SUSTAINABLE ENERGY ACTION PLAN

ACHKOUT LEBANON

Project funded by the EUROPEAN UNION

ENPI CBCMED
CROSS-BORDER COOPERATION IN THE MEDITERRANEAN

SHAAMS
STRATEGIC HUBS FOR THE ANALYSIS AND ACCELERATION OF THE MEDITERRANEAN SOLAR SECTOR

غرفة التجارة والصناعة والزراعة
Chamber of Commerce Industry and Agriculture
of Beirut and Mount-Lebanon في بيروت وجبل لبنان

GEORGES B. TABET

Sustainable Energy Action Plan

For Municipality Of

Achkout Lebanon

Prepared by

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DISCLAIMER

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Contents

LIST OF SYMBOLS

BEI	Baseline Emissions Inventory
BDG	Backup Diesel Generators
CAS	Central Administration for Statistics
CCU	Climate Change Unit
CEDRO	Country Energy Efficiency and Renewable Energy Demonstration Project for the Recovery of Lebanon
CES-MED	Cleaner Energy Saving Mediterranean Cities project
CoM	Covenant of Mayors
EDL	Electricité Du Liban
GHG	Green House Gas
LCEC	Lebanese Centre for Energy Conservation
LCPS	Lebanese Centre for Policy Studies
MoE	Ministry of Environment
MoEW	Ministry of Energy and Water
MoIM	Ministry of Interior and Municipalities
NCG	National Coordination Group
NEEAP	National Energy Efficiency Action Plan
NEEREA	National Energy Efficiency and Renewable Energy Account
SEAP	Sustainable Energy Action Plan
SWH	Solar Water Heater
UNDP	United Nations Development Program
WB	World Bank
IPCC	Intergovernmental Panel on Climate Change
UNFCCC	United Nations Framework Convention on Climate Change
EU	European Union
ENPI- CBC MED	European Neighbourhood and Partnership Instrument for Cross-Border Cooperation in the Mediterranean
SHAAMS	Strategic hubs for the analytical and acceleration of the Mediterranean solar sector
ENPI	European Neighbourhood and Partnership Instrument
CCIA	Chamber of Commerce Industry and Agriculture of Beirut and mount-Lebanon

1 SECTION 1: SUSTAINABLE ENERGY ACTION PLAN- ACHKOUT

1.1 Introduction

Achkout Sustainable Energy Action Plan aims to reduce the city's dependence on fossil fuels and support its citizens to reduce energy consumption and cost. The city's target towards mitigating GHG emission by 20% by 2020 is an important part of the council's sustainable strategy achieved through greater efficiency in areas such as residential and commercial buildings, street lighting and transportation along with local renewable energy production.

By setting the city's future strategies and policies, the SEAP seeks to develop a number of actions taken forward by the council and in partnership with other organizations and communities in both public and private sectors to create a clean and smart economy, resulting in sustainable living for our families, and the future generations to come.

1.2 Geography

Achkout is one of the biggest and oldest towns of Kesrwen District in Mount Lebanon, occupying 850 Hectares (8.5km^2) with around 10,000 inhabitants distributed among 3000 homes. Located at the heart of Kesrwen, it's around 25Km away from the Capital Beirut and between 800-1200 meters above sea level. It has a border with Feytroun and Bekaatat to the east, Ghosta and Bzommar to the west, Raachin and Dlebta to the north, Ajaltoun and Reyfoun to the south. Achkout is surrounded by mountains from three sides, Kerse el Kattin and Kerse el Moutran and Jabal Feytroun and it overlooks the sea and Beirut from the west side.
10% of its area is occupied for agriculture and crop cultivation. The climate of Achkout is of Mediterranean type with hot summers and cold winters. There are three main sources of water that nourish the town: Shabrouh Dam, Nabeh El Assal, and groundwater reservoirs with an amount of 910,000 m3. It is the home for 10,000 inhabitants.

Achkout is a town drowned in history and culture and known for exporting great men of faith and science. Sitting on seven small hills made it possible for people to come from all over, especially from the North 500 years ago when its founders came to survive. Achkout is a Hebrew term meaning "hard to get or arrive to", certainly because Achkout looks that way, for it is sitting in a curve in the heart of Kesrwen, surrounded by rocky mountains from three sides, and opening its fourth side on the capital Beirut from a deep valley called "The valley of Msaylekh".
The town has three schools, one public and two private schools and one hospital. The municipality of Achkout has worked on various projects for advancing the town and rehabilitating it. Among the main achievements are restoring, refurnishing and providing telecommunication supplies for the municipality building, building of the sidewalks. About 50 homes utilize the photovoltaic system that generates and supplies solar hot water.

1.3 Legal framework

Due to the growing concern over current environmental issues, the Municipality Council of Achkout received financial assistance from SHAAMS project, financed by the ENPI CBC-MED programme, for drafting its SEAP in year 2016.

All those in line with the governmental strategy which ratified the UNFCCC in 1994 and Kyoto Protocol in 2006 with law No.359 and 738 respectively. Followed by NEEAP the Lebanon's National Energy Efficiency Action Plan, which has been approved by the Lebanese Council of Ministers.

1.4 Objectives and Targets

Achkout is committed to reduce its greenhouse emissions by 20% by 2020, and thereby positioning itself as a "pioneer municipality" in renewable energy and energy saving actions in Lebanon. This pledge is to be achieved through the joint collaboration between the GT and the municipality through the SHAAMS program which is financed by the European Union.

Through this process, Achkout is preparing a sustainable Energy action Plan that is based on the analysed data of the baseline emission inventory. The actions across the various areas in the usage of renewable resources and in the residential, commercial and transportation sectors have been quantified in terms of their carbon reduction potential.

The objectives of the SEAP are to:

1. enhance and better coordinate the energy and climate policies
2. make the sustainable energy policy part of all key activities of the local authority
3. Reduce the economic expenditure on energy
4. Reduce the city's CO_2 emission
5. Increase Achkout's share of renewable and sustainable energy systems
6. Invest in public transport to support a strong infrastructure and liveable communities
7. Reduce electric demand through conservation and smart grid technology
8. Encourage a healthier, safer and more liveable environment that supports wellbeing for its citizens

These objectives aim at achieving sustainable actions- in the short and long run- to the current problems arising from climate change.

1.5 Achkout Vision Smart and Sustainable City

By 2020, Achkout will be on the path to transforming its energy use. Achkout city council is providing a framework for the city's actions to reduce energy demand and consumption, and increase renewable energy. This will be achieved through integrated and innovative solutions in partnership with stakeholders and communities.
It is also undertaking a range of short and long term initiatives which will help to maintain Achkout as a smart, sustainable city by 2020 for the sake of its citizens.
This long- term vision shows how Achkout is building the cornerstone that will help reduce the carbon footprint to 20 % which support its objectives:

- Leading in green energy and creating jobs
- Tackling greenhouse emissions in all sectors
- Promoting energy efficiency, and renewable resources
- Investing in road to support a strong infrastructure and liveable communities
- Reducing electric demand through conservation and smart grid technology

2 SECTION II:

2.1 Methodology for the Baseline Emission Inventory BEI

2.1.1 Introduction:

This section describes the methodological principles of data collection, the emission source categories inventoried, the origin of data for the analysis and the calculation methods used.

2.1.2 Method

The method used in BEI calculation will be considered as 'standard' emission factors in line with the Intergovernmental Panel on Climate Change (IPCC) principles and comply with United Nations Framework Convention on Climate Change (UNFCCC) reporting system.

CO_2 emissions from energy consumption within the territory of the local authority will be calculated either directly due to fuel combustion within the local authority or indirectly via fuel combustion associated with electricity and heat/cold usage within the area.
The emissions of CH_4 and N_2O will not be calculated.
CO_2 emissions from the sustainable use of biomass/biofuels, as well as emissions of certified green electricity, will be considered zero.
The standard emission factors will be based on the IPCC 2006 Guidelines (IPCC, 2006).

The base line year is 2013.

2.1.3 Sectors

Municipality
1. Buildings
2. Facilities
3. Equipment

Tertiary
1. Buildings
2. Facilities
3. Equipment

Residential buildings
1. Electrical Consumption
2. Fuel for Heating Consumption

Public Lighting
1. Municipality street lighting

Transport within Municipal area
1. Municipal Fleet
2. Public Fleet
3. Transport Private and Commercial Transport

2.1.4 Procedures

The approach requires a set of procedures:

- Conducting an interview with data resources employees and evaluating the data available
- Collecting and processing of quantitative data
- Establishment of indicators
- Gathering of qualitative information using document review and interviews or holding workshops with municipality

The selection of data sets will be based on criteria that is agreed on with municipality, which is then actively involved in data collection

2.1.5 Resources

1. Municipalities
2. Ministry of Environment
3. Ministry of Public Work and Transportation
4. Ministry of Energy and Water
5. Ministry Of Interior
   a. Transportation
      I. Ministry of Interior Traffic department
6. Electricite Du Liban (EDL)
   a. Collecting the data from Electricité Du Liban (EDL) for the following sectors:
      - Residential building
      - Industry sectors
      - Tertiary sectors
7. Data collection from the following departments in the Municipality & Governorate
   a. Department of Traffic
   b. Department of services water, Electrical & Lighting
   c. Department of Backup Generator
   d. Department of Facility and Building/Financial Division

2.1.6 Methodology Procedure

Identifying the needed data for the baseline emission and selecting the relevant data for the inventory based on the interview conducted with data resources employees, the next step is to assess and validate collected data, check their level of accuracy and reality and sort them out.

Base Year

The base year considered is 2013.

2.1.7 Diesel Generator Fuel Consumptions

2.1.7.1 The Methodology of Calculation the Fuel Consumption for the Backup Diesel Generators

Achkout suffers greatly from power outage which is characterized by daily cut-off counting around 12 hours in daily basis. In order to prevent power losses, BDG use becomes a need to provide power supply especially during the summer.

Since the database for BDG is insufficient and not well-documented, the private sector becomes the main provider for this service, but without getting any official control from the government.

In order to set a rule for calculating the emission part of BDG, the EDL data base will be used as reference, from which the estimated cut-off period will be calculated as KWh.

The fuel consumption will be counted according to the following:

The BDG fuel consumption depend on many factors:

- The capacity of Diesel Generators BDG in KVA
- load ratio to capacity of BDG
- Fuel
- years of operation
- The status of the engine -maintenance

The following link ,explains the effect for the capacity of BDG on fuel consumption with load ratio: www.dieselserviceandsupply.com

BDG	1/4 load	1/2 load	3/4 load	Full load
250 KW	5.7(Gal/Hour)	9.5 (Gal/Hour)	13.6 (Gal/Hour)	18 (Gal/Hour)

For example: for 250kw Generator consumes the following:

In order to evaluate the actual GHG emission, some factors have to be defined and assumed to help in calculating the GHG emission.

By consulting BDG providers and suppliers, the recommended maximum load share is 70% of the BDG capacity for more efficient use and long term of operation.

Assuming that the 75% load ratio, which is 13.6 Gal/hours for load of 187KW,then
One Gal = 3.78541 litres.
So, each one KWh load consumption will consume 0.275 litres, which has been confirmed by the BDG provider.

1 KWh =» 0.275 litre of Diesel

The above figures will be used to convert power generated by the BDG from data available for the fuel consumptions.

Method of calculation the consumption Power provided by BDG

In Achkout, EDL is the only source which is in charge of providing the data necessary for power consumption.
So, the power consumed by BDG is calculated from the combination of data provided by the BDG provider Fuel supplier and that of EDL data base.
Residential Sector also counts in calculating the power consumption by BDG. This can be done by analysing the database of EDL and estimating the consumption power of residence at cut-off time. Then it is tuned to meet the actual consumption according to some inputs from the stakeholders and collected data from some studies conducted before.

The classification of residential building can be obtained from EDL Database through daily average power consumption. It is supported by a model adapted by Ruble and Karaki 2013

For Tertiary sectors, a similar methodology will be considered based on data obtained from the EDL.

The methodology for calculating the BEI for Heating and Cooling power.

The weather in Achkout city is moderate in summer and cold in winter. There is no central cooling/ heating system in the city. Hence, the city's residents tend to heat one room in the flats or houses, while some other houses use central heating system. All commonly employ the fuel diesel oil.
The database for diesel fuel consumptions for heating had been provided through the municipality.

2.1.8 The methodology for calculating the BEI for Public Street Lighting

Due to the shortage of power from EDL in daily base, EDL database will not reflect the actual power consumption in cut-off time, so there is a need to define the way to calculate the ideal power consumptions for the street lights by including the cut-off time power consumptions.

The future actions should indicate both the actual issues and solutions even the assumption regarding the availability of EDL power for 24 hours, as normal situation. Thus, in order to find out the actual consumption for the street lighting, the cut-off time, for Achkout city, along with the ideal street light operation hours according to sunrise and sunset will be defined.

The cut-off program in the city at a rate of 12 hours a day is measured as follows: on the first day from 6:00AM to 10:00AM, and from 10:00 AM till 2:00 PM on the second day and so forth .The cut-off timing interval is 4 hours in day time from 6:00 AM till 6:00PM, and 6 hours from 6:00PM till 6:00AM. As a whole, there will be 12 hours daily cut-off.

Time of operation for street lights

Any action on the street light depends on operation of light photo cells which operates according to the level of lights, and according to sunrise and sunset. For that, the sunrise and sunset data, which can be taken from the following source, will help in defining the timing of operation:
http://www.timeanddate.com/sun/lebanon/zahle?month=2&year=2015

Since the timing is changed in daily base, it is more convenient to have the average time for each month as a base for calculation. Although we know that there are variations due to the type of photo cell and light sensitivity, we will consider it minor in order to have simple and accurate calculation.

The following table summarizes the hours of operation all over the year

MONTH	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
average daily Time calculated from sunset to sunrise	13.63	13.5	12	11.20	10.27	9.8	10.14	11	12	13	13.73	14.2
number of days per each month	31	28	31	30	31	30	31	31	30	31	30	31
Total hours of operation per month	422.53	370	372	336	318	294	314	341	360	403	412	440

Time of operation for Public street lights with cutoff time from EDL

The following table explains the calculated cut-off time in one selected month. The cut-off time is 207 hours out of 422 hours which is about 49% for the month of January.
The month of December will be 50%, and, for the whole year, the cut-off time will be 50%. Thus, we will consider this factor in calculation. The total operation time is 4400 hours a year, and according to above information, the EDL data base will indicate only 50% of actual power consumptions.
So, the actual power consumption for the street light in Achkout will be as follows:

$$EST = (2 \times EEDL)$$

EST Actual power consumptions for street lights in MWh.
EEDL EDL database for power consumptions for street lights in [t/MWh] (0.65

Emission from public street lighting power

ECO_2 = EST x $NEFE$
ECO_2 CO_2-e emissions of Electrical Consumption in Year t CO_2-e
EST Actual power consumptions for street lighting In KWh.
$NEFE$ National Emission Factor for electricity

2.1.8.1 THE METHODOLOGY for calculating the BEI for electrification in the Tertiary sector

The EDL database is used in calculating the power consumption during the EDL operation and is analysed to calculate the power consumption on cut-off time from backup diesel generator. Following this method, the tertiary sector will continue to consume power as long as EDL is available without the reduction in consumption during the cut-off time.

Emission calculation formula

2.1.8.2 Emission from EDL power

The EDL will provide the actual power consumption in one year.
The calculation for GHG emission from power consumptions for the tertiary:

$ECO_2 = ET \times NEFE$

ECO_2	CO_2-e emissions of Electrical Consumption in year tCO_2-e
ET	Actual power consumptions For tertiary in KWh.
NEFE	National Emission Factor for electricity [t/MWh] (0.65)

2.1.8.3 Emission from BDG

The power consumption from BDG will be the same as that of EDL due to the 3 hours daily cut-off time from EDL.
Then we can follow the same formula followed in the Backup Diesel Generator BDG Fuel Consumption & BEI Methodology section:

1 KWh =» 0.275 litre of Diesel.
The above figures will be used to convert power consumption for the BDG for
Fuel = The power consumed from BDG in MWH x 0.275 x 1000
The calculation for GHG emission for *fuel consumption* for BDG can be calculated according to the following formula in accordance with IPCC guidelines:

$EFC = EFf \times Fuel \times NCV \times D \times 10^{-6}$

EFC	CO_2-e emissions for fuel combustion in year tCO_2-e
Fuel	Amount of Fuel of type a (Diesel) in litre consumed in a year
EFf	Emission Factor of Fuel (Diesel) in tCO_2-e/TJ Diesel = 74.1 tCO_2-e/TJ t
NCV	Net Calorific Value of Diesel which is equal to 43.TJ/Gg
D	Density of Diesel equal to 0.8439 Kg/litre
10^{-6}	to convert from Gg to Kg

Values obtained from Table 1.2, table 1.4, chapter 1, Volume 2, IPCC 2006 inventory guidelines

2.1.9 Transportation BEI Methodology

In Achkout, the GHG emission is mostly attributed to the transportation sector.
The consumption data will be taken from those provided by the municipality team.
Traffic count data include the following:

- -Distance in Km.
- -Average consumption litre / Km
- -Percentage of Passenger cars and taxis
- -Percentage of Heavy and light-duty vehicles
- -Percentage of Buses and other vehicles used for public transport services
- -Percentage of Two-wheelers.

The default fuel consumption values which will be used are:

- -10Km/litre for gasoline vehicles
- -5Km/litre for Diesel vehicles

The calculation for GHG emission for fuel combustion for transportation can be calculated according to the following formula in accordance with IPCC guidelines:

$$EFC = EFf \times Fuel \times NCV \times D \times 10^{-6}$$

EFC CO_2-e emissions for fuel combustion in year tCO_2-e

Fuel Amount of Fuel of type a (Gasoline /Diesel) in litre consumed in a year

EFf Emission Factor of Fuel (Gasoline /Diesel) in tCO_2-e/TJ
Gasoline 69.3 tCO_2-e/TJ t
Diesel 74.1 tCO_2-e/TJ t

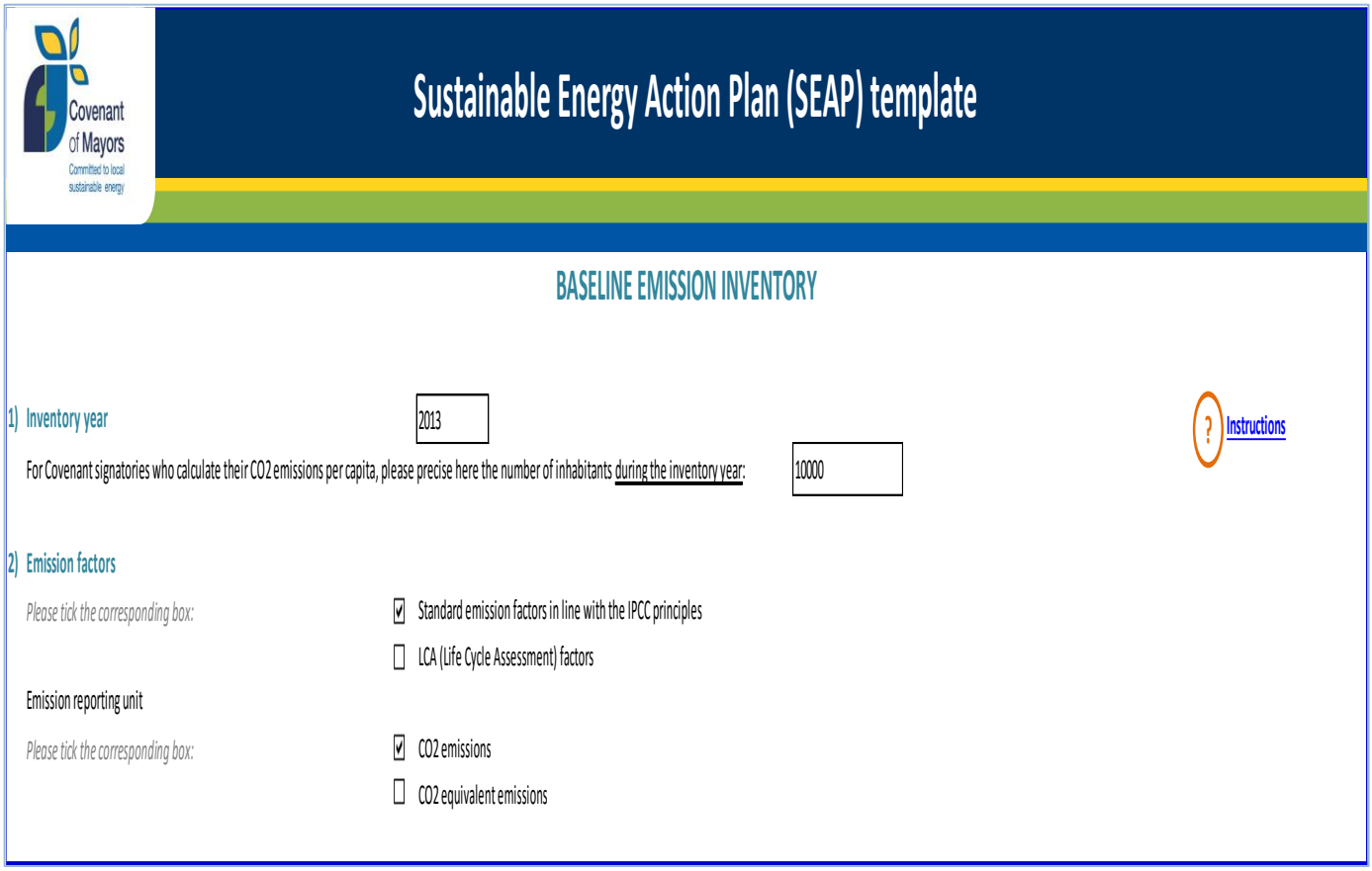
NCV Net Calorific Value of
Gasoline is 44.3TJ/Gg
Diesel is 43.TJ/Gg

D Density of
Gasoline 0.7407 Kg/litre
Diesel 0.8439 Kg/litre

10^{-6} to convert from Gg to Kg

Values obtained from Table 1.2, table 1.4, chapter 1, Volume 2, IPCC 2006 inventory guidelines

2.1.10 BEI TABLE



Covenant of Mayors
Committed to local sustainable energy

Sustainable Energy Action Plan (SEAP) template

BASELINE EMISSION INVENTORY

1) Inventory year: 2013

? Instructions

For Covenant signatories who calculate their CO2 emissions per capita, please precise here the number of inhabitants during the inventory year: 10000

2) Emission factors

Please tick the corresponding box:

- [x] Standard emission factors in line with the IPCC principles
- [ ] LCA (Life Cycle Assessment) factors

Emission reporting unit

Please tick the corresponding box:

- [x] CO2 emissions
- [ ] CO2 equivalent emissions

3) Key results of the Baseline Emission Inventory

Green cells are compulsory fields

Grey fields are non editable

A. Final energy consumption

Please note that for separating decimals dot [.] is used. No thousand separators are allowed.

Category	FINAL ENERGY CONSUMPTION [MWh]															
			Fossil fuels								Renewable energies					
	Electricity	Heat/cold	Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:																
Municipal buildings, equipment/facilities	9					20										29
Tertiary (non municipal) buildings, equipment/facilities	13,858					3576										17434
Residential buildings	6,984					42915										49899
Municipal public lighting	2,144															2144
Industries (excluding industries involved in the EU Emission trading scheme - ETS)	3,676															3676
Subtotal buildings, equipments/facilities and industries	26,671					46511										73182
TRANSPORT:																
Municipal fleet						224	0									224
Public transport						0	0									0
Private and commercial transport						7459	8383									15842
Subtotal transport						7683	8383									16066
Total	**26671**					**54194**	**8383**									**89248**

Municipal purchases of certified green electricity (if any) **[MWh]:**	0
CO2 emission factor for certified green electricity purchases (for LCA approach):	0

B. CO2 or CO2 equivalent emissions

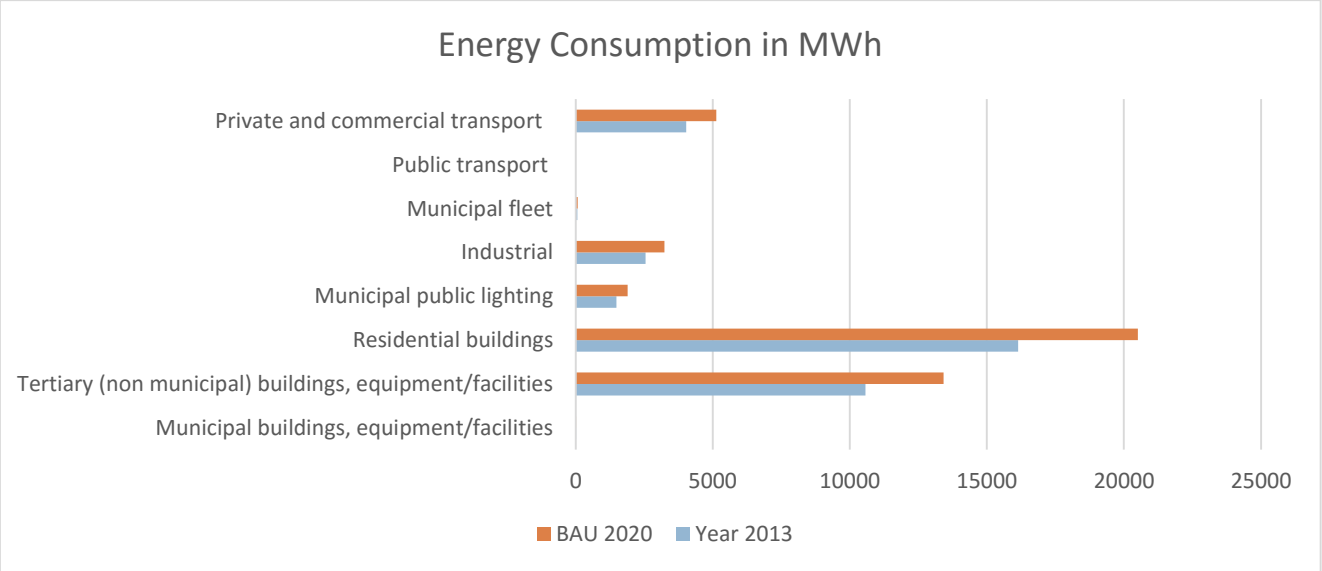
Please note that for separating decimals dot [.] is used. No thousand separators are allowed.

Category	CO2 emissions [t]/ CO2 equivalent emissions [t]															
			Fossil fuels								Renewable energies					
	Electricity	Heat/cold	Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel	Plant oil	Other biomass	Solar thermal	Geothermal	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES:																
Municipal buildings, equipment/facilities	6					5										11
Tertiary (non municipal) buildings, equipement/facilities	9628					941										10569
Residential buildings	4852					11293										16145
Municipal public lighting	1490															1490
Industries (excluding industries involved in the EU Emission trading scheme - ETS)	2554															2554
Subtotal buildings, equipments/facilities and industries	18530					12239										30769
TRANSPORT:																
Municipal fleet						59	0									59
Public transport						0	0									0
Private and commercial transport						1963	2075									4038
Subtotal transport						2022	2075									4097
OTHER:																
Waste management																
Waste water management																
Please specify here your other emissions																
Total	**18530**					**14261**	**2075**									**34866**
Corresponding CO2-emission factors in [t/MWh]	0.695					0.263	0.248									
CO2 emission factor for electricity not produced locally [t/MWh]	0.65															

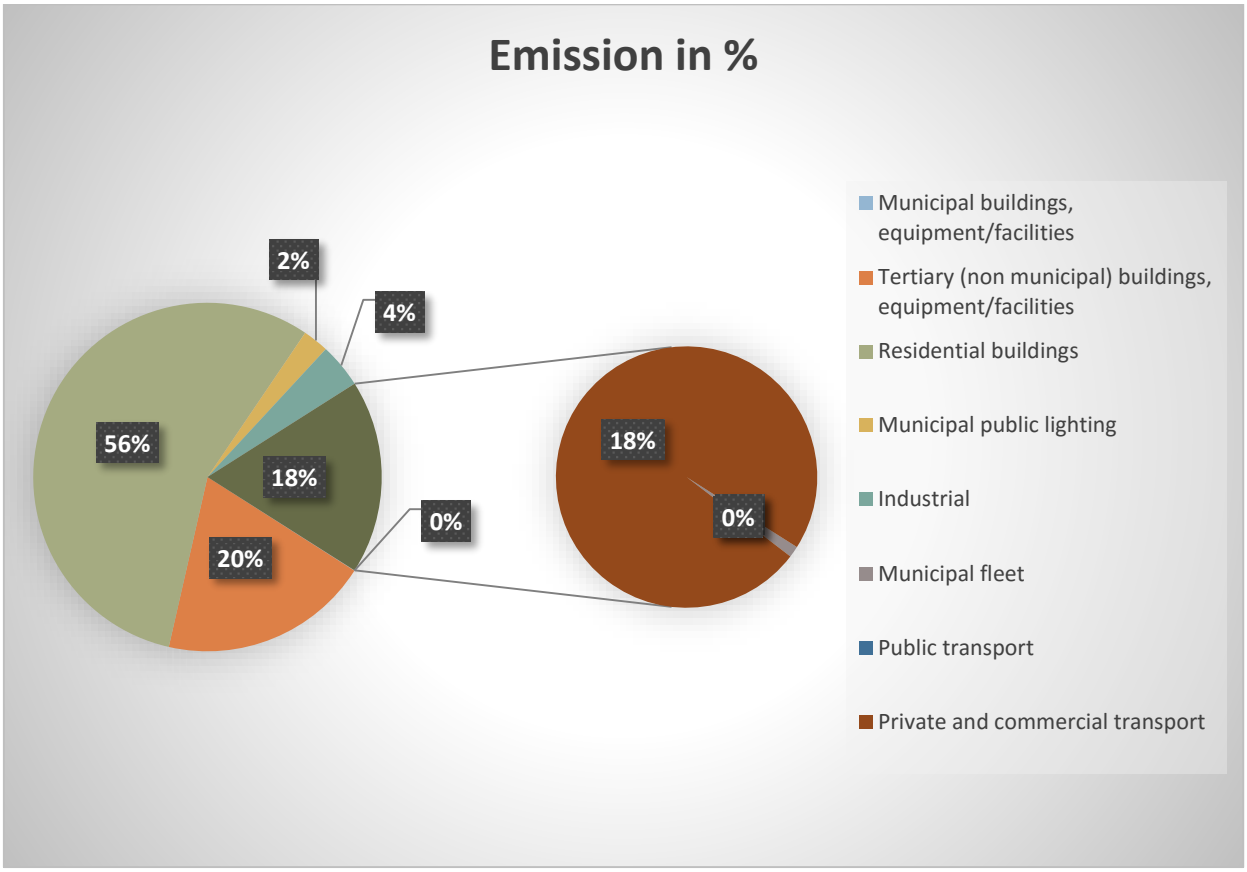
3 SECTION II: SUMMARY OF BASELINE EMISSION INVENTORY WITH BAU SCENARIO

Achkout consumes 89,248 MWh/y as counted in year 2013 which corresponds to 113,341 MWh/year in 2020, according to JRC expectation for Lebanon if no action has been applied. Though this increase is considered, this doesn't reflect the current situation as the number of Syrian refugees is increasing which counts for 25 % of the original population in Achkout.

	Energy Consumption in MWh/year	
BUILDINGS, EQUIPMENT/FACILITIES & TRANSPORTAION	**Base 2013**	**2020 as BAU**
Municipal buildings, equipment/facilities	29	37
Tertiary (non municipal) buildings, equipment/facilities	17,434	22141
Residential buildings	49,899	63371
Municipal public lighting	2,144	2723
Industrial	3,676	4668
Municipal fleet	224	284
Public transport	0	0
Private and commercial transport	15,842	20119
Total	89,248	113,343



BUILDINGS, EQUIPMENT/FACILITIES & TRANSPORTAION	Emissions in t CO_2 Base 2013	2020 as BAU
Municipal buildings, equipment/facilities	11	14
Tertiary (non municipal) buildings, equipment/facilities	10,569	13422
Residential buildings	16,145	20504
Municipal public lighting	1490	1892
Industrial	2554	3243
Municipal fleet	59	74
Public transport	0	0
Private and commercial transport	4,038	5128
Total	**34,866**	**44,277**



4 SECTION III: PLANNED ACTIONS AND MEASURES FOR THE FULL DURATION OF THE PLAN (2020)

4.1 Municipal building

4.1.1 OVERVIEW

The municipality of Achkout manages an area of around 8.5 Km². The energy consumption for the municipality building and its facilities reached 29 MWh/y in 2013 which was consumed by the municipality building itself.

Although the municipality council is the partner in implementing the sustainable energy action plan, which represents the pilot project for the municipality and stakeholders, it cannot deliver the action plan on its own. SEAP should be developed in close cooperation between the local authorities and stakeholder groups to achieve its targets. This would allow them to expertise the changes in consumption and giving positive feedback on the attitude of the staff and visitors. It would also show how the staff capacity is increased and involved in practical implementations.

The following actions should be taken for granted so that the municipality could achieve sustainability:

-Using high efficient light. The municipality building had conventional lighting, and still hasn't identified high efficient light in its design study. This issue rises up the importance of using lamps replacement with high efficient ones when lamps reach an end-of-life.

-Utilising lighting control system. The new building had no lighting control for occupancy in offices or in corridors. If lighting control is implemented, this could save a lot of power when offices are empty. It could also help in reducing the power consumptions, mitigating the emissions and reducing the unseen cost.

-Raising staff awareness. This aims to encourage energy conscious behaviour in a way that is simple and sustained so that good practice becomes a habit. The staff should be aware not to keep the PC and monitors on when they are out of office and turn off A/C or other electrical equipment or appliances.

-Identifying the set temperature for air-conditioning cooling and heating will help in reducing the power consumptions.

-Updating the procurements policy and procedures to include the sustainability conditions and rating for efficiency for the new purchase of equipment. This is essential in maintaining SEAP implementation plan.

-Installing Power Analyser in the building. It will help in identifying the power consumptions and support the municipality in its plan for monitoring consumptions and identifying the required steps in the plan to mitigate the consumptions and minimize billing costs.

4.1.2 SHORT TERM ACTION

The municipality has to involve local stakeholders and show them how certain implementations for sustainable energy action plan in their facilities are performed. In the process of saving energy, the following short term actions are proposed:

- Implement Energy Saving Instruction for employees to fulfil the reduction and unseen consumption as follows:

- Switch off the light while leaving the office.
- Fix the Air-condition thermostat on 22°C to24°C in winter/ summer.
- Utilize as possible day lights through windows and reduce using artificial lights as possible.
- Set the PC monitor on sleep mode for maximum 2 minutes of ideal condition.
- Switch off PC, UPS and printer when leaving the work.
- Minimize the usage of printing as possible.

❖ Conduct Awareness and Training Campaign for the municipality staff. This should include the representative of NGOs of the local community in order to increase the municipality capacity in the implementation of sustainable energy action plan.

Many solutions can be simple and there is a great potential to reduce power consumption and minimize total costs by using technologies and raising staff awareness through the training campaigns held.

4.1.3 LONG TERM ACTION

In the short term phase, the municipality would have the Energy Saving Instruction completed. Also the municipality employees will notice the development of the approach being implemented as an essential transition to a low carbon economy.

With long term actions, the municipality will continue implementing actions set in the first phase and will support it with additional actions to achieve the final target-the reduction of power consumptions.

❖ Use LED lamps. The municipality building contains lamps with energy saving one and CFL Fluorescent with lumen output equal to 60 to 70 lumen /watt. By replacing those lamps with LED lamps, this could increase the efficiency to 100-144 lumen per watt and reduce the power consumptions. 50% in power reduction for the lighting will be achieved.

❖ Install motion lighting sensors. This will also support the mitigation of energy, as it will help in insuring the lights are off when no one is using the place.

❖ Air-conditions units consume high energy especially the non-saving model one. The new technologies of power saving A/C would save 30% less than the ordinary types; the replacement of the A/C with Rated A+++ would be a good solution to be implemented by the end of the life cycle of the existing units.

As a result, energy saving implementation can be achieved by converting lamps, A/C, and the installation of motion sensors.

1. Start replacing the Fluorescent and FLC lamps with LED lamps when needed to be replaced
2. Replace the Air Condition with A+++ Inverter type when new air condition is needed to be replaced
3. Install lighting motion sensors in building

4.1.4 PUBLIC PROCUREMENTS OF PRODUCTS AND SERVICES

The Sustainable Procurement Policy embedded in the municipality process is intended to be an efficient public policy that saves natural and financial resources and promotes sustainable patterns of consumption and production. By identifying the reliable and efficient energy saving products through purchasing, setting an example and choosing more sustainable options, the municipality can positively reach effective environmental and social outcomes.
Such green procurement would also be promoted in local schools and other local municipality or governor offices as much as possible.

4.1.5 EXPECTED REDUCTION IN CONSUMPTIONS FOR SHORT & LONG TERM ACTIONS

SECTORS & fields of action	KEY actions/measures	BAU Scenario		Mitigation in Energy		Mitigation in %		Costing
		MWh/a	t CO_2 /a	MWh/a	t CO_2 /a			
MUNICIPAL BUILDING		**37**	**14**	**4**	**3**	**0.007%**	**€**	**38,000**
Short Term Action	ENERGY SAVING INSTRUCTION			1	0.666	0.002%	€	5,000
	AWARENESS AND TRAINING CAMPAIGN			0.05	0.0333	0.000%	€	5,000
Long Term Action	REPLACING THE FCL LAMPS WITH LED LAMPS			1	0.666	0.002%	€	10,000
	REPLACE THE AIR CONDITION WITH A+++ INVERTER TYPE WHEN NEW AIR CONDITION BY END OF LIFE (10 YEARS			1	0.666	0.002%	€	10,000
	INSTALL LIGHTING MOTION SENSORS IN BUILDING			1	0.666	0.002%	€	3,000
	PUBLIC PROCUREMENTS OF PRODUCTS AND SERVICES			0.05	0.0333	0.000%	€	5,000

4.1.6 FINANCIAL ANALYSE AND PROPOSAL SOLUTION

Local or Outsource Finance	Private (or own) funds	Bank Loan	Interest rate	Amortization period in years
80%	0%	20%	4.50%	10
Fixed Financial amortization costs			Total loan repayment due:	Loan (principal) capital:
Loan repayment (annualized)	€ 960	/year	€ 9,595	€ 7,593
Annual revenues in €	Reduction in consumptions in MWh/a	Payback time in year	NPV(20 years) in €	PPA Tariff
481	4	20 YEARS	4,182	€ 0.12/Kwh

Time schedule for implementation of the Short and long term action					
YEAR	2016	2017	2018	2019	2020
Short Term Actions	X	X	X	X	X
Long Term Actions			X	X	X

4.2 Public Street Lighting

4.2.1 OVERVIEW

The city has 2300 street lights and would be an essential part to establish the smart monitoring and management system for it.

The mitigation for GHG emission in public street lighting becomes essential with the increase in power demand, thus replacing existing street lights with more energy efficient systems is a practical way of achieving carbon savings and lowering maintenance costs.

4.2.1.1 LIGHT SOURCE

In Achkout, like any other city in Lebanon, roadways and various public spaces have been illuminated for decades by conventional means which are the High Pressure Sodium (HPS) lamps. The total number of street lights reached two thousand three hundred street light luminaries with most of the lamps rated for 400/250 watt.

As of now, new LED Street lights technology has been developed to enhance illumination along city streets. This could provide savings through increased energy efficiency, decreased maintenance needs with longer-rated lifetimes. The potential cost savings in energy consumption could be as high as 40% or more.

Because LED street lights are capable of producing a better quality white light with less energy consumption than HPS, the perception of more powerful light could be improved, while reducing the power of the light that is actually emitted.

The successful application of LED lights in Achkout and other regions across Lebanon has shown an improvement in their facilities. Respondents generally felt that the facility was cleaner, had better access and mobility, and was generally a safer place to park than it was prior to installation of LED lights.

LEDs are rapidly gaining recognition and acceptance as an alternative means of street lighting primarily for their low power consumption, low maintenance and excellent light quality.

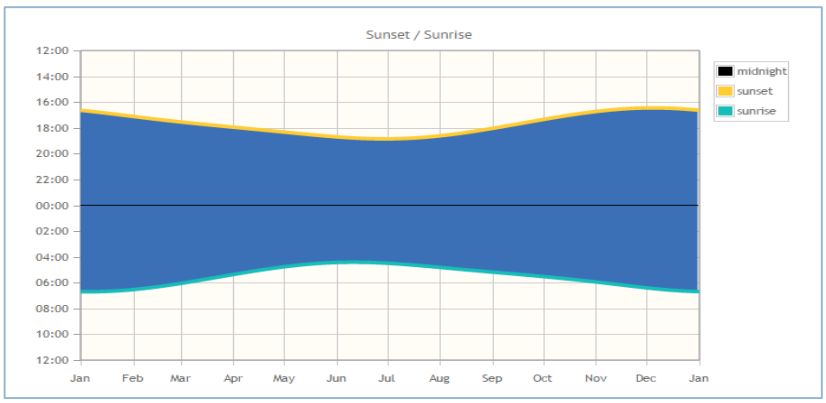
Most demonstration pilot programs using LED street lights record a 40% to 60% reduction in energy consumption. The efficacy of LEDs is approaching that of HPS lamps; some products reaching 100 lumens per watt. Therefore, a comparable lighting output can be achieved through LED lamps, but with approximately half the power consumption. The estimated life for these products can range from 12-15 years compared with HPS lamps which are 3 to 5 years.

The environmental benefits of LED are not limited to a reduced greenhouse gas emission as a result of lower energy consumption. LED lights are also recyclable and do not contain any heavy metals such as mercury or lead and no toxic gasses that can be found in HPS lamps. This reduces maintenance through less frequent bulb replacement. LED fixtures also do not use tungsten filaments and are, therefore, more rugged than their HPS counterparts.

4.2.1.2 ASTRONOMIC TIMER

The other part which could also be considered is the switch timing for the street lights that relays on photocell. This can be replaced with **Astronomic timer** which is more accurate and precise timer compared with photocell.

This step will reduce the consumption power by 15% as explained in following chart which shows the sunrise and sunset timing where the photocell acts little before/after timing and counts for loss of around 365 hours of operation per year.



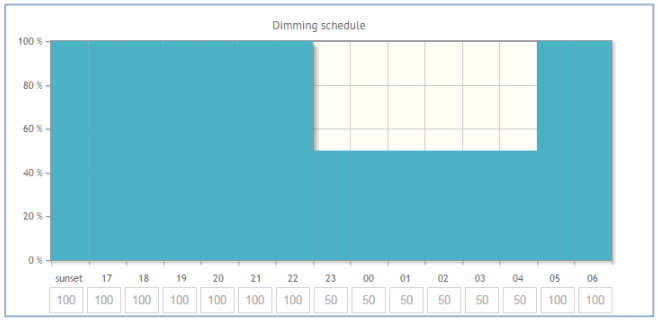
Astronomic timer use would also help in precise timing for switching and programming the actual operation after 20 min of sun set and almost 30 min before sun rise which is an acceptable trimming as light will be still there.

In Achkout there are thirty feeder pillars which control the 2300 street lights through photocells. Replacing photocells by Astronomic timer would support the mitigation in power consumptions.

4.2.1.3 DIMMING AND CONTROL

The dimming and street lightning control can be employed for HPS lamps with the introduction of new technologies. This step will not be encouraging; as nowadays the LED, as efficient lamps, is available with dimming features. To demonstrate the effects in power reduction, the action will be divided into **two scenarios:**

The first scenario is to set a standalone control gear for the street light which has internal timer. It can dim the lights for 6 hours daily to 50% at midnight as shown in the chart below.

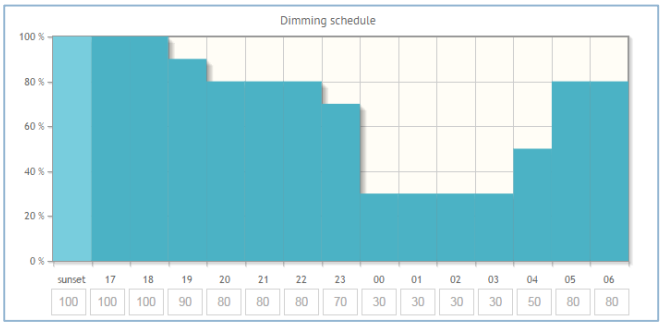


Although it could produce saving in power for around 25% reduction in power consumptions, the internal timer in the control gear of luminary will be affected by the power instruction, which is the main feature of Lebanon's network till we wrote our report.

The **second scenario** is to have a central control and monitoring system for the street lighting. This step will overcome the previous issue in scenario one and will be functioning and operating after

the power is back to normal. Also this scenario will set the platform for smart city and increase the range of operation from 10 -12 years to 15 to 20 years.

This solution is best suited as it can reprogram the dimming in different scenarios with different areas, the case that fits Achkout.



4.2.1.4 THE MAIN CHALLENGES

A set of challenges can be highlighted from poor maintenance and network quality to the lack of monitoring process. The following points summarise those challenges and propose the needed actions for them.

- Administrative challenges
  - Infrastructure of the city does not have any master plan for the street lighting. There is also no street lighting standard and policy available.
  - There is no unit responsible for street lighting in the municipality which monitors the work and reports the issues with the maintenance team.
- Technical challenges
  - The identification number on the lighting column is not available. This causes serious issues in the credibility of the maintenance costing and the efficiency of maintenance or technical support.
  - The feeder pillars have faulty metering that affect the monitoring process needed for future evaluation.
  - The main feeder doesn't have power analyser to detect the leakage in power. This may happen due to week tightening of wiring, vandalism or line theft.
  - The protection against Earth Leakage and surge protection is not available which affects much the service.

4.2.2 SHORT TERM ACTION

The short term action suggests producing a master plan with precise strategies and policies which help monitor the achievements through establishing the basic measures of consumption and the monitoring process.

The actions include:

1. Establishing street lighting unit to support the implementation of the SEAP for street lighting sector.
2. Preparing the master street lighting drawing where each pole should have identification number with full data like power and type, and to assign number for each pole in the site as to the master drawing.
3. Identifying each feeder pillar by a number and installing new KWh meters to calculate the total load connected on each feeder. Each month the data collected for the load consumption should be taken for each feeder and be verified with actual connected load.

4. Preparing the maintenance check form which includes the maintenance process, identification number for the street lighting, and type of issues and action made for fixing it along with detail spare parts used in maintenance with time consumed and costing.
5. By using the master plan drawing, the public lighting unit will define the main roads, the sub main roads and branches and assign each area with the recommended power for street lights.
6. Conducting a technical training for the maintenance staff to insure compliant with the technical and efficiency of work.
7. Monitoring process: Add additional page for the municipality web site to include the citizen feedback on or complain for any defective street lights as tool for monitoring the maintenance staff.

There will be real reduction in consumption for this action as line theft will be prevented and the maintenance efficacy will be improved which is estimated between 10 to 15 % reduction in consumptions, but as mentioned it will be justified when real measures are taken.

4.2.3 LONG TERM ACTION

In the long term action, a pilot project is to be implemented in order to set the platform for a smart city. Despite the city's specific area, the general plan will be fulfilled when fund total is available.

1. Install new Smart Feeder pillars with full protection and measurement tools required equipment which contain:
    - Outdoor enclosure with security lock
    - Astronomical timer
    - Power analyser/metering
    - Control components
    - Protection devices short circuits, over current , Earth faults, Surge protection
    - Wireless communication with main station
2. Install new LED lighting according to the master plan with dimmable drivers. The LED light should be selected according to international standard to comply with safety regulation for the street lighting and meet the location and site needs. Also the street lighting should have enough space for controller which will be added in the future inside the street light near to the street light driver.
3. Install remote monitoring and control for the system which consist of:
    - Electronic ballast controller designed for carrying out the remote management of a luminary in street lighting installations inside the street lighting with impeded power line controller.
    - Control component inside the feeder pillar to communicate with street lighting and the main station in the municipality.
    - Main station in the municipality with remote software and monitoring and control tools
    - Proper training on the system.

The preferable step in the installation will be to complete one phase of work with around 230 street lighting or (20%) along with their feeder pillars and main control in the municipality building. The total project is estimated for around twelve years to be fulfilled.

4.2.4 EXPECTED REDUCTION IN CONSUMPTION

It is expected that short term action with part of the long term action will be completed before 2020. The long term action will continue after that till year 2030 when a complete converting of the street lighting to smart system is accomplished. Unless the financing mechanism was solved, implementation period could be minimized accordingly.

SECTORS & fields of action	KEY actions/measures	BAU Scenario		Mitigation in Energy		Costing	
		MWh/a	t CO_2 /a	MWh/a	t CO_2 /a		
PUBLIC STREET LIGHTING		**2,723**	**1,770**	**1,597**	**1,038**	**€**	**4,222,200**
Short Term Action	PUBLIC STREET LIGHTING UNIT					€	30,000
	MASTER STREET LIGHTING DRWAING ASSIGN NUMBER FOR EACH POLE					€	20,000
	IDENTIFY EACH FEEDER PILLAR BY NUMBER AND INSTALL NEW KWH METERS					€	10,000
	PREPARE THE MAINTENANCE CHECK FORM			272	177	€	1,000
	DEFINE THE MAIN ROADS AND SUB MAIN ROADS AND BRANCHES					€	1,000
	TECHNICAL TRAINING FOR THE MAINTENANCE STAFF					€	3,000
	MONITORING PROCESS					€	2,000
Long Term Action	INSTALL NEW LED LIGHTING			1,029	669	€	1,752,600
	INSTALL NEW SMART FEEDER PILLARS			141	91	€	650,000
	INSTALL REMOTE MONITORING AND CONTROL			155	101	€	1,752,600

4.2.5 FINANCIAL ANALYSE AND PROPOSAL SOLUTION

Local or Outsource Finance	Private (or own) funds	Bank Loan	Interest rate	Amortization period in years
80%	0%	20%	4.50%	10
Fixed Financial amortization costs			Total loan repayment due:	Loan (principal) capital:
Loan repayment (annualized)	€ 123,144 /year		€ 1,231,435	€ 974,400

Annual revenues in €	Reduction in consumptions in MWh/a	Payback time in year	NPV(20 years) in €	PPA Tariff
190,065	1,579	0	2,445,075	€ 0.12/Kwh

Time schedule for implementation of the Short and long term action

YEAR	2016	2017	2018	2019	2020
Short Term Actions	X	X	X	X	X
Long Term Actions			X	X	X

4.3 Local renewable energy production

4.3.1 OVERVIEW

Many basic factors contribute to the success of generating electricity on solar energy in Achkout. The presence of three hundred sunny days and the many locations like schools, gardens, central library and other buildings help in generating renewable energy plans.

The municipality now has a huge opportunity to optimize some of the projects in the city, such as municipal buildings, and the water pumping stations, from which it provides local needs of consumption that can be linked with backup diesel generators to provide power and save biofuels.

4.3.2 MAIN SCHOOL IN ACHKOUT

The municipality of Achkout will work on applying certain actions and pilot projects, in line with the sustainable urban development vision of the city.

One of the projects will be establishing a micro station on the top roof of Achkout School. The system would transform solar energy into electrical energy to contribute to the generation of electricity from renewable sources. The exceed power will be fed back into the utility grid. This project will generate a minimum of **38 MWh** per year and mitigate the emission by **– 24.85 t CO_2/year** with a budget of 40,000 Euro. 80% of project budget will be financed by EU or international donors.

Local or Outsource Finance	Private (or own) funds	Bank Loan	Interest rate	Amortization period in years
80%	0%	20%	4.50%	10
Fixed Financial amortization costs			Total loan repayment due:	Loan (principal) capital:

Loan repayment (annualized)	€ 1,030	/year	€ 10,298	€ 8,148
Annual revenues in €	Reduction in consumptions in MWh/a	Payback time in year	NPV(20 years) in €	PPA Tariff
4,574	38	0	64,851	€ 0.12/Kwh

4.3.3 PUBLIC GARDEN IN ACHKOUT

The municipality would like to build a canopy of solar panels on certain area in the public garden. The system would transform solar energy into electrical energy to contribute to the generation of electricity from renewable sources.

This project would be able to generate green power of 226 MWh per year and mitigate the emission by – 147 t CO_2/year.

The main obstacle facing the municipality is not being allowed to produce and sell electricity, as EDL is the sole agent that produces and sells electrical power in Lebanon. Also the internal policy for EDL does not allow purchasing electricity from a third party. In order to overcome these obstacles, the municipality can come up with an agreement with EDL to execute this action and then handover the project to EDL, in return EDL will ensure providing the city with 24/24 hour of electricity or improve the cut-off time.

Local or Outsource Finance	Private (or own) funds	Bank Loan	Interest rate	Amortization period in years
80%	0%	20%	4.50%	10
Fixed Financial amortization costs			Total loan repayment due:	Loan (principal) capital:
Loan repayment (annualized)	€ 7,583	/year	€ 75,827	€ 60,000
Annual revenues in €	Reduction in consumptions in MWh/a	Payback time in year	NPV(20 years) in €	PPA Tariff
27,204	226	0	381,163	€ 0.12/Kwh

4.4 Building

4.4.1 OVERVIEW

The buildings in the residential and tertiary sectors are responsible for 76.5 % of total city energy consumption and represent the largest energy consumer and CO_2 emitter in urban areas; therefore, setting efficient policies to reduce energy consumption and CO_2 emissions in this sector is essential.

The electrification and heating are the main reasons for causing those emissions and can be summarized as follows:

- The electrification represents the 41.5 % of total GHG emissions of the city (27.6 % in tertiary sector and 13.9% in residential sector).

- Heating in the buildings represents 35 % of total city GHG emissions (32.3 % in residential sector and 2.7% in tertiary sector).

The municipality as a prime local authority can enact a leading role in implementing policies, develop and update legislations for proper implementation of the SEAP.

Good performance of the building envelope makes it a key factor in affecting the energy consumptions for the heating in buildings in addition to the walls insulation and building orientation.
To promote energy efficiency and renewable energies in buildings, essential measures and policies have to be promoted in the mitigation plan. These combined measures have the potential to reduce the city's emissions through changing behaviour, the efficiency of technical installations, the ability to benefit from natural lighting, and the efficiency of electrical appliances.
The expected scenario for the increase in GHG emission in 2020 is 27% compared with the base year 2013. Although this figure looks low compared with the current situation and the noticeable increase in refugee due to Syrian crisis, it makes the challenges in the implementation of the plan a real fight against the stream. For that it is so important to stuck to the plan and carefully monitor the results.

The short term will concentrate on changing behaviours and raising awareness campaign supported with clear understanding for the beneficiary in reduction costs and saving money; whereas, the long term focuses on creating policies and rules and looking for initiatives. However, through implementation, the process can be adjusted according to the achievements and results.

4.4.2 RESIDENTAIL SECTOR

The residential sector represents 46.2% of total city emission. The need for effective citizens' involvement on values, leading to an effective and long term behavioural change, is a key element in mitigation energy plan for the city.
The short term action focuses on conducting awareness campaigns that emphasize on promoting the usage of energy saving technologies and addressing the changing behaviour for citizen.

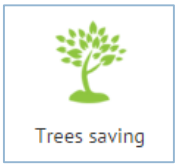
4.4.2.1 SHORT TERM ACTION

The short term actions for the residential sector will be as follows:

4.4.2.1.1 WORKSHOPS WITH LOCAL NGO'S

The local NGO's play an innovative leading role in the city. The action will concentrate on increasing the NGO capacity and knowledge in reducing the houses energy and carbon footprint, with a general title 'saving the environment and planting trees.'

Reducing energy is equal to planting trees/year



The NGO will be supported with experts who can train and give them the knowledge and the tools in conveying those to the citizens.
In the workshop, the municipality could target the changing behaviour and connect it with saving earth and planting trees knowing the fact that each replacement of electrical water heater with solar water heater is equal to planting twenty trees yearly. The municipality could also request support from NGO's in implementing the plan through their NGO's members and their regular activities in the city.

4.4.2.1.2 THE OPEN SOLAR DAY

Open solar day aims at creating awareness on solar energy as free and clean energy source to the citizen. It focuses on recognizing the benefits of using solar power to create a more sustainable future by relying less on traditional forms of energy.
The Open Day will open the door for citizens to rely more on sun in life and remove the constraints for using the solar energy. The Open Day can be preceded by a series of workshops held for local concerned NGO's and finance institutions, supported by LCEC.
The event could be held in a public area like Central library parking area, with demo kits for solar heaters and PV. A marketing material can be published and distributed throughout the day, which shows the national initiative (BDL is offering $200 per replacement). This day is open to public especially school students who can share in the demonstration of solar system for visitors. Free kids educational games will be set to allow the new generation know about the use of solar heaters. In the event, there will be withdraw on five or more free solar water heaters which can be financed by the event sponsors.

4.4.2.1.3 PUBLIC AWARENESS CAMPAIGN IN SCHOOLS

This action plan targets the student to change their behaviour and link it to save money in houses through regulating the power consumptions. It will lead to a long term behavioural change. This can be supported with guideline instruction that shows the steps to proper and successful achievement in changing behavioural and addressing energy conservation. This part of action is under the actions of SUDEP programme.

4.4.2.1.4 INCREASE THE INITIATIVES FOR SOLAR WATER HEATER FOR LOW INCOME HOMES

The municipality could play a good role in increasing the replacement of electrical water heater with solar heaters. This is accomplished through increasing the incentives from only $200, which the BDL offers ,to $400.
The replacement programme will enhance the smooth implementation of solar water heaters in the city. The programme can be enhanced with the support of local banks which can offer short loans offer. The municipality council can search for finance through local or international donors and payment can be deducted from the local taxes for the citizen with defined legal part with the internal laws. This brings the cost down by $400 for Water Solar Heater and the remaining amount can be

supported through the bank with almost zero interest, for two years. The monthly payment would be $20 to $30 per month and this amount is affordable for low income homes.
The estimated cost for this action will be in range of € 200,000. The programme could cover around 1000 houses with most low income one.

4.4.2.2 LONG TERM ACTION

The long term can be established in two phases. Phase one will try to implement the building codes in new buildings and the second phase will search for finance to support the replacement of electrical water heater with solar water heater by increasing the initiatives.

4.4.2.2.1 BUILDING CODE

The Building Code for Lebanon is supposed to be set in the coming year, in which a building energy efficiency code will be set for new buildings and major retrofits in Lebanon.
This code is supposed to define the minimum acceptable energy performance for buildings by addressing equipment energy efficiency and enveloping thermal requirements accordingly with Lebanese climatic conditions.
The buildings will typically be constructed to be used for many decades. Improvement of buildings' efficiency at the planning stage is relatively simple, while improvements after their initial construction are much more difficult. The decisions made during a building's project phase will hence determine much of the consumption, if not all, of a building's lifetime.
By applying new expected building code, mitigation of the GHG emissions and supporting the conservation in energy consumption in the new building will be achieved.
It is considered a step forward if the municipality could set new legislation laws for modern buildings to include the energy efficient requirement in new building. This requires:

- Building double walls for external walls in new building with thermal insulation
- Supporting new building with thermal study and efficient approach.

4.4.2.2.2 INCLUDE SOLAR WATER HEATING SYSTEM IN NEW BUILDING

The new building should include the solar water heater as part of building standard. This could insure the usage of solar water heater in new building.

4.4.2.2.3 SUMMARY AND EXPECTED RESULT FOR THE SHORT AND LONG TERM ACTION

SECTORS & fields of action	KEY actions/measures	BAU Scenario		Mitigation in Energy		Mitigation in %		Costing
		MWh/a	t CO_2 /a	MWh/a	t CO_2 /a			
BUILDING RESIDENTAIL SECTOR		63371	20504	4840	1861	5.76%	€	300,000
	WORKSHOPS WITH LOCAL NGO'S			133	92	0.28%	€	10,000

Short Term Action	THE OPEN SOLAR DAY	133	92	0.28%	€	30,000
	PUBLIC AWARENESS CAMPAIGN IN SCHOOLS	133	92	0.28%	€	30,000
	INCREASE THE INITIATIVES FOR SOLAR WATER HEATER FOR LOW INCOME HOMES	400	277	0.86%	€	200,000
Long Term Action	BUILDING CODE	3476	915	2.83%	€	15,000
	INCLUDE SOLAR WATER HEATING SYSTEM IN NEW BUILDING	565	393	1.22%	€	15,000

4.4.2.3 FINANCIAL ANALYSE AND PROPOSAL SOLUTION

Local or Outsource Finance	Private (or own) funds	Bank Loan	Interest rate	Amortization period in years
80%	0%	20%	4.50%	10
Fixed Financial amortization costs			Total loan repayment due:	Loan (principal) capital:
Loan repayment (annualized)	€ 7,583	/year	€ 75,827	€ 60,000
Annual revenues in €	Reduction in consumptions in MWh/a	Payback time in year	NPV(20 years) in €	PPA Tariff
582,593	4,840	0	8,643,947	€ 0.12/Kwh

Time schedule for implementation of the Short and long term action					
YEAR	2016	2017	2018	2019	2020
Short Term Actions	X	X	X	X	X
Long Term Actions			X	X	X

4.4.3 TERTIARY SECTOR

The tertiary sector is responsible for 13 % of total city emission and 27.5% for electrification emissions, and represents a key element in mitigation process.

4.4.3.1 THE SHORT TERM ACTION IN TERTIARY SECTOR

4.4.3.1.1 PUBLIC AWARENESS CAMPAIGN

Public awareness campaign will be held for tertiary sectors addressing energy conservation, behavioural changes, and energy efficiency. The campaign will concentrate on tools and

policies to tune the consumptions patterns, and to allow for strong engagement of tertiary sector on values, leading to an effective and long-term behavioural change.
The awareness campaign will start with a workshop conducted to the owners and administrative staff of the tertiary sector followed by instruction leaflets posted in locations and yearly meeting to compare the results and get support from experts for any obstacles.

4.4.3.1.2 CERTIFICATION FOR GREEN CEDAR CERTIFICATION

The action will aim to implement an innovative mechanism to create a kind of competition between society components and the tertiary sector to indicate its commitment, role, participation and sense of responsibility towards the environment and community.
The municipality will publish a Green Cedar Certification (GCC) to be presented in tertiary sectors like offices, shops, showrooms, companies, establishments etc.., to those who are willing to participate in this programme. The certification will show in metaphorical way the quantities of trees which have been saved in annual base.
The municipality in coordination with the local NGO's and experts in energy and social behaviours will set the standards to motivate the implementation of the action. They will also provide the tools for training and proper implementation, supported with workshops and distribution of flyers, and brochures
This action will have the impact to motivate the social and civil society in reducing the footprint and address energy conservation with behavioural changes.

4.4.3.2 LONG TERM ACTION

4.4.3.2.1 IMPLEMENTING BUILDING CODES IN NEW BUILDINGS.

This could reduce the expected consumption in energy and support the future plan, details for it can be taken as that of the residential sector.

4.4.3.2.2 SUMMARY AND EXPECTED RESULT FOR THE SHORT AND LONG TERM ACTION

SECTORS & fields of action	KEY actions/measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing
		MWh/a	t CO_2 /a	MWh/a	t CO_2 /a		
BUILDING TERTIARY SECTOR		22,141	13,423	6,450	4,355	13.48%	€ 125,000
Short Term Action	PUBLIC AWARENESS CAMPAIGN			880	611	1.89%	€ 10,000
	CERTIFICATION FOR GREEN CEDAR CERTIFICATION			5280	3668	11.35%	€ 100,000

Long Term Action	BUILDING CODE	290	76	0.24%	€ 15,000

4.4.3.3 FINANCIAL ANALYSE AND PROPOSAL SOLUTION

Local or Outsource Finance	Private (or own) funds	Bank Loan	Interest rate	Amortization period in years
80%	0%	20%	4.50%	10
Fixed Financial amortization costs			Total loan repayment due:	Loan (principal) capital:
Loan repayment (annualized)	€ 3,159	/year	€ 31,595	€ 25,000
Annual revenues in €	Reduction in consumptions in MWh/a	Payback time in year	NPV(20 years) in €	PPA Tariff
776,389	6,450	0	11,540,890	€ 0.12/Kwh

Time schedule for implementation of the Short and long term action					
YEAR	2016	2017	2018	2019	2020
Short Term Actions		X	X	X	X
Long Term Actions			X	X	X

4.5 Transportation

4.5.1 OVERVIEW

The transportation sector is responsible for 11.7 % of the city total emission as it produces 4,097 t CO_2/ year (2013).The municipality fleets produce 0.17 % (59 t CO_2) of transportation emission and the remain 99.8 % are caused by private transportation.

4.5.2 MUNICIPALITY FLEET/ PRIVATE TRANSPORTAION

The municipality transport doesn't show high figures in consumption and gas emissions. The need to prevent further increase is crucial in this aspect because of the non-consideration of its increase. The most affected sector is the private one which needs collective efforts to reduce its effects.

Transportation is responsible for 11.7% of the city emission making it a factor to fight against emission and an important action needed to be implemented. The city becomes crowded as all mouton cities have narrow roads and shortage of parking areas with limited spacing.

4.5.2.1 SHORT TERM ACTION

4.5.2.1.1 CONDUCT AN AWARENESS CAMPAIGN ON ECO DRIVE

The campaign conducted for the municipality staff and public concentrates on eco-drive and explains the recommended drive technique as a modern, smart and efficient way to save fuel and reach destination. Specific local NGO's & volunteers will be invited to attend the training delivered by qualified driving instructors allowing them to share the experience with others.

4.5.2.2 LONG TERM ACTION

The main obstacle in transportation is the absence of public transportation, allowing the private sector to take its reign despite the lack of organization and punctuality. The public transport stations are unprepared and ill-equipped and lack the stimuli and good services commensurate with the modern requirements. Due to the city's features, the distance from the ultimate location to the nearest main street or bus station is 5km .Hence, the possibility to bring the bus station much nearer will be difficult and commercial is not accepted as the private sector is providing this service.

Suggested priorities to overcome the challenges focus on increasing the road capacity , allocating and providing bus station in the city.

4.5.2.2.1 INCREASE THE ROAD CAPACITY

The expansion of roads and identifying corridors for pedestrians will contribute to reducing congestion on the roads.

4.5.2.2.2 ALLOCATE AND PROVIDE BUS STOP STATION IN THE CITY

- Assigning proper places with bus station would be very important like public services, governmental building, schools supermarkets, main souk, down town...etc., to insure the service is available and encourage people to use it.
- Providing safety regulations to insure the service is a safe protection from car accident by using barriers around the station
- Providing a pedestrian crossing road with marking and stop signs to insure safe crossing the roads
- Installing bus stop station in all locations
- Providing the bus stop with proper lighting
- Providing maps with timing schedules
- Advertising sign can be provided to insure covering the maintenance cost in the future
- Conducting awareness campaign to enhance using the public transport supported with flyers and brochures.

4.5.2.3 SUMMARY AND EXPECTED RESULT FOR THE SHORT AND LONG TERM ACTION

SECTORS & fields of action	KEY actions/measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing
		MWh/a	t CO_2/a	MWh/a	t CO_2/a		
TRANSPORTATION		**20,404**	**5,203**	**4,285**	**1,093**	**3.40%**	**€ 1,210,000**
Short Term Action	CONDUCT AN AWARENESS CAMPAIGN ON ECO DRIVE			20	5	0.02%	€ 10,000
Long Term Action	INCREASE THE ROAD CAPACITY			4081	1041	3.22%	€ 1,000,000
	ALLOCATE AND PROVIDE BUS STOP STATION			204	52	0.16%	€ 200,000

4.5.2.4 FINANCIAL ANALYSE AND PROPOSAL SOLUTION

Local or Outsource Finance	Private (or own) funds	Bank Loan	Interest rate	Amortization period in years
80%	0%	20%	4.50%	10
Fixed Financial amortization costs			Total loan repayment due:	Loan (principal) capital:
Loan repayment (annualized)	€ 30,588	/year	€ 305,884	€ 242,037
Annual revenues in €	Reduction in consumptions in MWh/a	Payback time in year	NPV(20 years) in €	PPA Tariff
515,787	4,285	0	7,578,570	€ 0.12/Kwh

Time schedule for implementation of the Short and long term action

YEAR	2016	2017	2018	2019	2020
Short Term Actions	X	X	X	X	X
Long Term Actions			X	X	X

4.6 SUMMARY FOR THE SUSTAINABLE ACTION PLAN

SECTORS & fields of action	KEY actions/measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing
		MWh/a	t CO_2 /a	MWh/a	t CO_2 /a		
MUNICIPAL BUILDING		**37**	**14**	**4**	**3**	**0.007%**	**€ 38,000**
Short Term Action	ENERGY SAVING INSTRUCTION			1	0.666	0.002%	€ 5,000
	AWARENESS AND TRAINING CAMPAIGN			0.05	0.0333	0.000%	€ 5,000
Long Term Action	REPLACING THE FCL LAMPS WITH LED LAMPS			1	0.666	0.002%	€ 10,000
	REPLACE THE AIR CONDITION WITH A+++ INVERTER TYPE WHEN NEW AIR CONDITION BY END OF LIFE (10 YEARS			1	0.666	0.002%	€ 10,000
	INSTALL LIGHTING MOTION SENSORS IN BUILDING			1	0.666	0.002%	€ 3,000
	PUBLIC PROCUREMENTS OF PRODUCTS AND SERVICES			0.05	0.0333	0.000%	€ 5,000
PUBLIC STREET LIGHTING		**2,723**	**1,892**	**1,597**	**1,051**	**2.56%**	**€ 4,222,200**
Short Term Action	PUBLIC STREET LIGHTING UNIT						€ 30,000
	MASTER STREET LIGHTING DRWAING ASSIGN NUMBER FOR EACH POLE			272	189	0.46%	€ 20,000
	IDENTIFY EACH FEEDER PILLAR BY NUMBER AND INSTALL NEW KWH METERS						€ 10,000
	PREPARE THE MAINTENANCE CHECK FORM						€ 1,000

	DEFINE THE MAIN ROADS AND SUB MAIN ROADS AND BRANCHES					€ 1,000
	TECHNICAL TRAINING FOR THE MAINTENANCE STAFF					€ 3,000
	MONITORING PROCESS					€ 2,000
Long Term Action	INSTALL NEW LED LIGHTING			1029	669	1.63%	€ 1,752,600
	INSTALL NEW SMART FEEDER PILLARS			141	91	0.22%	€ 650,000
	INSTALL REMOTE MONITORING AND CONTROL			155	101	0.25%	€ 1,752,600
LOCAL RENEWABLE ENERGY PRODUCTION				**264**	**172**	**0.42%**	**€ 340,000**
Long Term Action	THE MAIN SCHOOL IN ACHKOUT			38	24.8	0.06%	€ 40,000
	PUBLIC GARDEN			226	146.9	0.36%	€ 300,000
BUILDING RESIDENTAIL SECTOR		**63,371**	**20,504**	**4,840**	**1,861**	**4.54%**	**€ 300,000**
Short Term Action	WORKSHOPS WITH LOCAL NGO'S			133	92	0.22%	€ 10,000
	THE OPEN SOLAR DAY			133	92	0.22%	€ 30,000
	PUBLIC AWARENESS CAMPAIGN IN SCHOOLS			133	92	0.22%	€ 30,000
	INCREASE THE INITIATIVES FOR SOLAR WATER HEATER FOR LOW INCOME HOMES			400	277	0.68%	€ 200,000
Long Term Action	BUILDING CODE			3476	915	2.23%	€ 15,000
	INCLUDE SOLAR WATER HEATING SYSTEM IN NEW BUILDING			565	393	0.96%	€ 15,000

BUILDING TERTIARY SECTOR		**22,141**	**13,422**	**6,450**	**4,355**	**10.61%**	**€ 125,000**
Short Term Action	PUBLIC AWARENESS CAMPAIGN			880	611	1.49%	€ 10,000
	CERTIFICATION FOR GREEN CEDAR CERTIFICATION			5280	3668	8.94%	€ 100,000
Long Term Action	IMPLEMENTING BUILDING CODES IN NEW BUILDINGS			290	76	0.19%	€ 15,000.00
TRANSPORTATION		**20,404**	**5,203**	**4,285**	**1,093**	**2.68%**	**€ 1,210,000**
Short Term Action	CONDUCT AN AWARENESS CAMPAIGN ON ECO DRIVE			20	5	0.01%	€ 10,000
Long Term Action	INCREASE THE ROAD CAPACITY			4081	1041	2.54%	€ 1,000,000
	ALLOCATE AND PROVIDE BUS STOP STATION			204	52	0.13%	€ 200,000
		108,676	**41,035**			**20.81%**	**€ 6,235,200**

According to the above plan, it will be possible to reach 20% reduction in emission by 2020 subject to availability of finance mechanism.

5 ANNEX

Report:1

Minutes of Meeting In Municipality of Achkout

Sub: Sustainable Energy Action Plan for Achkout Municipality

Project Title (Acronym): SHAAMS
Reference: I-A/23/234
Programme: ENPI CBC MED
Contracting authority: Chamber of Commerce, Industry and Agriculture of Beirut & Mount Lebanon (CCIA-BML) – Partner 4
Location of the contract: Achkout–Lebanon
Date of meeting: 26 Sep 2015 at 11:00AM
Attendance:
Municipality:

Dr. Jean Rizk Mayor of Achkout Municipality
Architect: Abdo Chidiac Municipality member Council
Mr. Georges Fahd Municipality member Council
Engineer : Gabriel Creidi. Municipality member Council

Consultants:

Eng. Georges B. Tabet
Eng. Osama kassamani

Agenda

- Explanation of SAP and the steps which will be followed in data collection and presenting the actions.
- General Over view of the city.
- Explore the Needs the Municipality and the future projects of the city.
- The economic, social and geography status of the city.
- The Backbone of the city economy and the city needs in line with the city vision.
- The process for data collection for preparation of Base emission inventory for the energy consumptions in the main sectors Residential, Tertiary, Municipality, Public lighting and transportation.
- Agree on the focal point with municipality ،means the dedicated person for the project.

Minutes of Meeting:

The consultant's presented the following:

- The sustainable energy action plan and the importance in the future of converting the city to sustainable city.
- The process for elaboration of Sustainable Energy Action Plan (SEAP) and the steps will be followed to prepare of the base emission inventory.
- The activities which will be covered in BEI and measures in order to play substantial role for an efficient transition towards sustainable local energy systems.
- The guide line for data collection, in order to prepare of base emission inventory and collection of data.
- A guide table to be filled for the available data in the municipality for the BEI inventory, which they promised to, fill it in short period of time (10 to 14 days).

The Municipality Mayor presented the following:

- Explained that the city as no-industrial nor agriculture city, relays on providing services for the surrounding villages, Achkout represent a focal position between the arid and coast, and represent a central traffic line between the surrounding villages.
- The city has main commercial centers that serves most of the surrounding areas around it and represent main economic backbone of the city.
- The municipality vision to transfer the city to a main service center for the villages around it and concentrate on the Tourist attractions such as the Public Garden distinctive and the commercial sectors.

Explained the town challenges:

Electricity cutoff and the high demand on diesel generators.
The Infrastructure for the waste water treatments is not available.
The high traffic congestion in the main entry of the town.
The high cost for public street lighting.
The shortage in supply water in summer time although it is fed from Chabrouh dam.
The shortage in finance for the development projects and infrastructure

Primary data and information given by the municipality

The total population of the city is ten thousands along with one thousands two hundred refugee. And the population decreases in winter time to six thousands fife hundred.
The total number of houses is two thousand five hundred; the average house area is 160 meter square, the total area of the Achkout is eight Km^2.
There are around 300 commercial shops
The total number of street lighting poles is around one thousands three hundred fifty poles.

The next Steps:

- The Consultant will be reviewing the data collected by the municipality.
- The consultant will submit request to the EDL to collect the Data for Electricity related to Achkout.

- The consultant will arrange a second meeting with the municipality for reviewing the data and proposing the actions.
- The Municipality will request a public meeting with the stakeholders of Achkout and the social community representatives in order to explain the importance of their participations in the proposed actions of SEAP for the future of the city.

Report: 2

Minutes of Meeting In Municipality of Achkout

Sub: Sustainable Energy Action Plan for Achkout Municipality

Project Title (Acronym): SHAAMS
Reference: I-A/23/234
Programme: ENPI CBC MED
Contracting authority: Chamber of Commerce, Industry and Agriculture of Beirut & Mount Lebanon (CCIA-BML) – Partner 4
Location of the contract: Achkout–Lebanon
Date of meeting: 1st Oct 2015
Attendance:
Municipality:
Architect: Abdo Chidiac Municipality member Council
Consultants:
Eng. Georges B. Tabet
Eng. Osama kassamani

Minutes of Meeting:

- Review the data collection and verifying the information provided by the municipality
- The consultant review the proposed actions for each sector in the city.
- The Municipality will have a public meeting with the stakeholders of Achkout and the social community representatives in order to explain the importance of their participations in the proposed actions of SEAP for the future of the city.