Emission Inventory – Data Management

Twinning Turkey, Ankara, Sept 2011

Content

- **In Theory**
  - Why do we need an air emission database ?
  - Specify the data content and functionality of a software tool
  - Minimum requirements for an emission inventory database
- **In Praxis**
  - Work/data flow of inventory preparation process
  - Main tasks of data management
  - Inventory database – main functionality and content
  - Database structure sample

Why do we need an air emission database ?

- Central data collection, storage and computing assists to keep in most of the „inventory rules": transparency, consistency, completeness, comparability.
- Provide a link of detailled bottom-up data with reporting format (NFR)
- Avoid errors in data computing and data transfer
- Efficient data processing

Software Specification

- An air emission inventory software could include a lot of content and functionality.

- What functionality/complexity do we need from a software ?
  - A wide range of software and data structure complexity is possible
    - Software complexity can be decreased if complex calculations (other than multiplying activity rates with emissions factors) is done externally by e.g excel spreadsheets.
  - High software complexity means high costs regarding
    - Implementation (specification)
    - User training
    - Maintenance (including error searching)

Data content and functionality (1)

- ? Integrated inventory
  - Reporting to CLRTAP/NEC
  - Reporting to UNFCCC
- ? Support of spatial distribution
  - EMEP-Grid
  - Air quality-models
  - Point sources
    - LCP (Large Combustion Plants)
    - PRTR (Pollutant Release and Transfer Register)
    - ETS (Emission trading)
  - Line sources
    - Motorways

Data content and functionality (2)

- ? Accessability
  - Single user (local database on PC)
  - Multi user system (client/server)
- ? Storage
  - 1 database for a single inventory year
  - 1 database for each inventory/submission
  - 1 database for multiple inventories (recalculations)
- ? QA/QC
  - Documentation
  - Validation (at data import)
  - Potential outlier detection (at data import)
  - Detection of Recalculations (History information)

Data content and functionality (3)

- ? Reports
    - NEC and CLRTAP reporting: NFR tables
    - Time series reports (NFR, CRF or SNAP nomenclature)
    - Identification of recalculations (time series)
    - Key source analysis
    - Highlight potential outliers in time series
    - Specific tables for inventory report
    - Reports for spatial distribution

Minimum requirements

- Data management
  - Activity (edit, add, delete)
- Primary data
  - Activity rates, emissions, emission factors
- Data dimensions
  - Activity
    - Activity code (SNAP = technology specific nomenclature)
    - Technology (optional)
    - Fuel (optional)
    - Reporting code (NFR, CRF)
  - Pollutant
  - Year
  - Inventory version
- Reporting
  - Aggregation of activities to NFR/CRF/SNAP categories
  - NFR tables

Work/Data Flow Example of Inventory Preparation Process
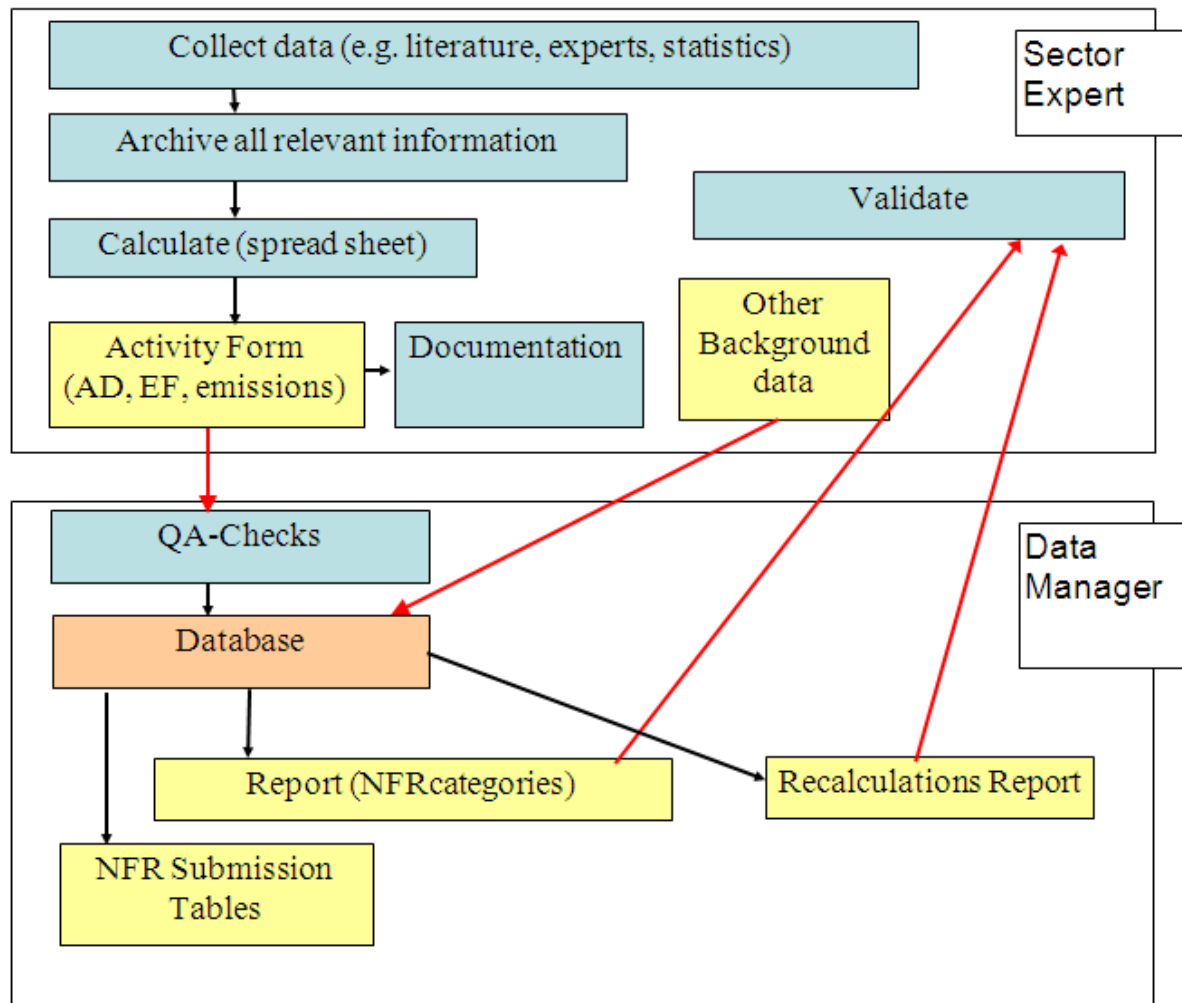
Main Tasks of Data Management

- Storage of data/record keeping
  - Central server repository (Backup). Manage access privilegs.
  - Well-defined directory/file-structure to store and find all relevant information of any inventory
- Data must be structured, consistent and complete
  - Inventory database(s) stores complete time series from 1980 on
- Support of Transparency
  - Manage Archive (literature and emails relevant for inventory)
- Manage data flow from and to sector experts
  - Usage of standard forms (Activities, Background data) and reports
  - Transparency: data flow must be traceable
  - Time management (deadlines)
- Reporting
  - Generate time series (tables)
  - Generate excel reports (NFR)
- QA/QC
  - Recalculation detection (Reports)
  - Consistency checks: at activity level

Inventory Database – Main Functionality

- Manage sources
  - Add, edit, delete
- Data import
  - QA/QC (completeness)
  - Validation
- Data aggregation
  - Calculate time series reports (tables)
  - Handling of Notation Keys (e.g. for sources not reported)
- Reporting
  - Excel tables generation (e.g. NFR)
- QA/QC
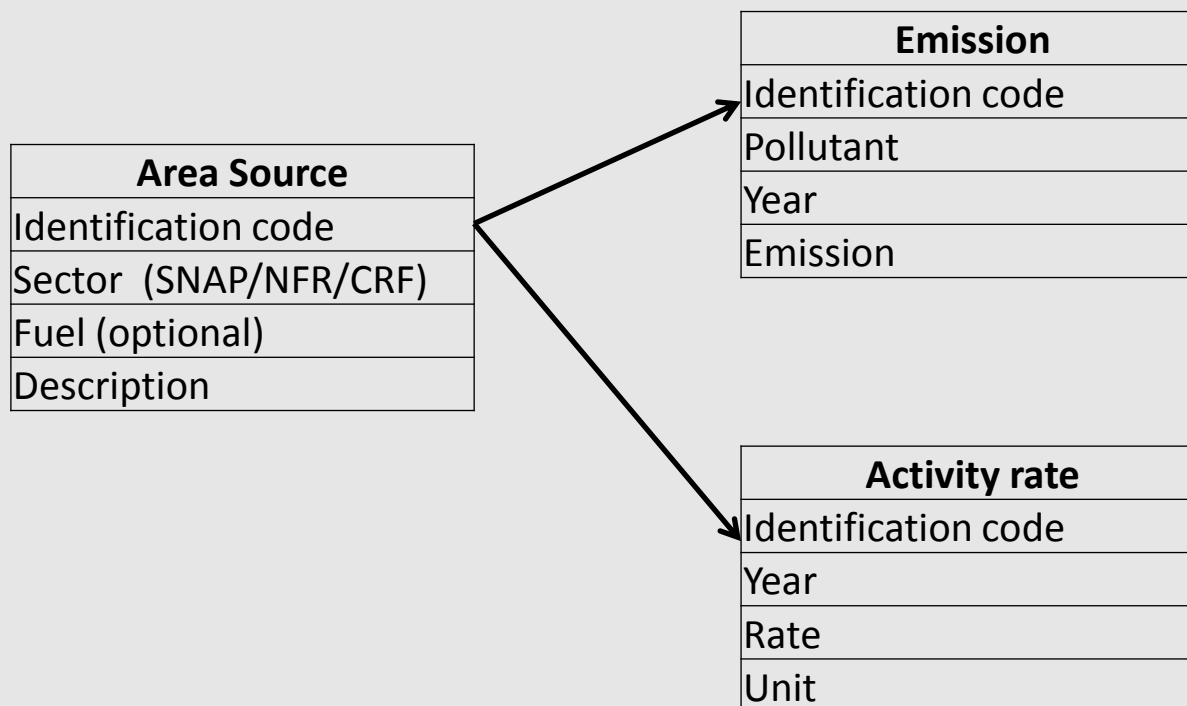 - Recalculation-information
  - Basic outlier checks

Inventory Database – General Properties

- Relational database structure
- Use of notation keys NE, NA, NO, IE
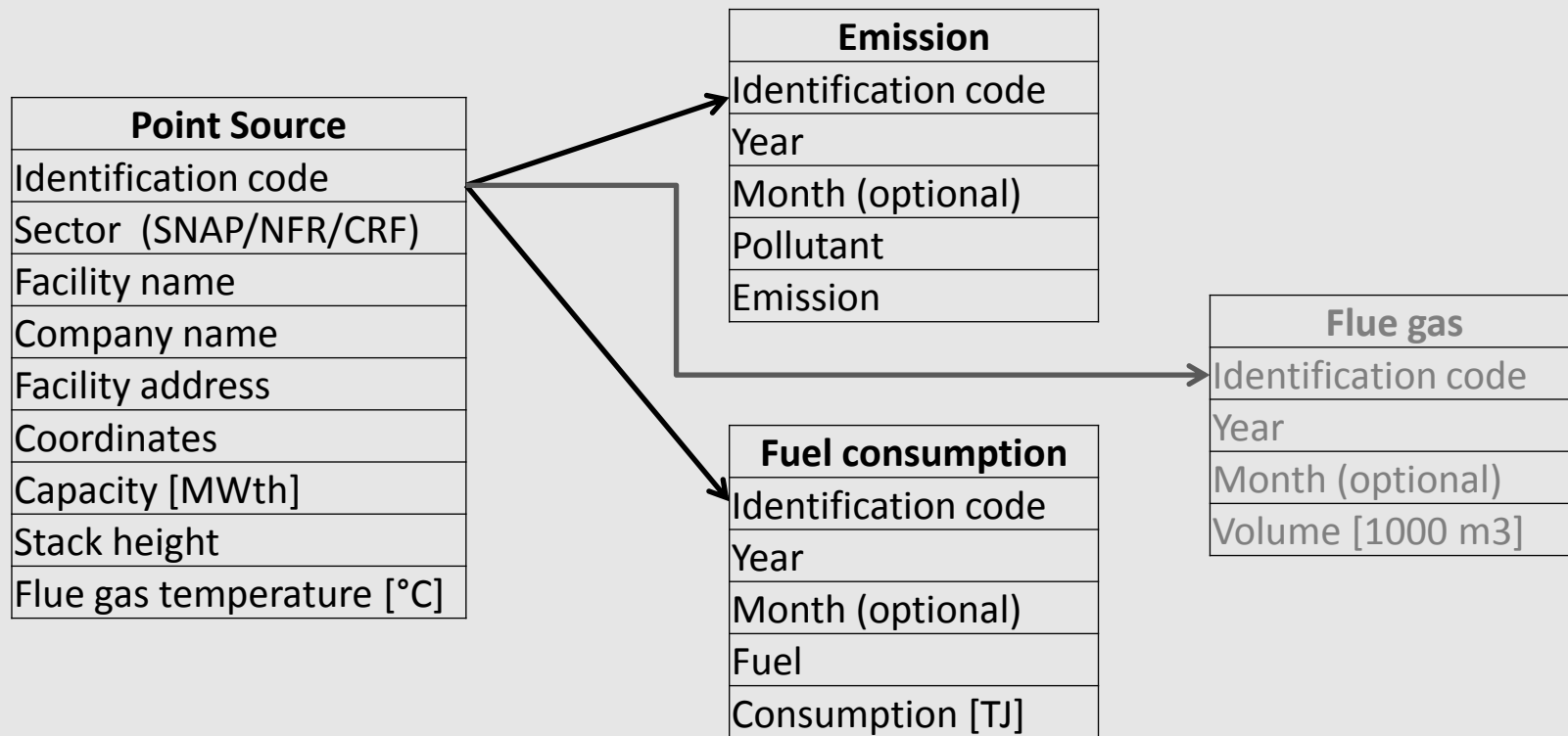- NFR nomenclature for reporting

Inventory Database - Content

- Activity data (fuel consumption, process input material)
- Emission factors (constant or yearly)
- Emissions
- Additional background data
- Metadata, e.g:
  - Units
  - Pollutants
  - Nomenklatures: SNAP, IPCC, NFR
- Report tables
- Point source data
  - Activity data
  - Emissions
- Log message table (Administration-info)

Database structure – Area Source

Area Source
Identification code
Sector (SNAP/NFR/CRF)
Fuel (optional)
Description

Emission
Identification code
Pollutant
Year
Emission

Activity rate
Identification code
Year
Rate
Unit

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Database structure – Point Source

Point Source
Identification code
Sector (SNAP/NFR/CRF)
Facility name
Company name
Facility address
Coordinates
Capacity [MWth]
Stack height
Flue gas temperature [°C]

Emission
Identification code
Year
Month (optional)
Pollutant
Emission

Fuel consumption
Identification code
Year
Month (optional)
Fuel
Consumption [TJ]

Flue gas
Identification code
Year
Month (optional)
Volume [1000 m3]

CollectER Software (1)

- CollectER III (EEA)
  - Public http://acm.eionet.europa.eu/country_tools/ae/CollectER_III.html
  - Single user
  - Time series (older versions: single year)
  - Area and point sources
  - Sources are defined by SNAP, Technology, Fuel, location
  - NFR export (flat file)
  - Used by some new EU-Member states
  - Functional design
    http://acm.eionet.europa.eu/docs/meetings/080528_collecter_reporter_ws/05d_CollectER_Functional_Design_02_2.pdf

CollectER Software (2)

Other Software

- Mesap (Seven 2 One)
  - http://www.seven2one.de/de/technologie/mesap.html
  - Multi user (client/server)
  - Complex/Flexible
  - Used by Germany, Switzerland and Luxemburg
- Excel
  - Country specific
  - e.g. Austria, Bulgaria.
- Access
  - Country specific
  - E.g. United Kingdom, Denmark (based on CollectER)

Austrian System - Setup

- Excel spreadsheets (tables) managed by VBA macros
  - 1 set of tables for each inventory
- Size
  - 550 area sources (by fuel type)
  - Time series: 1980 to year-1
  - 6 GHGs + 18 air pollutants
- Point sources
  - External database (Access)
  - Used for spatial inventory (Gridded data, NUTS 2) only
- Used for CLRTAP and UNFCCC
- Emissions are disaggregated to 9 federal states in a separate project (Bundesländerinventur)
- Gridded data has been calculated by consultant

Austrian System – Activities (SNAP)

SNAP code	SNAP name	Fuel	Technology	Remark	NFR
0101	Public power			Reported PM10 (PM2.5, TSP) from boilers >= 50 MW	1 A 1 a
010101	Combustion plants >= 300 MW (boilers)	Hard coal		Other than PM10.	1 A 1 a
010101	Combustion plants >= 300 MW (boilers)	Lignite		Other than PM10.	1 A 1 a
010101	Combustion plants >= 300 MW (boilers)	Natural Gas		Other than PM10.	1 A 1 a
010101	Combustion plants >= 300 MW (boilers)	Fuel oil		Other than PM10.	1 A 1 a
020202	Combustion plants < 50 MW (boilers)	Gasoil	Central Heating	Residential.	1 A 4 b 1
020202	Combustion plants < 50 MW (boilers)	Gasoil	Apartment Heat.	Residential.	1 A 4 b 1
040402	Nitric Acid			Reported process emissions.	2 B 2
0701	Passenger cars	Gasoline	Conventional	From Transport model.	1 A 3 b 1
0701	Passenger cars	Gasoline	Catalyst	From Transport model.	1 A 3 b 1
0701	Passenger cars	Diesel	All	From Transport model.	1 A 3 b 1
100501	Dairy cows			PM emissions from livestock (IE) included in 1010 (NFR 4.G)	4 B 1 a
100502	Other cattle			PM emissions from livestock (IE) included in 1010 (NFR 4.G)	4 B 1 b

Austrian System – Activity Form

	Inventur OLI 2010	Letzte Änderung 18.11.10 0:00	Emissions from refinery. NMVOC includes Ethyleneproduction.
V2.0	Bearbeiterln *****	Übertragen am 6.12.10 16:52	

IPCC	SNAP
FUGITIVE EMISSIONS FROM FUELS 1 B	PRODUCTION PROCESSES 04
Refining / Storage 1 B 2 a 4	Processes in petroleum industries 0401
NFR	Processes in petroleum industries 0401
FUGITIVE EMISSIONS FROM FUELS 1 B	default XXX
Refining / Storage 1 B 2 a 4	no fuel

	Aktivität		SO2		NOX		NMVOC		CH4		CO		CO2		N2O		NH3
	Ref	Mg PRODUCT	Ref	g/Mg PRODUCT	Ref	g/Mg PRODUCT	Ref	g/Mg PRODUCT	Ref	g/Mg PRODUCT	Ref	g/Mg PRODUCT	Ref	kg/Mg PRODUCT	Ref	g/Mg PRODUCT	Ref	g/Mg PRODUCT
11 konst	crude oil - refinery intake								2	31.66							
12 1990	1	7 952 100					1	472.31									
17 1995	1	8 619 100					x	174.03									
22 2000	1	8 239 600					x	168.09									
23 2001	1	8 798 700					x	61.71									
24 2002	1	8 946 500					x	61.81									
25 2003	1	8 818 800					x	61.69									
26 2004	1	8 442 000					x	59.23									
27 2005	1	8 742 859					x	58.91									
28 2006	1	8 472 009					x	59.61									
29 2007	1	8 496 058					x	60.15									
30 2008	1	8 709 759					x	57.87									
31 2009	1	8 333 402					x	56.28									

			Emiss.[Mg]		Emiss.[Mg]		Emiss.[Mg]		Emiss.[Mg]		Emiss.[Mg]		Emiss.[Gg]		Emiss.[Mg]		Emiss.[Mg]
33 1990				NA		NA	x	3 756	x	252		NA		NA		NA		NA
38 1995				NA		NA	1	1 500	x	273		NA		NA		NA		NA
43 2000				NA		NA	5	1 385	x	261		NA		NA		NA		NA
44 2001				NA		NA	7	543	x	279		NA		NA		NA		NA
45 2002				NA		NA	7	553	x	283		NA		NA		NA		NA
46 2003				NA		NA	8	544	x	279		NA		NA		NA		NA
47 2004				NA		NA	9	500	x	267		NA		NA		NA		NA
48 2005				NA		NA	10	515	x	277		NA		NA		NA		NA
49 2006				NA		NA	11	505	x	268		NA		NA		NA		NA
50 2007				NA		NA	12	511	x	269		NA		NA		NA		NA
51 2008				NA		NA	13	504	x	276		NA		NA		NA		NA
52 2009				NA		NA	14	469	x	264		NA		NA		NA		NA

NFR time series – Example NO$_X$(Gg)

NFR code	NFR name	1990	2008	2009
0	Total without sinks	194.88	204.65	187.32
1	ENERGY	183.47	197.18	180.21
1 A	FUEL COMBUSTION ACTIVITIES	183.47	197.18	180.21
1 A 1	Energy Industries	17.74	13.24	12.03
1 A 1 a	Public Electricity and Heat Production	12.05	10.61	9.60
1 A 1 b	Petroleum refining	4.32	1.20	1.05
1 A 1 c	Manufacture of Solid fuels and Other Energy Industries	1.37	1.43	1.39
1 A 2	Manufacturing Industries and Construction	32.83	34.16	31.64
1 A 2 a	Iron and Steel	5.41	5.09	4.56
1 A 2 b	Non-ferrous Metals	0.25	0.23	0.24
1 A 3	Transport	105.15	125.07	113.12
1 A 3 a	Civil Aviation	0.41	1.19	1.11
1 A 3 a 1	Civil Aviation (Domestic, LTO)	0.04	0.08	0.08
1 A 3 a 2	Civil Aviation (International, LTO)	0.37	1.11	1.03
1 A 3 b	Road Transportation	101.85	119.73	108.50
1 A 3 b 1	R.T., Passenger cars	45.14	39.10	37.45
1 A 3 b 2	R.T., Light duty vehicles	7.78	5.85	5.50
1 A 3 b 3	R.T., Heavy duty vehicles	48.80	74.33	65.09
1 A 4	Other Sectors	27.68	24.63	23.33
1 A 4 a	Commercial/Institutional	3.44	2.51	1.85
1 A 4 a 1	Commercial/Institutional: Stationary	3.44	2.51	1.85
1 A 4 a 2	Commercial/Institutional: Mobile	IE	IE	IE
2	INDUSTRIAL PROCESSES	4.80	1.59	1.26

*) highlighted sectors are official NFR categories.

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Twinning Turkey NEC

Ankara, Sept. 2011