CURRENT CONDITIONS IN THE REGIONS ON THE PATH OF THE EGNATIA MOTORWAY

cohesion       mobility       balance       environment

1st spatial impacts report - March 2005
The present report on the spatial impacts of the Egnatia Motorway is based on the results obtained from the indicators used by the Egnatia Odos Observatory as well as on the results of research carried out under the title “Spatial Impacts of the Egnatia Motorway: Report on the Current Conditions in the Zones of Influence”, which was elaborated by a research team of the Aristotle University of Thessaloniki (AUTH) with the funding, and under the supervision, of Egnatia Odos A.E.

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Foreword by the Chair of the Board of Directors, Egnatia Odos A.E.

It is with a profound sense of satisfaction that I welcome this 1st Spatial Impacts Report by the Egnatia Odos Observatory. The Observatory is an innovative initiative by Egnatia Odos A.E. born from our collaboration with the European Union and thanks to its financial support. Its mission is to record and evaluate the spatial impacts of the Egnatia Motorway, in full harmony with the endeavours of the European Union to measure the impact of the Trans-European Networks on social, economic and territorial cohesion.

The development and running of the Observatory is not restricted to the simple role of a source that provides records and analyses of data. Its ambition is to constitute an efficient tool that supports suitable policies devised by competent development bodies responsible for the implementation of regional and spatial planning programmes.

At the European level, the Egnatia Motorway constitutes an extension of Pan-European Corridors IV (Vienna – Thessaloniki), IX (Helsinki – Alexandroupoli) and X (Berlin – Thessaloniki) cutting across Europe from North to South. As such, it plays a significant developmental role for the Balkans and South-Eastern Europe, and it is by virtue of this role that it has been included among the fourteen priority projects of the Trans-European Transport Networks.

It is our view that the Egnatia Motorway, along with its vertical axes, will have a decisive effect on the development of the whole of Northern Greece and, more broadly, on the national territory. Thanks to the Egnatia Motorway, Greece will play a more dynamic role towards shaping the budding regional Balkans and South-Eastern Europe market, providing high standard communication and transport channels, as well as creating opportunities for further commercial and cultural exchanges between these regions and the wider European area.

It is already clear that, at the local level, sections of the Egnatia Motorway in Eastern Macedonia & Thrace Region have been operating and delivering results, which are linked to a significant increase in mobility. The Kastania By-Pass section has also brought about the transformation of transport connections in Western and Central Macedonia Regions with regard to the traffic characteristics.

In this respect, the importance of this Report is by no means negligible, since it is the first documented and official record of the initial conditions and early effects of the operation of the Egnatia Motorway sections in Northern Greece. Investigating issues such as mobility and accessibility, economic and social cohesion, the balanced urban systems and urban networks, as well as the quality of the environment, the 1st Spatial Impacts Report of the Egnatia Motorway presents a broad synopsis of the main results obtained from the indicators monitored by the Egnatia Odos Observatory. Although it would be premature to draw conclusions at this stage, it is nonetheless clear that the Egnatia Motorway constitutes one of the vital axes of development in Northern Greece.

By means of the Observatory, Egnatia Odos A.E. monitors and evaluates the developmental impact of the Egnatia Motorway. This is done by considering the conditions in respect of the project's pre-
and post-implementation stages. It is in this way that it will be possible to obtain a clear picture of the motorway’s impact on social and economic cohesion, on spatial organisation and, finally, on the transport system and the environment in Northern Greece.

The Report that follows, and all the information processed by the Egnatia Odos Observatory, are at the disposal of all bodies involved in the planning and decision-making process for territorial cohesion and regional development in the wider area of influence of the Egnatia Motorway. We hope that this information will prove useful to them at times when informed and competent choices need to be made, and decisions reached, for the development and cohesion of this region.

Apostolos Goulas
Chair of the Board of Directors, Egnatia Odos A.E.
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Executive Summary

The present “1st Spatial Impacts Report of the Egnatia Motorway” seeks to evaluate the current conditions of development and of the environment over a broad area crossed by the Egnatia Motorway system and of its vertical axes. The area in question comprises five Greek Regions: Eastern Macedonia & Thrace, Central Macedonia, Western Macedonia, Epirus and Thessaly. The Report is based on the examination of the results provided by 30 indicators, with the help of which a number of issues were investigated, such as: patterns relating to traffic and mobility of the population across the road network; degree of accessibility of the Regions and of their centres; detection of intra-regional inequalities; degree of convergence with the European Union (E.U.) average; structure of the urban system; and, finally, estimated environmental impacts resulting from the operation of the motorway.

In fact, this 1st Spatial Impacts Report constitutes an evaluation of the conditions at an early stage of the project in the area of the five Regions, and of the various transformations that were recorded once the first phase of operation of the Egnatia Motorway had taken place. Measurements which relate to the 1990s are considered to draw a picture of the situation as it had been shaped before the construction of the Egnatia Motorway, and constitute foundations on which to base estimates regarding its impact in the future.

The first chapter of the Report provides basic information about the project and the role it is expected to play in terms of development. The Egnatia Motorway constitutes a receptive axis towards which converge Pan-European Corridors IV (Vienna-Thessaloniki), IX (Helsinki-Alexandroupoli) and X (Berlin-Thessaloniki), all of which lead from North to South. The Egnatia Motorway has thus acquired the status of a project of major importance in terms of development for South-Eastern Europe. It is for this reason that the Egnatia Motorway was included among the 14 priority-projects of the Trans-European Transport Network and it benefits, on this account, from substantial funding from the European Union.

The funding guaranteed by the European Union for the axis so far amounts to € 4,640 M plus V.A.T. (joint funding from the European Union and national resources). The net amount from EU funds is € 2,290 M. All of the above funding is intended for the construction of 586 km of new motorway. In addition, the European Investment Bank has approved five loans for the Egnatia Motorway projects to a total of € 1,950 M, to cover part of Public Expenditure. The Egnatia Odos A.E. Company is responsible for the management of the construction process as well as the operation, maintenance and exploitation of the motorway. In view of the later, it has already proceeded to compiling a set of guidelines for both the implementation of innovative transport telematics and automated traffic control systems.

The Egnatia Motorway is fed by 9 vertical axes that provide links to 5 maritime ports and 6 airports. Four of these vertical axes constitute extensions of Pan-European Corridors. Egnatia Odos A.E., in addition to the main axis, has undertaken the design and construction management of three important vertical axes that constitute sections of the Trans-European Transport Networks. Specifically, these are the axes: Siatista-Krystallopigi, Thessaloniki-Serres-Promachonas, and Ardanio-Ormenio. The cost for the completion of these axes is estimated at approximately € 800 M, while the guaranteed funding for it is € 430 M.

As far as the progress of the project is concerned, 487 km out of the total of 680 km of the Egnatia Motorway were open to traffic
towards the end of 2004. This represents 72% of the axis. In the Region of Eastern Macedonia & Thrace, the sections of the motorway that were open to traffic represent 36% (174 km) of the total, in Central Macedonia 23% (112 km), while the construction work in Epirus (45 km, 12%) and in Western Macedonia (62 km, 16%) presents serious technical difficulties, having encountered challenges of a geomorphological nature and environmental restrictions.

The Egnatia Motorway, however, is not simply a modern motorway. The first question asked by everyone may well be directed at issues such as the progress of the actual operation of the 680 kilometres of its total stretch. But the real stakes lie with issues relating to its wider contribution in terms of the development of the area within its sphere of impact. The Egnatia Motorway with its vertical axes has implications not only on the transport and communication systems as a whole, but also on the regional development and the spatial structure, as well as on the environment. At the same time it provides opportunities for the broadening of economic and cultural exchanges with the neighbouring Balkans. Besides, this development-oriented dimension of the Egnatia Motorway project is taken into consideration within the broad scope of policy making, both at a regional / local level and in national and even European terms. The Egnatia Motorway, as a backbone of regional development, has given rise to expectations, which bring up for discussion the need to start on a course of coordinated action and effective collaboration involving public and private bodies.

The second chapter includes the statement of intent, an outline of the scope of the project and an introduction to the system of indicators of the Egnatia Odos Observatory. The Observatory stands as an innovative initiative on the part of Egnatia Odos A.E. in so far as it responds in practical terms to the perceived necessity of evaluating and monitoring the spatial impacts of the Egnatia Motorway. This is carried out in full harmony with the endeavours to assess the impact of the Trans-European Networks on development and cohesion at the European scale. In other words, the Observatory is developing into a strategic tool of information and support for policies and programmes of regional and spatial planning, at the service not only of the Company’s Management, but also of all the Regional and Civil Authorities and development agents in the motorway’s wider area of influence. The Observatory grounds the continuous monitoring and analysis of the spatial impacts of the Egnatia Motorway in a system of indicators, operating on scientifically documented specifications, methods and tools that characterise current international good practice.

The indicators system of the Observatory consists of a total of 50 indicators which, thanks to specific and measurable values, make it possible to estimate in a comprehensive manner the spatial impacts of the Egnatia Motorway and its vertical axes. For the system to be operable and in order to preserve the concordance with the specific categories of spatial impacts of a motorway, the indicators fall under three major headings: socio-economic indicators, indicators for environmental issues, and transport indicators relating mainly to the operational characteristics and effects of the road network. Each indicator corresponds to determined spatial fields of implementation which are the Zones of Impact of the Egnatia Motorway. Five Zones of Impact have been established and these were determined as follows: first, the zone of the axis itself to a depth of 500-1,000 metres; second, the widest geographical area of the Prefectures and Regions which are crossed both by the Egnatia Motorway and by its vertical axes; and finally, a wider area in the Greek and Balkans territory,
which is affected as a result of the changes brought about to the transport system as a whole.

The third chapter unfolds the scope and the conceptual framework of the analysis handled by the Report. In order to produce a synthetic evaluation, the indicators monitored by the Observatory were divided into categories and assessed on the basis of their consistency with four fundamental parameters that relate to key-objectives of European policy:

(a) mobility and accessibility,
(b) economic and social cohesion,
(c) urban balance and networking,
(d) quality of the environment.

The following chapters of the Report develop and analyse the results of indicators in the light of the four parameters.

To start with, the fourth chapter presents the general profile of the Regions crossed by the Egnatia Motorway and underlines the linking of the project, and more specifically the Observatory, with the provisions for development and spatial planning in Northern Greece. The basis for this is provided by the Regional Operations Programmes under the Community Support Framework and the Regional Framework for Spatial Planning and Sustainable Development enactments.

Next, the fifth chapter follows with the presentation of the results of indicators dealing with issues regarding the “mobility and accessibility” parameter. They relate to measurements of such features as the traffic volume, the composition of the traffic, travel time and time-distance relationships. Traffic volume measurements, which were carried out in 2004 point to highest levels on the sections of the motorway crossing the peripheral area of Thessaloniki, and in particular between K4 (TITAN Exit) and Serres Interchanges. It is worth noting that, for almost all of the sections of the Egnatia Motorway in operation, the daily traffic volume comes to the level of, or exceeds, the 70% threshold of the figure predicted for the year 2010. Moreover, it is estimated that over the whole length of the Egnatia Motorway the composition of the traffic is relatively uniform. A breakdown of the traffic composition reveals that the majority of vehicles (80-90% of the total number) are passenger vehicles or vehicles of similar size. On most of the sections of Egnatia, it is estimated that the average speed pitches near to the recommended speed (120 km per hour) while, once completed, Egnatia will allow optimal reductions in travel time in Northern Greece. More specifically, it is estimated that the travel time from Thessaloniki to Igoumenitsa will be reduced by more than 180 minutes, while the travel time from Thessaloniki to Kipi (on the Greek-Turkish border) will be reduced by about 120 minutes.

In a next stage, the Report examines issues of accessibility for every Region in relation to the population, as well as to the market size and the labour force that benefit, owing to enhanced access opportunities from, and towards, other areas. It is estimated that the total population that will directly benefit in terms of mobility and accessibility once the system of the Egnatia Motorway and its vertical axes are fully in operation, represents one third of the population of the country. This is an observation of prime importance. Concerning the market size, it has been calculated that in the year 2000 the Gross Domestic Product (GDP) which was yielded by the five Regions en bloc totalled €40,928.4 M, which represents one third of the total national GDP. Central Macedonia yielded over half of the GDP of the five Regions put together, while the smallest contribution was made by Western Macedonia and Epirus (under 10%). The distri-
bution of the labour force over the five Regions reflects the distribution of the population and the market size. In more specific terms, 50% of the labour force is concentrated in Central Macedonia, while Western Macedonia (7%) and Epirus (8%) claim the smallest share.

The Chapter on “mobility and accessibility” proceeds with the evaluation of the transformations regarding the accessibility of urban centres and the generated gain for every Prefecture. This evaluation follows the SASI model (Socio-Economic and Spatial Impacts of Trans-European Networks), used by the European Union to assess the impact of the Trans-European Networks (TENs-T). The results show a clear improvement in terms of accessibility, particularly for the most remote areas. At the same time, the Egnatia Motorway acts as a link for, and improves the accessibility of, other means of transport (five ports, 8 airports, a railroad network including terminals and frontier stations). It also improves the accessibility of areas of special significance (18 Industrial Zones, a wealth of tourist and cultural attractions etc.). The extent to which, however, these beneficial transformations will lead to regional convergence or, on the contrary, to backwash effects to the benefit of more developed regions, will depend on the successful implementation of development and spatial planning policies as a whole, and not solely on the operation of the motorway.

The sixth chapter presents the results obtained from the indicators in relation to the “economic and social cohesion” parameter. The indicators of crucial importance for the evaluation of economic and social cohesion are, first of all, the level of growth (calculated on the basis of the Gross Domestic Product per head) and the rate of unemployment. On the other hand, significant information is also obtained from indicators that provide a breakdown of the composition of production and employment, as well as the foreign trade. For all these indicators, it is necessary to analyse the underlying conditions, the most important transformations experienced with reference to the previous five or ten years, as well as the way in which these measurements compare with corresponding measurements on a national and European levels. In the year 2000, at the regional level, the highest Gross Domestic Product per head (GDP p/h) was recorded in Central Macedonia, followed closely by Western Macedonia, while Epirus was found to have the lowest GDP p/h. In relation to the convergence with the Europe of the 15, Central Macedonia pitches itself on the same level as Greece (67.9%), again, followed closely by Western Macedonia (67%). The least affluent areas are the Regions of Thessaly, Eastern Macedonia, Thrace and Epirus, where the GDP p/h for the year 2000 stands below the national average and much below the European average. In the period 1996-2000, Epirus, however, experienced the highest annual rate of GDP p/h increase, and the most marked rate of improvement in terms of convergence with European levels.

On the other hand, the calculation of the average unemployment rate for the five Regions en bloc produced a figure around 12% in 2001. Western Macedonia experienced an unemployment rate significantly higher than this average (16%), while Thessaly experienced the lowest unemployment rate (11%). The results provided by the indicator for “composition of production” underline the clear dominance of the Tertiary industry sector, as the latter produced more-or-less two thirds (2/3) of the total Gross Value Added (GVA) of the five Regions. In second most important position is the Secondary industry sector, which produced 24.4% of the total GVA, while the Primary industry sector produced 10.6% of the total GVA. Addressing the issue of the composition
of employment, it would appear that 54% of the population of the five Regions is employed in the Tertiary industry sector. In second position of importance for employment is the Secondary industry sector, which gathers 24% of the employed population and, in third position is the Primary industry sector with 22%, a high enough percentage, however, as compared to the European average (European Union 15 = 4.2% for 2001). As regards foreign trade, it appears that the exports-imports ratio in the zone of the five Regions is equal to 0.86, while for the country as a whole it is equal to 0.40. This fact demonstrates the exportation-oriented nature of trade in Northern Greece.

In the seventh chapter, the results provided by the indicators relating to "urban balance and networking" are presented, as well as other data of the research around these issues. They refer to measurements such as the population distribution, change and density, the urban networking, the gravity of, and the mobility between, the urban centres in the five Regions. In the course of the 1991-2001 decade, the population of the five Regions increased as a whole by 6.7%, a percentage more than twice above the growth rate in the E.U.15 (3%). The rate of increase is particularly impressive in the four (4) urban centres of Thrace (Alexandroupoli, Xanthi, Orestiada and Komotini) where it fluctuates between 16.1% and 32.1%.

Generally speaking, the Egnatia Motorway system with its vertical axes has an influence on the organization of the settlements, by reducing distances and facilitating communication between them. More specifically, the Egnatia Motorway induces significant changes in the urban centres networking. According to the results of the National Origin-Destination Survey 2002, the mobility between urban centres at the cross-regional level is on the increase. This is resulting from either the creation of new moves or the demand for moves which was pre-existent but which could not be met because of the poor quality of the road network available (depressed demand). A remarkable indication of the Egnatia Motorway’s dynamic impact on the networking of urban centres is that the pattern of mobility between the cities of Kavala – Xanthi – Komotini – Alexandroupoli increased by between 85% and 150%. On the other hand, the rural areas and smaller settlements benefit in a different way. For these areas, the significant factor is how successfully the main motorway connect with a dense and reliable web of secondary roads and interchanges, making it thus possible to serve the network of the smaller towns and of any other settlements. On the whole, the study of the parameter “urban balance and networking” fully demonstrates the role played by Egnatia as a generator of conditions for the interconnection of the urban centres, and for spatial re-organization towards more polycentric systems.

In the last chapter, the Report presents the results obtained by the indicators relating to the parameter “quality of the environment”. Noise pollution, air pollution, the fragmentation of environmentally fragile areas and, more broadly, the alterations affecting patterns of land use and land value, are all regarded as crucial indicators in the evaluation process of the environmental impact of important transport projects such as the Egnatia Motorway. In this context, the Report initially points out that on the basis of the CORINE Land Cover categorization it is estimated that, over a total distance of 680 km, the land which the axis crosses is divided as follows in terms of percentage and use: 68% cultivated agricultural land, 30% uncultivated natural areas, 1% aquatic ecosystems and 1% urban areas. Besides, 6% of the total length of the axis itself cuts across protected areas (Natura 2000 and Ramsar). When this occurs, provision has been made for specific technical solutions to
limit the impact on the environment.

As far as the noise pollution indicator is concerned, using a prediction model, it is estimated that the percentage of the population which is exposed to noise levels between 60 and 70 dB(A) is negligible and is localized in the periphery of Thessaloniki and in the plains of Central Macedonia (a scarce 0.1% of the population of Central Macedonia). The air pollution indicator which was evaluated, with the use of a prediction model for issues surrounding this parameter, revealed that allowable limits are possibly exceeded only on the sections of the motorway in the peripheral area of Thessaloniki, where it is expected that the traffic volumes circulation would be the highest.

As for the impact on the greenhouse effect, it was estimated that the total CO$_2$ emissions by vehicle/km remain relatively even across different sections of the motorway. They fluctuate at levels of a similar order, although slightly below the total CO$_2$ level for the country as a whole and the overall level for the European Union. On the other hand, the number of settlements that could potentially be affected by the road network is reduced from 97 (before the construction of Egnatia) to 75 (after the construction of Egnatia). The diversion of the traffic away from the important urban centres, where the majority of the population lives, causes a qualitative improvement in their living conditions. As concerns the fragmentation of natural areas and crossing with surface waters, it appears that the Egnatia Motorway affects such ecosystems only to a limited extent, compared to the effects of the road network without Egnatia.

On the whole, the impact of the Egnatia Motorway in terms of traffic circulation patterns on the road network, on increased mobility, on the networking of urban centres and on the improvement of accessibility, is positive and immediate. It is expected that alterations of this order will have a decisive effect on the cohesion of distinct areas of the Northern Greece and, more generally, on its spatial model of development. It is worth noting that in some of the sections where the Egnatia Motorway operates (the Eastern region) some of the observed macroscopic changes appear to be of a particularly positive nature. Finally, the earliest results of the environment-related indicators show that the Egnatia Motorway either has a limited and controlled impact or, on the contrary, and inspite of the increased traffic volumes, leads to the creation of conditions which are significantly more desirable than the conditions prior to Egnatia.

When the focus is specifically directed onto the five Regions crossed by the Egnatia Motorway, the first distinctive feature is, undoubtedly, the dominance of the Region of Central Macedonia. It claims a little less than half of the five Regions’ total population, and stands as the most developed area, since it has historically cumulated the most significant advantages, in close connection with the existence of the Greater Thessaloniki Area. As concerns the development trends of the five Regions, a fair number of divergences can be observed in the case of every parameter. The Region of Central Macedonia presents the highest rate of population increase, clear trends of intensification of the market, but also a high unemployment rate without falling trends. The Eastern Macedonia & Thrace Region, which stands in the third position in terms of population size and experiences a rate of increase that matches the average national level, presents a low GDP growth rate. At the same time, the high percentage of its labour force in the Primary industry sector is worthy of note. In addition, this Region is characterized by a fairly balanced network of urban centres that show a perseveringly increasing trend towards interconnection. Western Macedonia, the least populated of all five regions, appears to enjoy together
with Central Macedonia the highest GDP p/h as well as a clear trend for employment in the Secondary industry sector. It is, furthermore, distinguished by the highest unemployment rate and it is the only Region where this rate is on the increase. Epirus, the Region in fourth position in terms of population size, may be the least dynamic in terms of its market size but stands out, however, with the highest GDP growth rate. It is also characterized by a trend in employment firmly rooted in the Tertiary industry sector. Thessaly, finally, which stands in the second position in respect of its size among the five Regions, lags behind in terms of its population growth and of the importance of its market size. It is also important to note that, at a national level, Thessaly contributes substantially to the domain of agricultural production.

The 1st Spatial Impacts Report establishes, on the whole, the true potential of the Egnatia Motorway to function as a development axis complementary to the “traditional” PATHE (Patras – Athens – Thessaloniki – Evzoni) axis. As a transport infrastructure and especially as an inter-regional road network which links the main centres of development of Northern Greece, it has an immediate impact on the overall improvement of the economy and on quality of life. At the same time, however, it will be necessary to link up with complementary regional development policies and plans. These will thus enhance the productivity of the existing framework, spatial organization and the protection of the environment. Particular attention must be paid to the more vulnerable areas, which are the ones mostly exposed to the intensely competitive context of an expanding European Union.

It is hoped that this Report will contribute to the dialogue and to the cooperation efforts between development agencies towards the improvement of the planning and decision-making processes on issues of transport infrastructure and regional development. At the same time, it is expected to become the basis for the future expansion and documentation of the developmental role played by the Egnatia Motorway. Besides, through this Report, the Egnatia Odos Observatory is ambitious to open up the scientific discussion and contribute towards an integrated and systematic evaluation of the spatial impacts of important transport infrastructure projects in Greece and South East Europe.
I. The Egnatia Motorway

The Egnatia Motorway spans from Igoumenitsa to Kipi on the Greek - Turkish border. It is 680 km long. It is designed and built as a closed motorway of international standards. It is a dual carriageway with a central reserve, 24.5 m wide, or 22.0 m on a number of difficult sections. Each carriageway has two lanes and a hard shoulder; with the exception of the Outer Ring Road of Thessaloniki where each carriageway has three traffic lanes and a hard shoulder.

The motorway comprises a) numerous long twin bridges which constitute 40 km of the motorway (80 km of single carriageway), b) a large number of tunnels which constitute more than 49 km of the motorway (98 km of single bore) and c) 50 interchanges, 350 underpasses and overpasses, and 720 km of service roads.

At the national level, the Egnatia Motorway represents the backbone of the Northern Greek transport system, making it possible to break the isolation of remote Regions such as Epirus and Western Macedonia & Thrace. At the European level, the Egnatia Motorway operates simultaneously as a point of confluence for the merging flow of transport from the Balkans and South-Eastern Europe. It is there that the Pan-European Comidors IV (Berlin-Sofia-Thessaloniki), IX (Helsinki – terminating at Alexandroupoli) and X (Vienna-Belgrade-Thessaloniki) terminate.

I.1. The funding of the project

Until the end of 2004 the secured funding for the Egnatia Axis amounted to € 4,640 M plus VAT (joint - funding from the European Union and national resources), amongst which:

- € 1,415 M plus VAT from the programmes for the period 1994-1999.
- € 3,225 M plus VAT from the programmes for the period 2000-2006.

The net amount from the EU funds is € 2,290 M.
Out of this amount €1,450 M are provided by the European Regional Fund (ERF), €807 M from the Cohesion Fund (CF) and €33 M from the Community Budget for the Department of Trans-European Transport Networks (TENs-T).

The above funding relates to the construction of 586 km of new motorway and does not include work carried out over 59 km of the axis, the cost of which has been estimated at €800 M (5 km in Epirus, 37 km on the section Panagia - Grevena and 17 km at the crossing of the Nestos River). The European Investment Bank has equally sanctioned five loans for the projects of the Egnatia Motorway to a total of €1,950 M, to cover most of the national contribution.

1.2. The vertical axes

The Egnatia Motorway is fed by 9 vertical axes which provide links to 5 ports and 6 airports. Four of these axes are extensions of Pan-European Corridors. These vertical axes are:

- Ioannina – Kakavia (Albania - Trans-European Axis)
- Siatista – Krystallopigi (Albania
- Kozani – Florina – Niki (FYROM – Pan-European Corridor X)
- Thessaloniki – Evzoni (FYROM – Pan-European Corridor XI)
- Thessaloniki – Serres – Promachonas (Bulgaria – Pan-European Corridor IV)
- Drama – Nevrokopi – Exochi (Bulgaria)
- Xanthi – Echinos (Bulgaria)
- Komotini – Nymphaea (Bulgaria)
- Ardanio – Ormenio (Bulgaria – Pan-European Corridor IX)

Egnatia Odos A.E. has undertaken, in parallel to its commitments regarding the main axis, the design & construction of three essential vertical axes which constitute sections of the Trans-European Transport Network. It involves, specifically, the axes: Siatista – Krystallopigi (link to Albania of a total length of 82 km), Thessaloniki – Serres – Promachonas (link to Bulgaria of a total length of 96 km), and Ardanio – Ormenio (link to Bulgaria of a total length of 127 km). The total cost for the completion of these axes is calculated to be approximately €800 M. The amounts that have been secured to date amount to €430 M.
1.3. Progress of the Project

In February 1997, Egnatia Odos A.E. undertook the management of design & construction of the Egnatia motorway. By the end of 2004, 487 km of the total 680 km of the Motorway had been opened to traffic (94 km before 1994 and 393 km over the 1994-2004 period), corresponding to 72% of the length of the axis. In the Regions of Eastern Macedonia and Thrace, it corresponds to 49% of the sections under construction, in Central Macedonia to 28%, while the work in Epirus (48.5 km, 10% so far) and in Western Macedonia (62 km, 13% so far) having encountered serious technical difficulties, due to geomorphological and environmental requirements.

Table 1: The progress of the Egnatia Motorway (January 2004)

<table>
<thead>
<tr>
<th>Sections of the Egnatia Motorway</th>
<th>Km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructed before 1994</td>
<td>94</td>
</tr>
<tr>
<td>Work carried out after 1997</td>
<td>586</td>
</tr>
<tr>
<td>Completed and opened to traffic (December 2004)</td>
<td>393</td>
</tr>
<tr>
<td>Sections under construction</td>
<td>133</td>
</tr>
<tr>
<td>Tenders in progress</td>
<td>54</td>
</tr>
<tr>
<td>Remaining sections to be tendered in 2005</td>
<td>6</td>
</tr>
<tr>
<td>Total length of axis</td>
<td>680</td>
</tr>
</tbody>
</table>

Table 2: Geographical distribution of the constructed sections of the Egnatia Motorway (January 2004)

<table>
<thead>
<tr>
<th>District/Region</th>
<th>Total length of sections (km)</th>
<th>Length of sections opened to traffic (km)</th>
<th>Percentage of constructed sections (487 km)</th>
<th>Overall percentage of implementation (680 km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epirus</td>
<td>123</td>
<td>48.5</td>
<td>10%</td>
<td>39%</td>
</tr>
<tr>
<td>Western Macedonia</td>
<td>110</td>
<td>62</td>
<td>13%</td>
<td>56%</td>
</tr>
<tr>
<td>Central Macedonia</td>
<td>191</td>
<td>137</td>
<td>28%</td>
<td>72%</td>
</tr>
<tr>
<td>Eastern Macedonia and Thrace</td>
<td>256</td>
<td>239.5</td>
<td>49%</td>
<td>93%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>680</td>
<td>487</td>
<td>100%</td>
<td>72%</td>
</tr>
</tbody>
</table>

1.4. Operation, maintenance and exploitation

Egnatia Odos A.E., beyond the management and construction of the project, has undertaken the management of the operation, maintenance and exploitation of the Motorway for a period of 50 years. The administration of the above undertakings is the responsibility of the Operations, Exploitation and Maintenance Division of the Company.

On the basis of the relevant British specifications and of the TENs-T operation standards, the Operations, Exploitation and Maintenance Division of Egnatia Odos A.E. compiled the Maintenance Regulations and the Operating Guidelines for the motorway that were approved by the Ministry of Environment, Planning and Public Works. The Maintenance Regulations consist of the following:

i. Routine maintenance guidelines

ii. Motorway winter maintenance guidelines

iii. Health & Safety guidelines for maintenance employees

iv. Capital maintenance guidelines

v. Electro-Mechanical tunnel installations maintenance guidelines
CURRENT CONDITIONS IN THE REGIONS OF THE PATH OF THE EGNATIA MOTORWAY - 1st SPATIAL IMPACTS REPORT

1. THE EGNATIA MOTORWAY

Map 1: Progress of the Egnatia Motorway, January 2005
As concerns the operation and the exploitation of the Egnatia Motorway, Toll Stations (TS), Service Areas (SA) and Rest Areas (RA) have been planned, as well as 5 Transportation Management Centres (TMC). By decision of the Board of Directors of the Company, two toll stations should be installed at the early stage: One toll station in Epirus (in the area of Paramythia) and another in Polymylos (between Veria and Kozani). The commencement of operation of the above toll stations is awaiting a ministerial decision. In accordance with a decision of the Company, toll collection at the final stage will be carried out electronically.

The implementation of the current maintenance, operation and exploitation programme of the Egnatia Motorway includes:

- The supervision of the on-going operation and maintenance contract work
- The elaboration of studies and research programmes such as:
  - Traffic management (CCTV cameras, emergency telephones, automatic incident detectors/AID).
  - Collection and processing of data concerning road accidents.
  - Telematics monitoring of the electro-mechanical installations (E/M), (road lighting, traffic signals, electro-mechanical installations in tunnels, monitoring of the consumption of electric power).
  - Survey of the road surface.
  - Collection of anemometric data.
- The installation and operating of a telemetric system which allows the immediate transmission of data from the traffic monitoring posts to an electronic database for the monitoring of traffic.
- The compilation of procedures for the maintenance and operation of tunnels, for addressing emergencies and for the management of dangerous goods/oversize vehicles.
- The organisation of the imminent setting into operation of Polymylos toll station.

1.5. An axis for development and cooperation

The Egnatia Motorway is one of the two Trans-European transport axes (the other being PATHE) which cut across Greece. Together with the “Eleftherios Venizelos” airport (the third pole of the Trans-European Networks), they are the three gateways of the country in the European context. The Greek spatial planning framework has seriously taken into account the role and the operation of the Egnatia Motorway.

The National “General Framework for Spatial Planning and Sustainable Development”\(^1\) has identified two broad objectives: firstly, the “creation of a peripheral zone of functional cross-border links”; and secondly, the “upgrading and integration of the Development Axes and Poles within the national territory”. The Egnatia Motorway is an essential component of both these objectives. In particular, and with relation to the first objective, the Egnatia Motorway stands as the key project in Northern Greece for the creation of connections with the countries of the Balkans and of the Black Sea. It is expected to operate as a zone of cooperation promoting selected economic activities, transport and energy networks.

exchanges of technical knowledge, as well as the effective preservation of the environment and of cultural heritage. It is also expected to promote the geographical cohesion of South-Eastern Europe (refer to Figure 1).

As concerns the second objective, the Egnatia Motorway constitutes the development axis for the North of the country and is connected via vertical axes, northwards to the Pan-European Corridors and, via the PATHE motorway and the western Ionian axis, to the rest of Greece. Moreover, the maritime gateways via Alexandroupoli, Kavala, Thessaloniki and Igoumenitsa link it to the islands of the Aegean and Ionian Seas. Four of the six international air transportation gateways of the country are also directly connected with the Egnatia Motorway (Igoumenitsa, Thessaloniki, Kavala, Alexandroupoli) (refer to Figure 2).

It does appear from the above that the Egnatia Motorway does not simply constitute an important transport axis. It is expected and planned to play a much more important development role as a networking axis with the rest of Europe and with the Mediterranean and the Middle East as well. Besides, in the “General Framework for Spatial Planning and Sustainable Development”, it is stated that:

“The regions of Northern Greece which have the Egnatia Motorway and its vertical connections towards the Balkans as their primary transport frame and which have as their focal poles of development the metropolitan area of Thessaloniki, the cities of Igoumenitsa and Ioannina, the bipolar urban systems Kozani – Ptolemaida and Komotini – Alexandroupoli, are established as an elaborate system of the regional network of interconnections, forming part of the web of the Trans-European international axis of confluence of Egnatia. This axis unifies the Eastern and Western Mediterranean poles in the north and connects them to the Black Sea countries and Asia Minor / the Middle-East and Central Asia, the Balkans, and Central, Eastern and Western Europe,

**Figure 1: Zones and axis of co-operation and development**

2. The Egnatia Odos Observatory

2.1. Statement of intent and scope

Egnatia Odos A.E., being aware of the wider importance of the project for the cohesion and the development of Northern Greece and Southeast Europe, set up the “Egnatia Odos Observatory”, which monitors the spatial impacts of the Egnatia Motorway.

The Observatory makes use of documented scientific methods and of a state-of-the-art ICT (Information & Communication Technologies) infrastructure, in order to collect, process and produce sound and up-to-date data and information about the conditions in the areas affected by the construction and operation of the Egnatia Motorway. The data and the information constitute the basis for the evaluation of the spatial impacts of the motorway, considering issues such as the following:

- The level of development and the degree of cohesion, competitiveness and regional disparities.
- The degree of accessibility of the regions and of their urban centres, as well as of the locations of production and consumption.
- The development of settlements and the networking of urban centres and other areas of special interest.

Therefore, the overall evaluation of the project must be based on the monitoring and assessment of its spatial impacts, not only in terms of transport infrastructure and its specific traffic characteristics, but also in relation to the economic and social cohesion, the environment and the spatial organization of the Northern Greek territory.
The Egnatia Odos Observatory has set up an integrated Information System of Documentation and Data Management, which relies on the operation of a specifically configured Geographic Information System (GIS) and includes processed statistics and cartographic information for:

- mobility and accessibility
- social and economic cohesion
- urban balance and networking
- quality of environment,

in the Prefectures and the Regions of the immediate and wider impact zone of the Egnatia Motorway and its vertical axes.

The Observatory’s Information System is based on an infrastructure that is continuously updated:

- A computer network supported by a Geographical Information Management System (including a Spatial Database Engine - SDE) and equipped with specialised software (GIS, measurement processing, statistics, graphics and Web development, production of printed material etc.) and support hardware (colour printers, plotter, scanner etc.).
- Official information and processed statistical data from the Greek National Statistics Agency and the Eurostat.
- Environmental data based on official E.U. information (CORINE Land Use, RAMSAR, NATURA 2000 etc.).
- Traffic and transport information (measurement of traffic volumes on the road network, information on the composition, classification and assessment of the road network, information from National Origin-Destination Surveys etc.)
- Digital data on Regional and Spatial Planning Programmes and also information about the Trans-European Networks (TENs-T), the Pan-European Corridors (TINA), and policy programmes for regional development.
- Cartographic data:
  - Digital elevation model (DEM, 3D)
  - Aerial photographs, SPOT satellite images and ortho-photomaps
  - Administrative and geographical boundaries/borders (NUTS 1-3, Master Plans, Local Authorities, conservation areas, land use CORINE etc.),
  - Digital data WDC – ESRI,
  - Up-to-date Road and Rail Network,
  - Up-to-date Settlements Network,
  - Up-to-date hydrographic Network and Coastline,
  - Contours network.
- Equipment for transport and environment measurements supported by a Global Positioning System (GPS).
- Electronic library and database for the collection of support material and metadata.

http://observatory.egnatia.gr
2. THE EGNATIA ODOS OBSERVATORY

- The features of the transport system, the level of the transport infrastructure, and the operation of the road network.

- The quality of the natural and cultural environments and the possible impact on these from the operation of the motorway.

The documentation available at the Observatory is at the disposal of the agencies that are responsible for regional development policy and planning.

The Observatory is thus evolving as a strategic instrument for the supply of information and for the provision of support services, not only to Egnatia Odos A.E., but to all regional and national authorities and other development agencies in the wider area of influence of the motorway.

Within this definition of its functions, the Observatory was organized and operates as a unit of Egnatia Odos A.E. Its activities are determined on the basis of the Five Year Action Plan 2003-2007, which is based on the following key actions:

- Compiling, recording and processing data and measurements in relation to a variety of socio-economic and environmental evaluation indexes, as well as in relation to data pertaining to the transport infrastructure and the operation of the Egnatia Motorway.

- Drawing up reports, carrying out research and issuing recommendations towards supporting development policies and programmes.

- Publicising and diffusing the results through reports, information bulletins and leaflets, and the Internet. At the same time, it organises informational events and scientific workshops or conferences about the contribution of the Egnatia Motorway in the development process.

- Networking and collaborating with research centres and other Observatories for spatial planning and transport, as well as with the Regional and local authorities other national and local authorities and, more generally, with public and private development agents.

2.2. The indicators system

The monitoring and evaluation of the spatial impacts from the operation of the Motorway is based on a system of indicators, defined in observance of the current European practice for monitoring similar phenomena. This system consists of a total of 50 indicators. These, by means of specific and measurable standards, make it possible to carry out an estimation of the condition of the development, social, environmental and transport features of the areas under the influence of the Egnatia Motorway and its vertical axes. Because of operational
requirements, the indicators fall into three main classification groups: (a) socio-economic indicators, (b) environmental indicators, and (c) transportation and road-network operation indicators.

The indicators in each category are further classified according to their importance and their rank of priority on three levels: primary, secondary and specific. The primary level comprises indicators that are considered to be of crucial importance in evaluating the spatial impacts of the motorway, and which are monitored and systematically updated by the Observatory. At the secondary level, the indicators involved are those that refer to more general phenomena, which interact with the phenomena monitored via the primary level indicators, and which

<table>
<thead>
<tr>
<th>Code</th>
<th>Socio-Economic Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>SE-P</td>
<td>Primary</td>
</tr>
<tr>
<td>SE-P-1</td>
<td>Benefiting population</td>
</tr>
<tr>
<td>SE-P-2</td>
<td>Market size (GDP)</td>
</tr>
<tr>
<td>SE-P-3</td>
<td>City gravity</td>
</tr>
<tr>
<td>SE-P-4</td>
<td>Rate of growth (GDP p/h)</td>
</tr>
<tr>
<td>SE-P-5</td>
<td>Rate of unemployment</td>
</tr>
<tr>
<td>SE-S</td>
<td>Secondary</td>
</tr>
<tr>
<td>SE-S-1</td>
<td>Accessibility of transport modes</td>
</tr>
<tr>
<td>SE-S-2</td>
<td>Accessibility of industrial areas</td>
</tr>
<tr>
<td>SE-S-3</td>
<td>Accessibility of sites of cultural &amp; tourist interest</td>
</tr>
<tr>
<td>SE-S-4</td>
<td>Population changes within Impact Zones</td>
</tr>
<tr>
<td>SE-S-5</td>
<td>Urban population changes</td>
</tr>
<tr>
<td>SE-S-6</td>
<td>Hierarchy of urban centres</td>
</tr>
<tr>
<td>SE-S-7</td>
<td>Population density</td>
</tr>
<tr>
<td>SE-Sp</td>
<td>Specific</td>
</tr>
<tr>
<td>SE-Sp-1</td>
<td>Composition of production by industry sector (GVA)</td>
</tr>
<tr>
<td>SE-Sp-2</td>
<td>Labour force</td>
</tr>
<tr>
<td>SE-Sp-3</td>
<td>Composition of employment by industry sector</td>
</tr>
<tr>
<td>SE-Sp-4</td>
<td>Business location</td>
</tr>
<tr>
<td>SE-Sp-5</td>
<td>Foreign trade</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Environmental indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN-P</td>
<td>Primary</td>
</tr>
<tr>
<td>EN-P-1</td>
<td>Population exposed to noise pollution</td>
</tr>
<tr>
<td>EN-P-2</td>
<td>Quality of air in tunnels</td>
</tr>
<tr>
<td>EN-P-3</td>
<td>Cohesion-fragmentation patterns of settlements</td>
</tr>
<tr>
<td>EN-S</td>
<td>Secondary</td>
</tr>
<tr>
<td>EN-S-1</td>
<td>Population no longer exposed to noise pollution</td>
</tr>
<tr>
<td>EN-S-2</td>
<td>Landscape restoration</td>
</tr>
<tr>
<td>EN-S-3</td>
<td>Fragmentation of natural areas</td>
</tr>
<tr>
<td>EN-S-4</td>
<td>Pressure for land use change</td>
</tr>
<tr>
<td>EN-S-5</td>
<td>Proximity to conservation areas</td>
</tr>
<tr>
<td>EN-Sp</td>
<td>Specific</td>
</tr>
<tr>
<td>EN-Sp-1</td>
<td>Degree of air pollution</td>
</tr>
<tr>
<td>EN-Sp-2</td>
<td>Crossings with surface waters</td>
</tr>
<tr>
<td>EN-Sp-3</td>
<td>Pattern of use of combined modes of transport</td>
</tr>
</tbody>
</table>
make it possible to comprehend, to interpret and to evaluate the observed trends. At the specific level, the indicators are those that relate to specific categories of phenomena and are evaluated as individual cases.

2.3. The Impact Zones of the Egnatia Motorway

Every indicator uses specific field-related standards of implementation, which are the impact zones of the Egnatia Motorway. The impact zone of a transport axis with the scope and importance of the Egnatia Motorway constitutes a dynamic system, reflecting changes in the type and chronological span of these impacts. Taking into joint consideration the theoretical background of the existing regional and spatial planning system and the applied methodology and practice, five zones of impact were established. These cover: the zone of the axis itself to a depth of 500-1,000 metres; the widest geographical area of the prefectures and regions, crossed by the Egnatia Motorway axis and its vertical axes; and the widest area in the Greek and Balkans territory, which is affected as a result of the changes in the transport system as a whole.

On the basis of the macroscopic spatial impacts, and keeping in mind the fact that the developmental planning projections are mostly configured on the basis of programmes at the Regional level, the Observatory focuses on Zone IV; that is, the Zone comprising the

<table>
<thead>
<tr>
<th>Code</th>
<th>Transportation Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR-P</td>
<td>Primary</td>
</tr>
<tr>
<td>TR-P-1</td>
<td>Traffic volumes (AADT)</td>
</tr>
<tr>
<td>TR-P-2</td>
<td>Traffic composition</td>
</tr>
<tr>
<td>TR-P-3</td>
<td>Average occupancy rate</td>
</tr>
<tr>
<td>TR-P-4</td>
<td>Travel speed</td>
</tr>
<tr>
<td>TR-P-5</td>
<td>Travel time</td>
</tr>
<tr>
<td>TR-P-6</td>
<td>Total number of commuters</td>
</tr>
<tr>
<td>TR-P-7</td>
<td>Commercial transportation</td>
</tr>
<tr>
<td>TR-P-8</td>
<td>Time distance between towns and terminal destinations</td>
</tr>
<tr>
<td>TR-P-9</td>
<td>Generalised cost of transport</td>
</tr>
<tr>
<td>TR-P-10</td>
<td>Road safety</td>
</tr>
<tr>
<td>TR-S</td>
<td>Secondary</td>
</tr>
<tr>
<td>TR-S-1</td>
<td>Traffic capacity</td>
</tr>
<tr>
<td>TR-S-2</td>
<td>Level of service</td>
</tr>
<tr>
<td>TR-S-3</td>
<td>Induced traffic</td>
</tr>
<tr>
<td>TR-S-4</td>
<td>Patterns of mobility at border stations</td>
</tr>
<tr>
<td>TR-S-5</td>
<td>Combined transport modes</td>
</tr>
<tr>
<td>TR-S-6</td>
<td>Service Stations (S.S.)</td>
</tr>
<tr>
<td>TR-S-7</td>
<td>Housing changes</td>
</tr>
<tr>
<td>TR-S-8</td>
<td>Changes in the spatial patterns of industrial development</td>
</tr>
<tr>
<td>TR-S-9</td>
<td>Changes in the value of road-side plots</td>
</tr>
<tr>
<td>TR-Sp</td>
<td>Specific</td>
</tr>
<tr>
<td>TR-Sp-1</td>
<td>Trip generation rates due to special land uses</td>
</tr>
<tr>
<td>TR-Sp-2</td>
<td>Changes in the choice of locations for dwelling purposes (residential) and occupational purposes (workplace)</td>
</tr>
<tr>
<td>TR-Sp-3</td>
<td>Changes in the modal split</td>
</tr>
</tbody>
</table>
five Regions crossed by the Egnatia Motorway and its vertical axes: Western Macedonia and Thrace, Central Macedonia, Eastern Macedonia, Epirus and Thessaly. Zone IV is formed by Zones I, II and III; these are the zones corresponding to the distance of 1000 metres from the axis, the Prefectures crossed by the motorway, and the Prefectures crossed by the vertical axes respectively. A number of indicators focus on Zones I, II and III, depending on the subject of the monitoring and on the geographical span involved.

The Egnatia Odos Observatory compiles Annual Results Reports on the progress of the essential measurements monitored by the indicators system. The Impact Reports of the Egnatia Motorway are compiled at regular intervals in view of presenting a periodical synopsis of the conditions and outcomes in the zones of impact, focusing in particular on Zone IV. In general, the Reports produced by the Observatory aim at highlighting the fundamental issues, in order to support authorities and bodies in charge of regional and local development policies, of the motorway’s spatial impacts.

The Egnatia Motorway was put into operation in stages since late 1990’s. Accordingly, this 1st Impact Report actually assess an initial state of implementation in Zone IV, and at the same time presents an evaluation of specific transformations that were detected after the first phase of operation of the Egnatia Motorway. The measurements obtained in the 1990’s reflect the situation before the construction of the Egnatia Motorway. They constitute a source of reference that can be consulted for the future and overall evaluation of the motorway’s spatial impacts.

The scope of the analysis of the Egnatia Motorway impact rests on the fundamental assumption that defines the relationship between transport infrastructure and regional development, namely, that a better, more modern transport system contributes to the reduction of the cost of transport on the one hand and on the other hand, it makes affordable a more extensive range of choices for the establishment both of business enterprises and of households. Improvements such as these increase the competitive potential of an area in terms of production and raise the prospects of promotion of the regional economy.

As a general principle, the impact of a newly created transport infrastructure can be conceived as the following cause-and-effect sequence of processes: a new system reduces the cost of transport, resulting in increased accessibility to its zones of influence (albeit altering at the same time their relative positioning). This

<table>
<thead>
<tr>
<th>ZONE</th>
<th>Description</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZONE I</td>
<td>Axis Zone</td>
<td>500-1,000 on either side of the axis</td>
</tr>
<tr>
<td>ZONE II</td>
<td>Zone of transit of the axis</td>
<td>Prefectures crossed by the axis (11 prefectures)</td>
</tr>
<tr>
<td>ZONE III</td>
<td>Zone of transit of the vertical axes</td>
<td>Prefectures crossed by the vertical axes (13 Prefectures)</td>
</tr>
<tr>
<td>ZONE IV</td>
<td>Zone constituted by the Regions</td>
<td>Combination of Zones II and III (5 Regions)</td>
</tr>
<tr>
<td>ZONE V</td>
<td>Wider zone of impact of the Egnatia Motorway system</td>
<td>Wider region of the Greek and Balkans territory</td>
</tr>
<tr>
<td>ZONE V-A</td>
<td>Zone of impact on Greek territory</td>
<td>Central and Western Greece, Attica, Northern Aegean Region and Ionian Islands</td>
</tr>
<tr>
<td>ZONE V-B</td>
<td>Cross-border zones of impact</td>
<td>As far as the capital cities of the countries of South-Eastern Europe sharing cross-border zones</td>
</tr>
<tr>
<td>WIDER/GREATER REGIONAL ZONE</td>
<td>European zone of impact</td>
<td>Operation of the Egnatia Motorway system as part of the Trans-European Transport networks (TENs-T) and of the Pan-European Corridors.</td>
</tr>
</tbody>
</table>
increased accessibility affects the demand for mobility in the zones of impact, resulting in an increase both in economic production and in household demand (albeit altering at the same time their relative positioning), consequently affecting the population concentration patterns and activity. These transformations, in turn, lead to the alteration of the demand for mobility, and this high demand generates pressure for a new transport infrastructure to be created and, more broadly, for changes in the transport system. As a whole, the above transformations have an impact on the environment (both natural and built) and on natural and cultural resources.

This 1st Spatial Impacts Report of the Egnatia Motorway is based on the study of the results provided by thirty indicators that investigate issues such as the mobility, the accessibility of the regions and of their urban centres, the attenuation of intra-regional inequalities, the degree of convergence achieved by Northern Greece towards average European Union standards, the organisation of settlements, and the impact on the environment.

The European policies broadly concerned with economic and social cohesion, with transport policies and the Trans-European Networks as well as with spatial planning at the European level, constitute the essential material for the analysis and the evaluation of the results obtained from the indicators. The targets of European transport policies include a wide spectrum of strategic issues; of main concern among these, are the issues of the Trans-European Networks construction and completion. On the other hand, the link between transport policies and sustainable development has become explicit (changes in the existing transport distribution according to type of transport, elimination of traffic congestion in saturated networks, the anthropocentric perspective of the transport policy measures, and handling the phenomenon of the globalisation of transport). At the same time, the European Spatial Development Perspective (ESDP) lays the following objectives: (a) parity of access to infrastructure, innovation and knowledge, (b) balanced spatial development and new urban-rural relationships, (c) conservation and protection of the natural and cultural environments.

In general terms, European integration presupposes that transport policies keep pace with the policies aiming at achieving economic and social cohesion, competitiveness and sustainable development. The Trans-European Networks, are expected to play a decisive role towards achieving the objectives of even and harmonious development set by the European authorities. According to the Third Report on Economic and Social Cohesion, one of the fundamental priorities that must be considered is the need to improve communication, particularly regarding the completion and improvement of the transport, telecommunications and energy networks. According to this same Report, an efficient transport network is a prerequisite condition for regional economic development, even though improvements in the transport domain alone cannot be sufficient to ensure development.

The study of the spatial impacts of the Trans-European Networks is one of the priorities of the E.U. Its purpose is concerned with the

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evaluation of the extent to which such an ambitious programme contributes to an increase in the competitiveness of the European Union and to the attenuation of inequalities across the entire region. Evaluation of both the socio-economic impact of the road networks and of their effect on the environment have become objects of debate of great political significance both at the level of the European Union as a whole, and at the level of individual member-states. In order to address these issues, a common platform is critical for providing a technical and information infrastructure by means of compatible databases, cartographic information sources and of a systematized framework of indicators.

All of the above European policies constitute the basic framework for the analysis, classification, and study of the results provided by the indicators under observation. Thus, the study of the spatial impacts of the Egnatia motorway is classified on the basis of four critical parameters:

- Mobility and accessibility.
- Economic and social cohesion.
- Urban balance and networking.
- Quality of the environment.

4. The Regions on the path of the Egnatia Motorway: general features

The evaluation of the current progress status in the impact zone of the Egnatia Motorway takes into account the situation in the Regions of Zone IV as a whole, that is, the Regions of Eastern Macedonia & Thrace, of Central Macedonia, of Western Macedonia, of Epirus and of Thessaly. This area covers 66,000 km², a surface which represents 50% of the national territory. In respect of size, the largest Region is Central Macedonia, which covers a little under a third of the total surface of Zone IV, while the smallest is Epirus, with only 14% of the total surface. As for Zone II, which is the Zone that corresponds to the Prefectures on the path of the Egnatia Motorway axis, it covers 32,000 km² and represents 24.5% of the national territory and 49% of the total surface of Zone IV.

According to the 2001 Census, the actual population of Zone IV adds up to 3,892,249 inhabitants, which represents over one third of the population of the country (35.5%). This figure divides itself between the 2,319,052 inhabitants of Zone II (Zone of the Prefectures crossed by the Egnatia Motorway) and the 1,573,197 inhabitants of Zone III (Zone of the Prefectures crossed by the vertical axes of the Egnatia Motorway). Central Macedonia has the highest population of all the Regions, representing 48% of the population of Zone IV, while the population of Western Macedonia standing as the lowest, representing a mere 8% of the population of Zone IV. The Prefecture of Thessaloniki is of course the most populated of the Prefectures since it concentrates 27% of the population of Zone IV. En bloc, 52.4% of the population of Zone IV is based in urban centres, a percentage which represents 18.6 % of the total population of the country. The population of the metropolitan area of Thessaloniki, which adds up to around one million inhabitants, represents one quarter of the total population of Zone IV.

With reference to the following features, Zone IV, which includes the 5 Regions, represents:

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50% of the total surface of the country,
35.5% of the population of the country,
33% of the country’s Gross Domestic Product (GDP),
60% of the production of energy of the country,
41% of national exports,
33% of the national employment figures,
33% of the country’s Gross Value Added (GVA), and finally, it is to be noted that
the Gross Domestic Product per head for the five Regions in 2001 was 11,174 €, a figure lower than the average national GDP per head (12,008 €), and which corresponded to 68.7% of the EU25 average GDP per head (in Purchasing Power Standards - PPS).

All the Regions of Zone IV benefit from the enactment of the “Regional Framework for Spatial Planning and Sustainable Development” on the basis of the 2742/99 Act for “Spatial Planning and Sustainable Development and other directives”. The Regional Framework for Spatial Planning initially analyses and evaluates the position of every Region in both the national and European contexts, as well as the role played by these Regions and their comparative position in relation to other regions; it also registers and evaluates the level of cross-regional activity that the Regions have developed or have the potential to do so, the factors that influence the long-term development and spatial organisation and, finally, the impacts of the European, national and regional policies and programmes. Next, in a 15-year perspective, the Regional Frameworks for Spatial Planning define the priorities and the strategic choices to be made towards achieving the integral and sustainable development of the Regions: these priorities and choices are expected to drive forward the regions’ integration on an equal footing within the wider national, European and international contexts.

All of the Regional Frameworks for Spatial Planning emphasize the role played by the Egnatia Motorway towards regional development, and stress its distinctive character as an interchange network within the whole transport system. At the same time they suggest the undeniable character of the contribution of the Egnatia Motorway to the spatial planning integration of every single Region at the cross-regional and international levels. It is estimated that at the intra-regional level the Egnatia Motorway will function as a crucial

Graph 1: Population in the zones of impact of the Egnatia Motorway in relation to the overall population of Greece, 2001
factor towards a more cohesive settlement system, significantly affecting travel time and the organisation of the transport system, as well as the home-workplace relationships, particularly in the urban centres. It should be pointed out that the Egnatia Motorway on its own cannot counteract regional isolation problems, and that, in parallel, thorough provision of development policies is required.

In the approved Regional Frameworks for Spatial Planning of the Regions of Eastern Macedonia & Thrace, Central Macedonia, and Western Macedonia, there is a specific reference to the Egnatia Odos Observatory highlighting the fact that:

“There is an evident necessity for the Observatory to work in association with the current spatial planning programme at the regional level, in particular with regard to intra-regional spatial impacts, but also with regard to cross-border issues.” (Government Bulletin Publications ref: 1478/9-10-2003, 2188/6-2-2004 and 1472/9-10-2003, available only in Greek).

The Egnatia Motorway also constitutes a point of reference for regional planning in the sense that it does not only constitute the principal axis of development of the Regions of Zone IV. It also absorbs a substantial part of the funding from the Third Community Support Framework 2000-2006 for all the programmes and projects in Zone IV. More specifically, the Egnatia Motorway secures 16.5% of the funding for all the projects of the 3rd Community Support Framework (CSF III) (falling into the sections of Operational Programmes and Regional Operational Programmes), which are being carried out in the five Regions of Zone IV. This amount corresponds to 50% of the funding of Regional Operational Programmes of the five Regions. It is worth noting that the cost of the work carried out on the Egnatia Motorway system and on its vertical axes amounts to 67% of the funding for roadworks in the five Regions, of which the work in Epirus secured the highest amount (87.2%) and Thessaly none.

5. Mobility and Accessibility

The main impact produced by the provision of a transport infrastructure is the enhancement of travelling opportunities between various areas, and of access to and from various centres of activity within or out of an area. This manifes-

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4 The projects that were listed on all Operational Programmes of CSF III 2000-06, are recorded by the Integrated Information System (IIS) “ERGORAMA” of the Ministry of Economy and Finance, at the address http://www.mnec.gr/ergorama/defaultx.asp

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Table 3: Variations in the number of inhabitants of the Regions in Zone IV

<table>
<thead>
<tr>
<th>Regions</th>
<th>Population in 1991</th>
<th>Population in 2001</th>
<th>Variation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Macedonia and Thrace</td>
<td>570,496</td>
<td>611,067</td>
<td>7.1%</td>
</tr>
<tr>
<td>Central Macedonia</td>
<td>1,708,977</td>
<td>1,871,952</td>
<td>9.5%</td>
</tr>
<tr>
<td>Western Macedonia</td>
<td>293,015</td>
<td>301,522</td>
<td>2.9%</td>
</tr>
<tr>
<td>Thessaly</td>
<td>734,846</td>
<td>753,888</td>
<td>2.6%</td>
</tr>
<tr>
<td>Epirus</td>
<td>339,728</td>
<td>353,820</td>
<td>4.1%</td>
</tr>
<tr>
<td>ZONE IV</td>
<td>3,647,062</td>
<td>3,892,249</td>
<td>6.7%</td>
</tr>
<tr>
<td>TOTAL FOR THE COUNTRY</td>
<td>10,259,900</td>
<td>10,964,020</td>
<td>6.9%</td>
</tr>
</tbody>
</table>

Source: Greek National Statistics Agency, 2001
5. MOBILITY AND ACCESSIBILITY

The concept of impact introduces two fundamental concepts: the concept of accessibility and the concept of mobility. The first expresses how easily an activity can be accessed, while the second conveys travel demand. The concept of accessibility is to a great extent related to that of mobility because it refers to how it is possible to reach a chosen destination. It is obvious that an improvement in accessibility will have a dynamic effect on mobility. Improved accessibility of the various areas, aiming at ensuring the parity in the use of the newly generated infrastructure, happens to be one of the prime objectives of the European Transport Policy but equally of the European Spatial Development Plan and, more generally, of economic and social cohesion policies. Parity in the use of the infrastructure is an aim which is reflected in the indicators which are concerned with the provision of the transport system and the transport cost. These indicators are also related to the impact of the motorway on the accessibility of cities, towns and terminal destinations of other means of transport, and of other specific areas (industrial areas, tourist attractions). Other important indicators are concerned with the basic socio-economic figures (population, market size in terms of GDP, the size and the composition of the labour force), all of which become potentially more accessible thanks to the operation of the motorway.

5.1. Mobility

i. Traffic volume

In order to obtain a picture of mobility patterns the main indicator is concerned with the traffic volume per section of the Egnatia Motorway. Results obtained with the help of other indicators, such as traffic composition and the number of people travelling, are also very important.

Traffic volume counts carried out in 2004, estimating average daily number of vehicles that travelled between two successive interchanges of Egnatia, indicate that the highest traffic volumes are recorded between Interchange 4 (TITAN Exit) and Serres (over 54,000 vehicles daily). This high volume is expected since this section services the traffic between Thessaloniki and Langadas province, as well as the traffic of two very important routes (from Thessaloniki to Serres and Kilkis via the National Road, and from Thessaloniki to Kavala via the Egnatia Motorway or the National Road).

It appears, that almost on all of the open motorway’s sections the daily traffic volume reaches or exceeds 70% of the forecast for 2010 (Siatista – Kozani: 78%, Veria – Klidi: 72%, Komotini – Alexandroupoli: 78%). With reference to the results of measurements carried out in 2003, it can be said that the daily volume of the traffic appears to have increased on all sections in operation at rates fluctuating between 5% (I/C Veria – I/C Kouloura) and 120% (I/C Kalamia – I/C Siatista).

Some seasonal variations are also worthy of attention. In 2004, on the section linking the Ardanio Interchange and the Industrial Zone of Alexandroupoli, the average traffic volume was 4,900 vehicles per day. A more detailed analysis of the data for this section, looking into the distribution of the traffic according to destination, reveals an interesting pattern of variation over the summer: in June and July the figures for Eastbound journeys are higher by 9% and 40% respectively, as compared to those for Westbound journeys, while in August and September, the figures for Eastbound journeys are in fact lower by 17% and 14% respectively, as compared to Westbound journeys. A likely explanation could be that these variations are the result of the large number of Turkish emigrants who work in Europe and travel back to
Map 3: Traffic Volume in the Egnatia Motorway, 2004
THE TRAFFIC COUNTS SYSTEM AND THE TRAFFIC MODEL OF EGNATIA ODOS A.E.

The Department of Traffic and Telematics - Division of Operation, Exploitation & Maintenance of Egnatia Odos A.E. - is the main source of primary data for the measurement of transport activity and provides the support necessary for the monitoring and processing of the indicators relating to the operation and evaluation of the road network. More specifically, the Department of Traffic and Telematics is responsible for a range of issues that concern the operation of the motorway. One of its main areas of competence is the provision of information about traffic, forecasts and analyses for both the Egnatia Motorway and its Vertical Axes and the broader “corridor” of the Egnatia Motorway.

TRAFFIC COUNTS SYSTEM

Egnatia Odos A.E. started as early as 1997 the programme of traffic counts along the path of the Egnatia Motorway, conducting systematic traffic counts on the sections of the Egnatia Motorway and of its vertical axes open to traffic. The Department of Traffic and Telematics has developed an integrated system for the collection and processing of traffic counts. When finalized, this system will comprise a total of 65 traffic count sites (tolls included). The systems used in these sites are inductive loops and remote traffic microwave sensors, while counts are collected by means of specialized Telemetry software and with the use of telematics equipment, thus allowing the transmission of data from all remote locations of the motorway to the headquarters of Egnatia Odos A.E. in Thessaloniki.

Moreover, the Department of Traffic and Telematics collects and processes the traffic information compiled by the Departments of Work Maintenance Control of the Regions of Central Macedonia and Eastern Macedonia & Thrace.

The way in which the collection and analysis of traffic data is carried out makes it possible not only to successfully reach a thorough level of knowledge of the traffic characteristics (category of vehicles, peak hours, speed, quality of service etc.) by calculating respective indicators, but has equally made it possible to bridge the gap between the Egnatia traffic model and the actual Egnatia Motorway, which is an essential condition for producing reliable traffic forecasts.

TRAFFIC MODEL

In 1997, as a result of a more urgent need for reliable traffic forecasts that would help towards the planning of the motorway, Egnatia Odos A.E. developed a traffic forecast model based on all available data about the transport network and the demand for mobility.

The traffic model of Egnatia Odos A.E. is used for the production of a wealth of traffic information, projections and analyses. These are utilised in the decision-making process for the planning of the motorway, for the required Electro-Mechanical installations and for the necessary telematics applications, for the toll system, the Service Stations, as well as in feasibility studies, in the appraisal of environmental parameters, in planning the maintenance of the road surface etc.
Turkey for their summer holidays.

ii. Traffic composition

The counters installed over the length of the Egnatia Motorway to record the traffic volume also keep a record of the length of every vehicle. This last recording makes it possible to classify the travelling vehicles into four main categories: passenger vehicles and small trucks (<5.2m), larger trucks (<7m), non-articulated HGV (<12m) and articulated HGV (>12m).

The pattern of composition of the traffic over the total length of the Egnatia Motorway is relatively uniform. The majority of the vehicles (between 80% and 90% of the total number) are passenger cars. The remaining 10% to 20% are HGV’s, half of them articulated and the other half non-articulated.

The seasonal fluctuations of the traffic volume also affect to some extent the composition of the traffic. During the summer months the average daily traffic increases as a rule in comparison to conditions throughout the remainder of the year. Passenger cars represent the greatest part of this increase, while the number of HGV’s remains relatively constant throughout the year.

iii. Travelling speed

The Egnatia Motorway was designed and built as a closed motorway of international standards, with a dual carriageway divided by a central reserve. Each carriageway is divided into two lanes and a hard shoulder, with the exception of the Kaldi – Langadas section where each carriageway has three traffic lanes and a hard shoulder. This lay-out makes it possible for road users to attain and maintain high travelling speeds.

The current traffic volume on most of Egnatia sections is below capacity, so that the average speed is relatively close to the recommended speed (120 km/hour). Indeed, over numerous
sections of the Eastern part of the motorway, the number of cars that keep steadily to speeds over 120 km per hour is significant.

There are at present two Egnatia sections (Kavala Bypass and K4 I/C– Derveni I/C) where relatively low speeds are recorded, with an average speed below 100 km per hour; due to the road geometry (horizontal and vertical alignment).

iv. Travel time

The completion of the Egnatia Motorway will result in a substantial saving in travel time on journeys throughout the North of the country. Map 4 shows an evaluation of the reduction in time – as compared to pre-Egnatia conditions – which will be achieved on journeys from Thessaloniki to all areas once the motorway is completed. As the map indicates, the travel-time from Thessaloniki to Igoumenitsa will be reduced by three hours, while the travel-time from Thessaloniki to Kipi (Greek-Turkish border) will be reduced by two hours.

5.2. Accessibility

i. Benefiting population

The method used to assess how many people benefit from the operation of the Egnatia Motorway depended on taking distance as a function of the road network, as follows: taking first, the 50 km radius from the centres of the Prefectures, which corresponds to a commuting distance potentially covered in one day and consequently to a spatial functional entity; and second, the 150 km radius from the centres of the Regions, which potentially represents a wider area characterised by frequent journeys and, consequently, with increased possibilities of functional links.

Set against the entirety of the population of Zone IV, the percentage of inhabitants who are

Table 4: Population situated up to 50 km from the centres of the Prefectures of Zone II

<table>
<thead>
<tr>
<th>Town/City</th>
<th>Benefiting Population 2001</th>
<th>% of the total benefiting population (with overlapping)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Igoumenitsa</td>
<td>55,574</td>
<td>2 %</td>
</tr>
<tr>
<td>Ioannina</td>
<td>163,838</td>
<td>6 %</td>
</tr>
<tr>
<td>Grevena</td>
<td>126,950</td>
<td>5 %</td>
</tr>
<tr>
<td>Kozani</td>
<td>211,820</td>
<td>8 %</td>
</tr>
<tr>
<td>Veria</td>
<td>390,603</td>
<td>15 %</td>
</tr>
<tr>
<td>Thessaloniki</td>
<td>1,181,344</td>
<td>46 %</td>
</tr>
<tr>
<td>Serres</td>
<td>209,054</td>
<td>8 %</td>
</tr>
<tr>
<td>Kavala</td>
<td>292,175</td>
<td>11 %</td>
</tr>
<tr>
<td>Xanthi</td>
<td>261,213</td>
<td>10 %</td>
</tr>
<tr>
<td>Komotini</td>
<td>236,590</td>
<td>9 %</td>
</tr>
<tr>
<td>Alexandroupoli</td>
<td>145,310</td>
<td>6 %</td>
</tr>
<tr>
<td>Total benefiting population over 50 km (no overlapping)</td>
<td>2,588,037</td>
<td></td>
</tr>
<tr>
<td>Total Population of Zone II</td>
<td>2,319,052</td>
<td></td>
</tr>
<tr>
<td>Total Population of Zone IV</td>
<td>3,894,511</td>
<td></td>
</tr>
</tbody>
</table>

considered, overall, to benefit most from the existence of the Egnatia Motorway is markedly high. The number of inhabitants situated over a distance of up to 50 km from the centres of the Prefectures of transit of the axis (Zone II) is 2,588,037. This figure is higher by 268,985 (in other terms, 12%) as compared to the population of Zone II and corresponds to 2/3 of the total population of Zone IV, and to 1/4 of the population of country.

Thessaloniki, which enjoys a connection with 46% of the total population that benefits from the Egnatia Motorway, stands in a distinctive place in terms of the benefiting population situated at a distance of 50 km. A number of the other towns, however, such as Ioannina, Veria,
Komotini, Kavala and Xanthi are also connected to a significant degree (over 10%) with the benefiting population of Zone II.

The total population situated 150 km of the centres of the Regions of Zone IV adds up to 3,517,605 inhabitants. This figure represents 90% of the population of Zone IV and corresponds to almost one third of the population of the country.

Upon a close examination of 5 regional centres, up to a distance of 150 km from the road network, it appears that Thessaloniki enjoys a connection with around 2.3 million inhabitants, which represents 64% of the total population of Zone IV. Over an equal distance, the town of Kozani is connected with 2.2 million inhabitants, that is 62% of the total population of Zone IV which is a figure slightly under that for Thessaloniki over an equal distance. These results indicate the chief role of the Regions of Central and Western Macedonia in terms of the motorway operation. As for the corresponding figures for the regional centres of Epirus and Eastern Macedonia & Thrace, while they are lower for reasons of geographical location (17% and 14% respectively for Ioannina and Komotini), they nonetheless reveal that these centres connect with a number of inhabitants much higher than the total population of their own region: the city of Ioannina is in connection with a number of inhabitants more or less twice that of Epirus, while for Komotini this number of inhabitants is slightly lower than the total population of Eastern Macedonia & Thrace.

ii. Market size

Market size is calculated by using the regional Gross Domestic Product (GDP). In the year 2000, the total GDP which was recorded for the five Regions of Zone IV added up to 40,928.4 million Euros, that is, a third (1/3) of the total GDP for Greece. Its distribution over the five regions is exceptionally unequal. Central Macedonia yielded over half the GDP of Zone IV; while Thessaly with 19% and Eastern Macedonia with 13% yielded a relatively important share of the GDP of Zone IV. Western Macedonia and Epirus on the other hand take the smallest share of the GDP generated in Zone IV (under 10%).

A more detailed examination at the Prefectural level shows that the most important share of the GDP (63%) was yielded by the Prefectures of Zone II. The Prefecture of Thessaloniki, as would be expected, scores with the most important share of the GDP of Thessaloniki, since their share of the percentage fluctuates from a figure as low as 1% (Prefecture of Thesprotia and Prefecture of Grevena) to a maximum of 7.4% (Prefecture of Larissa). The Prefectures that present the least important market size in the country are those of Grevena, Kastoria, Florina, Thesprotia, Preveza and Arta, along with the Prefectures of Evritania and Fokida, and also including some island Prefectures. It should be noted that the prefectures with the highest market size are those situated along the PATHE motorway axis.

Over the period 1996 to 2000, the average yearly percentage of GDP growth at fixed value for Zone IV as a whole, presented a variation slightly above that of the national average. The Region of Epirus was marked by the most noticeable rate of growth (6.31%) and in two other Regions, Western Macedonia and Thessaly (4.9% and 4.8% respectively), the rate of GDP growth exceeded that of the national average. The Region of Eastern Macedonia &
5. MOBILITY AND ACCESSIBILITY

Map 5: Annual GDP Rate Shift by Prefecture (1996 - 2000)

**LEGEND**

PREFECTURES:
ANNUAL GDP RATE SHIFT 1996 - 2000
(in million Euros, constant prices 1995)

- < 0%
- 0% - 3%
- 3% - 6%
- 6% - 9%
- > 9%

- **EGNATIA ODOS INTERCHANGES**
- **EGNATIA ODOS**
- **EGNATIA VERTICAL AXES**
- **PATHE MOTORWAY**
- **MAIN ROAD NETWORK**

Data source: REGIO Database, Eurostat 2004
Thrace (with 2.7%), presented the least significant rate of growth which was, moreover, lower than the national average. At the Prefectural level, the Prefectures of Grevena and Ioannina enjoyed a high rate of growth (10.8% and 9% respectively), followed by the Prefectures of Evros, Kilkis, Chalkidiki and Florina. On the other hand, the Prefectures of Imathia, Pella, Drama, and Kavala experienced a negative rate of growth of their GDP, at fixed value.

iii. Labour force

Research into issues regarding the labour force was carried out on the basis of data provided by the National Census for the years 1991 and 2001. In 2001 the labour force of Zone IV amounted to 1,573,537 persons, a figure exceeding the one third (1/3) of the labour force for the whole of Greece. The main share of the labour force (61%) is concentrated in Zone II, which comes in first position in terms of population size. The pattern of distribution of the labour force reflects to a great extent the pattern of distribution of the population: 50% of the labour force of Zone IV is concentrated in Central Macedonia, followed by Thessaly (19%) in second place, Eastern Macedonia & Thrace coming next in the third place (15.5%), and with the Regions of Western Macedonia (7%) and Epirus (8%) taking the smallest share. The highest concentration of the labour force is recorded in the Prefecture of Thessaloniki (30% of the labour force of Zone IV). The lowest concentration is recorded in the Prefecture of Grevena (0.8% of the labour force of Zone IV). In the remainder of the Prefectures the rate of concentration varies between 1.1% (Prefecture of Thesprotia) and 7.5% (Prefecture of Larissa).

Taking the population of Zone IV as a whole, the rate of participation of the labour force is 40.4% and stands a little below the national average (42.1%). The Regions of Epirus (36.9%) and Western Macedonia (37.2%) have the lowest rate of labour force participation whereas, the corresponding percentage for Central Macedonia (42.1%) is the highest.

Table 6: Regional GDP, 2000

<table>
<thead>
<tr>
<th>Region</th>
<th>Million €</th>
<th>% of the Greece’s total GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attica</td>
<td>45,943.4</td>
<td>37.3%</td>
</tr>
<tr>
<td>Central Macedonia</td>
<td>21,177.8</td>
<td>17.2%</td>
</tr>
<tr>
<td>Central Greece</td>
<td>8,737.8</td>
<td>7.1%</td>
</tr>
<tr>
<td>Thessaly</td>
<td>7,873.6</td>
<td>6.4%</td>
</tr>
<tr>
<td>Peloponnesus</td>
<td>6,669</td>
<td>5.4%</td>
</tr>
<tr>
<td>Western Greece</td>
<td>6,523.7</td>
<td>5.3%</td>
</tr>
<tr>
<td>Crete</td>
<td>6,448.9</td>
<td>5.2%</td>
</tr>
<tr>
<td>Eastern Macedonia and Thrace</td>
<td>5,308.7</td>
<td>4.3%</td>
</tr>
<tr>
<td>Southern Aegean</td>
<td>3,757.6</td>
<td>3.1%</td>
</tr>
<tr>
<td>Western Macedonia</td>
<td>3,516</td>
<td>2.9%</td>
</tr>
<tr>
<td>Epirus</td>
<td>3,052.3</td>
<td>2.5%</td>
</tr>
<tr>
<td>Ionian Islands</td>
<td>2,093.4</td>
<td>1.7%</td>
</tr>
<tr>
<td>Northern Aegean</td>
<td>2,071</td>
<td>1.7%</td>
</tr>
<tr>
<td>Zone of Influence IV</td>
<td>40,928.4</td>
<td>33.2%</td>
</tr>
<tr>
<td>Total for the country</td>
<td>123,173.3</td>
<td>100.0%</td>
</tr>
<tr>
<td>Europe of the 15</td>
<td>8,571,003.2</td>
<td></td>
</tr>
</tbody>
</table>

Source: REGIO Database, Eurostat 2004
The observed changes for the period 1991-2001 show that the labour force of Zone IV rose by 13.5%, which is rather lower than the national average (19%). An increase of the labour force was observed in all five Regions. Central Macedonia presents the highest rate of increase (17%) and Epirus presents the lowest (5%). From an intra-regional perspective, the labour force change reveals a significant disparity between Prefectures. Although the majority of Prefectures experience an increase in their labour force, with the Prefecture of Thessaloniki, where the growth exceeded 25%, heading the list. The changes affecting the Prefectures of Grevena and Serres (in Zone II), and the Prefecture of Arta (in Zone III), showed a negative or low trend at rates ranging from -1.5% to 9%.

### iv. Accessibility of urban centres

The evaluation of the degree of accessibility of urban centers in Zone IV, in function of the urban population and the time-distance factors between the urban centres before and after the construction of the motorway, was achieved using a model applied within the European research programme under the acronym SASI (Socio-Economic and Spatial Impacts of Trans-European Transport Networks).

This evaluation revealed that for all the urban centers and in absolute values, the degree of accessibility is substantially enhanced as a result of the operation of the Egnatia Motorway, although to a different extent for each town. The urban centers that enjoy the greatest degree of improvement of their accessibility are those situated towards the ends of the axis. This fact affects in particular the cities of Igoumenitsa, Ioannina, Grevena, Arta, and Preveza (West side) and Alexandroupoli and Orestiada (East side). As concerns the accessibility of the towns situated towards the centre of the axis, such as Thessaloniki and the majority of urban centres in Central Macedonia, the enhancement is much less significant in comparison to the towns previously mentioned.
These transformations demonstrate unquestionably the contribution of the Egnatia Motorway to the convergence of the levels of accessibility across the urban centres, as the variations in travel time between them is significantly reduced.

Inferences of a similar nature can be made in relation to the accessible GDP of the Prefectures. Graph 3 shows the alterations affecting the accessibility of the Prefectures and their GDP p/h. The Prefectures in the West (Ioannina, Thesprotia, Grevena etc.) appear on the third dispersion quadrant of the graph reserved for the less affluent Prefectures of Zone IV (under-the-average GDP per head).

The presence of the Egnatia Motorway leads to an important enhancement of accessibility (above the average) for these prefectures. This is a positive occurrence, since it provides evidence of the way the Egnatia Motorway makes it possible for the remote and less developed Prefectures to become more accessible.

However, the extent to which this positive shift will lead to further local development as well as to regional cohesion or, on the contrary, to regional bleeding in benefit of more developed areas, will depend on the overall regional and spatial policies, and not exclusively on the operation of the Egnatia motorway.
Map 6: Changes in the pattern of accessibility of the urban centers in Zone IV

Legend:
- Red circle: Change in accessibility pattern of urban centers in Impact Zone IV
- Arrow symbols: Percentage shift

Graduate School of Environmental Engineering, University of Thessaly, Greece, using accessibility indicators

Support Services EODOS - Observatory of EODOS
5.3. Accessibility of areas of special significance

The optimal connection of the Egnatia Motorway with the maritime ports and the airports of Northern Greece constituted one of its principal design requirements and constitutes a fundamental component of the role it plays towards development.

In Zone IV the transport system is complemented by the connection of the Egnatia Motorway and its vertical axes with five maritime ports, eight airports as well as a rail network. More specifically, five airports (Thessaloniki, Kavala, Alexandroupoli, Kozani and Ioannina) and four maritime ports (Thessaloniki, Kavala, Alexandroupoli and Igoumenitsa) are situated in Zone II. Likewise, Zone III benefits from the service of three airports (Kastoria, Aktio and Nea Aghialos) and one maritime port (Volos).

The Egnatia Motorway will be connected to the Pan-European Networks (TINA) via its vertical axes. More specifically, the vertical Axes Ardanio – Ormenio and Komotini – Nymphaea, as well as the section Komotini – Alexandroupoli constitute parts of Corridor IX. The Axis Thessaloniki – Promahonas forms a part of Corridor IV and the Axis Thessaloniki – Evzoni comes under Corridor X. This Corridor will also link-up with the Egnatia Motorway at another point of its path, via the Vertical Axis Siatista – Krystallopigi.\(^2\)

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The improvement of the accessibility of primary development infrastructures, which constitute nuclei of economic activity, also affects the overall economic development of a region. In Zone IV there are 18 Industrial Areas, as well as various other zones reserved for commercial activity (Industrial Estates, Industrial Parks on schedule, etc.). Connections from the Egnatia Motorway serving a fair number of these development infrastructures have been or are expected to be built.

Other important centres of economic activity are, of course, the tourist sites. Zone IV constitutes an area that includes a wide variety of sightseeing areas (archaeological sites, traditional villages, sea-side resorts, sites of natural beauty etc), many of which are centres of attraction for a large number of tourists.

Keeping a record of all these prime areas of interest, of their potential and of the distance and travel time from the nearest interchange of the Egnatia Motorway, will become a special area of research, which the Observatory is expected to carry out in the course of its Five Year Action Plan.

5.4. Summary

The study of “mobility and accessibility” was carried out by analysing the results of indicators such as the traffic volume, travel time, accessibility of urban centres, benefiting population etc., that bear a direct relation to the operation of the Egnatia Motorway. It is clear that the impact of the Egnatia Motorway on mobility and accessibility is immediate. The established fact that on almost all of the sections of the Egnatia Motorway in operation the daily traffic volume has reached or exceeded the 70% rate forecast for 2010 is worthy of note. Over most of the sections of the Egnatia Motorway, the average speed is close to the design speed (120 km per hour), while the completion of the Egnatia motorway will make it possible to achieve the most significant reduction in travel time across Northern Greece. The estimate of the total population that will benefit directly from the full operation of the system of the Egnatia Motorway and its vertical axes verges on one third (1/3) of the country’s population and requires particular attention. The improvement of the accessibility of remote areas is also clear and prominent. At the same time, the Egnatia Motorway connects with, and improves the accessibility of, other transport means and areas of prime importance. Transformations of this nature are expected to have a decisive impact on the connection between the separate regions of Northern Greece and, more generally, on its pattern of spatial development. The degree to which these areas will benefit from the above-mentioned improvements and changes will fundamentally depend on considerations of spatial planning and regional development policies.

6. Economic and social cohesion

The main goal of European policies over the last 15 years is economic and social cohesion. The need to guarantee the freedom of movement of production factors within the European Common Market constitutes a priority of regional policy as much as of transport policy. The impacts that the motorway axes might have on regional convergence and cohesion remain difficult to determine, considering the fact that if the majority of regions benefit in absolute terms, it does not automatically follow that their relative position will also improve. Other policies should be also put in action in the event that inequalities might be caused by the operation of the motorway axes. At the
same time, the successful interconnection of transport policies with policies aimed at countering social exclusion and unemployment, finds its expression in the improved mobility of production factors and the promotion of the optimal match between the supply and the demand of employment. This reconciliation is, of course, neither automatic nor exclusively dependent on the mobility potential. A correlation is called for with other policies and, in particular those relating to investment, innovation, and to professional training at the regional level. In the first instance, the level of GDP p/h and the level of unemployment represent vital indicators for the evaluation of economic and social cohesion, while other significant information is provided by indicators such as those relating to the composition of production, to the composition of employment and to foreign trade.

6.1. Level of growth and prosperity

The amount of GDP per head (GDP p/h) constitutes a basic indicator regarding the level of growth and prosperity of a region. The comparison of the regional GDP with the average GDP of the European Union constitutes, in addition, a basic parameter of economic and social convergence. In the year 2000 the GDP p/h of the Prefectures in Zone IV amounted to 10,647.1 €, lower than the GDP p/h of the country (11,282.7 €). In terms of Purchasing Power Standards (PPS), the GDP p/h of Zone IV corresponded to 62.3% of the average GDP p/h for the Europe of the 15.

In the year 2000 the Region of Central Macedonia enjoyed the highest GDP p/h, closely followed by Western Macedonia, whereas Epirus turned out the lowest GDP p/h. Regarding the degree of convergence with the Europe of the 15, Central Macedonia is on a par with the country’s overall GDP level (67.9%), with Western Macedonia following close in second position. The less affluent Regions are Thessaly, Eastern Macedonia & Thrace, and Epirus where the GDP p/h fluctuates at levels noticeably lower than the national average, and markedly lower than the European average.

During the 1996 – 2000 period, and at a fixed rate, the level of GDP p/h rose in all the Regions of Zone IV. Epirus, the poorest region, enjoyed the highest annual rate shift (9.4%), whereas the Regions of Eastern Macedonia & Thrace experienced the lowest (1.6%). As for the Prefectures, the relatively less affluent ones (Grevena, Ioannina, Thesprotia, Florina) enjoyed a significant growth of their GDP p/h, whereas three Prefectures (Pella, Drama and Kavala) experienced a negative growth at fixed value.

Of special interest is the degree of convergence with the average GDP p/h of the EU 15. The increase in the rate of convergence of Zone IV taken as a whole (1.8%) appears to be slightly higher than the corresponding increase for the country (1.7%). Epirus, out of the five Regions, experienced the highest rate of improvement in respect of its convergence with the E.U. (10.8%). However it remains the Region that experiences at the same time the highest rate of divergence with the average

* According to the Statistical Services of the E.U. (Eurostat, Statistics in Focus, Theme 2, 56/2002), it is acceptable to carry out the evaluation of the convergence degree of areas, regions and other geographical units on the basis of the GDP p/h in a specific year, in units of Purchasing Power Standards (PPS). It is not acceptable, however, to compare the GDP in terms of Purchasing Power Standards across different years. To approach the problem of the diachronic changes of the convergence degree it is necessary to consider the GDP p/h in real terms (i.e. at constant prices) which explicitly adjust for price changes between years.
Map 8: GDP per head and degree of convergence with the European average by Prefecture, 1996 - 2000

LEGEND

PREFECTURES:
GDP/hab in PPS, 2000
(Purchasing Power Standards)

Convergence with EU15
(GDP/hab in PPS)

< 10,000
10,000 - 12,000
12,000 - 13,500
13,500 - 16,000
> 16,000

EGNATIA ODOS INTERCHANGES
EGNATIA CIDOS
EGNATIA VERTICAL AXES
PATHIE MOTORWAY
MAIN ROAD NETWORK

Data source:
REGIO Database, Eurostat 2004
European GDP p/h. Thessaly and Western Macedonia figure next, in second place, with a rate of improvement well in excess of the corresponding levels for the country and for Zone IV. By contrast, though the Regions of Eastern Macedonia & Thrace, and of Central Macedonia count among the five regions of the country (the others being Central Greece, Western Greece, and Crete) that experienced a decrease in the rate of convergence with the average European GDP p/h (-2.1% and -1%, respectively).

From a cross-Prefectural perspective, important divergences come to light. Eight of the Prefectures recorded either a negative rate of convergence or no change for the period 1996-2000. The Prefectures concerned are those of Pella, Drama, Kavala, Imathia, Arta, Pieria, Serres and Kastoria. With regard to the other Prefectures of Zone IV that experience an increase of their level of convergence with the E.U.15, the Prefectures of Grevena, Ioannina, Florina and Evros enjoyed the highest level of improvement (with percentages ranging from 35% to 15%), followed by the Prefectures of Kilkis and Chalkidiki (with a percentage of their degree of improvement exceeding 10%).

### 6.2. Unemployment rate

The unemployment rate in an area is undoubtedly a vital parameter for the evaluation of its social cohesion. According to the figures of the 2001 National Census, the average unemployment rate for the total area in Zone IV was around 12%. The unemployment rate in Western Macedonia was significantly in excess of this average (16%), while the lowest level was observed in Thessaly (11%). The levels for the other three Regions fluctuated at rates comparable to the average for Zone IV. At a cross-Prefectural level, however, significant divergences come to light, with the Prefectures of Kastoria and Drama experiencing the highest rates of unemployment (24% and 18%, respectively), and the Prefectures of Evros and Rodopi experiencing the lowest rate (9%).

A fundamental feature is the high level of participation of the younger ages to the total unemployed population of Zone IV (51%) which, in fact, exceeds the national average (48%). At the level of individual Regions, the problem is particularly acute in Epirus and Thessaly where the rate of participation of the younger ages to the level of unemployment exceeds by far not only the national average, but also the average for Zone IV (60% and 58%, respectively). The levels of unemployment in Western Macedonia, on the other hand, remain close to the levels for Zone IV (51%) whereas the Regions figuring in a better position are Central Macedonia and Eastern Macedonia & Thrace, where young unemployment fluctuates at similar, or slightly lower rates than those recorded for the country as a whole (48% and 47%, respectively).

From the records of the Annual Labour force Surveys of the Greek National Statistics Agency for the period 1998-2002, it appears that, in comparison to the average national rate of unemployment, all the Regions of Zone IV with the exception of Eastern Macedonia & Thrace experienced an increase in their unemployment rates, with the highest rate of increase in Western Macedonia (over 20%). In comparison to the average European levels in 2002, all five Regions experienced higher rates of unemployment compared to both the average for the Europe of the 15 (7.8%) and the average for the Europe of the 25 (8.9%).

### 6.3. Composition of production and employment
Map 9: Unemployment Rate, 1998 - 2002

LEGEND

regions: unemployment (%), 2002

- 6.0%
- 6.1% - 7.5%
- 7.6% - 10%
- 10.1% - 12.3%
- 12.6% - 13%

Egnatia Odos Interchanges
Egnatia Odos
Egnatia Vertical Axes
Pathe Motorway
Main Road Network

Data source: Greek National Statistics Agency, 2001
i. Composition of production

In 2000, the Tertiary industry sector represents around two thirds (2/3) of the total Gross Value Added (GVA)\(^9\) for Zone IV. The Secondary industry sector takes the second position with 24% of the total GVA, while the Primary industry sector stands in the third position, producing 10.6% of the total GVA for the Zone IV. This pattern differs by Region and by Prefecture. By means of a location quotient calculation, it was established that the Prefectures of Xanthi, Thessaloniki and Kozani specialise in the Secondary industry sector; the Prefecture of Ioannina in the Tertiary industry sector; and all the remaining Prefectures in the Primary industry sector.

The transport industry, more specifically, appears to have turned out 6.3% of the total GVA of Zone IV in the year 2000. The share of the transport industry in Central Macedonia and in Eastern Macedonia & Thrace remains close to the average of the Zone IV, whereas in Western Macedonia it is particularly limited. By contrast, the transport industry has the most important share of the total GVA in the Region of Epirus with 8.3%, an average appreciably higher than the average of Zone IV.

ii. Composition of employment

On the basis of data from the National Census of 2001 it is established that 54% of the population of Zone IV works in the Tertiary industry sector. The second most important sector of employment is the Secondary industry, which attracts 24% of the manpower and in third position stands the Primary industry sector with 22%, a figure high enough nevertheless, in comparison to the European average (E.U.15 = 4.2%, year 2001). The participation of the Tertiary and Secondary industry sectors to the overall employment pattern in the E.U.15 is more important than the participation of these industry sectors in the overall employment pattern of Greece. By extension, it is much higher still by comparison with Zone IV (28.7% in the Secondary industry sector and 67% in the Tertiary industry sector for the year 2001).

It appears that, in comparison to the 1991 figures, the percentage of the population employed in the Primary industry sector decreased by 23%. The highest decrease was recorded in Epirus (-25.6%), and the lowest in Thessaly (-12.2%). A decline was also observed in the participation of the Secondary industry sector to the overall employment (-9.4% out of the total of Zone IV). This decline, however, is less important than the decline recorded for the country as a whole (-10.9%). The participation of the Tertiary industry sector increased in Zone IV at a higher rate than the national average (18.5% for Zone IV and 12.8% for the country). In three out of the five Regions, (Western Macedonia, Epirus and Eastern Macedonia & Thrace) the share of the Tertiary industry sector increased at a rate exceeding 20%.

The Tertiary industry sector attracts the most important share of the labour force of all the Prefectures, with the exception of the Prefectures of Rodopi, Pella, and Karditsa. On the other hand, the share of the Primary and Secondary industry sectors varies considerably by area.

In sectors of activity that relate to transport infrastructure and to its improvement (commerce, transportation and construction), the following developments were observed: com-

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\(^9\) The GVA measurement is used for the calculation of the total product in an administrative-geographic region.
6. ECONOMIC AND SOCIAL COHESION

Map 10: GVA and Industry Sector by Prefecture, 2000

LEGEND

PREFECTURES:

SECTOR'S SHARE TO PREFECTURE GVA, 2000

AGRICULTURE
INDUSTRY
SERVICES

DOMINANT SECTOR ACCORDING TO LOCATION QUOTIENT, 2000

AGRICULTURE
INDUSTRY
SERVICES

EGNATIA ODOS INTERCHANGES
EGNATIA ODOS
EGNATIA VERTICAL AXES
PATHE MOTORWAY
MAIN ROAD NETWORK

Location Quotient compares the development of prefecture sector with the sector at national level.

Data source: REGIO Database, Eurostat 2004
Map II: Labour force and Industry Sector by Prefecture, 2001
commercial activity attracts 14.7% of all employees of Zone IV, construction work 8.3% and transportation 5%. In the course of the 1991-2001 decade, in Zone IV the participation of the commercial and transportation sectors to the overall employment pattern declined (-14% and -3.8%, respectively), while the participation of the construction sector increased (9%).

6.4. Foreign trade

Research in the patterns of foreign trade was carried out on a Regional basis. It addresses the trade flow of the Regions both in relation to other European Union countries and in relation to countries outside the European Union. The import activity of Zone IV totalled 5,638 million Euros, representing 19% of the country’s total import. The exports of Zone IV for the same year totalled 4,859 million Euros, representing in this case 41% of the country’s total exports. The fact that the export-import ratio in Zone IV is 0.86, whereas it is 0.40 for the whole country, highlights the externally – oriented nature of trade in Northern Greece.

<table>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Macedonia and Thrace</td>
<td>603.59</td>
<td>572.39</td>
<td>10.0%</td>
<td>10.5%</td>
<td>4.5%</td>
<td>2.8%</td>
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<tr>
<td>Central Macedonia</td>
<td>4,095.68</td>
<td>3,306.09</td>
<td>14.7%</td>
<td>18.2%</td>
<td>3.1%</td>
<td>5.2%</td>
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<td>Western Macedonia</td>
<td>248.15</td>
<td>289.26</td>
<td>8.0%</td>
<td>6.9%</td>
<td>-1.0%</td>
<td>-14.4%</td>
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<td>Thessaly</td>
<td>546.16</td>
<td>565.40</td>
<td>7.1%</td>
<td>6.8%</td>
<td>5.9%</td>
<td>-12.8%</td>
<td>1.04</td>
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<tr>
<td>Epirus</td>
<td>144.57</td>
<td>126.26</td>
<td>3.9%</td>
<td>4.5%</td>
<td>9.3%</td>
<td>-0.2%</td>
<td>0.87</td>
</tr>
<tr>
<td>Ionian Islands</td>
<td>30.74</td>
<td>18.64</td>
<td>0.8%</td>
<td>1.4%</td>
<td>-4.3%</td>
<td>-14.3%</td>
<td>0.61</td>
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<td>Western Greece</td>
<td>256.97</td>
<td>329.12</td>
<td>4.8%</td>
<td>3.8%</td>
<td>-1.4%</td>
<td>-1.4%</td>
<td>1.28</td>
</tr>
<tr>
<td>Central Greece</td>
<td>945.69</td>
<td>597.25</td>
<td>6.3%</td>
<td>10.0%</td>
<td>8.9%</td>
<td>7.4%</td>
<td>0.63</td>
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<tr>
<td>Peloponnesus</td>
<td>1,685.43</td>
<td>933.78</td>
<td>13.7%</td>
<td>24.7%</td>
<td>16.3%</td>
<td>28.8%</td>
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<td>Attica</td>
<td>20,269.24</td>
<td>4,691.96</td>
<td>9.4%</td>
<td>40.8%</td>
<td>6.0%</td>
<td>-0.8%</td>
<td>0.23</td>
</tr>
<tr>
<td>Northern Aegean</td>
<td>120.20</td>
<td>61.54</td>
<td>2.7%</td>
<td>5.4%</td>
<td>13.0%</td>
<td>53.9%</td>
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<tr>
<td>Southern Aegean</td>
<td>79.63</td>
<td>53.30</td>
<td>1.3%</td>
<td>2.0%</td>
<td>19.1%</td>
<td>0.2%</td>
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<td>Crete</td>
<td>268.43</td>
<td>250.26</td>
<td>3.7%</td>
<td>3.9%</td>
<td>6.8%</td>
<td>6.9%</td>
<td>0.93</td>
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<tr>
<td>Zone of Influence IV</td>
<td>5,638.16</td>
<td>4,859.40</td>
<td>11.3%</td>
<td>13.1%</td>
<td>3.5%</td>
<td>1.2%</td>
<td>0.86</td>
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<tr>
<td>Total for the country</td>
<td>29,294.48</td>
<td>11,795.27</td>
<td>9.0%</td>
<td>22.3%</td>
<td>5.6%</td>
<td>1.0%</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Source: Greek National Statistics Agency, 2001
Map 12: Export - Import ratio by Region and export destination, 2001
An examination of patterns at the regional level reveals that 73% of the imports and 68% of the exports of Zone IV are to, or from, Central Macedonia. It is also noteworthy that in two of the five Regions, Western Macedonia and Thessaly, the trade balance indicates a surplus since the export-import ratio is more than one.

On the whole, 57% of the exports of Zone IV are directed towards countries outside the European Union, while the remaining 43% are within the European Union, which reflects the countrywide pattern of exports. The regions that engage in important export activity with countries outside the European Union are Western Macedonia and Eastern Macedonia & Thrace (73% and 62%, respectively). Given the assurance of trade with the Balkans, it is clear that the completion of the Egnatia Motorway system and its vertical axes, thanks to the improvements in accessibility that will follow, is bound to contribute to the enhancement of this flow of trade.

In addition, exports play a significant role in the local economy of Zone IV. Exports in the five Regions represent 11.3% of the total GDP of the Zone, whereas, the national percentage corresponds to 9%. The Region of Central Macedonia enjoys the highest percentage (14.7%), which is at the same time the highest for the whole country. Eastern Macedonia & Thrace come in second position (10%). By contrast, the value of imports corresponds to 13.1% of the total for Zone IV and to 22.3% of the total for the country. It is worth noting that Central Macedonia appears to be dependent on imports to a greater degree than the other Regions of Zone IV (18.2%).

Finally, as regards the dynamics of exports, a smaller increase is observed over the 1998–2001 period in relation to the overall increase for the country (3.5% for Zone IV and 5.6% for the country). A more detailed examination reveals a significant rate of increase of exports in Epirus (9.3%), whereas in Western Macedonia the exports experience a decline mainly due to the crisis in the fur industry which is the key export for the region. As for the dynamics of imports, the rate of increase remains close to the national level of increase (1.2%).

6.5. Summary

The analysis addressing the parameter “economic and social cohesion” was carried out by using a range of macroscopic data, observations and evaluations that are related to issues such as the levels of prosperity and of unemployment, the patterns of employment and production, and the foreign trade. With the purpose of fully establishing the existing trends of the five-Regions Zone within the national and European contexts, the study of indicators regarding the above issues took place by carrying out an analysis of the underlying situation, of the fundamental changes over the preceding five or ten year period, and of the way these indicators compare to indicators at the national and European levels. Generally speaking, the research regarding the parameter “economic and social cohesion” provides full evidence of the predominance of the Region of Central Macedonia in virtue of the very existence of the metropolitan area of Thessaloniki. At the same time, the construction and gradual operation of the Egnatia Motorway to this day is accompanied by positive trends of convergence of the other Regions with the average E.U. standards. During the five-year period 1996-2000, for instance, the poorest Region, Epirus, experienced the highest annual rate of growth of its GDP p/h and the most significant improvement in terms of convergence with Europe.
There is no doubt that the results of the indicators that have been analysed at this stage depict conditions shaped by long-term trends in economic and social development. It is not possible to establish correlations, however, at this stage between the trends that were established and the observed transformations affecting mobility and accessibility. In any case the degree to which the Egnatia Motorway affect rates of transformation of vital socio-economic patterns remains a matter for further long-term research, detailed documentation and scientific interpretation.

7. Urban balance and networking

Transport networks have an influence on urban systems, since they bring closer the urban centres on their path, by reducing the relative distance between them and by enhancing communication opportunities. This is particularly true in the case of connections between the main urban centres of areas on the path of an important road network such as the Egnatia Motorway and its vertical axes. Rural areas and less important urban settlements benefit from the presence of the road network in a different way. For these, the important factor is the degree to which the main transport axes and interchanges connect with a web of secondary roads and interchanges, serving the network of medium and small towns.

In current spatial planning policy, the appraisal of urban networks involves factors of prosperity and development in the sense that the towns that form part of these networks get involved in collaboration and the merging of their
resources, developing complementary areas of operation or sharing services. The development of polycentric urban systems constitutes a chief goal for the European Spatial Development Perspective adopted by the Third Report of the European Council on economic and social cohesion. Some of the important indicators for the comprehension of the urban structure are the distribution, change and density of the population, urban hierarchy, and the patterns of mobility between urban centres.

7.1. Population distribution and change – hierarchy of the urban system

i. Population density

Population density is examined in Zone II with the intention of recording the trend of concentration of the population in relation to the Egnatia Motorway. It appears that over 50% of the population of Zone II occupies areas where the density exceeds 1,000 inhabitants/km², a figure that represents the population that lives in urban centres. It is nevertheless worth noting that a quarter of the population of Zone II occupies areas of very low population density (under 100 inhabitants/km²). A fact which is due to the pronounced pattern of dispersion of very small settlements in rural areas, and particularly in mountainous areas.

ii. Population change

Over the 1991 – 2001 decade the population of Zone IV grew by 6.7% in total, a percentage of increase slightly below the national average (6.9%), but more than twice the average increase for the Europe of the 15 (3%). In all Regions a positive rate of growth was observed for the same period. Two of the five Regions experienced an increase of their population at a higher rate of transformation than the national average (Central Macedonia and Eastern Macedonia & Thrace), while the other three Regions experienced a lower rate of growth than the national average.

The population growth of Central Macedonia
is mainly due to the high rate of increase recorded in the Prefecture of Thessaloniki, which exceeded 11% (higher than the national average by 5 percentage units). Apart from the significant increase in the Greater Thessaloniki Area, most of the other urban centres of Zone IV experienced a growth in population above the national average. Eastern Macedonia & Thrace experienced a rate of increase a little higher than the national average, with the Prefecture of Xanthi enjoying the highest percentage (11.9%). A striking percentage of growth of the population was observed in the four urban centres of Thrace (Alexandroupoli, Xanthi, Orestiada and Komotini) at rates ranging between 16.9% and 32.1%. By contrast,

Table 9: Classification of the Urban Centers in Zone IV by population size, 1991 - 2001

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Thessaloniki (Greater Area of Thessaloniki)</td>
<td>981,933</td>
<td>1</td>
<td>877,239</td>
<td>1</td>
<td>-</td>
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<tr>
<td>Volos (Urban conglomeration)</td>
<td>124,639</td>
<td>2</td>
<td>116,031</td>
<td>2</td>
<td>-</td>
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<tr>
<td>Larissa</td>
<td>124,394</td>
<td>3</td>
<td>112,777</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Ioannina (Urban conglomeration)</td>
<td>75,179</td>
<td>4</td>
<td>68,072</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Kavala</td>
<td>58,663</td>
<td>5</td>
<td>56,571</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>Katerini (Urban conglomeration)</td>
<td>54,941</td>
<td>6</td>
<td>47,011</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Serres</td>
<td>54,266</td>
<td>7</td>
<td>49,380</td>
<td>6</td>
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</tr>
<tr>
<td>Alexandroupoli</td>
<td>48,885</td>
<td>8</td>
<td>36,994</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>Trikala</td>
<td>48,686</td>
<td>9</td>
<td>44,232</td>
<td>8</td>
<td>-1</td>
</tr>
<tr>
<td>Xanthi</td>
<td>45,111</td>
<td>10</td>
<td>34,889</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Komotini</td>
<td>43,326</td>
<td>11</td>
<td>37,036</td>
<td>11</td>
<td>-</td>
</tr>
<tr>
<td>Veria</td>
<td>42,794</td>
<td>12</td>
<td>37,858</td>
<td>9</td>
<td>-3</td>
</tr>
<tr>
<td>Drama</td>
<td>42,501</td>
<td>13</td>
<td>37,604</td>
<td>10</td>
<td>-3</td>
</tr>
<tr>
<td>Kozani</td>
<td>35,242</td>
<td>14</td>
<td>31,553</td>
<td>14</td>
<td>-</td>
</tr>
<tr>
<td>Karditsa</td>
<td>32,031</td>
<td>15</td>
<td>30,067</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>Ptolemaida</td>
<td>28,679</td>
<td>16</td>
<td>25,125</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>Giannitsa</td>
<td>26,296</td>
<td>17</td>
<td>22,504</td>
<td>17</td>
<td>-</td>
</tr>
<tr>
<td>Naoussa</td>
<td>19,870</td>
<td>18</td>
<td>19,794</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td>Arta</td>
<td>19,435</td>
<td>19</td>
<td>19,087</td>
<td>19</td>
<td>-</td>
</tr>
<tr>
<td>Edessa</td>
<td>18,253</td>
<td>20</td>
<td>17,128</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Kilkis</td>
<td>17,430</td>
<td>21</td>
<td>12,139</td>
<td>25</td>
<td>4</td>
</tr>
<tr>
<td>Preveza</td>
<td>16,321</td>
<td>22</td>
<td>13,341</td>
<td>22</td>
<td>-</td>
</tr>
<tr>
<td>Orestiada</td>
<td>15,246</td>
<td>23</td>
<td>12,691</td>
<td>23</td>
<td>-</td>
</tr>
<tr>
<td>Kastoria</td>
<td>14,813</td>
<td>24</td>
<td>14,775</td>
<td>21</td>
<td>-3</td>
</tr>
<tr>
<td>Florina</td>
<td>14,279</td>
<td>25</td>
<td>12,355</td>
<td>24</td>
<td>-1</td>
</tr>
<tr>
<td>Alexandria</td>
<td>13,229</td>
<td>26</td>
<td>12,109</td>
<td>26</td>
<td>-</td>
</tr>
<tr>
<td>Tyrnavos</td>
<td>11,116</td>
<td>27</td>
<td>12,028</td>
<td>27</td>
<td>-</td>
</tr>
<tr>
<td>Grevena</td>
<td>10,177</td>
<td>28</td>
<td>9,345</td>
<td>28</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Greek National Statistics Agency, 2001
the rate of population increase of Kavala city remains low (3.7%).

As for Western Macedonia, the overall rate of increase remained at very low levels (2.9%). This fact indicates a rate of growth below the normal rate, with, in addition, a rate of growth almost equivalent to nil in the Prefecture of Kastoria. With the exception of the town of Kastoria, which remained stagnant in respect of population change, the remaining four centres of Western Macedonia experienced a significant increase at rates ranging between 8.9% (Grevena) and 15.6% (Florina).

In Epirus there are indications of a limited rate of population growth (4.2%). There, the Prefecture of Ioannina appeared to enjoy the most dynamic rate of change (7.6%) whereas the Prefecture of Arta, by contrast, experienced a negative rate of growth. It was observed that the rate of increase in the town of Ioannina exceeded 10% and that in Preveza it remained very high indeed (22.3%). With a rate of increase higher still, Igoumenitsa, a town that falls under the category of semi-urban centres, stood in a particularly dynamic position with 28%.

An examination of population growth in Thessaly reveals that the Region experiences the lowest rate of increase among the five Regions of Zone IV (2.6%). While the Prefecture of Magnisia enjoys the highest rate of growth, the Prefecture of Trikala, which is the single Prefecture on the path of the Egnatia Motorway, experiences a negative rate of growth of the order of -1%. On the other hand, in Thessaly also significant rates of growth are recorded for the capital cities of the Prefectures. In any case, the two important urban centres of the Region, Larissa and Volos, happen to be the only urban centres of Zone IV, after Thessaloniki, to boast a population of over 100,000 inhabitants.

iii. Urban hierarchy

28 urban centres come under Zone IV, and 14 of these come under Zone II. As concerns the hierarchy in respect of population size, one centre, Thessaloniki, has essentially the character of a metropolitan area, with a population of around one million inhabitants. Two other urban centres have a population in excess of 100,000 inhabitants, Larissa and Volos, both in Zone III (the Zone on the path of the vertical axes of the Egnatia Motorway).

7.2. City gravity – urban networks

i. City gravity

The evaluation of an indicator that determines the potential gravity amongst the urban centres situated in Zone IV was carried out with a gravity model, and solely as a factor of the distance in kilometres between the centres and the Egnatia Motorway as a reference point of measurement. The calculation of this indicator was carried out prior to, and again subsequently to, the start of the operating of the Egnatia Motorway. The fact that in both cases the results of the 2001 National Census were taken into account is worth noting. Thus, in essence, the variation of the level of gravity amongst towns is recorded, owing to the single factor of the improvement of the distance in kilometres between the urban centres.

On the whole, the indicator of the patterns of gravity of towns emphasises the marked influence of Thessaloniki, that is, of the metropolis of Zone IV. Thessaloniki produces the most significant indicator readings, both before and after the operation of the Egnatia Motorway. Larissa is in second position, being the third largest town in respect of population size in Zone IV. In the next position are three
urban centres of Central Macedonia (Katerini, Veria and Giannitsa), which are situated on the geometric centre of the axis.

In relation to the situation prior to the operation of the Egnatia Motorway, a clear improvement was observed on the indicator results for Thessaloniki and the two regional centres of the Western Region (Kozani and Ioannina). The latest are situated at a point where the distance in kilometres decreases significantly as a result of the Egnatia Motorway axis alignment. It must be noted that the variation of the indicator for the towns of Eastern Macedonia & Thrace registers as almost nil or negative. This is due to the fact that in the area concerned the path of the Egnatia Motorway is, for the most part, identical to the path of the old national road network.

ii. Urban networking

In the Regional Framework for Spatial Planning and Sustainable Development for the five Regions of Zone IV, the accent is on the need to bring together a balanced and polycentric network of urban centres in combination with the development of complete transport systems, and with the enhancement of their accessibility and cohesion. As it stands, the operating of the Egnatia Motorway and of its vertical axes improves the connection between the towns of Zone IV, with a definite effect on spatial structure.

For almost all of the above urban networks, a high rate of transformation affecting population size was recorded over the past decade. To be certain, in a fair number of cases such as the
networks in Thrace, the rate of transformation was significantly higher than even the average overall rate of transformation of the urban centres of the country.

The profile of road journeys in the shape of the flow chart of Map 17, establishes that in 1993 the cross-regional links were relatively restricted, and that only in the case of Thessaloniki, along with a number of towns in Western Macedonia (Kozani), of Eastern Macedonia & Thrace (Kavala and Drama), and of Thessaly (Larisa and Volos) were these links of any significance.

On the basis of information produced by the National Origin-Destination Survey for the year 1993 and the year 2002, the pattern of mobility between the scattered centres of the urban networks and the important changes recorded over the last decade were analysed in view of obtaining an assessment of the degree of mobility and networking before the construction of the Egnatia Motorway, and after long sections of the motorway had been put into operation. It should be noted that the data obtained from the National Origin-Destination Survey are for the purpose of exemplification only, and were therefore used strictly as an indication of particularly dominant trends of networking between the urban centres.

In 1993, the degree of mobility recorded in Central Macedonia from Kilkis to Thessaloniki was particularly impressive as it represented around 52% of the total mobility recorded from Kilkis to all areas of the country. No less impressive were the levels recorded in respect
of mobility from Giannitsa to Thessaloniki (47% of the total mobility recorded from Giannitsa) but also from Imathia (Veria and Alexandria) to Thessaloniki (33% of the total mobility recorded from Imathia to all areas of the country). In the year 2002, an examination of the mobility, points to an increase, as would be expected, of the order of 20% to 40% (Imathia – Thessaloniki: 18%; Giannitsa – Thessaloniki: 28%; Edessa – Thessaloniki: 33%).

Considering Eastern Macedonia & Thrace, a particularly marked connection between the towns of Drama and Kavala was observed in 1993 along with indications of elements of dependency of Drama on Kavala: mobility from

<table>
<thead>
<tr>
<th>Region</th>
<th>Urban networks</th>
<th>Zone of Impact</th>
<th>Population</th>
<th>Main Road Network Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Macedonia</td>
<td>Greater Thessaloniki Area</td>
<td>II</td>
<td>981,933</td>
<td>Egnatia Motorway, PATHE (vertical axis), remaining national network</td>
</tr>
<tr>
<td></td>
<td>Thessaloniki - Kilkis</td>
<td>II-III</td>
<td>999,363</td>
<td>PATHE (vertical axis), national network</td>
</tr>
<tr>
<td></td>
<td>Thessaloniki - Giannitsa</td>
<td>III</td>
<td>1,008,229</td>
<td>Remaining national network</td>
</tr>
<tr>
<td></td>
<td>Alexandria – Veria – Naoussa - Edessa</td>
<td>II-III-IV</td>
<td>94,146</td>
<td>Egnatia Motorway, remaining national network</td>
</tr>
<tr>
<td>Eastern Macedonia and Thrace</td>
<td>Drama – Kavala - Xanthi</td>
<td>II-III</td>
<td>146,275</td>
<td>Egnatia Motorway, vertical axis</td>
</tr>
<tr>
<td></td>
<td>Xanthi – Komotini - Alexandroupoli</td>
<td>II</td>
<td>137,322</td>
<td>Egnatia Motorway</td>
</tr>
<tr>
<td></td>
<td>Alexandroupoli - Orestiada</td>
<td>II</td>
<td>64,131</td>
<td>Vertical axis</td>
</tr>
<tr>
<td></td>
<td>Drama – Kavala – Xanthi – Komotini – Alexandroupoli - Orestiada</td>
<td>II-III</td>
<td>253,732</td>
<td>Egnatia Motorway, vertical axes</td>
</tr>
<tr>
<td>Western Macedonia</td>
<td>Kozani – Ptolemaida - Florina</td>
<td>II-III</td>
<td>78,200</td>
<td>Egnatia Motorway, vertical axis</td>
</tr>
<tr>
<td></td>
<td>Kozani - Grevena</td>
<td>II-III</td>
<td>45,419</td>
<td>Egnatia Motorway</td>
</tr>
<tr>
<td></td>
<td>Kastoria - Grevena</td>
<td>II-III</td>
<td>24,990</td>
<td>Egnatia Motorway, vertical axis</td>
</tr>
<tr>
<td>Epirus</td>
<td>Ioannina - Igoumenitsa</td>
<td>II</td>
<td>83,901</td>
<td>Egnatia Motorway</td>
</tr>
<tr>
<td></td>
<td>Arta - Preveza</td>
<td>III-IV</td>
<td>35,756</td>
<td>Ionion Motorway (vertical axis), remaining national network</td>
</tr>
<tr>
<td>Thessaly</td>
<td>Larissa - Volos</td>
<td>III</td>
<td>249,033</td>
<td>PATHE (vertical axis)</td>
</tr>
<tr>
<td></td>
<td>Trikala - Karditsa</td>
<td>III</td>
<td>80,717</td>
<td>National network (vertical axis)</td>
</tr>
<tr>
<td></td>
<td>Volos – Larissa – Trikala - Karditsa</td>
<td>III</td>
<td>329,750</td>
<td>PATHE-national network (vertical axes)</td>
</tr>
</tbody>
</table>

Table 10: Urban Networks in Zone IV (as suggested by the Regional Frameworks for Spatial Planning) and main road network connections
Drama to Kavala represented around 45% of the total mobility recorded from Drama to all areas of the country. The flow recorded between Xanthi and Komotini registered as significant and at the same indicative of a more balanced pattern of mobility towards each other (rates of 31% and 24%, respectively, in relation to the total mobility generated by these two points of departure towards all areas of the country). In comparison to the patterns in Central Macedonia reviewed above, the urban centres of Eastern Macedonia & Thrace revealed a reduction in the pattern of mobility in the direction of Thessaloniki. A more significant dependence on the latter was observed in the case of Drama, with Kavala in second position, which are the urban centres of Eastern Macedonia within the shortest radius from Thessaloniki. Using sample information contained in the National Origin-Destination Survey for the year 2002, it is estimated that the pattern of mobility between Kavala, Xanthi, Komotini and Alexandroupoli pointed to increases at rates ranging between 85% and 150%. These are taken to be very significant rates of increase, considering the fact that a rate of increase of 100% over a period of nine (9) years represents an increase of the traffic volume at a rate of 8% per year. It is revealing that the rate of mobility between Alexandroupoli and Komotini increased by 153%, which is equivalent to an increase of the traffic volume at a rate of 11% per year. Underlying this fact is the yearly rate of increase of 5.6% in car ownership in 1990 (information source Eurostat, for the whole of Greece). It follows that the highest rates of increase of the patterns of mobility must be attributed not just to the increase in car ownership, but also to access to the improved transport infrastructure. It is reckoned that over the 2000-2002 period, the 169 kilometres of the Egnatia Motorway in the Eastern sector have unquestionably contributed to a gain of this magnitude. It must be noted that mobility patterns from Thessaloniki also, in the direction of the above-mentioned towns – all of them on the Egnatia axis – indicated rates of increase ranging from 95% (Thessaloniki – Alexandroupoli) to 108% (Thessaloniki – Xanthi). By contrast, mobility between Thessaloniki and Drama increased by 45% only.

With regard to Western Macedonia, the data obtained for the year 2002 indicated a significant degree of networking between Kozani – Ptolemaida – Florina: 56% of mobility originating from Florina was bound for Ptolemaida, and at the same time a high rate of mobility was recorded between Kozani and Ptolemaida (38% and 48% respectively of the rate of increase of mobility of the two towns towards all areas of the country). The degree of connection of the towns of Western Macedonia with Thessaloniki in 1993, on the other hand, appears to be limited. From the sample data provided by the National Origin-Destination Survey for 2002 it is possible to infer that the rate of increase of the mobility between Kozani and Ptolemaida registered as 39%, between Kozani and Florina hardly 4%, while between Kozani and Grevena it registered as 95%. A fact that also reflects the role played by the Egnatia Motorway (bearing in mind that the sections Kozani – Siatista and Siatista – Grevena were opened to traffic during the course of the year 2000, and of the year 2001, respectively). The rate of mobility between Kozani and Thessaloniki increased by 59%, which appears to be relatively low in comparison to the rates achieved by the towns of Eastern Macedonia & Thrace. It is reckoned that the rate of increase of the mobility both to, and from, Western Macedonia will experience a marked acceleration thanks to the Kastania By-Pass opening to traffic.
As for Epirus, the rate of mobility from Ioannina to Igoumenitsa in the year 1993 reached 6% of the overall rate of mobility originating from Ioannina towards all areas of the country. In the opposite direction, the rate of mobility from Igoumenitsa to Ioannina reached 7% of the mobility rate from Igoumenitsa towards all areas of the country. The rate of mobility from the towns of Epirus to Thessaloniki was insignificant. The sample data provided by the National Origin-Destination Survey 2002 points to a rate of increase of the mobility rate from the urban centres of Epirus on the one hand and Thessaloniki on the other, much lower than the rates recorded in areas of operation of the Egnatia Motorway. The rate of mobility between Ioannina and Igoumenitsa, for instance, increased by hardly 15%, and between Ioannina and Thessaloniki by 24%. It is expected that the completion of the work and the opening to the traffic of the Egnatia Motorway’s section Ioannina – Igoumenitsa, in combination with the Kastania By-Pass, will bring a significant increase of the mobility rate from and to the Region of Epirus.

Overall, the first results established by the sample data processing of the National Origin-Destination Survey for the year 2002 indicate that there are trends towards rates of increase of little or of great importance at the cross-Prefectural level and at the cross-Regional level. It is expected that in due course these trends will clearly take the shape of significant cross-regional connections, in step with the progress of the completion and operation of the Egnatia Motorway.

Finally, in Thessaly the patterns of mobility in the year 1993 between Volos and Larissa was higher than those between urban centres. The more significant rate of mobility was recorded from Volos to Larissa (22% of the rate of mobility from Volos towards all areas of the country). Around 5% of the journeys from Larissa and from Volos were bound for Thessaloniki. The rate of mobility from Karditsa to Trikala conversely remained at a significantly high level (44% and 27%, respectively) as did that from Trikala in the direction of Larissa (19% of the overall rate of mobility). There is no data available regarding the rate of mobility in the Region of Thessaly for the year 2002.

7.3. Summary

The results of the study of the parameter “urban balance and networking” prove that the Egnatia Motorway creates the necessary conditions for the better interconnection of urban centres and hence the spatial organisation towards more polycentric systems. It stands as a prominent feature, that the Egnatia Motorway apparently led to an increased mobility between the urban centres of Eastern Macedonia & Thrace. There is no doubt, however, that it is the effective functioning of the networks and not simply the increase in mobility that constitutes the foundation for the development of such polycentric systems. From another angle, the Egnatia Motorway unquestionably becomes a focus for newly generated activities. Consequently, it has the potential to influence the distribution, for instance, of the establishment of businesses and households, thus creating conditions of pressure and bringing about changes in the value and in the use of land. The areas more likely to experience such phenomena are mainly the outer zones in the proximity of the motorway, or the interchange zones giving access to settlements. The relevant indicators will constitute a subject of research for the Observatory in the immediate future.
The result of such analyses will be considered in relation to the issues of mobility and accessibility, as well as in relation to essential indicators of socio-economic development.

8. Quality of the environment

The quality of the environment constitutes a fundamental component of the European Union policies for social and spatial cohesion, particularly concerning the impact of transport policies. Noise, air pollution, fragmentation, especially in the case of environmentally sensitive areas, and more generally the transformations affecting the land use are all significant indicators used to assess the environmental impact of important road transport projects such as the Egnatia Motorway. The indicators related to the quality of the environment that are monitored by the Egnatia Odos Observatory are compatible with the respective indicators monitored by qualified services of the European Union such as the European Environmental Agency.

8.1. Nature reserves

Zone IV constitutes an area that boasts a wide variety of natural areas. Its features taken as a whole reveal four geographic subsystems: plains, hilly areas, very mountainous areas, and littoral areas. Taking the total surface area of Zone IV, it appears that two thirds (2/3) are cultivated areas and pastureland (31.1% and 35.5%, respectively), while a significant degree of forested areas is recorded (25% of the total
## THE EGNATIA MOTORWAY AND ENVIRONMENTAL ISSUES

The Egnatia Motorway is one of the first large-scale public projects that benefit from the implementation of environmental management procedures, that is, procedures for the organizing and implementation of measures for the protection of the environment throughout the planning, construction and operation processes.

The Department of Environment of Egnatia Odos A.E. has been operating since 1996 and is responsible for a range of issues concerning the licensing of the project on environmental matters and Environmental Impact Assessments (EIA). More specifically, the Department of Environment develops the following areas of activity:

- Monitoring the quality of air pollution, inside and outside tunnels.
- Monitoring the quality of aquatic resources, and more particularly of streams – rivers, in view of establishing whether there is a need for the implementation of a system of Pollution Control Units.
- Monitoring the quality of the auditory environment following the preparation of special studies for the evaluation of traffic noise levels and for the installation of noise barriers, by carrying out measurements of the level of noise on the sections of the motorway open to traffic.
- The protection of fragile ecosystems situated on the path of the Egnatia Motorway by elaborating and implementing programmes for their protection, such as the programme for the monitoring of large mammals (bears, wolves etc.), which is designed for the area corresponding to the section Panagia – Grevena, and such as the recording of bird wildlife in the area of the Nestos river (section Chrysoupoli – Vaniano).
- The protection of embankments from erosion and the restoration of the landscape on the construction sites of the motorway, as well as the reinstatement of these sites into their natural environment, by means of either hydroseeding and eco-engineering works, initially, or by growing flora with different methods (planting and transplanting, creation of vegetation patterns), with the preparation and implementation of Lanscape Restoration Studies.
- Monitoring the necessary archaeological excavations and promoting the essential procedures required for obtaining permissions from the archaeological services (e.g. Central Archaeological Council). To enable the successful handling of these procedures, the Guidelines for the Administration of Excavation Work Expenditure were drafted and research was carried out to record the archaeological sites situated along the path of the Egnatia Motorway.
- Developing the awareness of road users for environmental issues with the creation of relevant infrastructures such as the design-built project and operation of the ecomuseum of Grevena, and with the cooperation of a number of services such as the Greek Biotope/Wetland Centre.
- Participation in the compilation of Technical Descriptions for environmental issues for all projects to be tendered.
- Drafting and submission to the qualified services of the Ministry for the Environment, Spatial Planning and Public Works, of the annual report on the implementation of Environmental Terms.

### Table: Land Use Distribution in Greece

<table>
<thead>
<tr>
<th>Region/Macedonia &amp; Thrace</th>
<th>Surface Area</th>
<th>% of Total Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Macedonia &amp; Thrace</td>
<td>57%</td>
<td>35%</td>
</tr>
<tr>
<td>Thessaly</td>
<td>57%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Central Macedonia</td>
<td>57%</td>
<td>7.6%</td>
</tr>
<tr>
<td>Western Macedonia</td>
<td>57%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Epirus</td>
<td>57%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Poteisia</td>
<td>57%</td>
<td>2.7%</td>
</tr>
</tbody>
</table>

In respect of the proportion of surface waters (lakes, rivers etc.), the most important part is recorded in Central Macedonia, followed by Epirus and Western Macedonia.
The Management of Environmental Issues in the section Panagia – Grevena (natural habitat of the brown bear)

The section Panagia – Grevena (4.1) of the Egnatia Motorway is physically located in the districts of Western Macedonia and Thessaly, in the Prefectures of Grevena (the longest part) and Trikala (a short section situated towards the beginning of the road alignment), respectively.

The design of the Egnatia Motorway alignment for this section anticipates a large number of structures (tunnels, bridges, wildlife passages) with the purpose of protecting one of the most beautiful forests of Pindus, as well as an area representing the habitat of rare fauna species, such as the brown bear, wolves, the roe deer etc. It was decided, therefore:

• To safeguard the unhindered quest and discovery of food, the reproduction and the minimisation of violent killing of these species.
• To discourage the spread of human activity generated by the construction and operation of a motorway.
• To ensure that a renewed ecological balance establishes itself in the area.

With a view to establishing the degree of effectiveness of the proposed measures, in collaboration with environmental organizations and with the contribution of university departments (The Aristotle University of Thessaloniki, The University of Thessaly), Egnatia Odos A.E. devised a specific programme for the monitoring and evaluation of the impact of the construction of the motorway on large mammals and their habitats.

The main phases for the implementation of the programme are the following:

• Recording the current situation.
• Monitoring throughout the construction phase.
• Monitoring throughout the operation phase.

The implementation of the programme required a wide range of up-to-date technological support and methods such as use of telemetric systems (GPS collar), thermosensitive or infra-red cameras, laboratory analyses of DNA and bio-inferencing samples, development of a Geographical Information System (GIS), where all data collected in the field is input, statistical processing of the data, and development of multi-variable forecast models.

The coordinated implementation of all the above will help to draw conclusions and will support the search for the best possible solutions for the protection of the ecosystem of the area, in the context of the construction and operation of the motorway.

The evaluation of the occupation of land by the Egnatia Motorway was carried out by using the CORINE Land Cover classification, summarised in into four main categories: urban areas, agricultural cultivated areas, natural areas, and areas of aquatic ecosystems. Over a total of 680 km of the Egnatia Motorway, the land that the motorway axis crosses is divided into the following proportions: 68% of cultivated agricultural land, 30% of natural areas, 1% of aquatic ecosystems and 1% of urban areas.
A large number of important conservation areas lie within Zone IV (areas of conservation listed on the Ramsar Convention, as well as areas listed on the Natura Network 2000). More specifically, Zone IV hosts 8 of the 11 national aquaculture zones which are on the list of the Aquatic Areas of International Significance of the Ramsar Convention: the Evros Delta, the lake system of Vistonida, Porto Lagos, Ismarís Lake and surrounding lagoons, the Nestos Delta and its lagoons, Volvi and Koronia Lakes, the Axios, Loudias, and Aliakmonas Deltas, Mikri Prespa Lake and the Amvrakikos Gulf.

In addition, of the 296 sites listed on the Natura 2000 network (Directive 92/43/ECM), 125 are situated in Zone IV (44 in Eastern Macedonia and Thrace, 33 in Central Macedonia, 13 in Western Macedonia, 16 in Thessaly and 19 in Epirus). Over 6% of its length, the path of Egnatia itself crosses conservation areas. In those cases special technical solutions have been found to limit the impact on the environment.

8. Main environmental issues and pressures

i. Noise levels

At the present stage an evaluation of noise levels has been carried out for the entire motorway with the use of a model. For this reason, the data of the evaluation must be

The level of noise was evaluated using the British method and on the basis of the projected traffic volumes for the year 2010. The approach in question is of a macroscopic nature and inevitably required assumptions on a number of points: a) The ratio 86% light – 14% heavy vehicles was assumed to represent an average traffic composition pattern. b) In areas for which no average speed had been recorded, an average of 105 km/h was used. c) It was assumed that the longfall was nil, a most unfortunate condition for noise levels. d) The terrain was not taken into account because the evaluation of the noise level was not localised.

Graph 4: Noise levels at different distances from the axis

The geographical position of the Egnatia Motorway section codes can be found in Map 2.
taken as indicative only and essentially reflect a picture of the distribution of the levels of noise over the total length of the motorway. The noise level was evaluated on the basis of three separate distances standards from the axis: 100, 250 and 500 metres.

In accordance with the implementation of the evaluation model, the only sections where the results indicate levels in excess of 70dB(A) (the ceiling allowed by Greek law), are located in the suburban zone of Thessaloniki over an evaluation distance of 100 metres from the motorway. However, it has been calculated that the total population affected by noise levels over 70 dB(A) as a result of the existence of the Egnatia Motorway is nil for the entire axis.

ii. Air pollution

The indicator addressing the issue of air pollution is subdivided into two different indicators: a) the concentration of CO$_2$ and NOx (under peak-hour traffic conditions), in areas up to 150 metres from the Motorway, and b) the greenhouse effect, in terms of yearly CO$_2$ emissions.
per kilometre, per section, per vehicle-kilo-
metre in every section and by extension per vehicle-kilometre in every Region. The evalua-
tion of air pollution for the entire motorway
was carried out with the use of the British
model, which is based on data from Great
Britain regarding the number of vehicles with
a catalyst, the size of the engine, the climatic
conditions etc. The results therefore, should be
seen as indicative only.

With regard to the indicator about the local
impact of the motorway (CO and NOx), at
a distance of 100 metres from the axis, the
calculation of the average level of concentra-
tion of carbon monoxide (CO) revealed a
figure of 22.2 mg/m³. The highest levels of
concentration are recorded in the Region of
Central Macedonia, and more specifically in
the Prefectures of Imathia and Thessaloniki.
The results are significantly lower than the
authorised maximum safety limit for humans,
as set by Directive 2000/69/EC (the highest
authorised average level for 8 hours of CO
concentration is fixed at 10mg/m³).

As concerns the pattern of concentration of
nitrogen oxide (NOx), the highest recorded
levels are, once more, in the Region of Central
Macedonia but, equally, in the Prefecture of
Kavala (Region of Eastern Macedonia &
Thrace), while the average level for the totality
of the axis at peak hours is equivalent to 25.2
mg/m³. The levels of concentration of NOx on
the sections of the Prefecture of Imathia and
Thessaloniki appear to exceed the maximum
annual level of concentration authorised by
Directive 1999/30/EC for the protection of
ecosystems and particularly of the flora. The
same Directive states that the authorised
maximum concentration safety limit for Nitrate
Dioxide (NO²) for humans is 40mg/m³).

With regard to the indicator addressing the
greenhouse effect (total yearly emissions of
CO₂), it was estimated that the total CO₂
released every year from the Egnatia Motorway
will reach 592 thousand tons, a quantity which
is roughly equivalent to 3% of the total CO₂
produced by all road transport for the country
as a whole. As would be expected, the most
important contributors to this quantity of CO₂
are the central section of the motorway, and
more specifically the section located within the
Prefecture of Thessaloniki, as a consequence
of the increase in traffic volumes. The overall
CO₂ emissions by vehicle-kilometre present a
picture of relatively even distribution between
the various sections of the motorway. Their
respective levels indicate fluctuations of a
somewhat similar order, although they remain
slightly lower (average level for the axis: 252
tons/10⁶ vehicle-kilometres) than the national
level (276 tons), but also lower than the EU
level (272 tons).

iii. Cohesion – fragmentation of settle-
ments

The by-pass of settlements constitutes one
of the essential concerns when major motor-
ways are built. The old national road network
for the journey Kipi – Igoumenitsa crossed, in
numerous places, settlements and even the
central areas of urban centers (e.g. Kavala,
Komotini). Prior to the construction of the
Egnatia Motorway, the national road network
crossed around 211 settlements in Zone II
(which includes the Prefectures on the path of
the Egnatia Motorway). The construction of the
Egnatia Motorway has made it possible to by-
pass all the settlements, which were previously
on the path of the old national road network
linking Kipi to Igoumenitsa.
In order to obtain an evaluation of the transformations brought about by the construction of the Egnatia Motorway, an estimate was carried out of the number of settlement units created as a result of the process of fragmentation of the 211 settlements. Prior to the construction of the Egnatia Motorway the above mentioned 211 settlements had appeared as 478 settlement units with an average size of 50.27 ha, and an average population of 2,755 inhabitants. With the construction of the Egnatia Motorway the number of these settlement units shrank to 298, indicating a 38% fall in their number. This outcome indicates a pattern of decrease in the number of settlements, which is a result of the expressed intention, when constructing the Egnatia Motorway, to by-pass all the settlements on the Kipi - Igoumenitsa route. In accordance with this result, an increase in the average size and in the average population of these settlement units is observed.

This data has also made it possible to estimate a “fragmentation indicator” before and after
the operation of the Egnatia Motorway. For the whole of Zone II, the “fragmentation indicator” registers a decrease from 262.0 settlement units (before the construction of the Egnatia Motorway) to 163.3 (after the construction of the Egnatia Motorway), a pattern which indicates a clear improvement in the cohesion and, by implication, in the sustainable development of these settlements. The decrease registered by the indicator varies between 25% in the Prefecture of Kozani, to as high as 55% in the Prefectures of Rodopi and Xanthi.

iv. Fragmentation of natural areas – Proximity to conservation areas

For systems that are environmentally sensitive, the fragmentation resulting from the existence of motorways is a serious factor regarding their

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**Fragmentation of natural areas**

**GIS Methodology:**
At the pixel layer (250x250m) CORINE Landover and with the overlap of the road network (both with and without the Egnatia Motorway) the level of activity of the natural areas (fragile/sensitive surfaces) is recorded. Next, the consistency of the sensitive pixels is recorded and the degree of fragmentation in the area is evaluated. The evaluation of the indicator is applied to establish the conditions before and after the Egnatia Motorway. The value calculated by the indicator is determined with the equation:

\[
\text{Indicator of fragmentation} = \frac{\text{number of consecutive pixels}}{\text{average surface sensitive areas}} \times \text{total surface sensitive areas}
\]

**Indicator Scale Reference:**

<table>
<thead>
<tr>
<th>Minimal</th>
<th>Small</th>
<th>Medium</th>
<th>Fair</th>
<th>Large</th>
<th>Maximal</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.01</td>
<td>0.01 – 0.1</td>
<td>0.1 - 1</td>
<td>1 - 10</td>
<td>10,100</td>
<td>&gt;100</td>
</tr>
</tbody>
</table>

Source: DG AGRI, EUROSTAT, ISPRA, EEA, From Land Cover to Landscape Diversity in the European Union, 2000

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**Table II: Degree of fragmentation of the natural areas**

<table>
<thead>
<tr>
<th>Region</th>
<th>Prefecture</th>
<th>Indicator values without EGNATIA</th>
<th>With EGNATIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western</td>
<td>Thesprotia</td>
<td>3.23</td>
<td>2.74</td>
</tr>
<tr>
<td></td>
<td>Ioannina</td>
<td>2.60</td>
<td></td>
</tr>
<tr>
<td>Central</td>
<td>Grevena</td>
<td>3.81</td>
<td>3.88</td>
</tr>
<tr>
<td></td>
<td>Kozani</td>
<td>3.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Imathia</td>
<td>4.59</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thessaloniki</td>
<td>4.57</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Serres</td>
<td>3.16</td>
<td></td>
</tr>
<tr>
<td>Eastern</td>
<td>Kavala</td>
<td>2.64</td>
<td>3.15</td>
</tr>
<tr>
<td></td>
<td>Xanthi</td>
<td>3.03</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rodopi</td>
<td>2.32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Evros</td>
<td>4.18</td>
<td></td>
</tr>
<tr>
<td>Zone I</td>
<td></td>
<td>15.26</td>
<td></td>
</tr>
<tr>
<td>Zone II</td>
<td></td>
<td>3.35</td>
<td></td>
</tr>
</tbody>
</table>
degradation. The freedom of movement of the fauna is discouraged and its habitat becomes more restricted. The fragmentation of natural areas was studied using an indicator partitioning the entirety of natural areas, that is, all areas excluding agricultural cultivated areas and urban areas, regardless of their conservation status. Information regarding land use relied on the cartographic CORINE Land Cover standard for codified land use, on a 1:50,000 scale.

Within a buffer zone of 2 km, the construction and operation of the Egnatia Motorway has caused fragmentation of natural areas. In this zone, the indicator registers an increase from 15.26 to 21.37, which reflects a degree of stability of the impact, since it is on the same scale range (large), in comparison to the situation before the construction of the Egnatia Motorway. Within a wider area (Zone II, which includes the Prefectures on the path of the motorway), the indicator reveals a slight increase from 3.35 to 3.45, once again indicating a degree of stability of the impact, on the same scale range (fair) in comparison with the situation before the construction of the Egnatia Motorway.

**Proximity to protected areas**

**GIS Methodology:**

The use of the polygon layer of the conservation areas (network Natura 2000, Ramsar, sites of natural beauty) provides a corresponding point layer made up of the centres of gravity of the polygons. The distance from each of these centres to any axis of the road network is calculated to dissociate them and to measure the distances under 5km.

The results provided by the indicator include the sum of the protected areas inside Zone IV, which are affected by the road network and their proportion out of the total. The estimate of the indicator is applied to establish the conditions before and after the construction of the Egnatia Motorway.

**Graph 8: Conservation areas (Natura 2000) in terms of their proximity to the road network**

Conservation Areas (Natura-Ramsar) in their proximity of motorway axis

- **Bulk of Conservation Areas**
  - East Macedonia & Thrace: 44%
  - Central Macedonia: 29%
  - Western Macedonia: 23%
  - Eastern Sector: 23%
  - Central Sector: 29%
  - Western Sector: 29%
  - Zone IV: 23%

- **Percentage in the proximity of Egnatia (%)**
  - East Macedonia & Thrace: 44%
  - Central Macedonia: 29%
  - Western Macedonia: 23%
  - Eastern Sector: 23%
  - Central Sector: 29%
  - Western Sector: 29%
  - Zone IV: 23%
The research on the proximity to conservation areas revealed that one third (1/3) of the areas, which have been listed under the nature conservation network Natura 2000 (Directive 92/43/ECC), have their environmentally sensitive core situated at a distance of under 5km from the closest road axis. Access to these areas is consequently facilitated, which implies that potential effects as a result of human activity are more likely to occur. On the whole, the alignment of the Egnatia Motorway has a limited effect on the pressure that motorway axes bring to protected areas, since the degree of impact as a result of proximity varies between 34.5% and 37%.

v. Crossings with surface waters

The average number of crossings of the motorway with surface waters (permanent or occasional streams, accumulations/stagnating waters) is 4.34 per kilometre. With the construction of Egnatia motorway the frequency of such crossings of the national road network with surface waters in Zone II is equivalent to

Crossings with surface waters

GIS Methodology:

The indicator was estimated by using the cartographic layer of the totality of the hydrographic network in combination with the layer of the national road network and the Egnatia Motorway. The process was carried out by considering the cartographic layers in pairs:

1. The hydrographic network with the national road network without the Egnatia Motorway.
2. The hydrographic network with the national road network and the Egnatia Motorway.

For each pair the section point between the two linear layers was measured (hydrographical and road network) and the results were recorded in a table.

Table 12: Frequency of crossings of the road network with surface waters (intersections/km)

<table>
<thead>
<tr>
<th>Zone of influence/Region</th>
<th>Indicator Value (without Egnatia)</th>
<th>Indicator Value (with Egnatia)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone I</td>
<td>-</td>
<td>4.34</td>
</tr>
<tr>
<td>Zone II</td>
<td>1.08</td>
<td>1.29</td>
</tr>
<tr>
<td>Zone III</td>
<td>1.12</td>
<td>1.12</td>
</tr>
<tr>
<td>Zone IV (II &amp; III)</td>
<td>1.10</td>
<td>1.21</td>
</tr>
<tr>
<td>Thesprotia</td>
<td>1.28</td>
<td>1.82</td>
</tr>
<tr>
<td>Ioannina</td>
<td>1.05</td>
<td>1.13</td>
</tr>
<tr>
<td>Grevena</td>
<td>1.36</td>
<td>1.63</td>
</tr>
<tr>
<td>Kozani</td>
<td>1.24</td>
<td>1.41</td>
</tr>
<tr>
<td>Imathia</td>
<td>1.13</td>
<td>1.46</td>
</tr>
<tr>
<td>Thessaloniki</td>
<td>1.19</td>
<td>1.43</td>
</tr>
<tr>
<td>Serres</td>
<td>0.76</td>
<td>0.79</td>
</tr>
<tr>
<td>Kavala</td>
<td>1.11</td>
<td>1.45</td>
</tr>
<tr>
<td>Xanthi</td>
<td>0.71</td>
<td>0.80</td>
</tr>
<tr>
<td>Rodopi</td>
<td>0.99</td>
<td>1.47</td>
</tr>
<tr>
<td>Evros</td>
<td>1.78</td>
<td>2.33</td>
</tr>
</tbody>
</table>
Current Conditions in the Regions of the Path of the Egnatia Motorway - 1st Spatial Impacts Report

8. Quality of the Environment

Map 19: Crossings of the Egnatia Motorway axis with surface waters

Legend:
- Crossings with surface waters
- Egnatia Odos
- Public road network
- Hydrographic network
- Cities and local authorities
- Prefectures
1.29 intersections per km of the network, and is 19.4% in excess of the value produced by the indicator at the pre-Egnatia stage (1.1).

In Zone IV, the indicator relating to the crossings with surface waters produced a higher value before the construction of the Egnatia Motorway in the Regions of Eastern Macedonia & Thrace (1.05), and a lower value in Western Macedonia (0.88). With the construction of the Egnatia Motorway, this indicator was measured in Eastern Macedonia & Thrace at 1.31, while Western Macedonia shows a higher degree of pressure detected by the higher value of the indicator at 1.37. In Central Macedonia and Epirus the value of the indicator pitches at 1.13 and 1.12 respectively.

8.3. Summary

With the help of models, the impact of the Egnatia Motorway, when fully put in operation, was evaluated in relation to significant environmental parameters, such as noise and air pollution, the cohesion of settlements and the fragmentation of natural areas.

The outcome indicates that the Egnatia Motorway has either limited or controllable impact, and inspite of increased traffic volumes, it creates conditions which are significantly more desirable than those at the pre-Egnatia era. In accordance with the traffic volume forecast for 2010, the Egnatia Motorway - excluding a number of sections, particularly in the suburban area of Thessaloniki - is operating at levels of nuisance below the authorised ceiling of environmental strain.

The Observatory, in close collaboration with the Dept. of Environment of the Egnatia Odos A.E., will be further studying and monitoring patterns of environmental strain and the variations of impacts for specific areas and crucial indicators, in order to efficiently address any negative trends.
CURRENT CONDITIONS IN THE REGIONS OF THE PATH OF THE EGNATIA MOTORWAY -

1st SPATIAL IMPACTS REPORT