



The Swedish charge on NOx emissions from stationary combustion plants

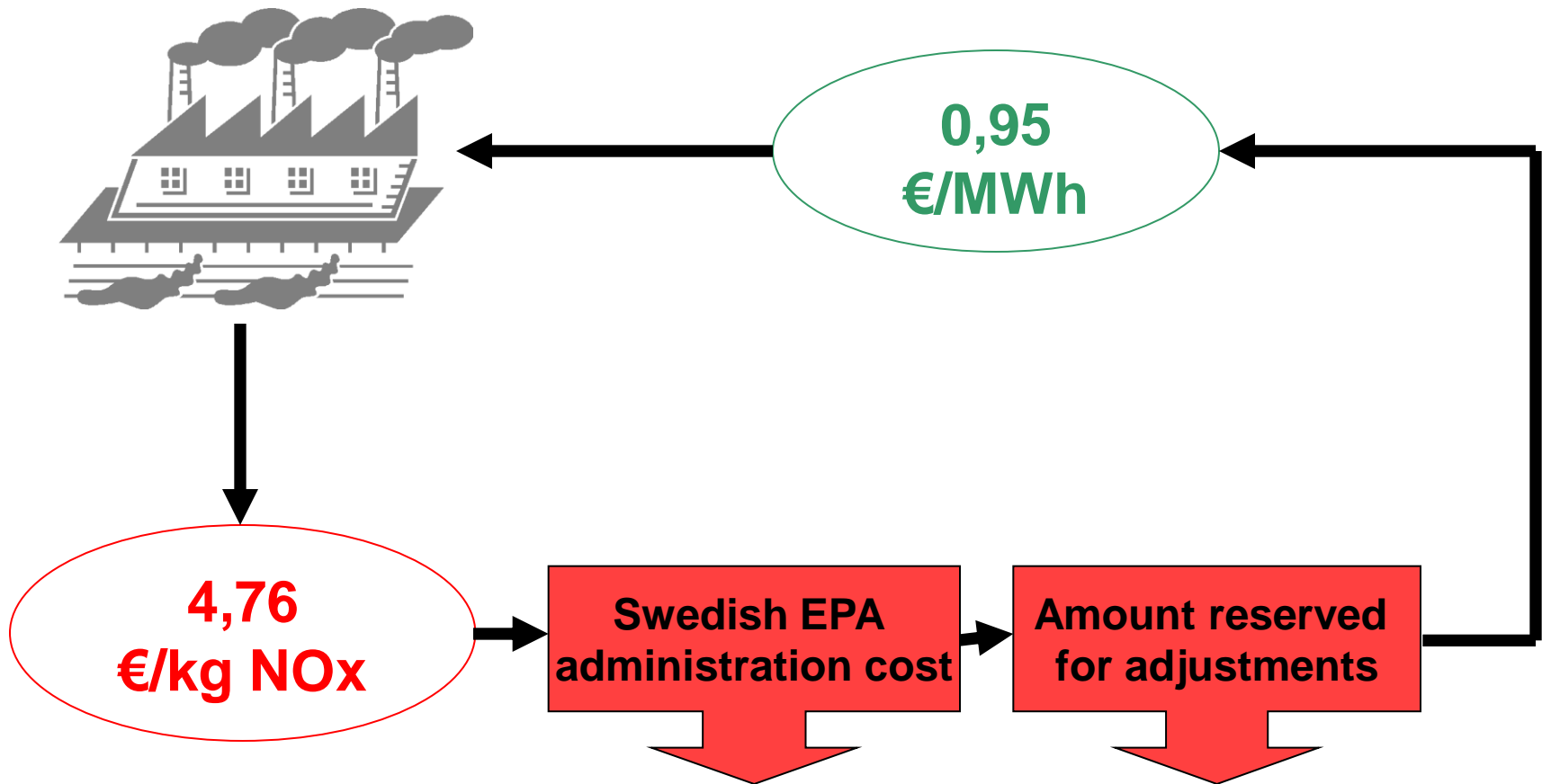
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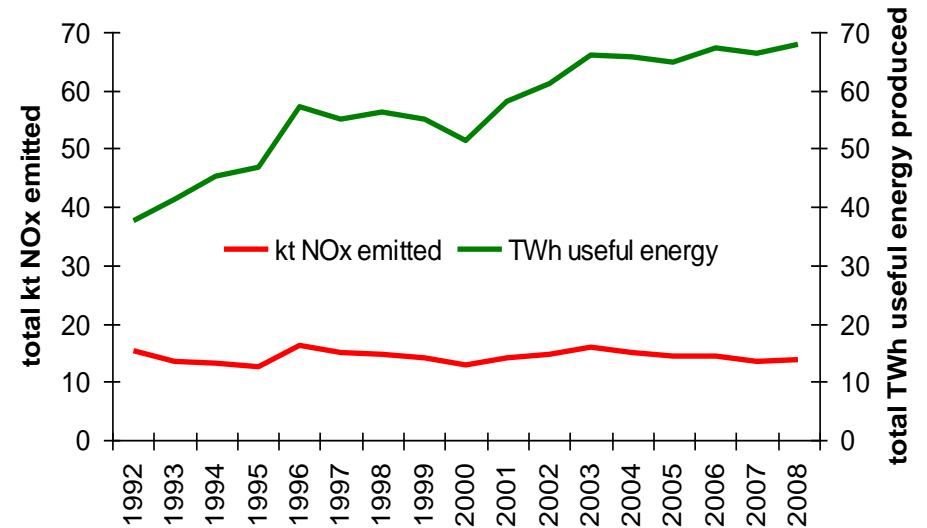
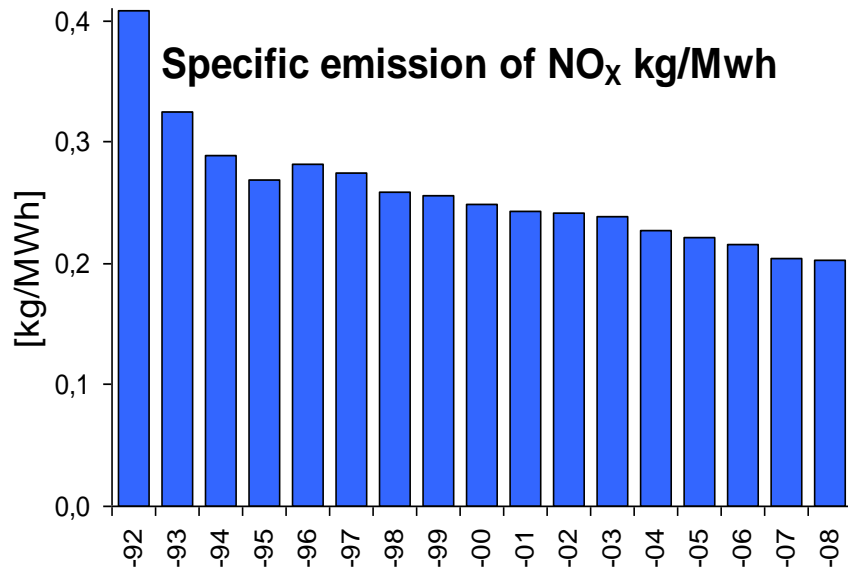
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The refund mechanism



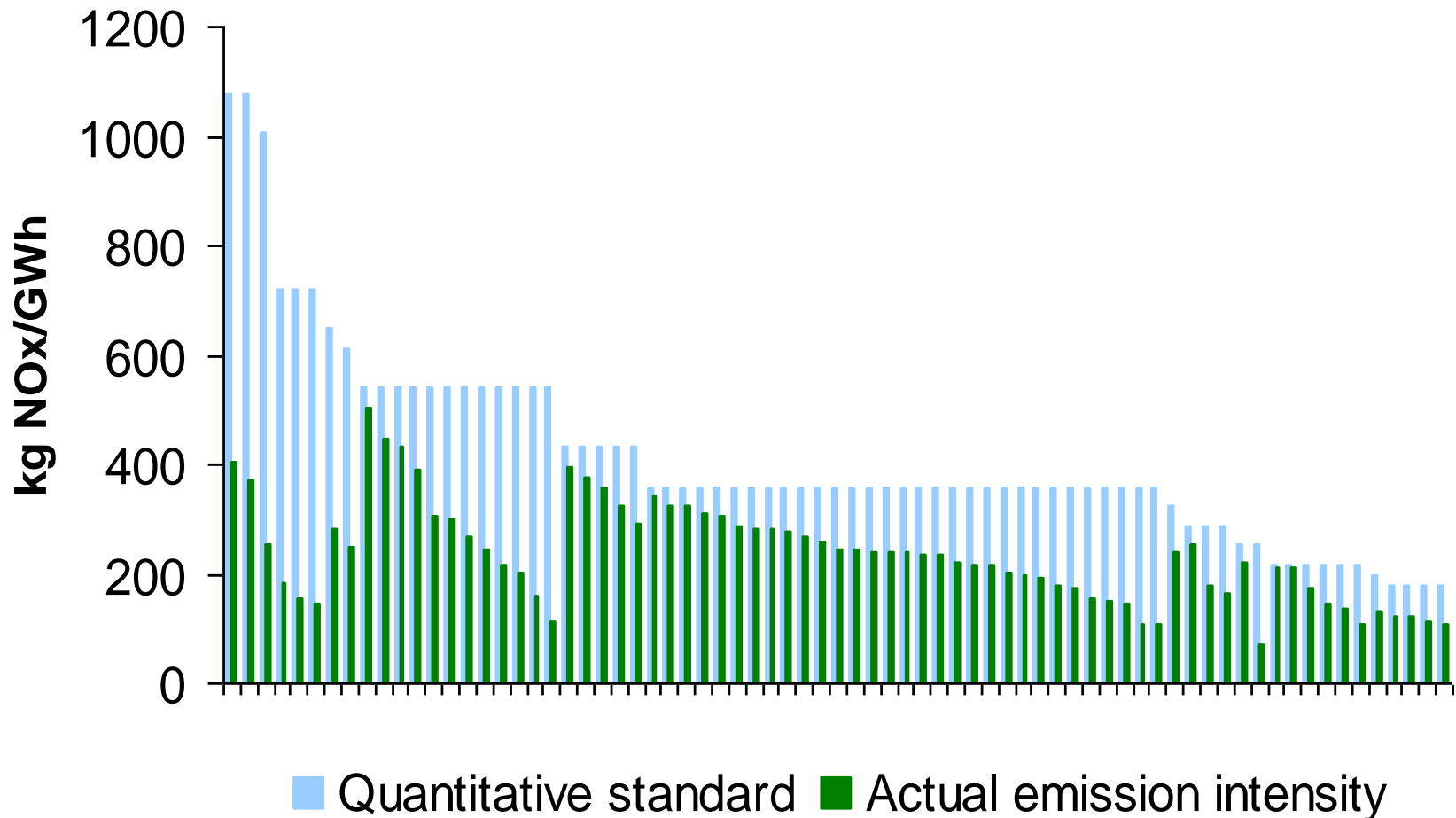
Decreasing emissions, increasing energy output



Purpose and implementation of the Swedish NOx charge

- Introduced 1992 in order to reach national environmental goals for acidification and eutrophication
- Law, ordinance and code of statutes
- Includes over 400 production units with useful energy output higher than 25 GWh per year
- Excluded sectors are some industrial processes such as iron- and steel processes or lime processes
- Excluded boiler types are recovery boilers and sulphite liquor boilers

Environmental effectiveness of charge vs parallel quantitative limits



Design, implementation and monitoring

- Administration must be effective and equivalent
- Scrutinize returns
- Audits

- Continuous monitoring of emissions and energy output
- External control of monitoring system
- Annual return to authority

Output-based refunding of emission charge

Advantages:

- High charge level possible to combine with low polluter resistance →
Strong effects on abatement and innovations
- Compulsory continuous monitoring → allows process engineers to exploit the full range of technical and non-technical abatement options
- Low administration cost
($<1\%$ of total refunds or 6% of abatement costs)
- Enforcement in the interest of polluters as the “proof” burden lies with the polluters
- Predictable long-term gains from innovations (when continuously adjusted for inflation)

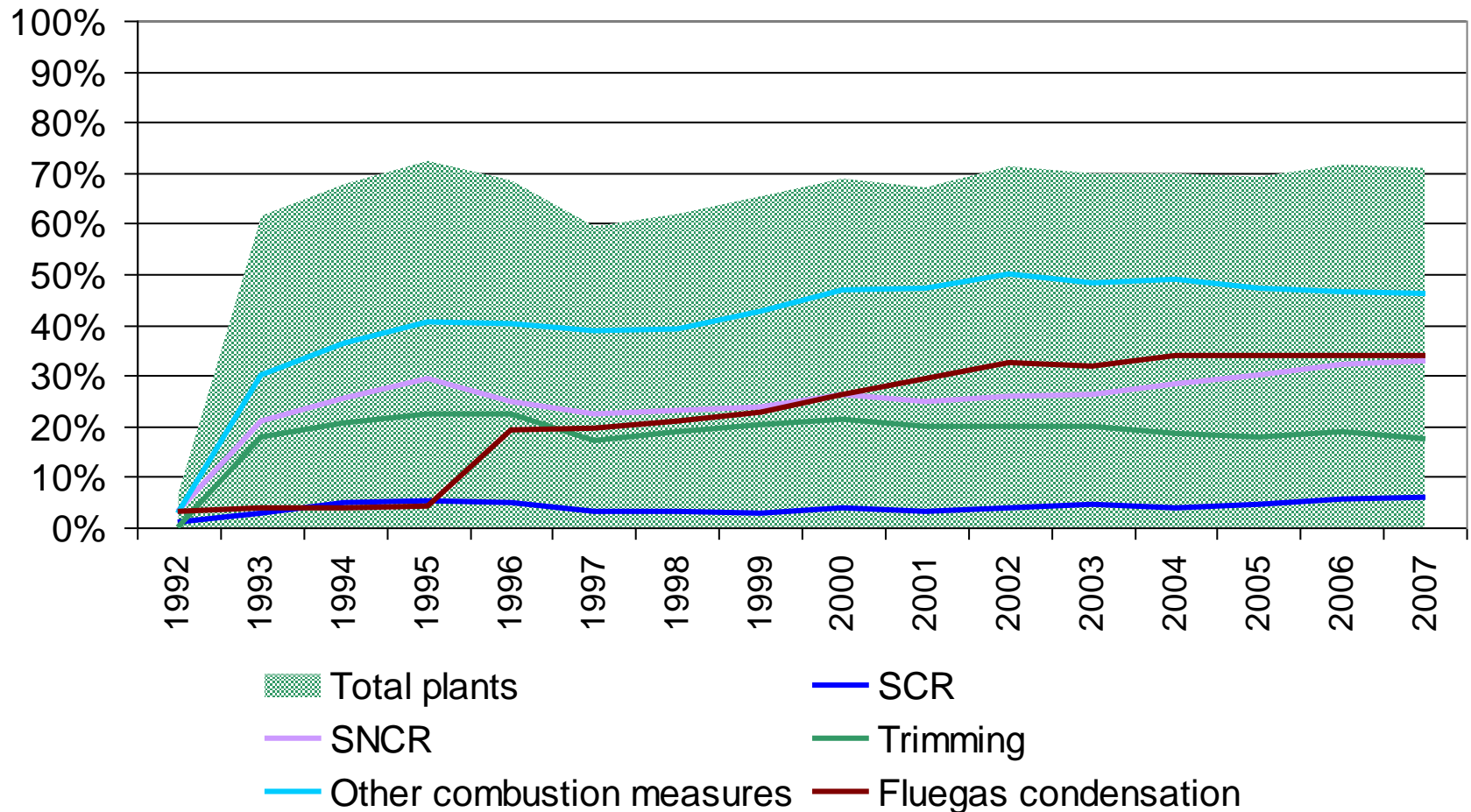
Output-based refunding of emission charge

Disadvantages/limitations:

- Basis for refund: single output independent of abatement
- Polluter community large enough to create competitive situation
- Monitoring: careful and costly –limits targeting to large stationary polluters
- Presence of unutilized technical abatement potential necessary for system to have environmental impact
- Refunding inhibits spread of information on abatement innovations between polluters
- Polluter Pays Principle violated, which preserves already existing distortions in resource allocation (small for Swedish NO_x charge)

Adoption of NOx abatement technology in regulated plants

(n=182 to 427)



Empirical evidence of innovation effects of the Swedish NOx charge

- **Evidence from emission intensity analysis:**
~270 large plants regulated 1997-2007: Average emission intensity falls by 3% per year both among plants that have adopted physical abatement technology and among plants that have not (due to non-technical measures).
- **Evidence from estimation of marginal abatement cost curves:**
55 power plants regulated 1992-97: Statistically significant downward shift in the marginal abatement cost curve over time (i.e. marginal cost reduced given a certain emission intensity level).
- **Evidence from patent data analysis:**
Sweden among top five in patent applications per person for NOx abatement technology
Type of technologies in patent applications (~ 50% combustion technology and ~ 50% post-combustion technology) suits technology adoption pattern of targeted plants.

Further information in English

- On the Swedish NOx charge:

www.naturvardsverket.se/Documents/publikationer/620-8245-0.pdf

www.naturvardsverket.se/en/In-English/Menu/Legislation-and-other-policy-instruments/Economic-instruments/The-Swedish-charge-on-nitrogen-oxides/

- On innovation effects of the Swedish NOx charge:

L. Höglund Isaksson and T. Sterner, Innovation effects of the Swedish NOx charge, OECD Global Forum on eco-innovation -background papers, www.oecd.org/document/

- Other on the Swedish NOx charge and output-based refunding:

Höglund Isaksson, L., Abatement costs in response to the Swedish NOx charge, J. Env. Econ. Managem. (2005)

Sterner, T and L. Höglund Isaksson, Refunded emission payments theory, distribution of costs, and Swedish experience of NOx abatement, Ecol. Econ. (2007)

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