

Nepote, Daniela; Ferlaino, Fiorenzo; Bagliani, Marco; Crescimanno, Alberto

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Environmental Disparities At Regional Level: The Evidence Of Namea In Italy

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ENVIRONMENTAL DISPARITIES AT REGIONAL LEVEL: the evidence of Namea in Italy.

1. INTRODUCTION

The motivation for this study is driven by the increasing worldwide interest in developing a broader set of environmental statistics. These statistics give values to factors left outside the traditional economic system.

There is a need to develop more comprehensive measurement tools rather than focusing mainly on essential economic indicators such as GDP (Gross Domestic Product). The aim is to draw attention to sustainable development policies.

There are many examples of non-market issues such as environmental factors that are not counted in the GDP or other conventional economic indicators. From local to international levels, there is a growing emphasis on “evidence-based policy making”. This requires improved measures of the current outcomes of programmes and policies, thus requiring statistical and analytical approaches that go beyond national borders and the conventional reporting system.

The study presented deals with the increasingly complex issues of hybrid environmental and economic accounts.

The object of this paper is therefore to present an introductory quantitative analysis system for the relationship between the economy and the environment of the various economic sectors. The aim is to use the quantification of environmental pressures caused by the economy as a comprehensive measurement mechanism to complement conventional economic indicators (such as GDP), therefore, enabling comparisons of sustainable development.

Environmental-economic accounting brings together economic and environmental information in a common framework to measure the contribution of the environment to the economy, and the impact of the economy on the environment.

Henceforth the issue of environmental-economic accounting is crucial to assessing the static and dynamic performance of economic systems.

This study develops an empirical analysis using the Namea (National Accounting including Environmental Accounts), which is a statistical information system

allowing the investigation of the pressures placed on the environment by production activities and combines economic figures with related environmental factors.

The intention is to show the extent to which Namea is a sound basis for understanding economic-environment relationships and for that reason is an aid for policy making.

The use of this methodology is not so widespread in socio-economic analysis and the study presented has the aim of defining the boundary and benchmark evaluation.

The objective is quantify the environmental pressures caused by the economic sectors and compare them with the ecological factors and socio-economic quantities (i.e. Added Value and Employment). Operating in this way is possible to evaluate, not just the absolute value of the impact on the various ecosystems but also the levels of economic efficiency and employment efficiency.

In order to understand the case of the Piedmont Region, the macro-sector environmental impacts indicators and environmental efficiencies are compared with the Italian regional average. These used as a benchmark the regions of Northern Italy (Lombardia, Veneto, Emilia-Romagna and Toscana) that traditionally Piedmont is compared.

The first part of the paper, shows how the Piedmont macro-sector environmental impact indicators and environmental efficiencies are compared with the Italian regional average. This draws the attention to the sectors which are more or less eco-efficient. The factors chosen are those that are more significant for the socio-economic environment (green house effect, acid rain, ozone gas, lead and particulate matter). In referring to a regional framework, the analysis is very significant since it allows the investigation to focus on fundamental and idiosyncratic features compared with national averages.

The last part of the paper indicates there is a complementary analysis for the years 2005-2008 which reconstructs the trend of the economic sectors at a regional level illustrating the relative and absolute de-linking in relation to each emission.

The case presented provides evidence on the drivers of environmental efficiency and on sector specificity. This represents an important step towards the analysis of the interaction between the economy and environment, with a special focus on the assessment of the impact of various economic sectors on the environment.

The presented expresses the concept of how the Namea dataset can be used for decision-making purposes with strategies that follow a sustainable growth path. In order to fulfil this objective, the development and use of integrated economic-environmental indicators are proven to be a valuable resource.

2. THE ACCOUNTING OF NAMEA

2.1 National and International NAMEA measurement system

In recent decades, as a result of the growth of awareness of the environmental pressures, there have been indicators and environmental measurement tools proposed. These try to estimate quantitatively the various ecological problems. Amongst them are some particularly interesting new methodologies that aim to build an integrated accounting methodology between economic and environmental aspects.

There are studies and applications that lead environmental assessments within the economic sphere proposing cost accounting systems based upon the environmental function. One of them is a particularly interesting method of accounting, the SERIEE (Système Européen de Rassemblement Economique de l'Information sur l'Environnement), developed by Eurostat 1994, which describes, in monetary units, the costs incurred by “economy for the protection of the environment and to the sustainable use and management of natural resources”. It is an alternative accounting system in respect to traditional measurement of national accounts.

Other proposals, by contrast, introduce a fully structured accounting system in material units: these include the MFA (Material Flow Analysis), which quantifies the relationship between society and environment in terms of material flows, using tons; the EFA (Ecological Footprint Analysis) that leads to the quantification of an ecosystem area used and HANPP (Human Appropriation of Net Primary Production) that accounts for the carbon mass.

There are different systems based on the methodological approach which introduce parallel accounting, in which the economic aspects are treated as monetary units and the environmental aspects as material units. Amongst the methods, the most commonly used appears to be one known as NAMEA (National Accounts Matrix including Environmental Accounts), this is the one which has been used as the basis of this study.

The NAMEA is a matrix accounting system based on monetary units, which are related to the amounts of natural resources, wastes and emissions, calculated in material terms. The measurement system of NAMEA organises information relating

to socio-economic and environmental areas categorising them in a similar manner. In this way it becomes possible to analyze and compare, in a consistent fashion, according to the methodology of Eurostat; thereby taking into account economic amounts relative to production, value added, employment and household consumption, and relating them to environmental pressures caused by different productive activities.

The basic idea of the methodology adopted in the NAMEA matrix takes its inspiration from the work of Keuning and co-workers (de Boo, Bosch, Gorter and Keuning, 1991; Keuning, 1991; Keuning, Thorbecke, 1992, de Haan, Keuning, Bosch, 1994) that have taken up and developed the matrix approach of the Input-Output (Leontief, 1970; Leontief, Ford, 1972). The development of a more profound Namea dataset, both in sectorial and timescale issues has been matched by an increasing analytical effort over the last decade. Contributions by de Haan (2004), and Mazzanti and Montini (2010) have emphasized the usefulness of Namea dataset for econometric investigation covering a wide range economic aspects.

The National Institute of Statistics (Netherlands) has proposed, in 1994, a first operational formulation at national level. Subsequently, a number of EU countries have dealt with the construction of National NAMEA matrices. This has occurred also in response to the significant boost from international bodies such as the EU, the OECD and the UN. In 1995 the European Community adopted the NAMEA methodology for statistical programs in the EU as a key instrument for the development of environmental measurement within the framework the national accounts.

The innovative idea of the NAMEA, when it was first introduced is to quantify the environmental external factors not only in monetary terms but also in material units. This application allows to overcome the many limitations that characterize the economic evaluation of environmental aspects. Through a parallel accounting system it becomes possible is to assess the material resources necessary for the economic production process (energy, minerals, biomass, etc..). And, secondly, to quantify the environmental consequences resulting from those same activities (emissions and waste) .

In Italy, Istat has produced, in 1999, the first NAMEA matrix at the national level, using as a reference year 1990. The calculation was also carried out for the following years. To date, the matrices are available NAMEA for Italy, for the years 1990-2009. They quantify the emissions of the following air pollutants: carbon dioxide (CO₂), nitrous oxide (N₂O), methane (CH₄), nitrogen oxides (NO_x), sulfur oxides (SO_x),

ammonia (NH₃), volatile organic compounds not methane (CONVM), carbon monoxide (CO), particulate matter (PM₁₀), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), selenium (Se), zinc (Zn). The NAMEA also shows the direct sampling of four types of natural resources: endogenous steam, fossil fuels, minerals and biomass.

2.2 Regional NAMEA Matrices

A new wave in data generation is regarded as the “regionalization” of the Namea which has brought new possibilities of research since it considers both regional and sector aspects.

These regionalized Namea statistics maintain that many different pollutants and /or environmental factors differentiated by their geographical distribution such as a more global climate change issue or a more localized acidification process.

Interesting results may arise from application of a regional Namea in assessing innovation environmental proposals and environmental factors based upon economic decisions at a local level.

In Italy, the Italian National Statistical Institute (ISTAT) has been regularly publishing emissions figures at national level since 2004. There has been a regionalization of data generation which has led to an Italian regional Namea for the year 2005. Istat has published data in 2009 involving 20 regions, 24 productive sectors and 10 pollutants which results in a quite extensive and unique dataset.

The great advantage of this new tool is that it adds a geographical dimension to the sectoral one which already exists. This assists with disentangling the physical and efficiency factors behind a regional environmental performance. It also assesses which drivers are relevant to determining the distribution of environmental performances at regional and sectoral level.

As emphasized by Gibbs (2006) regional analyses based on economic and environmental accounts may contribute to establishing grounds for useful research on environmental issues that remain comparatively under-researched and provide normative prescriptions for a properly designed environmental policy in a context of geographical and economic heterogeneity.

As stated before, Namea Matrices have recently been produced by Istat at a regional level. These includes for the year 2005 which contain the emission for 10 of the 18 pollutants considered at national level: carbon dioxide (CO₂), ozone (N₂O), methane

(Ch₄), ozone oxide (Nox), sulphur oxide (Sox) ammonia (Nh₃), volatile organic matter, carbon monoxide (Co), particular matter (PM 10), lead (Pb).

The information provided at a regional level is not as comprehensive as that of national data; however, it does provide a useful data-base on the environment connected to local pollution emissions which are relevant to this study.

In order to evaluate the amount of pollutants, three indices, already calculated by Istat, need to be consulted.

The foremost emission and first index and is that of the “greenhouse effect”. This is a measurement which contribute to the measurement of the effect.

This information relates to the GWP (Global Warming Potential) that has been calculated by the IPCC (Intergovernmental Panel of Climate Change) regarding the different “greenhouse” gases.

In our case the gases considered are carbon dioxide, ozone and methane, measured together in terms of tons of Co₂.

The second index regards the emission of acids. This table represents a collection of acid pollutants: sulphur, oxides, ozone oxides and ammonia.

The action of acid emissions are weighted by their acid potential (PAE), Potential Acid Equivalent, that takes into account hydrogen ions that would potentially occur in case of a total deposit. The final value is expressed in terms of tons of potential acid equivalent.

The third index takes into consideration the emissions that contribute to atmospheric ozone in the first few hundred metres above the ground. In this instance the pollutants are weighted on the basis of their potential to form ozone and relate to: methane, ozone oxide, volatile organic matter and carbon monoxide.

The regional Namea matrix produced by Istat encompasses 23 territories including 20 regions, 2 autonomous regions and 1 area called “extraregional” that contains the datas relating to the extraction of petrol, natural gas in international waters and public administration overseas (embassies, consulates, military bases, research centres). The extra-regional areas have not been taken into consideration because of the impossibility of finding objective criteria between the other regions.

The regional tables present the results in terms of 24 economic sectors that follow the classification ATECO 2002 and expenses of the family divided into three according to the COICOP (Classification and Individual Consumption by Purpose). For each

sector the Italian Institute of Statistics supply both the environmental factors generated by the economy (for instance the Co₂ generated by chemical reaction in the cement industry), but also the ones that spur from the transport activities or the process of generating energy for heating.

For a precise understanding of the data and a correct interpretation of the results it is worth stressing that Namea does not include the atmospheric emissions due to natural phenomenon. However, it is worth noting that the sector of Transport includes the environmental factors of the transport of people and goods which refer directly to that sector. It does not take into consideration the environmental pressures caused by private transport (this is included in the sector “expenses of families”) and the transport activities of other economic sectors.

2.3. NAMEA data use at a Regional Level

The primary contribution of this section is to explore how environmental efficiency is distributed amongst the regions under examination and economic sectors in the Italian context. This then investigates the accumulative effects occur and if they correspond to a regional or sectoral criterion.

The geographical distribution of polluting emissions reveals in some cases a strong spatial concentration of heavily polluting sectors in restricted areas. This may not always correspond to regions with relatively less stringent environmental regulation or lower capital and environmental innovation. A deeper investigation of such a clustering process would shed some light on the driving forces influencing the emergence of cleaner and unclean production areas.

The analysis undertaken focuses on 5 environmental factors taken from the regional NAMEA matrices.

Three synthetic indices:

1. “greenhouse effect”
2. Acidification
3. Ozone Gases

And two emissions:

1. Lead
2. Particulate Matters

The last point refers to particles less than ten thousandths of a millimeter.

This is a selective choice and is not exhaustive in relation to all effects on the ecosystem as it is extremely difficult to have a coherent set of data for all aspects and all types of economic sectors.

The chosen matrices are considered more than satisfactory for the environmental, economic and regional perspective.

The five typologies taken into consideration are more representative than all other especially in relation to environmental dangers and include problems such as global warming and acidification.

There is also a concentration on pollution in relation to ozone, PM10 and lead.

However, the indicators neglect some of the most important problems such as the loss of biodiversity, deforestation, land erosion and contamination by agents other than lead.

These 5 emissions relate to the Italian system of production:

- Greenhouse gases are directly connected to energy production and relate to all economic sectors
- Acidification relates to specific economic sectors such as agriculture
- Ozone, Pm 10 and lead also relate to specific economic sectors

The 5 indicators pertinent to the territories can be considered sufficiently exhaustive given the diverse size and scale: the micro-level regarding health and pollution relating to local monitoring of dust and lead: miso-scale and macro regional which is characterized by the phenomenon of ozone gases below a few hundred meters above ground, acid rain; planetary –wide scale which refers to the problems of global warming.

The separate and complementary analysis within the five indicators can allow an estimate of the environmental pressures related to the economic sectors and different territorial scale.

3. THE EUROPEAN CONTEXT

The European context has to be studied before examining the situation of Piedmont within an Italian context. This is important so a well-rounded assessment of the greening the sectors concerned can be assessed. The data used for the analysis of some European countries come from EIONET (European Environment Information and Observation Network) and are related to greenhouse gas emissions for the year 2000. The EIONET uses a method of calculating the same as the Italian Namea: the

data is therefore directly comparable and can be used as background in the analysis of the Piedmont.

Only the most relevant data and categories provided by EIONET have been considered here i.e. the economic eco-efficiency (expressed in EUR / quantity of emissions) regarding greenhouse gas emissions and the ozone gases. Some countries can only be compared with Italy which have used the methodology of NAMEA (Germany, Sweden and the Netherlands). Table 1 shows, for the year 2000, the economic eco-efficiency referred to 14 economic sectors.

Table 1. Ecoefficiency of the 14 economic sectors of the economy with respect to greenhouse gas emissions and ozone gases

14 sectors	Greenhouse Effect (€ kg)				Ozone Gases (€ / gr)	
	Italy	Germany	Netherlands	Sweden	Italy	Germany
Agriculture	0,56	0,30	0,40	3,33	0,11	0,24
Mining and Extraction	8,06	0,16	1,95	9,67	0,65	0,11
Food	7,78	2,82	2,36	34,79	0,48	0,48
Textile Industry	13,33	7,29	3,65	49,37	0,45	2,05
Chemical Industry	4,41	5,50	5,07	36,55	0,32	1,58
Non-metallic minerals	0,77	0,70	0,26	14,45	0,17	0,14
Iron and Steel Industry	0,39	0,42	0,82	2,83	0,10	0,18
Heavy Manufacturing Industries	1,23	0,83	0,91	7,52	0,19	0,23
Other Manufacturing Industries	12,23	12,71	10,99	192,22	0,81	0,17
Energy	0,12	0,09	0,11	7,63	0,09	0,09
Construction	19,85	9,75	12,45	49,24	0,65	1,23
Transport	17,12	21,29	16,82	231,13	1,48	3,42
Service Industries	1,99	2,09	0,90	12,27	0,17	0,29
Tertiary	10,62	11,45	5,99	108,05	2,34	5,31
Total	2,47	2,46	1,94	34,21	0,49	0,64

Source: Based on data from IRES EIONET, 2000

The Power Industry has shown remarkably low greenhouse gas emission in Sweden. This is due to the fact that the Swedish energy model (similar to Danish and Finnish) was (in 2000) and still is very diversified and low CO₂ emissions, with 13% of the primary energy (and about 35% of the power) that comes hydroelectric power and 17% (48% in electric mode) from nuclear power. Such a system was, in 2000, able to have an overall eco-efficiency of less than 37 € / kg CO₂-equivalent produced, compared to the 4 euro of Italy. In Germany it appears that in the year 2000 has a high level of greenhouse gas emission derived by the high percentage of energy produced from coal, lignite and gas. The Netherlands has for example in 2000, a very low ecoefficient energy system.

The analysis of the data in Table 1 for the individual sectors shows promising figures for Italy in the industrial field, where, in many areas of traditional specialization, there is excellent eco-efficiency, second only to Sweden. Fields such as the

construction sector and the textile industry (made in Italy) show good eco-efficient results.

4. THE ITALIAN CONTEXT

The European context has been described, so this can now be analyzed the important aspects of Italy at a National scale. This section emphasizes the Italian situation using the NAMEA data from 1990 to 2009.

Figure 2. Progressive evolution of the five environmental factors (greenhouse effect, acidification, ozone gases, lead and particulate matter) in relation to added value and units of work for the Italian economy as a whole (values year 1990 = 100)

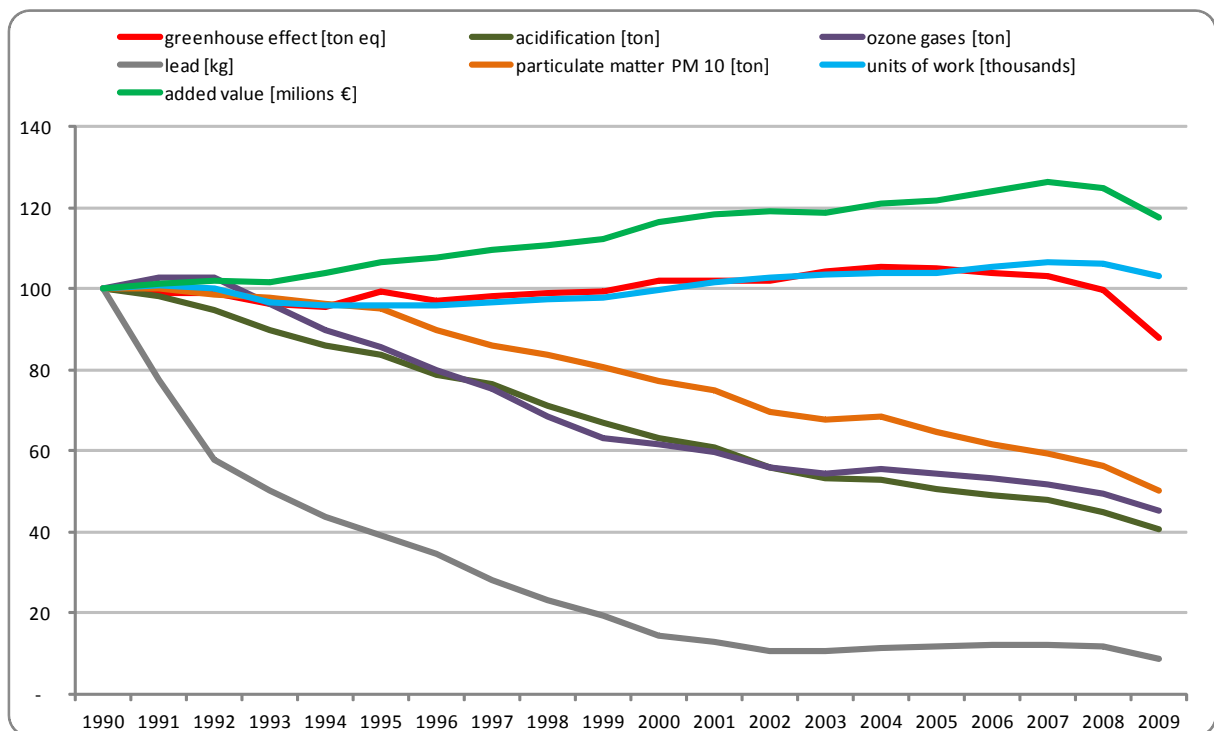


Figure 2 shows the progressive evolution of five environmental external factors, which includes added value and units of work for the Italian economy as a whole. The values are based on the year 1990 (= 100). Three dynamics emerge that clearly distinct from each other.

The acidification, ozone, lead and particulate matter are characterized by a continuous and progressive decrease: for example, the reduction of lead emissions in the Italian economy between 1990 and 2009 was 91% of the initial value. There is also a decrease of acidification (-59%), ozone (-55%) and particulate matter (-50%).

The greenhouse gases exhibit a more uncertain behavior, fluctuating upwards and downwards. The data illustrates a marginal decline during the years 1990-94 and 1995-96. This alternates with periods of increase (1994-95, 1996-2004), which arrive at the peak of 2004-05 with an increase of emissions by 5% compared to 1990. The last phase (2005-09) highlights the first signs of the economic crisis, thereby illustrating a decline based on the reduction in energy use for production purposes, which results in a decrease of 12%.

Another important factor is the added value and the unit of work that exhibit a trend of regular growth until 2007. There is an increase of 26% for the added value and 7% for units of work. However, the last two years show the onset of the economic downturn leading to a rapid decline of both indices, in 2009, 18% (added value) and 3% (unit of work).

The chart illustrates the decrease of emissions from the major environmental factors, which corresponds to a trend of growth of value added elements, however, the Gross Domestic Product (GDP) fails to take this into account. In this sense it is appropriate to introduce the concepts of eco-efficiency of an economic nature and types of employment.

The definition of eco-efficiency for economic aspects of a certain environment, means, quite simply, the ratio of the added value of the economic sector in relation to the environmental factors. A parallel definition can be introduced for the occupational efficiency that sees the work units divided by the environmental factors. The economic eco-efficiency is then measured in euro / kg emission, and employment in work units / kg of emission.

The first indicator therefore shows the change in the composition of the wealth produced and the impact generated and, therefore is concerned with the sphere of investment on capital (technical and energy) and work (as the added value coincides with that of wages and of gross profits). The second is related to the use of the labour force in the production environment. These measurements can be compared in production performance (reflected by the added value and the unit of work) with the environmental factors. It is evident that higher values of economic (employment) highlights situations in which, for a given added value (jobs), you cause environmental emissions.

The quantification of the "greening" or lack of within the different economic sectors can also be measured. Depending on environmental factor the "greening" effects vary: for CO₂ there is de-carbonization, general resources indicated by de-

materialization. The words delinking or decoupling are used to explain the separation between the evolution of value added (which ideally should be upwards) and the environmental pressures (which should ideally be downwards).

An increase in eco-efficiency can still hide two different dynamics, referred to as absolute and relative growth of eco-efficiency. The first indicates situations in which not only the eco-efficiency increases (thus indicating that for emissions produced, we can have more added value or employment), but the total amount of pollutants actually emitted decreases, with a real advantage for the environment. A relative increase of eco-efficiency can still indicate an increase of pollutants emitted. The latter situation is possible if you have an increase in emissions and, in parallel even greater growth of added value and / or work units.

Figure 3. Progressive evolution of economic efficiency compared to the five environmental factors (greenhouse effect, acidification, ozone gas, lead and particulate matter) for the whole of the Italian economy (year 1990 = 100).

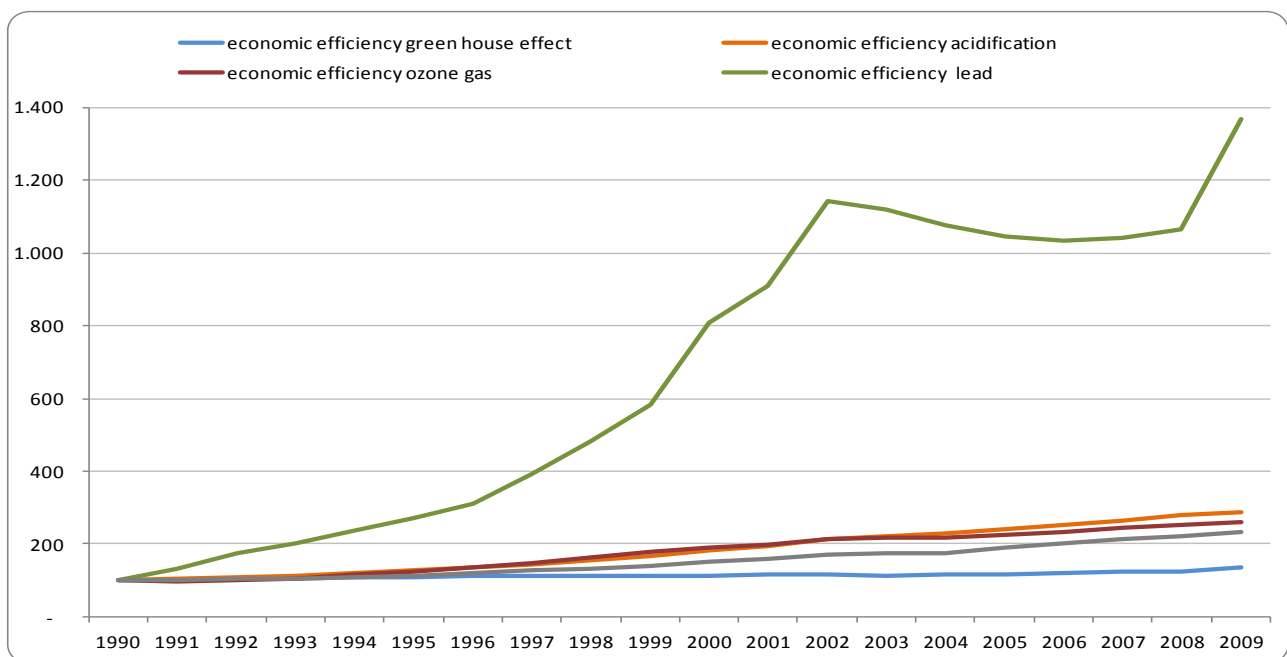


Figure 3 shows, for the whole of the Italian economy. The progressive evolution of is less than the five considered environmental factors (greenhouse effect, acidification, ozone gas, lead and particulate matter). The values are for the year 1990 (= 100). There emerges an enormous growth in energy-related emissions of lead, which, as seen above, have been subject to a strong reduction, compared with an increase of added value. This is mainly as a result of the conversion of the processes of oil refining using the low use of lead.

Eco-efficient economic areas relating to other environmental factors show a trend of high growth. Between 1990 and 2009 the acidification has increased by 189%, ozone and the particulate matter by 134%, while for the greenhouse effect readings are more modest 34%.

The data indicates eco-efficiency is on the rise, and in Figure 2 shows that the absolute values for the different emissions have, however, decreased between 1990 and 2009. This leads to the conclusion that, on average, the production Italian system, was characterized by an absolute increase in 1990-2009.

The data also confirms a parallel growth of employment eco-efficiency (not shown in the figures) and therefore it can be concluded that in the last twenty years there has been a change towards greening the economy at the national level. This due to an increase growth in the tertiary sector.

5. A MACRO-SECTORAL ANALYSIS: THE CASE OF PIEDMONT AND OTHER NORTH ITALIAN REGIONS

After the description of the European and the Italian context is worth outline the structure of the Italian Namea at the regional level for the year 2005 for progressive steps.

The first one, presented in this section focus on the aggregate results in relation to the 5 macro-sectors in order to find out about the principal properties and dynamics.

In order to offer a more comprehensive analysis a comparison with the average Italian values and 4 regions on the North of Italy is presented. These are: Lombardy, Veneto, Toscana and Emilia-Romagna.

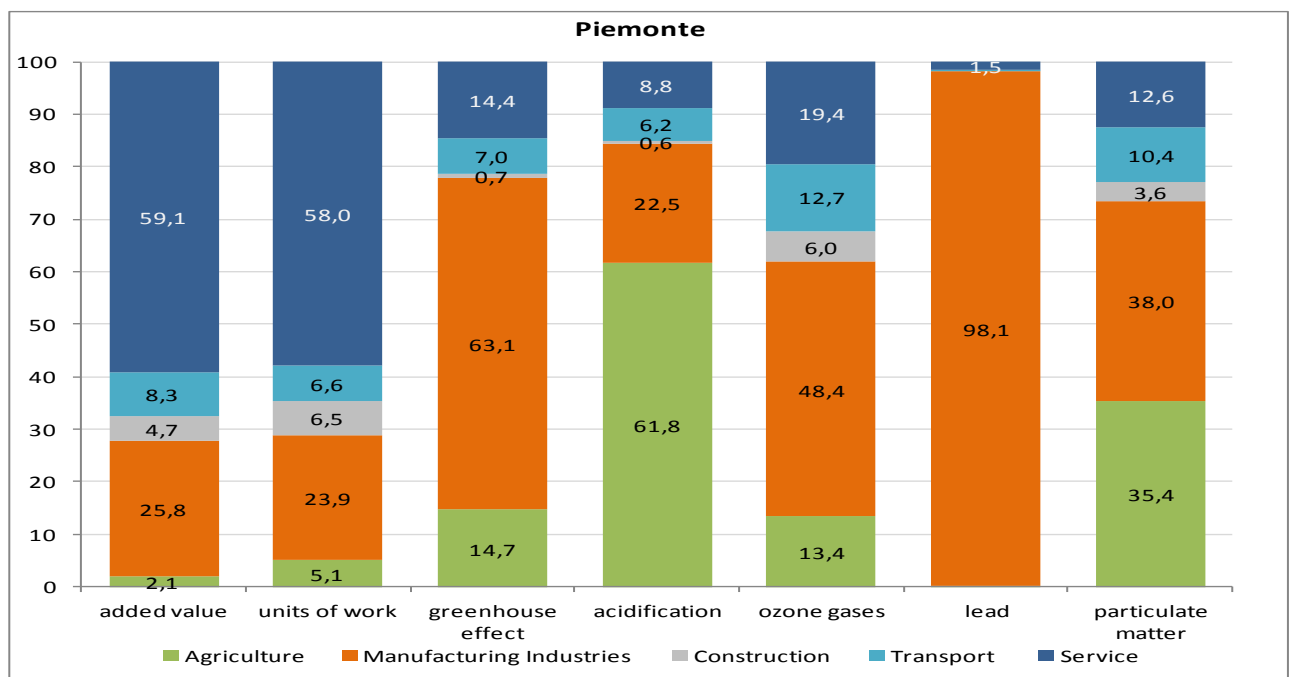
The Macro-sectors are:

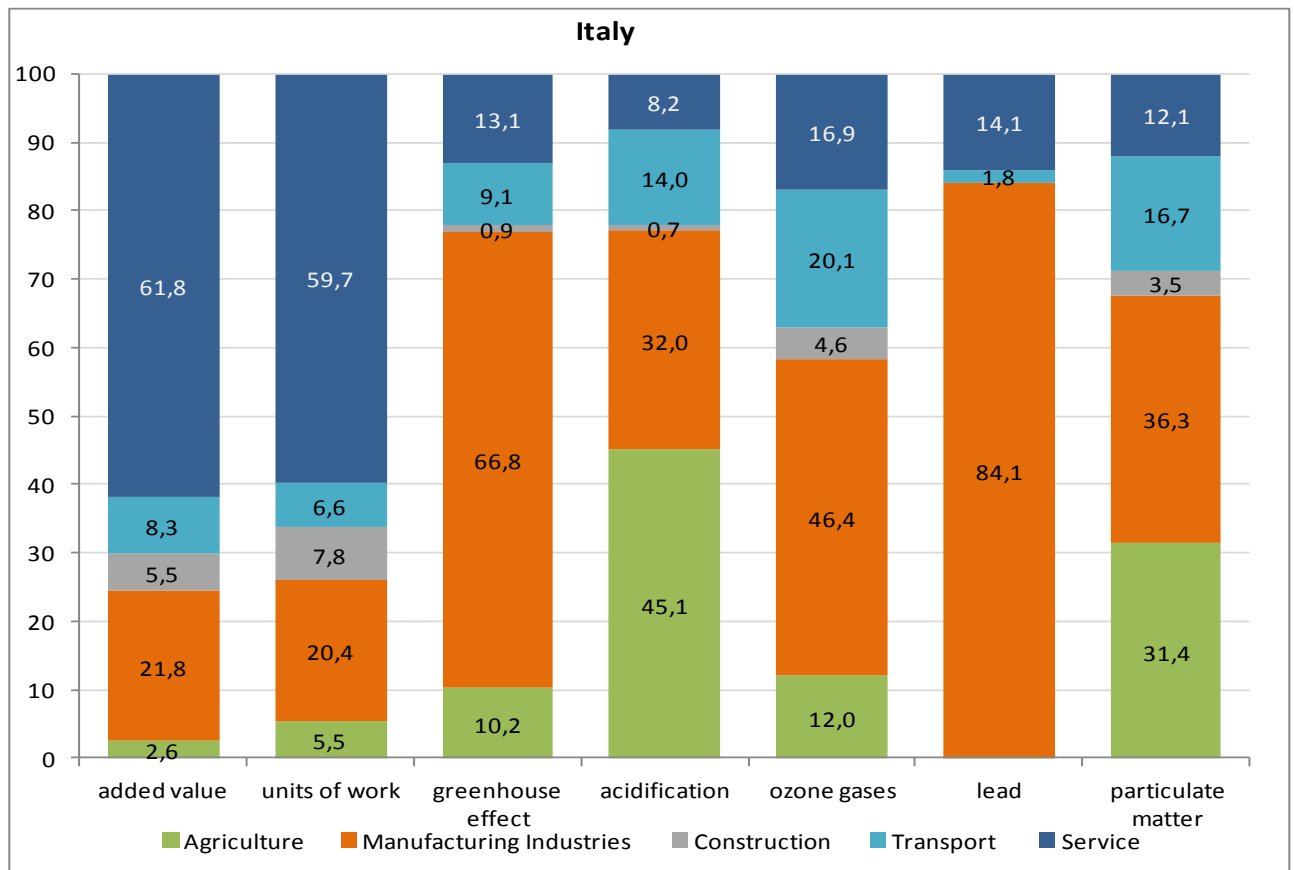
1. Agriculture
2. Industry (including Mining Industry, all the manufacturing sector and the production and distribution of Energy)
3. Constructions
4. Trasports
5. Services (including all the profit organizations and also the Public Administration).

5.1 Environmental Externalities and macrosectors: an analysis of their contribution

An interesting approach is to investigate the contributions of the macro-sectors in relation to the added value and unit of work regarding the 5 externalities taken into consideration.

Figure 4 shows the contribution for the macro-sectors for Piedmont and Italy in relation to the added value, unit of work and the five externalities taken into consideration (greenhouse effect, acidification, ozone gases, lead and particulate matter) Year 2005.





From the graphs one could see the percentages are basically the same for Piedmont and for Italy.

The major contribution to the Added Value and for the Unit of Work is given by the sector of Services with the 59,7% and 58% in the case of Piedmont and percentage slightly superior (61,8% and 59,7%) for the Italian ones.

Then follow the Industry sector with Italian percentages that are a fifth and in Piedmont it is a little superior. This confirms the strong industrial legacy of this territory.

The process of greening, as it will be explain later in detail, is supported in relation to the growing importance of the Tertiary sector.

The analysis of the environmental factors is characterized by strong similarities for Piedmont and Italy. The percentages of Added Value and Employment are nearly the same, however the environmental factors show a different version .

The green house effect is caused, to differing extents, by all macro-sectors in Piedmont and in Italy. The gases are produced especially during the

combustion process (Co₂) for the production of energy and for transport, which are used by all economic sectors. This results in gases in the atmosphere contributing to the global warming effect.

Heavy Industry is the major producer of green house effects with a percentage of two third, nearly both in Piedmont and Italy. The sector of Services is around 15%, then follow the contribution of the Agriculture , Transport and Construction industry.

The acidification process is linked to particular phenomena: the production and distribution of manure which is responsible for the emission of ammonia. This acidification process contributes to acid rain. It creates therefore a problem which is not just local but has effects at a macro-regional level. This emission requires intervention and policies jointly at national level and international level.

Figure 4 shows the responsibility of the agricultural sector for the acidification. In Piedmont is 61,8% and in Italy 45,1%; the industrial sector is responsible for percentages that varies from 22,5% (Piedmont) to 32% (Italy).

Ozone is a secondary pollutant and its effects are at a macro-region level. From the graph presented it is shown that the emissions are due to basically all industrial processes. The Transport sector is generally speaking a major creator of this type of pollution. However for Piedmont the ozone present percentages are inferior (12,7%) to the Italian average (20,1%).

The sector of Services contribute for the ozone gases with the percentage of 19,4% for Piedmont and 16,9% for Italy.

Lead is a toxic metal and is responsible for 98% of the macro-sector Industry of Piedmont.

Finally particulate matter does contribute to the emission of Industry for 38% for Piedmont and 36,3% for Italy.

The high values showed in the Agricultural sector that reaches 35,4% for the Piedmontese territory and 31,4% for Italy are linked to the use of fertilizer, incineration of waste and the use of agricultural machinery.

5.2 Environmental Profiles by Macrosectors

From reading the data in figure 4 in relation to the various sectors, it is possible to provide an environmental profile for each macro-sector.

Figure 5 graphically illustrates the different proportions obtained between added value and the unit of work indicated with the colours dark, blue and purple, in comparison with the 5 external environmental sectors indicated with the colours yellow and red. In this way it is possible to see the effects of the different sectors in proportion to pollution characteristics.

The data presented highlights three different cases. Firstly the service sectors demonstrates that in Piedmont Italy has an elevated share of pollution creation, in respect of the Added Value and Work Unit.

Evidently the service sector plays an important role in this region and has a weighting of 60%. In parallel this macro-sector is responsible for emissions that do not go above 20% of the overall figure, one can see that this sector has an elevated proportion of employment in relation to its pollution emissions, therefore, one can label this macro-sector as a low polluter.

The next factors that emerge are those of the Agricultural and Industrial sectors that exhibit the inverse proportion to that of the Service sectors. For Agriculture the employment level is less than 6% however it registers a high level of pollution emissions. For example:

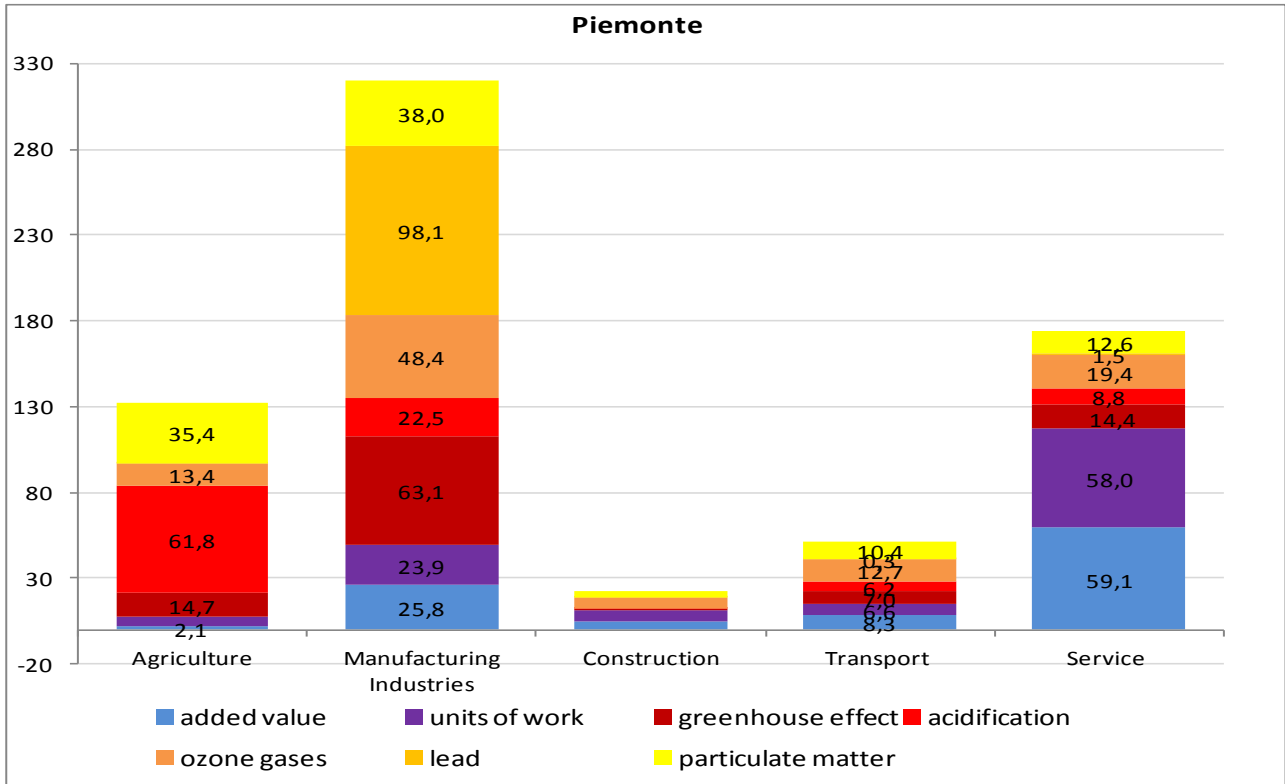
- acid substances 45,1% in Italy and 61,8% in Piedmont
- particulate matters 31,4% in Italy and 35,4% in Piedmont
- greenhouse gas and ozone higher emissions in relation of employment levels.

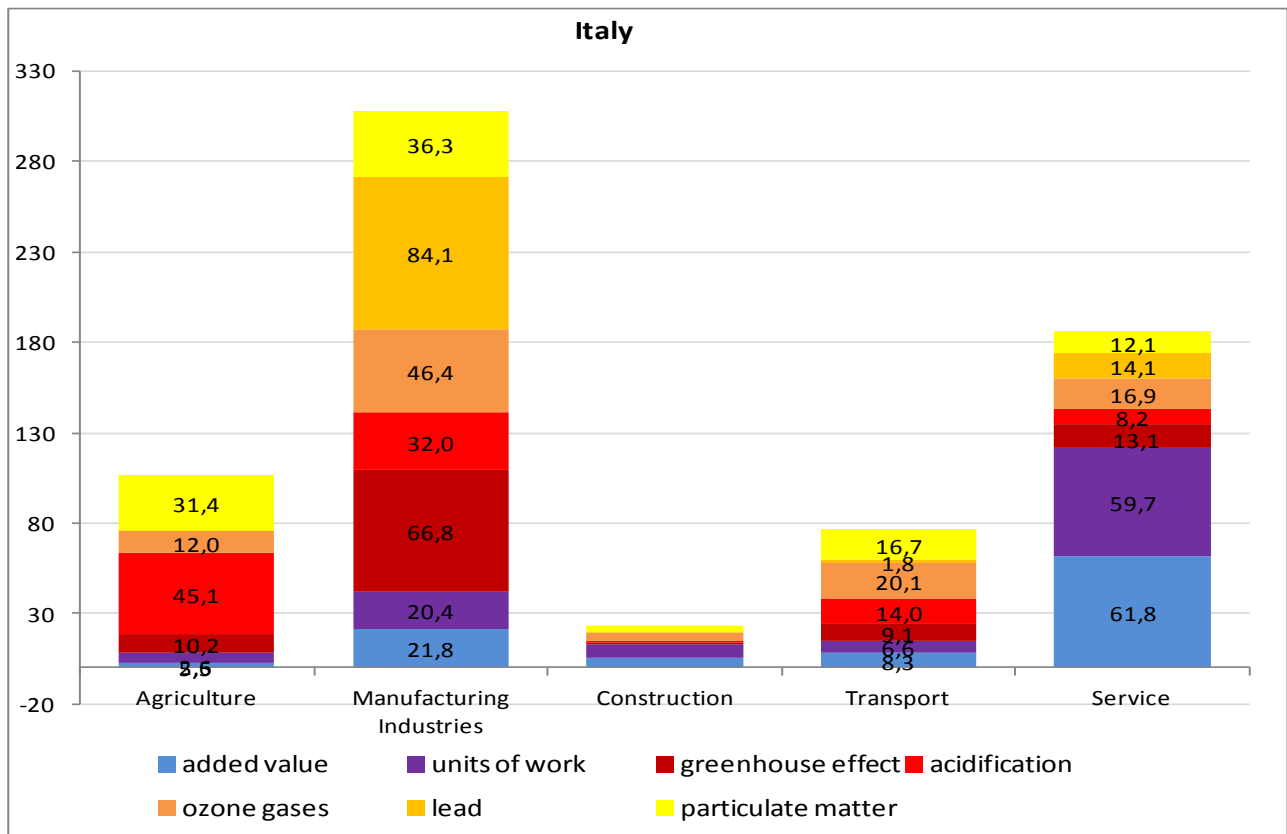
The Industrial sector shows the same trend as Agriculture. In this case the employment level is around 20% to 26% whilst the pollution emissions are high (with the exception of acidification in Piedmont) as illustrated in figures 6 and 7.

The worst pollutant is that of lead in which Industry produces 98,1% in Piedmont and 84,1% in Italy. In this case we can say that the Agriculture and Industrial sector are high polluters.

Finally in terms of emissions the sector of Construction and Transport fall between the Service sector and Agriculture and Industry, therefore can be said to be medium polluters.

Figure 5 The graph highlight the percentages of added value, unit of work and the five externalities. Year 2005





5.3. Environmental Impact of Macro-sectors: A Regional Comparison

The following part of the research amplifies the analysis of the relevant macro-sectors data in comparison to Piedmont and that of the other traditionally compared regions (Lombardy, Veneto, Tuscany and Emilia-Romagna).

The most relevant comparisons are with Piedmont and Emilia-Romagna for Industry, Tuscany for Agriculture and Veneto for Transport. For the less green macro-sectors (percentages of emissions above the medium level) e.g. acidification of the Italian plains *Pianura Padana* (situated across several regions). Furthermore in respect of the Agricultural sector Piedmont is characterized by a higher level of acid and climate changing emissions that the national average. A major contribution to the greenhouse effect in certain areas of Piedmont (such as Vercelli and Cuneo) is the linked to the methane produced from the treatment of rice and by-products from the farmed animals.

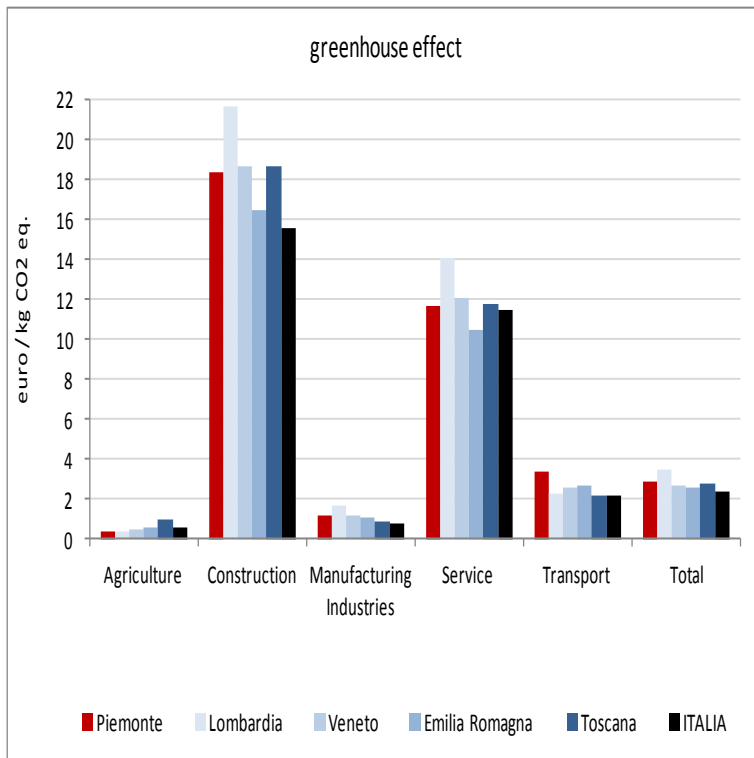
Tuscany has a large percentage of emissions from Industry, whereas the Service sector has more impact in Emilia-Romagna and Lombardy.

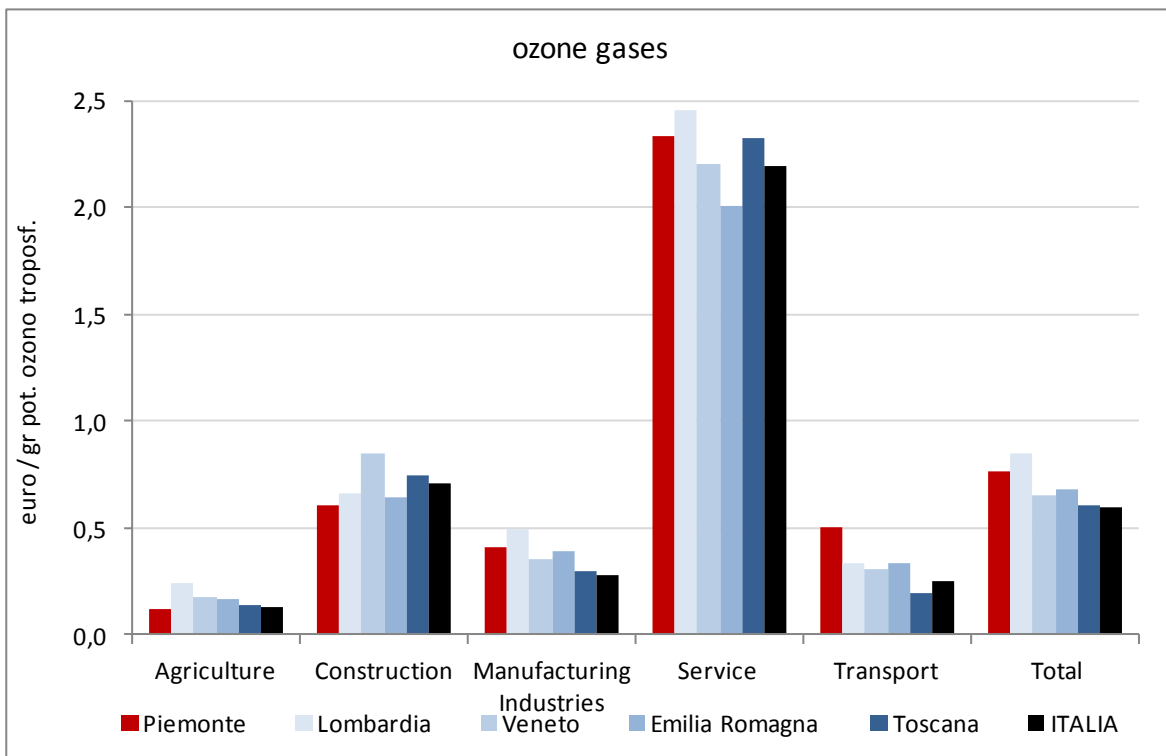
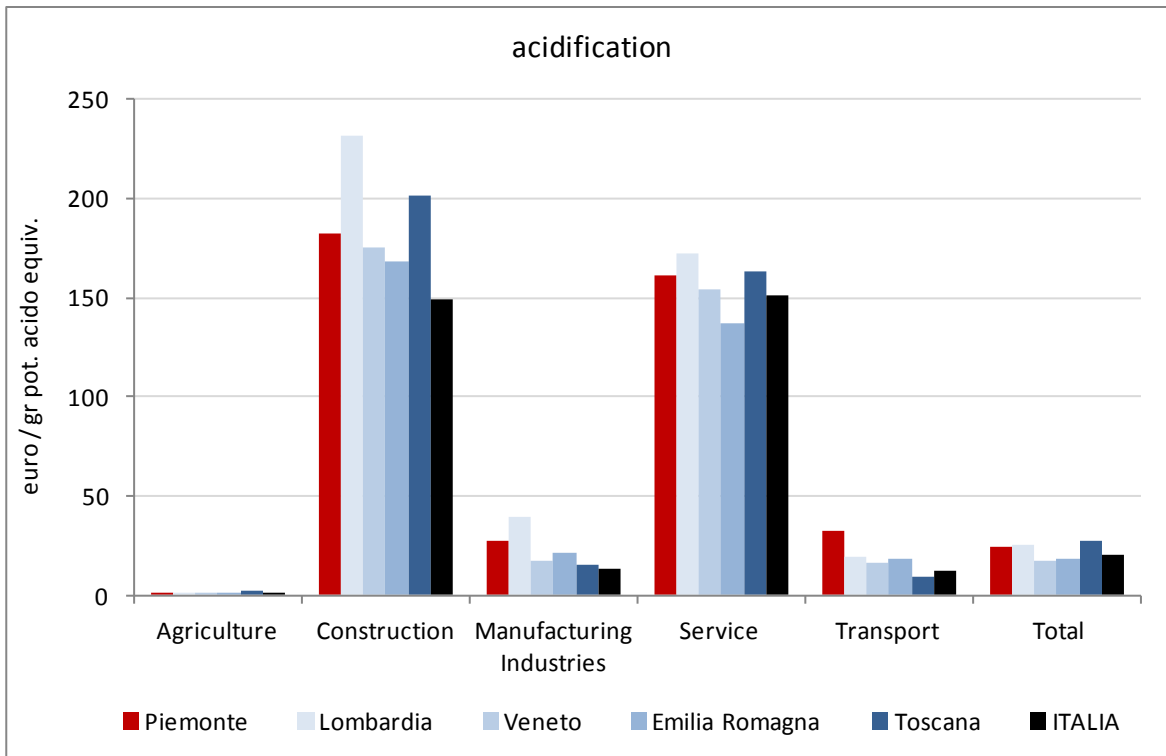
In Tuscany transport impact is twice that of other regions, 23,2% as respect to 10% of the others and is superior to the median of 16,7% of the national average.

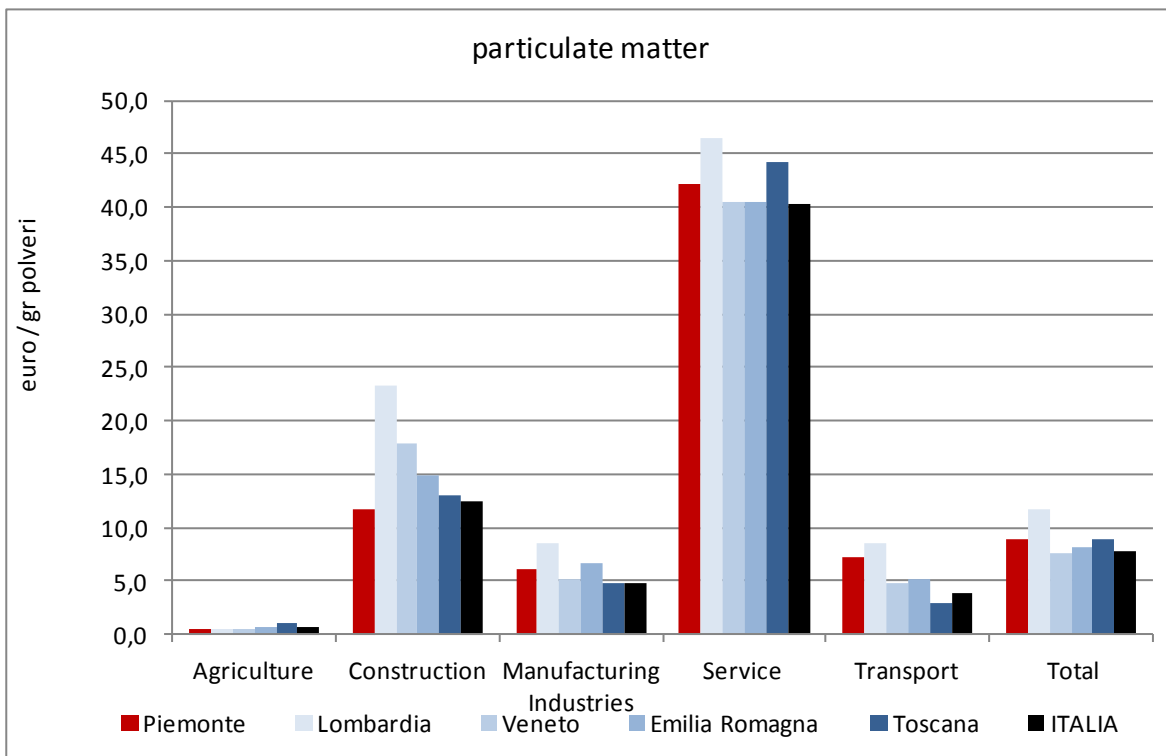
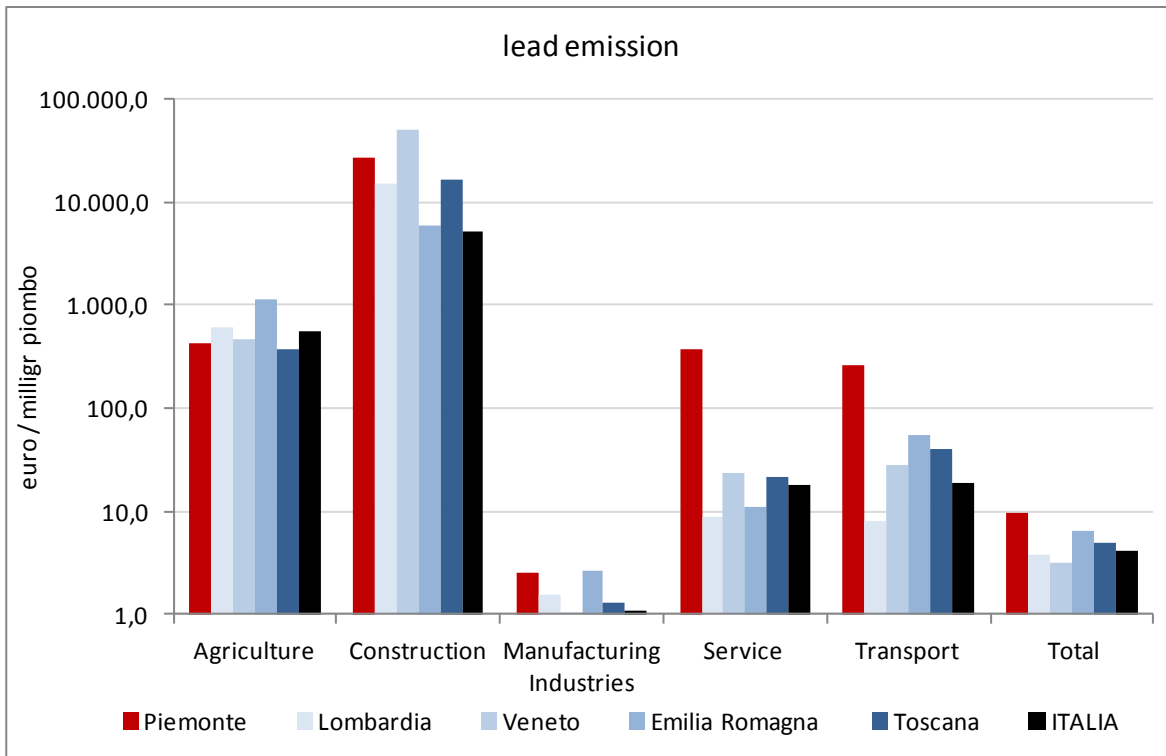
5.4 The Ecoefficiency of the Macro-sectors : A Regional Comparaison

The analysis of the macro-sectors in terms of different environmental effects can be undertaken and percentages of pollution measured as show. These is, however, the very important socio-economic factor that take into account which measures the impact of the eco-system in proportion to the economic power of the macro-sector. As discussed in part 4 of this research the rationalization of the values given relate to added value and work unit which permit the calculation of the eco-efficient, economic and occupation levels of the various sectors.

Figure 6 shows the economic eco-efficiencies in respect of the environment effects (greenhouse effect, acid emissions, ozone gases, lead emission, particulate matter) for Piedmont, Italy and the four comparative regions.







From the analysis of this, it can be seen that there are considerable differences.

In the case of the greenhouse effect, Piedmont produces less than average with a figure of 1,17 Euro/Kg. for Industry and 0,4 Euro/Kg for Agriculture. On the contrary, Services producing 11.71 Euro/Kg. and Construction 18,4 Euro/Kg. have a high level of emissions. The Piedmontese economy has an eco-efficiency equal to

2,86 Euro/Kg. that result higher than average than of Italy 2,42 Euro/Kg. and the other comparative regions apart from Lombardy which has 3,43 Euro/Kg..

Acid emissions follow a similar trend and Piedmont has figures of 161,42 Euro/gr. for Services, 182,59 Euro/gr. for Construction with Industry having 14,83 Euro/gr. and Agriculture having much less 0,80 Euro/gr.

Piedmont arrives in third position with 24,10 Euro/gr. in relation to the overall eco-efficiency figures below Lombardy with 25,07 Euro/gr. and Tuscany with 27,34 Euro/gr.

The Piedmont eco-efficiencies linked to ozone gases demonstrate a different effect in this case. Services indicate a low level of emission in relation to the aggregate figure (therefore representing a good level of eco-efficiency equal to 2,33 Euro/gr.) while Construction has a low/medium figure of 0,61 Euro/gr. which is followed by Transport and Agricultural sectors.

Lead emissions reflect different characteristics as in this case Industry is the major producer with a poor eco efficiency rating of 2,51 Euro/milligram for Piedmont compared with intermediate value for Transport 258,12 Euro/milligram, Services 368,63 Euro/Milligram and Agriculture 423,96 Euro/Milligram.

Construction appears to have the highest efficiency rating in Piedmont with a figure of 26,760.94 Euro/Milligram.

Finally the emissions of particulate matter shows that Services with a figure of 42,10 Euro/Milligram in Piedmont has a high level of ecoefficiency; worse is the sector of Construction with 11,81 Euro/Gr. , Transport with 7,20 Euro/gr. and Industry with the figure of 6.06 Euro/gr. The worst is Agriculture which has a very poor figure of 0,52 Euro/gr.

The occupational eco-efficiency not explained in detail here are similar to the high and low figures reflected in the macro-sectors analysis.

To conclude it seems that the situation in relation to economic eco-efficiency and occupation is generally positive if it is compared to the average in Italy. Taking into account the reference regions it is more varied.

The research hints that action is necessary to improve the eco-efficiency of the Agricultural sector in Piedmont which seems weak in term of its green credentials.

A more positive situation appears in the Construction section. In this case the eco-efficiency is above the average Italian in relation to the greenhouse gas emissions, acidification and lead.

The Industrial sectors seem to have green credentials in Piedmont. For all the emissions taken into consideration the eco-efficiency is above the Italian average.

6. GREEN PATH SECTORS: THE VARIATIONS 2005-2008

A complementary analysis can be realized that points to the various tendencies of the different sectors through the estimates of regional environmental emissions for 2008. Thanks to this, it is possible not only to examine the characteristics of the socio-economic regional system in the year 2005 but also the evolution that has happened in the year 2008 thereby a comparison can be made between the two years.

For every economic sector (apart from the energy which use Bilanci Energetici Regionali) using the Italian Namea data in regard of greenhouse gas emissions for 2005 and respective 2008 regional figures.

Estimates can be worked out comparing the year 2005 and 2008. The figures show a direct correlation between the amount of energy consumed and the amount of greenhouse gas produces. While for the other environmental emissions the correlation is less evident, and the variations depend upon each sub-sector and the same composition of the statistics of each region is considered.

Figure 8 shows the differences (expressed in percentage terms) between the 2005 and 2008 figures for the following: Added Value, Work Unit, emissions including greenhouse gases, economic eco-efficiency for the 13 economic sectors taken into consideration.

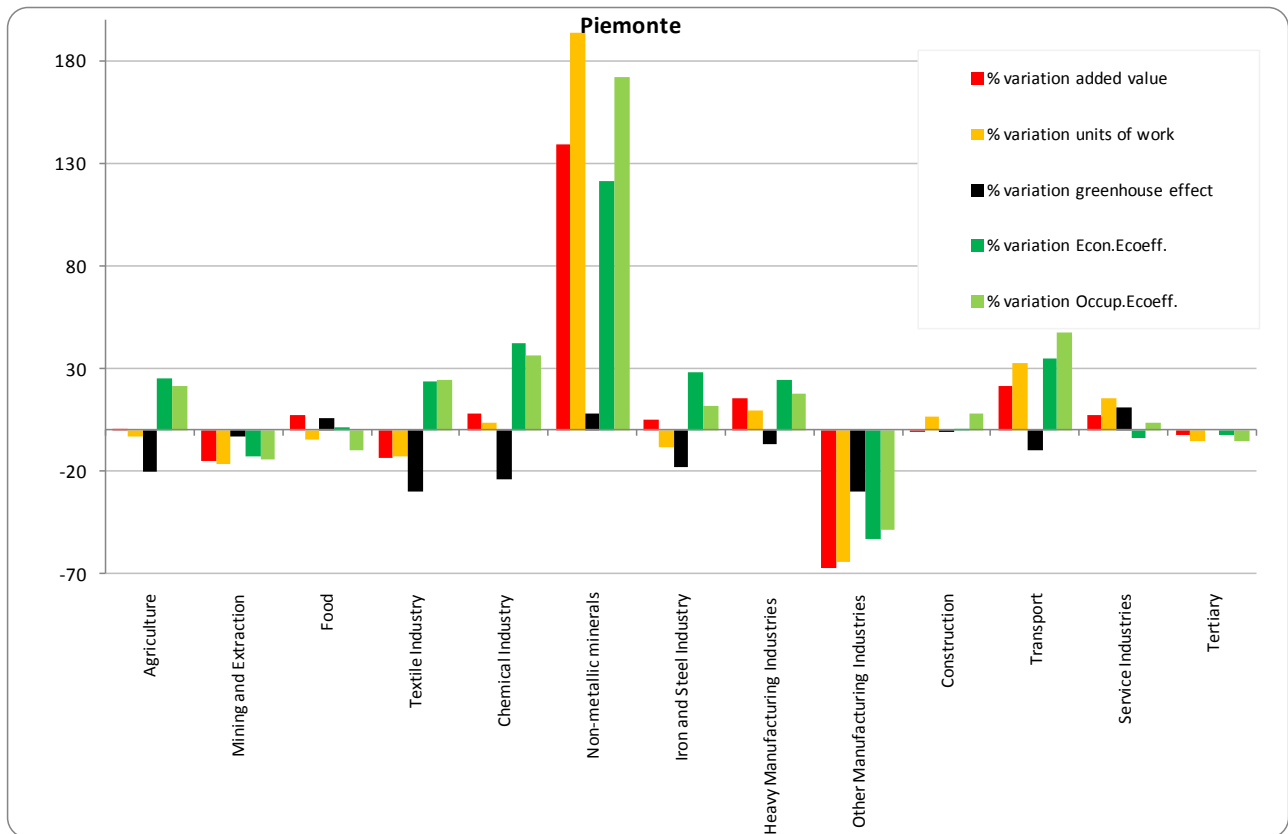


Figure 8 % variation added value, unit of work, greenhouse effect, ecoefficiencies

Looking at the sectors one could see a diminution of emissions of 14,6% in relation to the 2005 values. Nine sectors out of thirteen recorded a diminution of greenhouse emissions. This dynamic is in line with the trend shown at a national level, illustrated in section 2.

The positive trend, in other words, the contraction of emissions, is due, generally speaking, also for the regional case because of the economic crisis, less production mean less use of energy therefore less emissions.

The sectors where this trend is truly relevant are the Textile and the other manufacturing sector which show a contraction of around 30%.

Other economic sectors show less relevant trends but with, nevertheless, a diminution of emissions.

There are, however, economic sectors that in the period taken into consideration, have registered an increase of emissions of greenhouse gas. These are the food sector, Manufacture of other non-metallic mineral products, Public Administration and other services which are sectors that have suffered less than the others in relation to the current economic crisis.

7. CONCLUSION

The overall aim of this study has been to outline the regional Namea as a tool to support sustainable regional policy and possibly environmental assessments of regional plans and programmes.

Piedmont in the national context is a region which highlights the general trends of eco-efficiency in both economy and employment, superior than that of Italy as a whole and is fully comparable with the most important regions in the north of the country. There are a number of areas, particularly transport and construction that appear to perform better whilst agriculture seems to have a high ecological footprint which reflects badly on the processes used, however, there appears to be moves towards eco-efficiency in recent years which gives hope to the future. This needs to go hand in hand with the public interventions aimed at increasing local food production.

Amongst the sectors with higher eco-efficiency which show a good environmental trend are chemistry, heavy Industry, transport and communications, and have favourable economic and environmental indicators with regard to the actual production greenhouse gases.

The processing sector of non-metallic minerals is instead definitely stronger in terms of Added Value and Employment in the face of a slight, increase in greenhouse gases. The Iron and Steel Industry seems to following a green pathway, although at the cost of a contraction in employment which, however, does not undermine its eco-efficiency. Even the food industry follows this trend albeit to a less significant rate; whilst the textile industry appears to respond to its crisis and its economic contraction and employment with eco-efficiency trends relevant in both economic and employment terms. The mining industries, the other manufacturing sectors etc. that already emerge as sectors in crisis, seem unable to respond to the green trend. The same is true of the tertiary, public administration and other service industries which have not yet reversed the environmental impact, although they face the worsening economic climate therefore struggle with eco-efficiency and employment trends.

The Namea framework presented in its most comprehensive version and in its future possible developments could have several purposes.

First of all, it is a monitoring system which has analyzed the pressure placed on the environment by the economic sectors. This has been particularly important as it has helped to identify the “red spots” in terms of environmental pressures but also the de-linking patters.

Secondly it has been used as a benchmarking tool that can compare sub-national entities unable to identify which are the most eco-efficient sectors in the region and could be helpful in verifying environmental-economic inter-relations between the sectors.

Last but not least one hopes that Namea could also be seen as a motivating tool that should make decision makers but also consumes aware of the environment and therefore make they move away from environmental damaging behavior.

The strategic aim of Namea could be therefore to support policy-making at a regional level, providing an evidence base for sustainable policies thus integrating sustainable development aspects at all levels. In other words, linking environmental and economic indicators could encourage and facilitate the involvement of decision-makers who are more likely to be more familiar with socio-economic concepts but who are going to pay an increasing amount of attention to the aspects of economic activities on the environment.

In conclusion the paper provides new empirical evidence on regional-national disparities in environmental efficiency in Italy and demonstrates how an analytical exploitation of Namea offers a rich array of insights for regional policy making. Environmental, industrial and sector oriented policy making can derive valuable information from the evidence provided in this study.

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