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Covenant of Mayors for Climate & Energy

Kurdistan Region of Iraq

Sulaymaniyah Governorate

Sustainable Energy Action Plan (SEAP)

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Kurdistan Region of Iraq

Sulaymaniyah Governorate

- IRAQ -

2018

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BC	Behavioural changes
BDG	Backup Electrical Diesel Generator
BE	Building envelope
BEI	Baseline Emission Inventory
BS	Building standards
CAS	Central Administration for Statistics
CES-MED	Cleaner Energy saving Mediterranean Cities
CoM	Covenant of Mayors for Climate and Energy.
ECL	Energy certification/ labelling
ECT	Energy carbon taxes
EE	Energy efficiency
EM	Energy management
ESO	Energy supplier's obligations
EU	European Union
GHG	Green House Gas
GS	Grants and subsidies
IA	Integrated actions (all above)
ICT	Information and communication technologies
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
KRI	Kurdistan Region of Iraq
LA	Local Authority
LADP	Local Area Development programme
LUPR	Land use planning regulation
NDC	National Determined Contribution
PP	Public procurement
PPP	Third party financing
RE	Renewable energy
SEAP	Sustainable Energy Action Plan
SECAP	Sustainable Energy and Climate Adaptation Plan
SWH	Renewable energy for Hot water
TBD	To be developed
tCO2	Ton CO2
UNDP	United National Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

Acknowledgements

The Sustainable Energy Action Plan (SEAP) has been prepared for the Governorate of Sulaymaniyah in Kurdistan Region of Iraq through its participation in the Local Area Development Programme (LADP), funded by the European Union(EU) and implemented by UNDP.

The plan has used a set of frameworks to support the governorate of Sulaymaniyah in planning a Sustainable Energy Action for the period 2018-2030, and open the door for the Governorate to join the world biggest initiative for sustainable development, the Covenant of Mayors for Climate and Energy. The plan was elaborated together with the local authority through several trainings and technical assistance in formulating and applying sustainable policies in the city.

This assignment was managed by Consortium of Planet S.A, Greece & Stars Orbit, Jordan, led by Mr. Ivan Davidov. The development of the plan has greatly benefited from the joint efforts, close collaboration and strong engagement of the Sulaymaniyah Governorate team and SEAP Steering and Technical Committee with representatives across all sectors and led by LADP team under the patronage of the KRI Ministry of Planning.

The final document was prepared by Mr.Oussama Kaassaamani, SEAP Consultant using CES-MED tool kit, EU Joint Research Centre methodology and Covenant of Mayors for Climate and Energy's guidelines with support efforts of Mr.Simone Antinucci.

The information and data gathered resulted for the efforts and dedication of all parties involved.

We would like to extend special gratitude and appreciation to the following person:

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Furthermore, we would like to acknowledge the crucial role of all parties, who are not mentioned, for their devotion and dedication to work.

We are looking forward to a smart and sustainable city with green power, clean air and water and healthy citizens.

Section I: SEAP Executive Summary

This report represents the work plan for implementation of Sustainable Energy Action Plan for the governorate of Sulaymaniyah. It has been prepared with the participation of Sulaymaniyah Governorate drawing up quest to sustainability and outlining possible steps to mitigate emissions in gases such as carbon dioxide that affect the environment and cause climate change.

The report contains an explanation of how emissions are calculated through the inventory of human-induced emissions through energy consumption and fossil fuel combustion.
The measures that affect public life have been reviewed in various sectors such as buildings belonging to the local authority, residential and non-residential buildings, transport, agriculture, renewable energy, water, sewage, solid waste, and others, knowing that Sulaymaniyah Governorate is in the Region of Kurdistan, with an area of 21,071 km2. Sulaymaniyah contains fourteen districts: Sulaymaniyah central district; Pishdar, Penjween, Chamchamal, Darbandikhan, Dukan,, Kalar, Kifry, Mawat, Qaradagh, Raniya, Said Sadiq, Sharazur, Part of Khanaqeen, Sharbazhe and Sulaymaniyah District. it includes 43 sub-districts. After cutting the Halabja district and the three sub-districts affiliated with it since 2014.

The report outlines the methodology followed to prepare the Baseline Emission Inventory which is in line with Covenant of Mayors and Joint Research Centre of EU.
While developing the report, some main factors on the national level were needed. However, data is not totally available due to the unstable situation in Iraq caused by wars and fights against ISIS. Hence, to ensure proper results, the calculations made rely on the assumptions based on some factors that reflect the current situation.
For example, the Emission factor has been considered 0.82 tCo2/MWh and Business as usual scenario 1.62 compared to base year of 2015 which is considered in the calculation (more detail explained in the report).

The project development is established by the contribution of the LA in the preparation stage, which allowed various departments and directorates to present their needs and priorities, including raising the sense of sustainable thinking, and link them to sustainable development. The participation of all departments that address the basic needs made it possible for us to start the report and shed light on these priorities.
The report as mentioned before includes the Baseline Emission Inventory, which is a measuring tool to compare the results of the implemented action before and after, through Business as Usual Scenario. In the course of developing the scenario, normal development is traced, with a direct sense towards a sustainable investment.
The report has also developed five action fiches which allow the governorate to share its projects with the local and external funding agencies in a scientific and practical context, clarifying the needs and summarizing the objectives, including costs and return on investment.

The developed actions are given as guidelines which can be annually updated and reviewed according to the progress made and lessons learned during the development process. Raising awareness, in line with the developed action, is needed to ensure proper participation of stakeholders in implementation process and successful results.
A successful action plan requires an efficient teamwork among its staff to face the challenges and obstacles and find proper solutions to overcome them. The specialised team along with NGOs have to cooperate to improve the implementations. Last but not least, working with funding agencies is essential to improve the time frame and avoid the delay in implementation.

Sulaymaniyah Governorate had joined the Covenant of Mayors. Yet, it will need around two years to submit this report with the Climate Adaptation Plan report to keep it is membership valid with the Covenant of Mayors.
During this stage, the Governorate could benefit from other members in the CoM and gain experience through their implementation of SEAP.

In the following part, we will summarise the results obtained from mapping the energy consumption in different sectors which is called Baseline Emission Inventory of the governorate and the mitigation action proposed for all sectors. Which include LA building and facilities, Public lighting, Residential sector, Tertiary Sector, Transportation Sector, Renewable Energy, Solid Waste, Wastewater, Agriculture and Water.

Baseline Emission Inventory:

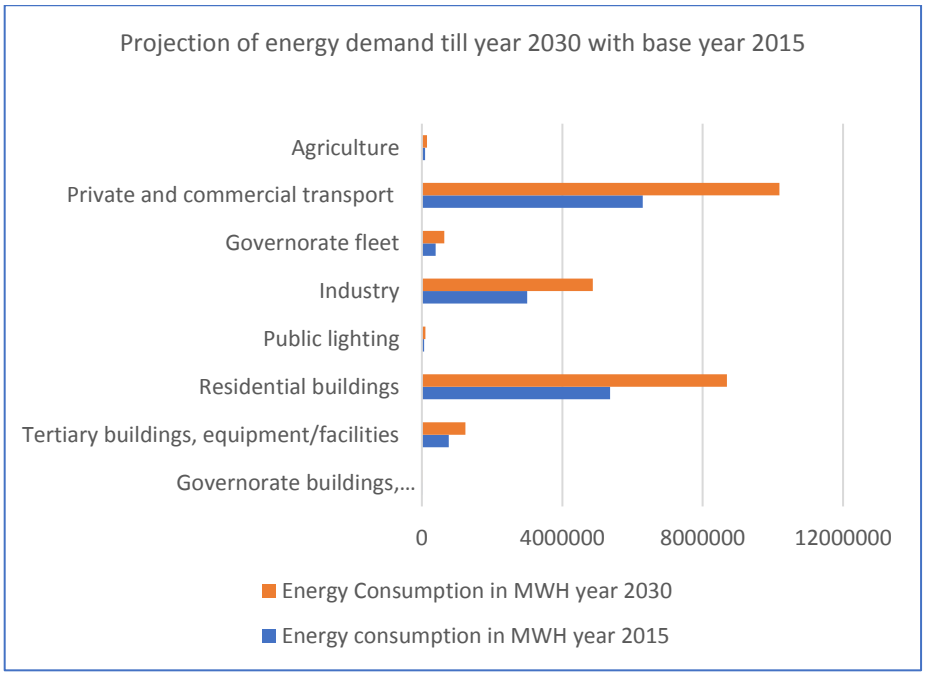

Figure 1 Projection of energy demand till year 2030 with baseline year 2015

The mapping of energy consumption in the governorate of Sulaymaniyah has shown the emission per capital is 3.8 tCO2 and 7.9MWh/capital. The below chart shows the expected increase in demand for energy that will be reached in 2030. If we know that the annual deficit in the electricity budget reaches around three billion USD, we can expect the deficit to reach 4.86 in 2030 if the price of a barrel of oil stayed stable. This is believed to be an overload on the future generation that may not afford. For that, it is important to work out possible mitigation to avoid future problems.
The calculated emission will also increase from 7,667,125 tCO2 in year 2015 to 12,420,740 tCO2 in year 2030 which means more impact on the environment.

The document also describes a range of priority actions which will help maintain a sustainable city by 2030 in three main sectors, the governorate buildings, the residential and transportation sectors. The actions are summarized as follows:

GOVERNORATE BUILDINGS, EQUIPMENT/FACILITIES

The main action related to governorate building concentrates on improving the services by applying E-management to the governorate, developing maintenance and operation process to the governorate buildings and applying saving consumption measures to the buildings, and sustainable public procurements. These measures could support improving the services, reduce the running cost and ensure proper sustainable development in long term.

The table below summarises the results that could be obtained by applying the listed measures which could save 39% of energy bill and mitigate 53% of the emission produced annually.

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
GOVERNORATE BUILDINGS, EQUIPMENT/FACILITIES			12012	7231	4685	3839	53%	9,180,000

RESIDENTIAL SECTOR

The residential sector represents the core element in producing the Greenhouse Gas emission and is responsible for 46% as shown in figure 1. The proposed actions will look into the precise solution for the causes in houses demand for energy and promote measures for energy conservation in buildings. This includes applying green building code in new buildings, promoting high reflective roofs to minimize energy consumption in residential buildings to improve space cooling, generalizing the use of renewable energy like solar water heater, implementing the legislation to rationalise the demand for energy and moderate the local laws and regulation to support implementation of EE and RE legislation on the local level.

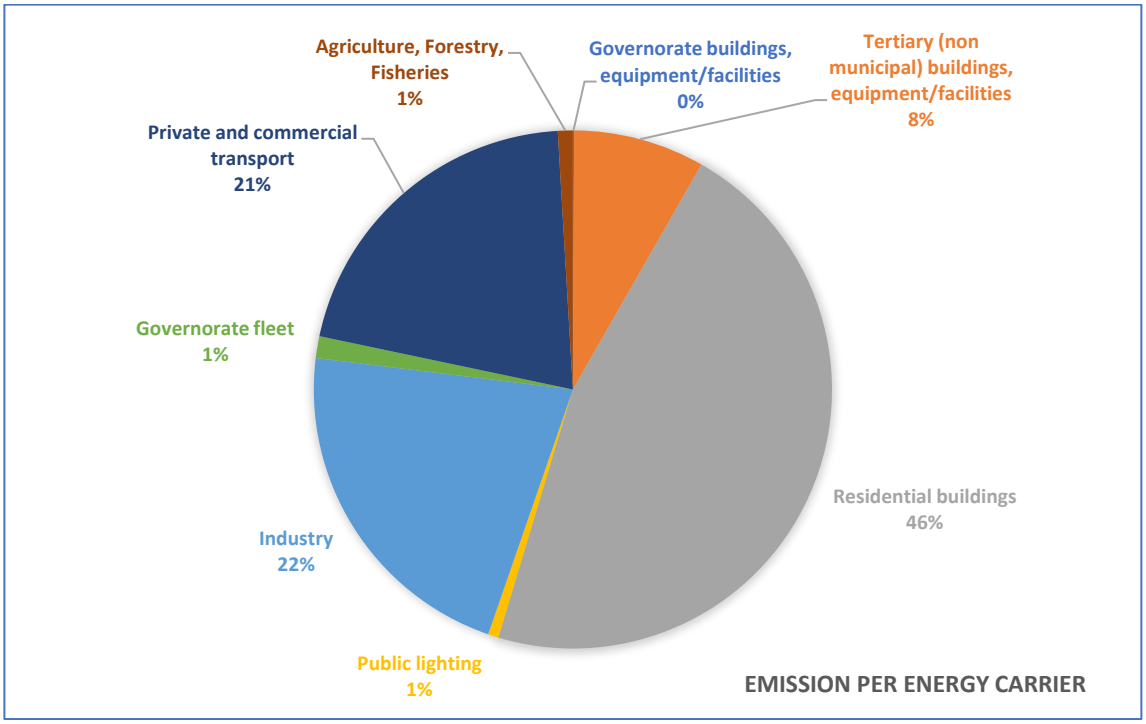

Figure 2 Emission per energy carrier

The table below summarises the results that could be obtained by applying the listed measures which could save 34% of energy bill and mitigate 41% of the emission produced annually.

	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
	MWh	tCO2	MWh	tCO2		
Residential building	8687629	5762222	2978674	2338225	41%	38,483,221

TERTIARY SECTOR

The tertiary sector represents the non-residential buildings like governmental building and commercial buildings. This sector is responsible for 8% of total emissions in the governorate where the main actions are summarised by the following: improving Energy Efficiency, ensuring proper implementation of new Public Procurement, and developing operation and maintenance management.

	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
	MWh/a	t CO2/a	MWh/a	t CO2/a		
Tertiary building	1240594	1017287	67476	55330	5%	19,670,264

PUBLIC LIGHTING SECTOR

The public lighting plays an important role in emission, where modernization of the public street lighting and energy efficiency has become a priority consideration due to the long operating hours of most outdoor lights. Increased energy efficiency in street lighting systems significantly reduces operation and maintenance costs. This could be achieved through the initial investment associated with more efficient lighting technologies which is easily outweighed by the lower overall life-cycle costs.
Setting street lighting measures is of great importance as the operational bill is becoming high; and due to the technological advancement, effective and successful solutions have come to be available.
The report includes the measures to this sector which could achieve reduction of 67% of emission and energy bill.

	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
	MWh/a	t CO2/a	MWh/a	t CO2/a		
Public Street Lighting	99487	81580	66549	54570	67%	39,980,325

TRANSPORTATION SECTOR

The transportation contributes by 26.5% to GHG emission and represents an important sector after the buildings. The actions are summarised in improving the smooth movement in the main roads, using of public transport, regulating the use of taxi and proving better and efficient car parking.

	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
	MWh/a	t CO2/a	MWh/a	t CO2/a		
Transportation Private and commercial	10190681	2579641	1482182	375176	14.54%	4,876,400

Agriculture

The action includes building a laboratory for the examination of agricultural crops, research and development of Fruit Nurseries Orchards, Botanical Garden, study on land use database in addition to take measures at Hawary Shar Park aims to improve the efficiency in energy consumption.

	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
	MWh/a	t CO2/a	MWh/a	t CO2/a		
Agriculture	141484	116018	3908	3204	2.76%	11,053,300

Waste water management

Building sewage treatment plant and management of health waste water are the main actions.

Solid Waste management

The basic actions include construction of damp fill in Kalar, Chamchamal, Pishdar, recycling waste plant in Said Sadiq and Jwarta and converting solid waste to energy.

Water

The plan for a groundwater monitoring network in Sulaymaniyah includes a wide hydrology and hydrogeology survey for basic groundwater data, rehabilitation of Dukan 2 and 3 water treatment stations and a feasibility study for design and construction of Khewata Dam.

Industrial sector

Install ambient and continuous air quality monitoring system and build new industrial area.

Local Renewable Energy generation

Establishment of a 10 MW Solar/Photovoltaic Power Station in Garmyan, installing three Mini Hydro units at Dukan Dam, reconstruction of two units of Mini Hydro in Darbandikhan dam, supply of spare materials for Dukan and Darbandikhan hydroelectric plants & replacement of cooling system Dukan and Darbandikhan stations, in addition to replacement of Turbine Shaft Seal Module for Unit 3 in Dukan Damp.

The summary of action will bring mitigation to following figures:

Sector	BAU target year 2030		Mitigation		Mitigation in %
	Energy in MWH	Emission in t CO_2	Energy in MWH	Emission in t CO_2	Emission in t CO_2
Governorate buildings, equipment/facilities	12012	7231	4685	3839	0.04%
Tertiary buildings, equipment/facilities	1240594	1017287	67476	55330	0.57%
Residential buildings	8687629	5762222	2978674	2338225	24%
Public lighting	99487	81580	66549	54570	0.56%
Governorate fleet	641285	169240			0.00%
Public transport					0.00%
Private and commercial transport	10190681	2579641	1482182	375176	3.85%
Agriculture	141484	116018	3908	3204	0.03%
Local Renewable Energy Production			2278966	1868751	19.20%
Total	21,013,172	9,733,219	6,882,440	4,699,095	48.25%

Based on the existing CO2 reduction potential, the Governorate of Sulaymaniyah is committed to reduce the emissions to a 40% by 2030, satisfying the CoM target. This commitment is subject to the availability of funds to implement the measures developed in the SEAP in close collaboration with local, national, and international initiatives. However, Iraq, nationally, is determined to reduce the GHG emissions by 14% until 2030 compared to a BAU scenario level. If the objectives aren't achieved, the Governorate of Sulaymaniyah will have to assign possible actions and measures to respect the national commitment of Iraq- NDC ''National Determined Contribution''.

Section II: Overall strategy

Introduction

The Sulaymaniyah Governorate is leading the city fight against climate change, and has made it its top priority. It committed itself to reducing its overall emissions to at least 40 % below 2015 levels by 2030 conditionally and subject to availability of international financial aid and support.

The outcome targets above are accompanied by an assorted combination of numerous GHGs cut-oriented actions in all involved sectors of emissions.

The local authorities, that acknowledge the importance of mitigating climate change, play a key role in the achievement of the EU's energy and climate objectives. The Covenant of Mayors is a European initiative by which towns, cities and regions voluntarily commit to reducing their CO2 emissions beyond this 40 % target. This formal commitment is to be achieved through the implementation of Sustainable Energy Action Plans (SEAPs).

The purpose of the current Sustainable Energy Action Plan for Sulaymaniyah Governorate is to help the Covenant of Mayors signatories reach the commitments they have taken by signing the Covenant.

This document contains:

a Baseline Emission Inventory (BEI);

a Sustainable Energy Action Plan (SEAP).

BEI is a prerequisite to SEAP elaboration, which will provide knowledge of the nature of the entities emitting CO2 on the Local Authority territory, and will thus help select the appropriate actions. Inventories conducted in later years will help in determining if the actions would provide sufficient CO2 reductions and if further actions are necessary to be addressed.

The current document provides detailed step-by-step action plans for the entire process of elaborating a local energy, from initial political commitment to implementation.

It is divided into 3 parts:

- **Part I** relates to the description of the overall SEAP process and covers the strategic issues;
- **Part II** gives the methodology followed to elaborate the Baseline Emission Inventory (BEI) along with the produced data on BEI;
- **Part III** is dedicated to the description of technical measures that can be implemented at local level by the local authority in the different sectors of activity;

This document also provides a coherent set of actions and recommendations related to energy and will allow local authorities to implement the SEAP in a way that suits their own circumstances, permitting the Local Authority to come on board of the Covenant of Mayors, while continuing to follow the approaches they have previously used with as little adjustments as possible.

Objective(s) and Targets

At the National level

Iraq ratified Kyoto Protocol on 28 March 2008. The Kyoto Protocol is an international agreement which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that commits State Parties to reduce greenhouse gas emissions, based on the premise that Global Warming exists and human-made CO2 emissions have caused it. The Kyoto Protocol implemented the objective of the UNFCCC to fight global warming by reducing greenhouse gas concentrations in the atmosphere to "a level that would prevent dangerous anthropogenic interference with the climate system". The Protocol is based on the principle of common but differentiated responsibilities: it puts the obligation to reduce current emissions on developed countries on the basis that they are historically responsible for the current levels of greenhouse gases in the atmosphere.

Figure 3 Sulaymaniyah Governorate

On 12 November, 2015, Iraq submitted its Intended Nationally Determined Contribution INDC with new climate action plan to the UNFCCC. This INDC comes in advance of a new universal climate change agreement. The agreement will come into effect in 2020, empowering all countries to act to prevent average global temperatures rising above 2 degrees Celsius and to reap the many opportunities that arise from a necessary global transformation to clean and sustainable development.

At the Local Level

The Governorate of Sulaymaniyah is committed to reduce the emission to a 40% by the year 2030 starting at the baseline emissions of the year 2015. Through its commitment, the Governorate would be achieving the Covenant of Mayors target of 40% by 2030.

This commitment is subject to the sustainability of the security situation and conditions in the neighbouring cities of Sulaymaniyah, and also to the availability of fund to implement the action developed through the SEAP.

On the other hand, if both circumstances aren't achieved, the governorate will need to assign possible actions and measures to respect the national commitment of IRAQ-INDC ''Intended National Determined Contribution''.

Current framework

Geographical Locations and Sites

Sulaymaniyah Governorate is in the Region of Kurdistan, Iraq. It's located in the north east of Iraq and shares border with Iran to the west and interior borders with Diyala and Salahadeen to the south, Kirkuk from the west and Erbil from the north; together with Duhok and Erbil, it is part of Kurdistan region covering an area of 21,071 km2. Sulaymaniyah contains sixteen districts: Sulaymaniyah central district; Pishdar, Penjween, Chamchamal, Darbandikhan, Dukan, Halabja, Khanaqeen, Kalar, Kifry, Mawat, Qaradagh, Raniya, Said Sadiq, Sharazur, Sharbazhe and Sulaymaniyah District and includes 48 sub-districts.

Demographic Tendencies

Sulaymaniyah total population amounted to 2,023,266 persons in 2015 to represent 5.62% of all Iraq. 11,184 IDPs from different locations of Iraq are based in Sulaymaniyah.

Climatic Characteristics

Sulaymaniyah is a mountainous area with cold and snowy winters, mild and moderate summers. The weather varies from one area to another; the temperature reaches to -5°C in mountainous areas than in plains.

Existing Infrastructure

Infrastructure, especially in the Fields of Public Transport and Sanitation

Sulaymaniyah has made some progress in the field of infrastructure in the past years, as 83.2% of homes have been linked with the public sewerage network and 85.5% with the drinking water network. However, it is necessary to gradually complete the coverage during the years of the plan. Regarding public transport, it is still at an early stage, with no kind of public transport now in the Province. Public transport is a service that enhances tourism and entails a positive impact on the natural environment and the level of pollution. In the next phase, where the focus is on "Sulaymaniyah, Capital of Culture", the establishment of a public transport network and provision of necessary modes of public transport is considered a priority. The Sulaymaniyah needs a public transport network to link different areas of the Sulaymaniyah with the city centre and related cultural attractions, as well as the other sites of cultural and artistic festivals, as an initial step on the path of a comprehensive transport network to all areas of the Province.

Local Expertise and Competencies and the Use of Technology

Sulaymaniyah is scoring high levels of education in the Region and has now diverse local academic expertise, but still needs specialized and professional expertise and

competencies in the coming phase to support the realization of its vision and development goals. Academically, for example, there are disciplines
closely related to culture, archaeology, and tourism, but still need to be developed. On the other hand, there are weak aspects in the curriculum in terms of quality and alignment with modern participatory approaches, which stimulate creativity and analysis and harness technology for the benefit of education, either academic or vocational. However, vocational education and training is the most needed for development and improvement.

Garbage Disposal

A percentage of 79% of Sulaymaniyah population receives waste collection service, while 21% disposes of household waste by throwing them in open places. (strategic development plan of Sulaymania governorate 2018-2016).
Waste collection service is a municipal service that needs to be further developed in the next phase in terms of comprehensiveness and regularity of coverage and the number of times waste is being collected per day, in addition to separating hazardous waste; such as industrial, medical and household waste, and finally the ways to deal with; processing, refining, safe burial, etc. These are among the fields in which investments can be encouraged either by the private sector or in partnership between the government and the private sector.

Legal Stand

The Governorate Council Election in the Kurdistan region held on April 30 2014 is governed the emended law No. 4 for 2009 on governorates, districts and sub-districts council elections in the Iraqi-Kurdistan region. The number of seats allocated for Sulaymaniyah Governorate are 32 seats to be competed among162 candidates both males and females representing different political, ethnical and religious backgrounds. The result of the election in the provincial council is set with the 32 seats Dr. Haval Abubekir was nominated to be the governor of Sulaymaniyah for having the highest number of votes. The governor has the executive role in the governorate, while the legislation role is represented by the provincial council. The governor is entitled to manage the governorate including all the administrative districts and general directorates.

Complementary with the national actions

SEAP focused on transportation, housing and public services; these three components are reflected in Kurdistan vision 2020, which focused on water management and the importance of having studies and projects to improve sewerage services in the region. Also, one of the goals is to create an economically prosperous region taking the environment protection into consideration. Since climate change will drastically affect our air, water and land resources, actions are taken by establishing the environmental protection and improvement board who passed the law in 2008 and amended it in 2010. The board mandate, to protect public health and natural resources, remove and treat biological and chemical weapons, and increase environmental awareness. Developing energy efficient building, starting to conduct environmental impact assessments,

developing a strategy to adapt to climate change, supporting environment protection groups, and improving the urban environment are the components to be achieved through maintaining the integrity of environment for future generation to enjoy the same benefits. (Ministry of planning, Kurdistan vision 2020, P35-37)

The provincial development strategy for Sulaymaniyah Governorate for the years 2016, 2017 and 2018 has six main goals as response to vision 2020. The PDS is cross cutting with SEAP in three goals as following: administrative and financial efficiency, public services and investment attracting environment. (Sulaymaniyah PDS 2016-2019).

UNDP / LADP project has signed long term agreement with the Ministry of Planning in KRG as main counterpart. The three governors of Kurdistan region stated that UNDP will be the primary interlocutor with governorates and selected technical directorates, and link technical directorates in each governorate to relevant support and expertise as required. UNDP will tap into the specialised expertise of several partner UN Agencies as per their mandates like UN-HABITAT, ILO, UNICEF and WHO.

Complementary with the local authority plans and other related actions

Local Area Development Programme (LADP) set Charter as an agreed framework between the respective Governorates and the United Nations Development Programme (UNDP) on behalf of UN Agencies for the implementation of the LADP funded by the European Union; This Charter is considered as key document for agreement and commitment to what it entails by all concerned parties for the aim of facilitating the development, organization, coordination and implementation of the respective activities entailed in the Programme document.
SEAP team has conducted series of workshops and meetings with governmental counterparts to develop the strategy. The provincial council was nominated in all these meetings and workshop represented by the provincial council members.

Short description of the governorate

Sulaymaniyah is an Iraqi city located in the north-east of Iraq on the Iraqi-Iranian border in Kurdistan region, in the north-west of the city of Sulaymaniyah, the Dukan dam that is located on the small Zab River. Sulaymaniyah was known before the founding of a modern city in 1784 as it was the capital of the Emirate of Baban. The city was established on 14 November 1784 by the Kurdish prince Ibrahim Pasha Baban, who named the city Sulaymaniyah in relation to the name of his father Suleiman Pasha. In 1785, the establishment of the commercial markets and the Governor's Palace was completed. The inhabitants of the neighbouring villages began to move to the new city and the city of Sulaymaniyah remained the capital of the Babylonian emirate until 1851. There is an international airport called Sulaymaniyah International Airport located in the western part of the city opened on July 21, 2006. Sulaymaniyah has become a tourist centre for tourists from all over Iraq, where the number of tourists in 2009 reached 60,000 tourists. The existence of the waterfalls of Ahmed Awa, Dukan and Darbandikhan, makes the city the focus of tourist destination for tourists in the

summer, as well as many modern hotels such as High Crest Hotel and Arin Hotel which overlook Azadi Park, Mount Azmer and Sulaymaniyah Palace Hotel.
Sulaymaniyah is known as city of culture which produces number of writers and novelist. The most prominent artists in the field of art and culture and singers are Nali, Mawlewi, Mahwi, Kordi, Birmerid, Kuran, Fayeq.

Vision for the future

The vision of Sulaymaniyah is "Sulaymaniyah is the capital of culture where citizens enjoy a stable and attractive environment for development investments, reinforced by district entrepreneurial resources that are optimally used per the principal of social justice".

Organizational and financial aspects

Coordination with national and local authorities

The coordination between the governorate and the ministries are regular through daily communications and monthly meetings. The general directorates have two side directions of communications, vertically communication with their ministries and horizontal communication with the governorate. They report to their ministries and governorate at the same time. The general directorate who provide public services might receive fund from their ministries or from the governorate as well.

Adaptation of administrative structure.

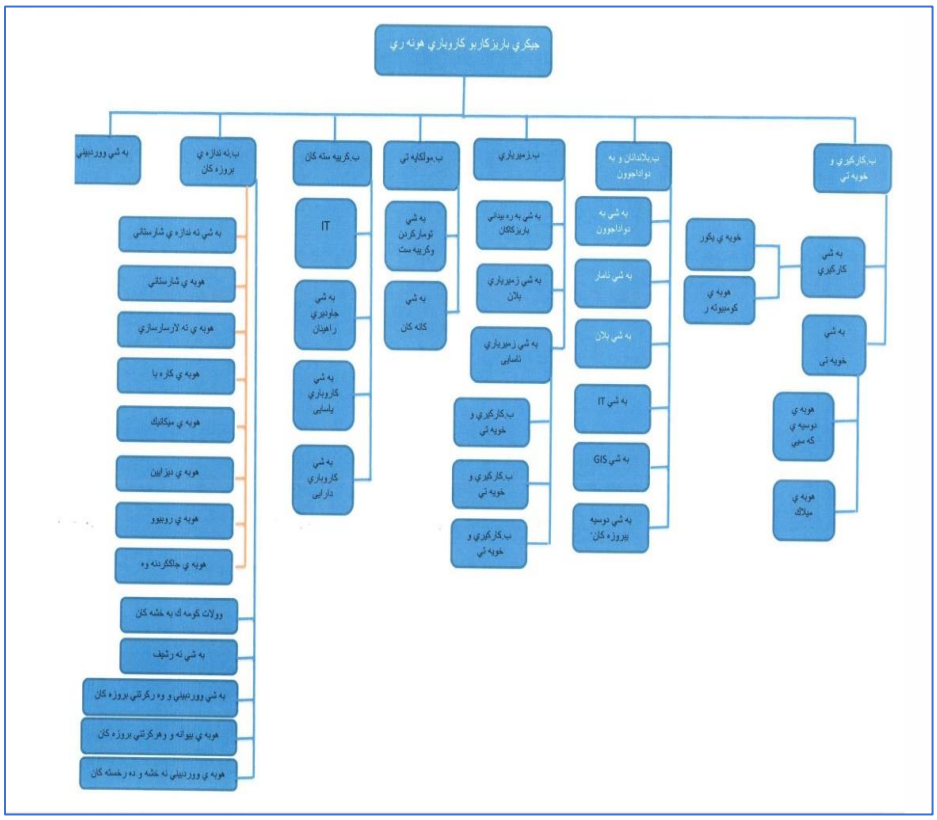

Figure 4 Organization structure of governorate

Organizational structures created/assigned to prepare and implement the SEAP

The administrative structure of the governorate as shown above adding to them all the related directorates expressed great support to SEAP. Two committees were established from the governorate: Steering Committee chaired by the vice governor to include most of the general directors of the governorate and number of University Academics expert in renewable energy, while the technical committee includes engineers from each directorate. A focal point is appointed by the vice governor to communicate the work between UNDP and the two committees.

Department	Personnel met with	Email
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NGO – Earth Network	Dr. Rozhan Faraidun – Director of Earth Network	rozhanfaraidun@gmail.com
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Public relations officer – Gov. of Suly	Ms. Vian Khan	-
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Involvement of stakeholders and citizens

Many stakeholders were involved in SEAP, in addition to the engineers from different general directorates like water, electricity, municipalities and others participated in developing projects and providing us by the required data. The universities have great role in supporting SEAP as well, both Academics and students. The Academics participated in meetings and workshops to provide many new ideas and vision for the

project. The students participated in sustainable projects competitions who could develop many projects fully related to SEAP and might greatly support environment protection against climate change.

Reference to Citizen Awareness Promotion Plan

The awareness represents important role in plan where each sector has part of awareness plan, more work need to be developed for awareness plan for each sector to ensure best results.

Budget

The forecast budget for implementation of SEAP is $ 601,051,531 where this calculated-on base of estimation which require further verification and recalculation at time of implementation.

Foreseen financing sources for the investments within your action plan

Foreseen financing opportunities might be available from both local investments, and international donners. It is obvious that some local entrepreneurs are ready to invest in some small projects related to public services and awareness campaign. At the same time, some international associations and NGO are operating in the area and have similar plans.

Section III: Baseline Emission Inventory

Introduction

Baseline Emission Inventory (BEI): Quantifies the amount of CO2 emitted due to energy consumption in the territory of the local Authority in the baseline year. It allows to identify the principal anthropogenic sources of CO2 emissions and to prioritise the reduction measures accordingly. (Mayors, 2010)
Elaborating a BEI is of critical importance. This is because the inventory will be the instrument allowing the local authority to measure the impact of its actions related to climate change. The BEI will show where the local authority was at the beginning, and the successive monitoring emission inventories will show the progress towards the objective. Emission inventories are very important elements to maintain the motivation of all parties willing to contribute to the local authority's CO2 reduction objective, allowing them to see the results of their efforts. (Mayors, 2010).

Methodology.

This section describes the methodological principles of data collection, the emission source categories inventoried, the origin of data for the analysis and the calculation methods used. The method used in BEI calculation will be considered as 'standard' emission factors in line with the Intergovernmental Panel on Climate Change (IPCC) principles and comply with United Nations Framework Convention on Climate Change (UNFCCC) reporting system.

CO2 emissions from energy consumption within the territory of the local authority will be calculated either directly due to fuel combustion within the local authority or indirectly via fuel combustion associated with electricity and heat/cold usage within the area. The emissions of CH4 and N2O will not be calculated. CO2 emissions from the sustainable use of biomass/biofuels, as well as emissions of certified green electricity, will be considered zero. The standard emission factors will be based on the IPCC 2006 Guidelines (IPCC, 2006).

Base line year

Baseline year: Baseline year is the year against which the achievements of the emission reductions in 2030 shall be compared. The base line year is 2015.

Per capita target:

The local authority set the target as 'per capita'.
In this document, the emissions in the baseline year 2015 are divided by the population, and the target for year 2040 is calculated on that basis.

Activity Data

Activity data quantifies the human activity occurring in the territory of the local authority, for example:

- Oil used for transportation [MWhfuel];
- Electricity consumed in buildings [MWhe];
- Heat consumed by buildings [MWhheat]

Sectors for the activity data

- Governorate Buildings, Facilities, Equipment
- Tertiary Buildings, Facilities, Equipment
- Residential buildings Electrical Consumption, Fuel for Heating Consumption
- Public Lighting Local Authority public lighting
- Transport within Governorate area, Governorate Fleet, Public Fleet, Transport Private and Commercial Transport
- Industry
- Agriculture
- Others like Solid waste

Procedures

The approach requires a set of procedures:

- Interview with data resources employees and evaluating the data available;
- Collection and processing of quantitative data;
- Establishment of indicators;
- Gathering of qualitative information using document review and interviews /workshops with Governorate;
- The selection of data sets will be based on criteria that is agreed on with Governorate, who are then actively involved in contributing data.

Resources

- Governorate of Sulaymaniyah.
- Ministry of Municipalities and Tourism KRG.
- Ministry of Electricity KRG
- Ministry of Natural Resources KRG.
- Ministry of Interior KRG
- Ministry of Planning KRG
- Ministry of Agriculture & Water Resources KRG
- Ministry of Higher Education and Scientific Research KRG
- Ministry of Transport and Communication KRG
- Ministry of Health KRG

Methodology

- Identify the needed data for the baseline emission.
- Interview with data resources' representatives.
- Select the relevant data for the inventory.
- Assessment & validation of collected data.
- Checking level of accuracy & reality of collected data.
- Sorting the collected data.

Emission factor

Emission factors are coefficients which quantify the emission per unit of activity. The emissions are estimated by multiplying the emission factor with corresponding activity data. Examples of emission factors are:

- amount of CO_2 emitted per MWh of oil consumed [t CO_2/MWhfuel];
- amount of CO_2 emitted per MWh electricity consumed [t CO_2/MWhe];
- amount of CO_2 emitted per MWh heat consumed [t CO_2/MWhheat].

Electricity Emission Factor

In order to define the electrification emission factor, the following need to be addressed:

1. National emission factor Electricity is consumed in the territory of each local authority (LA), but the main units that produce it are only concentrated on the territory of a few of them. These major production units are often large CO_2 emitters (in the case of fossil fuel thermal plants), but their electricity production is not meant to cover only the electricity needs of the LA on which they are built, but the needs of a larger area. In other words, the electricity that is consumed in a particular LA generally comes from different plants either inside or outside the LA. As a consequence, the CO_2 that is emitted due to this electricity consumption actually comes from those various plants. To quantify this for each individual LA would be a challenging task, as the physical flows of electricity cross the borders and vary depending on several factors. In addition, the LA in question usually has no control on the emissions of such plants. For these reasons, and keeping in mind that the focus of the Covenant of Mayors is on the demand (consumption) side, it is recommended to use a national or European emission factor as a starting point to determine the local emission factor. (Mayors, 2010)
2. This emission factor reflects the average CO_2 emissions related to the national electricity production. The national emission factors fluctuate from year to year due to energy mix used in electricity generation. These fluctuations are caused by the heating/cooling dem and, availability of renewable energies, energy market situation, import/export of energy and so on. These fluctuations occur independently of the actions taken by the local authority. Therefore, it is recommended to use the same emission factor in the BEI and in the MEI, because otherwise the result of the emission inventory could be very sensitive to factors on which the local authority has no influence. (Mayors, 2010)
3. In Iraq, the emission factor has not been updated since it was reported **0.82 tCo2/MWh**
4. The emission factor will be assumed **0.82 tCo2/MWh** as base for calculation.

Emission from Kerosene and Diesel fuel

- The power consumption from space heating
- The calculation of GHG emissions for fuel consumption for heating can be calculated with the following formula in accordance with IPCC guidelines and the assumption that the combustion is ideal:

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

Where:

EFC	CO_2 emissions for fuel combustion in year tCO_2
Fuel	Amount of Fuel of type a (Diesel) in litre consumed in a year
Eff	Emission Factor of Fuel (Diesel) = 74.1 tCO_2/TJ and for Kerosene 71.9tCO_2/TJ
NCV	Net Calorific Value of Diesel which is equal to 43.33TJ/Gg and for Kerosene 43.8TJ/Gg
D	Density of Diesel equal to 0.8439 Kg/litre, Density of Kerosene equal to 0.795 Kg/litre
10^{-6}	To convert from Gg to Kg

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

The conversion factor between Litres to KWh (EMEP/EEA 2009; IPCC, 2006)

Table 1 Fuel conversion factor KWh/L

Fuel	Conversion factor KWh/L
Gasoline	9.2
Diesel	10
Kerosene	9.7

Emission factor for fuels (IPCC, 2006)

Table 2 Fuel conversion factor t/MWh

Fuel	CO2 Emission factor t/MWh
Gasoline	0.249
Diesel	0.267
Kerosene	0.259
LPG	0.227

Emissions from Electrification in KRG

The calculation for GHG emission from power consumptions of the tertiary sector are realized in line with the equation below:

$$ECO2 = ET \times NEFE$$

ECO_2	CO_2 emissions of Electrical Consumption in year tCO_2
ET	Actual power consumption for tertiary sector in KWh.
NEFE	National Emission Factor for electricity [tCO_2/MWh] (0.82).

The country emission factor couldn't be obtained during the mission where the last country emission factor for Iraq reported 903 tCO_2/GWh for year 2012, to avoid uncertainty, we report it as methodology IPCC -2006.

In this study, the emission factor will be assumed better in 2015 in KRG and will considered 0.82tCO_2/MWh.

Emissions from Transportation

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

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

Where:

EFC	CO_2 emissions for fuel combustion in year tCO_2
Fuel	Amount of Fuel of type a (Diesel) in litre consumed in a year
Eff	Emission Factor of Fuel (Gasoline /Diesel) in tCO2-e/TJ Gasoline 69.3 tCO_2/TJ t Diesel 74.1 tCO_2/TJ t
NCV	Net Calorific Value of gasoline is equal to 43.TJ/Gg, Diesel is 43.TJ/Gg
D	Density of Gasoline 0.7407 Kg/litre, Diesel 0.8439 Kg/litre
10^{-6}	To convert from Gg to Kg

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

Heating and Cooling power consumption BEI methodology for the residential sector

Sulaymaniyah climate is hot in summer and cold to mild in winter, where temperatures in July and August reach to 50°C and 2°C in January, varying from one area to another; the temperature reaches to -5°C in mountainous areas than in plains.
There is no central cooling/ heating system in the city. Hence, the city's residents tend to heat one room in the flats or houses, while some other houses use central heating system. Most commonly use the A/C for cooling/heating or the Electrical Heater in addition to fuel like Kerosene.
The database for Kerosene fuel consumptions for heating had been provided though Sulaymaniyah Governorate.

Electrical Diesel Generator

Fuel consumption for backup diesel generators (BDG)

Iraq is highly dependent on fossil fuels to generate power which, despite recent improvements,
the generated power does not meet peak demand; the reliability of supply is inadequate and load-shedding is a common daily experience for KRG. Private Diesel power generation has grown significantly to meet the gap.
The population growth in KRG estimated in around 5.5 million with 1.8 million refugees in 2015 had increased the demand for electricity.
It is estimated that 55,000 to 80,000 private diesel generators in Iraq, are supplying an estimated 21 TWh, or 30% of the total electricity generated. The operators are often licensed by the local provincial council, but are otherwise poorly regulated. They contribute to chronic air and noise pollution problems, at great local health cost, but provide much-needed electricity. As a result, primarily of private diesel generators, air pollution in Iraqi cities is well above World Health Organization and local guidelines.

These pollutants have adverse effects on human respiratory, neurological and immune systems. In addition, as they settle or as they are spread by wind and rain, they cause acidification and pollution of water and soil.

In KRI and especially in Sulaymaniyah, faces daily cut-off in electricity which counts for around 4.48 hours in daily basis. The governorate doesn't have sufficient database for BDG and is not well- documented. The private sector becomes the main provider for this service, but without getting any official control from the government.
In order to set a rule for calculating the emission part of BDG, the MOE-KRG data base will be used as reference, from which the estimated cut-off period will be calculated as KWh.

The fuel consumption will be counted according to the following:
The BDG fuel consumption depends on many factors: The capacity of Diesel Generators BDG in KVA, Load ratio to capacity of BDG, Fuel, Years of operation and the status of the engine -maintenance.
The following link, explains the effect for the capacity of BDG on fuel consumption with load ratio:
www.dieselserviceandsupply.com for example: for250kw Generator consumes the following:

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

Figure 5 *Fuel consumption for The Backup diesel generator*

In order to evaluate the actual GHG emission, some factors have to be defined and assumed to help in calculating the GHG emission.
By consulting BDG providers and suppliers, the recommended maximum load share is 70% of the BDG capacity for more efficient use and long term of operation.
Assuming that the 75% load ratio, which is 13.6 Gal/hours for load of 187KW. (One Gal = 3.78541 litres).
So, each one KWh load consumption will consume 0.275 litres, which has been confirmed by the BDG provider.

1 **KWh =» 0.275 litre of Diesel**

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

Power provided by BDG

In Sulaymaniyah, MOE-KRG is the only source which is in charge of providing the data necessary for power consumption. So, the power consumed by BDG is calculated from the combination of data provided by the BDG provider Fuel supplier and that of MOE-KRG data base.

In this study, we will consider the consumption from MOE-KRG as base for 19 hours and convert it to 24hours of operation.to avoid the uncertainly in BDG.
The Fuel data which includes the total fuel consumed in Sulaymaniyah will be with BDG consumption; however, still the fuel data given are not 100% certain as there are parts of supply that come from outside the city.
In our assumption for calculation, we will count the Fuel data as fully consumed.

Emission from BDG

The power consumption from BDG will be the same as that from MOE-KRG, as the cut-off time is 5 hours daily. The assumptions presented in the above sections (Backup Diesel Generator BDG Fuel Consumption & BEI Methodology) can then be adopted, namely
1 KWh =» 0.275 litre of Diesel.
The above figures will be used to convert power consumption for the BDG for:
Fuel = power consumed from BDG in MWH x 0.275 x 1000
The calculation of GHG emissions for fuel consumption for BDG can be calculated with the following formula in accordance with IPCC guidelines:

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

Where:

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

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

Building and facilities

Electricity Sector

The Electricity Sector Consumption in Sulaymaniyah Governorate Electrification is a core element in the emission mitigation action. The information for consumption of electricity has been obtained from the Directorate of Sulaymaniyah Electricity. Such data has an identified category according to the approved billing system that is issued every two months at regular intervals.

Table 3 Electrical consumption in Sulaymaniyah governorate per sector for year 2015

Sector		Electrification in (MWh)	Emission in tCO_2
Governorate		6870	4318
Residential		3917444	3212304
Tertiary	Government	513884	422700
	Commercial	251915	206570
Industrial		1570301	1287647
Agricultural		87336	71616
Public Lighting		61412	50358
Total		6409162	5255513

Analyses of Electricity consumption per area

In figure 3, the residential sector represents 61 percent in Sulaymaniyah Governorate electrical consumptions followed by the industrial sector with 25 percent, tertiary sector 12% where public lighting, agriculture sectors each of which consumes 1 percent.

Governorate energy consumption

Table 4 Energy consumption in Governorate for base year 2015 and projection for 2030

		MWh 2015	Emission t CO_2 for year 2015	BAU MWh in 2030	Emission t CO_2 as to BAU
	Electrification in MWH	4493	3684	7278	5968
Fuel for BDG/month in litre	237750	2377	634	3850	1027
Fuel for space heating in litre	54540	545	145	883	235
	Total	7415	4463	12011	7230

Residential sector

By analysing the consumptions in **Residential Sector**, table 4, developed in base that electricity in Sulaymaniyah is available 24 hours a day without any cut-off with an assumption that the consumption will continue in the same manner. When comparing the results with neighbour countries like Jordan, which has an average consumption of 8.8 Kilowatt hour per day (Electricty, 2015),or Lebanon 9 Kilowatt hour per day, it can

be seen that the average consumption in Sulaymaniyah governorate is 22 Kilowatt hour per day per household, where Kalar consumes 31KWh/d kilowatt hours per day per household and Kifry and Rizgary consume 28 KWh/d, Dukan & Chamchamal consume 24 KWh/d and Sulaymaniyah, Sharsour, and Pebaz consume 21, 20, 19 and 13Kilowatt hour per day respectively.

These figures show high demands on consumption which need to be addressed carefully if knowing that 61 percent of consumption of electricity is made by household. Moreover, the yearly increase in electricity demand is 5 to 9 percent which will lead to an increase in blackout period which is currently five hours per day.
In this report, the actual demand for electricity will be considered as power which is available 24 hours and leads to the total consumption of **3,917,445 MWh**.

Table 5 Residential sector consumption in Sulaymaniyah Governorate in year 2015 with average house hold consumption per day.

Residential Sector			
District	Average number of Subscribers	Electrical Consumption in MWh	Average Electrical Consumption of household in KWh/day
Sulaymaniyah	234173	1,821,860	21
Sharazour	67964	492,848	20
Raniya	70129	484,120	19
Dukan	28028	247,456	24
Chamchamal	36997	321,028	24
Kalar	31287	356,931	31
Kifry	8554	86,632	28
Rizgary	9398	94,550	28
Pebaz	2506	12,022	13
Total	489,036	3,917,445	22

In Sulaymaniyah, as in KRG, there is no central heating or cooling system where space heating and cooling represents huge amount of energy in buildings. The main source for energy in space cooling depends on electricity but the space heating depends on both electricity and the use of fuel like kerosene.

In Sulaymaniyah, the electrification records for consumption look almost swinging at the same level with uncertainty if the records and measurements have been well monitored and evaluated. If those measures are well documented, there is then a real issue in energy consumption as it should show variation in consumption according to the weather condition.
In order to come up with real action and implement policies to sustain energy transition to reach a higher efficiency, there is a need to collect precise information to show the factors that influence energy consumption and to establish Smart grids to collect some information on consumer behaviour. Studying different types of factors such as socio-demographic, economic and dwelling characteristics will be useful tools to help policy makers and energy producers set their actions

Energy conservation measures are nearly non-existent, yet in KRG, and they can potentially lead to substantial reductions in energy demand growth, environmental damages and public expenditures.

The need for real study about household appliances in KRG will model the effect of mandatory appliance standards on electricity consumption, and support the energy key players to translate the real situation to productive actions in energy mitigation and help in developing the initiative programmes contributing to economic development. It will also show that economic efficiency favours the introduction of standards for appliances, introduce mandatory standards for energy efficiency for different household appliances (refrigerator/freezers, AC split units, washing machines and lighting) and support the reduction of energy bill.
Establishing an energy labelling system and setting a Minimum Energy Performance Standards for household appliances will be important steps that will support maximizing the efficient use of energy and the use of renewable energy.
It is clear from the dialogues with the steering and technical committees that there are several barriers currently faced in KRG, which require a lot of important steps to be addressed, but not limited to the following:

- Enhanced capacity on the Government and energy agency units for appliance Energy Efficacy (EE) policy development, implementation and market surveillance;
- Structured verification and enforcement of appliance Energy Efficacy (EE) labels and standards;
- Enhanced consumer awareness of appliance energy efficiency characteristics, standards and labels and the costs and benefits of more efficient products;
- Increased capacity of manufacturers to produce and market Energy Efficacy (EE) appliances;
- The usage of Electrical heater is in houses and replacement with solar water heater is important step to be addressed.

Tertiary Sector

The tertiary sector will be divided to two main parts the Governmental and the commercial each one will be analysed:

Tertiary sector consumption of electricity	Governmental sector	Commercial sector
MWh		
Tertiary Sector 765799	251915	513884

Governmental Sector:

Though local authority sector consumes 8 percent of total electrification consumption in Sulaymaniyah, it represents important core in consumption. It plays an important role in implementing policies and promoting energy efficiency in Buildings, and leading by example energy efficiency to their building, promoting the Energy Efficiency (EE) to building owners throughout the community, Benchmark and improving energy use.
Furthermore, Local Authority can support increased building efficiency by working with community groups and considering voluntary and regulatory policies.
It is so important to provide local Authority with tools and resources, such as Energy codes to set minimum energy efficiency standards for building technologies and design

elements that may include: the building envelope; heating, ventilation, and air conditioning (HVAC) systems; lighting; and service water heating systems ..etc.
This should be accomplished with developing specific tailored programs to help local officials improve energy efficiency and reduce greenhouse gas emissions for multiple building types in their community with financial benefits of energy efficiency to all building owners can help local authority efforts to reduce energy costs and greenhouse gas emissions.
The role of other groups in the community is so important in supporting raising awareness about the environmental and promoting changing behavioural and saving energy.
For that it is important to have Building energy codes as regulatory instruments that specify minimum energy efficiency standards for the residential and commercial building sectors, and mandate certain energy efficiency characteristics for building technologies. With effective implementation, building energy codes can support energy cost savings and complementary benefits associated with electricity reliability, air quality improvement, greenhouse gas emission reduction, increased comfort, and economic and social development.

Commercial Sector:

Commercial sector electrification represents 4 percent of total electrification consumption. Although this percent is low, it is expected to rise due to the increase in demand for commercial sector.
While they are not high figures, it would be good if this has been further reviewed to ensure policies respected in matter of consumption to avoid sudden increase due to the increase in future demand for these sectors.

Agriculture:

Agriculture electrification is considered a small percentage, as indicated, 1percent of total electrification in the Governorate of Sulaymaniyah. Although they are not high figures, it would be good if this has been further reviewed to ensure policies respected in matter of consumption to avoid sudden increase due to the increase in future demand for these sectors.

Industrial:

Industrial electrification is considered high percentage as indicated 25 percent of total electrification in the Governorate of Sulaymaniyah. It represents an important sector due to the high demand for electricity. Even if it is an optional sector in SEAP, it is an important regulation to ensure efficient consumption and less emission.

Public Lighting Sector:

The public lighting consists of street lights and traffic lights, where the street lights consume the largest proportion of energy due to the usage of High pressure lamps.
According to the data provided by the Sulaymaniyah Governorate with support from the MOE-KRG and General Directorate of Sulaymaniyah Electricity, the following table summarises the overall information for public lighting which is mainly the public street lighting. The information given represents the case of the governorate in year 2015.

The main switching system used in the public lighting is the photo cell which was before considered to be a good solution. Now as technologies lead, the use of **Astronomical**

timer becomes more precise and avoids many wrong operation of photocell in cloudy days and also brings much more options by giving wider possibilities to adjust the timing of switching on and off according to the sunrise and sunset.

The usage of more efficient lighting like **LED** had been tested in pilot projects which show much saving as 400 watt HPS lamps had been replaced by 150 watt led and this brings the saving to around 250 watt per each lamp which counts for 1MWh/year/ lamp per 400 watt. This process can be simply extended to all public lighting.

Moreover, the possibility of using the new **smart technologies** in LED drivers which can be programmed to operate in normal full load, will adjust the light output at certain operation hours like after mid night and before the sunrise. This feature is important as it increases the life time of the street lights and reduces the energy consumed in no rush hours in the streets and contributes in emission reduction. By applying these technologies, it is possible to reduce the power consumptions by the following:
The total Consumption for the Public lighting is **48,618** MWh and equal to **61,412** MWh in year 2015 by considering the cut-off time, the detailed data for street lighting are not available. For that we had used the average yearly consumptions which is **1519**KWh per year and counts for **40429** street lights.

By applying new technology in the LED Drivers, the lamp can be dimmed after mid nights. This will contribute in energy saving and will extend the life time of the LED lamp. Astronomical timer helps adjusting street light operation according to the Dusk and Dawn which could save 365 days per year, also will avoid Worthless functioning at cloudy days and with broken Photocell. All those benefits could be achieved with well-developed, organised and monitored plan.
The Governorate has successfully converted two percent of the HP street lamps to LED as fruitful project in energy mitigation. The plan will be continued but it requires technical alignment to improve the efficient results and measures.

Energy Sector

Fuel consumptions for Space Heating, Industry & Cooking

The fuel consumption details were provided by the Ministry of Energy and Mineral Resources for the full governorate of Sulaymaniyah which count for 2,058,811 inhabitants.

Fuel consumption for space heating

Table 6 Kerosene Fuel consumptions in Sulaymaniyah year 2015

Fuel type	Kerosene/Governorate
In litre	201092078
MWH	1,950,593
tCO_2	505,204

By comparing the amount of Kerosene consumed in Sulaymaniyah compared with other governorates, it looks high. The assumed reason for that is the use of fuel in industry. There is no data available on percentage of usage by industry. For that we are going to use special models for calculation that depend on number of inhabitants.

Table 7 Estimated Kerosene Fuel consumptions in Sulaymaniyah year 2015 by houses

Fuel type	Kerosene/Governorate
In litre	53,291,872
MWH	516,931
tCO_2	133,885

Liquefied Petroleum Gas LPG consumption for heating and cooking

Table 8 LPG fuel consumption in Sulaymaniyah year 2015

Fuel type	LPG/Governorate
In KG	Not provided
MWH	
tCO_2	

For that we are going to consider similar data as provided by other governorate in base of inhabitants

Table 9 LPG fuel consumption in Sulaymaniyah year 2015

Fuel type	LPG/Governorate
In KG	70,867,000
MWH	928,358
tCO_2	210,737

Transportation Sector
Fuel consumption for Transportation for all sectors

Table 10 Diesel and Gasoline fuel consumption in Governorate of Sulaymaniyah year 2015

Fuel type	Diesel	Gasoline 90
In litre	177,369,666	533,989,342
MWH	1,773,697	4,912,702
tCO_2	473,577	1,223,263

Fuel consumption for Sulaymaniyah Governorate Transportation

Table 11 Governorate Fuel consumption in Sulaymaniyah year 2015

Fuel type	Diesel	Gasoline 90
In litre	20,675,992	6,575,945
MWH	206,760	60,499
tCO_2	55,205	15,064

Solid waste

Average waste generation of 3120 tonnes per day or 963,030 tonnes in year 2015 is currently scattered throughout the governorate without any separation or treatment.

Table 12 Governorate Fuel consumption in Sulaymaniyah year 2015

Fuel type	Diesel	Gasoline 90
In litre	12,108,145	816,870
MWH	121,081	7,515
tCO_2	32,328	1,871

Summary of Energy consumption and GHG emission

Table 13 Summary of energy consumption with GHG emissions in Sulaymaniyah year 2015

Sector	MWH	tCO_2
Governorate buildings, equipment/facilities	7415	5779
Tertiary buildings, equipment/facilities	765799	627955
Residential buildings	5362733	3556926
Public lighting	61412	50358
Industry	3003963	1658965
Governorate fleet	395855	104469
Public transport	0	0
Private and commercial transport	6290544	1592371
Agriculture	87336	71616
Total	15975057	7668439

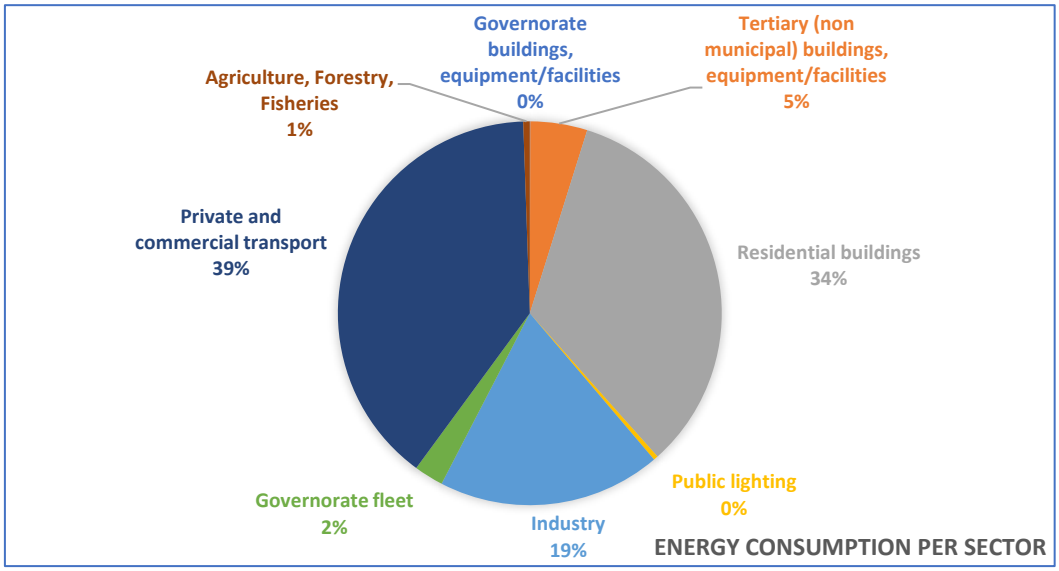
Final energy consumption

Table 14 final energy consumption baseline year 2015

Sector		FINAL ENERGY CONSUMPTION [MWh]					
		Electricity					Total
			LPG	Diesel	Gasoline	Kerosene	
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES							
Governorate buildings, equipment/facilities		4493		2922			7415
Tertiary (non-municipal) buildings, equipment/facilities		765799					765799
Residential buildings		3917444	928358			516931	5362733
Public lighting		61412	0				61412
Industry	Non-ETS	1570301				1433662	3003963
	ETS (not recommended)						0
Subtotal		6319449	928358	2922	0	1950593	9201322
TRANSPORT							
Governorate fleet				327841	68014		395855
Public transport							0
Private and commercial transport				1445856	4844688		6290544
Subtotal		0	0	1773697	4912702	0	6686399
OTHER							
Agriculture, Forestry, Fisheries		87336					87336
TOTAL		6406785	928358	1776619	4912702	1950593	15975057

Covenant Key Sectors

Figure 6 Final energy consumption per sector



Emission per sector

Sector		CO_2 emissions [t] / CO_2 eq. emissions [t]					
		Electricity	LPG	Diesel	Gasoline	Kerosene	Total
BUILDINGS, EQUIPMENT/FACILITIES AND INDUSTRIES							
Governorate buildings, equipment/facilities		3684	0	780	0	0	4464
Tertiary (non-municipal) buildings, equipment/facilities		627955	0	0	0	0	627955
Residential buildings		3212304	210737	0	0	133885	3556926
Public lighting		50358	0	0	0	0	50358
Industry	Non-ETS	1287647	0	0	0	371318	1658965
	ETS (not recommended)	0	0	0	0	0	0
Subtotal		5181948	210737	780	0	505204	5898669
TRANSPORT							
Governorate fleet		0	0	87534	16935	0	104469
Public transport		0	0	0	0	0	0
Private and commercial transport		0	0	386044	1206327	0	1592371
Subtotal		0	0	473577	1223263	0	1696840
OTHER							
Agriculture, Forestry, Fisheries		71616	0	0	0	0	71616
OTHER NON-ENERGY RELATED							
Waste management							0
Waste water management							0
Other non-energy related							0
TOTAL		5253564	210737	474357	1223263	505204	7667125
Covenant Key Sectors							

Figure 7 Final emission per energy carrier

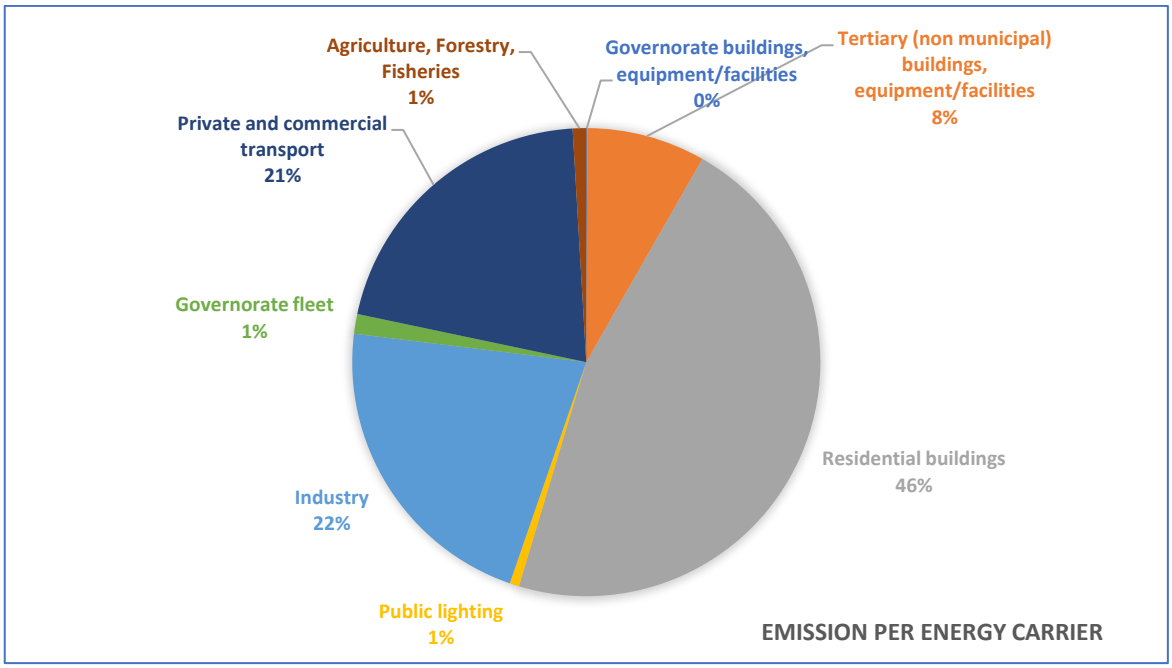


Figure 8 Emission per energy sector

Emission Inventory		
Baseline Emission Inventory		
1)	Inventory year	2015
2)	Number of inhabitants in the inventory year	2023266
3)	Emission factors	☑ ☐
4)	Emission reporting unit	☑ ☐

Baseline year: 2015

1) Greenhouse gas emissions and final energy consumption per capita

Emission factor	t CO_2 (eq.) /capita	MWh/capita
	3.8	7.9

Business as Usual (BAU) scenario

In order to set the measures for the target year which is year 2030, the BAU usual is set by the JRC which is not developed to Iraq or KRG. For that, the following processes have been developed to create an assumption for BAU factor to be used for forecast the increase in emission for year 2030 compared with base year.

In this report, the same factor which was used in Jordan have been applied for Iraq, so the BAU factor will be 1.62%.

Sector	Base year 2015		BAU 2030	
	Energy consumption in MWH	Emission in tCO_2	Energy Consumption in MWH	Emission in tCO_2
Governorate buildings, equipment/facilities	7415	4464	12012	7231
Tertiary buildings, equipment/facilities	765799	627955	1240594	1017287
Residential buildings	5362733	3556926	8687627	5762220
Public lighting	61412	50358	99487	81580
Industry	3003963	1658965	4866420	2687523
Governorate fleet	395855	104469	641285	169240
Private and commercial transport	6290544	1592371	10190681	2579641
Agriculture	87336	71616	141484	116018
Total	15975057	7667125	25879592	12420740

Section IV: Sustainable Energy Action Plan

Outline

The following section explains the proposed actions to support the mitigation of emission due to the increased use of energy. Climate change mitigation, as planned in the SEAP, covers the four main sectors in addition to other optional ones that the Governorate will decide on in the future.

The main sectors which will be covered are:

- Governorate buildings and facility;
- Public Lighting;
- Residential sector;
- Tertiary sector;
- Transportation;
- Waste water management;
- Solid Waste management;
- Water;
- Renewable energy production.

The report includes the proposed actions related to energy efficiency, use of renewable energy, water sector and solid waste in addition to some other important sectors to be included in the plan.

The calculated contribution for each sector to the mitigation of emission is summarised in following diagram:

Table 15 the action mitigation related to each sector

Sector	BAU target year 2030		Mitigation		Mitigation in %
	Energy in MWH	Emission in t CO_2	Energy in MWH	Emission in t CO_2	Emission in t CO_2
Governorate buildings, equipment/facilities	12012	7231	4685	3839	0.04%
Tertiary buildings, equipment/facilities	1240594	1017287	67476	55330	0.57%
Residential buildings	8687629	5762222	2978674	2338225	24%
Public lighting	99487	81580	66549	54570	0.56%
Governorate fleet	641285	169240			0.00%
Public transport					0.00%
Private and commercial transport	10190681	2579641	1482182	375176	3.85%
Agriculture	141484	116018	3908	3204	0.03%
Local Renewable Energy Production			2278966	1868751	19.20%
Total	21,013,172	9,733,219	6,882,440	4,699,095	48.25%

Governorate buildings and facilities

The actual energy consumption for Governorate buildings could not be obtained due to the lack of information. However, for base of calculation, the estimated consumption was made on base of other governorate consumptions.

Before the governorate will start the implementation of action, a proper mapping for energy consumption should be conducted to ensure proper monitoring for implementation.

		Base year 2015		BAU in 2030	
		Energy Consumption in MWh	Emission in t CO_2	Energy Consumption in MWh	Emission in t CO_2
Electrification		4493	3684	7278	5968
Fuel for BDG/month in litre	237750	2377	634	3850	1027
Fuel for space heating in litre	54540	545	145	883	235
	Total	7415	4463	12011	7230

Sector	Base year 2015		BAU 2030	
	Energy consumption in MWH	Emission in tCO_2	Energy Consumption in MWH	Emission in tCO_2
Governorate buildings, equipment/facilities	7415	4464	12012	7231
Governorate fleet	395855	104469	641285	169240

Solid waste

The average waste generation of 3120 tonnes per day or 963,030 tonnes in year 2015 is currently scattered throughout the governorate without any separation or treatment.

Table 16 Governorate Fuel consumption in Sulaymaniyah year 2015

Fuel type	Diesel	Gasoline 90
In litre	12,108,145	816,870
MWH	121,081	7,515
tCO_2	32,328	1,871

Fuel consumption for Sulaymaniyah Governorate Transportation

Table 17 Governorate Fuel consumption in Sulaymaniyah year 2015

Fuel type	Diesel	Gasoline 90
In litre	20,675,992	6,575,945
MWH	206,760	60,499
tCO_2	55,205	15,064

Sector	Electrification in (MWh)	Emission in tCO_2
Governorate	6870	4318

Smart Services in Governorate and Local Authority Buildings and Facilities

Background

In KRG, the traditional and concentrated administrative work method in public and local authorities (LA) like directorates, municipalities, Governorate … etc consumes citizens' time, money and creates stress. This is happening though we are almost reaching year 2020, when integrated communication and network is spreading and becoming varied especially with the accessibility of smart phones and the publicity of social media.

Mitigation	
MWh/a	t CO_2/a
TBD	TBD
Contribution in %	
TBD	
Cost in $	
3000000	
Years of Implementation	
Key performance Indicator	
Number of operation made per month	
Measurement Units	
% of online service / total services	
Priority of action	
Area of intervention	
ICT	
Origin of action	
Local Authority	
Policy instrument	
E-government	

Part of the local authorities (LA) developed an internal software system without verifying or prioritising the accessibility and integration with other LA, which leave the decision makers in directorates work independently due to lack of clear national policies and strategy for E-management.

The E-management policies and strategy became persistent needs for various directorates to be able to work independently, but in coherent integration and communication with other directorates, which should be supported with national legislation.
Though we know the E-management should be combined with upgradable banking systems which are not corresponding to the current case of Iraq, delaying the development of E-management would economically drain the private and public sectors and delay the response to the future demand services.

The lack in preparing the base for E-Governmental work, has been a marked decline in the institutional performance, in the governorate interactive role with its various departments and regions, as well as a decline in the interactive role with citizens and community institutions, which has led to an increase in the financial burden rate and operating expenses, time consumption, lack in the process speed measures and dissatisfaction of citizens.

Building on these facts, there must be an integrated, secure and reliable information technology system that links the governorates directorates, departments and regions to a common database, capable of facilitating the work, strengthening the partnership between the Governorate and the local community sectors, meeting their needs and enhancing an effective monitoring role that could have a positive impact on the public service and other institutions.

Description of the action

Evolving from Traditional Management to E-management:

E-management is an organizational and functional electronic system aiming at transforming the normal management process from manual to computer-based management, relying on strong information systems that help in administrative decision-making in faster time and at the lowest costs. The E-management objective is to reform governmental systems and processes leading to better delivery of

governmental services to citizens and economic gains through improvements in governmental productivity. And this cannot happen without prior steps of building policies and strategy at national level and support it with legislation. For that, the following are the actions which should be taken to promote the process of E-management and enhance the smooth changing into electronic process.

On National Level:

The recommendation on national level should develop a vision, policy and strategy to make use of information communication technology (ICT) in pursuing reform both in Local Authority (LA), government and regional level. This strategy should be structured around central pillars to provide more innovative and proven ways of enabling a more rapid realization of the benefits of E-management taking into account the experience and lessons learned during the past years and to learn from international successes.
The establishment of a legal framework to permit the use of electronic processes in conducting business should be applied and implemented, taking in consideration that the implementation of E-management solution should be customer centric rather than organizational, remove dependence on specific individuals and introduce transparent system of working.

On Local Level:

Modernising the communications infrastructure realizes the full benefits of E-management, where the internal and external communications are key factors in E-management that contribute to fully introduce transparency and accountability within any administration leading to an improved and well-developed e-management. In order to move from traditional management to e-management, the following stages must be followed:

- **Automating the internal management system** and converting all paperwork management information into electronic information; and that is achieved through:
  - **Conducting evaluation studies for all procedures, transactions and services** in the Governorate and identifying all items to implement a computerized information system in all departments and regions of the various directorates with the decentralization concept, **connecting these departments and regions with an information system** that enhances the coordination and integration between them to save time and effort on the employee and citizen at work and to access accurate and correct information associated with any transaction or service, as well as reducing potential risks and facilitating the ongoing procedures;
  - **Setting the correct items, material names**, organizational structure and job descriptions;
  - Setting an effective monitoring and evaluation system corresponding each procedure in the new system;
  - **Introducing a management accounting and costs department** to identify the causes of the failures and provide the accurate and necessary information to decision makers.

- **Providing the essential infrastructure** to link all departments to a network system and exchanging information between different parties with the following requirements:
  - Strong, fast and secure network infrastructure;
  - Strong information structure (robust and compatible information systems);
  - Well - trained staff on the use of modern technologies to set up investments in skills;
  - A technical staff capable of carrying out continuous technical support and developing various information systems;
  - Identifying all transactions/contacts between the citizen and each institution and converting them into electronic ones.
- Implementation phase
  - Well **organized awareness programme** to motivate the usage of E-management services on citizen level and national level.
  - Establishing the **indicators and monitoring** process to evaluate the service provided by the E-management and produce the solution to improve the services.
  - **Launch the programme** and follow the procedures and monitor and improve the results.

General objectives

The E-management provides a set of instruments which entirely empower the sectors of the society to participate with Local Authorities (LA), in one platform where multiple LA services can be brought to common service point throughout KRG. Thus, citizens can get access to many LA services without having to visit an LA building.

This also will permit citizens to download forms electronically, complete and submit them, and effect payment electronically from any terminal throughout KRG. This will simplify and speed up the whole process of application and approval, leave a sound audit track, remove any chance of corruption (and so increases good governor), and reduce costs.

There would also be economic gains through increased efficiency of local authority's services and reduced spending as a consequence of greater focus on measuring outcomes using the standard performance indicators and increasing management accountability. The private sector will also benefit from the partnership as a result of the growth in this sector; thus, increasing the economic prosperity for KRG. It enables a single access point to the "government" which minimizes citizens need to know how the government is organized or who provides the information and services they require.

E-management will contribute in combining the working procedures in LA, each in its major, to share best practices that could serve with all parties concerned, identifying the employment qualifications to ensure quality and unified standards of the working procedures, building and strengthening the supervision and evaluation unit in the LA to monitor and assess the work.

In addition, the E-management will motivate the employee potential and unexploited community to help its citizens live a better life and would reduce potential fraud by studying the weaknesses and setting effective control measures; On cost of services, the E-management will improve the LA financial standards and its ability to provide income, reduce costs and ensure services, raise the institutional capacities, enhance the efficiency and capacity planning, as well as implementing and establishing development strategies and investment planning; and support the implementing projects efficiently and effectively with a focus on the use of available resources and the application of computerized systems, to raise the efficiency of the directorates management.

Developing Operation and Maintenance Management for Governorate Buildings

Background

The maintenance concept is not well defined in the Governorate Administration Structure, but it is well distinct in Municipalities Administration Structures. The Governorate technical department handle the design and construction of new buildings without documentation for the maintenance and operation.

During the facility design/build phases, it was uncommon to devote substantial resources to life-cycle Operation and Maintenance (O&M) concerns. Also, the proactive maintenance concept and linkage with sustainability was ungeneralised.
Furthermore, it was noticed that in most of public buildings and facilities, the O&M of buildings handled without fully dedicated staff and with shortage of prevention maintenance programme, accompanied with no indicators or evaluation for the O&M procedures, expenses and energy auditing.

Mitigation	
MWh/a	t CO_2/a
600	492
Contribution in %	
7%	
Cost in $	
1000000	
Years of Implementation	
Key performance Indicator	
Track the action implementation	
Measurement Units	
Done or pending	
Priority of action	
Area of intervention	
BM	
Origin of action	
Local Authority	
Policy instrument	
EM	

Description of the action

Through the preparation of this report, it is well noted in the governorate buildings and facilities, the O&M measures related to energy conservation are not considered, which cause tremendous losses for the opportunities in saving the O&M cost, and could be achieved through simple measures in O&M procedures. So, **understanding why building systems are operated and maintained the way they are**, and where and what improvements are most beneficial and cost-effective is the first step to obtaining energy-efficient building performance.
To simplify the understanding of operation and maintenance, two main definitions will be considered as role of work:

- **Efficient O&M** is one of the most cost-effective methods for ensuring reliability, safety and energy efficiency. Insufficient maintenance of energy-using systems is a major cause of energy loss in the public buildings and facilities. Energy losses, water and air leaks, and other losses from poor maintenance are often significant. Good maintenance practices can generate substantial energy savings and should be considered a resource. Moreover, improvements to facility maintenance programs can often be accomplished immediately and at a relatively low cost.
- **Operational Efficiency represents the life-cycle,** cost-effective mix of preventive, predictive, and reliability-centred maintenance technologies, coupled with equipment calibration, tracking, and computerized maintenance management capabilities all targeting reliability, safety, occupant comfort, and system efficiency.

The action is summarised as follows:

- Create Operation and Maintenance unit in the Governorate:
  - Develop the frame work, responsibility and role of work;
  - Assign the task and qualification of staff to run the unit;

- Book budget for their work and provide them with sufficient tools and testing equipment;
- Specify the roles and responsibilities of all the important administration elements in the process of O&M in the Governorate.

➢ Assess of the O&M in the governorate building and facilities:

- The O&M unit should **conduct an** O&M assessment for Governorate building and facilities to provide a systematic look at all aspects of the current O&M practices including the management structure, policies, and user requirements that influence them. It includes the following:
- Interviews with management, personnel and service contractors;
- A review of equipment condition, building documentation, and service contracts;
- Spot tests of equipment and controls;
- Trend or data logging of critical data points (temperatures, pressures, electrical, etc.) over time;
- The gathering and analysis of this information reveals where improvements are needed and which improvements are most cost-effective.

➢ Roles and responsibilities of governmental directorates and municipalities:

- Clarify the role and responsibility of governmental directorates with their provincial counterparts, in the planning, implementation and monitoring of Governorate and municipal building and facilities. These roles and responsibilities are critically important to ensure that governorate and municipal infrastructure projects result in sustainable services;
- Outline the role for sector departments that they need to play towards ensuring that Governorate infrastructure development is part of sustainable human settlements (as opposed to the delivery of sectoral infrastructure which takes place in a parallel manner);
- Specific support to be provided to Governorate in terms of Governorate infrastructure through the service delivery life cycle;
- The framework within which Governorate infrastructure support should be provided with a focus on the importance of collaboration across sectors.

➢ Present facilities specific O&M manuals:

- **For new building**, the Operation and Maintenance (O&M) procedures represent the greatest expense in owning and operating a facility over its life cycle. The accuracy, relevancy, and timeliness of well-developed, user-friendly O&M manuals are becoming increasingly important. Hence, it is becoming more common for detailed, facility-specific O&M manuals to be prepared prior to commissioning**;**

For each new building, the role of O&M should be defined and developed along with commissioning of the building and facility, supported with user-friendly O&M manuals along and assigned trained staff;

- **For existing building, user-friendly O&M manuals** should be developed. This could be achieved by assigning specialized consultant to help in developing the maintenance procedures and train the O&M staff.

The Guideline for Operations and Maintenance (O&M) achieving operational efficiency, provide useful information about O&M management, technologies, energy and water efficiency, and cost-reduction approaches. In addition, it includes the key energy- and operational-efficiency-related elements in the SEAP as indicted below:

The decisions and actions regarding the control and upkeep of property and equipment are inclusive, but not limited to the following:

- Actions focused on scheduling, procedures, and work/systems control and optimization,

performance of routine, preventive, predictive, scheduled and unscheduled actions aimed at preventing equipment failure or decline with the goal of increasing efficiency, reliability, and safety;

- Enhance efforts toward sustainable buildings and communities in governorate building and facilities, with the implementation of high-performance sustainable Governorate building design, construction, operation and management, maintenance, and deconstruction. Managing existing building systems to reduce the consumption of energy, water, and materials, identifying alternatives to renovation that reduce existing asset-deferred maintenance costs and reducing potable water consumption;
- Reconsideration of traditional irrigation methods and irrigated agriculture of landscapes, and reduce the water consumptions.

General objectives

The goal is to effectively and efficiently support the life cycle of the facility by eliminating unplanned shutdowns and realizing life-cycle cost savings. The O&M provides a means to reduce operating costs as part of a comprehensive Maintenance Program.

The assumption for reduction is 5% of total energy consumption could be reduced when implementing this action.

Implementation of the Consumption Saving Measures and use of the Renewable Energy in the Governorate Buildings

Background

There are many Governorate buildings and facilities in Sulaymaniyah Governorate, where they consume around 4,493 MWh for electrification and 292290 L for space heating and BDG, which is equal to 4463 t CO_2 in base year 2015.

The data provided is not well verified due to the difficulty in recording mechanism.

The majority of emission related to electrification is (5968 t CO_2) which brings the regulation of electrical consumption a main priority according to the table below:

		Base year 2015		BAU in 2030	
		Energy Consumption in MWh	Emission in t CO_2	Energy Consumption in MWh	Emission in t CO_2
Electrification		4493	3684	7278	5968
Fuel for BDG/month in litre	237750	2377	634	3850	1027
Fuel for space heating in litre	54540	545	145	883	235
	Total	7415	4463	12011	7230

Mitigation	
MWh/a	t CO_2/a
4085	3347
Contribution in %	
46%	
Cost in $	
5080000	
Years of Implementation	
Key performance Indicator	
Energy saving and RE production	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
– RE - EE	
Origin of action	
Local Authority	
Policy instrument	
EM	

Description of the action

The measures to be taken vary between measures that help to reduce consumption and those that improve energy efficiency and are detailed as follows:

- Conducting an analytical study of consumption in these buildings or facilities to identify the source of consumption and then advise the measures that could help reduce energy consumption;
- Implementing **consumption saving measures** by providing and distributing instructions, following-up their implementation and holding an internal awareness campaign addressed on how to apply them, including but not limited to:
  - **Turning off the lights** after leaving the place;
  - Focusing on the **use of natural lighting** whenever possible through:
  - Spreading the idea among employees that natural lighting, when present, can be dispensed with industrial lighting;
  - If the financial cost allows, it is possible to benefit from the **natural and industrial lighting to be balanced** by using the lighting sensors to detect the need of industrial lighting in the room;
  - **Proper use of the computer and electronic equipment.** It is better to set it automatically on the energy saving mode;
  - **Setting the temperature** cooling unit in summer at the rate of 25°C and in winter at 20°C and developing the thermal calendar that clarifies the actions

taken and distributing it among the various administrations to be used efficiently;
- **Painting the roof with white** colour to reduce the heat observation;
- **Installing eyebrow** to the windows (Sun shade).

- **Activating the maintenance role** of the adaptation units to ensure work efficiency and reduce energy consumption;
- Using of **high efficiency equipment** in modern procurement;
- **Installing motion sensors** in public places such as bathrooms and stairs to automatically switch off light when no occupancy;
- **Replacing the traditional lighting** by a more efficient type as the LED lighting;
- Use of **Renewable Energy** in the Governorate Buildings.

The Governorate buildings and facilities in Sulaymaniyah Governorate consume around 4,493 MWh for electrification. The following are the recommended projects related to the use of renewable energy in these Governorate buildings.
By providing Photovoltaic Solar Panel on the top roof of the buildings and connecting it, the utility power would support the usage of green energy and reduce the losses due to the transmission. The system could also be connected with the backup electrical generator to reduce the Fuel consumption.
The following is a proposed renewable energy installation:

PV Capacity	Number of installation	Energy produced MWh/a	Number of PV 250-watt Solar panel in each installation	Estimated Installation cost per one project in $	Total installation cost in $
20 KWp	11	401	80	40000	440 K$
30 KWp	5	273	120	60000	300 K$
70 KWp	3	383	280	140000	420 K$
90 KWp	4	657	360	180000	720 K$
150 KWp	1	273	600	300000	300 K$
200 KWp	1	365	800	400000	400 K$
	25	2352 MWh/a			2580 K$

General objectives

The actions undertaken by the Governorate could reflect the critical role of the Governorate by participating in implementing such actions and learning from them to explore the strengths and weaknesses and work on overcoming the difficulties. These actions contribute in raising the governorate's potentials and its team through the experiences gained. This does not stop here, but rather it contributes indirectly to an environmental awareness-raising to its members that outreach the family community, in addition to the daily supervisors.

The success of these measures will facilitate the transfer of the expertise to all other governorate departments, which are distributed in all areas of Sulaymaniyah. In addition, the actions will contribute in reducing the annual financial cost of the Governorate to less than 30% of the current cost, thus providing a new source of funding that can be used to improve community services. Consequently, the aforementioned measures will reduce emissions and the energy bill, improve the governorate's financial proficiencies, strengthen its sustainability expertise, enhance sustainable development opportunities in the short term, and raise awareness among citizens to use such technologies so as the governorate becomes a good exemplary.

Ensure proper Implementation of New Public procurement in Sulaymaniyah

Background:

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
100000	
Years of Implementation	
■ ■ ■ ■	
Key performance Indicator	
Applied in all Governorate procurement and tenders	
Measurement Units	
Followed	
Priority of action	
■ ■	
Area of intervention	
Integrated action	
Origin of action	
Local Authority	
Policy instrument	
PP	

The public procurement impacts on Sulaymaniyah GDP count for more than 30% , making it an important tool for public authorities to implement national energy efficiency policies, by promoting the production and the consumption of energy efficient products and services. This means using the opportunity created by the governorate to orientate the use of this money on products and services aimed at the production of renewable energy and energy saving, improving competitiveness and promoting a balanced and sustainable economic growth in the governorate.

Public procurement plays a key role in rationalizing public expenditures and in strengthening accountability, enhancing transparency and consequently contributing to sustainable development. Kurdistan Government has reformed the new regulation on public procurement; the law was officially issued by the Minister of Planning in January 2016, and the Regulation became effective in July 2016. The KRG Government officially adopted the modern Public Procurement Regulation (Regulation #2 for 2016) defining the legal, institutional and procedural framework.

The new rule relies on developing a new legal framework based on clear and comprehensive provisions, whose centre piece being the new Procurement Regulation embodies a balanced, win-win approach to allocating risks and responsibilities between the public and private sectors. The new legal framework also specifies institutional arrangements related to the execution of contracts, development of policies at the central level and ensuring methodical supervision, as well as other provisions that reinforce transparency and accountability.
The main obstacles are the difficulties in implementation which are facing the tendering department in the governorate because most of the governorate departments are not well trained. Moreover, the contactor is still not fully aware of the new rules and doesn't know how to implement them.

This imposes more pressure on the contracting department which cannot be fully able to implement it inclusively.
The unfavourable legislative conditions that could hinder the implementation include:

- institutional hurdles and low skills;
- Available information is unevenly provided;
- Low awareness, which causes lack of perception, demand and acceptance;
- Increased energy demand, due to the population growth and urbanization;
- national energy markets with different rules;
- The cities characterized by an inefficient management of energy;

- market conditions do not allow the formation of a critical mass of suppliers.

Description of action:

A comprehensive capacity building programs on the new regulation to cover the governorate and private sectors.

- Assign a consultant to support the developing and implementing sustainability rules in the public procurement;
- Upgrade the internal procedure and regulation of procurement to include the sustainability clause;
- Training the Local Governors administration departments and related representatives on the new rules;
- Training the private sector on procurement in cooperation with the KRG Contractors' Federation aiming to:
  - qualify the capability to participate in tendering procedures involving;
  - Provide guidance to energy efficient products and services.
- Regularly update the procedures and rules in the public procurement and monitor the implementation and results achieved.

General objectives:

Building an effective and socially accountable public procurement system will:

- Deliver quality services and support the sustainable development of KRG in line with the KRG 2020 Vision of 'Effective, transparent, trusted and honest Government', achieving Shared Prosperity and Protecting the Vulnerable;
- Save the local resources;
- Improve the energy efficacy and improve the sustainability;
- promote the adoption of transnational approach for the shaping of energy efficient public procurement policies and procedures,
- Override the national constraints in the implementation of energy efficient public procurement procedures, facilitating the coordination at transnational level and the achievement of national energy and resources policies objectives in KRG and precisely in Sulaymaniyah;
- Exchange best practices on energy efficient public procurement practices;
- contribute to the re-orientation of suppliers towards the production of energy efficient services and products, through the removal of barriers which prevent enterprises from participation to public tenders requiring energy efficient measures/procedures, thus creating new business opportunities for the economic sector;
- upgrade the competences of private sector, increasing their awareness on the economic benefits deriving from a smart use of energy, thus fostering the creation of new enterprises and jobs in energy;
- enhance the role of public authorities, at all levels, in the diffusion of energy efficient behaviours in private sector, paving the way for transnational strategies in sustainable development and achieving energy efficacy objectives;
- increase the awareness of regional/local authorities and professional organizations representatives on the importance of sustainable procurement and upgrade their competences on the preparation/participation to energy efficient public tenders;

- Seek the optimum combination of whole life costs and quality, instead of the lowest initial price;
- Value for money, to acquire the goods, works or services needed, on the best available terms;
- Consider the quality assurance and environmental management systems;
- use criteria specified for ecological labels.

Policy Instrument:

The Government of Kurdistan Region remains keen on activating the reform roadmap to better serve its people, and acknowledges the support of international development partners, particularly the World Bank, which values its strong relation with KRG.

In line with the KRG 2020 Vision of 'Effective, transparent, trusted and honest Government', and as part of the 3-year economic reform plan aimed at "Achieving Shared Prosperity and Protecting the Vulnerable" launched in June 2016, the Government is exerting every effort to build an effective and socially accountable public procurement system that delivers quality services and supports the sustainable development of KRG.

Summary results for Governorate Sector

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario MWh/a	BAU Scenario t CO_2/a	Mitigation in Energy MWh/a	Mitigation in Energy t CO_2/a	Mitigation in %	Costing in $
GOVERNORATE BUILDINGS, EQUIPMENT/FACILITIES			12012	7231	4685	3839	53%	9,180,000
Priority Action NO 1	1.0	Smart services in Governorate and Local Authority						3,000,000
	1.1	Automating the internal management system						
	1.2	Providing the essential infrastructure						
	1.3	Implementation phase						
	2.0	Developing Operation and Maintenance management for Governorate Buildings			600	492	7%	1,000,000
	2.1	Create Operation and Maintenance unit in the Governorate,						
	2.2	Assess of the O&M in the governorate building and facilities.						
	2.3	Roles and responsibilities of governmental directorates and municipalities						
	2.4	Present facilities specific O&M manuals.						
	3.0	Implementation of the Consumption Saving Measures and use the Renewable Energy in the Governorate Buildings						
	3.1	Conducting an analytical study of consumption						
	3.2	Implementing consumption saving measures			364	298	4%	
	3.3	Activate the maintenance role						
	3.4	Using of high efficiency equipment			278	227	3%	
	3.5	Installing motion sensors						
	3.6	Replacing the used lighting by a more efficient type as the LED lighting			1091	894	12%	2,500,000
	3.7	Use of Renewable Energy in the Governorate Buildings			2352	1928	27%	2,580,000
	4.0	Public Procurement						100,000
	4.1	Assign a consultant to support the developing and implementing sustainability						

	rules in the public procurement	
4.2	Upgrade the internal procedure and regulation of procurement to include the sustainability clause	
4.3	Training the Local Governors administration departments and related representatives on the new rules	
4.4	Regularly update the procedures and rules in the public procurement and monitor the implementation and results achieved	

Residential Sector

Introduction

Sulaymaniyah Governorate has fifteen districts Chamchamal, Darbandikhan, Dukan, Kalar, Khanaqeen, Kifry, Mawat, Penjween, Pishdar, Qaradagh, Raniya, Said Sadiq, Sharazur, Sharbazhe and Sulaymaniyah

In 2015, the consumption of energy in Sulaymaniyah governorate reported that electrification in buildings counted for 90% of total governorate consumption.

In the table below, the average house consumption varies between 31 (Kalar) to 13 (Pebaz) (Kilo watt hours per day), can be compared with other countries like Jordan around 8.8KWh/d and Lebanon 9 KWh/d. This presents the importance of applying the energy code for building in Kurdistan that requires much work in improving the measures.

Table 18 Electrification consumption in residential sector year 2015

Residential Sector District	Average number of Subscribers	Electrical Consumption in MWh	Average Electrical Consumption of household in KWh/day
Sulaymaniyah	234173	1,821,860	21
Sharazur	67964	492,848	20
Raniah	70129	484,120	19
Dukan	28028	247,456	24
Chamchamal	36997	321,028	24
Kalar	31287	356,931	31
Kifry	8554	86,632	28
Rizgary	9398	94,550	28
Pebaz	2506	12,022	13
Total	489,036	3,917,445	22

In addition, the governorate suffers from daily cut-off of electricity from main utility for around 4 hours. And this cut-off time is subject to an increase in the coming years due to the increase in demand with limited capacity of power stations.
The shortage in power supply pushes people to use diesel generators, which causes a lot of pollutants and diseases due to their locations near the houses, causing additional financial burdens to low-income people.

In Sulaymaniyah, as in KRG, there is no central heating or cooling system where space heating and cooling represents huge amount of energy in the buildings. The main source for energy in space cooling depends on electricity, but the space heating

depends on both electricity and the use of fuel like kerosene. The Kerosene consumption was counted for 516,913 MWh in 2015 in Sulaymaniyah which represented the space heating for buildings counting for 133,885 t CO_2 GHG emission. Liquefied Petroleum Gas LPG consumption for heating and cooking counted for 928,358 MWh and produced 210,737 t CO_2.

In Sulaymaniyah, the electrification records for consumption look almost swinging at the same level with uncertainty if the records and measurements have been well monitored and evaluated. If those measures are well documented, there is then a real issue in energy consumption as it should show variation in consumption according to the weather condition.

The total consumption will continue to increase each year if no measures have been applied and the expected increase would be a multiple by a factor of 1.62 compared with 2015 which is the business as usual (BAU), so calculation of the consumption in year 2030 will be as follows:
The fuel consumption details were provided by the Ministry of Energy and Mineral Resources for the full governorate of Sulaymaniyah which count for 2,058,811 inhabitants.

By comparing the amount of Kerosene consumed in Sulaymaniyah compared with other governorates, it looks high. The assumed reason for that is the use of fuel in industry. There is no data available on percentage of usage by industry, for that, we are going to use special models for calculation that depend on the number of inhabitants.

Table 19 Energy consumption in residential sector in year 2015 and BAU scenario for 2030

Source of energy	Base year 2015 consumption in MWh	Consumption as BAU in year 2030 in MWh	Emission in t CO_2 in year 2030	Ratio
Electrification	3917445	6346261	5203934	90.3%
Kerosene	516931	837428	216894	3.8%
LPG	928358	1503940	341394	5.9%
Total	5362734	8687629	5762222	

In order to come up with real actions and implement policies to sustain energy transition to reach a higher efficiency, there is a need to collect precise information to show the factors that influence energy consumption and establish Smart grids to collect some information on consumer behaviour. Studying different types of factors such as socio-demographic, economic and dwelling characteristics will be useful tools to help policy makers and energy producers set their actions.
Energy conservation measures are nearly non-existent, yet in KRG, they can potentially lead to substantial reductions in energy demand growth, environmental damages and public expenditures.

The need for real study about household appliances in KRG will model the effect of mandatory appliance standards on electricity consumption, and support the energy key players to translate the real situation to productive actions in energy mitigation and help in developing the initiative programmes contributing to economic development.

It will also show that economic efficiency favours the introduction of standards for appliances, introduce mandatory standards for energy efficiency for different household appliances (refrigerator/freezers, AC split units, washing machines and lighting) and support the reduction of energy bill.

Establishing an energy labelling system and setting a Minimum Energy Performance Standards for household appliances will be an important step that will support maximizing the efficient use of energy and the use of renewable energy.
It is clear from the dialogues with the steering and technical committees that there are several barriers currently faced in KRG, which require a lot of important steps to be addressed, but not limited to the following:

- Enhanced capacity on the Government and energy agency units for appliance **Energy Efficacy (EE) policy development**, implementation and market surveillance;
- Structured verification and enforcement of appliance **Energy Efficacy (EE) labels and standards**;
- **Enhanced consumer awareness** of appliance energy efficiency characteristics, standards and labels and the costs and benefits of more efficient products;
- **Increased capacity of manufacturers and traders** to produce/provide and market Energy Efficacy (EE) appliances;
- The usage of Electrical heater in houses and replacement with **solar water heater** is an important step to be addressed;
- Building insulation and developing the building code is an important measure;
- Promoting energy saving measures like using Pressure cooker could save lot of LPG gas.

In table 22 the estimated reduction in consumption by applying EE and RE measures:

Table 20 Analysing the household appliance consumption

Number of houses 2015 estimated 489036, Number of houses in 2030 estimated 792238								
Analysing the house consumption								
Type of load in house	Load in watt	Hours of operation per day	Number of Appliances	Actual energy consumption KWh/day	Contribution to energy consumption in houses	Energy saving in MWh/a	Energy saving Contribution	Energy saving Contribution
Other	100	2	4	1	4%	11567	0.05	0.22%
Water Heater	1300	1	2	3	12%	617946	2.59	11.55%
A/C	1800	2.5	2	9	40%	520500	2.18	9.73%
Washing Machine	1800	0.6	1	1	5%	15615	0.07	0.29%
Refrigerator	500	8	1	4	18%	578334	2.42	10.81%
Freezer	500	7	1	4	16%	506042	2.12	9.46%
Lighting	60	6	4	1	6%	208200	0.87	3.89%
white Painting roof					0%	349077	1.46	6.53%
				22	100%	2807281	11.77	52.48%

In the following are the proposed actions related to Residential buildings:

Promoting measures for energy conservation in residential buildings

Background

The proposed action will look into the precise solutions for the causes in houses demand for energy and give the solutions and measures in order to come up with in-house developed actions related to energy conservation in KRG- and specifically in Sulaymaniyah. These measures will be tested and reviewed with the support of academic people from university and in collaboration with the governorate.

It is taken for granted that for each KWh of electricity provided in city, the government supports 90% of its cost. This action is very important to support the reduction of financial burden, and save the unseen cost in the Government annual budget. The high demand for energy conservation in buildings, that represent an important pillar in the city, needs to be addressed and solutions to be found to reduce it.

The Building sector is the main contributor to energy consumption, that represents the main pillar that should be addressed in the Sustainable Energy Action Plan.

Mitigation	
MWh/a	t CO_2/a
278027	227853
Contribution in %	
3.95%	
Cost in $	
1884000	
Years of Implementation	
■ ■	
Key performance Indicator	
Number of houses	
Measurement Units	
Saving measures in MWh	
Priority of action	
■ ■	
Area of intervention	
EE- RE	
Origin of action	
Local Authority	
Policy instrument	
EM	

Description of the action

The activities will concentrate on analysing the pattern of energy consumption in houses, and propose measures in energy conservation supported with awareness campaigns. The measures will be selected in a way that can be replicated in different districts in Sulaymaniyah governorate.

Existing building

The activities will be conducted in each district in Sulaymaniyah Governorate according to the following plan:

- Joining efforts by assigning the support team from stakeholders and energy team to support implementation of promotion of green building.
  - The recommended stakeholder representatives from Sulaymaniyah Governorate, chamber of commerce and industry, Local NGO's related to construction of houses, Ministry of electricity, Ministry of Municipalities and Tourism, Ministry of Higher Education's & Scientific Research, Ministry of Housing, Ministry of Planning and statistic office;
  - Create the frame of work and define the outcomes, participant role of work, indicators and evaluation process.
- Setting the base for Energy Auditing for houses
  - Assign consultants for energy auditing from local universities in Sulaymaniyah, and define tasks, responsibilities to accomplish energy statistics;
  - Develop the framework, methodology, procedures and measures for energy statistics, along with basic energy indicators for measurement in houses;
  - Set the criteria for selecting the houses, like climate zone, type of dwelling and districts, below the poverty line, low income family, families lost the breadwinner, disabled families…etc;

- Create the inventory procedures to reduce the uncertainty in data collection. This should include the following important minimum measurement points:
  - Home appliances (refrigerators, lights, water heater, air-conditions, air-cooler, TV…) and their contribution for consumption of energy;
  - Type of house one floor, two floor, apartment;
  - House condition (area, wall crack, roof insulation…etc.);
  - Size of family and house occupancy time;
  - Energy bill.
- Assign the tools and equipment needed for the survey;
- Formation of Energy audit method for the residential in comprehensive and simplified form;
- Develop recommendation leaflet for energy saving in house to educate the family what they can do to reduce their energy bill and save energy.

➢ Establishment of social committee to support the collection of data for houses
- Assign social committee for each district and define tasks, responsibilities and role of work for supporters to accomplish the energy auditing in houses;
- Selection of houses according to the criteria set by consultants.

➢ Establish household technical support group
- Establish a technical committee (undergraduate student engineering divisions);
- Launch training session for technical committee on collection of data from houses based on the developed form by the consultants;

➢ Conduct energy auditing
- With the support of social committee and technical committee, conduct energy audits on 1000 households and assign the appropriate energy retrofit package, fill out the Energy audit forms (taking pictures, measurements, investigating potential EE measures, and obtaining relevant information from the residents), and collect the Utility bills for households for measurement and verification;
- Deliver a summary report for the house owner with recommendation for retrofit solution he could use to reduce his energy bill;
- Analyse and sort-out the information quantitatively and qualitatively;
- Develop the recommended measures according to the analyses of energy Auditing and retrofit measures.

➢ Prepare Procurement package

With support of consultants prepare procurement package for:
- LED lamps (3 per household + adapter);
- Low water flow accessories (aerator + showerhead);
- Resolve the leak of house insulation;

Waterproofing household walls and roofs (high reflective roofs *characterized by SR 0.8 and TE 0.9*).

➢ Implementation phase
- Launch the tenders and assign the contractors and suppliers, determine the work plan for installation and monitoring of implementation;
- Develop guideline booklet with success models and stories;
- Develop handout materials that gave tips on how to save energy at home.

➢ Develop the Information Kit and CAPP

- Develop the online portal with the technical content such as technical specifications, lessons learned, activities, related developed documentation and marketing material;
- Develop the public awareness materials, and provide the technical content; Slogan: "Towards the generalization of the sustainability concept and rationalizing energy consumption in local community of Sulaymaniyah governorate";
- Develop guidebook based on the pilot experience of the project;

➢ **Launch awareness campaigns towards sustainable movement** targeting all residential sectors in Sulaymaniyah Governorate.

- Conduct awareness campaigns with participants from the local community to share with them the results and distribute the project booklets in each district;
- Utilise the lesson learned from previous actions and develop the awareness strategic plan for all residential sectors in the Governorate of Sulaymaniyah;
- Launch the awareness campaigns accompanied by the demonstration effective solutions that are available and easy to apply targeting the residential sectors in all Sulaymaniyah Governorate. The targeting measures should cover key factors affecting the energy consumptions, rationalising the water consumption, energy consumption, thermal insulation, green areas:
  - Regulation of water consumptions;
  - Regulating the electricity consumption;
  - House appliance EE rating;
  - Promoting the Solar Water Heater;
  - Replacement of lights with more efficient light like LED;
  - Paint the roof with white colour to reduce the heat observation;
  - Promote the heat insulation for walls and roof as possible;
  - Reduce the house temperature leakage;
  - Turning off the lights after leaving the place;
  - Focusing on using natural lighting whenever possible;
  - Promoting the thermal calendar (Setting the temperature cooling unit in summer at the rate of 25^{o}C and in winter at 20^{o}C);
  - Installing eyebrow on the windows (Sun shade);
  - Promoting planting trees around the houses (preferable *need little water*)
  - promoting energy saving measures like using Pressure cooker could save lot of LPG gas

In the campaign, the affordable solutions with tools should be presented with lessons learned to support the success of the campaign. Utilising the public media like social networks, Newspaper, TV, Sign boards…etc.

- Monitor and review the awareness campaign achievement and do the needed modification or update on the plan to gain better results.

➢ Develop the recommendation for National strategic plan for regulating energy consumption in houses:

- Develop the recommended policies for national strategic plan to promote Energy Efficiency, and the recommended measures related to suitability in residential sectors;
- Develop the model to assess the effect of mandatory appliance standards on electricity consumption, and produce actions in energy mitigation and help in developing the initiative programmes contributing to economic development;
- Introduce the recommended standards for appliances and energy efficiency for different household appliances (refrigerator/freezers, AC split units, washing machines and lighting) and support the reduction of energy bill. Set the recommendations for national level on establishing an energy labelling system and setting Minimum Energy Performance Standards for household appliances;
- With support from the local finance institutions develop the recommended National finance mechanism to support promoting the EE measures in the local community and the possible initiative with possible finance from international funding agencies;
- Develop recommended guideline on national level for developing the sustainable market regime and promoting the Energy solution companies (ESCO) in KRG.

General objectives

The information resulting from integrating the various methods should be contrasted with the energy information existing in the sector, and obtained through top-down procedures. In addition to that, this action should apply new role for national statistics procedure which is conducted in regular base to improve the collected data and have better understanding of demand for energy. This also should contribute to the development of legislative to support the usage of conservative equipment's in house appliances and set the national initiatives for house appliances.
The calculation for reduction on consumption is based on the following developed table 24 where it can be verified after the energy auditing is made.

Table 21 Analysing the action reduction on consumption

Type of load in house	Energy saving Contribution per house in KWh/day	Total reduction calculated for 1000 houses in MWh
Lighting replaced with efficient led lights	0.87	317
Paint the roof with White Painting *SR 0.8 and TE 0.9*	1,46	1460
Kerosene	0.20 annual	211
		1988
Estimated reduction with 15%	Total Energy saving in MWh/a in houses	Total reduction calculated for houses in MWh
Other	11567	1735
A/C replaced with EE type	520500	78075
Washing Machine replaced with EE type	15615	2342
Refrigerator replaced with EE type	578334	86750
Freezer replaced with EE type	506042	75906
Lighting replaced with efficient led lights	208200	31230
		276039

The emission calculated as follows: (276039 + 262 +1460) MWh x 0.82 (emission factor for electricity) + 211 MWh X 210 (Emission factor for Kerosene) = 227853 tCO2.

Applying Green Code to the buildings in Sulaymaniyah

Background

Mitigation	
MWh/a	t CO_2/a
664978	441123
Contribution in %	
7.66%	
Cost in $	
340000	
Years of Implementation	
■■■■□□□	
Key performance Indicator	
Number of new green building	
Measurement Units	
Consumption in KWh/square meter	
Priority of action	
■■□□□□□	
Area of intervention	
IA	
Origin of action	
Local Authority	
Policy instrument	
BS	

The proposed action will look into the precise solution for the causes in houses demand for energy and give the solutions and measures in order to come up with in-house developed actions related to energy conservation in KRG and specifically in Sulaymaniyah. These measures will be tested and reviewed with the support of academic people from university and in collaboration with the governorate.

Knowing that each KWh of electricity provided in the city, the government supports 90% of its cost. This action is very important to support the reduction of financial burden, and save the unseen cost in Government annual budget. The high demand for energy conservation in the building represents an important pillar in the city that needs to be addressed and solutions to be found to reduce it.

The Building sector is the main contributor to energy consumption, and represents the main pillar that should be addressed in the Sustainable Energy Action Plan. For new building, Green building practice goes beyond enacting legislations; it requires an effective work to avoid any failure in taking actions and implementations that hinder its achievement.

The original Iraq code contains a lot of important basic codes for building; however, recently and with the support of UNDP and Un-Habitat an effective, efficient and locally adapted building control regime Building for the Kurdistan Region of Iraq was launched in order to improve the investment environment and contribute to sustainable development.

This regime will support the new and refurbished buildings when they try to obtain the license. However, the old existing building is still not covered by this regime, for that, the proposed action will cover the promotion plan for existing building which will support the method of converting it to much more conservative building related to energy consumption.

New building

The functional requirements are split in two phases:

1. The first phase is applied in the first 5 years since the issuance of this code, and is characterised by limited but easy to apply requirements.
2. The second phase is applied from the 6th year from the issuance of this code, and is characterised by the full requirements applied in the building codes and technical standards of the most advanced countries.

FIRST PHASE

The first phase focuses on simple requirements having a large impact on energy performance in buildings, whose compliance may be simply evaluated.

List of mandatory performance level: like heat loss coefficients, roof painting, boilers and stoves, air-to-air heat pumps, air-to-air heat pumps, thermostatic valves, thermostats.

SECOND PHASE

To be applied after 5 years of application of Phase 1. List of mandatory performance level: boilers, the thermal Insulation Code provides degree days for the region, and heat transfer calculation methods.

Description of the action

To activate this law, a series of actions must be taken that include:

- Inviting not only engineers working in the field, but also developers, investors in the city constructions, public and private stakeholders and NGOs to attend a discussion panel informing them about the green building laws with recommendations on how take sustainable initiatives;
- Issuing detailed instructions on how to implement the system;
- Issuing legislation and regulations to grant building license within the Green Building Code;
- Giving incentives for developers, building owners and buyers;
- Imposing a penalty on buildings that abate building conditions;
- Raising awareness campaigns addressing citizens on the importance of green building, that aims at not only protecting the environment but also at reducing the costs and encouraging citizens to impose pressure on real estate developers. This would be achieved through audio-visual communication means, social media, lectures held in schools and worship places to encourage them use environmentally friendly renewable energy source and recognize its positive effects on the economic and social levels;
- Distributing green building certificates among the committed owners that can be placed at the entrances to the buildings;
- An annual review of the progress and the difficulties faced providing solutions to develop the sector;
- Strict legislative enforcement of the building law.

By applying the above measures the following table envisaged the expected reduction in energy consumption:

Green building code calculation							
Source of energy	Base year 2015 consumption in MWh	Consumption as BAU in year 2030 in MWh	Emission in t CO_2 in year 2030	Increase in consumption 2030 in MWh	Increase in t CO_2 in 2030	saving in MWh 20%	t CO_2 saving
Electrification	3917445	6346261	5203934	2428816	1991629	485763	398326
Kerosene	516931	837428	216894	320497	83329	64099	16666
LPG	928358	1503940	341394	575582	130657	115116	26131
Total	5362734	8687629	5762222	3324895	2205615	664978	441123

General objectives

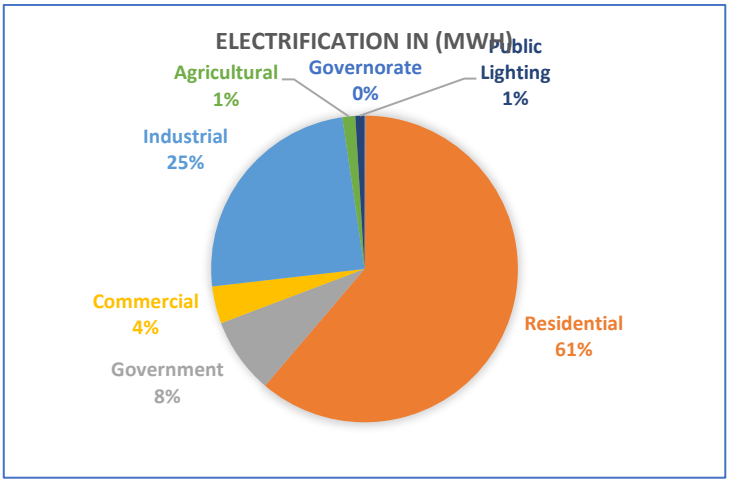
The objectives of the actions do not only aim at reducing consumption and pollution caused by burning fuel to generate electricity, but also at saving consumption costs on citizens and reducing the contribution rate of the government to support the energy sector and ease the burden on its citizens.

High reflective roofs to minimizing energy consumption in residential buildings

Background

Mitigation	
MWh/a	t CO_2/a
10826	8877
Contribution in %	
0.15%	
Cost in $	
120000	
Years of Implementation	
Key performance Indicator	
Number of houses apply the measures	
Measurement Units	
Compare the measure in reduction of energy consumption in MWh	
Priority of action	
Area of intervention	
BE	
Origin of action	
Local Authority	
Policy instrument	
EM	

Residential buildings are considered the main source of energy consumption in Iraq that consume 48% of the country's total electricity production[1]. It has been shown that Iraqi buildings have very poor energy performance with no insulation, single glazing, and inefficient HVAC systems.
Houses in Iraq are often attached to other houses on three sides, a factor that restricts the effects of solar radiation on exterior walls. These attached/shared walls act like interior walls. Many papers and researches had investigated the effectiveness of applying high reflective roofs to reduce the cooling loads of houses and in turn electricity demand by about 45% compared to the typical roof finishes for various climates[2]. It was indicated in the research that energy conservation equal to 73% for the whole year by using high reflective roof characterized by SR 0.8 and TE 0.9. When applied at large -scale, high reflective roofs can contribute to a change of albedo in the cities.



According to the above studies, preliminary energy simulations indicate that high reflective roofs can provide a significant reduction in cooling loads compared to the typical roof finishes of Iraqi houses; therefore, potentially reducing the energy demand on the country's energy infrastructure, knowing that in Sulaymaniyah the residential sector represents 61% of electrification consumptions.

[1] Rashid, S., Electricity Problem in Iraq. Academia, 2012: p. 22.
[2] Effectiveness of High Reflective Roofs in Minimizing Energy Consumption in Residential Buildings in Iraq Haider Mohamedª0F*, Jae D. Changb , Mohammed Alshayebc

Description of the action

To calculate the effect of high reflective roofs on the use of air-condition in household, it is important to obtain the air-condition portion in household consumption. To do so, a simplified model for energy consumption of household appliances which have been obtained from other countries was used as measuring tools, but with further tuning to match the high demand of air-condition use in Iraq.
This used model will be further reviewed for uncertainly by the previous action related to "Promoting measures for energy conservation and use of renewable energy in building".
The table 18 represents the average daily consumption of household in Sulaymaniyah.The air-condition represents the 40% of household appliances consumption, with an assumption that the cooling and heating share same consumption use which brings the cooling to 20 % on house consumption. On that base, the effect of high reflective roofs will be obtained.

According to table 22, the air-condition consumes 40% of annual consumptions which is counted for 8.8KWh/d x 182.5 days (50% of annual consumption) = 1606 KWh for cooling. By applying high reflective roofs measures, the estimated reduction on consumption will be around 26.9% equal to saving 432 KWh/annual which is counted for 342247 MWh/a (year 2030) "(432Kwh x 489036 houses x 1.62 increase in load demand by year 2030)". To count the cost of this reduction and convert it to real figures, by 180 IQD (15 C USD) cost for each KWh, this is equal to saving 51,337,050 USD per annual.
Such an action would cost the house around 60USD and would benefit in reducing the burden subsidy in electricity which counts for 90% of cost (46,203,345 USD).

Details of the action:

- Carry out advertising campaigns targeting the residential sector to promote the implementation of high reflective roofs and explain the importance of reducing the house temperature in summer (*with specific information high reflective roof characterized by SR 0.8 and TE 0.9 to ensure obtaining the good results*).
- Conduct sample implementation around 1000 houses and implement high reflective roof as to the following:

Residential Sector		
District	Average number of Subscribers	Number of houses to be selected for project for each District
Sulaymaniyah	234173	479
Sharazur	67964	139
Raniya	70129	143
Dukan	28028	57
Chamchamal	36997	76
Kalar	31287	64
Kifry	8554	17
Rizgary	9398	20
Pebaz	2506	5
Total	489,036	1000

- Workout with national level in legislation to support the promoting of the high reflective roofs initiative. (*This could be free toward houses and could support reducing the burden by a support subsidy for electricity*)
- Carry out advertising campaigns targeting the residential sector to promote the set point temperature in summer on 25°C and 20°C in winter.
- Support establishing the support mechanise to apply the initiative for high reflective roofs in all existing building (*after the publishing legislation*)

The calculated reduction in consumption is based on the following:

- The action applied for 1000 houses will reduce the consumption in each house in around 432KWh/a which counts for 432 MWh/a for 1000 houses, which is equal to 432 x 0.82 (emission factor for electricity) = 354 tCO2.
- The estimated 3% of houses will follow the same methodology through awareness campaigns. 349077 MW saving from table 22 for white roof equal to 10472 MWh.

Launching the concept of SWH and ESCO in KRG

Background

Mitigation	
MWh/a	t CO_2/a
19318	15841
Contribution in %	
0.27%	
Cost in $	
1270000	
Years of Implementation	
Key performance Indicator	
Number of houses apply the measures	
Measurement Units	
Compare the measure in reduction of energy consumption in MWh	
Priority of action	
Area of intervention	
BE	
Origin of action	
Local Authority	
Policy instrument	
EM	

Kurdistan bears the highest financial cost to support the internally displaced people (IDP) and refugees who reached 1.5 million IDPs and 247,339 Syrian refugees. This has brought financial and economic implications on the local host community associated with that influx which led to the reduction of expenditures, suppression of the development and investment projects, lack of employment opportunities and immigration.

As a result of the economic crisis, Kurdistan Government has been unable to absorb the increase in energy demand which has grown with the high population growth ,attributed to the displaced people, on which the cost the government is spending to support electricity has reached approximately 3 billion dollars a year ; Besides, the government could not impose additional costs on energy on its citizens due to the critical economic condition, which has extended greatly making the region suffer from rationing of electricity supplies, thus promoting its citizens to use private generators to compensate for the shortage of electricity supplies.

The Kurdistan Region of Iraq has more than 300 sunny days and the buildings represent about 70% of the electricity consumption, 30% of which depend on water heating. Therefore, solar heaters are the alternative solutions for the consumption of electric power, on which its success and distribution at the regional level, will contribute to the generalization of the Renewable Energy concept.
Hence, it is important to help the region overcome this critical stage by supporting energy solutions and giving it the right model in dealing with the crisis in a creative and sustainable way.

Description of the action

In order to rationalise the water consumption and the pave the way to promote the usage of Solar water heater in houses, it is important to develop market of SWH through promoting the usage of SWH and facilitate the payment through national financial support mechanism, supported with promotion a new company concept of Energy Service Companies (ESCO) which contribute to open new business market and generate new opportunities of work.
The following action will have three main pillars. The first is to establish a technical base, the second is to run successful installation example in different districts in Sulaymaniyah Governorate to show how installation triggers demand, and the third pillar is to develop the national models for financing to support sustain use of SWH.

- Join efforts by assigning the support team from stakeholders and energy team to support implementation of promotion of SWH in building.
    - The recommended stakeholder representatives from Sulaymaniyah Governorate, chamber of commerce, Local NGO's, Ministry of

Electricity, Ministry of Municipalities and Tourism, Ministry of Higher Education's & Scientific Research, Ministry of Housing, Ministry of Planning;
- Create the framework and define the outcomes, participant role of work, indicators and evaluation process.

➢ Assessment of the technologies and potential of Solar Heat boilers in different types of buildings in Private Houses
- Assign consultants for energy auditing from local universities in Sulaymaniyah, and define tasks, responsibilities to accomplish energy statistics;
- Conduct technology assessment on SWH (price and capacities, years of operations, savings of electricity in terms of CO2 and cost), Rate of return of the investment;
- Conduct an analytical study in houses to analyse the hot water and electrification consumption;
- Conduct pilot installation of SWH to obtain the results and see the results in different type of houses (single floor, two floor, multi floor);
- Identify the type/technology of SWH that can meet the Kurdistan criteria and atmosphere;
- Publish a guideline manual to select the appropriate solar heater for those wishing to purchase and install it in the future;

- Publish installation manual for proper and recommended installation of SWH;
- Conduct Training for ESCO on installation of solar heater.

➢ Setting the base for Energy Auditing for houses formation in comprehensive and simplified form:
- Develop the framework, methodology, procedures and measures for energy statistics, along with basic energy indicators for measurement in houses;
- Set the criteria for selection the houses, like climate zone, type of dwelling and districts, below the poverty line, low Income family, families lost the breadwinner, disabled families…etc;
- Develop a score card for each type of building, to identify the houses which for the need, provides an estimation what investment is needed and for how long it will be repaid (based on the electricity bill and based on the electricity bill + the subsidy)
- Create the inventory procedures to reduce the uncertainly in data collection;
- Assign the tools and equipment needed for the survey;

➢ Based on best results install 1000 solar water heaters in Sulaymaniyah districts:
- Preparing the tender document for supply installation and maintaining 1000 SWH in Sulaymaniyah district;
- Following-up the solar heaters installation and evaluating their quality and results;

- Evaluating the companies' performance and classifying them according to the follow-up results;
- Developing the skills and potentials of the technicians throughout their career;
- Issuing certificates for workers in this field;

Residential Sector		
District	Average number of Subscribers	Number of houses to be selected for project for each District
Sulaymaniyah	234173	479
Sharazur	67964	139
Raniah	70129	143
Dukan	28028	57
Chamchamal	36997	76
Kalar	31287	64
Kifry	8554	17
Rizgary	9398	20
Pebaz	2506	5
Total	489,036	1000

- **Based on the analysis and best practices in the region propose models for financing** the Solar water heater for private housing. There should be additional incentives for the people since they will not be able to repay the investment in a reasonable life time.

  There could be a support from the state or public-private model where an investor makes the investment and it's paid back from the state based on the saved cost of electricity.

  - Legal analysis of the PPP models developed, it has to be assessed whether there is a need for any legislative changes for such PPP;
  - Present the models to the local banks and seek their recommendations and refine the PPP model (if there is a possibility for the people to take bank loan on lower rate, which can be supported by the KRG, which would make commercial sense for them to invest in such solar heater boilers).
  - Finalize the PPP model for the different type of buildings;
  - Draft action plan to implement the PPP model

- **Present the recommendation for national authority,** the second phase will be to implement the Solar Heat programme based on the assessments made and through the PPP or direct financing from KRG or with the support of an IFI. The whole programme can be done as blending financing (the pilot phase could be in a form of a grant and the second phase as a loan).
- Raising awareness campaigns to rationalize electricity and water consumption at the regional level;
- Raising awareness campaigns to rationalize electricity and use of solar water heater for homes benefiting from the project.

General objectives

- The main goal of this assignment is to motivate the installation of 1000 solar heaters in governorate of Sulaymaniyah through enhancing coordination between the Universities and Private sector under the umbrella of the governorate.
- The suggested proposal involves a sustainable solution that creates new employment opportunities, promotes sustainable development, reduces the burdens on citizens, and helps reduce the annual cost of electricity subsidies, which will improve the government increase of the opportunities for creating sustainable energy solutions, expand the economic cycle and reduce environmental issues resulting from the use of private generators.
- All this aims at preparing and establishing sound and steady foundations that contribute to sustainable development through:
    - Establishing an affordable and reliable sustainable energy market;
    - Involving stakeholders from the governorate, universities, consultants, university students, associations and citizens in this work;
    - Providing the opportunity for universities to participate in preparing for the work through

  study, supervision, implementation and evaluation of the results;
    - Preparing manuals and technical instructions for proper installation and maintenance procedures;
    - Evaluating the experience at the regional level;
    - Encouraging the establishment of specialized companies by ESCO;
    - Creating new job opportunities;
    - Training technicians on proper installation and maintenance;
    - Reducing financial expenses on citizens;
    - Training the technical staff in the governorates on the various stages of installation of solar heaters and how to maintain and evaluate their performance;
    - Mainstreaming the concept of quality, quality and efficiency as a new measure through local procurement and implementing the sustainability law in public procurement;
    - Expanding the concept of sustainability in the governorate, and giving it a role in leading the community with a sustainable vision.
- Workout with national level in legislation to support the promoting of the SWH initiative. (This could be free toward houses and could support reducing the burden by support subsidy for electricity)
- Support establishing the support mechanise to apply the initiative for SWH in all existing building (*after the publishing legislation*)

The calculated reduction in consumption is based on the following:

- The action applied for 1000 houses will reduce the consumption in each house in around 780 KWh/a which counts for 780 MWh/a with 1000 houses, which is equal to 780 x 0.82 (emission factor for electricity) = 639.6 tCO2.
- The estimated 3% of houses will follow the same methodology through awareness campaigns. (617946 MWh) 18538 MWh and this equals to 15201 tCO2.

Implementing the legislation for rationalise the demand for energy

Background

After publishing the new national legislation for EE and RE in KRG, a further action should be developed on local level to enhance the implementation and link it with the service provided by the governorate.

Mitigation	
MWh/a	t CO_2/a
2005525	1644531
Contribution in %	
28.54%	
Cost in $	
12000000	
Years of Implementation	
■■■■□□□□	
Key performance Indicator	
Number of houses apply the measures	
Measurement Units	
Compare the measure in reduction of energy consumption in MWh	
Priority of action	
■■□□□□□□	
Area of intervention	
BE	
Origin of action	
Local Authority	
Policy instrument	
EM	

Description of the action

By applying the developed recommended National strategic plan for regulating energy consumption in houses:

- Moderate the local laws and regulation to support implementation of EE and RE legislation on local level, by providing the incentive and taxation;
- Apply the national legislation of the **high reflective roofs** and establish the support mechanise to apply the initiative for high reflective roofs in all existing building;
- Apply the national legislation polices related to energy efficiency **appliances** in residential sectors;
- Apply the national legislation polices related to **Solar Water Heater;**
- Raising awareness campaigns to rationalize electricity and water consumption for homes benefiting from the project;
- **Carry out advertising campaigns to promote the implementation of high reflective roofs and** explain the importance on reducing the house temperature in summer (*with specific information high reflective roof characterized by SR 0.8 and TE 0.9 to ensure obtaining the good results*).
- **Launch the yearly awareness campaign** accompanied by the demonstration effective solutions that are available and easy to apply targeting the residential sectors in all Sulaymaniyah Governorates. The targeting measure should cover key factors affecting the energy consumptions, rationalising the water consumption, energy consumption, thermal insulation, and green areas:
  - Regulation of water consumptions;
  - Regulating the electricity consumption;
  - House appliance EE rating;
  - Promoting the Solar Water Heater;
  - Replacement of lights with more efficient light like LED;
  - Paint the roof with white colour to reduce the heat observation;
  - Promote the heat insulation for walls and roof as possible;
  - Reduce the house temperature leakage;
  - Turning off the lights after leaving the place;
  - Focus on using natural lighting whenever possible through;
  - Promote the thermal calendar (Setting the temperature cooling unit in summer at the rate of 25oC and in winter at 20oC);

- Installing eyebrow on the windows (Sun shade);
- Promote planting trees around the houses (preferable *need little water*);
- Promoting energy saving measures like using Pressure cooker could save lot of LPG gas.

In the campaign, the affordable solutions with tools should be presented with lessons learned to support the success of the campaign and utilising the public media like social networks, newspaper, TV, sign boards…etc.

- **Monitor and review the awareness campaign** achievement and do the needed modification or update on the plan to gain better results.

Summary Results of actions for residential sector

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh	tCO2	MWh	tCO2		
Residential building			8687629	5762222	2978674	2338225	41%	38,483,221
	5.00	Promoting measures for energy conservation in existing building			278027	227853	3.95%	1,884,000
	5.11	Join efforts by assign the support team from stakeholders and energy team to support implementation of promotion of SWH in building.						20,000
	5.12	Setting the base for Energy Auditing for houses						100,000
	5.13	Establishment of social committee for support the collection data for houses						30,000
	5.14	Establish household technical support group						50,000
	5.15	Conduct energy auditing						24,000
	5.16	Prepare Procurement package						20,000
	5.17	Implementation phase						100,000
	5.18	Develop the Information Kit and CAPP						20,000
	5.19	Launch awareness campaign toward sustainable movement						1,500,000
	5.20	Develop the recommendation for National strategic plan for regulating energy consumption in houses						40,000
	6.0	Implementing and promoting Green Building code in new building			664978	441123	7.66%	340,000
	6.1	Conduct a round table to debate on Green Building law with developers, investors, designers, consultants, universities and NGO's in coordination with national authorities						10,000
	6.2	Issuing detailed instructions on how to apply, implement and process the Green Building with clear frame work supported by national authorities						10,000
	6.3	Issuing instructions for granting building licenses within the Green Building Code in local level base						10,000
	6.4	Promote a package of incentives for developers and owners as well as for buyers in New Green Building Code						10,000
	6.5	Imposing fines on buildings that violate building instructions						
	6.6	Raising awareness on Green building code among citizens to promote the green culture.						300,000

	6.7	Issuing certificates for buildings committed for Green Building Code						
	6.8	Annual review of progress made and achievement monitoring for new Green building code						
	6.9	Strict legislative enforcement of the building law in two phases:						
	7.0	High reflective roofs to minimize energy consumption in residential buildings			10826	8877	0.15%	120,000
	7.1	Carry out advertising campaigns targeting the residential sector to promote the implementation of high reflective roofs (*with specific information high reflective roof*						20,000
	7.2	Conduct sample implementation around 1000 houses and implement of high reflective roofs						100,000
	7.3	Workout with national level in legislation to support the promoting of the high reflective roofs initiative						
	7.4	Carry out advertising campaigns targeting the residential sector to Promote the set point temperature in summer on 25°C and 20°C in winter						
	7.5	Support establishing the support mechanise to apply the initiative for high reflective roofs						
	8.0	Launching the concept of SWH and ESCO in KRG			19318	15841	0.27%	1,270,000
	8.1	Join efforts by assign the support team from stakeholders and energy team to support implementation of promotion of SWH in building.						
	8.2	Assessment of the technologies and potential of Solar Heat boilers in different types of buildings in Private Houses						20,000
	8.3	Setting the base for Energy Auditing for houses Formation in comprehensive and simplified form						50,000
	8.4	Based on best results install 1000 solar water heater in Sulaymaniah districts:						1,000,000
	8.5	Based on the analysis and best practices in the region propose models for financing						
	8.6	Present the recommendation for national authority						
	8.7	Raising awareness campaigns to rationalize electricity and water consumption at the regional level;						100,000
	8.8	Raising awareness campaigns to rationalize electricity and water consumption for homes benefiting from the project						100,000
	9.0	Implementing the legislation for rationalise the demand for energy			2005525	1644531	28.54 %	34,869,221
	9.1	Moderate the local laws and regulation to support implementation of EE and RE legislation on local level						
	9.2	Apply the national legislation of the high reflective roofs			104723	85873	1.49%	to be developed
	9.3	Apply the national legislation polices related to energy efficiency appliances in residential sectors;			1100000	902000	15.65 %	to be developed

	9.4	Apply the national legislation polices related to Solar Water Heater.			185 383	152014	2.64%	to be developed
	9.5	Raising awareness campaigns to rationalize electricity and water consumption						1,000,000
	9.6	Carry out advertising campaigns to promote the implementation of high reflective roofs						1,000,000
	9.7	Launch the yearly awareness campaign			615 419	504644	8.76%	10,000,000
	9.8	Monitor and review the awareness campaign						

Tertiary Sector

Sulaymaniyah Directorate General of Health

Introduction

The information from Healthcare facilities in Sulaymaniyah Governorate was not provided; however, the model of Duhok will be used as it contains the information of energy consumption.

The source of information on the number of PHC and HC will be used from RAND Corporation report on the future of health care in the Kurdistan Region-Iraq.

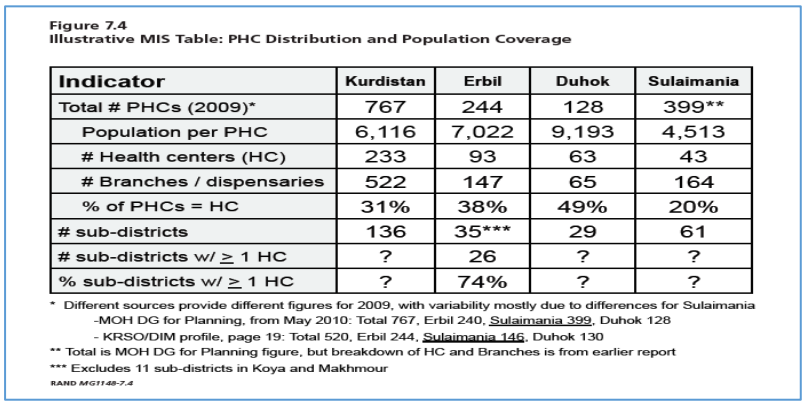


Figure 7.4
Illustrative MIS Table: PHC Distribution and Population Coverage

Indicator	Kurdistan	Erbil	Duhok	Sulaimania
Total # PHCs (2009)*	767	244	128	399**
Population per PHC	6,116	7,022	9,193	4,513
# Health centers (HC)	233	93	63	43
# Branches / dispensaries	522	147	65	164
% of PHCs = HC	31%	38%	49%	20%
# sub-districts	136	35***	29	61
# sub-districts w/ ≥ 1 HC	?	26	?	?
% sub-districts w/ ≥ 1 HC	?	74%	?	?

* Different sources provide different figures for 2009, with variability mostly due to differences for Sulaimania
-MOH DG for Planning, from May 2010: Total 767, Erbil 240, Sulaimania 399, Duhok 128
- KRSO/DIM profile, page 19: Total 520, Erbil 244, Sulaimania 146, Duhok 130
** Total is MOH DG for Planning figure, but breakdown of HC and Branches is from earlier report
*** Excludes 11 sub-districts in Koya and Makhmour
RAND MG1148-7.4

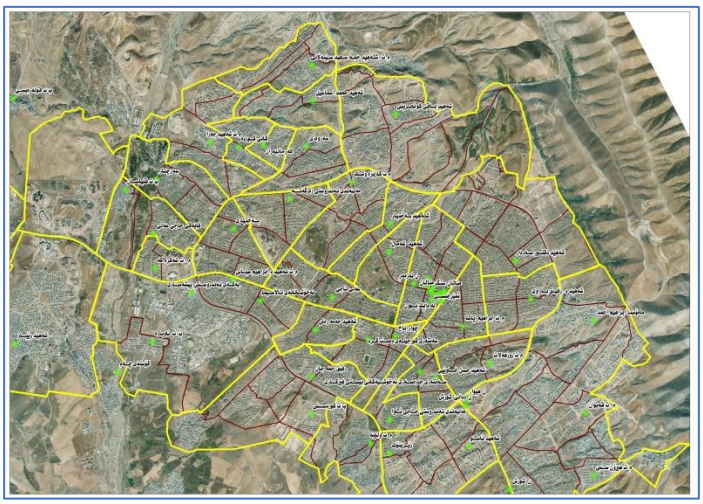
Figure 9 Data on PHC and HC centres in KRG

The data for consumption of energy will be estimated based on Duhok data with the support of the information provided in figure 5, due to non-availability of data from Sulaymaniyah Directorate General of Health at time of preparing the report.

Electrification consumption for utility supply and backup generators								Base year 2015		BAU 2030 x 1.62	
The following analyses was made according to given data on litre stage more precise data should be collected and verified				Consumption of electricity in	Cost in Iraq Diners 150 IQD/KWh	Quantity of Fuel consumed for BDG	Estimated fuel cost in Iraq Dinners				
	cost of electricity from utility for each building in IQD	consumption in each building KWh	number of buildings	total consumption in building KWh	cost of electricity from utility for building in IQD	Fuel in Litre	657.5	Energy in MWh	Emission in tCO2	Energy in MWh	Emission in tCO2
Sulaymaniyah DGH main building	60,264,000	401,760	1	401,760	60,264,000	21,454	14,105,994	482	395	781	640
Sulaymaniyah DGH admin. Buildings	11,000,000	73,333	11	806,667	121,000,000	43,076	28,322,470	968	794	1,568	1,286
Hospital	385,560,000	2,570,400	1	2,570,400	385,560,000	137,259	90,248,029	3,084	2,529	4,997	4,097
emergency Hospital	199,260,000	1,328,400	1	1,328,400	199,260,000	70,937	46,640,788	1,594	1,307	2,582	2,118
other hospitals	50,000,000	333,333	30	10,000,000	1,500,000,000	534,000	351,105,000	12,000	9,840	19,440	15,941
specializes centres	1,620,000	10,800	43	464,400	69,660,000	24,799	16,305,316	557	457	903	740
primary clinic	516,000	3,440	399	1,372,560	205,884,000	73,295	48,191,268	1,647	1,351	2,668	2,188
others	450,000	3,000	164	492,000	73,800,000	26,273	17,274,366	590	484	956	784
				17,436,187	2,615,428,000	931,092	612,193,232	20,923	17,157	33,896	27,795

Fuel consumption space heating The following analyses was made according to given data on litre stage more precise data should be collected and verified	unit cost IQD	Fuel in litre 657.5 IQD/L	number of buildings	Consumption of space heating in IQD	Total fuel consumption in litre	Base year 2015 Energy in MWh	Base year 2015 Emission in t CO2	BAU 2030 x 1.62 Energy in MWh	BAU 2030 x 1.62 Emission in t CO2
the electricity is used for space heating									
DDGH main building	-	-	1	0	-				
DDGH admin. Buildings	-	-	11	0	-				
Diesel fuel for space heating									
Hospital	470400000	715,437	1	470400000	715,437	7,154	1,910	11,590	3,095
Emergency Hospital	109,200,000	166,084	1	109200000	166,084	1,661	443	2,691	718
Other Hospitals	121,597,727	184,940	30	3647931810	5,548,185	55,482	14,814	89,881	23,998
Kerosene fuel for space heating								-	-
specializes centres	1,000,000	1,521	43	43000000	65,399	634	164	1,028	266
primary clinic	652,941	993	399	260523459	396,233	3,843	995	6,226	1,613
others	-	-	164	0	-	-	-	-	-
				4,531,055,269	6,891,339	68,775	18,327	111,415	29,690

It will be required before starting to verify the energy consumption data and update the table to ensure proper monitoring and successful implementation of actions.



Improvement of Energy Efficiency in Sulaymaniyah Directorate General of Health SDGoH Main Building and branches

Background:

Sulaymaniyah Directorate General of Health is responsible for managing 27 hospitals (public 20 and private 7), 244 primary healthcare centres (PHCs), 19 specialized centres, more than 200 private clinics and laboratories. They provide healthcare services for patients from all over Sulaymaniyah Governorate that are focused on providing tertiary and advanced health care services for the community. The annual energy bill represents a huge part of the Directorate's annual expenditure and it is constantly rising due to the increase in demand on the services. For that reason, it is vital to enhance the Sulaymaniyah technical and administrative staff capacity in facing the current challenges by developing energy audit measures supported with performance indicators.

Converting Sulaymaniyah DGoH building to green building would assist the technical and administrative staff to keep pace with the implementation of the energy measures and ensure successful implementation, thus facilitating the replication of the measures in other similar sites.

The participation of research institutes such as universities would enrich the process through the development of energy standards, measures and support the monitoring process, and would also promote creating new jobs and give high credibility and professionalism in the implementation.

Mitigation	
MWh/a	t CO_2/a
696	571
Contribution in %	
1%	
Cost in $	
356000	
Years of Implementation	
Key performance Indicator	
Annual energy Bill	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
SWH-BC-EELS	
Origin of action	
Local Authority	
Policy instrument	
EM	

Description of the action

To start, it is important to assign a technical partner from the research centres like university who is specialised in engineering and sustainable development. The technical partner would lead the process of work starting from the development of the energy auditing guidelines, measures and indicators and support in producing the reports, analyses and guideline books. Also, it is important to cooperate with the local specialist technical companies to benefit from the available technologies in the market and to enhance the technical staff capacity in understanding new technologies. This should also be supported with a visibility study to ensure compliance with the standards.

The action will target the Main Sulaymaniyah DGoH with branch office as a pilot project to implement the below actions, which could also be reviewed and updated by the technical teams prior to implementation.

- **Assigning energy team from the staff of Sulaymaniyah DGoH with Energy Consultant** to follow up the implementation of actions in collaboration with the Sulaymaniyah University.
- Implementing simplified consumption saving measures supported with training and leaflet
  - Turning off the lights before leaving the room;
  - Depending on natural lighting whenever possible;

- Proper use of the computer. It is better to set it automatically on the energy saving mode;
- Prevent printing paper unless it is necessary;
- Setting the temperature cooling unit in summer at the rate of 25°C and in winter at 20°C and developing the thermal calendar;
- Activation of periodic maintenance works such as cleaning the air-condition unit filters on a monthly base and cleaning the outdoor units every two months to check the thermostat functioning and gas pressure each year;
- Installing photo cell for outdoor lights;
- Installing motion sensors in public places such as bathrooms and stairs;
- Replacing the defective lamps with efficient lamps like LED.
- Replace the Water taps in the bathrooms with motion seniors to reduce the water consumptions

➢ Conducting an analytical study of energy consumption:

- Conducting an analytical study of consumption in these buildings or facilities to identify the source of consumption and then issuing advice of measures that could help reduce energy consumption which is called Energy Auditing for buildings;
- Launch meeting with Sulaymaniyah DGoH staff to explain the results and present the actions as a kind of raising awareness activities;
- Review the feedback and update the plan;
- Prepare simplified form for Energy Auditing which can be used in other new health centres as a result of lessons learned from this action.

➢ Applying the measure related to the Energy Auditing and monitoring the results

Divide the action into three types: simplified activates which do not need high budget and can be easily implemented, activates which can be done with business as usual process, and other activates which need budget.

- For simplified affordable activates:
  - Set the measures, monitoring and evaluation indicators;
  - Apply the measures;
  - Review the results and update the actions to obtain best results;
  - Share the results with the staff and obtain their feedback;
  - Prepare report on activities and reached conclusion as best practice;
  - Other suggested actions by energy auditing.
- The activates which can be done with business as usual process while replacement of defective equipment, appliances and fittings for example:
  - Ensure purchasing energy saving appliances in any new purchase;
  - Replace defective equipment with efficient one;
- The activates which need budget, assign the budget and sources of fund then if needed split the work to phases according to the fund availability:
  - Replace normal lights with efficient LED lights;
  - Replace the old A/C units with Energy saving one;
  - Other suggested actions by the energy auditing;

➢ Design, supply and install solar water heater on the building

- Install solar water heater with proper capacity on the roof top of the building;

- Train the maintenance staff on the operation and maintenance of the system;
- Replace the water taps in the bathrooms with motion seniors to reduce the water consumptions.

- Lessons learned report along with the challenges, solutions and benefits of the project to ensure best practices.
- Preparing a guideline book for Main and Branch buildings to convert them to green buildings.
- **Conducting a workshop with the head of department and maintenance staff** of Health clinics centres to explain the progress and results obtained from the project.
- Repeating the same actions in other buildings, benefiting from the lessons learned from previous projects and planning new projects in other centres.

General objectives:

These measures will be a model for transforming existing Sulaymaniyah DGoH main building and branches into sustainable building and could establish for successful subsequent stages in development policies in Health Clinics.

The reduction in operation and maintenance will be the main objectives, where the energy consumption will not only reduce the energy bill but also will bring live examples to the people that can-do part of the activates with low investment.

Improvement of Energy Efficiency of Health Facilities in Sulaymaniyah Hospitals

Background:

Sulaymaniyah Governorate constitutes of 27 hospitals (public 20 and private 7). The annual energy bill represents a huge part of the hospitals annual expenditure and is constantly rising due to the increase in demand on the services. Energy conservation is an important part of the action and should be addressed in hospitals, knowing that electricity accounts for around 20% of a hospital's delivered energy consumption and it represents over 50% of a hospital's energy costs.

The lighting of hospitals in Sulaymaniyah Governorate comprises 42% of the electricity used. Currently, more than 85% of the hospital lighting system is incandescent and halogen lamps, with only little use of compact fluorescent lamp (CFL) or light-emitting diode (LED). Upgrading incandescent lamps, halogen lamps and CFLs to LEDs represents a significant energy saving opportunity in the interest of the community.

Mitigation	
MWh/a	t CO_2/a
5632	4618
Contribution in %	
8%	
Cost in $	
1370386	
Years of Implementation	
Key performance Indicator	
Annual energy Bill	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
SWH-BC-EELS	
Origin of action	
Local Authority	
Policy instrument	
EM	

For year 2015		
	Annual energy consumption in MWh	Annual cost of Consumption of Fuel for diesel generators in litre
Sarezh Hospital	574	20000

Converting the Sulaymaniyah hospitals to green building would allow the tech and admin staff to keep pace with the implementation of the energy measures, test and ensure their proper implementation, thus facilitating the implementation and replication of the measures at other sites.

The participation of research institutes such as universities will enrich the process through the development of energy standards and measures, support the monitoring process, and promote creating new jobs to give high credibility and professionalism in implementation.

Description of the action

Sarezh Hospital has been selected as a pilot in this project.

To start, it is important to assign a technical partner from the research centres like university who is specialised in engineering and sustainable development. The technical partner would lead the process of work starting from the development of the energy auditing guideline, measures and indicators and support in producing the reports, analyses and guidelines books. Also, it is important to cooperate with the local specialist technical companies to benefit from the available technologies in the market and to enhance the technical staff capacity in understanding the new technologies. This should also be supported with a visibility study to ensure the compliance with the standards. The list below will brief the main base of measures which could be made to ensure successful implementation and could be reviewed and updated by technical teams prior to implementation:

- **Assigning energy team from the Hospital staff with Energy Consultant** to follow up the implementation of actions in collaboration with the Sulaymaniyah University.

- Implementing simplified consumption saving measures supported with training and leaflet:
  - Turning off the lights before leaving the room;
  - Depending on natural lighting whenever possible;
  - Proper use of the computer. It is better to set it automatically on the energy saving mode;
  - Prevent printing paper unless it is necessary;
  - Setting the temperature cooling unit in summer at the rate of 25^{o}C and in winter at 20^{o}C and developing the thermal calendar;
  - Activation of periodic maintenance works such as cleaning the air-condition unit filters on a monthly base and cleaning the outdoor units every two months to check the thermostat functioning and gas pressure each year;
  - Install photo cell for outdoor lights;
  - Installing motion sensors in public places such as bathrooms and stairs;
  - Replacing the defective lamps with efficient lamps like LED.
  - Replace the water taps in the bathrooms with motion seniors to reduce the water consumptions
- Conducting an analytical study of energy consumption:
  - Conduct an analytical study of consumption in these buildings or facilities to identify the source of consumption and then issuing advice on measures that could help reduce energy consumption which is called Energy Auditing for buildings;
  - Launch meeting with hospital's staff to explain the results and present the actions as a kind of raising awareness activities;
  - Review the feedback and update the plan;
  - Prepare simplified form for Energy Auditing which can be used in other new health centres as results of lesson learned from this action.
- Applying the measures related to the Energy Auditing and monitoring the results.

Divide the action into three types, simplified activates which do not need high budget and can be easily implemented, activates which can be done with business as usual process, and other activates which need budget.

  - For simplified affordable activates:
    - Set the measures, monitoring and evaluation indicators;
    - Apply the measures;
    - Review the results and update the actions to obtain best results;
    - Share the results with the staff and obtain their feedback;
    - Prepare a report on activities and reached conclusion as best practice;
    - Other suggested actions by energy auditing.
  - The activates which can be done with business as usual process while replacement of defective equipment, appliances and fittings for example:
    - Insure purchasing energy saving appliances in any new purchase;
    - Replace defective equipment with efficient one;
  - For the activates which need budget, assign the budget and sources of fund then if needed split the work to phases according to the fund availability:
    - Replace normal lights with efficient LED lights;
    - Replace the old A/C units with Energy saving one;

        - Other suggested actions by the energy auditing.
- Design, supply and install solar water heater on the building:
- Install PV solar system with proper capacity on the roof top of the building
- Train the maintenance staff on the operation and maintenance of the system
- Lessons learned report along with the challenges, solutions and benefits of the project to ensure best practices.
- Preparing a Guideline book for hospitals to convert them to green buildings.
- **Conduct workshop with the head of department and maintenance staff** of Health clinics centres to explain the progress and results obtained from the project.
- Repeat the same actions in other hospitals, benefiting from the lessons learned from previous projects and planning new projects in other centres.

General objectives:

These measures will be a model for transforming existing hospitals into sustainable building and could establish for successful subsequent stages in development policies in hospitals.

The reduction in operation and maintenance will be the main objectives, where the energy consumption will not only reduce the energy bill, but also will produce and bring live examples to the people that can-do part of activates with low invest. Using the PV solar system and integrating it with backup generators would not only reduce the fuel consumption, but also would help in increasing the life span of generators and reduce air pollution.

Pilot project in Health Clinic Centres / Primary healthcare centres (PHCs),

Background:

Mitigation	
MWh/a	t CO_2/a
1252	1027
Contribution in %	
1.79%	
Cost in $	
1016571	
Years of Implementation	
■ ■	
Key performance Indicator	
Annual energy Bill	
Measurement Units	
MWh	
Priority of action	
■ ■	
Area of intervention	
SWH-BC-EELS-	
Origin of action	
Local Authority	
Policy instrument	
EM	

The usage of renewable energy sources (RE) in the health clinic buildings and facilities is a necessity, due to their high demand for energy and long hours of operation with a significant number of health clinics. Due to the inadequate power production capacity, the power provider has in recent years instituted a rotating power outage regimen in KRG, forced the Health Clinics to turn to the diesel generators during the power outages, causing addition burden to their budget due to the high cost for operation and maintenance of generators, not to mention the effects of air pollution knowing that, around 40 % of energy losses occur in transmission of power from the main power station to facilities. Using the RE resources in Health Clinic buildings & facilities will not only mitigate the emissions, but also will reduce the unseen losses due to power transmission. Moreover, the cost for producing one KWh of electricity in Sulaymaniyah is counted for 180 IQD where the actual tariff is only 60 IQD per one KWh, so using renewable energy resources will have significant benefits in producing clean energy as well in reducing public burden expenditures. The General Directorate of Sulaymaniyah Electricity had carried a number of measures for health clinics in Sulaymaniyah Governorate to find out the best suitable places for the use of the RE resource. These measures did not denote the data for energy auditing, which is highly recommended to do along with energy conservation actions before any implementation of RE in these buildings. In the following action, the selected clinics will have three step- measures starting from Energy Auditing and selection of actions related to energy conservation followed with implementation of RE. In addition, those measures can be the first phase of work to convert all clinics to green ones.

Description of action:

- **Assigning energy team from the staff of the clinic with Energy Consultant** to follow up the implementation of actions in the clinics in collaboration with the University.
- Implementing simplified consumption saving measures supported with training and leaflet:
  - Turning off the lights before leaving the room;
  - Depending on natural lighting whenever possible;
  - Proper use of the computer. It is better to set it automatically on the energy saving mode;
  - Prevent printing paper unless it is necessary;
  - Setting the temperature cooling unit in summer at the rate of 25°C and in winter at 20°C and developing the thermal calendar;
  - Activation of periodic maintenance works such as cleaning the air-condition unit filters on a monthly base and cleaning the outdoor units every two months to check the thermostat functioning and gas pressure each year;

- Install photo cell for outdoor lights;
- Installing motion sensors in public places such as bathrooms and stairs;
- Replacing the defective lamps with efficient lamps like LED.

➢ Conducting an analytical study of energy consumption:

- Conducting an analytical study of consumption in these buildings or facilities to identify the source of consumption and then issuing advice on the measures that could help reduce energy consumption which is called Energy Auditing for buildings;
- Launch meeting with clinic staff to explain the results and present the actions as a kind of raising awareness activities;
- Review the feedback and update the plan;
- Prepare simplified form for Energy Auditing which can be used in other new health centres as results of lessons learned from this action.

➢ Applying the measure related to the Energy Auditing and monitoring the results:

Divide the action into three types: simplified activates which do not need high budget and can be easily implemented, activates which can be done with business as usual process, and other activates which need budget.

- For simplified affordable activates:
  - Set the measures, monitoring and evaluation indicators;
  - Apply the measures;
  - Review the results and update the actions to obtain best results;
  - Share the results with the clinic staff and obtain their feedback;
  - Prepare report on activities and reached conclusion as best practice;
  - Other suggested actions by energy auditing.
- The activates which can be done with business as usual process while replacement of defective equipment, appliances and fittings for example:
  - Ensure purchasing energy saving appliances in any new purchase;
  - Replace defective equipment with efficient one;
- For the activates which need budget, assign the budget and sources of fund then if needed split the work into phases according to the fund availability:
  - Replace normal lights with efficient LED lights;
  - Replace the old A/C units with Energy saving one;
  - Other suggested actions by the energy auditing.

➢ Design, supply and install PV Solar System to supply Green Energy to the building:

- Design, supply and install the PV solar energy system in a way to have 50% of building energy consumption estimated for 100 PV solar panel with each one having a 250 W with a total capacity of 25KWp. The PV system, operated On Grid system, should be integrated with the Backup Generators;
- Install solar water heaters with a capacity of 400L on the roof top of the buildings;
- Train the maintenance staff of the MOH on the operation and maintenance of the system;
- Replace the water taps in the bathrooms with motion senior ones to reduce the water consumptions

➢ Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.

➢ Preparing a Guideline book for Health Clinics to convert them to green buildings.

- **Conduct workshop with the head of department and maintenance staff** of Health clinics centres to explain the progress and results obtained from the project.
- Repeat the same actions in another Health Clinic Centres, benefiting from the lessons learned of previous projects.

General objectives:

These measures will be a model for transforming existing health clinic centres into sustainable building and could establish for successful subsequent stages in development policies in Health Clinics.

The reduction in operation and maintenance will be the main objectives, where the energy consumption will not only reduce the energy bill, but also will produce and bring live example to the people that can-do part of activates with low invest. Using the PV solar system and integrating it with backup generators would not only reduce the fuel consumption, but also would help in increasing the life span of generators and reduce air pollution.

Ensure proper Implementation of New Public procurement in Sulaymaniyah DGoH

Background:

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
Years of Implementation	
Key performance Indicator	
Annual energy Bill	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
SWH-BC-EELS	
Origin of action	
Local Authority	
Policy instrument	
EM	

The public procurement impacts more than 30% of Sulaymaniyah DGoH, making it an important tool for public authorities to implement national energy efficiency policies, by promoting the production and the consumption of energy efficient products and services. This means using the opportunity created by the KRG government to orientate the use of this money on products and services aimed at the production of renewable energy and energy saving, improving competitiveness and promoting a balanced and sustainable economic growth in the governorate.

The public procurement plays a key role in rationalizing public expenditures and in strengthening accountability, enhancing transparency and consequently contributing to sustainable development. Kurdistan government has reformed the new regulation on public procurement. The law was officially issued by the Minister of Planning in January 2016, and the regulation became effective in July 2016. The KRG Government officially adopted the modern Public Procurement Regulation (Regulation #2 for 2016) defining the legal, institutional and procedural framework.

The new rule relies on developing a new legal framework based on clear and comprehensive provisions, the centre piece being the new Procurement Regulation embodies a balanced, win-win approach to allocating risk and responsibilities between the public and private sectors. The new legal framework also specifies institutional arrangements related to the execution of contracts, development of policies at the central level and ensuring methodical supervision, as well as other provisions that reinforce transparency and accountability.

The main obstacles are the difficulties which are facing the tendering department in the governorate in the implementation where most of the governorate departments are not well trained on implementation; moreover, the contactor is still not fully aware of the new rules and doesn't know how to implement it.
This brings more pressure on the contracting department which cannot be fully able to implement it inclusively.
The unfavourable legislative conditions include:

- institutional hurdles and low skills;
- Available information is unevenly provided;
- Low awareness, which causes a lack of perception, demand and acceptance;
- Increased energy demand, due to the population growth and urbanization;
- national energy markets with different rules;
- The cities characterized by an inefficient management of energy;
- market conditions do not allow the formation of a critical mass of suppliers.

Description of action:

A comprehensive capacity building programs to be established on the new regulation to cover the governorate and private sectors:

- Assign a sustainable procurement specialised to support conducting the following actions;
- Training the administration departments on Sustainable Procurement procedures;
- Organize training of private sector representatives aiming Sustainable Procurement procedures;
- Update the procurement specifications and procedures to meet the Sustainable Procurement;
- Monitor the implementation and apply suitable actions to improve the results.

General objectives:

Building an effective and socially accountable public procurement system will:

- Deliver quality services and support the sustainable development of KRG;
- Be in line with the KRG 2020 Vision of 'Effective, transparent, trusted and honest Government';
- Achieve Shared Prosperity and Protecting the Vulnerable;
- Save the local resources;
- Improve the energy efficacy and improve the sustainability;
- promote the adoption of transnational approach for the shaping of energy efficient public procurement policies and procedures;
- Override the national constraints in the implementation of energy efficient public procurement procedures, facilitating the coordination at transnational level and the achievement of national energy and resources policies objectives in KRG and precisely in Sulaymaniyah;
- Exchange of best practices on energy efficient public procurement practices;
- Contribute to the re-orientation of suppliers towards the production of energy efficient services and products, through the removal of barriers which prevent enterprises from participation to public tenders requiring energy efficient measures/procedures, thus creating new business opportunities for the economic sector.
- Upgrade the competences of private sector, increasing their awareness on the economic benefits deriving from a smart use of energy, thus fostering the creation of new enterprises and jobs in energy;
- Enhance the role of public authorities, at all levels, in the diffusion of energy efficient behaviours in private sector, paving the way for transnational strategies in sustainable development and achieving energy efficacy objectives;
- Increase the awareness of regional/local authorities and professional organizations representatives on the importance of sustainable procurement and upgrade their competences on the preparation/participation to energy efficient public tenders;

- Seek the optimum combination of whole life costs and quality, instead of the lowest initial price;
- Value for money, to acquire the goods, works or services needed, on the best available terms;
- Consider the quality of assurance and environmental management systems;
- Use specified criteria for ecological labels.

Policy Instrument:

The Government of Kurdistan Region remains keen on activating the reform roadmap to better serve its people, and acknowledges the support of international development partners, particularly the World Bank, which values its strong relation with KRG.

In line with the KRG 2020 Vision of 'Effective, transparent, trusted and honest Government', and as part of the 3-year economic reform plan aimed at "Achieving Shared Prosperity and Protecting the Vulnerable" launched in June 2016, the Government is exerting every effort to build an effective and socially accountable public procurement system that delivers quality services and supports the sustainable development of KRG.

Summary of Actions in Sulaymaniyah Directorate general of Health

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO_2/a	MWh/a	t CO_2/a		
Tertiary building								
		Health buildings and Facilities	145311	57484	7580	6216	10.81%	2,842,957
	10.0	Improvement of Energy Efficiency in Sulaymaniyah Directorate General of Health Main Building and branches	2349	1926	696	571	0.99%	356,000
	10.1	Assign energy team from the staff with Energy Consultant	781	640				10,000
	10.2	Implementing simplified consumption saving measures			26	21	0.04%	1,000
	10.3	Conducting an analytical study of energy consumption:						5,000
	10.4	Applying the measure related to the Energy Auditing and monitor the results.			208	171	0.30%	100,000
	10.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			45	37	0.06%	50,000
	10.6	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						5,000
	10.7	Prepare Guide Line book for Health Clinics to convert them to green building.						5,000
	10.8	Conduct workshop with the head of department and maintenance staff						10,000
	10.9	Repeat the same actions in other buildings	1568	1286	417	342	0.59%	170,000
	11.0	Improvement of Energy Efficiency of Health Facilities in Sulaymaniyah Hospitals	131181	49967	5632	4618	8.03%	1,370,386
	11.1	Assign energy team from the Hospital staff with Energy Consultant			350	287	0.50%	11,589
	11.2	Implementing simplified consumption saving measures						1,000

	11.3	Conducting an analytical study of energy consumption:				0		5,000
	11.4	Applying the measure related to the Energy Auditing and monitor the results.			2672	2191	3.81%	635,195
	11.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			95	78	0.14%	105,427
	11.6	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						5,000
	11.7	Prepare Guide Line book for Health Clinics to convert them to green building.						5,000
	11.8	Conduct workshop with the head of department and maintenance staff						10,000
	11.9	Repeat the same actions in other Hospitals,			2515	2062	3.59%	592,175
	12.0	Pilot project in Health Clinic Centres / Primary healthcare centres (PHCs),	11781	5591	1252	1027	1.79%	1,016,571
	12.1	Assign energy team from the staff of the clinic with Energy Consultant						10,000
	12.2	Implementing simplified consumption saving measures			48	39	0.07%	1,714
	12.3	Conducting an analytical study of energy consumption:						5,000
	12.4	Applying the measure related to the Energy Auditing and monitor the results.			260	213	0.37%	180,795
	12.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			110	90	0.16%	134,063
	12.6	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						5,000
	12.7	Prepare Guide Line book for Health Clinics to convert them to green building.						5,000
	12.8	Conduct workshop with the head of department and maintenance staff						10,000
	12.9	Repeat the same actions in another Health Clinic Centre			834	684	1.19%	665,000

	15.0	Ensure proper implementation of new Public Procurement						100,000
	15.1	Assign a Sustainable procurement specialised to support conducting the following actions						
	15.2	Training the administration departments on sustainable Procurement procedures						
	15.3	Organize training of private sector representatives aiming Sustainable Procurement procedures						
	15.4	Update the procurement specifications and procedures to meet the Sustainable Procurement.						
	15.5	Monitor the implementation and apply suitable actions to improve the results						

Directorate of Sulaymaniyah Endowment & Religious Affairs

Introduction

Endowment & Religious affairs Directorate in Sulaymaniyah Governorate constitutes of 8 directorates and administration facilities. The data for the number of mosques and churches are not provided from Sulaymaniyah. For that, the report will use the analyses report provided by Duhok governorate to evaluate the consumption in Sulaymaniyah based on the total number of mosques in Kurdistan which is around 5337 in year 2013. The current financial and economic crisis has put additional impact on the Directorate in a way to improve the services and reduce the cost. For that, it will be important to develop the indicators to improve the services and regulate the energy consumptions and reduce the energy bill.

The water consumption is not measured in the mosques where there are around 32815 taps in 2235 mosques in the Sulaymaniyah Governorate which represent the core element in water consumption. Thus, certain measures and actions should be included to mitigate the water consumption and save the water resources.

The following assumption on the number of Mosques per governorate, the number of Churches will be considered same in all governorates (118).

Governorate	Local Population	Number of mosques and churches	Number of Taps	water heater	Electrical consumption in 2015 in MWh	Electrical consumption as to BAU scenario 2030 in MWh	Emission in tCo2 in 2030
Duhok	1423080	1352	18118	2452	20,290	32,870	26,953
Erbil	1957486	2353	31532	4267	35,312	57,206	46,909
Sulaymaniyah	1784920	1986	26614	3602	29,804	48,283	39,592

Source of consumption and power sharing in MWH				Energy saving calculation per action in MWh			
Governorate	Light will share 30%	A/C will share 30%	Electrical water heater will share 30%	changing light to LED efficient energy saving lights	adjust temperature of Air condition	Convert Air condition to Energy saving one	Solar water Heater
Duhok	9,861	9,861	9,861	4,930	986	2,958	6,574
Erbil	17,162	17,162	17,162	8,581	1,716	5,149	11,441
Sulaymaniyah	14,485	14,485	14,485	7,242	1,448	4,345	9,657

Governorate	cost for changing light to LED efficient energy saving lights	Cost adjust temperature of Air condition	Cost for Solar Water Heater in USD
Duhok	BAU scenario	Instruction and follow up	4,380,480
Erbil	BAU scenario	Instruction and follow up	7,623,720
Sulaymaniyah	BAU scenario	Instruction and follow up	6,434,640

Developing operation and maintenance management in Endowment & Religious Affairs Directorate in Sulaymaniyah Governorate Buildings and facilities

Background

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
55000	
Years of Implementation	
Key performance Indicator	
Annual energy Bill	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
SWH-BC-EELS	
Origin of action	
Local Authority	
Policy instrument	
EM	

Endowment & Religious Affairs Directorate in Sulaymaniyah Governorate manages around 8 directorates and administration facilities in addition to 2235 Mosques and 118 churches without generalization. With a proactive maintenance concept or linkage with sustainability, the Operation and Maintenance (O&M) represents the greatest expense in owning and operating a facility over its life cycle.
Through the preparation of this report, it is well noted in the buildings and facilities that the O&M measures related to energy conservation are not considered. This causes tremendous losses for the opportunities in saving the O&M cost, which could be achieved through simple measures in O&M procedures.
So, **understanding why building systems are operated and maintained the way they are**, and where and what improvements are most beneficial and cost-effective is the first step to obtaining energy-efficient building performance.

To simplify the understanding of operation and maintenance, two main definitions will be considered as a role of work:

- **Efficient O&M** is one of the most cost-effective methods for ensuring reliability, safety and energy efficiency. Insufficient maintenance of energy-using systems is a major cause of energy loss in the public buildings and facilities. Energy losses, water and air leaks, and other losses from poor maintenance are often significant. Good maintenance practices can generate substantial energy savings and should be considered a resource. Moreover, improvements to facility maintenance programs can often be accomplished immediately and at a relatively low cost.
- **Operational Efficiency represents the life-cycle,** cost-effective mix of preventive, predictive, and reliability-centred maintenance technologies, coupled with equipment calibration, tracking, and computerized maintenance management capabilities all targeting reliability, safety, occupant comfort, and system efficiency.

Description of the action

The following proposed actions:

- **Establish technical team and supporter** from Sulaymaniyah General Directorate of Education and MOE and Universities to perform the following measures.
- **Conduct an O&M assessment for Endowment & Religious Affairs Directorate building and facilities** to provide a systematic look at all aspects of the current O&M practices including the management structure, policies, and user requirements that influence them. It includes the following:
  - Interviews with management, O&M personnel and service contractors;

- A review of equipment condition, building documentation, and service contracts;
- Spot tests of equipment and controls;
- Trend or data logging of critical data points (temperatures, pressures, electrical, etc.) over time;
- The gathering and analysis of this information reveals where improvements are needed and which improvements are most cost-effective. More technical details can be obtained from references like best practice for Energy-Efficient Building Operations.

➢ **Preparation of a Guideline for Operations and Maintenance** (O&M) achieving operational efficiency, and providing useful information about O&M management, technologies, energy and water efficiency, and cost-reduction approaches. And, includes the key energy- and operational-efficiency-related elements in the SEAP as indicted below:

Technical Phase:
The decisions and actions regarding the control and upkeep of property and equipment are inclusive, but not limited to, the following:

- actions focused on scheduling, procedures, and work/systems control and optimization; and performance of routine, preventive, predictive, scheduled and unscheduled actions aimed at preventing equipment failure or decline with the goal of increasing efficiency, reliability, and safety.
- Enhance efforts toward sustainable buildings and communities in building and facilities.
- Specific requirements include the implementation of high-performance sustainable building design, construction, operation and management, maintenance, and deconstruction.
- Managing existing building systems to reduce the consumption of energy, water, and materials, and identifying alternatives to renovation that reduce existing asset-deferred maintenance costs.
- Reconsideration of traditional irrigation methods and irrigated agriculture of landscapes, and reduce the water consumptions.

Administrative Phase:

- Specify the roles and responsibilities of all the important administration elements in the process of O&M in the Endowment & Religious Affairs Directorate in Sulaymaniyah Governorate

➢ Train the staff on using the Guideline for Operations and Maintenance (O&M).
➢ Monitor the operation and apply additional measure to improve and maintain the results.

General objectives

The goal is to effectively and efficiently support the life cycle of the facility by eliminating unplanned shutdowns and realizing life-cycle cost savings. The O&M manual provides a means to reduce operating costs as part of a comprehensive Maintenance Program.

Improvement of Energy Efficiency in Mosques/churches and the administration Buildings in Sulaymaniyah Directorate for Endowment & Religious Affairs

Background:

Mitigation	
MWh/a	t CO_2/a
18346	15044
Contribution in %	
38%	
Cost in $	
9,274,056	
Years of Implementation	
Key performance Indicator	
Annual energy Bill	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
SWH-BC-EELS	
Origin of action	
Local Authority	
Policy instrument	
EM	

Endowment & Religious affairs Directorate in Sulaymaniyah Governorate constitutes of 8 directorates and administration facilities in addition to 2235 Mosques and 118 churches.
The current financial and economic crisis has put additional impact on the Directorate in a way to improve the services and reduce the cost. For that, it will be important to develop the indicators to improve the services and regulate the energy consumptions and reduce the energy bill, knowing that there are around 4706 water heaters and 31532 water taps. Regulating energy/water consumptions and using renewable energy resources will have significant benefits in producing clean energy as well in reducing public burden expenditures.

Description of the action

The actions concentrated on assigning technical team to enhance the directorate staff capacity, developing energy conservation measures to ensure successful implementation which also could be reviewed and updated by technical teams prior to implementation. The list below briefs the main base of measures which could be made to ensure a successful implementation which could be also reviewed and updated by technical teams prior to implementation.

- Assigning energy team from the directorate staff with Energy Consultant

It is important to assign a technical partner from the research centres like university, specialised in engineering and sustainable development to lead the process of work starting from developing the energy auditing guideline, measures and indicators and support in producing the reports, analyses. Also, it is important to cooperate with the specialized local technical companies to benefit from the available technologies in the market and to enhance the technical staff capacity with new technologies. This also should be supported with visibility study to ensure compliance with the standards.

- Sorting the mosques/churches according size and capacity or other base according to consultant recommendation

The sorting will support developing simplified form of action according to the mosques size or capacity.
Selecting one mosque from each category and apply the certain measures:

- Implementing simplified consumption saving measures supported with awareness raising and training
  - Turning off the lights before leaving the room;
  - Use of natural lighting whenever possible;
  - Proper use of the computers, set them automatically on the energy saving mode;
  - Prevent printing paper unless it is necessary;

- Setting the temperature cooling unit in summer at the rate of 25°C and in winter at 20°C and developing the thermal calendar;
- Activation of periodic maintenance works such as cleaning the air-condition unit filters on a monthly base and cleaning the outdoor units each two months to check the thermostat functioning and gas pressure each year;
- Install photo cell for outdoor lights;
- Installing motion sensors in public places such as bathrooms and stairs;
- Replacing the defective lamps with efficient lamps like LED.

➢ Conducting an analytical study of energy consumption

- Conducting an analytical study of consumption in these buildings or facilities to identify the source of consumption and issuing an advice of measures that could help reduce energy consumption which is called Energy Auditing for buildings;
- Launch meeting with staff to explain the results and present the actions as kind of raising awareness activities;
- Review the feedback and update the plan;
- Prepare simplified form for Energy Auditing which can be used in other new mosques/churches as results of lesson learned from this action.

➢ Applying the measure related to the Energy Auditing and monitoring the results.

Divide the action into three types: simplified activates which do not need high budget and can be easily implemented, activates which can be done with business as usual process, and other activates which need budget.

- For simplified affordable activates:
  - Set the measures, monitoring and evaluation indicators;
  - Apply the measures;
  - Review the results and update the actions to obtain best results;
  - Share the results with the staff and obtain their feedback;
  - Prepare report on activities and reached conclusion as best practice;
  - Other suggested actions by energy auditing.
- The activates which can be done with business as usual process while replacement of defective equipment, appliances and fittings for example:
  - Insure purchasing energy saving appliances in any new purchase;
  - Replace defective equipment with efficient one.
- For the activates which need budget, assign the budget and sources of fund then if needed split the work to phases according to the fund availability.
  - Replace normal lights with efficient LED lights;
  - Replace the old A/C units with Energy saving one;
  - Other suggested actions by the energy auditing.

➢ Design, supply and install solar water heater

- Install solar water heater with proper capacity on the roof top of the building;
- Train the maintenance staff on the operation and maintenance of the system.

➢ Replace the water taps with motion seniors to reduce the water consumptions.

➢ Replace normal lights with efficient LED lights.

➢ Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.

➢ Prepare a Guideline book to convert to green building.

- Conduct a workshop with the head of department and maintenance staff to explain the progress and results obtained from the project.
- Repeat the same actions in other mosques/churches, benefiting from the lessons learned from previous projects and planning new projects in other centres.

General objectives:

These measures will be a model for transforming existing mosques/churches into sustainable buildings and could establish for successful subsequent stages in the development of the sustainable policies.

The reduction in operation and maintenance will be the main objectives, where the energy consumption will not only reduce the energy bill, but also will bring live examples to the people that can be part of activates with low investments.

Ensure proper Implementation of New Public procurement in Endowment & Religious affairs Directorate in Sulaymaniyah Governorate

Background:

The public procurement impacts more than 30% on Endowment & Religious affairs Directorate in Sulaymaniyah Governorate, making it an important tool for public authorities to implement national energy efficiency policies, by promoting the production and the consumption of energy efficient products and services. This means using the opportunity created by the KRG government to orientate the use of this money on products and services aimed at the production of efficient and renewable energy and energy saving, improving competitiveness and promoting a balanced and sustainable economic growth in governorate.

Mitigation	
MWh/a	t CO_2/a
5148	4221
Contribution in %	
9%	
Cost in $	
100000	
Years of Implementation	
Key performance Indicator	
Annual energy Bill	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
SWH-BC-EELS	
Origin of action	
Local Authority	
Policy instrument	
EM	

Public procurement plays a key role in rationalizing public expenditures and in strengthening accountability, enhancing transparency and consequently contributing to sustainable development. Kurdistan government has reformed the new regulation on public procurement, the law was officially issued by the Minister of Planning in January 2016, and The Regulation became effective in July 2016. The KRG Government officially adopted the modern Public Procurement Regulation (Regulation #2 for 2016) defining the legal, institutional and procedural framework.

The new rule relies on developing a new legal framework based on clear and comprehensive provisions, the centre piece being the new Procurement Regulation embodies a balanced, win-win approach to allocating risk and responsibilities between the public and private sectors. The new legal framework also specifies institutional arrangements related to the execution of contracts, development of policies at the central level and ensuring methodical supervision, as well as other provisions that reinforce transparency and accountability.
The main obstacles are the difficulties which are facing the tendering department in the governorate in the implementation where most of the governorate departments are not well trained on implementation; moreover, the contactor is still not fully aware of the new rules and doesn't know how to implement it.

This brings more pressure on the contracting department which cannot be fully able to implement it inclusively.
The unfavourable legislative conditions include;

- institutional hurdles and low skills;
- Available information unevenly provided;
- Low awareness, which causes a lack of perception, demand and acceptance;
- Increased energy demand, due to the growth and urbanization;
- national energy markets with different rules;
- The cities characterized by an inefficient management of energy;
- market conditions do not allow the formation of a critical mass of suppliers

Description of action:

A comprehensive capacity building programs are established on the new regulation to cover the governorate and private sectors:

- Assign a Sustainable procurement specialised to support conducting the following actions;
- Train the administration departments of the Endowment & Religious affairs Directorate in Sulaymaniyah Governorate on sustainable Procurement procedures;
- Organize training of private sector representatives aiming at Sustainable Procurement procedures;
- Update the procurement specifications and procedures to meet the Sustainable Procurement;
- Monitor the implementation and apply suitable actions to improve the results.

General objectives:

Building an effective and socially accountable public procurement system will:

- Deliver quality services and support the sustainable development of KRG;
- Be in line with the KRG 2020 Vision of 'Effective, transparent, trusted and honest Government';
- Achieve Shared Prosperity and Protecting the Vulnerable;
- Save the local resources;
- Improve the energy efficacy and improve the sustainability;
- promote the adoption of transnational approach for the shaping of energy efficient public procurement policies and procedures;
- Override the national constraints in the implementation of energy efficient public procurement procedures, facilitating the coordination at transnational level and the achievement of national energy and resources policies objectives in KRG and precisely in Sulaymaniyah;
- Exchange of best practices on energy efficient public procurement practices;
- contribute to the re-orientation of suppliers towards the production of energy efficient services and products, through the removal of barriers which prevent enterprises from participation to public tenders requiring energy efficient measures/procedures, thus creating new business opportunities for the economic sector;
- upgrade the competences of private sector, increasing their awareness on the economic benefits deriving from a smart use of energy, thus fostering the creation of new enterprises and jobs in energy;
- enhance the role of public authorities, at all levels, in the diffusion of energy efficient behaviours in private sector, paving the way for transnational strategies in sustainable development and achieving energy efficacy objectives;
- increase the awareness of regional/local authorities and professional organizations representatives on the importance of sustainable procurement and upgrade their competences on the preparation/participation to energy efficient public tenders;

- Seek the optimum combination of whole life costs and quality, instead of the lowest initial price;
- Value for money, to acquire the goods, works or services needed, on the best available terms;
- Consider the quality of assurance and environmental management systems;
- Use criteria specified for ecological labels.

Policy Instrument:

The Government of Kurdistan Region remains keen on activating the reform roadmap to better serve its people, and acknowledges the support of international development partners, particularly the World Bank, which values its strong relation with KRG.

In line with the KRG 2020 Vision of 'Effective, transparent, trusted and honest Government', and as part of the 3-year economic reform plan aimed at "Achieving Shared Prosperity and Protecting the Vulnerable" launched in June 2016, the Government is exerting every effort to build an effective and socially accountable public procurement system that delivers quality services and supports the sustainable development of KRG.

Summary of Actions in Endowment & Religious affairs Directorate in Sulaymaniyah Governorate

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO_2/a	MWh/a	t CO_2/a		
Tertiary building								
		Directorate of Sulaymaniyah Endowment & Religious Affairs	57,206	46,909	22691	18607	47.0%	9,429,056
	16.0	Developing operation and maintenance management in Endowment & Religious Affairs Directorate in Sulaymaniyah Governorate Buildings and facilities						55,000
	16.1	Establish technical team and supporter						10,000
	16.2	Conduct An O&M assessment for Endowment & Religious Affairs Directorate building and facilities						20,000
	16.3	Preparation of a Guideline for Operations and Maintenance (O&M						10,000
	16.4	Train the staff on using the Guideline for Operations and Maintenance (O&M).						5,000
	16.5	Monitor the operation and apply additional measure to improve and maintain the results						10,000
	17.0	Improvement of Energy Efficiency in Mosques/churches and the administration Buildings in Sulaymaniyah Directorate for Endowment & Religious Affairs			18346	15044	38.0%	9,274,056
	17.1	Assign energy team from the staff with Energy Consultant						10,000
	17.2	Sorting the Mosques/churches according size and capacity or other base according to consultant recommendation						10,000
	17.3	Implementing simplified consumption saving measures supported with awareness raising and training			1448	1187	3.0%	10,000
	17.4	Conducting an analytical study of energy consumption:						50,000
	17.5	Applying the measure related to the Energy Auditing and monitor the results.						10,000
	17.6	Design and Supply and install Solar water heater			9656	7918	20.0%	6,434,640

	17.7	Replace the Water taps with motion seniors to reduce the water consumptions						2,661,416
	17.8	Replace normal lights with efficient LED lights			7242	5938	15%	58,000
	17.9	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						10,000
	18.0	Prepare Guide Line book to convert to green.						10,000
	18.1	Conduct workshop with the head of department and maintenance staff						10,000
	18.2	Repeat the same actions in other Mosques/churches, benefiting from the lessons learned from previous projects and planning new projects in other centres.						
	19.0	Ensure proper Implementation of New Public procurement in Endowment & Religious affairs Directorate in Sulaymaniyah Governorate			4345	3563	9%	100,000
	19.1	Assign a Sustainable procurement specialised to support conducting the following actions						
	19.2	Training the administration departments of the Endowment & Religious affairs Directorate in Sulaymaniyah Governorate on sustainable Procurement procedures						
	19.3	Organize training of private sector representatives aiming Sustainable Procurement procedures						
	19.4	Update the procurement specifications and procedures to meet the Sustainable Procurement.						
	19.5	Monitor the implementation and apply suitable actions to improve the results						

Sulaymaniyah General Directorate of Education

Introduction

Sulaymaniyah General Directorate of Education manages a high number of schools counting around 170 KG, 1210 Basic, 280 Secondary, 17 Primary, 16 technical, 19 institutes, and 21 special schools, of total 1733 schools, with around 473,616 students according to statistics 2015-2016.

The total measures for the schools are not defined due to many reasons from which we can summarise that the energy consumption is not that part of consideration in their basic plans for monitoring; however, the following could be obtained from the Duhok General Directorate of Education which will be used as base for calculation in Sulaymaniyah due to non-availability of data:

133 schools of different types obtained the following data for one area:

Table 22 analysing of energy consumption in 133 schools in Duhok as model for calculation

School identified according to the number of classes	Number of Schools	Area per school type	Consumption in KWh/month from utility power per school type	Annual consumption by X 7.3 months In KWh	Estimated electrification consumption with 24-hour available electricity without cut-off	Annual Space heating fuel in litre per school type	total annual Space heating fuel in litre
27	3	2400	6463	141,540	169,848	3159	9477
18	15	1710	4309	471,836	566,203	2106	31590
12	41	1215	3277	980,806	1,176,967	1632	66912
9	10	1200	2457	179,361	215,233	1224	12240
6	64	400	1594	744,717	893,660	816	52224
1317	133				3,021,911		172,443
Ave. No. class per school	10	Average electrical consumption per class in KWh in each hour of use		1	Space heating consumption per class in litre		131

Table 23 the consumption calculated for schools in Sulaymaniyah

The total electrical consumption that included the generators is not provided. For quick review, we will assume the data given are actual on which the analyses will be built on and suggest the actions accordingly, where it will be more convenient to have well documented data in the future to compare the results of actions and measures. The current financial and economic crisis has put an additional impact on the Directorate in a way to improve the services and reduce the cost. For that, it will be important to develop the indicators to improve the services and regulate the energy consumptions and reduce the energy bill.

Total number of schools	1,733
Total number of Classes	19,541
Total estimated Electrical Consumptions KWh	44,837,632
Total space heating fuel consumption in Litre	2,558,625
Average number of students per class	24
Total Number of students	473,616
Power consumption per students in KWh	95
power consumption per class in KWh	2,295

	Actual consumption in MWH for year 2015	BAU consumption in MWh for year 2030	BAU Emission 2030 in tCO2
Total estimated Electrical consumptions in KWh	44,837	72,637	59,562
Total space heating fuel consumption in litre	2,558,625	40,206	10,413
Total	58,167	112,843	69,976

Developing operation and maintenance management in Sulaymaniyah General Directorate of Education

Background

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
55000	
Years of Implementation	
Key performance Indicator	
Annual energy Bill	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
SWH-BC-EELS	
Origin of action	
Local Authority	
Policy instrument	
EM	

Sulaymaniyah General Directorate of Education manages around 8 directorates and administration facilities in addition to 1733 schools without specific proactive maintenance concept linkage with sustainability where the Operation and Maintenance (O&M) represents the greatest expense in operating a facility over its life cycle.
Through the process for preparing this report, it is well noted that the O&M measures related to energy conservation are not considered in the building and facilities an issue that causes tremendous losses for the opportunities in saving the O&M cost, which could be achieved through simple measures in O&M procedures.
So, **understanding why building systems are operated and maintained the way they are**, and where and what improvements are most beneficial and cost-effective is the first step to obtaining energy-efficient building performance.

To simplify the understanding of operation and maintenance, two main definitions will be considered as role of work:

- **Efficient O&M** is one of the most cost-effective methods for ensuring reliability, safety and energy efficiency. Insufficient maintenance of energy-using systems is a major cause of energy loss in the public buildings and facilities. Energy losses, water and air leaks, and other losses from poor maintenance are often significant. Good maintenance practices can generate substantial energy savings and should be considered a resource. Moreover, improvements to facility maintenance programs can often be accomplished immediately and at a relatively low cost.
- **Operational Efficiency represents the life-cycle,** cost-effective mix of preventive, predictive, and reliability-centred maintenance technologies, coupled with equipment calibration, tracking, and computerized maintenance management capabilities all targeting reliability, safety, occupant comfort, and system efficiency.

Description of the action

The following proposed actions:

- **Establish technical team and supporter** from Sulaymaniyah General Directorate of Education and MOE and Universities to perform the following measures.
- **Conduct An O&M assessment for** Sulaymaniyah General Directorate of Education building and facilities (include Schools) to provide a systematic look at all aspects of the current O&M practices including the management structure, policies, and user requirements that influence them. It includes the following:
  - Interviews with management, O&M personnel and service contractors;
  - A review of equipment condition, building documentation, and service contracts;

- Spot tests of equipment and controls;
- Trend or data logging of critical data points (temperatures, pressures, electrical, etc.) over time;
- The gathering and analysis of this information reveals where improvements are needed and which improvements are most cost-effective. More technical details can be obtained from references like best practice for Energy-Efficient Building Operations.

➢ **Preparation of a Guideline for Operations and Maintenance** (O&M) achieving operational efficiency, and providing useful information about O&M management, technologies, energy and water efficiency, and cost-reduction approaches.

This includes the key energy- and operational-efficiency-related elements in the SEAP as indicted below:
Technical Phase:
The decisions and actions regarding the control and upkeep of property and equipment are inclusive, but not limited to, the following:

- Actions focused on scheduling, procedures, and work/systems control and optimization; and performance of routine, preventive, predictive, scheduled and unscheduled actions aimed at preventing equipment failure or decline with the goal of increasing efficiency, reliability, and safety.
- Enhance efforts toward sustainable buildings and communities in building and facilities.
- Specific requirements include the implementation of high-performance sustainable building design, construction, operation and management, maintenance, and deconstruction.
- Managing existing building systems to reduce the consumption of energy, water, and materials, and identifying alternatives to renovation that reduce existing asset-deferred maintenance costs.
- Reconsideration of traditional irrigation methods and irrigated agriculture of landscapes, and reduce the water consumptions.

Administrative Phase:
Specify the roles and responsibilities of all the important administration elements in the process of O&M in the Sulaymaniyah General Directorate of Education:

➢ Train the staff on using the Guideline for Operations and Maintenance (O&M).

➢ Monitor the operation and apply additional measure to improve and maintain the results.

General objectives

The goal is to effectively and efficiently support the life cycle of the facility by eliminating unplanned shutdowns and realizing life-cycle cost savings. The O&M manual provides a means to reduce operating costs as part of a comprehensive maintenance program.

Pilot project in Schools in Sulaymaniyah General Directorate of Education

Background:

Mitigation	
MWh/a	t CO_2/a
29,055	23825
Renewable Energy	
MWh/a	t CO_2/a
8,000	6560
Contribution in %	
44%	
Cost in $	
7,243,250	
Years of Implementation	
Key performance Indicator	
Annual energy Bill	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
SWH-BC-EELS-	
Origin of action	
Local Authority	
Policy instrument	
EM	

Applying energy conservation regulation and renewable energy sources (RE) in schools' buildings and facilities is necessity, due to their high demand for energy and long operation of hours. The significant number of schools counts for around 1733 and serve 473,616 students (year 2105-2016), working in two to three shifts to cover the IDPs and refugee demand which increased rapidly in recent years.

Moreover, due to an inadequate power production capacity, the power provider has in recent years instituted a rotating power outage regimen in KRG, forced the schools to work without electricity or rely on backup generators during the power outages, causing an additional burden to their budget due to the high cost for operation and maintenance of generators, not to mention the effects of air pollution.

Knowing that, around 40 % of energy losses occur in transmission of Power from the main power station to facilities. Using of the RE resources in educational buildings & facilities will not only mitigate the emissions but also will reduce the unseen losses due to power transmission. In addition to that, the cost for producing one KWh of electricity in Sulaymaniyah is counted for 180 IQD where the actual tariff is only 60 IQD per one KWh, so using renewable energy resources will have significant benefits in producing clean energy as well in reducing public burden expenditures.

The General Directorate of Sulaymaniyah Electricity had carried a number of measures for schools in Sulaymaniyah Governorate to find out the best suitable places for the use of the RE resource. These measures did not denote the data for energy auditing, which is highly recommended along with energy conservation actions before any implementation of RE in these buildings. In the following action, the five selected schools will have three step measures starting from Energy Auditing and selection of actions related to energy conservation followed with implementation of RE.

Description of action:

- **Assign energy team from the staff of the school with Energy Consultant** to follow up the implementation of actions in the school in collaboration with the University and the MOE.
- Implementing simplified consumption saving measures supported with training and leaflet:
  - Turning off the lights before leaving the room;
  - Depending on natural lighting whenever possible;
  - Setting the temperature cooling unit in summer at the rate of 25°C and in winter at 20°C and developing the thermal calendar;
  - Activation of periodic maintenance works such as cleaning the air-condition unit filters on a monthly base and cleaning the outdoor units each two month to check the thermostat functioning and gas pressure each year;

- Installing photo cell for outdoor lights;
- Installing motion sensors in public places such as bathrooms and stairs;
- Replacing the defective lamps with efficient lamps like LED.

➢ Conducting an analytical study of energy consumption:

- Conducting an analytical study of consumption in the selected schools to identify the source of consumption and issuing an advice of measures that could help reduce energy consumption which called Energy Auditing for buildings;
- Launch meeting with school staff explain the results and present the actions as kind of raising awareness activities;
- Review the feedback and update the plan;
- Prepare simplified form for Energy Auditing which can be used in other new schools as results of lessons learned from this action.

➢ Applying the measure related to the Energy Auditing and monitoring the results. Divide the action into three types: simplified activates which do not need high budget and can be easily implemented, activates that can be done with business as usual process, and other activates which need budget.

- For simplified affordable activates:
  - Set the measures, monitoring and evaluation indicators;
  - Apply the measures;
  - Review the results and update the actions to obtain best results;
  - Share the results with the school staff and obtain their feedback;
  - Prepare report on activities and reached conclusion as best practice;
  - Other suggested actions by energy auditing.
- The activates which can be done with business as usual process while replacement of defective equipment, appliances and fittings for example:
  - Ensure purchasing energy saving appliances in any new purchase;
  - Replace defective equipment with efficient one.
- For the activates which need budget, assign the budget and sources of fund then if needed split the work to phases according to the fund availability.
  - Replace normal lights with efficient LED lights;
  - Replace the old A/C units with Energy saving one;
  - Other suggested actions by the energy auditing.

➢ Design and supply and install PV Solar System to supply Green Energy to the building.

- Design, supply and install the PV solar energy system in a way to have 50% of building energy consumption estimated for 100 PV solar panels each one having 250 W with a total capacity of 25KWp. The PV system is operated as On Grid system and should be integrated with the Backup Generators if available.
- Install solar water heater with a capacity of 200L on the roof top of the building;
- Train the maintenance staff of the operation and maintenance of the system;
- Replace the water taps in the bathrooms with motion senior ones to reduce the water consumptions

➢ Lessons learned report along with the challenges, solutions and benefits of the project to ensure best practices.

➢ Prepare a Guideline book for schools to convert them to green buildings.

- Conduct workshops with the head of department and maintenance staff of Sulaymaniyah General Directorate of Education to explain the progress and results obtained from the project.
- Repeat the same actions in other schools, benefiting from the lessons learned of previous projects.

General objectives:

These measures will be a model for transforming existing schools into sustainable buildings and could establish for successful subsequent stages in development policies in schools.

The reduction in operation and maintenance will be the main objectives, where the energy consumption will not only reduce the energy bill, but also will bring live examples to the people that can-do part of activates with low invest. Using the PV solar system and integrating it with backup generators would not only reduce the fuel consumption, but also would help in increasing the life span of generators and reducing air pollution.

The assumption of calculation of energy saving:

The estimated power consumption in school identified as to consumption of classroom which is 1KW, the replacement of lamps with efficient and long life LED lamps would save 50% of actual consumptions. On this base of assumption, the saving of energy in school is calculated.

According to the schools indicated above, the detailed type of load is not defined where some schools have air-conditions and some don't have. We will put the following assumptions that the school with high load type will be considered with equipped with air-condition so that the load sharing will be 10% for offices and 45% for Air-condition and 45% for Lights.

The schools which do not have air-condition, the load will be assumed 20% for offices and 80% will be for lighting.

Total saving for pilot schools is 69.7 MWh which counts for 40% of electrification consumptions.

Total renewable energy production is 79.8 MWh which count for 46% of electrification consumption.

When this action is applied on all schools the estimated reduction on consumption will be as follows:

	Actual consumption in year 2015 in MWh	BAU consumption in MWh in year 2015	BAU Emission 2030 in tCO2	Reduction in consumption in MWh	Renewable energy in MWh
Total estimated Electrical consumptions	44,837	72,637	59,562	29,055	20,625

Ensure proper Implementation of New Public procurement in Sulaymaniyah General Directorate of Education

Background:

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
100000	
Years of Implementation	
Key performance Indicator	
Annual energy Bill	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
SWH-BC-EELS	
Origin of action	
Local Authority	
Policy instrument	
EM	

The public procurement impacts more than 30% on Sulaymaniyah General Directorate of Education, making it an important tool for public authorities to implement national energy efficiency policies, by promoting the production and the consumption of energy efficient products and services. This means using the opportunity created by the KRG government to orientate the use of this money on products and services aimed at the production of efficient and renewable energy and energy saving, improving competitiveness and promoting a balanced and sustainable economic growth in governorate.

Public procurement plays a key role in rationalizing public expenditures and in strengthening accountability, enhancing transparency and consequently contributing to sustainable development. Kurdistan Government has reformed the new regulation on public procurement. The law was officially issued by the Minister of Planning in January 2016, and The Regulation became effective in July 2016. The KRG Government officially adopted the modern Public Procurement Regulation (Regulation #2 for 2016) defining the legal, institutional and procedural framework.

The new rule relies on developing a new legal framework based on clear and comprehensive provisions, the centre piece being the new Procurement Regulation embodies a balanced, win-win approach to allocating risk and responsibilities between the public and private sectors. The new legal framework also specifies institutional arrangements related to the execution of contracts, development of policies at the central level and ensuring methodical supervision, as well as other provisions that reinforce transparency and accountability.

The main obstacles are the difficulties which are facing the tendering department in the governorate in the implementation where most of the governorate departments are not well trained on implementation; moreover, the contactor is still not fully aware of the new rules and doesn't know how to implement it.
This brings more pressure on the contracting department which cannot be fully able to implement it inclusively.

Unfavourable legislative conditions; the obstacles can be summarised as follows:

- institutional hurdles and low skills;
- Available information unevenly provided;
- Low awareness, which causes a lack of perception, demand and acceptance;
- Increased energy demand, due to the population growth and urbanization;
- national energy markets with different rules;
- The cities characterized by an inefficient management of energy;
- Market conditions do not allow the formation of a critical mass of suppliers.

Description of action:

A comprehensive capacity building programs on the new Regulation to cover the governorate and private sectors.

- Assign a Sustainable procurement specialised to support conducting the following actions;
- Train the administration departments of the Sulaymaniyah General Directorate of Education on sustainable Procurement procedures;
- Organize training of private sector representatives aiming at Sustainable Procurement procedures;
- Updating the procurement specifications and procedures to meet the Sustainable Procurement;
- Monitoring the implementation and applying suitable actions to improve the results.

General objectives:

Building an effective and socially accountable public procurement system will:

- Deliver quality services and support the sustainable development of KRG;
- Be in line with the KRG 2020 Vision of 'Effective, transparent, trusted and honest Government';
- Achieve Shared Prosperity and Protecting the Vulnerable;
- Save the local resources;
- Improve the energy efficacy and improve the sustainability;
- Promote the adoption of transnational approach for the shaping of energy efficient public procurement policies and procedures;
- Override the national constraints in the implementation of energy efficient public procurement procedures, facilitating the coordination at transnational level and the achievement of national energy and resources policies objectives in KRG and precisely in Sulaymaniyah;
- Exchange of best practices on energy efficient public procurement practices;
- Contribute to the re-orientation of suppliers towards the production of energy efficient services and products, through the removal of barriers which prevent enterprises from participation to public tenders requiring energy efficient measures/procedures, thus creating new business opportunities for the economic sector;
- Upgrade the competences of private sector, increasing their awareness on the economic benefits deriving from a smart use of energy, thus fostering the creation of new enterprises and jobs in energy;
- Enhance the role of public authorities, at all levels, in the diffusion of energy efficient behaviours in private sector, paving the way for transnational strategies in sustainable development and achieving energy efficacy objectives;
- Increase the awareness of regional/local authorities and professional organizations representatives on the importance of sustainable procurement and upgrade their competences on the preparation/participation to energy efficient public tenders;

- Seek the optimum combination of whole life costs and quality, instead of the lowest initial price;
- Value for money, to acquire the goods, works or services needed, on the best available terms;
- Consider of quality assurance and environmental management systems;
- Use criteria specified for ecological labels.

Policy Instrument:

The Government of Kurdistan Region remains keen on activating the reform roadmap to better serve its people, and acknowledges the support of international development partners, particularly the World Bank, which values its strong relation with KRG.

In line with the KRG 2020 Vision of 'Effective, transparent, trusted and honest Government', and as part of the 3-year economic reform plan aimed at "Achieving Shared Prosperity and Protecting the Vulnerable" launched in June 2016, the Government is exerting every effort to build an effective and socially accountable public procurement system that delivers quality services and supports the sustainable development of KRG.

Summary of Actions in Sulaymaniyah General Directorate of Education

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO_2/a	MWh/a	t CO_2/a		
		Sulaymaniyah General Directorate of Education	138489	85879	37205	30508	44 %	7,398,250
	20.0	Developing of Operation and maintenance management in Sulaymaniyah General Directorate of Education						55,000
	20.1	Establish technical team and supporter						10,000
	20.2	Conduct An O&M assessment for Endowment & Religious Affairs Directorate building and facilities						20,000
	20.3	Preparation of a Guideline for Operations and Maintenance (O&M						10,000
	20.4	Train the staff on using the Guideline for Operations and Maintenance (O&M).						5,000
	20.5	Monitor the operation and apply additional measure to improve and maintain the results						10,000
	21.0	Pilot project in Schools in Sulaymaniyah General Directorate of Education			37205	30508	43.6%	7,243,250
	21.1	Assign energy team from the staff of the clinic with Energy Consultant						10,000
	21.2	Implementing simplified consumption saving measures						10,000
	21.3	Conducting an analytical study of energy consumption:						50,000
	21.4	Applying the measure related to the Energy Auditing and monitor the results.			70	57	0.1 %	12,000
	21.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			80	65	0.1 %	131,250
	21.6	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						10,000
	21.7	Prepare Guide Line book for School to convert them to green building.						10,000
	21.8	Conduct workshop with the head of department and maintenance staff						10,000
	21.9	Repeat the same actions in another Schools,			37055	30385	43.4%	7,000,000
	22.0	Ensure proper implementation of new Public Procurement in Sulaymaniyah General Directorate of Education						100,000
	22.1	Assign a Sustainable procurement specialised to support conducting the following actions						
	22.2	Training the administration departments of the DDERAD on sustainable Procurement procedures						
	22.3	Organize training of private sector representatives aiming Sustainable Procurement procedures						

	22.4	Update the procurement specifications and procedures to meet the Sustainable Procurement.						
	22.5	Monitor the implementation and apply suitable actions to improve the results						

Ministry of Higher Education
Establishing a Sustainable Energy Research Group (SERG)

Background:
Innovations and inventions in sustainable design and energy solutions are continuously growing, thanks to continuous research in the field. To complement, sustain, and thrive the other proposed projects (producing professionals and skilled technician in sustainable energy technologies), it is important to have a research group that undertakes state-of-art research in the field that can be used by and benefits different stakeholders from government, private, and education sectors.

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
80000	
Years of Implementation	
Key performance Indicator	
Increase in research capacity and projects in the area of sustainability -Increase in demands on sustainable energy technology solutions	
Measurement Units	
- Number of researchers in the field -Number of research that serves the region's market -Number of related publications in local and international conferences and journals	
Priority of action	
Area of intervention	
SWH-BC-EELS	
Origin of action	
Local Authority	
Policy instrument	
EM	

Description of action:
The proposed research group conducts innovative research in sustainability field to keep up with the latest in the field and provide consultancy to government and private sectors using a multidisciplinary Research and Development (R&D) approach. Such research group can also establish international connection and conduct collaborative research on related innovative projects.
The main activities involved with establishing the research group are:

1) Building a research group from qualified researchers who have postgraduate education and training (MSc. or PhDs) in sustainable design and sustainable energy technologies. Faculty members who received training for teaching in the proposed Bachelor's degree program in Environmental Design (Action No. 1) are also qualified to join the research group.
2) Establishing specialized MSc and PhD programs in sustainable design and sustainable energy and promoting the program to potential candidates.
3) Providing online access to related conference proceedings, journals, and other publications to the research group members.
4) Training the group researchers in writing grant applications and applying for funds for undertaking innovative sustainability related research projects.
5) Connecting the research group to counterpart research groups and centres around the world to establish research collaborations and contribute to the international scientific community.

General objectives:
Building research capacity and infrastructure to undertake state-of-art research in sustainability related field that can tackle both local and global challenges related to energy and finding environmentally friendly alternatives such as renewable energy.
Keeping up with the latest in the field of sustainable design and sustainable energy

Area of intervention:

Research and innovative research projects in different areas of sustainable design and energy using a multidisciplinary approach.

Policy Instrument:

Conducting research and increasing awareness in sustainable design and sustainable energy solutions.

Responsibility body: Sulaimani Polytechnic University (SPU)

Name: Dr. Alan Faraydoon Ali. Position: President of SPU

Name: Dr. Rozhen Kamal Mohammed-Amin. Position: Lecturer & Research Centre Coordinator

Stakeholders involved:

Sulaimani Polytechnic University: Sulaimani Governorate: Engineering Syndicate (Sulaimani Branch): Construction industry

Certified technical trainings in sustainable energy technology

Background:

Despite the slowly increasing supply in sustainable energy solutions and technologies by some private companies in Kurdistan Region of Iraq (KRI), the adoption and wide scale use of those solutions in ACE (Architecture, Construction, Engineering) industry is still very limited, even with the obvious needs. In addition to awareness and lack of willingness to breakaway from cheaper (yet less efficient) traditional solutions, one of the main contributing factors to slow adaption and low desire on using sustainable energy solutions is lack of local skilled technicians who can affordably maintain those technologies in a sustainable and long-term basis.

Description of action:

The proposed certified technical trainings target a wide range of area, technical skills, and education levels, including technical high school and diploma students and graduates. The goal is to increase number of local technicians who can affordably install and maintain sustainable energy technologies in the region to tackle the shortage in number of certified technicians and integration of sustainable energy interventions from the scale of houses to cities.

The training program can also offer exam preparation courses to professionals (engineers) or any other interested individuals in Leadership in Energy and Environmental Design (LEED) and other international green building certificates.

The main activities involved with establishing and offering such training program are:

1) Assessing the skill needs and shortages by engaging local authorities, private sector, and ACE industry.
2) Designing and developing training programs in the targeted areas.
3) When developing the programs, consulting international experts and the companies that provide or sell sustainable energy solutions that fit into the context of Kurdistan Region.
4) Training local academic staff and faculty members who will be offering the trainings (in other words, training the trainers).
5) Establishing lab and providing equipment, if needed.

General objectives:

Producing local skilled technicians who can use/install and maintain sustainable energy solutions and technologies whether on the scale of buildings (building envelops) or appliances.

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
100000	
Years of Implementation	
Key performance Indicator	
-Increase in public &ACE industry awareness about sustainable energy solutions -Increase in using sustainable building and energy efficient solutions (materials, technologies, process, etc) -Increase in demands on sustainable energy technology solutions	
Measurement Units	
-Number of buildings (public, commercial, office, residential, etc) with resource efficient solutions -Number of buildings that have obtained or are qualified to obtain green building certificates such as LEED	
Priority of action	
Area of intervention	
SWH-BC-EELS	
Origin of action	
Local Authority	
Policy instrument	
EM	

Introducing the use of sustainable energy technologies into a mass market in the region.

Area of intervention:

Technician capacity building for long-term and sustainable introduction, operation, and maintenance of sustainable energy interventions and technologies in the region

Policy Instrument:

Educating and training technicians in sustainable energy technologies

Responsibility body: Sulaimani Polytechnic University (SPU)

Name: Dr. Alan Faraydoon Ali. Position: President of SPU

Name: Dr. Rozhen Kamal Mohammed-Amin. Position: Lecturer & Research Centre Coordinator

Stakeholders involved:

Sulaimani Polytechnic University: Sulaimani Governorate: Engineering Syndicate (Sulaimani Branch): Construction industry

Establishing a Bachelor's degree program in Environmental Design (5 Years)

Background:

Unlike the traditional BSc. Architectural Engineering programs are offered in Kurdistan Region of Iraq (KRI) and even Iraq. Currently, the region suffers from lack of skilled professionals with knowledge and skills in sustainable design and practices. As a result, attempts to introduce sustainable energy solutions, policies, and technologies into ACE (Architecture, Construction, Engineering) industry are challenged by lack of local architects who can understand and integrate sustainable energy solutions into their designs and projects.

Description of action:

The proposed Environmental Design (ED) program transforms the traditional and disconnected architecture education and training in the region into one that relates to the local and global challenges and focuses on teaching and training about the principles and practices of sustainable design and integration of sustainable energy solutions and technologies in crafting the built environment.

The main activities involved with establishing such program are:

1) Engaging local stakeholder from higher education, government, and private sectors to identify professional skills gaps in the area of sustainable design and sustainable energy.
2) Designing and developing the program curriculum and courses content in consultation with experts in the field from leading international universities and engagement of the stakeholders.
3) Training local academic staff and faculty members in the subject matters to teach in the program.
4) Providing print and electronic library resources in the field to the program's library given their limited availability in the region.
5) Establishing lab and providing equipment based on the need of the curriculum.

General objectives:

- Producing much needed skilled professionals who can help with crafting ecologically sustainable built environments in the region.
- Building professional and academic capacities in sustainable design and practices.
- Boosting integration of environmentally responsible and resource-efficient solutions in ACE industry
- Transforming ACE industry of the region into one that comply with green building (sustainable building) requirements and rating systems such as those of Leadership in Energy and Environmental Design (LEED).

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
150000	
Years of Implementation	
Key performance Indicator	
-Increase in ACE industry awareness about sustainable building and energy solutions -Increase in using sustainable building and energy efficient solutions (materials, technologies, process, etc) -Increase in demands on sustainable energy technology solutions	
Measurement Units	
-Number of buildings (public, commercial, office, residential, etc) with resource efficient solutions -Number of buildings that have obtained or are qualified to obtain green building certificates such as LEED	
Priority of action	
Area of intervention	
SWH-BC-EELS	
Origin of action	
Local Authority	
Policy instrument	
EM	

Area of intervention:

Professional capacity building for long-term and sustainable introduction and maintenance of sustainable design and energy interventions such green and sustainable design, sustainable building envelops, net-zero energy buildings, sustainable energy technologies, smart building, etc.

Policy Instrument:

Educating and training skilled professionals in sustainable design and building as well as sustainable energy technologies

Responsibility body:

Sulaimani Polytechnic University (SPU)

Name: Dr. Alan Faraydoon Ali. Position: President of SPU

Name: Dr. Rozhen Kamal Mohammed-Amin. Position: Lecturer & Research Centre Coordinator

Stakeholders involved: Sulaimani Polytechnic University: Sulaimani Governorate: Engineering Syndicate (Sulaimani Branch): Construction industry

Summary of Actions in Sulaymaniyah Ministry of Higher Education

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
		KRG Ministry of Higher Education						330,000
	23.0	Establishing a Sustainable Energy Research Group (SERG)						80,000
	23.1	Building a research group from qualified researchers who have postgraduate education and training (MSc. or PhDs) in sustainable design and sustainable energy technologies						
	23.2	Establishing specialized MSc and PhD programs in sustainable design and sustainable energy						
	23.3	Providing online access to related conference proceedings, journals, and other publications to the research group members.						
	23.4	Training the group researchers in writing grant applications and applying for funds for undertaking innovative sustainability related research projects						
	23.5	Connecting the research group to counterpart research groups and centres around the world to establish research collaborations and contribute to the international scientific community.						
	24.0	Certified technical trainings in sustainable energy technology						100,000
	24.1	Assessing the skill needs and shortages by engaging local authorities, private sector, and ACE industry.						
	24.2	Designing and developing training programs in the targeted areas.						
	24.3	When developing the programs, consulting international experts and the companies that provide or sell sustainable energy solutions that fit into the context of Kurdistan Region.						
	24.4	Training local academic staff and faculty members who will be offering the trainings (in other words, training the trainers).						
	24.5	Establishing lab and providing equipment, if needed.						
	25.0	Establishing a Bachelor's degree program in Environmental Design (5 Years)						150,000
	25.1	Engaging local stakeholder from higher education, government, and private sectors to identify professional skills						

		gaps in the area of sustainable design and sustainable energy.						
	25.2	Designing and developing the program curriculum and courses content in consultation with experts in the field from leading international universities and engagement of the stakeholders.						
	25.3	Training local academic staff and faculty members in the subject matters to teach in the program.						
	25.4	Providing print and electronic library resources in the field to the program's library given their limited availability in the region.						
	25.5	Establishing lab and providing equipment based on the need of the curriculum						

Ministry of transportation & communication Directorate of Post & Communication

Repeater Station (Located at Zmnako Mountain)

Background:

The station is located at a remote area where there is no commercial power supply:

- The location is not habitable.
- The location located on the top of the mountain where the access road is not safe especially in winter season.
- The system is powered by 33kv Diesel Engine Generator, causing many technical and environmental problems.

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
Years of Implementation	
Key performance Indicator	
Measurement Units	
-Number of buildings (	
Priority of action	
Area of intervention	
Origin of action	
Local Authority	
Policy instrument	

Description of action:

It is important to install solar power system to replace the existing diesel generator, to be sufficient for:

- power microwave telecom system;
- power AC system, 1.5 ton;
- power illumination system;
- Estimated PV system, for the above-mentioned purposed is 5kw/h capacity with storing energy battery bank;
- Deep cycle type.

General objectives:

To support continuous telecom service in the area, minimize service interruption due to the continuous engine running failure, and to minimize smoke and CO2 emission.

Area of intervention:

Renewable energy for information and communication technologies

Policy Instrument:

Energy management

Responsibility body:

Ministry of Transportation & Communication Directorate of Post & Communication
Name: Dler Ibrahim Saeid Position: Director
Name: Karim A. Aghabawa Position: Technical director

Repeater Station (located at SARA Mountain)

Background:

- The station is located at a remote area where there is no commercial power supply
- The location is not habitable.
- The location is situated on the top of the mountain where the access road is not safe especially in winter season.
- The system is powered by 33kv Diesel Engine Generator, causing many technical and environmental problems.

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
Years of Implementation	
Key performance Indicator	
Measurement Units	
-Number of buildings (	
Priority of action	
Area of intervention	
Origin of action	
Local Authority	
Policy instrument	

Description of action:

To install a solar power system to replace the existing Diesel generator, to be sufficient for:

- power microwave telecom system;
- power AC system, 1.5 ton;
- power illumination system;
- Estimated PV system for the above-mentioned purpose is 5kw/h capacity with storing energy battery bank;
- Deep cycle type.

General objectives:

To support continuous telecom service in the area, minimize service interruption due to continuous engine running failure, and to minimize smoke and CO2 emission.

Area of intervention:

Renewable energy for information and communication technologies

Policy Instrument:

Energy management

Responsibility body:

Ministry of Transportation & Communication Directorate of Post & Communication
Name: Dler Ibrahim Saeid Position:Director
Name: Karim A. Aghabawa Position: Technical director

Summary of Actions in Tertiary Sector

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
Tertiary building			1240594	1017287	67476	55330	5%	20,100,264
		Health buildings and Facilities	145311	57484	7580	6216	10.81%	2,842,957
	10.0	Improvement of Energy Efficiency in Sulaymaniyah Directorate General of Health Main Building and branches	2349	1926	696	571	0.99%	356,000
	10.1	Assign energy team from the staff with Energy Consultant	781	640				10,000
	10.2	Implementing simplified consumption saving measures			26	21	0.04%	1,000
	10.3	Conducting an analytical study of energy consumption:						5,000
	10.4	Applying the measure related to the Energy Auditing and monitor the results.			208	171	0.30%	100,000
	10.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			45	37	0.06%	50,000
	10.6	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						5,000
	10.7	Prepare Guide Line book for Health Clinics to convert them to green building.						5,000
	10.8	Conduct workshop with the head of department and maintenance staff						10,000
	10.9	Repeat the same actions in other buildings	1568	1286	417	342	0.59%	170,000
	11.0	Improvement of Energy Efficiency of Health Facilities in Sulaymaniah Hospitals	131181	49967	5632	4618	8.03%	1,370,386
	11.1	Assign energy team from the Hospital staff with Energy Consultant			350	287	0.50%	11,589
	11.2	Implementing simplified consumption saving measures						1,000
	11.3	Conducting an analytical study of energy consumption:				0		5,000
	11.4	Applying the measure related to the Energy Auditing and monitor the results.			2672	2191	3.81%	635,195
	11.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			95	78	0.14%	105,427
	11.6	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						5,000
	11.7	Prepare Guide Line book for Health Clinics to convert them to green building.						5,000
	11.8	Conduct workshop with the head of department and maintenance staff						10,000

	11.9	Repeat the same actions in other Hospitals,			2515	2062	3.59%	592,175
	12.0	Pilot project in Health Clinic Centres / Primary healthcare centres (PHCs),	11781	5591	1252	1027	1.79%	1,016,571
	12.1	Assign energy team from the staff of the clinic with Energy Consultant						10,000
	12.2	Implementing simplified consumption saving measures			48	39	0.07%	1,714
	12.3	Conducting an analytical study of energy consumption:						5,000
	12.4	Applying the measure related to the Energy Auditing and monitor the results.			260	213	0.37%	180,795
	12.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			110	90	0.16%	134,063
	12.6	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						5,000
	12.7	Prepare Guide Line book for Health Clinics to convert them to green building.						5,000
	12.8	Conduct workshop with the head of department and maintenance staff						10,000
	12.9	Repeat the same actions in another Health Clinic Centre			834	684	1.19%	665,000
	15.0	Ensure proper implementation of new Public Procurement						100,000
	15.1	Assign a Sustainable procurement specialised to support conducting the following actions						
	15.2	Training the administration departments of the DDERAD on sustainable Procurement procedures						
	15.3	Organize training of private sector representatives aiming Sustainable Procurement procedures						
	15.4	Update the procurement specifications and procedures to meet the Sustainable Procurement.						
	15.5	Monitor the implementation and apply suitable actions to improve the results						
		Directorate of Suliymaniah Endowment & Religious Affairs	48283	39592	22691	18607	47.0%	9,429,056
	16.0	Developing operation and maintenance management in Endowment & Religious Affairs Directorate in Sulaymaniah Governorate Buildings and facilities						55,000
	16.1	Establish technical team and supporter						10,000
	16.2	Conduct An O&M assessment for Endowment & Religious Affairs Directorate building and facilities						20,000
	16.3	Preparation of a Guideline for Operations and Maintenance (O&M						10,000
	16.4	Train the staff on using the Guideline for Operations and Maintenance (O&M).						5,000
	16.5	Monitor the operation and apply additional measure to improve and maintain the results						10,000

	17.0	Improvement of Energy Efficiency in Mosques/churches and the administration Buildings in Sulaymaniah Directorate for Endowment & Religious Affairs			18346	15044	38.0%	9,274,056
	17.1	Assign energy team from the DERAD staff with Energy Consultant						10,000
	17.2	Sorting the Mosques/churches according size and capacity or other base according to consultant recommendation						10,000
	17.3	Implementing simplified consumption saving measures supported with awareness raising and training			1448	1187	3.0%	10,000
	17.4	Conducting an analytical study of energy consumption:						50,000
	17.5	Applying the measure related to the Energy Auditing and monitor the results.						10,000
	17.6	Design and Supply and install Solar water heater			9656	7918	20.0%	6,434,640
	17.7	Replace the Water taps with motion seniors to reduce the water consumptions						2,661,416
	17.8	Replace normal lights with efficient LED lights			7242	5938	15%	58,000
	17.9	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						10,000
	18.0	Prepare Guide Line book to convert to green.						10,000
	18.1	Conduct workshop with the head of department and maintenance staff						10,000
	18.2	Repeat the same actions in other Mosques/churches, benefiting from the lessons learned from previous projects and planning new projects in other centres.						
	19.0	Ensure proper Implementation of New Public procurement in Endowment & Religious affairs Directorate in Sulaymaniah Governorate			4345	3563	9%	100,000
	19.1	Assign a Sustainable procurement specialised to support conducting the following actions						
	19.2	Training the administration departments of the Endowment & Religious affairs Directorate in Sulaymaniah Governorate on sustainable Procurement procedures						
	19.3	Organize training of private sector representatives aiming Sustainable Procurement procedures						
	19.4	Update the procurement specifications and procedures to meet the Sustainable Procurement.						
	19.5	Monitor the implementation and apply suitable actions to improve the results						
		Sulaymaniah General Directorate of Education	112843	69976	37205	30508	44%	7,398,250
	20.0	Developing of Operation and maintenance management in						55,000

		Sulaymaniah General Directorate of Education						
	20.1	Establish technical team and supporter						10,000
	20.2	Conduct An O&M assessment for Sulaymaniah General Directorate of Education building and facilities						20,000
	20.3	Preparation of a Guideline for Operations and Maintenance (O&M						10,000
	20.4	Train the staff on using the Guideline for Operations and Maintenance (O&M).						5,000
	20.5	Monitor the operation and apply additional measure to improve and maintain the results						10,000
	21.0	Pilot project in Schools in Sulaymaniah General Directorate of Education			37205	30508	43.6%	7,243,250
	21.1	Assign energy team from the staff of the schools with Energy Consultant						10,000
	21.2	Implementing simplified consumption saving measures						10,000
	21.3	Conducting an analytical study of energy consumption:						50,000
	21.4	Applying the measure related to the Energy Auditing and monitor the results.			70	57	0.1%	12,000
	21.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			80	65	0.1%	131,250
	21.6	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						10,000
	21.7	Prepare Guide Line book for Schools to convert them to green building.						10,000
	21.8	Conduct workshop with the head of department and maintenance staff						10,000
	21.9	Repeat the same actions in another Schools,			37055	30385	43.4%	7,000,000
	22.0	Ensure proper implementation of new Public Procurement in Sulaymaniah General Directorate of Education						100,000
	22.1	Assign a Sustainable procurement specialised to support conducting the following actions						
	22.2	Training the administration departments on sustainable Procurement procedures						
	22.3	Organize training of private sector representatives aiming Sustainable Procurement procedures						
	22.4	Update the procurement specifications and procedures to meet the Sustainable Procurement.						
	22.5	Monitor the implementation and apply suitable actions to improve the results						
		KRG Ministry of Higher Education						330,000
	23.0	Establishing a Sustainable Energy Research Group (SERG)						80,000

	23.1	Building a research group from qualified researchers who have postgraduate education and training (MSc. or PhDs) in sustainable design and sustainable energy technologies						
	23.2	Establishing specialized MSc and PhD programs in sustainable design and sustainable energy						
	23.3	Providing online access to related conference proceedings, journals, and other publications to the research group members.						
	23.4	Training the group researchers in writing grant applications and applying for funds for undertaking innovative sustainability related research projects						
	23.5	Connecting the research group to counterpart research groups and centres around the world to establish research collaborations and contribute to the international scientific community.						
	24.0	Certified technical trainings in sustainable energy technology						100,000
	24.1	Assessing the skill needs and shortages by engaging local authorities, private sector, and ACE industry.						
	24.2	Designing and developing training programs in the targeted areas.						
	24.3	When developing the programs, consulting international experts and the companies that provide or sell sustainable energy solutions that fit into the context of Kurdistan Region.						
	24.4	Training local academic staff and faculty members who will be offering the trainings (in other words, training the trainers).						
	24.5	Establishing lab and providing equipment, if needed.						
	25.0	Establishing a Bachelor's degree program in Environmental Design (5 Years)						150,000
	25.1	Engaging local stakeholder from higher education, government, and private sectors to identify professional skills gaps in the area of sustainable design and sustainable energy.						
	25.2	Designing and developing the program curriculum and courses content in consultation with experts in the field from leading international universities and engagement of the stakeholders.						
	25.3	Training local academic staff and faculty members in the subject matters to teach in the program.						
	25.4	Providing print and electronic library resources in the field to the program's library given their limited availability in the region.						
	25.5	Establishing lab and providing equipment based on the need of the curriculum						

		Ministry of transportation & communication Directorate of Post & Communication						100,000
	26.0	Telecom repeater station in Zmnako						50,000
	27.0	Telecom repeater station in SARA						50,000

Public Lighting
Modernise and transform street lighting system

Background

Mitigation	
MWh/a	t CO_2/a
66549	54570
Contribution in %	
67%	
Cost in $	
39,980,325	
Years of Implementation	
Key performance Indicator	
Annual energy Bill	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
Origin of action	
Local Authority	
Policy instrument	
EM	

Street Lighting (or Roadway Lighting) is one of the most common forms of exterior lighting. The general purpose and importance of street lighting is to allow drivers and pedestrians to travel safely, see hazards, recognize objects and have a sense of security, as a result of improved night time visibility. Properly designed and maintained street lighting can provide comfort and safety during night-time conditions for both vehicle and pedestrian traffic.

In fact, street lighting does more than just reduce night-time traffic accidents, it can also:

- Reduce the level of petty crime and personal robbery, and give citizens a better feeling of security;
- Help road users without head lamps (e.g. the non-motorized, two-wheelers, etc.) to see potholes and small obstacles;
- On multi-purpose roads, enhance commercial and social activity during the hours of darkness, particularly after dusk; small installations in village centres, even operating for a few hours, can enhance community life;
- Make urban centres more attractive, especially for visitors and tourists.

General Directorate of Electricity (GDE) in Sulaymaniyah Governorate is responsible for providing street lighting services to its main streets and sub roads within its organized areas.

Modernization of the public street lighting should consider the design and specifications for roadway lighting, which include the light level, colour quality, light distribution, maintenance and initial cost. The energy efficiency has become a priority consideration due to the long operating hours of most outdoor lights. Increased energy efficiency in street lighting systems significantly reduces operation and maintenance costs. And this could be achieved through initial investment associated with more efficient lighting technologies which is easily outweighed by the lower overall life-cycle costs.

The following are the main features for street lighting which need to be addressed:

- The main switching system used in the public lighting is the **photo cell** which was before considered to be a good solution. Now as technologies lead, the use of **Astronomical timer** becomes more precise and avoids many wrong operation of photocell in cloudy days and also brings much more options by giving wider possibilities to adjust the timing of switching on and off according to the sunrise and sunset.

Astronomical timer helps adjusting street light operation according to the Dusk and Dawn which could save 365 days per year, also will avoid worthless functioning at cloudy days and with broken photocell.

- The usage of more efficient lighting like **LED** had been tested in pilot project which shows much saving as 400 watt HPS lamps had been replaced by 150 watts led and

this brings the saving to around 250 watts per each lamp which counts for 1MWh/year/ lamp per 400 watts. This process can be simply extended to all public lighting.

- Moreover, the possibility of using the new **smart technologies** in LED drivers which can be programmed to operate in normal full load, will adjust the light output at certain operation hours like after mid night and before the sunrise. This feature is important as it increases the life time of the street lights and reduces the energy consumed in no rush hours in the streets and contributes in emission reduction.

Description of the action

Setting street lighting measures is of great importance as the operational bill is becoming high; and due to the technological advancement, effective and successful solutions have come to be available. For example, incorporating the advanced and effective LED lighting offers high results in energy efficiency.
The measures could be summed as follows:

- Launch technical team from MOE and University with support of expert in street lighting to implement and apply the following measures:
- Develop design, installation, operation and maintenance guideline for public street lighting which include but not limited to the following;
  - Develop a **management and maintenance plan** to activate the role of regular maintenance and improve the efficiency of street lighting;
  - Develop **master plan** for street lighting classifying the type of street light according to the type of road;
  - Develop a **training programme** to train the maintenance personnel on the new measures;
  - Develop **specification and standard** for street lighting and main feeder pillars with support of specialist in street lighting.
- Apply the development and maintenance plan
  - Apply training to the staff on operation and maintenance procedures;
  - Apply the master plan for street lighting;
  - Apply management and maintenance plan;
- Apply the modernization and transition of public lights in phases, each phase would include upgrading of around five thousand streets lights which include the following:
  - Replace mercury lamps and sodium (HPS) lamps with efficient LED with smart drivers and surge protection;
  - Replace the photo cells in feeder pillars with astronomic timer;
  - Provide surge protection in main feeder pillars;
  - Track the development and the measurement in periodical time.
- Replace the street light by LED Lights on 60m ring road (Abusana Bridge to walwba bridge)
- Replace the street light by LED Lights on 60m ring road (Jawarta Bridge to walwba bridge)
- Replace the street light by LED Lights on 60m ring road (Jawarta Bridge to abusana bridge)

General objectives

- Saving energy consumption value;
- Improving services;
- Reducing emissions;
- Saving energy consumption value so as the street lighting and energy bill;
- Utilizing clean energy for street lighting;
- Improving the intensity of street, parks and building lighting;
- Raising citizen's awareness and encouraging them to replace lighting units with energy efficient ones.

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
Public Street Lighting			99487	81580	66549	54570	67%	39,980,325
	28.00	Modernise and transform street lighting system	99487	81580				
	28.01	Launch technical team						
	28.02	Develop a management and maintenance plan						10,000
	28.03	Develop master plan for street lighting						10,000
	28.04	Develop a training programme						10,000
	28.05	Develop specification and standard						10,000
	28.06	Apply training to the staff on operation and maintenance procedures;						10,000
	28.07	Apply the master plan for street lighting;						
	28.08	Apply management and maintenance plan;						
	28.09	Apply the modernization and transition of public lights in phases, each phase would include upgrading of around five thousand streets lights which include the following:						
	28.10	Replace mercury lamps and sodium (HPS) lamps with efficient LED with smart drivers and surge protection.			60820	49872		39,277,470
	28.11	Replace the photo cells in feeder pillars with astronomic timer;			5729	4698		217,618
	28.12	Provide surge protection in main feeder pillars;						435,237
	28.13	Track the development and the measurement in periodical time						
	28.14	Replace the street light by LED Lights on 60m ring road (Abusana Bridge to walwba bridge)						
	28.15	Replace the street light by LED Lights on 60m ring road (Jawarta Bridge to walwba bridge)						
	28.16	Replace the street light by LED Lights on 60m ring road (Jawarta Bridge to abusana bridge)						

Transportation

The energy consumption in transportation sector is listed below with BAU scenario:

Sector	Base year 2030		BAU 2030	
	MWH	t CO_2	MWH	t CO_2
Governorate fleet	395855	104469	641285	169240
Public transport			0	0
Private and commercial transport	6290544	1592371	10190681	2579641
Total	6686399	1696840	10831966	2748881

The following developed action is related to transportation.

Review, Update and implement the Existing Master Plan for Sulaymaniyah City to Include the Feature of Sustainability.

Background

Sulaymaniyah city Master Plan, of an area 473 km2, has been prepared in 2009 by a German company for 30 years under the supervision of Sulaymaniyah Municipality with a vision to develop the city

The goal was to prepare a land use plan for the city with a general layout of infrastructure networks. The main problem that the Municipality faced during the implementation of the plan up till now is the absence of infrastructure plans of the city especially in the transportation network and traffic management. Besides, there was not any detailed land use plan for the urban area.

The population of the city in 2016 is (906,583) inhabitants, "note: the ratio of age (15-64) is %64.9".

Family size is (4.6), "note: number of female for each 100 males is 101.7", Number of car/family is (1.5). Number of building approximately is (173,360). The ratio of green area is %10.

Since 2013, the city has become a (Cultural Capital) of Kurdistan-Iraq. The source of water is mainly from Dukan Lake which is (70 km) far from north west of the city.

Till today the city doesn't have the WWTP. Solid waste is collected by local companies then put in an open dump site without any recycling process and no sanitary landfill.

Mitigation	
MWh/a	t CO_2/a
1019068	257964
Contribution in %	
10%	
Cost in $	
1000000	
Years of Implementation	
Key performance Indicator	
Smooth movement of cars in congested roads	
Measurement Units	
Number of cars used	
Priority of action	
Area of intervention	
Urban planning	
Origin of action	
Local Authority	
Policy instrument	
Land use planning regulation	

Description of the action

- Data collection and assessment of existing situation.
- Formation of development strategy and forecasts.
- Applying the sustainability feature in the development plan in the aim to minimize the energy consumption, reduce power and water demands, encourage the green modes of transportation and using of renewable energy sources.
- Preparation of new master plan for the city with consideration of sustainability in regards of land use, infrastructure and transportation.

- Preparation of transportation plan in the aim to reduce car usage and promote public transport.
- Preparation of EIA.

General objectivise

- Creating a sustainable clean environment compatible with nature.
- Reducing traffic loads and promotes a more environmentally friendly transportation mode.
- Review the existing master plan and preparation of an updated master plan with consideration of reducing the energy consumption and promoting sustainable development.
- Increasing the green area and promoting urban agriculture in the master plan area close to inhabitants.
- Develop the city to grow parallel with its identity which is a Cultural Capital.
- Develop the City to become a centre for "Education, Health and Sport" facilities for all Iraq and the region as well.

In case this plan has not been prepared to review the city master plan and it is left as it is, in the near future, many problems will be faced regarding the transportation, infrastructure network, land use plan, people who live or visit the city, …etc.
For example regarding the transportation network, today the city has a congested network because of lack in traffic management, poor public network, high level of car usage,…. ect. For example, we have (350, 000) three hundred fifty thousand registered vehicles in the city which use approximately (2,000, 000 L /D) two million litres of petrol and gasoil daily, and there are around (25, 000) twenty-five thousand taxis in the city without any arrangements in which the majority spend most of the time on the road to catch passengers.

- Regarding the infrastructure and the environment issues, the city may face big problems because of the weak management plan in solid waste treatment (The city has 1,500 tons of solid waste daily which are dumped without any treatment), absence of waste water treatment plant (The city has aprox.220, 000 cubic meter of waste water daily which is flooding to the stream without any solutions or getting any re-use of it) and because of the heavy usage of petrol and gasoil as mentioned above.
- Regarding the land use, the city has to re-arrange its future plan to use and manage its land in a better way to increase green areas, and open spaces and to decrease the car usage, traffic load and the length of the infrastructure networks as it can have it in compact city patterns.
- Regarding the people who are the main contributors of the issues, all the above-mentioned factors will affect their life in the city. For example, traffic congestion will lead to time consumption, economic factors, and energy consumption and environmental problems will cause health issues, economic problems, less working time,…ect.

Body in charge:

Mayor of Sulaymaniyah Municipality Mr. Yousif Yassin
Mr. Myran Ahmed Mohamed Planning engineer

Shuttle bus / Express bus in regular congested roads.

Background

Express bus service is a type of fixed route that typically picks up passengers from park-and-ride lots in suburban areas and takes them to a central urban location. This transit service usually operates for longer-distance trips on a Saturday through Thursday, peak commuter time schedule.

These commuter routes have limited stops, typically travel non-stop on highways (utilizing any available High-occupancy vehicle (HOV) lanes), and terminate at the central business district in the city. Fares for the service may be comparable to park-and-ride fares, slightly higher than typical local fixed route service.

Adequate planning is the most important thing to consider when implementing an express bus route. Before implementation, planners should collect demographic and regional data prior to route planning.

Data collection involves origin and destination surveys, mapping of major employment centres, and service attractors, survey the potential users to determine schedules and routing, and should typically offer service in conjunction with one or more park-and-rides

Careful required planning, especially in areas of high transit demand during peak periods. Vehicle size should be taken into consideration during planning; larger vehicles should be assigned to the routes with the highest demand.

Mitigation	
MWh/a	t CO_2/a
101907	25796
Contribution in %	
1%	
Cost in $	
3400000	
Years of Implementation	
Key performance Indicator	
Number of cars per day	
Measurement Units	
cars	
Priority of action	
Area of intervention	
Improve transportation and reduce congestion	
Origin of action	
Local Authority	
Policy instrument	
Land use planning regulation	

Description of the action

The proposed action is to provide 50 Express buses to carry 10,000 passengers per day with estimated distance of 100 Km.

The main action concentrates on creating an Express bus, but before that it is recommended to ensure the action will be the right solution. The following basic steps of actions should be taken prior to implementation:

1. ***Establish Board committee*** to follow up the preparation for the action with representative of local and national level with stakeholders.
2. Proposal Development
   - Service analysis— collect demographic and regional data prior to route planning and determine whether express bus service is needed or would be a good fit for the area.
   - Initial concepts—provide basic schematics on proposed routing and scheduling. Review of customer and operator input and comments to determine if there has been demand in a specific area for express level service. Based on the comments, refine the design and schedules; develop costs for service based on hours of service needed to run route.
   - Initial proposals—selection of proposed route(s) and schedule(s) with internal stakeholders (marketing, scheduling, and operations).

- Community outreach (riders, general public, advisory committees, etc.)—take proposals to advisory groups and targeted populations the route(s) would serve to gather feedback. Hold meetings in central locations accessible by public transit to gather additional feedback. Then revise proposals based on all information gathered.

3. Board Process
   - Board committee review—present initial proposals and community feedback received to board work session or board planning committee.
   - Public hearing—hold separate public hearing for last-round of comments.
   - Final recommendations—present final proposal and recommendations for service to transit board of directors.
   - Board decision—transit board of directors approves or disapproves service.
4. Implementation Preparation
   - Schedule development—if service is approved, schedules are tested and finalized.
   - Operator work assignments—route is presented for operator bidding at the next work assignment period.
   - Marketing and communication materials—development and distribution of marketing and communications materials advertising the service offered.
   - Capital upgrades (vehicles, facilities, stops, etc.)—development and building of accessible stops, benches, shelters, and stations associated with the route. Purchase of new vehicles, if needed.
   - Information technology updates—updates and upgrades to agency website, automatic vehicle location (if applicable), and operator schedule sheets.

General objectives

Commuters from suburban areas, including state employees, students, and employees working in the central city are viable users of this service. Typically, commuters who would otherwise utilize freeways to travel to and from work during the week serve as potential users, because this service can use HOV lanes and create a less-stressful commute.
In addition, it will support the following:

- Increased transit usage can reduce the number of single occupancy vehicles on major freeways and highways. This decreases the traffic demand on the major urban freeways and streets.
- Express service can serve as an alternative to personal automobiles. Suburban commuters can depend on this transit service to commute to the urban central business district.
- Passengers can improve their time management by working on the bus, which is typically equipped with Wi-Fi services. Commuters can have more time to handle personal and business matters, rather than wasting time on a congested freeway.
- Express route travel times should be competitive to driving a personal vehicle so they can be a viable solution to mitigate congestion.
- Reduce the emission in the city.

Regulating Taxi Service in Main Centres

Background

Sulaymaniyah city is a small city of international standards covering an area of 473 Km^2. It's not expandable because it's between two mountains that make natural bounders for the city. Based to the data of Traffic police, today there are 110, 000 private vehicles, 50,000 Pickups and 20,000 taxis and minibuses in Sulaymaniyah governorate. This happened with the unavailability of policies to limit the number of taxi cars entering the city, where the city suffers from complexity of taxi operation with system grows out of the inherent randomness of taxi services and accompanied with vacant taxis cruise in the city to search for passengers.

The equilibrium and regulation in the taxi market by taking account of congestion externalities and adopting new rules for taxi services in main souk centre is important, taking into consideration specific taxi allowed to operate in the main souk with special structure queuing system.

The number of taxi cars driving without passengers are 40% of total 5000 taxi cars in the main souk with travel distance for around 20 Km with round trip of around four times per day.

These are helpful to taxi supervisor for regulating urban taxi operation system more efficiently and taxi drivers for providing better service.

Mitigation	
MWh/a	t CO_2/a
101907	25796
Contribution in %	
1%	
Cost in $	
50000	
Years of Implementation	
■■□□□□□□	
Key performance Indicator	
Number of cars per day	
Measurement Units	
cars	
Priority of action	
■■□□□□□□	
Area of intervention	
Improve transportation and reduce congestion	
Origin of action	
Local Authority	
Policy instrument	
Land use planning regulation	

Description of the action

- Assign technical committee consisting of Traffic department, planning department in the Governorate and the municipality, transport union and other related stakeholders to review all steps for successful implementation.
- Assign a consultant in transportation and planning to conduct a study on proposed locations for taxi stop stations in the main souk and develop the plan for implementation taking in consideration the opinion of the stakeholders (Taxi owners, Shops owners, visitors and traders), analysing the risks and challenges and proposing the solutions. In addition, review the project implementation cost and propose the alternative financial solutions for funding. Also, the use of technologies should be part of the solution to obtain real time results and have accurate data for proper management and efficient operation. Include the signage for citizen to guide them to the taxi parking area.
- Review the proposed design by the consultant and follow up the recommendation prior the implementation.
- Launch a coordination meeting with the national authority to gain approval for implementation and to get acceptance for participation of private sector in financing, installation, operation and maintenance the system through partnership with the private sector.
- Have community coordination meeting for promoting the implementation of the project with support of the Citizen Advisory Committee.

- Prepare the tender document and launch the project with private sector.
- Assign company to handle the monitoring and sustainability of operation.
- Monitor the implementation and operation.

General objectives

The project aims at establishing taxi parking within Sulaymaniyah in order to:

- Have the taxi parking generate income for the Governorate which can be used in improving the roads quality in these areas.
- Have the taxi parking also open new job opportunity for citizens and improve the sales for the shops and offices.
- Regulate the taxi in the main souk and assign special parking area to reduce traffic congestion and facilitate the movement of people throughout the city.
- Mitigate CO_2 emissions resulting from traffic congestion.
- Keep a clean and healthy environment for pedestrians.

Smart Taxi Service through Allocating Taxi Offices in Different Areas

Background

Sulaymaniyah is a small city of international standards covering an area of 150 Km^2. It's not expandable because it's between two mountains that form naturalboundaries for the city. Based on the data of traffic police, today there are 110, 000 private vehicles, 50,000 pickups and 20,000 taxis and minibuses in Sulaymaniyah governorate. This happened with the unavailability of policies to limit the number of taxi cars entering the city, since the city suffers from complexity of taxi operation systems that grow out of the inherent randomness of taxi services and accompanied with vacant taxis cruise in the city to search for passengers.

The equilibrium and regulation in the taxi market, taking into account the congestion externalities and adoption of new rules for taxi services in the main souk centre, is important. Assigning taxi offices is only allowed to operate in the city. This will help to supervise and regulate urban taxi operation systems more efficiently and taxi drivers will provide better service, spend less money and avoid travelling without passengers.

Mitigation	
MWh/a	t CO_2/a
50953	12898
Contribution in %	
0.5%	
Cost in $	
30000	
Years of Implementation	
■■	
Key performance Indicator	
Number of cars per day	
Measurement Units	
cars	
Priority of action	
■■	
Area of intervention	
Improve transportation and reduce congestion	
Origin of action	
Local Authority	
Policy instrument	
Land use planning regulation	

Description of the action

The estimated number of taxi offices is 30, and each office can manage 50 taxi cars with a total of 1500 taxi car.

- Obtain the legislation for allowing to open on call taxi offices in the cities
- Divide the areas into zones and determine the number of offices that can be granted a work permit with assigned number of taxis.
- Develop the indicators for proper monitoring the operation and ensure efficient services.
- Ensure integration of technologies in the service to reduce the operation cost and maintain the service in affordable level to users.
- Launch a coordination meeting with the national authority to gain approval for implementation and to get acceptance for participation of private sector in financing, installation, operation and maintenance the system through partnership with the private sector.
- Have community coordination meeting for promoting the implementation of the project with support of the Citizen Advisory Committee.
- Prepare the tender document and launch the project with private sector.
- Assign company to handle the monitoring and sustainability of operation.
- Continue to monitor the implementation and operation.

General objectives

The project aims at establishing taxi offices within Sulaymaniyah in order to:

- Have the taxi offices generate income for the Governorate which can be used in improving the roads quality in the theses areas.

- Have the taxi offices open new job opportunity for citizens and improve the sales for the shops and offices.
- Regulate the taxi in the city to reduce traffic congestion and facilitate the movement of people throughout the city, and avoid movement of taxis without passengers.
- Mitigate CO_2 emissions resulting from traffic congestion.
- Keep a clean and healthy environment for pedestrians.

Construction of a Unified Garage Project (Public and Private Transport) in Chamchamal District

Background

There is no unified garage to control the public transport in the judiciary, so the benefit of this project lies in the service of local authority and public utilities and residents of residential buildings, universities and industrial areas, agriculture and tourism and others.

Mitigation	
MWh/a	t CO_2/a
203814	51593
Contribution in %	
2%	
Cost in $	
1100000	
Years of Implementation	
■■□□□□□	
Key performance Indicator	
Number of cars per day	
Measurement Units	
cars	
Priority of action	
■■□□□□□	
Area of intervention	
Improve transportation and reduce congestion	
Origin of action	
Local Authority	
Policy instrument	
Land use planning regulation	

Description of the action

Chamchamal is a large district with several expansive areas and different neighborhoods. Therefore, there is a general urban garage to collect transportation in one area that serves the preparation of the circus. This project contributes to increase activity and increase the employment opportunities of the local population.

The construction of the structure of local materials with low cost and high specifications, the use of heating devices (use of hot water heating) and means of lighting by economic means, are conducive to the environment (solar lighting) and gas (for easy extraction of gas in the region) and provide enough space to protect the means of transport and passengers from different environmental conditions (sun and rain).

It is preferable to rely on inexpensive means to establish the project such as grants, subsidies and financing, and that the investment has a hand because it helps in increasing access to resources from different sources.

General objectives

1. Reduce environmental pollution
2. Reducing the incidence of traffic accidents (traffic jams)
3- Improving the general management of transport
4. Protecting the environment (keeping the environment clean)
5. Increase employment opportunities for citizens
6. Support the health sector

Body in charge:

Ministry of Public Municipalities Directorate General of Public Municipalities / Sulaymaniyah

Name: M / Bahaa El Din Ibrahim Fares Location: Director of Public Municipalities in Sulaymaniyah Governorate

Name: M / Noshirwan Hama Karim Location: Director of Planning and Follow-up

Provide Car parking spaces by applying smart park meters at side roads.

Background

The city of Sulaymaniyah, with its various regions, has a high increase of car ownership that facilitates the movement of people throughout the city. In addition, there are limited parking lots, that lead the driver to pass the same route several times to find a position for his car, where most of side road parking areas are usually full all over the day with no time limit applied for these parking lots.

This causes congestion in the road and waste of time for people searching for a parking space

Also, this creates issues for the shopping areas and others. Limiting the time of parking would be the proper solution for limiting the time used in parking; besides, providing alternative parking areas would be good for shop owners or long stopping time needs. It is estimated there are 750 cars using the side parking area of the road with distance of 4.5 Km.

The parking meters would also reduce traffic congestion, stimulate commercial and economic traffic in the capital and allow as many cars as possible to stand regularly in the streets.

Mitigation	
MWh/a	t CO_2/a
4533	1128
Contribution in %	
0.04%	
Cost in $	
368400	
Years of Implementation	
Key performance Indicator	
Number of cars per day	
Measurement Units	
cars	
Priority of action	
Area of intervention	
Improve transportation and reduce congestion	
Origin of action	
Local Authority	
Policy instrument	
Land use planning regulation	

Description of the action

Provide smart park meters for around 500 cars with street length around 3Km as to following procedures:

- Assign high demand areas where to Install Parking meters in the city;
- Hold coordination meeting with the national authority to gain approval for implementation and to get acceptance for participation of private sector in financing, installation, operation and maintenance the system through partnership with the private sector;
- Have community coordination meeting for promoting the implementation of the project with support of the Citizen Advisory Committee;
- Provide alternative long time parking area for the shops/offices owners and employees;
- Prepare the tender document and launch the project with private sector;

- Install parking meters with electronic meters that accept credit card payment (in addition to pay-by-phone, coins, and parking cards);
- Apply smart application on mobile phone to easy access to empty parking position;
- Make parking even more convenient by making it easier to pay and avoid citations with time limit of at least two hours;
- Assign company to handle the monitoring and sustainability of operation;
- Assign open free parking after working hours to allow for local citizen to park their cars.

General objectives

The project aims at establishing leased car parking within Sulaymaniyah in order to:

- Have the parking meters generate income for the municipality which can be used in improving the roads quality in these areas;
- Have the parking meters also open new job opportunity for citizens and improve the sales for the shops and offices;
- Make the parking meters a solution to reduce traffic congestion and facilitate the movement of people throughout the city;
- Mitigate CO_2 emissions resulting from traffic congestion;
- Keep a clean and healthy environment for pedestrians.

Summary of actions related to transportation

			BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
Transportation Private and commercial			10190681	2579641	1482182	375176	14.54%	4,876,400
	29.00	Review, Update and implement the Existing Master Plan for Sulaymaniyah City to Include the Feature of Sustainability.			1019068	257964	10.00%	TBD
	30.00	Shuttle bus / Express bus in regular base lines			101907	25796	1.00%	3,400,000
	31.00	Regulate taxi service in main centres			101907	25796	1.00%	5,000
	32.00	Smart taxi service through allocation taxi offices in different areas			50953	12898	0.50%	3,000
	33.00	Build New Garage station for public and private buses in Chanchamal District			203814	51593	2.00%	1,100,000
	34.00	Provide Car parking spaces by applying smart park meters at side roads			4533	1128	0.04%	368,400

Agriculture

Supply and install and operate Laboratory for agricultural crops

Background

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
4333300	
Years of Implementation	
Key performance Indicator	
Cultivation of 250 dunums of land with different plants	
Measurement Units	
Studying plant species present in the region	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

The Crop and Environment Laboratory (CEL) is a dedicated complex that offers a broad range of facilities and support services for research into plant and environmental science, with the control of various environmental variables, including: temperature, light intensity and quality, day length, relative humidity, irrigation, nutrient availability, and CO_2 concentration.

The laboratories provide agricultural lab tests on everything from seed to harvest for customers seeking to increase their production. From backyard gardeners to family farms to commercial farmers, tests include livestock wastes, grain, fruits, produce, dairy, vineyards, poultry, water, soil, and tissue.

The test includes:

Soil

The major objective of soil analysis is to inventory the soil's nutrient reserves and chemical composition. Since imbalances in essential elements can limit crop yields, this information is vital to determine what, if any, additions of nutrients are justified to produce maximum economic yields. Soil analysis is the best way to ensure that lime and fertilizer nutrients are applied in both an economically and environmentally responsible manner.

Backed by chemistry and research, soil analysis should be part of every producer's arsenal to control costs, maximize returns, and protect the environment.

Soil pH is one of the most important factors affecting soil fertility. Plant nutrients are most available when soil pH is maintained at a level just below neutral (pH 6.5 to 6.8). Ground agricultural limestone can be used to raise soil pH to a desirable level.

Fertilizer

Fertilizer raw material manufacturers, distributors, dealers, and growers all have a vested interest in knowing that the products that they handle meet or exceed quality and content specifications. The only way to be sure that the product that you are making, buying, or selling meets quality and content specifications is to have it tested by a laboratory.

Plant Tissue

Plant tissue analysis is a diagnostic tool that has been used for many years. It is based on the concept that, up to a certain critical point, the content of a nutrient in plant tissue is directly related to yield. And, nutrient concentrations in plants are directly related to the quantity of that nutrient in the soil that is available or that is in some way limited to the plant. Therefore, plant tissue analysis and soil testing go hand in hand.

Compost & Manure

Compost is widely used in horticulture and it helps improve the soil structure and enrich the nutrient content of the soil. As a result, there is an increasing interest in composting.

Manure is a valuable resource that can supply essential crop nutrients to displace the need for commercial fertilizers and organic matter to improve soil structure. Efficient utilization of manure can substantially reduce your production costs and protect our environment. Safe utilization of soil amendments from livestock sources such as manure does require particular safety precautions as it applies to use under the Food Safety Modernization Act (FSMA).

Water

Water is consumed in larger quantities than any other nutrient. A comprehensive water analysis can indicate the suitability of a water supply for household, irrigation, or livestock use. GAP and FSMA require the use of analytically verified potable water. Evaluating and documenting the microbial water quality utilized on your farm is a prerequisite step to providing safe agricultural products.

Whether it is the water quality in your home, school, business, favourite swimming hole, or farm knowing the exposure risks from bacteria just makes sense.

Environmental

New Age Laboratories provides a full range of environmental analytical testing services, such as analysis of soil, sediment, water, leachates, dust, and air. The range of analytical services provided for the above-mentioned matrices includes routine, trace, and ultra-trace level organics (volatiles, semi volatiles, pesticides, PCBs, herbicides), and metals. Analysis methods are based on well-established and internationally recognized procedures such as those published by the U.S. Environmental Protection Agency.

Description of the action

Supply, install and operate a laboratory to provide a variety of analytical and diagnostic agricultural and environmental testing. This provides many services (extension; training; improving agricultural practices) for farmers and academic students and researchers.

Main Analytical Services:

Soil Testing: as a management tool to help in decisions related to fertilizer applications. It provides a scientific basis for maintaining optimum soil fertility levels and protects against the expense and environmental hazards resulting from excessive fertilizer applications and other agricultural practices.

Drinking & Irrigation Water Analysis: for assessing water quality based on chemical and microbial contents.

Fertilizers: Quality and quantity control of imported fertilizers as official services.

Animal Waste Analysis (compost): for determining the nutrient content and other substances of animal waste as the initial step in utilizing the nutrients for crop production.

Feed and Forage Analysis: provides extension services to dairy and poultry industry such as proximate analysis for feed diets and concentrate formulation.

Toxicogenic Fungi Analysis: Food Quality Control: detection of toxic fungi on food, detection of their mycotoxins. The study of toxicogenic factors promotes fungi contamination of mycotoxins.

General objectives

This laboratory aims to help create healthier and more hygienic lives, and contributes to improving the yield of food crops and agricultural productivity.

The laboratory is engaged in the development of new agricultural chemicals and functional fertilizers, more effective and safer household insecticides, and technologies for preventing infectious diseases, as well as efficient synthetic methods for pharmaceutical chemicals.

Policy Instrument:

Increase public awareness and scientific agricultural / training

Responsibility body:

General Directorate of Agriculture in the province of Sulaymaniyah / Directorate of Horticulture / Department of fruit and nurseries

Name: Rezgar Mohammed Agha Kader

Name: Jalil Shams Aldeen Hamid

Studying and Development Orchids Nurseries

Background

Within the province of Sulaymaniyah and its districts, there are six nurseries and two seed plants. These farms are specialized in planting trees and various fruit seedlings by 400,000 to 500,000 seedlings and increasing the number of green areas in the area and in particular, increasing the species suitable for air and soil in the region such as olive trees, grapes, almonds, fennel, apricots, pistachios, etc. This has a positive impact on climate change and desertification. The cultivation of these trees increases the areas of the region decreases the use of carbon dioxide (CO_2), which increases oxygen emissions in the atmosphere, thereby increases the production of fruit seedlings by farmers working in these farms or by people who manage agricultural projects. With the exception of farmers, this project creates employment opportunities for many people who live in the surrounding areas of the city where the nurseries are located in their areas.

The importance of nurseries is that they are the only ones which provide the region with the seeds required to supply them for the needs of the region and increase the green areas. Hence, farmers are provided with fruit trees, especially the trees that are required to be supplied to farmers.

These nurseries annually produce more than 500,000 seedlings. However, due to the deterioration of the economic situation in the region, the seedlings required for farmers became scarce and completely damaged due to the lack of funds and care.

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
4333300	
Years of Implementation	
Key performance Indicator	
Cultivation of 250 dunums of land with different plants	
Measurement Units	
Studying plant species present in the region	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

Description of the action

The project is the provision of labor and production requirements and the provision of manpower, machinery and technical mechanisms for the production of seedlings in the following areas: (Bazian, Kanye Panke, Bakhar , Nalaparz, and Saqad Saib). Olive and pistachio plantations in Sulaymaniyah and Kannarui, are major sources of seed and seed production as raw materials. A number of activities are followed and divided into two main categories:

1. Species that multiply with seeds. These seeds will grow and become seedlings and then be bred and grafted by specialists in this field after two years of progress for farmers and agricultural entrepreneurs.
2. The species that are propagated by pens, after obtaining the pens and their farming, are taken care of and then distributed to the farmers and the owners of the agricultural projects.

The implementation of this project requires the allocation of funds and a special budget to implement the project to ensure continuity and the provision of seeds and seedlings on a continuous basis.

General objectives:

The objectives of this project are summarized in the following points:

1. Providing the seeds that are needed to forestall the areas to be irrigated, which will positively affect the environment in the future and reduce the emission of carbon dioxide in the atmosphere and its adverse effects on the environment;
2. Reducing the importation of foreign seeds, which in many cases lead to non-registered diseases that are not previously registered and affecting crops. In order to treat these agricultural pests, we need to use antibiotics that are contaminated with the environment and at the same time increase expenditures on the state. Reducing the import of these seeds will strengthen the country's infrastructure and thus strengthen the economy;
3. Increasing employment opportunities for the population of these areas because such projects need to be labor intensive and will increase the income of families;
4. Creating job opportunities for women who live in these areas;
5. Producing seeds that are suitable for the atmosphere of the region.

Policy Instrument:

Increase public awareness and scientific agricultural / training

Responsibility body:

General Directorate of Agriculture in the province of Sulaymaniyah / Directorate of Horticulture / Department of fruit and nurseries
Name: Rezgar Mohammed Agha Kader
Name: Jalil Shams Aldeen Hamid

Botanical Garden

Background

The project began with the allocation of land with an area of 250 dunums, and the cultivation of 10 000 different shrubs.

Description of the action

Establishment of the Botanical Garden, a scientific project to study the natural plants in the area and how to benefit from them.

General objectives:

The project has a social impact on how to benefit from plants and herbs from an agricultural, productive and medical perspectiveIn addition, it encourages tourism and increasing income.

Area of intervention:

Complete the Botanical Garden project.

Policy Instrument:

Increase public awareness and scientific agricultural / training

Responsibility body:

Directorate General of Agriculture Land Department
Name: Faridoon Omar Hussein
Name: Jamal Aziz Rahman

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
3720000	
Years of Implementation	
Key performance Indicator	
Cultivation of 250 dunums of land with different plants	
Measurement Units	
Studying plant species present in the region	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

Study on land use database

Background

The paper records for farmers with their lands, estimated for hundred thousand of paper documents which are subject to decomposition as they date back to more than 90 years old.
The sustainability in agricultural requires reliable database for land use, data on farmers, crops,..etc ,is accessible to and effective for farmers, and leads to the improvements in food productivity.
So, converting the paper records to electronic and work within sustainable framework is important.

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
500000	
Years of Implementation	
Key performance Indicator	
Measurement Units	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

Description of the action

Digitalising the records and converting them to electronic document is a main action to be taken as first step in the process to ensure saving the rights of the landowners and have data base on land use and other related agriculture information.

- Develop the policies and legislation for sustainable agriculture sector to include the long-term strategy for sustainability in agriculture along with frame of work and main players and actors.
- Identify and assign the national coordination group to support the development with main stockholders.
- Identify and assign the team of work for data collection.
- Develop the capacity of the team work in map archiving, tabulation and database creation.
- Equip the infrastructure of equipment, offices, technical equipment, accessories and communications network with technical qualified staff for maintenance.
- Purchase and install software along with supply of Server, Pc's, Printers to suite the work and operation of system.
- Assign technical staff for development and programming and software to link it with other facilities.

General objectives:

- Protect records from destruction.
- The speed of completion of farmer's transactions.
- Control of records and non-manipulation of transactions.
- Provide accurate statistics of the number of farmers, contracts and areas.
- Reduce the number of employees.

Area of intervention:

Information and Communication Technology

Policy Instrument:

Energy management

Responsibility body:

Directorate General of Agriculture Land Department
Name: Chalao Jamal Messenger Location: Director General
Name: Rizkar Hamad Khader Location: Assistant Director General

Park Hawary shar, Efficient energy consumption in the Garden

Background

Mitigation	
MWh/a	t CO_2/a
3908	3204
Contribution in %	
3%	
Cost in $	
2500000	
Years of Implementation	
Key performance Indicator	
Measurement Units	
Priority of action	
Area of intervention	
RE/EE	
Origin of action	
LA	
Policy instrument	
EM	

Hawary Shar Park represents the breathing lungs for Sulaymaniyah due to its large green area it covers, and its closeness to the city, where, it represents a destination for the citizens seeking tranquillity, coolness and fresh air. It is also one of the largest parks in the world. It was created within an area amounting to at least 4,400 acres (17.8 Square meter).
Managing such an area is not an easy task. It needs a lot of experience and team work in addition to a sufficient amount of budget to keep it green. Such work cannot be made possible without a sustainable plan to the park supported with short and long terms of actions.
In the following report, we will highlight two main parts of development related to energy and they are as follows:

- Improve the maintenance and development of work;
- a group of actions related to the use of renewable energy and energy efficiency as listed below:

All are related to sustainable development of Hawary Shar Park which is divided into main parts.

Description of the action

❖ Sustainable maintenance actions

The following recommendation obtained from the National park services of US department of interior with "*BEST MANAGEMENT PRACTICES USED AT URBAN PARKS IN NATIONAL AND INTERNATIONAL LOCATIONS"*

The recommendation for maintenance is considered as part of sustainable development in the parks.
Develop a landscape maintenance program that complements landscape quality standards.

This will cover the park's size and complexity, usage levels, maintenance infrastructure, and staffing and volunteer structures.

➢ Improve staffing model that works for the organization

The staffing model should complement the needs and desired culture of the organization. One model does not fit all situations.

The steps required to improve staffing model can be summarised as follows:

- Assess different staffing models, including in-house staff, contract services, and private/public partnerships.
- Maintain an adequate level of expertise in specialty skills on the park staff (e.g., landscape architecture).
- Use volunteers to enhance staff and contractor efforts. Engage volunteers in maintenance activities. The use of volunteers can enhance the parks' landscape maintenance program, with volunteers integrated into regular and seasonal activities. Volunteers with specialty skills bring a fresh perspective, along with a genuine interest in helping the park achieve its goals.

➢ Ensure goals, standards, and design intent are understood

- Ensure that maintenance staff and contractors understand quality expectations.
- Link landscape standards to day-to-day maintenance activities. An understanding of landscape standards at the operational level is essential so that standards are not viewed as solely a theoretical discussion.
- Maintenance staff must be educated on the activities required to achieve standards, with monitoring of maintenance and landscape staff and contractors against the agreed standards.
- Monitor maintenance performance against landscape quality standards.
- Reward consistently high performance and address poor performance immediately.
- Promote respect through a zero-tolerance approach toward trash on the ground or overflowing from trash receptacles, graffiti, and other forms of vandalism.
- Demonstrate respect for the park through high maintenance standards.
- Maintenance staff reinforces resource protection messaging through constant attention to the park's image.
- A zero-tolerance approach toward trash on the ground or outside trash receptacles, graffiti, and other forms vandalism promotes respect by visitors.

➢ Organize maintenance staff by zone and specialties

- Organize staff by geographic zones to develop expertise and to instil pride in one's work and a caring attitude toward the park. Organizing staff by district or zone and by specialty instils a sense of pride and accountability to established landscape quality standards.
- Manage zones to specific landscape standards.
- Develop specialty teams that work in all zones as needed.
- Develop a sense of pride in work through staffing by zone and specialty.

➢ Develop staff

- Hire staff based on both experience and attitude with great hiring choices. A well-thought-out hiring and retention process guarantees a fully engaged and capable staff. Hiring should be based on relevant education and demonstrated

skills, but more importantly on the ability to interact with the public, enthusiasm, and a willingness to perform duties. Where possible, permanent staff should be recruited from high-calibre seasonal staff. Using job titles such as landscapers and gardeners, instead of labourers, adds prestige for staff.

- Support the professional development and upward mobility of employees to boost morale and satisfaction levels. Encourage staff to continuously improve. Continuously motivating employees through increased responsibilities, upward mobility, training opportunities, skills acquisition, and mentoring helps build a committed staff. Showing appreciation through regular events for staff (e.g., quarterly luncheons) helps ensure that the staff are recognized for their accomplishments. Professional development, such as industry certifications and licenses, should be encouraged, along with support for attending classes, workshops, talks, and seminars from local landscape and turf organizations.
- Ensure that managers visibly participate in day-to-day activities. Develop a culture of active management. Having managers actively engage in day-today operations helps remove the communication barrier between line staff and management.

➢ Develop plans for regular and emergency maintenance

- Develop creative and flexible approaches and written schedules for recurring, periodic, and seasonal maintenance activities. Schedule maintenance to address regular and unexpected needs. Maintenance planning for known recurring, periodic, and seasonal activities should be conducted annually. Flexibility is needed so that schedules can be quickly modified to accommodate shifts in visitor use patterns, seasonality, weather, personnel availability, events, managerial priorities, and park projects. Static schedules, while easy to plan, fail to serve maintenance needs effectively over time. Supervisors should distinguish between frequently recurring tasks, such as mowing, and less frequent tasks, such as pest control, and balance scheduling between these two types of tasks. Regular meetings between park maintenance managers and line supervisors help coordinate work and facilitate decisions on staffing and schedule requirements. Special event staff maintain close communication with maintenance staff regarding anticipated needs.
- Develop a system to address typical emergencies and complaints. Respond to problems and complaints effectively. Both internal and external systems should be developed for dealing with emergencies, complaints, and general inquiries in a timely fashion. With procedures in place to respond to issues, the quality and safety of the landscape improves. Examples of issues to watch out for include being alerted to activities on closed turf areas, irrigation systems that are malfunctioning, vandalism of site furnishings, and hazardous trees. Calls from the public regarding landscape management issues are important for other monitoring efforts by park or contractor staff.
- Respond to complaints in a timely manner, and develop and maintain a system to convey that action has occurred. Plan efficient approaches to regular activities.
- Creative thinking is needed in determining how to achieve maintenance activities. Perhaps timing and equipment can be modified to achieve goals.

- Develop a system to monitor and track park conditions. Actively engage the public in monitoring landscape standards. The landscape standards need to be known to the public. A web-based monitoring system can clearly state the desired landscape conditions and engage with the public in monitoring progress

➢ Use sustainable maintenance practices

- Begin to move toward organic practices and implement them as possible. Move toward an organic landscape management approach. The expertise and supporting systems for organic landscape management practices need to be developed. Organic compost can be bought from other suppliers in the area, or a facility can be established within the park.

- Limit the use of commercial fertilizers, pesticides, and herbicides, and use chemicals responsibly when necessary. Limit commercial fertilizers, pesticides, and herbicides. Rather than using chemicals to treat turf, trees, flowers, and other natural resources in the park, other scientifically supported practices to reduce the negative impacts of fertilizers, herbicides, and pesticides should be considered.
  - Include a runoff prevention program within a park's turf grass management program to reduce the loss of sediment, nutrients, and possible pollutants into nearby water areas from fertilizers, herbicides, and pesticides.
  - Do not apply fertilizers or pesticides to saturated soils, frozen soils, or non-target surfaces (concrete, plastic, hardscapes), since application on these surfaces will likely increase chemical runoff during subsequent rainfalls.
  - Use slow-release nitrogen and phosphorus fertilizers as well as aeration. Slow release products provide a small amount of soluble nutrient at any given time, thereby reducing potential runoff.
  - Aeration helps increase the surface infiltration rate and slows soil saturation that results in runoff. While aeration may increase leaching, the surrounding soil is an excellent filter and provides resistance.

- Address soil compaction with turf closures and rotations, limited traffic, post event treatments, engineered soils, and irrigation. Regular, routine maintenance procedures and reasonable restrictions on the use of turf areas can mitigate soil compaction resulting from high use.
- Use irrigation systems strategically. Irrigation systems must function properly and be operated effectively. Staff should be trained to monitor irrigation systems and adjust irrigation scheduling based on use patterns and climate. Coordinating between event management and maintenance staff maximizes the effectiveness of irrigation and minimizes the damage that could be caused by the combination of wet turf and heavy pedestrian or vehicle traffic. Adequate irrigation is an essential maintenance element for turf grass that is subject to high temperatures and high use. All study sites have irrigation systems, with the majority using

underground systems or a combination of underground and manual or aboveground irrigation.

- **Actions related to use of Renewable Energy and Energy Efficiency**

In order to develop the action, the following background information are given by the Park department:

Year of Establishment: 2010
Area: 500 Donim (1 Donim = 2,500 m2)
Number of planted trees: 55,000 (missed types of trees)
Number of staff & Workers: 29
Number of wells: 2
Number of Generators: 2
Number of Surface basins: 2 (with capacity of 25,000 lit)
Number of Sustained basins: 1 (with capacity of 50,000 lit)
Water distribution network: 1 network for all the Park
Number of pumps for feeding water from surface to sustained basin: 2
Amount of Diesel needed: 20,000 lit/year
Amount needed for Electricity: 2,000,000 ID / year

Electrification:
The public lighting consists of the following load:

Type	Number	watt	total watt	Current annual consumption in KWh
3-meter pole	1850	60	111000	488400
8-meter pole	420	4x70	117600	517440
9-meter pole	42	250	10500	46200
20-meter pole	3	6x 1000	18000	79200
20-meter pole	8	6x400	19200	84480
12-meter pole	111	2x250	55500	244200
12-meter pole	42	250	10500	46200
10-meter pole	739	250+150	295600	1300640
		Total load in watt	637900	2806760
Lighting Load in KW			638	2,806,760

- **The action related to public street lighting:**

The following table summarises the possible reduction in consumption for the park lighting

Type	Number	Current annual consumption in KWh	annual consumption by using LED lamps in KWh	By using Astronomical timer	By using Smart driver for LED lamps	SUMMARY OF ENERGY SAVING IN KWH
3-meter pole	1850	488400	56980	52253	39190	449210
8-meter pole	420	517440	221760	203364	152523	364917
9-meter pole	42	46200	11088	10168	7626	38574
25-meter pole	3	79200	59136	54230	40673	38527
25-meter pole	8	84480	33792	30989	23242	61238
12-meter pole	111	244200	97680	89577	67183	177017
12-meter pole	42	46200	18480	16947	12710	33490
10-meter pole	739	1300640	552772	506917	380188	920452

TOTAL LOAD IN KWh	2806760	1051688	964446	723334	2083426
SAVING %		63%	66%	74%	74%

The current public lighting load counted for 638KW where this type of load could be reduced by replacing the current FLU and HPS lamps with LED efficient lamps and this would bring the total load down to 239KW, which count for 63% reduction in consumption. With astronomical timer and with intelligent dimming system, the saving could reach 74% of current load, where it will be possible to dim the lights and save energy after 12:00 mid night. The estimated cost will be in range of 1,000,000USD where the current energy bill cost 2,806,760 KWh x 130 IQD = 364,878,800 (306,498 $)/a which could be reduced to 94,033,420 IQD (78,988 $).
With yearly saving (income)= 227,510$/a, and emission saving 2083 MWh x 0.82= 1708 tCO2/a

Water supply

The Park has two sources for water supply:
The **first source** of water pumped through 16 KM pipe lines from the river, through several pumping stations and storage tanks according to the following table:

Water pumping load type in KW	Daily working hours	Annual average operation in Months	Annual consumed power in KWh/a
30	18	8	129600
50	18	8	216000
500	18	8	2160000
500	18	8	2160000
Total KWh/a			4,665,600

The **second source** of water comes through 9 wells, which they operate only on Utility power, The estimated time for operation is around 8 hours per day. The pumps load is (55Kw x 6 + 7.5Kw x 2 + 18.5Kw x 1) 363.5Kw and they consume 697920 kWh/a.
along with the well there are four storage tanks and there are 8 water pumps (30Kw x 4 + 22Kw x 4) 208Kw, and they consume 399360 Kwh/a

Type of pump in Kw	QUANTITY	Total Load	Consumption in Kwh/a
7.5	2	15	64800
55	6	330	1425600
18.5	1	18.5	79920
30	4	120	518400
22	4	88	380160
Total consumptions in KWh/a			2,468,880

In addition to that, there are water pumps for fountains and channels and drinking water. The total actual load is estimated to be:
This brings the total consumption of electricity per year with public lighting to: **11,975,096 KWh/a,** which counts for around 12 GWh /a.
The consumption cost is calculated as follows:
130 IQD x 12,000,000 KWh=1,560,000,000 IQD (1,310,400 $).
From which 306,498$ for public lighting and remain is for water pumping and irrigation.
The city suffers a cut-off in electricity from Utility for that backup diesel generator of 100KVA at cut-off time, the estimated consumption of BDG is around 25L/h of fuel.

Kw	Kwh/a
256	1244160
120	583200
37	39960
50	54000
44	47520
28.6	30888
5.6	6048
15	16200
5.5	5940
5.5	5940
Total consumptions in KWh/a	2,033,856

- Action related to Water pumping station

  By providing Photovoltaic Solar Power Station (PV power station) will reduce dependence on Utility Power grid and will contribute in reducing the energy bill.
  The proposed PV power station is 1MW. This could produce 1,825 MWh/a and generate an income of 200,000$/a with a total invest of 1,500,000$.
  The calculated reduction in emission is = 1,825 MWh x 0.82= 1496 tCO2/a.

Summary of actions related to Agriculture

			BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
Agriculture			141484	116018	3908	3204	2.76%	11,053,300
Action priority 2	35.0	Supply and install and operate Laboratory for agricultural crops						
	36.0	Research and development of fruit Nurseries Orchards						4,333,300
	37.0	Botanical Garden						3,720,000
	38.0	Study on land use database						500,000
	39.0	Park Hawary shar, Efficient energy consumption in the Garden			3908	3204	2.76%	2,500,000

Waste water Management

Sewerage Treatment Plant for Black Water into Derbandakhan Dam

Background

Currently black water and residual materials, from recycling of engine oil, hospitals, industrial, trade and agriculture, directly go through combined sewerage network towards Tanjaro stream.

Finally, it subsidies toward Darbandikhan dam, which accounts as a source of potable water for Darbandikhan district, fish fortune, tourism and hydropower source.

Hence, the colour of the stream waves towards gray or black ending up in negative environmental impact.

Description of the action

At least the construction of sewerage treatment plant with a capacity of 200,000 cubic meter per daywill qualify sewerage water to better standards with no bad health influence.

General objectives

- Getting back the colour of stream to natural source;
-Planting with better quality water;
-Preventing water born disease like Vibrated Cholera, vomit and diarrheawith minimal treatment, that can be used as potable water;
-Residuals from treated sewerage can be used as fertilizers-Better environmental surroundings
-Extension the quantity of fish inside river and dam
-Extend life of hydropower instruments when most of chemical and biological ingredients will be removed.

Cost: 150,000,000 USD

Responsible body:

Department in charge Directory of Sewerage- Sulaymaniyah
Name: Sarbast Othman Qader Location: Director / DWS
Name: Avan Noori Location: Deputy Director
Project duration: 24 months

Management of Healthcare Environmental Hazards Wastewater

Background

The wastewater in hospitals and health care centres contains different types of hazard liquids. For example chemicals that include anaesthetics, disinfectants (formaldehyde, glutaraldehyde), chemicals from laboratory activities, photochemical solutions (hydroquinone), and X-ray contrast media containing absorbable organo halogen compounds (AOX), mercury from dental amalgams or lab chemicals, excessive nutrients and nitrates, pharmaceuticals, including antibiotics, radioactive wastes, infectious agents, including bacteria, viruses and parasites, where the wastewater is potentially infectious.

With no sewer systems or watertight facilities with healthcare and with improper wastewater management, the wastewater can leak into groundwater, and may result in the pollution of local drinking water sources, or the contamination of natural resources.

Description of the action

The improper and inadequate management of the biomedical waste in health care facilities would increase the incidence of health risks to the healthcare workers, the patients, and their environment and to the community at large.

The safe and effective management of biomedical waste in different forms of solid or water would reduce the risks to health. Hence, the development of safe and effective management of biomedical waste along with handling protocols, institutional plans and policies, appropriate training and feedback programs on proper waste management and handling for all the healthcare workers are highly recommended.

- Review and evaluation on the institutional plans and policies and legislation for health facilities waste management in its different forms and identify the weakness and gaps in legislation.
- Identify and assign the national coordination group to support the development of waste management legislation with support of main stockholders.
- Conduct mapping for all kind of wastes in healthcare facilities and the review the procedures and workflow for treatment.
- Develop waste management protocol and legislation with support of health waste management consultants.
- Apply the action in healthcare facilities through short and long term plans.

General objectives

The safe and effective management of health care biomedical waste has received much attention for improper and inadequate management which is associated with an increase in the incidence of health risks to the healthcare workers, the patients, and their environment and to the community at large. Hence, the development of safe and effective management of biomedical waste along with handling protocols, institutional plans and policies, appropriate training and feedback programs on proper waste management and handling for all the healthcare workers are highly recommended.

Solid Waste management

''The KRI lacks modern and efficient infrastructure for collection and disposal. It is common to see heaps of garbage both in urban and rural areas set on fire or polluting water sources. Ultimately, these risky practices are a result of insufficient services and regulation, as well as an uninformed citizenry.
Currently, solid waste collection and disposal is a strain on the environment and human health, as well as the economy''.[3]
Furthermore, ''Solid waste is a major problem and the ultimate solution is recycling; while this is being under consideration, the establishment of a controlled landfill in an area that is much farther from the river is probably the most appropriate immediate solution to the solid waste disposal problem for Sulaymaniyah City.
Immediate measures need to be taken to prevent further pollution of the Tanjaro River, by isolating the polluting sources. Industrial activities need to be regulated and monitored in terms of environmental and occupational safety operations and standards''.[4]

Also, these shortfalls in services represent an opportunity for improvement, investment and economic growth. Reducing landfill waste is an environmental and public health necessity, but also an opportunity to provide jobs in reprocessing some of the materials for industrial use.
The solid waste management sector is one that will operate and provide income opportunities regardless of the economic situation. An assessment that identifies market linkages, as well as market gaps, is needed for improvement of the system of waste collection and disposal, and to provide opportunities for the recovery of the local economy at the same time. [5]

The solution lies in better management of solid waste and efficient collection and sorting; in addition to some other solutions like incineration in which some data about it is listed below in order to be aware of the available technologies in market.

Incineration

''A waste treatment technology, which includes the combustion of waste for recovering energy, is called as "incineration". Incineration coupled with high temperature waste treatments are recognized as thermal treatments. During the process of incineration, the waste material that is treated is converted in to IBM, gases, particles and heat. These products are later used for generation of electricity. The gases, flue gases are first treated for eradication of pollutants before going in to atmosphere.
Incineration reduces the mass of the waste from 95 to 96 percent. This reduction depends upon the recovery degree and composition of materials. This means that incineration however, does not replace the need for landfilling but it reduced the amount to be thrown in it.

[3] https://uncareer.net/vacancy/solid-waste-management-value-chain-assessment-kurdistan-regi-157969
[4] Environmental Health Assessment in Sulaymaniyah City and Vicinity, by Nasih Othman Kurdistan Institution for Strategic Studies and Scientific Research, Thomas t Kne William Joiner institute, University of Massachusetts Boston,
[5] https://uncareer.net/vacancy/solid-waste-management-value-chain-assessment-kurdistan-regi-157969

Incineration comes with a number of benefits in specific areas like medical wastes and other life risking waste. In this process, toxins are destroyed when waste is treated with high temperature.

Incinerators and their types:

Incinerator can be understood more precisely as a furnace where waste is burnt. Modern incinerators are equipped with pollution improvement systems, which play their part in cleaning up the Flue gas and such toxicants. Following are the types of plants for burning waste:

Moving Grate:

The incineration plant used for treating MSW is moving grate. This grate is capable for hauling waste from combustion chamber to give way for complete and effective combustion. A single such plant is capable for taking in thirty-five metric ton of waste every hour for treatment. Moving grates are more precisely known as incinerators of municipal solid waste.

This waste is poured in the grate with a help of crane from and opening or throat. From here, the waste has to move towards the ash pit. Waste is further treated and water locks wash out ash from it. Air is then flown through the waste and this blown air works for cooling down the grate. Some of grates are cooled with help of water.

Air is blown through the boiler for another time but this time comparatively faster than before. This air helps in complete burning of the flue gases with the introduction of turmoil leading to better mixing and excess of oxygen. In some grates, the combustion air at fast speed is blown in separate chamber.

European Waste Incineration Directive is of the view that an incineration plant must be designed so that operating worker must know that flue gases are reaching the temperature of eight fifty degrees centigrade with in two seconds. This would ensure complete and required breakdown of toxins of organic nature. In order to achieve this every time backup auxiliary burners must be installed.

Fixed Grate:

This was the fixed and much older version for grate. This kind generally is lined with the brick while lower or ash pit is made up of metal. This grate generally has an opening at the top and for loading purpose; a side of the grate is left open. A number of fixed grate were first formed in houses, which today are replaced by waste compactors.

Rotary-kiln:

Industries and municipalities generally use this sort of incinerator. This incinerator consists of two chambers i.e. primary and secondary chamber.

Fluidized Bed:

In this sort of incineration, air is blown at high speed over a sand bed. The air gets going through the bed when a point comes where sand granules separate and let air pass through them and here comes the part of mixing and churning. Therefore, a fluidized bed comes in to being and fuel and waste are then can be introduced.

The sand along with the pre-treated fuel or waste is kept suspended and is pumped through the air currents. The bed is thus mixed violently and is uptight while small inert particles are kept suspended in air in form of fluid like form. This let the volume of the waste, sand and fuel to be circulated throughout the furnace, completely.

Specialized incineration:

When it comes to the furniture factory for incineration of the waste, they need to take special precautions, as they have to handle inflammable material. For this purpose, they have incinerators, which are installed with burn back prevention systems and are

very much necessary for the dust suspensions when they are more able to catch up the fire.

Use of Heat:

The heat that is produced by an incinerator can be used for generating steam, which is used for driving a turbine in order to produce electricity. The typical amount as is produced by Municipal waste per ton is 2/3 MWh for electricity and two MWh for heating.

Pollution:

Incineration is conducted with a number of outputs, which includes ash and flue gas emission. Before the flue gas cleaning systems were introduced, the flue gas has to move to atmosphere thus leading to pollution.

Emission of Gases:

Furans and Dioxins

The biggest most concern, which has caught thoughts of environmentalists about MSW's incineration, is production of a huge number of furans and dioxins. These are considered staidly injurious to health. Modern generators are equipped with special equipment to clean emission of gases from these injurious components. There was a time when no governmental regulation was there to bound incineration and save environment and atmosphere from this hazardous emission of gases, but today there are strict and rigid rules and regulations to follow and conduct incineration.

Carbon dioxide

Incineration while being conducted produces a vast amount of carbon dioxide. Carbon dioxide plays a due role in global warming, as this is the greenhouse gas. It has been observed that almost everything which has carbon in its composition is when processed by incineration evolves out as carbon dioxide.

Extra Emissions

Some other emissions of gases by waste processing are sulfur dioxide, hydrochloric acid, fine particles and heavy metals.

Cleaning out Flue Gas:

A number of processes are involved for the cleaning up of flue gas.

The mixture of flue gas is collected by means of Particle filtration and this filtration is conducted using electrostatic precipitators and baghouse filters. Baghouse are very effective for fine particles. The next step of the processing and cleaning of flue gas is processing of scrubbers, which are critical for the removal of hydrochloric acid, nitric acid, mercury, hydrofluoric acid, lead and residuary heavy metals. With the reaction of lime, sulfur is converted in to gypsum. The wastewater, which comes out of scrubbers, is then passed through wastewater treatment plant.

Desulphurization is a process that is used to remove sulfur dioxide with the limestone slurry injection directly in to flue gas. Nitric component or gases are reduced with catalytic reduction with help of ammonia application. Heavy metals are removed with the help of active carbon injection. Particles are the collected at filters.

Solidify Outputs

Flue ash and Bottom ash is produced with the processing of waste materials and settle at the bottom of the incineration plant. The ash, which is produced, is four to five percent of total weight of the waste processed while the flue ash makes up some ten to twenty percent of total weight of waste material. The heavy metals, which are contained in the flue or bottom ash, are lead, cadmium, zinc and copper. A small amount of furans and dioxins are also produced. It is to mention here that bottom ash seldom has heavy metals in it. Flue ash is hazardous while bottom ash is not that dangerous or injurious to health.

Other issues related to Pollution:

Older models of incinerators have inconvenience that this produce odor pollution. However, in modern plants are saved from producing dust and odor pollution. They are designed to store waste in enclosed containers along with a negative pressure to keep from odor and dirt dispersal.

Another issue that is affecting community is increased load of traffic due to WCV for hauling waste materials. This is the issue, which has forced incinerators to move in to industrial areas.

A debate over Incineration

Usage of incineration is for waste management is divisive. The debate for incinerators generally involves business interests, regulations of government, activists of environment and citizens.

Arguments supporting incinerations:

- The first concern for incineration stands against its injurious effects over health due to the production of furans and dioxin emission. However, the emission is controlled to greater extent by developing modern plants and governmental regulations.
- Incineration plants are capable for producing energy and can substitute power generation plants of other sort.
- The bottom ash, after the process is completed, is considered non-injurious that is still capable for being land filled and recycled.
- Fine particles are removable by processing through filters and scrubbers.
- Treating and processing medical and sewage waste produce non-injurious ash as product.

Arguments against incinerations:

- Extremely injurious matter needs adequate disposing off. This requires additional miles and needs special locations for land filling this material.
- Although after a lot of regulations, restrictions and developments concerns, there are still aware of the emission of furans and dioxins.
- Incinerating plants are producers of heavy metals, which are injurious even in minor amounts.
- IBA is consistent over a considerably high level of heavy metals and can prove fatal if they are not disposed of or reused properly.
- Initial investment costs are only recovered through long periods of contract for incinerating plants.
- Local communities always have opposed the presence of incinerating plant in the locality.
- The upheld view is to recycle, reuse and waste reduction instead of incineration".[6]

The master plan for SWM is developed for Sulaymaniyah where the incineration is not part of it. Through SEAP, it was suggested to include the action for incinerations which we have doubts about.For that, it is useful to include the above information which will help in better selection for actions in the future. However, that action for incineration will be included and needed to be improved in the future work.

[6] http://www.wrfound.org.uk/articles/incineration.html

Convert Solid Waste to Energy through Waste Incineration

Background

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
TBD	
Years of Implementation	
Key performance Indicator	
Measurement Units	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

Human activity in Sulaymaniyah produces 1300 tons of waste per days which affect much the health and environment. Thus, waste management is so important to recover the energy resources from waste and ensure efficient management from collection to final disposing. Waste management includes collection, transport, processing, recycling or disposing, managing and monitoring of waste materials.

Waste-to-energy

The process, which involves waste for the production of energy, is named as waste-to-energy and Energy-from-waste. WtE is a process, which recovers energy from the waste materials. It is required to mention here that WtE is a process in which energy is gained through the process of combustion directly or sometimes fuel is produced from waste, which is the source for energy.

Incineration:

The most common source for WtE is "incineration" which means to burn organic waste to get energy. Incineration is not just conducted to recover energy rather it is most of time conducted to get rid of waste but it is banned in the countries with ODEC. Additionally, the ODEC countries only conduct WtE when they have plants following strict rules for emission. Therefore, today the plants to conduct incineration are much advanced as compared to older ones. The modern plants are capable for reducing the volume for given waste up to 95 to 96 percent. The compression reduction depends upon the composition and recovery degree of the waste materials.

The incineration becomes an issue because of emission of fine particles, metals of heavy configuration and acidic emission in form of gases. No doubt the emissions from incineration are in smaller quantities in modern plants but still they are if great concern. Some other concern for incineration are emission if poisonous fly ash and IBA (incinerator bottom ash). When discussed light was thrown over the destruction of valuable resources and it is said, "The incineration can affect the forthcoming recycling campaign".

WtE technologies (other than incineration)

A number of technologies have emerged on the scene for WtE or EfW. These technologies are capable for recovering energy from waste materials. Most of these technologies come with the power to give out power that is more electric and yes, that from the same amount of fuel as is produced by the incineration. This increased capability is result of the deduction of ash from the extracted fuel resultantly, higher temperature produced from combustion. Some technologies, however, are capable for converting liquid fuel in to gas.

These technologies are as follows:

Thermal technologies

- Gasification
- Pyrolysis
- Thermal De-polymerization

- PGP (Plasma Arc Gasification)

Non-thermal technologies

- Anaerobic Digestion
- Mechanical biological treatment
- MBT + Anaerobic digestion
- Ethanol Production
- MBT to Refuse Derived Fuel

Emission of Carbon dioxide

When we speak about the WtE, it must be known that almost every part, which has carbon in its makeup, gets out from the bulk of the waste as Carbon dioxide CO_2 and is taken to the environment. Solid waste from municipal has carbon dioxide in approximately 27 percent of its composition. Therefore, treating 1 metric Tons of Municipal solid waste would produce 1 metric Ton of Carbon dioxide.

When the waste is got to fill landfill then MSW in amount, 1 metric ton would produce 62 cubic meters of methane gas due to the decomposition conducted by anaerobic reactions. This gas produced comes with the double potential for playing its share for global warming as compared to one meter ton of carbon dioxide. In most of the countries around the globe, the gas is collected but still residue left away is handsome enough to contribute to global warming.

Description of the action

- Waste is dumped from garbage trucks into a large pit.
- A giant claw on a crane grabs waste and puts it in a combustion unit.
- The waste is burned.
- The heat turns water into steam in a boiler.
- The high-pressure steam turns the blades of a turbine generator to output electricity.
- An air pollution control system removes pollutants from the combustion gas before it is released through a smoke stack.
- Ash is collected from the boiler and the air pollution control system then it can be re-used for the purposes of street paving.

General objectives

- Get rid of gasses emission that produced by burning MSW.
- Reduce the amount of material that would probably be burned in landfills.
- Producing electricity by burning MSW. As Sulaymaniyah City needs additional electrical energy due to population expansion.
- Reduce the volume of the original waste by 80 % to get most beautiful and cleanest environment.
- Increase environmental awareness among the community of the need to exploit the waste of all kinds.

Responsible body:

Environmental Protection and Improvement Board/ Sulaimani Directorate of Environment Name: Diar Gharib Latif Location: Director of Sulaimani Environment
Name: Akhlas Almas Brakhas Location: Head of environmental LAB. In Sulaimani Directorate of Environment
Project duration: 24 months. Cost: TBD

Design and Construct Damp fill for Solid Waste Factory in Klar District

Background

Collect and transport solid waste from public places to disposal sites.

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
2000000	
Years of Implementation	
Key performance Indicator	
Measurement Units	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

Description of the action

The operation of the landfill, includes site preparation, installation and operation of the landfill.
Its waste management plan aims at increasing its volume and profitability, and recycling it. Separating waste from the source is one of the main steps to achieve this objective. The current phase is the collection and planned transfer of all the resources. The gradual phase of the collection and transport of the different types is progressively planned separately. Special cells are prepared for medical waste, construction and demolition residues and other residues. The ventilation tracks and gas tracks are constructed in the controlled landfill with a path to rain water. A waste-treatment plant is constructed after the establishment of the landfill, to convert the treated waste into solid fuel from Residues (RDF) to minimize waste to landfill.

General objectives

- Reduce environmental pollution.
- set no fires at the site.
- General management of solid waste.
- Protect the environment.
- Reduce gas emissions (CO2, CH4).
- Improve home living.
- Reduce health costs.
- Preservation of properties (soil, air, water)

Responsible body:

The municipalities / General Directorate of the General Municipalities of Sulaymaniyah
Name: M / Bahaaldin Ibrahim Fares
Location: Director of Public Towns of Sulaymaniyah
Name: M / Noshirwan Hama Karim
Location: Director of Planning
Project duration: 24 months.
Cost: 2000000 USD

Design and Construct Damp fill for Solid Waste Factory in Chamchamal District

Background

Collect and transport solid waste from public places to disposal sites

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
2000000	
Years of Implementation	
Key performance Indicator	
Measurement Units	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

Description of the action

The operation of the landfill includes site preparation, installation and operation of the landfill.
Its waste management plan aims at increasing its volume and profitability, and recycling it. Separating waste from the source is one of the main steps to achieve this objective. The current phase is the collection and planned transfer of all the resources. The gradual phase of the collection and transport of the different types is progressively planned separately. Special cells are prepared for medical waste, construction and demolition residues and other residues. The ventilation tracks and the gas tracks are constructed in the controlled landfill with a path to rain water. A waste-treatment plant is constructed after the establishment of the landfill to convert the treated waste into solid fuel from Residues (RDF) to minimize waste to landfill.

General objectives

- Reduce environmental pollution.
- Set no fires at the site.-General management of solid waste.
- Protect the environment.
- Reduce gas emissions (CO2, CH4).
- Improve home living,
- Reduce health costs.
- Preservation of properties (soil, air, water)

Responsible body:

The municipalities / General Directorate of the General Municipalities of Sulaymaniyah
Name: M / Bahaaldin Ibrahim Fares
Location: Director of Public Towns of Sulaymaniyah
Name: M / Noshirwan Hama Karim
Location: Director of Planning
Project duration: 24 months.
Cost: 2000000 USD

Design and Construct Damp fill for Solid Waste Factory in Pishdar District

Background

Collect and transport solid waste from public places to disposal sites

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
2000000	
Years of Implementation	
Key performance Indicator	
Measurement Units	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

Description of the action

The operation of the landfill, including site preparation, installation and operation of the landfill.
Its waste management plan aims at increasing its volume and profitability, and recycling it. Separating waste from the source is one of the main steps to achieve this objective. The current phase is the collection and planned transfer of all the resources. The gradual phase of the collection and transport of the different types is progressively planned separately. Special cells are prepared for medical waste, construction and demolition residues and other residues. The ventilation tracks and the gas tracks are constructed, in the controlled landfill with a path to rain water. A waste-treatment plant is constructed after the establishment of the landfill to convert the treated waste into solid fuel from Residues (RDF) to minimize waste to landfill

General objectives

- Reduce environmental pollution.
- Set no fires at the site.
- General management of solid waste.
- Protect the environment.
- Reduce gas emissions (CO2, CH4).
- Improve home living,
- Reduce health costs.
- Preservation of properties (soil, air, water)

Responsible body:

The municipalities / General Directorate of the General Municipalities of Sulaymaniyah
Name: M / Bahaaldin Ibrahim Fares
Location: Director of Public Towns of Sulaymaniyah
Name: M / Noshirwan Hama Karim
Location: Director of Planning
Project duration: 24 months.
Cost: 2000000 USD

Designing the Construct Waste Recycling Plant in Said Sadiq

Background

Collection and transport of solid waste from public places to treatment sites for the transfer of waste to the landfill and separation of materials (Pe, Con, Paper, RDF)

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
8000000	
Years of Implementation	
Key performance Indicator	
Measurement Units	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

Description of the action

The operation of the controlled landfill includes the preparation of the site, and the installation and operation of the landfill.

Its waste management plan aims at increasing its volume and profitability, and recycling it. Separating waste from the source is one of the main steps to achieve this objective. The current phase is the collection and planned transfer of all the resources. The gradual phase of the collection and transport of the different types is progressively planned separately. Special cells are prepared for medical waste, construction and demolition residues and other residues. The ventilation tracks and the gas tracks are constructed in the controlled landfill with a rainwater drainage path. To achieve this goal, it is necessary to establish a waste-treatment plant after the establishment of the landfill, to convert the treated waste into steel fuel from the RDF to reduce waste to landfill from the RDF to operate the cement plant.

General objectives

- Reduce waste transferred to the landfill.
- Benefit from materials separated (Pe, Con, Paper, RDF).
- Reduce environmental pollution.
- Set no fires in landfills due to waste treatment.
- General management of solid waste.
- Protect the environment.
- Reduce gas emissions (CO2, CH4).
- Improve home living,
- Reduce health costs.
- Characterization (soil, air, water)

Responsible body:

The municipalities / General Directorate of the General Municipalities of Sulaymaniyah
Name: M / Bahaaldin Ibrahim Fares
Location: Director of Public Towns of Sulaymaniyah
Name: M / Noshirwan Hama Karim
Location: Director of Planning
Project duration: 24 months.
Cost: 8000000 USD

Design and construct recycling solid waste Plant in Jwarta district

Background

Collection and transport of solid waste from public places to treatment sites for the transfer of waste to the landfill and separation of materials (Pe, Con, Paper, RDF)

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
8000000	
Years of Implementation	
Key performance Indicator	
Measurement Units	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

Description of the action

The operation of the controlled landfillincludes the preparation of the site, and the installation and operation of the landfill.
Its waste management plan aims at increasing its volume and profitability, and recycling it. Separating waste from the source is one of the main steps to achieve this objective. The current phase is the collection and planned transfer of all the resources. The gradual phase of the collection and transport of the different types is progressively planned separately. Special cells are prepared for medical waste, construction and demolition residues and other residues. The ventilation tracks and the gas tracks are constructed in the controlled landfill with rainwater drainage path. To achieve this goal, it is necessary to establish a waste-treatment plant after the establishment of the landfill, to convert the treated waste into steel fuel from the RDF to reduce waste to landfill from the RDF to operate the cement plant.

General objectives

- Reduce waste transferred to the landfill.
- Benefit from materials separated (Pe, Con, Paper, RDF).
- Reduce environmental pollution.
- Set no fires in landfills due to waste treatment.
- General management of solid waste.
- Protect the environment.
- Reduce gas emissions (CO2, CH4).
- Improve home living,
- Reduce health costs.
- Characterization (soil, air, water)

Responsible body:

The municipalities / General Directorate of the General Municipalities of Sulaymaniyah
Name: M / Bahaaldin Ibrahim Fares
Location: Director of Public Towns of Sulaymaniyah
Name: M / Noshirwan Hama Karim
Location: Director of Planning
Project duration: 24 months.
Cost: 8000000 USD

Summary of actions related to Solid waste management

			BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
Solid Waste Management					0	0	0%	22,000,000
	42.0	Convert solid waste to energy through waste incineration						TBD
	43.0	Design and construct damp fill for solid waste factory in Klar district						2,000,000
	44.0	Design and construct damp fill for solid waste factory in Chamchmal district						2,000,000
	45.0	Design and construct damp fill for solid waste factory in Pishdar district						2,000,000
	46.0	Design and construct recycling solid waste plant in Said Sadiq district						8,000,000
	47.0	Design and construct recycling solid waste Plant in Jwarta district						8,000,000

Water

Watered by the major tributaries of the Tigris River, the north-eastern highlands of the Kurdistan Region of Iraq (KRI) enjoy higher rates of precipitation compared to the alluvial plain stretching across central and southern Iraq and the western desert lying south of the Euphrates River. [7]

The main sources of Sulaymaniyah drinking water are Dukan Lake (two pipe lines: project 1 and project 2), Sarchinar ground water and a few small sources in the city. Some peripheral neighbourhoods lack piping and are still supplied through tankers. [8]

"On national level the following recommendations which have been suggested by Institute of Regional and International Studies (IRIS) The American University of Iraq, Sulaymaniyah are listed here.

MONITORING INFORMATION SYSTEM

- Implement and improve hydrogeological data collection and analysis procedures in line with international standards
- Develop a monitoring framework of surface and groundwater resources based on a
- geo-referenced central database and dissemination units
- Train specialized personnel to survey and map hydrogeological resources in the KRI

INSTITUTIONAL CAPACITY BUILDING

- Institutionalize coordination mechanisms for data exchange and water use between KRG ministries and levels of government
- Centralize water planning and management in a dedicated Ministry of Water Resources

GROUNDWATER OVER-EXTRACTION

- Monitor groundwater withdrawals and enforce strict regulation on wells drilling
- Introduce metering and water pricing to limit wasteful overconsumption
- Incentivize the adoption of water saving measures and advanced irrigation systems
- Invest in small-scale decentralized projects to increase water supply and recharge groundwater

WATER QUALITY

- Promote awareness campaigns on water consumption
- Maintain, repair, and expand water distribution networks, especially in rural areas
- Establish wastewater treatment plants and sewerage systems
- Implement landfill and waste management processes
- Monitor soil and water pollution levels

TRANSBOUNDARY COOPERATION

[7] Institute of Regional and International Studies (IRIS) The American University of Iraq, Sulaymaniyah
[8] Environmental Health Assessment in Sulaymaniyah City and Vicinity

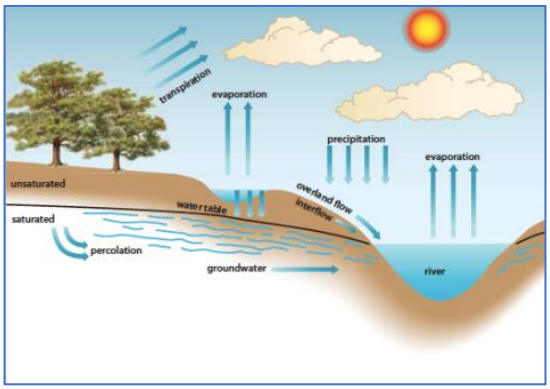
- Jointly with the Government of Iraq, engage in multilateral negotiations with neighboring countries to achieve an equitable water sharing agreement in the Tigris- Euphrates basin
- Promote a common-pool approach for the integrated management of water resources at the regional and federal level".[9]

[9] Institute of Regional and International Studies (IRIS) The American University of Iraq, Sulaymaniyah

Groundwater monitoring through wide hydrology and hydrogeology survey

For basic groundwater data, including water-level and water-quality data, and a reliable database is being established for the purpose of managing total water resources.

Background:



In Kurdistan Region of Iraq, rapid economic growth, rising standards of living, and an altered societal structure have in recent years put severe demands on water supplies. Because of its stable quantity and quality, groundwater has long been a reliable source of water for domestic, agricultural, and industrial users.

The concerns over water resources and the environment increase, the importance of considering ground water and surface water as a single resource has become increasingly evident. Issues related to water supply, water quality, and degradation of aquatic environments are reported on frequently. The interaction of ground water and surface water has been shown to be a significant concern in many of these issues. Contaminated aquifers that discharge to streams can result in long-term contamination of surface water; conversely, streams can be a major source of contamination to aquifers. Surface water commonly is hydraulically connected to ground water, but the interactions are difficult to observe and measure and commonly have been ignored in water-management considerations and policies, where, many natural processes and human activities affect the interactions of ground water and surface water. But the establishment of a management program that integrates groundwater and surface-water use has been hampered by the lack of groundwater data.

The Department of Water Resources in Sulaymaniyah initiated a program entitled "Groundwater Monitoring Network Plan in Sulaymaniyah." Under this program, basic groundwater data, including water-level and water-quality data, are going to be collected, and a reliable database will be established for the purpose of managing total water resources. The plan calls for constructing hydrogeological survey stations and groundwater monitoring wells. Under this program, water-level fluctuations are continuously monitored, whereas water-quality samples are taken for analysis only at the initial drilling stage and, subsequently, at the time when a monitoring well is being serviced.

Description of action:

The place of work is Sulaymaniyah and Halabja governorates. The nature of work is to conduct wide experience on the geologic, hydrologicaj and hydrogeological aspects. It would be better to start with **developing Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for Directorate of ground water in Kurdistan in general and in Sulaymaniyah in particular.** The methodology would be similar to "Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes" by "*John Barnett & Associates Ltd. / Eugene Daly & Associates in association with the National Roads Authority and Mr. Derek Luby, Mr Eugene Daly, Dr. John Kelly, Dr. Les*

Brown and Mr. Tim Morgan" ***and*** **Identifying the actions on following or similar process:**

- Evaluating the current Relevant Legislation including the:
  - Planning and Development Act
  - Water Quality Legislation
  - Water Framework Directive
  - Flooding Directive
  - Groundwater Directive
  - Habitats Directive/Habitats Regulations
  - Heritage Act
  - Minerals Acts
- Assign consultants and Stakeholders
  - Statutory Consultees
  - Non-Statutory Consultees
  - Requirements of Geological, Hydrological
  - Hydrogeological Consultants
  - Interaction with Other Environmental Consultants

The following will be included in the study

- GEOLOGICAL, HYDROLOGICAL AND HYDROGEOLOGICAL ASPECTS OF ROAD SCHEMES
  - Geological Aspects
  - Soil
  - Economic Geology
  - Geo-hazards
  - Geological Heritage
  - Geomorphology
  - Made Ground / Landfills
  - Construction Materials
  - Construction Stage Impacts
- Hydrological Aspects
  - Hydrological Cycle
  - Climate Change
  - Flooding
  - Surface Water Quality
  - Resource and/or Amenity Value
- Hydrogeological Aspects
  - Aquifers
  - Groundwater Quality
  - Groundwater Supply
  - Groundwater Ecosystems
  - Karst
- Collection of Baseline Information

Baseline studies should be scoped and planned on the basis of available information on the geological, hydrological or hydrogeological environment and the preliminary design

of the proposed road scheme. These studies will typically comprise some or all of the following:

- walkover surveys and geological field mapping;
- inspection of impacted sites, features and attributes;
- ground investigation contract(s), to include boreholes, rotary drill holes, trial pits, geophysical surveys, dynamic probes, cone penetration testing, in-situ testing of subsoils and groundwater permeability, monitoring of groundwater levels, laboratory testing and reporting in paper and digital format;
- Well surveys;
- surface water monitoring (flows and levels), and
- surface and groundwater quality testing.

In planning and scoping these surveys, it is critical to ensure that they are:

- sufficient to characterise and evaluate the receiving environment;
- sufficient to identify and assess the impacts on the environment, and
- focused on those impacts which are both likely and significant.

A Scientific survey by 8 teams consists of 3 geologists and 1 hydrogeologist (supervisor), the survey is daily continuing since water year from 21/6/2018 to 20/6//2019.
The job needs trucks, for trance, GPS instruments, compass, Sounder, Laptop and Mapper Programs.
The project needs to be run by a staff in several ways that exist in the directorate of ground water in Sulaymaniyah. Their work includes the collection of information and analyzing it using a data base or by(GIS) which enters that information and drop it on maps.

- Reporting
  - Contents of Constraints Study Report (Soil and Geology)
  - Contents of Constraints Study Report (Hydrology)
  - Contents of Constraints Study Report (Hydrogeology)
- Identify and Categorise the Impacts
  - Direct Impact where the existing geological, hydrological or hydrogeological environment along or in close proximity to the route corridor is altered, in whole or in part, as a consequence of road construction and/or operation.
  - Indirect Impact where the geological, hydrological or hydrogeological environment beyond the proposed route corridors is altered by activities related to road construction and/or operation.
  - No Predicted Impact – where the proposed route corridor has neither a negative nor a positive impact on the geological, hydrological or hydrogeological environment.
- ENVIRONMENTAL IMPACT STATEMENT (EIS)
  - Environmental Impact Assessment – General
  - Environmental Impact Assessment – Soil and Geology
    - Description of the Existing Geological Environment
    - Geological Impact Assessment
    - Geological Mitigation Measures
    - Contents of Geological EIS Report

- Environmental Impact Assessment - Hydrology
    - Description of the Existing Hydrological Environment
    - Hydrological Impact Assessment
    - Hydrological Mitigation Measures
    - Hydrological EIS Report
- Environmental Impact Assessment – Hydrogeology
    - Description of the Existing Hydrogeological Environment
    - Hydrogeological Impact Assessment
    - Hydrogeological Mitigation Measures
    - Hydrogeological EIS Report

At the outset of the EIA for each topic, all data acquired at Constraints Study and Route Corridor Selection phases should be reviewed and collated. Any additional information which may be relevant should also be sought at this stage. Details of the preliminary road design and topographical mapping should be obtained from the engineering design team.
For each of the three topics, the description of the existing environment in the EIS should initially address its context, having regard to the regional data presented in the Constraints Study and Route Corridor Selection Reports. Thereafter more detailed, site-specific information obtained from surveys, inspections, ground investigation, monitoring and testing should be used to make an evaluation of the local environment along the proposed road scheme taking account of its:

- character;
- significance, and
- sensitivity

General objectives:

- Water resource survey will be conducted.
- The available volume of water in these two governorates (Sulaymaniyah and Halabja) will be determined.
- From the collected data, more researches will be capable.
- From the researches we can determine the ground water potential areas.
- After data analyzation and interpretation, we can go through scientific water management.
- Renovation sectors of (Agriculture, Industry, Community, ... ect.)

Responsible Body:
Directorate of ground water in Sulaymaniyah: Individual contact details: Mr. Abas Ali Ahmed director of ground water in Sulaymaniyah Mr. Nawroz mohammed Omer scientific research unit.
Project cost: 3,000,000$

Rehabilitation of Dukan2 Water pumping stations

Background

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
6000000	
Years of Implementation	
Key performance Indicator	
Measurement Units	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

The following report, provided by humanitarian response- UN OCHA, was issued by the end of 2015 and explains the situation of water supply in Sulaymaniyah which is self-explanatory.

"The Dukan water system supplies the vast majority of Sulaymaniyah governorate: Chamchamal, Piramagrun, Dukan, Sulaymaniyah city, Tasluja, Bazyan and Shoresh. The estimated population served by the network is around 2 million people. Other districts are either supplied by the Darbandikhan dam in the south (Darbandikhan, Halabja, part of Kalar), or by surface water, wells and boreholes. A large number of boreholes and wells exist in Sulaymaniyah governorate, however only a few (4 or 5) boreholes are part of the public service and, therefore, managed and monitored by the Directorate of Water. The rest of water points are private and are not supervised

Sources

The main source of water for the system is the lake of Dukan, artificially created by the construction of hydroelectric dam over the Little Zab. It is fed by two different streams and a large catching area from the surrounding mountains. The seasonal water level variations have estimated amplitude of 15 m, the surface area is of 270 km^2 and the water volume varies from 6.8–8.3 km^3 of fresh water. A secondary source is the Sarchinar spring waters, in Sarchinar area in Sulaymaniyah city.

Production

The intakes are located on the Little Zab stream and raw water is fed to a treatment plant. The maximal capacity of the system is of 16,000 m3/h and operates 24h. The current pumping capacity of the system is however in average 12,000 m3/h. Indeed, pumping stations have currently a maximal capacity of 3,000 m3/h for Dukan 1 and 10,000 m3/h for Dukan 2. A project for a third station Dukan 3 with a capacity of 3,000 m3/h was initiated some years ago but was stopped at the beginning of the crisis. An additional 3,000 m3/h are supplied from Sarchinar station (not visited). The production has, however, large seasonal variations.

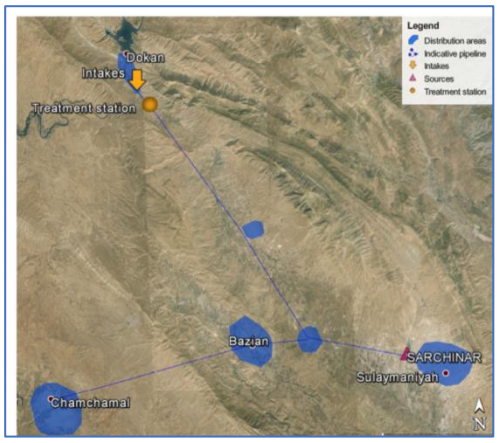


Figure 10 . Overview of the water supplied from Dukan and Sarchinar

The repair and spare parts for the pumps remains a challenge due to the cost associated with out-of-the-country supply.

Currently, in Dukan 2 pumping station, out of the 14 pumps only 9 are functional, which implies that to maintain the production rate, these 9 pumps must operate continuously 24h/24, preventing regular maintenance and shortening therefore lifetime.

Additional 4 boosting stations, with 14 pumps each, operate along the pipeline up to the distribution areas, face similar challenges: 20 pumps currently need to be replaced

or repaired. Spare parts need to come either from Germany, US or South Africa, and some of the pumps had to be sent to Turkey for repair. The estimated budget for internationally-supplied spare parts and maintenance needed for 2016 reaches $2,000,000. This has been a long-standing issue, nevertheless, recent budget limitations from central government and the increased pressure on resources from additional displaced population have escalated the situation in 2015, and foreseeably the summer of 2016 will be also a critical period.

Distribution and use

The main limitation of the production system is the pumping capacity. In average, users receive potable water during 2 hours every 3 days. It is estimated by the Directorate of Water, that for the city of Sulaymaniyah, over 95% of the habitations have access to the public network. A large storage capacity is needed to cope with the short distribution periods. A large majority of users has a complementary mode of water supply that includes private truck vendors, private wells and boreholes.

The current system does not include individual flow meters; a project to install these has started and will be running as funding becomes available. Therefore, there is currently neither an estimation of the level of leakages in the network nor an understanding of the most critical sections of the system.

The cost recovery system in place is linked to the habitation surface: one connection max per habitation and 50IQD/m3/month.

Management and Operation

Until recently, the network operation was done by a private company. The contract having already expired, employees of the Directorate of Water are currently in charge of the operation, maintenance, repair and consumables, until the ongoing tender process is finalized.

The new contract aims as including all aspects of operation, maintenance and repair of the whole source and production systems – including consumables, spare parts, repair and regular maintenance. The outcome the tender and the start of the new operator is expected by early 2016.

Main challenges

The list below includes issues related to the water system from Dukan,

- Pumping capacity needs to be increased - Maintenance and repair of pumps, increase number of pumping stations
- pH correction and caustic soda injection unit in Dukan 2 station
- Monitoring capacity needs to be increased – number of monitors and number and types of tests
- Chemicals and other consumables supply needs to be secured
- Consumption rationalization through measurement

- Leakage control: need for diagnosis, measurement and control. Spare parts supply (including hydraulic valves)."[10]

Currently works with half of its initial design efficiency which was 12000 cubic Meter per hour due to the lack of maintenance

Description of the action

Water is a source of life. Currently the city of Sulaymaniyah suffers from deep shortage in water supply,which causes social, economic and environmental crisis through inhabitants of this city and its neighbour districts that depends on the same source.
Now adays DWS (Directory of water \ Suly.) supplies 2 hour each 72 Hrs.
These are being famous with dry and escalated degree of heat especially during summer season, which needs consuming a large amount of water.

General objectives

- Increase of supply time of water for host community, refugee, IDPs and vulnerable inhabitants
- Solve economic, social and environmental disputes via all mentioned categories.
- Develop better quality of supplied water.
  Cost: 6000000 USD

Responsible body:

Department in charge Directory of Sewerage- Sulaymaniyah
Name: Sarbast Othman Qader Location: Director / DWS
Name: Avan Noori Location: Deputy Director
Project duration: 24 months

[10] https://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/assessments/20150902_-_dukan_water_network.pdf

Construction Dukan-3 Water Treatment Plant

Background

Water resources are at risk globally due to climate change and population growth.
In Sulaymaniyah recently, there is a large shortage in potable water supply, and according to Kurdistan Region there must be 320 litre/capita/day. The produced water is not exceeding 150,000 Cubic meter / day.According to last master plan for water and sewerage conducted by SGI (Italian company), about 35 to 40% goes through losses for many reasons. Nowadays DWS supplies water 2 hours each 72 hour. There is a need for increasing level of production by (at least) 10,000 cubic meter /hour.

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
Years of Implementation	
Key performance Indicator	
Measurement Units	
Priority of action	
Area of intervention	
Origin of action	
LA	
Policy instrument	

Description of the action

Construction of following premises with all requirements for producing 10000 cubic meter /Hour:

- Intake pump station
- Water treatment plant, clarifiers, filtration and pump station.
- Booster pump station (2 Numbers)
- Water reservoirs with capacity 20000 cubic meter and 5,000 cubic meter

General objectives

- Increasing potable water production to cover standard water demand
- Preserving from water born disease
- Minimizing social disputes among consumers
- According to studies, permanent supply of water saves Non-revenue water (losses) and violation upon water network.
- In case shortage of water, people will be obliged to buy or get non-qualified water.
- Solving economic part, especially current economic crisis
- Impact positively upon environmental for supplied areas.

Cost: USD TBD
Responsible body:
Department in charge Directory of Sewerage- Sulaymaniyah
Name: Sarbast Othman Qader Location: Director / DWS
Name: Avan Noori Location: Deputy Director
Project duration: 24 months

Feasibility study for Design and construction of Khewata Dam

Background

Last 10 years, the demand for water supply in Sulaymaniyah rose significantly due to population growth along with the increase of immigration toward the city, causing expansion in urban areas and increase demand on agriculture sector for irrigation with considerable demand for industrial sector. This causes high impact on the source of water which feeds the city from Sarchinar spring and Dukan dam.

Moreover, the number of towns and regions that have increased are to be supplied by Sulaymaniyah water projects such as Piramagrun, Chamchamal, Shorsh and Bazyan basin.

The method used to drag water to the city requires pumping the water to a level higher than 700 meters and for a distance around 72 km length and costs around 1,800,000,000 ID/month.

The terms of the amount of water production from both Dukan Sulaymaniyah projects and Sarchinar project were compared with the amount of consumption. It appears that the Sulaymaniyah city is in a shortfall in production, in which the production from old Dukan water treatment plant and from Sarchinar springs cover only 64.2% of Sulaymaniyah demands especially in the months of August and September where the discharge of the streams and springs is at the lowest level, so there is a great deficit of water supply to the city.

Mitigation	
MWh/a	t CO_2/a
438000	359160
Contribution in %	
Cost in $	
3,000,000	
Years of Implementation	
Key performance Indicator	
Reduction in energy consumption	
Measurement Units	
MWh	
Priority of action	
Area of intervention	
IA	
Origin of action	
NA/LA	
Policy instrument	
ESO	

Description of the action

The proposed project is to build a new dam close to the city to provide water to the city smoothly, to cover the large water shortage and provide the cost of large pumping over long distances compared to the traditional way.

The project is to study the proposed site for the construction of the new dam geologically and its ability to absorb and store the large quantity of water as well as the economic and strategic feasibility of it and to estimate the financial cost of its construction and proposed sources of funding.

The proposed location is Khewata which is the nearest and most suitable place for collecting water to Sulaymaniyah city located in a higher place compared to Dukan. In addition to that, it is suitable to construct a new water treatment plant with a capacity20,000 cu.m/hr, which will increase the amount of water production, cause water shortage and ensure the continuity supply for the city until 30 years later. We also save an amount of 50 MW/hr that is used for supplying water to the city which costs 1,800,000,000 ID/month

General objectives

Constructing a new water dam may be used for many purposes such as providing domestic, commercial, and industrial water for Sulaymaniyah city, providing water for irrigation and agricultures. It may also be used as a tourism area for the city and maybe used for producing hydro power plan.

The Cost: USD
Responsible body: Department in charge Directory of Sewerage- Sulaymaniyah
Name: Sarbast Othman Qader Location: Director / DWS
Name: Avan Noori Location: Deputy Director
Project duration: 24 months

Summary of actions related to Water

			BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh /a	t CO2/a	MWh/a	t CO2/a		
Water					0	0	0%	12,000,000
Priority Action No 3	48.0	Plan for a groundwater monitoring network in Sulaymaniyah, through wide hydrology and hydrogeology survey for basic groundwater data						3,000,000
	49.0	Rehabilitation of Dukan 2 water pumping station						6,000,000
	50.0	Construction of Dukan3 water treatment plant						
	51.0	Feasibility study for Design and construction of Khewata Dam			438000	359160		3,000,000

Industrial Sector

Ambient and continuous Air Quality Monitoring System

Background

Mitigation	
MWh/a	t CO_2/a
Contribution in %	
Cost in $	
711,538	
Years of Implementation	
Key performance Indicator	
Air monitoring	
Measurement Units	
NO, NO2 and NOX and others	
Priority of action	
Area of intervention	
Information and Communication Technologies	
Origin of action	
LA	
Policy instrument	
Awareness raising	

Ambient air monitoring is the systematic, long-term assessment of pollutant levels by measuring the quantity and types of certain pollutants in the surrounding, outdoor air.
Ambient Air Quality Monitoring is essential for local authorities as well as for major public and private industries to understand and prevent air pollution and assess emission sources, air quality monitoring involves the measurement of pollution in ambient conditions.
Ambient air monitoring is an integral part of an effective air quality management system. Reasons to collect such data include to:

- assess the extent of pollution;
- provide air pollution data to the general public in a timely manner;
- support implementation of air quality goals or standards;
- evaluate the effectiveness of emissions control strategies;
- provide information on air quality trends;
- provide data for the evaluation of air quality models; and
- support research (e.g., long-term studies of the health effects of air pollution).

There are different methods to measure any given pollutant. A developer of a monitoring strategy should examine the options to determine which methods are most appropriate, taking into account the main uses of the data, initial investment costs for equipment, operating costs, reliability of systems, and ease of operation.
The locations for monitoring stations depend on the purpose of the monitoring. Most air quality monitoring networks are designed to support human health objectives, and monitoring stations are established in population centers. They may be near busy roads, in city centers, or at locations of particular concern (e.g., a school, hospital, particular emissions sources). Monitoring stations also may be established to determine background pollution levels, away from urban areas and emissions sources.
Systems are needed to ensure that data are of acceptable quality, to record and store the data, and to analyse the data and present results.[11]

Description of the action

Supply and install the following air monitoring equipment for:

- Monitor atmospheric NO, NO2 and NOX concentrations using a cross-flow modulated semi decompression chemiluminescence method, highest levels of sensitivity and accuracy.

[11] https://www.epa.gov/air-quality-management-process/managing-air-quality-ambient-air-monitoring

- Monitor atmospheric THC, NMHC, and CH_4 concentrations using a cross-flow modulated selective combustion type method combined with a hydrogen ion detection method.
- Monitor atmospheric ozone concentrations using a cross flow modulated ultraviolet absorption method.
- Monitor atmospheric ozone concentrations using a cross flow modulated ultraviolet absorption method.
- Monitoring of atmospheric SO_2 using UV fluorescence.
- Monitor for Suspended Particulate Matter (SPM) ensure the long-term stability and self-diagnostic capabilities as well as efficient collection of fluorine resin tape.
- Measure SO_2 converted H_2S through oxidation catalyst based on Ultra Violet Fluorescence. In order to reduce measurement error by water concentration fluctuation in ambient, humidifier is set at sample line. It enables long-term stability according to stabilizing catalytic reaction
- Monitor measures increased nitrogen oxide (NOx) reacted through oxide catalyst treatment as Ammonia (NH_3) concentration with chemiluminescent (CLD) method.
- CO_2 analyser using Non-dispersive infrared (NDIR) modules to measure gases such as CO_2.
- Monitoring of emission and emission levels of organic pollutants in ambient air in the range of C4-C2. The instrument is characterized by its compact design and its outstanding detection sensitivity in the ppt range
- Mass flow controller (MFC) for accurate and consistent particulate sampling.
- Calibrate gas analysers manually, remotely controlled or automatically, installed in air pollution monitoring stations, for quality assurance in the laboratory and also for the production of gas analysers
- , data acquisition visualization of the I/O- Expander, and providing quick and easy access to stored data.
- Air Quality Control System, containing functions for data transmission between the Measurement Network Control Centre and connected measuring stations.
- Complete Data Communication system for receiving the data from AQM monitoring stations and configuration remotely.

General objectives

- Monitoring the air quality is important in protecting the health of populations and is performed by Ambient Air Quality Monitoring Stations (AAQMS) that are totally integrated with gas analysers, particulate monitors, calibration equipment, data loggers and data reporting software.
- The ultimate goal is to secure a cleaner environment with that, a reduction in health-care burden.
- Education and awareness
- The general consensus within the environmental health community is that there is a greater need to engage and educate society as a whole, about what is undoubtedly the complex relationship between air quality and ill health.
- At the policy level, within local communities where air quality management plans, and in central government where objectives and limit values are created

- The data can be used to underpin a wealth of epidemiological research, investigating the effects air pollutants have on various health outcomes
- Output from measured concentrations of pollutants is used to provide real-time data and advanced warnings of potentially health-damaging events in the form of a public air pollution information and forecasting service, in line with national legislation.

Example of equipment may be used:
Real-time gas analysers are available for the measurement of all major organic and inorganic pollutants including Oxides of Nitrogen (NOx), Sulphur Dioxide (SO_2), Ozone (O_3), Carbon Monoxide (CO), Hydrogen Sulfide (H_2S), Ammonia (NH_3), Benzene (C_6H_6), Carbon Dioxide (CO_2), BTEX and VOC's.
Add in advanced calibration systems, data-logging, internet data distribution
Mobile Ambient Air Pollution Monitoring
Ambient NO, NO2, NOX continuously monitor, Ambient THC monitor, Ambient Ozone monitor, Ambient Carbon Monoxide monitor, Ambient Sulfur Dioxide monitor, Ambient Dust Monitor, Ambient Hydrogen Sulfide Monitor, Ambient Ammonium Monitor, CO2 Analyzer, high volume (TSP) air sampler, Multipoint Multi gas Calibrator, Data acquisition with IOVIS, Reporting Program and Data Communication.
Responsible body:
Environmental Protection and Improvement Board/ Sulaimani Directorate of Environment
Name: Diar Gharib Latif Location: Director of Sulaimani Environment
Name: Akhlas Almas Brakhas Location: Head of environmental LAB. In Sulaimani Directorate of Environment
Project duration: 12 months.
Cost: 711,538 USD

Establishing an advanced industrial zone

Background

The current industrial zone has been established for years. It does not have suitable means for industrial works because it is located in an area close to residential areas.

Description of the action

The establishment of an advanced industrial zone in the province of Sulaymaniyah needs to allocate a large area by the municipality and the concerned land as well as local authorities.

After the initial approval of the allocation of land, a comprehensive feasibility study should be prepared with all concerned parties and includes a full study of all its aspects (project location, land area, project cost, project design, time of project implementation, problems and challenges, etc.)

General objectives

The objective of establishing an advanced industrial zone in Sulaymaniyah Governorate:

- concentration of infrastructure in one area to reduce the costs of each industry (methods - high-power electric supplies - water supply and other services)
- Reducing the environmental and social impact of industrial applications and controlling emissions.
- Provide environmental controls for the needs of the industrial zone.
- Attract new business and employment opportunities

Local Electricity Production

Establishment of a 10 MW Solar/Photovoltaic Power Station

Background

Mitigation	
MWh/a	t CO_2/a
18250	14965
Contribution in %	
0.2%	
Cost in $	
5000000	
Years of Implementation	
Key performance Indicator	
RE produced	
Measurement Units	
In MWh	
Priority of action	
Area of intervention	
Renewable energy Photovoltaics	
Origin of action	
NA and LA	
Policy instrument	
Energy supplier's obligations	

Kurdistan of Iraq bears the highest financial cost to support the internally displaced people whose number reached around 2 million. This has created financial and economic burden on the local community that has contributed to the displaced people, leading to an increase in expenditures and inadequacy of the previous development plan due to the sudden and steady population growth. This addresses a higher need to the increased development projects and infrastructure investments resulting from the excessive use and the inability to cover all the needs in the near future.

As a result, the demand for electricity has largely increased because of population increase and growth which is significantly accompanied by the government subsidy to the electricity sector, amounting to more than 3 billion USD/year.

Energy conservation and efficient use of renewable resources are main pillars to reduce the burden subsidy cost of electricity. Through this context, the following actions contribute for use of renewable solar energy and promote sustainable energy as main energy source in the governorate.

Description of the action

Establishing a Renewable Power Station, and using Photovoltaic Power Station on Sulaymaniyah produce electricity synchronized with public utility grid. The location to be selected should be characterized by high brightness and technical appropriateness, where the electricity will be transferred through national electricity networks. It may be preferable to be located between the city and main power stations to minimize the transmission losses and to ensure proper synchronises with main power station to prevent sudden shutdown.

The action is summarised as follows:

- Review the National Policies and Regulation supporting the Renewable Energy Sources (RES):
  - Ensure long-term polices and regulation supporting the RES.
  - Evaluate the risks and obstacles of RES investment and management for long-run and provide solutions and add values for successful implementation and operation.
  - Obtain required license with long–term operation contract.
- **PROJECT DEVELOPMENT OVERVIEW -**refer to Annex for more details

STAGE 1 – CONCEPT DEVELOPMENT AND SITE IDENTIFICATION

1. Identification of potential site(s)
2. Funding of project development
3. Development of rough technical concept

STAGE 2 – PREFEASIBILITY STUDY

1. Assessment of different technical options
2. Approximate cost/benefits
3. Permitting needs
4. Market assessment

STAGE 3 – FEASIBILITY STUDY

1. Technical and financial evaluation of preferred option
2. Assessment of financing options
3. Initiation of permitting process
4. Development of rough technical concept

STAGE 4 – PERMITTING, CONTRACTS AND FINANCING

1. Permitting
2. Contracting strategy
3. Supplier selection and contract negotiation
4. Financing of project

STAGE 5 – ENGINEERING, PROCUREMENT, CONSTRUCTION AND COMMERCIAL OPERATION

1. Preparation of detailed design for all relevant lots
2. Preparation of project implementation schedule
3. Finalization of permitting process
4. Construction supervision
5. Performance testing
6. Preparation of as build design (if required)

- ***Raising citizens' awareness to*** utilize these techniques so that the photovoltaic cell system will be installed in the commercial, investment and residential buildings, taking the Governorate as a good exemplary.
- Operation and maintenance phase to ensure efficient operation and long life of project.

Action	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Establishment of the first phase of the station 1 MW												
Establishment of the second phase of the plant 3 MW												
Construction of the third phase of the plant 3 MW												
Establishment of the fourth phase of the station 3 MW												
Awareness campaigns to reduce energy consumption												

General objectives

1. Reducing CO_2 emissions;
2. Reducing the energy bill;
3. Using renewable energy sources and environmentally friendly clean energy;
4. The generated energy from the photovoltaic cells include all the activities that require the consumption of electrical energy in all its forms from street lighting,

buildings and various facilities, parks, travel agencies and other governorate facilities;

5. Raising citizens' awareness to utilize these techniques so that the photovoltaic cell system will be installed in the commercial, investment and residential buildings, taking the Governorate as a good exemplary.

Action	Energy produced when applying the action in MWh	Amount of reduction in emission in tCO2	Cost in $
Establishment of the first phase of the plant 1 MW	1825	1496.5	640000
Establishment of the second phase of the plant 3 MW	5475	4489.5	1200000
Construction of the third phase of the plant 3 MW	5475	4489.5	1200000
Establishment of the fourth phase of the plant 3 MW	5465	4489.5	1200000
Connection with the main Utility power			660000
Awareness			100000
Total	18250	14965	5000000

The calculation based on following assumption:
10MW PV x 5 average hours/per day x 365days per year = 18250MWh/year
18250 MWh x 0.82 t CO2/MWh= 14965 tCO2.
Responsible body:
General Directorate of Electricity Sulaymaniyah
Name: Salar Hossam El Din Location: Director General Electricity
Name: Karwan Ibrahim Faki Location: Project follow-up manager
Project duration: 12 months

Install three mini hydro units at Dukan Dam and rehabilitation of two units of mini hydro in Darbandikhan Dam

Background

The **Darbandikhan Dam** is located on the Diyala River, immediately upstream of the town of Darbandikhan. It is approximately 150km upstream of the Hemren Dam. The site is approximately 420 km by road northeast of Baghdad and 65 km southeast of Sulaymaniyah city. It is also within 15 km of Iranian border to the southwest[12].

The purpose of the dam is irrigation, flood control, hydroelectric power production and recreation. The Hydropower of the dam consists of Hydraulic head 80 m, Turbines 3 x 83 MW, Installed capacity 249 MW [13].

The **Dukan Dam** is located on the Lesser Zab River, approximately 220 km upstream from its confluence with the Tigris River. The site is located adjacent to the town of Dukan and approximately 295 km north of Baghdad and 65 km northwest of Sulaymaniyah city. With Hydraulic head 95 m, Turbines 5 x 80 MW and Installed capacity 400 MW.

Dukan and Darbandikhan Dams, with a capacity of 400 MW and 249 MW respectively, are the two largest power stations in the Kurdistan Regional Governorate, and are connected to the national power grid. Each power station is part of a multipurpose scheme for power production and irrigation at each of the locations.

Mitigation	
MWh/a	t CO_2/a
28110	23050
Contribution in %	
0.2%	
Cost in $	
195000000	
Years of Implementation	
Key performance Indicator	
RE produced	
Measurement Units	
In MWh	
Priority of action	
Area of intervention	
Hydropower	
Origin of action	
LA	
Policy instrument	
Energy supplier's obligations	

Description of the action

Micro-hydro-electric power is an efficient and reliable form of clean source of renewable energy because it requires very little water in order to power the turbine. The water will run straight through the turbine and back into the river or stream to use it for the other purposes.

Turbine units at Dukan and Darbandikhan Dams designed to operate by small water discharge, when hydroelectric units are shut down (for electricity control or technical reasons), about 25 m3 / s of water is drained from the spillway to supply water projects at the bottom of the Dukan dam. By installing three Mini Hydro units at the bottom of the Dukan Dam with a capacity of 2.55 MW per unit, 10 m3 / s, water can be discharged to meet part of the needs of irrigation.

In **Derbandakhan Dam**, two hydroelectric units (0.86 MW) were installed for each unit to supply the dam and the area near the dam with electric power. These two units have ceased to function because of the unavailability of spare materials for maintenance.

The action summaries as follows:

In Dukan Dam,

- Install three Mini Hydro units with a capacity of 2.55 MW per unit.
- Supply of materials crisis reserve for the operation of huts for 5 years.

[12] The world Bank E 1547

[13] https://en.wikipedia.org/wiki/Darbandikhan_Dam

- Training the staff necessary for the operation and maintenance of units.

In Derbandakhan Dam

- Rehabilitation of two existing units.
- Providing the necessary spare parts for maintenance and operation,
- Training the staff to operate and maintain the two units.

General objectives

In Dukan Dam, utilization of the water energy discharged during the Dukan hydroelectric plant stops working to meet the needs of the water circus at the bottom of the Dukan dam where it can generate 22,950 MW/hour of electric power annually. "

In Derbandakhan Dam

These units can be operated during the three hydropower units at the Derbandikhan station. The two units can be discharged (5m3 / sec) of water for the environment and water projects at the bottom of the dam. If we take the Derbandakhan station completely, it will be at least 3000 hours per year and 5160 MWHr can be generated by these two units within a year.

In General: The initiation of an increase in the productivity of renewable energy is used in the region's electricity network.

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Renewable energy		Mitigation in %	Cost in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
Local Renewable energy generation					28110	23050		
		In Dukan Dam, Install three Mini Hydro units with a capacity of 2.55 MW per unit. Supply of materials crisis reserve for the operation of huts for 5 years. Training the staff necessary for the operation and maintenance of units. In Derbandakhan Dam Rehabilitation of two existing units. Providing the necessary spare parts for maintenance and operation, Training the staff to operate and maintain the two units			28110	23050		195000000

The calculation is based on following assumption:

In Dukan Dam, Producing 22,950 megawatts per year "by these units, Cost 16500000 USD. In Derbandakhan Dam , (5160 MWHr) can be produced annually by these two units, cost 3000000 USD (22950 + 5160) MWh x 0.82 t CO2/MWh= 23132 tCO2. Cost: 19,500,000 USD

Responsible body:

General Directorate of Electricity Sulaymaniyah

Name: Salar Hossam El Din Location: Director General Electricity

Name: Karwan Ibrahim Faki Location: Project follow-up manager

Project duration: 12 months

Provision of spare materials for Dukan and Darbandikhan hydroelectric plants & replacement of cooling system Dukan and Darbandikhan stations

Background

The Dukan and Darbandikhan hydropower stations are 400MW and 249MW respectively, providing the Kurdistan Region Network with an electrical card. Due to the shortage of spare materials, most of the time, these two sources cannot be used to produce electricity.

The Dukan Hydroelectric Station was built and operated in the 1970s. The Durbanikahn station was built in the 1980s. The two stations (especially the Dukan station) were old and the equipment was not equipped for long periods of time, some of which became inefficient and unsafe.

Mitigation	
MWh/a	t CO_2/a
1962576	1609312
Contribution in %	
16.5%	
Cost in $	
15000000	
Years of Implementation	
Key performance Indicator	
RE produced	
Measurement Units	
In MWh	
Priority of action	
Area of intervention	
Hydropower	
Origin of action	
LA	
Policy instrument	
Energy supplier's obligations	

Description of the action

- Provision of spare parts needed to determine the suspension of hydroelectric units and increase the productivity and readiness of the two stations.
- Replacement of the Dukan cooling water system
- Replacement of cooling water system station in Darbandikhan
- Supply and installation of oil pump for the speed regulator of Unit No. 2 in the station Darbandikhan.

General objectives

Make the most of the Dukan and Darbandikhan water reserves since the capacity of Dukan Lake Sink is 7 billion cubic meters and the capacity of the Darbandikhan Lake is 3 billion cubic meters of water. The suspension of the units for long periods leads to the non-utilization of the energy part of the water in the two lakes mentioned.

The project leads to an increase in the renewable energy output used in the region's electricity grid.

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Renewable energy		Mitigation in %	Cost in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
Local Renewable energy generation					1962576	1609312		
		Provision of spare materials for Dukan and Darbandikhan hydroelectric plants Replacement the Dukan cooling water system. Replacement water system cooling station Darbandikhan. Supply and installation of oil pump for the speed regulator of Unit No. 2 in the station Darbandikhan.			1962576	1609312		15000000

The calculation is based on following assumption:

(400 +249) MW x 6 months x 30days per month x 24 hour of operation x 70% efficiency= 1962576MWh/year
1962576 MWh x 0.82 t CO2/MWh= 1609312 tCO2.
Cost: 15,000,000 USD
Responsible body:
General Directorate of Electricity Sulaymaniyah
Name: Salar Hossam El Din Location: Director General Electricity
Name: Karwan Ibrahim Faki Location: Project follow-up manager
Project duration: 12 months.

Replacement of Turbine Shaft Seal Module for Unit 3 in Dukan Damp Hydroelectric facility

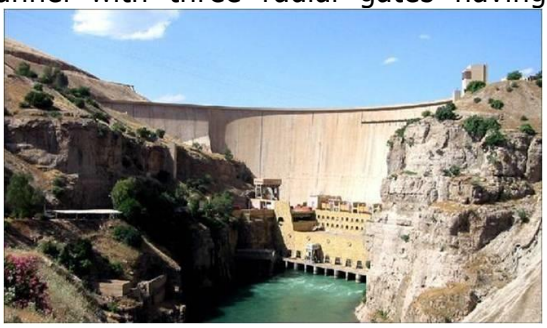
Background

Mitigation	
MWh/a	t CO_2/a
241920	198374
Contribution in %	
2%	
Cost in $	
500000	
Years of Implementation	
Key performance Indicator	
RE produced	
Measurement Units	
In MWh	
Priority of action	
Area of intervention	
Hydropower	
Origin of action	
LA	
Policy instrument	
Energy supplier's obligations	

The Dukan Dam is a multi-purpose concrete arch dam at Sulaymaniyah Governorate. It impounds the Little Zab, thereby creating Lake Dukan. The Dukan Dam was built between 1954 and 1959 whereas its power station became fully operational in 1979. The dam is 360 metres long and 116.5 metres high and its hydroelectric power station has a maximum capacity of 400 MW.

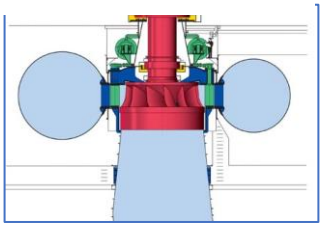
The Dukan Dam was built as a multi-purpose dam to provide water storage, irrigation and hydroelectricity. The power station was designed in 1973 by the Russian company Hydro-project and became operational in 1979. Due to lack of maintenance and repairs, the power station has underperformed and is now, after 30 years of service, due for replacement. In 2007, the World Bank began a US$40 million project to repair the Dukan and Darbandikhan Dams. Repairs to the Dukan Dam are expected to cost over $8 million and be complete in late 2012.

The Dukan Dam base is 32.5 metres wide, tapering off to 6.2 metres at the top. The combined maximum discharge of the dam is 4,300 cubic metres per second. This is divided over a spillway tunnel with three radial gates having a combined maximum discharge of 2,440 cubic metres per second, and an emergency bellmouth spillway with a capacity of 1,860 cubic metres per second. Two irrigation outlets with a combined discharge of 220 cubic metres per second have not been operated over the last ten years.



The powerhouse of five **Francis units** at 80 MW each releases between 110 and 550 cubic metres per second. Lake Dukan, the reservoir created by the Dukan Dam, has a surface area of 270 square kilometres. Its anticipated capacity is 6.8 cubic kilometres with a maximum of 8.3 cubic kilometres.[14]

Figure 11 Francis Unit



The Dukan hydroelectric plant consists of five 80 MW units of turbines, one of the production units is out of work due to a large leakage of water from the **Turbine Shaft Seal**. This leakage is due to faulty design of the sealed for the turbine shaft, which result in significant losses in efficiency and revenue at a hydroelectric facility.

The selected seal type for a particular application can be extremely costly in terms of increased downtime and high leakage.

[14] https://en.wikipedia.org/wiki/Dukan_Dam

The cost of leakage

Excessive leakage from a hydro turbine creates unnecessary damage and cost. This damage can come in the form of flooding of the turbine guide bearing or corrosion of the surrounding structure and degradation of the civil works. All seals must leak to survive, and the amount of leakage may range anywhere from imperceptible (less than 1 L/min) to extreme (defined as a flow rate approaching or exceeding the capacity of the head cover drain). In most cases, excessive leakage from the main shaft seal is due to selection of an incorrect seal type or a badly designed seal.

Many people can be involved in the sealing of a turbine shaft. All turbine manufacturers have their own seal designs, and there are specialist companies whose sole purpose is to provide a sealing solution for a particular application. The specialist companies typically will design a system for a particular hydro turbine, thus avoiding the pitfalls of a "one size fits all" solution.

Unfortunately, some turbine operators believe that leakage of 400 L/min, or even more, is acceptable. In fact, acceptable leakage is only the amount required to sufficiently cool and lubricate the sealing faces. So, where did this perception come from, and how do we overcome it, Education is part of the answer.

For example: Leakage at a pumped-storage facility that had been operating for several decades averaged 400 L/min for each of the two turbine-generating units. To put this into perspective, leakage of 400 L/min equates to 210,240 m3/year. This is enough water to fill 84 Olympic-size swimming pools every year or enough water to supply the average family household for about 800 years.

The turbine manufacturer told the facility owner that this amount of leakage was to be expected because of the arduous conditions under which the seal had to operate. These conditions consisted of a circumferential velocity of up to 15 m/sec and 8 bar pressure in both water and air. While this may have been the case when the turbine was originally designed, this amount of leakage should not be considered acceptable today in light of the materials and technology available.

Seals at this facility consisted of three-tier radial carbon segment seals. The water that leaked while the units were operating had to be pumped from the turbine pit into the common drain and then passed through separators before being discharged into the lower reservoir. The irony is that, because this is a pumped-storage facility, the leaked water made no contribution to generation and then had to be pumped back to the upper reservoir, only to appear as leakage again. Not the most efficient use of power or water!

Another negative effect resulting from seals that allow water to leak profusely is that these seals will allow air to pass with even greater ease. Thus, when the unit is running in the "blown down" condition (i.e., the water level is depressed and the turbine is spinning in air), the air escapes past the shaft seal. This requires all the facility's 3 MVA compressors to run at full capacity just to keep the water level depressed. This provides yet another example of inefficient use of available power at this facility.

A secondary effect of seal leakage is corrosion. This is not easy to quantify, but excessive leakage causes corrosion that leads to bacterial and algae growth, which create a significant health risk for personnel as well as equipment blockages and malfunction. Excessive leakage from the turbine main shaft seal wastes water that could be used for generation and can cause damage to the plant, including corrosion of the surrounding equipment. The cumulative losses involved equate to about a high reduction in unit efficiency.[15]

Description of the action

It was well noticed from first days of operation that there are issues with design of the main shaft of Turbine for that it is recommended to review the design in order to prevent repeating of the problem, all of the effects described above are as a direct result of the wrong seal type being selected for this application. This was determined through calculations, based on pressure and flow, which proved that the existing seal was totally ineffective. But, most people in the hydro industry may not even realize they have a choice with regard to design of the main turbine shaft seal. Therefore, education must take place for several people involved in the process.
The following suggested sequence of action to be followed to implement the replacement of Turbine Shaft Seal:

- Assign specialist company or consultant in field of Turbine Shaft Seal design and manufacture. To run the education on important and quality assurance for Turbine Shaft Seal for the following participants:
  - **Owners:** Most owners do not routinely count the cost of leakage, and some may not realize they have such losses. Generally, because hydro plant operators may not be able to quantify the losses from leakage, owners cannot justify the expenditure needed to reduce the problem.
  - **Operators:** Most operators, particularly well-established ones, accept high leakage as "normal," and many have installed extra pumps to deal with the problem. Whole life costs related to the leakage have not been fully evaluated.
  - **Buyers:** Most buyers, their agents, or consulting agents do not address levels of efficiency for the shaft seal, apart from longevity of the wearing parts.
- The consultant with support of the operators should provide the following factors for tender document:
  - Quantify the current losses from leakage;
  - Justify the expenditure needed to reduce the problem;
  - Evaluate fully the Whole life costs related to the leakage;
  - Calculate the levels of efficiency for the shaft seal, apart from longevity of the wearing parts;
  - Calculate the quality of water and moisture contents.
- Prepare and launch the tender document for the replacement for the Turbine Shaft Seal

[15] http://www.hydroworld.com/articles/print/volume-18/issue-5/articles/seals/turbine-main-shaft-seal-leakage-understanding-the-problem.html

- The requirements on such seals include, but are not limited to, effective operation, long wear life, easy maintenance and low initial cost. The main shaft seal should withstand and operates under harsh working conditions. And must provide high wear resistance against abrasives within the water and be able to operate at high rubbing velocities with low leakage;
- Identify the measurement and technical evaluation procedure in the tender document to ensure proper selection of products and specialised companies to ensure replacement and long operation of Turbine;
- A new design for Turbine Shaft Seal to solve the resulting problems in this part of the Turbine;
- Include the spare parts for future maintenance;
- Include the testing and commission procedures and run the evaluation and indicators for efficient implementation of tender;
- Include the training of operator on future maintenance of the Turbine Shaft Seal.

➢ Assig the contractors for Manufacturing and design of the new Turbine Shaft Seal
- processing materials reserve part of the Turbine.

➢ **Raising citizens' awareness** to utilize these techniques so that the improving Damp efficiency in producing clean energy will be effective in the project.

General objectives

The replacement of the Turbine Shaft Seal will increase the capacity of renewable energy by 80 MW, also this will allow to evaluate the existing Turbine and assess the leak of water which will insure best efficient use of energy.

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Renewable energy		Mitigation in %	Cost in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
Local Renewable energy generation					241920	198374	2%	
		Replacement of Turbine Shaft Seal for unit 3			241920	198374	2%	500000

The calculation is based on following assumption:
80MW x 6 months x 30days per month x 24 hour of operation x 70% efficiency= 241920MWh/year
241920 MWh x 0.82 t CO2/MWh= 198374 tCO2.

Responsible body:

General Directorate of Electricity Sulaymaniyah
Name: Salar Hossam El Din Location: Director General Electricity
Name: Karwan Ibrahim Faki Location: Project follow-up manager
Project duration: 12 months

Summary of all actions of local electrical production

			BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
Local Renewable energy generation			0	0	2278966	1868751.4	19%	26,500,000
Priority Action No 4	55.0	Establishment of a 10 MW Solar/Photovoltaic Power Station			18250	14965	0.1538%	5,000,000
	55.1	Review the National Policies and Regulation supporting the Renewable Energy Sources (RES): - Insure long-term polices and regulation supporting the RES. - Evaluate the risks and obstacles of RES investment and management for long-run and provide solutions and add values for successful implementation and operation. - Obtain required license with long–term operation contract.						
	55.2	STAGE 1 – CONCEPT DEVELOPMENT AND SITE IDENTIFICATION 1. Identification of potential site(s) 2. Funding of project development 3. Development of rough technical concept						
	55.3	STAGE 2 – PREFEASIBILITY STUDY 1. Assessment of different technical options 2. Approximate cost/benefits 3. Permitting needs 4. Market assessment						
	55.4	STAGE 3 – FEASIBILITY STUDY 1. Technical and financial evaluation of preferred option 2. Assessment of financing options 3. Initiation of permitting process 4. Development of rough technical concept						
	55.5	STAGE 4 – PERMITTING, CONTRACTS AND FINANCING 1. Permitting 2. Contracting strategy 3. Supplier selection and contract negotiation 4. Financing of project						
	55.6	STAGE 5 – ENGINEERING, PROCUREMENT, CONSTRUCTION AND COMMERCIAL OPERATION 1. Preparation of detailed design for all relevant lots 2. Preparation of project implementation schedule 3. Finalization of permitting process 4. Construction supervision 5. Performance testing						

		6. Preparation of as build design (if required)						
	55.7	Raising citizens' awareness to utilize these techniques so that the photovoltaic cell system will be installed in the commercial, investment and residential buildings, taking the Governorate as a good exemplary.						
	55.8	Operation and maintenance phase to insure efficient operation and long life of project.						
Priority Action No 5	56.0	Install three Mini Hydro units at Dukan Dam and Reconstruction of two units of Mini Hydro in Darbandikhan dam			28110	23050	0.2%	19,500,000
		Dukan Dam,			22950	18819	0.2%	
	56.1	Install three Mini Hydro units with a capacity of 2.55 MW per unit.						
	56.2	Supply of materials crisis reserve for the operation of huts for 5 years.						
	56.3	Training the staff necessary for the operation and maintenance of units.						
		Derbandakhan Dam			5160	4231.2	0.0%	
	56.4	Rehabilitation of two existing units.						
	56.5	Providing the necessary spare parts for maintenance and operation,						
	56.6	Training the staff to operate and maintain the two units.						
	57.0	Provision of spare materials for Dukan and Darbandikhan hydroelectric plants & replacement of cooling system Dukan and Darbandikhan stations			1962576	1609312	16.5%	1,500,000
	58.0	Replacement of Turbine Shaft Seal Module for Unit 3 in Dukan Damp Hydroelectric facility			241920	198374	2.0%	500,000

Summary of all actions of local electrical production

Sectoral & field of action	Action NO.	Key actions and Measures	BAU Scenario		Mitigation in Energy		Mitigation in %	Costing in $
			MWh/a	t CO2/a	MWh/a	t CO2/a		
GOVERNORATE BUILDINGS, EQUIPMENT/FACILITIES			12012	7231	4685	3839	53%	9,180,000
	1.0	Smart services in Governorate and Local Authority Building and Facilities						3,000,000
	1.1	Automating the internal management system						
	1.2	Providing the essential infrastructure						
	1.3	Implementation phase						
	2.0	Developing Operation and Maintenance Management for Governorate Buildings			600	492	7%	1,000,000
	2.1	Create Operation and Maintenance unit in the Governorate,						
	2.2	Assess of the O&M in the governorate building and facilities.						
	2.3	Roles and responsibilities of governmental directorates and municipalities						
	2.4	Present facilities specific O&M manuals.						
	3.0	Implementation of the Consumption Saving Measures and use the Renewable Energy in the Governorate Buildings						5,080,000
	3.1	Conducting an analytical study of consumption						
	3.2	Implementing consumption saving measures			364	298	4%	
	3.3	Activate the maintenance role						
	3.4	Using of high efficiency equipment			278	227	3%	
	3.5	Installing motion sensors						
	3.6	Replacing the used lighting by a more efficient type as the LED lighting			1091	894	12%	2,500,000

	3.7	Use of Renewable Energy in the Governorate Buildings			2352	1928	27%	2,580,000
	4.0	Ensure proper Implementation of New Public procurement in Sulaymaniyah						100,000
	4.1	Assign a consultant to support the developing and implementing sustainability rules in the public procurement						
	4.2	Upgrade the internal procedure and regulation of procurement to include the sustainability clause						
	4.3	Training the Local Governors administration departments and related representatives on the new rules						
	4.4	Regularly update the procedures and rules in the public procurement and monitor the implementation and results achieved						
Residential building			8687629	5762222	2978674	2338225	41%	38,483,221
	5.00	Promoting measures for energy conservation in existing building			278027	227853	3.95%	1,884,000
	5.11	Join efforts by assign the support team from stakeholders and energy team to support implementation of promotion of SWH in building.						20,000
	5.12	Setting the base for Energy Auditing for houses						100,000
	5.13	Establishment of social committee for support the collection data for houses						30,000
	5.14	Establish household technical support group						50,000
	5.15	Conduct energy auditing						24,000
	5.16	Prepare Procurement package						20,000
	5.17	Implementation phase						100,000
	5.18	Develop the Information Kit and CAPP						20,000
	5.19	Launch awareness campaign toward sustainable movement						1,500,000

	5.20	Develop the recommendation for National strategic plan for regulating energy consumption in houses						40,000
	6.0	Implementing and promoting Green Building code in new building			664978	441123	7.66%	340,000
	6.1	Conduct a round table to debate on Green Building law with developers, investors, designers, consultants, universities and NGO's in coordination with national authorities						10,000
	6.2	Issuing detailed instructions on how to apply, implement and process the Green Building with clear frame work supported by national authorities						10,000
	6.3	Issuing instructions for granting building licenses within the Green Building Code in local level base						10,000
	6.4	Promote a package of incentives for developers and owners as well as for buyers in New Green Building Code						10,000
	6.5	Imposing fines on buildings that violate building instructions						
	6.6	Raising awareness on Green building code among citizens to promote the green culture.						300,000
	6.7	Issuing certificates for buildings committed for Green Building Code						
	6.8	Annual review of progress made and achievement monitoring for new Green building code						
	6.9	Strict legislative enforcement of the building law in two phases:						
	7.0	High reflective roofs to minimiz energy consumption in residential buildings			10826	8877	0.15%	120,000
	7.1	Carry out advertising campaigns targeting the residential sector to						20,000

		promote the implementation of high reflective roofs (*with specific information high reflective roof*						
	7.2	Conduct sample implementation around 1000 houses and implement of high reflective roofs						100,000
	7.3	Workout with national level in legislation to support the promoting of the high reflective roofs initiative						
	7.4	Carry out advertising campaigns targeting the residential sector to Promote the set point temperature in summer on 25°C and 20°C in winter						
	7.5	Support establishing the support mechanise to apply the initiative for high reflective roofs						
	8.0	Launching the concept of SWH and ESCO in KRG			19318	15841	0.27%	1,270,000
	8.1	Join efforts by assign the support team from stakeholders and energy team to support implementation of promotion of SWH in building.						
	8.2	Assessment of the technologies and potential of Solar Heat boilers in different types of buildings in Private Houses						20,000
	8.3	Setting the base for Energy Auditing for houses Formation in comprehensive and simplified form						50,000
	8.4	Based on best results install 1000 solar water heater in Sulaymaniah districts:						1,000,000
	8.5	Based on the analysis and best practices in the region propose models for financing						
	8.6	Present the recommendation for national authority						
	8.7	Raising awareness campaigns to rationalize electricity and water						100,000

		consumption at the regional level;						
	8.8	Raising awareness campaigns to rationalize electricity and water consumption for homes benefiting from the project						100,000
	9.0	Implementing the legislation for rationalise the demand for energy			2005525	1644531	28.54%	34,869,221
	9.1	Moderate the local laws and regulation to support implementation of EE and RE legislation on local level						
	9.2	Apply the national legislation of the high reflective roofs			104723	85873	1.49%	to be developed
	9.3	Apply the national legislation polices related to energy efficiency appliances in residential sectors;			1100000	902000	15.65%	to be developed
	9.4	Apply the national legislation polices related to Solar Water Heater.			185383	152014	2.64%	to be developed
	9.5	Raising awareness campaigns to rationalize electricity and water consumption						1,000,000
	9.6	Carry out advertising campaigns to promote the implementation of high reflective roofs						1,000,000
	9.7	Launch the yearly awareness campaign			615419	504644	8.76%	10,000,000
	9.8	Monitor and review the awareness campaign						
Tertiary building			1240594	1017287	67476	55330	5%	19,670,264
		Health buildings and Facilities	145311	57484	7580	6216	10.81%	2,842,957
	10.0	Improvement of Energy Efficiency in Sulaymaniah Directorate General of Health Main Building and branches	2349	1926	696	571	0.99%	356,000
	10.1	Assign energy team from the staff of DDGoH with Energy Consultant	781	640				10,000
	10.2	Implementing simplified consumption saving measures			26	21	0.04%	1,000
	10.3	Conducting an analytical study of energy consumption:						5,000

	10.4	Applying the measure related to the Energy Auditing and monitor the results.			208	171	0.30%	100,000
	10.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			45	37	0.06%	50,000
	10.6	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						5,000
	10.7	Prepare Guide Line book for Health Clinics to convert them to green building.						5,000
	10.8	Conduct workshop with the head of department and maintenance staff						10,000
	10.9	Repeat the same actions in other buildings	1568	1286	417	342	0.59%	170,000
	11.0	Improvement of Energy Efficiency of Health Facilities in Sulaymaniah Hospitals	131181	49967	5632	4618	8.03%	1,370,386
	11.1	Assign energy team from the Hospital staff with Energy Consultant			350	287	0.50%	11,589
	11.2	Implementing simplified consumption saving measures						1,000
	11.3	Conducting an analytical study of energy consumption:				0		5,000
	11.4	Applying the measure related to the Energy Auditing and monitor the results.			2672	2191	3.81%	635,195
	11.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			95	78	0.14%	105,427
	11.6	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						5,000
	11.7	Prepare Guide Line book for Health Clinics to convert them to green building.						5,000
	11.8	Conduct workshop with the head of department and maintenance staff						10,000
	11.9	Repeat the same actions in other Hospitals,			2515	2062	3.59%	592,175

	12.0	Pilot project in Health Clinic Centres / Primary healthcare centres (PHCs),	11781	5591	1252	1027	1.79%	1,016,571
	12.1	Assign energy team from the staff of the clinic with Energy Consultant						10,000
	12.2	Implementing simplified consumption saving measures			48	39	0.07%	1,714
	12.3	Conducting an analytical study of energy consumption:						5,000
	12.4	Applying the measure related to the Energy Auditing and monitor the results.			260	213	0.37%	180,795
	12.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			110	90	0.16%	134,063
	12.6	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						5,000
	12.7	Prepare Guide Line book for Health Clinics to convert them to green building.						5,000
	12.8	Conduct workshop with the head of department and maintenance staff						10,000
	12.9	Repeat the same actions in another Health Clinic Centre			834	684	1.19%	665,000
	15.0	Ensure proper implementation of new Public Procurement						100,000
	15.1	Assign a Sustainable procurement specialised to support conducting the following actions						
	15.2	Training the administration departments of the DDERAD on sustainable Procurement procedures						
	15.3	Organize training of private sector representatives aiming Sustainable Procurement procedures						
	15.4	Update the procurement specifications and procedures to meet the						

		Sustainable Procurement.						
	15.5	Monitor the implementation and apply suitable actions to improve the results						
		Directorate of Suliymaniah Endowment & Religious Affairs	48283	39592	22691	18607	47.0%	9,429,056
	16.0	Developing operation and maintenance management in Endowment & Religious Affairs Directorate in Sulaymaniah Governorate Buildings and facilities						55,000
	16.1	Establish technical team and supporter						10,000
	16.2	Conduct An O&M assessment for Endowment & Religious Affairs Directorate building and facilities						20,000
	16.3	Preparation of a Guideline for Operations and Maintenance (O&M						10,000
	16.4	Train the staff on using the Guideline for Operations and Maintenance (O&M).						5,000
	16.5	Monitor the operation and apply additional measure to improve and maintain the results						10,000
	17.0	Improvement of Energy Efficiency in Mosques/churches and the administration Buildings in Sulaymaniah Directorate for Endowment & Religious Affairs			18346	15044	38.0%	9,274,056
	17.1	Assign energy team from the DERAD staff with Energy Consultant						10,000
	17.2	Sorting the Mosques/churches according size and capacity or other base according to consultant recommendation						10,000
	17.3	Implementing simplified consumption saving measures supported with awareness raising and training			1448	1187	3.0%	10,000

	17.4	Conducting an analytical study of energy consumption:						50,000
	17.5	Applying the measure related to the Energy Auditing and monitor the results.						10,000
	17.6	Design and Supply and install Solar water heater			9656	7918	20.0%	6,434,640
	17.7	Replace the Water taps with motion seniors to reduce the water consumptions						2,661,416
	17.8	Replace normal lights with efficient LED lights			7242	5938	15%	58,000
	17.9	Lesson learned report along with the challenges, solutions and benefits of the project to ensure best practices.						10,000
	18.0	Prepare Guide Line book to convert to green.						10,000
	18.1	Conduct workshop with the head of department and maintenance staff						10,000
	18.2	Repeat the same actions in other Mosques/churches, benefiting from the lessons learned from previous projects and planning new projects in other centres.						
	19.0	Ensure proper Implementation of New Public procurement in Endowment & Religious affairs Directorate in Sulaymaniah Governorate			4345	3563	9%	100,000
	19.1	Assign a Sustainable procurement specialised to support conducting the following actions						
	19.2	Training the administration departments of the Endowment & Religious affairs Directorate in Sulaymaniah Governorate on sustainable Procurement procedures						
	19.3	Organize training of private sector representatives aiming Sustainable Procurement procedures						

	19.4	Update the procurement specifications and procedures to meet the Sustainable Procurement.						
	19.5	Monitor the implementation and apply suitable actions to improve the results						
		Sulaymaniah General Directorate of Education	112843	69976	37205	30508	44%	7,398,250
	20.0	Developing of Operation and maintenance management in Sulaymaniah General Directorate of Education						55,000
	20.1	Establish technical team and supporter						10,000
	20.2	Conduct An O&M assessment for Sulaymaniah General Directorate of Education building and facilities						20,000
	20.3	Preparation of a Guideline for Operations and Maintenance (O&M						10,000
	20.4	Train the staff on using the Guideline for Operations and Maintenance (O&M).						5,000
	20.5	Monitor the operation and apply additional measure to improve and maintain the results						10,000
	21.0	Pilot project in Schools in Sulaymaniah General Directorate of Education			37205	30508	43.6%	7,243,250
	21.1	Assign energy team from the staff of the schools with Energy Consultant						10,000
	21.2	Implementing simplified consumption saving measures						10,000
	21.3	Conducting an analytical study of energy consumption:						50,000
	21.4	Applying the measure related to the Energy Auditing and monitor the results.			70	57	0.1%	12,000
	21.5	Design and Supply and install PV Solar System to supply Green Energy to the Building			80	65	0.1%	131,250
	21.6	Lesson learned report along with the challenges, solutions and benefits of the						10,000

		project to ensure best practices.						
	21.7	Prepare Guide Line book for Schools to convert them to green building.						10,000
	21.8	Conduct workshop with the head of department and maintenance staff						10,000
	21.9	Repeat the same actions in another Schools,			37055	30385	43.4%	7,000,000
	22.0	Ensure proper implementation of new Public Procurement in Sulaymaniah General Directorate of Education						100,000
	22.1	Assign a Sustainable procurement specialised to support conducting the following actions						
	22.2	Training the administration departments on sustainable Procurement procedures						
	22.3	Organize training of private sector representatives aiming Sustainable Procurement procedures						
	22.4	Update the procurement specifications and procedures to meet the Sustainable Procurement.						
	22.5	Monitor the implementation and apply suitable actions to improve the results						
		KRG Ministry of Higher Education						330,000
	23.0	Establishing a Sustainable Energy Research Group (SERG)						80,000
	23.1	Building a research group from qualified researchers who have postgraduate education and training (MSc. or PhDs) in sustainable design and sustainable energy technologies						
	23.2	Establishing specialized MSc and PhD programs in sustainable design and sustainable energy						
	23.3	Providing online access to related conference proceedings, journals,						

		and other publications to the research group members.						
	23.4	Training the group researchers in writing grant applications and applying for funds for undertaking innovative sustainability related research projects						
	23.5	Connecting the research group to counterpart research groups and centres around the world to establish research collaborations and contribute to the international scientific community.						
	24.0	Certified technical trainings in sustainable energy technology						100,000
	24.1	Assessing the skill needs and shortages by engaging local authorities, private sector, and ACE industry.						
	24.2	Designing and developing training programs in the targeted areas.						
	24.3	When developing the programs, consulting international experts and the companies that provide or sell sustainable energy solutions that fit into the context of Kurdistan Region.						
	24.4	Training local academic staff and faculty members who will be offering the trainings (in other words, training the trainers).						
	24.5	Establishing lab and providing equipment, if needed.						
	25.0	Establishing a Bachelor's degree program in Environmental Design (5 Years)						150,000
	25.1	Engaging local stakeholder from higher education, government, and private sectors to identify professional skills gaps in the area of						

		sustainable design and sustainable energy.						
	25.2	Designing and developing the program curriculum and courses content in consultation with experts in the field from leading international universities and engagement of the stakeholders.						
	25.3	Training local academic staff and faculty members in the subject matters to teach in the program.						
	25.4	Providing print and electronic library resources in the field to the program's library given their limited availability in the region.						
	25.5	Establishing lab and providing equipment based on the need of the curriculum						
		Ministry of transportation & communication Directorate of Post & Communication						100,000
	26.0	Telecom repeater station in Zmnako						50,000
	27.0	Telecom repeater station in SARA						50,000
Public Street Lighting			99487	81580	66549	54570	67%	39,980,325
	28.00	Modernise and transform street lighting system	99487	81580				
	28.01	Launch technical team						
	28.02	Develop a management and maintenance plan						10,000
	28.03	Develop master plan for street lighting						10,000
	28.04	Develop a training programme						10,000
	28.05	Develop specification and standard						10,000
	28.06	Apply training to the staff on operation and maintenance procedures;						10,000
	28.07	Apply the master plan for street lighting;						
	28.08	Apply management and maintenance plan;						

	28.09	Apply the modernization and transition of public lights in phases, each phase would include upgrading of around five thousand streets lights which include the following:						
	28.10	Replace mercury lamps and sodium (HPS) lamps with efficient LED with smart drivers and surge protection.			60820	49872		39,277,470
	28.11	Replace the photo cells in feeder pillars with astronomic timer;			5729	4698		217,618
	28.12	Provide surge protection in main feeder pillars;						435,237
	28.13	Track the development and the measurement in periodical time						
	28.14	Replace the street light by LED Lights on 60m ring road (Abusana Bridge to walwba bridge)						
	28.15	Replace the street light by LED Lights on 60m ring road (Jawarta Bridge to walwba bridge)						
	28.16	Replace the street light by LED Lights on 60m ring road (Jawarta Bridge to abusana bridge)						
Transportation Private and commercial			10190681	2579641	1482182	375176	14.54%	4,876,400
	29.00	Review, Update and implement the Existing Master Plan for Sulaymaniyah City to Include the Feature of Sustainability.			1019068	257964	10.00%	TBD
	30.00	Shuttle bus / Express bus in regular base lines			101907	25796	1.00%	3,400,000
	31.00	Regulate taxi service in main centres			101907	25796	1.00%	5,000
	32.00	Smart taxi service through allocation taxi offices in different areas			50953	12898	0.50%	3,000
	33.00	Build New Garage station for public and private buses in Chamchamal District			203814	51593	2.00%	1,100,000
	34.00	Provide Car parking spaces by applying smart park meters at side roads			4533	1128	0.04%	368,400
Transportation Governorate fleet			641285	169240	0	0	0	-

Agriculture			141484	116018	3908	3204	2.76%	11,053,300
Action priority 2	35.0	Supply and install and operate Laboratory for agricultural crops						
	36.0	Research and development of fruit Nurseries Orchards						4,333,300
	37.0	Botanical Garden						3,720,000
	38.0	Study on land use database						500,000
	39.0	Park Hawary shar, Efficient energy consumption in the Garden			3908	3204	2.76%	2,500,000
Wastewater Management				0	0	0	0%	-
	40.0	Sewerage treatment plant for black water in to Derbandakhan dam						
	41.0	Management of Healthcare Environmental Hazards Wastewater						
Solid Waste Management					0	0	0%	22,000,000
	42.0	Convert solid waste to energy through waste incineration						TBD
	43.0	Design and construct damp fill for solid waste factory in Klar district						2,000,000
	44.0	Design and construct damp fill for solid waste factory in Chamchmal district						2,000,000
	45.0	Design and construct damp fill for solid waste factory in Pishdar district						2,000,000
	46.0	Design and construct recycling solid waste plant in Said Sadiq district						8,000,000
	47.0	Design and construct recycling solid waste Plant in Jwarta district						8,000,000
Water					0	0	0%	12,000,000
Priority Action No 3	48.0	Plan for a groundwater monitoring network in Sulaymaniyah, through wide hydrology and hydrogeology survey for basic groundwater data						3,000,000
	49.0	Rehabilitation of Dukan 2 water pumping station						6,000,000
	50.0	Construction of Dukan3 water treatment plant						

	51.0	Feasibility study for Design and construction of Khewata Dam			438000	359160		3,000,000
Industrial					0	0	0.00%	-
	53.0	Ambient and continuous air quality monitoring system						711,538
	54.0	Construct modern industrial area						
Local Renewable energy generation			0	0	2278966	1868751.4	19%	26,500,000
Priority Action No 4	55.0	Establishment of a 10 MW Solar/Photovoltaic Power Station			18250	14965	0.1538%	5,000,000
	55.1	Review the National Policies and Regulation supporting the Renewable Energy Sources (RES): - Insure long-term polices and regulation supporting the RES. - Evaluate the risks and obstacles of RES investment and management for long-run and provide solutions and add values for successful implementation and operation. - Obtain required license with long–term operation contract.						
	55.2	STAGE 1 – CONCEPT DEVELOPMENT AND SITE IDENTIFICATION 1. Identification of potential site(s) 2. Funding of project development 3. Development of rough technical concept						
	55.3	STAGE 2 – PREFEASIBILITY STUDY 1. Assessment of different technical options 2. Approximate cost/benefits 3. Permitting needs 4. Market assessment						
	55.4	STAGE 3 – FEASIBILITY STUDY 1. Technical and financial evaluation of preferred option 2. Assessment of financing options 3. Initiation of permitting process						

		4. Development of rough technical concept						
	55.5	STAGE 4 – PERMITTING, CONTRACTS AND FINANCING 1. Permitting 2. Contracting strategy 3. Supplier selection and contract negotiation 4. Financing of project						
	55.6	STAGE 5 – ENGINEERING, PROCUREMENT, CONSTRUCTION AND COMMERCIAL OPERATION 1. Preparation of detailed design for all relevant lots 2. Preparation of project implementation schedule 3. Finalization of permitting process 4. Construction supervision 5. Performance testing 6. Preparation of as build design (if required)						
	55.7	Raising citizens' awareness to utilize these techniques so that the photovoltaic cell system will be installed in the commercial, investment and residential buildings, taking the Governorate as a good exemplary.						
	55.8	Operation and maintenance phase to insure efficient operation and long life of project.						
Priority Action No 5	56.0	Install three Mini Hydro units at Dukan Dam and Reconstruction of two units of Mini Hydro in Darbandikhan dam			28110	23050	0.2%	19,500,000
		Dukan Dam,			22950	18819	0.2%	
	56.1	Install three Mini Hydro units with a capacity of 2.55 MW per unit.						
	56.2	Supply of materials crisis reserve for the						

		operation of huts for 5 years.						
	56.3	Training the staff necessary for the operation and maintenance of units.						
		Derbandakhan Dam			5160	4231.2	0.0%	
	56.4	Rehabilitation of two existing units.						
	56.5	Providing the necessary spare parts for maintenance and operation,						
	56.6	Training the staff to operate and maintain the two units.						
	57.0	Provision of spare materials for Dukan and Darbandikhan hydroelectric plants & replacement of cooling system Dukan and Darbandikhan stations			1962576	1609312	16.5%	1,500,000
	58.0	Replacement of Turbine Shaft Seal Module for Unit 3 in Dukan Damp Hydroelectric facility			241920	198374	2.0%	500,000
			21013172	9733219	6882439	4699095	48%	149743510

Priority Action Fiche #1
Management of Healthcare Environmental Hazards Wastewater

Background

The wastewater in hospitals and health care centres contain different types of hazard liquids. For example, chemicals that include anaesthetics, disinfectants (formaldehyde, glutaraldehyde), chemicals from laboratory activities, photochemical solutions (hydroquinone), and X-ray contrast media containing absorbable organo halogen compounds (AOX), mercury from dental amalgams or lab chemicals, excessive nutrients and nitrates, pharmaceuticals, including antibiotics, radioactive wastes, infectious agents, including bacteria, viruses and parasites, where the wastewater is potentially infectious.

With no sewer systems or watertight facilities with healthcare and with improper wastewater management, the wastewater can leak into groundwater, and may result in the pollution of local drinking water sources, or the contamination of natural resources.

Description of the action

The improper and inadequate management of the biomedical waste in health care facilities would increase the incidence of health risks to the healthcare workers, the patients, and their environment and to the community at large.

The safe and effective management of biomedical waste in different forms of solid or water would reduce the risks to health. Hence, the development of safe and effective management of biomedical waste along with handling protocols, institutional plans and policies, appropriate training and feedback programs on proper waste management and handling for all the healthcare workers are highly recommended.

- Review and evaluation on the institutional plans and policies and legislation for health facilities waste management in its different forms and identify the weakness and gaps in legislation.
- Identify and assign the national coordination group to support the development of waste management legislation with support of main stockholders.
- Conduct mapping for all kind of wastes in healthcare facilities and review the procedures and workflow for treatment.
- Develop waste management protocol and legislation with support of health waste management consultants.
- Apply the action in Healthcare facilities through short and long term plans.

General objectives

The safe and effective management of health care biomedical waste has received much attention for improper and inadequate management is associated with an increase in the incidence of health risks to the healthcare workers, the patients, and their environment and to the community at large. Hence the development of safe and effective management of biomedical waste along with handling protocols, institutional plans and policies, appropriate training and feedback programs on proper waste management and handling for all the healthcare workers are highly recommended.

Technical description

Main Technology to implement and equipment to use

This part should be developed by the expert in hazarded wastewater from healthcare facilities.

Previous or linked studies

Following the methodology obtained from the report below could be reviewed to identify the main part of it.

The gef "Global environment facility" by following the link

http://www.who.int/water_sanitation_health/facilities/waste/module23.pdf ,

Further review and comment should be taken before implementation starts.

- Wastewater Management

  To ensure appropriate action, the principle of effective wastewater management can be summarised as follows:
  - Strictly limit the discharge of hazardous liquids to sewers.
  - Segregation, waste minimization, and safe storage are just as important for liquid wastes as for solid wastes
  - Chemical and pharmaceutical wastes—such as photographic chemicals, aldehydes, colorants and antibiotics—should not be discharged directly into the sewer drain.
- Implement Collection arrangements in tow possible scenarios according to sight condition:
  - "Central system" of sewage pipes bringing wastewater from throughout the facility to a central underground location for treatment or disposal
  - "De-centralized system" wherein pipes from some medical areas pass wastewater to septic tanks or cesspits *(not a preferred approach)*
- Construction of two separate collection systems
  - Sewage system for wastewater
  - Storm water system for rainwater, which can be used for gardens, toilet flushing or washing of paved areas
  - Manholes to allow access for maintenance every 50 meters or less
  - Watertight sewage pipes and manholes
  - Pre-treatment to reduce or eliminate contaminants in non-domestic wastewater, or in altering its nature before discharging it into the sewer.
- Pre-Treatment of Hazardous Liquids

- Pre-treatment for the medical laboratory (recommended) includes acid-base neutralization, filtration and sedimentation, or autoclaving.
- Pre-treatment for feaces or vomit during an outbreak such as cholera involves decontamination with lime milk (hydrated calcium oxide or calcium hydroxide) – ratio of 1:2 for stool and vomit with lime for 6 hours minimum; ratio of 1:1 for urine with lime for 2 hours minimum.
- Blood can be discharged in the sewer (using PPE to protect from blood splatter) if a risk assessment shows that the organic loading does not require pre-treatment. Otherwise, blood can be pre-treated by a thermal method or disposed directly into a septic tank if safety measures are used. NOTE: 5% hypochlorite is not effective for high organic loads like blood.

- Pre-treatment for the dental department entails installing amalgam separators in sinks, especially by patient treatment chairs; the separated mercury waste must be safely stored.
- Pre-treatment for the radiotherapy department involves separate collection of radioactive wastewater (e.g. urine of patients from the thyroid treatment) and storage for decay in a secured die-away basin until background concentrations have decreased; after the required storage time, the wastewater can be disposed of in the sewer system.
- Pre-treatment for kitchens entails a grease trap to remove grease, oil, and other floating materials.

➢ Liquids That Do Not Require Pre-Treatment
- Non-hazardous chemicals such as syrups, vitamins, or eye drops
- Small quantities of blood and rinsing liquids from surgical theaters can be discharged in the sewer system without pre-treatment
- Large quantities of blood may require pre-treatment if it is indicated by a risk assessment.

➢ Healthcare Sewage System

The preferred method is to connect the healthcare sewage system to the municipal sewage system and to discharge healthcare wastewater after adequate pre- treatment to municipal sewage if the municipal sewage treatment plant meets the following minimum requirements:
- Use of primary, secondary and tertiary treatment
- Removal of >95% of bacteria
- Treatment of sewage sludge to destroy helminth eggs to < 1 egg per litre
- Compliance with local regulatory requirements
- If no municipal sewage system exists, or the municipal sewage system does not meet basic requirements, or the area experiences epidemics of enteric diseases or endemic intestinal helminthiasis:
    - The recommended option is on-site wastewater treatment
    - The objective is to treat effluent so it is suitable for reuse or discharge into the environment, usually into surface water.

➢ On-Site Wastewater Treatment for Large Healthcare Facilities

3 Stages for efficient on-site treatment:
- Primary treatment: to remove of heavy solids
- Secondary treatment: to remove dissolved and suspended biological matter using indigenous bacteria
- Tertiary treatment: to further treat the wastewater for the purpose of reducing pathogens, suspended solids, excessive phosphorus and nitrogen nutrients, and/or chemical contaminants

➢ On-Site Wastewater Treatment
- On-site wastewater treatment produces sludge which contains high concentrations of pathogens
- Options for treatment of sludge:
    - Anaerobic digestion
    - Aerobic digestion

- Composting
- Reed beds

Project Life time exploitation or use duration

25 years

Engineering Studies

The consultant will be covering this part

Availability of environmental impact assessment or mitigating measures to protect environment if any

This action is related to reduce the environment impact.

Priority Action Fiche #2

Supply and install and operate Laboratory for agricultural crops

Background

The Crop and Environment Laboratory (CEL) is a dedicated complex that offers a broad range of facilities and support services for research into plant and environmental science, with the control of various environmental variables, including: temperature, light intensity and quality, day length, relative humidity, irrigation, nutrient availability, and CO_2 concentration.

The laboratories provide agricultural lab tests on everything from seed to harvest for customers seeking to increase their production. From backyard gardeners to family farms to commercial farmers, tests include livestock wastes, grain, fruits, produce, dairy, vineyards, poultry, water, soil, and tissue.
The Test includes:
Soil
The major objective of soil analysis is to inventory the soil's nutrient reserves and chemical composition. Since imbalances in essential elements can limit crop yields, this information is vital to determine what, if any, additions of nutrients are justified to produce maximum economic yields. Soil analysis is the best way to ensure that lime and fertilizer nutrients are applied in both an economically and environmentally responsible manner.
Backed by chemistry and research, soil analysis should be part of every producer's arsenal to control costs, maximize returns, and protect the environment.
Soil pH is one of the most important factors affecting soil fertility. Plant nutrients are most available when soil pH is maintained at a level just below neutral (pH 6.5 to 6.8). Ground agricultural limestone can be used to raise soil pH to a desirable level.
Fertilizer
Fertilizer raw material manufacturers, distributors, dealers, and growers all have a vested interest in knowing that the products that they handle meet or exceed quality and content specifications. The only way to be sure that the product that you are making, buying, or selling meets quality and content specifications is to have it tested by a laboratory.
Plant Tissue
Plant tissue analysis is a diagnostic tool that has been used for many years. It is based on the concept that, up to a certain critical point, the content of a nutrient in plant tissue is directly related to yield. And, nutrient concentrations in plants are directly related to the quantity of that nutrient in the soil that is available or that is in some way limited to the plant. Therefore, plant tissue analysis and soil testing go hand in hand.
Compost & Manure
Compost is widely used in horticulture and it helps improve the soil structure and enrich the nutrient content of the soil. As a result, there is an increasing interest in composting.
Manure is a valuable resource that can supply essential crop nutrients to displace the need for commercial fertilizers and organic matter to improve soil structure. Efficient utilization of manure can substantially reduce your production costs and protect our

environment. Safe utilization of soil amendments from livestock sources such as manure does require particular safety precautions as it applies to use under the Food Safety Modernization Act (FSMA).

Water

Water is consumed in larger quantities than any other nutrient. A comprehensive water analysis can indicate the suitability of a water supply for household, irrigation, or livestock use. GAP and FSMA require the use of analytically verified potable water. Evaluating and documenting the microbial water quality utilized on your farm is a prerequisite step to providing safe agricultural products.

Whether it is the water quality in your home, school, business, favourite swimming hole, or farm knowing the exposure risks from bacteria just makes sense.

Environmental

New Age Laboratories provides a full range of environmental analytical testing services, such as analysis of soil, sediment, water, leachates, dust, and air. The range of analytical services provided for the above-mentioned matrices includes routine, trace, and ultra-trace level organics (volatiles, semi volatiles, pesticides, PCBs, herbicides), and metals. Analysis methods are based on well-established and internationally recognized procedures such as those published by the U.S. Environmental Protection Agency.

Description of the action

Supply, install and operate a Laboratory to provide a variety of analytical and diagnostic agricultural and Environmental testing. It also provides many services (extension; training; improving agricultural practices) for farmers and academic students and researchers.

Main Analytical Services:

Soil Testing: as a management tool to help in decisions related to fertilizer applications. It provides a scientific basis for maintaining optimum soil fertility levels and protects against the expense and environmental hazards resulting from excessive fertilizer applications and other agricultural practices.

Drinking & Irrigation Water Analysis: for assessing water quality based on chemical and microbial contents.

Fertilizers: Quality and quantity control of imported fertilizers as official services.

Animal Waste Analysis (compost): for determining the nutrient content and other substances of animal waste as the initial step in utilizing the nutrients for crop production.

Feed and Forage Analysis: provides extension services to dairy and poultry industry such as proximate analysis for feed diets and concentrate formulation.

Toxicogenic Fungi Analysis: Food Quality Control: detection of toxic fungi on food, detection of their mycotoxins, study of toxicogenic factors promoting fungi contamination of mycotoxins.

General objectives

This laboratory aims to help create healthier and more hygienic lives, and contribute to improving the yield of food crops and agricultural productivity.

The laboratory is engaged in the development of new agricultural chemicals and functional fertilizers, more effective and safer household insecticides, and technologies for preventing infectious diseases, as well as efficient synthetic methods for pharmaceutical chemicals.

Technical description

Main Technology to implement and equipment to use

TBD

Previous or linked studies

TBD

Project Life time exploitation or use duration

Long life more than 40 years

Engineering Studies

TBD

Availability of environmental impact assessment or mitigating measures to protect environment if any

This project is to reduce the environment effect and improve the healthy live.

Summary of related Awareness Raising (AR) actions

AR related to the action

- Target Audience: Farmers, agriculture sectors, Citizen
- Key Message: Healthy food with healthy environment
- Objectives: save our and our child health.

AR related to community

Assumptions and risks

- The Assumptions:
- The Risks:

Key success factors

Next steps

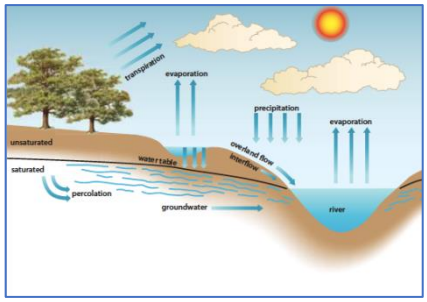
- Looking for finance to start developing the actions.

Priority Action Fiche #3

Plan for a groundwater monitoring network in Sulaymaniyah

Through wide hydrology and hydrogeology survey for basic groundwater data, including water-level and water-quality data, and a reliable database is being established for the purpose of managing total water resources.

Background:



In Kurdistan Region of Iraq, rapid economic growth, rising standards of living, and an altered societal structure have in recent years put severe demands on water supplies. Because of its stable quantity and quality, groundwater has long been a reliable source of water for domestic, agricultural, and industrial users.

The concerns over water resources and the environment increase, the importance of considering ground water and surface water as a single resource has become increasingly evident. Issues related to water supply, water quality, and degradation of aquatic environments are reported on frequently. The interaction of ground water and surface water has been shown to be a significant concern in many of these issues. Contaminated aquifers that discharge to streams can result in long-term contamination of surface water; conversely, streams can be a major source of contamination to aquifers. Surface water commonly is hydraulically connected to ground water, but the interactions are difficult to observe and measure and commonly have been ignored in water-management considerations and policies, where, many natural processes and human activities affect the interactions of ground water and surface water. But the establishment of a management program that integrates groundwater and surface-water use has been hampered by the lack of groundwater data.

The Department of Water Resources in Sulaymaniyah initiated a program entitled "Groundwater Monitoring Network Plan in Sulaymaniyah." Under this program, basic groundwater data, including water-level and water-quality data, are going to be collected, and a reliable database will be established for the purpose of managing total water resources. The plan calls for constructing hydrogeological survey stations and groundwater monitoring wells. Under this program, water-level fluctuations are continuously monitored, whereas water-quality samples are taken for analysis only at the initial drilling stage and, subsequently, at the time when a monitoring well is being serviced.

Description of action:

The place of work is Sulaymaniyah and Halabja governorates. The nature of work is to conduct wide experience on the geological, hydrological and hydrogeologicalaspects It would be better to start with **developing Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for Directorate of ground water in Kurdistan in general and in Sulaymaniyah in particular.** The methodology would be similar to "Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes" by "*John Barnett & Associates Ltd. / Eugene Daly & Associates in association with the National Roads Authority and Mr. Derek Luby, Mr Eugene Daly, Dr. John Kelly, Dr. Les*

Brown and Mr. Tim Morgan" ***and*** **Identifying the actions on following or similar process:**

- Evaluating the current Relevant Legislation including the:
  - Planning and Development Act
  - Water Quality Legislation
  - Water Framework Directive
  - Flooding Directive
  - Groundwater Directive
  - Habitats Directive/Habitats Regulations
  - Heritage Act
  - Minerals Acts
- Assign consultants and Stakeholders
  - Statutory Consultees
  - Non-Statutory Consultees
  - Requirements of Geological, Hydrological
  - Hydrogeological Consultants
  - Interaction with Other Environmental Consultants

The following will be included in the study

- GEOLOGICAL, HYDROLOGICAL AND HYDROGEOLOGICAL ASPECTS OF ROAD SCHEMES
  - Geological Aspects.
  - Soil
  - Economic Geology
  - Geo-hazards
  - Geological Heritage
  - Geomorphology
  - Made Ground / Landfills
  - Construction Materials
  - Construction Stage Impacts
- Hydrological Aspects
  - Hydrological Cycle
  - Climate Change
  - Flooding
  - Surface Water Quality
  - Resource and/or Amenity Value
- Hydrogeological Aspects
  - Aquifers
  - Groundwater Quality
  - Groundwater Supply
  - Groundwater Ecosystems
  - Karst
- Collection of Baseline Information

Baseline studies should be scoped and planned on the basis of available information on the geological, hydrological or hydrogeological environment and the preliminary design

of the proposed road scheme. These studies will typically comprise some or all of the following:

- walkover surveys and geological field mapping;
- inspection of impacted sites, features and attributes;
- ground investigation contract(s), to include boreholes, rotary drill holes, trial pits, geophysical surveys, dynamic probes, cone penetration testing, in-situ testing of subsoils and groundwater permeability, monitoring of groundwater levels, laboratory testing and reporting in paper and digital format;
- Well surveys;
- surface water monitoring (flows and levels), and
- surface and groundwater quality testing.

In planning and scoping these surveys, it is critical to ensure that they are:

- sufficient to characterise and evaluate the receiving environment;
- sufficient to identify and assess the impacts on the environment, and
- focused on those impacts which are both likely and significant.

A scientific survey by 8 teams consists of 3 geologists and 1 hydrogeologist (supervisor), the survey is daily continuing since water year from 21/6/2018 to 20/6//2019.
The job needs trucks, for trance, GPS instruments, a compass, sounder, laptop and mapper programs.
The project needs to be run by a staff at several ways that exist in the directorate of ground water in Sulaymaniyah. Their work includes is the collection of information and analyzing it by using a data base or the (GIS) which enters that information and drop it on maps.

- Reporting
  - Contents of Constraints Study Report (Soil and Geology)
  - Contents of Constraints Study Report (Hydrology)
  - Contents of Constraints Study Report (Hydrogeology)
- Identify and Categorise the Impacts
  - Direct Impact where the existing geological, hydrological or hydrogeological environment along or in close proximity to the route corridor is altered, in whole or in part, as a consequence of road construction and/or operation.
  - Indirect Impact where the geological, hydrological or hydrogeological environment beyond the proposed route corridors is altered by activities related to road construction and/or operation.
  - No Predicted Impact – where the proposed route corridor has neither a negative nor a positive impact on the geological, hydrological or hydrogeological environment.
- ENVIRONMENTAL IMPACT STATEMENT (EIS)
  - Environmental Impact Assessment – General
  - Environmental Impact Assessment – Soil and Geology
    - Description of the Existing Geological Environment
    - Geological Impact Assessment
    - Geological Mitigation Measures
    - Contents of Geological EIS Report

- Environmental Impact Assessment - Hydrology
    - Description of the Existing Hydrological Environment
    - Hydrological Impact Assessment
    - Hydrological Mitigation Measures
    - Hydrological EIS Report
- Environmental Impact Assessment – Hydrogeology
    - Description of the Existing Hydrogeological Environment
    - Hydrogeological Impact Assessment
    - Hydrogeological Mitigation Measures
    - Hydrogeological EIS Report

At the outset of the EIA for each topic, all data acquired at Constraints Study and Route Corridor Selection phases should be reviewed and collated. Any additional information which may be relevant should also be sought at this stage. Details of the preliminary road design and topographical mapping should be obtained from the engineering design team.
For each of the three topics, the description of the existing environment in the EIS should initially address its context, having regard to the regional data presented in the Constraints Study and Route Corridor Selection Reports. Thereafter more detailed, site-specific information obtained from surveys, inspections, ground investigation, monitoring and testing should be used to make an evaluation of the local environment along the proposed road scheme taking account of its:

- character;
- significance, and
- sensitivity

General objectives:

- Water resource survey will be conducted.
- The available volume of water in these two governorates (Sulaymaniyah and Halabja) will be determined.
- From the collected data, more researches will be capable.
- From the researches we can determine the ground water potential areas.
- After data analyzation and interpretation, we can go through scientific water management.
- Renovation sectors of (Agriculture, Industry, Community, ...ect.)

Responsible Body:
Directorate of ground water in Sulaymaniyah: Individual contact details: Mr. Abas Ali Ahmed director of ground water in Sulaymaniyah Mr. Nawroz Mohammed Omer scientific research unit.
Project cost: 3,000,000$

Technical description
Main Technology to implement and equipment to use
Previous or linked studies
Project Life time exploitation or use duration
Engineering Studies

Availability of environmental impact assessment or mitigating measures to protect environment if any

Summary of related Awareness Raising (AR) actions

AR related to the action

- Target Audience:
- Key Message:
- Objectives

AR related to community

Assumptions and risks

- The Assumptions:
- The Risks:

Key success factors

Next steps

- Looking for finance to start developing the actions.

Projected Energy Estimates in 2030		Cost of Implementation										Available and foreseen sources of funding	
Mitigation		All cost										Local authority's own resources	20%
MWh/a	t CO_2/a	Initial and start-up expenses										National Funds and Programmes	10%
		Approximate operational Costs (including maintenance										International Financial Institutions	70%
Per capita calculated reduction		Approximate annual income for energy producing projects										EU Funds & Programmes and other external funds	
MWh/c	t CO_2/c	Draft calculation of the NPV.										Public-Private Partnerships amount/share (available or to raise)	
		Key performance Indicator										Lined up private investments	
Contribution for	Reduction as related to BAU scenario	Measurement Units										Loans and potential borrower	
		Years of Implementation										Expected annual cost savings to the City budget	
		1	2	3	4	5	6	7	8	9	10	Other	

Organisation and procedures							
Area of intervention				Involvement of Stake Holders	LA	H	
Policy Instrument					External	H	
Origin of action	LA				Other	H	
Staff Capacity	L	M	H	Technical assistance needs			

Priority Action Fiche 4

Title: 16MW utility-scale solar PV power plant in Garmyan

Background

Kurdistan of Iraq bears the highest financial cost to support the internally displaced people whose number reached around 2 million. This has created financial and economic burden on the local community that has contributed to the displaced people, leading to an increase in expenditures and inadequacy of the previous development plan due to the sudden and steady population growth. This addresses a higher need to the increased development projects and infrastructure investments resulting from the excessive use and the inability to cover all the needs in the near future.
As a result, the demand for electricity has largely increased because of population increase and growth which is significantly accompanied by the government subsidy to the electricity sector, amounting to more than 3 billion USD/year.

According to these facts, Governorate of Sulaymaniyah has an ambitious plan to build large Photovoltaic modules grid-connected solar power plants in the territory, with a cumulative installed capacity of 10MW by 2026.
Photovoltaic modules or panels are made of semiconductors that allow sunlight to be converted directly into electricity and can provide a safe, reliable, maintenance-free and environmentally friendly source of power for long years.

The action frame work obtained from the publication of International Finance Corporation (IFC)-2015, More details can be seen in the full report at the following link.
http://www.ifc.org/wps/wcm/connect/f05d3e00498e0841bb6fbbe54d141794/IFC+Solar+Report_Web+_08+05.pdf?MOD=AJPERES

It is very important to ***successfully develop, finance, construct and operate*** utility-scale solar PV power plants. The project development process should be the first part in the action including site identification, plant design, energy yield, permits/licenses, contractual arrangements and financing.

Key element of the project According to IFC-2015 report this process should cover the following:

1. **Optimum power plant design**: A key project development challenge is to design a PV power plant that is optimally balanced in terms of cost and performance for a specific site.
2. **Project implementation:** Achieving project completion on time and within budget with a power plant that operates efficiently and reliably, and generates the expected energy and revenue, is another key concern for developers.
   Key aspects of project implementation include: permits and licensing, selection and contracting of the Engineering, Procurement and Construction (EPC) Company, power plant construction, and operations and maintenance (O&M).
3. **Commercial and financing aspects:** PV regulatory frameworks and specific types of incentives/support mechanisms for the development of PV projects, such as preferential tariffs and other direct and indirect financial supports, have an important impact on the financial viability of the project, as they affect the revenue stream.

Power Purchase Agreements (PPAs) specify the terms under which the off-taker purchases the power produced by the PV plant; this is the most important document to obtain financing.

Description of the action

The action summarised is to develop, finance, construct, operate and maintain 10 MW utility-scale solar PV power plants in Sulaymaniyah.

Before starting, it is essential for a successful project to have suitable expertise within the project team.

This does not only apply to ***technical expertise but also to financial, legal and other relevant fields***. Suitable expertise can be incorporated in a variety of ways: by hiring staff, using consultants or partnering with other organisations.

Establishing a power station using photovoltaic cells and using the best solar cell systems on a 500 dunum plot of land located in the village of Al-Khanasri.

The village is characterized by high brightness and technical appropriateness for the establishment of this station, where the electricity will be transferred through national electricity networks, knowing that:

- A permit for the establishment of a 16 MW solar power plant has been obtained and approved by the Ministry of Environment, Ministry of Energy and Mineral Resources, Ministry of Municipal Affairs, Electricity Regulatory Commission, and the Electric Power Company;
- The approval for transmitting the generated electricity by its networks has been obtained from the National Electric Power Industry;
- An actuarial study of the energy bill for 2017 has been made;
- The Governorate will train skilled personnel on the maintenance and continuity of the station

PROJECT DEVELOPMENT OVERVIEW -refer to Annex for more details

STAGE 1 – CONCEPT DEVELOPMENT AND SITE IDENTIFICATION

4. Identification of potential site(s)
5. Funding of project development
6. Development of rough technical concept

STAGE 2 – PREFEASIBILITY STUDY

5. Assessment of different technical options
6. Approximate cost/benefits
7. Permitting needs
8. Market assessment

STAGE 3 – FEASIBILITY STUDY

5. Technical and financial evaluation of preferred option
6. Assessment of financing options
7. Initiation of permitting process
8. Development of rough technical concept

STAGE 4 – PERMITTING, CONTRACTS AND FINANCING

5. Permitting
6. Contracting strategy
7. Supplier selection and contract negotiation
8. Financing of project

STAGE 5 – ENGINEERING, PROCUREMENT, CONSTRUCTION AND COMMERCIAL OPERATION

7. Preparation of detailed design for all relevant lots
8. Preparation of project implementation schedule
9. Finalization of permitting process
10. Construction supervision
11. Performance testing

12. Preparation of as build design (if required)

General objectives

1. Reducing CO2 emissions;
2. Reducing the energy bill;
3. Using renewable energy sources and environmentally friendly clean energy;
4. The generated energy from the photovoltaic cells include all the activities that require the consumption of electrical energy in all its forms from street lighting, buildings and various facilities, parks, travel agencies and other municipal facilities;
5. Raising citizens' awareness to utilize these techniques so that the photovoltaic cell system will be installed in the commercial, investment and residential buildings, taking the Governorate as a good exemplary.

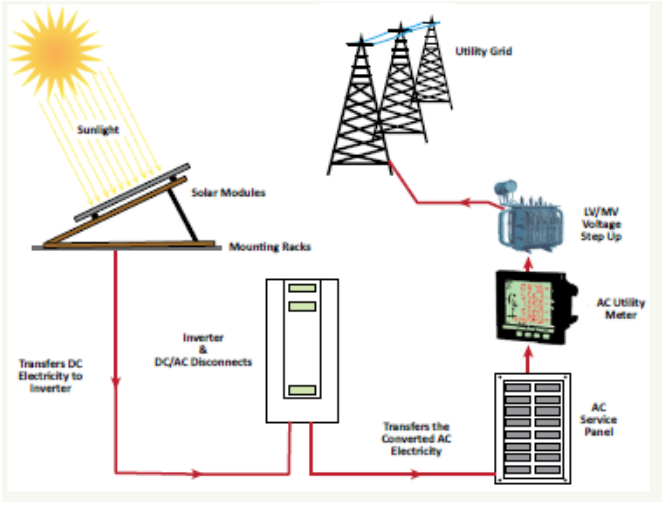
Action	Energy produced when applying the action in MWh	Amount of reduction in emission in tCO2	Cost in $
Establishment of the first phase of the plant 1 MW	1825	1496.5	640000
Establishment of the second phase of the plant 3 MW	5475	4489.5	1200000
Construction of the third phase of the plant 3 MW	5475	4489.5	1200000
Establishment of the fourth phase of the plant 3 MW	5465	4489.5	1200000
Connection with the main Utility power			660000
Awareness			100000
Total	18250	14965	5000000

Technical description

- **Main Technology to implement and equipment to use**

SOLAR PV TECHNOLOGY OVERVIEW

This section discusses module technologies, mounting systems, inverters and methods of quantifying plant performance. It provides an overview of current commercially available technologies used in utility-scale solar PV projects. The purpose is to provide a framework of understanding for developers and investors before they commit to a specific technology.



PV cell technologies are broadly categorised as either crystalline or thin-film. Crystalline silicon (c-Si) cells provide high efficiency modules. They are sub-divided into mono-crystalline silicon (mono-c-Si) or multi-crystalline silicon (multi-c-Si). Mono-c-Si cells are generally the most

efficient, but are also more costly than multi-c-Si. Thin-film cells provide a cheaper alternative, but are less efficient.

There are three main types of thin-film cells: Cadmium Telluride (CdTe), Copper Indium (Gallium) Di-Selenide (CIGS/CIS), and Amorphous Silicon (a-Si).

The performance of a PV module will decrease over time due to a process known as degradation. The degradation rate depends on the environmental conditions and the technology of the module.

Modules are either mounted on fixed-angle frames or on sun tracking frames. Fixed frames are simpler to install, cheaper and require less maintenance. However, tracking systems can increase yield by up to 45 percent. Tracking, particularly for areas with a high direct/diffuse irradiation ratio also enables a smoother power output.

Inverters convert direct current (DC) electricity generated by the PV modules into AC electricity, ideally conforming to the local grid requirements. They are arranged either in string or central configurations. Central configuration inverters are considered to be more suitable for multi-MW plants.

String inverters enable individual string Maximum Power Point Tracking (MPPT) and require less specialised maintenance skills. String configurations offer more design flexibility.

PV modules and inverters are all subject to certification, predominantly by the International Electro Technical Commission (IEC). New standards are currently under development for evaluating PV module components and materials.

The performance ratio (PR) of a well-designed PV power plant will typically be in the region of 77 percent to 86 percent (with an annual average PR of 82 percent), degrading over the lifetime of the plant. In general, good quality PV modules may be expected to have a useful life of 25 to 30 years.

- Previous or linked studies

The PV installation had proven successful implementation all over the world and in Sulaymaniyah 10 MW utility-scale solar PV power plants was installed in Muffrek for around 5 years and it has proven stability and good results which can be taken as example to lessons learned in order to cover the weak point and improve the new design.

- Project Life time exploitation or use duration

PV systems are generally designed for a 25–30 year lifetime.

- Engineering Studies

The action includes five stages of preparation and implementation where in all these stages a precise successful achievement is expected

Implementation plan or construction plans necessary for the implementation and their availability

PROJECT DEVELOPMENT OVERVIEW -refer to Annex for more details
STAGE 1 – CONCEPT DEVELOPMENT AND SITE IDENTIFICATIO
STAGE 2 – PREFEASIBILITY STUDY
STAGE 3 – FEASIBILITY STUDY
STAGE 4 – PERMITTING, CONTRACTS AND FINANCING

STAGE 5 – ENGINEERING, PROCUREMENT, CONSTRUCTION AND COMMERCIAL OPERATION

Availability of environmental impact assessment or mitigating measures to protect environment if any

Already included in the project preparation stages

Summary of related Awareness Raising (AR) actions

AR related to the action

Target Audience:

- Civil society
- Private and public operators
- Professionals in energy sector

Key Message:

- Green society with Renewable energy reliable and green production of electricity

Objectives:

- Reduce the city's energy bills
- Limit the impact of the emission of the greenhouse gas.
- Promote the use of renewable energy in buildings.

AR related to community

- Meetings with the community members to promote the municipal action and promoting the usage of renewable energy in the city
- Create awareness with posters to alert citizens on Governorate action. The actions will be accompanied by strong visual campaign in the municipal and local media.
- AR campaign on being an eco-citizen: Explain the side effect of greenhouse gas emission and the usage of renewable energies technologies (electricity from natural resources) through messages conveyed by television, the radio and the written press.
- Creating an info centre to inform citizens about new technologies
- Training to the students (primary and secondary schools) on using the energy correctly.

Assumptions and risks

According to IFC-2015 report "The Key risks associated with the PV projects":

- Completion risks affected by permitting/licensing and construction delays.
- Energy yield: how much energy the facility will be producing depends on the energy resource and the design of the PV plant. An incorrect estimation of the energy resource, an unforeseen change in weather patterns and performance degradation of the PV plant could significantly affect the revenue of the project.
- Regulatory environment: Changes impacting the amount of power the off-taker is obligated to purchase and the price they pay can clearly impact the project, especially when applied retroactively.

- Off-taker credit worthiness: A thorough due diligence of the off-taker is an essential step before financing is finalized.
- The appropriate financing arrangement depends on the specifics of each PV project, including investor risk appetite. The most common arrangement for such projects generally is to use a project finance type arrangement, typically with at least 30 percent equity and the remainder as debt.

Key success factors

Next steps

Annexes
STAGE 1 – CONCEPT DEVELOPMENT AND SITE IDENTIFICATIO
STAGE 2 – PREFEASIBILITY STUDY
STAGE 3 – FEASIBILITY STUDY
STAGE 4 – PERMITTING, CONTRACTS AND FINANCING
STAGE 5 – ENGINEERING, PROCUREMENT, CONSTRUCTION AND COMMERCIAL OPERATION

Projected Energy Estimates in 2030		Cost of Implementation		Available and foreseen sources of funding	
Mitigation		All cost	$20,760,000	Local authority's own resources	20%
MWh/a	t CO2/a	Initial and start-up expenses	$2,660,000	National Funds and Programmes	20%
18250	14965	Approximate operational Costs (including maintenance	$266,000	International Financial Institutions	10%
Per capita calculated reduction		Approximate annual income for energy producing projects	Each one KWh cost IQD 180 equal to 0.15 USD So, Income $ 2,737,500/a	EU Funds & Programmes and other external funds	30%
MWh/c	t CO2/c	Draft calculation of the NPV.		Public-Private Partnerships amount/share (available or to raise)	20%
0.009	0.0073	Key performance Indicator	Production capacity	Lined up private investments	
Contribution for	Reduction as related to BAU scenario	Measurement Units	KWh/a	Loans and potential borrower	
	0.0015%	Years of Implementation		Expected annual cost savings to the City budget	
		1 2 3 4 5 6 7 8 9 10		Other	

Organisation and procedures							
Area of intervention	Photovoltaics			Involvement of Stake Holders	LA	H	
Policy Instrument	Energy suppliers' obligations				External	H	
Origin of action	LA				Other	H	
Staff Capacity	L	M	H	Technical assistance needs			

Annex for Priority action 1
STAGE 1 – CONCEPT DEVELOPMENT AND SITE IDENTIFICATION

Concept development stage includes identification of the investment opportunity at a specific site and the formulation of a strategy for project development.

These require a detailed assessment that carefully considers the risk–reward appetite of the project developer (Governorate) and potential investors.

1. SITE IDENTIFICATION
2. THE PV PROJECT
3. OUTLINE OF PROJECT STRUCTURE
4. THE REGULATORY FRAMEWORK AND SUPPORT MECHANISMS
5. OFF-TAKER DUE DILIGENCE
6. FINANCING STRATEGY

Concept Stage Checklist

The checklist below covers key questions and factors the developer should consider when deciding whether to proceed to the next stage, which is to conduct a prefeasibility study.

- Project structure outlined.
- Does the country and power sector provide adequate risk-reward benefits to private investors?
- Regulatory support and tariffs, especially the duration and timeline for any incentives for solar power.
- Suitable site identified taking account of site constraints.
- Grid access (proximity, capacity, and policy provisions for access).
- Appropriate funds available to carry out the feasibility assessments.
- Identification of off-taker and available infrastructure to take the power generated

STAGE 2 – PREFEASIBILITY STUDY

Develop a preliminary plant design and investment requirements, which allow further assessment of the financial viability of a project. This assessment involves more detail than the previous stage and determines whether to proceed further with the project and commit additional financial resources.

A prefeasibility study should, at a minimum, include an assessment of:

- The project site and boundary area, ensuring access to the site is possible, both legally and technically.
- A conceptual design of the project giving different options of technology (if applicable) and the financial impacts, including estimation of installed capacity.
- The approximate costs for land, equipment, development, construction and operation of the project, as well as predicted revenue.
- Estimated energy yield of the project. While site specific analysis should be performed at a later stage, for prefeasibility purposes, published, high-level solar resource data and estimates of plant losses, or an assumed performance ratio (based on nominal values seen in existing projects) can be used. Seasonal production estimates should be taken into account.
- The anticipated electricity tariff to be received based on market analysis in a deregulated market, a published Fit in a market with specific incentives for renewables, or the relevant components of the tariff in a market under consideration.
- A financial model to determine the commercial viability of the project for further investment purposes.
- Grid connection cost and likelihood of achieving a connection within the required timeline.
- Identification of key environmental and social considerations and other potential "deal-breakers."

Prefeasibility Checklist

Below is a checklist of key considerations for the developer during the prefeasibility stage:
Assessment of the site and boundary areas including access permissions and restrictions.

- Conceptual design completed including consideration of technology options and their financial impacts.
- Approximate costs for land, equipment, delivery, construction, and operation identified along with predicted revenue.
- Indicative energy yield completed.
- Identification of anticipated electricity tariff to be received, and review of expected terms/conditions of PPAs in the relevant market.
- High-level financial analysis completed.
- Cost and likelihood of achieving grid connection in the required timescales identified.
- Main environmental constraints identified along with other potential "deal breakers."
- Assessment of current and potential future regulatory environment completed.
- An initial concept of the project's legal/corporate structure.
- Solutions to project challenges.
- Permitting requirements/costs identified.
- Preliminary project timeline/workflow showing spacing of key activities drafted

- Permitting requirements, costs, and likelihood of achieving consent. Assessment of the current regulatory environment, stability assessment and possible risk of future changes (for example, likelihood of changes during upcoming regional/national elections).
- An initial concept of the project's legal/corporate structure; this should be formulated to take advantage of existing/future incentives. At the prefeasibility stage, the developer may begin making assumptions about the project company which, if the project moves ahead, would be set up to develop and own the specific project or portfolio.
- Solutions to specific challenges; as challenges to the project arise, possible solutions will begin to be identified. For example, if the power off-taker does not have a strong credit rating, the developer may want to explore the possibility of a sovereign guarantee, and/or support from an export credit agency or a multilateral institution – for example, a partial risk guarantee from the World Bank.
- Preliminary timeline for project activities; while the scheduled workflow will inevitably change significantly, it is important to begin to understand the spacing and timing of key required activities at an early stage.

STAGE 3 – FEASIBILITY STUDY

The feasibility phase will build on the work undertaken at the prefeasibility stage by repeating the assessment in more detail using site-specific data, such as solar resource measurements, and should consider any previously identified constraints in more detail. If multiple sites are being assessed, then the preferred site needs to be selected. The objective of the feasibility study is to provide more detailed information on the potential project design, the investment requirements, and to plan for financing and implementation. If the results of the study are favourable, the Governorate should be prepared to invest more to advance the project to the financing stage.

1. TECHNICAL DESIGN OF SYSTEM

Outline system design. Essentially, this is a plan for the project's physical development, including the lay-out, identification of equipment, and costs, etc. The system design is often required to obtain permits/consents.

To select an initial conceptual design, it is worthwhile to evaluate various design configurations and module sizes, so that a design can be selected that is optimised for the site.

- Assessment of shading and initial solar PV plant layout. Enables optimisation and typically takes into account:
  - Shading angles.
  - Operations and maintenance (O&M) requirements
  - Module cleaning strategy.
  - Tilt angle, orientation, and tracking.
  - Temperature and wind profiles of the site.
  - Cable runs and electrical loss minimisation.
- Production of a detailed site plan, including site surveys, topographic contours, depiction of access routes, and other civil works requirements.
- Calculation of solar resource and environmental characteristics, especially those that will impact performance of technical requirements (temperature, wind speed, and geological hazards).. While the accuracy of satellite data is increasing, and is acceptable in many cases, it is often desirable to implement site-specific measurements of irradiation3 as early in the project planning process as possible; the feasibility study stage is a good time to bring such data into the planning process. Note that irradiation levels often vary across seasons, and this needs to be accounted for in the financing model.
- Electrical cabling design and single line diagrams.

Feasibility Checklist

Below is a checklist for developers with the key considerations that must be addressed during the feasibility stage.

Detailed site plan produced.

Solar resource assessed including assessment of shading.

- Environmental characteristics that may affect performance identified.
- Detailed review of environmental and social considerations conducted.
- Detailed review of required permits and licences undertaken.
- Assessment of Capex for technology and supplier options; cost/benefit for options and project location completed.
- Pre-application discussions with relevant consenting authority undertaken.
- Initial consultations with key stakeholders including from the community completed.
- Grid connection assessment completed.
- Predicted energy yields established.
- Further assessment of anticipated electricity tariff undertaken.
- Financial analysis carried out. Preliminary financing planned.
- Project implementation plan developed.
- Options agreements for land access (where required) secured.
- Evaluation and concept of the commercial structure of the project and project company(s) carried out

- Electrical connections and monitoring equipment.
- Grid connection design, including transformers and metering, etc.
- Full energy yield analysis using screened solar data and the optimised layout.
- Assessment of all technology options and cost/benefit analysis of potential suppliers given the project location, including:
    - Module selection. This is an optimized selection based on the feasibility phase output, current availability, and pricing in the market place. Note that in countries where the solar industry is still in its infancy, there may be challenges when importing solar modules and other critical components of plant infrastructure. Examples include delays at customs and difficult negotiations on the terms of sale with manufacturers lacking a local sales representative or distributor.
    - Inverter selection. Manufacturers are predominately based in Europe and North America, though others are emerging in China and Japan. As above, importation can result in delays to project schedules.
    - Mounting frame or tracking system selection, including consideration of site specific conditions.

1. PERMITTING AND ENVIRONMENTAL, HEALTH AND SAFETY (EHS) REQUIREMENTS

- Detailed review and inventory of all necessary permits and licences needed for constructing and operating the power plant. Examples are environmental permits, land use permits, and generator licences.
- Pre-application discussions with the relevant consenting authority about the schedule for permitting, to understand the financial implications.
- Detailed review of environmental and social considerations, such as wildlife conservation or other designations that may affect permissible activities at the project sites; this is usually performed with a desk based assessment and if possible supplemented by an initial site survey.
- Initial consultation with key stakeholders, including local community stakeholders, as relevant.
- Grid connection issues. This should be a more detailed assessment of likelihood, cost, and timing of grid connection, as well as transmission line capacities and constraints. This may also include submission of an initial application into the grid interconnection queue or achieving a "feasibility stage tariff" approval from the regulator.

2. FINANCIAL FEASIBILITY OF PROJECT

- Financial modelling to determine commercial viability and attractiveness of the project. Such modelling includes all costs and revenues. It should also involve a sensitivity analysis to start assessing the project risks.
- Further assessment of the anticipated electricity tariff. This is especially pertinent in markets where the tariff is expected to fluctuate, either by:
    - Deliberate design, such as in a power market where the developer is an Independent Power Producer (IPP) selling power in a wholesale or spot exchange;
    - Market forces, such as use of Renewable Energy Credits (RECs) or another market-based instrument, which could contribute to the developer's revenue; or

- Potential for revision of negotiated tariffs, such as if the government decides to revise the tariffs retroactively (uncommon but has occurred) or the off-taker asks for re-negotiation.

3. PROJECT DEVELOPMENT/COMMERCIAL ASPECTS

- Project implementation plan – Level 1 (minimum) including a Gantt chart laying out the project timeline, resource requirements, project development budget, procurement concept (e.g., full turnkey or multi contracting approach), and O&M concept.
- Option agreements for land access for all privately held land or access roads, or a concession agreement with the relevant authority.
- Evaluation of the commercial structure of the project. This includes evaluating the project company or companies, which may involve a Special Purpose Vehicle (SPV), depending on company structures allowed under local law. This also includes evaluating any off-shore parent-company structures and incorporation location based on legal, financial and tax criteria corresponding to the project.
- Investment and funding requirements and the investment concept. This should include equity contribution amounts and sources, equity partner requirements and financing assumptions to be included in the financial model.
- A project structure and risk-mitigation strategy. In many emerging markets, to make a project "bankable" (i.e., able to attract reasonably-priced debt financing) it is typically necessary to secure credit enhancements, which can be either private (letters of credit, escrow accounts) or governmental (sovereign guarantees).
- Procurement of Owner's Engineer. As the intention to proceed with the project grows, so too the technical scope for the EPC or other technical tendering procurement contracts needs to be drafted and reviewed by the Owner's Engineer. The EPC's Owner's Engineer scope of work may also include support for the technical procurement (e.g., PV plant components) and technical design review. The same firm usually follows through as the Owner's Engineer during the construction phase.
- Tender and award of Owner's Counsel to support contracts development and negotiation as well as any relevant legal-structuring needs and company set-up during the development phase.

STAGE 4 – PERMITTING, CONTRACTS AND FINANCING

After the feasibility stage and assuming that the project still seems to be financially viable, the project moves to the next stage. This includes obtaining final permits, securing project finance and pre-implementation activities (commercial contracts). The timing and sequencing of this stage will vary significantly by project, but this phase usually includes the following activities:

1. Engagement of relevant community or stakeholders.
2. Preparation and submission of relevant permit and licence applications and associated documents for the proposed project.
3. Environmental and social assessments (agreed in consultation with permitting authority and other statutory bodies), which may include a full Environmental and Social Impact Assessment (ESIA).
4. Preparation and submission of a grid connection application.
5. Review of the design and any permit/consent conditions; revision of design or consents as needed.
6. Contractor prequalification, ranking, and short list selection.
7. Decision on the financing approach (e.g., sources and proportions of equity and debt, including construction financing).
8. Securing financing for the project.
9. Decision on contracting strategy (i.e., EPC contract or multi-contract).
10. Preparation of solar PV module tender documentation. Supplier/contractor selection and contract negotiations.
11. Preparation of construction or balance of plant tender documentation.
12. Preparation of PPA documentation and final negotiations.
13. Preparation of O&M concept and contracts, as relevant.
14. Preparation of Owner's Engineer tender (if technical advisor is not continued into construction).
15. Contracting and procurement of relevant insurances (i.e., construction, operation, etc.).
16. Preparation of Lender's Engineers and Lender's Council tenders.
17. Finalisation of grid interconnection agreement with grid operator or relevant authority.
18. Preparation of detailed, bankable financial model covering the full lifecycle of the plant. Typically this will only be completed after negotiating the EPC or equipment and Balance of Plant (BoP) contracts, as well as O&M contracts, so that the financial model can incorporate final costs of capital and O&M.
19. Completion of a project risk analysis.
20. Transportation analysis as necessary for difficult-to reach project locations.
21. Finalisation of all land, surface area, and access agreements— and trigger land agreement options to convert to long-term leases or easements, as necessary.
22. Finalisation of the detailed project implementation plan.

1. PERMITTING

An approved permit must be obtained before construction of a project commences. Permit requirements vary widely between different countries and regions. In general, the type of permits may include, but are not limited to:

1. Land lease agreement(s).
2. Access agreements.
3. Planning/land use consents.
4. Building/construction permits.
5. Environmental permits (forestry, endangered species, EIA, etc.).
6. Social impacts (i.e., cultural heritage/archaeological sites, stakeholder consultations).
7. Energy permit.
8. Grid connection application.
9. Operator/generation licences.

2. FINANCING

Financing a solar PV project is similar in principle to financing other types of power projects; however, certain risks that are unique to solar PV must be accounted for in the financing plan. Risks associated specifically with solar PV projects are related to the energy resource (irradiation), project siting and permitting, solar technology (relatively new), potential degradation of PV modules, and reliability of long-term plant performance, as well as potential uncertainty of the tariff and revenue collection

3. CONTRACTS

Contract Strategy

Contracts present developers with several important considerations. Perhaps foremost is establishing a project company or SPV (special purpose vehicle); if not already initiated, an SPV should be formally established. The developer typically creates and owns the project company, potentially with equity co-investment from another financial backer (sponsor), such as an infrastructure fund.

All contracts, land agreements, financing and secured project permits and licenses need to be issued in the name of the SPV; transferring these later to the SPV

Checklist for Permitting, Financing, and Contracts

Below is a checklist of critical issues that a developer needs to consider during the stage of project development that involves securing permitting, contracts, and financing.

☐Preparation and submission of relevant permit and license applications.

- Environmental and social assessments (as required) completed.
- ☐Grid connection application prepared and submitted. Grid connection agreement signed.
- Review of design and permit/consent conditions completed.
- ☐Contracting strategy approach determined.
- Financing structure decided. Financing secured for the project.
- ☐Community or stakeholder engagement completed.
- ☐Solar PV tender documentation prepared.
- ☐Supplier selection and ranking undertaken.
- PPA documentation prepared.
- ☐O&M concept and contracts prepared.
- Owner's Engineer tender prepared.
- ☐Relevant insurance procured and contracted.
- Lender's Engineer and Lender's Council tenders prepared.
- ☐Tendering and evaluation of bidders for all contracts carried out.
- Contract negotiations completed.
- ☐Bank-grade energy yield completed.
- Detailed bankable financial model completed.
- ☐Transportation analysis (if required) carried out.
- All land and access agreements finalised.
- ☐Project risk analysis completed.
- PPA finalised with off-taker.
- ☐Detailed project implementation plan finalised.
- Technical and legal due diligence completed (if required).

can be very difficult and time consuming. Also, lenders often insist upon the rights of assignability (e.g., the right for project assets and liabilities to be assigned to them in the event of default). Considering assignability at early stages of incorporation can save significant time later in the development process.

Coordination of Contract Signing

It is critical that the developer or project sponsor closely coordinates the structure, terms and timelines for execution of key strategic documents. Without close coordination, there are likely to be conflicts or contradictions between documents, or worse, the developer can create financial obligations that cannot be met. Critical path analysis is essential to identify interdependencies and key activities that require close monitoring to avoid project delays. Project timelines and corresponding contractual signing should be coordinated to avoid sub-optimal bargaining positions in reaching financial close. Examples of poor coordination include:

- The signing of a PPA without knowing the requirements of the grid interconnection agency and/or without having a grid connection agreement.
- Signing of an EPC contract without the necessary financial commitment from investors. If the financing is not yet in place, a developer should commit only to an EPC agreement that is not binding until financial close is reached.
- Signing of an EPC contract before all permits and licenses are obtained.

STAGE 5 – ENGINEERING, PROCUREMENT, CONSTRUCTION AND COMMERCIAL OPERATION

2.6.1 ENGINEERING AND PROCUREMENT

2.6.1.1 Development of Detailed PV Design

The EPC contractor will prepare the necessary detail documentation for the solar PV plant to be tendered and constructed. The following documentation will be prepared:

- Detailed layout design.
- Detailed civil design (buildings, foundations, drainage, access roads).
- Detailed electrical design.
- Revised energy yield.
- Construction plans.
- Project schedule.
- Interface matrix.
- Commissioning plans.

Key electrical systems must be designed in rigorous detail.

This will include equipment required for protection, earthing and interconnection to the grid. The following designs and specifications should be prepared:

- Overall single line diagrams.
- Medium voltage (MV) and low voltage (LV) switch gear line diagrams.
- Protection systems.
- Interconnection systems and design.
- Auxiliary power requirements.
- Control systems.

2.6.1.2 Energy Yield

The energy yield should include:

- An assessment of the inter-annual variation and yield confidence levels.
- Consideration of site-specific factors, including soiling or snow, and the cleaning regime specified in the O&M contract.
- Full shading review of the PV generator including near and far shading.
- Detailed losses and performance degradation over time.
- A review of the proposed design to ensure that parameters are within design tolerances.

2.6.1.3 Detailed Project Documentation

The information that should be included is detailed below:

- Site layout showing the location of modules, inverters, and buildings.
- Indicative plans showing
- Mounting frame and module layout.
- Inverter locations and foundations/housings.
- Security measures.
- Initial electrical layouts:
- Schematics of module connections through to the inverter.
- Single line diagrams showing anticipated cable routes.
- Grid connection and potential substation requirements.
- Bill of materials for major equipment.
- Energy yield analysis.
- Losses assumed with regard to the energy yield forecast.
- Financial model inputs including:

• Long term O&M costs and contingencies (up to the end of the design life and/or debt term).
• Availability assumptions.
• Degradation of module performance assumptions.
• Spare parts inventory cost.
• Connection cost for electricity and services.
• Cash flow model including maintenance of a specified debt service coverage ratio (DSCR) 5 if applicable, and contingency reserve to be used for inverter replacement, weather damage, and other unexpected costs associated with plant operation.
• Copies of all contracts negotiated:
• PPA.
• EPC Contract.
• Equity subscription agreement and incorporation documents for project SPV.
• Copies of applicable insurance and other risk mitigation.
• Other documents, such as currency hedging agreements, etc., as applicable.
• Details of the permitting and planning status.
• Environmental impact, restrictions, and mitigation plans.

2.6.2 CONSTRUCTION AND COMMERCIAL OPERATION

After the contract(s) have been awarded (whether multiple or a single EPC), the role of the developer is to oversee the implementation of the project. This can be done using the developer's own staff, if they have the expertise and experience, or by hiring an Owner's Engineer. Each contractor designs, procures, and installs the components of the PV plant under the terms of its contract. If multiple contracts are awarded, coordination of schedule and interfaces is critical.
Critical tasks that need to be carried out independently for each type of contract include:
• Planning and sequencing of tasks.
• Cost management
• Risk management.
• Coordination among all organizations involved in the project

Priority Action Fiche #5

Construction of MINI Hydro Plants at Darbandikhan Dam and Dukan Dam

Background

The **Darbandikhan Dam** is located on the Diyala River, immediately upstream of the town of Darbandikhan. It is approximately 150 km upstream of the Hemren Dam. The site is approximately 420 km by road northeast of Baghdad and 65 km southeast of Sulaymaniyah city. It is also within 15 km of Iranian border to the southwest[16].

The purpose of the dam is irrigation, flood control, hydroelectric power production and recreation. The Hydropower of the dam consists of Hydraulic head 80 m, Turbines 3 x 83 MW, installed capacity 249 MW [17].

The **Dukan Dam** is located on the Lesser Zab River, approximately 220 km upstream from its confluence with the Tigris River. The site is located adjacent to the town of Dukan and approximately 295 km north of Baghdad and 65 km northwest of Sulaymaniyah city with Hydraulic head 95 m, Turbines 5 x 80 MW and Installed capacity 400 MW.

Dukan and Darbandikhan Dams, with a capacity of 400 MW and 249 MW respectively, are the two largest power stations in the Kurdistan Regional Governorate, and are connected to the national power grid. Each power station is part of a multipurpose scheme for power production and irrigation at each of the locations.

Description of the action

Micro-hydro-electric power is an efficient and reliable form of clean source of renewable energy because it requires very little water in order to power the turbine. The water will run straight through the turbine and back into the river or stream to use it for the other purposes.

Turbine units at Dukan and Darbandikhan Dams designed to operate by small water discharge, when hydroelectric units are shut down (for electricity control or technical reasons), about 25 m3 / s of water is drained from the spillway to supply water projects at the bottom of the Dukan dam. By installing three Mini Hydro units at the bottom of the Dukan Dam with a capacity of 2.55 MW per unit, 10 m3 / s of water can be discharged to meet part of the needs of irrigation.

In **Derbandakhan Dam**, two hydroelectric units (0.86 MW) were installed for each unit to supply the dam and the area near the dam with electric power. These two units have ceased to function because of the unavailability of spare materials for maintenance.

The action summaries as follows:

In Dukan Dam,

- Install three Mini Hydro units with a capacity of 2.55 MW per unit.
- Supply of materials crisis reserve for the operation of huts for 5 years.
- Training the staff necessary for the operation and maintenance of units.

In Derbandakhan Dam

- Rehabilitation of two existing units.

[16] The world Bank E 1547

[17] https://en.wikipedia.org/wiki/Darbandikhan_Dam

- Providing the necessary spare parts for maintenance and operation,
- Training the staff to operate and maintain the two units.

General objectives

In Dukan Dam, utilization of the water energy discharged during the Dukan hydroelectric plant stops working to meet the needs of the water circus at the bottom of the Dukan damwhere it can generate 22,950 MW.hour of electric power annually.
In Derbandakhan Dam
These units can be operated during the three hydropower units at the Derbandikhan station. The two units can be discharged (5m3 / sec) of water for the environment and water projects at the bottom of the dam. If we take the Derbandakhan station completely, it will be at least 3000 hours per year and 5160 MWHr can be generated by these two units within a year.

Technical description

Main Technology to implement and equipment to use

The project needs to assign specialised company in design and installation of Micro Hydro Turbine, the technology is well known.

Previous or linked studies

There was previous study by the World Bank.

Project Life time exploitation or use duration

The estimated life time is 25 year.

Engineering Studies

The project needs an engineering study.

Availability of environmental impact assessment or mitigating measures to protect environment if any

The project is using renewable energy which has less impact on the environment.

Summary of related Awareness Raising (AR) actions

AR related to the action

- Target Audience: The Local Authority and national Authority management staff
- Key Message: Saving water resources would safe life
- Objectives: To ensure Optimal use of water resources

AR related to community

- Target Audience: College of Engineering in all sectors, Schools, Members of LA councils,
- Key Message: Saving water resources would safe life
- Objectives: To ensure Optimal use of water resources

Assumptions and risks

- The Assumptions:
  - The system is well designed.
  - The annual maintenance and spare parts are available.
  - The operation and maintenance run with qualified technical staff.
- The Risks:
  - Low tariff cost.

- Future SHP plant investments should take into account the need to operate in a free market and to compete with technologies based on fossil fuels or large hydro.
- The annual energy prediction from the hydro system is based on long-term average flows, but year-to-year flows can vary significantly about this average: this can be very beneficial if you have a series of wetter.

Key success factors

Next steps

Projected Energy Estimates in 2030		Cost of Implementation		Available and foreseen sources of funding	
Mitigation		All cost USD	19,5000,000	Local authority's own resources	20%
MWh/a	t CO_2/a	Initial and start-up expenses	5,000,000	National Funds and Programmes	10%
28110	23050	Approximate operational Costs (including maintenance	975,000	International Financial Institutions	70%
Per capita calculated reduction		Approximate annual income for energy producing projects in USD	4,216,500	EU Funds & Programmes and other external funds	
MWh/c	t CO_2/c	Draft calculation of the NPV.		Public-Private Partnerships amount/share (available or to raise)	
0.138	0.011	Key performance Indicator	Installation of new micro turbine and rehabilitation of existing one	Lined up private investments	
Contribution for	Reduction as related to BAU scenario	Measurement Units	Start production of energy in MWh	Loans and potential borrower	
	0.2%	Years of Implementation		Expected annual cost savings to the City budget	
		1 2 3 4 5 6 7 8 9 10		Other	

Organisation and procedures							
Area of intervention	Hydropower			Involvement of Stake Holders	LA	H	
Policy Instrument	Energy supplier's obligations				External	L	
Origin of action	NA				Other	L	
Staff Capacity	L	M	H	Technical assistance needs			