department of economics
"S. Cognetti de Martiis"

Via Po, 53 – 10124 Torino (Italy)
Tel. (+39) 011 6704917 - Fax (+39) 011 6703895
URL: http//www.de.unito.it

WORKING PAPER SERIES

Local environmental accounting: Methodological lessons from the application of NAMEA tables at sub-national levels

Silvana Dalmazzone e Alessandra La Notte

Dipartimento di Economia “S. Cognetti de Martiis”

Working paper No. 10/2009

Università di Torino

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Authors:

Silvana Dalmazzone
Dipartimento di Economia 'Cognetti de Martiis'
Univeristà degli Studi di Torino
Via Po 53, 10124 Torino, Italia
silvana.dalmazzone@unito.it

Alessandra La Notte
When working at this paper: research fellow at
Dipartimento di Economia 'Cognetti de Martiis'
Univeristà degli Studi di Torino
Via Po 53, 10124 Torino, Italia

Current position: grantholder at
European Commission- Joint Research Centre
Institute for Environment and Sustainability
Via E. Fermi, 2749
21027 Ispra (VA), Italia
alessandra.la-notte@jrc.ec.europa.eu

Abstract

Extending the application of integrated environmental and economic accounts from the national to the local level of government serves several purposes. They can be used not only as an instrument for communicating on the state of the environment and reporting the results of policies, but also as an operational tool – for setting the objectives and designing policies – if made available to the local authorities who have responsibility over the administration of natural resources, land use and conservation policies. The purpose of this paper is to test the feasibility of applying hybrid flow accounts at regional and sub-regional levels. NAMEA for air emissions and wastes is applied for Piedmont Region, Province of Turin and Municipality of Turin (covering the three nested levels of local government in Italy). The study identifies the main issues raised by environmental accounting at the local level and provides an applied illustration of feasible solutions.

Keywords: environmental accounting, NAMEA, local government, air pollution, waste.

JEL Codes: Q53, Q56

1. Introduction

Since the 1970s several national statistical offices as well as academic researchers and practitioners have been developing frameworks and methodologies aimed at consistently integrating traditional macroeconomic indicators with environmental information (Hecht, 2007). In the early 1990s the experts of the statistical unit of the United Nations tried to standardize different frameworks and methodologies by proposing a single *System for Integrated Environmental and Economic Accounting* (SEEA) (Bartelmus *et al*. 1991). The UN Statistics Division, together with the European Union, the OECD, the World Bank, national statistical offices and other organizations, created an international forum – the London Group – to exchange experiences and promote further development. The original 1993 SEEA handbook (UNSD, 2000), that focused on the adjustment of macro-indicators, evolved into the SEEA 2003 framework, that comprises four categories of accounts in turn made up of several environmental accounting modules (UNSD *et al*. 2003).

Integrated environmental and economic accounts provide descriptive statistics that should help policy makers monitor the interaction between the economy and the environment and the effect of implemented policies. The data and information made available by the accounting modules is also a potentially crucial resource for strategic planning and policy analysis for those governments engaging in the design and pursuit of sustainable development paths. The significance of integrated environmental and economic accounting and the process by which the SEEA standard reached its current form are described in detail for example in Smith (2007). Lange (2003) provides an in depth discussion of the policy uses.

Environmental accounting at the level of local governments is at a very different stage compared to what is happening at the national levels. The activity that has reached some diffusion in the last decade are 'green budgeting' schemes, initiated independently (and uncoordinatedly) by a number of local governments in different countries, which are generally based on indicators (that is, on aggregate information) and whose scope is to help monitor the effectiveness of policies and communicate their results to the general public. Integrated environmental and economic accounts, instead, despite being the standard in national environmental accounting, are only now starting to be extended, in isolated cases, to local governments.

Integrated environmental and economic accounts serve the double purpose of monitoring the state of the environment subject to pressure by anthropic activities, and of simulating the impact of policies and thus supporting national programming (UNSD *et al*. 2003). Policies for many environmental and natural resources, however, in most countries are designed and implemented at sub-central levels of government. Municipalities, for instance, are often in charge of urban pollution control policies, and the power over land uses and protected areas is often assigned at intermediate levels (regional/provincial). Making environmental accounting an operational tool not only for reporting results, but

also for setting the objectives and designing policies, requires that detailed accounts, of a kind that allows analysts to trace the origin of the emission or resource consumption by sector and sub-sector of economic activity, be compiled not only at a national, but also at a local scale, and thus made available to local planners and public managers who have the responsibility to administer and regulate natural resources, local development actions and conservation policies. The importance of extending systematic and standardized environmental accounting at the local level and of harmonizing it with the accounting held at a higher jurisdictional level is what motivates the research and pilot application described in this paper.

The Millennium Ecosystem Assessment (MEA, 2005) forcefully stresses the significance of multi-scale assessment, stating that the multi-faceted attributes of sustainability (environment, society and economy) have each a characteristic scale that varies in duration and extent. A spatial scale could be defined in natural or human terms:[1] in the former case the relevant boundaries are natural, while in the latter the boundaries are political/administrative. Obviously, they generally do not match.
The spatial scale in the applications in this paper is defined in terms of political boundaries (government levels), because our focus is on policy options for the relevant decision makers.
" 'Scale' and 'level' are not synonymous: the former measures in physical terms extent, size, span, details, etc., the latter is a 'characterization of perceived influence (…). It is not a scale but can have a scale' (MEA, 2005, p.64).
MEA's analysis is in terms of 'scale', with the objective of matching ecological phenomena with their corresponding reference scale. Ours will be set in terms of 'levels' because the purpose of our exercise is the construction of economic-environmental accounts working as satellite of the economic accounting of national and sub-national governments. Our assessment process thus relates to the MEA's *comprehensive* multiscale assessment category (in our work: multilevel) in that it too is composed of many complete interacting assessments (environmental accounting modules) *one nested within the other*: the municipal into the provincial into the regional level.
By focusing on political-administrative boundaries, our approach cannot retain the direct connection between environmental issue and the relevant ecological scale; a multilevel approach retains nonetheless the potential to enable analyses that link information from various scales into a coherent picture and thus highlight the causality of economic-environmental impact. To make an example, designing policies to deal with air pollution requires information not only on concentrations measured at the various receptors, but also on emissions from the sources, so as to identify the linkages between impacts and driving forces. Environmental-economic accounts declined down to the municipal level would enable decision makers to investigate the linkage between emission and concentration data and highlight, by economic activity and by pollution type, whether the bulk of the problem originates within the municipality, or is uniformly distributed within the province or region, or else is imported from neighboring regions. It is the kind of information that would be needed in order to target policies to the correct scale.

[1] The MEA includes is a third definition, related mainly to the users of the assessment, such as communities within a well-established catchment area.

The international state of the art in environmental accounting sees at present:

- at the national level, most industrialized countries following the guidelines of the SEEA framework and compiling standardized modules of integrated environmental and economic accounts;
- at the local level, governments participating in LA21 programs applying environmental reporting schemes that make use of a range of indicators and in some cases environmental expenditure reclassification.

There is virtually no experience yet of a comprehensive system of environmental accounting systematically extended at all levels of government. A few countries have tested episodic applications, on one resource or another, at one jurisdictional level or another. In Italy, the national statistical office (ISTAT) has tested the compilation of the hybrid flow accounts matrix (the National Accounting Matrix including Environmental Accounts, NAMEA) in one region (Lazio), and the same experiment has been conducted by a regional research institute in Tuscany. Within the European project 'GROW', five European regions have started to compile NAMEAs for air emissions. In the Netherlands some applications related to water accounts are implemented with respect to river basins. In Sweden there has been work on regional accounts for the Stockholm area and several studies have been made at district level for water accounts. In Germany the statistical offices of the Länders compile material flow accounts at the regional level, and generally the results for the 16 Länders sum up to the results for Germany as a whole. In Canada there are two NGOs producing environmental accounts at the provincial level, but there is no coordination activity between the national statistical office and these organizations. The same happens in the United Kingdom, where a local NGO produces environmental accounts for Wales. In New Zealand physical stock accounts for water are compiled by the central statistical office on both a national and a regional scale. In the Philippines, in the Cordillera Administrative Region and in the province of Palawan all asset accounts compiled at the national level are also compiled at the regional and provincial levels (Dalmazzone and La Notte, 2009).

No comprehensive research is yet available comparing the experiences of these different experimental applications and drawing lessons and methodological implications. This paper describes a pilot application – the compilation of hybrid accounts (NAMEA) connecting economic sectors productivity and employment capacity to emissions of pollutants at the regional, provincial and municipal level in the Piedmont Region (Italy) – developed with the explicit purpose of testing the feasibility and reliability of integrated environmental and economic accounts at all sub-national levels of government and identifying criticalities and possible solutions.

NAMEA was initially developed by the Dutch national statistical office (CBS) in 1990s (de Haan and Keuning, 1996). Subsequently the European statistical office (Eurostat) established task forces composed by representatives from the member states statistical offices and aimed at testing the framework, with the purpose of supporting its diffusion as the standard to be adopted in UE countries. NAMEA divides the economy into industry and household categories and shows how each industry and the households contribute to selected environmental issues, consistently bringing together economic and

environmental information. All accounts are presented in matrix format. The core of the framework is the national accounting matrix (NAM) as compiled in national economic accounts. NAMEA's main advantage is flexibility: the structure (that records entries per rows and outgoings per columns) allows for enlargements and is thus well suited to build more complex matrices.[2] Economic accounts report data on value added and production, and environmental accounts report all the emissions and wastes generated by the economic sectors and the raw materials withdrawn as inputs for each economic activity. Because the environmental accounts are often in physical units (mass, volume or energy units) while economic data are expressed in monetary terms, the NAMEA is reported in the SEEA 2003 handbook within the 'hybrid' flow account section. Its success in terms of number of applications and popularity can indeed be explained by the integration of economic and environmental data without forcing a monetization of the latter: the economic part expresses data on production and value added in monetary terms and data on employment in number of employees (and local units), whereas the environmental part may express data on withdrawals and emissions, for instance, in tonnes.

The aim of this paper is to show that integrated environmental and economic accounts, and specifically NAMEA matrices, can also be applied at local government levels, where an important share of the management and implementation of policies takes place. The case study concerns the Piedmont Region, the Province of Turin and the Municipality of Turin – the three nested levels of local government existing in Italy. After specifying the approach to the data and information collected during the application (section 2), the paper discusses the main issues arising in the compilation of NAMEA at sub-national levels: the identification of suitable sources of economic data at sub-regional jurisdictional levels (section 3), the reclassification of data when databases at different levels are structured differently (e.g. by production process *vs.* by economic activity), and the disaggregation and re-aggregation of data when groupings in the databases do not correspond (e.g. waste subdivided in 'hazardous and non-hazardous, mixed' rather than 'hazardous and non-hazardous' as required by NAMEA) (section 4). Section 5 concludes.

2. Data and information

For what concerns the environmental module, local governments and agencies usually maintain accurate and in-depth environmental databases, whose locally gathered, bottom-up information is employed both in the design and the implementation stage of their policies. The information often requires to be harmonized, because the (usually public) institutes or agencies responsible for collecting data on the environment in some cases adopt different approaches.

On the front of the data required by NAMEA's economic module, national statistical offices generally produce statistics at the national and sometimes at the regional levels, but not at lower (provincial and municipal) levels. The only data systematically collected

[2] Another well known extension of NAM is the *Social Accounts Matrix* (SAM).

at a central level pertaining the most junior government levels are census surveys, which usually take place every ten years as recommended by the United Nations – too long a periodicity for the purpose of environmental accounting. At the sub-regional level the best available source of economic data is the register for active enterprises (ASIA[3]), created by the national statistical office, which integrates important national administrative archives with other minor sectorial registers and with ISTAT statistical surveys. ASIA offers reliable, standardized yearly statistical information on the territorial distribution of economic activities and on employment, thus enabling the extension to local governments of the possibility to compile proper integrated economic-environmental accounting based on SEEA 2003's methodological guidelines.

In matters of local government environmental accounting a bottom-up approach, if coupled with methodological rigor in the selection and verification of sources, has the potential to improve the accuracy and reliability of the accounts and, by offering a multiple scale/level view of complex economy-environment interactions, to enhance our understanding of the causality links. In addition, the diversification of sources in building local accounts represents a step in the direction of integrated assessments based on a multi-disciplinary (using ecological, economic, socio-political information) and multi-stakeholder perspective, that can help improve our understanding of complex relationships. On the other hand, analysts from different disciplines use different languages, express their ideas in different ways, and their priors are reflected in their system of data collection and classification. As a consequence, combining different data bases is not a trivial issue.

When data at local level are available, it is fundamental that their reliability be checked: data must be precise, accurate and homogeneous. The notion of precision depends on how complete the survey is; when based on samples, precision depends on the sample size. Moreover, precision requires that surveys planned with the objective to obtain data at the regional level should not be used to obtain estimates at the provincial or municipal level. Accuracy depends on the way data are collected, classified and checked: this is critical when data have to be compared and integrated.
Data must also be homogeneous: they must show completeness in the processing of information and must cover the whole object area. Data resulting from *ad hoc* studies are specific for a single area and time period, they are not systematically gathered and processed and thus not accountable.

Not only the quality of the information matters, but also when it is made available; data sources must be able to provide information in a compatible time frame, and with the appropriate periodicity.

The metadata framework behind the data is fundamental in allowing the analyst to check all these characteristics. It must include:

- sources of data. It is important to check whether the responsibility of providing the data is of a public institution, of a voluntary based initiative, of a private organization, etc. It would also be helpful to highlight the purpose for which data

[3] The acronym ASIA means *Archivio Statistico delle Imprese Attive.*

are collected: it might help explain the way processing is undertaken and thus possible inconsistencies in the final results.
- Processing procedure. Only by looking into the way data are collected, classified, processed and stored it is possible to ensure precision, accuracy and consistency.
- Scale. Aggregating small consistent units in order to obtain a larger administrative/territorial unit is possible and advisable, but the disaggregation from a larger scale aimed at estimating values for smaller units exposes results to several criticisms.
- Time. Sources must be able to provide up-to-date data and to maintain a regular, adequate periodicity.

3. NAMEA economic module: suitable data

As mentioned above, the issue of data availability and quality at the local level concerns mostly the economic module, and the issue deserves some deepening. While at the national level a considerable amount of economic data is regularly available (in the Italian case, yearly reports by the national statistical office (ISTAT), the General report on the country's economic situation,[4] the annual report of the governor of the Bank of Italy, etc.), at the sub-national level centrally collected information is incomplete – some data are not available and some are available only with long periodicity (e.g. from surveys collected every five or ten years).[5] More specifically, the national statistical office publishes data on production, value added and employees at the national and regional levels following the two basic rules of adopting the residence principle and of only considering the economic territory of a country[6] ; they also publish provincial data on the same variables, but aggregated into three sectors (primary, secondary and tertiary) and thus not usable in compiling NAMEA. At the municipal level the only very detailed economic data available come from censuses that take place every ten years – as we said, too long a periodicity for the purpose of environmental accounting. In addition, the purpose for which census data are collected does not match the focus of interest of environmental accounting: in local governments priority tends to be given to data useful for programming and monitoring local development policies supported by national

[4] Published yearly by the Ministry of Economics and Finance.

[5] At the European level the Council Regulation (EEC) No. 2186/93 aims at fostering coordination among local governments in the compilation of business registers for statistical purposes. Data on enterprises should however be harmonized in order to remove the impact of different legal and organizational infrastructures (Eurostat-OECD, 2007). The Regulation (EC) No. 177/2008 of the European Parliament and of the Council of February 20, 2008 establishes a common framework for business registers for statistical purposes. In Italy the rules on surveying, processing, analysis, distribution and storage of administrative and statistical data are set by the D.lgs. No.322 (6/9/89) and D.lgs. 39/93. The three-year National Statistical Program states typology and objective of the information to be compiled.

[6] An economic territory consists of all the institutional units that are resident in that territory. The residence principle assigns each economic unit to the territory with which the unit has the strongest link, in other words, its predominant centre of economic interest. Adopting a residence principle for corporations, for example, means considering the corporation a resident of the territory in which it was created.

authorities and EU funds, and such data are not appropriate for well-timed analyses of the productive system and of ongoing technological transformations.

One possible way ahead is to integrate data from official statistical sources with data from administrative sources such as the Chamber of Commerce or the Institute for Social Security, or from databases produced and sold by IT companies.[7] If on the one hand administrative data are collected continuously and they cover the whole jurisdiction, on the other hand they may give rise to issues of consistency and methodological rigor. The extent to which these administrative sources may represent a viable solution to the lack of centrally collected local data has to be subject to a case by case evaluation, as collection methods, controls and the resulting quality and reliability may vary considerably from country to country as well as among jurisdictions within the same country.

In addition, integrating statistical and administrative data is not straightforward, due to the different underlying methodological and classification frameworks. In Italy, however, the task has been accomplished by the national statistical office with the creation of ASIA, a register of active enterprises which integrates important national administrative archives with other minor sectorial registers and with ISTAT statistical surveys. The aim of ASIA is to provide every year statistical information on the territorial distribution of economic activities and on employment (as the census does every 10 years). Some of the major administrative sources of the business register are the Chamber of Commerce Register of Enterprises, the Minister of Economy and Finances Tax Register, the Social Security Archives (INPS) and insurance declarations (INAIL) and also the Yellow Pages (SEAT).

ASIA is based on a set of rules to convert the administrative data into statistical information and on an *ad hoc* methodology developed to estimate and validate the characteristics of the identified statistical units (Consalvi *et al*., 2008). The first records on enterprises start in 1996. Data entering the business register go through a normalization and standardization procedure aimed at changing the administrative unit into statistical units. The processing of the business register for year *t* starts during the last months of year *t+1* when all data coming from administrative sources are collected and thus standardized. All the information produced goes through a quality control. Information relates to enterprise legal data and location, NACE classification of the economic activity, enterprise size and number of employees, and income class. Information is about enterprises that are still performing their activity and are thus active.

The number of enterprises does not provide information on the territorial distribution of local units (UL) and employees: starting from 2004 the ASIA-UL (a newly created subsection of the ASIA database dedicated to local units) provides every year (with a two years delay) information on local units, thus integrating the source information with a new direct survey on local units of multi-location enterprises of large dimension (IULGI). When dealing with local units several sub-classifications must be considered: a multi-

[7] One such database available for Italy is AIDA (Analisi Informatizzata Delle Aziende), by the Bureau van Dijk Electronic Publishing, which provides data on company accounts, ratios, activities, ownership, management and consolidated accounts.

establishment enterprise may be a firm from a given region which has all its local units in different parts of the same region, as well as a firm from that region with local units in other regions or countries, or even a firm from another region or country which has its local units in that region. The results of ASIA-UL queries from the administrative units we work on is presented in Table 1. The reference year for the whole application is 2004.

The compilation of the economic part of NAMEA requires to organize data according to the NACE (*Nomenclature générale des Activités économiques dans les Communautés Européennes*, rev.1.1) classification, as shown in Table 2 where the first column presents the Italian economic sector classification (ATECO 2002).

(Table 1 about here)

(Table 2 about here)

Administrative data record number of employees and number of local units. NAMEA at the national level includes 'value added' and 'production' as main variables. These data are not directly available from ASIA but ways of calculating them using the ASIA input data are being tested (Faramondi, 2007). In this paper we refer to data on employees and local units, as shown in Table 3.

(Table 3 about here)

An important shortcoming of the ASIA database in its current form is that it does not include the primary and public sectors. The available data on education, health care and social work refer to private and not-for-profit institutions. This can be partly overcome resorting to a National Statistical Programme (NSP) consisting of an operative plan updated every year, which, in its last edition (2008-2010), contains several actions aimed at updating and integrating statistical and administrative sources and thus enhances the range of application of ASIA, particularly with respect to the primary sector (SISTAN, 2008).

4. NAMEA environmental module: Data reclassification

In Italy, data on the environment are collected and processed mainly at the local level: the regional environmental protection agencies coordinate the internal network and make data flow into the national information system. In many cases data are collected and processed to respond to national and European legal requirements on given environmental issues.

Whereas the economic data in the ASIA database are collected locally but harmonized centrally by the national statistical office, the collection of environmental data is more fragmented: the two main actors are the network of environmental protection agencies (the national agency [the former APAT, now ISPRA] that coordinates the regional agencies [ARPAs] and responds to the European agency [EEA]) and the environmental departments of the regional government. They ought to cooperate and follow the EU suggested best practices, but are inevitably acting within the capacity constraints of their administrations. The result is often locally accurate data that however do not conform to the structure by economic sector of economic data nor to the NAMEA requirements, and thus make some re-classification and disaggregation procedures necessary.

4.1 Reclassification issues: from economic process to economic sector

The NAMEA environmental module concerning air emissions records, compared to any other environmental issue, the largest number of national case studies, starting from the EC's pilot studies (European Commission, 1999) to numerous recent applications (Claro 2005, FEA 2003, Gilis and Vandille 2006, Hass and Sørensen 2002, Jensen and Olsen 2003, Šapoliene A. 2007, OFS/OFE 2005, Tudini and Vetrella 2004). After a few initial case studies at the regional level (Bertini *et al.* 2005, ARPA Emilia Romagna 2008, ISTAT 2006), NAMEA air emission matrices are now available also for all Italian regions (ISTAT 2009). In consideration of the large number of applications of NAMEA-Air in most EU member states, Eurostat has published methodological guidelines (EC 2003; EC 2009).

Data on air emissions are available at all different jurisdictional levels. The national environmental protection agency maintains a national emission inventory which collects data on greenhouse gases, acidifying and eutrophicating substances, tropospheric ozone precursors, benzene, particles, heavy metals, aromatic polycyclic hydrocarbons, dioxins and furans. Data are estimated according to the CORINAIR method[8]. Online available databases concern national emissions, provincial emissions and factors of emissions.[9] Provincial emissions are estimated starting from national data.

The Piedmont regional Environmental Protection and Restoration Unit has created, using the CORINAR method, a regional inventory of air emissions (IREA). The IREA should help identifying the sectors towards which actions to reduce air pollution should be addressed. IREA covers the whole regional territory and is built on a municipality base. It uses a bottom-up approach: all the information on economic activities refers to a municipality or a geographically identified location. For air pollution the IREA has become the reference database for local policy makers, as bottom-up estimated data have proved more reliable than top-down estimates from the national environmental protection agency.

[8] CORe INventory AIR emissions is the framework proposed by the European Environment Agency.
[9] http://www.apat.gov.it/site/en-GB/Environmental_Services/National_air_emissions_inventory_(CORINAIR-IPCC)/default.html

IREA records data according to the SNAP (Selected Nomenclature for Air Pollution) classification. It includes 11 macro-sectors, 75 sectors and 430 activities. The pollutants recorded are methane
(CH_4), carbon monoxide (CO), carbon dioxide (CO_2), nitrogen dioxide (N_2O), ammonia (NH_3), Non-Methane Volatile Organic Compounds (NMVOC), oxides of nitrogen (NOx) and sulphur dioxide (SO_2). Information for fine particulate matters (PM10) are incomplete.

Sources of pollutants can be point, line and area sources. The Large Point Sources (LPS) are critical activities whose emissions must be estimated directly through *ad hoc* surveys: in Piedmont 142 punctual sources have been identified, surveyed and geo-referenced.
For area sources the quantity of pollutant emitted (E) is estimated through emission factors[10] (EF) and activity indicators[11] (A). For each activity emissions are calculated as:

$$E = A * EF$$

Line sources refer to vehicle traffic. They are estimated through the COPERT model[12], that defines more than 100 vehicle classes, factor emissions and parameters depending on speed, external temperature, engine temperature, trail characteristics. All data related to roads and highways is in the Regional Transport and Communication Plan and for the 1403 arches of the road network a full amount of data (on traffic flows) is available.

NAMEA integrated environmental and economic accounts allow all this information on emissions to be directly accounted together with their sources. The SNAP process classification should be turned into NACE sector classification in order to exclude all emissions generated by natural processes.[13] Table 4 shows the SNAP macro-sector classification.

(Table 4 about here)

Re-classification implies two steps:
1. to each NACE economic sector a correspondent SNAP production process is assigned (qualitative assignment);
2. whenever the link to the process involves multiple sectors, emission allocations must be estimated (quantitative assignment).

[10] Factor emissions are unique for each pollutant generated by each activity. It is the technical parameter expressing the quantity of pollutant emitted.
[11] This indicator is the parameter which expresses the importance of the activity in the context.
[12] COmputer Programme to calculate Emissions from Road Traffic financed by the European Environment Agency to calculate air pollutant emissions from road transport.
[13] As suggested by the Eurostat handbook, all processes with codes 1101-10 and 1121-25 must be excluded.

Qualitative and quantitative assignments require knowing how emission were estimated for each SNAP process: cooperation between the environmental accounting analyst and statisticians or technical staff who built the inventory is crucial and time saving.

Table 5 reports the NACE sectors which, in our application, required a quantitative assignment: they present common production processes[14] and this does not allow to attribute the right share of pollutant emissions to each source economic activity.

(Table 5 about here)

Production processes linked to LPS directly refer to the economic activity generating pollution: the business register at the Chamber of Commerce can provide information on the sector to which it belongs. For production processes linked to areal sources, the main available methods for the estimates are:

- the consumption of fuel by using the ISTAT table for the 101 productive branches;
- the number of employees per sector and the proportional attribution according to the sector 'size'.

Table 6 provides an example of code assignment for production activities that use solvent for paint – the case of a product that finds application in multiple economic activities.

(Table 6 about here)

The problem, in this case, is to attribute the proper share of NMVOC to the proper economic sectors: while the Eurostat handbook provides quite a clear indication about the 06.01.04 activity, it does not give a unique assignment for the other paint applications. The regional unit technicians who worked at IREA, going back to the way they built the LPS and areal estimates, provided indications about 06.01.05, 06.01.06 and 06.01.07. In order to attribute the share of NMVOC emissions to the activity 06.01.08 data from 2001 industry-census were used to make a proportion and assign, according to the size of the questionable sectors, a quantity of emissions (Table 7).

(Table 7 about here)

[14] As showed in a number of applications, production processes that are difficult to classify are 02030200, 03010200, 03010300, 03010400, 02010300, 050401, 05050202, 06010701, 06040600, 06010800 and the macro-sector 07.

Once all quantitative assignments are assembled for all activities (Table 8) all the pollutants can be summed up through the economic sectors that generated them and a first NAMEA matrix can be drafted (Table 9).

(Table 8 about here)

(Table 9 about here)

The transport source of emissions needs refinement: the current procedure assigns sources of emissions to economic sectors on the ground of the vehicle class: it assigns cars and motorcycles to 'households' while midsize and large vehicle classes to the 'transport sector' or primary sector (where the classification specifies 'rural'). It would be preferable to integrate data with estimates from the studies, surveys and reports of ACI (the driver and vehicle licensing agency), ANFIA (National Association of Vehicle Trade and Marketing Companies), and ISFORT (Education and Research Institute for Transports) in order to provide a more precise attribution of emissions from traffic to households, the transport sector and other sectors.

The IREA database has been compiled in 1997 and 2005, and since 2007 updated every two years by the responsible unit within the regional authority. As compilation techniques improve it will be necessary to project data for the previous years in order to have consistent time series.

The way in which the quantitative assignment is undertaken is strictly linked to productive settlements, land use and characteristics of the territory: accurate assignments crucially require collaboration with the experts working on the air emission inventory who have a specific knowledge of the territory. Figure 1 provides a summary of the step of the procedure and the units involved.

(Figure 1 about here)

4.2 Reclassification issues: The disaggregation of current figures and the building of the new framework

The data source for wastes is the Waste Register (Catasto Rifiuti[15]) whose purpose is to collect into a unitary system data all along the waste cycle, from the producers to the transporters to the dischargers. The main source of this database is the environmental declaration archive (MUD[16]): the form is structured into 5 sections (general data,

[15] The Waste Register was established with Law n. 475/88, and it became effective with D.Lgs.vo 22/97 and D.M. n. 372/98.
[16] The acronym MUD means *Modello Unico di Dichiarazione.*

quantities of wastes, costs and revenues, commerce and packages). Almost[17] all enterprises that produce, manage and/or recycle wastes are required by Law n.70/1994 to fill and submit the MUD. The Waste Register is updated yearly and is managed nationally by the APAT and regionally by the equivalent units within the regional authorities and the ARPAs. The latter's duties include: data collection and management, data validation and processing, transmission of information to institutional agencies and local authorities. Municipal wastes follow a different database setting: data are available for every single municipality and are managed for planning purposes through consortia constituted on the territory.

The classifications of the wastes we are dealing with refer to the List of Waste (LoW, the formerly European Waste Catalogue) and the NACE rev.1. The LoW is a catalogue reporting the different types of waste classified into chapters, sub-chapters and waste types. The LoW is a (mainly) substance-oriented statistical classification of waste.[18]

(Table 10 about here)

Tracking waste flows among regions is made complicated by the fact that the non-municipal waste's final destination is not necessarily within the source region.[19] What requires attention are changes in regulations over time that may affect the waste coding system or the definition of some waste typologies (e.g. from non-hazardous to hazardous): time series must be harmonized before using them.[20]

The environmental side of NAMEA-waste is mainly compiled by distinguishing hazardous versus non hazardous wastes and by typology. Data from the Waste Register are available at regional, provincial and municipal level and both LoW and NACE classification are recorded. The NACE classification is used to reclassify wastes according to the generating economic activities, whereas the LoW is used to solve some reclassification issues.

The main problem to solve in order to make the waste classification suitable for compiling NAMEA is to disaggregate what in the Waste Register is classified as 'mixed hazardous and non-hazardous waste'. The steps to be undertaken include the 6 digit

[17] Exceptions are small enterprises in agriculture and handicraft, and a few waste categories which are not included in the MUD waste typologies.
[18] The List was established by Commission Decision 2000/532/EC of 3 May 2000, replacing Decision 94/3/EC and has been amended by Commission Decisions 2001/118/EU, 2001/119/EU and 2001/573/EU. The type of information that EU Member States should transmit to the Commission, as well as the definitions and classifications that must be observed, are specified by Regulation (EC) No 2150/2002 of the European Parliament and of the Council of November, 25 2002 on Waste Statistics.
[19] According to the EU definition and classification of wastes non-municipal wastes include: industrial waste, hazardous wastes, construction and demolition wastes, mining wastes, waste from electrical and electronic equipment, packaging waste, end-of-life vehicles and tyres and agricultural wastes.
[20] In 2002 an important revision took place in Italy (following the EU directives): some waste classification was shifted from 'non hazardous' to 'hazardous'.

codification of the waste according to the LoW: by identifying the production process that generated the waste it is possible to define each mixed waste type produced by each economic sector as hazardous or not hazardous.

An example of item re-aggregation is provided at the provincial level. Acid, alkaline or saline wastes, which can be both hazardous or non hazardous, are classified as 'mixed waste'. It is necessary to investigate the production process that generated them in order to establish whether the waste is hazardous or non hazardous. For example, when the code of alkaline waste is 01.22.0 the 197,1 tons generated by 'Manufacture of basic metals and fabricated metal products' (NACE code 27-28) are non hazardous while the 2359,8 tons (coded 01.22.1) are hazardous (Table 11).

(Table 11 about here)

Once all 'mixed wastes' are disaggregated it becomes possible to sum the hazardous parts and the non hazardous parts as shown in Table 12, in order to have the two-item subdivision necessary to build the NAMEA-waste tables (Table 13).

(Table 13 about here)

When the classification relates to waste fractions, the compilation of NAMEA is direct and easier.
The correspondence between the Waste Register and ASIA is perfect: the MUD (over which the Waste Register is based) is taken as one of the information sources of ASIA itself (Berntsen, 2004).
The MUD in fact provides detailed information not only about waste generation and treatment but also on the very local units generating wastes and dealing with wastes in every step of their management process (transport, disposal, recycling). All data provided by MUDs are suitable to be used in the compilation of NAMEA. A first draft of NAMEA from the 'origin' side at regional and sub-regional level is thus easy to apply from a methodological point of view: data are available every year for each municipality. More sophisticated methodological techniques must instead be devised in order to compile the waste 'destination' side. Figure 2 provides a summary of the steps of the procedure and the units involved.

(Figure 2 about here)

5. Conclusions

Environmental accounting applications and the surrounding debate, at present, focus on three different levels: the macro and sectoral level, dealing mainly with national

accounts; the green budgeting level that focuses on the accountancy of public local units, and the micro-level that relates to the internal accounts of private firms and enterprises. In our view, what is still missing is a standardized, rigorous accounting framework, of the kind proposed by the SEEA 2003 international standard, implementable at the level of local governments, and aimed at providing instruments to local decision makers and agencies in charge of implementing environmental policies comparable with those that are widely becoming available at the level of central governments: a macro framework applied at a local government scale.

Even though, due to the variety of situations and capacity constraints, it may not be feasible to immediately pursue the implementation if a rigorous unique standard as is done at national level, it should nonetheless be possible to define consistent methodological guidelines, coherent with the internationally accepted SEEA, to help local authorities proceed in an harmonized way both horizontally (among governments at the same level) and vertically (among governments at different levels).

The pilot implementation in Piedmont, Italy of integrated environmental and economic accounting at all the nested levels of local government (regional, provincial, municipal) illustrated in this paper highlights the existence of an information system that sometime needs refinement but does not show huge gaps nor requires large investments. One of the main objections against the extension to local governments of environmental accounting modules consistent with national environmental accounting and thus vertically integrable – the availability of data – is thus shown not to be necessarily an insuperable impediment. What is needed is co-ordination among the different units, institutions, and sectors: the integration process and thus the rules and procedures to be implemented should take place at the stage in which the data, coming from different sources, must combine in a consistent way. The information so far available is not exhaustive but the NSP is playing an important role in identifying the missing information and promoting its acquisition.

The level of processing and analysis of data depends on prospective users and on the utilization target. The data processed for the compilation of integrated accounts should be offered in different formats tailored to different purposes. Data can be processed into aggregate, immediately informative indices when they are meant to allow citizens to access information on the state of the environment and on the effectiveness of policies. When they are directed to technical staff working on monitoring and planning land and natural resource uses, the full tables are needed together with analytical statistical processing and, when necessary, simulation procedures.

The main methodological differences between the official compilation at the national level and our local level application concerns the data sources and the adjustments related to non-residents. The unavailability of suitable official, centrally collected economic data pertaining the provincial and municipal levels led us to base our application of the NAMEA economic module on databases such as ASIA and IREA that integrate different sources, from national administrative archives to local sectorial registers and ISTAT statistical surveys. If on the one hand this is the result of a factual constraint, on the other it also presents, in our view, several advantages. These are informational sources

compiled *ad hoc* for the local level rather than structured for the national level and adapted at sub-national contexts. The range of questions that national accounting must answer may differ substantially from that implied by the 'operational use' required by local planners and resource managers in sub-national jurisdictions, and databases conceived for the local level are better tailored to the latter purpose. Typical goals of local environmental authorities are planning and implement actions, monitoring impacts and assessing results: for instance, to design plans for air emissions reduction, integrated systems for waste collection, treatment, reduction and reutilization & recycling, to coordinate land use change of municipalities at provincial and regional levels, to provide incentives to specific activities in specific territories (and becoming responsible for the projected impacts on people and environment), and so on. The information required as support to these tasks is based on a territorial principle (rather than on the residence principle adopted in national accounting) and must refer to the real physical space with its biological and topological features (rather than to the economic territory).
In addition, some data gathered or estimated at the local level with a 'high resolution scale' are more reliable and precise than data estimated at national level. For instance, thanks to the level of detail in the ASIA database it is possible to distinguish residential from non-residential units and this enables the analyst to calculate the proportional contribution of economic sectors to polluting emissions, thus solving one of the main issues that arise in national accounts.[21]
The main disadvantage of using different sources is that the link between national and local tables is not direct, in the sense that the vertical aggregation of local units will not necessarily produce exactly the national total – a level of integration not feasible with the current data sources.

The first uses of these modules so far show that associating environmental with economic data and downscaling the information at the local level can be extremely useful in pinpointing the roots of environmental issues:

- data on hazardous wastes become more informative in terms of policy implications when associated with economic data that allow decision makers to identify the source industries; the authorities that can operate in terms of planning and actions are the region, the province and consortia of municipalities (La Notte, 2008b);
- data on emissions by sector can change their weight and importance when considered at provincial and municipal levels: local policies should act properly in order to hit the right target (La Notte, 2008a);
- when considering air emissions, only by compiling data down to (at least) the municipal level we can link pollutant emissions and destination: once again policy makers must be aware of the sources of pollution and their impacts in order to plan proper action (La Notte, 2008a). The only way to make this feasible is to calculate emissions and concentrations from the same database – IREA. This is an example to explain how the municipal level can help understand the pollution impact at a larger scale.

[21]The attribution of emissions generated by traffic is more complicated. Their allocation among economic sectors, households and non-residents deserve a more specific study.

This application is only a starting point: the applied modules can be enhanced, other modules can be compiled (e.g. waste water, energy, and so on) and more potential users and uses must be investigated.

Local authorities in many countries often suffer from a lack in the resources that would be needed to process all the information and data available for use in the administration of environmental legislation. This risks to give rise to resistances in front of the prospect to extend environmental accounting obligations to all levels of government. Environmental accounts, however, have a potential, certainly underutilized at present, but also often underestimated, in terms of the strategic role they can play at the operational level. The experiences developed until now, and this study among them, convey promising signals on the fact that the integration of environmental and economic accounting requires an initial, generally feasible investment in personnel capacity and specialization, after which it becomes a precious informational support for making decisions that impact on the environment and for managing natural resources in an informed, responsible, sustainable way.

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Table 1. Local units classification: Piedmont Region (2004)

Size category of personnel	**Municipality of Turin**		**Province of Turin**		**Piedmont Region**	
	Local units	*Employees*	*Local Units*	*Employees*	*Local Units*	*Employees*
Single establishment Piedmont enterprises in Piedmont						
1	47779	47513	49412	49120	87153	86819
…	…	…	…	…	…	…
Total	75400	169202	83091	232918	150294	406356
Multi-establishment Piedmont enterprises in Piedmont						
1	4456	4069	5391	4944	7807	7272
…	…	…	…	…	…	…
Total	10029	51792	13264	86499	19082	112235
Multi-establishment Piedmont enterprises that have units in and outside Piedmont						
1	342	303	182	155	701	621
…	…	…	…	…	…	…
Total	1245	56322	1241	54438	3115	77027
Not Piedmont enterprises with local units in Piedmont						
1	271	276	387	364	1416	1278
…	…	…	…	…	…	…
Total	2016	52054	2230	48211	5323	70245

Table 2. NACE classification: economic sectors in NAMEA as set in ISTAT regional economic accounts

ATECO	NACE_NAMEA	Description
112-145	10 14	Mining and quarrying
151-159	15-16	Manufacture of food products, beverages and tobacco
171-183	17-18	Manufacture of textiles and textile products
191-193	19	Manufacture of leather and leather products
211-223	21-22	Manufacture of pulp, paper and paper products; publishing and printing
232-247	23-24	Manufacture of coke, refined petroleum products and nuclear fuel
261-268	26	Manufacture of other non-metallic mineral products
271-287	27-28	Manufacture of basic metals and fabricated metal products
291-355	29-35	Manufacture of machinery and equipment n.e.c
361-372, 201-5, 251-2	20, 25, 36-37	Manufacture of wood and wood products, of rubber and plastic products
401-410	40-41	Electricity, gas and water supply
451-455	45	Construction
501-527	50-52	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
551-555	55	Hotels and restaurants
601-642	60-64	Transport, storage and communication
651-672	65-67	Financial intermediation
701-748	70-74	Real estate, renting and business activities
-	75	Public administration and defense; compulsory social security
801-804	80	education
851-853	85	Health and social work
900-930	90-93	Other community, social and personal service activities
-	95	Private households with employed persons

Table 3. Employees and local units for three administrative levels in Piedmont (2004)

	regional level		provincial level		municipal level	
	employees	local units	employees	local units	employees	local units
Mining and quarrying	2542	407	689	102	51	20
Manufacture of food products, beverages and tobacco	38592	5644	8096	1441	4286	864
Manufacture of textiles and textile products	48075	4296	6241	651	2188	635
Manufacture of leather and leather products	1975	266	592	74	171	42
Manufacture of pulp, paper and paper products; publishing and printing	23401	2678	7471	696	5689	855
Manufacture of coke, refined petroleum products and nuclear fuel	15108	637	4364	221	1333	121
Manufacture of other non-metallic mineral products	14645	1845	3689	500	907	222
Manufacture of basic metals and fabricated metal products	94261	11806	45575	4642	7962	1529
Manufacture of machinery and equipment n.e.c	172491	11387	77489	4050	33705	2213
Manufacture of wood and wood products, of rubber and plastic products	65864	9375	22346	2512	5373	1284
Electricity, gas and water supply	10137	619	2492	163	3788	72
Construction	141707	54000	41388	16840	24899	8527
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	254416	102860	71181	28550	57685	24599
Hotels and restaurants	68659	20451	18022	5172	16120	4769
Transport, storage and communication	91829	15351	27623	4583	27344	3167
Financial intermediation	48776	9039	8063	2099	19408	2266
Real estate, renting and business activities	224507	77582	52376	17930	88924	26661

Table 4. SNAP Macro-sectors

Code	Description
01	Public power, cogeneration and district heating plants
02	Commercial, institutional and residential combustion plants
03	Industrial combustion
04	Production processes
05	Extraction and distribution of fossil fuels
06	Solvent use
07	Road transport
08	Other mobile sources and machinery
09	Waste treatment and disposal
10	Agriculture
11	Nature

Table 5. Productive sectors NACE-ATECO critical for SNAP code assignment

ATECO2002	Description ATECO2002
A	Agriculture, forestry and fishing
B	Fishing, fish farms and activities incidental to fishing
C	Mining and quarrying
D	Manufacturing
E	Electricity, gas and water supply
F	Construction
G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
H	Hotels and restaurants
I	Transport, storage and communication
J	Financial intermediation
K	Real estate, renting and business activities
L	Public administration and defense; compulsory social security
M	Education
N	Health and social work
O	Other community, social and personal service activities
P	Private households with employed persons
Q	Extra-territorial organizations and bodies

Table 6. Emissions generated by the use of solvent in paint application: SNAP codes (regional level, 2005)

Macro-sector	Sector	Activity	CH_4 (t)	CO (t)	CO_2 (kt)	N_2O (t)	NH_3 (t)	NMVOC (t)	NO_2 (t)	PM_{10} (t)	SO_2 (t)
06 - Solvent use	01 – Paint application	06 01 04 - Domestic use (except 060107)						739,10			
06 – Solvent use	01 - Paint application	06 01 05 - Coil coating						56,31			
06 – Solvent use	01 - Paint application	06 01 06 - Boat building						198,11			
06 – Solvent use	01 - Paint application	06 01 07 - Wood						2.118,58		1,00	
06 - Solvent use	01 - - Paint application	06 01 08 - Other industrial paint application						4.906,09			

Table 7. 'Other industrial paint application' activity assignment method (regional level)

NACE code	Employees	NMVOC Emissions
29-35	192358	2617,70
27-28	98954	1346,61
36-37	69205	941,78
Total	360517	4906,09

Table 8. Emissions generated by the use of solvent in paint application: NACE codes (regional level, 2005)

SNAP Code	06 01 04		06 01 05		06 01 06		06 01 07		06 01 08			
NACE Code		*households*		*28*		*35*		*20-36*		*29-35*	*27-28*	*36-37*
CH_4 (t)		0,00		0,00		0,00		0,00				
CO (t)		0,00		0,00		0,00		0,00				
CO_2 (kt)		0,00		0,00		0,00		0,00				
N_2O (t)		0,00		0,00		0,00		0,00				
NH_3 (t)		0,00		0,00		0,00		0,00				
NMVOC (t)	739,10	739,10	56,31	56,31	198,11	198,11	2.118,58	2.118,58	4.906,09	2.617,70	1.346,61	941,78
NO (t)		0,00		0,00		0,00		0,00				
PM_{10} (t)		0,00		0,00		0,00	1,00	1,00				
SO_2 (t)		0,00		0,00		0,00		0,00				

Table 9.
NAMEA-Air emissions for the secondary sector (Piedmont Region, year 2005)

	Economic module		Environmental module								
	Empl.	Local units	CH_4 (t)	CO (t)	CO_2 (kt)	N_2O (t)	NH_3 (t)	NMVOC (t)	NO_2 (t)	PM_{10} (t)	SO_2 (t)
Mining and quarrying	2600	398	0,421	2,195	5,66	0	0	0,405	5,965	0,59	4,196
Manufacture of food products, beverages and tobacco	39105	5584	0,00	0,00	0,07	0,00	0,62	3184,72	106,60	6,01	0,00
Manufacture of textiles and textile products	45044	4106	11,24	209,91	7,12	0,00	92,99	34,46	12,71	60,33	21,79
Manufacture of leather and leather products	1770	248	0	0	0	0	0	2221,135	0	0	0
Manufacture of pulp, paper and paper products; publishing and printing	22984	2634	4,98	186,59	134,88	0,00	1,23	569,87	245,87	78,24	156,14
Manufacture of coke, refined petroleum products and nuclear fuel	16121	630	4,29	662,40	1439,74	19897	37,84	4032,02	2321,06	711,91	8402,2
Manufacture of other non-metallic mineral products	14354	1788	7,18	2064,46	2154,96	4,21	17,06	934,85	9391,51	1217,59	989,47
Manufacture of basic metals and fabricated metal products	93457	11569	23,17	8627,15	37,16	0,00	9,95	2960,12	1230,44	1243,22	119,57
Manufacture of machinery and equipment n.e.c	170139	11216	37,43	1244,23	23,72	0,00	7,08	6656,38	278,92	243,44	72,76
Manufacture of wood and wood products, of rubber and plastic products	170139	11216	13,47	252,83	8,53	0,00	2,13	4769,00	33,28	946,40	26,07

Table 10. European Waste Catalogue: chapters

Code	Description
01	Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals
02	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
03	Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard
04	Wastes from the heather, fur and textile industry
05	Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal
06	Wastes from inorganic chemical processes
07	Wastes from organic chemical processes
08	Wastes from manufacture, formulation, supply and use of coatings, sealants and printing inks
09	Wastes from photographic industry
10	Wastes from thermal processes
11	Wastes from chemical surface treatment and coating of metals and other materials; non ferrous hydro-metallurgy
12	Wastes from shaping and physical and mechanical surface treatment of metals and plastics
13	Oil wastes and waste of liquid fuels
14	Waste organic solvent, refrigerants and propellants
15	Waste packaging; absorbents, wiping cloths, filter materials and protective clothing
16	Wastes not otherwise specified in the list
17	Construction and demolition wastes (including excavated soil from contaminated sites)
18	Wastes from human or animal health care and/or related research
19	Wastes from waste management facilities, off-site waste waster treatment plants and the preparation of water intended for human consumption and waster for industrial use
20	Municipal wastes including separately collected fractions

Table 11. Mixed wastes disaggregation (provincial level, year 2004)

NACE code	Acid, alkaline or saline wastes (01.2)					
	Acid wastes (01.21)		Alkaline wastes (01.22)		Other saline wastes (01.24)	
	Non hazardous	*Hazardous*	*Non hazardous*	*Hazardous*	*Non hazardous*	*Hazardous*
01 02	0,000	0,000	0,000	0,000	0,000	0,000
10 11 12 13 14	0,000	0,000	0,000	0,330	0,000	0,000
15 16	0,000	0,060	0,000	0,000	0,000	0,000
17 18	0,000	2,820	0,000	34,360	7,300	27,850
19	0,000	0,000	0,000	0,000	0,300	0,000
20 25 36 37	0,000	53,073	0,000	566,386	29,608	545,834
21 22	0,000	541,612	65,080	759,255	29,870	0,000
23 24	0,000	2,045	0,000	0,790	977,506	20,148
26	0,000	0,000	0,000	0,165	0,000	1.370,540
27 28	0,000	3.679,669	197,060	2.359,830	460,308	2.073,406
29 30 31 32 33 34 35	0,000	1.236,604	374,540	1.622,770	518,241	819,848
40 41	0,000	3,250	0,000	1,610	0,028	228,654
45	0,000	0,063	0,000	0,000	82,780	0,000
50 51 52	0,060	61,941	0,000	103,949	7,720	14,490
55	0,000	0,000	0,000	0,000	0,000	0,000
60 61 62 63 64	0,000	0,000	0,000	0,380	0,000	3,750
65 66 67	0,000	0,000	0,000	0,000	0,000	0,000
70 71 72 73 74	0,000	211,371	0,000	210,139	0,300	0,272
75	0,000	0,905	0,000	0,900	0,000	0,000
80	0,017	1,741	0,038	0,931	0,109	0,676
85	0,000	208,636	0,000	216,052	0,194	0,040
90 91 92 93	0,000	22,981	0,000	36,041	33.992,485	0,543
95	0,000	0,000	0,000	0,000	0,000	0,000
Total	0,077	6.026,772	636,718	5.913,888	36.106,748	5.106,050

Table 12. Mixed waste re-aggregation (provincial level, year 2004)

	Environmental module						
NACE CODES	Hazardous only	Hazardous mixed	Total hazardous	Non hazardous only	Non hazardous mixed	Total non hazardous	Total per sector
01 02	55,75	7,66	63,42	2011,23	864,9166	2.876,15	2.939,56
10 11 12 13 14	49,83	5,14	54,97	181,47	7118,64	7.300,11	7.355,08
15 16	23,54	314,65	338,19	9293,96	7284,62	16.578,58	16.916,77
17 18	30,98	277,88	308,86	3461,94	5638,15	9.100,10	9.408,96
19	9,62	6,22	15,84	769,75	1746,46	2.516,21	2.532,05
20 25 36 37	3419,53	10076,01	13.495,54	30204,24	200064,81	230.269,05	243.764,59
21 22	91,69	4222,71	4.314,41	69146,37	17905,93	87.052,30	91.366,71
23 24	1724,60	11351,79	13.076,39	3772,79	22441,21	26.214,00	39.290,39
26	52,02	1935,95	1.987,97	428,54	55512,84	55.941,39	57.929,36
27 28	17701,15	38065,93	55.767,07	7447,71	706271,16	713.718,87	769.485,94
29 30 31 32 33 34 35	36329,09	23091,87	59.420,96	21321,73	277059,06	298.380,80	357.801,76
40 41	1421,90	10197,17	11.619,07	2743,39	17784,52	20.527,91	32.146,98
45	2844,14	5453,93	8.298,07	11210,04	425151,35	436.361,39	444.659,47
50 51 52	6145,16	27215,68	33.360,85	40181,56	69174,77	109.356,34	142.717,18
55	8,02	7,35	15,37	732,66	175,19	907,85	923,22
60 61 62 63 64	1326,34	3408,09	4.734,43	14882,01	22034,57	36.916,57	41.651,01
65 66 67	2,05	8,63	10,68	713,64	300,53	1.014,17	1.024,85
70 71 72 73 74	163,41	6242,89	6.406,31	7913,44	6259,78	14.173,22	20.579,53
75	8,91	167,23	176,14	252,13	1571,57	1.823,70	1.999,84
80	9,16	23,99	33,15	7,2	68,53	75,73	108,88
85	166,25	953,52	1.119,78	1797,49	457,56	2.255,05	3.374,83
90 91 92 93	27391,87	38535,01	65.926,87	449777,52	409945,96	859.723,49	925.650,36
95	0,00	0	0,00	0	2,34	2,34	2,34
Total wastes	98975,02	446570,14	545.545,16	678250,85	1989833,68	2.668.084,52	3.213.629,68

Table 13. NAMEA-Waste for the secondary sector (Province of Turin, year 2004)

	Economic module		Environmental module		
	Employees	Local units	Hazardous	Non hazardous	Total
Mining and quarrying	689	102	54,97	7300,11	7355,08
Manufacture of food products, beverages and tobacco	8096	1441	338,19	16578,58	16916,77
Manufacture of textiles and textile products	6241	651	308,86	9100,10	9408,96
Manufacture of leather and leather products	592	74	15,84	2516,21	2532,05
Manufacture of pulp, paper and paper products; publishing and printing	7471	696	4314,41	87052,30	91366,71
Manufacture of coke, refined petroleum products and nuclear fuel	4364	221	13076,39	26214,00	39290,39
Manufacture of other non-metallic mineral products	3689	500	1987,97	55941,39	57929,36
Manufacture of basic metals and fabricated metal products	45575	4642	55767,07	713718,87	769485,94
Manufacture of machinery and equipment n.e.c	77489	4050	59420,96	298380,80	357801,76
Manufacture of wood and wood products, of rubber and plastic products	22346	2512	13495,54	230269,05	243764,59
Electricity, gas and water supply	2492	163	11619,07	20527,91	32146,98
Construction	41388	16840	8298,07	436361,39	444659,47
Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	71181	28550	33360,85	109356,34	142717,18
Hotels and restaurants	18022	5172	15,37	907,85	923,22
Transport, storage and communication	27623	4583	4734,43	36916,57	41651,01
Financial intermediation	8063	2099	10,68	1014,17	1024,85
Real estate, renting and business activities	52376	17930	6406,31	14173,22	20579,53

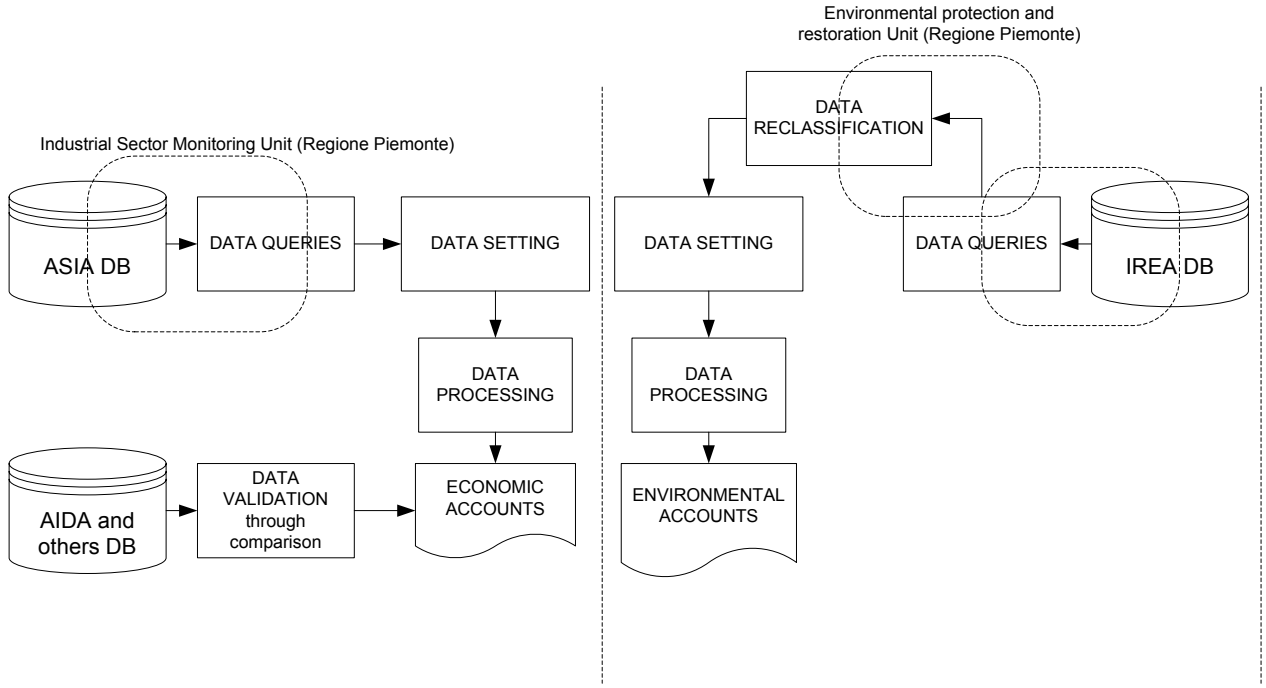

Figure 1. The compilation of NAMEA-AIR: procedural steps

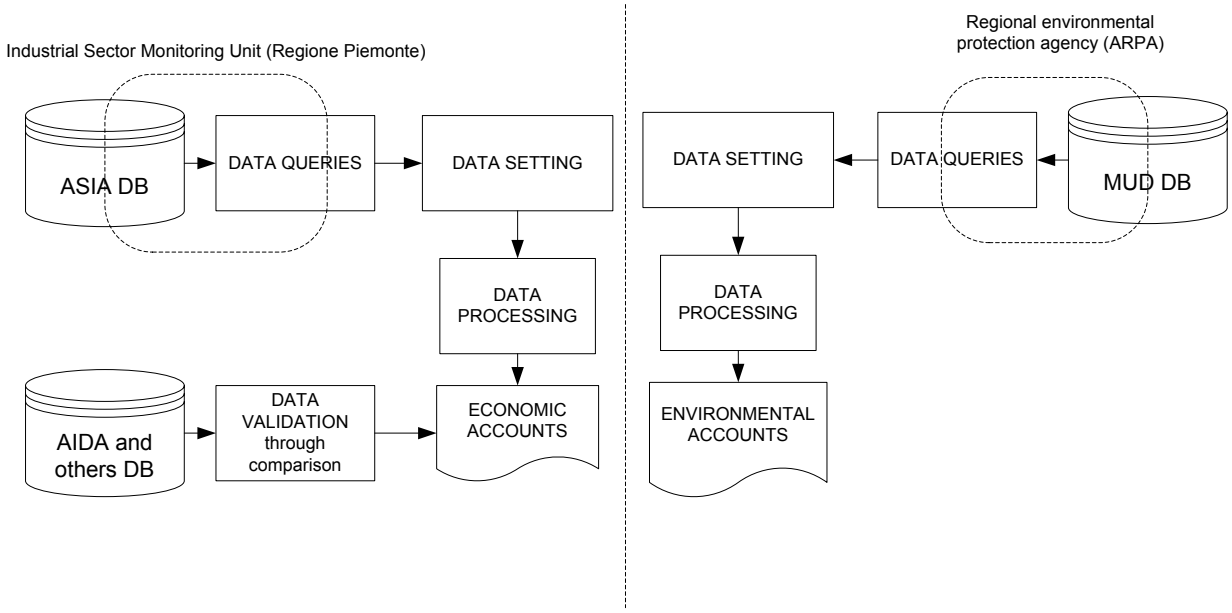

Figure 2. The compilation of NAMEA-WASTE: procedural steps