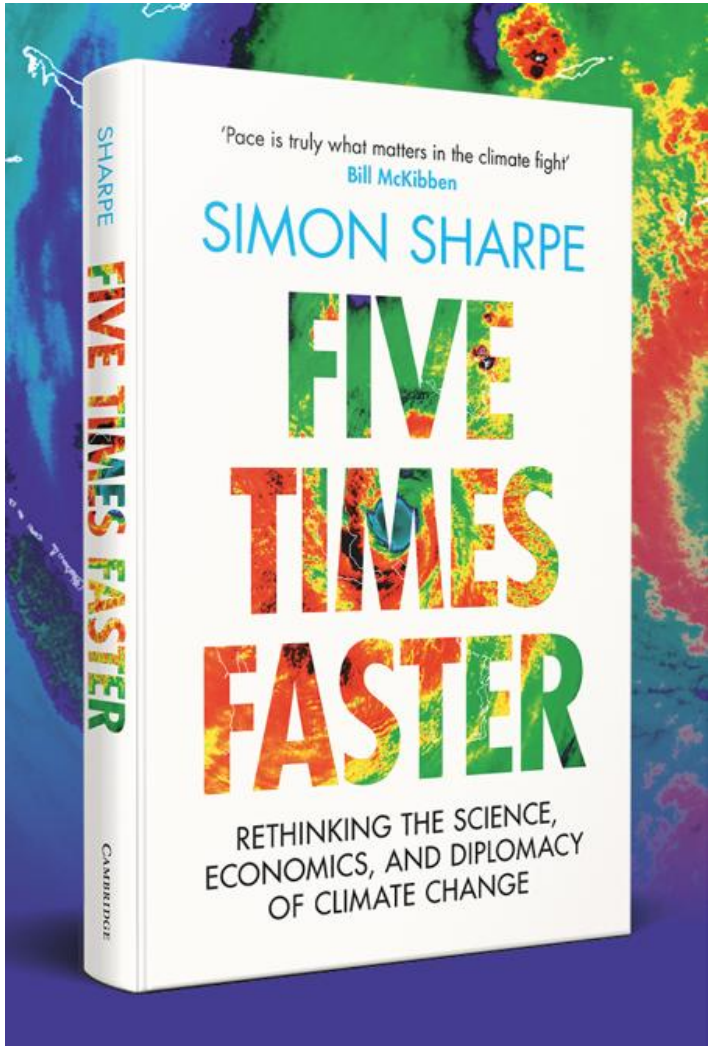


FIVE TIMES FASTER

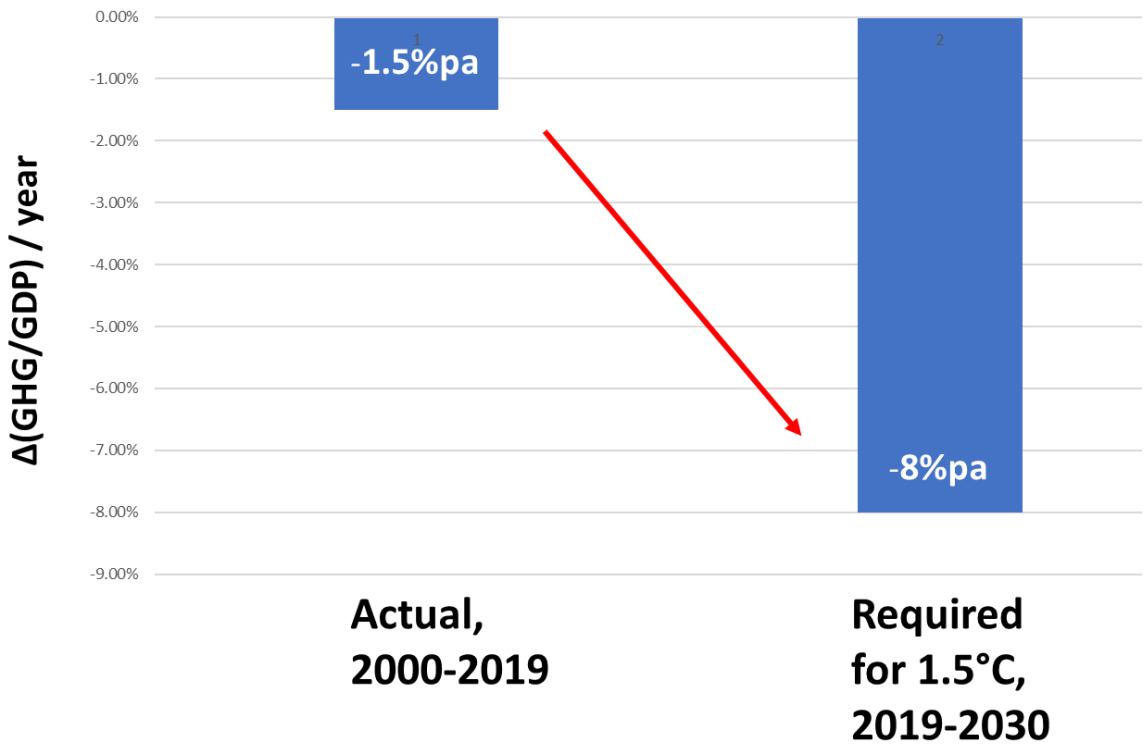
Rethinking the science, economics, and diplomacy of climate change

Simon Sharpe

Presentation for Citizens' Climate Lobby Canada

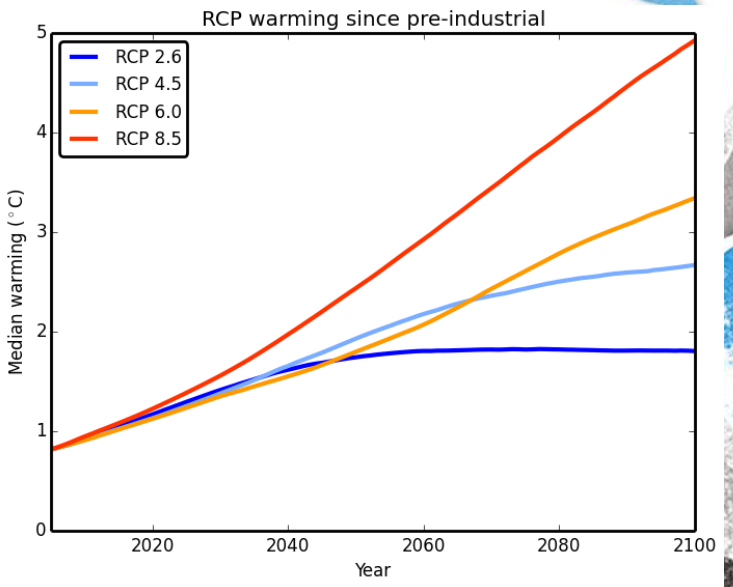
15 January 2026

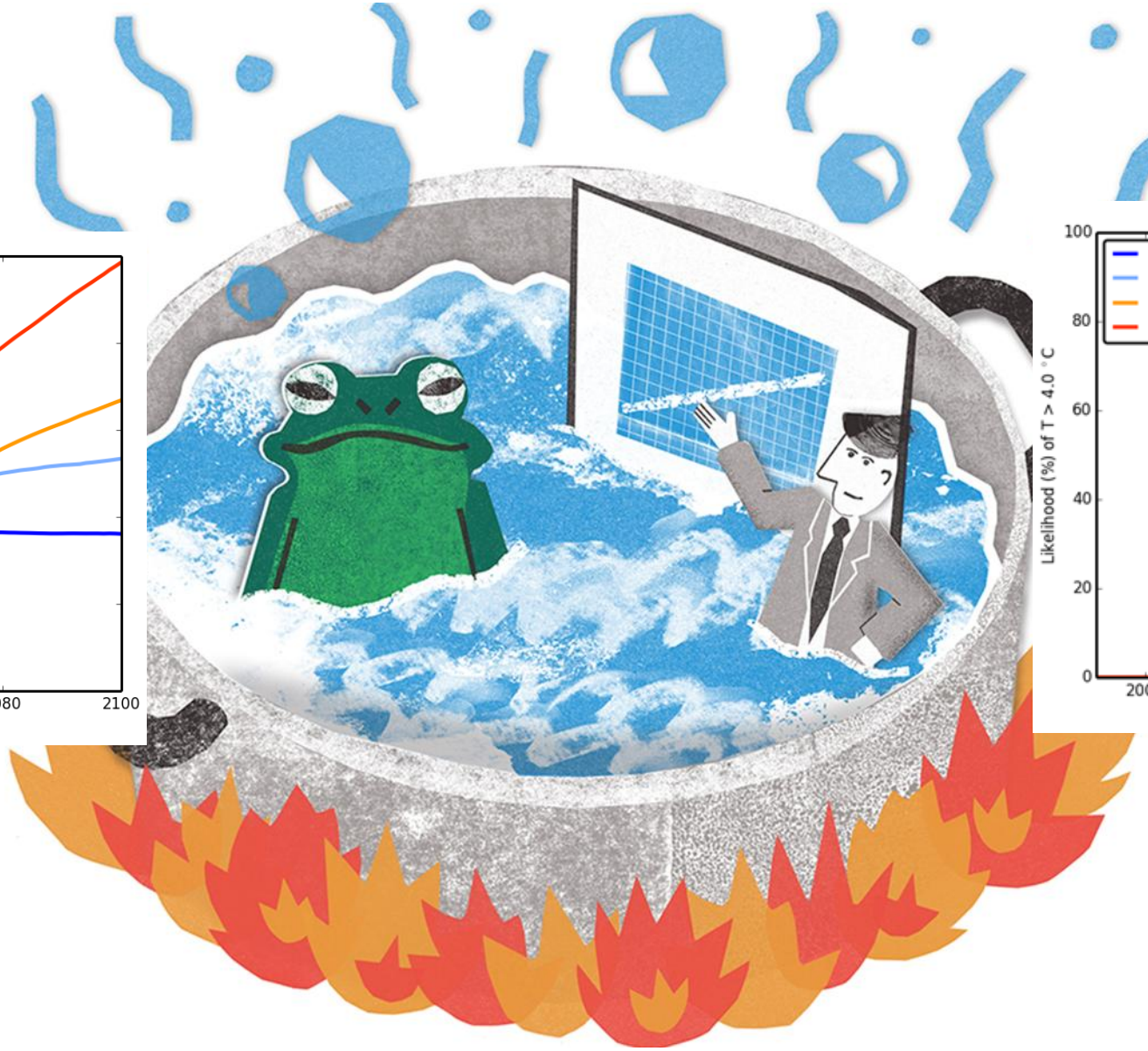
Rate of decarbonisation of the global economy



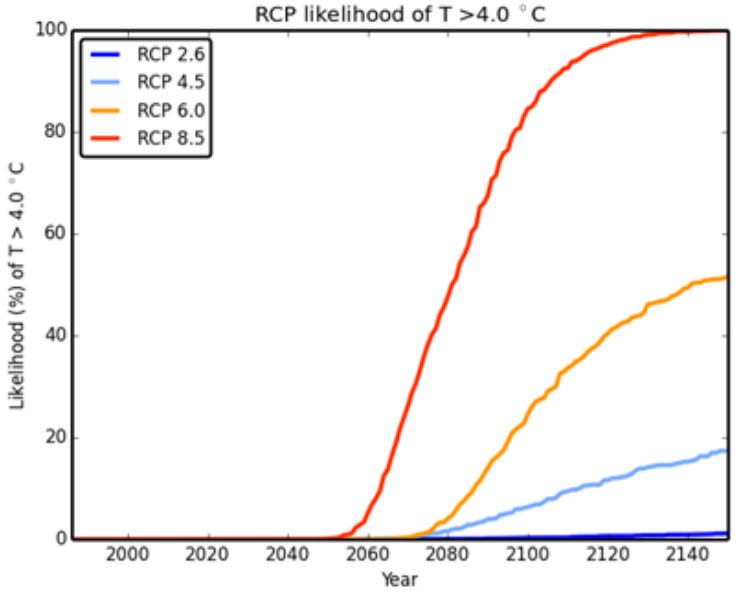
SCIENCE

Prediction



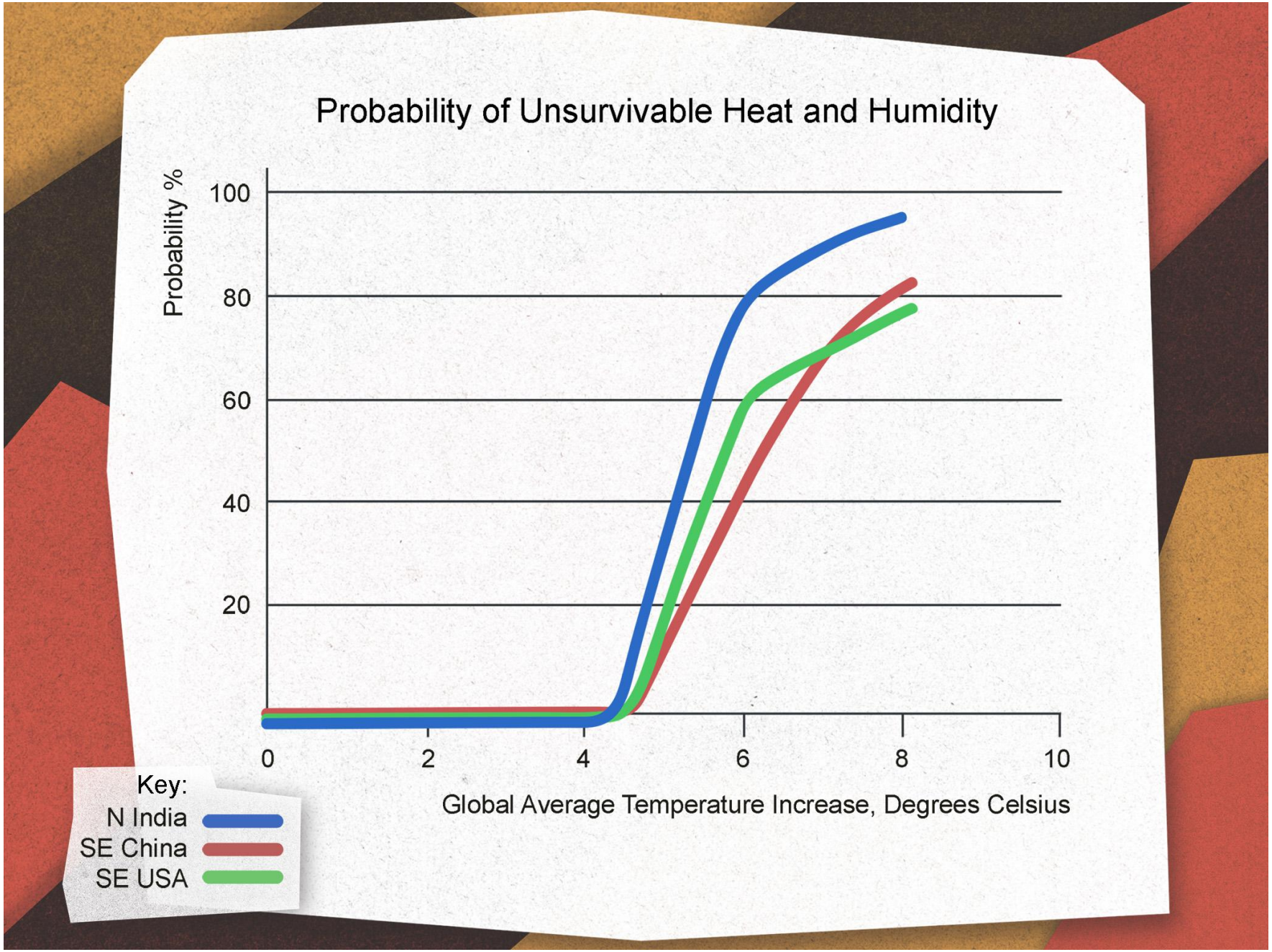


Risk assessment

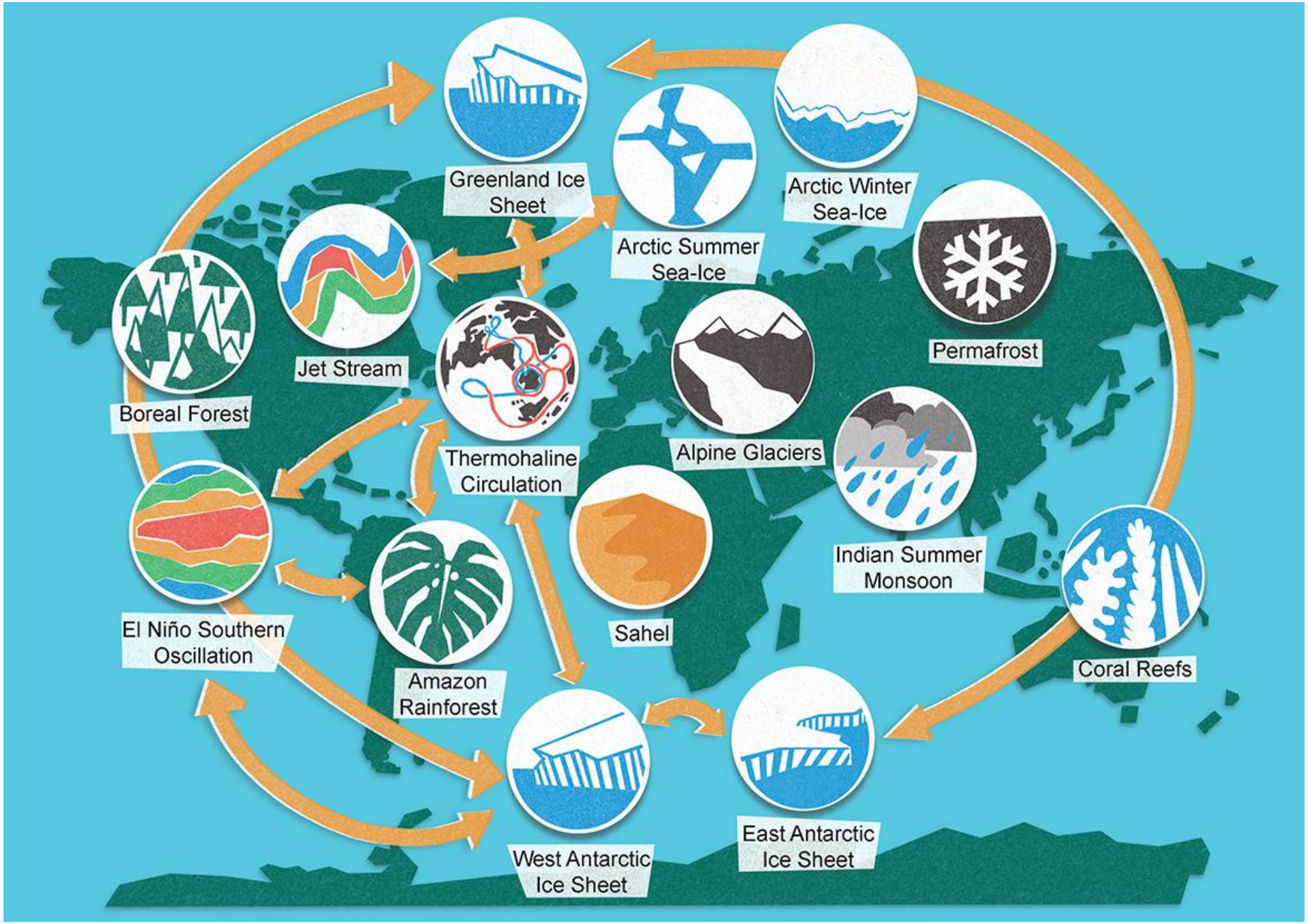


"…the catastrophic norms of the future can be seen in the tail risks of today."

Mark Carney, 2015



Each tipping point we pass increases the likelihood of activating others



ECONOMICS

Equilibrium: *'a situation in which nobody has any immediate reason to change their actions, so that the status quo can continue, at least temporarily'*

(Oxford dictionary of economics)

Meeting climate goals requires…

*'rapid and far-reaching **systems transitions…** unprecedented in terms of scale'*

Intergovernmental Panel on Climate Change (2018)

What is the economy like?

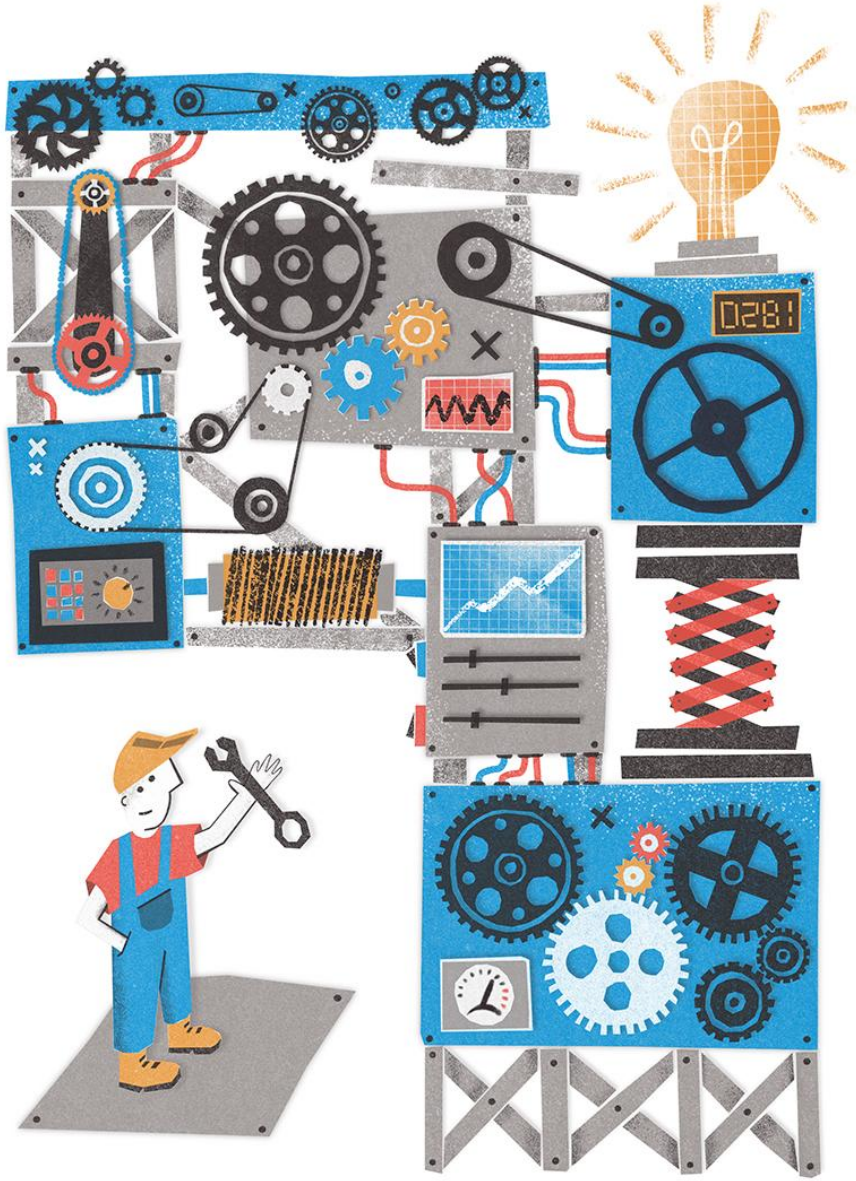
EQUILIBRIUM ECONOMY

Static

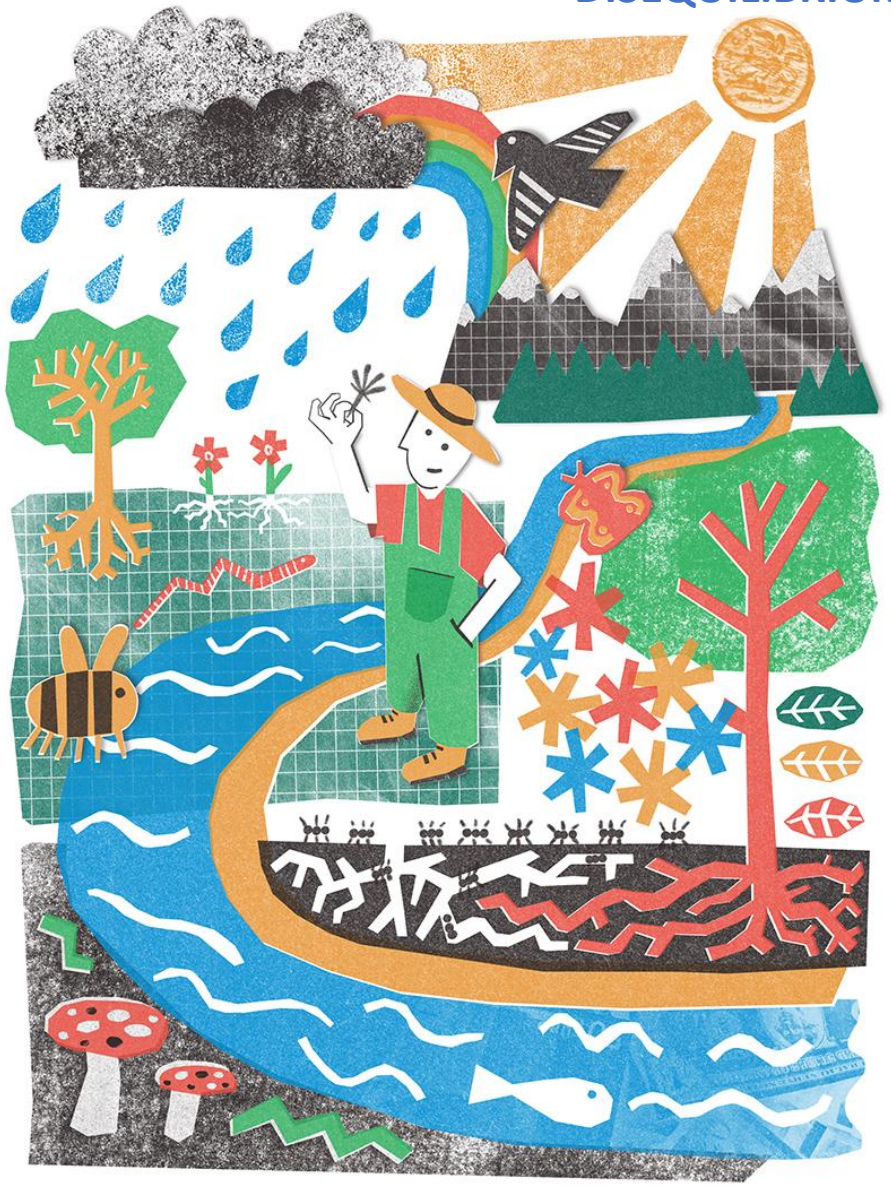
Predictable

Limited possibilities

Role of policy: fix it when it fails



DISEQUILIBRIUM ECONOMY



Evolving

Uncertain

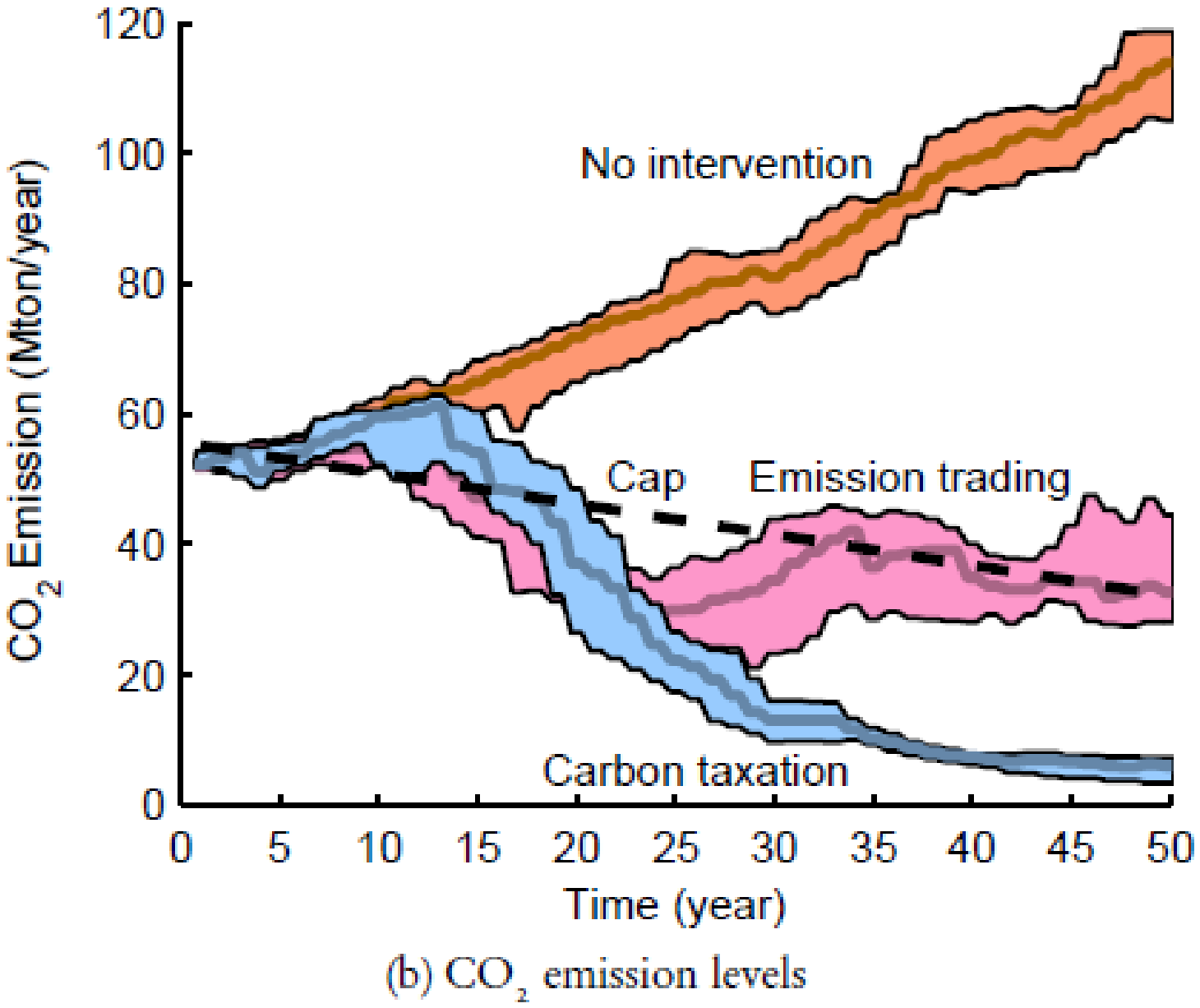
Unlimited possibilities

Role of policy: steer its evolution in desired direction

*"The **cap-and-trade**… sets a floor on emissions. Emissions cannot go lower than this floor, because the price of permits on the market would crash, bringing down fossil fuel prices and again making it more economical… to burn fossil fuels"*

*"In contrast, the **fee-and-dividend** approach has no floor… Indeed, your actions [to reduce emissions] may also spur your neighbour to do the same. That snowballing (amplifying feedback) effect is possible with fee-and-dividend, but not with cap-and-trade."*

James Hansen



(b) CO_2 emission levels

A cap-and-trade scheme is less dynamically efficient than a fixed carbon tax

Comparison of carbon tax and ETS with same average carbon price, using an agent-based model

Source: Chappin (2010): http://chappin.com/ChappinEJL-PhDthesis.pdf

Carbon pricing "is the most cost-efficient solution" to achieve climate goals

"Meaningful carbon prices are a cornerstone of any effective policy framework".

Kristalina Georgieva, Managing Director, IMF

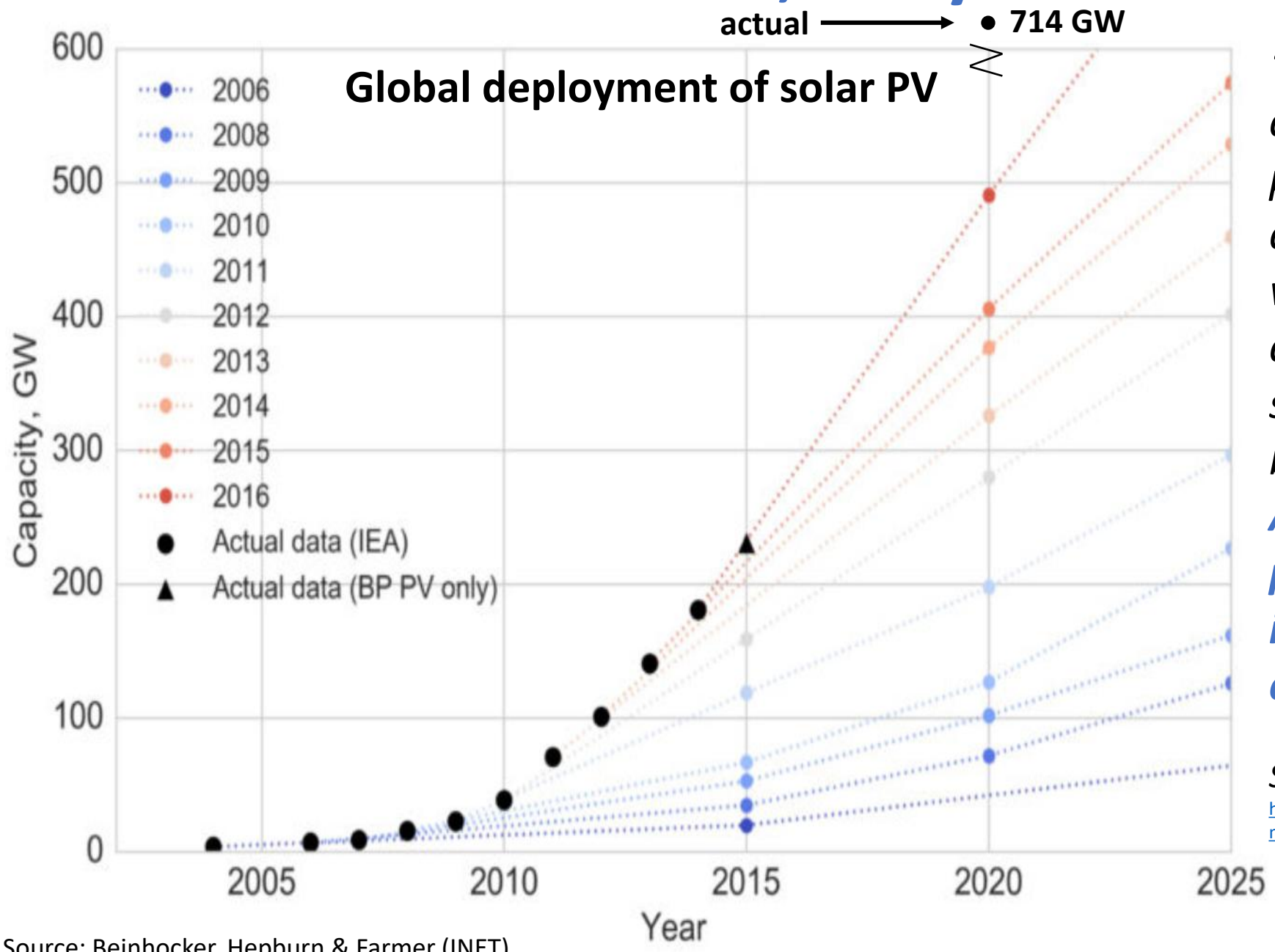
Ursula von der Leyen, President, European Commission

Ngozi Okonjo-Iweala, Director General, World Trade Organisation

Mark Carney, UN Special Envoy on Climate Action and Finance (2021)

Joint op-ed in Financial Times, 3 Dec 2023. 'No more business as usual: the case for carbon pricing.'

1. Investment beats tax, early in a transition



"Today, renewable energy is cheaper than coal in many places in the world, all major car manufacturers are working on several electric car models, and cities are starting to switch to electric buses.

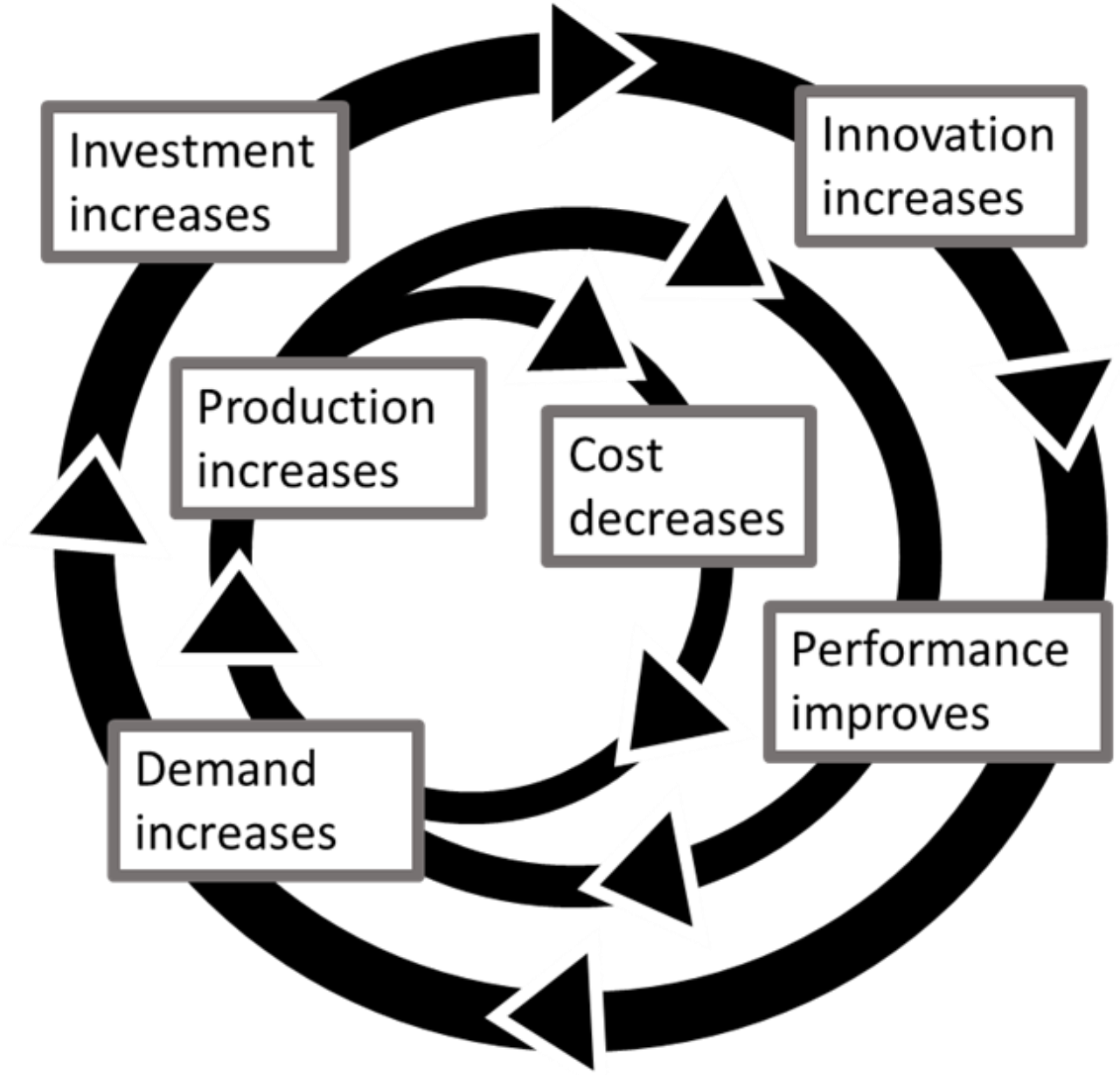
All of this was achieved with policies focussed on new investments, not with carbon taxes."

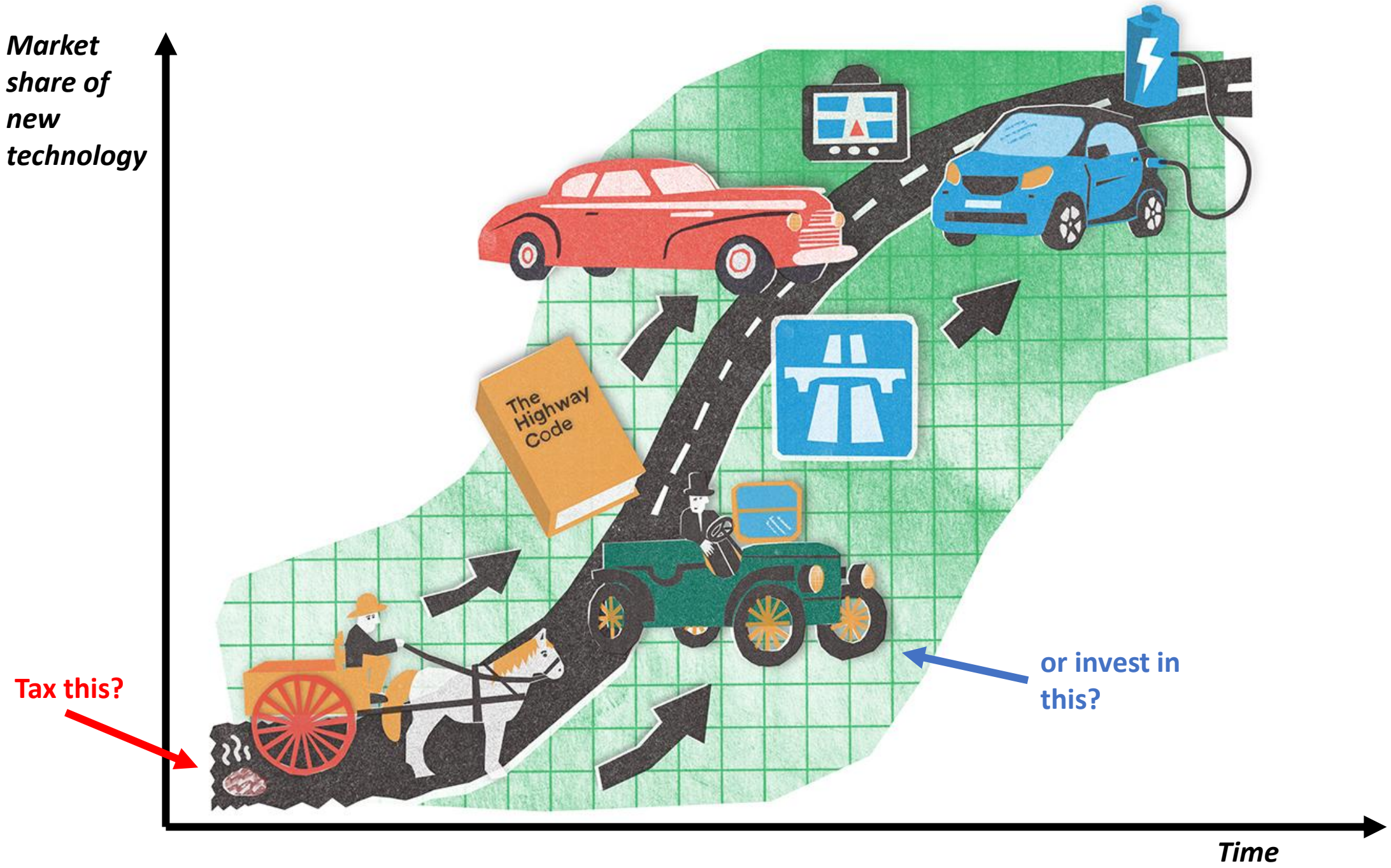
Stephane Hallegatte & Julie Rozenberg
https://blogs.worldbank.org/climatechange/all-hands-deck-mobilizing-all-available-instruments-reduce-emissions

Source: Beinhocker, Hepburn & Farmer (INET)

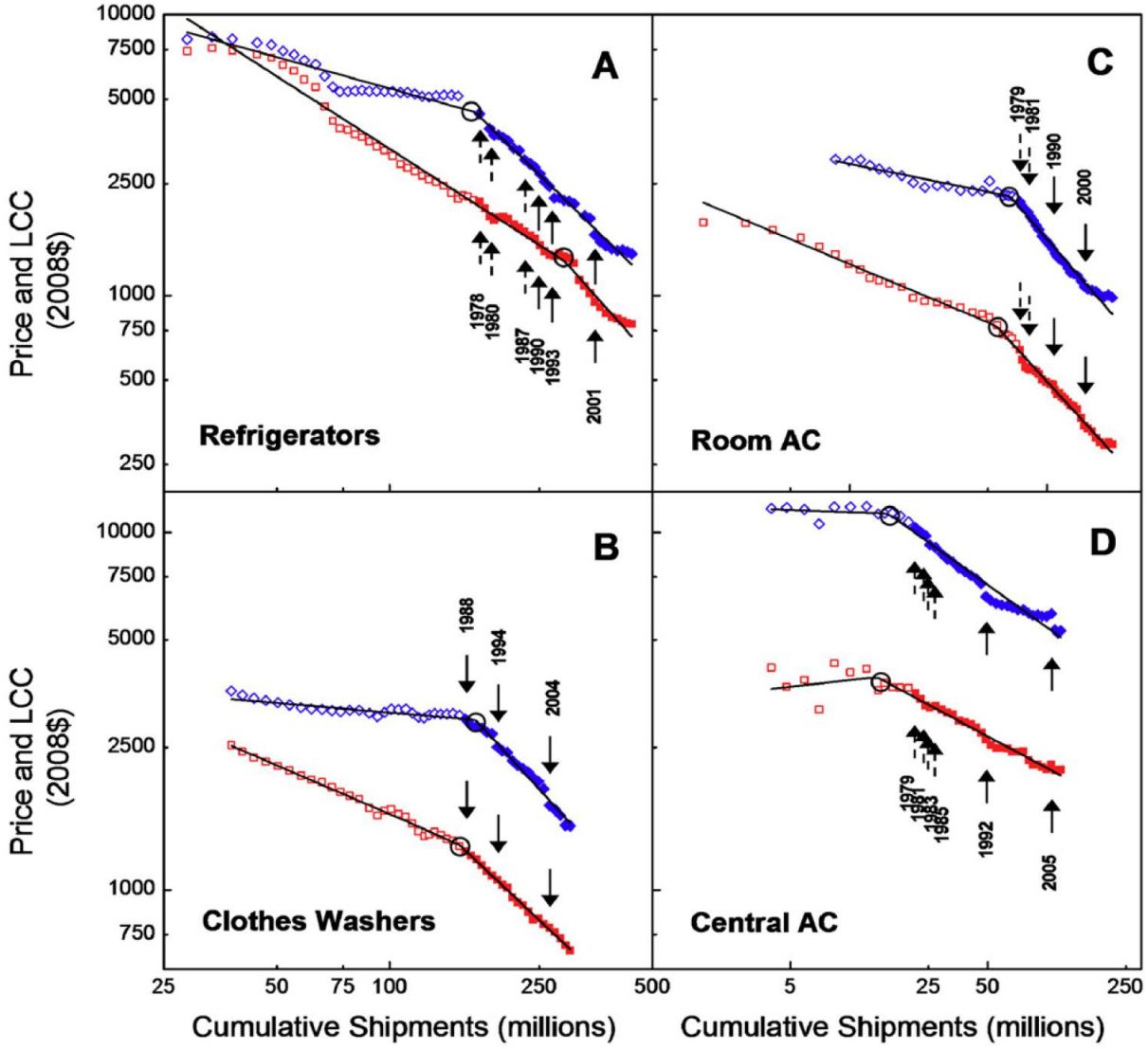
Reinforcing feedbacks:

- Learning by doing
- Economies of scale
- Emergence of complementary technologies
- Investment - innovation - increasing demand




Market share of new technology
The Highway Code
Tax this?
or invest in this?
Time

2. Regulation reallocates finance, and forces innovation

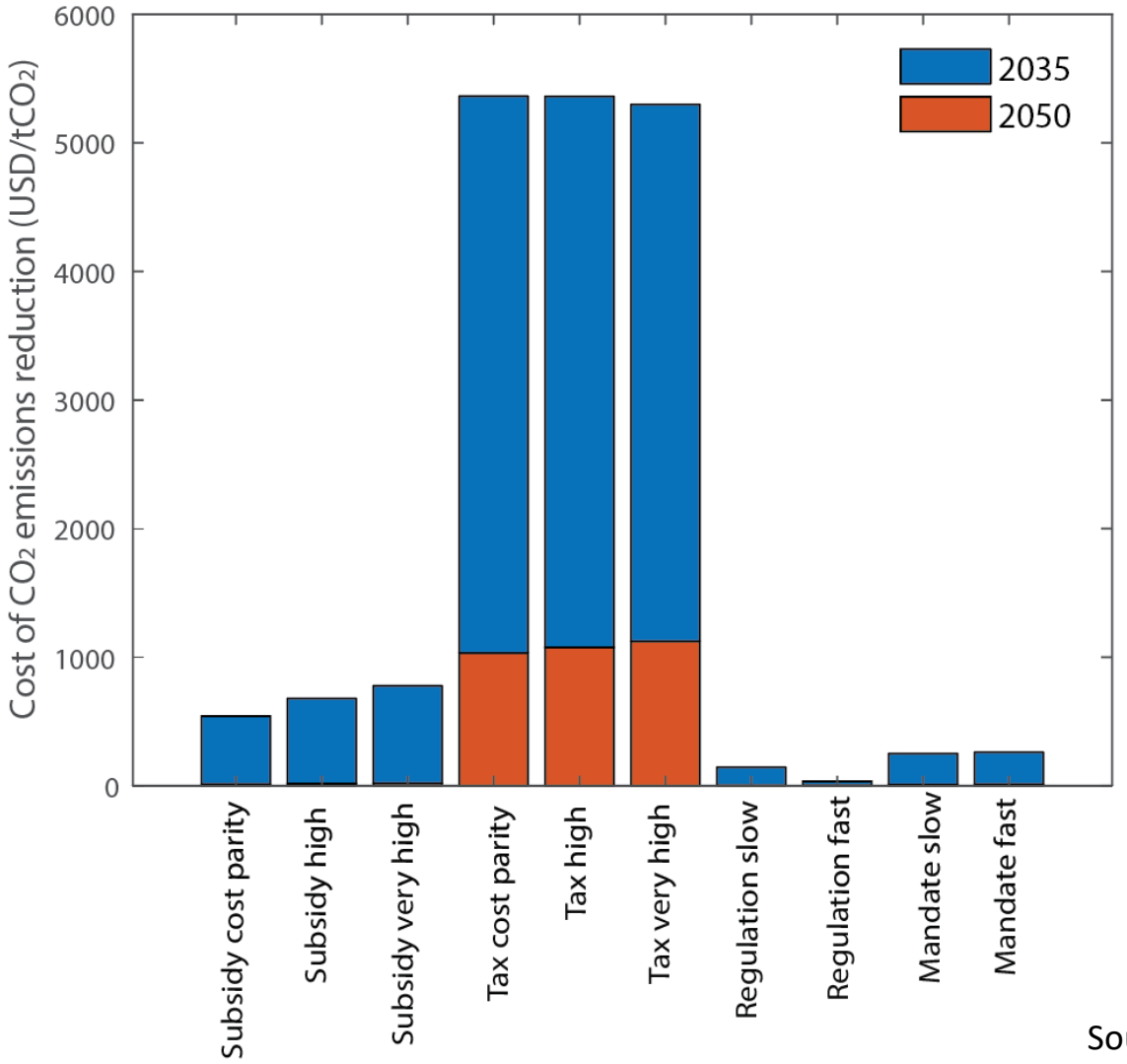


"In contrast to the classical picture of the impact of efficiency standards, the introduction and updating of appliance standards is not associated with a long-term increase in purchase price; rather, quality-adjusted prices undergo a continued or accelerated long-term decline."

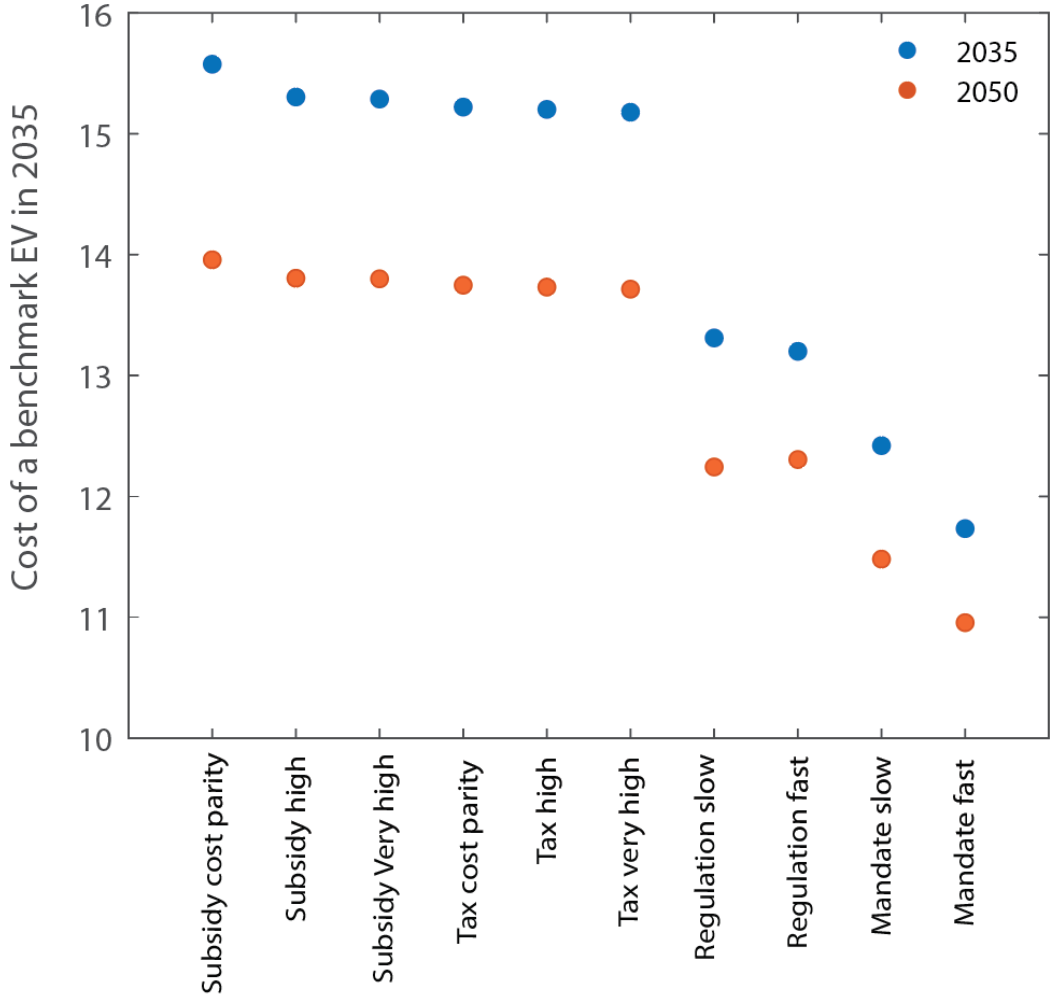
A retrospective investigation of energy efficiency standards: policies may have accelerated long term declines in appliance costs
R D Van Buskirk, C L S Kantner, B F Gerke and S Chu

ZEV mandates drive the fastest cost reduction in electric vehicles

Cost per tonne of emissions reduction



Cost of benchmark electric vehicle in 2035



Source: Lam & Mercure

Policy options to deploy electric vehicles in India

The social cost of carbon: economics, science, or philosophy?

"Today we are issuing updated values for the Social Cost of Carbon (SCC), which are used to estimate the value to society of reducing carbon emissions… These technical corrections result in a ***central estimated value of… $37 per metric ton of CO_2*** *… The estimate of the SCC has been developed over many years, using the best science available… Rigorous evaluation of costs and benefits … The interagency group estimated the improved SCC values using the most widely cited climate economic impact models."*

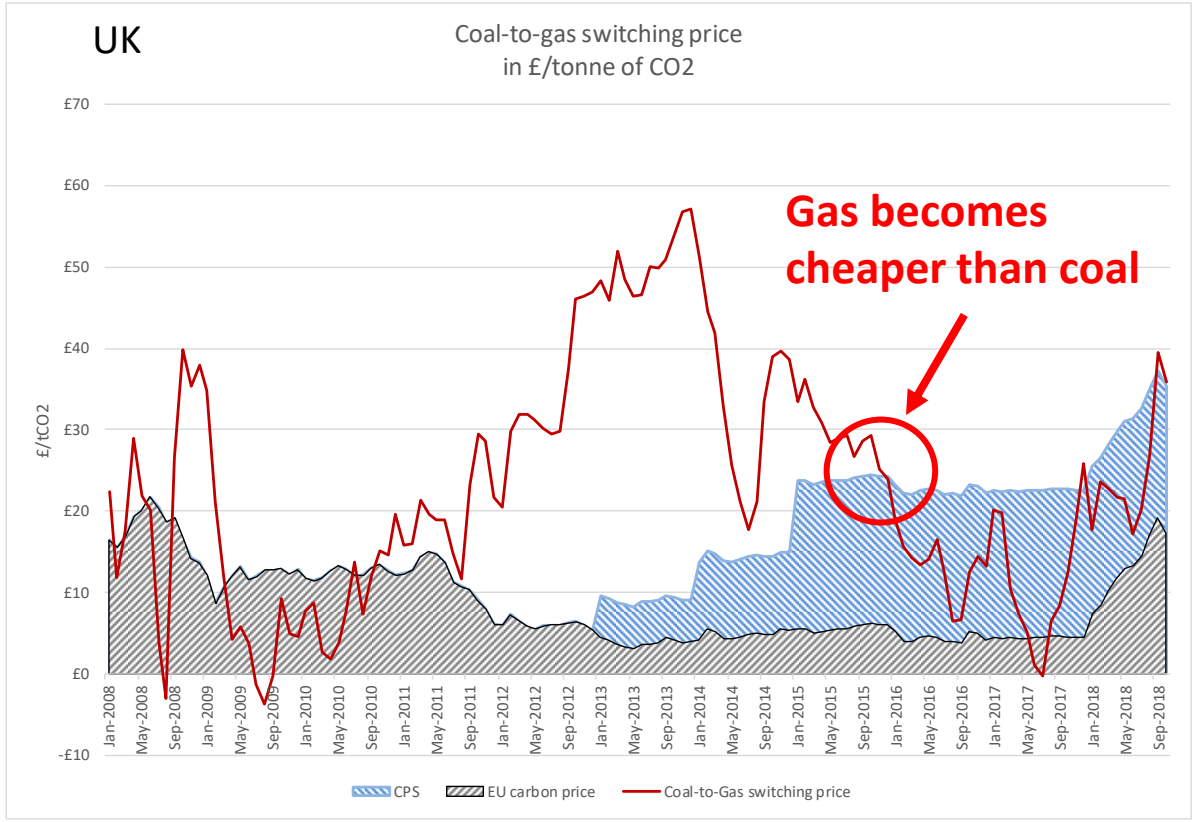
– US White House Council of Economic Advisers (November 2013)

"A further source of uncertainty is whether and how the possibility of catastrophic damages is accounted for, which requires bounding potential losses with a parameter akin to the value of a statistical life (representing, essentially, willingness to pay to avoid human extinction). Without such a parameter, 'social cost of carbon' estimates incorporating risk aversion and potential catastrophic impacts ***can be unboundedly high****."*

- IPCC AR5 WGII Ch.19 early draft (November 2013)

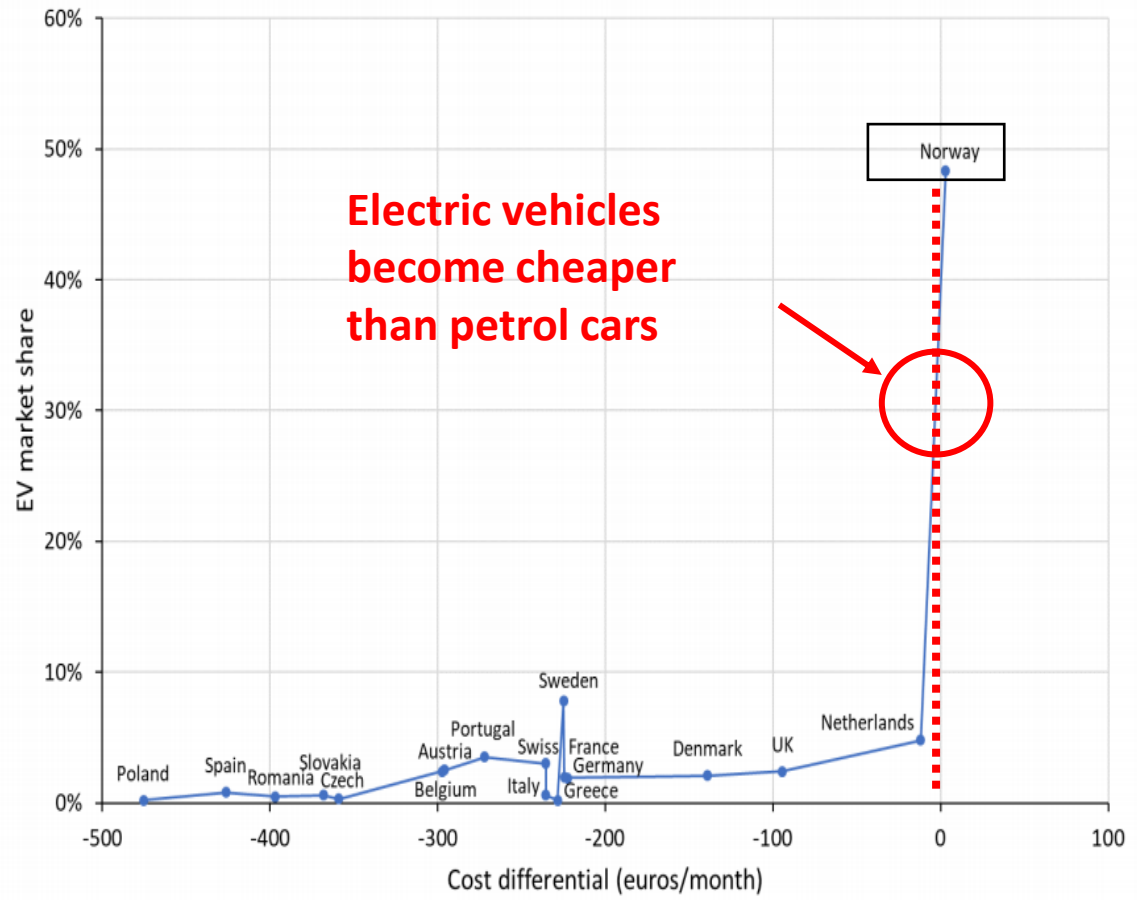
3. Tax should target tipping points

World's fastest power sector decarbonization



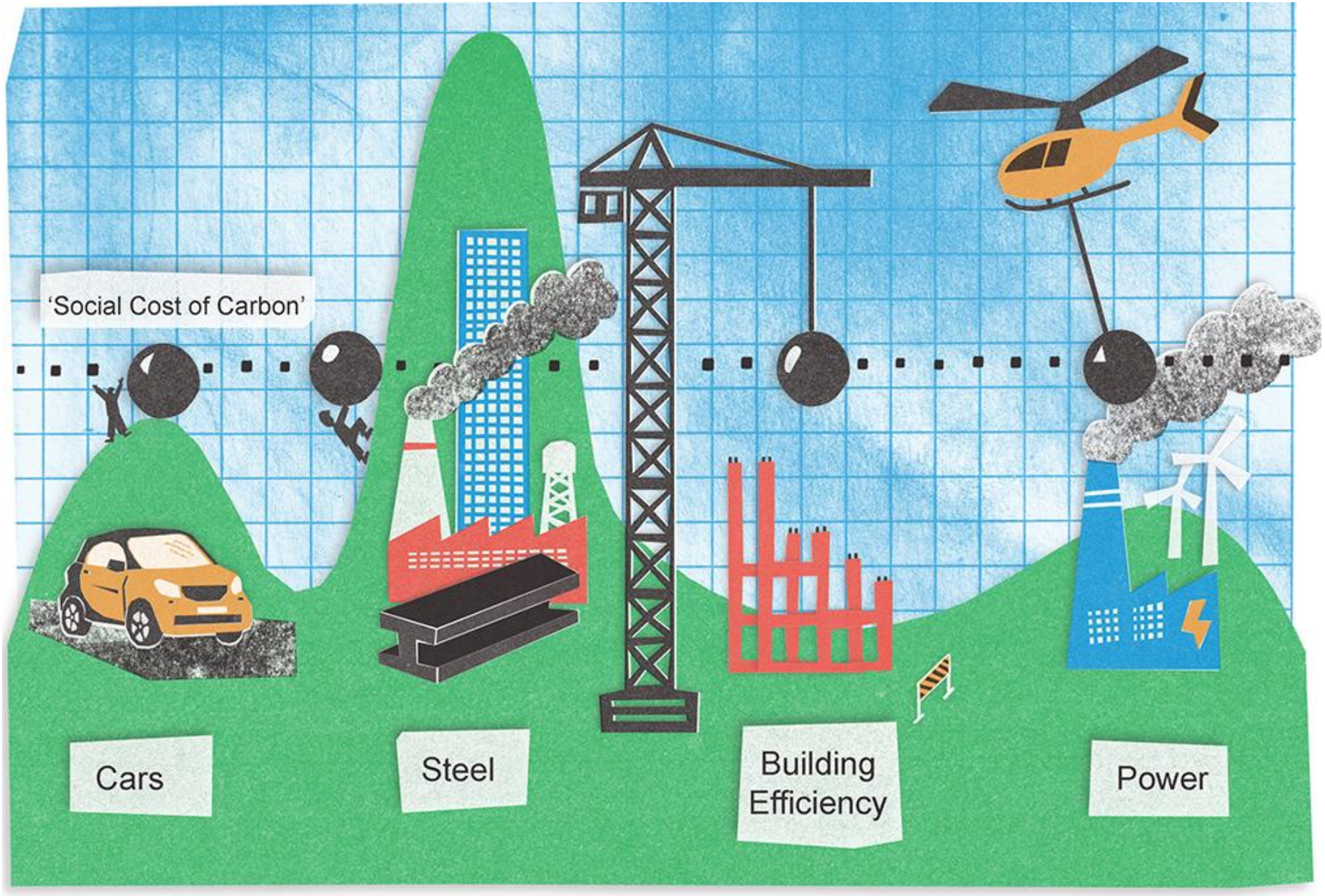
Grey shading: EU emissions trading carbon price
Blue shading: UK carbon price floor
Red line: coal-to-gas switching price

World's fastest transition to electric vehicles

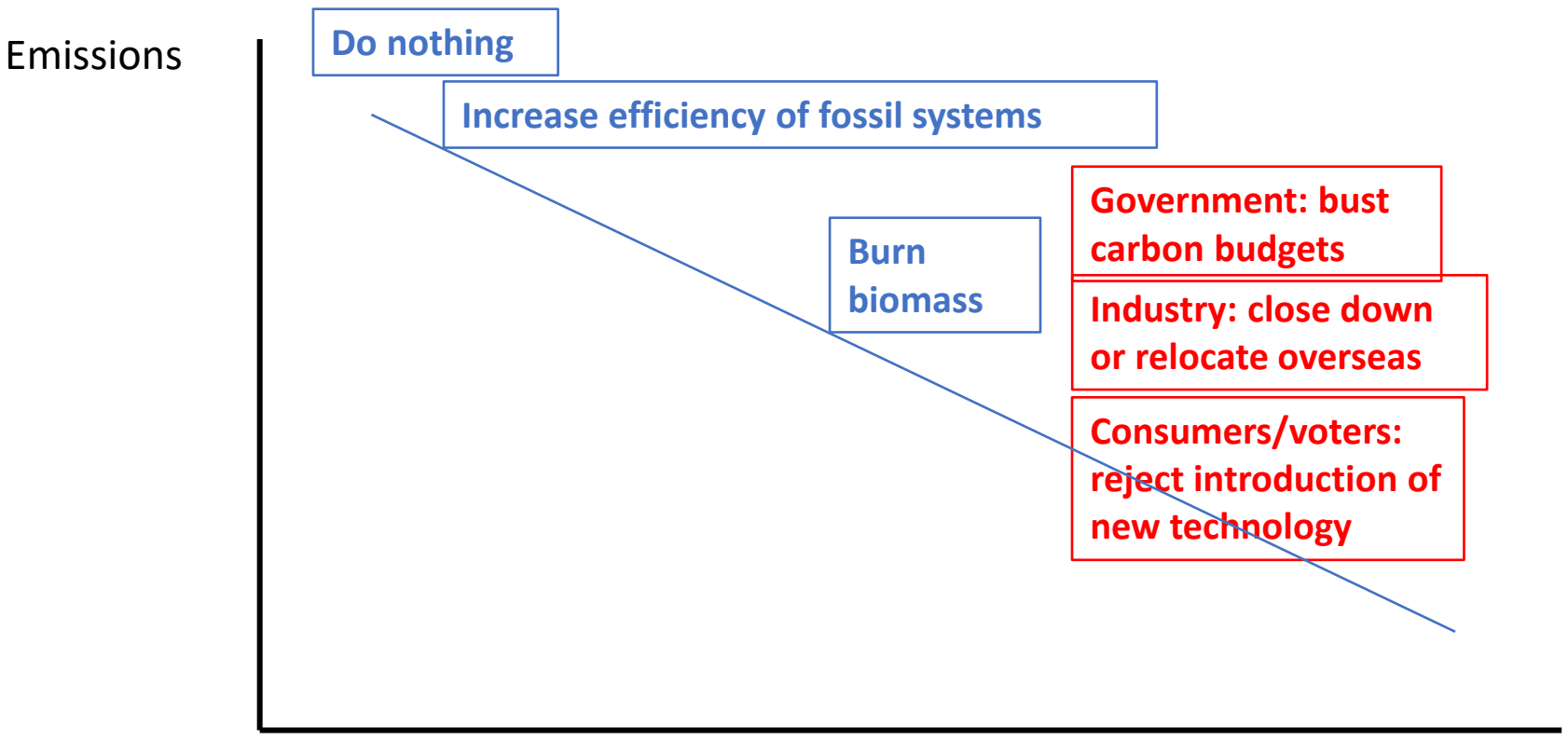


Sharpe & Lenton: Upward-scaling tipping cascades to meet climate goals: plausible grounds for hope

An equal carbon price across the whole economy is dynamically inefficient



4. A strategy focused on short-term emissions reductions stores up problems for the future



Each step delays the necessary

path-dependent development in zero-emission-related:

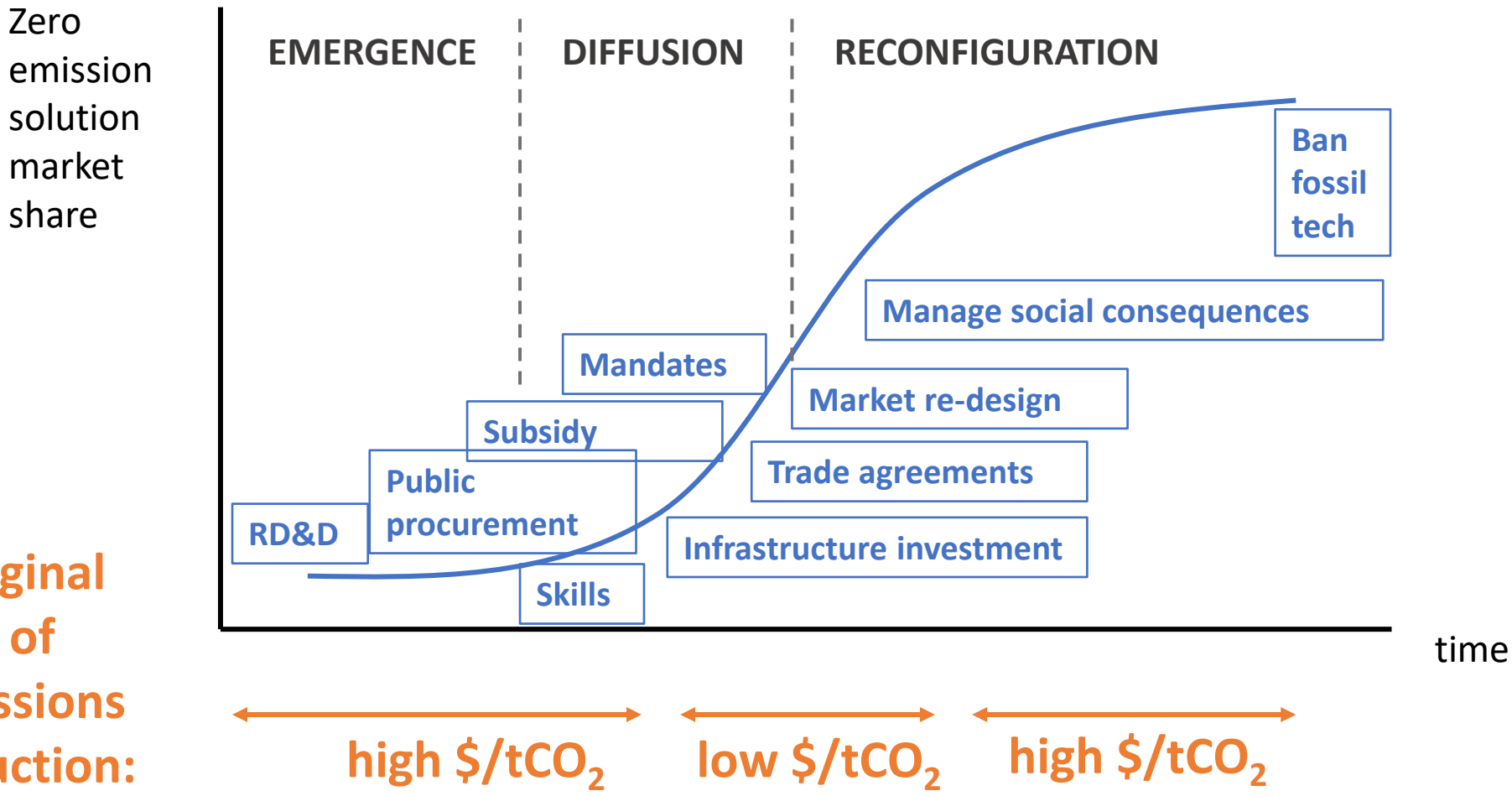
- Technologies
- Infrastructure systems
- Supply chains, and business models
- Workforce skills
- Consumer / investor confidence

Marginal cost of emissions reduction:

low $/tCO$_2$

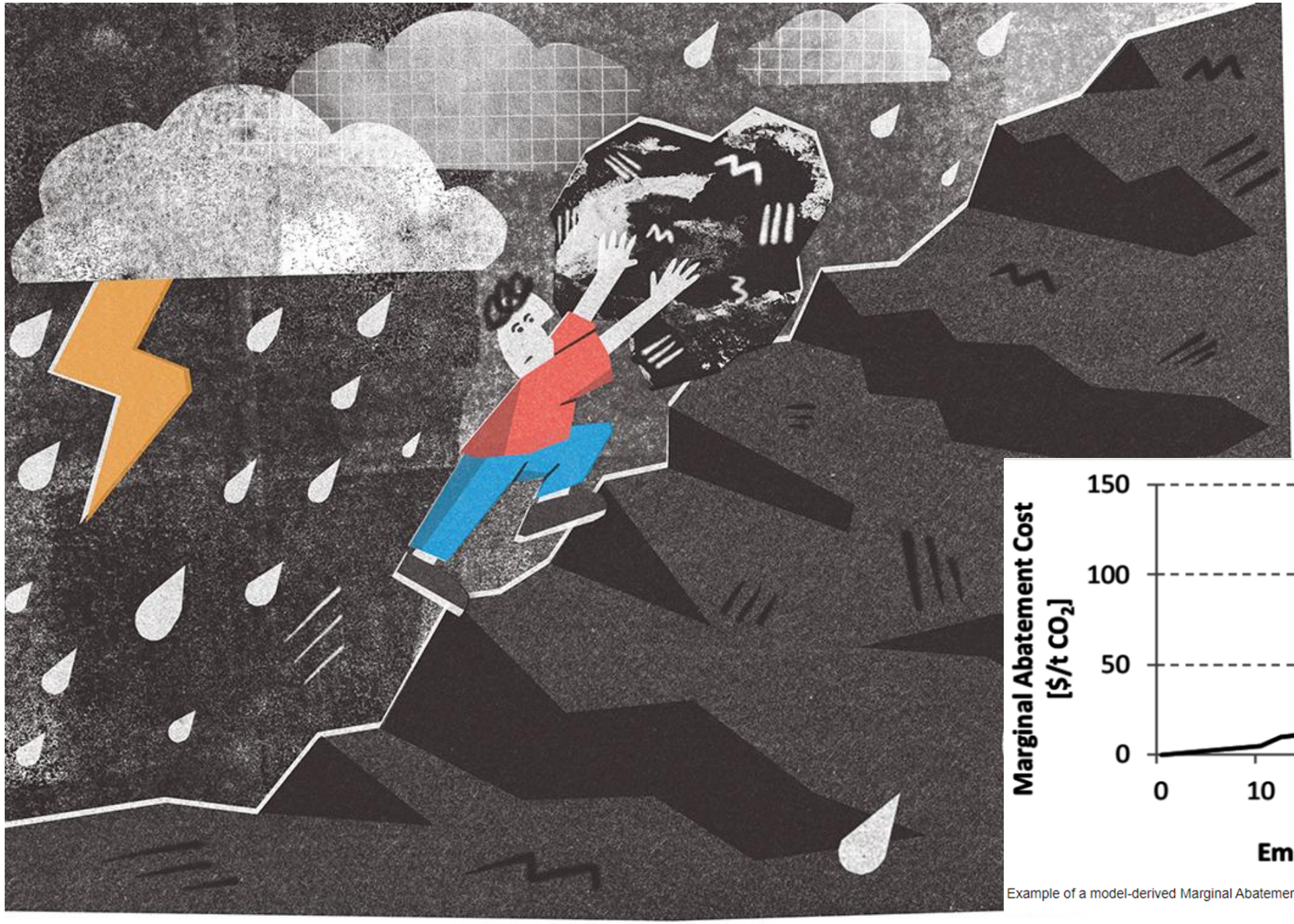
very high $/tCO$_2$ or unachievable in time

Focus instead on deployment of zero-emission solutions

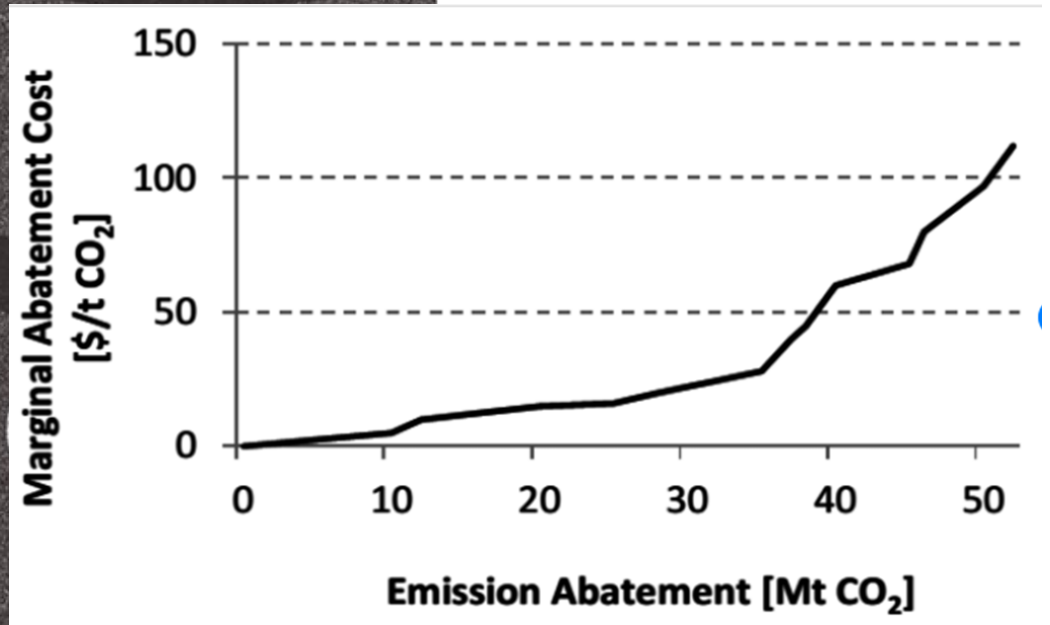


Each step enables the next

DIPLOMACY



Does decarbonisation only ever get more difficult?



Example of a model-derived Marginal Abatement Cost curve

Balancing feedbacks dominate

Reinforcing feedbacks dominate

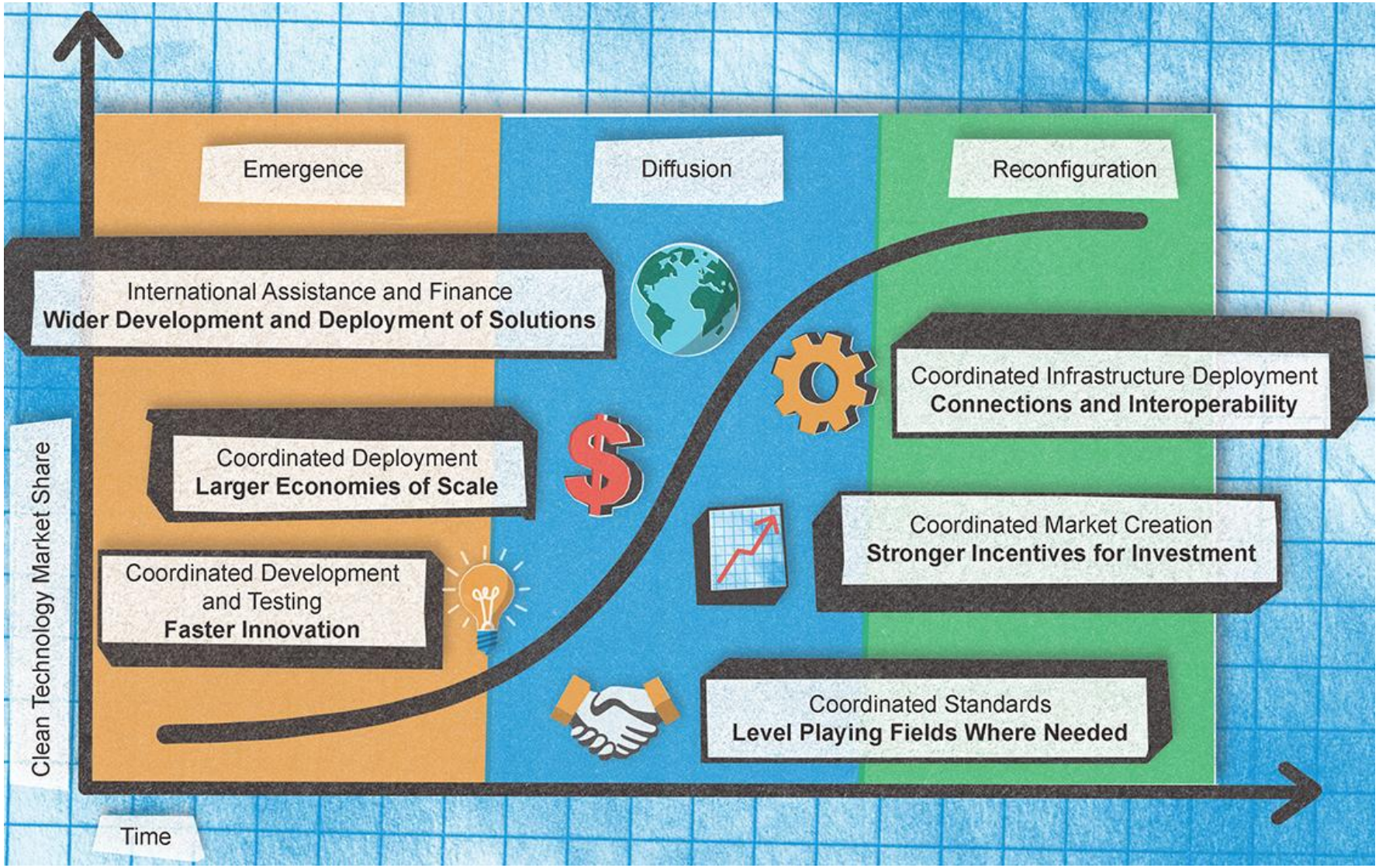
Dirty fossil economy

Clean economy with $12 trillion savings

Negative sum diplomacy in a static economy

How to divide up the global carbon pie

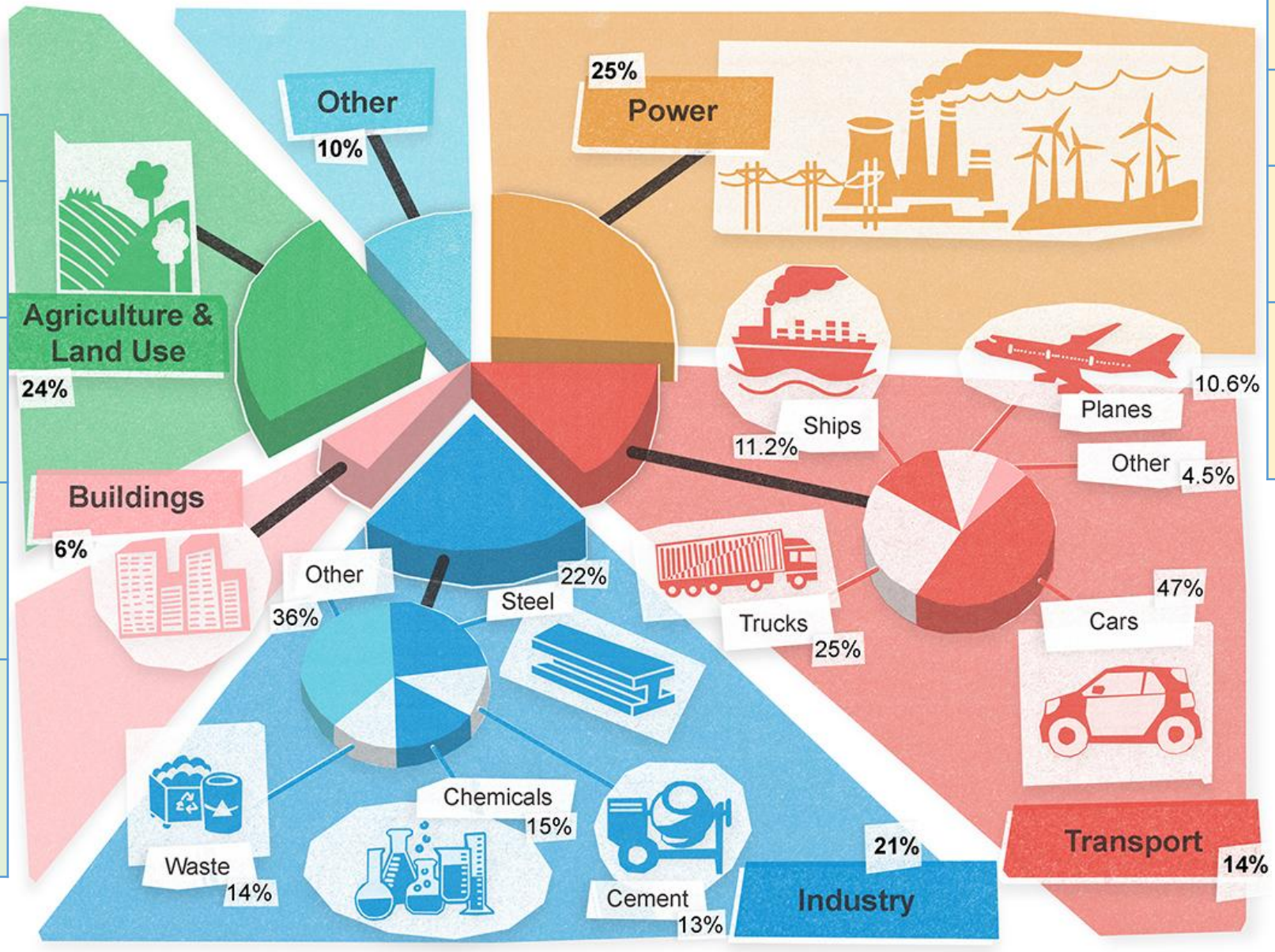
Positive sum diplomacy in a dynamic economy



Adapted from IEA, IRENA & Climate Champions, *The Breakthrough Agenda Report 2022* and Victor, Geels & Sharpe, *Accelerating the low carbon transition* (2019)

1. Scope: focus cooperation within sectors

LAND USE
Politics: food security, rural development, consumer preference
Technologies: sustainable agriculture practices
Problem: international trade flows incentivize deforestation
Influential countries: Indonesia, Malaysia, Brazil, Ghana, Cote d'Ivoire, EU, China, India, US, Argentina



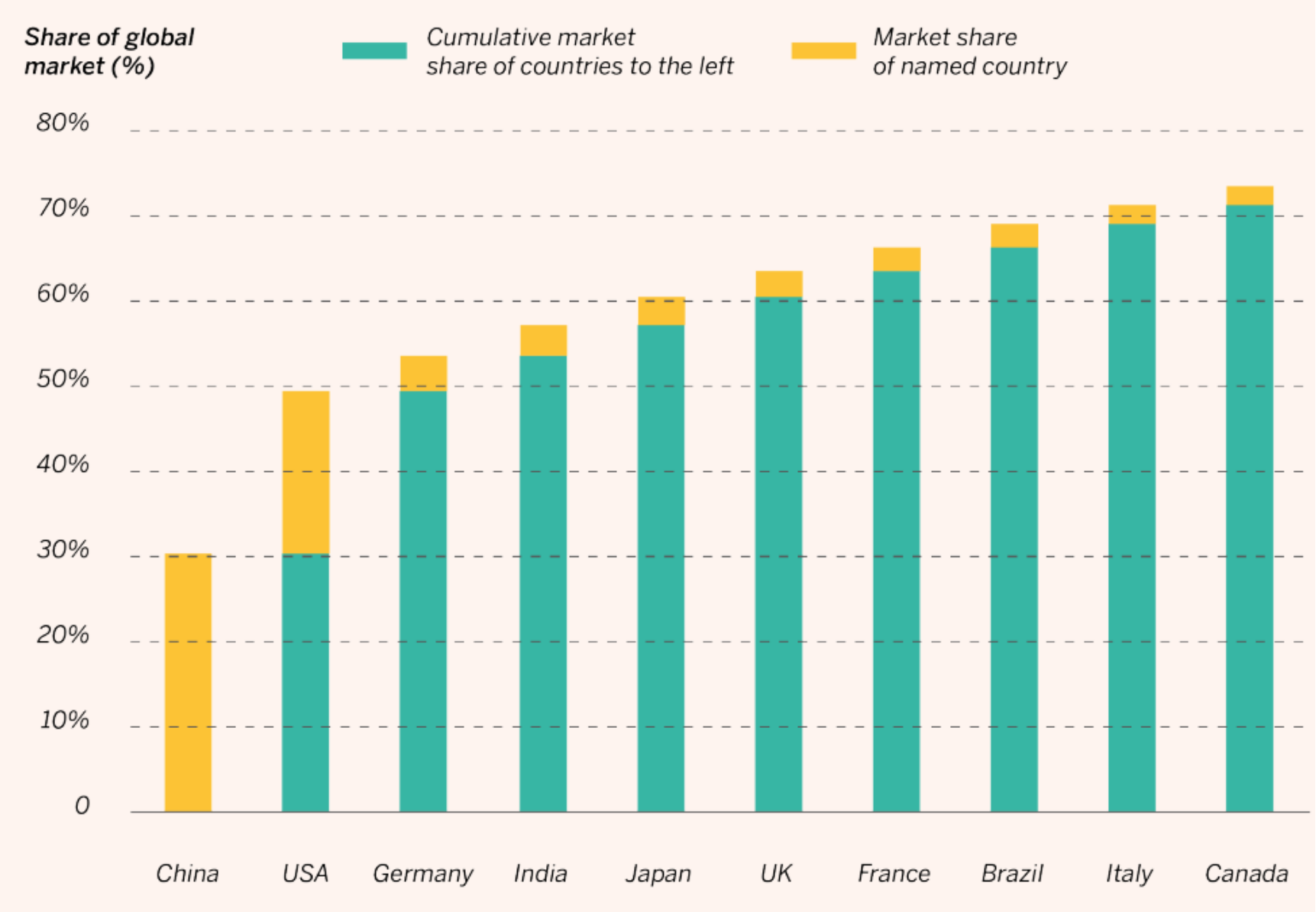
GLOBAL EMISSIONS BY SECTOR

POWER
Politics: energy security, electricity costs, coal jobs
Technologies: wind and solar vs coal and gas
Problem: infrastructure and markets designed for old technologies
Influential countries: China, India, US, Japan, Germany, South Africa, Vietnam

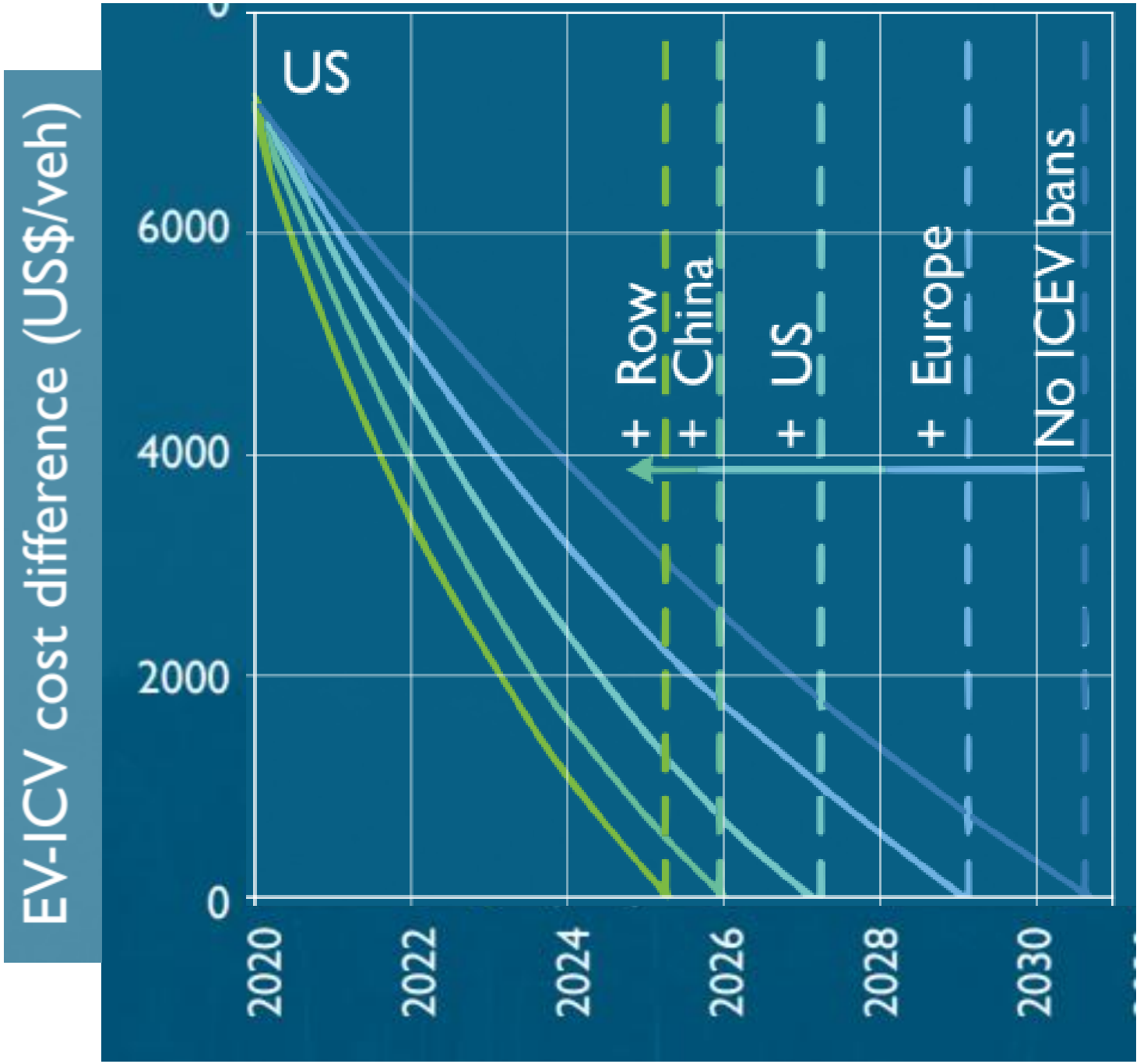
ROAD TRANSPORT
Politics: costs, manufacturing jobs
Technologies: electric motors and batteries vs combustion engines
Problem: technology costs, infrastructure
Influential countries: EU, China, US / California

2. Participation: focus on a critical mass of actors

Cumulative share of global car sales

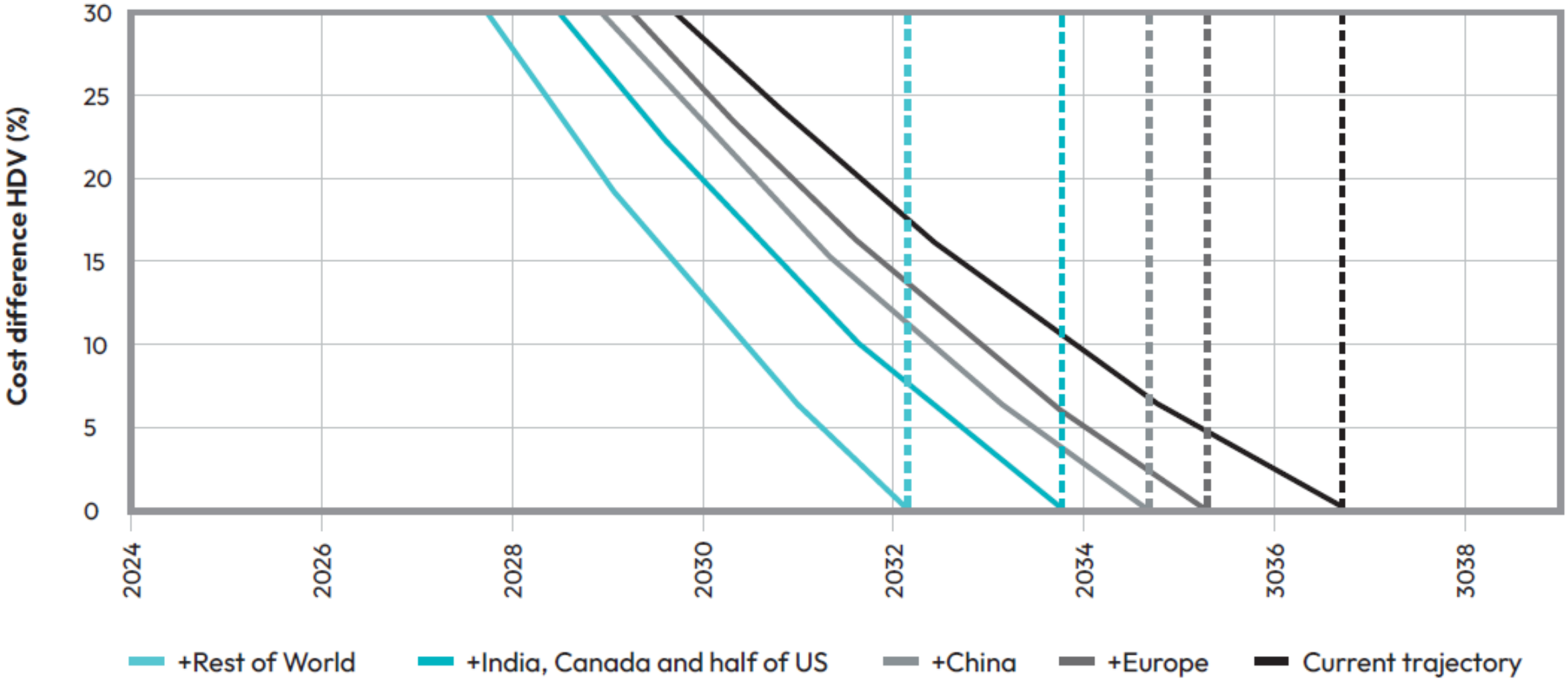


Three regulators can bring forward the electric vehicle tipping point by 5 years



Source: Lam & Mercure, *'Evidence for a global electric vehicle tipping point'* (2022)

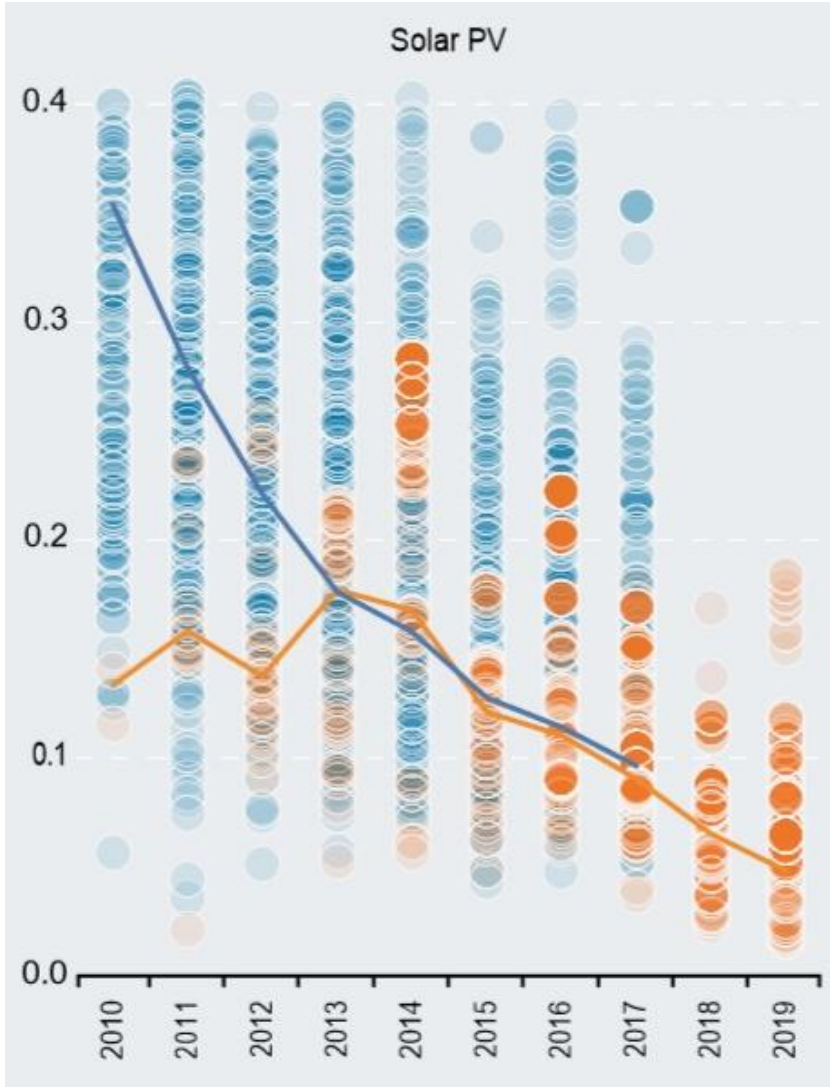
Five leading markets can bring forward the trucks tipping point by 3 years

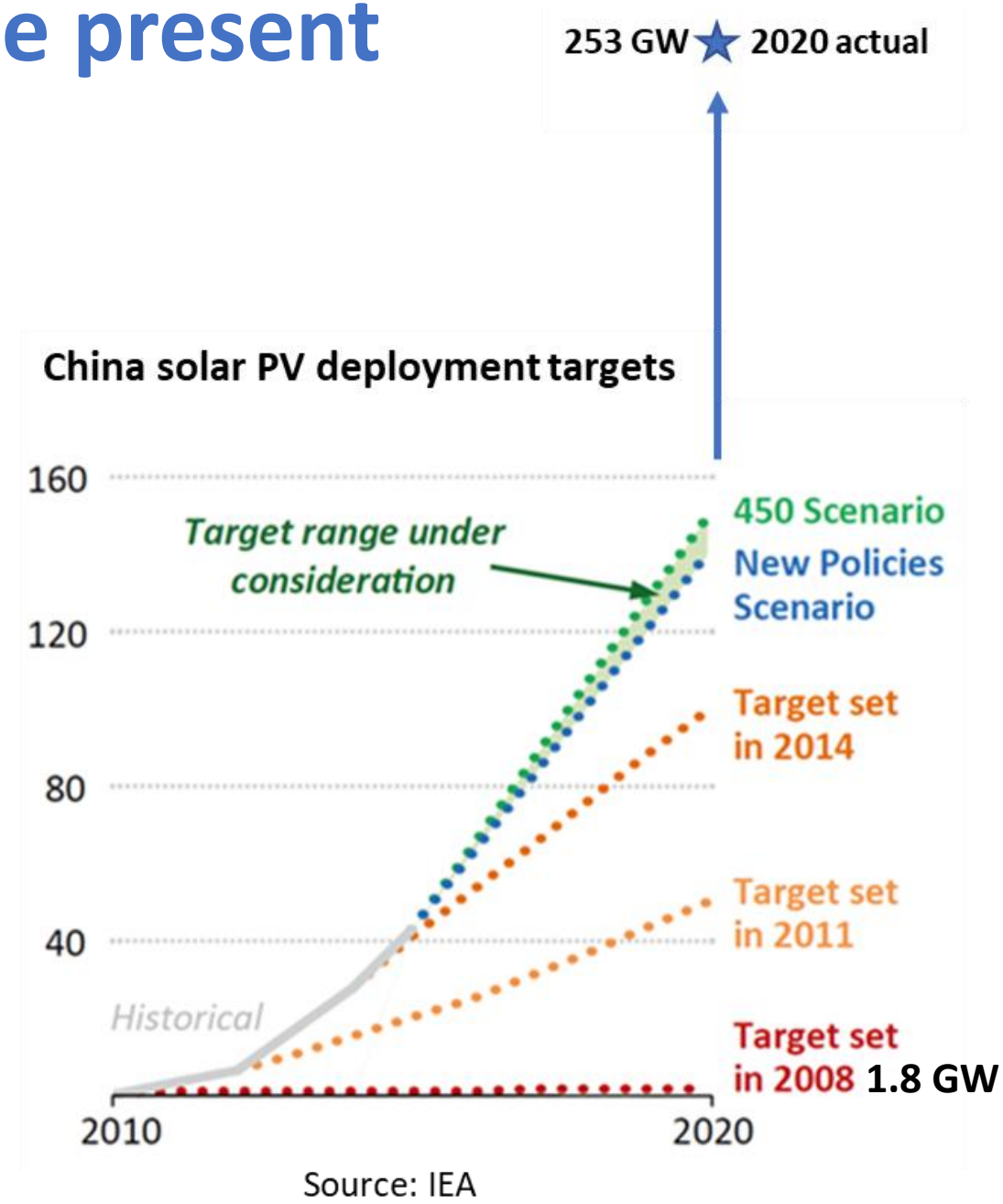


The effect of international coordination on the purchase price difference between BEVs and diesel vehicles in China.

Source: Akther, A. *et al* (2025): Driving the transition to zero emission trucks

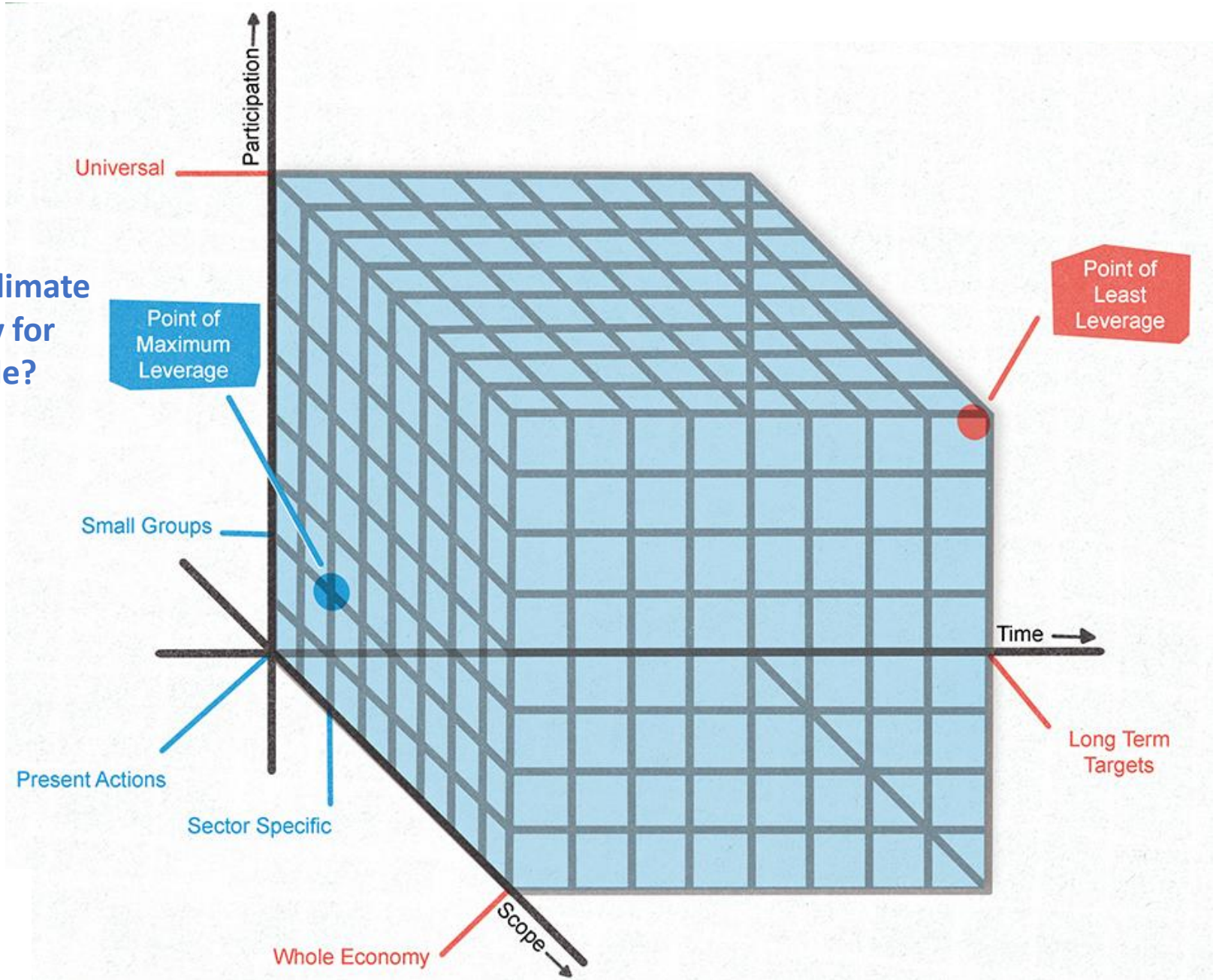
3. Timescale: focus on the present





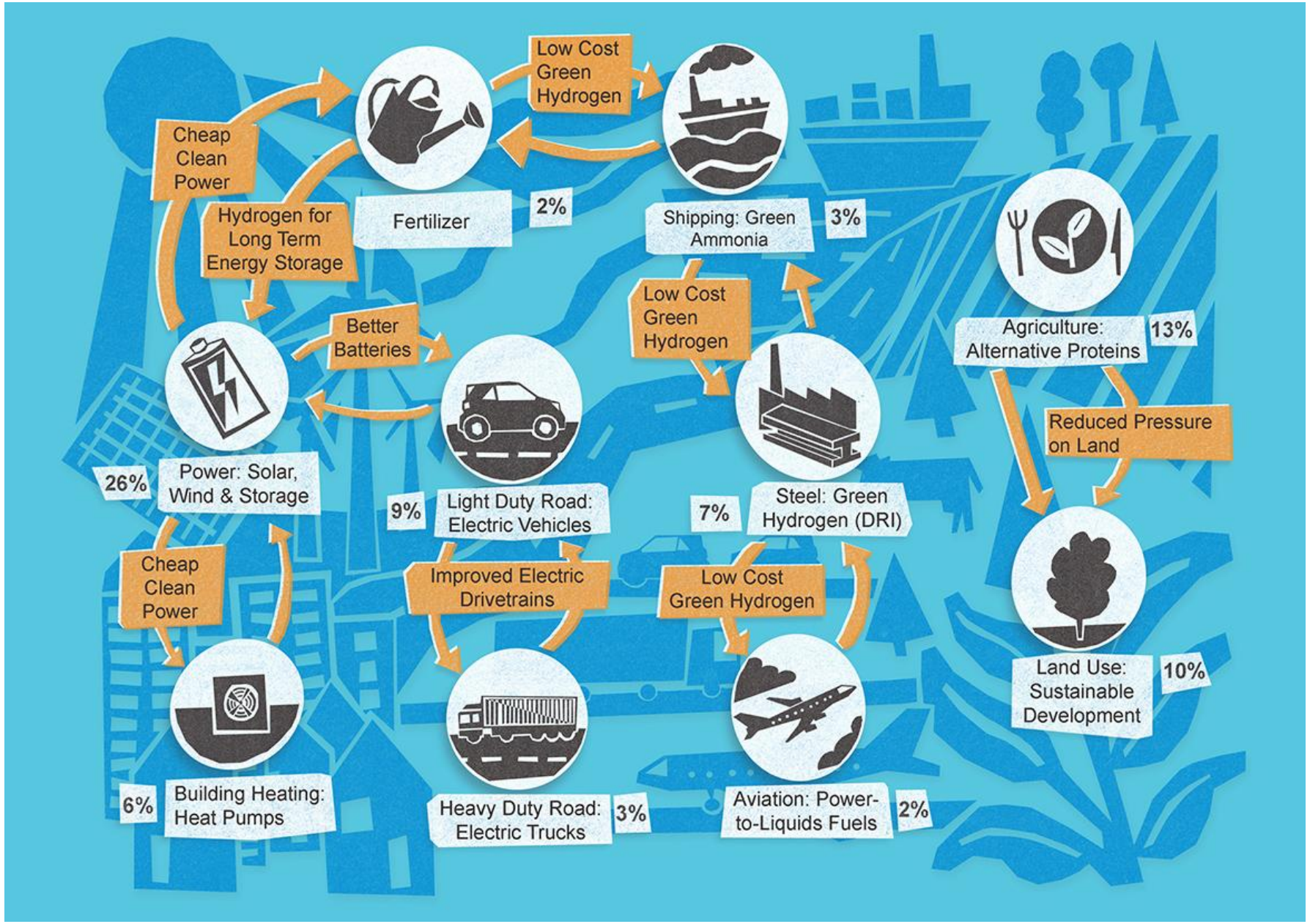
Source: IEA

Focus of climate diplomacy for this decade?



Focus of climate diplomacy for the last 30 years

Each positive tipping point that is crossed increases the chances of crossing others

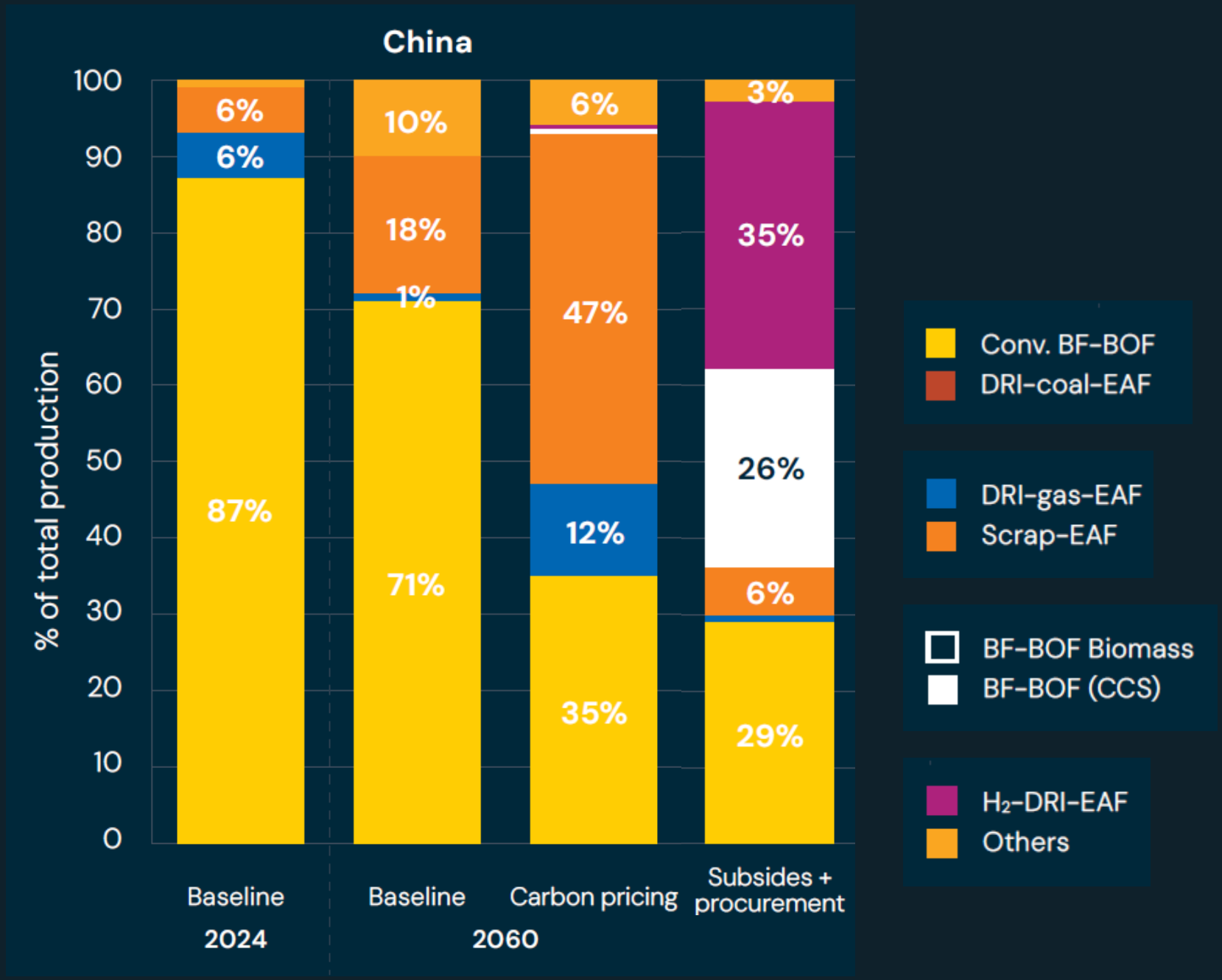


Adapted from Meldrum et al, *'The Breakthrough Effect'* (2023)

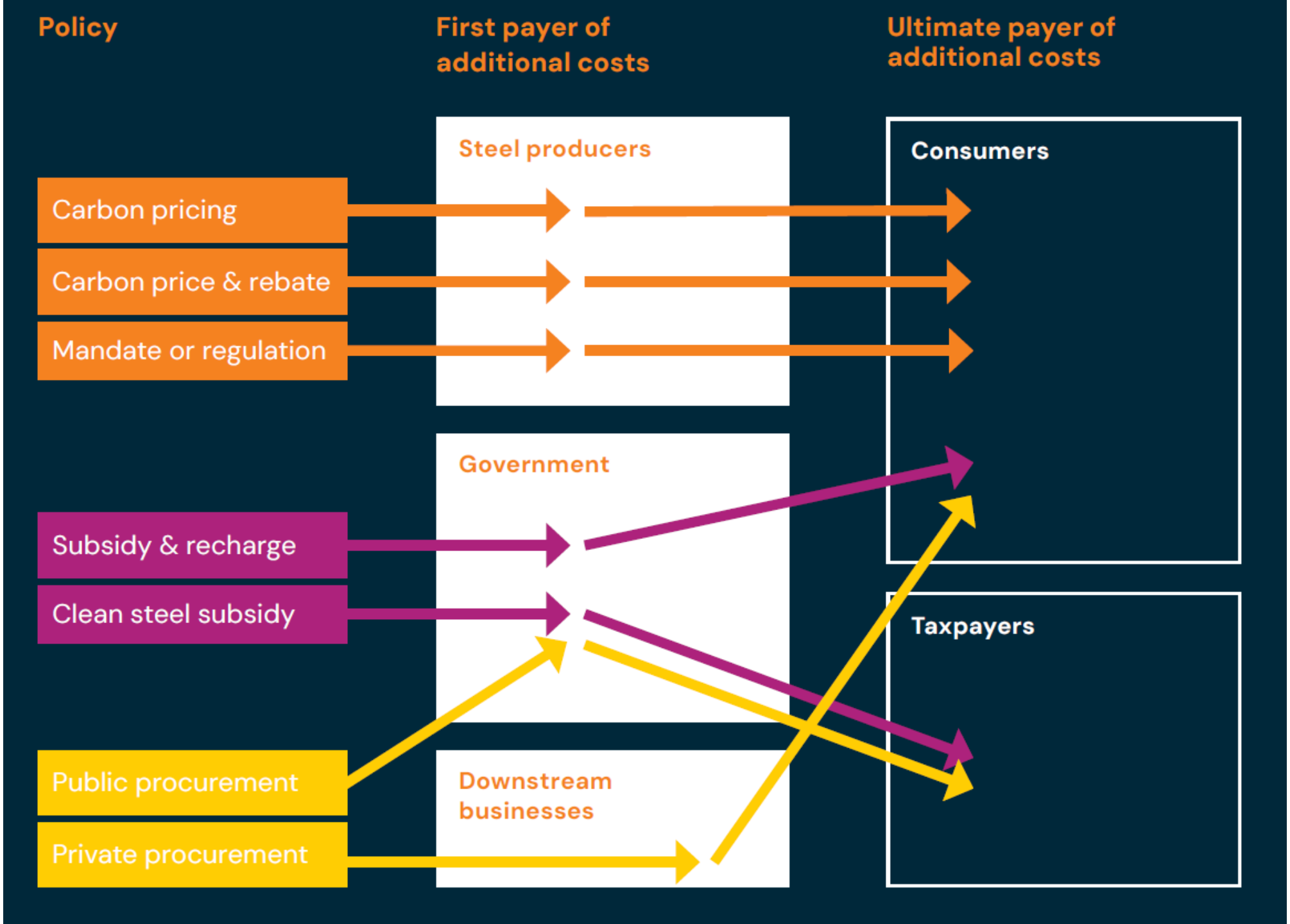
STEEL: a case study

Carbon pricing drives a shift to recycling and gas

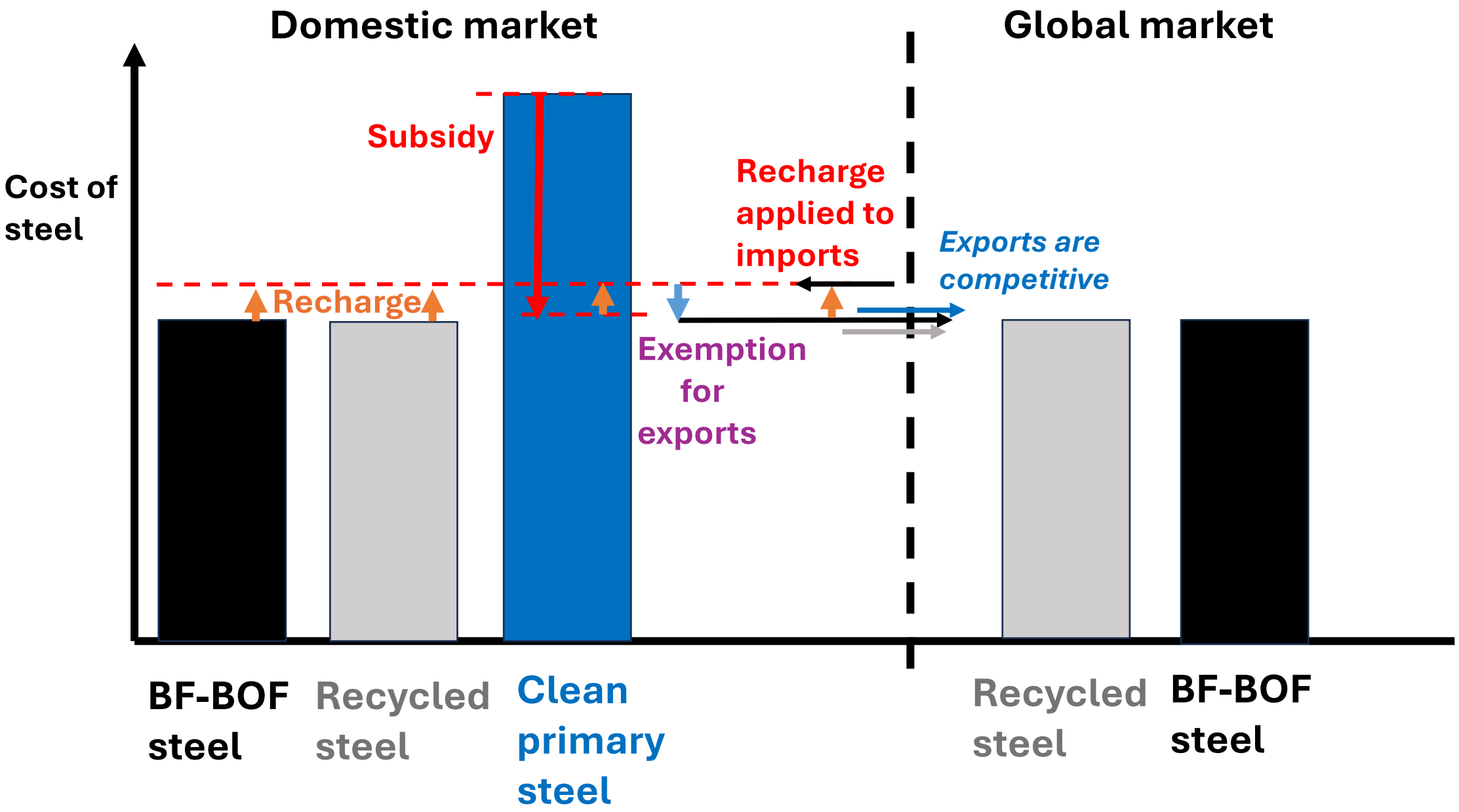
Subsidies can deploy clean primary steel



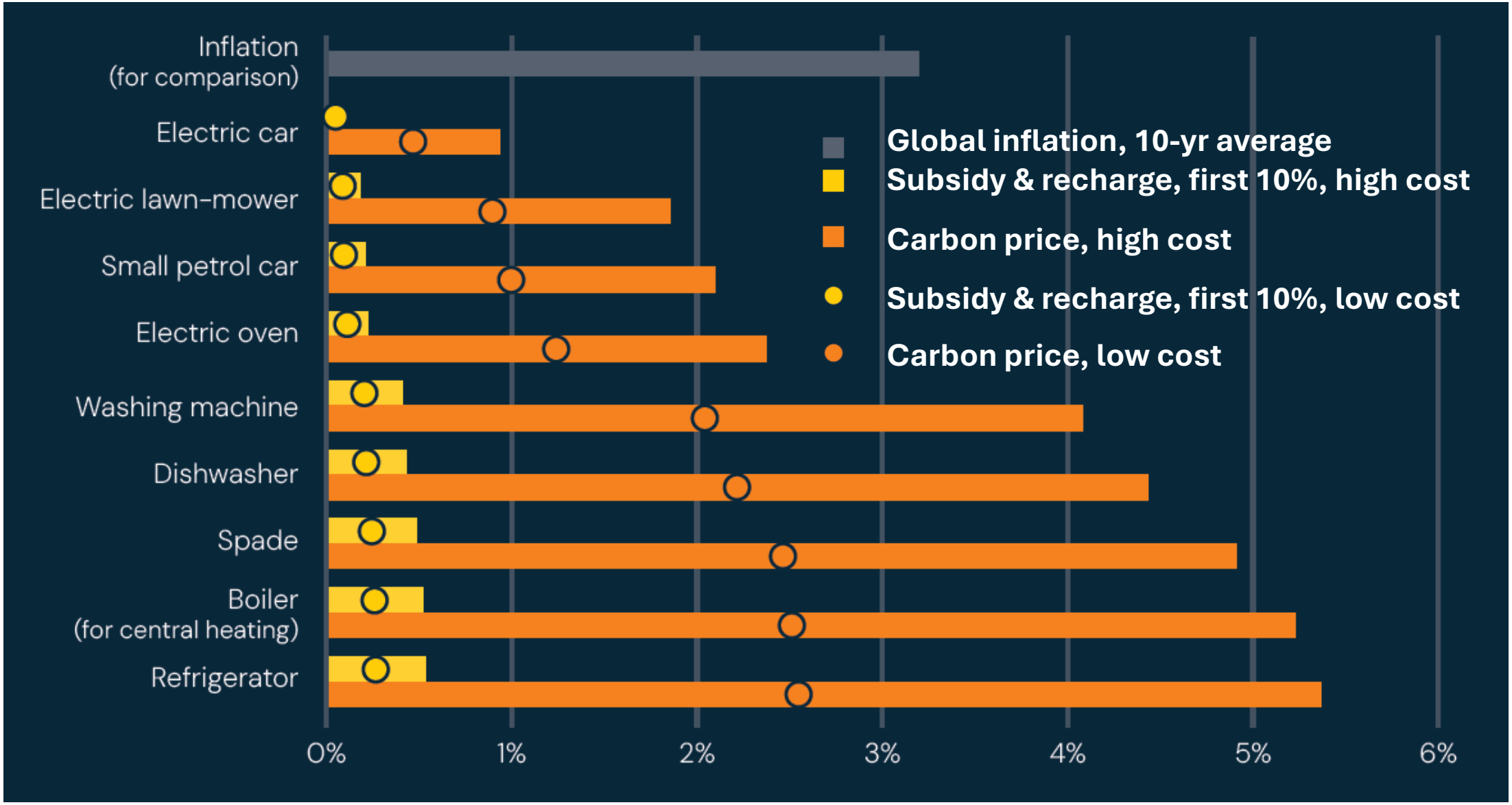
Dayal, S. et al., 2025. Towards near-zero emission steel: modelling-based policy insights for major producers. Available at www.scurveeconomics.org


Policy
First payer of additional costs
Ultimate payer of additional costs
Steel producers
Consumers
Carbon pricing
Carbon price & rebate
Mandate or regulation
Government
Subsidy & recharge
Clean steel subsidy
Taxpayers
Public procurement
Private procurement
Downstream businesses

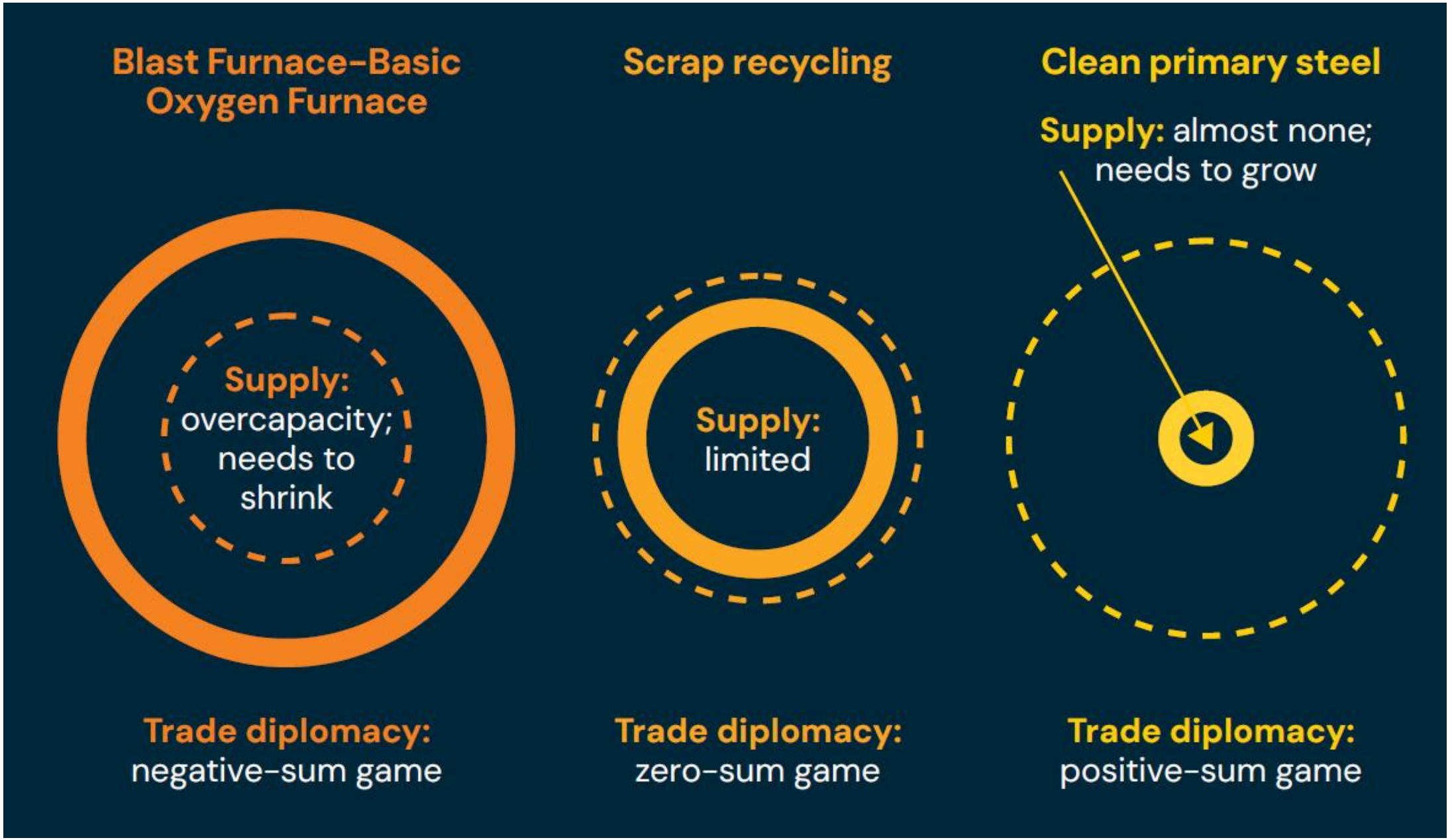
Subsidy-and-recharge creates no competitiveness risks



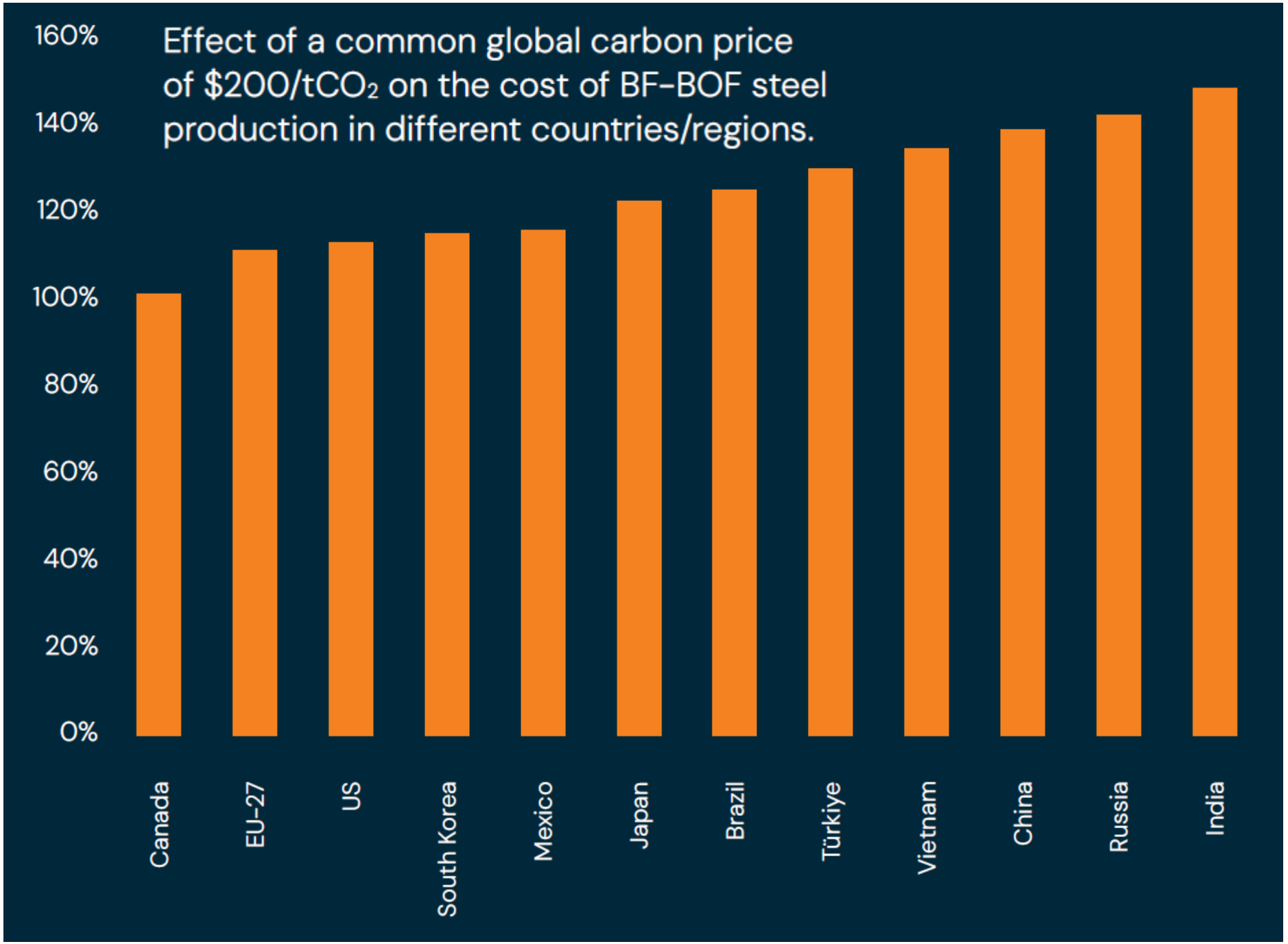
Deploying clean steel can be trivially low cost to consumers



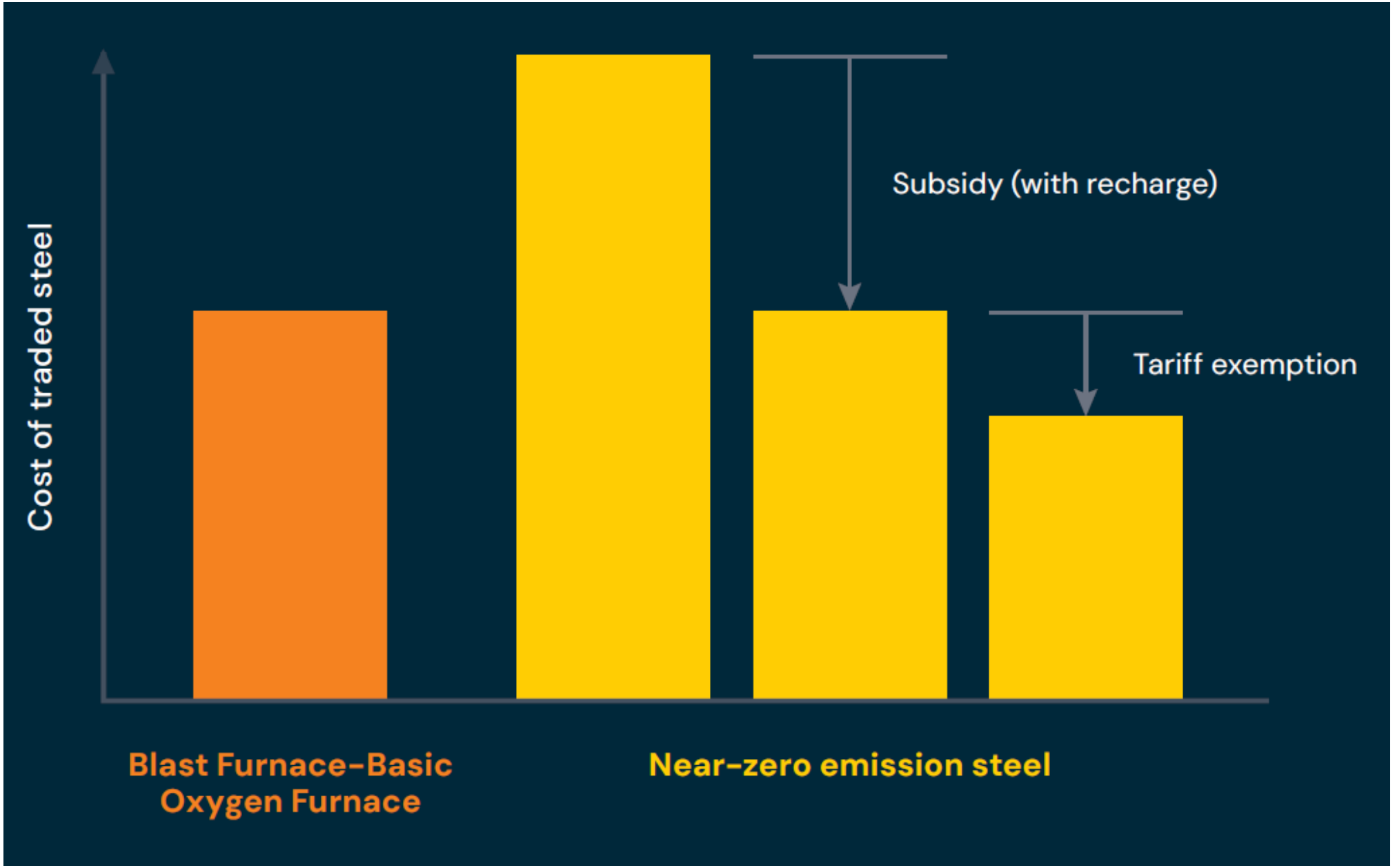
The dynamics of steel trade diplomacy depend on its focus



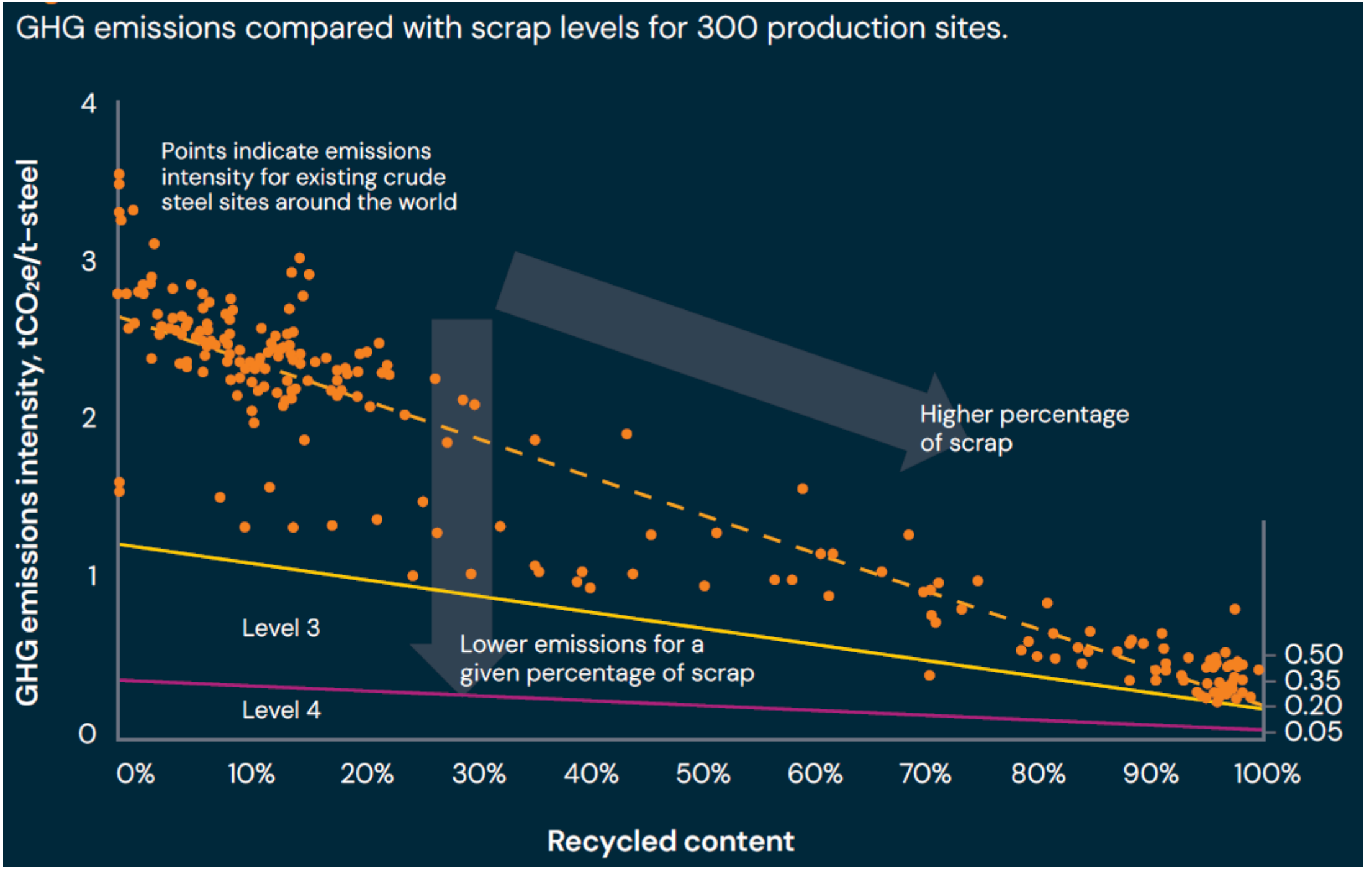
Internationally, a common carbon price could be particularly difficult to agree



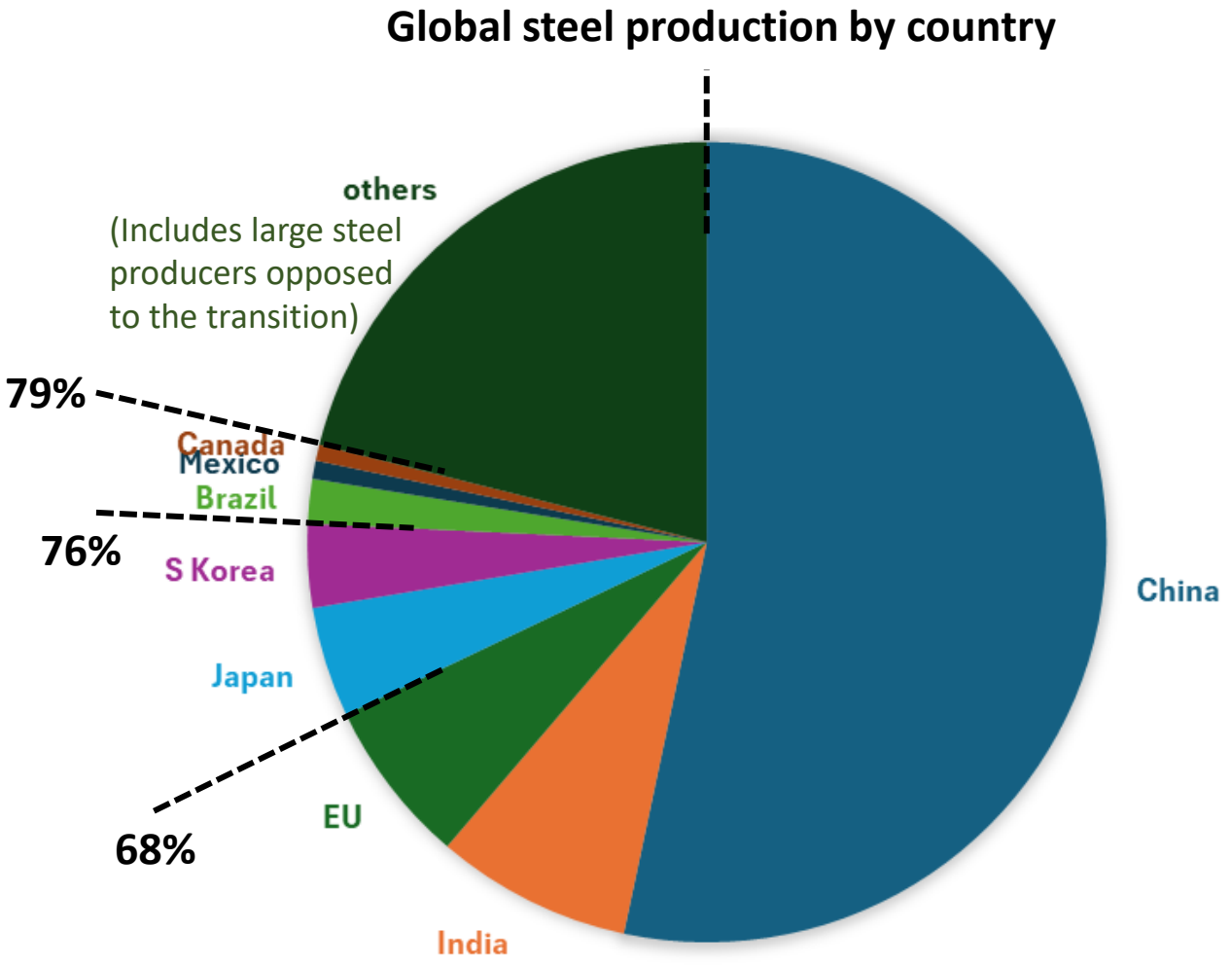
A plurilateral clean steel tariff exemption could give near-zero emission steel the advantage in international trade



If based on a near-zero emission standard, the tariff exemption would have no immediate impact on costs or trade



A small number of countries could move the global market

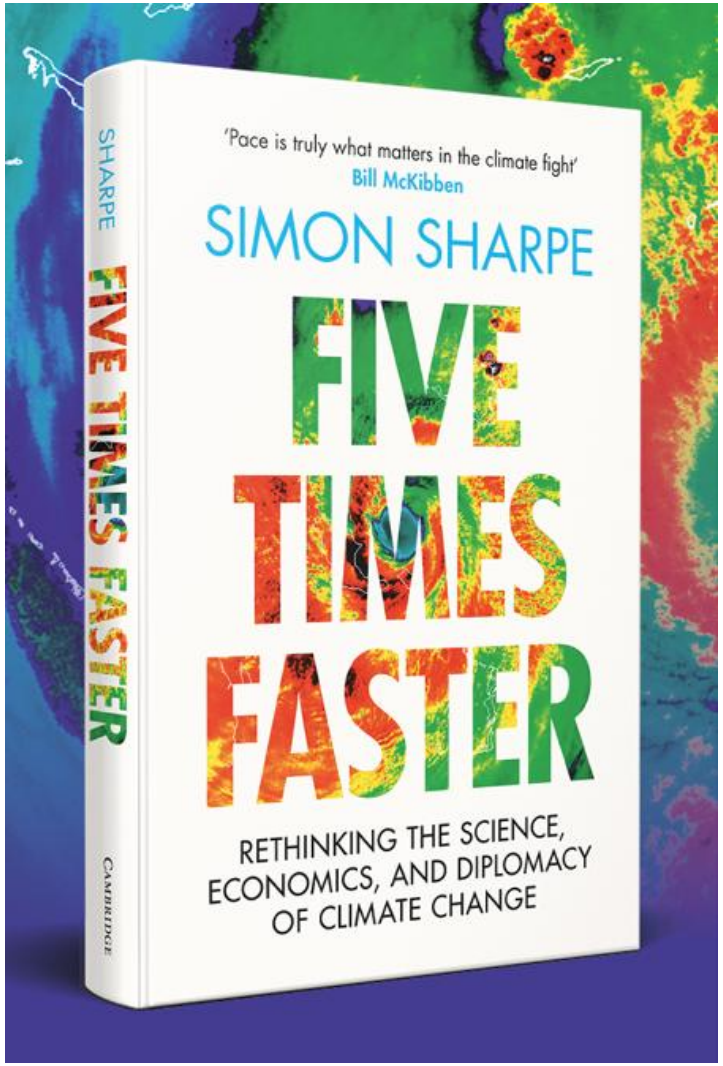


Data from WorldSteel

Thank you! More info available at…

scurveeconomics.org

s-curve economics



fivetimesfaster.org