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Jordan
Sustainable Energy and Climate Action Plan for Aqaba Special Economic Zone Authority

This Sustainable Energy and Climate Action Plan has been developed by the Consortium of Institute of Communication and Computer Systems (ICCS) – National Technical University of Athens (Greece) and National Energy Research Center (NERC) (Jordan) and it was led by the ICCS.

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Sustainable Energy and Climate Action Plan (SECAP) for Aqaba Special Economic Zone Authority

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List of Abbreviations

ASEZA	Aqaba Special Economic Zone Authority
BAU	Business As Usual
BEI	Baseline Emissions Inventory
CAPP	Community Awareness Promotional Plan
EF	Emission Factor
HDD	Heating Degree Days
ICCS	Institute of Communications and Computer Systems
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Center
LPG	Liquefied Petroleum Gas
MEMR	Ministry of Energy and Mineral Resources
NERC	National Energy Research Center
NTUA	National Technical University of Athens
SECAP	Sustainable Energy and Climate Action Plan

Executive Summary

In the year 2001 and under the direction and leadership of His Majesty King Abdullah II, the Aqaba taskforce was created. Aqaba taskforce consists of a team that shares one vision and that is, to turn the Aqaba Special Economic Zone into a world class Red Sea business hub and leisure destination enhancing the quality of life and prosperity of the community through sustainable development and a driving force for the economic growth of Jordan.

Today, Aqaba remains one of the most important cities of the region, ensuring its role as a distinctive destination for living, business, and tourism. The Aqaba Special Economic Zone Authority (ASEZA) functions as your one-stop investment and information center. Furthermore the city of Aqaba has one of the highest growth rates in Jordan.

ASEZA has adopted a number of policies associated with the control, management and protection of the natural environment. The environmental policy requires preservation and protection of the environment and the sustained development of the Zone's natural resources. Moreover the energy conservation policy promotes the provision of adequate energy to consumers at the least possible cost, while attempting to achieve sustainable development of the energy sector and to meeting the needs of socioeconomic development in the Zone.

ASEZA has committed to a 14% reduction of the municipality's GHG emissions as well as to an adaptation in climate change, in line with the national commitments for 2030. The involvement of all citizens and stakeholders of the municipality is considered crucial for achieving the set targets. The citizens are the most important resource for the city, especially in the GHG saving targets. The overall reduction target of ASEZ region is 85,122.87 tn CO_2 up to 2030 compared with the BAU scenario. This amount regards the 14% reduction target according to the Intended Nationally Determined Contribution (INDC), supported by GIZ. Within the framework of potential participation in the Covenant of Mayors for Climate and Energy Initiative, another scenario of mitigation actions has been developed for ASEZA, reaching up to 40% against the calculated 2030 emissions (243,208.21 tn CO_2). The achievement of this scenario is conditional upon the funding availability from grants, international donors and financing institutions.

Regarding the total budget for the SECAP's implementation, for the 1st scenario (14%) the total cost is 155 million JOD, namely for the Authority is 33 million JOD approximately whereas for the private sector is around 122 million JOD. For the 2nd scenario (40%) the total cost for the Authority is calculated at 37.5 million JOD, while for the private sector has been estimated at 352.6 million JOD approximately, resulting in an overall budget of 390.1 million JOD.

The energy balance for ASEZA (Baseline Emissions Inventory) has been developed for 2012, in line with the CoM guidelines and utilizing the IPCC emission factor approach, for all the compulsory sectors and one optional, namely:

- Municipal Buildings, Equipment & Facilities;
- Municipal Public Lighting;
- Residential Buildings;

- Tertiary Buildings, Equipment & Facilities;
- Transport (Municipal / Public / Private);
- Solid Waste Management.

The highest energy consumer is the Tertiary sector, followed by the Private Transport and Residential sectors, while the municipal sector consumptions are the lowest. The total energy consumption in ASEZA is presented in the following spider chart:

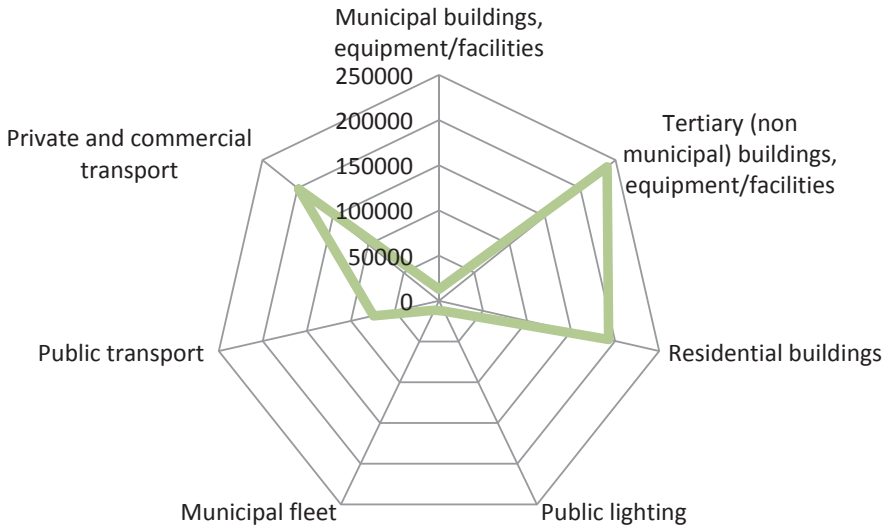


Figure 1: Energy consumption per sector in ASEZA

The Authority, including the Municipal Buildings, the Public Lighting and the Municipal fleet consumes 36,887 MWh, while these consumptions have almost equally balanced contributions, as presented in the next figure.

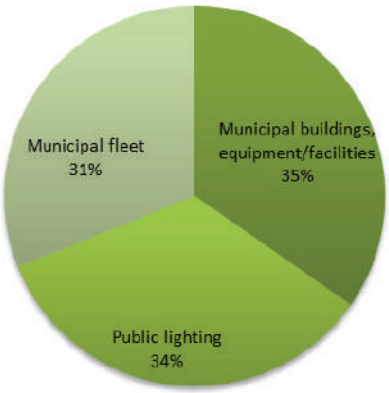


Figure 2: Energy consumption allocation of ASEZA's responsibilities

Regarding the total energy consumption, all the sectors in ASEZ consume 740,292 MWh. Each sector's contribution is presented in the following pie chart (ASEZA's share includes Municipal buildings, Municipal fleet and Public Lighting).

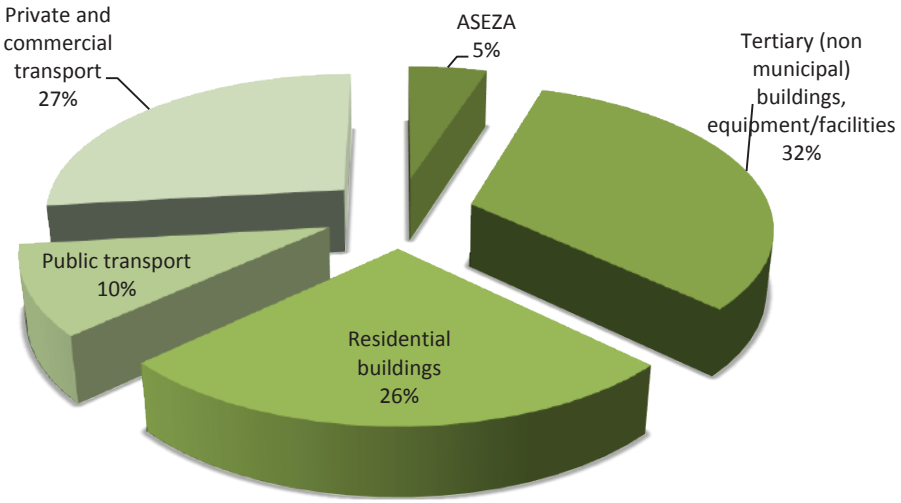


Figure 3: Energy consumption allocation per sector

A more detailed allocation of the calculated energy consumption in ASEZ is presented in the next figure per sector and per fuel.

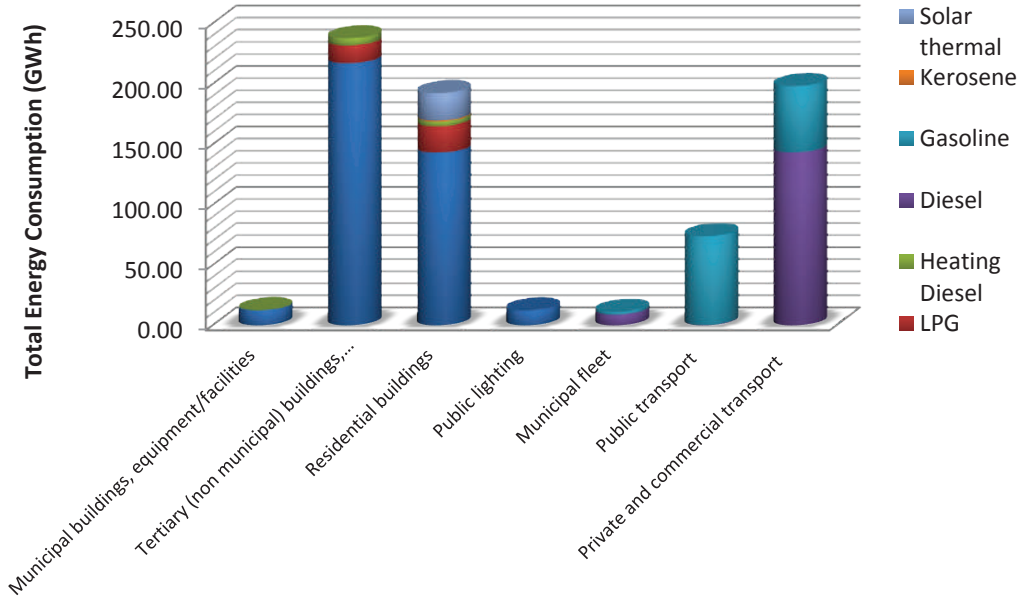


Figure 4: Energy consumption per sector & per fuel

The respective total emissions for the baseline year, including emissions from waste management, equal 339,676 tn CO_2 and they are presented in the following chart.

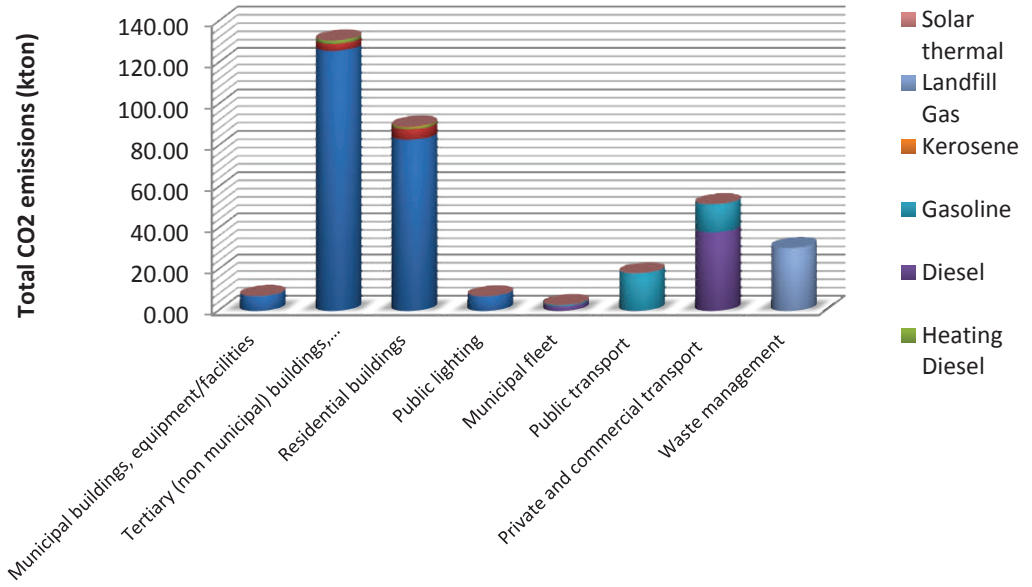


Figure 5: Total CO_2 emissions per sector & per fuel

In order to set the emission reduction targets, they have to be calculated against the Business as Usual (BAU) scenario, in line with the JRC guidelines for South Municipalities, considering that Jordan, as a country with developing economy, will face an increase in its energy demand due to the expected economic and population growth. Thus, the forecasted emissions under the BAU scenario for 2030 have been calculated to be 608,021 tn CO_2. As mentioned above, 2 different emission reduction target scenarios have been developed, one scenario for 14% and another for 40%.

An overview table of the actions per sector, as well as the calculated emission reductions per action for both scenarios, is presented below.

		Action	Energy Savings (MWh)	Energy production (MWh)	Emission Reduction (tn)
Municipal buildings	1.1	Green procurement procedures for ASEZA buildings	1,145.96		664.96
	1.2	Improving energy efficiency in ASEZA buildings	2,622.42 (14%)		1,521.70 (14%)
			3,746.32 (40%)		2,173.86 (40%)
	1.3	Energy Upgrade and RES in ASEZA main building	2,487.00	1,359.00	2,231.70
	1.4	Energy manager appointment in ASEZA	64.02		37.15
	1.5	Awareness raising activities for ASEZA employees	204.86		118.88
	1.6	Adoption of bioclimatic principles in ASEZA buildings /Strict application of green building codes in ASEZA buildings	1,264.40 (14%)		733.69 (14%)
			4,046.06 (40%)		2,347.79 (40%)
	1.7	Promotion of recycling			824.76
	1.8	Awareness raising campaigns to reduce the organic content of waste)			164.95
	1.9	PVs in ASEZA buildings (500 KWp)		849.28	492.81
	1.10	Green Municipal Building	186.00	34.00	127.66

		Action	Energy Savings (MWh)	Energy production (MWh)	Emission Reduction (tn)
		Eco Science Park awareness raising	2,584.00		1,499.41
	1.11	Landfill		6,053.00	18,871.09
	1.12	Establishment of an Energy Saving Department			0.00
	1.13	Web portal creation			0.00
		Total	10,558.66 (14%) 14,464.22 (40%)	8,295.28 (both scenarios)	27,288.76 (14%) 29,555.02 (40%)
Street Lighting	2.1	ASEZA lighting study and lighting system upgrade	8,649.64		5,019.09
	2.2	Solar cells installation for lighting network		382.00	221.66
	2.3	Green procurement procedures for the future lighting equipment	4,988.85		2,894.86
		Total	13,638.49	382.00	8,135.61
Residential Buildings	3.1	Awareness raising activities for modification of the residents' consumption behavior	5,784.86		3,356.76
	3.2	Promotion of Green Buildings' concept / Strict application of the building code	5,673.54 (14%)		3,292.16 (14%)
			45,388.34 (40%)		26,337.31 (40%)
	3.3	Campaign for promoting high energy label equipment and other awareness activities	5,784.86		3,356.76
	3.4	3MW/5MW Photovoltaics in residential rooftops		5,095.69 (14%)	2,956.86 (14%)
				8,492.82 (40%)	4,928.09 (40%)
	3.5	Replacing existing electric water heater with solar collectors		28,487.38 (14%)	16,530.25 (14%)
				42,731.06 (40%)	24,795.38 (40%)
	3.6	Replacement of existing lamps with LEDs	1,540.47 (14%)		893.89 (14%)
			4,621.42 (40%)		2,681.66 (40%)
	3.7	Replacement of existing air-conditioners with more efficient ones	7,002.16		4,063.11
	3.8	Use of cool colors in rooftops	622.41		361.17
	3.9	Replacement of single glazing with double/Window shading	135.72		60.01
		Total	26.544.03 (14%)	33,583.07 (14%)	34,870.96 (14%)
			69,339.78 (40%)	51,223.88 (40%)	69,940.24 (40%)
Tertiary buildings	4.1	Seminars and trainings on selected professional groups	2,920.68		1,694.77
	4.2	10% energy reduction campaign in commercial buildings-Energy friendly label	1,947.12		1,129.85
	4.3	Promotion of green buildings concept	5,156.05 (14%)		2,991.88 (14%)
			51,560.54 (40%)		29,918.82 (40%)
	4.4	Campaign for promoting high energy label equipment	7,788.47		4,519.38
	4.5	10 MW/15 MW Photovoltaics in rooftops		16.985.64 (14%)	9,856.19 (14%)
				25,478.46 (40%)	14,784.28 (40%)
	4.6	Replacing existing electric water heater with solar collectors		1,459.13	846.68
	4.7	Replacement of existing lamps with LEDs	19,743.12 (14%)		11,456.26 (14%)
			59,229.35 (40%)		34,368.78 (40%)
	4.8	Replacement of existing air conditioners with more efficient ones	7,342.48		4,260.59
	4.9	Use of cool colors in rooftops	3,915.99		2,272.32
	4.10	Installation of lighting automations & thermostats	6,934.57		4,023.89

		Action	Energy Savings (MWh)	Energy production (MWh)	Emission Reduction (tn)
	4.11	External shading installation	2,936.99		1,704.24
	4.12	Awareness raising campaigns for pupils/ students	126.39		73.34
	4.13	The 10% voluntary campaign for energy reduction in schools	544.86		316.16
		Total	59,356.71 (14%)	18,444.77 (14%)	45,145.55 (14%)
			145,247.52 (40%)	26,937.59 (40%)	99,913.10 (40%)
Municipal fleet	5.1	Replacement of the existing ASEZA vehicles with new. more efficient vehicles (hybrid etc.) & plan to purchase only efficient vehicles in the future	998.82		477.37
			289.01		128.82
	5.2	Installation of tracking and monitoring system for more efficient management of the fleet and better planning routes	572.64		150.96
	5.3	ASEZA fleet maintenance (for the existing & the new ones)	1,332.53		351.28
	5.4	Eco-driving seminars for the drivers of the ASEZA fleet	1,640.04		432.34
		Total	4,833.05	0.00	1,540.76
Private & Commercial Transport	5.5	Information events on the new vehicle technologies	0.00		0.00
	5.6	*Replacement of gasoline vehicles with Hybrid*	*2,935.51*		*730.94*
	5.7	*Replacement of diesel vehicles with new more efficient*	*5,146.75*		*1,374.18*
	5.8	Improve public transportation/ promote the use of public transport	4,892.51		1,218.24
	5.9	Cycling promotion and creation of related infrastructure	2,935.51		730.94
	5.10	Promotion of walking and car sharing and car pooling campaigns	4,109.71		1,023.32
	5.11	Improvement / development of parking infrastructure	4,403.26		1,096.41
	5.12	Promotion of eco-driving	10,659.80		2,793.25
	5.13	Replacement of gasoline vehicles with electric ones		546.65	136.12
	5.14	Transportation master plan			
		Total	35,083.05	546.65	9,103.40
Public transport	5.15	Promotion of eco-driving for public transport's drivers	5,320.93		1,325.60
	5.16	Promotion of new technology buses in the public transportation	9.51		2.54
	5.17	Installing track and monitoring system in public transportation	11,078.17		2,758.70
	5.18	Replacing the existing Taxi vehicles with Hybrid vehicles	31,192.00		7,767.00
	5.19	Installing Solar systems on the buses related to Aqaba Company for transportation and logistics'(coach buses)		12.85	3.20
		Total	47,600.61	12.85	11,857.04
		Total transportation	*87,516.71*	*559.50*	*22,501.19*
Local Renewable	6.1	10 MW PVs in southern ports		16,985.64	9,856.19
	6.2	5 MW PVs in ASEZA main building		8,492.82	4,928.09
	6.3	1 MW PVs in the north of Aqaba		1,698.56	985.62

		Action	Energy Savings (MWh)	Energy production (MWh)	Emission Reduction (tn)
	6.4	1 MW PVs in solar power plant		1,698.56	985.62
	6.5	0.1 MW PVs in the marine visitors center		170.00	98.65
		Total		*29,045.59*	*16,854.17*
	TOTAL	***14%***	***197,614.59***	***90,310.20***	***154,796.24***
		40%	***330,206.62***	***116,443.84***	***246,899.34***

It should be highlighted at this point that the total reduction potential of the actions envisaged under the 14% scenario, reaches 25% of the BAU emissions. And an additional 15% is achieved based on the actions suggested under the 40% reduction scenario.

ASEZA acknowledges that some of the actions are more important than the others since they seem to be of high priority. For this reason, these actions have been analyzed separately in details. Five "Project Fiches" have been developed and are presented in Chapter 5, while an overview is provided in the next table.

Table 1: Project fiches

Project Fiches	Emissions reduction (tn CO_2)	Contribution to emissions reduction target		Cost (JOD)
		1st scenario (14% target)	2nd scenario (40% target)	
Eco-Science Park	1,626	1.91%	0.67%	1,010,153
Smarter Transportation System	10,816	12.71%	4.45%	185,489
Energy rationalization in ASEZA main building	2,232	2.62%	0.92%	1,203,702
Rationalize energy consumption used in street lighting	5,241	6.16%	2.15%	3,582,683
Aqaba landfill development	18,871	22.17%	7.76%	13,356,595
Total	**38.786**	**45.57%**	**15.95%**	**19,338,622**

The fourth Chapter of the SECAP concerns the Adaptation to climate change. The last 20 years significant changes in the global climate have occurred which negatively affect life in many aspects. This section presents the current situation in ASEZ and the expected problems due to the climate change impacts. Subsequently a set of actions are proposed towards the city protection against the forecasted extreme weather events. Jordan has already launched the "Jordan's Third National Communication on Climate Change" report in 2014, which is dealing with the above mentioned topic. The national targets presented on this report are consistent with the SECAP actions. The total estimated budget for this set of actions is 2,280,000 JOD. An overview table of the actions per sector is presented below.

Table 2: Adaptation Actions

Public health	Infrastructure	Built Environment	Economy	Biodiversity
Health action plan for the extreme events	Water management plan	Enforcement of building codes for more energy efficient and heat tolerant structures	Elaboration of water and ground water management plan	Educating the citizens
Provide access to public buildings during extreme events	Modelling predicted supply changes in the electricity from the locally available RES	Integrated land use planning with zoning system depending on the different areas	Adoption of integrated land use planning for the touristic activities	Trees planting
Developing an early warning system to alert citizens in the case of extreme	Mapping of sites with landslides and flood risks	Educational campaigns on informing the citizens on the benefits of adopting the suggested actions in their premises	Educating tourist on ways to conserve natural resources	
Educational and awareness raising campaigns about health-related effects of extreme events	Developing guides and awareness raising campaigns for citizens on how to save water and energy, especially	Greening infrastructure such as buildings' roofs and walls	Adoption of energy efficient and water conservation programs at resorts	
Regular cleaning and maintenance of the sewage and drainage system	Integration of sustainable drainage systems	Increasing the amount of shade and green areas in the city by planting trees and using green pavements to reduce the heat island effect		
		Building exemplary districts with adapted urban forms and buildings		
		White roofs (cool colors), shading and bioclimatic design		
		Rainwater collection and use		
		Adoption of methods to reduce water demand		

Chapter 1: Introduction

1.1 ASEZA 2030 Targets

The Ministry of Planning and International Cooperation (MOPIC) is collaborating with the "Cleaner Energy Saving Mediterranean Cities - CES MED" project (financed under the EUROPAID Programme), in order to support selected municipalities in Jordan in their effort towards energy sustainability.

ASEZ has been selected as one of the three cities to be supported by the CES MED program at the national level, as one of the most important cities of the region, ensuring its role as a distinctive destination for living, business, and tourism. ASEZA acknowledges the need to counteract the increasing energy demand and its harmful impacts on the environment and thus the Authority has agreed to the national target on the emission reductions. At the same time ASEZA has studied a 2nd scenario of setting a higher emission reduction target, within the framework of the Covenant of Mayors for Climate and Energy initiative, which is conditional upon the funding availability.

The overall target that has been set for 2030 is 14% CO_2 emissions reduction (according to the Intended Nationally Determined Contribution - INDC). The second scenario developed focuses on achieving an emission reduction of 40%. Under both scenarios, emphasis is placed on working closely with all community actors.

The municipality will take all necessary measures on its facilities, establishing a good example for the community, while it will put efforts on collaborating with the public and achieving significant reductions from the residential, tertiary and transport sectors, with waste being also a priority for the local administration.

The target of 40% is more challenging and there will be need of more intensive efforts from the Authority and the Governmental Bodies while it is of utmost importance to attract more donors and funds.

1.2 Current status

1.2.1 Geographical location

Aqaba is the administrative center of the Aqaba Governorate in Jordan and it is Jordan's only coastal city. It is located at Jordan's southernmost point, on the Gulf of Aqaba lying at the tip of the Red Sea and its area extends to 375 km^2.

The Governorate of Aqaba located south of Amman (the capital of Jordan) is the fourth largest governorate in the country.

Aqaba city is administered by the Aqaba Special Economic Zone Authority and plays a major role in the development of the Jordanian economy, through the vibrant trade and tourism sectors.

Figure 6: Aqaba map

Aqaba's location next to Wadi Rum and Petra has placed it in Jordan's golden triangle of tourism, which strengthened the city's location on the world map and made it one of the major tourist attractions in Jordan. Aqaba's strategic location at the northeastern tip of the Red Sea between the continents of Asia and Africa, has made its port important over the course of thousands of years. The ancient city was called Ayla, its strategic location and proximity to copper mines, made it a regional hub for copper production and trade in the Chalcolithic period.

Today, Aqaba remains one of the most important cities of the region, ensuring its role as a distinctive destination for living, business, and tourism. In 2001 Aqaba city was announced as a Special Economic Zone (ASEZ) with its own Authority (ASEZA). ASEZA encompasses an area of 375 km^2. Its purpose was to incorporate the entire Jordanian coastline, Jordanian sea-ports, and the historical city of Aqaba as a duty-free, low tax- multi-sectoral development zone. ASEZA provides global investment opportunities within tourism, recreational services, professional services, multi-modal logistics, value-added industries, and light manufacturing sectors. [1]

Figure 7: Aqaba city

1.2.2 Climate characteristics

Aqaba has a desert climate with a warm winter and a hot dry summer. There is virtually no rainfall all year long, with June to be the driest month with 0mm of precipitation. The rainfall here averages 32 mm. August is the warmest month and January has the lowest average temperature of the year. The average temperature in Aqaba is 24.6 °C and the average wind speed is 13.57 km/h. [2]

Table 3: Monthly temperatures and precipitation in Aqaba

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min Temp. (°C)	10.3	11.1	14.1	17.6	20.6	24.0	25.4	25.6	24.1	20.7	16.4	11.8
Max Temp. (°C)	21.0	22.6	26.3	30.1	35.1	38.0	38.9	39.3	35.7	32.6	27.8	22.6
Average Temp. (°C)	15.7	16.9	20.2	23.9	27.9	31.0	32.2	32.5	29.9	26.7	22.1	17.2
Preci-pitation (mm)	5	6	5	4	1	0	0	0	0	1	4	6

Considering the climate conditions in ASEZA area, and the average desired temperature for internal conditions to be 21°C, the heating degree days (HDD) for the area are calculated to be approximately 422 HDD, meaning that the needs for heating during the winter period are very low.

Figures 3 and 4 below present the monthly temperatures during the year in Aqaba (min, max and average), as well as the monthly precipitation levels over the months.

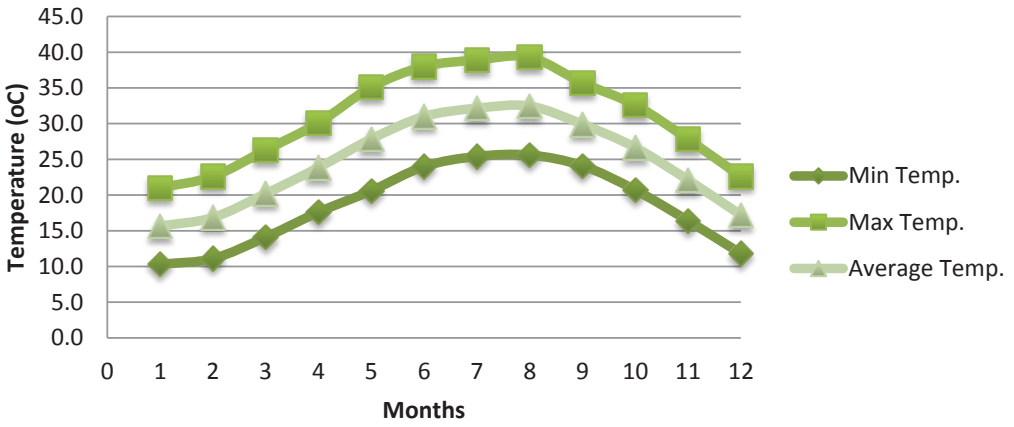


Figure 8: Monthly Temperatures in Aqaba

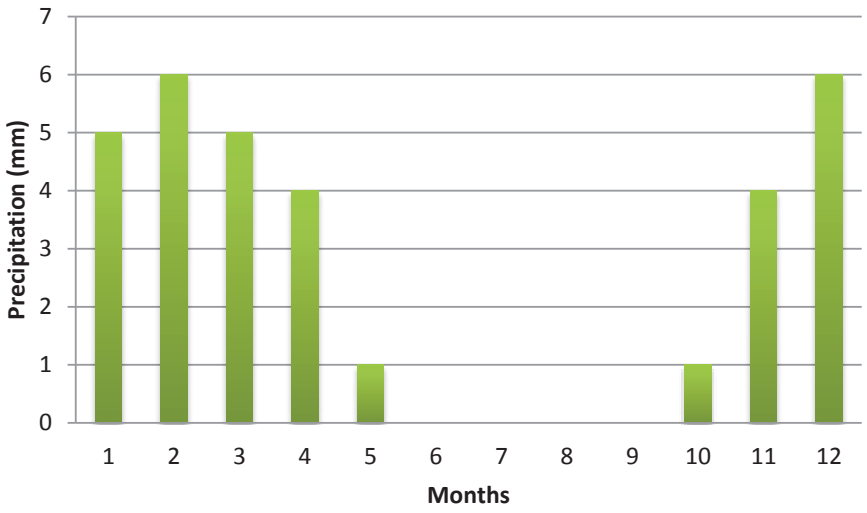


Figure 9: Monthly Precipitation in Aqaba

1.2.3 Demographic tendencies

The estimated population inside Aqaba Governorate is 188,026 in 2015, consisting of 45% women and 55% men. The population in 2004 was 101,967, meaning there was a huge rise of 84% in only 11 years. Concerning the population at the Aqaba Authority level, this rises up to 118,000 and is the population used for the calculations realized within the current study. [3]

1.2.4 Employment

Analyzing the statistics acquired by the official webpage of the Department of Statistics, the employees in Aqaba Governorate are approximately 37% of the population (ages under 15 not included). In the part of economically active citizens there is an 11% which is currently unemployed and looking for a job. An important mention is that only 10.91% of the population (ages under 15 not included) comprises of economically active women. (2015) [3]

1.2.5 Education

Regarding the educational status of Aqaba Governorate's citizens, a percentage of 95% of the total population was enrolled in education in 2015, most of which (91.5%) was in primary education and only 9.5% in the highest education levels (Diplomas, Masters, PhD etc.). Considering two population groups, the first one between 4 and 25 years old and the second one older than 25 years old, the following assumptions can be extracted:

- In the first age group, which comprises a little over than half the governorate's population (52%), almost 12% has not enrolled, while another 61% is currently following educational courses at all levels. The remaining 27% had enrolled in courses in the past, but has now either completed or terminated his education.
- In the second age group, almost 21% has received no education at all, another 0.6% is currently enrolled, while the rest of the population (78%) has received education. [3]

1.2.6 Infrastructures

Aqaba comprises the only port in Jordan in which regular ferry routes are available daily to Taba. In the north of Aqaba there is the only civilian airport outside Amman, the King Hussein International Airport. The railway which operates in the city is only used for cargo transportation and no longer functions for travelers, except for the route to Wadi Rum. As for the road network, Aqaba city is connected by an 8,000 km modern highway system to surrounding countries. The road network within the governorate comprises of 419 km. [1, 4]

The registered households in Aqaba Governorate are 38,519, while there are 35,209 housing units in conventional buildings. (2015)

The Governorate provides a public network for access in water and drinking water. More than 99% of housing units have access in the network for water and a 56% for drinking water. The remaining percentage uses, mainly, mineral water for drinking. (2013)

In addition, there is a developed public system for sewage and thus almost 97% of housing units have access in the public network. The rest of them are been served by cesspools. [3]

Figure 10: Aqaba city

1.2.7 Complementarity with municipal and national plans and other related actions

ASEZA's decision for the implementation of a SECAP study is in line with national legal framework, targets, and priority actions set. Abiding with the 14% emission reduction target by 2030 is consistent with the national target for that period, as expressed through the Intended Nationally Determined Contributions (INDCs) submitted to the UNFCCC.

Under the current legal framework, the municipalities are entitled to the development of their energy policy plans, such as the current study on Sustainable Energy and Climate Action Plan for ASEZA. In addition, they can influence the energy consumptions related to their own use (buildings, vehicles, street lighting, solid waste and waste water management, water pumping etc.), as well as promote legislative measures for the adoption of the building codes in place, or the use of Solar Water Heaters (SWH).

ASEZA is also planning for a number of Renewable Energy projects, either in its facilities, or promoting such initiatives in the private sector. RE projects are endorsed by the Renewable Energy and Energy Efficiency Law (REEEL) No. 13 (2012), which is the basis for supporting schemes and other incentives for the private sector to invest in renewable energy.

The National Energy Efficiency Action Plan (NEEAP) is the umbrella regarding energy efficiency at the national level. Some of the most relevant actions for local authorities, as addressed in the NEEAP, include energy labels for home appliances and replacement of compact fluorescent lamps (CFLs) with LED lighting.

Although ASEZA is involved in energy efficiency activities for some years, it has not realized an integrated citizens' awareness plan. Therefore, there is a need for significant action, with high visibility that will include all key stakeholders and groups in the community. The action will create a vast impact, bringing the issue of energy efficiency, energy savings and renewable energy to the center of attention.

1.3 Vision for the future

Aqaba is a rapidly growing city that has managed to almost double its population within a decade. This trend is expected to continue in the future, even at a lower rate. This population increase trend poses significant pressures on the existing and future infrastructures and the further development of the city.

ASEZ Authority is deeply committed to a sustainable future for the city; their vision is “Go green – The future of Aqaba city”, as this is expressed through the actions selected in this SECAP, focusing not only in reducing the energy consumption through energy efficiency, or producing more clean energy, but also on “greening” the existing as well as the future infrastructures at the municipal, as well as the city level.

1.4 Organizational and financial aspects

1.4.1 Coordination with national and local authorities

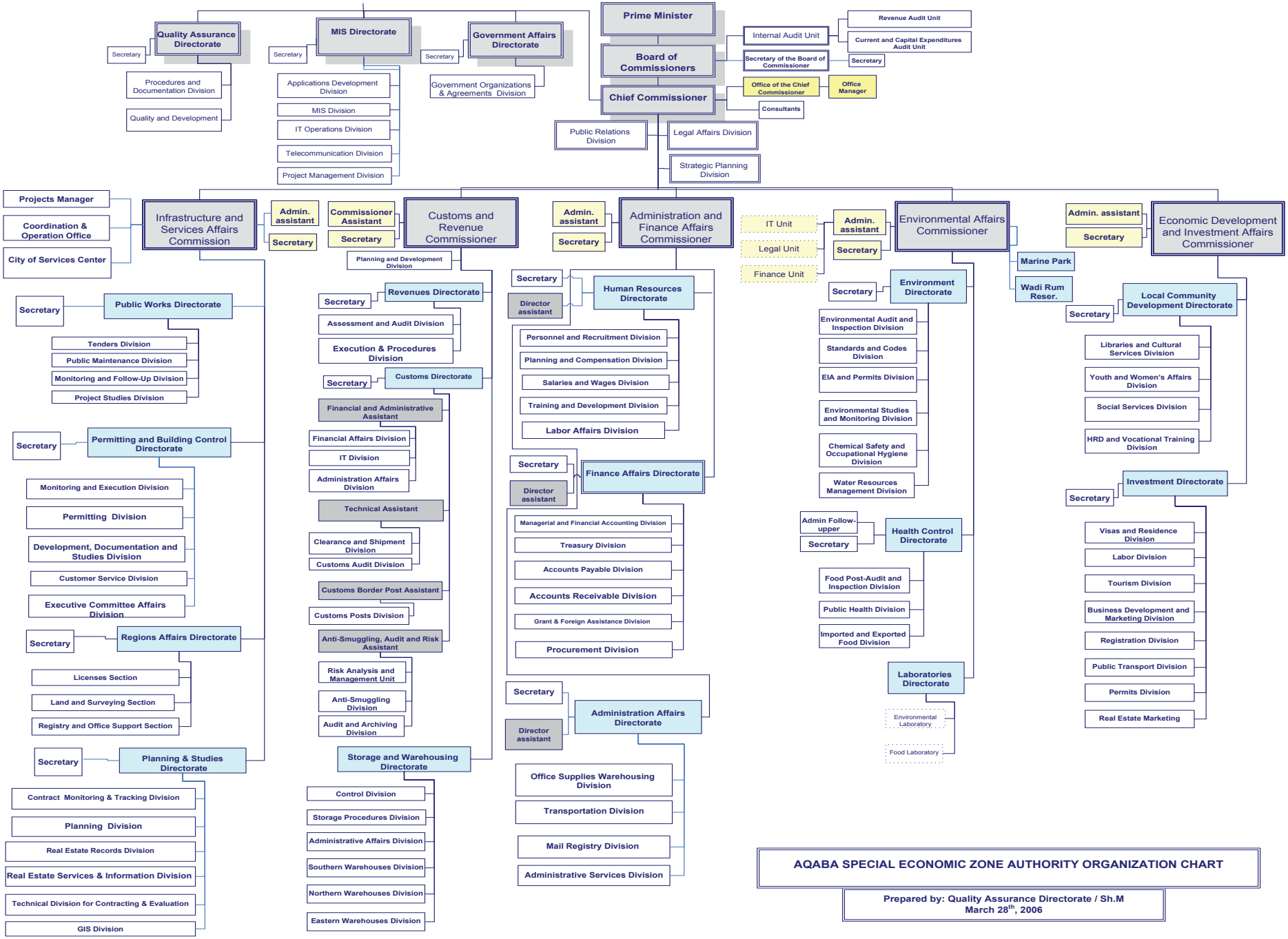
During the SECAP implementation, ASEZA is going to coordinate closely with the affiliated ministries, namely the Ministry of Planning and International Cooperation (MoPIC), which is also the CES MED Focal Point, the Ministry of Environment, especially with regards to the Climate Adaptation actions, as well as the Ministry of Energy and Mineral resources, as relates to the energy efficiency and renewable energy projects and initiatives.

At the same time, ASEZA will exchange experience with the other two Jordanian cities that have benefitted from CES MED for the development of their SECAPs, namely Karak and Irbid, while it will share best practices and experience gained with other municipalities interested in realizing similar activities.

1.4.2 Adaptation of administrative structures

The departments that will be engaged with the SECAP are the Planning and Studies Directorate (responsible: Vice-President), the Environment Department (responsible: Environment Commissioner), the Public Works Directorate, the Engineering Tenders Directorate and the Permitting and Building Control Directorate (responsible: City Affair Commissioner) and finally the Transport Directorate and the Tourism Directorate (responsible: Economic Affair Commissioner).

The general organization structure of ASEZA is presented in the next page.



AQABA SPECIAL ECONOMIC ZONE AUTHORITY ORGANIZATION CHART

Prepared by: Quality Assurance Directorate / Sh.M
March 28th, 2006

1.4.3 Involvement of stakeholders and citizens

Having conducted the analysis of the energy consumption patterns in the territory, it should be highlighted that ASEZA is responsible for only 5% of the consumptions realized at the city level. Thus, it is evident that the involvement of all citizens and stakeholders of the private sector is considered crucial for achieving the set targets, for either the 14% scenario, or more importantly the 40% reduction target scenario. A high level collaboration is expected with private investors interesting to realize small or larger scale RES investments in the city, while efforts for close contacts with associations from the tertiary and residential sector will be placed. Moreover, in all schools several programs for GHG emission reduction shall be incorporated.

1.4.4 Budget – SECAP financing sources

Regarding the total budget for the SECAP's implementation, for the 1st scenario (14%) the total cost is 155 million JOD, namely for the Authority is 33 million JOD approximately whereas for the private sector is around 122 million JOD. For the 2nd scenario (40%) the total cost for the Authority is calculated at 37.5 million JOD, while for the private sector has been estimated at 352.6 million JOD approximately, resulting in an overall budget of 390.1 million JOD.

It should be noted that the 1st scenario costs cover a maximum emission reduction target of 25.5% actually. In case the minimum 14% reduction target is set, this will reflect on the projects' selection and the set priorities, thus affecting the overall costs.

Any action to be implemented will have a clear budget and implementation plan and will be executed pending the approval of the yearly budget, as required by the municipal regulations.

Chapter 2: Baseline Emission Inventory (BEI)

2.1 BEI Methodology

2.1.1 Baseline Year

According to the Covenant of Mayors Guidelines, to develop the energy balance sheet and consequently specify the CO_2 emissions, the year 1990 should be considered as the baseline year. In case there aren't adequate data for this year, as baseline year should be considered the nearest year to 1990 for which there are complete data. Thus, for the Aqaba Special Economic Zone Authority the baseline year that has been chosen is 2012 because sufficient data were available for this year. [5]

2.1.2 SECAP administrative body

Following a meeting of the consultants (consortium ICCS/NTUA and NERC) with the ASEZA representatives, it was made clear that their wish for the SECAP is to cover the administrative boundaries of ASEZA, and not that of the whole governorate. Therefore, all the figures provided on the municipal sector concern strictly ASEZA.

2.1.3 Sectors to be included in BEI

The sectors for which the appropriate data were gathered and calculations for the total energy consumption and CO_2 emissions are presented below:

A. Buildings, Equipment & Facilities
   - Municipal Buildings, Equipment and Facilities
   - Public lighting
   - Residential buildings
   - Tertiary buildings, equipment and facilities (non-municipal)

B. Transport
   - Municipal fleet
   - Public transport
   - Private and Commercial transport

C. Solid waste management

The industry sector is not included because the collection of its actual data was impossible and it was considered that approaches based on national averages will not be representative of the actual consumptions. This decision was further enforced by the fact that the non ETS industrial sector is an optional sector according to the Guidelines, since the ASEZ Authority has limited potential on reducing its consumptions through convincing the respective key stakeholders. Also, no agricultural activities take place in the region, so the specific sector has been neglected.

2.1.4 Emission factors and Conversion rates

The emission factors which were used in the SECAP were derived from the Covenant of Mayors Guidebooks with the only exception of the electricity emission factor, which is characteristic for the country. It was not possible to acquire the electricity emission factor for Jordan directly from the Ministry of Energy and Mineral Resources (MEMR), or any of the

utilities servicing the country. Therefore, as the best approach to identify it was considered to be the utilization of available statistical data from the International Energy Agency (IEA) and MEMR. To this end, data regarding the emissions from fuel combustion for the generation of electricity and heat from the IEA [6] highlight publication, as well as data regarding the electricity generation from the annual MEMR [7] reports were used, and the EF results as follows:

$$EF = \frac{CO_{2\ emissions\ tot}}{Total\ Electricity\ Production}$$

The available data for 2012 (the baseline year) are presented in the next table:

Table 4: Electricity Emission Factor

	2012
CO_2 Emissions (tn)	10,500,000
Electricity Generation (GWh)	16,596
Electricity Emission Factor (tn/MWh)	**0.623**

Emissions Factors for each source are gathered in the table below.

Table 5: Emission Factors & Conversion Rates

	Emission Factors (tn CO2/MWh)	Conversion Rates
Electricity	0.623	Not applicable
LPG	0.227	13.1 MWh/tn
Heating Oil (heating diesel)	0.267	10 KWh/lt
Diesel	0.267	10 KWh/lt
Gasoline	0.249	9.2 KWh/lt
Kerosene	0.259	790 kg/m3
		12.2 MWh/tn
Solar thermal	0	Not applicable

Furthermore, emissions from the waste management were calculated according to the IPCC method. Landfilling process creates methane emissions (CH_4) which are converted to CO_2 emissions with the equivalence "*1 tn CH_4 = 25 tn CO_2*".

2.2 Energy Consumption

The total amount of energy consumed in Aqaba Authority is 684.45 GWh and a general description for the total energy consumption is presented in the next table. Further analysis of the consumptions per sector is provided in the following sections.

Table 6: Total Energy consumption per sector

MWh Sector	Electricity	LPG	Heating Oil	Diesel	Gasoline	Kerosene	Solar thermal
Municipal Buildings, Equipment, Facilities	12,804						
Public Lighting	12,630						
Residential Buildings	143,634	21,811	3,883			803	22,481
Tertiary Buildings, Equipment, Facilities	217,555	14,541	5,876				
Municipal fleet				9,300	2,153		
Public Transport				531	73,784		
Private & Commercial Transport				143,764	54,742		

2.2.1 Municipal Buildings, Equipment & Facilities

This sector includes 80 buildings managed by ASEZA, such as the Municipal Hall which consumes a 25% of the whole energy consumption in the municipal buildings, the library and cultural buildings. The given consumption of these buildings is 12,804 MWh of electricity.

2.2.2 Municipal public lighting

As far as the municipal public lighting is concerned, this sector is related to the street lighting and public areas' lighting. The electricity consumption for this sector is 12,630 MWh and it is based on bills.

2.2.3 Residential Buildings

Electricity

Aqaba's households consume electricity for lighting and electrical appliances such as refrigerator, air conditions and others, as well as in space and water heating. The consumed electricity in this sector according to utility data is 143,634 MWh.

Liquefied Petroleum Gas

LPG is used mainly in cooking and space heating. A smaller amount is also consumed in water heating. For this fuel the available data include both the residential and the tertiary sector, since it was unfeasible to separate the bills. According to ASEZA technical service's expert opinion, it was assumed that the Residential sector consumes 60% of the total consumption, with the rest being allocated to the tertiary one. According to the main gas distributor, ASEZA provided the following data: Aqaba city consumes 450 LPG cylinders daily (12.5 kg/cylinder) from March till September and 850 cylinders daily from December to February. Using also the calorific value of Liquefied Petroleum Gas based on IPCC 2006 guidelines, which is 13.1 MWh/tn, it is calculated that the residential sector consumes:

$$(450cyl.* 30d * 7mo + 850cyl.* 30d * 5mo) * \frac{12.5kgr}{cyl.}$$
$$= 2{,}775{,}000kgr\ LPG\ for\ both\ sectors$$
$$2{,}775{,}000kgr * 60\% = 1{,}665{,}000\ kgr\ LPG\ in\ Residential$$
$$1{,}665\ tn * 13.1\frac{MWh}{tn} = 21{,}811.50\ MWh\ LPG\ in\ Residential$$

So the LPG consumption in ASEZA's Residential sector is 21,811.50 MWh.

Kerosene

Many households in ASEZA use kerosene for space heating purposes. Since data gathering at the municipal level wasn't possible, data that had been gathered for the same purpose in Karak municipality by the consultants were utilized. Estimations for these consumptions were realized according to the data gathered directly from the gas stations for Karak Municipality (350,000 lt). An adjustment at the Authority level was realized using the population ratio and the heating degree days' ratio, since Aqaba has higher average temperatures than Karak and in order to identify how much less fuel is needed for space heating, the degree days were calculated according to the next table. Kerosene's density, 790 kg/m^3, and net calorific value, 12.2 MWh/tn, were also used.

Table 7: Energy consumption in tertiary sector per type of building

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Karak	Average Temp.(°C)	7.7	9.0	11.5	15.4	19.4	22.4	24.2	24.5	22.4	19.3	14.0	9.3	
	HDD	412.3	337.4	296.1	168.0	51.2	-40.5	-99.2	-108.5	-40.5	52.7	210.0	364.3	**1,892**
Aqaba	Average Temp.(°C)	15.7	16.9	20.2	23.9	27.9	31.0	32.2	32.5	29.9	26.7	22.1	17.2	
	HDD	164.3	114.8	24.8	-87.0	-213.9	-300.0	-347.2	-356.5	-267.0	-176.7	-33.0	117.8	**422**

HDD: heating degree days

The base temperature used was 21°C and the summation of degree days includes only the positive values since the degree days for heating are needed. Finally, it appears that Aqaba's heating degree days are only the 23% of Karak's, hence the kerosene used for heating will be considered with the same percentage.

$$\frac{350{,}000lt * 118{,}000inhabitants}{114{,}000} * 0.23 = 83{,}324.56\ lt$$
$$83{,}325m^3 * 790\frac{kgr}{m^3} = 65{,}826.40kg$$
$$65.83tn * 12.2\frac{MWh}{tn} = 803.08MWh\ \text{kerosene}$$

The consumption derived is about 803 MWh.

Diesel (heating oil)

There is also an amount of diesel consumed in ASEZA for space and water heating needs. The approach here was based in Karak Municipality's consumption for Diesel in the residential sector (16,309 MWh), followed by adjustments with population's and heating degree days' ratios.

$$\frac{16{,}308.58MWh * 118{,}000inhabitants}{114{,}000\ inhabitants} * 0.23 = 3{,}882.59MWh\ Diesel$$

Solar thermal

In addition, a great number of households own solar water heaters (SWH), thus they consume solar power in order to heat water. In order to determine this quantity, the Ministry of Energy and Mineral Resources (2012) provided data at a national level (1,421,000 MWh) and subsequently the solar thermal energy was calculated, based on the population owning solar water heaters. According to the Department of Statistics [3] the 10.88% of Jordan population has SWH (723,746 inhabitants), thus the specific production per capita is 1,934 MWh per SWH owner. Since according to official statistics, 9.32% of Aqaba Governorate population own solar heaters, it was assumed that the percentage is approximately the same in ASEZA, thus the population with SWH is 10,999 at the Authority level. Based on the above assumptions and data, the solar thermal consumption at the municipal level was calculated to be 22,480.87 MWh in the baseline year.

Summary

Gathering all the data from the residential sector, it seems that residents mainly use 4 distinct energy sources. In the figure below, the percentages that each fuel type contributes to the residential sector's consumptions is depicted:

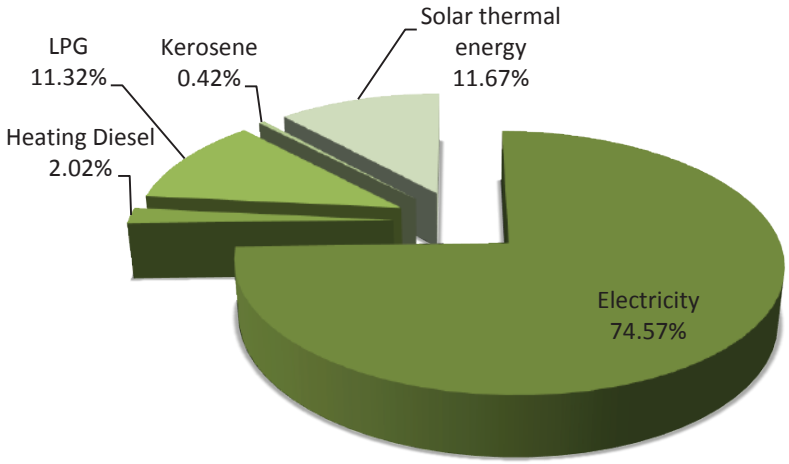


Figure 11: Energy consumption per fuel in Residential Sector

2.2.4 Tertiary Buildings, Equipment & Facilities

The tertiary sector includes a number of buildings such as hotels, offices, restaurants, stores, public buildings, banks, hospitals etc. which provide services in Aqaba's citizens. The energy consumption which refers to electricity and diesel derives from EDCO [8]. In case of LPG, as it is mentioned in the residential sector, the tertiary sector consumes 40% of the 2,775,000 kg, which is the total residential and tertiary consumption. Consequently it is calculated that the LPG consumption equals 14,541 MWh. In the table below the respective data are presented.

Table 8: Energy consumption in tertiary sector per type of building

Types of Buildings in the Tertiary Sector	Electricity (MWh)	LPG (MWh)	Diesel (MWh)
Hotels	22,592	14,541	70
Offices	93,500		
Commercial buildings			
Stores			
Companies			
Small industries	74,683		
Private Schools			
Hospitals			5,806
Charities			
Banks			
Public buildings	26,780		
Worshiping places			
Public schools			
Total (MWh)	**217,555**		**5,876**

In the next chart, it is obvious that the consumption's allocation in the tertiary sector is dominated by electricity, with LPG and diesel having only minor contributions.

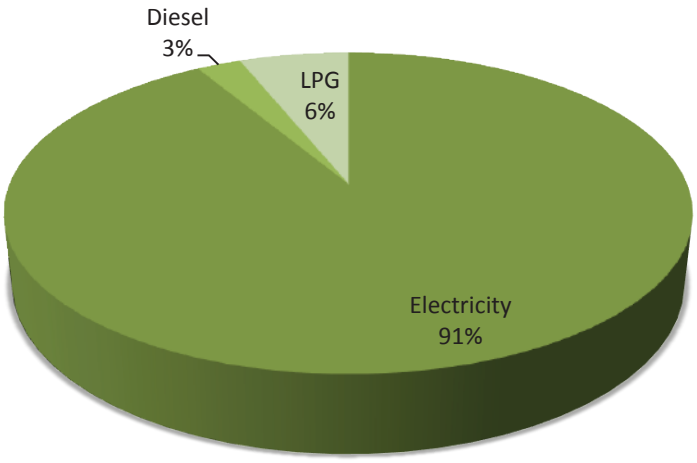


Figure 12: Consumption in tertiary sector per fuel

2.2.5 Buildings' & facilities' Synopsis

The consumed energy allocation for all the buildings and facilities in ASEZA is presented in the next figure. Electricity is the dominant fuel in this category, with a percentage of 85%.

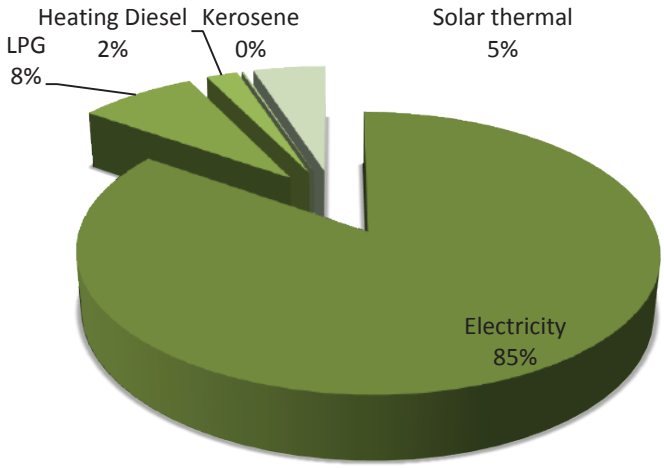


Figure 13: Consumption in buildings and facilities per fuel

2.2.6 Transport

2.2.6.1 Municipal fleet

As far as the consumption of the municipal vehicles is concerned, the available data, followed by the vehicles' type, was collected and is presented in the next table. Aqaba's municipal fleet has 111 vehicles which use diesel and gasoline.

Table 9: Energy Consumption in Municipal fleet of Aqaba

Type of Municipal vehicles	Number of vehicles	Diesel (MWh)	Gasoline (MWh)	Total (MWh)
Pick-up	149	9,300.00	2,152.80	**11,452.80**
Passenger Vehicles	81			
Buses	16			
Construction Vehicles	62			

2.2.6.2 Public Transport

Public transport refers to buses and taxes which serve Aqaba's citizens. The data available for the sector included the average consumption per type of vehicle according to the total distance travelled within municipal limits. The results are summarized in the table below. Further analysis is presented in Appendix.

Table 10: Energy consumption in Public Transport

Vehicle Type	Number of vehicles	Diesel (MWh)	Gasoline (MWh)	Total (MWh)
Small Buses	37	270.10		**74,314.66**
Coach Buses	11	260.98		
Taxis	517		73,783.66	
Total:	**565**	**531.08**	**73,783.66**	

2.2.6.3 Private and Commercial Transport

The previous methodology with assumptions on the distance travelled and average consumptions per vehicle type was used in this sector too. The registered private and commercial vehicles are 20,541 and the total consumption, regarding Diesel and Gasoline, is 198,507 MWh. In Appendix there is also the analysis per vehicle.

Table 11: Energy consumption in Private and Commercial Transport

Vehicle Type	Number of vehicles	Diesel (MWh)	Gasoline (MWh)	**Total (MWh)**
Motor cycle	38	-	77.49	**198,506.51**
Small Passenger cars	11,839	-	54,664.93	
Medium Passenger Cars	239	1,310.51	-	
Cargo Vehicles	2,502	13,700.03	-	
Trailer Head	254	9,049.87	-	
Trailer (trucks)	2,500	88,968.75	-	
Construction vehicle	269	9,581.43	-	
Small buses (Vans)	2,898	21,153.50	-	
Total	**20,541**	**143,764.09**	**54,742.43**	

In the next figure the proportion between Diesel and Gasoline in the Private and Commercial vehicles is presented, with diesel being the dominating fuel.

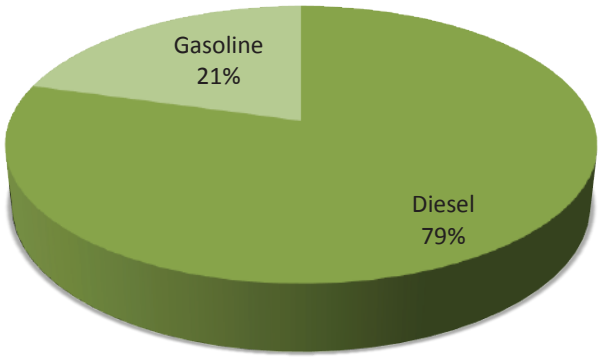


Figure 14: Energy consumption in Private and Commercial vehicles per fuel.

2.2.7 Final Energy Consumption

In the next table all the energy consumptions within Aqaba are presented, totaling 740.3 GWh.

Table 12: Total Energy Consumption in ASEZA

Sector	FINAL ENERGY CONSUMPTION [MWh]															
			Fossil fuels								Renewable energies					Total
	Electricity	Heat/cold	Natural gas	Liquid gas	Heating oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Plant oil	Biofuel	Other biomass	Solar thermal	Geothermal	
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																
Municipal buildings, equipment/facilities	12,804.00			0.00	0.00											12,804.00
Tertiary (non municipal) buildings, equipment/facilities	217,555.00			14,541.00	5,876.39											237,972.39
Residential buildings	143,634.00			21,811.50	3,882.59					803.08				22,480.87		192,612.04
Public lighting	12,630.00															12,630
Industry – Non-ETS																0.00
Industry – ETS (not recommended)																0.00
Subtotal	**386,623.00**	**0.00**	**0.00**	**363,52.50**	**9,758.98**	**0.00**	**0.00**	**0.00**	**0.00**	**803.08**	**0.00**	**0.00**	**0.00**	**22,480.87**	**0.00**	**456,018.43**
TRANSPORT																
Municipal fleet						9,300.00	2,152.80									11,452.80
Public transport						531.08	73,783.66									74,314.73
Private and commercial transport						143,764.09	54,742.43									198,506.51
Subtotal	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**153,595.16**	**130,678.88**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**284,274.04**
OTHER																
Agriculture, Forestry, Fisheries																0.00
TOTAL	**386,623.00**	**0.00**	**0.00**	**36,352.50**	**9,758.98**	**153,595.16**	**130,678.88**	**0.00**	**0.00**	**803.08**	**0.00**	**0.00**	**0.00**	**22,480.87**	**0.00**	**740,292.47**

2.3 Local electricity production

In ASEZ there are photovoltaic panels producing electricity. The total installed capacity of these PVs is 15.6 MW and the total electricity production is approximately 26,520 MWh.

2.4 CO_2 emissions

2.4.1 Energy related emissions

In the previous paragraphs the consumed energy in Aqaba was described and now the CO_2 emissions will be calculated, based on the IPCC emission factors. [9]

Electricity

In order to calculate the local emission factor for electricity, the following equation is used:

$$EFE = \frac{(TCE-LPE-GEP)*NEEFE+CO2LPE+CO2GEP}{TCE}$$ [10]

Where:

EFE: Local emission factor for electricity (tn/MWh)
TCE: Total electricity consumption in the local authority (MWhe)
LPE: Local electricity production (MWhe)
GEP: Green electricity purchased by the local authority (MWhe)
NEEFE: National or European emission factor for electricity (tn/MWh_e)
CO2LPE: CO_2 emissions due to the local production of electricity (tn)
CO2GEP: CO_2 emissions due to production of certified green electricity purchased by the local authority (tn)

$$EFE = \frac{(386{,}623 - 26{,}520 - 0) * 0.623 + 0 + 0}{386{,}623} = 0.580$$

As calculated from the above, due to the amount of electricity production from PVs, the local emission factor for electricity is reduced compared to the national one, from 0.623 to 0.58.

Heating Oil (Diesel)

According to the SECAP guidelines the CO_2 emission factor for the diesel used in heating is 0.267 tn/MWh.

Diesel

According to the SECAP guidelines the CO_2 emission factor for the diesel used in vehicles is 0.267 tn/MWh.

Gasoline

According to the SECAP guidelines the CO_2 emission factor for gasoline is 0.249 tn/MWh.

LPG

According to the SECAP guidelines the CO_2 emission factor for liquefied petroleum gas is 0.226 tn/MWh.

Kerosene

According to the SECAP guidelines the CO_2 emission factor for kerosene is 0.259 tn/MWh.

Solar thermal

The solar thermal power hasn't emissions thus its emission factor is zero according to the guidelines.

2.4.2 Non energy related emissions

Apart from the CO_2 emissions released from the daily activities there is also a significant amount of Greenhouse Gases derived from waste management. In order to calculate these emissions, the IPCC default method was used as it appears below. [11]

$$\text{Methane emissions (Gg/yr)} = (MSW_T \bullet MSW_F \bullet MCF \bullet DOC \bullet DOC_F \bullet F \bullet 16/12\text{-}R) \bullet (1\text{-}OX) \quad (1)$$

Where:

- MSW_T total MSW generated (Gg/yr)
- MSW_F fraction of MSW disposed to solid waste disposal sites
- MCF methane correction factor (fraction)
- DOC degradable organic carbon (fraction) (kg C/ kg SW)
- DOC_F fraction DOC dissimilated
- F fraction of CH_4 in landfill gas (IPCC default is 0.5)
- 16/12 conversion of C to CH_4
- R recovered CH_4 (Gg/yr)
- OX oxidation factor (fraction – IPCC default is 0)

The IPCC default method assumes that all the potential of CH_4 emissions are released during the same year the waste is disposed of. The method introduces various specific default values and recommendations, for use in countries with lack of statistical data for Solid Waste.

The calculation of the degradable correction factor (DOC) is based in the following equation.

$$DOC=0.4*A+0.17*B+0.15*C+0.3*D \quad (2)$$

Where:

- A Percentage of paper and textiles in SW
- B Percentage of garden and park waste and other organic putrescibles in SW
- C Percentage of Food waste in SW
- D Percentage of wood and straw waste in SW

The form of this suggested equation wasn't followed directly because in the case of Aqaba there was a different composition of solid waste. New factors were found in order to calculate the DOC.

The total quantity of solid for 2012 was 43,200 tn. The entire amount is landfilled because there is no recycling. Waste composition as well as the results from the calculations is presented in the next two tables.

Table 13: Solid waste composition in ASEZA, 2012

Solid waste composition	Percentage	Quantity(tn)
Paper and Cardboard	11%	4,752
Glass	2%	864
Metal	2%	864
Plastic	16%	6,912
Organic Waste	62%	26,784
Other	7%	3,024
Annual Quantity of Solid waste (tn)	100%	43,200

Table 14: Waste Emissions Calculation factors

Variables	Values
MSWt:	43.2 Ggr
MSWf:	1
MCF:	0.4
DOC:	0.1708
DOCf:	0.6244
F:	0.5
16/12:	1.3333
R:	0
OX:	0

Where DOCf=0.014*T+0.28 (T: average temperature in Aqaba, 24.6^{o}C)

All things considered, 1,228.70 tn of methane are released due to the waste management. This quantity equals to 30,717.48 tn of equivalent CO_2. (According to the guidelines the factor which was used for the conversion is 25)

2.4.3 Final CO_2 emissions

The emissions of CO_2 for the sectors that have been described in the previous sections are available, in total, in the following table, summing up to 339,676 tn CO_2.

Table 15: Total CO2 emissions for the ASEZA

Sector		CO2 emissions [t] / CO2 eq. emissions [t]															
				Fossil fuels								Renewable energies					Total
		Electricity	Heat/cold	Natural gas	Liquid gas	Heating Oil	Diesel	Gasoline	Lignite	Coal	Other fossil fuels	Biofuel	Plant oil	Other biomass	Solar thermal	Geothermal	
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES																	
Municipal buildings, equipment/facilities		7,429.73			0.00	0.00											7,429.73
Tertiary (non municipal) buildings, equipment/facilities		126,239.76			3,300.81	1,569.00											131,109.57
Residential buildings		83,345.92			4,951.21	1,036.65					208.00				0,00		89,541.78
Public lighting		7,328.76															7,328.76
Industry	Non-ETS																0.00
	ETS (not recommended)																0.00
Subtotal		**224,344.17**	**0.00**	**0.00**	**8,252.02**	**2,605.65**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**235,409.83**
TRANSPORT																	
Municipal fleet							2,483.10	536.05									3,019.15
Public transport							141.80	18,372.13									18,513.93
Private and commercial transport							38,385.01	13,630.86									52,015.88
Subtotal		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**41,009.91**	**32,539.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**73,548.95**
OTHER																	
Agriculture, Forestry, Fisheries																	0,00
OTHER NON-ENERGY RELATED																	
Waste management																	30,717.48
Waste water management																	0.00
Other non-energy related																	0.00
TOTAL		**224,344.17**	**0.00**	**0.00**	**8,252.02**	**2,605.65**	**41,009.91**	**32,539.04**	**0.00**	**0.00**	**208.00**	**0.00**	**0.00**	**30,717.48**	**0.00**	**0.00**	**339,676.26**

2.5 Results' Graphical Analysis

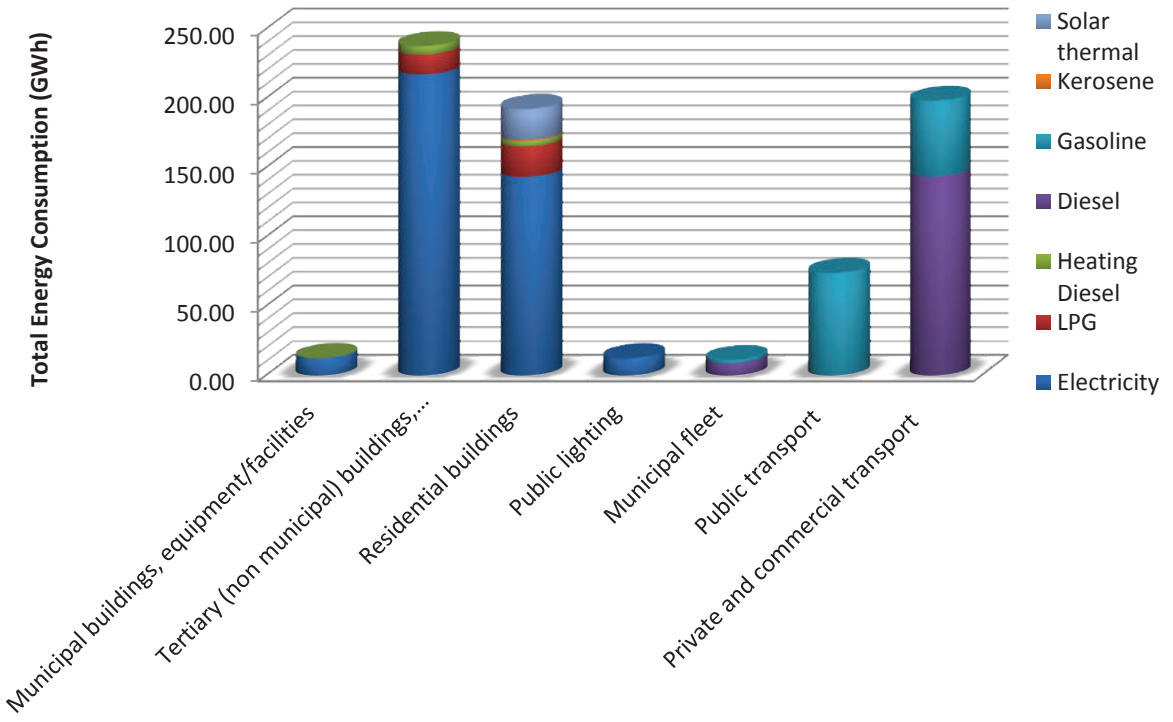


Figure 15: Energy consumption per sector and per fuel.

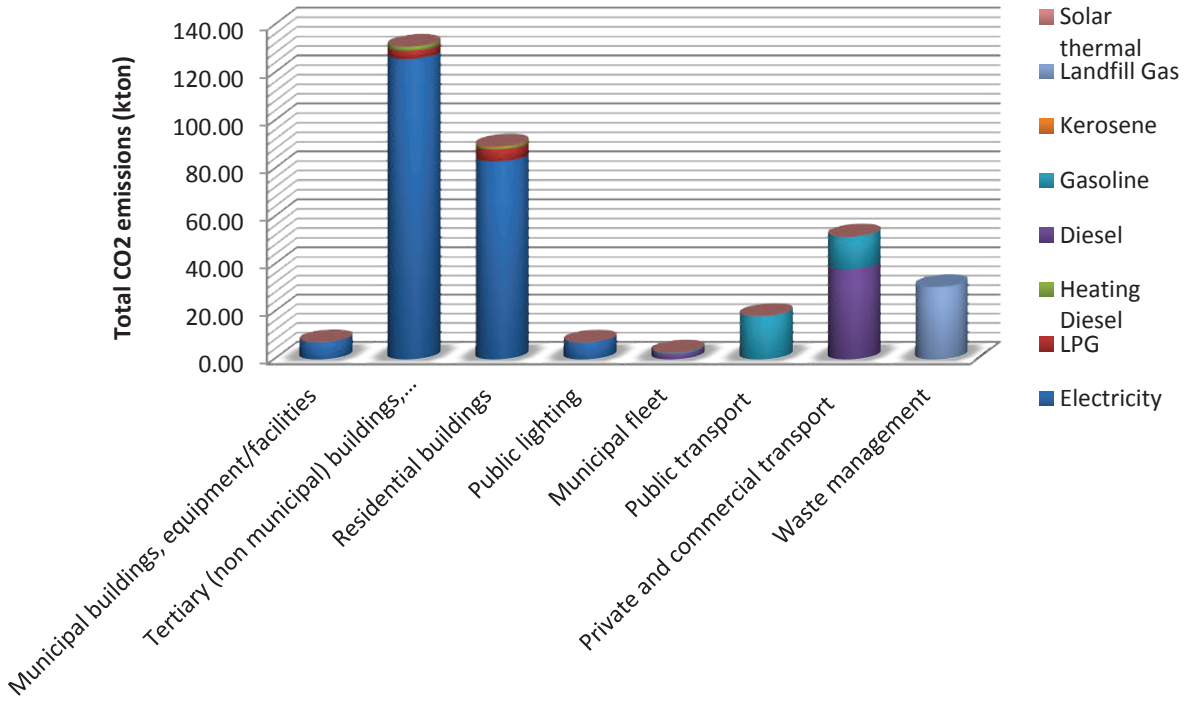


Figure 16: Total CO_2 emissions per sector and per fuel.

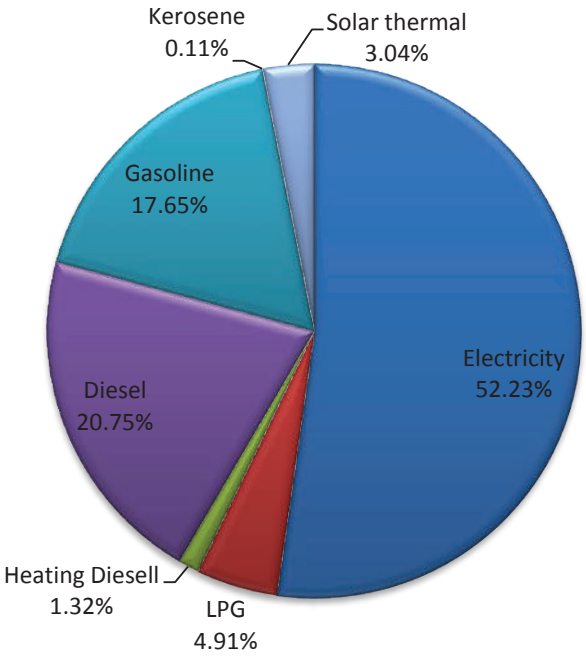


Figure 17: Energy consumption per fuel

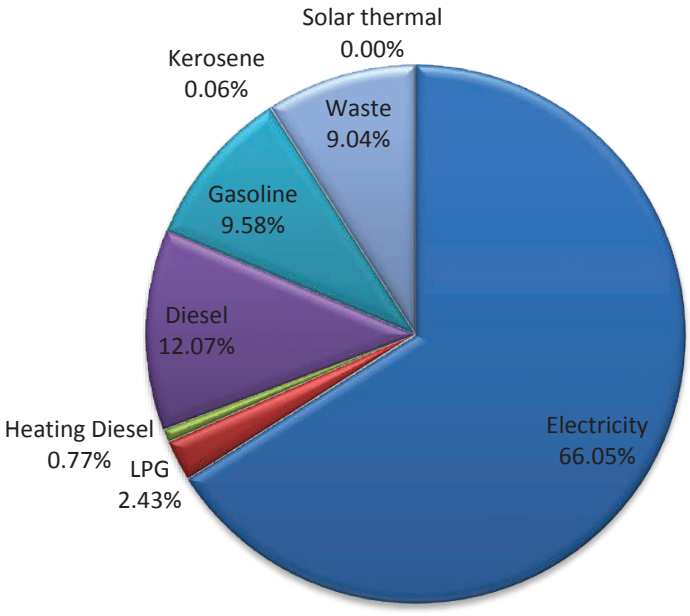


Figure 18: Total CO_2 emissions per fuel

Chapter 3: SECAP Actions

3.1 Target for 2030

ASEZA is called upon to take double role in the efforts towards CO_2 reduction, both as a demonstrator giving the good example to its citizens, as well as a triggering power and coordinator for all activities in the area. The first role, giving the good example, should be realized through the adoption of actions to reduce the emissions resulting from the buildings/ facilities / vehicles etc. under its direct responsibility. Emissions from waste are another sector under the direct responsibility of ASEZA. Nevertheless, the municipal direct related emissions are only a relatively low percentage of the total. Therefore, it should act as a triggering power and coordinator of the activities to be realized by the private sector in a series of activity fields. According to the BEI, the sectors contributing the most to the carbon footprint are the Tertiary (38.60%), the Residential (26.36%) and the Private & Commercial Transport (15.31%). Thus, the Authority should focus on the actions through which the citizens will be encouraged and take the appropriate measures in order to reduce the CO_2 emissions from their activities. At the same time actions in the other sectors will be suggested as well.

In this respect, the first step is the calculation of the Business as Usual (BAU) scenario, in line with the JRC guidelines for South Municipalities, considering that Jordan, as a country with its economy under development, will face an increase in its energy demand due to the expected economic and population growth. Considering the use of the BAU scenario for the calculation of the 2030 emission levels and in turn the respective reduction target, the following calculations are realized according to the guidelines.

$$Emissions_{CO_2}^{2030} = Emissions_{CO_2}^{Baseline\ year} \times k$$

In ASEZ, the emissions for the baseline year, 2012, were 339,676.26 tn CO_2. For the calculation of the BAU scenario for 2030, the national coefficient k for the baseline year of 2012 in Jordan is 1.79. Therefore, the forecasted emissions for 2030 are

$$Emissions_{CO_2}^{2030} = 339{,}676.26 \times 1.79 = 608{,}020.51\ tn\ CO2$$

The emission reduction target for ASEZ according to the Intended Nationally Determined Contribution (INDC), supported by GIZ, is 14% (85,122.87 tn CO_2) up to 2030 compared with the BAU scenario. If the Covenant of Mayors' requirements are considered, the target should be at least 40% against the calculated 2030 emissions, thus 243,208.21 tn CO_2.

As a result, the current study focuses on the development of two parallel action scenarios that will allow ASEZ to achieve either one of the above targets set. It should be highlighted that the actions in both scenarios are the same and the main difference is in specific actions in the building sector. Jordan has already developed the "Energy Efficient Building Code" which provides the minimum requirements for designing an energy efficient building (green building). The Code is not mandatory so the first scenario will be based in adopting a few measures in the buildings, while the application field in these buildings, both existing and new, will be relatively limited.

On the other hand, in order for the 40% target to be achieved, strict measures are needed which should be enforced through the development and implementation of the respective legislative framework.

Calculations for both scenarios have been realized based on the suggested actions and it is envisaged that in the first scenario, the total CO_2 reduction could reach a maximum of 25.46 %, thus satisfying the INDC target of 14%, whereas the respective number under the strict implementation of the legislative framework could be 40.61%. Therefore the first target seems to be technically achievable in the next years and the second one depends on the intensive effort of ASEZA and government in order to attract additional financing and broadly engage the private sector investors.

Each sector's contribution in the overall reduction target under each scenario is presented in the next Figures.

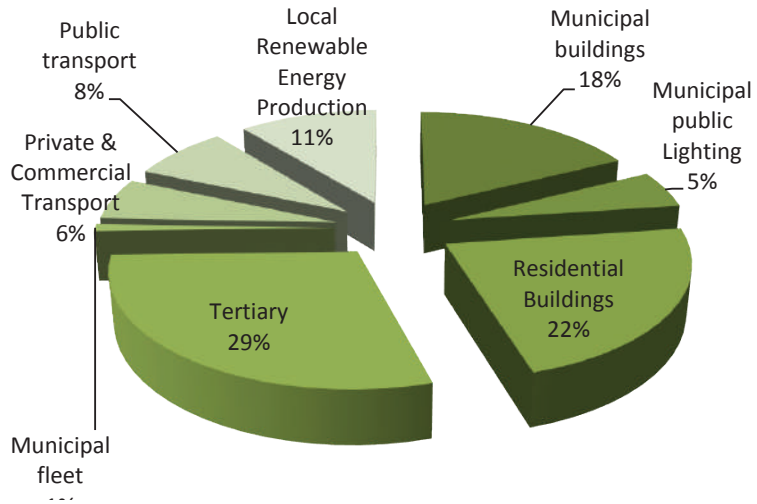


Figure 19: Sectors' contribution in the 1st Scenario's attainment (INDC target – Reduction potential of 25.46%)

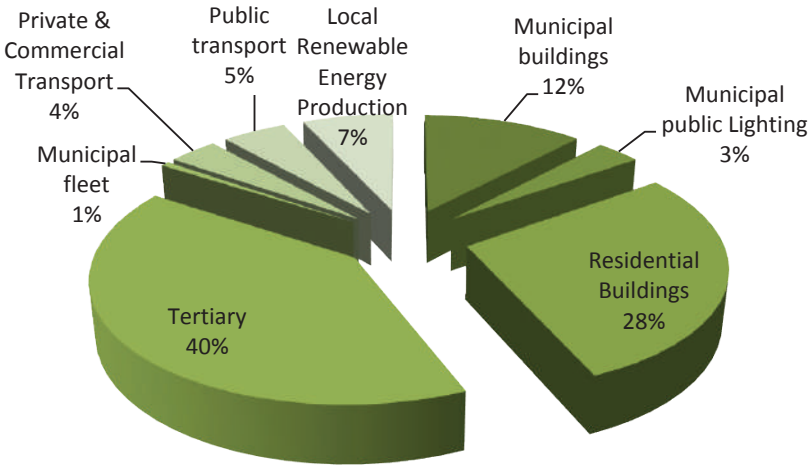


Figure 20: Sectors' contribution in the 2nd Scenario's attainment (CoM reduction target – Reduction potential of 40.61%)

In the next sections a more detailed analysis per action for each sector is provided. It should be noted that for awareness raising activities conducted by ASEZA, besides the implementation cost born by ASEZ Authority and its potential funding sources, the amount of the private funds mobilized is reported as well where relevant. Moreover awareness actions implemented by the Authority with impacts on private sector are considered to be beneficiary

actions and the NPV is not calculated for them (NPVs have been calculated for each action's lifetime and not for the target's timeline).

3.2 Municipal Buildings, Equipment/Facilities

This sector contributes in the carbon footprint with only 2.20%. Nevertheless the possible actions to be implemented in the Municipal Buildings could set an example for the citizens and the employees. ASEZA acknowledged the measures which best fit its needs so as to achieve energy savings and emission reductions. In the following sections, a comprehensive set of actions is being analysed.

The suggested actions for this sector consist of energy conservation and green energy production measures. Focus has been placed on energy saving activities and PVs on buildings' roofs, since these are considered to be easily implemented, unlike the bigger RES facilities requiring more time and more free spaces available.

Apart from these categories of actions, there are also some envisaged actions which target the user through awareness raising activities. These actions aim to make the inhabitants' behavior environmental friendly, as well as to properly educate the new generations in environmental and energy related issues.

An overview of this sector's actions and achieved reductions is presented on the table below.

Table 16: Actions in Municipal Buildings, Equipment/Facilities

Action No.	Action	Emission Reductions (tn CO_2)	
		1st Scenario 14% target	2nd Scenario 40% target
1.1	Green procurement procedures for ASEZA buildings	664.96	
1.2	Improving energy efficiency in ASEZA buildings	1,521.70	2,173.86
1.3 (F)	Energy upgrade and RES in ASEZA main building	2,231.70	
1.4	Energy manager appointment in ASEZA	37.15	
1.5	Awareness raising activities for ASEZA employees	118.88	
1.6	Adoption of bioclimatic principles in ASEZA buildings /Strict application of green building codes in ASEZA buildings	733.69	2,347.79
1.7	Promotion of recycling	824.76	
1.8	Awareness raising campaigns to reduce the organic content of waste)	164.95	
1.9	PVs in ASEZA buildings (500 KWp)	492.81	
1.10 (F)	Green Municipal Building	127.66	
	Eco Science Park awareness raising	1,499.41	
1.11 (F)	Landfill	18,871.09	
1.12	Establishment of an Energy Saving Department	0.00	
1.13	Web portal creation	0.00	
	Total	27,288.76	29,555.02

3.2.1 Green procurement procedures for ASEZA buildings

Green procurements are the procedures where the local authority seeks to purchase goods and services with a reduced environmental impact throughout their life cycle. Selecting

products of high efficiency that minimize the environmental impacts, it is possible to consume less energy thus reduce the CO_2 emissions and achieve monetary savings. The action is envisaged to be applied in all new office equipment that ASEZA plans to purchase for their increasing needs and for the gradual substitution of old, inefficient one. Especially for high energy consuming office equipment, high efficiency products will be targeted, while minimum efficiency standards and requirements will be set in all relevant ASEZA tenders. An average estimation of 5% savings achieved against the BAU consumptions is envisaged.

In the next table, calculations regarding the cost, the savings and the financial viability of the action are presented.

Table 17: Action 1.1 in numbers

Green procurement procedures	
Duration	2018 - 2030
Total Implementation Cost (JOD)	976,600
Annual Energy Savings (MWh)	1,145.96
Annual Emission Reduction (tn CO_2)	664.96
Funding Source	Own funds
Net Present Value (NPV)	>0

3.2.2 Improving energy efficiency in ASEZA buildings

Another important measure to be implemented is the energy enhancement of electrical systems and building's envelope according to the guidelines of "Energy Efficient Building Code". Starting from the lighting, ASEZA should replace the old lamps with new, more efficient ones, such as LEDs. LEDs consume less energy while they offer higher levels of brightness. They are more expensive than the conventional ones but they have longer lifetime. Moreover, the upgrade of cooling & heating systems is a way to reduce the electricity consumption as well. Regarding the building envelope, insulation and double glazing or even window shading are great solutions to keep the inner thermal comfort using less the cooling/heating systems. It is envisaged that these measures will be gradually implemented on the existing ASEZA buildings, leading on energy savings of at least 30%, and respective CO_2 reduction and monetary savings. In the 1st Scenario, these measures will be implemented in 70% of the ASEZA buildings and facilities (besides the main ASEZA building), while in the 2nd scenario (40% reduction), the same measures will be applied in all existing ASEZA buildings, besides the main building of ASEZA that is examined separately in the next section.

In the next table, calculations regarding the scenario of 14% and 40% are presented.

Table 18: Action 1.2 in numbers

Improving energy efficiency in ASEZA buildings		
	1st Scenario 14% target	2nd Scenario 40% target
Duration	2018-2020	2018 - 2023
Total Implementation Cost (JOD)	1,421,000	4,350,000
Annual Energy Savings (MWh)	2,622.42	3,746.32
Annual Emission Reduction (tn CO_2)	1,521.70	2,173.86
Funding Source	Own funds, Donors & Government	
Net Present Value (NPV)	>>0	>0

3.2.3 Energy upgrade and RES in ASEZA main building

ASEZA plans to upgrade the main public building so as to achieve energy savings and to perform as a demonstrative example of good practices for its citizens. The measures planned within this action include the following:

- Installation of an 800 KWp PV system so as to cover a part of the building's electricity consumption through the production of "clean" energy.
- Lamps' replacement by LEDs and installation of sensors and timers for controlling them.
- Upgrade of the HVAC system, in parallel with shadings' and digital thermostats' installation, so as to manage the temperature in all spaces.

These measures comprise the project fiche "Energy rationalization in ASEZA main building", where more a detailed analysis is provided.

In the next table, related calculations to this action in terms of initial cost, energy and emission savings, as well as financial viability are presented.

Table 19: Action 1.3 in numbers

Energy upgrade and RES in ASEZA main building	
Duration	2020 - 2023
Total Implementation Cost (JOD)	1,203,702
Annual Energy Savings (MWh)	2,487.00
Annual Energy **Production** (MWh)	1,359.00
Annual Emission Reduction (tn CO_2)	2,231.70
Funding Source	Own funds, International Financial Institutions
Net Present Value (NPV)	>>0

3.2.4 Energy manager appointment in ASEZ Authority

One of the prerequisites of ASEZA's adhesion to the Covenant of Mayors is the creation of the appropriate administrative structures, in order to establish the working team to implement and monitor the progress of the SECAP activities. In this respect, this action focuses not only on the satisfaction of the above mentioned prerequisite, but goes well beyond it.

The energy manager will not only be the responsible person to monitor the energy consumptions and provide the necessary solutions when a problem is identified, but will act proactively in order to ensure the good coordination of the whole ASEZA team for the proper implementation of the envisaged SECAP actions. The benefits related to the energy manager's appointment are considered multi-dimensional since strong coordination of the overall initiative is required, although strictly economic indicators are not encouraging. In case a member of the existing ASEZA staff is appointed to this position, this will have even greater benefits for the ASEZ Authority.

Table 20: Action 1.4 in numbers

Energy manager appointment in ASEZA	
Duration	2018 - 2030
Total Implementation Cost (JOD)	420,000
Annual Energy Savings (MWh)	64.02
Annual Emission Reduction (tn CO_2)	37.15
Funding Source	Own funds
Net Present Value (NPV)	<0

3.2.5 Awareness raising activities for ASEZ Authority's employees

A significant step to achieve the planned targets is to have properly communicated ASEZA's intentions to the people working within those buildings. In this respect, this action comprises of a set of targeted awareness raising activities towards the ASEZA employees. The aim of these activities is to encourage the ASEZA employees to change their behavior and habits in order to achieve the envisaged results.

The set of awareness raising and training actions to be realised for the ASEZA employees includes the following:

- Training workshops and seminars for the team members directly involved in the SECAP implementation and monitoring. This activity aims at the capacity building regarding SECAP development and project implementation of the employees directly involved in the SECAP implementation team. These workshops and seminars could be targeted on how to attract financing from international donors, to manage the project implementation or even focus on the exchange of best practices and ideas with other municipalities in Jordan and abroad that face the same challenges. Workshops on the latest available know how in terms of energy efficiency and RES technologies are envisaged as well.
- Development and circulation of promotional material through the employees' e-mails on the benefits of energy efficiency and how simple behavior changes impact the total consumption.
- Contest for the ASEZA administrative building with the highest energy savings achieved (in terms of %) due to users' behavior change. This contest prize could be any incentive provided to the employees, such as two additional days off that year or the development of posters with the pictures and names of the employees that contributed to the goal. The aim would be to achieve energy savings through strictly behavioral change, such as turning off the lights, the A/C and office equipment when leaving the office, not leaving open windows with the A/C on etc. This measure could be used during the first couple of years, when the rest of the energy efficiency interventions will be gradually taking place.

Table 21: Action 1.5 in numbers

Awareness raising activities for ASEZA employees	
Duration	2018-2023
Total Implementation Cost (JOD)	20,000
Annual Energy Savings (MWh)	204.86
Annual Emission Reduction (tn CO_2)	118.88
Funding Source	Own funds
Net Present Value (NPV)	>0

3.2.6 Adoption of bioclimatic principles in ASEZA buildings/ Strict application of green building codes in ASEZA buildings

Due to the expected economic and population growth in site of 2030 horizon, citizens' needs will be increased, therefore ASEZA's services should be extended. As a result, new buildings will be constructed to meet city's needs and consequently there will be an increase in energy consumption, as envisaged in the BAU scenario. In order to mitigate this increase, the construction of new buildings under the two different scenarios should be either based on the partial adoption of bioclimatic principles (1st scenario), or strictly abide with the Energy Efficient Building Code.

According to these, under the 1st scenario it is envisaged that in 50% of the new ASEZA buildings to be constructed, a series of measures to curtail the building's energy consumption by 25% against a conventional building, will be applied. These measures include the adoption of natural lighting and ventilation, insulation in exterior surfaces, as well as shading in the glazing. In addition to the above, the use of cool colors especially in roofs will also contribute significantly to the reduction of energy losses. Moreover the building's orientation should be taken into consideration.

All the above measures (plus other appropriate bioclimatic principles where it is possible), as well as strict application of the existing Energy Efficient Building Code will be implemented in all new buildings under the 2nd scenario, so as to reduce the expected increase in energy and CO_2 emissions.

Table 22: Action 1.6 in numbers

Adoption of bioclimatic principles in ASEZA buildings /Strict application of green building codes in ASEZA buildings		
	1st Scenario 14%	2nd Scenario 40%
Duration	2018 - 2030	
Total Implementation Cost (JOD)	400,000	1,800,000
Annual Energy Savings (MWh)	1,264.40	4,046.06
Annual Emission Reduction (tn CO_2)	733.69	2,347.79
Funding Source	Own and governmental funds	
Net Present Value (NPV)	>0	>0

3.2.7 Promotion of recycling

As waste contributes with a 9% to the total municipal emissions, ASEZA is dedicated to actively implement awareness activities to promote the recycling context. The target is to achieve 15% recycling rates by 2030. The promotional campaign will include info days, promotional material like leaflets and posters or even messages in local media (TV, radio, social media) regarding the benefits of recycling and instructions on how to do it.

ASEZA will also ensure that the proper infrastructure (recycling bins and vehicles) is available for the waste sorting and collection on the streets, including recycling of electrical devices. Furthermore, in order to lead by example, the ASEZ Authority will install recycling bins in all ASEZA buildings and facilities, promoting the use of recycled paper for the local administration.

Table 23: Action 1.7 in numbers

Promotion of recycling	
Duration	2018 - 2025
Total Implementation Cost (JOD)	1,000,000
Annual Emission Reduction (tn CO_2)	824.76
Funding Source	Own funds
Net Present Value (NPV)	<<0

3.2.8 Awareness raising campaigns to reduce the organic content of waste

The next stage of the recycling activities is the effort to reduce the amounts of organic waste which is a significant source of GHG emissions. ASEZA will organize raise awareness campaigns so that citizens understand the harmful impacts that the discarded food may cause during its combustion in the landfill. The idea is to inform inhabitants how to separate organic waste and persuade them to purchase composting bins in order to use their compost product in domestic cultivation. Alternatively, the ASEZ Authority will install a number of bins in specific areas to collect the organic waste and transfer them in composting units.

The awareness campaign will include the dissemination of messages through radio, newspapers and television, especially using local media, launching of promotional material (leaflets, brochures, posters) and perhaps billboard advertisements. Special events for schoolchildren will be realized as well.

Table 24: Action 1.8 in numbers

Awareness raising campaigns to reduce the amounts of discarded food (reduction of the organic content of waste)	
Duration	2018 - 2025
Total Implementation Cost (JOD)	200,000
Annual Emission Reduction (tn CO_2)	164.95
Funding Source	Own funds
Net Present Value (NPV)	>0

3.2.9 PVs in ASEZA buildings (500 KWp)

The solar energy potential for the country and the ASEZ is very high, thus the Authority has to exploit this opportunity and install PVs to cover a part of ASEZA buildings' electricity consumption. The ASEZ Authority is planning to utilize the rooftops of its buildings besides ASEZ main building, so as to install another 500 KW. The produced electricity from Renewable Energy Sources like sun has zero emissions. Consequently the substitution of electricity production source with alternative ones will contribute to the CO_2 reduction. Data on the duration of the action, its cost and related figures on electricity production and CO_2 emissions reduction are presented in the next table.

Table 25: Action 1.9 in numbers

PVs in ASEZA buildings (500 KWp)	
Duration	2018 - 2025
Total Implementation Cost (JOD)	500,000
Annual Energy Production (MWh)	849.28
Annual Emission Reduction (tn CO_2)	492.81
Funding Source	Own funds, IFIs, Donors
Net Present Value (NPV)	>0

3.2.10 Green Municipal Building and Eco Science Park Awareness Raising

The aim of this action is the construction of an Eco-Science Park driven by environmental obligations and incorporating a variety of demonstrative applications of Renewable Energy Sources (RES), as well as the construction of a Green Building to house ASEZA services and operate as best practice example, enhancing the living conditions of its employees and the

citizens visiting it. This state-of-the-art Eco science park will engage a number of demonstrative RES technologies and will act as a demonstration of environmental themes such as Smart Green building, Energy, Transportation, Water, Waste, Organic and sustainable farming, Sustainable tourism, eco-tourism, and fishing. In this context awareness raising activities will be organized as well by the Green Building's staff in order to inform citizens of the environmental friendly characteristics and facilities of the park and encourage them to engage in the effort of energy savings through their behavioral change. This action constitutes a priority for the ASEZ Authority, and for this reason is developed in detail in the project fiche "Eco-Science Park".

Table 26: Action 1.10 in numbers

Construction of a Green Municipal Building (as a pilot project) & Awareness Raising activities organized from Green Building (impacts from Eco Science Park)	
Duration	2018 - 2030
Total Implementation Cost (JOD)	1,010,153
Annual Energy Savings (MWh)	2,770.0
Annual Energy Production (MWh)	34.00
Annual Emission Reduction (tn CO_2)	1,627.07
Funding Source	Own funds, IFIs, Donors
Net Present Value (NPV)	<0

3.2.11 Landfill

ASEZA's Solid Waste is currently disposed of in an unlined landfill with no environmental controls. This leaves the soil and air vulnerable to pollution and may expose landfill employees and users of the surrounding area to health risks. ASEZA plans to develop an integrated solid waste management plan, consisting of a waste segregation/treatment facility and a properly engineered sanitary landfill so as to efficiently manage the big amounts of the city's waste and reduce the GHG emissions. The treatment facility is envisaged to capture half of the produced methane in order to produce electricity as well. This action constitutes a priority for ASEZA and thus is described in detail in the "Aqaba landfill development" project fiche. Key data on the investment are also presented in the table below.

Table 27: Action 1.11 in numbers

Landfill	
Duration	2018 - 2025
Total Implementation Cost (JOD)	13,356,595
Annual Energy Production (MWh)	6,053.0
Annual Emission Reduction (tn CO_2)	18,871.09
Funding Source	Own and EU funds, IFIs, Public-Private Partnerships
Net Present Value (NPV)	<<0

3.2.12 Establishment of an Energy Saving Department

The creation of an Energy Saving Department is proposed, to be staffed with 2 or 3 people according to ASEZA's needs. These employees should be qualified with energy issues so as to promote appropriate activities related to energy savings and support citizens. Citizens will turn to this department in order to be informed for new practices and to receive techno-

economic advices regarding their energy related investments. In addition to the above, this department can support the activities of the energy manager and undertake the responsibility for monitoring the SECAP actions' progress, in close collaboration with the employee directly involved with their implementation. The implementation of this action is not considered to derive direct energy savings and CO_2 reduction benefits, but it is seen as a supplementary one to the rest of the actions in the sector.

Table 28: Action 1.12 in numbers

Creation of Energy Saving Department	
Duration	2018 - 2030
Total Implementation Cost (JOD)	1,260,000
Funding Source	Own funds

3.2.13 Web portal creation

The creation of a web portal regarding energy savings could be a tool for the Energy Saving Department so as to interact with the citizens. The aim is to inform inhabitants about the ASEZA's actions and events related to the SECAP implementation, new measures for energy savings as well as funding sources. Moreover the webpage will host a discussion forum where they could exchange their opinions, find out solutions to their questions and keep in touch with the Energy Saving Department's staff. No direct energy savings have been allocated to this action, but it is considered to be a significant contribution in encouraging citizens to adopt the "green" practices and as a major tool in the promotion of all related awareness raising activities by the ASEZ Authority. This website can be a dedicated site linked to ASEZA's one, or be integrated within it.

Table 29: Action 1.13 in numbers

Web portal creation	
Duration	2018 - 2030
Total Implementation Cost (JOD)	3,000
Funding Source	Own funds

3.3 Municipal Public Lighting

The municipal public lighting includes street lighting and public areas' lighting. It is estimated that with the appropriate upgrades of this system there will be significant energy savings and respective emission reductions.

An overview of this sector's actions is presented in the table below, while a detailed analysis with calculations for each action follows in the next paragraphs.

Table 30: Actions in Municipal Public Lighting

Action No.	Action	Emission Reductions (tn CO_2)
2.1 (F)	ASEZA lighting study and system upgrade	5,019.09
2.2 (F)	Solar cells installation for lighting network	221.66
2.3	Green procurement procedures for future lighting equipment	2,894.86
	Total	8,135.61

3.3.1 ASEZA lighting study & System upgrade

First thing required before any new measure, in the herein sector, is to prepare and submit a detailed study (Lighting feasibility study). The study will present the current situation and it will examine and suggest any additional measures to be taken besides lamps' replacement, in order to achieve the envisaged energy savings while keeping high efficiency in the street lighting. These measures could be the increase or reduction of the distance between the lighting poles, in order to improve light quality or reduce phenomena of light pollution. Subsequently the first proposed measure is to replace the sodium (12,000 x 275W) and mercury (6,000x275W) lamps with LED lamps. This action will ensure great monetary savings for ASEZA and significant reduction in electricity consumption. These two actions constitute part of the "Rationalize energy consumption used in street lighting" project fiche, where there is provided a more detailed analysis of the related costs and calculated energy savings. Key data on the action is presented in the below table.

Table 31: Action 2.1 in numbers

ASEZA lighting study & System upgrade	
Duration	2018 - 2025
Total Implementation Cost (JOD)	3,582,683 (total #5 fiche cost)
Annual Energy Savings (MWh)	8,649.64
Annual Emission Reduction (tn CO_2)	5,019.09
Funding Source	Own funds, IFIs, EU Funds and Programs, other external funds
Net Present Value (NPV)	>0

3.3.2 Solar cells installation for lighting network

Another action planned is to build power systems based on micro-technology and the use of solar cells and components of the current lighting network, including the installation of on-grid PV micro inverters, to reduce the electricity consumed by the Electricity Distribution Company. The PV panels' capacity will be 225 KWp and they will cover a part of the street lighting's electricity consumption thus reducing the CO_2 emissions. More details about this action are available in the respective project fiche. Key data on the action are presented below.

Table 32: Action 2.2 in numbers

Solar cells installation for lighting network	
Duration	2018 - 2025
Total Implementation Cost (JOD)	3,582,683 (total #5 fiche cost)
Annual Energy **Production** (MWh)	382.00
Annual Emission Reduction (tn CO_2)	221.66
Funding Source	Own funds, governmental funds
Net Present Value (NPV)	>0

3.3.3 Green procurement procedures for the future lighting equipment

Green procurement constitutes the procedure where the municipalities seek to procure goods with reduced environmental impact throughout their life cycle and high efficiency standards. In this way selection of products that minimize environmental impacts takes place,

emphasizing on highly energy efficient equipment. This action is envisaged for the future lighting equipment purchases within the 2030 horizon, since it is expected that the network will expand due to the city's growth. Key data on the action is presented in the table below.

Table 33: Action 2.3 in numbers

Green procurement procedures for the future lighting equipment	
Duration	2020 - 2030
Total Implementation Cost (JOD)	2,322,600
Annual Energy Savings (MWh)	4,988.85
Annual Emission Reduction (tn CO_2)	2,894.86
Funding Source	Own funds
Net Present Value (NPV)	>>0

3.4 Residential Buildings

This sector includes the energy consumption of all the private residents regarding the activities in each household (lighting, heating, use of electric appliances etc.). This consumption constitutes the 26.02% of the total consumption with 26.36% contribution to the CO_2 emissions.

The initial actions are informational and they will be realized by ASEZA. ASEZA does not have the possibility of direct interventions in terms of projects' realization thus a series of actions will be planned aiming at encourage inhabitants to take the proposed measures in order to reduce their energy consumption and carbon emissions.

An overview of this sector's planned actions is presented in the next table.

Table 34: Actions in Residential Buildings

Action No.	Action	Emission Reductions (tn CO_2)	
		1st Scenario 14% target	2nd Scenario 40% target
3.1	Awareness raising activities for modification of the residents' consumption behavior	3,356.76	
3.2	Promotion of Green Buildings' concept / Strict application of the building code	3,292.16	26,337.31
3.3	Campaign for promoting high energy label equipment and other awareness activities	3,356.76	
3.4	3MW/5MW Photovoltaics in residential rooftops	2,956.86	4,928.09
3.5	Replacing existing electric water heater with solar collectors	16,530.25	24,795.38
3.6	Replacement of existing lamps with LEDs	893.89	2,681.66
3.7	Replacement of existing air-conditioners with more efficient ones	4,063.11	
3.8	Use of cool colors in rooftops	361.17	
3.9	Replacement of single glazing with double/Window shading	60.01	
	Total	34,870.96	69,940.24

3.4.1 Awareness raising activities for modification of the residents' consumption behavior

The initial step is that ASEZA should organize frequently within the 2030 horizon, awareness raising campaigns for the residents of ASEZ. Citizens' engagement is of utmost importance since the 26% of the total energy consumption is due to the residential sector. The aim is to enhance the environmental consciousness of the citizens through the following activities:

- Organization of "Energy days", in line with its participation in the Covenant of Mayors initiative. In these energy days the importance of energy saving and protecting the environment will be stressed, through simple actions such as modification of the energy behavior, changing incandescent lamps with fluorescent or LED lamps, importance of purchasing high energy class appliances, installation of solar panels for water heating in existing buildings etc.
- Projection of freely available environmental documentaries.
- Participation in "Earth hour" event by WWF, where people across the world turn their lights off for one hour on a designated day.

Related calculations on the action in terms of initial cost and emission savings are presented in Table 33 below. As an awareness raising activity, it is considered that the action is exponentially beneficial to the local authority against the related costs.

Table 35: Action 3.1 in numbers

Awareness raising activities for energy reduction through actions and modification of consumption behavior of the residents	
Duration	2018 - 2025
Total Implementation Cost (JOD)	60,000
Annual Energy Savings (MWh)	5,784.86
Annual Emission Reduction (tn CO_2)	3,356.76
Funding Source	Own funds, governmental funds
Net Present Value (NPV)	>>0

3.4.2 Promotion of Green Buildings' concept / Strict Application of the Building Code

The lack of mandatory application of the Energy Efficient Building Code in Jordan is one of the key issues behind the moderate energy behavior of buildings in the country. This action is focusing only in new buildings, and has been developed around the two aforementioned scenarios.

The 1st scenario envisages the promotion of specific elements of the green buildings' concept that can lead to a reduction of approximately 25% against contemporary buildings and be applied in around 20% of the new buildings to be constructed. This 20% penetration level has been considered an average rate with which citizens adopt such types of measures, following the intensive awareness raising activities to be realized by ASEZA. Also, ASEZA will proceed in consultations with the building constructors and try to establish voluntary agreements with them in order that they apply some minimum energy efficiency standards in the new constructions, to be commonly agreed.

Customised sets of potential interventions and actions will be suggested to the citizens through info days and awareness activities in the local media (local newspapers, TV and radio), as well as distribution of dissemination material (flyers, brochures etc.). These interventions will be mainly focusing on the need to install shadings in the southern glazing and roof

insulation, as well as paint the buildings' facade and roofs with cool colours, that reduce thermal absorption. Low cost efficient technologies will be promoted as well, such as the use of energy efficient lamps (e.g. LEDs). The green municipal building will serve as a demonstration basis of these technologies and the existing potential for energy and cost reductions.

The 2nd scenario focuses on the legislative adoption of the existing Energy Efficient Building Code, and its compulsory use for all new residential buildings. The penetration level of the current scenario is considered to cover 100% of the new buildings to be constructed within the 2030 horizon, while the envisaged savings against a contemporary building and the BAU scenario are approximately 40%.

Related calculations on the action in terms of initial cost and emission savings are presented in the table below. As an awareness raising activity, it is considered that the action is exponentially beneficial to ASEZA against the related costs.

Table 36: Action 3.2 in numbers

Promotion of Green Buildings' concept / Strict application of the Building Code		
	1st Scenario 14%	2nd Scenario 40%
Duration	2019 - 2030	
Total Implementation Cost (JOD)	250,000	300,000
Private Funds Mobilized (JOD)	21,186,220	105,931,000
Annual Energy Savings (MWh)	5,673.54	45,388.34
Annual Emission Reduction (tn CO_2)	3,292.16	26,337.31
Funding Source	Own funds, Governmental funds, Private funds	
Net Present Value (NPV)	<<0	<<0

3.4.3 Campaign for promoting high energy label equipment

Another important activity the ASEZ Authority should organize is the campaign for promoting among the residents the purchase and use of high energy label equipment. The old equipment (refrigerators, stoves, vacuum cleaners etc.) consumes greater amounts of energy compared to new technology's equipment which is more efficient.

The aim is to inform residents about the benefits of goods with a reduced environmental impact throughout their life cycle, emphasizing also on the monetary benefits for the users themselves, since when selecting energy efficient products this leads in less energy consumption as well.

As presented in the previous sections, dedicated awareness raising activities should also take place in order to disseminate the advantages of purchasing such electrical appliances. Such awareness raising campaigns include brief spots on the local TV and radio, posters, info days etc.

Key data on the action and its expected impact is presented in the table on next page.

Table 37: Action 3.3 in numbers

Campaign for promoting high energy label equipment	
Duration	2018 - 2023
Total Implementation Cost (JOD)	100,000
Private Funds Mobilized (JOD)	5,040,000
Annual Energy Savings (MWh)	5,784.86
Annual Emission Reduction (tn CO_2)	3,356.76
Funding Source	Own funds, Governmental funds, Private funds
Net Present Value (NPV)	>0

3.4.4 3MW/5MW Photovoltaics in residential rooftops

As mentioned before, the solar energy potential is very high in the region. The households have the opportunity to install PV panels in the buildings' rooftops in order to substitute a part of the current electricity consumption with "green" energy from Renewable Energy Sources. In that way, and since electricity from solar energy has zero emission factor, the CO_2 emissions will be reduced. In the 1st scenario 3MW PVs in total are proposed to be installed while in the 2nd scenario 5MW PVs are considered. Key data on the action are presented in the table below.

Table 38: Action 3.4 in numbers

3MW/5MW Photovoltaics in residential rooftops		
	1st Scenario 14%	2nd Scenario 40%
Duration	2018 - 2030	
Private Funds Mobilized (JOD)	3,000,000	5,000,000
Annual Energy **Production** (MWh)	5,095.69	8,492.82
Annual Emission Reduction (tn CO_2)	2,956.86	4,928.09
Funding Source	Private funds, Loans	
Net Present Value (NPV)	>>0	>>0

3.4.5 Replacing existing electric water heater with solar collectors

A standard permanent need in every household is the use of hot water for personal hygiene and house chores. Subsequently, currently a significant share of electricity consumption is consumed for this activity. At the same time, although the use of solar water heaters in the country is quite extensive, it is considered that it could be further strengthened in the future. In order to mitigate the emissions derived from this activity's electricity consumption the solution is to exploit the solar energy potential replacing the electric water heaters with solar water heaters.

A penetration level of the SWH in 30% (for the 14% target) and 45% (for the 40% target) respectively of the existing households currently using an electric water heater is envisaged, considering that ASEZA will work towards this direction with its citizens through awareness raising activities and dedicated events. Data on the energy savings from the use of a SWH per

household have been retrieved from the "Jordan third national communication on climate change".

Table 39: Action 3.5 in numbers

Replacing Existing Electric Water Heaters with Solar Collectors		
	1st Scenario 14%	2nd Scenario 40%
Duration	2018 - 2025	
Private Funds Mobilized (JOD)	4,520,000	6,779,000
Annual Energy Production (MWh)	28,487.38	42,731.06
Annual Emission Reduction (tn CO_2)	16,530.25	24,795.38
Funding Source	Private funds	
Net Present Value (NPV)	>>0	>>0

3.4.6 Replacement of existing lamps with LEDs

Currently, the use of LED lamps in the residential sector is relatively limited. The use of LED technology is suggested, since it can lead in energy and monetary savings on one hand, while these lamps provide great luminosity quality on the other. Their cost is higher from the conventional ones, but they have long life expectancy and a quite positive cost benefit ratio.

There are two scenarios envisaged for this action, focusing on lighting in existing buildings. Under the 1st scenario, it is expected that through the awareness raising activities citizens will be encouraged to implement measures like this with a penetration level of 30%, thus contributing to the energy savings and CO_2 reduction in the region.

Under the 2nd scenario, it is considered that ASEZA will take upon legislative action to ban the use of mercury and low efficiency lamps in the area. Thus, the penetration level for high efficient lamps such as LEDs has been considered 100%.

Key data on the action are presented in the next table.

Table 40: Action 3.6 in numbers

Replacement of existing lamps with LEDs		
	1st Scenario 14%	2nd Scenario 40%
Duration	2018 - 2025	2018 - 2030
Private Funds Mobilized (JOD)	1,287,000	3,862,000
Annual Energy Savings (MWh)	1,540.47	4,621.42
Annual Emission Reduction (tn CO_2)	893.89	2,681.66
Funding Source	Private funds	
Net Present Value (NPV)	>0	>0

3.4.7 Replacement of existing air-conditioners with more efficient ones

The hot climate in ASEZ region evokes the intense use of cooling systems in buildings and as a result a quite big percentage of electricity consumption is due to this need. In order to cut down the energy consumption the replacement of the existing A/Cs with units of higher energy class is suggested. Since A/Cs can constitute a significant part of the household's electricity bill, it is considered that within the 2030 horizon and following intensive awareness raising activities by ASEZA, the residents who are going to install/replace an A/C unit, will

prefer one with relatively high performance standards. An overall penetration level of 25% of the action in existing households is assumed.

Related calculations on the action in terms of initial cost and emission savings are presented in the table below.

Table 41: Action 3.7 in numbers

Replacement of existing conditioners with more efficient ones	
Duration	2018 - 2025
Private Funds Mobilized (JOD)	5,363,600
Annual Energy Savings (MWh)	7,002.16
Annual Emission Reduction (tn CO_2)	4,063.11
Funding Source	Private funds
Net Present Value (NPV)	>0

3.4.8 Use of cool colors in rooftops

As mentioned above, the share of electricity consumption by cooling systems in residences is very high due to the region's hot climate. Another measure to partially curtail the electricity consumption for cooling, besides the previous one, is the use of cool colors in rooftops or even the external walls in order to reflect a higher percentage of the absorbed heat, thus maintaining the inner temperature at lower levels. Use of cool colors and/or materials is a technology easily applied on the building, since its use is like any other regular paint.

The energy savings from such an action are usually allocated in the top building floor and reach 20% of the electricity consumption for cooling purposes. The penetration level of this action in existing buildings is considered to be 10%. ASEZA's role once again is to communicate to the citizens the benefits of this action, also utilizing the demonstrative projects and other awareness activities to be conducted.

Related calculations on the action in terms of initial cost and emission savings are presented in the table below.

Table 42: Action 3.8 in numbers

Use of cool colors in rooftops	
Duration	2018 - 2030
Private Funds Mobilized (JOD)	572,000
Annual Energy Savings (MWh)	622.41
Annual Emission Reduction (tn CO_2)	361.17
Funding Source	Private funds
Net Present Value (NPV)	≈0

3.4.9 Replacement of single glazing with double/Window shading

A supplementary action with limited but not negligible savings is glazing replacement. In ASEZ, although summers are very hot, in winter heating systems are required to achieve thermal comfort inside buildings.

These heating systems consume LPG, Diesel and Kerosene and it is feasible to reduce their consumption by 15%, by reducing the building's heating losses via replacement of the single

glazing with double. This action can also have impact in the electricity consumption, especially if it is to be combined with the installation of shading in the windows.

Related calculations on the action in terms of initial cost and emission savings are presented in the table below.

Table 43: Action 3.9 in numbers

Replacement of single glazing with double/Window shading	
Duration	2018 - 2025
Private Funds Mobilized (JOD)	13,409,000
Annual Energy Savings (MWh)	135.72
Annual Emission Reduction (tn CO_2)	60.01
Funding Source	Private funds
Net Present Value (NPV)	<<0

3.5 Tertiary Sector

This sector includes the energy consumption of commercial buildings, stores, offices, companies, schools, hospitals, hotels etc. regarding the activities in each one (lighting, heating, use of electric appliances etc.). This consumption constitutes the 32.15% of the total consumption, with 38.59% contribution to the CO_2 emissions.

The initial actions are informational and they will be realized by ASEZA. ASEZA does not have the possibility of direct interventions in terms of projects' realization, thus a series of actions will be planned aiming at encourage building managers/owners to take the proposed measures in order to reduce their energy consumption and carbon emissions.

An overview of this sector's planned actions is presented in the next table.

Table 44: Actions in Tertiary Sector Buildings

Action No.	Action	Emission Reductions (tn CO_2)	
		Scenario 1 14%	Scenario 2 40%
4.1	Seminars and trainings on selected professional groups	1,694.77	
4.2	10% energy reduction campaign in commercial buildings-Energy friendly label	1,129.85	
4.3	Promotion of green buildings concept/ Strict Application of the Building Code	2,991.88	29,918.82
4.4	Campaign for promoting high energy label equipment	4,519.38	
4.5	10 MW/15MW Photovoltaics in rooftops	9,856.19	14,784.28
4.6	Replacing existing electric water heater with solar collectors	846.68	
4.7	Replacement of existing lamps with LEDs	11,456.26	34,368.78
4.8	Replacement of existing air conditioners with more efficient ones	4,260.59	
4.9	Use of cool colors in rooftops	2,272.32	
4.10	Installation of lighting automations & thermostats	4,023.89	

4.11	External shading installation	1,704.24	
4.12	Awareness raising campaigns for pupils/ students	73.34	
4.13	The 10% voluntary campaign for energy reduction in schools	316.26	
	Total	45,145.55	99,913.10

3.5.1 Seminars and trainings on selected professional groups

Lifelong learning activities are a key for the continuous evolvement of citizens and the society. Based on this fact, and taking into consideration the contribution of the tertiary sector on the municipality's carbon footprint, ASEZA intends to organize a series of seminars to targeted professional groups in order to promote the concept of energy management and energy saving practices and provide advice on ways to improve at low cost the energy efficiency of the related buildings and facilities.

ASEZA is orientated towards the realization of a series of seminar rounds, where in each seminar a different group of interested stakeholders will participate. These seminars will be differentiated depending on the type of the group of stakeholders being represented, so different solutions will be suggested for small buildings/ shops/ companies, and alternative options will be provided for medium or large size ones.

Since key energy consumers in buildings of the tertiary sector are mainly HVAC and lighting, which consumption is highly determined by the energy behavior of the buildings' and facilities' users, suggested technical solutions per group of stakeholders may include simple modification of the users' energy behavior, installation of automations and thermostats, use of cool colours, replacement of lamps with LEDs etc.

An overall reach out level of 15% is considered for the above mentioned activities. Key data on the action is provided in the following table.

Table 45: Action 4.1 in numbers

Seminars and trainings on selected professional groups	
Duration	2018 - 2025
Total Implementation Cost (JOD)	150,000
Annual Energy Savings (MWh)	2,920.68
Annual Emission Reduction (tn CO_2)	1,694.77
Funding Source	Own funds, Governmental funds

3.5.2 The 10% voluntary campaign for energy reduction in tertiary buildings

This campaign's aspiration is to establish environmental consciousness through the voluntary commitment of its citizens. It is designed in the form of a promotional campaign to increase the sense of responsibility towards the environment and the community among the citizens, while at the same time it will offer visibility benefits to those participating.

ASEZA will launch this program as a voluntary campaign, where shops and business owners can participate in order to reduce their facilities' energy and carbon footprint, and more importantly to reduce their electricity bill. Stakeholders who would like to participate will have to fill a form, potentially via the ASEZA's website, and submit the last year's electricity bills for the respective building/facility. Moreover, participants will attend informational and educational events organized by ASEZA with advice on how to reduce building's energy

consumption with simple actions. All the participants will also receive informational material as well. At the end of the year, participants will submit their electricity bills once more in order to prove at least a 10% of energy savings.

Subsequently ASEZA will organize a ceremony to provide the "Energy friendly business label" to those who achieved the target of 10% reduction, while it will publish their brands' names in the local newspapers and /or magazines, as an example of good practices. More specifically, this action is already implemented in the tourism sector with the "Green Key" eco-labeling certificate that aims to contribute to prevention of climate change and sustainable tourism by awarding and promoting good initiatives. A penetration level of 5% has been assumed for this initiative.

Related calculations on the action in terms of initial cost and emission savings are presented in the table below. As an awareness raising activity, it is considered that the action is exponentially beneficial against the related costs.

Table 46: Action 4.2 in numbers

The 10% voluntary campaign for energy reduction in tertiary buildings	
Duration	2018 - 2025
Total Implementation Cost (JOD)	20,000
Annual Energy Savings (MWh)	1,947.12
Annual Emission Reduction (tn CO_2)	1,129.85
Funding Source	Own funds & Governmental funds

3.5.3 Promotion of green buildings concept/ Strict application of the Building Code

In line with the respective action of the residential sector, this action is targeted towards the new buildings to be constructed in the tertiary sector until the 2030 horizon, and has been developed around the two aforementioned scenarios.

The 1st scenario envisages the promotion of specific elements of the green buildings' concept that can lead to a reduction of approximately 20% against contemporary buildings and be applied in around 15% of the new buildings to be constructed. This 15% penetration level has been considered an average rate, following the intensive awareness raising activities to be realized by ASEZA. Also, ASEZA will proceed in consultations with the building constructors and try to establish voluntary agreements with them in order that they apply some minimum energy efficiency standards in the new constructions, to be commonly agreed. Customised sets of potential interventions and actions will be suggested to the citizens through info days and awareness activities in the local media (local newspapers, TV and radio), as well as distribution of dissemination material (flyers, brochures etc.). Emphasis will be placed on the optimal orientation of the building, the need for increased natural lighting and natural ventilation, the inclusion of a minimum level of insulation in the buildings' exterior surfaces (walls and roof), as well as shading in the glazing. In addition to the above, the use of cool colours will also contribute significantly to the reduction of energy losses.

The 2nd scenario focuses on the legislative adoption of the existing Energy Efficient Building Code, and its compulsory use for all new tertiary buildings. The penetration level of the current scenario is considered to cover 100% of the new buildings to be constructed within the 2030 horizon, while the envisaged savings against a contemporary building and the BAU scenario are approximately 30%. This percentage has been considered on the basis that in tertiary

buildings there is usually additional equipment use that is not affected by the building's behavior.

Related calculations on the action in terms of initial cost and emission savings are presented in the table below. As an awareness raising activity, it is considered that the action is exponentially beneficial against the related costs.

Table 47: Action 4.3 in numbers

Promotion of green buildings concept/ Strict application of the Building Code		
	Scenario 1 14%	Scenario 2 40%
Duration	2019 - 2030	
Total Implementation Cost (JOD)	The cost is included in the respective action in the Residential Sector	
Private Funds Mobilized (JOD)	19,254,000	120,336,000
Annual Energy Savings (MWh)	5,165.05	51,560.54
Annual Emission Reduction (tn CO_2)	2,991.88	29,918.82
Funding Source	Private funds	
Net Present Value (NPV)	<<0	<<0

3.5.4 Campaign for promoting high energy label equipment

Another important activity ASEZA should organize is the campaigns for promoting high energy label equipment in the tertiary sector. The old electrical appliances consume significant energy amounts compared to newer technological options available. The aim is to inform business owners/managers about the benefits of goods with a reduced environmental impact throughout their life cycle. Selecting products of high efficiency that minimize the environmental impacts, it is possible to consume less energy thus reduce the CO_2 emissions and achieve monetary savings. As mentioned above, awareness raising activities should also take place in order to disseminate the advantages of purchasing such electrical appliances.

Table 48: Action 4.4 in numbers

Campaign for promoting high energy label equipment	
Duration	2018 - 2023
Total Implementation Cost (JOD)	100,000
Private Funds Mobilized (JOD)	6,786,000
Annual Energy Savings (MWh)	7,788.47
Annual Emission Reduction (tn CO_2)	4,519.38
Funding Source	Private funds
Net Present Value (NPV)	>0

3.5.5 10 MW/15 MW Photovoltaics in rooftops

The solar energy potential for the country and the ASEZ is very high thus businesses will be encouraged to exploit this opportunity and install PVs in order to cover a part of their electricity consumption. The utilization of rooftops is proposed for the installation of a total capacity of 10 MW of PVs (for the 14% target) and 15 MW respectively (for the 40% target). The produced electricity from Renewable Energy Sources like sun has zero emission factor.

Consequently the substitution of electricity production source with alternative ones will contribute to the CO_2 reduction.

Table 49: Action 4.5 in numbers

Photovoltaics in rooftops 10 MW/15 MW		
	Scenario 1 14%	Scenario 2 40%
Duration	2018 - 2030	
Private Funds Mobilized (JOD)	10,000,000	15,000,000
Annual Energy **Production** (MWh)	16,985.64	25,478.46
Annual Emission Reduction (tn CO_2)	9,856.19	14,784.28
Funding Source	Private funds	
Net Present Value (NPV)	>>0	>>0

3.5.6 Replacing existing electric water heater with solar collectors

Several businesses activated in the tertiary sector, such as hospitals and hotels, utilize extensively water heating for covering theirs and their customers' needs. Since the penetration of SWH in the sector in the baseline year was negligible, there is a significant potential for electricity savings through the adoption of SWH.

Key data on the action are presented in the following table.

Table 50: Action 4.6 in numbers

Replacing existing electric water heater with solar collectors	
Duration	2018 - 2025
Private Funds Mobilized (JOD)	232,000
Annual Energy **Production** (MWh)	1,459.13
Annual Emission Reduction (tn CO_2)	846.68
Funding Source	Private funds
Net Present Value (NPV)	>>0

3.5.7 Replacement of existing lamps with LEDs

Similarly to the respective action in the residential sector, there are two scenarios envisaged for this action, focusing on lighting in existing buildings.

Under the 1st scenario, it is expected that through the awareness raising activities business owners and building managers will be encouraged to implement measures like this with a penetration level of 30%, thus contributing to the energy savings and CO_2 reduction in the region.

Under the 2nd scenario, it is considered that ASEZA will take upon legislative action to ban the use of mercury and low efficiency lamps in the area. Thus, the penetration level for high efficient lamps such as LEDs has been considered 100%.

Key data on the action are provided in the below table.

Table 51: Action 4.7 in numbers

Replacement of existing lamps with LEDs		
	1st Scenario 14%	2nd Scenario 40%
Duration	2018 – 2025	2018 - 2030
Private Funds Mobilized (JOD)	16,500,00	49,494,000
Annual Energy Savings (MWh)	19,743.12	59,229.35
Annual Emission Reduction (tn CO_2)	11,456.26	34,368.78
Funding Source	Private funds	
Net Present Value (NPV)	>>0	>>0

3.5.8 Replacement of existing air conditioners with more efficient ones

The hot climate in ASEZ region evokes the intense use of cooling systems in buildings and as a result, a very big percentage of electricity consumption especially in the tertiary sector is required in order to cover this need. In order to cut down the energy consumption, the replacement of the existing A/Cs with units of higher energy class until the 2030 horizon is suggested. This action leads to significant energy savings and CO_2 reduction. An overall penetration level of 25% of the action in existing tertiary sector businesses is assumed. Key data on the action are provided in the table below.

Table 52: Action 4.8 in numbers

Replacement of existing air conditioners with more efficient ones	
Duration	2018 - 2030
Private Funds Mobilized (JOD)	5,624,000
Annual Energy Savings (MWh)	7,342.48
Annual Emission Reduction (tn CO_2)	4,260.59
Funding Source	Private funds
Net Present Value (NPV)	>>0

3.5.9 Use of cool colors in rooftops

The share of electricity consumption by cooling systems in tertiary buildings is very high due to the hot climate the region has. A measure to reduce this consumption is the use of cool colors in rooftops or even the external walls in order to protect the interior from the excessive heating thus maintain the inner temperature as low as it is possible.

Use of cool colors and/or materials can be easily applied on the building, since its use is like any other regular paint. The energy savings from such an action are usually allocated in the top building floor and reach 20% of the electricity consumption for cooling purposes. The penetration level of this action in existing buildings is considered to be 20%, since it is an action with significant monetary savings.

ASEZA's role once again is to communicate to the citizens the benefits of this action, also utilizing the demonstrative projects and other awareness activities to be conducted.

Related calculations on the action in terms of initial cost and emission savings are presented in the table below.

Table 53: Action 4.9 in numbers

Use of cool colors in rooftops	
Duration	2018 - 2030
Private Funds Mobilized (JOD)	3,600,000
Annual Energy Savings (MWh)	3,915.99
Annual Emission Reduction (tn CO_2)	2,272.32
Funding Source	Private funds
Net Present Value (NPV)	≈0

3.5.10 Installation of lighting automations & thermostats

Light and heat automations are one of the most cost effective and simple options for the proper control and reduction of the energy related costs in the tertiary sector, as it is a very usual phenomenon for the users to leave cooling equipment/lights etc. turned on upon their departure, or adjust the thermostat in improper temperatures, resulting in unnecessary consumptions. A solution to this is the installation of automations such thermostats, timers, movement sensors etc. In this way, the occupants are being monitored and consumptions outside the normal office working hours are being avoided. Since automations are considered a value for money investment, it has been assumed that the penetration of the action within the 2030 horizon will reach 25%. Key data on the action are provided in the table below.

Table 54: Action 4.10 in numbers

Installation of lighting automations & thermostats	
Duration	2018 - 2030
Private Funds Mobilized (JOD)	100,000
Annual Energy Savings (MWh)	6,934.57
Annual Emission Reduction (tn CO_2)	4,023.89
Funding Source	Private funds
Net Present Value (NPV)	>>0

3.5.11 External shading installation

The sunlight coming through windows increases the buildings' indoor temperature and consequently the use of A/Cs and other cooling systems during the summer months when the climate conditions in Aqaba are especially challenging. Installation of shadings in existing buildings constitutes a significant measure since it can prevent part of the heating due to sunlight and thus limit the energy consumption of the cooling systems. It is considered that such an investment can lead to significant energy savings and improvement of the living conditions in these buildings. A penetration level of 20% in the existing buildings has been considered until 2030.

Table 55: Action 4.11 in numbers

External shading installation	
Duration	2018 - 2030
Private Funds Mobilized (JOD)	200,000
Annual Energy Savings (MWh)	2,936.99
Annual Emission Reduction (tn CO_2)	1,704.24

Funding Source	Private funds
Net Present Value (NPV)	>>0

3.5.12 Awareness raising campaigns for pupils/ students

Apart from the suggested actions above, this action has been designed as a supplementary action for schools. Awareness raising activities will be designed and carried out by the ASEZA education department, utilizing also available educational material. Schools will be educating the students through lessons and thematic energy days, where dedicated professionals will be invited as well to explain the benefits for the environment and the significance of preserving energy. Moreover, through all awareness raising and capacity building activities realised, schoolchildren will put the corner stone for building an environmental consciousness and adopt an energy efficient behavior in their houses and as adults.

The action includes the development of explanatory brochures, the implementation of a thematic energy day, excursions to energy saving projects in ASEZ to show case the technologies and their results, as well as a drawing or essay contest on what the environment and energy means to them. Through activities and games, students can be informed about the climate change and its intense repercussion in environment and form a proper energy behavior while developing environmental consciousness.

Table 56: Action 4.12 in numbers

Awareness raising campaigns for pupils/ students	
Duration	2018 - 2025
Total Implementation Cost (JOD)	30,000
Annual Energy Savings (MWh)	126.39
Annual Emission Reduction (tn CO_2)	73.34
Funding Source	Own funds

3.5.13 The 10% voluntary campaign for energy reduction in schools

Another set of action focusing on schools is the 10% commitment campaign since students will have already embraced the basic practices from the previous awareness raising. This ambitious action will be realised to promote the environmental consciousness and personal responsibility against the environment and society among the students.

This campaign is a voluntary action, where schools choose to commit to a target of at least 10% reduction. This action is strictly based on modification of the energy behavior of the students and the teachers, without any investments on energy efficiency equipment. This campaign can also take the form of a contest between the different participating schools, on identifying the one achieving the highest energy saving percentage.

The achieved energy savings will be validated against the energy bills and the meters' readings, while the schools that achieve the commitment will receive an honorary praise. The school to win the contest and its students will receive the School Energy Cup by the Mayor in an open ceremony, while the financial resources saved for ASEZA will be invested in the school for simple energy efficient projects (automations etc.). This campaign will be rolled out at the same time with the one targeting the business sector, minimizing the organizational burden to the possible minimum.

Table 57: Action 4.13 in numbers

The 10% voluntary campaign for energy reduction in schools	
Duration	2018 - 2025
Total Implementation Cost (JOD)	20,000
Annual Energy Savings (MWh)	544.86
Annual Emission Reduction (tn CO_2)	316.16
Funding Source	Own funds

3.6 Transport

The share of the Transportation sector, including ASEZA fleet, private and commercial transport and public transport is 38.4% out of the total energy consumption in ASEZ, with 21.65% contribution in CO_2 emissions. The proposed actions are presented in the next table and a more detailed analysis for each one is following.

Table 58: Actions in Transport

Action No.		Action	Emission Reductions (tn CO_2)
5.1	Municipal fleet	Replacement of the existing ASEZA vehicles with new, more efficient vehicles (hybrid etc.) & plan to purchase only efficient vehicles in the future	606.18
5.2(F)		Installation of tracking and monitoring system for more efficient management of the fleet and better planning routes	150.96
5.3		ASEZA fleet maintenance (for the existing & the new ones)	351.28
5.4		Eco-driving seminars for the drivers of the ASEZA fleet	432.34
5.5	Private & Commercial Transport	Information events on the new vehicle technologies	0.00
		Replacement of gasoline vehicles with Hybrid	730.94
		Replacement of diesel vehicles with new more efficient	1,374.18
5.6		Improve public transportation/ promote the use of public transport	1,218.24
5.7		Cycling promotion and creation of related infrastructure	730.94
5.8		Promotion of walking and car sharing and carpooling campaigns	1,023.32
5.9		Improvement / development of parking infrastructure	1,096.41
5.10		Promotion of eco-driving	3,724.34
5.11 (F)		Replacement of gasoline vehicles with electric ones	136.12
5.12		Transportation master plan	0.00
5.13	Public Transport	Promotion of eco-driving for public transport's drivers	1,325.60
5.14		Promotion of new technology buses in the public transportation	2.54
5.15 (F)		Installing track and monitoring system in public transportation	2,758.70
5.16 (F)		Replacing the existing Taxi vehicles with Hybrid vehicles	7,767.00
5.17 (F)		Installing Solar systems on the buses related to Aqaba Company for transportation and logistics'(coach buses)	3.20
		Total	**23,432.28**

3.6.1 Replacement of the existing ASEZA vehicles with new, more efficient vehicles (hybrid etc.) & plan to purchase only efficient vehicles in the future

ASEZA's fleet consists of 308 vehicles which consume 11,453 MWh of Diesel and Gasoline. Purchasing new more efficient vehicles and/or with alternative fuels is a way to contribute to fuels savings and CO_2 reduction.

Moreover, in view of the future development, there will be need for some extra vehicles so as to cover ASEZA's activities and serve the growing number of citizens. It is planned that these vehicles will be efficient, operating with fuels of low carbon emissions so as to mitigate the increase in the consumption.

For the financing of the action, the use of national resources is considered necessary.

Table 59: Action 5.1 in numbers

Replacement of the existing ASEZA vehicles with new, more efficient vehicles (hybrid etc) & plan to purchase only efficient vehicles in the future	
Duration	2018 - 2030
Total Implementation Cost (JOD)	415,800
Annual Energy Savings (MWh)	1,287.83
Annual Emission Reduction (tn CO_2)	606.18
Funding Source	Own funds & National Grants
Net Present Value (NPV)	≈0

3.6.2 Installation of tracking and monitoring system for more efficient management of the fleet and better planning routes

This action consists a part of the Project fiche for "Smarter Transportation System". The aim is to increase operational efficiency while reducing environmental impact. This action focuses on gathering real-time information from Global Positioning System devices in ASEZA vehicles (and from public and private transport), traffic sensors, transit systems, pollution monitors and weather information. The data will be processed using streaming analytics software, giving city managers, real-time information on traffic flow, public parking areas, travel times and best commuting options. Thus the routes that the fleet has to follows will be planned after taking into consideration these parameters so as to aid the vehicles to consume less fuel. Key data on the action are provided in the table below, while for more details please check the respective action fiche in the report's annex.

Table 60: Action 5.2 in numbers

Installation of tracking and monitoring system for more efficient management of the fleet and better planning routes	
Duration	2018 - 2030
Total Implementation Cost (JOD)	185,489 (total #2 fiche cost)
Annual Energy Savings (MWh)	572.64
Annual Emission Reduction (tn CO_2)	150.96
Funding Source	Own funds & EU Funds and Programs and other external funds
Net Present Value (NPV)	>0

3.6.3 ASEZA fleet maintenance (for the existing & the new ones)

Regular and proper maintenance of the ASEZA fleet can yield significant energy savings, ensure the proper operation of the vehicles and prevent costly damages. The vehicles are already maintained but the target of this action is to create a plan so as to realize the maintenance in a better organized manner, giving priority to those that are in more frequent use, while ensuring that all related service works are conducted on time. Moreover these measures proposed to be implemented during the forthcoming years as well, for every new acquisition.

Table 61: Action 5.3 in numbers

ASEZA fleet maintenance (for the existing & the new ones)	
Duration	2018 - 2030
Total Implementation Cost (JOD)	1,272,200
Annual Energy Savings (MWh)	1,332.53
Annual Emission Reduction (tn CO_2)	351.28
Funding Source	Own funds
Net Present Value (NPV)	<0

3.6.4 Eco-driving seminars for the drivers of the ASEZA fleet

Eco-driving comprises a set of actions, something like “behavioral changes”, regarding the way someone drives. The adoption of these principles by ASEZA fleet’s drivers is considered a good way to decrease the fuel consumption. The effectiveness depends upon the seminars and trainings ASEZA will organize, as well as their repeatability to ensure that every single driver will understand the tips and implement the advices.

Related calculations on the action in terms of initial cost and emission savings are presented in next table. As an awareness raising activity, it is considered that the action is exponentially beneficial to ASEZA against the related costs.

Table 62: Action 5.4 in numbers

Eco-driving seminars for the drivers of the ASEZA fleet	
Duration	2018 - 2023
Total Implementation Cost (JOD)	30,000
Annual Energy Savings (MWh)	1,640.04
Annual Emission Reduction (tn CO_2)	432.34
Funding Source	Own funds
Net Present Value (NPV)	>0

3.6.5 Information events on the new vehicle technologies

Private and commercial vehicles have the larger share in energy consumption between the other transports. It is proposed that the ASEZ Authority will organize raise awareness activities in order to inform the citizens about new technology’s cars and the double fuel cars followed by their economic and environmental benefits. The next step will be citizens purchasing these cars instead of conventional ones, for instance replacing gasoline cars with hybrid or diesel vehicles with more efficient ones.

Table 63: Action 5.5 in numbers

Information events on the new vehicle technologies	
Duration	2018 - 2025
Total Implementation Cost (JOD)	100,000
Private Funds Mobilized (JOD)	5,284,000
Annual Energy Savings (MWh)	8,082.26
Annual Emission Reduction (tn CO_2)	2,105.12
Funding Source	Own and Governmental funds, Private funds
Net Present Value (NPV)	<<0 (for Hybrids), >0 (for diesel)

3.6.6 Improve public transportation/ promote the use of public transport

The envisaged master plan aims to identify the routes which are not adequately serviced so as to establish new ones or enhance the frequency of the existing routes. The general approach is to connect the highways, establish bus stops near schools and other points of interest regularly visited by citizens. One of ASEZA's priorities is to increase pupils' mobility while ensuring safety, thus ease congestion made by parents' cars picking up their children. Additional modifications to increase the transit possibilities for workers will be realized according to the master plan suggestions.

On the other hand, there should be efforts to promote the use of the improved public transport by the inhabitants via awareness raising events thus achieving energy savings and CO_2 reductions.

Table 64: Action 5.6 in numbers

Improve public transportation/ promote the use of public transport	
Duration	2018 - 2030
Total Implementation Cost (JOD)	200,000
Annual Energy Savings (MWh)	4,892.51
Annual Emission Reduction (tn CO_2)	1,218.24
Funding Source	Own & Governmental Funds

3.6.7 Cycling promotion and creation of related infrastructure

The topography of the city is appropriate for constructing bike lanes and convincing citizens to use these alternative means instead of their cars, thus reducing the gasoline consumption and limit the respective emissions.

This activity includes three distinct levels for achieving its target:

- Dissemination activities including information events, material such as flyers, brochures and posters, and advertisements on the local media (TV, radio).
- Construction of the relative infrastructure. It has already been planned where the bicycle lane will pass from as it is shown in the next figure.
- Establishment of a bicycling sharing program. Within this program's framework, a number of bicycles will be available to the citizens at a low rental price, backstopped by a number of stations throughout the city, where the citizen may get on and off.

Figure 21: Planned bike lane

Table 65: Action 5.7 in numbers

Cycling promotion and creation of related infrastructure	
Duration	2018 - 2030
Total Implementation Cost (JOD)	1,800,000
Annual Energy Savings (MWh)	2,935.51
Annual Emission Reduction (tn CO_2)	730.94
Funding Source	Governmental funds, EU funds

3.6.8 Promotion of walking and car sharing and car pooling campaigns

This action is focused on a different series of activities that will promote walking across the ASEZ. Such activities include:

- Installation of walking signs throughout the city, informing the citizen on the distance and time required to reach ASEZ key sites. Optionally, the signs could also include info on the calories required to cross such a distance.
- Improvement of the pavements and making them friendlier for walking. This can be achieved with better maintenance (replacement of damaged or broken flagstone tiles), enlargement of the pavement where considered feasible or even planting of trees and flowers.
- Creation of pedestrian roads, especially in the commercial zone, or close to low circulation roads.
- Renovation of parks or other public areas (squares etc.) which will offer shade and resting spots, making them more attractive to the citizens.
- Large scale awareness campaign on walking, presenting the benefits for the health and the environment.

The cost of the proposed actions is significant high and there will be need for funding, since it constitutes an infrastructure action. However it will contribute to the enhancement of living conditions. Additional indirect benefits should be considered for the project's profitability such as attraction of residents and tourists to ASEZ and improvement of quality of life. Therefore, it is considered necessary for the city, even though it brings no economic profit directly to the ASEZ Authority. For more convenience, a mobile application could also be developed.

In other cases, where the distances are larger, for instance the commutes, it would be a great alternative way for people working together (or in nearby buildings) to arrange driving to work in groups, using one car. Here, the ASEZA website might be useful, which can serve people with same transport habits to communicate and organize their trips.

Table 66: Action 5.8 in numbers

Promotion of walking and car sharing and car pooling campaigns	
Duration	2018 - 2025
Total Implementation Cost (JOD)	30,000
Annual Energy Savings (MWh)	4,109.71
Annual Emission Reduction (tn CO_2)	1,023.32
Funding Source	Own and Governmental funds

3.6.9 Improvement / development of parking infrastructure

Traffic congestion is a problem within ASEZ. Therefore, in order to decrease the time and fuel spent by the drivers in their attempt to find a parking space, ASEZA intends to improve/extend the existing parking infrastructure and develop new ones where required. More specifically, the plan is to develop large parking lots in the outskirts of the center, and have municipal shuttles to the center and the industrial center.

Table 67: Action 5.9 in numbers

Improvement / development of parking infrastructure	
Duration	2018 - 2030
Total Implementation Cost (JOD)	350,000
Annual Energy Savings (MWh)	4,403.26
Annual Emission Reduction (tn CO_2)	1,096.41
Funding Source	Own and Governmental funds

3.6.10 Promotion of eco-driving for the private and commercial transport

As it is mentioned in the ASEZA fleet's actions, the principles of eco-driving are a measure which can lead in significant decrease of fuel consumption. The role of ASEZA here is to organize awareness raising activities and regular trainings for the drivers of private and commercial transport so as to make the citizens be aware its environmental and economic benefits.

Table 68: Action 5.10 in numbers

Promotion of eco-driving for the private and commercial transport	
Duration	2018 - 2023
Total Implementation Cost (JOD)	40,000
Annual Energy Savings (MWh)	14,213.07
Annual Emission Reduction (tn CO_2)	3,724.34
Funding Source	Own and Governmental funds

3.6.11 Replacement of gasoline vehicles with electric ones

Pure battery electric vehicles (BEVs) are considered "zero emission" because they don't release greenhouse gases or other pollutants during use. ASEZA has a double role here; first

to undertake the promotion campaign for these vehicles in order to inform citizens about this new technology and its advantages. In parallel, a fixed Solar Electrical Vehicle charging station will be installed in ASEZ region which will provide free electricity for vehicles' charging so as to encourage people replace their conventional cars with electrical ones. This action is part of the "Smarter Transportation System" project fiche.

Table 69: Action 5.11 in numbers

Replacement of gasoline vehicles with electric ones	
Duration	2018 - 2030
Total Implementation Cost (JOD)	185,489 (total #2 fiche cost)
Annual Energy **Production** (MWh)	546.65
Annual Emission Reduction (tn CO_2)	136.12
Funding Source	Own funds, & EU Funds and Programs, Other external funds
Net Present Value (NPV)	>0

3.6.12 Transportation master plan

The transportation master plan is the key to success for all activities envisaged in the transportation sector, so that the activities are coherent and not simply segmented ideas. In this respect, this master plan constitutes the city's blueprint for planning, developing and operating its walking, cycling, transit and road networks over the coming decades.

The plan has a twofold objective. On one hand to improve mobility and access in the city in a way that is safe and convenient and on the other hand to do so by minimizing auto congestion, air pollution, and noise. Key areas of focus for the current plan will include integrating the concept of complete streets, updating modal share targets, advancing strategies to improve walking and cycling, and supporting transit-oriented development.

The plan will also identify a number of modifications to road and transit infrastructure priorities to account for adjustments in growth patterns, emerging issues and strategic opportunities.

The implementation of this study is not considered to derive direct energy savings and CO_2 reduction benefits, but it is seen as a prerequisite for the rest of the actions in the sector.

Table 70: Action 5.12 in numbers

Transportation master plan	
Duration	2018 - 2023
Total Implementation Cost (JOD)	100,000
Funding Source	Own & Governmental funds

3.6.13 Promotion of eco-driving for public transport's drivers

Focusing now on the Public Transportation sector, the first proposed action is the promotion of eco driving. Similarly with the two previous sectors, public transport's drivers may be encouraged to adapt eco-driving principles in order to reduce fuel consumption and CO_2 emissions from the public fleet. This can be achieved through raising awareness activities and trainings realized by the ASEZ Authority.

Table 71: Action 5.13 in numbers

Promotion of eco-driving for public transport's drivers	
Duration	2018 – 2023
Total Implementation Cost (JOD)	50,000
Annual Energy Savings (MWh)	5,320.93
Annual Emission Reduction (tn CO_2)	1,325.60
Funding Source	Own funds

3.6.14 Promotion of new technology buses in the public transportation

ASEZA will be in close collaboration with the public transportation companies' representatives, in order to promote as much as possible new technology vehicles that are highly efficient. Replacing old buses with new more efficient is a way to achieve energy savings and emissions' reduction since these vehicles consume less fuel while they perform same or even better compared to the previous ones.

This action has no cost for ASEZA and is expected to contribute significantly in its carbon footprint's reduction.

Table 72: Action 5.14 in numbers

Promotion of new technology buses in the public transportation	
Duration	2018 - 2030
Total Implementation Cost (JOD)	60,000
Private Funds Mobilized (JOD)	38,400
Annual Energy Savings (MWh)	9.51
Annual Emission Reduction (tn CO_2)	2.54
Funding Source	Private funds
Net Present Value (NPV)	<0

3.6.15 Installing track and monitoring system in public transportation

The plan is to install a tracking and monitoring system not only in the ASEZA fleet but also in the Public transportation, more specifically in 517 taxis and in 48 small and coach buses. This action focuses on gathering real-time information from Global Positioning System devices, traffic sensors, transit systems, pollution monitors and weather information. The data will be processed using streaming analytics software, giving city managers, travelers and freight customers' real-time information on traffic flow, public parking Areas, travel times and best commuting options. Consequently, there will be significant fuel and monetary savings. This action constitutes part of the "Smarter Transportation System" project fiche and it is further analyzed there.

Table 73: Action 5.15 in numbers

Installing track and monitoring system in public transportation	
Duration	2018 - 2030
Total Implementation Cost (JOD)	185,489 (total #2 fiche cost)
Annual Energy Savings (MWh)	11,078.17
Annual Emission Reduction (tn CO_2)	2,758.70

Funding Source	Own funds, EU Funds and Programs, Other external funds
Net Present Value (NPV)	>0

3.6.16 Replacing the existing Taxi vehicles with Hybrid vehicles

The inefficiencies of today's transportation systems can translate into deteriorating service, excess cost, energy use and environmental impact. The old taxis (517) which consume gasoline, should be replaced with Hybrids in order to achieve higher energy efficiency and thus fuel and monetary savings. This action is envisaged through the provision of the respective legislative framework that supports exemptions for replacing taxis with Hybrid cars. This action is also a part of the "Smarter Transportation System" project fiche.

Table 74: Action 5.16 in numbers

Replacing the existing Taxi vehicles with Hybrid vehicles	
Duration	2018 - 2030
Total Implementation Cost (JOD)	185,489 (total #2 fiche cost)
Annual Energy Savings (MWh)	31,192.00
Annual Emission Reduction (tn CO_2)	7,767.00
Funding Source	Own funds, EU Funds and Programs, Other external funds
Net Present Value (NPV)	>0

3.6.17 Installing Solar systems on the buses related to Aqaba Company for transportation and logistics.

The proposed action is the installation of a solar system in the 11 coach buses related to the "Aqaba Company for transportation and logistics". The idea is to install solar panels on top of buses in order to gather energy during the day and then use the generated power to light up buses, promotional panels and bus information boards during evenings and nights. Such energy can be used for the Air conditioning system as well. Therefore there will be need for fuel only for the vehicles' shift, thus achieving energy savings and CO_2 reduction. This action is also a part of the "Smarter Transportation System" project fiche.

Table 75: Action 5.17 in numbers

Installing Solar systems on the buses related to Aqaba Company for transportation and logistics	
Duration	2018 - 2030
Total Implementation Cost (JOD)	185,489 (total #2 fiche cost)
Annual Energy **Production** (MWh)	12.85
Annual Emission Reduction (tn CO_2)	3.20
Funding Source	Own funds, EU Funds and Programs, Other external funds
Net Present Value (NPV)	>0

3.7 Local Electricity Production

Besides the above mentioned small scale RES projects by private investors and ASEZA, there are also plans for big scale Renewable Energy Projects which will significantly contribute to the region's CO_2 reduction. Agreements have already been signed between ASEZA and private

investors regarding the next projects: A wind farm (50 MW), 10 MW PVs in the southern new ports, 5 MW PVs in ASEZA main building (which will be a fixed or a movable system), 1 MW PVs in the north of Aqaba (private), 1 MW PVs in the solar power plant with dual power generation technologies (bio gas from waste water treatment and solar energy) and finally 0.1 MW PVs in the marine visitors center. In the next table figures about the respective electricity production and CO_2 reduction are presented.

Table 76: RES projects

	Electricity Production (MWh)	Emission Reduction (tn CO_2)
10 MW PVs in southern ports	16.985,64	9.856,19
5 MW PVs in ASEZA main building	8.492,82	4.928,09
1 MW PVs in the north of Aqaba	1.698,56	985,62
1 MW PVs in solar power plant	1.698,56	985,62
0.1 MW PVs in the marine visitors center	170,00	98,65
Total	29.045,59	16.854,17

The wind farm has not been included in SECAP calculations since, according to the CoM Guidelines, the plant/unit should be below or equal to 20 MW. [5]

3.8 Actions' Overview

In the next table the complete list of the SECAP Actions is presented followed by the respective energy savings/production and the CO2 reduction.

		Action	Energy Savings (MWh)	Energy production (MWh)	Emission Reduction (tn)
Municipal buildings	1.1	Green procurement procedures for ASEZA buildings	1,145.96		664.96
	1.2	Improving energy efficiency in ASEZA buildings	2,622.42 (14%)		1,521.70 (14%)
			3,746.32 (40%)		2,173.86 (40%)
	1.3	Energy Upgrade and RES in ASEZA main building	2,487.00	1,359.00	2,231.70
	1.4	Energy manager appointment in ASEZA	64.02		37.15
	1.5	Awareness raising activities for ASEZA employees	204.86		118.88
	1.6	Adoption of bioclimatic principles in ASEZA buildings /Strict application of green building codes in ASEZA buildings	1,264.40 (14%)		733.69 (14%)
			4,046.06 (40%)		2,347.79 (40%)
	1.7	Promotion of recycling			824.76
	1.8	Awareness raising campaigns to reduce the organic content of waste)			164.95

		Action	Energy Savings (MWh)	Energy production (MWh)	Emission Reduction (tn)
	1.9	PVs in ASEZA buildings (500 KWp)		849.28	492.81
	1.10	Green Municipal Building	186.00	34.00	127.66
		Eco Science Park awareness raising	2,584.00		1,499.41
	1.11	Landfill		6,053.00	18,871.09
	1.12	Establishment of an Energy Saving Department			0.00
	1.13	Web portal creation			0.00
		Total	10,558.66 (14%) 14,464.22 (40%)	8,295.28 (both scenarios)	27,288.76 (14%) 29,555.02 (40%)
Street Lighting	2.1	ASEZA lighting study and lighting system upgrade	8,649.64		5,019.09
	2.2	Solar cells installation for lighting network		382.00	221.66
	2.3	Green procurement procedures for the future lighting equipment	4,988.85		2,894.86
		Total	13,638.49	382.00	8,135.61
Residential Buildings	3.1	Awareness raising activities for modification of the residents' consumption behavior	5,784.86		3,356.76
	3.2	Promotion of Green Buildings' concept / Strict application of the building code	5,673.54 (14%)		3,292.16 (14%)
			45,388.34 (40%)		26,337.31 (40%)
	3.3	Campaign for promoting high energy label equipment and other awareness activities	5,784.86		3,356.76
	3.4	3MW/5MW Photovoltaics in residential rooftops		5,095.69 (14%)	2,956.86 (14%)
				8,492.82 (40%)	4,928.09 (40%)
	3.5	Replacing existing electric water heater with solar collectors		28,487.38 (14%)	16,530.25 (14%)
				42,731.06 (40%)	24,795.38 (40%)
	3.6	Replacement of existing lamps with LEDs	1,540.47 (14%)		893.89 (14%)
			4,621.42 (40%)		2,681.66 (40%)
	3.7	Replacement of existing air-conditioners with more efficient ones	7,002.16		4,063.11
	3.8	Use of cool colors in rooftops	622.41		361.17
	3.9	Replacement of single glazing with double/Window shading	135.72		60.01

		Action	Energy Savings (MWh)	Energy production (MWh)	Emission Reduction (tn)
			26.544.03 (14%)	33,583.07 (14%)	34,870.96 (14%)
		Total	69,339.78 (40%)	51,223.88 (40%)	69,940.24 (40%)
Tertiary buildings	4.1	Seminars and trainings on selected professional groups	2,920.68		1,694.77
	4.2	10% energy reduction campaign in commercial buildings-Energy friendly label	1,947.12		1,129.85
	4.3	Promotion of green buildings concept	5,156.05 (14%)		2,991.88 (14%)
			51,560.54 (40%)		29,918.82 (40%)
	4.4	Campaign for promoting high energy label equipment	7,788.47		4,519.38
	4.5	10 MW/15 MW Photovoltaics in rooftops		16.985.64 (14%)	9,856.19 (14%)
				25,478.46 (40%)	14,784.28 (40%)
	4.6	Replacing existing electric water heater with solar collectors		1,459.13	846.68
	4.7	Replacement of existing lamps with LEDs	19,743.12 (14%)		11,456.26 (14%)
			59,229.35 (40%)		34,368.78 (40%)
	4.8	Replacement of existing air conditioners with more efficient ones	7,342.48		4,260.59
	4.9	Use of cool colors in rooftops	3,915.99		2,272.32
	4.10	Installation of lighting automations & thermostats	6,934.57		4,023.89
	4.11	External shading installation	2,936.99		1,704.24
	4.12	Awareness raising campaigns for pupils/ students	126.39		73.34
	4.13	The 10% voluntary campaign for energy reduction in schools	544.86		316.16
			59,356.71 (14%)	18,444.77 (14%)	45,145.55 (14%)
		Total	145,247.52 (40%)	26,937.59 (40%)	99,913.10 (40%)

		Action	Energy Savings (MWh)	Energy production (MWh)	Emission Reduction (tn)
Municipal fleet	5.1	Replacement of the existing ASEZA vehicles with new. more efficient vehicles (hybrid etc.) & plan to purchase only efficient vehicles in the future	998.82		477.37
			289.01		128.82
	5.2	Installation of tracking and monitoring system for more efficient management of the fleet and better planning routes	572.64		150.96
	5.3	ASEZA fleet maintenance (for the existing & the new ones)	1,332.53		351.28
	5.4	Eco-driving seminars for the drivers of the ASEZA fleet	1,640.04		432.34
		Total	4,833.05	0.00	1,540.76
Private & Commercial Transport	5.5	Information events on the new vehicle technologies	0.00		0.00
	5.6	*Replacement of gasoline vehicles with Hybrid*	*2,935.51*		*730.94*
	5.7	*Replacement of diesel vehicles with new more efficient*	*5,146.75*		*1,374.18*
	5.8	Improve public transportation/ promote the use of public transport	4,892.51		1,218.24
	5.9	Cycling promotion and creation of related infrastructure	2,935.51		730.94
	5.10	Promotion of walking and car sharing and car pooling campaigns	4,109.71		1,023.32
	5.11	Improvement / development of parking infrastructure	4,403.26		1,096.41
	5.12	Promotion of eco-driving	10,659.80		2,793.25
	5.13	Replacement of gasoline vehicles with electric ones		546.65	136.12
	5.14	Transportation master plan			
		Total	35,083.05	546.65	9,103.40
Public transport	5.15	Promotion of eco-driving for public transport's drivers	5,320.93		1,325.60
	5.16	Promotion of new technology buses in the public transportation	9.51		2.54
	5.17	Installing track and monitoring system in public transportation	11,078.17		2,758.70
	5.18	Replacing the existing Taxi vehicles with Hybrid vehicles	31,192.00		7,767.00
	5.19	Installing Solar systems on the buses related to Aqaba Company for transportation and logistics'(coach buses)		12.85	3.20

		Action	Energy Savings (MWh)	Energy production (MWh)	Emission Reduction (tn)
		Total	47,600.61	12.85	11,857.04
		Total transportation	*87,516.71*	*559.50*	*22,501.19*
Local Renewable Energy Production	6.1	10 MW PVs in southern ports		16,985.64	9,856.19
	6.2	5 MW PVs in ASEZA main building		8,492.82	4,928.09
	6.3	1 MW PVs in the north of Aqaba		1,698.56	985.62
	6.4	1 MW PVs in solar power plant		1,698.56	985.62
	6.5	0.1 MW PVs in the marine visitors center		170.00	98.65
		Total		29,045.59	16,854.17
		TOTAL ***14%***	***197,614.59***	***90,310.20***	***154,796.24***
		40%	***330,206.62***	***116,443.84***	***246,899.34***

Regarding the costs, for the 1st scenario (14%) the total cost for the Authority derives 33,040,000 JOD approximately whereas for the private sector is 121,996,220 JOD approximately. For the 2nd scenario (40%) the total cost for the Authority derives 37,420,000 JOD approximately and for the private sector derives around 352,651,000 JOD, without considering the costs for the big scale RES projects.

It should be noted that in line with the actions described above, the 1st Scenario ensures the reduction of emissions by 25.5%, while the 2nd Scenario envisages an overall reduction of 40.6% of the BAU emissions. In order to achieve the 40% target, ASEZA and the Government should place intensive and consecutive efforts towards the strict implementation of the SECAP and seek for agreements and grants with national and international organizations.

3.9 Monitoring

Monitoring of the Authority's progress against the set targets is very significant, especially since it has to be realised in a frequent basis. The following table includes the suggested indicators to monitor each action's progress against the initial objectives, in order any deviations from the target to be noticed quickly, and appropriate correction measures to be taken.

These indicators will be also utilised during the production of the actions' monitoring report in line with the Covenant of Mayors requirements, as well as common practice, in order to demonstrate the achieved progress and results.

	Action	Key Performance Indicators	Measurement units
Municipal buildings			
1.1	Green procurement procedures for ASEZA buildings	• Number of equipment bought with green procurement procedures	• Equipment number/year
1.2	Improving energy efficiency in ASEZA buildings	• Number of lamps replaced with LEDs • Area covered with automations in lighting • Upgrades in cooling & heating systems • Insulation • Double glazing	• Number of lamps replaced each year • m^2 • Number of new heating & cooling systems/ year • m^2 of insulation • m^2 of windows
1.3	Energy Upgrade and RES in ASEZA main building	• Installed capacity of PVs • Percentage of installed capacity compared to the initial target • Number of lamps that were replaced with LEDs • Area covered with sensors and timers • Upgrade of the HVAC system • Area of shadings installed	• KWp • % out of 800 KWp • Number of lamps replaced each year • m^2 • Number of new heating & cooling systems/ year • m^2

	Action	Key Performance Indicators	Measurement units
		• Installation of digital thermostats • Average temperature in the buildings	• Number of thermostats • ^{o}C
1.4	Energy manager appointment in ASEZA	• Years that the Energy Manager is appointed and active • Quantity of municipal infrastructure under his supervision • Energy savings under his supervision	• Number of years • Number and % of municipal infrastructure being supervised • KWh
1.5	Awareness raising activities for ASEZA employees	• Number of training seminars that were implemented • Municipal employees that were trained	• Number of seminars • Number of employees
1.6	Adoption of bioclimatic principles in ASEZA buildings /Strict application of green building codes in ASEZA buildings	• Number of new buildings with bioclimatic principles	• Number of buildings
1.7	Promotion of recycling	• Total amount of recycled waste in the Municipality • Number of implemented actions to promote recycling • Available infrastructure in terms of recycle bins coverage	• tn/year • Number of seminars, leaflets and other actions • Number of recycle bins per square km area
1.8	Awareness raising campaigns to reduce the organic content of waste)	• Reduction of the amounts of discarded food • Total actions implemented to raise awareness	• tn/year • Number of workshops, seminars, etc.
1.9	PVs in ASEZA buildings (500 KWp)	• Installed PV capacity on roofs • Percentage of installed capacity against the initial target	• KWp • % out of 500 KWp
1.10	Green Municipal Building Eco Science Park awareness raising	• Installed PVs capacity • Total energy consumption/m^2 • Number of campaigns that were implemented • Number of visitors in the park	• KWp • KWh/m^2 • Number of campaigns • Number of visitors

	Action	Key Performance Indicators	Measurement units
1.11	Landfill	• Construction completion state • Total amount of solid waste deposited in landfill • Electricity Production	• % • tn • MWh
1.12	Establishment of an Energy Saving Department	• Number of people served by the Energy Department • Employees in the Energy Saving Department	• Number of people • Number of employees
1.13	Web portal creation	• Number of visits in the site • Average time a user spent in the site	• Number of visits • Min/visit
	Street Lighting		
2.1	ASEZA lighting study and lighting system upgrade	• Lighting study implementation • Lamps that were replaced with energy efficient ones	• YES/NO answer • Number of lamps
2.2	Solar cells installation for lighting network	• MWh produced from PVs installed on lighting poles • % of lighting grid covered by automations	• MWh • %
2.3	Green procurement procedures for the future lighting equipment	• Number of devices that were bought with green procurement procedures	• Device number/year
	Residential Sector		
3.1	Awareness raising activities for modification of the residents' consumption behavior	• Number of seminars & information days • Attendants in each event	• Number of activities • Number of people attending each event
3.2	Promotion of Green Buildings' concept / Strict application of the building code	• Number of promotion actions • Average attendance • Share of new Green buildings in total new buildings • Average energy savings of green building/m^2	• Number of seminars, leaflets etc. • People attended each action • % • KWh/m^2

	Action	Key Performance Indicators	Measurement units
3.3	Campaign for promoting high energy label equipment and other awareness activities	• Number of promotion actions • Average attendance	• Number of seminars, leaflets etc. • Number of people attending each event
3.4	3MW/5MW Photovoltaics in residential rooftops	• Installed PV capacity on roofs • Percentage of installed capacity against the initial target	• MWp • % out of 3MWp or 5MWp
3.5	Replacing existing electric water heater with solar collectors	• Increase of solar water heaters installation	• Number of solar water heaters
3.6	Replacement of existing lamps with LEDs	• Number of lamps replaced with LEDs	• Number of lamps replaced each year
3.7	Replacement of existing air-conditioners with more efficient ones	• Number of A/Cs replaced with new ones	• Number of A/Cs
3.8	Use of cool colors in rooftops	• Surface that cool colors have been applied • Number of buildings using cool colors	• m^2 • Number of buildings
3.9	Replacement of single glazing with double/Window shading	• Surface of double glazing • Surface of shading	• m^2
	Tertiary		
4.1	Seminars and trainings on selected professional groups	• Number of awareness raising seminars • Attendants in each event	• Number of activities • People attending each activity
4.2	10% energy reduction campaign in commercial buildings-Energy friendly label	• Total reduction % against the initial energy consumption • Total energy savings	• % • kWh
4.3	Promotion of green buildings concept	• Number of buildings refurbished to become ‘Green’ • Number of promotion actions • Average attendance	• Number of buildings • Number of seminars, leaflets etc. • Number of people attending each action

	Action	Key Performance Indicators	Measurement units
4.4	Campaign for promoting high energy label equipment	• Number of promotion actions • Average attendance	• Number of seminars, leaflets etc. • Number of people attending each event
4.5	10 MW/15 MW Photovoltaics in rooftops	• Installed PV capacity on roofs • Percentage of installed capacity against the initial target	• MWp • % out of 10MWp or 15MWp
4.6	Replacing existing electric water heater with solar collectors	• Number of solar water heaters installed	• Number of solar water heaters
4.7	Replacement of existing lamps with LEDs	• Number of lamps replaced with LEDs	• Number of lamps replaced each year
4.8	Replacement of existing air conditioners with more efficient ones	• Number of A/Cs replaced with new ones	• Number of A/Cs
4.9	Use of cool colors in rooftops	• Surface that cool colors have been applied • Number of buildings using cool colors	• m^2 • Number of buildings
4.10	Installation of lighting automations & thermostats	• Area covered by lighting automations • Area covered by thermostats	• m^2
4.11	External shading installation	• Area of shadings installed	• m^2
4.12	Awareness raising campaigns for pupils/ students	• Number of implemented campaigns • Students reached from the campaigns	• Number of campaigns • Number of students
4.13	The 10% voluntary campaign for energy reduction in schools	• Total energy consumption in schools • Average consumption per m2 in each school • Savings achieved per participating school in kWh and %	• kWh • kWh/m^2 • kWh and %

Transport			
5.1	Replacement of the existing ASEZA vehicles with new, more efficient vehicles (hybrid etc.) & plan to purchase only efficient vehicles in the future	• Number of vehicles replaced • Fuel saved at an annual basis	• Number of vehicles • MWh and lt of Gasoline and Diesel
5.2	Installation of tracking and monitoring system for more efficient management of the fleet and better planning routes	• Total distance covered by municipal vehicles per year • % of distance reduction at an annual basis • Estimated savings	• km • % of total km reduced • kWh and Lt of diesel and gasoline
5.3	ASEZA fleet maintenance (for the existing & the new ones)	• Number of cars maintained • Maintenance coverage percentage	• Number of cars • % of maintained cars against the total
5.4	Eco-driving seminars for the drivers of the ASEZA fleet	• Number of seminars implemented • Percentage of ASEZA drivers that attended the seminars	• Number of seminars • % out of total number of drivers
5.5	Information events on the new vehicle technologies	• Number of events • Attendants in each event	• Number of events • Number of people attending each activity
5.6	*Replacement of gasoline vehicles with Hybrid*		
5.7	*Replacement of diesel vehicles with new more efficient*		
5.8	Improve public transportation/ promote the use of public transport	• Number of bus routes with increased itineraries • Estimated people outreach	• Number of bus routes • Number of events, leaflets etc.
5.9	Cycling promotion and creation of related infrastructure	• Total length of cycling roads constructed • Total bicycle parking areas constructed	• km • Number of bicycle parking areas
5.10	Promotion of walking and car sharing and car pooling campaigns	• Length/surface of pavements constructed/refurbished • Number of walking signs installed • Number of parks etc. renovated • Number of awareness raising activities	• km/ km^2 • Number of signs • Number of public areas • Number of activities

5.11	Improvement / development of parking infrastructure	• Number of parking lots constructed	• Number of parking lots
5.12	Promotion of eco-driving	• Number of seminars implemented • Number of drivers attending the seminars	• Number of seminars • Number of drivers
5.13	Replacement of gasoline vehicles with electric ones	• Number of electric cars purchased	• Number of electric cars
5.14	Transportation master plan	• Development of the transportation plan study • Percentage of the city area covered by the public transport	• YES/NO • % in total area
5.15	Promotion of eco-driving for public transport's drivers	• Number of seminars implemented • Percentage of drivers that attended the seminars	• Number of seminars • % out of total number of drivers
5.16	Promotion of new technology buses in the public transportation	• Number of buses replaced with new	• Number of buses
5.17	Installing track and monitoring system in public transportation	• Total distance covered by municipal vehicles per year • % of distance reduction at an annual basis • Estimated energy savings	• km • % of total km reduced • MWh and Lt of diesel and gasoline
5.18	Replacing the existing Taxi vehicles with Hybrid vehicles	• Number of Hybrid Taxis	• Number of Hybrid Taxis
5.19	Installing Solar systems on the buses related to Aqaba Company for transportation and logistics'(coach buses)	• Fuel saved at an annual basis	• lt of Gasoline and Diesel
Local Renewable Energy Production			
6.1	10 MW PVs in southern ports	• Installed PVs capacity • Percentage of installed capacity compared to the initial target	• kWp • % out of 10MWp
6.2	5 MW PVs in ASEZA main building	• Installed PVs capacity	• MWp • % out of 5MWp

		• Percentage of installed capacity compared to the initial target	
6.3	1 MW PVs in the north of Aqaba	• Installed PVs capacity • Percentage of installed capacity compared to the initial target	• MWp • % out of 1MWp
6.4	1 MW PVs in solar power plant	• Installed PVs capacity • Percentage of installed capacity compared to the initial target	• MWp • % out of 1MWp
6.5	0.1 MW PVs in the marine visitors center	• Installed PVs capacity • Percentage of installed capacity compared to the initial target	• MWp • % out of 0.1MWp

Chapter 4: Adaptation to climate change

4.1 Introduction on climate change impact

During the last 20 years studies and observations have shown significant changes in the global climate which negatively affect life in many aspects. Indicatively in the next two figures the rise in the temperature and sea level are presented.

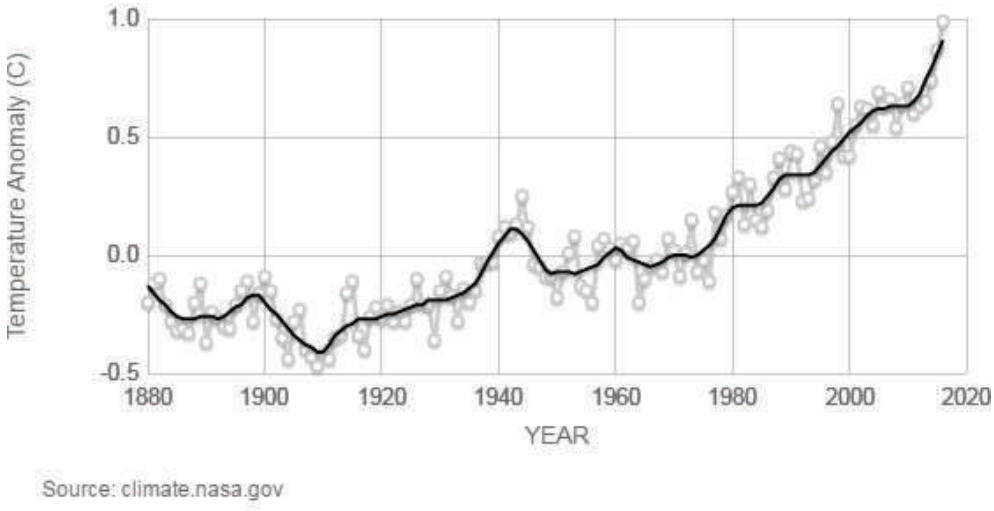


Figure 22: Land-ocean temperature variation

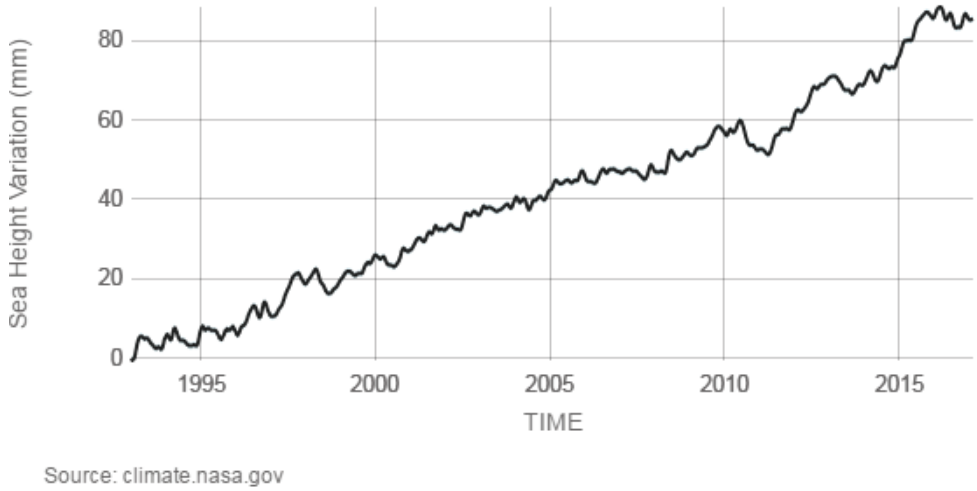


Figure 23: See level variation

In addition in the next figure the global temperature variation is presented from 1884 to 2016 in a worldwide map. [12]

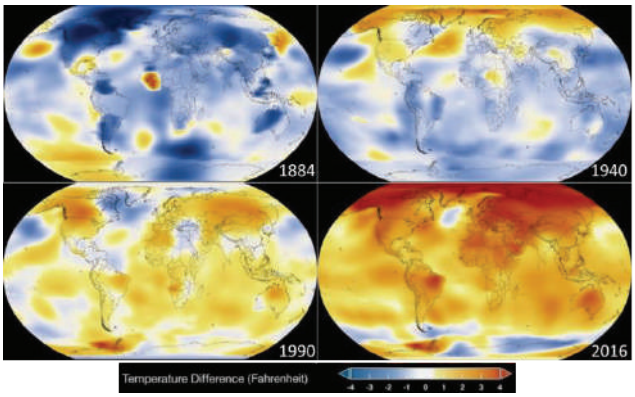


Figure 24: Global temperature variation

More specifically, the Mediterranean region is rich in a large variety of complex climatic phenomena, caused by its morphology and its geographical location. The location of the Mediterranean Sea in a transitional band between subtropical and midlatitude regimes produces a large climate variability at multiple timescales and a strong seasonal variability of precipitation in many areas [13].

The Mediterranean has been identified as one of the most prominent “Hot-Spots” in future climate change projections [14]. The water cycle and its extremes are one of the major concerns, since there are many countries that are over exploiting the water resources, a problem that is expected to deteriorate in the future.

Episodes of extreme precipitation are also taking place and disastrous floods are a major threat for the region and especially the coastal areas. In addition to the above, phenomena taking place especially in the Southern Mediterranean Countries, such as cultivation of marginal land, overgrazing and firewood harvesting, put more pressure on the environment [13].

The Mediterranean region has experienced drastic changes in its climate over the years and according to Luterbacher et al. [15], has shown large climate shifts in the past. Twenty thousand years ago, cold steppes (with sparse forests) extended from the south of Spain to Caucasus. In the northern part of the Mediterranean basin, the temperature of the coldest month was 15°C lower than it is today. Less water was available for vegetation.

Over the last 2000 years, the climate over the Mediterranean has experienced a sequence of humid/dry and warm/cold periods that have produced effects on environmental conditions.

In the Figure 25 presented below, the seasonal mean temperature for the period 1961-1990 is being depicted in panels A-D, while the total precipitation maps for the same period are depicted in panels E-H.

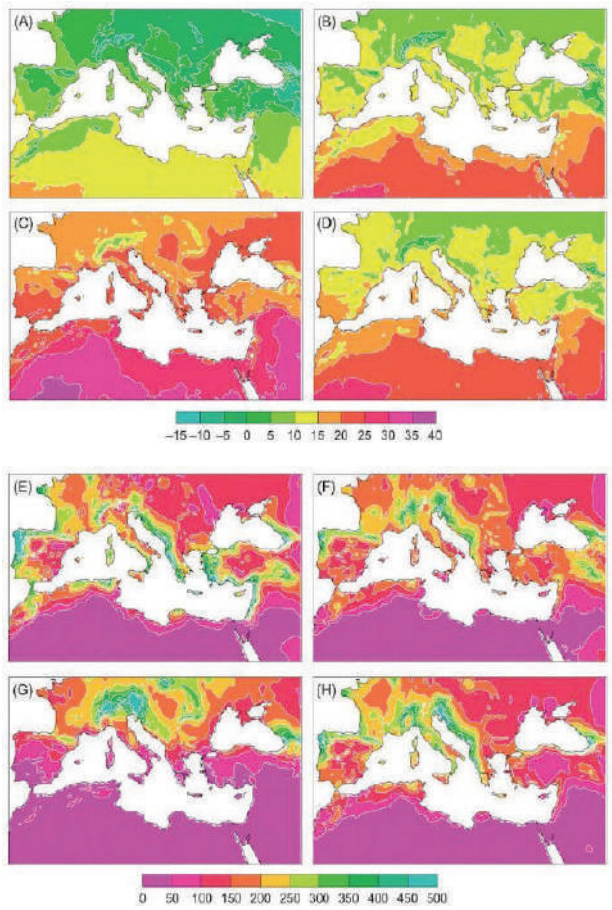


Figure 25: Seasonal (winter: December – January – February; spring: March – April – May; summer: June – July – August; autumn: September – October – November) mean temperature (°C, panels A-D) and total precipitation (mm per season, panels E-H) maps for the period 1961 -1990 based on CRU data

Source: Lionello, 2012

The increase of the projected temperatures in the Mediterranean region in the period 2071 - 2100 compared to 1961-1990 is at least 3 degrees in the South countries and could be even higher, depending the season, as presented in the figure below [14].

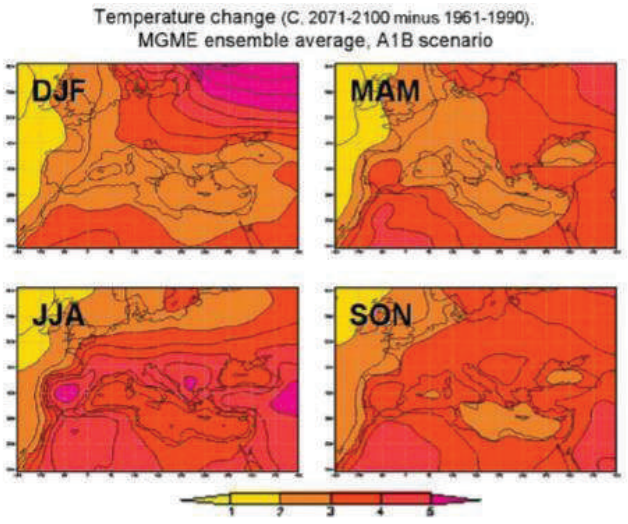


Figure 26: Multi Global Model Ensemble (MGME) average change in surface air temperature for the four seasons, 2071–2100 minus 1961–1990. Units are °C. DJF is December–January–February, MAM is March–April–May, JJA is June–July–August, SON is September–October–November

Source: Giorgi et al., 2008

According to an EIB report of 2008, for the Mediterranean region, climate experts anticipate during the 21st century:

- An increase in air temperature in the range of 2.2 C° to 5.1 C° for the countries of Southern Europe and the Mediterranean region over the period 2080 – 2099 with respect to the period 1980 – 1999;
- A significant decrease in rainfall, ranging between -4 and -27 % for the countries of Southern Europe and the Mediterranean region (while the countries of Northern Europe will report a rise between 0 and 16 %);
- Increase in drought periods manifested by a high frequency of days during which the temperature would exceed 30 °C. Extreme events, such as heat waves, droughts or floods, are likely to be more frequent and violent.
- An increase of the sea level which, according to some specific studies, could be around 35 cm up to the end of the century.

Giannakopoulos et al. (2005) underlines that in line with the results of the projection scenarios, the most significant temperature increases in the 21st century are expected in Eastern Egypt and especially the Nile Delta, Lebanon, Israel and the Maghreb. It is therefore evident that the more vulnerable Mediterranean areas will be those of North Africa adjacent to desert areas, the major deltas (such the Nile one), the coastal areas (Northern rim and Southern rim of the Mediterranean basin), as well as the high-demographic growth and socially vulnerable areas (Southern and Eastern rim, densely populated cities and suburbs).

In the Mediterranean region, 50% of the urban population lives in an altitude of less than 10 meters from the sea level, in areas which are vulnerable to sea level rise. In addition to the above, tourist destinations in these areas are vulnerable not only due to the sea level rise, but also due to the temperature increase encountered [16].

The impacts of climate change on the Mediterranean environment will relate particularly to [17]:

- Water, via a change of its cycle due to a rise in evaporation and a decrease in rainfall. This water problem will be of crucial importance with regard to the issue of sustainable development in the region;
- Soil, via the acceleration of already existing desertification phenomena;
- Land and marine biological diversity (animal and plant), via a displacement northwards and in altitude of certain species, extinction of less mobile or more climate sensitive species, and emergence of new species;
- Forests, via a rise in fire hazards and parasite risks.

These impacts will exacerbate already existing pressures on the natural environment connected with anthropogenic activities, such as agriculture and fishery (reduction of yields), tourism attractiveness (heat waves, water scarcity), coastal areas and infrastructures (significant exposure to the action of waves, coastal storms and other extreme weather events, rise in sea level), human health (heat waves), the energy sector (water needs for power plants, hydropower and increased consumption).

In line to the above, the Southern and Eastern Mediterranean Countries (SEMCs) appear to be more vulnerable to climate change than the Northern Mediterranean Countries (NMCs).

Indeed, they are, on the one hand, more exposed to accelerated desertification, soil aridity and water scarcity and, on the other hand, presenting economic structures that are more strongly dependent on natural resources, as well as technical and financial capacities that are too limited to help implement large-scale adaptation options [17].

The Mediterranean, and more especially the Southern and Eastern rim, is and will be more affected by climate change than most other regions of the world in the course of the 21st century. The impacts of the rise in temperatures, the decrease in rainfall, the multiplication of the number and intensity of extreme events and the possible rise in sea level overlap and amplify the already existing pressures of anthropogenic origin on the natural environment.

Through the crucial issue of scarcity of water resources, their impacts are fraught with consequences in the 21st century for human activities, in particular agriculture, fishery, tourism, infrastructures, urbanised coastal areas and hydropower production. In order to minimize as much as possible the economic losses and damages, several adaptation options must be thought out and implemented.

Energy lies at the heart of the climate change issue. On the one hand, it is the main GHG emitting sector, and CO2 emissions in the future are likely to increase much more rapidly than the global average. On the other hand, hydropower production—relatively significant in certain countries (13% of power production in the SEMCs)—is affected by the climate as well as by the plant cooling constraints. Lastly, the energy demand (in particular, electricity) which is growing at a very high pace in the region, is likely to be further accelerated by the additional demand necessary to lessen the impacts of climate change (water desalination, air-conditioning of buildings, etc.).

4.2 National and Regional Strategy on Climate Change Adaptation

Jordan signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and ratified it in 1993. The main focal point for climate change issues in Jordan is the Ministry of Environment (MoE). After becoming the first country in the Middle East to develop a national climate change policy in 2013, Jordan has created a special directorate for Climate Change at the Ministry of Environment to act as a coordinating platform for all climate change activities in the country.

Also, Jordan participates in the Paris Agreement, a world climate agreement reached within UNFCCC and during COP21, which focuses on bringing all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects. The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework will be put

in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives.

Jordan signed on the 22nd of April, 2016, the Paris Agreement, which was entered into force in the country on December 4th of the same year. The Intended Nationally Determined Contributions (INDCs), as set by each country, have been laid by Jordan at 1.5% reduction of the GHG emissions by 2030 compared to the BAU scenario. This target is to be achieved unconditionally, namely is the country's national target without external support. Also, Jordan has set a conditional on international support target of 14% by 2030 compared to the BAU scenario.

Jordan has started developing national plans and signing conventions about environmental, energy and climate strategies since 1991. Lately Jordan committed to the international environmental convention UNFCC and initiated with its support a National Economic and Environmental Development Study (NEEDS) for Climate Change which aims at identifying financing needs to implement adaptation and mitigation measures. In addition linkages with financial and regulatory instruments are identified to support the implementation of adaptation and mitigation measures. The study is based on three axes: Selection of key sectors for climate change mitigation and adaptation measures, Assessment of the financing needs in parallel with finding financial instruments, Raising awareness and facilitating informed consensus among government agencies on the policy actions required to mobilize finance and investment in mitigation and adaptation measures. [18]

With its Third National Communication Report of 2014 to UNFCCC, Jordan has set a series of mitigation and adaptation actions. The mitigation actions adopted in the previous chapter are in line with the national policy, focusing on the promotion of RES and SWH, adoption of green building codes, energy efficiency and awareness raising across all activity sectors, promotion of recycling, public transport, electric vehicles etc. The national strategy adaptation actions focus on drinking water resources and their protection, on health related activities, such as protection of the public from heat waves and water-, air- and vector borne diseases, on ecosystems and biodiversity protection, as well as food security and socioeconomic adaptation. The suggested adaptation actions for ASEZ Authority are in line with the national priorities.

4.3 Climate data and Clima projections

Current situation

Jordan's climate is characterised by the variation from a Mediterranean-like climate in the west to a desert-like climate in the east and south, but the land is generally arid. The southern stretch of the Wadi Araba is the hottest and driest part of the geographical zone. The map in Figure 27 below clearly shows that the hottest parts of the country are those closest to the coastal regions of the Dead Sea and along the Wadi Araba. The mean annual average temperature at the Test and Demonstration Center site is 25 °C, with variations in summer up to 44 °C and in winter down to 4 °C. The average winter humidity is about 65%, and in summer it is typically below 40% and can drop to as low as 15%. Regarding precipitation, Jordan experiences very low amounts (Figure 28) with average annual rainfall to be below 50mm.

Therefore, there is severe scarcity of the country's water sources. Actually, Jordan is the third poorest country in the world in terms of per-capita water resources with the current usage rate to be 145 m^3 annually per person.

Table 77 shows climate data for Aqaba, which is similar to that at the Test and Demonstration Center site to the north of the city.

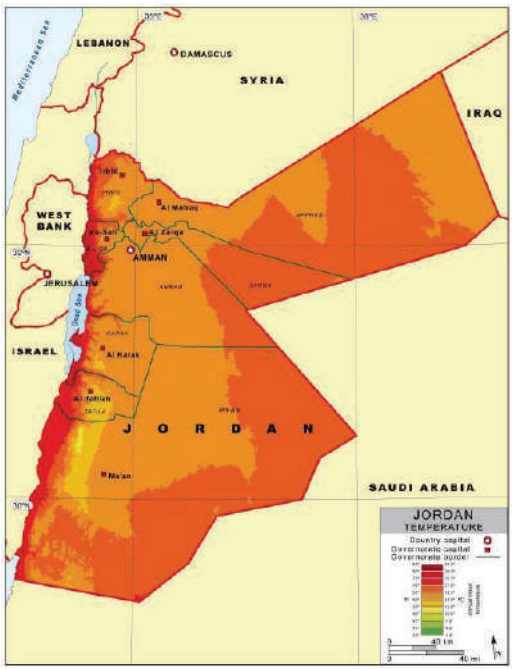


Figure 27: Temperature Map of Jordan

Source: Bestcountryreports.com

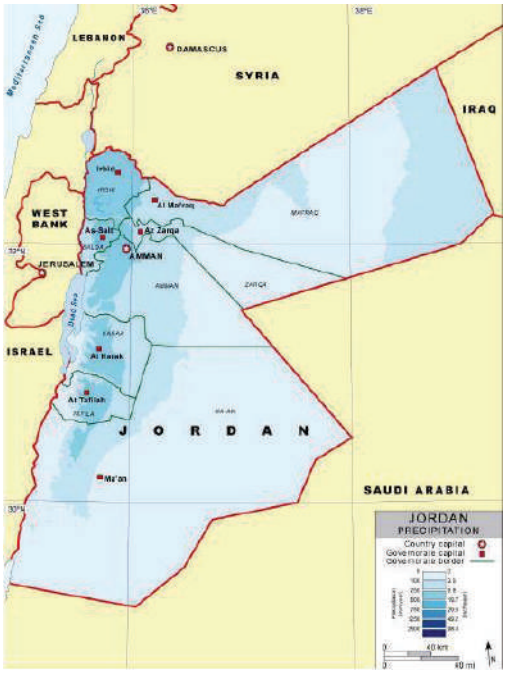


Figure 28: Precipitation Map of Jordan

Source: Bestcountryreports.com

Table 77: Climate data for Aqaba, Jordan

Month	Mean temperature(°C)		Mean total rainfall (mm)	Mean number of rain days
	Daily minimum	Daily maximum		
January	8.9	20.5	4.9	2.0
February	10.1	22.2	5.2	1.4
March	12.9	25.7	4.6	1.5
April	17.0	30.7	3.4	0.8
May	20.7	35.1	1.0	0.5
June	23.6	38.4	0.0	0.0
July	25.1	39.4	0.0	0.0
August	25.3	39.1	0.0	0.0
September	23.3	36.4	0.0	0.0
October	19.9	32.7	1.8	0.6
November	14.9	27.0	3.0	0.9
December	10.3	21.8	7.7	1.9

Source: http://worldweather.wmo.int/069/c00591.htm.

As far as the wind is concerned, the prevailing winds in the country are westerly to south-westerly. However hot, dry and dusty winds frequently occur, blowing from the south-east as well. Known locally as the *kham-sin*, these winds blow most often in the early and late summer and can last for several days at a time before terminating abruptly as the wind direction changes and much cooler air follows. In the Wadi Araba the predominant wind direction is from the north-west – blowing directly down the rift valley. This contributes to the very low levels of humidity in the southern parts of the valley because the wind blows over large tracts of extremely arid terrain.

Table 78: Aqaba region wind distribution

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	SUM
Wind probability >= 4 Beaufort (%)	27	27	42	43	40	47	39	48	55	39	38	29	39
Average Wind speed (Knots)	10	10	11	11	11	11	10	11	12	11	10	10	10
Average air temp. (°C)	17	20	23	27	31	35	36	36	32	29	23	19	27

Source: windfinder.com

Regarding the Temperature and Rainfall the last 114 years in Jordan, the next Figures present the historical data trends in the region and the increase and decrease respectively are obvious. [19]

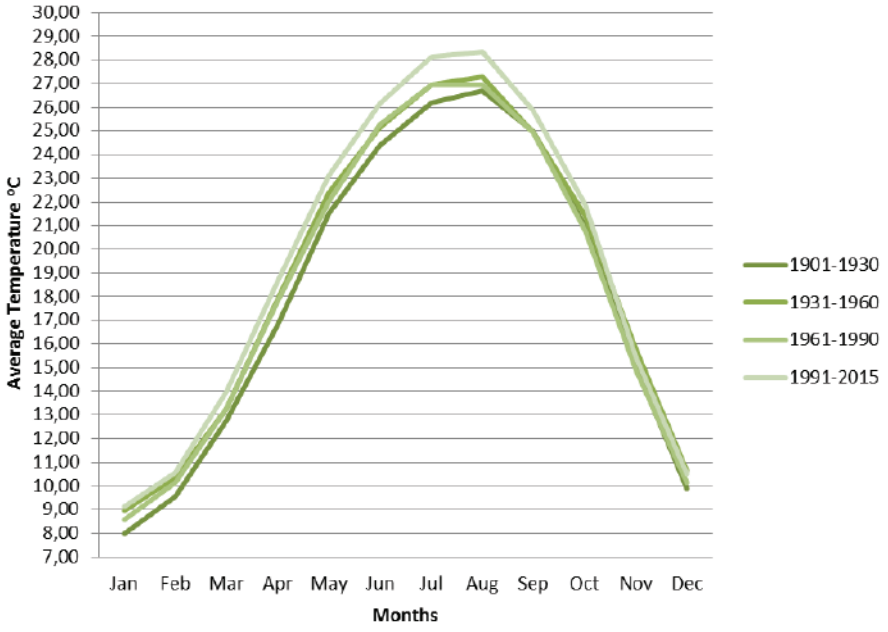


Figure 29: Average Temperature between 1901-2015 in Jordan

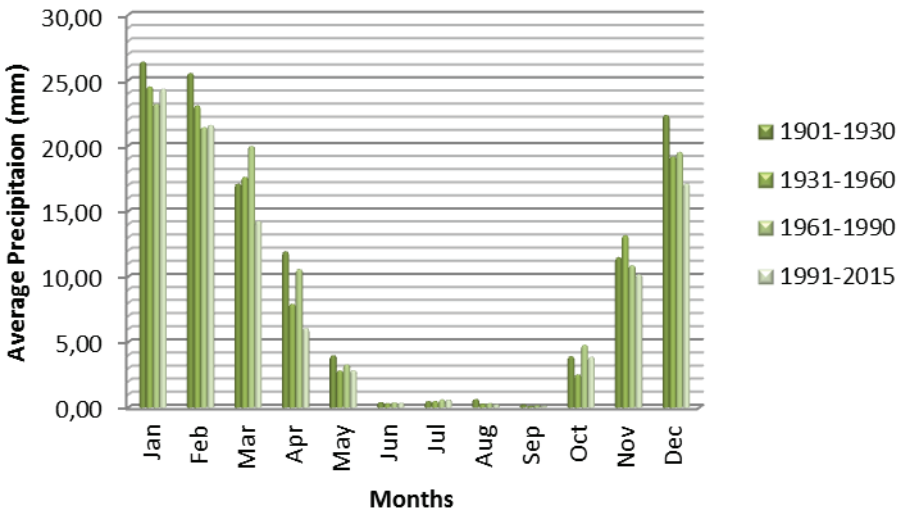


Figure 30: Average Precipitation between 1901-2015 in Jordan

Climate change Projections

Trends show that the mean, maximum and minimum temperature tends to increase by 0.02, 0.01 and 0.03 °C per year respectively. Furthermore, annual precipitation tends to significantly decrease at a rate of 1.2 mm per year. On the other hand the relative humidity tends to increase by an average of 0.08%/year. The number of days of dust storm tends to decrease significantly by 0.09 days/ year and 0.06 days/year for visibility less than 1km and 5km. The projections' results totally agree with previous work of Second National Communication (SNC) to UNFCCC and are consistent with IPCC-AR5. [20]

4.4 Adaptation Scoreboard

The adaptation scoreboard is part of the SECAP template developed by the JRC. The ASEZ Authority has realized a self-assessment of its adaptation status, putting a grade from A to D, in line with its progress.

More specifically:

- "A", corresponds to completion level of 75 - 100%.
- "B", corresponds to completion level of 50-75%.
- "C", corresponds to completion level of 25-50%. Finally,
- "D", corresponds to completion level of 0-25%.

The ASEZ Authority has put one of these four grades to each one of the adaptation cycle specific steps, as presented in the following table.

Table 79: ASEZA's score in the Adaptation Cycle Specific Steps (SECAP template)

Adaptation Cycle Steps	Actions	Grade
Step 1: Preparing the ground for Adaptation	Adaptation commitments defined/integrated into the local climate policy	C
	Human, technical and financial resources identified	C
	Adaptation team (officer) appointed within the municipal administration and clear responsibilities assigned	C
	Horizontal (e.g. across departments) coordination mechanisms in place	C
	Vertical (e.g. across governance levels) coordination mechanisms in place	C
	Consultative and participatory mechanisms set up, fostering the multi stakeholder engagement in the adaptation process	C
	Continuous communication process in place	C
Step 2: Assessing risks and vulnerabilities to climate change	Mapping of the possible methods and data sources for carrying out a Risk &Vulnerability Assessment conducted	C
	Assessment of climate risks and vulnerabilities undertaken	C
	Possible sectors of actions identified and prioritized	D
	Available knowledge periodically reviewed and new finding integrated	D
Steps 3 and 4 – Identifying, assessing and selecting adaptation options	Full portfolio of adaptation actions compiled, documented and assessed	D
	Possibilities of mainstreaming adaptation in existing policies and plans assessed, possible synergies and conflicts identified	C
	Adaptation actions developed and adopted	C
Step 5: Implementing	Implementation framework set with clear milestones	C
	Adaptation actions implemented and mainstreamed as defined in the SECAP document	C
	Coordinated action between adaptation and mitigation set	C
Step 6: Monitoring and evaluation	Monitoring framework in place for adaptation actions	C
	Appropriate monitoring and evaluation indicators identified	D
	Regular monitoring of the progress and reporting to the relevant decision makers	C
	Adaptation strategy and/or Action Plan updated, revised and readjusted according to the findings of the monitoring and evaluation procedure	D

4.5 Risk Assessment and Vulnerability Analysis

In order to conduct a risk assessment and vulnerability analysis, as a first step, the climate hazard types should be identified. These hazard types in general are presented in the Table below, while those applicable for ASEZ have been identified.

Table 80: Climate Hazard Types

General Climate Hazard Types	Applicable for ASEZ region
Extreme heat	√
Extreme cold	
Landslides	√
Storms	
Droughts	√
Sea level rise	
Floods	√
Extreme precipitation	
Forest fires	
Ice and snow	

ASEZA is called in to assess the impact that each climate hazard type has on a series of Vulnerable/ Impacted sectors, namely:

- Health
- Infrastructure (Energy, Water, Transport)
- Built environment
- Economy (Tourism, Agriculture and Forestry)
- Biodiversity (Coastal areas, Green zones/ forests)

These sectors have been identified as the most relevant for the ASEZ Authority, taking also into consideration the adaptation priorities, as set under the 3rd National Communication Report to UNFCCC.

ASEZ Authority has filled in Table 81 below, in order to conduct the vulnerability analysis, based on sources such as the Future Cities Adaptation Compass Tool and UNFCCC, as well as the CES MED Internal Guidelines for the Climate Adaptation Chapter.

Table 81: Vulnerability analysis (based on the Future Cities Adaptation Compass tool)

	Receptors	Extreme weather event	Potential effects	Who/What is affected
Population	Public Health	Extreme heat	- Deaths due to cardiovascular diseases - Spread of vector born and infectious diseases - Altered allergic pattern - Heat stress	Everyone, but especially elderly people, babies, children, workers in outdoor environments and sensitive groups of people
		Landslides	- Injuries and deaths	All people living or working in the area
		Droughts	- Asthma and cardiovascular diseases - Accumulation of trace elements	All people living or working in the area
		Floods	- Injuries and deaths - Water-borne diseases - Asthma and respiratory allergies	All people living or working in the area
Infrastructure	Transport	Extreme heat	- Rail and road network damages - Change in behavior patterns - Air quality problems - Higher maintenance costs	Roads, rail roads, public transport, people mobility
		Landslides	- Damages - Mobility difficulties in afflicted areas	Roads, rail roads, public transport, people mobility
		Droughts	- Difficult transport of bulk material	Waterways, water management
		Floods	- Damages - Mobility difficulties in afflicted areas	Roads, rail roads, public transport, people mobility
	Energy	Extreme heat	- Altered electricity peaks/demand - Damages - Cooling problems - Reduction of efficiency yield from conventional power plants and distribution grid - Higher maintenance costs	Conventional power plants, electricity providers and consumers

Receptors		Extreme weather event	Potential effects	Who/What is affected
Infrastructure		Landslides	- Damages - Operational difficulties	All facilities in the electricity generation (including RES such as PVs), as well as the electricity transmission and distribution grid
		Droughts	- No/lower production from hydro power plants - Energy supply and demand patterns' shift - Higher maintenance costs - Cooling problems	Conventional and renewable energy facilities (hydro, PVs, etc.)
		Floods	- Damages - Operational difficulties	All facilities in the electricity generation, transmission and distribution grid in the affected areas
	Water	Extreme heat	- Higher water demand - Water quality issues - Higher maintenance costs	Public health, water infrastructures
		Landslides	- Damages - Water quality issues	Public health, water infrastructures
		Droughts	- Water scarcity - Water quality issues - Higher maintenance costs	Public health, water infrastructures
		Floods	- Water quality issues - Water management issues - Damages - Higher maintenance costs	Public health, water infrastructures
	Social	Extreme heat	- Higher electricity demand to cover cooling needs - Changes in behavior patterns, e.g. living outdoors - Burdening of the health care facilities due to the increased number of patients in hospitals	Hospitals, schools, public places, municipal facilities/infrastructure, athletic facilities
		Landslides	- Damages in social facilities in afflicted areas	Hospitals, schools, public places, municipal facilities/infrastructure, athletic facilities

	Receptors	Extreme weather event	Potential effects	Who/What is affected
		Droughts	- Difficulties in meeting water demand for athletic facilities (e.g. swimming pools) and green public spaces	Hospitals, schools, public places, municipal facilities/infrastructure, athletic facilities
		Floods	- Flooding of social facilities in afflicted areas - Burdening of the health care facilities due to the increased number of patients in hospitals	Hospitals, schools, public places, municipal facilities, athletic facilities
Built Environment	Building stock and material	Extreme heat	- Concrete's damages - Increased cooling demands - Higher maintenance costs - Urban heat island effect	All building infrastructure
		Landslides	- Extensive damages	All building infrastructure in afflicted areas
		Droughts	- Higher water demand	All building infrastructure
		Floods	- Damages - Higher maintenance costs	All building infrastructure in afflicted areas
Economy	Tourist	Extreme heat	- Increased demand for cooling - Lower touristic flows during the impacted seasons - Higher water demand	Tourists, tourist infrastructure, tourist related economy
		Landslides	- Lower touristic flows - Damages in touristic infrastructure	Tourists, tourist infrastructure, tourist related economy
		Droughts	- Increased pressure on water resources, escalating water scarcity issues - Increased water supply costs	Tourists, tourist infrastructure
		Floods	- Damages in touristic infrastructure and related costs for repairs	Tourists, tourist infrastructure
	Agriculture	Extreme heat	- Changes in growth cycle - Damages / loss of harvest - Livestock loss and impacts on health - Lower crop yields	Farmers, food industry, consumers

	Receptors	Extreme weather event	Potential effects	Who/What is affected
Economy		Landslides	- Damages / loss of harvest in afflicted areas / loss of livestock - Potential property loss in afflicted areas - Loss of soil resources	Farmers, food industry, consumers
		Droughts	- Damages / loss of harvest - Lower crop yields - Livestock loss and impacts on health - Land degradation	Farmers, food industry, consumers
		Floods	- Damages / loss of harvest in afflicted areas / loss of livestock	Farmers, food industry, consumers
Biodiversity	Coastal zone ecosystems	Extreme heat	- Increased coral bleaching - Migration of coastal species towards higher altitudes - Reduction of vulnerable fishing stock - Altered flora and fauna, new and invasive species	Ecosystem, fish industry, consumers
		Landslides	- No effects	-
		Droughts	- Increase of coastal water salinity - Loss of species - Altered flora and fauna, new and invasive species	Ecosystem
		Floods	- Loss of species - Altered flora and fauna, new and invasive species	Ecosystem

Table 82: Risk assessment

	Receptors	Weather Sensitivity	Future Risk	Impact
Population	Public Health	Extreme heat	- Increased number of deaths - Reinforcement of heat stress - Increased infectious diseases - Altered allergic patterns - Chronic respiratory diseases - Vector Born Diseases (VBD) - Skin diseases Melanoma and sunburn	High
		Landslides	- Increased number of injuries and deaths - More respiratory problems	Medium
		Droughts	- Increased allergic incidents - Decreased air quality - More respiratory problems - Consumption and use of unsafe (contaminated) water for drinking due to water scarcity - Malnutrition - Food shortages	High
		Floods	- Limitations to the healthcare access - Increased numbers of injuries and deaths - Epidemics of water and food-borne diseases	High
Infrastructure	Transport	Extreme heat	- Damages on road and rail network - Modification of transport frequency and means - Air quality problems - Higher maintenance costs	Low
		Landslides	- Damages on road and rail network - Modification of transport frequency and means - Higher maintenance costs	High
		Droughts	- Difficult transport of bulk material	Low
		Floods	- Damages - Mobility problems	High
	Energy	Extreme heat	- Blackouts and inability to cover demand load - Damages, especially in the thermal power plants	High
		Landslides	- Damages in the transmission and distribution grid - Damages in any power generating plants, including RES (PVs) in afflicted areas	High

	Receptors	Weather Sensitivity	Future Risk	Impact
Infrastructure		Droughts	- Blackouts and inability to cover demand load - Higher maintenance costs - Cooling problems in power plants	High
		Floods	- Damages / power cuts	Medium
	Water	Extreme heat	- Water scarcity - Water quality issues	Medium
		Landslides	- Water scarcity due to infrastructure damages - Water quality issues due to infrastructure damages	Medium
		Droughts	- Water scarcity - Water quality issues	High
		Floods	- Increased damages and related maintenance costs - Water management issues - Water quality issues	High
	Social	Extreme heat	- Increased needs for air conditioned public spaces	Medium
		Landslides	- Damages - Mobility problems - Increase in the numbers of people burdening the health care facilities	Medium
		Droughts	- Increased numbers of people presenting respiratory problems and burdening the health care facilities - Inability to cover the water demand - Difficulties in the operation of certain facilities due to lack of water (e.g. swimming pools)	Medium
		Floods	- Damages - Increased maintenance costs - Flooding at the city level of the afflicted public building infrastructure (schools, hospitals, etc.) - Difficulties in providing the envisaged services	High
Built Environment	Building stock and material	Extreme heat	- Concrete's damages - Increased cooling demands - Higher maintenance costs - Urban heat island effect	Low
		Landslides	- Damages	Low
		Droughts	- Higher water demand	Medium
		Floods	- Damages - Increased maintenance costs	Medium

	Receptors	Weather Sensitivity	Future Risk	Impact
Economy	Tourist	Extreme heat	- Change of the tourism season – lower touristic flows - Reduction of the tourism related economy	Medium
		Landslides	- Potential damage to touristic infrastructures and sites	Low
		Droughts	- Increased water supply costs - Potential increase of indirect costs for the tourists (infrastructure related) and reduction of touristic flows	Low
		Floods	- Damages to touristic facilities - Potential effects on the touristic flows, in areas with flooding history	High
	Agriculture	Extreme heat	- Changes in growth cycle - Damages / loss of harvest - Livestock loss and impacts on health - Lower crop yields - Increased fire risks	High
		Landslides	- Damages/ loss of harvest - Loss of soil and reduction of cultivated lands	Medium
		Droughts	- Damages / loss of harvest - Lower crop yields - Livestock loss and impacts on health - Land degradation - Increased fire risks	High
		Floods	- Damages/ loss of harvest in afflicted areas - Livestock loss - Surface soil erosion	High
Biodiversity	Coastal zone ecosystems	Extreme heat	- Loss of specific species (fish, etc.)	High
		Landslides	- No expected risks	-
		Droughts	- Increase of coastal water salinity	Medium
		Floods	- Soil erosion	High

4.6 Adaptation Actions

The ASEZ Authority, having compiled the vulnerability analysis and risk assessment, has identified a specific set of actions that will allow it to adapt to the situation it faces. The suggested adaptation actions have been identified from the international literature and best practices available, and are in line with the national adaptation actions adopted.

For each one of the five sectors, a further distinction of the adaptation actions in four categories is realized:

- Strategic actions. Actions regarding the formulation of action plans, or strategic policy planning documents, that set the basis for all the actions to come in the specific sector.
- Alert /Communication actions. These are focusing on alerting the citizens on a situation, such as an extreme climate event or hazard (high temperatures, floods, tsunamis etc.).
- Educational actions. The focus in this case is given on increasing the awareness raising level of the citizens on a specific threat or situation that ASEZA is faced and requires the citizens' collaboration in one way or another.
- Technical actions. Activities that are directly addressing in a technical the specific climate hazard.

4.6.1 Public Health

The first sector to be examined, Public Health is of utmost importance since it has direct impacts on population and their living. Table 83 below focuses on a set of suggested adaptation actions on the population and public health.

Table 83: Adaptation actions for public health

Actions' characteristic	Adaptation Actions
Strategic	Health action plan for the extreme events that ASEZA is facing e.g. heat etc. (heat health action plan) - Collaboration with the regional medical services to increase preparedness level
	Provide access to air conditioned public buildings during heat waves or other extreme events, for those citizens that lack the infrastructure to protect themselves (people living in underground apartments during floods, or lacking AC during extreme temperatures etc.)
Alert / Communication	Developing an early warning system to alert citizens in the case of extreme weather events
Educational	Educational and awareness raising campaigns about health-related effects of extreme events
Technical	Regular cleaning and maintenance of the sewage and drainage system
	Frequent monitoring of water and air quality

Health action plan for the extreme events

The health action plan should include the framework for the implementation, coordination and evaluation of extreme events response activities in order to reduce the health impacts. It aims to provide measures for a successful coordination between government departments, health care professionals such as emergency medical personnel, health center staff, and hospital staff, and community groups. The proposed effective actions will ensure that health care and social systems are ready to act and strengthen the health and well-being. Preventive measures for those high risk target groups will be also considered, such as not working outside in high temperatures for workers/technicians, or modification of their working hours during heat waves etc. The estimated cost for this action is 80,000 JOD and it is planned to start in 2018 and be finalized within one year.

Provide access to public buildings during extreme events

There is a part of the population which lacks the infrastructure to protect themselves during extreme weather events. ASEZA may provide air conditioned spaces in public buildings for those who have not ACs in their residences so as to eliminate the health impacts due to high temperatures. Moreover public buildings may be provided as well, to citizens living in underground apartments, in case of floods. The estimated cost for this action is 15,000 JOD in an annual basis, since existing buildings and structures will be utilized, and only the administrative and energy cost for the action has been considered, and it is planned to start in 2018 for the whole 2030 horizon and beyond.

Developing an early warning system to alert citizens in the case of extreme weather events

Following the forecasting of an extreme event, immediate notification of the public and all those participating in the response is critical to ensure safety. The warning system should include early meteorological announcements followed by protection and medical advices. The aim is to alert those citizens who are most at risk so as to take the appropriate precautions. These extreme weather events take into account heat waves, floods, droughts, as well as landslides in specific areas. The estimated cost for this action is 500,000 JOD and state support and collaboration will be sought in order to carry out such an ambitious action. This Early Warning System is planned to start in 2025, in order to allow time for the identification of the financial resources and coordination at the state level, and be completed and be fully operational within the next 2 years, beginning of 2026.

Educational and awareness raising campaigns about health-related effects of extreme events

Campaigns should include information and advices for citizens on how they can protect themselves in case of extreme heats, floods, landslides, vector borne diseases etc. so as to prevent impacts and infections. The aim is to communicate the risks disseminating public messages through media, informational material and social media. Special efforts should be made to reach vulnerable population such as elderly people, children, citizens with chronic diseases and employees working outdoors. The estimated cost for this action is 30,000 JOD and it is planned to start in 2020 and end in 2022.

Regular cleaning and maintenance of the sewage and drainage system

A rise in temperature due to climate change will increase microorganisms' growth. In addition, floods as a result of extreme rainfall leads to disruption of water purification and contamination with sewage disposal systems, leading to increase the probability of epidemics. Subsequently the regular cleaning and maintenance of the sewage and drainage system is vital in order to mitigate the health risks. The estimated annual cost for this action is 80,000 JOD and it is planned to start in 2019 until the 2030 horizon.

4.6.2 Infrastructure

The next section regards infrastructure and actions to mitigate the climate impacts on them are presented.

Table 84: Adaptation actions for infrastructure

Actions' characteristic	Adaptation Actions
Strategic	Water management plan
	Modelling predicted supply changes in the electricity from the locally available RES
	Mapping of sites with landslides and flood risks
Educational	Developing guides and awareness raising campaigns for citizens on how to save water and energy, especially during crisis
Technical	Integration of sustainable drainage systems

Water management plan

The expected reduced precipitation, the temperature increase and the evaporation will result in less recharge and less replenishment of surface water and groundwater reserves. In addition the water demand is increased and contributes in reducing per capita shares. An important action is to develop a plan so as to manage the water supply systems in order for instance to detect leakages, organize regular maintenance and notify the Authority when such incidents take place. The estimated cost for this action is 80,000JOD and it is planned to start in 2020 and be completed within the same year.

Modelling predicted supply changes in the electricity from the locally available RES

A certain part of electricity consumption in ASEZA, but also in all Jordan, depends on Renewable Energy Sources. The extreme weather events may cause malfunctions in the energy supply leading in major problems in the city (e.g. patients who lives in their homes under technical assistance). Subsequently, problems should be predicted via prediction models in order for ASEZA to plan what actions should take to face the situation in each case. The estimated cost for this action is 100,000 JOD and it is planned to start in 2020 and end within one year.

Mapping of sites with landslides and flood risks

Another strategic action is the systematic mapping of sites that face landslide or flood risk. Since prevention is the basic tool to avoid future destructions, ASEZA will invest on the mapping of its whole territory, determining the areas with low, medium and high risk for phenomena such as the above. Basic aim of this exercise, depending on the extent of the afflicted areas, is potentially to ban the establishment of infrastructures in areas with high risk, or to require specific permits for building in these areas and only if certain high standards are to be followed in the construction. The estimated cost for this action is 150,000 JOD, and is expected to be initiated in 2022, and run for 2 years.

Developing guides and awareness raising campaigns for citizens on how to save water and energy, especially during crisis

As part of the mitigation actions envisaged in the previous chapter, ASEZA is going to implement numerous awareness raising activities and campaigns for the citizens, in order to

make them more aware on how to save energy. These actions could be further enhanced with water saving advice, especially during heat waves, droughts or other extreme weather events that require savings in these resources. The cost for this action can be covered through the dedicated amount in the mitigation actions, and is expected to have the same duration.

Integration of sustainable drainage systems

Since floods consist an expected problem due to the climate change, ASEZ Authority should take appropriate measures to handle the impacts and protect buildings and infrastructure. A drainage system is comprised of a network of channels, drains and hydraulic engineering. The main elements of a drainage system are the regulating, protective, and conducting networks, which make up the drainage network; the water relief system, that is, the body of water, such as river, lake, or sea, receiving the drained water; the hydraulic engineering structures (overfalls, channel openings, sluices, manholes, and pumping stations); the road network (roads, bridges, culverts, and livestock crossings); and the operating structures (benchmarks, observation shafts). The capital cost for this action is similar or even lower to traditional drainage systems; however, the maintenance cost is higher compared to the conventional systems. According to several studies, the annual average maintenance cost is approximately 6 JOD more, compared to the traditional system, per property [21]. The action is planned to start in 2022 and end in 2025.

4.6.3 Built Environment

The next section is about the actions to be implemented in order to enhance the built environment and protect it from the future climate repercussions.

Table 85: Adaptation actions for built environment

Actions' characteristic	Adaptation Actions
Strategic	Enforcement of building codes for more energy efficient and heat tolerant structures
	Integrated land use planning with zoning system depending on the different areas
Alert / Communication	Not applicable
Educational	Educational campaigns on informing the citizens on the benefits of adopting the suggested actions in their premises
Technical	Greening infrastructure such as buildings' roofs and walls
	Increasing the amount of shade and green areas in the city by planting trees and using green pavements to reduce the heat island effect
	Building exemplary districts with adapted urban forms and buildings
	White roofs (cool colors), shading and bioclimatic design
	Rainwater collection and use
	Adoption of methods to reduce water demand
	Using water resistant construction materials

Enforcement of building codes for more energy efficient and heat tolerant structures

In ASEZA, as well as Jordan in general, building codes are applicable for new structures; however, these codes are not strictly enforced, since their implementation remains somehow optional. Therefore, the legislative framework is there, and ASEZA should work towards promoting its use or decide its strict enforcement. Moreover, techniques on how to protect infrastructure from floods (e.g. minimum floor heights, water proofing etc.) are also required. This action has been suggested as part of the mitigation actions across all building infrastructure in the territory. The estimated cost and duration for this action has been considered in the mitigation actions.

Integrated land use planning with zoning system depending on the different areas

This action is basically the integration in the land use planning of the mapping of the region conducted before, depending the high, medium and low risk for phenomena such as flooding and landslides for characterizing certain zones. This action will be realized internally by the Authority upon the completion of the mapping.

Educational campaigns on informing the citizens on the benefits of adopting the suggested actions in their premises

ASEZ Authority should organize educational campaigns in order to inform inhabitants about the risks and climate hazards on the region and propose the appropriate measures via guidebooks or other material. Thus citizens will be able to modify their residences and businesses and convert them to more safe places which could resist floods and heat. Since ASEZA is going to implement a series of awareness activities in the mitigation and adaptation thematic fields, it is the Authority's intention to group where possible these activities for better coordination.

Greening infrastructure such as buildings' roofs and walls

A green roof is covered with vegetation and between other purposes it serves to provide insulation and help to lower air temperatures. It also contributes in mitigating the heat island effect and in cleaning the air in parallel with decreasing stress of the inhabitants. The development of demonstrative projects for this purpose by the Authority is envisaged within the 2030 horizon. The estimated cost for this action is 60,000 JOD, while the action is planned to start in 2023.

Increasing the amount of shade and green areas in the city by planting trees and using green pavements to reduce the heat island effect

In order to adapt to the high temperatures, the ASEZ Authority could create shade and green areas in places where a lot of people gather or pass through their day. Trees and parks can contribute in reducing the heat island effect and provide outdoor thermal comfort as well as a shaded and breezy place for the people passing to rest. In addition, the chosen material for the construction of sidewalks should be heat absorbing so as to prevent the extra heating from the ground to be reflected. In that way, citizens will feel euphoria and will be partially

protected by a heat stroke. The estimated cost for this action is 400,000 JOD for the application of the above in selected parts of the city, and it is planned to start in 2020 and end in 2030.

Building exemplary districts with adapted urban forms and buildings

A great way to attract more citizens so as to adapt the measures is to build exemplary districts with adapted urban forms and buildings to perform as a demonstration project. ASEZA in this way can lead by example its citizens and comprise the basis and reference for similar future works in the country. The action is envisaged at demonstrative scale upon the receipt of the related funds. Since the Authority already has plans for buildings and will implement such activities, the estimated cost for this action is for transforming them into green neighborhoods, namely the additional cost is 500,000 JOD, and it is planned to start in 2019 and run until 2030, depending on fund availability.

White roofs (cool colors), shading and bioclimatic design

The main measures to adapt for a building are those which can prevent temperature increase. Cool colors in rooftops or even the external walls reflect a percentage of the absorbed heat, thus maintaining the inner temperature at lower levels. Shadings can also contribute to the preservation of indoor thermal comfort since they block the sunlight to pass through glazing. Taking also into consideration the general bioclimatic designs, such as building orientation, construction materials etc. is also a way to maintain the desirable temperature inside the building. This action has already been suggested as a measure for the mitigation of energy consumption and related emissions.

Rainwater collection and use

Collecting rainwater is an excellent way to conserve the fresh water. Using rain barrels, rainwater collection systems with big tanks underground (to avoid evaporations) can lead to significant water savings. This water could be used for domestic purposes like gardening, washing vehicles and equipment, flushing toilets etc. This action envisages rainwater collection in selected municipal buildings at first, as a pilot study. The estimated cost for this action in selected ASEZA buildings is 30,000 JOD and it is planned to start in 2019 and be finalized by 2020. Depending on the action's results, potential multiplication in other buildings will be considered.

Adoption of methods to reduce water demand

Since water scarcity is a major problem for Jordan in general, and Aqaba especially, a solution is to adopt methods to reduce its use. Using proper showerheads, toilet flushes with adjustable flow, wash machines only when they are full are easy activities to follow in order to save water and adapt to the increasing problem of water scarcity. The estimated cost for this action is 10,000 JOD for implementation of such measures in selected ASEZA buildings. Potential replication of the results is also envisaged, including awareness raising (to be combined with previous actions) targeting the residents. The action is planned to start in 2018 and be finalized within the year.

4.6.4 Economy

Climate changes and extreme events affect the economy sector and create problems that have to be addressed promptly.

Table 86: Adaptation actions for economy

Actions' characteristic	Adaptation Actions
Strategic	Elaboration of water and ground water management plan
	Adoption of integrated land use planning for the tertiary sector
Alert / Communication	-
Educational	Educating tourists on ways to conserve natural resources
Technical	Adoption of energy efficient and water conservation programs at resorts

Elaboration of water and ground water management plan

This action has been also considered above, in the infrastructure section. The water management plan to be developed should target the economic sectors in the region as well.

Adoption of integrated land use planning for the touristic activities

Integrated land use planning is a strategy to prevent climate impacts such as flooding, drought, water scarcity and heat stress, as well as to avoid exposure of valuable elements to risks. The planning for the tertiary sector (including touristic activities) proposes that construction in flood areas should be avoided if possible, urban development should be planned in low hazard areas, development of buildings, housing, economical values etc. in flood risk areas should be restricted and storm water services should be planned. This action can be considered part of the urban planning and zoning system suggested above, under the Built Environment, with specific emphasis on the building permits issued for touristic infrastructure and resorts.

Educating tourist on ways to conserve natural resources

Since Aqaba is a development touristic region, ASEZA should also plan educational campaigns and raise awareness activities for the tourists. Tourists visit the region throughout the year and use a part of the country's natural resources. The first pillar of the campaign should inform tourists on how to conserve natural resources especially during extreme weather events (e.g. water), while the second one should provide advices and safety tips. The estimated cost for this action, to be implemented in close collaboration with the hotel and touristic associations, is 80,000 JOD and it is planned to start in 2020 and run until 2030.

Adoption of energy efficient and water conservation programs at resorts

Resorts have to be developed responsibly in water-stressed regions. In order to create a water conservation program they have to measure their water consumption and set some tangible targets. There are some actions to be implemented in the resorts so as to manage the water use. Concerning the bathrooms, shower flow should be no more than 10 liters / min. Another measure is the installation of duel flush toilets so guests can opt for a shorter flush and regular maintenance to avoid leakages. Regarding swimming pools some actions could be the regular maintenance to prevent leaks, backwash the swimming pool every two to three days rather

than daily, cover swimming pools when not in use to prevent evaporation etc. These actions are to be realized by the private sector, in close collaboration with ASEZA, therefore their cost doesn't burden ASEZA. The action is planned to start in 2020, to allow time for coordination, and end in 2025.

For this sector there is also a number of actions which were presented extensively in the Mitigation Actions of the SECAP. These actions regard replacement of old systems with new more efficient, installation of supportive equipment to manage lighting and ACs as well as installation of RES to cover electricity needs and Thermal Water Heaters to supply hot water for domestic use. All these measures contribute to the reduction of GHG emissions and consequently in the effort to adapt to the climate change's impacts.

4.6.5 Biodiversity

Biodiversity – the variety of life on the planet – is essential for the economy and for people well-being, but one of the main environmental challenges facing the planet is the loss of it. Conserving biodiversity and maintaining nature's capacity to deliver the related goods and services is became a priority at global scale.

Table 87: Adaptation actions for biodiversity

Actions' characteristic	Adaptation Actions
Strategic	-
Alert / Communication	-
Educational	Educating the citizens
	Trees planting

Educating the citizens

A significant measure is citizens' education regarding the importance of biodiversity for their wellbeing. People have to realize that their actions and activities are connected directly with the state of the environment thus effecting their own living conditions. Campaigns should be organized so as to inform inhabitants how they can adopt an environmental friendly behavior and protect their natural habitat. The estimated cost for this action is considered as part of other awareness raising activities to be conducted by ASEZA.

Trees planting

An important action towards the protection of biodiversity is the tree planting and the expansion of green areas with friendly drought-tolerant plants. Trees not only contribute to the preservation of the natural habitat of fauna but they can also prevent floods and soil erosion. Moreover they are significant actors in air cleaning which means that more trees and plants can reduce more the greenhouse gasses. This action focuses on motivating and coordinating voluntary initiatives from the residents, perhaps with the financial support of certain companies activated in the city, in the form of a sponsor.

Chapter 5: Project Fiches

5.1 #1 - Eco-Science Park

Eco-Science Park- # No 1

1. General Presentation

Location	Start date	Project Lifetime
Aqaba Special Economic Zone Authority – Aqaba City, Jordan	Upon receiving the fund	20-30 years (building)

Project Owner / Lead Actor

Aqaba Special Economic Zone Authority

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Summary of the Action

The aim of this project is the construction of an Eco-Science Park driven by environmental obligations and incorporating a variety of demonstrative applications of Renewable Energy Sources (RES), as well as the construction of a Green Building to house municipal services and operate as best practice example, enhancing the living conditions of its employees and the citizens visiting it. The estimated cost is 1,010,153 JOD (1,323,300 €). The CO2 reduction derives 1,626 tn.

General Framework

Energy crisis, climate change, and environmental pollution have positioned sustainability high on the global agenda (EPA, 2008).

Jordan is among the most dependant countries in the world on foreign energy sources, with 96% of the country's energy needs coming from imported oil and natural gas from neighbouring Middle Eastern countries. This complete reliance on foreign oil imports consumes a significant amount of Jordan's GDP. This led the country to plan investments of $15 billion in renewable and nuclear energy. To further address these problems, the National Energy Strategy for 2007-2020 was created, projecting to boost reliance on domestic energy sources from 4 per cent to 40 per cent by the end of the decade. The National Energy Strategy includes ambitious targets to increase the contribution of renewable energy sources to the national energy supply. The share of renewable energy in the total energy mix is anticipated to reach 7% by 2015 and 10% by 2020. Plans are in place for up to 2,000 MW in solar and wind energy projects by the end of the decade.

Jordan is also classified as one of the top countries in the world on water scarcity, especially for the purposes of potable water and agriculture (UNICEF/WHO Joint report, 2011). A high rate of natural population growth, combined with massive influxes of refugees, has resulted into an unbalanced situation between population and water.

The sustainability of human development in Jordan is dependent on the availability of secure, adequate and clean energy sources and threatened by the decline in both the quantity and quality of water resources and degradation in the quality and availability of arable land due to urbanization and poor land-use policies.

This Eco- science park will develop state-of-the-art Park to perform as a demonstration of environmental themes such as Smart Green building, Energy, Transportation, Water, Waste, Organic and sustainable farming, Sustainable tourism, eco-tourism, and fishing.

The rapidly evolving and exponentially growing smart green building movement is arguably the most successful environmental movement worldwide. In contrast to many other areas of environmentalism that are stagnating, smart green buildings have proven to yield substantial beneficial environmental and economic advantages. In the context of smart green buildings, resource efficiency means high levels of energy and water efficiency, appropriate use of land and landscaping, the use of environmentally friendly materials, and minimization of the life-cycle effects of the building's design and operation, hence, reduced environmental impact throughout the life cycle.

Statistics show that the operation cost for buildings and urban transportation takes up over half of the total energy consumption in the city (UNEP, 2011). In addition, at a global level, the International Energy Agency (IEA, 2009) estimate that nearly more than 40% of the world's electricity is consumed in residential and commercial buildings.

Aqaba Special Economic Zone Authority (ASEZA) strongly recognizes the need to start initiatives of promoting integrated eco-science parks. This project, "Eco-science park ", is driven by a broad range of international and regional obligations, national and local legislations. The obligations range from broad concerns about the sustainability of economic development, to a specific requirement on Jordanian codes about how a smart green building is constructed and managed.

Promoting environmentally friendly park as a lead example by ASEZA, has an opportunity to show how industry and government are coming together to dramatically reduce the impact of buildings on the environment, using new technologies and systems.

Being the first integrated eco science park in the region, it will attract citizens, visitors, environmental responsible stakeholders, builders, other institutions, researchers and development industry to learn about its knowhow and technology.

Technical Background

Main Activities:

Smart Green Building:

The Smart Green building area is estimated to be **2,250 m²**, and will include the following components:

Components	Area (m^2)	Components	Area (m^2)
Green educational Centre, includes: Gallery #1: Renewable Energy Module (200 m^2) Gallery #2: Solid Waste Module (100 m^2) Gallery #3: Water Conservation Module (100 m^2) Gallery #4: Farming Module (100 m^2) Meeting Hall (100 m^2) Theatre (500 m^2)	1,100	Working offices adequate to occupy 20 employees	250
		Control Room	50
		Reception Hall	50
		Employee Toilets	100
		Storage Area	100
		Public toilets	200
		Corridors and natural lighting system	400

Therefore, the land needed to construct the smart green building will be less than the area of 2,250 m^2 depending on the final architecture design, whether it is two levels or three levels or even more.

A sustainable building may consume less than 20% of the energy that a conventional building consumes. A conventional building would consume 120KWh/m^2 (final energy consumption). The estimation of the reduced energy consumption is 37KWh/m^2[1]. Thus the **Green Building** will consume approximately **83.25 MWh annually** (186 MWh energy savings). Given also the electricity emission factor, the CO_2 reduction will be 108 tn.

Utilities at the Parks:

Component	Area (m2)
Car parking	1,000
Grey water Unit	100
Solid waste recycling unit	200
Electrical cars charging station	100
Green houses (2)	500
Public Toilets	200
Small solar charging stations for mobiles.	100
Kids Playing Areas (2 ones)	200
Open space Learning Centre	200
Sitting Areas	200
Cafeterias (2)	200
Total	**3,000**

The overall area required for the proposed project will be 5,250 (2,250 m^2 for the building and 3,000 m^2 for the utilities).

Park:

The remaining area will be allocated for the park which will include the water friendly garden.

Regarding the budget, an overall estimation for the *Green building*'s special costs is presented in the table below:

Type	Number of units	Cost/unit (€)	Total Cost (€)
Green Economy Energy Center Design & Development			
Preparation of architectural designs	1	6,000	6,000
Preparatory ground & concrete works	1	60,000	60,000
Ductwork channelling & insulation material and services		11,000	11,000
Hydraulic bulb connectors equipment & works	1	4,000	4,000
Electrical & Mechanical wiring works & equipment	1	9,000	9,000
Painting and decoration works	1	20,000	20,000
Finishing works		10,000	10,000
		Subtotal:	*120,000*[2]
Equipment for smart energy management system			
Smart meters (purchase of equipment)	2	300	600

[1] http://future-megacities.org/fileadmin/documents/konferenzen/Megacities_in_Balance_2010/b3_visser.pdf
[2] Initial expenses

Smart meters (installation in Green Economy building)	2	250	500
		Subtotal:	*1,100*
Software for equipment operation			
Cloud hosting services	1	18,000	18,000
RES equipment			
Small Scale Wind Turbine model 1	1	25,000	25,000
Small Scale Wind Turbine model 2	1	10,000	10,000
Small Scale Bio Gas Digestor Anaerobic model	1	20,000	20,000
Small Scale solar photovoltaic plant	1	10,000	10,000
Small Scale solar thermal model	1	20,000	20,000
Small Scale Geothermal model	1	60,000	60,000
Lab Equipment	1	50,000	50,000
		Subtotal:	*195,000*
Engineering, feasibility studies, energy audits, impact assessments, simplified EIA etc.			
Site Evaluation, Requirement Analysis and Assessment	1	8,000	8,000[3]
Expenditure verification / Audit			
Applicant ASEZA	2	3,000	6,000
Evaluation costs			
Identification of indicators for evaluating project outputs, results and impact	1	1,400	1,400
Mid-term evaluation of the project	1	6,000	6,000
		Subtotal:	*7,400*
Costs of dissemination conferences/workshops			
Organisation of Opening Conference	1	7,000	7,000
Organisation of Closing Conference	1	8,000	8,000
Participation in International Events/Conferences (as Exhibitor)	3	15,000	45,000
		Subtotal:	*60,000*
Training material and events			
Organisation of Capacity Building Seminars (selection of trainees, assessment of training needs, development of training curricula, organisation of training sessions, and evaluation)	5	10,000	50,000
Visibility Actions			
Elaboration of the Communication Plan	1	6,000	6,000
Design of the Project Identity (logo/motto) - Applications	1	4,000	4,000

[3] Initial expenses

Design and Production of Project Brochures	3,000	1.50	4,500
e-Newsletters	6	500	3,000
		Subtotal:	*17,500*
		Total:	**483,000**
		Other contingency costs (10%):	**48,300**
		Construction cost (352€/m²) **Includes water saving technologies, efficient cooling & ventilation, insulation, shadings, environmental friendly materials, efficient lighting (based on a similar sustainable building construction)[4]**	**792,000**
		Totalinvestment:	**1,323,300 €** **1,010,153 JOD**

*1 JOD=1.31€

The Net Present Value, given an interest rate of 8%, derives negative considering only the reduced operational costs and energy savings. That was expected since the project introduces on one hand the construction of a whole new infrastructure and not the enhancement of an existing system, and on the other hand it includes a wide dissemination component and costs that do not have a direct financial benefit for the ASEZ Authority.

In addition, the estimated operational cost of the Green Building is 8,400€/yr (6,412 JOD) for consumables, bills and maintenance.

Regarding the PVs installation, it is estimated that they will be 20 KWp and they will produce 34 MWh/year (1,698 hrs/year operation and 19.39% capacity factor). Given also the electricity emission factor, the CO_2 reduction will be 19.7 tn.

Moreover due to raise awareness trainings that are planned to be organized and due to the impact the Eco Science Park will have to the citizens, an indirect energy saving is expected. Every person will succeed 200 Wh reduction of energy from different activities. It is also estimated that this action will reach approximately the 30% of ASEZ citizens (34,500 people) and thus the total annual electricity reduction derives 2,584 MWh. Given also the electricity emission factor, the CO_2 reduction will be 1,499 tn.

General Objectives of the Project	Principal partners and stakeholders
The primary objective of this project is to construct a state-of-the-art Eco-Science Park to perform as a demonstration of environmental themes such as: Smart Green facility, Water Friendly Garden, Wind Turbines for street lighting, Solid waste recycling unit green transportation and Aquaponics system. The Smart Green Building will be designed to meet certain objectives including energy conservation, water and waste management, minimizing destruction of natural resources, reducing carbon dioxide (CO2) emissions, increasing the efficiency of resource use – energy, water, and material – while reducing building impacts on human health and the environment in an integrated way during the building's lifecycle, through better sitting, design, construction, operation, maintenance, and removal. The following are the main objectives for the green building: 1. Exploring ways to improve drinking water and waste water efficiency and management (e.g. using grey water technology for irrigation), harvesting water for safe indoor use in innovative ways and generally minimizing water use in the sector. 2. Install photovoltaic cells and use energy-conserving fixtures within the building.	1. Aqaba Special Economic Zone Authority 2. Green Building Council 3. Ministry of Energy 4. Electricity Companies 5. Jordan Engineers Association (Aqaba Branch) 6. Environmental NGO's at Aqaba 7. Aqaba Water Company 8. Ministry of agriculture

[4] http://future-megacities.org/fileadmin/documents/konferenzen/Megacities_in_Balance_2010/b3_visser.pdf

3. Using fewer, more durable materials and generating less waste, as well as accounting for a building's end of life stage by designing for demolition waste recovery and reuse. 4. Engaging building users in reuse and recycling. 5. Bringing a breath of fresh air inside, delivering high indoor air quality through good ventilation and avoiding materials and chemicals that create harmful emissions. 6. Incorporating natural light and views to ensure building users' comfort and enjoyment of their surroundings, reducing lighting energy needs in the process. The Water Friendly Garden will be designed to apply water conservation concept, such as replacing thirsty plants with a friendly drought-tolerant plants to reduce water for irrigation, adding water-efficient elements, grey water reuse, improve park soil to retain water and nutrients better allowing plants to use them more efficiently. Promote native landscaping which demands little or no added water. The Wind Energy Use will be through shifting towards LED street lights to provide a use for small scale wind turbines, the capacity of which will be calculated after the relevant studies. The solid waste recycling unit will introduce solid waste separation containers to the public, in order to promote the solid waste recycling concept and demonstrate the recycling concept within the garden landscape (i.e. Empty bottles, rubber rings and other consumables). The green transportation will be through promoting two electrical cars for employee movement and enhancing walking through the park by developing a net for pedestrian movement. The Aquaponics system is a hybrid technology that combines "aqua-culture" (fish farming), and "hydro-ponics" (growing plants without soil). This is an environmentally sound technology that wastes hardly any water, uses practically no plant foods, and needs no filtration system for the fish. It works as an eco-system between plants and fish, where fish waste provides a food source for the growing plants, and the plants provide a natural filter for the fish.	

Ultimate beneficiaries of the project		**Link to municipal development plans / urban plans / other municipal or city programs**
1. Aqaba Special Economic Zone Authority 2. Local community 3. Researchers 4. Students 5. Tourists		The park will be a part of the main city park, which is within the development plan of ASEZ.
Estimated investment cost needed		
EUR:	1,323,300 (Green Building, Trainings, Visibility Actions)	
JOD:	1,010,153 JOD (Green Building, Trainings, Visibility Actions)	

2. Technical Description

Area(s) of intervention (sectors as specified in the SECAP proposed by CoM)	**Main adopted Technology & Equipment**
1. Buildings 2. Transport 3. Solid waste management, waste water management, farming and Agriculture	Bioclimatic principles and architectures, Photovoltaic cells, energy conservation fixtures, electrical rechargeable vehicles, Grey water technology, water conservation fixtures, Information & Communication Technology (ICT), Solid waste.

Site / Place	Status of the action			
Aqaba City – 10,000 m^2 Within the underdevelopment city park, as marked in the figure below, within blue marking. 	**New**	*Planned*	*Under implementation*	*Following previous action*

Start date	Project Lifetime	Previous or linked studies
Upon receiving the fund	20-30 years	Not available

Engineering Studies	6 months
Implementation plan / Construction plan	Estimated duration for the activities are 30 Months: 1- Gathering information & need assessment document 2- Tendering for Architect design and bills of quantities 3- Tendering for Equipment and tools. 4- Implementation for the project 5- Developing websites, mobile applications, digital media and awareness. 6- Training and workshops to build capacity for ASEZA's employees
Other previous studies	Not available
Environmental impact assessment	According to Regulation no 21 for the year 2001 "Regulation for Protecting Environment at Aqaba Special Economic Zone". The project is an environmental friendly project and there is no need for EIA.

3. Organization and procedures

Formal approval	Legal responsible body
In process	1. ASEZA 2. Ministry of Energy 3. Electrical companies

Staff allocated to prepare, implement and monitor the action		Municipal / City Staff Training Needs
(ECO Science):		1. Training / Workshop in the field of Renewable Energy Resource and how to be applied in life; 2. Training course / workshop in developing grey waste water systems and solution techniques;
Project Manager	30 Months	
Technical Manager	30 Months	
Project Quality Assurance	30 Months	
Project Communication	30 Months	
Project Accountant	30 Months	
Senior Renewable Energy Specialist	6 Months	

Senior Water Quality Management Specialist 6 Months Senior Solid Waste Management Specialist 6 Months Senior Agricultural Specialist 6 Months Senior Awareness Specialist 18 Months Senior Graphic Designer 12 Months Senior Web Master 8 Months Senior Software Developer 8 Months	3. Training course in development of solid waste management and techniques; 4. Workshop in foundations and concepts of green economy and its role in economic and community development; 5. Green Building Class room courses (LEED); 6. LEED AP Operations + Maintenance; 7. Training course in development of E-learning building contents and techniques; 8. Training course / workshop in in public awareness concepts and techniques.
Technical Assistance Needs	**Role of Partners**
1. Consultation in the field of green building design; 2. Consultation in green building construction; 3. Consultation in green building operation and maintenance. 4. Consultation in solid waste recycling. 5. Consultation in grey water systems. 6. Consultation in development of e-learning materials and web sites content 7. Consultation in landscaping and ECO Science Parks design 8. Consultation in development of multimedia products	Not available

4. Cost Estimates

Initial and start-up expenses	1,323,300 € 1,010,153 JOD	**Net Present Value (NPV)**	**Return of Investment (IRR)**
Operational Costs (approx.)	8,400€/yr (Green Building) 6,412 JOD/yr	<0	<0
Annual Income (approx.)	34,521 € (Green Building) 26,352 JOD	Due to the different lifetime of the actions, both NPV and IRR have been calculated for a period of 15 years	

5. Funding Sources

Funding Source	Fund
Local Authority's own resources	20 % (project land) 10,000 m^2 Human resources to implement the investment
National Funds and Programs	
International Financial Institutions	
EU Funds & Programs and other external funds	80%
Public-Private Partnerships	
Lined up Private Investments	
Loans and Potential Borrower	
Expected Annual Cost Savings to City Budget	
Other	

6. Projected Energy Estimates in 2030

Energy Savings (MWh/a)		Renewable Energy Production (MWh/a)
186 (from Green Building)	2,770 (from Green Building and Awareness Raising)	34
The rest will be determined upon the completion of the engineering studies		

CO_2 Reduction (tn CO_2/a)		
Target Year	2030	
	From PVs and Green Building	**From PVs, Green Building and Awareness Raising**
Net reduction on the Territory	127	1,626
Reduction as related to BAU Scenario	0.02%	0.27%
Per Capita calculated reduction	1.08 kg	13.78 kg

7. Summary of Related Awareness Raising (AR) Actions

Awareness Raising related to the Action

Conducting a workshop for the decision makers and project stakeholders in green economy, how it will be implemented in life and its benefits.

Awareness raising related to the Community

1. Creating Green Economy Awareness Program (Training, Workshops, and free consultation).
2. Conducting Green Economy campaign.
3. Design and implement Green Economy E-learning Web site bilingual (Arabic and English).
4. Prepare and design handbooks and brochures to help people implement the suitable green economy solution for their needs.
5. Processing mini-simulation uses clean, renewable energy models

8. Assumptions and risks

1. ASEZA decision makers may not agree on allotment a space allocation of land for the project – This again will be addressed through internal marketing of the project and/or creating a virtual computer system to simulate the real functions of the eco science park
2. Resistance to change by ASEZA staff and stakeholders that could originate from unfamiliarity with eco science park or special skills required for the operation and maintenance of the project – This again will be addressed through internal marketing of the project, as well as tailored topics to be included in the capacity building seminars and training.
3. Relevant stakeholders, not showing interest in participating in the project presents a risk that could reduce the effectiveness of project's activities – This risk can be reduced by a careful analysis of stakeholders in the communication plan and implementation of communication activities from the project start to attract the interest of relevant stakeholders and trigger their participation.
4. Failure to maintain political commitment induces a risk in the effectiveness of the project's activities – This risk can be avoided by using internal marketing actions to continuously update support

9. Key Success Factors

1. There is a national plan for renewable energy and this project is consistent with it;
2. The project is compatible with the main goals of SECAP;
3. There is a development plan for a city park where eco Science Park is part of.
4. There is qualified staff within the authority of the Aqaba Special Economic Zone. Staff can work on the project which will contribute to its continuity and sustainability after the completion of its implementation;

10. Next Steps

Validation of the action fiche through the approval of the SECAP study, in which it will be integrated, by the municipal council.

11. Annexes / References to Annexes

Not available

5.2 #2 - Smarter Transportation System (STS)

Smarter Transportation System (STS)- # No 2

1. General Presentation

Location	Start date	Project Lifetime
Aqaba Special Economic Zone Authority –	TBD	24 months (implementation)

Project Owner / Lead Actor

Aqaba Special Economic Zone Authority

Contact person

Saed Al Masoud
Technical Expert
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Summary of the Action

This project envisages the effective management of the Transport Sector, the replacement of specific vehicles in the municipal fleet with new, more efficient ones, as well as the use of incentives (legislative or other) to promote clean vehicles' use in the private transport (mainly taxis) and the use of RES technologies in public transport (buses). The total cost is 185,489JOD (242,990€). The CO2 reduction from the actions in all sectors is more than 10,600 tn.

General Framework

Our approach to Smart Transportation system (STS) begins with creating a strategic transportation vision, identifying and communicating with key stake holders, and aligning with the overarching goals of the ASEZA. ASEZA will take the responsibility not only to implement the actions for energy reduction in the municipal fleet but it will also coordinate the proposed actions in the public and private sector and support respectively the citizens. All the energy savings and CO2 reductions-except from this for the municipal fleet- will be realized if the inhabitants decide to implement the proposed measures. Therefore in section 6, two different numbers for each estimation are provided. Smart Transportation strategic approach will address 4 key imperatives in parallel:

1- Predict demand and optimize capacity, assets and infrastructure. Current transportation systems experience both congestion and under-utilization because demand is not accurately predicted, capacity is poorly managed and loads are not balanced. This wastes money and time and degrades the quality of the provided service. Transportation providers need deeper insights and predictive models for demand throughout the network. Some are already collecting and analysing historic and real-time data from digital devices to see patterns based on recurring factors such as location, time and date, as well as unplanned factors such as weather. The sources of this information include sensors on vehicles and infrastructure, video monitoring, GPS data, mobile phone signals, satellite images, traffic control data, reservation systems, smart fare cards and more.

2- Improve the end-to-end experience for travellers and freight customers. In a smarter transportation system, travellers and freight customers are empowered with information and tools to determine themselves the best way to move from origin to destination, throughout all transportation modes, with due consideration to cost, time, convenience and environmental impact.

3- Increase operational efficiency while reducing environmental impact. The inefficiencies of today's transportation systems can translate into deteriorating service, excess cost, energy use and environmental impact. In urban areas we are reaching the limits of how much land can be dedicated to new roads, rails and terminals. Transportation systems are tremendously

asset-intensive and use large amounts of energy. Smarter systems optimize existing assets and infrastructure, minimizing the need for increased investments. They save money and time by knowing the location, status and availability of all equipment and assets. They can shift from scheduled to predictive maintenance which improves up time and equipment life.

4- Assure safety and security. Paramount to the success of any transportation system is safety and security, which cannot be compromised. Fortunately, a smarter system can improve safety and security even as costs are reduced. Also, a smarter transportation system can improve security by detecting and evaluating threats through analysis of collected data by various resources.

5- Pure battery electric vehicles (BEVs) are considered "zero emission" because they don't release greenhouse gases or other pollutants during use. Electric vehicles do reduce pollutants generated by burning petroleum fuel in the vehicle, in proportion to the reduction in vehicle fuel consumption. And to go green as much as possible we are going to implement a fixed Solar Electrical Vehicle charging station in ASEZ region, which will be available for free in order to encourage people use electrical vehicles.

This action focuses on gathering real-time information from Global Positioning System (GPS) devices in governmental cars, expanded to public transportation buses, delivery trucks, traffic sensors, transit systems, pollution monitors and weather information.

The data will be processed using streaming analytics software, giving city managers, travellers and freight customers' real-time information on traffic flow, public parking areas, travel times and best commuting options.

Technical Background

More particularly, the specific activities to be realized under this action include:

- Installation of the tracking and monitoring system on the targeted public and government vehicles. This includes 863 vehicles, namely 308 municipal fleet vehicles, 517 taxis and 48 small & coach buses. This action is expected to lead in the following savings:

Type	Annual Diesel Consumption (Lit/yr)	Annual Gasoline Consumption (Lit/yr)	Estimated saving due to use of tracking & monitoring system	Estimated annual Diesel Saving (Lit/yr)	Estimated annual Gasoline Saving (Lit/yr)	Monetary savings from both fuels*(JOD/year)
Municipal fleet	930,000	234,000	5%	46,500	11,700	30.683
Taxi vehicles (public)	0	8,019,963	15%	0	1,202,994	812.021
Small & Coach buses (public)	53,107	0	2%	1,062	0	520
Total	983,107	8,253,963	-	47,562 lt 476 MWh	1,214,694 11,175 MWh	843.224 JOD 1,104,624 €**

*1lt diesel=0.49 JOD, 1lt gasoline=0.675 JOD
**1 JOD=1.31€

Moreover, given that the emission factors for diesel and gasoline are 0.267 tn/MWh and 0.249 tn/MWh respectively, the total emission reduction derives 2,910 tn CO_2/year.

The GPS systems are already installed in the vehicles, there will be a cost for purchase the software for the operation of the tracking (data collection).

- Replacement of 517 taxis with hybrid vehicles, with more than 40% savings in the gasoline consumption. This action is envisaged through the provision of the respective legislative framework that supports exemptions for replacing taxis with Hybrid cars. More specifically:

	Annual Diesel consumption after implementing measure#1 (Lit/yr)	Fuel Saving Percentage	Fuel Saving per year (all the vehicles are to be replaced)	Monetary savings per year	Monetary savings from Maintenance per/year
Taxis	6,816,969	49.74%	3,390,450 lt 31,192 MWh	2,288,554 JOD 2,998,005 €	257,633 JOD 337,499 €

1lt gasoline=0.675 JOD
**1 JOD=1.31€

Regarding the cost of this action and given that the price of a new hybrid car is 13,000 JOD and the salvage value is 3,777 JOD the total investment derives 4,768,045 JOD (6,246,139 €). The Net Present Value is positive, considering an interest rate of 8%. In addition, through the implementation of this action a total amount of 9,137 tn CO_2 will be saved.

- Installation of a solar system in the 11 coach buses related to the 'Aqaba Company for transportation and logistics'. Solar panels are installed on top of buses in order to gather energy during the daytime and then use the generated power to light up buses, promotional panels and bus information boards during evenings/nights. Such energy can be used for generating the Air Conditioning (AC) system as well. Assuming that the AC in coach buses constitutes 5% of the fuel consumption, while lighting comprises another 1% (based on the night operation of the lighting which is 35%), the energy savings will be 1,396 lt (13 MWh) which means 684 JOD (896 €) savings per year given that the diesel price equals 0.49 JOD/lt.
- Installation of fixed Solar Electrical Vehicle charging stations in ASEZ region.

  It is envisaged that 1 % of ASEZ region's citizens will replace their cars with electrical ones which means that 118 cars will not consume gasoline at all, thus there will be an annually saving of 59,418 lt (547MWh) and a monetary saving of 40,107 JOD (52,541 €) given that gasoline costs 0.675 JOD/lt. In addition, regarding the CO2 emissions, there will be a reduction of 136 tn based on the emission factor for gasoline which is 0.249 tn CO2/MWh.
- Development of a website and self-service technology like smart phones apps. In self-service technology like smart phones apps, travellers and freight customers are empowered with information and tools to determine for themselves the best way to move from origin to destination, throughout all modes of transportation, with consideration to cost, time, convenience and environmental impact.

Energy use, carbon emissions and cost can be reduced by monitoring vehicles in real time Data and building a smarter transportation circulatory system. The overall objective of the action is the Development and Demonstration of Advanced Methods, for Quantifying Freight Truck Activity, Energy Use and Emissions.

As far as the investment cost is concerned, in the next table the base costs of the project are presented. These costs regard only ASEZA's actions and not the total investment of actions on behalf of the citizens.

Type	Number of units	Cos/unit (€)	Total Cost (€)
Software for equipment operation			
GIS software and Remote sensing	1	30,000	30,000
GPS tracking software	1	20,000	20,000
Web site and mobile apps	1	30,000	30,000
Cloud hosting services*	1	20,000	20,000
		Subtotal:	*100,000*
Equipment for installation works			
Solar Electrical Vehicle charging station	3	10,000	30,000

Expenditure verification/Audit			
Applicant (ASEZA)	2	3,000	6,000
Evaluation costs			
Identification of indicators for evaluating project outputs, results and impact (Applicant ASEZA)	1	1,400	1,400
Mid-term evaluation of the project (Applicant ASEZA)	1	6,000	6,000
		Subtotal:	*7,400*
Costs of dissemination conferences/workshops			
Organisation of Opening Conference	1	7,000	7,000
Organisation of Closing Conference	1	8,000	8,000
Participation in International Events/Conferences (as Exhibitor)	3	15,000	45,000
		Subtotal:	*60,000*
Visibility actions			
Elaboration of the Communication Plan	1	6,000	6,000
Design of the Project Identity (logo/motto) - Applications	1	4,000	4,000
Design and Production of Project Brochures	3,000	1.50	4,500
e-Newsletters	6	500	3,000
		Subtotal:	*17,500*
		Total:	**220,900**
		Other contingency costs (10%)	**22,090**
		Total investment:	**242,990€** **185,489 JOD****

*Services needed to host the cloud-based system refer to a true virtual computing environment, allowing to use web service interfaces, to launch instances with a variety of operating systems, load them with C-BEMS custom application environment,

manage network's access permissions, and run image using as many or few systems desired. The cloud hosting services are categorised as follows: a) Pre-configured, templated Cloud Machine Image (AMI) running immediately; repository containing applications, libraries, data, and associated configuration settings; b) Security high-end configuration and network access on cloud hosting instance; c) Selection of type of instances and monitoring using the web service cloud hosting APIs or the variety of management tools provided; d) Availability to run in multiple locations, utilise static IP endpoints, or attach persistent block storage related to instances; and e) Charge only for the resources that are actually consumed, like instance-hours or data.

**1 JOD=1.31€

General Objectives of the Project	Principal partners and stakeholders
Overall: to build truly smarter transportation systems through integrating digital technology with physical infrastructure. Specific: to reduce downtown traffic by 18 %, and reduce CO2 emissions by 20 % in the city centre, and increase public transportation by 10.000 passengers per day, using green cars.	1. Aqaba Development Company. 2. Ministry of Transportation. 3. Jordanian Civil Aviation Regulatory commission. 4. Ports Authorities. 5. Traffic Department in the Directorate of General Security. 6. NGO's at Aqaba.

Ultimate beneficiaries of the project	Link to municipal development plans / urban plans / other municipal or city programs
• 118,000 inhabitants of Aqaba; • Governmental bodies; • Mobility services; • Commercial arena; • Travellers; • Tourism industry; • Freight and Supply chain industry (Logistic Providers).	It's part of the City Affairs commission plans to develop and enhance the Transportation system and reduce the CO2 at Aqaba City.

Estimated investment cost needed	
EUR:	242,990
JOD:	185,489

2. Technical Description

Area(s) of intervention (sectors as specified in the SECAP proposed by CoM)	Main adopted Technology & Equipment
Transportation sector	1. ICT (Cloud Computing, web technology, Mobile technology) 2. Geographical Information system 3. Monitoring and Tracking systems, 4. Hybrid systems / Electrical Cars, 5. Solar Technology

Site / Place	Status of the action			
Aqaba City, Aqaba Special Economic Zone Authority (ASEZA)	New	*Planned*	*Under implementation*	*Following previous action*

Start date	Project Lifetime	Previous or linked studies
TBD	2 years	Not Available

Engineering Studies	3 Months (Initiation studies)
Implementation plan / Construction plan	1 year from project start date
Other previous studies	Not Available
Environmental impact assessment	It's a friendly environment project, dedicated to protect the Environment. No environmental impact study is required.

3. Organization and procedures

Formal approval	Legal responsible body
In process	It will be issued later by ASEZA commission board

Staff allocated to prepare, implement and monitor the action		Municipal / City Staff Training Needs
Project Manager	24 Months	1. Training / Workshop in the field of intelligent systems. 2. Training / workshop in the field of Smart transportation systems. 3. Training in in public awareness concepts and techniques 4. Training in Mobile Application development technology. 5. Workshop in Information & Communication Technology and how to be used within the monitoring and controlling systems and cloud computing solutions.
Technical Manager	24 Months	
Communication Manager	24 Months	
Quality Assurance Manager	12 Months	
Project Accountant	24 Months	
Senior GIS Specialist 1	12 Months	
Senior Software Developer1	12 Months	
Electrical Power Engineer	6 Months	
Civil Engineer Specialist	6 Months	
Environmental Engineer	6 Months	

Technical Assistance Needs	Role of Partners
1. Consultation in the field of intelligent transportation planning 2. Consultation in Monitoring and Tracking systems. 3. Consultation in development of web, mobile applications and cloud computing. 4. Consultation in programme management (Multi Project Managements). 5. Consultation in using and installing the solar technology in Bus and public transportation.	TBD

4. Cost Estimates

Initial and start-up expenses	242,990€ 185,489JOD	**Net Present Value (NPV)**	**Return of Investment (IRR)**
Operational Costs (approx.)		88,379 € (regarding ASEZA's investment and savings for a period of 14 years)	14%
Annual Income (approx.)	40,195€ 30,683 JOD	67,465 JOD	

5. Funding Sources

Funding Source	Fund
Local Authority's own resources	20% of the project Budget, including human resources for the implementation of the action
National Funds and Programs	
International Financial Institutions	
EU Funds & Programs and other external funds	80% of the project Budget
Public-Private Partnerships	
Lined up Private Investments	
Loans and Potential Borrower	
Expected Annual Cost Savings to City Budget	
Other	

6. Projected Energy Estimates in 2030

Energy Savings (MWh/a)		Renewable Energy Production (MWh/a)
573 (Municipal fleet)	42,830 (Public and Private)	547 (Private)

CO_2 Reduction (tn CO_2/a)		
Target Year	2030	
Net reduction on the Territory	151 (Municipal fleet)	10,665 (Public and Private)
Reduction as related to BAU Scenario	0.02%	1.75%
Per Capita calculated reduction	1.28 kg	90.38 kg

7. Summary of Related Awareness Raising (AR) Actions

Awareness Raising related to the Action
Conducting a workshop for the decision makers and project stakeholders and local community to clarify the expected benefits of this project, trying to get the required support till achieving the desired goals.
Awareness raising related to the Community
1. Conducting intelligent transportation public awareness campaign (Training, Workshops, and free consultation). 2. Distributing the web site and application link to encourage the concerned parties and stakeholders to download and use the Apps. 3. Prepare and design brochures to introduce and share the system to Aqaba visitors.

8. Assumptions and risks
1. ASEZA decision makers may not support this project IDEA – This can be minimized by elaborating and presenting the future promising objectives of the project. 2. Resistance to change by ASEZA staff and stakeholders that could originate from unfamiliarity with ICT required and the eLearning platform or special skills required for the operation and maintenance of the project – This again will be addressed through internal marketing of the project. 3. Relevant stakeholders, not showing interest in participating in the project presents a risk that could reduce the effectiveness of project's activities – This risk can be reduced by a careful analysis of stakeholders in the communication plan and implementation of communication activities from the project start in order to attract the interest of relevant stakeholders and trigger their participation.
9. Key Success Factors
1. There is a national plan for enhancing transportation and this project is consistent with it; 2. The project is compatible with the main goals of SECAP; 3. There are qualified staff within ASEZA to work on the project who will contribute to the continuity and sustainability of the project after its implementation;
10. Next Steps
TBD
11. Annexes / References to Annexes
Not available

5.3 #3 - Energy rationalization in ASEZA main building

Energy rationalization in ASEZA main building# No 3

1. General Presentation

Location	Start date	Project Lifetime
Jordan, Aqaba Aqaba Governorate within the Aqaba Special Economic Zone Authority	TBD	25 years

Project Owner / Lead Actor

Aqaba Special Economic Zone Authority

Contact person

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Summary of the Action

The aim of this project is to achieve energy savings in the main municipal building of ASEZA through the enhancement of lighting and air-conditioning systems as well as the installation of PVs. The total cost is estimated at 1,203,702 JOD (1,576,850€). The GHG reduction is approximately 2,200 tn CO_2.

General Framework

Electricity is a major burden on all energy-consuming sectors in the Aqaba Special Economic Zone. High temperature is the most important factor in increasing energy consumption, due to the wide range of air conditioning systems' use. The aim is the optimal use of energy resources and the rationalization of the energy consumption, following the proper operating procedures.

On the internal level, the energy consumed in ASEZA building is more than 30 % of the total energy consumed in all the municipal buildings according to data of the Electricity Distribution Company (EDCO). The amount of energy consumed for that building was 4,332 MWh. Therefore, because of this significant consumption, there is a need to build a real model at the national level and for all official institutions and individuals to clarify the concept of rationalization of energy consumption and optimal use of resources via the activities presented in the next section.

Technical Background

- Securing a part of the main building's electricity needs by using solar generating systems (PVs). A 800KWp system will be installed and is estimated to produce 1,359 MWh (assuming 1,700 hrs/ year of operation with 19.40 capacity factor). Consequently there will be a reduction of 788tn CO_2 annually given that the electricity emission factor is 0,580 tn CO_2/MWh. The available space in parking lots as well as any other available space will be utilized for the installation of this system.
- Completing the procedures for rationalizing energy in the main building of the Authority and circulating it among other ASEZA buildings. In the next table the savings for each proposed measure are presented. Regarding the HVAC upgrade savings, the energy consumption forecast in 2030 (Baseline as Usual Scenario – BAU) has been taken into consideration, assuming that the temperature will be increased and therefore the energy demand will be increased as well. The calculations were based on the increase coefficient for Jordan of 1.79 (baseline year 2012). It should be also highlighted

that since the suggested actions are complementary to each other, the calculated savings have been estimated on the basis that the previous actions have been realized as well.

	Energy Saving percentage in the overall building consumption	Energy savings per year (MWh)	Monetary savings per year (JOD)	CO_2 emissions reduction* (tn CO_2)
Lighting Retrofitting	33.00%	1,430	171,559	788
Installing lighting control systems (Motion sensor, Timers etc.)	4.40% (after implementing the lighting retrofitting	190	22,875	111
HVAC System upgrade	4.50%	349	41,876	202
Installing Window film in the skylight	6.64%(after implementing system upgrade)	356	42,714	206
Installing Digital Thermostat to control the temperature settings in the HVAC system	3.03% (after implementing upgrading and window film measures)	162	19,458	94
Total: (for energy rationalization in the main building)	-	2,487	298,482 JOD 391,011 €**	1,443

*0,580 tn CO_2/MWh
**1 JOD=1.31€

- Establishment and development of an energy flow monitoring system for the highest energy consumption municipal building. In ASEZA the system will be developed by the local authority itself, while in other buildings new systems will have to be established. Basically, a monitoring system with real time data is envisaged, that will allow partial control of the loads.

More specifically the actions that they are going to be implemented are presented in the next table followed by their respective costs.

Type	Number of units	Cost/unit (€)	Total Cost (€)
Equipment and supplies			
Replacement of all conventional lighting by LED lighting	1	150,000	150,000
Lighting control units	1	12,000	12,000
Smart digital thermostat for HVAC System	1	25,000	25,000
Overall maintenance works for HVAC system	1	15,000	15,000
Centralized monitoring system by smart meters for buildings energy flow	1	40,000	40,000
Shading and isolation of ASEZA main building skylights	1	20,000	20,000
RES electricity generation systems for self-	1	1,100,000	1,100,000

consumption in building - PV System 800 KW			
		Subtotal:	*1,362,000*
Engineering, feasibility studies, energy audits, impact assessments, simplified EIA etc.			
Site evaluation, requirement analysis and assessment	1	7,000	7,000
Evaluation costs			
Identification of indicators for evaluating project outputs, results & impact	1	1,500	1,500
Mid-term evaluation of the project	1	3,000	3,000
		Subtotal:	*4,500*
Dissemination conferences/workshops			
Organization of opening conference	1	7,000	7,000
Organization of closing conference	1	8,000	8,000
		Subtotal:	*15,000*
Training material and events			
Organization of capacity building seminars (selection of trainees, assessment of training needs, development of training curricula, Organization of training sessions, and evaluation)	2	10,000	20,000
Visibility actions			
Elaboration of the Communication Plan	1	3,000	3,000
Design of the Project Identity (logo/motto) – Applications	1	4,000	4,000
Design and production of project brochures	2	3,000	6,000
e-Newsletters	5	400	2,000
Educational competitions for schools and universities	2	5,000	10,000

Subtotal:	*25,000*
Total:	**1,433,500**
Other contingency costs (10%)	**143,350**
Total investment:	**1,576,850€** **1,203,702 JOD**

*1 JOD=1.31€

In addition, costs for building maintenance will emerge. These costs are estimated to be 3,000 JOD (3,930 €) at an annual basis.

General Objectives of the Project	Principal partners and stakeholders
1. Building a pioneering and realistic model that achieves the concept of rational energy consumption and optimal use of RES in ASEZ. 2. Reduce the electricity consumption in the buildings of the Authority by at least 20% of the annual consumption rate through energy conservation programs. 3. Benefit from the presence of parking spaces and available space to build a solar power system of 800 kW which will cover part of the electricity needs of the main building. 4. Build technical capacity and promote the concept of energy conservation and environmental conservation in all sectors and target groups of the project.	TBD
Ultimate beneficiaries of the project	**Link to municipal development plans / urban plans / other municipal or city programs**
1. Aqaba Special Economic Zone Authority. 2. Aqaba Development Company. 3. Electricity Distribution Company. 4. Environmental NGOs in Aqaba. 5. Jordan Engineers Association, educational and media institutions in the city of Aqaba. 6. All institutions and individuals at the local and national level.	Not available

Estimated investment cost needed	
EUR:	1,576,850
JOD:	1,203,702

2. Technical Description

Area(s) of intervention (sectors as specified in the SECAP proposed by CoM)	Main adopted Technology & Equipment

Aqaba Special Economic Zone Authority's (Municipal) buildings	1. Reducing the thermal load of buildings. 2. Modern lighting technology and method of rationalizing electrical energy. 3. Energy flow monitoring systems. 4. Power generation using solar cell panels through a net metering system.

Site / Place	Status of the action			
Within the limits of Aqaba Special Economic Zone Authority	***New***	*Planned*	*Under implementation*	*Following previous action*

Start date	Project Lifetime	Previous or linked studies
TBD	25 years	Energy Efficiency through Behavioural Change in Aqaba Special Economic Zone's Public Buildings

Engineering Studies	3 months
Implementation plan / Construction plan	24 months include: 1. Preparation of a full study which includes the most appropriate means to implement the project, cost estimations, technical and administrative requirements, duration of implementation and the period of capital recovery. 2. Comprehensive maintenance program for the central AC system and control of its operation according to areas and hours of building occupancy, summer and winter AC loads and periodic maintenance programs. 3. Training and qualifying for ASEZA teamwork staff. 4. Replacement of all traditional lighting units used in ASEZA main building (such as halogen, tungsten, metal halide, fluorescent) with LED lighting units of higher efficiency and quality so as to save more than 40% of the total lighting consumption. 5. Use lighting control systems where necessary (motion detectors, digital timers, opacity systems..). 6. Shading all sky-light areas in the main building to reduce the increase in convection and increase the efficiency of central air conditioners. 7. Installation of intelligent digital thermostats to determine the appropriate temperature for AC operation and reduction of the human factor's presence impact in order to ensure optimal operation of the cables and reduce the loads of air conditioning at rates of not less than (10%). 8. Establishment of a centralized system to monitor the electrical loads of the main ASEZA building, analyze the flow of energy up to date and determine the means of rationalization of consumption and application according to the data received from the system. 9. Building an 800 kW solar power system to secure a part of the building's actual energy needs, taking advantage of parking spaces and building surfaces to secure space. 10. Mainstream and disseminate a culture of energy conservation among the Authority's employees from the beginning, and expand to all sectors and target groups.
Other previous studies	Not available
Environmental impact assessment	Energy Efficiency through behavioural Change in Aqaba Special Economic Zone's Public Buildings

3. Organization and procedures

Formal approval	Legal responsible body
In process	1. Aqaba Special Zone Authority.

	2. Energy & Minerals Regulatory Commission (EMRC) and the Electricity Distribution Company (EDCO) to approve the Solar Power Generation System.

Staff allocated to prepare, implement and monitor the action		Municipal / City Staff Training Needs
Project Manager	24 months	1. Design and installation of solar cell systems.
Quality Assurance Manager	24 months	2. BMS Electromechanical Management Systems.
Project Communications Manager	24 months	3. Electrical energy audit systems and procedures (CEA, CEM, REP, CRM).
Technical Director of the project	24 months	4. Electrical power management.
Project Accountant	24 months	5. Energy audit and rationalization.
M. Programming and information systems	8 months	6. Renewable energy systems.
M. Electricity (2)	18-24 months	7. Carbon emission reduction management.
M. Mechanical	18 months	
M. civilian	6 months	
M. environmental	6 months	
Electricity technician(4)	12 months	

Technical Assistance Needs	Role of Partners
1. Technical consultations of experts in the systems of auditing and rationalization of electrical energy. 2. Technical consulting for solar cell systems. 3. Technical consultation for electromechanical control systems for buildings. 4. Identify similar experiences and adjust the details and details of the project where necessary.	Not applicable

4. Cost Estimates

		Net Present Value (NPV)	Return of Investment (IRR)
Initial and start-up expenses	1,576,850€ 1,203,702 JOD		
Operational Costs (approx.)	3,930 € 3,000 JOD	>>0 Due to the different lifetime of the partial actions, both NPV and IRR have been calculated for 14 years	36%
Annual Income (approx.)	604,622€ 461,544JOD		

5. Funding Sources

Funding Source	Fund
Local Authority's own resources	20% of the value of the project – provision of the necessary human resources for its implementation
National Funds and Programs	
International Financial Institutions	EU, JICA, GIZ
EU Funds & Programs and other external funds	
Public-Private Partnerships	
Lined up Private Investments	
Loans and Potential Borrower	
Expected Annual Cost Savings to City Budget	
Other	

6. Projected Energy Estimates in 2030

Energy Savings	Renewable Energy Production

(MWh/a)	(MWh/a)
2,487	1,359
CO_2 Reduction (tn CO_2/a)	
Target Year	2030
Net reduction on the Territory	2,231 tn CO_2
Reduction as related to BAU Scenario	0.37%
Per Capita calculated reduction	18.91 kg/capita

7. Summary of Related Awareness Raising (AR) Actions

Awareness Raising related to the Action

1. Awareness raising procedures related to the project
2. The launch ceremony includes all target sectors.
3. Holding specialized workshops that summarize the stages of the project and its outputs and include all the main sectors benefiting from the project.

Awareness raising related to the Community

1. Develop educational brochures and posters and distribute them to target groups.
2. Holding public workshops in cooperation with the educational institutions, Jordan Engineers Association, and media organizations in the city of Aqaba to communicate with all segments of society.
3. Launch a scientific and cultural competition for school and university students to develop knowledge about project objectives.

8. Assumptions and risks

1. Issuing approvals by financiers for the required amounts within the specified time frame.
2. The administrative gap between the team members and the number of responsible departments.
3. The team needs to develop some technical aspects of team members due to the lack of similar experiences.
4. The solar power generation system is linked to the approval of Energy & Minerals Regulatory Commission (EMRC) and the Electricity Distribution Company (EDCO) and the need to implement the relevant procedures.

9. Key Success Factors

1. Full responsibility for the implementation of the project is limited to Aqaba Special Economic Zone Authority.
2. Provide the necessary information and data required for the success of the project in the team.
3. Great congruence with the pattern of electric power consumption within power buildings and other government buildings.
4. Availability of qualified staff in the Authority capable of prioritizing, analyzing data and implementing the project.

10. Next Steps

TBD

11. Annexes / References to Annexes

Not available

5.4 #4 - Rationalize energy consumption used in street lighting

Rationalize energy consumption used in street lighting- # No 4

1. General Presentation

Location	Start date	Project Lifetime
All internal and external roads within the jurisdiction of Aqaba Special Economic Zone	TBD	10 years for the LED lamps, 25 for the PV components

Project Owner / Lead Actor

Aqaba Special Economic Zone Authority

Contact person

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Summary of the Action

The aim of this project is to reduce the energy consumption in street lighting, mainly via the replacement of current mercury and HPS lamps with LEDs and via the installation of PV systems. The total cost is 3,582,683 JOD (1,379,573€) and the estimated CO_2 reduction derives 5,200 tn annually.

General Framework

Street lighting in Aqaba is one of the most important factors where the nature of the tourist city at night is reflected. The lighting network extends to all city's neighbourhoods and external roads surrounding it. This fiche focuses in dealing with managing and sustainable operating this street lighting network. It should be noted that the electricity consumption in this sector has been growing significantly, with its consumption reaching 12,630 MWh in 2012, constituting the 3.3% of the total electricity consumed in the Aqaba region.

The current status of the lighting network can be described as follows:

1. In the neighbourhood streets there are mercury lamps,
2. In all major roads inside and outside the city there are mainly sodium lamps (HPS).

Initial information indicates that mercury lamps constitute 30-40% of the lamps used in the Aqaba region and it looks urgently needed to entirely dispense this type of lighting due to the low efficiency, high operating cost as well as its destructive environmental effects. The sodium units are not much different from mercury ones, although their efficiency and longevity are higher. However, the low colour rendering index (CRI) and high operational costs makes it necessary to look for more efficient options with higher quality and less energy consumption, leading to the study and installation of LED lamps, supported by solar cell systems, on grid PV micro inverters, including also controlling, monitoring and data transfer that increases the network efficiency.

Technical Background

The specific activities envisaged under this project include:

1. Preparation and submission of a detailed study (Lighting feasibility study) including the most appropriate means to implement the project, its estimated cost and technical and administrative requirements, the duration of implementation and the period of recovery of capital.
2. Replacement of 12,000 x 275W sodium lamps with LEDs of 90W (leading to savings of 67.3%) and 6,000 mercury lamps of 275W with 80W LEDs (saving 70.9% of the energy consumption). The current situation of the street lighting is as follows:

Type	Quantity	Power (Watts)	Electricity Consumption (MWh)
Mercury Vapor Lamps	6.000	275	4,210
High Pressure Sodium Lamps	12.000	275	8,420

For the calculation of the electricity consumption in the above table, the same operational hours for both types of lamps have been considered. Based on the above, 8,650 MWh will be saved annually, leading in 1,008,548 JOD (1,321,197€) annual cost saving, taking into consideration that 1 KWh of electricity costs 0,1166 JOD and using the conversion rate 1 JOD=1,31€. The specific lamp sizes were selected in order to ensure the proper light quality on the road network.

The costs of the purchase are:

- 150JOD per lamp for the 6,000 LED lamps of 80W, namely 900,000 JOD and
- 170 JOD per lamp for the 12,000 LED lamps of 90W, thus 2.04million JOD.

The total cost for the equipment is 2,940,000 JOD (3,851,400€) and the NPV of this action is positive, considering an interest rate of 8% and a lifetime of 10 years. Regarding the CO_2 emissions there will be a reduction of 5,017 tn CO2 since the electricity emission factor for Aqaba equals to 0.580 tn CO2/MWh.

3. Building power systems based on micro-technology and the use of solar cells and components of the current lighting network, including the installation of on-grid PV micro inverters, to reduce the electricity consumed by the Electricity Distribution Company. The PV panels' capacity will be 225 KWp with an estimated energy production of 382 MWh annually (1,700 hrs operation and 19,4 % capacity factor). The annual monetary savings, based on the fact that 1 KWh costs 0.117 JOD and 1 JOD=1.31€ will be 44,562 JOD (58,376 €). The total investment for the PVs installation is 225,000 JOD (294,750 €), while the respective NPV for a period of 25 years is positive. Regarding the CO_2 emissions, there will be a reduction of 222 tn CO2 since the electricity emission factor for Aqaba equals 0.580 tn CO2/MWh.

Some additional actions are proposed in order to further support the project:

4. Building a system for monitoring, controlling and transmitting data through the street lighting network and handling the faults.
5. Numbering all street lighting columns and adding their coordinates, locations and data to GIS.
6. Activate the use of the annual timers (Astronomical Switches) in all street lighting control boxes and adjust the operation in line with each site.

In the next table the costs for each action are presented in detail in euro.

Type	Number of units	Cost/unit (€)	Total Cost (€)
Equipment and supplies			
Replacement of 12,000 Sodium Lighting Units By LED Lighting	12,000	222.7	2,672,400
Replacement of 6,000 Mercury Lighting Units By LED Lighting	6,000	196.5	1,179,000
Building of monitoring and controlling system for Street Lighting network	1	65,000	65,000

Perfecting of Construction and Calibration of Astronomical Switches for Street Lighting Panels	1	10,000	10,000
Photovoltaic System-Microinverter Units 225 KWp	225	1,310 (€/kW)	294,750
		Subtotal:	*4,221,150*
Evaluation costs			
Identification of indicators for evaluating project outputs, results and impact	1	1,500	1,500
Mid-term evaluation of the project	1	3,000	3,000
		Subtotal:	*4,500*
Costs of dissemination conferences/workshops			
Organisation of Opening Conference	**1**	8,000	8,000
Organisation of Closing Conference	**1**	8,000	8,000
		Subtotal:	*16,000*
Visibility actions			
Elaboration of the Communication Plan	1	3,000	3,000
Design of the Project Identity (logo/motto) - Applications	1	4,000	4,000
Design and Production of Project Brochures	2	3,000	6,000
eNewsletters	5	400	2,000
Educational Competitions for Public Awareness	2	5,000	10,000
		Subtotal:	*25,000*
		Total:	**4,266,650**
		Other contingency costs (10%)	**426,665**
		Total investment:	**4,693,315€** **3,582,683JOD**

*1 JOD=1.31€

General Objectives of the Project	Principal partners and stakeholders

1. Building a modern and environmental lighting model that reduces the amount of energy consumed in street lighting by more than 60% of its current annual consumption and reflects the city's modernity and tourism. 2. Use the available resources of the legislation and components of the street lighting network to generate solar energy and data transmission and overcome the scarcity of land in the city. 3. Reducing the high costs incurred in the maintenance of lighting of roads resulting from the replacement of lighting units or the treatment of tampering and theft. 4. Raising local, national and international awareness in the field of rationalizing energy consumption, preserving the environment and building the necessary capacities to maintain the street lighting system and enhance its role in the framework of safety and environment and exploitation of available resources.	Aqaba Special Economic Zone Authority

Ultimate beneficiaries of the project	**Link to municipal development plans / urban plans / other municipal or city programs**
1. Aqaba Special Economic Zone Authority. 2. Electricity Distribution Company. 3. All institutions and individuals at the local, national and international levels. 4. The Ministries of Public Works, Municipalities and Greater Amman Municipality. 5. Educational institutions represented by the Directorate of Education and local universities. 6. Jordan Engineers Association and institutions concerned with energy conservation and environmental conservation. 7. Hotel sector and institutions with high energy consumption.	Not available

Estimated investment cost needed	
EUR:	4,693,315
JOD:	3,582,683

2. Technical Description

Area(s) of intervention (sectors as specified in the SECAP proposed by CoM)	**Main adopted Technology & Equipment**
Street Lighting Network	1. Street lighting technology and the use of means to rationalize electrical energy. 2. Power generation using solar cell panels (PVs) and micro-inverter technology with a net metering system. 3. Control system, control and data transmission through the spread of the street lighting network.

Site / Place	**Status of the action**			
Inside and around Aqaba	**New**	*Planned*	*Under implementation*	*Following previous action*

Start date	**Project Lifetime**	**Previous or linked studies**
TBD	10-25 years (10 years for the LED lamps, 25 for the PV components)	Not available
Engineering Studies	3 months	

Implementation plan / Construction plan	24 months
Other previous studies	Not available
Environmental impact assessment	Not needed for this action

3. Organization and procedures

Formal approval	**Legal responsible body**
In process	1. Aqaba Special Zone Authority 2. Electricity Distribution Company

Staff allocated to prepare, implement and monitor the action		**Municipal / City Staff Training Needs**
Project Manager	24 months	1. Design and installation of solar cell systems and micro-inverter systems. 2. Design and implementation of lighting systems and intelligent systems for street lighting. 3. Electrical energy audit systems and procedures (CEA, CEM, REP, CRM). 4. Electrical power management. 5. Energy audit and rationalization. 6. Renewable energy systems. 7. Carbon emission reduction management.
Technical Manager and Quality Assurance	24 months	
Project Communications Manager	24 months	
Project Accountant	24 months	
M. Electricity	24 months	
M. Programming and information systems	6 months	
Private GIS	18 months	
Electricity technician (8)	12 months	

Technical Assistance Needs	**Role of Partners**
1. Technical consultations of experts in the systems of auditing and rationalization of electrical energy in street lighting. 2. Technical consulting for solar systems and micro-fiber technology. 3. Identify similar experiences and adjust the details and details of the project where necessary.	There are no partners.

4. Cost Estimates

		Net Present Value (NPV)	**Return of Investment (IRR)**
Initial and start-up expenses	4,693,315€ 3,582,683 JOD		
Operational Costs (approx.)		4,563,735 € (combined actions/10 years lifetime) 5,013,924 € (lamps' replacement/10 years lifetime) 328,401 € (PVs' installation/25 years lifetime)	27% (combined actions/10 years lifetime) 32% (lamps' replacement/10 years lifetime) 20% (PVs' installation/25 years lifetime)
Annual Income (approx.)	1,379,573€ 1,053,109 JOD	3,483,767 JOD 3,827,436 JOD 250,688 JOD	

5. Funding Sources

Funding Source	**Fund**
Local Authority's own resources	Aqaba Region Authority's contribution to 20% of the value of the project.
National Funds and Programs	
International Financial Institutions	EU, JICA, GIZ

EU Funds & Programs and other external funds	SODAP
Public-Private Partnerships	
Lined up Private Investments	
Loans and Potential Borrower	
Expected Annual Cost Savings to City Budget	
Other	

6. Projected Energy Estimates in 2030

Energy Savings (MWh/a)	Renewable Energy Production (MWh/a)
8,650	382

CO_2 Reduction (tn CO_2/a)	
Target Year	2030
Net reduction on the Territory	5,238 tn
Reduction as related to BAU Scenario	0.86%
Per Capita calculated reduction	44.40 kg/capita

7. Summary of Related Awareness Raising (AR) Actions

Awareness Raising related to the Action

1. The launch ceremony includes all target sectors.
2. Holding specialized workshops that summarize the stages of the project and its outputs and include all the main sectors benefiting from the project.

Awareness raising related to the Community

1. Develop educational brochures and posters and distribute them to target groups.
2. Holding public workshops in cooperation with the educational institutions, Jordan Engineers Association, and media organizations in the city of Aqaba to communicate with all segments of society.
3. Launch a scientific and cultural competition for school and university students and the general community to develop knowledge about project objectives.

8. Assumptions and risks

1. Issuing approvals by financiers for the required amounts within the specified time frame.
2. The spread of the street lighting network to all the areas covered by the areas of power.
3. The administrative gap between the team members and the number of responsible departments.
4. The team needs to develop some technical aspects of team members due to the lack of similar experiences.
5. The solar power generation system is associated with the approval of the Electricity Distribution Company and the need to implement the related procedures.

9. Key Success Factors

1. Full responsibility for the implementation of the ASEZA project.
2. Provide the necessary information and data required for the success of the project in the team.
3. Availability of qualified staff in the Authority capable of prioritizing, analyzing data and implementing the project.

10. Next Steps

TBD

11. Annexes / References to Annexes

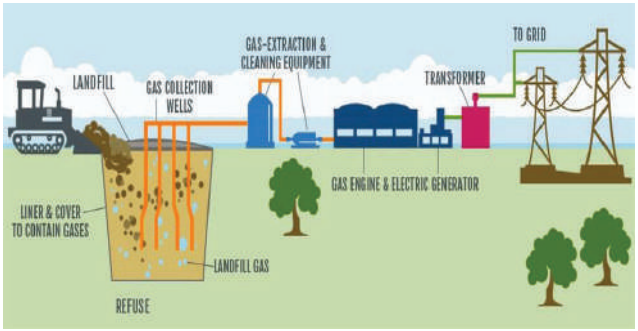
Not available

5.5 #5 - Aqaba landfill development

Aqaba landfill development- # No 5

1. General Presentation

Location	Start date	Project Lifetime
Aqaba Special Economic Zone Authority – Aqaba City, Jordan	Upon receiving the fund	5 years for the initial actions' implementation



Project Owner / Lead Actor

Aqaba Special Economic Zone Authority

Contact person

Eng. Mays Al Sawalha
Green Economy division – Environment directorate
Tel: ++ 962 3 2091000 ext. 2182, Mobile : ++962 799986215

Summary of the Action

ASEZA plans to develop an integrated solid waste management plan, consisting of a waste segregation/treatment facility and a properly engineered sanitary landfill so as to efficiently manage the big amounts of city's waste and reduce the GHG emissions. The treatment facility is envisaged to capture half of the produced methane in order to produce electricity. The cost of the project is 13,356,595 JOD(17,497,139 €). The estimated CO_2 reduction from the methane capture is around 15,300 tn, while another 3,500 tn CO_2 will be avoided due to the green electricity produced.

General Framework

Aqaba City is a central industrial and tourist hub for Jordan, in addition to being home to the only port in the country. The population is increasing rapidly, and the city is expanding as investments pour into the local economy. Current Municipal Solid Waste (MSW) generation rates in Aqaba City are at approximately 120 tons/day (Waste Characterization of the City of Aqaba, 2013). This MSW is currently disposed of in an unlined landfill approximately 12 km south-southeast of Aqaba City and adjacent to the base of the Aqaba Mountains.

In addition to being unlined, the landfill has no environmental controls whatsoever. This leaves the soil and air vulnerable to pollution and may expose landfill employees and users of the surrounding area to health risks. The lack of daily cover also raises concerns regarding vector breeding and landfill fires, while the site lacks proper fencing and security to eliminate unauthorized access. Contracted scavengers collect recyclables at the site; this practice poses potential health and safety risks, such as exposure to contaminants, contact with vectors, and personal injury.

The primary challenge concerning the Aqaba site is to develop an integrated solid waste management plan, consisting of a properly engineered sanitary landfill and a waste segregation/treatment utility. This project presents the design for the Aqaba Landfill Facility.

The existing Aqaba Landfill is currently broken up into two areas, the Old Landfill site and the Active Landfill site. The Old Landfill site consists of blackened piles, which are the result of burning practices at the time of disposal in the 1980's, when waste was

sometimes burnt and sometimes left without burning. Within the last few years, waste scavengers returned to the site and dug up some of this old waste to collect recyclables and left the site's soil cover disturbed and the old waste exposed. The current landfill is almost full loaded and should be closed as soon as possible.

Current waste recycling practices at the Active Landfill site consist of contracted labourers picking recyclables directly from the freshly dumped waste on the active working face of the landfill before it gets compacted and covered. This is not an acceptable or efficient method for recycling. This practice also poses potential health and safety risks for workers, such as exposure to contaminants, contact with vectors, and personal injury. Waste is also typically left uncovered and uncompacted, which is prohibited by Regulation No.27 for 2005.

The primary challenge concerning the Aqaba site is to develop an integrated solid waste management plan, consisting of a waste segregation/treatment facility and a properly engineered sanitary landfill.

Technical Background

This design report for Aqaba landfill prepared for USAID addresses the following components:

1. Access control for site;
2. Material Recovery Area to replace current waste scavenging practices;
3. Re-utilization of existing waste/burnt waste/soil mass to allow for stabilization of existing in-place waste;
4. Design of individual landfill cells with the bottom of each cell sloping towards leachate collection system;
5. Design of a base geosynthetic liner to prevent liquids collected from entering subsurface soils and regional groundwater;
6. Design of leachate collection, conveyance and storage/treatment system;
7. Design of final grading plan to allow surface water drainage;
8. Design of final cap and storm water management system;
9. Design of landfill gas management system (maximum annual generating capacity is 6.053 MWh). The gas management system will minimize potential landfill fires and control landfill gas migration by installing landfill gas wells and collecting pipes and excavate and utilize existing burnt waste/soil mix as daily cover material.

The targeted minimum airspace for the Aqaba Landfill is to provide for 20 years of waste disposal for the population of Aqaba. The incoming waste is expected to be about 0.95 kg/person-day, according to the "Country Report on the Solid Waste Management in Jordan" prepared by SWEEP-Net (2012).

Based on the USAID report, the maximum annual gas generation rate was estimated as 12.73 m^3/min. Considering a conservative 50% system efficiency for the purposes of estimating power generation potential, the maximum gas collection rate is estimated at approximately 6.36 m^3/min near the end of the landfill active life. This corresponds to the maximum annual generating capacity of 691 kW (6.05 GWh). Calculations indicate that a 250 to 300 kW electric generator could be installed at year 7 and another identical one could be added at year 16.

In the Baseline year, the reference emissions were calculated to be 30,717.48 tn CO_2 eq, according to the following equation (see BEI section).

Methane emissions (Gg/yr)=(MSWt*MSWf*MCF*DOC*DOCf*F*16/12-R)*(1-OX)

Since the methane gas (symbolized as F in the equation above) to be collected at an annual basis is considered to be half of that generated, the emission reductions based on the BEI calculations will be cut in half, considering that the rest of the parameters remain the same. Thus they will be reduced by 15,358.74 tn CO_2 eq at an annual basis. It should be noted that the above approach is the simplified method for the calculation of emissions, and if additional gases should be considered besides methane, other approaches should be followed. Also, it is highlighted that the BEI data and not the BAU estimations have been utilized, since the landfill is expected to close before 2030, but remain operational as far as the electricity generation is concerned till then.

Finally, emission reductions from the biogas generated electricity that substitutes fossil fuel generated electricity should be also taken into consideration. These are estimated to be 3,510.74 tn CO_2, if the EF of 0.58 is used.

Regarding the budget, in the next table there are the project's actions followed by the respective costs.

Item	Cost(JOD)	Cost with Contingency (JOD)
Infrastructure	1,647,689	1,894,843
Construction of cell #1	2,049,353	2,356,756
Construction of cell #2	2,247,807	2,584,979
Construction of cell #3	1,504,648	1,730,346
Cconstruction of cell #4	1,646,463	1,893,433
Closure and landfill management phase 1	83,395	95,904
Closure and landfill management phase 2	111,041	127,697
Closure and landfill management phase 3	90,642	104,238
Closure and landfill management phase 4	2,233,390	2,568,399
Total:	11,614,428 JOD 15,214,900 €	**13,356,595 JOD** **17,497,139 €**

Moreover the estimated operational cost is 378,229 JOD (497,371 €) and includes landfill operations such as waste & soil placement, Leachate & Biogas Collection and Treatment/Disposal.

The project covers highly needed infrastructure needs for ensuring the quality of life for Aqaba citizens. For this reason, although the calculated financial indicators are negative, since the cost of externalities (impact on environment and health) has not been considered, it constitutes a necessity for the region.

General Objectives of the Project	Principal partners and stakeholders
1. Control the amount of infiltration of storm water through the landfilled waste by 2. Developing the landfill cells into distinct landfill cells with base slopes and sumps to capture leachate 3. Capping the landfill surface with an evapotranspiration (ET) cover 4. Installing a surface water management system consisting of open channels, chutes, culverts, and a lagoon 5. Minimize potential landfill fires and control landfill gas migration by installing landfill gas wells and collection pipes; and, 6. Excavate and utilized existing burnt waste/soil mix as daily cover material.	1- Aqaba Special Economic Zone Authority 2- Ministry of Energy 3- Ministry of Municipal Affairs 4- Private sector-investors

Ultimate beneficiaries of the project	Link to municipal development plans / urban plans / other municipal or city programs
1. Aqaba Special Economic Zone Authority 2. Aqaba's citizens	The new landfill project is set as a high priority project for the need of the city since the current landfill capacity has already exceeded its designed capacity. The project is indeed one of the main projects within the development plan of ASEZA. The Aqaba New Landfill project was introduced in the National green growth plan which was issued officially in May this year 2017

Estimated investment cost needed	
EUR:	17,497,139
JOD:	13,356,595

2. Technical Description

Area(s) of intervention (sectors as specified in the SECAP proposed by CoM)	Main adopted Technology & Equipment

Waste management	1. Base Liner System 2. Leachate Collection and Transmission System 3. Storm Water Management System 4. Evapotranspiration Cover System (to minimize infiltration and erosion)

Site / Place	Status of the action			
12 km southeast of the City of Aqaba and 5 km east of the eastern section of the coastal flatlands of the Gulf of Aqaba 	*New*	***Planned***	*Under implementation*	*Following previous action*

Start date	Project Lifetime	Previous or linked studies
TBD	(5 years implementation)	1. Aqaba Waste Management And Landfill Design Report, October 2014 2. Aqaba Waste Management And Landfill Feasibility And Environmental Considerations Report, March 2014

Engineering Studies	A geotechnical investigation was conducted at the site by ACES, a specialized geotechnical firm in Jordan, in order to provide sufficient geotechnical parameters for the design and construction of the proposed project.
Implementation plan / Construction plan	1. Design access, regulate traffic of haulers, entrance driveway construction 2. Scale House and Landfill Management Building (including the communications equipment, computers, offices, convenience and locker room facilities, and storage areas to accommodate the weigh master, landfill management team, and landfill operators/laborers.) 3. Vehicle Maintenance and Equipment Parking Area 4. Materials Recovery Facility / Segregation Pad 5. Fuel Dispensary 6. Leachate Storage/Evaporation Lagoon (2-meter-deep lagoon has been designed with approximately 4,160 cubic meters of storage capacity from its invert to its crest) 7. Stormwater Management Basin (5,055 cubic meters) 8. Landfill Gas Management Facility (1200-mm-diameter High Density Polyethylene landfill gas condensate knockout). Potential options for gas management include construction/utilization of a small generation power facility (maximum annual generating capacity is 6.052.974 kWh) or compression and sale of gas to potential end-users. 9. The landfill will be designed with four cells; each draining to its own sump from which collected leachate will be pumped to the leachate evaporation lagoon. Each cell will be segregated from adjacent cells with a 1.5 meter (minimum height) lined interim/intercell berm.
Other previous studies	Studies for Landfill Capacity and Global Landfill Stability

Environmental impact assessment	Currently, waste is being dumped in dug unlined cells adjacent to the old dumping site (which contains methane producing material). Additionally, covering of the waste is not being done regularly. These operations may cause soil and water contamination as well as vector breeding due to uncovered waste. With regards to material recovery and recycling, the process is done manually. Up to approximately 30 labourers sort through dumped waste as it is delivered at the landfill. This potentially imposes health risks on the workers such as exposure to contaminants, contact with vectors, personal injury from sharp objects or slips/falls, etc. In order to reduce / eliminate the problems associated with operating the current landfill, the design team proposes the construction of a new landfill composed of four lined cells with leachate collection system and material recovery facility at the old dumping site adjacent to the current landfill. Generally, providing a new landfill with appropriate lining and leachate collecting system will improve the environmental and health conditions at the area.

3. Organization and procedures

Formal approval	Legal responsible body
This actions is included in the SECAP for the ASEZ Authority and will undergo approval by the municipal council	1- ASEZA 2- Ministry of Energy 3- Electrical Company
Staff allocated to prepare, implement and monitor the action	**Municipal / City Staff Training Needs**
1- Project manager 2- Technical manager 3- Project quality assurance 4- Communication manager 5- Accountant 6- Civil engineer 7- Solid waste management specialists 8- Mechanical engineer 9- Senior Geologist 10- Environmental Engineer	1- Landfill operators certification training program 2- Training on gas management at the landfill 3- Training on recycling 4- Solid waste management and regulation 5- Marketing recycling 6- Leachate management 7- Landfill monitoring
Technical Assistance Needs	**Role of Partners**

4. Cost Estimates

Initial and start-up expenses	17,497,139 € 13,356,595 JOD	**Net Present Value (NPV)**	**Return of Investment (IRR)**
Operational Costs (approx.)	497,371 € 378,229 JOD	<<0	<<0
Annual Income (approx.)	475,673 € 363,178 JOD	<<0	

5. Funding Sources

Funding Source	Fund
Local Authority's own resources	√
National Funds and Programs	
International Financial Institutions	

EU Funds & Programs and other external funds	√
Public-Private Partnerships	√
Lined up Private Investments	
Loans and Potential Borrower	
Expected Annual Cost Savings to City Budget	
Other	

6. Projected Energy Estimates in 2030

Energy Savings (MWh/a)	**Renewable Energy Production (MWh/a)**
Not relevant	6,053
CO_2 Reduction (tn CO_2/a)	
Target Year	2030
Net reduction on the Territory	15,358.74 (tn Co2/Year) from methane capture 3,510.74 tn CO_2 from green electricity
Reduction as related to BAU Scenario	4.5% against BEI scenario
Per Capita calculated reduction	159.9 Kg CO2/year

7. Summary of Related Awareness Raising (AR) Actions

Awareness Raising related to the Action

Workshop for decision makers and stakeholders who are related to the landfill operation process and sustainability

Awareness raising related to the Community

1- Conducting workshops for schools and universities to introduce the recycling concept
2- Conduct workshops for the local community through the related NGO's to introduce the project and how they can contribute through changing behavior to minimize waste production

8. Assumptions and risks

TBD

9. Key Success Factors

1- The Landfill project was included in the national green growth plan for the year 2017
2- The project is a need for the city and the environment

10. Next Steps

TBD

11. Annexes / References to Annexes

1. Aqaba Waste Management And Landfill Design Report, October 2014
2. Aqaba Waste Management And Landfill Feasibility And Environmental Considerations Report, March 2014

Chapter 6: Citizen Awareness Promotion Plan (CAPP)

"Go green – The future of Aqaba city"

6.1 Preparing and including the "Awareness Raising Actions" component in the SECAP.

In addition to the requirement linked to the public consultation of the SECAP, a Citizen Awareness Promotion Plan (CAPP) has to be elaborated by the municipality as part of the Sustainable Energy Climate and Action Plan document (SECAP).

Identification of CAPP actions through participatory training workshops

The CES-MED project has conducted a tailored communication and CAPP training workshop for the local authority and its communication team in coordination with (and attended by) the Focal Point and the SECAP Consultants. Prior to conducting the workshop, which was led by CES-MED key communication expert (KE), three parts "Communication Kit" was handed on to the local authority and SECAP Consultant, who were asked to get acquainted with its content prior to conducting the training.

The "Communication Info Kit" includes:

- Part 1: the "CAPP Guidelines" document: a tailored comprehensive manual prepared by CES-MED for the use of cities/municipalities on how to identify, plan and conduct awareness raising actions (Arabic, English and French versions)

  (http://www.ces-med.eu/publications/recommendations-and-guidelines-development-citizens-awareness-promotion-plan-capp)

- Part 2 includes:
  - PPT Presentation of the CAPP Guidelines;
  - Presentation of "how to prepare and implement a communication and an awareness campaign" showing techniques, materials and models;
  - Pools of benchmark examples and references to best practices from across the world towards citizen engagement and behaviour change, with adaptation to the CES-MED cities context.
- Part 3: consists of 4 Tables to assess CAPP conditions and identify actions.
  - Table 1 is used to conduct a rapid investigation to identify awareness situation, levels and needs linked to behavioural change in the city; and to initiate discussions with the workshop participants towards the identification of target audiences and the SECAP CAPP actions;
  - Table2: presents the content of a plan to implement a CAPP action related to a Pilot Project;
  - Table 3 presents the proposed actions related to the general sustainable energy challenges and to the city;
  - Table 4: presents the proposed CAPP actions linked to each SECAP priority projects.

During the workshop, the "Communication Kit" material was explained. The following discussions, assessment and analysis addressed awareness raising conditions and challenges,

communication concepts and CAPP methodologies, tools, techniques before examining and multiple benchmark applications.

A practical exercise was then conducted to specify the SECAP's CAPP actions, whereby the local authority general awareness raising needs and SECAP's priority actions (proposed in the Project Fiches) were looked over and proposed. In doing so, the template tables were "draftly" filled by the participants and the KE.

Following the workshop, the participants have thoroughly reviewed the tables and finalized them with CES-MED KE and the SECAP Consultants, prior to including them in the SECAP (below).

The Communication Info Kit and specially the CAPP Guidelines are to be used as reference work manuals for the subsequent detailed planning and implementation of the CAPP actions proposed in the in the SECAP document and other similar awareness raising actions.

6.2 Preparation of a COMMUNITY AWARENESS PROMOTIONAL PLAN (CAPP)

6.2.1 Template 1 - Situation analysis of Aqaba

Aim

The questions in the attached templates cover various areas of actions and levels of awareness linked to behavioral change. It has been used to conduct a quick investigation on the awareness situation and level of perception of the citizens in the city concerning renewable energy and energy saving.

The exercise of filling the templates has identified and assessed the conditions in the municipalities prior to preparing a CAPP and to answers a number of questions, including:

- Who are the target audience of a CAPP?
- What are the priority issues to be addressed by the CAPP (that also could be identified by the PAED as priority actions)?
- What is the level of awareness of energy key problems? And what are the first issues to raise awareness about?
- What are previous awareness raising actions, so that he CAPP can build on them?
- What is the situation as related to public consultation, based on which a public consultation is to be designed?

The exercise of filling the template helped pointing out how raising awareness can be utilized as a tool for improved energy policy to facilitate implementation of its actions; it has allowed initiating discussions in the Communication Workshop and helped identifying appropriate campaigns and actions.

Specific objectives:

- Provide the necessary information about the current conditions and the situation regarding awareness of energy saving and renewable energy.
- Help to identify the most appropriate a) awareness raising campaigns that would accompany the SECAP vision/strategy and b) the awareness raising actions that would accompany the priority actions determined in the SECAP.

Steps to follow:

- The SECAP team of ASEZA has filled the templates based on their understanding and perception of the of the city's inhabitants. They were free to seek the opinion of a limited number of persons to help fill the answers.
- The filled templates were discussed in the "CES-MED Communication Workshops", which were led by CES-MED Communication Expert and attended by the SECAP consultant and the SECAP municipal team. In parallel, the vision/strategy of the city and the proposed pilot actions in the SECAP were reviewed as part of the workshop exercise.

The outcome guided the selection of the most appropriate awareness raising campaigns and actions of the SECAPs including the ones related to priority projects.

I. Identification of the target audience and the importance they give to Sustainable Energy (audience targeted by the awareness raising campaigns and actions)			
Age group	**Level of importance**		
	Very important	**Important**	**Not important**
Youth	X		
Middle Age	X		
Seniors			X
Other (5-15)	X		

II. Identification of priority issues to be addressed by a sustainable energy action and their level of importance			
Issue	**Level of importance**		
	Very important	**Important**	**Not important**
High price of energy	X		
Availability/lack of energy	X		
Availability of transport	X		
Waste management	X		
Clean environment	X		

III. Identification of level of awareness (energy problems) and education of energy related issues			
	Very aware (through media or research)	Aware but not convinced	Not Aware
Impact on environment	X		
Cost of energy		X	
Waste of energy			X
Climate change			X
Ways to save energy consumption	X		
Existence of renewable energy	X		

IV. Previous awareness actions conducted by the city/municipality or by other actors	
Has the city or local authority done previous actions?	Yes
If yes, who conducted the actions (the city/municipality, NGO, national authority…)	• Aqaba Special Economic Zone Authority - Radio program through Voice of Aqaba Radio • Non-governmental organizations through JREEF • National Energy Research Center
If yes, describe the action	• Awareness campaign through the program of our environment responsibility through the Voice of Aqaba "weekly program." • Training workshop for medium and small industries on how to obtain funding for the work of the energy audit. • Awareness workshop on solar cells and their uses
If yes, what was the budget and how did you fund it	• Self-financing from the Authority • Local funding and support from the European Union
If yes, outcome, impact and feedback	Increase of awareness on renewable energy

Public consultation	
Does the city practice public consultation?	Yes
Has the city done public consultations for SECAP?	No
Is it part of the legislative process?	Yes
Foreseen consultation(s)	A consultation session for various stakeholders on the SECAP
Does the city liaise with national institutions, stakeholders?	Yes

Situation analysis

From this study concerning the target audience and its profile, it appears that the groups that are aware and informed about energy challenges are the middle age and young population, and the ones open to any information and who will behave accordingly are the children. They should be identified as our main target and they are probably well-aware and informed about issues related to this sector. It would be recommended to carry out the communication with them and get their full involvement as opinion sharing people who will disseminate ideas and new behavior.

The senior target group has very little interest in the topic of sustainable energy and doesn't seem to evaluate its importance. They should be considered as the audience that needs more persuasion as they are the ones to hold the purchasing power; we need to find out what would be the best way to anticipate the barriers that affect their choices and preferences for their environmental behaviors. The future awareness actions will be seen as a credible message if promoted through the proper insight: the cost of their bills which is a concrete concept as

where the climate change might sound like a virtual one. The one question they might need an answer to, would be: “what’s in it for me?”

On the other hand, young people and children are high dynamic and face changing situations; they are clearly educated to the energy issues and climate change. They will be able to influence the policy-making process while reshaping the general public interests and specific constituencies, such as consumers, workers, and households; it is essential to endorse their processes of perception, judgment and reasoning regarding renewable energies information.

The template shows that the population of Aqaba has identified the priorities issues to be addressed; therefore, the main leverages on which we can use and base our communication upon are: The price and (non) availability of energy, the transport issue and the cleanliness of the environment. The ambiguity lays in the fact that the citizens of Aqaba in general are aware about some energy issues and challenges such as impact on environment and ways and means to save energy; however, they do not seem to be informed about the existing energy waste nor the climate change.

Nevertheless, the Aqaba Special Economic Zone Authority has previously conducted awareness raising actions and campaigns related to sustainable energy towards the civil society and was able to assess their positive impact with a return of positive results; the actions have alerted the population about renewable energies and the importance of energy saving and have increased the awareness and interest on the topics.

The means of communication it used were a series of radio programmes engaging the citizens’ responsibility towards environment, capacity building trainings and informative workshops addressed to several related audiences.

Some of these actions have been funded through the Authority itself, as a token of its commitment and efforts; the others were financed and supported by the European Union.

Finally, ASEZA practices public consultations as part of the legislation of the city; however, it has not yet conducted one concerning the SECAP of ASEZA; More will be done in order to engage with the population and get its involvement through tailored messages and adequate tools.

6.2.2 Template 2.1 - Proposed Communication or Awareness Raising Action related to Specific/Pilot Project: Environment

1. Title of the Pilot Project

Program of environmental protection clubs for schools in the province of Aqaba

2. Title of the Communication Action related to the pilot project

Information and awareness visits of environmental clubs’ team to schools

3. Location

Schools of the city of Aqaba

4. Summary of the Communication Action

Environmental clubs’ members will be visiting the schools participating in the program, to familiarize the students and the school board and teachers with the environmental clubs’ plan and the important roles, duties and activities required of the club during the academic year.

General Objective:

Dissemination of the Directorate of Environment messages and objectives among all segments of civil society and its institutions to: i) raise awareness on the importance of preserving the environment and ii) involve them in the protection of natural resources in Aqaba.

Key message:

Students need to be empowered about taking care of their environment and learn about its important issues as well as helping their community.

The young generation needs to be aware about the environmental clubs' plans and the most important roles, duties and activities required from the club during the academic year;

Theme:

Sustainable Development Model / Supporting Local Initiatives

Target groups:

Schools students, School board, teaching staff

Tools and channels:

- Lectures, bulletins and brochures and a radio program.
- Launching competitions between schools.
- Produce tailored educational material in Arabic and English.
- Develop the communication strategy that includes Media communication campaign.
- Set up and maintain a high-quality and user friendly project website to ensure good communication, visibility and spread results, pictures and learning from the visits, announce further actions, disseminate good practices that could serve as model actions.

5. Organization

Roles and responsibilities:

The Environmental Awareness Section at Aqaba Special Economic Zone Authority together with the Schools Principals in Aqaba will be responsible of conducting this AR action.

Project lifetime:

The project started on 15/9/2017. It will carry on until 1/5/2018.

Link to other opportunities and/or events:

This campaign could be linked to International Days 'events such as "Earth Day" or "World Environment Day", meaning that some of the foreseen activities could be held in conjunction with these international occasions depending on the time availability.

Principal partners and stakeholders and their roles

Staff training needs:

Team trainings will be needed in renewable energy and rationalization of consumption

Technical assistance and expert needs:

The ASEZA team will need some ready-made programmes and other supporting teaching materials;

6. Cost estimate

Estimated implementation cost:

ASEZA funds

Funding source:

ASEZA will be funding the action for the time being.

Initial and start-up expenses and approximate operational Costs:

NA

7. Next steps:

Preparing an annual programme for the action.

8. Follow-up, evaluation and impact assessment

This project will be followed up by ASEZA team. after each visit, a monitoring and evaluation system will be established for observing, evaluating and studying the outcomes as well as properly implementing the specific program of visits.

6.2.3 Template 2.2 - Proposed Communication or Awareness Raising Action related to Specific/Pilot Project: Environment

1. Title of the Pilot Project:

Program of environmental protection clubs for schools in the province of Aqaba

2. Title of the Communication Action related to the pilot project

Information and awareness visits of environmental clubs' team to schools

3. Location:

Awareness action will take place in the Marine Park Visitors Center - Aqaba City

4. Summary of the Communication Action

Environmental clubs' members will be visiting the schools participating in the Marine Park visitors program, to sensitize and educate the students, the school board and teachers on the importance of preserving the environment (land and sea) in the Gulf of Aqaba, which comes to complete the school year plan.

General objective(s):

Dissemination of the message and objectives of the Directorate of Environment between all segments of society and its institutions to raise awareness of the importance of preserving the environment and involve them in the protection of natural resources in Aqaba.

Key Messages:

Environment protection is everyone's duty; take a turn in participating and saving the planet.

Raising school students' awareness on the importance of preserving the environment (land and sea) in the Gulf of Aqaba.

Theme:

Sustainable Development Model / Supporting Local Initiatives

Target groups:

Schools students, School board, teaching staff

Tools and channels:

- Disseminate information through Lectures, bulletins and brochures and a radio program.
- Produce tailored educational material in Arabic and English.
- Develop the communication strategy that includes Media communication campaign.
- Set up and maintain a high-quality and user friendly project website to ensure good communication, visibility and spread results, pictures and learning from the visits, announce further actions, disseminate good practices that could serve as model actions.

5. Organization

Roles and responsibilities:

All planned activities are to be led by the Environmental Awareness Section at Aqaba Special Economic Zone Authority, Aqaba School Principals, Air Quality Division and Ibn Hayyan Laboratories.

Project lifetime:

The planned communication activities will take place during 2017-2018

Link to other opportunities and/or events:

This campaign could be linked to International Days 'events such as "Earth Day" or "World Environment Day", meaning that some of the foreseen activities could be held in conjunction with these international occasions depending on the time availability.

Principal partners and stakeholders and their roles (1)

Staff training needs:

Team trainings will be needed in renewable energy and rationalization of consumption

Technical assistance and expert needs:

ASEZA team will need some ready-made programmes and other supporting teaching materials;

6. Cost estimate

Estimated implementation cost in Euros

ASEZA funds

Funding source (available and foreseen)

ASEZA will be funding the action for the time being.

7. Follow-up, evaluation and impact assessment

This project will be followed up by ASEZA team. After each visit, a monitoring and evaluation system will be established for observing, evaluating and studying the outcomes as well as properly implementing the specific program of visits.

6.2.4 Template 2.3 - Proposed Communication or Awareness Raising Action related to Specific/Pilot Project: Environment

1. Title of the Pilot Project:

Weekly Environmental Awareness Program "Our Environment is Our Responsibility"

2. Title of the Communication Action related to the pilot project

Preparation and presentation of a weekly radio program titled: “Environmental Magazine”.

3. Location:

Awareness action will take place in the Marine Park Visitors Center - Aqaba City

4. Summary of the Communication Action

A variety of live radio talk shows entitled "Our environment is our responsibility" are presented through the Voice of Aqaba every Thursday for one hour; several officials and specialists in various fields of environment are invited to debate about the subject of environment preservation (issue number, our Jordanian marine environment, the Jordanian land environment).

General objective(s):

Dissemination of the message and objectives of the Directorate of Environment between all segments of society and its institutions to raise awareness of the importance of preserving the environment and involve them in the protection of natural resources in Aqaba.

Key Messages:

It is important to raise civil society awareness on the importance of preserving the environment and involve the community in the protection of natural resources of Aqaba.

Theme:

Sustainable Development Model / Supporting Local Initiatives

Target groups:

All segments of civil society

Tools and channels:

- Prepare and disseminate information through a weekly radio program via Voice of Aqaba radio station.
- Promote the programme through the project website to ensure high audience and broadcast the show on the internet afterwards.
- Promote specialists’ speeches in schools and universities as influencers and opinion shapers.

5. Organization

Roles and responsibilities:

All planned programmes will be prepared and led by Media Unit in the Authority in collaboration with the Voice of Aqaba Radio Station Team.

Project lifetime:

The planned communication programme is planned for one full year.

Link to other opportunities and/or events:

NA

Principal partners and stakeholders and their roles (1)

Staff training needs:

Team trainings will be needed in the field of information and communication and awareness raising.

Technical assistance and expert needs:

None

6. Cost estimate

Estimated implementation cost in Euros:

-

Funding source (available and foreseen)

The talk show action will be self-financed.

7. Follow-up, evaluation and impact assessment

Broadcast and presentation for at least 35 episodes during the year. Monitoring and evaluation system will be established for observing, assessing and studying the outcomes of the programme.

6.2.5 Template 2.4 - Proposed Communication or Awareness Raising Action related to Specific/Pilot Project: Environment

1. Title of the Pilot Project:

Environmental awareness is going broadband in Aqaba.

2. Title of the Communication Action related to the pilot project

Promoting environmental preservation in Aqaba through the preparation of a media package mix.

3. Location:

Awareness action will take place in the City of Aqaba.

4. Summary of the Communication Action

General objective(s):

Establish a media plan and package in order to promote environmental protection, spread awareness and disseminate news and special activities to reach out to the largest public possible and through several media and social media networks: Facebook, YouTube, local newspapers and the website of the Marine Park.

Key Messages:

It is important to raise civil society awareness on the importance of preserving the environment and involve the whole community in the protection of natural resources of Aqaba.

Theme:

Sustainable Development Model / Supporting Local Initiatives

Target groups:

All segments of civil society

Tools and channels:

- Established social media networking sites such as a Facebook page, YouTube, etc.
- Set up and maintain a high-quality and user friendly Marine Park website to ensure good communication and visibility; spread results, pictures, educational material and learning from all awareness actions; announce further activities such as radio programmes, lectures, schools' visits; and disseminate good practices that could serve as model actions.
- Publication of at least 42 news and press-releases.
- Develop and produce awareness posters.
- Develop a comprehensive communication strategy that includes Media communication strategy.

5. Organization

Roles and responsibilities:

All planned activities are to be led by Environmental Awareness Section - Department Heads of the Environment Directorate

Project lifetime:

The planned communication programme is planned for one full year.

Link to other opportunities and/or events:

This campaign should be linked to a variety of worldwide as well as local events related to environment protection and preservation.

Principal partners and stakeholders and their roles (1)

Staff training needs:

Team trainings will be needed in the field of Public relations, social media communication and awareness raising.

Technical assistance and expert needs:

NA

6. Cost estimate

Estimated implementation cost in Euros

ASEZA funds

Funding source (available and foreseen)

The action will be self-financed.

7. Next steps:

A continuous annual program

8. Follow-up, evaluation and impact assessment

This project will be followed up by ASEZA team. Monitoring and evaluation system will be established for observing, assessing and studying the outcomes of the action throughout the year.

6.2.6 Template 2.5 - Proposed Communication or Awareness Raising Action related to Specific/Pilot Project: Environment

1. Title of the Pilot Project:

Planning International events to raise awareness on Environmental issues

2. Title of the Communication Action related to the pilot project

Promoting environmental preservation in Aqaba through the preparation of large scale events.

3. Location:

The events will take place in the City of Aqaba.

4. Summary of the Communication Action

General objective(s):

Dissemination of the message and objectives of the Directorate of Environment between all segments of society and its institutions to raise awareness of the importance of preserving the environment and involve them in the protection of natural resources in Aqaba.

Key Messages:

Environment protection is everyone's duty; join us and take a turn in learning and participating to on how to protect natural resources in Aqaba saving the planet.

Theme:

Sustainable Development Model / Supporting Local Initiatives

Target groups:

All segments of civil society as well as municipal staff and all actors in the energy field.

Tools and channels:

- Organise 10 large scale events to disseminate information through workshops, awareness campaigns, advertisements and lectures.
- Announce and promote the events on the Marine Park website to ensure good communication and visibility; spread results, pictures, educational material and learning from all awareness actions.
- Announce and promote the events on the Voice of Aqaba Radio station and invite lecturers and local authority stakeholders to endorse them.

- Engage with schools and university students and involve them in the preparation and/or attendance.

5. Organization

Roles and responsibilities:

All planned activities are to be led by Environmental Awareness Section - Department Heads in the Environment Directorate, Supplies and Procurement Department.

Project lifetime:

The duration of the communication action is planned for one full year.

Link to other opportunities and/or events:

This action could be linked to the coming COP23 in October in a parallel event.

Principal partners and stakeholders and their roles (1)

Staff training needs:

Team trainings will be needed in the field of Public relations, social media communication and awareness raising.

Technical assistance and expert needs:

NA

6. Cost estimate

Estimated implementation cost in Euros

The action will be self-financed.

Funding source (available and foreseen)

ASEZA will be funding the action for the time being.

7. Next steps:

A continuous annual program

8. Follow-up, evaluation and impact assessment

This project will be followed up by ASEZA team. A monitoring and evaluation system will be established for observing, evaluating and studying the outcomes as well as properly implementing the specific events.

6.2.7 Template 3.1 - Identification of CAPP CAMPAIGN TOPIC related to sustainable energy challenges

Once the Sustainable Energy challenges and priorities, general awareness raising priorities, and specific awareness raising needs related to SECAP actions have been identified, the CAPP's main areas of intervention and activities can be defined. The table below portrays the challenges, priorities and related AR activities.

Challenges:	Priorities:	Awareness Raising Priorities, Topic & Activities of CAPP Campaign
Increase of energy consumption.	• Reduce the city's energy consumption and bills. • Reduce the impact of greenhouse gas emissions. • Consume energy more responsibly.	**Topic**: **Energy saving measures are simple and easily applicable.** **Activities**: • Explain the harmful effects of GHG emissions through an AR campaign on "how to become an eco-citizen" and present the benefits of renewable energies technologies (electricity from natural resources). • Raise awareness by spreading the culture of the rationalization of energy and start to implement the procedures by giving practical advice to help saving energy in houses, centres and shops. • Launch exhibitions of solar houses, architectonical scale models, trade fairs for the general public and technical conferences for professionals of the building sector and city councils.
High cost of energy production	• Increase reliance on alternative and renewable energies. • Reduce the impact of greenhouse gas emissions. • Promote and practice responsible controlled energy consumption.	**Topic**: **Energy audits and ways of financing the use of renewable energies** **Activities**: • Explain with facts sheets the harmful effects of greenhouse gas emissions. • Provide practical tips on how to reduce energy consumption with stickers, educational films, documentaries. • Introduce awareness programs to finance the use of renewable energies and their benefits. • Implement educational programs in schools.
Unsustainable management of solid waste	• Construction of a sanitary landfill • Use of an integrated sustainable waste management program (in order to later improve the quality of life and reduce the cost of waste management). • Increase the efficacy of waste collection operations. • Implement the principles of the comprehensive and sustainable	**Topic:** **Stop waste in the city** **Activities:** • Explain the side effects of solid waste accumulation and its impact on citizens' health (spread of insects, rodents and bad smells) and on the beauty of the city in general. • Explain and clarify the need to support local authorities in solid waste management programs.

Challenges:	Priorities:	Awareness Raising Priorities, Topic & Activities of CAPP Campaign
	waste management and waste production.	• Provide practical advice on reducing solid waste from its source and tips for reusing and recycling. • Provide practical advice on waste sorting and on how to reuse it and recycle it.
Increased pressure on transportation	• Implementing a sustainable management of the city's transportation system. • Encouraging further reliance on public transport and car sharing to significantly decrease car's consumption among all private drivers. • Encouraging the use of clean-energy vehicles (less polluting vehicles).	**Topic:** **Intelligent management of the transport process and promotion of public transport to reduce the size of the traffic crisis.** **Activities:** • Implement awareness programs about the harmful effects of greenhouse gas emissions and introduce citizens to renewable energy technologies through leaflets and events such as a day without cars. • Set a department within the municipality to provide energy advice to the citizens. • Organize a series of seminars targeted at private and public transport professionals in Aqaba (taxi and public buses' drivers and later to truck drivers). The seminars will be subsidized by ASEZA and set up in close collaboration with all private transport sector companies activated in Aqaba, to ensure attendance of professionals to this training; session will be replicated if necessary, within the 2020 horizon (according to studies, trainings lead to consumption reduction up to 20% directly after training and about 5% in the long run). • Create a logo, a slogan, to promote the eco driving (i.e. "I am a green driver"); • Promote the green/eco driving through radio campaigns, the website and other relevant media available in Aqaba.

6.2.8 Template 3.2 - CAPP activities as related to SECAP Priority Actions of ASEZA

This template will guide ASEZA in the implementation of a strategy and the identification of adequate awareness raising activities according to the target group and its needs and related to the priority actions identified in the SECAP.

SECAP Priority Actions	Related CAPP Activities:
Energy rationalization in ASEZA main building	**Target Audiences:** • Decision makers and politics in Aqaba. • Governmental and private institutions. • Aqaba Special Economic Zone Authority. • Local community (every person concerned by public affairs including Municipal staff). **Key Messages:** • Reduce electricity consumption in order to save money from the annual ASEZA expenses. • Replacing traditional lighting in the building with LED lighting units of higher efficiency and quality, and using lighting control systems where necessary will save more than 40% of the total consumption of lighting units. • Consuming energy more responsibly will benefit the city at both environment and economic levels **Objectives:** • **Main objective**: Building a pioneering and realistic model that achieves the concept of energy conservation and optimal use of renewable energy resources in Aqaba Special Economic Zone. • **Secondary objectives:** ○ Reducing the consumption of electricity in the buildings and facilities of the Authority to save at least 30% of the annual consumption through energy conservation programs. ○ Building technical capacity and promote the concept of energy conservation and environmental conservation in all sectors and targeted groups of the project. **Communication Tools:** • Educating the Authority's employees to an appropriate behaviour concerning use of energy in offices (use of shadings increase efficiency of air conditioners, better control of AC volume) through workshops or competitions. • Creating a web portal regarding energy savings as a tool for the Energy Saving Department to interact with the citizens and inform them about ASEZA's actions and events related to the SECAP implementation, new measures for energy savings as well as funding sources. Moreover, the webpage will host a discussion forum where they could exchange their opinions, find out solutions to their questions and keep in touch with the Energy Saving Department's staff. No direct energy savings have been allocated to this action, but it is considered to be a significant contribution in encouraging citizens to adopt the "green" practices and as a major tool in the promotion of all related awareness raising activities by the

SECAP Priority Actions	Related CAPP Activities:
	ASEZ Authority. This website can be a dedicated site linked to ASEZA's one, or be integrated within it. • Enhancing the environmental consciousness of the citizens through the following activities: o Organizing "Energy days", in line with its participation in the Covenant of Mayors initiative, during which the importance of energy saving and protecting the environment will be stressed, through simple actions (change of behaviour, switching to fluorescent or LED lamps and high energy class appliances, installation of solar panels for water heating in existing buildings etc.). o Projection of free available environmental documentaries. o Participating to the international "Earth hour" event by WWF, where people across the world turn their lights off for one hour. o Launch a campaign promoting the purchase and use of high energy label equipment among the residents.
Energy rationalization in Street Lighting	**Target Audiences:** • Institutions and individuals at local, national and international levels. • Ministries of Public Works, Municipalities and Greater Amman Municipality. • Educational institutions represented by the Directorate of Education and local universities. • Citizens and visitors of the city. • Jordanian Engineers Association and institutions concerned with energy conservation and environmental conservation. • The local hotel industry and institutions with high energy consumption. **Key Messages:** • ASEZA is reducing energy consumption in town through smart and responsible management. • The replacement of all mercury lighting units and sodium lighting units with LED lighting units will benefit the city at both environment and economic levels **Objectives:** • **Main objectives:** o The construction of a modern and environment friendly lighting model that will reduce the amount of energy consumed in street lighting by more than 40% of its current annual consumption and reflects the city's anchorage in modernism and tourism. o Reduce the city's energy bills o Limit the impact of the emission of the greenhouse gas. • **Secondary objectives:** o Raising local, national and international awareness in the field of rationalizing energy consumption, preserving the environment and building the capacities necessary in maintaining the street lighting system working and enhance its importance in the framework of safety and exploitation of available resources.

SECAP Priority Actions	Related CAPP Activities:
	○ Promote the use of similar equipment in the households, and other or private buildings. **Communication Tools:** • Announcing, through the various available communication tools, the size of savings and reusing the money saved in social and public projects. • Producing explanatory posters nailed on street lamps to alert citizens on municipality action. • Promoting the usage of efficient lighting through a promotional distribution of led lamps to households. • Setting-up training to the students on using the energy correctly. • Organizing interdepartmental competitions to encourage and reward creative suggestions for energy efficiency improvements.
Smart transport system	**Target Audiences:** • All institutions and individuals at local, national and international levels. • The Ministry of Transportation. • Educational institutions represented by the Directorate of Education and local universities. • All citizens and visitors of the city. **Key Messages:** • For a cleaner, safer and more attractive city • Creating new models for innovative businesses in various sectors such as tourism, trade, transport and logistics. • Using the public bus will reduce delays, improve route planning and timetables for public transport. **Objectives:** • Reduce congestion by encouraging the use of public transport and green cars. • Making roads more efficient and convenient. • Increase the number of passengers of public transport to 100 thousand passengers per day, and encouraging the use of green cars (hybrids)will reduce traffic in the city center by 18%, and CO2 emissions by 20% in the city center. • Reduce the fuel consumptions and carbon footprint **Communication Tools:** • Means of transport working on clean energy will be used as a media conveying messages. • Conduct an awareness campaign on eco-driving that explains how the recommended drive technique is a modern, smart and efficient way to save fuel. Invite specific local NGO's & Volunteers to attend training by qualified driving instructors allowing them to share the experience with others. • Eco-driving comprises a set of actions, something like "behavioral changes", regarding the way someone drives. • The adoption of Eco-driving principles by ASEZA fleet's drivers is considered a good way to decrease the fuel consumption.

SECAP Priority Actions	Related CAPP Activities:
	The effectiveness depends upon the seminars and trainings ASEZA will organize, as well as their repeatability to ensure that every single driver will understand the tips and implement the advices. • Raise awareness activities in order to inform the citizens about new technology's cars and the double fuel cars followed by their economic and environmental benefits. • Promote the use of bikes as the topography of the city is appropriate for constructing bike lanes; convincing citizens to use these alternative means instead of their cars, thus reducing the gasoline consumption and limit the respective emissions. • This activity includes four distinct levels for achieving its target: ○ Dissemination activities including information events, material such as flyers, brochures and posters, and advertisements on the local media (TV, radio). ○ Establish a bicycling sharing program with bicycles available to the citizens at a low rental price, backstopped by several stations throughout the city, where the citizen may get on and off. (infrastructure of bike lanes is prepared) ○ Raise awareness to bikes drivers and cars drivers about their existence side by side and respect to each other while driving and biking. ○ Promote car sharing and car-pooling through campaigns on Authority website.
ECO- Science –Park Aqaba Environmental Park	**Target Audiences:** • Institutions and individuals at local, national and international levels. • Educational institutions represented by the Directorate of Education and local universities. • Citizens, volunteers and visitors of the city. **Key Messages:** • Take over the park and enjoy a cleaner environment for your children • The integrated park in the city of Aqaba is an entertainment and awareness center for citizens and supporting students in environmental matters. • The ecological park is a model for all types of renewable energy. **Objectives:** • Build an awareness center using sustainable construction techniques. • Provide energy to the building and park energy through solar cells and make it a model of protected and healthy environment including green technologies. **Communication Tools:** • Develop informative facilities, strategic services and accessible programs for schools, the public and citizens in

SECAP Priority Actions	Related CAPP Activities:
	general by providing them with opportunities to engage and interact with their natural environment in a meaningful, informative and responsible way, and sharing our vision for a better community. • Have participants of all ages take away a sense of connection to and commitment to the Park by creating volunteer opportunities for activities such as clean ups, invasive species management, trees and shrubs planting, trail maintenance, discovery walks and more. • Encourage community action by offering school programmes so to take environmental education to the classrooms and bring schools students to the park in order to teach them hands-on about nature and how nature and sustainable energy impact their lives and world.
Aqaba Waste Landfill development	**Target Audiences:** • Ministry of Municipalities, Ministry of Finance, Ministry of Planning and Aqaba Development Company, Ministry of Environment • Citizens and visitors of the city. **Key Messages:** • Waste should not be wasted: Reduce the amount of solid waste and save your environment. • Practice responsible and integrated waste management within the city for a better environment. **Objectives:** • Increase the awareness for reducing the thrown amount of waste • Reduce the billing cost for waste collection and transportation • Practice responsible and integrated waste management within the city. • Increase sustainability and change behaviour in solid waste management by increasing the awareness and reducing the use of non- recycled materials. • Generating energy out of waste **Communication Tools** • Launch AR regarding the SECAP and the ASEZA's vision • Provide incentives and taxes related to the solid waste in commercial and residential sectors • Awareness campaigns and seminars to explain the negative effects on solid waste accumulation and the harmful impacts that the discarded food may cause during its combustion in the landfill. • Provide practical tips to inform inhabitants on how to separate organic waste and purchase composting bins in order to use their compost product in domestic cultivation; provide information about the benefits of composting. Alternatively, the ASEZA Authority will install several bins in specific areas to collect the organic waste and transfer them in composting units.

SECAP Priority Actions	Related CAPP Activities:
	• Launch awareness operation: cleaning day and sorting in neighbourhood. Issue a «Clean» certificate for deserving ones. • The awareness campaign will include the dissemination of messages through radio, newspapers and television using local media, launching of promotional material (leaflets, brochures, posters) and perhaps billboard advertisements. • Organise special events for schoolchildren such as educational kits - with a view to teaching young people how to recycle and reuse waste.

Recommendations:

These tables have been thought and prepared by the communes and municipalities. In this approach, they aim to promote in a particularly innovative and ambitious way local communities' response to current challenges identified in the SEAPs and SECAPs, notably in the management of energy and the promotion of renewable energies. They allow us as well to identify the most appropriate communication actions to reach the local community.

In the case of ASEZA specifically, Aqaba municipality seems to be a very active force, setting various challenges and aiming at meeting them. It is also one of the few that has an in-house communication unit. However, it needs to assess the perception of options it offers to her citizens as viable and sustainable alternatives that will benefit them; use an adequate and well targeted medium to deliver its message and lead the people in their choices towards a change in behavior, enabling them to make informed decisions. Raising awareness should be carried out in an interconnected manner between the municipality and its citizens to create cohesion and therefore persuasion concerning the on-going projects and the future ones.

Therefore, it is important to use a leverage which we can use and base our communication upon such as:

Firstly, establish a strong and comprehensive communication methodology adjusted to all stakeholders (Professional, head teachers, youth movements, religious leaders, associations...) to facilitate the planning and implementation of the SECAPs; stick to the vision slogan in every communication; and highlight the goal aimed at and attain it (Going green is the future of the city);

Express a clear political commitment to involve individual target groups in future planning procedures to adapt/improve measures according to specific demands; set up a permanent forum with representatives of the various target groups; the idea of starting with the ones from the municipality by boosting energy rationalization at the municipality level will encourage citizens to master their consumption, know about renewable and efficient energy, and encourage their production and use; communicate and promote at the city/authority zone level about actions and measures toward energy saving and energy efficiency that could improve the quality of life in the city as it will increase public acceptance, in particular with regards to large-scale renewable energy projects.

Educate the audience by offering helpful energy efficiency tips to reduce cost and usage through entertainment, talk shows, special guests and things happening; This will convey a resonance regarding the populations' own energy consumption (e.g. using energy efficiency

to save money in the long term); and will make people aware of the positive effect their actions can have on their global and local environments.

Last but not least, empower the communication cell within the Authority and strengthen its capabilities and its human resources. It will be able to establish communication between the ASEZA and the civil society and keep it constantly aware of projects and involve it in order to implement the concept of eco-responsibility.

Appendix

Public Transport								
Vehicle Type	**Number**	Lit/km (@50 km/hr)	Lit/hr (@50 km/hr)	Fuel type	Driving time within Sahab Region plus stops (hr)	Type's total fuel consumed (Lit/day)	Annual Gasoline consumed (1000 Lit/year)	Annual Diesel consumed (1000 Lit/year)
Small buses	**37**	0,16	8	Diesel	0,25	74,00		27,01
Coach buses	**11**	0,26	13	Diesel	0,5	71,50		26,10
Taxis	**517**	0,11	5,67	Gasoline	7,5	21.972,50	8.019,96	
Total	**565**				**8,25**	**22.118,00**	**8.019,96**	**53,11**

Private and Commercial Transport								
Vehicle Type	**Number**	Lit/km (@50 km/hr)	Lit/hr (@50km/hr)	Fuel type	Driving time within Sahab Region plus stops (hr)	Type's total fuel consumed (Lit/day)	Annual Gasoline consumed (1000 Lit/year)	Annual Diesel consumed (1000 Lit/year)
Motor cycle	38	0,048	2,4	Gasoline	0,25	23,08	8,42	
Small Passenger cars	11.839	0,11	5,5	Gasoline	0,25	16.279	5.941,84	
Medium Passenger Cars	239	0,12	6	Diesel	0,25	359		131,05
Cargo Vehicles	2.502	0,12	6	Diesel	0,25	3.753		1.370,00
Trailer Head	254	0,39	19,5	Diesel	0,5	2.479		904,99

Private and Commercial Transport								
Vehicle Type	**Number**	Lit/km (@50 km/hr)	Lit/hr (@50km/hr)	Fuel type	Driving time within Sahab Region plus stops (hr)	Type's total fuel consumed (Lit/day)	Annual Gasoline consumed (1000 Lit/year)	Annual Diesel consumed (1000 Lit/year)
Trailers	2.500	0,39	19,5	Diesel	0,5	24.375		8.896,88
Construction vehicle	269	0,39	19,5	Diesel	0,5	2.625		958,14
Small buses	2.898	0,16	8	Diesel	0,25	5.795		2.115,35
Total	**20.541**				**2,75**	**55.690**	**5.950,26**	**14.376,41**

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