ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

IED
Institut für Umweltentscheidungen
Institute for Environmental Decision

The Economics of Climate Change

Lecture 9: Credit-based Mechanisms

Dr. Markus Ohndorf

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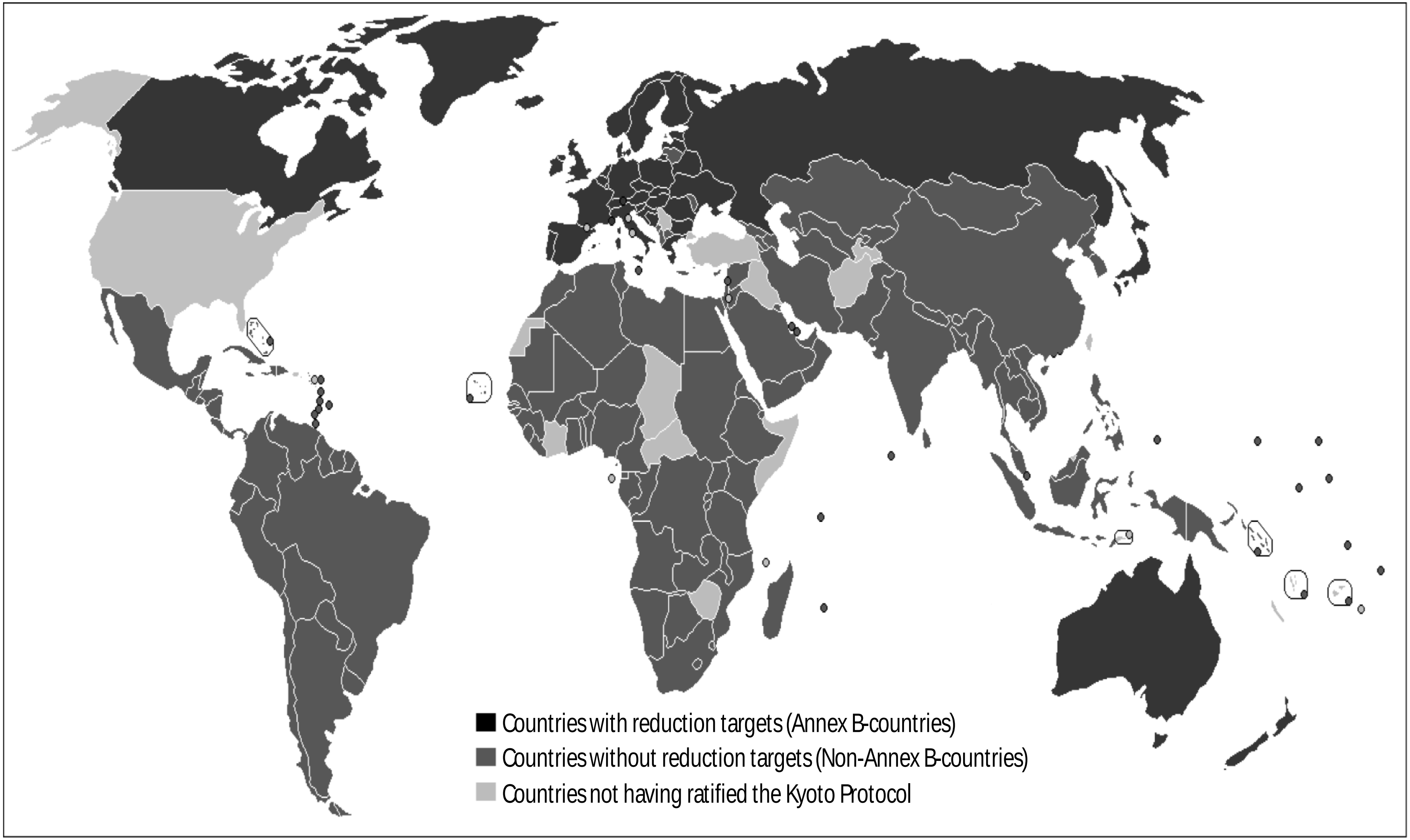
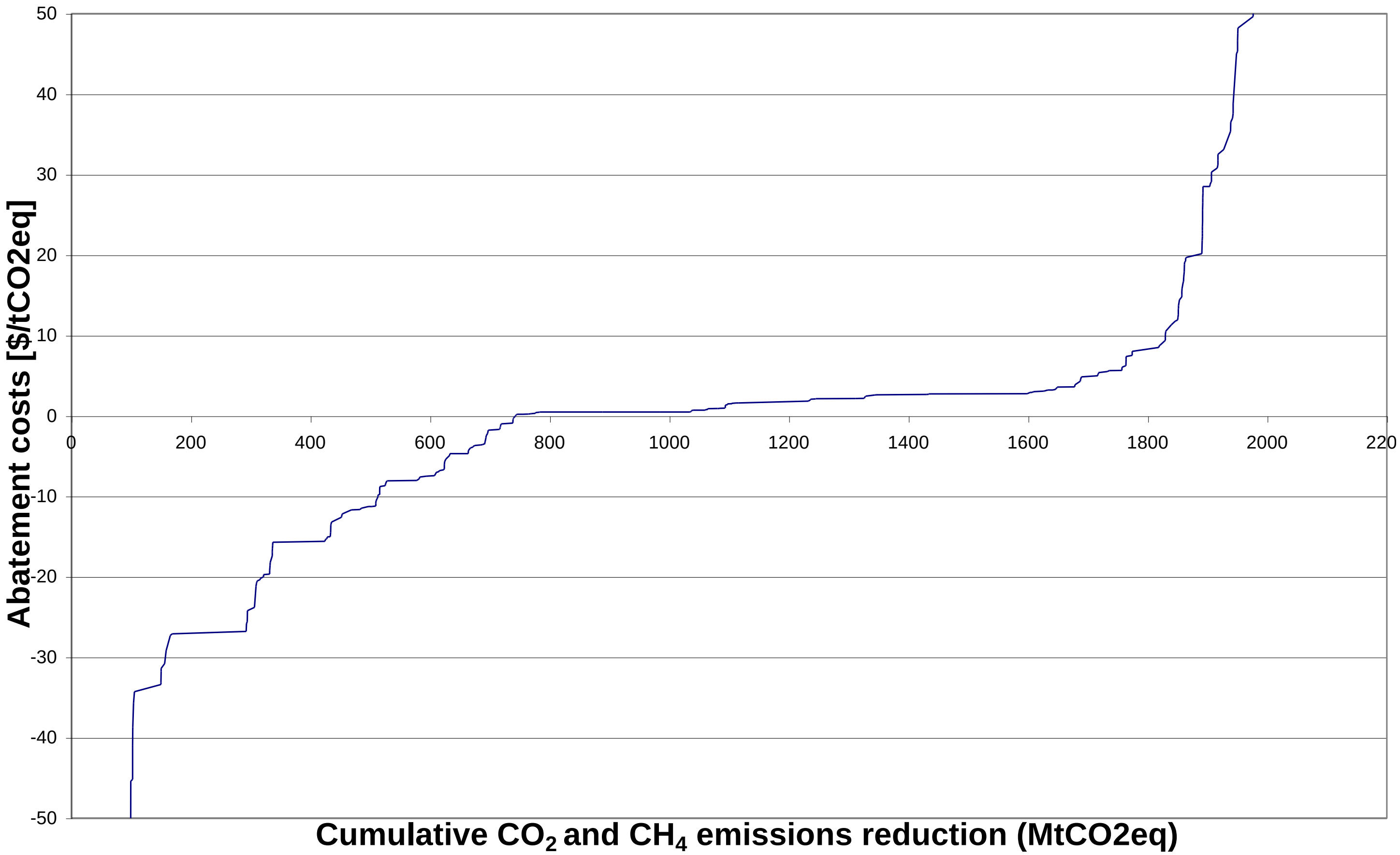
Previous lectures

- Discussion of Price- and Quantity Mechanisms
  - Can be first-best efficient
  - Require commitment of participating countries
- What about countries that do not want to commit, but have a high potential for low-cost reductions?
  - Developing countries

Remember the Kyoto World?



MAC curve for the whole non-Annex I region



Source: ECN (2010)

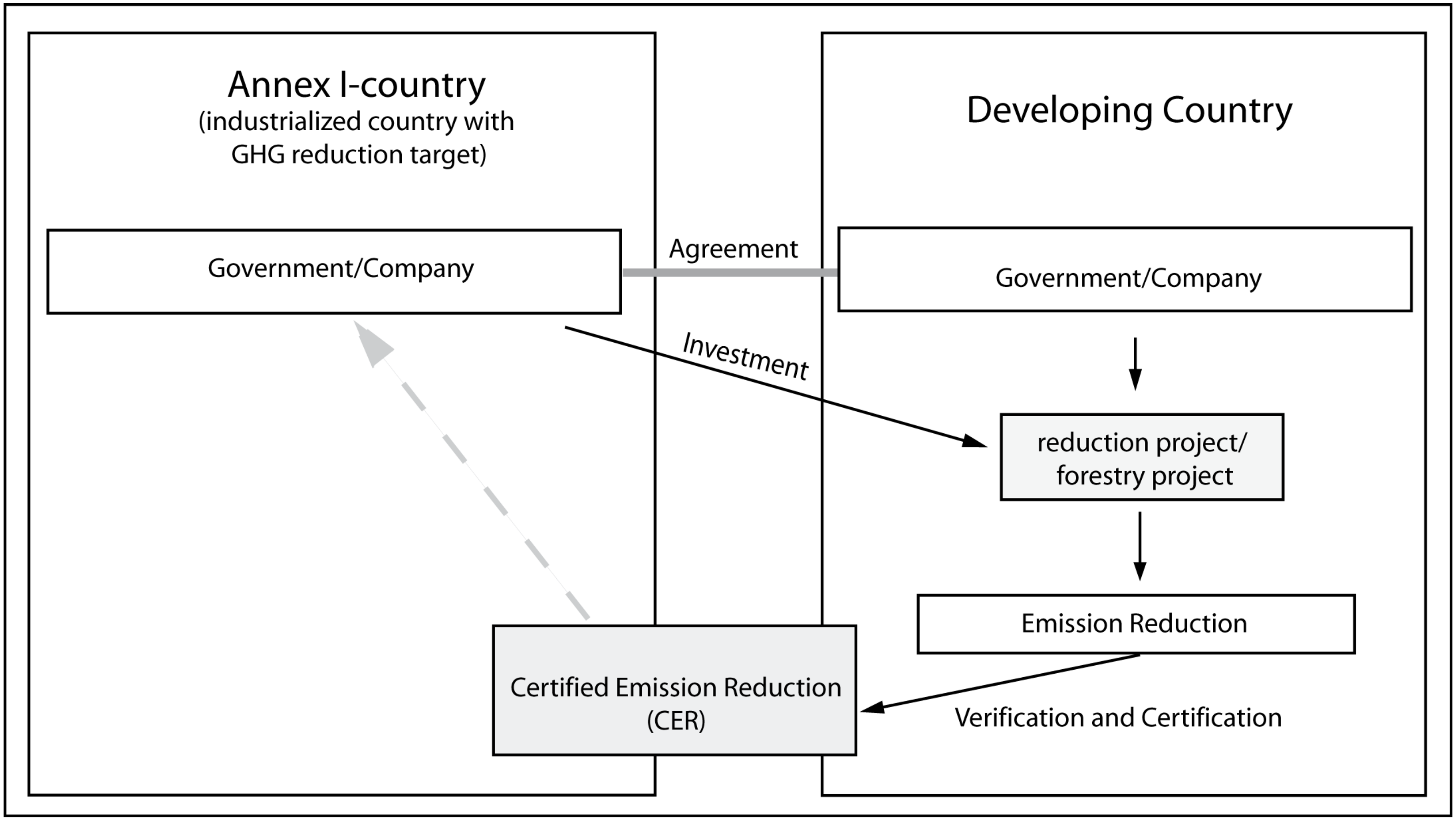
Findings of ECN study back in 2010

- Total identified GHG reduction potential in 2010 in the non-Annex I region as a whole amounts to 2.1 GtCO2 equivalent
- Most reduction potential (62 per cent) in the power sector (energy efficiency, fuel switch) and demand side energy efficiency measures
- Approximately 1.9 GtCO2 eq. is feasible at costs of up to US$ 4 per tCO2eq reduction
- Large fraction of identified potential can be realized in a limited number of non-Annex I countries. Most reduction potential has been identified in China and India (some 60 per cent)

Credit-based Mechanisms

- Best known: Clean Development Mechanism (CDM) and JI.
- CDM: Financing GHG reduction or sink projects in developing countries, i.e. outside of Annex B countries of the Kyoto Framework
- CDM certificates (Certified Emission Reductions, CERs) are in principle fully fungible with AAUs (Assigned Amount Units from inter-country emissions trading).
- Due to this fungibility, certificates also feed into other cap-and-trade systems, like the EU ETS.
- **Hence, non-additional certificates from credit-based schemes also affect the environmental effectiveness of cap-and-trade schemes**
- Monitoring is not only to maximize emission reductions, but also minimize overreporting

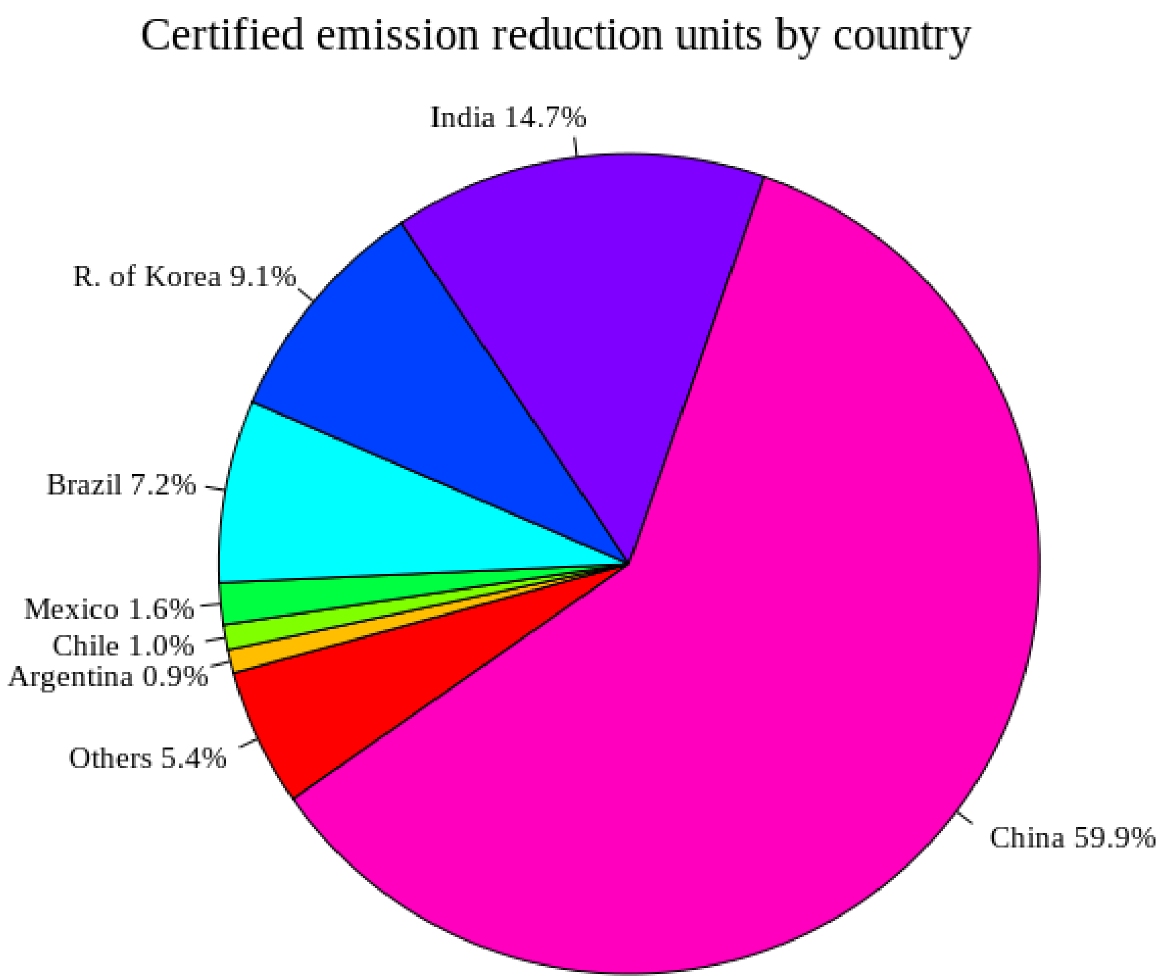
The Clean Development Mechanism



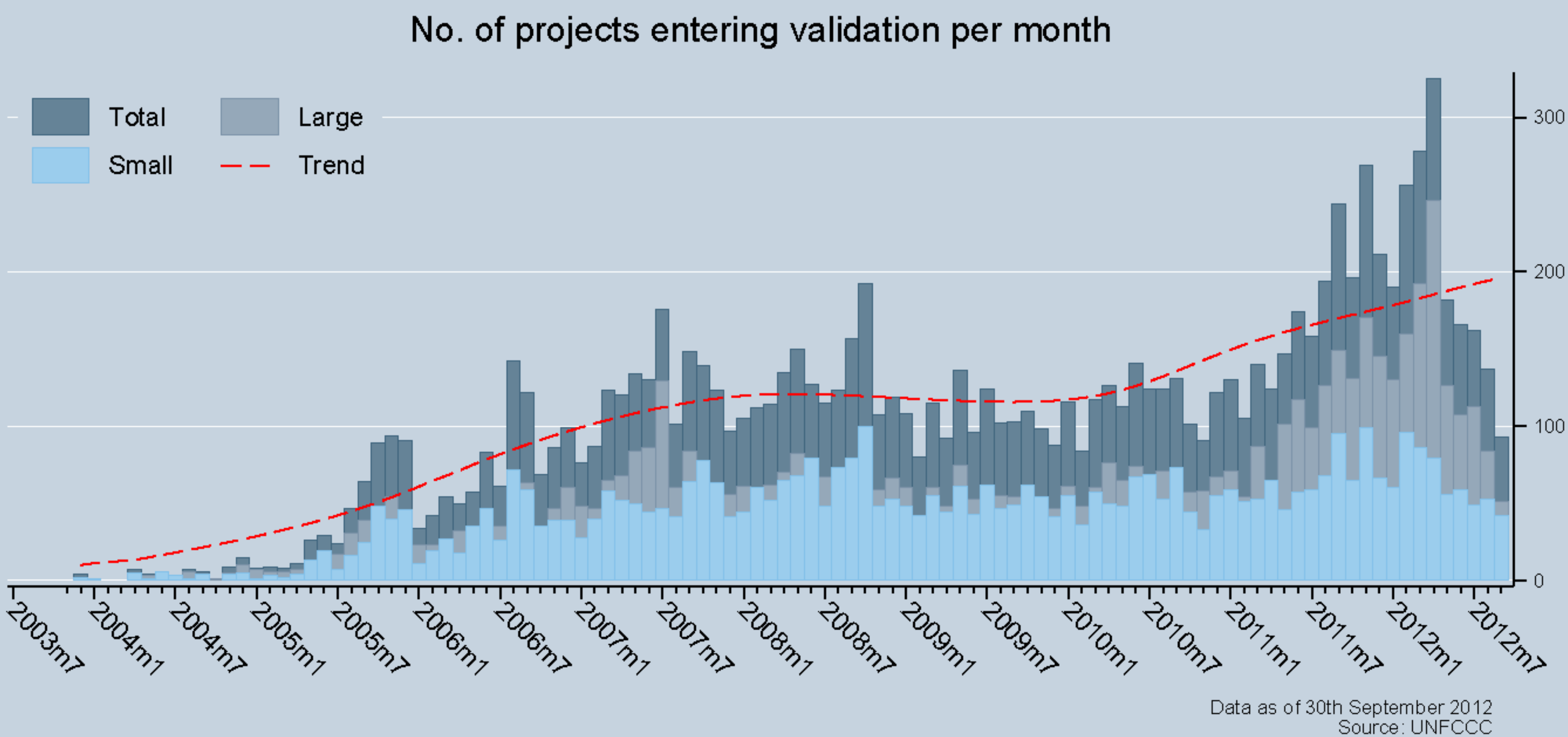
Technology transfer via the CDM

Table IV-4. **Technology transfer for projects in selected host countries**

Project type	Number of projects	Estimated emission reductions (tCO_2e/yr)	Average project size (CO_2e/yr)	Technology transfer claims as percent of: Number of projects (%)	Technology transfer claims as percent of: Annual emission reductions (%)	% of projects where technology transfer could not be determined
Brazil	338	34,269,995	101,391	25	54	32
Chile	69	7,182,105	104,088	52	72	43
China	1993	387,496,440	194,429	19	47	9
India	1254	117,940,808	94,052	13	23	40
Indonesia	100	11,207,814	112,078	59	43	38
Malaysia	127	7,009,300	55,191	60	65	35
Mexico	165	14,588,291	88,414	83	84	16
Republic of Korea	72	19,607,821	272,331	50	69	42
Thailand	115	6,369,257	55,385	80	79	16
Vietnam	106	6,772,217	63,889	73	60	24
All others	645	84,944,348	131,697	59	64	31
Grand Total	**4984**	**697,388,396**	**139,925**	**40**	**59**	**24**



Data: http://cdm.unfccc.int/Statistics/Issuance/CERsIssuedByHostPartyPieChart.html

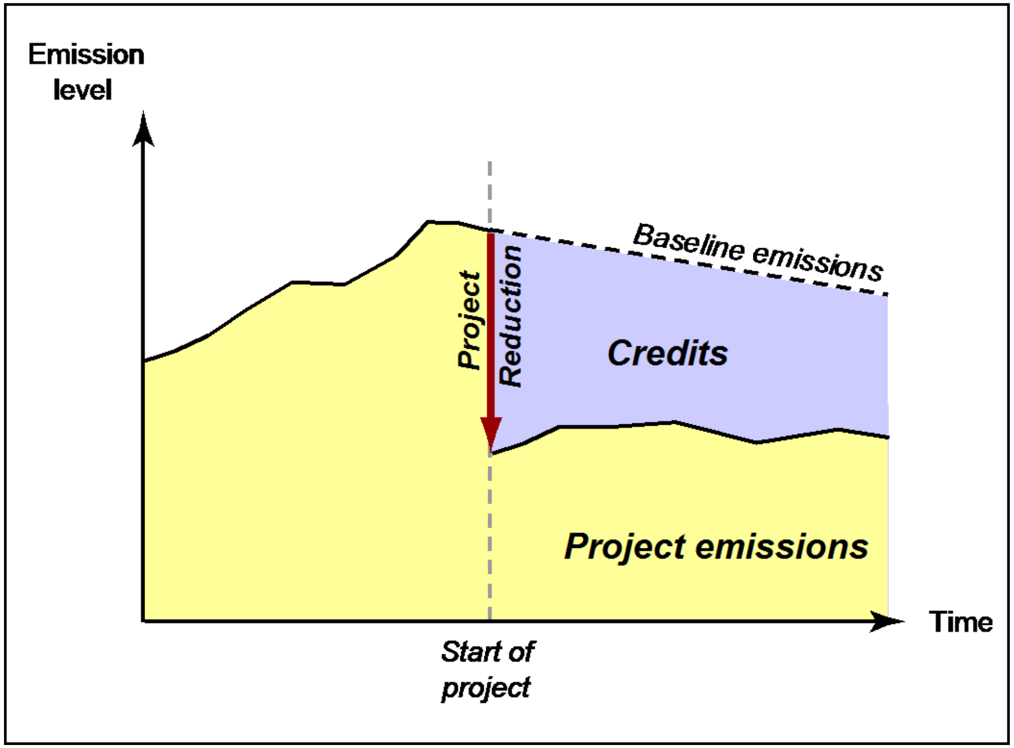


Notes: Trend is a locally weighted regression at a bandwidth of 0.50

Projects entering validation can be discontinued at any stage (excl. projects that have been resubmitted)

The Problem of „Cheating“ within the CDM

- A credit-based emissions trading system without exogenously set targets is subject to **information asymmetries,** which are more severe than within a cap-and-trade system
- The Project Developer has better information than the regulator
- Problematic, because the good traded on the market is entirely created by regulation
- Control Costs are considerably high.



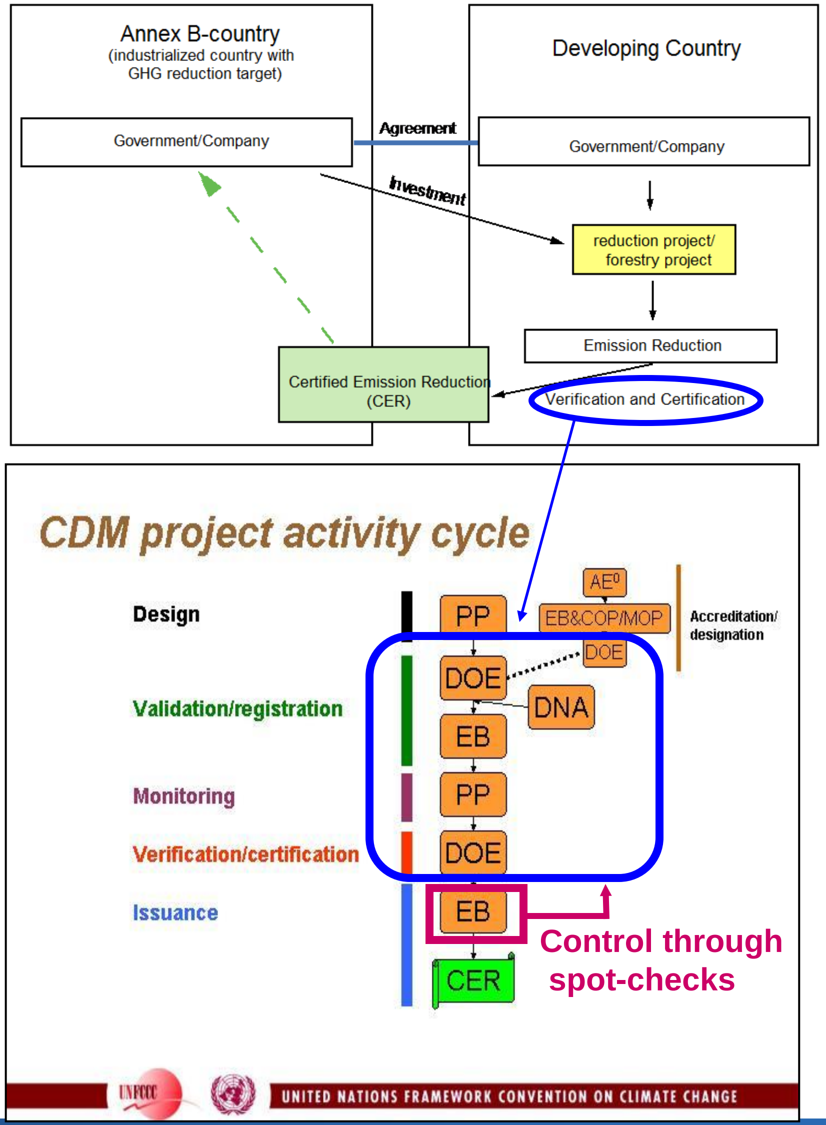
Generated Offsets = Baseline Emissions - Actual Emissions

Baseline Emissions: Asymmetric Information on Additionality

Actual Emissions: Problem of Underreporting

Verification and Monitoring within the CDM

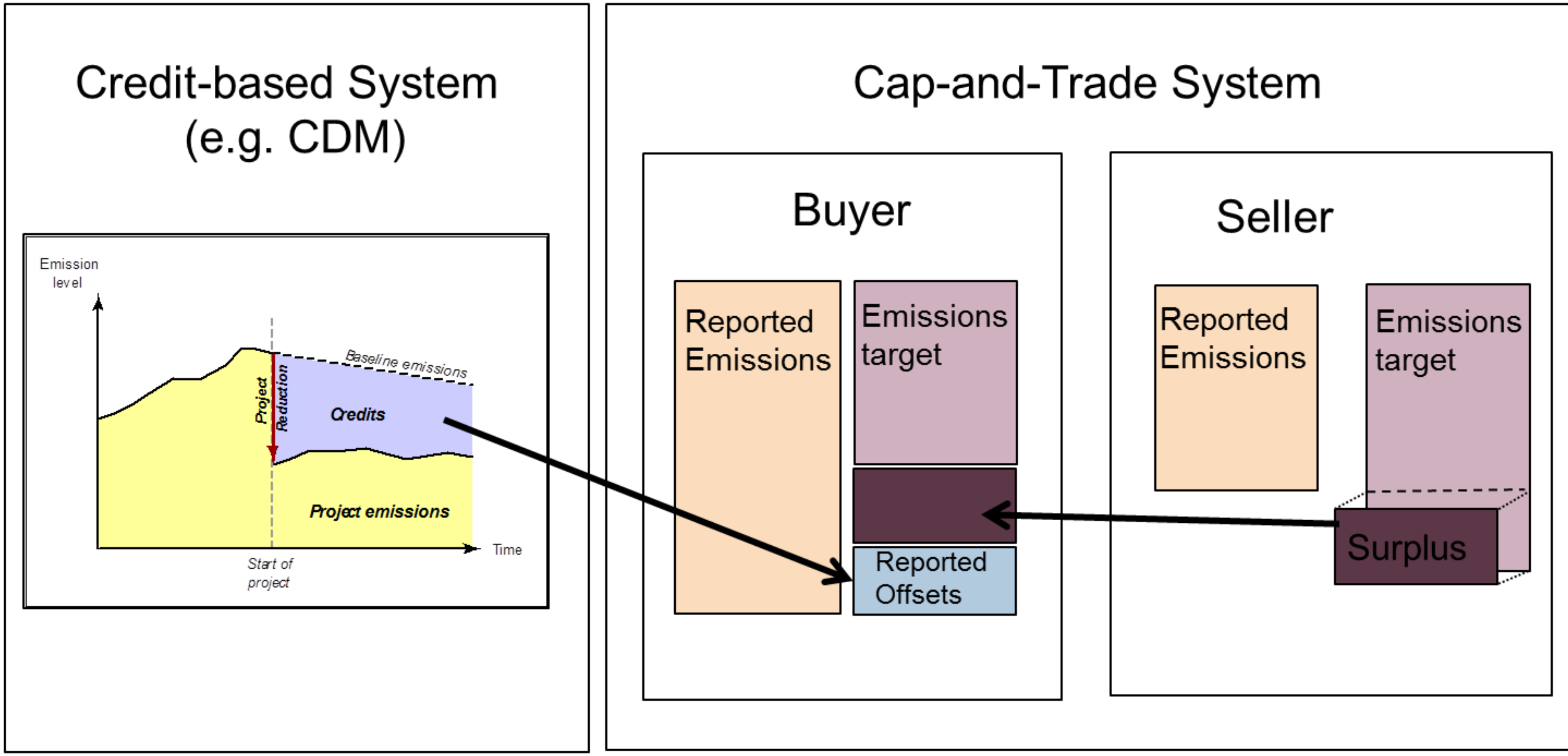
- Due to the lack of targets the seller and the buyer have an incentive to misreport either the baseline or actual emissions, or both.
- The CDM regulation is based on third-party verification by a so-called "Designated Operating Entity" (DOE).
- The DOE being remunerated by the project parties has, in principle, an incentive to collude. (Difference to other verification markets)
- The regulator (CDM Executive Board) needs to reduce the incentives to cheat within the market.
- The current main measure of enforcement are spot-checks.
- The budget to execute spot-checks is limited.



Discussion

- The CDM has been severely criticized.
  - What is your assessment on the efficiency of such mechanisms?
  - What are the alternatives?
  - How would you design an alternative approach?

Offsets under Cap-and-Trade



Overreported Reductions will also reduce the effectiveness of Cap-and-Trade scheme.

Incomplete enforcement Model Setup

- Project developers choose their level of reported reductions ***z*** and actual reductions **e** as an optimal response to the regulators monitoring pressure α**.**
- Overreporting if $z - e > 0$.
- The regulator can vary the monitoring intensity α over the different project types by increasing or decreasing spot-checks on projects.
- The regulator chooses to minimize overall overreporting, i.e. $\sum(z-e)$.
- Projects differ with respect to the degree of verifiability, i.e. an individ. Probability β of the regulator finding out the truthfulness of the report with $\beta \in [0,1]$. For simplicity, β is assumed to be uniformly distributed.
- Project *i* faces the probability of being discovered when misreporting of $\alpha\beta$. In case of cheating it risks sanction θ(x), with $x = z_i - e_i$, θ'(x)>0 and θ''(x)>0.

Information asymmetry over costs

- Emission reductions *e* for two different cost types of projects, $c_g(e)$ and $c_b(e)$, with $c_g(e) < c_b(e)$ and $c'_g(e) < c'_b(e)$.
- Cost functions are known to the regulator. Cost type is private information.
- Relative frequency of good type g is π (public information).
- Both types are present within each verifiability class $\boldsymbol{\beta}$.
- Under full compliance, $c'_j(e_j^*) = p$
- Regulator can hence **infer** the optimal level e_g^* from the cost function and price p.
- Hence, $z_j \leq e_g*$, as reports above e_g^* are automatically rejected.
- As projects will never reduce more than they report, $e \in [0, e_g^*]$.

Optimization problem of the Regulator:

$$\min_{\alpha} \int_0^1 \left[\pi \cdot \left(e_g^* - e_g(\alpha\beta) \right) + (1-\pi)\left(z_b(\alpha\beta) - e_b(\alpha\beta) \right) \right] \, d\beta$$

subject to

$$\int_0^1 \alpha(\beta) \cdot n \;\; d\beta \leq B,$$

$$e_g(\beta) \in \operatorname{argmax} \left\{ \mathrm{U}_g\left(e_g \right) \right\}$$

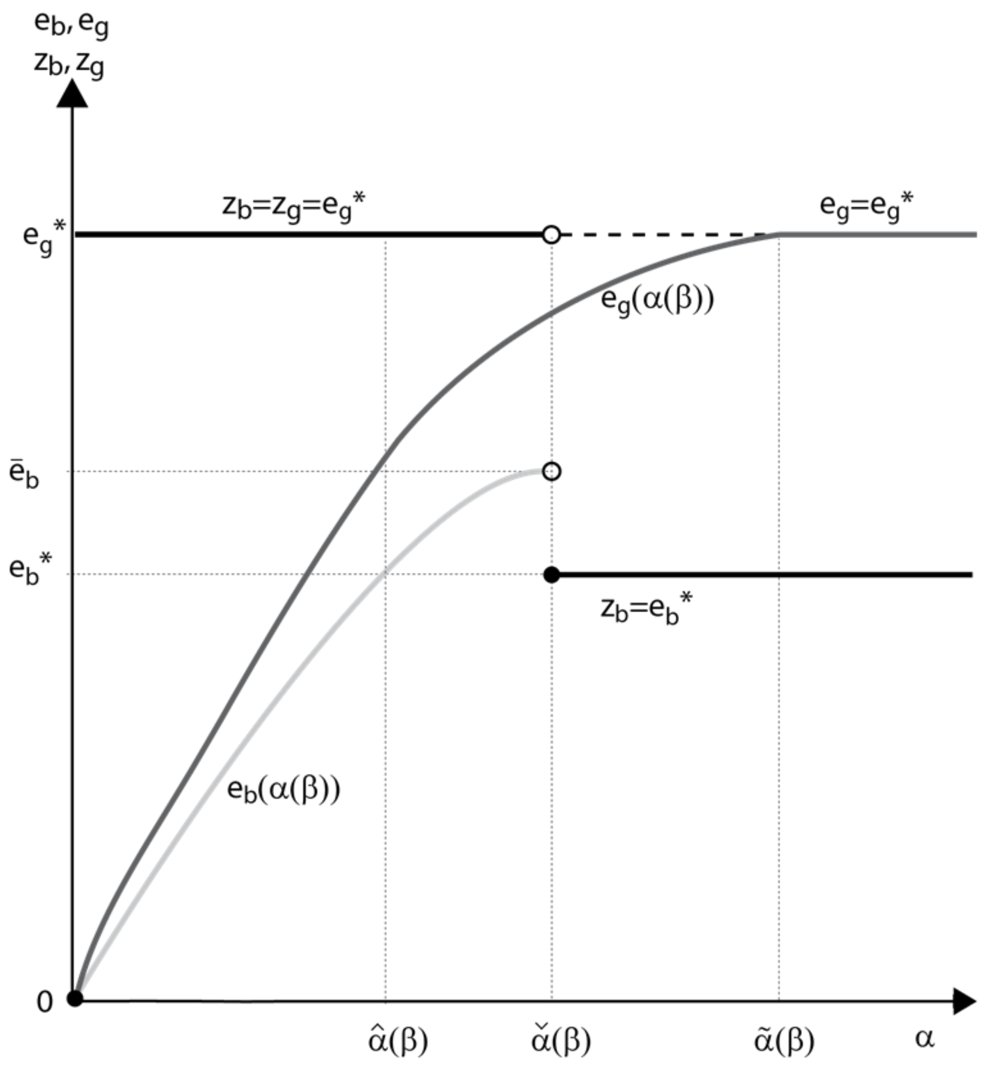
$$e_b(\beta), z_b(\beta) \in \operatorname{argmax} \left\{ U\left(e_b, z_b \right) \right\}$$

where

$$U_j(e_j, z_j) = p z_j - c_j\left(e_j \right) - \alpha\left(\beta \right) \cdot \beta \cdot \theta(z_j - e_j)$$

with c‘(e)>0, c“(e)>0, θ‘(x)>0 and θ“(x)>0; *p* is price per certificate and e^*_g is the maximum plausible reduction level.

Optimal response of project developer



Full compliance result:

$$c'_j\left(e_j^*\right) = p$$

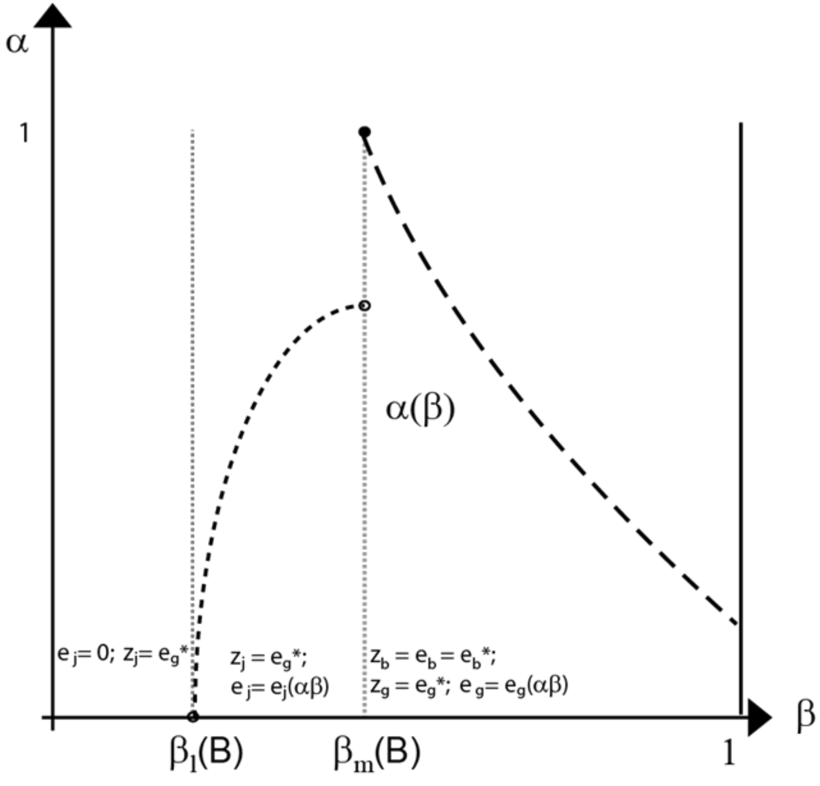
Thresholds:

$$\hat{\alpha}(\beta) \equiv \frac{p}{\beta \cdot \theta'\left(e_g^* - e_b^*\right)}$$

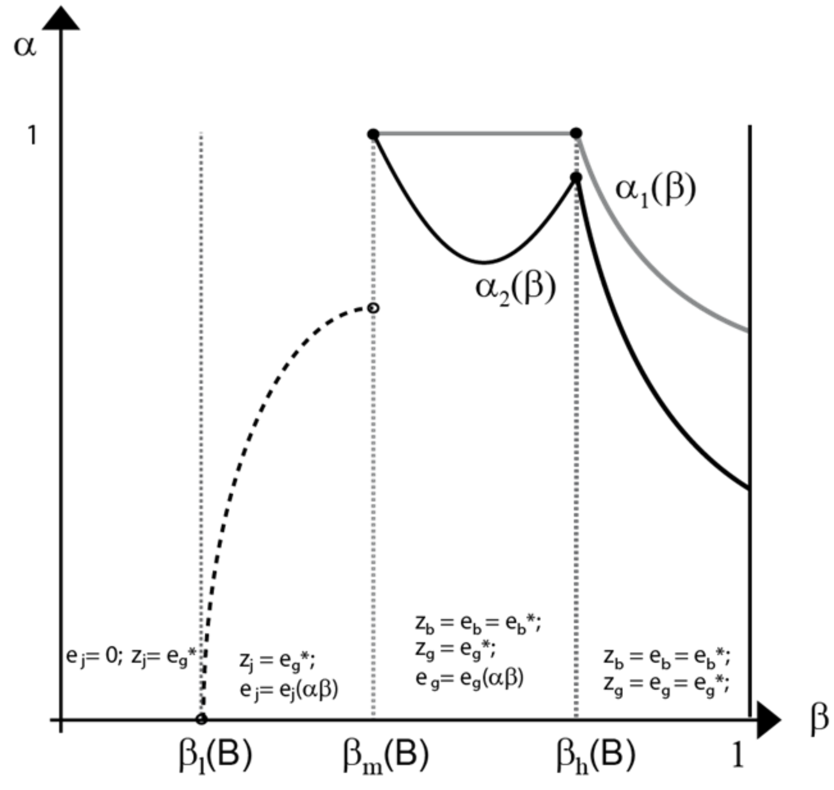
$$\breve{\alpha}(\beta) \equiv \frac{p \cdot \left(e_g^* - e_b^*\right)}{\beta \cdot \theta\left(e_g^* - \bar{e}_b\right)}$$

$$\tilde{\alpha}(\beta) \equiv \frac{p}{\beta \cdot \theta'(0)}$$

Characteristics of the optimal Monitoring Strategy



Case a:
Relatively small monitoring budget



Case b:
Relatively large (but still constrained) monitoring budget

Conclusions

- There are significant differences compared to optimal monitoring for a tax regime:
- With a large enough share of projects with high abatement costs, the regulator has an incentive to induce full compliance for these cost types **over the whole range of verifiability** where this is possible.
- With decreasing verifiability, the optimal audit pressure features a ‘jump’ downwards when reaching levels of verifiability, for which the regulator cannot deter overreporting by high-cost projects.
- For projects with intermediate verifiability, optimal monitoring pressure can be either non-increasing or ‘U-shaped’, depending on the relative stringency of the penalty schedule.
- The most cost effective way to prevent misreporting is to set high standards for project admission with respect to verifiability.

Current market prices for CERs

- Spot price as of November 18th: 0.42 €/t
- Reason for price drop:
  - Low demand meets oversupply
  - EU ETS will in the future accept only CERs from LDCs
  - Other potentially large buyers refrain from joining the KP