Using Carbon Pricing to Support Sustainable Development

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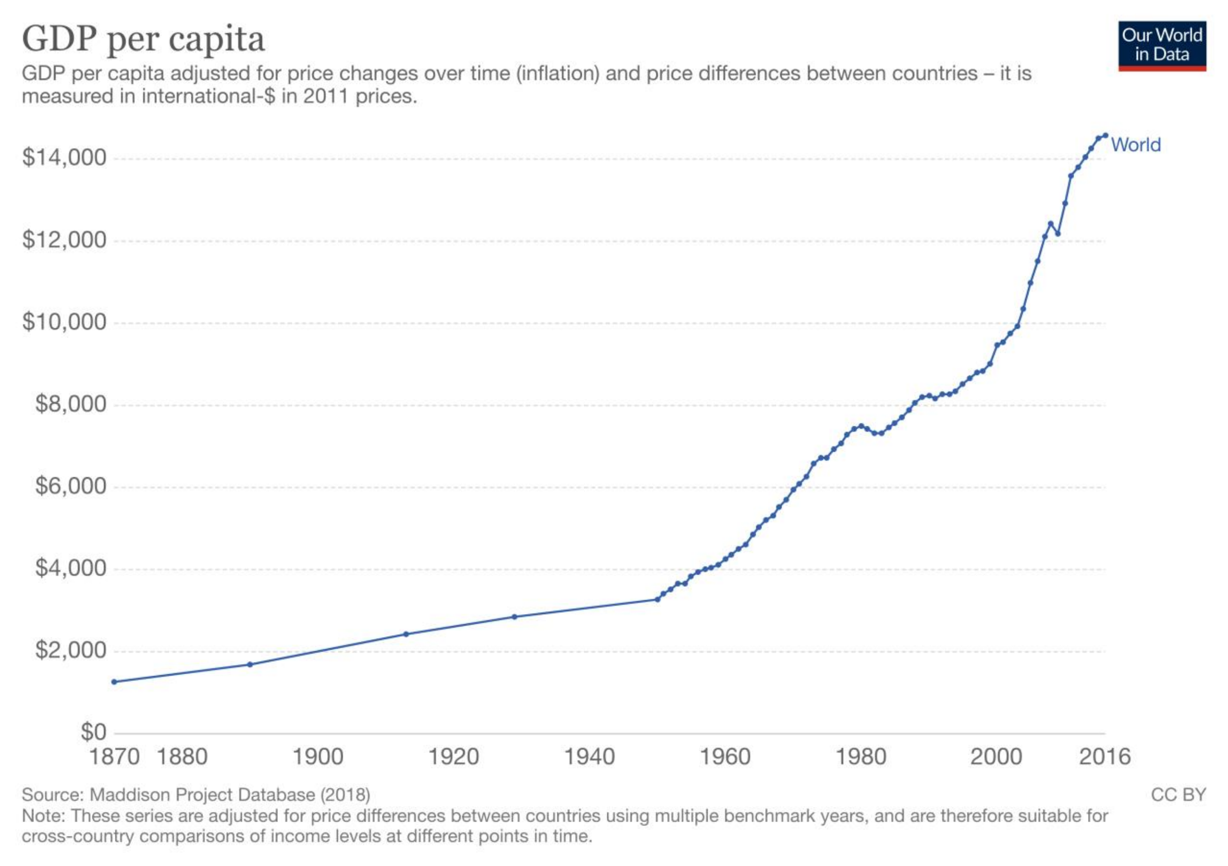
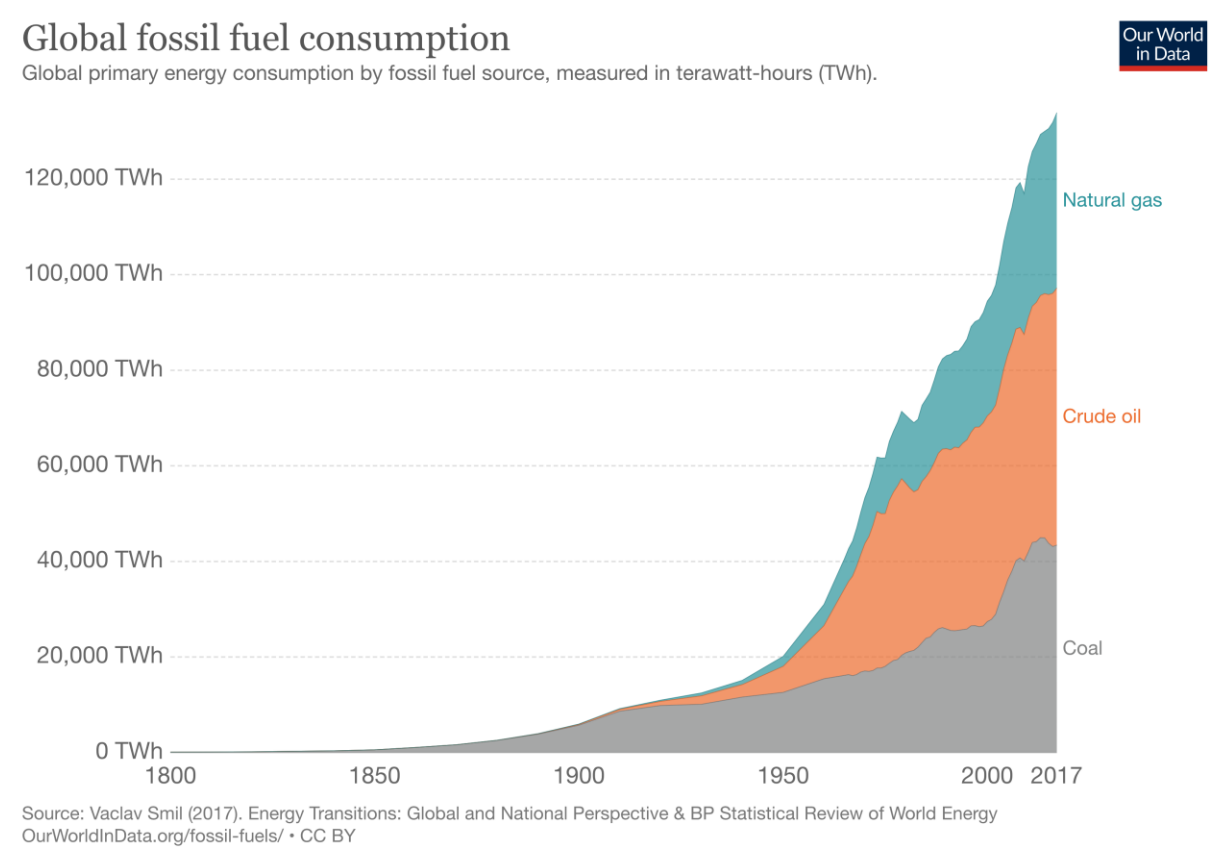
I. Carbon Pricing

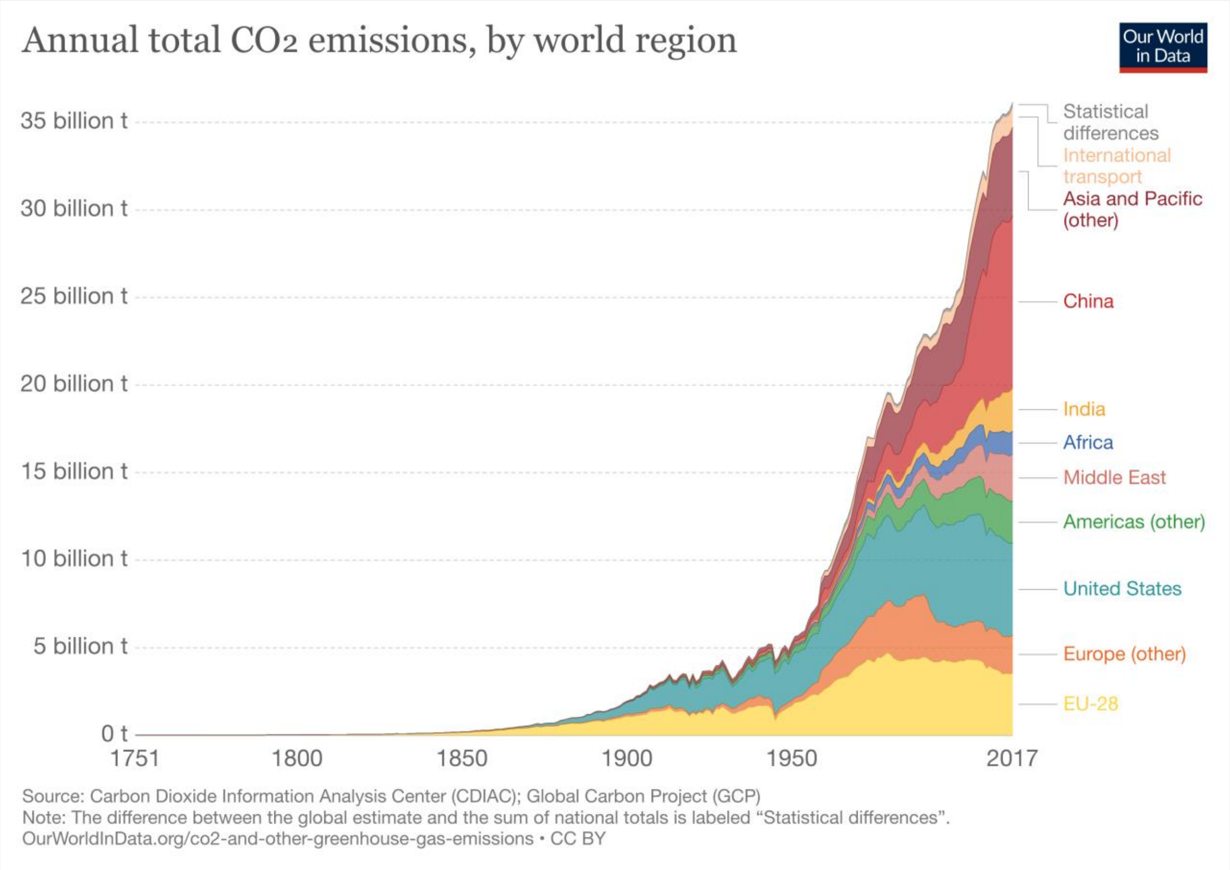
The Economics

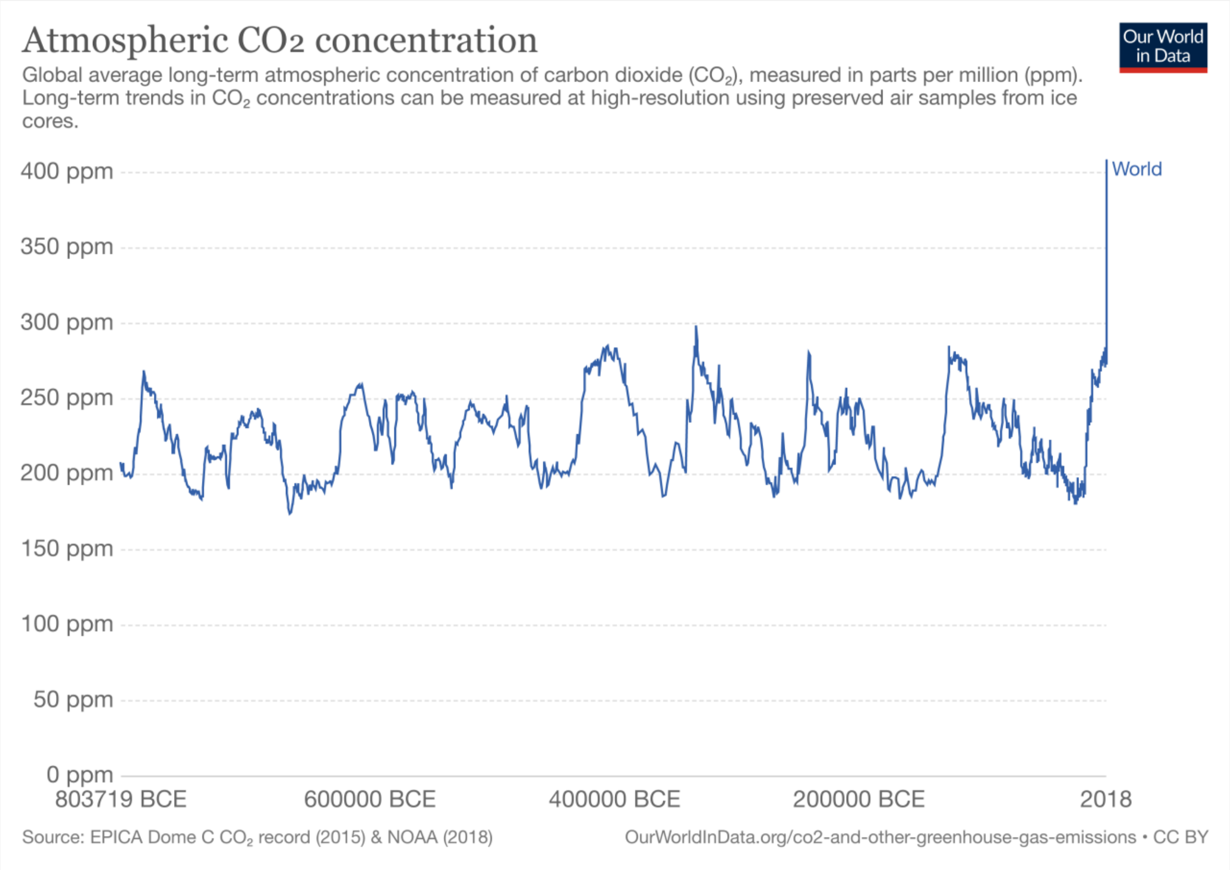
Since Industrial Revolution, fossil fuels ⟹ wealth



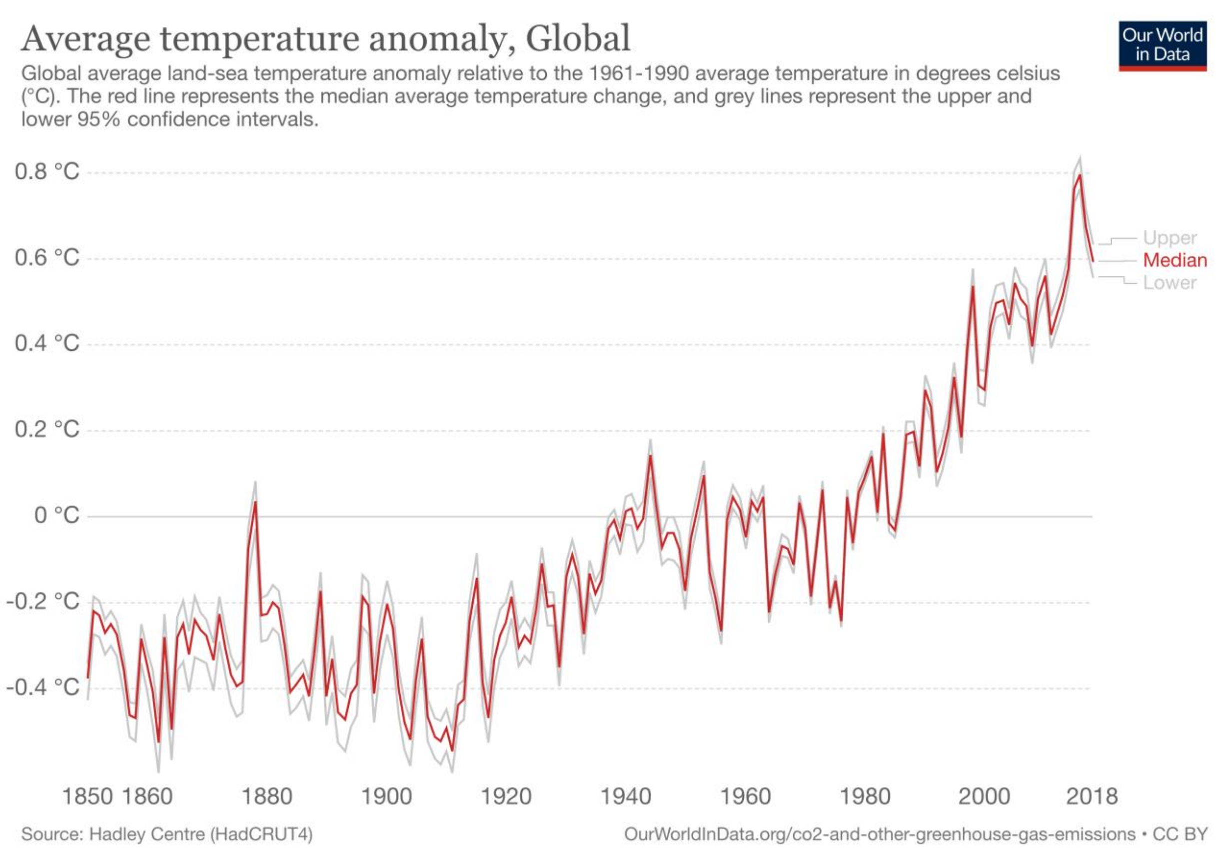


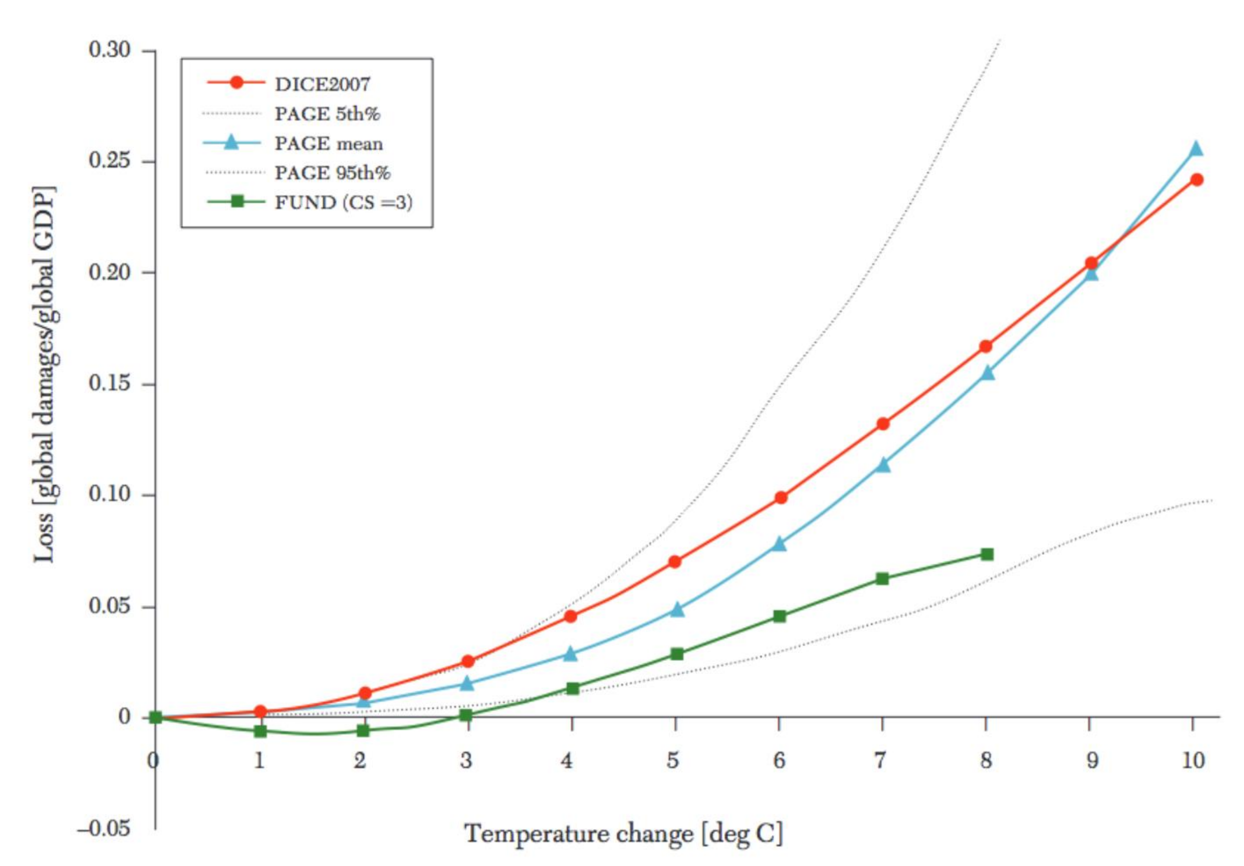
Overuse of fossil fuels $\Longrightarrow$ rise in atmospheric CO_2



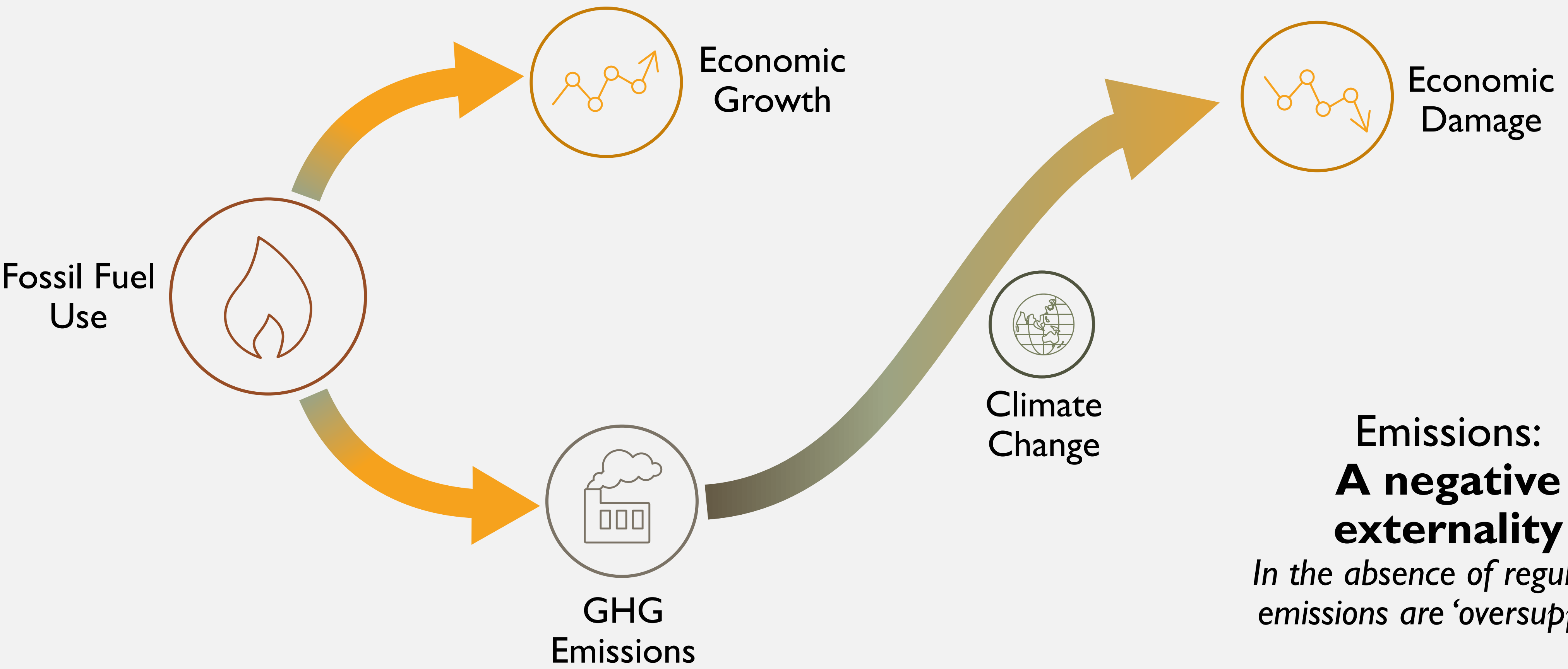


Which in raising global surface temperatures
⟹ economic damage



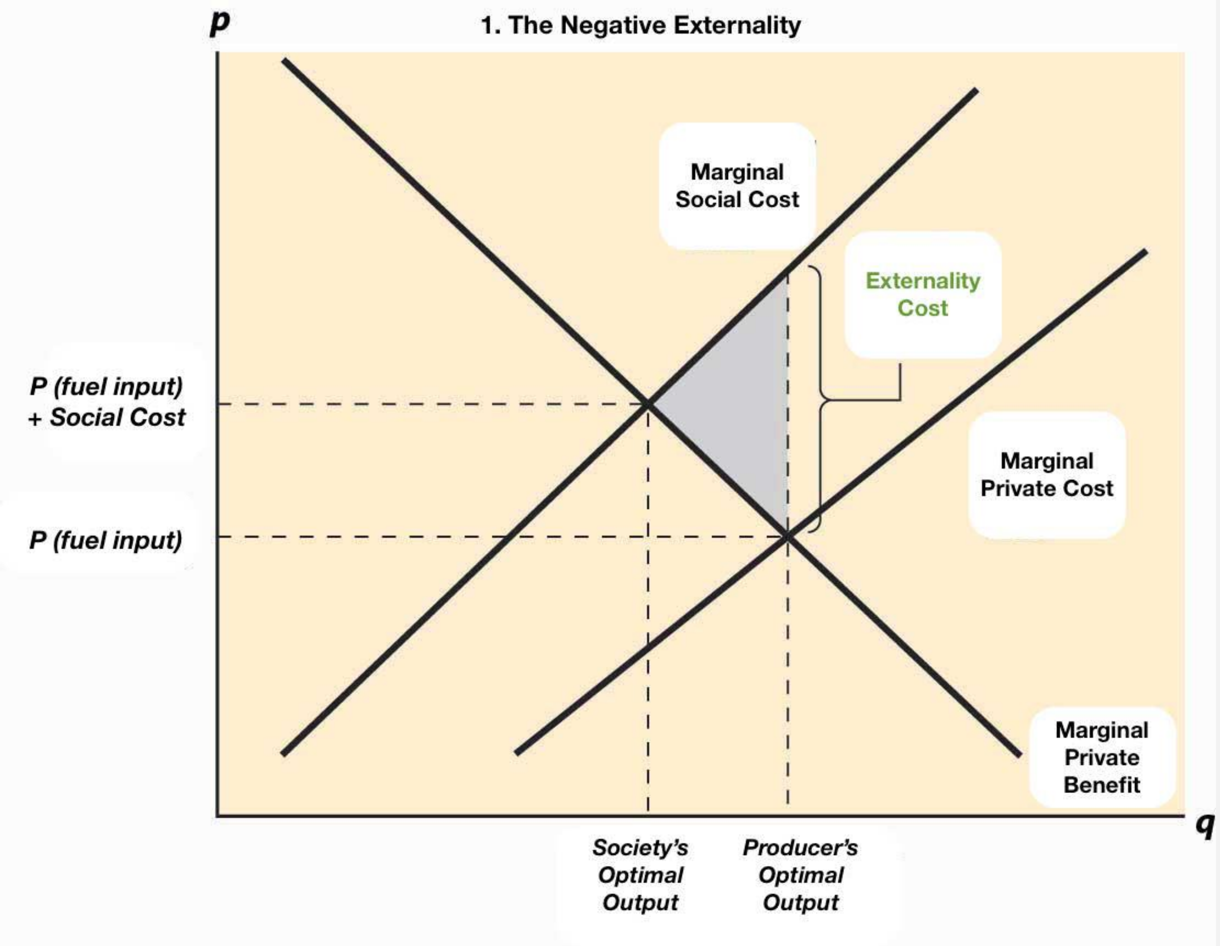


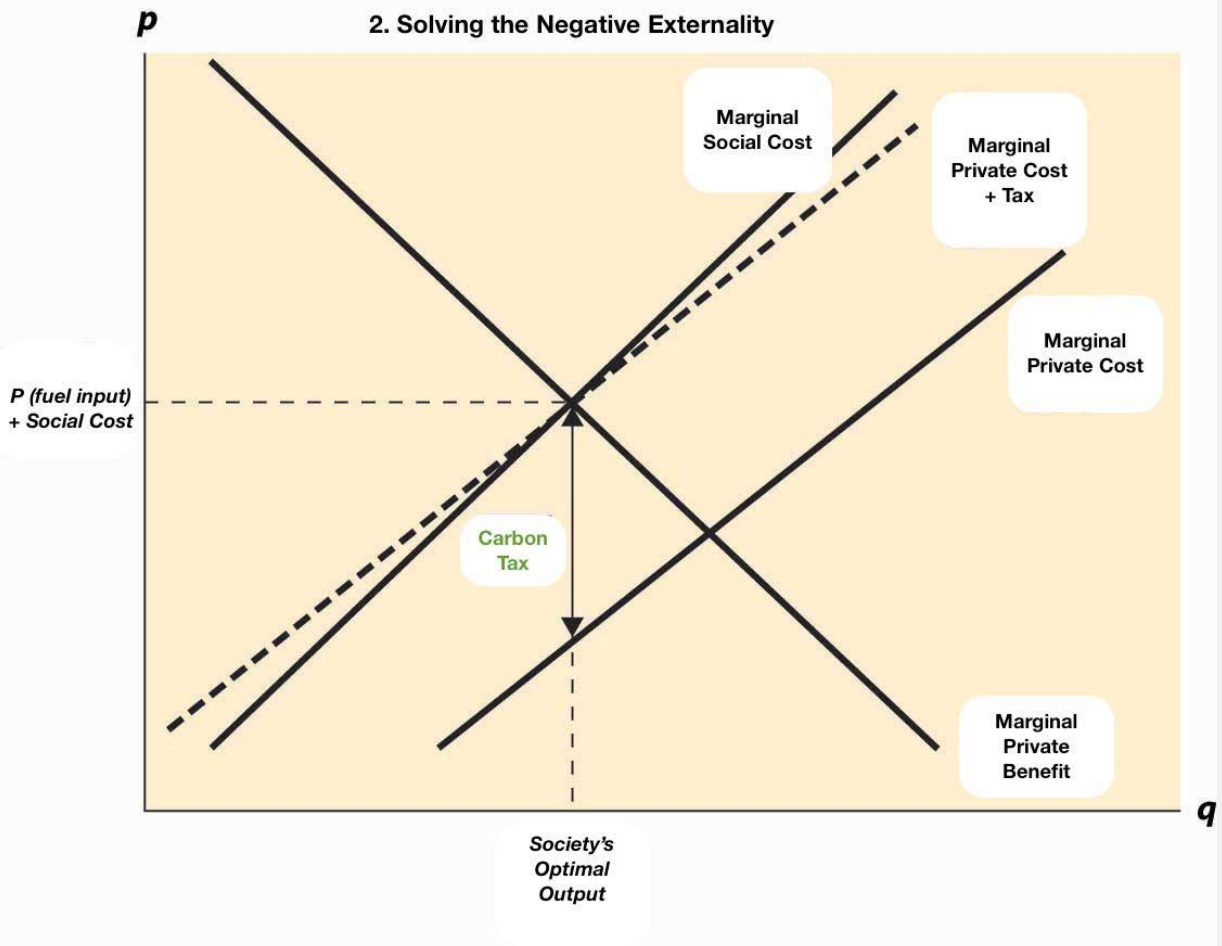
What does this tell us?



Emissions:
A negative externality
In the absence of regulation, emissions are ‘oversupplied’

Fundamental economic response: put a price on the negative externality

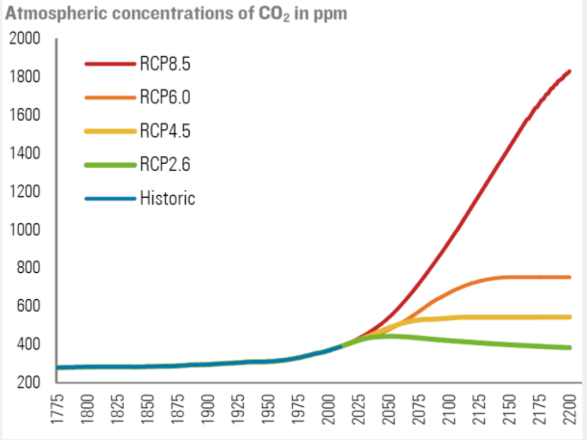




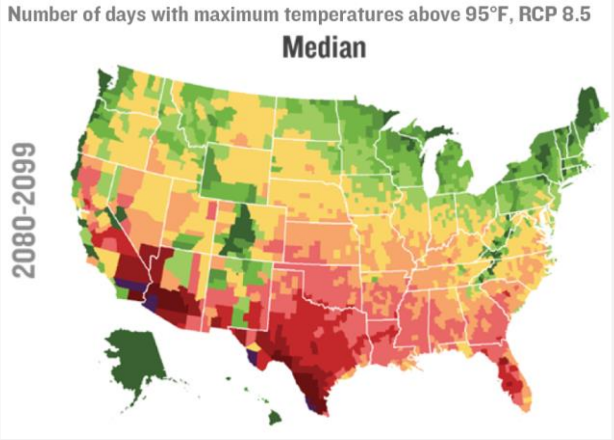
How do we calculate the price of carbon?

- The 'social cost of carbon' (SCC):
  1. The economic cost of an incremental ton of CO_2e – a per-unit tax
  2. SCC > 0
- Five steps to estimating SCC:

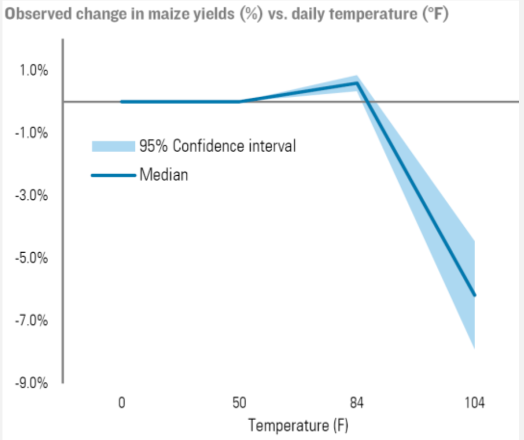
1. Emissions trajectories



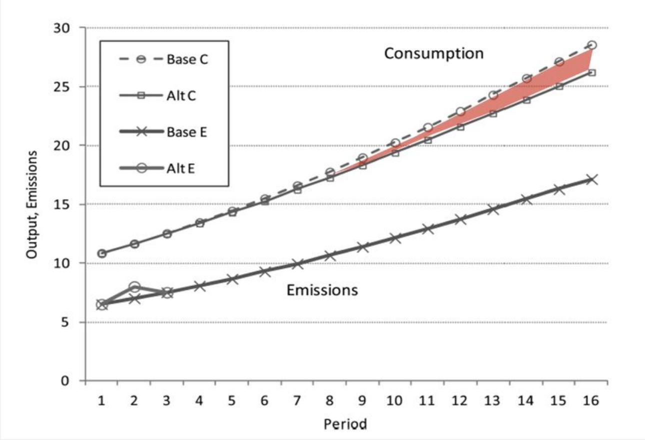
2. Model climate impacts



3. Project physical impacts

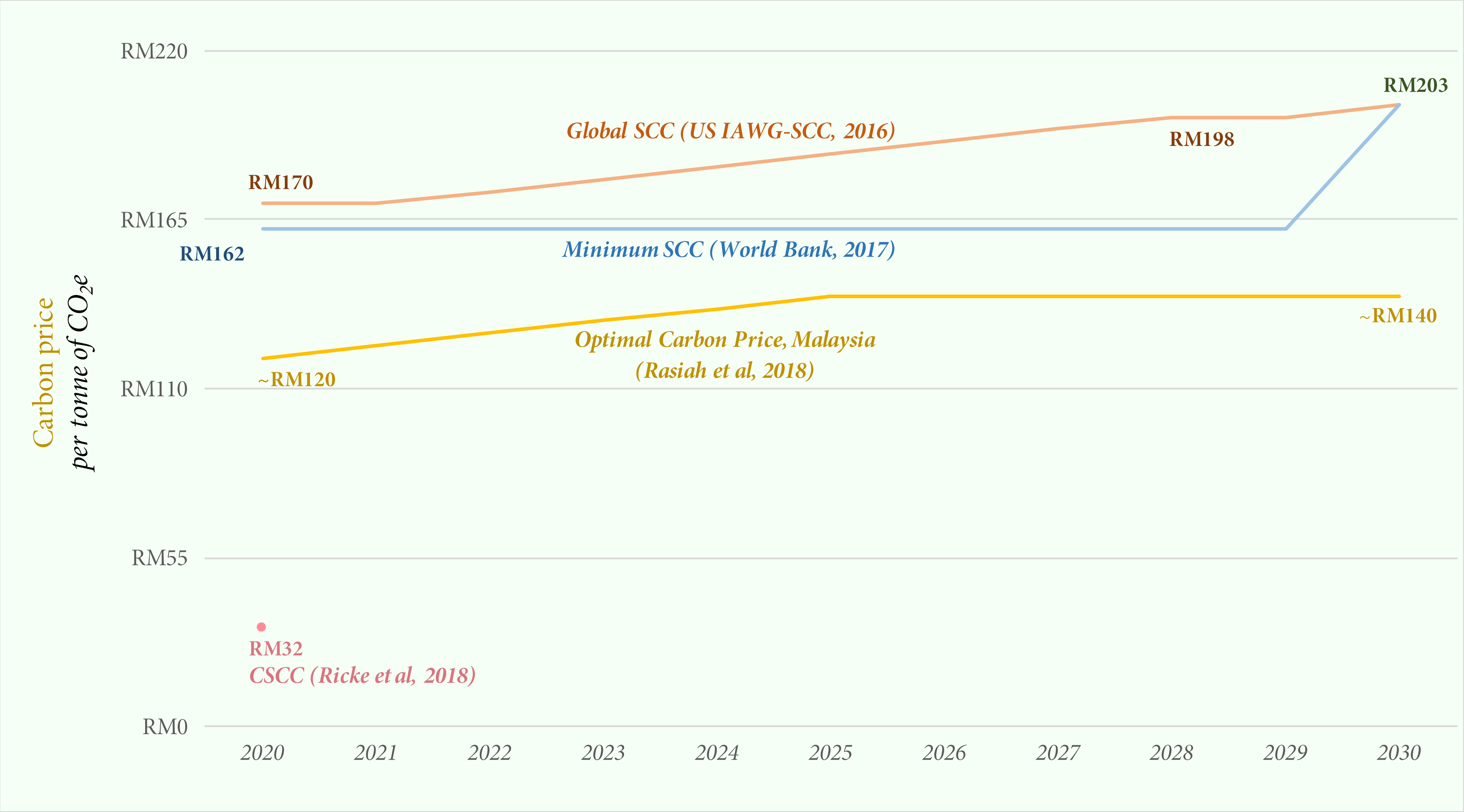


4. Convert to economic damages



5. Discounting future damages to reflect present values

What is the SCC?



How do we enforce a price on carbon?

01

Carbon Tax

Price-based measure

+ Control over price
+ Continuing price signal

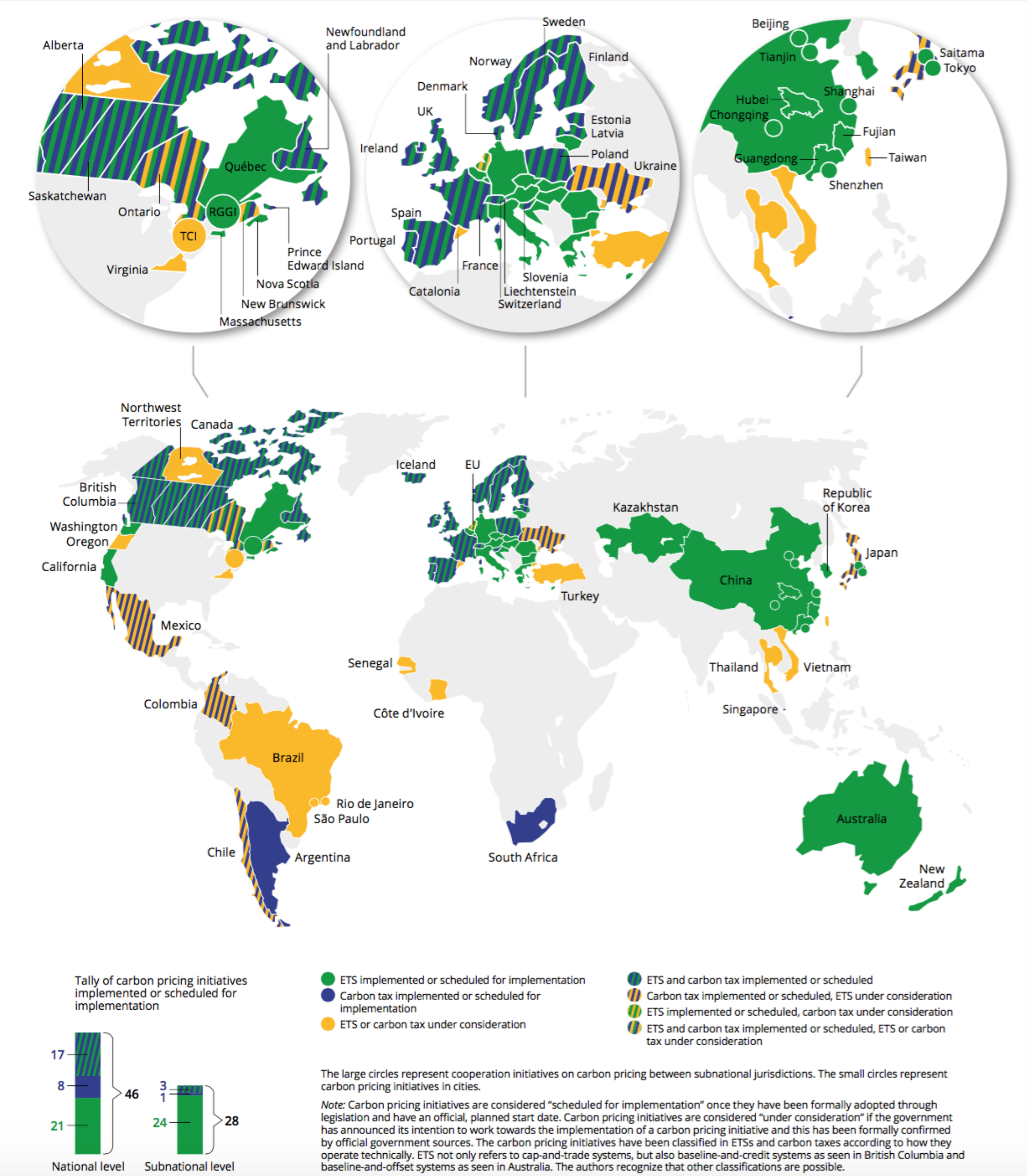
02

Emissions Trading Scheme

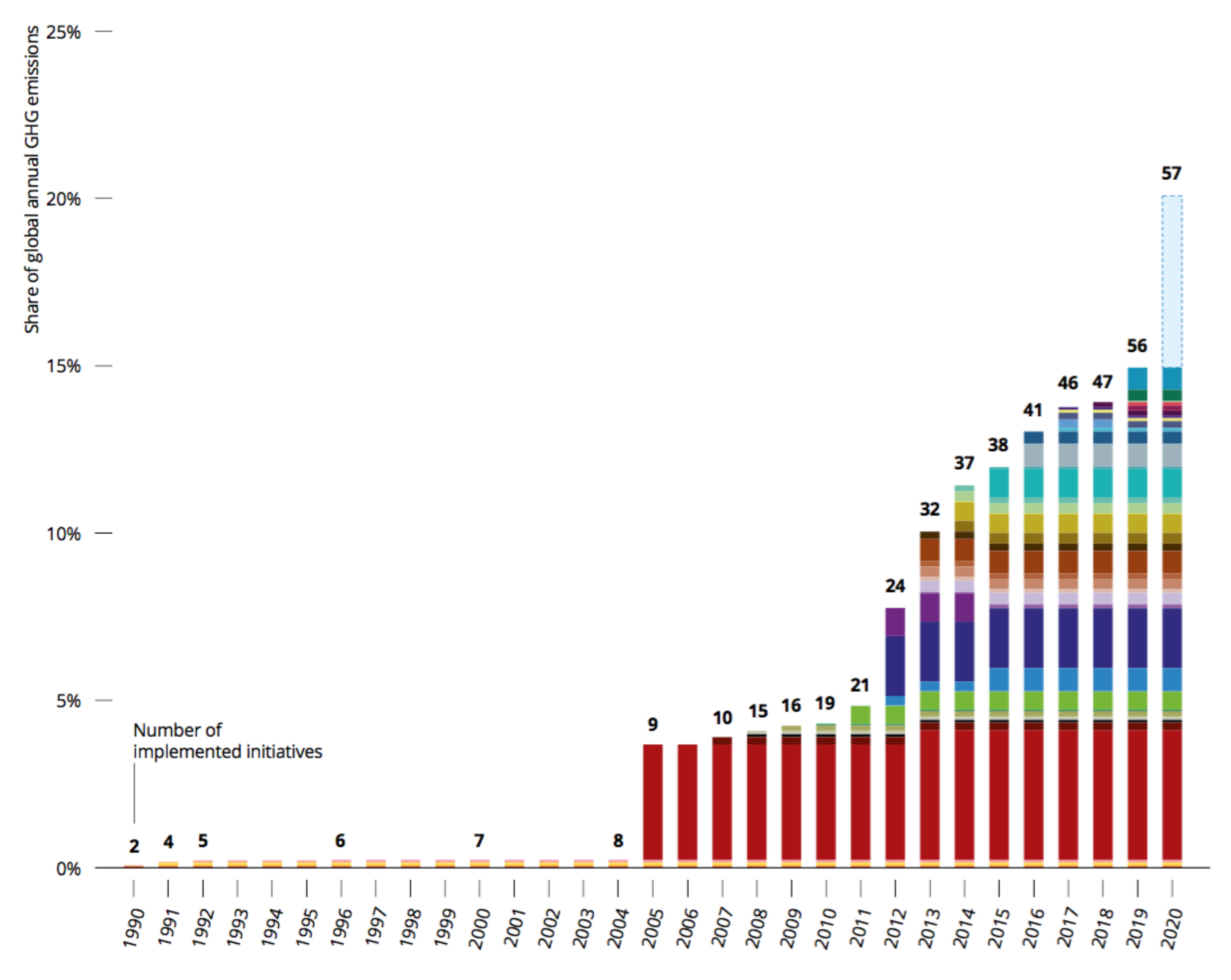
Quantity-based measure

– Inability to forecast long-term price
– Does not encourage emissions reductions beyond target

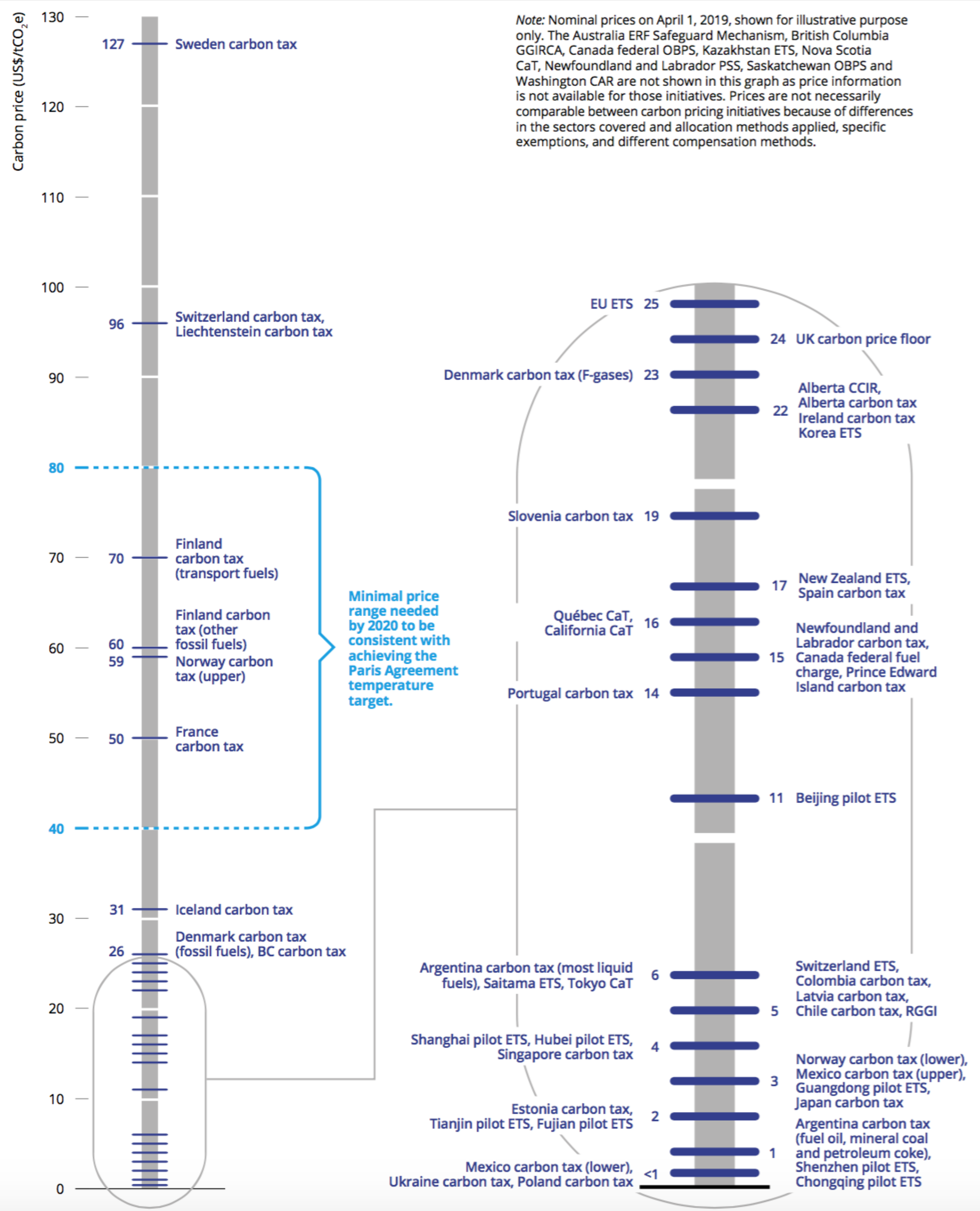
Carbon pricing around the world



57 initiatives already implemented



Price of carbon varies greatly across countries



Climate change: a global issue needs a global solution

- Whether a ton of CO_2 is emitted in Kuantan, Boston, Melbourne, or Timbuktu doesn't matter
  - Final destination: atmosphere
  - **Second market failure:** tragedy of the commons
    - Free access to public good: overuse
    - Example: atmosphere
- "Emissions arbitrage"
  - Where the country-level approach fails
- Long-run, first-best policy: uniform global price

II. Carbon Price-and-Rebate (CPR) in Malaysia

The Policy Proposal

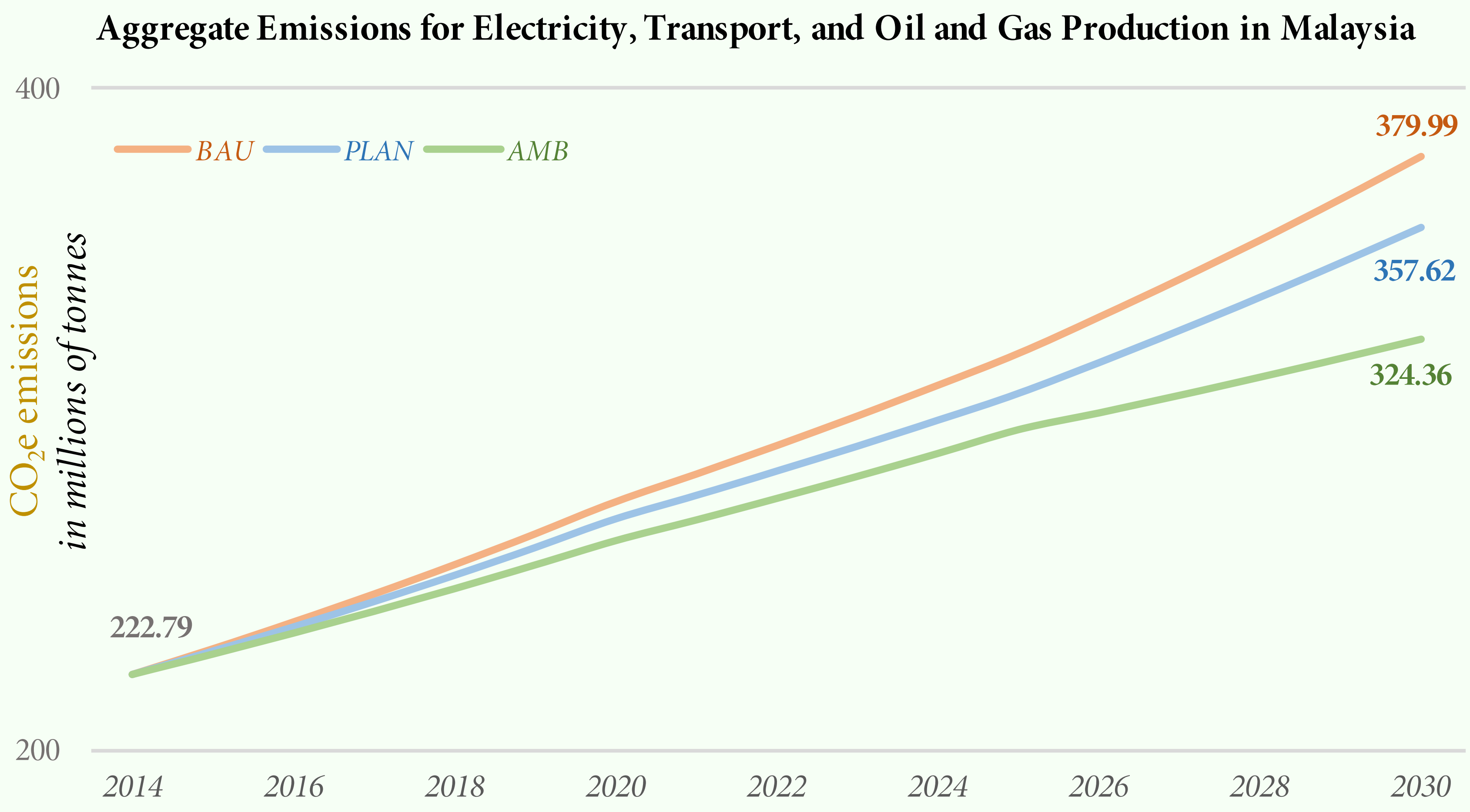
Scope encompasses three activities

Activity		Emissions, in *Mt*CO_2e	Share of Total GHG Emissions
Electricity and Heat Production		99.298	31.26%
Transport		64.385	20.27%
Oil and Gas Production Processes	*Petroleum Refining*	8.654	2.73%
	Manufacture of Solid Fuels and Other Energy Industries	25.535	8.03%
	Fugitive Emissions from Fuels	24.923	7.84%
Total		**222.794**	**70.14%**

1. Concurrently, encourage major players in other industries to adopt internal carbon pricing measures within CBA

2. Longer-term, include more subsectors within CPR scheme

By 2030, 46–71% rise in emissions



Source: MESTECC

On carbon pricing rates

01

End-goal: $P_{carbon} = SCC$

- First-best, long-run global price of carbon
- Future international agreement?

02

Until then…

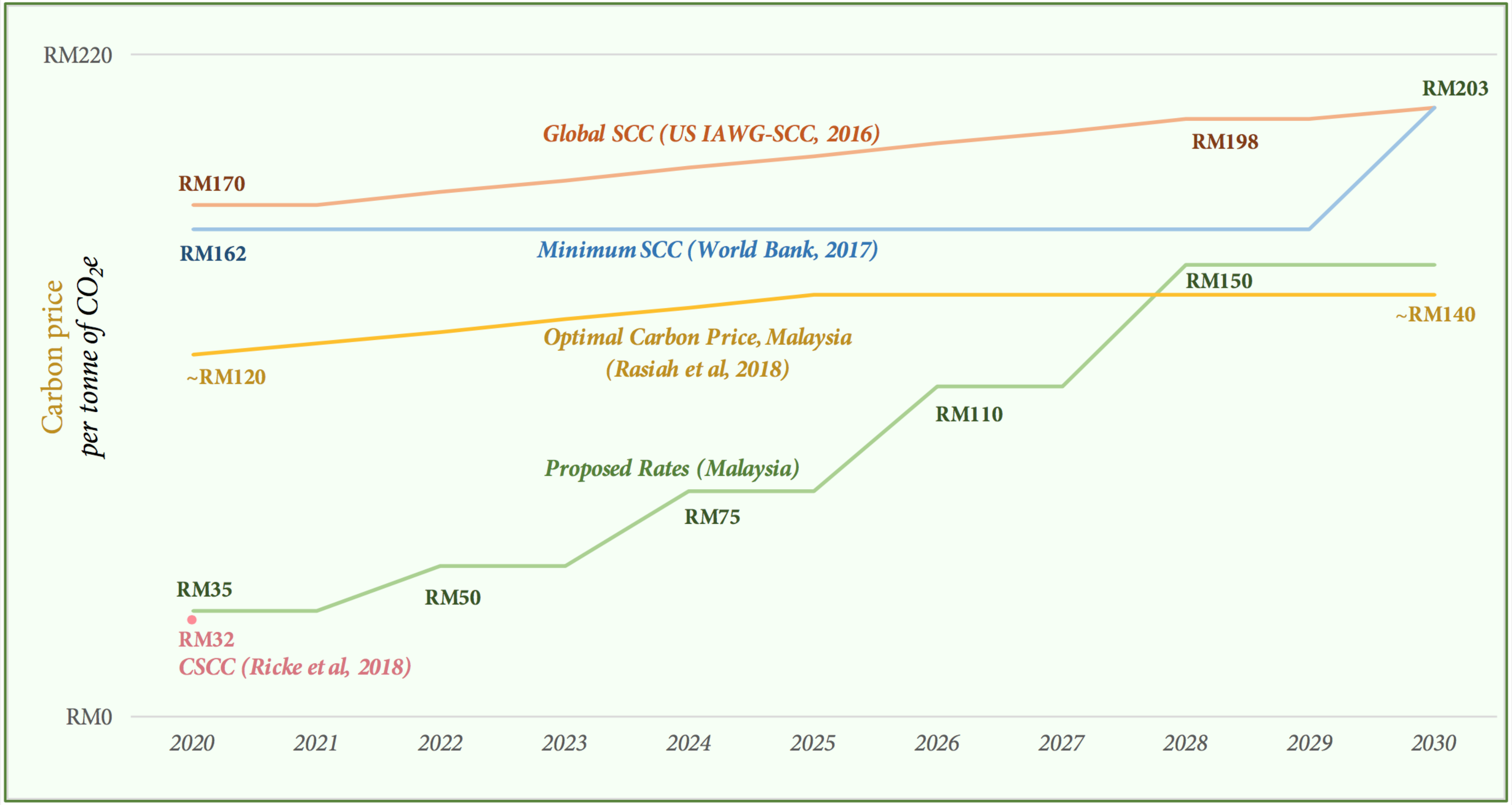
- Flexibility to adopt prices gradually trending towards SCC
- Get accustomed to CPR
- LR shift to global price of carbon smoother

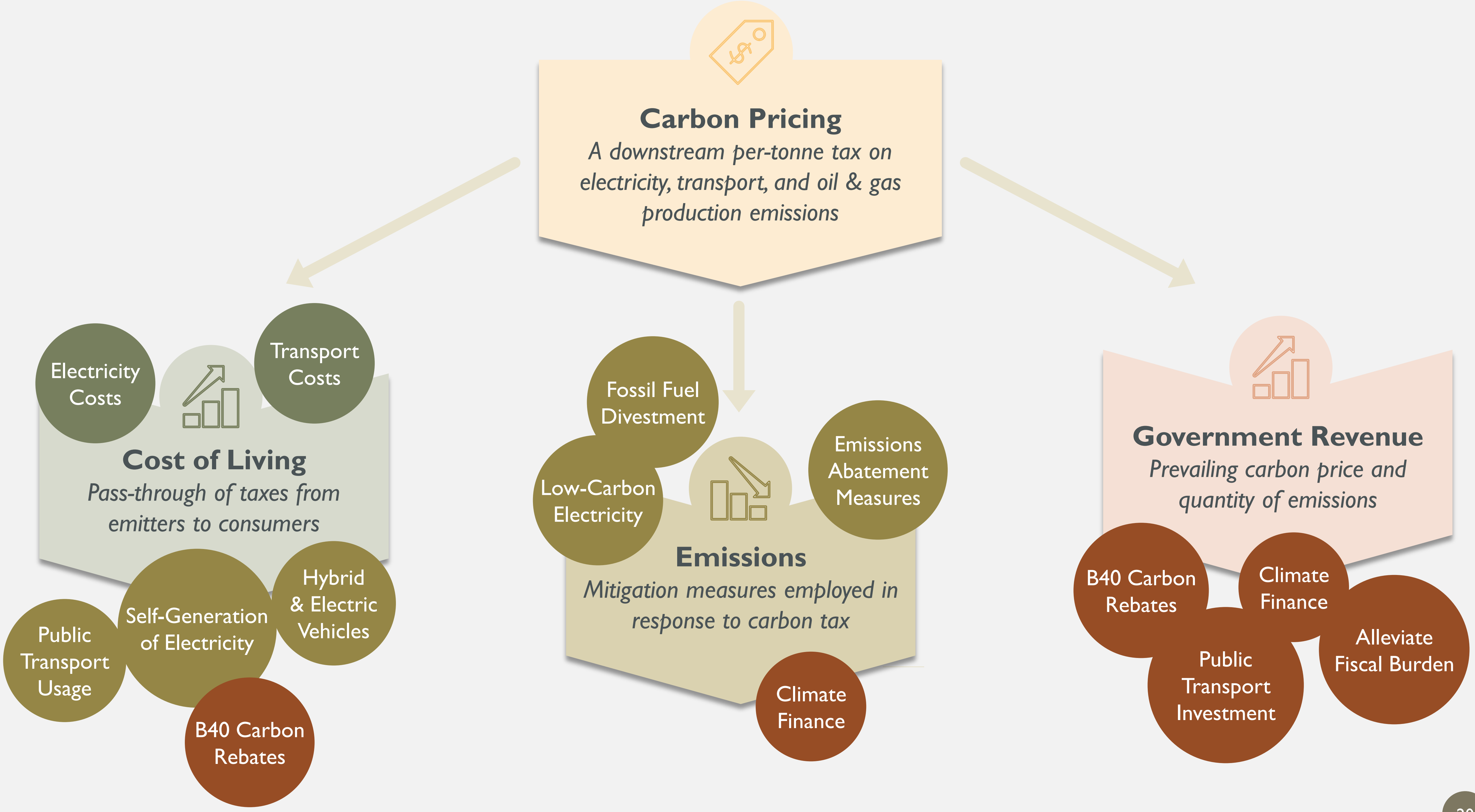
03

Price must not be…

- Too high: political feasibility? Economic harm?
- Too low: insufficient to incentivise decarbonisation
    - π_{max}: Abate as long as MAC ≤ SCC
    - As SCC rises…

Start at RM35/tCO_2e, biennial upward revision




Carbon Pricing
A downstream per-tonne tax on electricity, transport, and oil & gas production emissions
Electricity Costs
Transport Costs
Cost of Living
Pass-through of taxes from emitters to consumers
Public Transport Usage
Self-Generation of Electricity
Hybrid & Electric Vehicles
B40 Carbon Rebates
Fossil Fuel Divestment
Low-Carbon Electricity
Emissions Abatement Measures
Emissions
Mitigation measures employed in response to carbon tax
Climate Finance
Government Revenue
Prevailing carbon price and quantity of emissions
B40 Carbon Rebates
Climate Finance
Public Transport Investment
Alleviate Fiscal Burden

III. CPR in Malaysia

Sectoral Effects

III(a). CPR in Malaysia

Electricity

Carbon pricing hastens electricity sector disruption

- Enhances the competitiveness of lower-carbon technologies by placing a **price on environmental costs** of fossil fuel use.

Carbon Price *per* tCO_2e		Coal	Natural Gas (CCGT)
RM35 (2020/21)	Min	2.87	1.48
	Max	4.03	1.75
RM50 (2022/23)	Min	4.1	2.11
	Max	5.76	2.5
RM75 (2024/25)	Min	6.15	3.17
	Max	8.64	3.74
RM110 (2026/27)	Min	9.02	4.64
	Max	12.67	5.49
RM150 (2028-30)	Min	12.3	6.33
	Max	17.28	7.49

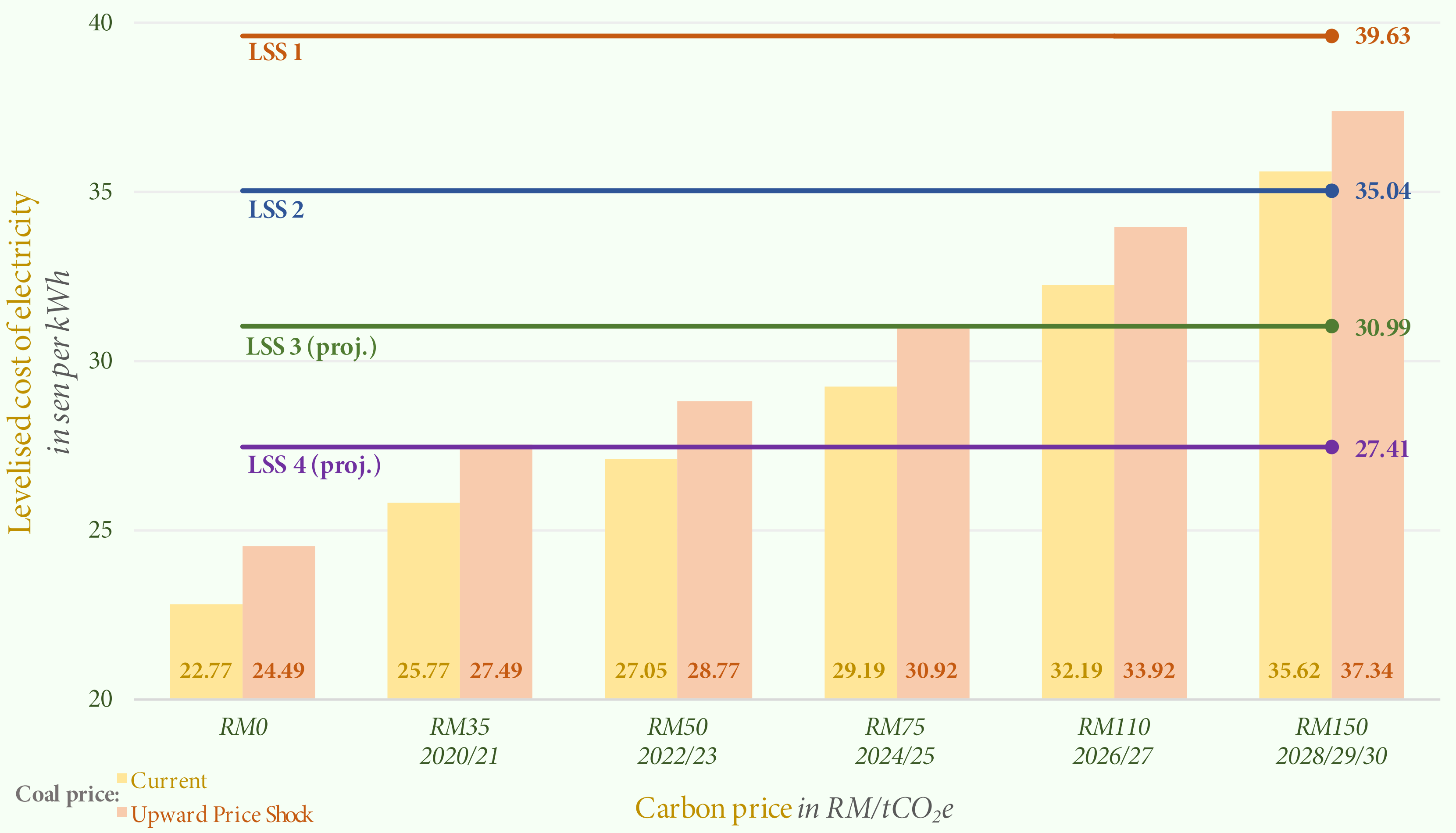
*Tax in sen per kWh
*Min/max dependent on plant efficiency

Quick look: coal vs natural gas

	Power Plants	Manjung 5 *Coal, 1GW*	Jimah East *Coal, 2GW*	Seberang Prai *CCGT, 1.07GW*	Pasir Gudang *CCGT, 1.44GW*	Average Cost Differential, CCGT *vs* Coal
	Estimated LCOE, ***no carbon price***	**22.77**	**24.79**	**34.7**	**37**	**50.8%**
Carbon Price *per* *tCO_2e*	**RM 35** (2020/21)	25.77	27.94	36.19	38.46	39%
	RM 50 (2022/23)	27.05	29.29	36.83	39.09	34.7%
	RM 75 (2024/25)	29.19	31.54	37.89	40.14	28.5%
	RM 110 (2026/27)	32.19	34.69	39.38	41.6	21.1%
	RM 150 (2028/29/30)	35.62	38.29	41.08	43.27	14.2%

*Cost in sen per kWh

Quick look: Manjung 5 vs large-scale solar



Note: Figures for LSS 1 and LSS 2 represent an average of the five lowest-cost approved bids in each auction. See Suruhanjaya Tenaga (2016) and Suruhanjaya Tenaga (2017). Estimations for LSS 3 and LSS 4 are based on projections of future LSS costs. See IRENA (2018) and EIA (2019).

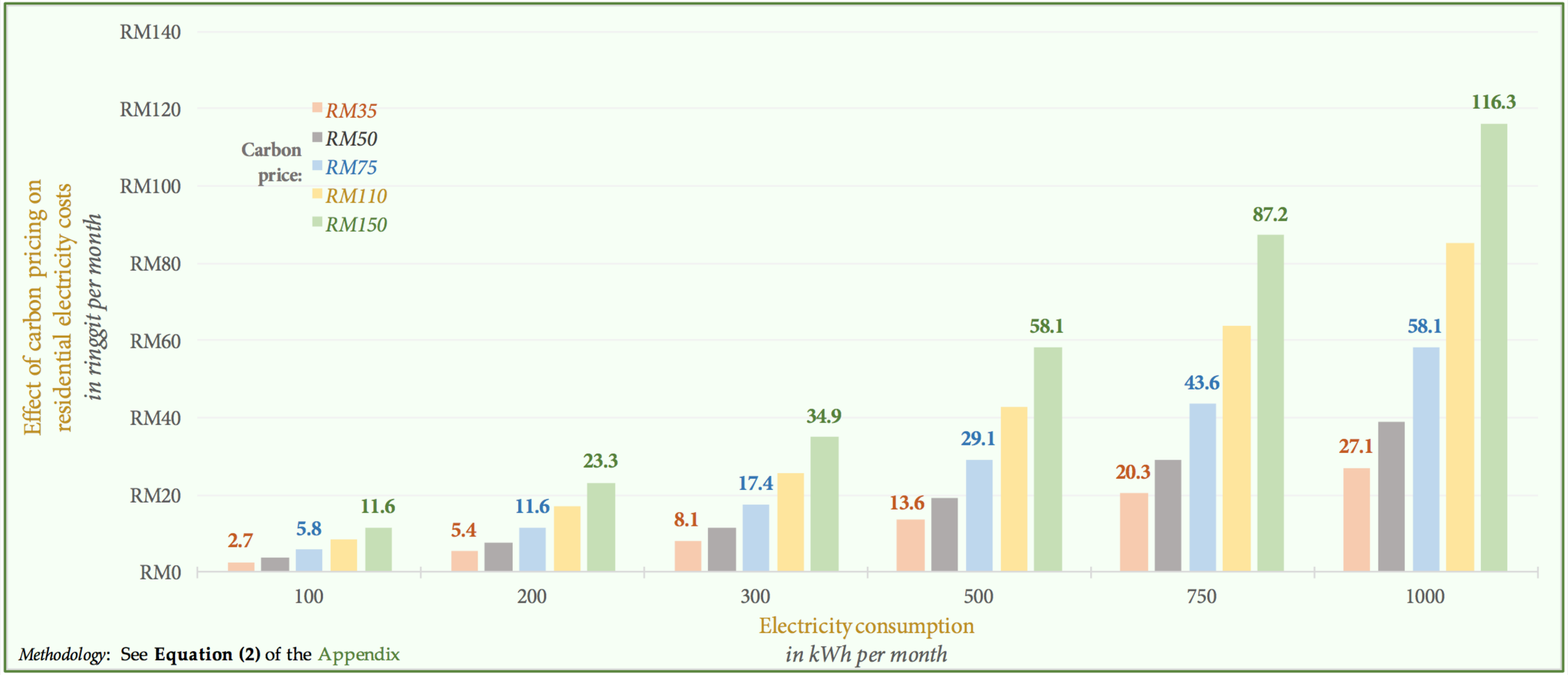
Aside on financing costs and the LCOE of RE

- Cheaper access to financing repeatedly found to enhance producer's ability to charge lower levelised tariffs.
- Azhgaliyeva et al (2018):
  - Improved access to loans $\Longrightarrow$ higher rate of private investment in RE projects
- Ondraczek et al (2015):
  - Variations in WACC a significant driver of LCOE (solar) across countries
- Monnin (2015):
  - Low interest rates $\Longrightarrow$ higher adoption of green technology
  - LCOE (RE) more reactive to Δ (interest rate) than fossil fuels
- **Evidence highlights importance of comprehensive national green financing framework**

Carbon pricing increases consumer electricity costs

- Cost pass-through (CPT) expected:
  - Fabra & Reguant (2014):
    - Estimate CPT in Spain electricity market following EU ETS
    - Inelastic demand, exercise of market power
    - **Results: 77–86% CPT**
- Assumption in this study: 90% pass-through
  - Illustrate "worst-case" effects
  - Along with:
    - Max emissions intensities of coal & natural gas
    - Current generation mix (57–40–3)
- Zaid & Graham (2017): per-occupant electricity usage in PPR flats 78–140kWh
  - Used to proxy for low-income households

B40 couple pays carbon taxes <RM8/month in 2021



Carbon pricing encourages adoption of RE

1. ∴ over time, effects of tax on rising electricity costs ↓
2. If RE target of 20% by 2025 reached, marginal price increases 31% lower than estimated in previous slide
3. Self-generation (e.g. installing solar panels) also reduces costs
   - Tax can act as incentive to invest and reduce household carbon footprints

III(b). CPR in Malaysia

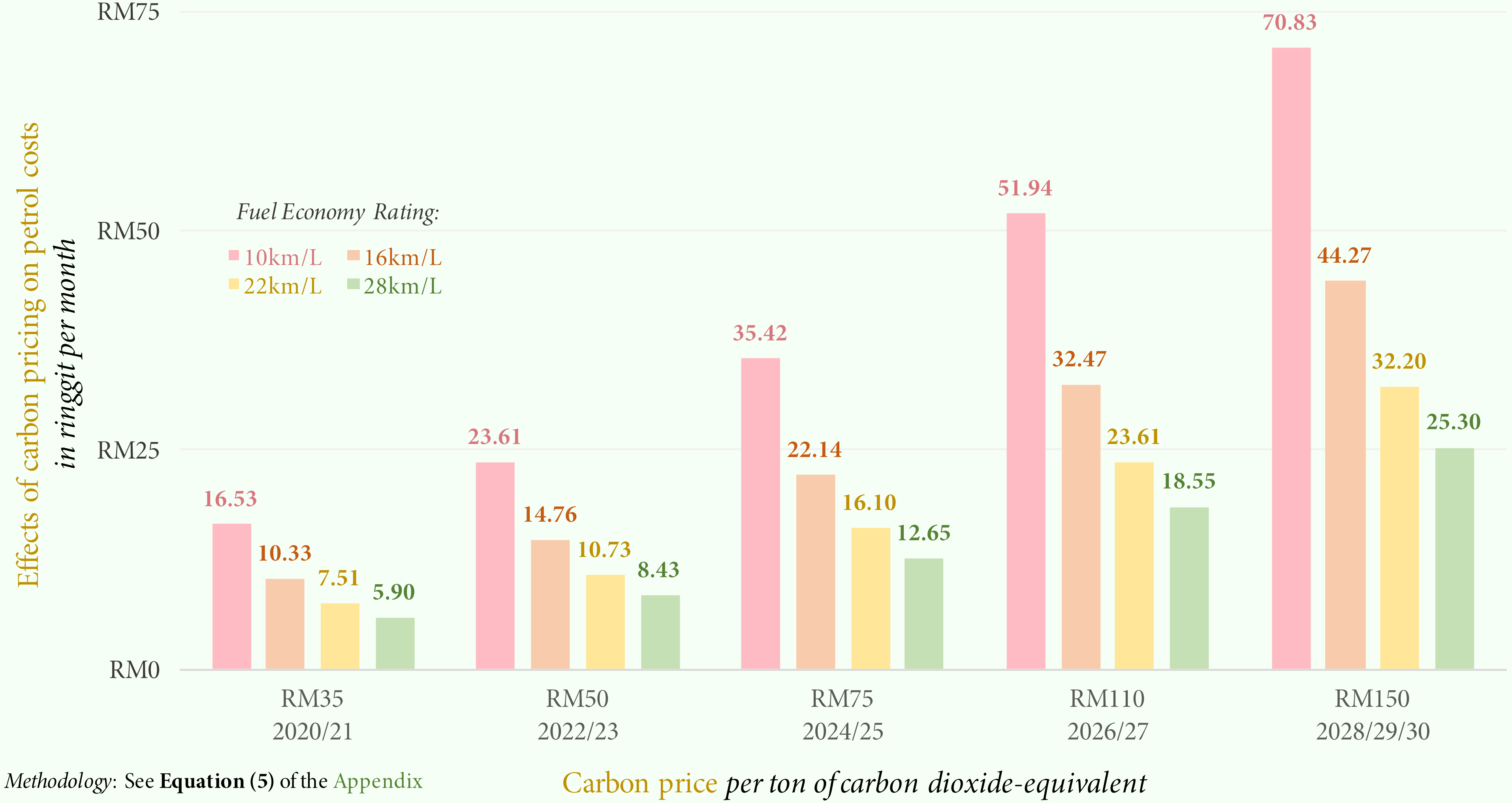
Transport

Taxes should be imposed at the pump

Transport Fuel	Emissions Intensity *in $kgCO_2$ per litre*	Taxes Incurred at Carbon Price of:				
		RM35	***RM50***	***RM75***	***RM110***	***RM150***
		per tCO_2e				
Petrol	2.35	8.22	11.74	17.61	25.83	35.23
Diesel	2.66	9.31	13.30	19.95	29.26	39.90

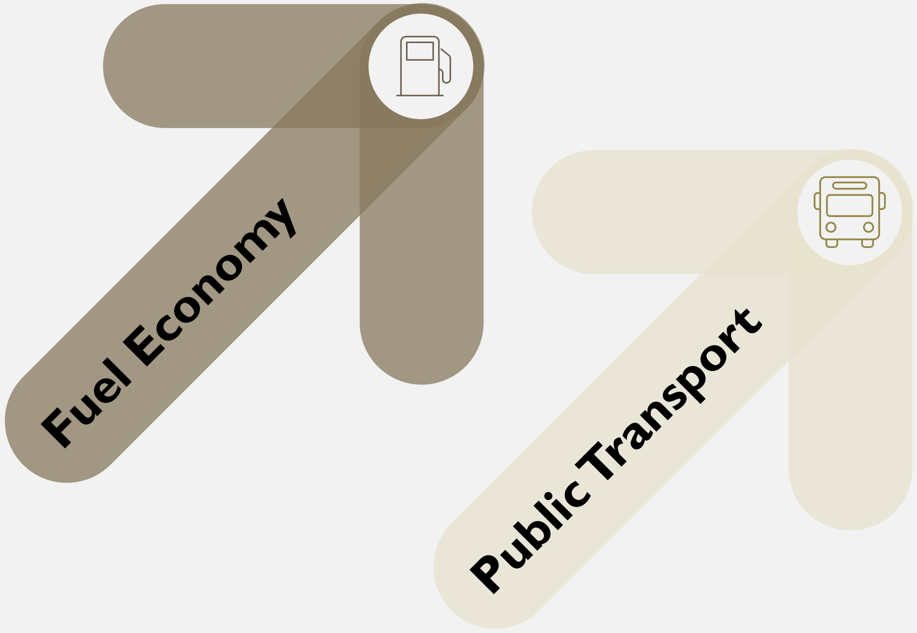
*Tax in sen per litre

Carbon pricing emphasises importance of fuel economy



Methodology: See **Equation (5)** of the Appendix

Downward pressures on transport emissions



Requirements in Malaysia:

1. **Policies**, which:
   a. Improve fuel-efficiency of vehicles
      e.g. *fuel economy standards*
   b. Encourage hybrid and electric vehicles
      e.g. *tax exemptions, local production*

2. **Investment** in:
   a. Public transportation
      e.g. *first/last-mile connectivity, urban and rural bus networks and services, increased capacity & frequency of trains during peak hours*
   b. Road (re)development
      e.g. *improve walkability, encourage cycling, bus lanes.*

III(c). CPR in Malaysia

Oil & Gas Production Processes

Emissions taxed from oil and gas production

1. Emissions from manufacture of oil, and natural gas transformation
2. Emissions at petroleum refineries
3. Fugitive emissions:
   - Venting & flaring of gas in oil production
   - Production, processing, flaring, transformation, storage, and distribution in natural gas production

Carbon pricing: market-based fiscal incentive for O&G players to mitigate emissions

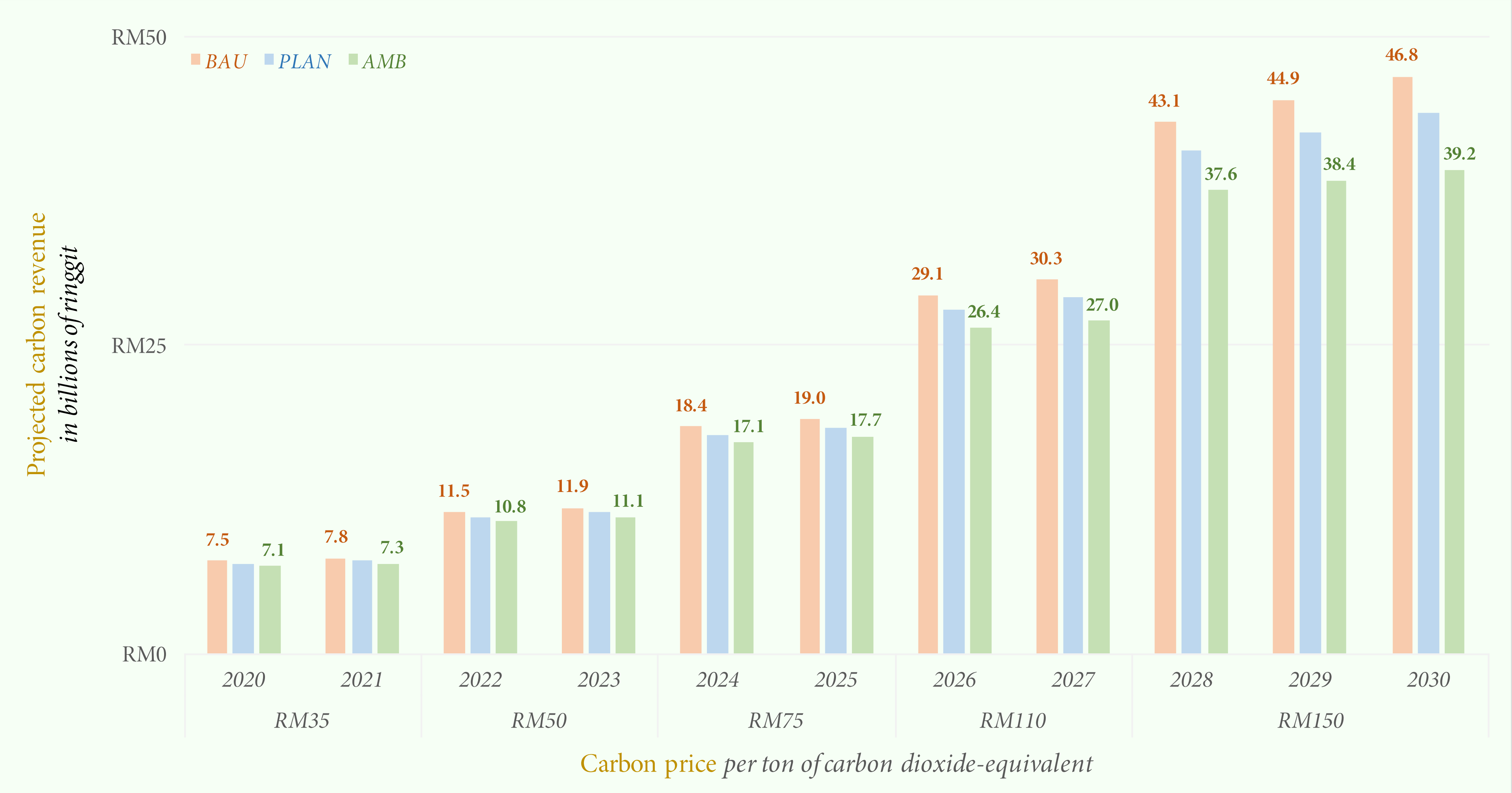
Oil and Gas Production Process	Mitigation Action(s) Required
Natural Gas Transformation	• Improvements in operations and plant efficiency through fuel consumption optimisation; • Flare reduction and recovery
Oil Refining	• Improvements in plant efficiency through fuel consumption optimisation; • Flare reduction and recovery
Fugitive Emissions	• Zero continuous flaring and venting in all operations
Sources: MESTECC (2018); Petronas (2018)	

- Add to this list: carbon capture-and-storage technologies and other carbon sink or abatement strategies
  - Recall π_{max}: abate as long as MAC ≤ SCC

IV. CPR in Malaysia

Revenue Collections and Redistribution

Carbon revenues ~RM7.8bn in 2021



By 2030, carbon tax to contribute up to 35% of direct tax revenue

Year	**Carbon Price** *per tCO_2e*	**Share of Total Tax Revenues** *in %*		**Share of Direct Tax Revenues** *in %*	
		BAU	*AMB*	*BAU*	*AMB*
2020	RM35	4.3	4.0	5.6	5.3
2022	RM50	6.5	6.1	8.5	8.0
2024	RM75	10.4	9.7	13.6	12.7
2026	RM110	16.5	15.0	21.5	19.6
2028	RM150	24.5	21.3	31.9	27.8
2030	RM150	26.6	22.3	34.7	29.1

*As a % of revenue in *Budget 2019*

B40 carbon rebates would consume 29–47% of revenue

- *Central estimate:* RM173 annual rebate per individual at RM35 tax
  - 150kWh monthly electricity usage
  - 16km/L driving ~2,000km per month
  - Requires ~29% of carbon revenue
- *Worst-case estimate:* RM263
  - 200kWh; 10km/L
  - ~47% of revenue

Carbon rebates can be disbursed alongside BSH

- Rebates act as supplement to Bantuan Sara Hidup grants
- Households can **profit** from rebates by reducing individual carbon footprints
  - Avoid full brunt of tax but receive full carbon rebates
  - Potential options include:
    - Investment in EE appliances and self-generation
    - Public transport usage
    - Driving more efficient cars
    - Reducing unnecessary electricity usage

Residual revenues can meet Malaysia's climate funding gap within four years – no foreign assistance required

Residual Revenues

Year	Min	Max
2020	4,111	5,284
2021	4,363	5,536
2022	6,606	8,282
2023	6,992	8,668
Total	**22,073**	**27,771**

Area	Funding Requirement
Administrative	
GHG Inventory Management	24.3
Mitigation	
RE Programs[60]	11,907
Energy Efficiency Programs	6,196
REDD+ Initiatives	1,620
Adaptation	
Initial Adaptation Measures	421.2
Development of a *National Adaptation Plan*	
Total	**20,169**

Source: MESTECC (2018)
Notes: MYR/US$ exchange rate – RM4.05/$1; REDD+ – reducing emissions from deforestation and forest degradation

*All figures in millions of ringgit

Carbon revenues can fund all future climate initiatives

- Sustained climate change mitigation and adaptation initiatives will require ever-larger magnitudes of financing
- Investment in local green industry:
  - Stimulate growth of industries which are centerpieces of sustainable development
- Funding for a national *'Green Financing Framework'*
  - Drive LCOE reductions for RE

Paper available for download on Penang Institute website

1. More detailed breakdown and analysis
2. Full breakdown of methodology and assumptions
3. References and recommended reading