“NOT ANOTHER COAL STORY”

NEAR-TERM POWER SECTOR TRANSITIONS IN INDIA

15 May 2019
Seminar #3

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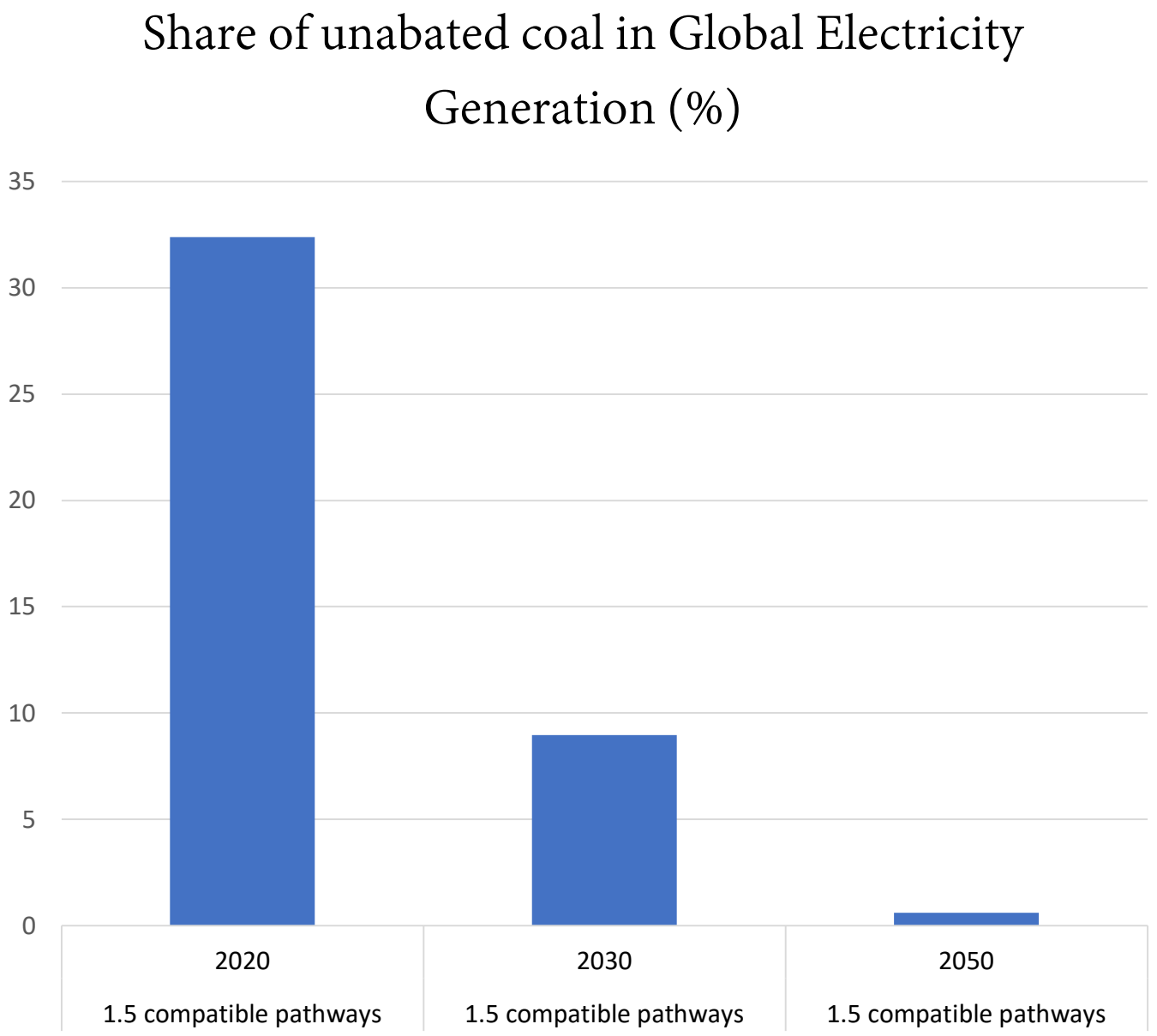
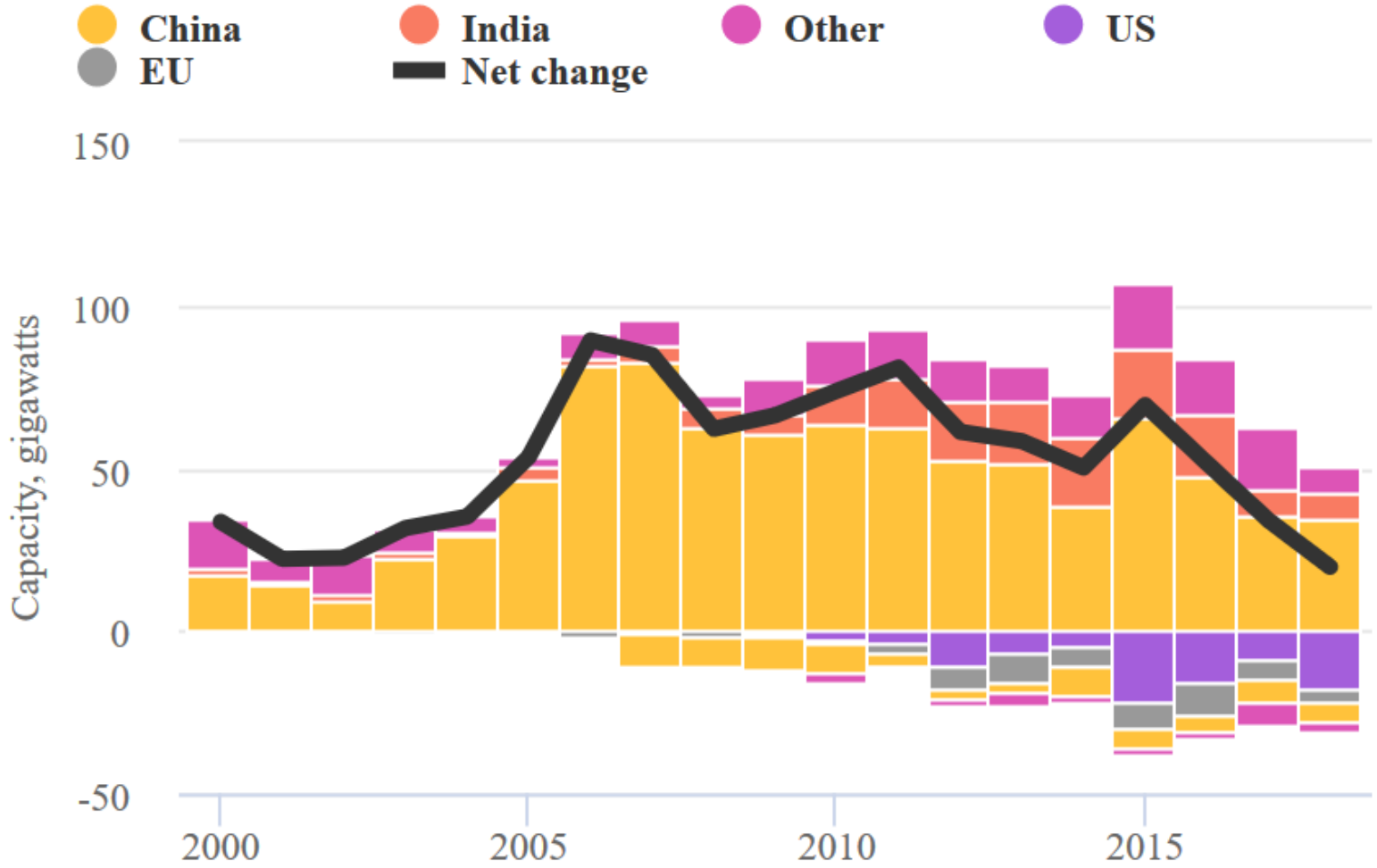
Climate Impact Research

Paris Agreement requires global unabated coal phase-out by 2050



Source: Rogelj et al., 2018

Global coal fleet is increasing albeit at a slower pace



Source: Carbon Brief

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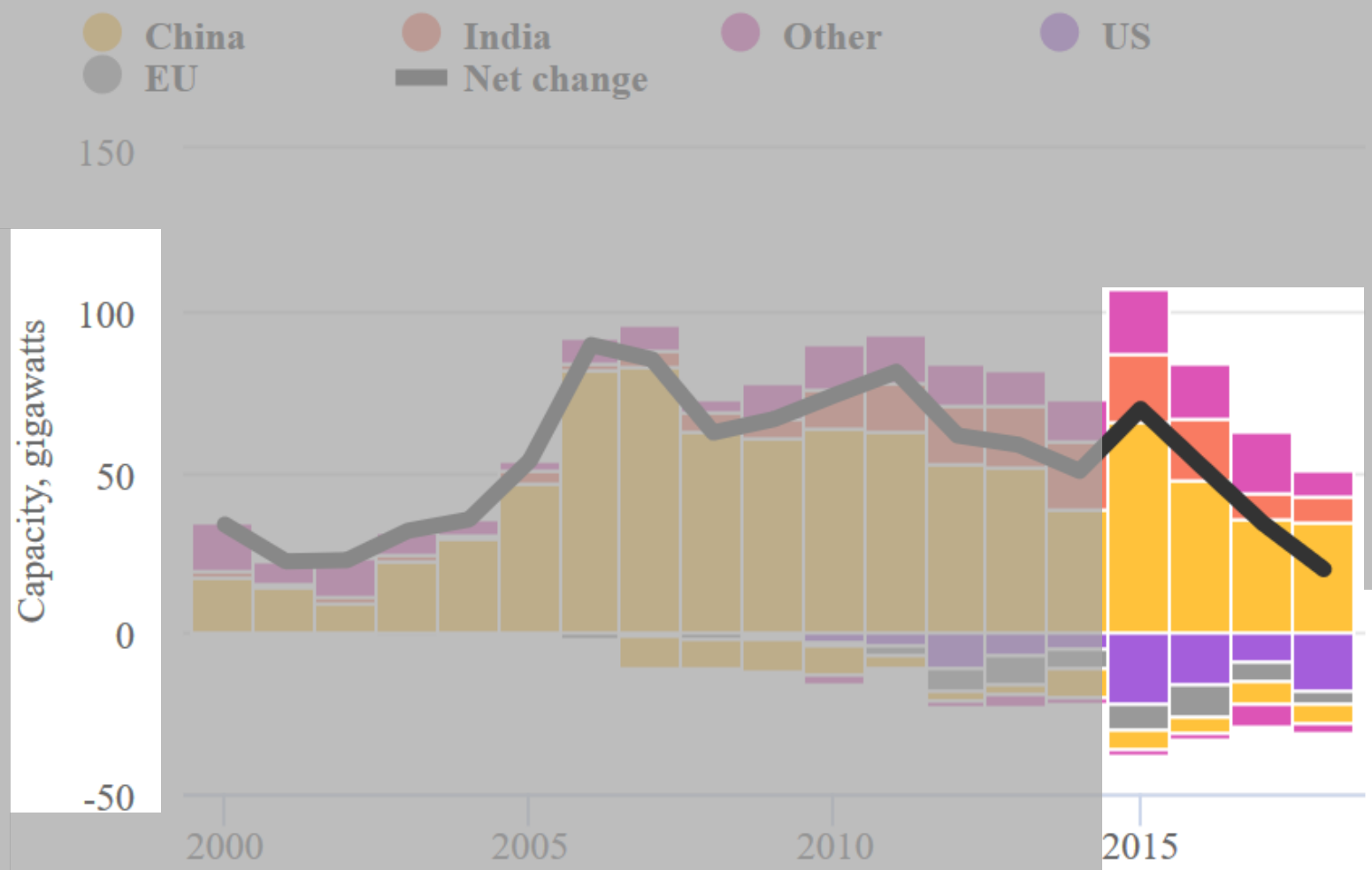
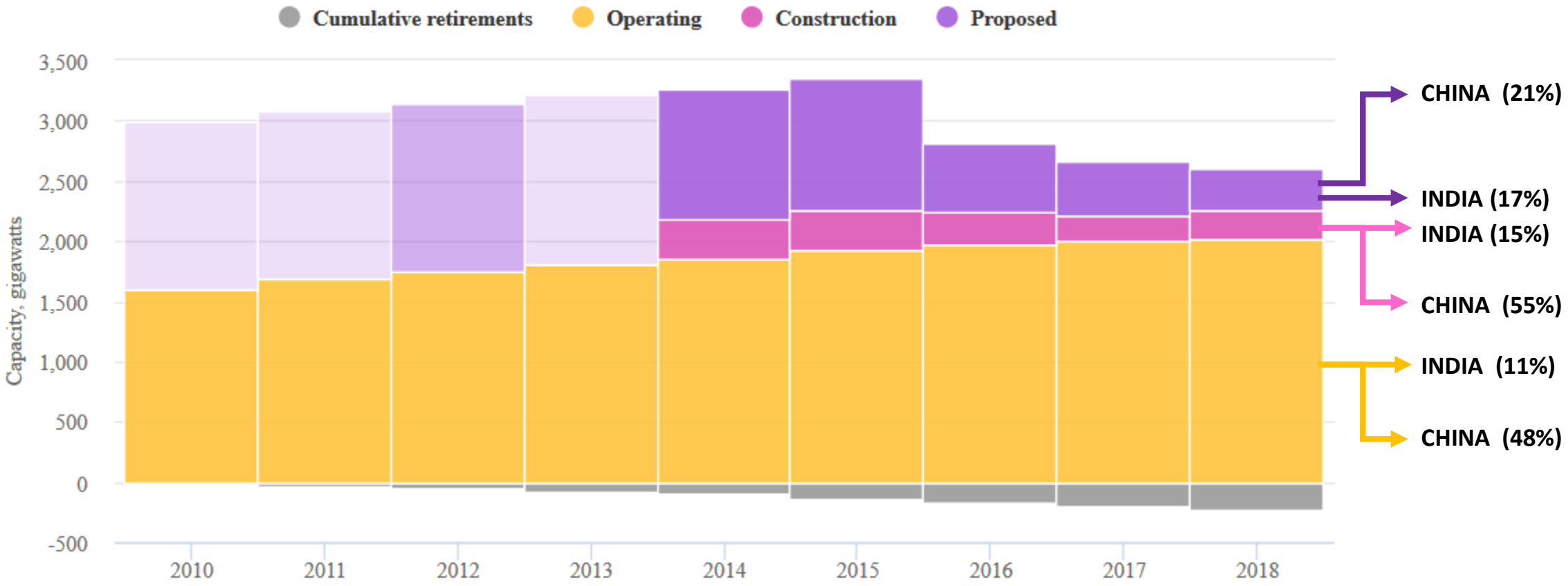


Paris Agreement: Closing 70GW of coal capacity <u>every year for the next 30 years</u>.

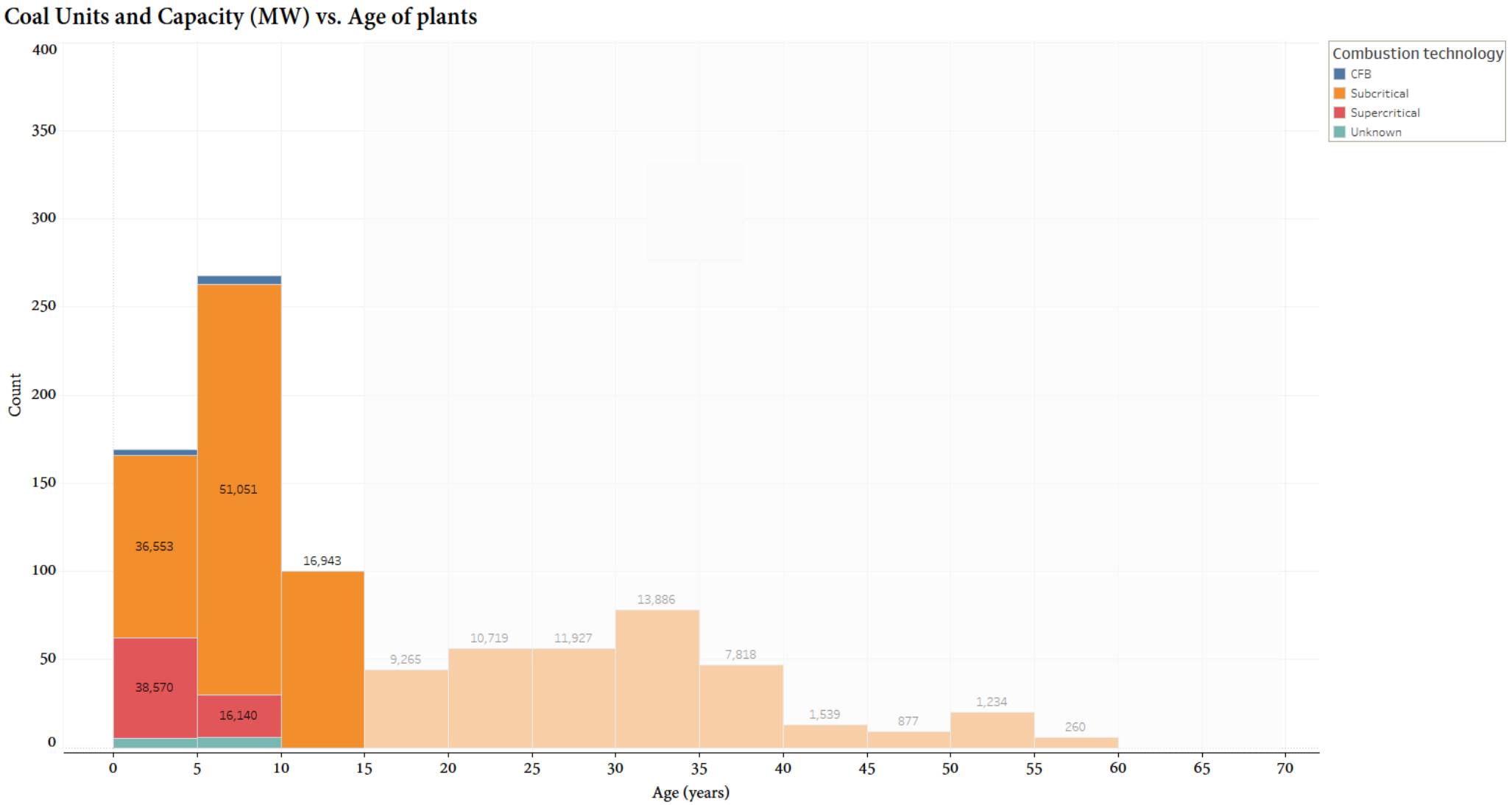
Source: Carbon Brief

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



Modified from Carbon Brief

Most coal plants in India are young and inefficient.



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.

Important Targets

- Renewable Energy Targets – 175 GW in 2022 (excluding Large Hydro)
  - Solar – 100 GW
  - Wind – 60 GW
  - Remaining: Biomass and Small Hydro

Motivation

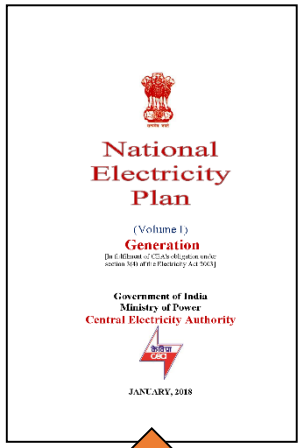
- How do current policies and NDC pledges:
  - Affect the future of coal power generation?
  - Impact future mitigation potential in line with the Paris Agreement?
- What are the potentials of coal alternatives to provide gross electricity?
- What short-term policies could help India to move to a cost-effective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

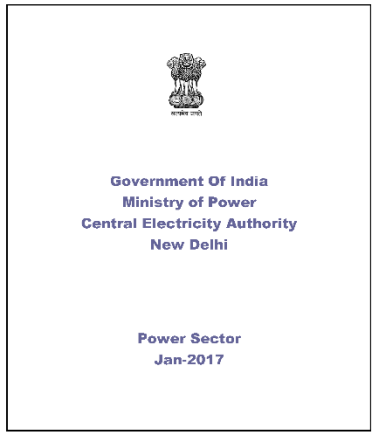
Scenario design

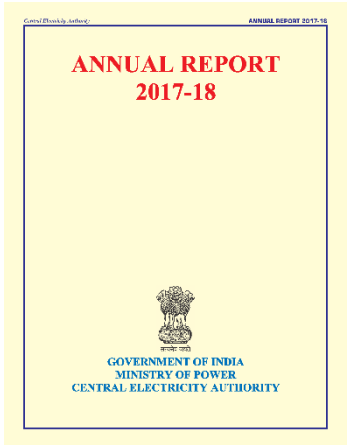
Scenario name	Definition
Early action	Currently implemented policies till 2020 followed by a carbon budget constraint till 2050, corresponding to well-below 2 C.
Delayed action	Currently implemented policies and NDC till 2030 followed by carbon budget constraint till 2050, corresponding to well-below 2 C

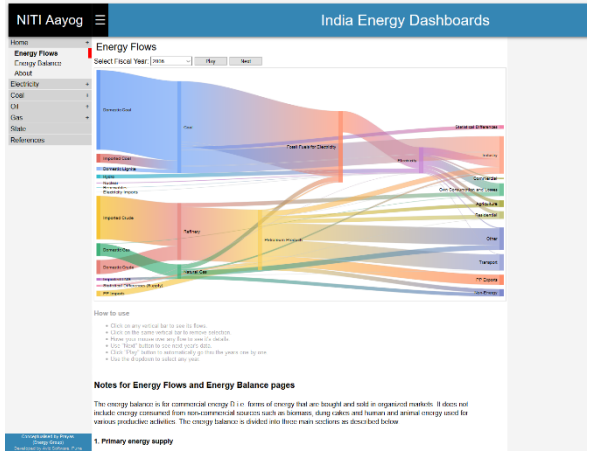
* The budgets for national models were chosen by the respective teams, representing the maximum mitigation effort , till 2050, possible through their models.
* The budgets for India for global models were the outcome of the global carbon budget which was the same across models (2011-2100 of 1000 $GtCO_2$)

Bottom-up sources



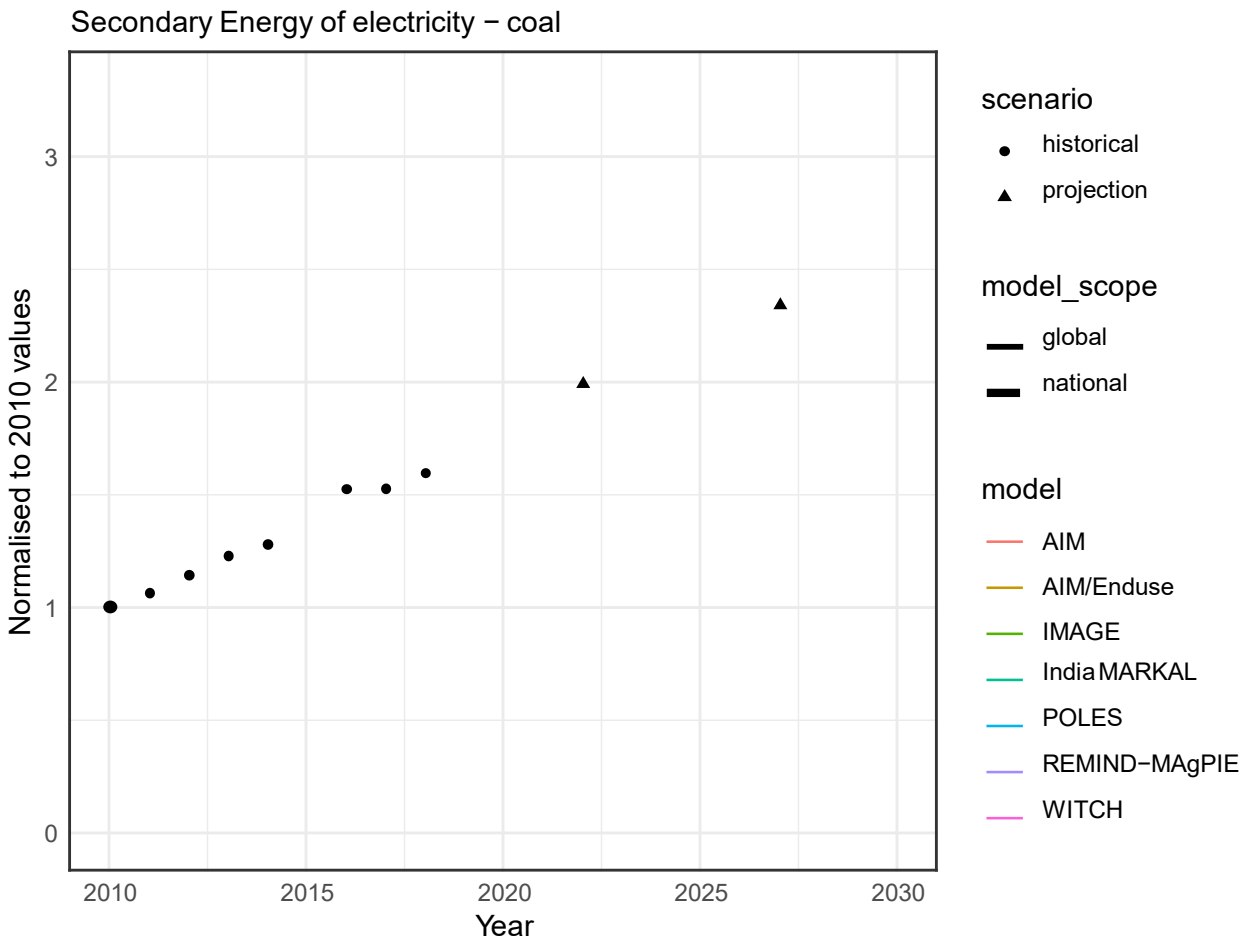






National Electricity Plan, January 2018
Central Electricity Authority (CEA)

Coal power generation increases under NDC



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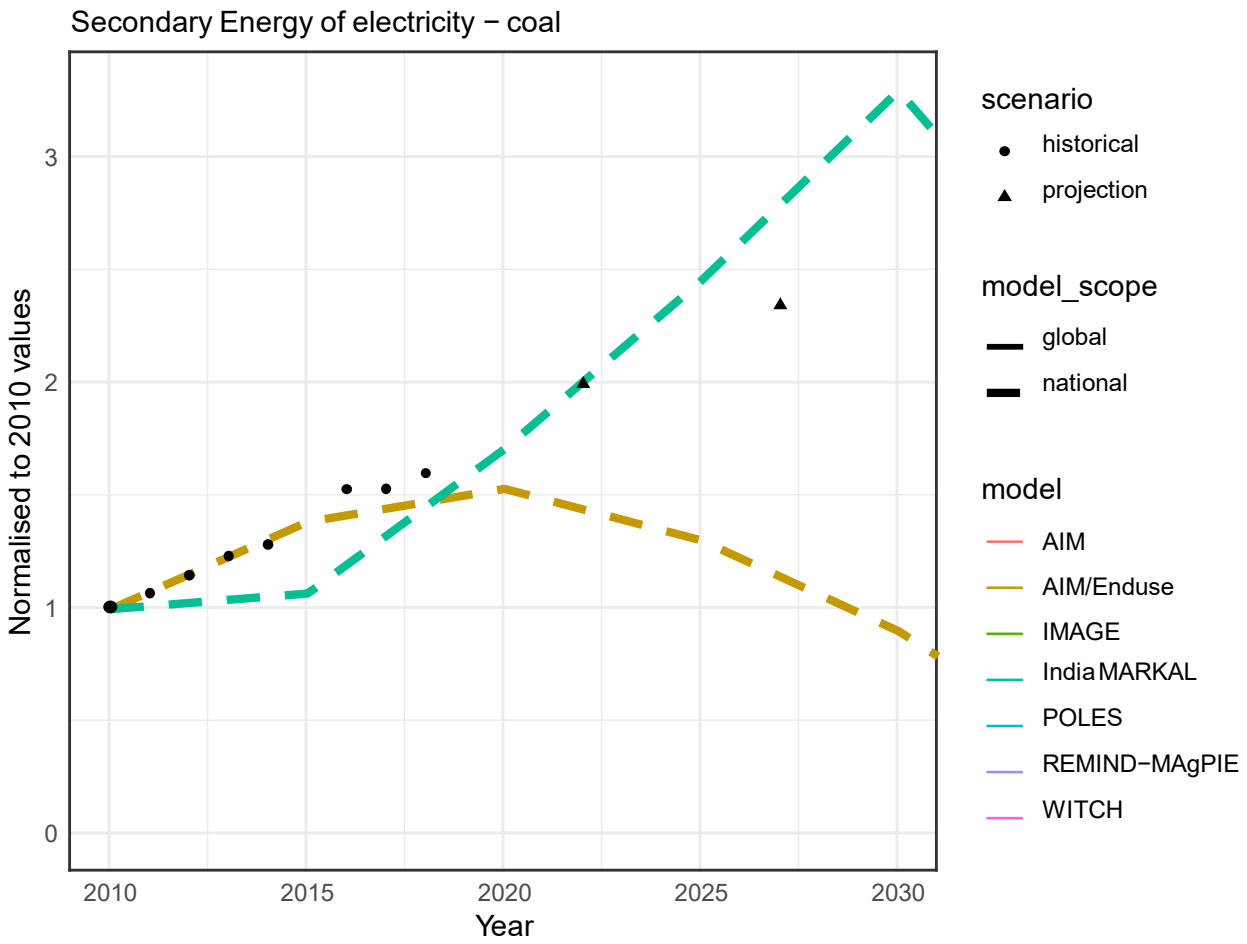

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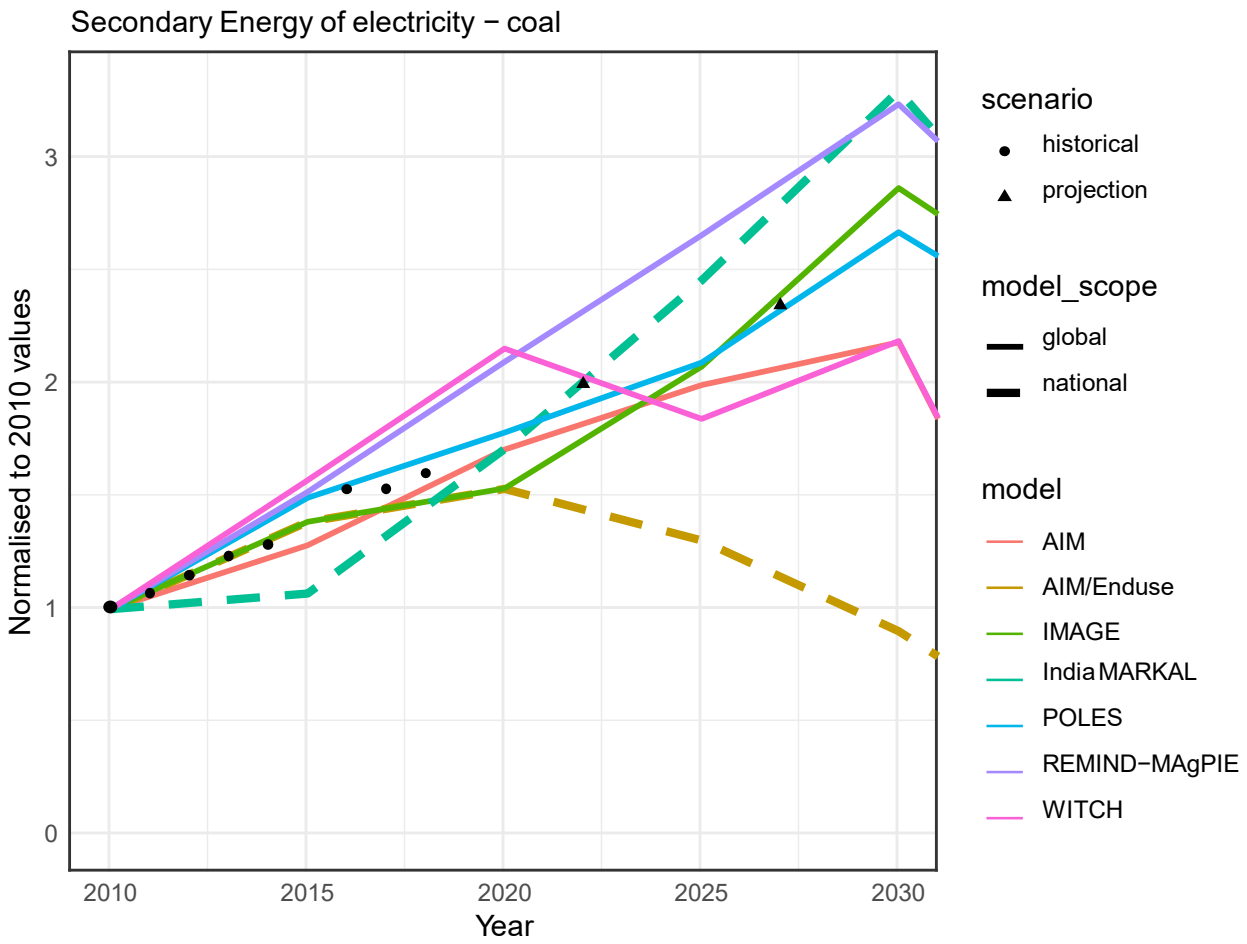
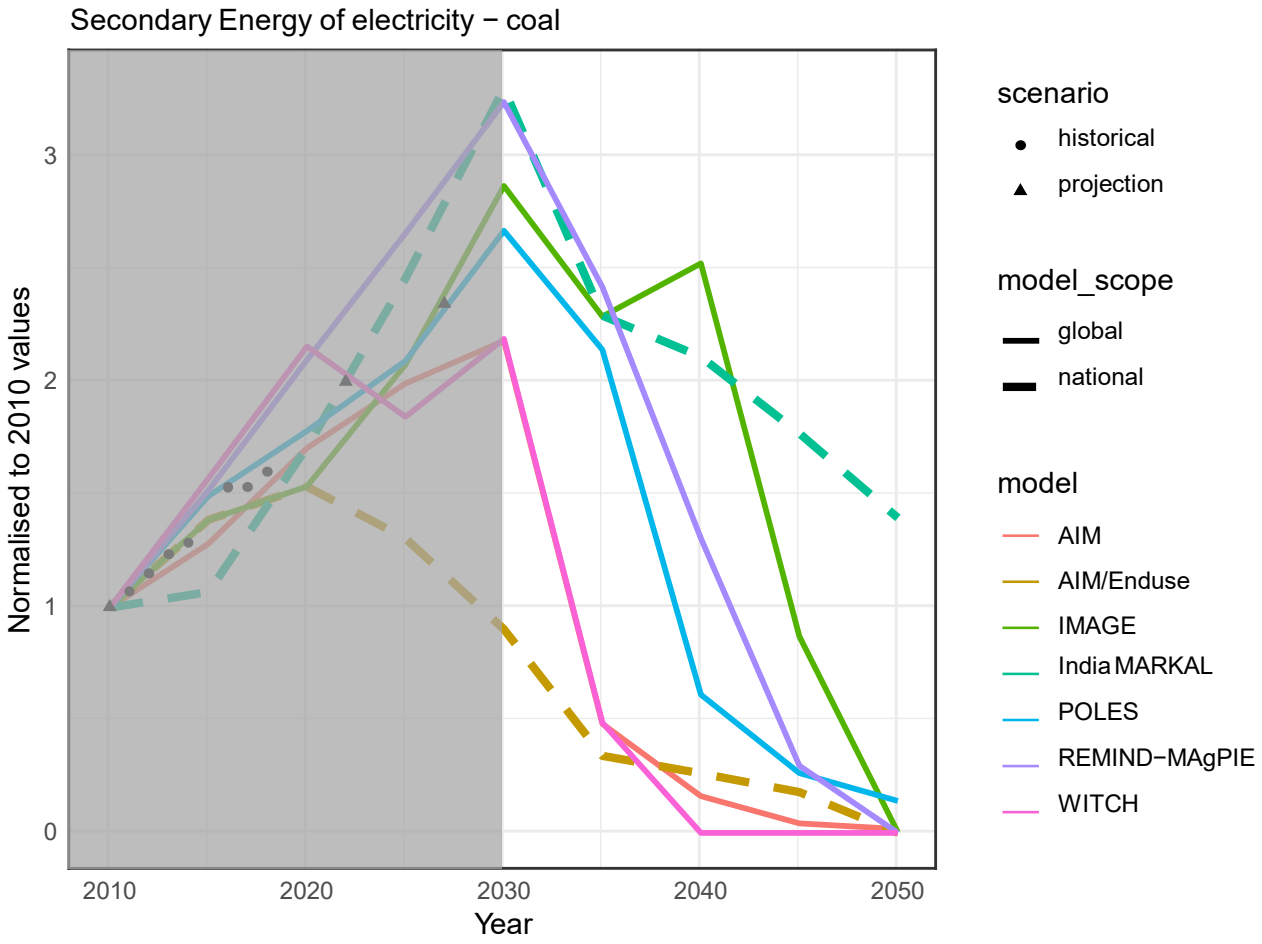


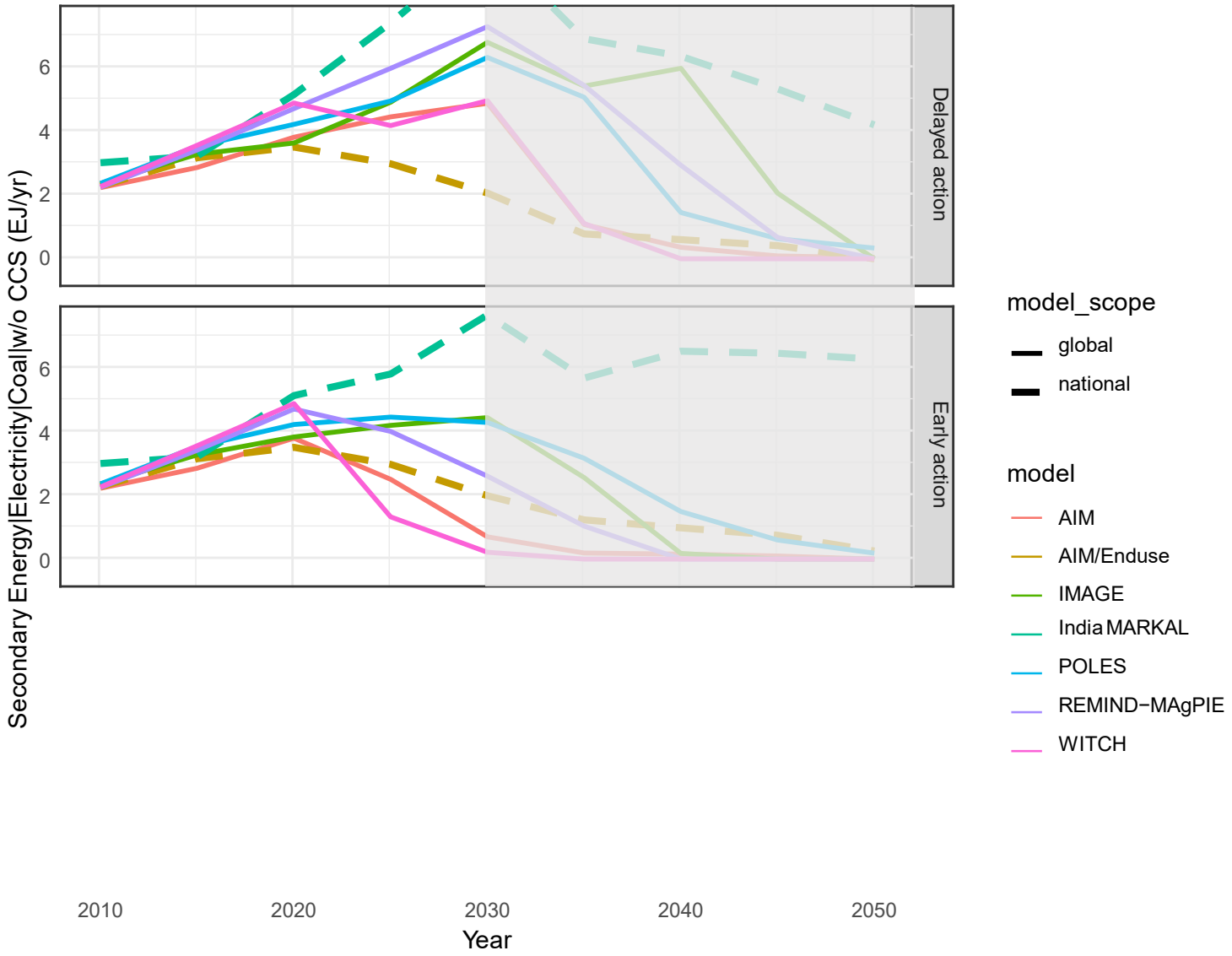
- Most models project that under NDC policies India will continue to build coal power plants
- Large model spread in 2030 but many within bottom-up projections.

which leads to drastic reductions in cost-effective mitigation



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

Early action avoids near-term coal build-up



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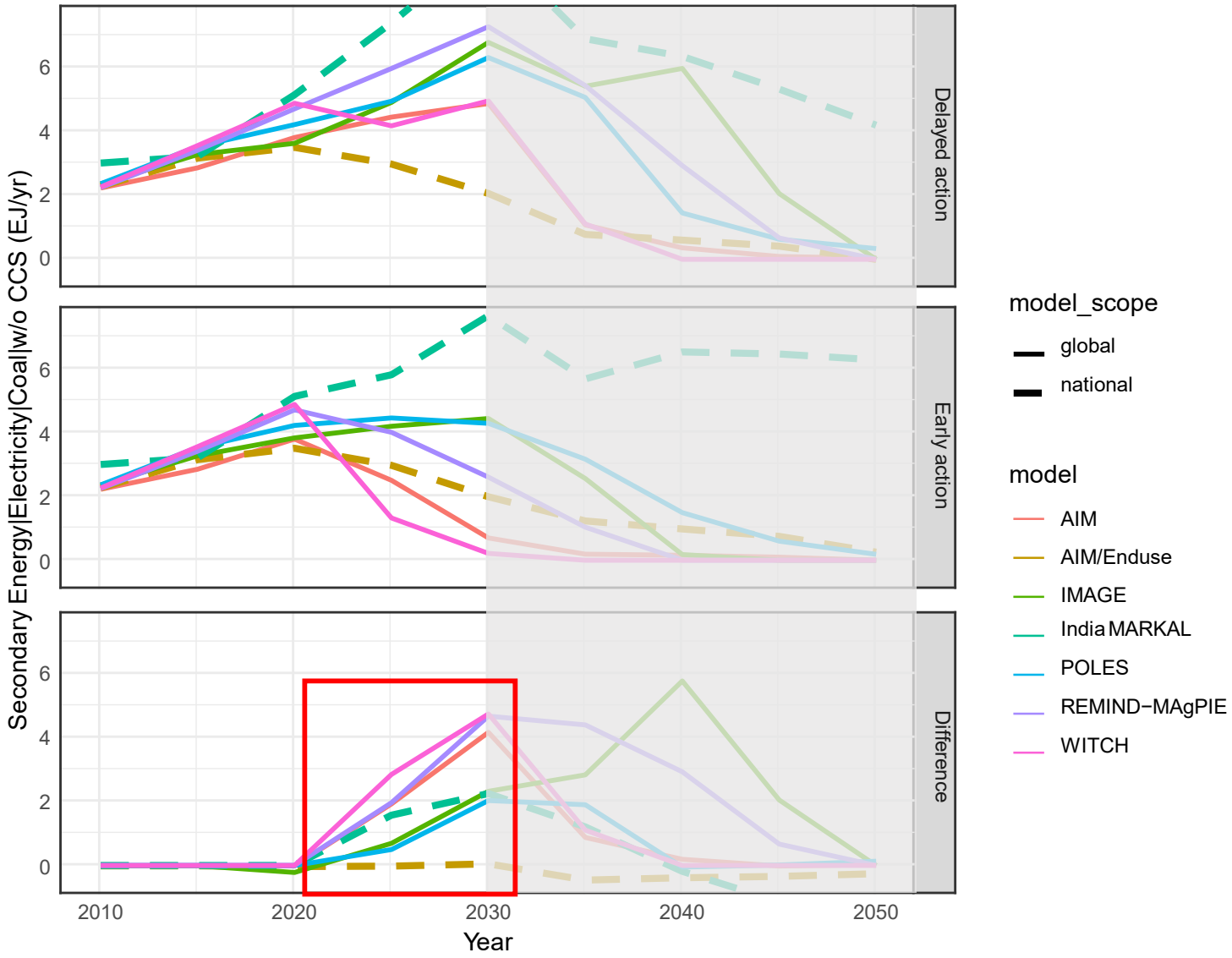
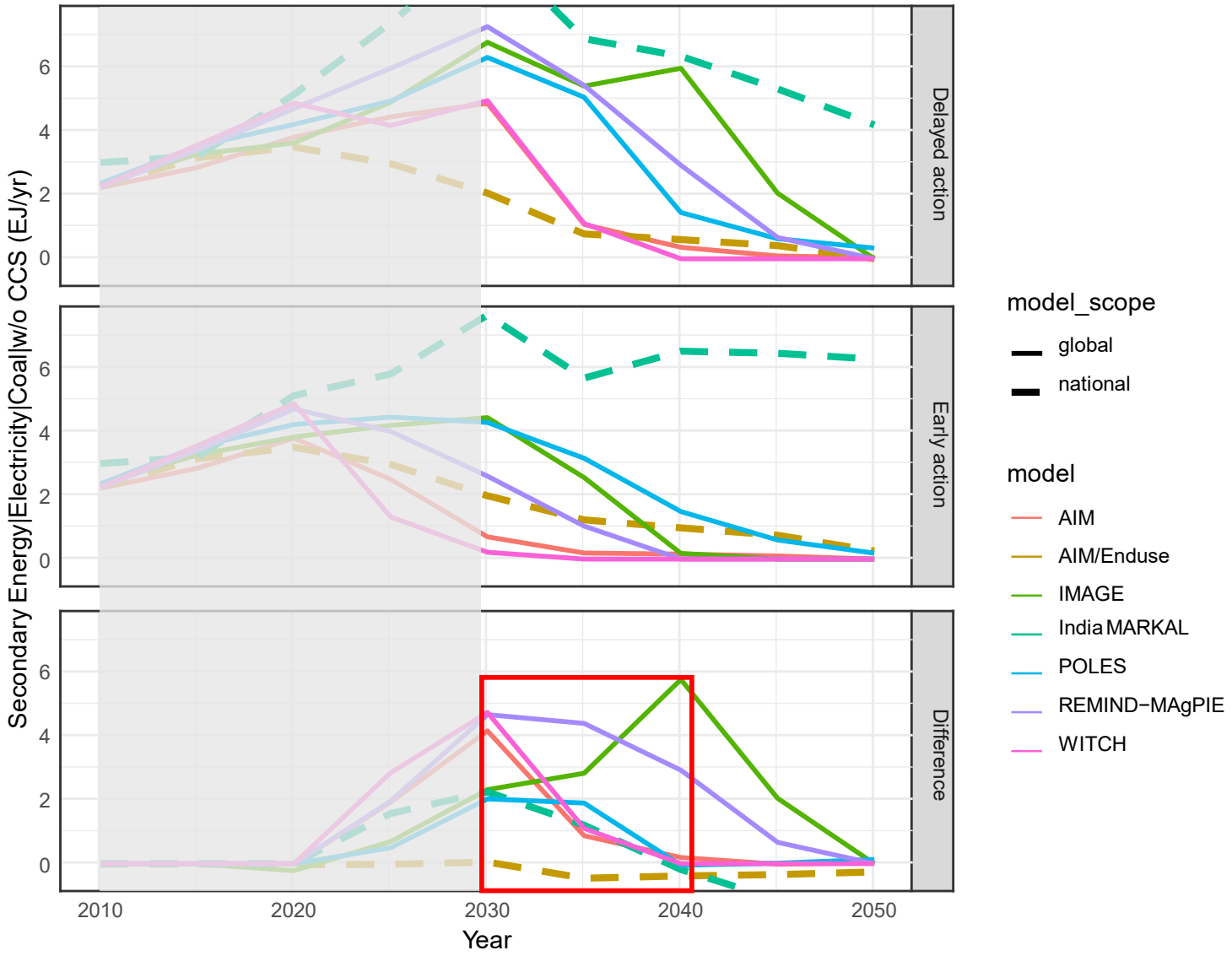
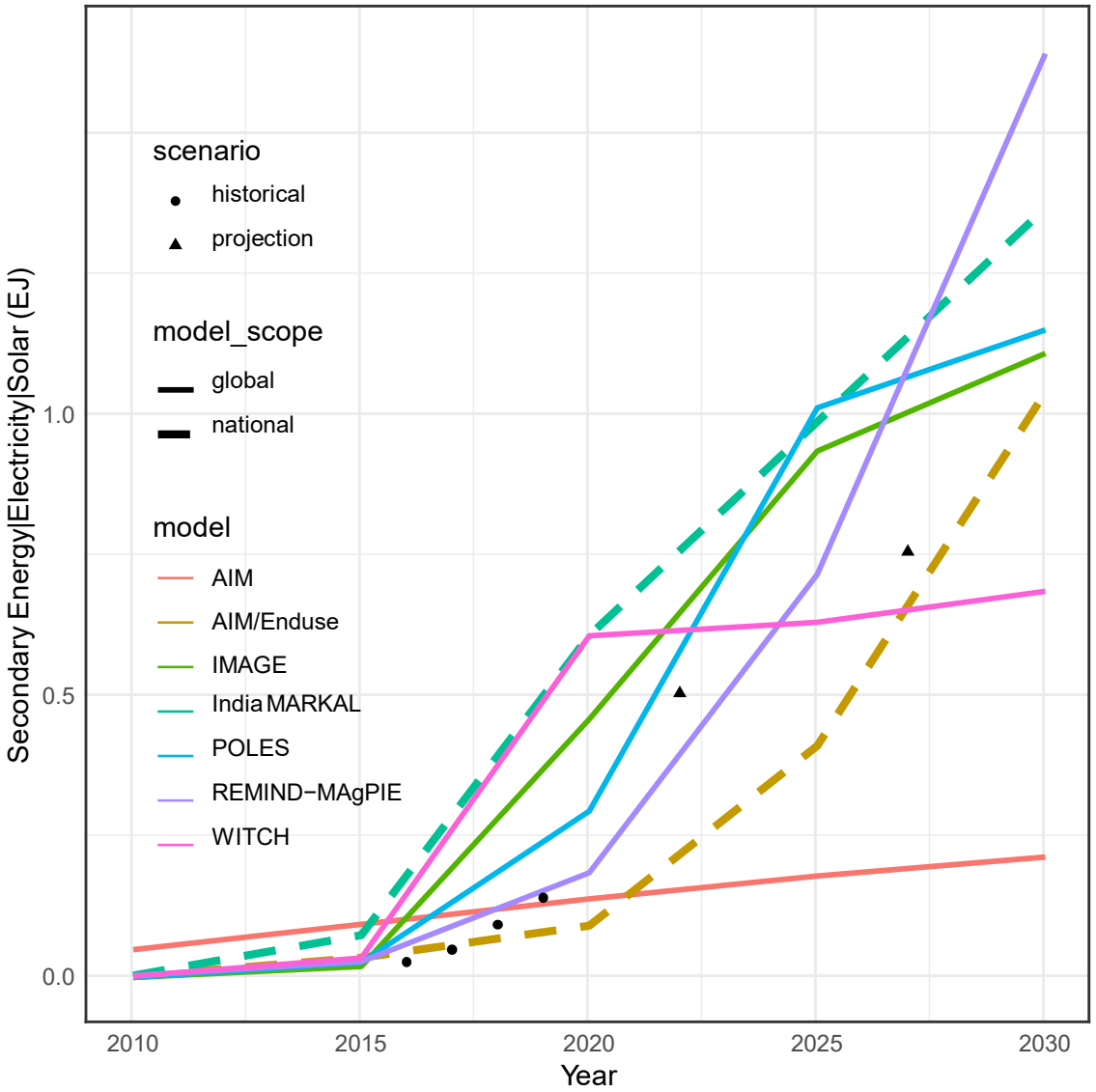


Which leads to lesser stranding but does not eliminate it



Significant increase in Solar and Wind under implemented policies – exceeding current VRE targets



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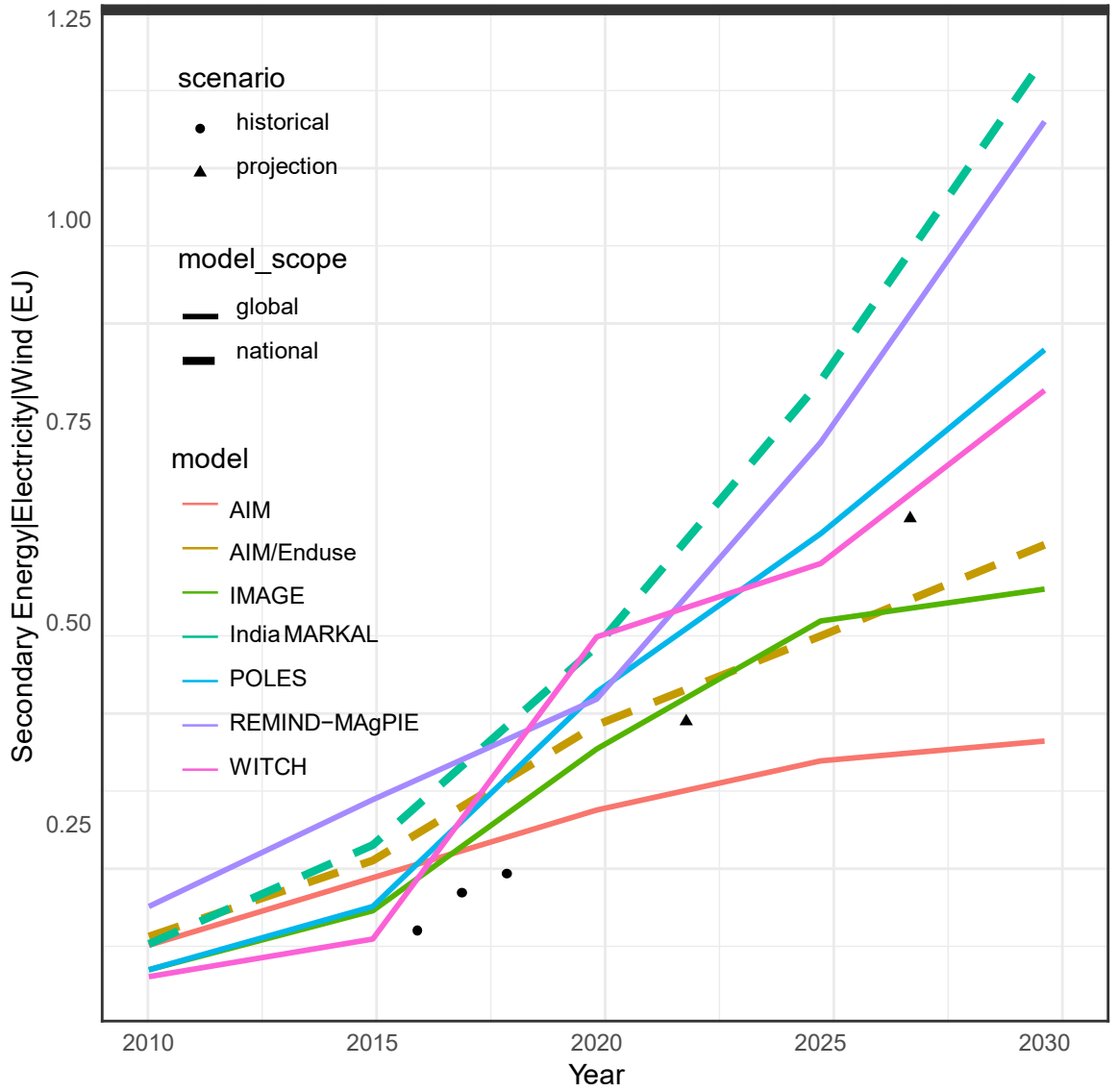

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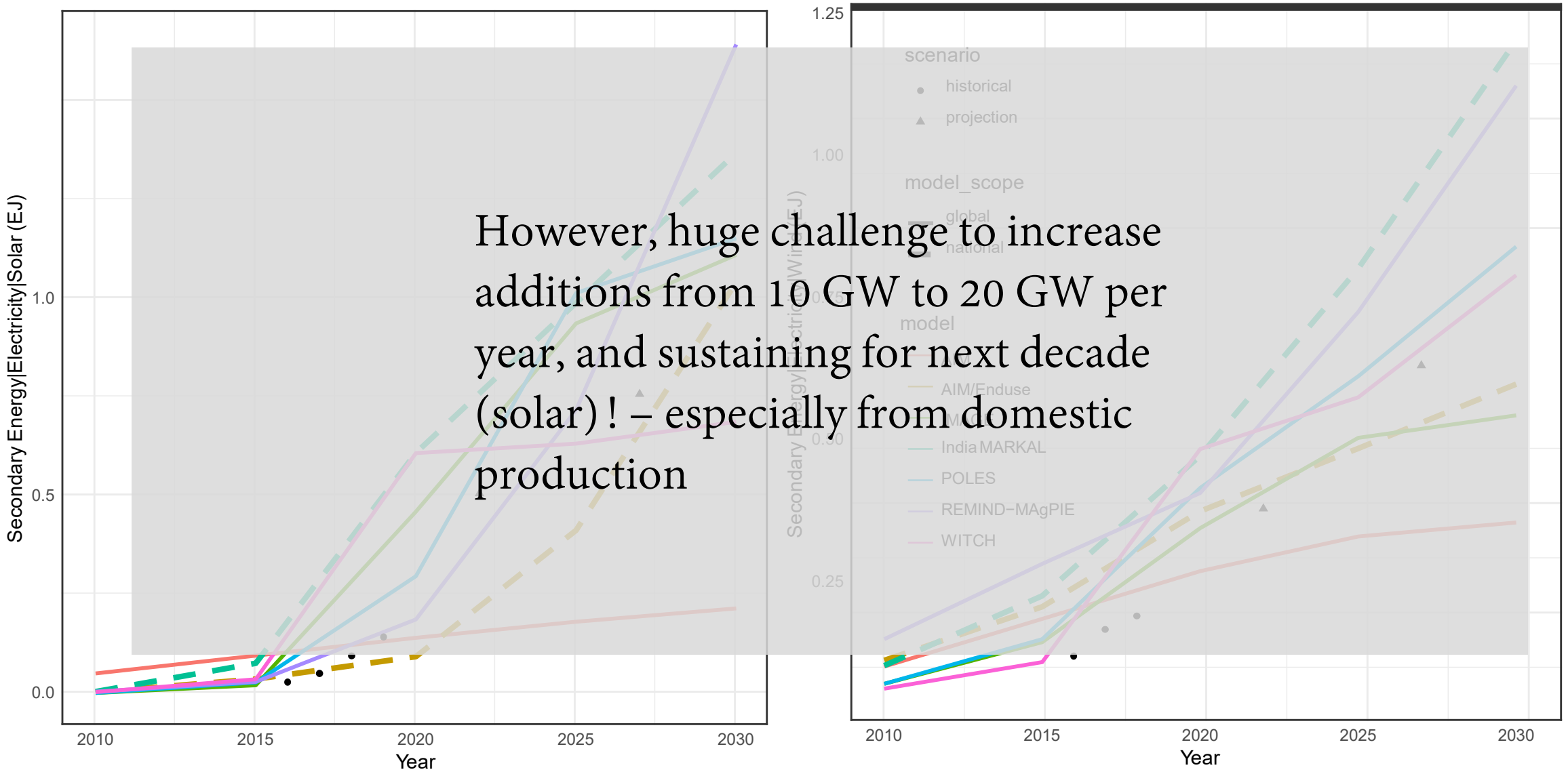
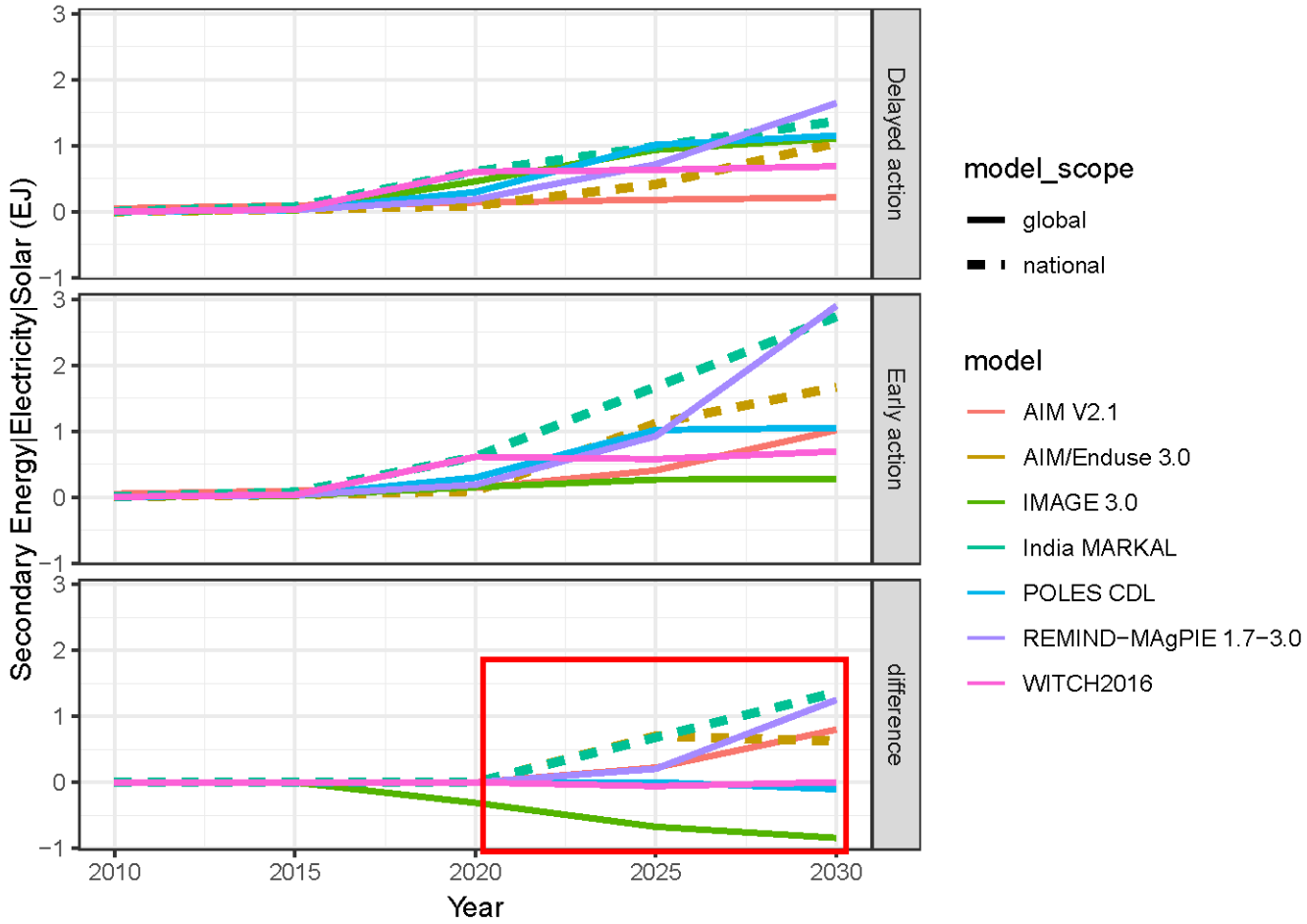


However, huge challenge to increase additions from 10 GW to 20 GW per year, and sustaining for next decade (solar) ! – especially from domestic production

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



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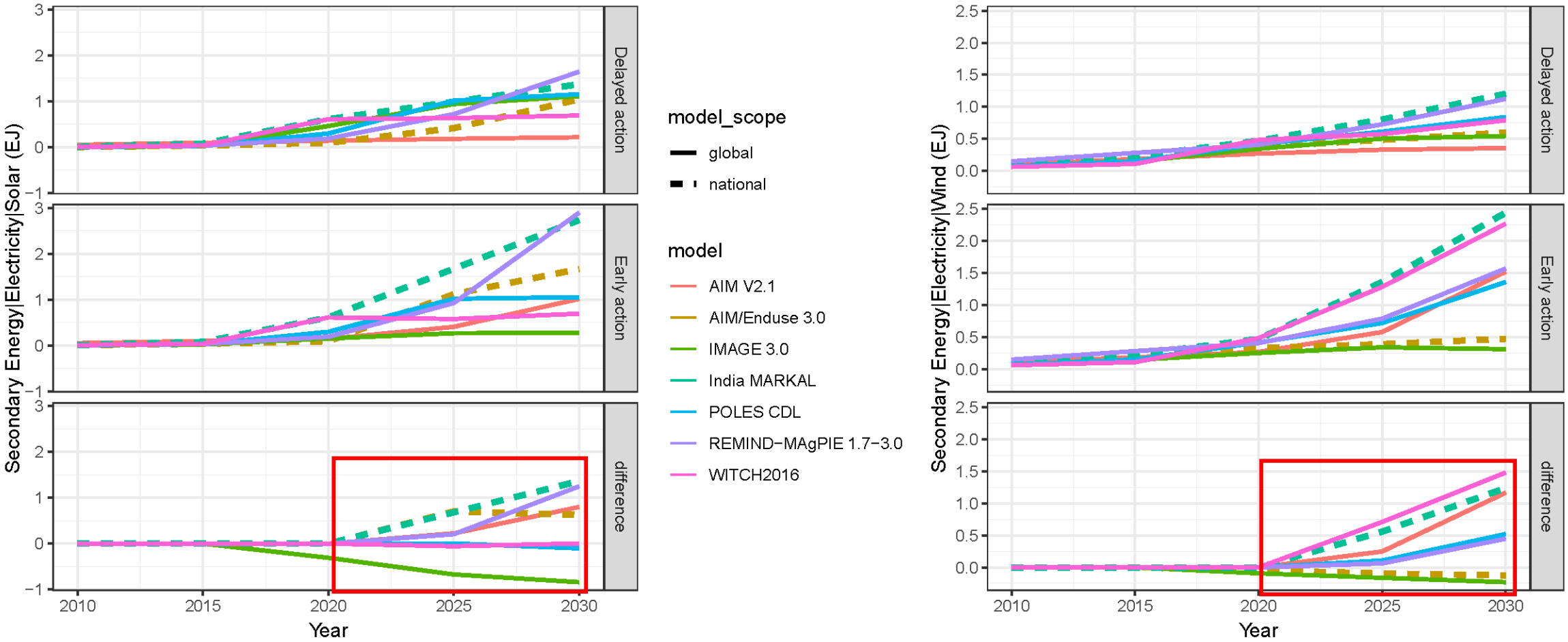
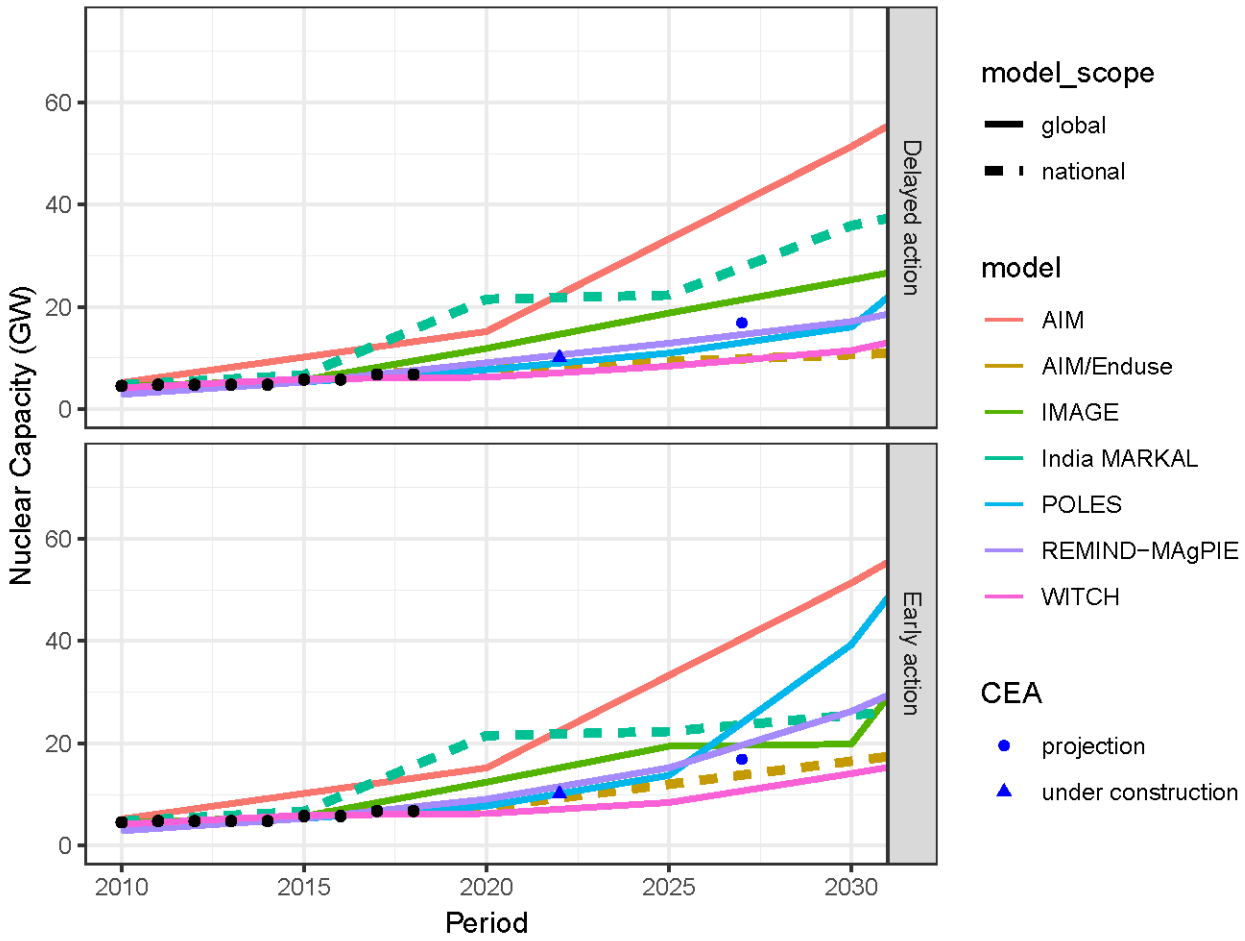
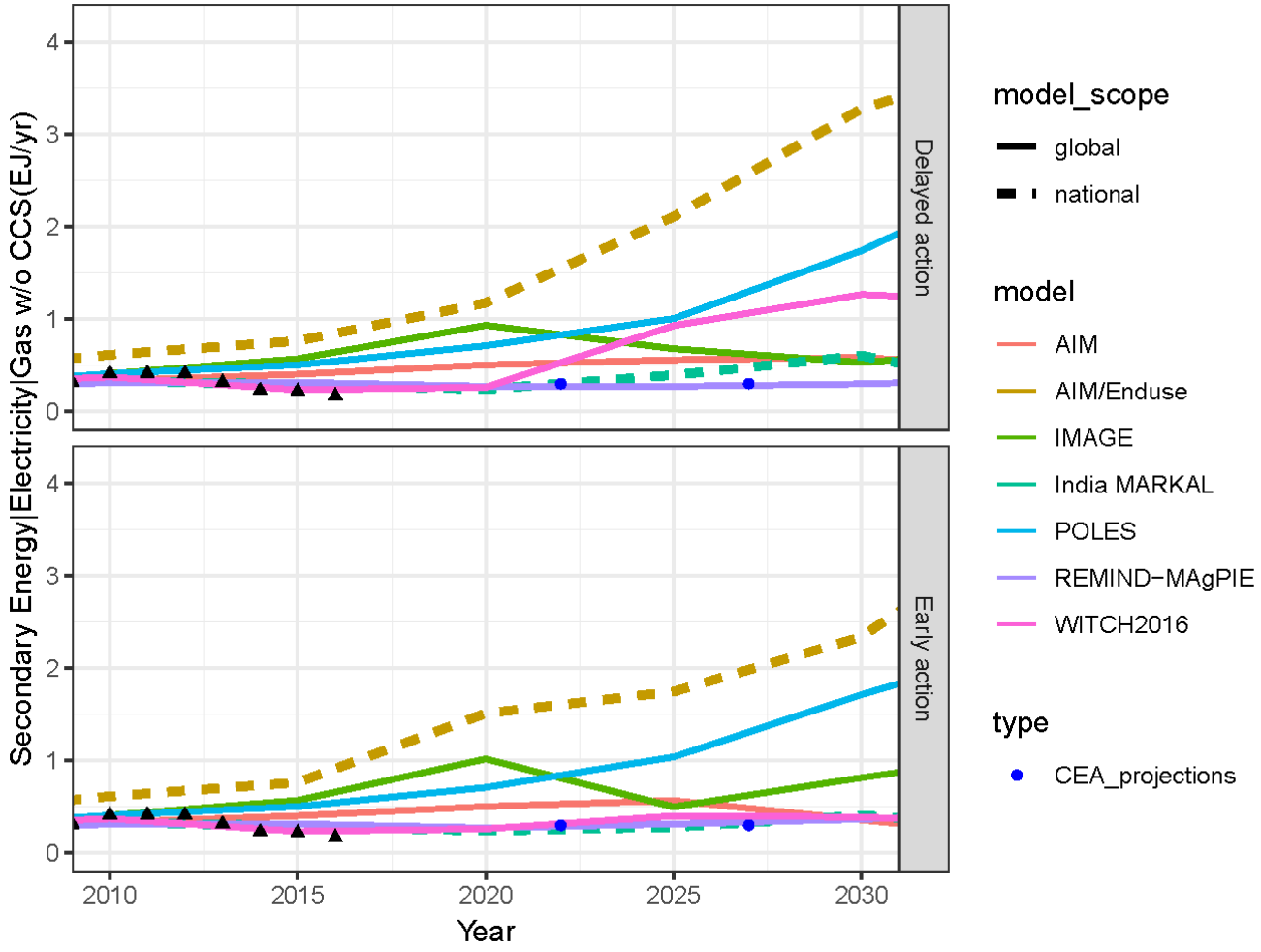


Role of nuclear in future decarbonization likely low



- 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



- Decreasing gas generation (scarcity, high prices and no long distance gas infrastructure from gas-rich countries).
- 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.

Policies required to limit coal power production !

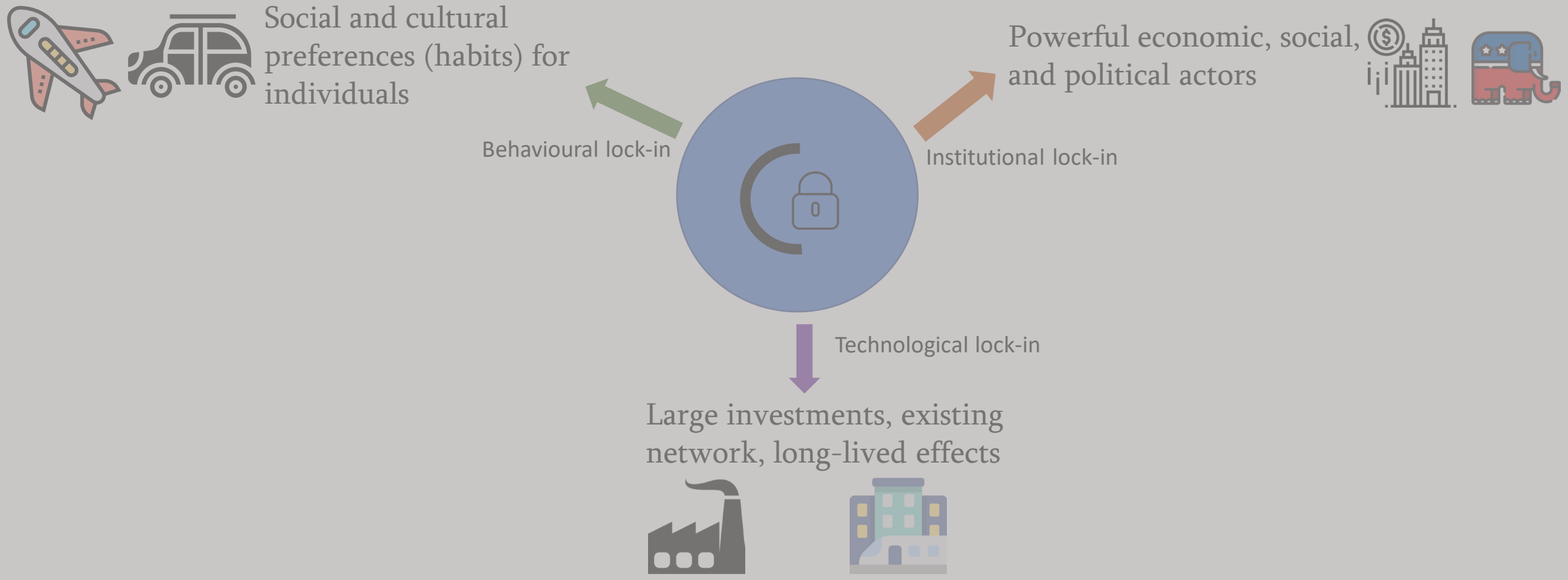
- Without explicit policies to limit coal based power generation, coal plants continue to be built. In spite of ambitious RE targets !
- Political infeasibility of immediate and high carbon price -> need for short term technological policies to be in line with Paris Agreement for e.g., no more new unabated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

Conclusions and paper storyline

- 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; reduce carbon lock-ins.

Future Work:
Carbon lock-ins of mitigation pathways

the tendency of carbon-intensive technological systems to **persist over time (inertia)**, *locking -out* lower-carbon alternatives



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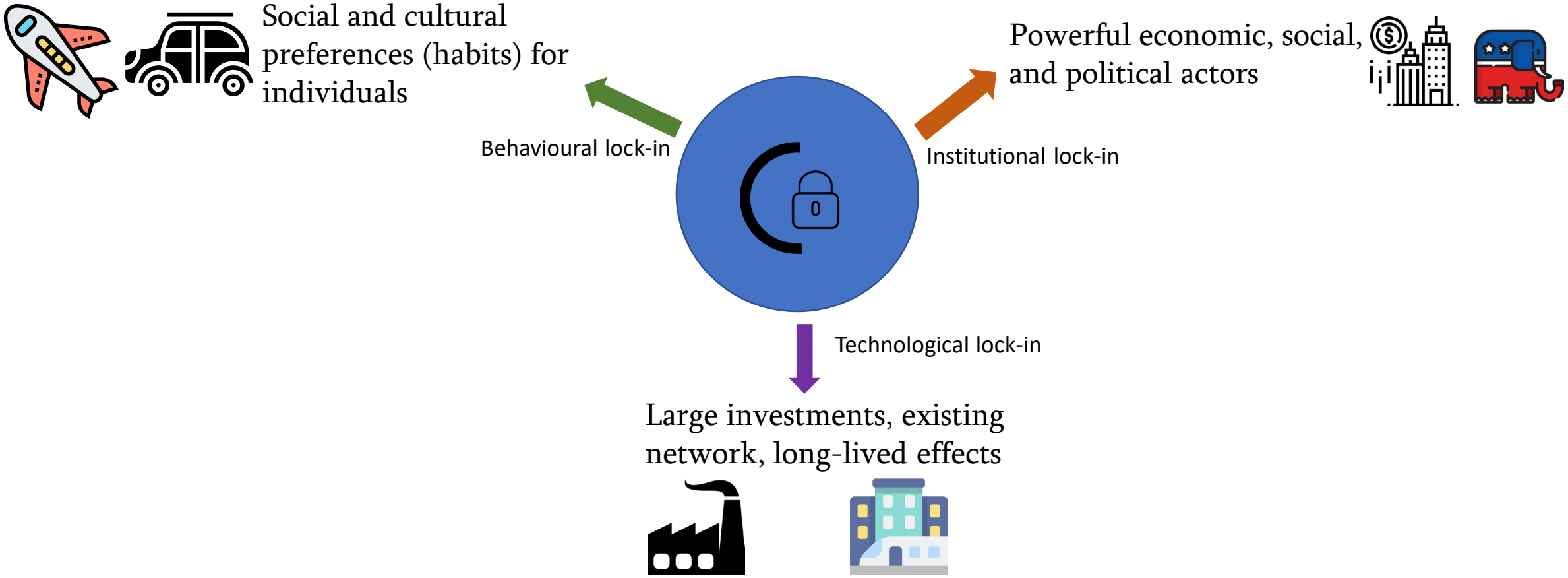
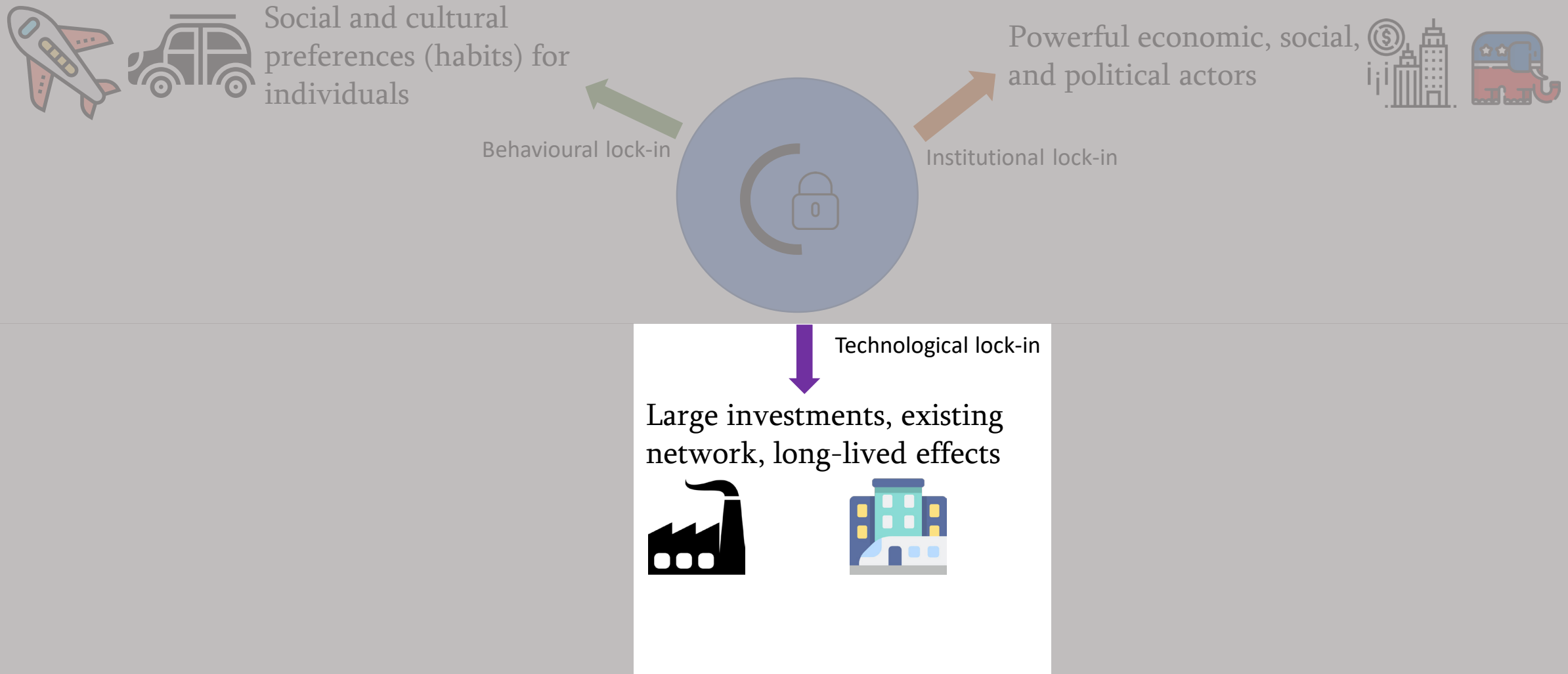


Carbon lock-ins of mitigation pathways



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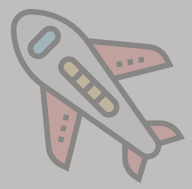


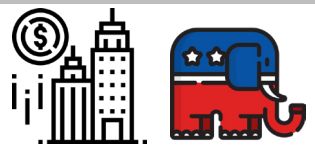
Social and cultural preferences (habits) for individuals

Behavioural lock-in

Technological lock-in

Large investments, existing network, long-lived effects

Powerful economic, social, and political actors



Institutional lock-in

Political Economy and Institutional Lock-ins

Institutional lock-ins are essentially caused by political economy agents in the society.

A proxy to represent PE could be Employment. For e.g., policies favouring job-formation are favoured and vice-versa.

Use Employment to study institutional lock-ins and political economy constraints of mitigation pathways

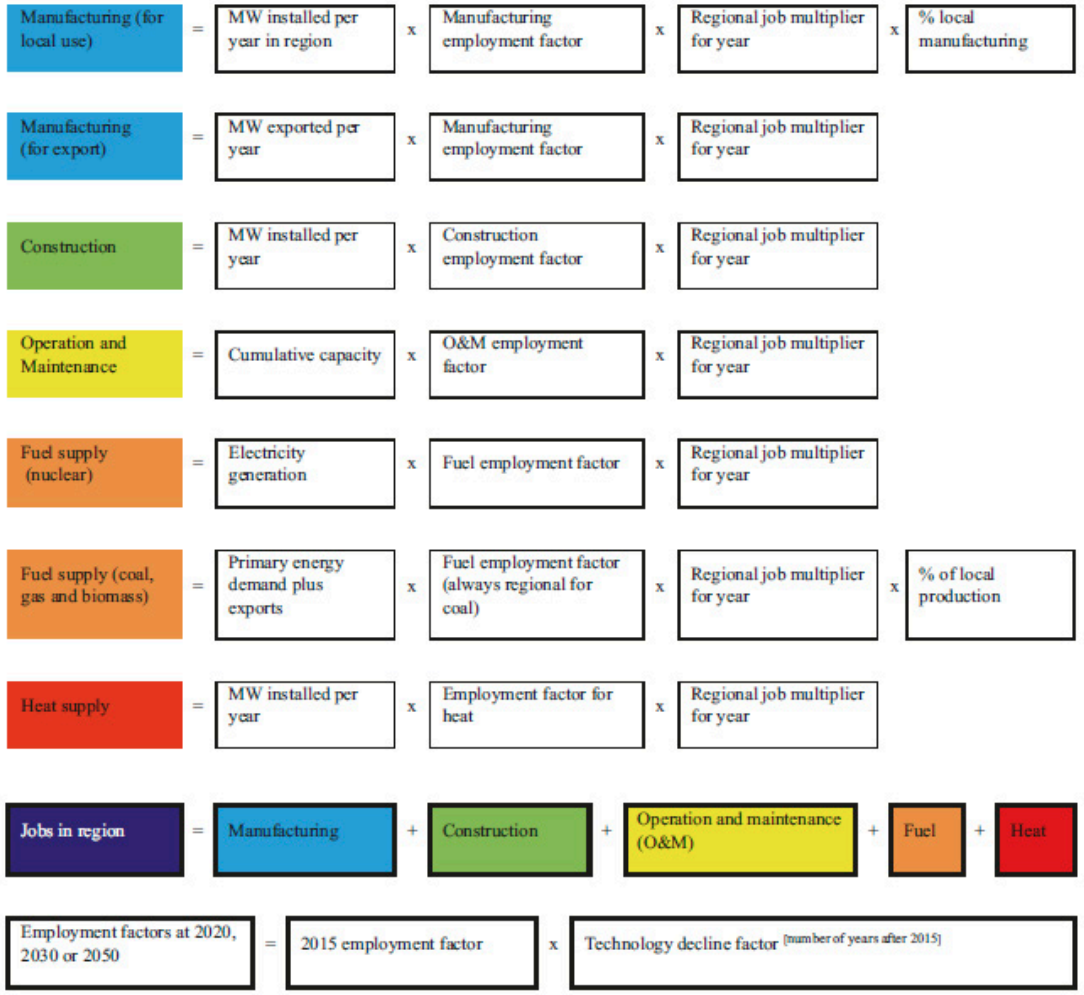
Employment numbers – bottom-up data

Table 1. Estimated Direct and Indirect Jobs in Renewable Energy, by Country and Technology

	World	China	Brazil	United States	India	Japan	Bang-ladesh	European Union[i]		
								Germany	France	Rest of EU
	THOUSAND JOBS									
Solar PV	**3,095**	1,962	4	241.9	121	302	140	31.6	16	67
Liquid biofuels	**1,724**	51	783[c]	283.7[f]	35	3		22.8	22	48
Wind power	**1,155**	509	32.4	102.5	60.5	5	0.33	142.9	22	165
Solar heating/ cooling	**828**	690	43.4[d]	13	13.8	0.7		9.9	5.5	20
Solid biomass[a, g]	**723**	180		79.7[e]	58			45.4	50	238
Biogas	**333**	145		7	85		15	45	4.4	15
Hydropower (small-scale)[b]	**211**	95	11.5	9.3[l]	12		5	6.7	4	35
Geothermal energy[a]	**182**			35		2		17.3	37.5	62
CSP	**23**	11		5.2				0.7		3
Total	**8,305[h]**	**3,643**	**875.9**	**777.3**	**385**	**313**	**162.3**	**334[j]**	**162**	**667[k]**
Hydropower (large-scale)[b]	**1,519**	312	183	28	236	18		6	9	46
Total (including large-scale hydropower)	**9,824**	**3,955**	**1,058**	**806**	**621**	**330**	**162**	**340**	**171**	**714**

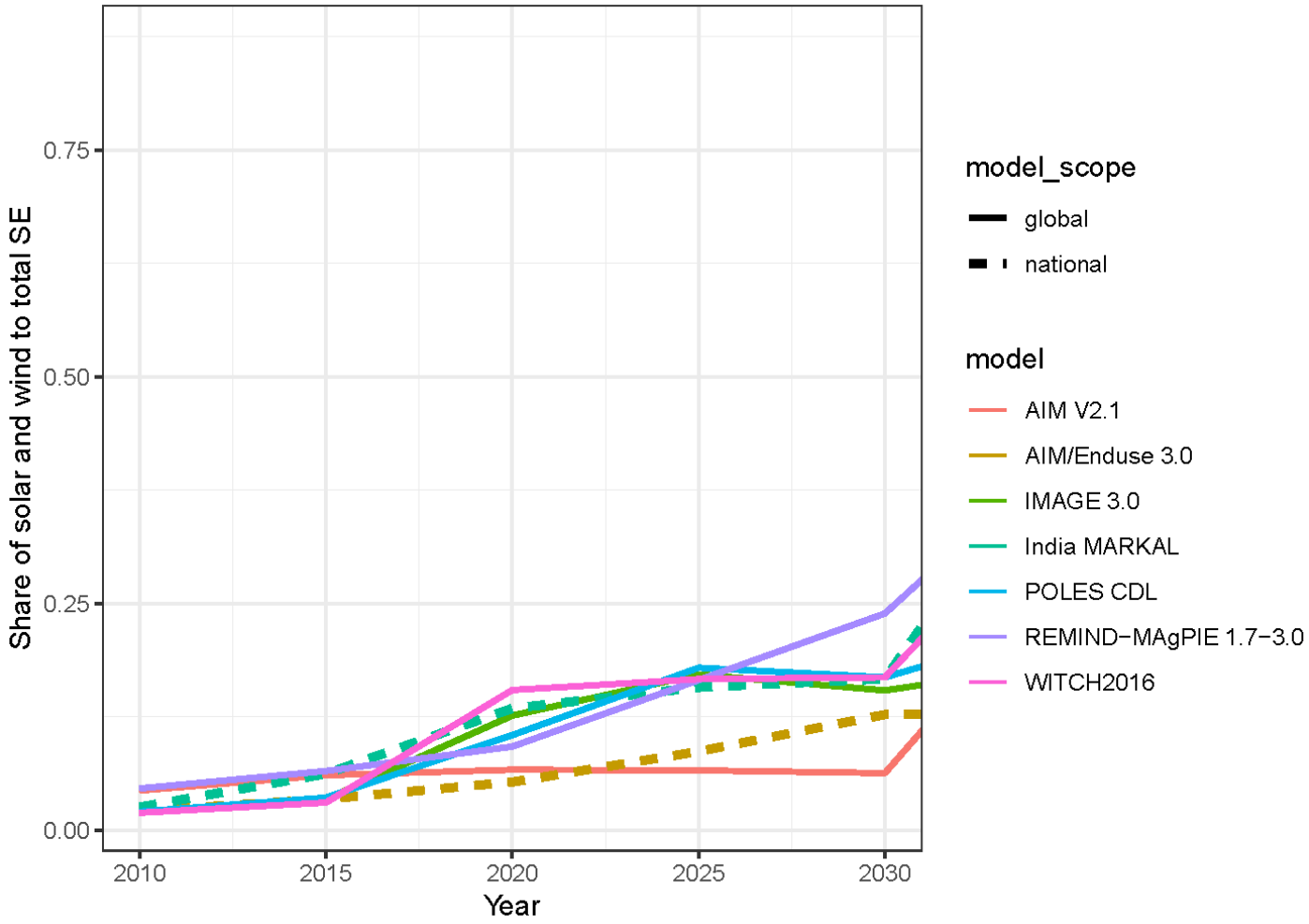
Source: REN21 Global Status Report

Ex-post employment analysis



Source: Dominish et al., 2018

Questions and Discussion


Share of solar and wind to total SE
0.75
0.50
0.25
0.00
2010
2015
2020
2025
2030
Year
model_scope
global
national
model
AIM V2.1
AIM/Enduse 3.0
IMAGE 3.0
India MARKAL
POLES CDL
REMIND−MAgPIE 1.7−3.0
WITCH2016

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