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Quality Assurance and Quality Control Approach for Local and Regional Air Pollutants Emission Inventories in Italy

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abstract

- in the paper the approach followed in Italy for quality assurance (QA) and quality control (QC) in some local and regional emission inventories is presented

- particular attention is devoted to the completeness of data, the quality control of data and the validation of resulting emissions

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topics

- **methodology used for emission inventory preparation at local level**
- **QA/QC procedures followed in Italy at local and regional level to guarantee the quality of the inventories:**
  - **definition of data collection plan**
  - **procedures for documentation of data collection ("contacts file")**
  - **validation procedure for point sources data**
  - **tests program in the frame of ISO 9001:2000 quality normative through a check list procedure**
- **use of the new Air Pollutants Computer System (APEX.com) to support the QA/QC procedure**

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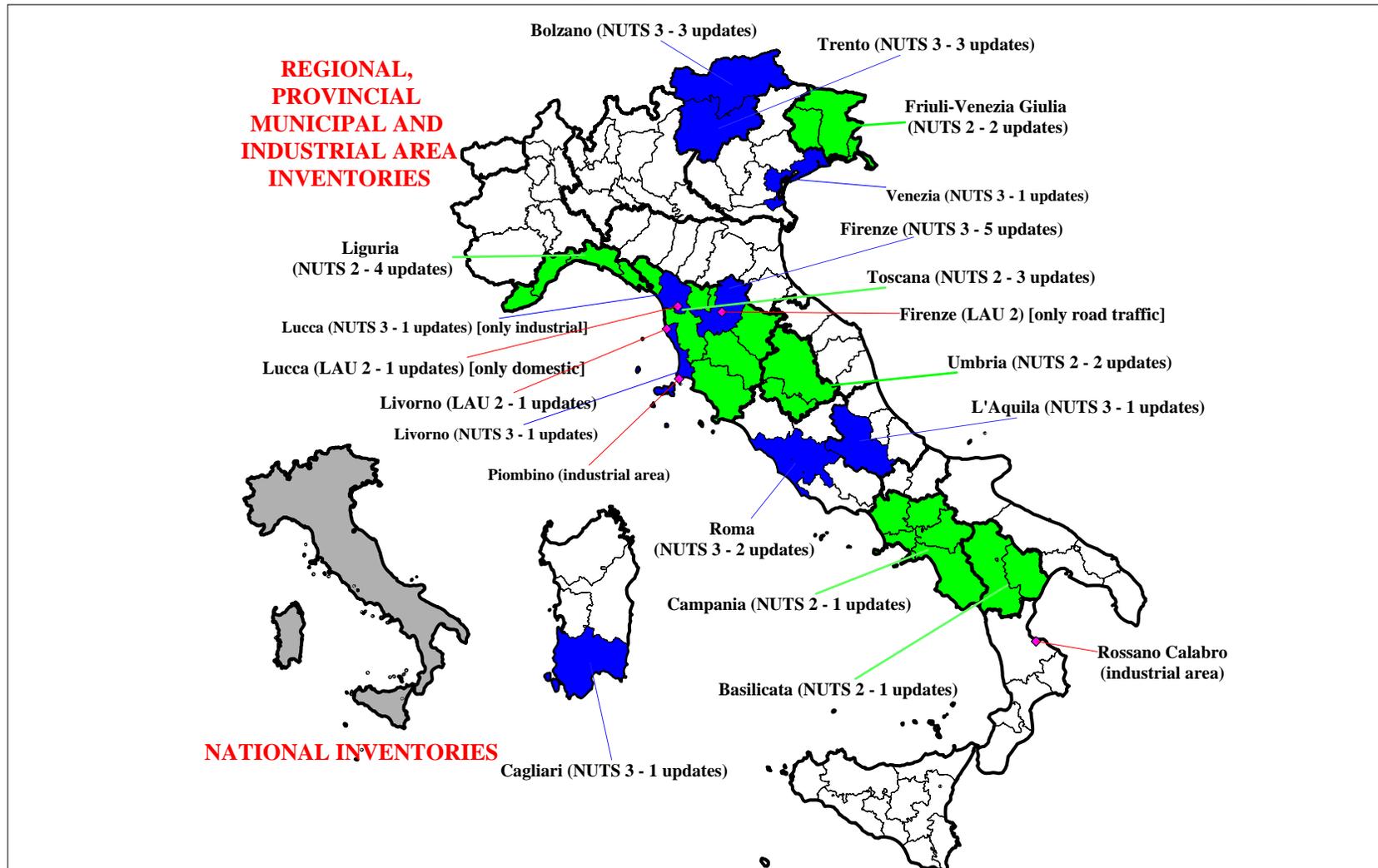Techne Consulting srl (Italy) – carlo.trozzi@techne-consulting.com

Emission inventory (EI)

➢ **emission inventory activities in Italy started in 1980 at a national level and has been applied at the local level since 1990**

➢ **nomenclature follows the guidelines of the European Commission CORINAIR working group; about 200 activities in 11 groups**

➢ **sources are generally split in:**
  - ➢ **main/minor point sources**
  - ➢ **linear/nodal sources (roads, rivers, railways, seaways, ports, airports)**
  - ➢ **area sources**

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Bolzano (NUTS 3 - 3 updates)

Trento (NUTS 3 - 3 updates)

REGIONAL, PROVINCIAL MUNICIPAL AND INDUSTRIAL AREA INVENTORIES

Friuli-Venezia Giulia (NUTS 2 - 2 updates)

Venezia (NUTS 3 - 1 updates)

Firenze (NUTS 3 - 5 updates)

Liguria (NUTS 2 - 4 updates)

Toscana (NUTS 2 - 3 updates)

Lucca (NUTS 3 - 1 updates) [only industrial]

Firenze (LAU 2) [only road traffic]

Lucca (LAU 2 - 1 updates) [only domestic]

Umbria (NUTS 2 - 2 updates)

Livorno (LAU 2 - 1 updates)

L'Aquila (NUTS 3 - 1 updates)

Livorno (NUTS 3 - 1 updates)

Piombino (industrial area)

Roma (NUTS 3 - 2 updates)

Campania (NUTS 2 - 1 updates)

Rossano Calabro (industrial area)

Basilicata (NUTS 2 - 1 updates)

NATIONAL INVENTORIES

Cagliari (NUTS 3 - 1 updates)

Reinventing Inventories – New Ideas in New Orleans

New Orleans, May 15 – 18, 2006

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QA/QC Methodology

- ➤ **Definition of data collection plan**
- ➤ **Documentation of data collection**
- ➤ **Validation for point sources**
- ➤ **Validation for area and line sources**
- ➤ **Internal validation on final results**
- ➤ **External validation on final results**
- ➤ **Air quality models application**

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Data collection plan

➢ **is defined applying the quality norms ISO 9001:2000**

➢ **contains all the information useful to the data collection and emissions estimates (source categories data, emission factors, emission thresholds, etc)**

➢ **contains an indication of the possible problems in the information retrieval process**

➢ **is available to the staff involved and to the authorities**

➢ **is periodically revised and, if necessary, updated**

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Documentation of data collection

All the data retrieval activities are documented through the "directory of the contacts", a data base in which are recorded in correspondence of every data owner:

➢ **typology of requests**

➢ **date of requests**

➢ **answers**

➢ **date of answers**

➢ **contacts**

➢ **etc.**

directory of the contacts record

➢ *Organization*

ENEL Produzione **– Pietrafitta Power plant**

➢ *Address* **S.S. 220 Pievaiola km 24 PG**

➢ *Tel.* **0759557611** *Fax* **0758355369** *E_Mail*

➢ *Contact* **Fabio Rossi**

➢ *Request type* **internal combustion engines data**

➢ *Our Reference*

ARPA Umbria letter prot.n.2051 of 05/11/2005

➢ *Organization answer* **10/06/2005 (answer)**

➢ *Note*

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Point sources data retrieval

➢ **information is gathered through a questionnaire that allows collection of general (identification, location, etc.), structural (stacks and units characteristics) and quantitative data (pollutant concentrations at the stacks, pollutant emissions, production, fuel consumptions)**

➢ **data are analyzed and evaluated in order to evidence eventual errors in the compilation or missing information for the corrected evaluation of the emissions**

➢ **in all the cases in which a situation of uncertainty is given the technical responsible of the plant are contacted in order to complete, confirm and correct information**

declared emissions validation

➢ **comparison of declared emissions with estimates obtained with emission factors:**

    ➢ **quite difficult for the high number of factors that influence the estimate (pricess technology, control systems, fuel and raw materials used, etc.) and for uncertainty associated to its**

    ➢ **approximate limit to proceed to verifications is ±50%**

➢ **verification of the declared emissions compared to those obtained as the sum of emissions of all stacks obtained by hourly gas flow, working hours for year and average concentration of pollutants**

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declared emissions integration

➢ **evaluation of emissions not emitted in stacks at all (such as Organic Compound emissions from ships paint) from:**

  ➢ **declared amounts of raw materials used (for example varnishing and solvents)**

  ➢ **content of organic compound in the materials**

  ➢ **specific control systems adopted**

➢ **insertion of emissions of pollutants not declared from the companies but of which the presence in relation to the activities carried out in the plant is known (calculated through emission factors)**

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example: power plant

Pollutant (*)	Declared emissions (Mg)	Emission Factors computed emissions (Mg)	Δ %
NO_x	1,25	1,62	29,4
SO_x	3,00	3,40	13,8
CO_2	587	582	0,9
PM_{10}	122	123	1,2
VOC	-	75	-
CO	-	120	-

inserted   inserted

Fuel	Consumption	Units
Oil	174731	Mg
Natural Gas	22183000	m3

example: shipyard (painting)

Year	Declared Emissions (Mg)	Varnishes used (Mg)	Estimated emissions (Mg)	Difference %
2000	3,2	13,2	8,580	168,1
2001	0,82	4,2	2,730	232,9
2002	3,3	19,8	12,870	290,0

inserted

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EI data retrieval: no point

➢ **linear/nodal sources: information is gathered through a questionnaire with activity data (vehicles counts, speed distribution, power and fuel distribution, ecc.)**

➢ **area sources: evaluated on a geographical basis (municipal administrative unit) using statistical or survey data on suitable activity indicators (for example paint or fuel consumptions) and emission factors**

Validation for area and line sources data

➢ report for single source category aactivity data to verify possible errors in data loading

➢ test on the correctness of emission factors for all the pollutant involved

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Internal final validation

➢ **tests and controls are specified in the Quality Plan, in agreement to the quality systems**

➢ **description of tests and results are summarized in an appropriate quality control report (DATA CHECKLIST)**

➢ **no data are delivered to the customer officially, until all the activities specified in the Quality Plan have been positively finished and relative documentation will not be available and approved**

Validation procedure

➢**existing inventory update: comparison between the emissions results for the various years under study**

➢**new inventory: the term of comparison can be an inventory elaborated for similar territory**

➢**when anomalies is detected for some source categories:**

➢**at first indicators are compared with the reference inventory**

➢**if no anomalies are evidenced, the emission factors are compared**

Validation procedure for space/time allocation

➢ **test that the total area source indicators is equal to the sum of the values allocated on square grids**

➢ **tests that the total is equal to sum of the values allocated temporarily on the hours of the year**

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DATA CHECKLIST

- tool to defines the plan of the tests used in the frame of the quality norm ISO 9001:2000
- articulated in two models "Ante" and "Post" correction to document the procedure of errors correction
- subdivided in sections, in which is specified the detail of requirements of the reports to carry out
- imposes the control of the reports of the source categories indicators and emissions data from area, linear and point sources and total
- evidence of the tests is obtained through reference to online documentation

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DATA CHECKLIST example

CHECKLIST – EMISSION INVENTORY				
REQUIREMENT ID	REQUIREMENT DESCRIPTION	VERIFICATOR	TEST RESULTS	DATE SIGNATURE
INV 06-1	Comparison and validation of inventory data *(indicate the year)* EMISSIONS REPORT (Area Sources total area, activity, pollutants: main, greenhouses gases, heavy metals, Benzene and PAHs)	Carlo Trozzi	activity "10020400 Vivai - non fertilizzati", at 1999, used data for 1990 census and not data for 2000 census	17-3-06

DATA CHECKLIST
ante vs post

➢ **in ante-correction, in test result column:**
- ➢ **is reported OK if the result of the test is positive,**
- ➢ **is written NO, with the indication of the found error, if it is negative**
- ➢ **in this case the test must be repeated, after modification of input data**

➢ **in post-correction, in test result column is placed:**
- ➢ **an OK with the error description**
- ➢ **a comment if the discrepancy it is imputable to effective data**

Statistical index

➢ **the last section of the CHECKLIST defines a synthetic statistical index calculated as relationship between number of the source categories for which the test shows positive result and the total of the evaluated source categories**

➢ **the index is a synthetic evaluation of the data quality in the inventory**

DATA CHECKLIST
Statistical index example

CHECKLIST – EMISSION INVENTORY				
REQUIREMENT ID	REQUIREMENT DESCRIPTION	VERIFICATOR	TEST RESULTS	DATE SIGNATURE
INV 07	Final validation	Carlo Trozzi	X/T=2/5	4-4-06

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final external validation

as we operate as consultants of local or regional boards an external independent audit from administration functionaries often follows

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air quality models application

finally emission inventories are often used as input on air quality models (diffusion and statistical models) and comparison of models results with monitoring data is useful to individuate possible errors in inventory data

APEX: air

- in Wi
- contain
- contains to municipal e

produc

PREM : model for emissions projections and to evaluate emission control measures

Emissions estimate models
- in Windows/ ACCESS environment,
- interfaced with *APEX* in an unique environment
- contains technologic projection factors database
- contains some tools to project emissions
- integrated with the *APEX* system

computer interface to ISC Long Term comput **computer** computer face to term mode Calme **CALF** **interface to** del data comin model integra **CAMx model integrating** from PREM a APEX, P **data from APEX, PREM** QUAR

com SETS a to ev dispe

data from APEX, PREM and QUAR

management and analysis
- developed in Windows/ORACLE environment
- use Statistica software to analyze data
- use ArcView or MapInfo for thematic map

| SETS CALINE Traffic | ISCLT/ST Gaussian Long/Short | M |

Air Diffusion.com – Air polluta

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conclusions

➢ **the application of the quality plans and of the controls defined, and in particular the final tests through check list, represents the most valid support to the validation of the emission inventories and to obtain a "better" final results in terms of reliability**

➢ **the control and the validation of data contribute to the reduction of the total uncertainty of the inventory**

➢ **the application of procedures QA\QC in the various processes that directly or indirectly are connected to the data retrieval and the data elaboration activities has a strong impact on the quality of the final product**