American Petroleum Institute

The macroeconomic impacts of a US carbon price

E3-US modeling results

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clarity from complexity

Methodology

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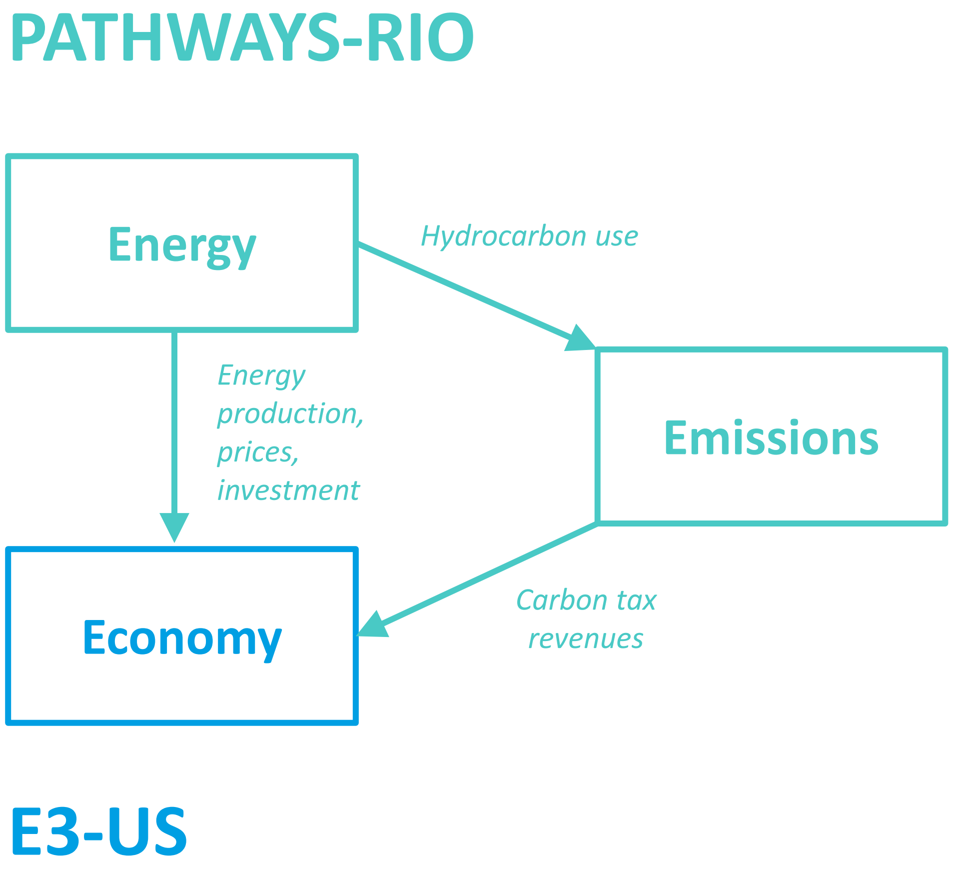
Role of E3-US

- **E3 modeling** captures interactions between **economy-energy-environment**
- In this project, **energy modeling** was conducted separately by Evolved Energy Research (EER) using PATHWAYS-RIO model
- **E3-US** uses **inputs from PATHWAYS-RIO** to capture the **macroeconomic impacts** of the carbon price scenario
  - Some **inputs from API-NEMS** were also used where these are not covered in PATHWAYS-RIO



Input assumptions for economic modeling

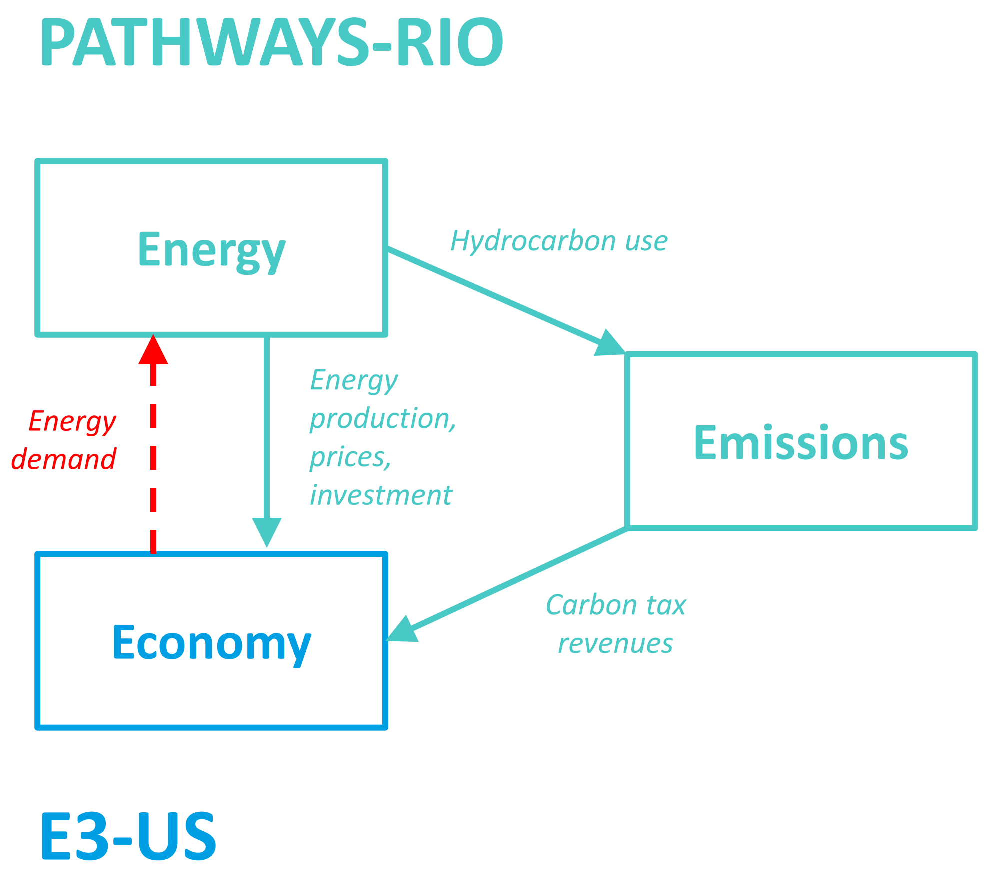
- **Reference case** inputs:
  - Macroeconomic aggregates aligned to API-NEMS forecast
  - Energy system forecast aligned to PATHWAYS-RIO
- **Carbon price scenario** inputs:
  - Energy system: production, use, prices, investment
  - Carbon revenues
- We model **energy-economy linkages with E3-US** to estimate macroeconomic outcomes

Scenario	Input	OnLocation (API-NEMS)	Evolved (PATHWAYS-RIO)
IRA reference case	Macroeconomy: GDP, population, employment	x	
	Energy use		x
	Energy prices		x
	Energy production		x
Carbon price scenario	Energy use		x
	Energy prices		x
	Energy production		x
	Carbon revenues		x
	Energy investment - Supply-side		x
	Energy investment - Demand-side	x	

Rebound effect

- Our approach involved a soft-linkage with the **PATHWAYS-RIO** model
  - We model **energy -> economy** feedbacks
  - But **not economy -> energy** feedbacks

- We do not capture the **potential rebound effect** if economic impacts are positive
  - EER did not model recycling of carbon revenues into the economy



Inputs

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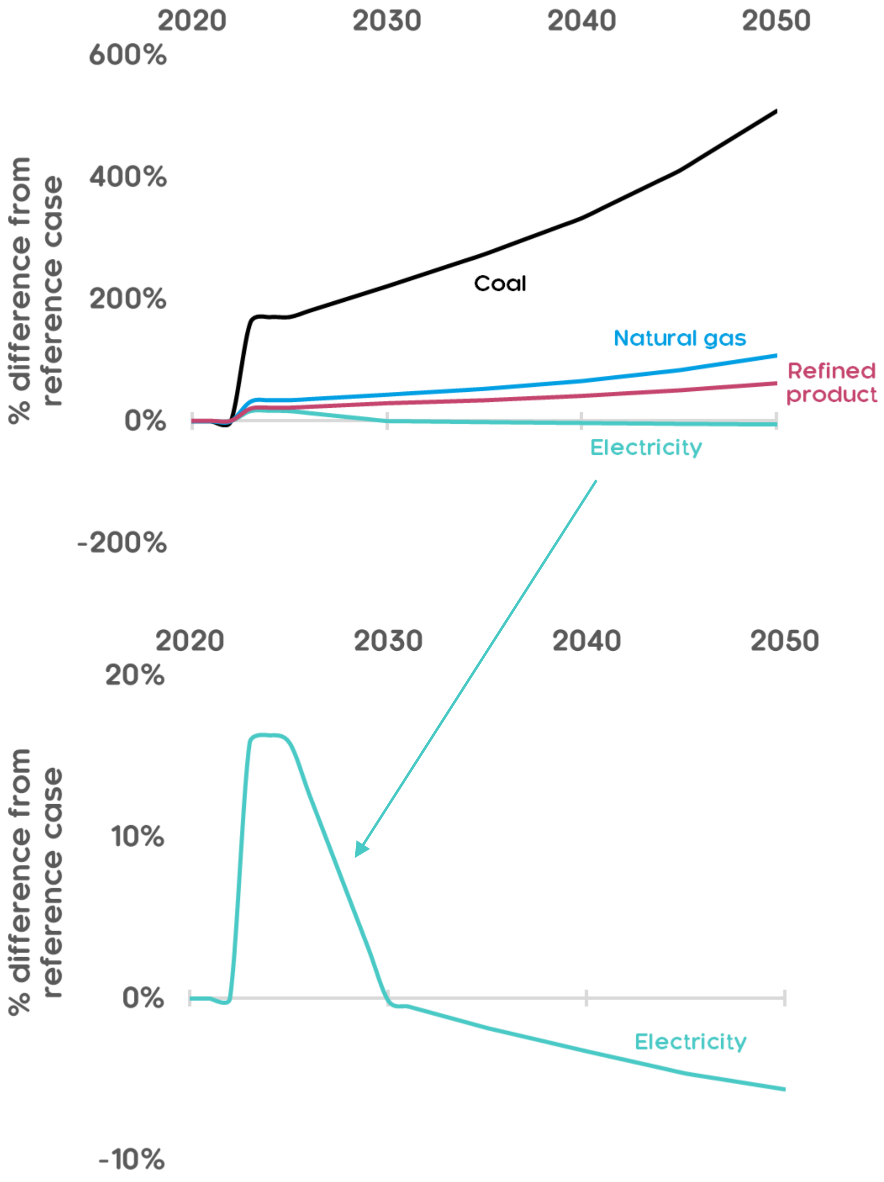
Inputs – Energy prices

- **Carbon pricing increases energy prices** for emissions-intensive energy sources
  - Coal prices are impacted more strongly than refined fuels/natural gas
  - However more refined fuels/natural gas are consumed than coal, so price increases in these fuels have a larger impact on the economy

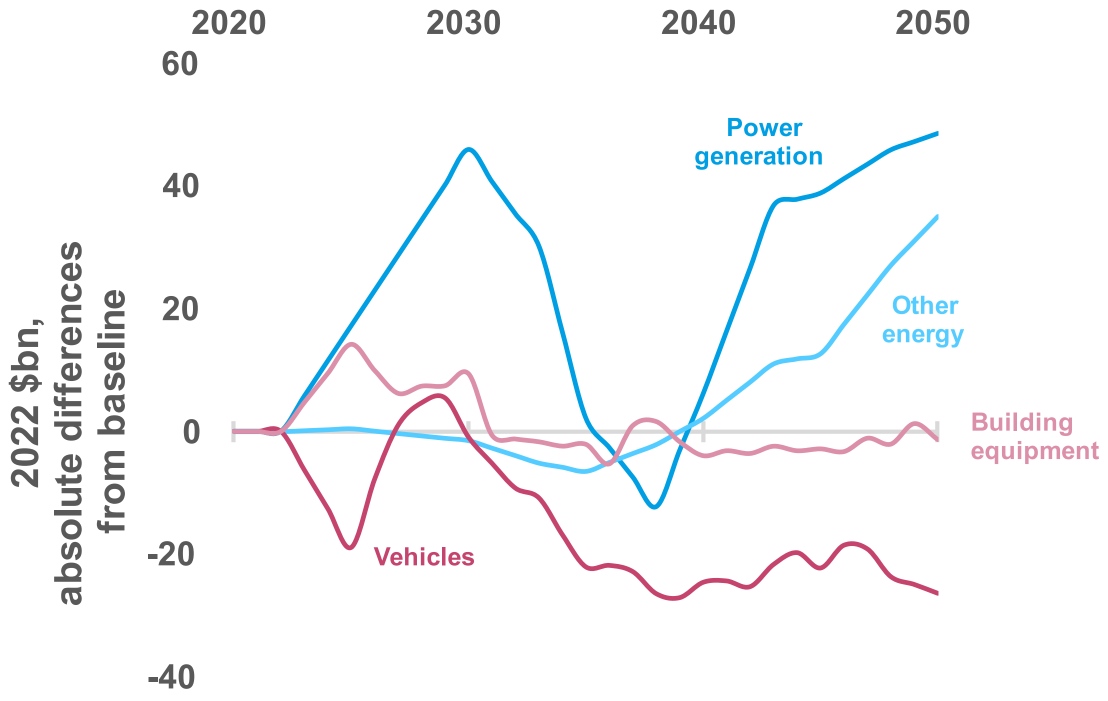
- **Electricity prices** change with technology shift in power generation sector
  - **Higher in short run**: reliance on fossil fuels
  - **Lower in long run**: adoption of renewables and CCS, with negative emissions via BECCS
  - The estimate of lower electricity prices from 2030 onwards is a key driver to the economic modeling results



Inputs – Investment

- **Supply-side investment** assumptions from PATHWAYS-RIO
  - Carbon price incentivizes **earlier investment in clean power generation** than in IRA reference case
  - Carbon price incentivises **continued investment in energy sectors** (biofuels, synthetic fuels, electrolysis) after expiry of IRA subsidies

- **Demand-side investment** assumptions from API-NEMS (not covered in PATHWAYS-RIO)
  - **Lower investment in vehicles** in long run, as R&D measures push down vehicle costs
  - **Earlier investment in building equipment** (e.g. solar PV, insulation)



Inputs – Investment

- **Supply-side investment** assumptions from PATHWAYS-RIO
  - Carbon price incentivizes **larger investment in clean power generation and other energy sectors** (biofuels, synthetic fuels, electrolysis) than in IRA reference case
- **Demand-side investment** assumptions from API-NEMS (not covered in PATHWAYS-RIO)
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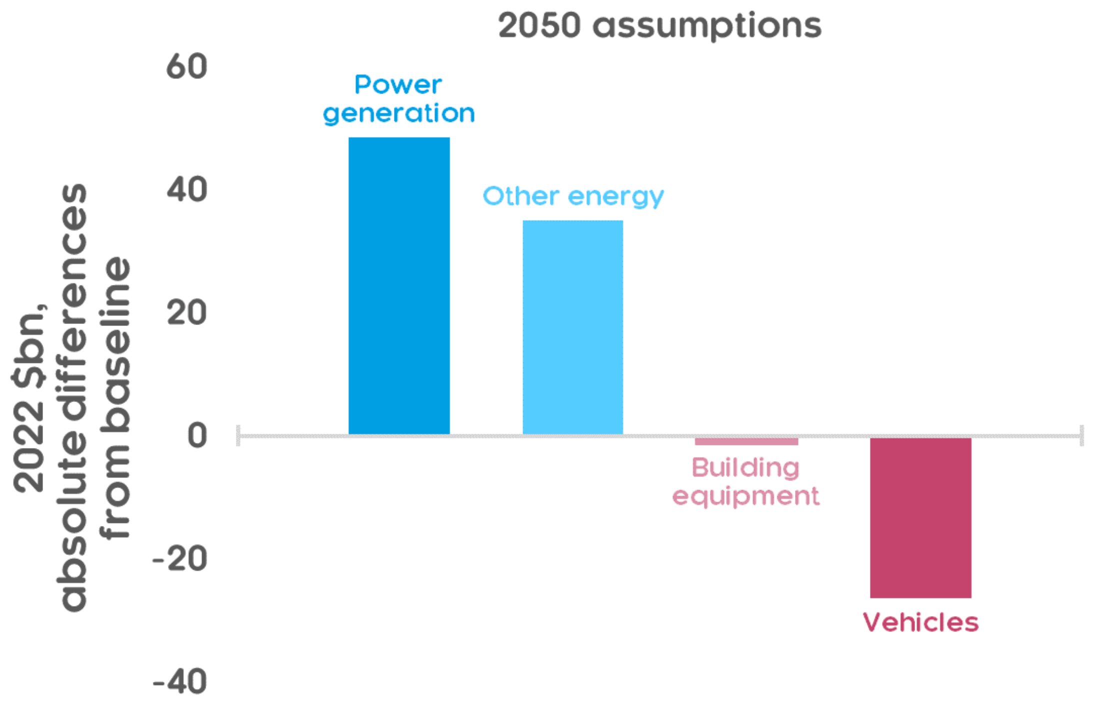

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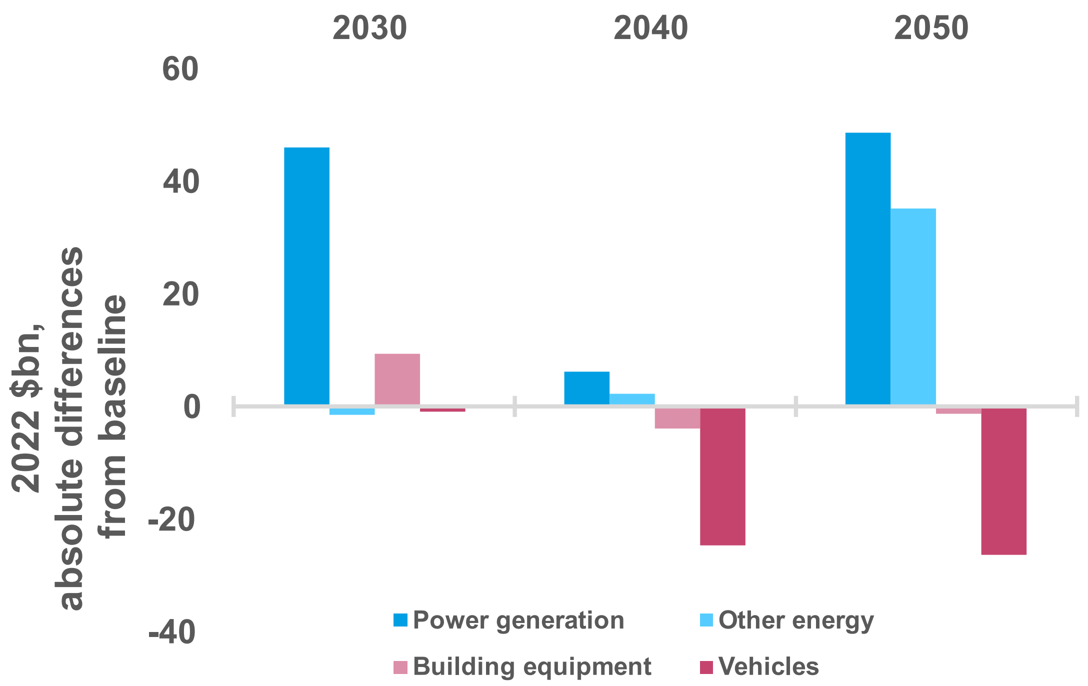
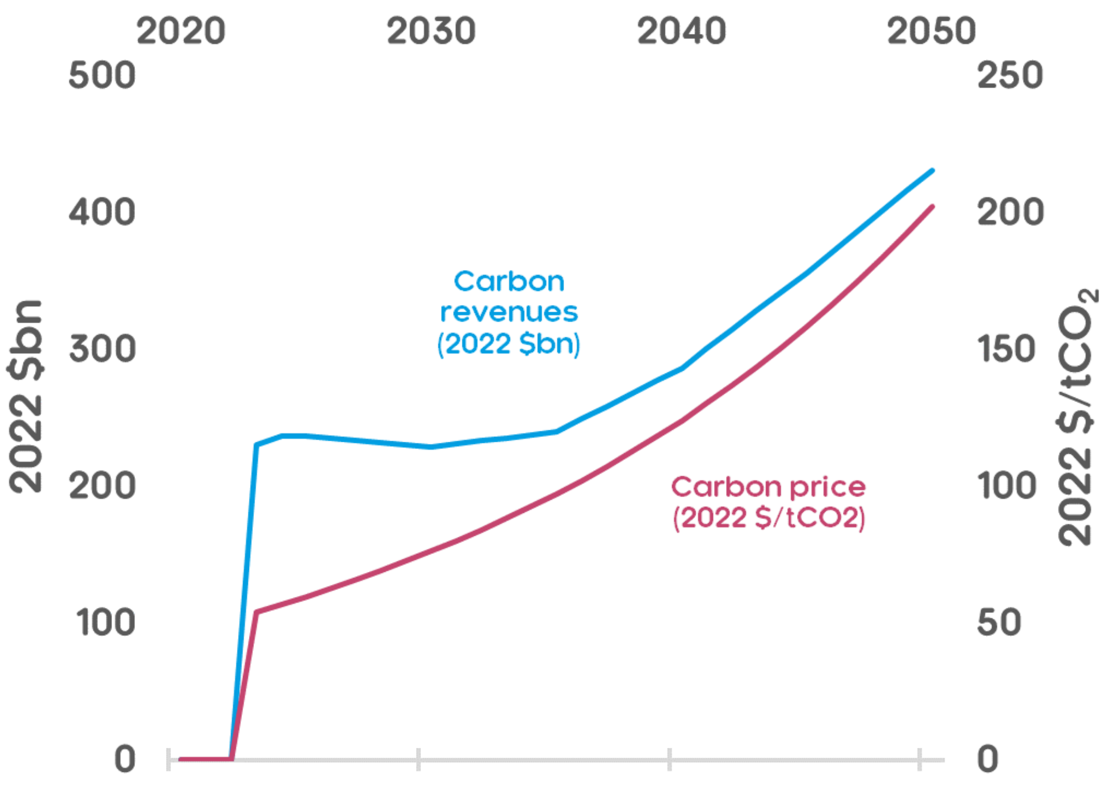


Inputs – Carbon revenues

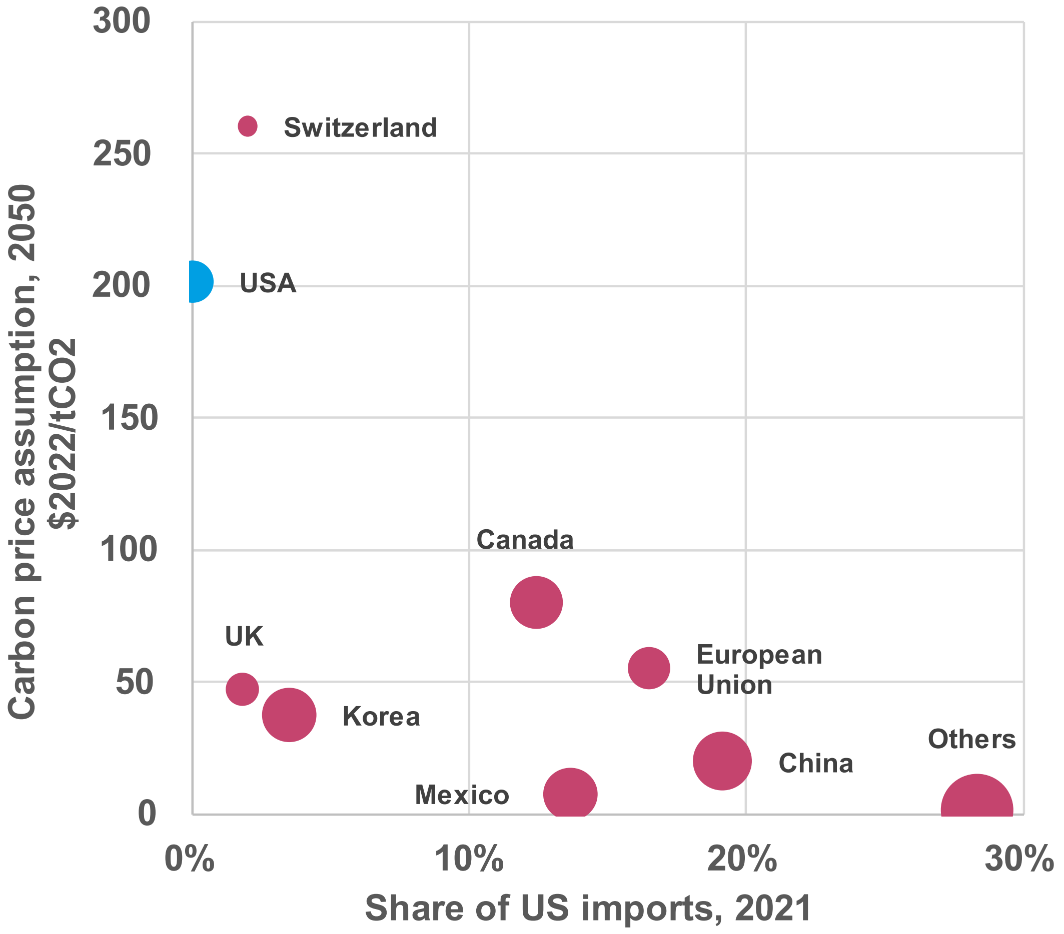
- **Carbon revenues** reach over $200bn annually by 2023, and over $400bn annually by 2050
- We assume 50% of revenues are **redistributed to households**
- Remaining 50% is allocated to **investments in low-emissions technology**
  - 7.5% on energy R&D
  - 42.5% on investments in energy sector (technology rollout)



Inputs – Carbon border adjustment

- Carbon border adjustment (CBA) is based on three factors:
  - **Carbon price** difference between US and trade partner*
  - **Emissions intensity** of the sector in the trade partner*
  - Trade partner's **share of US imports** of the sector's goods**

- Lower carbon price in trade partner (relative to the US) and higher trade partner emissions intensity lead to larger import tariff



Note: Bubble size represents relative emissions intensity of country's output in 2050, according to E3ME baseline.

* Assumption taken from E3ME baseline

** Assumption taken from historical shares in 2021

Modeling Results

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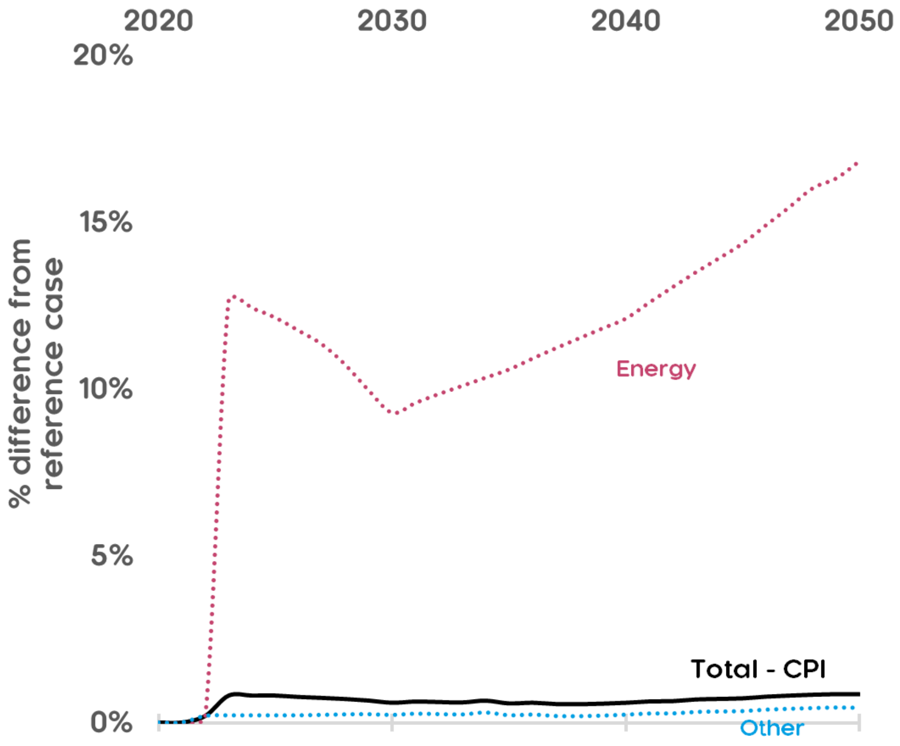
Economic Impact Modeling Results – Consumer prices

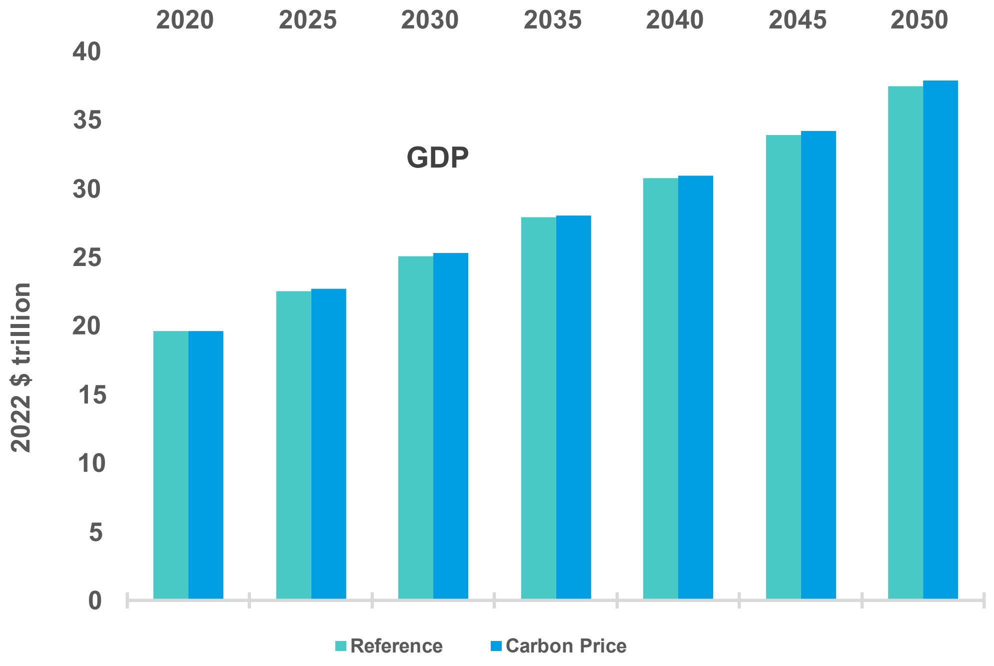
- Carbon pricing drives **higher energy prices**, and **modestly higher consumer prices** overall
- Energy price rises are muted by long-run **fall in electricity price** (relative to reference case)
- CPI impact is muted by relatively **low energy share of consumer expenditure** (~4%)

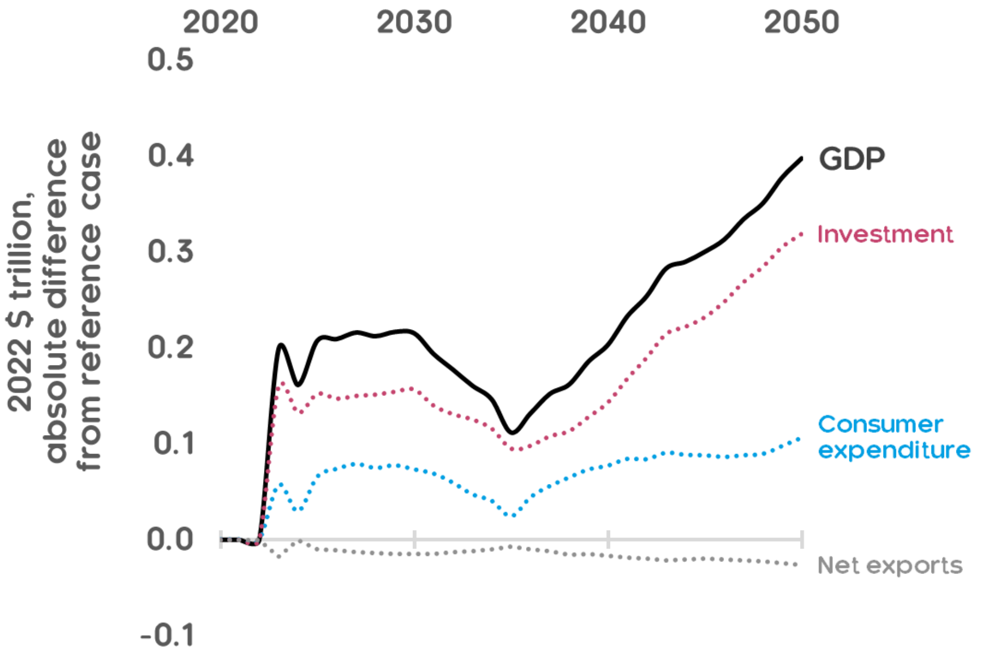


Note that these are modeled results given a specific set of assumptions, not price predictions.

Economic Impact Results - GDP

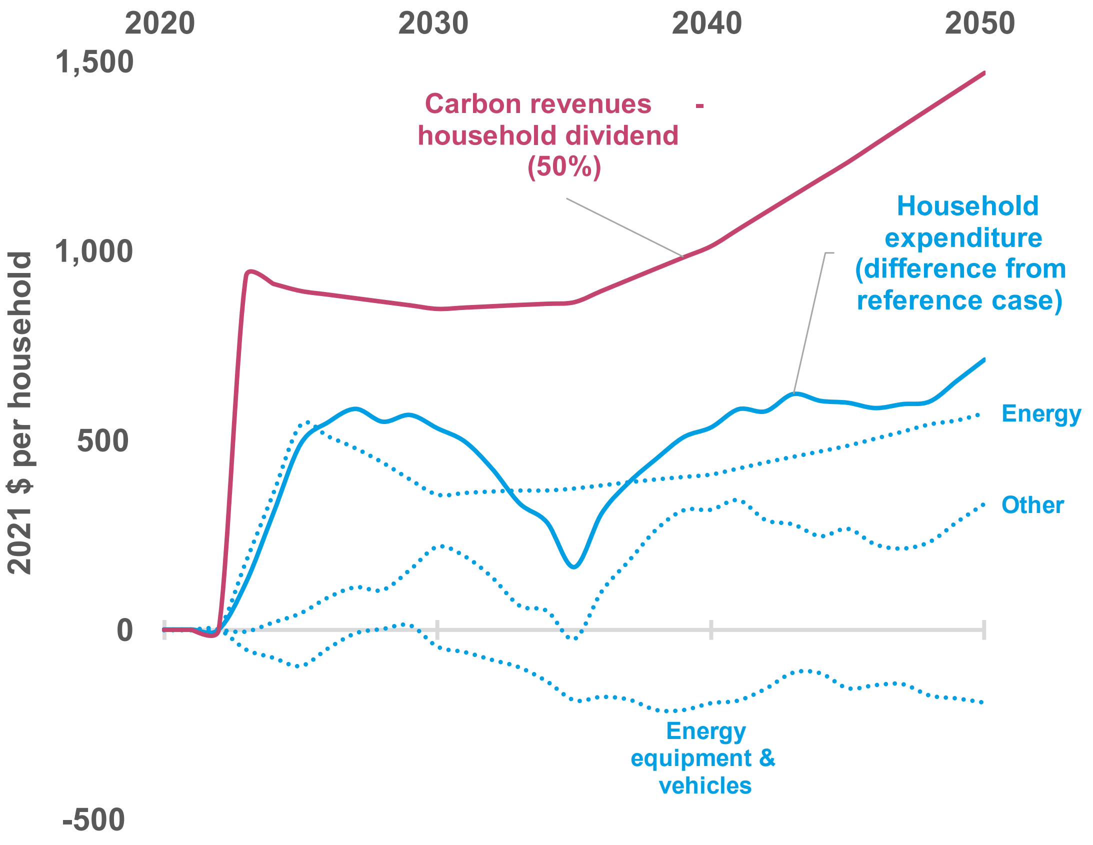
- Introducing a carbon price in the US would have a modest **beneficial impact on GDP**, reaching about $200 billion higher than the reference case annually by 2050 (+1%)
- The GDP impact is mostly driven by the energy **investment** inputs, especially in power generation
- A similarly large impact can be seen from higher **consumer expenditure**, due to the recycled carbon revenues boosting household income
- **Net exports** fall somewhat, due to **higher imports** from the additional consumer demand
- These stimulus effects **outweigh the negative impact of higher energy prices**





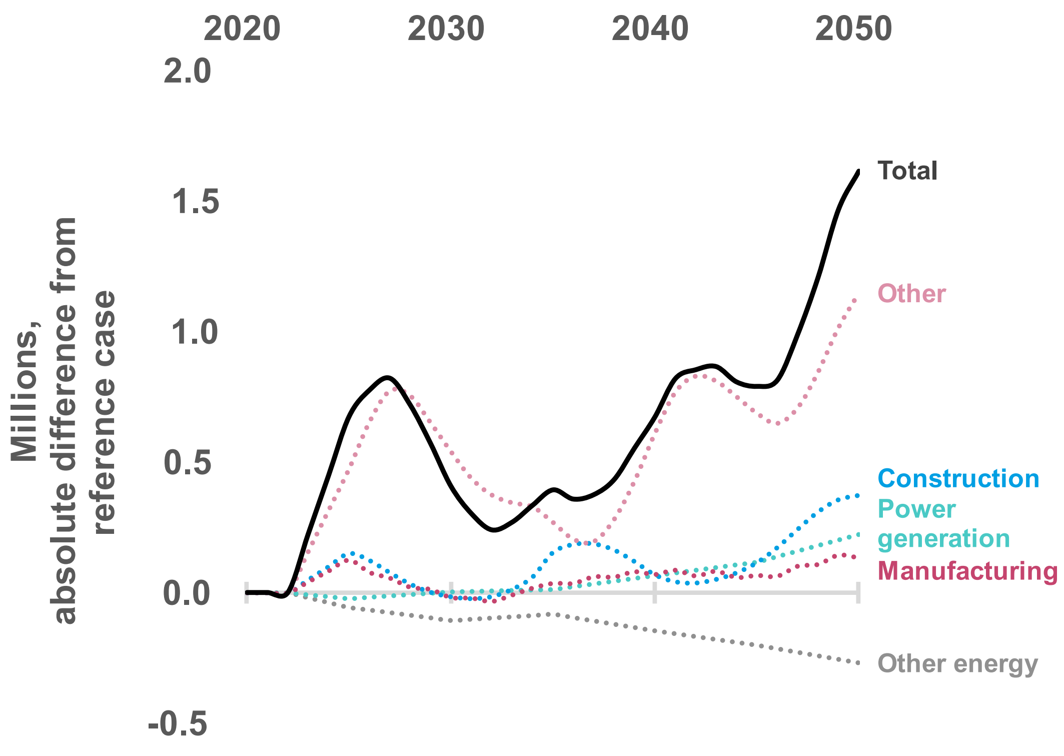
Economic Impact Results – Household expenditure

- The **household dividend** from carbon revenues (50% of total revenues) is larger than the increase in household **energy expenditure**, producing **net savings** for households
- Lower spending on **energy equipment and vehicles** creates **additional savings** for consumers
- **Some of these savings are spent** on other consumer products and services
- Real household **income, expenditures and savings** are therefore **higher than in the reference case**, despite the increase in energy prices



Economic Impact Results – Employment

- **Aggregate employment increases** across the US relative to the reference case by around 1.6m by 2050
- There is a **sectoral shift** from the transition, away from fossil fuel sectors and towards clean energy and other sectors.
  - **Power generation** sees an increase in employment, to meet a large increase in electricity demand
  - **Other energy** sectors see a fall in employment, including coal, oil, and gas
  - **Construction** also sees large employment gains due to higher fixed investment
  - The largest employment gains come from indirect impacts on other **manufacturing** and **services** sectors, in response to higher economic demand more generally



Note: "Other" includes employment in farming, forestry, and services sectors.

Sensitivity case – Use of carbon revenues

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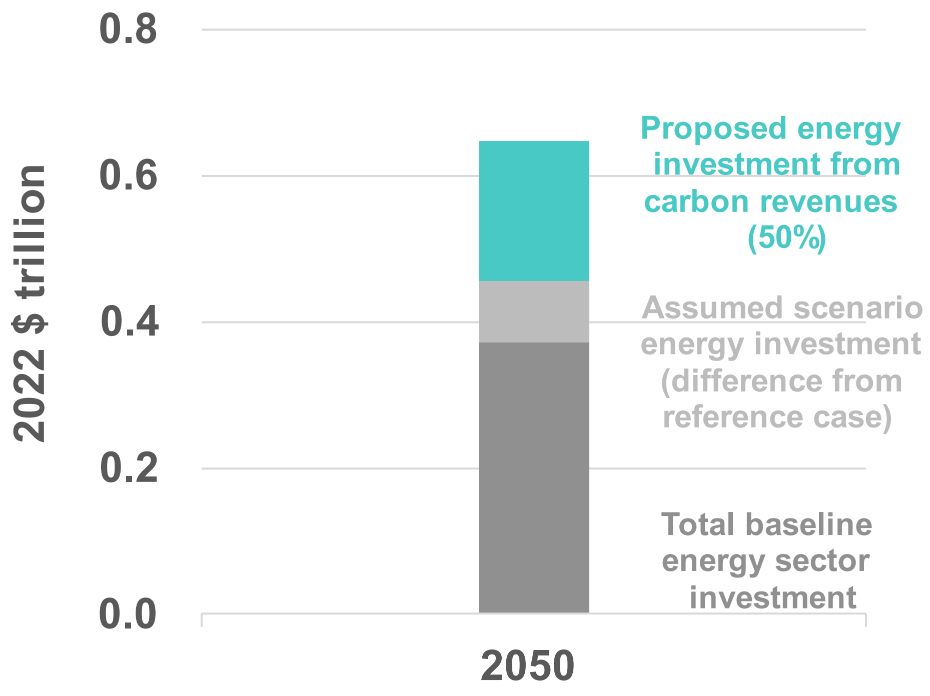
Sensitivity case – Use of carbon revenues

- **Core scenario** policy framework (50% of revenues to energy investment/R&D) may represent a **rigid and unrealistic approach**, given a scenario with $200bn+ annual revenues to spend

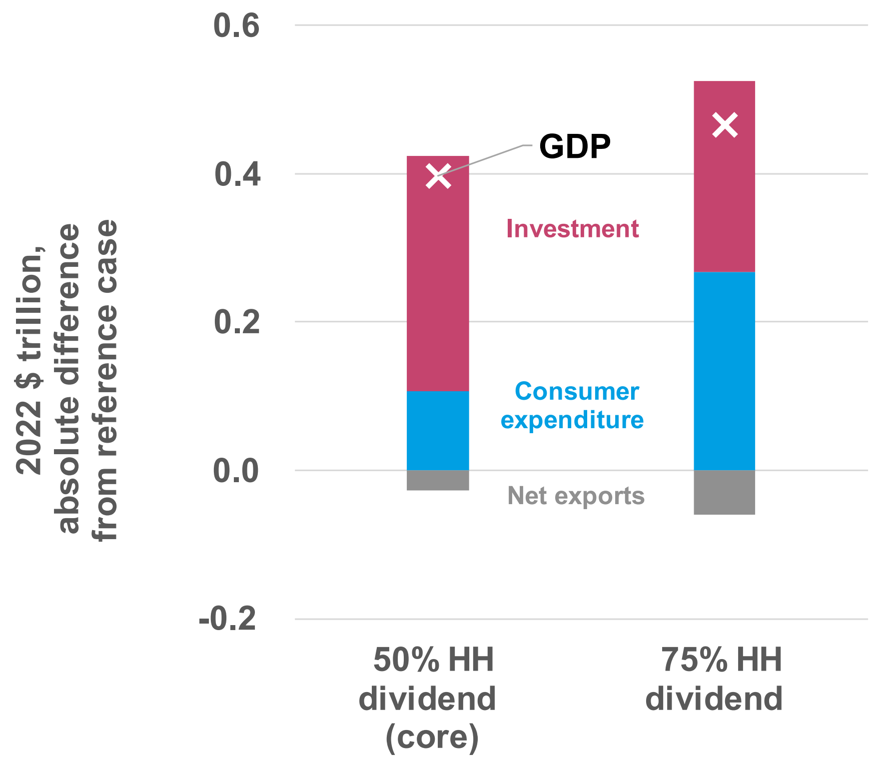
- Such a large additional investment would have a significant **impact on energy system**, which we do not capture



Sensitivity case – Use of carbon revenues

- **Splitting revenues 75:25** between households and energy investment may be a more realistic approach, with greater capacity of households to absorb funds

- This adjustment would alter the pattern of GDP impacts
  - **Larger GDP impacts** overall
  - Larger relative contribution of **consumer expenditure**



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