Carbon pricing and carbon neutrality: do they match ?

or Martin Weitzman revisited ?

Patrick Criqui

Climate Economics Chair

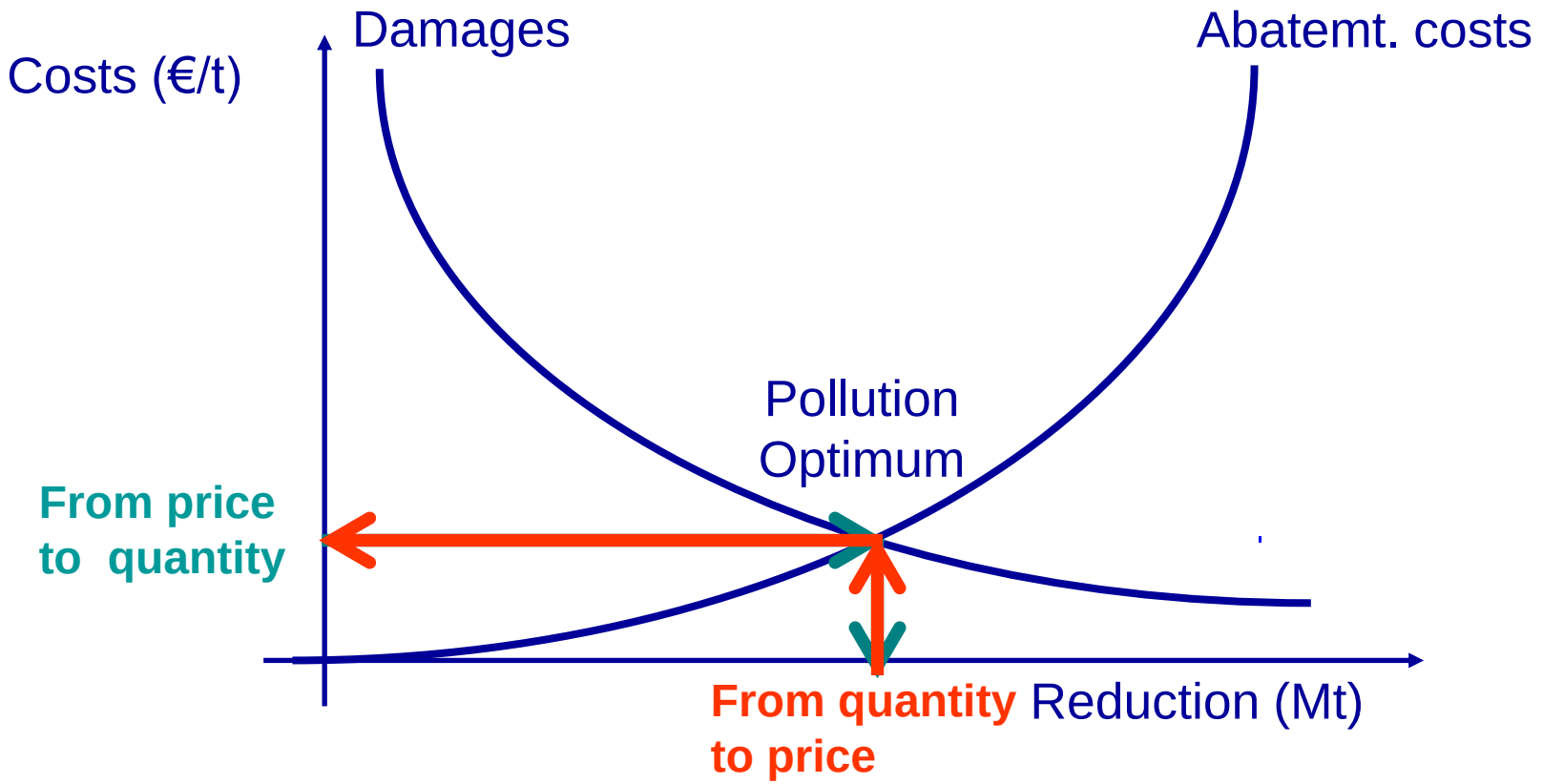
October 11, 2023

Carbon pricing and carbon neutrality

- ***Theoretical perspective***
- *Methodological issues*
- *Implementation challenges*

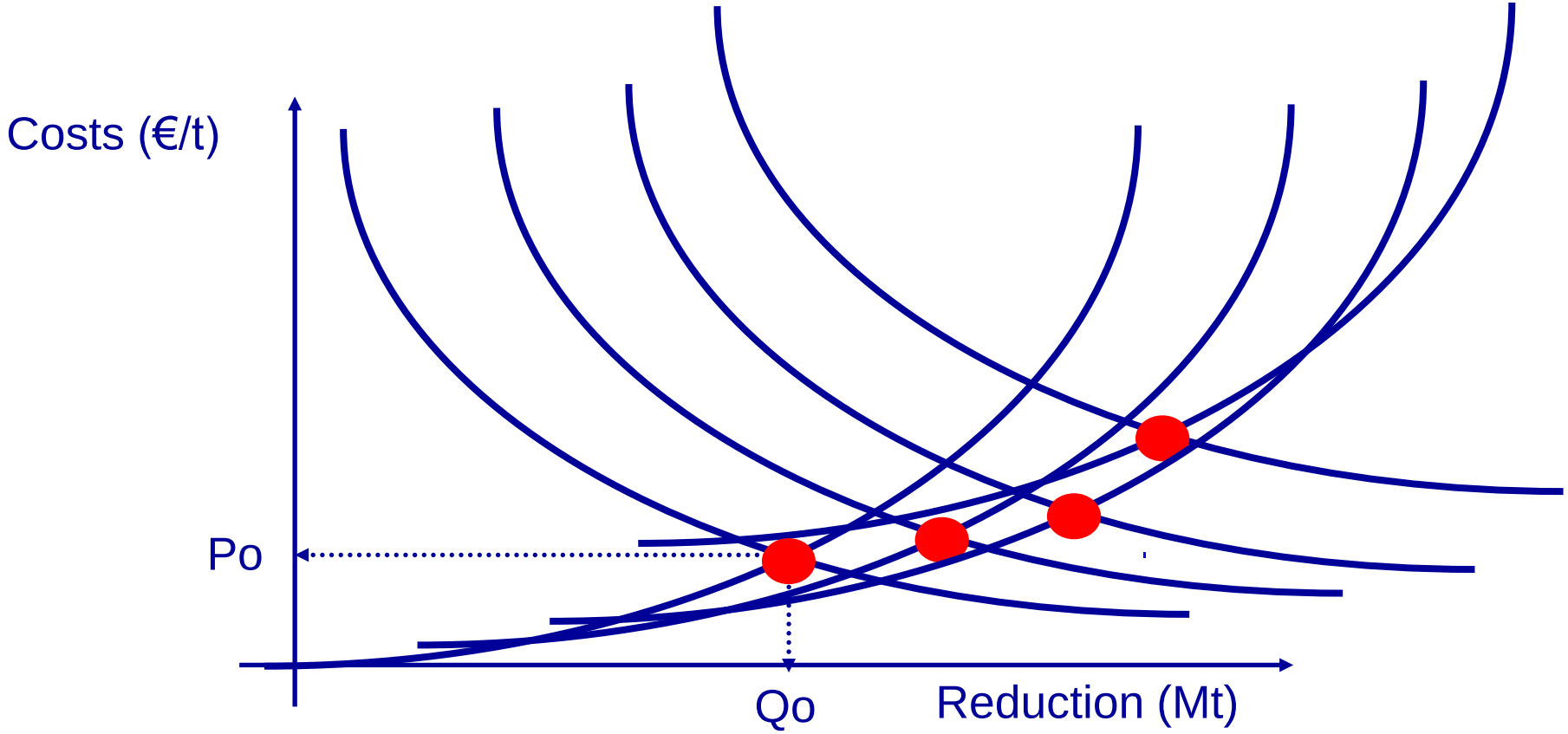
The Cost-Benefit Analysis (CBA) or the economists at the commands

- The CBA computes the damage costs and the abatement costs … and then compare them in order to determine the « pollution optimum »



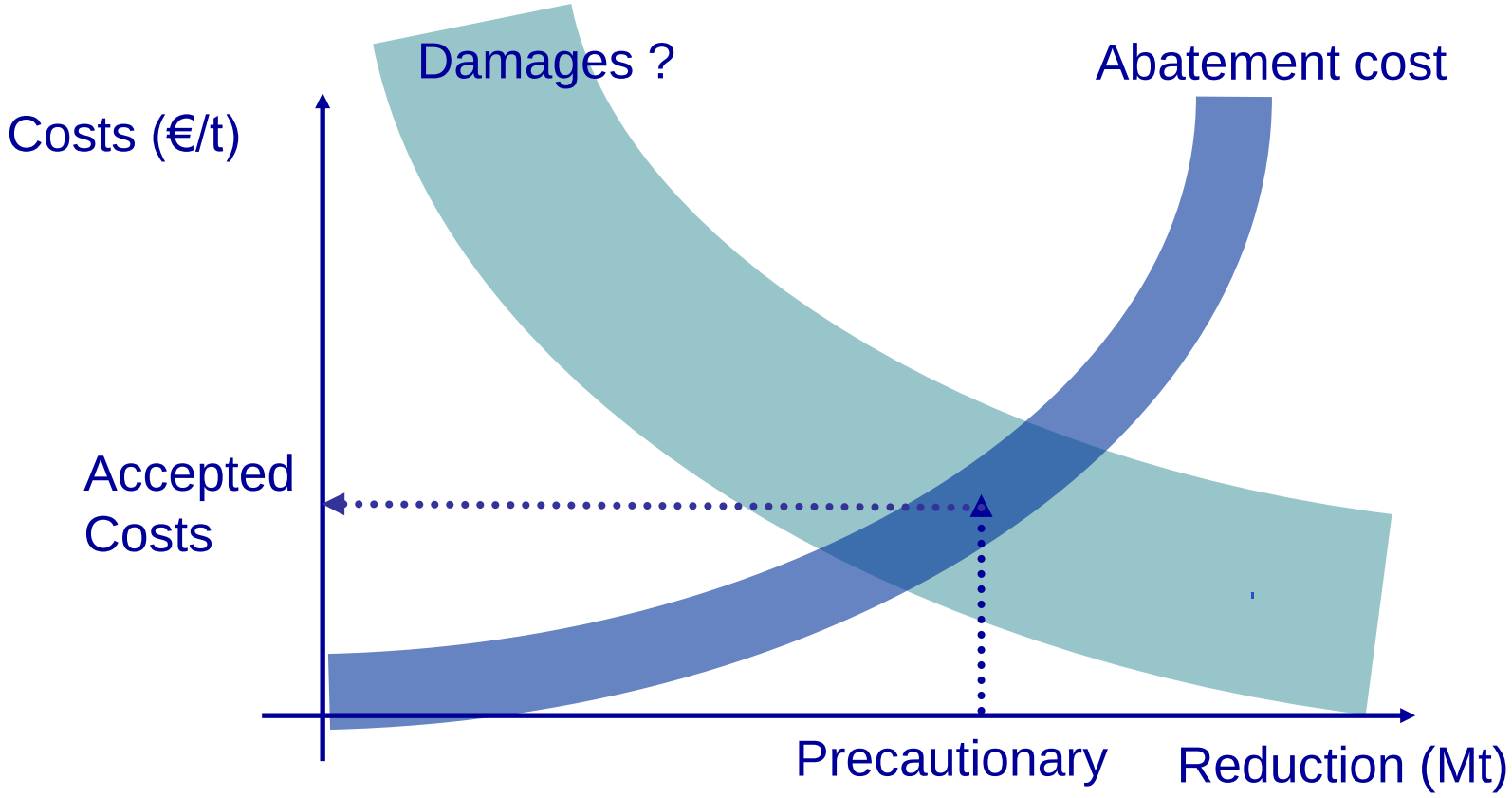
The intertemporal Cost-Benefit Analysis (CBA) or the economists at the commands

- The SCC corresponds to the year by year balance of discounted expected damages and discounted abatement costs



The Cost-Effectiveness Analysis (CEA) a more modest approach for economists

- In the Cost-Effectiveness approach the policy-maker, informed by the scientist determines a precautionary (exactly as in the Kyoto Protocol)
- Then economists have to find the least-cost solution to achieve the target



The discount rate and the « tragedy of the horizons » (Marc Carney)

- According to the *Hotteling rule*, the price of carbon should increase with the discount rate
- According to the *Ramsey rule*, the discount rate should be:

DR = PTP + (GR x RIA)

Discount Rate = Pure Time Preference + (Growth Rate x Risk or Inequality Aversion)

Growth rate	1,5	Decreasing aversion to inequality					
			1		2		3
Increasing pure time preference	0	Stern (2006)	1,5	Dasgupta (2006)	3		4,5
	1	Guesnerie (2021)	2,5	Lebègue (2005)	4		5,5
	2		3,5		5		6,5
	3	Nordhaus (1994)	4,5	Weitzman (2007)	6		7,5

Carbon pricing and carbon neutrality

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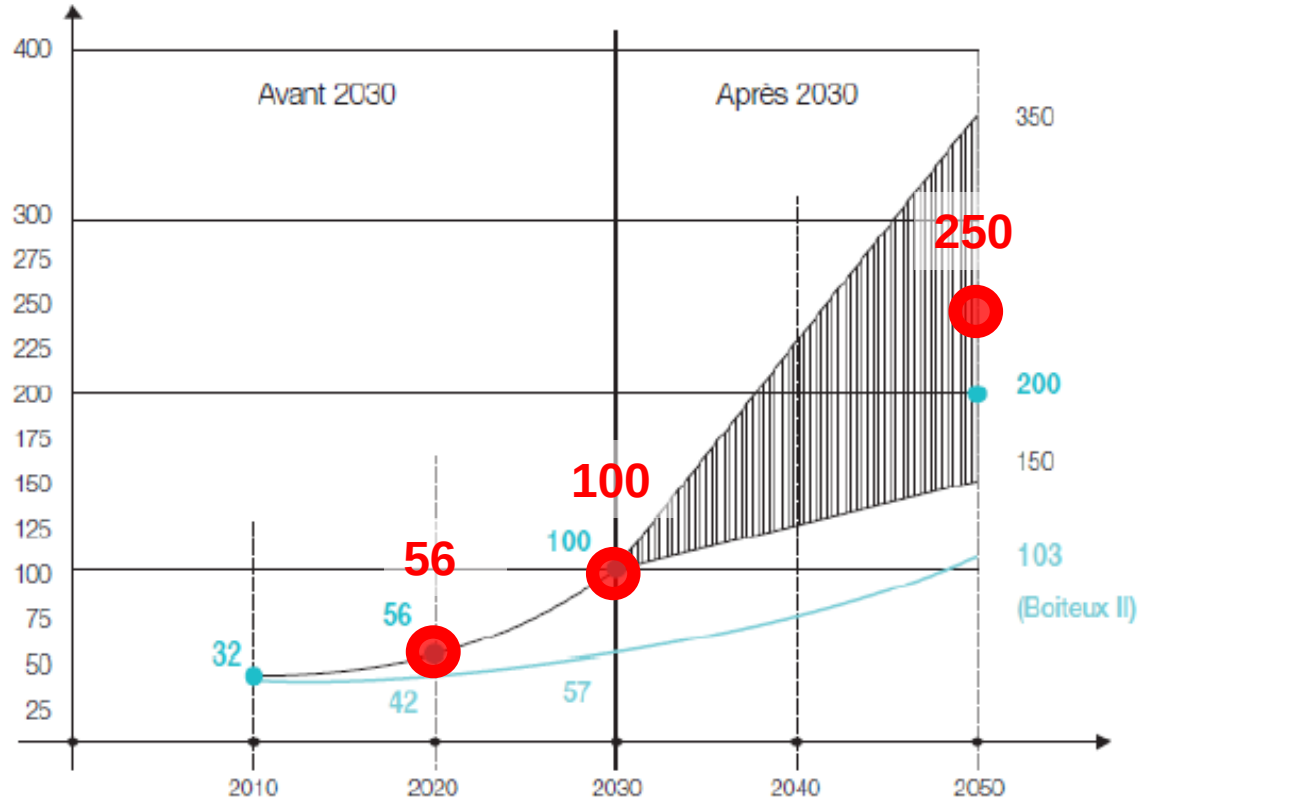
The Carbon Value in France

- In France the Carbon value, as estimated in the Rapport Quinet (2008 revised in 2013) corresponds to the price of carbon that has to be introduced in economic calculations (specially public investment) in order to comply to international or national commitments:

- le protocole de Kyoto qui engage juridiquement les principaux pays qui l'ont ratifié à réduire leurs émissions annuelles de gaz à effet de serre sur la période 2008-2012 par rapport à 1990 ;
- les engagements européens à réduire ses émissions de gaz à effet de serre à l'horizon 2020[1] de 20 % par rapport à 1990 de manière unilatérale voire 30 % en cas d'une mobilisation plus forte des pays sur les objectifs climatiques ;
- les perspectives du gouvernement français annoncées dans le cadre de la loi de programmation fixant les orientations de la politique énergétique (loi POPE du 13 juillet 2005) qui soutenait la définition d'un objectif de division par deux des émissions mondiales de gaz à effet de serre d'ici à 2050 et donc d'une réduction par 4 des émissions pour les pays développés.

The Carbon Value in France… as of 2008

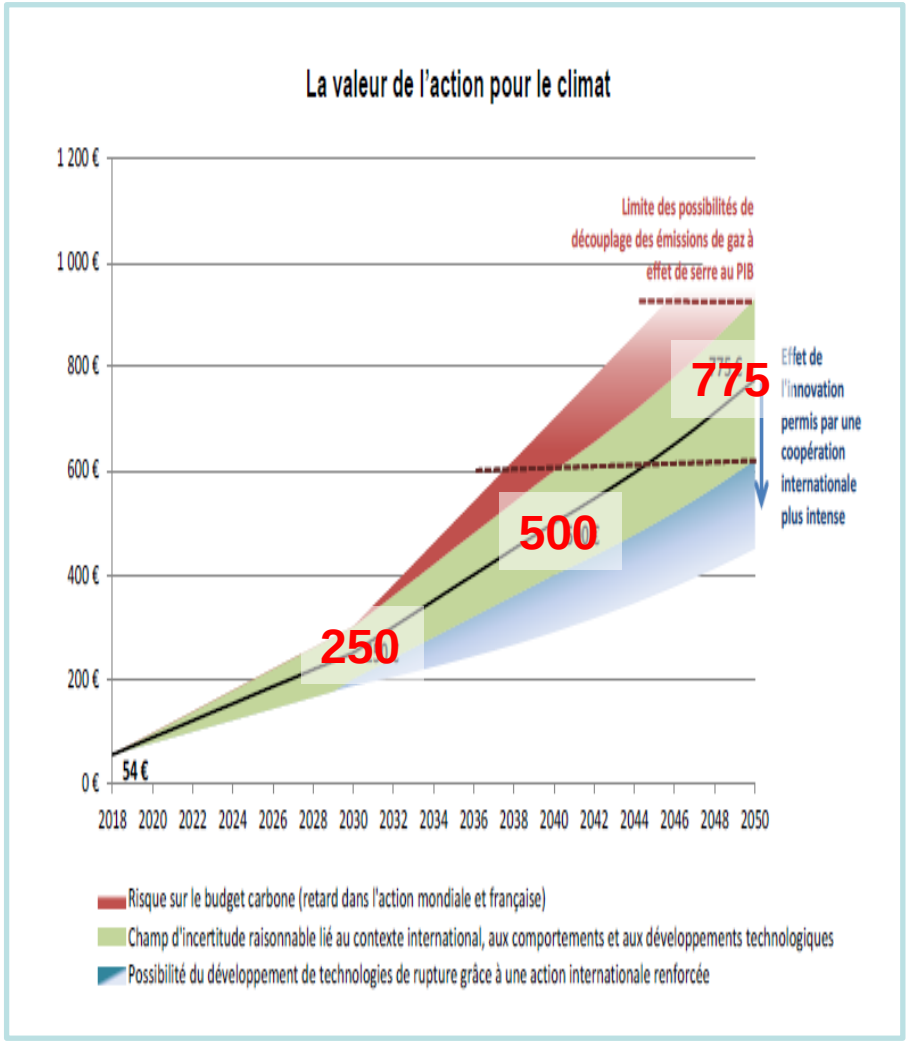
- The Quinet-1 report: the 100 €/tCO2 in 2030 is the focal point on the way to the Factor 4 abatement in 2050 the dynamics is provided by the discount rate (4-4.5 %)



Source : Centre d'analyse stratégique

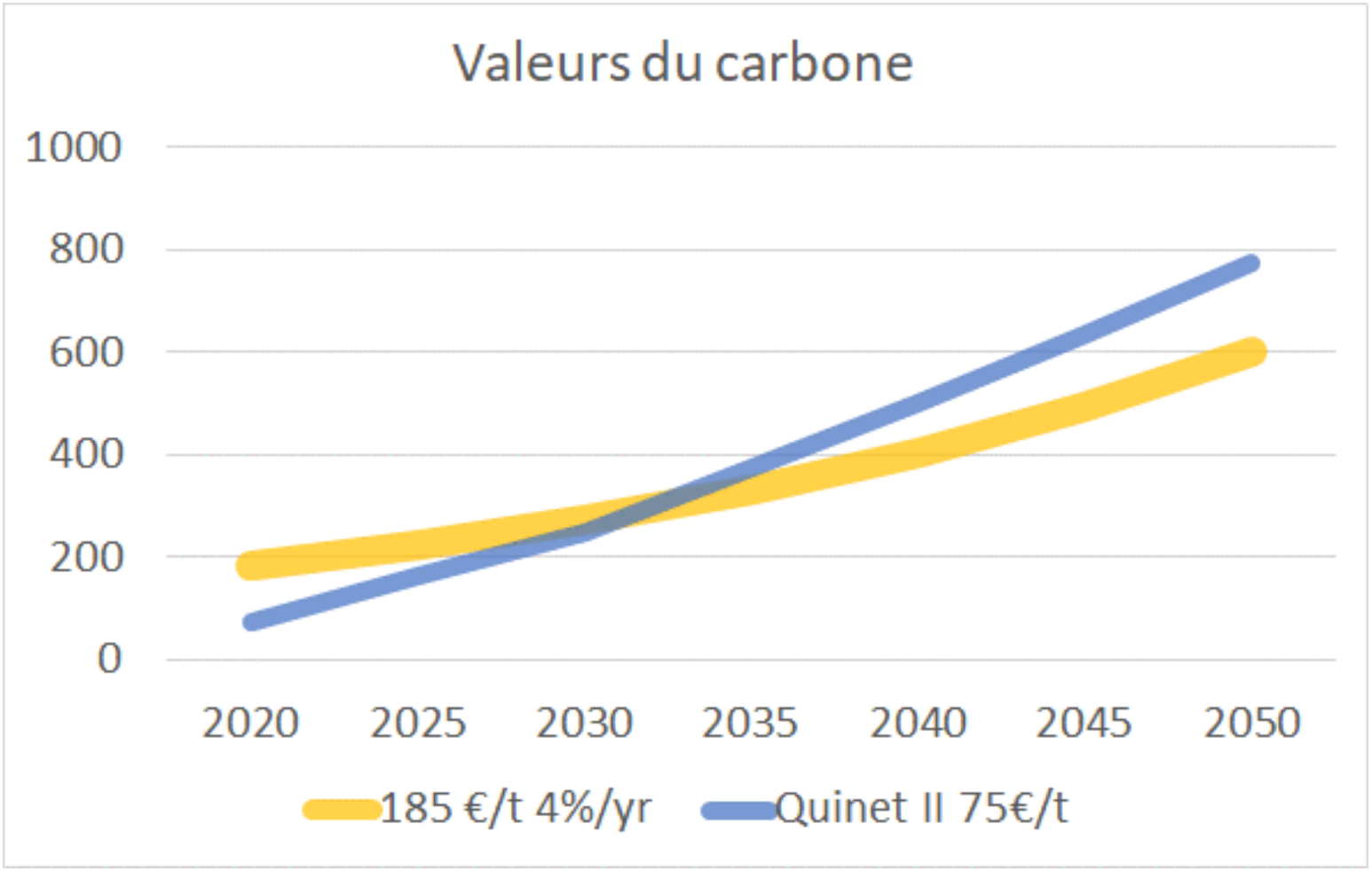
The Carbon Value in France… as of 2018

- In the Quinet-2 report carbon neutrality in 2050 (Factor 6) replaces the Factor 4 target
- According to the models, the Value of Climate Action should reach more than € 1,000/tCO2 (€ 2.5/l) in 2050
- Questions:
  - Have the existing models reached their limits of relevance ?
  - What about the « gilets jaunes » ?
  - And what role of radical innovations for carbon neutrality ?



A « waiting game » (C. Gollier)?

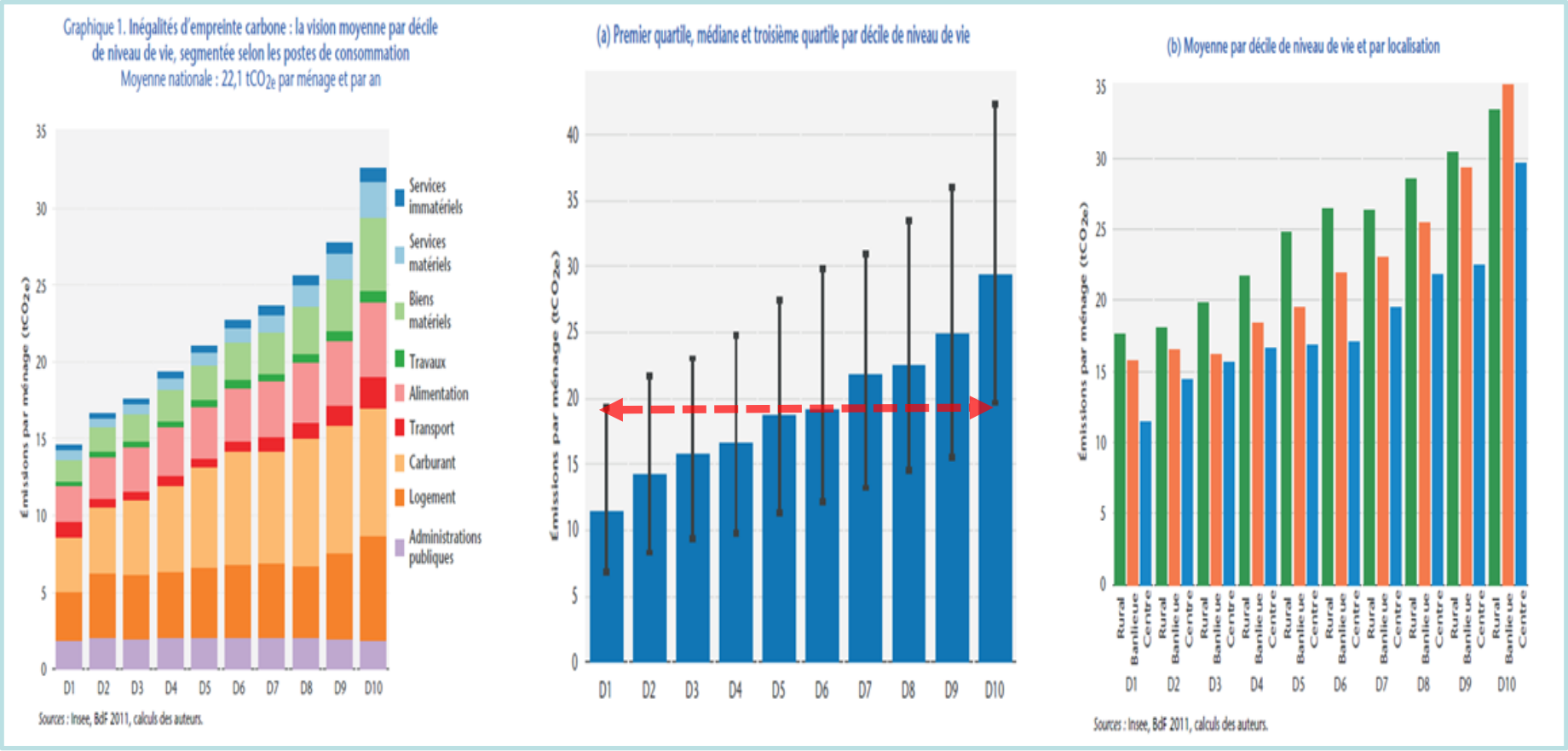
acceptability in the short run, performativity in the long run



Carbon pricing and carbon neutrality

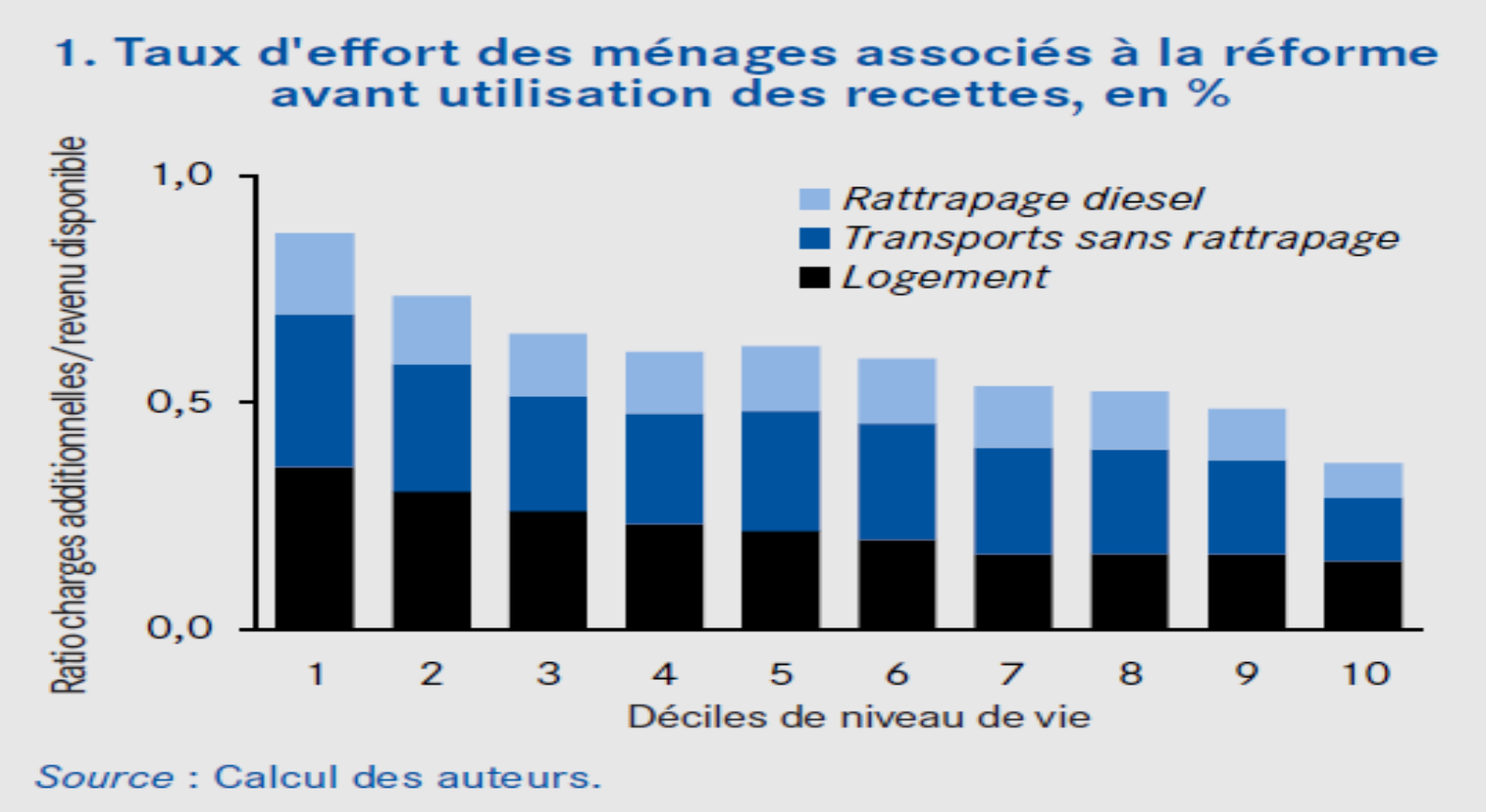
- *Theoretical perspective*
- *Methodological issues*
- ***Implementation challenges***

A 2,5 factor in household carbon footprint in France



Source: A. Pottier et al., Revue OFCE

Impact of the carbon tax reform on household budget in France



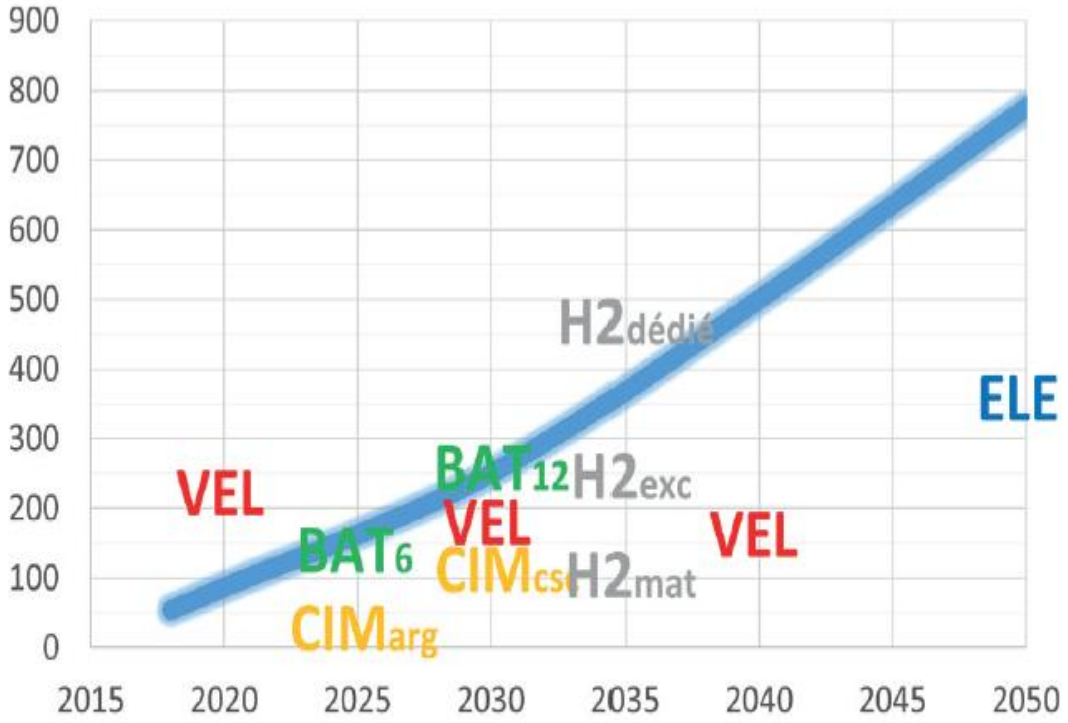
Source: Bureau, Henriet, Schubert

Note CAE N°50, March 2019

Carbon pricing: five principles

1. First, restore **balance to the energy price system**: what conditions for the removal of subsidies?
2. Then, build a **mix of price and non-price incentives**
3. Next, **choose a « trajectory »** for the introduction of carbon pricing: starting level and annual increase (at the discount rate?)
4. Above all, identify the **consequences for vulnerable populations** and set up compensation (energy check)
5. Finally, **arbitrate** between:
    i. Compensation,
    ii. Financing of investments, and
    iii. Contribution to the general budget

After the Quinet-2 report: the working group on abatement costs



VEL = véhicule berline électrique

BAT6, BAT12 = rénovation énergétique de respectivement 6 et 12 mill

H_2mat = hydrogène matière première, en reformage du méthane avec

H_2exc = hydrogène d'électrolyse d'excédents électriques

H_2dédié = hydrogène d'électrolyse en production dédiée

CIMarg = dans les cimenteries, substitution du clinker par de l'argile c

CIMcsc = captage et stockage du carbone dans les cimenteries

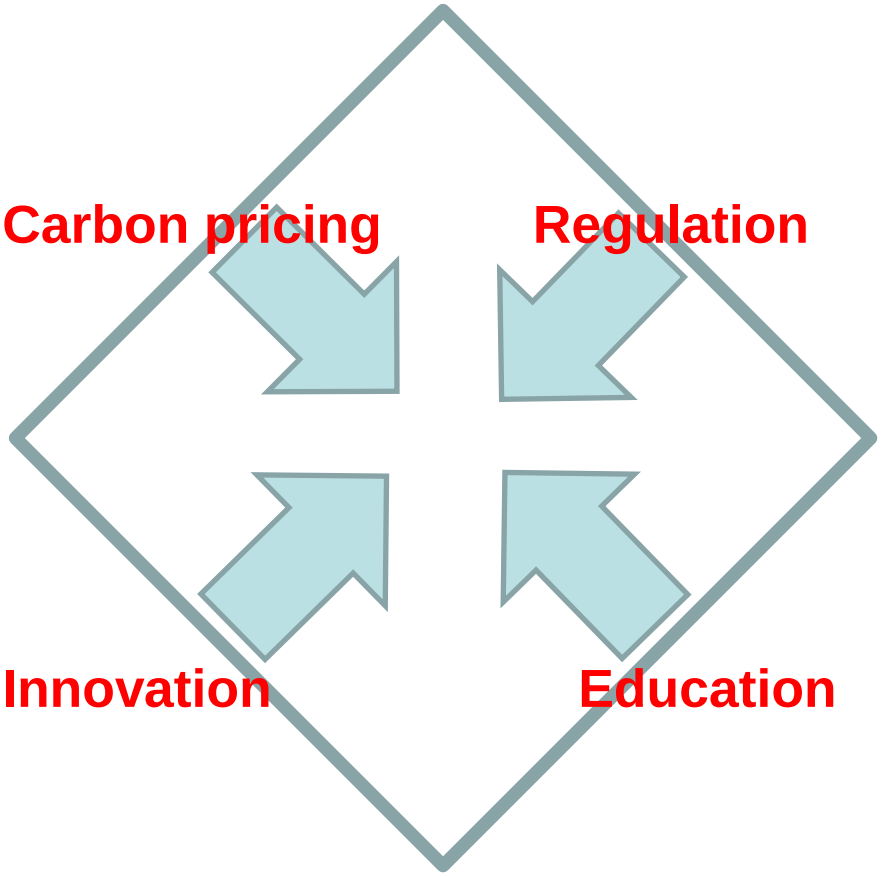
ELE = décarbonation complète du système électrique en 2050

Figure 9. VAC et coûts d'abattement

Source : Commission coûts d'abattement, France Stratégie, 2023

A mix of policies for new uncertainties

- The Weitzman theorem focused on the uncertainties on costs, whether of abatement or of damages
- Today major uncertainties pertain to social acceptability and technological innovation in the transition
- This supposes a careful balance of the four main pillars of public action for climate



What Role Does the Social Cost of Carbon Play in Carbon Pricing?

October 11, 2023

Maureen L. Cropper
University of Maryland and Resources for the Future

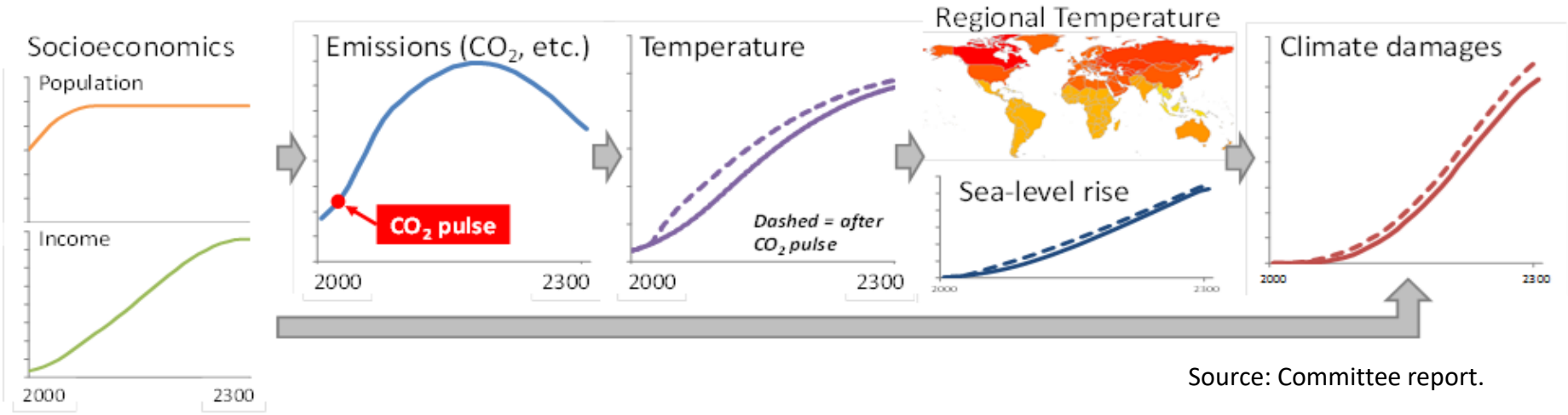
What Is the Social Cost of Carbon?

- The present value of global damages from emitting a ton of CO_2 into the atmosphere in a particular year
- Measures the monetized value of the additional CO_2 (both negative and positive impacts)

Including, but not limited to:

- Changes in net agricultural productivity
- Energy use
- Human health
- Property damage from increased flood risk
- Other impacts

The 4 steps of SCC estimation



Source: Committee report.

1. Projections of future population & GDP generate a CO_2 emissions path
2. CO_2 emissions path leads to predictions of mean global temperature change
3. Temperature change leads to damages, which are monetized and aggregated
4. Damages persist for many decades: discounting is used to sum them into a single present value

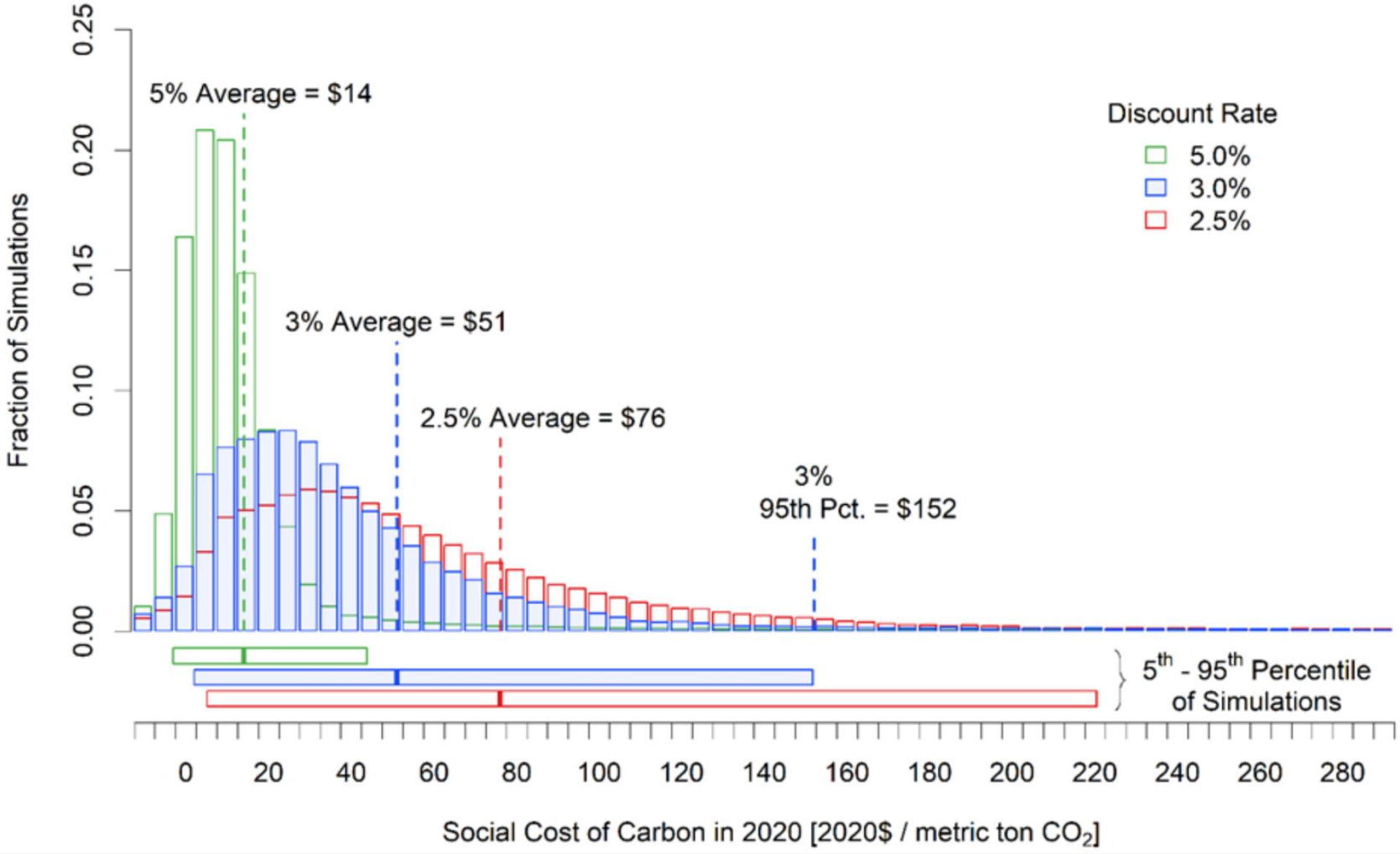
This 4-step procedure is done with both baseline emissions and with a small additional amount (a pulse) of CO_2 emissions in a particular year.

SCC is the per-ton difference in present value of damages due to the pulse.

US Government Calculation of the SCC

- Inter-agency Working Group began in 2008 and continued through 2016, until disbanded by Trump
- Combined results from 3 IAMs: DICE, FUND and PAGE
  - Using 5 equally weighted socio-economic scenarios
  - Using a common distribution over climate sensitivity
  - Preserving uncertainty in damage (and other) parameters in FUND and PAGE
- 150,000 Monte Carlo runs for each of 3 discount rates
  - 2.5%, 3.0%, 5.0%
  - Next slide shows distribution of results for all discount rates

Frequency Distribution of 2016 SCC Estimates in 2020$



US Interim SCC Estimates. February 2021

Social Cost of CO_2, 2020 – 2050 (in 2020 dollars per metric ton of CO_2)

	Discount Rate and Statistic			
Emissions Year	5% Average	3% Average	2.5% Average	3% 95th Percentile
2020	14	51	76	152
2030	19	62	89	187
2040	25	73	103	225
2050	32	85	116	260

How to Improve Estimates of the SCC? (2017 NRC Report)

"Unbundle" SCC estimation into 4 modules

- Socioeconomic Module
- Climate Module
- Damages Module
- Discounting Module

Each module to be developed based on expertise within the relevant disciplines

Uncertainty at each stage to be quantified and combined to generate a distribution of SCC values

How Has the USEPA Updated the SCC?

Socioeconomic Module

- Resources for the Future has used statistical methods to project distributions of GDP and population; expert elicitation to project population, emissions and GDP

Climate Module

- NRC Panelists developed the Finite Amplitude Impulse Response (FAIR) model

Damages Module

- Combines results from the Climate Impact Lab (U. of Chicago), RFF GIVE model and Howard & Sterner meta-analysis

How Has the USEPA Updated the SCC?

Damages Module

- RFF's GIVE model (Nature 2022)
  - Captures Mortality, Agriculture, Energy, Coastal Damages
- The Climate Impact Lab's DSCIM model
  - Captures Mortality, Agriculture, Energy, Coastal Damage, Labor supply

Discounting Module

- Damages discounted along each socioeconomic path using a Ramsey formula, with parameters chosen to match near-term discount rates to 1.5%, 2.0% and 2.5%

USEPA SCC Estimates, November 2022

Social Cost of CO2, 2020 - 2050 (in 2020 dollars per metric tons of CO2)
Near-Term Ramsey Discount Rate = 2%

Emission Year	Damage Module		
	DSCIM	GIVE	Meta-Analysis
2020	190	190	200
2030	230	220	240
2040	280	250	270
2050	330	290	310

How Is the SCC Currently Used?

- The SCC has been used to evaluate the benefits of reducing carbon emissions in > 80 federal regulations.
- Used by Minnesota, Illinois, New York and other states in evaluating power plant investments, including benefits of Zero Emission Credit programs
- Has been used in California's Climate Change Scoping Plan
- September 2023 – White House directed federal agencies to consider using SCC estimates in budgeting, procurement and other agency decisions

Why We Should Compute the SCC

- Setting a temperature target (e.g. < 2° C) entails implicit judgments about damages and the value of avoiding them
  - It does not avoid the uncertainty associated with climate impacts and climate damages
  - Calculating the SCC makes such judgments and uncertainties explicit
- Calculating damages makes the impacts of temperature targets real
  - Important to securing developing country buy-in
- Measuring damages necessary to estimate the benefits of adaptation and mitigation.

To What Extent Is Carbon Pricing Leading to Carbon Neutrality?

-- Recent Developments in the US and China --

October 11, 2023

Lawrence Goulder
Stanford University, RFF and NBER

US Inflation Reduction Act

- Subsidizes clean energy investment

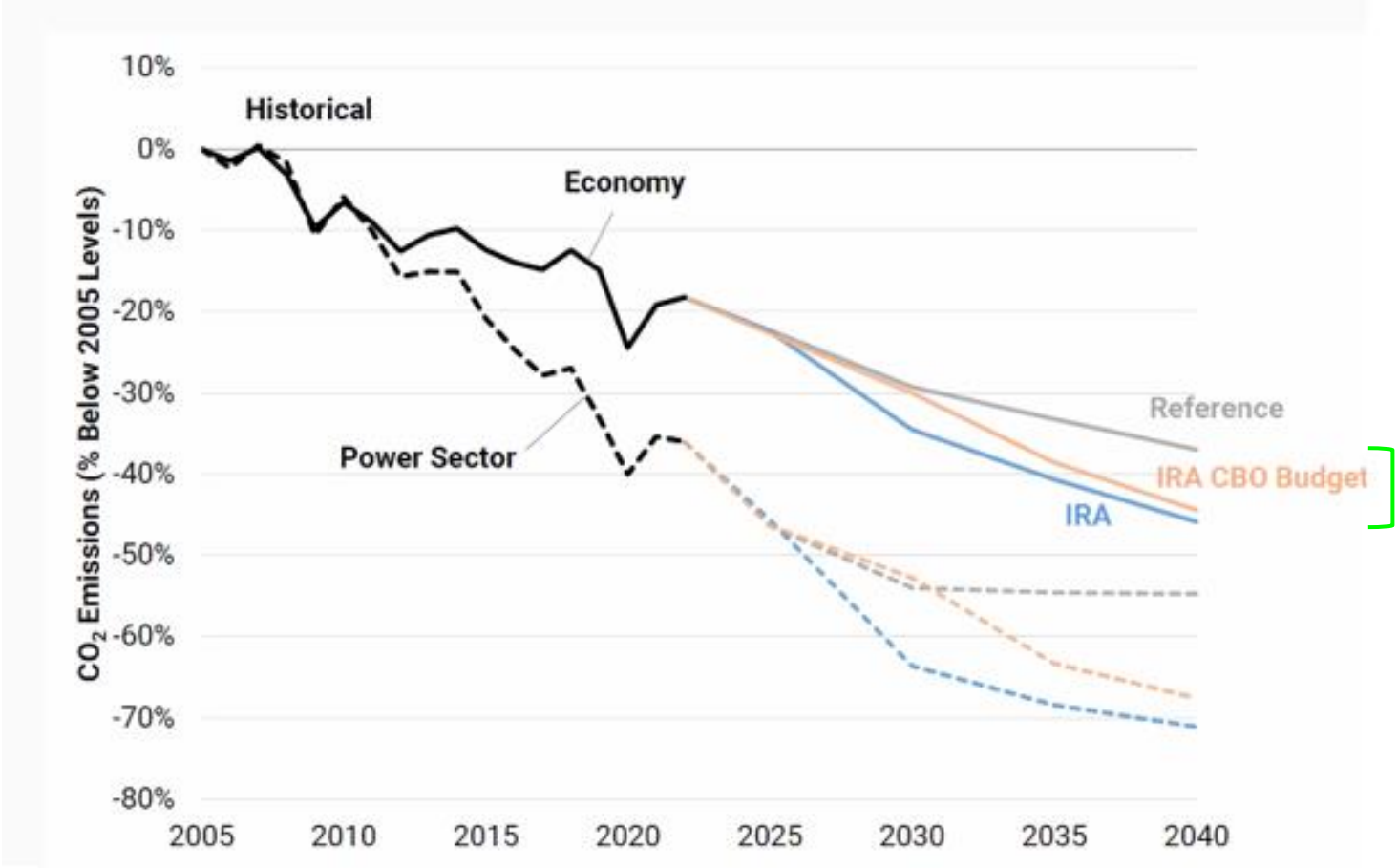
- Focus of the subsidies:
  - Clean electric power generation
    - Investment tax credit (ITC) and production tax credit (PTC)
    - Credits expire only after emissions-intensity targets are reached
  - Electric vehicles and residential appliances
    - $7500 EV tax credit, subject to sourcing/income requirements
  - Carbon capture and clean fuels
    - Financial incentives toward power plant investments in carbon capture and storage

- Attraction: political feasibility
- Limitation: less cost-effective

IRA Estimated to Lower Emissions by 7 Percentage Points Relative to BAU in 2040

(Analyses by Electric Power Research Inst. and US Congressional Budget Office)

Emissions Relative to 2005 Levels



China's Nationwide CO_2 Tradable Performance Standard

- Not a carbon tax or cap and trade; instead, a rate-based approach

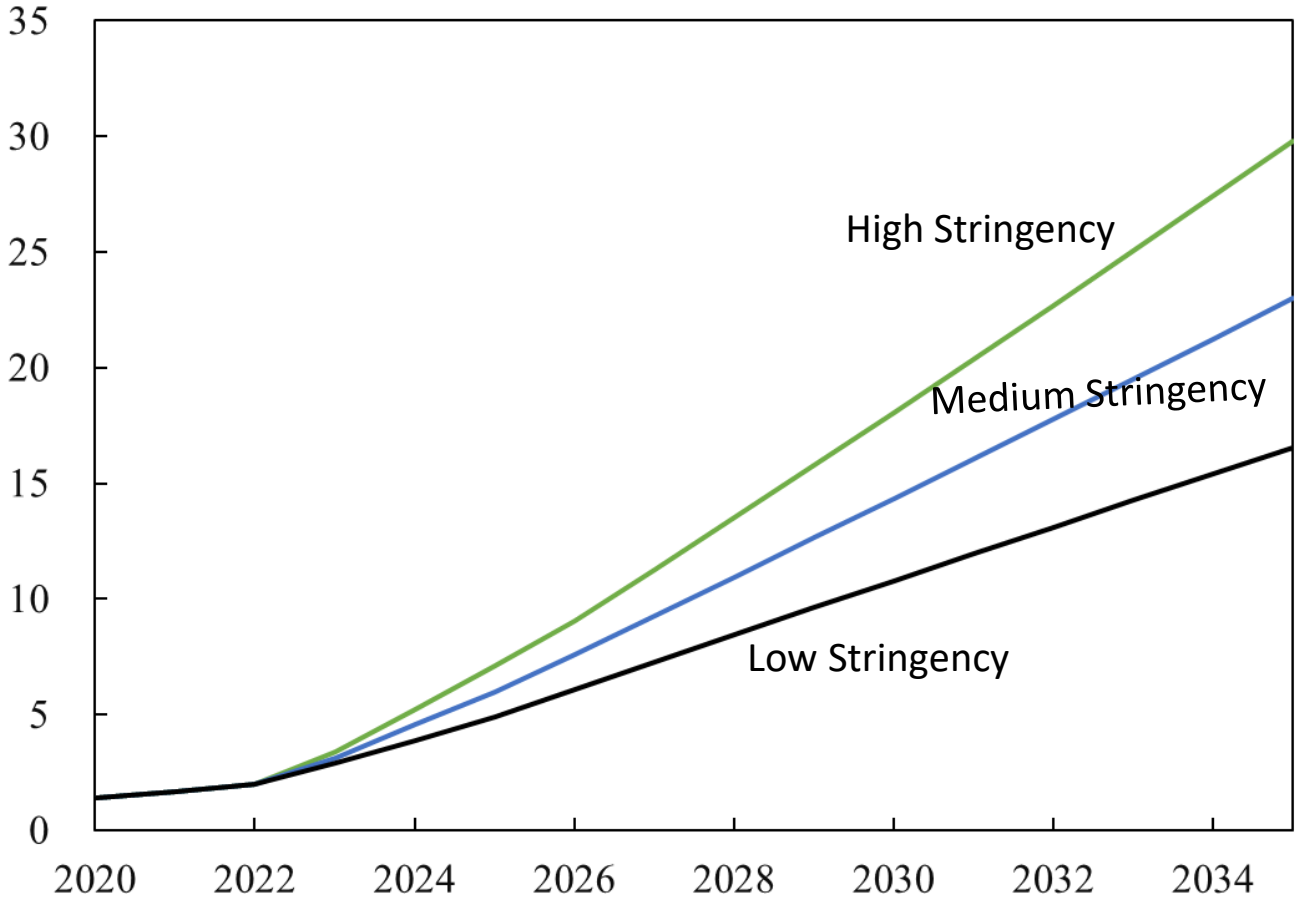
- Coverage:
  - 2020-2023: power sector
  - 2023-2026: add cement, aluminum, and iron&steel
  - 2026-: add pulp & paper, non-metal products, refined petroleum, and chemicals added

- Attractions: lower output prices, less emissions leakage
- Limitation: slightly less cost-effective than carbon tax or cap&trade

Nationwide Emission Reductions

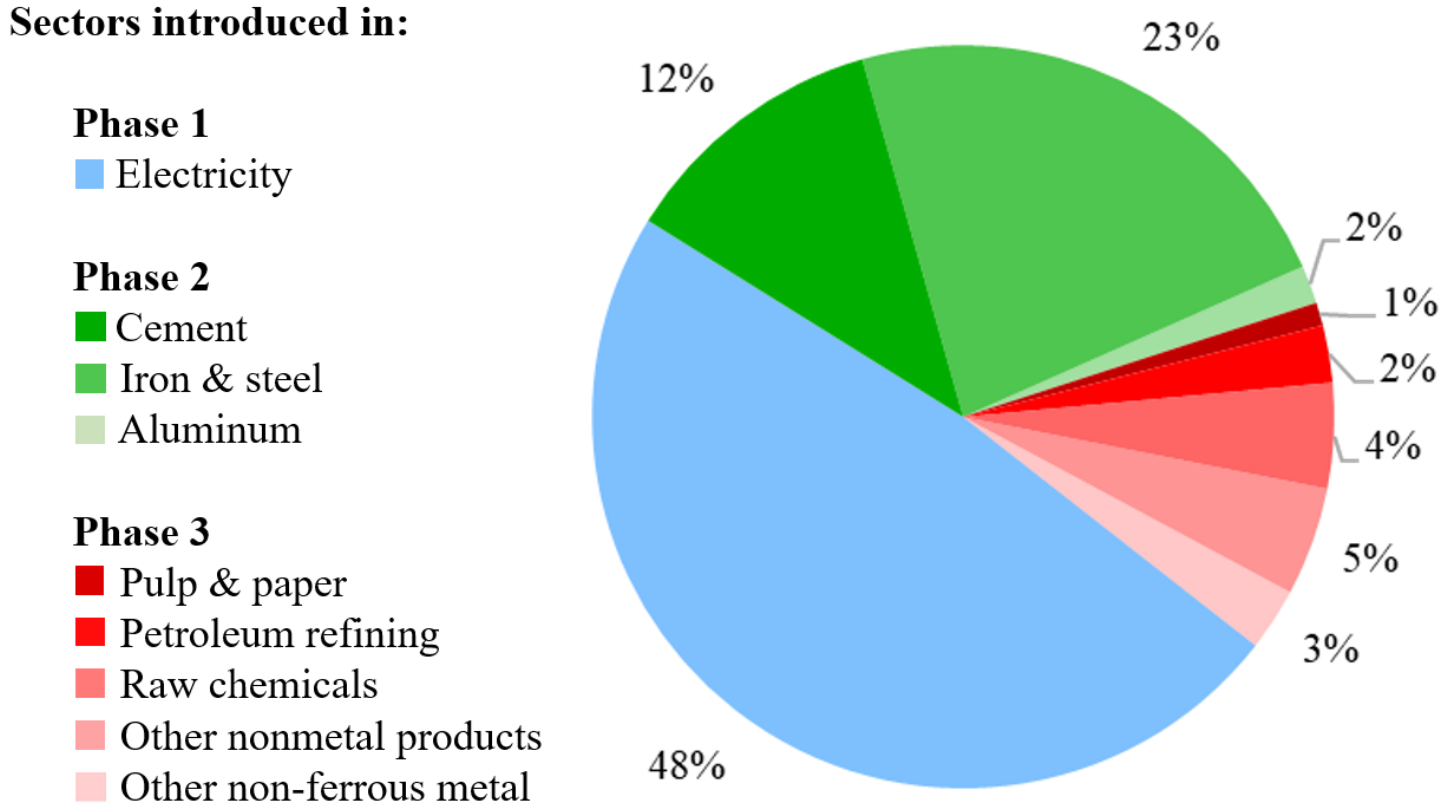
Results from Goulder-Long-Qu-Zhang GE Model

Percentage Reductions Relative to Baseline Emissions



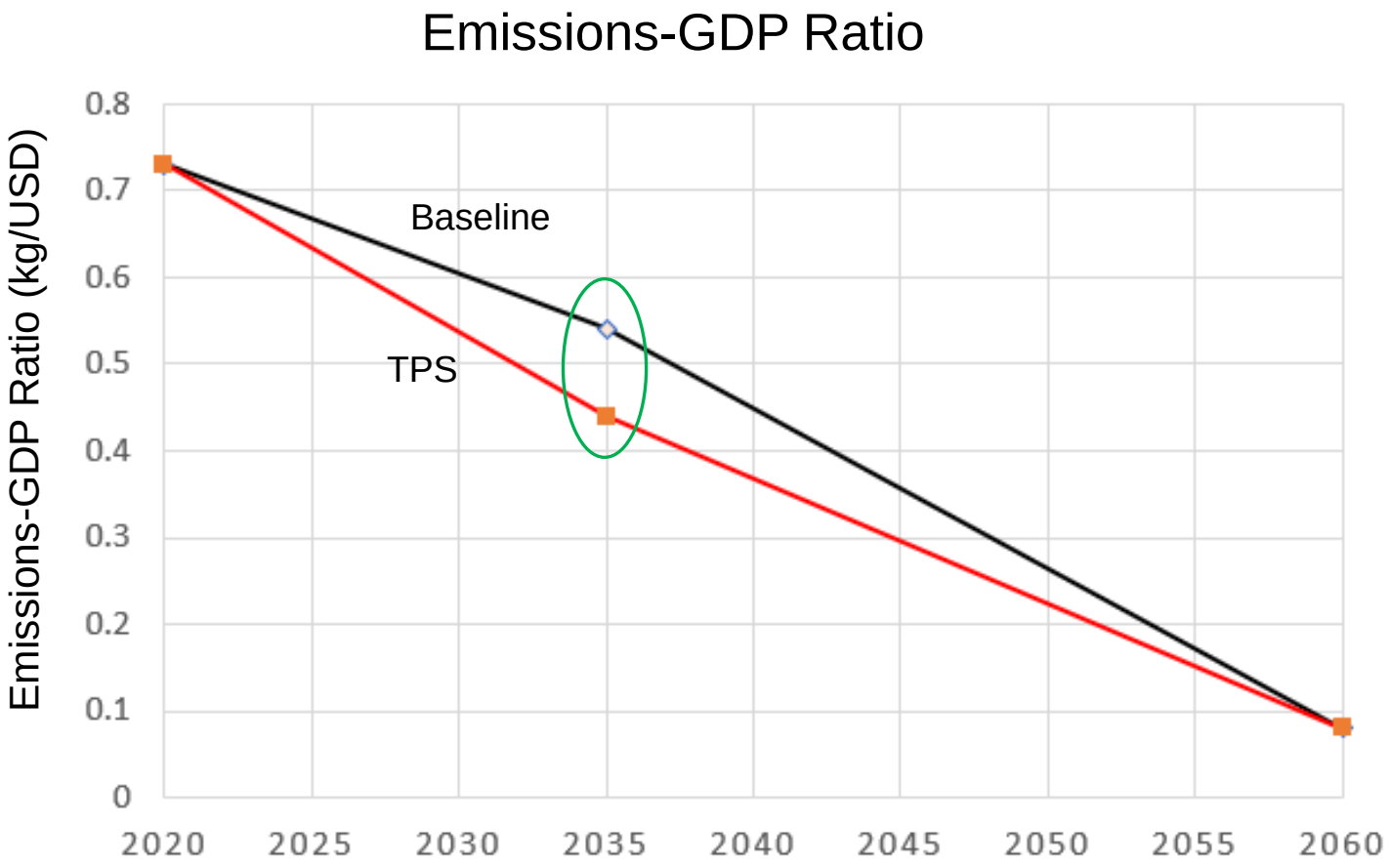
About Half of the Emission Reductions over 2020-2035 Interval Are From the Power Sector

Sectors' Relative Contributions to Aggregate Emissions Reductions



Is the TPS Moving China “Fast Enough” to Net Zero?

Is the TPS Moving China “Fast Enough” to Net Zero?



In Sum:

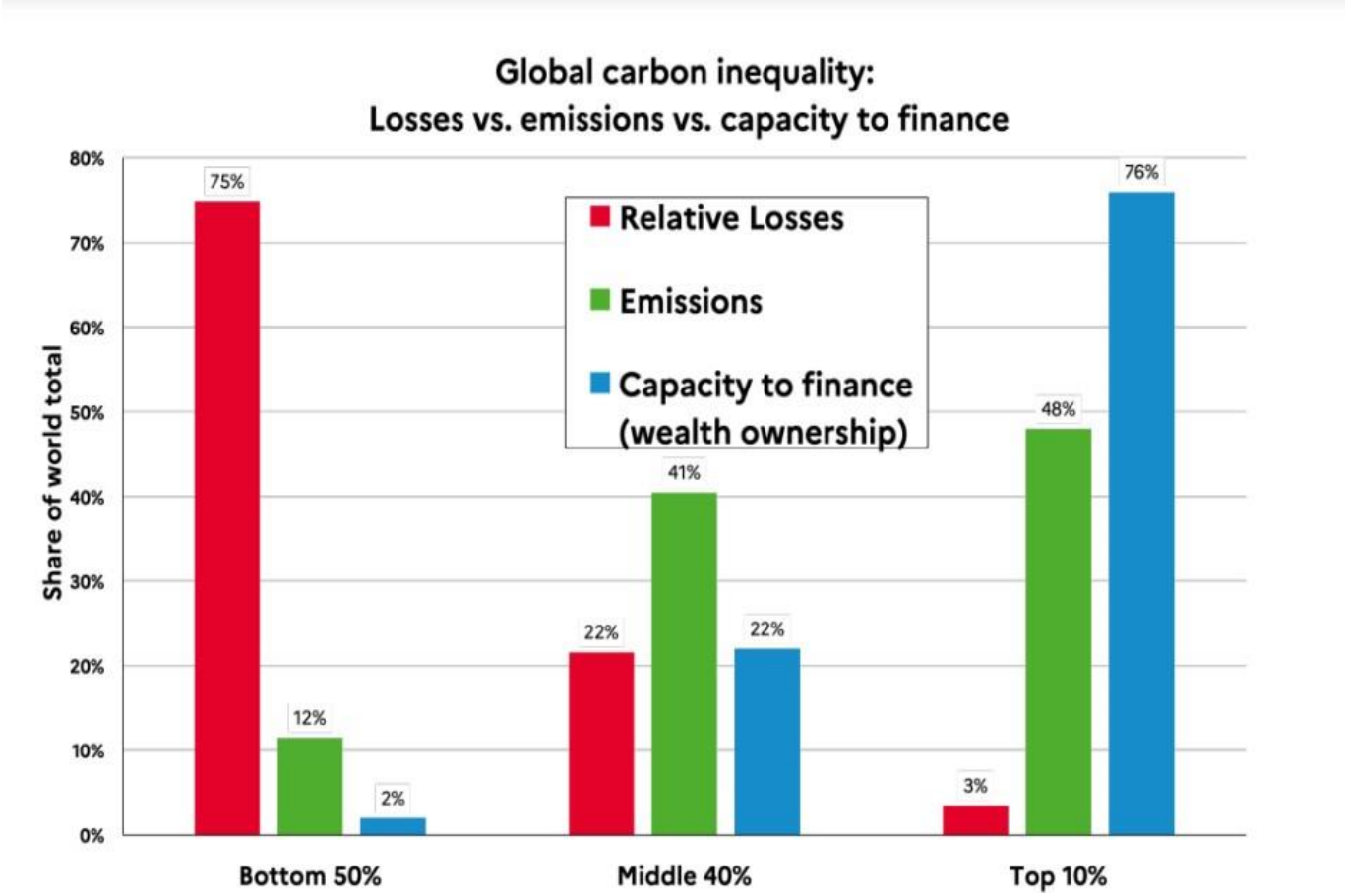
- At the national level in the US and China, carbon pricing does not take the form of a carbon tax or cap and trade (the approaches most favored by many economists)
  - US IRA – clean energy subsidies
  - China TPS – rate-based emissions trading system
- Nevertheless, these forms of emissions pricing are projected to reduce emissions considerably – and at costs below the benefits
- Will such pricing lead to net zero?
  - US – looks promising (if the subsidies remain in place!)
  - China – also a promising start – but continued tightening of standards will be needed
- Note: Economics justifies implementation of policies that complement emissions pricing (e.g., subsidies to innovation)

Carbon pricing and carbon neutrality

Do they match?

Suzi Kerr
SVP and Chief Economist
Environmental Defense Fund

Environmental Defense Fund



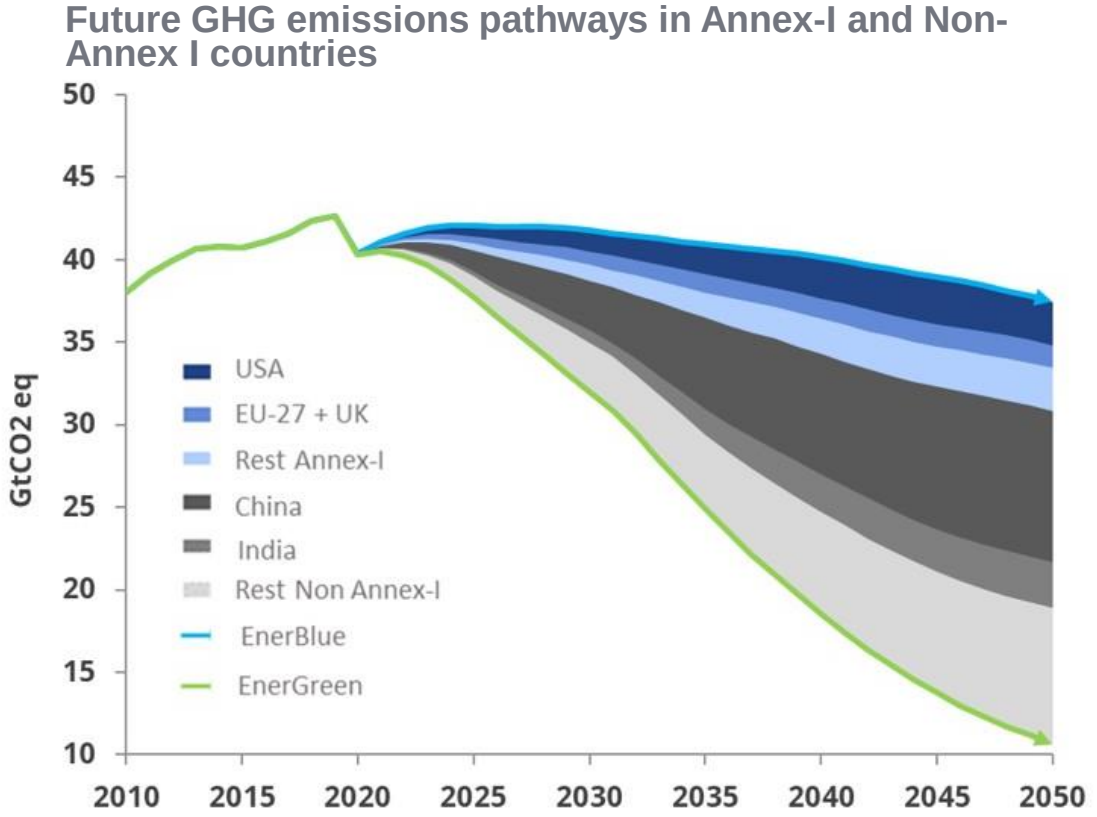
World Inequality Lab, 2023

The challenge:
75% of reductions need to be happen in developing countries

Around 50% from transition to clean electricity

Around 10% from avoiding deforestation

How can this be paid for and financed?



Source: *Enerdata, EnerFuture Edition 2021*

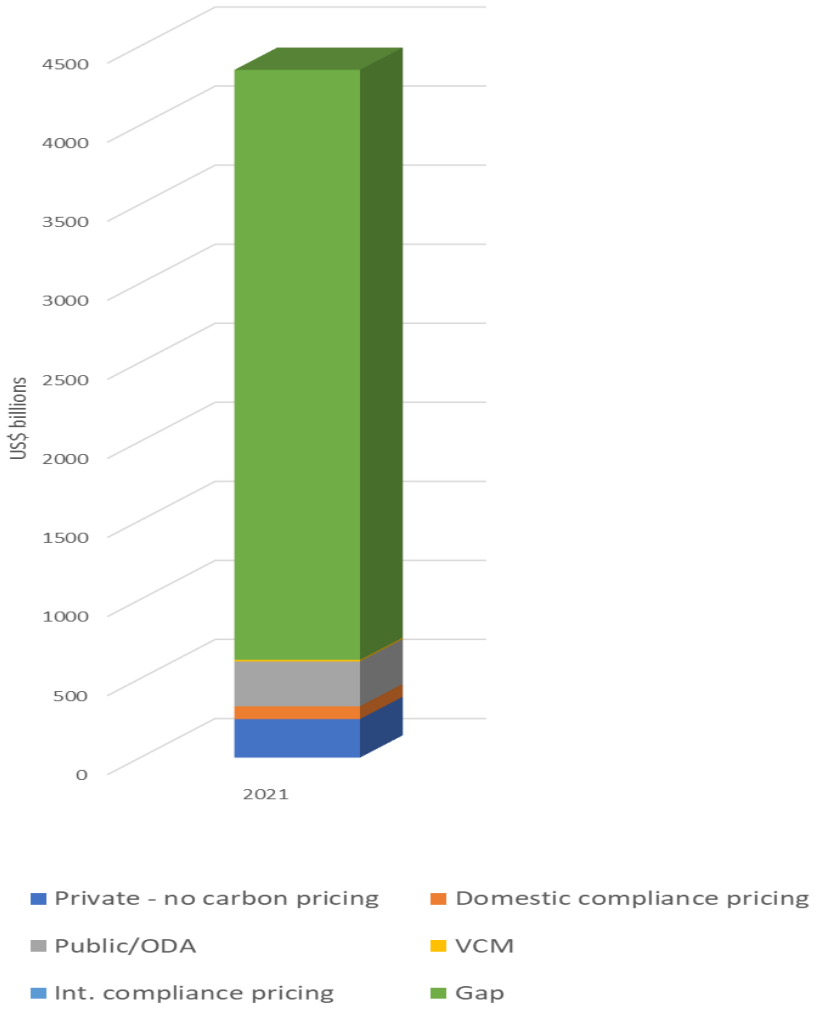
Total finance needed for clean transition annually by 2030

– 4.3 trillion

Finance gap in 2021

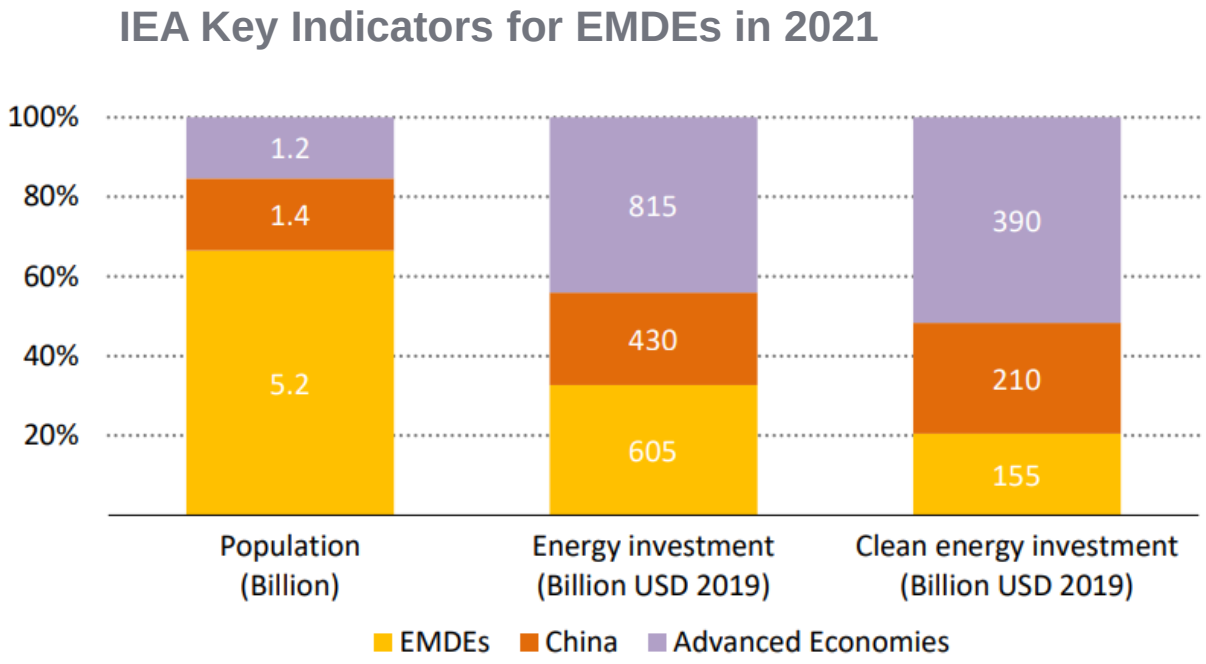
– 3.7 trillion

Climate Policy Initiative



Not enough clean energy investment where it counts

Emerging market and developing economies account for 2/3 of world's population but only 20% of global clean energy investment



Source: *IEA World Energy Investment 2021 Special Report*

Carbon ‘markets’: Transferring resources from those who have, to those who need, for mutual benefit and climate ambition

High concern

High wealth

High cost to accelerate climate action

Political resistance to spending offshore

Willing to contribute more – ethics and enlightened self-interest

$

skills

Technology

Political support

High concern

Low wealth

Low economic cost to accelerate climate action

Political resistance to local action

Willing to act but constrained by resources

International carbon markets could help fill the finance gap

Carbon revenues can raise the returns on clean investment.

- e.g., sell carbon reductions as well as renewable electricity

Sources of international demand for carbon credits:

- Voluntary carbon markets (VCM)
- Compliance carbon markets – Article 6 of Paris Agreement; CORSIA

Credits can come from:

- Projects – historically common
- Jurisdictional / sectoral – now used for forests but applicable to any system change – e.g., energy

International carbon markets could help fill the finance gap

Because carbon markets largely involve bespoke trades they can incorporate:

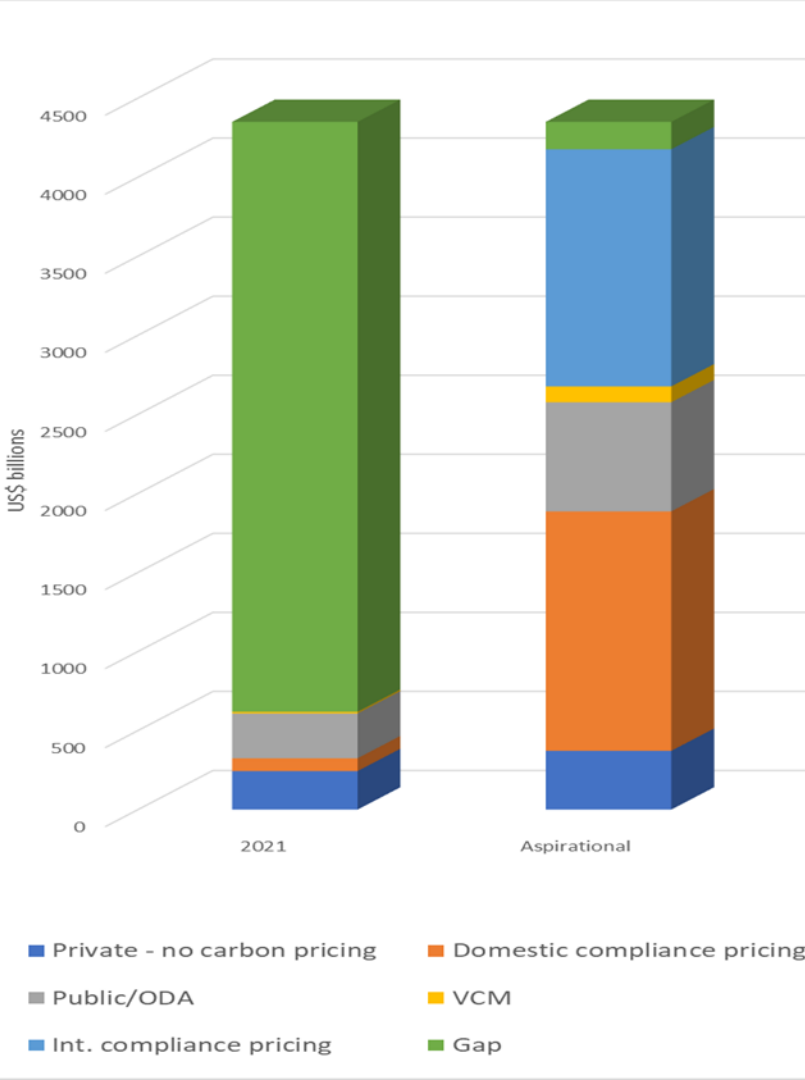
- advance payments from the buyer to de-risk investments – e.g. political risk and delivery risk - through insurance or an equity stake; and
- pricing that shares carbon price risk.

Sectoral agreements can support system change such as training programs, social protection and electricity reform

The higher returns, lower risk and more supportive economic and regulatory environment can then help mobilise private capital

International transfers for mitigation under Art. 6, CORSIA and VCM should play a major role in mobilizing private investment
- Complementing public funding

Domestic compliance pricing – broader than carbon tax - should also



But who will be willing to pay in the ‘North’?

Lack of trust in ‘crediting’ mechanisms (‘offsetting’ is the use of credits)

‘Aid’ mentality

Lack of trust in effective use of funds

Public resistance to use of domestic resources abroad in the face of domestic challenges

But this is not aid, it’s enlightened self-interest

Need for more effective instruments

And less transparent ones?

No global neutrality without global ‘carbon markets’

1. Rapid transition is not possible without support in most developing countries

   And we have a moral responsibility

2. We need to use all effective approaches to transfer resources

   Project-based credits

   Jurisdictional/sectoral crediting

   Multilateral Development Banks

   Aid agencies

   Private Philanthropy

   Results-based debt forgiveness…

3. Support capability, mobilise private capital


Merci
EDF.org