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Analysis and development of supply chains of forest biomass focusing on firewood in the area of Western Macedonia, Greece

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Introduction

The Greek forests cover 4.06% of the total forest land of the European Union. They cover 25.4% of the country's total area (3.359 thousand ha). Of these, two thirds (65.4%) belong to the state and the remaining 34.6% belong to private entities, local authorities, monasteries, and other welfare institutions.

The management, protection and general supervision of them is under the guidance of the **public forest service**.

The basic characteristics of the forest policy in Greece are a) activities for protection of the forests from fires, illegal cutting etc. b) sustainable development and management c) strong control of the state through the public forest service and d) the programming of road constructions, water management projects etc.







Forest distribution in Greece based on Corine Land Cover 2000







Condition and structure of regional and national forests

Table 1: Land use in Greece			
Land use	ha	%	
Forests	3.359.000	25.4	
Other wooded land/ Shrubland	3.154.000	23.9	
Water	120.000	0.9	
Other	6.563.000	49.7	
Total country	13.196.000	100	

Table 2: Forests in W. Macedonia			
Forests in W. Macedonia	Share (%)		
Grevena	34.07		
Florina	24.37		
Kastoria	40.00		
Kozani	9.26		
Tsotili	12.88		









The region of Western Macedonia is divided into 5 forest districts: Kozani, Tsotili, Grevena, Kastoria and Florina. **The forests cover 229.555,3 ha or 24.32% of the total area** (2007, regional forest services). Most of the forests exist in Kastoria and Grevena and the least in the combined area of Kozani and Tsotili.

Table 3: Production of wood (m³) in each forest district of W. Macedonia (2011)

Forest District	Technical timber	Industrial timber	Firewood	Total
Grevena	16.796,75	0,00	10.097,29	26.894,04
Kastoria	17.869,89	0,00	31.412,88	49.282,77
Kozani	4.207,36	0,00	9.439,53	13.646,89
Tsotili	4.952,88	206,17	6.606,02	11.765,07
Florina	557,00	146,00	10.295,00	10.998,00
Total	44.383,88	352,17	67.850,72	112.586,77





Greek forests in terms of productivity

The Greek forests as regards their productivity are divided into three categories:

Category 1: productive forests (**productivity 3 - 5m³ / year / ha**), mainly comprised of conifers, which are subject to systematic and intense exploitation.

- 21.07% of the surface of the country's forests

Category 2: middle range productive forests (**productivity 1 - 3m³ / year / ha**), mainly comprised of broadleaves (oak, beech, but also pines, firs). The reduced productivity is due to human interference (pasturage, excessive exploitation) and natural causes (erosion). **- 59.87% of the surface of the country's forests**

Category 3: low range productive forests/forest understory (bushes and small diameter trees, also called "evergreen broad-leaved bush land"), which occur at low altitudes with a very low productivity (**productivity 1m³ / year / ha**).

- 19.06% of the surface of the country's forests





Wood production in Greece

Table 4: Production of wood from public forests (m³) in Greece in 2010

Forest species	Technical timber	Industrial timber	Firewood	Total
I. Conifers				
Fir	39.889	3.198	2.327	45.414
Spruce/Picea abies	8.259	65	0	8.324
Pinus	95.992	51.387	40.121	187.499
Subtotal	144.140	54.650	42.448	241.237
II. Broadleaves				
Beech	30.289	7.825	149.082	187.196
Oak	980	1.374	249.497	251.851
Poplar	19.868	6.895	6.111	32.874
Chestnut	3.371	577	220	4.168
Others	301	43	21.136	21.480
Subtotal	54.809	16.714	426.047	497.569
Total	198.949	71.363	468.494	738.806

Production of firewood from public forests in the country (2010): 470.000 m³.

132.000 m³ under the auspices of forest services,

285.000 m³ by forest cooperatives (L. 1541/85 and PD 126/86) and

53.000 m³ from other private legal entities.

Production of firewood from non-public forestry (2010): 243.000 m³. Additionally, 103.000 m³ firewood to cover own energy needs of people living in forest areas or next to forests (so called "firewood tax-free collected").



Table 5: Production of wood from non public forests (m³) in Greece in 2010

Wood production in Greece

Forest species	Technical timber	Industrial timber	Firewood	Total
I. Conifers				
Subtotal	42.340	1.831	29.323	73.495
II. Broadleaves				
Subtotal	16.939	5.059	21.3664	235.662
Total	59.280	6.890	242.987	309.156

Firewood for own heating purposes

Firewood for own heating purposes or "tax-free collected" firewood is wood assigned to communities next to public forests.

Regional forest services may allow to residents to collect firewood and logging residues from adjacent forests with or without any permission and tax attribution, on some conditions:

Condition 1, without a permission of the local forest service: in most cases residents are allowed to collect branches of trees, bushes etc. without the use of chain saws. The daily amount of collected material should be below 1 loose cubic meter per resident.

Condition 2, with a permission of the local forest service: in most cases it is allowed to collect fire wood from trees, which cannot be utilized for commercial purposes, in the presence of a forest warden. The amount collected should be e.g. 4 loose cubic meters of fire wood per family per year in the period from November – April.







Current state of bioenergy consumption in the Greek energy market

- Total electricity production in Greece (2010): 58.86 TWh
- of which renewable sources: 7.84 TWh or 13%
- Renewable installed capacity: 4.11 GW
- of which biomass and biogas: 0.06 GW
- Final energy consumption in Greece: 21.53 Mtoe
- total biomass and biogas: 1.01 Mtoe
- total biofuels for transport: 0.11 Mtoe

Current situation

• Large quantities of wood harvested in forests are used by forest industries (e.g. sawmills, particle and fibre board industries) and their residues are directly converted to heat.

• Ministerial Degree of 1993 (MD 103/1993/B-369), biomass boilers were not allowed to be installed in the two major cities of Greece, Athens and Thessaloniki.

• This restriction was banned in 2011 to boost the biomass consumption throughout the country.







Forest and agricultural cooperatives

Two systems were used for the exploitation of state forests until the end of 1986:

- **self-supervision** by the local forest services (state forest farms), under the framework of State Forest Exploitation (KED from the Greek acronyms) according to article 137 of Law 86/69; **the state undertakes the exploitation of the forest by assigning its logging to forest cooperatives, which are then paid per production unit of forest product.**

- leasing of the forest production (allowable cut) by forest labour cooperatives (Law 86/69 article 134) or following an auction with interested parties (Law 86/69 article 120); the state leases the production to the forest cooperatives, who pay a fee per unit of produced product and then sell the products themselves, paying back to the "Green Fund" the fee that was agreed upon or achieved at the auction.







Forest and agricultural cooperatives

Since 1987 (Law 1541/1985 article 74 and the Presidential Decree 126/1986) **a third system** has been introduced for the exploitation of state forests, through which the latter is conceded to forest cooperatives, **who pay a certain rate based on the sales price of the forest products.** The payment is made to the "Green Fund" (12% of gross income for technical timber and 5% for firewood) and to the local authorities (5% of gross income), within whose administrative boundaries the forest is located.







Wood trading companies are buying wood logs either from forest cooperatives or from private forest owners. The wood purchased is in the form of logs not suitable for industrial use and mainly from **beech and oak** or pine in smaller quantities.

The wood is usually manually harvested by motor saw and transported to the forest road by means of a mini skidder (round wood) or mules (sawn logs of 1m length). The wood is bought at the forest road by the firewood trader and then transported to the company's facilities by trucks of 20th capacity. After unloading at the company's premises, the logs are chopped (cross cut and split) into firelogs of 25 – 33 cm length and afterwards stored for **natural drying** for a period of min. 2-3 months.

Main standards applied are **EN 14961 series** (e.g. EN 14961 - 5 Solid biofuels. Fuel specifications and classes. Part 5: Firewood for non-industrial use).









- Manual harvesting by chain saw
- On the spot transformation (manually)
- Extracting by mini skidder (roundwood) or by mules (sawn logs)
- Transportation to forest road
- Unload at forest road
- Load on truck
- Transportation to storage at wholesaler
- Unload at wholesaler
- Chopping and splitting
- Natural drying
- Storage
- Transportation to end consumer
- Unload at end consumer
- Storage at end consumer



Flow chart





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Table 7: Result of the SWOT analysis

Internal Strengths

- S1. Bordering strategic position, introduction of raw materials from the neighbouring countries
- S2. Increasing demand from the domestic sector for biomass heating
- S3. Urban areas located very close to rural areas (reduces logistical problems for domestic and small scale supply)
- S4. Quantity of wood harvested per year, is always less than the annual increment (sustainability)
- S5. Local/regional availability of feedstock
- S6. Short transport routes in procurement and distribution

Internal Weaknesses

- W1. Uncertainty of regular biomass yield (due to forest wildfires, illegal logging etc)
- W2. Low training and specialization of manpower
- W3. Lack of mechanized harvesting for wood (difficulties in establishment of supply chains)
- W4. Old legal framework. Wood harvesting is only allowed to forest cooperatives in public forests
- W5. Terrain (large slopes, not accessible areas, thus the production of wood is reduced)
- W6. Economies of scale that can not be achieved because of the fragmented and small sized forests







Table 7: Result of the SWOT analysis (continued)

External Opportunities

- O1. Scope for increase and more efficient use of the regional biomass resources
- O2. Promotion of education and training programs emphasizing on new technologies and skills
- O3. Emerging fire wood market also due to the high petrol taxation
- O4. Oil and gas suppliers exposed to the insecurity and price fluctuations of international markets

External Threads

- T1. Development efforts often restricted due to lack of financing instruments
- T2. Public is neglecting principles of sustainable development
- T3. Fast implementation of other renewable energy technologies feeding the market requests
- T4. Perception that technology is old and unattractive
- T5. Changing governmental policies
- T6. Economic change and volatility in fossil fuel prices
- T7. Illegal logging





Table 8: Cost structure (excl. VAT)

Costs for feedstock procurement	[€/solid m³ incl. bark]	[€/tn]
Feedstock	Beech and Oak	Beech and Oak
Feedstock costs at forest road	58 – 67	70 - 80
Transport forest road to storage	14.1	11.8
Administration	1.1	0.9
Costs at gate	73 - 82	82.7 – 92.7

*Mode/s of transport: mainly trucks without trailer - load capacity max. 20tn – average distance approx. 60km

Table 9: Costs for firewood production

Process	[€/solid m³]	[€/tn]
Chopping	5	4.2
Storing Including Natural Drying	2.3	1.9
Administration	0.6	0.5

Table 10: Conversion factors in use

Base unit	Converted Unit	Conversion rate
1 tn	Solid m ³	1.2
1 bulk m ³	Solid m ³	0.60







The wood trading company is buying the sawn fire logs of 1m length at 58-67 \in per solid m³ (70 – 80 \in /tn). The company organizes the transport.

The total average cost for the production of firewood is $94.3 \in$ per tonne, excluding the distribution cost of the product ($5.5 \in$ per tn), a 10% profit margin and VAT (13%) of the sold product.

The three main cost drivers are feedstock (80%), transportation (13%), and chopping (4%) which add to 97% of the total production costs of firewood.



Share of each process/cost factor on the total average production costs of 94.3€ per tonne of firewood







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Thank you for your attention!

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