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ISLAND SUSTAINABLE ENERGY ACTION PLAN

ISLAND OF SANTORINI

Date **30/4/2012**

Executive summary

The Municipality of Thira 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_2 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

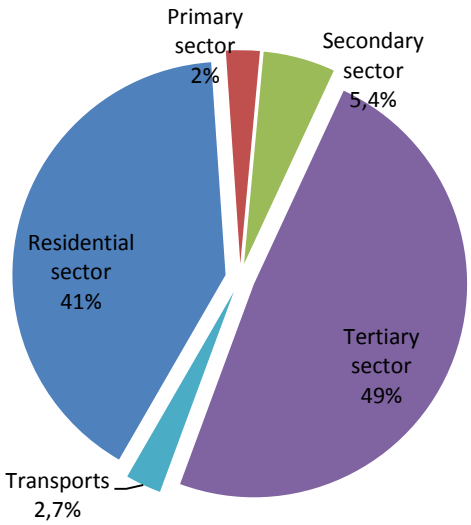
With the present sustainable energy action plan, Thira sets clear and ambitious objectives and targets concerning the island's local energy policy.

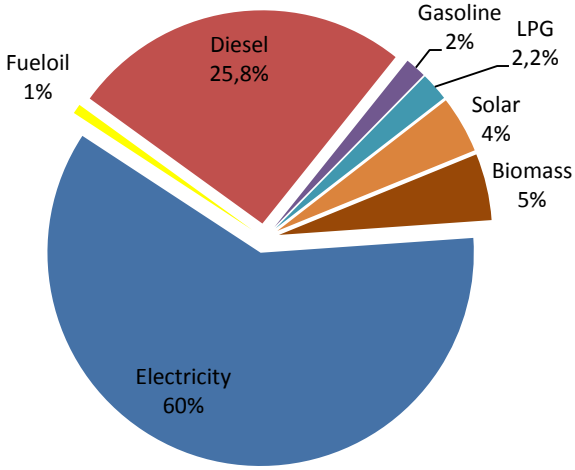
The objectives set for the target year 2020 focus on increasing the island's energy supply security, reducing its dependence on fuel imports and finally reducing the island's energy and CO_2 emissions footprint.

Specifically, the targets set for 2020 focus on reducing by 43% the primary energy demand and by 30% the CO_2 emissions in comparison to the projections of the business as usual scenario, meeting the 8% of the primary energy demand and the 10% of the electricity demand by the use of local renewable energy sources.

Energy balance and CO_2 emissions in the base year

The year 2005 was selected as base year for the energy planning process of Thira's ISEAP, following the EU targets set for fighting climate change. In the following figures Thira's 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

Santorini or Thira is the southest island of cyclades; it is 136 n.m. far from the port of Pireus and 68 n.m from the port of Iraklion in Crete. The island including the small island of Thirasia covers a total area of 88km2, with a coastline of 65km;

Santorini is essentially what remains of an enormous volcanic explosion that destroyed the earliest settlements on what was formerly a single island, which led to the creation of the current geological caldera.

The current ground is fairly flat and arid; with the highest peak is Prophet Elias (567m). The coastline, especially on the east side, is extremely smooth, without a strong division, forming beautiful beaches.

In the past years the inhabitants were cultivating wineyards and orchard for private use. Due the natural beauty of island, tourism growed vastly since 1970. In effectthe majoroity of the population turned into tourism sector and abandoned the agricultural activities. Nowadays, only a small part in the north of isalnd is exploited for agriculture. On the contrary, Thirasia retains its traditional form since the tourism growth is not spread there. The residents are still dealing with more traditional occupations.

Santorini is an autonomous power system with a local power station. The island of Therasia is powed from Santorini by submarine cable.

The following table presents the land use as percentage of the total area of the island.

Area under cultivation and fallow land	Pastures	Forests	Area under water	Areas occupied by the locality (buildings, roads, etc)	Other areas
59,9%	9,0%	1,8%	0,0%	9,8%	19,6%

Table 1.1. Land use

Figure 1.1. The Island of Santorini

1.2. Demography

During the decade 1961-1971 the island presented a significant population decline due to the adverse social and economic conditions and the great earthquake in 1956 which caused serious damage to settlements. However, the population of the island is growing since 1971; the largest increase appears during the decade (1991-2001) mainly because of the tourism development. According to the last administrative reformation the former municipality of Thira and community of Oia (north part of Santorini island and the small neighboring island of Thirasia) have merged to the municipality of Thira.

Year	Population	Growth rate
1961	7751	-
1971	6196	20%
1981	7083	14,3%
1991	8771	23,8%
2001	12440	41,8%

Table 1.2. Population evolution (source: EL.STAT)

1.3. Economy

Generally, the island's economy relies on the following sectors:

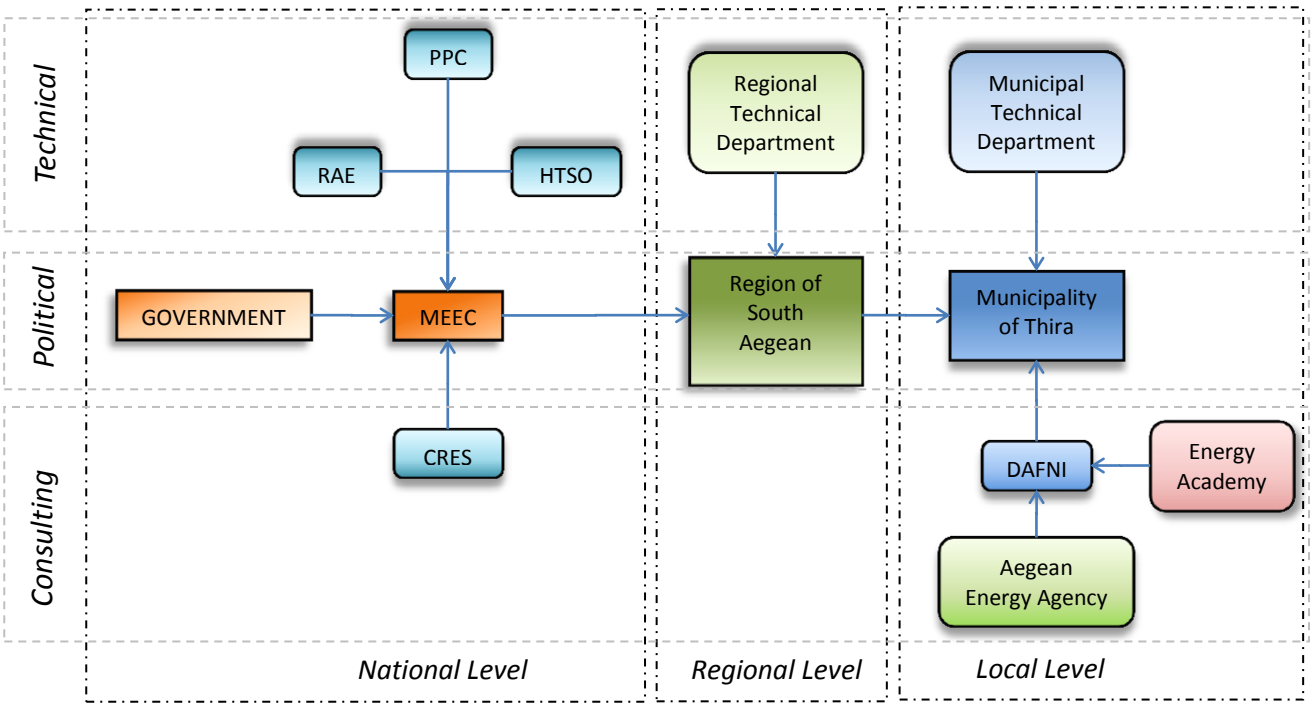
- Agriculture – Fishery
- Manufacturing
- Services
- Infrastructures – Construction

However, these sectors operate to serve the main economic sector of the island, tourism, which is rapidly growing. The largest percentage of economically active population is being occupied purely in tourism. In 2001 a percentage of about 29% of the active population of the former Community of Oia is employed for tourism. Based on 2004 data, the wider tourism sector employed more than 60% of the economically active population of the island. Regarding business, 83% of businesses on the island are directly or indirectly connected with tourism. The employment in services related to tourism such as hotels and restaurants is gradually inreasing. On the contrary the rural population of the island decreased to 7,5% of the total population in 1991 and to 5% in 2001.

1.4. Political and administrative structures

Santorini belongs in the region of south Aegean and with the late administrative reformation the former municipalities of Oia and Thira consolidated into the municipaity of Thira.

The political and administrative organisational structure of Santorini 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

Santorini island, , located at the South Cyclades complex, is the one of the most popular tourist destination in Greece, with thousands of visitors arriving to the island in an extended touristic period ranging from April till November. As a result the population of the island presents a great seasonal fluctuation leading to very high energy and carbon footprint especially in the summertime. Especially these values reach extremely high when present on a per capita basis of the permanent population.

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 CO2 emissions for the island of Santorini are expected to increase by 61% until 2020 in comparison to 2005 levels.

Santorini 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. As a result the island relies greatly to energy imports.

In this sense, the Municipality of Thira 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 8% 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[1] 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

[1] The targets refer to accumulated result among the whole of EU. However, the targets differ among the Member States.

The Municipality of Thira 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_2 emissions footprint

The targets set for 2020 focus on:

a. Reducing by 43% the primary energy demand in comparison to the BAU scenario
b. Reducing by 30% the CO_2 emissions in comparison to the BAU scenario
c. Restricting the CO_2 emissions increase only to 12% in comparison to 2005 levels, with the aim to reach at least the national level of 4% reduction on a second ISEAP planning phase
d. Meeting the 8% of the primary energy demand by renewable energy sources
e. Meeting the 10% 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 Thira 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
Residential	**28.288**	**28.964**	**3.588**	**3.503**	**8.003**	**72.346**
Hot water	4.151	3.386	0	3.503	1.051	**12.091**
Heating and cooling	11.895	25.578	2.162	0	5.764	**45.399**
Lighting	3.401	0	0	0	0	**3.401**
Cooking	2.377	0	1.426	0	1.188	**4.991**
Refrigerator and freezers	3.336	0	0	0	0	**3.336**
Laundry machines and dryers	203	0	0	0	0	**203**
Dish washing	284	0	0	0	0	**284**
Tv sets	264	0	0	0	0	**264**
Other electric appliances	2.376	0	0	0	0	**2.376**

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.

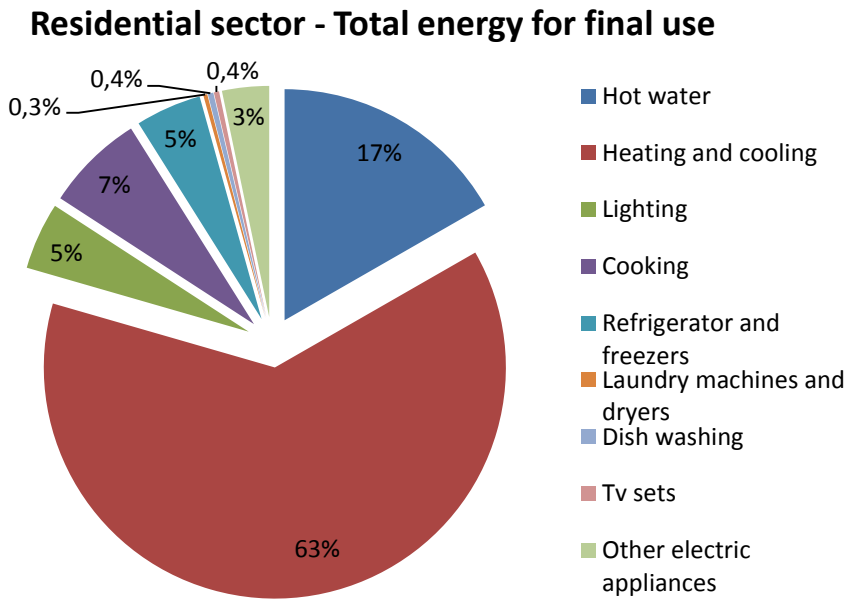


Figure 3.1. Distribution of residential final energy demand among the different sub-sectors

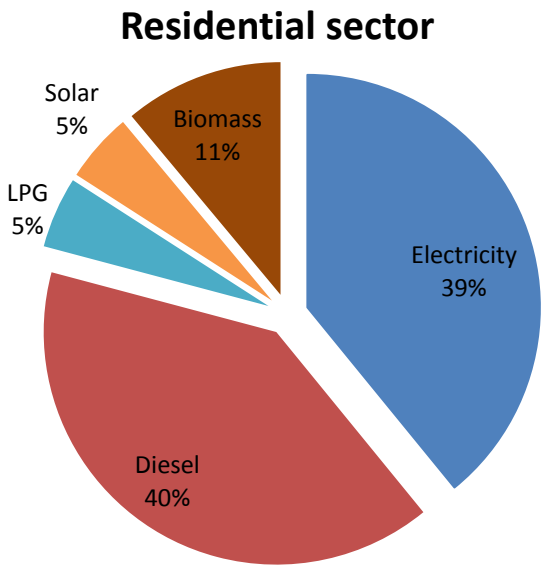


Figure 3.2. Distribution of the residential sector FED to the different energy carriers

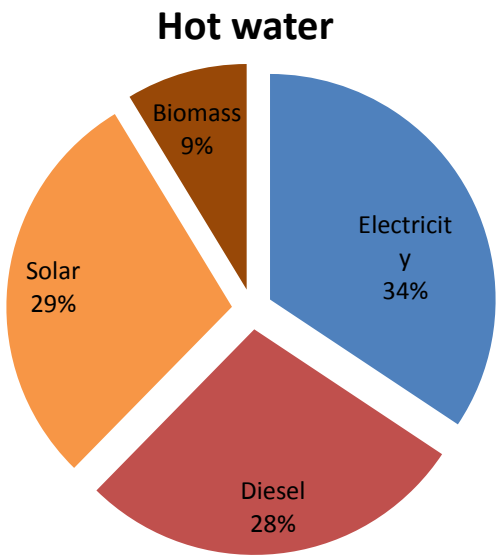


Figure 3.3. Distribution of hot water energy demand to the different energy carriers

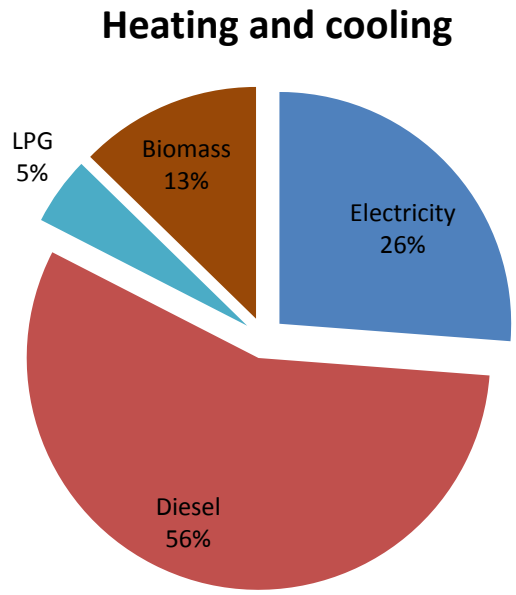


Figure 3.4. Distribution of heating and cooling energy demand to the different energy carriers

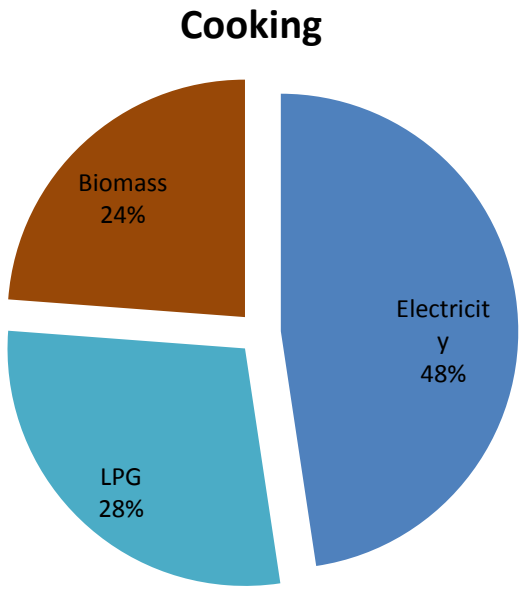


Figure 3.5. Distribution of cooking energy demand to the different energy carriers

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
Primary sector	**3.283**	**594**	**678**	**4.555**
Agriculture, forestry and fishing	3.283	594	678	**4.555**

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

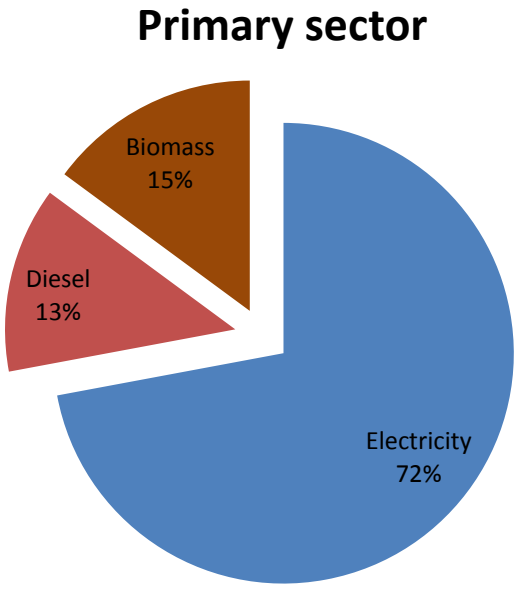


Figure 3.6. Distribution of the primary sector FED to the different energy carriers

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
Secondary sector	**6.856**	**1.308**	**1.367**	**64**	**36**	**80**	**9.713**
Manufacturing	820	458	479	64	36	80	**1.937**
Water supply, sewerage, waste management and remediation activities	4.515	0	0	0	0	0	**4.515**
Construction	1.522	850	889	0	0	0	**3.261**

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

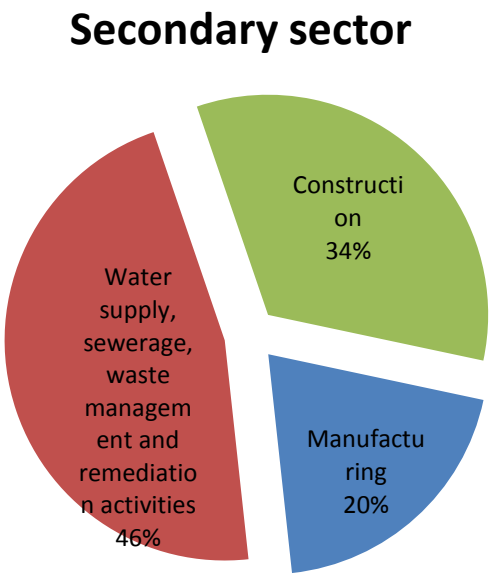


Figure 3.7. Distribution of the secondary sector FED to the different sub-sectors

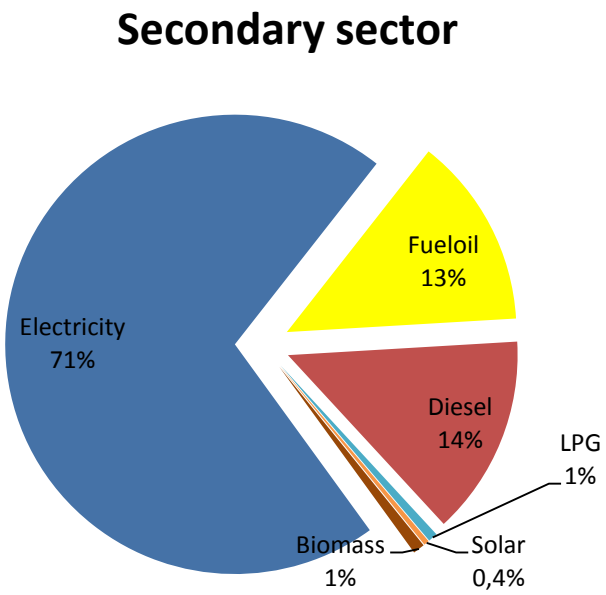


Figure 3.8. Distribution of the secondary sector FED to the different energy carriers

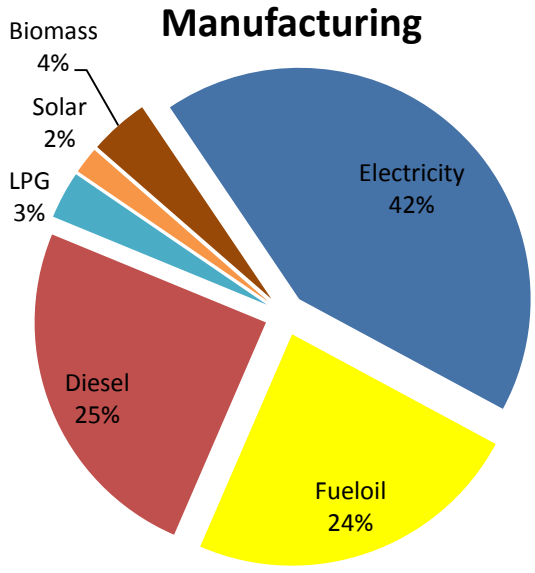


Figure 3.9. Distribution of manufacturing sector energy demand to the different energy carriers

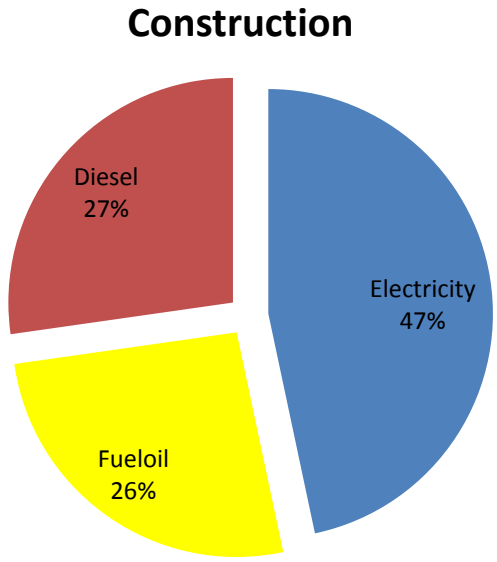


Figure 3.10. Distribution of construction sector energy demand to the different energy carriers

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
Tertiary sector	**69.152**	**13.073**	**192**	**4.165**	**251**	**86.833**
Wholesale and retail trade; repair of motor vehicles and motorcycles	13.206	1.747	0	159	0	**15.112**
Accommodation and food service activities	40.544	8.758	192	3.876	251	**53.621**
General public administration and social security	1.398	416	0	0	0	**1.814**
Education	533	692	0	0	0	**1.225**
Human health and social work activities	40	31	0	0	0	**71**
Other services	10.805	1.429	0	130	0	**12.364**
Public lighting	2.626	0	0	0	0	**2.626**

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

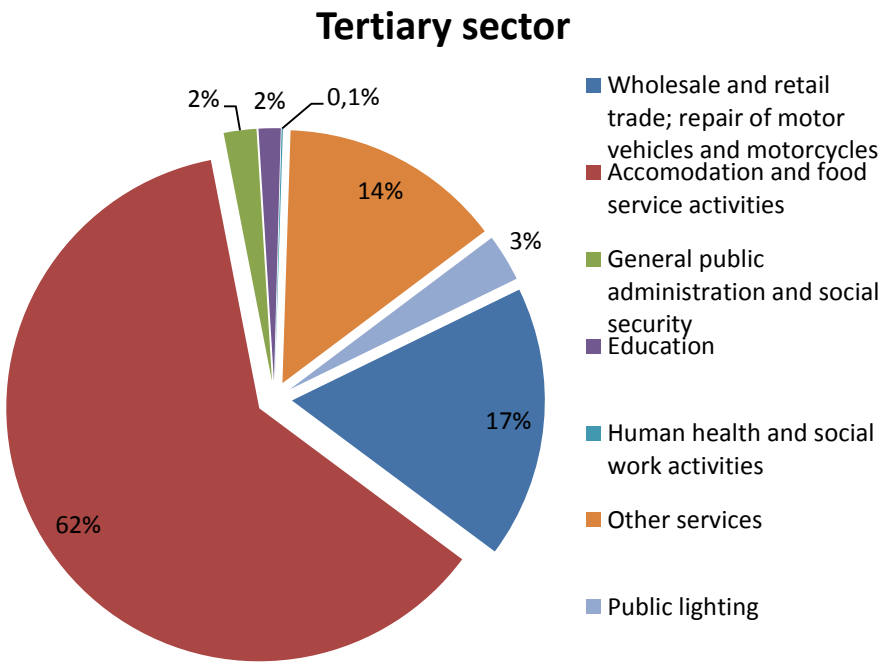


Figure 3.11. Distribution of the tertiary sector FED to the different sub-sectors

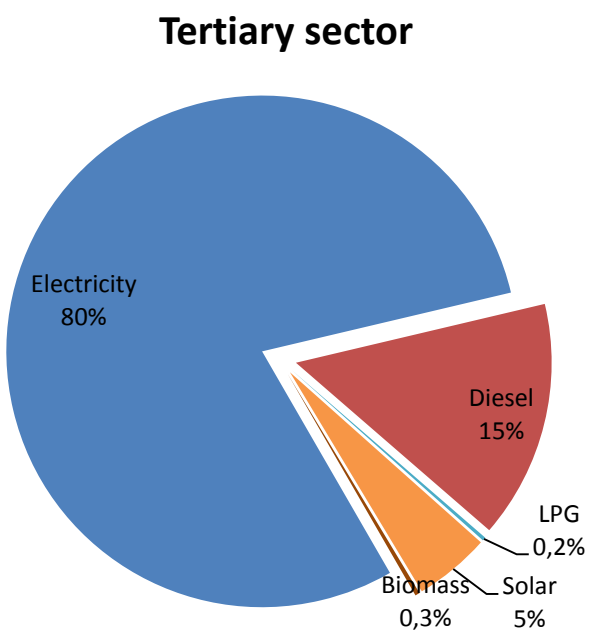


Figure 3.12. Distribution of the tertiary sector FED to the different energy carriers

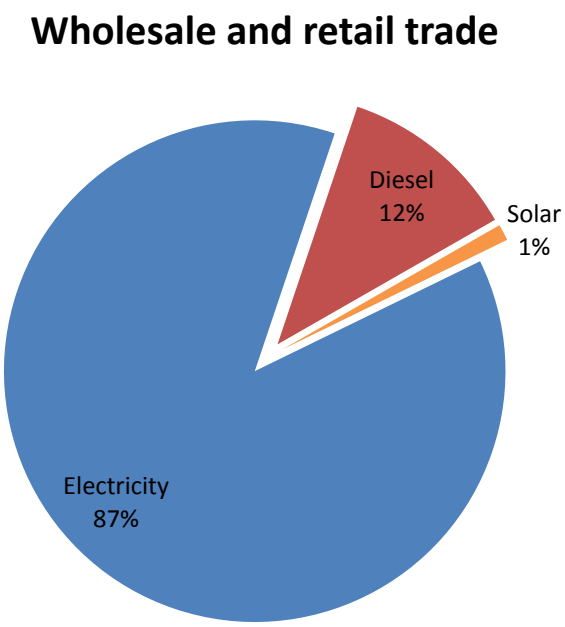


Figure 3.13. Distribution of wholesale and retail trade sector energy demand to the different energy carriers

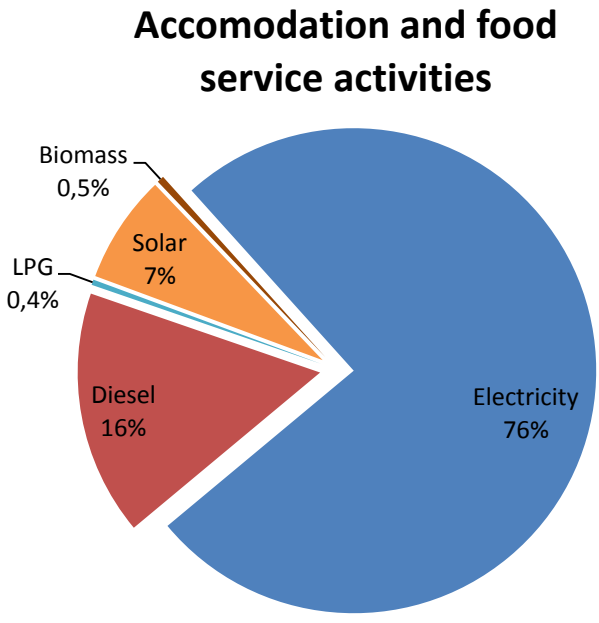


Figure 3.14. Distribution of accommodation and food service activities sector energy demand to the different energy carriers

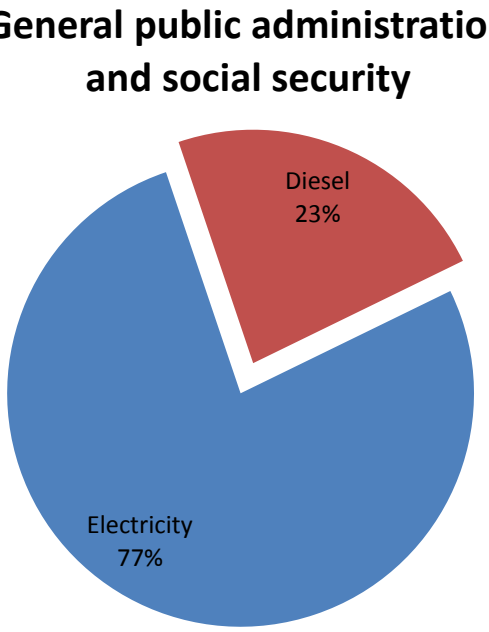


Figure 3.15. Distribution of general public administration and social security sector energy demand to the different energy carriers

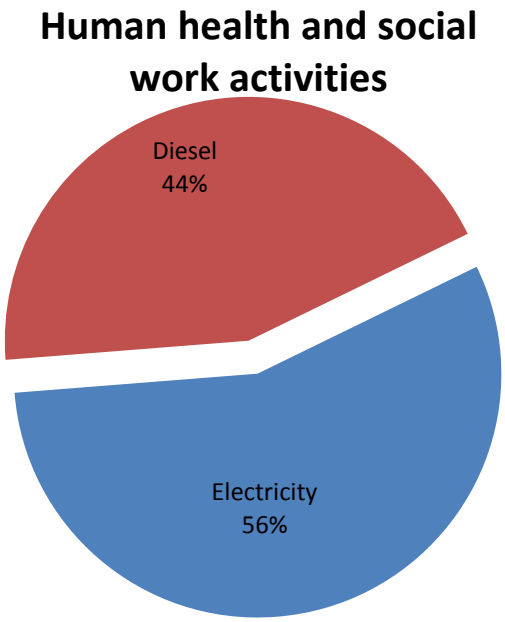


Figure 3.16. Distribution of human health and social work activities sector energy demand to the different energy carriers

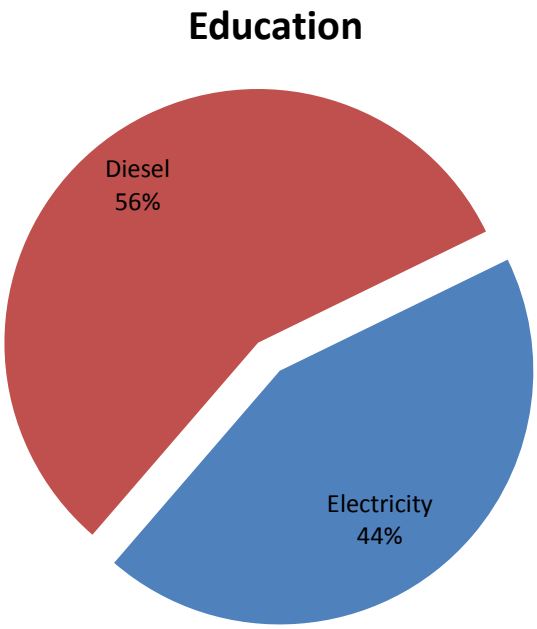


Figure 3.17. Distribution of education sector energy demand to the different energy carriers

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
Transports (vehicles)	**1.947**	**2.872**	**4.819**
Passenger transport by road (public transport, taxi, tourism, transfers, etc.)	86	20	**106**
Freight transport by road and removal services	1.417	327	**1.744**
Other fleet for public and private services	10	114	**124**
Private transports	435	2.412	**2.846**

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

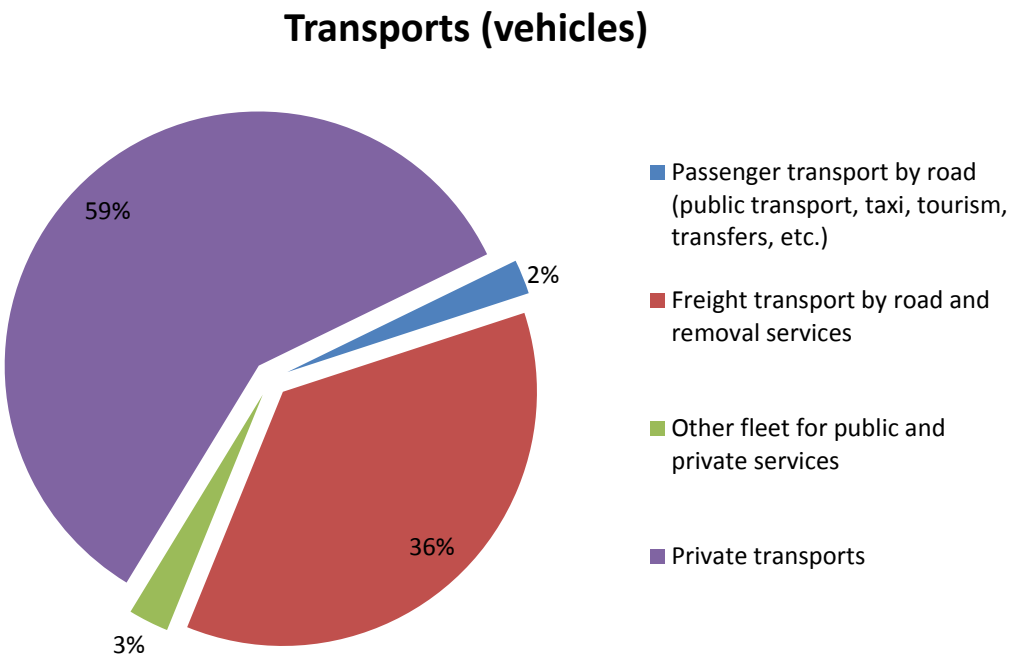


Figure 3.18. Distribution of the transports sector FED to the different sub-sectors

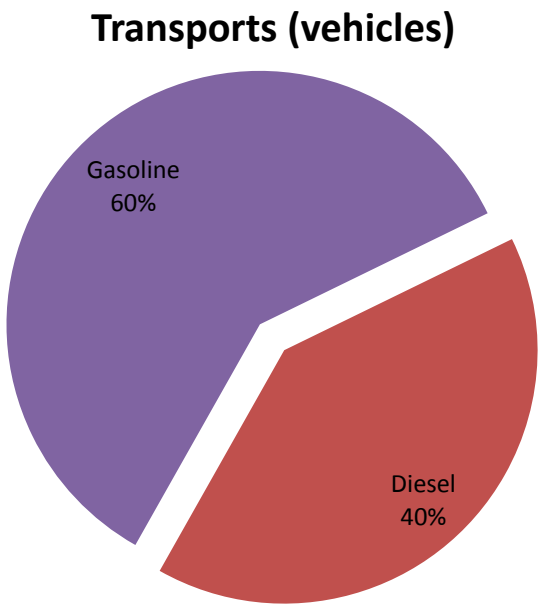


Figure 3.19. Distribution of the tertiary sector FED to the different energy carriers

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	28.288	3.283	6.856	69.152		107.578
Fossil fuels	Fueloil			1.308			1.308
	Diesel	28.964	594	1.367	13.073	1.947	45.946
	Gasoline					2.872	2.872
	LPG	3.588		64	192		3.844
Renewable Energy sources	Solar	3.503		36	4.165		7.704
	Biomass	8.003	678	80	251		9.013
TOTAL		**72.346**	**4.555**	**9.713**	**86.833**	**4.819**	**178.266**

Table 3.6. Final energy demand per sector and energy carrier

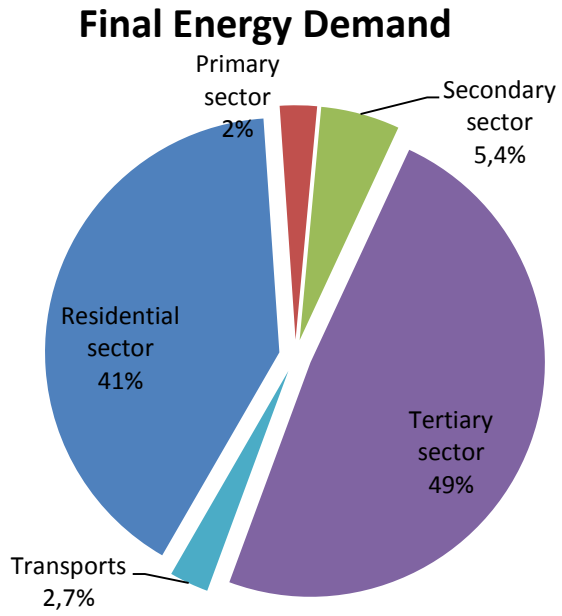


Figure 3.20. Distribution of Final Energy Demand to the different sectors

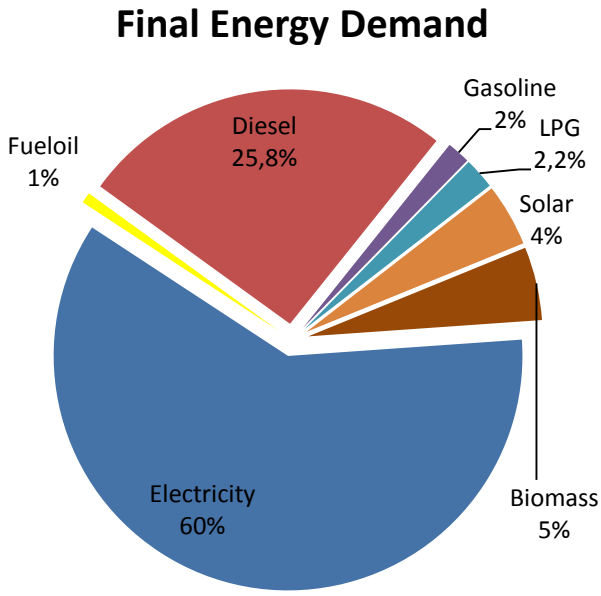


Figure 3.21. Distribution of Final Energy Demand to the different energy carriers

3.1.2. Energy conversion

Santorini 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.

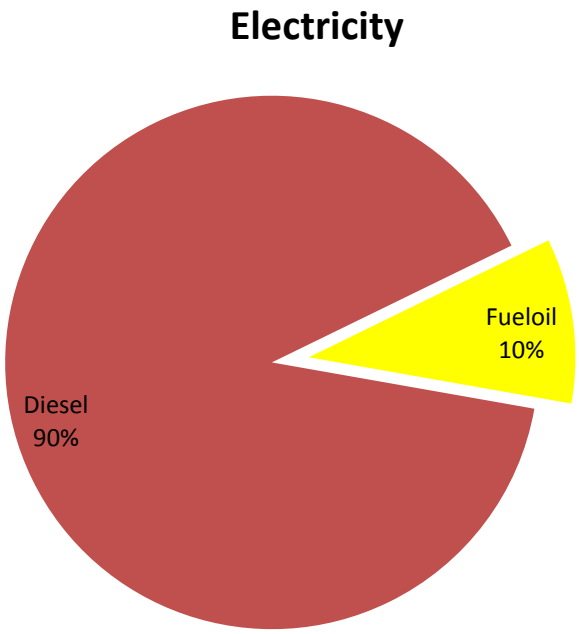


Figure 3.22. Distribution of Final Energy Demand to the different energy carriers

3.1.3. Primary energy demand

Only a fraction of 4,3% 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**	**393.423**
33.582	336.407	2.872	3.844	376.706	
Renewable energy sources [MWh]					
Hydro	Wind	Solar	Biomass	**Sub-total**	
0	0	7.704	9.013	16.717	

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

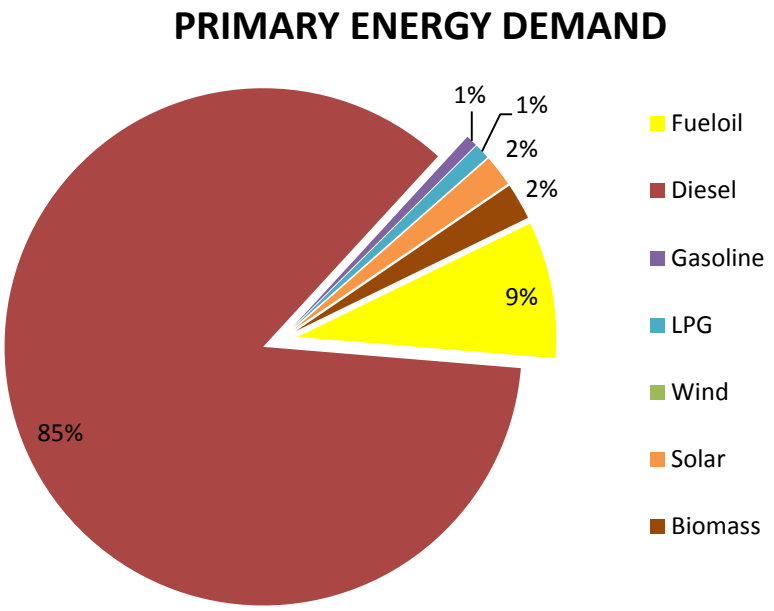


Figure 3.23. Primary energy demand distribution to the different energy carriers

3.1.4. Emissions of carbon dioxide

In the following tables and figures the emitted CO_2 from the locally consumed fossil fuels and the electricity imported are presented. For the latter amounts, the national CO_2 factor for electricity production is employed whereas generally for CO_2 emissions generated by fossil fuels consumption the proposed CO_2 factors from IPCC are used.

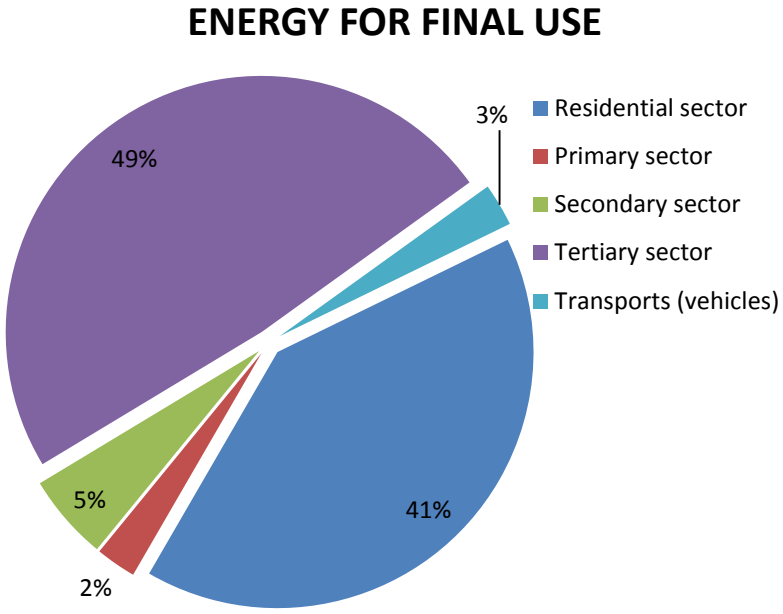


Figure 3.24. Distribution of overall CO2 emissions from final use to the different sectors

Residential sector

	Electricity	Diesel	LPG	Total
Residential sector	**22.760**	**7.733**	**861**	**31.355**
Hot water	3.340	904	0	**4.244**
Heating and cooling	9.571	6.829	519	**16.919**
Lighting	2.736	0	0	**2.736**
Cooking	1.912	0	342	**2.255**
Refrigerator and freezers	2.684	0	0	**2.684**
Laundry machines and dryers	163	0	0	**163**
Dish washing	229	0	0	**229**
Tv sets	212	0	0	**212**
Other electric appliances	1.912	0	0	**1.912**

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

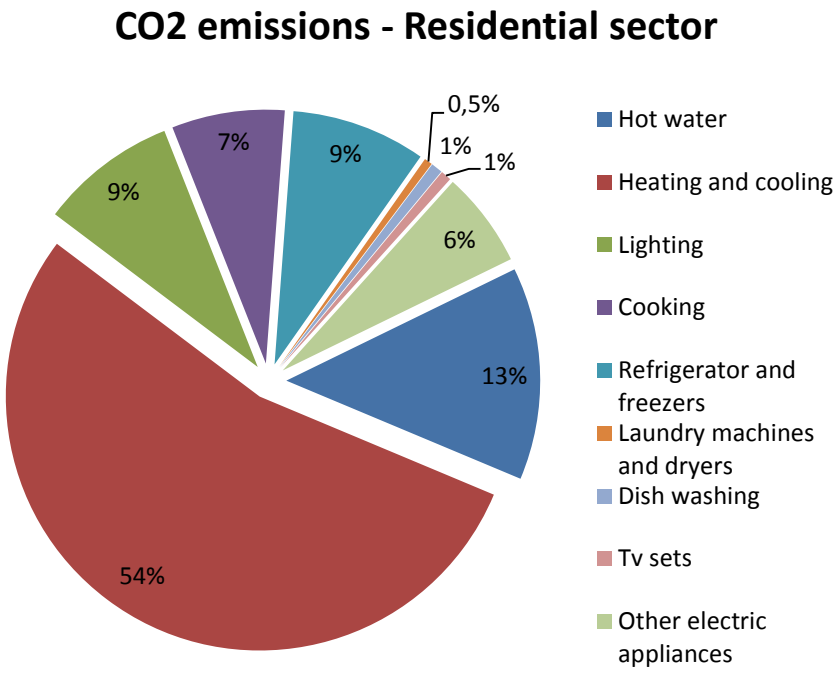


Figure 3.25. CO2 emissions from final use in the residential sector

Primary sector

	Electricity	Diesel	Total
Primary sector	**2.641**	**159**	**2.800**
Agriculture, forestry and fishing	2.641	159	**2.800**

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

Secondary sector

	Electricity	Fueloil	Diesel	LPG	Total
Secondary sector	**5.517**	**365**	**365**	**15**	**6.262**
Manufacturing	659	128	128	15	**930**
Water supply, sewerage, waste management and remediation activities	3.633	0	0	0	**3.633**
Construction	1.225	237	237	0	**1.699**

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

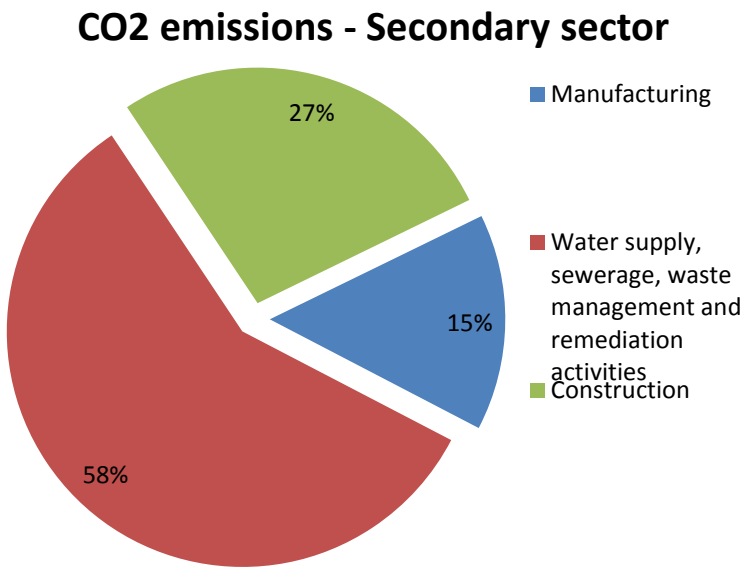


Figure 3.26. CO2 emissions from final use in the secondary sector

Tertiary sector

	Electricity	Diesel	LPG	Total
Tertiary sector	**55.639**	**3.490**	**46**	**59.176**
Wholesale and retail trade; repair of motor vehicles and motorcycles	10.625	466	0	**11.092**
Accommodation and food service activities	32.622	2.338	46	**35.006**
General public administration and social security	1.124	111	0	**1.236**
Education	0	0	0	**0**
Human health and social work activities	429	185	0	**614**
Other services	32	8	0	**40**
Public lighting	8.694	382	0	**9.075**

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

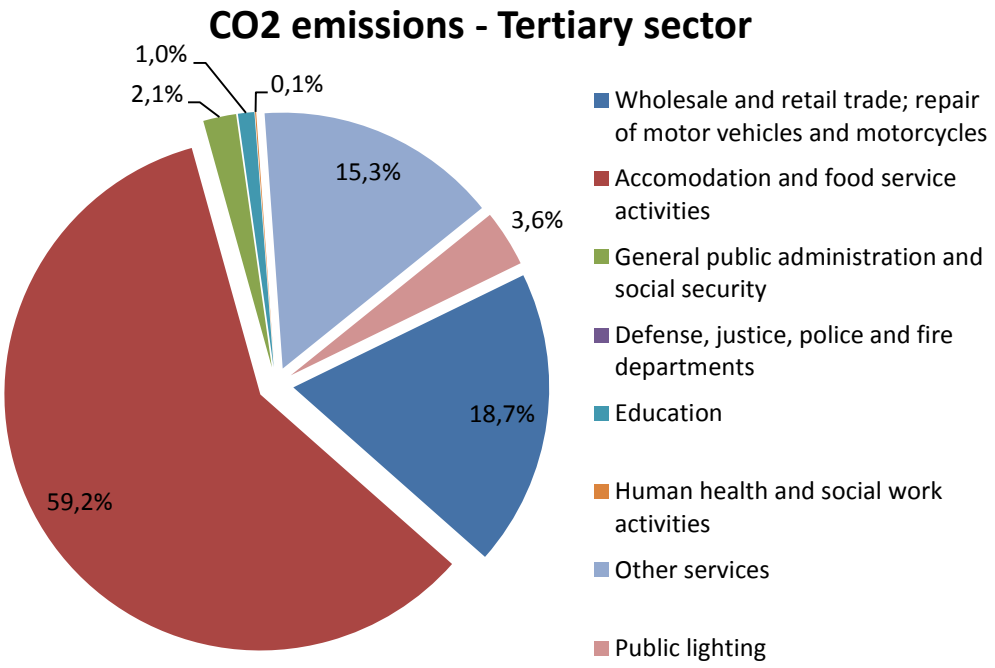


Figure 3.27. CO2 emissions from final use in the tertiary sector

Transports sector

	Diesel	Gasoline	Total
Transports (vehicles)	**520**	**715**	**1.235**
Passenger transport by road (public transport, taxi, tourism, transfers, etc.)	23	5	**28**
Freight transport by road and removal services	378	81	**460**
Other fleet for public and private services	3	28	**31**
Private transports	116	601	**717**

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

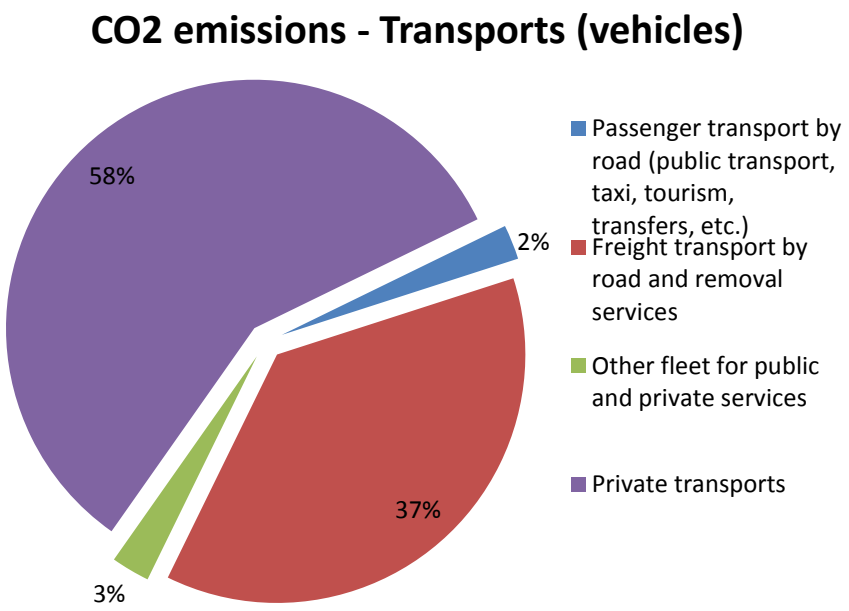


Figure 3.28. CO2 emissions from final use in the transports sector

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_2 emissions from final use from the base year 2005 till the target year 2020 are presented, showing an expected increase of 60% and 61% respectively.

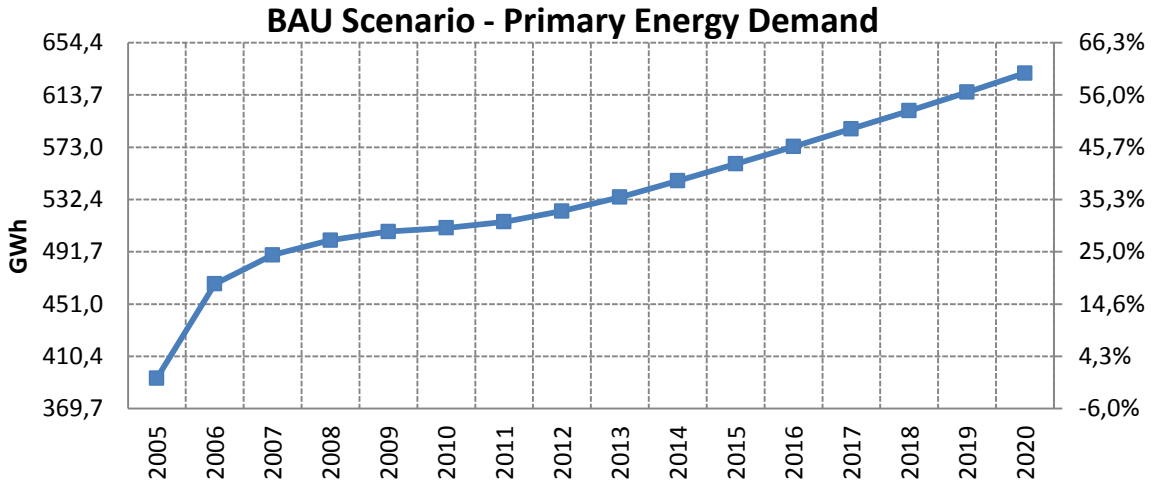


Figure 3.29. BAU Scenario – Growing trend of Primary Energy Demand

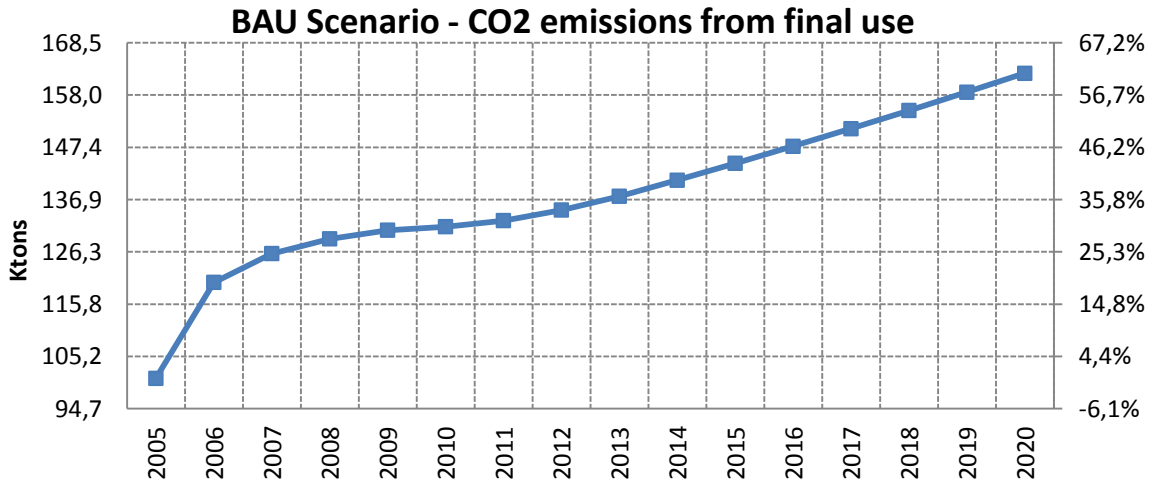


Figure 3.30. BAU Scenario – Growing trend of CO_2 emissions from final use

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.

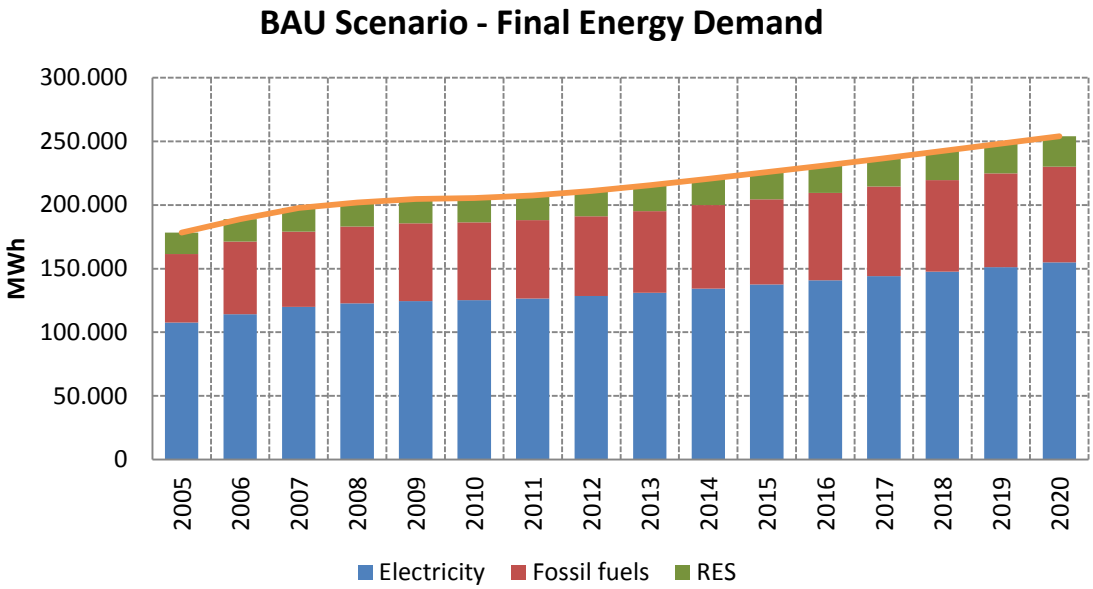
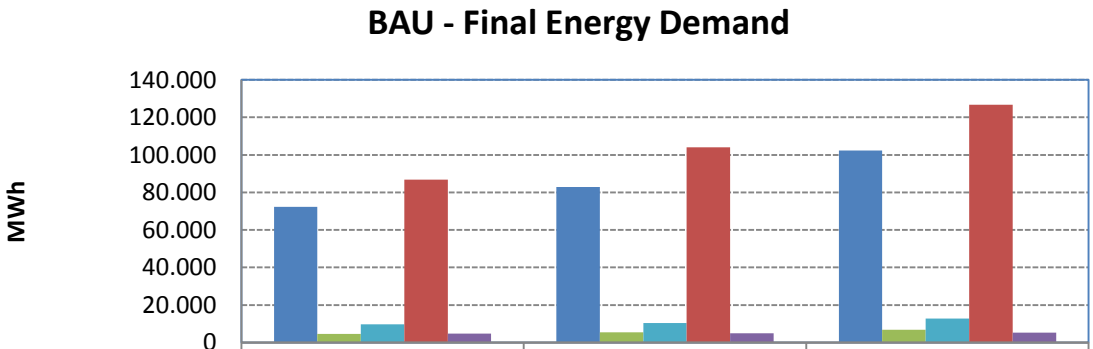


Figure 3.31. BAU Scenario – Final Energy Demand per energy source



	2005	2011	2020
Residential sector	72.346	82.811	102.390
Primary sector	4.555	5.469	6.761
Secondary sector	9.713	10.335	12.841
Tertiary sector	86.833	104.033	126.753
Transports sector	4.819	4.881	5.259

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 (61%) and diesel (26%) will account for more than 85% of the total demand with the residential (40%) and tertiary (50%) 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.

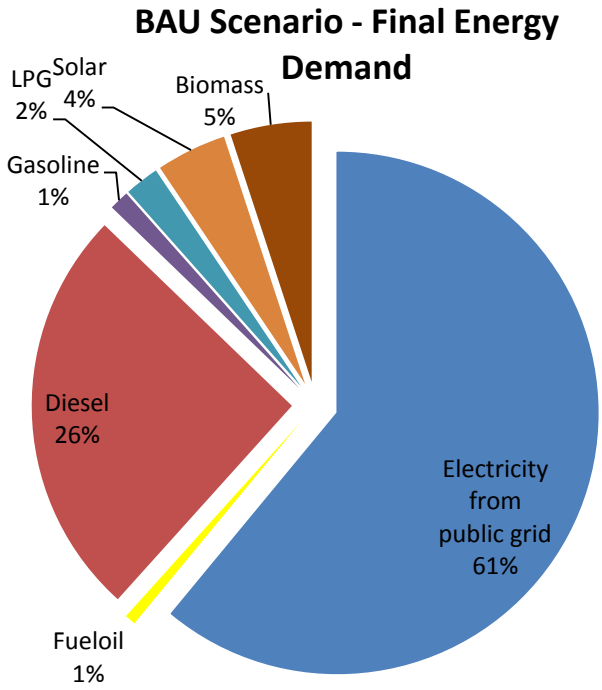


Figure 3.33. BAU Scenario – Final Energy Demand per energy carrier in 2020

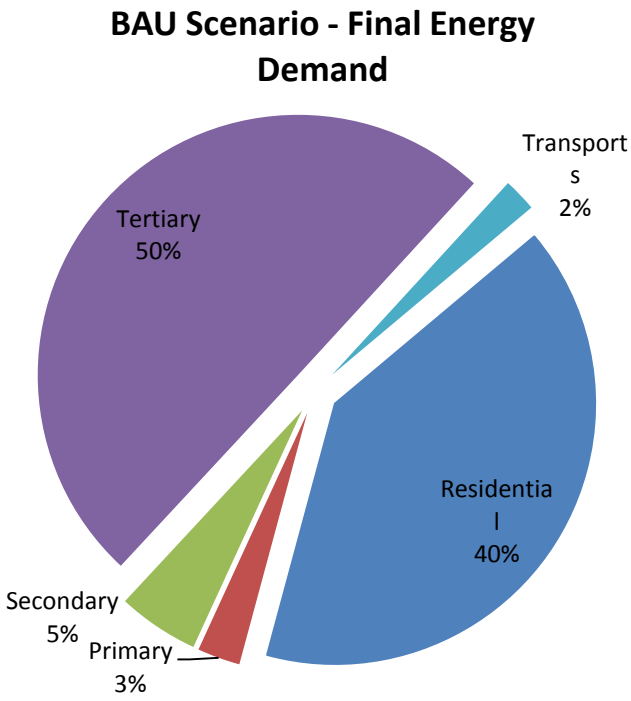


Figure 3.34. BAU Scenario – Final Energy Demand per sector in 2020

Energy carrier		Residential [MWh]	Primary sector [MWh]	Secondary sector [MWh]	Tertiary sector [MWh]	Transports [MWh]	TOTAL [MWh]
Centralized Energy services	Electricity	40.036	4.872	9.064	100.941		**154.913**
Fossil fuels	Fueloil			1.730			**1.730**
	Diesel	40.993	882	1.808	19.068	2.125	**64.875**
	Gasoline					3.134	**3.134**
	LPG	5.077		85	282		**5.444**
Renewable Energy sources	Solar	4.957		48	6.095		**11.100**
	Biomass	11.327	1.007	106	368		**12.808**
TOTAL		**102.390**	**6.761**	**12.841**	**126.753**	**5.259**	**254.004**

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

3.2.2. Energy conversion

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

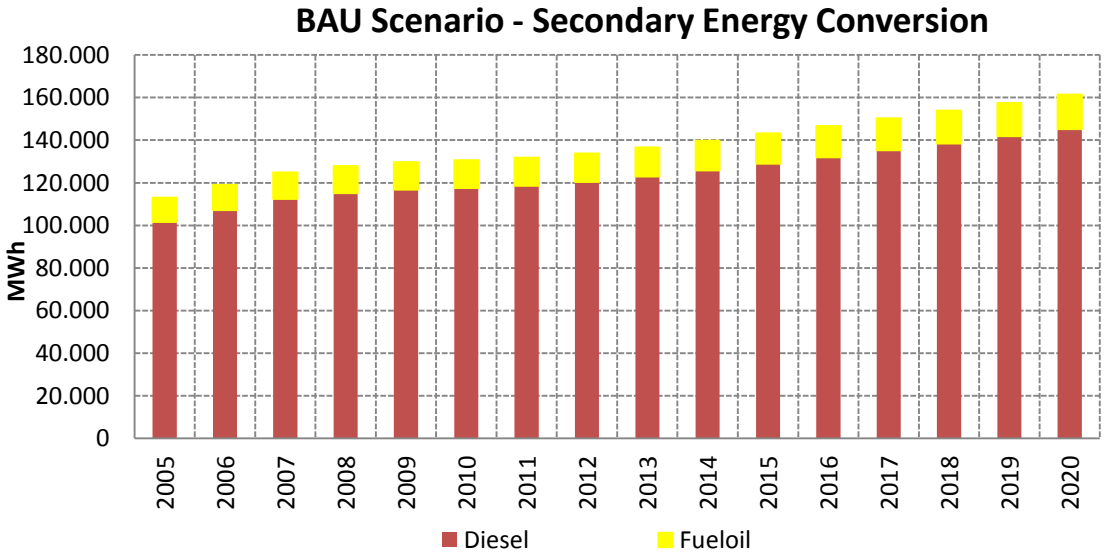


Figure 3.35. BAU Scenario – Secondary Energy Conversion

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.

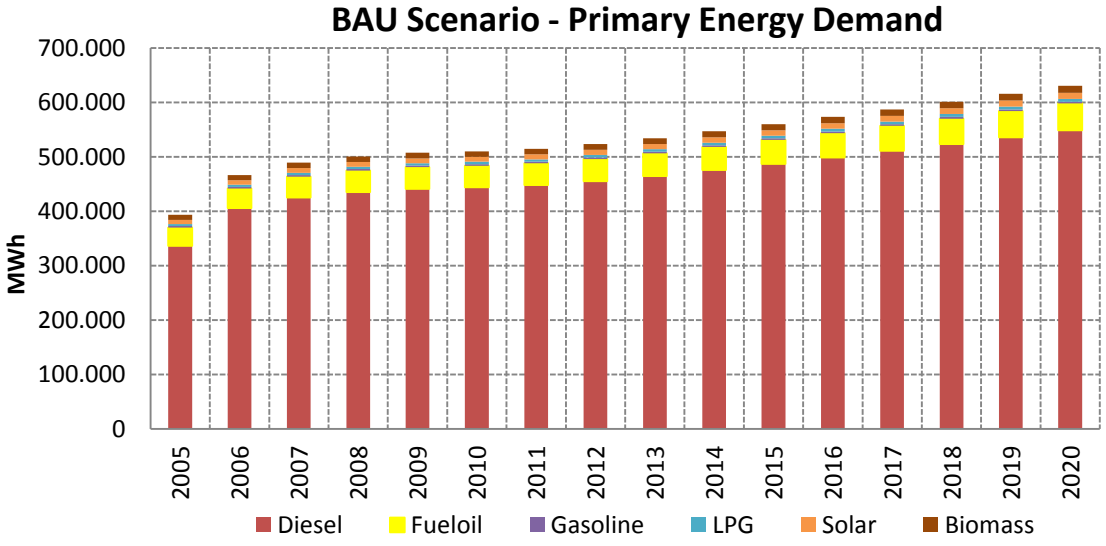


Figure 3.36. BAU Scenario – Primary Energy Demand projections per energy carrier

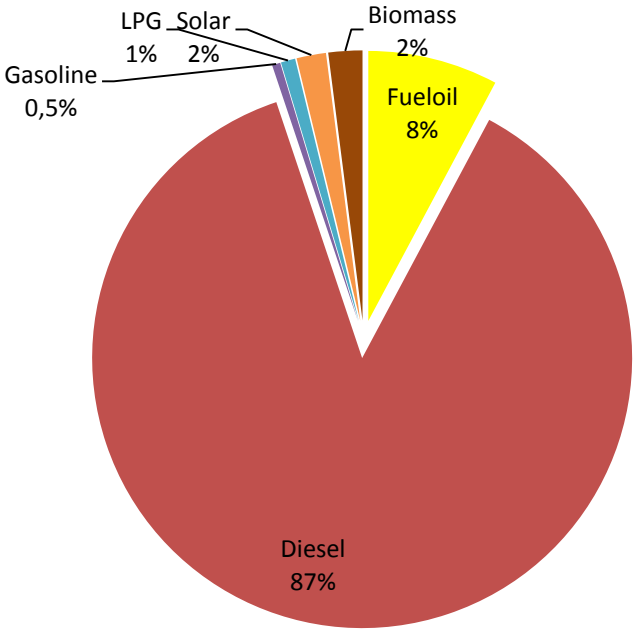
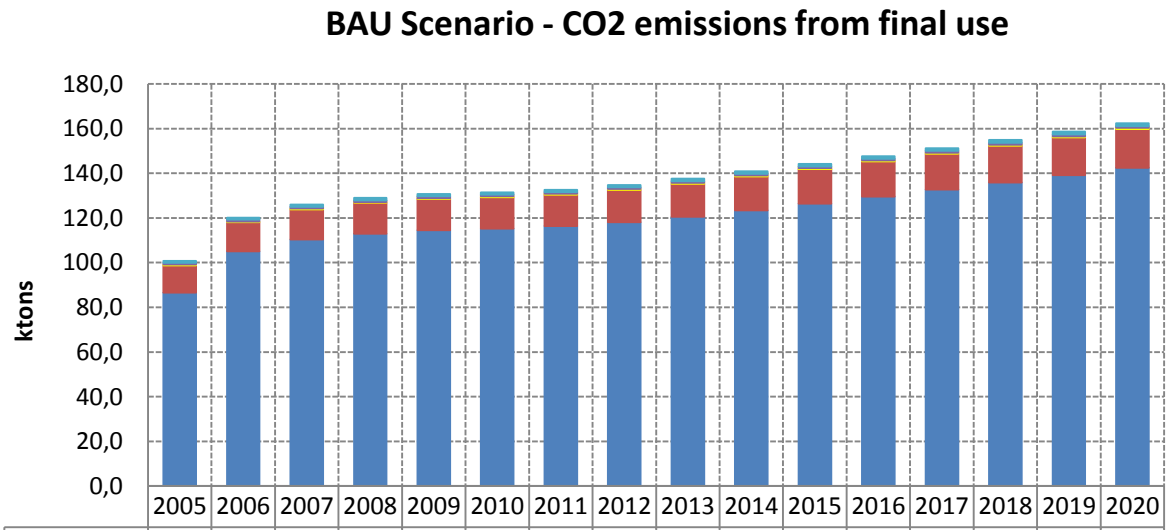


Figure 3.37. BAU Scenario – Primary Energy Demand per energy carrier in 2020

3.2.4. Emissions of carbon dioxide

In the following figures and tables the BAU scenario CO_2 emissions from final use per energy carrier and activity sector are presented.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
LPG	0,9	1,0	1,0	1,0	1,0	1,0	1,1	1,1	1,1	1,1	1,2	1,2	1,2	1,2	1,3	1,3
Gasoline	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,8	0,8	0,8	0,8	0,8
Fueloil	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,5	0,5	0,5
Diesel	12,3	13,0	13,5	13,8	13,9	14,0	14,1	14,4	14,7	15,1	15,4	15,8	16,2	16,5	16,9	17,3
Electricity	86,6	105,	110,	113,	114,	115,	116,	118,	120,	123,	126,	129,	132,	135,	139,	142,

Figure 3.38. BAU Scenario – CO_2 emissions from final use projections per energy carrier

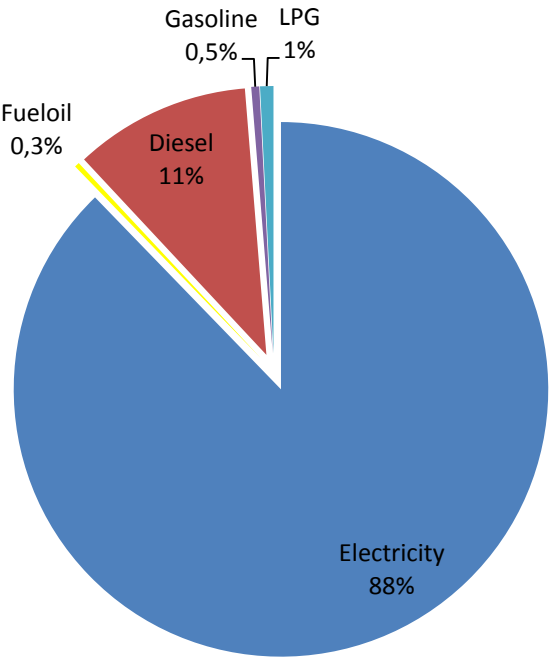
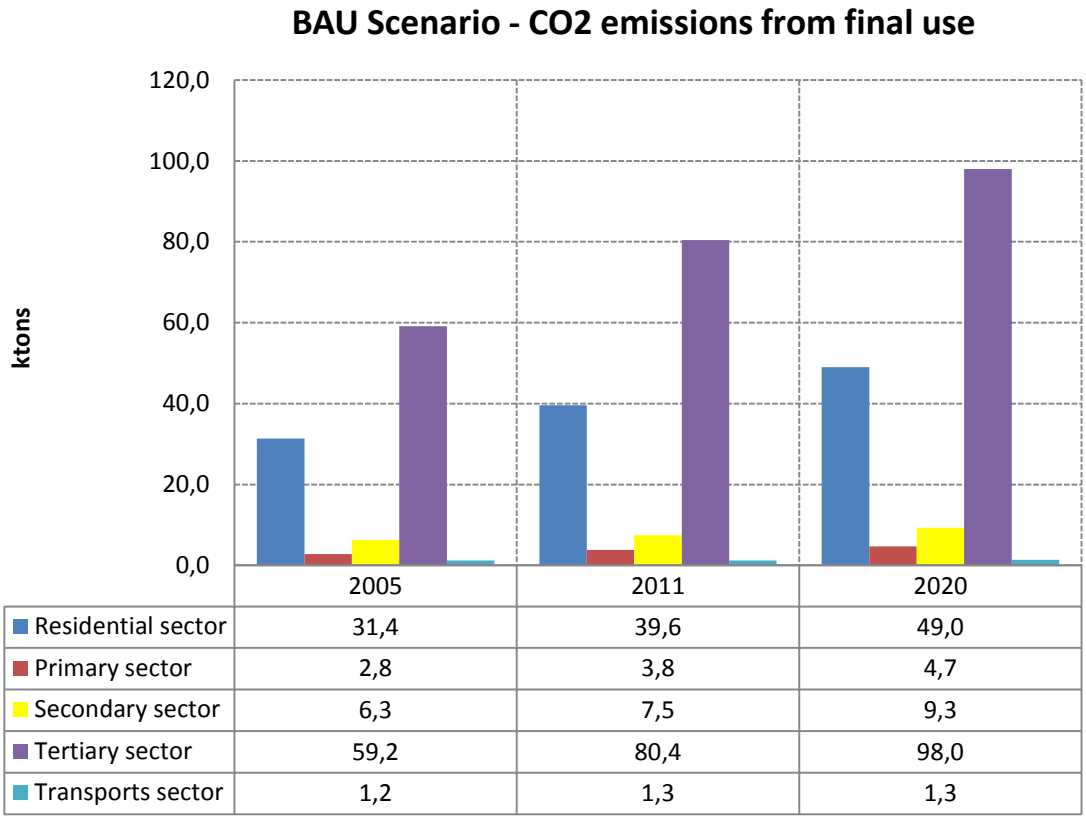


Figure 3.39. BAU Scenario – CO_2 emissions from final use per energy carrier in 2020



	2005	2011	2020
Residential sector	31,4	39,6	49,0
Primary sector	2,8	3,8	4,7
Secondary sector	6,3	7,5	9,3
Tertiary sector	59,2	80,4	98,0
Transports sector	1,2	1,3	1,3

Figure 3.40. BAU Scenario – CO_2 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 43% and the CO_2 by at least 30% in 2020 in comparison to the BAU scenario. However, in comparison to the baseline year (2005) values, the respective magnitudes will be increased by 17% and 12% respectively, as presented in the following figures. Although the goal is rather ambitious the future goal of the Municipality of Milos is to proceed to even more radical action planning that will result also to a net reduction of CO_2 emissions in comparison to the baseline year in accordance to the EU goals, which for Greece is set to 4% reduction of GHG emissions by 2020 in comparison to 2005.

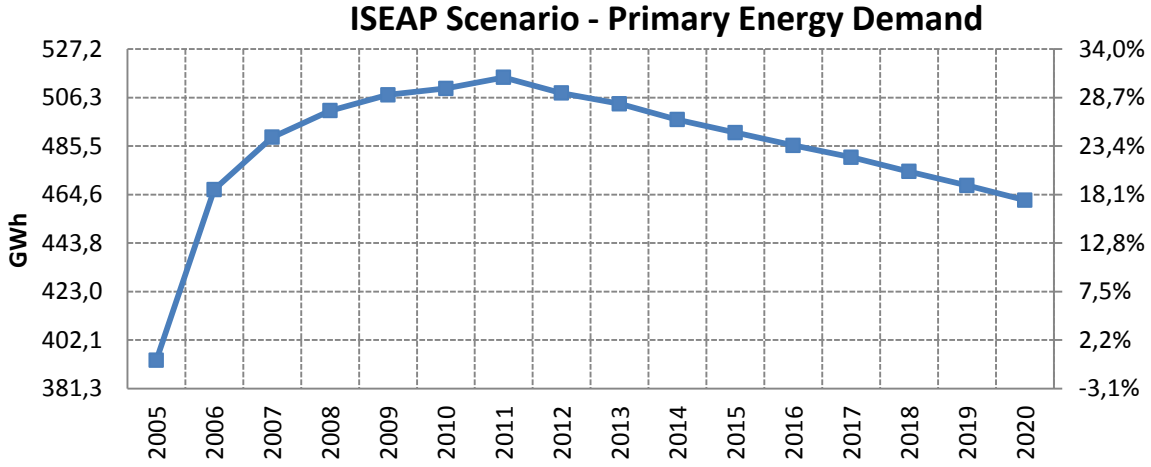


Figure 3.41. ISEAP Scenario – Growing trend of Primary Energy Demand

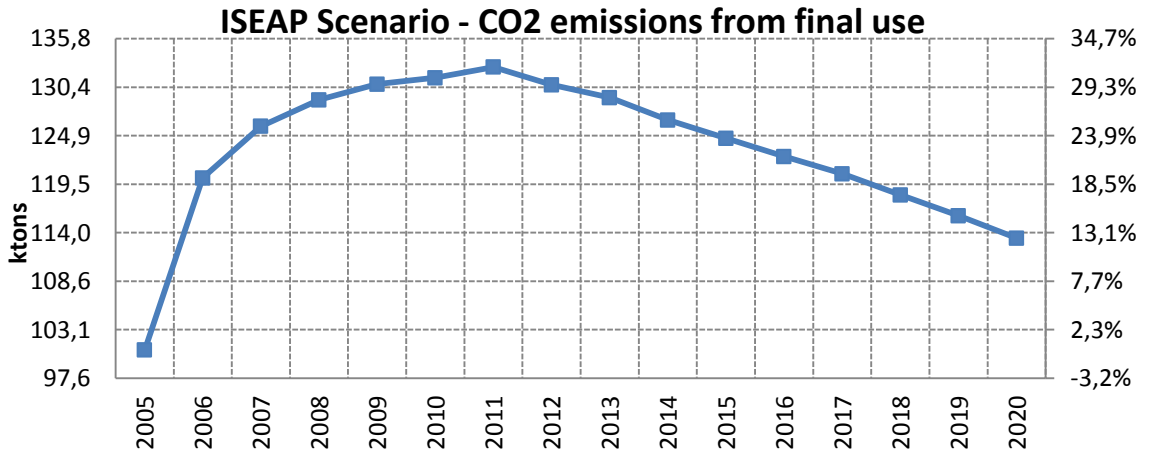


Figure 3.42. ISEAP Scenario – Growing trend of CO_2 emissions from final use

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 (7,7%), the tertiary (15%,3) and transports (32,7%) sectors (see Figure 3.44).

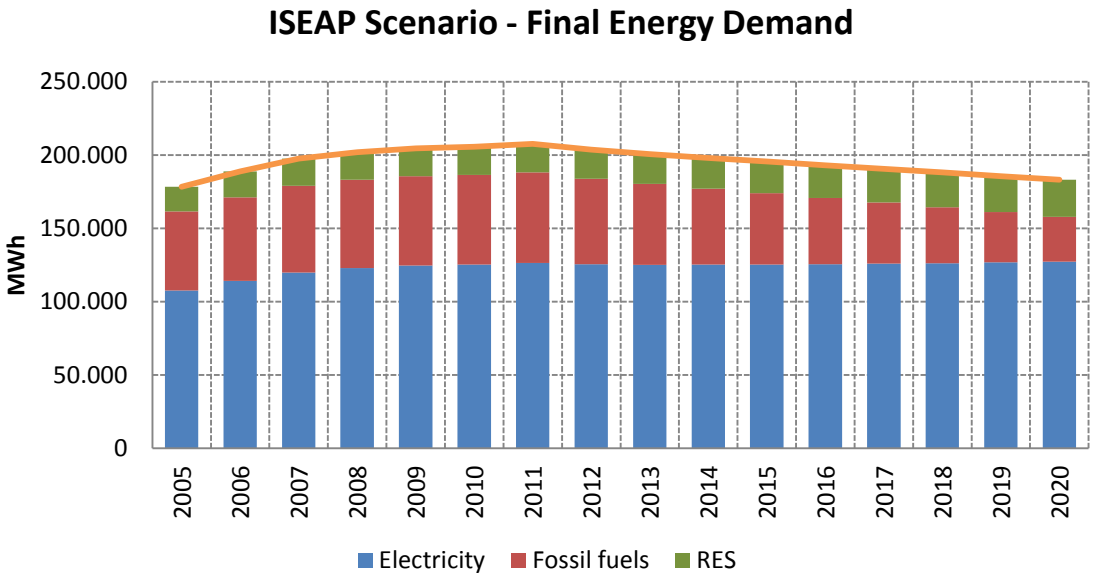
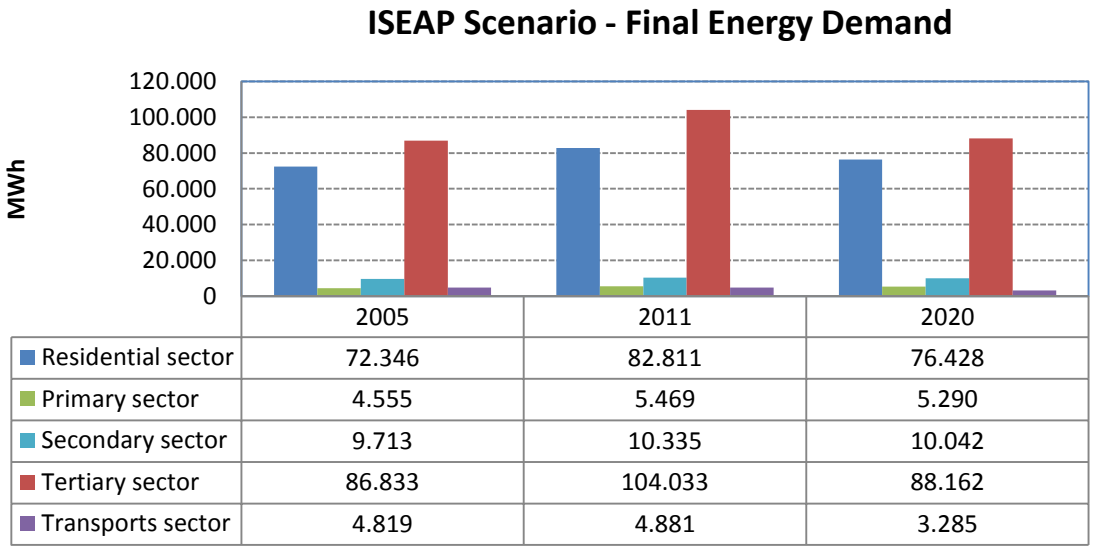


Figure 3.43. ISEAP Scenario – Final Energy Demand per energy source



	2005	2011	2020
Residential sector	72.346	82.811	76.428
Primary sector	4.555	5.469	5.290
Secondary sector	9.713	10.335	10.042
Tertiary sector	86.833	104.033	88.162
Transports sector	4.819	4.881	3.285

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 (69%) of the demand in comparison to the BAU scenario (61%) replacing a significant part of the diesel consumption (13% from 26% 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 82% 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	39.390	3.812	7.089	76.547	451	**127.290**
Fossil fuels	Fueloil			1.353			**1.353**
	Diesel	15.354	690	1.414	4.693	1.244	**23.395**
	Gasoline					1.590	**1.590**
	LPG	3.920		67	185		**4.172**
Renewable Energy sources	Solar	8.749		37	6.495		**15.282**
	Biomass	9.015	788	83	241		**10.126**
TOTAL		**76.428**	**5.290**	**10.042**	**88.162**	**3.285**	**183.208**

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.

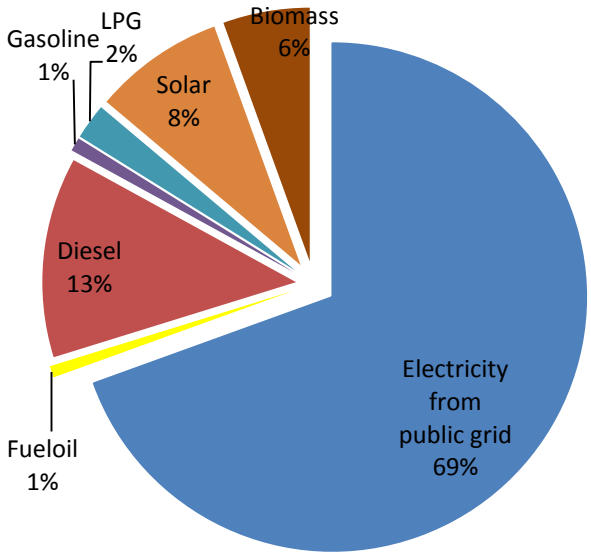


Figure 3.45. ISEAP Scenario – Final Energy Demand per energy carrier in 2020

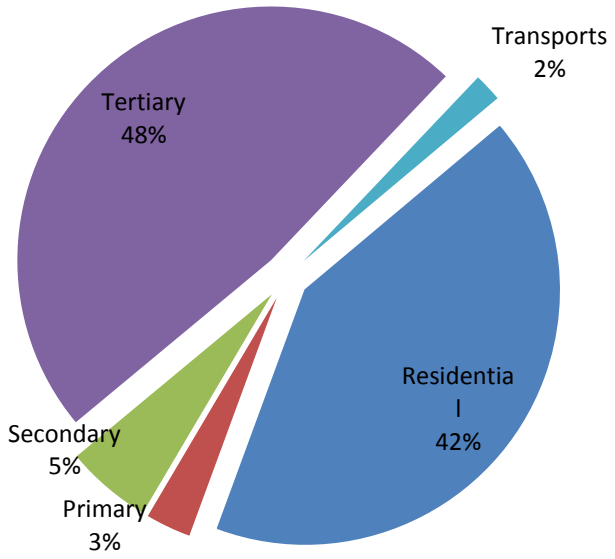


Figure 3.46. ISEAP Scenario – Final Energy Demand per sector in 2020

Energy carrier		Residential [MWh]	Primary sector [MWh]	Secondary sector [MWh]	Tertiary sector [MWh]	Transports [MWh]	TOTAL [MWh]
Centralized Energy services	Electricity	39.390	3.812	7.089	76.547	451	**127.290**
Fossil fuels	Fueloil			1.353			**1.353**
	Diesel	15.354	690	1.414	4.693	1.244	**23.395**
	Gasoline					1.590	**1.590**
	LPG	3.920		67	185		**4.172**
Renewable Energy sources	Solar	8.749		37	6.495		**15.282**
	Biomass	9.015	788	83	241		**10.126**
TOTAL		**76.428**	**5.290**	**10.042**	**88.162**	**3.285**	**183.208**

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 2014 and significant increase in wind turbine installation starting also in 2014. By 2020 the island is expected to cover almost 10% of the electricity demand from locally installed PV and wind power stations.

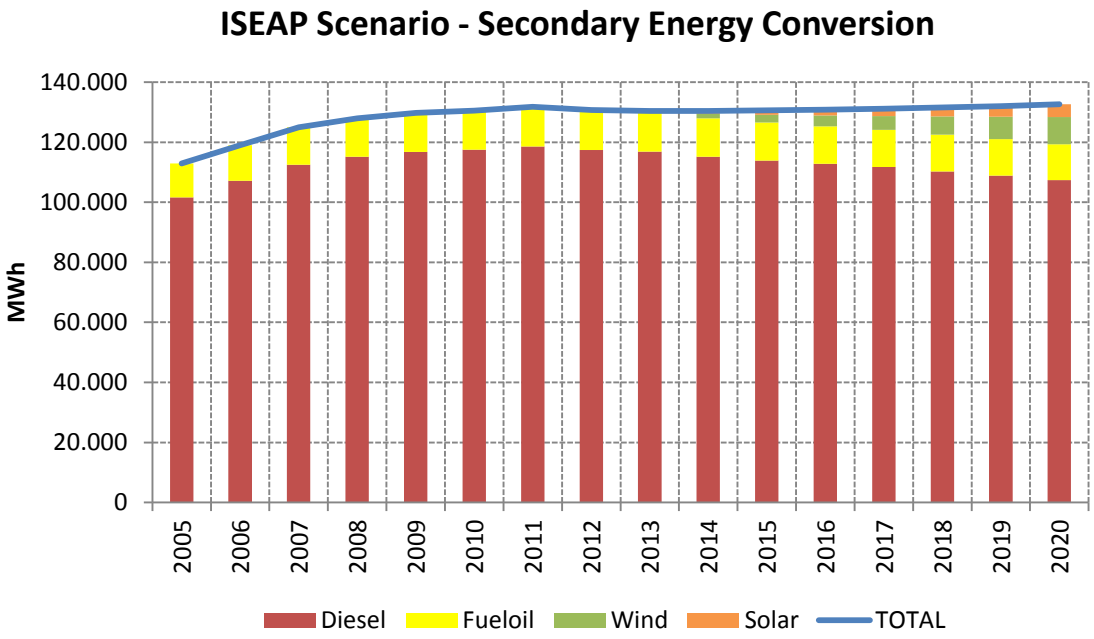


Figure 3.47. ISEAP Scenario – Growth trend of Secondary Energy Conversion

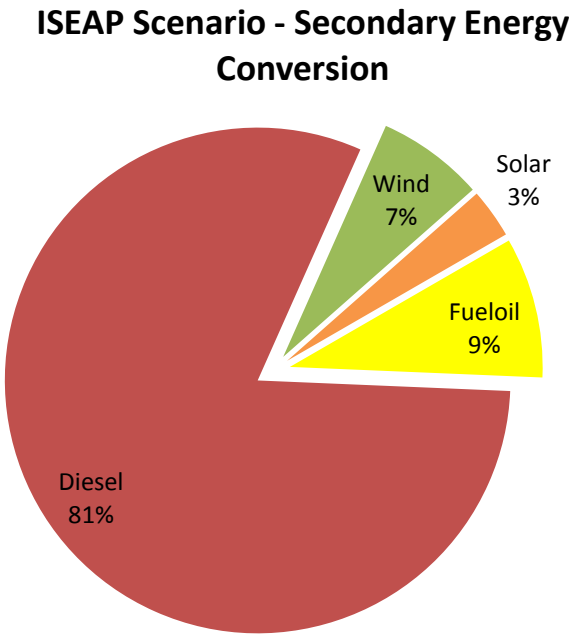


Figure 3.48. ISEAP Scenario – Secondary Energy Conversion per energy carrier in 2020

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.

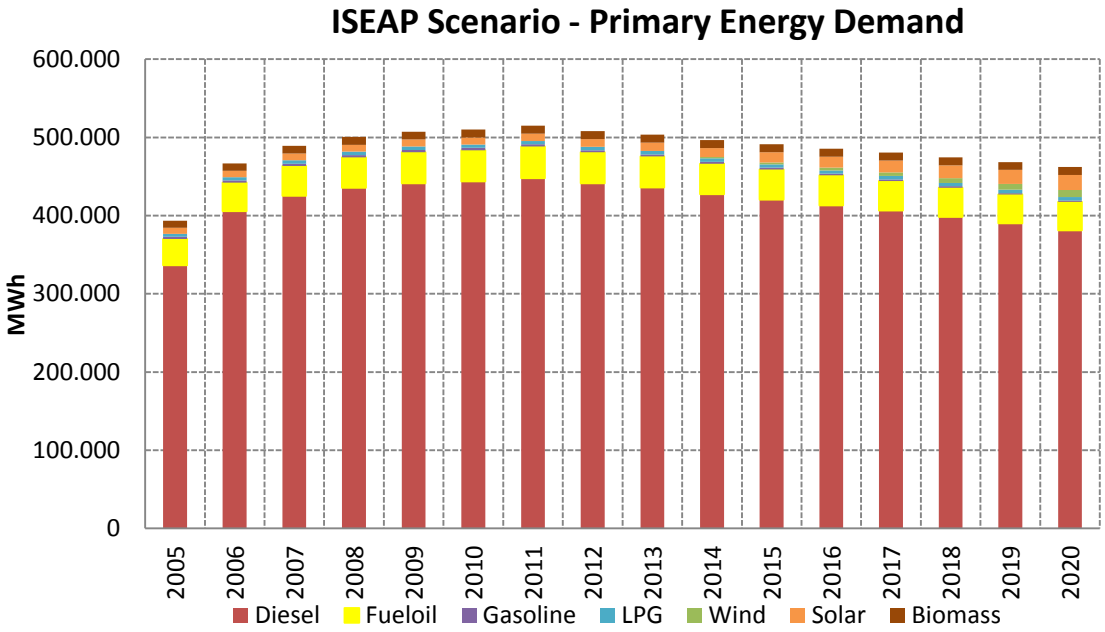


Figure 3.49. ISEAP Scenario – Growth trend of Primary Energy Demand per energy carrier

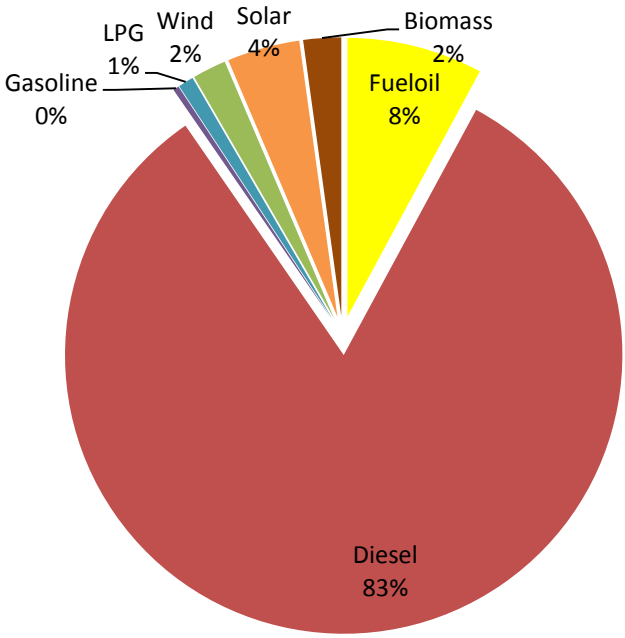
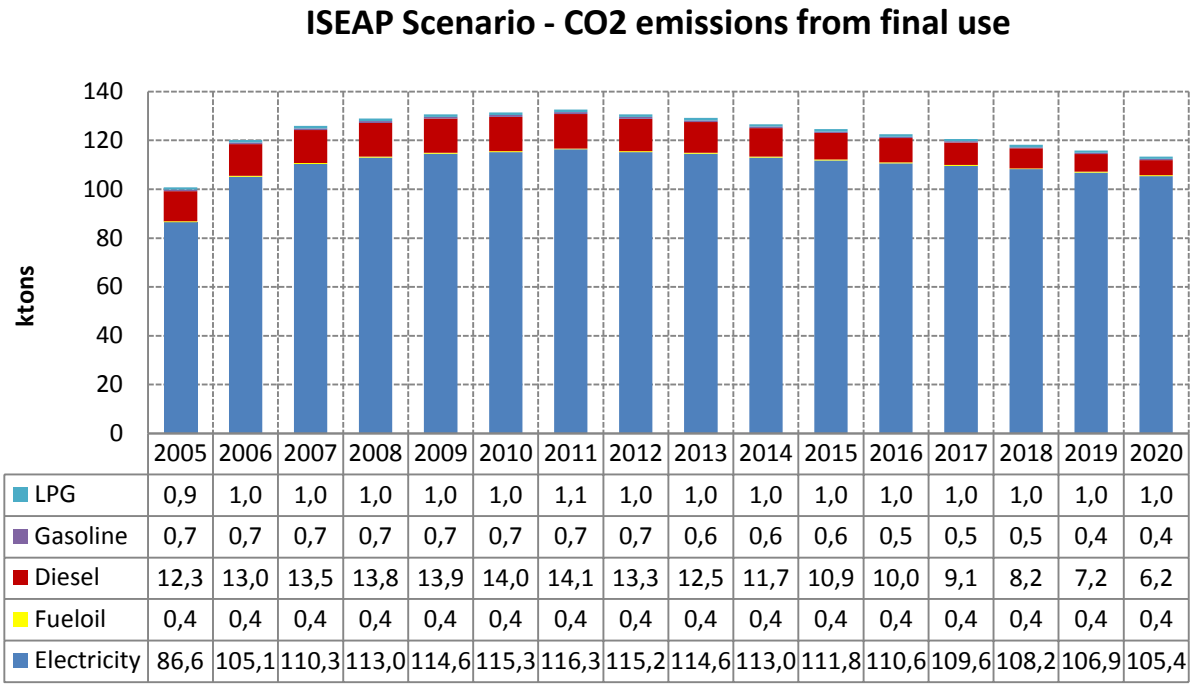


Figure 3.50. ISEAP Scenario – Primary Energy Demand per energy carrier in 2020

3.3.4. Emissions of carbon dioxide

In the following figures and tables the ISEAP scenario CO_2 emissions from final use per energy carrier and activity sector are presented. The share of CO_2 emissions resulting from the use of electricity (93%) is increased in comparison to the BAU scenario (88%) mainly because of the rapid decrease in the use of diesel for heating and the introduction of electrical vehicles.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
LPG	0,9	1,0	1,0	1,0	1,0	1,0	1,1	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Gasoline	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,6	0,6	0,6	0,5	0,5	0,5	0,4	0,4
Diesel	12,3	13,0	13,5	13,8	13,9	14,0	14,1	13,3	12,5	11,7	10,9	10,0	9,1	8,2	7,2	6,2
Fueloil	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4
Electricity	86,6	105,1	110,3	113,0	114,6	115,3	116,3	115,2	114,6	113,0	111,8	110,6	109,6	108,2	106,9	105,4

Figure 3.51. ISEAP Scenario – Growth trend of CO_2 emissions from final use per energy carrier

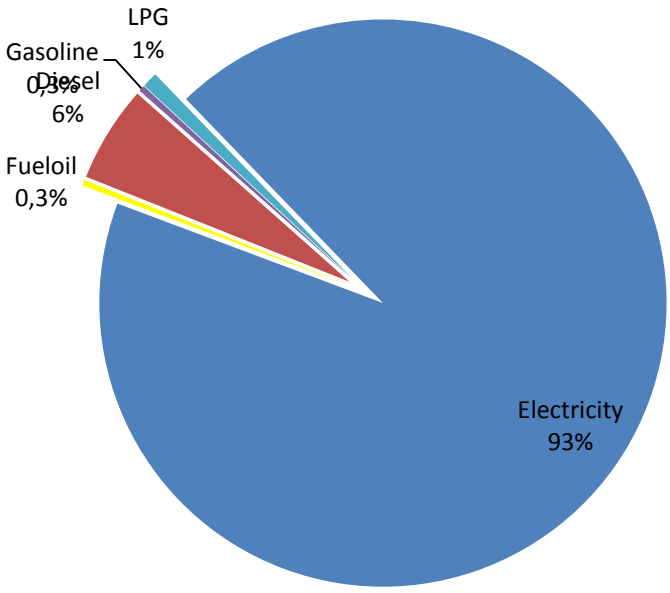
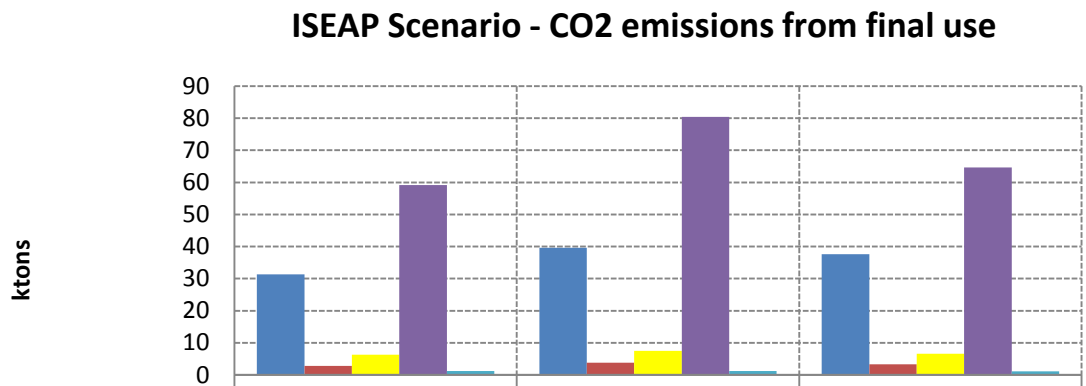


Figure 3.52. ISEAP Scenario – CO_2 emissions from final use per energy carrier in 2020



	2005	2011	2020
Residential sector	31,4	39,6	37,6
Primary sector	2,8	3,8	3,3
Secondary sector	6,3	7,5	6,6
Tertiary sector	59,2	80,4	64,7
Transports sector	1,2	1,3	1,1

Figure 3.53. ISEAP Scenario – CO_2 emissions from final use projections per sector

The contribution of each activity sector in the reduction of CO_2 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.

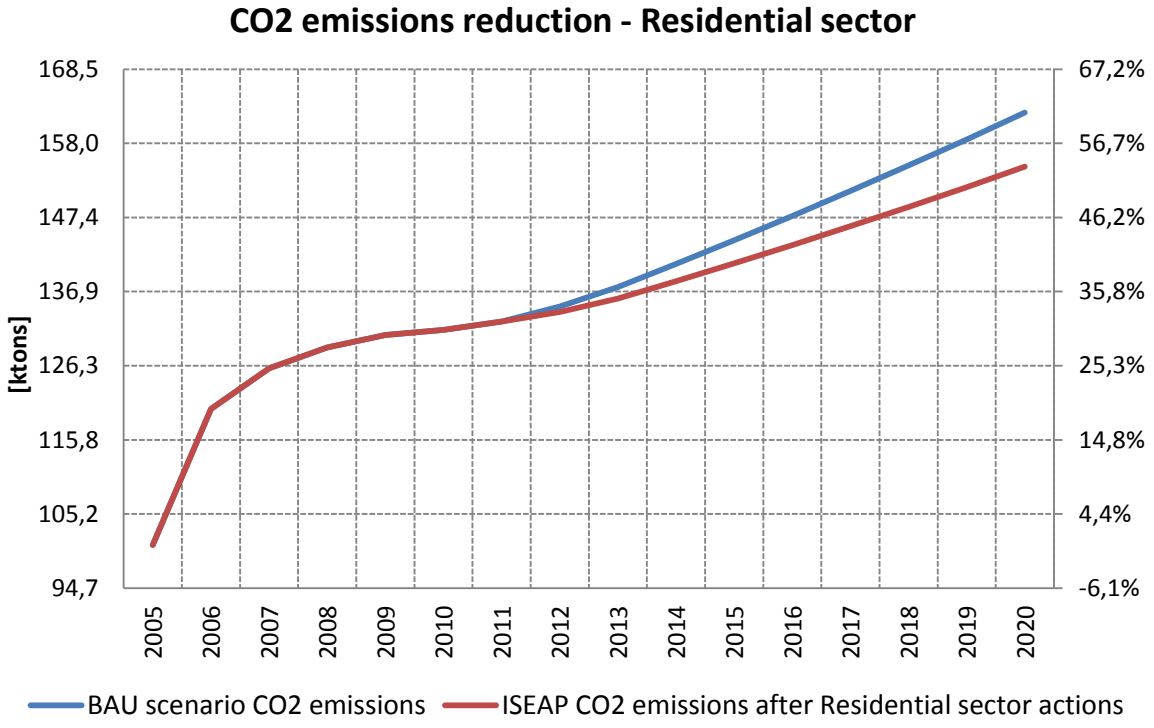


Figure 3.54. Comparison of CO_2 emissions from final use between BAU and ISEAP Scenarios in the residential sector

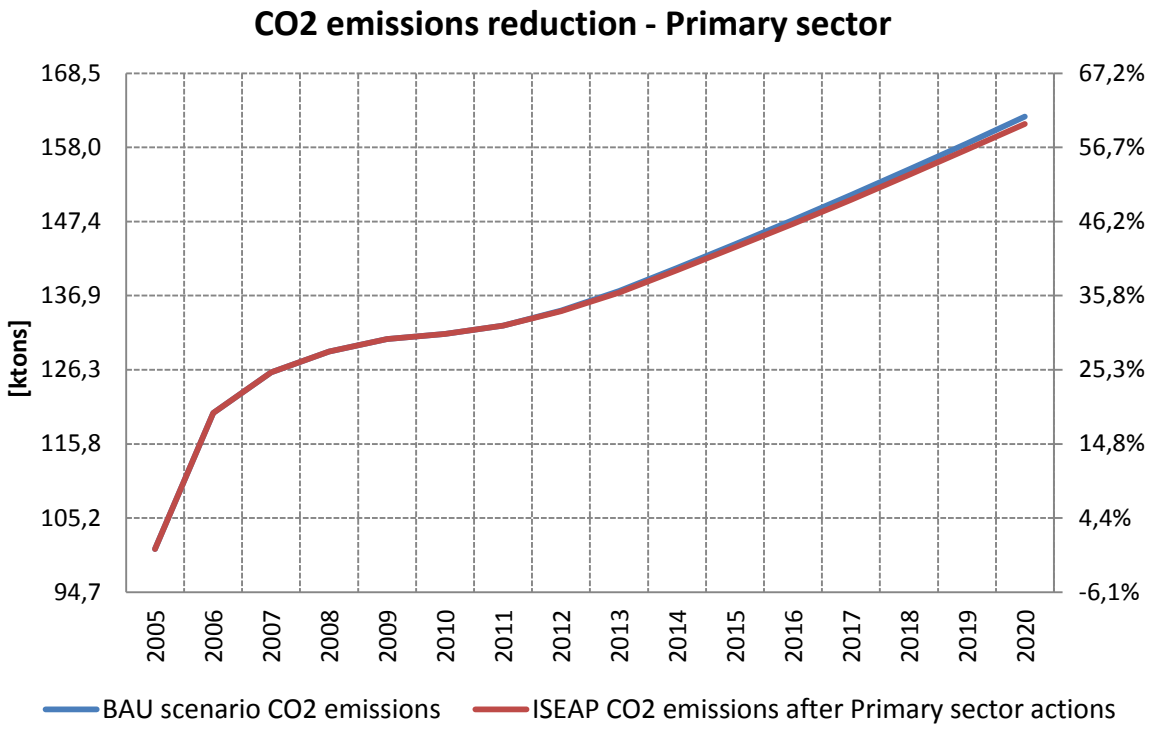


Figure 3.55. Comparison of CO_2 emissions from final use between BAU and ISEAP Scenarios in the primary sector

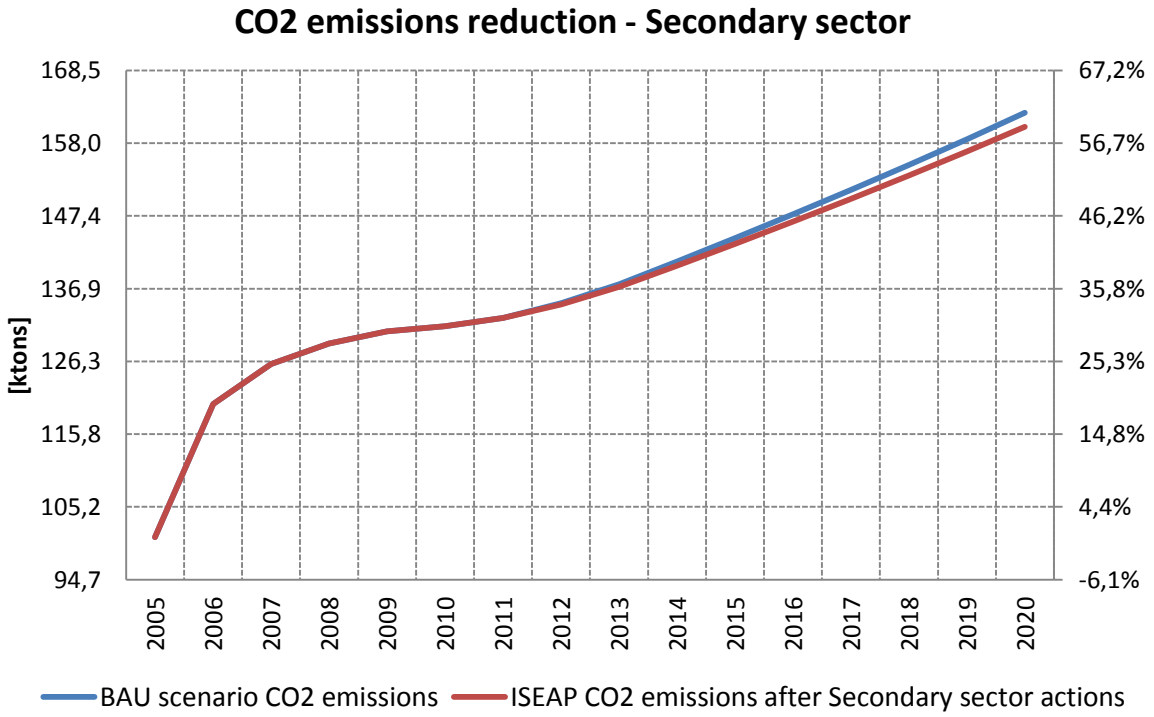


Figure 3.56. Comparison of CO_2 emissions from final use between BAU and ISEAP Scenarios in the secondary sector

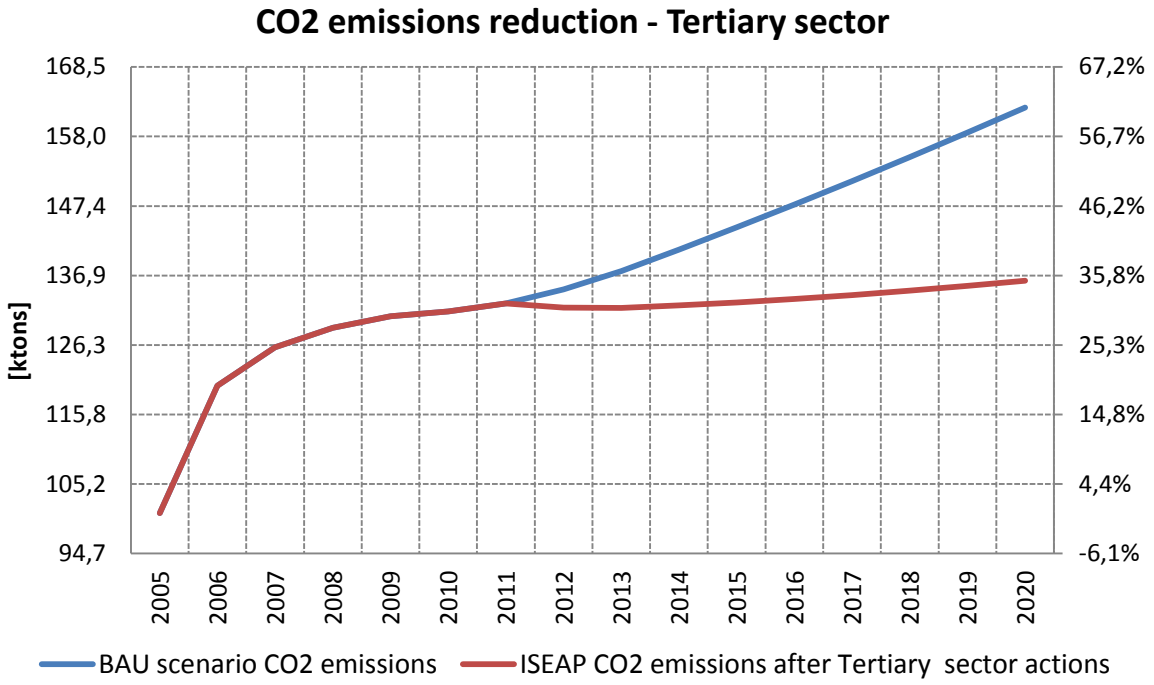


Figure 3.57. Comparison of CO_2 emissions from final use between BAU and ISEAP Scenarios in the tertiary sector

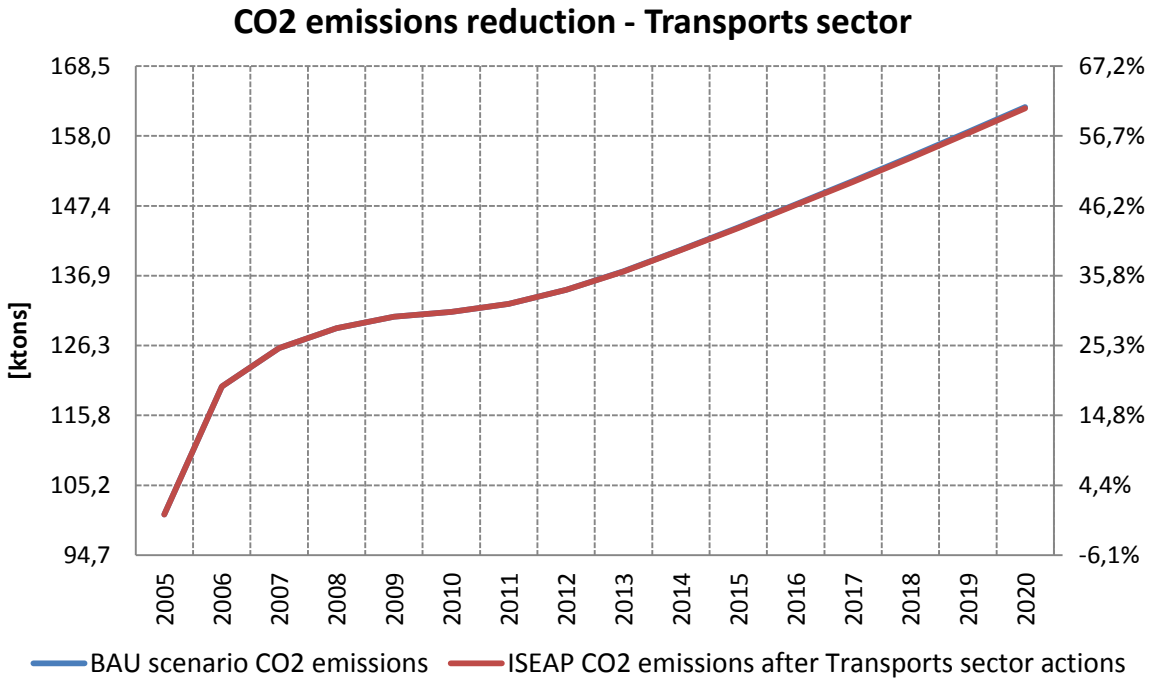


Figure 3.58. Comparison of CO_2 emissions from final use between BAU and ISEAP Scenarios in the transports sector

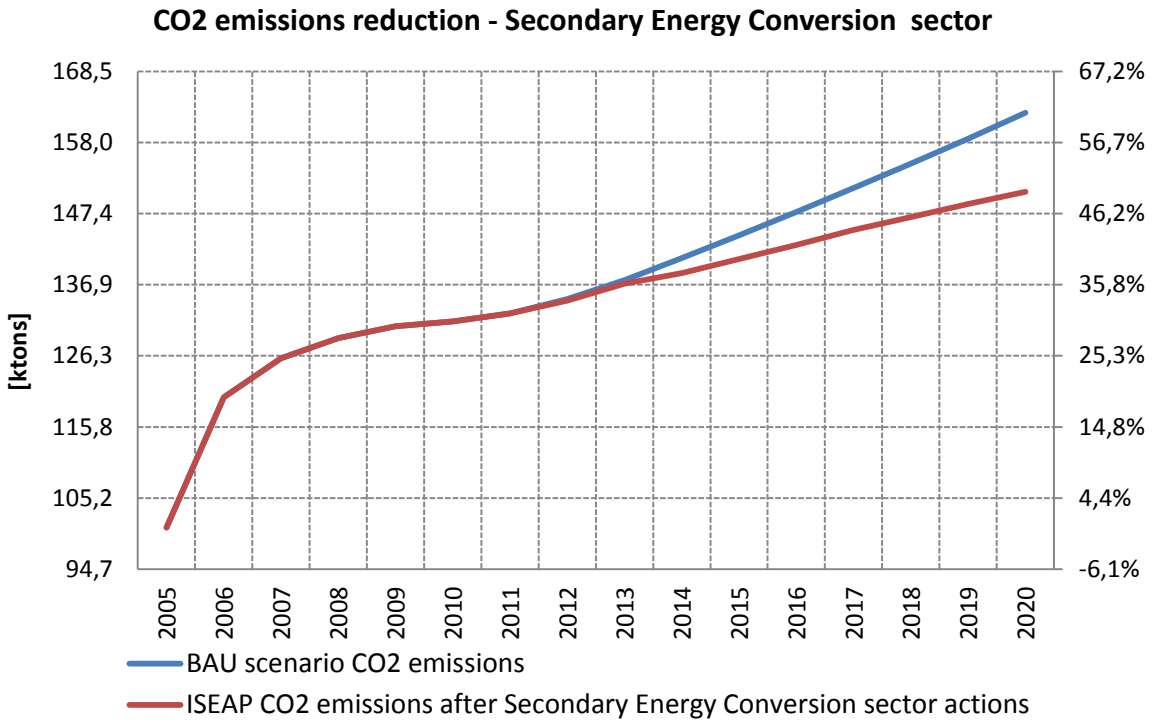


Figure 3.59. Comparison of CO_2 emissions from final use between BAU and ISEAP Scenarios in the secondary energy conversion sector

The following table summarizes the contribution of each sector in the reduction of CO_2 in comparison to the BAU scenario in the target year 2020.

Action Sectors	CO_2 emissions reduction
Residential	7,7%
Primary	1,0%
Secondary	2,0%
Tertiary	26,1%
Transports	0,2%
Electricity production	11,6%
TOTAL	**29,83%**

Table 3.15. Contribution in the CO_2 emissions reduction of each sector in comparison to the BAU scenario in 2020

4. ACTIONS

The ISEAP of Santorini 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 Thira is to succeed into restricting the rapidly increasing CO2 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_2 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_2 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]	CO2 REDUCTION TARGET IN 2020 [ton/year]
RESIDENTRIAL	3.059	164	857
PRIMARY	450		114
SECONDARY	845		226
TERTIARY	10.878	30	2.922
TRANSPORTS	97		23
SECONDARY ENERGY PRODUCTION		1.474	1.302
TOTAL	**15.329**	**1.669**	**5.444**

Table 4.1. ISEAP expected results in 2020 for evergy 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]
RESIDENTIAL SECTOR					
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 Thira	76		16
	Increase to 50% the total hot water energy demand supplied from solar thermal by 2020	Municipality of Thira	532	437	260
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 Thira	254		63
	Increase by 20% the total space heating energy demand supplied from heat pumps by 2020	Municipality of Thira	-2.227		-599
	Reduce the annual space cooling energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Thira	254		63
	Increase by 30% the energy efficiency of air-conditioning systems by 2020 through the promotion of air-conditioning with inverter	Municipality of Thira	2.340		576
Lighting	Reduce the annual lighting energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Thira	40		11
	Increase by 20% the energy efficiency of lighting systems by 2020 through the promotion of energy efficient lamps	Municipality of Thira	551		148
Cooking	Reduce the annual cooking energy demand growth rate by 10% by promoting every day energy saving measures from the consumers	Municipality of Thira	37		9

	Increase by 20% the energy efficiency of cooking appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Thira	339		80
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 Thira	39		10
	Increase by 20% the energy efficiency of electrical appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Thira	360		97
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 Thira	2		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 Thira	22		6
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 Thira	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 Thira	31		8
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 Thira	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 Thira	29		8
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 Thira	28		7
	Increase by 20% the energy efficiency of electrical appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Thira	257		69

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]
RESIDENTRIAL SECTOR		
3.059	**164**	**857**

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]
PRIMARY SECTOR					
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 Thira - Local association	45		11
	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 Thira - Local association	414		105

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]
PRIMARY SECTOR		
450		**114**

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]
SECONDARY SECTOR					
Manufacturing	Reduce the annual manufacturing energy demand growth rate by 10% by promoting every day energy saving measures from the professionals	Municipality of Thira - Local association	13		3
	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 Thira - Local association	116		30
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 Thira	51		14
	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 Thira	456		122
Construction	Reduce the annual construction energy demand growth rate by 10% by promoting every day energy saving measures from the professionals	Municipality of Thira - Local association	23		6
	Increase by 20% the energy efficiency of construction	Municipality of Thira - Local	205		55

	technologies by 2020 through the promotion of old systems substitution with new more efficient ones	association			

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]
SECONDARY SECTOR		
845		**226**

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_2 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]
TERTIARY SECTOR					
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 Thira - 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 Thira - Local association	1.192		318
	Increase by 20% the total space heating energy demand supplied from heat pumps by 2020	Municipality of Thira - Local association	-121		-33
Accomodation 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 Thira - Local association	503		131
	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 Thira - Local association	3.973		1.036
	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 Thira - Local association	116	210	87
	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 Thira - Local association	503		131

	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 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 - Increase by 30% the energy efficiency of cooking appliances by 2020 through the promotion of old devices substitution with more efficient ones	Municipality of Thira - Local association	4.521		1.179
	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 Thira - Local association	-132	94	-10
General public administration and social security	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 Thira	17		4
	Energy efficiency measures - Increase by 30% the energy efficiency of air-conditioning systems by 2020 through the introduction of air-conditioning with inverter - 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 - 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	Municipality of Thira	179		48
	Increase to 30% the total space heating demand supplied from heat pumps by 2020	Municipality of Thira	-42		-11
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 Thira - School boards	8		2

	Energy efficiency measures - 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 - 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	Municipality of Thira - School boards	90		24
	Increase to 30% the total space heating energy demand supplied from heat pumps by 2020	Municipality of Thira - School boards	-121		-33
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 Thira - Health centers - Hospital	1		0,1
	Energy efficiency measures - Increase by 30% the energy efficiency of air-conditioning systems by 2020 through the introduction of air-conditioning with inverter - 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 - 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	Municipality of Thira - Health centers - Hospital	5		1
	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 Thira - Health center	0	16	4
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 Thira - Local association	128		34

	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 Thira - Local association	975		260
	Increase by 20% the total space heating energy demand supplied from heat pumps by 2020	Municipality of Thira - Local association	-405		-109
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 Thira - PPC	29		8
	Increase by 20% the energy efficiency of public lighting systems by 2020 through the spatial and technical optimization of the lighting network.	Municipality of Thira - PPC	282		76

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]
TERTIARY SECTOR		
10.878	**30**	**2.922**

Table 4.9. Summary table of the actions planned in the tertiaty 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]
TRANSPORTS SECTOR					
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 Thira - Santorini KTEL	-1		-0,3
	Increase by 20% the energy efficiency of passenger transports by road by 2020 through the promotion of eco-driving practices.	Municipality of Thira - Transfer operators - Taxis	4		1
	Increase to 10% the passenger transport by road energy demand supplied from electricity by 2020 through the introduction of hybrid – electrical buses	Municipality of Thira	-3		-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 Thira	63		17
	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 Thira	-54		-15
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 Thira	6		2
	Increase to 10% the passenger transport by road energy demand supplied from electricity by 2020 through the promotion of hybrid – electrical trucks.	Municipality of Thira	-4		-1
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 Thira	14		4
	Increase by 20% the energy efficiency of private transports by 2020 through the promotion of eco-driving practices.	Municipality of Thira	138		35

	Increase to 10% the private transports energy demand supplied from electricity by 2020 through the promotion of hybrid – electrical vehicles	Municipality of Thira	-88		-24

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]
TRANSPORTS SECTOR		
97		**23**

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]
SECONDARY ENERGY PRODUCTION AND ENERGY FLUXES					
Wind	Promotion of wind turbines installation	Municipality of Thira		1.007	889
Solar	Promotion of PV installation on the ground and on the roofs	Municipality of Thira		467	412

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]
SECONDARY ENERGY PRODUCTION AND ENERGY FLUXES		
	1.474	**1.302**

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 Thira

- 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 Thira (1 person)

- The technical department of the Municipality of Thira (2 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 - CO2 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 Santorini's 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

www.islepact.eu

PACT OF ISLANDS

Elaboration:

DAFNI
Network of Aegean Islands for Sustainability

Local and regional authorities:

Municipality of Thira

ΠΕΡΙΦΕΡΕΙΑ ΝΟΤΙΟΥ ΑΙΓΑΙΟΥ
ΕΝΔΙΑΜΕΣΗ ΔΙΑΧΕΙΡΙΣΤΙΚΗ ΑΡΧΗ

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