

# **ISLAND SUSTAINABLE ENERGY ACTION PLAN**

## ***ISLAND OF LEMNOS***

**Date**

**30/4/2012**

## Executive summary

The Municipality of Lemnos by signing the Pact of Islands takes action towards sustainable development and the fight against climate change at local level. Together with other Greek and European islands commits to meet the targets set by the European Union for the reduction of greenhouse gas emissions.

The long-term vision of the local authorities is to succeed into restricting the rapidly increasing CO<sub>2</sub> emissions of the island by introducing the maximum amount of renewable energy sources in the energy production and demand side and by promoting the adoption of energy saving and efficiency in all activity sectors.

### Objectives and Targets

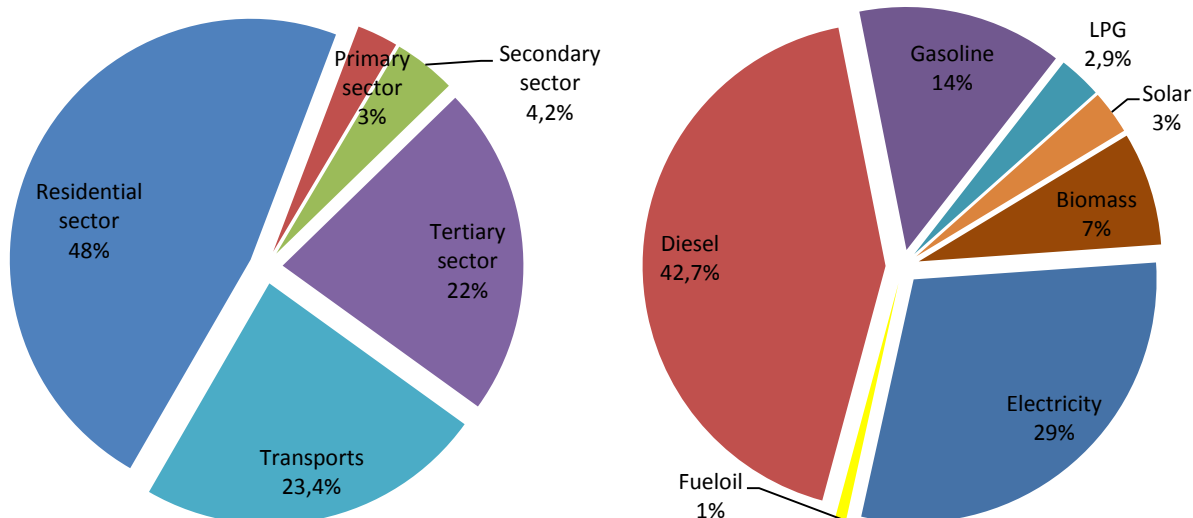
With the present sustainable energy action plan, Lemnos sets clear and ambitious objectives and targets concerning the island's local energy policy.

The objectives set for the target year 2020 focus on increasing the island's energy supply security, reducing its dependence on fuel imports and finally reducing the island's energy and CO<sub>2</sub> emissions footprint.

Specifically, the targets set for 2020 focus on reducing by 45% the primary energy demand and by 51% the CO<sub>2</sub> emissions in comparison to the projections of the business as usual scenario, meeting the 17% of the primary energy demand and the 32% of the electricity demand by the use of local renewable energy sources.

### Energy balance and CO<sub>2</sub> emissions in the base year

The year 2005 was selected as base year for the energy planning process of Lemnos' ISEAP, following the EU targets set for fighting climate change. In the following figures Lemnos' energy profile for the year 2005 is shown. The strong dependence on fossil fuels is apparent.



### **Main fields of action**

A wide range of actions is included in the action plan dealing with all the major activity sectors of the island. The selection of actions was carried out after considering several alternative scenarios with the scope to maximize the emissions reduction target with the minimum cost in the given time framework considering also the lately formulated national and local economic conditions.

### **Coordination structure**

A two level coordination and organizational structure is decided in order to ensure the efficient implementation of the ISEAP. The steering committee on the one hand will take over the coordination during the ISEAP's different phases while on the other hand the work group will mainly focus on the realization of the actions, the monitoring of the ISEAP and the possible updating of the ISEAP contents.

### **Budget and Financing**

*The budget will be finalized upon the final approval of the ISEAP.*

Securing the necessary financing sources and instruments for the successful implementation of the ISEAP will be one of the major challenges for the Municipality. The allocation of Municipal and Regional budget combined with loans, revolving funds, citizens cooperatives, third party financing, private investments and public and private sector partnerships are some of the financing schemes to be used for the realization of the ISEAP.

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# 1. CONTEXT

## 1.1. Geography and territory

Lemnos is the eighth largest island of Greece and is located in the North Aegean opposite of the Dardanelles Strait; it is 36nm far from Athos peninsula. The island covers an area of 477,3Km<sup>2</sup> and the coastline is 260Km.

Lemnos is mostly flat, but the west, and especially the northwest part, is rough and mountainous (highest elevation: Mount Vigla, 470 m). There are no surface waters and the surrounded sea waters are characterized by shallow depths in the east.

The main towns are Myrina, on the western coast, and Moudros on the eastern shore of a large bay in the middle of the island. Myrina possesses a good harbour, which is in the process of being upgraded through construction of a west-facing sea wall. It is the seat of all trade carried on with the mainland.

The hillsides afford pasture for sheep, and Lemnos has a strong husbandry tradition, being famous for its feta and melipasto cheeses, and for its yoghurt. Fruit and vegetables that grow on the island include almonds, figs, melons, watermelons, tomatoes, pumpkins and olives. The main crops are wheat, barley, sesame; Lemnos also produces honey (from thyme-fed bees), but, as is the case with most products of a local nature in Greece, the produced quantities are little more than simply sufficient for the local market. Muscat grapes are grown widely, and are used to produce an unusual table wine that is dry yet has a strong Muscat flavor. Since 1985 the variety and quality of Lemnos wines have increased greatly.

The land use in is mainly divided between agricultural (42.7%) and rangeland areas (35.7%). The artificial surfaces cover a small part of the island (4.2%) while there are no forests.

The island has an excellent airport, possessing a very long runway, capable of supporting Antonov carriers.

The economic activities of the last two decades are mainly related to the tertiary sector; tourism, services and trade are developed in of the primary sector. Industrial activities show a small but significant upward trend as a result of the development of the unique and known products of the island.

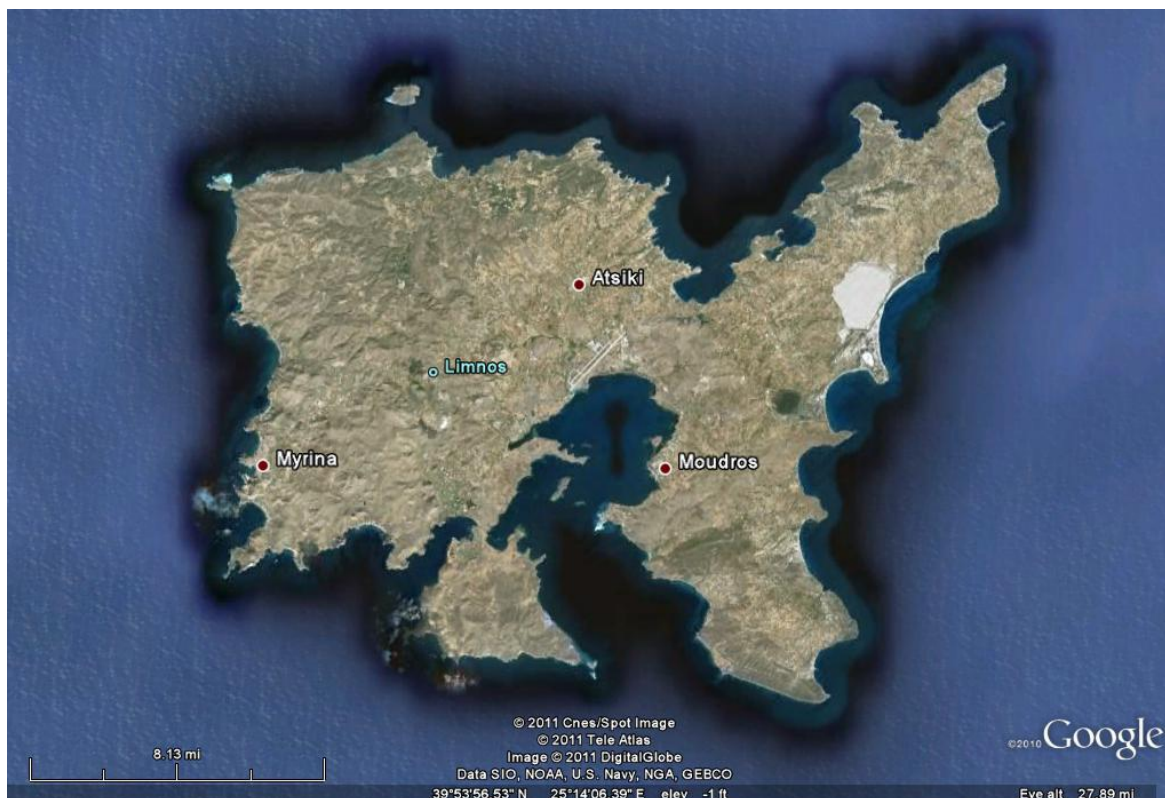


Figure 1.1. The Island of Lemnos

## 1.2. Demography

During 1951-1991, the population of the island showed an average annual decrease of 0.7%, with a peak in the decade of immigration 1961-1971 where the reduction reached 20%. During the period 1981-2001, the population increased since immigrants returned to the island and new population added to the former (military, foreign workers). Current estimates of the local authorities concur that the upward trend will continue but at a reduced pace.

YEAR	1951	1961	1971	1981	1991	2001
Population	24.018	21.812	17.445	15.721	17.931	18.475
		1951-1961	1961-1971	1971-1981	1981-1991	1991-2001
Population change		-2.206	-4.367	-1.724	1.889	544
Percentage of population change		-9,18%	-20,02%	-9,88%	12,02%	3,03%

Table 1.1. Population evolution (source: EL.STAT)

The population division among the former municipalities of Lemnos is shown in the following table:



MUNICIPALITY	1991	2001	CHANGE 1991-2001	PERCENTAGE CHANGE
Atsiki	2.341	2.295	-46	-1,96%
Moudrou	2.199	2.191	-8	-0,36%
Myrinaa	6.818	7.488	670	9,83%
Neas Koutalis	836	804	-32	-3,83%

Table 1.2. Population per major area (source: EL.STAT)

POPULATION	LEMNOS	
	NUMBER	%
Urban	5.107	28,21
Rural	12.997	71,79

Table 1.3. Population characterization

### 1.3. Economy

Since the '80s, there is a significant shift towards the tertiary sector, while the processing of agricultural products ceased to be a cottage level and began to take an industrial form.

The island's economically active population in 2001 was 6,602. Of them, 12% were employers, 20,5% self-employed, 55,3% wage-earners, 7,1% unemployed, auxiliary family members, and 5,1% did not declare line of occupation. Of the economically active population, 17,9% worked in agriculture, 5,3% in light manufacturing, 11% in construction, 6,7% in hotels & restaurants, and the rest in other lines of business

Regarding the composition of employment rates by activity sector, the data do not differ significantly from the corresponding data of the country.

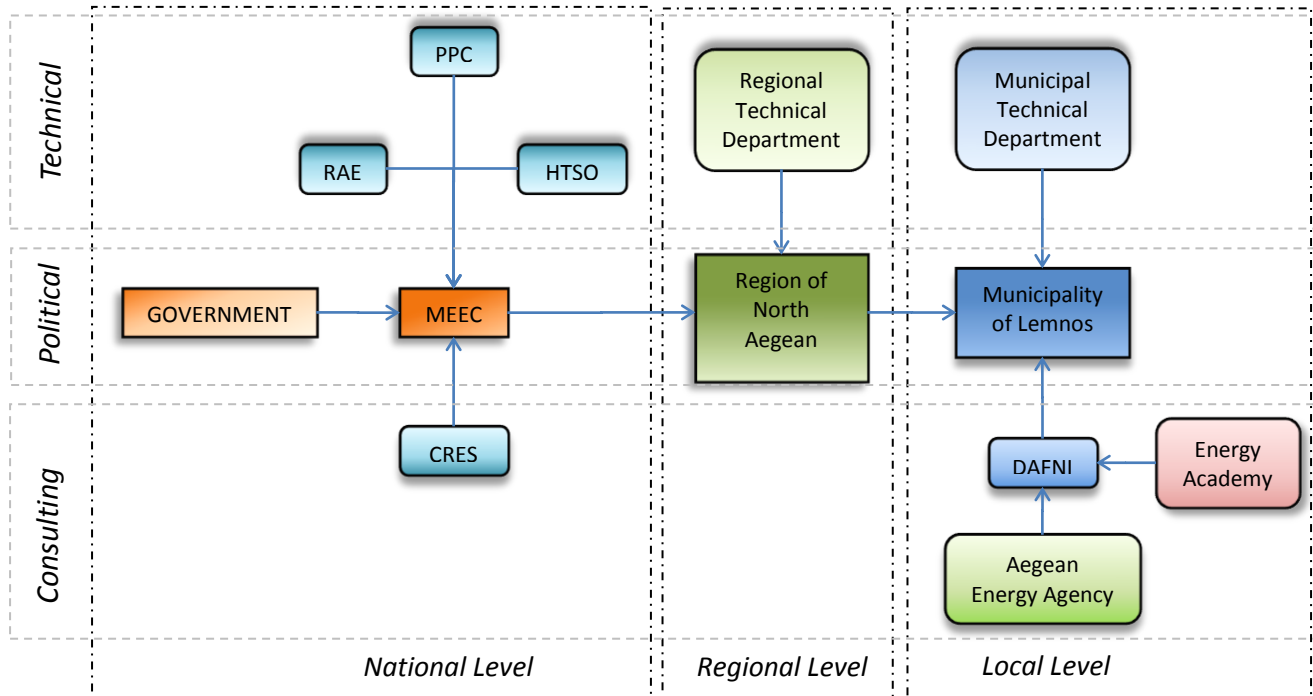
ACTIVITY SECTORS	%
Primary	20,8
Secondary	19,2
Tertiary	55,7

Table 1.4. Occupational Data per activity sector

## 1.4. Political and administrative structures

Lemnos belongs in the region of south Aegean and with the late administrative reformation the former municipalities consolidated into the municipality of Lemnos.

The political and administrative organisational structure of Lemnos island in relation to the energy field and sustainable development is presented in the following diagram.



PPC: Public Power Corporation

RAE: Regularity Authority for Energy

HTSO: Hellenic Transmission System Operator S.A.

MEECC: Ministry of Environment Energy & Climate Change

CRES: Centre for Renewable Energy Sources

DAFNI: Network of Aegean Islands for Sustainability

## 2. OVERALL STRATEGY

### 2.1. Current framework and vision for the future

Lemnos island, located at the North Aegean, makes it a rather isolated island but also one of the biggest Greek islands. As a result the population of the island is rather stable during the whole year, while still increasing during summertime when tourists and people with origins from the island arrive.

The permanent population of the island is expected to rise by 10% in 2020, resulting to increasing energy demand. According to the business as usual scenario the CO<sub>2</sub> emissions for the island of Lemnos are expected to increase by 49% until 2020 in comparison to 2005 levels.

Lemnos is electrically autonomous with a thermal power station installed on the island, using diesel and fuel oil as primary energy source. Also, large amounts of fossil fuels are imported to the island through boat transfers to cover mainly the demand of the transport and heating sectors. In present a minor wind farm and a small PV stations are installed also on the island. However, the island still relies greatly to energy imports.

In this sense, the Municipality of Lemnos aims to reduce the dependence of the island from energy imports by promoting the local energy production through small and medium scale RES installations with the expectation to cover 17% of the island's primary energy demand in 2020. In addition to that in order to increase the energy security of the island and reduce the per capita cost of energy and energy footprint demand side management actions will be promote and implemented by the municipality setting an example of effective energy saving and increased energy efficiency.

### 2.2. Objectives and targets

In December 2008 the EU adopted an integrated energy and climate change policy, including ambitious targets<sup>1</sup> for 2020. It hopes to set Europe on the right track - towards a sustainable future with a low-carbon, energy-efficient economy by:

- cutting greenhouse gases by 20% (30% if international agreement is reached)
- reducing energy consumption by 20% through increased energy efficiency
- meeting 20% of our energy needs from renewable sources.

Greece as an EU Member State must comply with the EU policy. The targets on national level are translated into 4% reduction of greenhouse gases according to 2005 levels and 18% penetration of renewable energy sources into the gross energy consumption

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<sup>1</sup> The targets refer to accumulated result among the whole of EU. However, the targets differ among the Member States.

The Municipality of Lemnos by signing the Pact of Islands and developing a concrete ISEAP commits to take actions on local level towards sustainability.

The objectives set for 2020 focus on:

- a. Increasing energy supply security
- b. Reducing dependence on energy imports
- c. Reducing the island's energy and CO<sub>2</sub> emissions footprint

The targets set for 2020 focus on:

- a. Reducing by 45% the primary energy demand in comparison to the BAU scenario
- b. Reducing by 51% the CO<sub>2</sub> emissions in comparison to the BAU scenario
- c. Reducing by 8,6% the CO<sub>2</sub> emissions in comparison to 2005 levels, going beyond the national targets and reaching the average target for the whole EU
- d. Meeting the 17% of the primary energy demand by renewable energy sources
- e. Meeting the 32% of the electricity demand by the use of local renewable energy sources

## 2.3. Strategic guidelines

The ISEAP strategic guidelines to achieve the objectives and targets set by the Municipality of Lemnos can be summarized in the following five (5) points:

1. Take advantage of the local renewable energy sources for electricity and heat production
2. Substitute fossil fuels with electricity to be produced locally from RES installations
3. Implement actions towards sustainability by the Municipality to set an example for the rest of the island
4. Increase energy efficiency and responsible energy saving behaviours from the end users to reduce the energy imports
5. Involve the visitors of the island to the realization of the ISEAP

## 3. ENERGY BALANCE AND EMISSION INVENTORY

### 3.1. Baseline situation

The year 2005 is chosen as the baseline year. In order to carry on with the energy modelling of the Business As Usual (BAU) and ISEAP scenarios a detailed, accurate and concrete description of the baseline situation is needed.

A bottom-up calculation approach was adopted making use of the in-house modelling tools to calculate the energy profile of the island. Several input data were employed either as a direct information of energy amounts (i.e. final energy demand of the sectors solely related to the municipality, fuel mix for the electricity production, etc.) or indirect statistical and general information supplied to the modelling tools (i.e. energy demand profile of different consumers, typical efficiency of technologies in use, etc.). For this purpose several questionnaires and energy audits were circulated to the different demand and production sectors with the active participation of the local authorities and dedicated working groups. Especially, it should be pointed out that information related to the energy behaviour and demand profile of the residential sector was gathered through an extensive collaboration with the local schools. The students circulated energy audits to their parents' and neighbouring houses collecting valuable information for the ISEAP and becoming active participants to the ISEAP development. Climate change, renewable energy sources, energy efficiency and energy saving were some of the subjects that the students got affiliated through this process.

Energy data related solely to the municipality (municipal buildings, public lighting, municipal equipment and facilities, etc.) were gathered in a consistent way creating an energy data base for the past years, starting from 2005, supplied from the energy bills stored in the municipal records. The foundations for the monitoring of the municipal energy profile were set providing to the municipality a substantial long-term insight to their energy demands and costs.

The information gathered in present time were projected back to 2005 taking into consideration the recorded demand growth rates of the last years. However, in many cases energy data depicting the values of 2005 were directly available.

#### 3.1.1. Final energy demand

##### Residential sector

In the following table the results of the energy modelling of the base year are presented for the residential sector. The energy carriers most in use in the domestic sector are electricity and diesel with the latter one mainly covering the space heating needs of the houses. LPG is mainly used for heating and cooking purposes, similarly with biomass which translated to simple firewood burnt in most cases in open fireplaces. Finally solar

energy is solely attributed to water heating demand through the solar water heater appliances.

	Electricity	Diesel	LPG	Solar	Biomass	Total
<b>Residential</b>	<b>28.044</b>	<b>53.887</b>	<b>5.926</b>	<b>4.906</b>	<b>14.024</b>	<b>106.787</b>
Hot water	5.815	4.743	0	4.906	1.472	<b>16.936</b>
Heating and cooling	7.007	49.144	4.153	0	11.075	<b>71.378</b>
Lighting	4.229	0	0	0	0	<b>4.229</b>
Cooking	2.956	0	1.773	0	1.478	<b>6.207</b>
Refrigerator and freezers	4.148	0	0	0	0	<b>4.148</b>
Laundry machines and dryers	252	0	0	0	0	<b>252</b>
Dish washing	353	0	0	0	0	<b>353</b>
Tv sets	328	0	0	0	0	<b>328</b>
Other electric appliances	2.955	0	0	0	0	<b>2.955</b>

Table 3.1. Final energy demand of the residential sector in base year 2005 [MWh]

In the following figures the distribution of final energy demand of the residential sector among the different sub-sectors (see Figure 3.1) and energy carriers (see Figure 3.2) is presented. The heating and cooling sub-sector is by far the most energy demanding area followed by the hot water demand. Also the energy demand distribution to the different energy carriers of the main sub-sectors is depicted in Figure 3.3 and Figure 3.4 and Figure 3.5.

### Residential sector - Total energy for final use

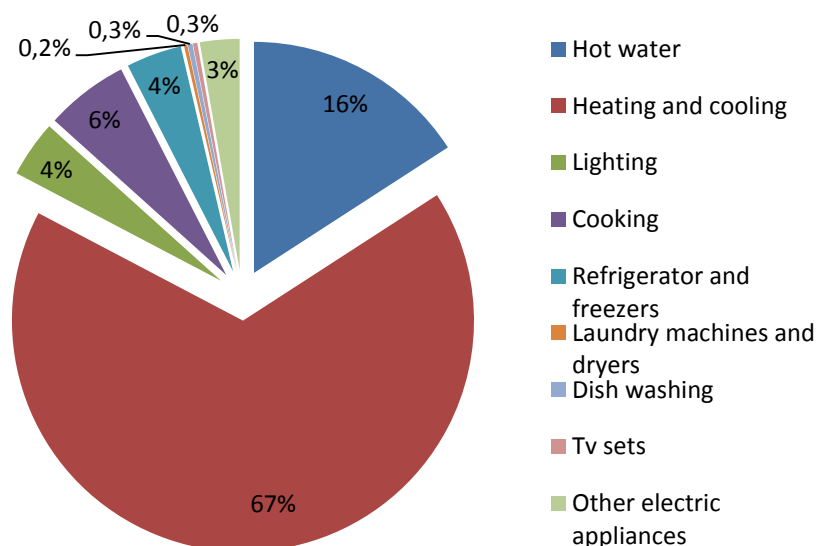


Figure 3.1. Distribution of residential final energy demand among the different sub-sectors

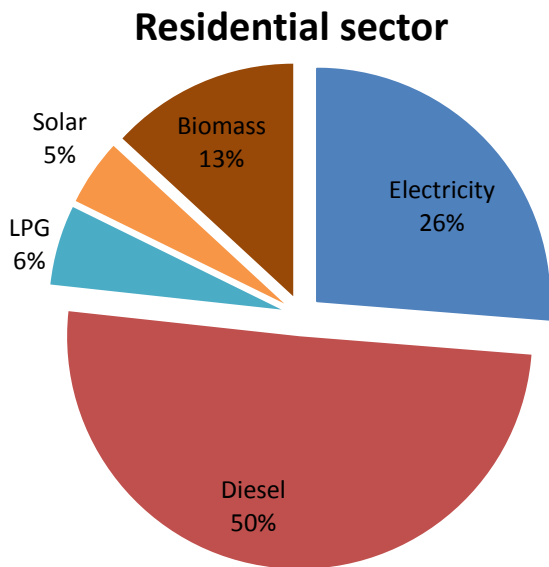


Figure 3.2. Distribution of the residential sector FED to the different energy carriers

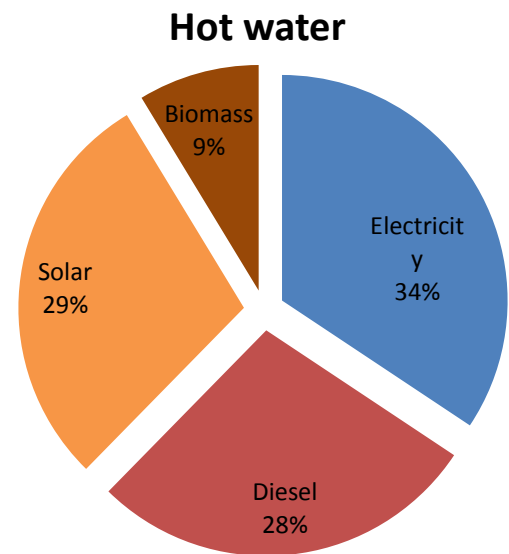


Figure 3.3. Distribution of hot water energy demand to the different energy carriers

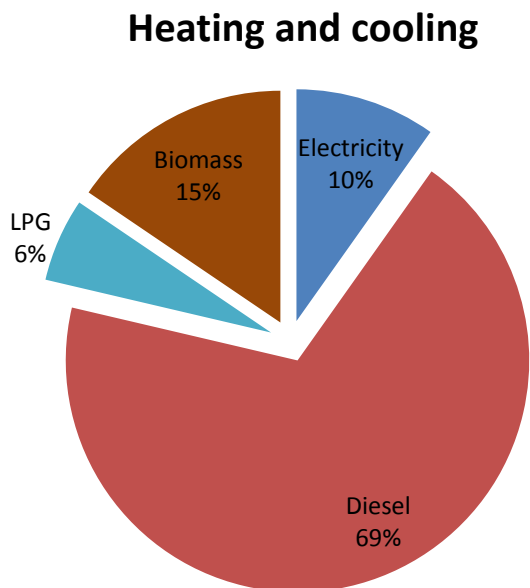


Figure 3.4. Distribution of heating and cooling energy demand to the different energy carriers

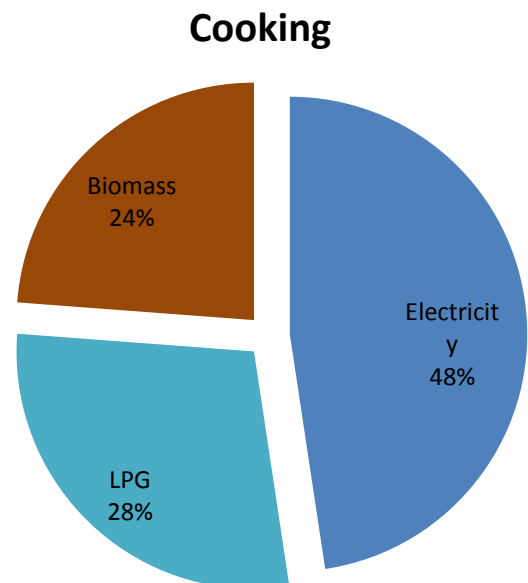


Figure 3.5. Distribution of cooking energy demand to the different energy carriers

### Primary sector

In the following table the results of the energy modelling of the base year are presented for the primary sector corresponding mainly to the energy demand of the agricultural and partially fishing activities. The energy carriers most in use are electricity, diesel and biomass covering the energy needs for irrigation, heating and cooling, lighting and operation of general instruments and equipment.

In the figure, following the table, a graphical analysis of the primary sector energy demand distribution to respective energy carriers is shown.

	Electricity	Diesel	Biomass	Total
<b>Primary sector</b>	<b>4.481</b>	<b>811</b>	<b>926</b>	<b>6.218</b>
Agriculture, forestry and fishing	4.481	811	926	<b>6.218</b>

Table 3.2. Final energy demand of the primary sector in base year 2005 [MWh]

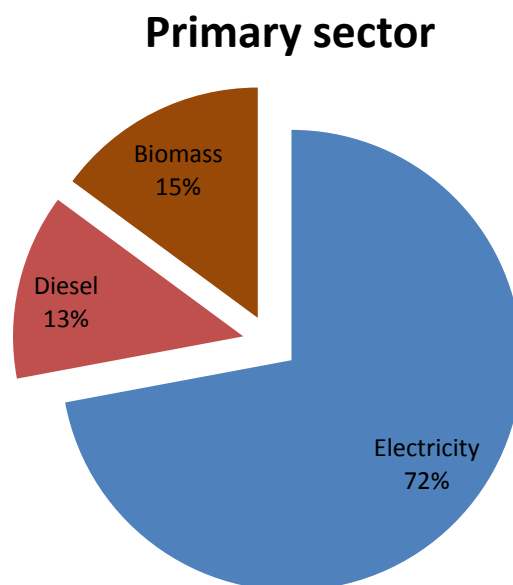


Figure 3.6. Distribution of the primary sector FED to the different energy carriers

### Secondary sector

In the following table the results of the energy modelling of the base year are presented for the secondary sector. The energy carriers most in use are electricity, diesel and fueloil.

The manufacturing and construction sub-sectors are the most energy demanding areas of the secondary sector, in Figure 3.9 and Figure 3.10, the energy demand distribution to the respective energy carriers is shown.

	Electricity	Fueloil	Diesel	LPG	Solar	Biomass	Total
<b>Secondary sector</b>	<b>4.024</b>	<b>1.645</b>	<b>1.719</b>	<b>174</b>	<b>98</b>	<b>1.766</b>	<b>9.425</b>
Manufacturing	2.208	1.233	1.289	174	98	1.766	<b>6.768</b>
Water supply, sewerage, waste management and remediation activities	1.081	0	0	0	0	0	<b>1.081</b>
Construction	736	411	430	0	0	0	<b>1.577</b>

Table 3.3. Final energy demand of the secondary sector in base year 2005 [MWh]



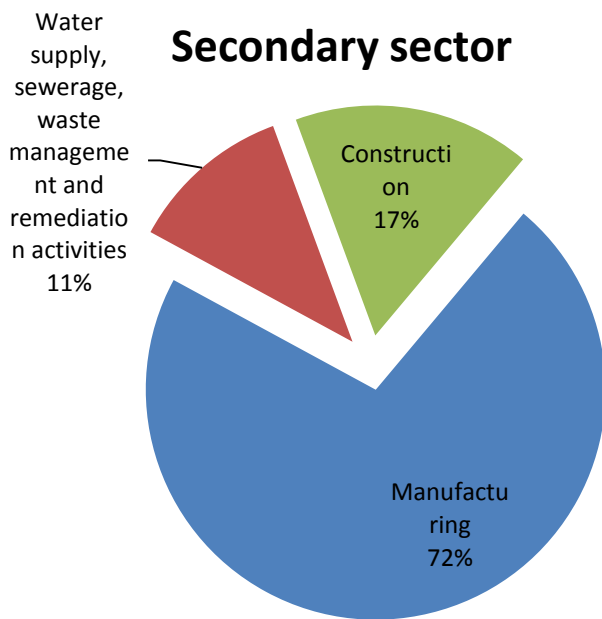


Figure 3.7. Distribution of the secondary sector FED to the different sub-sectors

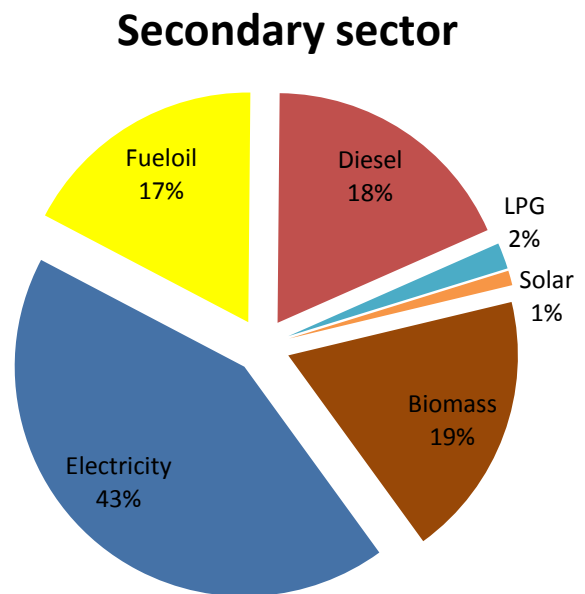


Figure 3.8. Distribution of the secondary sector FED to the different energy carriers

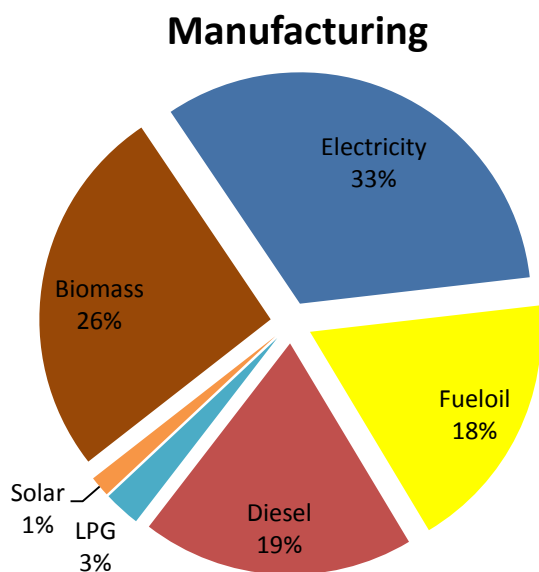


Figure 3.9. Distribution of manufacturing sector energy demand to the different energy carriers

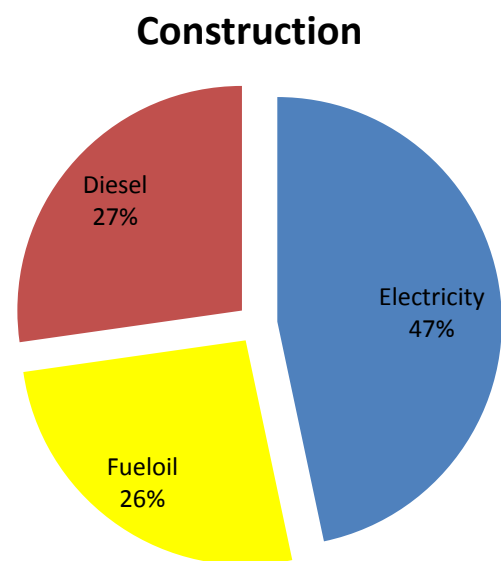


Figure 3.10. Distribution of construction sector energy demand to the different energy carriers

### Tertiary sector

In the following table the results of the energy modelling of the base year are presented for the tertiary sector. The energy carriers most in use in the tertiary sector are by far electricity followed by diesel. LPG and biomass (in the form of charcoal) are mainly used in restaurants for cooking purposes, whereas solar energy is solely attributed to water heating demand mainly in hotels.

In the following figures the distribution of final energy demand of the tertiary sector among the different sub-sectors (see Figure 3.11) and the energy demand distribution to the different energy carriers of the main sub-sectors (see Figure 3.13 – Figure 3.17) are depicted.

	Electricity	Diesel	LPG	Solar	Biomass	Total
<b>Tertiary sector</b>	<b>30.030</b>	<b>17.773</b>	<b>385</b>	<b>1.567</b>	<b>265</b>	<b>50.020</b>
Wholesale and retail trade; repair of motor vehicles and motorcycles	6.129	4.385	0	312	0	<b>10.827</b>
Accommodation and food service activities	12.498	7.152	385	1.005	265	<b>21.305</b>
General public administration and social security	2.600	748	0	0	0	<b>3.347</b>
Education	1.495	1.490	0	0	0	<b>2.985</b>
Human health and social work activities	485	489	0	0	0	<b>974</b>
Other services	4.903	3.508	0	250	0	<b>8.661</b>
Public lighting	1.920	0	0	0	0	<b>1.920</b>

Table 3.4. Final energy demand of the tertiary sector in base year 2005 [MWh]

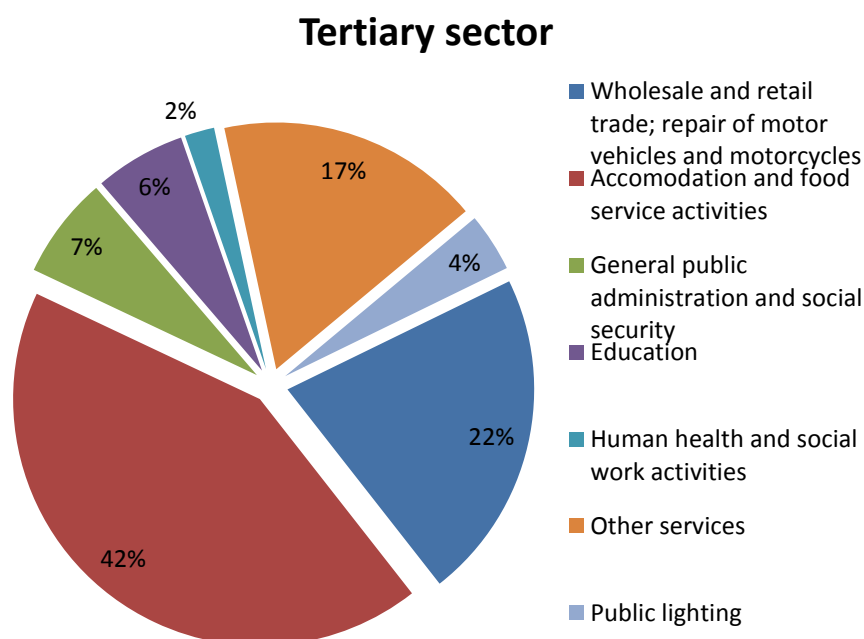


Figure 3.11. Distribution of the tertiary sector FED to the different sub-sectors

### Tertiary sector

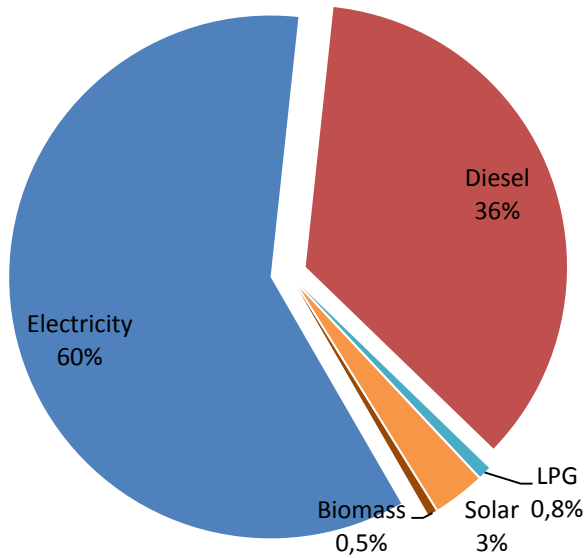


Figure 3.12. Distribution of the tertiary sector FED to the different energy carriers

### Wholesale and retail trade

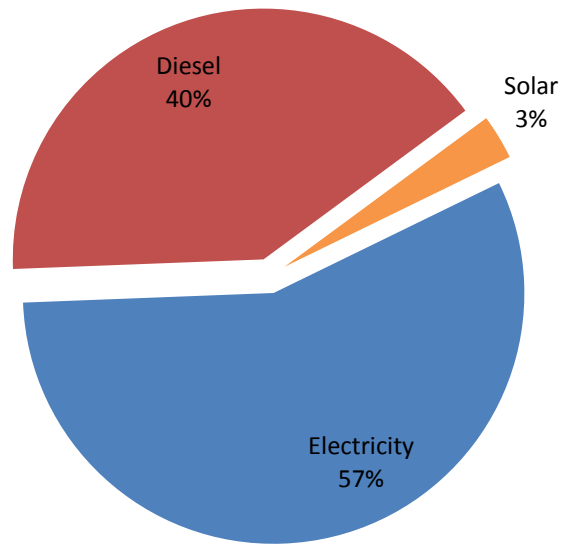


Figure 3.13. Distribution of wholesale and retail trade sector energy demand to the different energy carriers

### Accommodation and food service activities

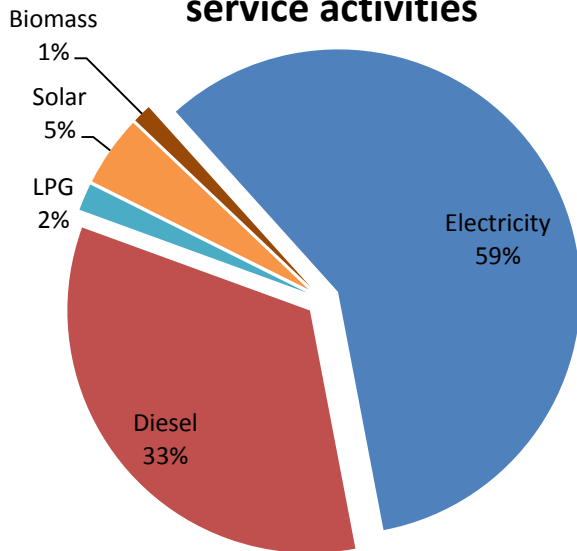


Figure 3.14. Distribution of accommodation and food service activities sector energy demand to the different energy carriers

### General public administration and social security

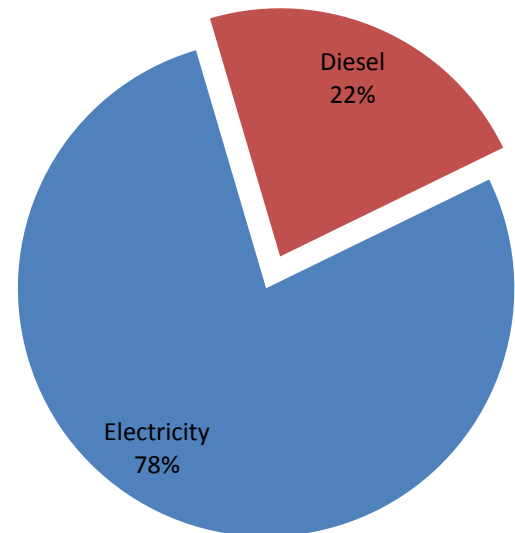


Figure 3.15. Distribution of general public administration and social security sector energy demand to the different energy carriers

### Human health and social work activities

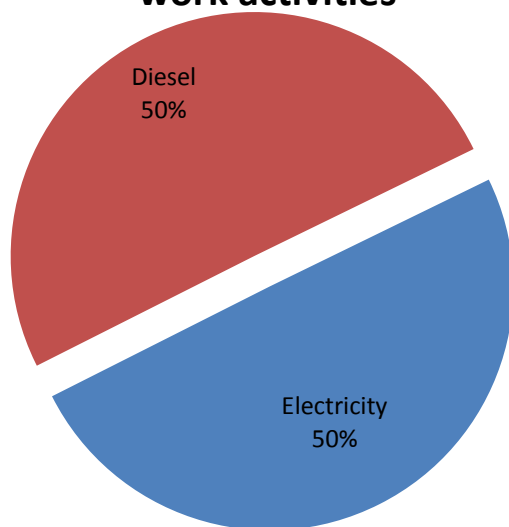


Figure 3.16. Distribution of human health and social work activities sector energy demand to the different energy carriers

### Education

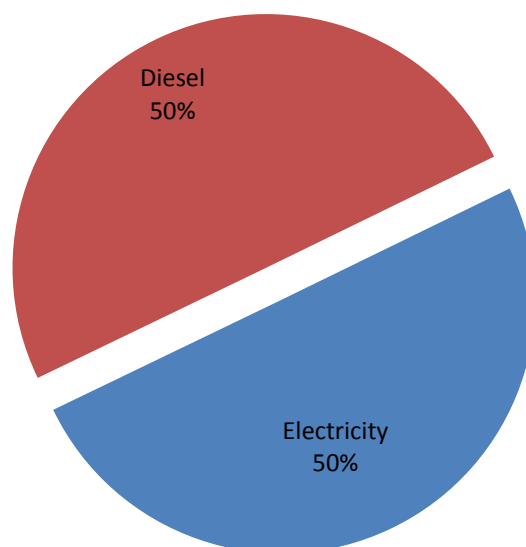


Figure 3.17. Distribution of education sector energy demand to the different energy carriers

### Transports sector

In the following table the results of the energy modelling of the base year are presented for the transports sector.

In the following figures the distribution of final energy demand of the transports sector among the different sub-sectors (see Figure 3.18) and the energy demand distribution to the different energy carriers of (see Figure 3.19) are depicted.

	Diesel	Gasoline	Total
<b>Transports (vehicles)</b>	<b>21.912</b>	<b>30.741</b>	<b>52.652</b>
Passenger transport by road (public transport, taxi, tourism, transfers, etc.)	139	32	171
Freight transport by road and removal services	16.916	3.901	20.817
Other fleet for public and private services	72	686	758
Private transports	4.785	26.122	30.907

Table 3.5. Final energy demand of the transports sector in base year 2005 [MWh]

### Transports (vehicles)

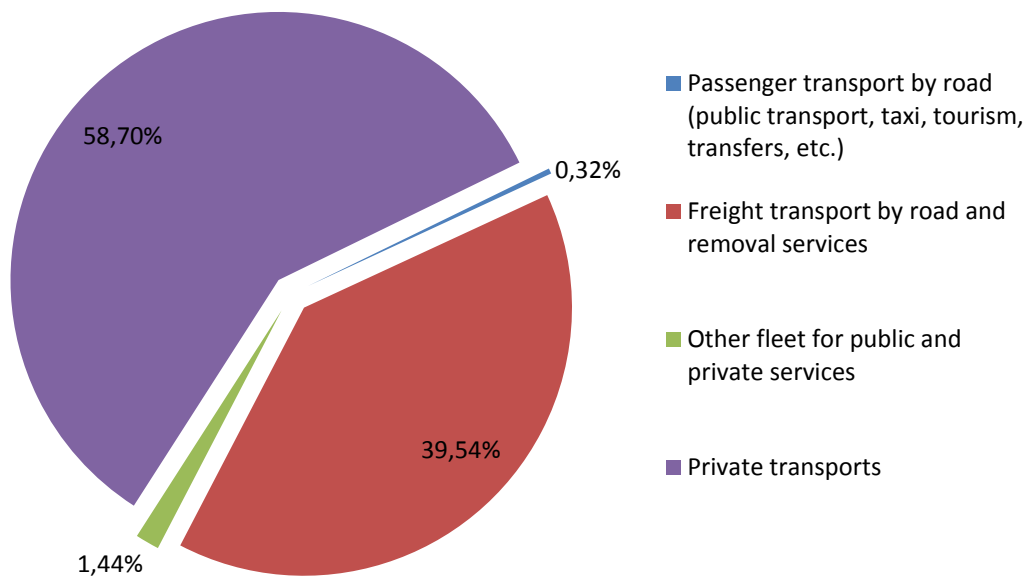


Figure 3.18. Distribution of the transports sector FED to the different sub-sectors

### Transports (vehicles)

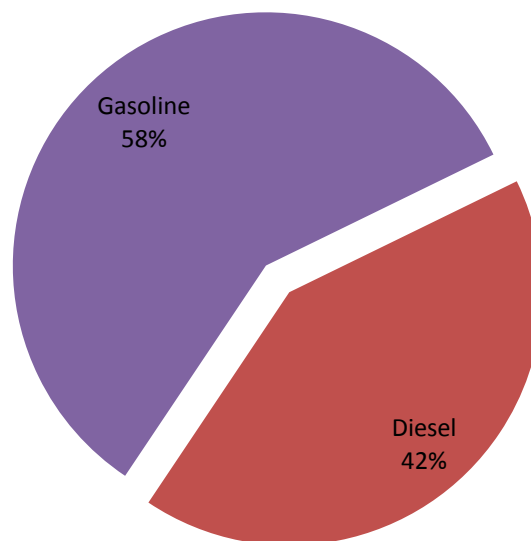


Figure 3.19. Distribution of the tertiary sector FED to the different energy carriers

#### Overall results

In the following table the overall results of the energy modelling of the base year are presented for the total final energy demand.

In the following figures the distribution of total final energy demand among the different sectors (see Figure 3.20) and the energy demand distribution to the different energy carriers of (see Figure 3.21) are depicted.

Energy carrier		Residential [MWh]	Primary sector [MWh]	Secondary sector [MWh]	Tertiary sector [MWh]	Transports [MWh]	TOTAL [MWh]
Centralized Energy services	Electricity	28.044	4.481	4.024	30.030		66.578
Fossil fuels	Fueloil			1.645			1.645
	Diesel	53.887	811	1.719	17.773	21.912	96.102
	Gasoline					30.741	30.741
	LPG	5.926		174	385		6.485
Renewable Energy sources	Solar	4.906		98	1.567		6.571
	Biomass	14.024	926	1.766	265		16.982
<b>TOTAL</b>		<b>106.787</b>	<b>6.218</b>	<b>9.425</b>	<b>50.020</b>	<b>52.652</b>	<b>225.102</b>

Table 3.6. Final energy demand per sector and energy carrier

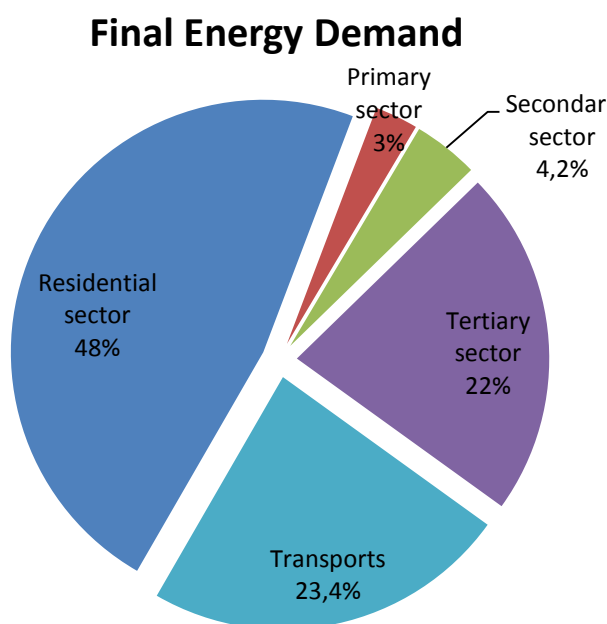


Figure 3.20. Distribution of Final Energy Demand to the different sectors

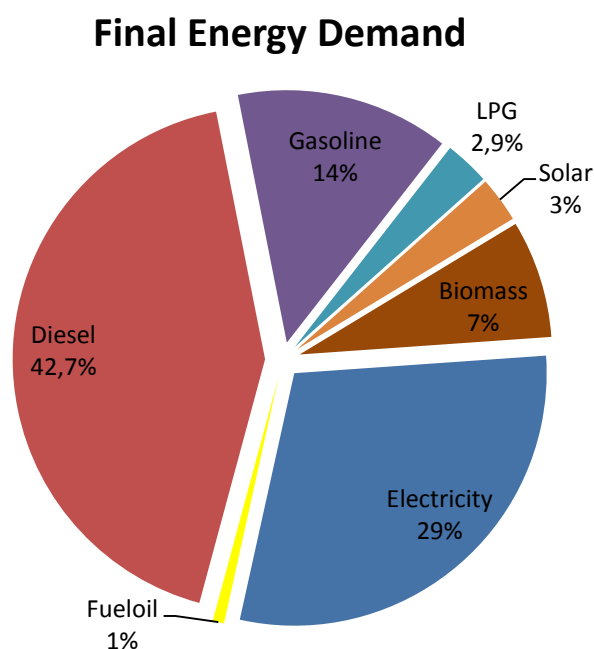


Figure 3.21. Distribution of Final Energy Demand to the different energy carriers

### 3.1.2. Energy conversion

Lemnos as an electrically autonomous island produces all the electricity from the local thermal station using solely diesel and fuel oil as primary energy source. In 2005 there were no installations of RES units.

There are no district heating or cooling installations.

In the following figure the electricity demand distribution to the different energy carriers is presented.

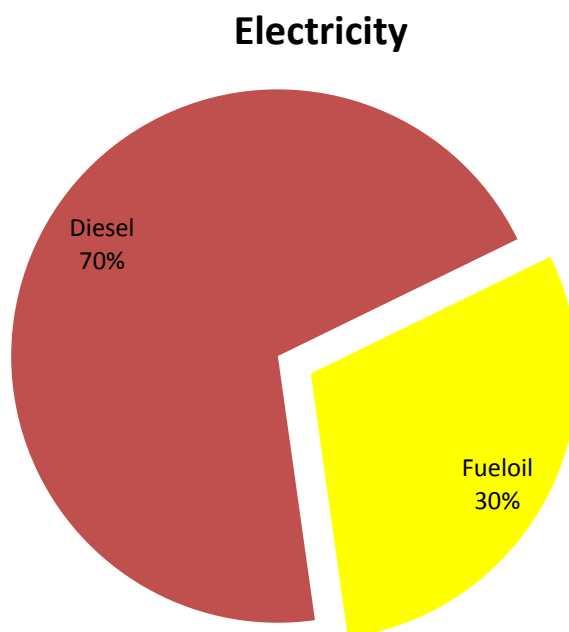


Figure 3.22. Distribution of Final Energy Demand to the different energy carriers

### 3.1.3. Primary energy demand

Only a fraction of 6,6% of the primary energy demand is covered by renewable energy sources and the remaining amounts are met through fossil fuel local consumption, with diesel being the dominant fossil fuel mainly because of the electricity and heating energy demand.

PRIMARY ENERGY DEMAND					
Fossil fuels [MWh]					TOTAL
Fueloil	Diesel	Gasoline	LPG	Sub-total	358.259
61.565	235.916	30.741	6.485	334.706	
Renewable energy sources [MWh]					
Hydro	Wind	Solar	Biomass	Sub-total	358.259
0	0	6.571	16.982	23.553	

Table 3.7. Primary energy demand per energy carrier [MWh]

### PRIMARY ENERGY DEMAND

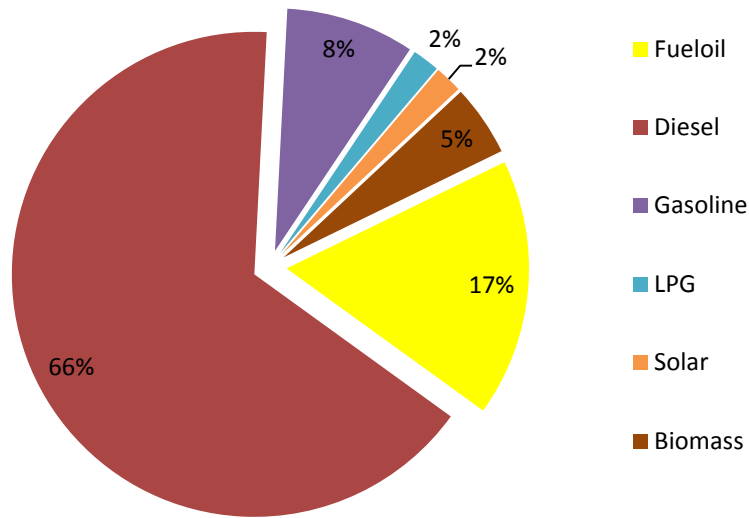


Figure 3.23. Primary energy demand distribution to the different energy carriers

#### 3.1.4. Emissions of carbon dioxide

In the following tables and figures the emitted CO<sub>2</sub> from the locally consumed fossil fuels and the electricity imported are presented. For the latter amounts, the national CO<sub>2</sub> factor for electricity production is employed whereas generally for CO<sub>2</sub> emissions generated by fossil fuels consumption the proposed CO<sub>2</sub> factors from IPCC are used.

### ENERGY FOR FINAL USE

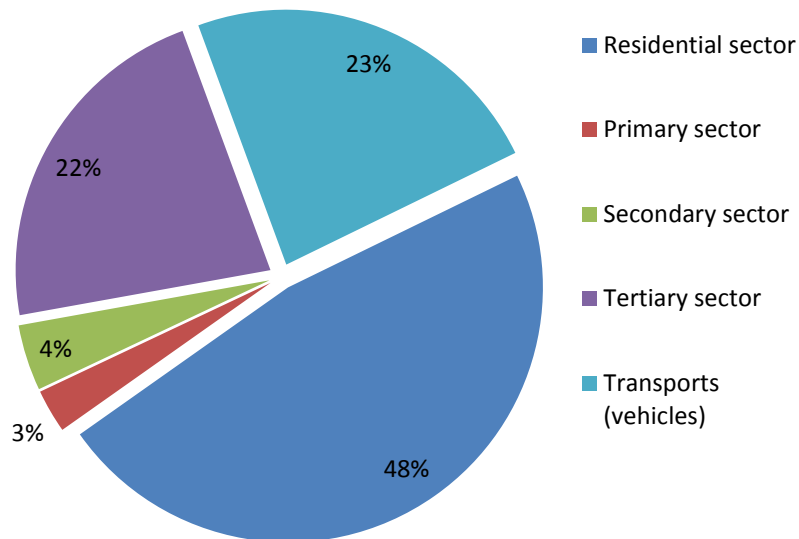


Figure 3.24. Distribution of overall CO<sub>2</sub> emissions from final use to the different sectors



## Residential sector

	Electricity	Diesel	LPG	Total
<b>Residential sector</b>	<b>22,766</b>	<b>14,388</b>	<b>1,422</b>	<b>38,576</b>
Hot water	4.720	1.266	0	<b>5.987</b>
Heating and cooling	5.688	13.121	997	<b>19.806</b>
Lighting	3.433	0	0	<b>3.433</b>
Cooking	2.399	0	426	<b>2.825</b>
Refrigerator and freezers	3.367	0	0	<b>3.367</b>
Laundry machines and dryers	205	0	0	<b>205</b>
Dish washing	287	0	0	<b>287</b>
Tv sets	267	0	0	<b>267</b>
Other electric appliances	2.399	0	0	<b>2.399</b>

Table 3.8. CO2 emissions of the residential sector per sub-sector and energy carrier [tons]

### CO2 emissions - Residential sector

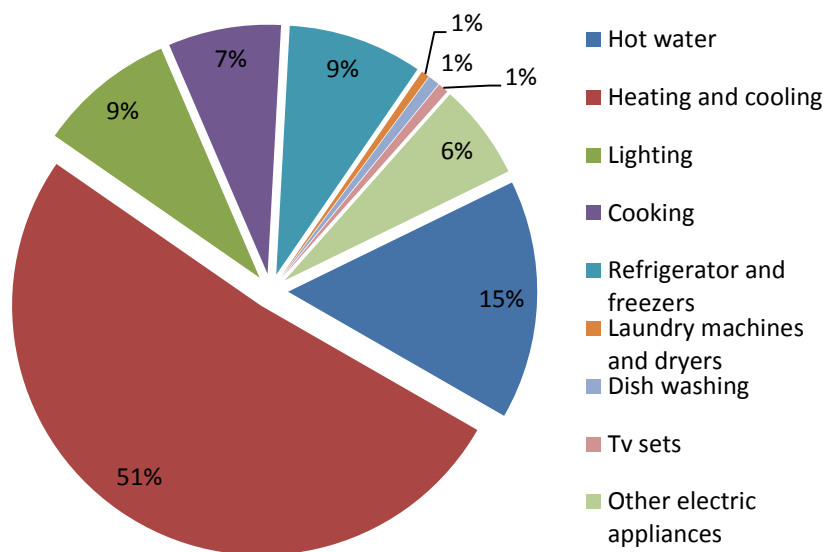


Figure 3.25. CO2 emissions from final use in the residential sector

### Primary sector

	Electricity	Diesel	Total
<b>Primary sector</b>	<b>3.638</b>	<b>217</b>	<b>3.854</b>
Agriculture, forestry and fishing	3.638	217	3.854

Table 3.9. CO2 emissions of the primary sector per sub-sector and energy carrier [tons]

### Secondary sector

	Electricity	Fueloil	Diesel	LPG	Total
<b>Secondary sector</b>	<b>3.267</b>	<b>459</b>	<b>459</b>	<b>42</b>	<b>4.226</b>
Manufacturing	1.792	344	344	42	2.522
Water supply, sewerage, waste management and remediation activities	877	0	0	0	877
Construction	597	115	115	0	827

Table 3.10. CO2 emissions of the secondary sector per sub-sector and energy carrier [tons]

### CO2 emissions - Secondary sector

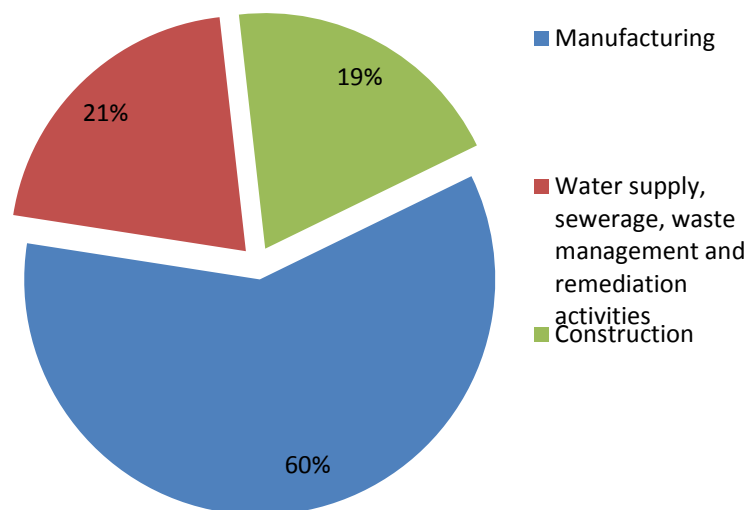


Figure 3.26. CO2 emissions from final use in the secondary sector

### Tertiary sector

	Electricity	Diesel	LPG	Total
<b>Tertiary sector</b>	<b>24.378</b>	<b>4.745</b>	<b>92</b>	<b>29.216</b>
Wholesale and retail trade; repair of motor vehicles and motorcycles	4.976	1.171	0	<b>6.147</b>
Accommodation and food service activities	10.146	1.910	92	<b>12.148</b>
General public administration and social security	2.110	200	0	<b>2.310</b>
Education	0	0	0	<b>0</b>
Human health and social work activities	1.213	398	0	<b>1.611</b>
Other services	394	131	0	<b>524</b>
Public lighting	3.981	937	0	<b>4.917</b>

Table 3.11. CO2 emissions of the tertiary sector per sub-sector and energy carrier [tons]

### CO2 emissions - Tertiary sector

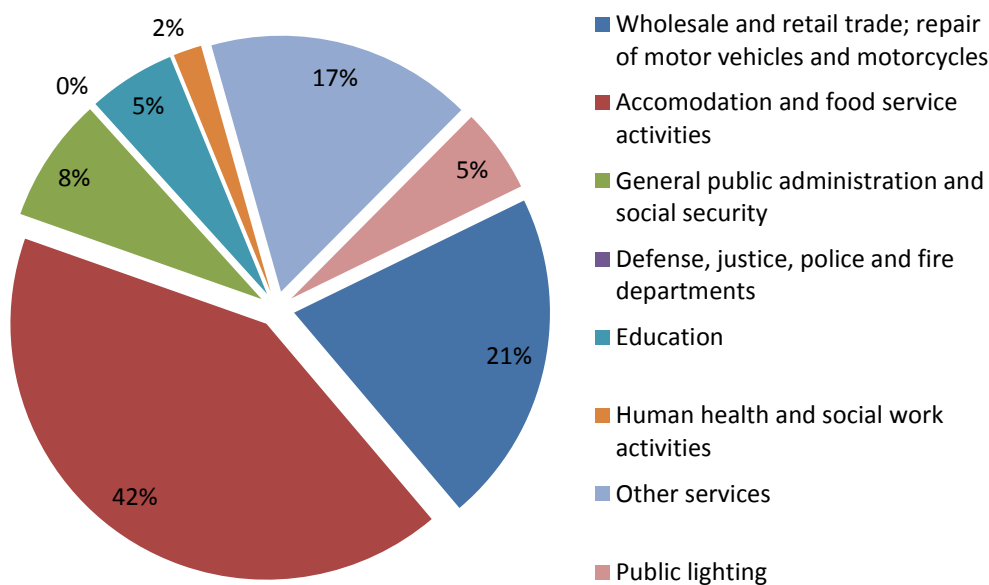


Figure 3.27. CO2 emissions from final use in the tertiary sector

## Transports sector

	Diesel	Gasoline	Total
<b>Transports (vehicles)</b>	<b>5.850</b>	<b>7.654</b>	<b>13.505</b>
Passenger transport by road (public transport, taxi, tourism, transfers, etc.)	37	8	45
Freight transport by road and removal services	4.517	971	5.488
Other fleet for public and private services	19	171	190
Private transports	1.278	6.504	7.782

Table 3.12. CO2 emissions of the transports sector per sub-sector and energy carrier [tons]

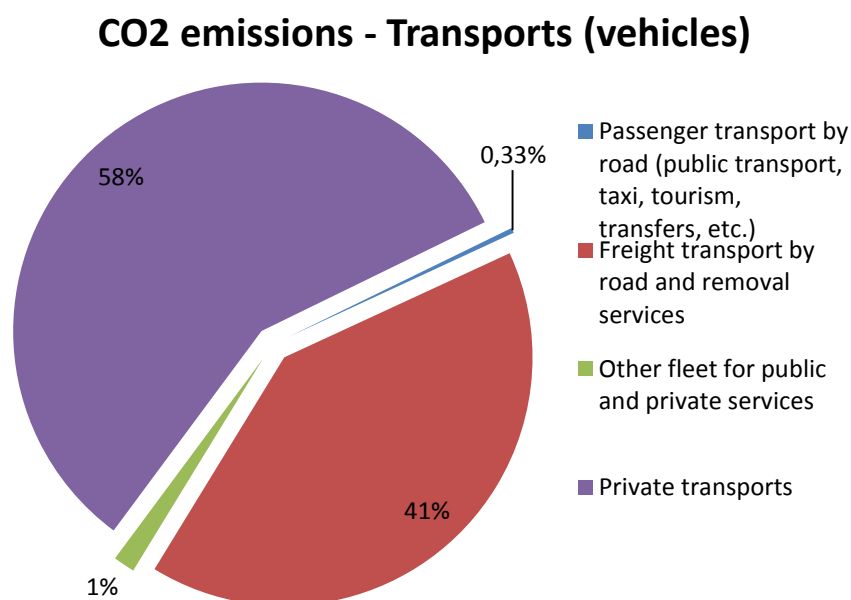


Figure 3.28. CO2 emissions from final use in the transports sector

### 3.2. Projections to 2020 – Business as usual scenario

The Business As Usual (BAU) scenario results from a combination of existing data for the period 2005 – 2011 and simulated growth rates for the period 2012 – 2020.

The estimation of growth rates is based on national statistics and on local special characteristics in relation to estimated economic growth of each activity sector.

However, it should be noted that because of the uncertain status of the national economy the estimations are susceptible to change during the ISEAP implementation period; in this case the projections will be re-evaluated and updated accordingly.

In the following figures the development of the primary energy demand and the CO<sub>2</sub> emissions from final use from the base year 2005 till the target year 2020 are presented, showing an expected increase of 48% and 49% respectively.

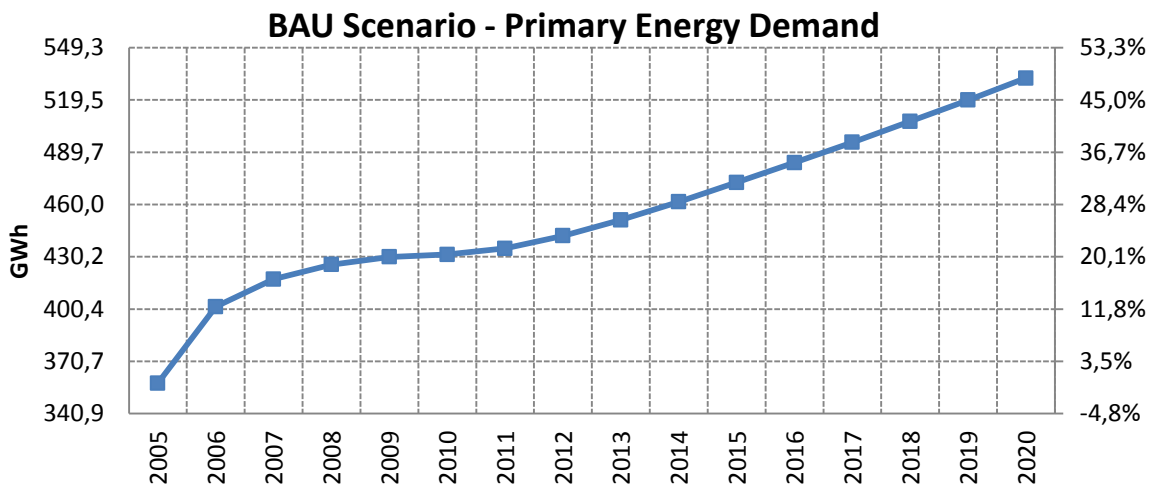


Figure 3.29. BAU Scenario – Growing trend of Primary Energy Demand

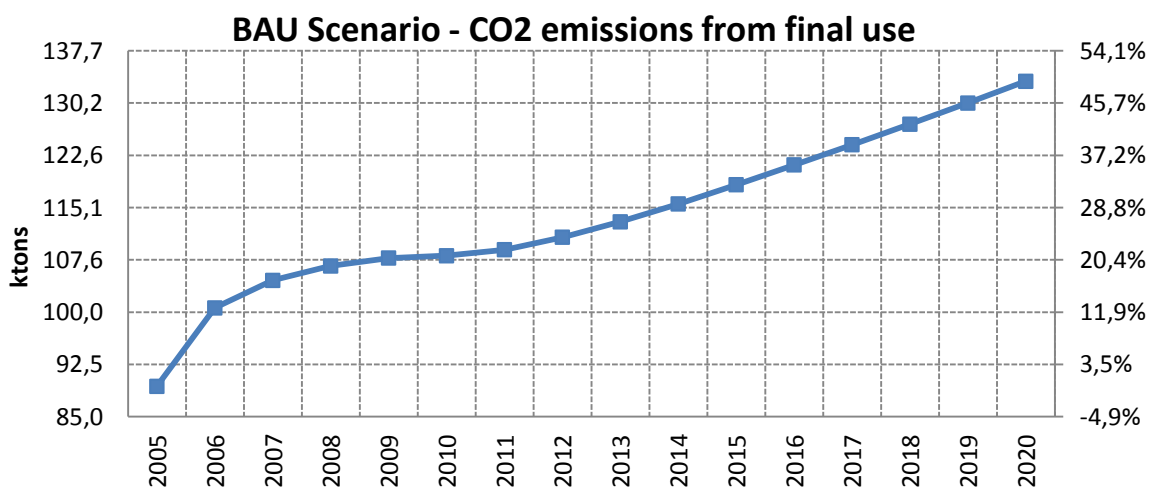


Figure 3.30. BAU Scenario – Growing trend of CO<sub>2</sub> emissions from final use

### 3.2.1. Final energy demand

The evolution of the final energy demand according to the BAU scenario is presented in the following figures. The projections are shown per energy source (electricity, fossil fuels and renewable energy sources) and activity sector.

An almost linear increase (see Figure 3.31) in the use of the available energy sources is expected, while a growth trend decrease is depicted for the period 2008 – 2011 mainly resulting from the national economic crisis.

**BAU Scenario - Final Energy Demand**

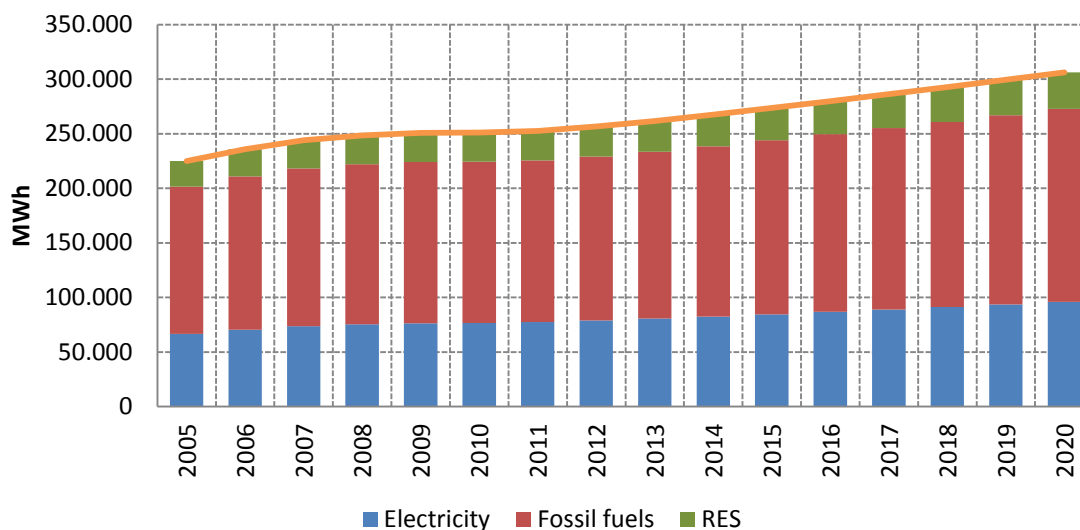


Figure 3.31. BAU Scenario – Final Energy Demand per energy source

**BAU - Final Energy Demand**

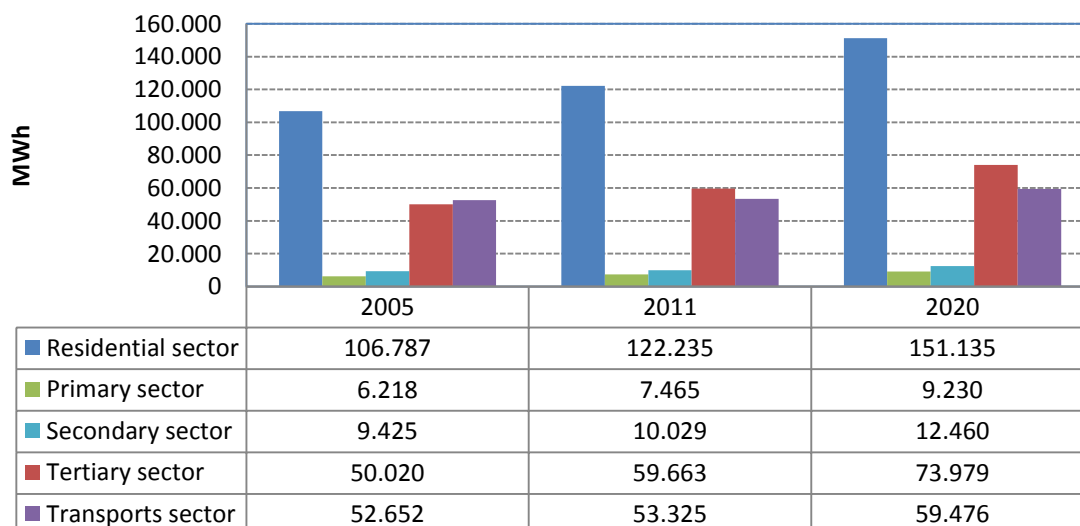


Figure 3.32. BAU Scenario – Final Energy Demand per activity sector

The final energy demand distribution per energy carrier and activity sector as expected for the year 2020 is presented in the following figures. Electricity (31%) and diesel (43%) will account for more than 80% of the total demand with the residential (49%) and tertiary (24%) sectors being the largest consumers.

In Table 3.13 a summary of the final energy demand distribution per energy carrier and activity sector for the target year 2020 is presented.

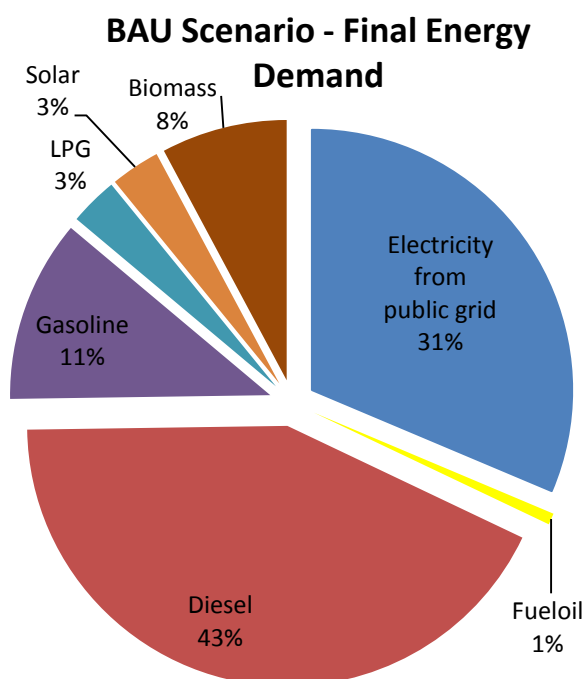


Figure 3.33. BAU Scenario – Final Energy Demand per energy carrier in 2020

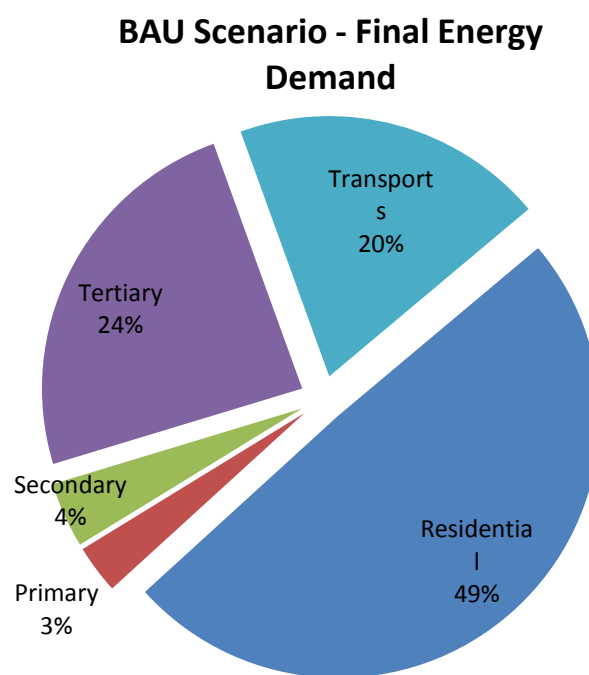


Figure 3.34. BAU Scenario – Final Energy Demand per sector in 2020

Energy carrier		Residential [MWh]	Primary sector [MWh]	Secondary sector [MWh]	Tertiary sector [MWh]	Transports [MWh]	TOTAL [MWh]
Centralized Energy services	Electricity	39.690	6.651	5.320	44.360		<b>96.021</b>
	Fueloil			2.174			<b>2.174</b>
Fossil fuels	Diesel	76.265	1.204	2.273	26.317	24.751	<b>130.810</b>
	Gasoline					34.724	<b>34.724</b>
	LPG	8.387		229	573		<b>9.190</b>
Renewable Energy sources	Solar	6.944		129	2.333		<b>9.406</b>
	Biomass	19.848	1.375	2.335	395		<b>23.953</b>
<b>TOTAL</b>		<b>151.135</b>	<b>9.230</b>	<b>12.460</b>	<b>73.979</b>	<b>59.476</b>	<b>306.279</b>

Table 3.13. BAU Scenario final energy demand per sector and energy carrier in 2020

### 3.2.2. Energy conversion

For the BAU scenario Lemnos is expected to be supplied by the existing thermal station. The estimated projection of electricity production is shown in the following figure. There are no district heating or cooling installations on the islands.

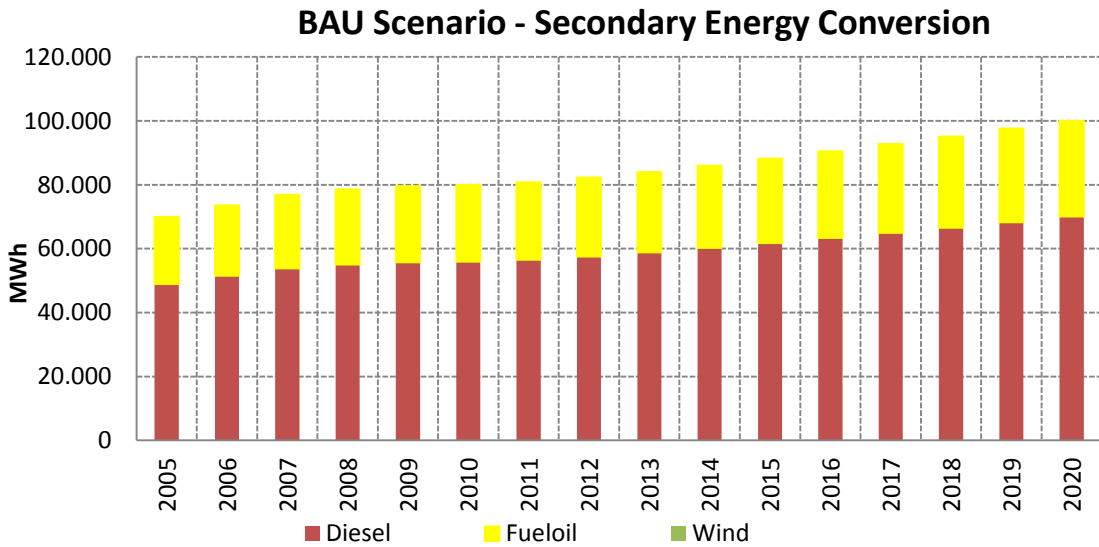


Figure 3.35. BAU Scenario – Secondary Energy Conversion

### 3.2.3. Primary energy demand

In the following figures the BAU scenario projection of the primary energy demand and the respective shares per energy carrier in the year 2020 are presented.

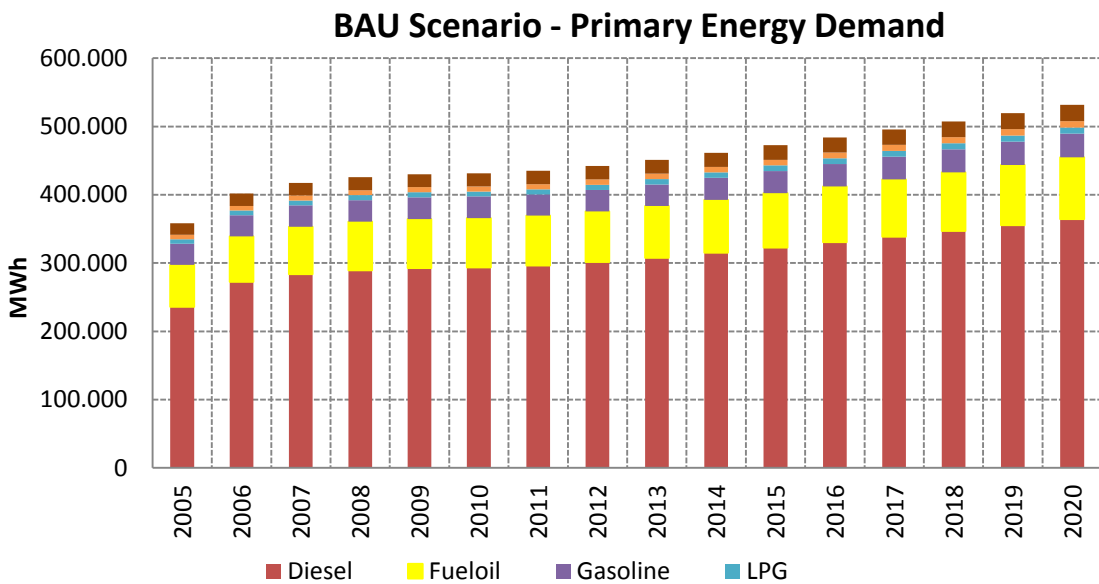


Figure 3.36. BAU Scenario – Primary Energy Demand projections per energy carrier



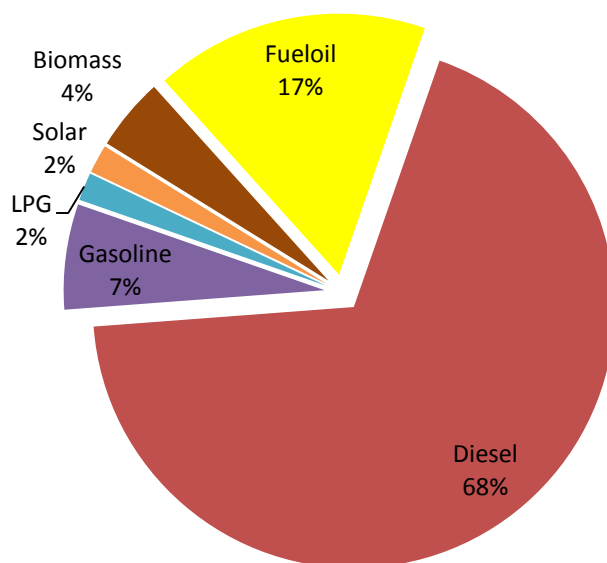


Figure 3.37. BAU Scenario – Primary Energy Demand per energy carrier in 2020

### 3.2.4. Emissions of carbon dioxide

In the following figures and tables the BAU scenario CO<sub>2</sub> emissions from final use per energy carrier and activity sector are presented.

#### BAU Scenario - CO<sub>2</sub> emissions from final use

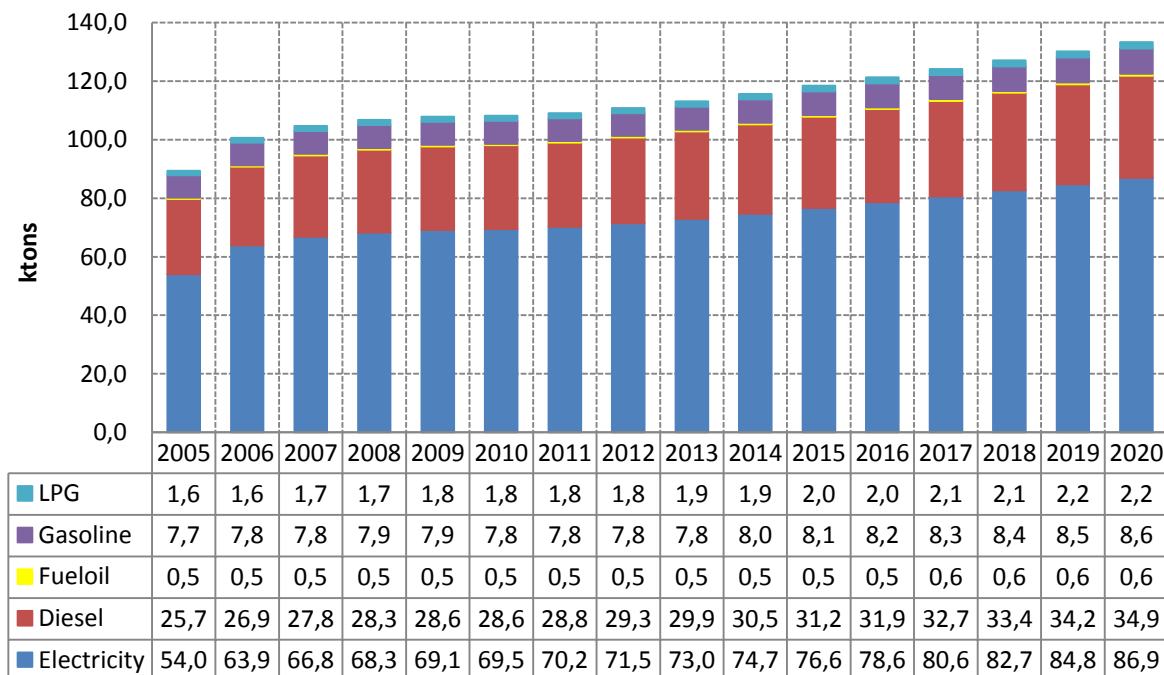


Figure 3.38. BAU Scenario – CO<sub>2</sub> emissions from final use projections per energy carrier

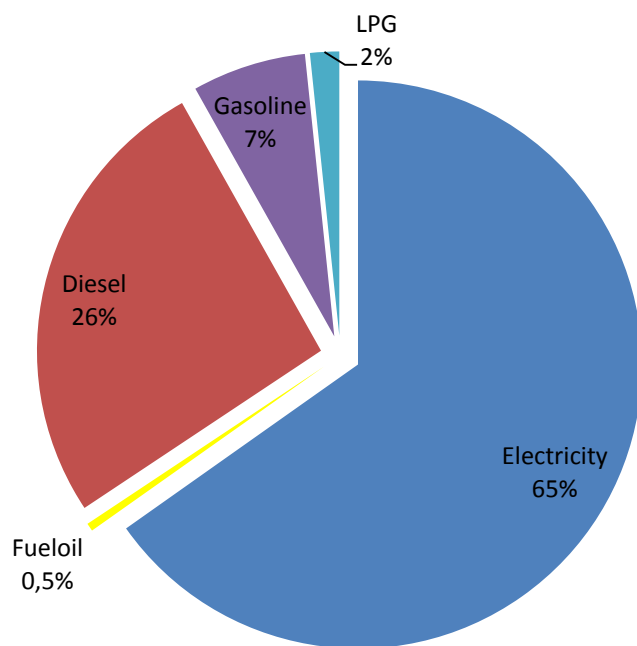


Figure 3.39. BAU Scenario – CO<sub>2</sub> emissions from final use per energy carrier in 2020

### BAU Scenario - CO<sub>2</sub> emissions from final use

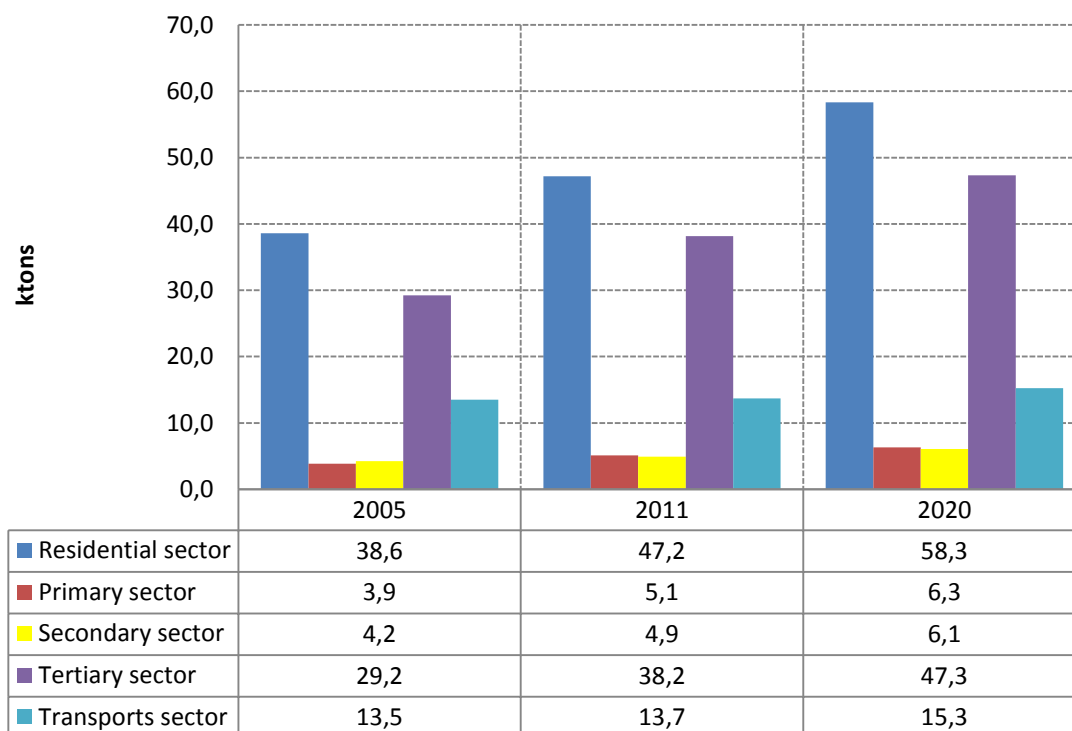


Figure 3.40. BAU Scenario – CO<sub>2</sub> emissions from final use projections per sector

### 3.3. Projections to 2020 – Action plan scenario

The ISEAP (Island Sustainable Energy Action Plan) scenario reflects the energy profile of the island to be achieved through the implementation of the planned actions in the period up to 2020. Several actions focusing on different activity sectors of the island contribute to the attainment of the ambitious goals of the local authority.

Specifically the local authority through the promotion and implementation of the ISEAP expects to reduce the primary energy demand by 45% and the CO<sub>2</sub> by at least 51% in 2020 in comparison to the BAU scenario. In comparison to the baseline year (2005) values, the respective magnitudes will be increased by 3% and decreased by 8,6% respectively, as presented in the following figures going beyond the EU goals, which for Greece is set to 4% reduction of GHG emissions by 2020 in comparison to 2005.

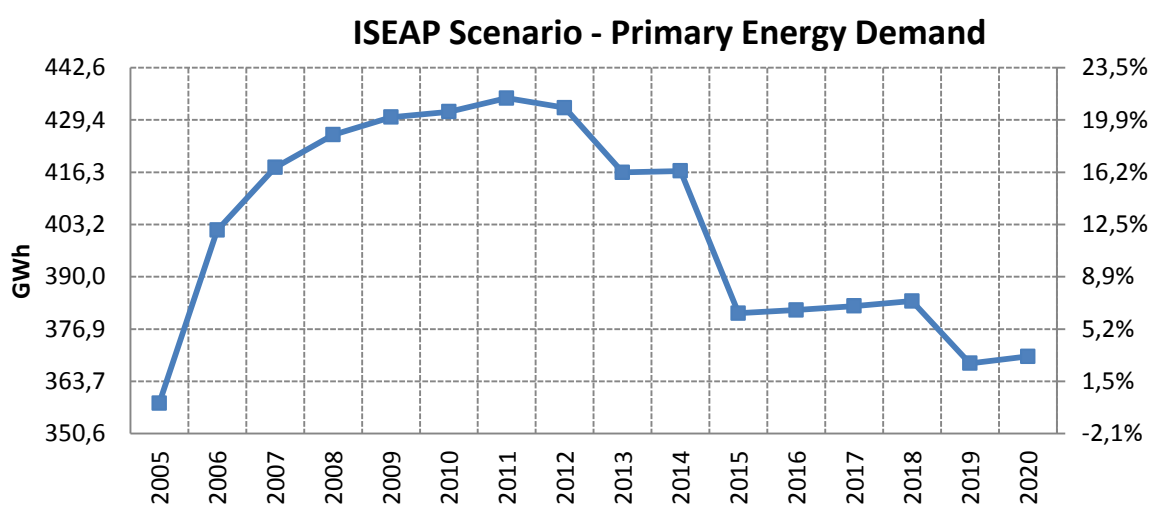


Figure 3.41. ISEAP Scenario – Growing trend of Primary Energy Demand

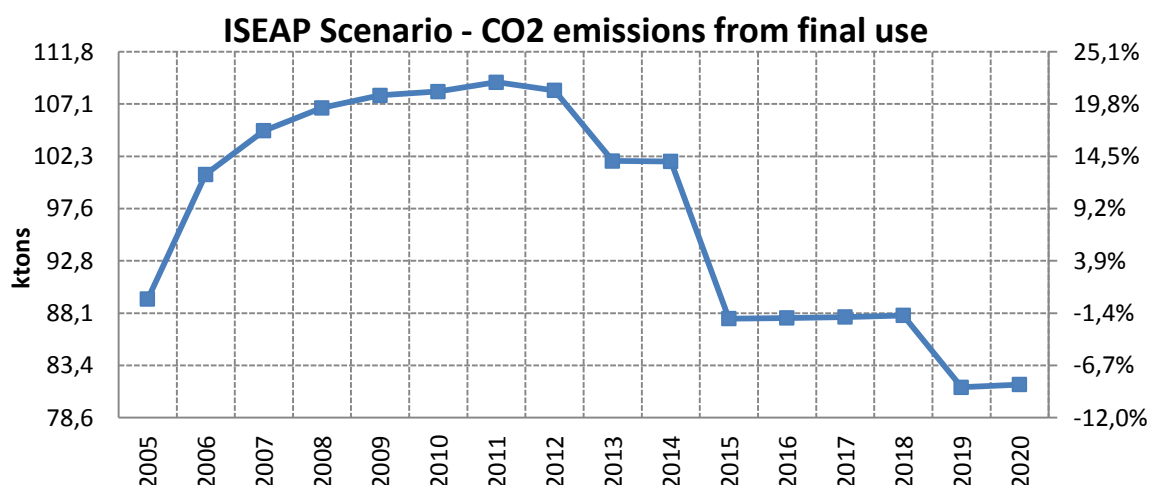


Figure 3.42. ISEAP Scenario – Growing trend of CO<sub>2</sub> emissions from final use

### 3.3.1. Final energy demand

The evolution of the final energy demand according to the ISEAP scenario is presented in the following figures. The projections are shown per energy source (electricity, fossil fuels and renewable energy sources) and activity sector.

The ISEAP scenario aims to shift the linearly increasing of the BAU scenario to linearly decreasing trend of the final energy demand from 2012 and on when the ISEAP implementation has initiated (see Figure 3.43). The highest reduction between 2011 and 2020 is expected in the residential (8,3%), the tertiary (11%) and transports (30,9%) sectors (see Figure 3.44).

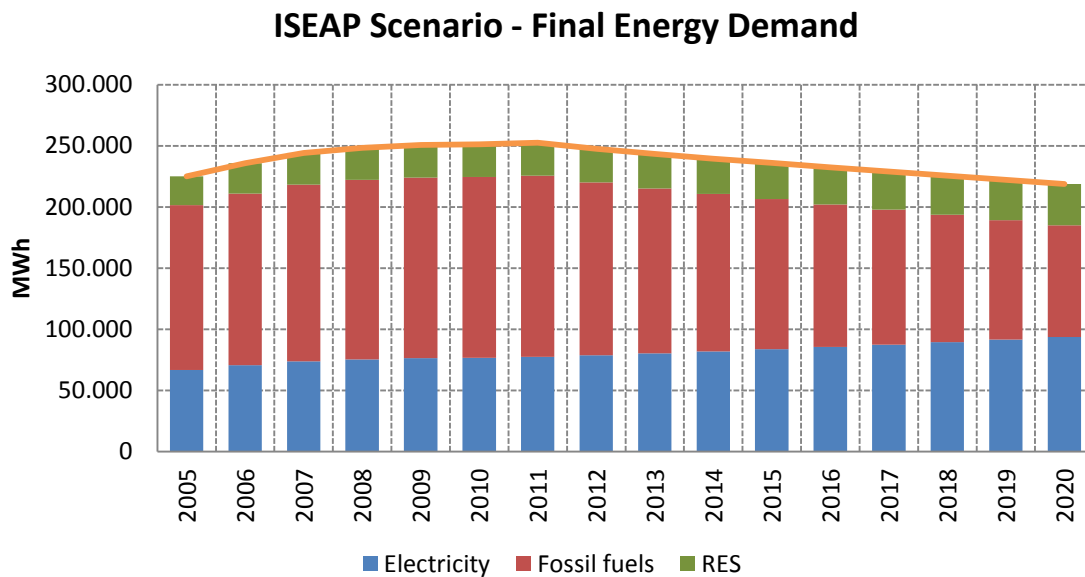


Figure 3.43. ISEAP Scenario – Final Energy Demand per energy source

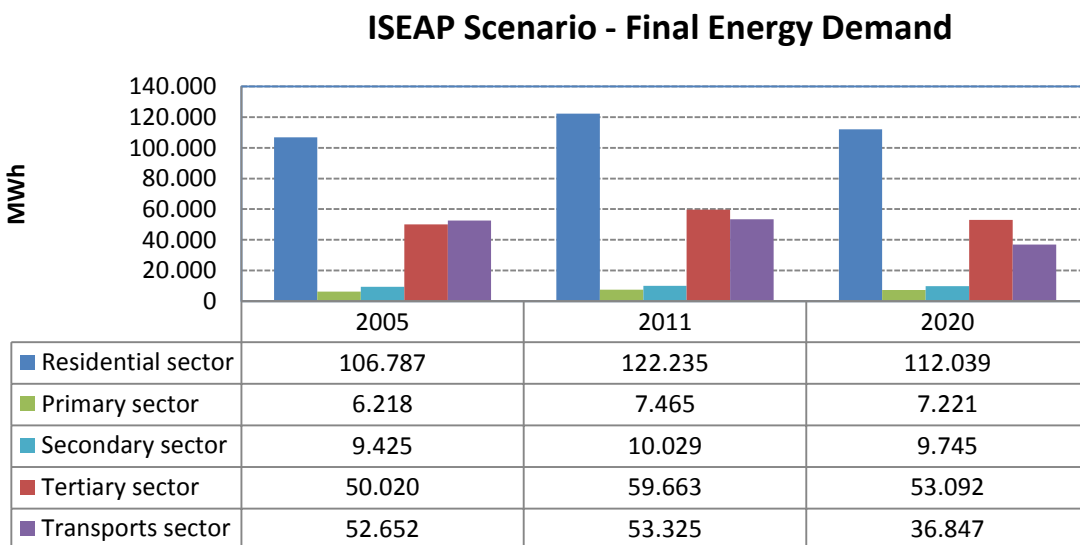


Figure 3.44. ISEAP Scenario – Final Energy Demand per activity sector

The final energy demand distribution per energy carrier and activity sector in the target year 2020 is presented in the following figures where electricity will cover a greater part (43%) of the demand in comparison to the BAU scenario (31%) replacing a significant part of the diesel consumption (30% from 43% in BAU scenario) mainly because of introducing efficient heat pumps to cover the space heating demand will traditionally is produced from stand-alone oil burners. The additional electricity demand will be covered by introducing locally produced electricity from wind and solar power stations. Electricity and diesel remains the dominant energy carriers accounting for 75% of the total demand. The residential and tertiary sectors remain the largest consumers.

In

Energy carrier		Residential [MWh]	Primary sector [MWh]	Secondary sector [MWh]	Tertiary sector [MWh]	Transports [MWh]	TOTAL [MWh]
Centralized Energy services	Electricity	44.309	5.204	4.161	34.975	4.994	<b>93.643</b>
Fossil fuels	Fueloil			1.700			<b>1.700</b>
	Diesel	33.342	942	1.777	14.700	14.448	<b>65.209</b>
	Gasoline					17.405	<b>17.405</b>
	LPG	6.462		179	369		<b>7.011</b>
Renewable Energy sources	Solar	12.255		101	2.793		<b>15.149</b>
	Biomass	15.670	1.075	1.826	255		<b>18.827</b>
<b>TOTAL</b>		<b>112.039</b>	<b>7.221</b>	<b>9.745</b>	<b>53.092</b>	<b>36.847</b>	<b>218.944</b>

Table 3.14 is presented a summary of the expected final energy demand distribution per energy carrier and activity sector for the target year 2020 after the implementation of the ISEAP.

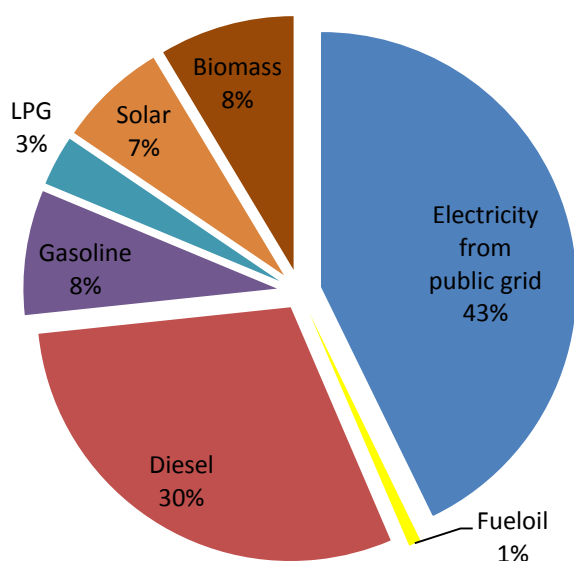


Figure 3.45. ISEAP Scenario – Final Energy Demand per energy carrier in 2020

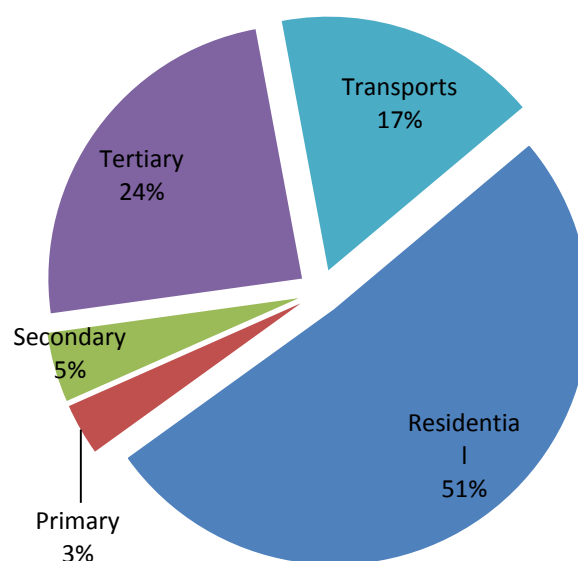


Figure 3.46. ISEAP Scenario – Final Energy Demand per sector in 2020

Energy carrier		Residential [MWh]	Primary sector [MWh]	Secondary sector [MWh]	Tertiary sector [MWh]	Transports [MWh]	TOTAL [MWh]
Centralized Energy services	Electricity	44.309	5.204	4.161	34.975	4.994	<b>93.643</b>
	Fueloil			1.700			<b>1.700</b>
Fossil fuels	Diesel	33.342	942	1.777	14.700	14.448	<b>65.209</b>
	Gasoline					17.405	<b>17.405</b>
	LPG	6.462		179	369		<b>7.011</b>
Renewable Energy sources	Solar	12.255		101	2.793		<b>15.149</b>
	Biomass	15.670	1.075	1.826	255		<b>18.827</b>
<b>TOTAL</b>		<b>112.039</b>	<b>7.221</b>	<b>9.745</b>	<b>53.092</b>	<b>36.847</b>	<b>218.944</b>

Table 3.14. ISEAP Scenario final energy demand per sector and energy carrier in 2020

### 3.3.2. Energy conversion

The introduction of locally produced electricity is foreseen in the ISEAP scenario, with the first PV installations starting in 2012 and significant increase in wind turbine installation in 2013, 2015 and 2019. By 2020 the island is expected to cover almost 32% of the electricity demand from locally installed PV and wind power stations.

### ISEAP Scenario - Secondary Energy Conversion

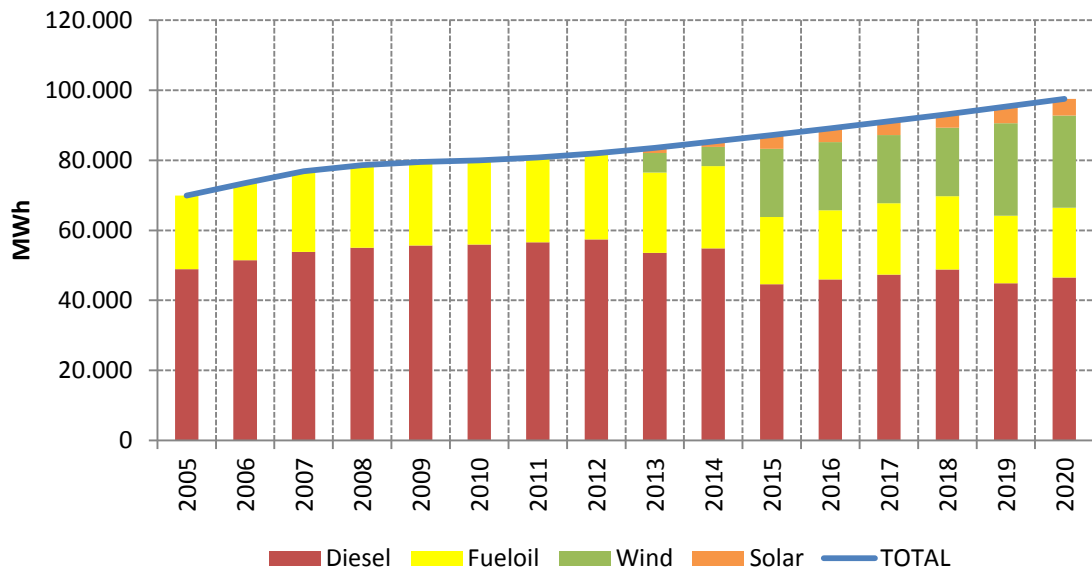


Figure 3.47. ISEAP Scenario – Growth trend of Secondary Energy Conversion

### ISEAP Scenario - Secondary Energy Conversion

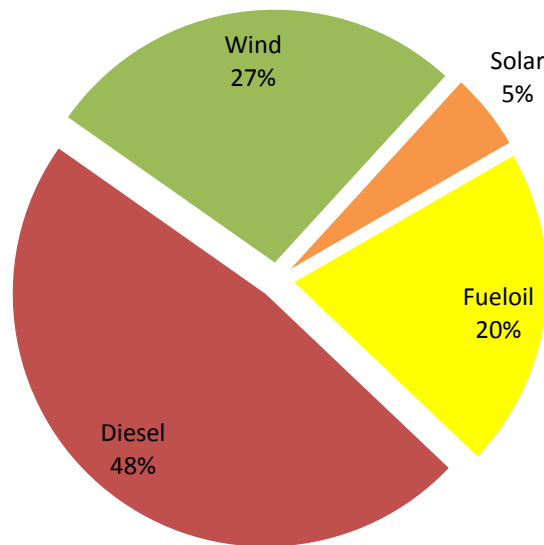


Figure 3.48. ISEAP Scenario – Secondary Energy Conversion per energy carrier in 2020

### 3.3.3. Primary energy demand

In the following figures the ISEAP scenario projection of the primary energy demand and the respective shares per energy carrier in the year 2020 are presented.

The use of fossil fuels is decreased because of the introduction of wind and solar energy for electricity production as locally exploited energy sources.

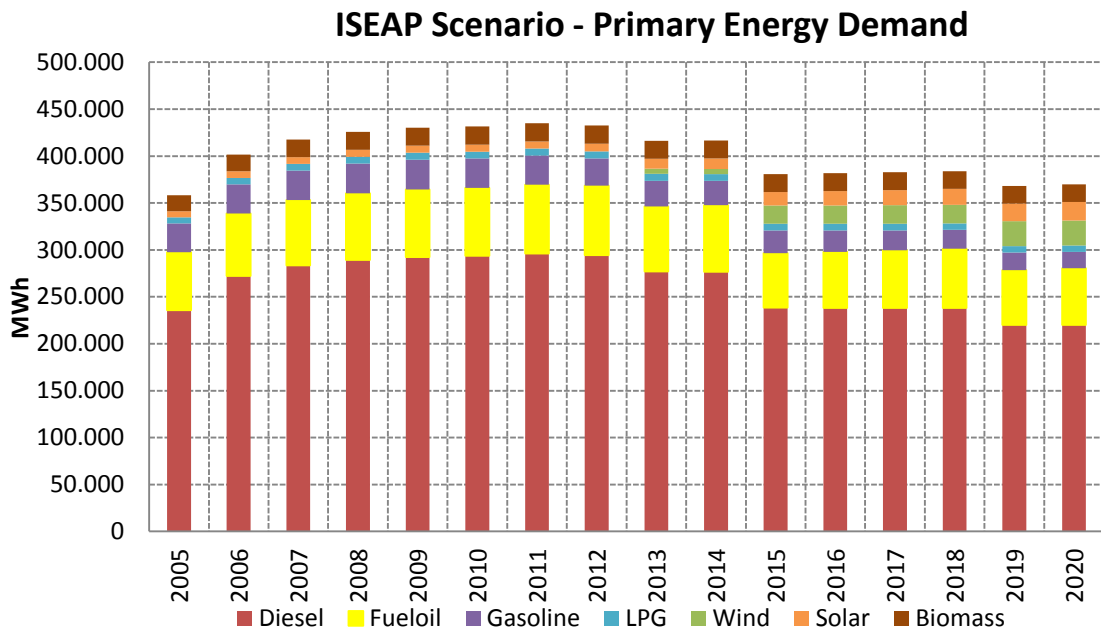


Figure 3.49. ISEAP Scenario – Growth trend of Primary Energy Demand per energy carrier

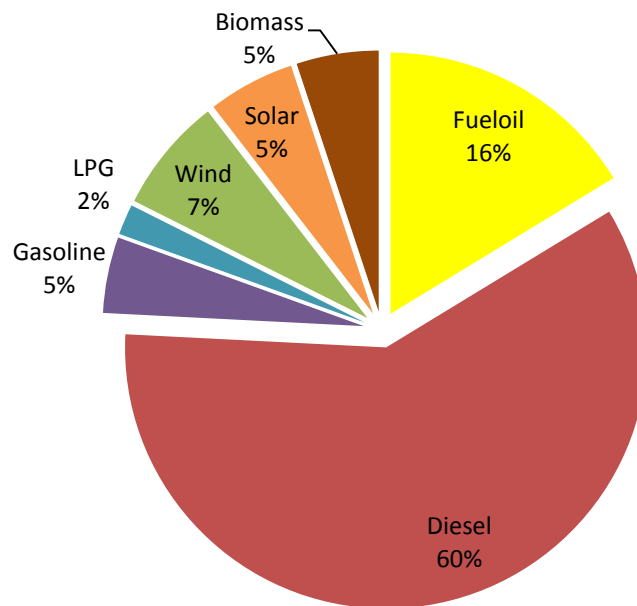


Figure 3.50. ISEAP Scenario – Primary Energy Demand per energy carrier in 2020



### 3.3.4. Emissions of carbon dioxide

In the following figures and tables the ISEAP scenario CO<sub>2</sub> emissions from final use per energy carrier and activity sector are presented. The share of CO<sub>2</sub> emissions resulting from the use of electricity (71%) is increased in comparison to the BAU scenario (65%) mainly because of the rapid decrease in the use of diesel for heating and the introduction of electrical vehicles.

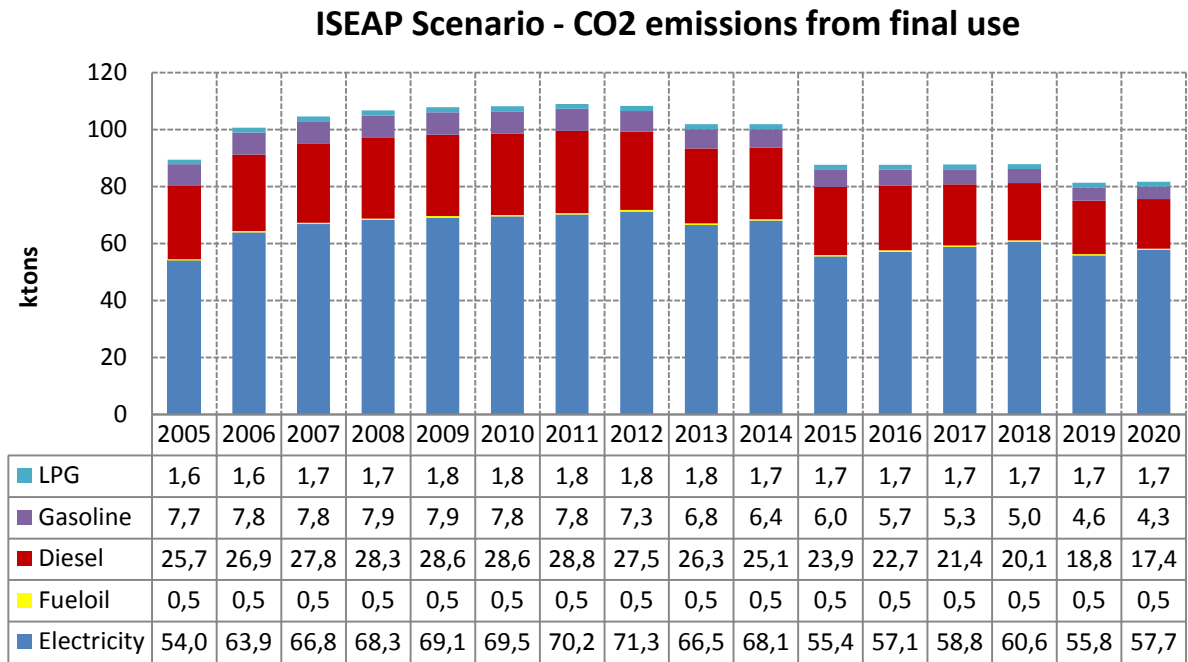


Figure 3.51. ISEAP Scenario – Growth trend of CO<sub>2</sub> emissions from final use per energy carrier

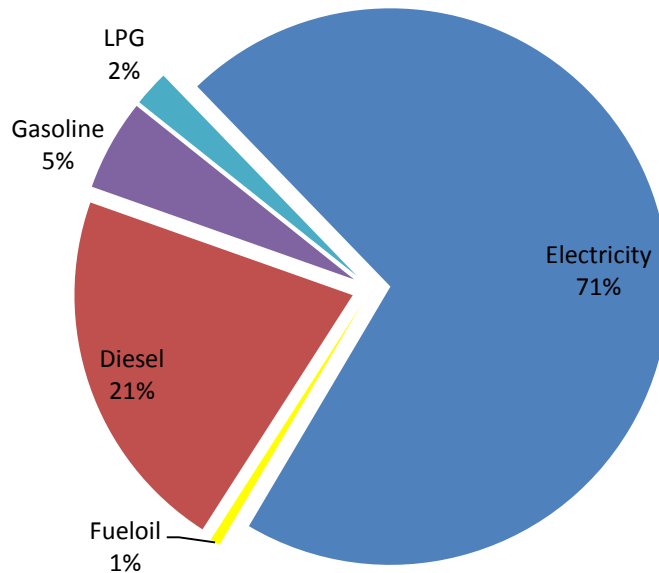


Figure 3.52. ISEAP Scenario – CO<sub>2</sub> emissions from final use per energy carrier in 2020

### ISEAP Scenario - CO2 emissions from final use

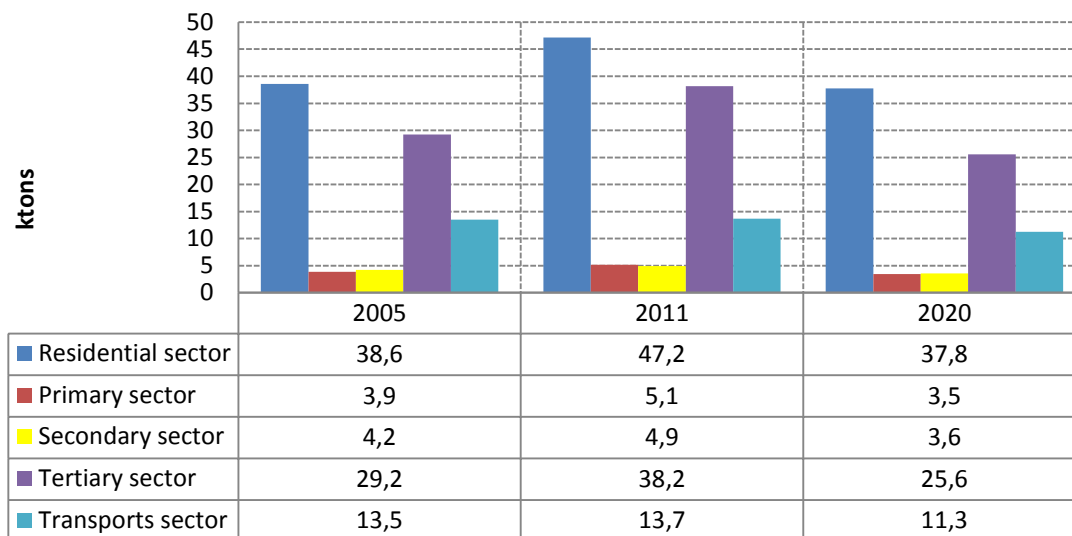


Figure 3.53. ISEAP Scenario – CO<sub>2</sub> emissions from final use projections per sector

The contribution of each activity sector in the reduction of CO<sub>2</sub> emissions is depicted in the following figures (Figure 3.54 to Figure 3.59) with the residential and tertiary sectors from the end use side along with the secondary energy conversion sector (i.e. the electricity production from RES units) are the most significant ones.

### CO2 emissions reduction - Residential sector

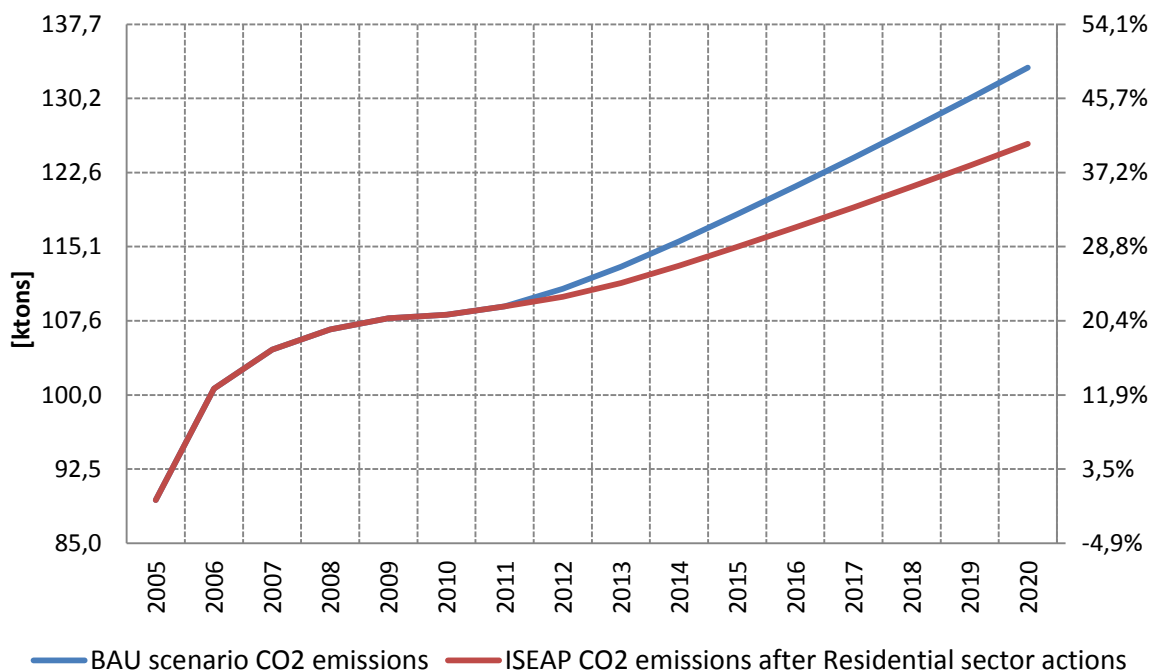


Figure 3.54. Comparison of CO<sub>2</sub> emissions from final use between BAU and ISEAP Scenarios in the residential sector

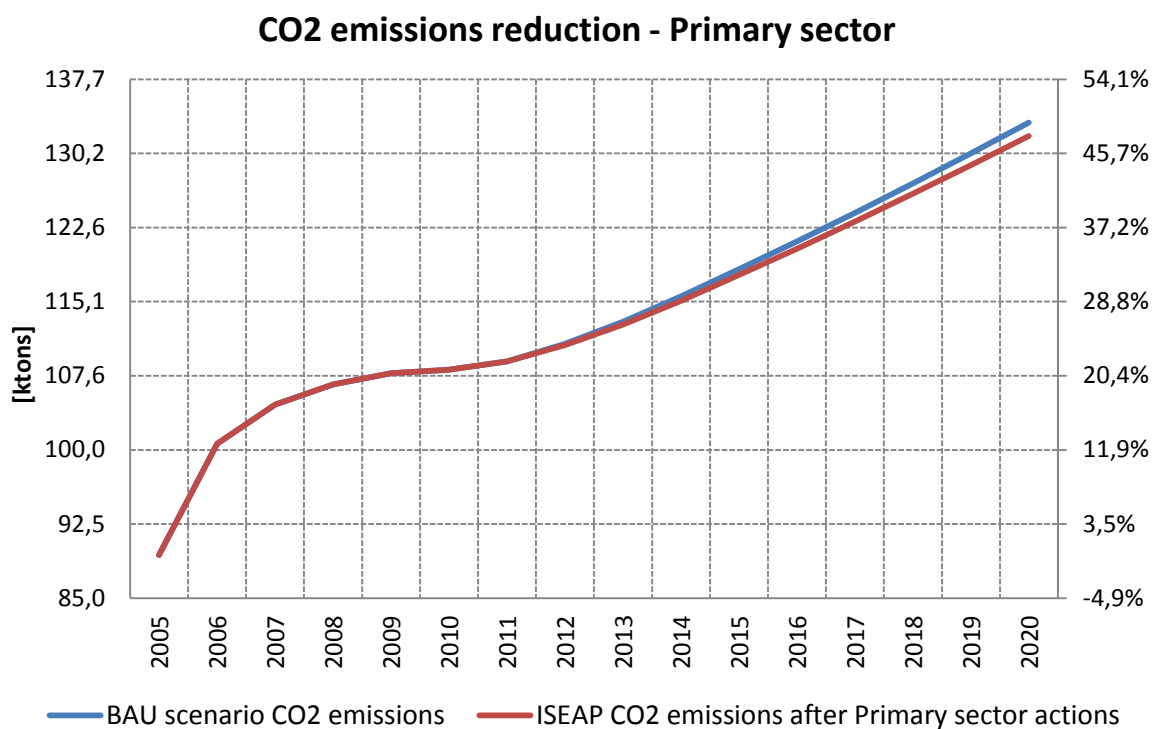


Figure 3.55. Comparison of CO<sub>2</sub> emissions from final use between BAU and ISEAP Scenarios in the primary sector

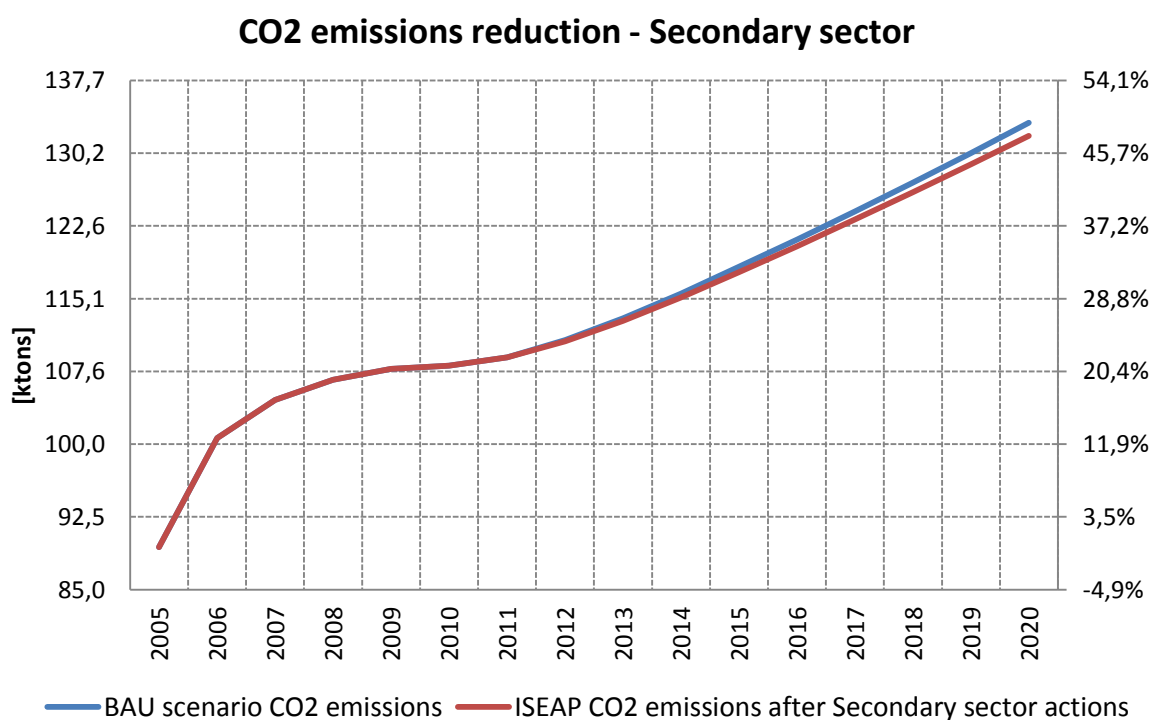


Figure 3.56. Comparison of CO<sub>2</sub> emissions from final use between BAU and ISEAP Scenarios in the secondary sector

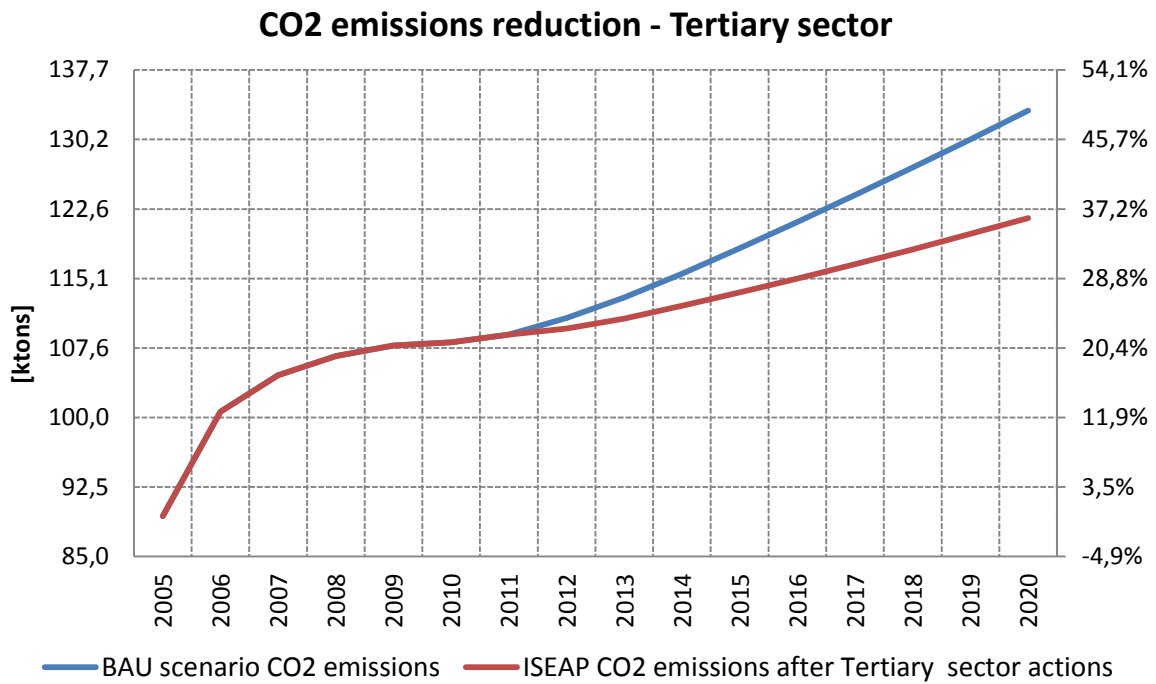


Figure 3.57. Comparison of CO<sub>2</sub> emissions from final use between BAU and ISEAP Scenarios in the tertiary sector

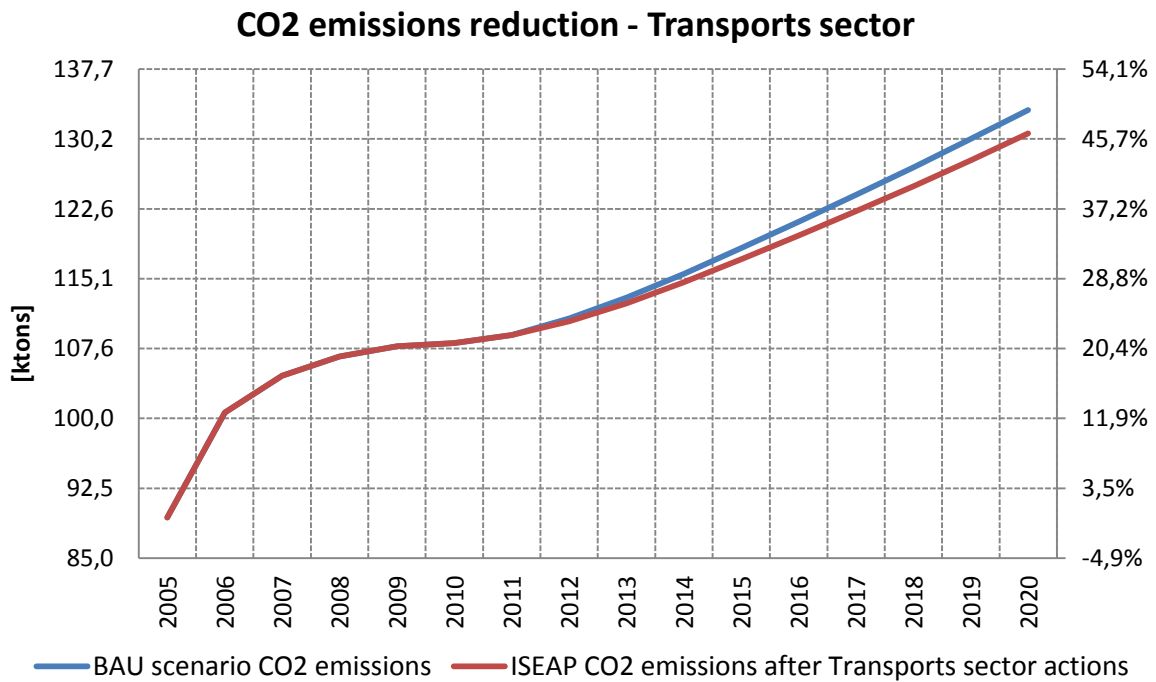
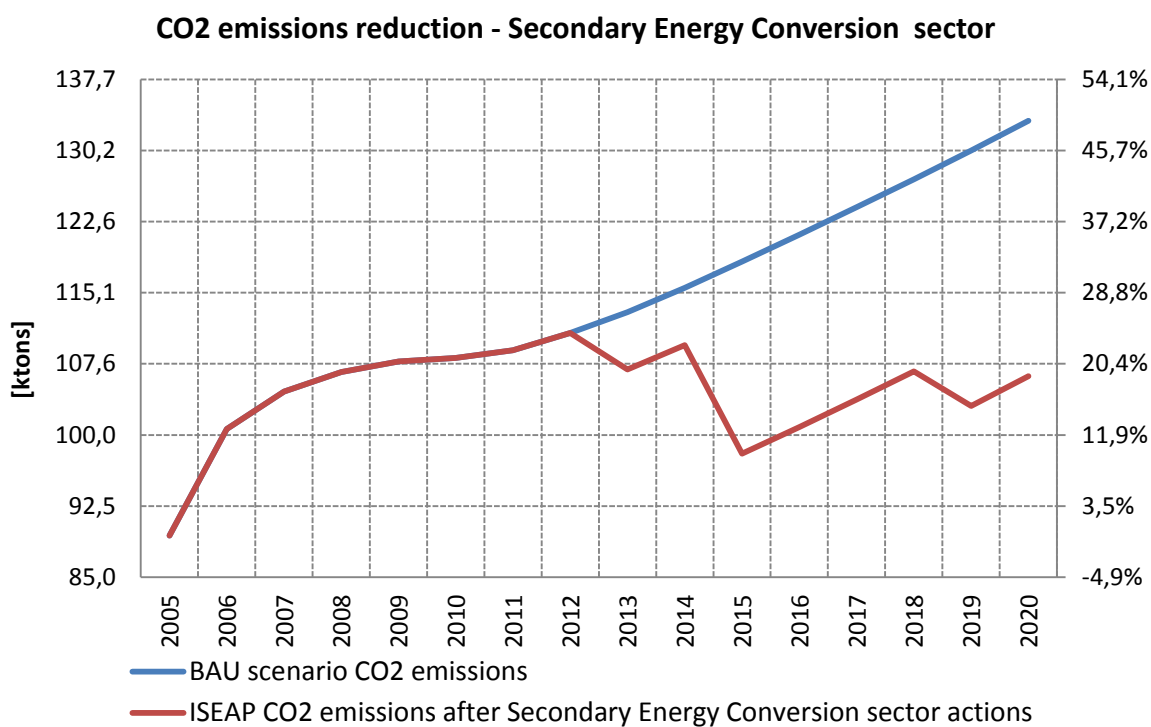


Figure 3.58. Comparison of CO<sub>2</sub> emissions from final use between BAU and ISEAP Scenarios in the transports sector



**Figure 3.59. Comparison of CO<sub>2</sub> emissions from final use between BAU and ISEAP Scenarios in the secondary energy conversion sector**

The following table summarizes the contribution of each sector in the reduction of CO<sub>2</sub> in comparison to the BAU scenario in the target year 2020.

Action Sectors	CO <sub>2</sub> emissions reduction
Residential	8,7%
Primary	1,5%
Secondary	1,5%
Tertiary	13,0%
Transports	2,8%
Electricity production	30,3%
<b>TOTAL</b>	<b>50,97%</b>

**Table 3.15. Contribution in the CO<sub>2</sub> emissions reduction of each sector in comparison to the BAU scenario in 2020**

## 4. ACTIONS

The ISEAP of Lemnos is developed in order to ensure the active contribution of the municipality, the citizens and stakeholders in reaching the national and European targets for greenhouse gases reduction until 2020. The long-term vision of the municipality of Lemnos is to succeed into restricting the rapidly increasing CO<sub>2</sub> emissions of the island by introducing the maximum amount of renewable energy sources on the energy production and demand side and by promoting the adoption of energy saving and efficiency in all activity sectors.

A wide range of actions is included in the action plan dealing with all the major activity sectors of the island. The selection of actions was carried out after considering several alternative scenarios with the scope to maximize the emissions reduction target with the minimum cost in the given time framework considering also the lately formulated national and local economic conditions.

For the public related sectors the municipality will function as an example for the rest of the island implementing energy saving and efficiency measures. For the rest of the activity sectors the municipality will promote respective horizontal actions while for the electricity production the aim is to maximize the local electricity production from RES in order to minimize the electricity imports to the mainland.

In the following table the expected results through the implementation of the ISEAP are summarized in terms of energy savings, renewable energy production and reduction of CO<sub>2</sub> emissions. The demand side management actions are contributing equally with actions for secondary energy production from RES in reaching the targets set for the island's CO<sub>2</sub> emissions. More details for the specific actions in each sector are presented in the following chapters.

SECTOR	ENERGY SAVINGS TARGET IN 2020 [MWh/year]	RENEWABLE ENERGY PRODUCTION TARGET IN 2020 [MWh/year]	CO <sub>2</sub> REDUCTION TARGET IN 2020 [ton/year]
RESIDENTIAL	3.138	126	860
PRIMARY	601	-	153
SECONDARY	604	-	147
TERTIARY	4.771	35	1.294
TRANSPORTS	1.210	-	282
SECONDARY ENERGY PRODUCTION	-	3.459	3.007
<b>TOTAL</b>	<b>10.325</b>	<b>3.621</b>	<b>5.744</b>

Table 4.1. ISEAP expected results in 2020 for every activity sector

## 4.1. Residential

In the following tables details of the actions planned for the residential sector are presented. The main focus is given on the promotion of energy saving and energy efficiency in everyday energy behaviour of the citizens but also in the use of renewable energy sources for the production of space and water heating. Also in some cases the substitution of fossil fuels consumption by electricity is promoted considering the fact that the local production of electricity from RES will be also promoted through the ISEAP.

SECTORS AND FIELDS OF ACTION	ACTIONS	RESPONSIBLE FOR IMPLEMENTATION	EXPECTED ENERGY SAVINGS [MWh/year]	EXPECTED RENEWABLE ENERGY PRODUCTION [MWh/year]	EXPECTED CO2 REDUCTION [ton/year]
<b>RESIDENTIAL SECTOR</b>					
Hot water	Reduce the annual hot water energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Lemnos	105		22
	Increase to 50% the total hot water energy demand supplied from solar thermal by 2020	Municipality of Lemnos	720	613	359
Heating and cooling	Reduce the annual space heating energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Lemnos	300		70
	Increase by 20% the total space heating energy demand supplied from heat pumps by 2020	Municipality of Lemnos	-3.348		-915
	Reduce the annual space cooling energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Lemnos	300		70
	Increase by 30% the energy efficiency of air-conditioning systems by 2020 through the promotion of air-conditioning with inverter	Municipality of Lemnos	2.765		644
Lighting	Reduce the annual lighting energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Lemnos	48		13
	Increase by 20% the energy efficiency of lighting systems by 2020 through the promotion of energy efficient lamps	Municipality of Lemnos	669		181
Cooking	Reduce the annual cooking energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Lemnos	45		11

	Increase by 20% the energy efficiency of cooking appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Lemnos	414		98
Refrigerator and freezers	Reduce the annual electrical appliances energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Lemnos	47		13
	Increase by 20% the energy efficiency of electrical appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Lemnos	437		118
Laundry machines and dryers	Reduce the annual electrical appliances energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Lemnos	3		1
	Increase by 20% the energy efficiency of electrical appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Lemnos	27		7
Dish washing	Reduce the annual electrical appliances energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Lemnos	4		1
	Increase by 20% the energy efficiency of electrical appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Lemnos	37		10
TV sets	Reduce the annual electrical appliances energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Lemnos	4		1
	Increase by 20% the energy efficiency of electrical appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Lemnos	35		9
Other electric appliances	Reduce the annual electrical appliances energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Lemnos	34		9
	Increase by 20% the energy efficiency of electrical appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Lemnos	312		84

**Table 4.2. Details for the actions planned in the residential sector**



ENERGY SAVINGS TARGET IN 2020 [MWh/year]	RENEWABLE ENERGY PRODUCTION TARGET IN 2020 [MWh/year]	CO2 REDUCTION TARGET IN 2020 [ton/year]
<b>RESIDENTIAL SECTOR</b>		
<b>3.138</b>	<b>126</b>	<b>860</b>

Table 4.3. Summary table of the actions planned in the residential sector

## 4.2. Primary sector

In the following tables details of the actions planned for the primary sector are presented. The actions focus on the agricultural sector aiming to the reduction of energy consumption by the professionals and to the energy efficiency upgrade of irrigation systems.

SECTORS AND FIELDS OF ACTION	ACTIONS	RESPONSIBLE FOR IMPLEMENTATION	EXPECTED ENERGY SAVINGS [MWh/year]	EXPECTED RENEWABLE ENERGY PRODUCTION [MWh/year]	EXPECTED CO2 REDUCTION [ton/year]
<b>PRIMARY SECTOR</b>					
Agriculture, forestry and fishing	Reduce the annual agricultural, forestry and fishing energy demand growth rate by 10% by promoting every day energy saving measures from the professionals	Municipality of Lemnos - Local association	60		15
	Increase by 20% the energy efficiency of agricultural irrigation systems by 2020 through the promotion of old irrigation systems substitution with new more efficient ones	Municipality of Lemnos - Local association	553		141

Table 4.4. Details for the actions planned in the primary sector

ENERGY SAVINGS TARGET IN 2020 [MWh/year]	RENEWABLE ENERGY PRODUCTION TARGET IN 2020 [MWh/year]	CO2 REDUCTION TARGET IN 2020 [ton/year]
<b>PRIMARY SECTOR</b>		
<b>601</b>		<b>153</b>

Table 4.5. Summary table of the actions planned in the primary sector

### 4.3. Secondary sector

In the following tables details of the actions planned for the secondary sector are presented. The main focus is given on the collaboration among the municipality and local associations to commit the local companies into setting initial mainstream targets for energy saving and increasing energy efficiency of their equipment and services. Concerning the water supply, sewerage and waste management activities supplied by the municipality actions concerning the energy consumption of the systems are planned and will be carried out by the municipality's own personnel and funding.

SECTORS AND FIELDS OF ACTION	ACTIONS	RESPONSIBLE FOR IMPLEMENTATION	EXPECTED ENERGY SAVINGS [MWh/year]	EXPECTED RENEWABLE ENERGY PRODUCTION [MWh/year]	EXPECTED CO2 REDUCTION [ton/year]
<b>SECONDARY SECTOR</b>					
Manufacturing	Reduce the annual manufacturing energy demand growth rate by 10% by promoting every day energy saving measures from the professionals	Municipality of Lemnos - Local association	39		9
	Increase by 20% the energy efficiency of manufacturing technologies by 2020 through the promotion of old systems substitution with new more efficient ones	Municipality of Lemnos - Local association	352		80
Water supply, sewerage, waste management and remediation activities	Reduce the annual water supply, waste management and remediation activities energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Lemnos	12		3
	Increase by 20% the energy efficiency of the pumping stations operating for the support of the sector by 2020 through the introduction of inverters to existing pumping stations or substitution of old stations with new efficient ones	Municipality of Lemnos	106		29
Construction	Reduce the annual construction energy demand growth rate by 10% by promoting every day energy saving measures from the professionals	Municipality of Lemnos - Local association	11		3
	Increase by 20% the energy efficiency of construction	Municipality of Lemnos - Local	97		26

	technologies by 2020 through the promotion of old systems substitution with new more efficient ones	association			
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**Table 4.6. Details for the actions planned in the secondary sector**

ENERGY SAVINGS TARGET IN 2020 [MWh/year]	RENEWABLE ENERGY PRODUCTION TARGET IN 2020 [MWh/year]	CO2 REDUCTION TARGET IN 2020 [ton/year]
<b>SECONDARY SECTOR</b>		
604		147

**Table 4.7. Summary table of the actions planned in the secondary sector**

## 4.4. Tertiary sector

In the following tables details of the actions planned for the tertiary sector are presented. The main focus is given on the collaboration among the municipality and local business associations to commit the local companies into setting initial mainstream targets for energy saving and increasing energy efficiency of their equipment and services.

Especially for the accommodation and food services service activities, considering the importance of tourism for the island, a wide range of actions are planned in order to reduce the seasonal increased CO<sub>2</sub> emissions during the touristic periods.

For the sub-sectors managed by the municipality (general administration, education, human health activities and public lighting) the actions concerning the energy consumption of the respective buildings (ex. town hall, schools, health centre, street lighting, etc.) and systems are planned and will be carried out in most cases by the municipality's own personnel and funding.

SECTORS AND FIELDS OF ACTION	ACTIONS	RESPONSIBLE FOR IMPLEMENTATION	EXPECTED ENERGY SAVINGS [MWh/year]	EXPECTED RENEWABLE ENERGY PRODUCTION [MWh/year]	EXPECTED CO2 REDUCTION [ton/year]
<b>TERTIARY SECTOR</b>					
Wholesale and retail trade; repair of motor vehicles and	Reduce the annual wholesale and retail trade energy demand growth rate by 10% by promoting every day energy saving measures from the professionals	Municipality of Lemnos - Local association	156		42

motorcycles	Energy efficiency measures - Increase by 30% the energy efficiency of air-conditioning systems by 2020 through the promotion of air-conditioning with inverter - Increase by 20% the energy efficiency of electrical appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Lemnos - Local association	648		173
	Increase by 20% the total space heating energy demand supplied from heat pumps by 2020	Municipality of Lemnos - Local association	-84		-23
Accommodation and food service activities	Reduce the annual accommodation service activities energy demand growth rate by 10% by promoting every day energy saving measures from the owners, personnel and the visitors	Municipality of Lemnos - Local association	313		82
	Energy efficiency measures - Increase by 30% the energy efficiency of air-conditioning systems by 2020 through the promotion of air-conditioning with inverter and door deactivating sensors - Increase by 30% the energy efficiency of electrical appliances by 2020 through the promotion of old devices substitution with more efficient ones and by introducing the key card electricity deactivating system	Municipality of Lemnos - Local association	1.346		354
	Increase by 20% the total space heating energy demand supplied from heat pumps by 2020 - Increase by 20% the total hot water energy demand supplied from solar thermal by 2020	Municipality of Lemnos - Local association	45	84	35
	Reduce the food service activities energy demand growth rate by 10% by promoting every day energy saving measures from the owners and personnel	Municipality of Lemnos - Local association	313		82

	<p>Energy efficiency measures</p> <ul style="list-style-type: none"> <li>- Increase by 30% the energy efficiency of air-conditioning systems by 2020 through the promotion of air-conditioning with inverter</li> <li>- Increase by 30% the energy efficiency of electrical appliances by 2020 through the promotion of old devices substitution with more efficient ones and by introducing motion sensors for the toilet lighting</li> <li>- Increase by 30% the energy efficiency of cooking appliances by 2020 through the promotion of old devices substitution with more efficient ones</li> </ul>	Municipality of Lemnos - Local association	1.346		354
	Increase by 20% the total space heating demand supplied from heat pumps by 2020 - Increase by 20% the total hot water energy demand supplied from solar thermal by 2020	Municipality of Lemnos - Local association	-49	38	-4
	Reduce the annual general public administration and social security energy demand growth rate by 10% by promoting every day energy saving measures from the employees	Municipality of Lemnos	56		15
General public administration and social security	<p>Energy efficiency measures</p> <ul style="list-style-type: none"> <li>- Increase by 30% the energy efficiency of air-conditioning systems by 2020 through the introduction of air-conditioning with inverter</li> <li>- Increase by 30% the energy efficiency of electrical appliances by 2020 through the substitution of old devices with more efficient ones (green procurement) and by introducing motion sensors for the toilet lighting</li> <li>- Increase by 30% the energy efficiency of heating systems by 2020 through the replacement of old window and door frames of public buildings with more efficient ones</li> </ul>	Municipality of Lemnos	331		89
	Increase to 30% the total space heating demand supplied from heat pumps by 2020	Municipality of Lemnos	-75		-20
Education	Reduce the annual education energy demand growth rate by 10% by promoting every day energy saving measures from the professors and students	Municipality of Lemnos - School boards	39		10

	<p>Energy efficiency measures</p> <ul style="list-style-type: none"> <li>- Increase by 30% the energy efficiency of electrical appliances by 2020 through the substitution of old devices with more efficient ones (green procurement) and by introducing motion sensors for the toilet lighting</li> <li>- Increase by 30% the energy efficiency of heating systems by 2020 through the replacement of old window and door frames of public buildings with more efficient ones</li> </ul>	Municipality of Lemnos - School boards	235		63
	Increase to 30% the total space heating energy demand supplied from heat pumps by 2020	Municipality of Lemnos - School boards	-291		-79
Human health and social work activities	Reduce the annual human health and social work activities energy demand growth rate by 10% by promoting every day energy saving measures from the employees and visitors	Municipality of Lemnos - Health centers - Hospital	13		3
	<p>Energy efficiency measures</p> <ul style="list-style-type: none"> <li>- Increase by 30% the energy efficiency of air-conditioning systems by 2020 through the introduction of air-conditioning with inverter</li> <li>- Increase by 30% the energy efficiency of electrical appliances by 2020 through the substitution of old devices with more efficient ones (green procurement) and by introducing motion sensors for the toilet lighting</li> <li>- Increase by 30% the energy efficiency of heating systems by 2020 through the replacement of old window and door frames of public buildings with more efficient ones</li> </ul>	Municipality of Lemnos - Health centers - Hospital	66		18
	Increase to 30% the total space heating energy demand supplied from heat pumps by 2020 - Increase to 30% the total hot water energy demand supplied from solar thermal by 2020	Municipality of Lemnos - Health center	-23	29	2
Other services	Reduce the annual other services energy demand growth rate by 10% by promoting every day energy saving measures from the professionals	Municipality of Lemnos - Local association	125		33

	Energy efficiency measures - Increase by 30% the energy efficiency of air-conditioning systems by 2020 through the promotion of air-conditioning with inverter - Increase by 20% the energy efficiency of electrical appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Lemnos - Local association	518		138
	Increase by 20% the total space heating energy demand supplied from heat pumps by 2020	Municipality of Lemnos - Local association	-155		-42
Public lighting	Reduce the annual public lighting energy demand growth rate by 10% through the promotion of energy saving measures from the local authorities.	Municipality of Lemnos - PPC	38		10
	Increase by 20% the energy efficiency of public lighting systems by 2020 through the spatial and technical optimization of the lighting network.	Municipality of Lemnos - PPC	205		55

**Table 4.8. Details for the actions planned in the tertiary sector**

ENERGY SAVINGS TARGET IN 2020 [MWh/year]	RENEWABLE ENERGY PRODUCTION TARGET IN 2020 [MWh/year]	CO2 REDUCTION TARGET IN 2020 [ton/year]
<b>TERTIARY SECTOR</b>		
<b>4.771</b>	<b>35</b>	<b>1.294</b>

**Table 4.9. Summary table of the actions planned in the tertiary sector**

## 4.5. Transports

In the following tables details of the actions planned for the transports sector are presented. The main focus is given on the promotion of eco-driving techniques by the respective users and the introduction of electric vehicles (EVs) in the island's fleet in collaboration to companies relevant to each sub-sector (buses, taxis, etc.) and the citizens. The increase of electricity consumption through the use of EVs leading to a reduction of fossil fuels is promoted considering the fact that the local production of electricity from RES will be also promoted through the ISEAP.

The municipality will function as an example for the rest of the transports sector being the first to implement the proposed actions to the public fleet.

SECTORS AND FIELDS OF ACTION	ACTIONS	RESPONSIBLE FOR IMPLEMENTATION	EXPECTED ENERGY SAVINGS [MWh/year]	EXPECTED RENEWABLE ENERGY PRODUCTION [MWh/year]	EXPECTED CO2 REDUCTION [ton/year]
<b>TRANSPORTS SECTOR</b>					
Passenger transport by road (public transport, taxi, tourism, transfers, etc.)	Double the annual passenger transport by road energy demand growth rate in favour of public transport by 2020 by assuring the quality offered by the public transports and promoting its use and by constructing bike roads.	Municipality of Lemnos - Lemnos KTEL	-3		-1
	Increase by 20% the energy efficiency of passenger transports by road by 2020 through the promotion of eco-driving practices.	Municipality of Lemnos - Transfer operators - Taxis	6		2
	Increase to 10% the passenger transport by road energy demand supplied from electricity by 2020 through the introduction of hybrid – electrical buses	Municipality of Lemnos	-5		-1
Other fleet for public and private services	Increase by 20% the energy efficiency of other fleet for public and private services by 2020 through the promotion of eco-driving practices.	Municipality of Lemnos	785		207
	Increase to 10% the other fleet for public and private services energy demand supplied from electricity by 2020 through the introduction – promotion of hybrid – electrical vehicles.	Municipality of Lemnos	-632		-173
Freight transport by road and removal services	Increase by 20% the energy efficiency of Freight transport by road and removal services by 2020 through the promotion of eco-driving practices.	Municipality of Lemnos	38		10
	Increase to 10% the passenger transport by road energy demand supplied from electricity by 2020 through the promotion of hybrid – electrical trucks.	Municipality of Lemnos	-23		-6
Private transports	Reduce to half the annual private transports energy demand growth rate by 2020 through the promotion of sustainable transports (public transports, bicycle).	Municipality of Lemnos	224		56
	Increase by 20% the energy efficiency of private transports by 2020 through the promotion of eco-driving practices.	Municipality of Lemnos	1.553		391



Increase to 10% the private transports energy demand supplied from electricity by 2020 through the promotion of hybrid – electrical vehicles	Municipality of Lemnos	-938	-261
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**Table 4.10. Details for the actions planned in the transports sector**

ENERGY SAVINGS TARGET IN 2020 [MWh/year]	RENEWABLE ENERGY PRODUCTION TARGET IN 2020 [MWh/year]	CO2 REDUCTION TARGET IN 2020 [ton/year]
<b>TRANSPORTS SECTOR</b>		
1.210		282

**Table 4.11. Summary table of the actions planned in the transports sector**

## 4.6. Secondary energy production and energy fluxes

In the following tables details of the actions planned for the secondary energy production and energy fluxes sector are presented. The municipality will promote the installation of renewable energy sources, specifically wind and PV parks, either in small or medium scale projects reassuring the respect to the island’s spatial planning and the local ecosystem. The municipality will also function as a hub of information and potential collaboration with investors interested to fund such projects.

SECTORS AND FIELDS OF ACTION	ACTIONS	RESPONSIBLE FOR IMPLEMENTATION	EXPECTED ENERGY SAVINGS [MWh/year]	EXPECTED RENEWABLE ENERGY PRODUCTION [MWh/year]	EXPECTED CO2 REDUCTION [ton/year]
<b>SECONDARY ENERGY PRODUCTION AND ENERGY FLUXES</b>					
Wind	Promotion of wind turbines installation	Municipality of Lemnos		2.930	2.547
Solar	Promotion of PV installation on the ground and on the roofs	Municipality of Lemnos		529	460

**Table 4.12. Details for the actions planned in the secondary energy production sector**

ENERGY SAVINGS TARGET IN 2020 [MWh/year]	RENEWABLE ENERGY PRODUCTION TARGET IN 2020 [MWh/year]	CO2 REDUCTION TARGET IN 2020 [ton/year]
<b>SECONDARY ENERGY PRODUCTION AND ENERGY FLUXES</b>		
	3.459	3.007

**Table 4.13. Summary table of the actions planned in the secondary energy production sector**

## 4.7. Land use planning

On this stage of the ISEAP development there are not included actions concerning the land use planning. However, the local authorities in collaboration also with the regional authorities will proceed to concrete land use planning studies in the near future resulting to actions to be included to the ISEAP on a next planning phase.

## 4.8. Public procurement of products and services

On this stage of the ISEAP development there are not included specific actions concerning the definition of standards for the public procurement of products and services. However, an initial phase of developing relevant actions are considered actions planned under the tertiary sector and especially the equipment for municipal buildings and public lighting focusing on the procurement of energy efficient units. On a next action planning phase it is expected these actions to be materialized also to specific procurement standards.

## 4.9. Citizen and stakeholders

Several actions planned under the residential, primary, secondary, tertiary and transports sectors are focusing on raising awareness of the citizens and stakeholders in order to contribute in reaching the ambitious targets of the ISEAP. The maximization of their involvement in the implementation of the ISEAP and their support and commitment to it is considered a key use for a success.

## 5. ORGANIZATIONAL AND FINANCIAL MECHANISMS

The success of the ISEAP besides the good planning and estimation of resources relies heavily on the organizational and financial mechanisms to be established. Specific coordination and organizational structures will be formulated and supported by staff allocated to carry out the different phases of the ISEAP implementation and monitoring. The citizens and stakeholders through their involvement to the ISEAP processes will also constitute a valuable organizational mechanism, critical for the success of this effort. However, in order for all these efforts to be materialized concrete budget allocations should be ensured by taking advantage of all possible financing sources and instruments.

### 5.1. Coordination and organizational structures

A two level coordination and organizational structure is decided in order to ensure the efficient implementation of the ISEAP. The steering committee on the one hand will take over the coordination during the ISEAP's different phases while on the other hand the work group will mainly focus on the realization of the actions, the monitoring of the ISEAP and the possible updating of the ISEAP contents.

***Steering Committee:***

- The Mayor of Lemnos
- DAFNI (Network of Aegean Islands for Sustainability)

***Work group:***

- The energy representative of the municipality
- The technical department of the municipality
- DAFNI (Network of Aegean Islands for Sustainability)

### 5.2. Staff capacity

It is absolutely clear that the ISEAP implementation and monitoring will require the allocation of devoted and committed staff that will be able to set the ISEAP as their occupation priority. The staff is consisted of:

- The energy representative of the municipality of Lemnos (1 person)
- The technical department of the municipality of Lemnos (4 persons)

Furthermore, it is of the municipality's main pursuit to involve the most of the citizens and especially school students in the process of the ISEAP implementation on a volunteering base, especially for the period when energy audits and intense monitoring processes will be taking place.

### **5.3. Involvement of stakeholders**

In order to reassure the active involvement of stakeholders in the implementation of the ISEAP frequent ISEAP info days and conferences will be organized.

Further involvement of the citizens is expected since periodically they will be asked to fill in energy audits in order to monitor the progress and change in their energy behaviours.

Also, specialized meetings and discussions will be held among the steering committee and the stakeholders related to specific sectors in all steps of the ISEAP implementation in order to maintain their interest and commitment to the ISEAP targets.

### **5.4. Budget**

(The budget will be finalized upon the final approval of the ISEAP)

### **5.5. Financing sources and instruments**

Securing the necessary financing sources and instruments for the successful implementation of the ISEAP will be one of the major challenges for the municipality. In the following list some of the expected financing sources are presented.

- Municipal budget allocations
- Regional budget allocations
- Loans
- Revolving funds
- NSRF (National Strategic Reference Framework)
- European Investment Bank
- Private investments
- Citizen cooperatives
- Third party financing
- Public and private sector partnerships

### **5.6. Monitoring and follow-up**

The Energy - CO<sub>2</sub> and ISEAP monitoring tools developed under the ISLE-PACT project will be used in combination to energy audits in order to monitor the success of the ISEAP and the development of Lemnos' energy profile. The monitoring task will be taken over by the work group. An ISEAP monitoring template and a respective report will be submitted at least every two years to the European Commission in order to highlight the progress in the ISEAP implementation.

## ***Bibliography***

***Elaboration:***



***Local and regional authorities:***



Municipality of Lemnos



Region of North Aegean

***Financial support:***



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