

BIOEUPARKS – Exploiting the potentialities of solid biomasses in EU Parks  
Contract N°: IEE/12/994

**REPORT**  
**D3.2. Pilot Localized Supply Chain Plan**  
**Rodopi National Park**

by

DUTH – Democritus University of Thrace, Department of Forestry and Management  
of the Environment and Natural Resources

RNP – Rodopi National Park

Prepared by:

Spyridon Galatsidas, Nikolaos Gounaris, Stavros Kechagioglou, Christos Karachristos



January 2014

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## **1. Introduction**

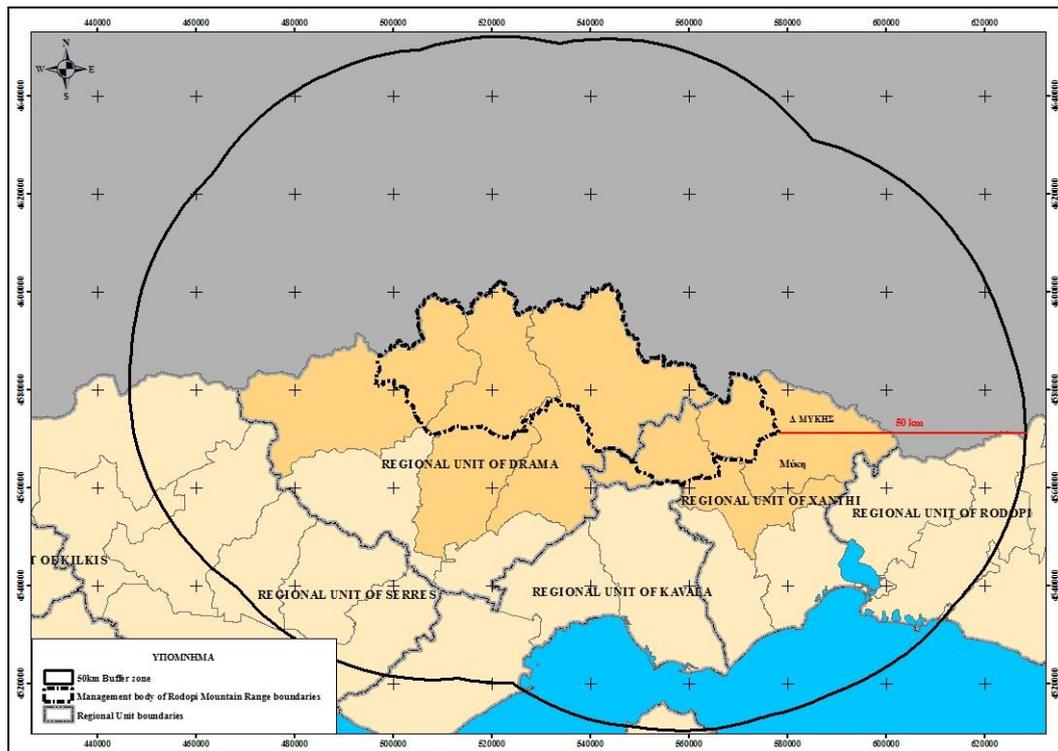
The Greek teams working in the project BIOEUPARKS should prepare a Localized Supply Chain Plan (LSCP) to promote the efficient, sustainable and environmental friendly use of solid biomass for energy in the area of Rodopi Mountain Range National Park (RNP). In this task, the team of RNP worked together with the team of DUTH (Democritus University of Thrace, Department of Forestry and Management of the Environment and Natural Resources) and followed the directions of the Common Supply Chain Guidelines, prepared earlier by the WP3 leader – FNR (Fachagentur Nachwachsende Rohstoffe).

This LSCP describes in detail and based on the best available data the supply and the demand side of the solid biomass as energy source in the area of RNP. It covers all key actors in the respective territory (stakeholder analysis) from the production phase of feedstock to the end user, outlines problems and deficiencies (economic, competition, technologic, institutional, legislative, political) that have been identified and discusses ways to overcome them and develop the pilot phase of the local supply chain.

The Rodopi Mountain Range National Park and Democritus University of Thrace will work together to implement the pilot LSCP in the trial period, bringing together all involved actors, committing them to work under sustainable schemes and demonstrate a way of local development based on local resources.

## **2. Reference area, management status and RES**

The RNP covers a very wide mountainous area in North Greece extended at 173,150 ha. The northern park boundaries coincide with the Greek-Bulgarian borders; they start from the region of Kato Neurokopi, at Drama and they end at the region of Dimario at Xanthi. The southern boundaries are consisted of the north-east slopes of Falakro Mountain and follow the course of Nestos River. The following figure 1 presents the RNP boundaries (trimmed line) and the 50km buffer zone (continuous line). Four middle sized towns of population higher than 40.000 inhabitants are inside this buffer zone and several small sized towns.



**Figure 1:** Boundaries of the RNP and 50km buffer zone.

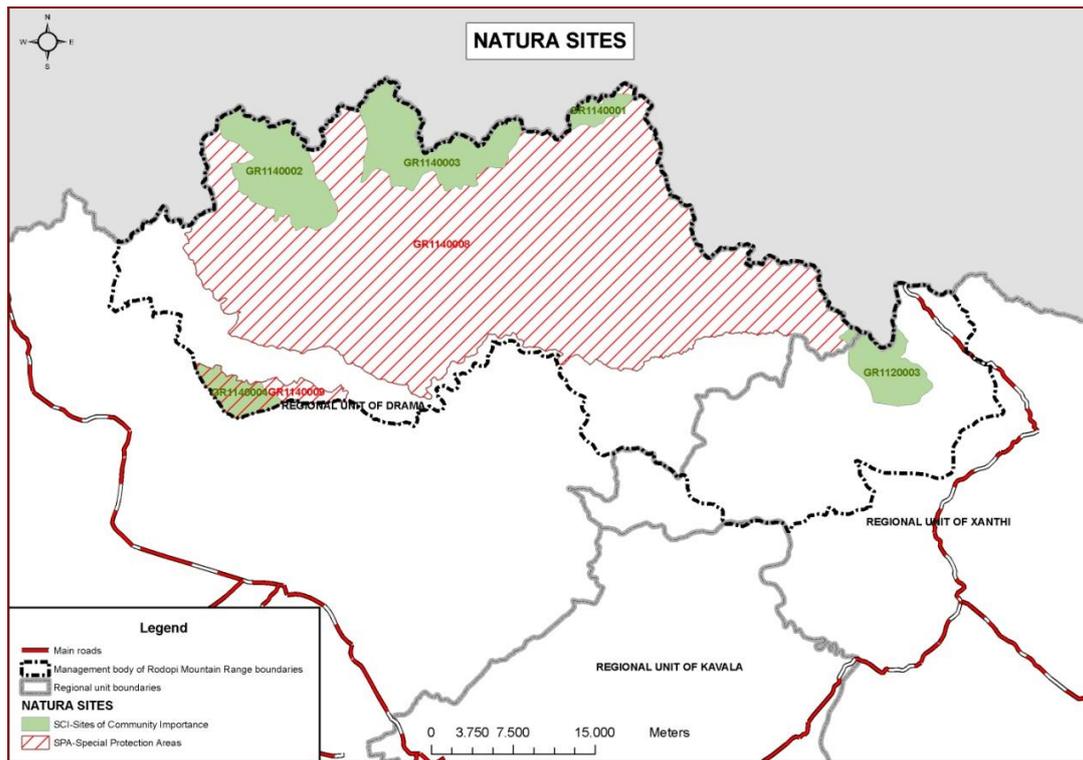
## 2.1. Administrative Framework

The RNP area which was established by Law 3044/2002, was designated as a National Park by the Joint Ministerial Decision 40379/01-10-2009 (GG 445/D/02-10-2009). Administratively the RNP belongs to the Region of East Macedonia and Thrace; it is included to the Regional Units of Drama and Xanthi and to the Municipalities of Kato Neurokopi, Drama, Paranesti, Miki and Xanthi. The Forest Agencies which are involved in the management of the forests in the RNP are the Forest Offices of Xanthi, Drama, Stavroupoli and Kato Neurokopi.

## 2.2. Protection Regimes

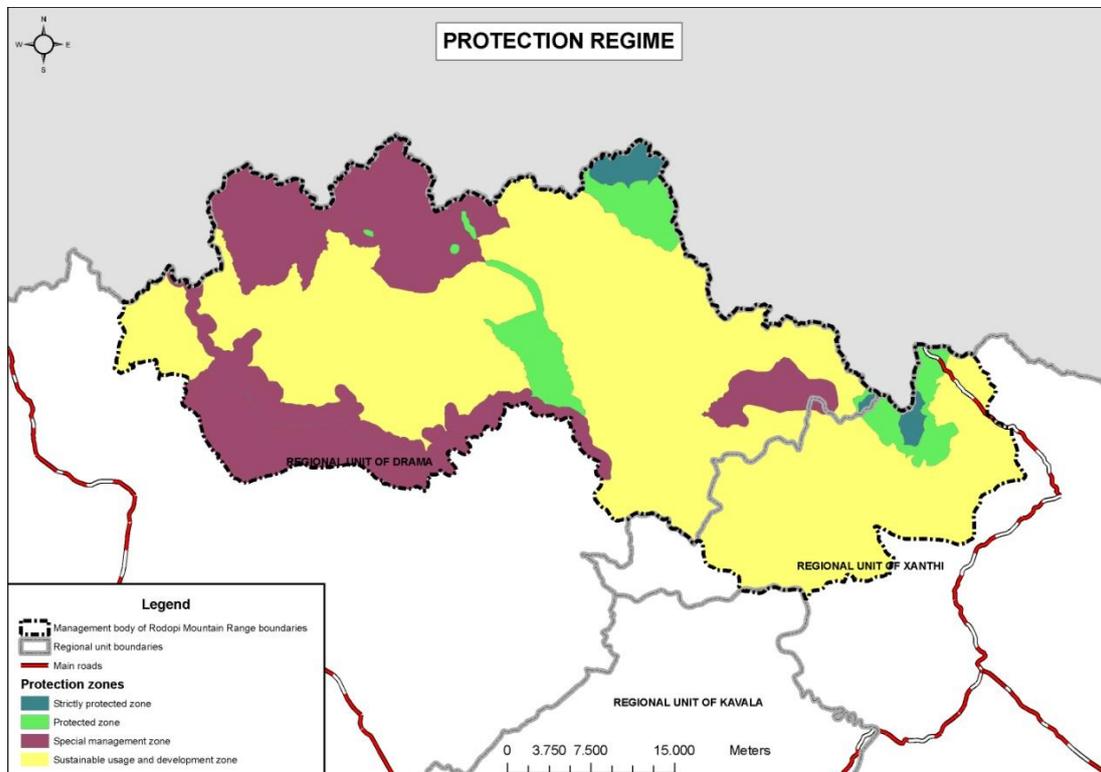
The RNP area is protected by multiple protection regimes at a National, European and Global level. In particular: seven (7) areas of the RNP have been included into the Natura 2000 network according to the Habitats Directive 92/43/EEC and the 2009/147/EC (2 SPA and 5 SCI); 2 areas have been characterized as Preserved Natural Monuments; seven (7) areas are Wildlife Reserves according to the Greek law and three (3) regions have been characterized by the European Council as Biogenetic Reserves. The spatial distribution of those protection regimes and zones is presented in the following figures.

Figure 2 shows the Natura 2000 sites. The green colored areas show the SCI sites and the red and white striped colored areas are SPA sites.



**Figure 2:** Natura 2000 sites inside the RNP area.

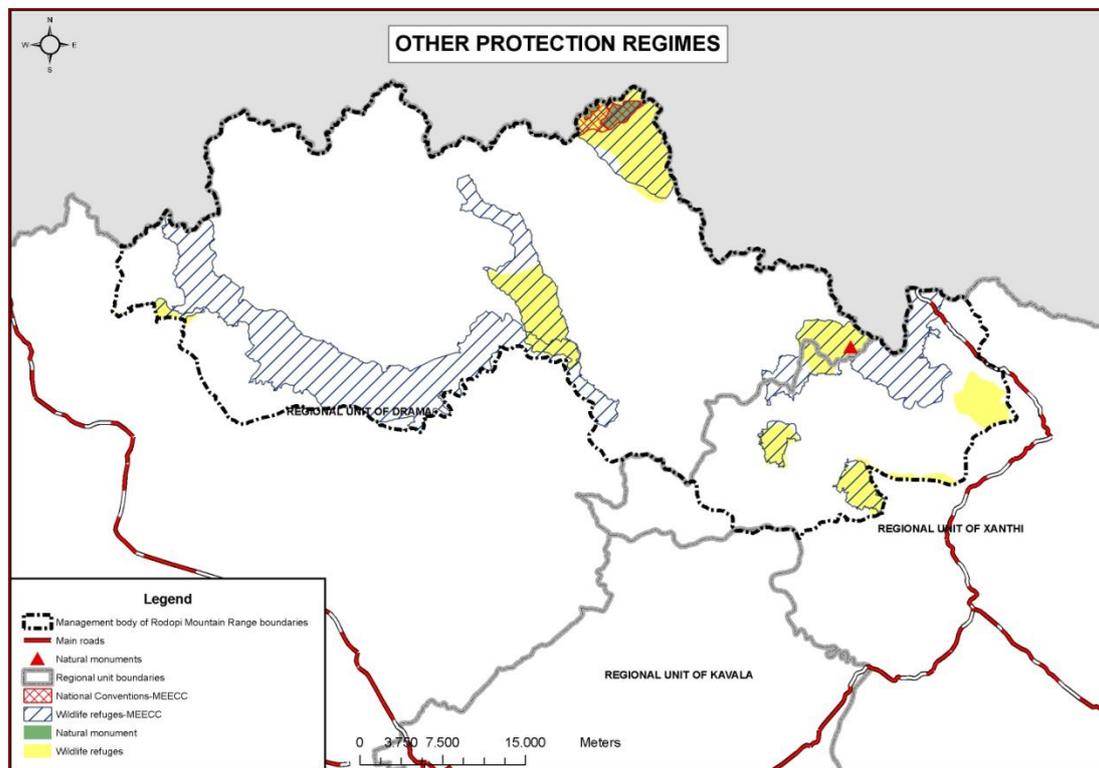
The Special Environmental Plan of the park delineates specific protection and management zones, which are presented in the figure 3.



**Figure 3:** Protection and management zones of the RNP area according the Special Environmental Plan

The strictly protected areas are colored grey-blue (Zone A); the areas where certain kinds of actions are prohibited are colored light green (Zone B) and finally the areas where actions are permitted after a positive opinion from the Management Body of RNP are colored purple and yellow (Zones C). The Zone A accounts for 1.53% of the total area and the Zone B and C for 6.55% and 91.92% respectively. The “special management zone” and the “sustainable usage and development zone” cover the great majority of the park area.

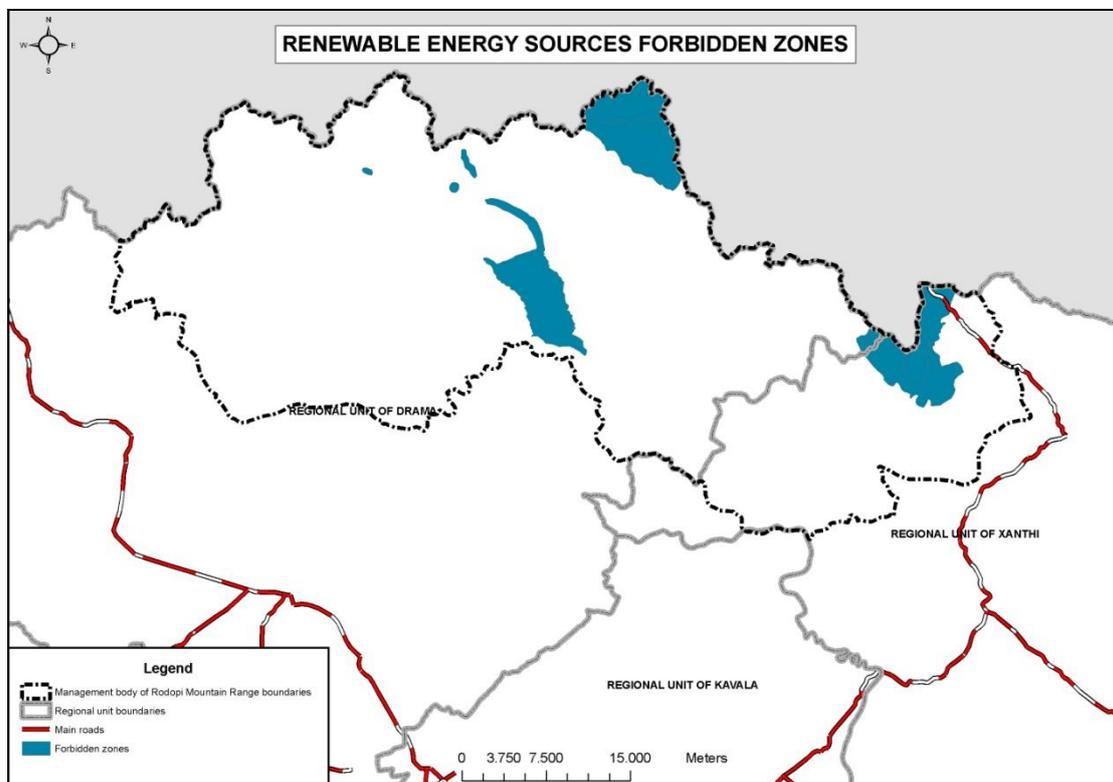
Other protection regimes in the area are derived from restrictions on hunting and other national declarations according to the protection status of specific sites and biotopes, e.g. like pure silver birch (*Betula pentula*) stands in Elatia forest. These additional protection regimes are presented in figure 4.



**Figure 4:** Wildlife Protection Zones and Biosphere Reserves in the RNP

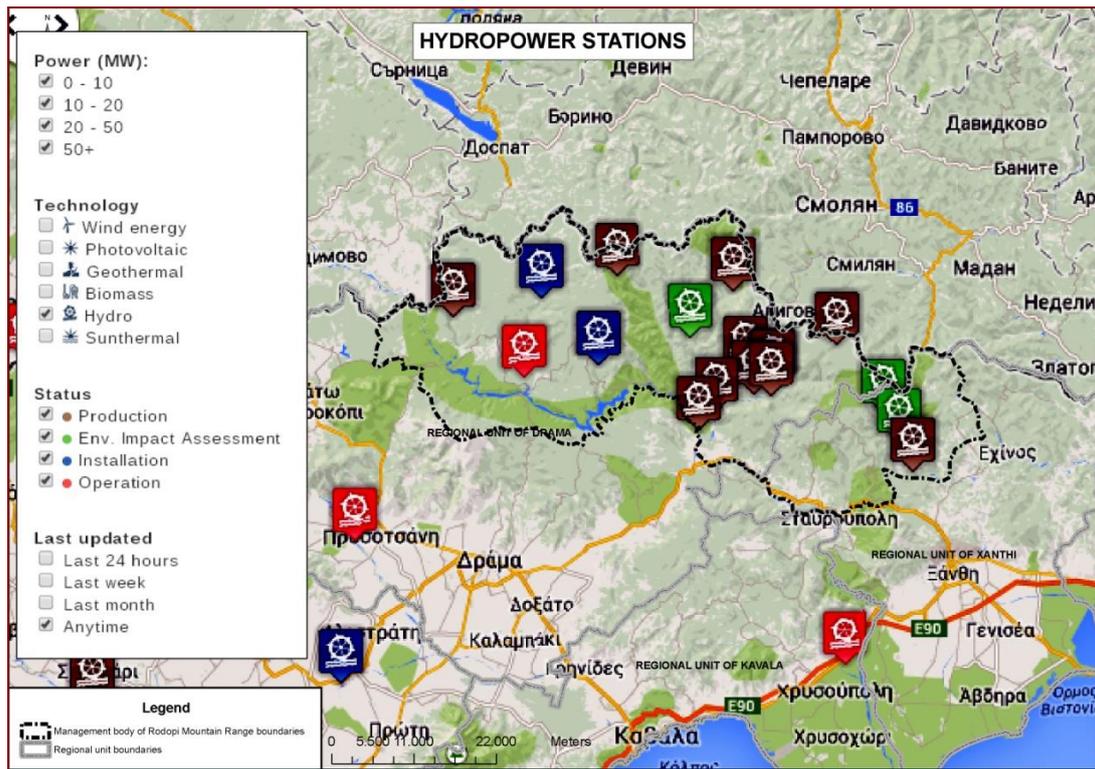
### 2.3. RES in the RNP Area

The Greek Regulative Authority for Energy has excluded Zones A and B in RNP from those where the RES installation is permitted. The area where RES installations are prohibited extends at 14,154 Ha and accounts for 7.08% of the total. The RES restriction Zones are presented in figure 5.



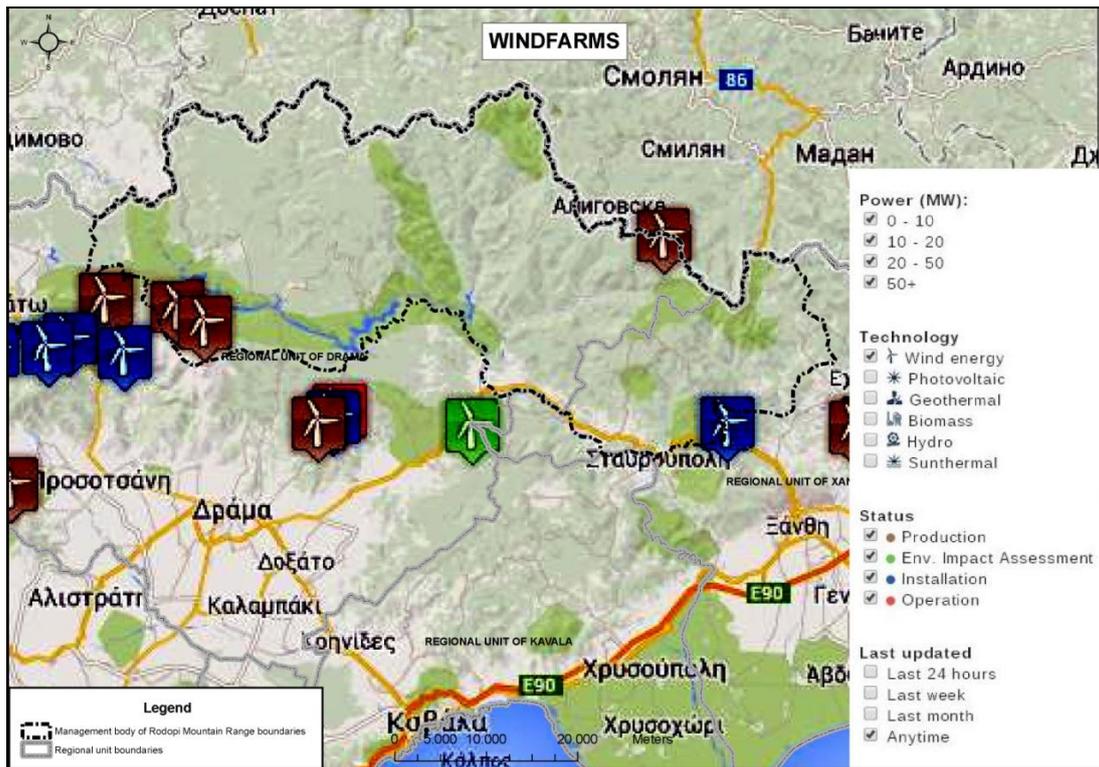
**Figure 5:** Prohibition zones for RES installation

The dominant type of RES in the area of RNP is the small hydropower installations. Their distribution and the investment status are presented in the following figure 6. Only one (1) of the 17 investments is operationally ready today and the rest 16 are classified in three different stages of permissions needed before operation. When all the installations will be operationally ready the total energy production capacity of them will account for 43.73 MW.



**Figure 6:** Small hydropower plant installations in the RNP area

Three (3) wind farms are planned to be installed inside the park or to the park's borders. All investments are in the stage of production permissions. The cumulative production capacity of them at the operational stage will be 70 MW. The distribution and the investment status of the wind farms are presented in the following figure 7. No photovoltaic parks, geothermal or helio-thermal plants exist in the area of the park.



**Figure 7:** Wind farms in the RNP area

Solid biomass produced in the National Park is mainly used for household heating through individual thermal units that the inhabitants operate independently. Some municipalities in the park area can be considered major consumers, since they use biomass to heat municipality buildings.

Currently, within the RNP area there is no biomass power plant installed, but there are ambitious plans for six (6) installations in the broader area of the National Park. Table 1 shows the characteristics of the planned investments in RES plants inside the RNP plus 50 km zone. No investment is operationally ready yet and only the No 2 and 4 are planned to produce energy using biomass derived from forests or/and agricultural residues.

**Table 1:** Power plants and their operational status inside the RNP and in a buffer zone 50km from RNP borders

No	Investor	Site	Plant Power (MW)	Fuel	Produced Energy	Operational Status	Notes
1	Biogas Energy Ltd	Serres	6.50	Biogas	Electricity & Thermal	Establishment Permission	
2	Biomass Kato Neuokopi S.A.	Neurokopi	7.60	Forest and Farm Residues	Electricity & Thermal	Establishment Permission	

No	Investor	Site	Plant Power (MW)	Fuel	Produced Energy	Operational Status	Notes
3	Greenhouses Dramas S.A.	Drama	2.18	Natural gas	Electricity & Thermal	Environmental Permission	
4	SEKE S.A.	Xanhti	2.50	Corn Cultivation Residues	Electricity	Production permission	
5	FYSIS S.A.	Xanhti	9.50	Wastes burning		Production permission	Investment Canceled
6	Biogas Xanthis S.A.	Xanhti	2.96	Biogas		Production permission	Permission Recalled

### 3. Biomass supply chain

The area of Rodopi National Park incorporates the most wood productive forests of Greece, managed under the frame of forest management plans for decades. Biomass production potential of the RNP area is considered high. Therefore, wood exploitation schemes are well developed in the area – though with distortions. DUTH and RNP teams will make use of the existing forest production exploitation schemes to develop the supply side of the local pilot chain.

Biomass use for energy was till recently applied in a traditional manner (household heating by stoves or fireplaces) in the park area. The economic crisis and the increasing oil prices in Greece have pushed people to more economic energy sources, with biomass to be the most commonly available. Consequently, the demand of forest biomass for household heating is also high in the area. Shortage of financial resources, among other reasons, has not permit plans for RES energy production to be realized in the area.

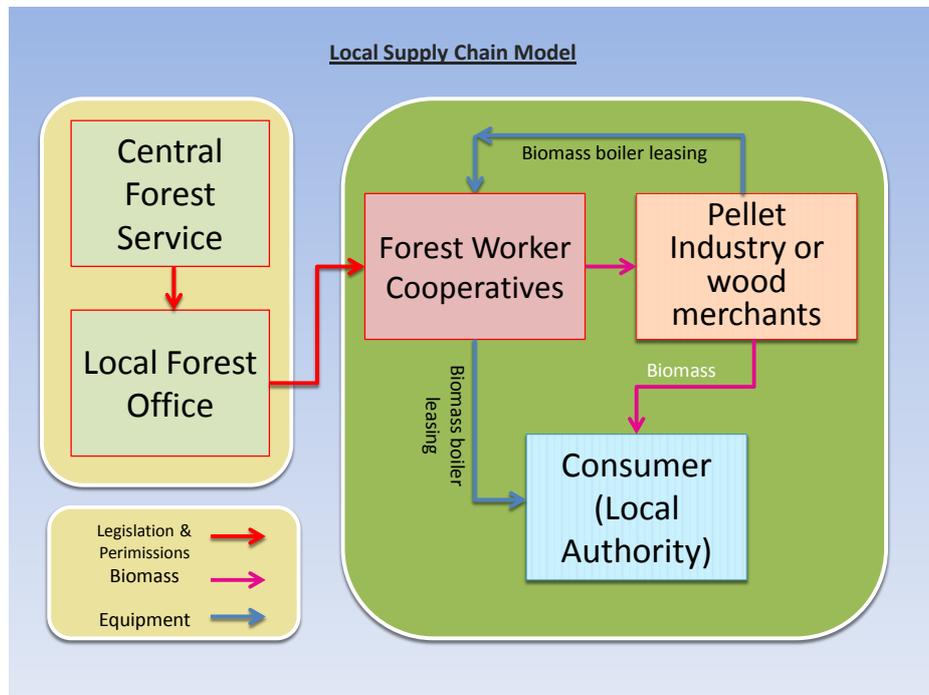
DUTH and RNP teams have contacted during the organized awareness events and round tables the local municipalities, which are potentially big energy consumers (in city halls, schools, administration buildings, etc.) and succeeded in an agreement to install a biomass burner in a municipality building in the town of Nevrokopi. Other municipalities also, realizing the benefits, expressed the willingness to proceed in similar installations and they are seeking financial means.

The proposed LSC follows the contemporary work flow applied in wood production and trading, since wood is the basic biomass source in RNP. The proposed LSC includes a Local Authority (Municipality) as an end consumer, from those who will sign the MoU. The Local Authority will be supplied with biomass from a biomass provider on a long term basis.

According to our recommendations, the provider should have the obligation to supply the Local Authority with biomass derived from the RNP area and/or to provide a biomass boiler for heating. The provider should also undertake the service

and the maintenance of the boiler. In the case that the provider offers the boiler at no cost (or lower than the current market cost), the Local Authority undertakes the obligation to buy biomass for a certain time period from the specific provider according to the terms and provisions that a contract would describe.

The following chart presents the main actors and interconnections of the LSCP in the area of Rodopi National Park.



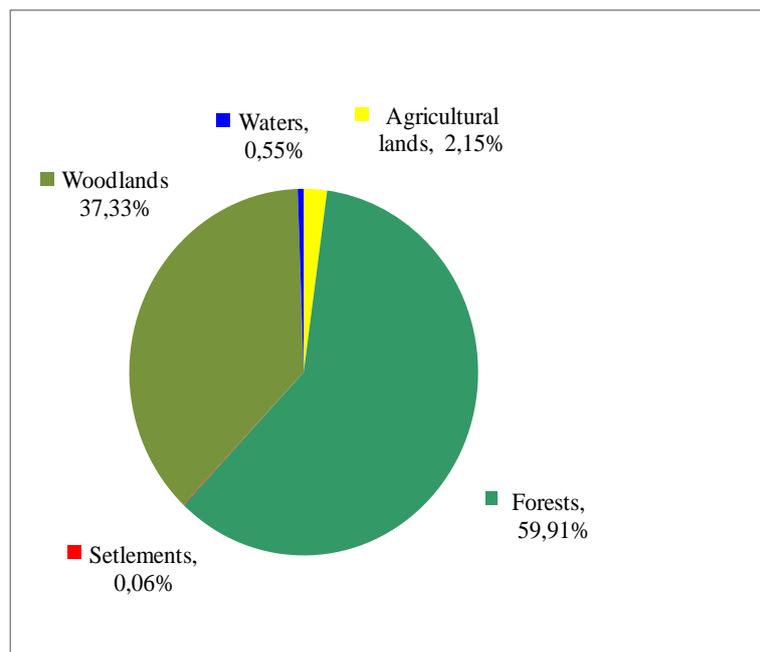
The LSCP of the park is described in detail in the next chapters, following the directions of the Common Supply Chain Guidelines of the project.

### 3.1. Feedstock

Feedstock is the raw material of solid biomass used for energy production. Potential sources of solid biomass in the area of the Rodopi National Park and their capacities are described in this chapter.

#### 3.1.1. Land Cover

The great majority (97.24%) of the park area is covered by forests and woodlands, while only 2.15% is agricultural lands. The distribution of land coverage is shown in figure 8. All forest and wood lands are owned by the Greek state. Forest Service is responsible for their management and supervision.



**Figure 8:** Land cover types in the area of RNP

The high proportion of forest and woodland cover types explain also the great significance of wood as biomass source in relation to residues derived from agricultural activities in the RNP area.

### 3.1.2. Energy Production Capacity

The database of the Ministry of Environment, Energy and Climate Change includes capacity estimates of available biomass sources for energy production at the level of communities in Greece. Table 2 has been extracted from this database and presents estimates of the solid biomass sources available in the communities of Rodopi National Park.

**Table 2:** Biomass energy production capacity in the RNP area.

Community	Plowing cultivations			Tree cultivations			Forests		
	The GJ	Avai GJ	Pro kg	The GJ	Avai GJ	Pro kg	The GJ	Avai GJ	Pro ton
Sidironeron	34	20	7400	146	117	8980			
Libadero				1964	1572	106600	419564	419564	21627
Skaloti	4	2	800	34	28	1800			
Makriplagion	609	304	40000	19	15	1000	176579	176928	9102
Mikromilea							13314	13340	683
Potamoi	5571	2934	594500	57	46	3000	12730	12755	653
Pagonerio				192	153	10000	12730	12755	653
Achladea	1050	549	113000				12730	12755	653
Mikrokleisoura	3135	1709	423000						
Bolakas	5339	2669	352200				12730	12755	653
Silli	1329	710	158000	140	112	8700			
Paranestion	9848	5270	1179800	313	250	19500			
Tholos	2035	1113	280000	87	70	6200			
Stauroupoli	147	74	10836	93	75	6050	18477	18859	952

Community	Plowing cultivations			Tree cultivations			Forests		
	The GJ	Avai GJ	Pro kg	The GJ	Avai GJ	Pro kg	The GJ	Avai GJ	Pro ton
Karyophyton	2	1	700	101	81	6720			
Neoxorio	5137	3049	1086250						
Pasxalia	2616	1564	565760	263	210	14150	117517	117663	6058
Gerakas	112	66	36110	178	142	9475			
Dafnonas	1420	843	300840	90	72	4700			
Kotyli	728	430	220760	392	314	23750	0	162	0
Exinos	1528	916	572990	40	32	2070	40312	40801	2078
Oraio	955	566	314300	229	184	12230			
Myki	2509	1501	931000	435	348	34200	15255	16362	786
<b>Total</b>	<b>44105</b>	<b>24291</b>	<b>7188246</b>	<b>4775</b>	<b>3819</b>	<b>279125</b>	<b>851936</b>	<b>854699</b>	<b>43897</b>
<b>The: Theoretical – Avai; Available – Pro: Produced</b>									

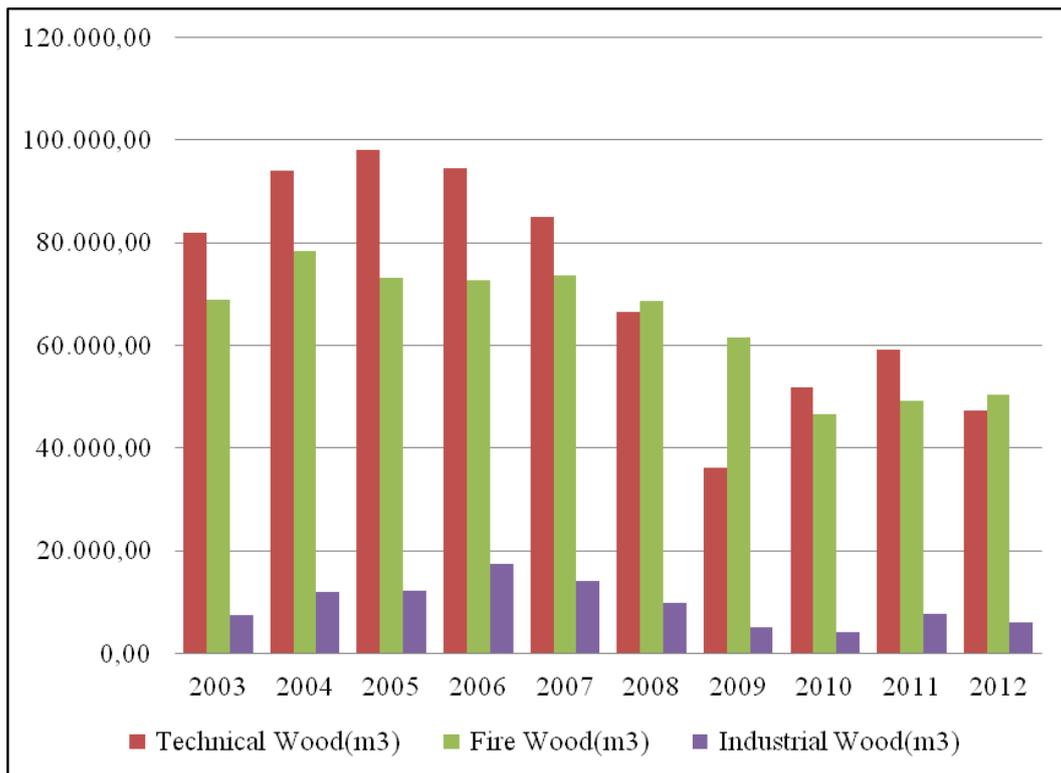
The feedstock source to be included in the local supply chain plan is forest biomass, mainly in the form of firewood. It should be noted that the great majority of the cultivations (plowing and trees) within the park communities extend in the lower plains outside of the park area and cannot be exploited in the frame of the current project. Their existence though, ~~consists~~ constructs a potential competitive source to the forest biomass.

A second source of available data to estimate forest biomass production capacity in the park is the data of the management plans of local forest services. Last decade data derived from the forest service show that the average annual wood volume harvesting is 71,577 m<sup>3</sup> of lumber, 64,301 m<sup>3</sup> firewood and 9,550 m<sup>3</sup> industrial or pulp wood. The average total annual yield of wood in the area is 145,428 m<sup>3</sup>.

Based on those data and following the project assumptions (see also report of the task 3.1.2) the average current production of biomass derived from firewood is 45,011 tons per year and could reach the 51,696 tons if it included the proportion of the industrial / pulp wood.

The estimated biomass production of forests from the ministry database is 43,897 tons, which is not far from the production of biomass calculated on the basis of the management plans of the forest services in the park (45,011 tons of biomass per year).

As figure 9 shows, the annually harvested wood volume presents fluctuations. In particular, the volume of the energy products presents significant fluctuations that may reach almost 50% of the highest production level in a decade. This fact should be taken into account in any possible investment project for a power plant facility in the region of the park, in order to avoid disruptions in the feedstock supply. That is, the lower level of the harvested volume should be considered as the base of feedstock source for any plan.



**Figure 9:** Wood volume harvested the last decade in RNP area

### 3.2. Harvesting

The public Forest Service as the owner and responsible for the management of the forests and local Forest Workers Cooperatives are involved in the harvesting procedures of the forest biomass.

#### 3.2.1. Forest Service

The Regional Forest Service belongs operationally to the Ministry of Interior and is responsible for the forest policy implementation which in general is prepared and issued from the Central Forest Service (Secretariat of the Ministry of Environment, Energy and Climate Change). The Regional Forest Service of the park area is divided into 2 Prefectural Directorates with 4 Local Forest Offices.

The Local Forest Offices play a crucial role in biomass production. They evaluate and ratify the relevant forest management plans inside their districts. They also monitor the harvesting operations and check every deviation from the annual forest harvesting program. They approve or reject deviations from the program and generally rule every procedure that is related to wood production and wood exploitation in both state and private forests.

#### 3.2.2. Forest Workers Cooperatives

The Forest Workers Cooperatives (FWC) are legal entities commissioned to operate in state forests providing logging services. The main legislation documents that rule their operation are:

1. Law 86/1969 “Forest Code”
2. Presidential Decree 126/1986 “Procedures for granting the operating, maintenance and improvement of forests belonging to the State and legal persons of the public sector in forest cooperatives”.

The above institutional framework makes the Forest Workers Cooperatives the only player in harvesting operations and therefore their participation in biomass production process in the LSCP is mandatory. In the area operate 72 Forest Workers Cooperatives including 463 members. The spatial distribution of FWC, drawn from data of the Local Forest Offices, is presented in the following table. These numbers and the overall amount of members reveal a great fragmentation and a small average size of members.

**Table 3:** Distribution of Forest Workers Cooperatives in the RNP area

Local Forest Office	Number of Forest Workers Cooperatives
Drama	49
Neurokopi	10
Stayroypoli	6
Xanthi	7
<b>Total</b>	<b>72</b>

The Forest Workers Cooperatives share the prescribed for harvesting wood volume according to annual or biennial programs, compiled by each Prefectural Directorate. Each FWC is installed in a stand inside the harvesting area by the Forest Service. By the signing the relevant contract, the cooperatives provide a letter of guarantee deposit equal to 5% of the value of the prescribed harvested wood volume. A 12% of the revenues derived from wood products sell are transferred to the Forest Service and to the Green Fund and an administrative fee of 5% is transferred to the municipality where the harvesting takes place.

The Forest Service during the installation procedure defines on site the harvesting borders for each [€](#)cooperative and marks the trees for logging. Cooperatives are obliged to accomplish the logging and move the logs outside the harvesting area within a certain time period.

The logs are cleared from branches and formed into timber products, which are transported and temporarily left collateral to forest roads or in a log yard. Fine wood residues remain in the stands. Skidding is used for technical wood, but fire-wood is transported from the stand by pack animals (mules). The wood logs are separated in product categories, compiled and counted on the road (or log yard) from the Forest Service in order to charge the State fees. After that, each Cooperative is free to sell the harvested products to wood traders, wood sawmill companies, pellet manufacturers, etc.



Forest Workers Cooperatives operate under a special and protective institutional framework, which suppresses competition and may distort [the](#) timber market and consequently the biomass supply. The great number of FWC and their small number of members limit their potentials in wood harvesting operations and deter large scale investments both in harvesting and aftermath wood processing.

### 3.3. Transport – Storage

After the logging operations and the approval of the forest service the wood products are sold at the road (or log yard) by the Forest Workers Cooperatives to the wood market (wood traders, wood sawmill companies, pellet manufacturers, etc.). The transportation of wood logs is done by trucks and the transport cost is charged to the purchaser.



Storage is also a responsibility of the purchaser. The major private companies active in the area of RNP (wood processors, trader and pellet producers) have their own depositories (open air and/or covered) to secure appropriate storage of raw material and final product as well.

#### 3.3.1. Wood biomass processors and traders

Wood processing and trading professions are exercised freely from individuals or legal entities in Greece. Even the Forest Workers Cooperatives could exercise wood processing and trading without restrictions, a case which is actually very rare. Relatively recent regulations have been issued to protect consumers in the transactions with wood trades:

1. Guide for firewood transport which is actual a technical description for biomass storage and trade published from the Ministry of Development and edited from CRES (Centre for Renewable Energy Sources)
2. Solid biomass fuels for non-industrial use – Requirements and Test Methods Ministerial Decision 198/2013 (GG 2499/B/04-10-2013), Ministry of Finance

In the area of Rodopi National Park there are currently two (2) major wood processing and trading companies and several minor ones. All are also active in firewood trading and would participate in the LSC. There are also two high capacity pellet producing facilities. One of them is established in the vicinity of the park borders and is expected to participate in the LSC.

Biomass importing in Greece is free and wood traders can import biomass from neighboring countries – and they actually do import. Since RNP is located in the Greek-Bulgarian borders, importing is easy and cheap and could deter exploitation of local biomass. The VAT legislation and import regulations among EU countries create disadvantages to the local biomass production inside RNP. Greek pellets production is charged with 23% VAT, while the same product imported from Bulgaria is charged with 0% VAT.

### **3.4. Conversion**

As presented in chapter 2.3, there is no biomass power plant installed in the RNP area. Consequently, the LSCP will include only thermal energy production form firewood and/or pellets.

During the awareness event of the project, DUTH and RNP teams stressed the disadvantages of the mainstream use of biomass in traditional stoves and fireplaces and pointed out the economic and environmental benefits of new technological solutions in the use of biomass for heating. Efficient conversion and minimal GHG emissions would also be the target in the installations at municipality buildings.

### **3.5. End consumer**

Since no biomass power plant is installed in the area of RNP, the end consumer of the LSCP will be the households which use firewood and pellet for heating. Local municipal authorities, which are potential major biomass consumers, will be involved as end users by installing biomass burners in order to heat municipal buildings. DUTH and RNP teams consider that local municipalities are the most appropriate bodies to promote efficient use of biomass coming from sustainably managed local forests through examples of installations that can be demonstrated as good practices.

Population dynamics and energy needs in the reference area of Rodopi National Park are presented in the following chapters, to describe the demand side of the local biomass supply chain.

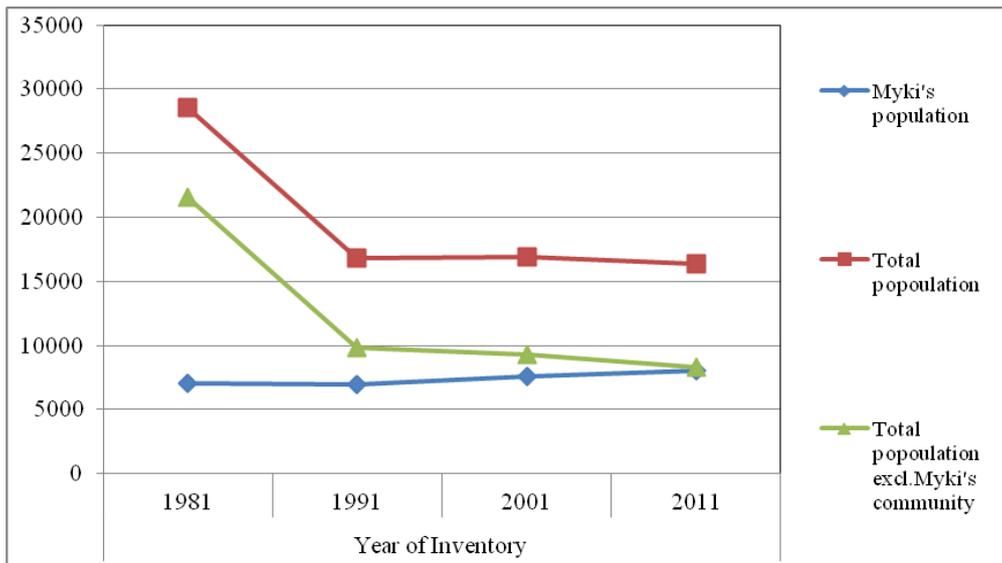
### 3.5.1. Population and settlements

The current population of the park area is 19.502 people, which are distributed in 23 small and medium sized communities. The demographic data derived from the four last population inventories reveal that the total population in the area shows a very slow decrease and the general trend is to be stabilized after a sharp decline between 1981 and 1991, when it was reduced by 29.57%. Detailed population data are presented in the table 4.

**Table 4:** population inventory data in RNP area

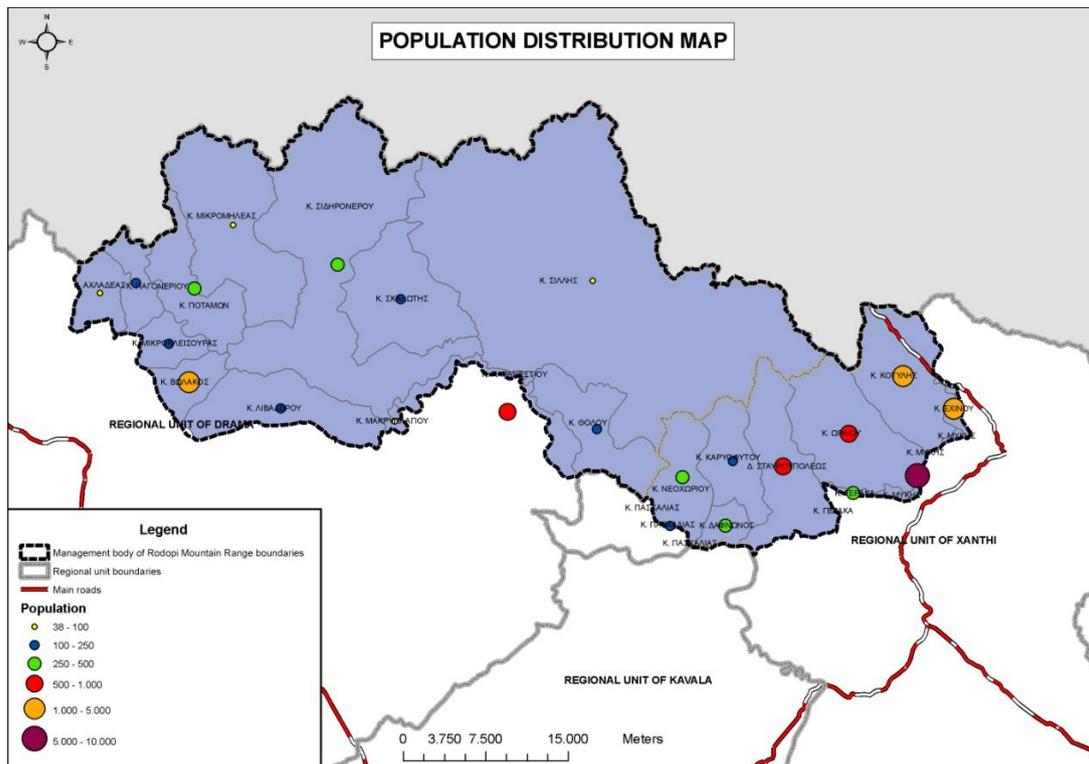
Community	Year of Inventory			
	1981	1991	2001	2011
Sidironeron	750	321	262	310
Libadero	506	193	143	139
Skaloti	272	95	72	102
Makriplagion	284	75	86	49
Mikromilea	112	32	36	38
Potamoi	683	292	276	323
Pagonerio	490	158	190	154
Achladea	180	78	78	92
Mikrokleisoura	344	147	101	137
Bolakas	1426	891	1008	1028
Silli	456	106	123	49
Paranestion	1842	1163	1000	881
Tholos	593	242	172	166
Stauroupoli	1493	958	884	574
Karyophyton	761	251	283	179
Neoxorio	1006	432	412	319
Pasxalia	451	151	202	130
Gerakas	756	556	394	297
Dafnonas	923	326	334	290
Kotyli	2842	2341	2341	2158
Exinos	3527	3053	2883	3074
Oraio	1825	1281	1177	962
Myki	7067	6993	7613	8051
<b>Total population</b>	<b>28,589</b>	<b>20,135</b>	<b>20,070</b>	<b>19,502</b>

A detailed examination of the presented population data reveals a significant fact. The 40% of the population lives in a single community (Myki), which is located in the eastern boundary of the park and the rest 60% in 22 communities scattered in the southern area. Moreover, only Myki community population didn't suffer the sharp decline of the 80's (figure 10).



**Figure 10:** General population trends versus those of Myki community

A division of the current population with the area of the park gives a population density of 11.26 people/km<sup>2</sup>, which is very low. The spatial distribution pattern of the population inside the park is presented in figure 11. It is obvious that the population is concentrated in the southern and eastern part of the park.



**Figure 11:** Population distribution in the communities inside the area of RNP

### 3.5.2. Population Activities

As it is presented in the following table 3, the active population of the park communities is about 6,867 people, which account for the 34.21% of the total population (2001 inventory data – more recent data are not available to permit for evaluation of the activities' trends). In addition, the 56.72% of the active population is engaged in the primary production: agriculture, forestry and husbandry. Also the data show that the more mountainous the community the higher the employment in the primary production. The results show that the mountainous communities of the area will gain mainly the advantages resulted from a successful establishment of a sustainable LSC.

**Table 2:** Population activities data in the RNP area

Community	Active Population (Inventory Data 2001)					
	Total	Primary Production NACE A-B	Percentage	Industry - Material Processing NACE C-F	Services NACE G-Q	Unidentif ied
Sidironeron	72	46	63,89%	6	19	1
Libadero	42	18	42,86%	2	8	14
Skaloti	31	22	70,97%	4	5	0
Makriplagion	14	0	0,00%	0	0	14
Mikromilea	13	12	92,31%	0	0	1
Potamoi	85	61	71,76%	5	16	3
Pagonerio	29	24	82,76%	1	3	1
Achladea	23	15	65,22%	6	2	0
Mikrokleisoura	34	24	70,59%	1	7	2
Bolakas	340	139	40,88%	115	74	12
Silli	40	34	85,00%	1	1	4
Paranestion	267	76	28,46%	45	126	20
Tholos	52	32	61,54%	4	16	0
Stauroupoli	221	38	17,19%	37	138	8
Karyophyton	81	20	24,69%	15	45	1
Neoxorio	93	42	45,16%	17	29	5
Pasxalia	43	17	39,53%	8	16	2
Gerakas	154	112	72,73%	23	17	2
Dafnonas	72	21	29,17%	18	30	3
Kotyli	919	611	66,49%	224	78	6
Exinos	1.080	765	70,83%	166	105	44
Oraio	568	494	86,97%	40	24	10
Myki	2.594	1.272	49,04%	969	272	81
<b>Total</b>	<b>6.867</b>	<b>3.895</b>	<b>56,72%</b>	<b>1.707</b>	<b>1.031</b>	<b>234</b>

Source: Hellenic Statistical Authority  
NACE Statistical Classification of Economic Activities in the European Community

### 3.5.3. Thermal Energy demand

The thermal energy demands of the communities inside the RNP according to the database of the Ministry of Environment, Energy and Climate Change, which append together the population inventory data of 2001, are presented in the following table 6.

**Table 6:** Energy demand data in the RNP area

<b>Community</b>	<b>Population</b>	<b>Heating Energy Request MJ</b>	<b>Hot Water Energy Request MJ</b>
Sidironeron	262	4.060.397,60	362.474,00
Libadero	143	2.194.560,40	159.214,00
Skaloti	72	756.484,80	87.756,00
Makriplagion	86	1.518.698,40	92.904,00
Mikromilea	36	614.316,40	63.034,00
Potamoi	276	6.997.852,60	424.915,00
Pagonerio	190	3.609.780,60	237.585,00
Achladea	78	1.823.294,80	90.046,00
Mikrokleisoura	101	1.743.295,80	143.895,00
Bolakas	1008	16.452.266,80	1.213.726,00
Silli	123	2.150.334,00	165.366,00
Paranestion	1000	17.972.909,20	1.294.912,00
Tholos	172	3.750.183,60	239.064,00
Stauroupoli	884	14.426.259,80	916.583,00
Karyophyton	283	5.124.190,60	358.237,00
Neoxorio	412	8.003.294,80	530.062,00
Pasxalia	202	3.630.760,80	242.808,00
Gerakas	394	7.482.492,60	410.739,00
Dafnonas	334	8.028.886,60	441.613,00
Kotyli	2341	30.567.303,00	2.461.905,00
Exinos	2883	44.904.015,00	3.086.271,00
Oraio	1177	19.621.639,80	1.289.817,00
Myki	7613	90.352.342,60	7.761.211,00
<b>Total</b>	<b>20,070</b>	<b>200.956.679,60</b>	<b>15.451.556,00</b>

The total cumulative energy demand per capita is 10,782 MJ which means 0.257 toe or 2,995 kWh per capita per year.

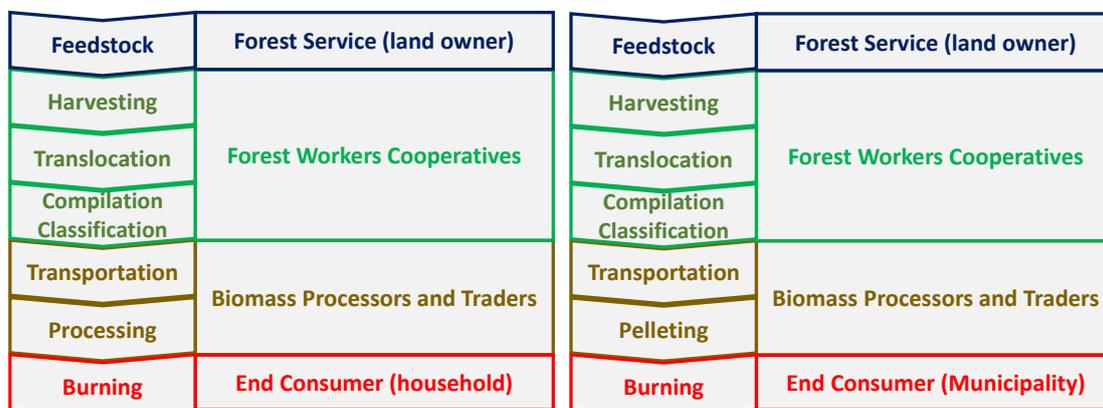
Comparing the energy demands of the RNP communities with the estimated wood production of the park (see chapter 3.1.2) we can conclude that the park has the potential to cover these demands by almost 4 times (table 7). If we increase the firewood production by 30%, which is a rational estimate according to the local forest offices data, energy demands can be covered by almost 6 times.

**Table 7:** energy demand and potential production in RNP.

Energy demand	MJ	Mcal
Heating	200.956.679,60	47.997.755,00
Hot Water	14.451.556,00	3.451.800,00
Total	215.408.235,60	51.449.555,00
RNP Production	kg	Mcal
Fire Wood	45.011.000,00	202.549.500,00
Pulp Wood	6.685.000,00	30.082.500,00
Increase by 30%	15.509.000,00	69.790.500,00
Total	67.205.000,00	302.422.500,00
RNP	MJ	Mcal
Percentage of Demand Cover per type of wood product	Fire Wood	393,69%
	Pulp Wood	58,47%
	Increase by 30%	135,65%
	Total	587,80%

#### 4. Important aspects of supply chain organization

The steps followed to develop the local supply chain for RNP have revealed the main actors of biomass exploitation, the local demands for energy and the efforts in progress to efficiently utilize it and the potentials of the park to cover the demands. The two alternative flows of biomass from the forest to the end consumer are summarized in the following figure 12.



**Figure 12:** biomass supply chain for thermal energy production in RNP.

It is a great advantage that the Greek state is the only owner of the forests within RNP. The great areal extension of the park involves four local Forest Offices in the management of forests. Forest Offices are working together in the management activities, applying the principles of sustainable forest management and guarantee a sustainable level of primary production – feedstock for the LSC. An institutional deficiency in the wood exploitation is the short term contracts (annual or biannual) that can be signed between Forest Service and Forest Workers Cooperatives. This fact does not support strong and long term commitment of the actors that could ensure a steady and continuous biomass supply to the end consumer. The point has been communicated to the central Forest Service, which is responsible for regulatory arrangements in wood exploitation.

Forest Worker Cooperatives acting as contractors for harvesting operations are important for the production of raw material. The great number of existing cooperatives (legal entities) with small number of members is a serious disadvantage for major investments in the biomass sector, but also for the pilot implementation of the LSC. To facilitate communication and coordination in the operation of the LSC, DUTH and RNP teams will keep close contact with the cooperatives involved. The federation of FWC will be the channel to disseminate the results of the pilot phase to the whole cooperative entities.

Wood biomass processors and traders constitute a key ring of the LSC. They are working in a free and competitive environment and their involvement is based mainly on economic criteria. VAT and RES policies applied in Greece have negative impact on their involvement in LSC. The processed biomass products, e.g. pellets and chips, are charged with a high rated VAT of 23%. On the contrary the VAT of fossil fuels (oil, natural gas) and of renewable fuels with low thermal efficiency (firewood for stoves and fireplaces) is 13%. Moreover, the Regulatory Authority for Energy delays licensing of biomass plant installations giving priority to photovoltaic and wind farms projects. The policy seems controversial and hostile to solid biomass. Institutional intervention is needed to reverse the situation in favor of the solid biomass.

Round table discussions in the awareness phase of the project revealed the need for a reform of the management scheme of the forests to orient it towards biomass production for energy and a reform of the FWC organization to allow the creation of schemes with bigger capacity and permit large scale viable investments.

Important amount of wood biomass imported from neighbor countries could potentially jeopardize the LSC. Also, Greek pellets production is charged with 23% VAT, while the same product imported from Bulgaria is charged with 0% VAT. Apart from imports, significant potential of agricultural residues is available in the lower plains outside the park area that could also threaten the successful exploitation of the park biomass. Both sources of biomass are developed by the activation of private investors and if the economic conditions are favorable they could have significant impact on the prices of the park biomass.

According to Anestis Arvanitidis CEO of Arvanitidis SA, which operates in cereal and olive trade, the corn grains is presented as an alternative competitor of other

biomass products. Corn prices are formed in commodities exchange market and the price in 2013 ranged between 0.13 – 0.14 €/kg, while a kg of wood pellet was sold in the retail market for 0.25 €/kg. Also corns grains are purchased already well dried during the harvesting and storage period (moisture content around to 12%) and have high calorific value because of oil and ethanol content. The maize heating power, is equal to 15.88 MJ/kg, for 13% moisture content (Kitani et al, 1999 Pimentel et al, 1999). The energetic power of 1 dm<sup>3</sup> of oil is equivalent to 2.25 kg of maize. This figure is essential to make any technical and economical evaluation on the use of corn as a fuel (Berruto et al, 2005).

Local municipal authorities installing new technology burners with efficient conversion and minimal GHG emissions at municipality buildings is seen as the vehicle to promote biomass for energy use in the RNP area. A good practice example is expected to be the Municipality of Nevrokopi, which has already installed two pellet burners in two municipal buildings and it is expected to expand the use of pellets as thermal source in another building as well in the near future. Other municipalities in the park are also searching for financial means to install similar heating facilities.

A point that deters utilization of solid biomass as heating source in municipal (or public authority) buildings is the annual contracts for fuel procurement, which is obligatory according to the Greek legislation. A multiannual contract would encourage burner providers to install burners at lower cost in conjunction with a guaranteed quantity of biomass fuel supplied for a long period of time.

It has been proved during the awareness events and round tables that local actors in Rodopi National Park had not fully appreciated the advantages of using local biomass as energy source. DUTH and RNP awareness raising activities have brought together suppliers and consumers and have contributed to decisions towards the efficient use of local biomass for heating. The project teams have also helped to the negotiations between the municipality of Nevrokopi and the biomass suppliers.

Awareness raising activities will be continued during the pilot implementation of the LSC, through continuous communication with all participants, following the monitoring procedures and providing support to the involved stakeholders.

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