

Meeting Saudi Arabia's Carbon Mitigation Goals: Some Preliminary Findings

David Wogan

The Strategic Policy Challenge



- Paris Accord took a decentralised approach to drive global collective action
- But the sum of nationally determined contributions to date is insufficient to meet currently agreed global goals
- A more practical policy approach is needed to help close the gap

Practical Climate Change Policies Research Project

- KAPSARC and IEEJ are undertaking a joint research project to examine more practical approaches to climate change policy
- Key elements of the project include:
 - Developing efficient global pathways that incorporate mitigation and adaptation
 - Examining nationally optimal approaches that reflect local starting points and how they might be influenced by stakeholder interests



Project Methodology

Step 1

- Calculate efficient global pathways for meeting agreed global emission outcomes/targets

Step 2

- Establish “emissions envelopes” at the country (or regional) level

Step 3

- Identify and evaluate potential country-specific policies and assess impacts

Step 4

- Explore how stakeholder interests may influence the choice of policies and their implementation at a country-level

KAPSARC's Saudi Arabian Carbon Mitigation Research Project

- **Objective**

- To identify economically optimal policies and pathways to meet Saudi Arabia's NDC and assess their impacts; and
- Explore how internal stakeholder interests may influence the choice of policies and their implementation

- **Study methodology**

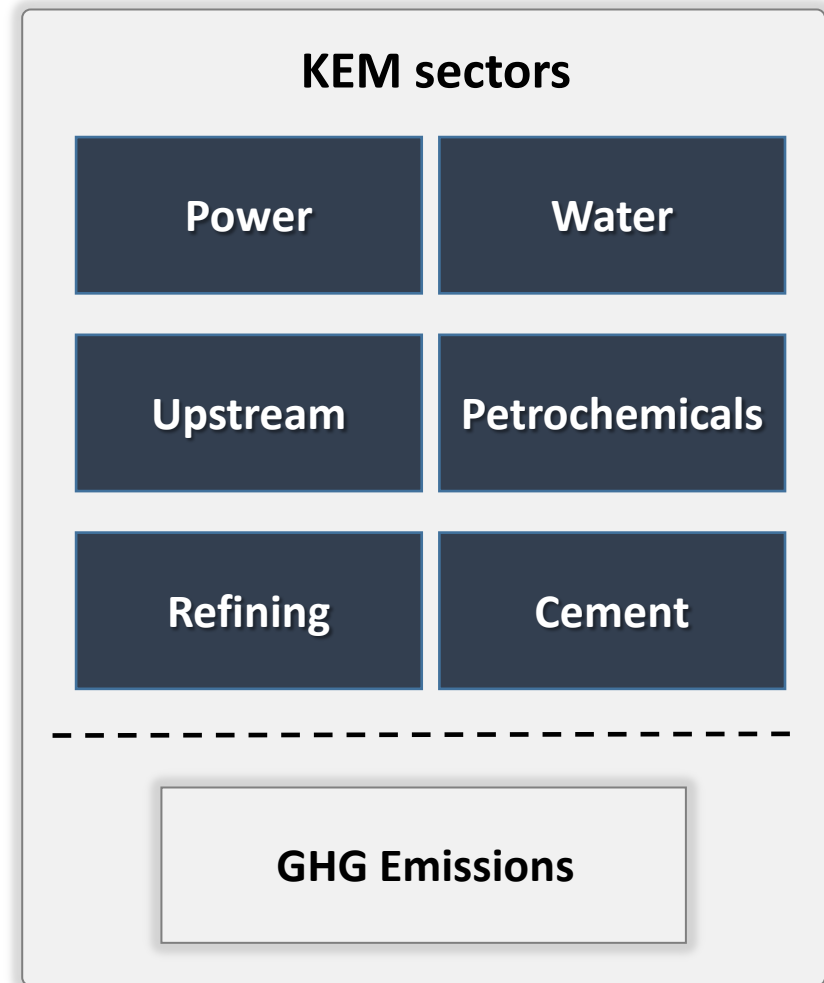
- Quantitatively assess least cost pathways for Saudi Arabia to achieve its NDC under the Paris Accord

- **Policy options**

- Carbon pricing
- Capital subsidies
- Industrial input fuel price deregulation

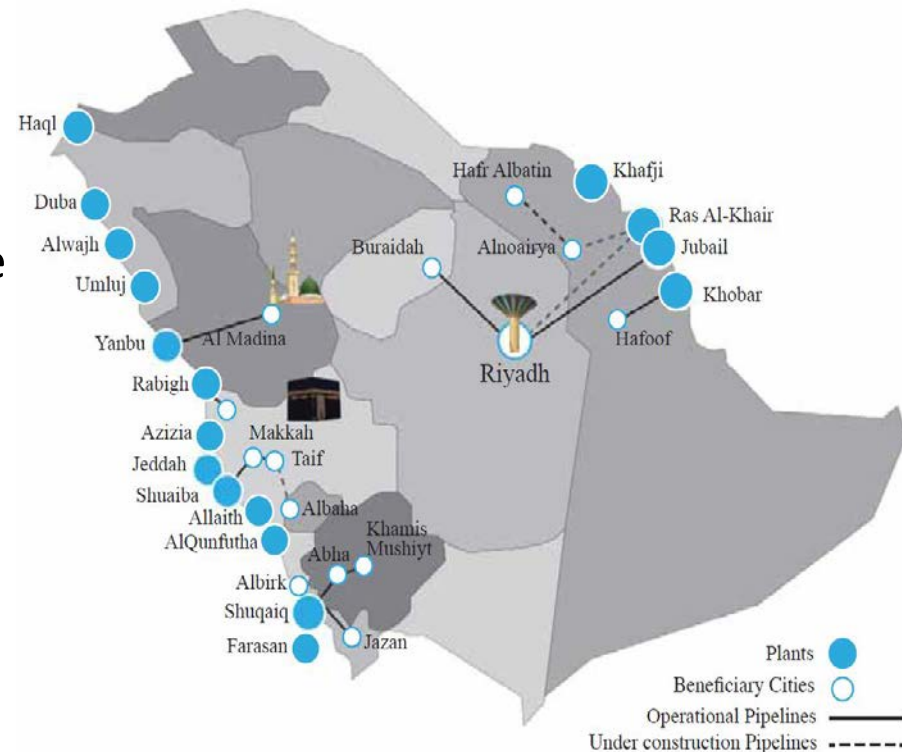
Analytical Framework

- Analysis uses the **KAPSARC Energy Model of Saudi Arabia (KEM)**
- Partial-equilibrium model for six integrated industrial sectors
- KEM seeks to minimize costs associated with meeting demand from these sectors
- Analysis focuses on the power and water sectors (including interaction of other sectors)



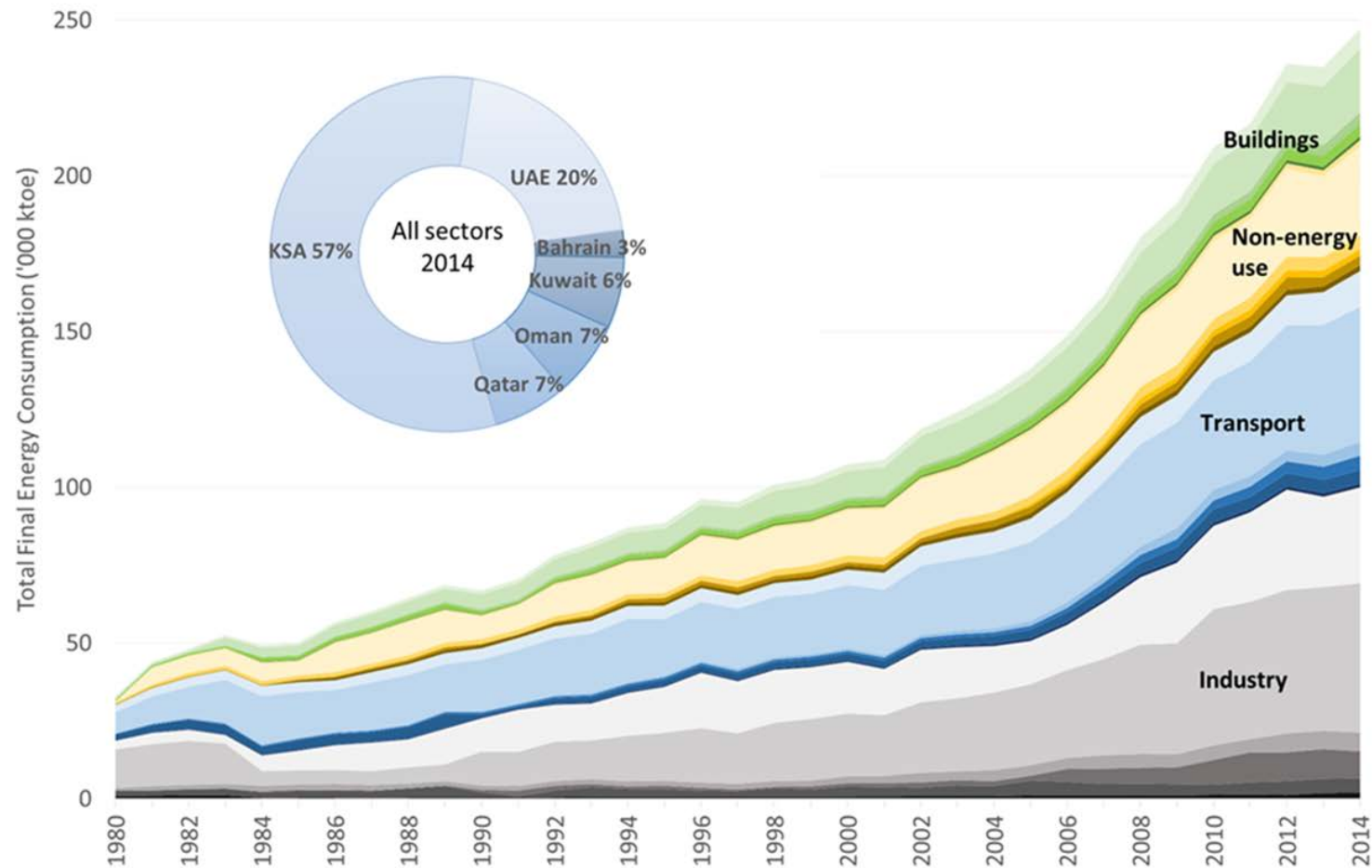
Saudi Arabian Energy Sector Overview

- Primary energy supply: 213.51 Mtoe
- Oil production: 552.9 Mtoe
- Petroleum exports: 429.65 Mtoe
- Final energy consumption: 141.69 Mtoe
 - Electricity: 290.66 TWh
 - Electricity sector operation and development is greatly influenced by the water sector (desalination)
- Population: ~ 31 million (2015)
- Carbon emissions: 506.59 MT CO₂e



Source: IEA 2016

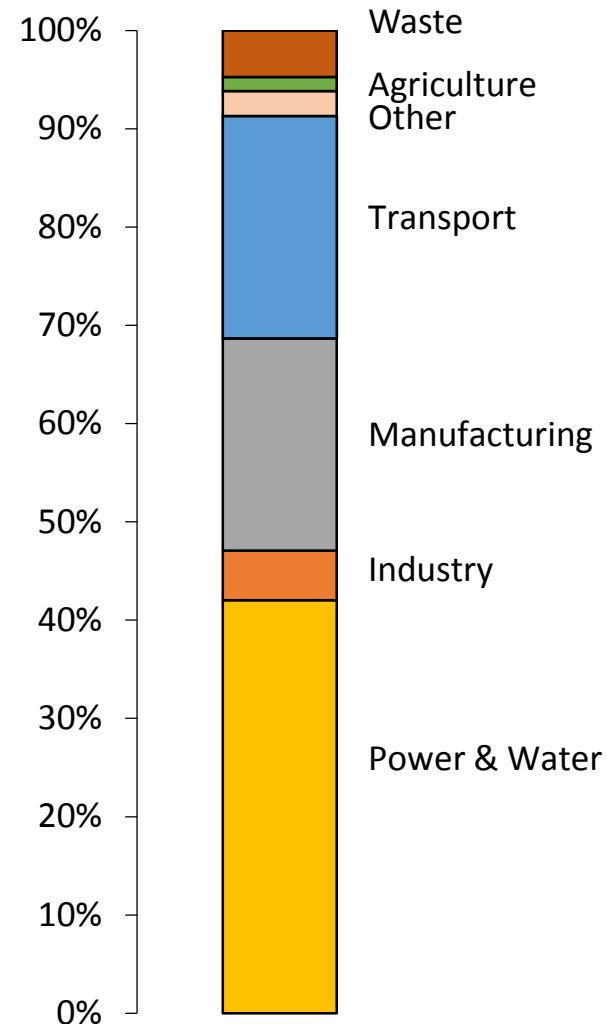
Saudi Arabia Drives Regional Energy & Carbon Emissions Growth



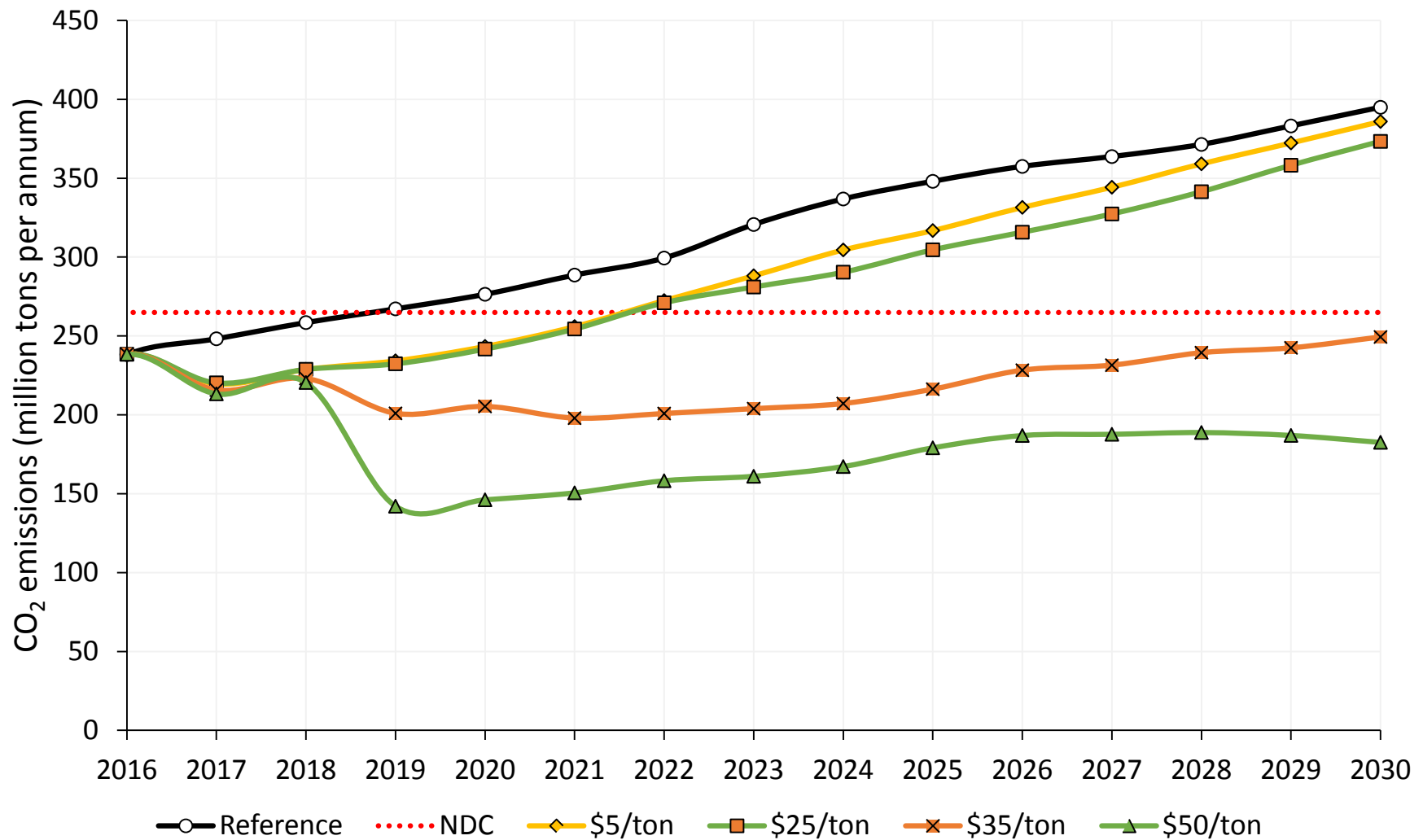
Saudi Arabia's Carbon Mitigation Goals

- Nationally Determined Contribution target of 130 million metric tons of CO₂ equivalent by 2030
- Greenhouse gas reductions viewed as co-benefits of economic diversification activities
- Mitigation measures include:
 - energy efficiency
 - renewable energy
 - carbon capture & utilization/storage
 - increased use of natural gas
 - methane recovery

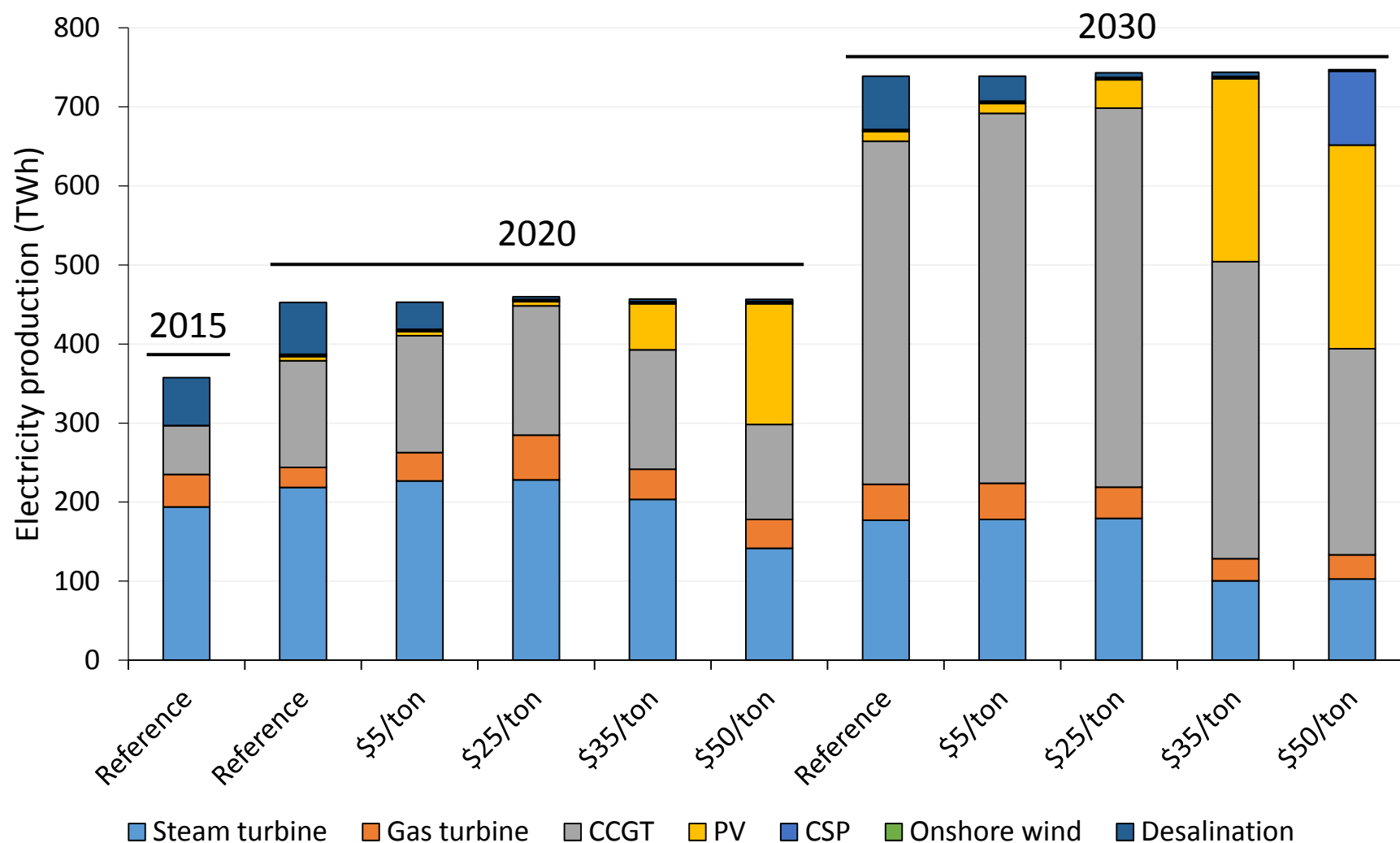
Carbon Emissions by Sector (2015)



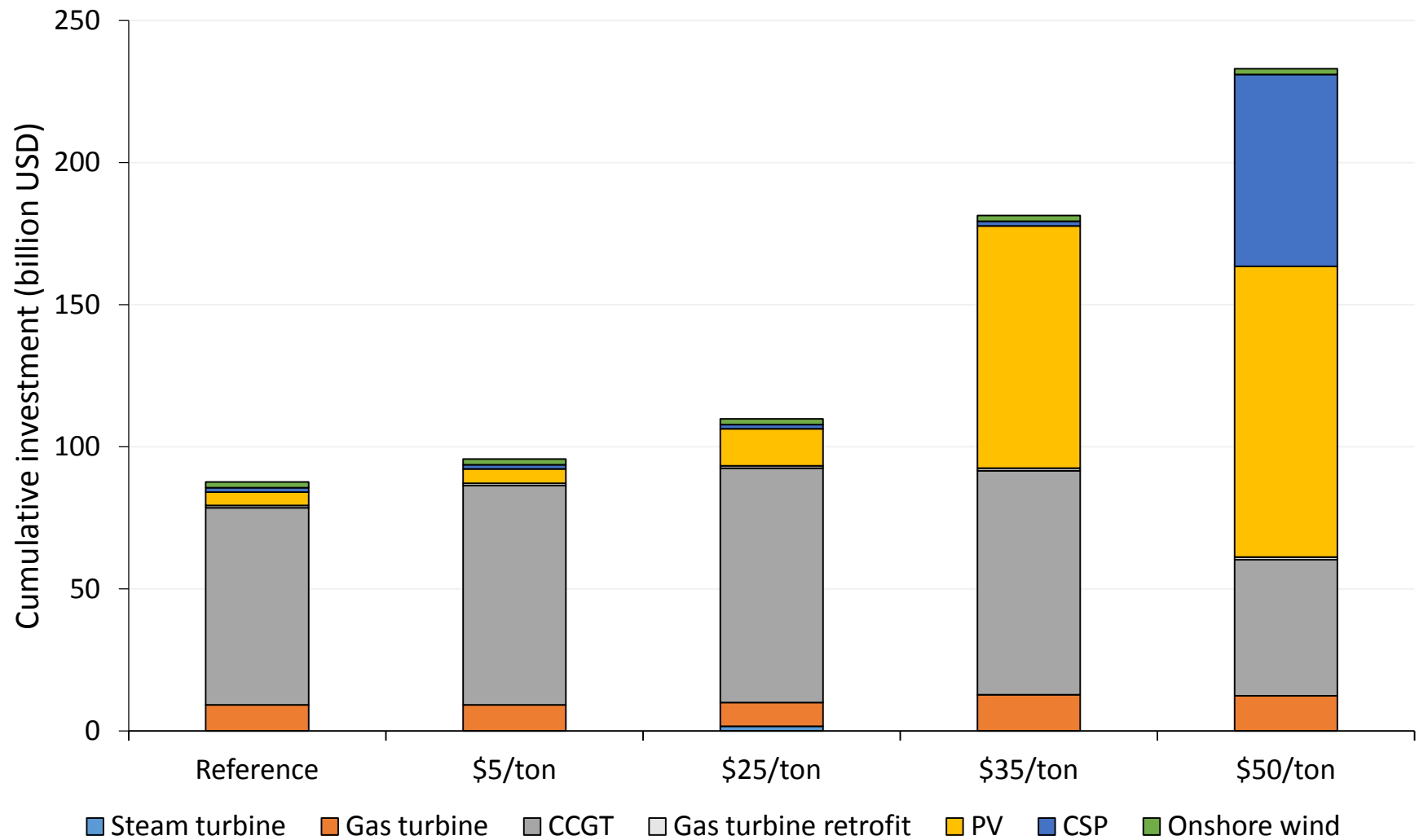
Carbon Pricing: Carbon Emissions



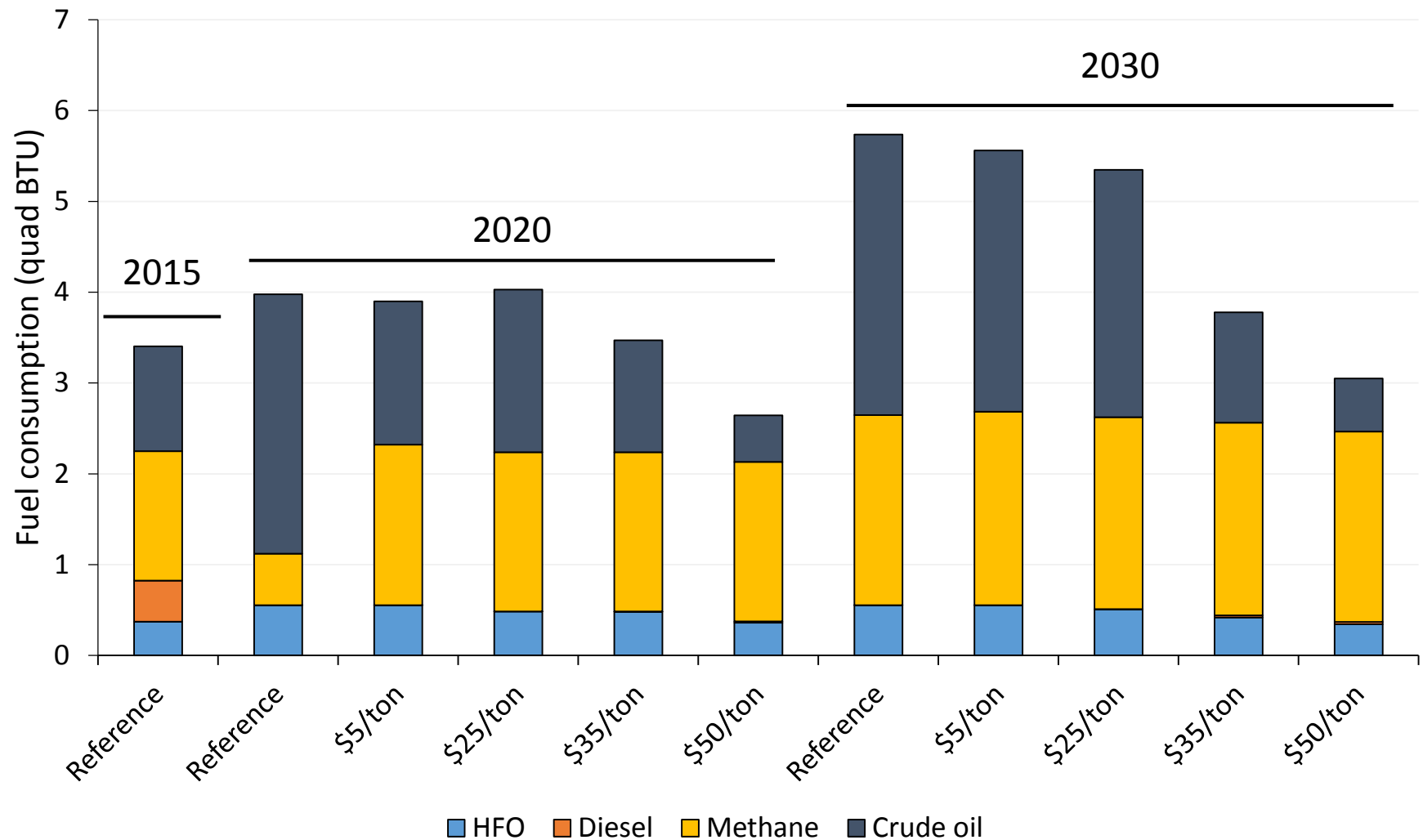
Carbon Pricing: Electricity Production



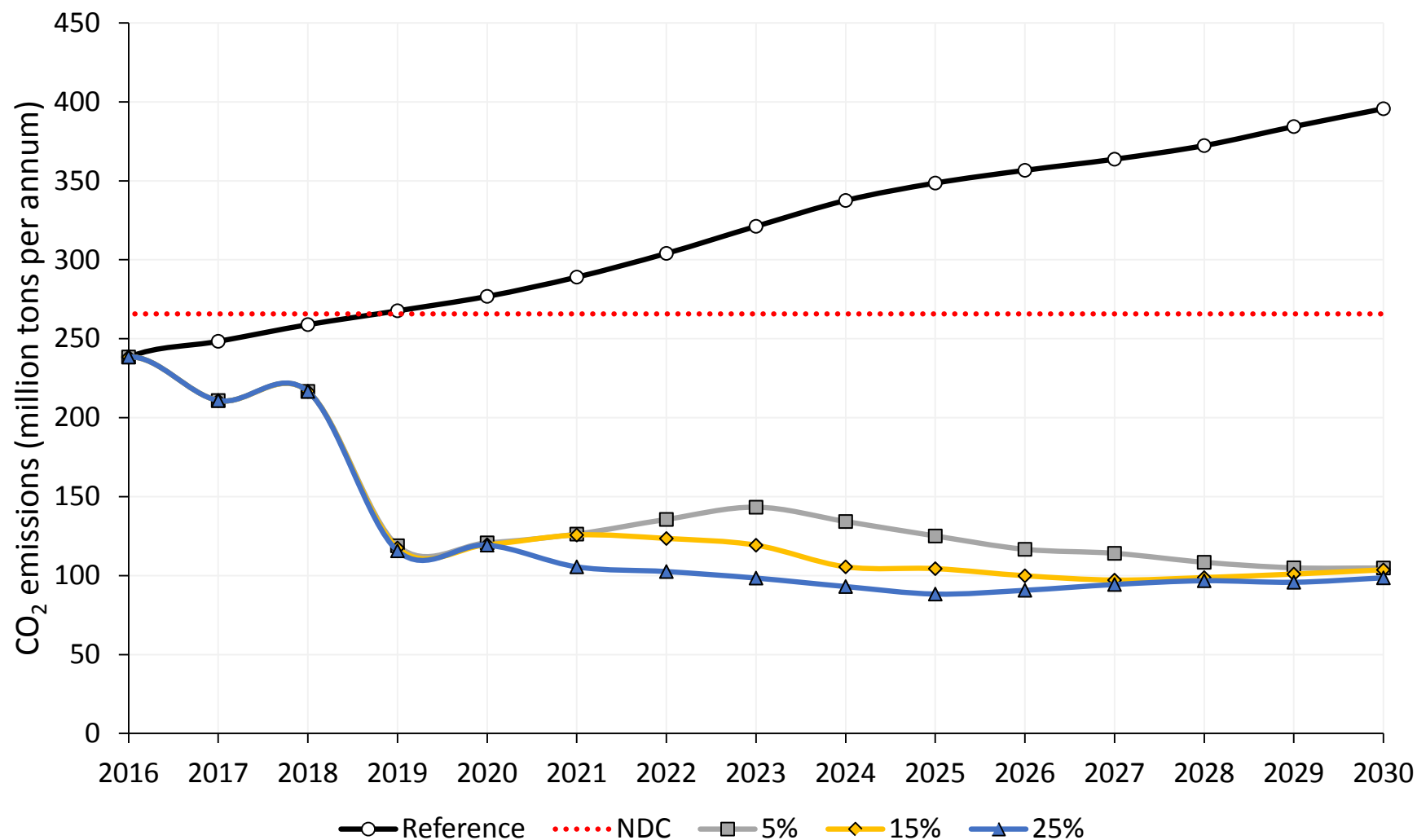
Carbon Pricing: Capital Investment



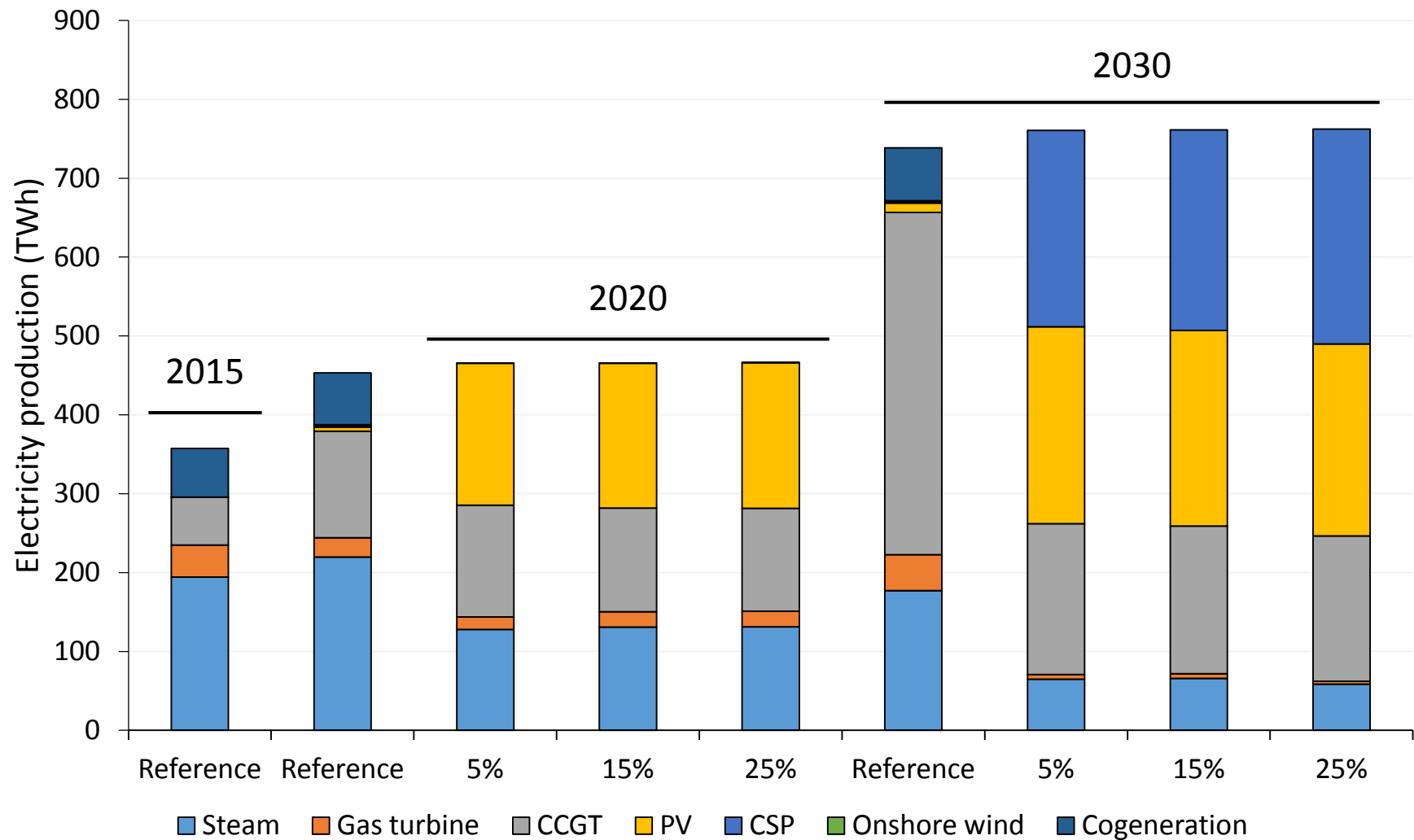
Carbon Pricing: Fuel Mix



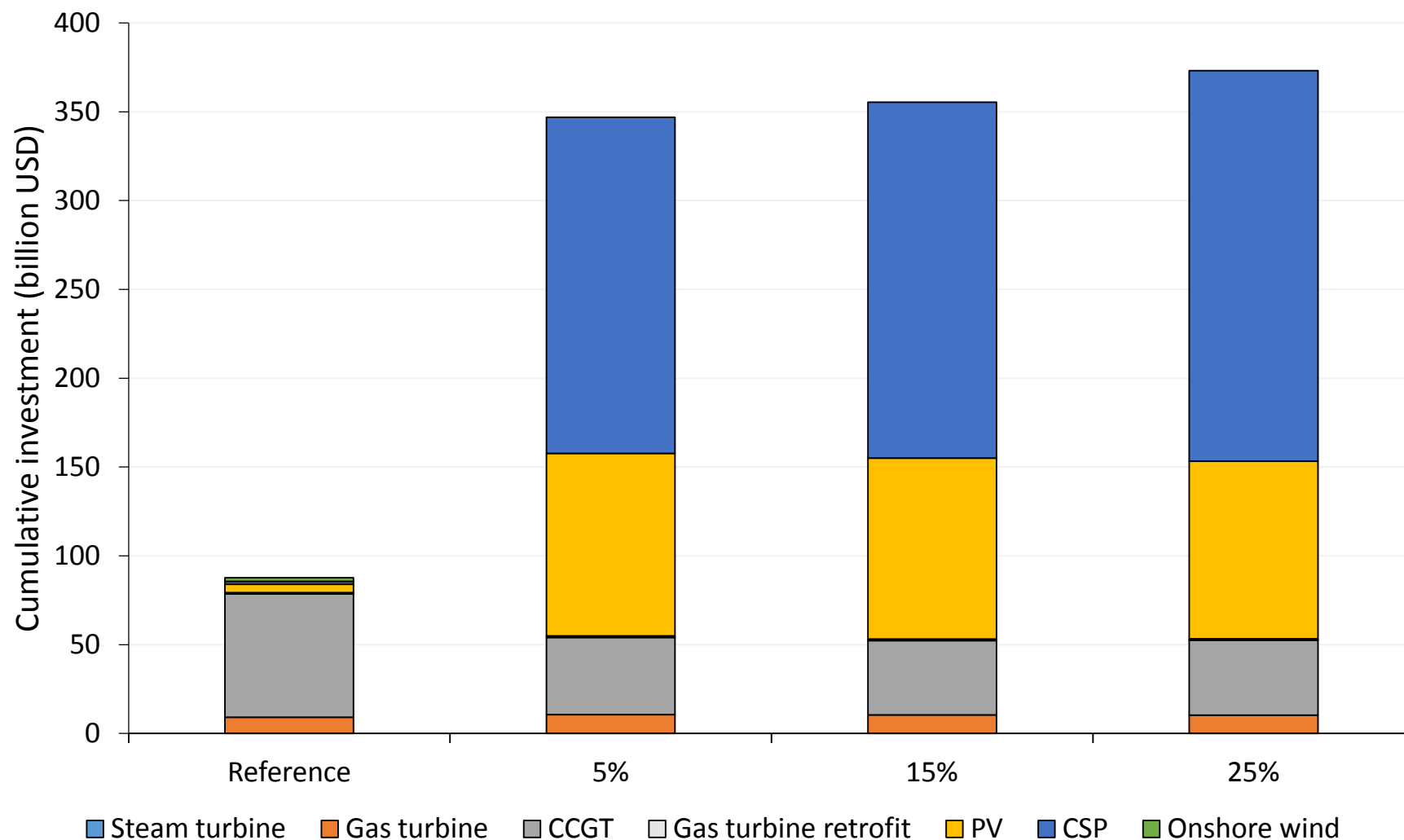
Capital Subsidies: Carbon Emissions



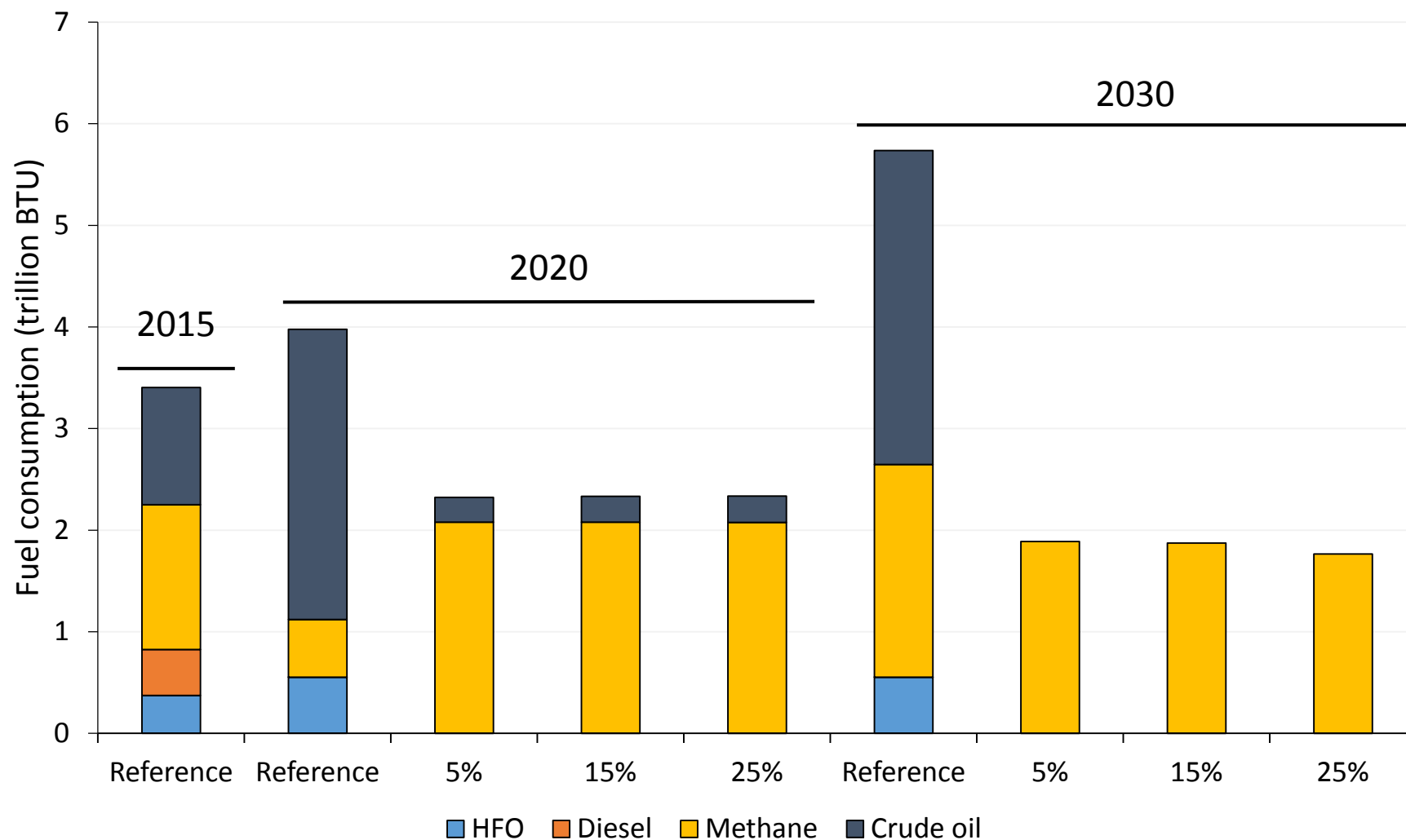
Capital Subsidies: Electricity Production



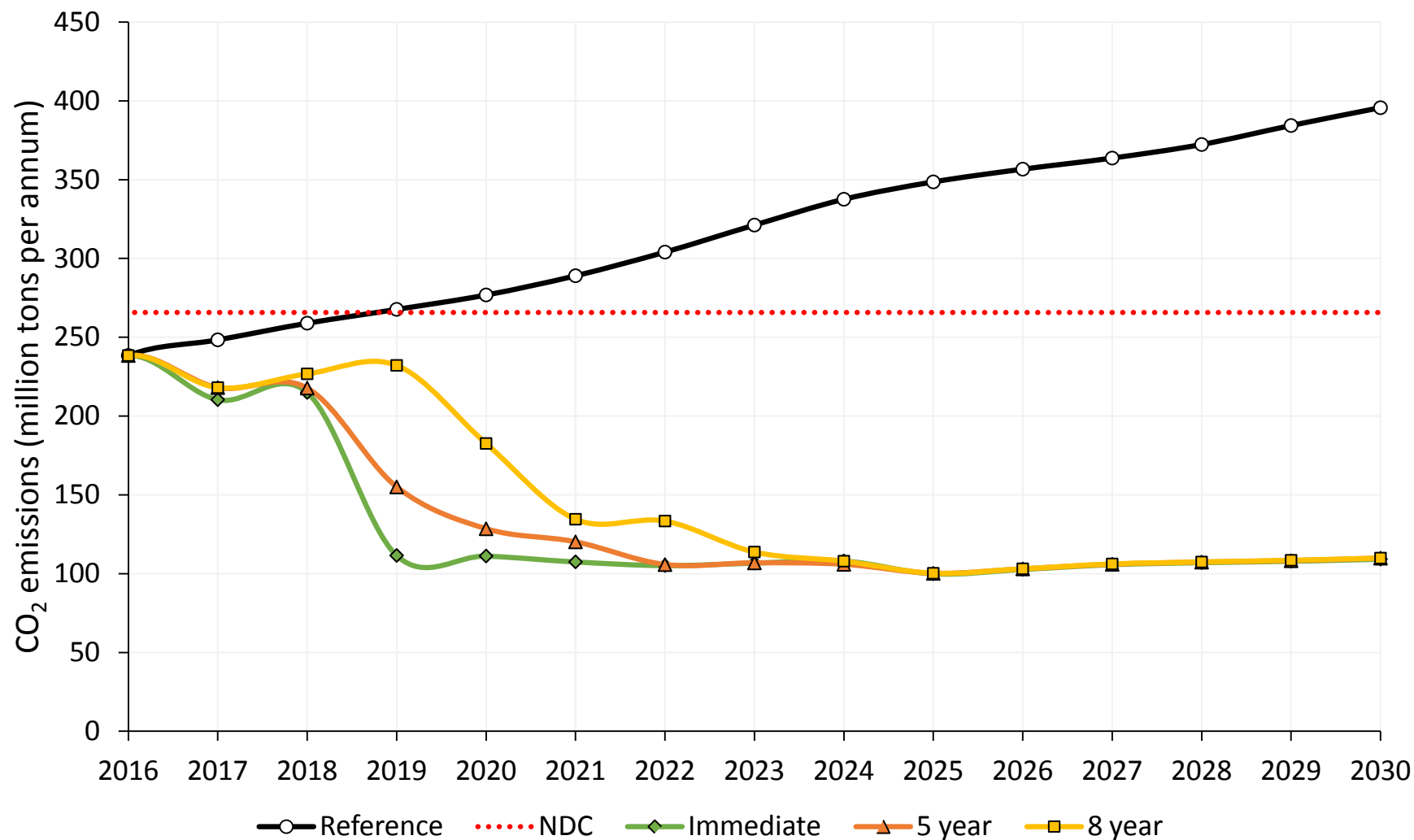
Capital Subsidies: Capital Investment



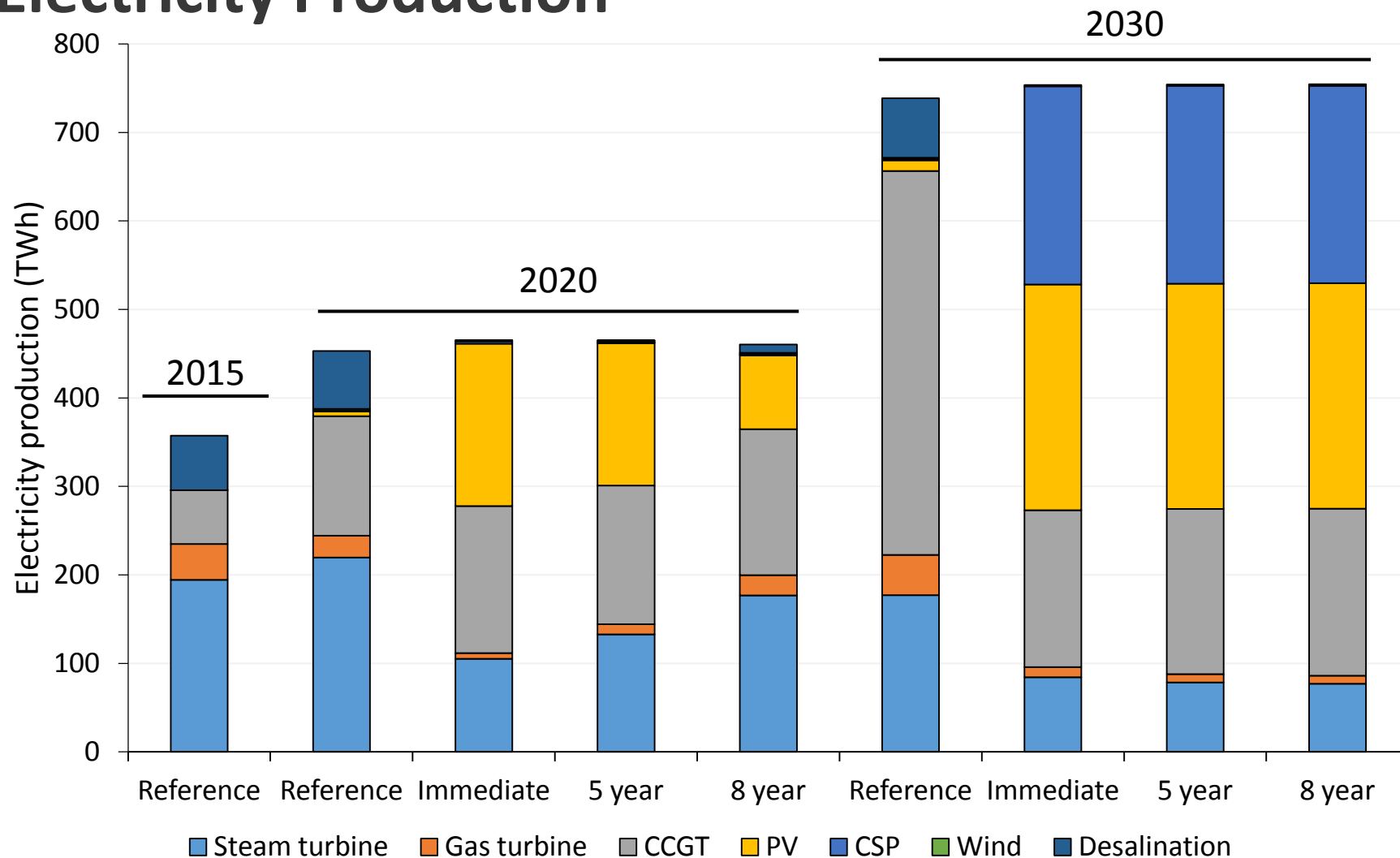
Capital Subsidies: Fuel Mix



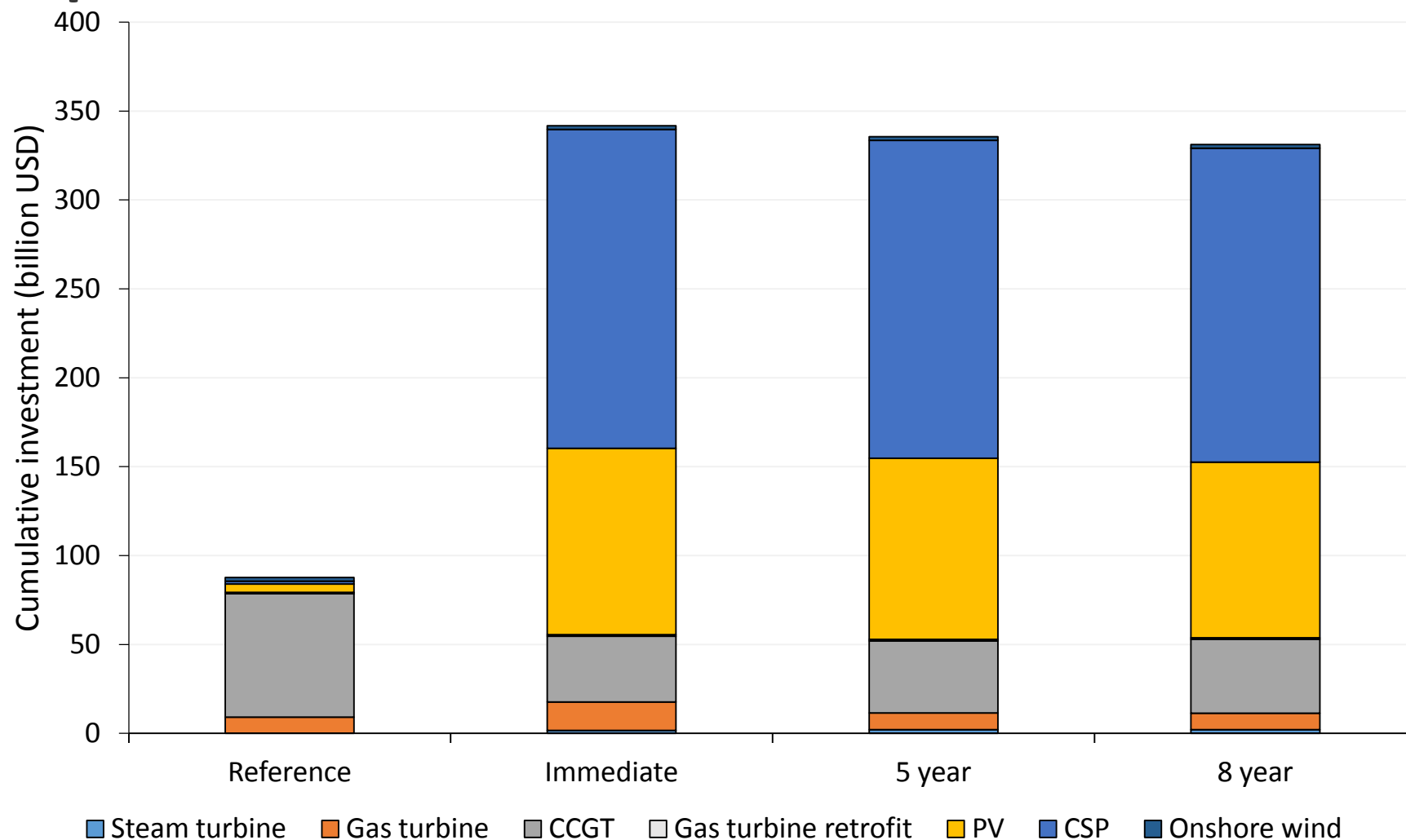
Industrial Input Fuel Price Reform: Carbon Emissions



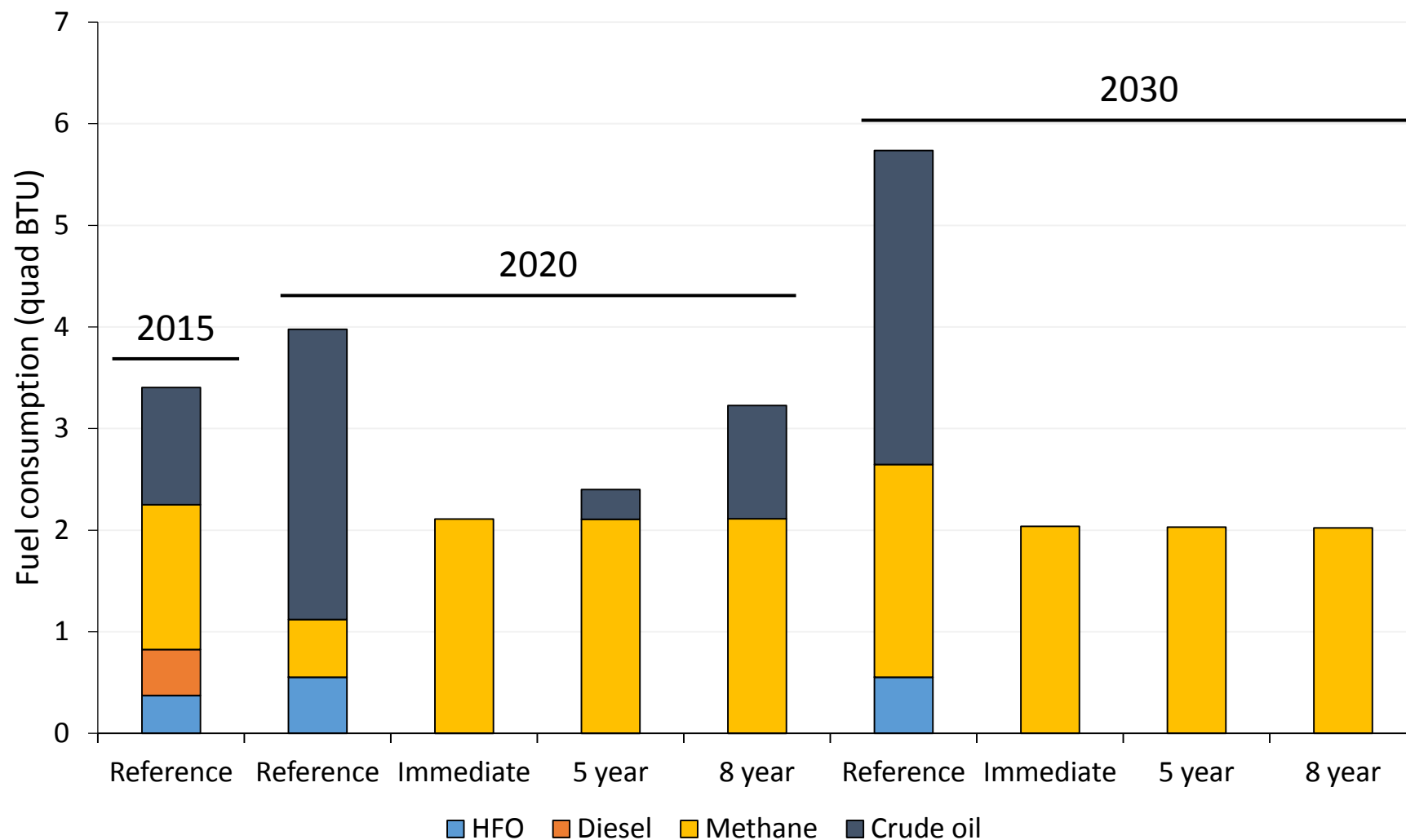
Industrial Input Fuel Price Reform: Electricity Production



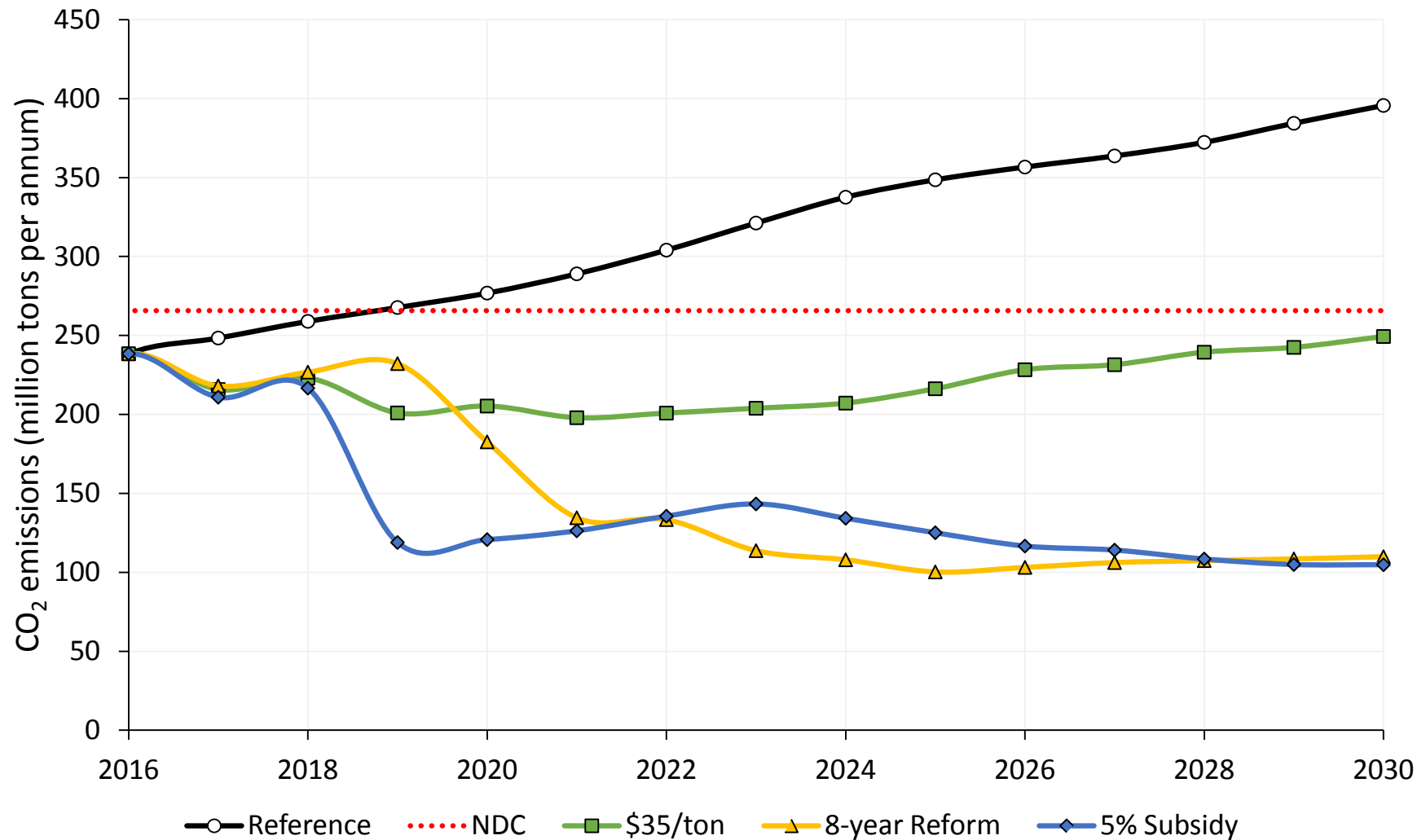
Industrial Input Fuel Price Reform: Capital Investment



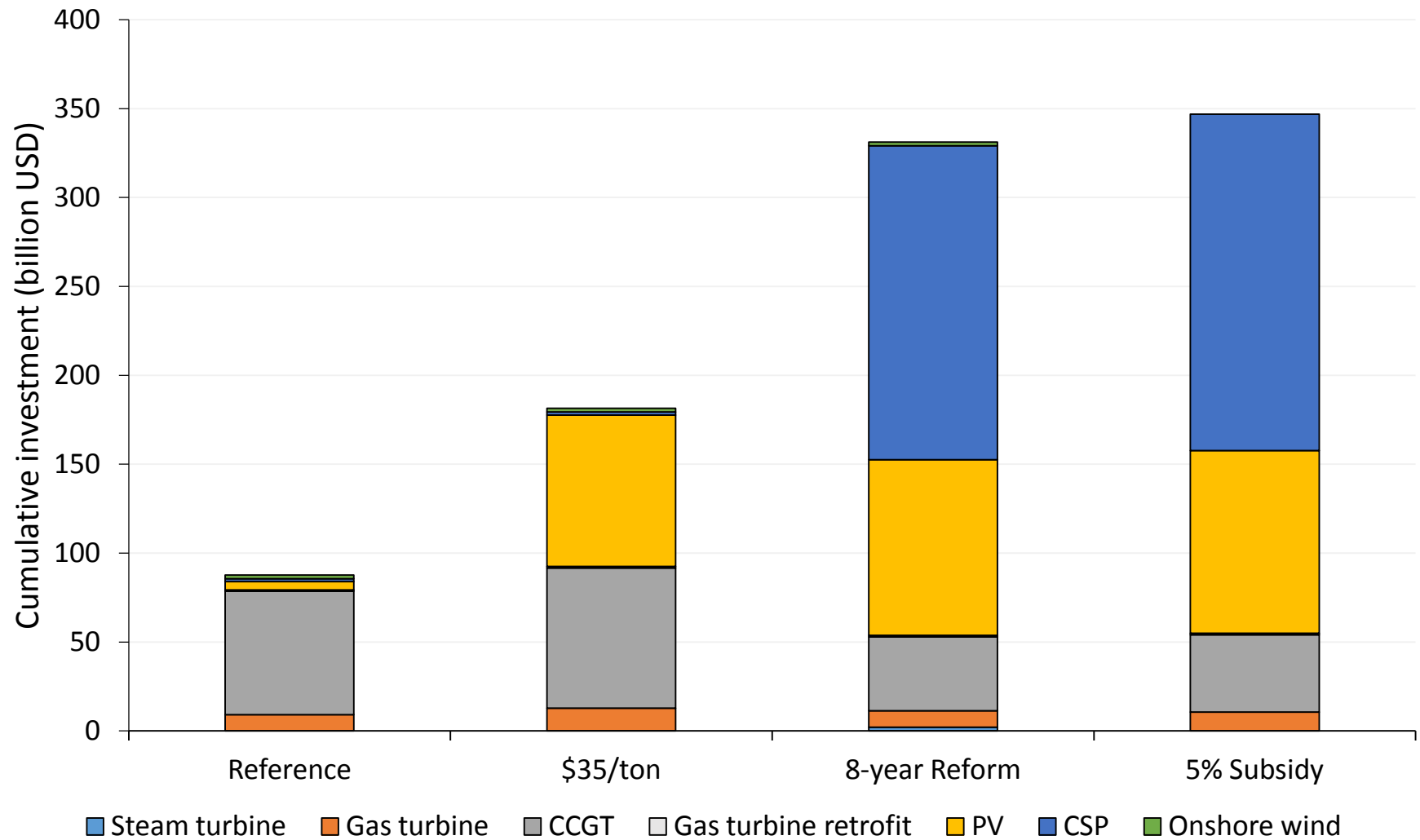
Industrial Input Fuel Price Reform: Fuel Mix



Some Preliminary Comparative Results



Some Preliminary Comparative Results



Summary of Preliminary Analysis

- A country-specific approach accounts for the characteristics of Saudi Arabia's industrial sectors and its role as a major energy producer and consumer
- Direct and indirect CO₂ mitigation policies can drive significant emissions reductions
- The effectiveness of each policy can be measured by many metrics
 - CO₂ emissions
 - Transition periods
 - Investment costs
 - Broader economic goals
 - Unintended consequences

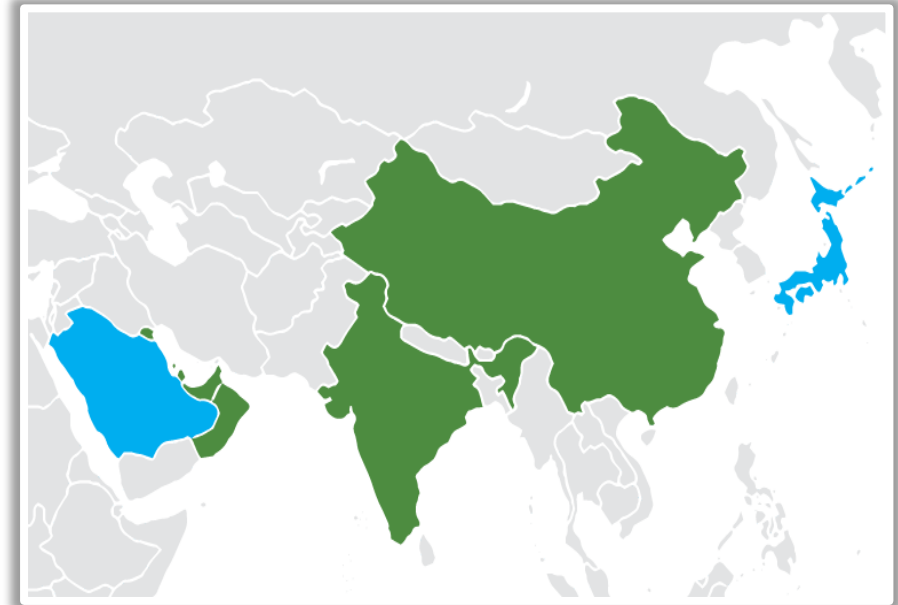
Anticipated 2017 Milestones

Research:

- Incorporate bargaining & macroeconomic analysis
- Expand study framework to examine China, India and the Gulf Cooperation Council states

Publications:

- Potential practical carbon policy options & pathways for Saudi Arabia
- Potential practical carbon policy options & pathways for Japan
- Optimal global emission pathways including mitigation & adaptation



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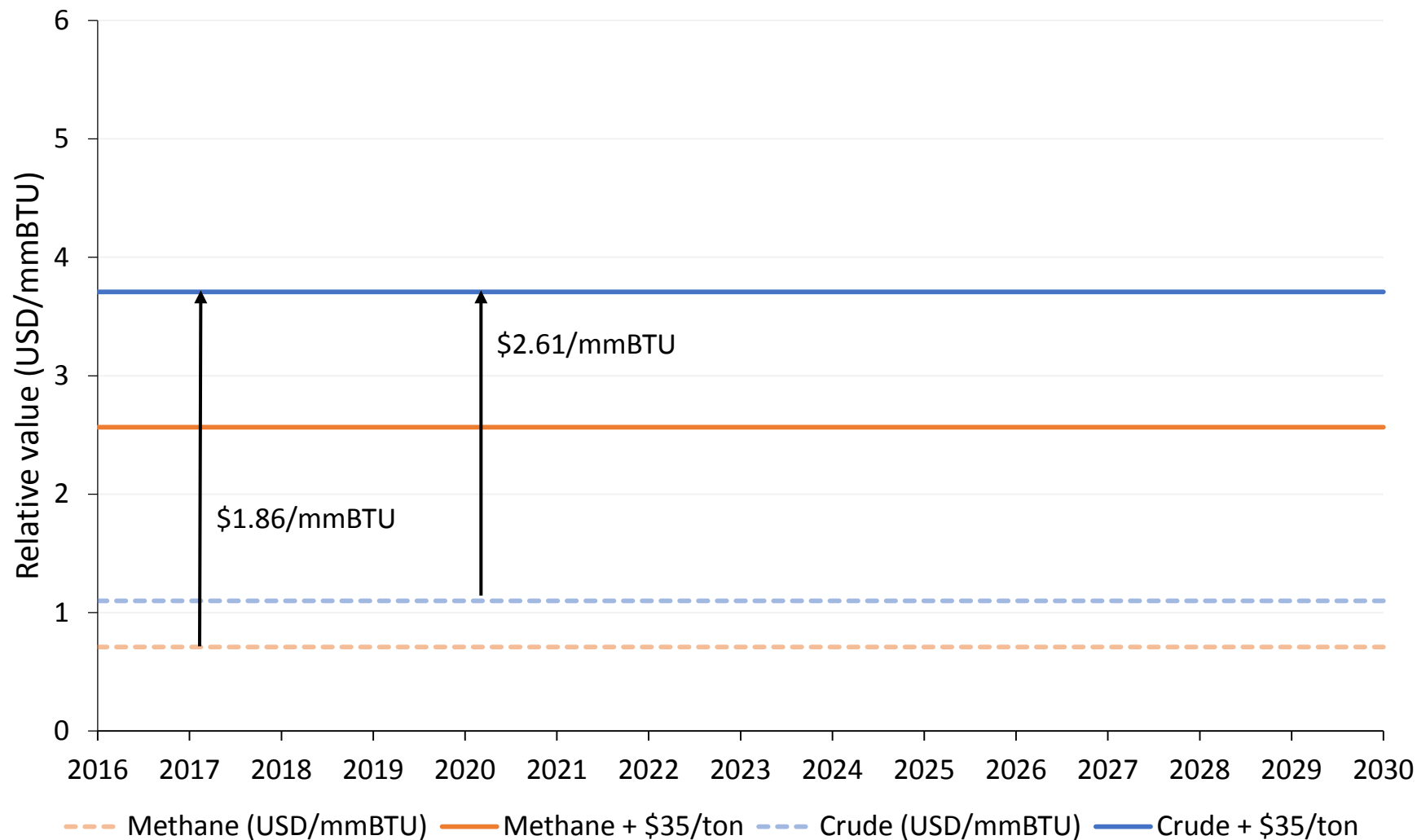
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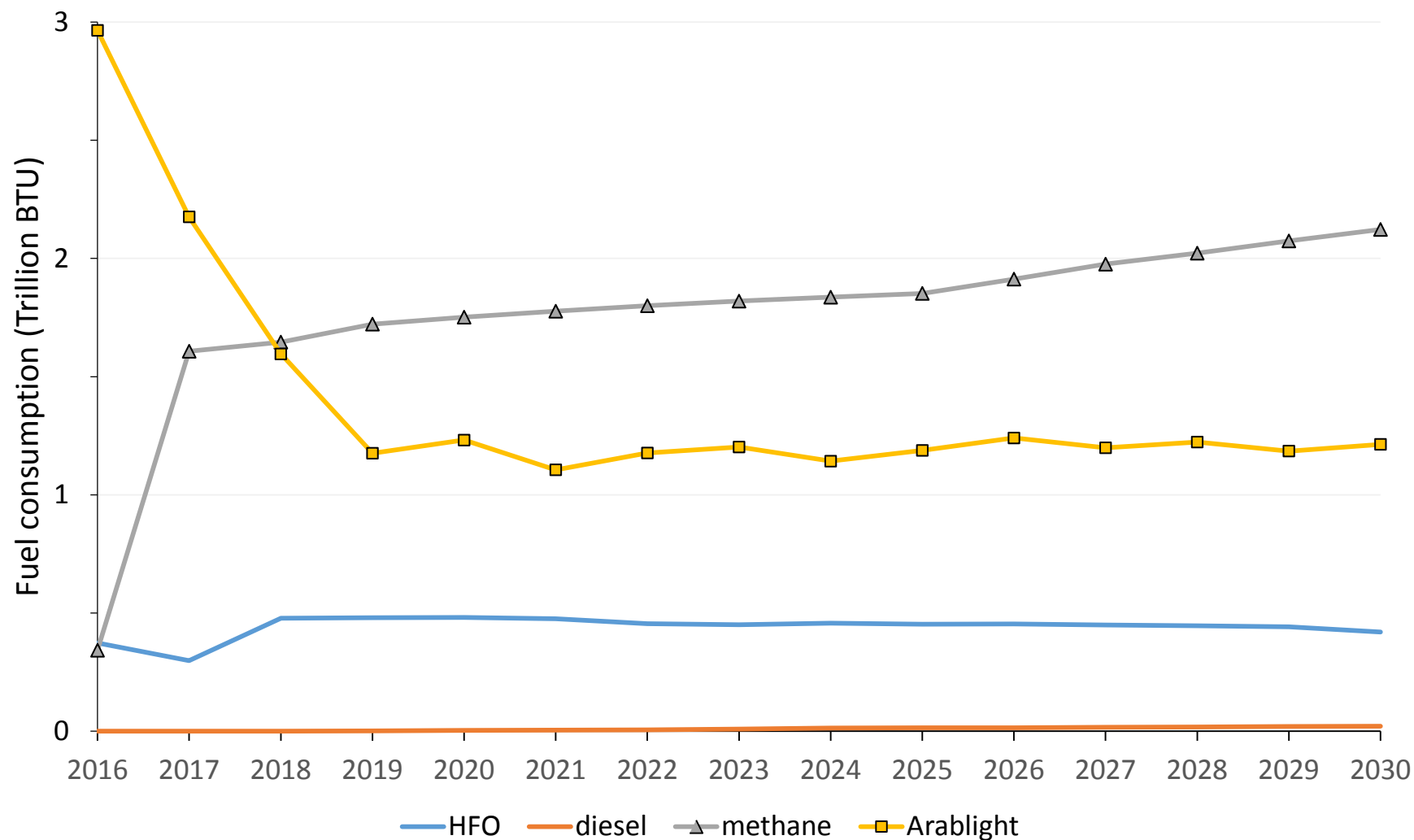
Supporting Material

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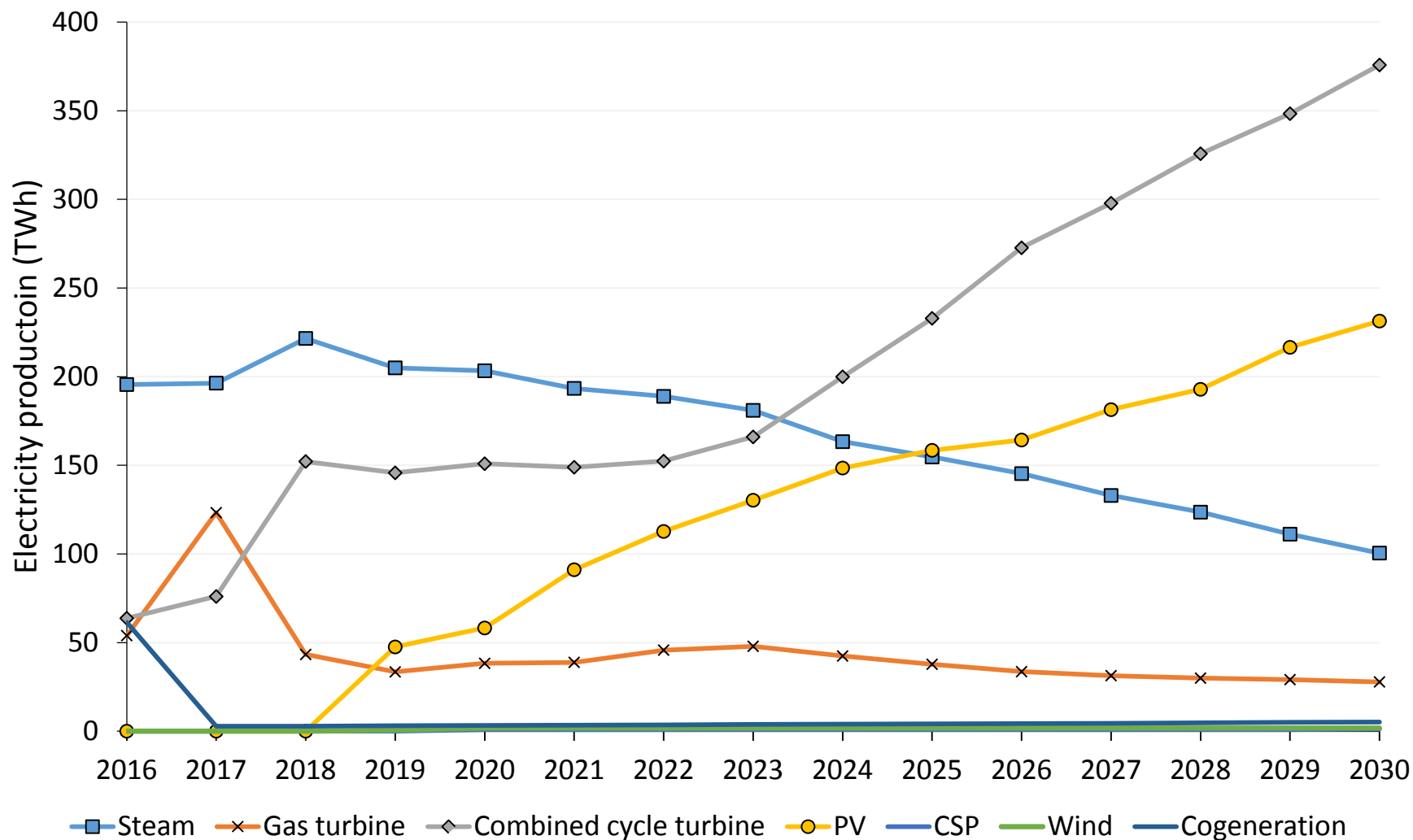
Carbon price (\$35/ton): relative cost of fuel



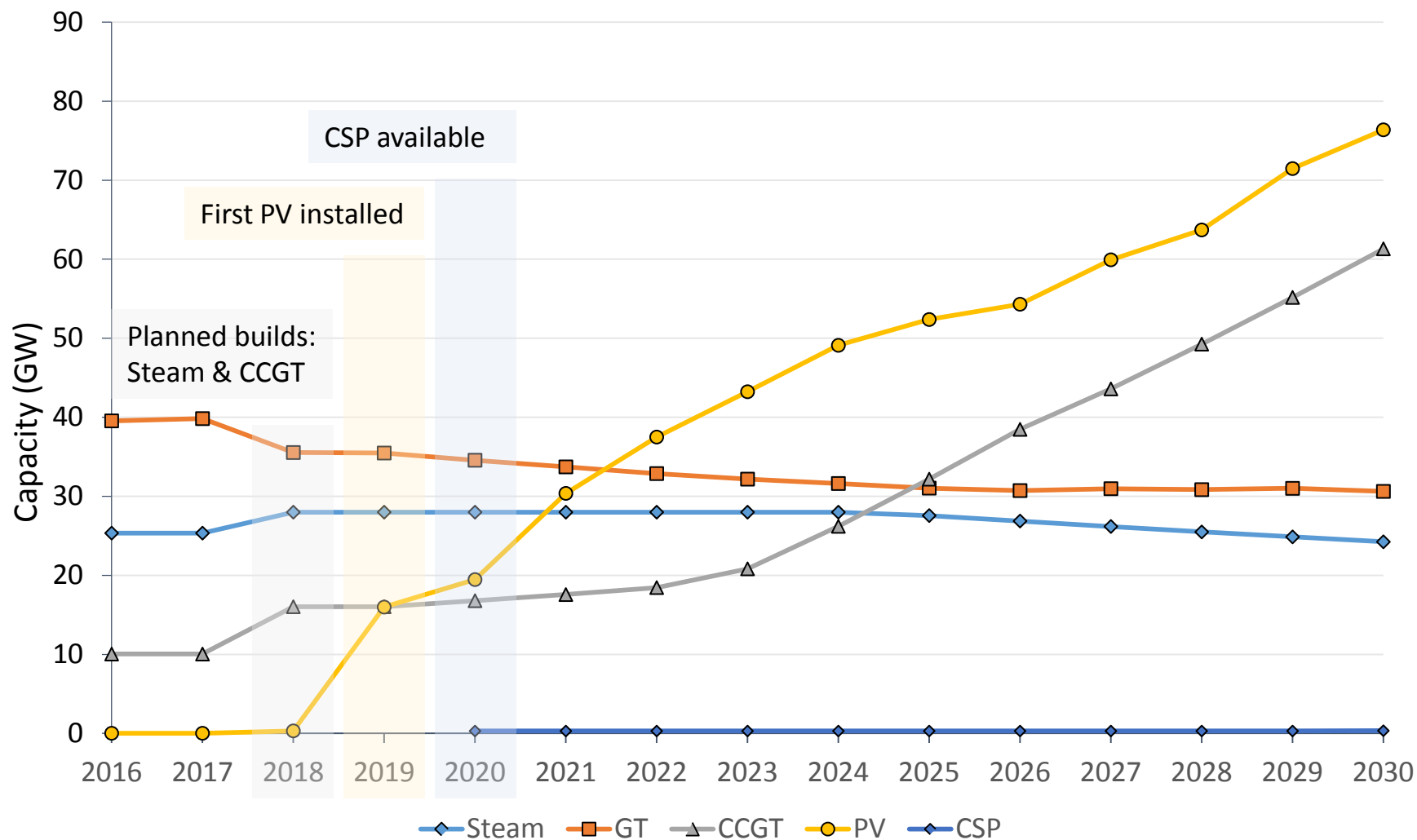
Carbon price (\$35/ton): fuel consumption



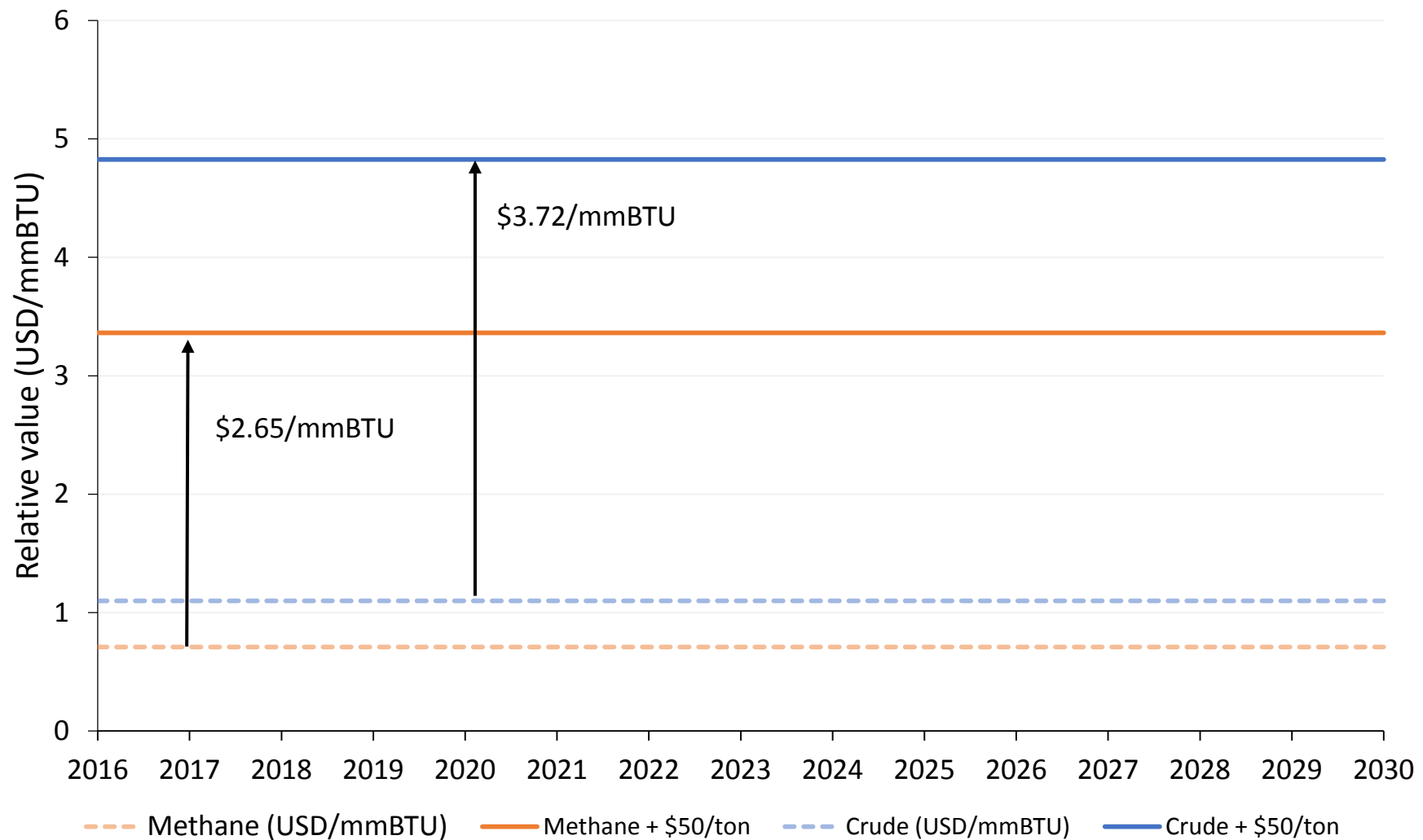
Carbon price (\$35/ton): electricity supply



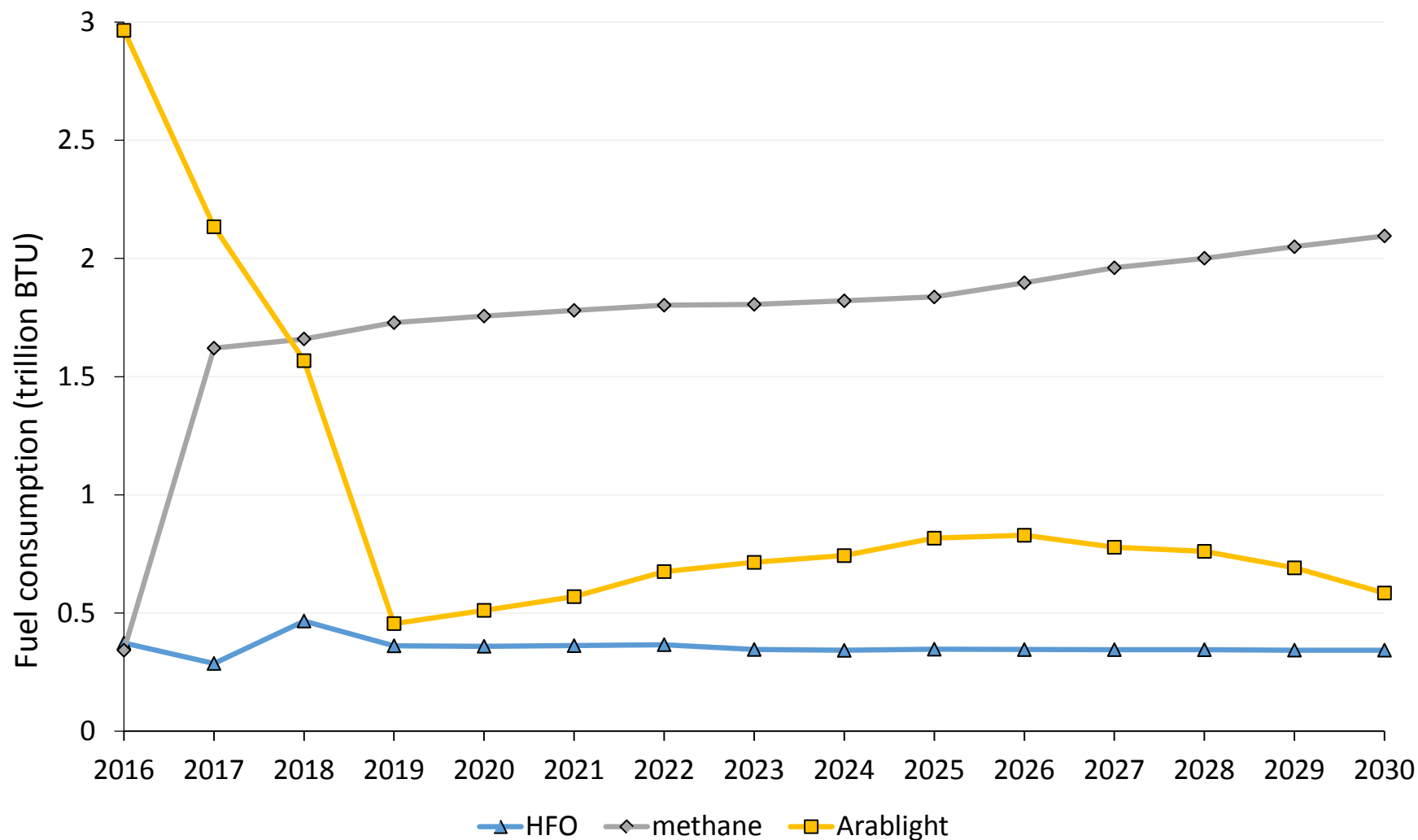
Carbon price (\$35/ton): capacity



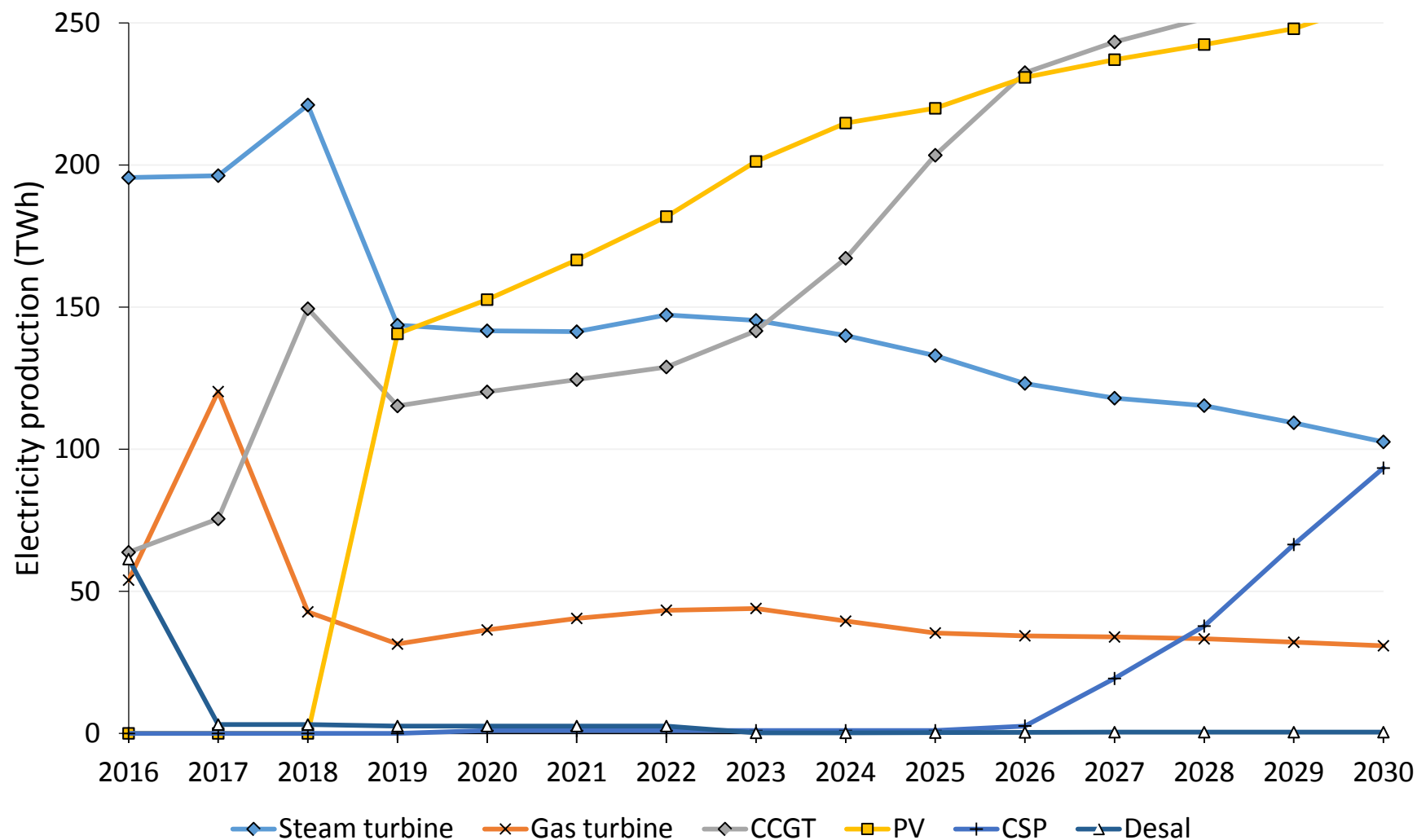
Carbon price (\$50/ton): relative cost of fuel



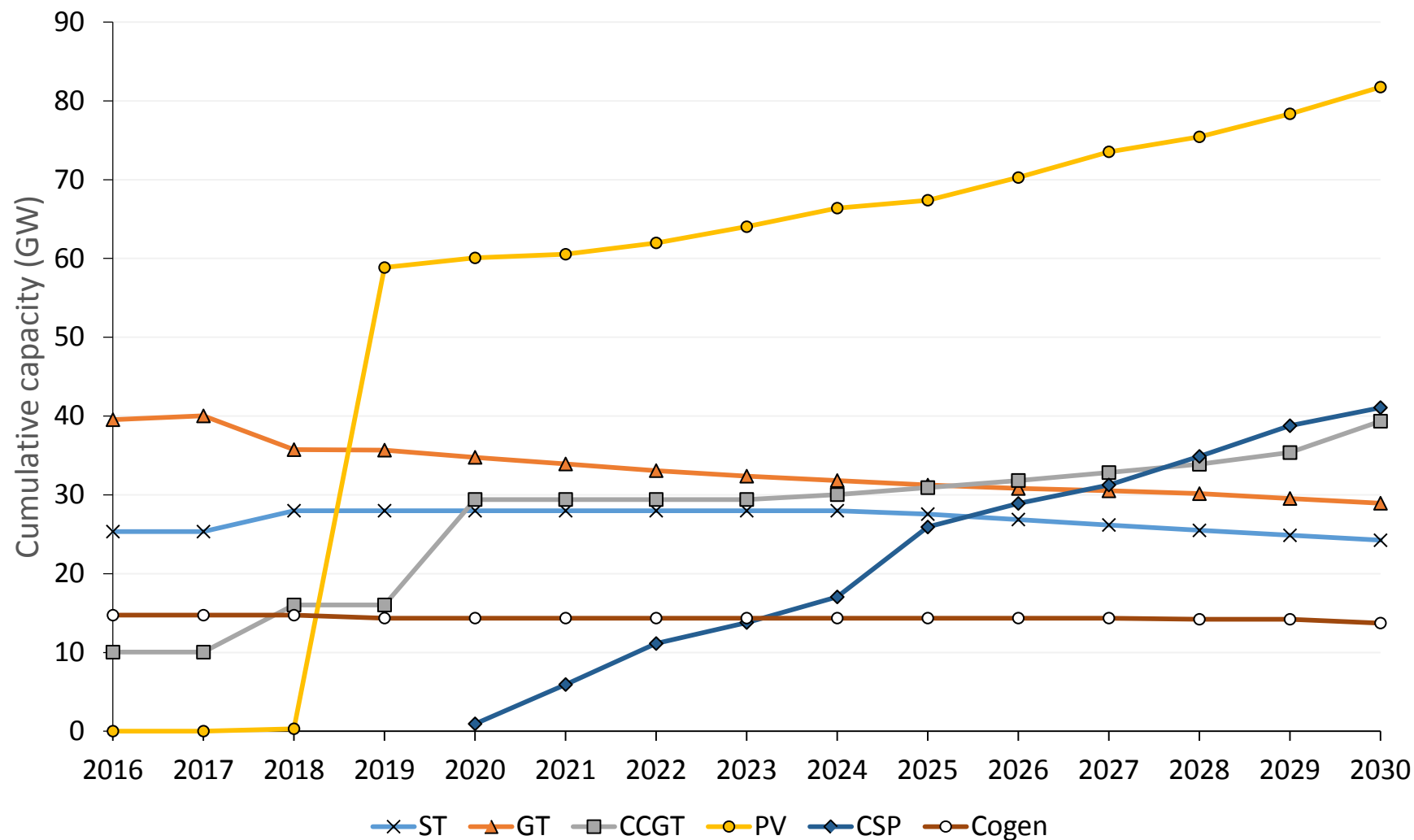
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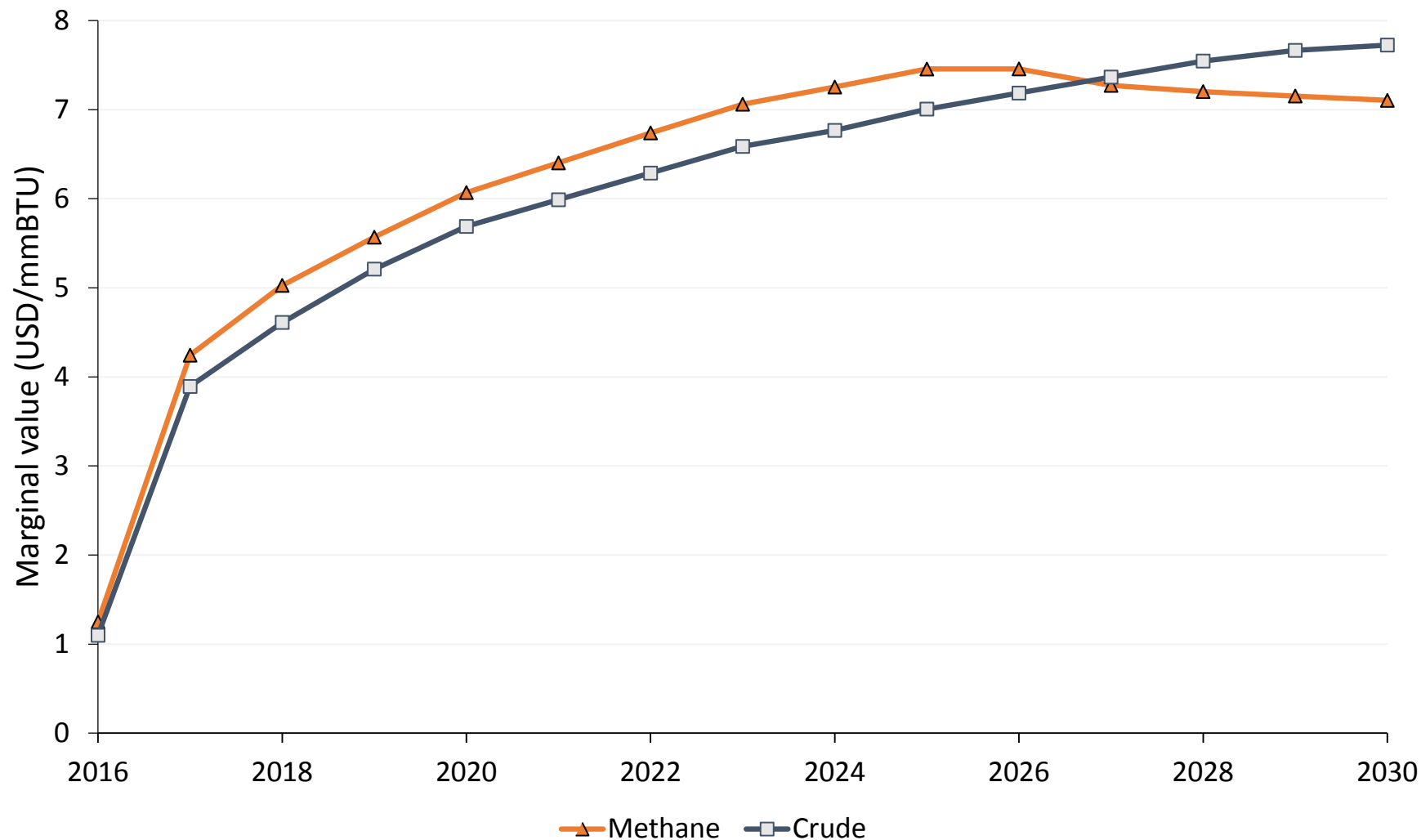
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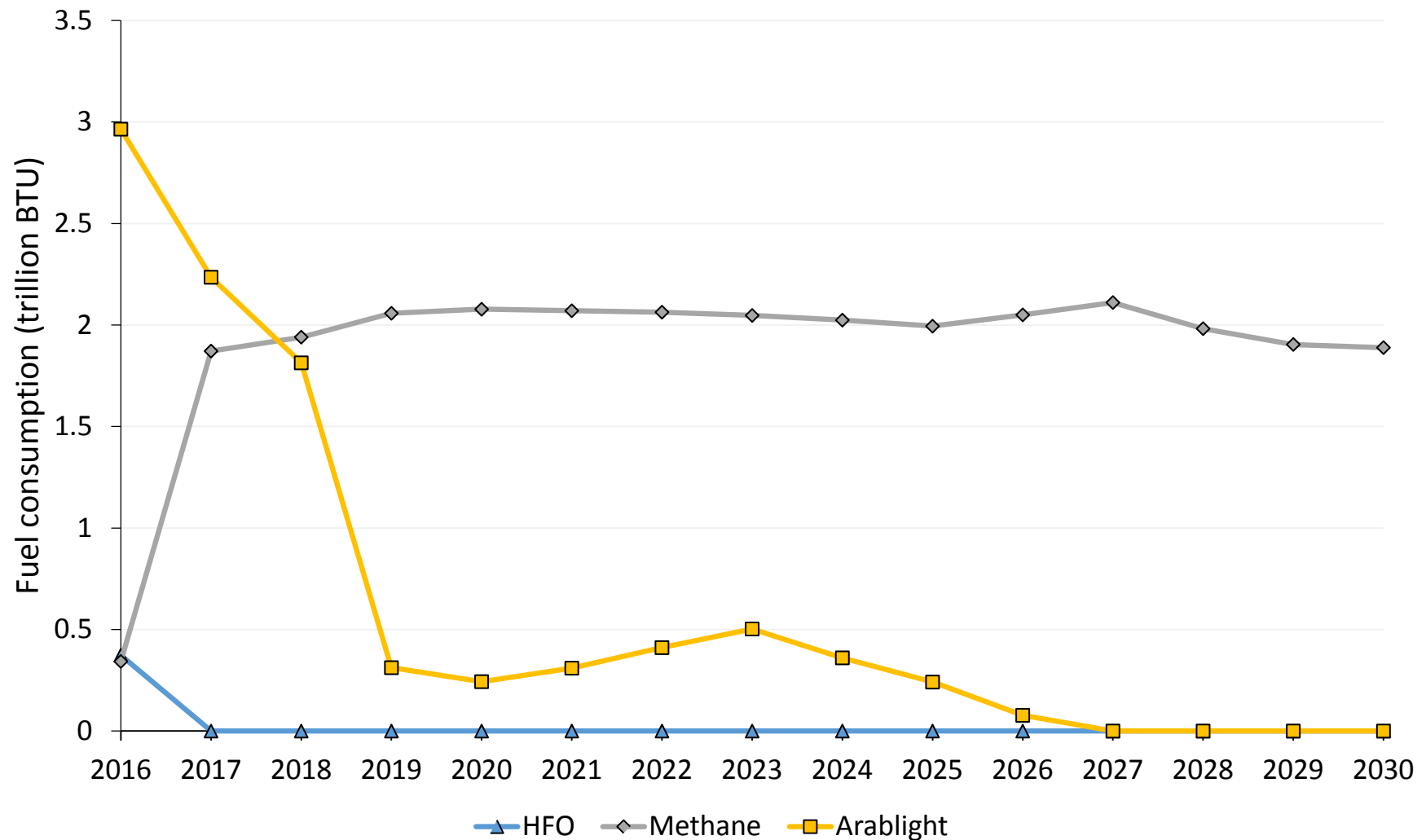
Carbon price (\$50/ton): capacity



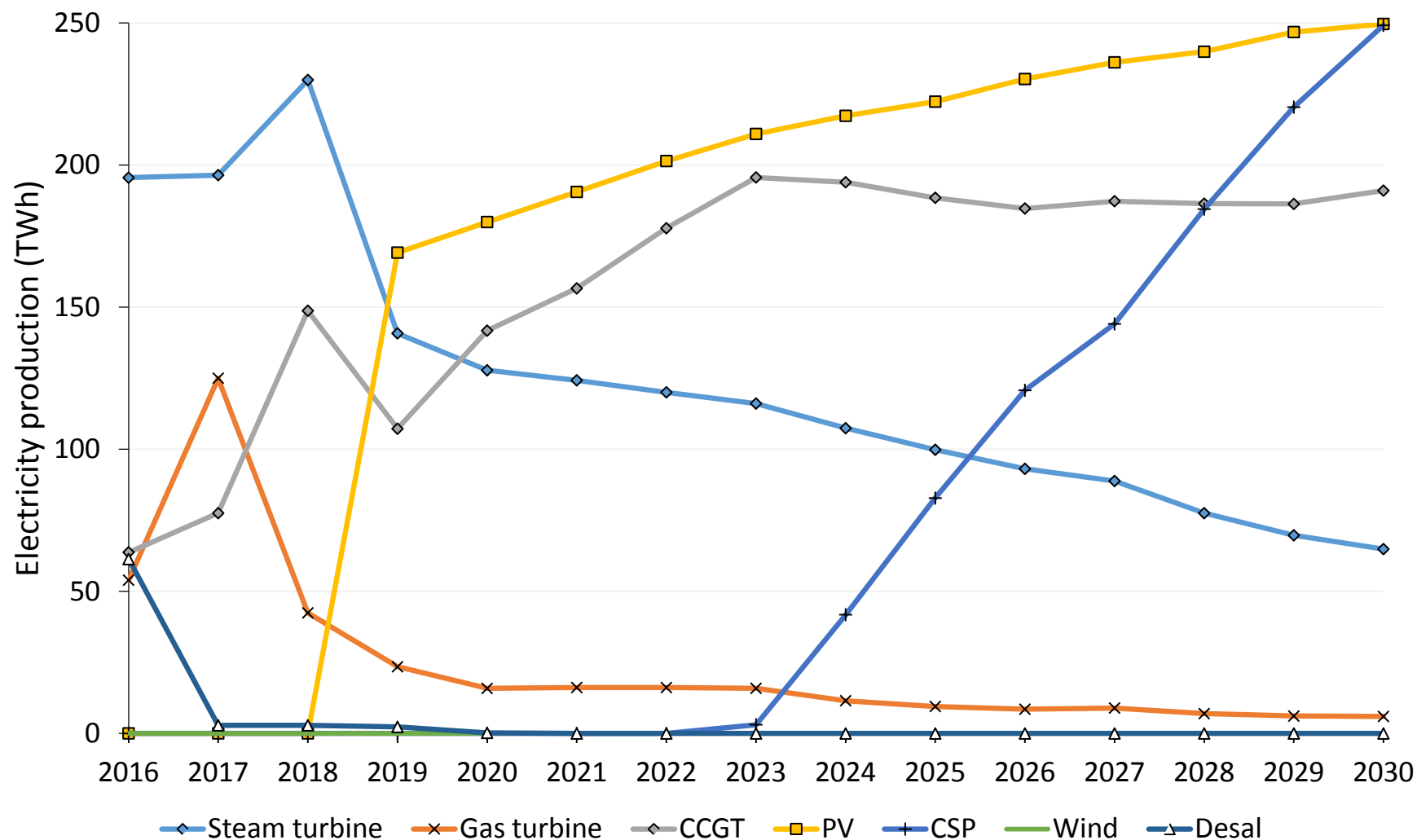
Capital subsidies (5%): relative cost of fuel



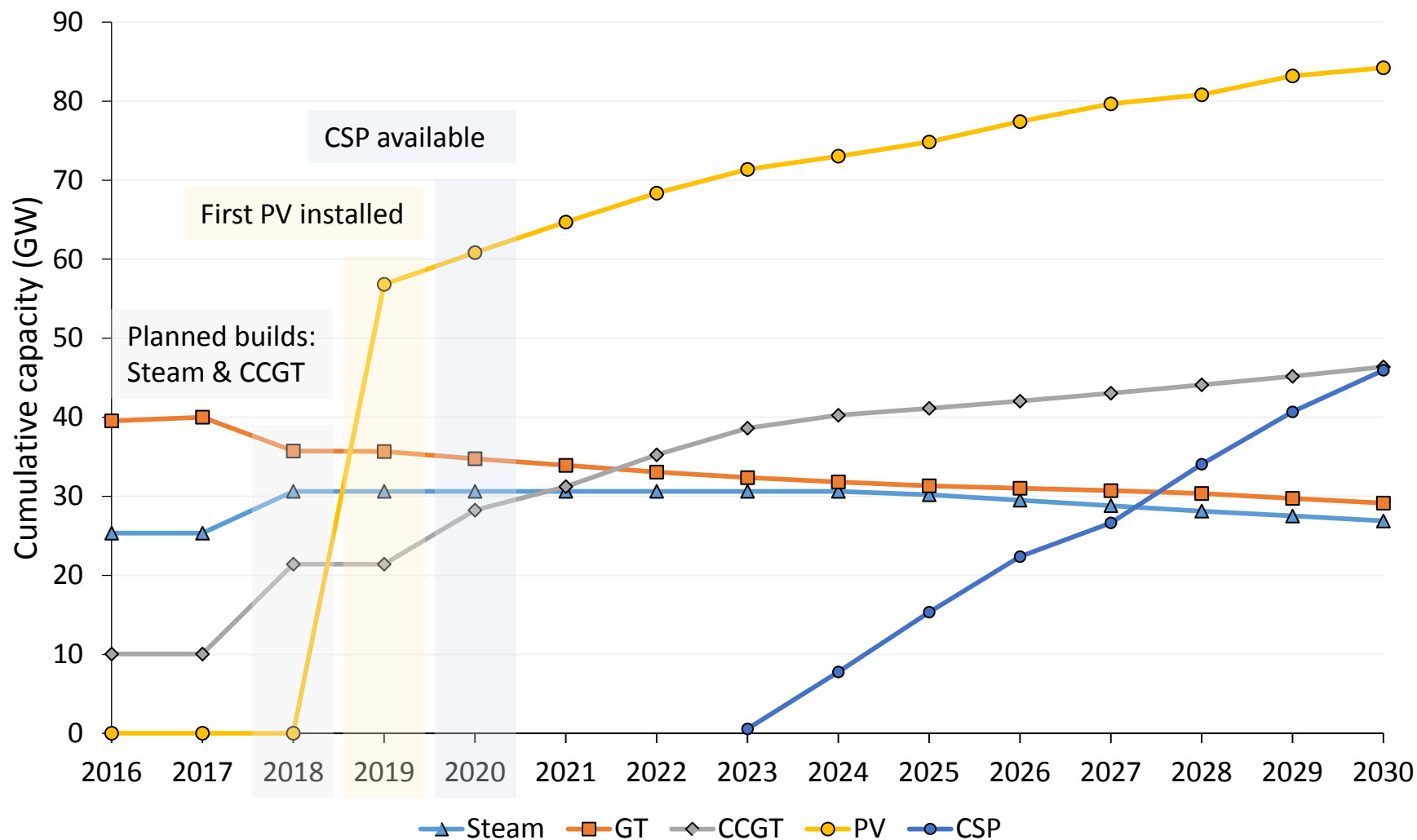
Capital subsidies (5%): fuel consumption



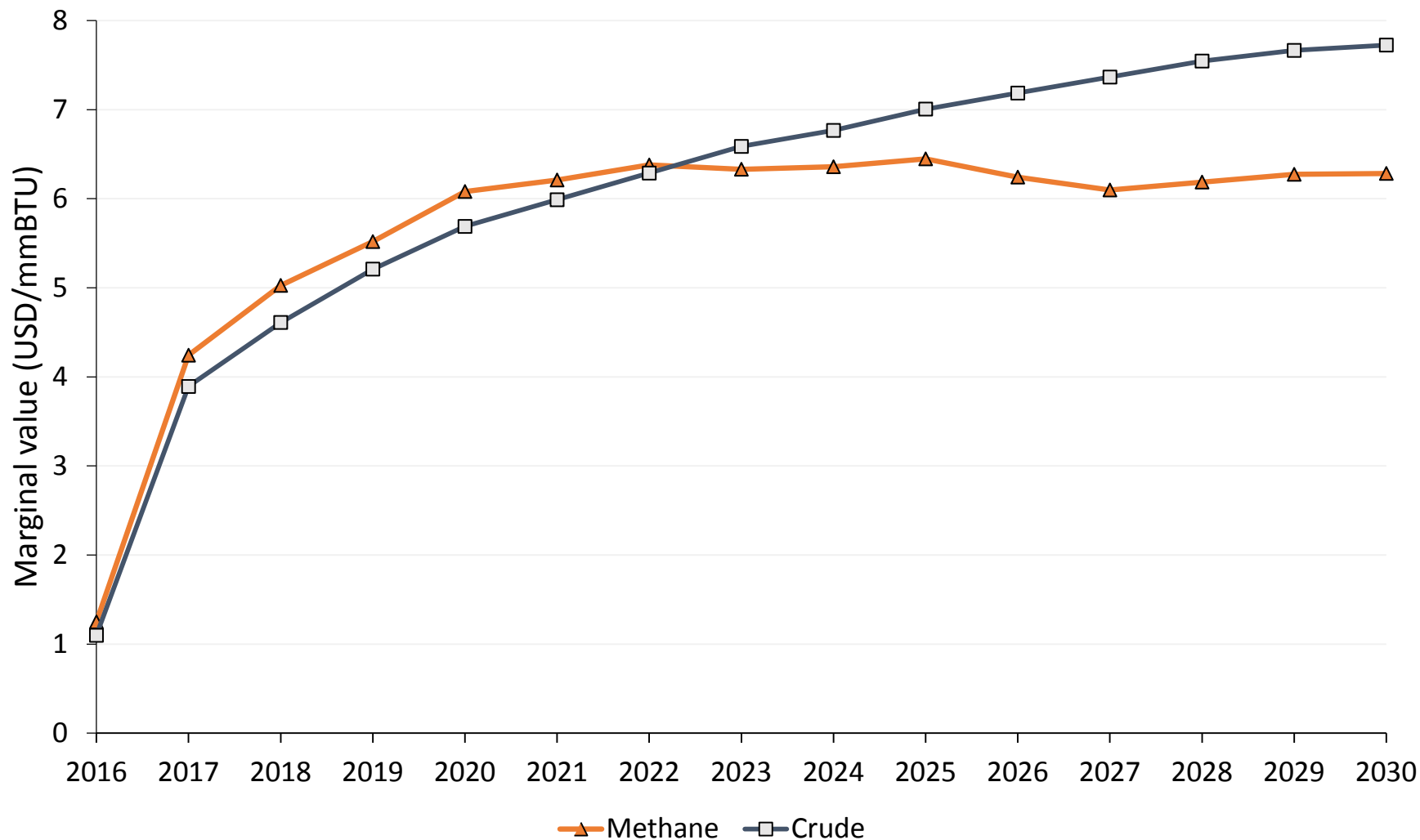
Capital subsidies (5%): electricity supply



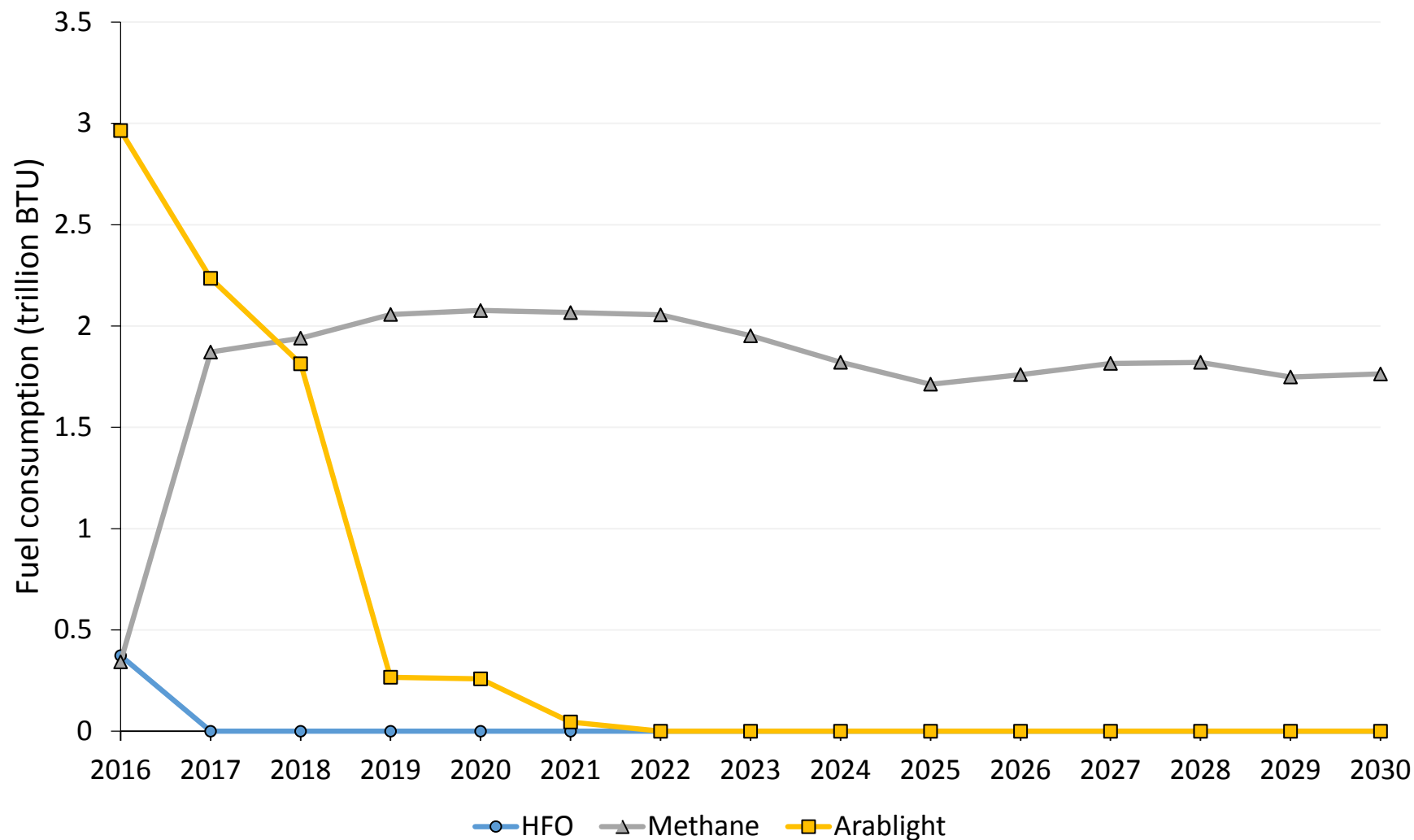
Capital subsidies (5%): capacity



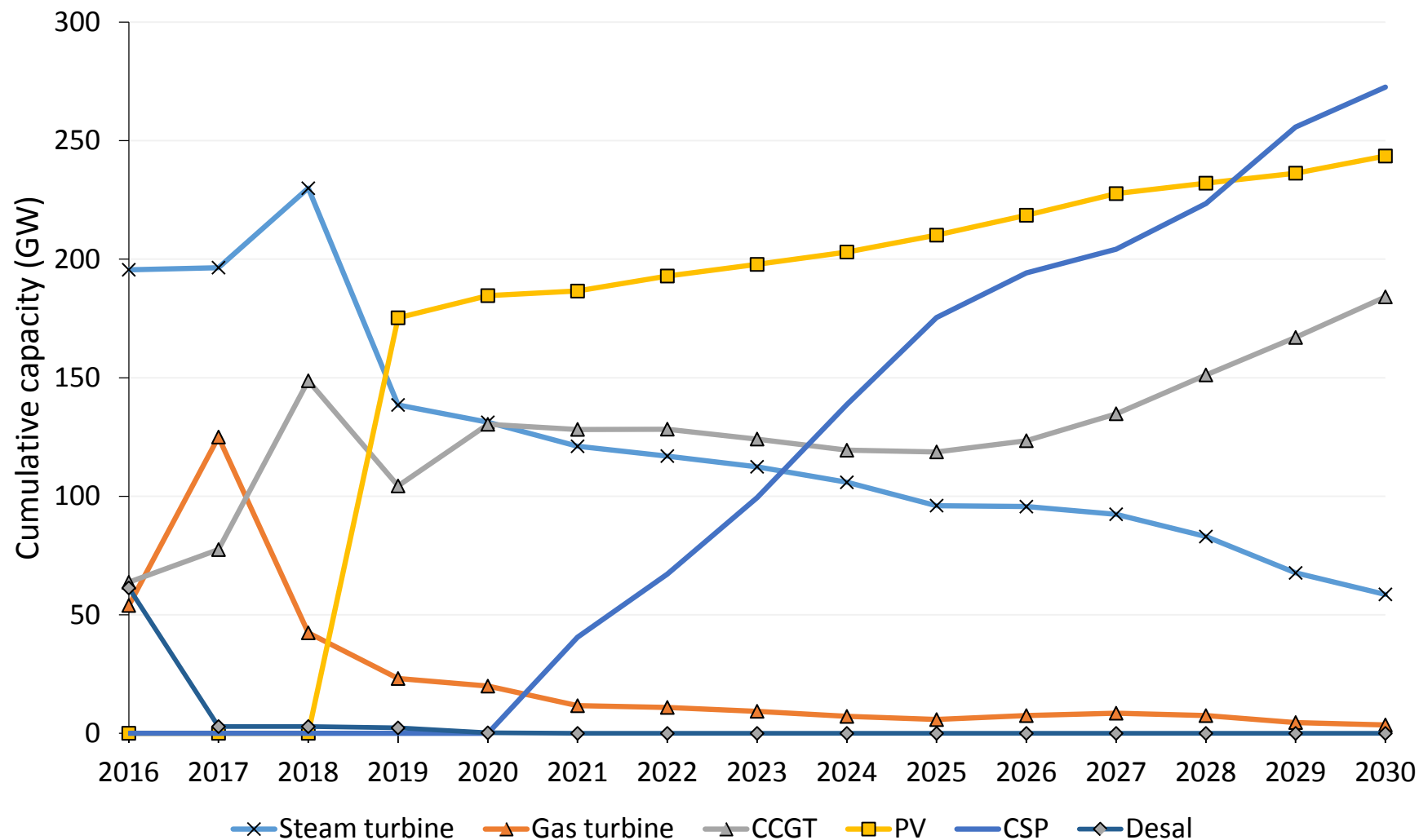
Capital subsidies (25%): relative cost of fuel



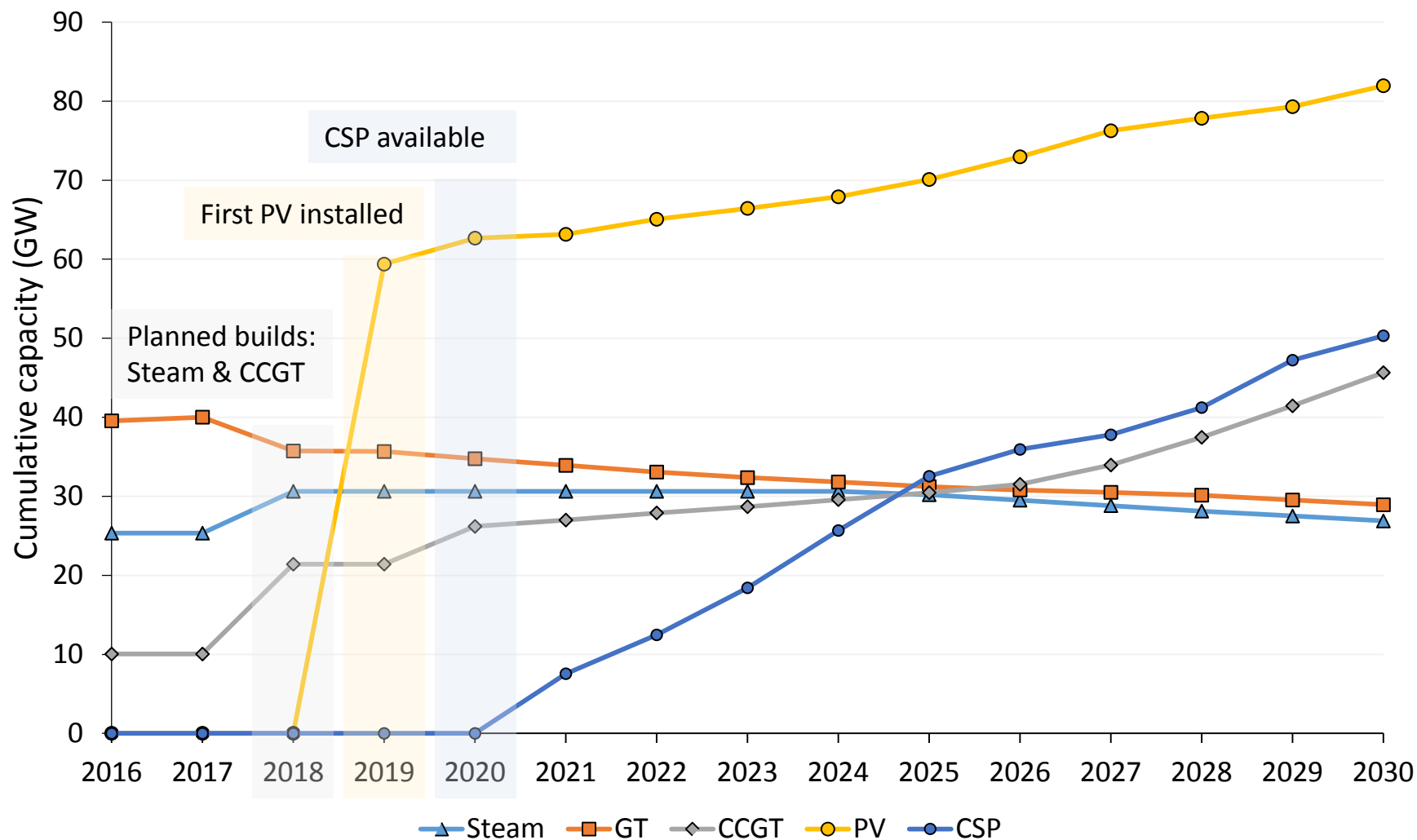
Capital subsidies (25%): fuel consumption



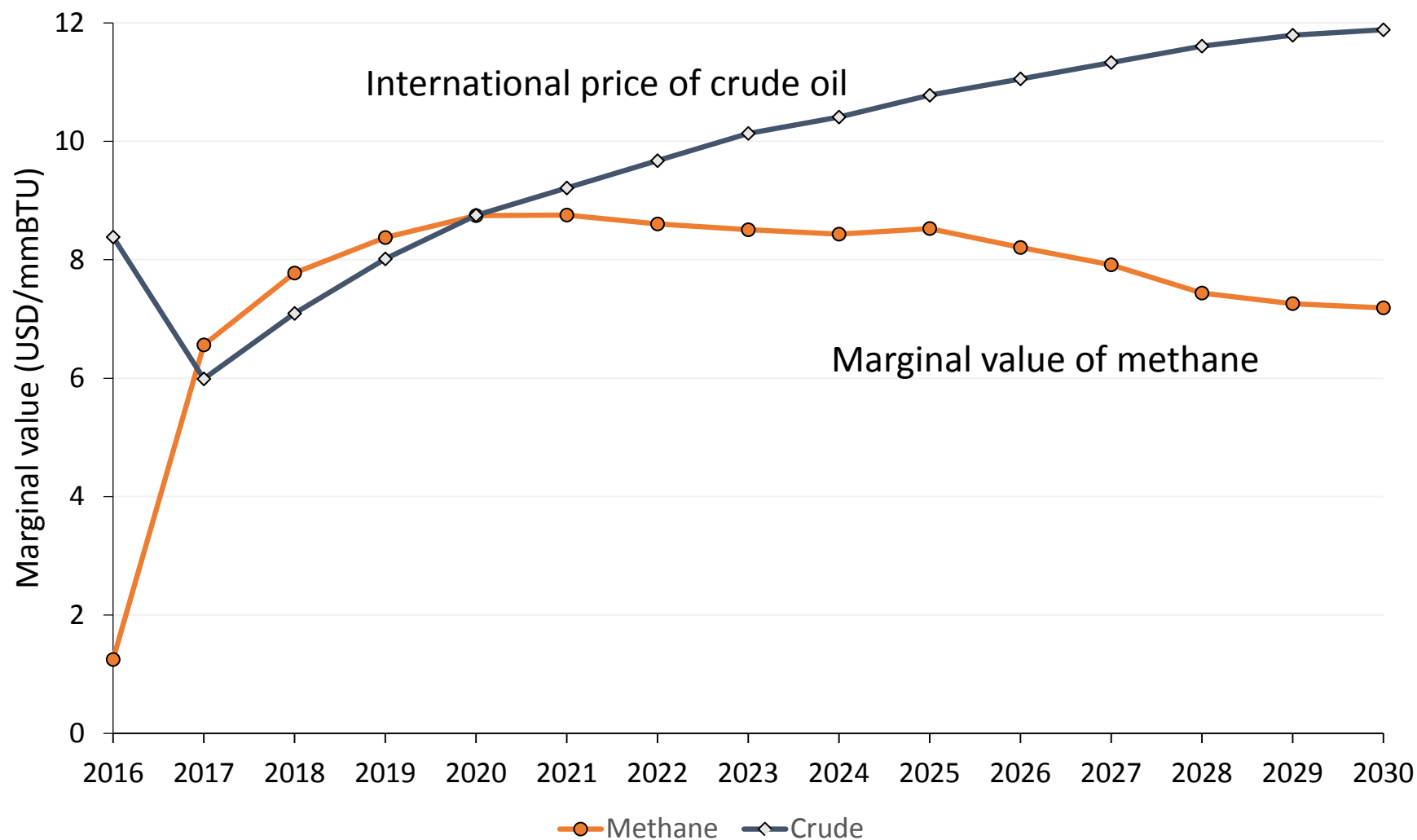
Capital subsidies (25%): electricity supply



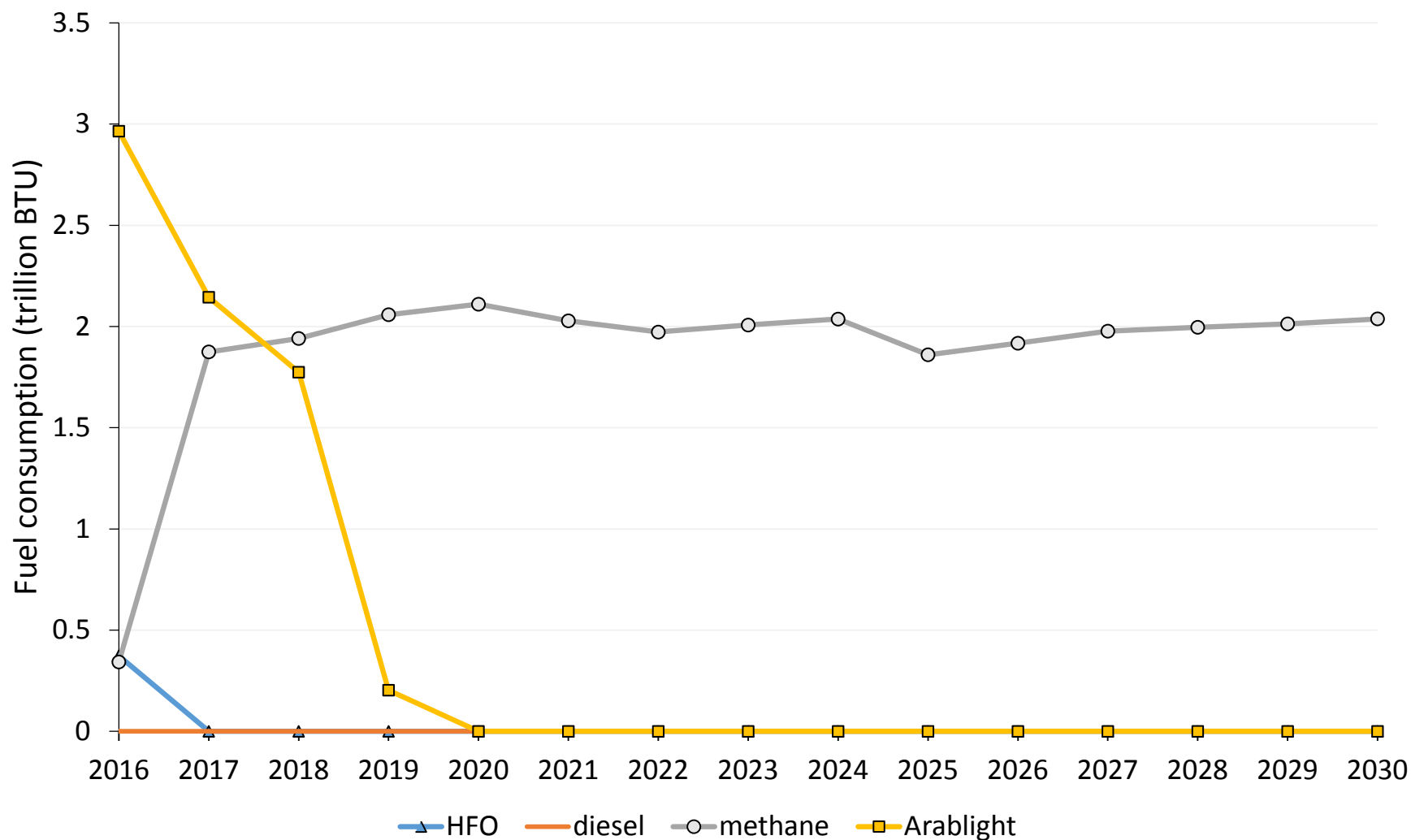
Capital subsidies (25%): capacity



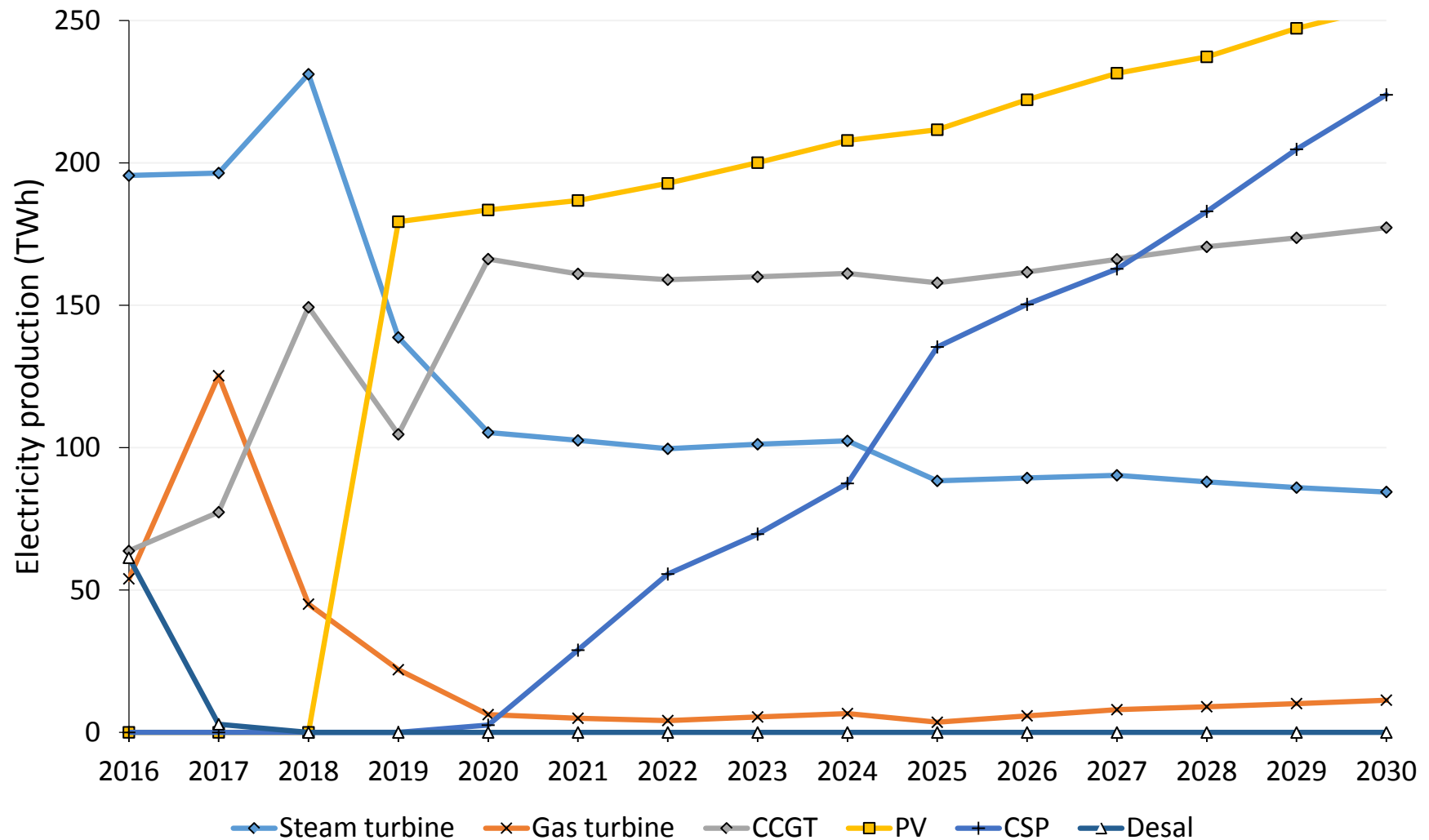
Immediate reform: relative cost of fuel



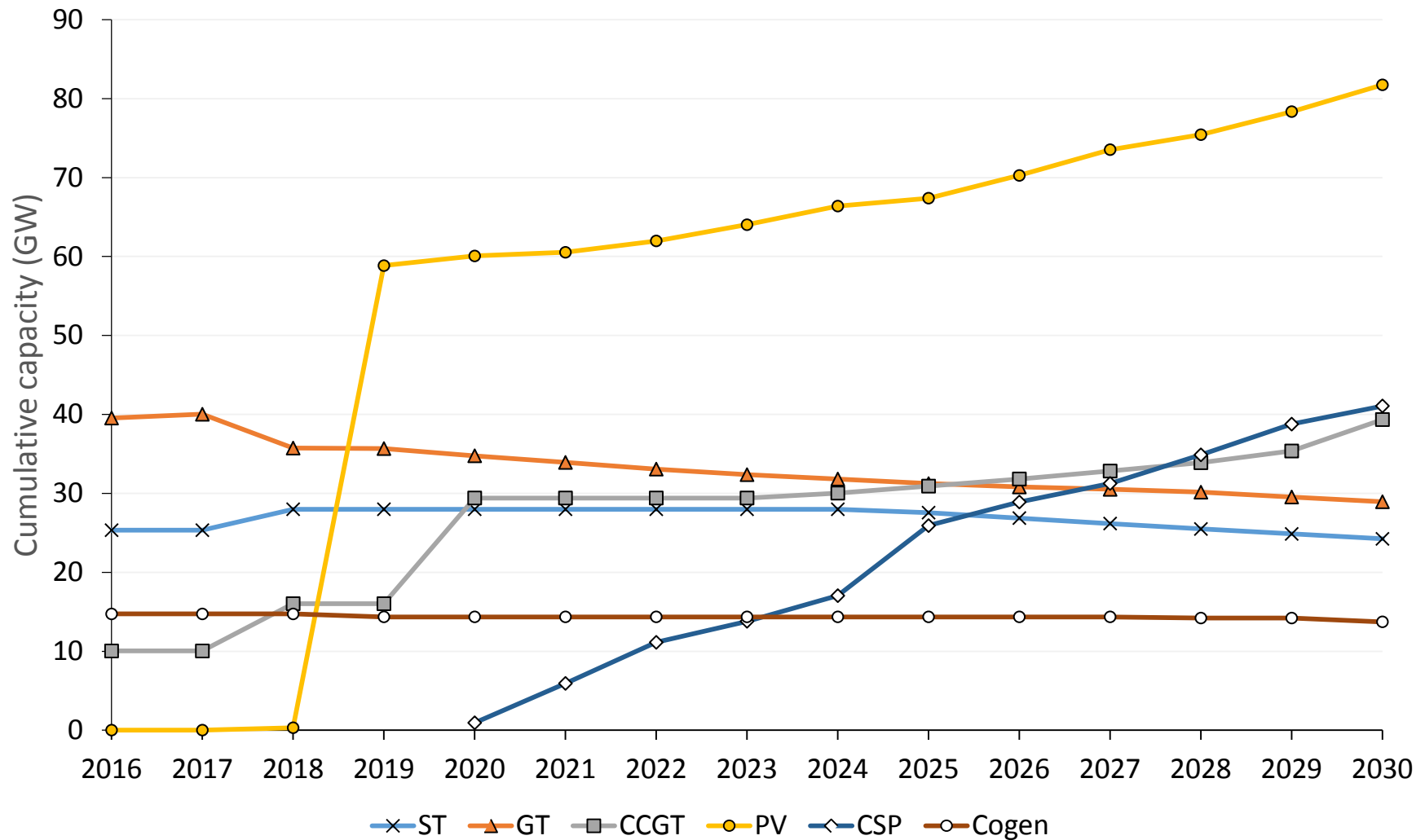
Immediate reform: fuel consumption



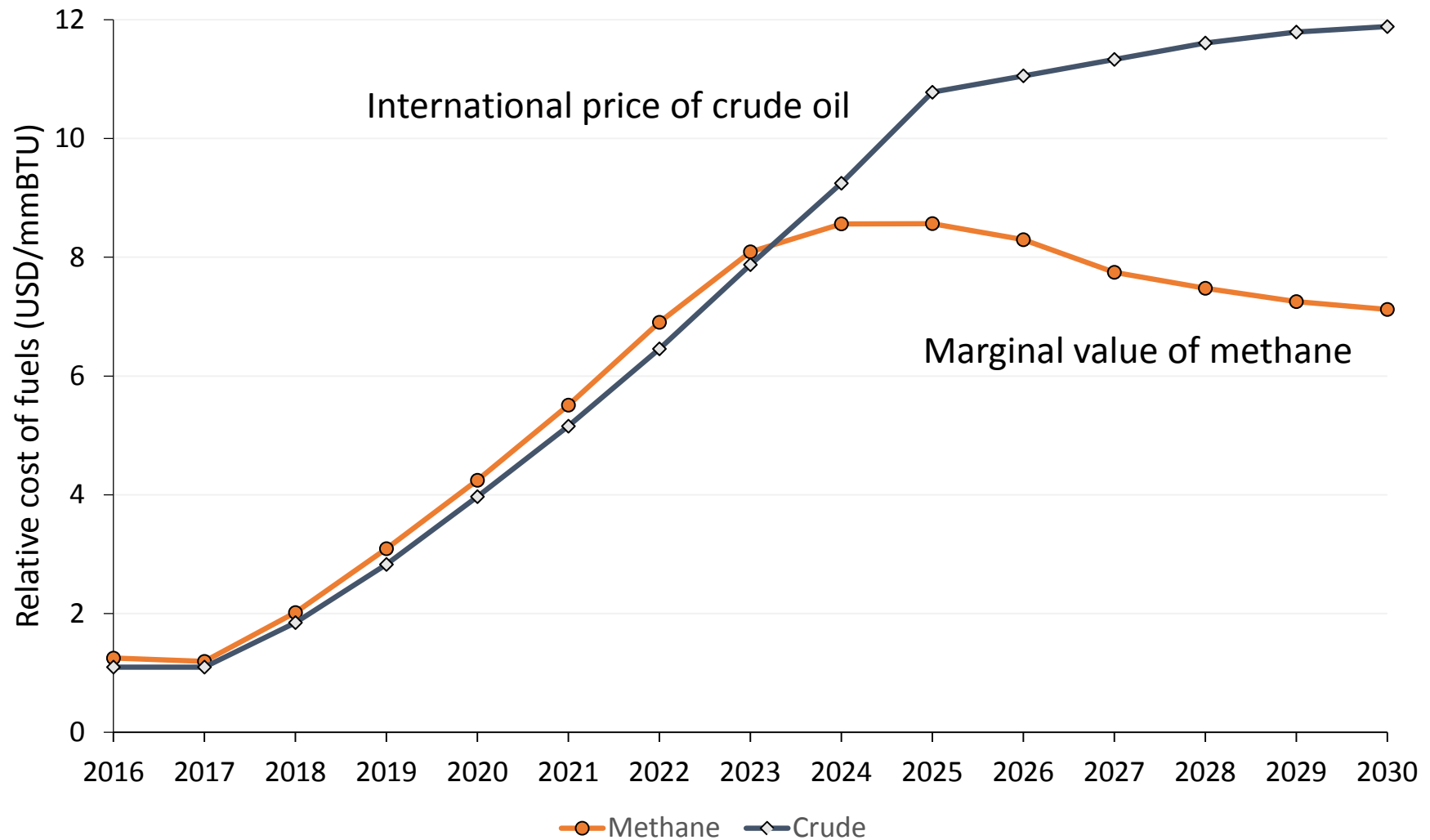
Immediate reform: electricity supply



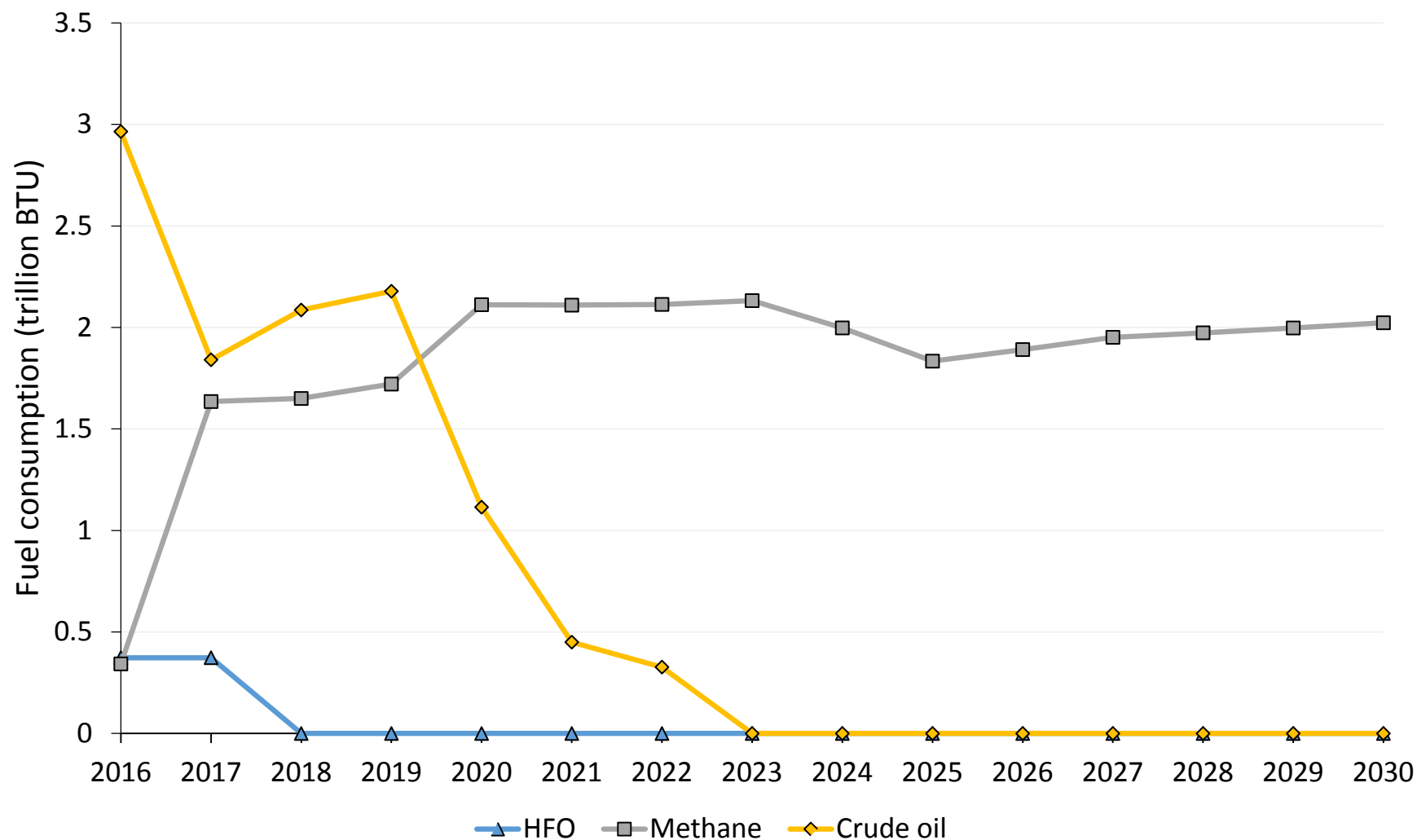
Immediate reform: capacity



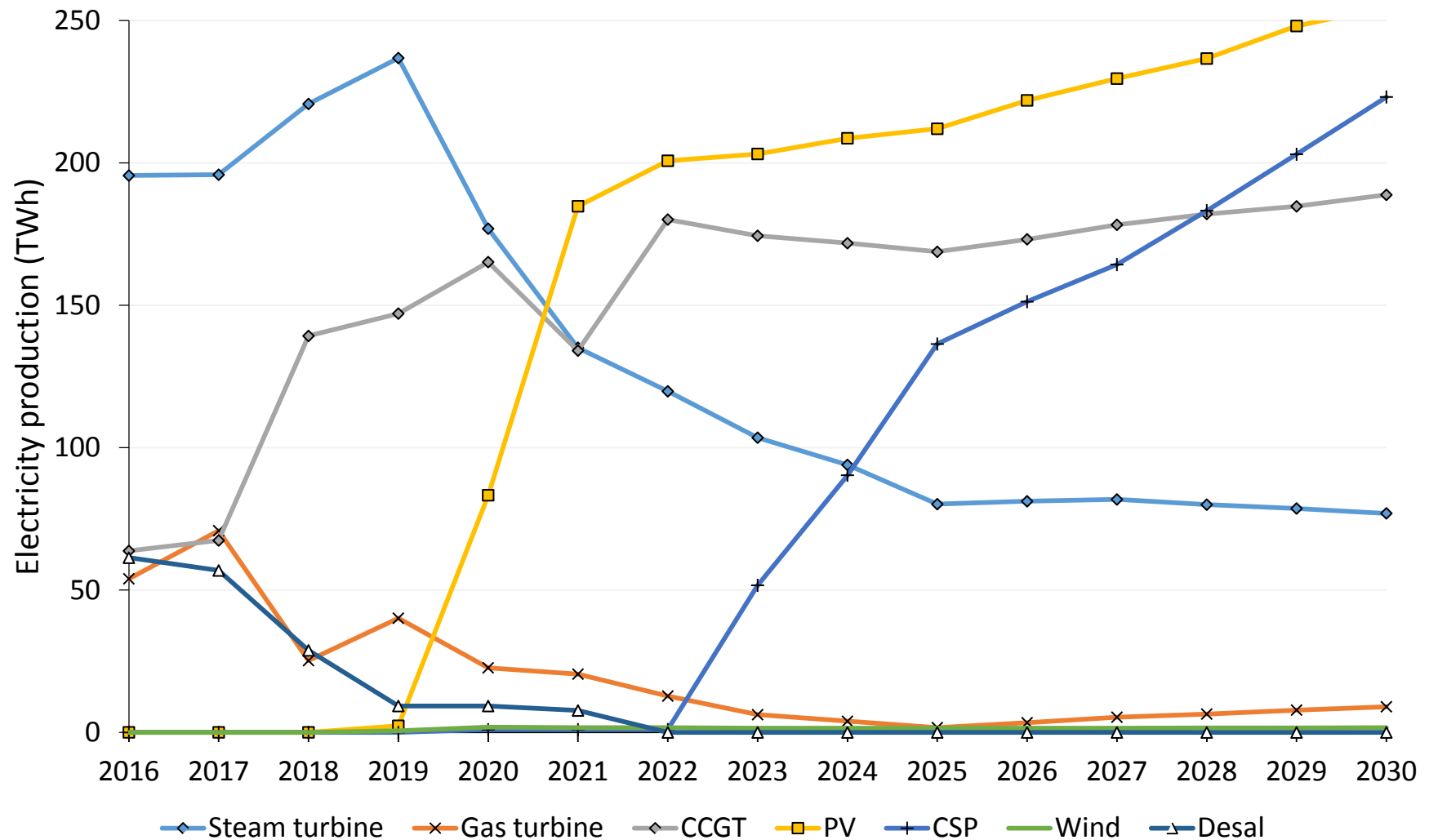
8-year reform: relative cost of fuel



8-year reform: fuel consumption



8-year reform: electricity supply



8-year reform: capacity

