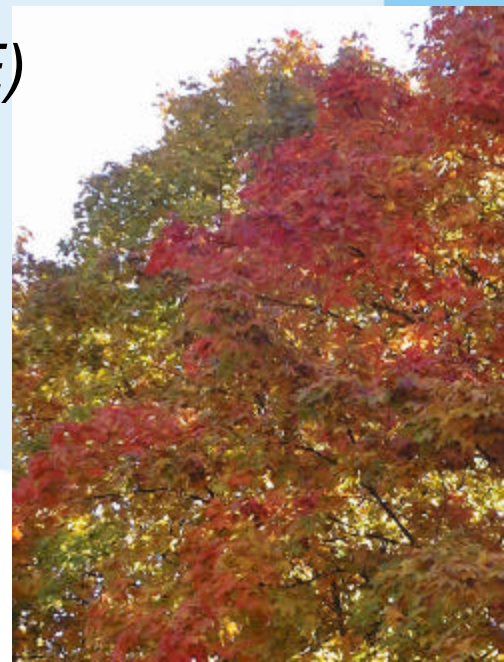


Emission scenarios for particulate matter research and policy assessment in Finland

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Aims of the study

- Finnish Regional Emission Scenario (FRES) model
 - anthropogenic emissions
 - emphasis on particulate matter
 - control potential (scenarios)
 - sectoral division
 - spatial distribution
 - additionally:
 - biogenic VOC emissions
 - particulate black and organic carbon
- absolute emitted mass and aerosol formation potential
- relevance as scientific and policy tool



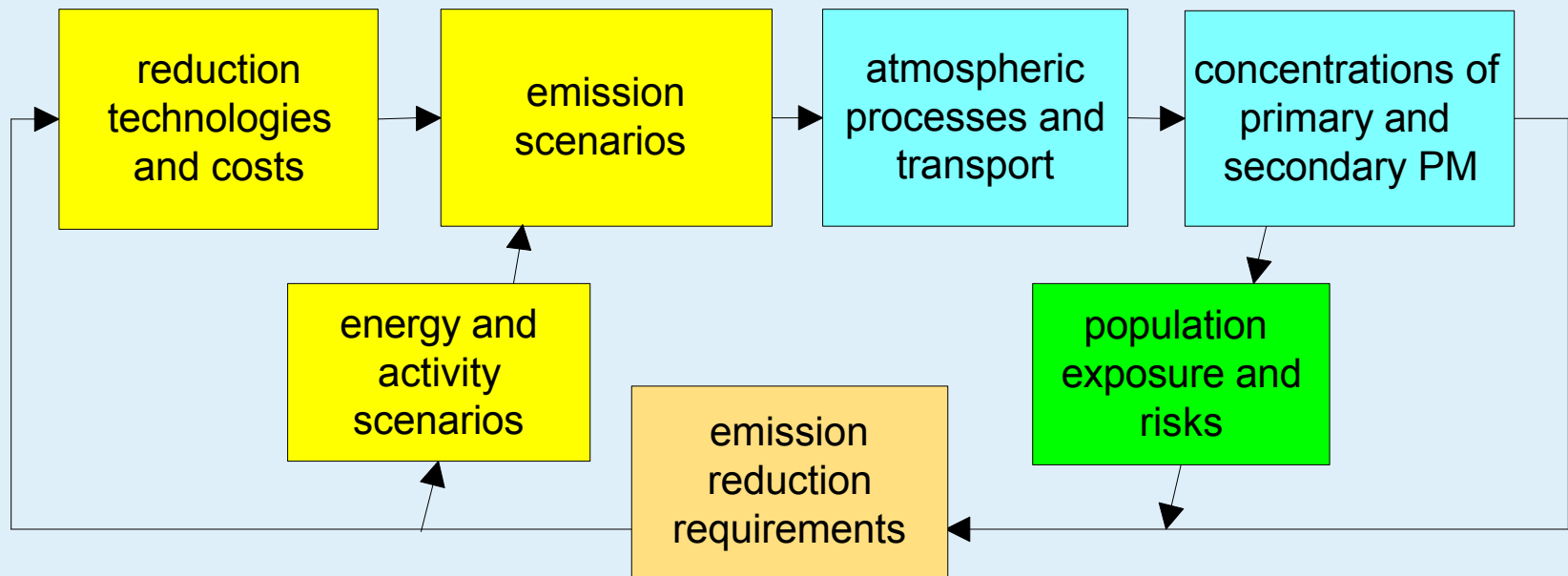
Topical air pollution problems

	SO ₂	NO _x	NH ₃	VOC	prim.PM
■ acidification	✓	✓	✓		
• forest soils, lakes, natural ecosystems					
■ eutrophication		✓	✓		
• forest soils, natural ecosystems					
■ ground-level ozone		✓		✓	
• effects on vegetation and human health					
■ fine particles	✓	✓	✓	✓	✓
• health effects	(precursor gases of secondary PM)				



S Y K E

Integrated assessment modelling of particulate matter in Finland



FRES model

- Finnish Regional Emission Scenarios
- **1990**, 1995, 1998, **2000** and **2010** (three scenarios)
- annual average emissions
- large point sources and municipalities
- comprehensive and consistent data readily available
 - SO₂, NO_x and PM (TSP, PM_{10-2.5-1})
 - inventory data for NH₃ and NMVOC
- natural PM and NMVOC lacking
- ongoing spatial refinement:
 - domestic biomass burning
 - traffic
 - population
 - NH₃ and NMVOC



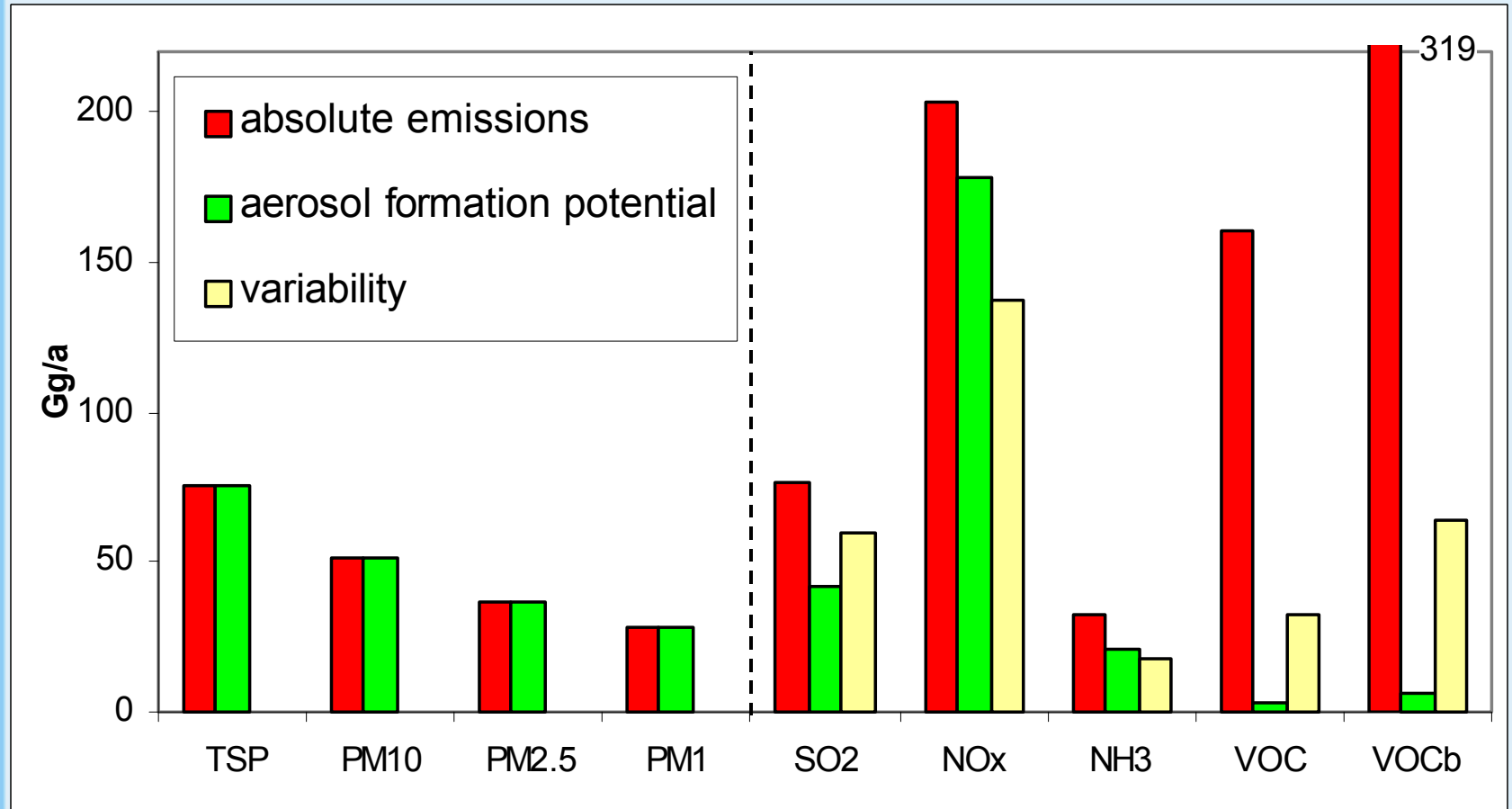
Aerosol formation factors

- secondary molecule = aerosol form of primary emission component
- M_p = molecular mass of the precursor gas component
- M_s = molecular mass of the secondary molecule
- Y = fraction of emission potentially leading to aerosol formation
- **F = fraction of emitted mass converted into secondary aerosols**
- $AF = M_s/M_p \times Y \times F$
- values in parentheses used to explore the potential variability

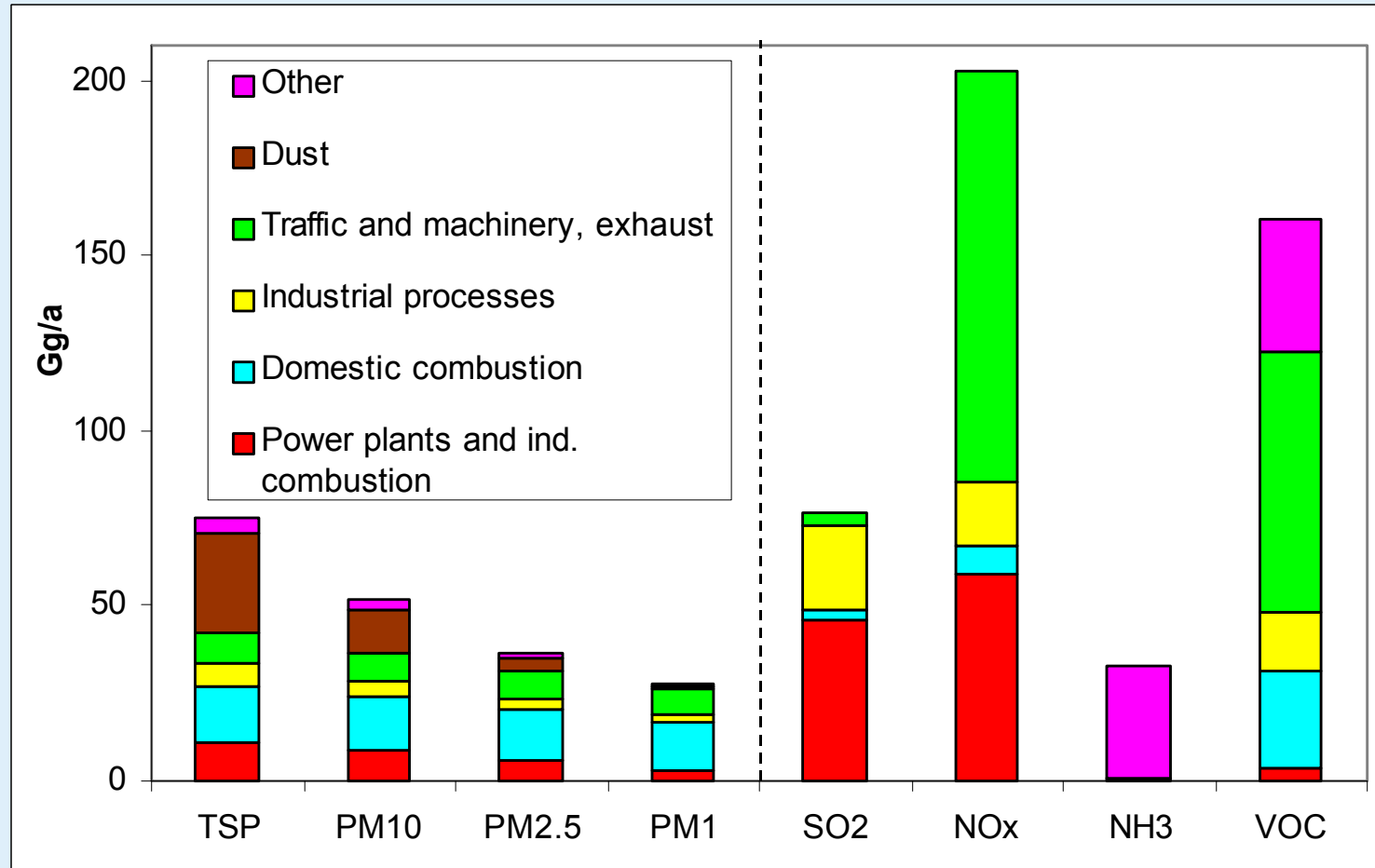
component	sec.molec.	M_s/M_p	Y	F	AF
primary PM	same	1	1	1	1
SO ₂	SO ₄	1.55	1	0.35 (0.50)	0.54 (0.78)
NO ₂	NO ₃	1.35	1	0.65 (0.50)	0.88 (0.68)
NH ₃	NH ₄	1.06	1	0.60 (0.50)	0.64 (0.53)
VOC	OxCy	1.5 (2)	0.25 (0.5)	0.05 (0.20)	0.02 (0.20)



Total emissions in 2000

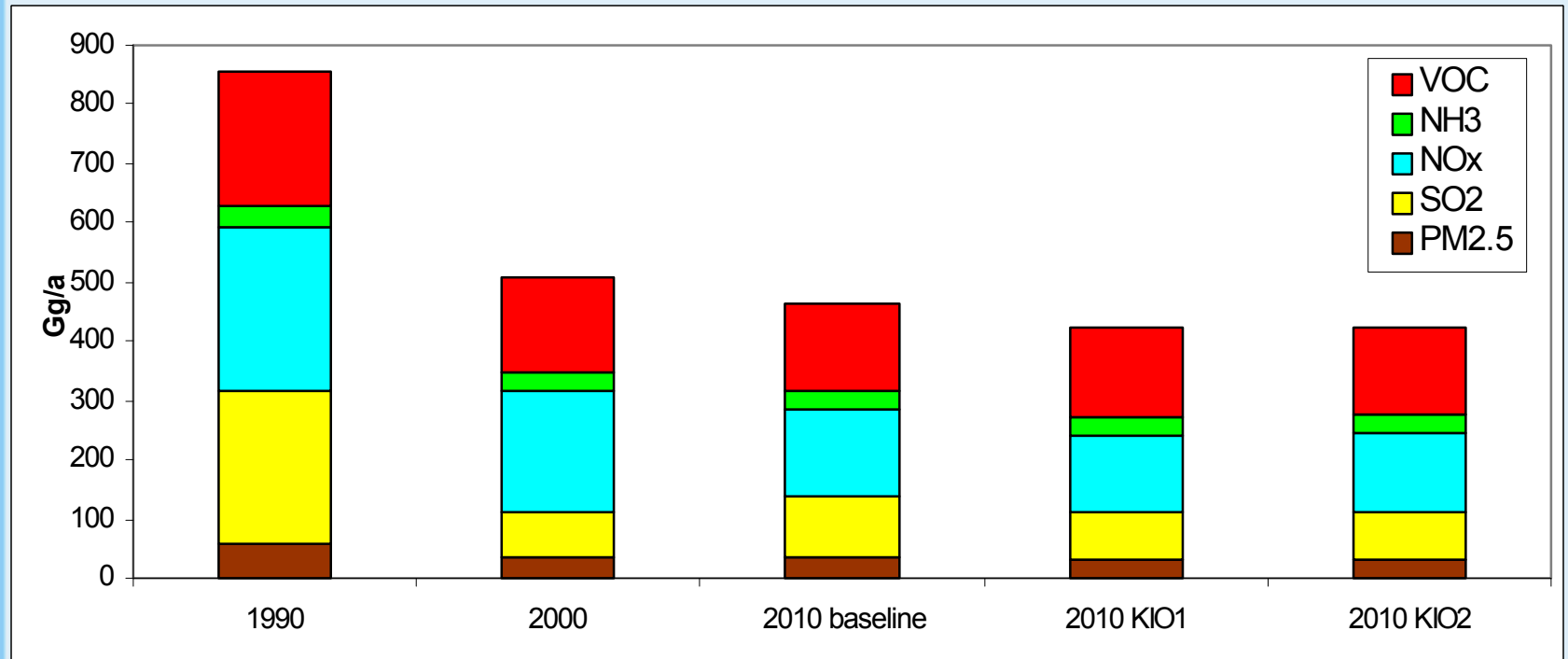


Sectoral emissions in 2000



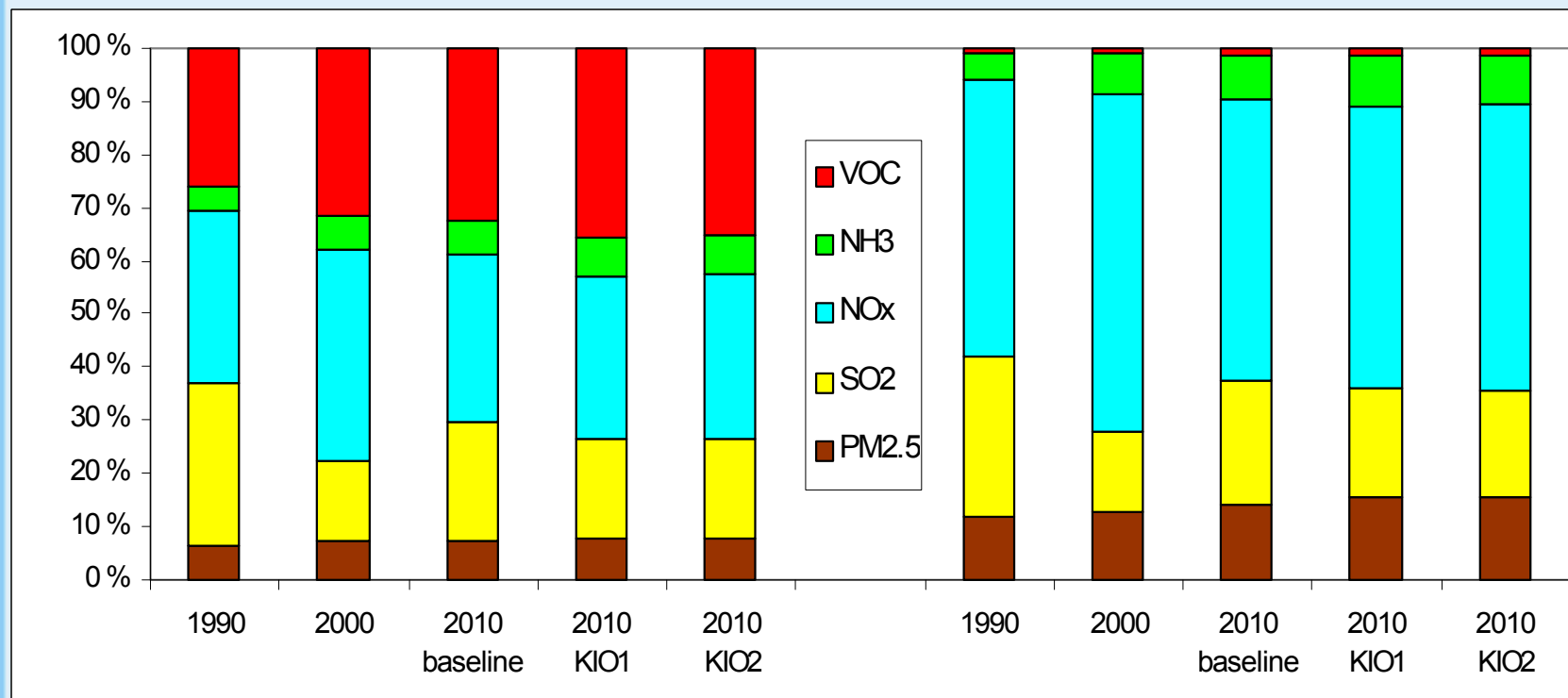
"others" denotes *agriculture* for NH3 and *solvent use* for VOC

Scenario emissions



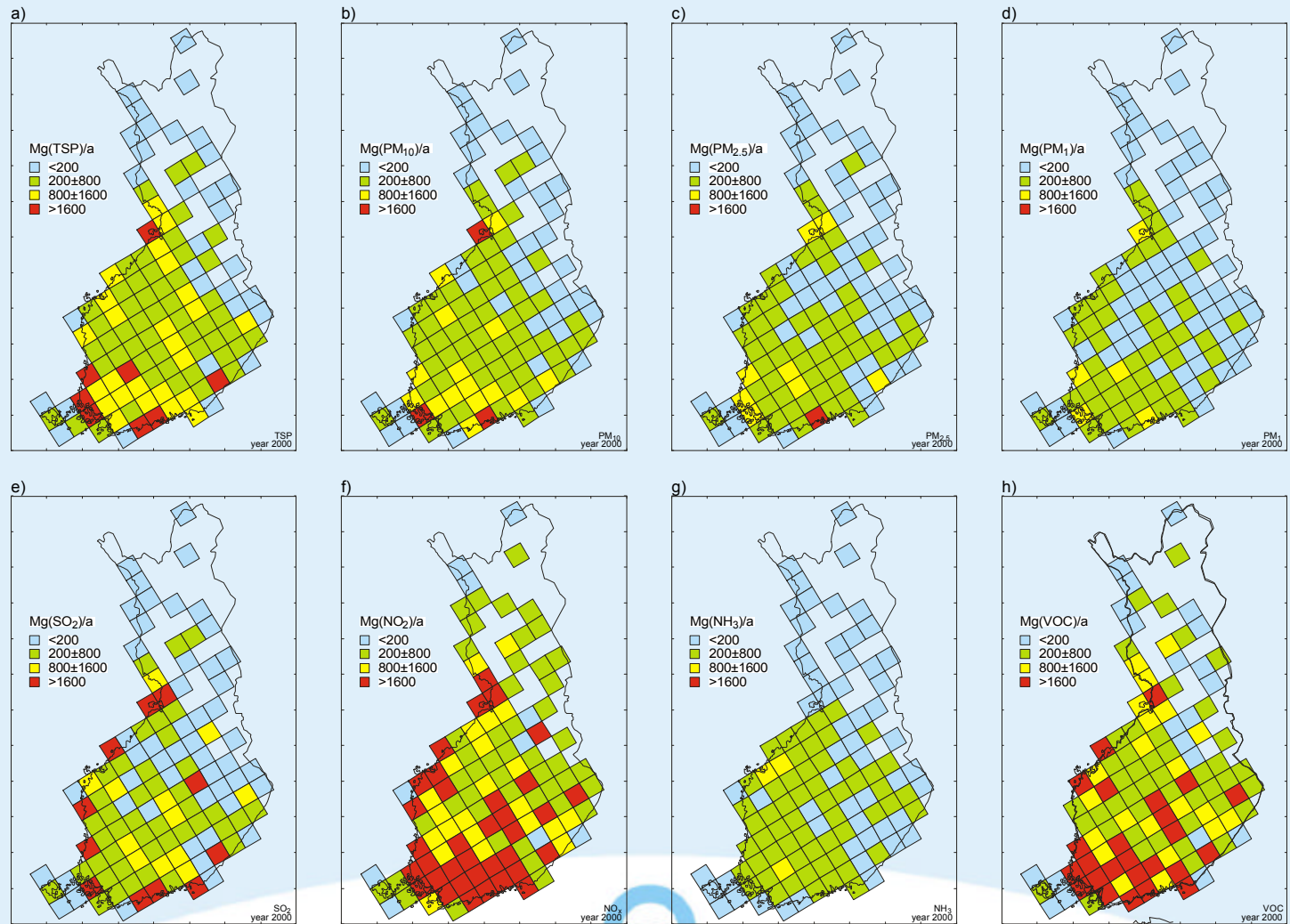
2010 with three energy scenarios:
baseline, "Kyoto-gas" (KIO1) and "Kyoto-nuclear" (KIO2)

Shares in emissions



absolute mass (left), aerosol formation factors weighted mass (right)

Emission distribution in 2000



Concluding remarks

- emission reduction needs revised in Europe in 2004-5
 - need for enhanced emission estimates
 - comparison of national data with the RAINS model of IIASA
- FRES model operatively calculates all relevant Finnish anthropogenic emissions
 - scenarios, sectors, spatial distribution
- results comparable with other sources
- large uncertainties in PM
 - fugitive dust, domestic wood combustion
- NO_x is major contributor in aerosol formation, NH₃ and VOC relatively minor

