RAMEA

REGIONAL ECONOMIC ENVIRONMENTAL ACCOUNTS

CASE STUDIES

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CASE STUDIES

arpa
agenzia regionale prevenzione e ambiente dell'emilia-romagna

ce cambridge econometrics
connecting you to the future

Environment Agency

SCPnet
sustainable consumption and production network

SEEDA SOUTH EAST ENGLAND DEVELOPMENT AGENCY
Working for England's World Class Region

SOUTH EAST ENGLAND Regional Assembly
COUNCILS AND COMMUNITIES IN PARTNERSHIP

Telos
the Brabant Centre for Sustainable Development

Contents

1.0 Introduction

RAMEA is an environmental accounting system which evaluates the economic and environmental performance of regions. It has been specifically designed to help regional policy-makers identify and quantify the potential environmental impacts associated with regional policies, based on best practice and robust regional data. It has been produced by a pan-European partnership comprising regions in Italy, the Netherlands, Poland and England, funded through the Interreg IIIc GROW programme.

The development of RAMEA is covered in greater detail in the RAMEA Construction Manual. This companion publication covers the Case Studies using RAMEA in each of the partner regions of:

- Emilia-Romagna, Italy
- Malopolska, Poland
- Noord-Brabant, Netherlands
- South East England, UK.

Copies of the RAMEA framework for each region are included in the Annex.

2.0 Regional Comparison / Benchmarking

This section provides a brief comparison of the air emissions from the four regions involved in the project, based on the RAMEA applications for each region and nation in 2003.

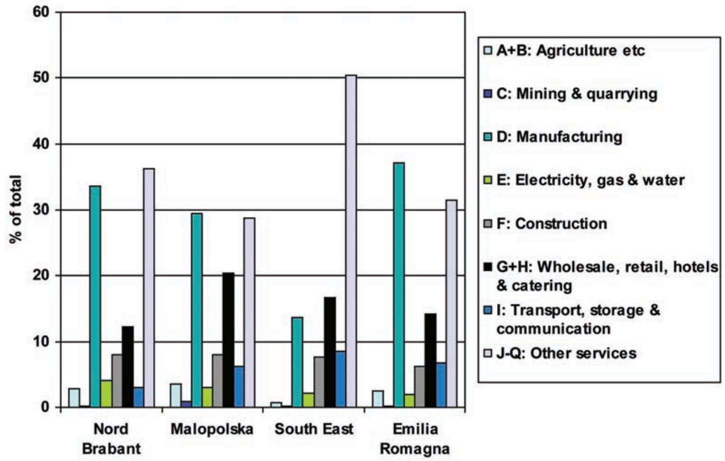
Comparison of economies

Chart 1.1 compares the broad sectoral output of each regional economy.

The chart shows that agriculture accounts for around 3% of output in each economy except South East England, where it accounts for less than 1% of total output.

Manufacturing accounts for around 30-40% of output in all economies except South East England, where it only accounts for around 14%, reflecting the bias of the South East England economy towards services.

CHART 1.1: SECTORAL COMPOSITION OF OUTPUT



The proportion of output attributable to electricity, gas and water supply is similar across the regional economies, at 3-4%. Construction also accounts for a similar proportion of output across the different economies, at 6-8%.

Wholesale distribution, retailing and hotels & catering accounts for the highest proportion of output in Malopolska, at 20%, compared with 12-17% in the other regional economies.

Transport, storage & communications ranges from 3% of output in Noord Brabant to 9% in South East England.

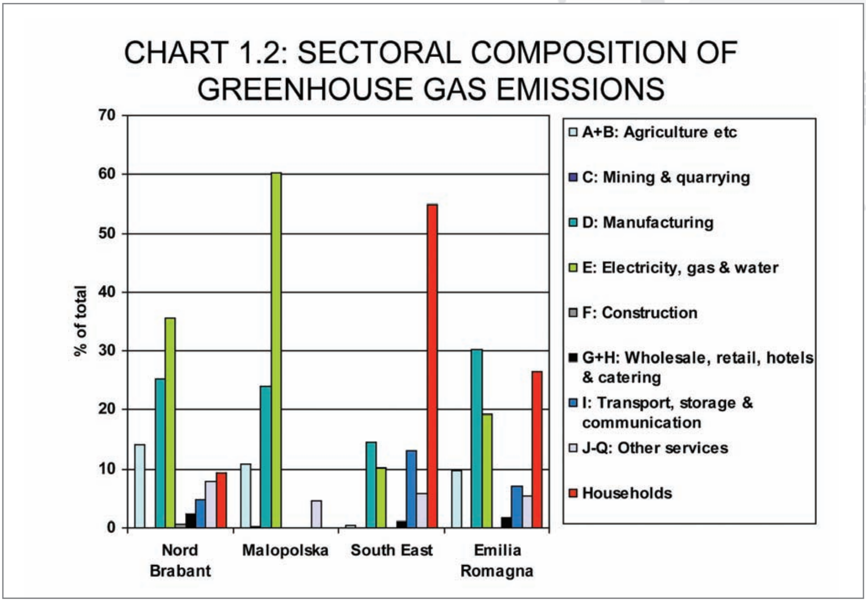
The greater significance of services in South East England is reflected in 'other services', which includes financial services, business services, public administration, education and health, and accounts for more than 50% of output in South East England but only 25-35% in the other regions.

Comparison of Greenhouse Gas Emissions

Chart 1.2 compares emissions of greenhouse gases (CO_2 equivalent) by broad sector across the regions. The data for Malopolska are not directly comparable with the other regions as they omit emissions from a number of sectors, including households.

The chart shows that agriculture accounts for more than 10% of greenhouse gas emissions in Noord Brabant, despite the sector accounting for less than 3% of output.

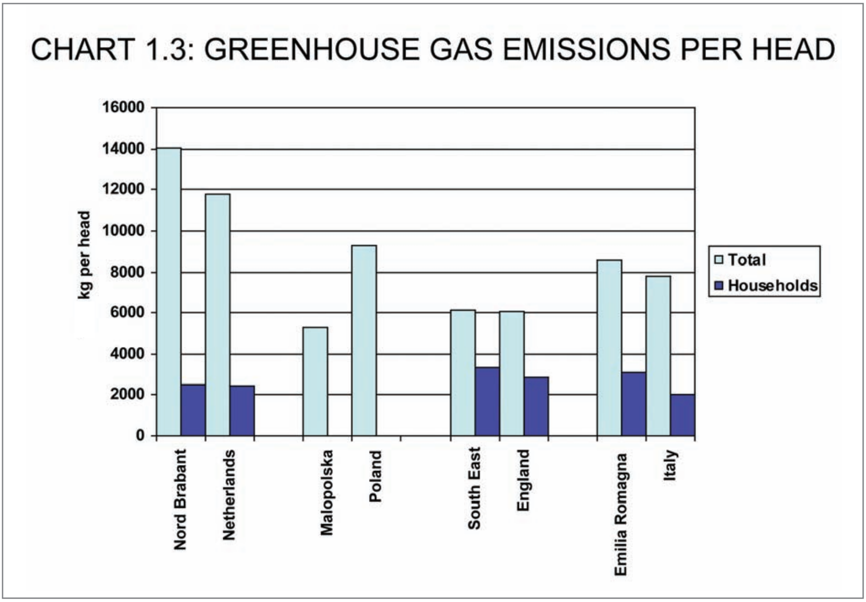
Among the regions that can be compared, Emilia Romagna has the highest proportion of greenhouse gas emissions from manufacturing, although, at 30%, this is lower than the proportion of output produced by manufacturing in the region.



As would be expected, electricity, gas and water supply in the regions accounts for a far higher proportion of greenhouse gas emissions compared to output. In Noord Brabant, emissions from this sector account for 36% of all greenhouse gas emissions in the region. In Emilia Romagna the sector accounts for 19% of all greenhouse gas emissions, and in South East England 10%. Clearly, emissions from this sector are dependent on the location and type of power stations.

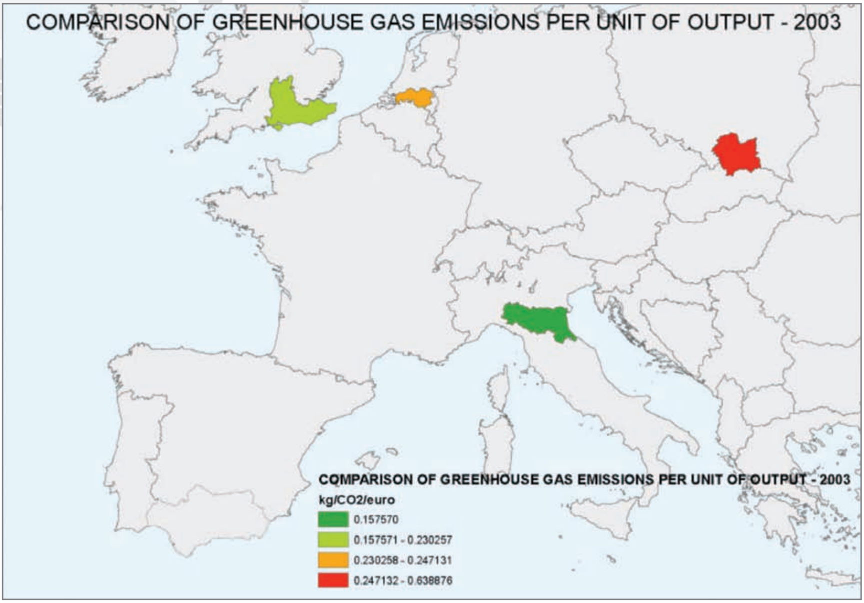
Although households account for less than 10% of greenhouse gas emissions in Noord Brabant, they are estimated to account for more than 25% in Emilia Romagna, and more than 50% in the South East of England. A number of influences are relevant here, including fuel mix and size of population, as can be seen in the next section.

Chart 1.3 compares greenhouse gas emissions per head in the regions and their respective national emissions. This shows that total emissions per head in both Noord Brabant and the Netherlands as a whole are estimated to be higher than in the other regions and countries (although, as mentioned above, the data for Malopolksa and Poland are incomplete, so their total emissions cannot be compared).

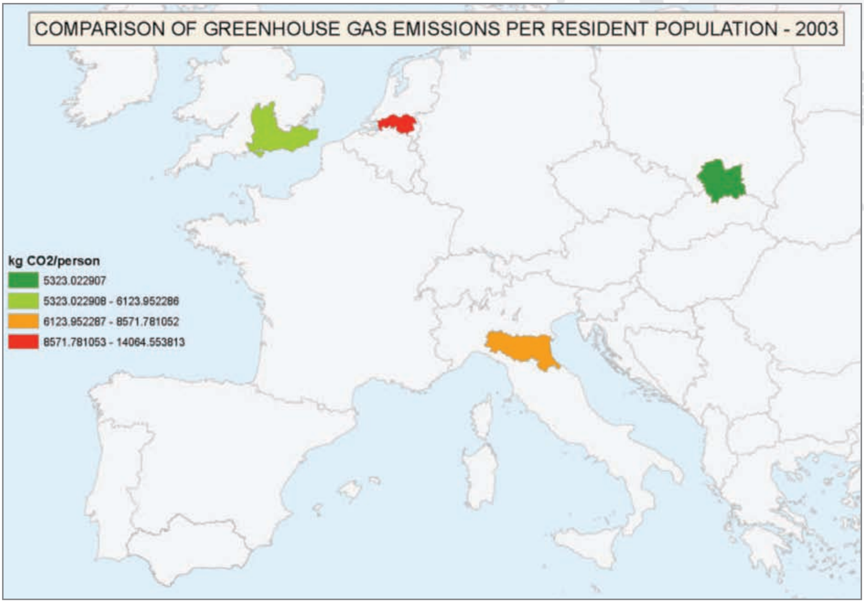


Total greenhouse gas emissions per head in South East England are similar to the average for England as a whole, and are relatively low compared to the other areas in the study. In Noord Brabant and Emilia Romagna total greenhouse gas emissions are estimated to be higher than the average for their respective countries.

However, whereas the household emissions for South East England were almost twice those of Emilia-Romagna, the emissions per head from households South East England, England and Emilia Romagna are all much closer. Overall Italy appears to produce the lowest household emissions per head at 2,000 kg. These variations per capita may be due to a combination of differences such as climate and fuel mix.



The chart above highlights the differences between the regions in terms of the emission of greenhouse gases from economic activity per unit of output.



The chart above highlights the differences in household emissions per head of population.

3.0 Application Case Study: South East England

3.1 Context & Objectives

RAMEA was applied in August 2007 to inform two distinct areas of policy that were under development at that time by the two key bodies involved in regional strategic planning and governance [the South East England Development Agency (SEEDA) and the South East England Assembly SEERA)]:

(i) the development of the Regional Economic Strategy (RES) Implementation Plan[1] for the South East, which sets out a series of actions to achieve the targets set out in the RES (2006-2016)[2] published in October 2006; and

(ii) the production of Regional Carbon Trajectories for the South East, as required by the draft Planning Policy Statement, PPS 1[3], covering the carbon emission rate for the region as an average over time for:

- new dwellings and
- new commercial floor space

Each application used the RAMEA for the South East of England, which was constructed using 2003 data. This was then used in conjunction with the Regional Economy-Environment Input-Output model (REEIO)[4] to project the RAMEA forward in time, under a series of alternative assumptions.

[1]http://www.seeda.co.uk/RES/docs/RES_implementation_plan.pdf
[2]http://www.seeda.co.uk/res/docs/RES_2006-2016.pdf
[3]http://www.communities.gov.uk/documents/planningandbuilding/pdf/147393
[4]http://www.wwflearning.org.uk/scpnet/tools/reeio/

3.2 RES Implementation Plan

3.2.1 Application of RAMEA

This section summarises work around regional CO_2 emissions undertaken to inform the development of the RES Implementation Plan for the South East of England. In particular, the project focused on Target 11 under the RES "Sustainable Prosperity" Objective:

"Climate Change & Energy: Reducing the region's CO_2 emissions by 20% from the 2003 baseline by 2016."

First, the 2003 RAMEA was used to identify those sectors in the region with the highest CO_2 emissions. A 'business as usual' projection was then forecast for the anticipated future pattern of economic growth in the South East to 2015, using REEIO, with the 2003 RAMEA as the baseline. This assumed a continuation of current trends based on historic data and the expected growth of the economy in the region. The outputs from this were then analysed to identify:

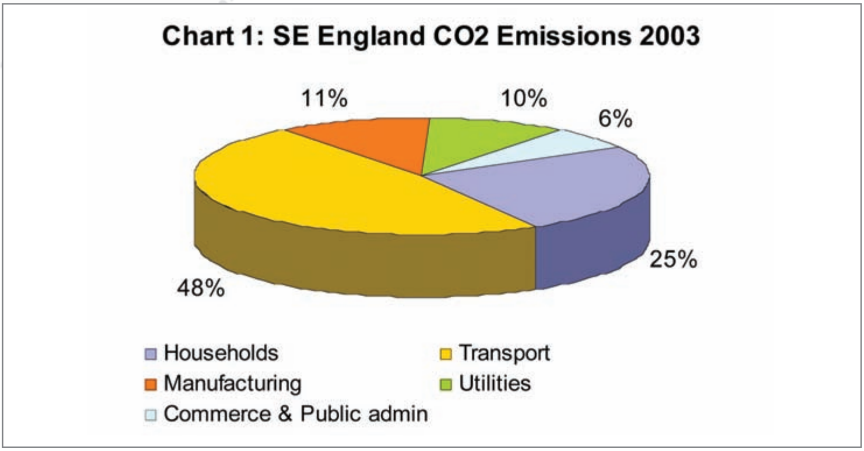
- sectors with the highest CO_2 emissions in 2015;
- the most emission intensive sectors in 2015;
- those sectors with the greatest increase in emissions between 2003 and 2015.

Finally, alternative scenarios were run with REEIO to identify:

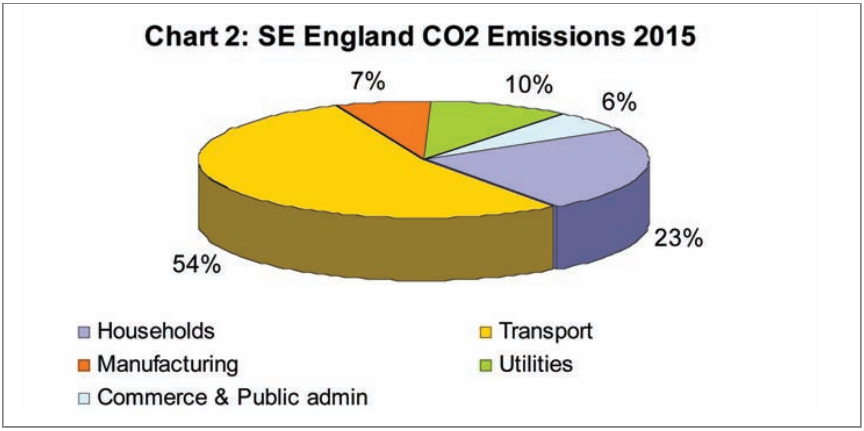
- where the most significant savings could potentially be found
- the order of magnitude of energy reduction required to achieve any significant effect on the region's total emissions.

3.2.2 Analysis of Findings and Outputs from RAMEA

Chart 1 below presents the 2003 RAMEA breakdown of regional carbon dioxide emissions by key sector.



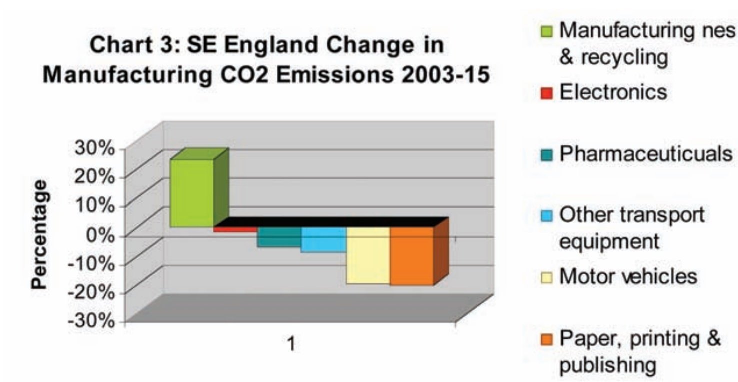
When compared with the same chart for 2015 from the "business-as-usual" scenario in REEIO, the transport sector shows the most significant increase, growing by 40% to become 54% of the total.



With the exception of manufacturing, Chart 2 also indicates a continuing growth in the other sectors, with utilities rising by 30%, commerce and public administration by 19% and domestic emissions by 17%.

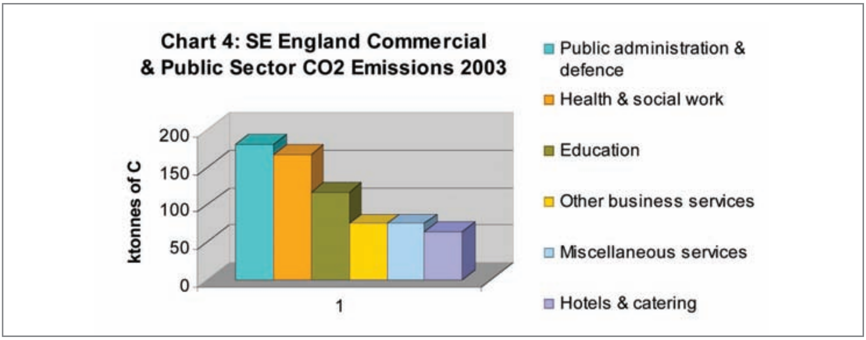
As in other regions, the overall emissions from industry are forecast to decline by 22%. This is further reinforced by a more detailed analysis of the forecast change in the manufacturing emissions, which indicates a general decline across all manufacturing sectors.

However there is one notable exception; miscellaneous manufacturing (nes), recycling (such as furniture, jewellery and sports goods), is showing a marked increase of 24% between 2003 and 2015, as indicated in Chart 3 below.



This may well be influenced by the increase anticipated in recycling activity. This would indicate that it is perhaps an area worthy of further review for the RES Implementation Plan.

A further analysis was carried out for the commercial and public sector. Chart 4 shows the top six emitters in 2003, together representing 85% of the CO_2 emissions from this sector.



An analysis of the 'business-as-usual' scenario for 2015 shows a similar grouping in the top six, as indicated in Chart 5.

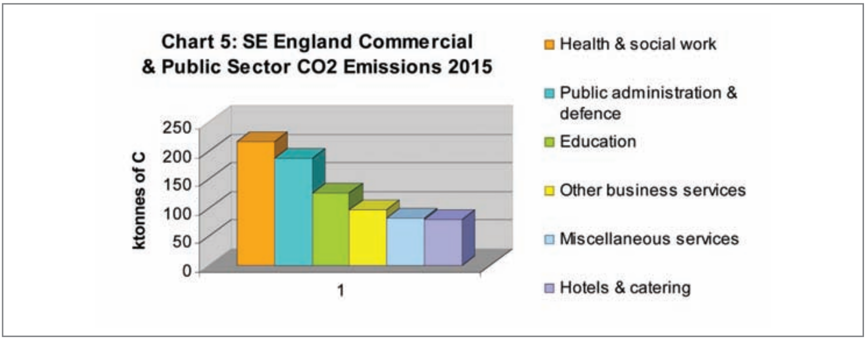
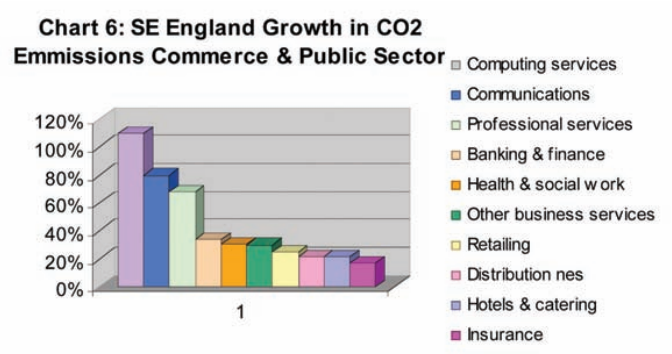


Chart 6 shows those sectors likely to show the greatest increase in emissions between 2003 and 2015.



This indicates the greatest emissions growth from the computing services, communications and professional services sectors.

3.2.3 Implications of Findings and Outputs

The key findings of the study are:

(i) achieving the magnitude of savings proposed (20% by 2016) is unlikely unless the emissions from transport and domestic households are significantly reduced, however both are shown as continuing to grow significantly during this period;

(ii) it may be possible to improve freight efficiency in the region by encouraging a reduction in the number of empty loads entering and leaving the region and through an increase in local sourcing. Further scenario modelling with REEIO could identify what degree of change would be necessary to achieve a meaningful contribution towards the overall goal of a 20% reduction;

(iii) passenger transport and household emissions are less easy to address at a regional level, being heavily influenced by user behaviour on the one hand and the energy efficiency of the existing housing stock on the other. However partnership working with the Regional Assembly and local authorities could achieve some progress in this area;

(iv) manufacturing emissions are generally in the decline, with the exception of small scale manufacture (furniture, jewellery, etc) and recycling. This sector therefore deserves some further investigation to see how this trend might be reversed, e.g. by examining the fuel used and energy intensity of plant and equipment used;

(v) emissions in the commercial and public sector are expected to grow by almost 20%, with the top six out of fourteen sub-sectors accounting for 84% of the emissions in 2003. These include the public administration & defence, health & social work, education and hotel & catering. However increases in excess of 50% are also expected in communications, computing and professional services. Improved energy efficiency in these sectors may be able to deliver further emissions savings.

3.2.4 Use of the Findings from RAMEA

The findings were discussed with representatives from SEEDA, reviewing:

- the numbers and size of companies that make up the various sectors;
- the relationship between these sectors and SEEDA's key sectors;
- possible actions SEEDA might want to take to help achieve Target 11.6 through the regional Carbon Action Plan and Target 12.4 through Business Link and its providers.

The South East region is the largest (in population terms) in England and has the most successful regional economy. Compared globally with national economies, in terms of GDP, the South East region is in the top 20, just above Austria.

As such it is under considerable growth pressures, in terms of development, population and use of resources, all of which impact on the environment of the region and beyond.

It is therefore critically important for SEEDA to include environmental accounting in its strategic planning, to help develop an understanding of the environmental costs of the region's economic activity, in terms of both monitoring and assessing the sustainability of current performance.

So far SEEDA has used RAMEA to identify the economic sectors with the highest carbon dioxide emissions, including emissions intensity (emissions/GVA). This will be used as the basis for agreeing with regional partners a series of actions in the RES Implementation Plan and will also help inform the ongoing development of a regional Climate Change Action Plan.

3.3 Regional Carbon Trajectories

3.3.1 Application of RAMEA

Planning policy within England is guided by Planning Policy Statements (PPS). The UK government has recently published a draft amendment to PPS 1: Delivering Sustainable Development, updating it to consider Climate Change. The PPS highlights that Regional Planning Bodies, such as the South East England Regional Assembly, should be monitoring the carbon emissions associated with their Regional Spatial Strategy (RSS) – the South East RSS is called the South East Plan.

Regional Planning Bodies need to establish a baseline from which data collection and monitoring can be carried out annually to determine the effectiveness of Climate Change mitigation policies in the RSS. The case study illustrates how RAMEA is being used to help provide this baseline.

The RAMEA baseline (2003) framework and the REEIO model were used together to gain a better understanding of the effect that changes in Building Regulations could have on household emissions of carbon dioxide associated with domestic fuel use. The projections were based on a set of stylised assumptions and forecasts, including the energy efficiency of the housing stock, rates of demolition and housing starts.

It was beyond the resources available to this project to develop a detailed model of the housing stock in the South East. However, the application provides an illustration of how such models and their outputs can be utilised. The key assumptions in this application are:

- Housing is split into three types, based on their relative performance in terms of energy use for heating.
  - o 'standard' houses have the average energy-use performance of the existing housing stock in 2003
  - o houses of 'Type X' are 15% more efficient to heat than a standard house
  - o houses of 'Type Y' are 40% more efficient than standard houses over 2006-09, 55% more efficient than standard houses over 2010-12, and 65% more efficient than standard houses over 2013-15, reflecting the targets identified in the Government's report "Building a Better Future; Towards Zero Carbon Development" (Energy improvement as compared to energy use performance of standard house in 2003)
- The rates of conversion between different types are:
  - o Standard to Type X, 0.5% of the Standard housing stock pa (approx 17,000 houses pa)
  - o Standard to Type Y, 0.05% of the Standard housing stock pa (approx 1,700 houses pa)
  - o Type X to Type Y, 0.5% of the Type X housing stock (approx 500 houses pa)
- All new build houses are of Type Y
- The rate of demolition of the Standard housing stock is 0.5% pa
- Assumptions for population, households and housing starts come from Cambridge Econometrics (CE) forecasts for the South East.

[5]Relative energy performance of 'upgraded' existing housing stock is based on calculations in http://www.woking.gov.uk/council/planning/planningapplications/energy/compliance.pdf.
[6]Relative energy performance of new build housing is based on figures in *Building a Greener Future: Towards Zero Carbon Development*, (p14) Communities and Local Government, December 2006.

These assumptions can be altered to assess the relative sensitivity of the outcome to each of the scenarios.

Scenario 1: no growth in per capita energy-use for heating (although average per capita incomes are projected to rise 'enabling' more people the option of improving the heat efficiency of their homes, it can also result in people increasing their 'comfort').

Scenario 2: reduction in per-capita energy-use for heating is assumed to be 1% pa over 2005-15. This is broadly equivalent to assuming a 10% increase in the energy efficiency of all housing over this period.

3.3.2 Findings & Outputs from RAMEA

Scenario 1: The key findings in terms of energy demand are indicated in the table opposite and can be summarised as follows:

- energy used for heating would be 0.36 mtoe (8%) lower than is projected in the baseline by 2015
- overall energy use by households would be reduced by 4.8% by 2015
- the rate of increase of domestic energy use would be reduced to 0.8% pa, from 1.2% pa

SUMMARY OF DOMESTIC Energy Demand IN THE SOUTH EAST – SCENARIO 1

	2003	2010	2015	2003-15
Baseline			mtoe	% pa
Energy used for heating	4.30	4.45	4.54	0.5
Other energy use	2.22	2.62	2.98	2.5
Total	6.52	7.07	7.52	1.2
Scenario			mtoe	% pa
Energy used for heating	4.30	4.28	4.18	-0.2
Other energy use	2.22	2.62	2.98	2.5
Total	6.52	6.90	7.16	0.8
Scenario differences from base			mtoe	
Energy used for heating	0.00	-0.17	-0.36	
Other energy use	0.00	0.00	0.00	
Total	0.00	-0.17	-0.36	
			% of base	
Energy used for heating	0.00	-3.87	-7.97	
Other energy use	0.00	0.00	0.00	
Total	0.00	-2.44	-4.81	

Source: Cambridge Econometrics.

The key findings in terms of CO_2 emissions are set out in the table below and can be summarised as follows:

- CO_2 emissions from domestic energy use would be reduced by 570 tonnes, or 4.4% of the baseline projection by 2015. This is equivalent to a reduction of around 1.0% in total CO_2 emissions in the South East by 2015. In calculating the reduction in direct CO_2 emissions, it has been assumed that the fuel mix of energy used for heating is the same as that for the overall use of energy from the household sector. In practice there is reason to believe that this may underestimate the use of gas (and other fuels other than electricity) and accordingly, underestimate the reduction in CO_2 emissions.

SUMMARY OF DOMESTIC CO_2 EMISSIONS IN THE SOUTH EAST – SCENARIO 1

	2003	2010	2015	2003-15
			tonnes	% pa
Baseline	11193.57	12238.51	13099.57	1.3
Scenario	11193.57	12037.46	12529.83	0.9
Scenario - difference from baseline				
Tonnes	0.00	-201.05	-569.74	
% of base	0.00	-1.64	-4.35	

Source: Cambridge Econometrics.

SUMMARY OF DOMESTIC ENERGY DEMAND IN THE SOUTH EAST – SCENARIO 2

	2003	2010	2015	2003-15
Baseline			mtoe	% pa
Energy used for heating	4.30	4.45	4.54	0.5
Other energy use	2.22	2.62	2.98	2.5
Total	6.52	7.07	7.52	1.2
Scenario			mtoe	% pa
Energy used for heating	4.30	4.07	3.78	-1.1
Other energy use	2.22	2.62	2.98	2.5
Total	6.52	6.69	6.76	0.3
Scenario differences from base				
			mtoe	
Energy used for heating	0.00	-0.38	-0.76	
Other energy use	0.00	0.00	0.00	
Total	0.00	-0.38	-0.76	
			% of base	
Energy used for heating	0.00	-8.58	-16.77	
Other energy use	0.00	0.00	0.00	
Total	0.00	-5.40	-10.13	
Baseline	11193.57	12238.51	13099.57	1.3
Scenario	11193.57	11739.86	11890.47	0.5
Scenario - difference from baseline				
Tonnes	0.00	498.65	1209.10	
% of base	0.00	4.07	9.23	

Source: Cambridge Econometrics.

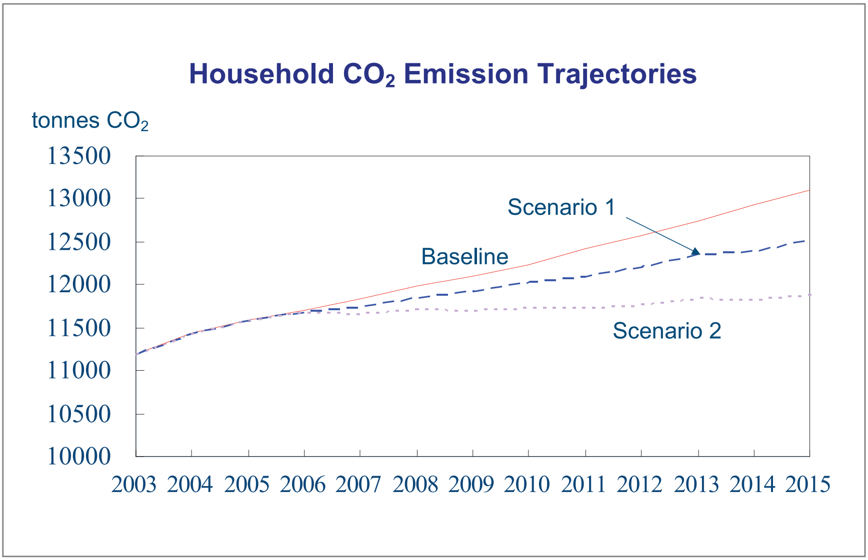
Scenario 2: The key findings on energy demand, as shown in the table below, are:

- energy used for heating would be 0.76 mtoe (17%) lower than is projected in the baseline by 2015
- overall energy use by households would be reduced by 10% by 2015
- the rate of increase of domestic energy use would be reduced to 0.3% pa, from 1.2% pa

For CO_2 emissions the key findings are:

- CO_2 emissions from domestic energy use would be reduced by 1,209 tonnes, or 9.2% of the baseline projection by 2015. This is equivalent to a reduction of around 2.1% in total CO_2 emissions of the South East by 2015.

These results are summarised in the trajectories below:



3.3.3 Implications of Findings and Outputs

The findings illustrate that the proposed changes to Building Regulations in isolation are likely to achieve a reduction in the regional CO_2 emissions of 2%. As the new housing will only form 1% of the total housing stock, in order to achieve a significant improvement in overall CO_2 emissions, a significant proportion of the existing housing stock will need to be improved to a higher standard of energy / CO_2 performance.

3.3.4 Use of the RAMEA Findings

The Regional Planning Bodies in the UK are likely to be required to measure performance against the Carbon Trajectories based on the anticipated carbon performance of new residential and commercial development for each region.

RAMEA can be used to provide the baseline against which the relative carbon emissions from different spatial distributions of new development in the region can be compared. This can then be used to inform the Strategic Environmental Assessment of the RSS. The case study further illustrates how, when the baseline produced by RAMEA is combined with the modelling capabilities of REEIO, a Carbon Trajectory for residential development can be produced.

In the future it is anticipated that a baseline and the trajectory will be further developed and used to both measure the carbon emissions associated with new development and inform policies on the spatial distribution of residential development in the South East.

3.4 Future Monitoring Proposals

The project partners have agreed to monitor the success or otherwise of the application of the findings of the RAMEA Case Studies in the South East of England over the next three years and to disseminate the results through SCPnet, the Sustainable Consumption and Production network which consists of all of the English Regions, the Environment Agency and WWF.

4.0 Application Case Study: Noord-Brabant

4.1 Context & Objectives

Using the RAMEA for Noord-Brabant, the different production sectors of the economy have been ranked in relation to their relative contribution to the range of indicators and environmental aspects. A good indicator for ecological efficiency is the relationship between the relative contribution of a particular sector to emissions in Noord-Brabant and that sector's relative contribution to the region's economic performance. The economic variables used were output, gross value added (GVA) and employment.

The analysis highlighted potentially significant environmental impacts associated with the agricultural sector, in terms of the following emissions:

Environmental Aspect / Emission	Percentage of Noord-Brabant Total Emissions
Greenhouse Gases	15%
Eutrophication	65%
Acidification	51%
N_2O	51%
CH_4	91%
NH_3	96%
N	69%
P	63%

The RAMEA data and indicators for Noord-Brabant were then analyzed and compared with the data from the three other European regions of Emilia-Romagna, Malopolska and South East England. This was followed by a more detailed assessment of sub-sectoral aspects of the agricultural sector, to achieve a better understanding of these issues and to try to identify measures to improve the environmental impact of this sector, whilst maintaining economic performance.

4.2 Agricultural Sector Analysis

4.2.1 Application of RAMEA

The Environmental Dimension of Agriculture
An analysis of the RAMEA of 2003 produces the following results for the agriculture sector in Noord-Brabant (N B). In terms of economic output it contributes 2.84% in NB, compared to 17.9% for the Netherlands (NL) as a whole. It also contributes 1.87% to the gross value added, 1.2% to the compensation of employees, 2.8% to the gross operating surplus and 3.62% to employment in NB.

However, in relation to environmental impact, the agricultural sector in NB contributes 6.42% to the total CO_2 emissions of production (6.22% of total emissions), 51.24% to N_2O emissions (50.25%), 91.59% to the CH_4 emissions (87.83%), 16.07% to the NOx emissions (13.45%), 13.71% to the SO_2 emissions (13.44%), 96.52% to the NH_3 emissions (90.45%), 69.19% to N emissions (58.24%), 63.21 to the P emissions (53.99%), 1.1% to the waste (0.7%), 25.33% to the PM_{10} emissions (20.14%), 15.44% to GHG theme of production (12.88), 51.72% to acidification (46.12%) and 65.97% to eutrophication (55.96%).
From these numbers it is evident that the agricultural sector in NB has relatively high impact on the environment in terms of air emissions, which in principle, is also valid for the rest of the Netherlands. The agricultural sub-sectors of Noord-Brabant were then compared with data from the other regions, summarized in the table opposite.

Table 1

Agricultural Sector	NB	MP	SE	ER
GHG/output 2003	1.19	1.93	0.06	0.88
GHG/GVA 2003	3.94	5.21	0.14	1.40
GHG/pop.2003	1921,43	563.28	24.53	1142.33
Acidification / output 2003	0.02	n.a.	n.a.	n.a.
Acidification / output 2003	0.36	n.a.	n.a.	n.a.
Acidification / GVA 2003	1.19	n.a.	n.a.	n.a.
Acidification / capita 2003	577.32	0,40	n.a.	0,70

Data source: P Stauvermann Calculations and data from RAMEA partners

Unfortunately, comprehensive data is not currently available for ER and SE. However, looking at the available data of the agricultural sector, the GHG emissions per output, GHG emissions per gross value added and GHG emissions per inhabitant in NB in almost every case are higher than in ER and SE. Only the GHG emissions per output and per GVA in MP are exceeding the values in NB. Why is this so in NB?

To try to answer to this question, the number of farm animals in each region was analyzed, taking into account the farms grazing and / or breeding livestock; in NB farm animal ownership ranges between 52% (COROP West-Noord Brabant) and 67% (COROP Centraal Noord-Brabant) of farms[8].

[8]The figures are based on the work of Bos, de Haan & Sukkel (2007) and calculations by P Stauvermann.

Table 2

2003	Emilia-Romagna	The Netherlands	Noord-Brabant	Malopolska	South East England
units	‘000	‘000	‘000	‘000	‘000
Beef Cattle	652.4	3759.2	638.9	273.9	496
Cows	301.6	1621.8	238.5	183.2	180
Buffalos	0.6	0	0	0	0
Pigs	1579.9	11169.1	4787.3	538.3	289
Sheep	89.8	1184.6	83.3	79.1	980
Goats	8.4	274.2	105.2	25.1	na
Horses	na	126.3	27.4	33.8	na
Poultry	na	81232	23198.5	6340.1	na
Total surface in 1000 ha	2211.7	3735.8	508.2	1519	na
Agricultural Surface in 1000 ha	1166.6	1924.3	260.3	749	1065.5

Data source: Eurostat 2007

This indicates that the numbers of cattle and cows in NB are higher than in the other regions. The agricultural land area is also much larger. The number of pigs in NB is at least twice as high as in the other three regions. Additionally, just around 43% of all Dutch pigs are located in Noord-Brabant. The table below assesses the density of animals per ha (100m x 100m) of the total regional area.

Table 3

2003	Emilia-Romagna	Netherlands	Noord-Brabant	South-East England	Malopolska
Animals/ha					
Beef Cattle	0.294	1.00	1.252	0.168	0.180
Cows	0.136	0.434	0.469	0.091	0.120
Buffalos	0.0002	0	0	0	0
Pigs	0.714	2.989	9.420	0.589	0.354
Sheep	0.040	0.317	0.163	0.010	0.052
Goats	0.003	0.073	0.207	0.006	0.016
Horses	Na	0.033	0.053	0.010	0.022
Poultry	Na	21.744	45.648	4.679	4.173

Data source: Eurostat and P Stauvermann calculations

This shows that NB also has the highest density of cattle, cows, pigs, goats, horses and poultry. The average occupancy of on an average ha of land in NB comprises 1.2 cattle, 0.5 cows, 9 pigs, 0.2 goats, 0.05 horses and 46 poultry and 0.21 humans. From this viewpoint it could appear that NB is overcrowded with farm animals. If we only take into account the agriculture area of each region we get the following results for NB per ha; 2.5 cattle, 0.9 cows, 18 pigs, 0.4 goats, 0.1 horses, and 89 poultry.

The next table examines the relationship of animals per capita.

Table 4

2003	Emilia-Romagna	Netherlands	Noord-Brabant	Malopolska	South East England
Animals per inhabitant					
Cattle	0.160	0.231	0.265	0.084	0.061
Cows	0.074	0.099	0.099	0.056	0.022
Buffalos	0.0001	0	0	0	0
Pigs	0.389	0.688	1.991	0.165	0.035
Sheep	0.022	0.073	0.034	0.024	0.121
Goats	0.002	0.016	0.043	0.007	na
Horses	na	0.007	0.011	0.010	na
Poultry	na	5.00	9.651	1.953	na

Data source: Eurostat (2007) and P Stauvermann calculations

In NB this averages out at around 12 animals per capita, compared with an average of around 6 animals per capita for the whole of the Netherlands. This explains why the emissions from farms in Noord-Brabant are relatively high in comparison to the three other European regions, because of the relatively high number and density of farm animals.

Of course other economic sectors are also responsible for emissions; however it should be noted that the agricultural sector is the only economic sector that has been subsidized over the last 40 years both nationally and by the EU. This might raise the question whether, given its high share of emissions, the agricultural sector should continue to be subsidized in the future. The next section looks at the economic dimensions of the Common Agriculture Policy (CAP) subsidies.

The Economic Dimension of Agriculture

The following table gives an overview of the extent of the Common Agricultural Policy (CAP) of the EU. It should be noted that the reasoning behind the subsidies is not based solely on economic efficiency considerations, but also on historical decisions. The idea in the 1950's was to give subsidies to farmers to guarantee a sufficient level of food production and to avoid the famine experienced during the war years. Since the 1970s it could be argued that this position is no longer tenable, because from a global perspective there is an excess supply of food.

Table 5

CAP subsidies 2005	**Taxes for CAP**		**Budgetary Loss/ Gain**	
	Total billion EUR	Per capita EUR	Total billion EUR	Per capita EUR
Netherlands	2.493	153.00	-1.225	-75.00
Noord-Brabant	0.368		-0.180	
Poland	1.542	40.00	0.394	10.00
Malopolska	0.130		0.032	
United Kingdom	5.580	90.00	-1.033	-17.00
South East England	0.727		-0.137	
Italy	6.818	118	-1.29	-22
Emilia-Romagna	0.479		-0.089	

Data source: http://farmsubsidy.org

The second column of the table above indicates the total amount of taxes paid by Dutch taxpayers to the EU, the third column - the amount of taxes per Dutch inhabitant per year, the fourth column - how much CAP subsidies a region or country receives total and in the final column, what that means per capita.

This would indicate that every Dutch inhabitant is losing around 75 EUR per year and the Dutch farms receive a total of 1.225 billion EUR, of which the farmers in Noord-Brabant receive 180 million EUR. What does that mean for the specific farm workers and farm land? This can be shown in the following table.

Table 6

CAP subsidies 2005	**Average payment per farm in EUR**	**Average payment per ha farm land in EUR**	**Average subsidy per farm worker in EUR**	**Share which is going to the to the top 10 % of those receiving subsidy**
Netherlands	9753.00	435.00	4503.00	47.00
Poland	652.00	87.00	647.00	42.00
United Kingdom	14473.00	238.00	11546.00	49.00
Italy	2722	406	3622	69

Data source: http://farmsubsidy.org and P Stauvermann calculations

From the table above it can be seen that the highest subsidy per hectare was paid in the Netherlands (435 EUR per ha) and 47% of all CAP subsidies in the Netherlands are going to the 10% who are receiving the highest subsidies[9]. Probably the average man on the street believes only farmers gain from the CAP subsidies, however this is not the case. The subsidies are going for the most part to food-producing firms such as Nestle or Campina, and not to farmers.

Additionally, this indicates that every job in the agricultural sector in NB is subsidized by 4503 EUR, which equates to around one third of the average yearly disposal income per capita in Noord-Brabant[10]. The labour costs per employee[1] (compensation per employee) are 12556.26 EUR per year. This means that the CAP subsidies reduce the labor costs of an agricultural employee in NB by around one third.

So far this analysis has demonstrated that the agricultural sector is highly subsidized - while the Dutch agricultural sector and the food sector realized a trade balance surplus of 13,235 million EUR in 2005. This means that the NL has produced much more in food and agricultural sectors than is consumed in the Netherlands.

For example in 2005 the Netherlands exported live animals and meat[12] with a value of 99,901,000 EUR to West-Africa (Mauritania, Mali, Burkina Faso, Niger, Chad, Cape Verde, Senegal, Gambia, Guinea Bissau, Guinea, Sierra Leone, Liberia, Ivory Coast, Ghana, Togo, Benin). On the other hand, the Netherlands imported live animals and meat with the value of only 584,000 EUR from West Africa. This imbalance of trade, especially with less developed countries, may inevitably have some negative impacts in relation to development policy.

[9]The top subsidy receivers in Noord-Brabant are for example; COOPERATIE VOEDINGS TUINBOUW NEDERLAND U.A. (27 539 488 EUR in 2005); EUR INTERFOOD BV (11.604.815 EUR in 2005); KONINKLIJKE BUISMAN ZUIVELEXPORT BV (10.808.556 EUR in 2005) ALPHA DAIRY B.V. (230.585 EUR in 2005); AGRI-BEST B.V. (3.382.796 EUR in 2005); VAN MELLE NEDERLAND B.V. (2.944.062 EUR in 2005); SENSUS OPERATIONS C.V. (12.588.603 EUR in 2005); CAS FOOD SERVICES B.V. (11.468.910 EUR in 2005). (data from: http://farmsubsidy.org).

[10] The average disposable income per capita in NB was 12800 EUR in 2003 (CBS).

[11]Labour costs are defined as the sum of the gross salary and social security contributions. The figures are based on the CBS and P Stauvermann calculations.

4.2.2 Analysis of the Findings - The Development Aid Dimension

A key objective of development policy is to help less-developed countries (LDCs) to develop their own industries, with particular emphasis on the agricultural sector to avoid famine. However, we have seen that a large part of the Dutch agricultural production is exported. What are the consequences for LDCs?

Taking the poultry market in Ghana as an example, in 1992 the Ghanaian poultry farmers provided 95% of their domestic poultry market, but by 2001 the Ghanaian poultry farmers served only 11% of this market.[13] It has been estimated that Ghana has just around 400,000 poultry farmers, a large proportion of which are unemployed. One third of the poultry meat sold in Ghana has been supplied by Dutch poultry-meat-producing firms, e.g. Nutreco, located in Boxmeer, Noord-Brabant, sold poultry-meat worldwide to a value of just around 3.5 billion EUR. On aggregate 8% of the total poultry exports from the EU are sold to the Ghanaian market.

It should be noted that the exported poultry meat has in principle, no value, because it consists only of the parts of the poultry, which can not be sold within the EU (e.g. chicken legs, chicken necks, chicken wings, chicken heads etc.) like chicken fillets. Alternatively within the EU, these parts could only be sold for the production of animal meal, which is not very attractive. It should also be noted that most of the exported poultry is frozen.

It is also important to note that in addition to the CAP subsidies, the EU also pays an export subsidy so that the export price is competitive. This has also had a significant impact on the Ghanaian poultry market. The minimum local price[14] per kg of locally-produced poultry meat is just around 28,000 cedis (Ghanaian currency) in 2005 whereas the price of imported poultry meat is only 16,000 cedis per kg. The consequence was and is that Ghanaian poultry farmers are being driven out of their own market and becoming increasingly unemployed.

According to Khor (2005) around 40% of all poultry farmers in Senegal have gone out of this business because they could not compete with the European suppliers. The price difference is mainly due to the fact that the export value per ton of poultry of 809 EUR was subsidized by 254 EUR per ton in 2002.

A second negative impact of the imported frozen poultry meat is that maintaining the freezing temperature during transit cannot be guaranteed, which can lead to health problems associated with salmonella and other dangerous bacteria. Interruptions to the refrigeration systems are partly due to a lack of cold stores and refrigerators and partly to a lack of knowledge amongst local consumers on how to treat frozen meat.
As a consequence, between 15% and 85% of the imported poultry-meat is infected with salmonella (see Khor (2005)). It is easy to imagine that the consequences of an infection in West Africa are likely to be much more significant compared to a similar infection in Europe.

This is further emphasized if one takes into account the fact that 78% of the Ghanaian population has a per capita disposable income lower than 2 US-$ a day and 45% of the population has a disposable income of less than 1 US-$ a day; and the GDP per head is only 2700 US-$ a year. As a measure of the importance of the agricultural sector in Ghana, it should be recognized that agricultural share of total production is 37.3% (2006) and 60% of the labour force is employed in the agricultural sector.

[12]consisting of: live animals, meat and edible meat offal, fish, crustaceans, molluscs and other aquatic vertebrates, milk and dairy products; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included.

[13]See Atarah (2005).

[14]This minimum price would guarantee the subsistence level of poultry farmers.

However, the Dutch government donates 24,000,000 EUR to Ghana per year - or just around one EUR per Ghanaian inhabitant per year. The Netherlands are the fourth largest supporter of Ghana, behind the World Bank, USA and United Kingdom. It would therefore appear that whilst on the one hand the Dutch government is helping Ghana to develop the economy, on the other, the economic development of the country is being undermined by subsidized Dutch exports of agricultural goods. These two policy measures would therefore appear to be in direct contradiction with each other. While this case study has only concentrated on one example, the same may be true for other agricultural goods and other less-developed countries.

4.2.3 Implications of the Findings

On the basis of the analysis so far, it could be concluded that the agrarian policy of EU cannot be justified on normative grounds. In short, the farmers receive subsidies which lead to an excess supply of agricultural goods and thereby to an increase in emissions. Because the excess agricultural supply can not be sold within the EU, the EU offers export subsidies to export these goods. However, because these goods are sold at a price that is below the world market price these exports are undermining the agricultural sectors in less-developed countries. As a consequence of the poor economic performance of these less-developed countries, the EU countries compensate part of the economic damage with development aid.

[15] 60% of the poultry meat market will be served by firms from the Netherlands and Belgium. (see Khor (2005).

[16] See Khor (2006).

[17] The numbers are taken from the Dutch ministry of development aid affairs and the CIA world fact book. See: www.minbuza.nl and www.cia.gov

4.2.4 Use of the Findings

Without doubt, the agriculture in both Noord-Brabant and the Netherlands has an intrinsic value to the majority of Dutch people. The abolition of the whole sector is thus not an option. An alternative could be to look to changing the production processes within the agricultural sector, e.g. changing to less-intensive farming and /or from conventional to organic farming.[18]

It should be noted that the Noord-Brabant's agricultural land area is just around 19% (2003) of Dutch agricultural land, but the proportion of land used for organic production in Noord-Brabant amounts to only 11% (2003) of the whole country. The share of organic farms is only 1.35% (2003) in the Netherlands and only 0.84% (2003) in Noord-Brabant.[19] These shares are very low in comparison to e.g. Austria, where the share is 10%. A change towards organic farming could lead to a significant reduction in emissions, as can be seen in the following table, which compares the emissions per ha for two types of soil.

Table 7

Soil	**Alumina**			**Sandy Soil**		
	Conventional Artificial fertilizer	Conventional Animal fertilizer	Organic	Conventional Artificial fertilizer	Conventional Animal fertilizer	Organic
CO_2/ha	3140	3041	2072	2644	2435	2230
N_2O/ha	9.0	11.3	5.8	10.2	11.1	7.0
GHG/ha	5942	6558	3844	5900	6071	4652

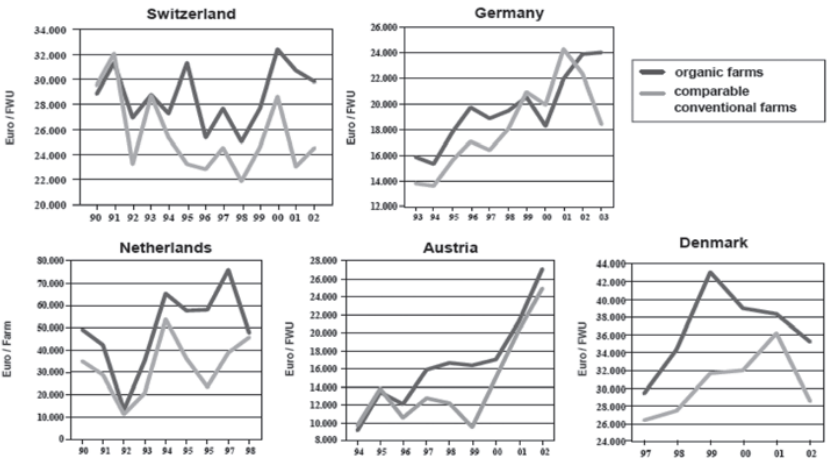
Data source: Bos, de Haan & Sukkel (2007)

Given these numbers, it is possible to calculate the possible emission reduction of a change from conventional to organic farming; the change lies between 8.41%-48.67% with an average reduction rate of 27.73%. A rough estimate of the absolute reduction of CO_2 emissions in Noord-Brabant for 2003 would indicate a reduction of 450 million kg CO_2. The whole country could thus reduce CO_2 emissions by 2619 million kg CO_2. For the province of Noord-Brabant that would mean a reduction 1.77% of all CO_2 emissions, and 1.59% reduction of CO_2 emissions for the whole of the Netherlands.

One of the principal arguments against organic farming is based on the higher production costs in comparison to conventional farming. However taking a look at the literature[20] gives a slightly different picture, where it is shown the even for different farm types organic farmers are ultimately better off because although the costs are increased, the organically-produced goods are sold for a higher price than conventionally-produced goods. The price difference of both types of farming lies between 60%-90%, depending on the product. The following graphs represent the income differentials between conventional farming and organic farming.

[18]Here we use the term "organic farming" in the sense of the International Federation of Organic Agriculture Movements (IFOAM), which defines organic farming: "The role of organic agriculture, whether in farming, processing, distribution, or consumption, is to sustain and enhance the health of ecosystems and organisms from the smallest in the soil to human beings." (See: http://www.ifoam.org/about_ifoam/principles/index.html). This definition coincides with the European Union regulations EEC 2092/91 in combination with EC 1804/1999.
[19]Note: the percentages are average values, because some differences exist regarding the different types of farms.

Graph 1[21]



This indicates that the incomes of organic farmers were almost equal to or higher than the incomes of comparable conventional farmers in the period 1990-2003.

What powers does the regional government have at its disposal to improve this situation? In the first instance, an advisory institution could be formed, to give farmers advice about the advantages to the farmer in converting their farms into organic farms. As investments must be made mainly in the transition phase, the region could offer credits at a lower rate of interest than the market rate, possibly even at a rate of zero.

This could possibly be financed by through the removal of CAP subsidies, where Noord-Brabant would gain just around 180 million EUR per year. This money could be used to compensate the interest rate loss to finance the credits and to finance the advisory institution.

For example, if the government could offer a loan where the interest rate is 4% lower than the market interest rate, then the credit could be 250,000 EUR per average farmer in Noord-Brabant (15136 farms). This would leave an additional 28.63 million EUR per year to finance the advisory institution. This would also not require any additional government expenditure.

Additionally, positive and / or negative incentives could be provided to encourage the transition. For example, the regional government could set higher standards for emissions per hectare for animals or the quantity of fertilizers allowed. Finally it should be noted that the production of ethanol and biogas from corn and other crops cannot be considered in isolation as a means to reduce greenhouse gas emissions, because the production process can cause more emissions than can be saved by driving with biogas.

[20]See e.g. Eukert & Simons (2006), Omelko (2004), Gernig (2001), Kratochvil (2003), Latacz-Lohmann, Recke, & Wolff (2001), Nieberg & Offermann (2001), Schneeberger & Lacovara (2003). or Pimentel, Hepperly, Douds & Seidel (2005).
[21]Taken from Offermann (2004).

5.0 Application Case Study: Malopolska

5.1 Context & Objectives

Concern for environmental issues is growing. This is especially true in the transition countries, like Poland, where - to deal with the remnants of the previous regime - a new environmental policy was implemented in 1991. In Poland, this is supplemented with regional programs of both environmental protection and waste management. The programme of Environmental Protection 2005-2012 in Małopolska sets the targets, priorities and direction of activities for the sustainable development and environmental protection of the region. The main strategic goal is identified as the prevention of health hazards and the minimisation of risks relating to exposure to harmful substances. The most significant risks to human health currently relate to:

- water pollution and potable water quality,
- air pollution,
- municipal waste,
- natural disasters (droughts and floods)

In Poland, apart from the strategic plans and programs, there is a system of environmental financial instruments in operation, such as environmental charges (fees and fines), which was introduced to internalise the external costs and promote incentives for sustainable development. The reasoning behind the charges was that every user of the environment should pay for it, since the resources are scarce. Environmental charges are collected through special funds, i.e. the National Fund of Environmental Protection and Water Management, as well as local community funds.

The system of environmental charges applies not only for pollutants released, but also to the storage of waste. The charges cover an extensive number of items:

- gases and particulates released to the air,
- waste waters released to soil and water,
- cooling waters,
- waste to landfill,
- underground and surface water abstraction,
- run-off from the contaminated areas.

Table 1 Example of Environmental Charges Rates in 2005 (Annual average exchange rate 1 EUR = 4.3978 PLN).

Substance	**Unit**	**Fee /Unit in PLN**	**Fee / Unit in EUR**
Sulphur dioxide (to air)	kg	0.41	0.09
Cadmium (to air)	kg	144.34	32.82
Benzene (to air)	kg	6.60	1.50
Carbon dioxide	Mg	0.22	0.05
Benzene (to water)	kg	91.44	20.79
Waste from metal ore mining	t	14.87	3.38
Waste from copper, zinc and lead mining (tailings)	t	9.59	2.18
Flotation waste containing dangerous substances	t	43.86	9.97

The system in Poland is unique in Europe in terms of the number of substances that are subject to charges. In terms of air emissions, 62 elements and compounds are covered by the regulations. The Statement from the Ministry of the Environment (updated annually) sets the level of charges pertaining to the emissions to the air grouped in 5 tables:

- Table A - Unit fees for gases and particulates emitted to the air.
- Table B - Unit fees for gases emitted to the air during the handling of gasoline. These are the fees paid per tone of handled gasoline, where handling means filling and emptying the containers, cisterns, etc.
- Table C - Unit fees for gases or particulates emitted to air from boilers with a capacity of up to 5MW fuelled by coal, coke, wood, oil, or gas, which do not require either IPPC or air emission permits. The fees are per unit of fuel burned in tonnes or cubic metres.
- Table D - Unit fees for gases and particulates emitted to the air from the combustion of fuels in combustion engines. The fees are per unit of burned fuel in tonnes.
- Table E - Unit fees for gases and particulates emitted to the air from poultry breeding. The fees are per 100 stands.

This system has worked well in a country in transition to increase efforts in environmental protection. Moreover, because of the significant impact of environmental charges on competitiveness, the level of any charges for any pollutant should be uniform within the EU. Experience in Poland would indicate that the introduction of the appropriate level of charges can promote environmental and economic efficiency, but it is an extremely complex and difficult task.

The objective of developing the RAMEA for Małopolska was to establish the link between the environment and the economy and to identify the most burdensome economic activities in the region. The RAMEA for Małopolska was prepared in accordance with the guidelines of Eurostat (2004). In particular the tables provided in the guidance were used. The Polish data used came from different publications from the National Office of Statistics (GUS), the Regional Data Bank and various publications from National Emissions Centre. The objective of the case study was to determine the sectoral structure of the entities required to pay for the use of the environment in order to improve emissions control system and fees collection.

5.2 Application to the Activities of the Marshal Office

5.2.1 Application of RAMEA

This case study covers the application of RAMEA to the Marshal Office activities relating to environmental protection, one of the many potential applications. These activities include not only the development and implementation of the environmental protection programmes but also collection of the environmental fees. RAMEA was used to indicate which sectors should receive the most attention from the Marshal Office, regarding emission monitoring, and the most appropriate target areas for a concentration of investments. Poland has the opportunity to use European Structural Funds for technology/infrastructure development and by using RAMEA it is possible to define sectors which should have priority for investment. A questionnaire survey was carried out on the Marshal Office to ascertain areas where RAMEA can be used and where it could be enhanced.

5.2.2 Findings/Output

RAMEA for Małopolska was prepared for the year 2003, an extract of which is shown in Table 2 opposite.

The output data, gross value added and intermediate consumption by sectors is regional data from Office of Statistics. The allocation of output of sector D is estimated on the basis of distribution of production sold in industries in Poland, as more detailed information on production is not collected.

The employment data is the average employment in the sectors, with the data on full-time jobs coming from the regional database of the Office of Statistics (available online). For the sector D the full-time jobs are estimated on the basis of average employment in the medium sized enterprises. Output within the manufacturing sector is allocated on the basis of the production sold.

The air emissions data are restricted to plants generating significant emissions as only these are monitored by sector and region. However they represent almost 70% of total CO_2 emissions recorded for Poland and 6.39% for Małopolska, which is slightly lower than region's share of the production sold for the sectors (C, D and E) at 6.41%.

The Małopolska's share of the output is equal to 7.11%, with GVA 7.30%. The biggest contributor to both output and CO_2 emissions is the manufacturing sector (29.46% of output, 25.51% of labour input and 27.07% of the emissions) and within this sector the biggest share of CO_2 emissions is attributed to manufacture of basic metals, although it represents only 5.51% of the total production sold by this sector.

Table 2. Extract from the RAMEA for Małopolska (PL) (2003)

Contribution of Production to Output, Gross Value Added, Employment and CO_2 Emissions

2003		**Ouwtput Małopolska %**	**Production sold Małopolska %**	**Labour input Małopolska %**	**GVA Małopolska %**	**CO_2 emissions Małopolska %**
Total economic activities		100	100	100	100	100
A+B	Agriculture hunting forestry fishing	3.50		0.68	2.84	
C	Mining and quarrying	0.89	1.11	0.48	1.05	0.29
D	Manufacturing	29.46	90.09	25.51	18.03	27.08
DA	Food, beverages and tobacco		15.37	5.21		0.45
DB+ DC	Textile and leather products		3.30	2.69		0.05
DE	21 Paper and paper products		1.23	0.28		0.08
DE	22 Publishing and printing		4.34	0.87		
DF	Coke, refined petroleum, nuclear fuel		3.42	0.17		0.34
DG	Chemical products		8.79	1.60		7.88
DH	Rubber and plastic products		4.31	1.19		
DJ	27 Manufacture of basic metals		5.51	0.96		15.45
DJ	28 Manufacture of metal products		8.08	2.49		
DK	Machinery and equipment		3.96	2.13		0.40

Table 2 Cont'd. Extract from the RAMEA for Małopolska (PL) (2003)
Contribution of Production to Output, Gross Value Added, Employment and CO_2 Emissions

2003		Output Małopolska %	Production sold Małopolska %	Labour input Małopolska %	GVA Małopolska %	CO_2 emissions Małopolska %
Total economic activities		100	100	100	100	100
DL	Electrical and optical equipment		14.21	2.90		0.09
DM	Manufacture of transport equipment		3.89	1.23		0.31
DN	Manufacturing n.e.c.		2.36	1.03		
E	Electricity, gas and water supply	2.95	8.79	2.86	2.77	64.15
F	Construction	7.87		5.49	6.35	8.27
G+H	Trade and repair, hotels	20.47		16.17	23.71	
I	Transport, storage and communication	6.18		4.62	6.04	
J	Financial intermediation	2.51		2.69	3.34	
K	Real estate, renting and business activities	11.46		6.82	13.39	
L	Pub. admin., defence, social security	4.00		6.70	6.36	
M	Education	3.57		15.58	6.32	
N	Health and social work	3.29		9.54	4.95	
O	Other community, social and personal service activities	3.47		2.87	4.15	0.20

On the other hand the two sectors of food, drink and tobacco and manufacturing of electrical and optical equipment together represent around 15% of the total production sold by this sector, while their environmental impact remains relatively low at less then 0.5%. The utilities sector (electricity, gas and water supply) contributes only 2.95% to the output, 2.85% to the labour input, but 64.15% of the of CO_2 emissions.

The RAMEA for Małopolska was prepared in conjunction with the regional Marshal Office, which is the body responsible for the recording and collection of environmental fees, and the main source of air emission data at a regional level. This covers all the emissions that are subject to environmental fees for using the environment (Environmental Protection Act from 27.04.2001 with later changes). The database is created by the Marshal Office to record the reports from companies on the fees for using the environment. The reporting is based on standardised forms and this duty to report is compulsory for every entity that conducts the activities that produce emissions. The database consists of information divided into four modules:

- gases and particulates released to the air,
- water abstraction
- waste waters released to soil and groundwater,
- waste to landfill.

Since the RAMEA for this case study covers the emissions to the air, the database content pertaining to these emissions is presented in more detail:

1. Air emissions by source
    a. Source of the emission
        i. Type, e.g. furnace, installation
        ii. Source capacity
        iii. Type of protection device
    b. The emission volume
        i. Type of fuel/substance, e.g. SO_2, NO_2, CO, CO_2, particulates, etc.
        ii. The effectiveness of protection device
        iii. The emission volume
    c. The place of emission, i.e. commune name

2. Air emissions from the handling of engine fuels is specified separately and includes:
    a. The volume of fuel handled
    b. The effectiveness of protection device
    c. The place of emission, i.e. commune name

3. Air emissions from boilers are another also reported and includes:
    a. Boilers of capacity smaller than 5MW
    b. Fuelled by coal, coke, wood, oil or gas
    c. Boilers for which the IPPC is not required
    d. Number of boilers
    e. Volume of fuel used

4. Air emissions from combustion engines
    a. Cars
    b. Trucks
    c. The type of fuel
    d. Volume of fuel used

The emission included in the Marshal Office database covers 62 substances, including: arsenic, ammonia, asbestos, benzene, vinyl chloride, chromium, tin, zinc, sulphur dioxide, carbon dioxide, methane, nickel, lead, particulates, mercury, carbon monoxide, nitrogen oxides, metallic elements and its compounds, etc.

The analysis of this database was carried out for the year 2005 since these data are available in electronic format and the results are presented in the Table 3. This shows that those same sectors that report the most emissions to the Marshal Office are those identified in the RAMEA as emitting the highest levels of air emissions e.g. of CO_2. For CO_2 emissions these include among others, electricity, gas and water supply (E), chemical products (DG) and manufacture of metals (DJ). The difference however is in the amount reported, but this may be due to the fact that the statistical information on which RAMEA is based covers only the most polluting plants.

Table 3. Emissions Data from Marshal Office database [t]

Sectors	CO_2	CH_4	NH_3	SO_2	CO
Section AB	2 605	–	0.06	59	8
Section C (CA)	0	51 170	–	0	2
Section C (CB)	70	–	–	1	32
Section D (DA)	65 991	132	3.23	614	347
Section D (DB+DC)	5 945	–	0.84	75	109
Section D (DD)	1 352	–	–	0	26
Section D (DE)	16 246	–	0.18	91	77
Section D (DF)	3 291	–	–	18	0
Section D (DG)	377 023	6	181	4 750	146
Section D (DH)	227	–	2.87	3	1
Section D (DI)	9 050 168	80 166	0.12	260	1 559
Section D (DJ)	65 322	–	0.34	701	259
Section D (DK)	21 636	0	0.40	114	98
Section D (DL)	6 846	–	0.01	1	2
Section D (DM)	39 230	–	–	91	242
Section D (DN)	14 540	–	–	822	74
Section E	5 134 635	111	0.01	37 298	1 573
Section F	8 289	–	–	39	79
Section G	5 264	–	0.03	27	44
Section H	909	–	–	2	0
Section I	0	4	–	0	0
Section K	24 171	–	3.76	102	181
Section L	2 962	–	–	9	32
Section M	0	–	–	1	1
Section N	24 197	–	–	66	57
Section OPQ	7 512	–	–	14	8
Not allocated	3 203 228	732	20.69	11 791	39 015
Total	18 081 659	132 320	214	56 950	43 973

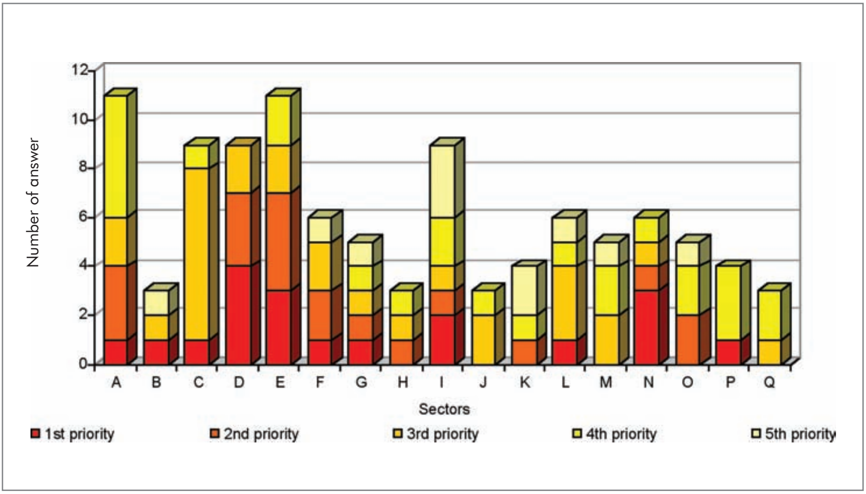
5.2.3 Use of Findings (policy, intervention, fiscal)

In Małopolska, the Marshal Office is the body responsible for the preparation and implementation of the environmental programmes and policies. The questionnaire was developed in conjunction with representatives from the Marshal Office to analyse the possible uses of the initial RAMEA project results and its application to set goals for environmental programmes and monitor their achievements / progress as well as identifying the needs for data in Marshal Office. The questionnaire was then distributed among the employees of the Marshal Office at the Department of Environment and Development of Rural Areas. The questionnaire consisted in 22 questions and 16 people responded.

Almost everyone (94%) agreed that it was important to consider all sectors of economy. However, 27% of the respondents indicated that they believed it was enough to consider only those sectors with the most significant environmental impact. Moreover, the respondents were given the opportunity to prioritise the sectors according to their importance (highest priority 1, lowest priority 5). The sectors identified as being of the highest priority were: agriculture, hunting and forestry (A) and electricity, gas and water supply (E) – almost 70% of those polled voted for these sectors.

The second group of sectors identified by 56% of the answers were: mining and quarrying (C), manufacturing (D) and transport, storage and communication (I). The third most important group of sectors was construction (F), public administration and defence; compulsory social security (L) and Health and social work (N), all indicated by 38% of respondents. Figure 1 presents the details of the responses and assigned priority of the sectors. These answers confirm the findings from the project, as RAMEA indicates the same sectors to be those with the biggest impacts – both economic and environmental.

Figure 1: Assessment of Priority Sectors Based on Responses Received.



A simple weighting was applied to the answers to perform the uniform ranking of the sectors. The results of this are presented in the Table 4, which indicates the top priority was assigned to the electricity, gas and water supply (E), followed by manufacturing (D) and agriculture, hunting and forestry (A).

Table 4. Weighted sector ranking

Sector	Sector name	Weighted priority
E	Electricity, gas and water supply	41
D	Manufacturing	38
A	Agriculture, hunting and forestry	33
C	Mining and quarrying	28
N	Health and social work	24
I	Transport, storage and communication	24
F	Construction	20
L	Public administration and defence; compulsory social security	17
G	Wholesale and retail trade	15
O	Other community, social and personal service activities	13
P	Activities of households	11
M	Education	11
H	Hotels and restaurants	9
B	Fishing	9
K	Real estate, renting and business activities	8
J	Financial intermediation	8
Q	Extra-territorial organizations and bodies	7

A high level of detail of environmental impact assessment and complexity was requested by the respondents, with everyone agreeing that a high level of detail is important for analysis, 87% of replies indicating that the desired level of detail should include group or class in terms of NACE classification.

This indicates that a higher level of detail is required than RAMEA currently provides, as the sector level was deemed sufficient by only 13% of respondents. The complexity of the environmental impact assessment in terms of covering all impacts (air emissions, water emissions, wastes) was considered important by all respondents. Only 19% indicated that they considered it sufficient to cover only those elements of the environmental impact assessment indicated, with, 69% being of the opposite view.

Referring these findings to the future development of RAMEA, it can be concluded that there is a considerable interest in expanding the analysis beyond just air emissions. The majority (94%) of the respondents believed that a high level of detail for the environmental impact assessment is essential with 75% of respondents indicating that it is not enough to consider only the most significant pollutants and substances.

The majority of those polled (81%) stated that all possible pollutants and substances should be considered in the analysis. All respondents stated that it was important that the analysis be based on the most current data and that the environmental and economic data should be analysed in a time series.

The questionnaire showed the importance of versatility and simplicity of a tool like RAMEA, together with its modelling possibilities and credibility. All agreed on the value of being able to compare between the regions and the simplicity of RAMEA (in terms of being able to understand how it is calculated).

The decision to carry out regional comparisons (benchmarking) using RAMEA was thus validated by the interest level of the potential users of the tool. More then half (56%) identified the importance of having a single score indicator instead of several indicators for environmental impact.

An aspect that virtually all (94%) liked about RAMEA was the possibility of simple modelling/simulation, e.g. how the emission lowers when the smelter is closed, or where a fall in production could result in a significant reduction in the amount of waste. At the same time the general acceptance of RAMEA tool was deemed important (e.g. among scientists) to establish its credibility (81% of respondents).

All agreed that the analysis prepared within RAMEA project would be of value to the Marshal Office and confirmed their interest in RAMEA results; while 63% stated that the Marshal Office has enough information about the environment from the national statistics, 25% disagreed. The information the most requested included:

- information on noise, natural resources & agriculture,
- information on the state of the environment (which the Voivodeship Inspection of Environmental Protection in Krakow collected in previous years, but this has since ceased), e.g. the soil and river polluting deposits e.g. heavy metals, etc.,
- the percentage of the inhabitants with separate Municipal Solid Waste (MSW) collection,
- the percentage of property owners with the agreements for MSW collection.

In conclusion, RAMEA was perceived as important tool that can be used not only to establish the sectoral goals for the environmental protection programme in Małopolska, but also to support the long term goals of environmental protection policy in Małopolska, i.e. compliance with the air quality norms with the associated reduction in air pollution. It is currently planned to achieve this goal by improving the transport infrastructure (roads) and the promotion of natural sources of energy, with a reduction in the use of coal and an increase of renewable energy.

The multi-faceted analysis by RAMEA of the environmental impact in the region would allow action to be focused on the most important areas. It is also worth mentioning that there is strong interest expressed in the application of RAMEA from the neighbouring regions.

5.2.4 Monitoring Proposal

RAMEA supports the life-cycle approach to environmental policy design and responds to the needs expressed by regional policy makers for simple, understandable and reliable indicators. The project outcome creates the basis for more effective decision-making (with the emphasis on the relation between economic activities and environmental effects) as well as for the further analysis e.g. input-output analysis. On the basis of information gathered in RAMEA there is a possibility to create sustainability indicators that will allow regional decision makers to better understand the outcomes / implications of the analysis.

The most important application of these indicators at present is to inform regional policy makers and provide them with the tool to transform the environmental strategy goals into the measures necessary to accomplish them and to assess the progress and the legitimacy of implemented environmental policy. RAMEA can be used within the framework of life-cycle analysis to support actually dealing with the environmental problems instead of shuffling them, as well as a means of organising the information available. At the same time, it also gives local government a quick way to assess the outcomes of policy introduced.

The models developed so far within the framework of the RAMEA project are promising and the project is expected to form the norm for presenting regional environmental information to policy makers and to generate ideas regarding dealing with missing data, which is a common problem for the development of such tools where there are no national statistics available, as in the Netherlands. The experiences gained through the RAMEA project will hopefully be a starting point for a more comprehensive environmental information system and will form the basis for the creation and revision of the environmental policy and a benchmarking tool, against which the policy measures implemented, could be assessed.

In the opinion of both regional policy makers and the project partners, RAMEA is an important undertaking, especially for regions where there is a need for a solid background against which to set environmental policy goals, including but not limited to environmental areas most in need of attention. For further information on how a hybrid accounting system like RAMEA could be used as an instrument for policy advice, refer to the paper "The Usefulness of Hybrid Accounting Systems for Environmental Policy Advice regarding Sustainability"[23] by Malgorzata Goralczyk and Peter J. Stauvermann, which was presented at the 16th International Input-Output Conference in Istanbul, Turkey, 2-6 July 2007.

[23]http://www.iioa.at/conferences-IO.html

6.0 Application Case Study: Emilia-Romagna

6.1 Context & Objectives

The first pilot project of RAMEA in Emilia-Romagna was carried out by ARPA Emilia-Romagna, the Regional Environment Agency, in close collaboration with IRPET[24] and ISTAT.[25] The main objectives of the study are:

- to link the economic knowledge on production and consumption activities to the air emissions;
- to build a tool useful for reports (in particular, Strategic Environmental Assessment - SEA), studies, scenarios, regional planning;

Two matrices were produced, for year 1995 and 2000, using:

- regional economic data supplied by IRPET for 30 economic sectors plus 3 types of household consumptions, using a multi-sector and multi-regional econometric model with the ability to produce economic accounting matrices, consistent with national accounting matrices, for all Italian regions (Casini Benvenuti & Paniccià, 2003);
- official database of 21 pollutant air emissions at a provincial level produced by the National Environment Agency (APAT, 2004)

The methodology to link the two sets of data was developed in close collaboration with IRPET and is partially based on the previous experiences of regional NAMEA for two Italian regions, Toscana and Lazio (Bertini et al. 2007, ISTAT 2006a-b)[26].

[24]IRPET, Regional Institute for Economic Planning in Tuscany (www.irpet.it).

[25]ISTAT, Italian National Institute of Statistics (www.istat.it).

[26]The methodology mainly deals with the activities carried out to shift from the CORINAIR process-oriented source nomenclature (SNAP 97 codes) to the RAMEA socio-economic nomenclature (which includes economic activities described by NACE codes plus household consumption), and in particular: (i) the analysis of the qualitative link between each SNAP 97 process and RAMEA economic activities and (ii) the quantitative allocation of the emissions of each SNAP 97 process to the related RAMEA activities. Since there is no standard connection between SNAP and NACE categories, the attribution of SNAP-based emission data to NACE-based accounts depends on the economic structure of the region. In addition to that, only emissions from anthropic sources are taken into account, excluding all emissions related to natural phenomena.

RAMEA 2000 was applied to three different kinds of analyses, to explore some of the possibilities that this type of tool offers to regional planning/reporting:

- monitoring regional air emissions and eco-efficiency;
- comparing regional and national eco-efficiency;
- understanding the indirect effects/responsibilities of the electricity sector.

RAMEA 2000 is illustrated in a simplified version in Table 5, with economic and environmental indicators for each macro-sector calculated as percentage of the total.

As a monitoring and descriptive system, RAMEA facilitates an analysis of the pressures placed on the environment by the activities of the economic sectors and households. In this report we highlight the key sectors for Greenhouse Gas (GHG) emissions, acidification and local air quality, directly linked to the economic performance of those sectors (in terms of production and value added) and developing the associated eco-efficiency indexes (i.e. tonnes of pollutants emitted per millions of euros of production/value added).

The eco-efficiency of Emilia-Romagna can then be readily compared with the same indicators for Italy. A more detailed analysis (Shift-Share analysis) is then carried out to better understand the different GHG emission intensities of regional economic sectors by comparison with those at a national level .

[27]Using Shift-Share analysis, the role of the productive structure as a cause for the average gap between regional and national efficiency can be isolated and quantified, whilst also obtaining, in a complementary way, a measure of the role of the specific efficiency of emissions of productive sectors. The choice of this methodology derives from the search of effects and factors that could explain the relative efficiency of Emilia-Romagna compared to Italy as a whole and could be shown in a more exhaustive way than a descriptive statistic analysis. As a matter of fact the latter can give indications on the relative efficiency of Italy with reference to the whole regional economy (Total Emissions/Total Added Value) or to specific fields, but it cannot measure two important effects: (i) the different sectoral composition of the regional

Table 1 - RAMEA 2000 for Emilia-Romagna Region (%).
Source: Arpa Emilia-Romagna

		Current Prices			GHG emissions	Acidification	Local air quality		
NACE (COICOP)	**Sectors**	**Output**	**Gross Value Added**	**Final Consumption**	**CO_2eq**	**H+ eq**	**PM_{10}**	**NMVOC**	**CO**
A, B	Agriculture, hunting and forestry, fishing	2,8	4,0	-	12,2	47,0	24,2	4,6	9,8
C	Mining and quarrying	0,1	0,1	-	0,1	0,1	0,2	0,2	0,0
D	Manufacturing activities	41,2	27,4	-	31,5	21,2	31,3	30,7	2,4
E	Electricity, gas and water supply	1,3	1,3	-	14,3	10,2	4,6	3,2	0,5
F	Construction	5,5	5,0	-	0,2	0,1	2,2	3,9	0,1
G, H	Wholesale and retail trade, hotels and restaurants	14,4	17,8	-	2,0	0,7	0,9	1,7	0,5
I	Transport, storage and communication	6,4	7,1	-	7,0	7,5	13,2	6,9	5,6
J-Q	Other services	28,2	37,1	-	6,2	1,9	2,1	1,3	2,1
07	Private traffic	-	-	3,4	12,3	9,1	13,3	34,1	70,3
04	Heating, cooking, air cond	-	-	2,1	14,1	2,1	8,0	1,9	8,0
-	Other consumptions	-	-	94,6	0,1	0,0		11,4	0,7
	Economic activities	**100,0**	**100,0**	**-**	**73,5**	**88,8**	**78,7**	**52,6**	**21,0**
	Households			**100,0**	**26,5**	**11,2**	**21,3**	**47,4**	**79,0**
	Total	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**

economy compared to that of the national economy; and (ii) the different efficiency of emission of the regional economic sectors compared to the national average. These effects and their combination can be collected and read by a Shift Share analysis that, thanks to the correspondence and coherence between sectoral economic and environmental variables given by RAMEA, allows attribution of the whole observable deviations to the combination of the effects mentioned above, and also quantifies them. Therefore the descriptive comparison between efficiency of every field (Emilia-Romagna/Italy) for GHG generates a deviation matrix between the regional and national average: the application of a Shift-Share analysis allows detailed consideration of such differentials.

6.2 Sectoral Eco-efficiency & Analysis of Electricity Sector

6.2.1 Application of RAMEA

The simplified version of RAMEA 2000 showed in Table 1 highlights the different contribution of economic sectors and households to the economy (output, value-added and final consumption) and the environment (GHG[28], acidification[29], local air quality), facilitating a simple but interesting analysis of the data, which shows that:

- Manufacturing is the sector with the higher contribution to the regional output (41.2%) but also has a high impact on the environment (GHG 31.5%, acidification 21.2% and PM[30] 31.3%);
- The Electricity sector makes a very little contribution to the regional output and value added (1.3% each) but has a significant environmental impact in terms of GHG (14.3%) and acidification (10.2%);
- Agriculture makes little contribution to the regional output (2.8%) and value-added (4.0%), but is relatively important in relation to GHG (12.2%), the highest for acidification (47%) and makes a strong contribution in terms of PM (24.2%);
- Households also have an impact on environment that cannot be overlooked, particularly for emissions such as CO_2 (31%), NO_X (29%), NMVOC (47%) and CO (79%) (See Figure 1).

[28]GHG takes into account the Global Warming Potential (tonnes of CO_2 equivalent) of CO_2, CH_4 and N_2O, with the formula $GHG = CO_2 + 21\ CH_4 + 310\ N_2O$
[29]Acidification takes into account the Potential Acid Equivalent (tonnes of H+ equivalent) of NO_X, SO_X and NH_3, with the formula $H+\ eq = 1/46\ NO_X + 1/32\ SO_2 + 1/17\ NH_3$
[30]Particulate Matter

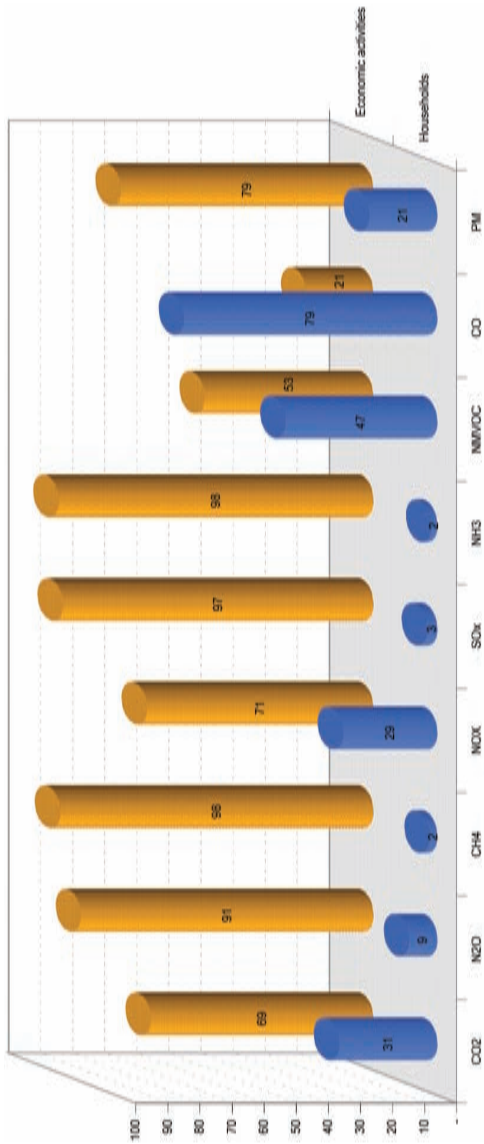


Figure 1
Economic and Household Contribution to Emissions (%)
Source: RAMEA 2000

Monitoring Regional Air Emissions and Eco-efficiency

Disaggregating the manufacturing sector D, analysis of the data in RAMEA 2000 highlights the key sectors in relation to the environmental aspects analysed and their relative contribution to the regional output.

Figure 2 shows the economic output of the industrial sectors in relation to their greenhouse gas emissions. The first three sectors (DI, E and A+B) contribute around 50% of the emissions but only contribute 8.4% of the output. In particular, sector DI, other non- metallic products (in Emilia-Romagna mainly manufacture of ceramic products), makes an overall contribution of 19% to the total of emissions and 4.3% to the output.

It also indicates that households contribute around 26.5% of the total emissions, i.e. the above three sectors plus household consumption total 72% of the total. Looking at the green bars (economic output) it is interesting to note that they are higher for sectors with little or no contribution to GHG emissions.

If we perform the same analysis for acidification, Agriculture has the major contribution (47%): adding sectors DI, E and households' emission we reach a contribution to the total potential acid equivalent of more than 80%, in comparison to an impact on the total output of about 8% (Figure 3).

Taking into account PM emissions for local air quality (Figure 4), Agriculture has again the highest contribution (24.2%), which was not expected, while in sector I "Transport, storage and communication", as well as sector DI (17.4%), has a relevant importance (13.2%). Even in this case the impact of domestic consumption, in comparison with economic activities, is quite important (21.3%).

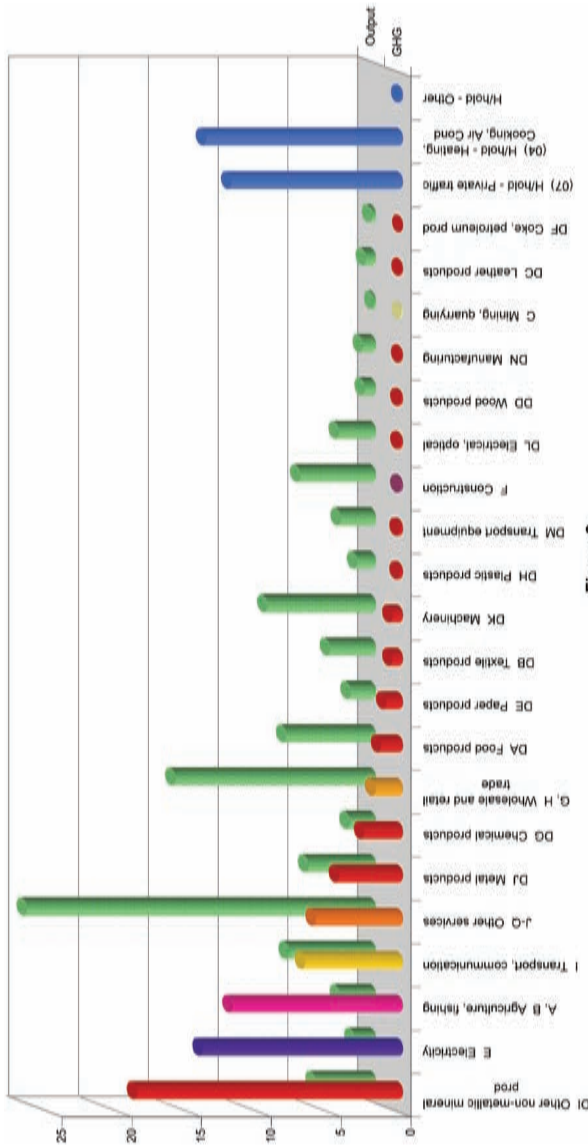


Figure 2
Sectoral Contribution to Greenhouse Gases and Output (%)
Source: RAMEA 2000

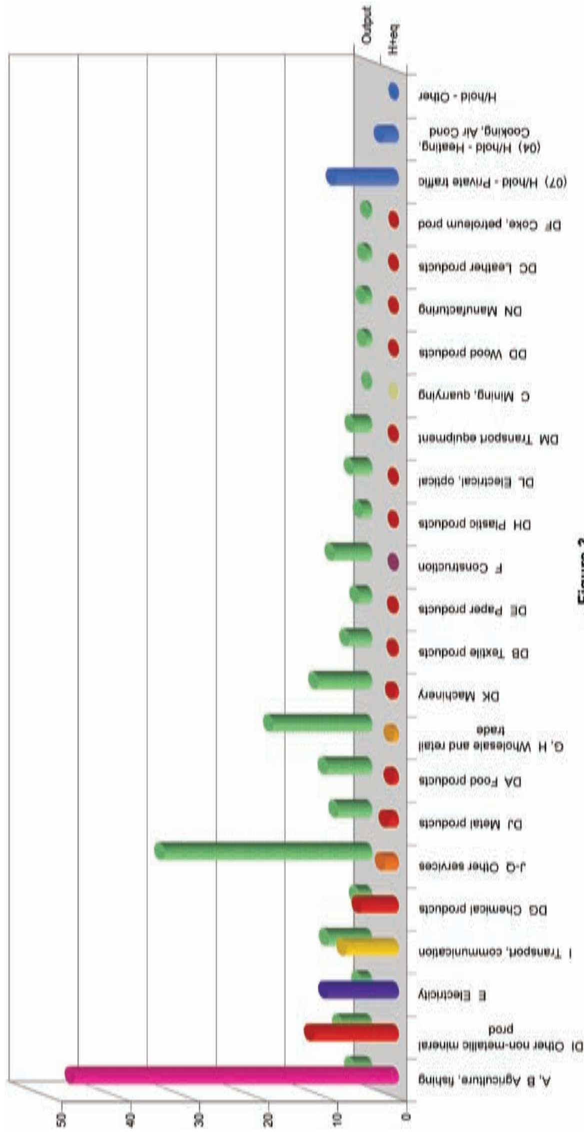


Figure 3
Sectoral Contribution to Acidification and Output (%)
Source: RAMEA 2000

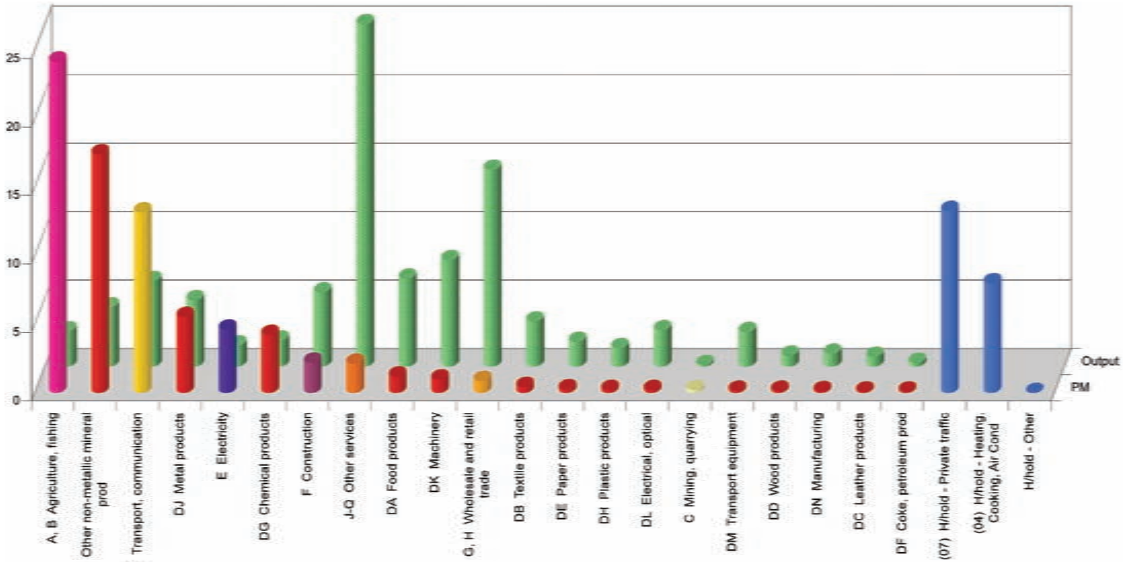


Figure 4

Sectoral Contribution to PM_{10} Emissions and Output (%)

Source: RAMEA 2000

Using the RAMEA data it is also possible to calculate "Emission Intensity" indicators, expressed as the ratio between emissions and production or value added. As explained in Cervigni et al (2005), this ratio can be considered representative, as an inverse index, of the ecological efficiency of a given activity and can form the basis for:

- different time period comparisons regarding an economic activity (a reduction in the ratio over time indicates an increase in ecological efficiency and vice versa);
- comparisons between different activities in the same country;
- comparisons amongst different countries or regions.

Figure 5 shows the emission intensity of GHG by production activity in Emilia-Romagna. In this case, the sector with the highest ratio (i.e. with the highest emission of GHG per unit of output) is the Electricity sector with an index of over 2000 tons of GHG per million euros, about double that of the nearest sectors, DI and A+B. These results are linked to the particular approach of this methodology, which is based on "Producer Responsibility". In the NAMEA/RAMEA framework environmental pressures are allocated directly to the producer, be it economic activity or household, responsible for generating the emissions / environmental impact. Some industries which directly emit large amounts of greenhouse gases, such as power generation, are presented in a bad light under this approach (Bertini et al, 2007:15).

Section 6.2.2: Understanding the Indirect Effects / Responsibilities of Electricity Sector, related to the Electricity sector, illustrates how it is possible to explore the concept of "Consumer Responsibility", using Input-Output analysis.

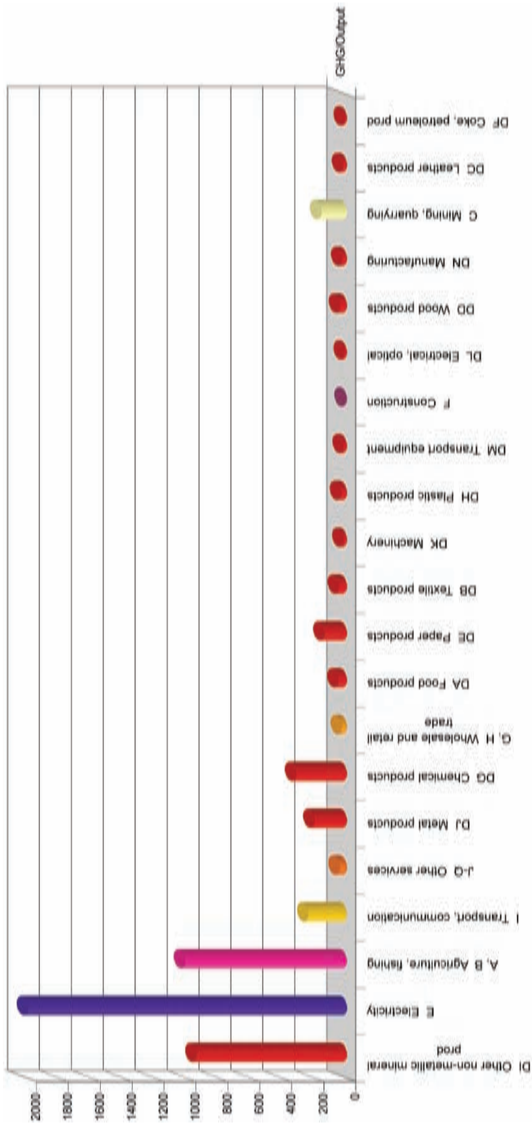


Figure 5
Intensity of Greenhouse Gas Emissions (Mg CO2eq/M Euro)
Source: RAMEA 2000

Comparing Regional and National Eco-efficiency

This section analyses the intensity of GHG emissions for the regional economy in Emilia-Romagna, compared to the national average, for all economic sectors covered by RAMEA 2000 and NAMEA 2000 (ISTAT, 2007). This approach has also been used in literature: see e.g. Zaccomer (2005).

Methodological Approach

The indicator "Emission Intensity", as "Emissions/Added Value", is used in this analysis as a measure of the efficiency in terms of GHG emissions. The regional average Emission Intensity (X_e) for GHG is the summation of the sectoral intensities of emission, weighted in relation to the ratios of the sectors for Total Added Value (P_e). The national average Emission Intensity (X) is defined in the same way.

The region may show a greater or lower Emission Intensity compared to the national average depending on the combination of the three Shift-Share effects:

- Industry mix (or Structural);
- Differential (or National Share);
- Allocative (or Regional Share).

The *Industry Mix Effect* estimates that element of greater/lower Emission Intensity which is due to the sectoral structure of the regional or national economy. This can show that although the Emission Intensity may be similar to the average national for every sector, the economic industrial mix may generate higher or lower indicators for the complete economic system.

The difference between the regional and national average Emission Intensities may depend on differences in the specific intensities of some or of all of the considered fields, marking out the *Differential Effect*.

Finally, the *Allocative Component* adds further analytic information. The covariance between the sectoral structure, assuming parity of efficiency, and the difference between the sectoral Emission Intensity, assuming parity of sectoral structure, indicates whether and how much the system has a productive specialization in the fields within which the comparative advantage of efficiency was assessed.

The total indicator of Emission Intensity shown as Total Emissions per Unit of Added Value is defined as $X= E/VA$ for the national average, and as $X_e= E_e/VA_e$ for E-R. It is important to note that the higher the ratio, the higher the inefficiency and vice versa.

By defining:

$X^s_e= E^s_e/VA^s_e$	the indicator of intensity of emission for every economic field in E-R;
$X^s= E^s/VA^s$	the indicator of intensity of emission for every economic field in Italy;
$P^s_e=VA^s_e/ VA_e$	the ratio of sectoral Added Value for E-R;
$P^s=VA^s/ VA$	the ratio of sectoral Added Value for Italy.

Consider:

$$\sum P^s_e=1 \qquad \sum P^s=1 \qquad e \qquad X= \sum P^s X^s \qquad X_e= \sum P^s_e X^s_e$$

This identifies three effects, provided by the Shift-Share model, which explains the Total Differential of Emission Intensity between E-R and Italy.

(i) The first effect (structural or Industry mix) is given by:

$$m_e= \sum X^s (P^s_e - P^s) \qquad \text{Hp: } X^s_e - X^s = 0 \text{ (parity of intensity of emission)}$$

m_e takes on positive value (algebraically negative) if the region specializes in sectors with a higher environmental efficiency (P^s_e - $P^s < 0$), as every differential of sectoral Added Value ratio is multiplied by X (as if the region were characterized by the national average efficiency). The effect takes on the minimal value if the region is specialized in more efficient fields on average, compared to the national average.

(ii) The second effect (Differential) is given by:

$p_e = \sum P^s (X^s_e - X^s)$ Hp: $P^s_e - P^s = 0$ (parity of sectoral structure)

p_e takes on positive value (algebraically negative) if the region is more efficient in terms of emissions (the shift between regional and national efficiency), as if the sectoral ratios of Added Value were the same for the region and for the national average ($X^s_e - X^s < 0$).

(iii) Finally, the effect of covariance between the two already mentioned, or Allocative component, is given by:

$a_e = \sum (X^s_e - X^s)(P^s_e - P^s)$

The effect is negative if the region is specialized, compared to the national average, in the fields with lower Emission Intensity. It takes on the minimal value, in our case, if the region is specialized in the fields in which it records the higher comparative advantage (low Emission Intensity). For this it is an indicator of covariance between m_e and p_e. Guarini and Tassinari (2000) gave a theoretical explanation of this statistical notion applied to the economic subject.

The total difference between regional and national average Emission Intensity equals the summation of the three effects:

$X_e - X = p_e + m_e + a_e$

Thus a quantitative assessment can be made of the causes of the differential Emission Intensities between E-R and the national average. This can be due to the sectoral structure, from "the history of development" of the economy, or the average state of production technologies, and the emissions in the region compared to the national average. For example, a higher value of regional Emission Intensity could be due solely to the production structure in areas where an energy-environmental policy cannot have a great influence; whereas it could have greater chance of effect if the relative total regional inefficiency were due to the specific environmental inefficiency of the sectors, due to their process technologies or inefficient public regulation assets.

The higher the Indicator the less efficient the considered system or sector. This is reflected in the interpretation of the differential between E-R and Italy; so if $X_e - X > 0$, E-R is relatively less efficient (e.g. produces more emissions for unit of Added Value than the national average). The same is true for the signs of the three Shift-Share effects. When they are algebraically negative they identify an efficiency advantage for the region E-R. The same methodology was used in a different analysis by Biffignandi and Fabrizi (2006) and by Biffignandi (1993).

Shift-Share Analysis of the Regional Economy[31]

First of all it is essential to observe the trend of the Indicator of efficiency (X_e-X) and (X^s_e-X^s), i.e., the variable object of the Shift-Share factorization. The four variables P_e P, (the relative combination of Added Value), and X_e X (the Total Emission per million Euro of Total Added Value), are the basis of the Shift-Share factorization study according to the described approach.

Figure 6 shows the matrix Sectors/Emissions of the percentage deviation between Indicators X^s_e and X^s, as is $[(X^s_e - X^s)/X^s]$.

However this kind of comprehensive information is insufficient to identify the main drivers of the efficiency gaps and consequently the possible implications for policy makers.

[31]Mazzanti et al. (2006) resolved similar analysis for another Italian region (Lazio), still compared to the national average.

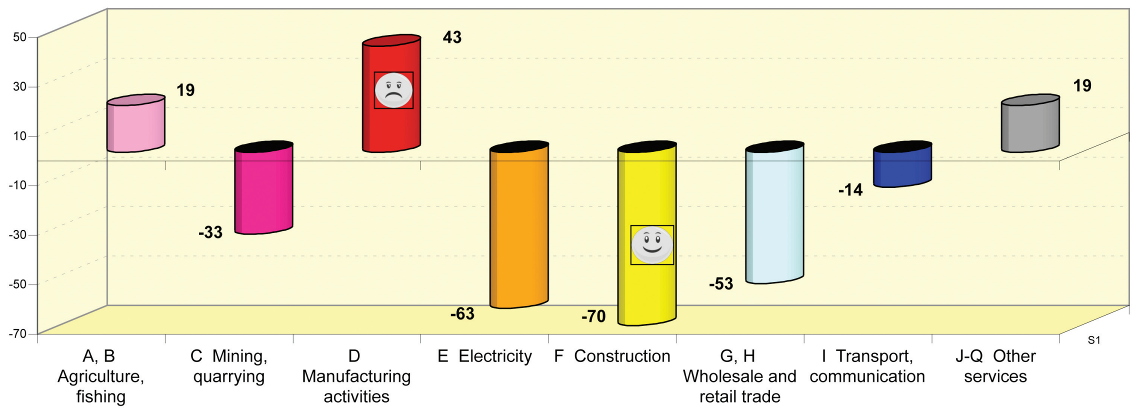


Figure 6

Difference between Key Perfomance Indicators (%): $(X^s_e - X^s)/X_s$
Source: RAMEA 2000

The main results of Shift-Share analysis are shown in Table 2 and Figure 7 in terms of effects/components (*m, p* and *a*) that contribute to explain the differentials (X_e-X), and are here studied for GHG, according to NAMEA.

Table 2 – Shift Share Analysis of the Regional Economy

Total economic activities	$\sum X_e$	$\sum X$	$\sum (X_e\text{-}X)$	$\sum(m_e+p_e+a_e)$	$\sum m_e$	$\sum p_e$	$\sum a_e$
GHG	0,340499	0,412959	-0,0724599	-0,0724599	-0,0248043	-0,0752752	0,0276196
% deviation compared to the national average			-18%				

The results of this first analysis show that the first two effects identified by Shift Share (m, p) are algebraically negative and highlight the fact that a major efficiency of E-R (X_e < X) is due to an efficient industrial sector mix and lower Emissions of GHG per unit of Added Value. It also shows an algebraically positive sign for the third factor (a), the covariance between m and p. This suggests an absence of specialization in E-R in the most efficient sectors, on average. A negative sign for *a* would indicate an effective mix of the first two effects. On the whole, the efficiency advantage of E-R (-18%) would appear to be associated with a factor of greater specific environmental efficiency (p= -0.0752752) rather than to reasons of sectoral specialization (m=-0.0248043), if they exist.

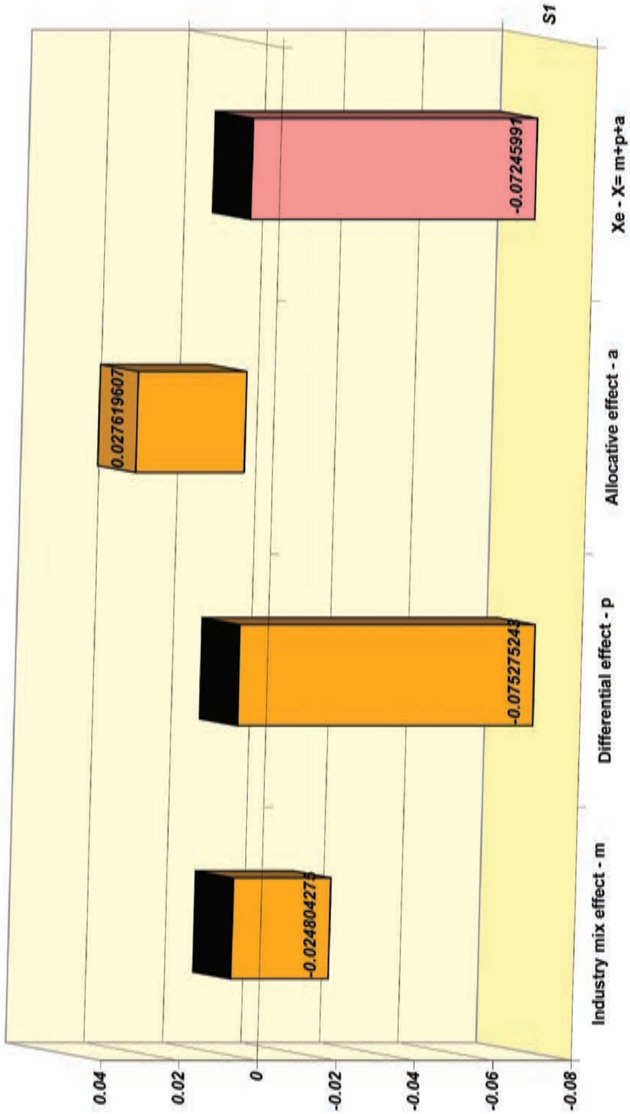


Figure 7
Three effects of Shift-Share Anlaysis of the Full Economy (E-R /Italy) X_e-X= m+p+a
Source: Ramea 2000:

Shift-Share Analysis of Regional Economic Fields (compared to the national average)

A further analysis of all of the economic sectors allows further interpretation within the regional economic system in terms of effects identified by Shift-Share. Mazzanti et al. (2006) also used this approach.

Starting the analysis from the efficiency gaps without distinguishing between the three different drivers (*industry mix, national share, allocative components*), in order to continue with the Shift-Share analysis and with the possible differences compared to the analysis identified in the whole economic system, it is evident that the analysis of the economic sectors does not confirm a huge variation in Emission Intensity across the sectors in E-R. It can then be verified whether or not the efficiency, in terms of Emissions per Unit of Added Value, where it still exists, is lower or higher in the macro-fields compared to the average data (benchmarking between regional and national average economic system), i.e. how much each sector contributes to the average advantage.

Such a comparison shows the cases in which the gap, favourable to the E-R whole economic system, is greater if it is analyzed specifically for the economic sectors. Only one sector (E) gives the relative advantage to the region in terms of Emissions per Unit of Added Value. In fact Figure 8 shows that the differential of efficiency per sector is higher or lower if compared to (X_e - X).

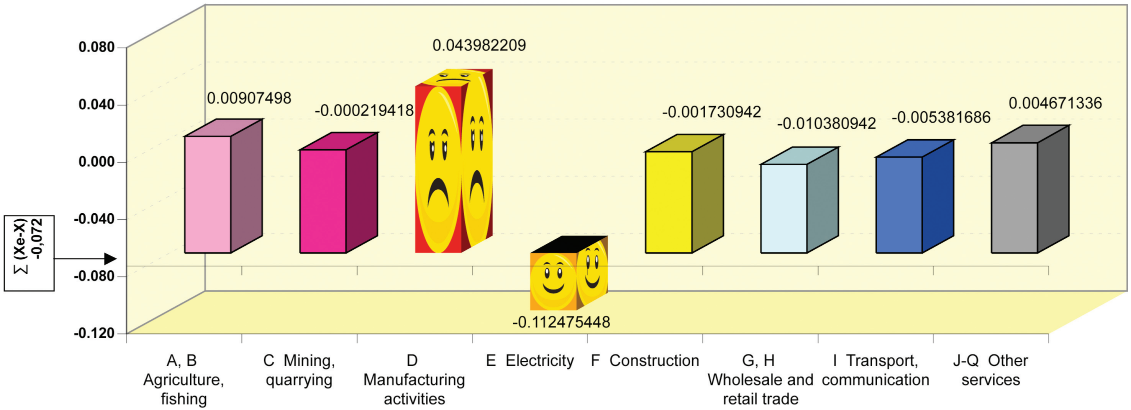


Figure 8

Benchmarking between Sectoral & Average Differential for the Full Economic System $[(X^{s}_{e}-X_{s})/(X_{e}-X)]$

Source: RAMEA 2000

The Shift-Share sectoral factorization shown in Figure 9 highlights other interesting aspects in relation to GHG emissions. Such results always relate to the comparison of the efficiency (and the linked drivers) of identified sectors with the national average efficiency. Starting from the result of a lower Emission Intensity in E-R, by comparing the sectors C, E, F, G+H, I to the corresponding sectors in national Italian economy, it is possible to measure and to rank the efficiency of the regional sectors, whilst also referring to their environmental efficiency.

In relation to GHG Emissions, the positive differential (algebraically negative) of E, compared to the efficiency in E-R on average, depends on the greater *industry mix* (m) and *differential* (p) effects, compared to the remaining sectors. Consequentially it would appear that the structure of Added Value is particularly effective in terms of efficiency of emissions (maximum negative value among the *p*) and of sectoral combination (maximum absolute value among the *m*); the positive sign of covariance remains and confirms the previous findings, i.e., the region does not specialize in sub-sectors with high environmental efficiency in terms of GHG Emissions.

In relation to sector D, the reverse is identified, with the maximum negative differential (algebraically positive) compared to efficiency found for E-R on average and compared to the other sector gaps. The greater relative difference derives from the contributions of the sectoral effect (maximum positive value among the *m*) and of specific emissions (maximum positive value among the *p*). The positive sign of the covariance would indicate value in continuing with a Shift-Share analysis of the manufacturing (D) sub-sectors.

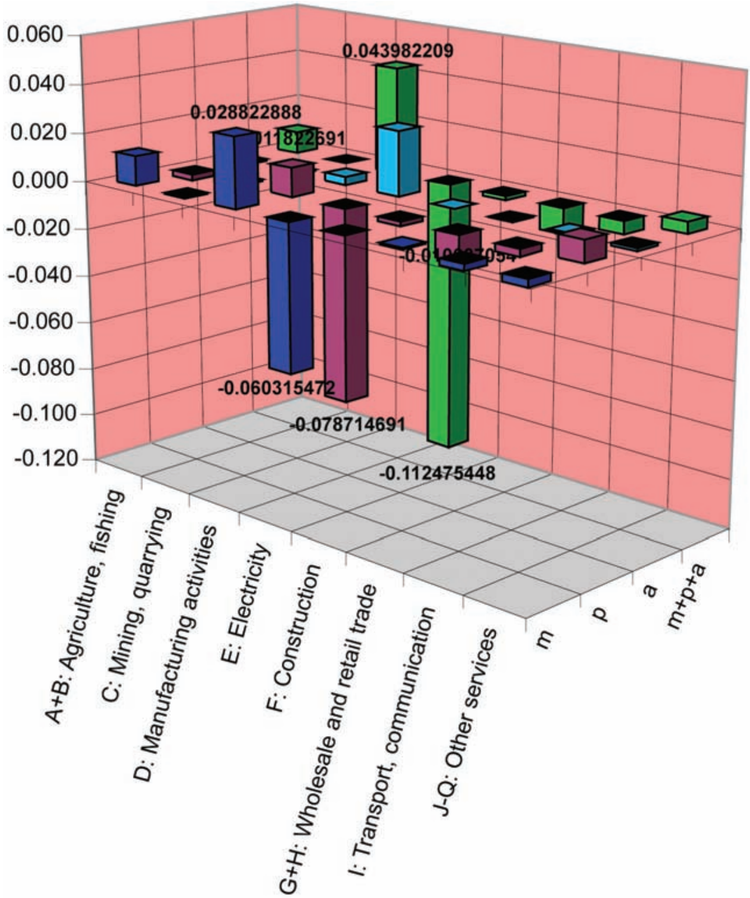


Figure 9
Sectoral Shift-Share Anaysis: Trend of Coefficients
Source: RAMEA 2000

Table 3 - Shift Share matrix

Total economic activities	$\sum X_e$	$\sum X$	$\sum (X_e\text{-}X)$	$\sum(m_e+p_e+a_e)$	$\sum m_e$	$\sum p_e$	$\sum a_e$
GHG	0,3404994	0,4129593	-0,0724599	-0,0724599	-0,0248043	-0,0752752	0,0276196
deviation %			-18%				
A+B: Agriculture, hunting and forestry, fishing	X^s_e	X^s	$(X^s_e{*}P^s_e) - (X^s{*}P^s)$	$m_s+p_s+a_s$	m_s	p_s	a_s
GHG	1,6036195	1,6925946	0,0090750	0,0090750	0,0122109	-0,0024940	-0,0006419
deviation %			19%				
C: Mining and quarrying	X^s_e	X^s	$(X^s_e{*}P^s_e) - (X^s{*}P^s)$	$m_s+p_s+a_s$	m_s	p_s	a_s
GHG	0,2843369	0,1346742	-0,0002194	-0,0002194	-0,0004528	0,0007365	-0,0005032
deviation %			-33%				
D: Manufacturing activities	X^s_e	X^s	$(X^s_e{*}P^s_e) - (X^s{*}P^s)$	$m_s+p_s+a_s$	m_s	p_s	a_s
GHG	0,5483483	0,4914558	0,0439822	0,0439822	0,0288229	0,0118227	0,0033366
deviation %			43%				
E: Electricity, gas and water supply	X^s_e	X^s	$(X^s_e{*}P^s_e) - (X^s{*}P^s)$	$m_s+p_s+a_s$	m_s	p_s	a_s
GHG	5,0695846	9,0570952	-0,1124754	-0,1124754	-0,0603154	-0,0787146	0,0265547
deviation %			-63%				
F: Construction	X^s_e	X^s	$(X^s_e{*}P^s_e) - (X^s{*}P^s)$	$m_s+p_s+a_s$	m_s	p_s	a_s
GHG	0,0149001	0,0491699	-0,0017309	-0,0017309	-0,0000421	-0,0017182	0,0000294
deviation %			-70%				
G+H: Wholesale and retail trade, hotels and restaurants	X^s_e	X^s	$(X^s_e{*}P^s_e) - (X^s{*}P^s)$	$m_s+p_s+a_s$	m_s	p_s	a_s
GHG	0,0531170	0,1169122	-0,0103809	-0,0103809	0,0005637	-0,0106371	-0,0003076
deviation %			-53%				
I: Transport, storage and communication	X^s_e	X^s	$(X^s_e{*}P^s_e) - (X^s{*}P^s)$	$m_s+p_s+a_s$	m_s	p_s	a_s
GHG	0,4763596	0,5165247	-0,0053817	-0,0053817	-0,0026492	-0,0029385	0,0002060
deviation %			-14%				
J-Q: Other services	X^s_e	X^s	$(X^s_e{*}P^s_e) - (X^s{*}P^s)$	$m_s+p_s+a_s$	m_s	p_s	a_s
GHG	0,0730957	0,0538107	0,0046713	0,0046713	-0,0029422	0,0086680	-0,0010545
deviation %			19%				

6.2.2 Analysis of Findings

Shift Share Analysis of the Manufacturing (D) Sub-sectors

A Shift-Share analysis in the macro-sector D highlights those components that contribute positively and negatively to the overall disadvantage of the field and those that confirm a non-efficient regional specialization. Such analysis is suggested by the positive covariance of sector D (a= 0,0033366 the region is not specialized in sub-sectors with greater environmental efficiency in terms of emissions of GHG).

Table 4 - Shift Share coefficients of sub-sector DI

DI Fabrication of non- metallic products	X^s_e	X^s	$(X^s_e*P^s_e) - (X^s*P^s)$	m_s	p_s	a_s
GHG	2,4742436	2,5881831	0,1597444	0,1749735	-0,0075262	-0,0077029
deviation %			93%			

The differential is the maximum positive value (0,1597444) and as a consequence the sector is highlighted as that with the most negative impact. However a good specific environmental efficiency is connected to a non-efficient sectoral composition of the economy (m_s=0,1749735).

Table 5 – Shift-Share Coefficients of Sub-sector DF

DF Coke processing industries and treatment of nuclear fuel	X^s_e	X^s	$(X^s_e*P^s_e) - (X^s*P^s)$	m_s	p_s	a_s
GHG	0,1080430	6,6672333	**-0,0718431**	**-0,0555891**	**-0,0709423**	0,0546883
deviation %			-99%			

Industry mix and *differential* effects are shown by maximum negative values (m_s= -0,0555891 and p_s= -0,0709423) and therefore give the maximum positive impact on the differential of sector D (-0,0718431). Between these two effects, the specific sub-sectoral efficiency prevails.

Shift Share Analysis Outputs

On the whole, therefore, the relative efficiency of E-R compared to Italy is explained more by a lower effective Emission Intensity per unit of Added Value, rather than by an efficient sectoral composition of the economy in terms of emissions produced. The covariance between the two effects (a), that of sectoral mix and of specific efficiency, is positive, which means that E-R is not characterized particularly by a specialization in sectors in which its differential in terms of emissions is greater than the national average. The most efficient sectors are not with those have the greatest impact on the economy.

Continuing with the Shift-Share analysis of single economic sectors produces some further results, indicating that the total differentials of efficiency for GHG do not remain in favour of E-R for every sector (see Figure 10). As far as the observed differential for the regional average is concerned, it can be seen that the macro-sectors contributing the most to the region's positive advantage are, in order of priority, (i) E (ii) G+H (iii) I, (iiii) F, (v) C. The sectors with the greatest negative impact on the regional average are, in increasing order vi)J-Q 7) A+B, 8) D.

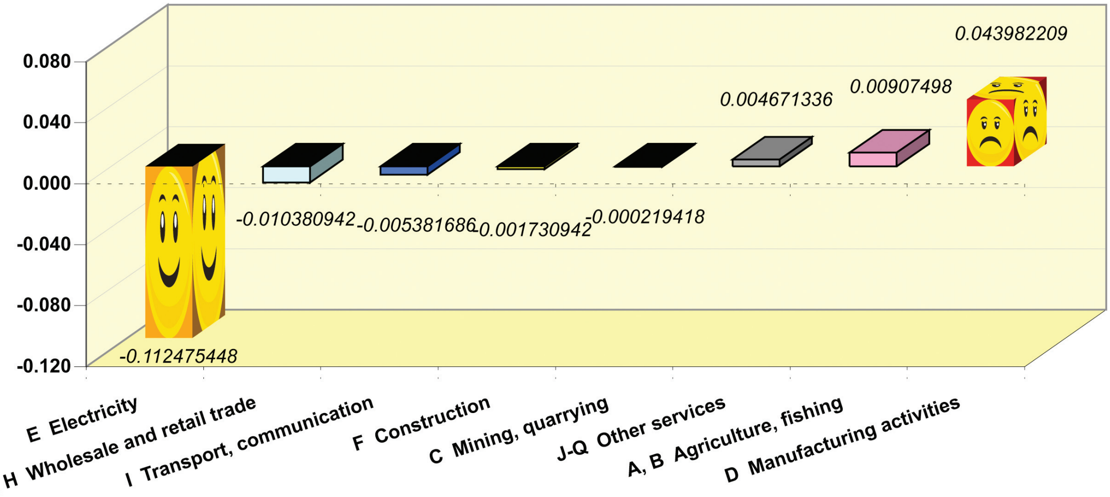


Figure 10
Sectoral Shift-Share Analysis ((E-R/Italy)
Source: RAMEA 2000

We can observe that the sector E contributes more positively than the other sectors to the positive differential efficiency of E-R compared to Italy. The sector E seems to be the main sectoral driver of the relative efficiency of E-R in terms of Emission of GHG (-0,1124754).

The same sector itself turns out to be also more efficient than the others from the point of view of environmental-specific efficiency (p maximum relative value) and from the point of view of industry-mix effect (m maximum value). Instead it is sector D which contributes the most negative effect on the average differential of economy (0,0439822): in particular all the three effects are >0, unlike all the other cases, with maximum values both for the effect *m* and for *p*.

A possible policy strategy to address this could entail a combined mix of regional development and environmental policy in the sector. The positive covariance indicates a non specialization of the macro-sectors with a greater comparative advantage (low Emission Intensity), that is, in the most efficient sectors (positive mix of m and p: m and p<0). Through further analysis in the sub-sectors, the *Ceramics* sector is been identified as having the disadvantageous differential. The relative ranking of the manufacturing sub-sectors (D) is shown in Figure 11.

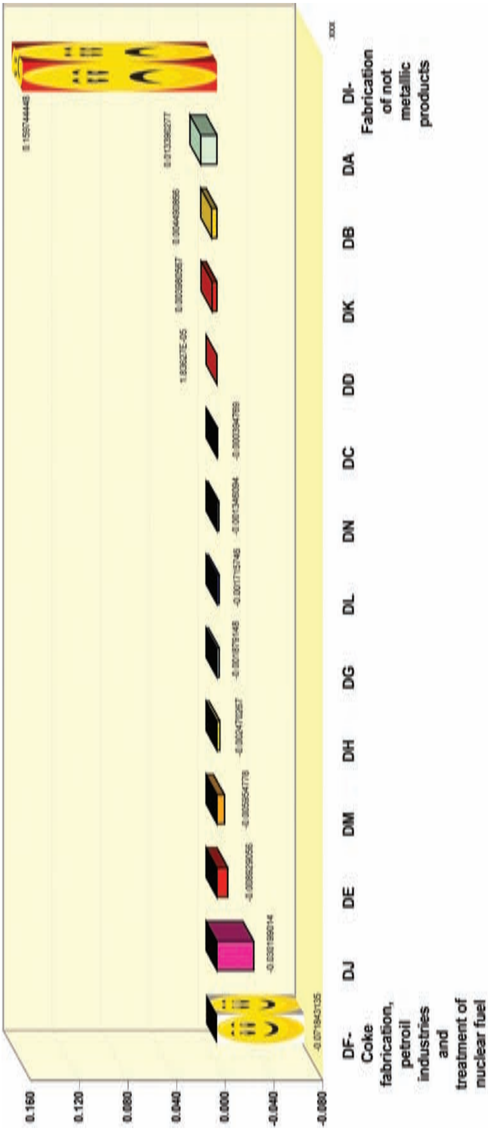


Figure 11
Shift-Share Analysis of Sector D (Emilia-Romagna / Italy) : (Xde*Pde-Xd*Pd)
Source: RAMEA 2000

Considering the sector A+B, which ranks second in relation to the most negative effect on the whole differential of the economy (0,0090750), the industry-mix effect denotes that inside this sector, the Added Value composition is not effective in terms of emission efficiency, even if the negative sign of the effect p remains. A negative covariance could influence regional policy to try and develop those sub-sectors with a lower Emission Intensity in order to make the most of this comparative advantage.

In no sectors is there a positive combination of the three effects (m, p, a<0); however more sectors are characterized by an environmental-specific efficiency (in decreasing order G+H, I, A+B, F). A general approach on how to derive and analyze the Shift-Share signs is explained in Foderà *et al*. (2005). In these sectors where, as a result of an analysis of the total air emissions for the sector, it is possible to verify a covariance <0 corresponding to an effect where m<0, regional strategies could encourage and / or develop sectoral technologies with lower air emissions, whilst increasing the positive effect on the economy. This would connect the impact due to the sectoral specialization (m<0) with a greater efficiency in terms of emission of GHG (in this case: C, J-Q).

Table 6 - Synthesis of the Shift-Share analysis for Sectors D, E, A+B

Sector	Impact	Comments	Notes
D	the most negative impacting ($Xs_e - Xs = 0439822$)	All the three effects are >0. The factors m and p are the highest. The Industry mix effect quantifies the higher part of Intensity of emission given by the weight of the sector D on the regional economy, compared to the national average.	Shift Share analysis of the sub-sectors
E	the most positive impacting ($Xs_e - Xs = -0,1124754$)	m and p are <0 and are relatively higher. More sector efficiency compared to the national average deriving both from the economy sectoral composition and from reasons connected to the lower emissions of GHG for unit of Added Value.	
A+B	the second sector for the disadvantage brought to the whole differential of the economic system: $Xs_e - Xs = 0,0090750$	Effect p<0, good environmental efficiency of emissions of GHG Effect m>0, shows that inside this sector the Added Value structure is not effective in terms of efficiency of emissions compared to the national average, even if the p sign is algebraically negative.	Covariance <0

Understanding the Indirect Effects / Responsibilities of Electricity Sector

As stated above (par. 6.1) the RAMEA (and NAMEA) approach considers the producer directly responsible for direct environmental pressures generated. The use of Input-Output (I/O) tables allows an analysis of the interface between the economy and the environment, based on the model proposed by W. Leontief in the 1970s, to identify not only which sectors directly contribute to production and any related pollution ("Producer Responsibility"), but also the sectoral and household responsibility related to the indirect impacts of consumption ("Consumer Responsibility").
In particular:

"the more an industry uses products of which the production is intensive in terms of pollution, the higher is the pollution indirectly caused by the production necessary to satisfy the final demand of its product"
(Eurostat 2004:71).

With the I/O table available in RAMEA, it is possible to highlight the consumption impacts of the sectors and households through their demand for electricity (Figure 12) and thus understand who is indirectly responsible for the high impact of this sector on the regional air emissions. The chart shows the different contribution to the total purchase from sector E, i.e. electricity demand from whom and by how much. This shows that part of the electricity produced is used to meet the needs of sectors DI (10.3%), E itself (9.9%), and Other Services and Commerce together (15.8%). However the biggest demand is from households, which could be held indirectly accountable for 34% of the emissions from sector E.

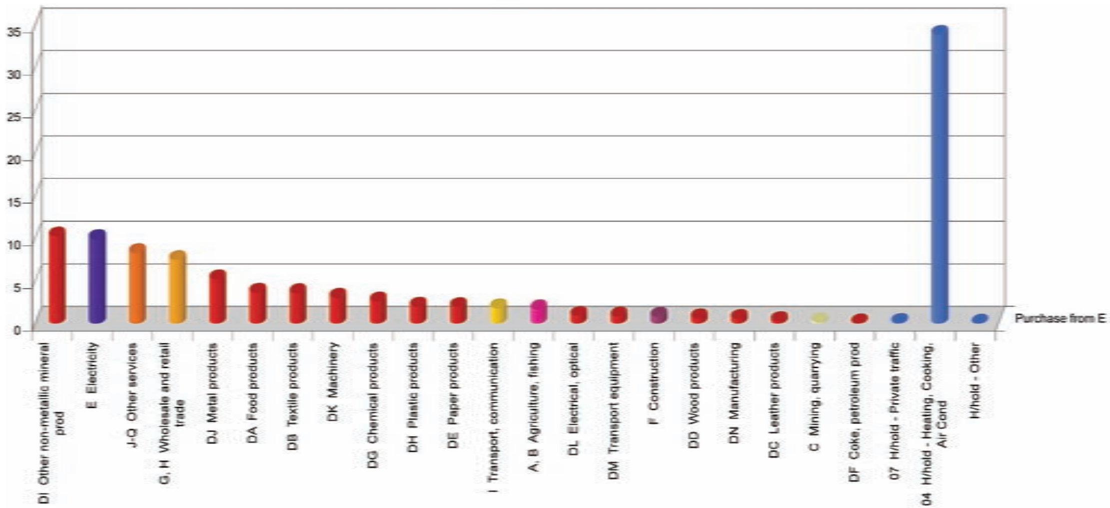


Figure 12
Indirect Sectoral Impact of Consumption from Sector E (Electricity, Gas and Water Supply) (%)
Source: RAMEA 2000

6.2.3 Use of the Findings from RAMEA

It is proposed to apply RAMEA in the Strategic Environmental Assessments (SEAs) of regional plans and programmes to forge a clear link between economy and environment and identify to decision-makers how the region could be developed economically and socially without causing environmental damage. In particular RAMEA can be invaluable in the:

- determination of the environmental issues, objectives and indicators that should be considered within an SEA;
- evaluation of the potential effects of plans and programmes on the environment (together with scenario analysis);
- evaluation of monitoring system for the programming document;
- decision-making on the basis of regional environmental information.

In Emilia-Romagna Region, RAMEA could be useful to assess regional plans and programmes prepared for the development of both the whole territory and of the different sectors (Energy, Agriculture, Industry…). Taking account of the results of the Shift-Share analysis, a prototype Decision Support Matrix (Table 7) has been constructed to support policy makers; after illustrating possible scenarios, depending on the possible combination of Shift-Share effects, a number of possible strategies have been identified for sectoral policy.

RAMEA could also be used help to inform the public about the decision-making process and chosen strategies, with the help of the integrated economic-environmental indicators already available or through the development of a single score indicator, like the ecological footprint or carbon footprint.

Table 7 - Effects of Shift Share Analysis & Possible Scenarios (Decision-Support Matrix)

m **Industry mix**	p **Differential**	a **Allocative**[32]	**How may Policy Makers react?**
-	-	-	
+	+	+	A combined programme of environmental and sectoral development Policy is advisable.
+	-	-	Sectoral development Policy to boost environmentally-efficient sectors.
+	+	-	
-	-	+	Double advantages of the effects m and p. A further Shift Share analysis of the sub-sectors allows us to look into their relative impacts, not being the mix of the effects m e p yet advantageous e.g. RAMEA E-R sector D (manufacturing).
-	+	+	A further Shift-Share analysis can give us information on the situations of the sub-sectors (a>0). An action aiming at the improvement and reduction of the Intensity of emission of sector would be useful.
-	+	-	An effective Environmental Policy can contribute to the technological development of sector. Besides improving the positive effect on the average economic system, it could combine the weight given by the sectoral specialization (m<0) with a greater efficiency in terms of emissions of GHG.

[32] Covariance

The availability of a more extended set of RAMEA together with analysis of all air, waste and water emissions, would allow this kind of analysis to be extended. In particular, it would be possible to characterize the trend of the three effects identified by Shift-Share analysis, separating out the trend of production structure factors and objectives of regional policy, from the trend of specific efficiencies, connected to the state of technologies and of the regulations and therefore objectives of the environmental policy.

6.3 Monitoring and Upgrading Proposals

RAMEA for Emilia-Romagna Region was built for years 1995 and 2000. An upgrade of the 2000 version for the year 2003 was developed for the benchmarking between RAMEA partners: while the 1995 and 2000 versions are based on robust data, the 2003 version, despite its suitability for the above purpose, should be viewed with lower level of confidence.

A first step in any upgrade should be to improve the 2003 version to the same level of uncertainty / confidence of the others, in order to have a more recent year and consistent time series. This will need considerable effort to gather sufficiently robust environmental data on air emissions which, in comparison to economic data, are usually updated less frequently. On the other hand environmental data are becoming more and more important for planners and, as related to the economic data, are of particular importance for the reduction of GHG emissions through trading schemes and Kyoto project-based mechanisms[33].

Another potential improvement under consideration is the extension of the RAMEA framework to include additional environmental aspects, such as liquid and solid waste, eutrophication, direct and indirect effects of energy, and the inclusion of the social dimension.

[33]see in particular Directive 2003/87/EC "Emissions Trading" and Directive 2004/101/EC "Linking"

7.0 Annex - RAMEA Frameworks

SE England

UK 2003	Output National	Output Regional	Output Regional / Output National	Gross Value-Added (GVA) National	GVA Regional	Compensation of Employees (National)
SIC '93	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*
Total economic activities	883492	136792	15.48310568	425256	62444	245752
A+B Agriculture hunting forestry fishing	23242	3892	16.74554685	9978	1171	2990
C Mining and quarrying	13851	130	0.938560393	10445	77	681
D	211057	45803	21.70172039	60170	13018	37192
E	25319	5427	21.43449583	7243	1631	1792
F	63650	10747	16.88452474	23598	3980	15719
G+H	113723	16782	14.75690933	64622	9896	36807
I	42632	4303	10.0933571	19531	2324	12500
J-Q	390018	49707	12.74479639	229669	30343	138071
Private Traffic (Consumers)	0	0	0	0	0	0
Others (consumers)	0	0	0	0	0	0
Total (consumers)						
A+B+G+H+I	179597	24977	0.139072479	94131	13391	52297

UK 2003	Compensation of Employees (Regional)	Population (National)	Population (Regional)	Labour Input (National)	Labor Input (Regional)	CO_2 (National)	CO_2 (Regional)
SIC '93	*mln. €uro*	*millions*	*millions*	*1000 FTE's*	*1000 FTE's*	*000 tonnes*	*000 tonnes*
Total economic activities	36580	16.2253	2.4036	6547.2	989.8	164224	29138.42808
A+B Agriculture hunting forestry fishing	440	16.2253	2.4036	224.6	35.9	9705	1625.155322
C Mining and quarrying	20	16.2253	2.4036	9.1	0.3	2470	23.1824417
D	8436	16.2253	2.4036	892.7	192.7	44978	6847.450728
E	244	16.2253	2.4036	30.5	4.2	54626	11708.80769
F	2622	16.2253	2.4036	460.2	77.1	1411	238.2406441
G+H	5693	16.2253	2.4036	1239.9	192.9	5031	746.0392667
I	1437	16.2253	2.4036	318.1	40.5	26106	1569.827487
J-Q	17690	16.2253	2.4036	3372	446.1	19898	2524.546718
Private Traffic (Consumers)	0	16.2253	2.4036	0	0	18161	2814.955
Others (consumers)		16.2253	2.4036			20216	2998.0328
Total (consumers)		16.2253	2.4036			38377	5812.9878
		16.2253	2.4036				
A+B+G+H+I	7570	16.2253	2.4036	1782.6	269.3	40842	3941.022076

UK 2003	N_2O (National)	N_2O (Regional)	CH_4 (National)	CH_4 (Regional)	CFCs (National)	CFCs (Regional)	NO_x (National)
SIC '93	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*tonnes*	*tonnes*	*000 tonnes*
Total economic activities	54.62	10.01664035	487.88	74.37976005	95	12.36178581	526.74
A+B Agriculture hunting forestry fishing	30.23	5.062178814	404.92	67.80606832	0	0	54.18
C Mining and quarrying	0	0	49.4	0.463648834	0	0	3.89
D	21.79	4.469773289	17.37	3.328545677	0	0	54.47
E	0.42	0.090024882	4.8	1.0288558	0	0	48.35
F	0.02	0.003376905	0.08	0.01350762	13	2.194988217	11.67
G+H	0.06	0.008851153	0.45	0.06675176	0	0	16.83
I	0.33	0.022073733	0.67	0.043718945	0	0	281.54
J-Q	1.77	0.222101156	10.24	1.275125863	82	10.16679759	55.81
Private Traffic (Consumers)	1.08	0.1674	3.04	0.4712	65	10.075	51.82
Others (consumers)	0.19	0.028177	18.05	2.676815	0	0	19.96
Total (consumers)	1.27	0.195577	21.09	3.148015	65	10.075	71.78
A+B+G+H+I	30.62	5.093103701	406.04	67.91653903	0	0	352.55

UK 2003	NO_x (Regional)	SO_2 (National)	SO_2 (Regional)	NH_3 (National)	NH_3 (Regional)	PM10 (National)	PM10 (Regional)
SIC '93	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*
Total economic activities	77.74638242	133.06	9.946023891	121.1	20.40317776	46.4	9.132390647
A+B Agriculture hunting forestry fishing	9.072737286	6.62	1.108555202	117.34	19.64922468	10.2	1.708045779
C Mining and quarrying	0.036509999	0.25	0.002346401	0	0	0.1	0.00093856
D	8.571275288	42.47	2.679350383	2.67	0.564379063	12.2	2.058225208
E	10.36357874	13.9	2.979394921	0.06	0.012860697	0.5	0.107172479
F	1.970424038	0.71	0.119880126	0.01	0.001688452	2	0.337690495
G+H	2.456514631	0.07	0.010252724	0.18	0.026455298	0.7	0.103018051
I	16.9775445	65.43	0.736519952	0.1	0.011610966	19	1.754469854
J-Q	6.995461695	3.64	0.447090453	0.71	0.090685162	5.4	0.673073914
Private Traffic (Consumers)	8.0321	0.56	0.0868	2.08	0.3224	11.2	1.736
Others (consumers)	2.960068	0.52	0.077116	7.04	1.044032	0	0
Total (consumers)	10.992168	1.08	0.163916	9.12	1.366432	11.2	1.736
A+B+G+H+I	28.50679642	72.12	1.855327877	117.62	19.68729094	29.9	3.565533684

UK 2003	GHG (National)	GHG (Regional)	Acidification (National)	Acidification (Regional)	Eutropohication (National)	Eutropohication (Regional)	Toxicity Potential (National)
SIC '93							
Total economic activities	191401.68	33805.56155	22732.5546	3201.134516	1361.56	224.566852	16.12601619
A+B Agriculture hunting forestry fishing	27579.62	4618.358189	8286.687	1387.651054	850.99	142.5029292	1.414803702
C Mining and quarrying	3507.4	32.91906722	92.3811	0.867052415	1.2	0.011262725	0.060178138
D	52097.67	8302.979907	2668.4147	303.2660007	137.39	28.70601537	3.847920069
E	54857	11758.32138	1489.0332	319.1667592	15.91	3.410228287	1.578349566
F	1418.88	239.5711447	276.4815	46.68258728	41.96	7.084746583	0.177486061
G+H	5059.05	750.1849113	378.6593	55.28112632	5.82	0.849481859	0.183056796
I	26222.37	1577.588442	8171.2491	392.7910229	86.65	5.298580359	7.996941585
J-Q	20661.74	2620.175719	1368.8216	171.3870151	226.84	28.15502694	0.869502256
Private Traffic (Consumers)	18559.64	2876.7442	1266.4124	196.293922	18.11	2.80705	0.594493464
Others (consumers)	20653.95	3062.980785	864.2732	128.1717156	241.29	35.783307	0.270219549
Total (consumers)	39213.59	5939.725	2130.6856	324.4656376	259.4	38.590357	0.864713013
A+B+G+H+I	58861.04	6946.131543	16836.5954	1835.723204	943.46	148.6509914	9.594802082

UK 2003	Toxicity Potential (Regional)	GHG / Output (National)	GHG / Output (Regional)	GHG/GVA (National)	GHG/GVA (Regional)	GHG / Capita (National)	GHG / Capita (Regional)	Acidity / Output (National)	Acidity / Output (Regional)
SIC '93									
Total economic activities	1.641756527	0.216642233	0.24713113	0.541374056	0.450085784	11796.4956	14064.55381	0.025730346	0.023401475
A+B Agriculture hunting forestry fishing	0.236916617	1.186628517	1.186628517	3.9439438	2.764042894	1699.791067	1921.433762	0.356539325	0.356539325
C Mining and quarrying	0.000564808	0.253223594	0.253223594	0.427520353	0.335797032	216.1685762	13.6957344	0.006669634	0.006669634
D	0.297940338	0.246841706	0.181275897	0.637807644	0.865841283	3210.891016	3454.393371	0.0126431	0.006621095
E	0.338311272	2.166633753	2.166633753	7.209271232	7.573795389	3380.954435	4891.962631	0.058810901	0.058810901
F	0.029967678	0.022291909	0.022291909	0.060193755	0.060127129	87.4486142	99.67180259	0.004343778	0.004343778
G+H	0.026722306	0.044485724	0.044701759	0.075806883	0.078286806	311.80009	312.108883	0.003329663	0.003294073
I	0.23539955	0.615086555	0.366625248	0.678824631	1.342602529	1616.140842	656.3440015	0.191669382	0.091283064
J-Q	0.108287113	0.052976375	0.052712409	0.086351901	0.089963121	1273.427302	1090.104726	0.003509637	0.003447945
Private Traffic (Consumers)	0.092146487					1143.870375	1196.848144		
Others (consumers)	0.040073559					1272.947187	1274.330498		
Total (consumers)	0.132220046					2416.817563	2471.178649		
						0	0		
A+B+G+H+I	0.499038473	0.32773955	0.278101115	0.518716417	0.625309834	3627.731999	2889.886646	0.093746529	0.073496545

UK 2003	Acidity / GVA (National)	Acidity / GVA (Regional)	Acidity / Capita (National)	Acidity / Capita (Regional)	Toxicity / Output (National)	Toxicity / Output (Regional)	Toxicity / GVA (National)	Toxicity / GVA (Regional)
SIC '93								
Total economic activities	0.36404706	0.053456164	1401.056042	1331.808336	1.82526E-05	1.20018E-05	3.79207E-05	2.62917E-05
A+B Agriculture hunting forestry fishing	7.076590094	0.830495791	510.7262732	577.3219564	6.08727E-05	6.08727E-05	0.000141792	0.00020232
C Mining and quarrying	1.199754545	0.008844528	5.69364511	0.360730743	4.34468E-06	4.34468E-06	5.76143E-06	7.33517E-06
D	0.204978852	0.044347926	164.4601148	126.1715763	1.82317E-05	6.50482E-06	6.39508E-05	2.28868E-05
E	0.912957204	0.205582383	91.77230621	132.7869692	6.23385E-05	6.23385E-05	0.000217914	0.000207426
F	0.069467714	0.011716311	17.04014718	19.42194512	2.78847E-06	2.78847E-06	7.52123E-06	7.52957E-06
G+H	0.038263874	0.005859604	23.3375839	22.99930368	1.60967E-06	1.59232E-06	2.83273E-06	2.70031E-06
I	3.516028012	0.418373309	503.6115881	163.4177995	0.000187581	5.47059E-05	0.000409449	0.000101291
J-Q	0.045111611	0.005959975	84.36340776	71.30429984	2.22939E-06	2.17851E-06	3.78589E-06	3.56877E-06
Private Traffic (Consumers)			78.05170937	81.66663422				
Others (consumers)			53.26700893	53.32489414				
Total (consumers)			131.3187183	134.9915284				
			0	0				
A+B+G+H+I	1.257306803	0.17886345	1037.675445	763.7390596	5.34241E-05	1.99799E-05	0.00010193	3.72667E-05

UK 2003	Toxicity / Capita (National)	Toxicity / Capita (Regional)	GHG / Employee National	GHG / Employee Regional	Acidity / Employee National	Acidity / Employee Regional	Toxicity / Employee National	Toxicity / Employee Regional
SIC '93								
Total economic activities	0.993880926	0.683040659	29.23412757	34.15393165	3.472103281	3.234122566	0.00246304	0.001658675
A+B Agriculture hunting forestry fishing	0.087197383	0.098567406	122.79439	128.6450749	36.89531167	38.65323271	0.006299215	0.006599349
C Mining and quarrying	0.003708908	0.000234984	385.4285714	109.7302241	10.15176923	2.890174717	0.006612982	0.001882694
D	0.237155558	0.123955874	58.3596617	43.08759682	2.989150554	1.573772708	0.004310429	0.001546136
E	0.097277065	0.140751902	1798.590164	2799.600328	48.82076066	75.99208553	0.051749166	0.080550303
F	0.010938846	0.012467831	3.083181226	3.107278141	0.600785528	0.605481028	0.000385672	0.000388686
G+H	0.011282183	0.011117618	4.080208081	3.888983469	0.305395032	0.286579193	0.000147638	0.000138529
I	0.492868642	0.097936241	82.43436026	38.95280103	25.687674	9.698543776	0.025139709	0.005812335
J-Q	0.053589287	0.045052052	6.127443654	5.873516519	0.405937604	0.384189677	0.00025786	0.000242742
Private Traffic (Consumers)	0.036639906	0.038336864						
Others (consumers)	0.01665421	0.016672308						
Total (consumers)	0.053294116	0.055009172						
	0	0						
A+B+G+H+I	0.591348208	0.207621265	33.01976888	25.7932846	9.444965444	6.816647618	0.005382476	0.001853095

Noord-Brabant

The Netherlands 2003	Output National	Output Regional	Output Regional / Output National	Gross Value-Added (GVA) National	GVA Regional	Compensation of Employees (National)
SIC '93	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*
Total economic activities	883492	136792	15.48310568	425256	62444	245752
A+B Agriculture hunting forestry fishing	23242	3892	16.74554685	9978	1171	2990
C Mining and quarrying	13851	130	0.938560393	10445	77	681
D	211057	45803	21.70172039	60170	13018	37192
E	25319	5427	21.43449583	7243	1631	1792
F	63650	10747	16.88452474	23598	3980	15719
G+H	113723	16782	14.75690933	64622	9896	36807
I	42632	4303	10.0933571	19531	2324	12500
J-Q	390018	49707	12.74479639	229669	30343	138071
Private Traffic (Consumers)	0	0	0	0	0	0
Others (consumers)	0	0	0	0	0	0
Total (consumers)						
A+B+G+H+I	179597	24977	0.139072479	94131	13391	52297

The Netherlands 2003	Compensation of Employees (Regional)	Population (National)	Population (Regional)	Labour Input (National)	Labor Input (Regional)	CO_2 (National)	CO_2 (Regional)
SIC '93	*mln. €uro*	*millions*	*millions*	*1000 FTE's*	*1000 FTE's*	*000 tonnes*	*000 tonnes*
Total economic activities	36580	16.2253	2.4036	6547.2	989.8	164224	29138.42808
A+B Agriculture hunting forestry fishing	440	16.2253	2.4036	224.6	35.9	9705	1625.155322
C Mining and quarrying	20	16.2253	2.4036	9.1	0.3	2470	23.1824417
D	8436	16.2253	2.4036	892.7	192.7	44978	6847.450728
E	244	16.2253	2.4036	30.5	4.2	54626	11708.80769
F	2622	16.2253	2.4036	460.2	77.1	1411	238.2406441
G+H	5693	16.2253	2.4036	1239.9	192.9	5031	746.0392667
I	1437	16.2253	2.4036	318.1	40.5	26106	1569.827487
J-Q	17690	16.2253	2.4036	3372	446.1	19898	2524.546718
Private Traffic (Consumers)	0	16.2253	2.4036	0	0	18161	2814.955
Others (consumers)		16.2253	2.4036			20216	2998.0328
Total (consumers)		16.2253	2.4036			38377	5812.9878
		16.2253	2.4036				
A+B+G+H+I	7570	16.2253	2.4036	1782.6	269.3	40842	3941.022076

The Netherlands 2003	N_2O (National)	N_2O (Regional)	CH_4 (National)	CH_4 (Regional)	CFCs (National)	CFCs (Regional)	NO_x (National)
SIC '93	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*tonnes*	*tonnes*	*000 tonnes*
Total economic activities	54.62	10.01664035	487.88	74.37976005	95	12.36178581	526.74
A+B Agriculture hunting forestry fishing	30.23	5.062178814	404.92	67.80606832	0	0	54.18
C Mining and quarrying	0	0	49.4	0.463648834	0	0	3.89
D	21.79	4.469773289	17.37	3.328545677	0	0	54.47
E	0.42	0.090024882	4.8	1.0288558	0	0	48.35
F	0.02	0.003376905	0.08	0.01350762	13	2.194988217	11.67
G+H	0.06	0.008851153	0.45	0.06675176	0	0	16.83
I	0.33	0.022073733	0.67	0.043718945	0	0	281.54
J-Q	1.77	0.222101156	10.24	1.275125863	82	10.16679759	55.81
Private Traffic (Consumers)	1.08	0.1674	3.04	0.4712	65	10.075	51.82
Others (consumers)	0.19	0.028177	18.05	2.676815	0	0	19.96
Total (consumers)	1.27	0.195577	21.09	3.148015	65	10.075	71.78
A+B+G+H+I	30.62	5.093103701	406.04	67.91653903	0	0	352.55

The Netherlands 2003	NO_x (Regional)	SO_2 (National)	SO_2 (Regional)	NH_3 (National)	NH_3 (Regional)	PM10 (National)	PM10 (Regional)
SIC '93	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*
Total economic activities	77.74638242	133.06	9.946023891	121.1	20.40317776	46.4	9.132390647
A+B Agriculture hunting forestry fishing	9.072737286	6.62	1.108555202	117.34	19.64922468	10.2	1.708045779
C Mining and quarrying	0.036509999	0.25	0.002346401	0	0	0.1	0.00093856
D	8.571275288	42.47	2.679350383	2.67	0.564379063	12.2	2.058225208
E	10.36357874	13.9	2.979394921	0.06	0.012860697	0.5	0.107172479
F	1.970424038	0.71	0.119880126	0.01	0.001688452	2	0.337690495
G+H	2.456514631	0.07	0.010252724	0.18	0.026455298	0.7	0.103018051
I	16.9775445	65.43	0.736519952	0.1	0.011610966	19	1.754469854
J-Q	6.995461695	3.64	0.447090453	0.71	0.090685162	5.4	0.673073914
Private Traffic (Consumers)	8.0321	0.56	0.0868	2.08	0.3224	11.2	1.736
Others (consumers)	2.960068	0.52	0.077116	7.04	1.044032	0	0
Total (consumers)	10.992168	1.08	0.163916	9.12	1.366432	11.2	1.736
A+B+G+H+I	28.50679642	72.12	1.855327877	117.62	19.68729094	29.9	3.565533684

The Netherlands 2003	GHG (National)	GHG (Regional)	Acidification (National)	Acidification (Regional)	Eutropohication (National)	Eutropohication (Regional)	Toxicity Potential (National)
SIC '93							
Total economic activities	191401.68	33805.56155	22732.5546	3201.134516	1361.56	224.566852	16.12601619
A+B Agriculture hunting forestry fishing	27579.62	4618.358189	8286.687	1387.651054	850.99	142.5029292	1.414803702
C Mining and quarrying	3507.4	32.91906722	92.3811	0.867052415	1.2	0.011262725	0.060178138
D	52097.67	8302.979907	2668.4147	303.2660007	137.39	28.70601537	3.847920069
E	54857	11758.32138	1489.0332	319.1667592	15.91	3.410228287	1.578349566
F	1418.88	239.5711447	276.4815	46.68258728	41.96	7.084746583	0.177486061
G+H	5059.05	750.1849113	378.6593	55.28112632	5.82	0.849481859	0.183056796
I	26222.37	1577.588442	8171.2491	392.7910229	86.65	5.298580359	7.996941585
J-Q	20661.74	2620.175719	1368.8216	171.3870151	226.84	28.15502694	0.869502256
Private Traffic (Consumers)	18559.64	2876.7442	1266.4124	196.293922	18.11	2.80705	0.594493464
Others (consumers)	20653.95	3062.980785	864.2732	128.1717156	241.29	35.783307	0.270219549
Total (consumers)	39213.59	5939.725	2130.6856	324.4656376	259.4	38.590357	0.864713013
A+B+G+H+I	58861.04	6946.131543	16836.5954	1835.723204	943.46	148.6509914	9.594802082

The Netherlands 2003	Toxicity Potential (Regional)	GHG / Output (National)	GHG / Output (Regional)	GHG/GVA (National)	GHG/GVA (Regional)	GHG / Capita (National)	GHG / Capita (Regional)	Acidity / Output (National)	Acidity / Output (Regional)
SIC '93									
Total economic activities	1.641756527	0.216642233	0.24713113	0.541374056	0.450085784	11796.4956	14064.55381	0.025730346	0.023401475
A+B Agriculture hunting forestry fishing	0.236916617	1.186628517	1.186628517	3.9439438	2.764042894	1699.791067	1921.433762	0.356539325	0.356539325
C Mining and quarrying	0.000564808	0.253223594	0.253223594	0.427520353	0.335797032	216.1685762	13.6957344	0.006669634	0.006669634
D	0.297940338	0.246841706	0.181275897	0.637807644	0.865841283	3210.891016	3454.393371	0.0126431	0.006621095
E	0.338311272	2.166633753	2.166633753	7.209271232	7.573795389	3380.954435	4891.962631	0.058810901	0.058810901
F	0.029967678	0.022291909	0.022291909	0.060193755	0.060127129	87.4486142	99.67180259	0.004343778	0.004343778
G+H	0.026722306	0.044485724	0.044701759	0.075806883	0.078286806	311.80009	312.108883	0.003329663	0.003294073
I	0.23539955	0.615086555	0.366625248	0.678824631	1.342602529	1616.140842	656.3440015	0.191669382	0.091283064
J-Q	0.108287113	0.052976375	0.052712409	0.086351901	0.089963121	1273.427302	1090.104726	0.003509637	0.003447945
Private Traffic (Consumers)	0.092146487					1143.870375	1196.848144		
Others (consumers)	0.040073559					1272.947187	1274.330498		
Total (consumers)	0.132220046					2416.817563	2471.178649		
						0	0		
A+B+G+H+I	0.499038473	0.32773955	0.278101115	0.518716417	0.625309834	3627.731999	2889.886646	0.093746529	0.073496545

The Netherlands 2003	Acidity / GVA (National)	Acidity / GVA (Regional)	Acidity / Capita (National)	Acidity / Capita (Regional)	Toxicity / Output (National)	Toxicity / Output (Regional)	Toxicity / GVA (National)	Toxicity / GVA (Regional)
SIC '93								
Total economic activities	0.36404706	0.053456164	1401.056042	1331.808336	1.82526E-05	1.20018E-05	3.79207E-05	2.62917E-05
A+B Agriculture hunting forestry fishing	7.076590094	0.830495791	510.7262732	577.3219564	6.08727E-05	6.08727E-05	0.000141792	0.00020232
C Mining and quarrying	1.199754545	0.008844528	5.69364511	0.360730743	4.34468E-06	4.34468E-06	5.76143E-06	7.33517E-06
D	0.204978852	0.044347926	164.4601148	126.1715763	1.82317E-05	6.50482E-06	6.39508E-05	2.28868E-05
E	0.912957204	0.205582383	91.77230621	132.7869692	6.23385E-05	6.23385E-05	0.000217914	0.000207426
F	0.069467714	0.011716311	17.04014718	19.42194512	2.78847E-06	2.78847E-06	7.52123E-06	7.52957E-06
G+H	0.038263874	0.005859604	23.3375839	22.99930368	1.60967E-06	1.59232E-06	2.83273E-06	2.70031E-06
I	3.516028012	0.418373309	503.6115881	163.4177995	0.000187581	5.47059E-05	0.000409449	0.000101291
J-Q	0.045111611	0.005959975	84.36340776	71.30429984	2.22939E-06	2.17851E-06	3.78589E-06	3.56877E-06
Private Traffic (Consumers)			78.05170937	81.66663422				
Others (consumers)			53.26700893	53.32489414				
Total (consumers)			131.3187183	134.9915284				
			0	0				
A+B+G+H+I	1.257306803	0.17886345	1037.675445	763.7390596	5.34241E-05	1.99799E-05	0.00010193	3.72667E-05

The Netherlands 2003	Toxicity / Capita (National)	Toxicity / Capita (Regional)	GHG / Employee National	GHG / Employee Regional	Acidity / Employee National	Acidity / Employee Regional	Toxicity / Employee National	Toxicity / Employee Regional
SIC '93								
Total economic activities	0.993880926	0.683040659	29.23412757	34.15393165	3.472103281	3.234122566	0.00246304	0.001658675
A+B Agriculture hunting forestry fishing	0.087197383	0.098567406	122.79439	128.6450749	36.89531167	38.65323271	0.006299215	0.006599349
C Mining and quarrying	0.003708908	0.000234984	385.4285714	109.7302241	10.15176923	2.890174717	0.006612982	0.001882694
D	0.237155558	0.123955874	58.3596617	43.08759682	2.989150554	1.573772708	0.004310429	0.001546136
E	0.097277065	0.140751902	1798.590164	2799.600328	48.82076066	75.99208553	0.051749166	0.080550303
F	0.010938846	0.012467831	3.083181226	3.107278141	0.600785528	0.605481028	0.000385672	0.000388686
G+H	0.011282183	0.011117618	4.080208081	3.888983469	0.305395032	0.286579193	0.000147638	0.000138529
I	0.492868642	0.097936241	82.43436026	38.95280103	25.687674	9.698543776	0.025139709	0.005812335
J-Q	0.053589287	0.045052052	6.127443654	5.873516519	0.405937604	0.384189677	0.00025786	0.000242742
Private Traffic (Consumers)	0.036639906	0.038336864						
Others (consumers)	0.01665421	0.016672308						
Total (consumers)	0.053294116	0.055009172						
	0	0						
A+B+G+H+I	0.591348208	0.207621265	33.01976888	25.7932846	9.444965444	6.816647618	0.005382476	0.001853095

Malopolska

Poland 2003	Output National	Output Regional	Output Regional / Output National	Gross Value-Added (GVA) National	GVA Regional	Compensation of Employees (National)
SIC '93	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*
Total Economic Activity	380132.4703	27037.71215	7.112707875	169021.2152	12342.21656	75254.69553
A+B Agriculture hunting forestry fishing	17853.79317	946.2810496	5.300168097	7341.079631	350.9482014	3624.698713
C Mining and quarrying	6338.941812	239.5319251	3.77873677	3058.165446	129.7012142	2573.445814
D	114142.2236	7965.833599	6.978866667	30850.49343	2225.226249	15779.52613
E	15437.69792	798.5672382	5.172838868	5426.781573	342.080131	2195.688753
F	25876.03656	2128.420756	8.225451184	9315.248533	783.2780026	3653.55405
G+H	66684.02701	5535.105666	8.300497007	36074.3781	2926.781573	10549.18368
I	27811.91755	1671.321229	6.009370716	12112.60176	745.4409023	5337.441448
J-Q	105987.8327	7752.650689	7.314661027	64842.46669	4838.760289	31541.15694
Private Traffic (Consumers)						
Others (consumers)						
Total (consumers)						
A+B+G+H+I	112349.7377	8152.707945	0.072565438	55528.05948	4023.170676	19511.32384

Poland 2003	Compensation of Employees (Regional)	Population (National)	Population (Regional)	Labour Input (National)	Labor Input (Regional)	CO_2 (National)	CO_2 (Regional)
SIC '93	*mln. €uro*	*millions*	*millions*	*1000 FTE's*	*1000 FTE's*	*000 tonnes*	*000 tonnes*
Total Economic Activity	5555.118468	38.2046	3.2451	6850.8	523.018	293177.81	12890.8
A+B Agriculture hunting forestry fishing	173.2457138	38.2046	3.2451	84.6	3.661		
C Mining and quarrying	106.0985038	38.2046	3.2451	196.3	2.625	1748.3	41.3
D	1156.714721	38.2046	3.2451	1918.2	139.924	44224.4	3795.8
E	143.0487971	38.2046	3.2451	227.1	15.965	172460	8993
F	289.8494702	38.2046	3.2451	333.1	31.891	57.4	6.6
G+H	839.7835281	38.2046	3.2451	828	78.347		
I	352.1306108	38.2046	3.2451	490.1	25.463		
J-Q	2494.247124	38.2046	3.2451	2773.4	225.142	54.9	28.4
Private Traffic (Consumers)		38.2046	3.2451				
Others (consumers)		38.2046	3.2451				
Total (consumers)		38.2046	3.2451				
		38.2046	3.2451				
A+B+G+H+I	1365.159853	38.2046	3.2451	1402.7	107.471	74632.81	25.7

Poland 2003	N_2O (National)	N_2O (Regional)	CH_4 (National)	CH_4 (Regional)	CFCs (National)	CFCs (Regional)	NO_x (National)
SIC '93	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*tonnes*	*tonnes*	*000 tonnes*
Total Economic Activity	77.21	5.49172175	1794.58	127.643233			805.15
A+B Agriculture hunting forestry fishing	52.96	3.76689009	441.97	31.43603499			0
C Mining and quarrying	0	0	0	0			0
D	14.05222	0.999493359	0	0			
E	7.41216	0.037498572	845.24718	60.11996273			261.9387
F	0	0	0	0			0
G+H	0	0	0	0			0
I	0	0	0	0			0
J-Q	2.54793	0.012890134	493.5095	35.10188907			112.721
Private Traffic (Consumers)							
Others (consumers)							
Total (consumers)							
A+B+G+H+I	0.23769	0.674949595	13.85332	0.985346183	0	0	430.4903

Poland 2003	NO_x (Regional)	SO_2 (National)	SO_2 (Regional)	NH_3 (National)	NH_3 (Regional)	PM10 (National)	PM10 (Regional)
SIC '93	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*
Total Economic Activity	57.26796745	1374.53	72.9	322.56	22.94275052		
A+B Agriculture hunting forestry fishing		0	0	311.76	22.17457807		
C Mining and quarrying		7.4	0.2	0	0		
D		117.7	10.1	0	0		
E	18.63093454	757.7	42.1	0	0		
F		0.2	4.7	0	0		
G+H		0	0	0	0		
I		0	0	0	0		
J-Q	57.02624523	0.2	0.0001	8	0.56901663		
Private Traffic (Consumers)							
Others (consumers)							
Total (consumers)							
A+B+G+H+I	75.65717977	491.33	15.7999	2.8	0.19915582	0	0

Poland 2003	GHG (National)	GHG (Regional)	Acidification (National)	Acidification (Regional)	Eutropohication (National)	Eutropohication (Regional)	Toxicity Potential (National)
SIC '93							
Total Economic Activity	354799.09	17273.74164	79.35477	4.873417565			115.12994
A+B Agriculture hunting forestry fishing	25698.97	1827.892663	18.39384	1.308300106			0.8907429
C Mining and quarrying	1748.3	41.3	0.2294	0.0062			0.5692308
D	48580.5882	4105.642941	3.6487	0.3131			9.0538462
E	192507.9604	10267.14377	29.2513514	1.71498056			61.041865
F	57.4	6.6	0.0062	0.1457			0.0153846
G+H	0	0	0	0			0
I	0	0	0	0			0
J-Q	11208.4578	769.535612	2.958062	1.288152476			1.2247786
Private Traffic (Consumers)	0	0	0	0			0
Others (consumers)	0	0	0	0			0
Total (consumers)	0	0	0	0			0
	0	0	0	0			0
A+B+G+H+I	74997.41362	255.6266443	24.8672166	2.166005048	0	0	42.334092

Poland 2003	Toxicity Potential (Regional)	GHG / Output (National)	GHG / Output (Regional)	GHG/GVA (National)	GHG/GVA (Regional)	GHG / Capita (National)	GHG / Capita (Regional)	Acidity / Output (National)	Acidity / Output (Regional)
SIC '93									
Total Economic Activity	6.2760637	0.933356442	0.638875861	1.399565592	2.099139387	9286.815986	5323.022907	0.000208756	0.000180245
A+B Agriculture hunting forestry fishing	0.0633559	1.439412329	1.931659377	5.208440037	3.500707157	672.666904	563.2777612	0.001030248	0.00138257
C Mining and quarrying	0.0153846	0.275803131	0.172419605	0.318424158	0.571682609	45.76150516	12.72688053	3.6189E-05	2.58838E-05
D	0.7769231	0.425614524	0.515406566	1.845045169	1.574710249	1271.590023	1265.182257	3.19663E-05	3.93054E-05
E	3.4345766	12.46999141	12.85695591	30.01385595	35.47368874	5038.868628	3163.891336	0.0018948	0.002147572
F	0.3615385	0.002218269	0.003100891	0.008426127	0.00616194	1.502436879	2.033835629	2.39604E-07	6.84545E-05
G+H	0	0	0	0	0	0	0	0	0
I	0	0	0	0	0	0	0	0	0
J-Q	0.6019097	0.105752307	0.099260968	0.159035696	0.172856746	293.3797972	237.137719	2.79094E-05	0.000166156
Private Traffic (Consumers)	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	#DIV/0!	#DIV/0!
Others (consumers)	0					0	0		
Total (consumers)	0					0	0		
	0					0	0		
A+B+G+H+I	2.0123373	0.66753528	0.031354814	0.063538603	1.350621907	1963.046691	78.77311771	0.000221338	0.000265679

Poland 2003	Acidity / GVA (National)	Acidity / GVA (Regional)	Acidity / Capita (National)	Acidity / Capita (Regional)	Toxicity / Output (National)	Toxicity / Output (Regional)	Toxicity / GVA (National)	Toxicity / GVA (Regional)
SIC '93								
Total Economic Activity	0.00642954	0.000469496	2.077099878	1.501777315	0.000302868	0.000232123	0.000681157	0.000508504
A+B Agriculture hunting forestry fishing	0.052411837	0.002505604	0.48145616	0.403161723	4.9891E-05	6.69526E-05	0.000121337	0.000180528
C Mining and quarrying	0.00176868	7.50123E-05	0.006004513	0.001910573	8.9799E-05	6.42278E-05	0.000186135	0.000118616
D	0.001639698	0.00011827	0.095504206	0.09648393	7.93207E-05	9.75319E-05	0.000293475	0.000349143
E	0.085510232	0.005390184	0.765649985	0.528483116	0.003954078	0.004300924	0.011248263	0.010040269
F	7.91545E-06	6.65575E-07	0.000162284	0.044898462	5.94551E-07	0.000169862	1.65155E-06	0.000461571
G+H		0	0	0	0	0	0	0
I		0	0	0	0	0	0	0
J-Q		4.56192E-05	0.077426854	0.396953091	1.15558E-05	7.76392E-05	1.88885E-05	0.000124393
Private Traffic (Consumers)		#DIV/0!	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Others (consumers)			0	0				
Total (consumers)			0	0				
			0	0				
A+B+G+H+I	0.006181	0.000447832	0.650895876	0.66746943	0.000376806	0.000246831	0.000762391	0.000500187

Poland 2003	Toxicity / Capita (National)	Toxicity / Capita (Regional)	GHG / Employee National	GHG / Employee Regional	Acidity / Employee National	Acidity / Employee Regional	Toxicity / Employee National	Toxicity / Employee Regional
SIC '93								
Total Economic Activity	3.013509894	1.934012429	51.78943919	33.02705	0.011583285	0.009317877	0.016805328	0.011999709
A+B Agriculture hunting forestry fishing	0.023315068	0.01952357	303.770331	499.2878074	0.217421277	0.357361406	0.010528875	0.017305637
C Mining and quarrying	0.014899535	0.004740876	8.90626592	15.73333333	0.001168619	0.002361905	0.0028998	0.005860806
D	0.236983142	0.239414217	25.32613294	29.3419495	0.001902148	0.002237643	0.00471997	0.005552465
E	1.597762177	1.058388536	847.6792619	643.1032743	0.128803837	0.107421269	0.268788485	0.21513164
F	0.00040269	0.111410576	0.172320624	0.20695494	1.8613E-05	0.004568687	4.61862E-05	0.011336693
G+H	0	0	0	0	0	0	0	0
I	0	0	0	0	0	0	0	0
J-Q	0.032058407	0.185482641	4.041414077	3.418001137	0.001066583	0.005721511	0.000441616	0.002673467
Private Traffic (Consumers)	0	0						
Others (consumers)	0	0						
Total (consumers)	0	0						
	0	0						
A+B+G+H+I	1.108088875	0.620115653	53.46646726	2.378563931	0.017728108	0.020154321	0.030180432	0.018724468

Emilia-Romagna

Italy 2003	Output National	Output Regional	Output Regional / Output National	Gross Value-Added (GVA) National	GVA Regional	Compensation of Employees (National)
SIC '93	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*	*mln. €uro*
Total Economic Activity	2587886.63	220612.6943	8.524820668	1203739.73	106218.0022	250830.2045
A+B Agriculture hunting forestry fishing	49248.18	5247.68072	10.65558305	30468.76	3310.010226	6535.245601
C Mining and quarrying	8332.48	205.3787181	2.464797012	4750.25	115.1801517	869.7134181
D	821347.81	81877.51187	9.9686772	229249.11	26453.65425	85081.10956
E	63209.93	4113.953356	6.508397266	24196.74	1677.826066	4410.025461
F	163899.8	13779.126	8.407042596	67795.48	6027.421498	17223.32113
G+H	436465.83	31340.71285	7.180565052	189496.87	17818.01823	53554.51461
I	209840.77	14770.67351	7.038991284	91938.1	7189.386216	27369.63337
J-Q	835541.83	69277.65728	8.291345184	565844.42	43626.50555	55786.64133
Private Traffic (Consumers)	na	na	na	na	na	na
Others (consumers)	na	na	na	na	na	na
Total (consumers)	na	na	na	na	na	na
A+B+G+H+I	695554.78	51359.06708	0.073838997	311903.73	28317.41467	87459.39358

Italy 2003	Compensation of Employees (Regional)	Population (National)	Population (Regional)	Labour Input (National)	Labor Input (Regional)	CO_2 (National)	CO_2 (Regional)
SIC '93	*mln. €uro*	*millions*	*millions*	*1000 FTE's*	*1000 FTE's*	*000 tonnes*	*000 tonnes*
Total Economic Activity	31819.83918	57.6047	4.0554	24282.9	2060.5	375397.4667	28148.13889
A+B Agriculture hunting forestry fishing	509.8462508	57.6047	4.0554	1388.8	113.8	8839.491679	839.2232454
C Mining and quarrying	27.32056996	57.6047	4.0554	41.4	1.399999981	552.751934	13.79393222
D	10309.30604	57.6047	4.0554	4914.9	554.7	100806.661	13592.36653
E	297.6857566	57.6047	4.0554	131.9	8.9	186536.2756	8017.126637
F	1220.439298	57.6047	4.0554	1794.1	127.1	2718.923666	33.98425921
G+H	5014.125096	57.6047	4.0554	4947.4	435.8	21308.51967	786.3737956
I	2104.25199	57.6047	4.0554	1575.7	123.2	38544.62953	3111.173036
J-Q	12336.86418	57.6047	4.0554	9488.7	695.6	16090.21363	1754.097456
Private Traffic (Consumers)	na	57.6047	4.0554	na	na	53579.41872	5608.81478
Others (consumers)	na	57.6047	4.0554	na	na	56852.88201	6503.196084
Total (consumers)	na	57.6047	4.0554	na	na	110432.3007	12112.01086
		57.6047	4.0554				
A+B+G+H+I	7628.223337	57.6047	4.0554	7911.9	672.8	68692.64088	4736.770077

Italy 2003	N_2O (National)	N_2O (Regional)	CH_4 (National)	CH_4 (Regional)	CFCs (National)	CFCs (Regional)	NO_x (National)
SIC '93	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*tonnes*	*tonnes*	*000 tonnes*
Total Economic Activity	126.783427	10.52023376	1665.453097	159.6471201	na	na	1024.793811
A+B Agriculture hunting forestry fishing	77.468119	7.656481205	831.04019	67.61371498	na	na	131.428179
C Mining and quarrying	0.092293	0.002566378	5.651808	0.075629282	na	na	4.820845
D	29.730205	2.159864453	78.363597	1.936642365	na	na	228.747937
E	7.09108	0.337860484	245.758605	45.32739319	na	na	160.21625
F	0.348969	0.00113025	0.223095	0.002507919	na	na	20.30195
G+H	1.939675	0.058231068	2.293295	0.151098664	na	na	120.06229
I	2.631004	0.172942856	2.83199	8.22195549	na	na	288.22718
J-Q	7.482082	0.131157066	499.290517	36.31817823	na	na	70.98918
Private Traffic (Consumers)	5.876891	0.635648912	24.093279	2.731505744	na	na	222.898428
Others (consumers)	5.717304	0.573152542	16.274745	1.424678426	na	na	47.708097
Total (consumers)	11.594195	1.208801454	40.368024	4.15618417	na	na	270.606525
A+B+G+H+I	82.038798	7.887655128	836.165475	75.98676913	#VALUE!	#VALUE!	539.717649

Italy 2003	NO_x (Regional)	SO_2 (National)	SO_2 (Regional)	NH_3 (National)	NH_3 (Regional)	PM10 (National)	PM10 (Regional)
SIC '93	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*	*000 tonnes*
Total Economic Activity	78.13006743	624.824847	48.51174198	419.824776	50.30637497	0	11.16105994
A+B Agriculture hunting forestry fishing	12.2635948	1.382909	0.136837225	411.346428	43.80792439	0	2.987526474
C Mining and quarrying	0.096148759	0.105397	0.005644266	0.007001	1.6085E-05	0	0.011960171
D	25.04611056	166.376263	20.35638083	0.733982	6.090059852	0	4.606892358
E	9.699830559	377.662903	26.27889588	0.21644	0.008080187	0	0.953500405
F	0.201334771	0.449566	0.009998611	0.050155	0.000120986	0	0.156243608
G+H	1.959404841	3.396911	0.092795883	0.683107	0.000599557	0	0.117238393
I	24.31585194	70.346509	1.422878068	0.346527	0.021316434	0	2.043926301
J-Q	4.547791202	5.104389	0.208311219	6.441136	0.378257475	0	0.283772231
Private Traffic (Consumers)	28.04823793	2.7265	0.396374094	15.177716	1.176531583	14.917337	2.060977512
Others (consumers)	5.916381865	14.720093	1.023377771	0.000013	9.81376E-06	14.48939	1.23035375
Total (consumers)	33.9646198	17.446593	1.419751865	15.177729	1.176541397	29.406727	3.291331262
A+B+G+H+I	38.53885157	75.126329	1.652511177	412.376062	43.82984038	0	5.148691168

Italy 2003	GHG (National)	GHG (Regional)	Acidification (National)	Acidification (Regional)	Eutropohication (National)	Eutropohication (Regional)	Toxicity Potential (National)
SIC '93							
Total Economic Activity	449674.8441	34762.00088	66.49888724	6.173560578	na	na	60.0502524
A+B Agriculture hunting forestry fishing	50306.45256	4632.620433	27.09586141	2.847668827	na	na	2.66510764
C Mining and quarrying	700.050732	16.1777242	0.108510625	0.002267603	na	na	0.058873201
D	111668.6601	14302.594	10.21541119	1.538856665	na	na	15.20814419
E	193895.4411	9073.738644	15.29779799	1.032565089	na	na	30.73809778
F	2831.789051	34.38730307	0.458363448	0.004696591	na	na	0.248430037
G+H	21957.97811	807.5984986	2.756488007	0.045532599	na	na	1.527066159
I	39419.71256	3337.446387	8.484770018	0.574345393	na	na	8.446230316
J-Q	28894.75991	2557.437889	2.081684549	0.127627811	na	na	1.15830308
Private Traffic (Consumers)	55907.21379	5863.227564	5.823768205	0.691358971	na	na	2.599394914
Others (consumers)	59053.88409	6710.791619	1.4971777	0.160603274	na	na	1.634505378
Total (consumers)	114961.0979	12574.01918	7.320945905	0.851962245	na	na	4.233900292
A+B+G+H+I	111684.1432	8777.665318	38.33711944	3.467546819	#VALUE!	#VALUE!	12.63840412

Italy 2003	Toxicity Potential (Regional)	GHG / Output (National)	GHG / Output (Regional)	GHG/GVA (National)	GHG/GVA (Regional)	GHG / Capita (National)	GHG / Capita (Regional)	Acidity / Output (National)	Acidity / Output (Regional)
SIC '93									
Total Economic Activity	4.697826722	0.173761416	0.157570266	0.327270332	0.373564844	7806.217966	8571.781052	2.56962E-05	2.79837E-05
A+B Agriculture hunting forestry fishing	0.26478191	1.021488562	0.882793882	1.399578889	1.651083029	873.3046532	1142.333785	0.00055019	0.000542653
C Mining and quarrying	0.001446312	0.084014691	0.078770207	0.140455833	0.147371345	12.15266692	3.989180895	1.30226E-05	1.10411E-05
D	1.846918889	0.135957823	0.174682812	0.540666097	0.487106188	1938.533837	3526.802288	1.24374E-05	1.87946E-05
E	2.123580095	3.067483876	2.205600759	5.408032947	8.013287784	3365.965643	2237.446033	0.000242016	0.000250991
F	0.002888783	0.017277563	0.002495608	0.005705143	0.041769585	49.15899312	8.479386269	2.79661E-06	3.40848E-07
G+H	0.027765172	0.050308585	0.025768351	0.045324822	0.115875149	381.1837942	199.1415147	6.31547E-06	1.45283E-06
I	0.365469399	0.187855356	0.22595086	0.464218542	0.42876362	684.3141716	822.9635515	4.04343E-05	3.88842E-05
J-Q	0.064976162	0.034582063	0.036915767	0.058621195	0.051064849	501.6042078	630.6253116	2.49142E-06	1.84227E-06
Private Traffic (Consumers)	0.227050306	#VALUE!	#VALUE!	#VALUE!	#VALUE!	970.5321578	1445.782799	#VALUE!	#VALUE!
Others (consumers)	0.062160495	#VALUE!	#VALUE!	#VALUE!	#VALUE!	1025.157393	1654.779213	#VALUE!	#VALUE!
Total (consumers)	0.289210802	#VALUE!	#VALUE!	#VALUE!	#VALUE!	1995.689551	3100.562012	#VALUE!	#VALUE!
		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0	0	#DIV/0!	#DIV/0!
A+B+G+H+I	0.658016482	0.160568436	0.170907803	0.309974107	0.358072484	1938.802619	2164.438852	5.51173E-05	6.75158E-05

Italy 2003	Acidity / GVA (National)	Acidity / GVA (Regional)	Acidity / Capita (National)	Acidity / Capita (Regional)	Toxicity / Output (National)	Toxicity / Output (Regional)	Toxicity / GVA (National)	Toxicity / GVA (Regional)
SIC '93								
Total Economic Activity		5.52436E-05	1.154400374	1.522306204	2.32044E-05	2.12945E-05	4.98864E-05	4.42282E-05
A+B Agriculture hunting forestry fishing		0.0008893	0.470375879	0.70219185	5.41159E-05	5.04569E-05	8.74702E-05	7.99943E-05
C Mining and quarrying		2.28431E-05	0.001883711	0.000559157	7.06551E-06	7.04217E-06	1.23937E-05	1.2557E-05
D		4.45603E-05	0.177336419	0.379458664	1.85161E-05	2.25571E-05	6.63389E-05	6.98172E-05
E		0.000632226	0.265565101	0.254614857	0.000486286	0.00051619	0.00127034	0.001265674
F		6.76097E-06	0.007957049	0.001158108	1.51574E-06	2.09649E-07	3.6644E-06	4.79273E-07
G+H		1.45464E-05	0.04785179	0.011227647	3.49871E-06	8.85914E-07	8.05853E-06	1.55826E-06
I		9.22879E-05	0.147293016	0.141624844	4.02507E-05	2.47429E-05	9.18687E-05	5.08346E-05
J-Q		3.6789E-06	0.036137408	0.031471078	1.38629E-06	9.37909E-07	2.04703E-06	1.48937E-06
Private Traffic (Consumers)		#VALUE!	0.101098838	0.170478614	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Others (consumers)		#VALUE!	0.025990548	0.039602326	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Total (consumers)		#VALUE!	0.127089385	0.21008094	#VALUE!	#VALUE!	#VALUE!	#VALUE!
		#DIV/0!	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
A+B+G+H+I		0.000122913	0.665520686	0.855044341	1.81702E-05	1.28121E-05	4.05202E-05	2.32372E-05

Italy 2003	Toxicity / Capita (National)	Toxicity / Capita (Regional)	GHG / Employee National	GHG / Employee Regional	Acidity / Employee National	Acidity / Employee Regional	Toxicity / Employee National	Toxicity / Employee Regional
SIC '93								
Total Economic Activity	1.042454043	1.158412665	18.51816892	16.87066289	0.002738507	0.002996147	0.002472944	0.002279945
A+B Agriculture hunting forestry fishing	0.046265455	0.065291195	36.22296411	40.70843966	0.019510269	0.025023452	0.001919	0.00232673
C Mining and quarrying	0.001022021	0.000356639	16.90943797	11.55551744	0.00262103	0.001619717	0.001422058	0.00103308
D	0.264008739	0.455422126	22.7204338	25.78437713	0.002078458	0.002774214	0.003094294	0.003329582
E	0.53360399	0.523642574	1470.018507	1019.521196	0.115980273	0.116018549	0.233040923	0.238604505
F	0.00431267	0.00071233	1.57838975	0.270553132	0.000255484	3.69519E-05	0.000138471	2.27284E-05
G+H	0.026509402	0.006846469	4.438286395	1.853140199	0.000557159	0.00010448	0.00030866	6.37108E-05
I	0.146623979	0.090119199	25.01727014	27.08966223	0.005384762	0.004661894	0.005360304	0.002966472
J-Q	0.020107788	0.016022134	3.045175831	3.67659271	0.000219386	0.000183479	0.000122072	9.34102E-05
Private Traffic (Consumers)	0.045124702	0.055987155						
Others (consumers)	0.028374514	0.015327833						
Total (consumers)	0.073499216	0.071314988						
	0	0						
A+B+G+H+I	0.219398836	0.162256863	14.11597002	13.04647045	0.004845501	0.005153904	0.001597392	0.000978027

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