The dynamic efficiency of ETS

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What is dynamic efficiency

- Dynamic efficiency is the most important criterium to assess environmental policies (Schultze and Kneese 1975).
- Continuous incentive to reduce emissions.
- Incentive for technological change (development, innovation, diffusion).

What is dynamic efficiency

- Meeting short-term and long-term targets at the lowest possible cost.
  - The technologies upon which any emissions reduction strategy depends need to be available at competitive costs at the time when they could make a significant difference (Rayner 2004).
- What is the extent of the challenge? A technological revolution...

Why is dynamic efficiency important for mitigation?

Category	CO_2 equivalent concentration (parts per million CO_2 equivalent)	Global mean temperature increase above pre-industrial at equilibrium using 'best estimate' climate sensitivity[a](°C)	Change in global CO_2 emissions in 2050 (% of 2000 emissions)	Range of reduction in GDP in 2050 because of mitigation (%)	Allowed emissions by Annex I Parties in 2020 (% change from 1990 emissions)	Allowed emissions by Annex I Parties in 2050 (% change from 1990 emissions)
I	445–490	2.0–2.4	-85 to -50	Decrease of up to 5.5	-25 to -40	-80 to -95
II	490–535	2.4–2.8	-60 to -30			
III	535–590	2.8–3.2	-30 to +5	Slight gain to decrease of 4	-10 to -30	-40 to -90
IV	590–710	3.2–4.0	+10 to +60	Gain of 1 to decrease of 2	0 to -25	-30 to -80
V	710–855	4.0–4.9	+25 to +85			
VI	855–1,130	4.9–6.1	+90 to +140			

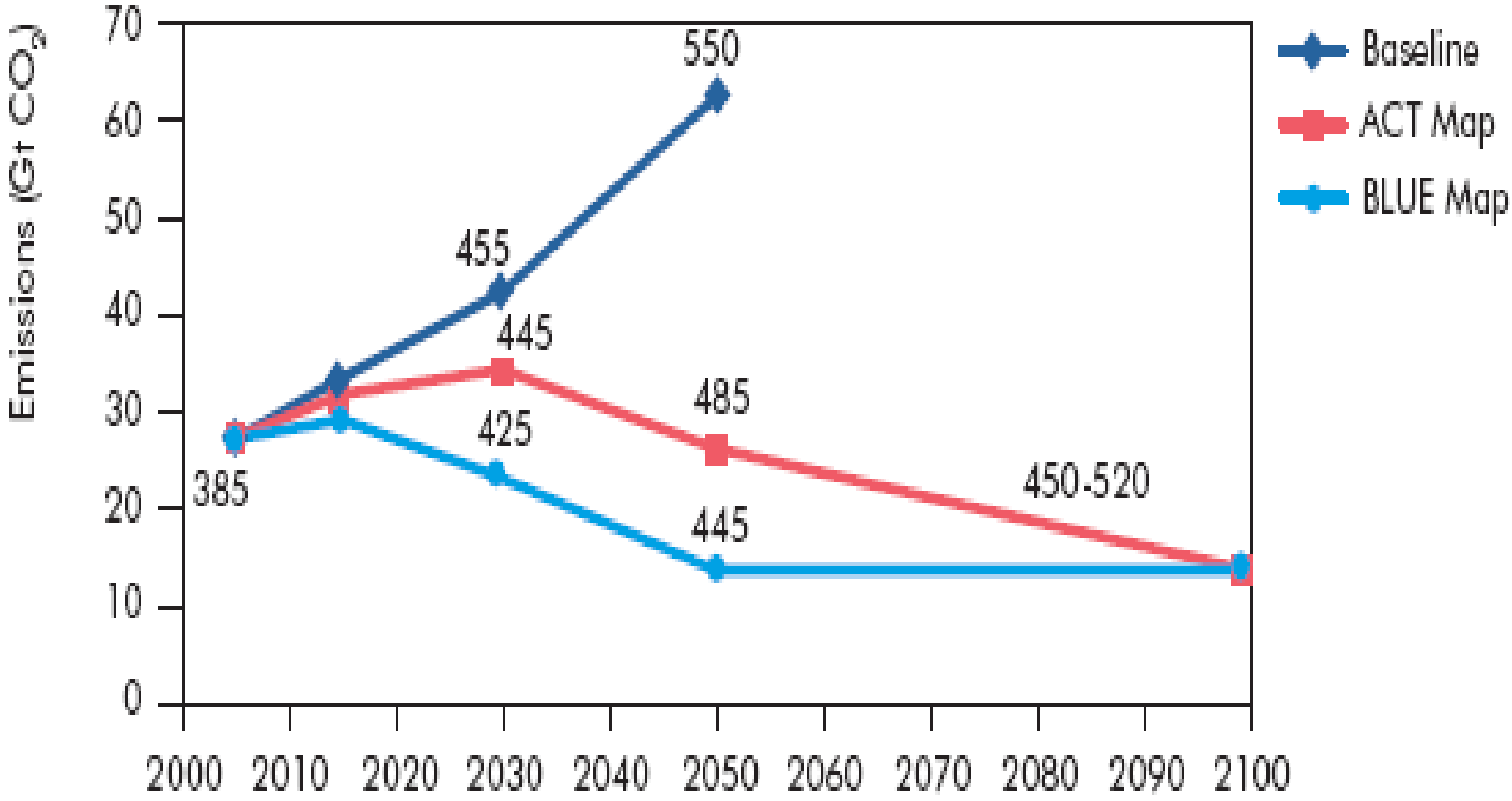
Source: IPCC 2007

Why is dynamic efficiency important for mitigation?

- European Commission (2009) defends a 50% (global) reduction of GHG emissions in 2050-1990 to reach the 2º.
- IEA ETP Scenarios (IEA 2008):
  - ACT scenario: 2050 emissions at current levels.
  - BLUE scenario: 50% emissions reductions in 2050 w.r.t. current levels.

Why is dynamic efficiency important for mitigation?

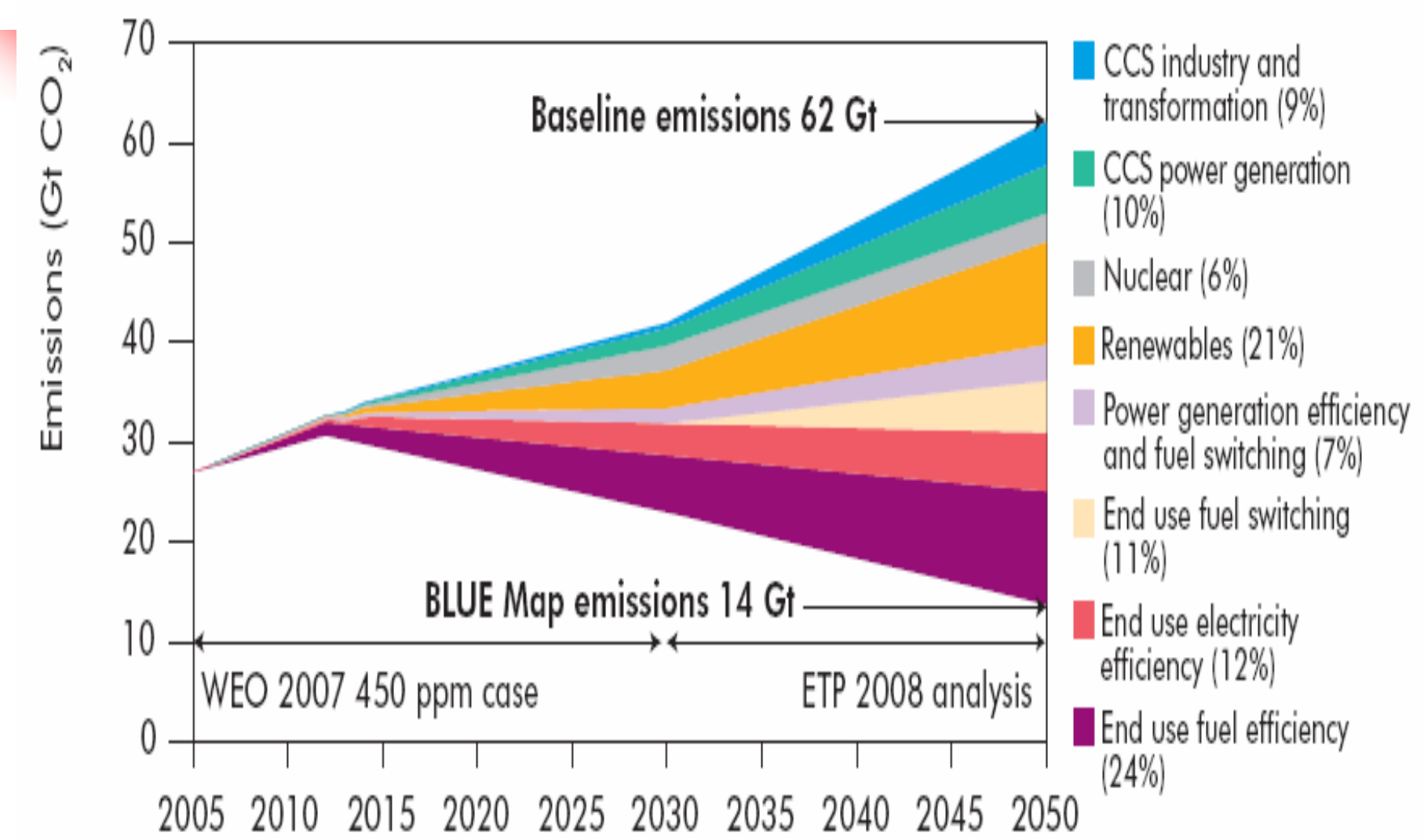
- **Emissions and concentrations in the scenarios.**



Note: Figures refer to CO_2 concentrations by volume (ppm CO_2).

Source: IEA ETP (2008)

Why is dynamic efficiency important for mitigation?



Source: IEA ETP (2008)

Why is dynamic efficiency so important for mitigation?

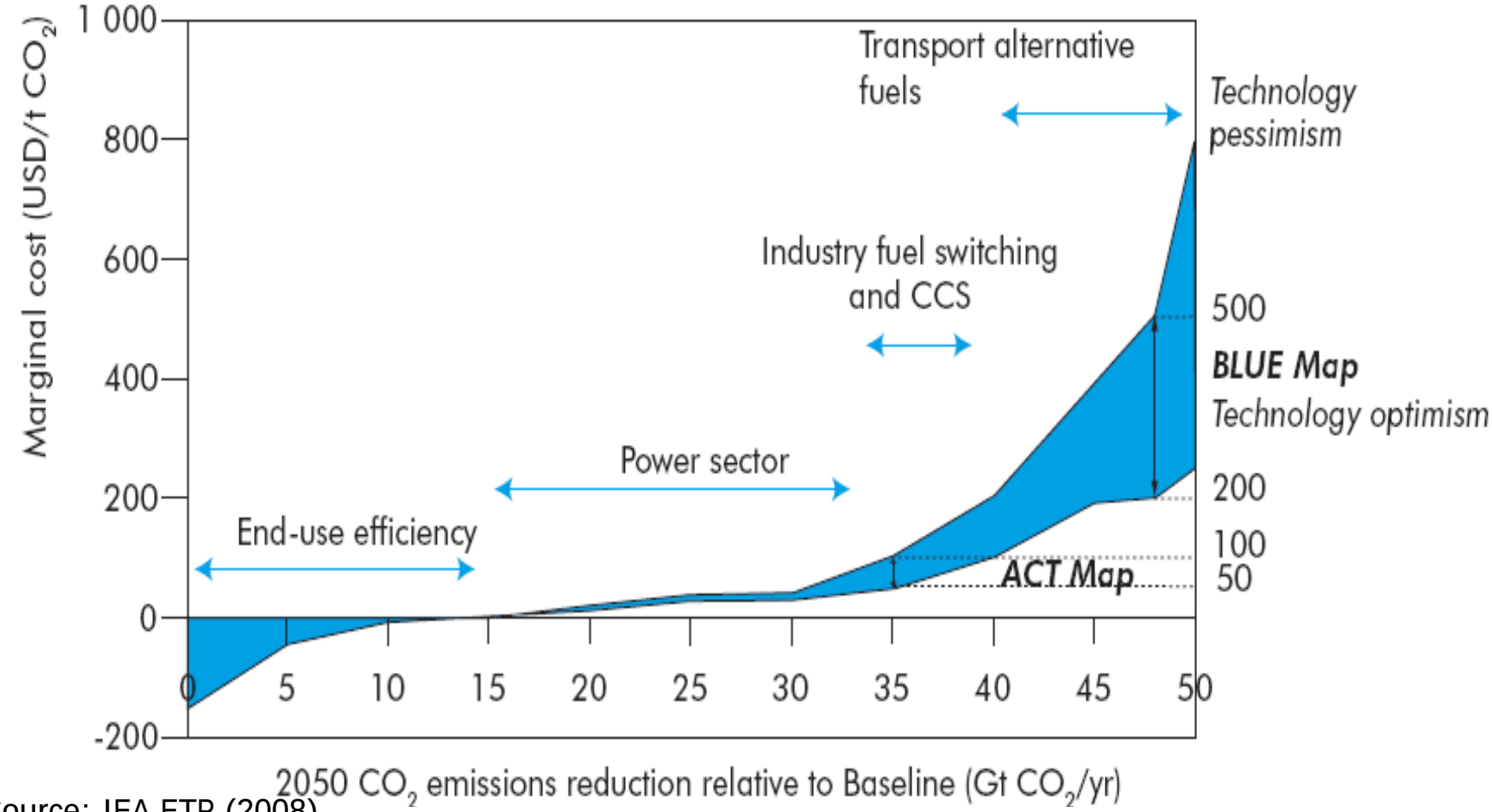
- The problem: large reductions are needed to reach the 450 ppm concentration level.
- Drastic systemic changes in current technologies will be required.
- Both new and already existing revolutionary technologies in the energy and transport sectors will have to be developed and diffused.

Why is dynamic efficiency important for mitigation?

- The more stringent the targets, the greater the need for emissions reductions and the greater the need to have dynamic efficiency, i.e., technologies at reasonable costs in the future (marginal costs increase most at levels of large emissions reductions).

Why is dynamic efficiency important for mitigation?

- **Marginal abatement cost for the global energy system in 2050 (BLUE scenario).**



Source: IEA ETP (2008)

Are ETS dynamically efficient?

- Common wisdom (among economists and environmental economists): MBIs are dynamically efficient.
- For some, thus, this would be a non-topic: Dynamic efficiency is assumed!!

Are ETS dynamically efficient?

- The empirical evidence provided by the literature on the superiority of ETS in stimulating innovation is surprisingly thin.
- More especifically, scarce empirical evidence to answer whether the EU ETS has spurred innovation.

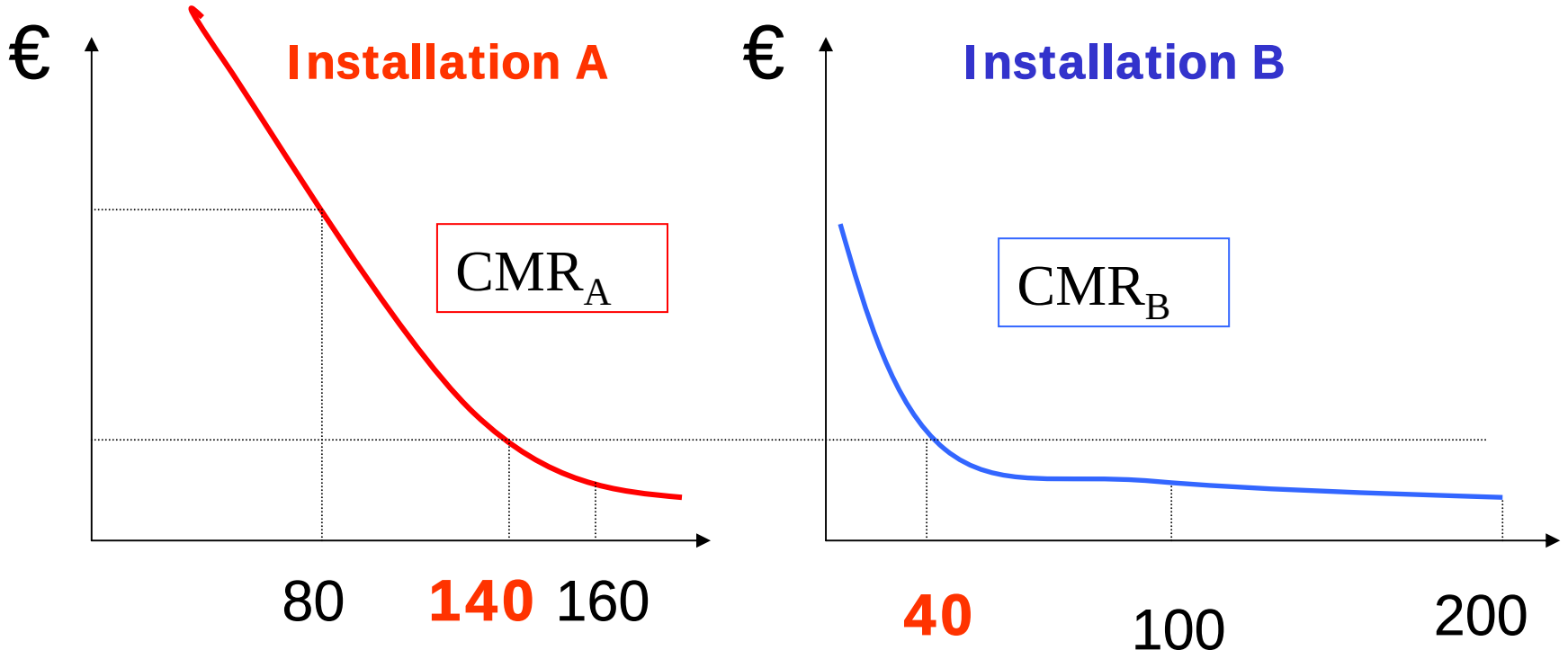
Are ETS dynamically efficient?

- The equimarginality rule.

Equimarginality

- Current emissions (2009): 360 MtCO2
- Target (2010): 180 MtCO2. Number of allowances: 180
- Initial distribution of allowances (free): 80 (A) and 100 (B)

Situation after the exchange: 140 (A) and 40 (B).



Are ETS dynamically efficient?

- “In theory, the cap-and-trade system automatically minimises the cost of reaching any given emissions target, by allowing whichever firms can reduce their emissions most cheaply to do so on behalf of others, using whatever technology they like” (The Economist March 14th 2009).
- “Most of (*other*) measures would be unnecessary if a cap-and-trade scheme was in place” (op.cit.).

Are ETS dynamically efficient?

- But are we watching a picture...
  ...or rather seeing a movie?
- Of course, we need cost-effective emissions reductions in the short-term...
- ...but we also need to reduce emissions cost-effectively in 10, 20, 30, 40, 50... years time.
- Does ETS encourage the uptake of mature technologies while discouraging the commercialisation of the currrently expensive ones which will be needed in the future to reduce emissions cost-effectivelly?
- I.e., does ETS lead to LOCK-IN?

Are ETS dynamically efficient?

- Do economic instruments currently being applied in climate policy create sufficiently strong price signals to counteract barriers to investment by businesses in energy and emissions abatement activities caused by volatility in base energy prices and the costs of major capital replacement programmes?
- I doubt so...
- ...some evidence: U.K., U.S., EU ETS (general), EU ETS (Germany)...
- The EU ETS cap is expected to be reduced in future periods, thereby increasing the incentive for technology investments

ETS, necessary but not sufficient

- An ETS is unable by itself to induce the investments in long-lived technology and infrastructures needed to reduce CO_2 emissions by between 50 and 80% by 2050.
- The price of permits must rise to at least 50$/t$CO_2$ before utilities will find it cost-effective to build coal-fired power plants with CCS. Similar or higher allowance prices are required for other types of low-carbon power plants (renewables)(Samaras et al 2009).
- The effect of such a “carbon price” on the transportation sector will probably be much smaller.

What produces dynamic efficiency

- i.e., what makes more attractive low-carbon technologies and reduces its costs in an intertemporal perpective?
  - High carbon prices.
  - R&D investments.
  - Learning investments.
  - Low risks for investments: stable policies, a less volatile carbon price (tax rate, allowance price...).

ETS, necessary but not sufficient

- The problem:
  - Carbon prices need to be high for dynamic efficiency to be achieved.
  - But high prices are politically unfeasible:
  - Therefore, in the real world, an ETS by itself will hardly be dynamically efficient!!!

ETS, necessary but not sufficient

- Are we asking for the impossible?

...we ask an ETS to be effective, cost-effective, politically acceptable/feasible...

...and also, dynamically efficient.

- Can a single instrument satisfy all criteria? Are there trade-offs between criteria?
- Should we have a mix of instruments?

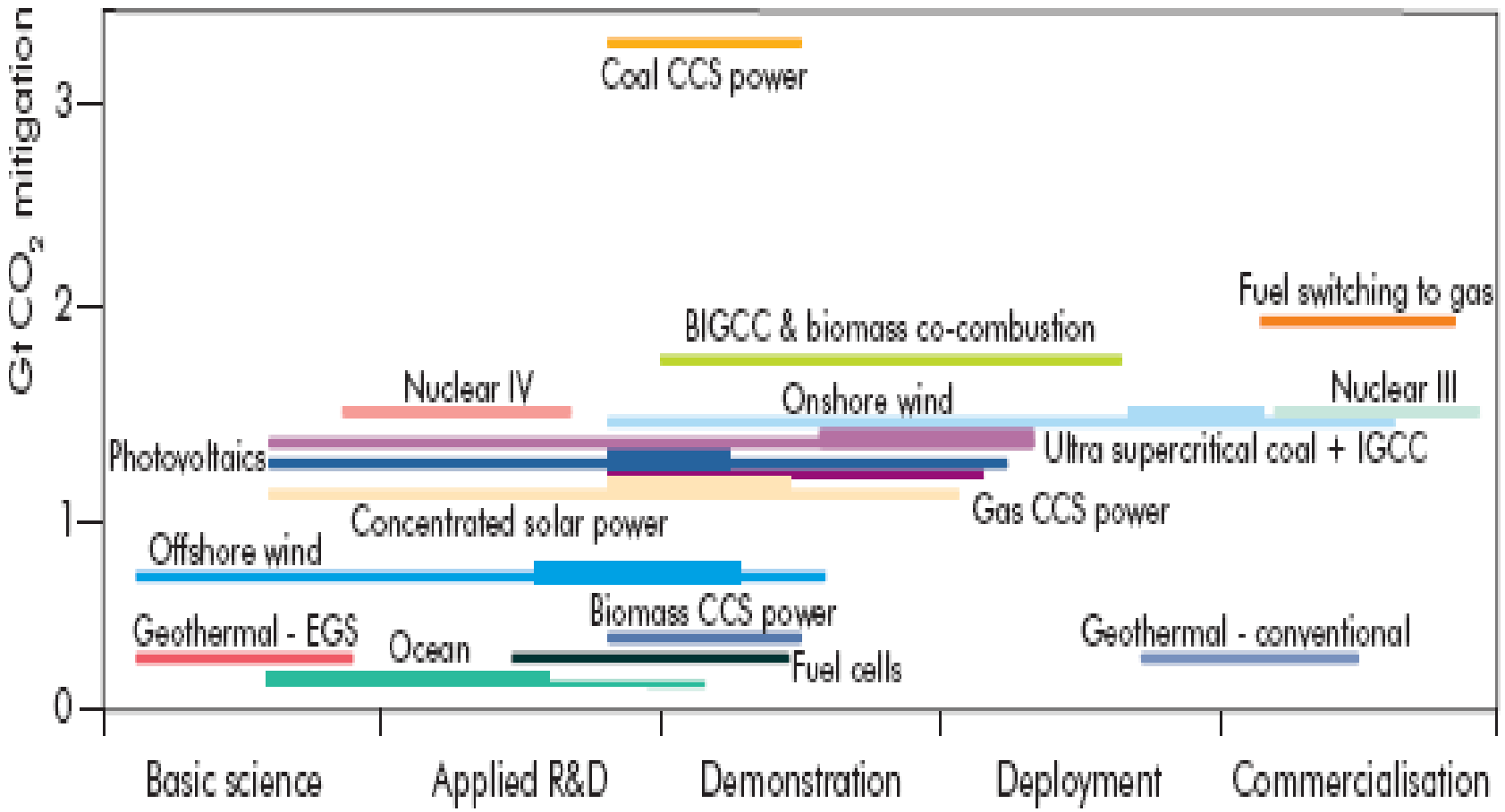
ETS, necessary but not sufficient

- Different maturity of technologies.
- Thus, necessary to complement an ETS with R&DD support for less mature technologies.

"An ETS may be useful to select technologies from the shelf, but not to put technologies on the shelf" (Azar and Sanden 2005).

IS AN ETS ABLE TO MITIGATE LOCK-IN?

Priorities in technological development in the short term and CO2 mitigation regarding power generation technologies.



Source: ETP IEA (2008)

ETS, necessary but not sufficient

- Furthermore, necessary to complement an ETS with sector-specific measures:
  - Electricity sector:
    - Promotion of renewables.
    - Promotion of energy efficiency.
  - Buildings and appliances:
    - Efficiency standards for building design and construction, appliances, equipment, lighting.
    - Building codes.
  - Road transport:
    - Efficiency standards.
    - Road pricing.
    - Investments in public transport.

IS AN ETS ABLE TO MITIGATE TECHNOLOGICAL LOCK-IN?

- What is lock-in in carbon-intensive technologies?
  - The classical technological lock-in problem.
  - The evolutionary view of lock-in (systems perspective).
    - Technological interrelateness.
    - Learning effects: different levels of maturity of the technologies,

How can an ETS be made more dynamically efficient?

- Issue of uncertainty:
  - Long-term emissions reduction targets.
  - Relatively stringent targets (scarcity of permits induces higher prices).
  - Design elements: banking/borrowing to shave price spikes (volatility), lenght of compliance periods, if any?

How can an ETS be made more dynamically efficient?

- Instrument combination required, depending on the level of maturity of technologies:
  - ETS for the mature ones.
  - R&D, demostration projects, strategic niche management for the inmature.
    - Foresight studies.
    - One policy can finance the other: auctioning of EU ETS allowances and earmarking of revenues for mitigation activities.

How can an ETS be made more dynamically efficient?

- I know, I know, picking winners might be inefficient...
- ...but technological neutrality might also be inefficient in an intertertemporal perspective.
- Strong need for instrument combination!!!