Environmental and Climate Economics

Choosing the Right Climate Policy Mix

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Emissions and ambitions across the world

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Climate policy in practice

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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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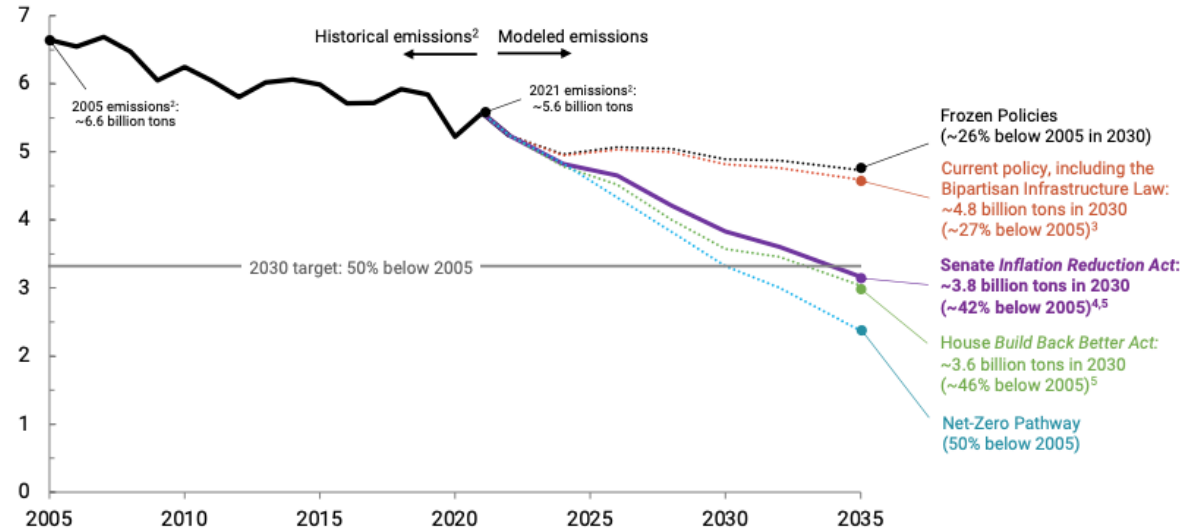

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- Subsidy rate 5 times lower if wage requirements are not met; bonus (up to 70% of costs) if project in low-income, energy community or sourced with U.S. materials.

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

Climate policy of the United States

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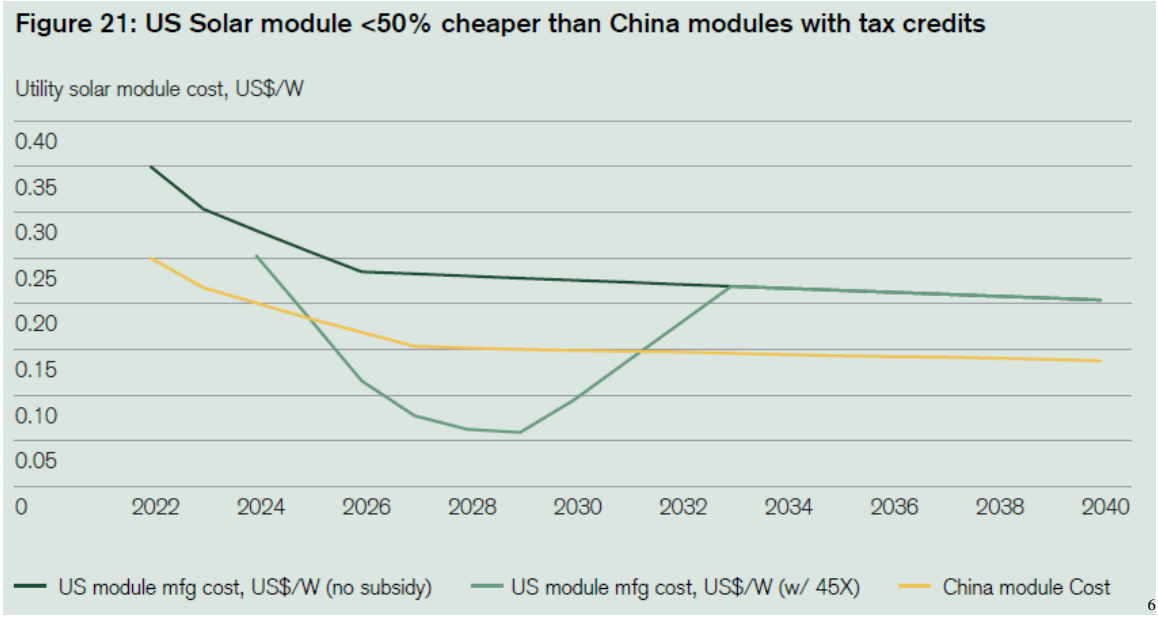
Figure 21: US Solar module <50% cheaper than China modules with tax credits
Utility solar module cost, US$/W
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
US module mfg cost, US$/W (no subsidy)
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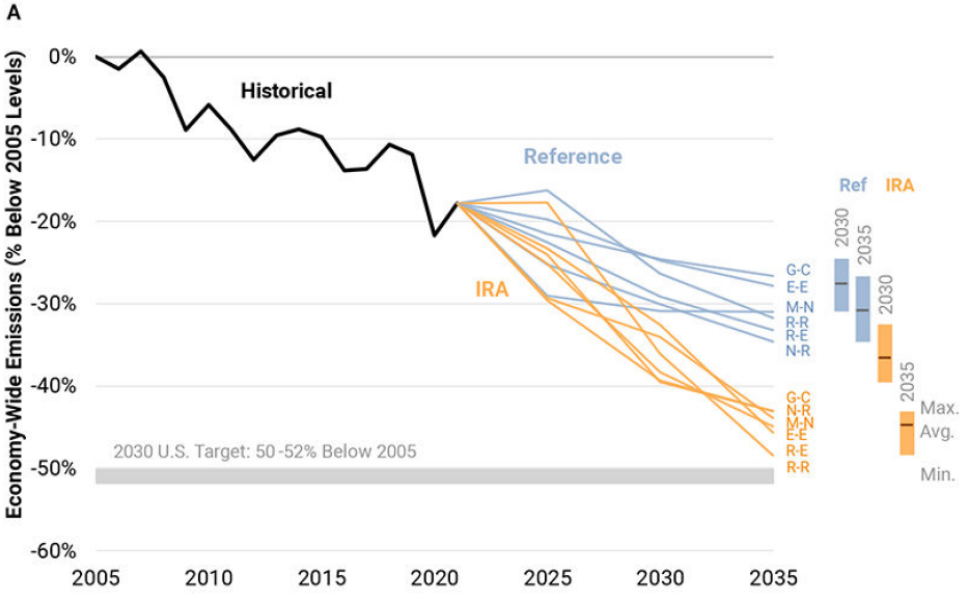

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- Paid by drug price negotiations, enhanced tax collection, higher corporate tax, tax on stock buybacks.

Figure 10. Average Household Benefits and Costs (2030)

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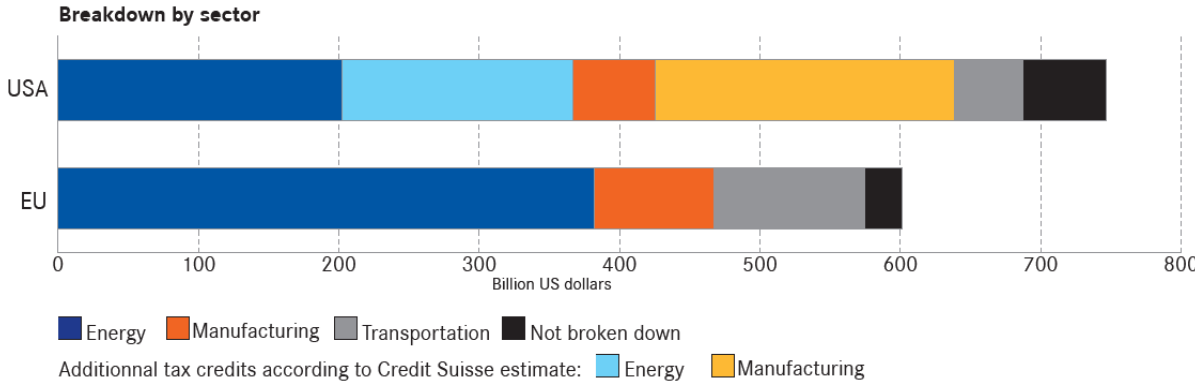
EU investments are comparable to U.S. ones: $\approx 0.3\%$ of GDP for 10 years.



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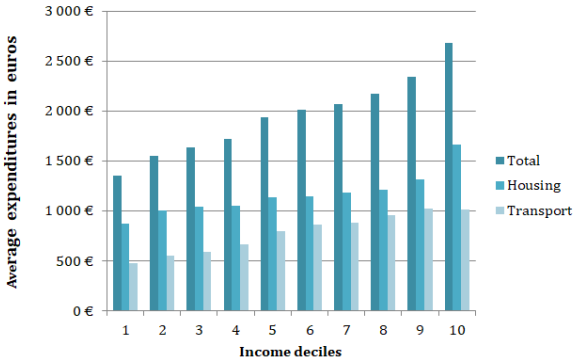
Figure 1: Households' annual expenditures in energy per c.u. (left) and as a share of their disposable income (right) in 2016, by income decile



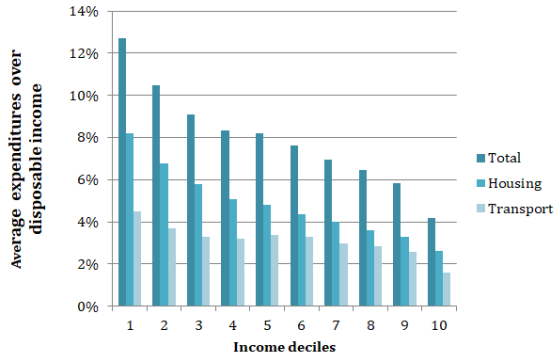
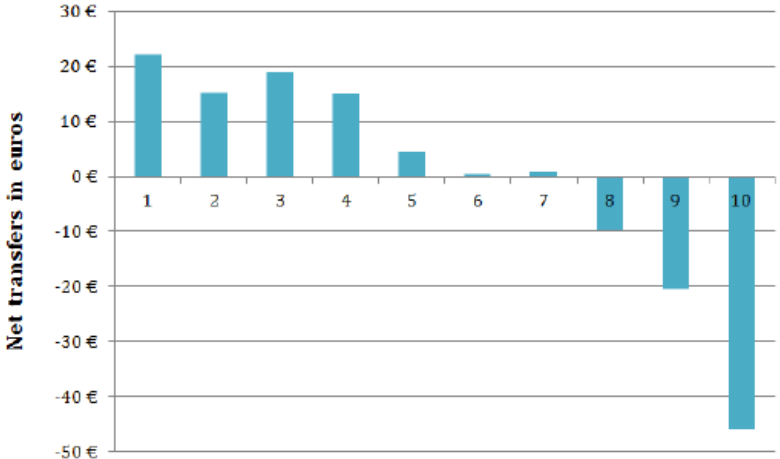


Figure 5: Average net transfers per c.u. after flat-recycling, by income decile



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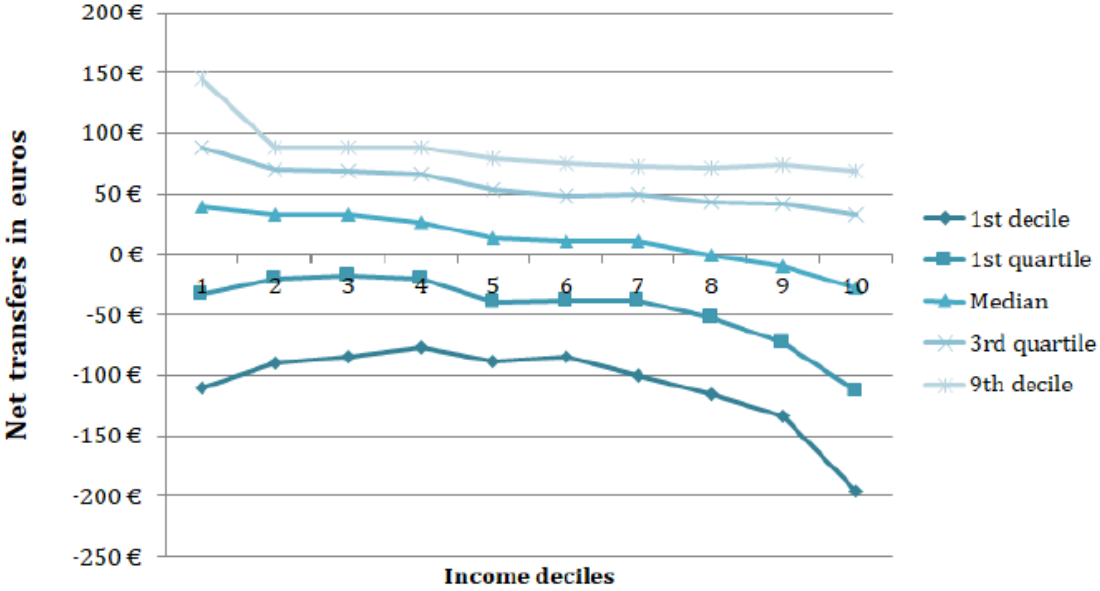

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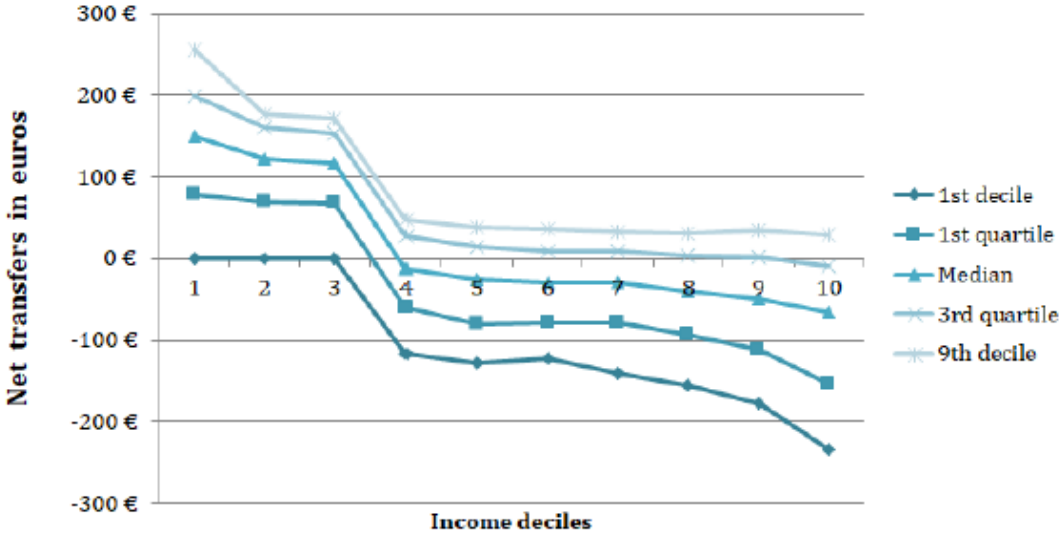

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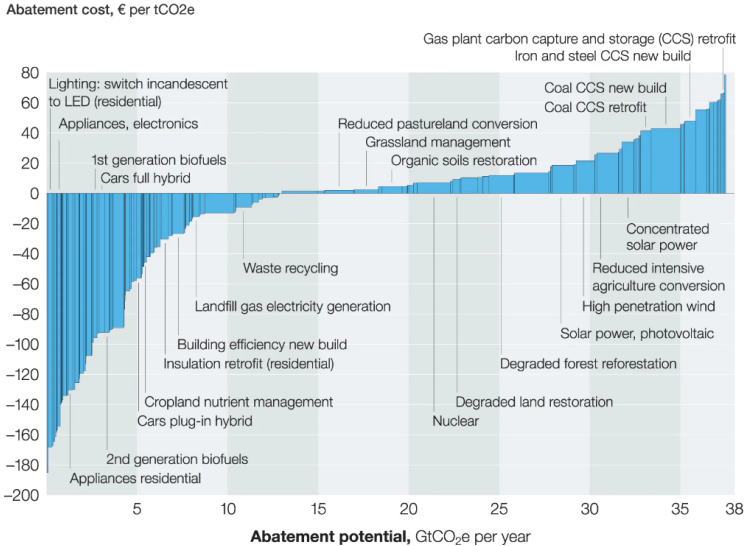
Determining the optimal carbon price

Marginal Abatement Cost Curve (McKinsey, 2017).



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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).

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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4. The Marginal Abatement Cost Curve (MACC): the price needed to achieve a given abatement target.

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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.

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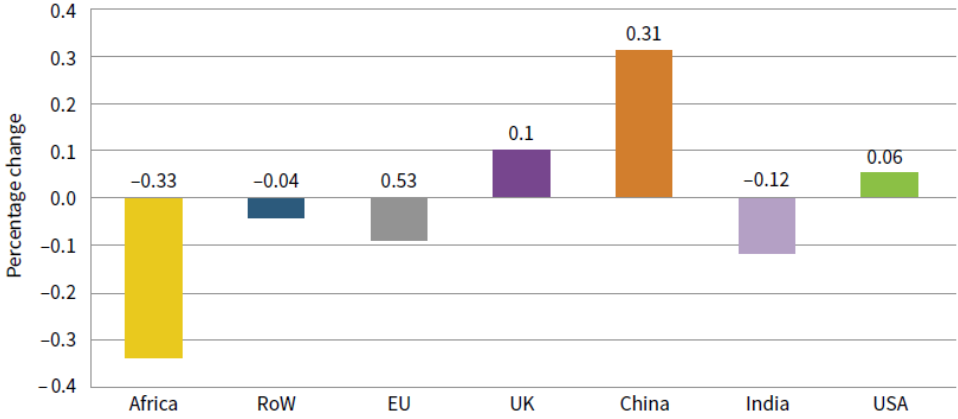
EU ETS revenue: €40G/year. CBAM revenue: €8G?
Losses for exporters: €30G? Highly uncertain, depends on decarbonization of exporters.
Largest losers: Mozambique, Russia, Ukraine, Africa. Some win as their exports are not as carbon-intensive.

Figure 9: Scenario 4: Impact of the CBAM on GDP, by economy (% change)



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- EU decarbonization (and its prevention of carbon leakage) benefits the whole world.
- What should be criticized instead is the lack of EU/HICs transfers to the Global South.

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.

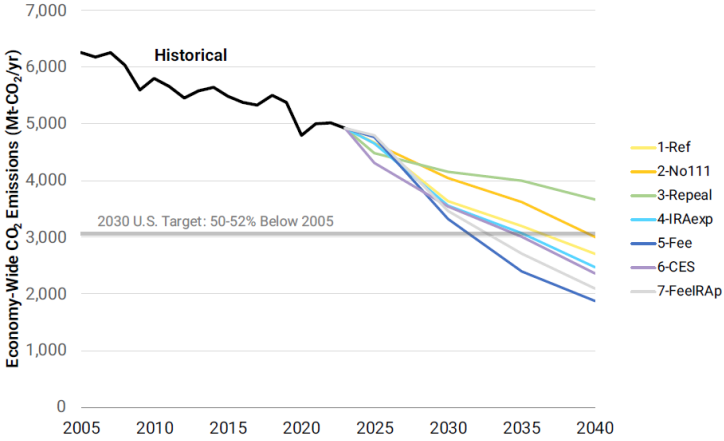

Figure 4: Historical and projected economy-wide CO_2 emissions by scenario. Emissions include gross energy and industrial process CO_2 emissions but do not include negative emissions from the land sink or non-CO_2 GHG emissions. Historical emissions come from the U.S. Environmental

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Generate revenues.

Can be progressive.

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

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Predictable path for producers
$\Rightarrow$ appropriate investment planning.

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Pros and Cons of subsidies

Pros	Cons
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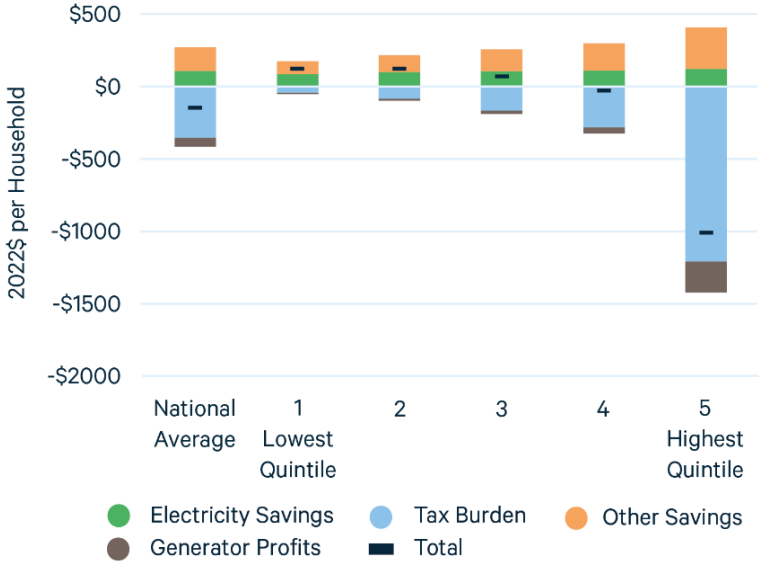
Pros and Cons of subsidies

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



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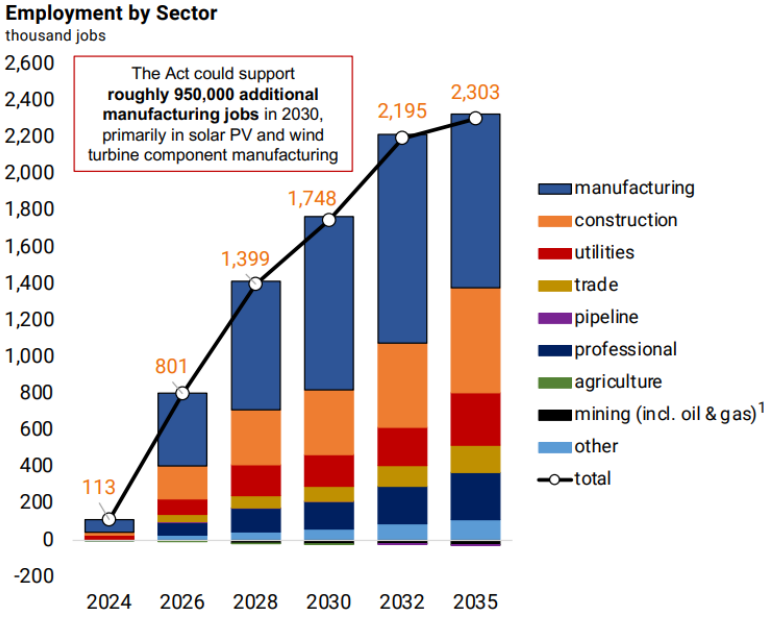

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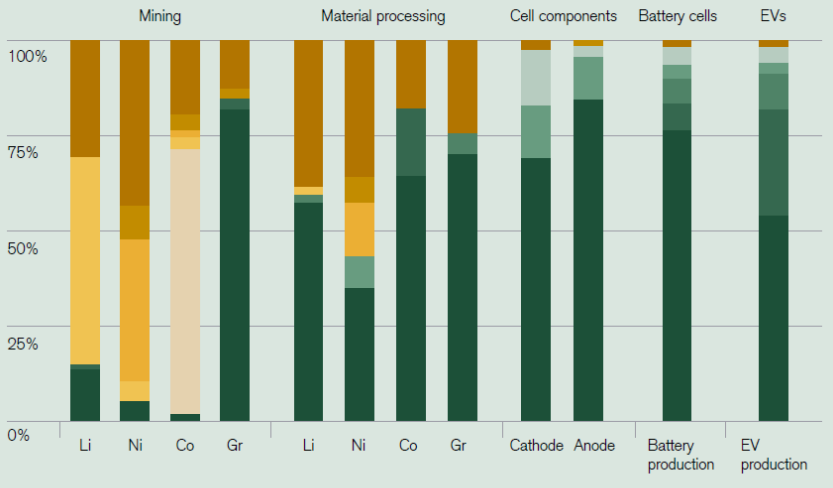
Pros and Cons of central planning

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



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Pros

Allows long-term optimization, predictability and in-depth coordination.

Avoids duplication of computations and decision-making.

Better if information can be standardized and centralized; and if investments need coordination as they strongly interact.

$\Rightarrow$ Adapted to large investment decisions in electricity and infrastructure.

Cons

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$\Rightarrow$ Inadapted to operational decisions (e.g. how much steel to produce today).

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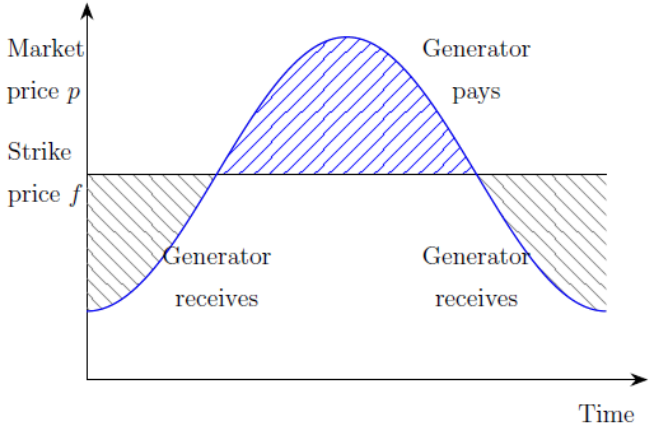

Figure 5: Contracts-for-Differences

Notes: Under a two-way Contract-for-Differences (CfD), generators sell their electricity in the market and then pay/receive the difference between a 'strike price' (f) and the 'reference price' (p). The shaded area represents total payments from the generator to the regulator or vice-versa.

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

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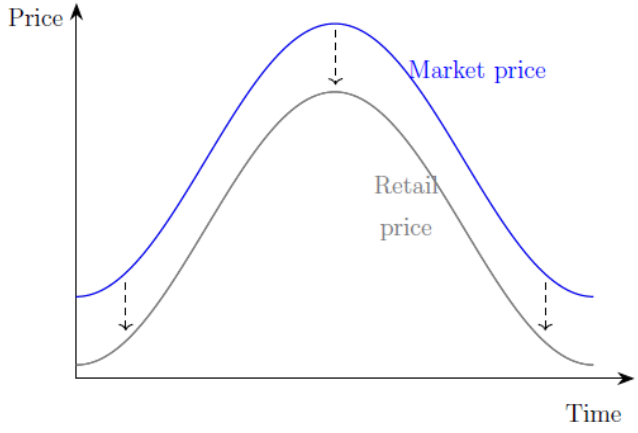

Figure 8: Passing on contract prices to final consumers

Notes: Once the CfD are settled, they provide a surplus/deficit distributed among consumers as a uniform rebate/charge over an extended horizon. This enables passing on the lower/higher prices at which renewable energy is bought without distorting the short-run price differences over time.

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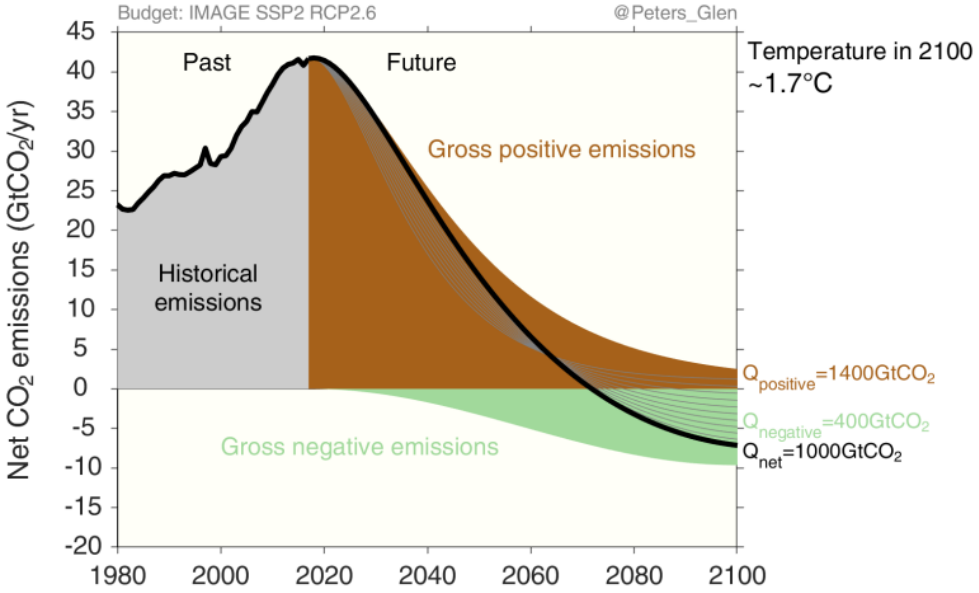
Key will be to develop inventories, governance, and local payments for environmental services.

Financing negative emissions



Financing negative emissions

To meet the (well below) 2°C target and offset residual emissions, negative emissions will be needed.

Financing negative emissions

Technology	Potentials	Costs	Storage duration
Afforestation/reforestation	0.5 - 10	0 - 50	Decades to centuries
BECCS	0.5 - 11	100 - 200	Millenia
Ocean alkalinization	1 - 100	14 - 500	Centuries
Enhanced weathering	2 - 4	50 - 200	Centuries
Biochar	0.3-6.6	30 - 120	Centuries
Modified patterns of agriculture	2 - 5	0 - 100	Years to decades
DACCS	5 - 40	100 - 300	Millennia

Table 1: Global potentials, in gigatonnes of CO_2 per year (estimate for 2050), and costs, in dollars of today's purchasing power per ton of CO_2, of relevant CDR technologies. Storage time for different

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Progressive taxes would make the rich pay for past emissions, e.g. a 2% global tax on wealth above \$5 M.