Techno-economic and political economy lock-ins in IAMs

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Seminar #2

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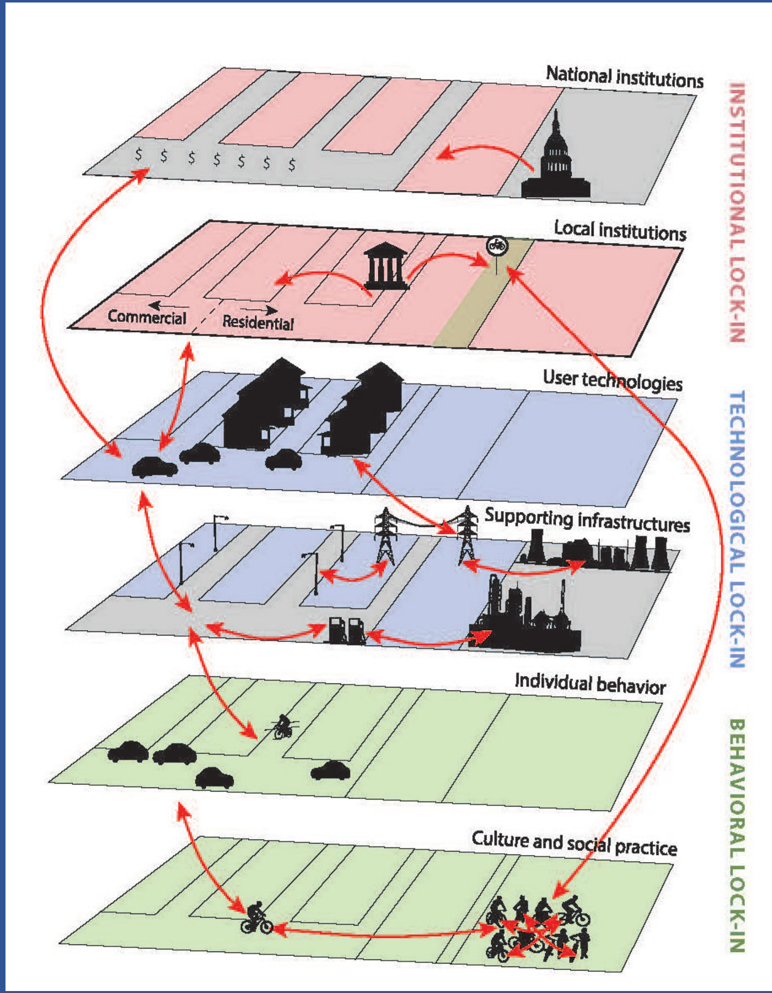
Outline

- Carbon lock-ins
    - Background and assessment
- Carbon lock-ins in India
    - Comparing power mix in early and delay scenarios
- Case in point for including political economy in IAMs.
- Political Economy
    - Background
    - Current approaches
    - Need for new approaches
    - Preliminary ideas
- Conclusion
- Future Work

Carbon lock-ins

- Refers to "the tendency of carbon-intensive technological systems to **persist over time (inertia)**, *locking -out* lower-carbon alternatives" [1]
- Arises because **of increasing returns to scale** [2,3], and **interconnections** between techno-institutional systems [3,4]

[1] Erickson et al., 2015
[2] Perkins, 2003
[3] Seto et al., 2016
[4] Unruh, 2000
[5] Unruh, 2002



Powerful economic, social, and political actors seek to reinforce status quo that favours their interests

Large investments, existing network, long-lived effects e.g., highways

Social and cultural preferences (habits) for individuals e.g., transportation

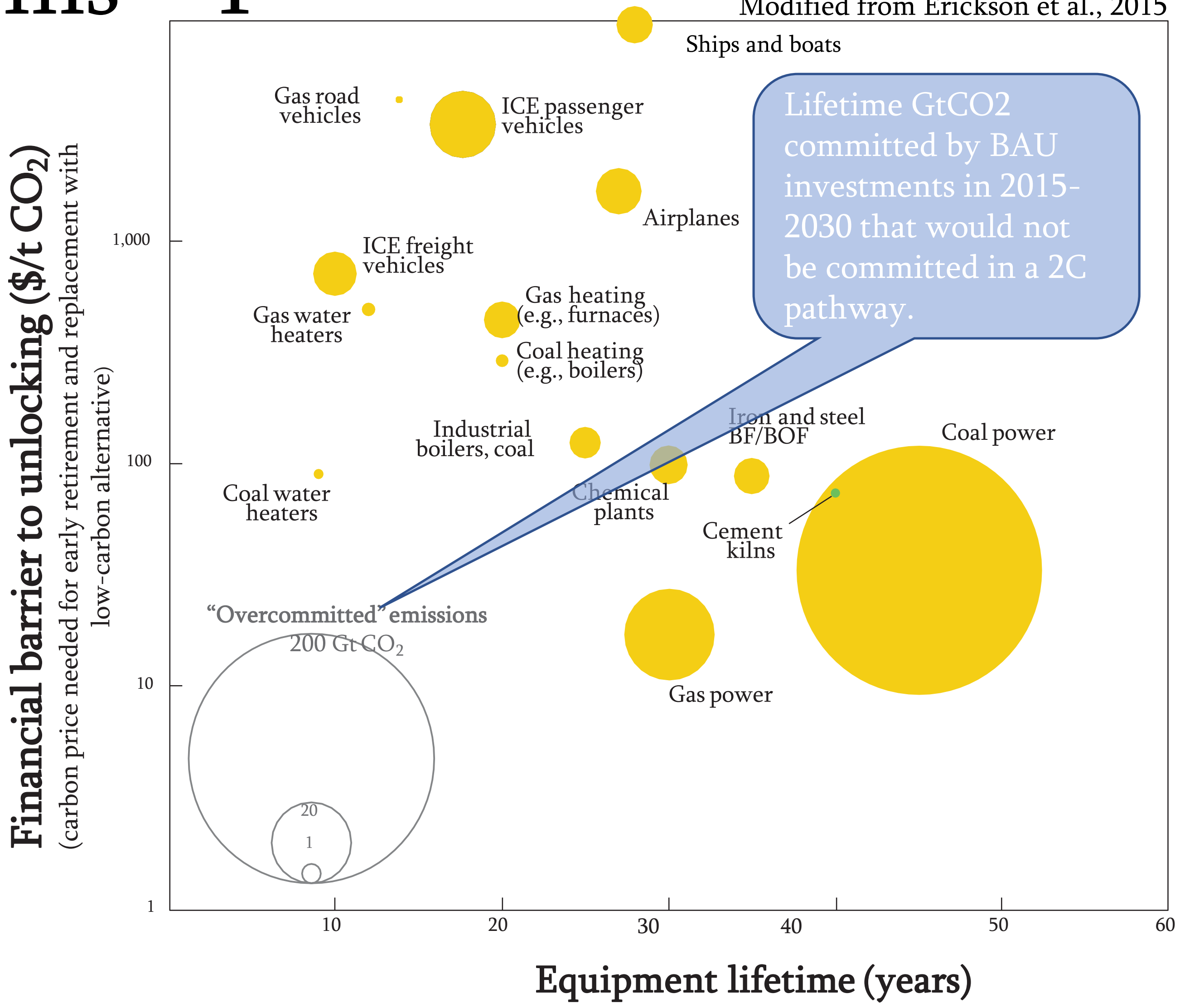
Seto et al., 2016

Assessing carbon lock-ins – I

coal's three strikes

- Among all fossil fuel infrastructure, coal power has the longest lock-in potential due to its long lifetime and large investment.
- At the same time, the "financial barriers" are lower.
- Coal power represents largest source of "overcommitted" emissions. [1,2]

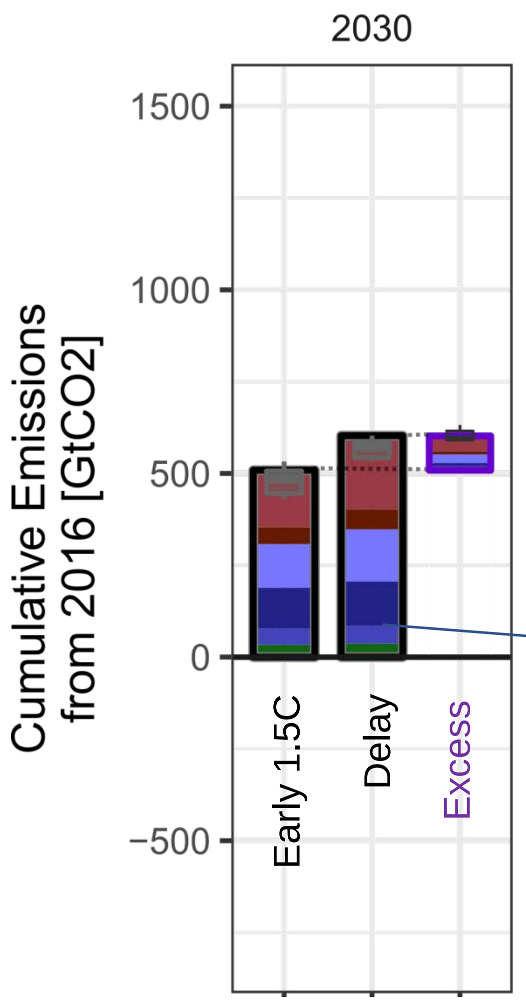
Modified from Erickson et al., 2015



[1] Bertram et al., 2015
[2] Erickson et al., 2015

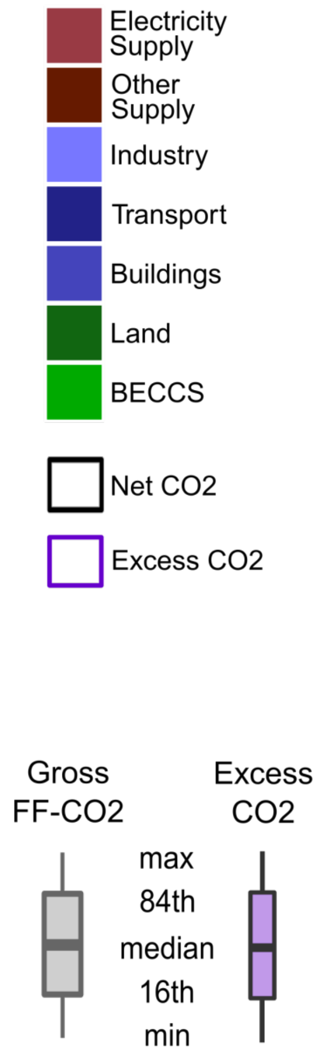
Assessing carbon lock-ins – II

Electricity dominates excess emissions



Impact of not strengthening before 2030

- 80 $GtCO_2$ of excess emissions in INDCs until 2030
- Over 50% of excess emissions from electricity sector.

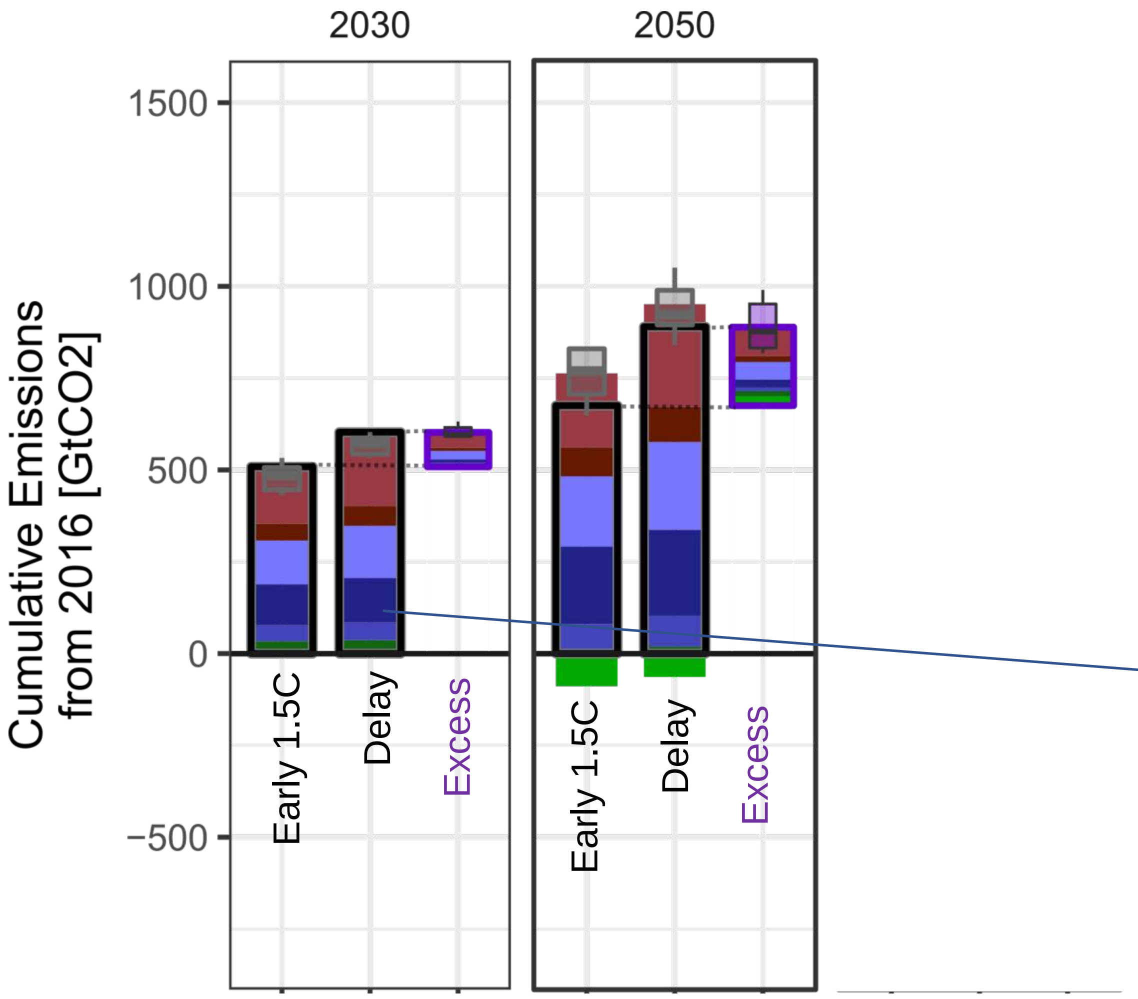


Delayed policy followed by same ambition (carbon price trajectory) as in early mitigation scenario.

Luderer et al., 2018

Assessing carbon lock-ins – II

Influence on long-term policy



Impact of not strengthening before 2030

- 80 $GtCO_2$ of excess emissions in INDCs until 2030
- Over 50% of excess emissions in 2030 from electricity sector.
- Growing to 250 $GtCO_2$ until 2050 due to carbon lock-ins

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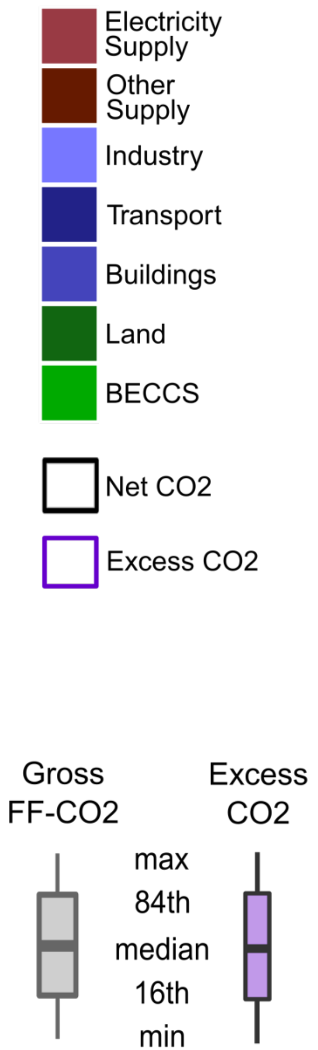


Luderer et al., 2018

Summary

- Carbon lock-ins as an example of **path-dependent** phenomena
- Electricity sector, specifically coal power represents greatest lock-in risks
- Near-term policies **strongly influence**
  - long-term action (1.5/2/overshoot),
  - ambition and
  - choice (more CDR^, premature retirement of coal plants etc.)

These results mostly include path-dependency from infrastructural lock-ins!

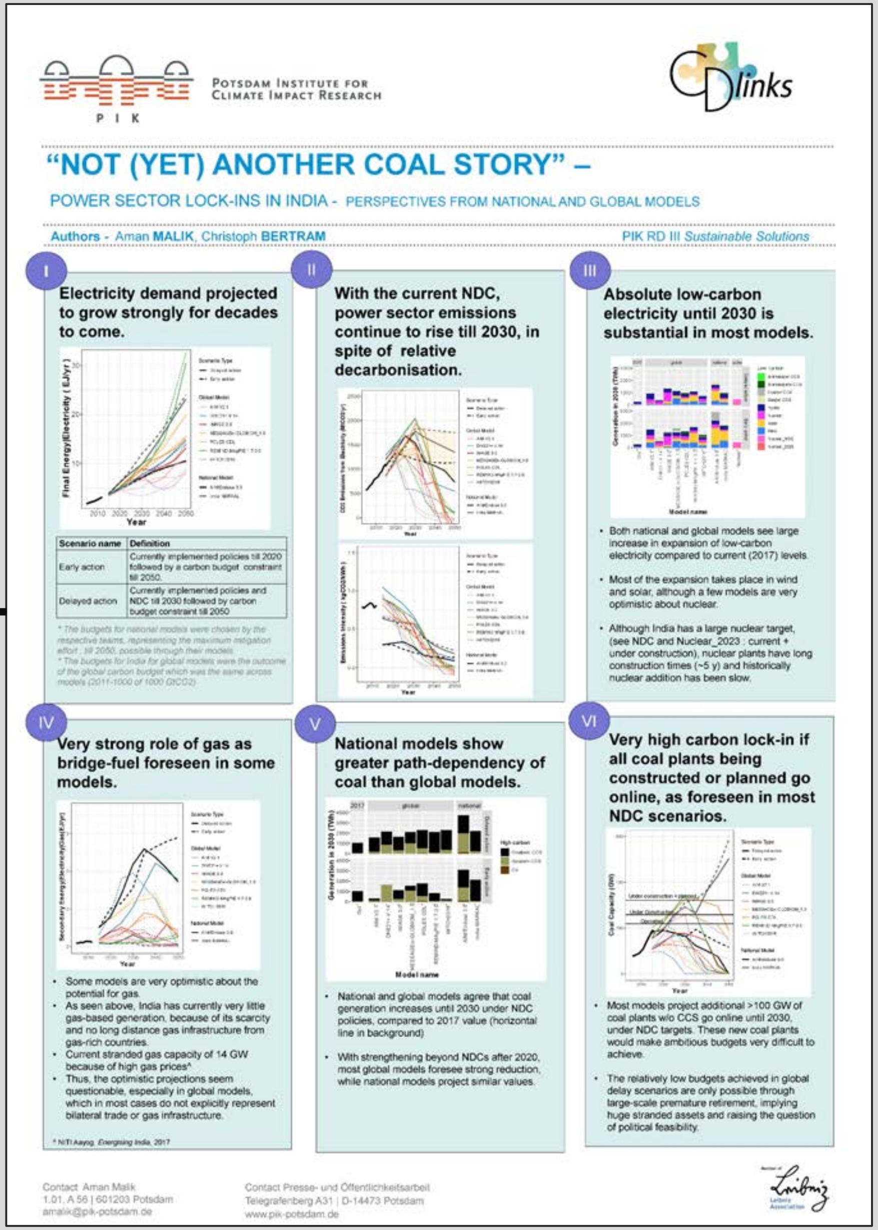
^ Carbon dioxide Removal

“NOT (YET) ANOTHER COAL STORY”

POWER SECTOR LOCK-INS IN INDIA –

Perspectives from Global and National Models

Aman MALIK, Christoph BERTRAM
IAMC 2018

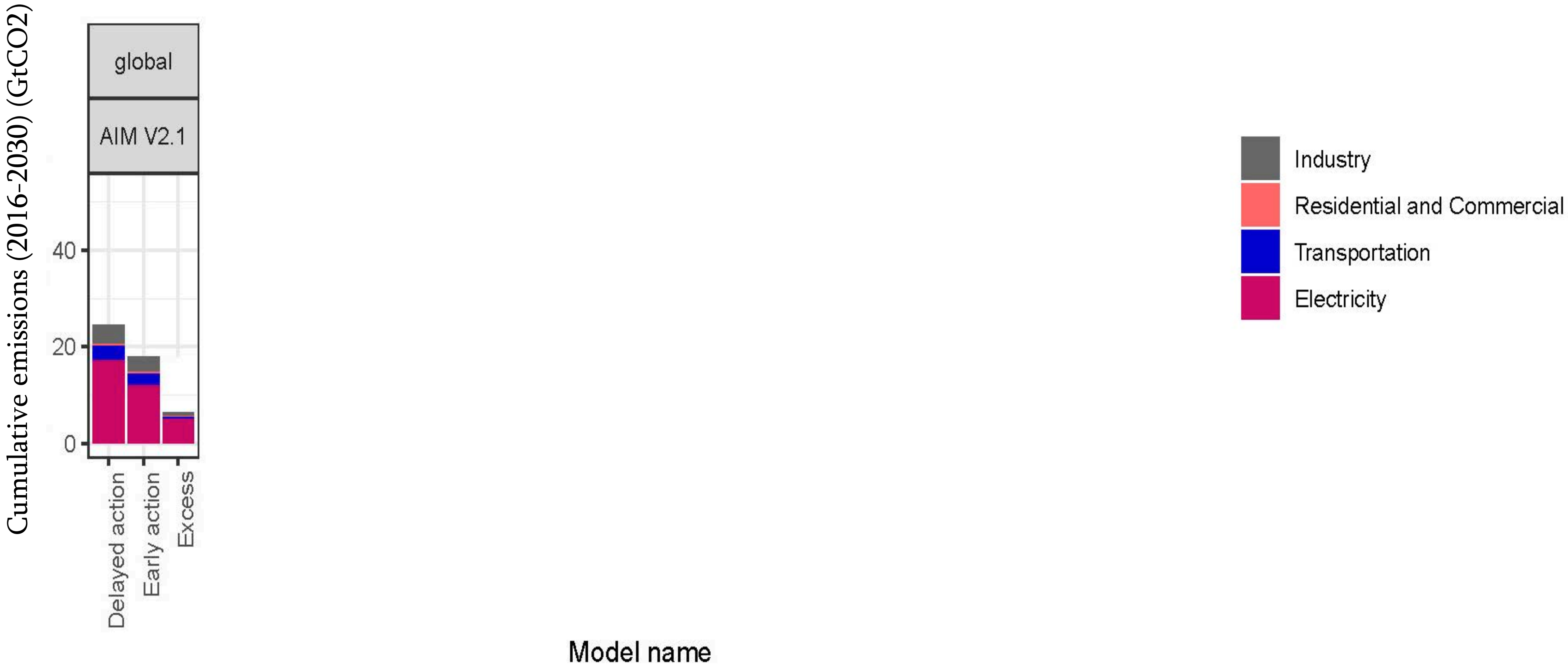


Scenario design

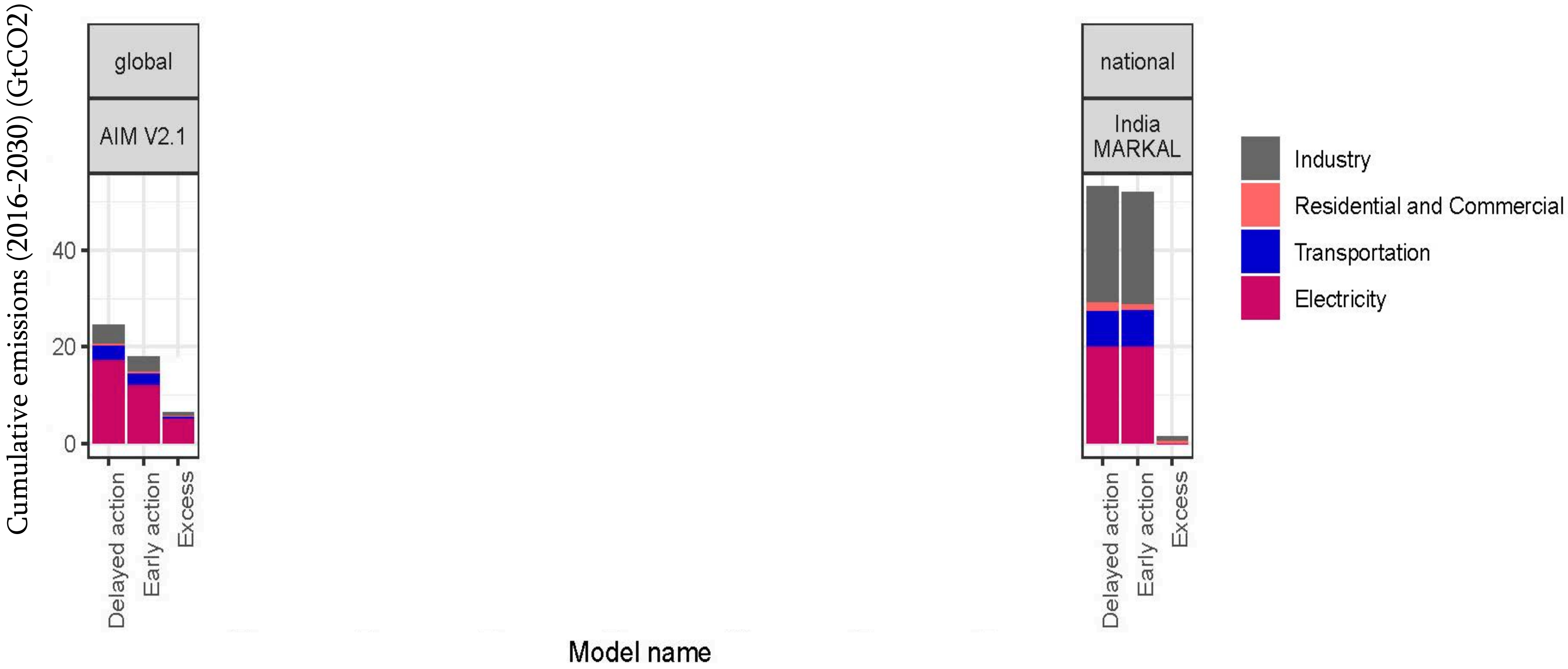
Scenario name	Definition
Early action	Currently implemented policies till 2020 followed by a carbon budget constraint till 2050.
Delayed action	Currently implemented policies and NDC till 2030 followed by carbon budget constraint till 2050

* 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 $GtCO_2$)

Quantifying lock-ins in India

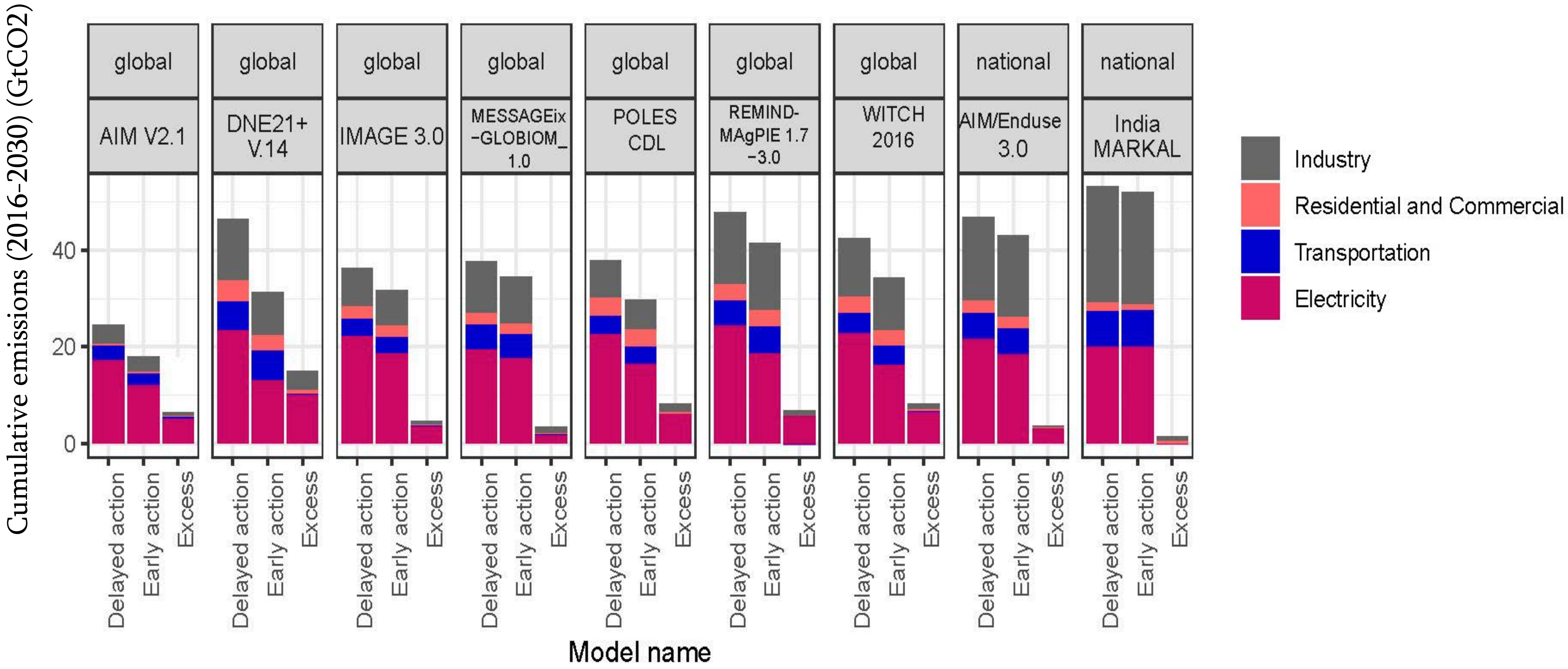


Quantifying lock-ins in India

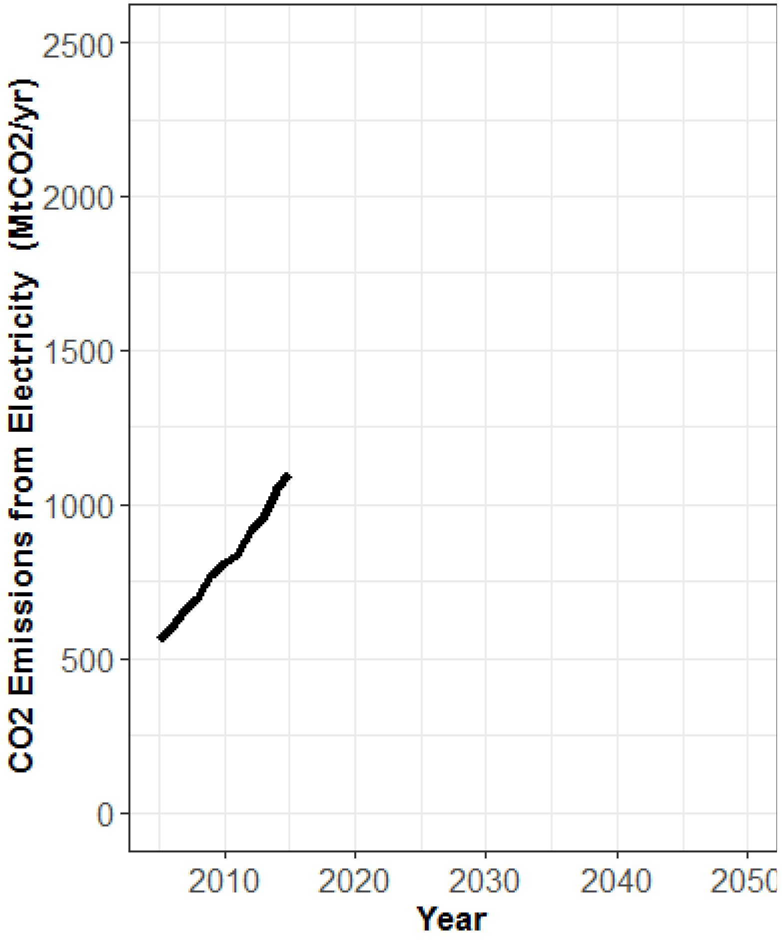


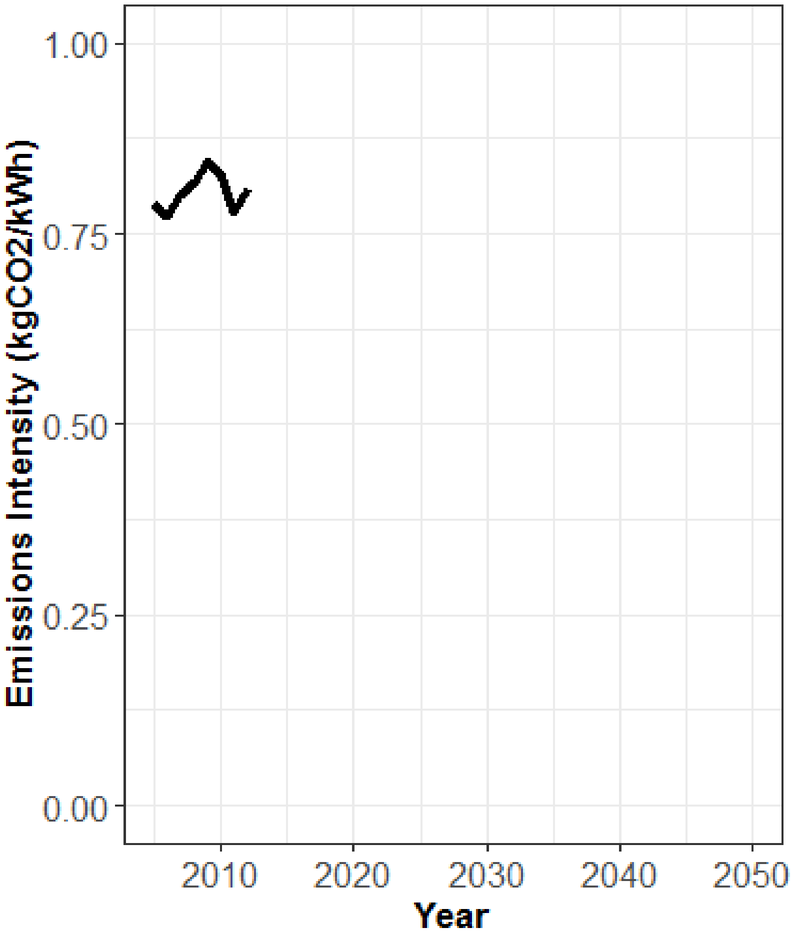
Quantifying lock-ins in India

Power sector main source of excess emissions

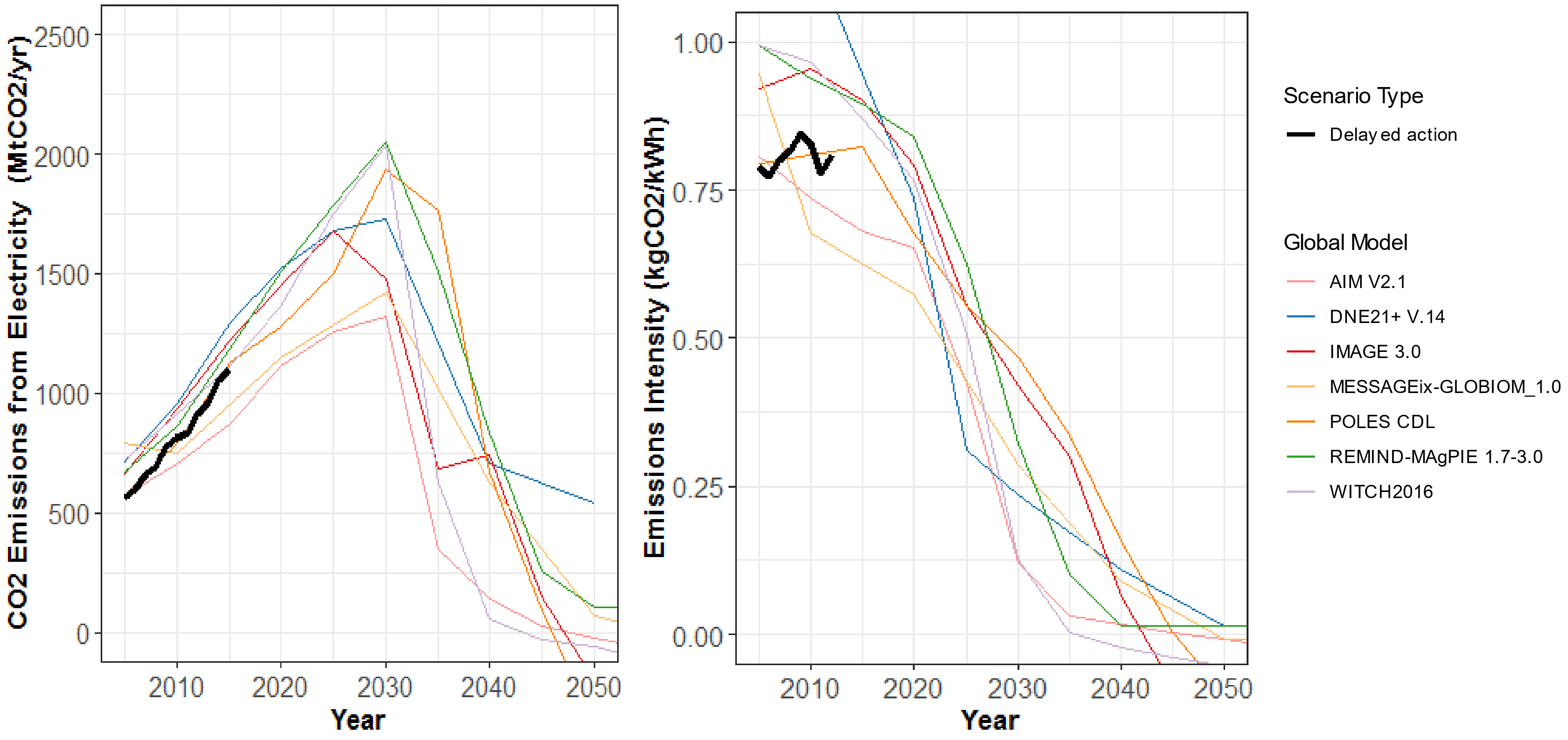


Emissions from Power sector

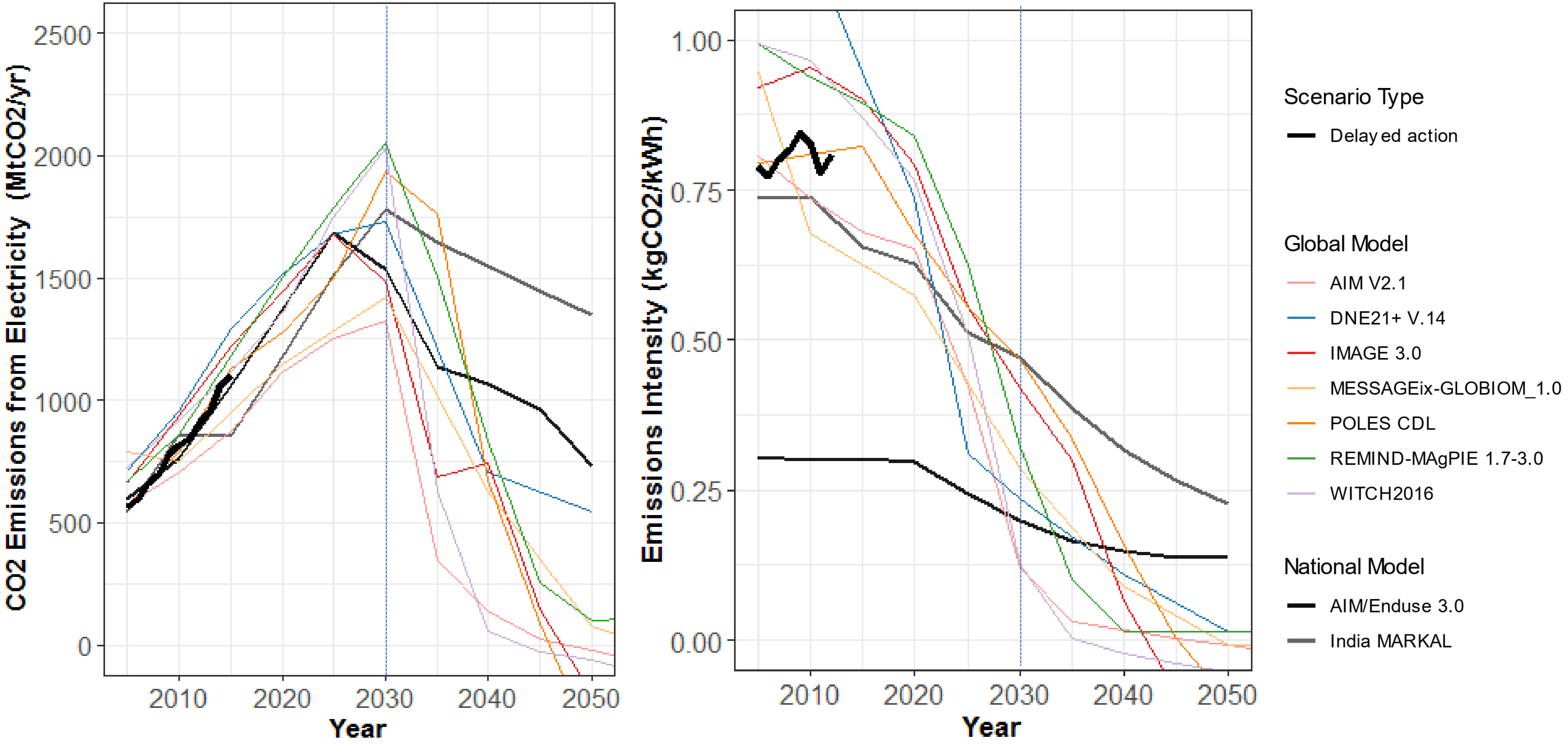




Emissions from Power sector

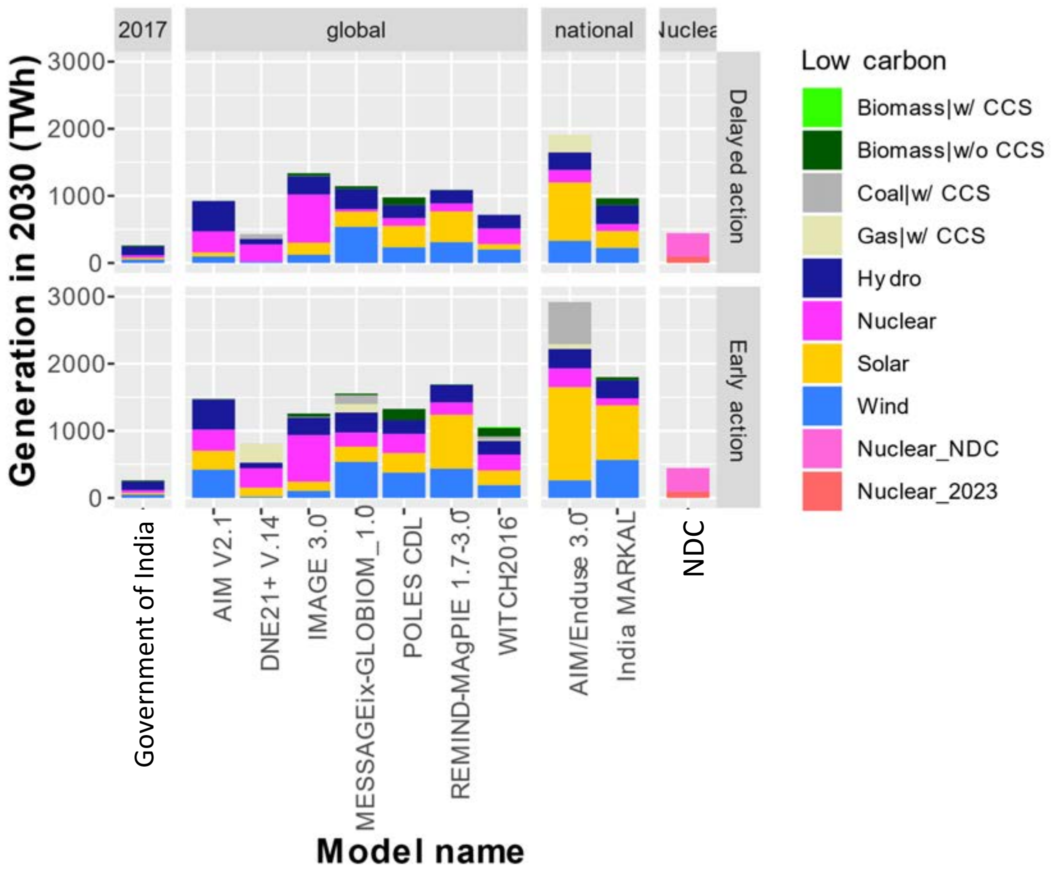


Emissions from Power sector



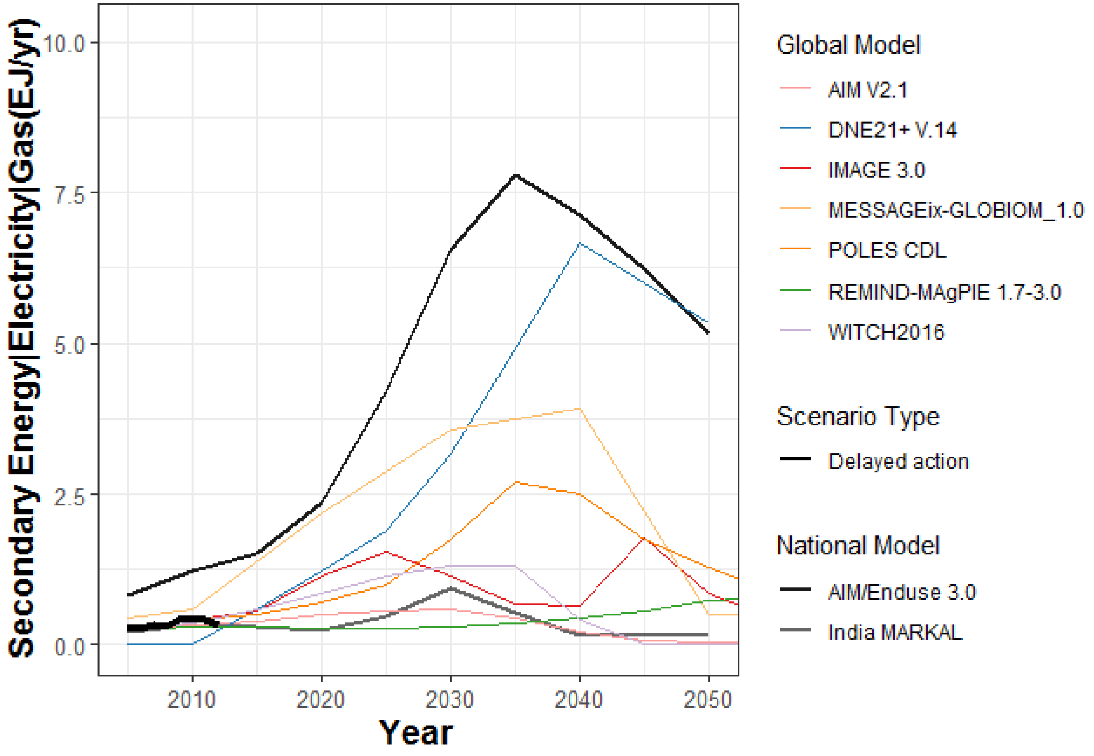
With the current NDC, power sector emissions continue to rise till 2030, in spite of relative decarbonisation.

Absolute low-carbon electricity until 2030 is substantial in most models.



- Large increase in expansion of low-carbon electricity
- Wind and solar dominate, a few models are very optimistic about nuclear.
- Although India has a large nuclear target 66GW, long construction times (~5 y) and historically low addition need to be considered.

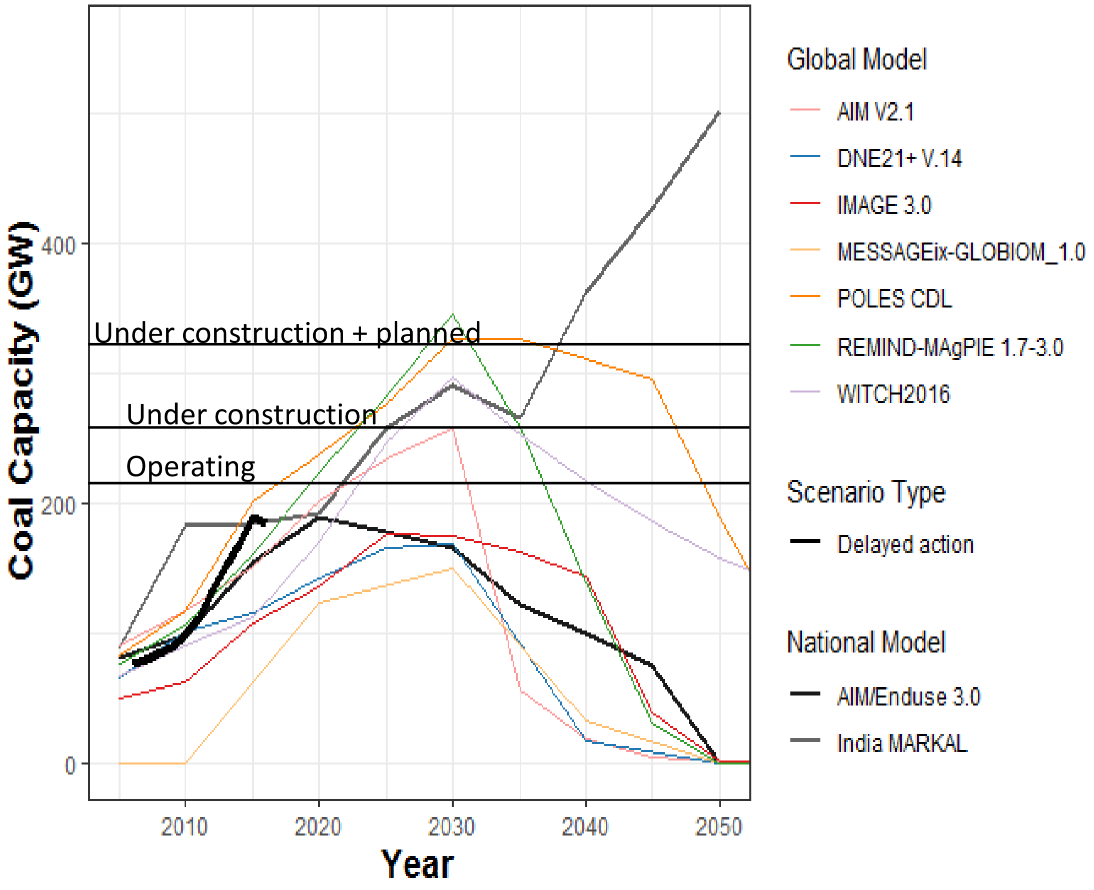
Very strong role of gas as bridge-fuel foreseen in some models.



- Optimism for gas
- Currently, very little gas-based generation - scarcity and no long distance gas infrastructure
- Current stranded gas capacity of 14 GW because of high gas prices [1]
- Optimistic projections seem questionable, especially in global models, no explicit represention of bilateral trade or gas infrastructure.

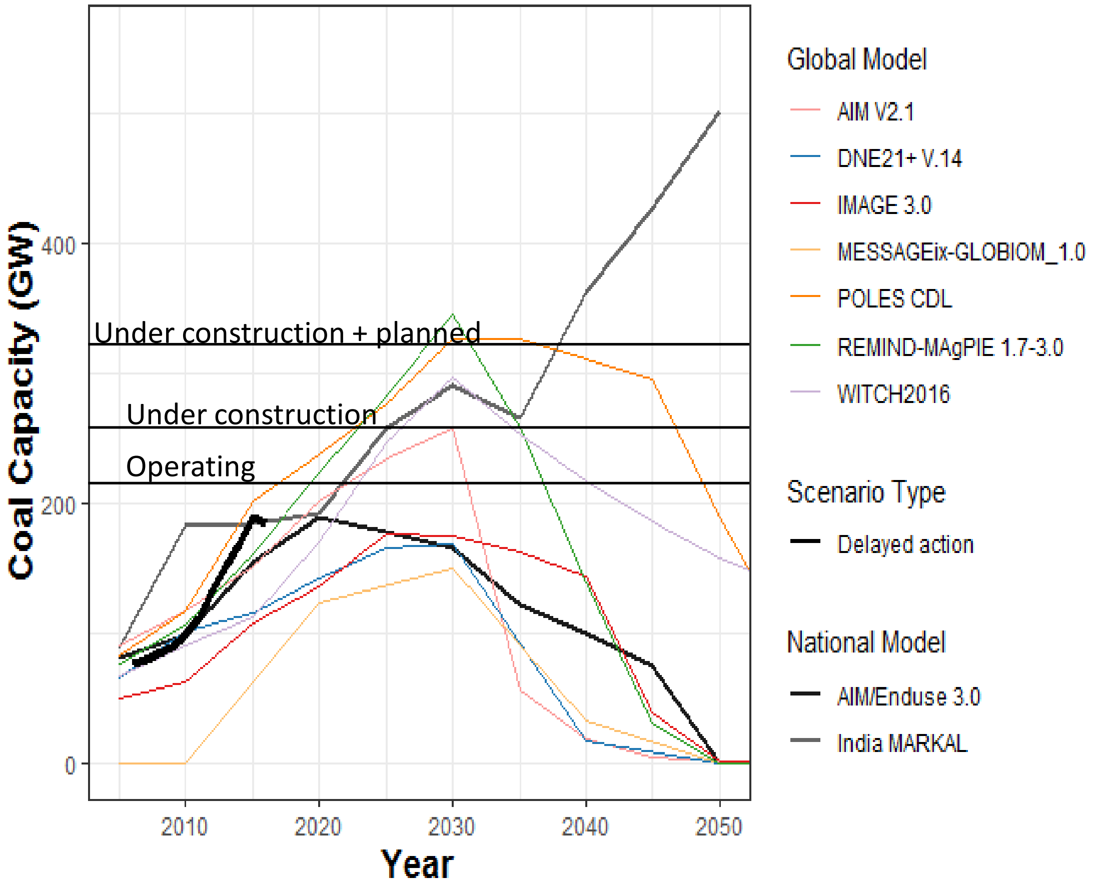
[1] NITI Aayog, Energising India, 2017

Coal Capacity



- Additional >100 GW of coal plants w/o CCS go online until 2030, under NDC targets. These new coal plants would make ambitious budgets very difficult to achieve.

Very high carbon lock-in if all coal plants being constructed or planned go online, as foreseen in most NDC scenarios.



- Additional >100 GW of coal plants w/o CCS go online until 2030, under NDC targets. Make ambitious budgets very difficult to achieve.

- Global delay scenarios use large-scale premature retirement for emission reductions, raising the question of political feasibility.

Recap

Carbon Lock-ins → India as a case study → Techno-economics without political feasibility might produce odd results

Political Economy
definitions

- "Existence of heterogeneous interests in the society and the need to make collective choices in the face of these conflicts" [1]

- "Circumstances that makes economy-wide emission target costlier to achieve than expected from a full-information and frictionless first-best economy" [2]

[1] Drazer, 2002
[2] Staub-Kaminski et al. , 2014

Actors of PE
politicians

- Policy makers might pursue their own self-interests, such as increasing their chances of re-election, or personal income. [2]
- Reluctant to pursue policies that are are:
  - unfavourable with the voters
  - regressive towards their campaign-supporting special interest groups, and large trade unions who yield considerable political influence. [1]
- Lack credibility – ETS prices, “on-off” carbon pricing policy (Australia)

[1] Grossman, 1992
[2] Staub-Kaminski et al. , 2014

Actors of PE
vested interests

- Includes industries with "high asset specificity" [1] i.e., assets for specific use, producing carbon intensive goods and services
- Examples - steel and cement, oil and coal mining and extraction, utilities with dominantly coal plants etc. [2]
- Influence policy making through campaign-support and lobbying.

"What do you figure this one would cost?", September 12, 1950.
Published in the *Washington Post*

[1] Murphy, 2004
[2] Jenkins, 2014

Actors of PE

citizens

- Resist policies which increases their immediate costs thereby reducing their perceived income [3]. E.g., protests in France over hike in gasoline prices
- Studies on WTP in the USA show it to be 3-5 times smaller than social cost of carbon estimates. [2]
- Revenue recycling important but not fully studied.[1]

[1] Jenkins, 2014
[2] Nemet, 2010
[3] Staub-Kaminski et al. , 2014

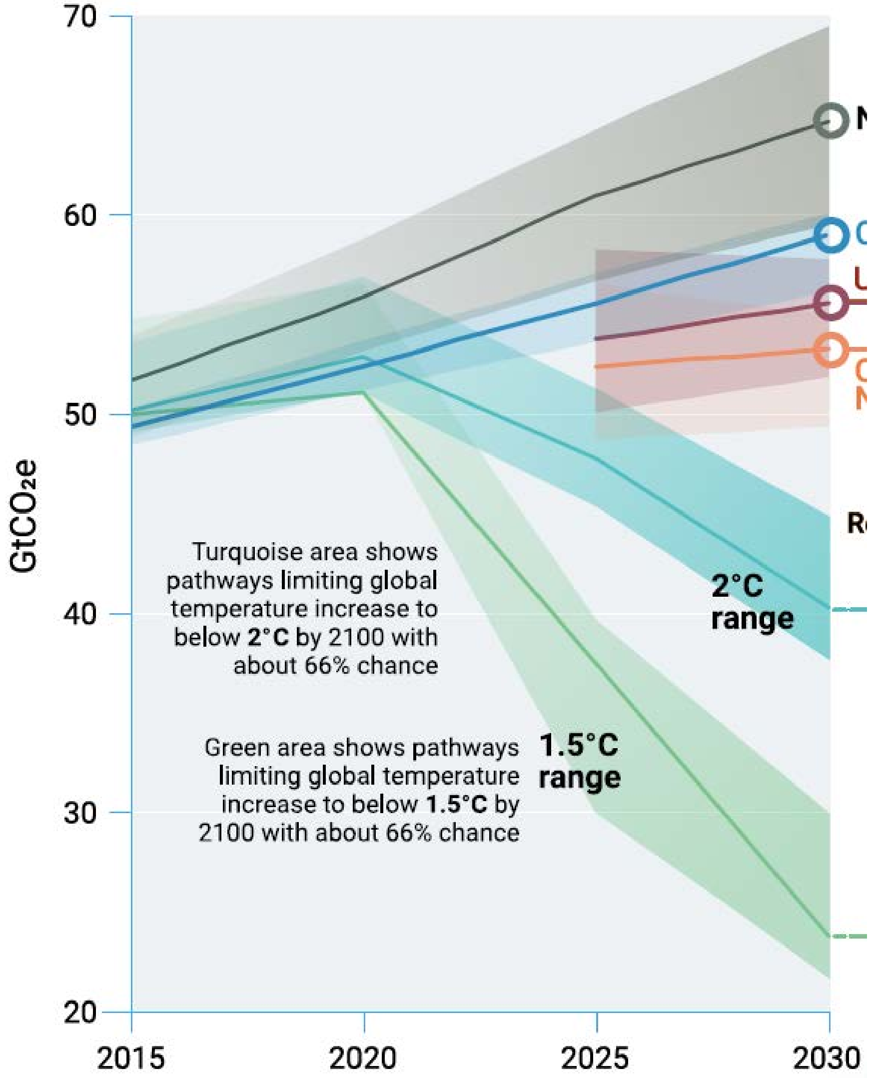

Daily Express

CNN

Reuters

Representing PE in IAMs need

- PE considerations play a very important role in real world climate policy.
- Critique: Mitigation pathways for 1.5C require extraordinary transformations, show sharp increases in carbon prices- "political infeasible".
- Better represent path-dependency in IAMs.
  - Critical for politically implementable short-term policies.
  - Relation between short and long-term policies.

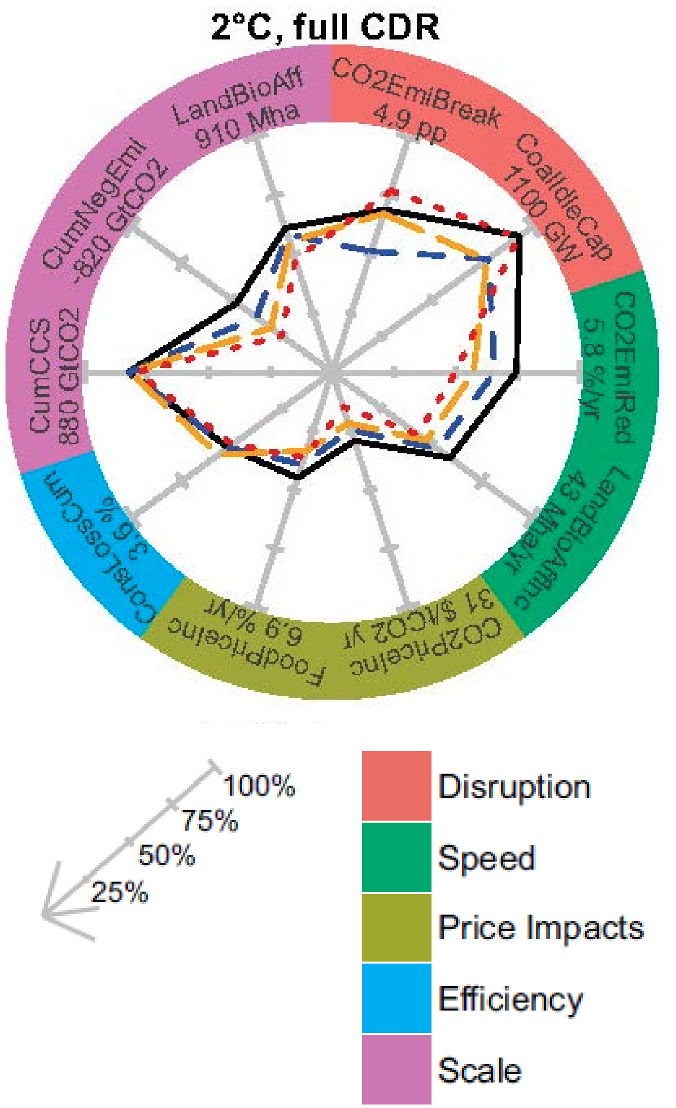


UNEP, 2018 (under embargo)

Representing PE in IAMs

approaches

- Both national models and global models implement PE to some extent.
  - **Scenario design and Model assumptions-** delay scenarios, limiting technology portfolio (CCS), early retirement, exclusion of certain sectors or regions[1]
  - **Ex-post**. Multi-criterion analysis using set of indicators. E.g. Kriegler et al., 2018
  - **Model structure/dynamics**
    - Requires abstraction on PE- Structured theory to generalize case studies [2]



Kriegler et al., 2018

[1] Staub-Kaminski et al., 2014
[2] Kriegler, PeP1p5, 2018

PE and carbon lock-ins
objective

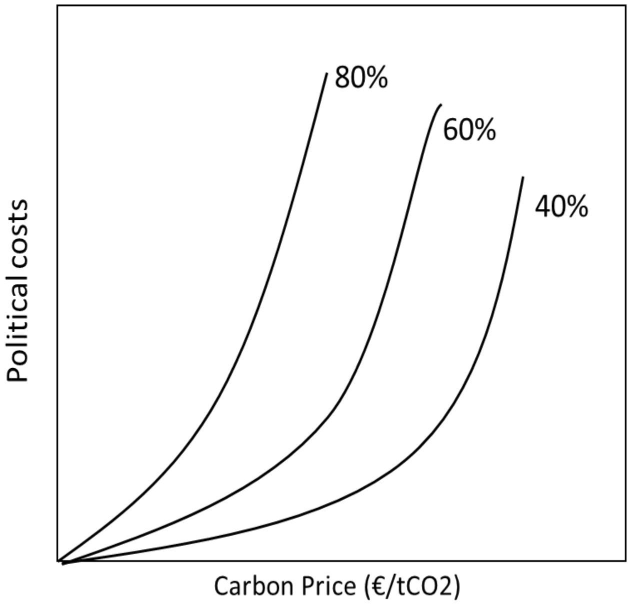
- Political systems greatly influenced by actors representing mature industries and technologies [1,2]
- Assumption: Delay in ambitious policy -> continued fossil fuel infrastructure and strengthening of vested interests -> dilute possibility of future ambitious policy.

To quantify the effect of PE on carbon lock-ins

[1] Walker, 2000
[2] Steves and Teytelboym, 2013

How to do it? Some ideas…

I



- Political costs are a function of carbon share and carbon price.
- For a certain level of tolerable political cost, the maximum carbon price emerges as a function of coal share
- **Questions**:
  - What are political costs? What are its components?
    - Restructuring regional industry, compensation, retraining
  - How can it be measured?

Conclusions

- Element of carbon lock-ins – institutional or political economy lock-ins, technological, and behavioural lock-ins
- India as an example, pure techno-economics might not produce realistic results.
- Need to explicitly implement PE considerations in IAMs
- Need workable ideas on how to quantify and implement PE in IAMs.

Future Work and Outlook

- 1st paper - Carbon Lock-ins in India
  - paper - Carbon lock-ins in China (Research visit Huan from Tsinghua Uni.)
- 2nd paper - Delay scenarios with PE considerations.

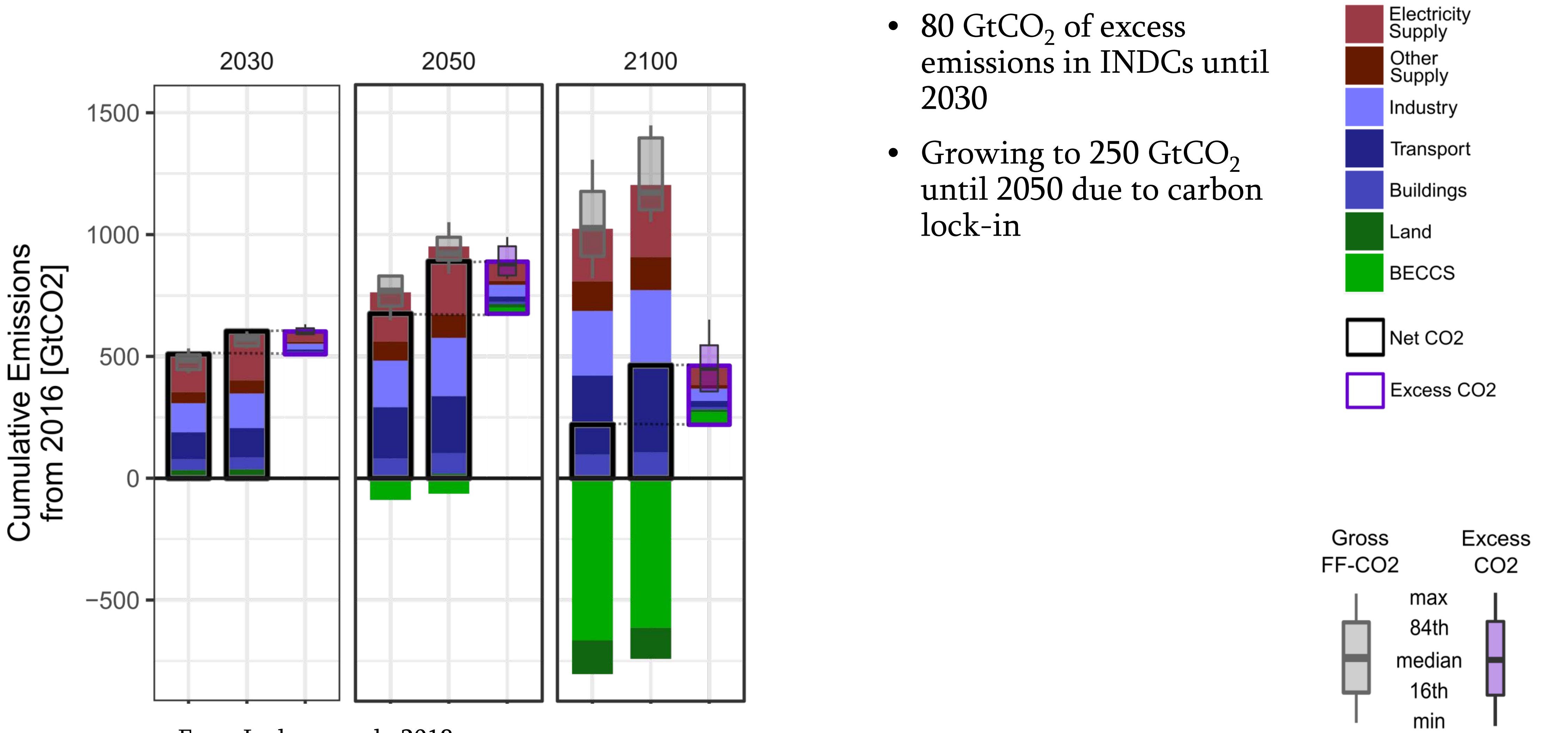
End.

Questions and Discussion

Appendix

- Almost every policy reform accompanied by huge transaction costs involving government compensation, grandfathering, or phased or postponed implementation.

Impact of not strengthening before 2030



From Luderer et al., 2018

- 80 $GtCO_2$ of excess emissions in INDCs until 2030
- Growing to 250 $GtCO_2$ until 2050 due to carbon lock-in

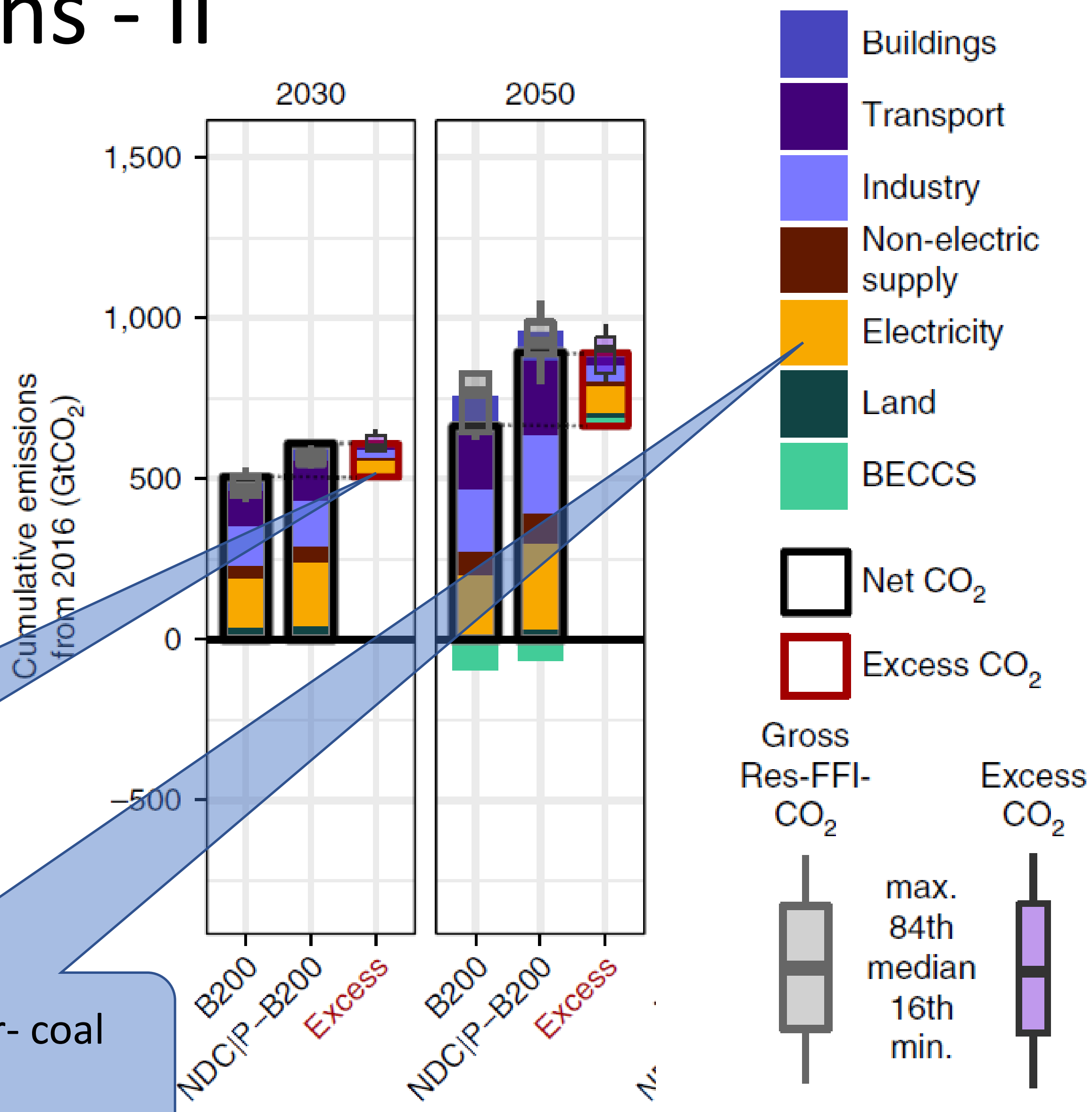
Assessing of carbon lock-ins - II

Approaches

1. Carbon lock-ins conventionally studied with early and delay scenarios. Same carbon budget but delayed climate policy. (e.g., Bertram et al. 2015, Erickson et al. 2015)
2. Delayed policy followed by same ambition (Carbon price trajectory) as in early mitigation scenario. (Luderer et al. 2018)
   - NDC|P-B200 : NDC till 2030 followed by carbon trajectory from B 200

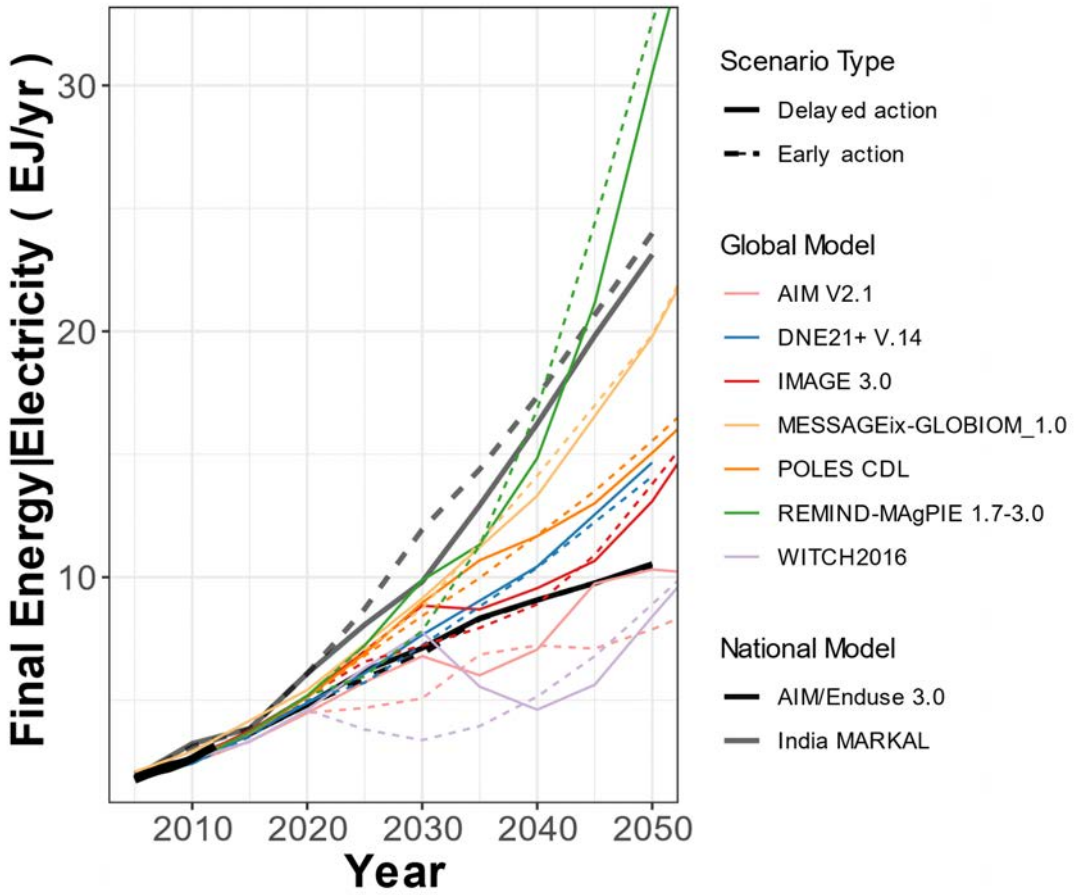
Significance of near-term action: results in excess emissions compared to cost-effective mitigation

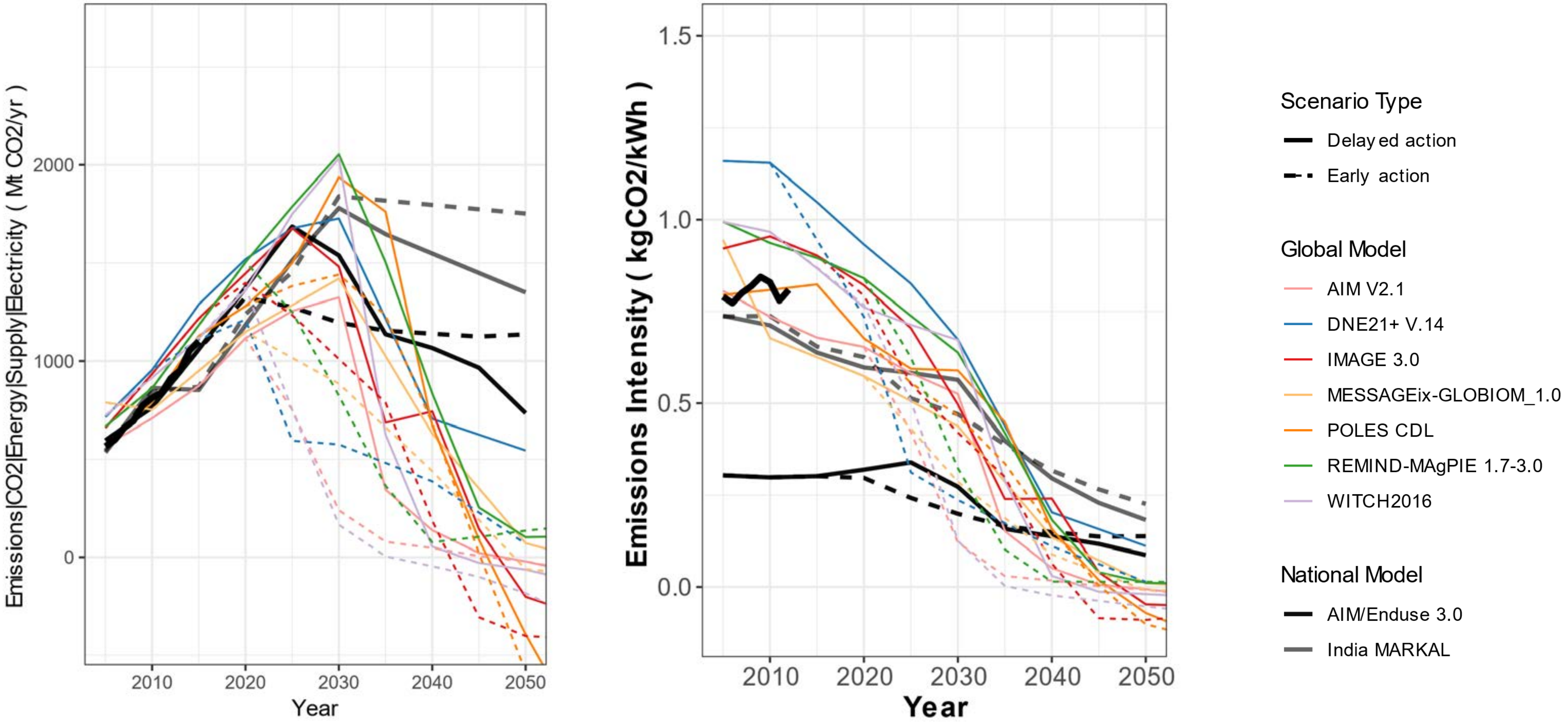
Role of electricity sector- coal power



From Luderer et al. 2018

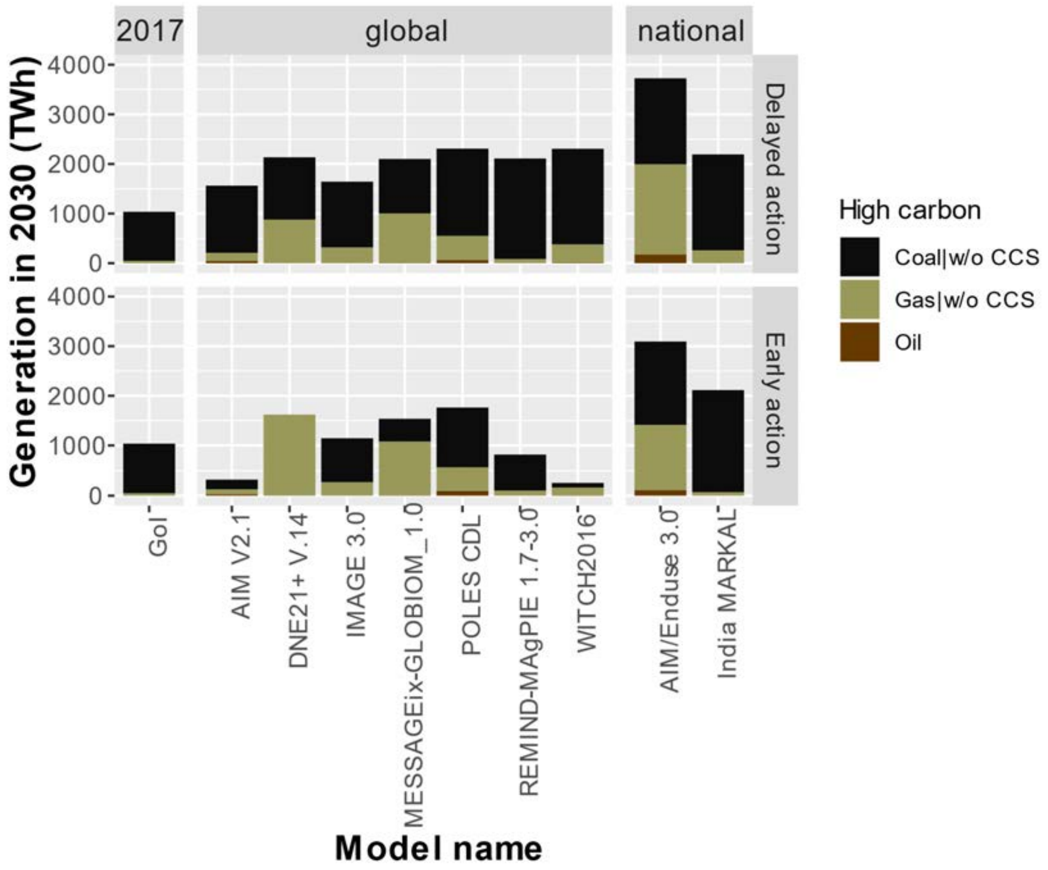
Electricity demand projected to grow strongly for decades to come.





With the current NDC, power sector emissions continue to rise till 2030, in spite of relative decarbonisation.

National models show greater path-dependency of coal than global models.



- National and global models agree that coal generation increases until 2030 under NDC policies, compared to 2017 value (horizontal line in background)
- With strengthening beyond NDCs after 2020, most global models foresee strong reduction, while national models project similar values.

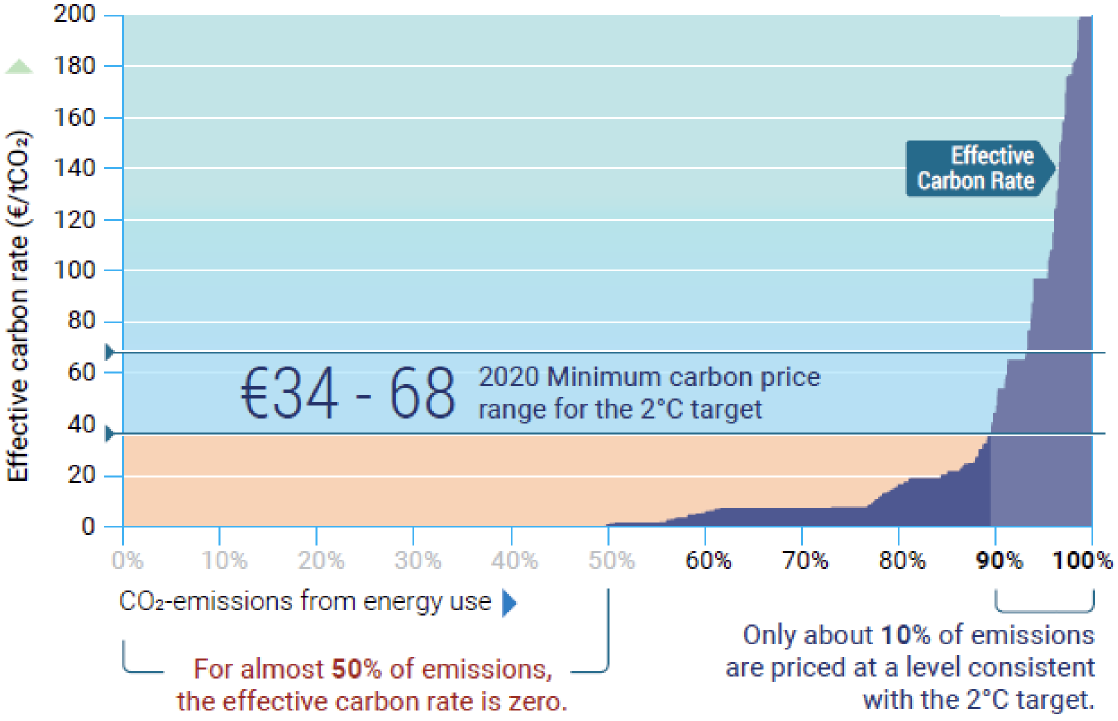
Background

"Deviating from social optimum"

- "First-best" advocating carbon pricing policies **not seen in reality**
    - Existing carbon prices way below social cost of carbon estimates [3]

- Many **rationales for "second-best" policies**, e.g., imperfect competition [2,5], presence of transaction costs [1], asymmetric information [7], "irrational" human behaviour [4,6]

[1] Coase, 1960
[2] Chamberlin, 1949
[3] Jenkins, 2014
[4] Kahneman, 2012
[5] Robinson, 1969
[6] Simon, 1955
[7] Stiglitz, 2000



Ch.6, UNEP, 2018 (Under embargo)