Increasing Energy Efficiency in the Water Sector (IEE)

Renewable Energy in the Water Sector (REW)

Energy Efficiency and Renewable Energy Policy for the Water Sector

2020 - 2030

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This document is an integral part of the National Water Strategy and related policies and action plans:

1. National Water Strategy 2016-2025.
2. Water Sector Capital Investment Program (2016-2025).
3. Water Demand Management Policy.
4. Energy Efficiency and Renewable Energy in the water sector Policy (2020 update).
5. Water Substitution and Re-Use Policy.
6. Water Reallocation Policy.
7. Surface Water Utilization Policy.
8. Groundwater Sustainability Policy.
9. Climate Change Policy for a Resilient Water Sector.
10. Decentralized Wastewater Management Policy.
11. Action Plan to Reduce Water Sector Losses (Structural Benchmark).

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List of Abbreviations

AWC	Aqaba Water Company
SEC	Specific Energy Consumption
CHP	Combined Heat and Power
CSP	Concentrated Solar Power
EE	Energy Efficiency
GoJ	Government of Jordan
EMRC	Energy and Mineral Resources Company
EnMS	Energy Management System
GIZ	Gesellschaft für Internationale Zusammenarbeit
GWh	Giga Watt Hour
MWh	Miga Watt Hour
kWh	Kilo Watt Hour
JVA	Jordan Valley Authority
KFW	Kreditanstalt für Wiederaufbau
WAJ	Water Authority of Jordan
MEMR	Ministry of Energy and Mineral Resources
MWI	Ministry of Water and Irrigation
MCM	Million Cubic Meter
NRW	Non-Revenue Water
O&M	Operation and Maintenance
PV	Photovoltaic
RE / REW	Renewable Energy / Renewable Energy in the Water Sector
WAJ	Water Authority of Jordan
WSC	Water Supply Companies
WWTP	Wastewater Treatment Plant
YWC	Yarmouk Water Company
AWC	Aqaba Water Company
MWC	Miyahuna Water Company

Executive Summary

Energy use to produce and deliver potable water to consumers in Jordan is a heavy burden that by the water sector as energy demands for producing potable water are really high in Jordan as compared to other countries. This is mainly due to the difficulty of our natural water resources as ground water is deep and far from cities, surface water quantities are minimum, and the nearest sea for desalination is the Red Sea in Aqaba. As populations grow and rely on energy and water to be readily available all the time, this burden becomes even larger.

This document is an update to the 2016 Energy Efficiency and Renewable Energy Policy and aims at providing a solid basis for promoting the desired change of achieving actual measurable improvement in energy efficiency and in increasing the use of renewable energy in the water sector.

The overall country wide energy intensity of total supplied water in 2019, if we eliminate the factor of NRW, would be around 3.4 kWh/m^3 and with accounting for NRW becomes 6.6 kWh/m^3. These values are high compare to international values but are unfortunately poised to become even higher in the future if business continues as usual due the following main reasons:

- Deterioration of the quality of available water resources
- Reduction in available water resources quantities and low ground water extraction efficiencies
- Water desalination as a future water resource

Therefore, sustainable and long-lasting changes in the energy utilization in the water sector have become a national priority and all public and private sector entities must work hand in hand to achieve this objective as water is clearly the most important development sector.

To achieve the desired changes, this policy presents 4 goals, 9 targets and 12 indicators. The goals are the general directions of the policy whereas the targets present specific measurable and time bound objectives, and the indicators are used to measure the progress towards the targets over time.

Goals 1 and 2 are considered the core goals and are the main objectives of this policy. Whereas goals 3 and 4 are supportive goals that promote positive practical changes in the water sector for facilitating the achievement of goals 1 and 2. The goals, targets, and indictors of the policy are presented below:

Goal-1 “Achieve improved levels of energy efficiency in water supply and wastewater treatment activities”

- *Target 1.1:* Increase energy efficiency by 15% in water supply and wastewater treatment activities by the year 2025 based on 2019 MWI energy consumption baseline
    - *Indicator 1.1.1:* kWh/m^3 of water billed
    - *Indicator 1.1.2:* kWh/m^3 of water produced

- *Target 1.2.a:* Develop an optimized target that reflects the full actual potential of energy efficiency in water supply based on a normalized energy model approach to be utilized for the period 2025 to 2030
  - *Indicator 1.2.1.a:* New target for energy efficiency in water supply developed (yes or no)
- *Target 1.2.b:* Develop an optimized target that reflects the full actual potential of energy efficiency in wastewater management and treatment based on a normalized energy model approach to be utilized for the period 2025 to 2030
  - *Indicator 1.2.1.b:* New target for energy efficiency in wastewater treatment developed (yes or no)

Goal-2 "Increase the use of renewable energy in all water sector activities"

- *Target 2.1:* Develop large (> 1 MW) and small scale (< 1 MW) renewable energy projects in collaboration with the Ministry of Energy and Mineral Resources (MEMR) to cover 20% of the 2019 MWI energy consumption baseline (10% by the year 2025 and 20% by the year 2030).
  - *Indicator 2.1.1*: GWh generated from renewable energy projects
- *Target 2.2:* Perform feasibility studies and implement renewable energy powered desalination plants for seawater by 2025 on 25% of the total water supply based on 2019 baseline
  - *Indicator 2.2.1:* Water supply projects capacity covered by feasibility studies (m^3 of water)
  - *Indicator 2.2.2:* Water supply capacity produced by renewable energy powered desalination plants (m^3 of water)

Goal-3 "Implement energy management systems to gradually cover the entire water sector activities"

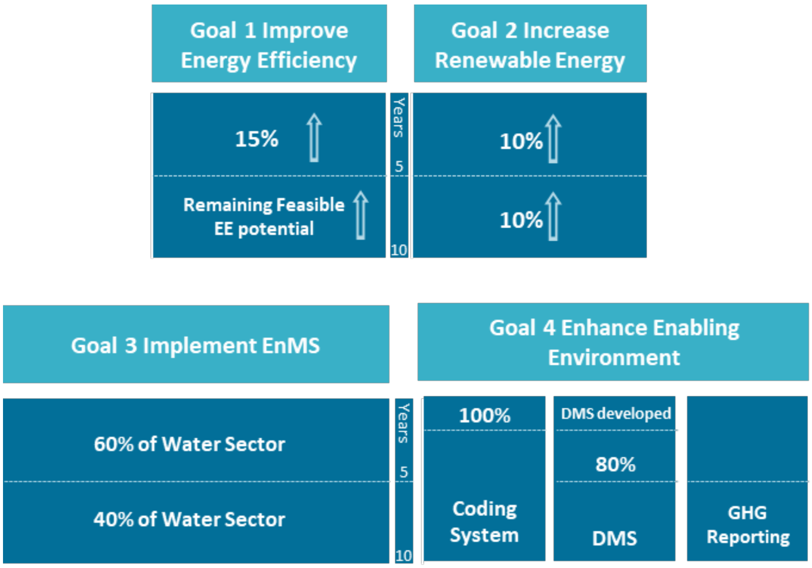
- *Target 3.1: Implement an Energy Management System to cover 60% of the water sector in Jordan by the year 2025 and 100% by the year 2030 measured by kWh consumed by water sector activities covered by EnMS*
  - *Indicator 3.1.1:* kWh consumed by water assets that are included within the scopes and boundaries of the EnMS divided by the total amount of electricity consumed by the Jordan water sector

Goal-4 "Enhance the enabling environment for achieving the goals of this policy"

- ***Target 4.1:*** Implement a coding system for the water sector to be used in all water sector data collection and reporting activities including energy billing by power companies by the end of 2022 measured by water assets capacity in MCM that are covered by the coding system divided by the total water sector capacity
  - *Indicator 4.1.1:* Percentage of water sector capacity that have implemented the coding system (MCM) compared to total water sector capacity (MCM).

- ***Target 4.2:*** Develop and implement a Water and Energy Data Management System (DMS) for the water sector. The DMS to be developed by 2022 and implemented in 80% of water sector by 2025 measured by water assets capacity in MCM that are covered by the DMS divided by the total water sector capacity in MCM.
    - *Indicator 4.2.1:* Percentage of water sector that have water metering systems
    - *Indicator 4.2.2:* Percentage of water sector that has water and energy data available on the predetermined platform in timely manner
- ***Target 4.3:*** Develop an energy and GHG emissions balance annual report for the water sector activities starting from 2025 onwards
    - *Indicator 4.3.1:* Is an annual energy and GHG emissions balance report produced or not?

A graphical representation of the goals and targets is presented below.



In addition to the goals, targets, and indicators presented in this policy, it is proposed to optimize opportunities available through the Water-Energy Nexus including:

- Optimizing the energy tariff for water sector
- Increasing renewable energy projects
- Exploring renewable energy powered desalination projects

Also, it is proposed to have a more detailed view of the relationship between the water sector and climate change and monitor and adopt to those changes. Climate change has an impact on the water sector which should be adopted to and the water sector has impacts on climate change which should be minimized.

Finally, a monitoring and evaluation table has been developed which summarizes the baseline values of each indicator along with the planned targets with empty blank cells to be filled for the annual monitoring and evaluation reports in order to compare actual progress to the baseline and target values for each indicator for that specific period.

Energy and Water Sectors Existing Situation in Jordan

The Hashemite Kingdom of Jordan has been facing chronic stresses in both the water and energy sectors mainly because of the scarcity of naturally available water and fossil energy resources while at the same time demand for those two resources have been steadily increasing as populations grow and rely on energy and water to be available when and where needed in their modern daily life styles.

Jordan government has launched several strategies and promising legislation aiming at promoting energy efficiency and promoting the use of renewable energy in the water sector including the National Water Strategy (2016-2025) and the Energy Efficiency and Renewable Energy Policy (2016). The existing policies have played an important role in promoting this topic. However, there are several tools and techniques that could support improved energy management even further and that is why it became important to update the policy. This document is an update to the 2016 policy and aims at providing a solid basis for promoting the desired change of achieving actual measurable improvement in energy efficiency and in increasing the use of renewable energy in the water sector.

The energy situation in Jordan is critical as most of Jordan's energy is imported from external sources. The Jordanian government is trying to increase the use of local sources of energy but still relies heavily on oil and gas imports. The energy mix in Jordan for the year 2020 as indicated in the Jordan energy strategy (see Figure 1) is 58% oil, 21% natural gas, 11% renewable energy, 8% oil shale, and 2 % coal. Oil and gas represent combined 80% and are almost entirely imported from abroad. The future plan over the coming 10 years includes a modest shift towards more natural gas (to increase it from 21% to 25%) and towards renewable energy (to increase it from 11% to 14%) while reducing the oil portion (from 58% to 51%). This is considered a modest shift (only 3% change) to renewable energy which means most sectors in Jordan will not be able to increase their share of renewable energy and that sectors will compete for this small available percentage shift. The water sector is clearly a core strategic sector that is suffering from high energy demand and should have a significant portion of this intended increase in the use of renewable energy sources, as the future of water in Jordan appears to be heavily dependent on energy due the predicted increase in water desalination and due to the predicted longer pumping distances. It is of strategic importance to move towards renewable energy in the water sector as much as possible, in order to keep water, cost reasonable, and to use locally available sources of energy to produce and pump fresh water instead of relying on external energy to produce water.

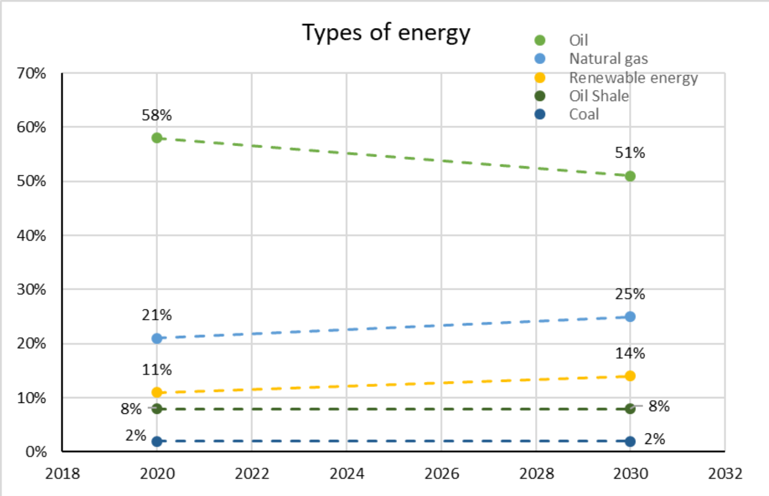


Figure 1 Current energy mix in Jordan and over the coming 10 years (Source: Energy Strategy, 2020)

Source of all water in Jordan, both surface and groundwater, really come directly from rain water and unfortunately Jordan's climate is arid to semi-arid with low rainfall and high evaporation rates. About 94% of Jordan's territory receives less than 200 mm of rainfall per year (see Figure 2). Due to climate change, rain is becoming less in quality and more dispersed in its distribution which increases the water scarcity stress overall in the country.

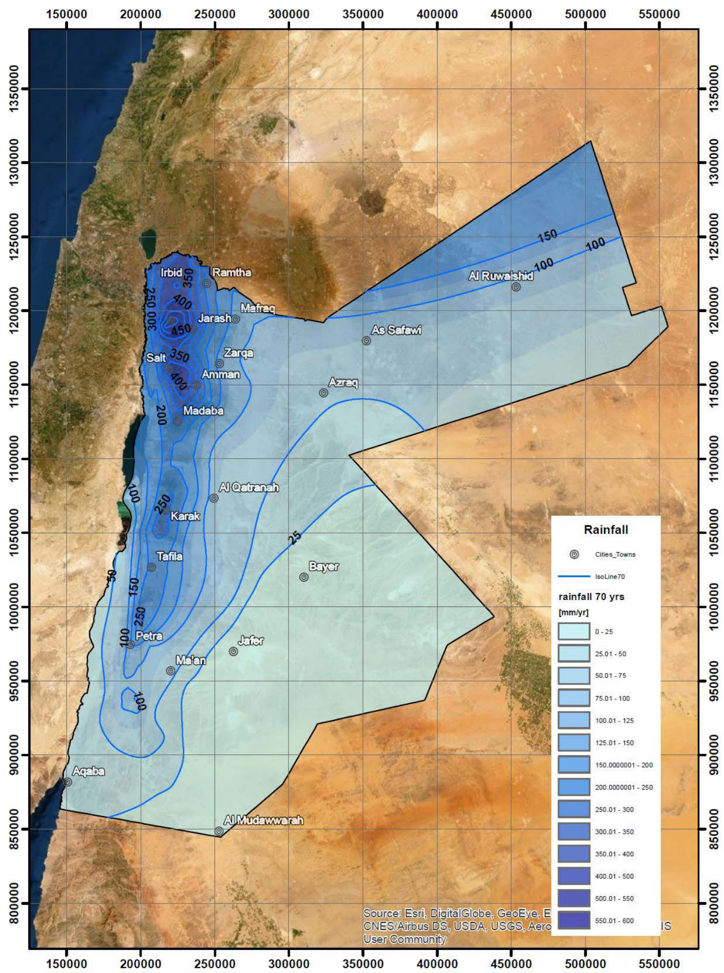


Figure 2 Rainfall distribution map for 70-years average of water years 1943/44 – 2012/13 (MWI, 2014)

The issue becomes more complex due to the rapid increase in Jordanian population over the last decades which creates a heavy burden on the already weak and diminishing water resources. Over the last 20 years population have more than doubled (see Figure 3) with an average growth rate of around 4.2% over 20 years which is around double the normal growth rate in Jordan.

In addition to the population growth, recurring political crises have forced a large number of dislocated people from the region, to seek refuge in Jordan. This caused sudden increases in demand for water supply and wastewater as well as for energy which in turn disrupted the existing water management plans and the smooth expansion plans for the water system.

With the limited water resources and the large population growth, the available water per capita in Jordan has declined significantly to reach below 100 m^3 per yr. The value for renewable internal freshwater resources per capita in Jordan was 76.46 m^3/capita as of 2014 and has probably declined further after that. As Figure 4 shows, over the past 52 years this indicator was at its highest of 674.81 m^3/capita in 1962 and a has steadily declined to 76.46 m^3/capita in 2014. Compared to the MENA region average, Jordan is way below that average as can be seen on the same figure. The average value in the world is orders of magnitude higher than the MENA region so would be difficult to even compare them on the same graphic.

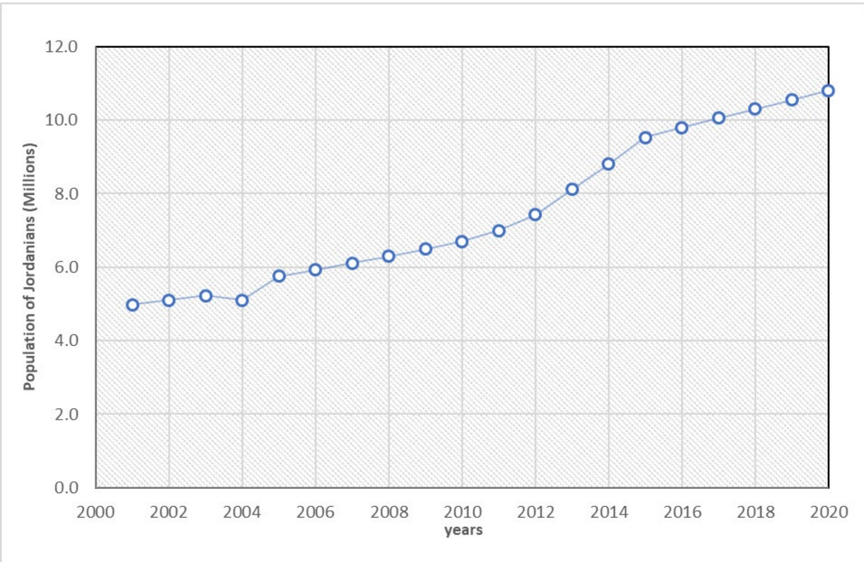


Figure 3 Population in Jordan over the last 20 years (Source DOS, 2021)

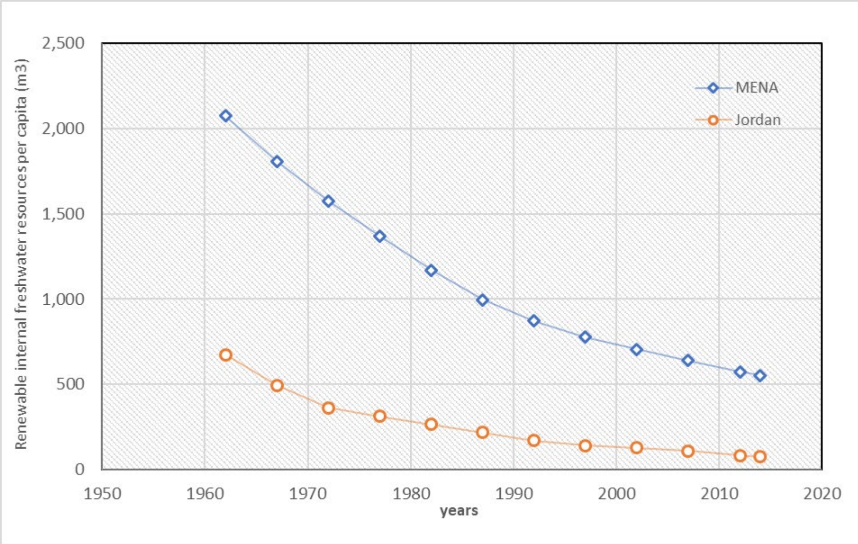


Figure 4 Renewable internal freshwater resources per capita for Jordan and MENA (Source AQUASTAT, 2021)

Energy Consumption by the Water Sector for Baseline Year 2019

The Ministry of Energy and Mineral Resources (MEMR) reports annually on the energy use in all sectors in Jordan. The way the water sector energy use is reported is as “water pumping”. Although the water sector utilizes energy for other reasons as well, but the majority is certainly for pumping. The reported energy use for all sectors in Jordan are summarized in **Figure 5** below. As can be seen, water sector is one of the large energy consumers in Jordan with “water pumping” in 2019 amounting to about 15 % of the total energy use in Jordan. The energy reported by MEMR as “Water Pumping” represents all private and public electric consumption activities.

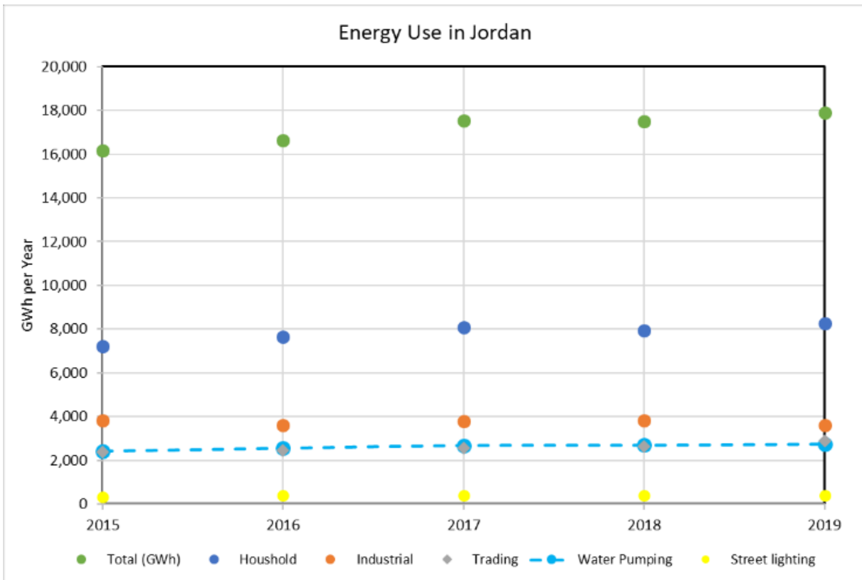


Figure 5 Energy use in Jordan for years 2015 to 2019 (Source MEMR, 2021)

The main energy consumers within the water supply cycle in Jordan are Miyahuna in Amman, followed by Yarmouk water company in the North, the Disi project, WAJ areas (which are Balqa, Karak, Maan, and Tafileh), Miyahuna Zarqa and Madaba, AWC in Aqaba, and finally Samra WWTP project. The actual energy consumption of these entities over the period 2015 until 2019 are presented in Table 1 below and the proportions of the consumption for the year 2019 is presented in Figure 6 below as well.

Table 1 Energy consumption of WSC and WAJ for years 2015-2019 in GWh (Source MWI, 2021)

Year	Miyahuna - Amman	YWC	Disi project	WAJ Areas	Miyahuna Governorates	Samra WWTP	AWC	Total (GWh)
2019	656.4	336.4	289.6	174.9	143.6	16.2	37.3	1654.4
2018	667.2	325.7	283	199.5	137.5	17.7	38.5	1669.1
2017	668.1	318.5	306.6	208.4	133.3	17.6	32.9	1685.4
2016	661.2	316.3	309.9	180.3	128.3	13.7	39.6	1649.3
2015	677.9	300.7	399.1	176.7	124.7	12.3	35.2	1726.6

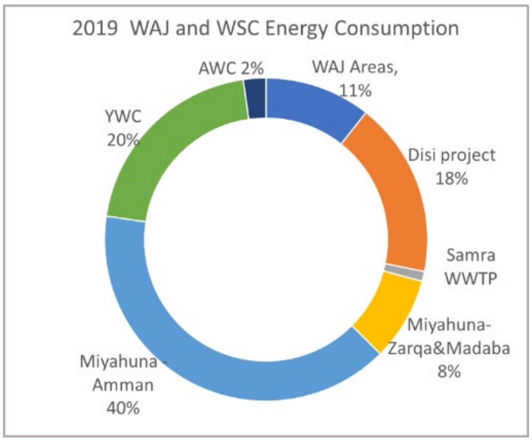


Figure 6 Distribution of energy consumption by WSC and major water sector PPP in 2019

Supply of potable water is typically the most energy consuming water sector activity in Jordan and internationally. In Jordan it is estimated that 485 million m^3 of water are extracted, treated, and pumped to consumers per year (2019 data). From this total amount, around 48% is lost as Non-Revenue Water (NRW) which leaves around 249 million m^3 of water as billed to consumers. The total energy used to get this amount of water to consumers (including treatment of the wastewater) is around 1,654.4 GWh per year which means that each m^3 billed consumed around 6.6 kWh/m^3 which is referred to as the energy intensity of potable water billed to consumers. This value is the overall baseline value of this policy and all the goals are focused on reducing this value over the coming 10 years. Another value to consider is the energy intensity of water produced and that value is calculated below as well. JVA numbers are not included within the potable water energy intensity of water as they deal only with irrigation water for the Jordan Valley and operate dams and other water assets, their total amount of water for 2019 was around 182.42 MCM of irrigation water and 49.319 GWh were consumed to provide this water. Therefore, the energy intensity of JVA water is around 0.27 kWh/m^3. This value is much lower than potable water as its sources are mostly run off from rain events that are collected by gravity without pumping. The energy intensities for the WSCs and for JVA are calculated in **Table 2**.

Table 2 Water produced and NRW per WSC for 2019 (Source MWI, 2021)

Utility / WSC	Water Produced (m^3)	Water Billed	NRW (m^3)	NRW %	Total (GWh/yr)	(kWh/m^3 billed)	(kWh/m^3 Produced)
Miyahuna Amman[1]	200,059,000	122,657,143	77,401,857	38.7	968.2	7.9	4.8
Miyahuna Zarqa	60,978,011	23,443,466	37,534,545	61.6	99	4.2	1.6
Miyahuna Ma'daba	10,152,003	5,412,600	4,739,403	46.7	38.6	7.1	3.8
Miyahuna (Overall)	271,189,014	151,513,209	119,675,805	44.13	1,106	7.3	4.1
YWC[2]	99,164,018	53,008,437	46,155,581	46.5	336.4	6.3	3.4
WAJ-Balqa	41,814,100	13,053,706	28,760,394	68.8	54.8	4.2	1.3
WAJ-Karak	22,514,996	7,513,267	15,001,729	66.6	70.8	9.4	3.1
WAJ-Tafileh	7,883,273	2,841,490	5,041,783	64	21.2	7.5	2.7
WAJ-Ma'an	15,551,332	4,221,331	11,330,001	72.9	25.1	5.9	1.6
AWC[3]	27,114,087	17,102,992	10,011,095	36.9	37.3	2.2	1.4
Total potable water[4]	485,230,820	249,254,432	235,976,388	48.6	1,654.4	6.6	3.4
JVA	NA	182,420,000	NA	NA	49.3	0.27	NA

[1] Electric consumption for Disi project and Samra were added to Miyahuna Amman for this calculation
[2] YWC is comprised of several departments which are Irbid, Jerash, Ajloun, and Mafraq
[3] About 5 GWh/yr of AWC energy consumption is used up for operation contracts of WWTP outside Aqaba
[4] Energy consumption of 3.0 GWh/yr is added for central administration buildings to the total energy use

The energy intensity of total supplied water, if we eliminate the factor of NRW, would be around 3.4 kWh/m^3. This value is considered to be a relatively high value when compared to the amount other countries may consume to supply water and this is caused by the natural water resources challenges in Jordan such as the high depth of ground water, the long distances from communities, and very low quantity of surface water. To understand the magnitude of this value, it is compared to average values in USA and Germany (See Table 3). Various studies in the United States and Germany (Voltz, T. and Grischek, 2018) have produced estimates of the energy intensity of water supply per unit volume of water supplied by a certain method. The amount of energy intensity of water depends heavily on the type of water source used. For example, surface water sources are the least energy intense and require about 0.42 kWh/m^3, while ground water sources require marginally more energy with 0.55 kWh/m^3, and desalination, the most energy intense of the water sources, requires about 3.17 kWh/m^3. By comparing these values to the Jordanian value (3.4 kWh/m^3) it can be seen that the energy demand in the water sector in Jordan is significantly higher than those other countries which is, as mentioned earlier, mainly due to the natural challenges of the water resources in Jordan. For this reason, this policy is really one of the most important policies for the water sector and very critical to implement in order to control and limit this high level of energy intensity (and its predicted increase) over the coming 10 years.

Table 3 Energy intensity of water in Jordan compared to Germany and USA

Parameter	Jordan (combined water sources not considering NRW)	Surface water supply (USA & Germany)	Ground water supply (USA & Germany)	Desalination water supply (USA & Germany)
Energy intensity of supplied water (kWh/m^3)	3.4	0.42	0.55	3.17

Challenges Facing Future Energy Demands in the Water Sector

As mentioned in subsequent sections, energy demands of the water sector in Jordan are considered to be on the high side already as compared to the total energy use in the country and as compared to energy use of water supply activities internationally. Unfortunately, however, this energy consumption is posed to increase even more in the future because of the following main challenges.

Deterioration of the Quality of Available Water Resources

Water quality deterioration means that more treatment would be required for the water and more locations have to be explored which leads to higher energy consumption. Unfortunately, there are reoccurring incidences of deteriorating water quality in the existing water resources. It is not clear right now the extend of quality deterioration overall, but it is apparent that this type of issue will keep reoccurring in the future because of over pumping from wells and because of other human activities. Therefore, the water sector should be prepared to deal with this issue by introducing more advanced treatment schemes and by developing new water resources which would both need additional amounts of energy.

Some effects of water quality deterioration have been observed as reported by GIZ, 2020 [1]:

1) Groundwater gradients and flow directions are changing; salinities are increasing in many parts of the A7/B2 aquifer that are currently exploited due to the mobilization of brackish groundwater from the eastern parts of the country towards the western part. Additional energy will be needed to deal with salinity.

2) In areas of high exploitation, there is less and less water in the water system. Irrigation return flows therefore have an increasing impact and salinities, particularly in the A7/B2 aquifer, will constantly rise. In some areas that are extensively cultivated, nitrate and other contaminants have reached levels where the use of water resources for domestic water supply is no longer possible.

3) Salinities are increasing locally due to the discharge of brine from small/mobile private desalination plants (injection into wells; discharge into rivers).

4) Heavy metal contents are increasing due to downward leakage from the B3 aquifer (oil shale) caused by declining hydraulic pressure in the A7/B2 aquifer.

5) Contaminations (other than microbiological) are becoming more widespread and more frequent as a result of human activities (e.g. due to mining; uranium, sulphate).

6) Microbiological contaminations are becoming more widespread and more frequent as a result of human activities (mainly wastewater).

Low Ground Water Extraction Efficiencies

One of the major energy consuming tasks in the water sector in Jordan is linked to pumping water from deep ground water wells. Several aspects of the current operation maybe be

[1] Rapid Assessment of the consequences of declining resources availability and exploitability for the existing water supply infrastructure (Margane, A. and Dwairi, M., 2020).

causing inefficiencies that should be improved to reach high energy efficiency in ground water extraction. Some of the existing issues include[2].

1) Well efficiencies are mostly only around 50%, mainly because of the low open area in the screens (commonly only ~1%), which results in a higher drawdown (or pumping lift) than necessary. A simple solution would be to increase the open area to around that of the porosity (~3-6%). About 5% of the energy is lost due to this factor.

2) Pump efficiencies (combined pump and motor efficiency) are equally low, mostly also around 50%. If the right pump were installed, there would normally be efficiencies of 70%. About 20% of the energy is lost due to this factor.

3) The optimal location of wells and other water supply infrastructure, based on energy consumption (topographic) considerations, is often not considered in the planning process. Much energy could be saved by choosing the optimal places for well galleries and pumping stations. More than 10% of energy is lost due to this factor.

Water Desalination as a Future Water Resource

The existing water resources in Jordan as discussed earlier are under tremendous stress and new sources are really needed to guarantee freshwater availability in the coming 5 years. After utilizing most of the groundwater aquifers and surface water options, it seems seawater desalination is the most important remaining option. Therefore, the Ministry of Water and Irrigation (MWI) announced the launch of the Aqaba-Amman Water Desalination and Conveyance National Project (AAWDC), describing it as “the largest water generation scheme to be implemented in the history of the Kingdom”.

The AAWDC project concept involves the development of infrastructure, to be located entirely on the territory of Jordan, starting from the Southern Red Sea coast in Aqaba and ending in the capital city of Amman. Water is to be desalinated in Aqaba with the treated water to be pumped to Amman in a similar manner to Disi project. After desalination, the water shall be pumped against approximately 1000 m elevation deficit and 340 km of horizontal distance.

The energy required to treat the water and pump it is quite significant, it is not like anything ever done before in Jordan and therefore should have a special status in the planning for large scale renewable energy sources to support this project.

The importance of this project is because the anticipated deficit in water resources is severe and it is coming fast. It is estimated that by the year 2025 a gap of around 130 MCM in water supply compared to demand must be filled and the gap will grow even further after that date[3] (Figure 7). In accordance with the latest plans, the AAWDC project is being developed to generate 300 MCM/year of drinking water for its full capacity. The project is planned to be implemented through a build-operate-transfer (BOT) scheme and should be operational by the year 2027.

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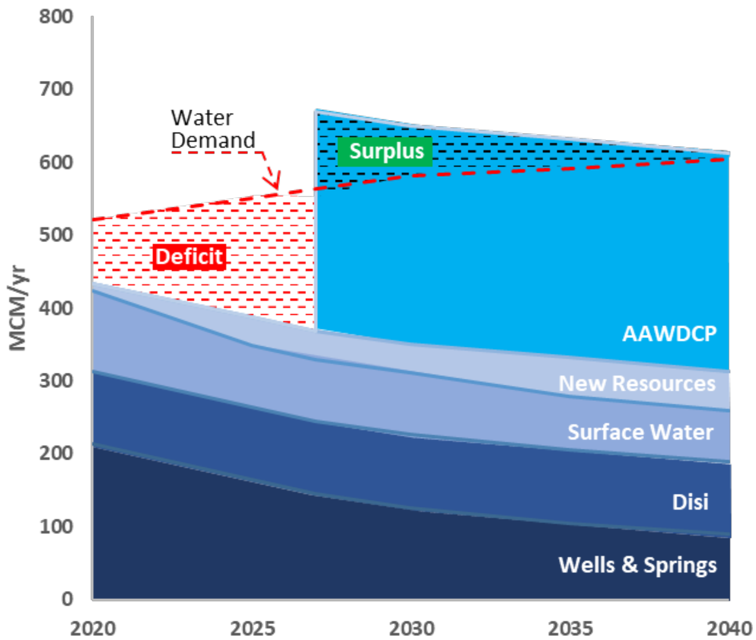
[2] Rapid Assessment of the consequences of declining resources availability and exploitability for the existing water supply infrastructure (Margane, A. and Dwairi, M., 2020).
[3] National Water Supply Infrastructure Master Plan 2020.



	2020	2025	2027	2030	2035	2040
AAWDCP	0	0	300	300	300	300
New Resources	8.9	38.9	38.9	38.9	53.9	53.9
Surface Water	111	85	85	85	73	70
Disi	100	100	100	100	100	100
Wells and Springs	213	164	145	126	105	89
Demand	521	551	563	582	591	604
Deficit/Surplus	-88.1	-163.1	105.9	67.9	40.9	8.9

Figure 7 Projected demands and supplies up to 2040 (MWI, 2020) with latest AAWDCP capacity as announced by MWI in July 2021

Goal-1 Improve Energy Efficiency

Table 4 Goal 1 Targets and Indicators

Goal-1 "Achieve improved levels of energy efficiency in water supply and wastewater treatment activities"	
Targets	**Indicators**
Target 1.1: Increase energy efficiency by 15% in water supply and wastewater treatment activities by the year 2025 based on 2019 MWI energy consumption baseline.	*Indicator 1.1.1:* kWh/m^3 of water billed *Indicator 1.1.2:* kWh/m^3 of water produced
Target 1.2.a: Develop an optimized target that reflects the full actual potential of energy efficiency in water supply based on a normalized energy model approach to be utilized for the period 2025 to 2030.	*Indicator 1.2.1.a:* New target for energy efficiency in water supply developed (yes or no)
Target 1.2.b: Develop an optimized target that reflects the full actual potential of energy efficiency in wastewater management and treatment based on a normalized energy model approach to be utilized for the period 2025 to 2030	*Indicator 1.2.1.b:* New target for energy efficiency in wastewater treatment developed (yes or no)

Target 1.1: Increase energy efficiency by 15% in water supply and wastewater treatment activities by the year 2025 based on 2019 MWI energy consumption baseline

The target for improving energy efficiency in the water sector has been divided into two periods in this policy. The first period is 2020 till 2025 and the second period is 2026 till 2030. Target 1.1 is for the first period only. This target has been set by the MWI (as a top down approach) in order to be a driver for improvement at the time being until more detailed data become periodically collected and readily available to move to more optimized target that reflect the actual potential on the ground as required in targets 1.2a and b. This approach will also accommodate the already ongoing plans which were built on the earlier policy (2016) and all the work that have been done so far with the Energy management system.

Target 1.1 Shall Utilize the Concept of a Simple Ratio

A simple ratio relates energy consumption to production or to one single output and is commonly referred to as specific energy consumption. In the case of the water sector, this would be the total energy consumption / the total water production or water that is actually billed to consumers (kWh/m^3). The baseline of this policy, as mentioned earlier, is the year 2019 which has a value for indicator 1.1.1 of 6.6 kWh/m^3 billed and a for indicator 1.1.2 a value of 3.4 kWh/m^3 produced.

Target 1.2.a: Develop an optimized target that reflects the full actual potential of energy efficiency in water supply to be utilized for the period 2025 to 2030

The target for improving energy efficiency in the water sector have been divided into two periods in this policy. The first period is 2020 till 2025 and the second period is 2026 till 2030. Target 1.1.2a is for the second period and is focused on water supply only which covers extraction of all types of water sources (groundwater, surface water, or seawater), water treatment, and supply to consumers.

Target 1.2.b: Develop an optimized target that reflects the full actual potential of energy efficiency in wastewater management and treatment to be utilized for the period 2025 to 2030

The target for improving energy efficiency in the water sector have been divided into two periods in this policy. The first period is 2020 till 2025 and the second period is 2026 till 2030. Target 1.1.2b is for the second period and is focused on wastewater management only which covers wastewater pumping and treatment.

Target 1.2 a and b Shall Adopt the Concept of a Normalized Model

The target itself shall be selected based on the actual energy efficiency potential of the water sector after the year 2025. By that time there should be enough data to be able to determine a realistic target that is based on the actual situation on the ground. A normalized model shall be utilized as it provides a more meaningful measure of energy performance than a single metric or simple ratio (which is what is used for target 1.1) to accurately represent the relationship between relevant variables and energy consumption. Here, regression analysis techniques are used to obtain a model that determine energy consumption based on independent variables.

In other words, the normalized baseline model describes the behavior of the energy consumption of a system under a current configuration, without considering the application of any future modification or improvement, but considering the influence of those variables, which can cause a change in the consumption, that are not under control of an operator / EnMS or subject of intentional modification.

Usually (a minimum) data over a period of 12 months is required to obtain an accurate model, if monthly data are to be used. The electrical consumption data and the correspondent water production or water supply data from the baseline period are used to establish the baseline models.

Once established, the baseline model is used to calculate with current variable data the energy consumption, which would be expected to occur, if no changes (improvements or degradations) had occurred in the system since the end of baseline period. Thus, the result of the calculation is called “Expected Consumption”.

Subsequently, the measured consumption from the same period to which the current variable data are corresponding to (called “actual consumption”) is compared with the previously calculated “Expected consumption” (applying the normalized or adjusted baseline model to the water production data).

Energy Savings (kWh) = Actual consumption (kWh) - Expected consumption (kWh)

The boundary of all Goal 1 targets, shall be as elaborated in Figure 8 below. Basically, efforts to improve energy efficiency shall cover all aspects of potable water supply cycle from source water abstraction to treatment and distribution and the full wastewater cycle from collection and conveyance to treatment and discharge or reuse. For JVA's irrigation water, although their energy requirements is much less, a similar approach can also be utilized.

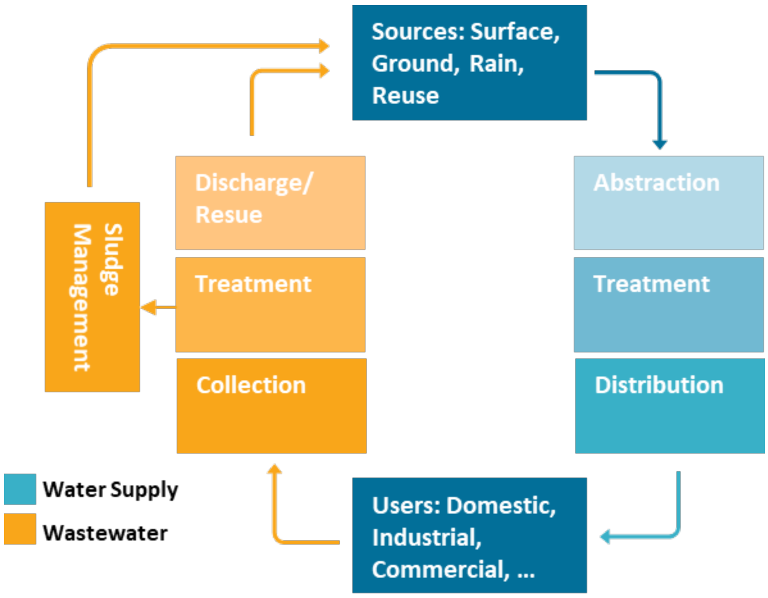


Figure 8 System boundary for Goal 1 targets

The main activities that shall improve the energy efficiency include:

Systems redesigns including for example adjustments in the ground water wells slot openings to improve wells efficiency, converting from pumping systems to gravity, restructuring of water distribution districts to reduce and control required pressures, introducing Best Available Technologies (BATs) to recover kinetic and biotic energy from wastewater plants.

System rehabilitation including for example replacement of pumps, changing pumps configurations, and rehabilitation of distribution networks to reduce leakage.

System Operation and Maintenance by integrating energy efficiency in the daily operation practices of water sector operation and maintenance.

Goal 2 Increase Renewable Energy

Table 5 Goal 2 targets and indicators

Goal-2 "Increase the use of renewable energy in all water sector activities"	
Targets	**Indicators**
Target 2.1: Develop large (> 1 MW) and small scale (< 1 MW) renewable energy projects in collaboration with the Ministry of Energy and Mineral Resources to cover 20% of the 2019 MWI energy consumption baseline (10% by the year 2025 and 20% by the year 2030).	*Indicator 2.1.1*: GWh generated from renewable energy projects
Target 2.2: Perform feasibility studies and implement renewable energy powered desalination plants for seawater by 2025 on 25% of the total water supply based on 2019 baseline.	*Indicator 2.2.1:* Water supply projects capacity covered by feasibility studies (m^3 of water)
	Indicator 2.2.2: Water supply capacity produced by renewable energy powered desalination plants (m^3 of water)

Target 2.1: Develop large (> 1 MW) and small scale (< 1 MW) renewable energy projects in collaboration with the Ministry of Energy and Mineral Resources to cover 20% of the 2019 MWI energy consumption baseline.

Despite the current limitation on the renewable energy projects in Jordan, the MWI shall attempt to develop a mixture of large (> 1 MW) and small (< 1 MW) renewable energy projects to produce a total of 20% from the 2019 baseline which is 1,654 GWh as reported in subsequent sections. 20% of the baseline is around 331 GWh which requires development of projects with total capacity of around 140 MW over the coming 10 years (2020 to 2030).

The most applicable and economical renewable power sources in Jordan seem to be Photovoltaic (PV) technology and wind farms. Net-metering, Wheeling mechanisms and Direct proposals can be used in collaboration with MEMR. Large scale water sector projects in Jordan are mostly being done as PPP so the element of renewable power supply should be added to the development packages.

Target 2.2: Perform feasibility studies and implement renewable energy powered desalination plants for brackish ground water and seawater

The most important project to study is the AAWC project but also there are other smaller projects for brackish ground water desalination. The approach of the feasibility studies would be to integrate renewable energy into the project and study the overall feasibility compared to traditional power. The target is for the feasibility study to cover at a minimum of 25% of the overall potable water supply which amounts to around 121 MCM. The renewable power portion is to cover as a minimum the desalination activities but to be expanded to pumping activities from Aqaba to Amman as well if it is feasible.

Goal 3: Implement Energy Management Systems (EnMS)

Table 6 Goal 3 targets and indicators

Goal-3 "Implement energy management systems to gradually cover the entire water sector activities"	
Targets	**Indicators**
Target 3.1: Implement an Energy Management System to cover 60% of the water sector in Jordan by the year 2025 and 100% by the year 2030 measured by kWh consumed by water sector activities covered by EnMS.	*Indicator 3.1.1:* kWh consumed by water assets that are included within the scopes and boundaries of the EnMS divided by the total amount of electricity consumed by the Jordan water sector.

The policy of the MWI shall be to develop and implement an EnMS according to ISO 50001 to gradually cover the entire water sector within the time frame of this policy. This EnMS shall provide a systematic, data-driven and facts-based process, focused on continually improving energy performance in order to ensure effective and measurable results over time. Energy performance is related to energy efficiency, energy use and energy consumption.

The EnMS is based on the Plan-Do-Check-Act (PDCA) continual improvement framework and shall incorporate energy management into existing MWI practices according the following general steps.

Plan: which is the phase of studying the full context, establishing an energy policy and an energy management team, considering actions to address risks and opportunities, conducting energy reviews, identify significant energy uses and establishing energy performance indicators, energy baseline(s), objectives and energy targets, and action plans necessary to deliver results that will improve energy performance in accordance with this policy.

Do: which is to implement the action plans, operational and maintenance controls, and communication, ensure competence and consider energy performance in design and procurement.

Check: which is to monitor, measure, analyze, evaluate, audit and conduct management review(s) of energy performance and the EnMS.

Act: which is to take actions to address nonconformities and continually improve energy performance and the EnMS.

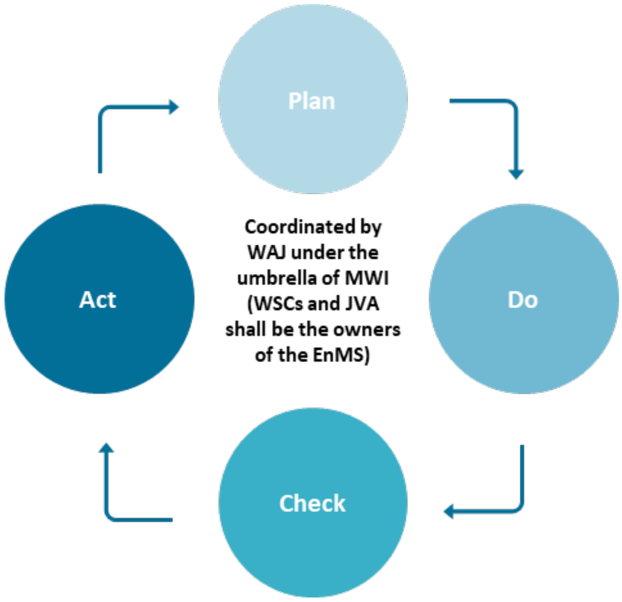


Figure 9 EnMS Plan-Do-Check-Act Cycle

The EnMS is being developed in two phases a pilot scale phase first and a full-scale implementation phase to follow. The pilot scale is already ongoing and it includes specific water assets within Miyahuna, YWC, AWC, WAJ operated areas (Balqa, Karak, Maan, and Tafileh) in addition to JVA. After the pilot scale is completed, full scale implementation shall be developed gradually to cover the complete water sector by 2030.

Goal 4: Enhance Enabling Environment

Table 7 Goal 4 targets and indicators

Goal-4 "Enhance the enabling environment for achieving the goals of this policy"	
Targets	**Indicators**
Target 4.1: Implement a coding system for the water sector to be used in all water sector data collection and reporting activities including energy billing by power companies by the end of 2022 measured by water assets capacity in MCM that are covered by the coding system divided by the total water sector capacity.	*Indicator 4.1.1:* Percentage of water sector capacity that have implemented the coding system (MCM) compared to total water sector capacity (MCM).
Target 4.2: Develop and implement a Water and Energy Data Management System (DMS) for the water sector. The DMS to be developed by 2022 and implemented in 80% of water sector by 2025 measured by water assets capacity in MCM that are covered by the DMS divided by the total water sector capacity in MCM.	*Indicator 4.2.1:* Percentage of water sector that have water metering systems.
	Indicator 4.2.2: Percentage of water sector that has water and energy data available on the predetermined platform in timely manner.
Target 4.3: Develop an energy and GHG emissions balance annual report for the water sector activities starting from 2025 onwards	*Indicator 4.3.1:* Is an annual energy and GHG emissions balance report produced or not?

Target 4.1 - Coding System

The policy of the MWI is to implement a coding system for the Jordanian water sector which has been developed in 2020 after proper consultations with relevant stakeholders. The anticipated benefits of the coding system include:

- Accurately identifying a facility by all parties: departments at WAJ/MWI, the water supply companies, and electricity distribution companies,
- Avoid the duplication/ and multiplication of naming,
- Facilitate the electronic data processing, by providing a common code in all IT systems, databases and software that eases the connection between them,
- Provide a brief description of the facilities, to which utility and operator do they belong,
- Reduce ambiguity, use of a standardized code eliminates the use of alternative descriptions and naming, and
- easily identify the facilities connected to electricity meters, once the code is reflected on the electricity bills.

The code was tailored for the Jordanian water sector and provides a description on group of facility, facility and component level, including:

- The water utility and operator to which it belongs
- The group of facility which it belongs - explained later in this document,
- The type of facility
- And type of component.

The proposed coding system consists of the following elements:

1- Code for Operator [Code_Op]

2- Code for Governorate [Code_Gov]

3- Code for Group of Facility Type [Code_GF]

4- Index of Group of Facility [Index_GF]

5- Code for Facility Type [Code_F]

6- Index of Facility [Index_F]

7- Code for Facility Component Type [Code_FC]

8- Index of Facility Component [Index_FC]

9- Well Code [WC]

Where;

- The five codes (No. 1, 2, 3, 5, 7) consist of a combination of letters as indicated in the tables below.
- The indexes (No. 4, 6, 8) consist of a triple digit number in the range from 000 to 999.
- As Well Code (No. 9) it is proposed to use the same as used by the WAJ Drilling Department.

The proposed Coding system has the following Syntax:

Table 8 Water sector proposed coding system

Facility	Code
For facilities other than wells:	[Code_Op]-[Code_Gov]-[Code_GF]-[Index_GF].[Code_F]-[Index_F].[CodeFC]-[Index_FC]
For wells:	[Code_Op]-[Code_Gov]-[Code_GF]-[Index_GF].[Code_F]-[Index_F].[CodeFC]/[WC]

The defined abbreviation of each of the elements and full details about the coding system are available in GIZ report developed for this purpose by “Increasing Energy Efficiency in the Water Sector (IEE)” project team.

Target 4.2 - Water and Energy Data Management System (DMS)

The policy of MWI shall be to develop a DMS to cover the entire Jordanian water sector within the time frame specified in this policy. Data management has become a critical function for water utilities. It is proposed that DMS shall attempt to provide a strategic solution to support gather, maintain, and analyze data within an integration data management environment. Transform data into useful information and to monitor energy and other performance indicators, optimize operation and decision making to improve energy performance and the use and supply of water resources. The proposed DMS will ensure accomplishing the following key functions.

Technical Functions Related to Data Collection, Storage, Interconnections, and Interoperability

- Water utilities facilities assets data modeling and data granularity management - considering connecting to existing data sources from various companies such as (Miyahuna, Aqaba, Yarmouk, ...etc.).
- Connecting existing and future IT-systems (wherever possible by technology) with existing / already implemented systems such as (SCADA, ERP, Telemetric Database, Billing, Energy Systems).
- Enable interoperability that reach water utilities company's core business systems to work in harmony with GIS, SCADA, technologies and provide corporate-wide, integrated solutions environment.

Analytical Functions Related to Data Categorization, Processing, and Evaluation to Generate Useful Information

- Provide level of data- / information aggregation and user interaction required by the different hierarchies of interest groups.
- Applying the necessary insights and analysis based on the indicators provided by the subject matter experts from water companies and visualize the results through dashboards and widgets within the platform.
- Provide required components that can perfectly disseminate and transfer data to information that can lead for better strategic planning and decision making, in other words the approach will help in moving from numbers read by various indicators to targets and action plans.

Detailed information about the DMS available by GIZ project "Efficient and Effective Energy Management within Jordanian Water Sector, 2021, Final DMS Report".

Target 4.3 - Energy and GHG emissions balance annual report

The policy of MWI is to start issuing a comprehensive annual GHG emissions report starting from the year 2025 after the completion of the DMS. A detailed baseline assessment of a water sector utility's GHG emissions is to be done first to set the starting reference point, against which the water sector can compare reductions from future scenarios and from implemented measures to demonstrate progress towards the goals. The quality and accuracy of the baseline relies on the data available which is why target 4.3 relies on target 4.2 in order to have the necessary data for this emissions balance annual report.

GHGs emitted from the water sector cycle include mainly CO_2, CH_4, and N_2O which when compared with respect to global warming potentials over the 100-year horizon, CO_2 accounts for the majority of the overall GHG emissions. However, CH_4 and N_2O also contribute significantly due to their high GWP of 34 and 298 CO_2-equivalents respectively (IPCC, 2014). The pathways of GHG emissions in the urban water cycle can be divided into energy-related and non-energy-related sources.

Energy Related Emissions

Energy consumption is a significant source of GHG emissions in the water sector. Energy is necessary for WSCs to empower their facilities, especially for pumping and treatment. The associated fossil fuel combustion results in indirect and direct emissions of GHGs, mainly CO_2, depending on whether the energy is transmitted from the public electricity grid or generated by on-site engines. Also, water distribution and wastewater disposal that take place by truck transport where pipelines and drainage networks are not available, emissions are released through fossil fuel combustion of these vehicles. In cases where the distribution and discharge are accomplished via gravity, no energy is needed.

Non-Energy Related Emissions

Non-energy related emissions are primarily CH_4 and N_2O, which are produced during the collection, treatment and discharge of wastewater. In wastewater treatment plants (WWTPs), methane is emitted as a result of anaerobic decomposition of organic matter. One of the main treatment processes that could be emitting CH_4 is the anaerobic digestion of sludge. To reduce this impact, emitted CH_4 should be captured and burnt preferably to recover energy but as a minimum to be flared. N_2O emissions are associated with the biodegradation of nitrogen components through microbial processes such as nitrification and denitrification, which take place in sewers and treatment plants as well as in discharged effluents that still contain Nitrogen compounds.

Opportunities to be Optimized Through Water – Energy Nexus

Water and Energy sectors have very strong dependencies between them and this topic has been gaining more and more attention all around the world in recent years and is referred to as Water-Energy Nexus. This is a very critical topic in Jordan as both Energy and Water sectors face major challenges that are getting more and more difficult with time. Solving issues of one sector should not negatively influence the other. Therefore, synergy and wholistic approach in developing these two sectors are favorable and this is what Water-Energy Nexus calls for. The water sector uses energy for collecting, pumping, treating, and desalinizing of water but also the energy sector requires water for cooling thermal power plants, and generating electricity in hydropower plants. The main aspects of the water-energy nexus dialogue which is taking place in Jordan include, but not limited to:

Optimizing the Energy Tariff for Water Sector

The basis for the electricity tariff for the water sector is not clear and has been changing with time significantly as can be seen in Figure 10. In late 2019, it was determined that the electricity tariff for the Water Sector shall be reduced by ten (10) Fills per kWh to take effect from the beginning of the year 2020 on condition of canceling some planned solar power projects which is really not a sustainable way of managing the situation. Through Nexus platform, the tariff should be carefully evaluated in order to support the severely stressed water sector and try to reduce it as much as possible. The tariff adjustment discussion should include management aspects that can support reducing the tariff such as use of pumped storage, load management projects, and time of use tariff structuring systems, etc.

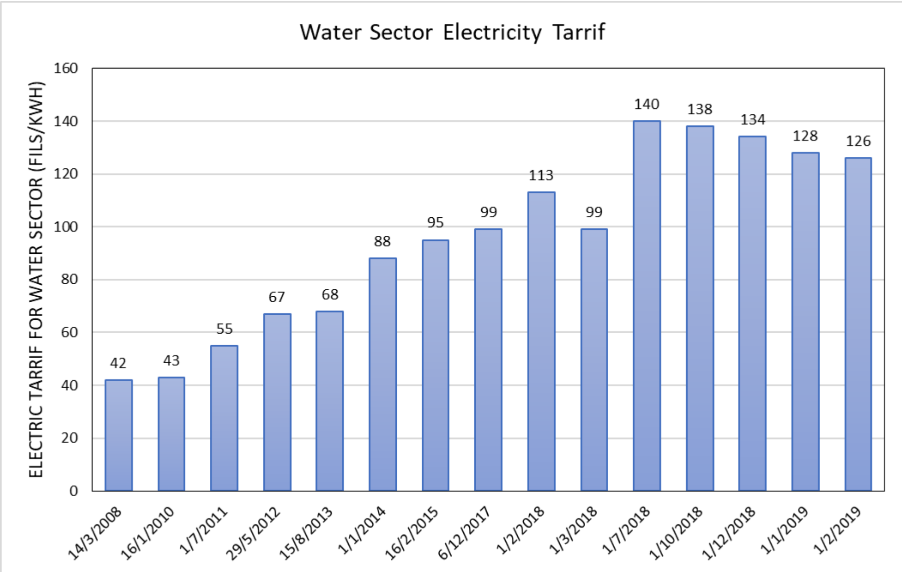


Figure 10 Electric tariff for the Water Sector (Source: MWI's Energy Unit, 2020)

Increasing Renewable Energy Projects

Due to the current energy policy in Jordan the Water Sector is allowed to develop RE projects of one (1) MWp capacity or less as per Cabinet Resolution no (2714) dated 9/1/2019.

As long as the relevant laws and regulations allow developing and implementing RE projects with the capacity of one (1) MWp or less, MWI can utilize such potential subject to the

Jordanian Electrical System requirements. The nexus platform should be used to make it easier for the water sector to expand its renewable energy projects and to even get special permission to develop large scale renewable energy projects (> 1 MWh AC generation capacity) as well. Also, some other energy related initiatives that can be developed through Nexus platform include:

- Development of the business models and complete feasibility study for the pumped storage initiatives.
- Development of load management model, assess the techno-economic feasibility, and study the institutional requirements.
- Study the possibility to use amounts of surplus RE energy in the energy sector for the existing and new loads in the water sector.

Exploring Renewable Energy Powered Desalination Projects

As mentioned earlier, a very important future water resource in Jordan and in the world, is water desalination. This type of technology is energy demanding as it relies on high pressure pumping. For its high energy demand, it is really preferable to develop it using renewable energy because without renewable energy, water desalination projects can significantly increase the price of water due to the high energy consumption and cost. The main water desalination project in Jordan is the Aqaba Amman National Conveyer in addition to smaller projects for Wells with brackish water which are expected to be developed in the coming 5 years.

Impact of Climate Change on the Water Sector and Impact of Water Sector on Climate Change

In this section, two topics shall be covered related to climate change which are impacts of climate change on the water sector and how to adopt to those impacts and the impacts of the water sector on climate change and how to measure and control those impacts.

Impact of Climate Change on the Water Sector

The most important potential impacts of climate change on the water sector are the reduced precipitation, increased temperature, and increase in droughts or dry days[4]. These impacts would decrease recharge and therefore less replenishment of surface water and groundwater reserves, which will result in a decline in the quality and quantity of surface and ground water resources. The increase in the potential evaporation will apply further stress on the availability and distribution of the water resources in Jordan. Therefore, adaptation strategies are proposed such as storm water harvesting on the level of homes, institutions, and districts, water efficiency, and wastewater treatment and reuse. In addition to most importantly, strengthening the current water treatment infrastructure, controlling lost water through leaks, and developing new water sources such as desalination of seawater in order to have a resilient water sector that can adapt to climate change impacts.

Impact of the Water Sector on Climate Change

Energy for water supply operations is provided by the national power companies and, until now, the water sector institutions have not been allowed to operate on-grid solutions for generating and feeding in renewable energy that exceeds 1 MW. This limits what the water sector institutions can do to reduce their carbon foot print and save energy mainly to energy efficiency measures.

Electrical power generation in Jordan relies predominantly on fossil fuels with significant impact on the environment through harmful greenhouse gases (GHG) such as CO_2 and NO_x. Percentage of oil, gas, coal, and oil shale, in the energy mix for 2019 was about 89% with 11% renewable energy.

The total electricity consumption for water supply in the year 2019 amounted to about 1,654 GWh as reported in subsequent sections. Using an emissions factor of 0.588 tCO_2/MWh yields a total carbon foot print of 972,600 ton of CO_2 equivalence for the water supply in 2019 which is the baseline for this policy.

[4] The National Climate Change Adaptation Plan of Jordan, MoENV, 2021.

Monitoring and Evaluation

For each Indicator, a baseline value from the year 2019, planned level of improvement up to the years 2025, and up to 2030 are presented in this section. The MWI shall monitor the progress of the indicators using the following sheets on yearly basis to follow up on progress and to ensure corrective action is made when progress is under the planned levels.

Goal-1 "Achieve improved levels of energy efficiency in water supply and wastewater treatment activities."														
Targets	**Indicators**	**2019 Baseline**	**2025 planed target**	**2030 planed target**	**2021 progress**	**2022 progress**	**2023 progress**	**2024 progress**	**2025 progress**	**2026 progress**	**2027 progress**	**2028 progress**	**2029 progress**	**2030 progress**
Target 1.1: Increase energy efficiency by 15% in water supply and wastewater treatment activities by the year 2025 based on 2019 MWI energy consumption baseline.	*Indicator 1.1.1:* kWh/m^3 of water supplied (billed)	6.6 kWh/m^3	5.61 kWh/m^3	NA										
	Indicator 1.1.2: kWh/m^3 of water produced	3.4 kWh/m^3	2.9 kWh/m^3	NA										
Target 1.2.a: Develop an optimized target that reflects the full actual potential of energy efficiency in water supply based on a normalized energy model approach to be utilized for the period 2025 to 2030.	*Indicator 1.2.1.a:* New target for energy efficiency in water supply developed (yes or no)	NA	New Baseline based on actual progress	New optimized target based on a normalized model										
Target 1.2.b: Develop an optimized target that reflects the full actual potential of energy efficiency in wastewater management and treatment based on a normalized energy model approach to be utilized for the period 2025 to 2030	*Indicator 1.2.1.b:* New target for energy efficiency in wastewater treatment developed (yes or no)	NA	New Baseline based on actual progress	New optimized target based on a normalized model										

Goal-2 "Increase the use of renewable energy in all water sector activities"														
Targets	**Indicators**	**2019 Baseline**	**2025 planed target**	**2030 planed target**	**2021 progress**	**2022 progress**	**2023 progress**	**2024 progress**	**2025 progress**	**2026 progress**	**2027 progress**	**2028 progress**	**2029 progress**	**2030 progress**
Target 2.1: Develop large (> 1 MW) and small scale (< 1 MW) renewable energy projects in collaboration with the Ministry of Energy and Mineral Resources to cover 20% of the 2019 MWI energy consumption baseline (10% by the year 2025 and 20% by the year 2030).	*Indicator 2.1.1*: GWh generated from renewable energy projects	1,654 GWh	165 GWh which requires 70 MW plants	330 GWh which requires 140 MW plants										
Target 2.2: Perform feasibility studies by 2025 and implement renewable energy powered desalination plants for seawater by 2030 on 25% of the total water supply based on 2019 baseline.	*Indicator 2.2.1:* Water supply projects capacity covered by feasibility studies (m^3 of water)	485 MCM	121 MCM	NA										
	Indicator 2.2.2: Water supply capacity produced by renewable energy powered desalination plants (m^3 of water) by 2030	485 MCM	NA	121 MCM										

Goal-3 "Implement energy management Systems to gradually cover the entire water sector activities"														
Targets	**Indicators**	**2019 Baseline**	**2025 planed target**	**2030 planed target**	**2021 progress**	**2022 progress**	**2023 progress**	**2024 progress**	**2025 progress**	**2026 progress**	**2027 progress**	**2028 progress**	**2029 progress**	**2030 progress**
Target 3.1: Implement an Energy Management System to cover 60% of the water sector in Jordan by the year 2025 and 100% by the year 2030 measured by kWh consumed by water sector activities covered by EnMS.	*Indicator 3.1.1:* kWh consumed by water assets that are included within the scopes and boundaries of the EnMS divided by the total amount of electricity consumed by the Jordan water sector, based on the electrical consumption of 2019.	1,654 GWh	994 GWh	1,654 GWh										

Goal-4 "Enhance the enabling environment for achieving the goals of this policy"														
Targets	**Indicators**	**2019 Baseline**	**2025 planed**	**2030 planed**	**2021 progress**	**2022 progress**	**2023 progress**	**2024 progress**	**2025 progress**	**2026 progress**	**2027 progress**	**2028 progress**	**2029 progress**	**2030 progress**
Target 4.1: Implement a coding system for the water sector to be used in all water sector data collection and reporting activities including energy billing by power companies by the end of 2022 measured by water assets capacity in MCM that are covered by the coding system divided by the total water sector capacity.	*Indicator 4.1.1:* Percentage of water sector capacity that have implemented the coding system (MCM) compared to total water sector capacity (MCM).	485 MCM	485 MCM	485 MCM										
Target 4.2: Develop and implement a Water and Energy Data Management System (DMS) for the water sector. The DMS to be developed by 2022 and implemented in 80% of water sector by 2025 measured by water assets capacity in MCM that are covered by the DMS divided by the total water sector capacity in MCM.	*Indicator 4.2.1:* Percentage of water sector that have water metering systems.	485 MCM	388 MCM	485 MCM										
	Indicator 4.2.2: Percentage of water sector that has water and energy data available on the predetermined platform in timely manner.	485 MCM	388 MCM	485 MCM										
Target 4.3: Develop an energy and GHG emissions balance annual report for the water sector activities starting from 2025 onwards	*Indicator 4.3.1:* Is an annual energy and GHG emissions balance report produced or not?	485 MCM	NA	485 MCM										