Instruments for climate policy: voluntary approaches, regulation, economic instruments

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Outline

- Various instruments allow for decentralisation of environmental protection
- Comparison and choice criteria
- Presentation and assessment of instruments

INTRODUCTION

Possible instruments and assessment criteria

Why instruments ?

- Engineering and planning models define the optimal abatement solution (quantity, distribution of efforts, asf.)
- Their implementation requires individual participation of the polluters

$\Rightarrow$ Decentralise

$\Rightarrow$ Different instruments are possible

POSSIBLE INSTRUMENTS

Paying for discharging waste into a landfill …

Honolulu's landfill

… but the atmosphere is a landfill for free

- Inform and call to reason: **voluntary approaches (self-regulation)**
- Forbid or limit deposits into the atmospheric landfill: **regulation**
- Put a price on deposits into the atmospheric landfill: **emissions tax**
- Set emissions quotas, allow for trading them: **emissions permits**

Instruments for environmental policy

- Voluntary approaches (self-regulation): stewardship, education, information, good examples, naming and shaming, labels, nudges…
- Command and control instruments or regulation: standards, obligations, bans, liability regulation, emission allowances…
- Economic instruments: incentive taxes, incentive subsidies, creation of property rights and markets (e.g. tradable emissions quotas)
- Service and infrastructure instruments: clean alternatives (e.g. public transportation), R&D, environmental criteria in procurement
- Combination of instruments

Fundamental differences

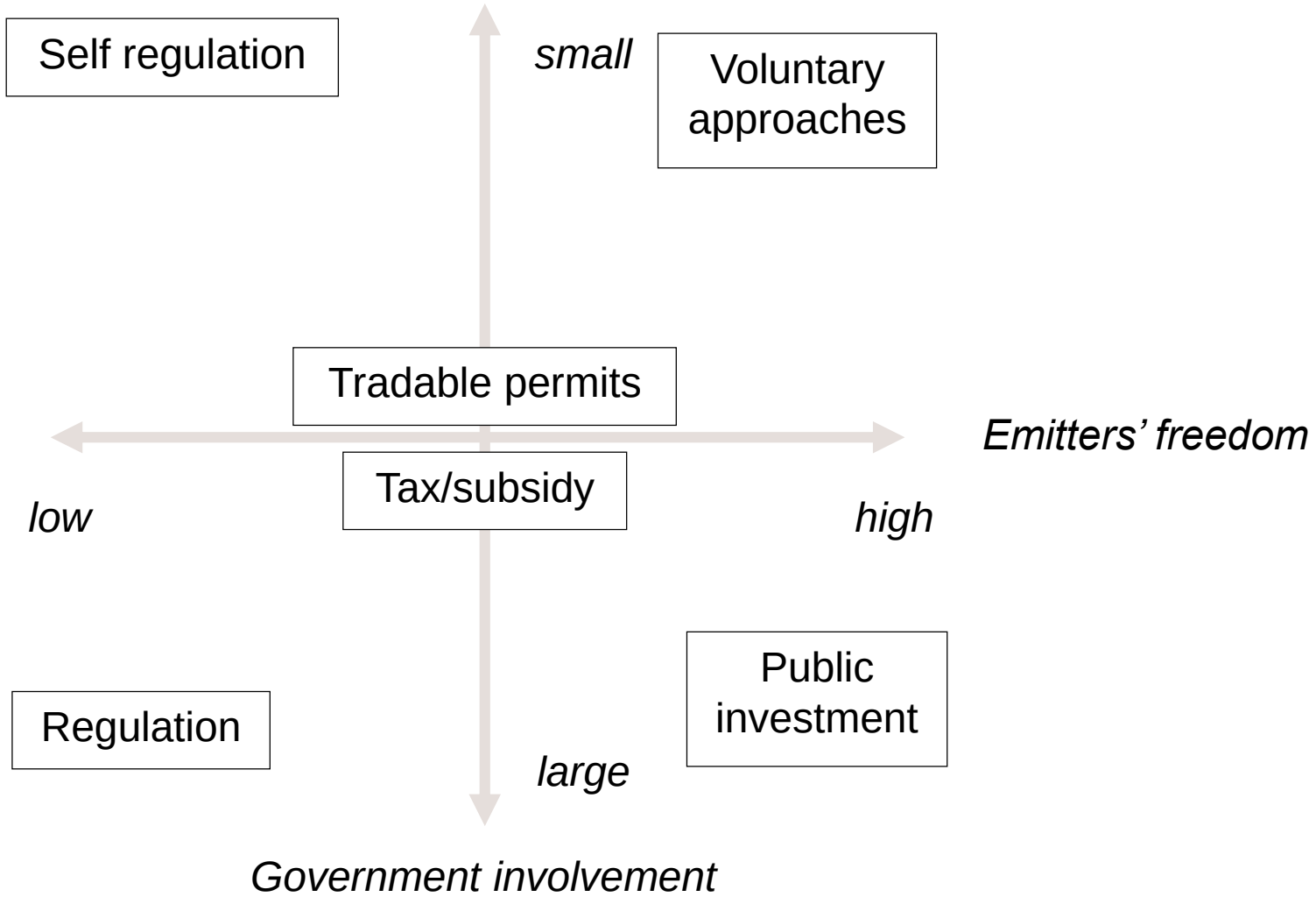
There exist many possible instruments for climate policy, which can be distinguished by the degrees of freedom they leave to market actors and the implications of the authorities

- **Regulation**: the quantity is set, sometimes even the means (standards, building codes, utility regulation, etc.) but not the price
- **Economic instruments** or incentive-based approaches: the price of pollution is set and market actors are let to decide about quantities and means
- **Intermediates solutions**: regulation with flexibility (e.g. tradable emission quotas)

Instruments that are not really instruments

- **Voluntary approaches**: information, persuasion, etc.
- **Public investment** in alternatives → subsidizing R&D, proposing infrastructure, etc.

Fundamental differences



COMPARISON AND CHOICE CRITERIA

Criteria for comparing instruments

- **Environmental effectiveness** – the extent to which an instruments achieves the intended environmental objective or realizes positive environmental outcomes
- **Cost-efficiency** – the extent to which the instrument achieves the objective at minimum cost to society, broadly defined
- **Equity** or fairness – the incidence, or distributional consequences of the instrument; who bears the costs
- **Feasibility** – the extent to which an instrument can be implemented and monitored at reasonable cost; its acceptability, i.e. the likelihood that it is viewed as legitimate and adopted; its compatibility with constitutional principles (equal treatment, proportionality, asf.)

Comparison and choice criteria

ENVIRONMENTAL EFFECTIVENESS

What is environmental effectiveness?

- In most cases, a target is set:
  - for emissions (e.g. max 1 ton CO_2 or 2 kW energy per person and year)
  - for emissions reduction (e.g. emissions decrease by 30% by 2030)
  - for environmental quality (e.g. max 450 ppm CO_2 in the atmosphere)
- Economists like ancillary targets, which are designed to ensure "environmental efficiency":
  - polluters pay for the costs of their pollution (at least the clean-up costs, polluter pays principle)
  - producers pay all production costs, including external costs (cost internalisation, level playing field)

Assessing the effectiveness of instruments

- When assessing instruments, these questions must be asked:
  - Is it possible to meet the target with the instrument?
  - Does the instrument guarantee that the target is met?
  - Does the instrument allow for fine-tuning (zeroing-in on the target, avoiding over-shooting)?
- Some instruments structurally fail these tests
- For most instruments, feasibility constraints limit their effectiveness

A few basic results about effectiveness

- The effect of voluntary approaches and public investment is particularly uncertain, as it depends strongly on the good-will of firms and consumers
- Such instruments are hard to fine-tune if they turn out not effective enough
- Effectiveness rises with the commitment of the authorities
- The direct regulation of emissions is very effective – when possible…
- Price instruments (taxes, subsidies) can easily been made more or less stringent – if acceptable…

Comparison and choice criteria

COST-EFFICIENCY

There exist generally many possible abatement measures

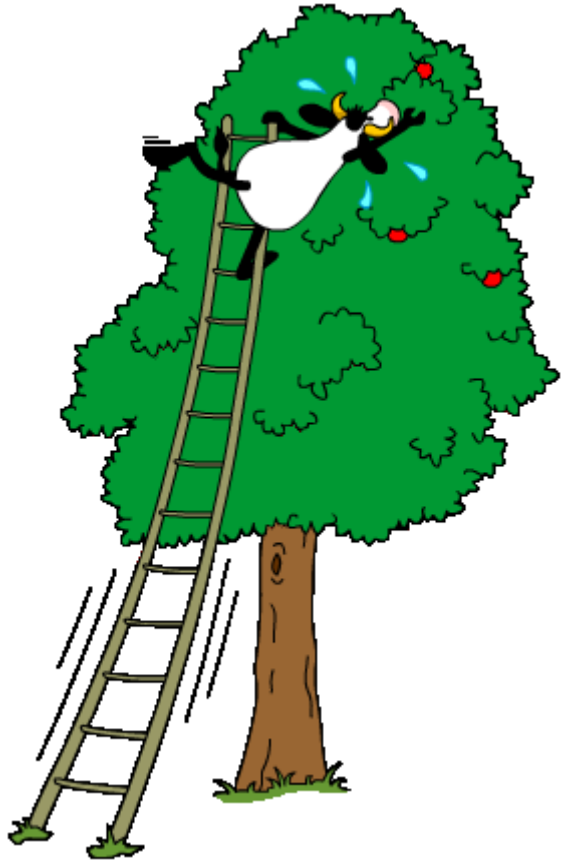
Many possibilities to reduce, e.g., CO_2 emissions from energy:

- adopting technologies to reduce actual emissions (end-of-pipe, CCS)
- switching to less CO_2-intensive fuels (e.g., natural gas for coal, renewables)
- increasing energy efficiency per unit of output by using less energy-intensive technologies
- reducing the production and consumption of energy-intensive goods (tertiarisation)
- increasing the sequestration of CO_2 through reforestation and other measures ('negative emissions')

Abatement costs depend very much on the abatement solution chosen

Cost-efficiency

As a first approximation, cost-efficiency requires that the cheapest abatement efforts be taken first, independent of who is responsible for the emissions and their reduction



http://www.recipeforlowhangingfruit.com/christmas/

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LEURE

The key concept is the marginal abatement cost

Total cost from emissions: damages + abatement costs:

$$\text{Total cost}(E) = D(E) + C(A)$$

Emissions are equal to emissions without abatement minus abatement:

$$E = E_0 - A$$

Minimization of total cost:

$$\text{Min}_A \ \text{Total cost}(A) = D(E_0 - A) + C(A)$$

First-order condition:

$$D'(E_0 - A^*) = \mathbf{C'(A^*)} \quad \textbf{marginal abatement cost}$$

General demonstration

Abatement cost minimization requires equal marginal abatement costs

$$\min_{\{A_i\}} \quad C = \sum C_i(A_i)$$

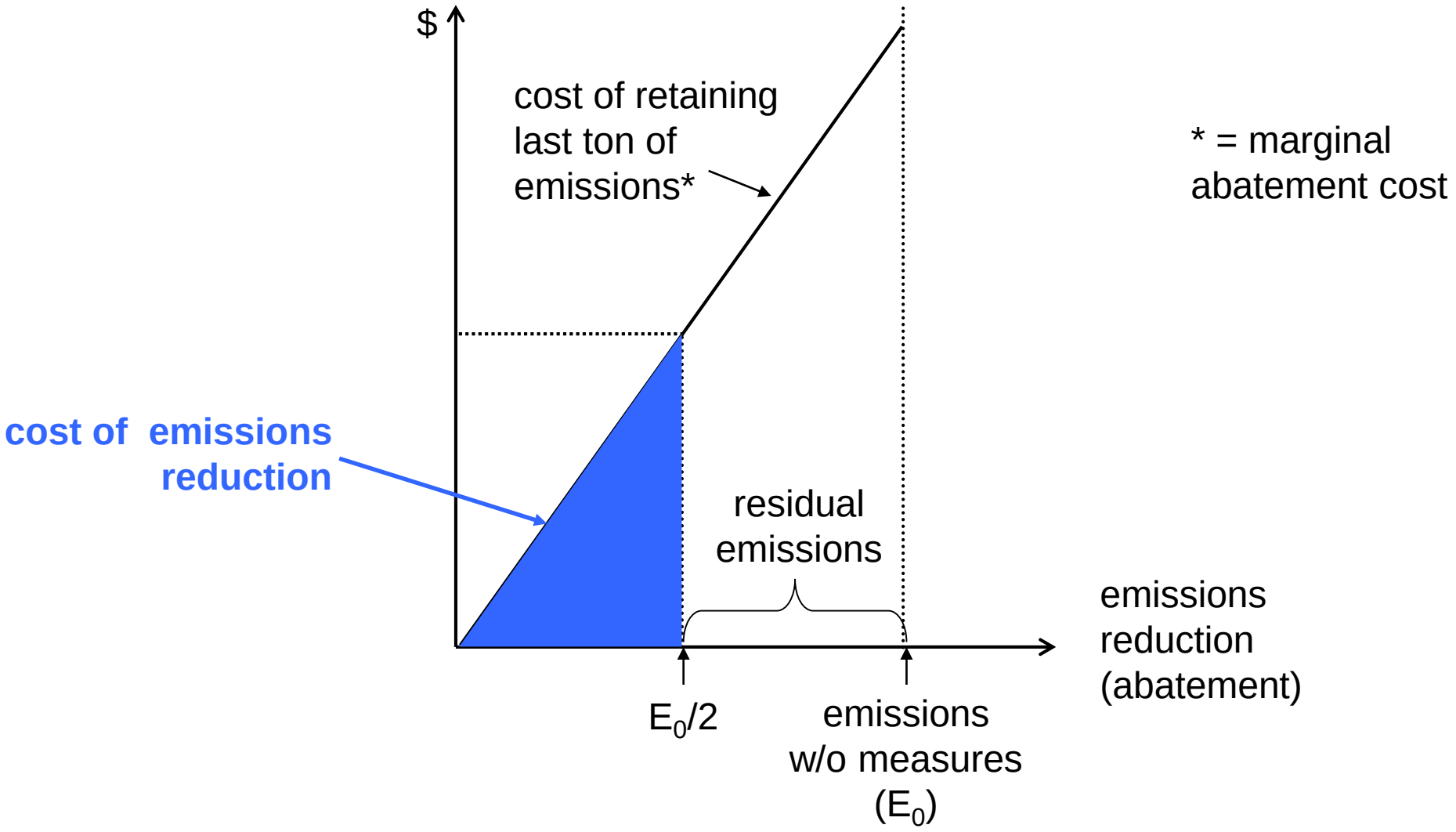
$$\text{s.t.} \quad \sum A_i \geq A^*$$

$$\Lambda = \sum C_i(A_i) - \lambda\left(\sum A_i \geq A^*\right)$$

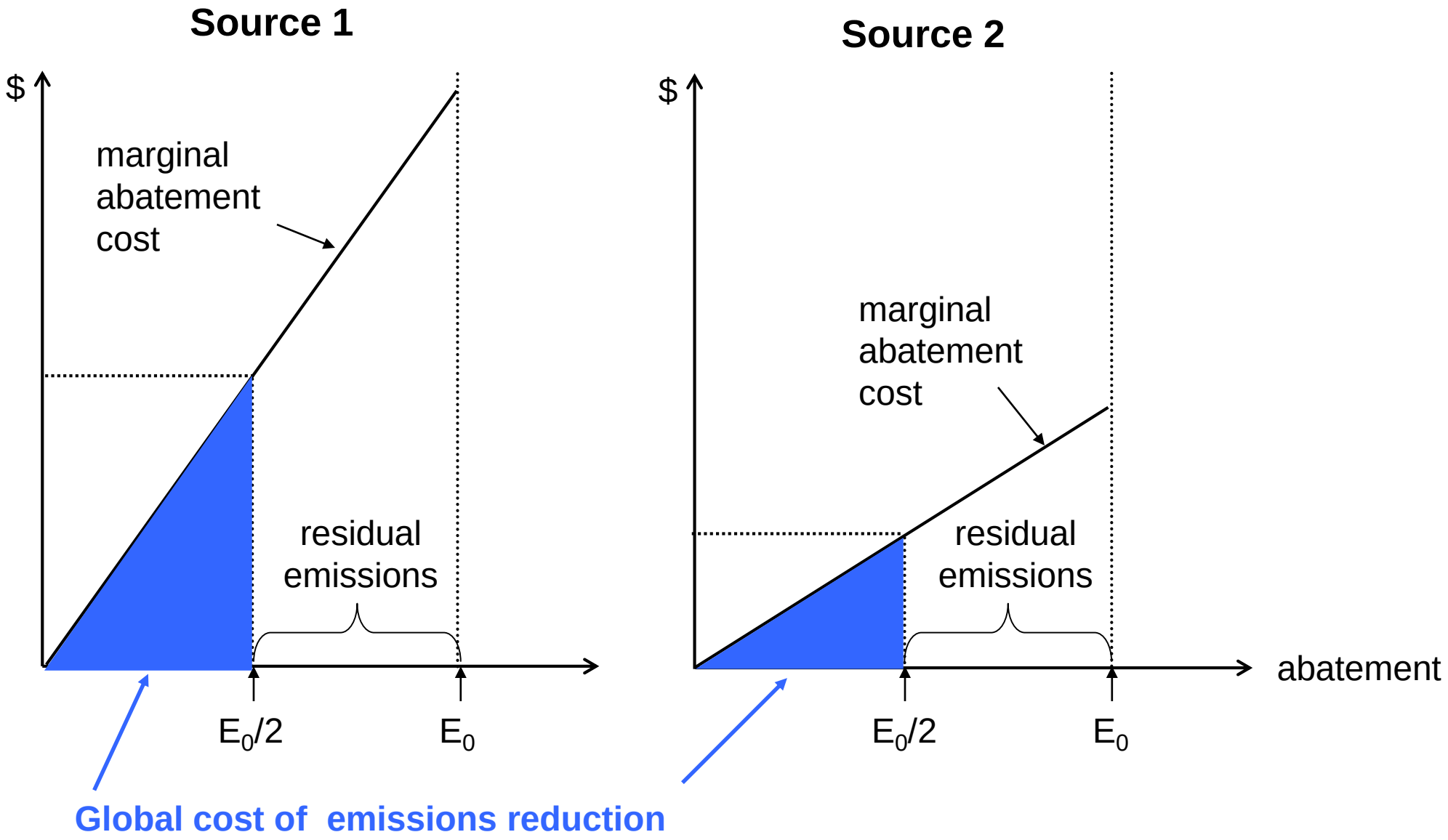
$$\frac{\partial \Lambda}{\partial A_i} = C_i'(A_i^*) - \lambda = 0$$

$$C_i'(A_i^*) = C_j'(A_j^*)$$

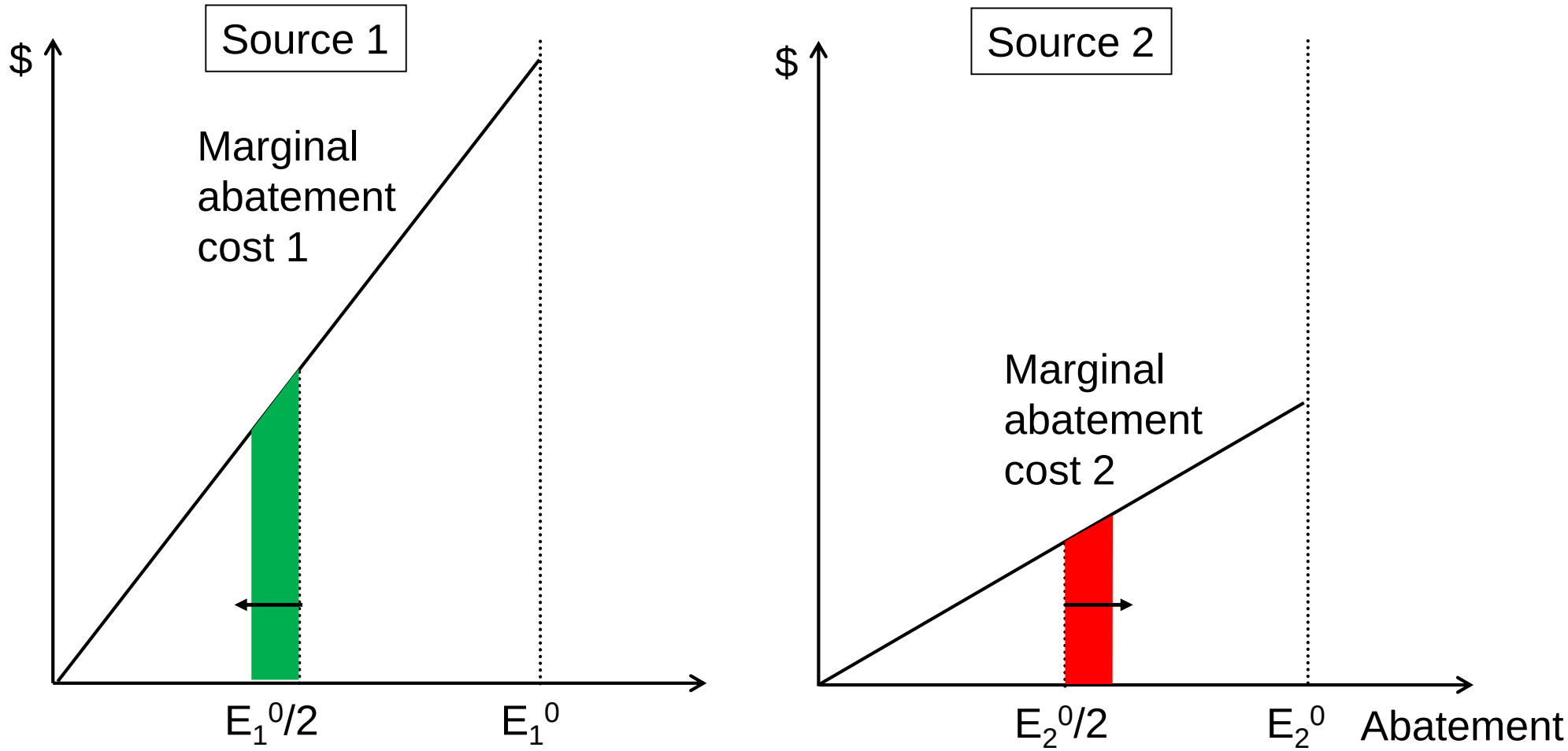
The cost of dividing emissions by two



Global cost of emissions reduction with two sources

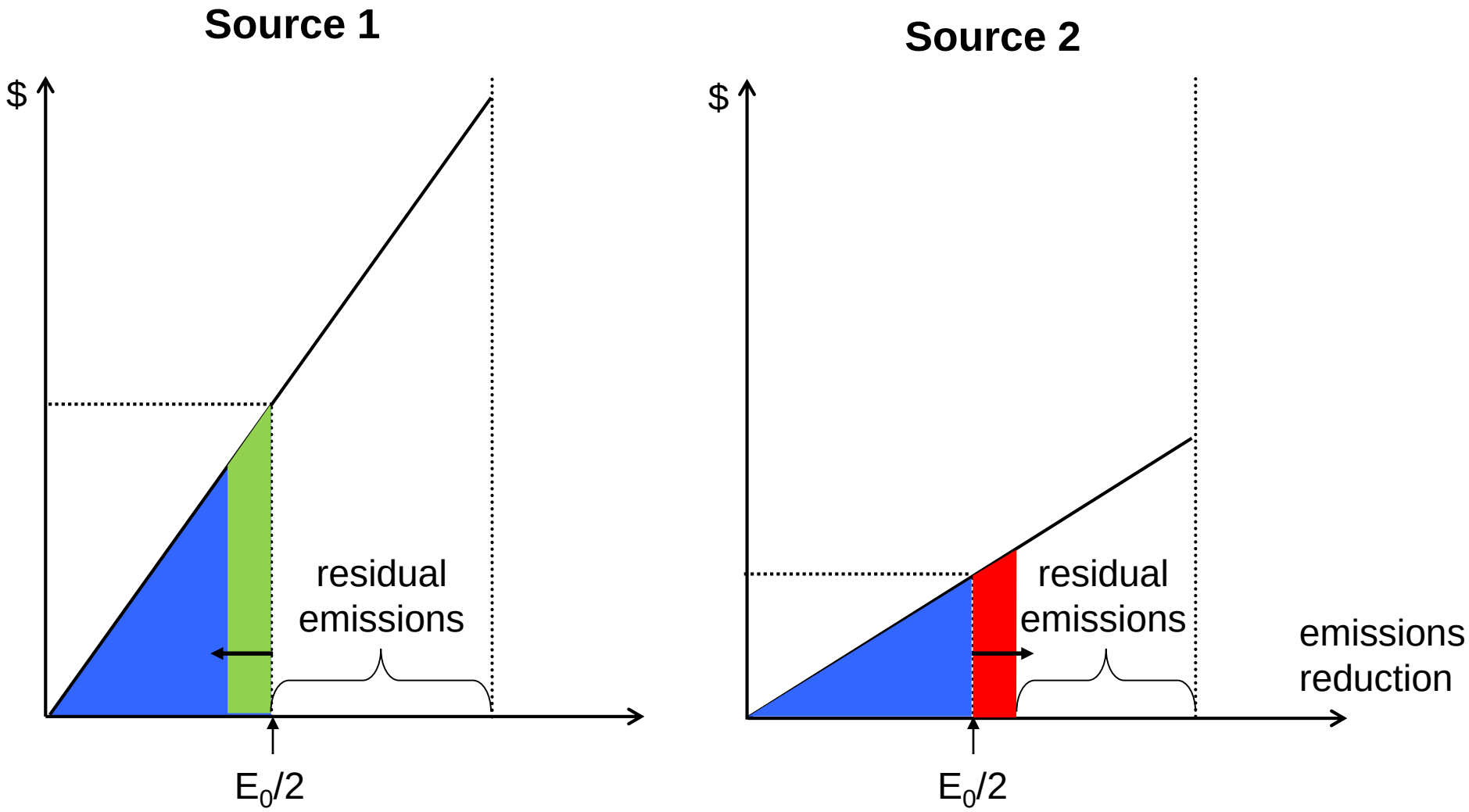


Cost-efficient allocation of mitigation efforts (1)



Efficiency = equal marginal abatement costs

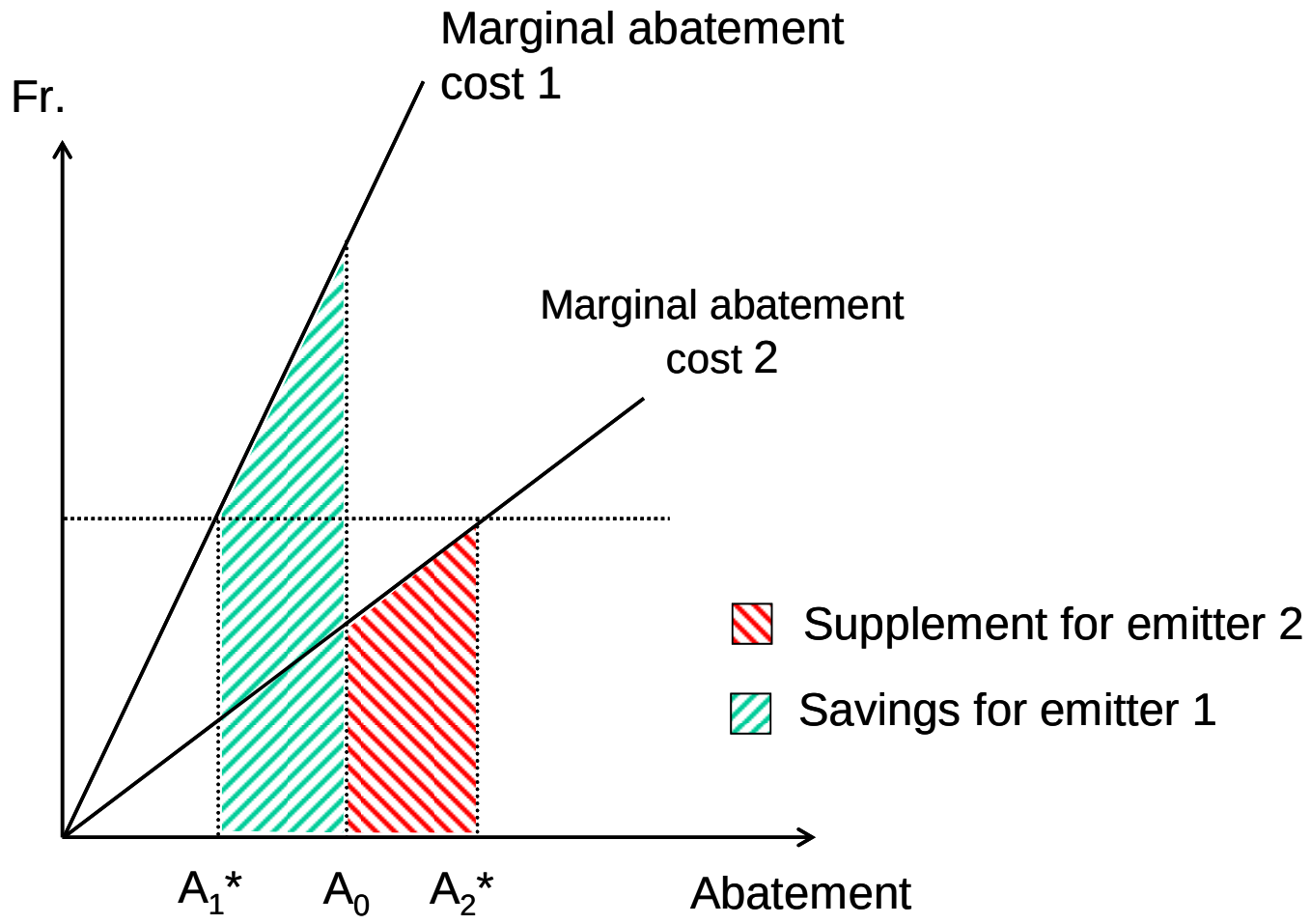
The global cost of dividing emissions by two can be lowered



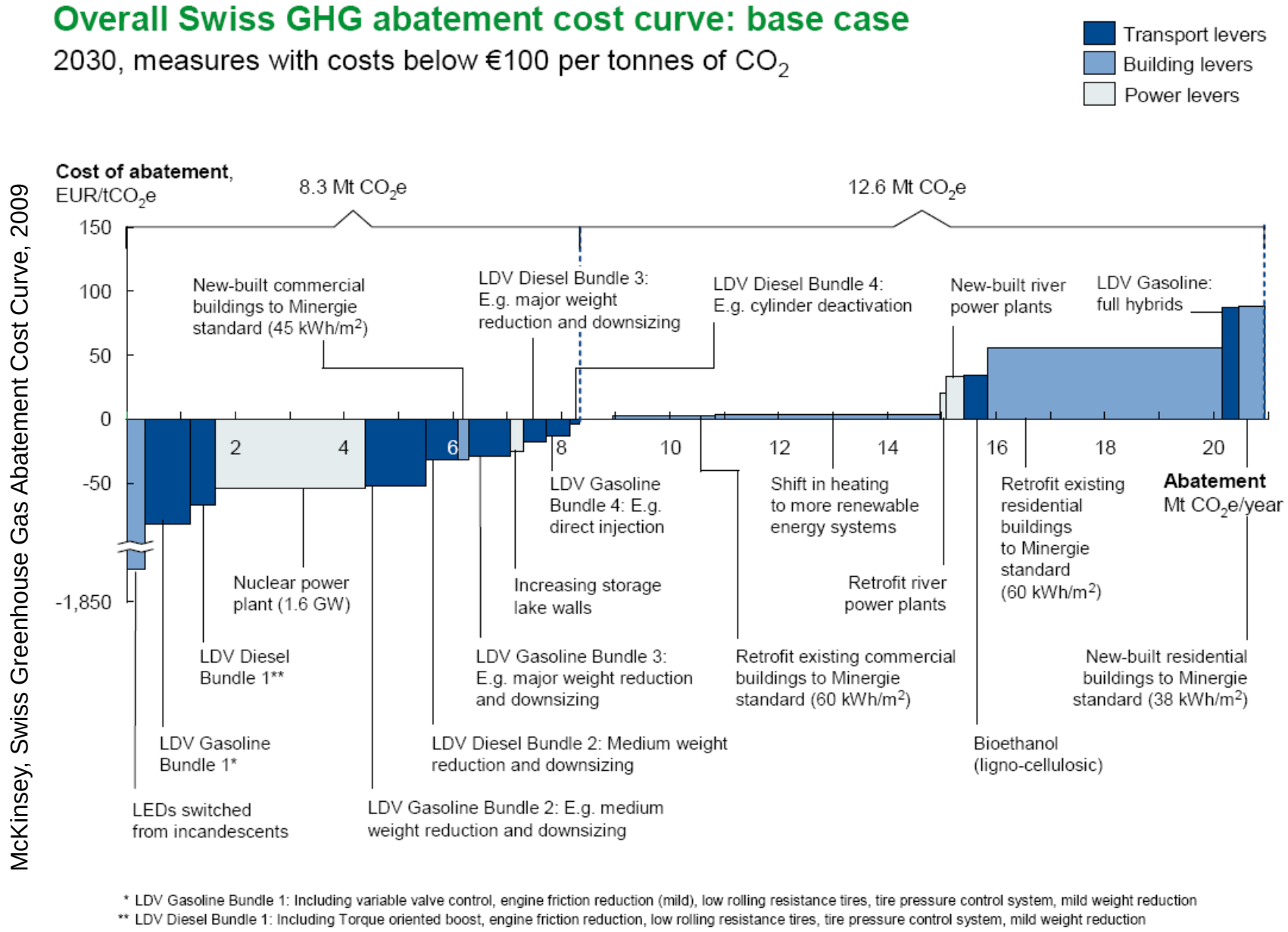
Efficiency = equal costs for the last ton retained

Reallocating abatement efforts (and costs)

Low-cost emitter 2 ought to spend more for abatement than high-cost emitter 1 !



Marginal emissions reduction costs for GHG in Switzerland

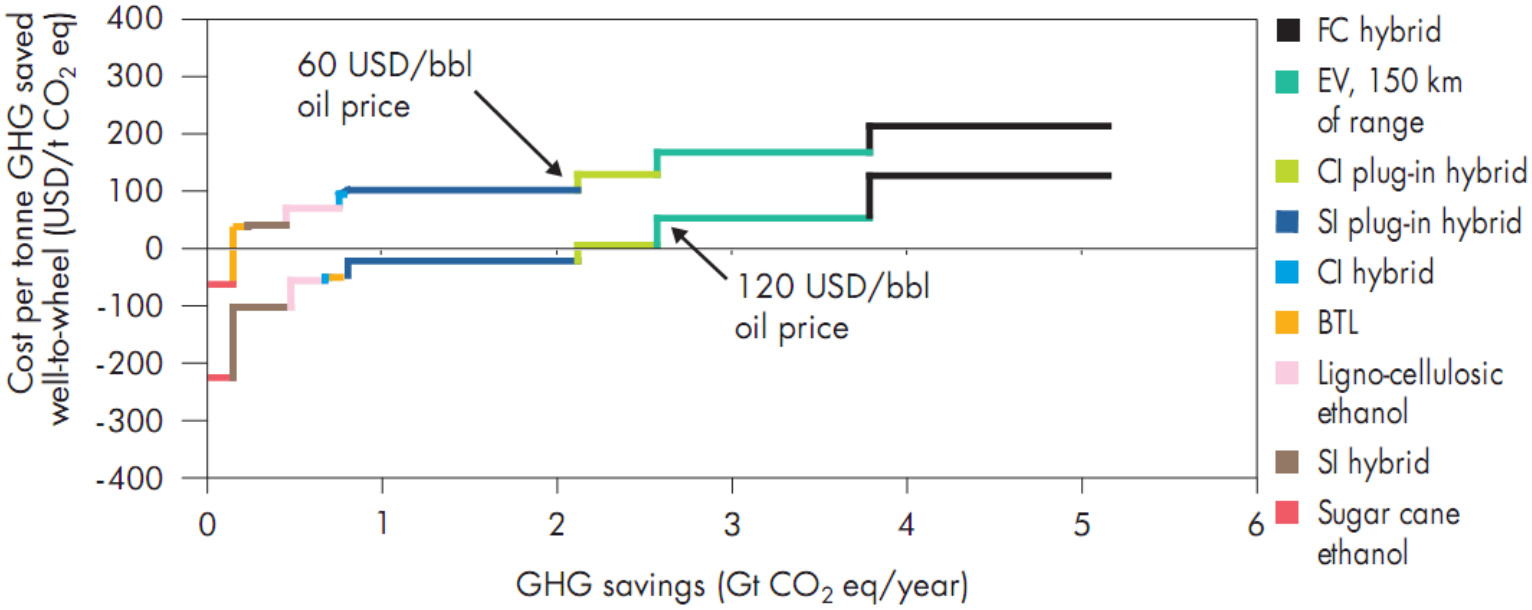


* LDV Gasoline Bundle 1: Including variable valve control, engine friction reduction (mild), low rolling resistance tires, tire pressure control system, mild weight reduction

** LDV Diesel Bundle 1: Including Torque oriented boost, engine friction reduction, low rolling resistance tires, tire pressure control system, mild weight reduction

Marginal GHG abatement costs for LDVs in the world

Figure ES-3 ▶ GHG reductions in BLUE Map for light-duty vehicles and fuels: contribution and estimated cost per tonne by vehicle and fuel type in 2050



Note: SI = spark ignition (gasoline) vehicle; CI = compression ignition (diesel) vehicle; ICE = internal combustion engine vehicle; "hybrid" refers to hybrid-electric vehicle; BTL = biomass-to-liquids biodiesel; FC = fuel cell; EV= electric vehicle.

Key point

Substantial low-cost GHG reduction opportunities appear available, especially at higher oil prices.

International Energy Agency (2009) *Transport, Energy and CO_2, Paris, p.37.*

Comparison and choice criteria

EQUITY

A separate criterion from feasibility?

- A more equitable instrument is politically more acceptable, so equity could be treated as a component of feasibility
- In fact, acceptability requires perceived equity (or fairness)
- Under the equity criterion, the distributional impacts of an instrument are assessed

What is equitable?

- A few principles are accepted in taxation:
  - Horizontal equity: persons in comparable condition, with equal capacity to contribution, should bear the same burden
  - Vertical equity: persons with higher capacity to contribution should bear a higher burden, which involves progressivity of contribution

What is taken into account?

- How is capacity to contribute defined?
  - Income? Which income?
  - Is contribution to pollution taken into account?
- How is the burden defined?
  - Direct burden: costs of compliance and mitigation
  - Indirect burden: translation of costs (e.g. more expensive products when producers pay for compliance and mitigation)
  - Is the environmental improvement taken into account?
  - Are ancillary benefits taken into account (e.g. revenue recycling)

Comparison and choice criteria

FEASIBILITY

Practical feasibility

- Regulation could be cost-effective…
  - if the authority knew all marginal abatement costs (perfect information)
  - if the authority were allowed to impose differentiated reduction targets (no equality of treatment)
- Firms are very protective of their production costs, including abatement cost information
- Firms have an incentive to misreport their abatement costs (cf. EU-ETS)

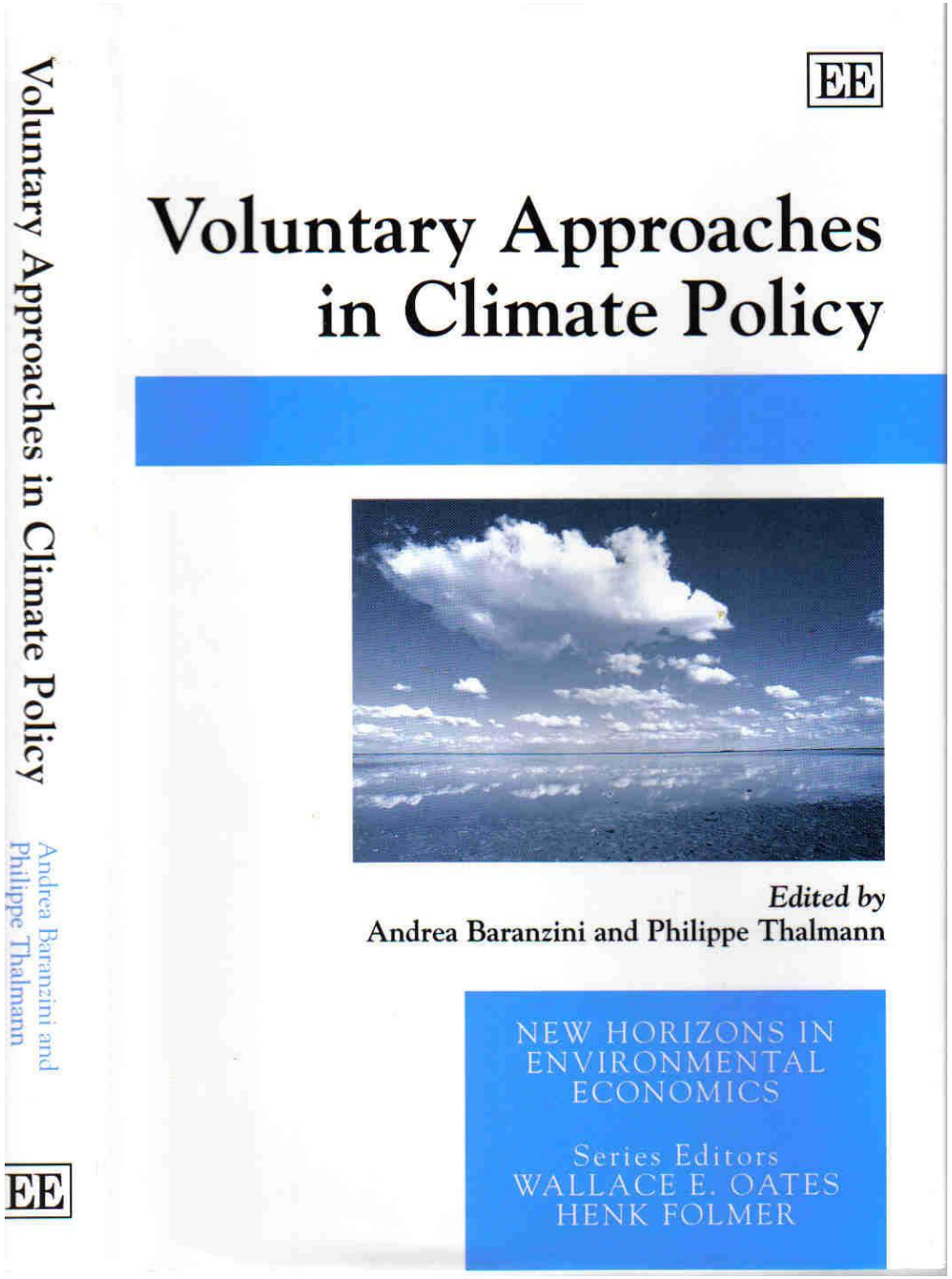
Acceptability

- Do not look at efficiency only : instruments must be accepted !
- Inefficient but acceptable instruments are actually used by policy-makers
- Typical conditions for acceptability:
  - Problem and solution are understood
  - Measure is perceived to be necessary
  - Measure is expected to yield sufficient environmental effect
  - Measure is perceived to be fair
  - No polluter bears an excessive burden, no firm is threatened in its survival
  - Firms are not strongly disadvantaged in international competition
  - Measure does not augment public budget (budget neutrality)

Textbook economic instruments can be made more acceptable

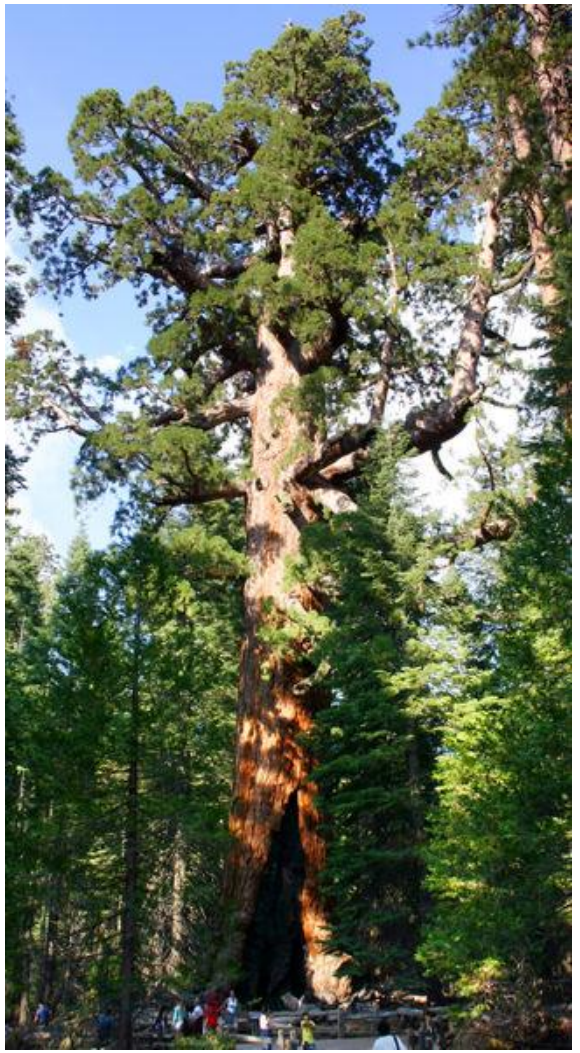
- Public budget neutrality can be achieved with combined tax-subsidy scheme or by free distribution of tradable emission permits (TEPs)
- Burdens can be limited with exemptions: tax exempted baseline, initial endowment of TEPs
- Compensation is possible through revenue redistribution

VOLUNTARY APPROACHES

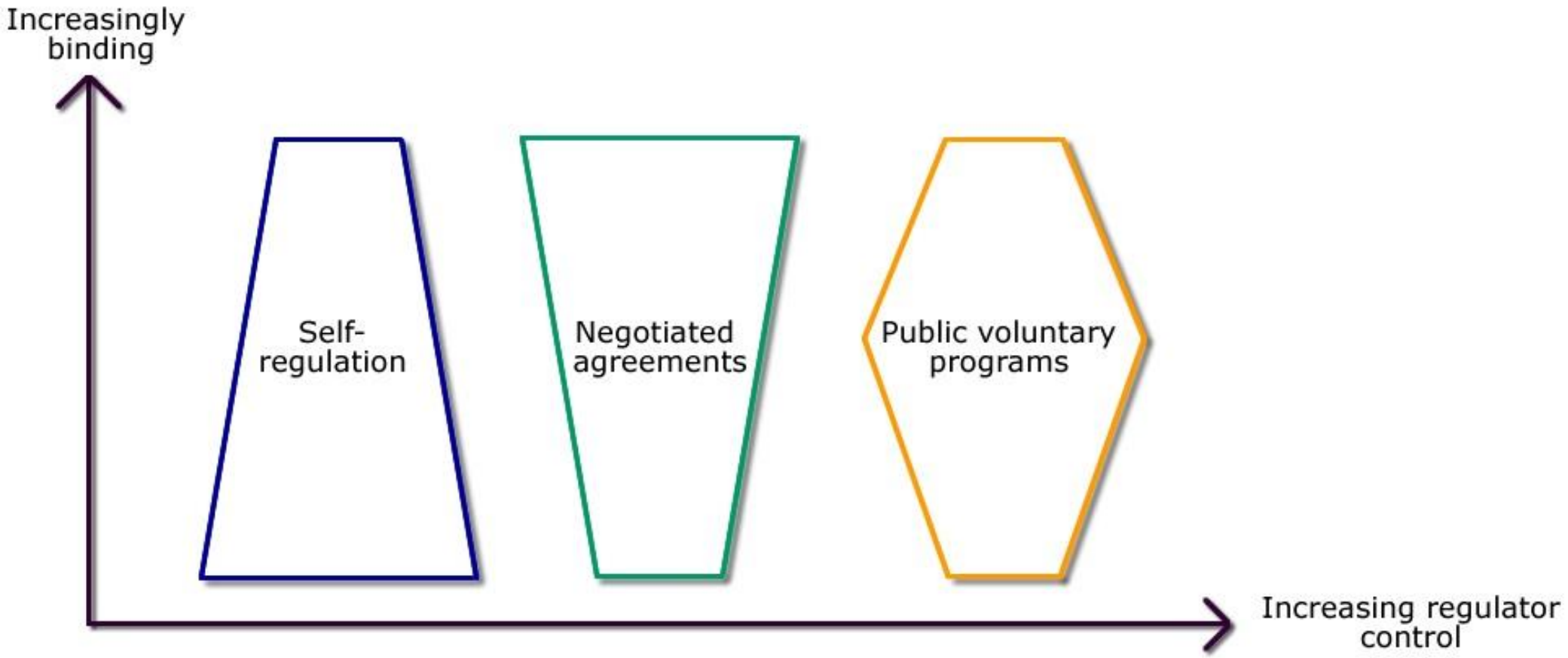


A long history

- Sierra Club, founded by John Muir in 1892 to save the giant sequoia
- Pro Natura founded in 1909 to create the Swiss National Parc



Principle types of voluntary approaches



Motives for participation

- Stewardship, no-regret/win-win → information and education
- Reputation building → transparency (green labels), information disclosure
- Strategic interaction → industry cooperation is tolerated or facilitated, best-practice is imposed
- Insurance motive → liability rule
- Bargain for advantage → constraining instrument in background (threat) or implemented (regulatory relief)

(*cf. Thalmann and Baranzini, 2004*)

Assessment (1)

- Environmental effectiveness
  - depends on motivation of polluter
  - higher with greater involvement by the authority
- Cost-efficiency
  - piecemeal, sector by sector, approach is a problem
  - the fact that not all polluters participate is a problem

Assessment (2)

- Equity
  - No polluter should suffer an excessively high burden
  - The fact that some (many) polluters do not participate makes it quite unfair
- Feasibility
  - Practical feasibility is attained by minimum involvement by the authority
  - Clearly the most acceptable instrument, as it leaves polluters the greatest freedom to comply or not

Conclusions of our book (I)
What's special about climate change?

- The uncertainty about abatement costs and consequences of warming is so great, that constraining measures are hardly acceptable
- Global and long term effects; no direct victims who could sue polluters
- Many polluters, many non-point sources

Conclusions of our book (II)
Do not expect too much of VAs

- Participation is greater when targets are energy or emissions intensities rather than absolute targets
- VAs work fine as long as they are costless (no regret)
- In general VAs reach their targets, but those targets are not very demanding
- They are costly to negotiate and implement (NAs with large polluters, PVP with small ones)

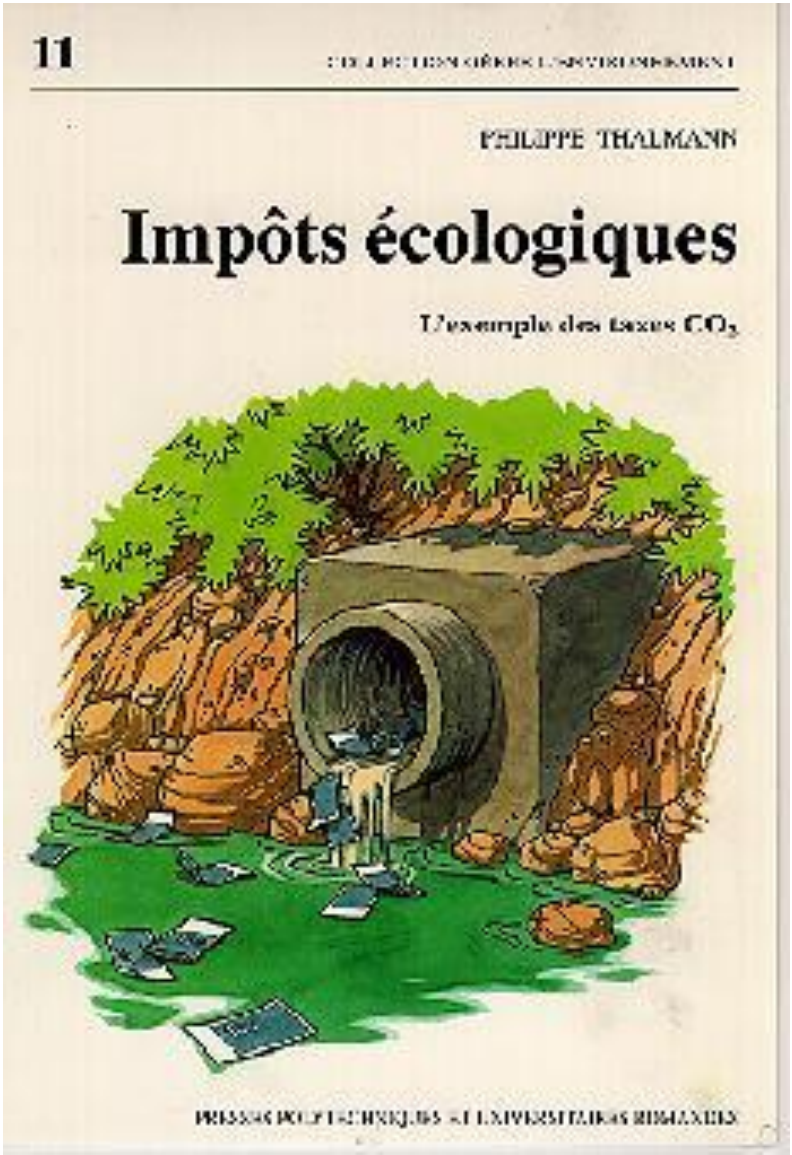
Conclusions of our book (III)
VAs are useful in early stage

- In early stage of environmental policy, VAs are often the only possible because acceptable instrument
- VAs can facilitate the preparation and implementation of more constraining instruments
- They can create support for those instruments
- They can also delay the implementation of more constraining instruments

Conclusions of our book (IV)
VAs should be part of policy mix

- Modern environmental policy combines diverse instruments in order to address the conflicting goals of efficiency and equity
- VAs do not particularly increase the effectiveness or efficiency of policy mixes, but they can increase their acceptance and influence burden sharing
- VAs are rather transitory measures that prepare the ground for more constraining instruments

ECONOMIC INSTRUMENTS



Economic instruments

COST-EFFICIENCY

The main advantage of economic instruments

- Economic instruments let the emitter choose the solution she prefers
- She will choose the cheapest solution
- If prices are right (external costs are internalized), this is also the cheapest solution from the point of view of society
  (E.g. a power plant's choice between using a less carbon-intensive fuel and geo-sequestration is efficient if the power plant must pay the full cost of each solution)

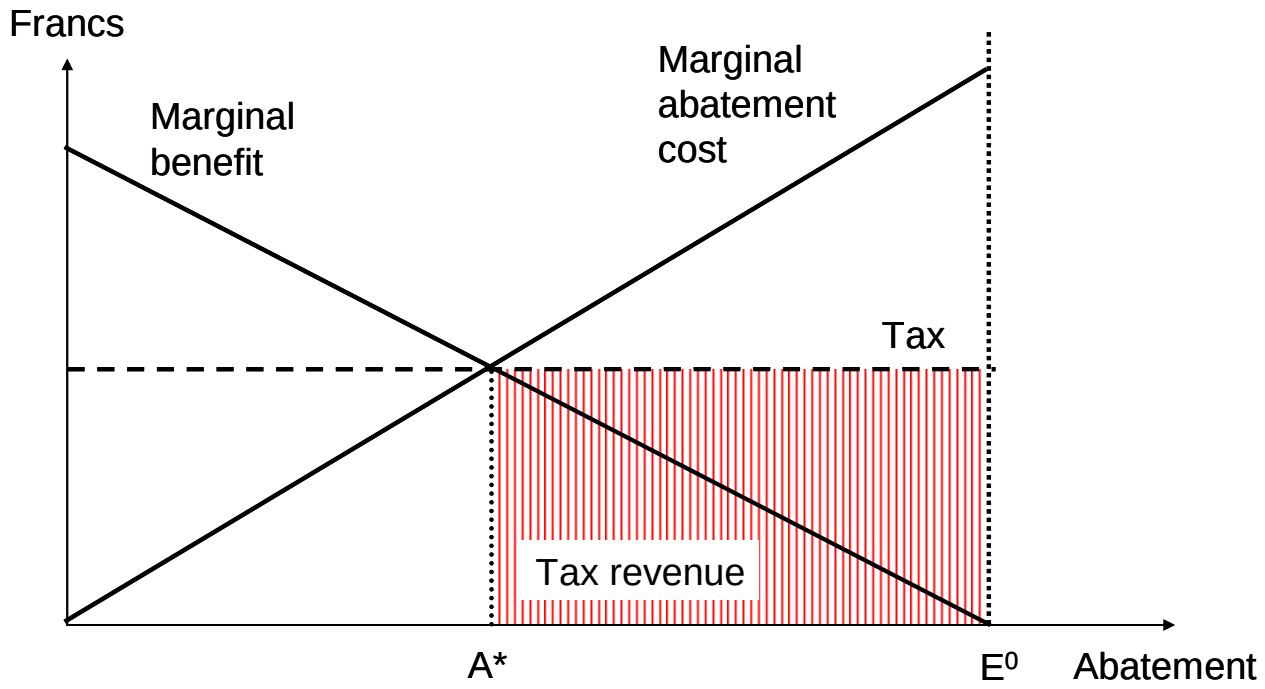
The main advantage of economic instruments

Cost efficiency

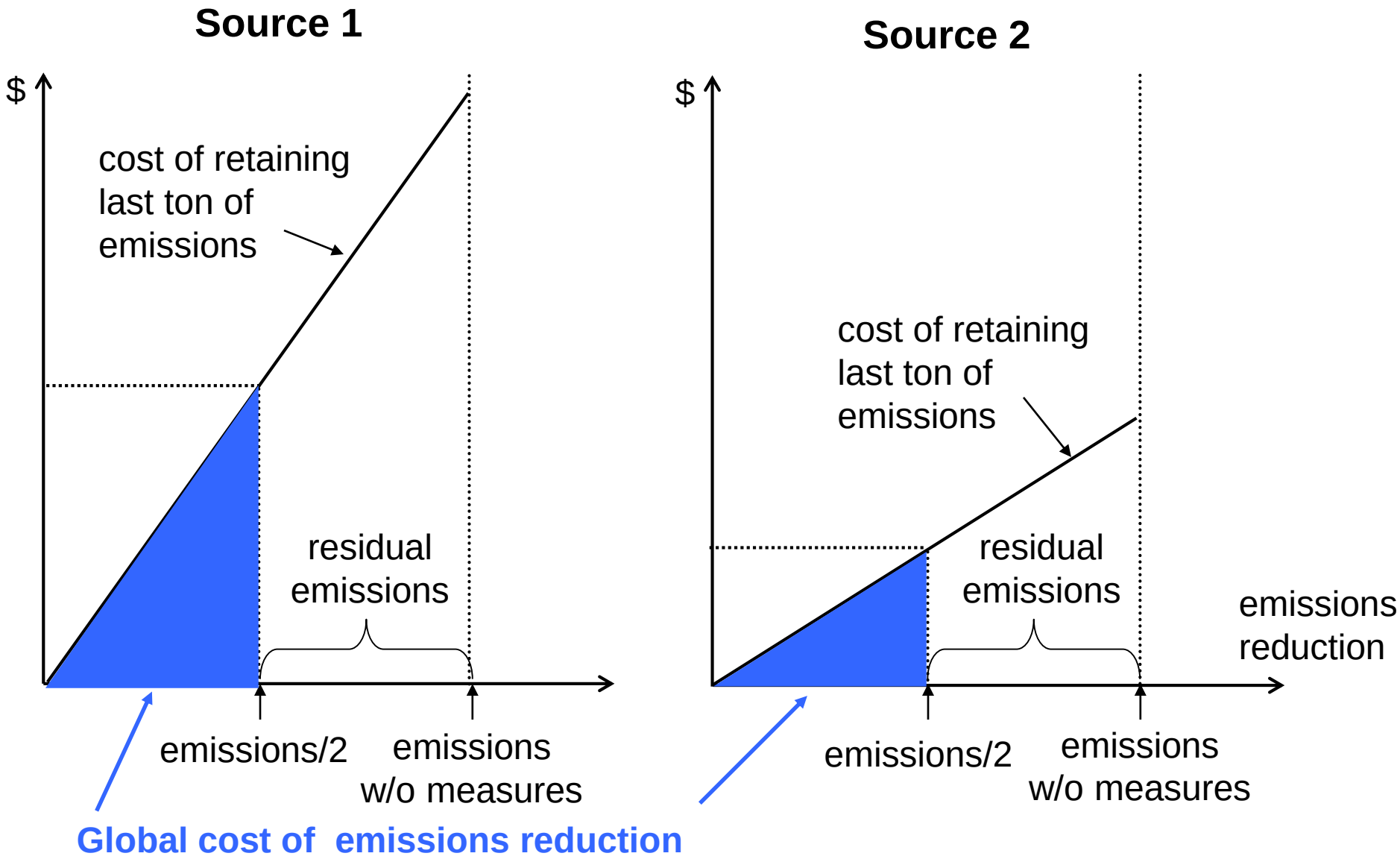
Emitter's calculation

$$\min_{A_i} \quad TC_i = C_i(A_i) + t(E_i^0 - A_i)$$

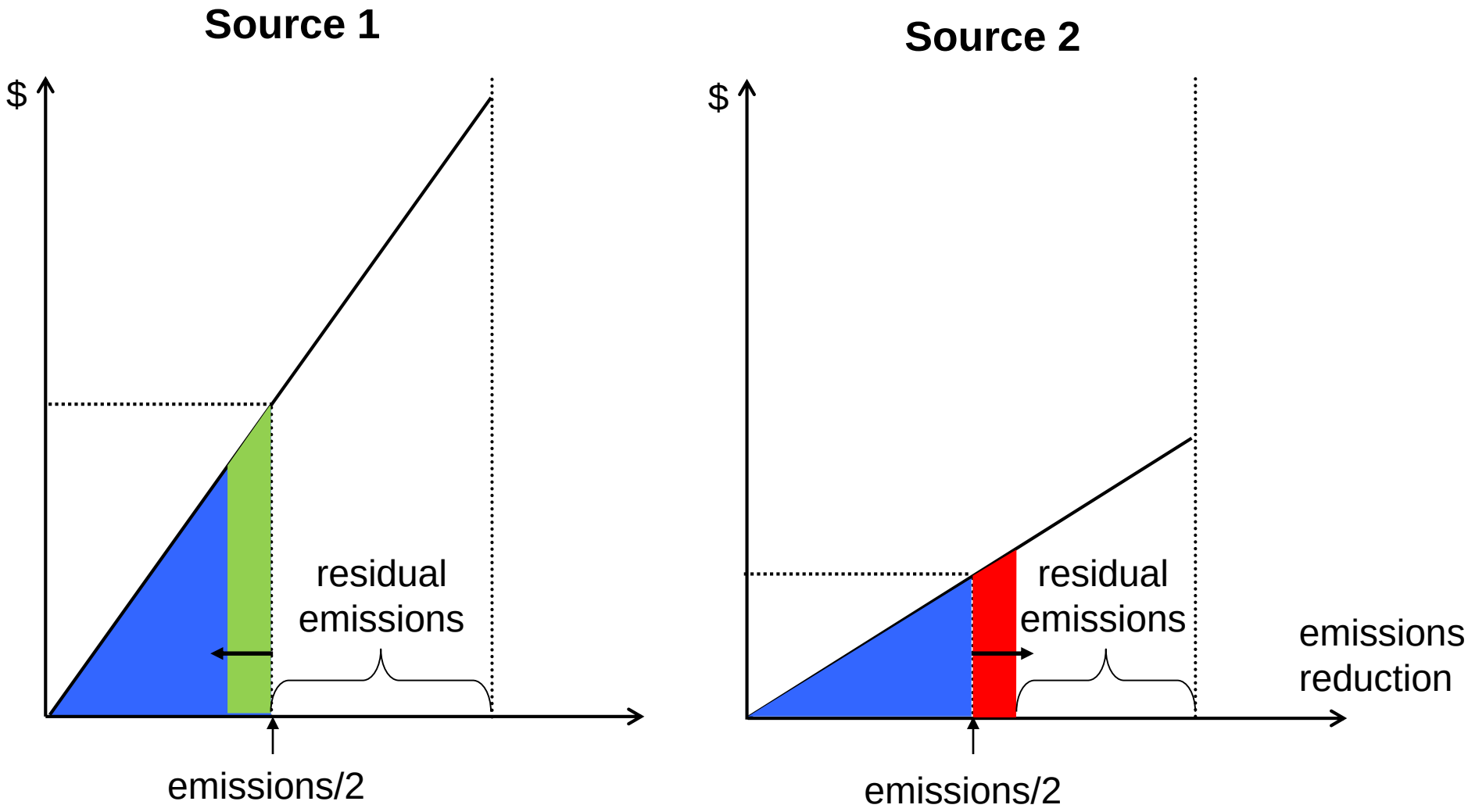
$$\frac{\partial TC_i}{\partial A_i} = C_i'(A_i^*) - t = 0$$



The global cost of emissions reduction with two sources

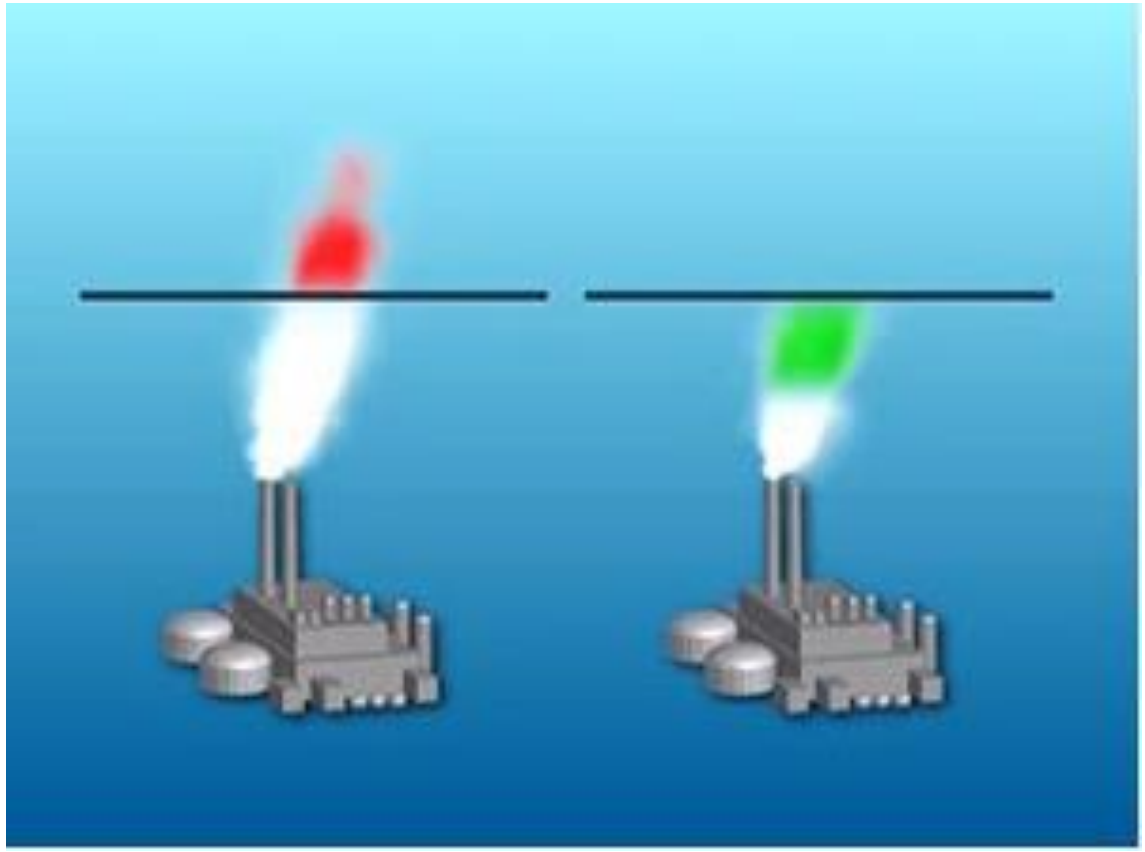


The global cost of dividing emissions by two can be lowered



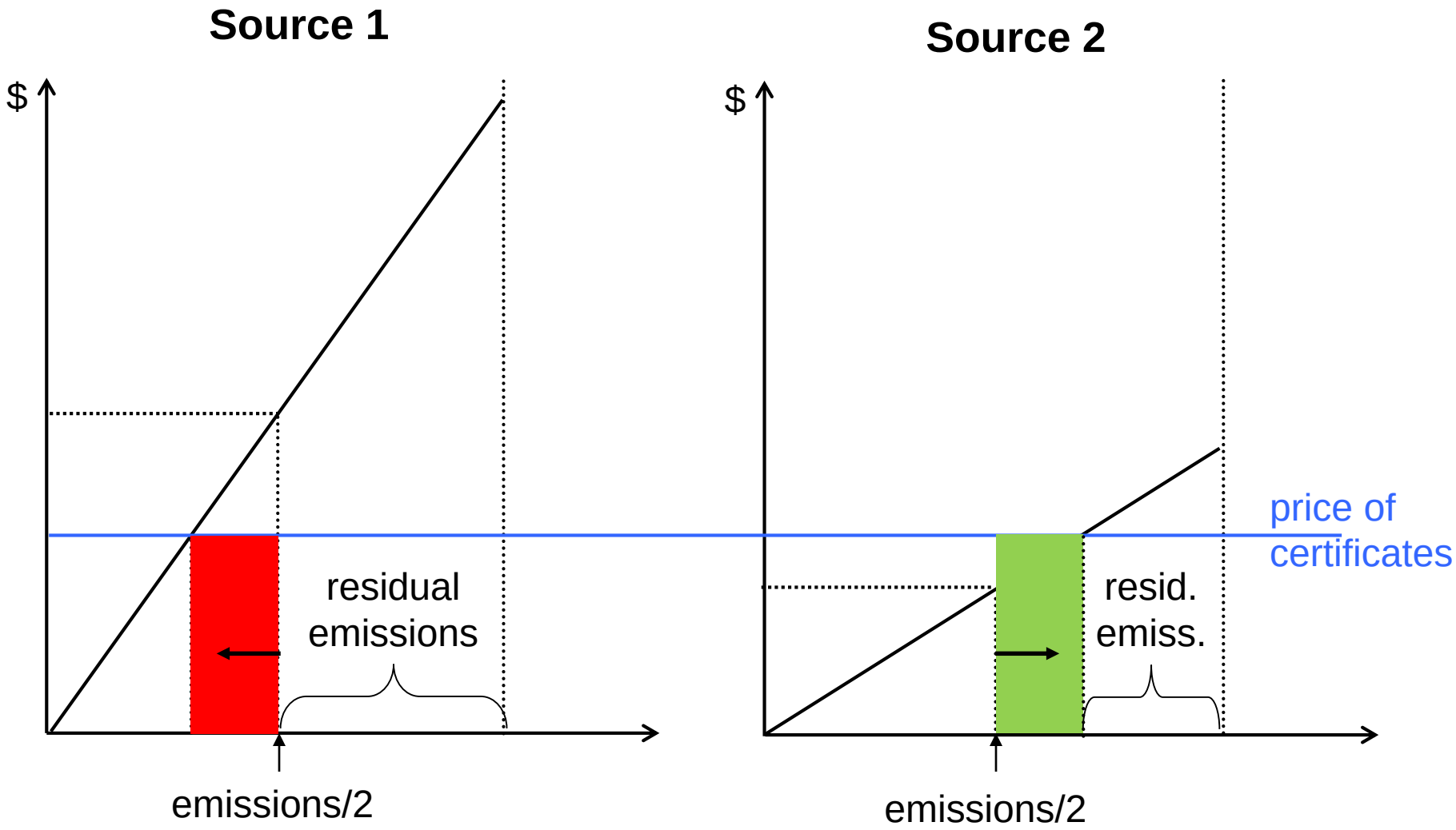
Efficiency = equal costs for the last ton retained

Trade in emission rights



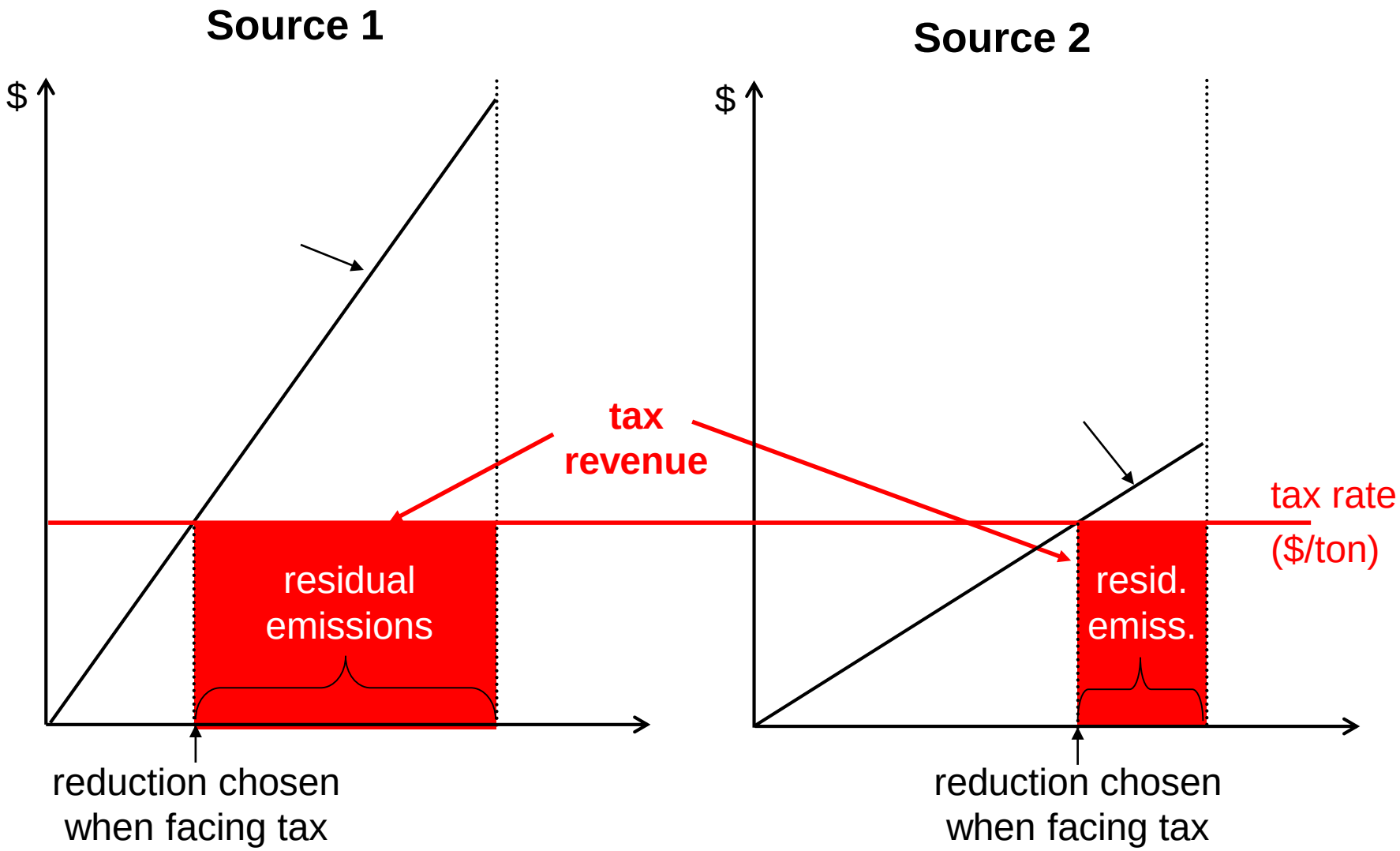
(illustration: European Environment Agency)

Tradable emissions quotas lead to cost-efficient abatement



Trading certificates → equal costs for the last ton retained

An emissions tax leads to cost-efficient abatement

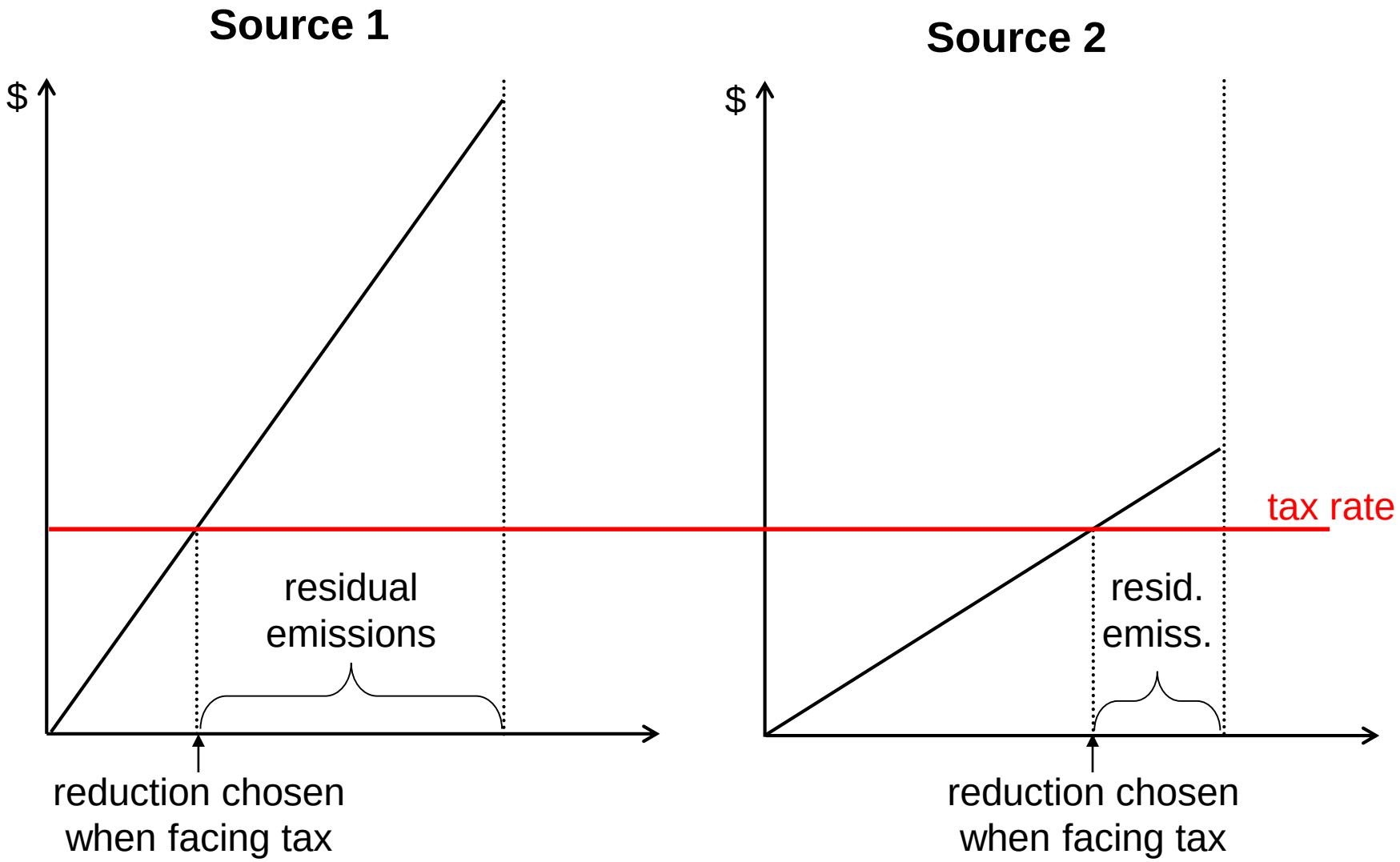


Emissions tax → equal costs for the last ton retained + tax revenue

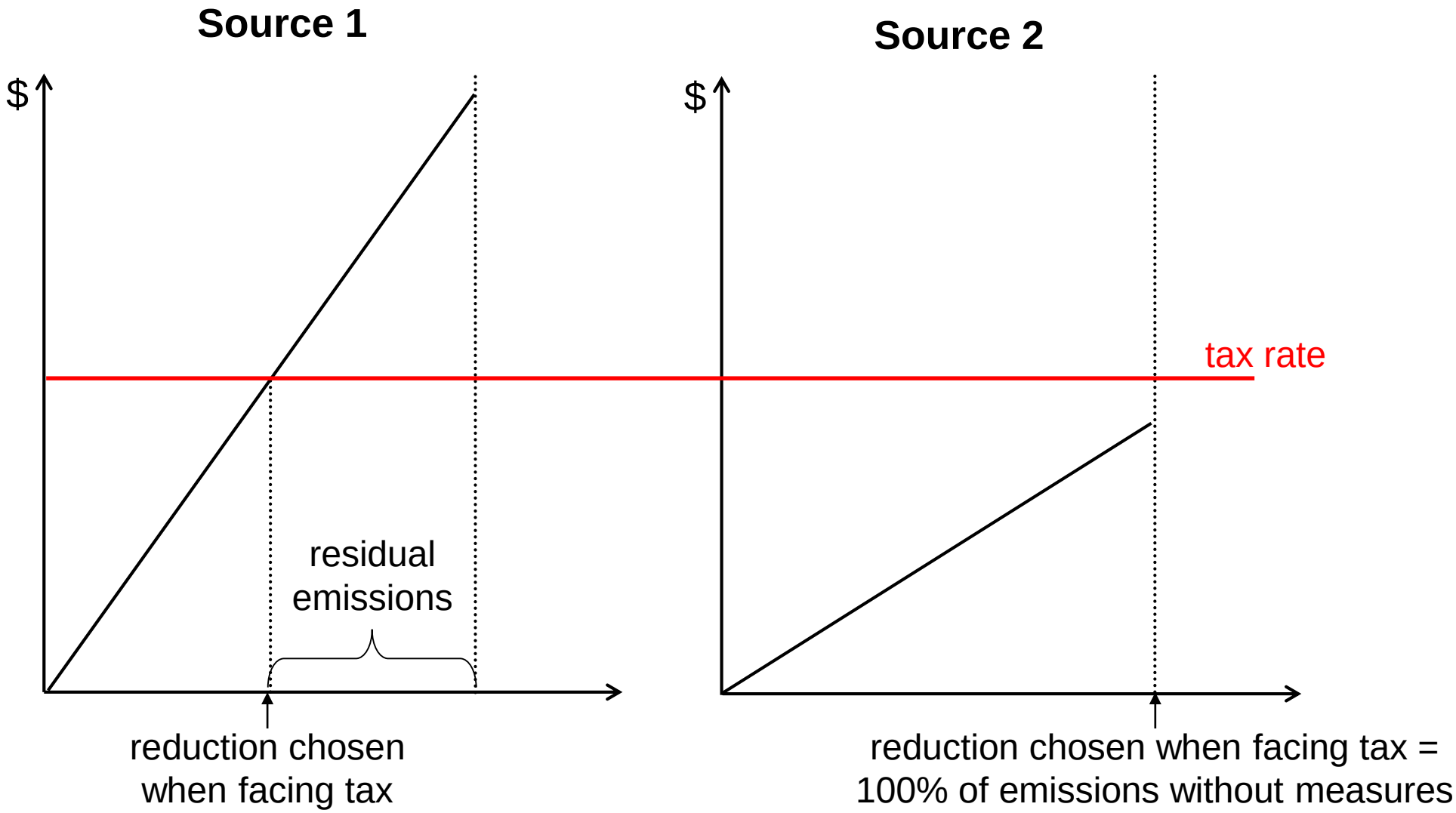
Economic instruments

EFFECTIVENESS

Tax can be adjusted to meet the emissions target



Tax can be adjusted to meet the emissions target



Economic instruments

SPECIAL ECONOMIC INSTRUMENTS

Other economic instruments

- **Green tax reform**: use the revenues from the incentive tax to replace taxes that discourage labour, education, saving, investment, innovation, risk taking, asf.: second dividend !

- **Joint Implementation** (JI) and **Clean Development Mechanism** (CDM): source 1 with high reduction costs pays for abatement by source 2 with low reduction costs

Economic instruments

CONCLUSIONS ON ECONOMIC INSTRUMENTS

Conclusions on economic instruments (1)

- Economic instruments can be effective at reducing emissions
- But it takes a tax high enough or a cap restrictive enough
- With price instruments (tax, subsidy), the marginal cost for emitters is known but not the volume of emissions
- With quantity instruments (cap & trade), the volume of emissions is known but not the marginal cost for emitters

Conclusions on economic instruments (2)

- Economic instruments leave it to the market actors to decide how they reduce their emissions
- They obtain emissions reduction at minimum total cost
- Economic instruments might generate large money transfers from high polluters to low polluters and, when implemented at international level, from industrialized to developing countries

With a CO_2 tax, Switzerland could reduce its CO_2 emissions to 1 ton per capita in 2020 for a cost around 1% GDP

Table 3: CO_2 prices and welfare cost in 2050

		1.5 t			1.0 t		
	Ref.	Uni	Uni-ETS	Diff-ETS	Uni	Uni-ETS	Diff-ETS
Average CO_2 price	82	652	637	746	1089	1010	1255
-ETS sector	252	652	193	196	1089	174	176
-transport fuel	0	652	738	419	1089	1331	794
-thermal fuel	121	652	738	1676	1089	1331	3175
Cost (in% of household cons.)		0.74%	0.85%	1.01%	1.33%	1.60%	1.88%

Thalmann, Philippe, and Marc Vielle, "Lowering CO_2 emissions in the Swiss transport sector", Swiss Journal of Economics and Statistics 155(1), December 2019, doi:10.1186/s41937-019-0037-3

REGULATION

To forbid, to impose, to regulate

Hummer H2 Limousine – Pully (VD)

One can distinguish regulations concerning:

- inputs
- procedures and techniques
- emissions
- ambient concentrations
- exposure (immissions)
- damage
- the risks

Going down this list increases administrative costs, but it gets closer to what matters.

Why regulate?

- Prohibition is a natural reaction to a harmful action
- It is a known response to many dangers (road traffic, natural hazards, etc.)
- Regulation promises a more certain effect than other instruments (but this is not always true); it is practically required if pollution is to be completely eliminated
- Regulation seems easy to monitor (when it is an outright ban)
- Regulation does not distinguish between rich and poor (as long as everyone respects it equally), which corresponds to a certain definition of equity

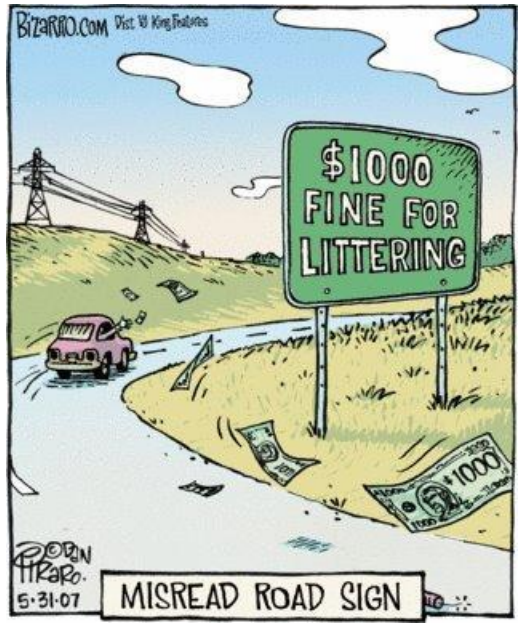
Evaluation of regulation

If the regulation is respected:

- It is a simple solution for mass-produced goods
- It guarantees the desired environmental result
- The desired result is not achieved at the lowest cost, because it can hardly differentiate according to abatement costs
- For cost efficiency, performance standards are preferable to technological standards, as they let emitters choose the cheapest solutions

But it is still necessary to ensure that the regulations are respected!

Disproportionate fines?



Death penalty for polluters

En Chine, les pollueurs risquent la peine de mort

> Punition Pékin annonce une série de mesures pour apaiser les esprits face au fléau

Philippe Grangereau PÉKIN

C'est assurément une première mondiale: la Cour suprême chinoise a décrété hier que la peine de mort s'appliquerait désormais dans les affaires de pollution particulièrement graves. «Cette nouvelle arme légale puissante qui vise les pollueurs facilitera le travail des juges», explique la circulaire – qui augmente ainsi de 55 à 56 le nombre de crimes passibles de la peine de mort.

Les pollueurs, très rarement traduits devant les tribunaux, encouraient jusqu'alors une peine maximale d'emprisonnement de 10 ans. Parmi les types de pollutions graves, la loi cite «les produits radioactifs, les virus contagieux» et les «produits chimiques très toxiques contenant du plomb, du cadmium et autres métaux lourds». Cette décision surprenante veut apaiser une population de plus en plus inquiète. Depuis 2011, une dizaine de manifestations contre l'installation d'industries polluantes ont éclaté – l'une d'elles a rassemblé 70000 personnes. L'industrialisation à marche forcée a créé des sources de pollution innombrables.

Des chercheurs de l'Université de Nankin ont établi qu'en 2011, au moins 10% du riz chinois était contaminé au cadmium. Ce métal lourd, issu de l'industrie, se dépose sur la terre et est absorbé par les plantes comme le riz. Les amendes ne sont que rarement infligées aux industriels, et lorsqu'elles le sont, leur montant est ridiculement bas.

Morts prématurées

Une étude publiée en avril par un organisme américain, le Health Effects Institute, estime que 1,2 million de Chinois sont morts prématurément dans l'ensemble du pays en 2010 en raison de la mauvaise qualité de l'air. Une autre étude, publiée ce mois-ci par Greenpeace, se concentre sur l'impact des émissions des 196 centrales électriques à charbon qui entourent Pékin – à l'exclusion de toute autre source de pollution de l'air. L'ONG estime que ces émissions ont entraîné le décès prématuré de 1982 habitants de Pékin en 2011, et d'environ 8000 autres dans la province du Hebei, qui jouxte la capitale. L'air vicié par les particules d'arsenic, de cadmium et de nickel résultant de la combustion du charbon a en outre provoqué 11000 cas d'asthme et 12000 cas de bronchite.

Les autorités chinoises ont annoncé la semaine dernière toute une série de mesures destinées à améliorer la qualité de l'air. Mais des engagements similaires avaient déjà été pris au cours des dix dernières années et, entretemps, la pollution n'a fait que s'aggraver. Dans la pratique, tout se passe comme si le développement économique demeurait toujours la grande priorité du gouvernement, coûte que coûte.

Le Temps, 21.06.2013

CONCLUSIONS

General comparison of instruments

	Environmental effectiveness	Cost-efficiency	Equity	Feasibility
Economic instruments (taxes)	Uncertain, unless instrument is regularly adjusted	Optimal, if the prices are right	Possibly high burden, but revenue can be recycled	Unpopular with polluters; not always practical to internalize external costs
Strict regulation	Rather certain, provided enforcement	Low: abatement costs vs administrative costs	Fairness with respect to quantity effort need not be equitable	Popular with polluters and regulators; requires detailed controlling
Regulation with trading	Rather certain, provided enforcement	Optimal in theory, if markets are efficient	Depends on initial allocation of permits	Popular with polluters and regulators; markets must be set up in addition to detailed controlling
Voluntary approaches	Low unless connected with stringent measures	High, provided the prices are not too wrong	Free riders, unless important advantages are granted to participants	Very popular with polluters and politicians
Public investment in alternatives	Low, particularly with poor governance	Expensive but ancillary effects	Depends on who pays for it and who benefits from it	Popular with politicians

There is a detailed discussion and evaluation of climate policy instruments in the IPCC Fourth Assessment Report, Working Group III, chap. 13

Conclusions

- The power of economic instruments is minimisation of global abatement cost (efficient allocation of abatement effort between polluters)
- The power of regulatory instruments is the guaranteed abatement result
- Their cost-ineffectiveness is smaller the closer they apply to the actual emissions
- Voluntary approaches are justified in a first stage, to build acceptance
- Public investments can lower abatement costs and contribute to acceptance (showing true involvement of the authorities)

Conclusions

- Practical policy questions when deciding what instrument to use to control emissions:
  - On what side – abatement cost or damage – is the cost of mistake greatest (steep increase in marginal cost) ?
  - Are there economies of scale or other non-convexities in emissions abatement technology

For an instruments mix

- The new environmental policies use a combination of instruments
- This makes it possible to individualize the measures and increase their effectiveness and efficiency
- A mix of measures signals coherence