

Preventing stranded assets and empowering renewables

NEAR-TERM POWER SECTOR TRANSITIONS IN INDIA

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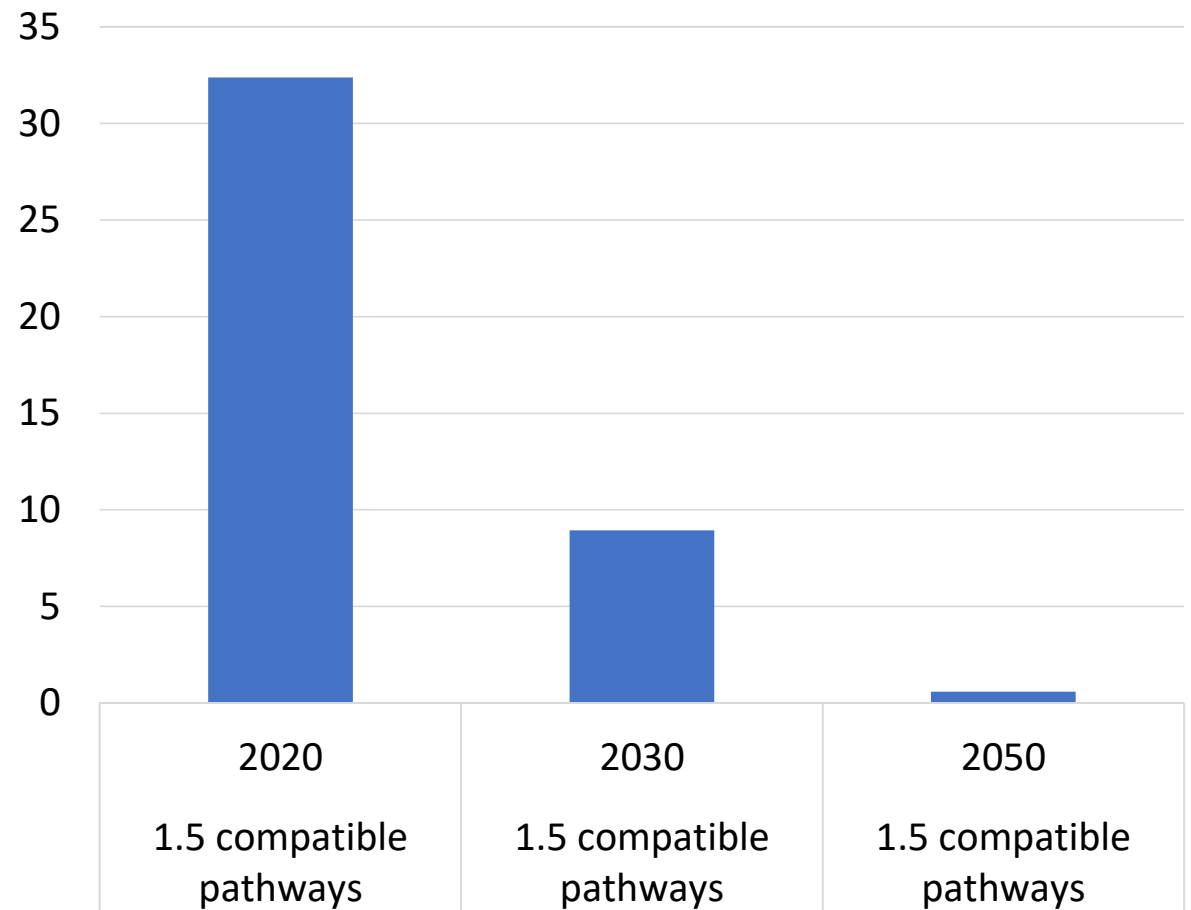


POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH

Paris Agreement
requires global
coal* phase-out
by 2050

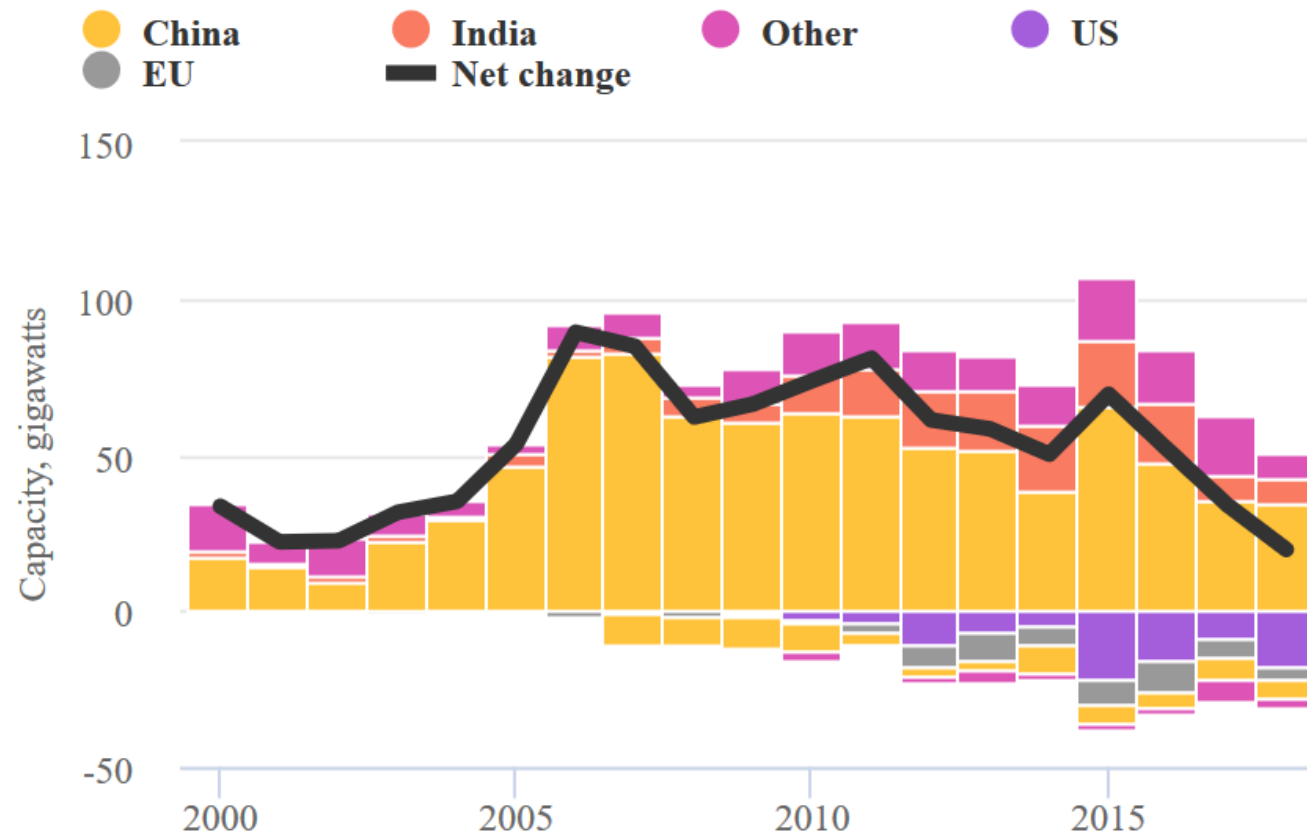
* Coal w/o
CCS

Share of coal in Global Electricity Generation
(%)



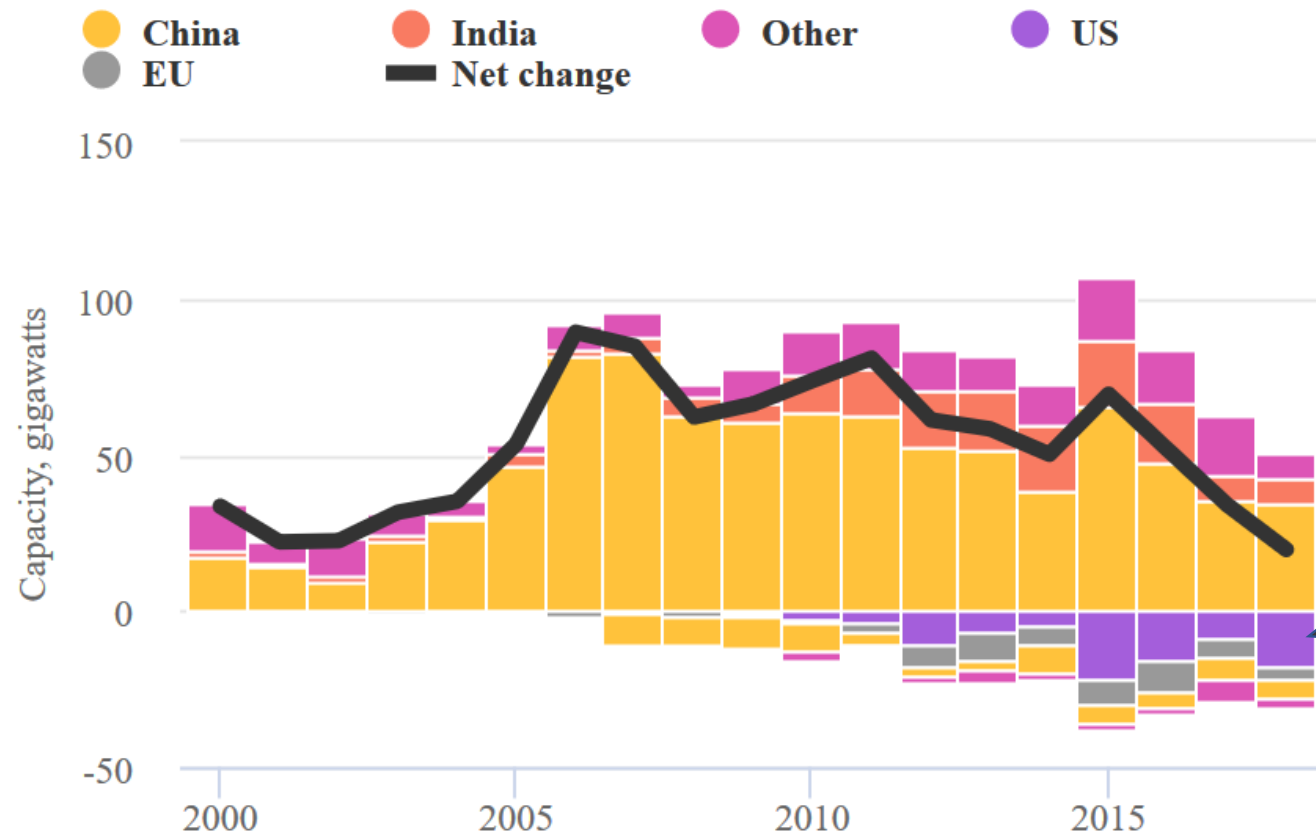
Source: Rogelj et al., 2018

Global coal fleet is increasing albeit at a slower pace



Source: Carbon Brief

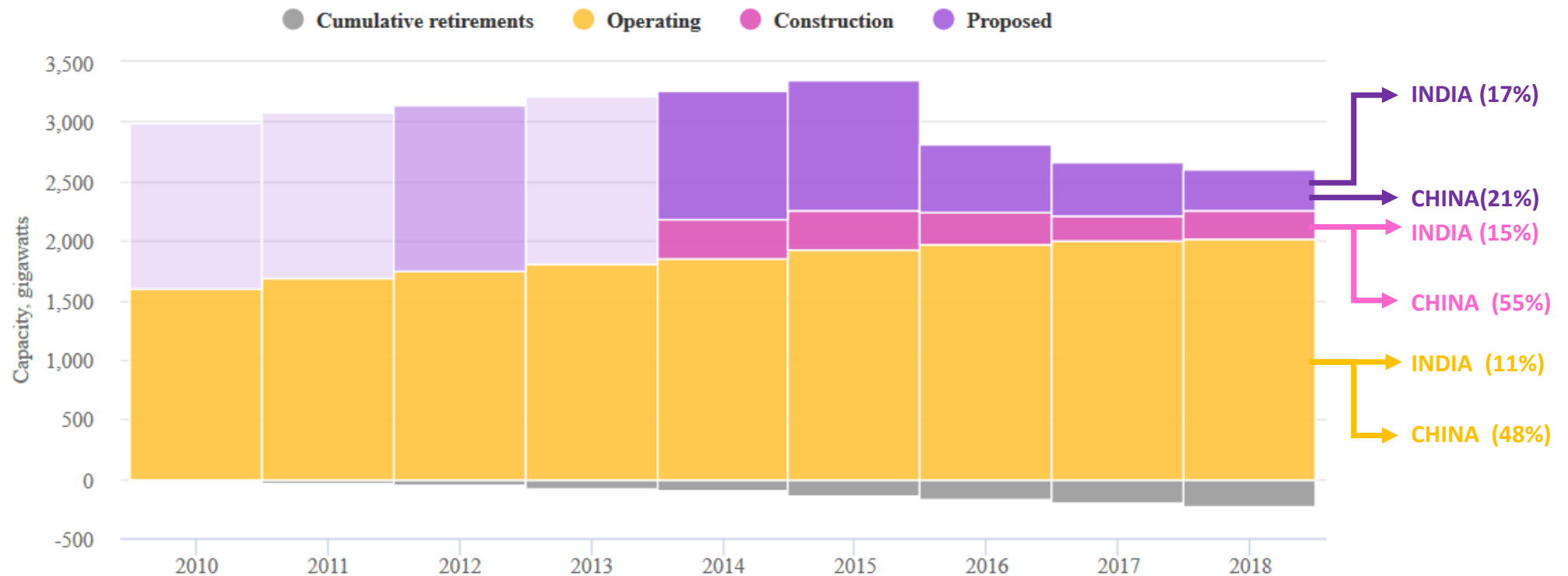
Global coal fleet is increasing albeit at a slower pace



***Paris Agreement:
Closing 70GW of
coal capacity
every year for the
next 30 years.***

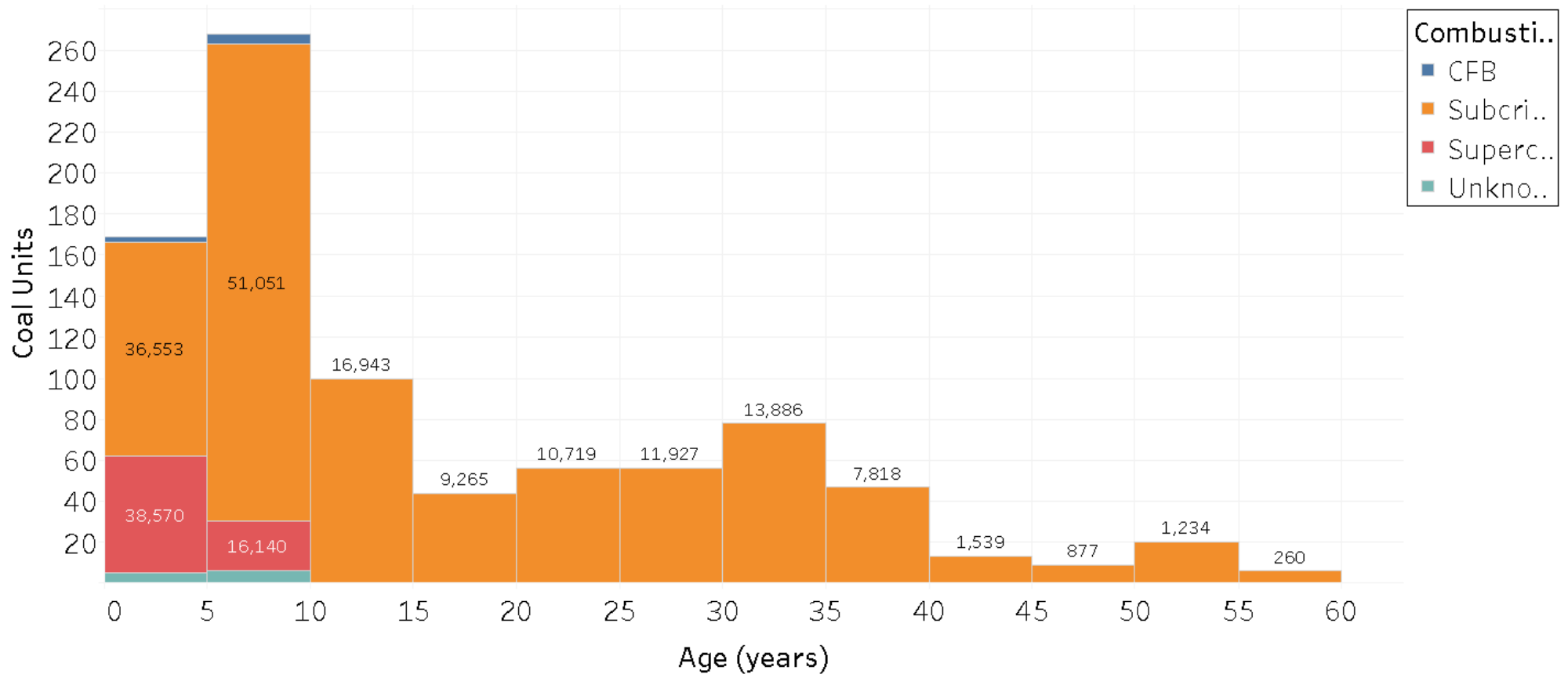
Source: Carbon Brief

After China, India has significant under-construction and planned coal plants

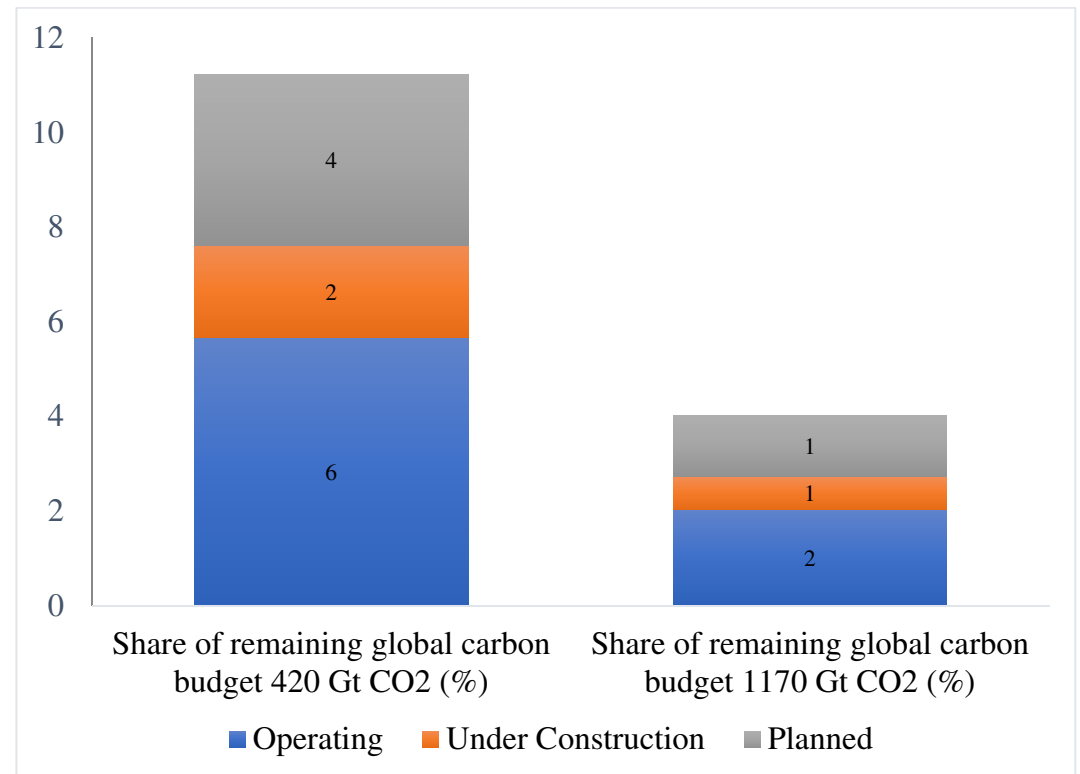
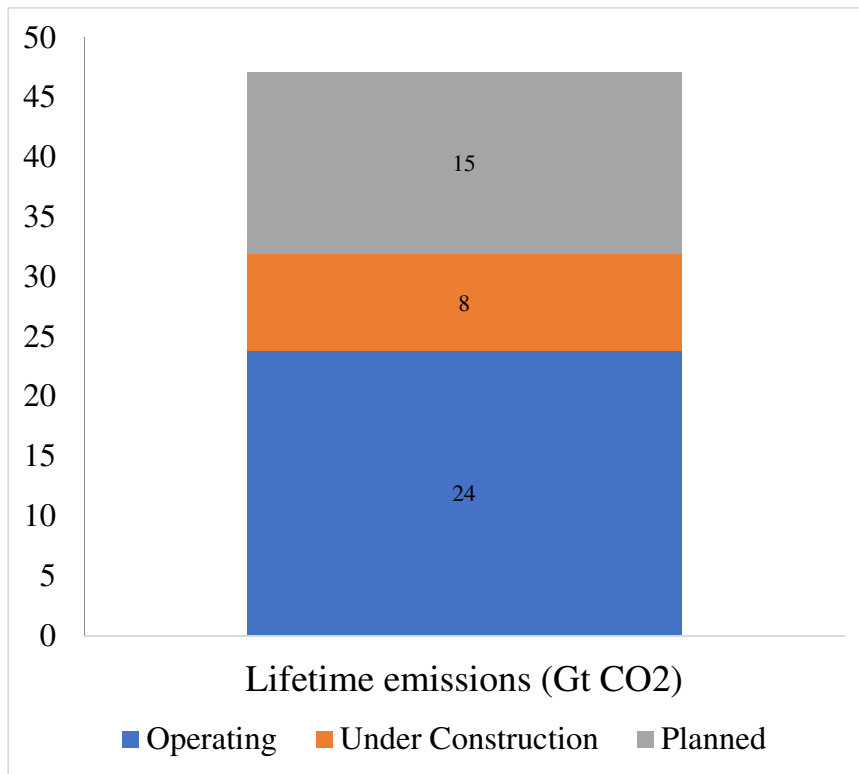


Modified from Carbon Brief

Most coal plants in India are young and inefficient.



Indian coal plants



India's NDC

- To reduce the **emissions intensity** of its GDP by 33 to 35 percent by 2030 from 2005 level.
- To achieve about **40 %** cumulative electric power installed capacity from **non- fossil** fuel-based energy resources by **2030** .
- To create an **additional carbon sink** of 2.5 to 3 billion tonnes of CO₂ equivalent through additional forest and tree cover by 2030.

Renewable Energy Targets – 175 GW in 2022 (excluding Large Hydro)

Solar – 100 GW

Wind – 60 GW

Remaining: Biomass and Small Hydro

Motivation

- How do current policies and NDC pledges:
 - Affect the future of coal power generation?
 - Impact future mitigation potential in line with the Paris Agreement?
- What are the potentials of coal alternatives to provide gross electricity?
- What short-term policies could help India to move to a cost-effective mitigation pathway?

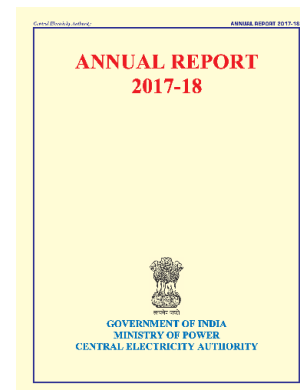
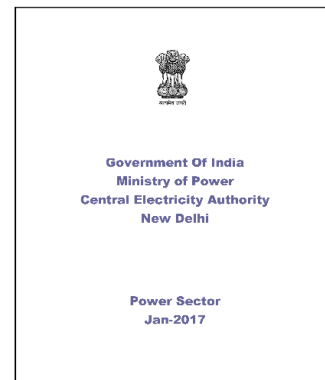
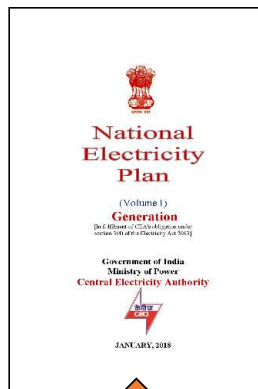
Scenario design

Scenario name	Description	National Models	Global Models
Early action	Currently implemented climate and energy policies till 2020 followed by a carbon budget constraint till 2050/2100.	Budgets represent the maximum mitigation effort, till 2050, possible through their models. Thus, the budget in AIM/Enduse is lower than the budget in India MARKAL	Same global carbon budget across all models (2011-2100 of 1000 Gt CO2 for total CO2 emissions including anthropogenic land-use)
Delayed action	Currently implemented climate and energy policies and NDC till 2030 followed by carbon budget constraint till 2050/2100, without anticipation of the constraint prior to 2030.		

Participating models

Global	National
AIM	INDIA MARKAL
IMAGE	AIM/ENDUSE
REMIND	
WITCH	
GEM_E3	
POLES	

Bottom-up sources



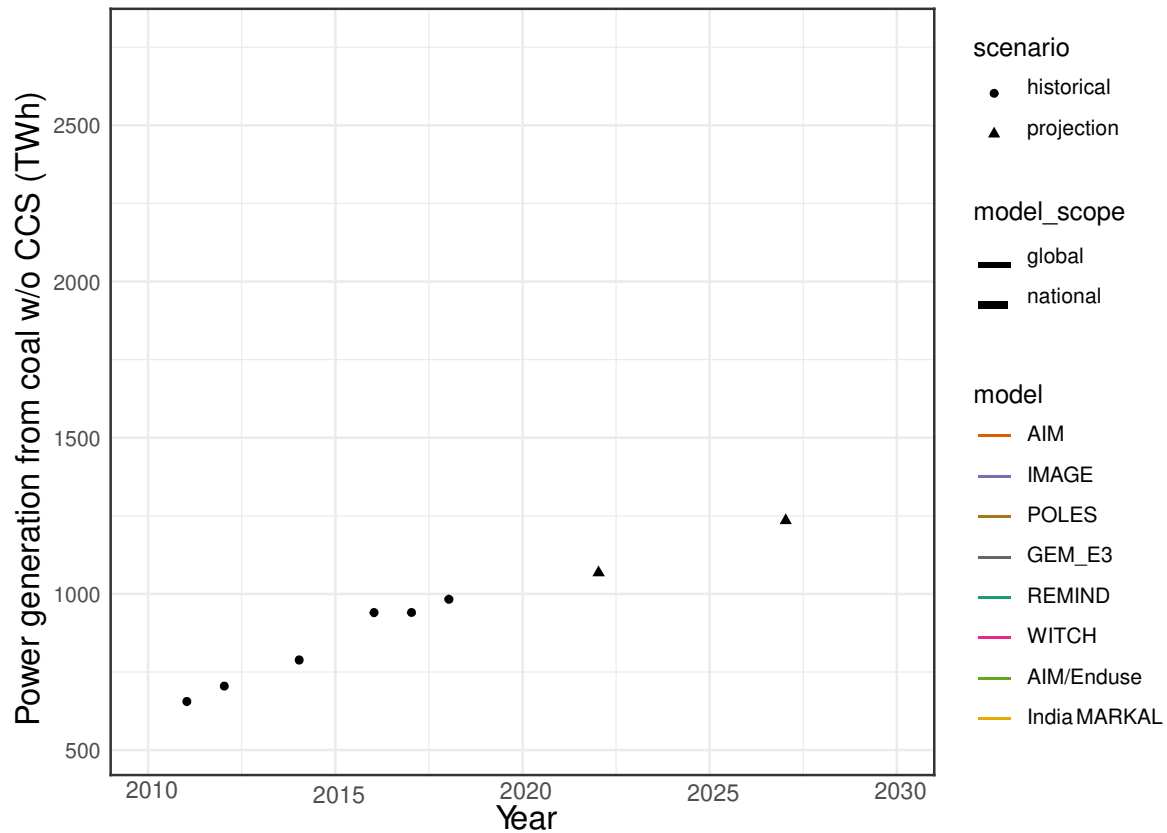
National Electricity Plan, January 2018
Central Electricity Authority (CEA)



Results

Coal power generation increases under NDC

Delayed action

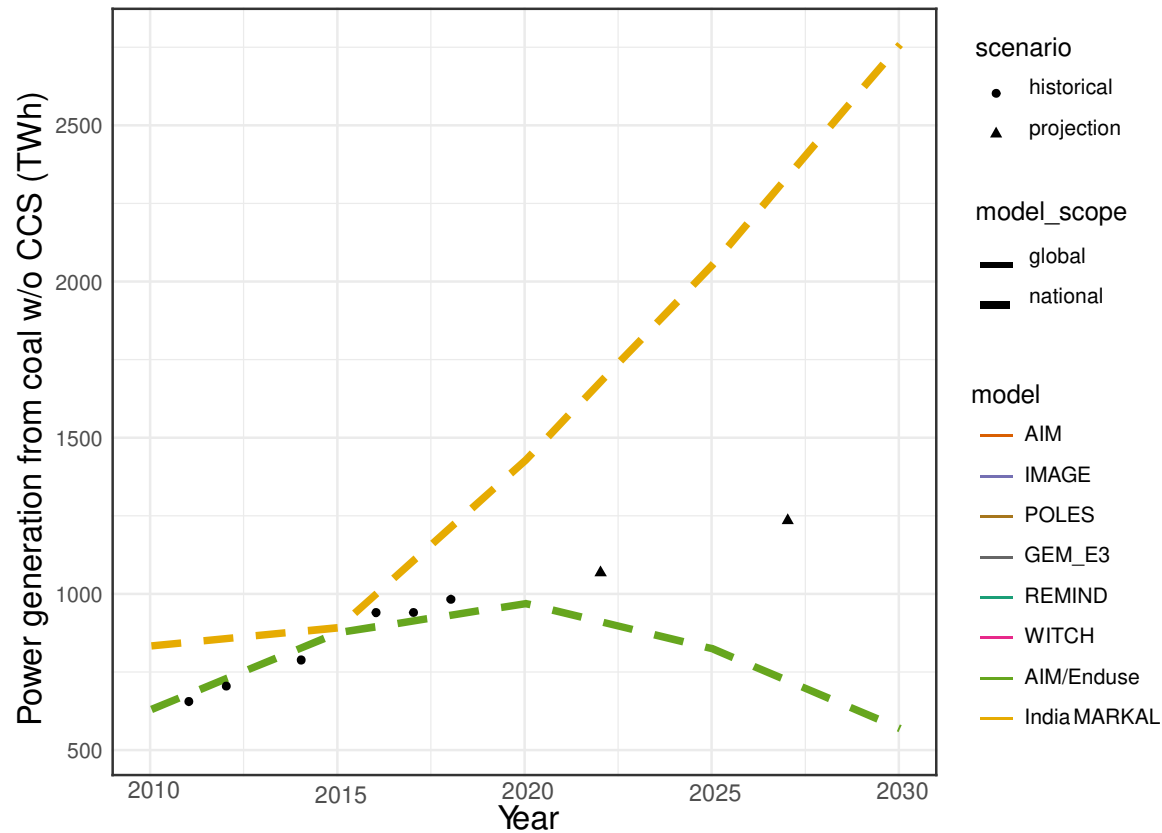


Bottom-up:

616 to 1670 TWh in 2030 (X 2.7)

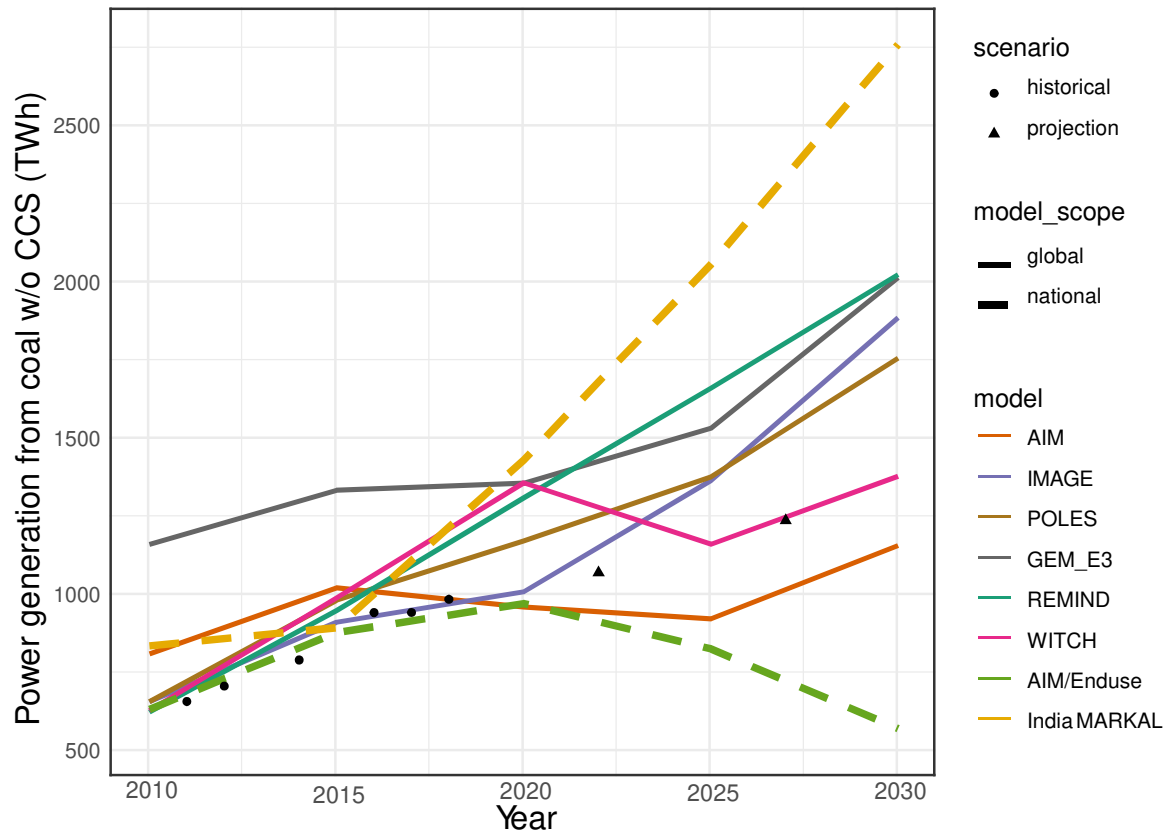
Coal power generation increases under NDC

Delayed action



Coal power generation increases under NDC

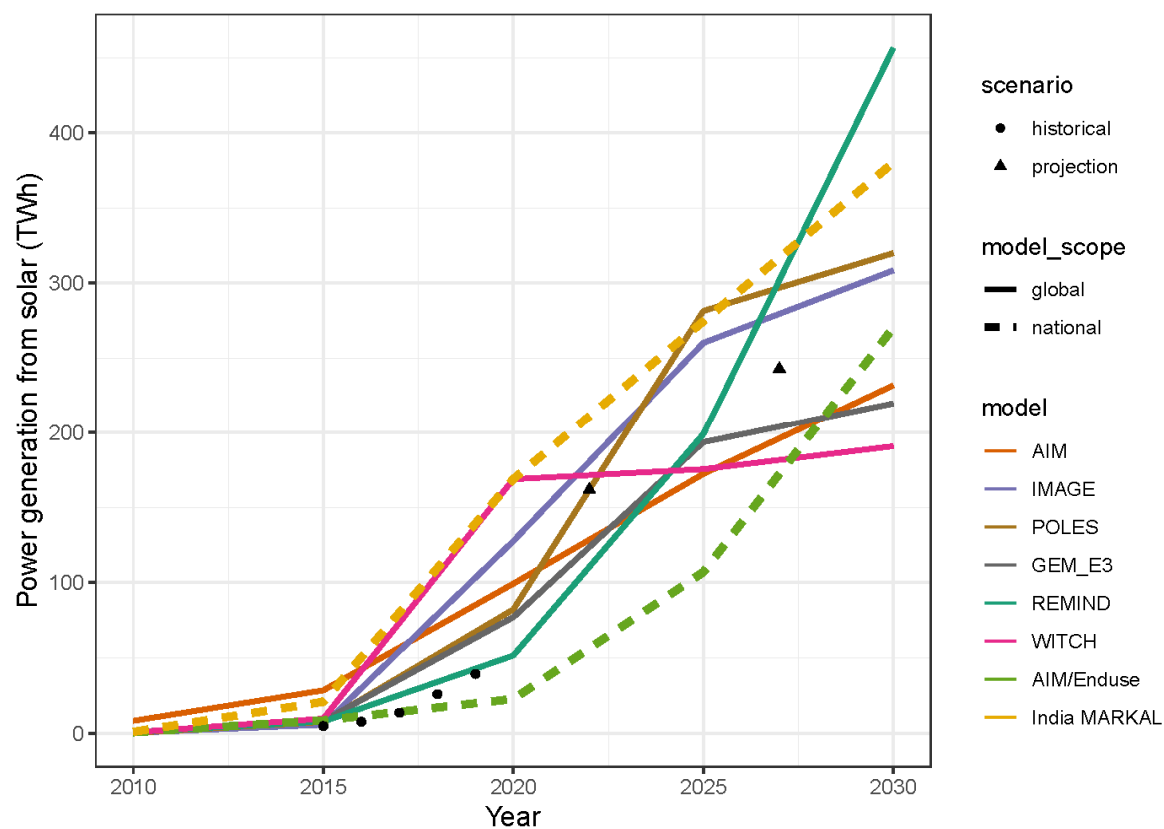
Delayed action



- Most models project that under NDC policies India will continue to build coal power plants
- Large model spread in 2030 (1158-2764 TWh) but many within bottom-up (1670 TWh) projections.

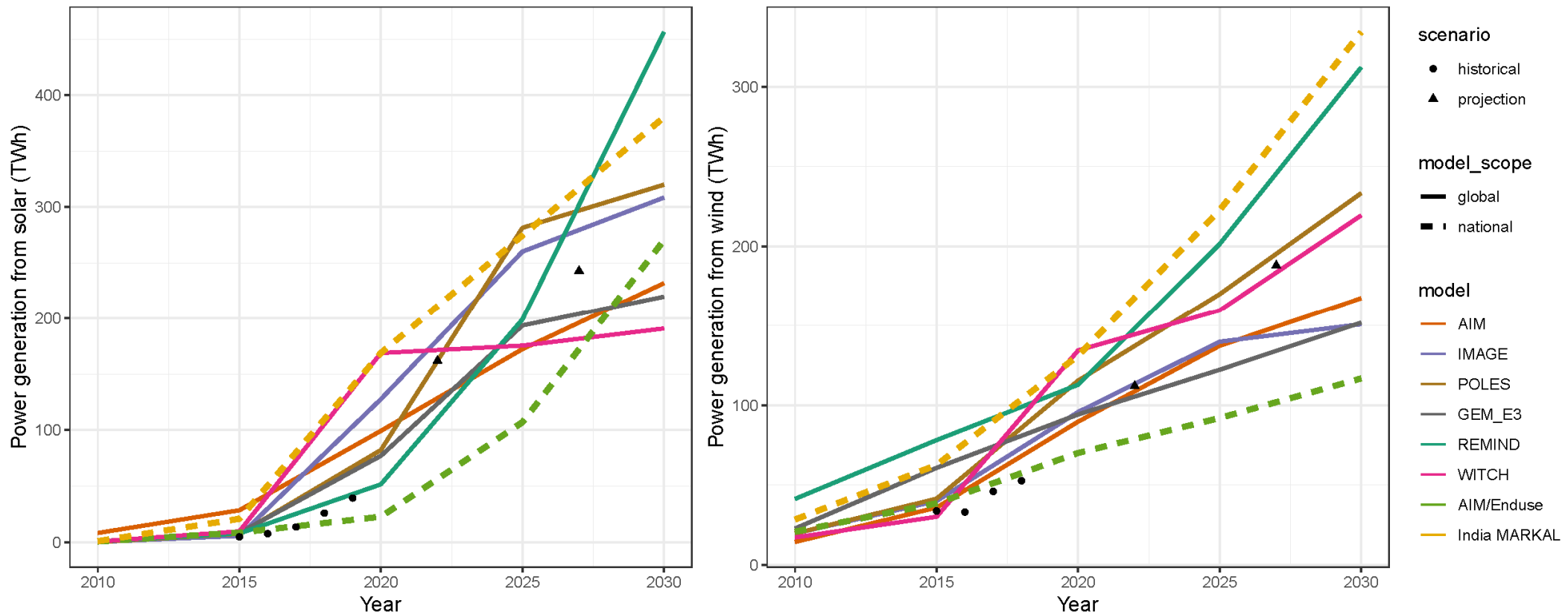
Significant increase in **Solar** and **Wind** under NDC

Delayed action



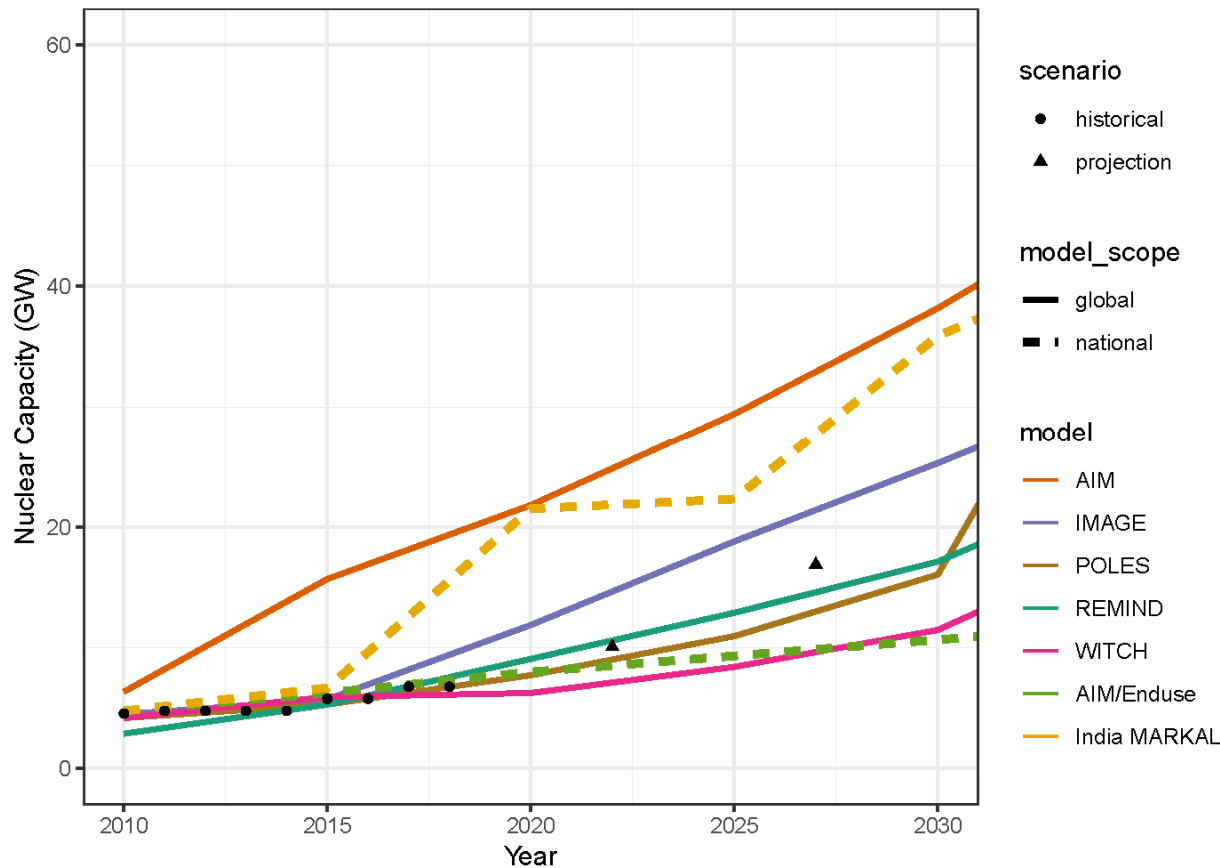
Significant increase in **Solar** and **Wind** under NDC

Delayed action



Role of **nuclear** in future decarbonization likely low

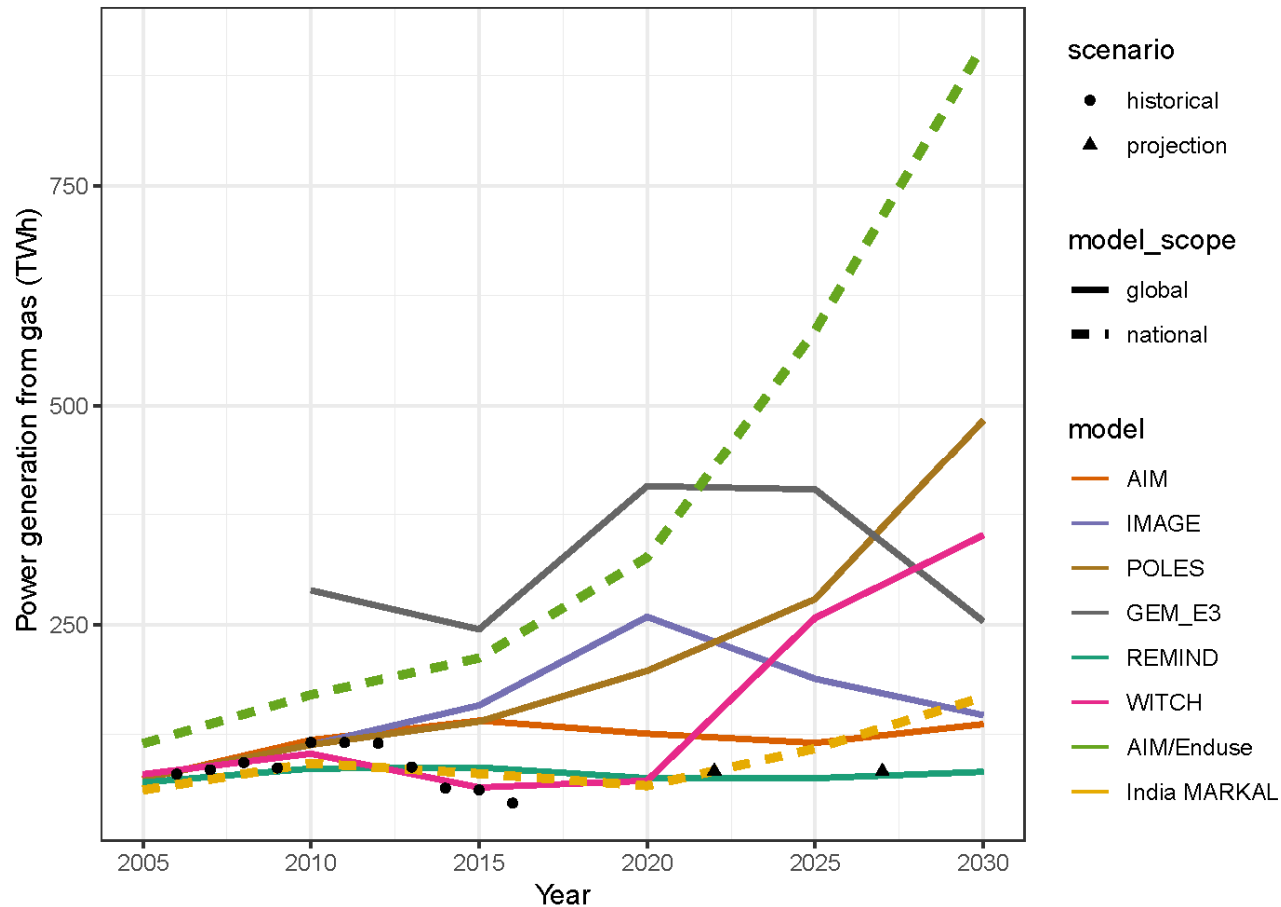
Delayed action



- Slow net addition: Up to 2x Longer construction times in India compared to world average.
- Under direct control of government control – no private entry.

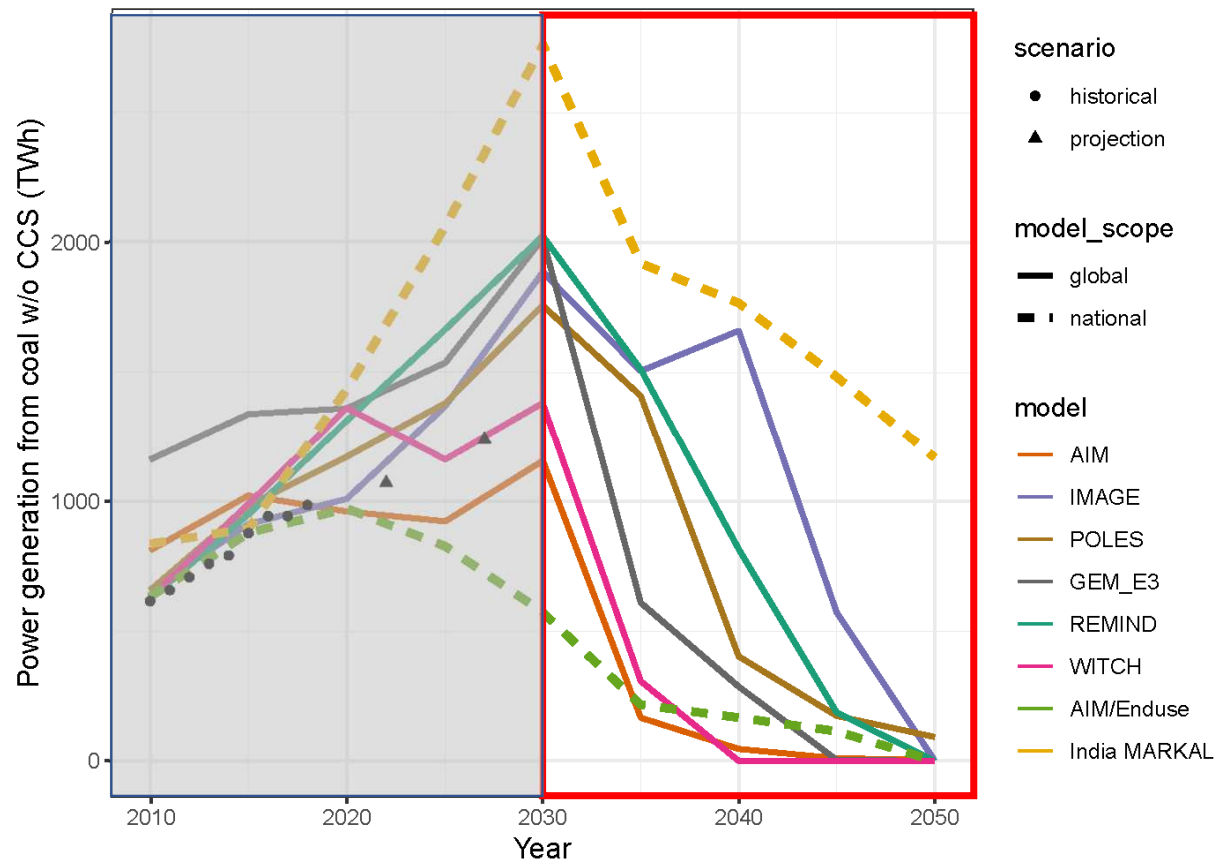
And the same for **gas**- although many models are optimistic

Delayed action



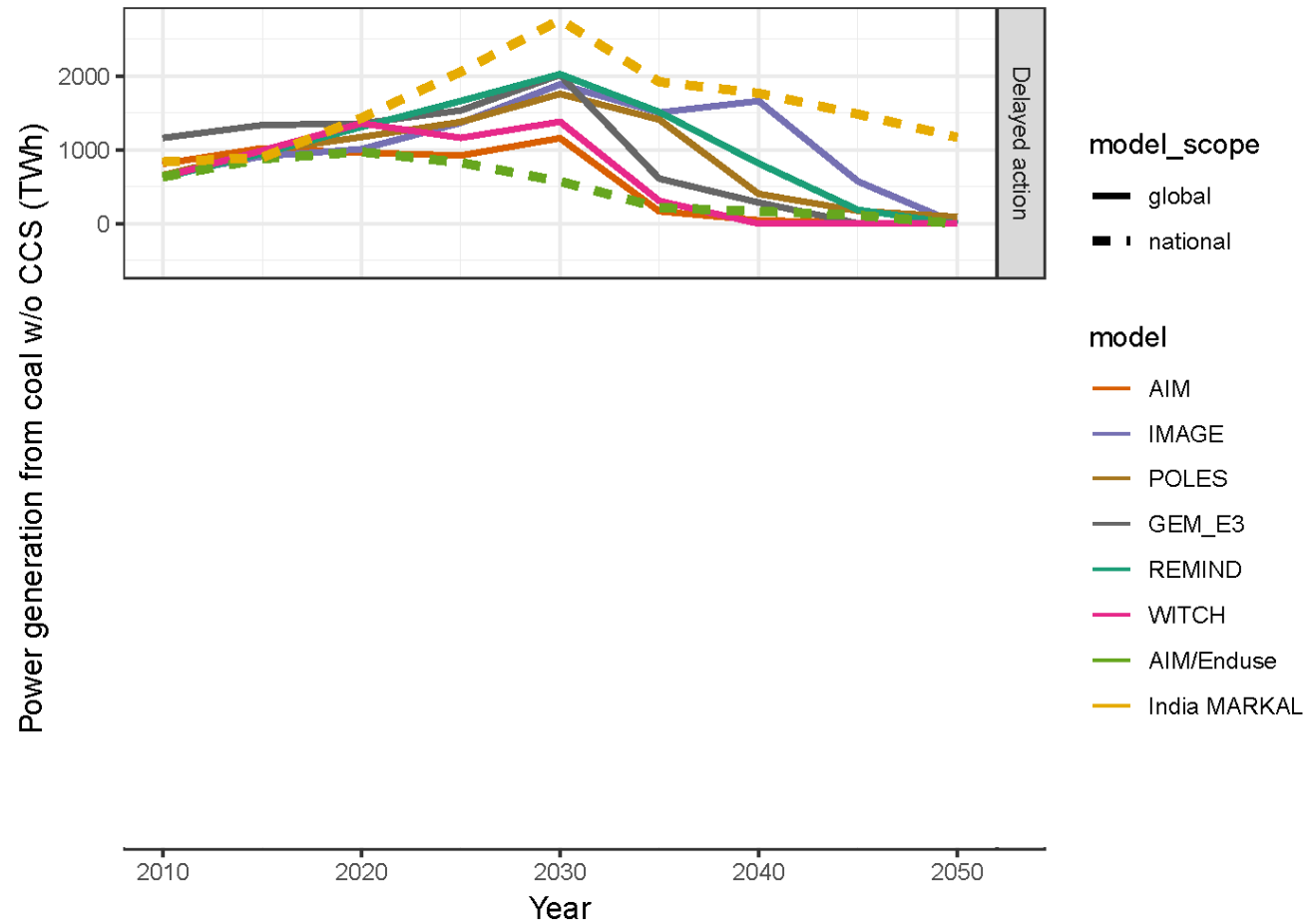
- Decreasing gas generation (scarcity, high prices of imported LNG).
- Current stranded gas capacity of 14 GW.
- Some models are very optimistic about the potential for gas.
- Optimistic projections seem questionable, especially in global models, which in most cases do not explicitly represent bilateral trade or gas infrastructure.

Drastic reductions in coal power generation to reach WB2C target

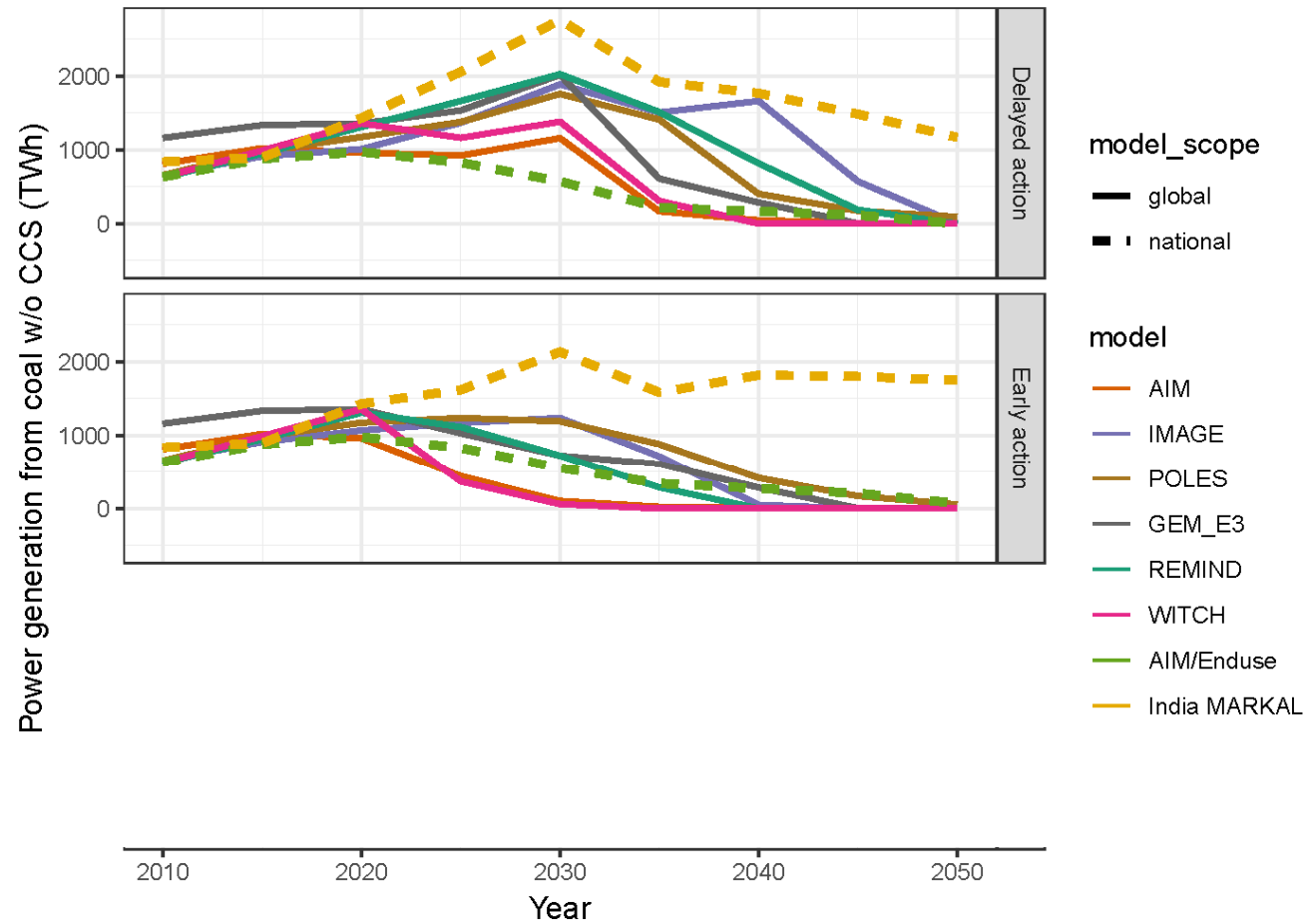


- Coal based generation steeply declines post 2030 (reducing capacity factor, early retirement), with complete decarbonization in global models.

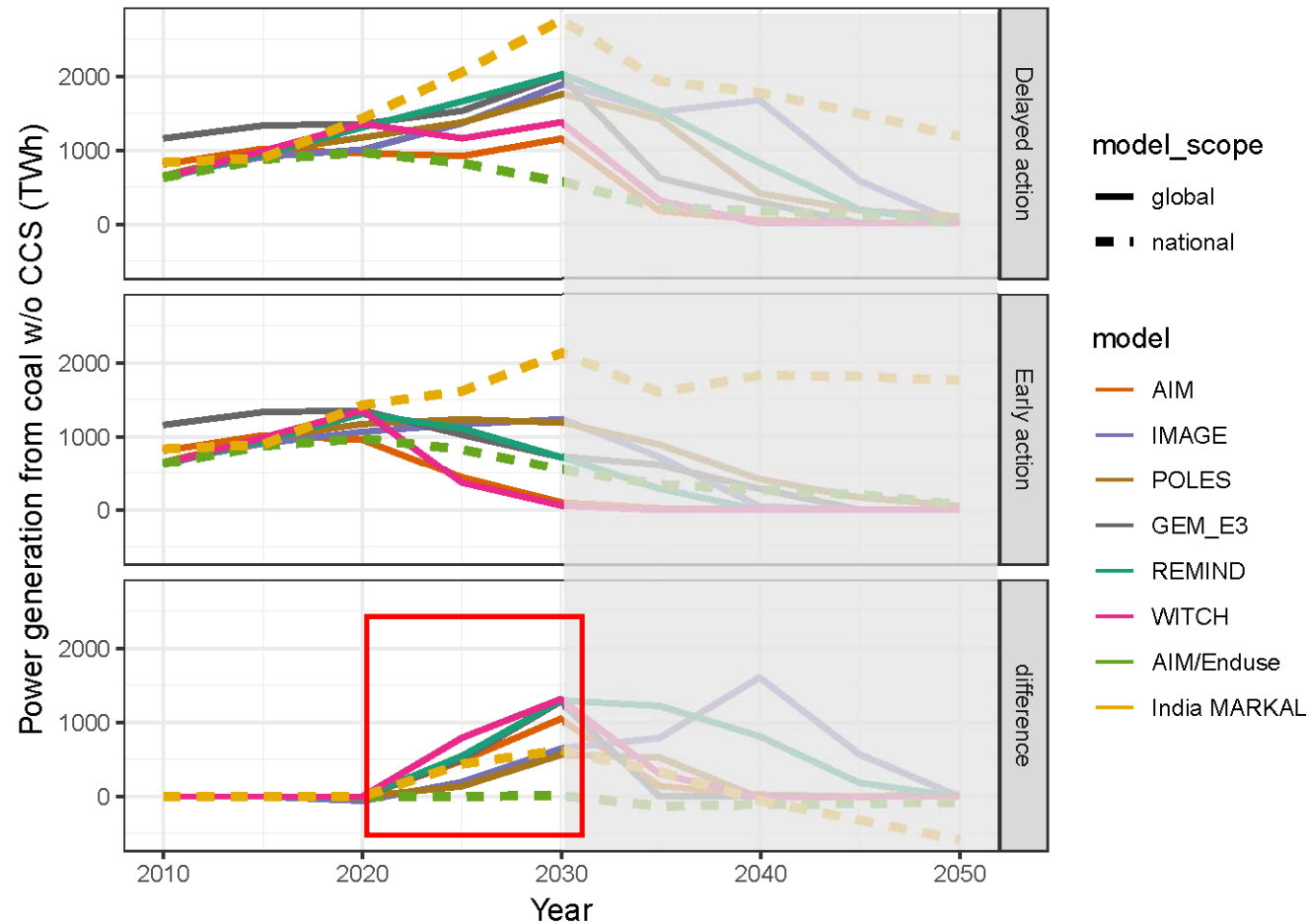
Early action



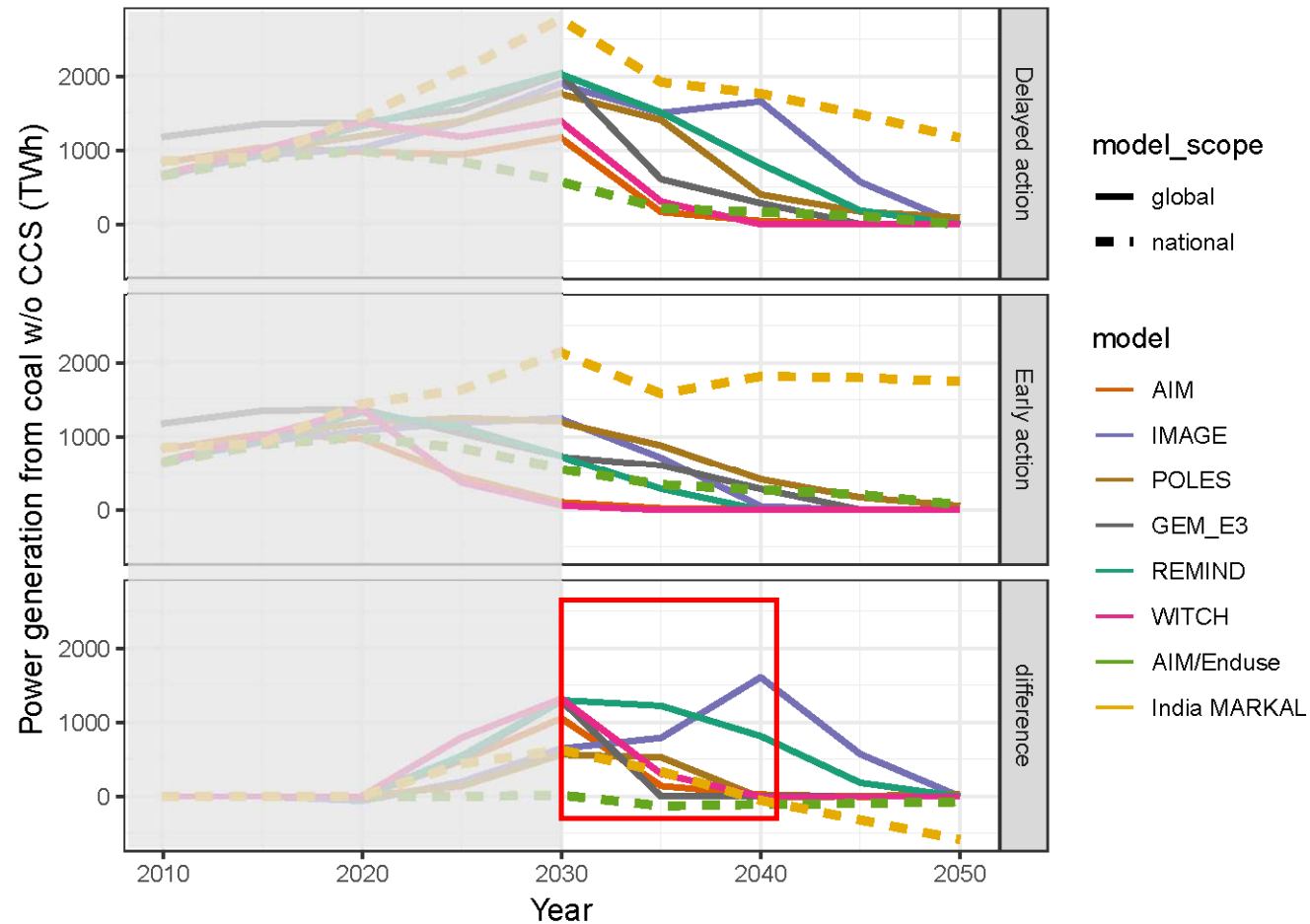
Early action



Early action avoids near-term coal build-up



Leading to lesser “stranding” but not eliminating it



Leading to lesser “stranding” but not eliminating it

Important:

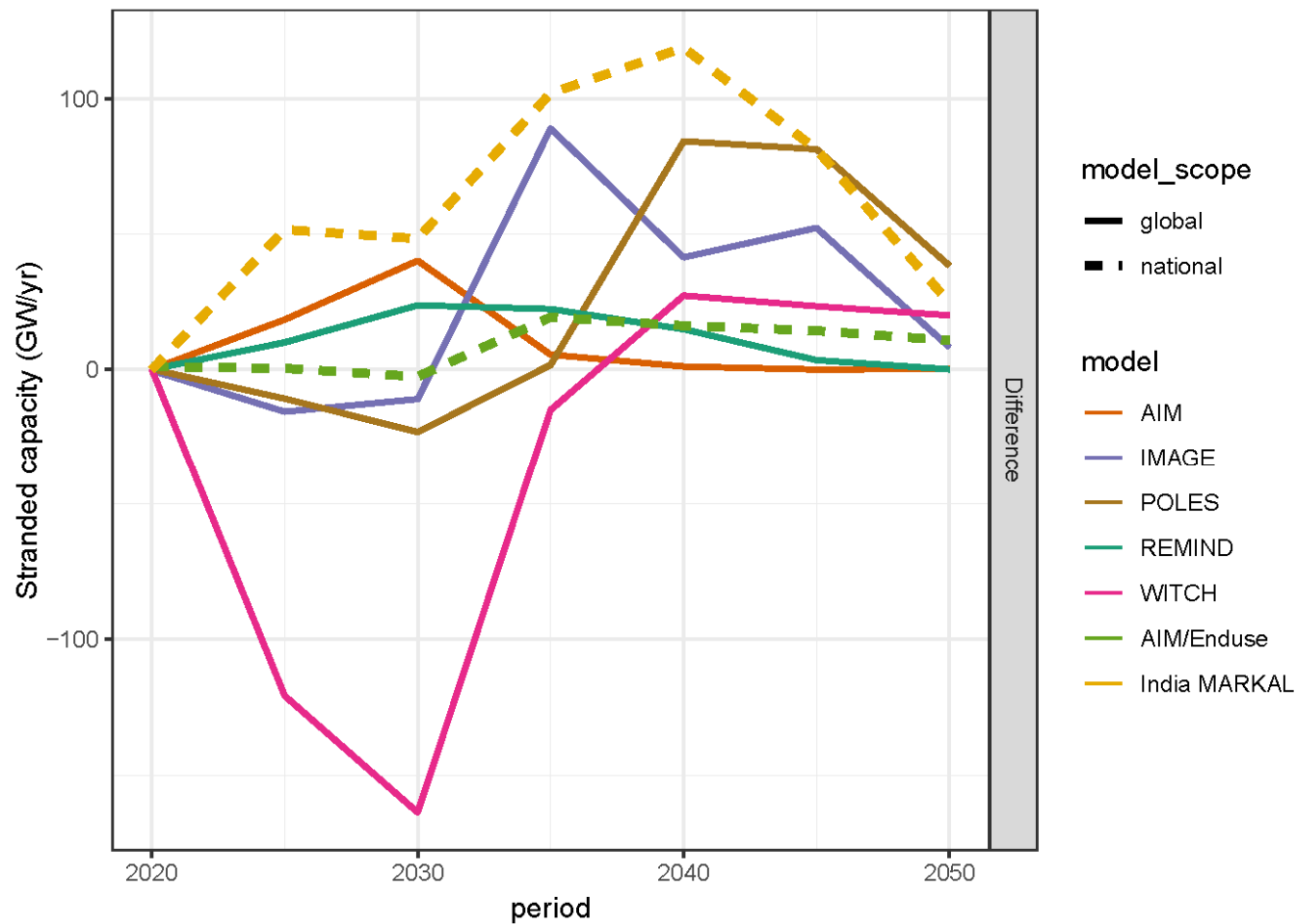
In Early action, only existing plants become stranded, planned without anticipation of low RE cost reductions and PA whereas in delay scenarios, these plants have yet to be built!

How much stranding?

As carbon price increases, coal producers run plant at low PLF (stranded), till a point is reached where plant must be retired early.

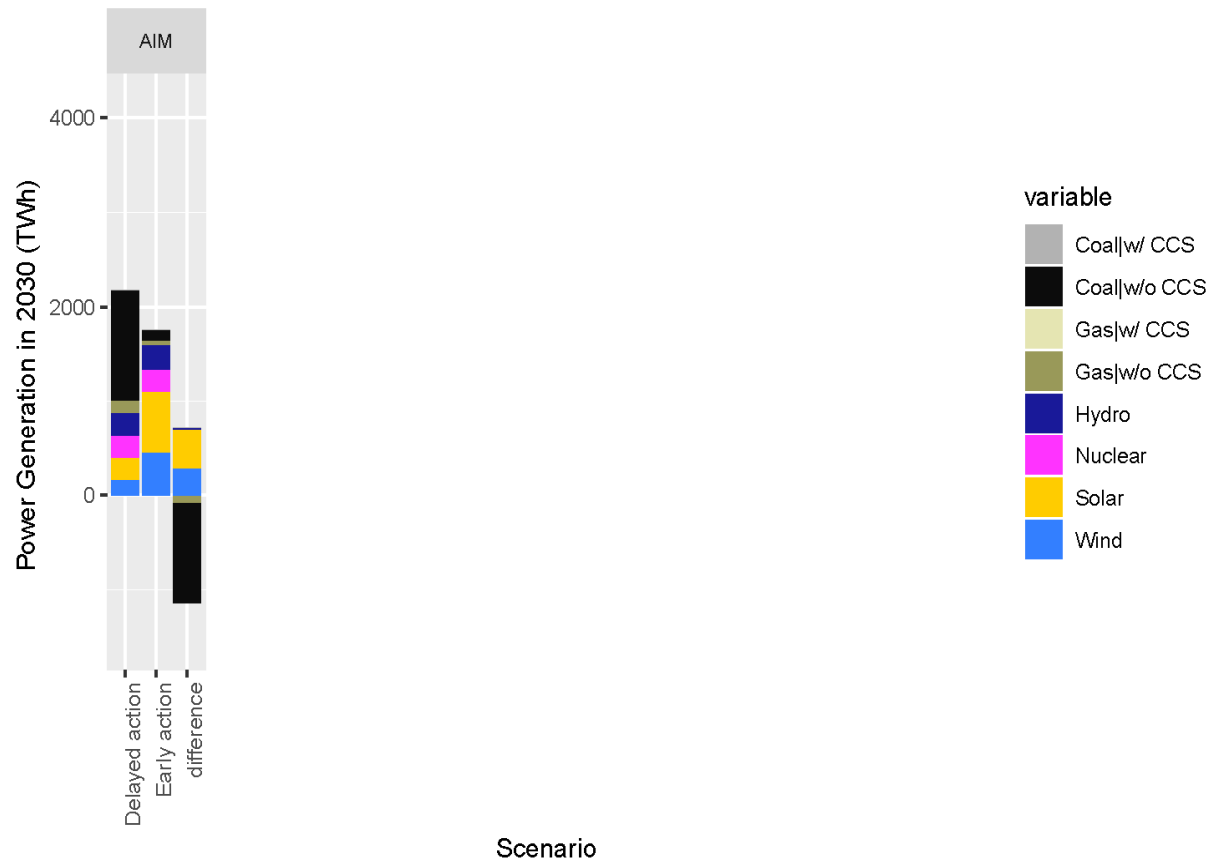
Stranded capacity is defined as the difference in needed capacity (calculated from secondary energy of coal and based on a capacity factor of 0.75) and actual capacity (from Johnson et al., 2015).

How much stranding?

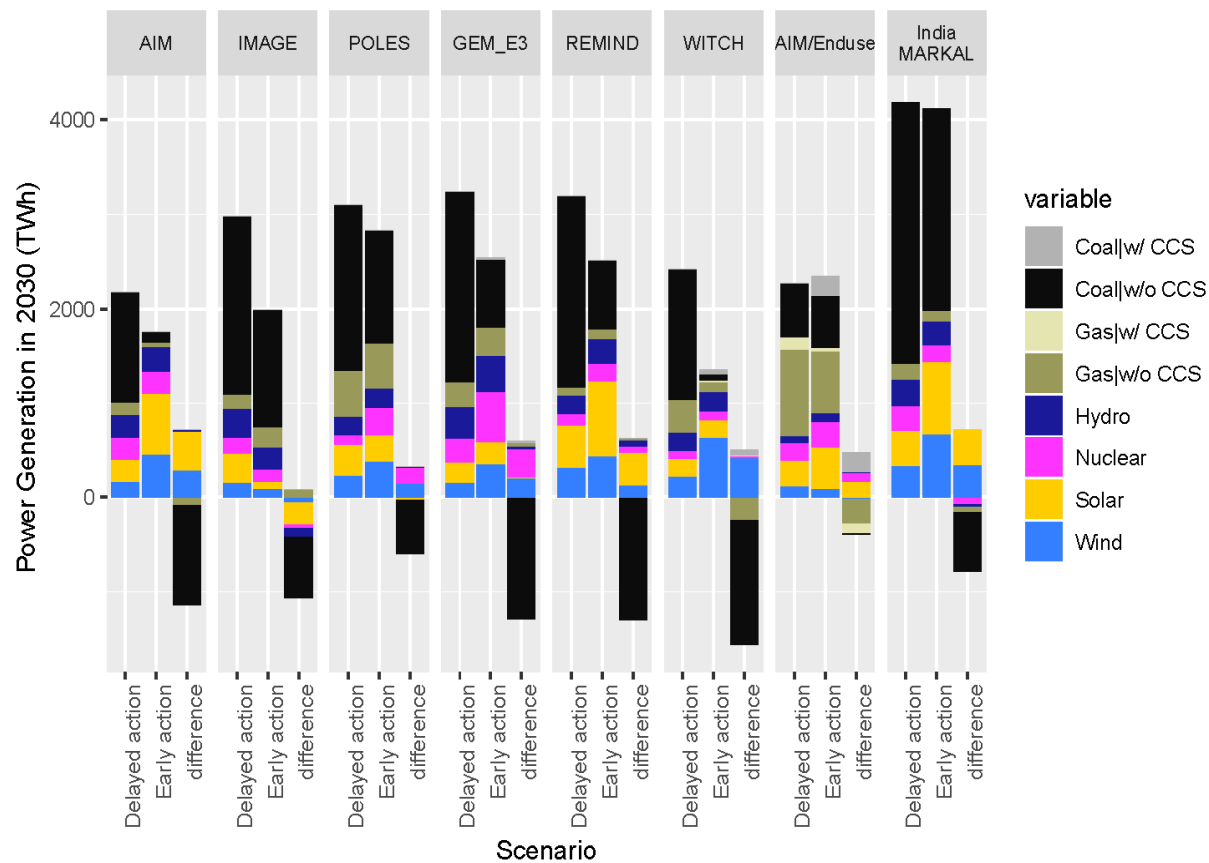


- Large range, however positive.
- 5-120 GW stranded capacity in 2040

Early action- growth of renewables



Early action- growth of renewables



Coal decrease : 500 – 1800 TWh

Solar increase: 50-500 TWh

Wind increase: 10-300 TWh

Policies required to limit coal power production!

- Without explicit policies to limit coal based power generation, coal plants continue to be built. In spite of ambitious RE targets!
- Political infeasibility of immediate and high carbon price -> need for short term technological policies to be in line with Paris Agreement for e.g., no more new coal beyond 2022 and continued natural retirement.
- Such a policy would prevent carbon lock-ins -thereby reducing stranded assets, assisting future ambitious climate

“ . . . ” . . . “ . . . ” . . .

Limitations

- Results don't include climate damages and avoided impacts
- Societal co-benefits or trade-offs of the pathways, and specific environmental constraints like water-use, are absent.

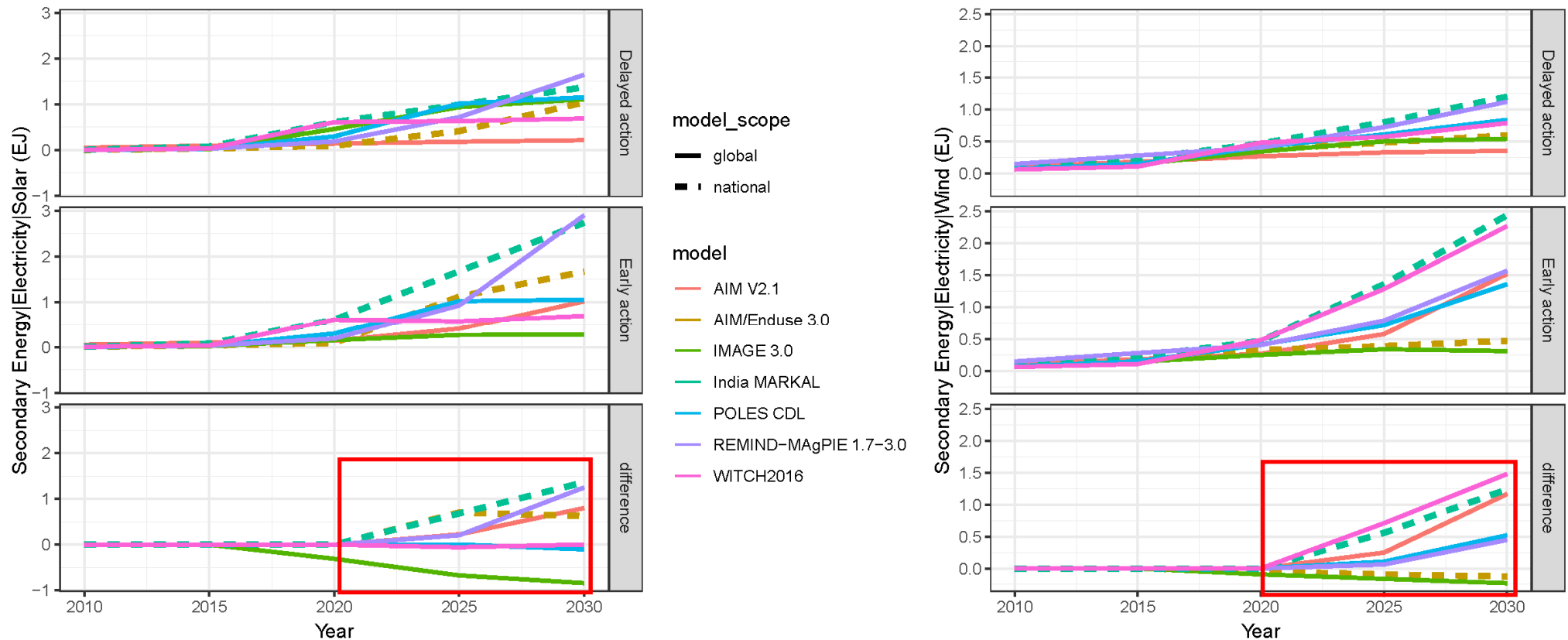
Thus, detailed analysis of the impact of alternative pathways for electricity access would be an important complement!

Conclusions

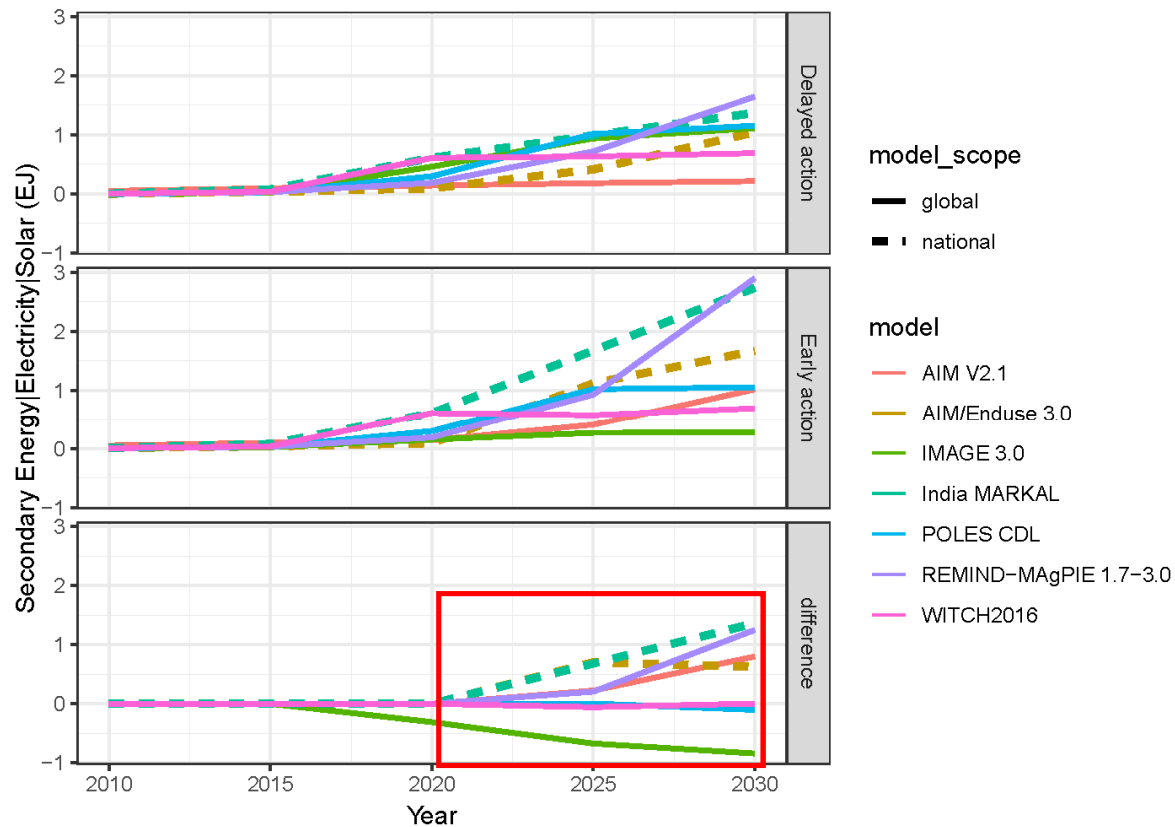
- India most likely continues to build coal plants under an NDC scenario; leads to early-retirement of coal under cost-effective mitigation.
- Solar and Wind more likely dominate future low-carbon energy mix, compared to nuclear and gas.
- To move towards cost-effective PA, a big step would be not building any more coal beyond under-construction; reducing stranded assets.

Questions and Discussion

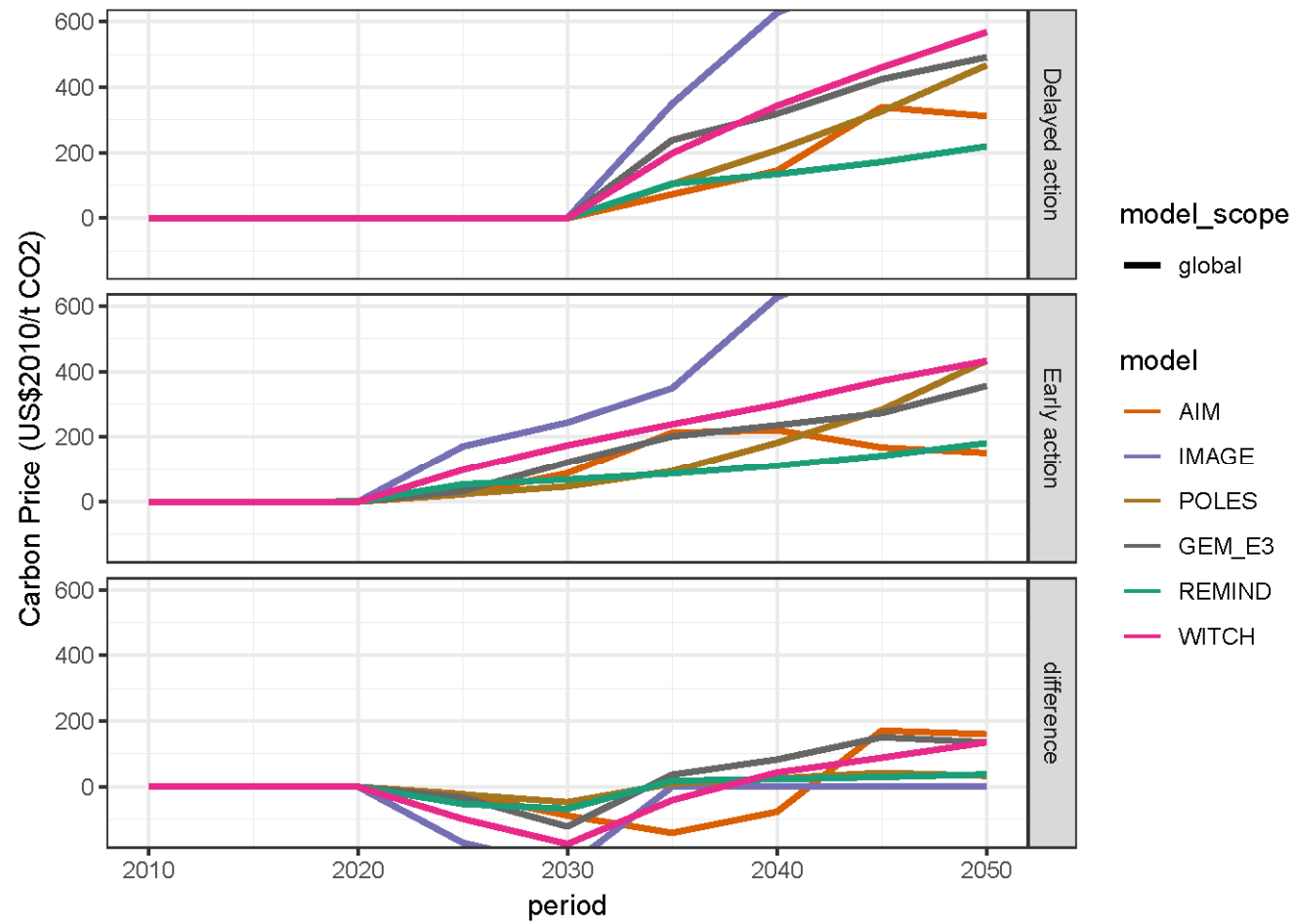
Early action increases near-term addition of both solar and wind



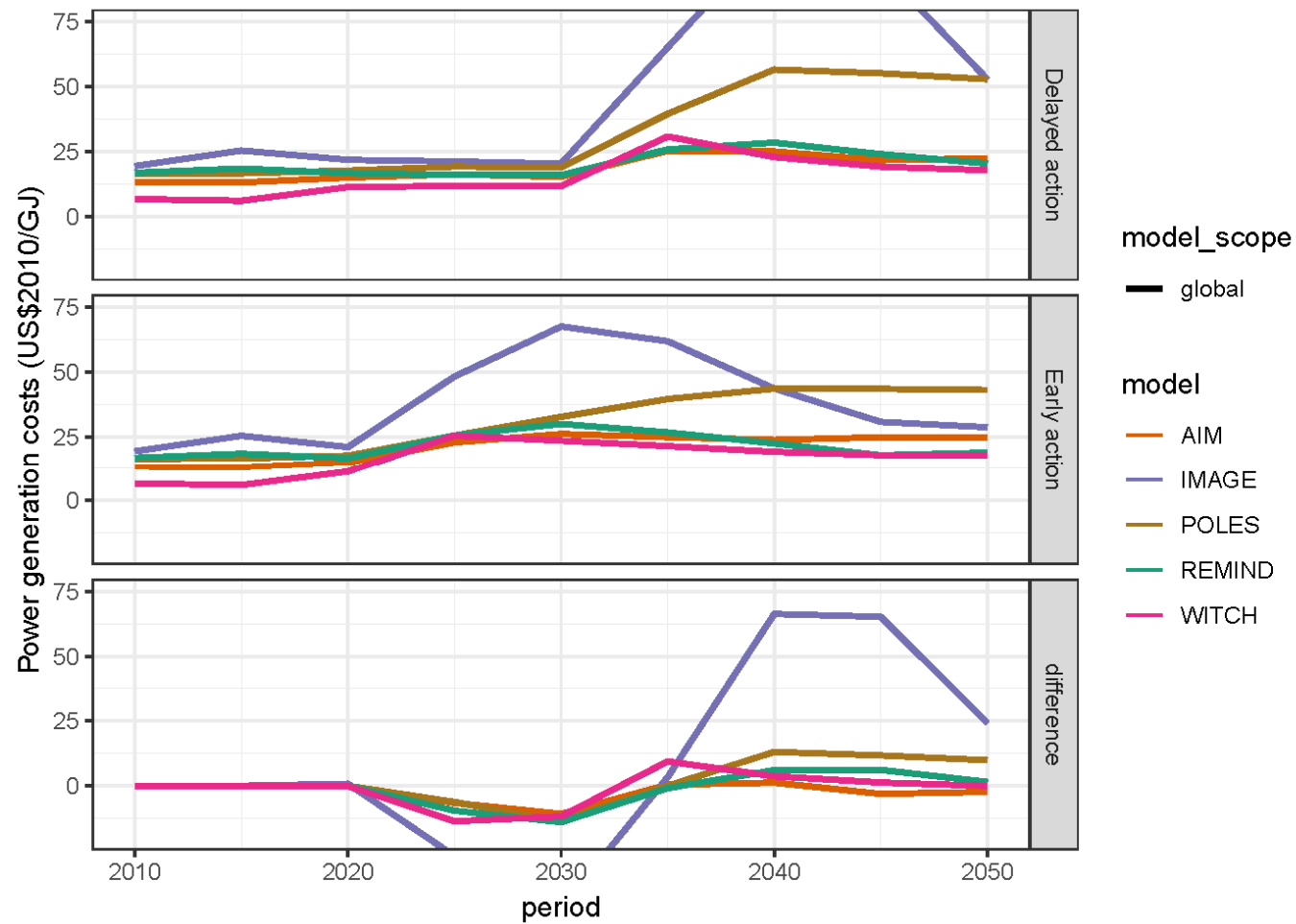
Early action increases near-term addition of both solar and wind



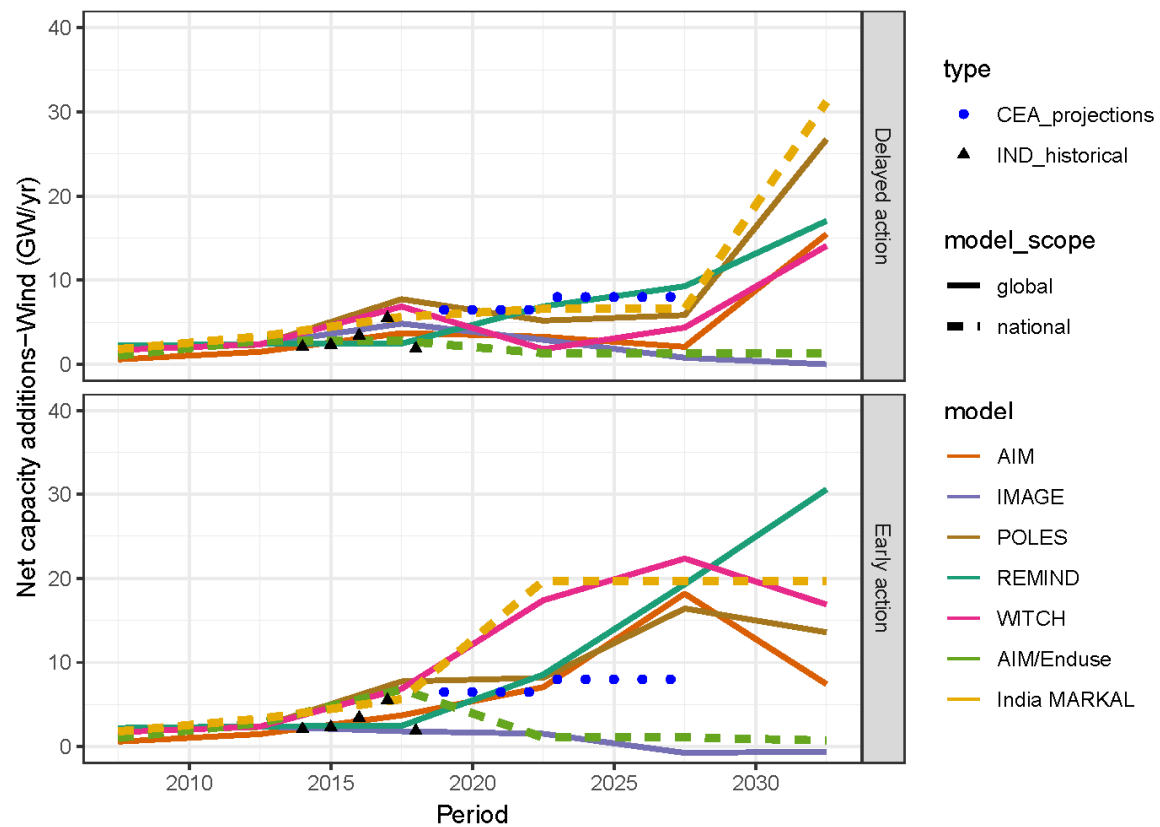
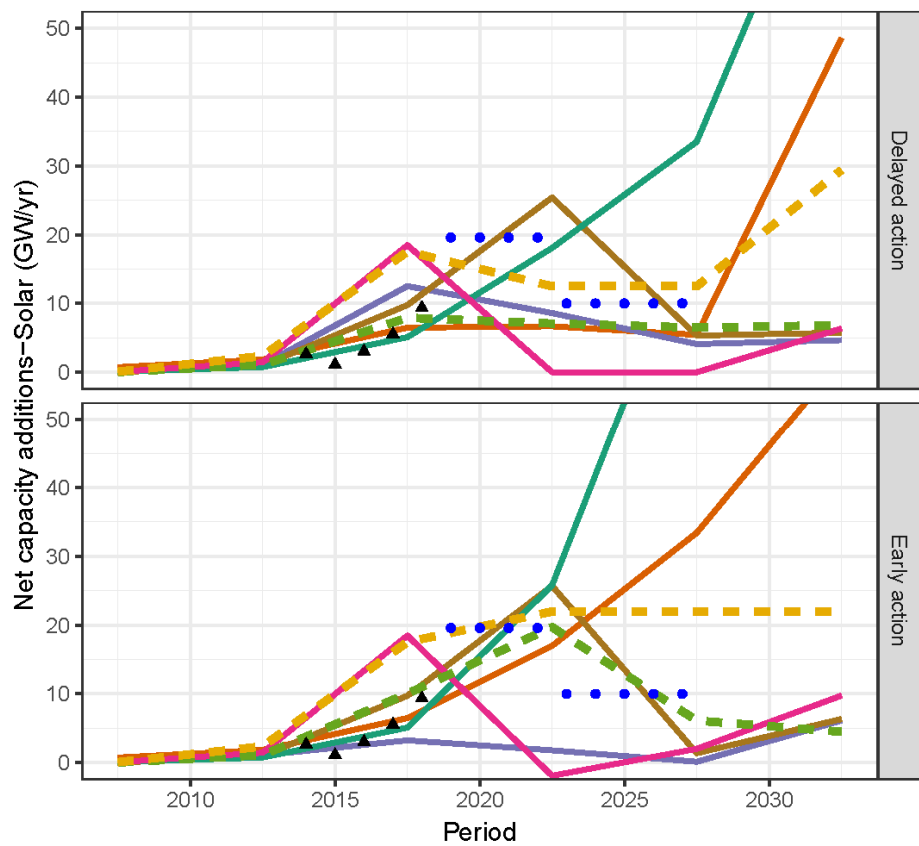
Carbon Price



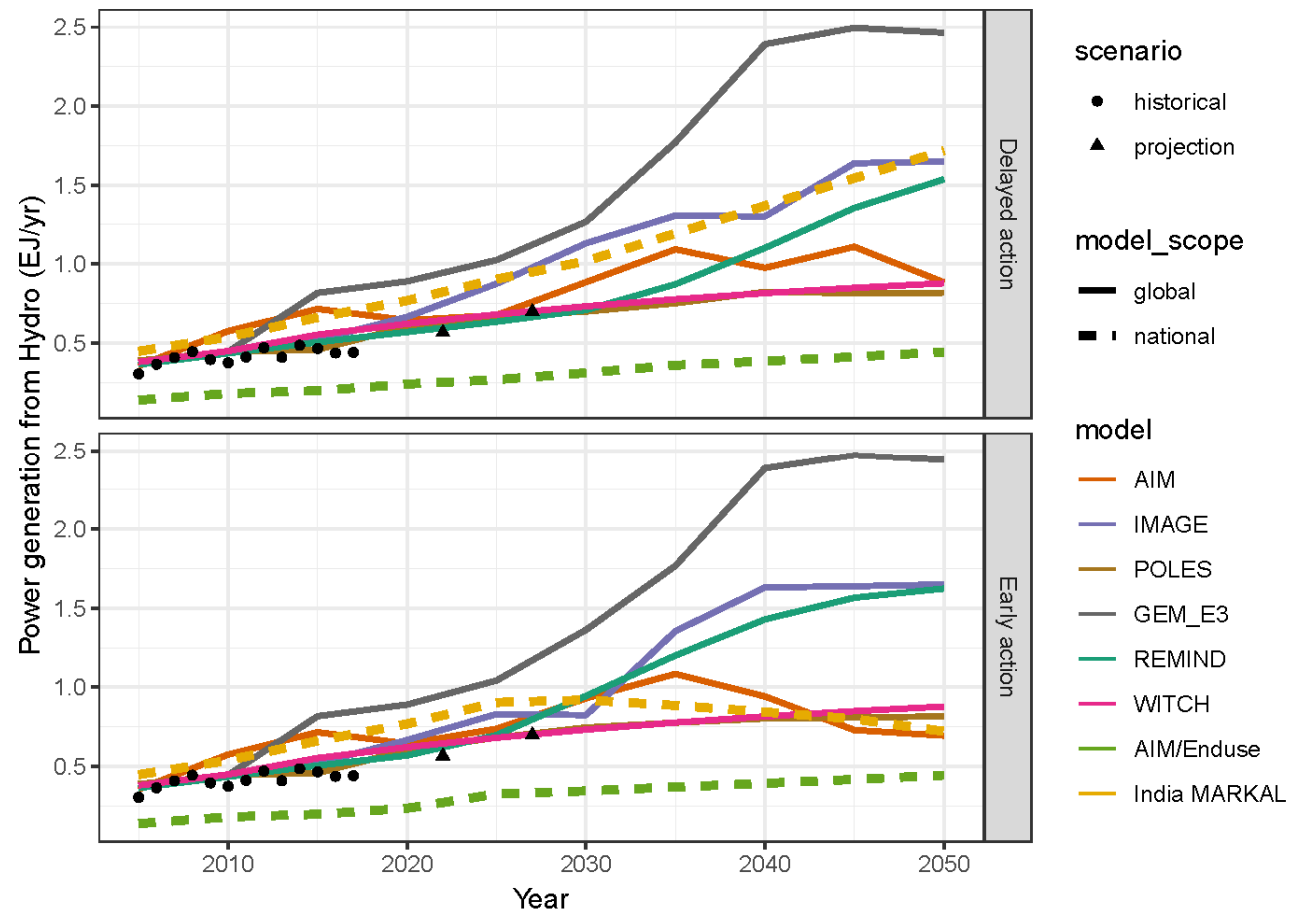
Generation costs



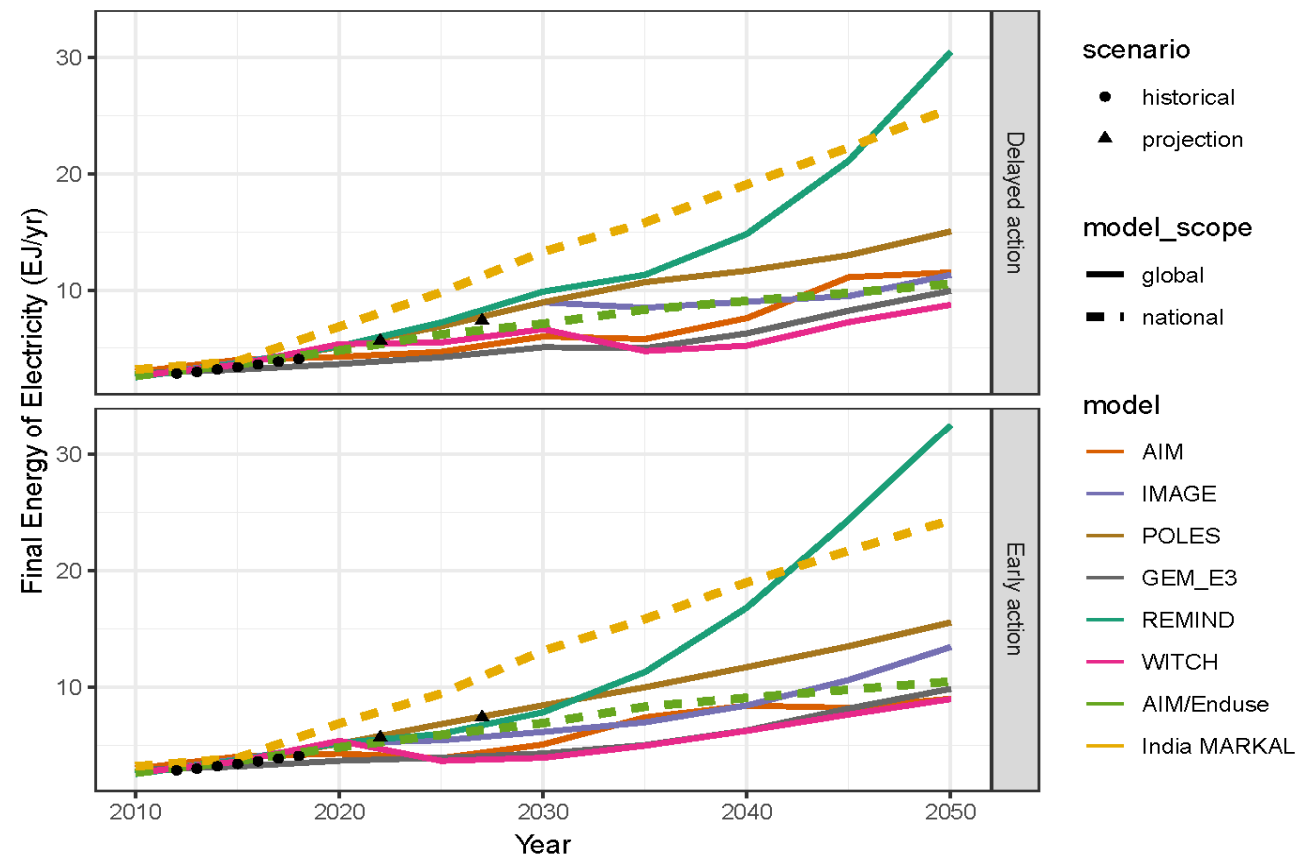
Capacity additions



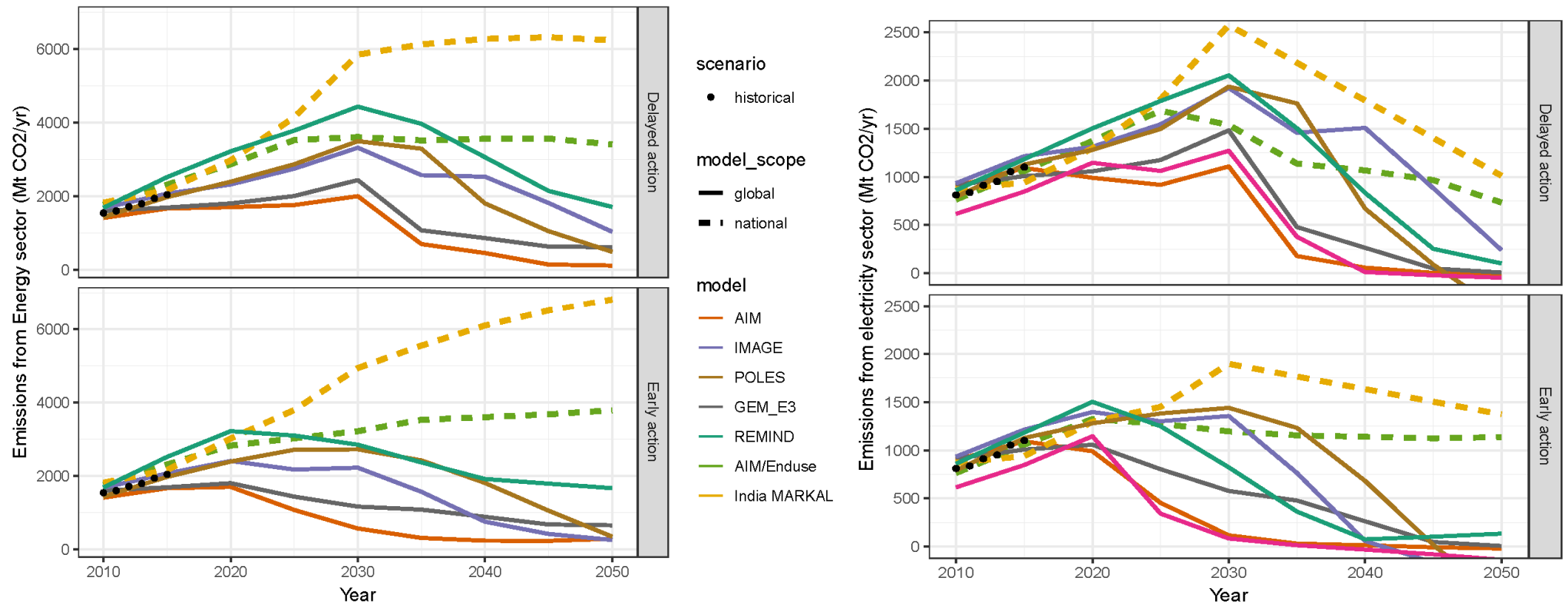
Power generation from Hydropower



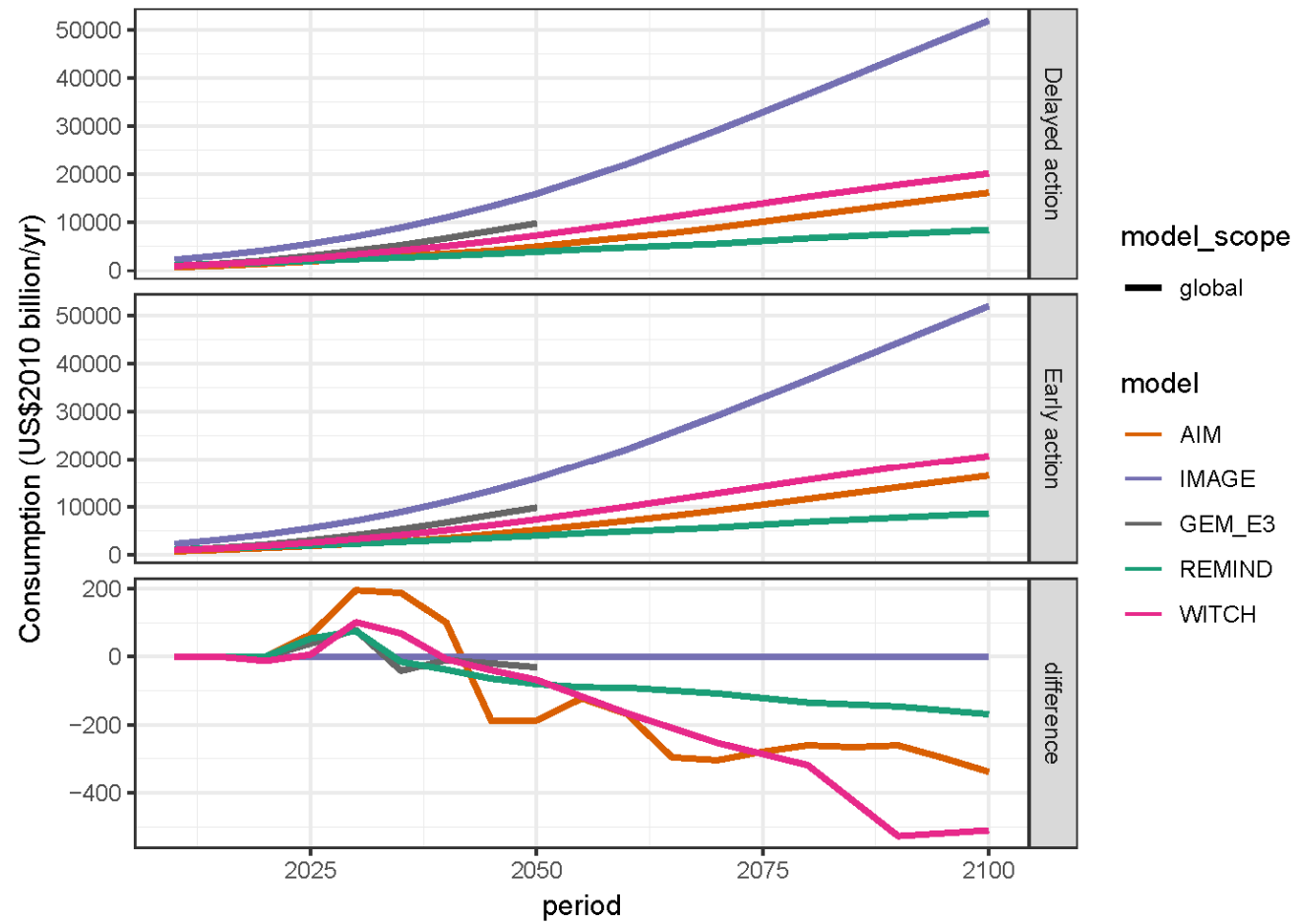
Final Energy of Electricity



Emissions



Consumption



Model	Emissions intensity (GDP) reduction of 33 to 35 percent by 2030 from 2005 level	40 % non-fossil installed capacity by 2030
AIM	61.4	0.458
IMAGE	56.5	0.491
POLES	39.3	0.505
REMIND	21.3	0.546
WITCH	40	0.480
AIM/Enduse	35	0.40
India MARKAL	50.3	0.474