Environmental and Climate Economics

Choosing the Right Climate Policy Mix

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Emissions and ambitions across the world

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- Intensity-based Emissions Trading System.
  - For now, covers the power sector, with mostly free allowances, and low price ($10/t$CO_2$).

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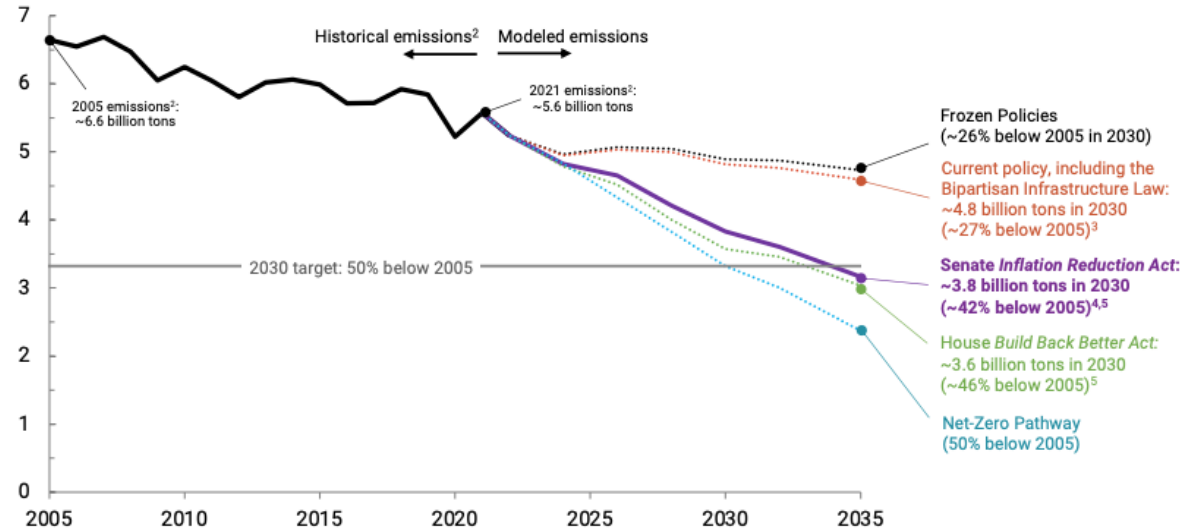

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- Scales up and extends tax credits created in 2005 until power mix is 75% low-carbon.

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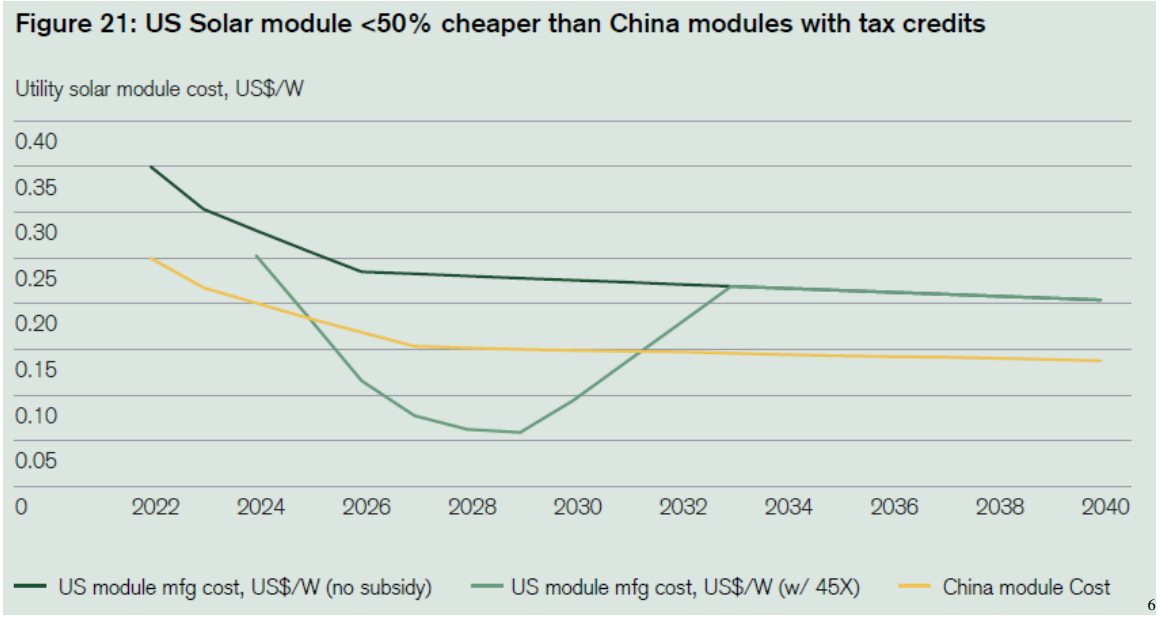
Figure 21: US Solar module <50% cheaper than China modules with tax credits
Utility solar module cost, US$/W
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
US module mfg cost, US$/W (no subsidy)
US module mfg cost, US$/W (w/ 45X)
China module Cost

Climate policy of the United States

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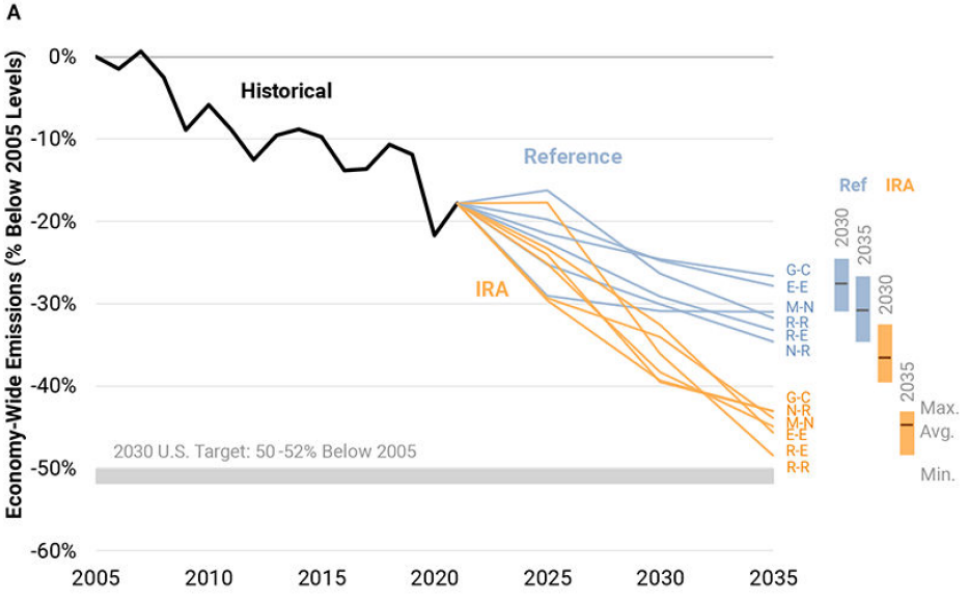

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- Paid by drug price negotiations, enhanced tax collection, higher corporate tax, tax on stock buybacks.

Climate policy of the United States

Figure 10. Average Household Benefits and Costs (2030)

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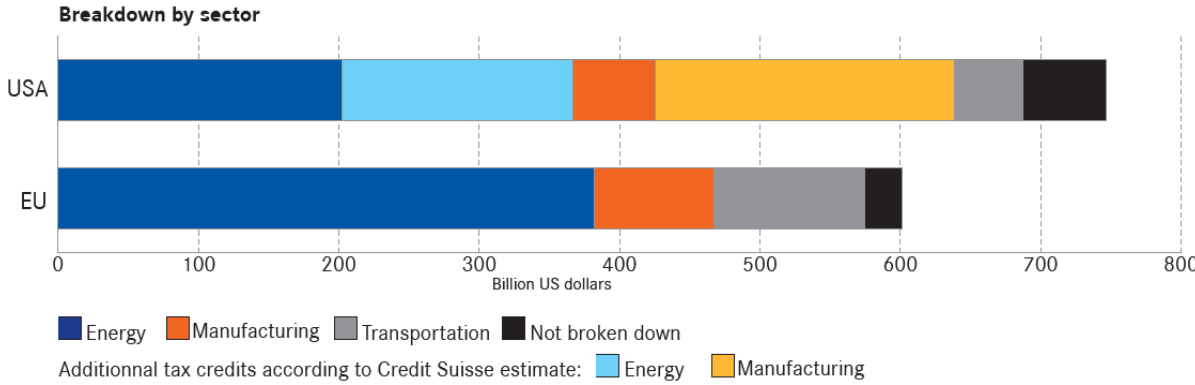
EU investments are comparable to U.S. ones: $\approx 0.3\%$ of GDP for 10 years.



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A Conservative + Far right alliance risks overturning it $\Rightarrow$ upcoming EU elections are key.

Climate policy mix in China, U.S., EU.

	China	U.S.	EU
Carbon pricing	✓		✓
Subsidies to households	?	✓	✓
Subsidies to industry, investments	✓	✓	✓
Credit controls/incentives	✓	≈	≈
Production/shutdown decisions	✓	≈	≈
Renewable energy auctions	✓	✓	✓
CO_2 car emissions standards		✓	✓
Other norms or standards	✓	?	✓
Bans	?		≈
Strong policy on food/agriculture	?		

Climate policy in theory

Rationale and limitations of carbon pricing

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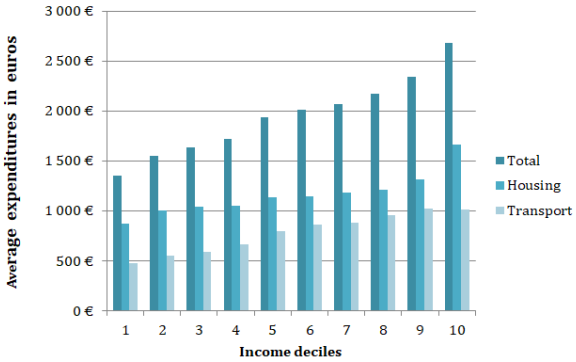
Figure 1: Households' annual expenditures in energy per c.u. (left) and as a share of their disposable income (right) in 2016, by income decile



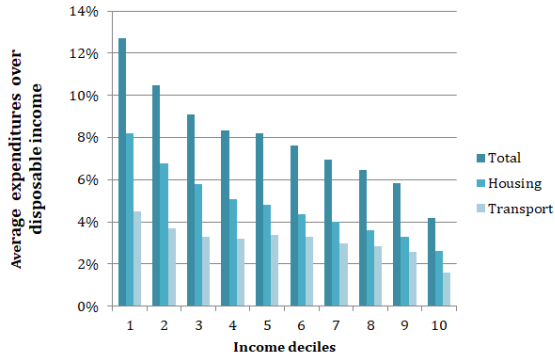
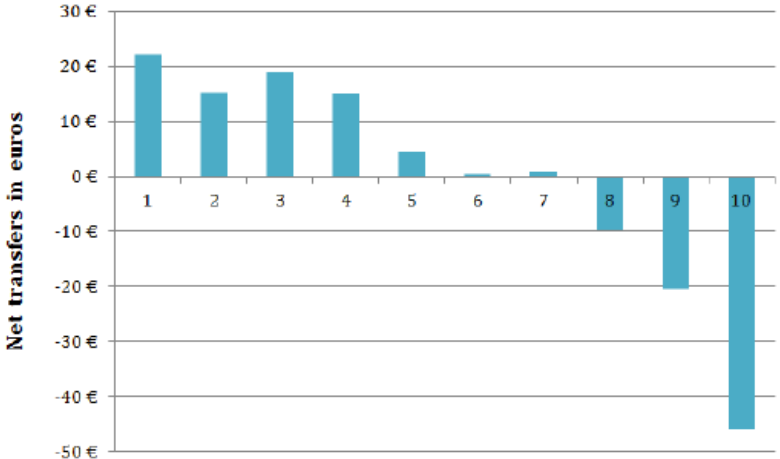


Figure 5: Average net transfers per c.u. after flat-recycling, by income decile



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$\Rightarrow$ But rebating carbon pricing revenues equally makes it progressive.

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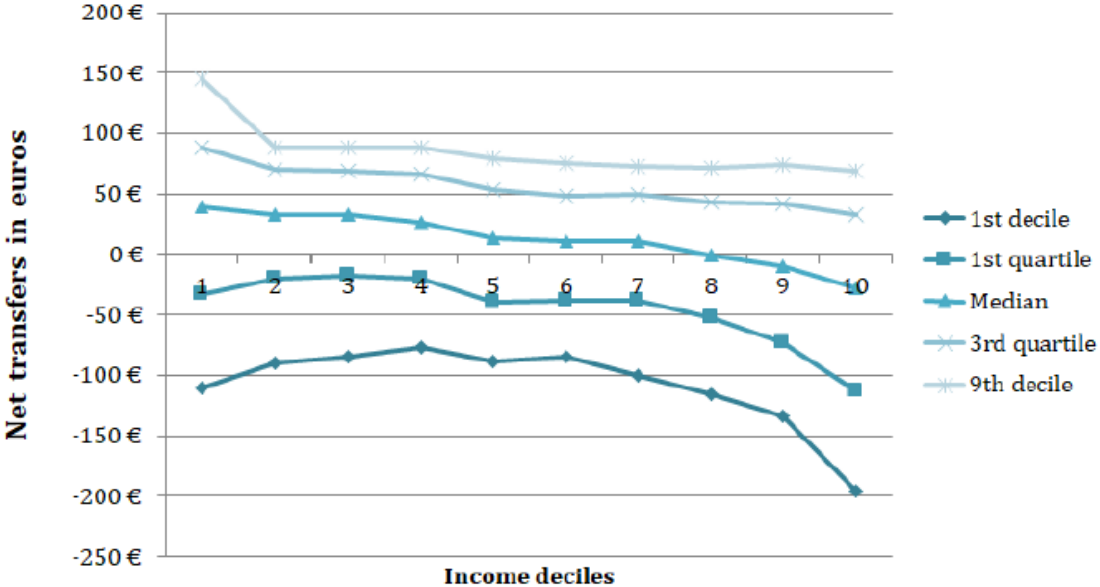

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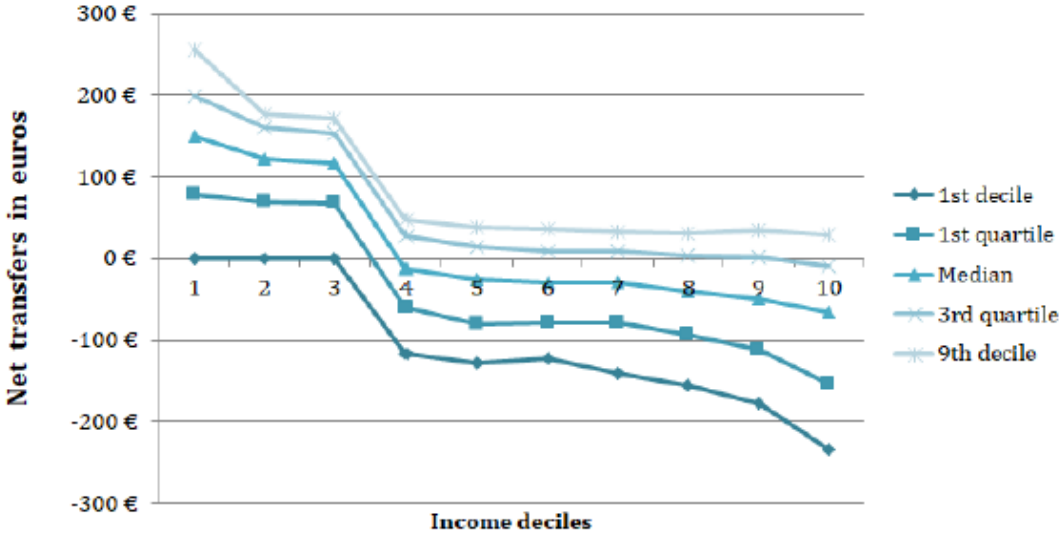

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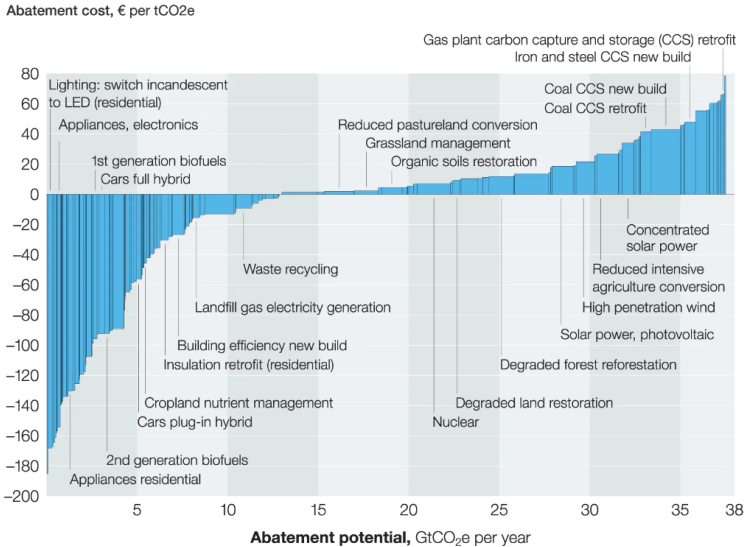
Marginal Abatement Cost Curve (McKinsey, 2017).



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At the optimum, the marginal benefit of emissions equals the Social Cost of Carbon (SCC).

In many models, the SCC is proportional to GDP. In the simplest/above case, with logarithmic utility and constant population: $\mathrm{SCC_t} = d \cdot Y_t / \rho$ where $\rho > 0$ is how much we discount future generations (Golosov et al., 2014).

Cost-efficiency: first set the climate goal, then find the least cost carbon price trajectory satisfying the goal.

Determining the optimal carbon price

Two approaches to set the value of the carbon price:

Cost-benefit analysis: intertemporal welfare maximization, e.g. utilitarianism: $\max \sum_t \frac{1}{(1+\rho)^t} u\left(C_t\right)$. It uses an Integrated Assessment Model, based on four elements:

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Setting a carbon budget, the carbon price grows at the rate of interest r, as the (present) value of an abatement is the same if it occurs now or later.

Pros and Cons of pricing

Pros	Cons
Cost-effective and efficient, as long as all emissions are priced (ensuring no leakage).	

Pros and Cons of pricing

A carbon tax would be less costly than the IRA.

	IRA	Carbon Tax
Generation Share (Change in pp from 2021 to 2035)		
Coal	-14	-18
Natural Gas	-21	-5
Coal CCS	+3	+0
Wind & Solar	+28	+19
Other	+7	+4
CO2 (% Drop from 2005)	68%	68%
Abatement Cost ($/t-CO2)	$83	$15

Pros and Cons of pricing

Introducing a carbon price and repealing IRA's most costly provisions (7-FeeIRAp) would achieve U.S. climate targets.

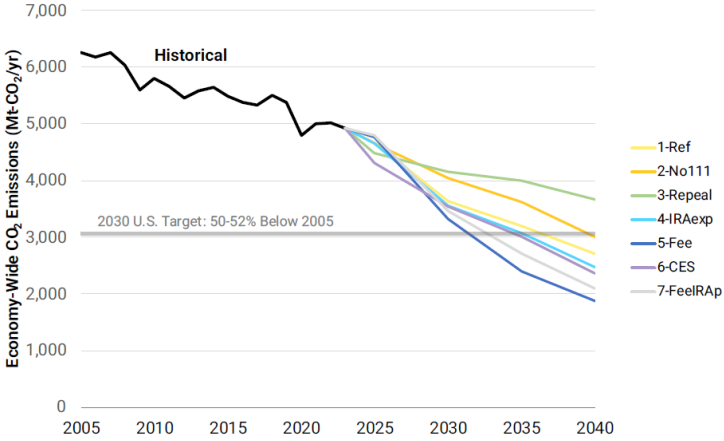

Figure 4: Historical and projected economy-wide CO_2 emissions by scenario. Emissions include gross energy and industrial process CO_2 emissions but do not include negative emissions from the land sink or non-CO_2 GHG emissions. Historical emissions come from the U.S. Environmental

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Can be progressive.

Can reduce distortionary taxes (e.g. on labor income).

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Pros and Cons of subsidies

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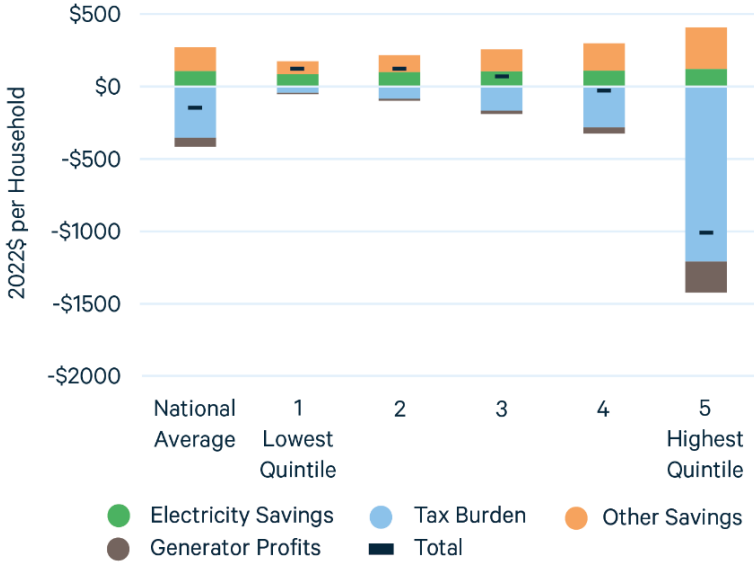
Pros and Cons of subsidies

Figure 5. The Distribution of Changes in Ratepayer and Taxpayer Costs



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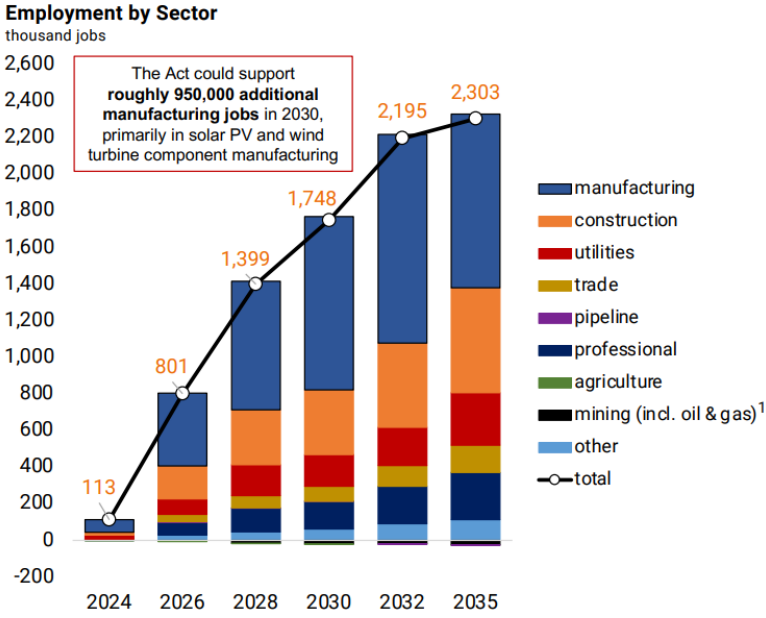

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Pros and Cons of central planning

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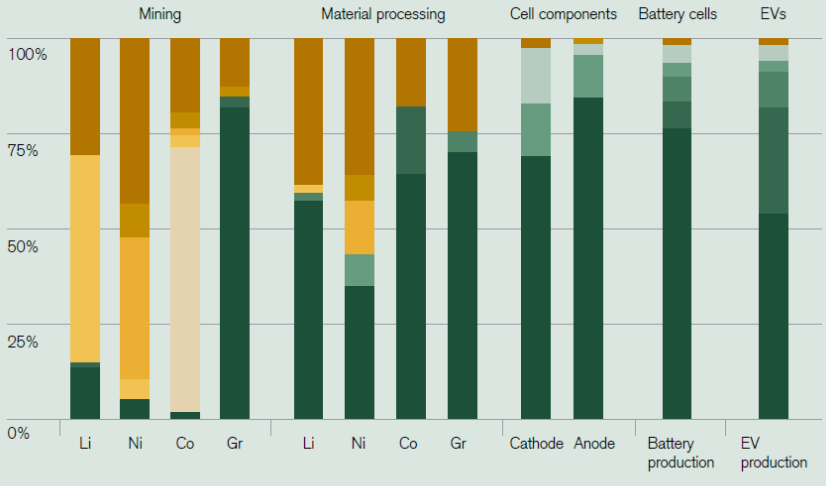
Figure 24: Geographical distribution of the global EV battery supply chain: China dominates cell and material components



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Optimal design ensuring: demand is always met, at lowest marginal cost, investments take place at the right scale and locations, on the long-run consumers should pay average prices while being exposed to short-run price signals (Fabra, 2022):

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  In CfDs, producers sell on the spot market and pay *reference price* − *strike price*.
  - Feed-in tariffs is the extreme case where reference price = spot market price.
  - We should set reference price = annual average market price for hydropower (storable).
  - Reference price = monthly average market price of same techno at same location for intermittent.
- Auctions to set the strike price of CfDs and for capacity of gas and storage.
- Regulations of the strike price of existing plants.

Optimal design of the electricity market

Optimal design ensuring: demand is always met, at lowest marginal cost, investments take place at the right scale and locations, on the long-run consumers should pay average prices while being exposed to short-run price signals (Fabra, 2022):

A carbon price to internalize the climate costs and incentivize energy savings.

- Revenues can either be redistributed for progressivity, or to firms to avoid horizontal inequities.
- Alternatively, a market for carbon intensity works well (and guarantees the intensity target).
- A Renewable Portfolio Standard is inferior as it does not distinguish coal vs. gas.

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Auctions to set the strike price of CfDs and for capacity of gas and storage.

Regulations of the strike price of existing plants.

For consumers, a rebate = monthly/yearly consumption × average market price - strike price.