Master Plan

for innovative energy structures in the Prefecture of Evros, which could be feasible for funding in the Structural Funds programmes beginning in 2007.

Energy 4 Cohesion - Deliverable 4. .

Elaborated by **the Agricultural University of Athens**

Contents

Executive Summary *(1/2 – 1 page)*

Please provide an executive summary page outlining the structure of the report and providing a short and precise overview of the outcome of the individual chapters.

1. Introduction *(3 pages)*

1.1 Background *(1/2 pages)*

This section is provided by the coordinator. Here, the e4c – project is briefly presented and the general context of work package 4 is described.

Regional focus

The Master Plans presented with this report has been developed in the scope of the **Energy 4 Cohesion (E4C)** project, funded under the Intelligent Energy for Europe (IEE) Program. E4C strives to prepare the ground for the extended use of Structural Funds for innovative renewable energy actions in rural regions of Europe which make use of the regional renewable energy potential and increase the energy efficiency. The European social **cohesion** requires a balance in the economic and social conditions in all European regions. **Energy** can play a major role in achieving this balance. The availability of cheap and reliable energy contributes to sustainable social and economic development. Moreover, the exploitation of the own energy resources of a region means to bring additional employment knowledge and investment into the region which otherwise would be dragged into the more developed municipal regions.

In view to this regional approach the eight E4C target regions are the focus of all project related strategy and planning efforts. These regions have been selected for their suitability for extended use of renewable energies and energy efficiency actions, namely:

- Rich resources for renewable energy generation particularly biomass resource
- Clear support of the political and administrative decision makers
- Availability of an extended knowledge and data basis for the planning process.

Based on these requirements the following target regions have been selected:

1. Czech Republic: Zlin Region
2. Estonia: Saaremaa Island
3. Greece: Prefecture of Evros
4. Italy: Alta Locride
5. Latvia: Limbazi Region
6. Lithuania: Kaunas Region
7. Poland: Poviat Nowa Sol
8. Slovak Republic: Velky Krtis

Cooperative Approach

In each target regions all main stakeholders have been brought together for a successful and efficient definition of innovative energy actions in the respective region. The E4C actor cycle includes municipalities, households, media, capital provider and financial experts. Within this actor cycle he E4C consortium partners were responsible for the coordination of the different actors, and the preparation of the regional **Master Plans**. Main focus was put to integrate suggestions and ideas existing in the region rather than exposing priorities from outside.

Action focused strategy

Comprehensive investigations were undertaken, starting from an abstract and general view on the regions, leading to concrete innovative energy set-ups, consisting of a range of RE and EE projects. A comprehensive and detailed methodology was developed within E4C, which is illustrated in chapter 1.3 of this report. It includes 3 main elements: 1.) Target Region Portrait, 2.) Analysis of future energy options, 3) Identification and investigation of concrete RE and EE actions. In this way it is ensured that concrete action potential is highlighted which is imbedded in an overall RE promotion concept for the region.

Targeted towards Structural Fund Support

The cornerstone of the E4C – strategy is to support the implementation of energy pilot actions in the selected regions feasible for public financial support, with main focus on **European Structural and Cohesion Funds (SF and CF)** during the funding period from 2007-2013. The main focus during the current programming period of SF and CF lies on the Lisbon Criteria. This reflects the ambition of the EC to reach greater sustainability, more employment and increased economic growth, targets that were set in the Lisbon Agenda. As stated above, renewable energies can contribute to these targets, moreover they increase the competitiveness of communities and regions, and foster European cohesion. However, up to date in most countries of Eastern and Southern Europe, only a small percentage of SF and CF measures have been dedicated to RE and EE projects. E4C strives to overcome the various constraints which currently hinder the broader use of Structural Funds for innovative energy actions in less developed and rural regions of Europe.

Conclusions

With the finalization of the Master Plans the core milestone of Energy 4 Cohesion has been accomplished. The large efforts undertaken by the respective partners in the regions have resulted in the selection of highly feasible and sustainable project ideas. The intense work for the Master Plans also has stimulated the interest and support of the local and regional decision makers for these results.

Since E4C is a project co-funded by European public funds, the results will be published at the E4C website. The Master Plans will also be widely disseminated in the target regions and neighboring regions, in order to gain the multiplier effect. Public funding applications and acquisition of private investment money will start from 2008 for the realization of the innovative energy set-ups presented in the Master Plans.

1.2 Objectives *(1/2 pages)*

Give an overview of the objectives of the Master Plan, including the overall goal and key objectives of the Energy Vision.

1.3 Methodology of Master Plan Development *(2 pages)*

This Master Plan is elaborated based on a methodology, which was elaborated within Task 3.2 of the Energy 4 Cohesion project. The aim of the methodology is to facilitate the decentralised energy actions planning in 8 Target regions within the context of European Cohesion Policies. The methodology presented on next page (*Figure 1*) should ensure that:

- The results of the Target region planning can be compared.
- The coordination work for the many regions is supported with a strong tool.
- The local partners find help and guidance for assessing their potential and defining suitable renewable energy and energy efficiency actions (which will be compiled in the regional Master plans that are to be elaborated within Task 4.5 of E4C project)

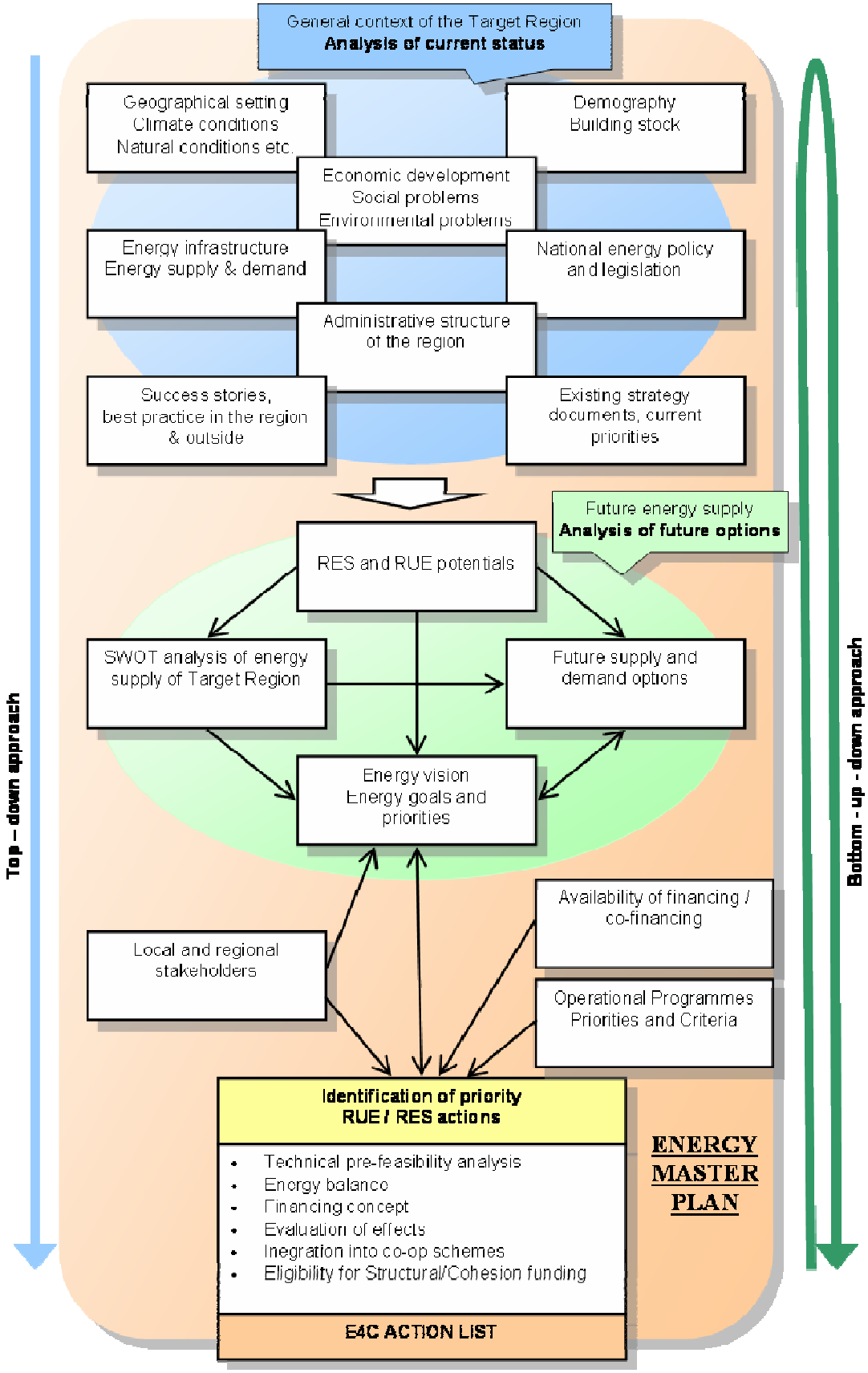

Figure 1: Methodology for elaboration of Master Plan

2. Target Region Portrait (7-15 pages)

2.1 Description of general context of the region (2-4 pages)

2.1.1 Geographical setting, natural conditions, climate, historical context

Geographical setting

The Prefecture of Evros is in the northeastern part of Greece and was incorporated in Greece in May 1920, following the Serves Treaty (1919). It is extended, in northern latitude between the 40o 28' and the 41o 45' parallels and in eastern longitude between the 25o 37' and the 26o 38' meridians. It is the largest prefecture of Thrace, covering an area of 4.242 Km^2 and occupying the sixth position among the prefectures of Greece. As far as the population is concerned, the Perfecture of Evros is on the 18^{th} place, having 143.000 inhabitants. The population density in the perfecture is 35,2 inhabitants/Km^2, holding the 41^{st} position in Greece. An important percentage of the population comes from the compulsory populations' exchange, a result of the Lausanne Treaty signing (1923). Its western borders are the Prefecture of Rodopi and Bulgaria, its northeastern and eastern borders are the European part of Turkey and on the south, the Prefecture borders with the Thracian Sea.

The Prefecture of Evros includes the island Samothrace, located northeast of Limnos island and opposite to Evros River debouchments. Samothrace covers an area of 178 km^2 and has a population of 3,000 inhabitants.

In Fig. 2, it is given the location of the Prefecture of Evros in the map of Greece.

Figure 2. Location of Evros Prefecture in Greece

Climate

The climate in the broader area is sub-Mediterranean, influenced by the continental climate, depending on the exposure of the site to boreal winds. The south part, receiving the beneficial influence of the sea, is characterized by mild winters and cool summers. The north part has ηπειρωτικό, characterized by cold winters and warm summers. The meteorological data by the metrologic stations of the Hellenic National Meteorological Service, located in Alexandroupolis (Latitude 40° 51′ and Longitude 25°57'), Orestiada (Latitude 41° 30′ and Longitude 26° 31') and Soufli (Latitude 41° 12′ and Longitude 26°17') are the following:

Air Temperature

The air temperature is one of the most important, meteorological/climatological variables for the description of the climate of a place or a region. In winter the air temperature varies between -1 and 7 °C in the Evros region. The lowest temperatures are found in winter (Decembers until February) in the mountains and the highest temperatures are found in the regions near the sea with lower elevation. In spring (March to May) the temperatures vary between 9 and 18 °C. The lowest temperatures are measured at higher elevations on the island Samothraki and the high-lying areas of the mountains in the west of the Evros area. In summer (June to August) average temperatures are between 18 °C and 24°C. In autumn (Septembers to November) the temperatures lie predominantly between 9°C and 11°C.

Relative Humidity

The measuring unit of relative air humidity is per cent (%) and the relative humidity indicates and describes how much per cent of the air is saturated with vapour. The relative air humidity in the district of Evros ranges between 75 and 80 % in winter and shows no spatial variability. In winter the relative humidity is highest of the whole year. In spring the humidity lies between 60 and 70 % and in summer between 50 and 60 %, representing the lowest values of the year. There is an east-west gradient with lower values in the west during summer. In autumn the relative humidity lies between 65 and 75 % with a west-east gradient

Wind speed

The distribution of the atmospheric pressure, the topography as well as the distribution of land and sea masses are the main causes for wind. The legend for wind velocity is always kept the same in the maps. The pattern of wind velocity is similar over the whole year, with values between 1.5 m/s und 4.5 m/s. The highest values are observed in the coastal zone and in the mountainous regions. The lowest average wind speeds are detected in summer, with higher values in autumn and spring.

Sunshine duration

The duration of sunshine is indicated in hours. The illustrations of the seasonal duration of sunshine show the proportional value of sunshine hours in each season. Cloud cover and radiation conditions are also illustrated. The duration of sunshine ranges between 35 % and 60 % in winter, where the highest values are found close to the coasts and the lowest are obtained in the northern and the mountainous areas. In spring the values lie between 55% and 75 % with the same distribution as in winter. In summer the duration of sunshine ranges between 70 % and 85 %; this is the season with the highest radiation benefit. In autumn the values ranges between 30 % and 60 % and thus show that the cloud cover has its maximum in autumn and winter.

Precipitation

The precipitation measures all water in the atmosphere that reaches the earth's surface. The precipitation unit is mm and 1 mm corresponds to 1 l/m². Precipitation is usually high in winter and the values range between 520 mm and 800 mm. The highest values are detected at higher elevations and the lowest values in the low-lying central inland region. In spring falls approx. 80 mm of precipitation in higher elevated areas and less than 30 mm near the coast. In summer the precipitation is below 30 mm and declines gradually from north to south. In autumn the precipitation increases again and the values rise to approx. 100 mm, whereby the highest values are obtained in the mountainous areas and in the south. The annual precipitation ranges between 740 mm and 960 mm with the highest values in high-lying parts of Samothraki and mountainous areas on the mainland. The lowest values are obtained in inland low-lying areas.

Frost - Snow

The average annual number of days with snow, recorded at the meteorological station of Alexandroupolis, is 10,6 and the snowfall is observed from November to April. As far as the meteorological station of Orestiada is concerned, the average annual number of days with snow is 5,23 and the snowfall is observed from November to April. Finally, the meteorological station of Soufli has recorded an average snowy days annual number of 12,4 days. The appearance of frost in Soufli has a frequency of 24,9 days per year.

2.1.2 Administrative structure of the Region

The Prefecture is divided into five counties: Alexandroupolis County (area: 1.107 sq. Km), Didimoticho County (area: 1.220 sq. Km), Orestiada County (area: 944 sq. Km), Samothrace County (area: 178 sq. Km) and Soufli County (area: 793 sq. Km), which are subdivided into 13 municipalities and 176 settlements.

The capital of the prefecture is Alexandroupolis, the only large port of Thrace and the most important transporting and commercial hub of the region. In the past, the city's name was Dedeagats and its inhabitants were a few fishermen. The city begun to develop after the construction of the railway joining Thessaloniki and Istanbul in 1870 and thus, Alexandroupolis was given the opportunity to become a commercial centre, exporting the prefecture's products. Additionally, the fact that it is situated by the sea helped Alexandroupolis to become a nodal port of the country. In 1912, it was occupied by the Greek army and then, by the Bulgarians. In 1920, it was incorporated in the rest of Greece and was named Alexandroupolis, after King Alexander.

Soufli, Didimoticho, Orestiada, Feres, Esimi and Makri are the biggest cities of the prefecture. The municipalities of the Prefecture of Evros are: Municipality of Alexandoupolis, Municipality of Orestiada, Municipality of Didimoticho, Municipality of Soufli, Municipality of Feres, Municipality of Trigono, Municipality of Orfeas, Municipality of Tychero, Municipality of Vyssa, Municipality of Kyprinos, Municipality of Metaxades, Municipality of Traianoupolis and Municipality of Samothrace.

2.1.3 Demography and the building stock

The population of the prefecture of Evros in the decade 1951-1961 was increased by 16.420 inhabitants (11,7%), while in the decade 1961-71it was reduced by 18.780 inhabitants (11,9%), due to the population movement towards the country's urban center and to the emigration abroad. In the decade 1971-81, the population was increased by 9.506 inhabitants (6,8%), partly due to repatriation of the emigrants. In the decade 1981-1991, the population slightly decreased by 4.734 inhabitants (3,1%), while in the decade 1991-2001, the population increased again by 5.354 inhabitants (3,8%).

In the Prefecture of Evros, it is concentrated 1.4% of the population of Greece with a tendency of reduction, judging by its high, and increasing, rate of natural reduction of population (rate of births per 1.000 inhabitants: -1,9 in 2002).

Between the Census of 1991 and 2001, the population has increased by 3.9%.

The population of the region moves internally towards the urban centers. The most dynamic population concentration is observed in the counties of Alexandroupolis and Orestiada, leading to the employment of the population in other activities, besides agriculture and animal husbandry.

Table 1. Distribution of urban and rural population in the municipalities of the Prefecture of Evros

MUNICIPALITY	TOTAL	URBAN	RURAL
ALEXANDROUPOLIS	52.720	49.176	3.544

VYSSA	8.184	2.844	5.340
DIDIMOTICHO	18.998	8.924	10.074
KIPRINOS	2.915	0	2.915
METAXADES	4.486	0	4.486
ORESTIADA	21.730	17.194	4.536
ORFEAS	6.146	0	6.146
SAMOTHRACE	2.723	0	2.723
SOUFLI	7.519	5.009	2.510
TRAIANOUPOLIS	3.335	0	3.335
TRIGONO	6.656	0	6.656
TYCHERO	4.103	0	4.103
FERES	9.839	5.461	4.378

2.1.4 Other important information about the region

General characteristics, economic indicators, prevailing economic activities

The economy of this Perfecture is mainly based on agriculture and animal husbandry. Thanks to the fertile lowland soils, irrigated by the water from Evros River and its confluents, to the climatological conditions, but mainly thanks to the land reclamation works, the Perfecture of Evros is situated among the ten most developed Perfectures of Greece, in terms of agriculture. Important place in the agricultural sector hold the cereals, the legumes and the vegetables. The main cultivations are mulberries, almonds, apple trees and pears. In Samothrace, the main cultivation is the olive tree. Meanwhile, during these past years, there is an increase in the cultivation of certain industrial crops, such as sunflower and sesame, mainly in the region of Orestiada. This increase is due to the increased exportation potential. The arboriculture of the prefecture in comparison to its area is limited. Special focus is put on the cultivation of sugar beets. Animal husbandry, the second most important economic factor presents a significant development these past years. Another important factor is fishing. In the Delta of Evros, there are many fisheries. Evros is the largest Greek river and the richest in fished. This is where the famous beluga is fished.

The economically active population reaches 36.2% (52,052) of total population of the Prefecture. The 39.1% of the population is employed in the primary sector, the 9.1% in the secondary sector and the 51.8% in the tertiary sector. Evros produces 1.2% of the Gross Domestic Product of the country, a percentage remaining almost stable since 1997, out of which the 23% comes from agriculture. It occupies the 2nd place in the wheat production, after Larisa, holding 9% of the total

production in 2003.

With a per capita product of 11,2 thousands Euros, the Prefecture occupies the 29th position in Greece, using as a base the average of Greece (87%) in 2002 (67% of the average of EU-25). Per 100 inhabitants, there are 24 cars (Greece average 33 in 2002) and 1,2 new residences of (Greece average 1,2 in 2002). With declared income of 11,3 thousands of Euros per tax payer (rise 4,9%, 86% of the Greece average), the tax payers from Evros paid an average of income tax of 634 Euros (Greece average 1.077 Euros). In this correspond 1,3% taxed (rise 2,2% in 2004), 1,1% of declared income of country (+ 7,2%) and 0,7% of tax of income individual (-3%). The sales of new cars increased 10% 2004.

Table 2. Indicators of Prosperity of the Prefecture of Evros

		Perfecture of Evros		Greece average	Classification of the Perfecture of Evros in the total of Greek Perfectures
GDP per capita	2002	11.2	thousands of Euros	12.9	29
Per capita saving deposits	2002	6.83	thousands of Euros	8.32	18
Declared income per tax payer	2003	10.8	thousands of Euros	12.5	24
Income tax per tax payer	2003	0.67	thousands of Euros	1.08	28
Natural population increase/ 1000 inhabitants	2002	-1.9		-0.01	26
Secondary school students/ 1000 inhabitants	2002	57		66	44
Primary school students/ 1000 inhabitants	2002	54		59	41
Contribution in the Greek total					
GDP	2002	1.2	%		17
Taxpayers	2003	1.3	%		20
Declared income	2003	1.1	%		17
Income tax	2003	0.8	%		19
Saving deposits	2003	1.1	%		15

Primary sector

The Prefecture is characterized by a prevailing agricultural sector, as far as both occupation and income are concerned. The main role in the configuration of income plays agriculture and

livestock-farming and in a lesser extent, forestry, hunting and fishery.

The Prefecture of Evros is flat, since only the 10.3% is covered by mountains, while the 62.4% is covered by plains. The existence of a big percentage of flat area (63,9% of the total area of the prefecture) and of an even bigger percentage of agricultural land (90,9% of flat ground), in combination with the important quantity of surface and underground waters provides enormous possibilities for the intensifying of agriculture.

In the Prefecture's periphery, mainly in the villages, the main occupation of the inhabitants is the agriculture and the production of high quality products, individually and collectively through the local associations. The main cultivations are cotton, wheat and beets.
Animal husbandry is the second most important economic activity in the prefecture, which henceforth faces a quite bad period, since in the past Evros possessed the greater percentages in the production of meat in Greece.

The extended pastures, the tradition in animal husbandry and the increased fodder production potential favors the breeding of a great number of cattle and sheep. The animal husbandry contributes in the configuration of the gross agricultural income, occupying a percentage of 40% (47% from meat production, 8% from milk production and 45% from other animal husbandry products). Nowadays, the animal husbandry production is significantly reduced.
The forest wealth of the Prefecture in combination with the work of reforestation and opening up of forest streets gives important margins for the exploitation of forests.
The traditional culture of silkworm was developed in the regions of Thessaly, Central Macedonia and Evros. The cores of the cocoon production in Evros are the villages of Soufli and Didymoticho. Although the culture of silkworm in the old days constituted an important capital for the increase of agricultural income in the above mentioned regions, today it has become problematic, resulting in a continuously decreasing production of cocoon.

Secondary sector

The manufacturing sector, except the alimentation and weaving sectors, is dominated by small industries with limited employment.

The horticultural cultivations, the dairy products and the forest products of the prefecture provide an increased potential for the development of the secondary sector.
Finally, as far as the mining activities are concerned, despite the potential offered by the prefecture, they remain in low levels and the contribution of the sector in the prefecture's economy is limited. The mining activity in the prefecture is limited in the exploitation of certain layers of lignite and sulphur mixtures. Additionally, minerals of copper, chromium, manganese, iron and titanium have been tracked, which present economic interest.

Tertiary sector

The Prefecture of Evros presents a high tourist interest, both for its natural beauties and its archeological treasures. Nowadays, the tertiary sector continuously gains ground against the primary sector. Thus, an always growing part of the population urns to the services sector.

Land uses

The Prefecture of Evros could be divided in three zones: flat, semi-mountainous to mountainous and semi-flat to semi - hilly. The flat zone, having a total arable area of 45000 hectares, is extended along the rivers Evros, Ardas and Erythropotamos. The semi – mountainous / mountainous zone, covering an area of 15000 hectares, is extended at the north-western part of the prefecture. The semi – flat / semi – hilly zone, covering an area of 100000 hectares, is the largest zone and is extended in between the other two zones.

The total area of the arable land in the Prefecture of Evros represents the 38,8% of the total prefecture area. Respectively, the 25,1% of the prefecture's area is covered by grassland, the 29,9% by forests, the 1,7% refers to water – covered areas, the 3,3% is occupied by settlements and the road network and finally, the 1,2% corresponds to arid land.

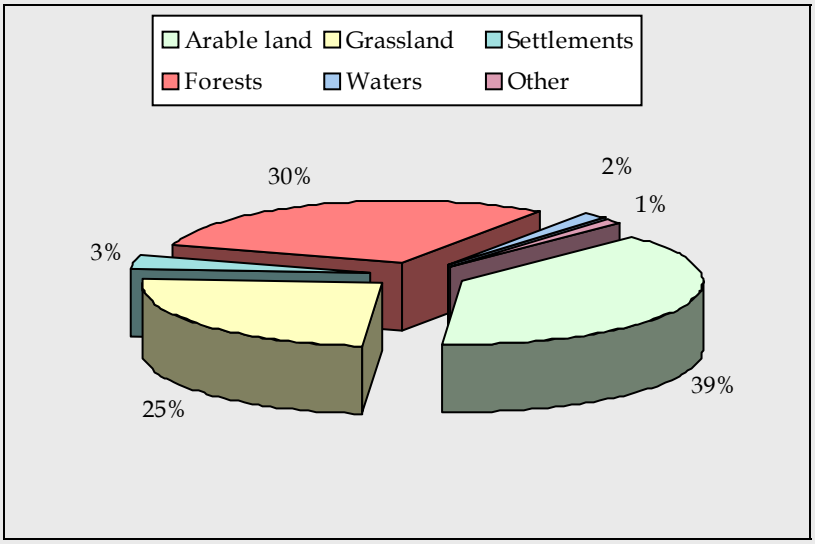

Figure 3. Land uses in the Prefecture of Evros

2.2 Current energy situation (2-6 pages)

2.2.1 Current energy infrastructure

Due to the nature of the Greek energy system, the key primary energy sources for the region coincide to the key primary energy sources for Greece, which are (in order of importance):

1. Coal (covers 55,9%)

2. Oil (13,5%)

3. Natural gas (12,9%).

Primary energy sources are imported in the region, as in any Greek region, according to the centralised energy system. The energy produced by various sources in every region is sold to the Public Power Corporation and then, distributed all around Greece.

District heat supply is not common in the region and in Greece, in general.

The current share of RES in primary energy supply for the region coincide to the ones for Greece, which is 12,2% (Incuded RES: Hydropower, wind energy, biomass and PV)

Total amount of primary energy supply (GWh/year): 51016 GWh/year (2004)

2.2.2 Current energy supply and consumption

Key final energy consumers: Domestic use: 33,2% - Commercial use: 21,5% - Industrial use: 20,8%.

2.3 Analysis of RUE/RES potentials (3-5 pages)

According to the Business As Usual Scenario for the estimation of the potential energy production from RES in the year 2010, created by the General Energy Directorate of the Greek Ministry of Development, the key RES with the highest potential are: 1. Wind energy: 3017 MW - 6,34 billions kWh 2. Hydropower (both large - scale and small - scale plants): 3577 MW - 5,34 billions kWh 3. Biomass (mainly forestry and agriculture residues): 71 MW - 0,56 billions kWh.

2.3.1 Biomass Potential

Agricultural Residues. Field crop residues, prunings from orchards and vineyards are of the most abundant resources. The estimation of agricultural residues potential was based on data derived from various sources and calculations that related to the type and origin of biomass.

In figures 4 to 6 is presented schematically the orchard prunings production by prefecture in Greece.

Figure 4. Orchard prunings production by vineyards in Greece (in dry tones)

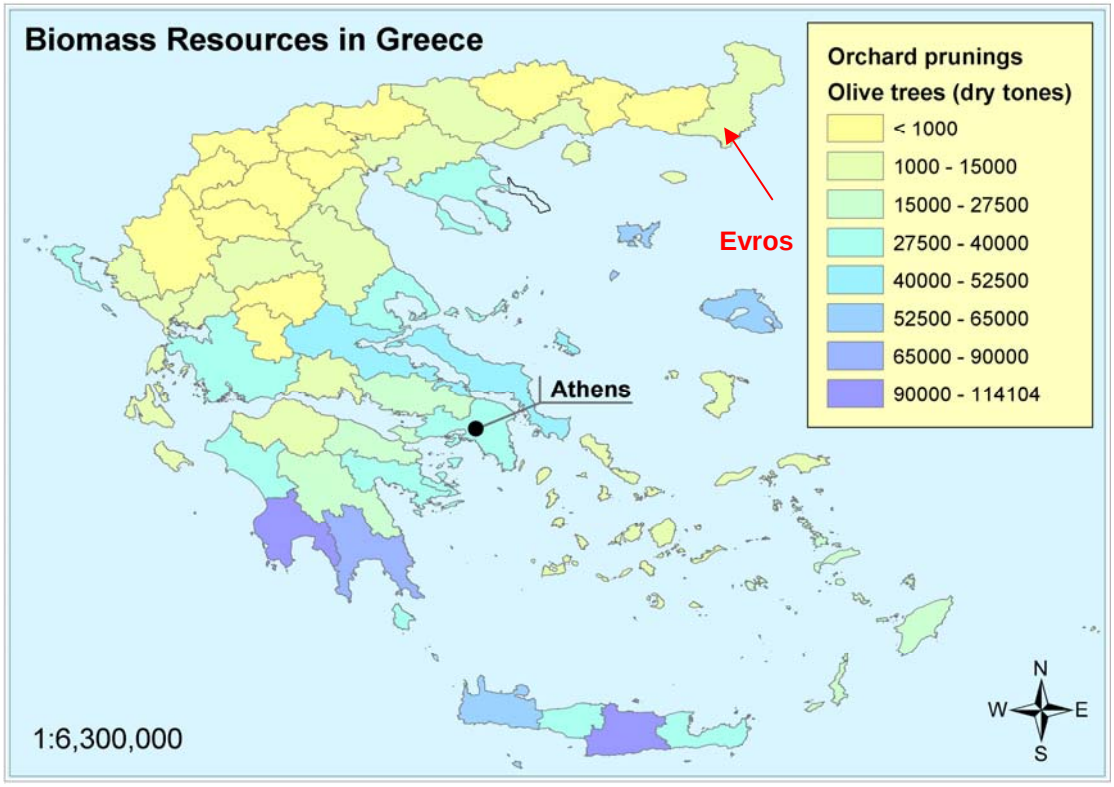

Figure 5. Orchard prunings production by olive trees in Greece (in dry tones)

Figure 6. Orchard prunings production in Greece (in dry tones)

Table 3. Potential of agricultural residues available for energy uses in the region of Thrace, in thousands tones (dry basis) and TJ

Residue type	000' t	TJ
Wheat straw	128.6	2,300.2
Rice straw		
Corn stalks	210.8	3,883
Cotton stalks	71.2	1329.3
Vine shoots	1.1	21.2
Olive trees prunings	3.6	65.5
Peach trees prunings	0.08	1.8
Other trees prunings*	1.3	23.9

Table 4. Available quantity of agricultural residues in the Prefecture of Evros, in tones (dry basis)

Prefecture	Straw	Stalks	Stems	Orchard prunings		
				Olive trees	Vines	Other
Evros	**104,473**	**114,656**	**12,985**	**2,934**	**661**	**71**

In figures 7 to 9 is presented schematically the available quantity of agriculture residues by prefecture in Greece.

Figure 7. The quantity of Straw biomass in Greece (in dry tones)

Figure 8. The quantity of Stems biomass in Greece (in dry tones)

Figure 9. The quantity of Stalks biomass in Greece (in dry tones)

Agro-industrial wastes. The most important agro-industrial wastes available for energy use are those from cotton gin mills, rice mills, peach processing units and olive oil and kernel mills.

In Figure 10, is presented the quantity of olive oil cake biomass production in Greece

Figure 10.The quantity of olive oil cake biomass production in Greece (in dry tones)

Forest biomass. Tree species which compose Greek forests include oak, beach-tree, chestnut-tree and various evergreen and broad-leaved species. Forest biomass is mainly consisted of wood and branches that are used either by the industry or as firewood. Thinner branches, leaves and roots are left on site due to high harvesting and transportation costs.

Table 5. Above ground forest biomass and annual increment in the prefecture of Evros, in tones (dry basis)

Prefecture	Above ground forest biomass (dry t)	Annual increment (dry t)
Evros	2,796,000	65,000

In figure 11 is presented the above ground forest annual increment in Greece.

Figure 11. Above ground forest in Greece

Wood industry wastes. Forest wood is basically processed in sawmills that produce industrial wood, furniture and wooden floors. The quantity of wood by-products, produced after wood processing, depends on the final product to be produced and is estimated to be about 35-55% of the volume of the wood material initially used. Wood wastes produced in sawmills is reported to have been about 213,000 t, containing 3,139.5 TJ of energy.

Sawmills are already exploiting the wood by-products for the production of thermal energy which is necessary for drying of wood during its processing.

Municipal solid wastes. Large quantities of urban refuse are produced every year in Greece. The lower heating value is ranged from about 4.4 MJ/kg to 7.7 MJ/kg, depending on their characteristics. The annual quantities of municipal solid wastes by administrative department is given in Table 6.

Table 6. Annual production of municipal solid wastes by administrative department

Prefecture	Quantity (t)
Eastern Macedonia - Thraki	205,000

2.3.2 Geothermal Potential

Geothermal sources

In the Prefecture of Evros there are four geothermal fields identified.

Aristino-Aetochori: Exploration carried out enlarged known extent and increased known temperature to 92ºC. A new well yields over 60 kg/s flow rate from 300 m.

Traianoupolis: Two production boreholes were opened within the area of the springs, yielding about 30 kg/s of 52oC water of water, which is used for the heating system of a community spa complex.

Therma, Samothraki: Three wells were drilled within the thermal area near existing spas, reaching a depth up to 120 m and yielding a high flow rate of fluid of high salinity and up to 100ºC temperature.

Table 7. Characteristics of the geothermal fields in the Prefecture of Evros

Geothermal Field	Surface Area (km^2)	Reservoir Depth (m)	Total Flow Rate (m^3/h)	T_{max} (°C)	T.D.S (g/L)	Type of water	Wells expl./prod. (<1994)	Wells expl./prod. (1995 – 1999)
PREFECTURE OF EVROS								
Aristino-Aetochori	30	350 – 450	400	92	12	Cl - Na	6/0	3/2
Traianoupolis		50 – 150	100+	52	8	Cl – Na	0/1	0/2
Tychero		400	500	38	1.5	Cl – Na – HCO_3	0/0	0/2
Therma, Samothraki		40 - 120	100	100	40	Cl – Na	0/0	0/3

The installed capacity in the country for the direct utilization of geothermal energy is approximately 75 MWt. About half of this is for thermal spas (in a few cases combined with space heating), and heating of open-air and covered pools. Recently, there has been a reduction in greenhouse and soil heating, although the latter had increased considerably in the previous five-year period. There has been a diversification in geothermal heat applications, with new enterprises such as fish farming, spirulina growing, and vegetable and fruit dehydration. Earth-coupled and groundwater (or seawater) heat pumps have shown a significant increase since 2000, comprising three large-capacity units totaling 1.0 MWt and producing 5.8 TJ/year of thermal energy, with other smaller units combining to produce a grand total of 4.0 MWt and 39.1 TJ/year (this is a conservative estimate based on site inspections, publications and information from heat pump dealers). Some interesting direct-use applications include soil heating for asparagus covering about 12 ha, a tomato dehydration plant, which has produced more than 15 tonnes of "sun-dried" tomatoes since 2002, a desalination plant on Kimolos Island, and cultivation of spirulina (a blueish-green algae), utilizing the geothermal waters for both heat and dissolved CO_2. The breakdown for direct applications in Greece is: individual space heating, 1.2 MWt and 14.3 TJ/year; greenhouse heating, 22.2 MWt and 231.2 TJ/year; fish farming, 8.9 MWt

and 72.0 TJ/year; agricultural drying, 0.2 MWt and 1.5 TJ/year; bathing and swimming, 36.0 MWt and 181.6 TJ/year; and others (spirulina cultivation and water desalination), 2.3 MWt and 27.5 TJ/year, for a grand total (including heat pumps) of 74.8 MWt and 567.2 TJ/year.

Greece. During the period 1995–1999, geothermal research and applications were mainly confined to low enthalpy fields. The research areas include northern Greece (Thrace, Macedonia), NW Greece (Epirus), and the islands of Chios and Lesvos (Aegean Sea). A new geothermal field was discovered in Thrace, near the village of Arisino, with temperatures approaching 92°C. In NW Greece, exploration wells discovered temperatures of 48°C, and on Chios a recently discovered field produced 90°C water. Many new developments have occurred in the last five years, including greenhouse heating, subsurface soil heating for early asparagus cultivation, spirulina production, space heating of a hotel near Nea Appollonia hot springs (Macedonia) and of a spa complex in Thrace, and heat pump applications near Athens and on the island of Rhodes.

2.3.3 Solar Potential

2.3.4 Hydroelectric Potential

2.3.5 Wind potential

INDICATORS	WIND SPEED LIMIT (m/sec)			
	>6	**>7**	**>8**	**>9**
Area of available region	253,74	62,58	13,10	1,33
Average annual wind speed (m/sec)	6,71	7,60	8,48	9,33
Technically exploitable potential	18648,08	5917,32	1474,01	164,22
Totally installed capacity (MW)	8656,00	2161,60	457,60	44,8
Utilization factor (%)	24,50	31,25	36,77	41,85

2.4 Analysis of potentials for energy savings

2.5 Analysis of potentials of RES

2.6 Identification of available RES/RUE options in the region

2.7 SWOT analysis

Strengths	Weaknesses
- High RES potential - High RUE potential in buildings - Serious grounds for innovation - Adequately developed legal framework for the motivation of business activity	- High energy dependency - Incomplete harmonization to the Community Law in environmental and energy matters - Inadequate development of environmental structures - Low share of electricity production from RES - Inadequate interconnection of media and networks - Ageing population in the agricultural areas leading to reduction of the agricultural activities and the productivity
Opportunities	**Threats**
- Revised Lisbon Strategy - Completion of the new energy networks (both national and international) - Deregulation of the energy market - Increased incentives for investments via the new Development Law - Development of the regional value in total, combining the natural and human environment	- Delay in the implementation of energy agreements and in the adaptation of policies (in international level)

2.8 Energy Vision

2.8.1 Energy Vision milestones

Summary Energy Balance of Greece and Indicators 1990 - 2020							
Mtoe	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Primary Production	9.7	10.2	10.1	10.6	10.6	10.4	9.2
Net imports	15.4	18.2	22.1	25.7	29.1	31.9	35.3
Gross inland consumption	22.8	24.7	28.7	32.6	35.8	38.4	40.5
Electricity generation in TWhe	34.8	41.3	52.2	61.4	71.3	80.5	90.9
Final energy demand (Mtoe)	15.0	16.3	18.9	21.7	24.3	26.4	27.9
CO_2 emissions (Mt of CO_2)	70.9	77.9	89.9	101.3	109.4	114.3	120.9

Gross Inland Consumption of Greece 1990 - 2020							
Mtoe	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Gross Inland Consumption by sector	22.8	24.7	28.7	32.6	35.8	38.4	40.5
Solids	8.1	8.8	9.6	10.3	10.3	9.8	10.9
Oil	12.8	14.0	15.9	18.0	19.5	20.7	21.3
Natural Gas	0.1	0.0	1.5	2.5	4.2	5.7	6.1
Other	1.7	1.9	1.7	1.8	1.8	2.2	2.3
Renewables in primary energy	1.6	1.8	1.7	1.7	1.7	2.0	2.1

Final Energy Demand of Greece 1990 - 2020							
Mtoe	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
Final energy demand by sector	15.0	16.3	18.9	21.7	24.3	26.4	27.9
Industry	3.8	4.0	4.7	5.2	5.3	5.3	5.2
- Metals	0.8	0.8	0.9	0.9	0.9	0.8	0.8

	- Chemicals	0.3	0.2	0.3	0.4	0.4	0.4	0.4
	- Other energy intensive industries	1.5	1.6	2.1	2.5	2.5	2.5	2.5
	- Other industrial sectors	1.2	1.4	1.4	1.5	1.5	1.5	1.5
	Domestic sector	3.8	3.9	4.4	4.8	5.2	5.6	6.2
	Tertiary sector	1.6	1.9	2.3	3.0	3.7	4.5	5.3
	Transport	5.8	6.4	7.5	8.8	10.1	11.0	11.2

2.8.2 Objectives and priorities

One of the main focus points of the new National Strategic Reference Framework is the **investment on sustainable infrastructure,** an important prerequisite for the attraction of investments and the improvement of the quality of life. For the energy sector, this means putting effort on the development of environment – friendly forms of energy and on the improvement of the energy supply. The above are expected to contribute in the development and the enhancement of the competitive position of Greece in the mid- and in the long-term.

Additionally, one of the general targets, set in the new National Strategic Reference Framework, is **the reinforcement of the energy sector contribution in the competitiveness, the extroversion and the sustainable development of the country**. This specific target could be subdivided into three interconnected targets:

• the enhancement of the geo-strategic role of Greece in the energy map of the broader area, which focused on the international liaison of Greece, through its incorporation into international networks of electricity, oil and natural gas transport.

• the reduction of the country's dependence to the petroleum oil, in environment – friendly way, which is succeeded through the promotion of the RES and natural gas penetration in the energy balance of Greece, through the improvement of the energy efficiency, through the promotion of energy saving measures, the research and development of innovative energy technologies and the rational use of the Natural Fossil Resources. At the same time, the promotion of such measures contributes in the achievement of the Directive 2001/77, as well as in the attraction of investments, in the framework of the Lisbon Strategy.

• the security of the energy supply and the smooth functioning of the liberated energy market, intends, first of all, to achieve further penetration of the natural gas in the energy balance of Greece, through the extension of the National Natural Gas Transportation System and the development of distribution networks in new areas. Furthermore, this target can be fulfilled through the enhancement and the modernization of the national interconnected electricity transport network. This includes also the interconnection of the islands to the continental system, which both covers their needs and contributes to the increase of the RES units' establishment potential. Finally, the issue of energy resources storage is quite important. The completion of the market liberation, through the necessary interventions in systems and accompanying investments will create an attractive environment for the further enhancement of private investments and the better quality assurance for the customers.

Another general target connected to the energy sector, is the **sustainable management of the environment.** In this set of targets, it is included the abatement of climate change, which focuses on the targets set by the Kyoto protocol, the reduction of greenhouse gases emission and the protection of the ozone layer. This is expected to be achieved through the improvement of the energy efficiency, the emissions trading system and the RES zoning planning.

Regarding the Region of Eastern Macedonia – Thrace, which faces the biggest development deficit, emphasis is put on actions that will reassure a high rate of GDP increase for the achievement of convergence. Thus, the main focus is on the evolution of the region into a transit, energy centre and a centre of entrepreneurship and scientific know – how of the broader Balkan area and the Black Sea, through the development of intergovernmental and interregional cooperation networks for the water resources and environmental management and the development of special activity sectors, in which the region presents competitive advantage.
The above could be achieved through:

- The research, assessment and recording of energy raw material, mining and remaining natural resources,
- The guarantee of supply of country in energy and water of suitable quality for each user,
- The support of SME of sector, that are activated in the natural resources,
- The protection of environment
- The observation of engagements of country concerning the emissions of gases of greenhouse as well as the increase of employment in the region.
- The Efficient use of energy in buildings
- The promotion of the use of RES and RUE

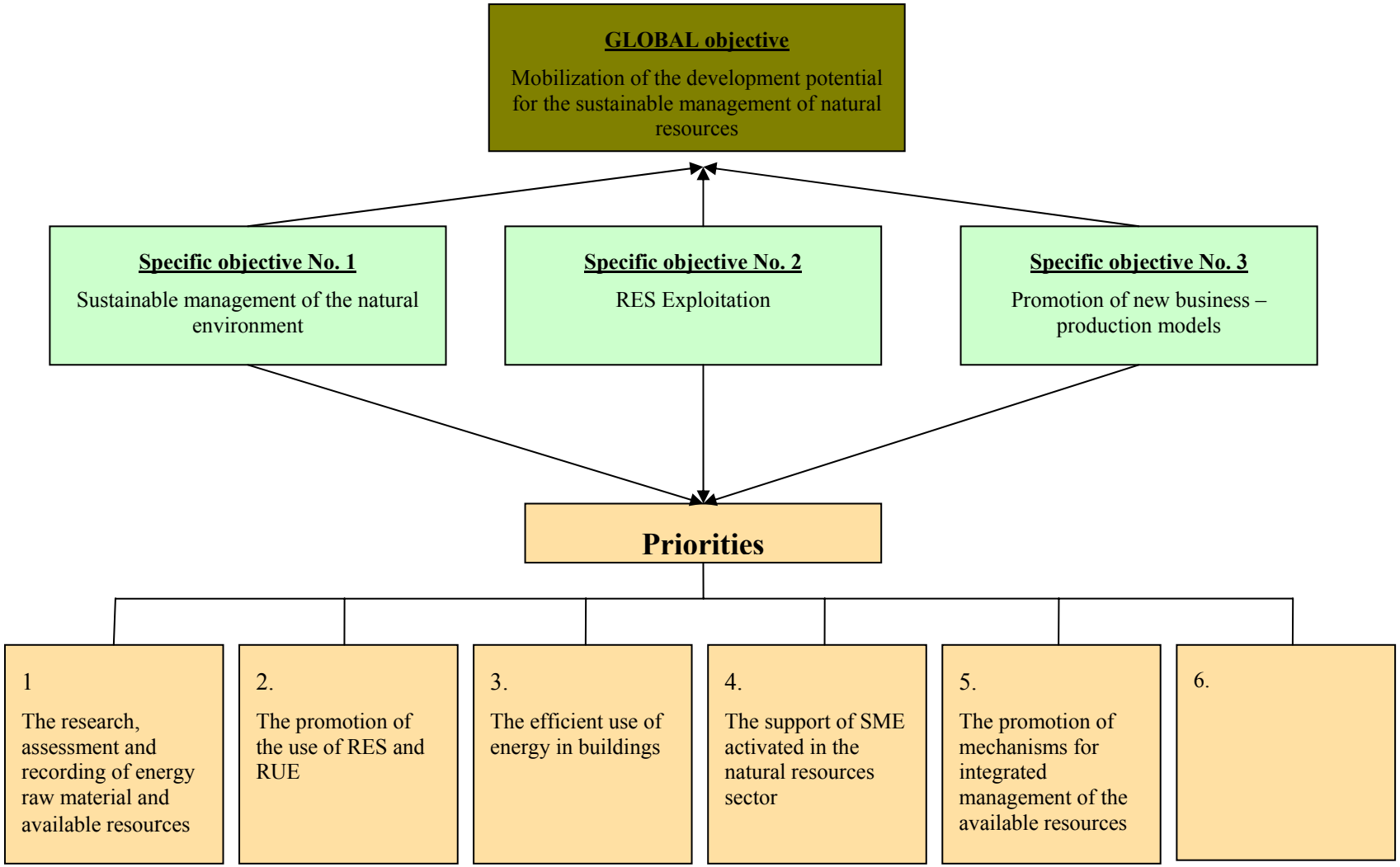

Figure 12: Structure of the Energy Vision of the Prefecture of Evros region

2.9 Presentation of feasible Energy Action Bundles suitable for Structural Funds *(1 page per Energy Action)*

Project Proposal 1 – Functioning of the biomass district heating plant in Dadia

Proposal concerns the functioning of the existing biomass district heating plant in Dadia, aiming to contribute in the sustainable regional development.

Current state

The BDH plant has been constructed in the framework of EU's ECOS – OUVERTURE Program, but has been used only for demonstration. It was not connected to the grid, due to non-technical reasons, thus it did not finally served its purpose. The aim is to make the necessary modifications, in order for it to function again and the residents to be able to benefit from it.

Technological solution

Biomass District Heating Plant in Dadia – a common project of AUA (Greece), Austro – Control (Austria) and Stratos (Greece).

	Dadia
Rated boiler output in kW	800.00
Fuel calorific performance in kW	927.73
Input material flows	
Wood in Kg/h	306.60
Wood in t/a	613.20
Water content in % by mass	36.00
Calorific value in MJ/kg	10,89
Combustion medium	
Air in kg/h	1748.37
Air in Nm^3/h	1352.18
Excess air lambda	1.50
Combustion air temperature in degree C	25.00
Heat transfer medium	
Water in kg/h	35427.61

Return temperature in degree C	70.00
Flue gas recirculation flow rate Bm^3, f/h	1013.62
Output-material flows	
Flue gas in kg, f/h	2048.59
Flue gas in Nm^3, f/h	1615.99
Flue gas temperature in degree C	200.00
Residual oxygen content O2tr in % by volume	7.00
Ash in kg/h (total)	1.86
Ash in kg/a (total)	3728.25
Heat transport medium	
Water in kg/h	35427.61
Supply temperature in degree C	90.00

Financial Support

EU (ECOS OUVERTURE Program)

Benefiting groups

Local population: economic and environmental benefits, gaining some energy independency

Financing

The project could be financed by EU Structural Funds OP "Environment – Sustainable Development".

Expected investment costs

-

Expected implementation time

-

Project Proposal 2 – Organization and function of a biooils production, treatment and utilization unit in transport

Proposal concerns the cultivation of energy crops, for the production of raw material, which will be treated in order to be used as biofuel. This biofuel will be used in the public transport, after appropriate modifications on the vehicles.

Current state

In Greece, there are no energy crops plantations, besides those for research purposes on a quite small scale. On the contrary, there is significant experience on large-scale plantations, which serve other purposes, but their products could be used as raw material for energy production, such as:
1) Maize Plantations: 250000 hectares today
2) Sunflower Plantations: 8200 hectares today (having reached even 40000 hectares in the past)
3) Sugar beet Plantations: 32000 – 41200 hectares
Additionally, the production of cotton reaches 1 million tonnes per year, while the respective potential for the oil production is 80000 tonnes per year. This production is expected to decrease drastically in the upcoming years.
The biomass energy potential in Greece is destroyed, having significant impacts to the environment, leading to the loss of valuable energy amounts and hundreds of job places in the Greek countryside.
On the other hand, liquid transport biofuels constitute an international commercial sector, which is constantly gaining ground, since more and more countries adopt promotion measures for the use of biofuels. This specific sector, from 13 M.t in 1992, exceeded 21 M.t in 2002 and is expected to exceed 40 M.t in 2012 (World Ethanol and Biofuels, Report F.O. Lichts 2004).
Moreover, the European Commission Legislation has already created an institutional framework for the use of biofuels in transports, through the Directive 2003/30/EE (8 May 2003) on the promotion of the use of biofuels or other renewable fuels for transport. This directive sets as a reference value a market share for the biofuels equal to 2% for the year 2005, while this share must reach 5.75% in 2010, with a perspective to reach 20% until 2020. The Greek legislation has conformed to the above directive (Act 3423/2005).
The implementation of the new Common Agricultural Policy from 2006 and on sets to the producers the dilemma of replacing the traditional cultivations with new ones, among which biofuels will have a dominant position.

Technological solution

The proposed technology has two main targets:

1) The production of oilseeds

2) The use of pure plant oil as biofuels.

As far as the oilseeds production is conserned, there are many research works going on at the moment for the investigation of the oilseed production from several cultivars and hybrids from seedoils from two species, under the particulare climate condition of the differents Greek Regions.

The results of the research work, taking place in Orestiada, have shown very good results from two hydrids species of sunflower, which overcome the local varieties. The research works on rapeseed oil (five varieties) in the same region has demonstrated that there is need to proceed with research, so that the know-how would take into action. In Europe, especially in Central and North, there is data on oilcramble, which however cannot be used in Greece.

The results concerning sunflower has shown that, under producer's conditions in the Region of Thrace, sunflower oils could be produced under the same or even better rates than those found in central and North Europe. (>350 gr/ acre sunflower, with 42% of oil concentration). The demonstrative effort will be based on these results.

As far as it concerns the use of pure seedoils in petrol engines, the only known research in Greece is the one done by Agricultural University of Athens. However, in Germany, Austria, Ireland, there is a wide use of seedoils and there are many patents, experience and relative legislation concerning the mentioned technology. This means that the demonstrative application will be based on the import of technology from abroad that will be guranteed with patents.

Benefiting groups

Local farmers: an alternative source of income, given the fact that they face a significant problem in promoting their current products to the market

Public transport: long-term economic benefits from the use of biooils as fuel

Financing

The project could be financed by EU Structural Funds OP "Competitiveness and Entrepreneurship" (5th Axis: reassurance of the energy supply, the introduction of Greece to the international networks of electricity, petroleum and natural gas transfer, supporting of the deregulation of the energy market and the promotion of renewable energy sources).

Expected investment costs

~ 1.5 million euros

Expected implementation time

-

Project Proposal 3 – Energy savings using geothermy in the municipal buildings and the airport of Alexandroupolis
The proposal aims to use the geothermal energy produced by the Aristino field, in order to cover the heat and cooling needs of Alexnadroupolis municipality buildings and the airport.
Current state
The energy savings through the greening of the buildings is a quite new concept for Greece, therefore a broad field for development is offered.
Technological solution
Possible solutions that could be implemented are: interventions in the building shell (solar walls, greenhouse constructions, windtowers e.t.c), measures for the energy management in the buildings (e.g. reduction of the heat produced by electric devices), shading using vegetation and awnings, exploitation of the natural ventilation and the sunlight.
Benefiting groups
Prefecture of Evros – lower energy demand for heating of public buildings**,** reduction of heating costs **Residents of Evros** – better environment to live in
Financing
The project could be financed by EU Structural Funds Regional Program Eastern Macedonia – Thrace.
Expected investment costs
-
Expected implementation time
-

Project Proposal 4 – Re-functioning of the Energy Agency of the Eastern Macedonia – Thrace Region
The proposal aims to re-organize the functioning of the Regional Energy Agency, in order for each staff to provide relevant services to the residents, to raise awareness on energy issues and to contribute in the energy planning for the region.
Current state
From 1999 until 2001, the Regional Energy Agency of Eastern Macedonia – Thrace was operating in the framework of the Local Association of Municipalities of the Xanthi Prefecture, developing a broad range of activities, collaborations and participations in projects, both in Regional and European level. After this period, the Regional Energy Agency of Eastern Macedonia – Thrace has remained idle.
Technological solution

Benefiting groups
Prefecture of Evros – The region could benefit from the opening of the Energy Agency, since it will manage to promote RES amongst its inhabitants and promote for financing various relevant projects. Plus, it will help the image of the Public Authorities, as a pioneer in RES actions. **Residents**– economic and environmental benefits
Financing
The project could be financed by EU Structural Funds Regional Program Eastern Macedonia – Thrace.
Expected investment costs
-
Expected implementation time
-

Action Bundles *(15 pages)*

Develop further the Energy Actions presented in the previous chapter in 6 separate steps. The first 3 steps cover the elaboration of the hard facts. Step 4-6 cover the general approach of the survey. Within this task 4.4., the components of the energy actions presented in chapter 3.3 are further developed.

2.10 Step 1: Technical pre-feasibility

Project Proposal - Functioning of the biomass district heating plant in Dadia

Installed Capacity, MW	
Installed Capacity Utilization Coefficient	
Number of Installed Capacity Utilization Annual Hours, (h) or plant capacity factor in percent[1]	
Annual Electricity Generation, mln. kWh	
Maximum Daily Electricity Generation, mil kWh[2]	
Minimum Daily Electricity Generation, mil kWh	

Project Proposal - Functioning of the biomass district heating plant in Dadia

Installed Capacity, MW	
Installed Capacity Utilization Coefficient	
Number of Installed Capacity Utilization Annual Hours, (h) or plant capacity factor in percent[3]	
Annual Electricity Generation, mln. kWh	
Maximum Daily Electricity Generation, mil kWh[4]	
Minimum Daily Electricity Generation, mil kWh	

[1] For the calculation of the plant factor you could easily use the RET SCREEN Excel Programme

[2] This is only relevant if the grid is not able to take all of the produced electricity.

[3] For the calculation of the plant factor you could easily use the RET SCREEN Excel Programme

[4] This is only relevant if the grid is not able to take all of the produced electricity.

Project Proposal - Energy savings using geothermy in the municipal buildings and the airport of Alexandroupolis

Installed Capacity, MW	
Installed Capacity Utilization Coefficient	
Number of Installed Capacity Utilization Annual Hours, (h) or plant capacity factor in percent[5]	
Annual Electricity Generation, mln. kWh	
Maximum Daily Electricity Generation, mil kWh[6]	
Minimum Daily Electricity Generation, mil kWh	

[5] For the calculation of the plant factor you could easily use the RET SCREEN Excel Programme

[6] This is only relevant if the grid is not able to take all of the produced electricity.

2.10.1 Detailed technical project description

1) Main characteristics

- Size and type of fuel or heat production facilities
- Please give the following specifications:

Installed Capacity, MW	
Installed Capacity Utilization Coefficient	
Number of Installed Capacity Utilization Annual Hours, (h)	
Annual heat or fuel Generation, GJ, mil tons	
Maximum Daily Electricity Generation, mil kWh[7]	
Minimum Daily Electricity Generation, mil kWh	

Technical project components:

Investigate the need for related buildings, equipment, rolling-stock. Describe the project components in detail best giving drawings.

2.10.2 Suitability of production technology

- *Investigate and compare technology providers.*
- *Determine reliability and competitiveness of technology (proven or unproven, state-of-the-art).*
- *Identify limitations or constraints of technology.*

2.10.3 Availability and suitability of site

- *Access to markets.*
- *Access to raw materials.*
- *Access to transportation.*
- *Access to a qualified labor pool.*
- *Access to production inputs (electricity, natural gas, water, etc.).*
- *Investigate emissions potential.*
- *Analyze environmental impact.*
- *Identify regulatory requirements.*
- *Explore economic development incentives.*
- *Explore community receptiveness to having the business located there.*

2.10.4 Raw materials

[7] This is only relevant if the grid is not able to take all of the produced electricity.

- *Estimate the amount of raw materials needed.*
- *Investigate the current and future availability and access to raw materials.*
- *Assess the quality and cost of raw materials and markets of easily substituted inputs.*

2.10.5 Other inputs

- *Investigate the availability of labour including wage rates, skill level, etc.*
- *Assess the potential to access and attract qualified management personnel*

2.11 Step 2: Energy balance

Indicate the framework parameters.

2.12 Step 3: Financing concept

Please use the excel – template for economic analysis of the project

2.12.1 Investment Cost

Please give specifications to the investment cost

2.12.2 Project Preparation Expenses

Also indicate the project preparation expenses (feasibility work, premiums, administration fees). Please indicate which expenses have been spent already and what is expected in the future.

2.12.3 Financial Engineering

Shortly explain the intended financial engineering using the following diagram:

Total investment
Euro

Private Funding		Public Funding	
Euro		Euro	
Equity	Commercial loan	Development Loan	Grant
Euro	Euro	Euro	Euro

Power station life time	Years

2.12.4 Economic Analysis

Please insert a profit and loss calculation which highlights the following financial key figures:

- Pay back Time (Period until the premium investment is back)
- Internal Return of Investment for the entire project
- Internal Return of Investment for the equity
- Production cost for 1 kWh of electricity.

The profit and loss should make reference to the yearly inflation and price raise.

2.13 Step 4: Positive effects in view to overall energy vision

2.14 Step 5: Cooperation scheme

2.15 Step 6: Strategy for financing Energy Actions by Structural Funds

3. Conclusion and Outlook *(1 page)*

Provide general conclusion of the target region energy planning and the developed energy action bundles in the Master Plan.

Annexes *(to be defined…)*