A first qualitative and quantitative (TIER 2) analysis on Dutch GHG emissions

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Structure

- **Introduction**

- **Qualitative analysis**
  - ◆ **typology of uncertainty**
  - ◆ **qualitative uncertainties**

- **Quantitative results of TIER 2**
  - ◆ **years 1990 and 1999**
  - ◆ **trend 1990-1999**
  - ◆ **key sources TIER 1 and TIER 2**
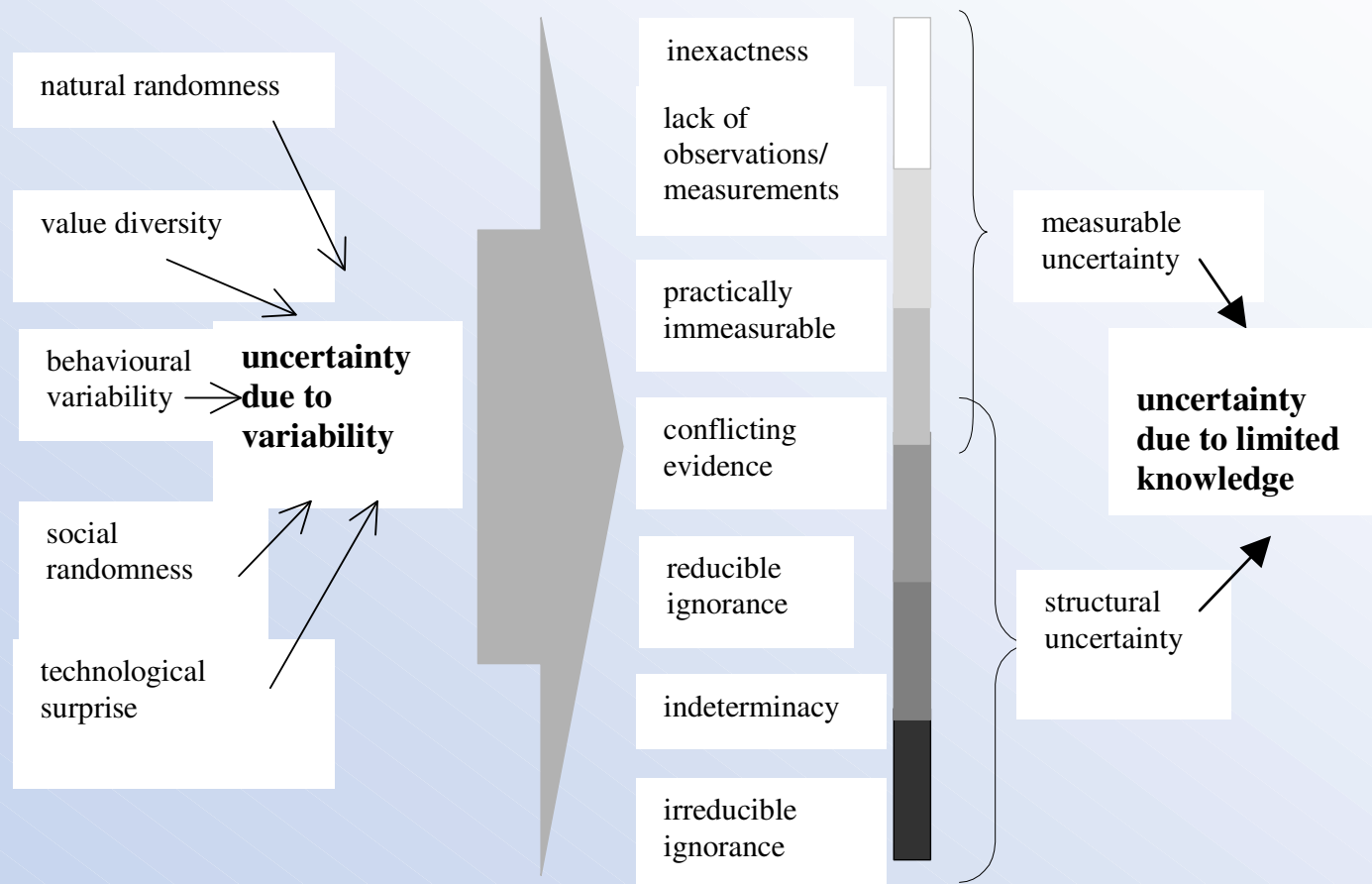
- **Conclusions**

Introduction

- **Improvement Program monitoring GHG emissions, 2000 onwards to prepare the National System**

- **One of the research project deals with the sources of uncertainties in Dutch Emission Registration (PER)**

- **Initial TIER 2 analysis also meant to stimulate further discussion and improvement is this regard**

- **New, improved and/or recalculated data on emissions came available after the project was started.**

Qualitative Analysis

- **Typology of uncertainty: focuses on underlying <u>sources</u> of uncertainty**

- **Two main types:**
  1. uncertainty due to variability
  2. uncertainty due to limited knowledge
    - **measurable uncertainty**
    - **structural uncertainty**

Qualitative typology of uncertainty

natural randomness

value diversity

behavioural variability → **uncertainty due to variability**

social randomness

technological surprise

inexactness

lack of observations/ measurements

practically immeasurable

conflicting evidence

reducible ignorance

indeterminacy

irreducible ignorance

measurable uncertainty

uncertainty due to limited knowledge

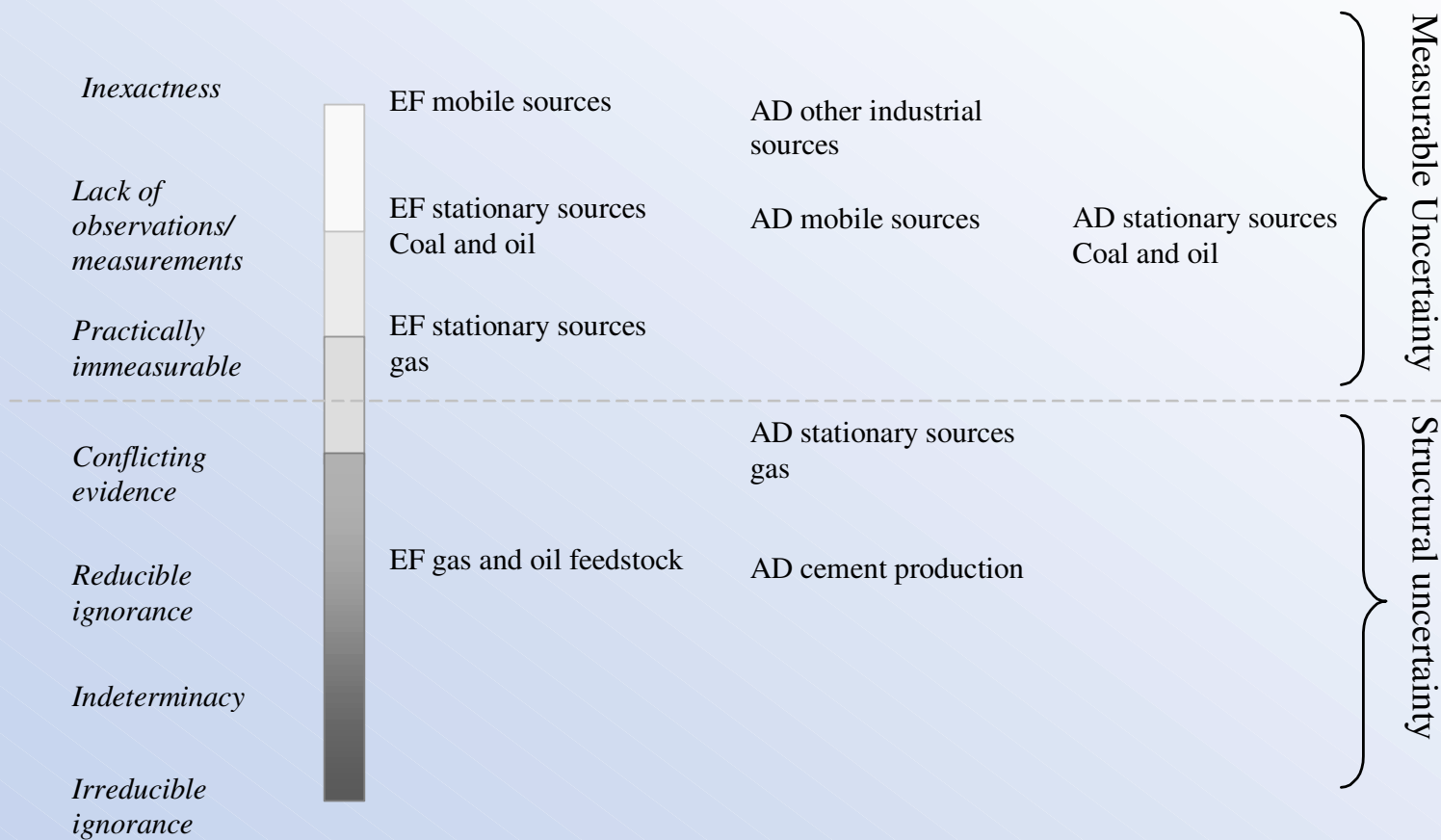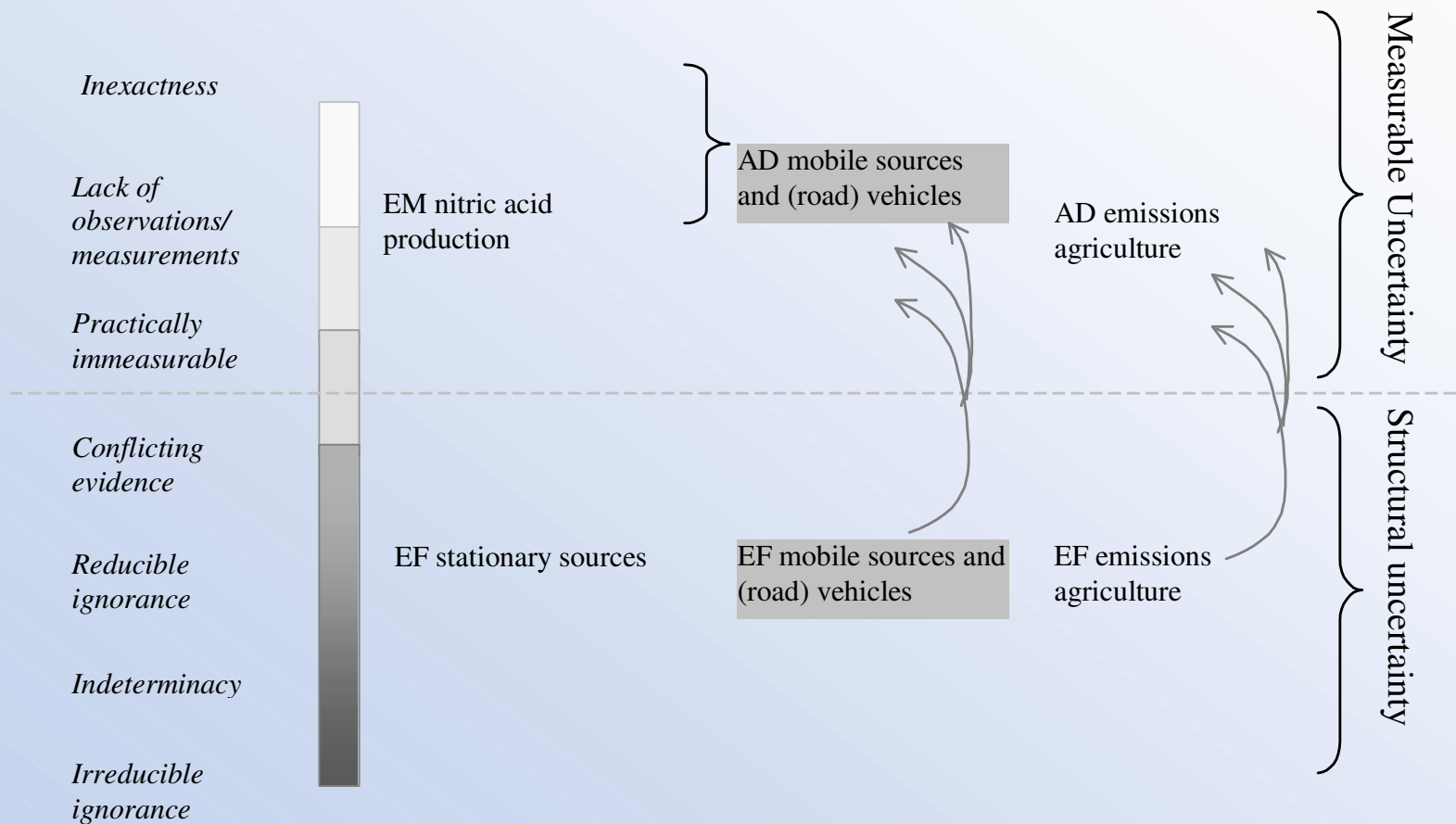structural uncertainty

Qualitative results for CO_2 emissions

- **Uncertainties are to a large extent 'measurable uncertainty**

- **Uncertainties in activity data are connecte to large amount and thus to mathematical statistics**

- **Uncertainty in emission is mainly related to EF for stationary sources and some indirect measurement in industrial sources (e.g. cement production)**

Qualitative uncertainties for CO$_2$ emissions

Inexactness	EF mobile sources	AD other industrial sources	
Lack of observations/ measurements	EF stationary sources Coal and oil	AD mobile sources	AD stationary sources Coal and oil
Practically immeasurable	EF stationary sources gas		

Measurable Uncertainty

Conflicting evidence		AD stationary sources gas	
Reducible ignorance	EF gas and oil feedstock	AD cement production	
Indeterminacy			
Irreducible ignorance			

Structural uncertainty

Qualitative uncertainties for N_2O emissions

Inexactness

Lack of observations/ measurements

Practically immeasurable

Conflicting evidence

Reducible ignorance

Indeterminacy

Irreducible ignorance

EM nitric acid production

EF stationary sources

AD mobile sources and (road) vehicles

AD emissions agriculture

EF mobile sources and (road) vehicles

EF emissions agriculture

Measurable Uncertainty

Structural uncertainty

Conclusions for qualitative uncertainty

- **Experts consider unreliability to be the nature of the uncertainty, but closer qualification shows a greater part attributed to**
  - inaccurate data
  - shortage of measurements

- **Uncertainty arising from conflicting information, ignorance and unreliability should get more attention as the calculated 95% interval gives an overly positive picture**

Quantitative Results of TIER 2

	1999	1990
Uncertainty	3.6 %	3.4 %
95% confidence	222 – 238 M tonnes	210 – 225 M tonnes
Standard deviation	4.097 M tonnes	3.719 M tonnes
Standard B coef EF manure (N2O)	0.409	0.182
Standard B coef Domestic consumption oil(products) (CO2)	<0.050	0.234

Quantitative Results of TIER 2; TREND

- **Increase of total emission by 5.8%;**
- **90% confidence: 3.5% tot 8.6%**

Variable	Standard β coefficient
N_2O emission factor manure/slurry injected/incorporated into fields	0.584
Domestic consumption of oil and oil products 1990 (PJ)	-0.328
Total consumption natural gas 1990 (PJ)	-0.284
N_2O emission factor manure/slurry on mineral soils (%N), if spread over land	-0.246
Consumption by oil refineries (PJ) 1999 /	0.221
Export of natural gas 1999 (PJ) / (Gg)	-0.210
Organic C-content of waste that is landfilled (kg/tonne)	-0.208
B 1999 oil and oil products (PJ)	-0.207

Key sources for TIER 1 and TIER 2

Gas	Source	Year 1999		trend 1990-1999	
		TIER 1	TIER 2	TIER 1	TIER 2
N_2O	Emissions from nitric acid production (2.5%)	1st place	1st place	5th place	-
N_2O	Direct N_2O emissions from agricultural soils (1.7%)	2nd place	-	-	-
CH_4	CH_4 emissions from solid waste disposal sites (1.3%)	3rd place	-	-	-
N_2O	Indirect N_2O emissions from nitrogen used in agriculture (1.3%)	4th place	-	-	-
N_2O	Polluted surface water (1.1%)	5th place	3rd place	-	-
CO_2	Emissions from stationary combustion: gas (1.0%)	6th place	-	1st place	-
HFC	HFC-23 emission from HCFC-22 manufacture (1.0%)	7th place	4th place	6th place	-
N_2O	Emission factor manure/slurry injected/incorporated into the fields	-	2nd place	-	1st place

Key sources for TIER 1 and TIER 2

Gas	Source	Year 1999		trend 1990-1999	
		TIER 1	TIER 2	TIER 1	TIER 2
N_2O	Polluted surface water. E-factor (kg N_2O per kg N)	-	3rd place	-	-
CH_4	Fraction of organic carbon reacting to gaseous material	-	5th place	-	-
N_2O	Measured gross emission grassland	-	6th place	-	-
N_2O	Emission factor (as N) from use of fertiliser		7th place		
CH_4	CH_4 emissions from solid waste disposal sites (1.0%)	-	-	2nd place	-
CO_2	Misc. CO_2 (0.9%)	-	-	3rd place	-
CO_2	Mobile combustion: other (0.8%)	-	-	4th place	-
CO_2	Emissions from stationary combustion: coal (0.6%)	-	-	7th place	-
CO_2	Domestic consumption oil and oil products (1990)	-	-	-	2nd place
CO_2	Total consumption natural gas PJ 1990	-	-	-	3rd place
N_2O	Emission factor manure/slurry on mineral soil (%N), if spread	-	-	-	4th place
CO_2	Consumption of Oil Refineries (PJ) 1999	-	-	-	5th place
CO_2	Export of natural gas 1999 (PJ/Gg)	-	-	-	6th place
CH_4	Organic C-content of waste that is landfilled (kg/tonne)	-	-	-	7th place

Conclusions

- **Majority of uncertainties in GHG emissions are caused by measurable uncertainties**

- **Considerable uncertainty in assessing changes in emission,**
  - this is related to changes in some emission processes
  - raise specific attention to this type of emissions in the base year

- **Results (especially standard B-coefficients) are used as a guidance for the research programme**

Conclusions (continued)

- **Project on TIER 2 was a first in-dept discussion on uncertainties**

- **Experts often holds conflicting opions**

- **New (forthcoming) studies and results:**
  - **updated emission factors**
  - **new carbon storage factors for feedstocks**
  - **improved documentation for GHG emission calculations**
  - **recalculation for CO2 emissions from 1990 onwards ongoing**
  - **in 2005 an update of the TIER 2 analysis is planned**