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Center on Global Energy Policy

Will China's new coal plants become stranded economic assets?

Are China's Power Companies Over-investing in New Coal Plants Given China's Climate Ambition

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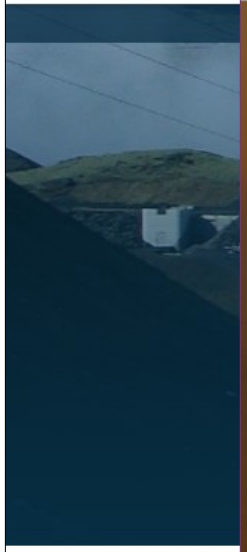
IAEE
December 10, 2021

Analysis by International Climate Experts Questions Coal's Profitability

Carbon Tracker



CarbonBrief
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SCIENCE ENERGY POLICY IN FOCUS DAILY BRIEFING

GUEST POSTS | 7 September 2020 11:30

Guest post: Why would anyone finance another coal power plant in China?

Smoke is discharged from chimneys at a coal-fired power plant in east China's Jiangsu province. Credit: Imagin

MAX DUPUY
07.09.2020 | 11:30am

GUEST POSTS Guest post: Why would anyone finance another coal power plant in China?

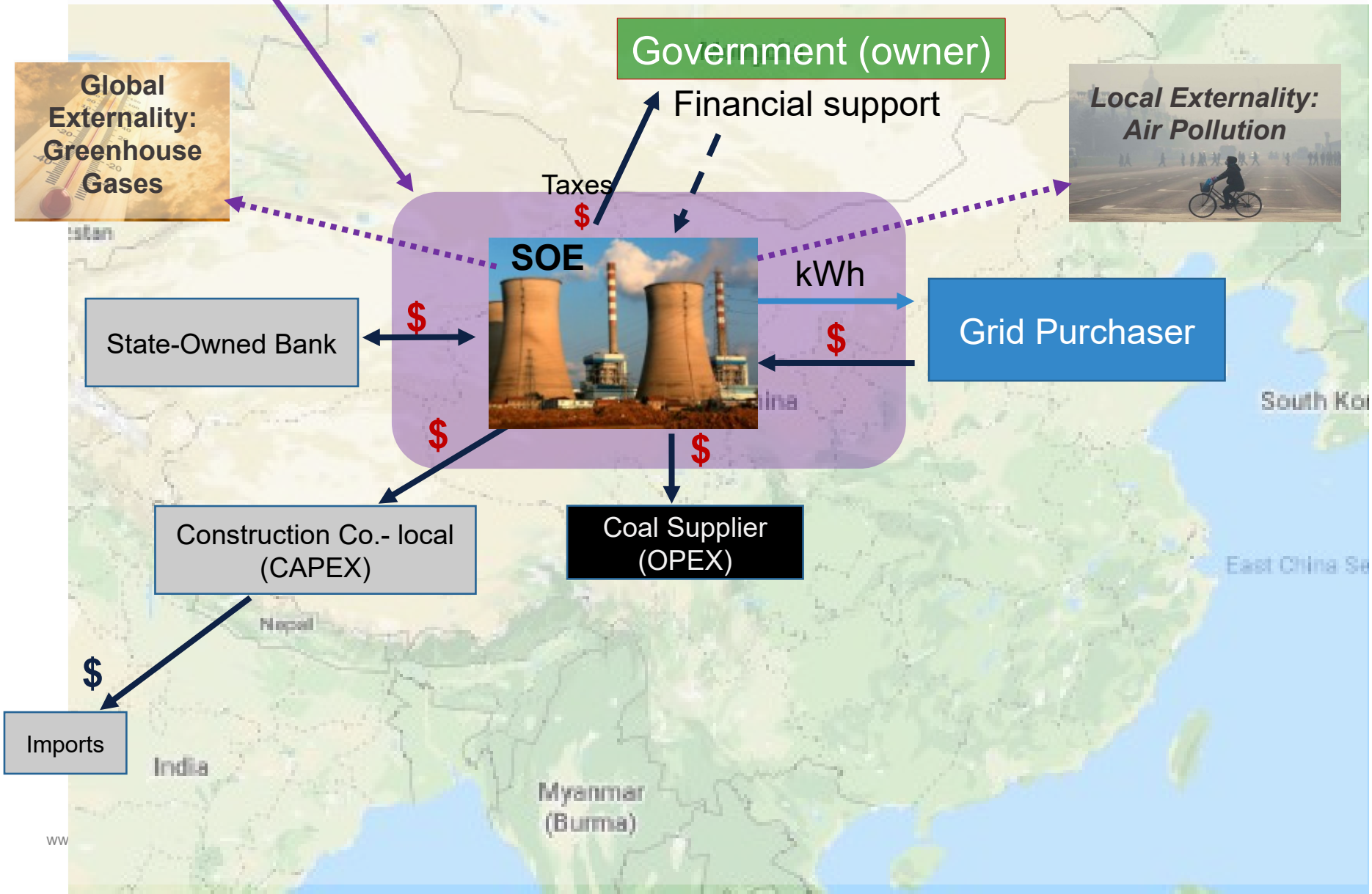
This guest post is by:

Max Dupuy, senior associate and acting China programme director at the thinktank the Regulatory Assistance Project.

Government officials and state-owned energy enterprises in China are currently debating another wave of coal power investment, despite a severely diminished business case for the technology.

These companies that own and operate China's coal fleet are already facing financial losses, thanks to increasing competition from renewables, market reforms and overcapacity in the sector. Some recent estimates find that the cost of building new solar generation in China is approaching the operating cost of coal generation

Financial (plant-level) analysis of a power plant



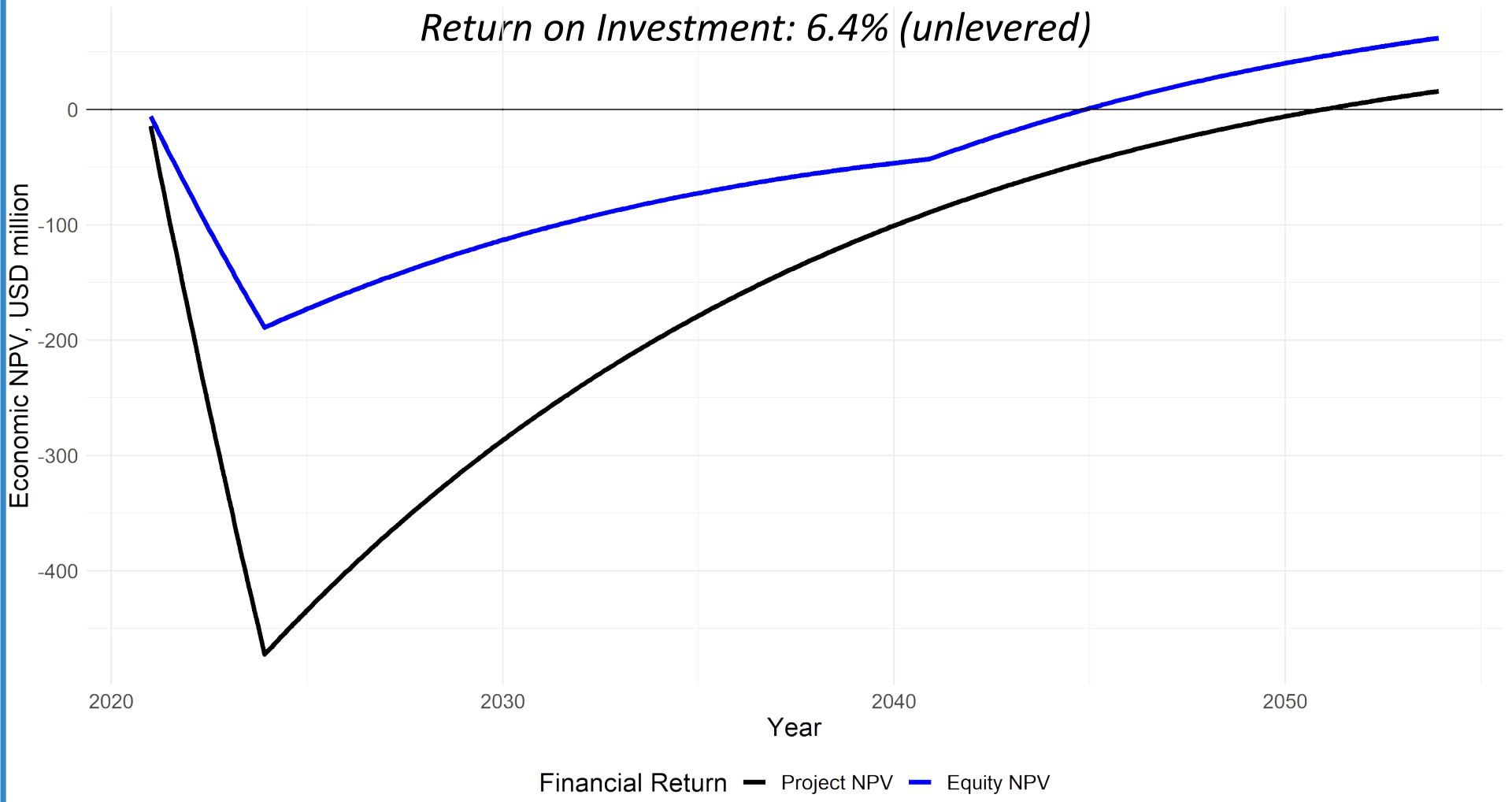
Financial analysis: inputs and assumptions

Component	Unit	Financial Analysis (nominal)
Physical Characteristics		
Capacity	MW	1,000
Coal energy content	MWh/ton	18.84
Plant efficiency	%	**48%**
Construction		
Construction period	years	**3**
Capital cost	US$ / MW	**517,366**
Financing		
Inflation rate costs - Tariff Index	%/year	2.1% for costs; 1.5% PPA tariff
Debt/Equity Ratio	%	**60/40**
Domestic financing	% of financing	100%
Loan tenor	years	**20**
Operations		
Operating life	years	30
Load factor	%	**48%**
Initial coal fuel cost	US$ / ton of fuel delivered	76.52
Initial operating costs	US$ / MW-year	11,549
Revenues/Benefits		
Electricity price received	US$/ MWh	**47.12**

Plant-Level Financial Analysis (simplified)

Return on Equity: 8.4% (levered)

Return on Investment: 6.4% (unlevered)



[illustrative 1GW ultra-supercritical coal-fired power plant]

Financial vs country-level economic analysis of a power plant

Government (owner)

Financial support

Taxes

$

SOE

kWh

$

State-Owned Bank

$

Grid Purchaser

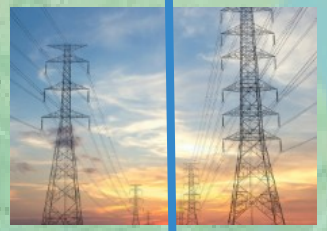
$

$

$

Construction Co.- local (CAPEX)

Coal Supplier (OPEX)



T&D costs

kWh

Household, Business, Industry Consumers

$

Imports

India

Myanmar (Burma)

Analytical framework: financial (plant-level) vs economic (country-level)

	Costs (Inputs)	Benefits (Outputs)	Externalities
Plant-level financial analysis • ***nominal $*** • ***return on equity focus***	• Engineering Procurement and Construction contract (EPC) • Financing • Fuel (coal)/OPEX • Taxes (including local pollution tax)	• Power Purchase Agreement (PPA) tariff (net of taxes)	• No carbon pricing assumed
Country-level economic analysis • ***constant $*** • ***economic return focus***	• EPC costs (adjusted to exclude taxes and import duties) • Fuel (coal)/OPEX (adjusted) • Transmission & distribution	• Economic value of kWh (i.e., value to the consumer)	• Local pollution externalities • Shadow carbon price (climate scenarios) • Economic stimulus multiplier effects • Upstream coal economic and environmental costs

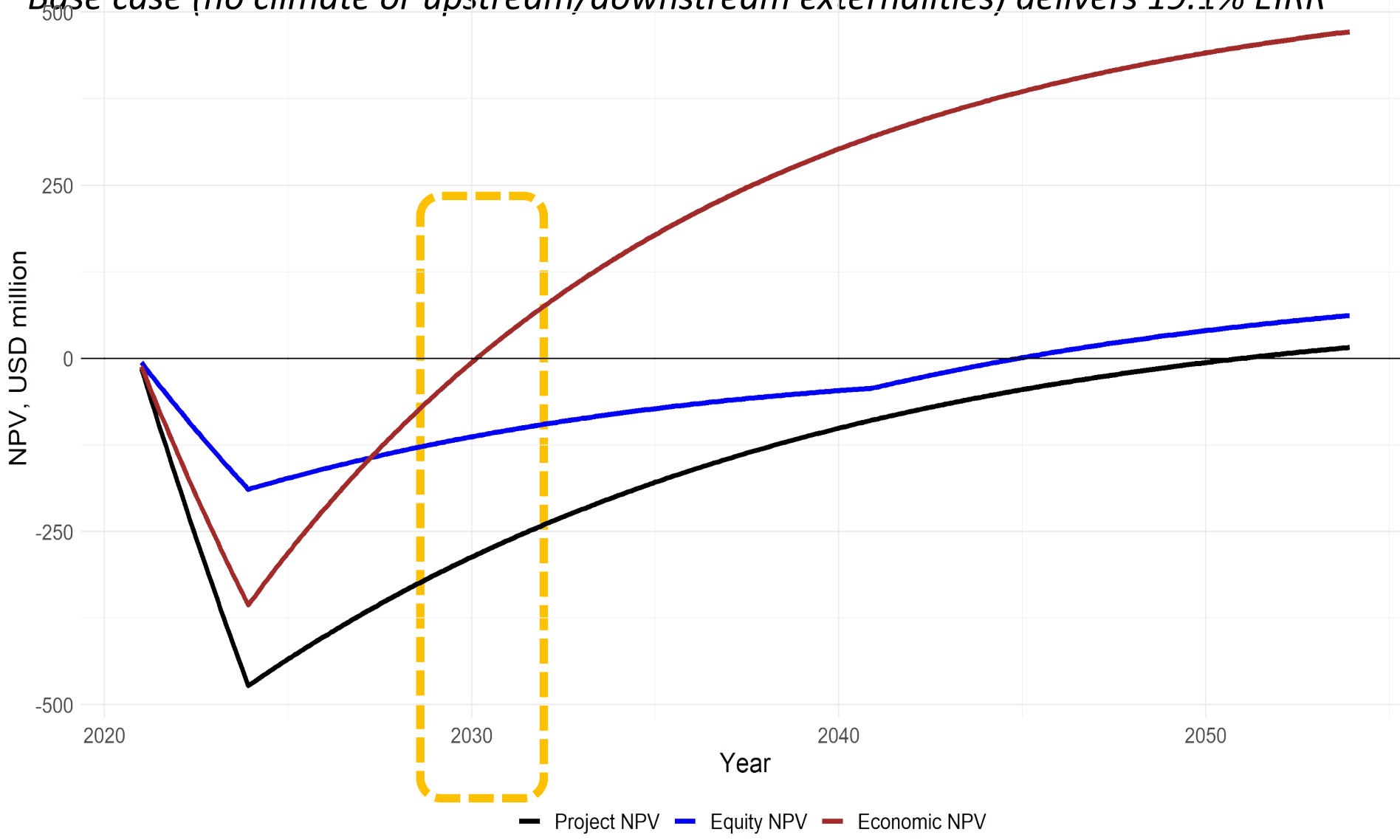
- Two key tests for country-level economic analysis:
  - Does project meet target EIRR, generate positive return (ENPV)
  - Opportunity cost (e.g., is a renewables investment preferable)

Adding economic Analysis: Inputs, assumptions

Component	Unit	Financial Analysis (nominal)	Economic Analysis (real)
Physical Characteristics			
Capacity	MW	1,000	
Coal energy content	MWh/ton	18.84	
Plant efficiency	%	48%	
Construction			
Construction period	years	3	
Capital cost	US$ / MW	517,366	**401,657**
Financing			
Inflation rate costs - Tariff Index	%/year	2.1% for costs; 1.5% PPA tariff	-
Financial discount rate	%/year	6%	-
Economic discount rate	%/year	-	**8%**
Domestic financing	% of financing	100%	
Loan tenor	years	20	-
Operations			
Operating life	years	30	
Load factor	%	48%	
Initial coal fuel cost	US$ / ton of fuel delivered	76.52	**72.57**
Initial operating costs	US$ / MW-year	11,549	**9,816**
Weighted average T&D costs	US$ / MWh	-	**30.0**
Revenues/Benefits			
Electricity price received	US$ / MWh	47.12	-
% industrial users	%	-	62%
Weighted average willingness to pay	US$ / MWh	-	**87.9**

Impact of considering economic analysis

Base case (no climate or upstream/downstream externalities) delivers 19.1% EIRR

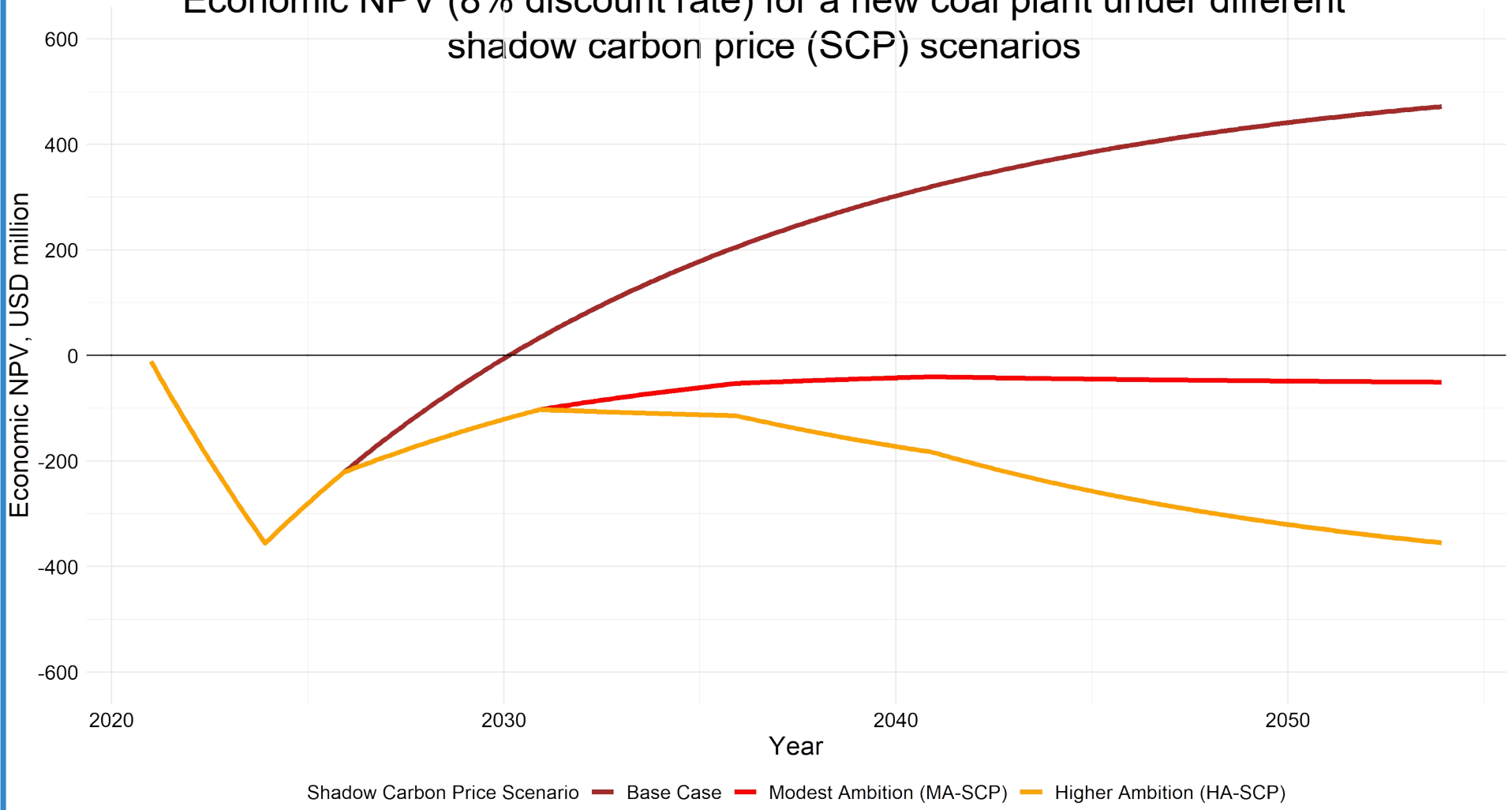


Key data points and scenarios explored

1. "Externalities"
   a. Local pollution
   b. Economic (e.g., capex, upstream coal production, etc.)
   c. Greenhouse gases

2. Climate scenarios
   a. Base Case
   b. Shadow carbon pricing scenarios (15th FYP, 16th FYP, etc.)
   c. Load reduction scenarios (15th FYP, 16th FYP, etc.)
   d. 2°C "compliant" scenario

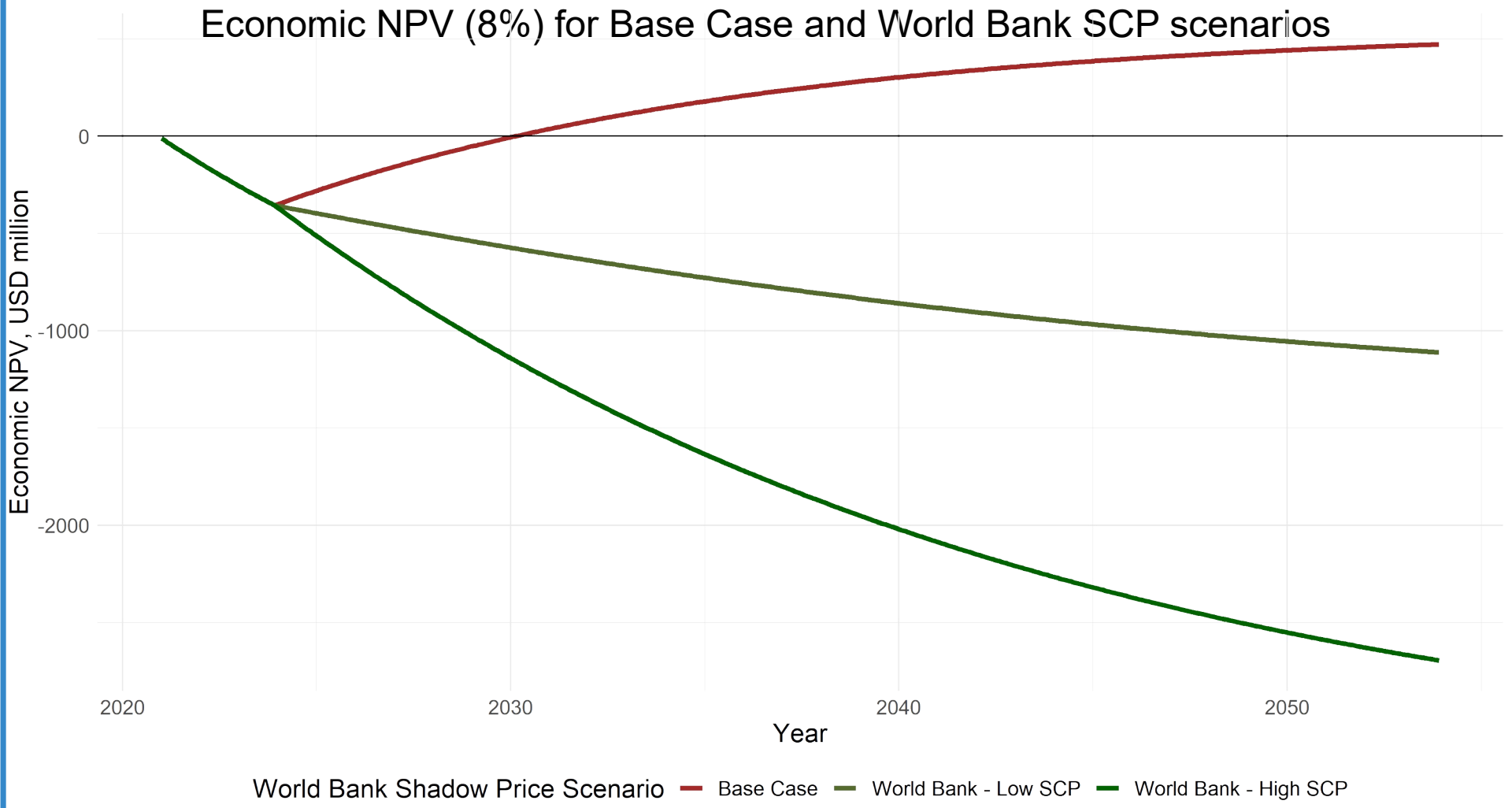
Economic shadow carbon price scenarios



Base Case: no shadow carbon price.
Modest Ambition: $15/tCO2 in 2026, increasing by $5 every 5 years to $30 in 2041
Higher Ambition: $15/tCO2 in 2026, increasing by $15 every 5 years to $60 in 2041

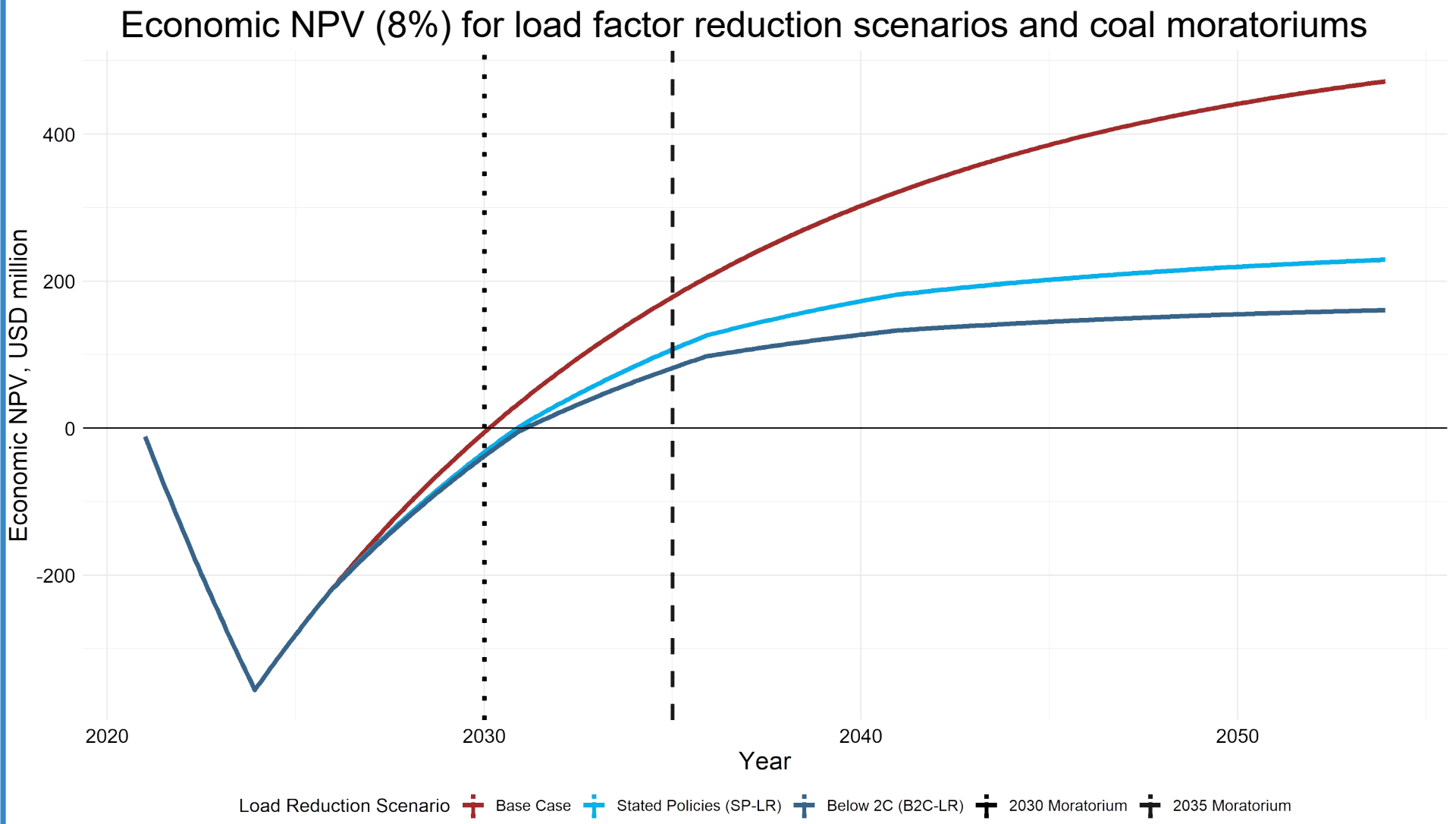
ENPV under Modest Ambition = -$50 million

Economic shadow carbon price scenarios using World Bank ranges



Low SCP: $40/ton as of 2020, increasing 2.25% per year
High SCP $80/ton as of 2020; increasing 2.25% per year

Economic Load Reduction Scenarios



Base Case: 48% load factor
Stated Policies: 43% (2026) to 18% (2041)
Below 2C: 41% (2026) to 13% (2041)

Economic alternatives analysis

- Possibilities:
  - Debottlenecking T&D / long-distance power lines
  - Energy Efficiency / demand-side response
  - Natural gas (CCNG/IGCC)
  - Renewables
    - Hydro
    - Wind
    - Solar PV or CSP
- “Base-load” power approximation, so modeled alternative is “solar PV w/storage”

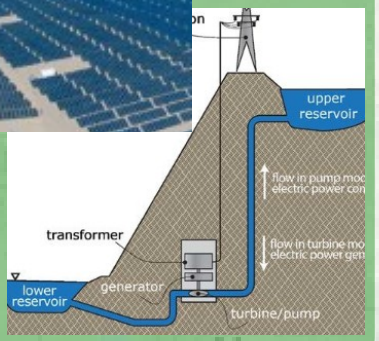
Opportunity cost and analysis of alternatives: Coal vs renewables with storage

Global Externality: Greenhouse Gases

SOE

coal

OR



renewables with storage

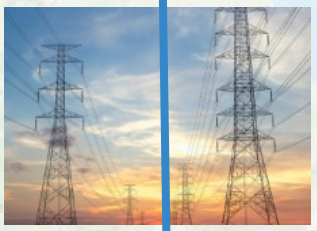
Government

Financial support

kWh

$

Grid Purchaser

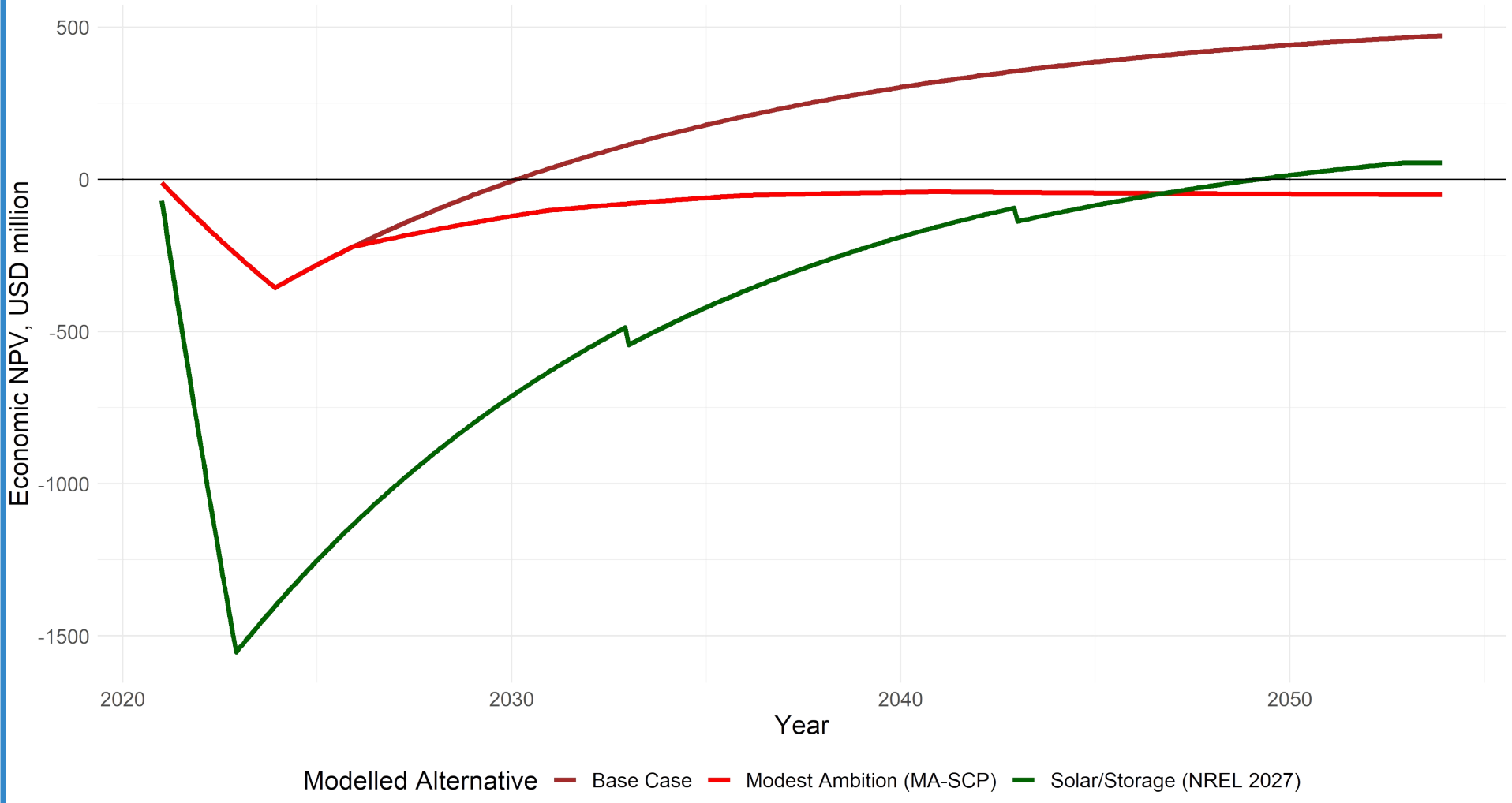


T&D costs

kWh

Households, Business, Industry Consumers

Economic alternatives: solar with storage, 2020 costs

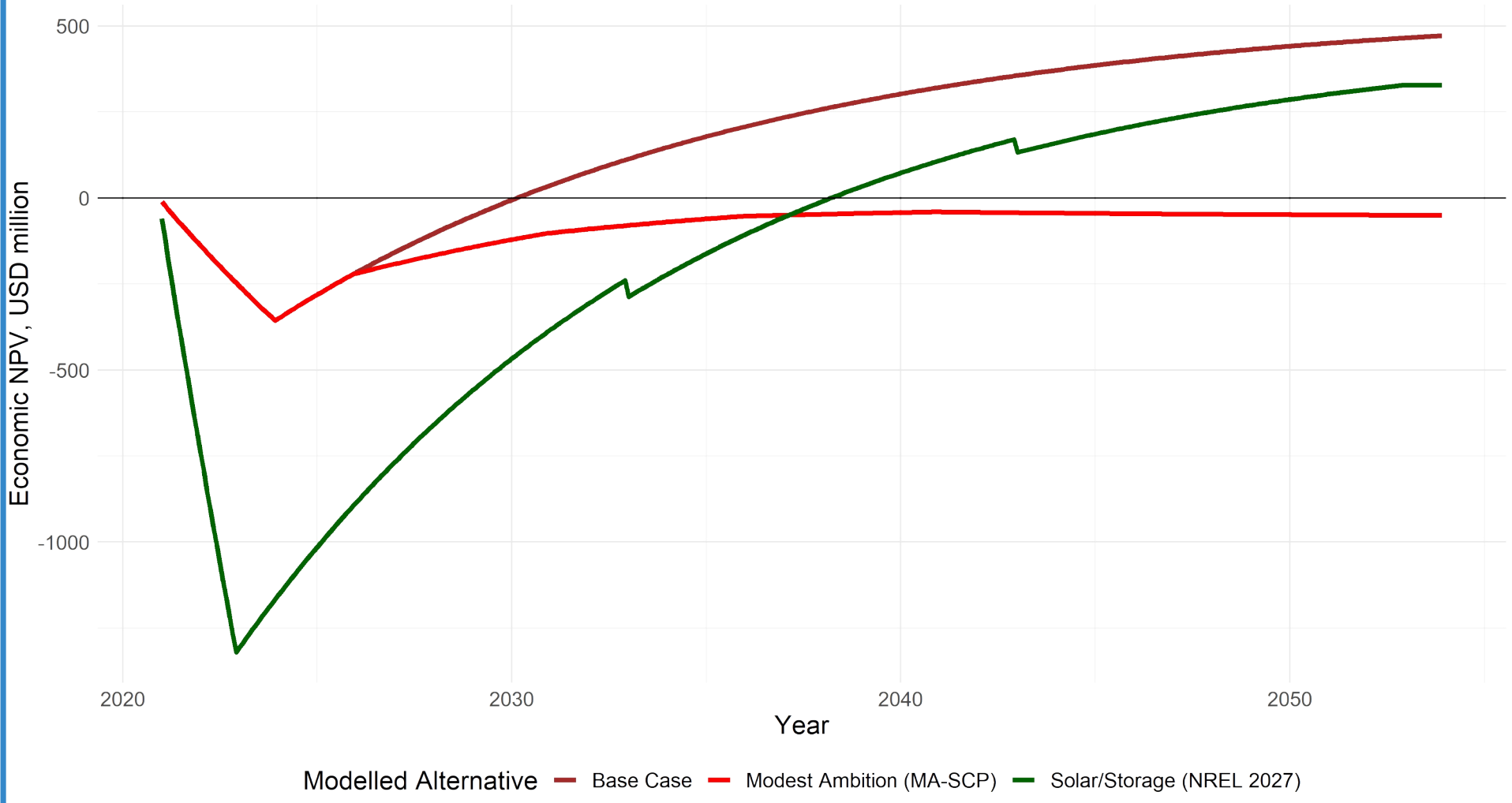


Coal (base case): 19.1% EIRR / $472 million ENPV

Coal (modest ambition): 5.1% / -$50 million

Solar + storage alternative (2020): 8.7% / $54 million

Economic alternatives: solar with storage, 2023 costs

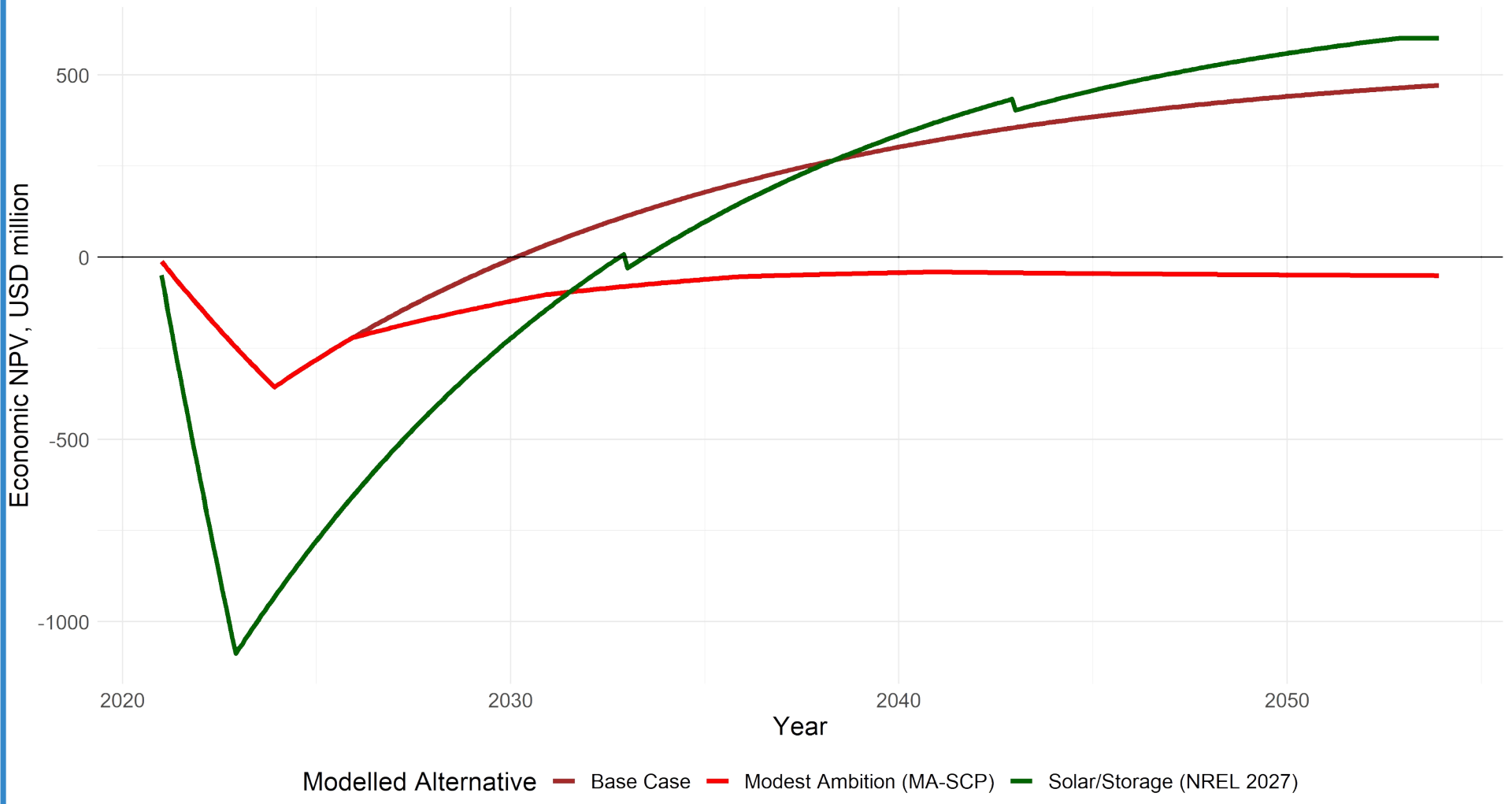


Coal (base case): 19.1% EIRR / $472 million ENPV

Coal (modest ambition): 5.1% / -$50 million

Solar + storage alternative (2023): 10.9% / $328 million

Economic alternatives: solar with storage, 2027 costs



Coal (base case): 19.1% EIRR / $472 million ENPV

Coal (modest ambition): 5.1% / -$50 million

Solar + storage alternative (2027): 13.9% / $600 million

Concluding remarks

- Plant-level financial analysis is only part of the picture: building more coal can appear to benefit “China, Inc” under a no-policy scenario, even when SOE plant operators are losing money
- Country-level economic analysis more relevant and complete for government shareholder, reflecting investment metrics of interests
- “Next plant” analysis is less sophisticated than comprehensive least-cost system expansion planning exercise, but reveals key insights
- Even under modest climate policy changes consistent with current targets, China’s SOEs may be wasting public resources by investing in new coal generation
- Further work required to refine value for “environmental” costs and properly include upstream/downstream impact
- Applicability to BRI investments: country-level economic analysis for Chinese investors + country receiving fossil fuel infrastructure investment