

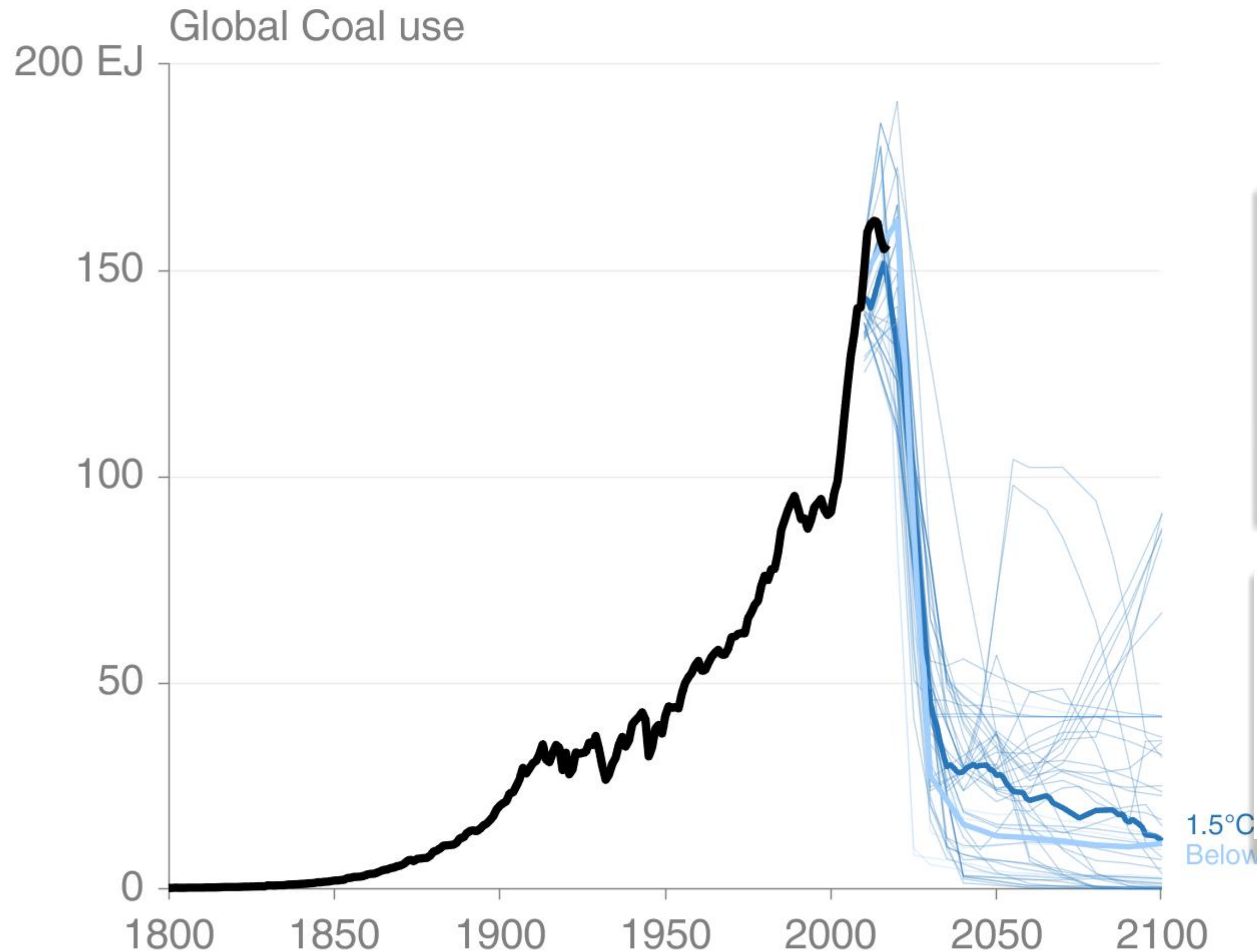
# **Insights from the Contractions project**

**Quitting fossil fuels: how fast can the world do it?**

**Jessica Jewell**

**11 January 2021 | Funded by the Norwegian Research Council**

# Dramatic decrease in coal needed to meet climate targets



Is this feasible?

Infeasibility [in models means] ... that **under a specific model parameterization** the transformation cannot be achieved.

[this] ... need[s] to be strictly differentiated from the **feasibility ... in the real world.**”

Riahi et al. 2015

**Can we phase-out fossil fuels fast enough to meet climate targets in the real-world?**



Data: IAMC 1.5°C Scenario Explorer (hosted by IIASA) • Figure: @Peters\_Glen

# How do we know what's feasible in the real world?

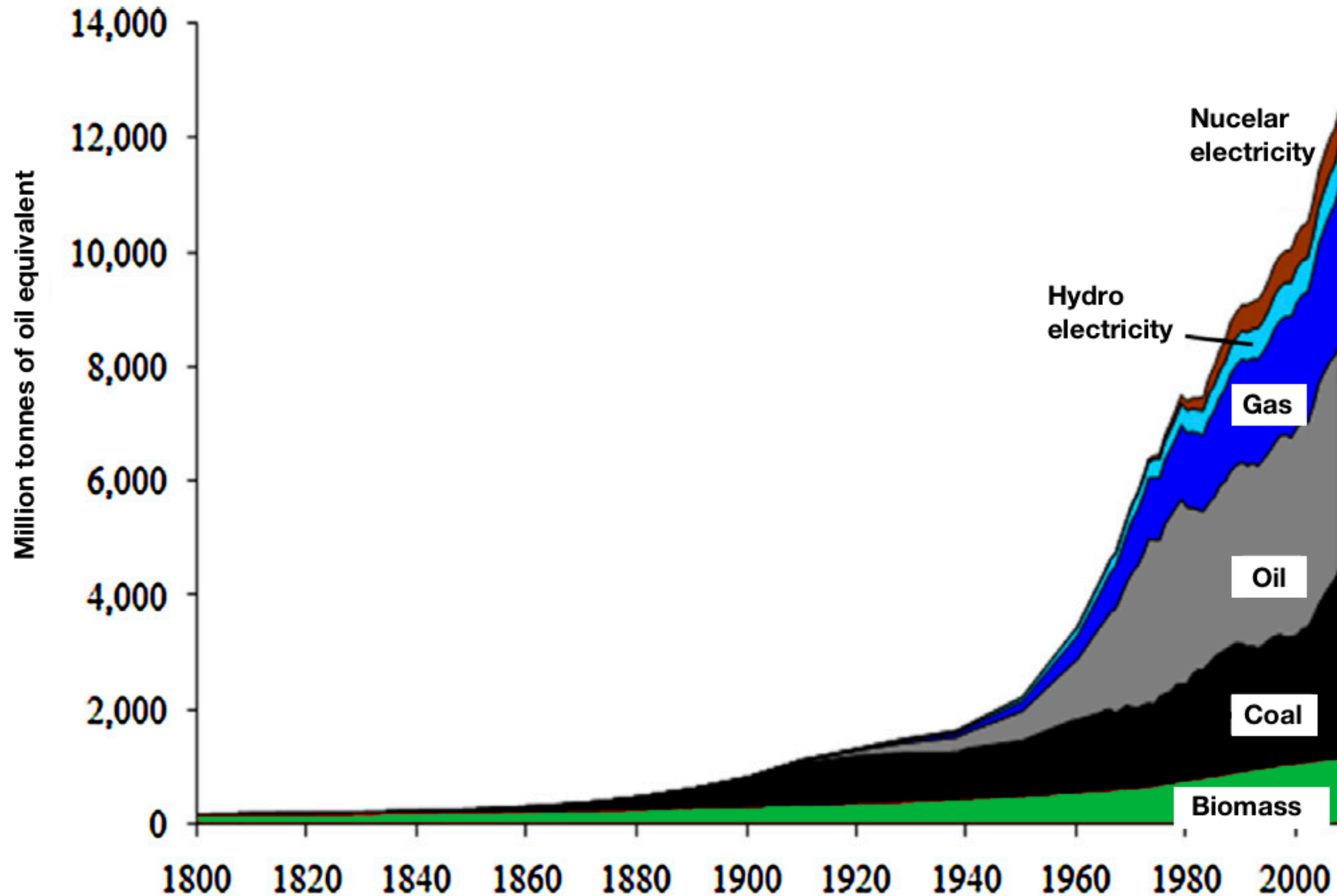
- Historical precedents of rapid fossil fuel decline
- Pledges and plans of fossil fuel decline
- Models and mechanisms of fossil fuel decline

When do fossil fuels decline?

How fast can fossil fuels decline?

What blocks and triggers decline?

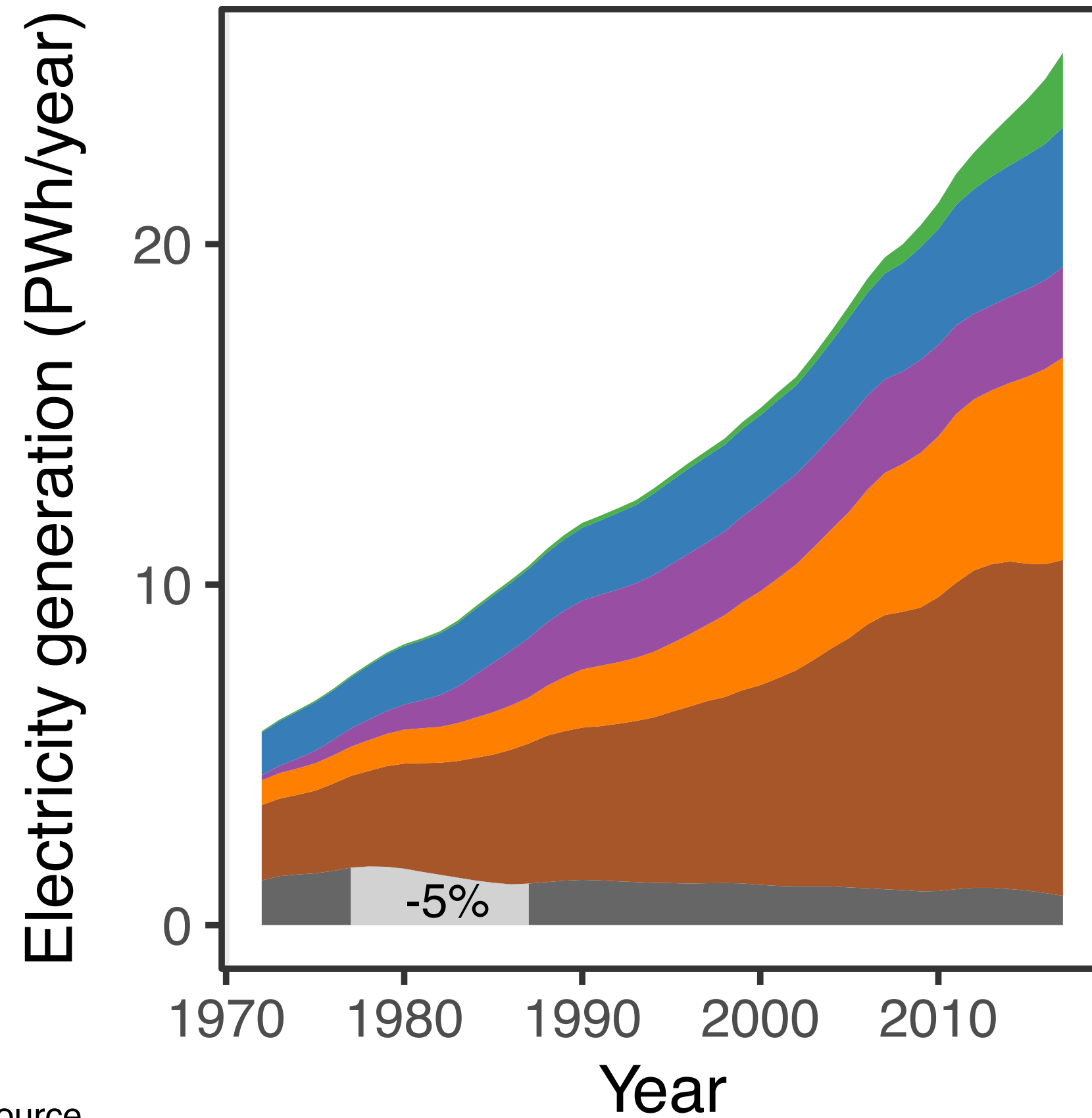
# energy additions instead of energy transitions



# How can we study fossil fuel decline if nothing ever declines?

## Look at electricity

(A) World



Source



### One Earth

Article

#### Historical precedents and feasibility of rapid coal and gas decline required for the 1.5°C target

Graphical abstract

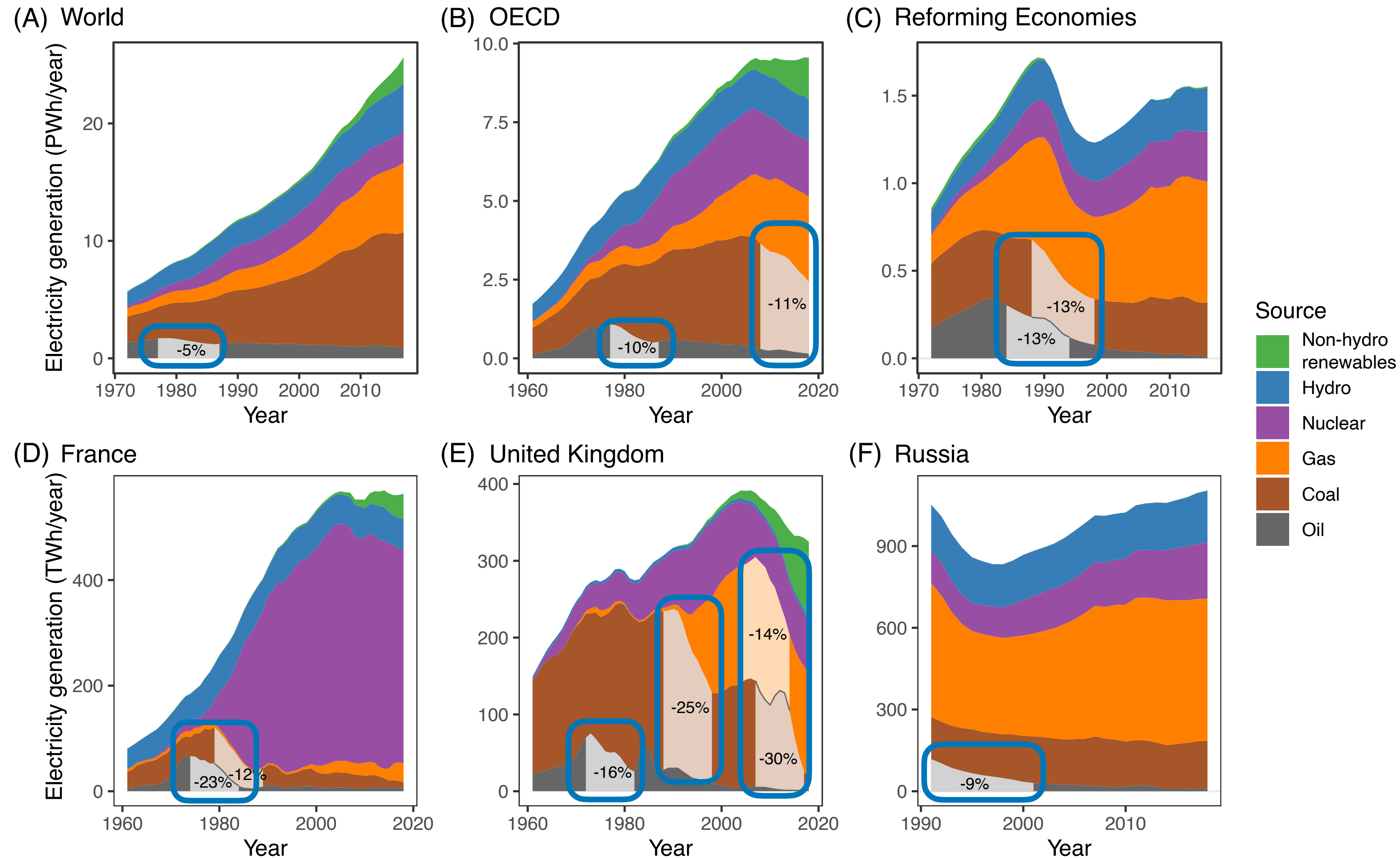
Authors

Vadim Vinichenko, Aleh Cherp,  
Jessica Jewell

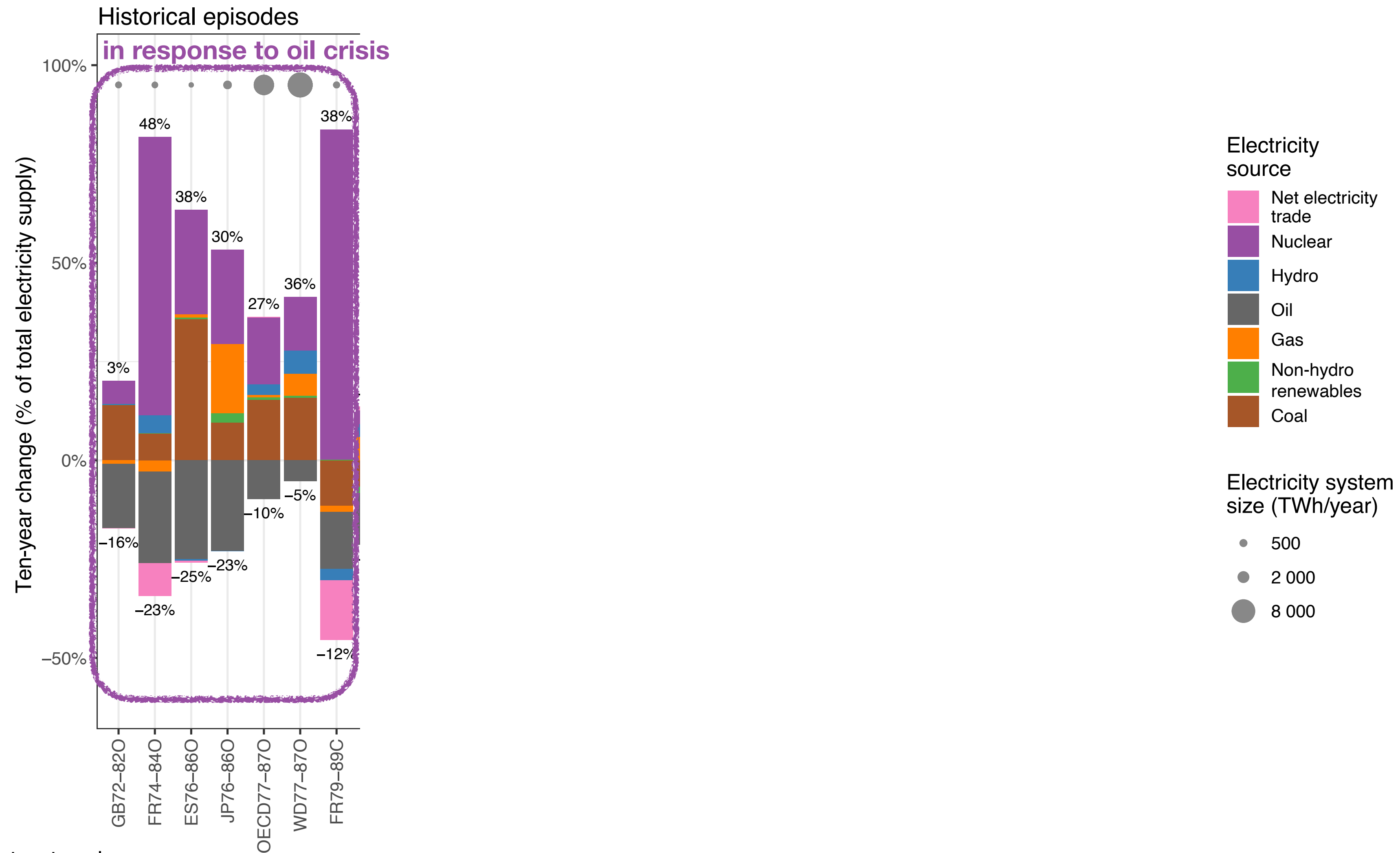
Feasibility space with feasibility zones for fossil fuel decline based on historical precedents

# How can we study fossil fuel decline if nothing ever declines?

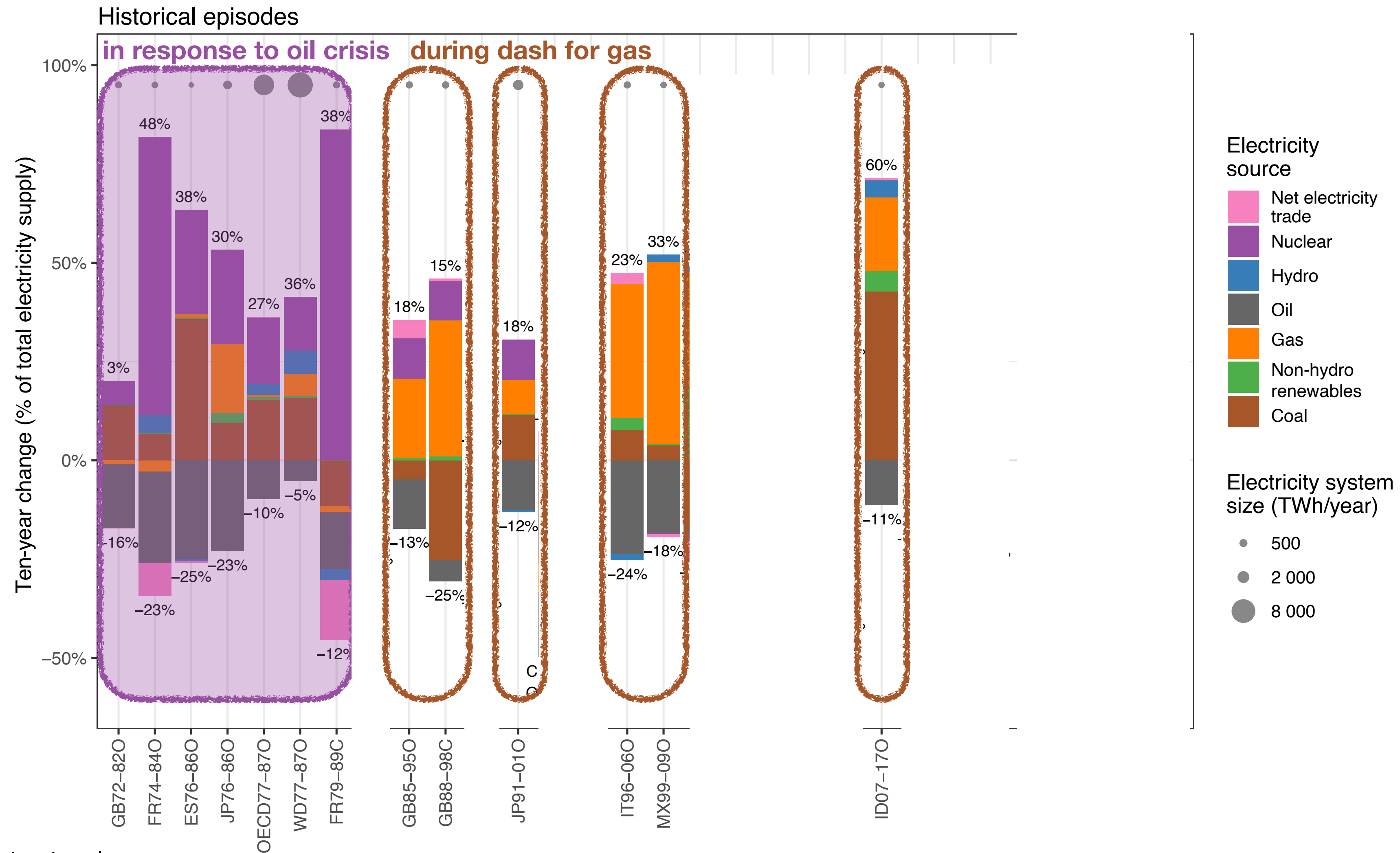
## Examine regions and countries



# Historically when and where did fossil fuels decline?

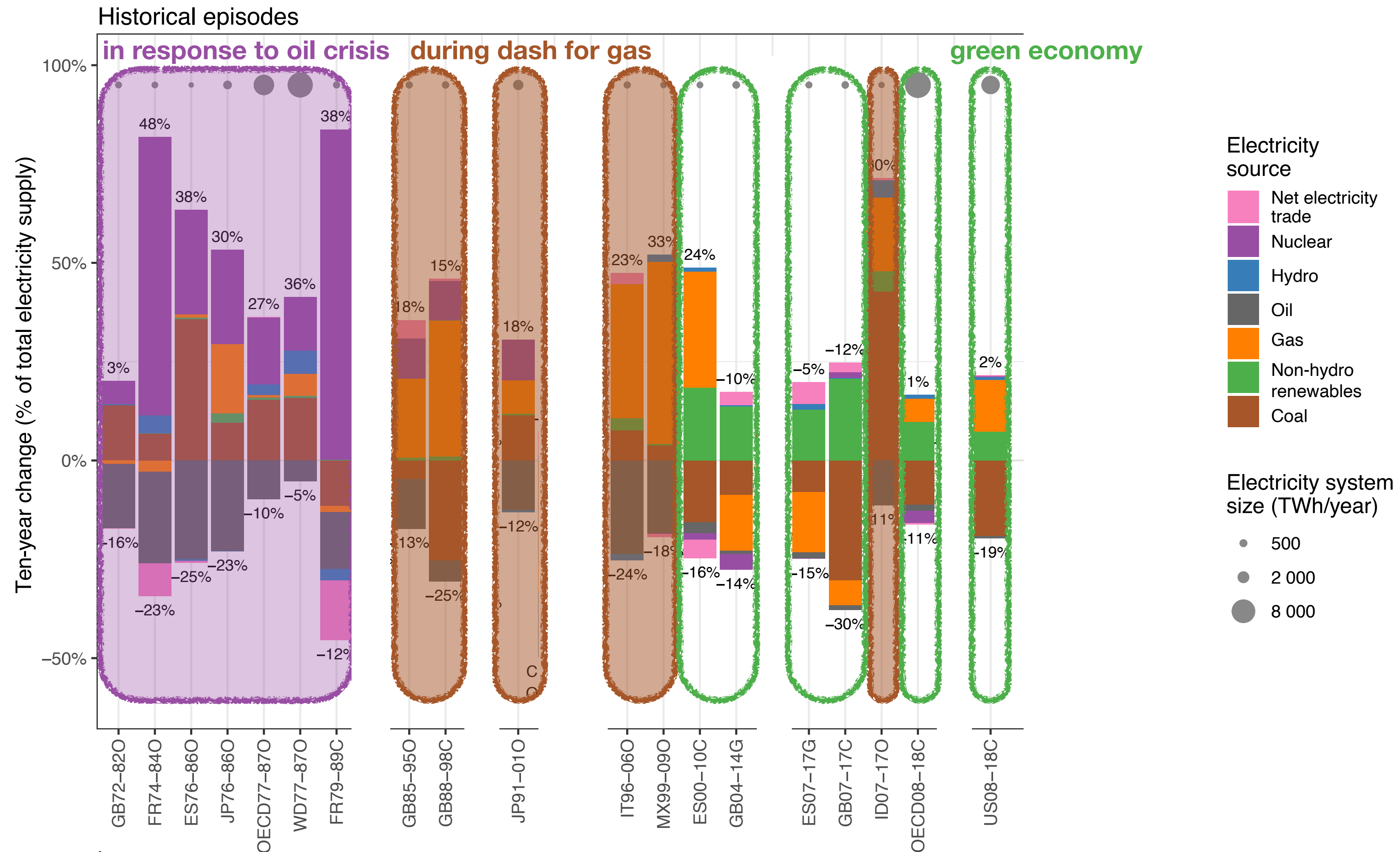


# Historically when and where did fossil fuels decline?

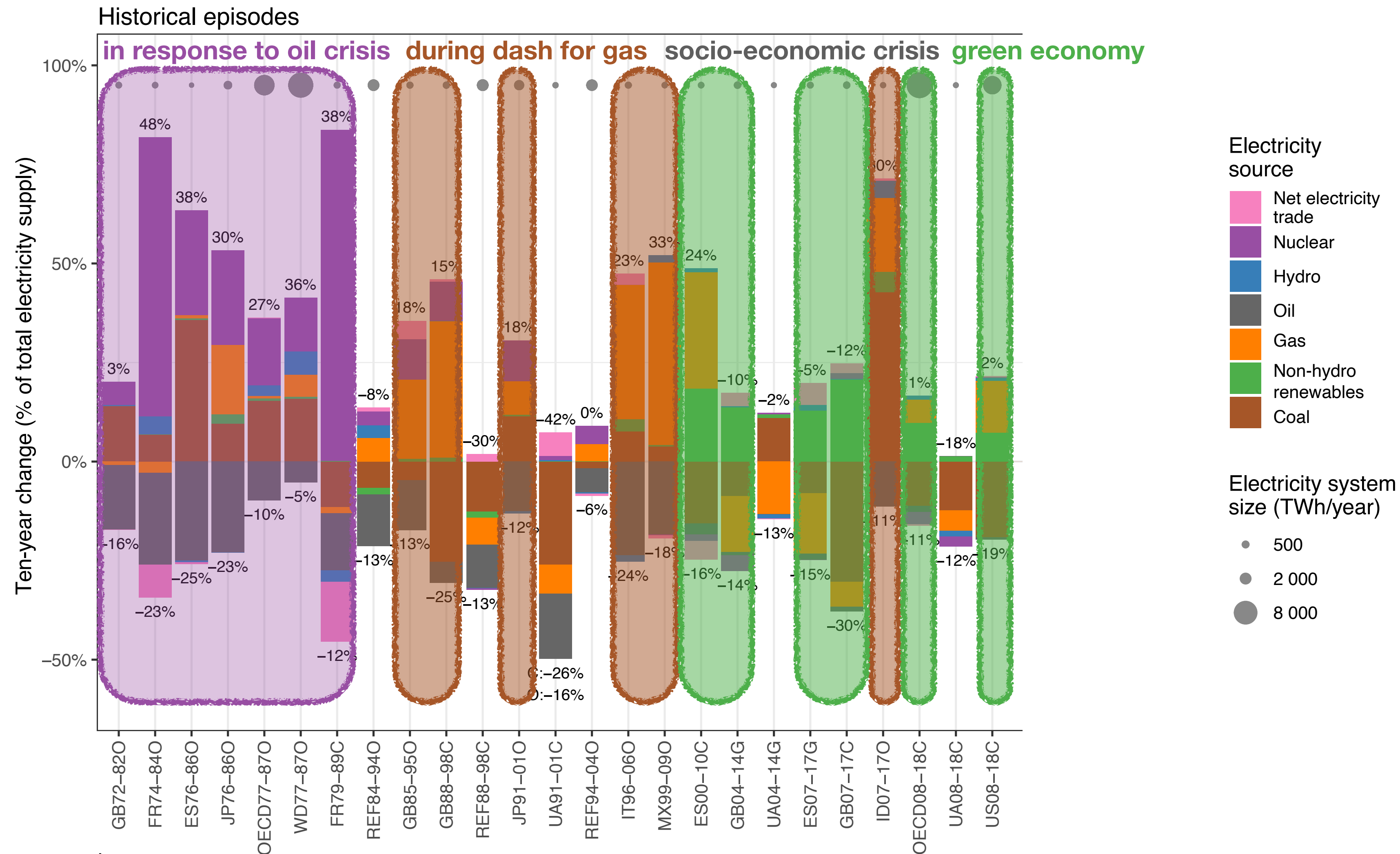




# Historically when and where did fossil fuels decline?



# Historically when and where did fossil fuels decline?



- Technological innovations
- Motivation and strong state policies

# Powering Past Coal Alliance (PPCA)

## COP23 in November 2017

Canada and the UK launch a global alliance to phase out coal electricity



Canada and the UK launch a global alliance to phase out coal electricity

commit to: “phasing out existing unabated coal power generation and a moratorium on new coal power generation without operational carbon capture and storage”

nature  
climate change

LETTERS

<https://doi.org/10.1038/s41558-019-0509-6>

### Prospects for powering past coal

Jessica Jewell<sup>1,2,3,4,7\*</sup>, Vadim Vinichenko<sup>2,3,5,7</sup>, Lola Nacke<sup>5</sup> and Aleh Cherp<sup>5,6,7</sup>

2019

# What makes PPCA countries different than non-PPCA countries?

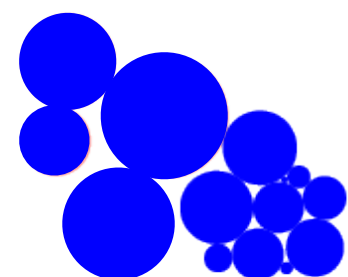
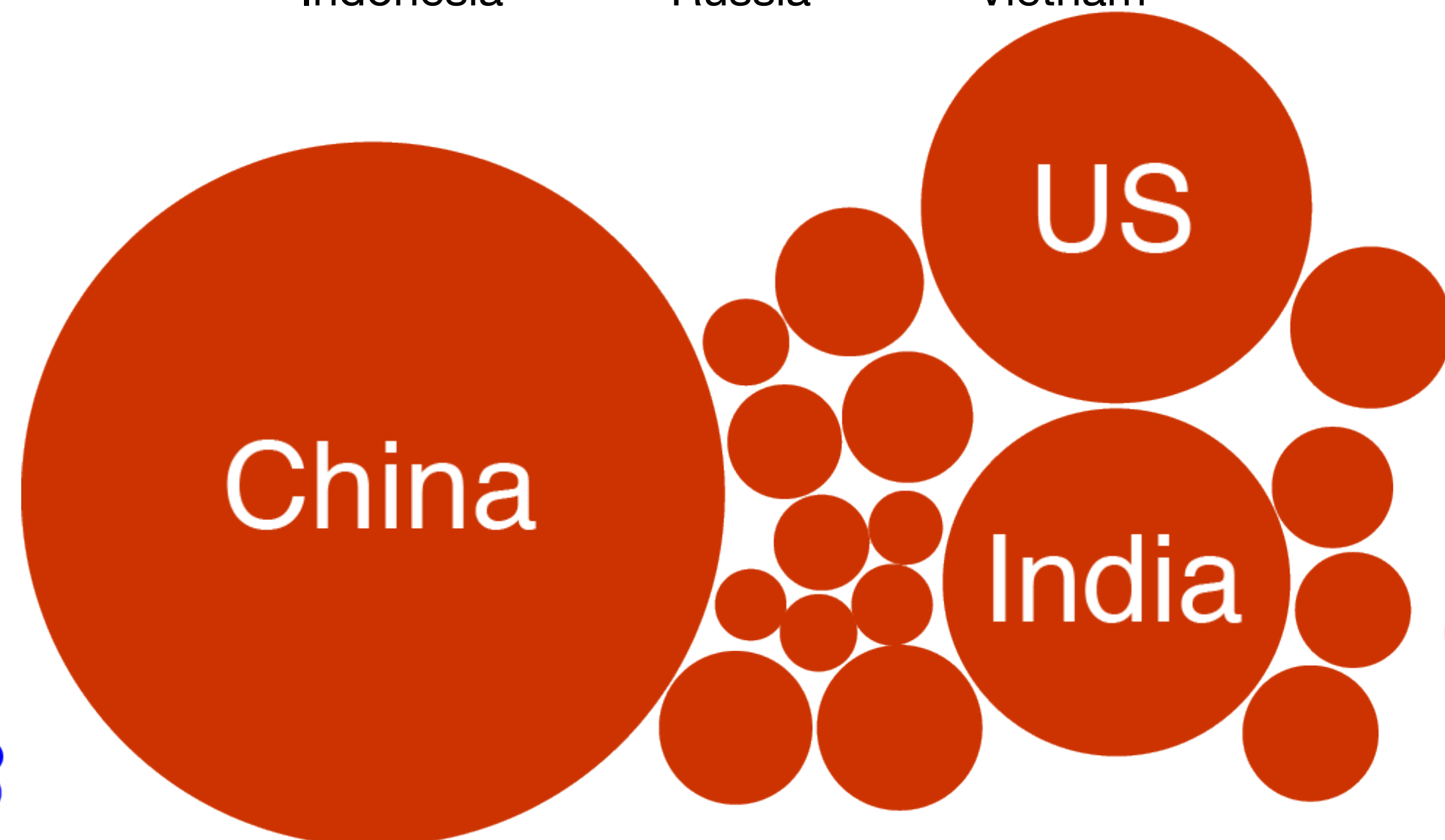
PPCA countries

Austria  
 Belgium  
 Canada  
 Denmark  
 Finland  
 France  
 Ireland  
 Israel  
 Italy  
 Mexico  
 Netherlands  
 New Zealand  
 Portugal  
 Sweden  
 United Kingdom

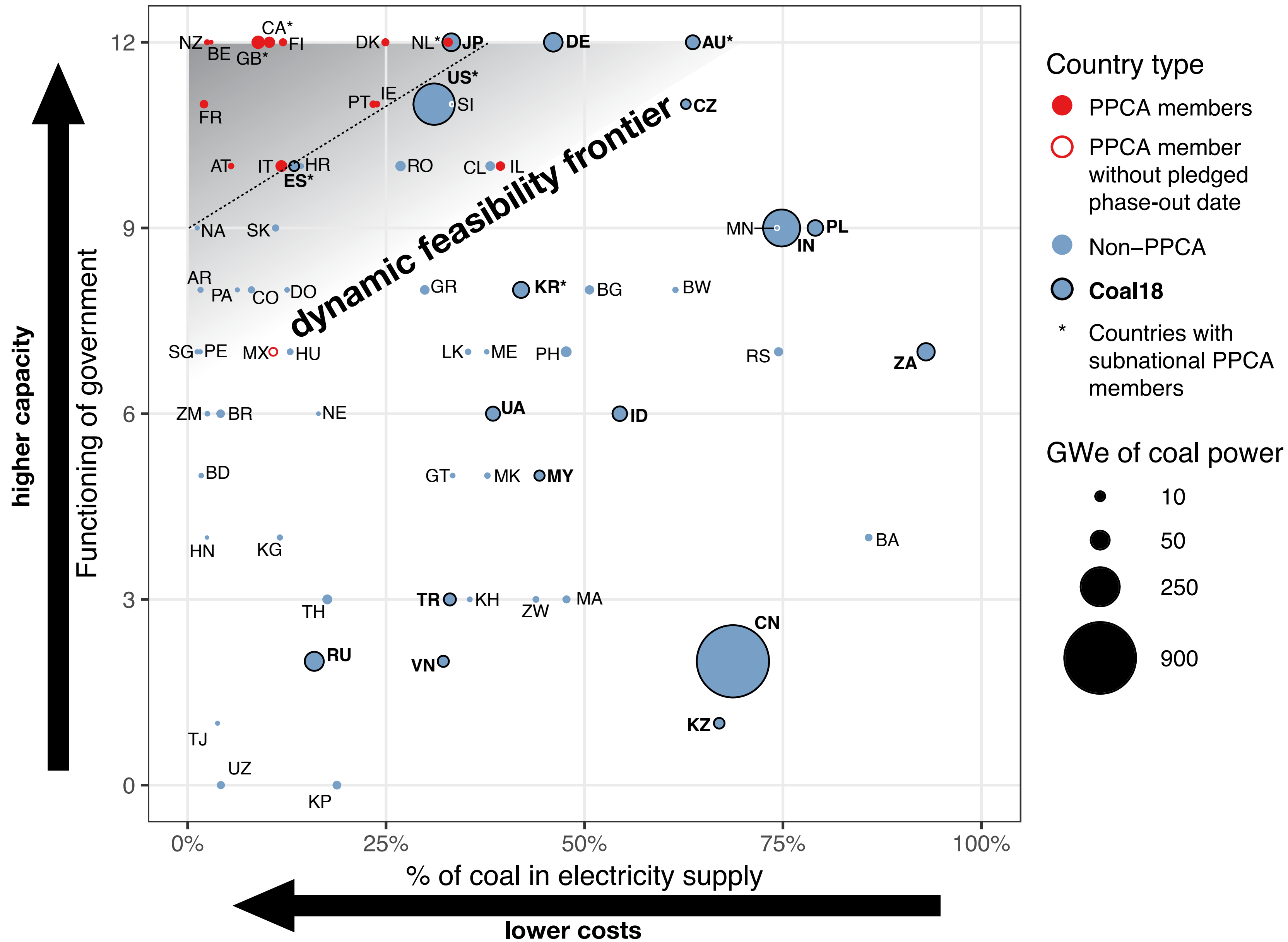
Biggest 18 Coal Consumers >  
 90% of coal power

Australia	Kazakhstan	South Africa
China	Korea	Spain
Czech Republic	Japan	Turkey
Germany	Malaysia	Ukraine
India	Poland	US
Indonesia	Russia	Vietnam

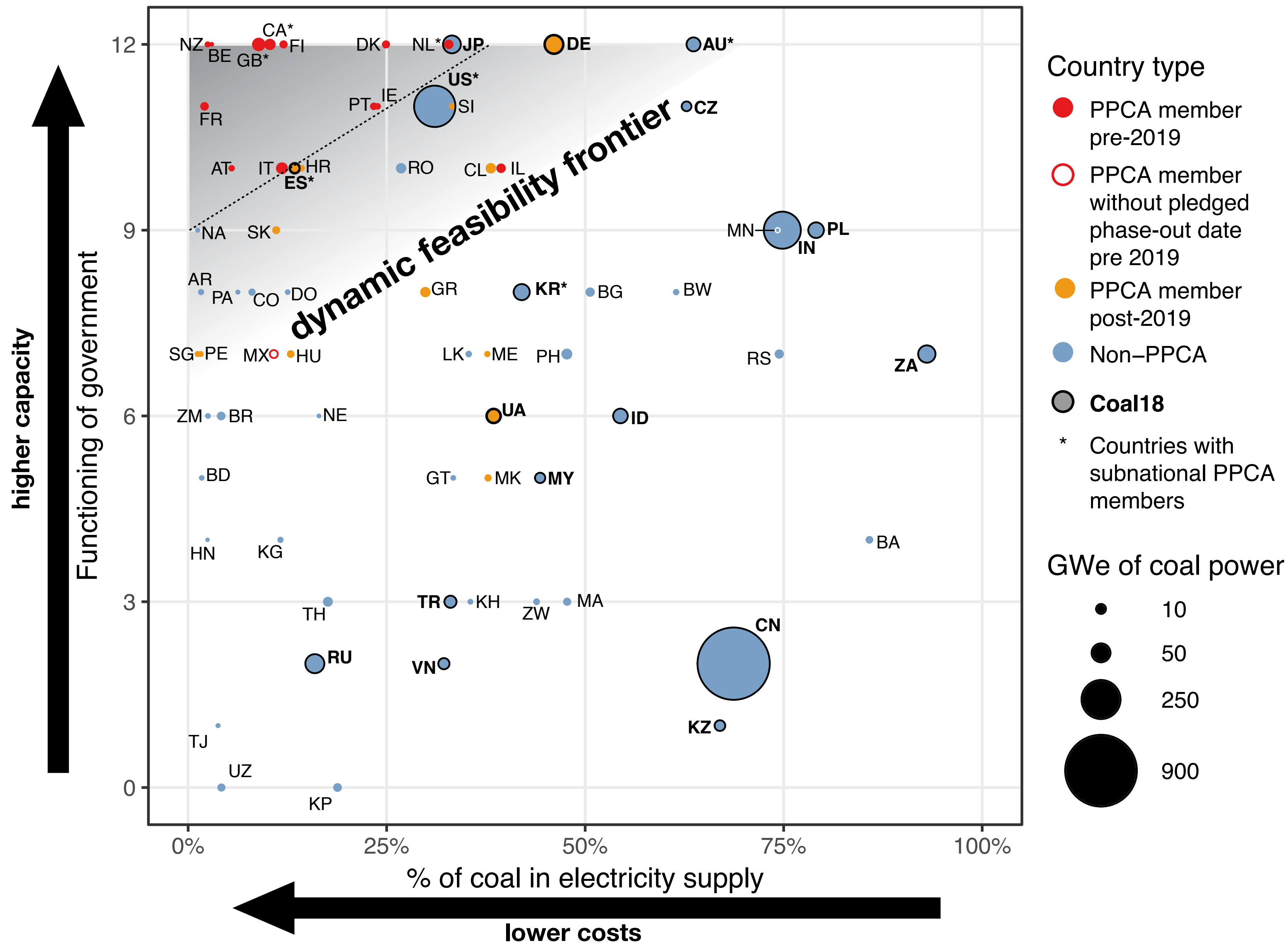
- Produce and use less coal
- Are richer and have better functioning governments



# Initial members of Powering past coal alliance = little coal + good government

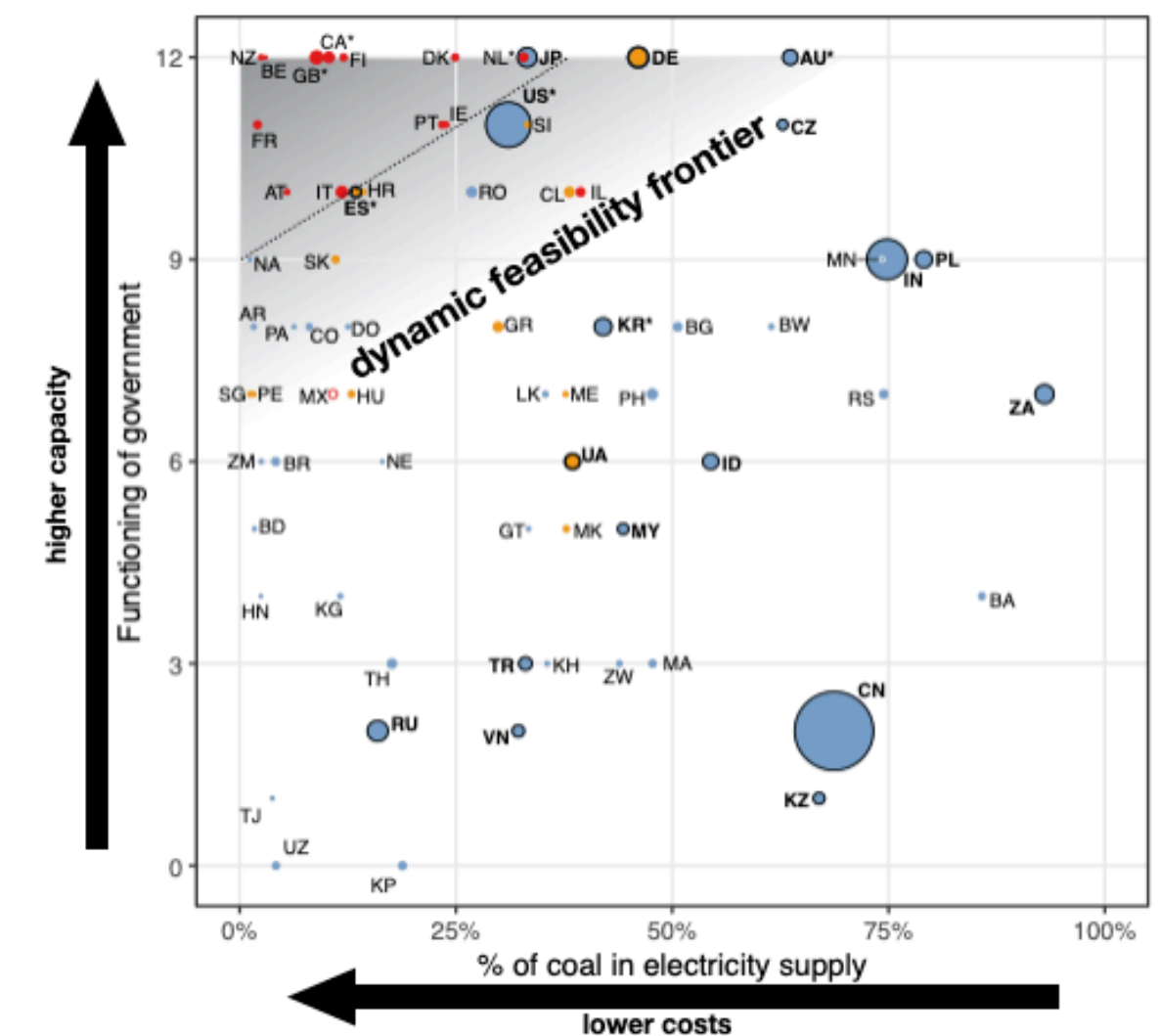
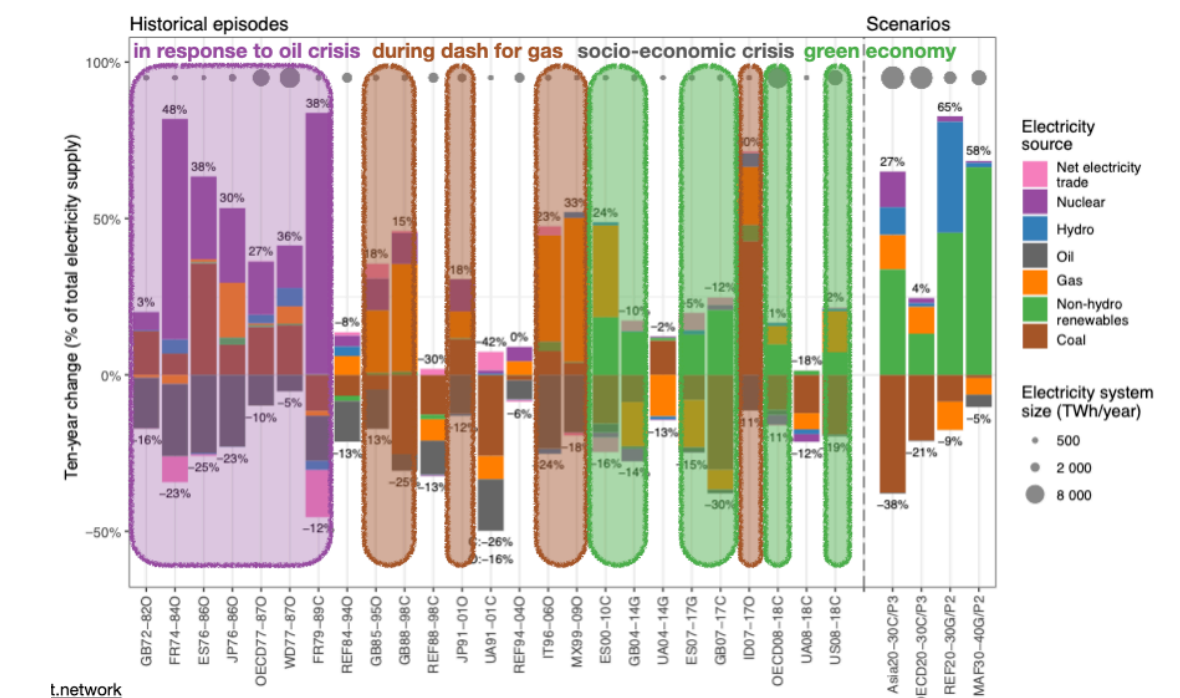


# New members of Powering past coal alliance indicate new opportunities

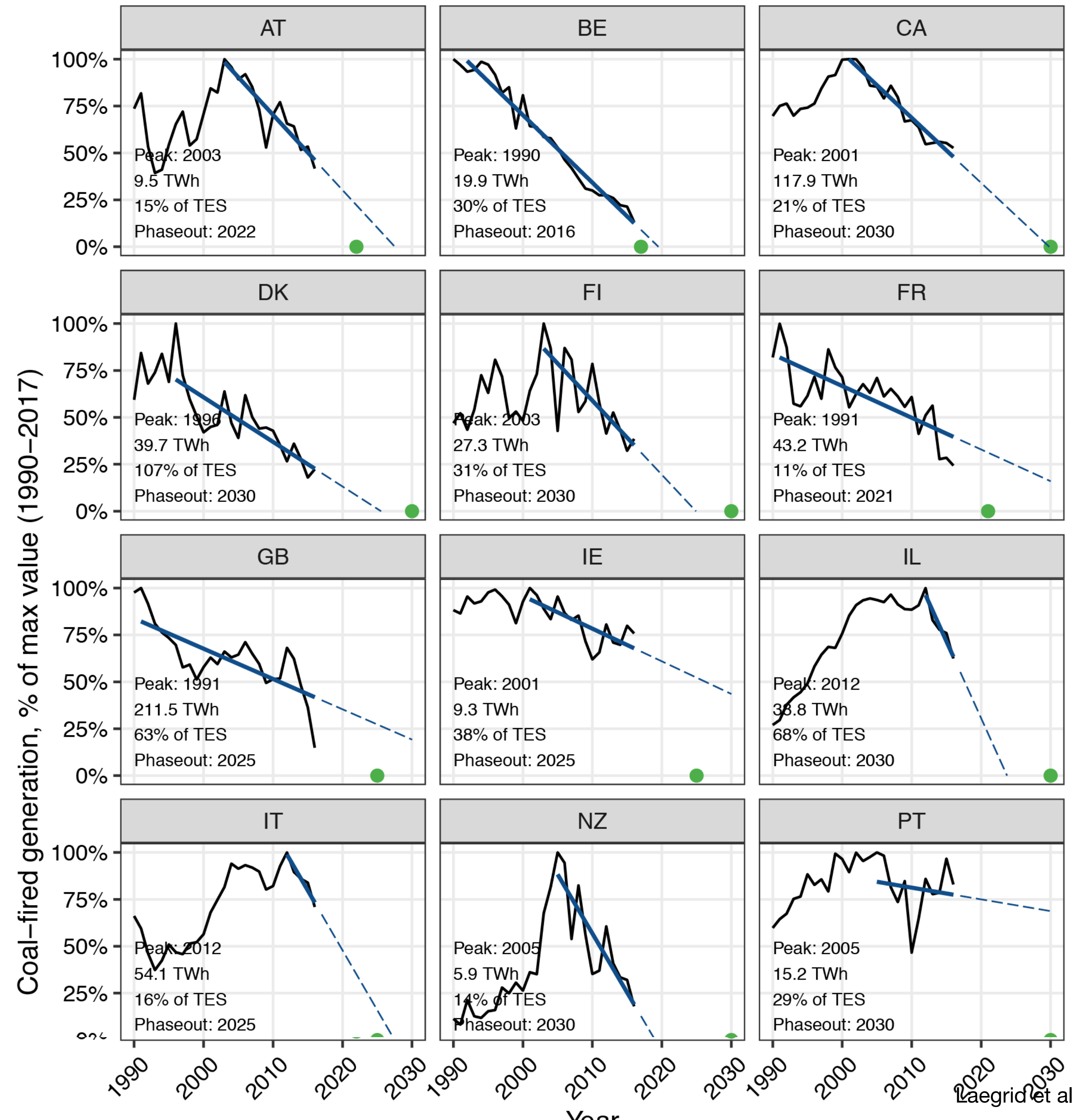


# When do fossil fuels decline?

- Fossil fuel decline has typically been accompanied by technological innovations
- Rapid decline was almost always achieved with strong state policies
- Strong policies are feasible in states with sufficient capacity to overcome the costs of phase-out



# When does coal power peak? Before Past Coal Pledges



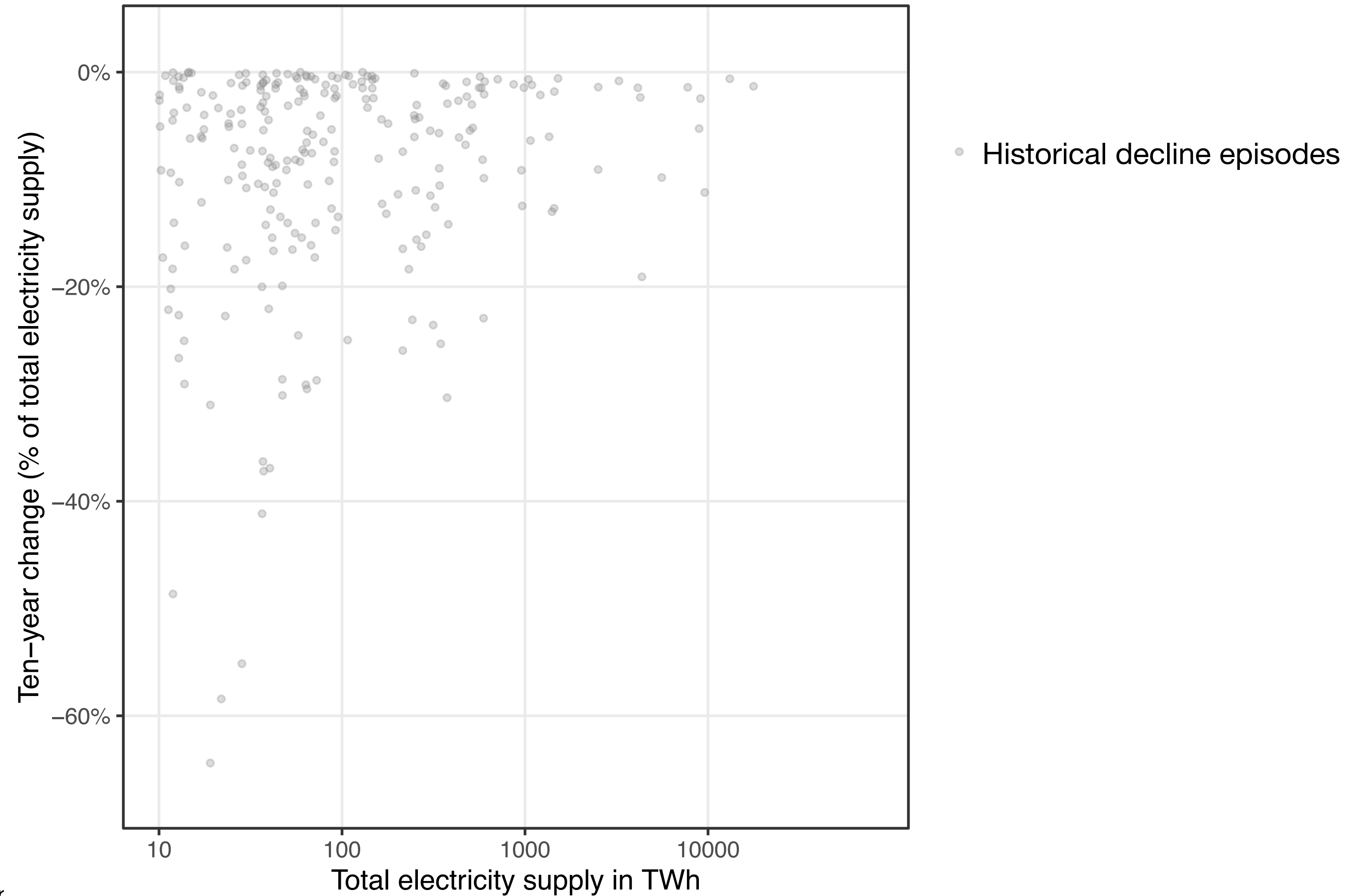


# When does coal peak?

	Number of countries		Year of peak		
	peak	non-peak	earliest	mean	latest
PPCA	18	4	1979	1997	2014
non-PPCA	2	26	2009	2010	2011

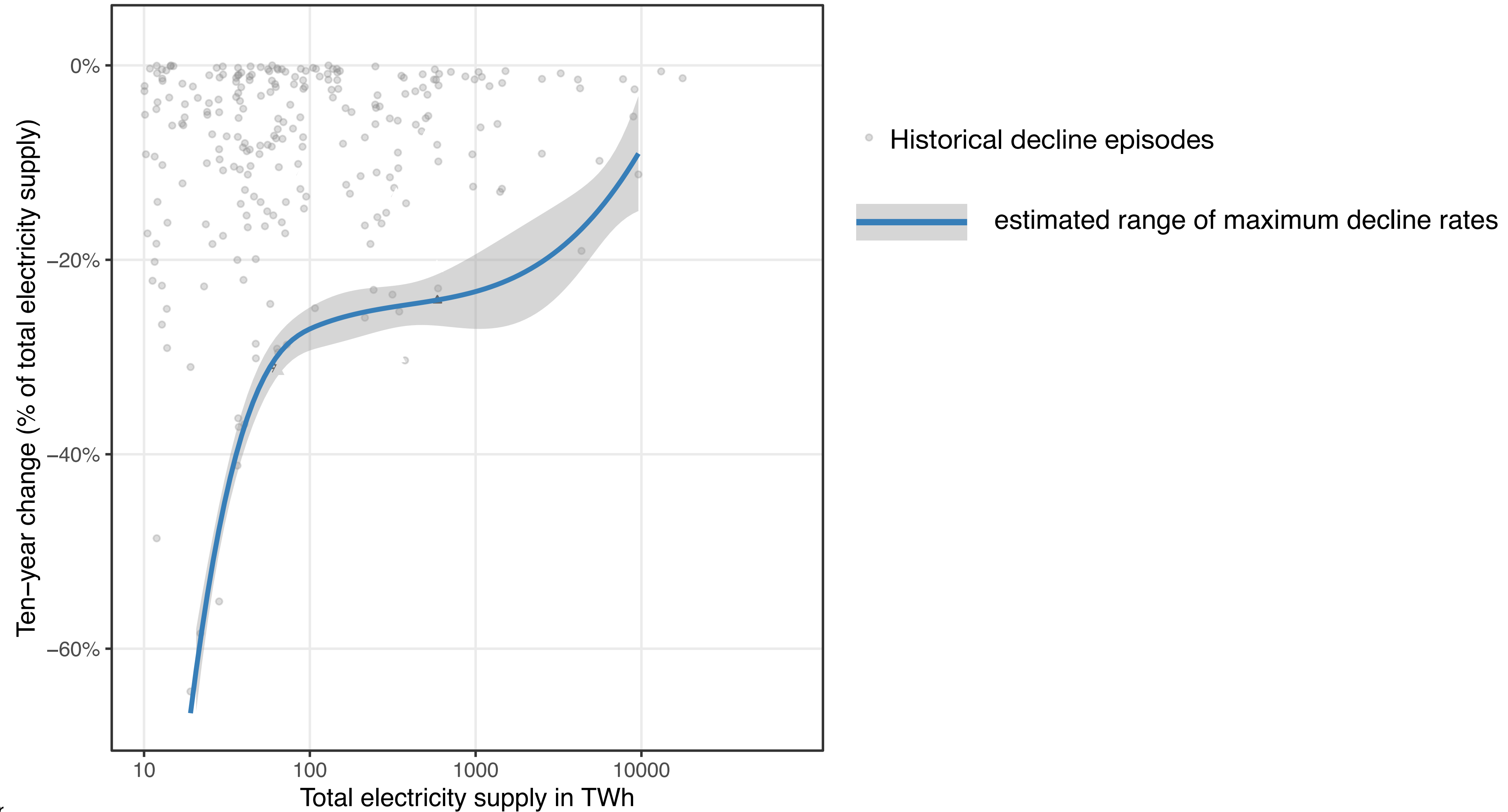
- Under low corruption and strong electoral democracy
- Under high GDP/capita
- During electricity demand stagnation

# How fast can fossil fuels decline?



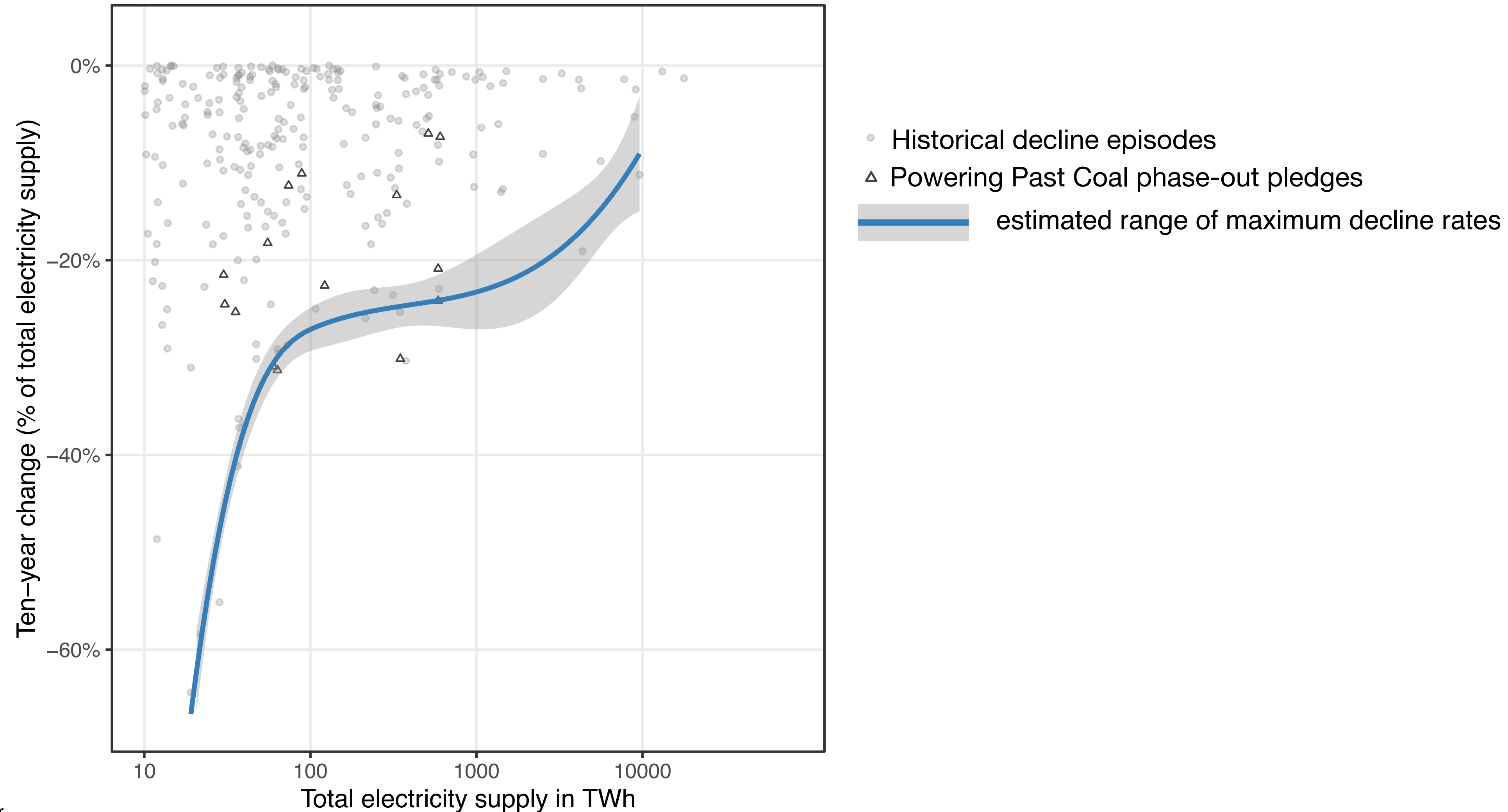
# How fast can fossil fuels decline?

Larger countries decline at slower rates



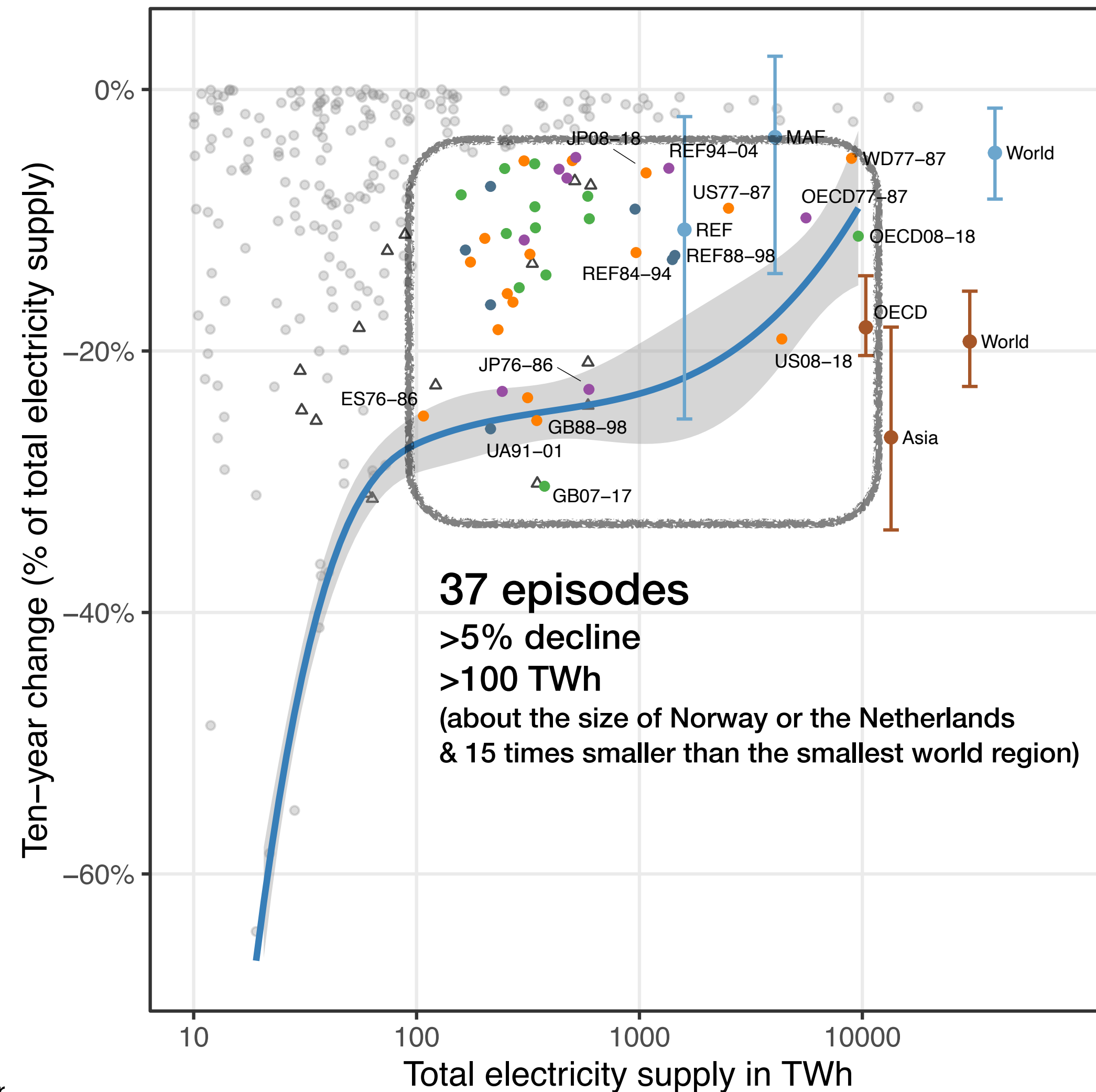
# How fast can fossil fuels decline?

Powering Past Coal pledges are in-line with historical rates



# How fast can fossil fuels decline?

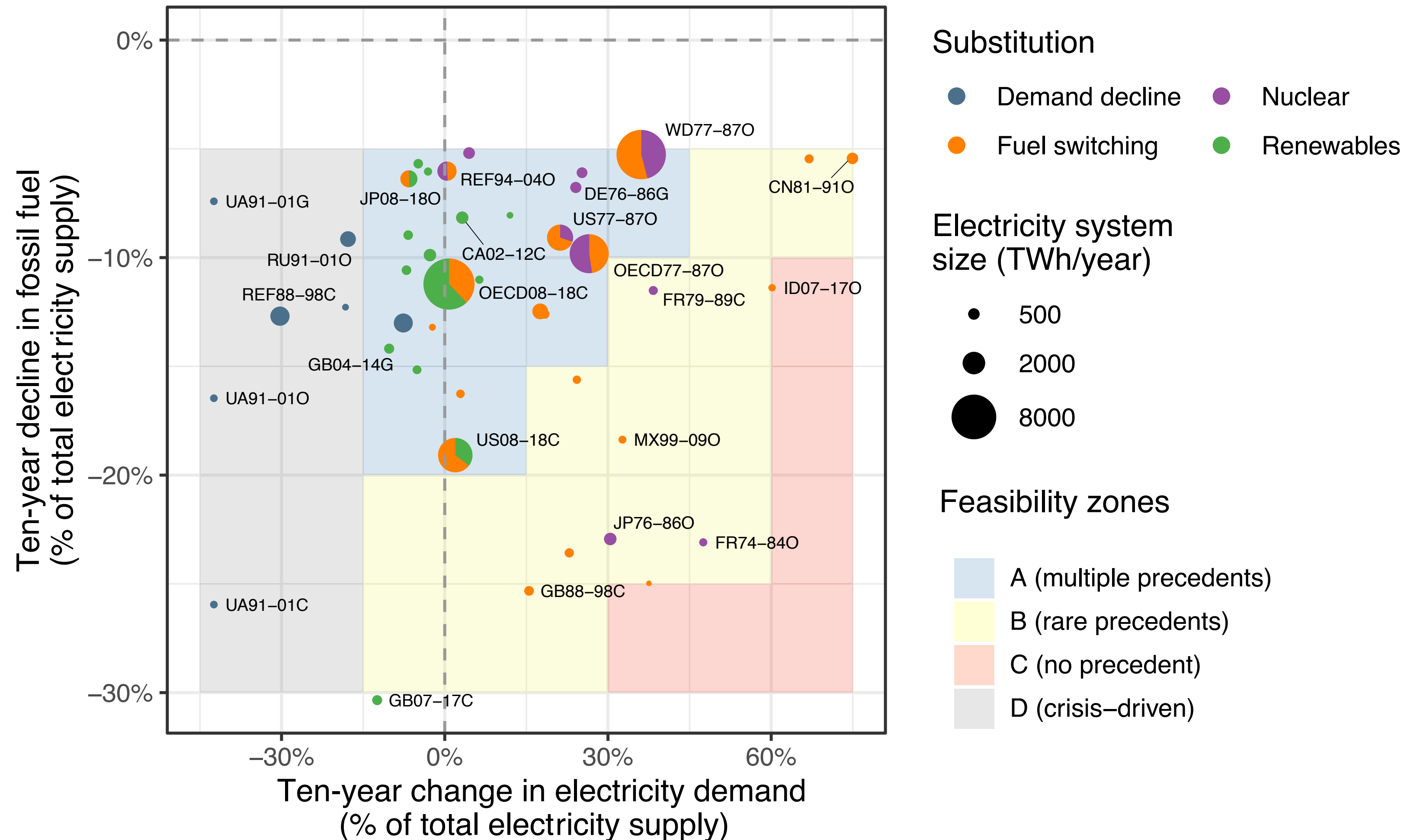
## Understanding the most important precedents



- Historical decline episodes >5%
  - △ Powering Past Coal phase-out pledges
  - estimated range of maximum decline rates
- Primary substitution in historical decline episodes
- Demand decline
  - Fuel switching
  - Nuclear
  - Renewables

# Faster decline more frequent under slow demand growth

## Mapping feasibility zones for fossil fuel decline



# How fast can fossil fuels decline?

- Fossil fuels can decline faster in larger systems
- Fossil fuels can decline faster in stagnant or slow-growing systems
- The maximum observed in a large system is -30% per decade which is an extreme case
- Powering Past Coal Pledges do not exceed these rates

# What do we need to know about models and mechanisms of decline?

- Driving and blocking factors of decline
  - Often get into stable configurations called 'lock-in'
  - Destabilisation when lock-in is released
- *We need to understand how lock-in occurs and when is destabilised*
- Lock-in is supported by 'regime resistance'
  - Level of resistance linked to jobs prospects
  - We also explored how different components of locked-in systems work together

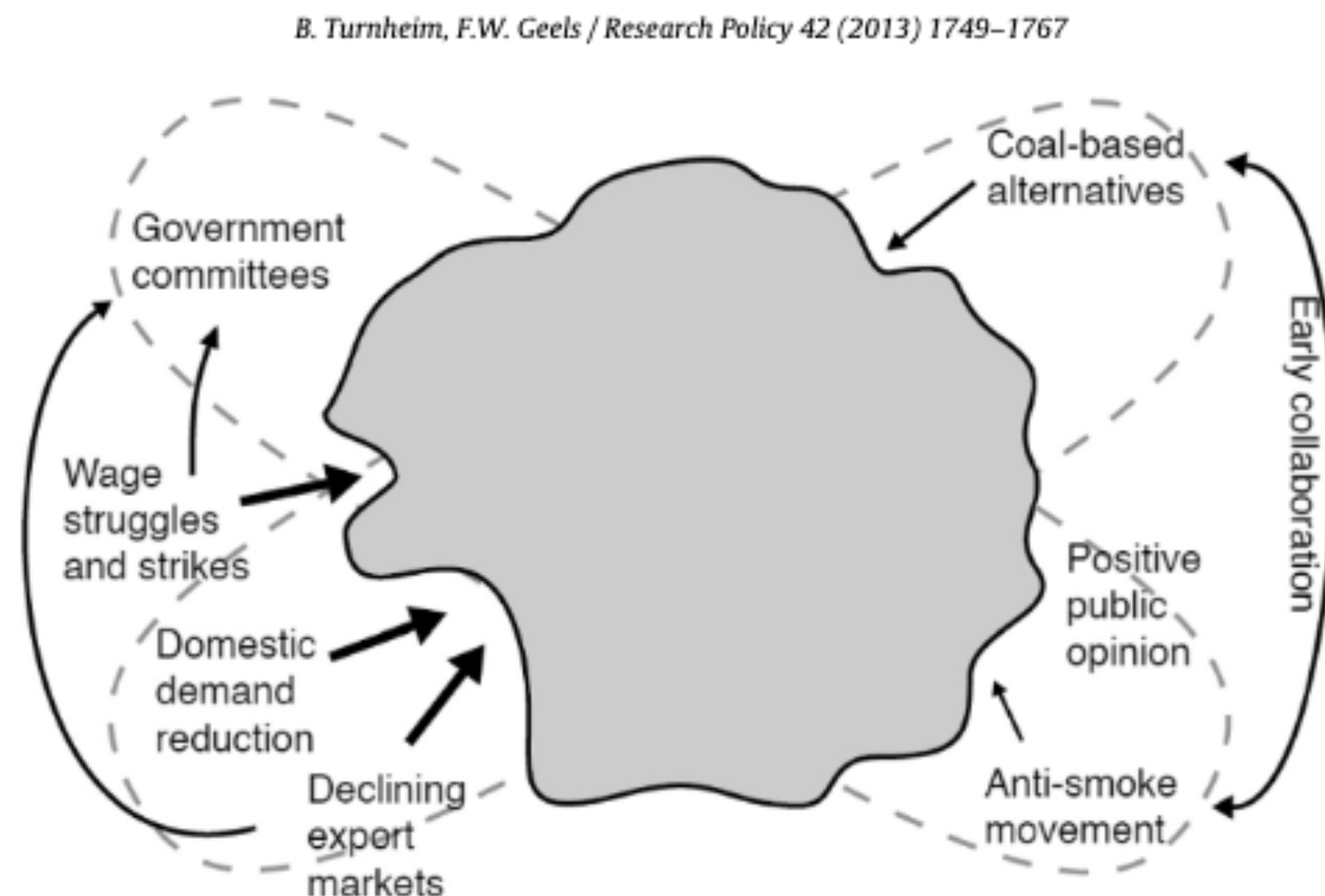
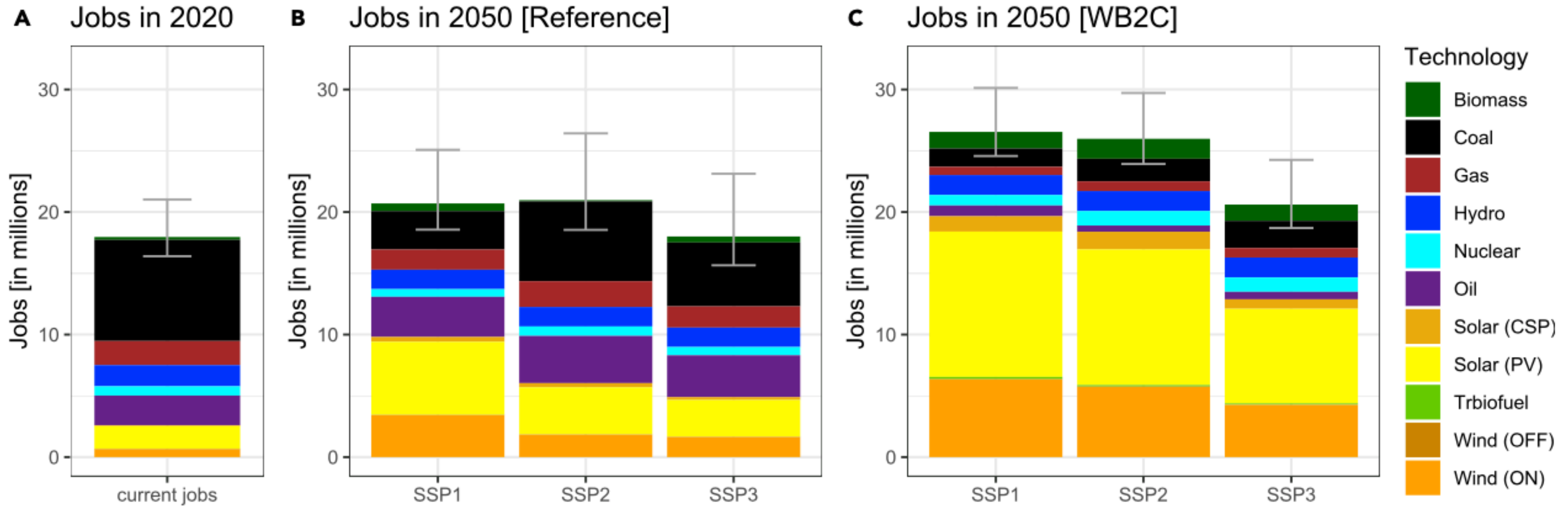


Fig. 7. Multi-dimensional pressures and spillovers (1913–1930).



# Can renewable jobs replace fossil fuel jobs?

## Globally well-below 2°C scenario leads to more jobs



One Earth

Meeting well-below 2°C target would increase energy sector jobs globally

Graphical abstract

Keeping global warming below two degrees entails energy system jobs transitions

Authors

Sandeep Pai, Johannes Emmerling, Laurent Drouet, Hisham Zerriffi, Jessica Jewell

Article

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JohannesEmm Update reference

1220881 on Aug 3, 2021 5 commits

energy\_jobs\_database.xlsx

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# Can solar and wind jobs replace coal mining jobs?

The New York Times

## Coming Soon to This Coal County: Solar, in a Big Way

In Martin County, Ky., where coal production has flatlined, entrepreneurs are promising that a new solar farm atop a shuttered mine will bring green energy jobs.



IOP Publishing

Environ. Res. Lett. 15 (2020) 034065

<https://doi.org/10.1088/1748-9326/ab6c6d>

Environmental Research Letters



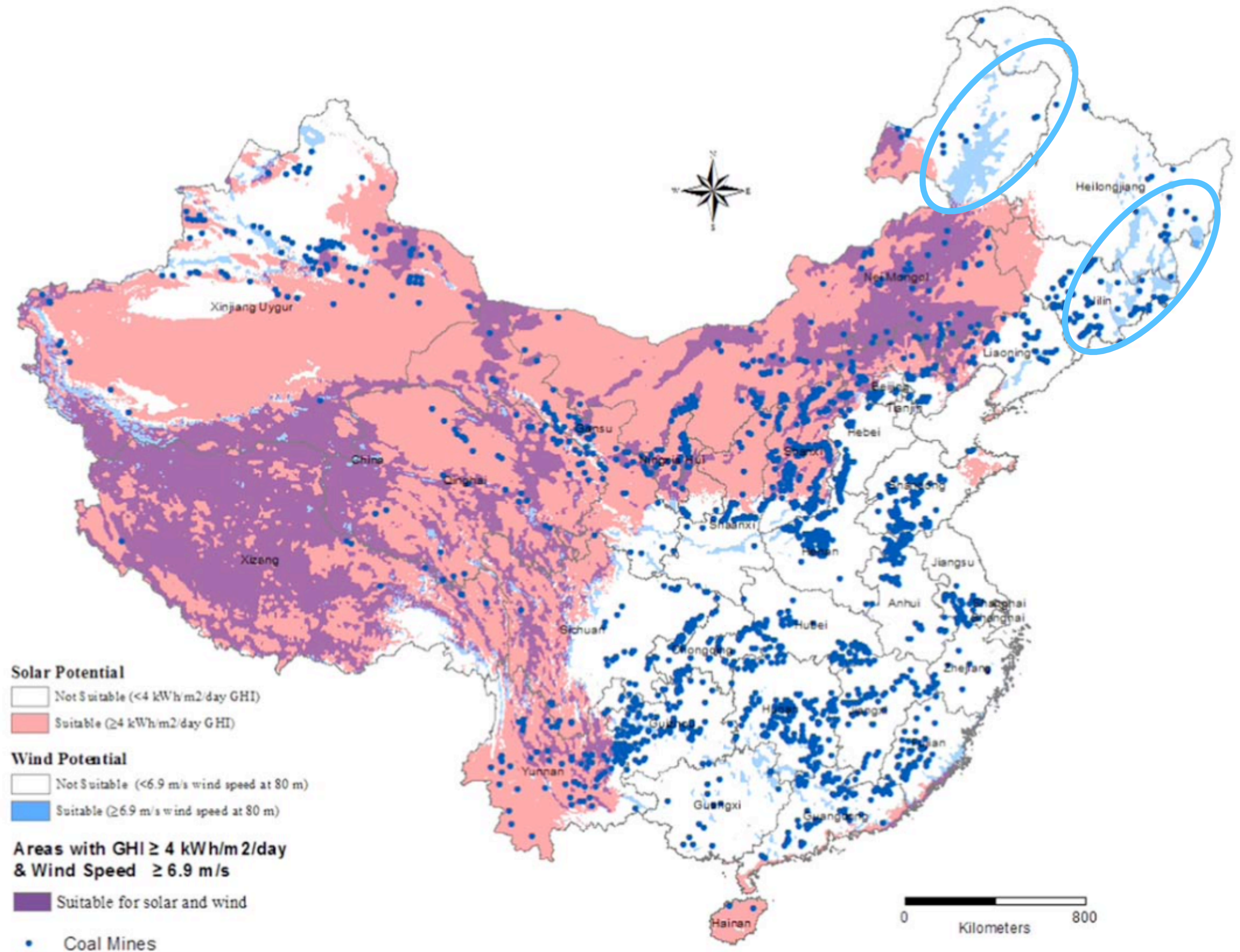
LETTER

Solar has greater techno-economic resource suitability than wind for replacing coal mining jobs

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24 May 2019

Sandeep Pai<sup>1</sup>, Hisham Zerriffi<sup>2,3</sup>, Jessica Jewell<sup>4,5,6</sup> and Jaivik Pathak<sup>2</sup>




# Can solar and wind jobs replace coal mining jobs?

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IOP Publishing Environ. Res. Lett. 15 (2020) 034065 <https://doi.org/10.1088/1748-9326/ab6c6d>

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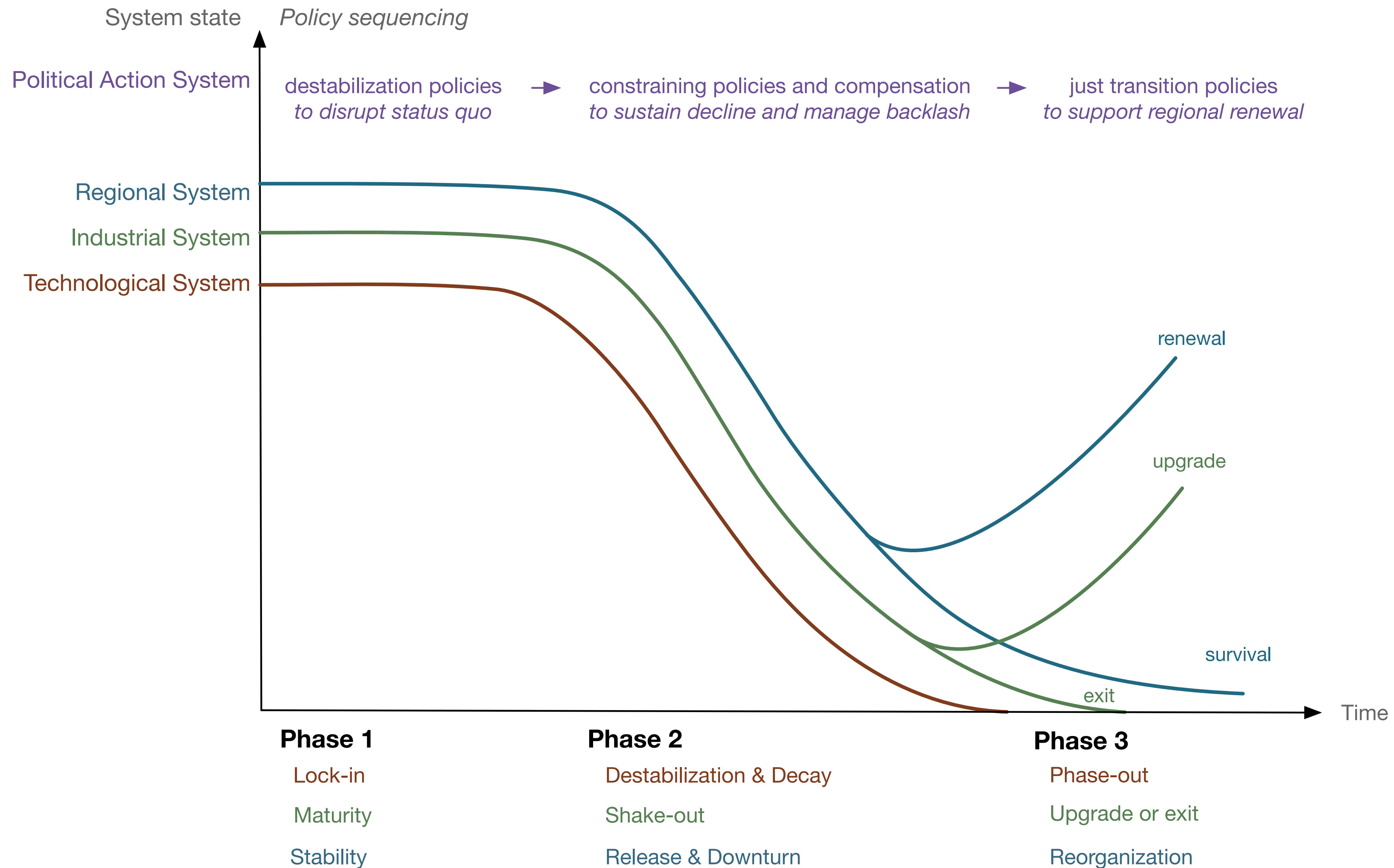
Solar has greater techno-economic resource suitability than wind for replacing coal mining jobs

Sandeep Pai<sup>1</sup>, Hisham Zerriffi<sup>2,3</sup>, Jessica Jewell<sup>4,5,6</sup> and Jaivik Pathak<sup>2</sup>

## Share of coal regions with sufficient potential of

	Solar power	Wind power
India	99%	1%
Australia	96%	4%
US	62%	7%
China	29%	5%

# Policy sequencing for feasible decline pathways



# What do we know now?

When do fossil fuels decline and where is coal being phased-out?

Under technological innovation, with strong state policies, in states with high capacity.

How fast can fossil fuels decline?

Faster in smaller systems and those which aren't rapidly growing

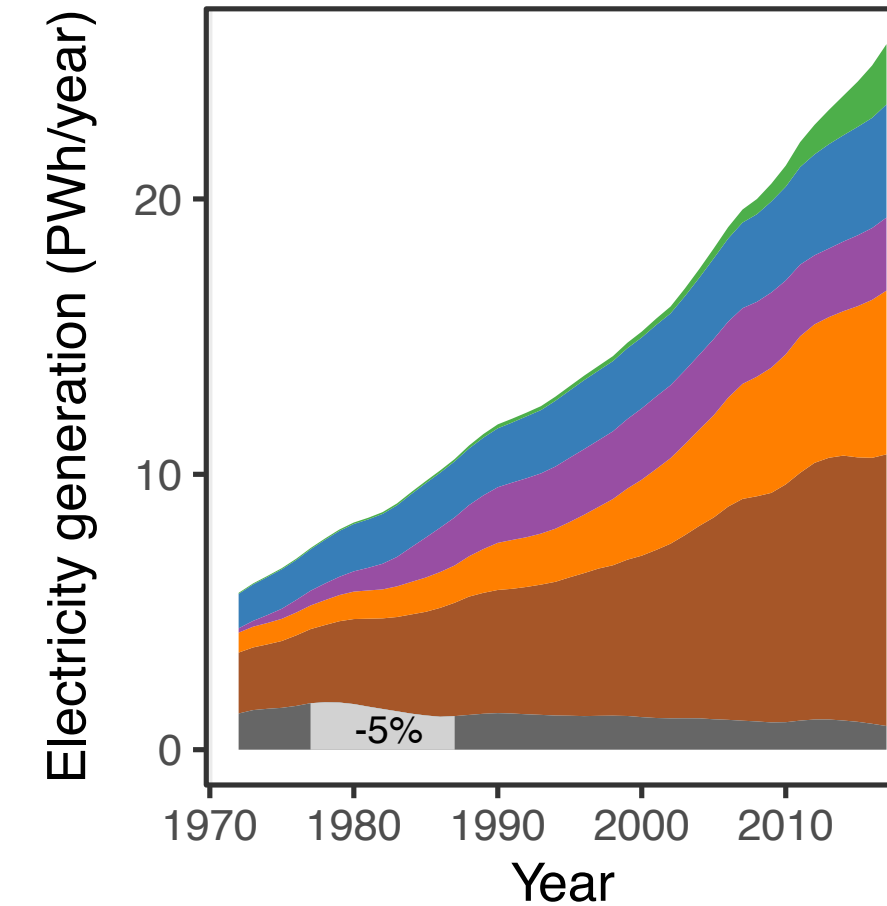
Not faster than 30%/decade in large systems

How can we overcome lock-in?

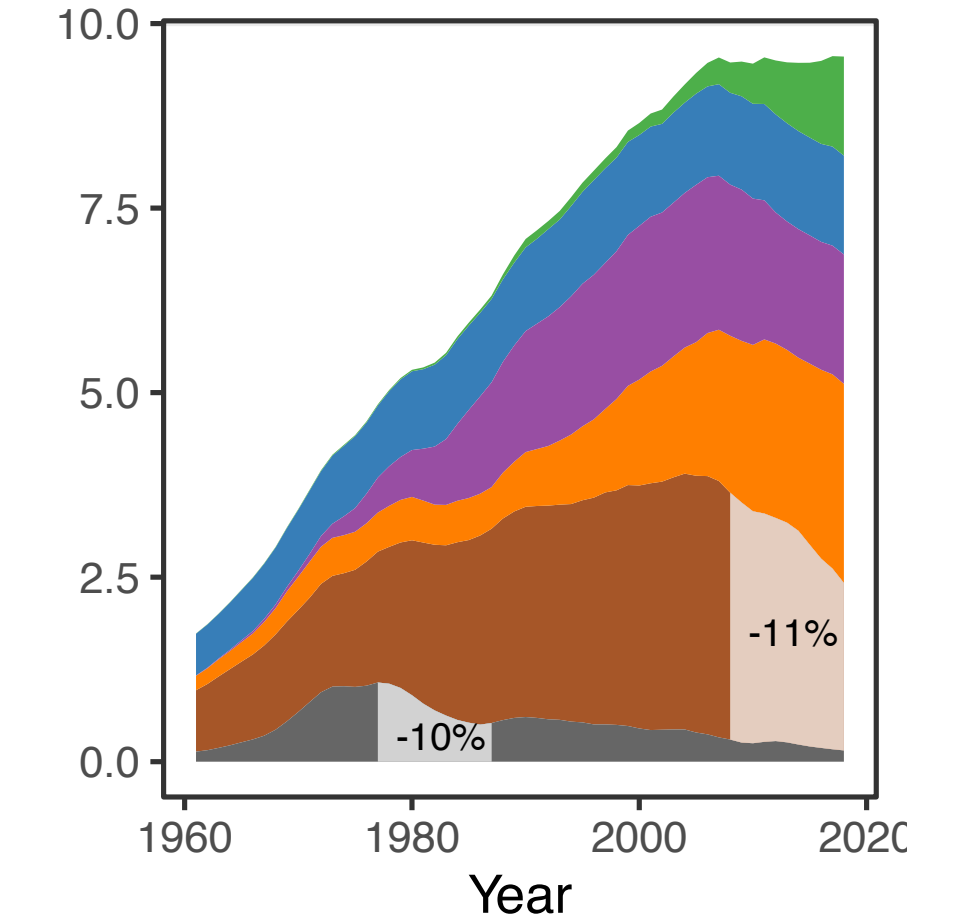
Low-carbon jobs offer an opportunity

Policy-sequencing for decline can release lock-in

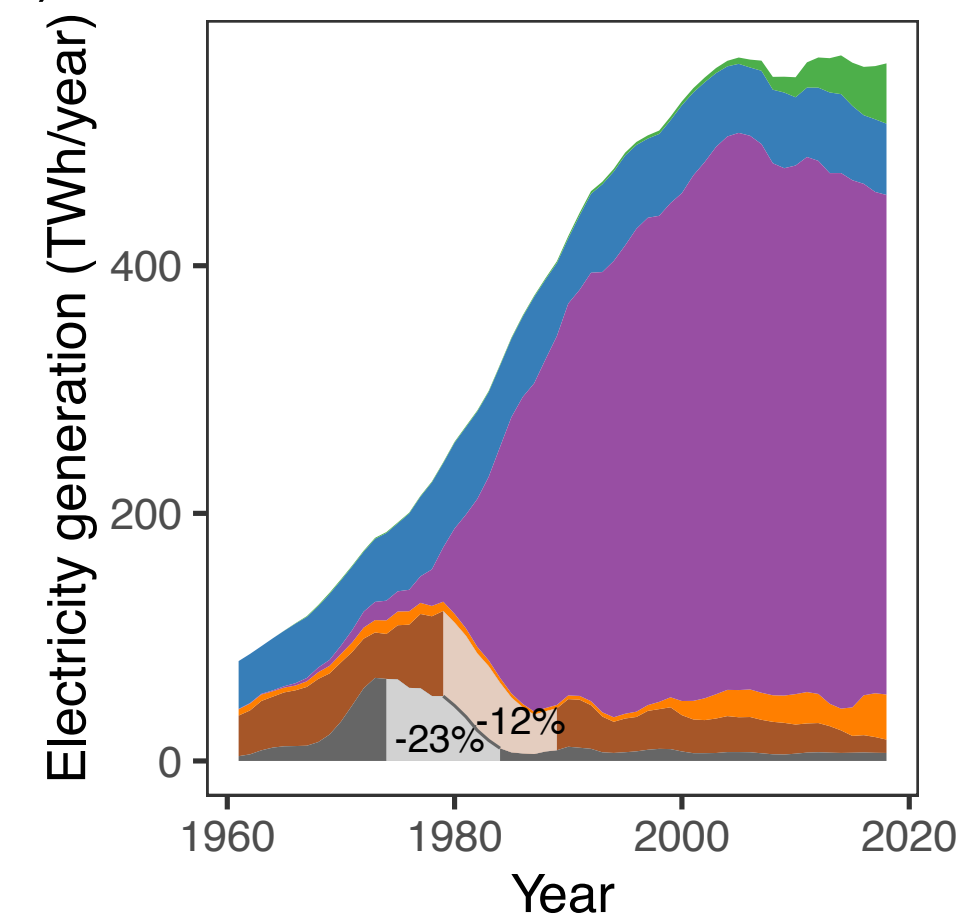
(A) World



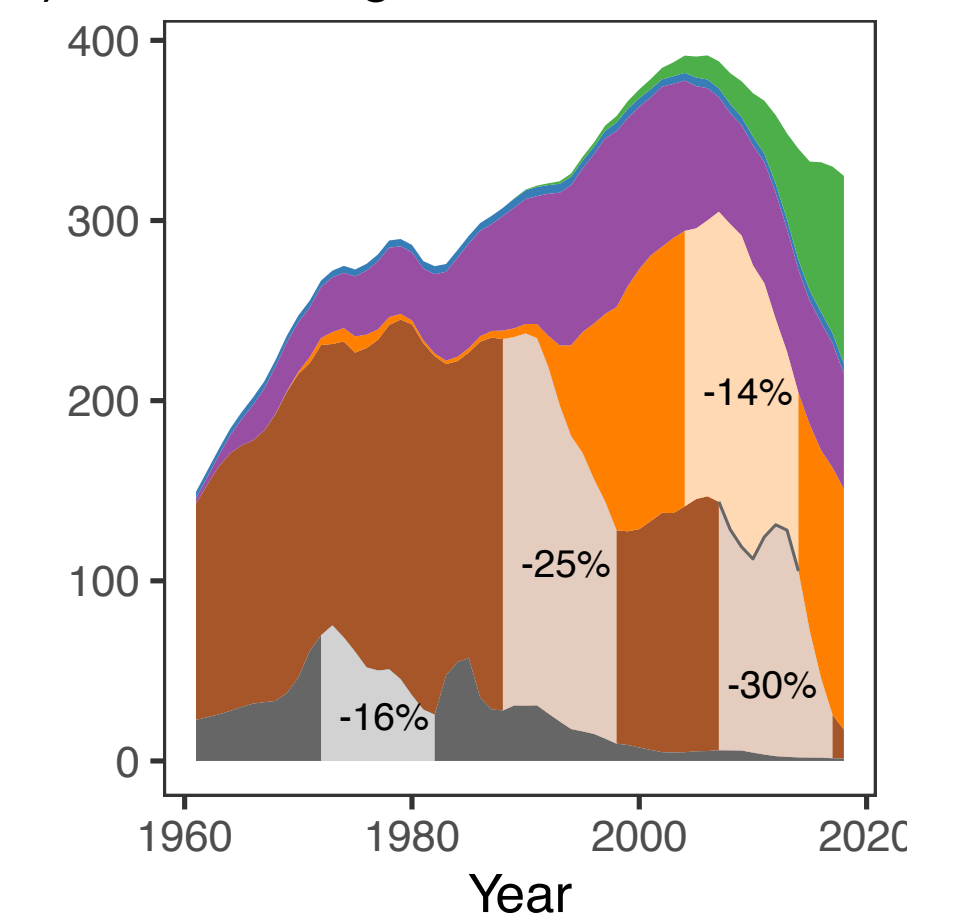
(B) OECD



(D) France



(E) United Kingdom



Source

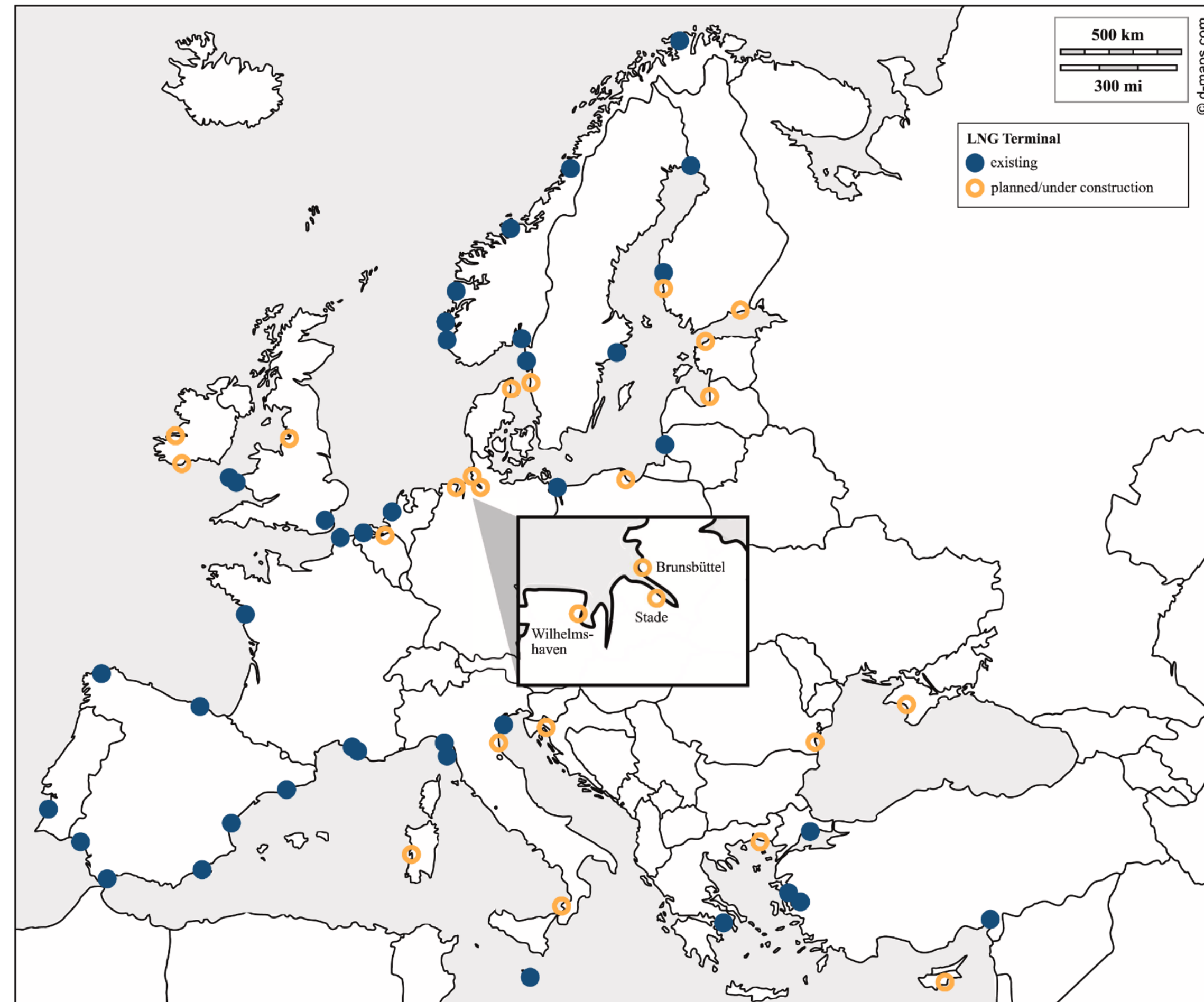


# Scientific and policy challenges ahead

## How can we phase-out other fossil fuels?

H. Brauers et al.

Energy Research & Social Science 76 (2021) 102059



Energy Research & Social Science 76 (2021) 102059



Energy Research & Social Science

journal homepage: [www.elsevier.com/locate/erss](http://www.elsevier.com/locate/erss)



Liquefied natural gas expansion plans in Germany: The risk of gas lock-in under energy transitions

Hanna Brauers<sup>a,b,c,1,\*</sup>, Isabell Braunger<sup>a,b,c,1</sup>, Jessica Jewell<sup>d,e,f</sup>



# Scientific and policy challenges ahead

## How to transfer lessons to developing and emerging economies?

"If we are going to put forward until 2040, then we need to have funding to retire coal earlier and to build the new capacity of renewable energy," —Indonesia Finance Minister Sri Mulyani at COP26.

