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PACT OF ISLANDS

SUSTAINABLE ENERGY ACTION PLAN

Azores Archipelago

March 2012

Executive summary

In the Autonomous Region of the Azores, an archipelago with nine islands, it was developed, in 2008, a set of general strategies for the use and supply of energy for the next decade. These strategies resulted on a partnership between the Regional Government of the Azores, the University of the Azores and the MIT-Portugal program, which is called the *Green Islands Project*. Among the main strategies are included the following: increase the use of endogenous energy resources; increase the efficiency in the use of the final energy; improve the design of the energy distribution networks in all nine islands of the archipelago.

In 2010, the Azores initiated its participation in the ISLE-PACT project, within the framework of the European Program "TREN/PREP/2009/D3/Islands", along with eleven other islands or island regions from Europe.

Among the objectives of ISLE-PACT is the contribution to the achievement of the European goal regarding energy sustainability and the fight against climate change through an ambitious commitment to reduce CO_2 emissions and increase energy efficiency in, at least, 20% by 2020.

In the framework of this project, it was signed a pact for the sustainable energy which renews the political objective of reducing CO_2 emissions by at least 20% until 2020 in all the participating islands, supported by the Commitment Declaration of each island's or islands region's authorities, assuming specific and measurable targets for the CO_2 emissions reduction, to be achieved through the implementation of fostering measures for renewable generation, energy efficiency and introduction to cleaner mobility technologies.

The stated measures compose Islands Sustainable Energy Action Plans (ISEAPS), which intend to setup the foundation to achieve the targets assumed in the Commitment, by a set of concrete actions that will have to be implemented.

In the case of the Azores, the intention has always been clear, the goal of this participation is to invest on the protection of the islands ecosystems, the improvement of its independency regarding the energy supply and the economic and employment development. The targets defined for the ISEAPs in the Azores are the result of the ambitious set of three goals defined for the *Green Islands Project*, which had to be lowered due to the economic crisis:

- 60% of the electricity from renewable sources;
- 20% of total primary energy from renewable sources;
- 35% of total primary energy used in the form of electricity.

The Islands Sustainable Energy Action Plan of ISLE-PACT project adds one more target to the previous three:

- Reduce the CO_2 emissions in at least 20%, regarding the reference year 2005, until 2020.

The goals to be achieved are the following:

- Reduce the fossil fuels imports, in order to increment energy Independence and security and improve the economic sustainability of the Region in the long run.
- Minimize the climate change effects caused by greenhouse gases emissions, particularly considering the specific contribution to the Regional economy of sectors like agriculture and tourism, which are deeply vulnerable to climatic issues.
- Stimulate the social and economic development, through the promotion of activities related with renewable energy sources, energy efficiency, urban planning, sustainable mobility, etc.

The ISLE-PACT ISEAP of the Azores archipelago proposes mainly the following sets of measures:

- Increase the renewable energy sources share in total primary energy.
- Increase the energy efficiency in several energy uses.
- Migrate fossil fuel energy uses to electricity or directly to renewable energy sources.

Budget

The whole budget predicted until the end of year 2020 for the implementation of the Azores ISEAP is close to 450 M€.

Because of the type of measures proposed in the Action Plans for each island, the three main energy use sectors touched by the measures are residential, transports and secondary energy production. The investment is shared in about a third for each of the sectors, with a little higher share to the residential sector.

A significant part of the investments will be carried out by citizens, mainly due to the fact that the residential sector is the one with most measures and biggest budget share and also because of the electric mobility budget which is also supported by the future owners.

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1. CONTEXT

1.1. Geography and territory

The Azores is an archipelago with nine islands, located in the Northern Atlantic, 1 400 km from Portugal mainland and 3 900 km from United States of America. The distance between the two farthest islands (Santa Maria and Flores) is about 615 km and the closest distance between two islands is about 8.3 km, between Pico and Faial.

The nine islands together cover an area of 2 333 km^2, and the total population is 246 102 inhabitants.

The archipelago is divided into three geographic groups, Western, Central and Eastern. The biggest island is São Miguel, with 747 km^2 and the smallest one is Corvo, with only 17 km^2.

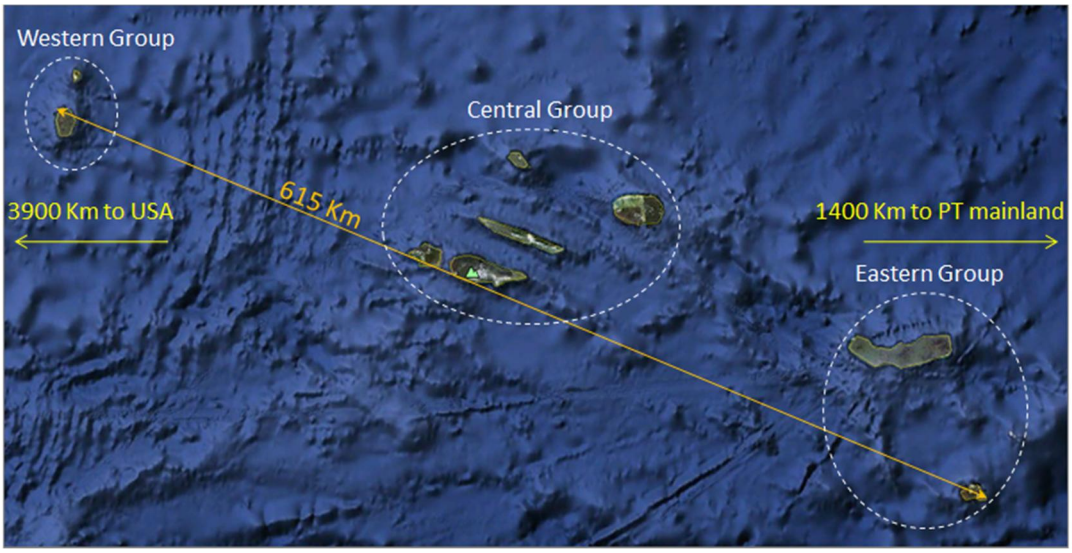

Figure 1 – Geographic context of the Azores archipelago

(Source: Google Earth)

According to the "Land Use Chart for the Autonomous Region of the Azores" (Carta de Ocupação do Solo da Região Autónoma dos Açores (SRAM/DROTRH, 2007)), land use in Azores has a similar pattern in all of the islands, with urban areas next to the coast line, strong presence of agriculture and pasture lands between the urban areas and the interior of the islands and forest and natural vegetation in the interior.

The same report also states that more than half of the regional territory is used for agriculture activities and pasture lands. Forest and natural vegetation, in turn, take about 35% of the territory, with 22% and 13% respectively. Urban use is relatively small, with only 4.96% of the whole territory.

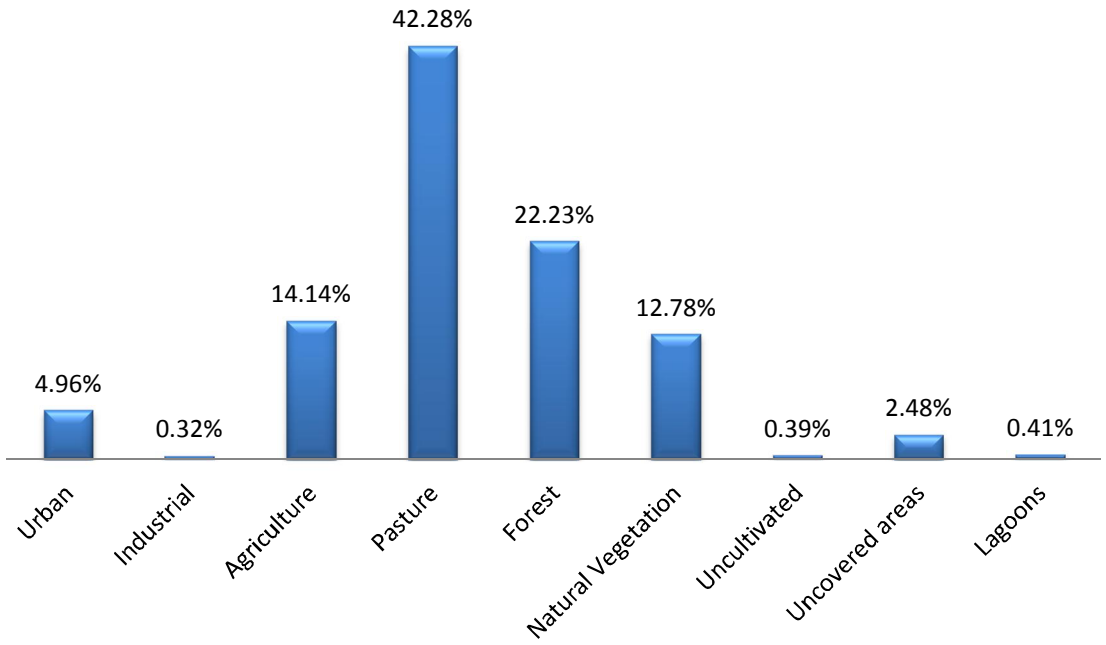

Figure 2 – Land use distribution in the Autonomous Region of Azores, in 2007

(Source: Carta de Ocupação do Solo da Região Autónoma dos Açores – Secretaria Regional do Ambiente e do Mar, 2007)

The land use distribution in the Azores is a result of the primary role of the agriculture in the regional economy. Agriculture and forestry are responsible for 7.3% of the wealth created in the Region (gross value added) and for 21.3% of the total employment.

It is important to highlight that the most representative use of land by forest and natural vegetation happens in areas where there is a particular protection status in the framework of the Regional Network of Protected Areas or on the Natura 2000 Network.

1.2. Demography

Looking at the spatial distribution of Azorean population, it is clear that the island of São Miguel has more than half the whole population of the Azores. The next island is Terceira, which has about a quarter of the whole, about the same as all the other seven islands together.

Looking at the population variation in the archipelago between 2001 and 2011, we see a growth from 238 000 to 246 000 inhabitants.

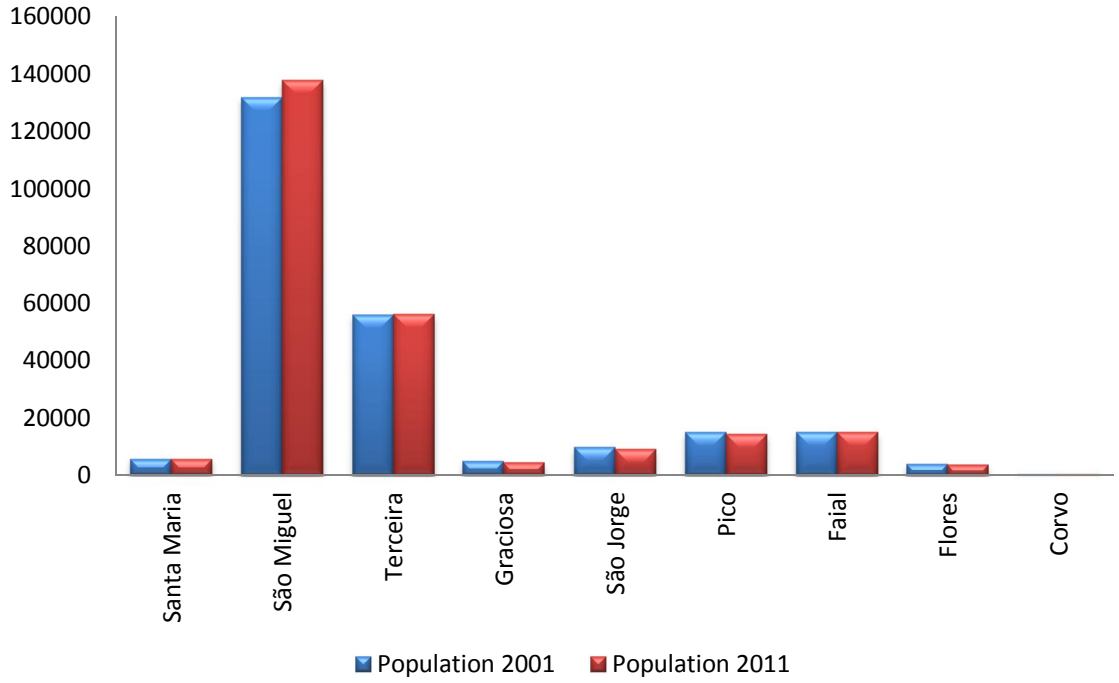

Figure 3 – Resident Population in the Azores, by island, in 2001 and 2011

(Source: Serviço Regional de Estatística - Censos 2001 e Censos 2011)

Between 2001 and 2011, the islands with higher percentages of population reduction are those which already had the smallest population absolute figures and lower economic activity. The only exception is the island of Corvo. On the other hand, the island with the highest percentage of population increment is the biggest island of the archipelago, which has today more than 57% of the whole Azorean population.

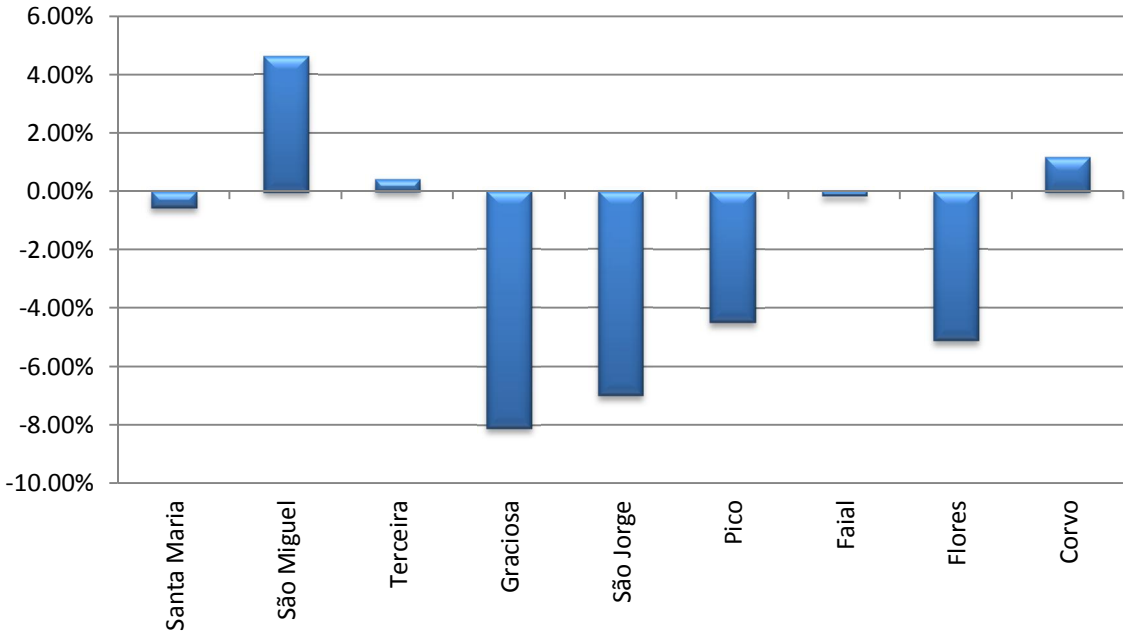

Figure 4 – Percentage variation of the population by island, between 2001 and 2011

(Source: Serviço Regional de Estatística)

Figure 5 shows the area and population density of each island. The larger islands and those with higher population, which are also those with stronger economic activity, are clearly those where the population density is also higher.

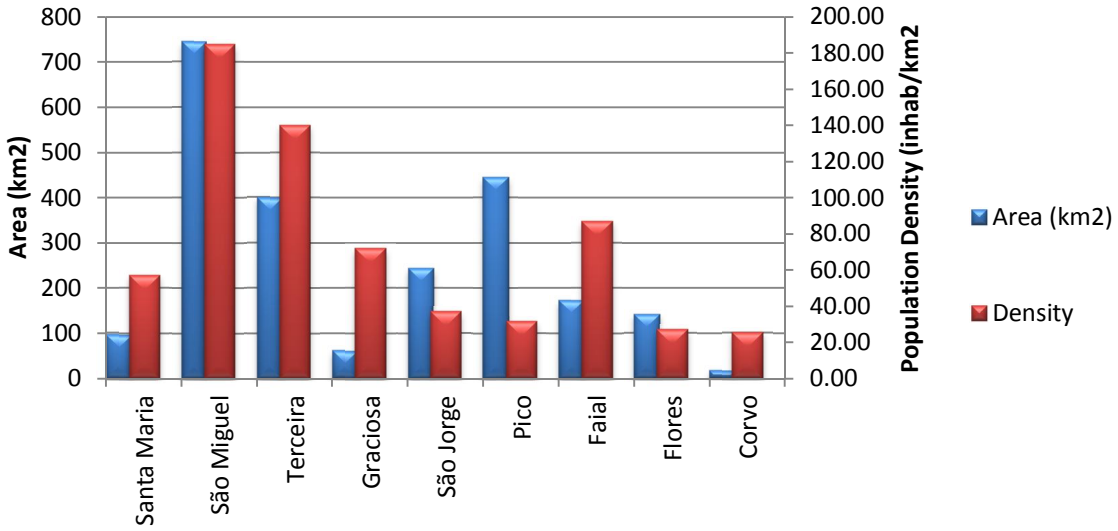

Figure 5 – Area and population density in each island

(Source: Serviço Regional de Estatística)

When looking at the relation between the population variation and the population density it is clear that it is on the islands with greater population and population density that we notice the greatest population increments during the last decade. If this trend continues in the future, one could say that the population is going to be concentrated on the biggest island – São Miguel.

Table 1 – Summary table with demographic and geographic data

(Source: Serviço Regional de Estatística)

Island	2001	2011	Δ %	Area (km2)	Density
Santa Maria	5.578	5.547	-0,56%	97	57,19
São Miguel	131.609	137.699	4,63%	745	184,83
Terceira	55.833	56.062	0,41%	400	140,16
Graciosa	4.780	4.393	-8,10%	61	72,02
São Jorge	9.674	8.998	-6,99%	244	36,88
Pico	14.806	14.144	-4,47%	445	31,78
Faial	15.063	15.038	-0,17%	173	86,92
Flores	3.995	3.791	-5,11%	141	26,89
Corvo	425	430	1,18%	17	25,29
Total	**241.763**	**246.102**	**1,79%**		

1.3. Economy

Gross Domestic Product (GDP) is one of the main economic indicators for a certain region and intends to measure its economic activity. This indicator shows the production of a region in terms of currency value, representing the sum of all the goods and services produced there during a certain time frame.

The evolution of GDP and GDP-PC in the Azores shows a constant growth between 2001 and 2008, with a small contraction in 2009, followed by another growth trend.

Table 2 – GDP and GDP-PC in Azores and in Portugal

(Source: Serviço Regional de Estatística)

Year	GDP Azores M€	GDP Portugal M€	GDP PC Azores €	GDP PC Portugal €
2001	2,694	134,471	11,353	13,064
2002	2,883	140,567	12,107	13,557
2003	2,990	143,472	12,490	13,741
2004	3,099	149,313	12,878	14,218
2005	3,241	154,269	13,408	14,623
2006	3,390	160,855	13,981	15,197
2007	3,549	169,319	14,580	15,961
2008	3,689	171,983	15,099	16,191
2009	3,650	168,504	14,912	15,848
2010	3,728	172,571	15,197	16,223

Gross Value Added (GVA) is an indicator of the productivity by economic activity sector. During the period between 2000 and 2010 there was a sustained growth of the Regional GVA in all economic activities.

In terms of productivity per sector, the activities which generated higher GVA in 2010 were “Public administration and defense; compulsory social security; education; human health and social work activities” and “Wholesale and retail trade; repair of motor vehicles and motorcycles; transport and storage; accommodation and food service activities”.

Table 3 – Gross Value Added (GVA), by economic activity, in Azores, between 2000 and 2010

(Source: Instituto Nacional de Estatística, contas regionais)

Economic activities	GVA Azores per economic activity in M€				
	2000	2005	2008	2009	2010
Agriculture, livestock-breeding, hunting, forestry and fishing	252.4	278.4	276.4	273.2	273.1
Extractive industry; manufacturing; production and distribution of electricity, gas, steam and cold air; water supply, sewerage, waste management and remediation activities	177.6	242.8	297.0	299.8	304.5
Construction	174.7	217.3	257.7	226.3	227.3
Wholesale and retail trade; repair of motor vehicles and motorcycles; transport and storage; accommodation and food service activities	507.5	708.2	791.2	809.0	833.6
Information and communication	51.0	63.7	74.5	66.5	66.1
Financial and insurance activities	73.3	94.9	136.4	122.9	115.1
Real estate activities	168.6	212.1	250.0	249.3	268.7
Consulting, scientific and technical activities; administrative and support services	64.2	92.8	104.5	100.4	102.2
Public administration and defense; compulsory social security; education; human health and social work activities	636.1	831.3	923.8	978.6	974.1
Arts and entertainment activities; repair of household goods and other services	46.1	60.6	91.2	95.5	97.9
TOTAL	**2,151.5**	**2,801.9**	**3,202.6**	**3,221.5**	**3,262.6**

Statistical data for employment in the Azores show that in 2011 the tertiary sector – services – was the one with the highest share of employment, with 73 862 people employed. The secondary sector – industry, construction, water and energy – in turn, employed 23 149 people and the primary sector – agriculture, forestry and fishery – employed 13 014 people.

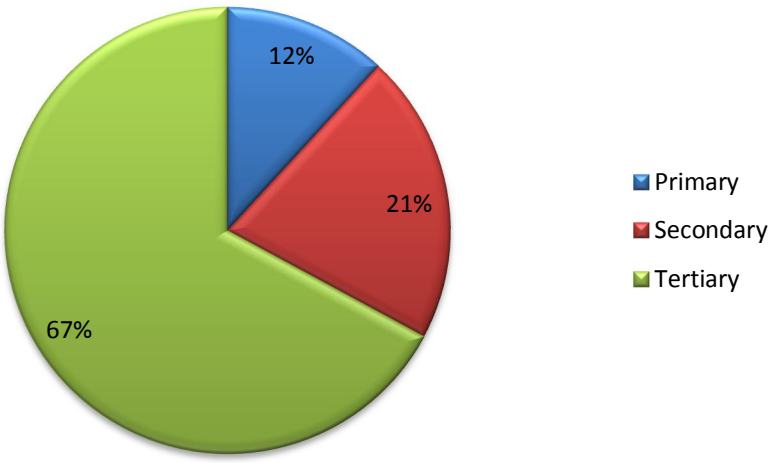

Figure 6 – Employment distribution structure in Azores archipelago, by activity sector, in 2011

(Source: Serviço Regional de Estatística)

Looking at the indicators Geography, Land Use, Demography and Socioeconomy, it is clear that in the Azores there is a particular set of constraints in terms of energy grids, among which are the following:

- All the nine electric grids are totally independent and isolated. There is not one single connection either to any mainland grid or between any two islands;
- The geographic scales of the nine islands are totally different (as stated above), with populations ranging from 480 inhabitants in Corvo to 135 000 inhabitants in São Miguel;
- Seven of the nine islands have less than 20 000 inhabitants, which is a solid constraint for the viability of renewable energy projects due to its small scale;
- On the smallest islands, supply of fossil fuels and energy equipment is often a considerable challenge, due to the small size of the harbors and the obstacle that bad weather represents on this part of the Atlantic.

1.4. Political and administrative structures

The Azores, officially known as the Autonomous Region of the Azores, is a transcontinental archipelago and an autonomous territory of the Portuguese Republic, located in the northeast Atlantic, endowed with its own government and political, administrative, financial, economic and fiscal autonomy, embodied in the Portuguese Republic Constitution and Political-Administrative Statute of the Autonomous Region of the Azores.

The agencies of the Government itself are the Legislative Assembly, and the Regional Government, composed by a President of the Government, a Vice President and the Regional Secretaries. The Portuguese Republic is represented in the Azores by a Representative of the Republic, appointed by the President of the Portuguese Republic.

The Azores are part of the European Union with the status of an ultra-peripheral region of the territory of the Union. While Portuguese territory, the Region is under both the European Community and the Portuguese legislation, in particular in respect to the EU's commitments on energy and climate, being the legislation transposed or adapted for regional legal regimes, according to regional specificities, namely the political-administrative ones.

The department of the Regional Government of the Azores responsible for energy is the Regional Secretariat for the Environment and the Sea (SRAM), which, among other issues, is responsible for defining and executing the regional policy on energy, promoting quality, education and incentives for saving energy.

The functions of SRAM on energy are:

- To ensure a rational use of energy, strengthening and encouraging the use of renewable energies;
- To promote information, awareness, education and training;
- To ensure cooperation with public and private, regional, national and international organizations;
- To promote monitoring, audit and inspection.

The Regional Directory of Energy is the executive service of the SRAM responsible for implementing the regional policy on energy and energy resources, with the responsibilities, among others:

- To assist and support the Regional Secretary in the formulation and implementation of policies in the energy sector;
- To promote the development of a sustainable energy system, based on the use of endogenous resources;
- To run regulatory legislation for the energy sector and for the exploitation of energy resources, including water, wind, geothermal resources, energy associated with the sea and resulting from the utilization of biomass and carbonaceous residues;
- To promote energy efficiency and the rational use of energy;
- To cooperate with other agencies and organizations on matters of relevance to the energy sector;
- To undertake the overall management and supervision system of energy certification and indoor air quality referred on the Regional Legislative Decree no. 16/2009/A º, 13 October;
- To develop and support training, awareness and education activities for sustainable use of energy.

2. GLOBAL STRATEGY FOR ENERGY

2.1. Current framework and vision for the future

The supply of primary energy to the Azores archipelago assumes great political, economic and strategic importance. The actual dependence from the exterior, in terms of fossil fuel imports, the price instability of this kind of products and the consequences of its use on climate change, are more than enough reasons to make the Region dedicate them special attention. Furthermore, the climate change effects may well threaten important regional economic sectors like tourism and agriculture.

Azores archipelago is considerably distant from any continental territory, and its islands are themselves so apart that until now there is not one single connection between any of the nine isolated energy grids. These constraints imply a considerably high cost on the supply of final energy, which in turn leverages the economic viability of renewable energy and energy efficiency projects, once the avoided costs are higher than in the mainland.

The Azores Regional Government defined in 2008 a vision for the future of energy systems, which intended to prevent the economic and environmental consequences of the use of fossil fuels in the Region. This document – "Plano Energético da Região Autónoma dos Açores" (Energy Plan for the Autonomous Region of Azores). This document, developed by the Government of Azores in 2008, became the reference in the Azores for the definition of strategic priorities regarding the energy sector.

2.2. Objectives and targets

The quantitative targets defined by the strategy for the Azores Island Sustainable Action Plan (ISEAP) are:

- 60% of the Electricity produced from renewable sources until 2020;
- 20% of total primary energy must be obtained from renewable energy sources until 2020;
- 35% of the total primary energy must be used in the form of electricity until 2020;
- Reduction of the CO_2 emissions of at least 20%, regarding the baseline year of 2005, until 2020.

The global goals to be achieved with the Action Plans are:

- Reduce fossil fuels imports in order to increase the energy Independence and security as well as assure the economic sustainability of the Region in the long run;

- Minimize the climate change effects caused by greenhouse gases emissions, particularly considering the specific contribution to the Regional economy of sectors like agriculture and tourism, which are deeply vulnerable to climatic issues;
- Stimulate the social and economic development, through the promotion of activities related with renewable energy sources, energy efficiency, urban planning, sustainable mobility, etc..

2.3. Strategic guidelines

The 2008 Strategic Plan for the Azores is a declaration of intentions which defined a course of action. It was later complemented, in 2010, with another document called "Azores Energy Outlook", which resulted from a cooperation between the MIT-Portugal program and the University of the Azores – the Green Islands initiative. This new document set the strategy to follow in order to achieve the goals of the Regional Government for the energy area, offering a guiding platform for the development of energy policies, with the aim of reinforcing the sustainability of energy, environment, economic development and job creation in the Region.

This document is the last step that was missing. Based on studies about endogenous resources availability, energy efficiency solutions, sustainable mobility and behavioral issues, it presents the best solutions – as concrete actions – to fulfill the goals and targets of the Strategic Plan for the Azores.

Therefore, this document defines the portfolio of concrete actions which will be adapted to each and every Azorean island, contributing for the different development vectors of the Strategic Plan, namely the increment of renewable generation, energy efficiency in all its aspects and consumption shifting from fossil to renewable energy.

This document includes the investment in renewable energy already predicted for Azores, namely geothermal, hydric, wind and biomass, and adds the actions of energy efficiency and consumption migration from fossil fuels to renewable energy.

The guidelines to follow to achieve the proposed goals are the following:

- Increase the percentage of primary energy coming from renewable sources – the three main endogenous sources used until now in Azores are: wind, hydro and geothermal energies. There is also, in smaller dimensions, wave energy (island of Pico), solar energy (PV and thermal) and biomass. One of the areas where the ISEAPs propose innovation is the biomass cogeneration power plants. Besides this new power plant technology, most of the investments on this area will be driven to the technologies already proven in each island.
- Increase the energy efficiency in all forms of energy use – this increment will be encouraged by several political mechanisms, like the energy certification of

buildings (Sistema de Certificação Energética dos Açores), the program to renew the public transports fleet (SIRIART), the improvement of the public transportation services in the cities and in the interior of some of the islands, and the inclusion a pollutant emissions while setting the driving taxes for private vehicles. There will also be promoted awareness campaigns for the household electrical appliances, being expected a considerable increment of the energy efficiency of refrigerators, freezers, water heaters, image and sound equipment and lighting. There is a program already running to reduce the electrical needs for public lighting, which will result on a reduction of 35% of the whole electricity used for this purpose.

- Shift uses of fossil fuels to electricity or directly to renewable energy sources – the fossil fuels imports are a critical matter for an archipelago like the Azores, so far apart from the mainland and also with nine islands separated from one another, not only from the economic standpoint but also considering the security and independence of the Region and the environmental matters. Shift fossil fuels use to renewable energy sources or electricity is one of the main pillars of this Action Plan. To implement such a shift it will be necessary a strong promotion of the electric vehicle, the use of thermal solar systems for domestic hot water and every other transference of fuel uses for electricity. The cogeneration biomass power plants will also have an important role in this subject, contributing to reduce the use of fossil fuels in the thermal processes of the industrial sector.

3. ENERGY BALANCE AND EMISSION INVENTORY

3.1. Baseline situation

The baseline situation describes the starting point in terms of energy demand and carbon dioxide emissions (CO_2), establishing the base from which the targets and goals of the action plans until 2020 will be defined.

In the case of the Azores, the reference year regarding energy demand, on top of which the scenarios will be setup, is the year 2008. As for the CO_2 emissions, the chosen baseline year is 2005.

The data presented in the tables and figures of the baseline situation, also used for the growth prediction for future scenarios, in the case of the imports and use of fuels for 2008, was supplied by the Economy Regional Secretariat (*Secretaria Regional da Economia*) and in the case of production and use of electricity, it was supplied by the company Electricity of the Azores - EDA (*Electricidade dos Açores S.A.*).

3.1.1. Final energy demand

Final energy represents the form on which the energy is used, being this form dependent of the sector itself.

According to the data supplied by the Regional Fund to Support Economic Development and Cohesion (*Fundo Regional de Apoio à Coesão e Desenvolvimento Económico)*, from the Economy Department, and the data from the EDA, the transport sector was, in 2008, the main responsible for the energy demand in the archipelago, with a share of 46.6%, the residential sector was the second one with 17.7%, followed by the primary, secondary and tertiary sectors with similar shares between 10.5% and 12.8%.

Table 4 – Final energy demand in the Azores, in 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

Energy carriers		Residential [MWh]	Primary Sector [MWh]	Secondary Sector [MWh]	Tertiary Sector [MWh]	Transports [MWh]	TOTAL [MWh]
Centralized energy services	Electricity	253,540.21	12,818.70	118,067.04	364,100.81	2,031.12	750,557
Fossil fuels	Fueloil	0	0	255,606	0	0	255,606
	Diesel	0	292,760	0	0	976,481	1,269,241
	Gasoline	0	0	0	0	385,277	385,277
	LPG	263,156	0	0	0	0	263,156
	Subtotal	516,696.21	305,578.70	373,673.04	364,100.81	1,363,789.12	2,923,837
TOTAL		**516,696.21**	**305,578.70**	**373,673.04**	**364,100.81**	**1,363,789.12**	**2,923,837**

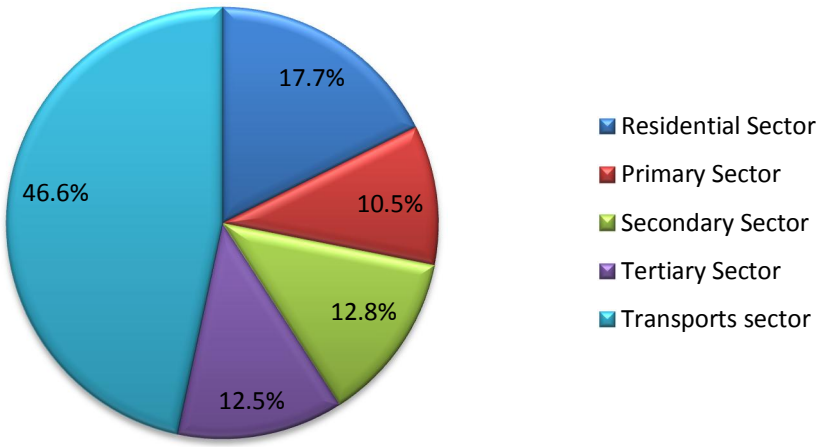

Figure 7 – Final energy demand in the Azores, by sector, in 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

In the case of the final energy demand per energy carrier diesel is the most used energy carrier (43.4%), followed by electricity. Once more, the transport sector is the responsible for the diesel share. Diesel and gasoline together represent 56.6% and the electricity represents 25.7%.

The electricity from renewable sources was not considered in this chart as final energy, although its share was not representative.

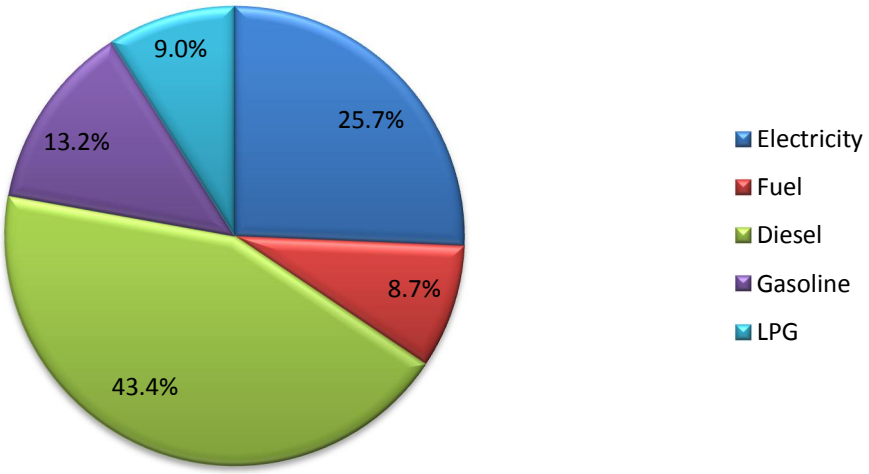

Figure 8 – Final energy demand in the Azores, by energy vector, in 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

3.1.2. Energy conversion

In the Azores archipelago, until now, the energy conversion produces nothing but electricity. There is neither district heating nor any heat or cold grid.

The percentage of electricity obtained from fossil fuels was 73% in 2008 (65% fuel and 8% diesel), being only 27% obtained from renewable sources (21% geothermal, 3% hydro and 3% wind).

Table 5 – Energy conversion in the Azores, in 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

Energy carriers		**Electricity production [MWh]**
Fossil fuels	Fueloil	540,779.1
	Diesel	69,505.7
	Subtotal	610,284.8
Renewable energy sources	Hydro	25,291
	Wind	21,900
	Solar	0
	Geothermal	170,280
	Biomass	0
	Urban waste	0
	Energy recovery	30
	Subtotal	217,501
TOTAL		**827,785.8**
Distribution losses and self-consumption		77,227.92

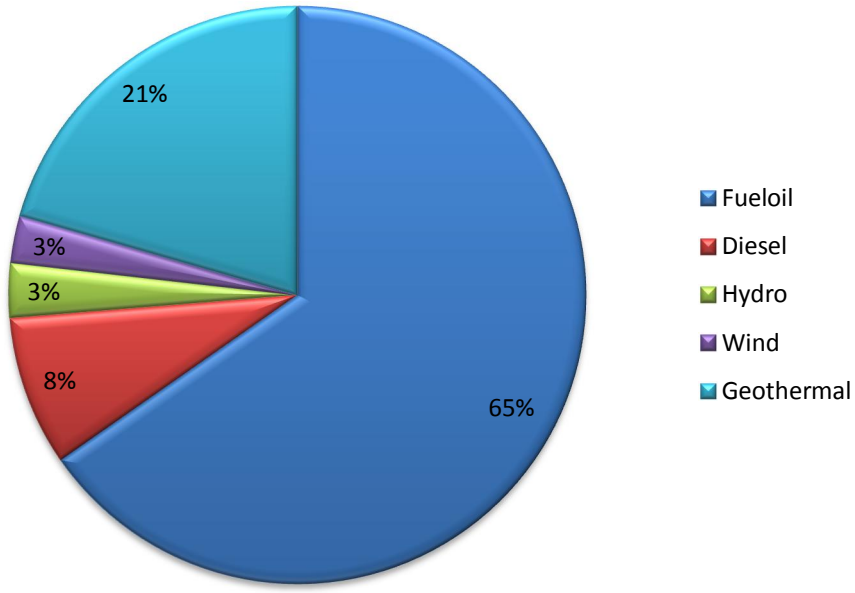

Figure 9 – Electricity production by source, in 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

3.1.3. Primary energy demand

Primary energy sources are the forms of energy coming from endogenous resources or imported to the Region, which will then be used directly as final energy or converted to secondary energy, like the fossil fuels, wind energy, geothermal energy, etc..

Comparing primary energy demand between 2005 and 2008, it is clear that, despite the stability on the use of fossil fuels, the renewable energy sources almost doubled, mainly as a result of the use of geothermal electricity.

Table 6 – Primary energy demand in 2005 and 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

Energy carriers		2005 [MWh]	2008 [MWh]
Fossil fuels	Fueloil	1,585,003	1,546,819
	Diesel	1,345,091	1,461,013
	Gasoline	420,698	385,277
	LPG	287,154	263,156
	Subtotal	3,637,946	3,656,265
Renewable energy sources	Hydro	30,870	25,291
	Wind	14,551	21,900
	Geothermal	70,669	170,280
	Subtotal	116,090	217,471
TOTAL		**3,754,036**	**3,873,736**

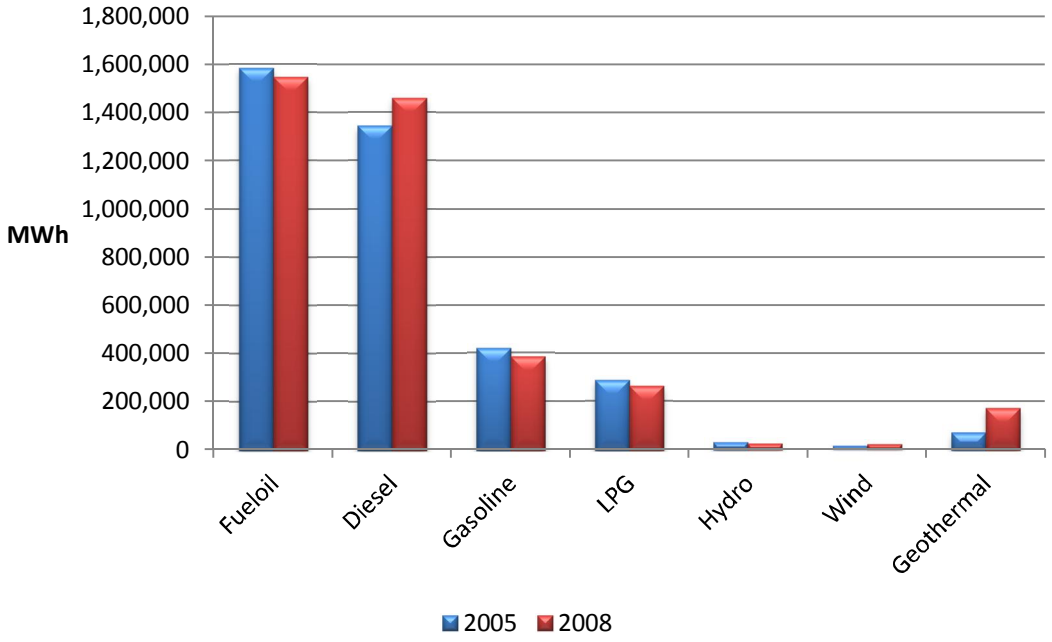

Figure 10 – Primary energy demand in the Azores, in 2005 and 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

Looking at the figure below, it is shown that the share of renewable sources in the whole primary energy was still quite low. Meanwhile, this situation changed has already gone through a few changes.

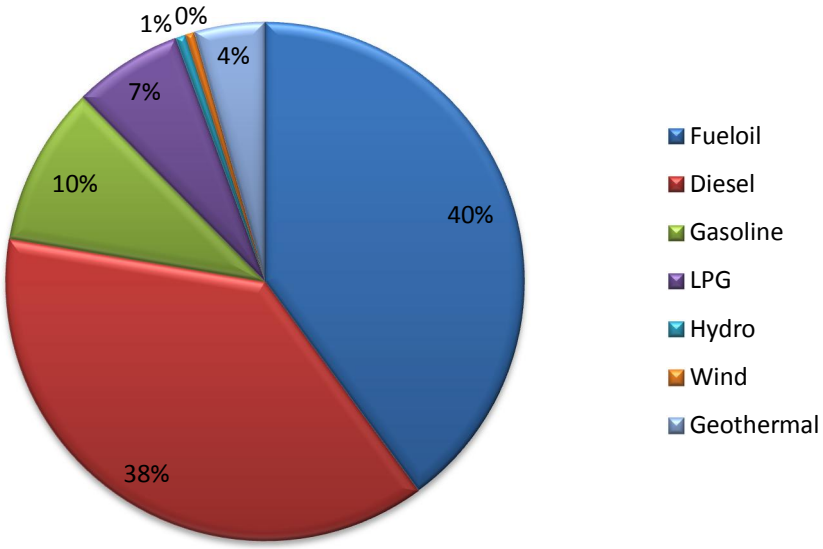

Figure 11 – Primary energy demand in the Azores, in 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

3.1.4. Emissions of carbon dioxide

The emissions of carbon dioxide were determined according to the IPCC (Intergovernmental Panel on Climate Change) methodology which considers the carbon content of fuels or fractions of non-renewable energy resources used in the combustion or in electricity production.

Looking at the CO_2 emissions by sector, it is clear that the transport sector was responsible for more than a third of all the emissions, with a share of 36%, followed by the residential and tertiary sectors, with 21% each.

Table 7 –CO_2 emissions by sector, in 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

Energy carriers		**Residential [t]**	**Primary sector [t]**	**Secondary sector [t]**	**Tertiary sector [t]**	**Transports [t]**	**TOTAL [t]**
Centralized energy services	Electricity	140,518	6,834	59,439	203,659	1,002	411,452
Fossil fuels	Fueloil	0	0	71,314	0	0	71,314
	Diesel	0	78,167	0	0	260,720	338,887
	Gasoline	0	0	0	0	95,934	95,934
	LPG	63,157	0	0	0	0	63,157
	Subtotal	**63,157**	**78,167**	**71,314**	**0**	**356,654**	
TOTAL		203,675	85,001	130,753	203,659	357,656	**980,744**

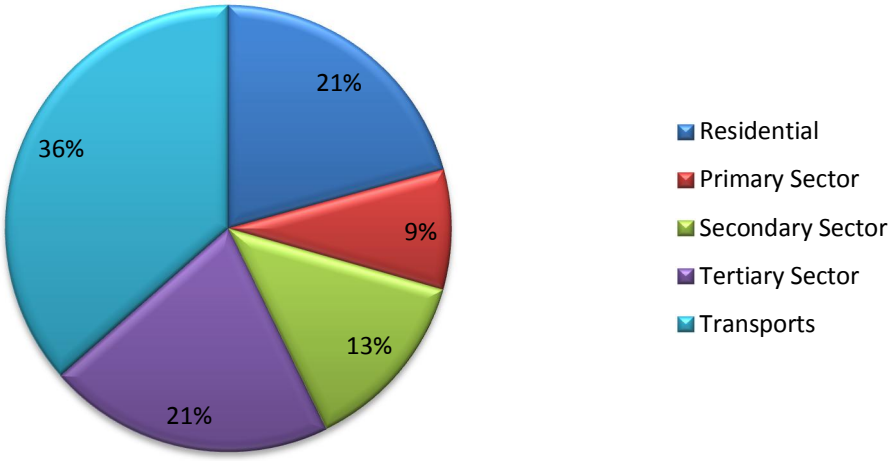

Figure 12 – CO_2 emissions by sector, in 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

Comparing the use of the various types of fuels, in 2005 and 2008, it is shown that there was a small decrease on the use of all of them, except diesel. Regarding the reduction on the use of fuel, it is surely related with the increase on the geothermal energy production, in the island of São Miguel.

Table 8 – CO_2 emissions by primary energy carrier, in 2005 and 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

Energy carriers		**2005** [t]	**2008** [t]
Fossil fuels	Fueloil	442,216	431,563
	Diesel	359,139	390,090
	Gasoline	104,754	95,934
	LPG	68,917	63,157
	Total	**975,026**	**980,744**

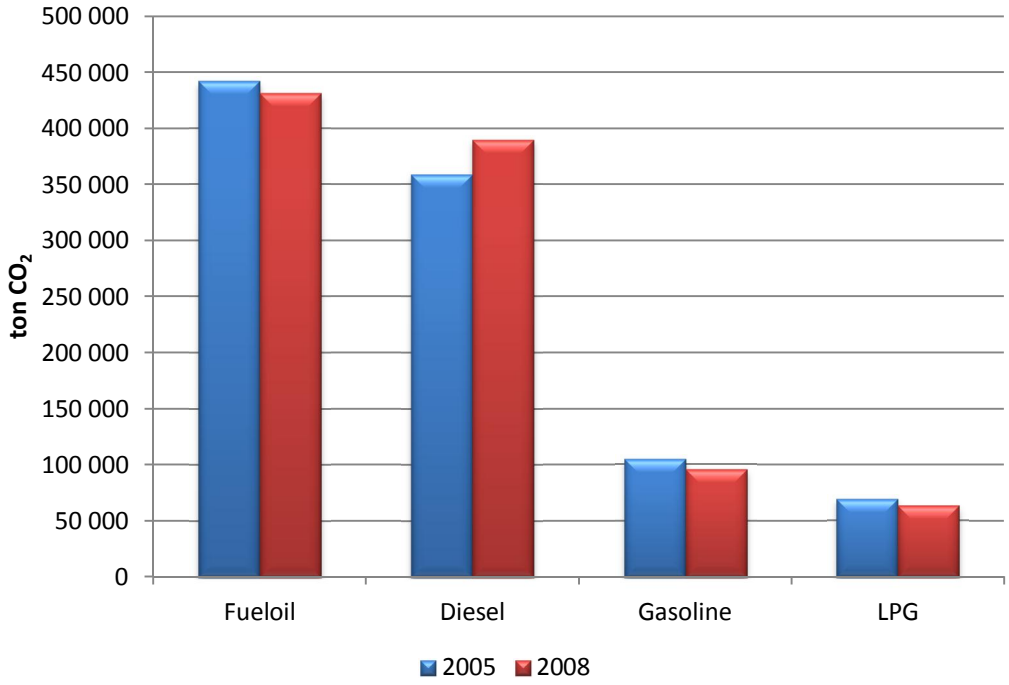

Figure 13 – CO_2 emissions by primary energy carrier, in 2005 and 2008

(Source: Secretaria Regional da Economia - Fundo Regional de Apoio à Coesão e Desenvolvimento Económico and Empresa Electricidade dos Açores, S.A.)

3.2. Projections to 2020 – Business as usual scenario

In order to determine the business as usual scenario, even without any actions introduced , the starting up point were the values from the energy demand and CO_2 emissions for the baseline year of 2008, than it was added to those the growth rates predicted for the final energy needs for each activity sector. These growth rates were based on final energy demand historical data and in the predictions found on the *Azores Energy Outlook* of the MIT-Portugal. There were also used statistical data both from the National Statistics Institute (INE) and from the Azorean Regional Statistics Service (SREA) for the sectors to which the energy data was not trustful.

These growth scenarios for energy demand take into account the recent years historical data but also considered the actual contraction context which led to clear reductions of demand from one year to the next. The efficiencies of the electricity generation systems and for the electricity use devices were kept constant as well as there were no new renewable sources projects considered along the way to 2020. The data for the next charts and tables was based on this business as usual scenario.

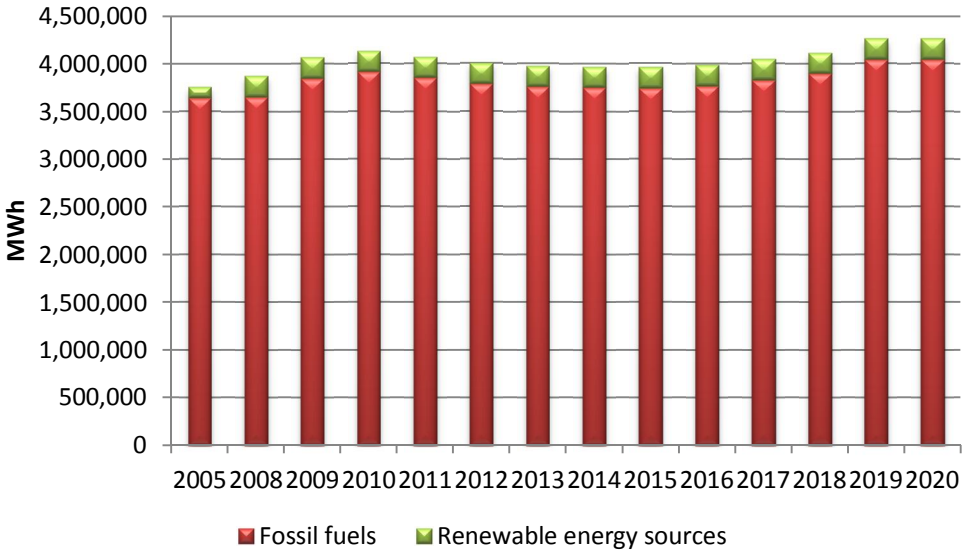

Figure 14 – Primary energy demand until 2020 – BAU scenario

Regarding CO_2 emissions for the BAU scenario, it is predicted a growth of 11.3% instead of the desired reduction of 20%, which is one of the target of the commitment of the Pact Of Islands.

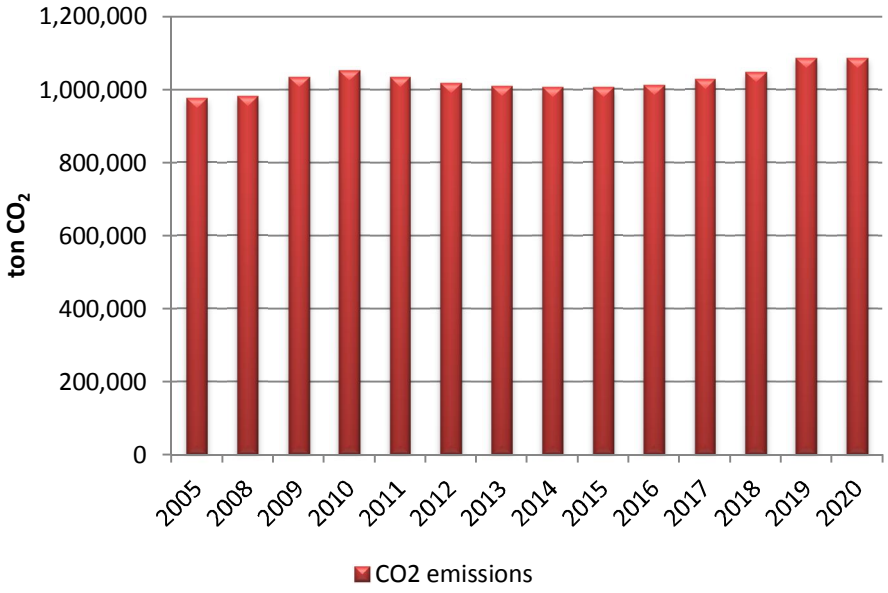

Figure 15 – CO_2 emissions until 2020 – BAU scenario

3.2.1. Final energy demand

The following table and figures show the final energy demand per energy carrier and per activity sector, predicted for 2020, according to the BAU scenario.

Looking at the BAU scenario for the final energy demand, it is shown that despite the predicted growth, the distribution of the final energy demand per economic sector and per energy carrier does not suffer significant changes.

Table 9 – Final energy demand in 2020 – BAU scenario

Energy carriers		Residential	Primary sector	Secondary sector	Tertiary sector	Transports	Total
		[MWh]	[MWh]	[MWh]	[MWh]	[MWh]	[MWh]
Centralized energy services	Electricity	274,025	13,912	130,093	405,376	2,251	825,657
	Heat	0	0	0	0	0	0
	Cold	0	0	0	0	0	0
	Subtotal	274,025	13,912	130,093	405,376	2,251	825,657
Fossil fuels	Fueloil	0	0	281,563	0	0	281,563
	Diesel	0	320,046	0	0	1,092,160	1,412,206
	Gasoline	0	0	0	0	429,851	429,851
	LPG	284,183	0	0	0	0	284,183
	Natural gas	0	0	0	0	0	0
	Coal	0	0	0	0	0	0
	Subtotal	284,183	320,046	281,563	0	1,522,011	2,407,803
Total		**558,208**	**333,958**	**411,656**	**405,376**	**1,524,262**	**3,233,461**

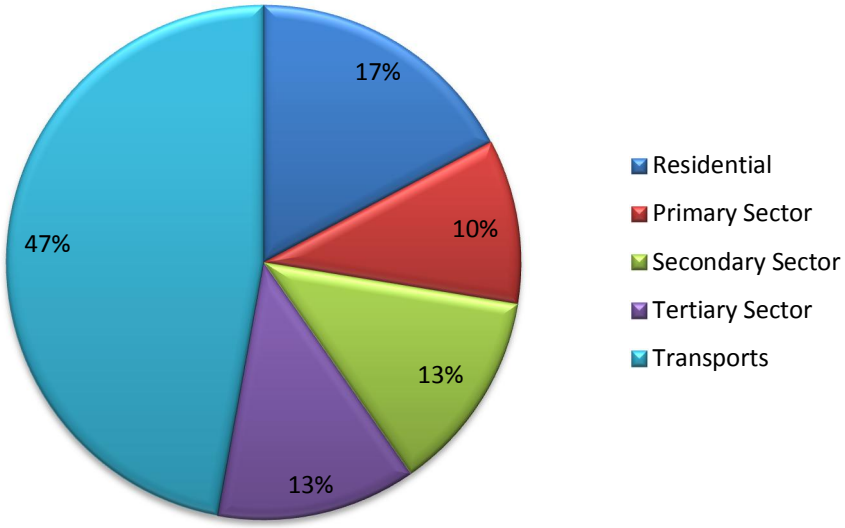

Figure 16 – Final energy demand per activity sector, in 2020 – BAU scenario

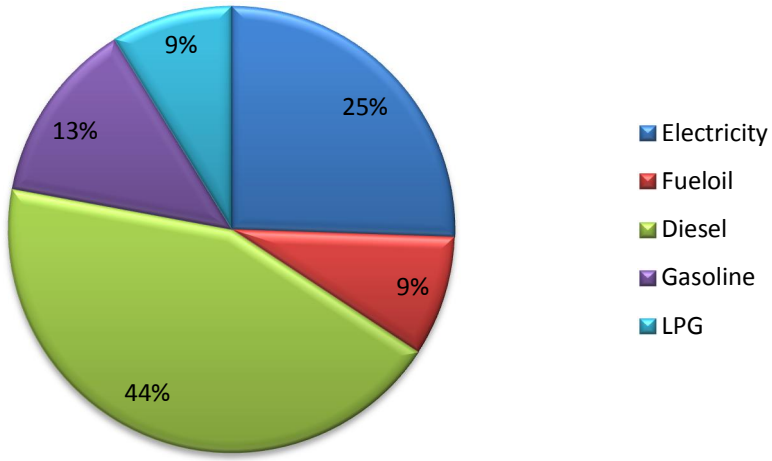

Figure 17 – Final energy demand per energy carrier, in 2020 – BAU scenario

3.2.2. Energy conversion

Regarding the energy conversion, for the BAU scenario, it was considered that the demand increments for electricity would be fulfilled with thermal generation, using in each island the fuel which has the biggest share on the actual thermal generation on that

island. Renewable energy projects from 2008 on were already considered as measures for the Action Plan scenario.

It is also assumed that there will be no heat or cold production as final energy.

Looking at the BAU scenario represented below, it is predicted that there will be an increase of 10.83% in the total electricity used in the archipelago, increasing the share of electricity coming from fuel from 65% to 68%. With this scenario the percentage of electricity coming from geothermal energy would decrease from 21% to 19%.

Table 10 – Energy conversion in 2020 – BAU scenario

Energy carriers		**Electricity [MWh]**
Fossil fuels	Fueloil	623,177
	Diesel	76,719
	Gasoline	0
	LPG	0
	Natural gas	0
	Coal	0
	Subtotal	699,896
Renewable energy sources	Hydro	25,291
	Wind	21,900
	Solar	0
	Geothermal	170,280
	Ocean energy	0
	Biomass	0
	Urban waste	0
	Energy recovery	30
	Subtotal	217,501
Total		**917,397**
Distribution losses and self-consumption		91,740

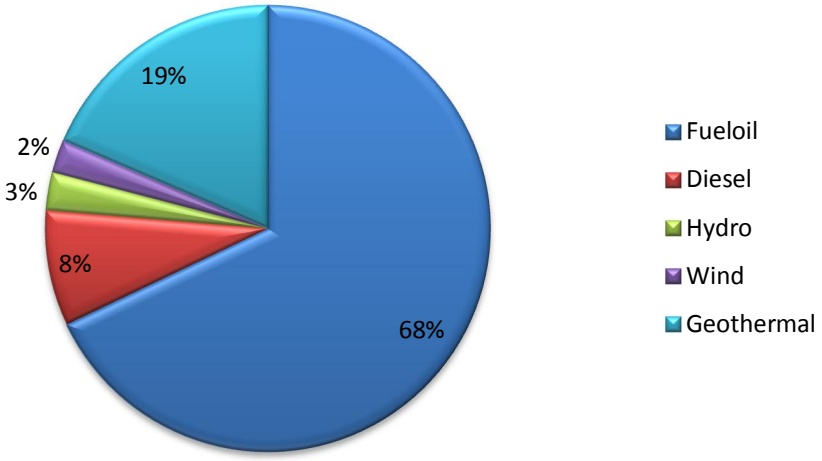

Figure 18 – Electricity production per energy source, in 2020 – BAU scenario

3.2.3. Primary energy demand

For the BAU scenario, regarding primary energy demand, it was considered that the primary energy demand will continue to depend mainly on the fossil fuels that were already used in the baseline year. On the other hand, the use of endogenous sources will remain constant.

Table 11 – Primary energy demand in 2005, 2008 and 2020 – BAU scenario

Energy carriers		2005 [MWh]	2008 [MWh]	2020 [MWh]
Fossil fuels	Fueloil	1,585,003	1,546,819	1,739,287
	Diesel	1,345,091	1,461,013	1,591,666
	Gasoline	420,698	385,277	429,851
	LPG	287,154	263,156	284,183
	Subtotal	3,637,946	3,656,265	4,044,987
Renewable energy sources	Hydro	30,870	25,291	25,291
	Wind	14,551	21,900	21,900
	Solar	0	0	0
	Geothermal	70,669	170,280	170,280
	Ocean energy	0	0	0
	Biomass	0	0	0
	Subtotal	116,090	217,471	217,471
TOTAL		**3,754,036**	**3,873,736**	**4,262,458**

The BAU scenario determined for the primary energy demand shows an increment of 10.03% on the primary energy demand, regarding 2008 and 13.54% regarding 2005. About the share of renewable sources in the whole primary energy demand, it is predicted 5.1% for 2020, while it was 5.6% in 2008, and 3.1% in 2005.

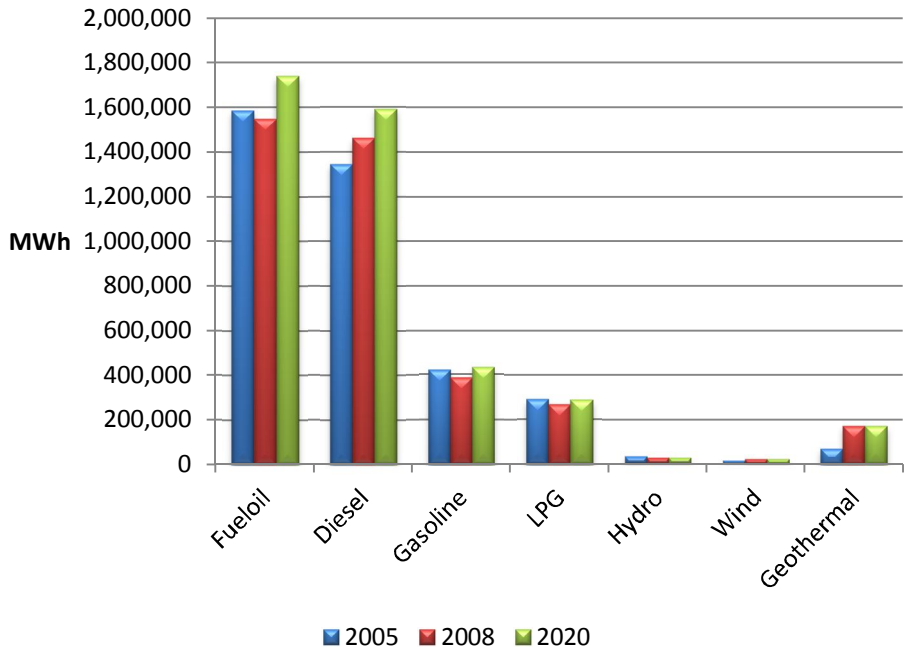

Figure 19 – Primary energy demand in 2005, 2008 and 2020 – BAU scenario

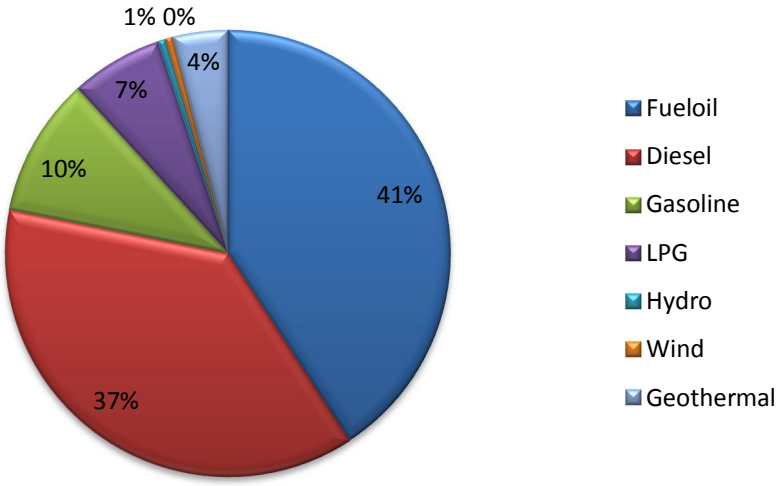

Figure 20 – Primary energy demand in 2020 – BAU scenario

3.2.4. Emissions of carbon dioxide

Using the same methodology as the one used to determine the carbon emissions for the baseline year, the predicted emissions for the year 2020 were also calculated, based on the energy demand growth rates assumed.

Although there is a considerable increment of the total CO_2 emissions from the baseline year to 2020, the distribution per activity sector has no significant changes on this BAU scenario prediction.

Table 12 – CO_2 emissions per sector, in 2020 – BAU scenario

Energy carriers		Residential	Primary sector	Secondary sector	Tertiary sector	Transports	Total
		[t CO2]	[t CO2]	[t CO2]	[t CO2]	[t CO2]	[t CO2]
Centralized energy services	Electricity	151,201	7,476	67,770	227,023	1,150	454,621
	Subtotal	151,201	7,476	67,770	227,023	1,150	454,621
Fossil fuels	Fueloil			78,556			78,556
	Diesel		85,452			291,607	377,059
	Gasoline					107,033	107,033
	LPG	68,204					68,204
	Subtotal	68,204	85,452	78,556	0	398,640	630,852
TOTAL		**219,405**	**92,928**	**146,327**	**227,023**	**399,790**	**1,085,473**

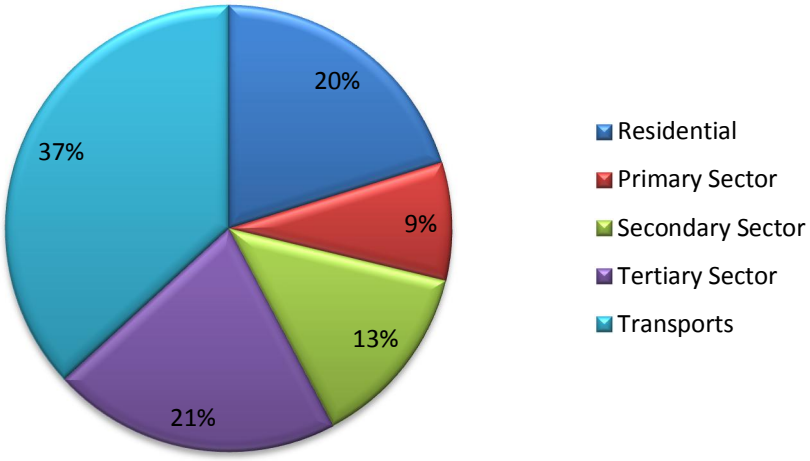

Figure 21 –CO_2 emissions per sector, in 2020 – BAU scenario

It is predicted that the total CO_2 emissions will raise 11.3% from 2005 to 2020 with the BAU scenario, as a result of the increase in the use of fueloil and diesel.

Table 13 –CO_2 emissions per primary energy carrier, in 2005, 2008 and 2020 – BAU scenario

Energy carriers		2005 [t CO2]	2008 [t CO2]	2020 [t CO2]
Fossil fuels	Fueloil	442,216	431,563	485,261
	Diesel	359,139	390,090	424,975
	Gasoline	104,754	95,934	107,033
	LPG	68,917	63,157	68,204
	Subtotal	**975,026**	**980,744**	**1,085,473**

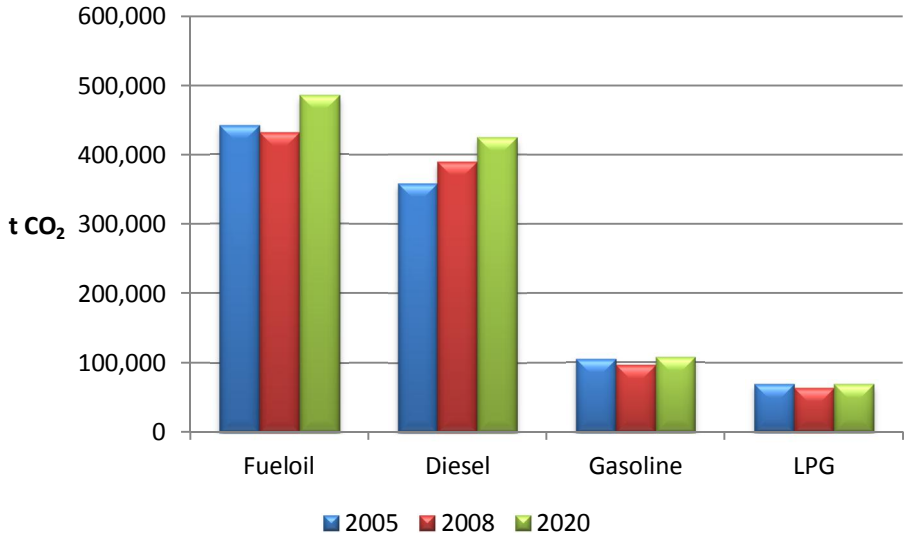

Figure 22 – CO_2 emissions per primary energy carrier, in 2005, 2008 and 2020 – BAU scenario

3.3. Projections to 2020 – Action Plan scenario

For the Action Plan scenario, the same energy demand growth rates were used, based on the evolution of the economic context, on historical data for energy demand and on historical data for demographic evolution. However, in this scenario were included the results of energy efficiency measures, renewable energy projects and migration of energy uses from fossil fuels to electricity or to renewable energy sources, as for the action plans of each island.

The reduction on CO_2 emissions result from three different ways: reducing the energy needs predicted in the BAU scenario through the implementation of energy efficiency measures; increasing the share of electricity coming from renewable energy sources; and shifting fossil fuel uses to electricity – the case of the electric vehicle – or directly to renewable energy sources – the case of thermal solar for domestic hot water.

The next bullets will show the energy needs and CO_2 emissions predicted for the period between 2008 and 2020, according to the Action Plan scenario.

The prediction for 2020 shows a reduction on the primary energy demand and an increase on the contribution of renewable energy sources.

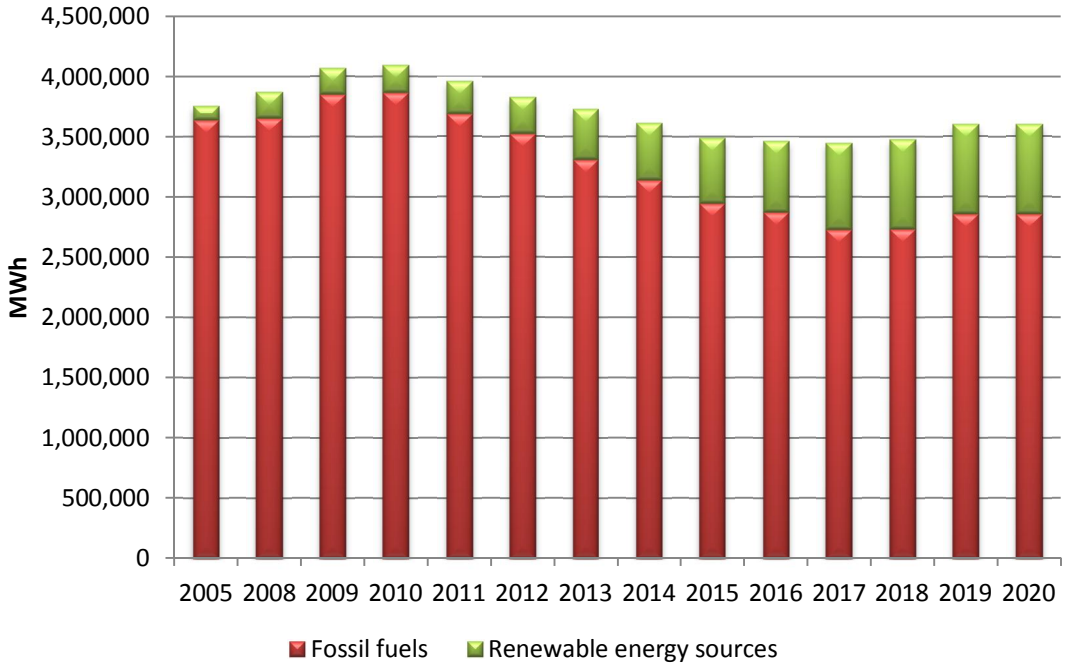

Figure 23 – Primary energy demand until 2020 – Action Plan scenario

The scenario prediction for 2020 shows a reduction on the CO_2 emissions of 21.6%, for the whole Azores archipelago, a value above the 20% of the Pact of Islands commitment.

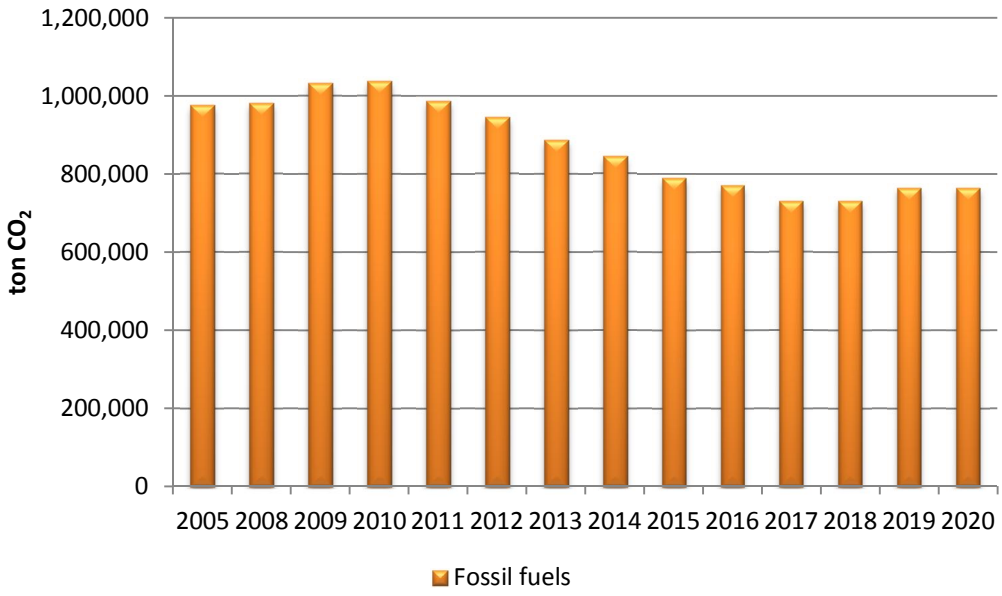

Figure 24 – CO_2 emissions until 2020 – Action Plan scenario

3.3.1. Final energy demand

The table and figures below show the final energy demand predicted for the Action Plan scenario, for the year 2020, for the Autonomous Region of Azores.

Comparing the values and percentages of final energy demand per sector and per energy carrier between the baseline year – 2008 – and with the 2020 BAU scenario, it is visible that:

- The final energy in 2020 for the Action Plan scenario is slightly higher than what it was in 2008 (2.4% above), but is clearly lower than the amount predicted for the BAU scenario, with an absolute reduction value of 238.903MWh, and representing 7.4% reduction.The share of electricity on the final energy in 2020 in the Action Plan scenario will be 28%, a value above the one recorded in 2008 (25.7%) and above the predicted value of the BAU scenario (25%).
- The transport sector, the main final energy sector for the Region, which had a share of 46.6% in 2008, increased to 47% with the BAU scenario and will be of 45% with the ISEAP scenario.

Table 14 – Final energy demand, in 2020 – Action Plan scenario

Energy carriers		Residential	Primary sector	Secondary sector	Tertiary sector	Transports	Total
		[MWh]	[MWh]	[MWh]	[MWh]	[MWh]	[MWh]
Centralized energy services	Electricity	236,534	13,912	141,926	380,218	71,933	844,523
	Subtotal	236,534	13,912	141,926	380,218	71,933	844,523
Fossil fuels	Fueloil	0	0	274,486	0	0	274,486
	Diesel	0	320,046	0	15,719	960,523	1,296,288
	Gasoline	0	0	0	9,297	313,487	322,784
	LPG	180,262	0	0	0	4,440	184,703
	Subtotal	180,262	320,046	274,486	25,016	1,278,450	2,078,260
Renewable energy sources	Hydro	0	0	0	0	0	0
	Wind	0	0	0	0	0	0
	Solar	70,112	0	0	0	1,663	71,775
	Geothermal	0	0	0	0	0	0
	Subtotal	70,112	0	0	0	1,663	71,775
Total		**486,908**	**333,958**	**416,412**	**405,234**	**1,352,046**	**2,994,558**

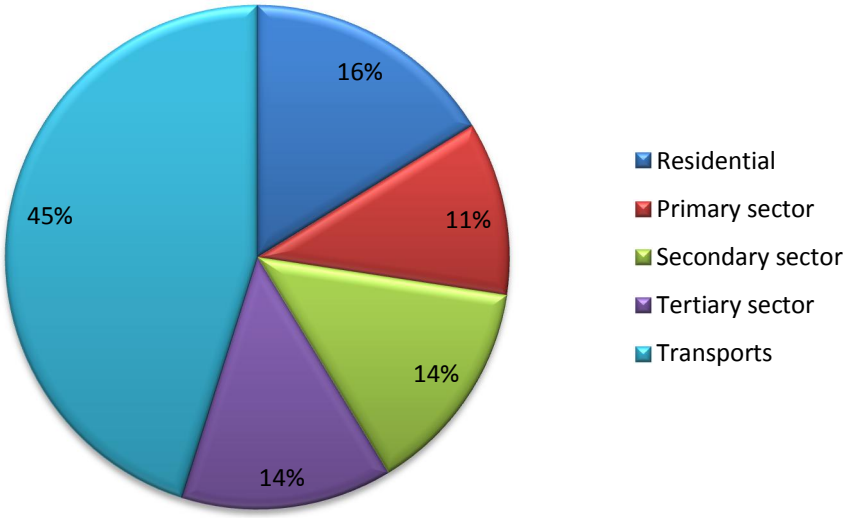

Figure 25 – Final energy demand per sector, in 2020 – Action Plan scenario

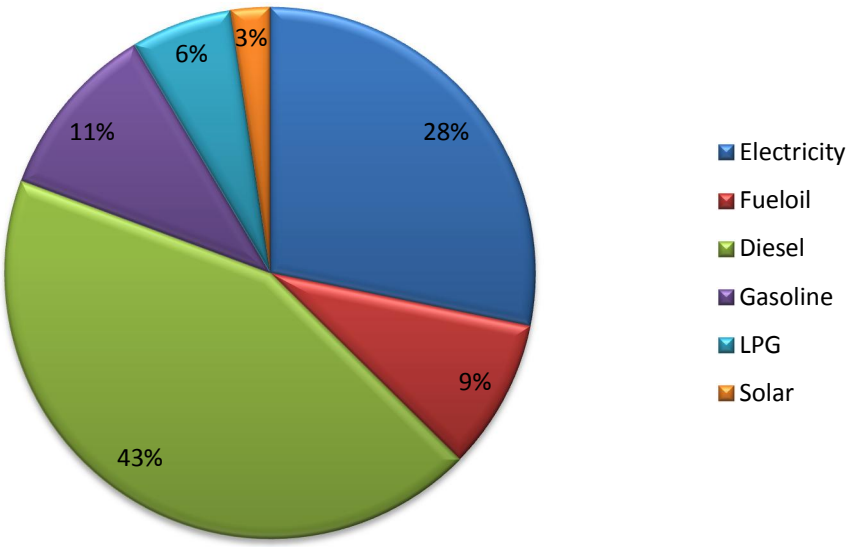

Figure 26 – Final energy demand per energy carrier, in 2020 – Action Plan scenario

3.3.2. Energy conversion

Energy conversion in the Azores regards only the production of electricity. In this context, increasing the share of electricity generation coming from renewable sources is a very important strategy of the Region.

Looking at the data resulting from the 2020 projection, there is a noticeable increment on the renewable generation of electricity, regarding the situation of 2008 baseline year, with a share of 62.1%.

Table 15 – Energy conversion, in 2020 – Action Plan scenario

Energy carriers		**Electricity [MWh]**
Fossil fuels	Fueloil	317,295
	Diesel	29,856
	Gasoline	0
	LPG	0
	Subtotal	**347,151**
Renewable energy sources	Hydro	77,264
	Wind	125,161
	Solar	8,651
	Geothermal	288,923
	Biomass	69,642
	Subtotal	**569,641**
TOTAL		**916,791**
Distribution losses and self-consumption		91,682

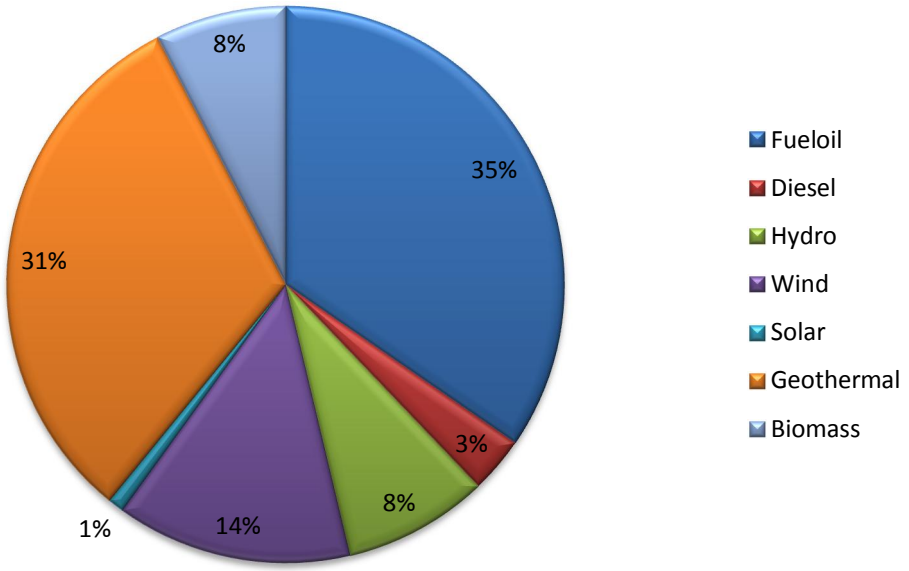

Figure 27 – Electricity production per energy source, in 2020 – Action Plan scenario

Regarding the energy conversion by energy source, the ISEAP projection predicts an increase in geothermal generation from 21% to 31%, hydro from 3% to 8%, wind from 3% to 14% and biomass from 0% to 8%, in 2020.

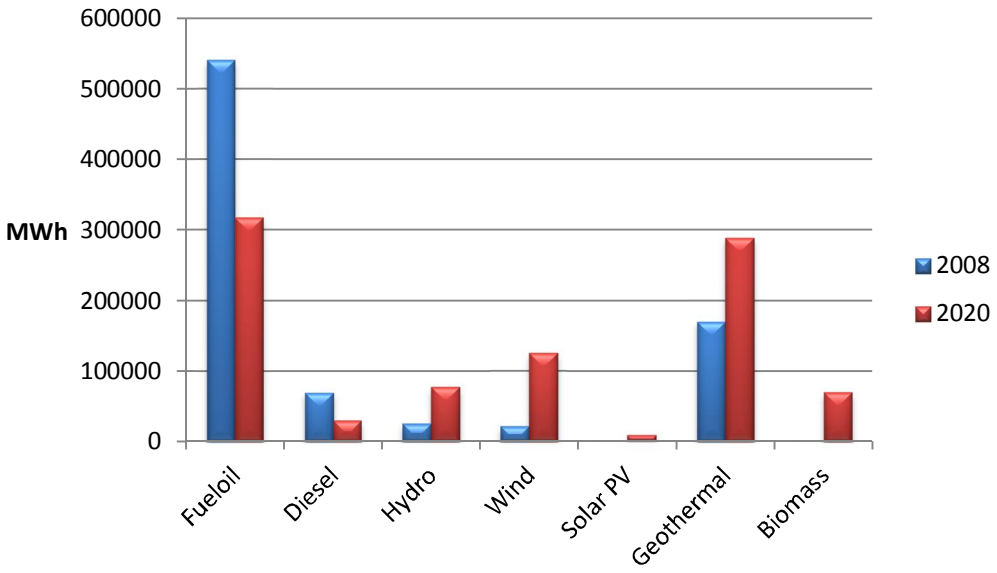

Figure 28 – Energy conversion variation, per energy source, in 2008 and 2020 – Action Plan scenario

3.3.3. Primary energy demand

Comparing the primary energy demand between 2005, 2008 and 2020 – ISEAP scenario – there is a considerable increment on the renewable energy sources share on the whole primary energy. It is predicted that this percentage will exceed the value of 20% in 2020, with the Action Plan scenario. In 2005 and 2008 this share was 3.1% and 5.6%, respectively.

There is a considerable growth on the contributions of geothermal, biomass and wind, resulting on a clear reduction of the contribution of fuel for the whole primary energy.

As for the total primary energy demand for the Azores Region, according to the Action Plan scenario, there is a reduction of 4.1% regarding the year 2005 and 7% regarding the baseline year of 2008.

Comparing the shares of the different energy sources on the primary energy, regarding the baseline year of 2008, there is a clear reduction on fueloil, from 40% to 28%, being diesel and gasoline shares almost kept the same. All the renewable energy sources increase their shares on primary energy, particularly with geothermal increasing from 4% to 8% and biomass, which didn't exist in 2008, rising up to 5%.

The share of primary energy used in the form of electricity will go over the targeted 35%, reaching to 40%

Table 16 – Primary energy demand, in 2005, 2008 and 2020 – Action Plan scenario

Energy carriers		2005 [MWh]	2008 [MWh]	2020 [MWh]
Fossil fuels	Fueloil	1,585,003	1,546,819	1,016,697
	Diesel	1,345,091	1,461,013	1,346,253
	Gasoline	420,698	385,277	313,487
	LPG	287,154	263,156	180,262
	Subtotal	**3,637,946**	**3,656,265**	**2,856,699**
Renewable energy sources	Hydro	30,870	25,291	77,264
	Wind	14,551	21,900	125,161
	Solar	0	0	78,763
	Geothermal	70,669	170,280	288,923
	Biomass	0	0	174,105
	Subtotal	**116,090**	**217,471**	**744,216**
Total		**3,754,036**	**3,873,736**	**3,600,915**
Percentage of renewable sources on the whole primary energy		3.1%	5.6%	20.7%

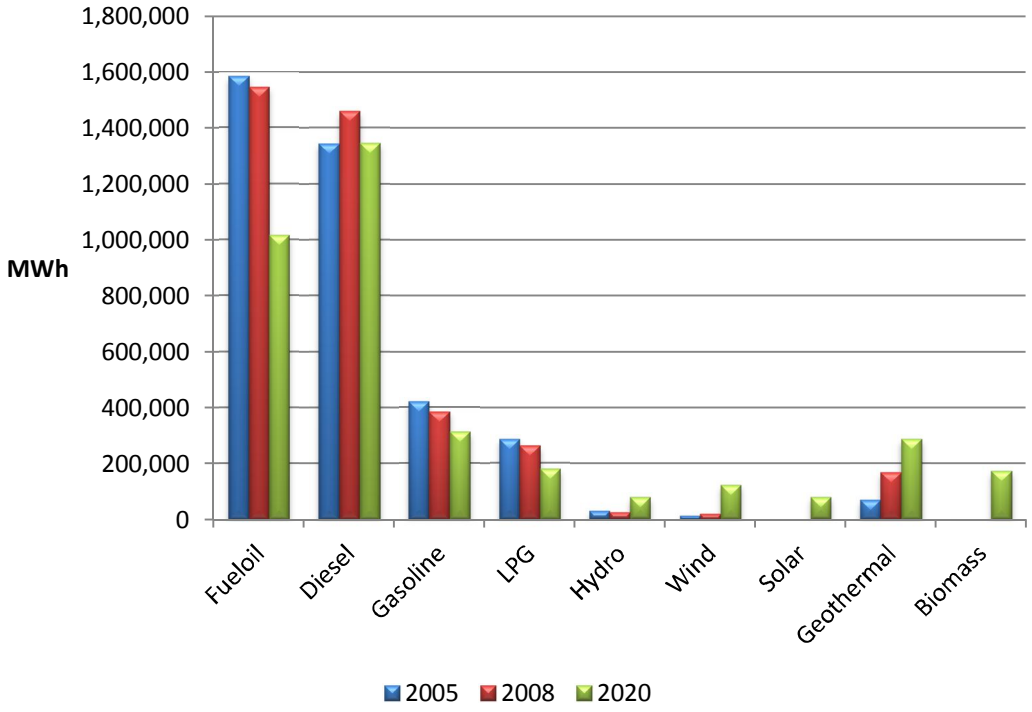

Figure 29 – Primary energy demand, in 2005, 2008 and 2020 – Action Plan scenario

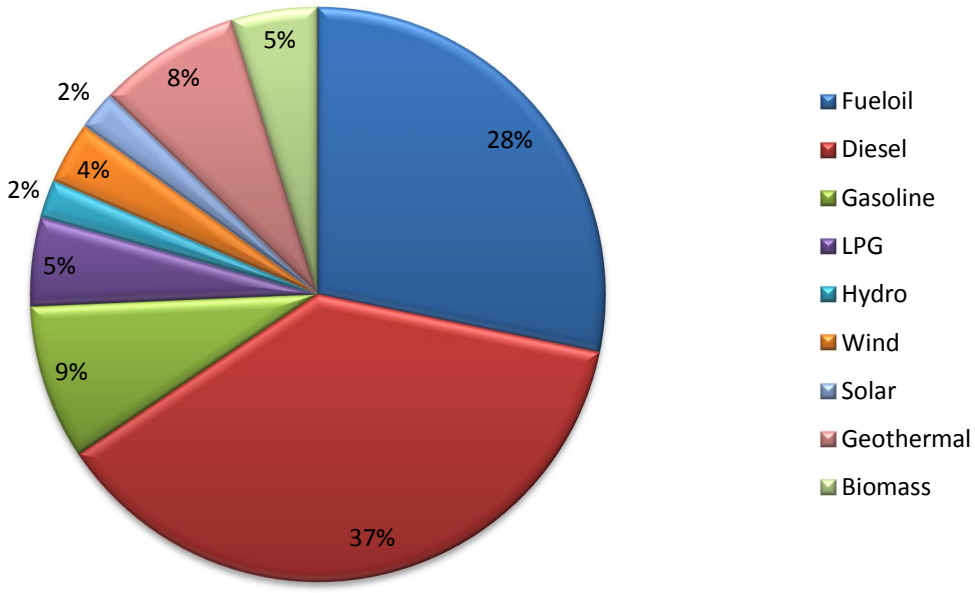

Figure 30 – Primary energy demand, in 2020 – Action plan scenario

3.3.4. Emissions of carbon dioxide

The CO_2 emissions in the year 2020, for the Action Plan scenario, were calculated in the same way as for the previous scenarios. In this case, based on the growth prediction of energy demand, it is expected that the CO_2 emissions are reduced in all sectors except on the primary sector. The highest reductions are on the residential and tertiary sectors.

Table 17 –CO_2 emissions per sector, in 2020 – Action Plan scenario

Energy carriers		Residential [t CO2]	Primary sector [t CO2]	Secondary sector [t CO2]	Tertiary sector [t CO2]	Transports [t CO2]	Total [t CO2]
Centralized energy services	Electricity	65,260	3,813	32,518	110,200	13,933	225,724
	Subtotal	**65,260**	**3,813**	**32,518**	**110,200**	**13,933**	**225,724**
Fossil fuels	Fueloil	0	0	76,581	0	0	76,581
	Diesel	0	85,452	0	0	255,351	340,803
	Gasoline	0	0	0	0	78,058	78,058
	LPG	43,263	0	0	0	0	43,263
	Subtotal	**43,263**	**85,452**	**76,581**	**0**	**333,409**	**538,706**
Total		**108,522**	**89,265**	**109,099**	**110,200**	**347,342**	**764,429**

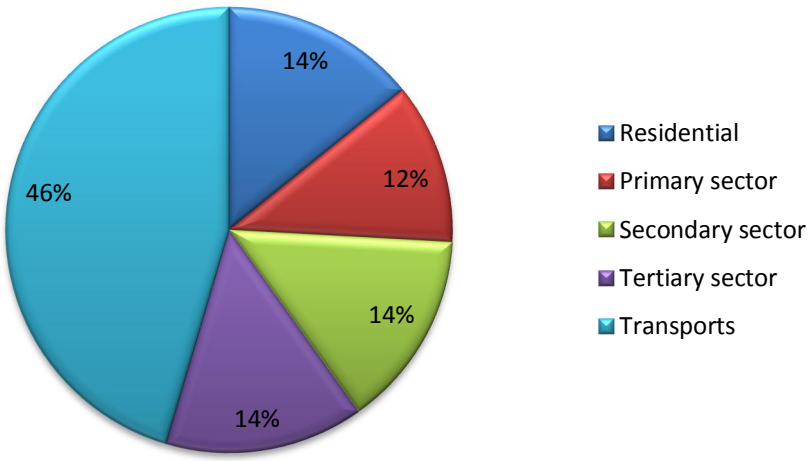

Figure 31 – CO_2 emissions per sector, in 2020 – Action Plan scenario

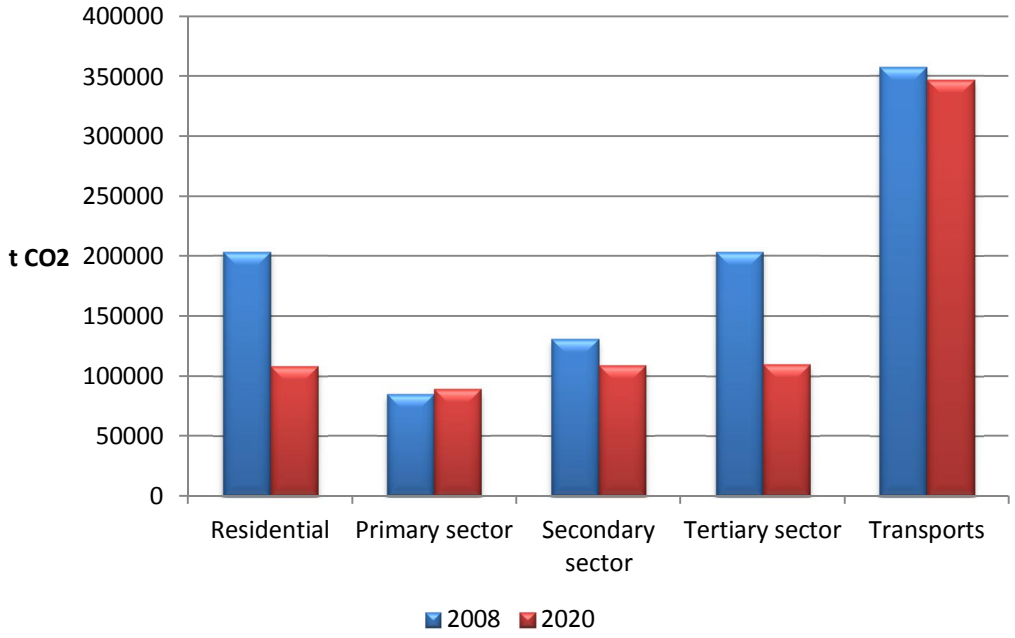

Figure 32 – CO_2 emissions per sector, in 2008 and 2020 – Action Plan scenario

The total CO_2 emissions predicted for 2020, with the ISEAP scenario, will be reduced in 22.1% regarding 2008 and 21.6% regarding 2005. These values are above the target line of 20% reduction regarding 2005.

Table 18 – CO_2 emissions per primary energy carrier, in 2005, 2008 and 2020 – Action Plan scenario

Energy carriers		2005 [t CO2]	2008 [t CO2]	2020 [t CO2]
Fossil fuels	Fueloil	442,216	431,563	283,658
	Diesel	359,139	390,090	359,450
	Gasoline	104,754	95,934	78,058
	LPG	68,917	63,157	43,263
Total		**975,026**	**980,744**	**764,429**

The highest share on the reduction of CO_2 emissions comes from fueloil, mainly because of the increase in renewable generation of electricity. The Electric Vehicle and the use of thermal solar are responsible for the reduction on the fuels associated with transportation and reduction of emissions related to the use of LPG.

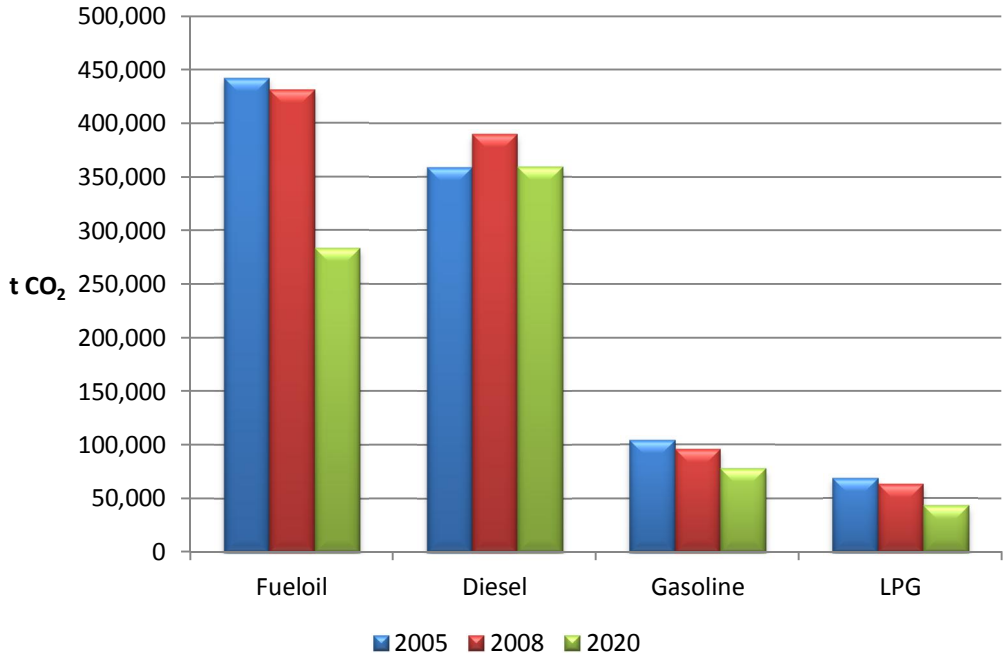

Figure 33 – CO_2 emissions, per primary energy carrier, in 2005, 2008 and 2020 – Action Plan scenario

4. ACTIONS

In order to achieve the targets defined for this Action Plan there will be three fronts of action: increase the share of renewable sources in the production of electricity; improve the energy efficiency either with the use of electricity or with the use of fossil fuels; shift fossil fuel use to electricity use or directly to renewable energy sources (like thermal solar for domestic hot water).

With this in mind, several scenarios were tested, based on the predicted growth rates for the energy demand of each island, so as to define the type and depth of the actions to implement in order to achieve the target of reducing the CO_2 emissions by 20% in each and every island and not only globally, in the whole Region. The actions resulting from the different scenarios tested were defined island by island, considering the particular endogenous energy potential for each one as criteria to choose the best renewable sources to generate electricity from.

4.1. Residential

The residential sector is one of the most important sectors both in the final energy demand and in the corresponding CO_2 emissions, on the BAU scenario.

Some of the actions recommended for this sector, namely the energy efficiency ones, exhibit investment payback periods relatively short, allowing the citizens to support those investments, with mutual advantages both for them and for the Region, with only some awareness campaigns and financial support programs from the Government, like the Proenergia programme.

Table 19 – Actions for the residential sector

Sectors and areas of intervention	Actions	Responsible for the implementation	Implementation schedule	
			Starting year	Ending year
Hot water	Installation of solar collectors for domestic hot water	• Citizens • Companies	2012	2020
	Installation of more efficient domestic hot water devices	• Citizens	2012	2020
	Use of stream reducers in hot water tap	• Citizens	2012	2020
Heating and cooling	Construction / Rehabilitation of buildings with more efficient standards – thermal certification of buildings.	• Citizens • Companies	2012	2020
Lighting	Replacement of 25% of the existing light bulbs by CFL or LED	• Citizens	2013	2020
Refrigerators and freezers	Replacement of 20% of all the refrigerators and freezers by more efficient ones	• Citizens	2013	2020
Image and sound appliances	Efficiency improvement on image and sound appliances and more intelligent use of the stand-by function	• Citizens • AZORINA	2013	2020

4.2. Primary Sector

There were no particular actions defined for the primary sector. However, some of the measures of other sectors, namely production of electricity from renewable sources, electric mobility and public lighting efficiency actions, will also affect this sector.

4.3. Secondary sector

The main action of the Action Plan which will have significant effect on this sector is the implementation of cogeneration biomass power plants, producing both electricity and heat, which in the dairy industries, considered very "energivorous", may represent an effective measure.

Table 20 – Actions for the secondary sector

Sectors and areas of intervention	Actions	Responsible for the implementation	Implementation schedule	
			Starting year	Ending year
Industry	Use of waste heat from biomass co-generation power plant for the thermal processes of manufacturing. Particularly for the dairy industry.	• Power companies • Industry	2014	2018

4.4. Tertiary sector

Some of the energy efficiency actions presented in the residential sector will apply equally to this sector, namely the change of light bulbs for more efficient ones and the energy certification of buildings. Particularly, there is a program already running for electricity demand reduction in public lighting which goal is to reduce 35% of that demand in all islands of the archipelago.

Table 21 – Tertiary sector

Sectors and areas of intervention	Actions	Responsible for the implementation	Implementation schedule	
			Starting year	Ending year
Public lighting	Reduction of 35% on the public lighting electricity demand with Schedule changes and reduction of active lamps.	• Regional Government	2012	2012
All buildings of tertiary sector	Construction / Rehabilitation of buildings with more efficient standards – thermal certification of buildings.	• Companies	2012	2020

4.5. Transports

In the transport sector, responsible for 47% of final energy demand and for 37% of the CO_2 emissions, on the BAU scenario there are two important actions recommended, aiming to reduce the fossil fuels demand: efficiency improvement on the public transports fleet and electric vehicle promotion, either with eventual financing support to the imports and acquisition of such vehicles or with the deployment of EV charging poles in strategically located places of the Azores main cities.

Considering the geographical context of the Azorean islands and the fact that the private transport, at this scale, has lower use constraints, either with commuting time spent or with parking problems in the cities (all of them relatively small), there are no natural incentives to the use of public transports. Thus, the actions concerning passenger transportation must always take more into account the electrification of the private car than intense campaigns towards using the public transports.

Table 22 – Actions for the transports sector

Sectors and areas of intervention	Actions	Responsible for the implementation	Implementation schedule	
			Starting year	Starting year
Passenger road transport	Replacement of 90% of the public transport fleet, with an estimate of 8% fuel consumption reduction per vehicle. SIRIART program	• Regional Government	2010	2014
	Increment of the number and frequency of bus services, diminishing the use of private car.	• Regional Government	2014	2020
Private transport	Promotion of the electric vehicle on all islands (detailed numbers on Table 23)	• Companies • Citizens	2013	2015

The number of EVs predicted for each Island was determined based on two factors, being the first one the specific needs of the islands in terms of CO_2 emissions reduction, taking into account the planned investments, and the second one the economic dynamism of each island.

Table 23 – Electric vehicles predicted per island

Island	Number of EVs	Percentage of families with EV
Santa Maria	670	33.23%
São Miguel	17 956	41.16%
Terceira	2 000	10.14%
Faial	2 176	39.82%
Graciosa	150	8.87%
Pico	1 445	28.57%
São Jorge	400	11.63%
Flores	50	3.34%
Corvo	25	12.82%

4.6. Secondary energy production

In the Azores Autonomous Region the production of secondary energy comes down to the production of electricity. The actions included in the Action Plan regard the production of electricity from renewable energy sources, considering the available resources in each different island.

Table 24 – Actions for secondary energy production

Island	Type of generation	Actions	Responsible for the implementation	Implementation schedule	
				Starting year	Ending year
Santa Maria	Wind	Enlargement of Figueiral Wind Farm – 0.6MW	• EDA	2012	2012
	Wind	New Wind Farm or enlargement of the existing one – 0.46MW	• Private companies or EDA	2016	2017
	Solar PV	Installation of 1.2MW PV in the residential sector	• Citizens	2016	2020
São Miguel	Hydro	Reversible hydro power plant at Lagoa das Furnas – 11.1MW	• EDA	2015	2017
	Wind	Graminhais Wind Farm – 9MW	• EDA	2011	2012
	Solar PV	Installation of 2.4MW PV in the residential sector	• Citizens	2016	2020
	Geothermal	Enlargement of Pico Vermelho power plant – 7.5MW	• EDA	2014	2016
	Biomass	Biomass cogeneration power plant – 4MW	• Private company	2016	2017
Terceira	Wind	Enlargement of Serra do Cume Wind Farm – 4.5MW	• EDA	2011	2012
	Wind	New Wind Farms – 2MW	• Private companies	2013	2014
	Solar PV	Installation of 1MW PV in the residential sector	• Citizens	2016	2020
	Geothermal	New geothermal power plant at Terceira island – 3MW	• Geoterceira • EDA	2014	2015
	Geothermal	Enlargement of the geothermal power plant – 3MW	• Geoterceira • EDA	2017	2018
	Biomass	Biomass cogeneration power plant – 2MW	• Private company	2013	2014
Faial	Wind	Enlargement of Lomba de Frades wind farm from 1.8MW to 4.25MW	• EDA	2012	2012
	Solar PV	Installation of 1.3MW PV in the residential sector	• EDA	2014	2020
Graciosa	Wind	Enlargement of Serra Branca Wind Farm – 0.46MW	• EDA	2012	2013
	Solar PV	Installation of 0.4MW PV in the residential sector	• Citizens	2016	2020
	Biomass	Biomass cogeneration plant – 1.5MW	• Private company	2015	2016

Island	Type of generation	Actions	Responsible for the implementation	Implementation schedule	
				Starting year	Ending year
Pico	Wind	Enlargement of Terras do Canto wind farm – 0.6MW	• EDA	2011	2012
	Wind	New wind farm or enlargement of the existing one – 3.6MW	• EDA or private companies	2015	2016
	Solar PV	Installation of 1.2MW PV in the residential sector	• Citizens	2016	2020
São Jorge	Wind	Enlargement of Pico da Urze wind farm – 0.44MW	• EDA	2011	2012
	Wind	New wind farm or enlargement of the existing one – 1MW	• EDA or private companies	2016	2017
	Solar PV	Installation of 0.4MW PV in the residential sector	• Citizens	2016	2020
	Biomass	Biomass cogeneration power plant – 1.5MW	• Private company	2014	2015
Flores	Hydro	Enlargement of Além - Fazenda – 0.128MW	• EDA	2012	2013
	Hydro	New hydro of Ribeira Grande – 1.1MW	• EDA	2015	2016
Corvo	Wind	New Wind Farm – 0.3MW	• EDA	2014	2016

4.7. Land use planning

The actions in this chapter will contribute to reduce the energy needs in transports and buildings, as well as to help to match the demand curve of the electric systems with the availability of renewable resources, allowing them to increase their share in the mix.

Table 25 – Actions for land use planning

Sectors and areas of intervention	Actions	Responsible for the implementation	Implementation schedule	
			Starting year	Ending year
Regional and local strategic planning	Integration of criteria and rules in land use planning which promote the minimization of the energy needs for transports and buildings.	• Regional Government • Municipalities	2012	2020
Transports and mobility planning	Elaboration of wide mobility plans which promote the public transport, the electric vehicle, with its charging network, as well as other means of transport less pollutant including pedestrian walk.	• Regional Government • Municipalities	2012	2020

Sectors and areas of intervention	Actions	Responsible for the implementation	Implementation schedule	
			Starting year	Ending year
Energy infrastructures planning	Installation of systems for dynamic power stabilization to diminish the disturbance of wind and solar production in the electrical grid.	• EDA	2012	2018
	Transfer of electricity use from peak hours to off-peak hours, through EV charging systems and also promoting schedule changes for the household appliances, maximizing the share of intermittent renewable sources in the electrical grid.	• Regional Government • EDA • Citizens	2012	2020
	Study on the feasibility of heat recover from the Ribeira Grande geothermal power plant, through district heating grid to use in hotels, industry or services (example: headquarters of the firebrigade of Ribeira Grande).	• EDA • Regional Government • Companies	2012	2020
	Study on feasibility of a small hydro at Lagoa das Furnas to improve the quality of water.	• EDA • AZORINA • Companies	2012	2020
Renewable energy land use planning	Assessment of the potential of renewable energy resources, development of prediction models for intermittent renewable sources and studies on the dynamic behavior of electrical grids.	• Regional Government • EDA • AZORINA • Companies	2012	2020
	Land use planning of wind farms, photovoltaic and other renewable energy installations, based on the assessment of the potential of the resources, the dynamic behavior of the electricity grid and the constraints in a territorial scope.	• Regional Government • EDA • Municipalities	2012	2020

4.8. Citizens and stakeholders

Once several actions depend upon the behaviors and choices of citizens and companies, in order to attain the goals of the Action plan, the whole society will have to be involved. This involvement will include the development of support services to energy users, the promotion of awareness and information actions, and the development of financial incentives which will promote the desired actions within the framework of the ISEAP

Table 26 – Actions for citizens and stakeholders

Sectors and areas of intervention	Actions	Responsible for the implementation	Implementation schedule	
			Starting year	Ending year
Advisory services	Creation of an information helpline and a forum with questions and answers, based on an e-learning platform, for domestic energy users, in order to clarify doubts and provide advice on energy efficiency, use of renewable energy and CO_2 emissions.	• Regional Government • Municipalities • EDA	2012	2020
Financial support and grants	Financial support for public promoters and non-profit organizations to implement the actions and measures within the framework of the ISEAP recommendations.	• Regional Government	2012	2018
	Financial incentive for business and residential promoters to implement voluntary measures of energy efficiency, use of renewable energy or reduction of CO_2 emissions.	• Regional Government	2012	2015
	Implementation of privileged conditions for the EV parking.	• Municipalities	2013	2020
	Promotion and support in the preparation and negotiation of energy service contracts and specific financial systems for energy efficiency and renewable energy, with energy services companies (ESCO) and credit institutions.	• Regional Government	2012	2015
Awareness raising and networking	Awareness-raising campaigns for adoption of passive measures in buildings, purchase of efficient equipment, installation of control devices, use of renewable energy for own consumption, sustainable and eco-efficient mobility, monitoring of consumptions and adoption of more efficient practices directed mainly at the residential and services sectors, involving schools, associations and the media.	• Regional Government • AZORINA	2012	2020
	Development of cooperation projects in the energy domain with other regions, in particular with outermost island regions presenting similar problems.	• Regional Government • AZORINA • EDA	2012	2020
	Elaboration of awareness-raising guides and brochures on urban regeneration, mobility, energy efficiency and use of renewable energy aimed at energy consumers, promoters, developers and professionals.	• AZORINA	2012	2016

Sectors and areas of intervention	Actions	Responsible for the implementation	Implementation schedule	
			Starting year	Ending year
	Promotion of cooperation activities in the energy field between public regional and local administration, research institutes, business associations, companies, credit institutions, NGOs and the media.	• Regional Government • AZORINA	2012	2020

5. ORGANIZATIONAL AND FINANCIAL MECHANISMS

To make the Island Sustainable Energy Action Plan real it will be required an organizational and coordination structure; a set of human resources endowed with enough technical competences; the involvement of stakeholders, including the common population; the mobilization of financial resources and financing schemes and, at last, the assurance of a follow-up of the Plans implementation and the achievement of its goals.

5.1. Coordination and organizational structures

In the Azores, the regional department responsible for the energy policies, including the implementation of the ISEAP, is the Regional Secretariat for Environment and Sea (*Secretaria Regional do Ambiente e do Mar* - SRAM). The Regional Directorate for Energy, tutored by SRAM, is the responsible body for the implementation of the policies and, in this case, also for the ISEAP execution.

The coordination and implementation of the ISEAP will be done by the Coordination Committee, which will have representatives of the following entities:

- Regional Directorate for Energy (DRE);
- Azorean Electricity Company - *Electricidade dos Açores* (EDA);
- AZORINA Sociedade de Gestão Ambiental e Conservação da Natureza S. A.

The Local Advisory Committee (LAC), composed of ISLE-PACT stakeholders' representatives, namely institutions, organizations, companies and public and private entities, ensures the society's support in the assessment and follow-up of the actions and targets of the ISEAP.

5.2. Staff capacity

Azores archipelago has abundant renewable energy resources, having been the pioneers at national level in the exploitation of hydro (1899 – one of the first plants in the country, in São Miguel island); geothermal (1980 – São Miguel island); wind energy (1988 – second wind farm in the country, at Santa Maria island) and wave energy (Pico island power plant, built between 1995 and 1999).

The Green Islands project, one of the main investigation projects of the MIT-Portugal program, coordinated by the Azores Regional Agency for Environment and Energy - ARENA (*Agência Regional da Energia e Ambiente da Região Autónoma dos Açores*), later merged into AZORINA, S.A., in cooperation with the University of the Azores, had as a main goal the maximization of the renewable energies share on the total primary energy. For this purpose, there were studies made and investigation work done which allowed to define which endogenous resources should be used in each different island of the archipelago.

This is the clear demonstration that there was from the beginning a great effort put in the creation of critical mass in the Region with technical competences in the energy field, which is believed to be needed and sufficient to implement and monitor the ISEAP. As a matter of fact, the goals and targets of the Green Islands project were the foundation of this Action Plan.

While the critical mass dedicated to technical issues is at the Regional Directorate for Energy and at the University of the Azores, at AZORINA, the project partner, there are highly competent technicians with knowledge in the area of environmental management, nature conservation, with special emphasis on communication, information and environmental awareness tasks. All together, these teams constitute the technical framework that will assure the execution of the actions to implement.

Out of this sphere, and talking about energy efficiency, the managing and supervising entity for the buildings energy certification system (SCE) is the Regional Directorate for Energy, part of the Regional Secretariat for Energy and Environment. Within the functions of the SCE, there are today more than two hundred qualified experts (engineers and architects with technical competences for project; energy auditing in buildings, HVAC systems, domestic hot water systems and equipment and gas installations). These are essential skills for the implementation of the actions regarding the energy efficiency of residential and service buildings. Also in the private sector, there are several companies available, covering areas from project and construction of efficient buildings to the installations of renewable energy systems or energy efficiency, including energy services companies, which is also a good sign of the existence of conditions and skills needed to implement the ISEAP measures.

5.3. Involvement of stakeholders

The involvement of stakeholders will be done essentially on two ways, on one hand, through the Local Advisory Committee (LAC), which has been following the development of the ISEAP and which will have a fundamental role on the follow-up and monitoring its implementation. This Committee has representatives of the various sectors which will have intervention or will be object of the Plan's recommended actions, and will keep on meeting regularly in order to add, correct or orientate the several measures and actions of the ISEAP. On the other hand, the whole population will also be involved, through awareness campaigns and media actions and through any other means considered adequate to bring them the messages. An important share of the actions, mainly in the scope of energy efficiency and good practice for the residential sector, strongly depend on the final energy users' reception, hence the great importance of the communication for this sector.

5.4. Budget

The budget predicted for the actions of this ISEAP is shown on the following table and figures.

Table 27 – Investments to be carried out until 2020 – ISEAP

Investment [M€]	**Promoters**				
Sectors and areas of intervention	Public companies	Regional Government	Private investment	Citizens	**Total**
Secondary energy production	76.96	0.00	16.75	39.50	133.21
Residential	0.00	3.46	0.00	176.59	180.05
Transports	0.00	0.00	0.00	136.52	136.52
Total	76.96	3.46	16.75	352.61	449.78

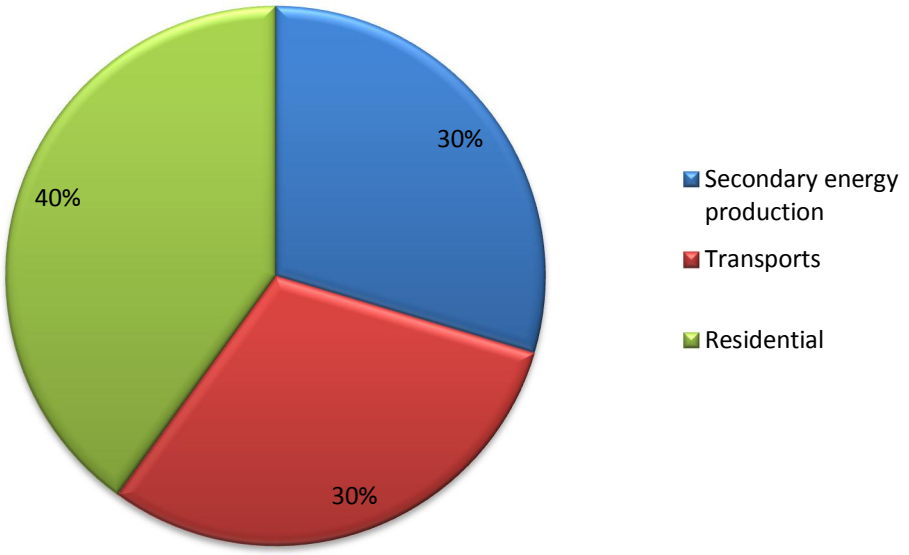

Figure 34 – Investment breakdown per sector – ISEAP

The budget will be equally distributed between the three areas on which the actions will be implemented.

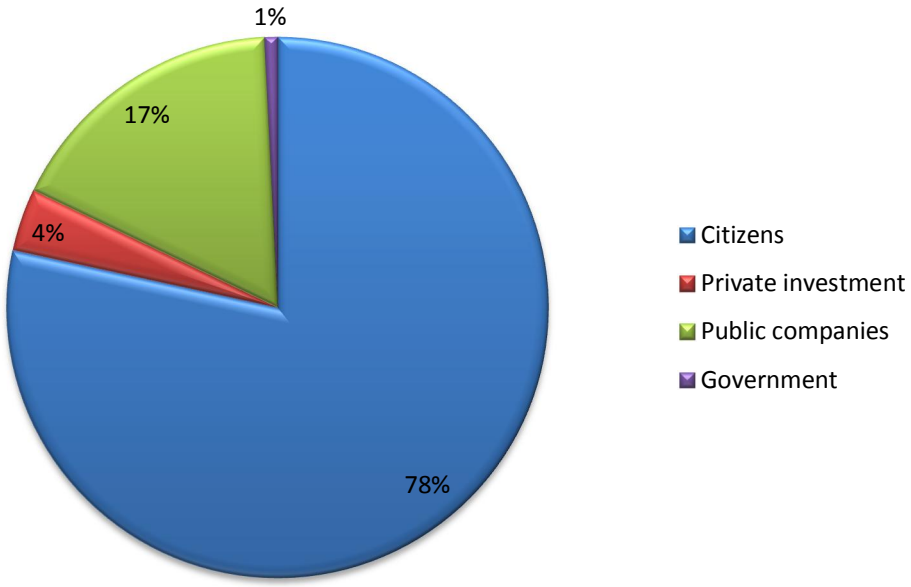

Figure 35 – Investment breakdown per type of promoter – ISEAP

There are two important issues contributing for the bigger share of citizens investments on the whole budget: on one hand, there are measures listed in the Action Plans, for the residential and transports sector, which include actions that would most probably happen outside the ISLE-PACT scope; on the other, there are actions which budget is still unknown, therefore not presented in the whole budget, as it is the case of some secondary energy production and public transports investments.

5.5. Financing sources and instruments

The next table shows the main financing sources and possible finance support schemes for the implementation of the actions contained in the ISEAP, per promoter.

Table 28 – Financing sources and instruments

Promoter	Financing sources	Support instruments
Regional Government	▪ Regional Budget. ▪ European Investment Bank. ▪ Bank loan. ▪ Energy Services Companies (ESCO).	▪ Operational programs ▪ European programs ▪ Energy Efficiency Fund
Public companies	▪ Regional Budget ▪ European Investment Bank ▪ Bank loan ▪ Energy Services Companies (ESCO)	▪ Operational programs ▪ European programs ▪ Energy Efficiency Fund
Municipalities	▪ Regional Budget ▪ European Investment Bank ▪ Bank loan ▪ Energy Services Companies (ESCO)	▪ Operational programs ▪ European programs ▪ Energy Efficiency Fund
Private companies and organizations	▪ Own funds ▪ Bank loan ▪ Energy Services Companies (ESCO)	▪ Incentive Systems ▪ Operational programs ▪ European programs ▪ Energy Efficiency Fund ▪ Tax benefits ▪ Special tariffs
Citizens	▪ Own funds ▪ Bank loan ▪ Energy Services Companies (ESCO)	▪ Energy Efficiency Fund ▪ Tax benefits ▪ Special tariffs

5.6. Monitoring and follow-up

For the implementation of the ISEAP to be monitored along the years while its measures are to be executed, until 2020, it will be necessary to collect periodically data regarding final energy demand – both in electricity and fuels or even others that are to be distributed as well – use of primary energy for energy conversion and status of implementation of the actions recommended by the ISEAP in each period.

Table 29 – Monitoring data collection

Data to collect	Information sources	Frequency
Fossil fuels demand	▪ Economy Regional Secretariat ▪ Fuel suppliers ▪ EDA	Yearly
Electricity demand	▪ EDA	Yearly
Electricity production	▪ EDA	Yearly
ISEAP actions for the period	▪ Entities responsible for implementation ▪ Local Advisory Committee ▪ Coordination Committee	Yearly

Based on the information gathered, according to the table above, DRE will create an energy balance, using the monitoring tools developed for the ISLE-PACT project, which will gather all data regarding primary and secondary energy demand, as well as their respective CO_2 emissions. A report will be produced every year with all that information and also the development status of the measures recommended for the period in analysis.

The Local Advisory Committee will meet at least once every second year, with the aim of analyzing the reports regarding the energy indicators, CO_2 emissions and the list of implemented actions. This way the LAC will be able to follow-up the ISEAP implementation and the outcomes already attained.

Whenever, for a given time period, the energy indicators, the CO_2 emissions or the implemented actions are behind what is expected, the reason for the delay should be analyzed and eventually be suggested new corrective actions or new deadlines for the missing actions.

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PACT OF ISLANDS

Elaboration:

azorina
Sociedade de Gestão Ambiental e Conservação da Natureza, SA

Cooperation:

SECRETARIA REGIONAL DO AMBIENTE E DO MAR
GOVERNO REGIONAL DOS AÇORES

EDA
Electricidade dos Açores

Financial support:

EUROPEAN COMMISSION
Directorate-General for Energy

Governo dos Açores

azorina
Sociedade de Gestão Ambiental e Conservação da Natureza, SA