2016

MENJEZ, THE GREENVILLE

Sustainable Energy Action Plan (SEAP)

MUNICIPALITE DE MENJEZ

بلدية منجز

Sustainable Energy Action Plan (SEAP)
Municipality of Menjez

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Foreword

At the Municipality of Menjez, we believe in sustainability. We believe in the power it comes with.

We do worry about the next generations and believe in their right to enjoy a healthy planet, we also care about our image and how green it is portrayed, and we value sustainable development and community growth, yet our motivation goes beyond it all. We acknowledge responsibility, and believe in our commitment to a sustainable living, for the sake of current generations as well as future ones to come.

In 2012, we started a movement. Menjez was the first municipality in Lebanon and the Middle East to be a committed fair trade town.

In 2014, we again joined a movement and created another. On the 19th of September 2014, we took the decision to join the EU Covenant of Mayors movement, and created a new movement in Lebanon together with 16 additional signatories of the Covenant from Lebanon.

The decision taken by the municipality was a reflection of the people of Menjez's vision to have a sustainable, smart, and environmentally-responsible village.

As the mayor of Menjez, I'm keen to see the village developing and moving towards sustainability, actively reducing its carbon emissions and shifting towards a low carbon economy.

Our ambitions are big, and so is our belief in making it happen. This Sustainable Energy Action Plan outlines how Menjez will achieve these ambitions and meet the commitments made under the Covenant of Mayors declaration. It details how we will be joining efforts with local and international partners to reduce our emissions and achieve a sustainable village that perfectly portraits our beliefs and ambitions.

I wish to thank SHAAMS ENPI CBC project for their support in financing this study and our expert Mr. Nader Hajj Shehadeh for his valuable efforts in designing Menjez's first SEAP, a major milestone towards the sustainable village we aim for.

Together we hope to achieve "Menjez, the greenville", the sustainably structured village, both now and for generations to come.

Dr. George Youssef

Mayor of the Municipality of Menjez

About SHAAMS

SHAAMS seeks to pave the way for a shared and unified approach on solar energy in order to contribute in building the necessary legal, regulatory, economic and organizational foundations for the effective deployment of the Mediterranean Solar Plan. To ensure a cultural and operational change towards solar energy driven solutions, the project addresses three socioeconomic pillars, namely policy development, entrepreneurial and research engagement, and social awareness. New funding mechanisms, innovative governance solutions, support to technology transfer, brokerage events, and large information campaigns are among those actions identified by SHAAMS to facilitate the take up of solar technologies in the Mediterranean region.

SHAAMS capitalization plan identified the experiences to be capitalized, captured significant experiences and established a framework of reference to identify the practices, common activities and significant case studies to be used during the project.

In this framework, one of the best practices identified by SHAAMS is the Sustainable Energy Action Plan (SEAP). A SEAP is the key document in which the signatory of the covenant of Mayors outlines how it intends to reach its CO2 reduction target by 2020. It defines the activities and measures set up to achieve the targets, together with time frames and assigned responsibilities. The elaboration of a SEAP at local level can play a substantial role for an efficient transition towards sustainable local energy systems, reaching the objectives of SHAAMS project.

The Chamber of Commerce, Industry and Agriculture of Beirut and Mount Lebanon, as an implementing partner of SHAAMS project, cooperated with the Municipality of Menjez in order to have a Sustainable Energy Action Plan drafted for the Municipality, in line with the objectives of SHAAMS.

SHAAMS is implemented under the ENPI CBC Mediterranean Sea Basin Programme. Its total budget is 3.200.344,40 Euros and it is financed for an amount of 2.880.309,96 Euros (90%) by the European Union through the European Neighborhood and Partnership Instrument.

About The Author

Nader Hajj Shehadeh is an energy specialist with more than 10 years of professional experience in Energy Efficiency and Renewable Energy at both technical and policy levels. He currently works as an independent energy consultant in Lebanon and the GCC, and heads a professional business and energy sustainability consultancy firm, OTB Consult (www.otbconsult.com), offering business development, renewable energy, and sustainability consultancy services to startup, established companies, and public institutions.

Nader has worked as a consultant to national and international institutions such as the UNDP, GIZ, Italian Cooperation, ILO, ESCWA and many others, implementing strategy development and capacity building at different levels. Nader is the lead author of Lebanon's first National Energy Efficiency Action Plan (NEEAP) as well as many other publications and reports. He also worked as a technical engineer in the private sector and then as an energy engineer with the UNDP at the Lebanese Center for Energy Conservation, implementing energy efficiency and renewable energy activities in a wide range of sectors.

Nader holds a BE in Mechanical Engineering with emphasis on renewable energy from Notre Dame University. He also holds a Master of Science in International Business from Kedge Business School, a Master of Business Administration from Notre Dame University, and a post-graduate degree in Management of Development Projects from École Polytechnique Fédérale de Lausanne (EPFL).

Nader Mr. Hajj Shehadeh is a LEED GA, a Certified Renewables Grid Manager, and a licensed solar energy trainer, with various publications including conference papers, published articles, and guide books.

List of Acronyms & Abbreviations

AC	Air Conditioner
ATV	All-Terrain Vehicle
BAU	Business as Usual
BDL	Banque Du Liban
B_o	Maximum Methane Producing Capacity (kg CH4 / kg BOD)
BOD	Biochemical Oxygen Demand
C	Carbon
CDR	Council for Development and Reconstruction
CES-MED	Cleaner Energy Saving Mediterranean Cities Project
CFC	Chlorofluorocarbon
CH_4	Methane
CHP	Combined Heat & Power
CO_2	Carbon Dioxide
CO_2-eq	Carbon Dioxide Equivalent
CoM	Covenant of Mayors
COP	Conference Of the Parties
EDL	Electricite du Liban
EE	Energy Efficiency
EF	Emission Factor
EPA	US Environmental Protection Agency
ESCO	Energy Service Company
EU	European Union
FIT	Feed-in Tariff
GHG	Greenhouse Gas
GIZ	Gesellschaft für Internationale Zusammenarbeit
GLS	General Lighting Service
GWh	Gigawatt-hour
ha	Hectare
HCFC	Hydrochlorofluorocarbon

HPMV	High Pressure Mercury Vapor
HPS	High Pressure Sodium
HVAC	Heating, Refrigerating and Air Conditioning
JRC	Joint Research Centre
km	Kilometer
kVA	Kilovolt-Amperes
kW	Kilowatt
kWh	Kilowatt-hour
l	Liters
LCEC	Lebanese Center for Energy Conservation
LED	Light Emitting Diode
LPS	Low Pressure Sodium
MCF	Methane Correction Factor
MCF	Methane Conversion Factor
MEW	Ministry of Energy and Water
MOIM	Ministry of Interior and Municipalities
MPW	Ministry of Public Works
MSW	Municipal Solid Waste
MWh	Megawatt-hour
N	Nitrogen
N_2O	Nitrous Oxide
NEEAP	National Energy Efficiency Action Plan
NEEREA	National Energy Efficiency and Renewable Energy Action
NREAP	National Renewable Energy Action Plan
OPCC	Intergovernmental Panel on Climate Change
PSL	Public Street Lighting
PV	Photovoltaic
RE	Renewable Energy
SIC	SEAP Implementation Committee
SME	Small and Medium Enterprises

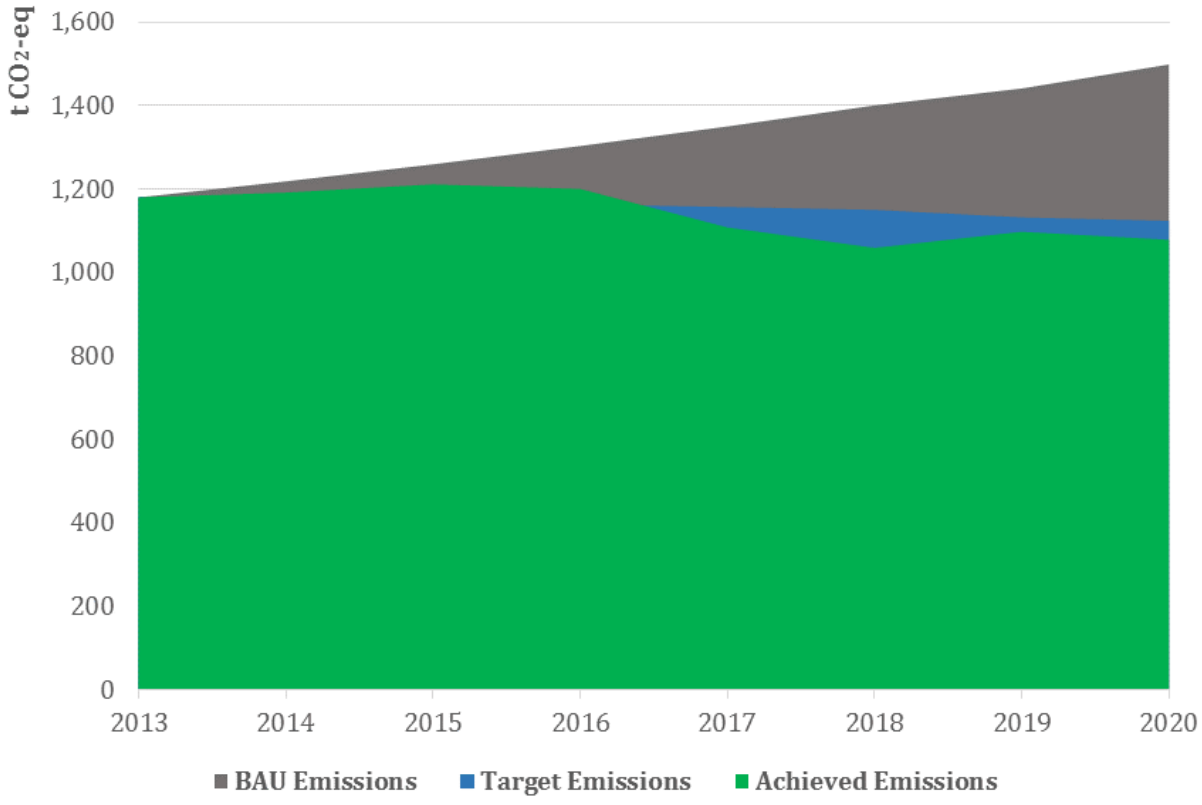
SUV	Suburban Utility Vehicle
SWH	Solar Water Heater
t	Tonnes
tC	Ton of Carbon
tCO_2	Tonnes of CO2
TFL	Tubular Fluorescent Lamp
TOW	Total Organically Degradable Carbon in Wastewater
TWh	Terawatt Hour (109 kWh)
UNDP	United Nations Development Programme
USD	United States Dollars

Executive Summary

Inspired by the 20% emission reduction target of the COM, Menjez has committed to a GHG emission reduction target of 25% by 2020 as compared to business as usual scenario. Starting with 2013 as the baseline year, Menjez was emitting 1,180 tCO_2-eq per year for energy and other applications, referring to the projection methodology recommended by the Covenant of Mayors, GHG emissions are expected to grow by 27% over the period of 7 years, to reach 1,499 tCO_2-eq if no action is taken.

Menjez targets controlling its 2020 emissions and limit them to a total of 1,124 tCO_2-eq. This is only achievable by integration a sustainable energy action plan featuring GHG reduction measures from different sectors and different categories including electricity, carbon stock, transportation, agriculture, and others.

A total of 23 measures are proposed that would lead to a GHG emission reduction of 28.05% if implemented all together, and reducing 420 tCO_2-eq per year for the year 2020. This is exceeding the target emissions by more than 3.05%.



In order to achieve the target, the following set of sustainability measures are put in action, with the ones in green already implemented between the period 2014 and 2015.

Ref	Measure	GHG Reduction (tCO_2-eq)	GHG Reduction (%)
E-01	Solar-Powered Public Street Lighting	11.41	0.76%
E-02	Back-up Generator Load Shift	20.80	1.39%
E-03	Solar PV Power Plant	64.32	4.29%
E-04	Solar Pumping	77.77	5.19%
E-05	Residential Solar Water Heaters	39.95	2.67%
E-06	Intelligent LED Street Lighting	32.38	2.16%
E-07	Solar Awareness Billboard	1.96	0.13%
E-08	Positive Energy Residential Kit	40.69	2.72%
E-09	House Doctor Program	36.17	2.41%
E-10	Low Carbon Homes	7.23	0.48%
T-01	Urban Planning - New Roads Phase 1	14.21	0.95%
T-02	Efficient Municipal Fleet – Phase 1	0.08	0.01%
T-03	In-village Doctor	1.14	0.08%
T-04	Urban Planning - New Roads Phase 2	12.89	0.86%
T-05	Upgrading Agri-COOP Fleet	10.88	0.73%
T-06	Cycling Routes	1.87	0.12%
T-07	Beirut-Menjez Public Transportation	2.65	0.18%
T-08	Efficient Municipal Fleet – Phase 2	0.30	0.02%
C-01	Forestation (Forest) - Phase 1	42.00	0.00%
C-02	Forestation (Fruit Trees) - Phase 1	13.70	0.00%
C-03	Forestation (Forest) - Phase 2	84.00	0.00%
C-04	Forestation (Fruit Trees) - Phase 2	13.70	0.00%
A-01	Fertilizer Planning Program	3.54	0.24%
A-02	Efficient Ranching Practices	9.26	0.62%
W-01	Rainwater Harvesting	0.13	0.01%
W-02	The Green Cone Composter	0.19	0.01%
G-01	General Awareness	30.55	2.04%

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BACKGROUND & METHODOLOGY

1.1 Carbon & the Globe

Greenhouse gases have been on the rise for the past decades, increasing by more than double for the past forty years. The increase was more intense in the past years, increasing by 50% since 1992 and thus causing concentrations in the atmosphere to increase by 11%.

Since then, efforts were focused on limiting this growth and improving the environmental performance of countries, with the Kyoto protocol being the first universal action to combat this environmental degradation. The Kyoto protocol of 1997 was a result of the UN Earth Summit held in Rio d Janeiro in 1992.

Despite all the efforts done, in 2012 emissions increased by 1.1%, whereas over the last ten years the annual increase was on average 3%.

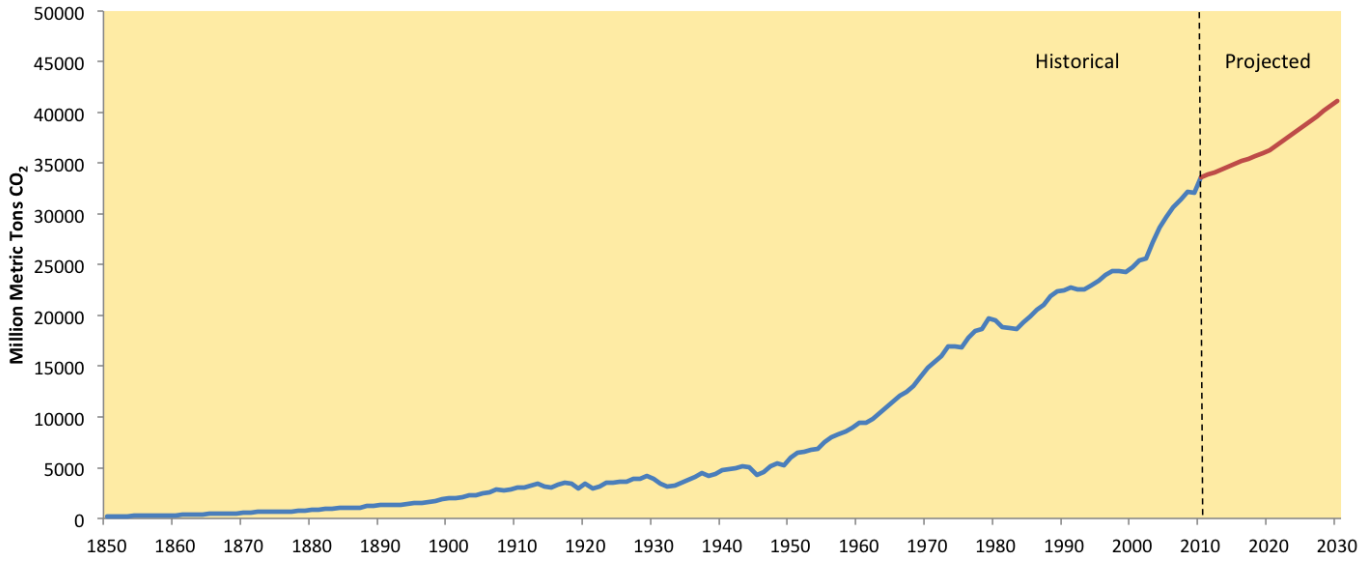


Figure 1: Global carbon dioxide emissions 1850-2030 [1][2]

As a result, the earth is warming, with its average surface temperature has increased by about 0.8°C since the late 1800s. Since the 1970s, each decade has been warmer than the previous decade.

According to NASA, the earth have witnessed its hottest records during the last two decades, leading to what is referred to as global warming and what consequences it comes with, "Climate Change".

Temperatures are on the rise, ocean levels caringly increasing, precipitation patterns are shifting, and more extreme climate events are occurring. The biodiversity system is being disturbed, and life in some major regions is becoming impossible.

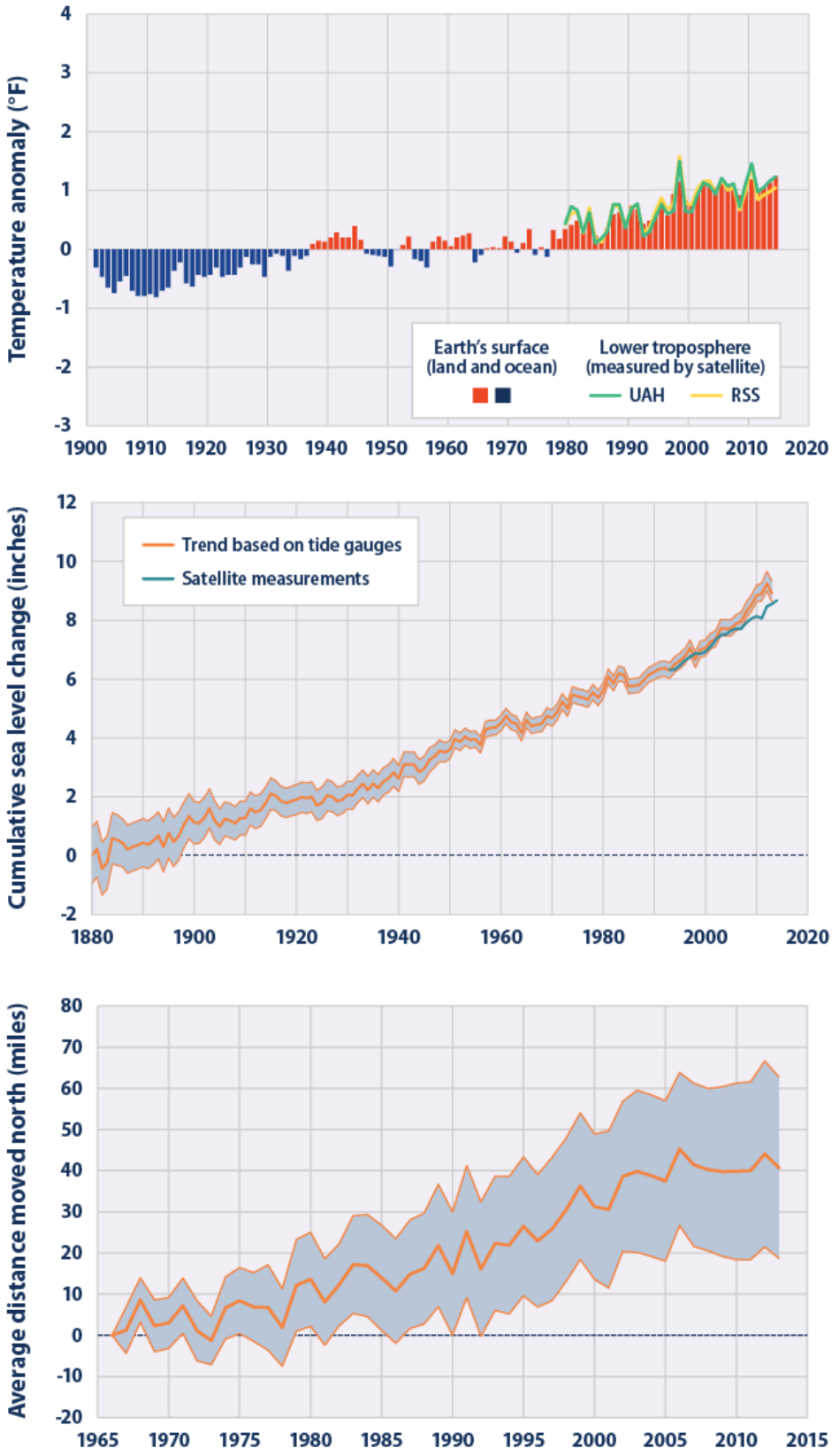


Figure 2: Global warming and climate change indicators [4][5][2]

With nations and countries recognizing the severity of this issue, a number of national and regional actions are being developed to promote sustainable development and raise environmental awareness. This includes actions like setting Renewable Energy Targets (RETs), establishing National Energy Efficiency Action Plans (NEEAP) and National Renewable Energy Action Plans (NREAP), and many others all aiming at reducing carbon and other greenhouse gas emissions.

In recent years, an additional action emerged, the so-called SEAP. A Sustainable Energy Action Plan (SEAP) is a tool developed by the European Union in its fight against climate change, and committed to by signatories of the Covenant of Mayors. The SEAP is expected to help the EU achieve its target of reducing emissions to at least 20% below 1990 levels by the year 2020.

The Covenant of Mayors is a European initiative by which towns, cities and regions voluntarily commit to reducing carbon emissions beyond the 20% target. The covenant currently has 6,480 signatories from 55 countries, led by Italy with a total of 3,568 signatories, followed by Spain with 1,438, Belgium with 247, then Portugal, Greece, and France with 123, 106, and 105 respectively. Lebanon ranks 23rd in the number of signatories per country, with a total of 17 signatories but no SEAP submitted to date. One of the 17 signatories of Lebanon is the Municipality of Menjez, being among the first signatories to join the Covenant of Mayors on the 19th of September 2014.

1.2 About Menjez

Menjez lies on a hill at an altitude ranging between 200 and 450 m above sea level, overlooking the river basin of Al Naher Al Kabir and the green valley forming the borderline with Syria. It is bordered by Kfarnoune, Rmah En Nahrieh, and Cheikhlar to the north-east; Syria to the north; El Barde and Qsair to the south; and Fraidis and Dabbabiye to the west.

The village of Menjez is relatively small; it is spread over a land area of 5.25 km^2. The landscape can be divided into five major areas: forested, urban, agricultural, and river basin. Menjez has an average of 100 ha of agro-forestry (private ownership as well as municipal lands) and 300 ha of crop/no vegetation lands (private ownership)

Figure 3: Menjez village on the map

The origin of Menjez name is Syriac, derived from Ngaz or Agnez which means to garner or to hide a treasure.

The village hosts 1,410 inhabitants, 750 of which are males and 660 are females. There around 250 houses with at least 70% considered all-year-long residences, and 30% occupied in certain periods of the year.

Around 18.5% of the villagers are considered youth (age less than 30), the students of which are studying either at the village's non-profit school or at Halba public school.

Figure 4: Menjez main archeological sites

In 2015, the village hosted 5 families of Syrian refugees residing in Menjez and benefiting from the public services and development initiatives undertaken at the community level.

Electricity supply in the village is limited with interruptible supply reaching 20 hours a day in some days of the year. On average, the village suffers from a 50% shortage. To cover this shortage there is a privately owned generator that is more than 15 years old, performing at very low efficiency, high pollution, and loud noise. Homes purchase power during cutoff hours at unreasonably high rate exceeding 100 USD a month.

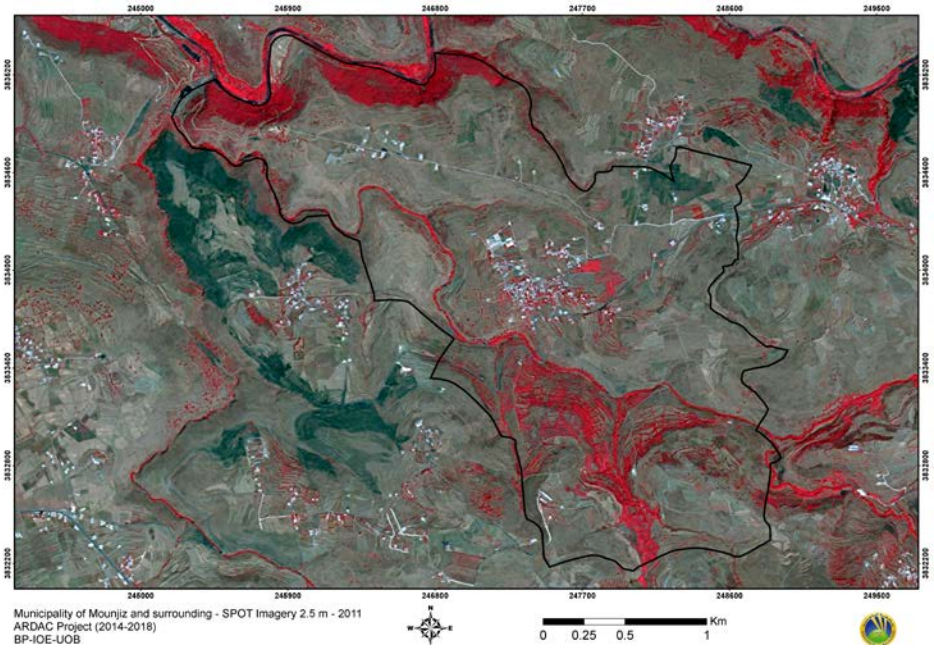


Figure 5: A map of the village of Menjez (Source: University of Balamand, ARDAC Project)

Located at an elevation of 350 meters above see levels, on 34°36'56.12"N and 36°14'43.60"E, the village is characterized with moderate climate, witnessing some harsh weather during winter times.

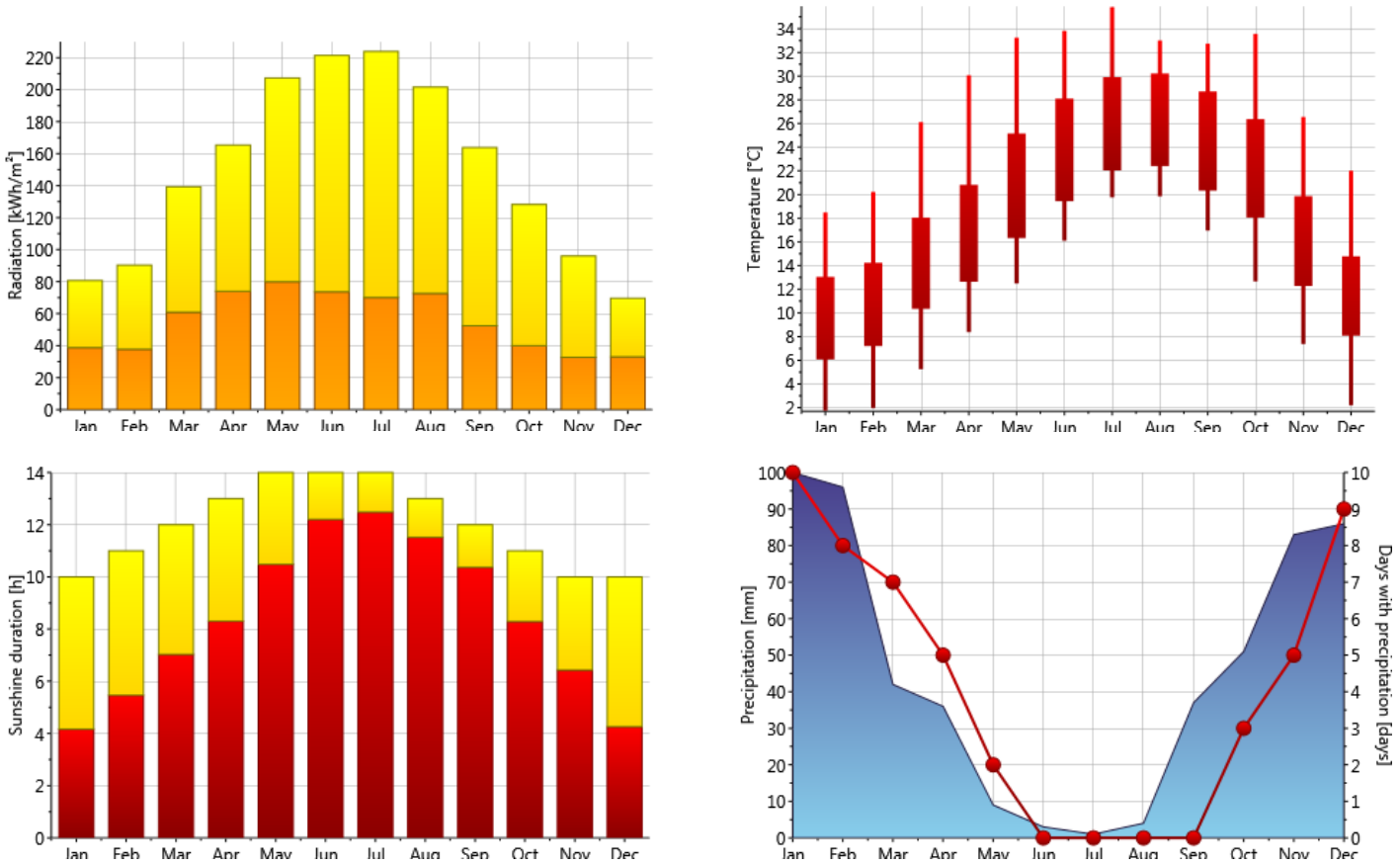


Figure 6: Meteorological data for the Municipality of Menjez (computed using Meteonorm 7.0)

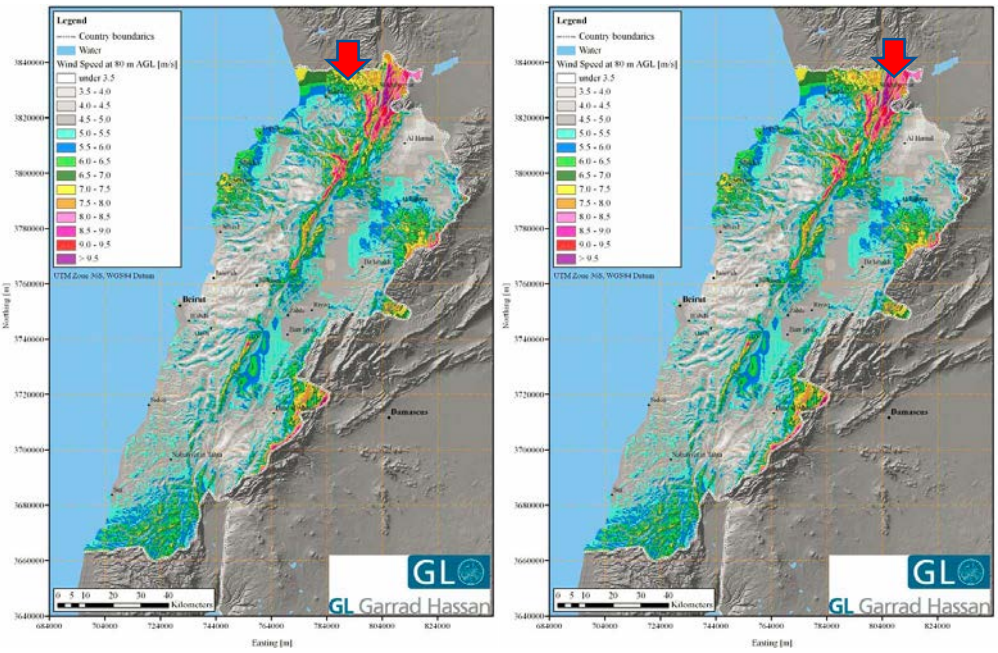


Figure 7: Wind altas for Lebanon showing great wind potential in Menjez

1.3 The SEAP Methodology

The Sustainable Energy Action Plan for Menjez was developed following the guiding steps presented in the Covenant of Mayors official guide on "How to develop a Sustainable Energy Action Plan". The SEAP development followed a cyclic and integrated management system, ensuring a collaborative approach bringing together the different stakeholders and decision makers in the village of Menjez to contribute and support in the development Phase. The major steps in the SEAP preparation are:

1. **Baseline review**

   The baseline review measures the current energy consumption and carbon emission trends and the penetration level of energy efficiency and renewable energy applications in the village of Menjez. This is done in a data collection process in collaboration with local authorities and concerned stakeholders.

   The baseline year was selected to be 2013, from which projections are made to reach the business as usual emissions using the coefficients developed by the JRC for the ten CES-MED project countries.

   Having the baseline defined, the target was set and ready for adoption. The target of 25% exceeds the CoM commitment requirements and goes beyond the country's commitments and targets on this matter.

   The target of emission reduction is discussed with the municipality of Menjez and its Mayor in addition to other stakeholders and involved parties. The stakeholders assigned for this activity and their contributions are presented later in this report.

2. **Feasibility analysis**

   Progressing from the baseline review and target commitment, a number of sustainability measures were identified and presented to the different stakeholders for feedback. Getting the input from the different parties, a final list of measures was established to be technically, socially, and financially assessed.

   Measures are set targeting different sectors and category groups, with each measure separately studied and assessed from a technical as well as financial perspective. The budget, implementation plan, timeframe, carbon emission reduction and other indicators were studied and presented in details.

3. **Environmental analysis**

   After identifying the emission factors for the different sectors and categories, the GHG emissions reductions can now be studied and projected to set up the proper action plan directed towards achieving the GHG reduction targets.

4. **Implementation & monitoring**

   Following the designed roadmap, implementation of the SEAP will begin as per the timeframe and schedules set. Monitoring of work progress and achievements will be regularly performed throughout the

implementation phase. The SEAP stakeholder group established during the previous phase will overlook the implementation process and assist in securing funds, providing support, and following up on the overall progress of the actions.

5. **Evaluation & reporting**

   A set of measures and key performance indicators are to be defined to be followed in the monitoring and evaluation of the SEAP. The draft monitoring and evaluation plan shall be considered by the ad-hoc stakeholder group for future assessment and review of the SEAP.

The five steps are distributed over four major phases. The first phase is the **initiation phase** during which political commitment was achieved. This started by the Municipality of Menjez signing the CoM, and continued by engaging stakeholders and lobbying for this commitment among authorities as well as the public.

Key stakeholders are identified and stakeholder analysis is performed. The aim was to create a more cooperative pool of stakeholders.

The second phase is the **planning phase**, during which current policies are assessed and baseline analysis is performed to quantify the carbon emissions and the energy performance at the municipality. With that done, the sustainable energy action planning starts to materialize. Planning was designed to have detailed description of each solution and its impact on the environment and the community. Financial resources for these solution are investigated and presented in a separate section.

Following are the **implementation phase** and the **monitoring and reporting phase**. These two phases are not included in the scope of this study but will be tackled in the planning phase. Key performance indicators and proper reporting methodologies will be presented.

1.4 SEAP Implementation Strategy

The successful implementation of the sustainable energy action plan is led by a comprehensive strategy including a clear implementation roadmap coupled with a well-designed monitoring and follow-up plan.

Under the direct supervision and the full support of the Municipality of Menjez, the major milestone is the creation of a SEAP implementation committee whose role is to ensure the proper and effective implementation.

SEAP Committee

The implementation of the Sustainable Energy Action Plan (SEAP) for the Municipality of Menjez will be undertaken under the direct supervision of the Municipality, with an ad-hoc committee established specifically for this purpose.

The committee, called the SEAP Implementation Committee (SIC), operates from with the municipality board. The committee structure and scope of work is detailed in Figure 8.

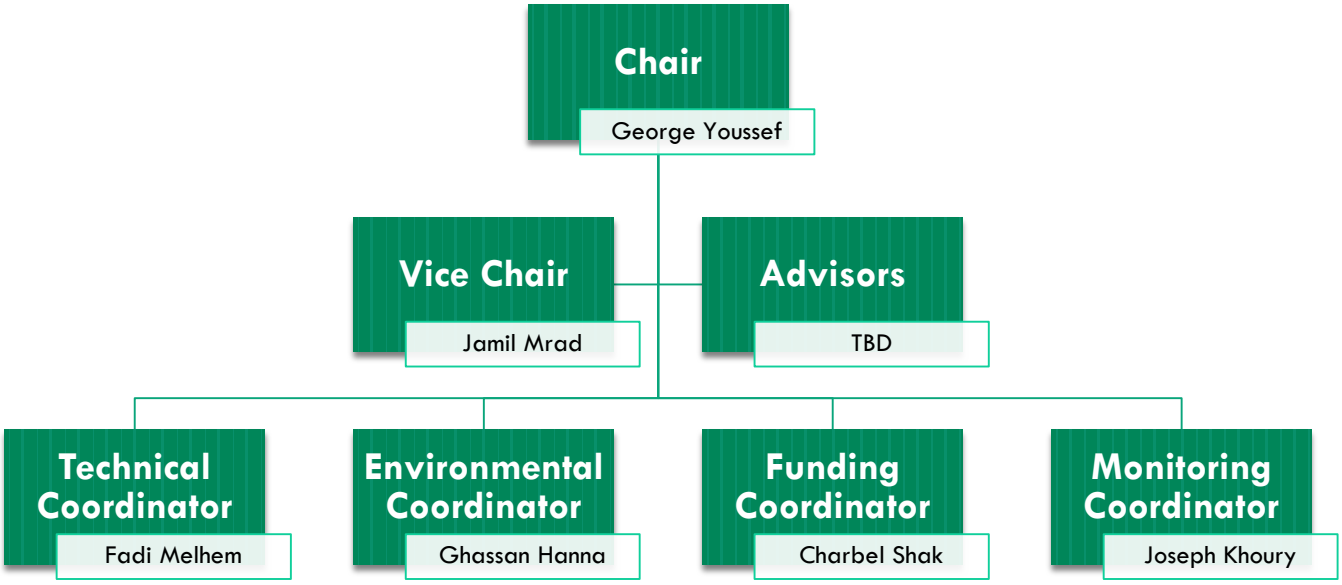


Figure 8: Organizational structure of the SIC

The committee includes members of the municipal board elected by the board members themselves. In following terms, when the board changes, previous members who wish to remain part of the SIC will be assigned as advisors to the committee. This will ensure smooth transfer of knowledge and sufficient flow of information among committees.

SEAP Monitoring

Monitoring of the implementation and progress towards achieving the emission reduction target is performed under the supervision and management of the SIC and the Municipality of Menjez. The detailed monitoring plan is presented later in this report, including periodic reporting and follow-up measures and actions.

1.5 The Stakeholders

The Covenant's commitments cover the whole geographical area of Menjez, including private as well as public sector activities, in addition to the local community that is the major stakeholder in this process.

With agriculture being the major economic activity in the village, the involvement of agricultural establishments and entrepreneurs is major with the municipality and the two agricultural cooperatives that are expected to play major roles in the development and execution of the SEAP.

With this in mind, stakeholders across the village of Menjez are identified and consulted and their views incorporated into this SEAP. The stakeholders group was formed to include individuals from different sectors, working groups, ages, genders, and involvement levels.

The stakeholders for the village of Menjez SEAP preparation phase includes:

- Municipality of Menjez
- Agricultural Cooperative of Menjez
- Agricultural Cooperative of Apiculture in Menjez
- Local farmers
- Monastery of Lady of the Fort
- Francis of Assisi Church
- Civil Defense Center
- Community & Interest Groups
- Backup generator owners and operators
- Groupe Missionnaire St Francois
- Menjez main figures

During the preparation phase of the SEAP, in addition to one-on-one interviews with stakeholders, a briefing workshop was held at the Municipality premises in Menjez in September 2015, where a preliminary version of the SEAP was presented and views sought.

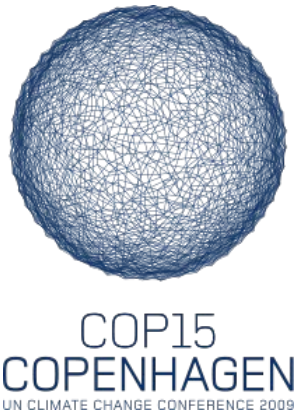
1.6 Policies

Except for the Covenant of Mayors commitment to reduce emissions at the municipality of Menjez, there are no official local policies or commitments made by the Municipality on this front. Yet there is a national commitment made by the government of Lebanon in 2010 to achieve renewable energy targets and reduce demand growths.

This commitment was first made in COP15 of Copenhagen in the year 2009, then clearly acknowledged by the Lebanese government in the 2010 Council of Ministers' declaration. In order to set an action plan for the implementation of energy efficiency and renewable energy measures to reach the new commitment and targets, a national action plan targeting renewable energy (NEEAP) was developed by the LCEC of the Ministry

of Energy and Water, and adopted by the government of Lebanon as a guiding document that outlines the steps and roadmap to meet the target.

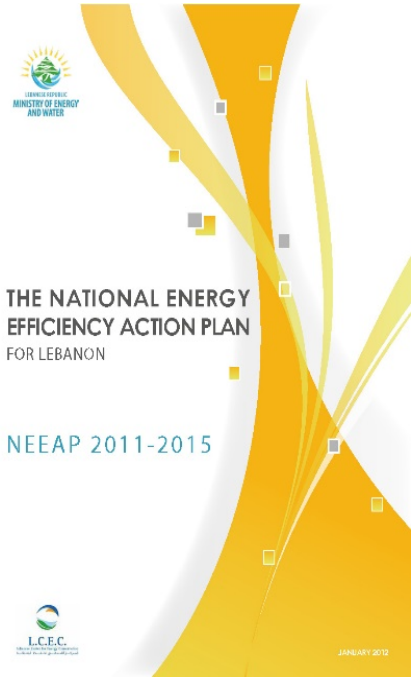
Copenhagen Declaration



At the COP15 in Copenhagen, in response to the increase in global carbon concentrations, the Government of Lebanon committed itself to reaching a share of 12% renewable energy in its energy mix by the year 2020. Lebanon's Copenhagen Declaration was later noted by the Policy Paper of the Energy Sector and adopted by the Council of Ministers in 2010.

The government of Lebanon commitments are set for the year 2020, aiming at reaching 12% renewable energy and reducing total energy demand by at least 5%.

National Energy Efficiency Action Plan (NEEAP)



The NEEAP is an official document that comprises 14 national initiatives paving the way for a structured approach towards achieving the national target of 12% renewable energy by 2020, it outlines energy conservation measures to be taken in the country in order to reach the national energy targets. It aims to strengthen the role of public sector in order to enhance the provision of information and advice to end-users and consumers, development of solar, wind, and hydro energy; the adoption of the energy conservation law; the banning of incandescent lamps; the development of financing mechanisms for energy efficiency projects; and finally the enforcement of the role of LCEC as the national energy agency for Lebanon.

Lebanon's first NEEAP issued in 2011 comprises of 4 energy efficiency measures and 6 renewable energy measures, in addition to 4 measures related to financing and awareness raising.

2

BASELINE ANALYSIS

Although the people of Menjez have been there for centuries, the municipality of Menjez is still young, established only in 2012. For this reason, and in order to select the year with sufficient data availability, the year 2013 is selected as the baseline year, from which energy consumption data and other greenhouse emitting activities are collected.

2.1 Electricity Consumption Profile

Electricity is supplied to the village through the national EDL grid, at an average supply of 12 hours a day, leaving the other 12 with no electricity supply. In order to cover the blackout period, backup diesel generators are available through two main networks.

EDL supplies electricity to the village through five 250 kVA stations, and distributed to 220 houses and facilities. Each user has an EDL meter at the interconnection point measuring the electricity consumption in kWh and billed monthly.

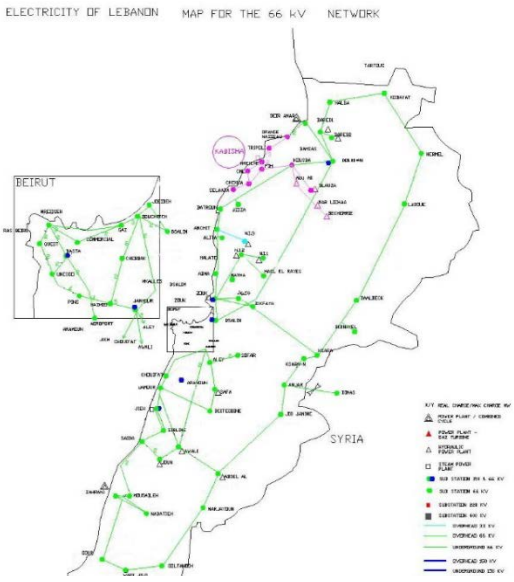


Figure 9: EDL grid 66kV network map

In order to quantify the EDL electricity consumption at the village, data is collected from EDL offices in Halba. Electricity consumed according to EDL for the year 2013 was 378,460 kWh at the end use side. Converting it to primary energy considering the 40% technical and nontechnical losses as reported by the EDL, the total energy consumption is 630,933 kWh.

While the overall billed energy is accurate, it doesn't reflect the real EDL electricity consumption of the village, due to the presence of illegal actions of grid connection, what can be referred to as electricity theft.

According to local observers, it is estimated that 8 houses practice illegal grid connections, quantified at 13,766 kWh of additional consumption per year, leading to a total end-use EDL electricity consumption of **392,326 kWh/year**.

During cut-off hours, back-up generation is in place. With two networks supplying the village and providing electricity to the 220 houses for an average of 12 hours a day with minor disruptions, the diesel consumption is collected from the two sources and converted into electrical energy to reach the additional back-up electricity consumption.

The first network consists of 1 generator with a capacity of 225 kVA supplying electricity to 185 houses and consuming 74,762 liters of diesel in 2013. The second network consists of 1 generator with a capacity of 70 kVA supplying electricity to 35 houses and consuming around 30,171 liters of diesel during the same year. Both networks together the consume **104,933 liters** of diesel to produce a total of **348,100 kWh per year**.

The quantification of diesel consumption for the two networks was done calculated based on a variety of factors and then double checked with the data provided by operators for verification.

The method uses the average diesel consumption per hour based on the different load provides as reported by the manufacturer. This value, presented in liters per hour, is collected for three different load profiles, 25% load, 50% load, and 75% load.

In addition, the local school has its own diesel generator that is used during cut-off hours. The overall diesel consumption of the generator is **17,778** liters per year as per the school officials. This leads to a total annual consumption of **122,711** liters of diesel for backup generation in the village, producing a total of **411.2 MWh** of electricity per year.

Two other sources of electricity consumption are available in the village. The first is for Public Street lighting with an annual consumption of **88,823 kWh** as reported by EDL, and the second being water pumping with 7 pumps in operation consuming a total of **119.6 MWh**.

End-use Electricity	
Village EDL: 392,326 kWh	**Generators Diesel: 92.92 t**
PSL EDL: 88,823 kWh	**School Diesel: 15.73 t**
Pumps EDL: 119,600 kWh	

2.2 Sectorial Emissions

The quantification of emissions use a number of emission factors related to grid power, diesel used for backup generators, and motor gasoline related to transportation. In addition to agricultural applications including livestock and agricultural soils.

For electricity supply, the national emission factor for the EDL supplied power as published by the Lebanese ministry of environment is **0.65 kg** of CO_2-eq per kWh. Back-up power is delivered through diesel generators with an overall emission varying between 0.98 and 1.63 kg of CO_2/kWh with a final average of **1.15 kg** of CO_2/kWh using IPCC's emission factor of 3.807 kg of CO_2 per liter of diesel [6]. The overall emission factor is computed considering the two generators available in the village with capacities of 225 and 70 kVA, operating at 25% load for an average of 2,300 hours a year, with the rest of the time distributed between 50% and 75% load over averages of 1,600 and 480 hours a year respectively. This value is double-checked with the IPCC published numbers of 1.002 kg/kWh to show only 13% variance.

For transportation, IPCC published an emission factor for motor gasoline of 69,300 kg/TJ (0.249 kg/kWh). In the case of Menjez, emissions are estimated using five types of vehicles as referred to in the EPA guidebook on Calculating CO_2 Emissions from Mobile Sources.

Table 1: Default Fuel economy factors for different types of mobile sources and activity data [7]

Vehicle Type	Liters /100km	kg CO_2 / km travelled
Medium gas automobile	7.8 – 10.7	0.19 – 0.25 (Avg. 0.22)
Large gas automobile	9.4 – 13.1	0.22 – 0.31 (Avg. 0.27)
Mid-size. Pick-up Truck	10.7 – 13.8	0.25 – 0.33 (Avg. 0.29)
Large-size. Pick-up Truck	13.1 – 15.7	0.31 – 0.37 (Avg. 0.34)
Diesel Bus	35.1	1.03

As for agricultural activities, a major contributor to GHG emissions is livestock, especially cattle, producing methane gas (CH_4) as part of their digestion in a process referred to as called enteric fermentation. In addition, manure storage and management methods contribute to CH_4 and N_2O emissions based on a number of factors including amount of exposure to oxygen and moisture. Finally, management practices of agricultural soils also contribute to GHG emissions, mainly N_2O (Nitrous Oxide) as a result of fertilizer application to methods of irrigation and tillage.

With no greenhouse inventory for Lebanon regarding emissions from cattle and other agricultural activities, average factors are extracted from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for developing countries and the U.S. Greenhouse Gas Inventory Report: 1990-2013 and used for the sake of emissions estimation. Emissions from different types of livestock are presented in Table 2.

Table 2: Emission factors from livestock enteric fermentation by animal type [8][9]

Cattle Type	Emission Factor (kg CH_4/head/year)
Cow	144
Horse	18
Sheep	5
Goat	5
Chicken	1

Manure produced by cattle emits greenhouse gases, mainly CH_4 and N_2O. Emissions are based on the manure management method applied.

Table 3: Emission factors for livestock manure by animal type at average temperature [8]

Cattle Type	Emission Factor (kg CH_4/head/year)
Cow	2.00
Horse	1.64
Sheep	0.15
Goat	0.17
Chicken	0.02

Table 4: Methane Conversion Factors for livestock manure by management system [8]

Management System	Description	MCF
No management	Manure from pasture and range grazing animals is allowed to lie as is, and is not managed	1.5%
Daily Spread	Manure is routinely removed from a confinement facility and is applied to cropland or pasture within 24 hours of excretion	0.5%
Solid Storage	The storage of manure, typically for a period of several months, in unconfined piles or stacks	4.0%
Anaerobic Digester	Animal excreta with or without straw are collected and anaerobically digested in a large containment vessel	0.0%

In soil management, with no rice agricultural activities in the village of Menjez, the main contributor to GHG emissions is the use of fertilizers, with research concluding an average emission of 1kg of N_2O per 100 kg of fertilizers applied.

As for waste production in the village, municipal solid waste and wastewater are considered two sources of greenhouse gas emissions. Although MSW collected from the village is not landfilled inside Menjez, but in a neighboring village, Menjez is considered responsible for the emissions produced as a result of the waste generated in it. The landfill emission factor 0.05 kg CH_4 per kg of MSW [10]. On the other hand, wastewater treatment emissions are estimated at 10.7 g CH_4/capita/day.

Table 5: Summary of emission factors for Menjez

Source	Unit	GHG Emitted	Emissions (kg/unit)
EDL	kWh	CO_2-eq	0.650
Private Generation	kWh	CO_2-eq	1.15
Medium gas automobile	km	CO_2-eq	0.22
Large gas automobile	km	CO_2-eq	0.27
Mid-size. Pick-up Truck	km	CO_2-eq	0.29
Large-size. Pick-up Truck	km	CO_2-eq	0.34
Diesel Bus	km	CO_2-eq	1.03
Cow (Breathing + Manure)	Head/year	CH_4	146.00
Horse (Breathing + Manure)	Head/year	CH_4	19.64
Sheep (Breathing + Manure)	Head/year	CH_4	5.15
Goat (Breathing + Manure)	Head/year	CH_4	5.17
Chicken (Breathing + Manure)	Head/year	CH_4	1.02
Fertilizer	100 kg	N_2O	1.00
MSW	kg MSW	CH_4	0.05
Wastewater	Capita/year	CH_4	3.90

Buildings, Facilities and Industries

Municipal Buildings & Facilities

Menjez includes a limited number of municipal buildings and facilities making minimal contributions to the energy consumption at the village. An inventory of municipal facilities, including religious facilities, is presented in Table 6.

Data about energy consumption are collected directly from the facility owner/operator.

Table 6: Energy consumption in municipal buildings and facilities

Facility	EDL Power (kWh/yr)	Backup Power (kWh/yr)	Final Electricity (kWh/yr)
Municipality	3,500	3,669	7,169
Agricultural Cooperative	2,500	2,620	5,120
Civil Defense	5,000	5,241	10,241
Army Barrack	6,000	6,289	12,289
Monastery of Lady of the Fort	15,000	15,723	30,723
Francis of Assisi Church	3,500	3,669	7,169
Total Electricity	**35,500**	**37,211**	**72,711**
Total CO_2-eq (t)	**23,075**	**42,793**	**65,868**

Municipal Buildings Electricity

EDL Electricity: 35.5 MWh
EDL Electricity CO_2-eq: 23.1 t
Backup Electricity: 37.2 MWh
Backup Electricity CO_2-eq: 43.8 t
Total Electricity: 72.7 MWh
Total Electricity CO_2-eq: 65.8 t

Commercial Buildings & Facilities

Commercial activities in Menjez are limited to small businesses. Except of the church-annexed school and the privately owned gas station, commercial activities are limited to small grocery shops, snacks, and water pumping operations. Data about energy consumption are collected directly from the facility owner/operator.

Table 7: Energy consumption in municipal buildings and facilities

Facility	EDL Power (kWh/yr)	Backup Power (kWh/yr)	Final Electricity (kWh/yr)
Francis of Assisi School	40,000	63,134	103,134
Menjez Gas Station	10,000	14,371	24,371
Goerge Nasri Snack	4,800	6,898	11,698
Furn Charbel	2,400	3,449	5,849
Bakery Shop	3,000	4,311	7,311
Shawki Market	3,600	5,174	8,774
Menjez Minimarket	3,600	5,174	8,774
Minimarket	3,600	5,174	8,774
Water Pumping	119,600	0	119,600
Total Electricity	**190,600**	**107,685**	**298,285**
Total CO_2-eq (t)	**123,890**	**123,838**	**247,728**

Commercial Buildings Electricity

EDL Electricity: 190.6 MWh
EDL Electricity CO_2-eq: 123.9 t
Backup Electricity: 107.7 MWh
Backup Electricity CO_2-eq: 123.8 t
Total Electricity: 298.9 MWh
Total Electricity CO_2-eq: 247.7 t

Residential Buildings

Quantification of residential electricity consumption is computed based on the overall reported electricity consumption at the village as provided by EDL, then subtracting from that the electricity consumed by the municipal and commercial sectors as well as municipal public lighting.

The overall village EDL electricity consumption is calculated previously to be 392,326 kWh for 2013. With municipal facilities consuming a total of 35,500 kWh from EDL per year, and commercial facilities consuming 71,000 kWh (excluding water pumping), summing to 106,500 kWh/year, the residential sector is estimated to be consuming 285,826 kWh per year. With all houses supplied with back-up generation, the residential electricity consumption is estimated at 76,796 liters of diesel per year, producing 213,816 kWh.

Residential Buildings Electricity	
EDL Electricity: 285.8 MWh	**EDL Electricity CO_2-eq: 185.8 t**
Backup Electricity: 213.8 MWh	**Backup Electricity CO_2-eq: 245.9 t**
Total Electricity: 298.9 MWh	**Total Electricity CO_2-eq: 431.7 t**

Municipal Public Lighting

The overall electricity consumption for public street lighting at the village is gathered from EDL office in Halba, with verification against the number of street poles, type of lamps, and operational profile. With data provided directly by the EDL the overall electricity consumption is 88,823 kWh per annum for 187 street poles.

In order to theoretically calculate the electricity consumption for the 187 poles consumption, the overall operating hours for public street lighting in Menjez is calculated based on dusk to down values for Lebanon reaching a total of 4,992 hours a year. With an average of 12 hours cutoff per day, the annual operating hours for public street lights is estimated at 2,496 hours. This value is multiplied by the number of poles and the power rating of the lamp that is a 200 Watts high pressure sodium bulb to reach an annual consumption of 93,350 kWh, with variance of 5% above the reported value. This is mainly to faulty lamps. With no back-up power supplied for municipal lights, the overall electricity consumption remains **88,823** kWh/year.

Municipal Public Lighting Electricity	
EDL Electricity: 88.8 MWh	**EDL Electricity CO_2-eq: 57.7 t**
Backup Electricity: 0 MWh	**Backup Electricity CO_2-eq: 0 t**
Total Electricity: 88.8 MWh	**Total Electricity CO_2-eq: 57.7 t**

Industries & Agriculture

Menjez major economic activity is agriculture, with no industrial activities taking place in the village. Electricity consumption is negligible in this combined category.

Transportation

Urban Rail Transportation, Aviation, Shipping/Fluvial Transport, Local Ferries

Not available in Menjez.

Urban Road Transportation: Municipal Fleet

This category includes municipal cars, waste transportation, and civil defense vehicles.

The municipality owns no vehicles for its own, but two cars are mainly used that are privately owned by board members. Both are SUVs. Average distance covered by each car to do municipality-related works is estimated at 35 km per week, adding up to 3,640 km per year. With an average emission of 0.27 kg CO_2 per km, the annual emissions is estimated at **0.98 t** CO_2 per year.

As for waste transportation, the municipality subcontracts a truck owner to transport the village's waste to a nearby landfill located in Srar. The landfill is reached following the highway and then through an internal road to cover an overall distance of 14.5 km each way, reaching a total of 29 km per trip. With the truck having a capacity of 7 tonnes, and the village producing 60 tons of MSW per month, the truck collects and transports waste twice a week, each time travelling a distance of 29 km, leading to an annual travel distance of 3,016 km.

Figure 10: Distance covered to transport Menjez waste to Srar Landfill

With the average carbon emissions for large-size trucks of 0.34 kg of CO_2 per km travelled, the annual emissions are calculated to be **1,025 kg** of CO_2.

Civil defence ons one IVECO firefighting truck. The 2001-made truck has a storage capacity of 9,000 liters and consumes an average of **650 liters** of diesel per month due to the high frequency of fires in the village, leading to **29,696 kg** of CO_2 emitted per year,

Urban Road Transportation: Public

Not available in Menjez.

Urban and Other Road Transportation: Private & Commercial

There is a total of 200 private cars in Menjez (SUV and sedan), in addition to 2 taxi cars, and 8 minivans. This is the total number of vehicles owned by the people of Menjez. The total number of vehicles passing through Menjez internal roads is estimated at 200 per day, while the 2 km highway in Menjez witnesses a daily average of 800 vehicles. The vehicle mix in these two types of roads are as such:

Table 8: Vehicles passing in Menjez by vehicle type

Vehicle Type	Internal Roads	Highway
Medium gas automobile	60%	50%
Large gas automobile	30%	30%
Mid-size. Pick-up Truck	5%	10%
Large-size. Pick-up Truck	0%	5%
Diesel Bus	5%	5%

Internal roads in the village are investigated to achieve a maximum road distance of 5 km between the two extremes of the village. The average internal trip is estimated to be 0.6 km.

In order to calculate the overall distance travelled for different car types, the total number of cars per application is multiplied by the daily distance covered and the number of days per year. For example, for private cars travelling within the village, the total number of cars is 150 per day, each travelling an average distance of 0.6 km per day over a period of 365 days a year. The total is (200 cars/day x 0.6 km x 365 days) = 43,800 km.

Table 9: Annual transportation emissions within the village of Menjez

Application	Vehicle Type	km travelled	kg CO_2 /km	kg CO_2 /yr
Private Car (City)	Medium gas automobile	318,280	0.22	70,022
Private Car (Highway)	Large gas automobile	188,340	0.27	50,852
Minivan (Highway)	Diesel Bus	60,590	0.29	17,571
Truck (Highway)	Mid-size. Pick-up Truck	29,200	0.34	9,928
School Bus	Diesel Bus	31,390	0.52	16,323
			Total	**164,695**

Off-Road Transport

Construction activities are minor in the village of Menjez, leaving agricultural machinery to be the main representative of off-grid transport. In order to quantify motor fuel consumption for agricultural vehicles, an inventory of available machinery is provided in Table 10, combined with data about average monthly diesel consumption for the operation of vehicles.

Table 10: Inventory of available agricultural vehicles

Vehicle	Model Number	Make	Lit/100km	Condition	Effectiveness
Tractor	Massey Ferguson 165	1972	24	✪✪✩✩✩	✪✩✩✩✩
Tractor	Massey Ferguson 135	1970	25	✪✩✩✩✩	✪✩✩✩✩

The cooperative, the owner and operator of these machinery, declared an average 400 liters of diesel consumed per month, summing up to 4,800 liters per year, emitting a total of **12,804.5 kg** of CO_2 per year.

Transport Emissions

Municipal Fleet: 0.89 t	**Emission Rate: 0.27 kg/km**
Waste Disposal: 1.03 t	**Emission Rate: 0.34 kg/km**
Firefighter: 29.7 t	**Emission Rate: 3.8 kg/lit**
Private Vehicles: 164.7 t	**Emission Rate: 0.26 kg/km**
Off-Road: 12.8 t	**Emission Rate: 2.7 kg/lit**

Emissions in CO_2-eq

Other Emission Sources

Agricultural Activities

GHG emissions exist as a result of ranching in principle, together with other agricultural activities. Methane gas is emitted by animals mainly during the digestion process, and also as a result of manure production.

Table 11: Annual methane emissions in ranching activities

Cattle Type	Fermentation (kg /head)	Manure (kg /head)	Quantity (heads)	Overall Emissions (kg /year)
Cow	144	2.00	15	2,190
Horse	18	1.64	6	118
Sheep	5	0.15	12	62
Goat	5	0.17	6	31
Chicken	1	0.02	2,000	2,040
Total				**4,411**

As a result of fertilizer usage for agricultural activities, N_2O is emitted. The average fertilizer consumption in Menjez is estimated at 282 kg per ha. With Menjez having a total of 400 ha of arable land, the total fertilizers consumption is estimated at 112.8 tonnes of fertilizers per year.

N_2O emissions are calculated as the product of fertilizer consumption, the nitrogen rate in the fertilizer, the emission coefficient which is 0.0117 tons N2O-N/ton N, and the molecular weight ratio of N_2O to N_2O as N which is 44/28. N_2O emissions are expected to be **228 kg** per year.

Land use

Changes in land use and forestry have an effect on carbon stock. These changes are considered in the sustainability measures to improve natural carbon sinks mainly through photosynthesis by terrestrial plants.

Primary forests have carbon stock of 350 ton per ha, 305 from vegetation and 45 from soil. Menjez Forest covers an area of 40 ha of Laurus nobilis trees, estimated to have a carbon storage of 14,000 ton. Agroforestry and fruit trees have a carbon stock of around 95 ton/ha, while crops have an average of 35 ton/ha.

Menjez has an average of 100 ha of agroforestry and 300 ha of crop/no vegetation, having carbon stock of 9,500 and 10,500 ton respectively. The total carbon stock is estimated at 34,000 ton when added to the forest carbon stock, leading to an average rate of 77.2 ton C/ ha, equivalent to **278.2 ton CO_2/ha**. This value

corresponds to an extended lifespan of the trees which is taken to be 75 years for forests, 50 years for agroforestry, and 20 years for crops. This leads to an annual CO_2 capture rates of 9.3, 4.6, and 2.5 kg per tree respectively, with respective average tree density of 1,800, 1,500, and 2,500 trees per ha.

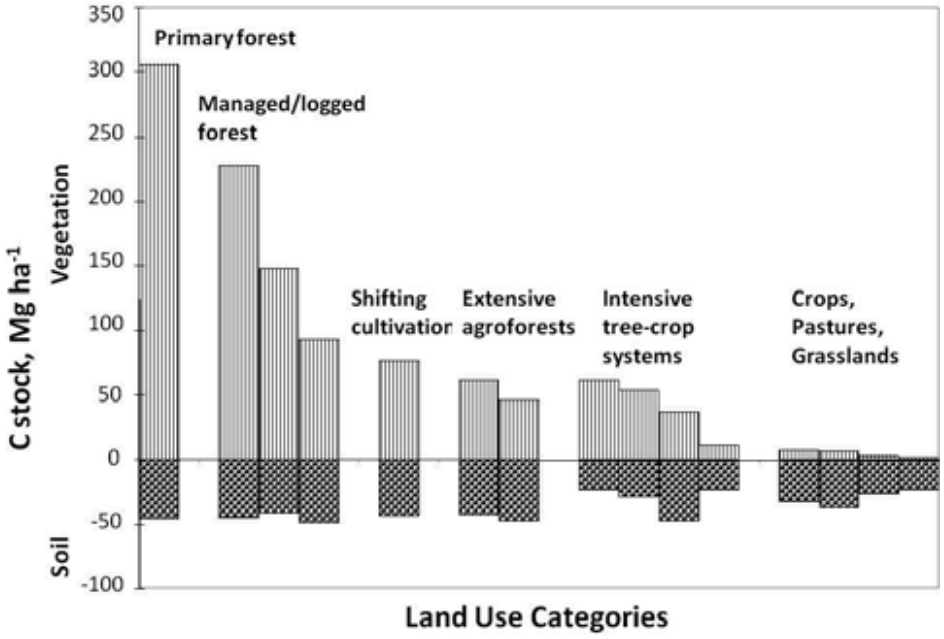


Figure 11: Reported aboveground time-averaged carbon stocks and total soil C [11]

Carbon stock is affected in the village of Menjez in two main forms, the first is due to uncontrolled fires hitting the village annually, destroying up to 20 ha a year, with an average of 10 ha annually. This is distributed as 5% for forests, 25% for agroforestry, and 75% for small crops as reported by the mayor of Menjez.

Using the factors computed earlier, the lost stock is 658 ton Carbon, equivalent to 70 tonnes CO_2 per year.

The second reason is the use of woodstoves for space heating by almost 100% of the residences in Menjez, consuming 440 ton of wood per year with the factor of 2 ton per house as the average collected from residents of Menjez. With an average forest tree making a total of 750 kg of wood, and an average rate of only 35% of sustainable logging as witnessed in the village, an average number of 587 is cut per year. This leads to a reduction of 0.21 ha per year, leading to an annual absorption potential loss of 3.1 tonnes of CO_2 per year.

Land-use will not be included in the BEI and the carbon reduction target, yet measures related to land-use and deforestation will be included in the sustainable energy action plan.

Solid Waste

No solid waste treatment facilities are available at Menjez, with all solid waste being disposed to the nearby landfill. With no solid waste stock available in the village of Menjez, GHG emissions are neglected.

Tourism-related Activities

The village of Menjez is the home to a number of interesting historical and religious sites, including temples, monasteries, and roman remains. The village is starting to attract touristic groups and individuals from all over the country, with main attractiveness to foreign archeology, history, and hiking enthusiasts.

Currently receiving around 200 tourists and visitors per year, the village is expected to grow this number gradually year after year. A touristic trip would normally cover Beit Jaalouk, crusader castle ruins, the Maronite Monastery of our Lady of the Fort, and the remains of an ancient Roman canal, with supporting walls 5 meters high. The whole trip is normally done in one day travelling a distance of 5.5 km. with the absence of organized transportation systems, it is estimated that a total of 80 trips take place during one complete year, covering a distance of 440 km. Using the average emissions for a mid-size gasoline vehicle, the overall emissions are estimated at **96.8 kg** of CO_2 per year.

Other Emissions	
Ranching: 4.41 t CH_4	**Emission Rate: 1.02-156 kg/head**
Fertilizer use: 1.03 t N_2O	**Emission Rate: 2.02 kg/t**
Tourism: 0.0968 t CO_2	**Emission Rate: 0.22 kg/km**

2.3 Baseline Emission Inventory

A. FINAL ENERGY CONSUMPTION (MWh)																
			FOSSIL FUELS								RENEWABLE ENERGIES					
CATEGORY	ELECTRICITY	HEAT/COLD	Natur. gas	Liq. gas	Heat. oil	Diesel	Gasoline	Lignite	Coal	Other	Plant oil	Biofuel	Biomass	Solar therm.	Geother.	TOTAL
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																
Municipal buildings	72.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	72.7
Commercial buildings	298.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	298.3
Residential buildings	499.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	499.6
Public Lighting	88.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.8
Industries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	959.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	959.5
TRANSPORT																
Municipal fleet	0.0	0.0	0.0	0.0	0.0	89.6	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	93.5
Private commercial	0.0	0.0	0.0	0.0	0.0	0.0	658.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	658.8
Off-road	0.0	0.0	0.0	0.0	0.0	53.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.3
Subtotal	0.0	0.0	0.0	0.0	0.0	142.8	662.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	805.6
TOTAL	**375**	**0**	**0**	**0**	**0**	**556**	**692**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,016**

B. CO_2-EQ EMISSIONS (t)																
			FOSSIL FUELS								RENEWABLE ENERGIES					
CATEGORY	ELECTRICITY	HEAT/COLD	Natur. gas	Liq. gas	Heat. oil	Diesel	Gasoline	Lignite	Coal	Other	Plant oil	Biofuel	Biomass	Solar therm.	Geother.	TOTAL
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																
Municipal buildings	65.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	65.9
Commercial buildings	247.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	247.7
Residential buildings	431.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	431.7
Public Lighting	57.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.7
Industries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	803.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	803.0
TRANSPORT																
Municipal fleet	0.0	0.0	0.0	0.0	0.0	30.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.7
Private commercial	0.0	0.0	0.0	0.0	0.0	0.0	164.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164.7
Off-road	0.0	0.0	0.0	0.0	0.0	12.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.8
Subtotal	0.0	0.0	0.0	0.0	0.0	43.5	165.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	209.2
TOTAL	**803**	**0**	**0**	**0**	**0**	**44**	**166**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1,012**

C. LOCAL ELECTRICITY AND HEAT/COLD PRODUCTION AND CORRESPONDING CO_2 EMISSIONS

			FOSSIL FUELS								RENEWABLE ENERGIES					CO_2-EQ (t)
CATEGORY	ELECTRICITY	HEAT/COLD	Natur. gas	Liq. gas	Heat. oil	Diesel	Gasoline	Lignite	Coal	Other	Plant oil	Biofuel	Biomass	Solar therm.	Geother.	
LOCAL ELECTRICITY																
Wind Power	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hydroelectric Power	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Photovoltaic	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CHP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	358.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	412.5
Subtotal	358.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	412.5
HEAT/COLD																
CHP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
District Heating Plant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**359**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**413**

D. OTHER SOURCES OF CO_2 EMISSIONS				
CATEGORY	CO_2	CH_4	N_2O	CO_2-EQ (t)
AGRICULTURE				
Ranching	0.0	4.4	0.0	93.3
Fertilizer Use	0.0	0.0	0.2	70.7
Subtotal	0.0	4.4	0.2	164.0
WASTE				
Wastewater	0.0	0.0	0.0	0.0
Solid Waste	0.0	0.0	0.0	0.0
Subtotal	0.0	0.0	0.0	0.0
OTHERS				
Tourism Activities	0.1	0.0	0.0	0.1
Subtotal	0.1	0.0	0.0	0.1
TOTAL	**0.1**	**4.4**	**0.2**	**167.7**

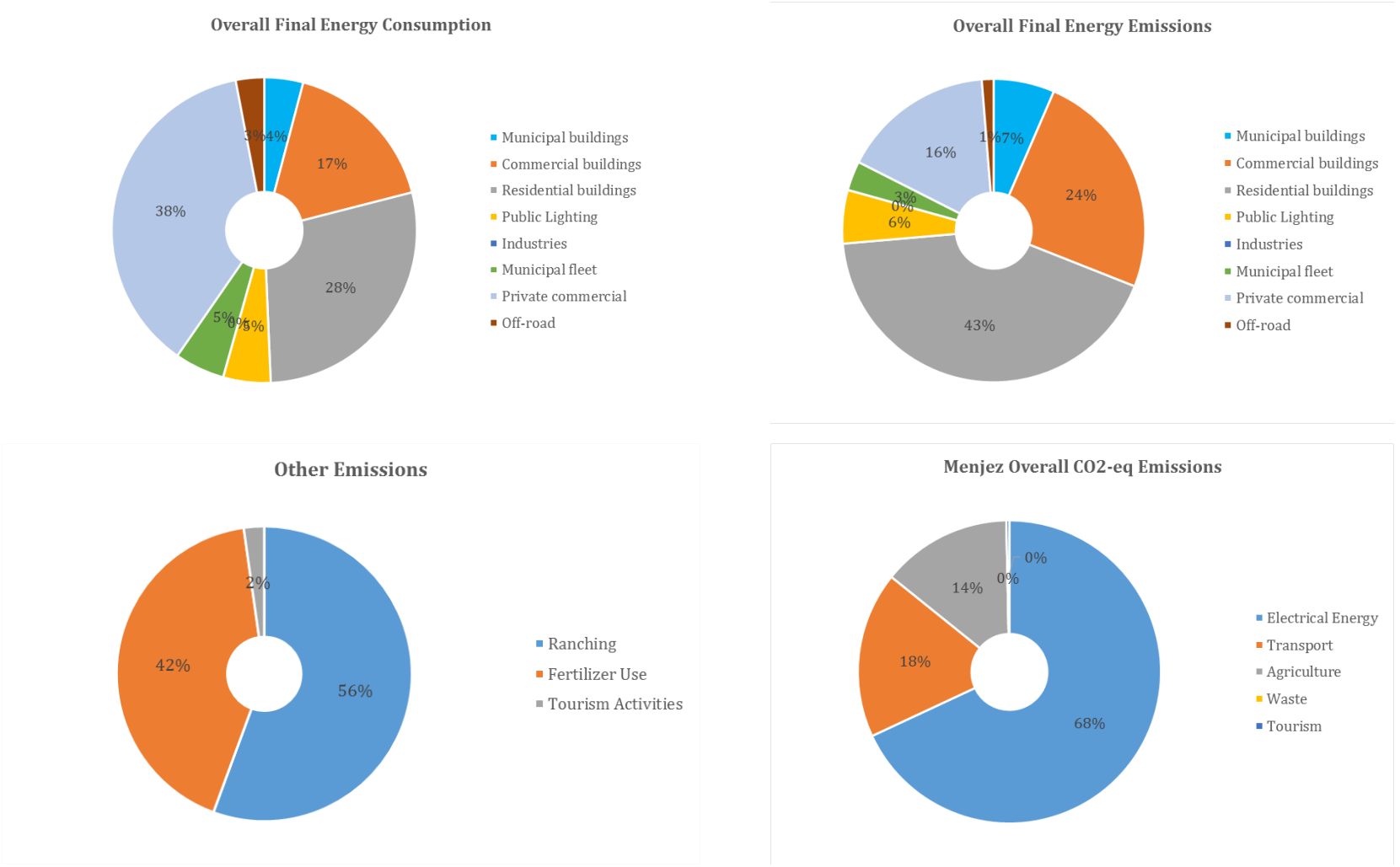


Figure 12: Energy consumption and GHG emission breakdown for Menjez

2.4 Business as Usual Emissions

The overall greenhouse gas emissions sum up to 1,180 tCO_2-eq per year. In order to quantify the expected emissions by 2020 to be considered as the business as usual case, the national GHG coefficient presented in Table 8 of the Guidelines for National Greenhouse Gas Inventories developed by the JRC for the ten CES-MED project countries.

Table 12: BAU scenario GHG emission coefficients to calculate BEI (using CO2-eq) [15]

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Algeria	1.97	1.81	1.66	1.50	1.45	1.39	1.33	1.27	1.21	1.19	1.17	1.15	1.13	1.11	1.09	1.06	1.04	1.02
Egypt	2.71	2.55	2.38	2.22	2.12	2.03	1.93	1.83	1.74	1.65	1.57	1.49	1.42	1.34	1.27	1.20	1.13	1.06
Israel	1.52	1.51	1.50	1.49	1.46	1.43	1.39	1.36	1.32	1.29	1.25	1.22	1.19	1.15	1.12	1.09	1.06	1.03
Jordan/Palestine	1.71	1.62	1.53	1.44	1.44	1.43	1.43	1.43	1.42	1.37	1.33	1.28	1.24	1.19	1.15	1.11	1.07	1.04
Lebanon	1.35	1.34	1.34	1.33	1.34	1.36	1.38	1.39	1.41	1.36	1.32	1.27	1.23	1.19	1.15	1.11	1.07	1.04
Libya	1.41	1.44	1.47	1.50	1.46	1.42	1.37	1.33	1.29	1.26	1.23	1.21	1.18	1.15	1.12	1.09	1.06	1.03
Morocco	2.25	2.16	2.07	1.97	1.90	1.83	1.76	1.68	1.61	1.54	1.47	1.40	1.34	1.28	1.22	1.16	1.10	1.05
Syrian Arab Republic	1.40	1.42	1.43	1.45	1.45	1.45	1.45	1.45	1.45	1.40	1.35	1.31	1.26	1.21	1.17	1.13	1.08	1.04
Tunisia	1.90	1.83	1.76	1.68	1.67	1.66	1.65	1.64	1.63	1.56	1.49	1.42	1.35	1.29	1.23	1.17	1.11	1.05

With the year 2013 being the baseline year, the coefficient to be used is 1.27. This value is multiplied by the baseline GHG emissions of 1,180 to reach a total GHG emissions in the year 2020 of 1,499 tCO_2-eq.

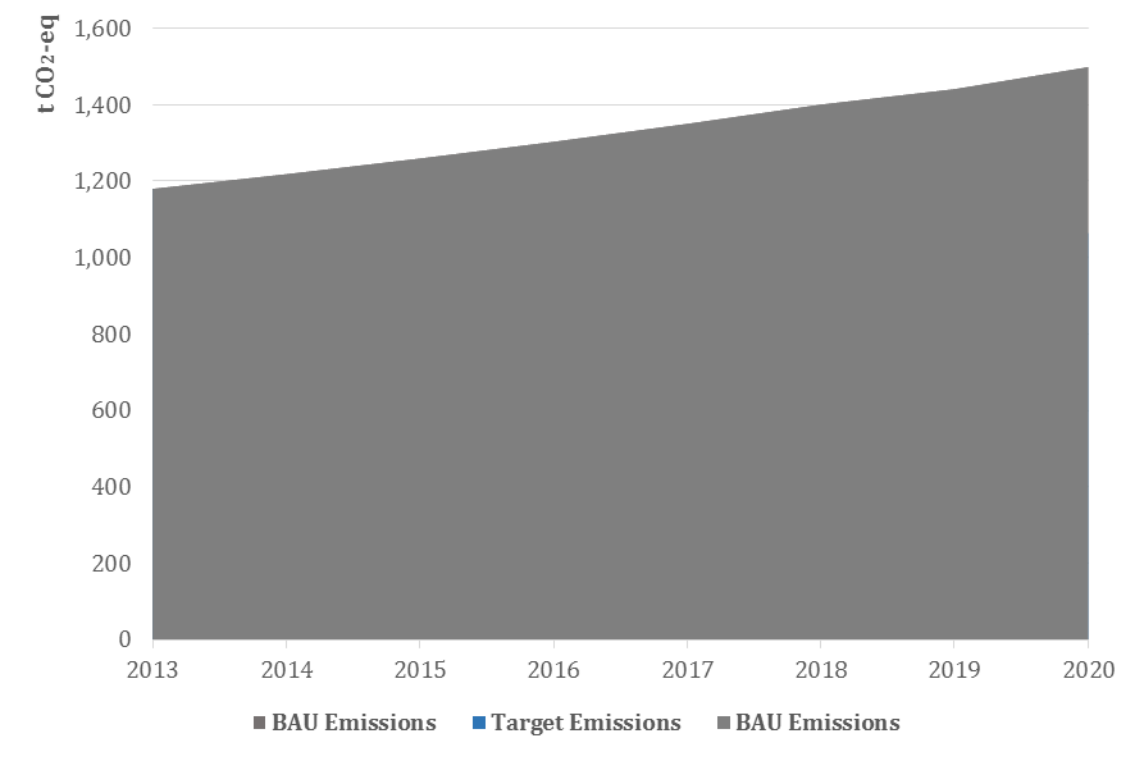


Figure 13: Business as Usual GHG emissions from 2013 to 2020

3

OVERALL STRATEGY

3.1 Objectives and targets

The Municipality of Menjez is committing to a 25% emission reduction by the year 2020 starting at the baseline emissions of the year 2013. By this, the municipality would be achieving the Covenant of Mayors target of 20% by 2020 as compared to year 1990 and exceeding it by an additional 5%.

To put things in numbers, Menjez is targeting an emission of 375 less tonnes of CO_2-eq by 2020, thus reaching an emission of 1,124 tonnes instead of 1,499 tonnes.

3.2 Current framework and vision for the future

Since its establishment in 2012, the municipality has undertaken several measures to reduce energy consumption and greenhouse gas emissions. A quantification of the emission reduction resulting from energy saving measures leads to an overall value of 47.8 tonnes of CO_2-eq reduced, estimated at 3.19% reduction of projected BAU emissions. The achievements to date are presented as part of the sustainability measures, where emissions reductions achieved during the period 2013 to 2015 are reported and quantified.

3.3 Organizational & Financial Aspects

Stakeholder Group

A SEAP stakeholder group was established to ensure public engagement and collaborative implementation of the measures. The group is formed to include the following:

Stakeholder	Entity
George Youssef	Municipality of Menjez
Joseph Mourad	Agricultural Cooperative of Menjez
Hanna Karam	Local farmer
Sr. Beatris	Francis of Assisi Church
Simon Slaiman	Civil Defense Center
Youssef Haddad	Apiculture COOP
Hikmat Mekhael	Backup generator owners and operators
Victor Elias	Groupe Missionnaire St Francois
Tanious Karam	Main Figure: Former President of the Cooperative
Tony Antonios	Main Figure: Mokhtar
Medhat Zainon	Main Figure: Highscool Professor

The SEAP stakeholder group played a major role in the design and customization of the SEAP and will be the dedicated committee that will follow up on the implementation and execution of the action plan provided within this document.

Budget Allocation

Achieving the target and making a change requires significant levels of investment in both human as well as financial resources. The projected budget for the implementation of all proposed measures is estimated at a total of $1,690,775 USD. The capital investments for the different solutions are presented in Figure 14.

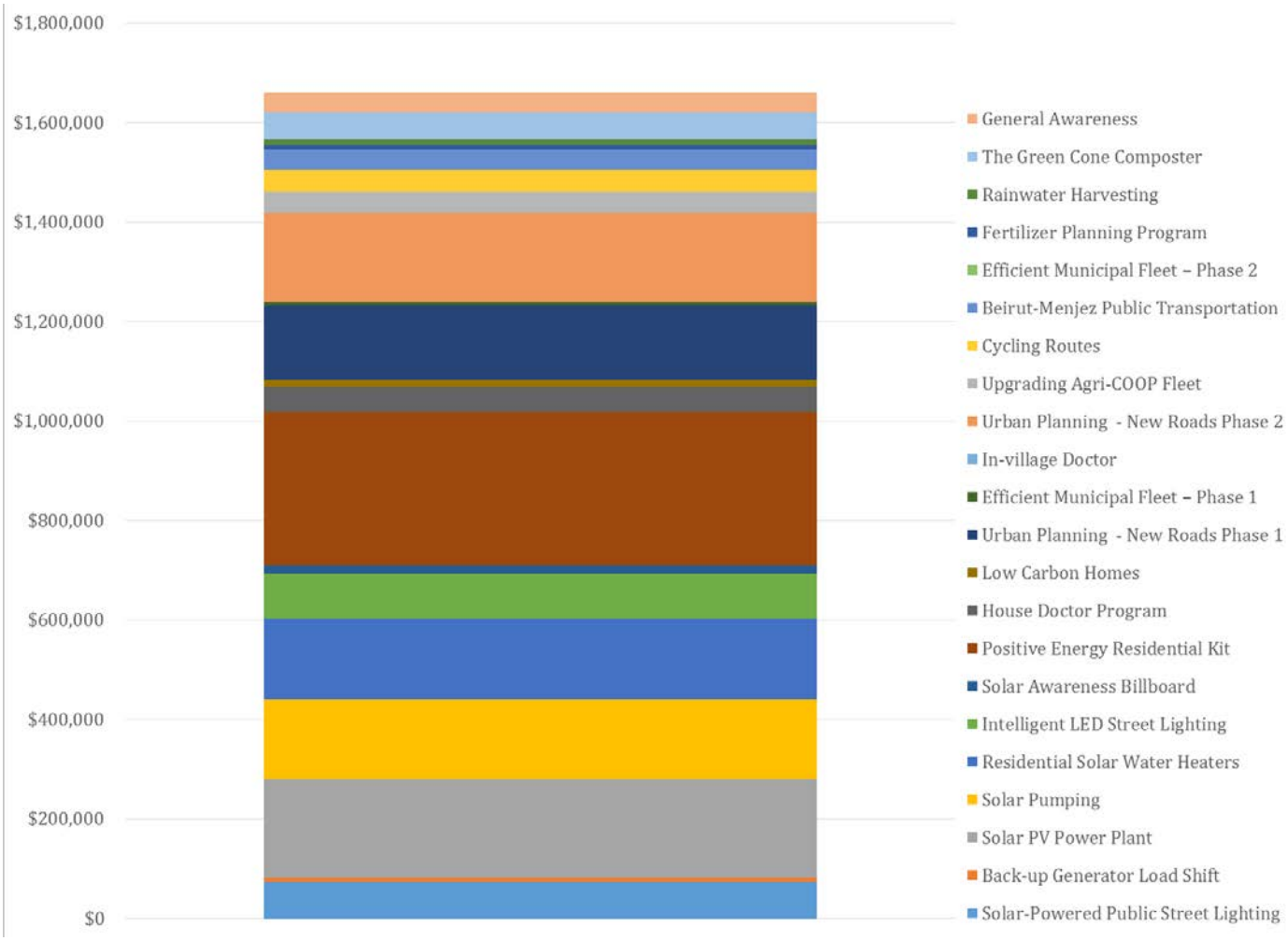


Figure 14: Capital investment for proposed sustainability measures

Financing Sources

Financing the implementation of these sustainability measures is only possible through having a wide range of sources and financing schemes. The exact sources of funding for each component of the SEAP is dependent on the nature of the specific initiative.

Four main types of financing will be in place, and shall be implemented based on the assigned solution and target group.

- ***Self-financing***

  With its limited resources and capabilities, the municipality of Menjez will only be able to finance small investments with a big share of the contribution being in kind.

- ***Grants & Aid Programs***

  The municipality will seek support of international organizations and aid programmes such as the USAID, UN, EU, Norwegian Aid, and others through the implementation of some large-capital sustainability measures.

- ***Governmental Subsidies***

  Subsidies and soft loans are sometimes offered by the Lebanese government and the central bank of Lebanon to environmental projects. This could be an attractive financial incentive to the inhabitants of Menjez to implement energy saving solutions such as solar systems and energy efficient equipment.

- ***ESCO Model***

  The ESCO model can be used for energy-related initiatives. An Energy Service Company (ESCO) usually finances the energy-saving projects with no expenses incurred on the local authority. The income the ESCO makes is a result of the energy savings it achieves.

  The ESCO model can be used for electricity supply, energy efficiency implementations, and green initiatives.

Planned Monitoring Measures

Monitoring is a main component of the SEAP planning and implementation, requiring regular progress reports to be prepared by the SEAP management and execution team.

A monitoring report shall be prepared and delivered to the responsible committee on annual basis, outlining progress on projects and achieved reductions in GHG emissions. A more detailed report shall be prepared and

submitted to the Covenant of Mayors, in order to monitor every action for progress to date and evaluate the quantifiable results if possible. This report will be prepared biennially.

Table 13: Monitoring plan in terms of occurrence and tasks

Activity	Tasks	Occurrence
Context Review	Adjust to adapt with policy changes and national strategies New and Emerging financing possibilities Include measures implemented but not mentioned in SEAP Update targets and timeframe for actions if needed	Annual
Activity Review	Progress updates and reporting Estimated GHG emissions savings to date Monitoring of identified indicators Lessons learn	Annual
Strategy Review	Revisit tools and models used Include changes taking place such as EF, national targets…	Annual
Performance Review	Assessment of the performance of different stakeholders Identify gaps or barriers hindering achieving targets	Annual
COM Reporting	Emission inventory monitoring Checklist of completed actions, pending, and eliminated List of corrective and preventive measures Action report Templates to be filled	Biennial

4

SUSTAINABILITY MEASURES

4.1 Summary of Sustainability Measures

Ref	Measure	Timeline	Budget	GHG Reduction (tCO_2-eq)	GHG Reduction (%)	Source of Reduction
E-01	**Solar-Powered Public Street Lighting**	2014	$74,000	11.41	0.76%	EDL
E-02	**Back-up Generator Load Shift**	2015	$7,000	20.80	1.39%	Diesel
E-03	**Solar PV Power Plant**	2017-2018	$200,000	64.32	4.29%	EDL & Diesel
E-04	**Solar Pumping**	2017	$160,000	77.77	5.19%	EDL
E-05	**Residential Solar Water Heaters**	2016	$162,000	39.95	2.67%	EDL & Diesel
E-06	**Intelligent LED Street Lighting**	2017-2018	$90,000	32.38	2.16%	EDL
E-07	**Solar Awareness Billboard**	2016	$16,000	1.96	0.13%	EDL & Diesel
E-08	**Positive Energy Residential Kit**	2017-2020	$309,375	40.69	2.72%	EDL & Diesel
E-09	**House Doctor Program**	2017	$50,000	36.17	2.41%	EDL & Diesel
E-10	**Low Carbon Homes**	2017-2020	$14,400	7.23	0.48%	EDL & Diesel
T-01	**Urban Planning - New Roads Phase 1**	2014	$150,000	14.21	0.95%	Car fuel
T-02	**Efficient Municipal Fleet – Phase 1**	2015	$6,000	0.08	0.01%	Car fuel
T-03	**In-village Doctor**	2014	N/A	1.14	0.08%	Car fuel

T-04	**Urban Planning - New Roads Phase 2**	2016-2018	$180,000	12.89	0.86%	Car fuel
T-05	**Upgrading Agri-COOP Fleet**	2016-2017	42000	10.88	0.73%	Car fuel
T-06	**Cycling Routes**	2017-2019	$45,000	1.87	0.12%	Car fuel
T-07	**Beirut-Menjez Public Transportation**	2017	40000	2.65	0.18%	Car fuel
T-08	**Efficient Municipal Fleet – Phase 2**	2017	$0	0.30	0.02%	Car fuel
C-01	**Forestation (Forest) - Phase 1**	2014	27000	42.00	0.00%	Carbon Stock
C-02	**Forestation (Fruit Trees) - Phase 1**	2015	$18,000	13.70	0.00%	Carbon Stock
C-03	**Forestation (Forest) - Phase 2**	2016-2020	$54,000	84.00	0.00%	Carbon Stock
C-04	**Forestation (Fruit Trees) - Phase 2**	2015-2018	$18,000	13.70	0.00%	Carbon Stock
A-01	**Fertilizer Planning Program**	2016	$10,000	3.54	0.24%	Nitrogen Emissions
A-02	**Efficient Ranching Practices**	2017	$30,000	9.26	0.62%	Methane Emissions
W-01	**Rainwater Harvesting**	2015	$10,000	0.13	0.01%	Water Saving
W-02	**The Green Cone Composter**	2016	$55,000	0.19	0.01%	Waste Disposal
G-01	**General Awareness**	2017-2020	$40,000	30.55	2.04%	General

4.2 Sustainability Measures Details

4.2.1 Electricity Measures

E-01. Solar-Powered Public Street Lighting

Sectors: Electricity

Progress Status	■■■■■
Impact	■■■■■
Investment	$74,000
MWh Saving	17.5
tCO_2-eq Saving	11.4
Contribution	0.76%
EF (kg/kWh)	0.650
Year	2014

Description

Public street lighting consumes large amounts of electricity per year to provide sufficient lighting within Menjez internal roads and local highways. Switching to solar power is a solution that would eliminate the need for grid supply especially when designed with sufficient autonomy and power backup. This solution replaces existing HPS with 70W LED, consuming only 35%, and powers each pole with its dedicated solar PV panel.

Baseline

Menjez has 187 street lights, conventionally each with a 200W HPS lamp, powered through the EDL grid. The total energy consumption per pole is 475 kWh per year, emitting 0.31 tCO_2-eq.

Results & Impact

The solar-powered street lights are providing sufficient lighting, saving 17,557 kWh of electricity, corresponding to 11,412 kg of CO_2 emissions per year. Carbon emission reductions result from the reduction of EDL power consumption through reducing the overall public street lighting consumption by 19.8%.

Budget & Financing

The project was funded by the UNDP/CEDRO project and implemented by a local contractor.

Timeline

The project was already implemented in the year 2014, starting in February and ending in October.

Indicators

Number of installed poles

Involved Parties

Internal: Municipality of Menjez

External: UNDP/CEDRO Project

E-02. Back-up Generator Load Shift

Sectors: Electricity

Progress Status	■■■■■
Impact	■■■■■
Investment	$7,000
MWh Saving	0
tCO_2-eq Saving	20.8
Contribution	1.39%
EF (kg/lit)	3.81
Year	2015

Description

One of the back-up generator networks uses one large generator with a capacity of 225 kVA. The generator mainly operates at a load that is lower than 50% of its capacity, thus reducing its efficiency in terms of liters per kWh. Having a smaller capacity generator to be operated during load times between 0% and 25% would increase the effectiveness and reduce diesel consumption.

Baseline

The generator consumes 60,832 liters of diesel during the entire year, at an average production of 3.47 kWh/liter. This leads to an emission of 231,600 kg of CO_2-eq per year.

Results & Impact

Shifting loads and using the smaller generator during 0-50% loads reduce diesel consumption by 9%, achieving a production rate of 3.82 kWh/liter. This leads to a diesel consumption reduction of 5,464 liters per year, corresponding to 20,801 kg of CO_2.

Budget & Financing

The project was funded by the Menjez Municipality.

Timeline

The project was already implemented in the year 2015, during the month of March.

Indicators

Liters of diesel consumed

Involved Parties

Internal: Municipality of Menjez

External: None

E-03. Solar PV Power Plant

Sectors: Electricity

Progress Status	■■□□□
Impact	■□□□□
Investment	$200,000
MWh Saving	60.0
tCO_2-eq Saving	64.3
Contribution	4.29%
EF (kg/kWh)	1.07
Year	2018

Description

Solar PV is a viable solution to generate electricity. A 50kWp system can save up to 60 MWh per year. The solar PV system would have the best environmental impact if used to reduce energy demand from the backup generation. The solar PV system will be able to provide power and store it in backup batteries for at least 5 years, after which it is expected to connect to the grid and benefit from it as a storage medium.

Baseline

Backup generation is estimated at 348 MWh, emitting a total of 299 tCO_2.

Results & Impact

A 50kWp system would be producing no less than 60 MWh per year, providing electricity in times of when it is highly needed. With no emissions in the process, the PV plant is expected to be reducing CO_2 by more than 64,324 kg per year.

Budget & Financing

The overall budget of the PV plant is 200,000 USD. The funding shall be secured through funds, grants, and other environmental programs. USAID is already approached and a proposal was submitted in 2015.

Timeline

The project is planned to be implemented in 2017 and fully operational by 2018. The major step is to secure funding.

Indicators

kWh produced

Involved Parties

Internal: Municipality of Menjez;

External: External consultant; TBD

E-04. Solar Pumping

Sectors: Electricity, Agriculture

Progress Status	■■■■■
Impact	■■■■■
Investment	**$160,000**
MWh Saving	**119.6**
tCO_2-eq Saving	**77.7**
Contribution	**5.19%**
EF (kg/kWh)	**0.65**
Year	**2018**

Description

With a total of 7 pumps in Menjez, adding up to 90 hp (67 kW), water pumping is a major consumer in Menjez. Utilizing solar energy to pump water without storage needs is an effective solution that would save large amounts of electricity and provide water regardless of grid conditions and backup generation availability. Solar pumps will be pumping water as long as the sun is there and delivering it to end-use point.

Baseline

Solar pumping consumption was calculated to be 119.6 MWh per year, with 2x20 hp pumps operating for 6 hours a day and 5x10 hp pumps working for 4 hours daily.

Results & Impact

The solar pumping system would eliminate the GHG emissions resulting from powering the water pumps using EDL, leading to an overall energy saving of 119.6 MWh and GHG emission reduction of 77,771 kg of CO_2.

Budget & Financing

The overall budget of the PV pumps is estimated at is 160,000 USD. The funding shall be secured through funds, grants, and other environmental programs.

Timeline

The project is planned to be implemented in 2018 and fully operational by the end of the year. The major step is to secure funding.

Indicators

Total volume of water pumped

Involved Parties

Internal: Municipality of Menjez;

External: External consultant;

E-05. Residential Solar Water Heaters

Sectors: Electricity

Progress Status	■■■■■
Impact	■■■■■
Investment	$162,000
MWh Saving	47.7
tCO_2-eq Saving	41.23
Contribution	2.67%
EF (kg/kWh)	0.86
Year	2016

Description

Using solar thermal for water heating is one of the most rewarding options. The plan is to transform Menjez into a 100% solar water heating village, reaching all houses within the village. There are 30 houses already having solar water heating, leaving 180 to use electricity for heating water. The program aims at offering facilitations and financial support to residences and push them to install SWHs.

Baseline

Electricity is used to heat water in 180 residences in the village. The installation of SWHs target80% of the houses assuming that there will be 10% with no possibility to install a SWH on the roof due to roof or other restrictions. The consumption is 47,737 kWh per year, emitting 41,228 kg CO_2 per year.

Results & Impact

The solar water heating system would eliminate the GHG emissions resulting from electricity consumed for water heating from EDL and generator supply. This is leading to an overall energy saving of 47.7 MWh and GHG emission reduction of 41,228 kg of CO_2.

Budget & Financing

The overall budget of the solar water heater is estimated at is 162,000 USD. The funding shall be secured through funds, grants, and other environmental programs.

Timeline

The project is planned to be implemented in 2016.

Indicators

Number of SWH installed

Involved Parties

Internal: Municipality of Menjez;

External: External consultant;

E-6. Intelligent LED Street Lighting

Sectors: Electricity

Progress Status	■□□□□
Impact	■■□□□
Investment	$90,000
MWh Saving	49.8
tCO_2-eq Saving	32.4
Contribution	2.16%
EF (kg/kWh)	0.650
Year	2018

Description

With 37 street lamps operating on solar PV, the plan is to transform the 150 left poles into energy efficient lamps and apply intelligent control that allows monitoring, control, dimming, and efficient operation of the street lighting network.

The plan includes switching into LED lamps and applying motion sensors, dimmers, remote control, and other intelligent strategies.

Baseline

The 187 lamps consume conventionally consume more than 88.7 MWh a year. With 37 already converted into solar powered LED, the 150 poles consume 71,2 MWh.

Results & Impact

The use of LED combined with intelligent control would reach savings more than 60%, resulting in a final energy consumption of 21.3 MWh, leading to 32,385 kg of CO_2 avoided.

Budget & Financing

The budget for the LED lamps with the intelligent control is estimated at around $90,000. Funds shall be secured through local and international funding agencies.

Timeline

The project is planned to be implemented by 2018. The major step at this stage is to secure funding.

Indicators

Number of lamps retrofitted

Involved Parties

Internal: Municipality of Menjez;

External: External consultant;

E-07. Solar Awareness Billboard

Sectors: Electricity

Progress Status	
Impact	
Investment	**$16,000**
MWh Saving	**2.3**
tCO_2-eq Saving	**2.02**
Contribution	**0.13%**
EF (kg/kWh)	**0.863**
Year	**2016**

Description

The Municipality plans to install an electronic LED billboard that shall be used for awareness programs and special announcements. Powering the billboard with solar PV would be an effective solution that would eliminate electricity consumption and allow off grid installation.

The 400W billboard will act as an awareness tool, and the PV system attached to it will produce enough power and store it in batteries.

Baseline

The billboard is expected to be operating for 16 hours a day (5,480 hours a year), consuming 2,336 kWh a year and emitting 2,017 kg of CO_2.

Results & Impact

Using solar energy, the 2,336 will be saved and the 2,017 kg of CO_2 will be avoided.

Budget & Financing

The budget for the complete system is not expected to exceed $16,000. The municipality shall seek financial support or co-financing through unbiased advertisement.

Timeline

The initiative can start anytime soon and will need 2 weeks to be completed.

Indicators

N/A

Involved Parties

Internal: Municipality of Menjez;

External: TBD

E-08. Positive Energy Residential Kit

Sectors: Electricity

Progress Status	■■■■■
Impact	■■■■■
Investment	$309,375
MWh Saving	48.6
tCO_2-eq Saving	42
Contribution	2.72%
EF (kg/kWh)	0.863
Year	2020

Description

The Positive Energy residential kit is an energy efficiency measure targeting residences and aiming at reducing end-use energy consumption at houses. The kit includes a 1kWp solar PV system, with 5 LED light bulbs and, a cooling fan. The plan is to offer these kits to every house at a subsidize rate that attracts homeowners.

Baseline

A typical house has an electricity consumption of around 2 MWh per year, emitting an average of 74 tCO_2 for the energy consumed from EDL and that from backup generators.

Results & Impact

The kit would save at least 50% of the electricity bill at the house. Assuming a potential to reach at least 50 residences by 2020, the expected savings are more than 48.6 MWh per year, leading to an avoidance of 41,991 kg of CO_2.

Budget & Financing

Each kit would cost around 12,000 USD and is planned to be subsidized by 50% from an external source. Adding a 500 USD on each kit for operational expenses, the overall required fund to mobilize this program is 309,375 USD. Each residence will be paying 6,250 USD which can be supported through a green loan offered by the central bank of Lebanon at only 1% interest rate with a repayment period of 10 years.

Timeline

The initiative would start in 2017 and extend to finish in 2020. Major milestones are:

(1) Secure partial funding (2) Hire consultant (3) Identify supplier (3) Secure banking support

Indicators

Sold kits

Involved Parties

Internal: Municipality of Menjez;

External: External consultant

E-09. House Doctor Program

Sectors: Electricity

Progress Status	■■■■■
Impact	■■■■■
Investment	**$50,000**
MWh Saving	**43.2**
tCO_2-eq Saving	**37.3**
Contribution	**2.41%**
EF (kg/kWh)	**0.863**
Year	**2017**

Description

The house doctor is an energy expert whose job is to visit the houses and perform efficiency assessment to advice on ways to reduce energy consumption. The house doctor will be equipped with necessary tool such as power measurement tools, infrared camera, AC optimization tools and others. In addition the house doctor will provide houses with solutions to basic problems such as air infiltration, thermal loss and others.

Baseline

A typical house has an electricity consumption of around 2 MWh per year, emitting an average of 74 tCO_2 for the energy consumed from EDL and that from backup generators.

Results & Impact

Such a program is expected to engage all 220 residences, with expected energy reductions of 10% in electricity consumption. This would lead to 43.2 MWh and 37.3 tCO_2 savings.

Budget & Financing

The program would require a fee for the house doctor in addition to a budget for tools, equipment, and material. This sums up to around $60,000.

Timeline

The program would run over a period of 4 months. Could start and commence in 2007.

Indicators

Engaged houses

Involved Parties

Internal: Municipality of Menjez;

External: External Consultant

E-10. Low Carbon Homes

Sectors: Electricity

Progress Status	■■■■■
Impact	■■■■■
Investment	$14,400
MWh Saving	8.6
tCO_2-eq Saving	7.5
Contribution	0.48%
EF (kg/kWh)	0.863
Year	2017

Description

A low carbon home is a house that reduces its carbon emissions to the maximum. To do so, several actions need to be taken by the homeowner. In order to incentivize homeowners to do so, the municipality can offer a rewards program that exempts the home from municipal fees for a period of 2 years post their conversion to low carbon. The benchmarking criteria will be set in details at a later stage.

Baseline

A typical house has an electricity consumption of around 2 MWh per year, emitting an average of 74 tCO_2 for the energy consumed from EDL and that from backup generators.

Results & Impact

Such a program is expected to engage at least of 22 residences, achieving reductions of 20% in electricity consumption. This would lead to 8 MWh and 7.4 tCO_2 savings.

Budget & Financing

The municipal fee paid annually is 100 USD per house. Expecting the engagement of 22 house, the municipality will be reducing its income by 4,400 USD. In addition, an external consultant is needed to set up the standards and guidelines for low carbon design, with an approximate budget of $10,000 to be secured through external financing.

Timeline

The initiative would start in 2017 after the municipality sets the necessary framework and achieves a certain level of awareness among the public.

Indicators

Engaged houses

Involved Parties

Internal: Municipality of Menjez;

External: External Consultant

4.2.2 Transportation Measures

T-01. Urban Planning - New Roads Phase 1

Sectors: Transportation

Progress Status	■■■■■
Impact	■■■■■
Investment	**$150,000**
MWh Saving	**-**
tCO_2-eq Saving	**14.2**
Contribution	**0.95%**
EF (kg/km)	**0.22**
Year	**2014**

Description

With a lot of areas in the village not being well connected, vehicles have to drive long distances to travel from one place to another. The two new roads, Al Harf and Al Rashadieh, would reduce travel distances from 6.10 to 1.23 km and 2.38 to 0.84 respectively.

This travel distance reduction affects 50 vehicles per day, and reduces emissions due to vehicle transportation by 80% and 65% for the two roads.

Baseline

On average, 10,950 cars drive along the old Al Harf road and 7,300 travel along Al Rashadieh, crossing 84,169 km a year. Considering an average vehicle size, emissions are 18.5 tCO_2/year.

Results & Impact

Instead of a total of 81,169 km travelled, 16,600 km are now travelled per year, reducing emissions by 14,205 kg of CO_2 per year. This corresponds to a reduction of 5,972 liters of gasoline, using an average of 9.25 liters of diesel per 100 km.

Budget & Financing

The project was funded by the EU and implemented under the CDR.

Timeline

The project was already implemented in the year 2014.

Indicators

Number of cars crossing the road

Involved Parties

Internal: Municipality of Menjez

External: CDR

Figure 15: Al Harf new road (green) compared to old road (red)

Figure 16: Al Rashadieh new road (green) compared to old road (red)

T-02. Efficient Municipal Fleet – Phase 1

Sectors: Transportation

Progress Status	■■■■■
Impact	■■■■■
Investment	$6,000
MWh Saving	-
tCO_2-eq Saving	0.08
Contribution	0.005%
EF (kg/km)	0.16
Year	2015

Description

With no cars belonging to the municipality, all works related to the municipal works are performed using personal SUV cars even if the task doesn't require a vehicle as big. Having an energy efficient ATV would allow to reduce gasoline and thus carbon emissions. Two ATV are need, each would emit as low as 0.11 kg of CO_2 per km crossed, which is 41% as compared to large SUV vehicles.

Baseline

SUVs emit 0.27 kg of carbon dioxide when travelling 1 km. With an average distance of 500 km crossed per year that can be avoided with the use of ATV, a total of 135 kg of CO_2 are emitted per year.

Results & Impact

Using ATV instead of SUVs would emit 0.11 kg instead of 0.27 kg of CO_2 per km. Since their purchase, the ATVs have crossed a distance of 380 km over a period of 9 months, thus saving 61 kg of CO_2, this number is expected to increase to reach 80 kg by the end of the year.

Budget & Financing

The project was implemented in January 2015, and fully financed by the Municipality of Menjez.

Timeline

The project was already implemented in the year 2015.

Indicators

Number of cars crossing the road

Involved Parties

Internal: Municipality of Menjez

External: -

T-03. In-village Doctor

Sectors: Transportation

Progress Status	■■■■■
Impact	■■■■■
Investment	N/A
MWh Saving	-
tCO_2-eq Saving	1.1
Contribution	0.07%
EF (kg/km)	0.22
Year	2014

Description

With no medical facility in the village of Menjez, patients have to travel to nearby town, Qubayat, to see a doctor or get medical advice. With an average patient rate of 20 patients per week, and an average travel distance of 6km, a total of 6.240 km is driven to reach for a doctor. Bringing the doctor to Menjez, would bring convenience to the village and avoid as much as 5,200 km of driving distance.

Baseline

Driving for a distance of 6 km, in a mid-size gasoline car that emits 0.22 kg of CO_2 per km, an average trim emits 1.32 kg of CO_2. With 1,040 trips per year, emission are 1,373 kg per year.

Results & Impact

The doctor is receiving 20 patients per week, who have to drive for 1 km instead of 6 km on average. The savings are results of a 5 km reduction per trip, i.e. 5,200 km. This corresponds to a carbon emission reduction of 1,144 kg of CO_2 per year.

Budget & Financing

The project was implemented in January 2015, and fully financed by GIZ.

Timeline

The project was already implemented in the 2014.

Indicators

Number of patiens

Involved Parties

Internal: Municipality of Menjez

External: -

T-04. Urban Planning - New Roads Phase 2

Sectors: Transportation

Progress Status	■□□□□
Impact	■□□□□
Investment	$180,000
MWh Saving	-
tCO_2-eq Saving	12.89
Contribution	0.86%
EF (kg/km)	0.22
Year	2018

Description

Three new roads, Douar Al Wadi, Rimmah, and Al Horsh, would reduce travel distances from 7.22 to 1.42 km, 1.48 to 0.71, and 3.75 to 2.1 respectively.

This travel distance reduction affects 55 vehicles per day, and reduces emissions due to vehicle transportation by 80%, 52%, and 44% for the three roads.

Baseline

On average, 7,300 cars drive along the old Douar Al Wadi road, 5,475 travel along Rimmah, and 7,300 travel along Al Horsh, crossing 88,184 km a year. Considering an average vehicle size, emissions are 19.4 tCO_2/year.

Results & Impact

Instead of a total of 88,184 km travelled, 56,801 km are now travelled per year, reducing emissions by 12,890 kg of CO_2 per year. This corresponds to a reduction of 5,421 liters of gasoline, using an average of 9.25 liters of diesel per 100 km.

Budget & Financing

The project needs a budget of around $180,000. External funding is needed.

Timeline

The project is expected to be implemented starting 2016 and ending in 2018.

Indicators

Number of cars crossing the road

Involved Parties

Internal: Municipality of Menjez

External: CDR

Figure 17: Douar Al Wadi new road (green) compared to old road (red)

Figure 18: Rimmah new road (green) compared to old road (red)

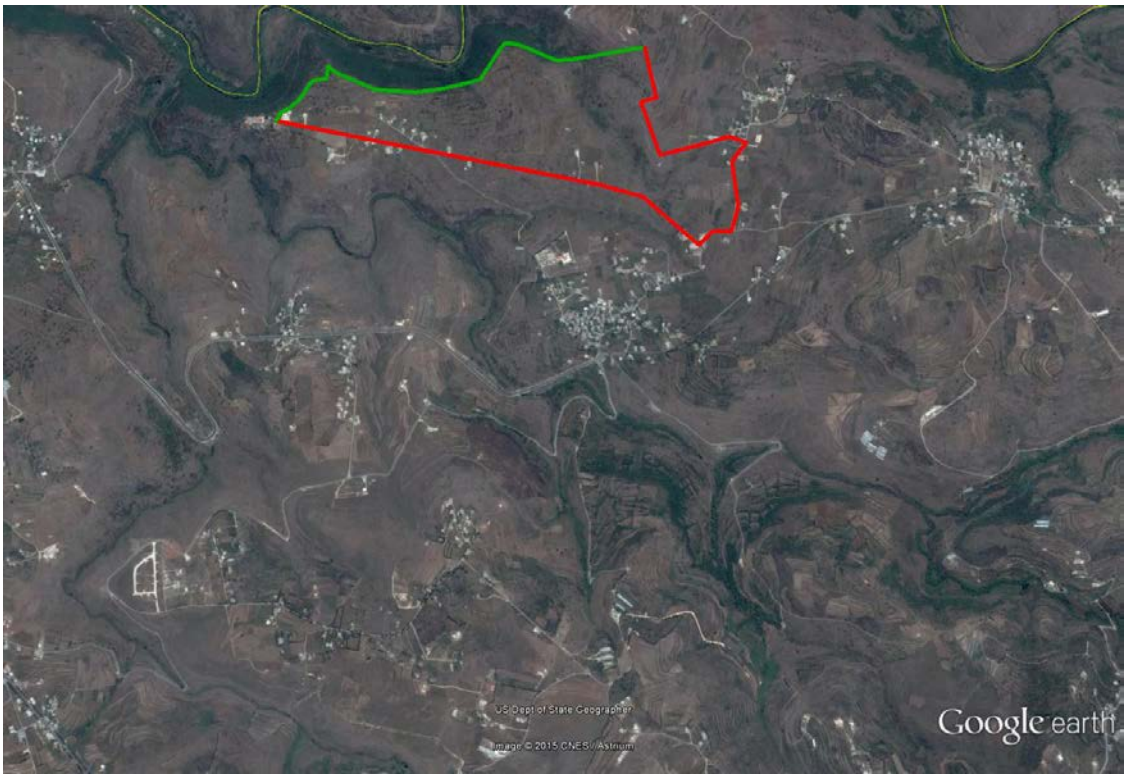


Figure 19: Al Horsh new road (green) compared to old road (red)

T-05. Upgrading Agri-COOP Fleet

Sectors: Transportation, Agriculture

Progress Status	■□□□□
Impact	■□□□□
Investment	$42,000
MWh Saving	-
tCO_2-eq Saving	10.8
Contribution	0.73%
EF (kg/lit)	2.67
Year	2017

Description

The agriculture Cooperative has limited resources with only two tractors that are insufficient to provide support to all farmers. With the fleet being too old highly inefficient, they are consuming large amounts of diesel compared to the services they are doing. The proposal is to upgrade the fleet and purchase three modern, highly efficient, tractors to be at the farmers' service when needed.

Baseline

The two tractors in operation consume an annual average of 4,800 liters of diesel, emitting a total of 12,804.5 kg of CO_2.

Results & Impact

Retrofitting old tractors with new ones having an improved operational efficiency would lead to a reduction of no less than 15% in the fuel consumption, reaching a total consumption of 4,080 liters of diesel and annual emissions of 10.8 tCO_2. This would be saving 1.92 tCO_2 per year.

Budget & Financing

The new tractors require a budget of $42,000. This requires external financing that should be sought through funding agencies.

Timeline

The project is expected to be implemented starting 2016.

Indicators

Diesel consumption

Involved Parties

Internal: Municipality of Menjez

External: -

T-06. Cycling Routes

Sectors: Transportation, Tourism

Progress Status	■□□□□
Impact	■□□□□
Investment	$45,000
MWh Saving	-
tCO_2-eq Saving	1.87
Contribution	0.12%
EF (kg/km)	0.52
Year	2019

Description

Menjez receives large numbers of visitors and tourists every year, mainly visiting for touristic locations and for hiking activities. Around 3.7 tCO_2 are emitted every year as a result of 7,200 km crossed annually. Offering reliable cycling service with safe and trustworthy cycling routes would reduce the emissions caused by fuel-based transportation. Bicycles are to be available to the people of Menjez and the visitors free of charge.

Baseline

Tourism transportation contributes to a total annual emissions of 3.7 tCO_2 for traveling a distance of 7,200 km.

Results & Impact

Assuming that at least half of the visitors would take the bicycle, it is expected to avoid 1,872 kg of CO_2 per year, in addition to the reductions caused by the people of the village using it instead of other carbon emitting vehicles.

Budget & Financing

The budget is needed for the cycling fleet consisting of 15 bikes and the infrastructure needed to have cycling routes in the village. The overall budget is estimated at $45,000. External funded is needed.

Timeline

The project can start by 2017 and be fully operational by 2019 the latest.

Indicators

Number of passengers

Involved Parties

Internal: Municipality of Menjez

External: -

T-07. Beirut-Menjez Public Transportation

Sectors: Transportation

Progress Status	■□□□□
Impact	■□□□□
Investment	$40,000
MWh Saving	-
tCO_2-eq Saving	2.65
Contribution	0.18%
EF (kg/km)	0.23
Year	2017

Description

More than 100 residents of Menjez travel to Beirut on weekly basis, driving private cars or taking individual taxis with no or minimal carpooling. These travel mainly on Sunday from Menjez towards Beirut, to be back on Friday.

Arranging for a large bus that travels to Beirut every Sunday morning and returns on Friday to be owned by operated by the Municipality would be an option that improves transportation efficiency in the village.

Baseline

100 residents driving to and from Beirut twice a week, using an estimate of 60 cars, each would be traveling an internal distance of 10km per week. This sums up to 21,840 km travelled within the territory of Menjez, emitting 4,804 kg of CO_2 per year.

Results & Impact

Arranging for a bus that would take 50 residents to and from Beirut every day would reduce the overall distance travelled to 11,232km. Considering the average emissions of a large bus and that of a mid-size vehicle, the relative emissions are 2,645 kg of CO_2.

Budget & Financing

The bus would cost around $40,000 as an investment. Running costs will be covered by the passengers through paying subsidized fees.

Timeline

The project is expected to be implemented starting 2017 as soon as funding is secured.

Indicators

Number of passengers

Involved Parties

Internal: Municipality of Menjez

External: -

T-08. Efficient Municipal Fleet – Phase 2

Sectors: Transportation

Progress Status	■■■■■
Impact	■■■■■
Investment	**$30,000**
MWh Saving	**-**
tCO_2-eq Saving	**0.3**
Contribution	**0.02%**
EF (kg/km)	**0.0.4**
Year	**2017**

Description

In continuation of Phase 1, the municipality could reduce emissions from fuel consumption by owning its own efficient cars achieving emissions of 0.18 kg of CO_2 per km travelled.

Baseline

SUVs emit 0.27 kg of carbon dioxide when travelling 1 km. With an average distance of 3,140 km crossed per year that can be avoided with the use of efficient cars.

Results & Impact

Using small efficient cars instead of SUVs would emit 0.18 kg instead of 0.27 kg of CO_2 per km., saving 0.094 kg of CO_2, per km, reaching a total of 0.3 tCO_2 per year.

Budget & Financing

A budget of 30,000 USD is needed to be secured through grants and donations.

Timeline

Cars are expected to be secured by 2017.

Indicators

Distance crossed using the cars

Involved Parties

Internal: Municipality of Menjez

External: -

4.2.3 Carbon Capture Measures

C-01. Forestation (Forest) - Phase 1

Sectors: Public

Progress Status	■■■■■
Impact	■■■■■
Investment	**$27,000**
MWh Saving	**0**
tCO_2-eq Saving	**42.0**
Contribution	**0%**
EF (kg/tree)	**9.3**
Year	**2014**

Description

Increasing the number of forest trees improves the land capabilities and potential for carbon sequestration and stocking. It improves the soil conditions, fights deforestation, and reduces the impact of GHG emissions on the village. Trees clean the air, emit oxygen, combat climate change, preserve water, and provide sustainable sources of biomass. The measure aims at increasing the forestry coverage in Menjez.

Baseline

There is currently 40 ha of forest land in Menjez, with a carbon stock capacity of 14,000 tC, and an annual carbon sequestration rate of 16.8 tCO_2 per year per ha, equivalent to 9.3 kg CO_2 per tree.

Results & Impact

Increasing the forest area would add to the carbon stocking capacity of the village at the rate of 350 tC per ha and 15.8 tCO_2 carbon sequestration per tree per year. With the plantation of 4,500 trees covering an area of 2.5 ha, the carbon sequestration is 42,000 kg of CO_2 per year.

Budget & Financing

The project was funded by the EU and implemented with the University of Balamand.

Timeline

The project was already implemented in the year 2014 in its first phase. Phase 2 will take place in 2016.

Indicators

Number of trees planted

Involved Parties

Internal: Municipality of Menjez

External: University of Balamand

C-02. Forestation (Fruit Trees) - Phase 1

Sectors: Public

Progress Status	■■■■■
Impact	■■□□□
Investment	$18,000
MWh Saving	0
tCO_2-eq Saving	13.7
Contribution	0%
EF (kg/tree)	4.56
Year	2015

Description

Increasing the number of fruit trees improves the land capabilities and potential for carbon sequestration and stocking. It improves the soil conditions, fights deforestation, and reduces the impact of GHG emissions on the village. Trees clean the air, emit oxygen, combat climate change, preserve water, and provide sustainable sources of biomass. The measure aims at increasing the green areas coverage in Menjez.

Baseline

Agroforestry and fruit trees currently cover 100 ha in Menjez, with a carbon stock capacity of 9,500 tC, and an annual carbon sequestration rate of 6.8 tCO_2 per year per ha, equivalent to 4.6 kg CO_2 per tree.

Results & Impact

Increasing the fruit trees area would add to the carbon stocking capacity of the village at the rate of 95 tC per ha and 4.6 tCO_2 carbon sequestration per tree per year. With the plantation of 3,000 trees covering an area of 1.33 ha, the carbon sequestration is 13,680 kg of CO_2 per year.

Budget & Financing

The project was implemented in two phases, the first with 2,000 trees financed by the Municipality of Menjez, and the second with 1,000 trees financed by Rotary Club

Timeline

The project was already implemented in the year 2014 in its first phase. Phase 2 will take place in 2016.

Indicators

Number of trees planted

Involved Parties

Internal: Municipality of Menjez

External: Rotary Club

C-03. Forestation (Forest) - Phase 2

Sectors: Public

Progress Status	■■■□□
Impact	■■■■□
Investment	$54,000
MWh Saving	0
tCO_2-eq Saving	84.0
Contribution	0%
EF (kg/tree)	9.3
Year	2020

Description

This is Phase 2 of the Forest Forestation program. With an additional 4,500 trees to be secured.

Baseline

There is currently 42.5 ha of forest land in Menjez, with a carbon stock capacity of 14,350 tC, and an annual carbon sequestration rate of 17.2 tCO_2 per year per ha, equivalent to 9.3 kg CO_2 per tree.

Results & Impact

Increasing the forest area would add to the carbon stocking capacity of the village at the rate of 700 tC per ha and 31.6 tCO_2 carbon sequestration per tree per year. With the plantation of 9,000 trees covering an area of 5 ha, the carbon sequestration is 84,000 kg of CO_2 per year.

Budget & Financing

The project fund is secured through the EU to be implemented with the University of Balamand in its first part. The second part is yet to be secured.

Timeline

The project is expected to be completed in 2016. The second part expected to be done in 2020.

Indicators

Number of trees planted

Involved Parties

Internal: Municipality of Menjez

External: University of Balamand; TBD

C-04. Forestation (Fruit Trees) - Phase 2

Sectors: Public

Progress Status	■■■■■
Impact	■■□□□
Investment	$18,000
MWh Saving	0
tCO_2-eq Saving	13.7
Contribution	0%
EF (kg/tree)	4.56
Year	2018

Description

This is a continuation of fruit trees forestation recommending the addition of 3,000 more fruit trees that would help in improvising the environmental performance of the village as well as generate additional income to farmers and inhabitants of the village.

Baseline

Agroforestry and fruit trees currently cover 113.3 ha in Menjez, with a carbon stock capacity of 9,595 tC, and an annual carbon sequestration rate of 4.6 kg CO_2 per tree.

Results & Impact

Increasing the fruit trees area would add to the carbon stocking capacity of the village at the rate of 95 tC per ha and 4.6 tCO_2 carbon sequestration per tree per year. With the plantation of 3,000 trees covering an area of 1.33 ha, the carbon sequestration is 13,680 kg of CO_2 per year.

Budget & Financing

The project was implemented in two phases, the first with 2,000 trees financed by the Municipality of Menjez, and the second with 1,000 trees financed by Rotary Club

Timeline

The project shall start in 2016, aiming at the addition of 1,000 trees per year throughout 2018. Steps needed:

(1) Seek funding (2) Implement action plan

Indicators

Number of trees planted

Involved Parties

Internal: Municipality of Menjez

External: TBD

4.2.4 Agriculture-Related Measures

A-01. Fertilizer Planning Program

Sectors: Agriculture

Progress Status	
Impact	
Investment	**$10,000**
MWh Saving	**0**
tCO_2-eq Saving	**3.54**
Contribution	**0.2%**
EF (kg/kg Fert.)	**0.63**
Year	**2016**

Description

In order to ensure using the right fertilizer, in the right amount, at the right time, and on the right place, a sustainable fertilizer application guide should be available at the agri-coop to provide technical support to farmers and ensure reducing nitrogen-based fertilizer applications and applying fertilizers more efficiently. An external expert is needed to prepare a fertilizer planning program.

Baseline

Each arable hectare in Lebanon consumes an average of 282 kg of fertilizers per year, leading to a total consumption of 112.8 tons of fertilizers annually for the 400 ha at Menjez.

Results & Impact

The proper use of fertilizers could reduce GHG emissions by 5-10%. Using the conservative side, a total of 5.6 tons of fertilizers per year. With an emission rate of 2 g of N_2O per kg of fertilizer, this corresponds to a reduction of 11.4 kg of N_2O per year, equivalent to 3.54 tCO_2 per year.

Budget & Financing

The overall consultancy assignment is estimated to be completed in 25 man-days, with an estimated budget of $10,000. External funding agencies, support programs, and agricultural organizations shall be approached.

Timeline

The project needs 2 months to be completed. Steps needed:

(1) Seek funding (2) Hire consultant (3) Implement action plan

Indicators

Amount of fertilizers consumed

Involved Parties

Internal: Municipality of Menjez

External: University of Balamand

A-02. Efficient Ranching Practices

Sectors: Agriculture

Progress Status	
Impact	
Investment	$30,000
MWh Saving	0
tCO_2-eq Saving	9.26
Contribution	0.62%
EF (kg/head)	45
Year	2017

Description

Improving animal and herd efficiency contributes to reducing GHG emissions by increasing the production per head and thus reduce the number of heads needed. This leads to reducing methane generated during digestion as well as the amount of nitrous oxide released by decomposing manure.

This includes using better feeds and feeding techniques.

Baseline

The overall emissions from ranching is 4,411 kg of CH_4 caused by a total of 2,039 heads. Leading to an average of 2.16 kg per head.

Results & Impact

The use of better feeds and feeding techniques would improve the efficiency of the animals by at least 10%, corresponding to 0.216 kg of CH_4 per head. This leads to a total of 440 kg of methane per year, equivalent to 9.26 tCO_2 per year.

Budget & Financing

The overall estimated budget for this activity is $30,000.

Timeline

The project needs 6 months to be completed. Steps needed:

(1) Needs assessment (2) Hire consultant (3) Implement action plan

Indicators

Production rate per head

Involved Parties

Internal: Municipality of Menjez

External: TBD

4.2.4 Waste & Water Measures

W-01. Rainwater Harvesting

Sectors: Water, Electricity

Progress Status	■■■■■
Impact	■■■■■
Investment	**$10,000**
MWh Saving	**-**
tCO_2-eq Saving	**0.13**
Contribution	**0.007%**
EF (kg/m^3)	**1**
Year	**2015**

Description

With water scarcity, rainwater harvesting is becoming more of a feasible solution. Benefiting from the rainfall taking place in the village of Menjez would have a positive impact on the environment.

A rainwater harvesting system with a storage capacity of 5 m^3 would provide around 125,000 liters of water and reduce energy consumption.

Baseline

It is estimated that providing a total volume of 125,000 liters of water would lead to emitting 125 kg of CO_2/year[17].

Timeline

The project was already implemented in the year 2015.

Results & Impact

The system provides an annual volume of 125 m^3, avoiding around 125 kg of CO_2 per year, at a rate of 1 kg per m^3.

Budget & Financing

The project was funded by the UNDP and Coca Cola Foundation and implemented with G Association.

Indicators

Capacity installed

Involved Parties

Internal: Municipality of Menjez

External: G Association

W-02. The Green Cone Composter

Sectors: Waste, Transporation

Progress Status	■■■■■
Impact	■■■■■
Investment	$55,000
MWh Saving	-
tCO_2-eq Saving	0.19
Contribution	0.013%
EF (kg/t waste)	1.42
Year	2016

Description

The green cone composter is a basic tool that can make compost out of kitchen waste. Waste is simply disposed into the cone composter, where natural decomposition is accelerated due to increased temperature and maintaining aerobic conditions. The system processes almost all household food waste, including vegetable scraps, raw and cooked meat or fish, bones, dairy products and other organic food waste.

Baseline

An average house produces 50 kg of food waste per month that can be put in the cone composter. With 220 houses in Menjez, this leads to 132 tons of food waste per year. Considering transportation costs only with an emission rate of 1.42 kg per solid waste tone disposed, this leads to 190 kg CO_2 per year.

Timeline

This initiative is planned for the year 2016.

Results & Impact

Distributing the green cone composter to all residences in Menjez would lead to the reduction 0.19 tCO_2per year. This is due to the reduction of waste volume and thus reduction in waste disposal emissions.

Budget & Financing

Each composter would cost 250 USD, leading to a total of $55,000.

Indicators

Number of composters distributed

Involved Parties

Internal: Municipality of Menjez

External: TBD

4.2.5 Governance and Awareness

G-01. General Awareness

Sectors: Public

Progress Status	
Impact	
Investment	**$40,000**
MWh Saving	**36.5**
tCO_2-eq Saving	**30.55**
Contribution	**2.04%**
EF (kg/kWh)	**0.863**
Year	**2017**

Description

A set of activities that cannot be evaluated in terms of emission reduction:

- The green festival: an annual event that gathers the public, featuring green activities, awareness raising, and engagement of the public.
- Activation of Menjez website to feature awareness tips and advertisements on latest ecofriendly activities and events.
- Workshops on energy efficiency in home and the commercial sector
- Workshops and presentations on fuel saving in the car
- Awareness on passive design and efficient operations in new buildings

Baseline

N/A

Timeline

The project is expected to achieve its target by year 2017.

Results & Impact

Raising awareness among could result in an energy saving of 200 Wh/day per person from different operations. This is an assumption to quantify the impact of trainings and awareness raising. The program is expected to reach 500 persons, saving 36,500 kWh per year, and reducing CO_2 emissions by 30,548 a year.

Budget & Financing

A total budget of 40,000 USD is estimated to arrange for activities, events, festivals, and special prizes. Sponsorship should be sought.

Indicators

Number of participants

Involved Parties

Internal: Municipality of Menjez

External: Civil Society;

5

SUSTAINABLITY IMPLEMENTATION & IMPACT

5.1 Impact

The comprehensive GHG emissions reduction resulting from all proposed sustainability measures sums up to 28.05%, which is 3.05% above the target of the Municipality of Menjez.

This value is achievable with no major overlapping between the different proposed measures.

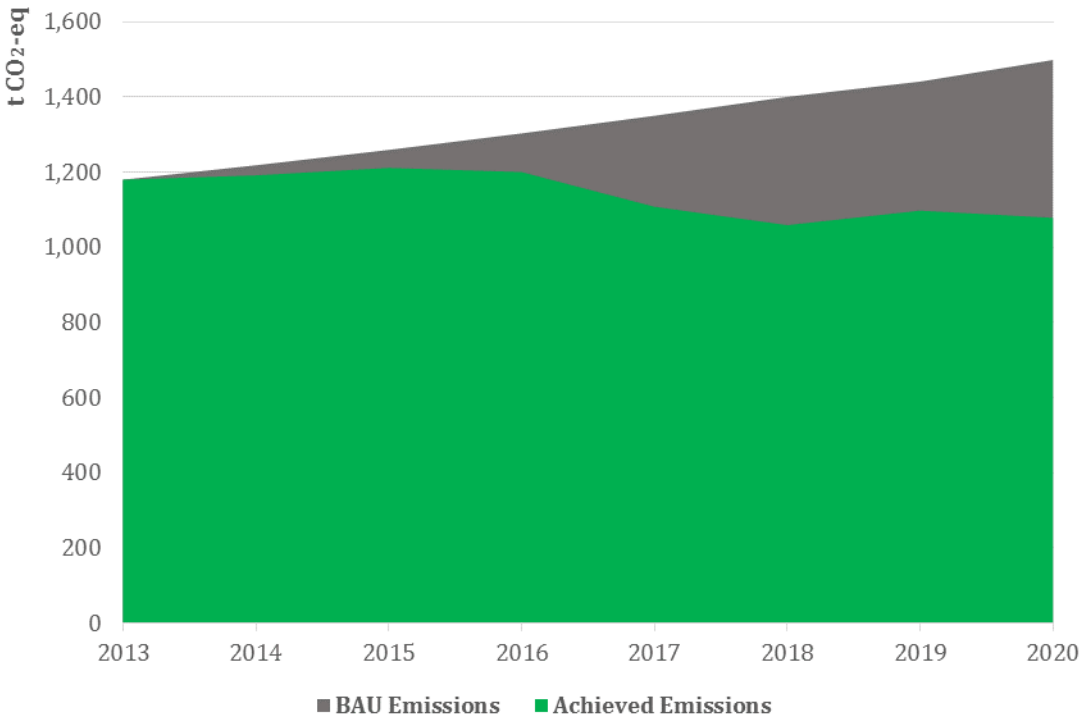


Figure 20: BAU vs Achievable GHG emissions

Figure 20 shows the gradual decrease in GHG emissions moving from the baseline year to the target year 2020. The distribution of the emissions is based on the timeframe selection for the implementation of each measure taking into account the time needed for the implementation, the duration required to secure the funding, and the period needed to start realizing results.

In order to achieve the target goal of 25% by 2020, a linear GHG reduction scenario is applied for illustrative purposes only. With the target emissions for each year set, the values are compared with the achievable emissions computed from the action items presented earlier. The overall difference at the end of the period is a positive 3.05%, showing that the target emissions was achieved and exceeded as presented in the table hereafter.

Table 14: GHG emissions comparison between BAU, Target, and Achievable (tCO_2-eq)

Year	Factor	BAU	Target	Achievable	Difference
2013	1.27	1,180	1,180	1,180	0.00%
2014	1.23	1,218	1,175	1,192	-1.43%
2015	1.19	1,259	1,169	1,211	-3.61%
2016	1.15	1,303	1,163	1,200	-3.17%
2017	1.11	1,350	1,157	1,108	4.25%
2018	1.07	1,400	1,150	1,059	7.93%
2018	1.04	1,441	1,132	1,098	3.04%
2020	1.00	1,499	1,124	1,078	4.04%

5.2 Financial Schedule

The overall budget requirement is 1.69 million USD, with measures related to electricity having the biggest share of 66% as shown in Figure 21, followed by transportation with 28%.

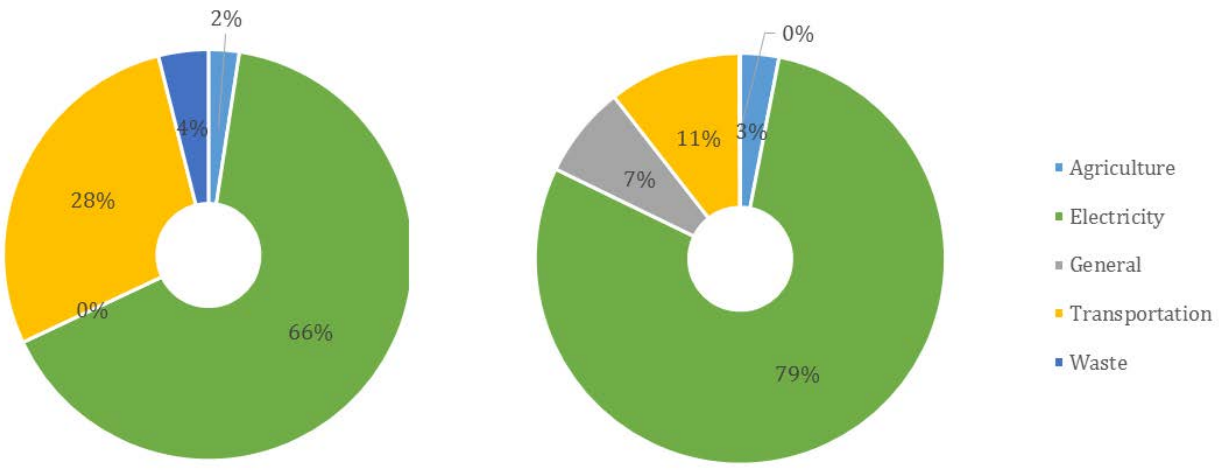


Figure 21: Category shares of overall investment budget (left) and GHG emission reduction (right)

When comparing achieved GHG emissions reductions, electricity share drops to 55% while carbon stock share increases to 25%, this relates to the smaller investment rate for carbon stock solutions when benchmarking against GHG emissions reduced.

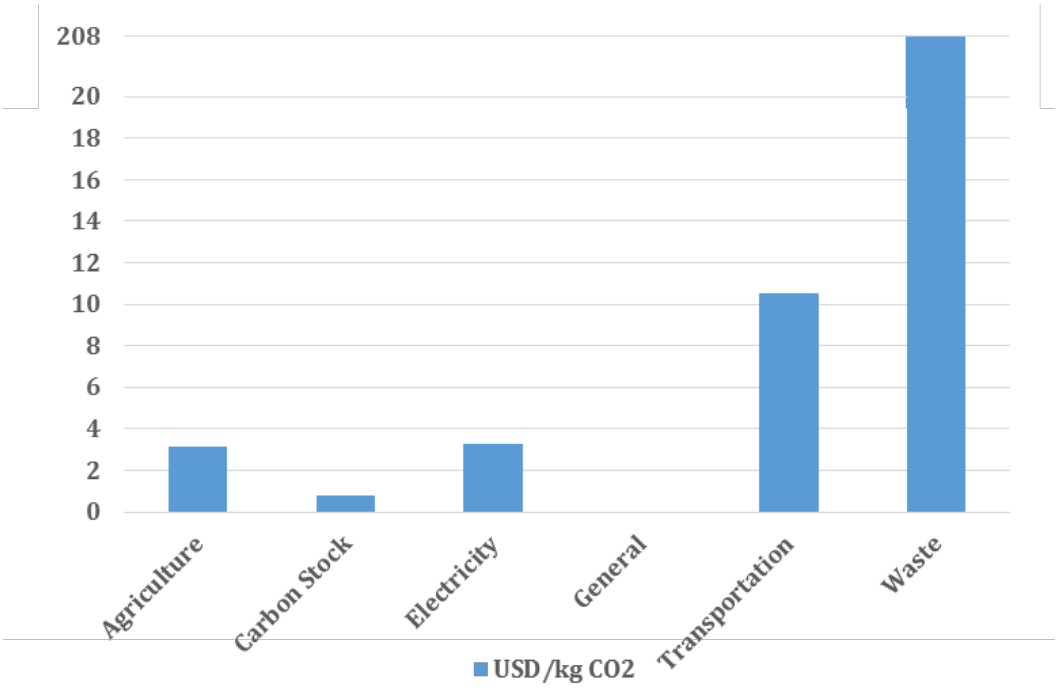


Figure 22: Benchmarks of investment in USD per kg CO_2-eq avoided

Each of the solutions proposed has its own budget requirements, with obvious variations noticeable. The implementation schedule of these solutions defines the annual expenditure profile as shown in Figure 24.

Figure 23 shows the investment budget for each of the proposed solutions, starting at few thousand dollars and exceeding 300,000 USD for some solutions, especially electricity related and car fuel saving methods and options.

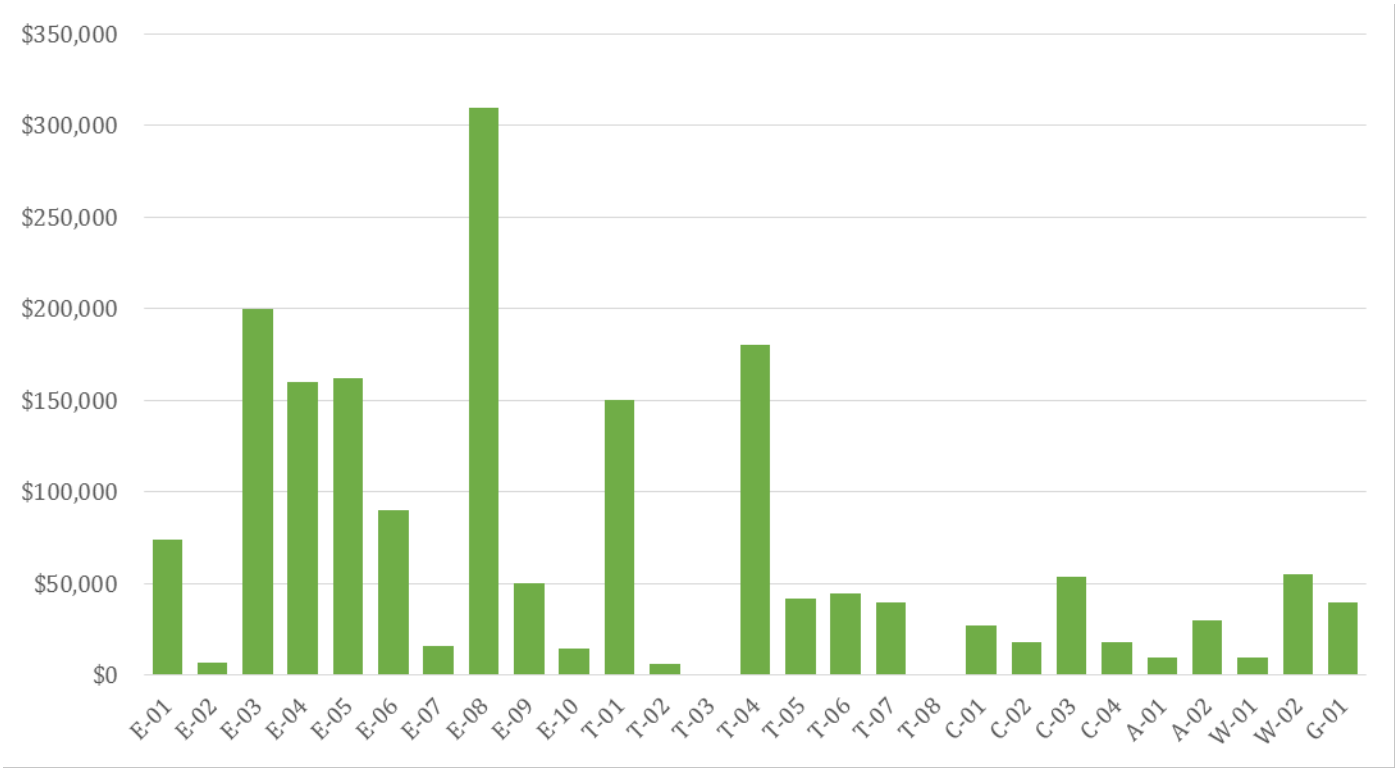


Figure 23: Investment value for the different proposed sustainability measures

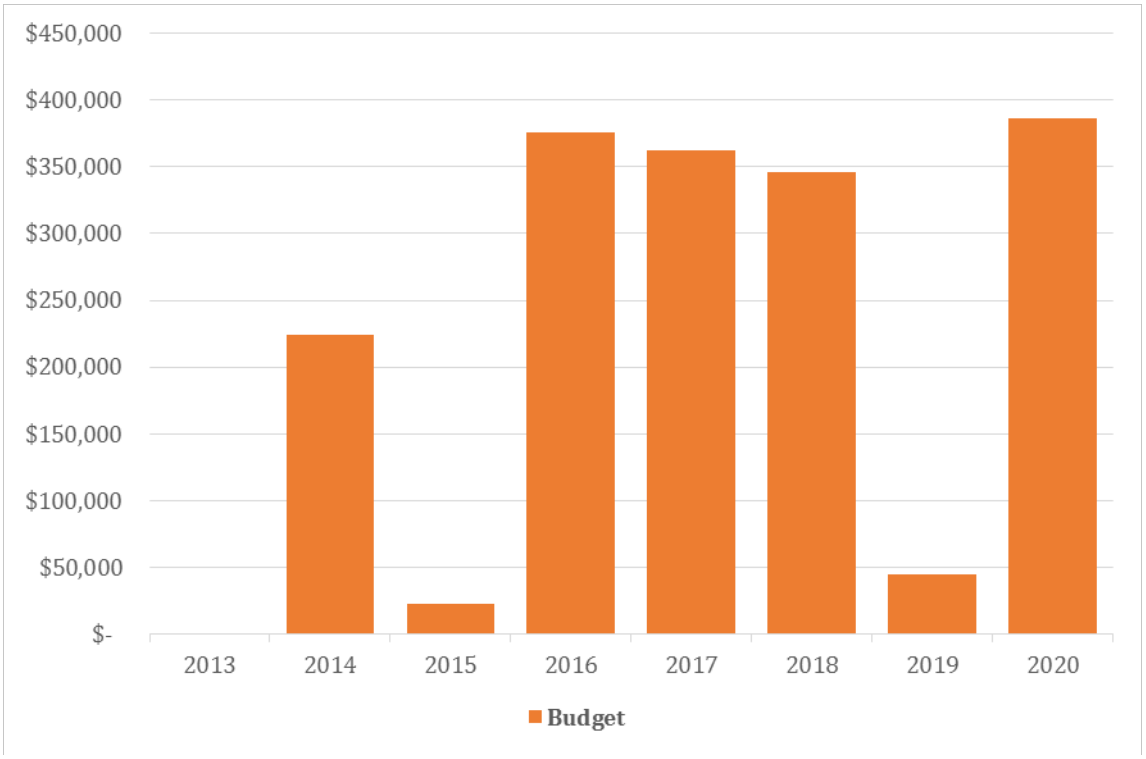


Figure 24: Proposed financial schedule over the period 2013-2020

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Appendices

Appendix I: Stakeholders Consultation Minutes of Meetings

SEAP - Menjez

Results Discussion with Mayor of Menjez

Thursday, September 17, 2015 17:00pm | City Mall, Beirut

Minute Taker	NHS
Attendees	Nader Hajj Shehadeh (NHS), George Youssef (GY)
About this meeting	The meeting is to present the draft SEAP report and discuss the output with the mayor of Menjez The meeting was called for By Nader Hajj Shehadeh (Author of SEAP) and attended by Dr. George Youssef (Mayor of the Municipality of Menjez)

	Type	Note	Owner	Due
1. Presentation of results	**INFO**	NHS presented the major output of the SEAP and discussed with GY the expected results and the final target to be achieved.	NHS	
2. Target	**DECISION**	The GHG emission reduction target was agreed to be 29% by 2020	GY	
3. Future work	**INFO**	GY and NHS discussed the future work that could be undertaken after the approval of the SEAP. This includes applying for funding opportunities and seeking support from different donors.	GY	

SEAP - Menjez

Kick-off Meeting with Mayor of Menjez

Friday, July 17, 2015 12:00pm | City Mall, Beirut

Minute Taker	NHS
Attendees	Nader Hajj Shehadeh (NHS), George Youssef (GY)
About this meeting	The meeting is held to kick off the assignment to prepare the Sustainable Energy Action Plan for the Municipality of Menjez. The meeting was called for By Nader Hajj Shehadeh (Author of SEAP) and attended by Dr. George Youssef (Mayor of the Municipality of Menjez)

	Type	Note	Owner	Due
1. Introduction	**INFO**	NHS introduced the SEAP and presented the preliminary action plan prepared to be discussed with GY. The discussion led to the update of the action plan and set a detailed follow-up approach	NHS	
2. Stakeholders	**INFO**	NHS asked to list the main stakeholders to be involved in this project. GY proposed a list that includes: Joseph Mourad, Agricultural Cooperative of Menjez Hanna Karam, Local farmer Sr. Beatris, Francis of Assisi Church Simon Slaiman, Civil Defense Center Youssef Haddad, Backup generator owners and operators Victor Elias, Groupe Missionnaire St Francois Tanious Karam, Main Figure: Former President of the Cooperative Tony Antonios, Main Figure: Mokhtar Medhat Zainon, Main Figure: University Professor	GY	
3. Meetings with Stakeholders	**TODO**	GY to arrange meetings with identified stakeholders in order to collect data and consult them about the SEAP action and goals.	GY	2015-07-28
4. Identification of the basic needs	**INFO**	NHS starts by a set of questions to identify the basic needs of the municipality and the sectors to focus on. GY highlights the importance of the agricultural sector as the major economic activity in the village. He also brings up the topic of electricity supply.	GY	
5. List of potential measures	**TODO**	GY asked NHS to prepare a list of all potential measures that could be included in the SEAP. The list will provide guidance to GY and give an idea at the potential output of the SEAP.	NHS	2015-07-25
6. General meeting day	**TODO**	NHS asked GY to identify a specific date on which NHS visits the village and have open meetings with the villagers, stakeholders, and inhabitants of the village	GY	2015-07-28
7. Previous Project	**TODO**	NHS asked for a list of previously implemented projects and activities within the municipality of Menjez.	GY	2015-07-30

SEAP - Menjez

Meeting Mayor of Menjez

Friday, July 31, 2015 17:00pm | City Mall, Beirut

Minute Taker	NHS
Attendees	Nader Hajj Shehadeh (NHS), George Youssef (GY)
About this meeting	The meeting is to collect major data about the municipality The meeting was called for By Nader Hajj Shehadeh (Author of SEAP) and attended by Dr. George Youssef (Mayor of the Municipality of Menjez)

	Type	Note	Owner	Due
1. Identification of the basic needs	**DONE**	GY arranged meetings with identified stakeholders in order to collect data and consult them about the SEAP action and goals.	GY	
2. List of potential measures	**DONE**	NHS provided a list of all potential measures that could be included in the SEAP.	GY	
3. General meeting day	**DECISION**	GY and NHS agreed on a specific date on which NHS visits the village and have open meetings with the villagers, stakeholders, and inhabitants of the village. The date is August 8, 2015.	GY	
4. Previous Project	**DONE**	GY provided a list of previously implemented projects and activities within the municipality of Menjez.	GY	
5. General information	**TODO**	NHS asked for detailed data about several sectors including electricity, agriculture, industry, and many others. in addition to demographic data and necessary information for the development of the SEAP.	GY	2015-08-05
6. Discussion of Measures	**IDEA**	With a list of potential measures provided, a discussion about these measures took place. Several ideas were brought up such as district water heating, waste water treatment, COOP organizational upgrade, and many other potential solutions.		

SEAP - Menjez

Meeting with Groupe Missionnaire St Francois

Thursday, July 30, 2015 18:00pm | City Mall, Beirut

Minute Taker	NHS
Attendees	Nader Hajj Shehadeh (NHS), George Youssef (GY), Victor Elias (VE)
About this meeting	The meeting is to present the draft SEAP report and discuss the output with the mayor of Menjez The meeting was called for By Nader Hajj Shehadeh (Author of SEAP) and attended by Dr. George Youssef (Mayor of the Municipality of Menjez) and Victor Elias (President of Groupe Missionnaire St Francois in Menjez)

	Type	Note	Owner	Due
1. Introduction	**INFO**	NHS introduced the SEAP and the concept behind it. The benefits that it would bring to Menjez were presented.	NHS	
2. Needs	**INFO**	NHS opened the floor to VE to hear about the needs of the group as well as the village. The aim of this was explained by NHS, which is to get the youth involved and bring the best benefits to the community of Menjez. VE was clear about the importance of environmental protection measures and the actions that should be focusing on youth involvement. VE focused on several measures including forestation and green spaces. VE also recommended measures related to renewable energy and clean energy supply.	NHS	
3. Role of Groupe Missionnaire St. Francois	**INFO**	VE, on behalf of Groupe Missionnaire St Francois, expressed the commitment to offer support and help in the implementation of SEAP.		

SEAP - Menjez

Meeting with Major Stakeholders

Saturday, August 08, 2015 11:00am | Menjez

Minute Taker	NHS
Attendees	Nader Hajj Shehadeh (NHS), George Youssef (GY), Joseph Mourad (JM), Hanna Karam (HK), Simon Slaiman (SS), Tanious Karam (TK), Tony Antonios (TA), Sr Beatris (Sr Beatris)
About this meeting	The meeting is to present the draft SEAP report and discuss the output with the mayor of Menjez The meeting was called for By Nader Hajj Shehadeh (Author of SEAP) and attended by: Dr. George Youssef (Mayor of the Municipality of Menjez) Joseph Mourad (Agricultural Cooperative of Menjez) Hanna Karam (Local farmer) Simon Slaiman (Civil Defense Center) Youssef Haddad (Backup generator owners and operators) Tanious Karam (Main Figure: Former President of the Cooperative) Tony Antonios (Main Figure: Mokhtar) Sr. Beatris (Francis of Assisi Church)

	Type	Note	Owner	Due
1. Introduction	**INFO**	NHS introduced the SEAP and the concept behind it. The benefits that it would bring to Menjez were presented.	NHS	
2. Needs	**INFO**	NHS opened the floor to attendee to hear about the needs of the villlage. The aim of this was explained by NHS, which is to get the community involved and bring the best benefits to the people of Menjez.	NHS	
3. Agricultural Cooperative of Menjez	**INFO**	JM presented the needs of the Cooperative and the role it plays in promoting agricultural development in the village. He highlighted the need for upgraded and more efficient equipment, and also presented the importance of enhancing the agricultural sector in the village.	JM	
4. Local farmer	**INFO**	HK emphasized on what JM mentioned. The role of the cooperative is very important to farmers. Better equipment is essential.	HK	
5. Civil Defense Center	**INFO**	SS is the head of the civil defense center in Menjez. They suffer from high fuel consumption for space heating as well as vehicles transportation. He explained the threats of fire and how uncontrollable they turn. The forests are being lost, and the center needs additional support to protect them.	SS	
6. Backup generator owners and operators	**INFO**	YH operates one of the two back up generators in the village. He understands the importance of the power supply at the village especially when suffering from more than 10 hours of blackout a day. YH provided data about the generator grid network and the high fuel consumption of the generator he owns and operates. He explained that he studied other renewable energy options but was faced by the high investment and the unavailability of technical knowledge. In his opinion, going solar is a very attractive option that should be studied and utilized in different aspects in the village of Menjez.	YH	

7. Former President of the Cooperative	**INFO**	TK is a former president of the agricultural cooperative of the village of Menjez. He proposed focusing on the different aspects not just on residential buildings. TK believes that different buildings and sectors shall be tackled equally to ensure a coherent implementation of the development initiative.	TK

SEAP - Menjez

Results Discussion with Mayor of Menjez

Thursday, September 17, 2015 17:00pm | City Mall, Beirut

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SEAP - Menjez

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SEAP - Menjez

Meeting with Groupe Missionnaire St Francois

Thursday, July 30, 2015 18:00pm | City Mall, Beirut

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Attendees	Nader Hajj Shehadeh (NHS), George Youssef (GY), Victor Elias (VE)
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	Type	Note	Owner	Due
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SEAP - Menjez

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SEAP - Menjez

Kick-off Meeting with Mayor of Menjez

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7. Previous Project	**TODO**	NHS asked for a list of previously implemented projects and activities within the municipality of Menjez.	GY	2015-07-30