



Macroeconomic Impacts of Climate Policies



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Paris Agreement (2015)

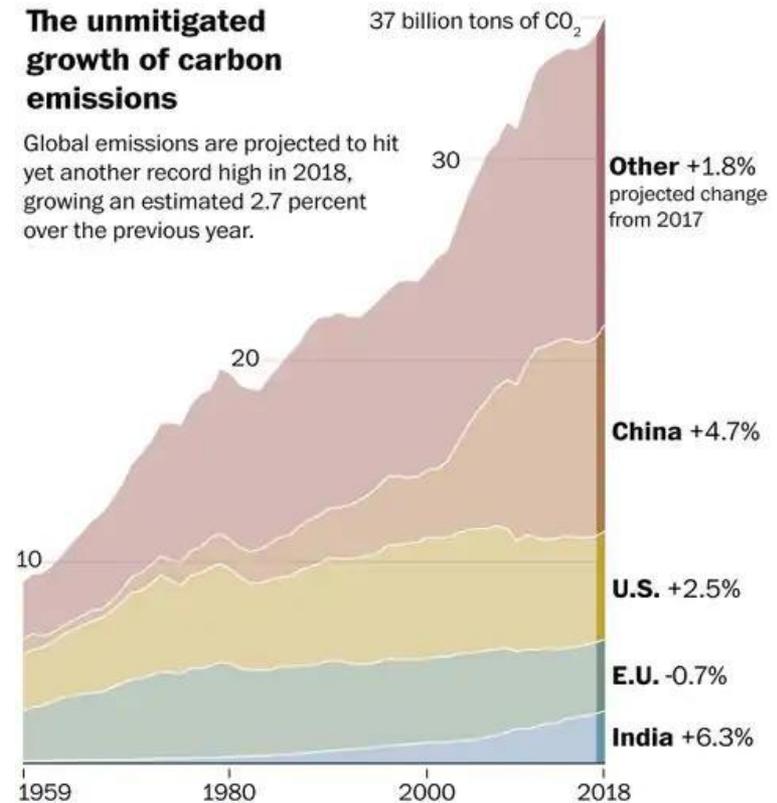
UN Paris Agreement Goal: **“Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels.”**

Signed: 195 countries



The unmitigated growth of carbon emissions

Global emissions are projected to hit yet another record high in 2018, growing an estimated 2.7 percent over the previous year.



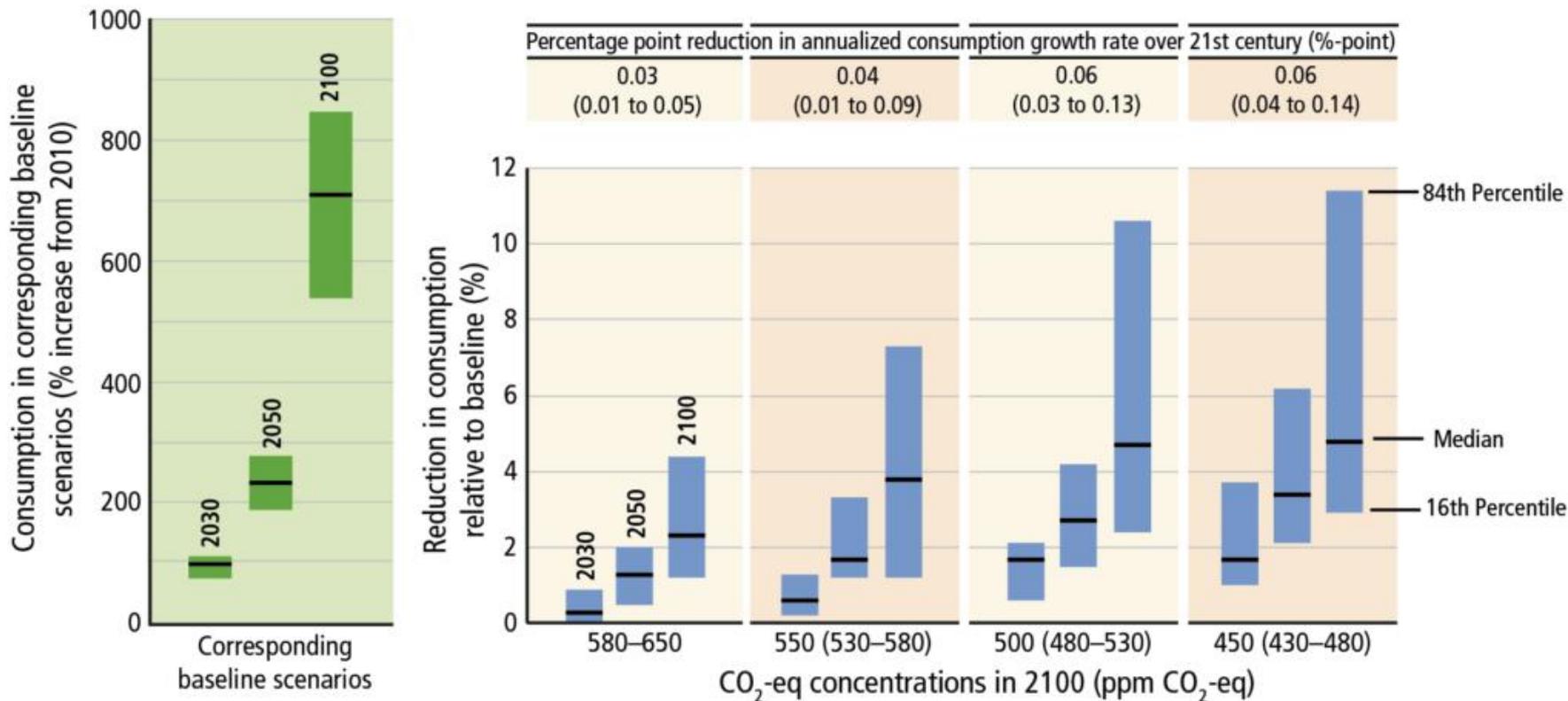
Figures show emissions from fossil fuels and industry, which includes cement manufacturing but not deforestation.

Source: Global Carbon Project

JOHN MUYSKENS/THE WASHINGTON POST

Cost of GHG Mitigation

Global mitigation costs and consumption growth in baseline scenarios

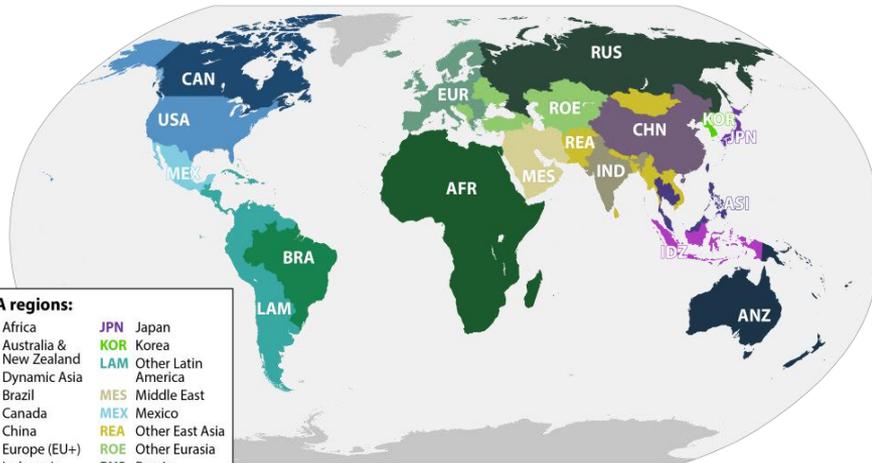


Source: IPCC AR5 (2014)

Representation: Global coverage, All sectors of economy



Major goals:
Energy, economy, GHG and air pollutants projections.



Cement CCS Options
Cement w/ Coal CCS
Cement w/ Gas CCS
Cement w/h Cryogenic CCS

Non-Energy
Crops
Livestock
Forestry
Food
Energy Intensive Ind.
Manufacturing
Services
Industrial Transport
Household Transport

Vehicle Types
ICE (gasoline & diesel)
Plug-in Electric
Battery Electric
Hydrogen

Biofuels
Current generation (Ethanol from Biodiesel)

Advanced biofuel

Energy
Crude oil
Refined oil
Liquid fuel from biomass
Oil Shale
Coal
Natural gas (conv., shale, tight, CBM)
Electricity
Synthetic gas (from coal)

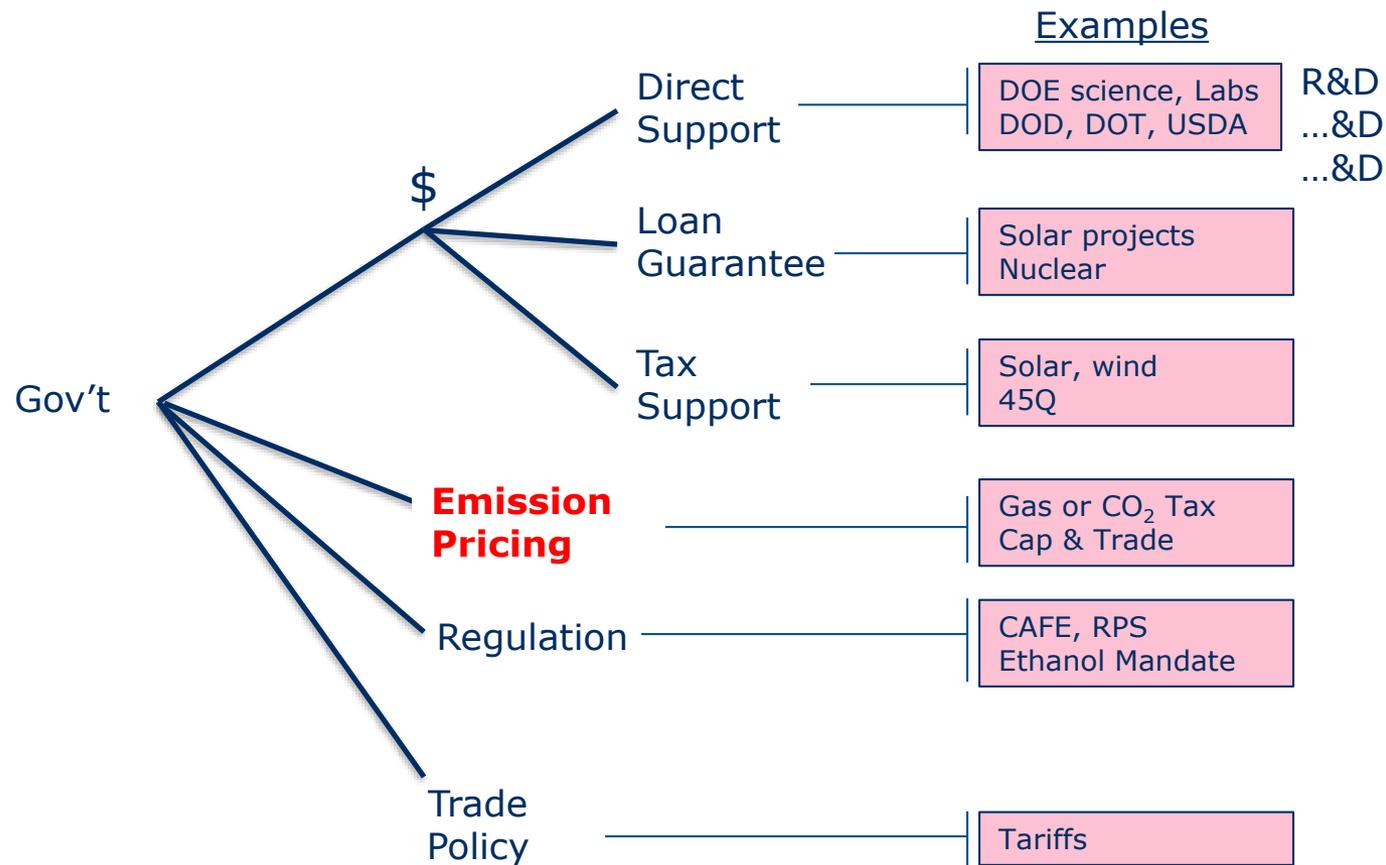
Technologies
Conv. Fossil (coal, gas, oil)
Adv. Fossil (NGCC, Adv Coal)
Coal with CCS
Coal + Bio Co-firing w/ CCS
Gas with CCS
Gas with Advanced CCS
Nuclear
Advanced Nuclear
Hydro
Solar
Wind
Wind with Gas Backup
Wind with Biomass Backup
Biomass
Biomass with CCS

Expansions (in progress): Industrial CCS options, Hydrogen production options, Hydrogen Pathways, Direct Air Capture, CO₂ utilization pathways

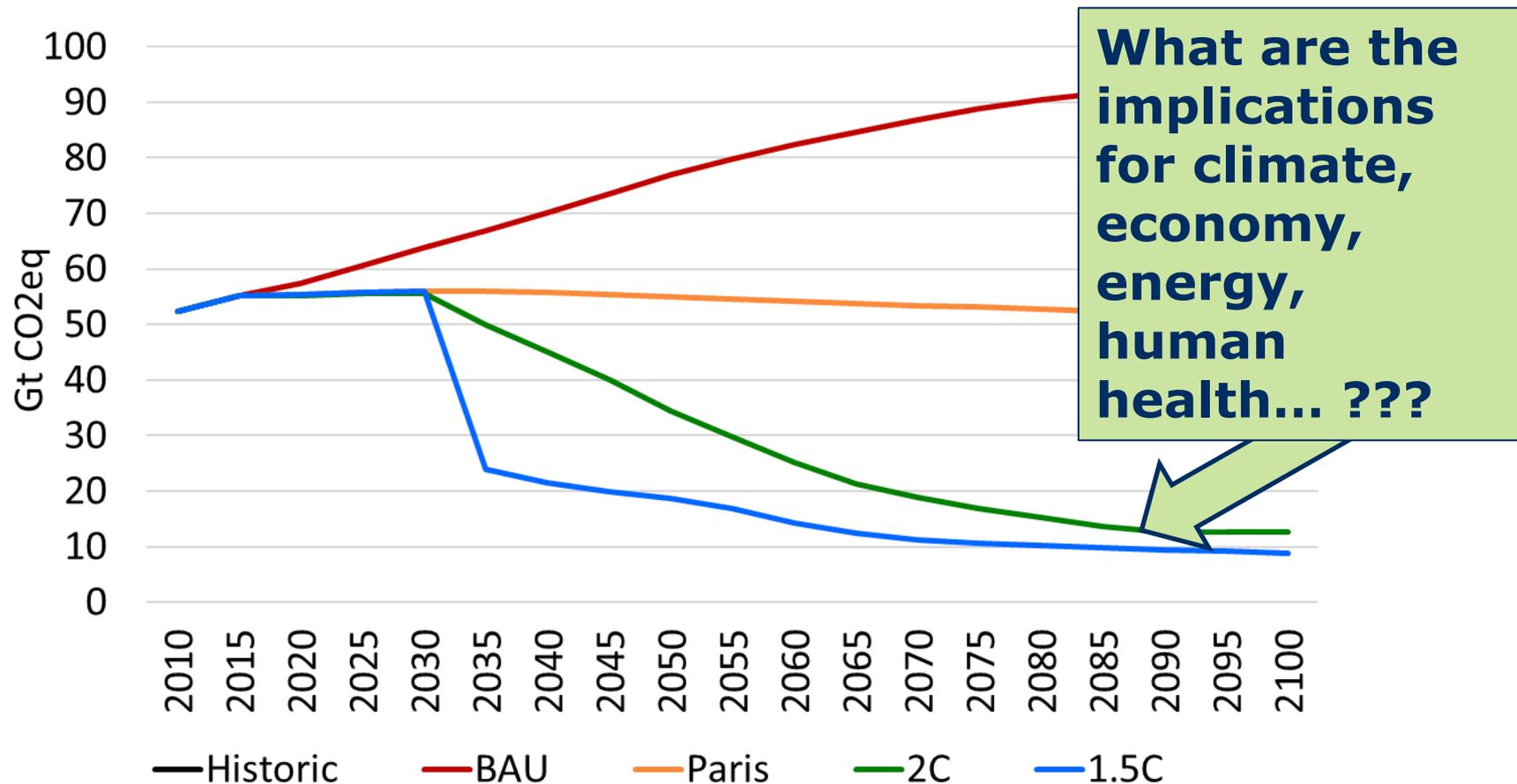
Model Features: Theory-based; Prices are endogenous; International Trade; Inter-industry linkages; Distortions (taxes, subsidies, etc); GDP and Welfare effects

Trade-off: Aggregated representation of regions, sectors, technologies

Menu of Policy Options

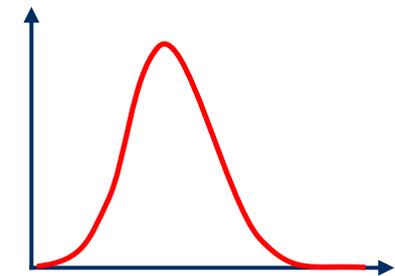


Paris Agreement and Global GHG Emissions



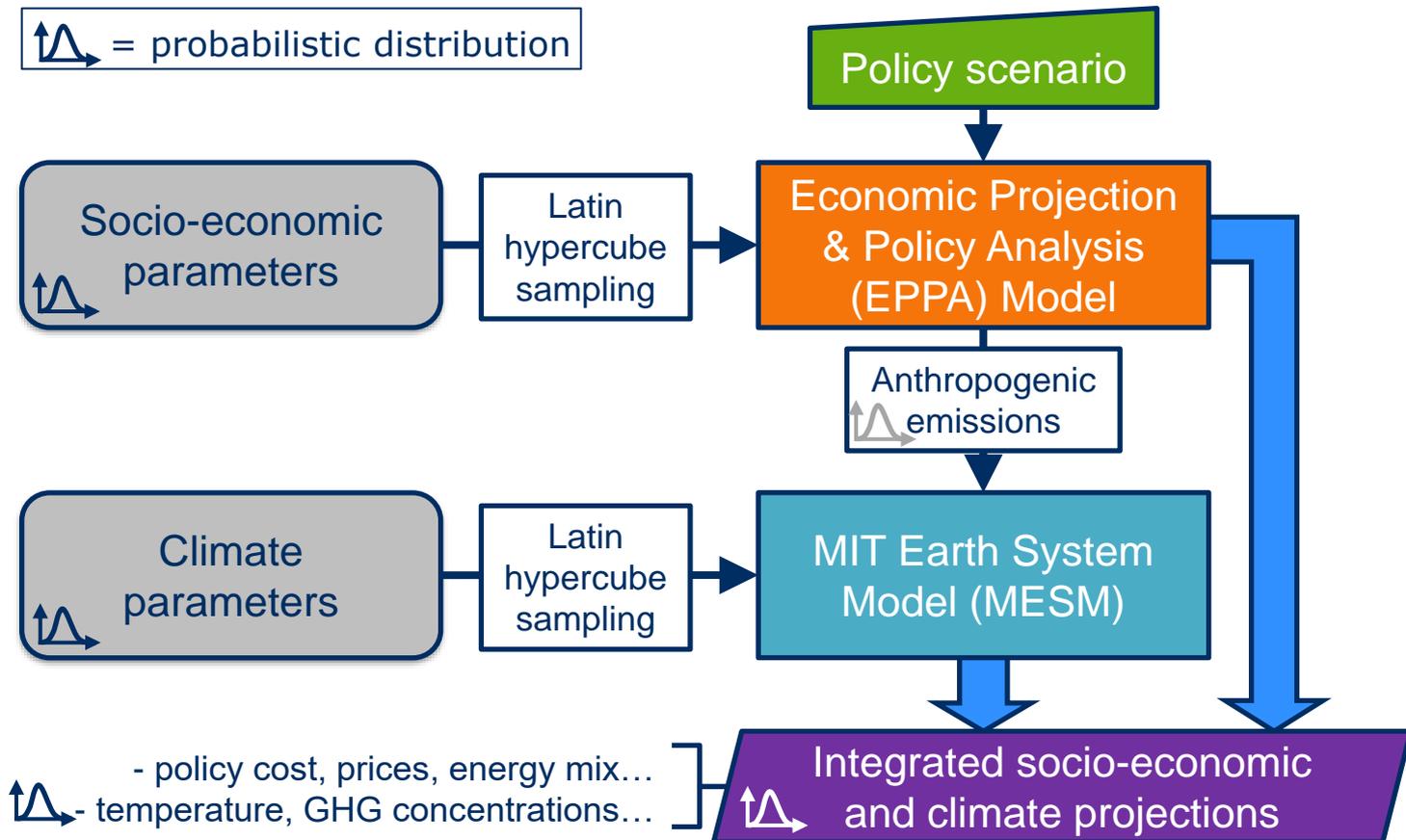
Key Uncertainties

- Socio-Economic Uncertainties
 - Population growth
 - GDP growth
 - Technology costs
 - Energy efficiency trends
 - Fossil fuel resource availability
 - Urban pollutants initial inventory and trends
 - Rate of technology penetration
- Climate Uncertainties
 - Climate sensitivity
 - Ocean heat uptake
 - Aerosol forcing



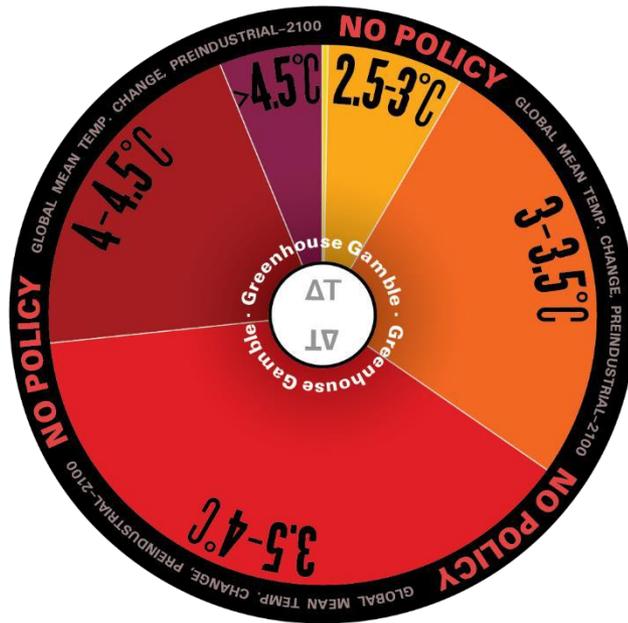
Probability distribution functions based on historical data, expert elicitation and scientific modeling

Integrated Global System Modeling

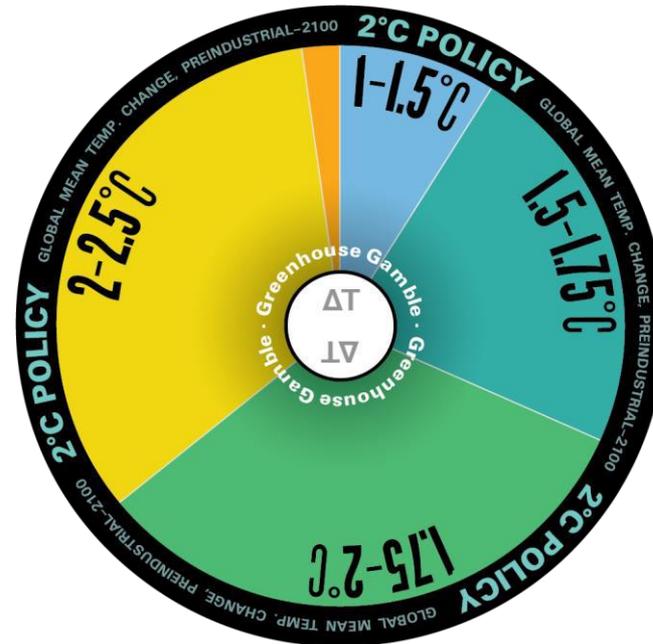


Greenhouse Gamble Wheels

REF



2°C

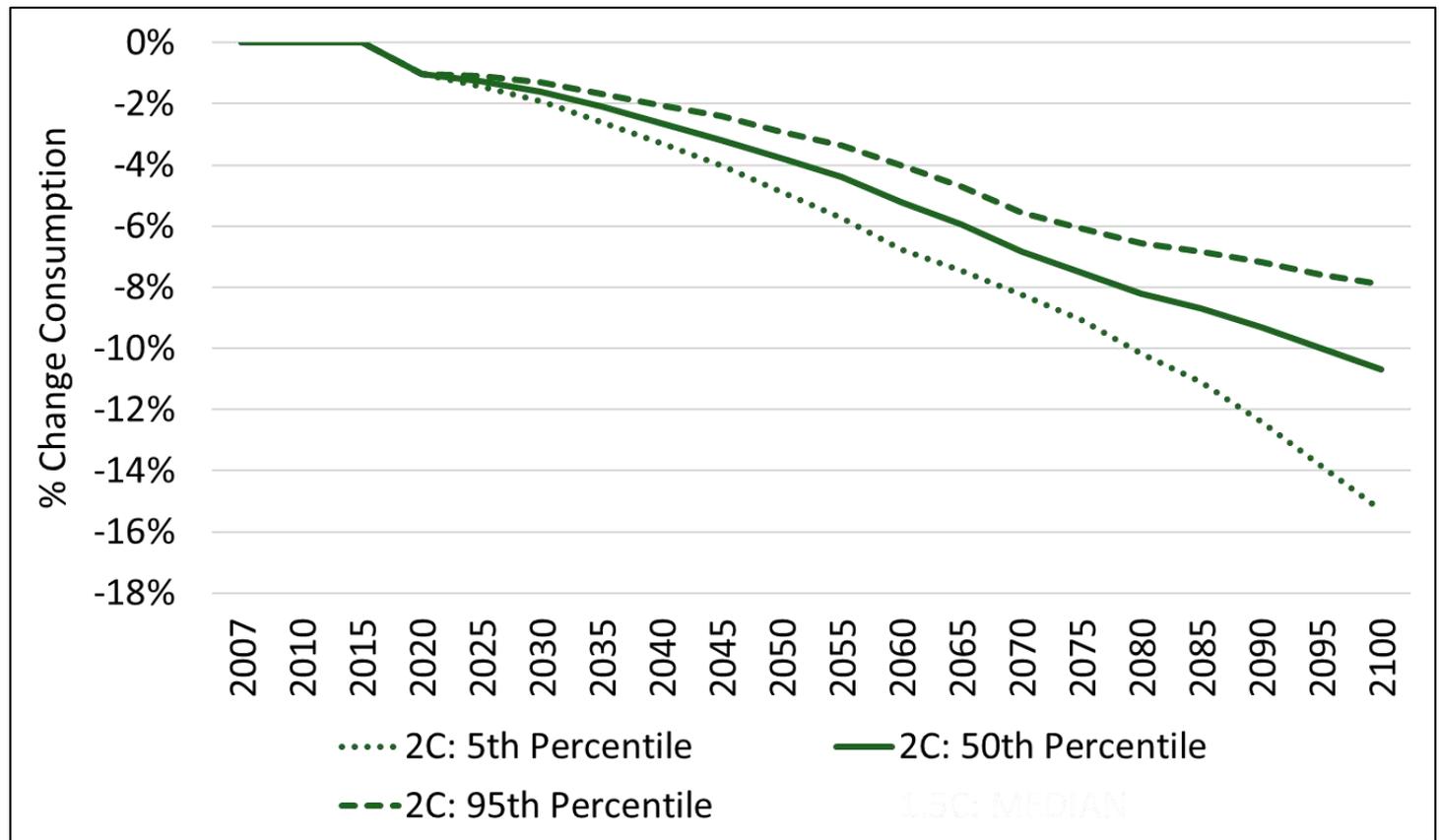


Which wheel would you rather spin?

How much does it cost to spin the 2C wheel?

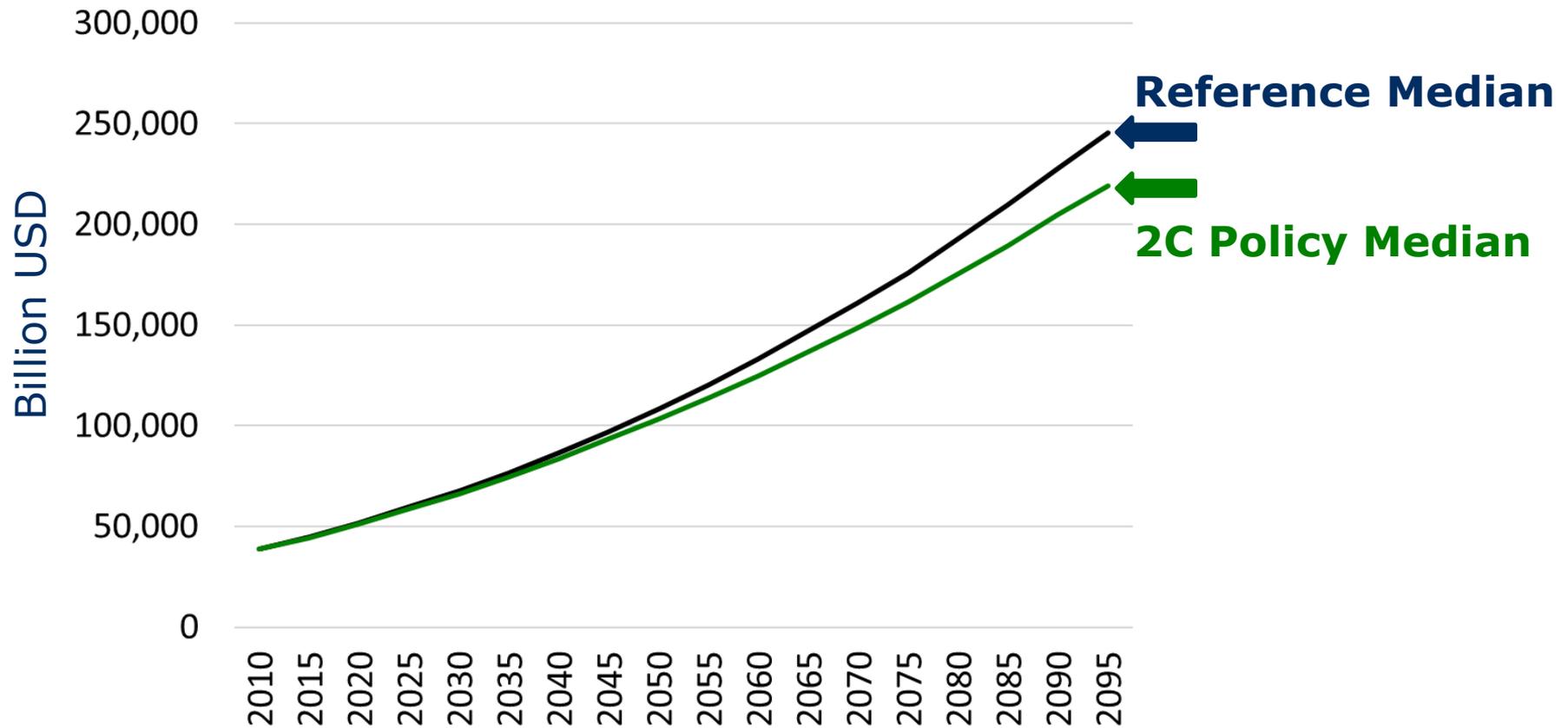
Global Policy Costs

Percentage change in consumption relative to consumption in the reference scenario



How much does it cost to spin the 2C wheel?

Global GDP

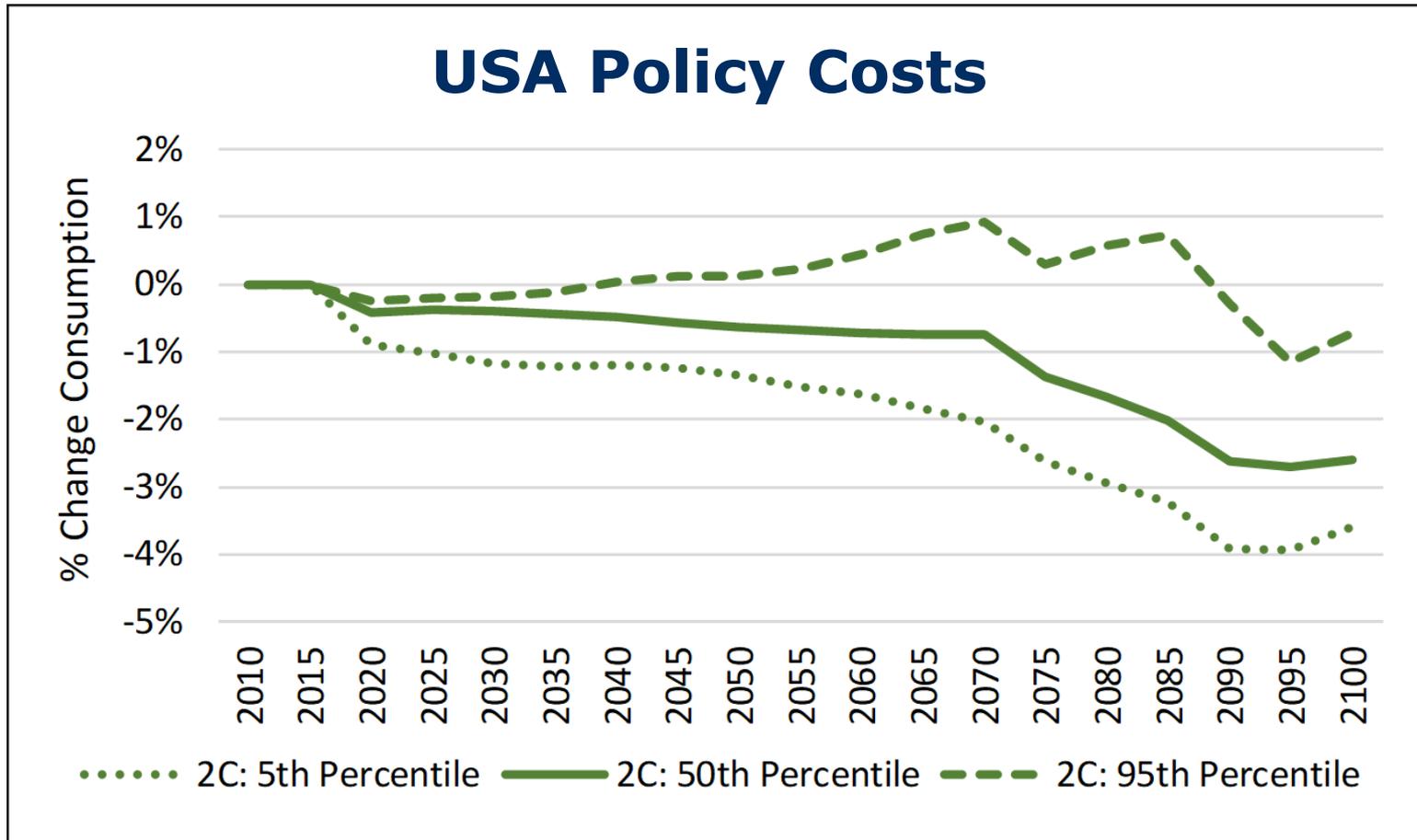


Reference Median

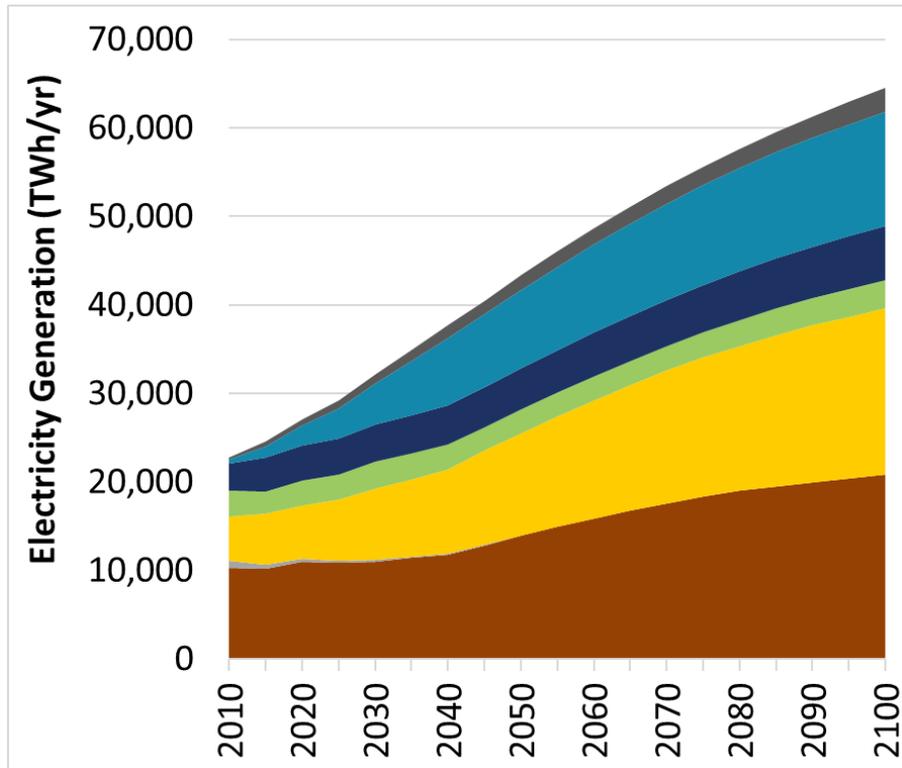
2C Policy Median

How much does it cost to spin the 2C wheel?

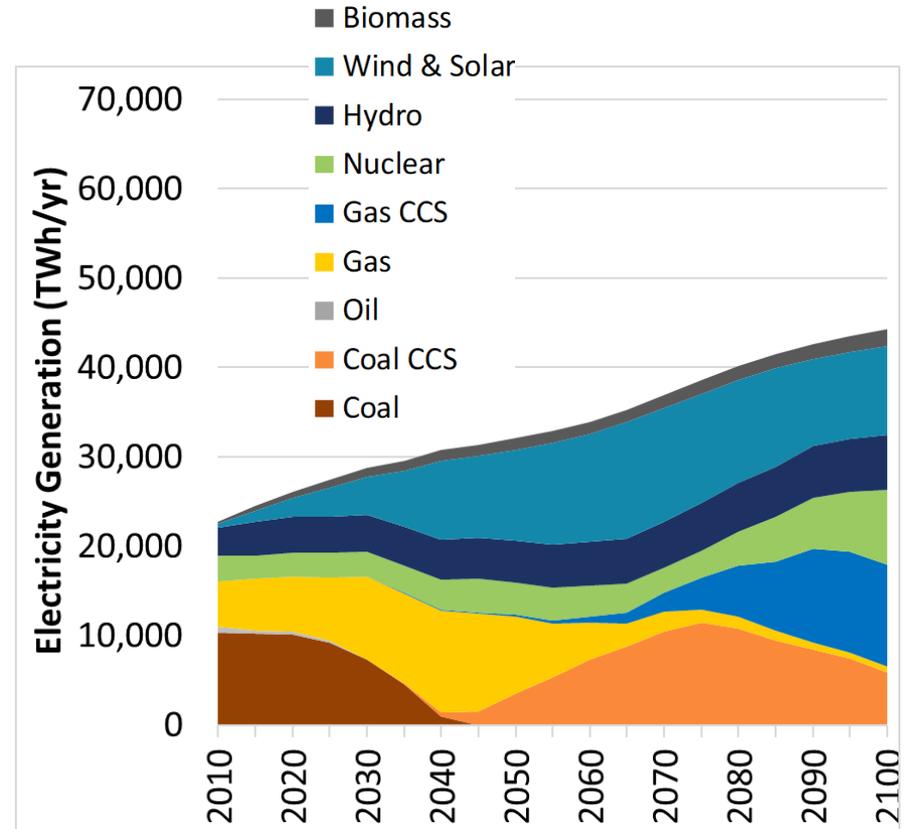
Percentage change in consumption relative to consumption in the reference scenario



Energy Implications



Reference

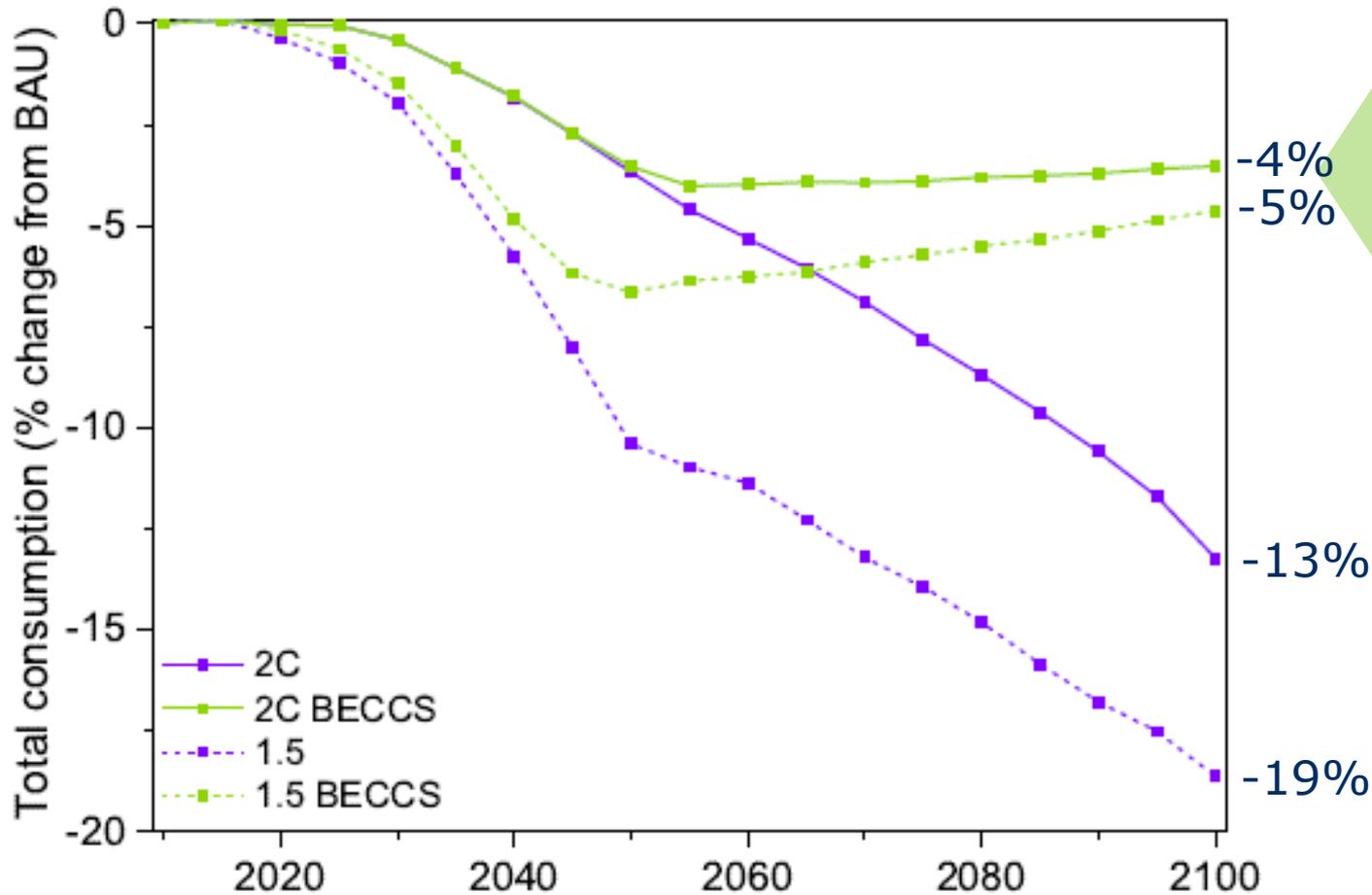


2C

Issue: Scaling Up Low-Carbon Options



Impact of Technologies: Global Policy Cost



BECCS significantly reduces the cost of meeting long-term targets

Implications

- A low-carbon energy system requires a **portfolio of technologies**
- Future energy mix depends on:
 - Technologies available
 - Cost of competing technologies
 - How quickly new technologies can expand
 - Public acceptance
 - **Policies: stringency and design**
- Design of policy has important implications for outcomes related to health, climate, economy, energy, etc.
- Uncertainty is unavoidable... but we can quantify and make decisions accordingly

Thank you

Questions or comments?

Please contact Sergey Paltsev at paltsev@mit.edu



<http://globalchange.mit.edu/>