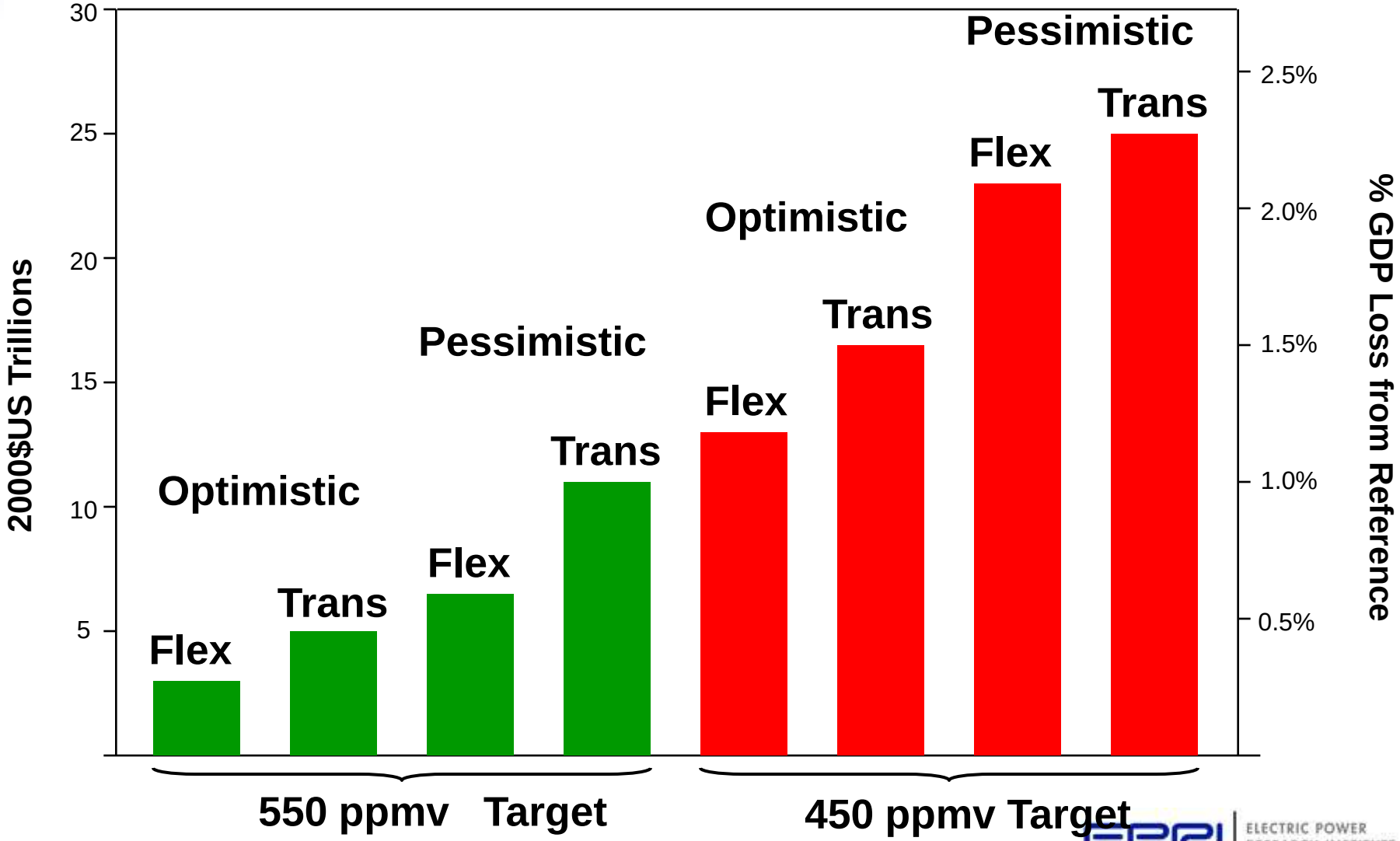
Global Discounted Sum of Economic Cost

At 5% through 2200



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Bottom Line

- With a constraint of 450 PPMV, emission paths are virtually identical in 1st Best and 3rd Best
  - But Costs are higher in 3rd Best
- With a constraint of 550 ppmv, emission paths vary between 1st Best and 3rd Best
  - Over-abate in 3rd Best case

But 3rd Best may be what we are stuck with since when and where flexibility is probably unattainable at least in the near-term

Thank You!