Expert Facility Activity No: EFS-EG-2
"Drought and Water Scarcity Risk Management"

Report of the Workshop on water conservation and water use efficiency technologies and practices in industries

Version	Document Title	Author	Review and Clearance
1.0	Report of the Workshop on water conservation and water use efficiency technologies and practices in industries	Maggie Kossida, SWIM-H202 SM Non-key Expert	

THE SWIM AND H2020 SUPPORT MECHANISM PROJECT (2016-2019)

The SWIM-H2020 SM is a Regional Technical Support Program that includes the following Partner Countries (PCs): Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestine, [Syria] and Tunisia. However, in order to ensure the coherence and effectiveness of Union financing or to foster regional co-operation, eligibility of specific actions will be extended to the Western Balkan countries (Albania, Bosnia Herzegovina and Montenegro), Turkey and Mauritania. The Program is funded by the European Neighborhood Instrument (ENI) South/Environment. It ensures the continuation of EU's regional support to ENP South countries in the fields of water management, marine pollution prevention and adds value to other important EU-funded regional programs in related fields, in particular the SWITCH-Med program, and the Clima South program, as well as to projects under the EU bilateral programming, where environment and water are identified as priority sectors for the EU co-operation. It complements and provides operational partnerships and links with the projects labelled by the Union for the Mediterranean, project preparation facilities in particular MESHIP phase II and with the next phase of the ENPI-SEIS project on environmental information systems, whereas its work plan will be coherent with, and supportive of, the Barcelona Convention and its Mediterranean Action Plan.

The overall objective of the Program is to contribute to reduced marine pollution and a more sustainable use of scarce water resources. The Technical Assistance services are grouped in 6 work packages: WP1. Expert facility,WP2. Peer-to-peer experience sharing and dialogue, WP3. Training activities, WP4. Communication and visibility, WP5. Capitalizing the lessons learnt, good practices and success stories and WP6. Support activities.

Acknowledgements:

The SWIM-H2020 SM team would like to acknowledge the support of the Federation of Egyptian Industries (FEI) and in particular Eng. Ahmed Kamal Abdel Moneim,Executive Director, FEI Technical Advisor, and the support of the Egyptian Ministry of Water Resources and Irrigation (MWRI) and in particular Dr. Eman Sayed, Head of the Planning Sector, MWRI, and Eng. Ms. Dina Mamdouh, Deputy Director for Mathematical Progammes, Planning Sector, MWRI, SWIM National Focal Point.

Disclaimer:

This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of the SWIM-H2020 SM Project and do not necessarily reflect the views of the European Union.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

BATs	Best Available Technologies
CEA	Certified Energy Auditors
EEAA	Egyptian Environmental Affairs Agency
ENCPC	Egypt National Cleaner Production Centre
ECC	Energy Cost Centres
EM	Energy Management Systems
ECO	Environmental Compliance Office
FEI	Federation of Egyptian Industries
HCWW	Holding Company for Water and Wastewater
LCCA	Life-cycle Cost Analysi
MCM	Million Cubic Meters
MoTI	Ministry of Trade and Industry
MWRI	Ministry of Water Resources and Irrigation
NCPCs	National Cleaner Production Centre(s)
NCPPs	National Cleaner Production Programme(s)
NGOs	Non-Governmental Organisations
O&M	Operation and Maintenance
PWSS	Public Water Supply System
SPP	Simple Payback Periods
SMEs	Small-Medium Enterprises
UNCEP	United Nations Environmental Programme
UNIDO	United Nations Industrial Development Organisation

1 GENERAL INTRODUCTION

Within the scope of the EFS-EG-2: “Drought and Water Scarcity Risk Management”, the EU-funded project “Sustainable Water Integrated Management & Horizon 2020 - Support Mechanism (SWIM-H2020 SM)”, in cooperation with the Federation of Egyptian Industries (FEI), has conducting a full-day workshop on various methods and technological options for water conservation in industries on 23/01/2019 in Cairo, Egypt. The purpose of this workshop was to build technical capacity of the relevant actors involved in industrial water management on methods of water conservation and efficiency in different types of industries (textile, food and beverage, etc.), and on options (both technical and management) to reduce water consumption and introduce water savings, Furthermore, the workshop brought together representatives from the Ministry of Trade and Industry (MoTI), the Federation of Egyptian Industries (FEI), the Ministry of Water Resources and Irrigation (MWRI) and the industrial sector who engaged in a mutual discussion about the key issues around industrial water use efficiency in Egypt, from the policy level down to implementation level at the factory.

1.1 BACKGROUND OF ACTIVITY

Limited water supply in Egypt is exacerbated by climate change and the fact that the country shares more than 93% of its resources (the Nile River) with ten other countries; all located in the upstream stretches of the River. In order to implement water demand management which is promoted by the National Water Resources Plan (NWRP) 2005-2017, the water sector has to (1) be aware of the different types of water losses and wastage (i.e. inefficient water use), (2) develop knowledge on water conservation and water efficiency methods and water demand management (WDM) tools (economic, technical, regulatory) as they are applied in the different sectors (domestic, touristic, industrial, agricultural), and (3) be informed on the prevailing water use patterns (applied in this case on the industrial sector) and the potential water use reduction through the application of best practices and best available technologies.

The SWIM-H2020 SM specific activity EFS-EG-2: “Drought and Water Scarcity Risk Management” aims to build capacity on methods of water conservation and efficiency, and conduct a workshop on various methods and technological options for water conservation, with a focus on industries.

2 OBJECTIVES OF ACTIVITY

The general objective of the workshop is to build technical capacity of the relevant actors on methods of water conservation and efficiency in the selected water sector (i.e. industry). The workshop seeks to

increase the knowledge and technical capacity of the participants on water conservation issues in different types of industries (textile, food and beverage, etc.) and options (both technical and management) to reduce water consumption and introduce water savings. As such, it aims at contributing to drought and water scarcity mitigation and risk management, by educating the stakeholders on using water conservation technologies, practices and tools, and at supporting the development of a robust demand management scheme in industries.

To achieve these objectives the workshop has been structured in three parts:

Part 1:

- Presentation and discussion of the legal framework and recent developments by the MoTI (Ministry of Trade and Industry)
- Presentation and discussion on the state of industrial water in Egypt

Part 2:

- Presentation of different technologies and options to introduce water conservation efficiency gains in industries (by the SWIM-H2020 SM NKE)
- Presentation of selected case studies by different industrial representatives
- Presentation on energy audits in industry: best practices and international experience
- Presentation on energy efficiency in Egyptian industries

Part 3:

- Presentation of support and financial mechanism by the Federation of Egyptian Industries (FEI)
- Participatory discussion on water metering and water auditing in industries, issues around the application of water saving technologies, constraints, etc.

3 RESULTS OF THE WORKSHOP

The main outcomes of the workshop are presented below:

1. Participants have gained an improved understanding of water conservation and water use efficiency technologies and practices in industries
2. Participants have been showcased with a portfolio of case studies
3. Participants gained improved knowledge on the actual benefits and constraints of the implementation by other colleagues who have already tested these interventions, as well as the prevailing legal frameworks and financial mechanisms
4. Participants increased their knowledge on issues around energy audits, learning international best practices, and on issues around energy efficiency
5. Policy-makers (MoTI), professional bodies (FEI) and industrial representatives (industries) engaged into a common dialogue on key aspects of water and energy efficiency in the industrial sector

3.1 KEY ELEMENTS OF THE PRESENTATIONS AND DISCUSSION POINTS

3.1.1 STRATEGY FOR OPTIMIZING WATER USE IN INDUSTRY

The objective of this presentation was to educate the participants the on-going MoTI strategy on industrial water use efficiency. The overall vision is to ensure the desired growth of the Egyptian industry and the continuous increase of the added value per unit of water used by adequately managing water resources at all levels of industrial decision-making and optimizing water use in industry. Three workshops have been undertaken so fare (in July, August and September 2018) to support the drafting of a roadmap for the implementation of operational tools, measures and monitoring methods (performance indicators) to optimize water use in industries. The MoTI strategy on optimization of industrial water use contains 11 policy pillars, as [resented below:

- Policy 1 - Establishment of joint database for industrial water and industrial wastewater: provide a platform for collecting water data in a holistic and systematic manner
- Policy 2 - Monitoring non-network water resources: complete the data that will be compiled into the database as proposed in Policy 1
- Policy 3 - Monitoring the amount of industrial wastewater: complete the data that will be compiled into the database as proposed in Policy 1
- Policy 4 - Gathering actual production of industrial facilities: complete the data required by the Policy 1
- Policy 5 - Structuring the pricing of industrial wastewater at the enterprise level: encourage water consumption reduction and increase water efficiency through water reuse and recycling while avoiding undesirable and inefficient water tariff increase
- Policy 6 - Extend responsibility for water resource management at the level of the industrial clusters: encourage water reuse, allow the development of a framework system (technical and financial) for reusing treated water inside or outside the cluster
- Policy 7- Water management plans as a prerequisite for obtaining operation licenses: further increase the efficiency of water use, development of a tool called WMPs as part of the operational licensing process for industrial development

  Policy 8- Creating a knowledge database: development of adaptation capabilities of establishments, building a knowledge platform that includes various information elements that will directly assist consultants and managers of industrial establishments in upgrading the efficiency of industrial plants in the use of water
- Policy 10 - Integration of water policies into industrial development policies for new investments: adapting economic growth with increasing pressure on water resources, reduce the pressure on traditional water resources

- Policy 11- Creating a market advantage for water performance excellence: create water blueprints and national green trademarks that take into account the local standards
- Policy 12 – Encouraging innovation: develop and implement Innovation Policy Annual Awards for innovative water saving solutions, apply government investment criteria, apply investments in education programs, apply subsidies for cleaner production research and development and infrastructure to support new technologies, encourage new projects with environmental value

A timetable towards the implementation of the policy pillar, along with the roles of the involved stakeholders, and the actions taken have been also presented.

During the discussion in was highlighted that the National Water Resources Plan (2017-2037) sets the total water allocation for industry not exceeding 5.8 billion cubic meters per year by 2037, as compared with the current allocation of 5.4 billion cubic meters. On the other hand, the industrial strategy for Egypt aims at an 8% industrial growth per year. To meet the expected growth on the activities it is thus paramount the optimal use of industrial water is achieved, as well as an integrated management of the scarce water resources as a whole.

The discussion also focused of the strengths, challenges, risks and opportunities of increasing the industrial water use efficiency in Egypt. Among the strengths are: the availability of meters to measure water consumption from the network, the availability of various options for optimizing water use, the availability of technical expertise and tools to provide technical support for small and medium enterprises (e.g. the Egyptian Environmental Affairs Agency - EEAA guidelines for inspection, including monitoring the use of water in different production units), the financial support plan for new projects in the textile sector, including waste treatment and recycling, etc. The challenges include technical and technological challenges (e.g. lack of information and data systems, weak technical expertise at the level of the establishments and of the regulatory bodies, lack of national criteria for consumption across various sectors, pollution control measures focus on end-of-pipe output and not at the source), organizational and legislative challenges (multiplicity of executive agencies, weak enforcement and lack of effective communication between the competent authorities, economic management of water companies), economic challenges (low use tariff t recovery, high cost of wastewater treatment and reuse technology). Some of the identified risks include: many processes require additional energy use, high costs of applying recycling and processing, legislation may prioritize the adoption of pollution mitigation measures instead of water use optimization, increasing water tariff may lead to pressure on groundwater resources if water optimization is not achieved, time required to build the capacity of the Industrial Development Authority to carry out environmental monitoring of industrial establishments). Finally, opportunities have been identified in relation to the management of the water resources at large, to water supply cost recovery and energy pricing, to the geographical distribution of new investments, to the technological advancement, and to the legislation and export requirements.

3.1.2 WATER RESOURCES INDICATORS IN EGYPT

The objective of this presentation was to increase awareness on the state of water resources in Egypt and the amounts allocated to the industrial water use. Total water use in Egypt in 2017 summed up to 80.25 billion m^3, of which 5.4 billion m^3 (i.e. about 1.25%) was used in industry. This water comes from surface water (Nile and canals) and cooling water in included. The industrial water withdrawal per capita

is estimated to be 59 m3/cap/year (2015 data). The nominal capacity of THE hydroelectric power plants was 2,800 Megawatts in 2017. Water production stations include the High Dam (2,100 MW), the Aswan Reservoir#1 (280 MW), the Aswan Reservoir#2 (270 MW), the Esna Barrage (86 MW). The total power generated from the water plants reached 12,850 GWH in 2018 (High Dam: 8,859 GWH; Aswan Reservoir#1: 1,489 GWH; Aswan Reservoir#2: 1,547GWH).

The following water use indicators have been estimated for 2017 and projected for 2030:

Estimated indicators in 2017

- Total industrial water use in 2017: 5,400 million m^3
- Industrial water use monitored by meters and accurate accounting: 1,080 mio m^3 (i.e. 20% of the total)
- Industrial water used for faucets and similar uses: 67.5 mio m^3 (1.25% of the total)
- Potential for industrial water savings: 1,147.5 million m^3
- Potential industrial use after deducting the savings: 4,252.5 million m^3
- Potential water reuse, after saving and processing: 3,402 million m^3 (i.e. 80%)

Projected indicators for 2030

- Total industrial water use in 2017: 7,711 million m^3
- Industrial water use monitored by meters and accurate accounting: 1,542 mio m^3 (i.e. 20% of the total)
- Industrial water used for faucets and similar uses: 96.4 mio m^3 (1.25% of the total)
- Potential for industrial water savings: 1,638.6 million m^3
- Potential industrial use after deducting the savings: 6,072.6 million m^3
- Potential water reuse, after saving and processing: 4,858.1 million m^3 (i.e. 80%)

Additional mentions were made to water quality in the water bodies and the Nile canals. The virtual water, imported and exported from Egypt, is estimated to amount to 49,293 and 7,842 MCM/year respectively. The industrial water productivity was calculated at 21.06 \$/m^3 in 2012 and 38.34 \$/m^3, which compared to the agricultural water productivities (crop per drop) of 0.49 \$/m^3 in 2012 and 0.53 \$/m^3 in 2015 is much higher. The employment rate in the industrial sector (job per drop) was estimated at 19.86 jobs/ MCM. The discussion also focused of water meters and losses from the supply networks, the later reaching about 2.3 billion m^3/year.

3.1.3 OVERVIEW OF DIFFERENT TECHNOLOGIES AND OPTIONS TO INTRODUCE WATER CONSERVATION EFFICIENCY GAINS IN INDUSTRIES

The objective of this presentation was to showcase to the participants different water efficiency technologies and practices that can be implemented in industries, focusing additionally on the textiles and food & beverages industries, and demonstrating relevant international case studies.

The industry is a growing sector in Egypt, with an annual water demand of about 5.4 billion m3/yr. The dominant sub-sectors are the petroleum sub-sector (35%), the food industry (24%), the textile industry (13%), and engineering and electrical industries (13%). Industrial water includes the water used both in the manufacturing process, for cooling, for cleaning the facilities, and used from the employees. In some cases industrial water use is included in the municipal (domestic) water use, and no separate

measurements exist. Industrial water is provided through the municipal Public Water Supply System by the HCWW (Holding Company for Water and Wastewater). Self-supply for industrial purposes is also applicable (e.g. in the Menofia Governorate), mainly from groundwater, with obtained permits form the MWRI (Ministry of Water Resources and Irrigation). Measurements of the water use are effectuated by the HCWW with water meters per factory and per month, and by the MWRI on the volumes that are abstracted and returned to the groundwater. Climate change is expected to impact the industrial sector. The main climate change risks on industries include the demand for energy to cool/heat facilities in response to seasonal periods or prolonged of warm/cool weather, and high/low temperature extremes, the increased demand for scarce water resources impacting operation processes and maintenance, future more frequent water supply interruptions and/or electricity shortages, as well as the thermal loading of structures and surfaces causing the expansion, buckling and stresses and the failure of building services. The mitigation of these impacts requires minor to major operational costs, minor to major capital costs for new equipment, repairs, and investments in water savings technologies and alternative water sources, as well as increased energy and water bills.

The different types of water uses, and their respective share in the total consumption, have been explained for the different types of industries. Fresh water in industry is used for cooling, heating, cleaning, transport, washing and is finally part of the final product. Fresh water in industry is used for cooling, heating, cleaning, transport, washing and is finally part of the final product. In the textile industry, for example, water is mainly used as a reaction medium (dyeing, finishing), for washing/rinsing, bleaching, dyeing, heating and cooling. In the food industry water is used as a reaction medium, for washing/rinsing, cleaning of equipment and heat transfer. Also water is used as raw material (e.g. as part of the final product). Some industry types are more water intense than others (i.e. they consume more water), such as the textile industry, the pulp and paper, and the food and beverage industries. On the other hand some industries have higher water productivity (i.e. value added per m3 of water consumed), such as the industries that manufacture electrical and mechanical equipment. Benchmark indicators of water efficiency and water productivity in industries vary of course among countries, and thus a careful selection and interpretation of the relevant indicators is necessary.

A wide range of water saving measures can be considered for the industrial sector accounting for the large diversity in conditions and processes. Different options and technologies have been presented, grouped under the following main categories:

- Reduction in wastage and leakages (engineering controls. work practices, water audits)
- Changes in cooling technology (eliminating once through cooling, increase cooling tower optimization by increasing the cycles of concentration
- Recycling and re-use of water (use any water-consuming component on site as a potential source of water for another component, use municipal wastewater as an alternative external source of water after solving wastewater BOD issues, use industrial wastewater from another Plant as an alternative external source of water)
- On-site rainwater harvesting (RWH) (collect rain and storm water from roof and impervious surfaces)
- Desalinated water (explore if desalination/ brackish water use is an option)

- Water saving fixtures/ landscaping (install water efficient fixtures -WC, urinals, taps, etc. in the bathrooms, use efficient landscaping & irrigation practices outdoors)
- Changes in production processes (several options according to industry types and machines)

For each of the above categories the technologies and/or processes employed, the estimated volume saved, the capital and operational costs, the relevant timeframes of implementation and the level of difficulty in execution have been presented and discussed.

The discussion evolved around the benefits of implementing water saving measures, performing water audits, and on the related constraints. The following benefits have been identified when implementing water saving measures:

- Reduced water demand
- Wastewater treatment savings
- Less environmental impact
- Cost savings (for water bills, wastewater treatment)
- Achievement of decoupling of the water use versus production
- Improved resilience and sustainability

The following points have been raised regarding water auditing of specific individual plants:

- Water auditing is the starting point for identifying the areas where water can be saved and the most appropriate strategy/ range of actions to be put in place for reducing water demand and increasing industrial value added.
- A water audit needs to consider both water quantity and water quality aspects as the need to reduce polluting discharges is often the key driver to water reuse and saving.

The following constraints have been identified:

- Sub-metering of the water used within the various processes and machines of the plants, as well as conducting water audits is not a usual practice, and expertise in this field are not widely spread
- The available water saving technologies are not always know to the industries
- The investment costs for some technologies are too high

3.1.4 CASE STUDY: THE EGYPTION SALTS & MINERALS COMPANY (EMISAL), AL-FAYOOM

The objective of this presentation was to showcase the water saving measures implemented at the EMISAL Company. EMISAL is an Egyptian joint stock company, established in 1984 in accordance with the Investment and Free Zones Law No. (43), with an authorized capital of EGP 150 million and a capital of EGP 110 million. EMISAL Al-Fayoom has the following strategic goals:

- Protect the environment of Lake Qaraoun as a natural reserve from the continuous rise of salinity and maintain the ecosystem inside the reserve.
- Extract salts and minerals dissolved in the lake by clean industrial means to cover the needs of local industries and export.
- Create many jobs by creating a new industrial development community in Al-Fayoom Governorate.

The main source of water of Lake Qaraoun is the agricultural drainage water of Al-Fayoum Governorate (Lake Qaraoun is the deepest part of Al-Fayoum low lying area, up to 44m below sea level. The lake receives annually more than 500 million m^3 of agricultural drainage water with a salts concentration of 1.5-2 gr/litre. About 15 million m^3 of water are withdrawn from the lake each year, with a salts concentration of about 37 gr/litre, to the solar concentration basins. The salts concentration of the water in the lake is increasing g the four consecutive basins, from 37 gr/litre in the first basin to 350 gr/litre at the end of the fourth basin. The implemented solution is to withdrawn water from the fourth basin and divert it to the factories to extract the salts through industrial processes. The industrial processes are primarily based on physical industrial methods without any chemical reactions or adding chemicals:

- Solar evaporation process (basins)
- Cooling process (in sodium sulphate plant) for the production of anhydrous sodium sulphate and magnesium sulphate plant (for the production of magnesium hydroxide sulfate)
- Evaporating process under pressure in vacuum evaporators

The industrial processes for the production of different salts depend on the raw material coming out of the factories in sequence. The salt solution coming out of the factories after extracting of the salts is returned to the storage tanks as raw material for future projects which the company started to implement, namely the production of bromine salts, boron, potassium and magnesium chloride salts. No drop of saline solution has been returned to the waters of Lake Qaraoun since the establishment of the company. Within EMISAL Al-Fayoom the following plants operate:

- Sodium Sulphate Sodium Plant Na_2SO_4: started actual production in 1992, with an annual production capacity of 120 thousand tons/year of anydrous sodium sulphate sodium
- Sodium Chloride Salt NaCl Welding, Purification and Refinery: started actual production in 2001, with an annual production capacity of 150 thousand tons/year of sodium chloride
- Magnesium Sulphate Factory $MgSO_4.7H^2O$ and sodium chloride salt and ultra-purity of facium salt: started actual production in 2008, with an annual production capacity of 40 thousand tons/year of fumaric salt and 27 thousand tons/year the production capacity of Epsum salt
- Expansion plant for production of fumaric salt and production of sodium chloride salt for medical uses: started actual production in 2015, with an annual production capacity of 40 thousand tons/year of fumaric salt and 15 thousand tons/year of Sodium Chloride

The discussion focused on the positive environmental and socio-economic impacts of the EMISAL operations. The extraction of soluble salt of economic importance from the waters of Lake Qaraoun led to the following:

- Preserving the environment of the lake and surrounding areas, which is reflected in the maintenance of the fishing profession, where more than 6 thousand families live in villages scattered around the shore of the lake
- Control of the salinity of agricultural lands surrounding the lake, which in turn led to an increase in reclaimed land, especially in the eastern part of the lake, where the total area of reclaimed land in the last ten years increased to more than 20 thousand acres, compared to 10 thousand acres before 2002

- Preserving tourist facilities spreading along the southern shore of the lake as well as other tourism projects that began to appear on the northern shore of the lake

3.1.5 ENCPC CASE STUDIES

The objective of this presentation was to demonstrate case studies from industries who have implemented water saving measures in Egypt in collaboration with the Egypt National Cleaner Production Centre (ENCPC). The ENCPC was established as a service provider for the Egyptian Industry in 2005 by the Ministry of Industry and Trade (MoIT) and SMEs, in close cooperation with the United Nations Industrial Development Organisation (UNIDO), as a part UNIDO/UNEP global network of NCPCs/NCPPs (51 centres) and part of the Egyptian Industrial Council for Technology and Innovation, and with support from the Swiss, Austrian and Egyptian Governments. The main services provided by the ENCPC are related to:

- Resource Efficiency and Cleaner Production
- Energy Efficiency and Renewable Energy applications in industry
- Transfer of Environmental Sound Technology
- Industrial waste Valorization
- Supporting Green Entrepreneurship
- Chemical Management and Innovative chemical Solutions

The presentation focused on MED TEST I and MED TEST II Projects. Different type of industries participated in the MED TESIT I Project, of which 31% food industries, 19% chemical industries, 19% paper industries, 13% petroleum industries, 6% engineering industries, 6% pharmaceutical industries, and 6% tannery industries. The 56% represented medium size industries, 31% large and 13% small industries. The water savings achieved and expected, as a result of the implementation of different measures, ranged from 15-95%, while the associated energy saving ranged from 55-97%.

The MED TEST II project involved 30 Demonstration Companies and10 private sector Service Providers, of which 50% food, 46% chemical and 4% textile companies. Regarding the geographical spread of the companies, 39% were located in Alexandria, 29% in 10th of Ramada, 21% in 6th of October and 11% in Sadat. The achieved annual reductions of resources and emissions after the implementation of the measures (a total of 255 measures) reached 2,020,606 m^3/year of water savings, 411 GWh/year of energy savings, 79,452 tons/year reduction of CO_2 emissions and 12,188 tons/year solid waste reduction, summing up to a total of 10,336,162 € in annual cost savings.

A total of 180 national experts (professional from academia, business associations, government institutions and industries) received training during the demonstration phase of the project, on-site training, and ccoaching of company teams. The discussion focused on the importance of these capacity building activities and the need to further continue them and expand them.

3.1.6 ENERGY AUDITS IN INDUSTRY: BEST PRACTICES AND INTERNATIONAL EXPERIENCE

The objective of this presentation was to improve the knowledge of the participants on how to perform energy audits in industries, on the best available practices, and on the exiting opportunities, also demonstrating examples from the international experience.

According to the definition provided in the European Directive 27/2012/EU, an energy audit is a systematic procedure with the purpose of obtaining adequate knowledge of the existing energy consumption profile of a building or group of buildings, an industrial or commercial operation or installation, or a private or public service, identifying and quantifying cost-effective energy savings opportunities, and reporting the findings. There are 6 main steps to be followed when performing an energy audit:

- Step 1: Preparation-data collection
- Step 2: Walk-through visit
- Step 3: Analysis of energy data
- Step 4: Measurements
- Step 5: Data analysis
- Step 6: Report

The following minimum criteria for an audit have been identified:

- Be based on up-to-date, measured, traceable operational data on energy consumption: this requires a methodology for **systematic collection of primary information**, as well as **targeted measurements** for the acquisition of integrated and reliable data needed for energy balances
- Comprise a detailed review of the energy consumption profile of buildings or groups of buildings, industrial operations or installations, including transportation: this requires an analysis at discrete Energy Cost Centres (ECC) to be defined at early stage.
- Build, whenever possible, on life-cycle cost analysis (LCCA) instead of Simple Payback Periods (SPP): this requires an analytical approach and calculation of the O&M costs (Operation and Maintenance costs) of each action, tools for financial viability analysis, an a risk and sensitivity analysis.
- Be proportionate and sufficiently representative to permit the drawing of a reliable picture of the overall energy performance and the reliable identification of the most significant opportunities for improvement: this requires transparent criteria for the selection of targeted objects, and the definition of a relationship of energy vs. critical parameters (e.g. production, etc.) interactive effects

A series of international examples have been demonstrated on Best Available Technologies (BATs), and opportunities for heat recovery, smart cooling, ice storage, insulation. International examples of energy audits in Europe and Energy Management Systems success stories have also been presented, along with the key elements of ISO 50001. With regard to the ISO 50001 the following key issues have been discussed:

- Quality: requirement for minimum criteria should prevail over cost-effectiveness
- Added value: lead to actions or are tools for compliance??
- Availability of support actions:

- Experience on energy audit programmes in industry show that if ran in isolation, they have limited impacts
- Benefits are multiplied if combined with complementary measures
- Need: incentive and support schemes, including SMEs, for the implementation of recommendations from energy audits and similar measures

3.1.7 ENERGY EFFICIENCY IN EGYPTIAN INDUSTRIES, TECHNICAL & FINANCIAL SUPPORT

The objective of this presentation was to inform the participants on the main services and activities of the Environmental Compliance Office of the Federation of Egyptian Industries (ECO-FEI) in the field of energy efficiency, as well as to present various energy efficiency technologies and demonstrate the benefits acquired by various energy efficiency projects implemented by ECO in large industries and SMEs (Small-Medium Enterprises).

Industry is the largest energy user in Egypt with a share of 37%. Energy efficiency actions in Egypt evolve around five main areas. These area are:

- Institutional Development
- Legislations and polices (In July 2014, Egypt introduced long-awaited Energy Subsidy Cut gradually for five years. In October 2014 a feed-in tariff was introduced as a policy mechanism designed to accelerate investment in renewable energy technologies)
- Training and awareness
- Energy information systems (case studies, etc.)
- Technical programs and Implementation projects

The Environmental Compliance Office (ECO) was established in 2001 within the Federation of Egyptian Industries (FEI) with the aim of presenting services to the industrial SMEs concerning sustainable development. Its main service is to provide technical & financial assistance for implementing cleaner production, energy efficiency & renewable energy technologies in the industrial sector, which in turn provides Egyptian companies the opportunity to present their products to international markets due to a lower carbon footprint. ECO-FEI provides financial support (soft loans), following standard procedures, for new industrial equipment for implementing energy efficiency, renewable energy and cleaner production technologies in the industrial sector, up to EGP 7 million per enterprise, repaid over 5 years including one year grace period, and with an 3.5% interest rate per year (can be through the National Bank of Egypt).

The Energy Sector of ECO provides the following services:

- Technical & financial assistance for implementing energy efficiency technologies in the industrial sector
- Realizing Energy Management Systems (EMS) review in companies and business to improve the performance of energy use and increase efficiency
- Training for managerial personnel for Certified Auditors to reduce energy costs in their facilities (Certified Energy Auditors - CEA)

In the framework of energy efficiency projects implemented by ECO, the following energy efficiency technologies have been discussed and showcased through implemented case-studies in industries and/or SMEs:

- Improving Combustion Efficiency: potential energy reduction 5-10%; application in all sectors
- Steam System Optimization: potential energy reduction 10-20%; application in **the food,** chemical, textile sectors
- Waste Heat recovery: potential energy reduction 30%; application in boiler installations and furnaces in all sectors
- Power Factor Improvement: potential energy reduction 5-10%; application in all sectors
- High Efficiency Lighting: potential energy reduction 30%; application in all sectors and commercial buildings
- High Efficiency Motors: potential energy reduction 10-15%; application in all sectors
- Variable speed drive for Compressors: potential energy reduction 20-30%; application in all sectors, especially for pumps and fans
- Cooling System Improvement: potential energy reduction 10-20%; application in the food sector
- Co-Generation: potential energy reduction 50%; application in food, chemical, textile sector companies with low-pressure steam demand

The following environmental and economic benefits have been identified from the implemented projects:

- Low consumption of energy leads to increased cost savings and higher profitability
- Addressing the increased energy prices
- Quick profits and conformity to environmental laws
- Reduction of GHG emission and global warming
- Wise use of water and chemicals represented in the recovery of condensation through steam system optimization

The discussion also focused on the barriers to energy efficiency project in Egypt, which include institutional limitations on the national level, and the numerous factors at the enterprise level, namely:

- Poor management and staff behaviour and awareness
- Biased management view: “Energy Efficiency = less productivity”
- Lack of or insufficient communication between management and staff
- Lack of energy cost-awareness
- Non-existence or marginalization of the Energy Engineer Position
- Lack of monitoring equipment and meters
- Lack of systematic monitoring and evaluation routines

Finally, the vision for the energy sectors was discussed and the following aspects have been highlighted:

- Total Energy Management (TEM) and Monitoring Systems implementation (awareness-raising concerning management and staff behavior, outlining energy management systems in companies in all sectors, installing hardware/meters for monitoring systems)
- Introduction of energy-conscious design (highlight the importance of energy efficiency versus cost efficiency when purchasing new equipment, obtain and examine energy-conscious designs, raise awareness for energy-efficient labelled equipment

- Generation of Energy Efficiency guidelines for each sector
- Consultancy and implementation of Energy Efficiency technologies

The ECO-FEI can support the transition to a more energy efficiency industry in Egypt since it has good contacts with FEI members and the industrial chambers, can act like an intermediate between industrial sector and researches centers, has financial mechanisms available for implementing Energy Efficiency & Resource Efficiency projects, and has accessibility to different types of industries.

Concluding, the following observations have also been made:

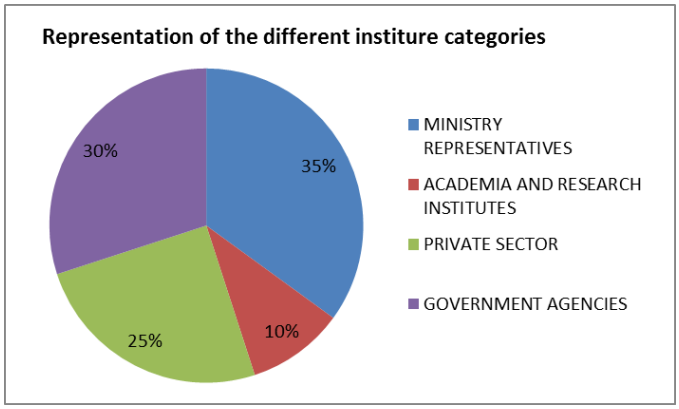
- There is a high potential for Energy Efficiency project implementation in Egypt
- The implementation must be supplemented by proposed consultancy, dissemination, and awareness-raising activities for effectiveness and sustainability
- The Energy subsidy cut is being a driving force for Energy Efficiency investments
- Energy Efficiency projects and activities must be in-line with national environmental and development goals

4 PROFILE OF THE PARTICIPANTS

The audience included technical staff from various industries, managerial staff from industries (who are involved in resource management/ efficiency issues), local engineers and consultants who may perform studies for water savings in industries, representatives (technical staff, planning directors) from the Ministry of Water Resources and Irrigation (MWRI), representatives (technical staff, planning directors) for the Ministry of Trade & Industry (MoTI), representative from the Federation of Egyptian Industries (FEI) (from the Environmental Compliance office and Sustainable Development ECO, and other departments)

Regarding the participants' demographics, a total of 23 participants attended the workshop (for a detailed participants' list refer to Annex 7.2), of which 40% women and 60% men, and with the following institutional mix: 35% from ministries, 10% from academia and research institutes, 25% from the private sector, 30% from Government Agencies (namely the Federation of Egyptian Industries - FEI) .

Figure 4-1: Representation of the different institute categories in the workshop



5 EVALUATION OF THE EVENT

5.1 RESULTS OF THE EVENT

A. <u>Organisational, administrative and planning issues before and during the event</u>

A set of 11 criteria (A1-A1 see table below) have been assessed by the participants, using a qualitative description ranging between "Excellent" to " Poor", with an opportunity to provide suggestions for improvement. For the sake of comparison, the qualitative descriptions are given Series Numbers as follows:

Excellent = 4 Good = 3 Average = 2 Poor = 1

A1	Appropriate handling of invitations, visa support, information sharing and smoothing obstacles
A2	Efficient logistics: accommodation, transportation, location of venue and interpretation (where applicable)
A3	Provision of support (if requested) for participants' preparation for the event
A4	Efficient and effective follow-up of preparations and progress towards the event
A5	Planning of the event: selection and design of methodology, programme/ daily agenda and work rules
A6	Smooth flow of programme, efficient handling of emerging needs and attentiveness to participants concerns
A7	Adequacy of the presentations (Presentations correspond and contribute to the planned objectives and are conducive to enhanced shared understanding and participation on addressed topics)
A8	Clarity, coverage and sufficiency of concepts, objectives, anticipated outputs
A9	Usefulness of the distributed material

A10	Efficiency and effectiveness of the facilitation
A11	Overall rating of the event

The results of the assessment for each criterion are presented in the table below and in the following graphs (per criterion).

Table 5-1: Results of the assessment (rating) of the organisational, administration and planning aspects of the workshop

No.	Criterion	Average score
A1	Appropriate handling of invitations, visa support, information sharing and smoothing obstacles	3.83 / 4
A2	Efficient logistics: accommodation, transportation, location of venue and interpretation (where applicable)	3.83 / 4
A3	Provision of support (if requested) for participants' preparation for the event	3.78 / 4
A4	Efficient and effective follow-up of preparations and progress towards the event	3.75 / 4
A5	Planning of the event: selection and design of methodology, programme/ daily agenda and work rules	3.75 / 4
A6	Smooth flow of programme, efficient handling of emerging needs and attentiveness to participants concerns	3.83 / 4
A7	Adequacy of the presentations (Presentations correspond and contribute to the planned objectives and are conducive to enhanced shared understanding and participation on addressed topics)	3.83 / 4
A8	Clarity, coverage and sufficiency of concepts, objectives, anticipated outputs	3.75 / 4
A9	Usefulness of the distributed material	3.09 / 4
A10	Efficiency and effectiveness of the facilitation	3.50 / 4
A11	Overall rating of the event	3.73 / 4

Figure 5-1: Rating of the organizational and administrative aspects on the workshop

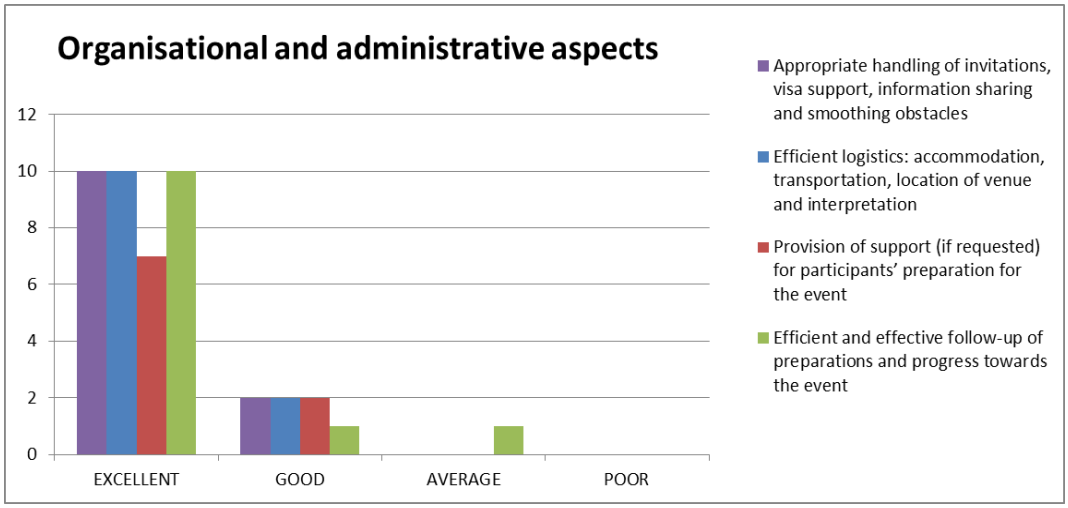


Figure 5-2: Rating of the workshop programme planning and flow

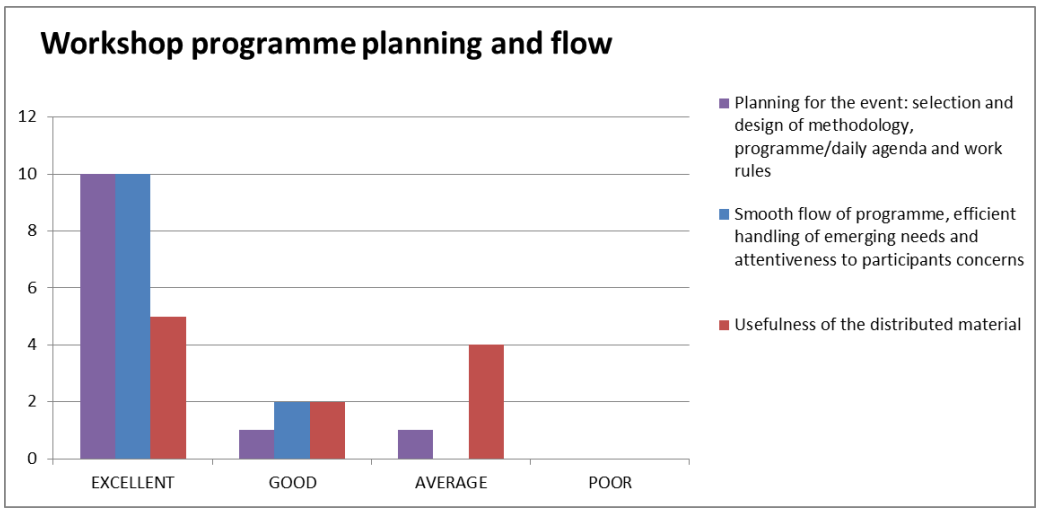
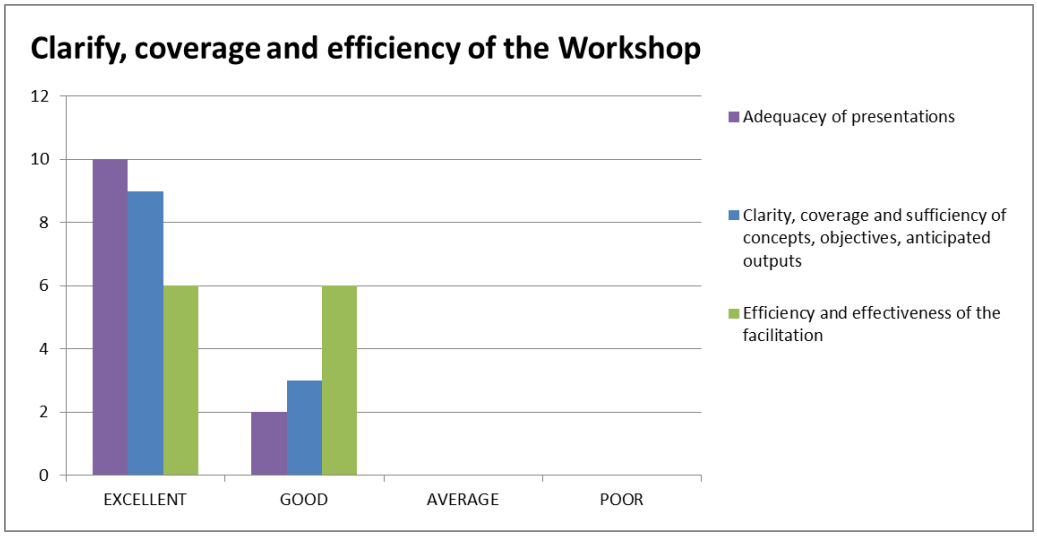


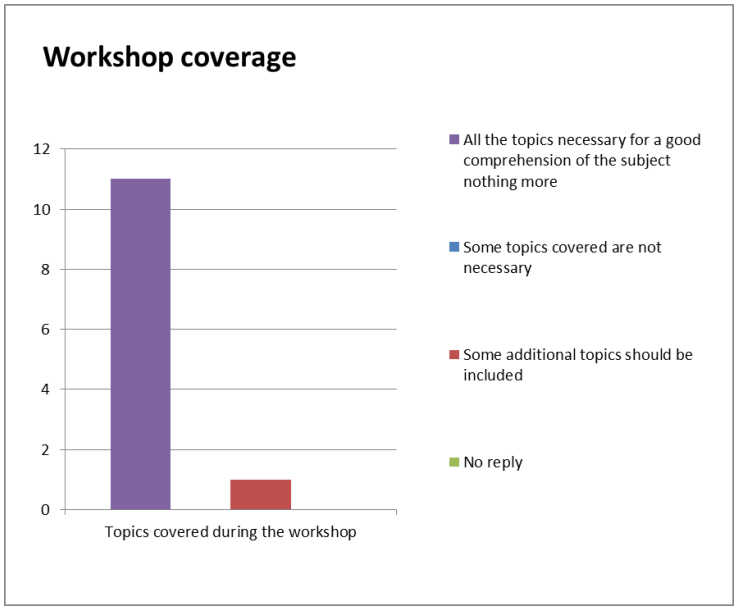
Figure 5-3: Rating of the workshop clarity, coverage and efficiency



B. Feedback by participants on technical aspects:

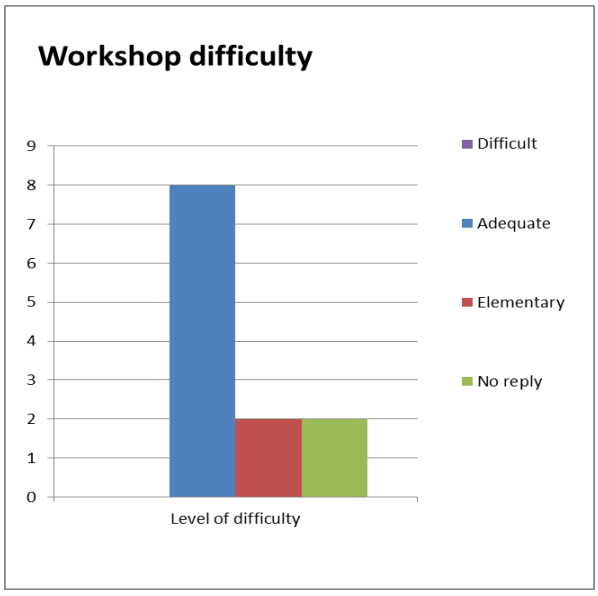
Coverage of the event: Regarding the event coverage evaluation, 92% of the participants felt that all the topics necessary for a good comprehension of the subject (and nothing more) were covered, and 8% felt that some additional topics should be included.

Figure 5-4: Rating of the workshop coverage



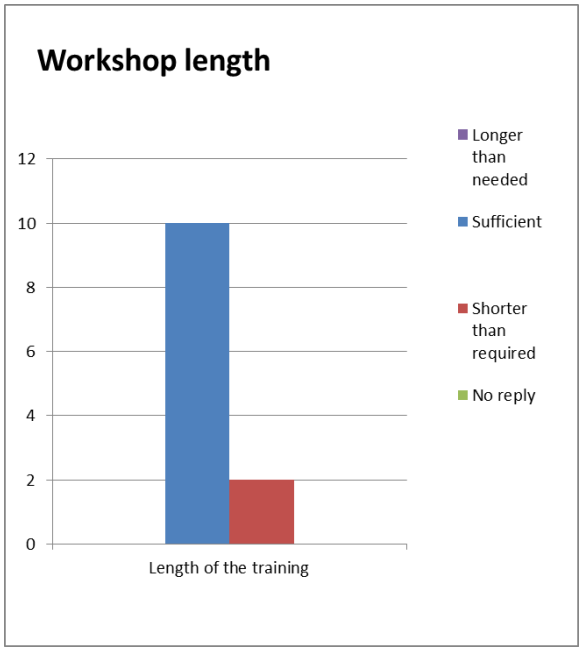
Level of difficulty: Regarding the evaluation of the level of difficulty of the workshop, 67% of the participants reflected it was adequate, and 17% of the participants reflected it was elementary, while 17% did not provide a reply to this question,

Figure 5-5: Rating of the level of difficulty of the workshop



Length of the workshop: Regarding the workshop duration, 83% of the participants thought it was sufficient, and 2% thought it was shorter than needed.

Figure 5-6: Rating of the workshop length



What is the most valuable thing you learned during the workshop (knowledge or skills)? The following answers have been provided by the participants:

(a) The success stories of factories in Egypt were really inspiring
(b) The different technologies of water efficiency case studies
(c) The international practices
(d) The water saving methods in selected industries, and the industrial processes of selected industries
(e) The nature of our resources like water and energy and how to save and use the resources in an efficient way
(f) All the new acquired knowledge
(g) The industrial development strategy for Egypt
(h) The legal frameworks of water conservation in Egypt and the policies presented
(i) The awareness about some data and indicators

How do you think that the current event will assist you in your future work on the subject? The following answers have been provided by the participants:

(a) In preparing water efficiency strategies and in water auditing
(b) In promoting the importance of saving and using the resources in the industrial sector
(c) In developing future focused programmes for industrial water savings, pollution prevention, wastewater reuse, and assessment of progress
(d) In consulting for companies, 6.it will help of course,

(e) In knowledge enrichment about water conservation for policy analysis related topics and policy formulation
(f) In developing water KPIs
(g) In sharing the knowledge and case studies among member companies

Please indicate whether (and how) you could transfer part of the experience gained from the event to your colleagues in your country. The following answers have been provided by the participants:

(a) By workshops and trainings for related key persons
(b) By re-applying projects on water saving-power saving-LE
(c) By sharing the presentations with other colleagues
(d) By sharin the knowledge and experience gained with other researchers in the hub, and even outside, who are working on similar projects

What did you like most about this event? The following answers have been provided by the participants:

(a) The efficiency of the workshop
(b) The clear targets
(c) The diversity of industries and relevant stakeholders present
(d) The knowledge gained
(e) The exposure to new topics and the presented cases from industries (including indicators)
(f) The new knowledge on statistics and numbers related to water consumptions and usages
(g) The way the topics were addressed
(h) The organisational, administrative and planning part

What needs to be improved? The following answers have been provided by the participants:

(a) Longer workshop duration (2 days)
(b) More case studies and more presentations about available water saving technologies

6 CONCLUSIONS & OVERALL ASSESSMENT

The workshop objectives have been met as the participants have gained an improved understanding of the Egyptian strategy on water efficiency and related policies, of the current state of industrial water use in Egypt, and of the variety of water saving options and technologies for different types of industries as demonstrated in theory and in practical application through the demonstrated case studies. Furthermore they have improved their knowledge on the different energy efficiency options, technologies and

international best practices, and on the key elements of performing energy audits and developing Energy Management Systems (EMS).

The case studies and Egyptian success stories have been well received by the participants, who have demonstrated great interest in them. They exchanged knowledge and experiences, and openly discussed various key issues during implementation.

One of the success elements of this workshop, which has been highly acknowledged by the participants, was that it managed to bring together different industries and stakeholder groups, linking directly the industry/ business representatives (end-users) with the policy-makers (MoTI, MWRI) and the relevant professional association (FEI), supporting thus experience exchange and networking. A constructive dialogue has been effectuated and a cooperation and continuation culture have been created.

7 ANNEXES

7.1 AGENDA

SWIM-H2020 SM Closing Workshop on methods of water conservation and water use efficiency technologies and practices in industries

Venue: Steigenberger Hotel

Wednesday, January 23rd, 2019

Item	Time	Description	Speaker
9:00 – 09:30		Registration and Coffee	
#1	09:30 – 10:00	▪ Welcome remarks ▪ Presentation of the workshop objectives and agenda ▪ Tour de table (introduction of the participants)	▪ Eng. Ahmed Kamal Abdel Moneim (Executive Director, FEI Technical Advisor) ▪ Maggie Kossida (SWIM-H2020 Non-key Expert)
#2	10:00 – 10:30	Water conservation and water use efficiency in industries: The legal framework and the recent developments	Dr. Hanan el Hadary (Chairman, Industrial Council of Technology and Innovation, MoTI)
#3	10:30 – 11:00	State of the Industrial Water in Egypt	Dr.khaled M.abuzeid (Regional Water Resources Program Manager)
#4	11:00 – 11:45	Overview of different technologies and options to introduce water conservation efficiency gains in industries	Maggie Kossida (SWIM-H2020 Non-key Expert

	11:45 – 12:15	**Coffee Break**	
#5	12:15 – 12:35	"EMISAL company case study "	Eng. Mostafa Salah
#6	12:35 – 12:55	"Water treatment case study "	Dr. Sameh , Mass food company
#7	12:55 – 13:15	"Water saving technologies case study"	MoTI
#8	13:15 – 14:00	Participatory discussion on the case studies	All participants
	14:00 – 15:00	**Lunch Break**	
#9	15:00 – 15:20	Energy Audits in Industry: Best practices and International experience	Eng. Savvas Louizidis, Head of Energy Unit, LDK Consultants
#10	15:20 – 15:40	Technical and financial mechanisms for implementing energy and water technologies in industries	Eng. Wafaa Ismail , Energy Department Head ECO/FEI
#11	15:40 – 16:30	Participatory discussion on water metering and water auditing in industries, issues around the application of water saving technologies, constraints, etc.	All participants
#12	16:30 – 16:45	Workshop Evaluation (Questionnaires) and Closing remarks	All participants
	16:45 – 17:15	**Coffee Break and Networking**	

7.2 LIST OF PARTICIPANTS

Table 7-1: List of participants

COUNTRY	TYPE OF INSTITUTION (please use the options provided*)	TITLE (Mr/Ms)	FIRST NAME	LAST NAME	POSITION/ FUNCTION	ORGANISATION/ INSTITUTION	EMAIL
EGYPT	MINISTRY REPRESENTATIVES	Ms	Hadeel	Ahmed	Economic analyst		hadeel_mohamed2013@Lefs.edu.eg
EGYPT	ACADEMIA AND RESEARCH INSTITUTES	Mr	Waleed	El-Deeb	Student	AUC -The Public Policy Hub	waleed.eldeeb@aucegypt.edu
EGYPT	ACADEMIA AND RESEARCH INSTITUTES	Ms	Omnia	AbdelRaheen	Student	AUC -The Public Policy Hub	omniaraheem@aucegypt.edu
EGYPT	MINISTRY REPRESENTATIVES	Ms	Dina	Mamdouh Mohamed	Civil Engineer	MWRI	dinamamdouh@hotmail.com
EGYPT	PRIVATE SECTOR	Mr	Mina	Soliman	TE 1er LE	Operating / Ajax	soliman.min@gmail.com
EGYPT	PRIVATE SECTOR	Mr	Mostafa	Saleh	R and D	Emisal	m.ahmad.saleh@emisalsalts.com
EGYPT	PRIVATE SECTOR	Mr	Ahmed	El Nemr	G. M.	Foodica	drahmedelnemr@HOTMAIL.COM
EGYPT	MINISTRY REPRESENTATIVES	Mr	Mostafa	Moghawry	Project manager	ENCPC	mustafa.maghawry@gmail.com

COUNTRY	TYPE OF INSTITUTION (please use the options provided*)	TITLE (Mr/Ms)	FIRST NAME	LAST NAME	POSITION/ FUNCTION	ORGANISATION/ INSTITUTION	EMAIL
EGYPT	MINISTRY REPRESENTATIVES	Mr	Maysara	Ahmed	Head of RECL Dpt	MTI (Ministry of Industry)	eng_maysara@hotmail.com
EGYPT	MINISTRY REPRESENTATIVES	Ms	Nehal	Shoukry	Project Manager	MTI (Ministry of Industry)	nehalshoukry@mti.gov.eg
EGYPT	MINISTRY REPRESENTATIVES	Mr	Khaled	Abdin	Senior Expert	MTI (Ministry of Industry)	khaledabdeen1973@yahoo.com
EGYPT	MINISTRY REPRESENTATIVES	Mr	Mohamed	Sabry	Deputy	ENCPC	m.s.rasoul@gmail.com
EGYPT	GOVERNMENT AGENCIES	Eng.	Noha	ElBakly	Sustainability Expert	ECO-FEI	noham@eco-fei.net
EGYPT	GOVERNMENT AGENCIES	Ms	Marwa	Hussien	CSR& Communication Coordinator	ECO-FEI	mhussien@eco-fei.net
EGYPT	GOVERNMENT AGENCIES	Ms	Wafan	AhdAlla	Energy Sector Head	ECO-FEI	wismail@eco-fei.net
EGYPT	GOVERNMENT AGENCIES	Mr	Hassan	Abuelata	Sustainable Development	ECO-FEI	habuelata@eco-fei.net
EGYPT	GOVERNMENT AGENCIES	Mr	Adel	Taha	SD Expert	ECO-FEI	ataha@eco-fei.net
EGYPT	GOVERNMENT AGENCIES	Mr	Ahmed	Kamal	ECO manager	ECO-FEI	akamal@eco-fei.net
GREECE	PRIVATE SECTOR	Mr	Savvas	Louizidis	Head of Energy Dpt	LDK Consultants	savvas@ldk.gr
GREECE	PRIVATE SECTOR	Ms	Maggie	Kossida	NKE	SWIM-H2020 SM	maggie@ldk.gr