The Swedish charge on NOx emissions from stationary combustion plants

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The refund mechanism

4,76 €/kg NOx

0,95 €/MWh

Swedish EPA administration cost

Amount reserved for adjustments
Decreasing emissions, increasing energy output

Specific emission of NO$_x$ kg/Mwh

kt NOx emitted

TWh useful energy produced
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 NOx 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](http://www.naturvardsverket.se/Documents/publikationer/620-8245-0.pdf)

- **On innovation effects of the Swedish NOx charge:**

- **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)

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