



# Comparison of Uncertainty in Different Emission Trading Schemes

September 25, 2004

Suvi Monni



## Background

- ◆ EU CO<sub>2</sub> emission trading 2005-2007
  - aim: to give one cost effective measure to reduce ghg emissions in the EU in order to achieve the Kyoto target
  - rules set in Directive 2003/87/EC and Guidelines for Monitoring
  - CO<sub>2</sub> from combustion and some raw materials in large installations (plants > 20 MW<sub>th</sub>, )
  - energy, pulp and paper, metal and mineral industry and oil refineries (excluding e.g. chemical industry)
  - 13 000 plants in the EU-25 area (plant-level emission data needed)
  - 2000 Tg CO<sub>2</sub>
  - share of CO<sub>2</sub> emissions included in trading varies from <30% to nearly 100% in different member states

## Background

- ◆ EU emission trading 2008-2012 (second phase)
  - rules will be decided in 2006
  - may be extended to cover other gases and/or sources
- ◆ Kyoto emission trading 2008-2012
  - rules set in the Marrakesh accords
  - begins, if the Protocol enters into force
  - emissions traded between parties
  - parties can enable companies to trade
- ◆ Uncertainty estimates required under the Kyoto Protocol

## Methods

- ◆ Aim: to estimate differences in uncertainty of different ETS
- ◆ Uncertainty in different ETS estimated based on uncertainties in GHG inventories
  - EU-15 and EU-25 concerned
  - method does not give the real uncertainty in emission trading, because of
    - uncertainties in point sources (EU ETS) different from uncertainty in inventories
      - in inventory, random errors cancel each other
      - systematic errors cumulate
    - uncertainty in changes of emissions
  - good for comparison of different schemes

## Cases

- ◆ EU CO<sub>2</sub> emission trading scheme for EU-15
- ◆ EU CO<sub>2</sub> emission trading scheme for EU-25
- ◆ Hypothetical EU CO<sub>2</sub> emission trading scheme extended to cover CH<sub>4</sub> & N<sub>2</sub>O for EU-15
- ◆ Kyoto Emission trading scheme without LULUCF for EU-15
- ◆ Kyoto Emission trading scheme with LULUCF for EU-15

## Comparison of different schemes

	EU CO <sub>2</sub> ETS	Kyoto ETS	Hypothetical extended ETS
Sectors	Energy, industry (partly)	Energy, industry, agriculture, waste, LULUCF	Energy, industry (partly)
Gases	CO <sub>2</sub>	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, HFCs, PFCs, SF <sub>6</sub>	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O
Limit for uncertainty	Yes (for activity data)	No	-
Accuracy of emission estimation methods	Calculations accurate for combustion (mass balance), measurements more accurate for some processes	measurement of all emission sources not possible	measurements of CH <sub>4</sub> & N <sub>2</sub> O from combustion more accurate than calculation

## Material

- ◆ National allocation plans (NAPs)
  - not available for all member states of the EU
  - difficult to separate emissions from combustion and processes (important for uncertainty assessment!)
- ◆ National inventories
  - all emissions from mineral products assumed to be included in EU ETS
  - all process emissions from iron and steel assumed to be included in EU ETS
- ◆ Uncertainty estimates
  - IPCC GPG2000
  - Guidelines for Monitoring (EU ETS)
  - inventory uncertainties estimated by the member states
  - Monte Carlo simulation

## Sources of uncertainty in different schemes

- ◆ In general
  - errors in models, measurement instruments, expert judgements
  - unrepresentativeness of emission factors used
  - natural variability
- ◆ EU ETS covers least uncertain sources, even though some sources are rather uncertain
  - waste combustion (share of fossil carbon in waste)
  - oil refineries
  - mineral products



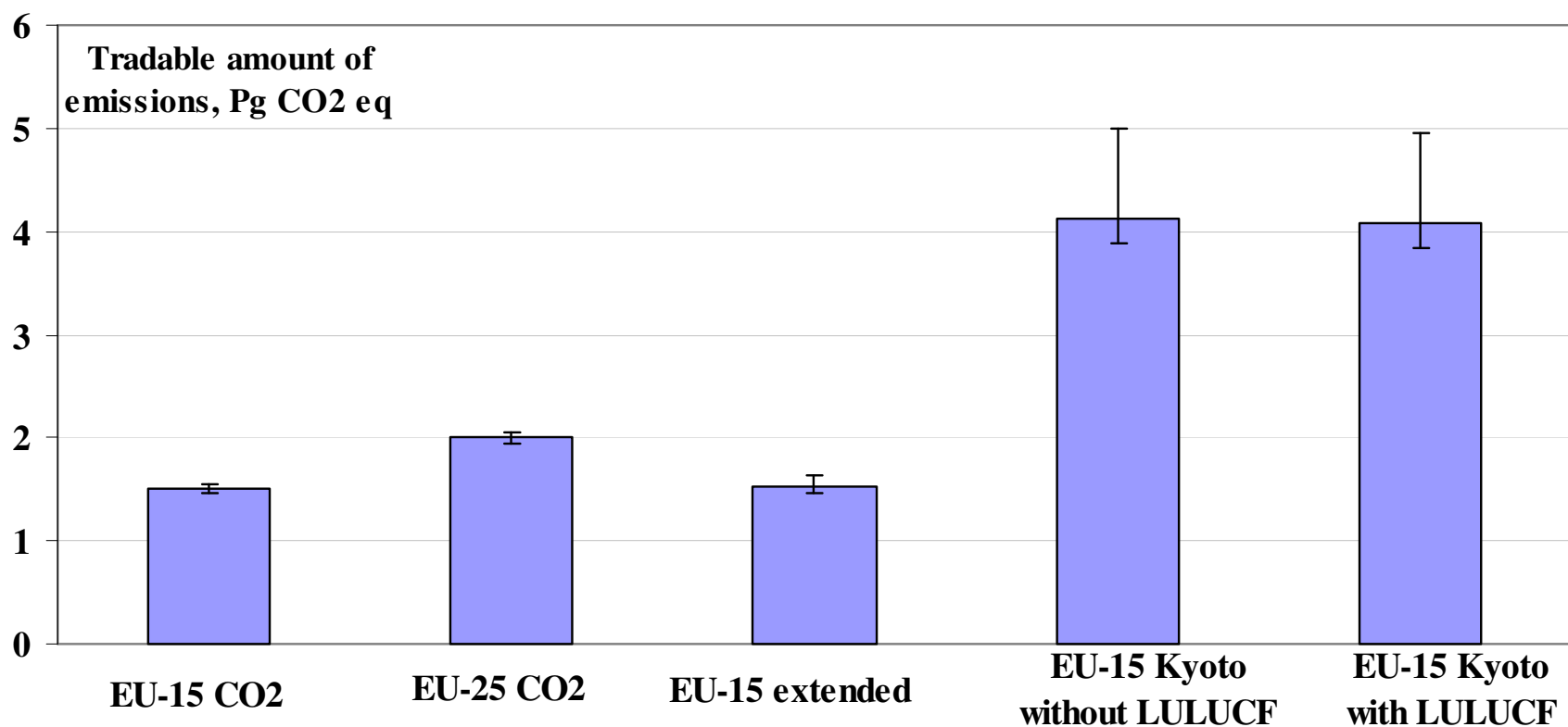
## Sources of uncertainty in different schemes (continued)

- ◆ Hypothetical extended EU ETS
  - CH<sub>4</sub> & N<sub>2</sub>O from same sources as in EU ETS
  - much larger uncertainties than in CO<sub>2</sub>
  - variability of emissions due to combustion technology, temperature, air fraction, fuel type, etc
- ◆ Kyoto ETS
  - many complex and uncertain emission sources, e.g.
    - landfills
    - agricultural soils
    - LULUCF

## Examples of input uncertainties

Emission source	Gas	Uncertainty
Stationary combustion under EU ET, EU-15	CO <sub>2</sub>	±3%
Stationary combustion under EU ET, new EU member states	CO <sub>2</sub>	±7%
Cement and lime production EU-15	CO <sub>2</sub>	±7%
Cement and lime production, new EU member states	CO <sub>2</sub>	±10%
Stationary combustion	CH <sub>4</sub>	±50%
Stationary combustion	N <sub>2</sub> O	-100 to +550%
HFCs and PFCs emissions	HFCs, PFCs	± 40%
Agricultural soils	N <sub>2</sub> O	-100 to +1000%
Landfills	CH <sub>4</sub>	± 45%
LULUCF	CO <sub>2</sub>	± 90%

## Results



## EU CO<sub>2</sub> ETS and extended EU ETS

- ◆ Uncertainty in EU ETS rather low ( $\pm 3\%$ )
  - inclusion of new EU member states did not increase uncertainty notably
- ◆ Inclusion of CH<sub>4</sub> & N<sub>2</sub>O in hypothetical emission trading scheme
  - small increase in market volume (2%), large increase in uncertainty (-4 to +7%)
  - uncertainties for measured emissions lower, but measurements costly
  - some emission reductions costs are lower than for CO<sub>2</sub>
  - various other possibilities to extend EU ET (e.g. CO<sub>2</sub> from transportation)

## Kyoto emission trading

- ◆ Kyoto emission trading without LULUCF
  - uncertainties increased notably (-6 to +21%)
  - agriculture and waste very uncertain
- ◆ Kyoto emission trading with LULUCF
  - inclusion of LULUCF does not increase uncertainty notably (small sector under the KP)
  - consideration of LULUCF did not include all categories (carbon stock changes in dead organic matter, N<sub>2</sub>O from forest soils) - inclusion of these may increase uncertainty
  - uncertainties difficult to estimate for activities under Articles 3.3. and 3.4
  - results with LULUCF only indicative

## Discussion

- ◆ Uncertainties in (small) installations not included in EU ETS estimated larger than for installations included
  - if included in ET, same rules may apply
- ◆ In the future, ET may cover wider range of countries
  - uncertainties larger in developing countries
  - same rules may be applied for all countries
  - share of non-CO<sub>2</sub> larger in developing countries - larger total uncertainty
  - participation of maximum number of countries may increase cost-efficiency
- ◆ Under the KP, not all emissions are to be traded (only a small share)

## Conclusions

- ◆ Significant differences in uncertainties in different ETS
- ◆ Here uncertainty assessment based on inventories
  - in reality based on data from single actors (countries, companies etc)
  - emission allowances exactly defined
- ◆ Inclusion of uncertainty in emission trading schemes in the future may be beneficial, e.g.
  - similar data quality between purchaser and vendor
  - limit for uncertainty in emissions to be traded
- ◆ Uncertainty should be concerned when planning future emission trading schemes