المبادرة العربية للتعريف بالهيدروجين الأخضر والمشروعات الخضراء

الراعي الذهبي

جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي

خلال الفترة من ٠١ يوليو حتى ٣٠ اكتوبر ٢٠٢٤

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تحديات ترابط المياه – الغذاء – الطاقة

مقدمة من
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مدرس بجامعة بدر بالقاهرة

تنظمها جمعية عين البيئة بمصر، بالتعاون مع شبكة بيئة أبوظبي بالإمارات، ومؤسسة مستقبل أخضر مستدام باليمن، وشركة (ODS) لخدمات الأعمال الرقمية بمصر، من ٠١ يوليو حتى ٣٠ أكتوبر ٢٠٢٤

شريك تنظيمي

الراعي الذهبي

WATER-ENERGY-FOOD NEXUS CHALLENGES

Presented by
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Assistant Professor – Badr University in Cairo (BUC)

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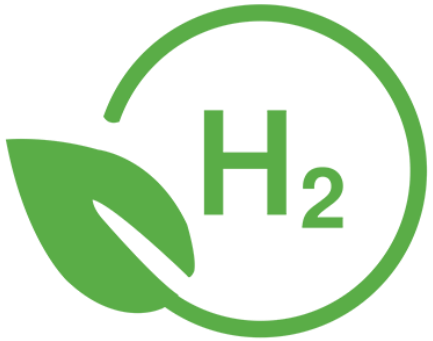
INTRODUCTION

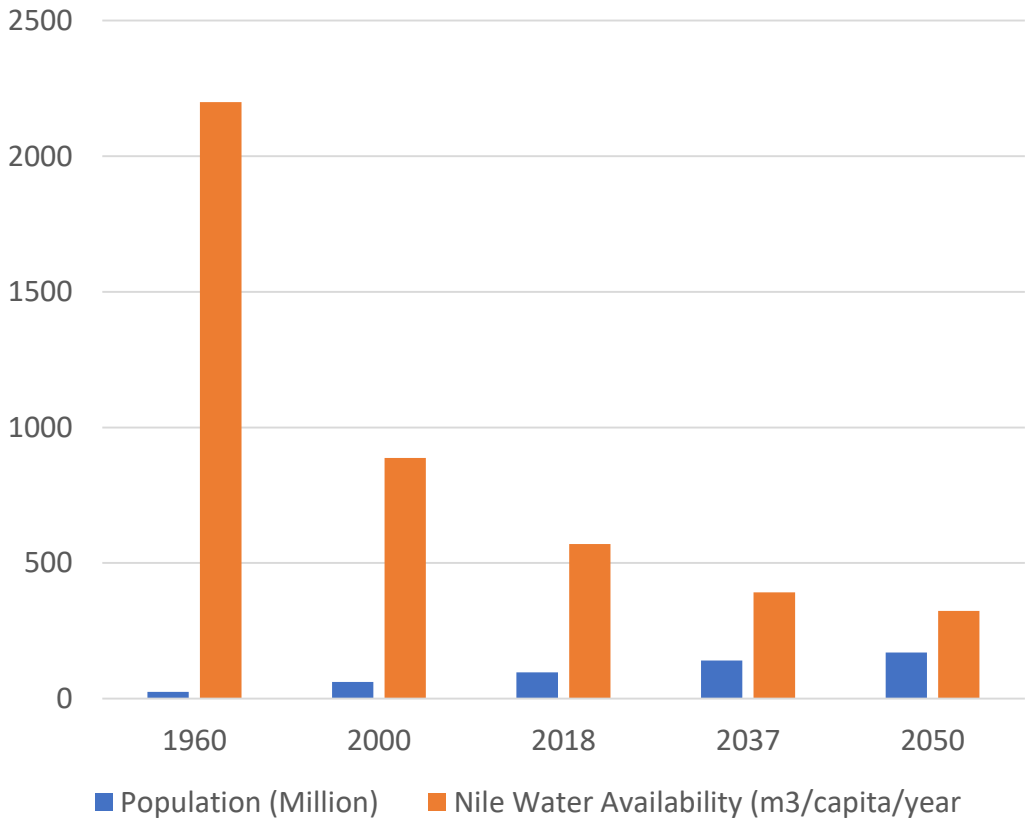
- 2011
  - ✓ The WEF published a report titled "Water, Energy, Food: The Nexus Challenge" that introduced the concept of the Nexus and highlighted the importance of integrated management of these resources.
- 2013
  - ✓ The WEF launched the Water, Energy, Food Nexus Initiative to promote the adoption and implementation of the Nexus concept globally.
- 2014
  - ✓ The WEF held its first Global Nexus Summit in Davos, Switzerland, which brought together policymakers, business leaders, and experts from around the world to discuss the challenges and opportunities related to the Nexus.

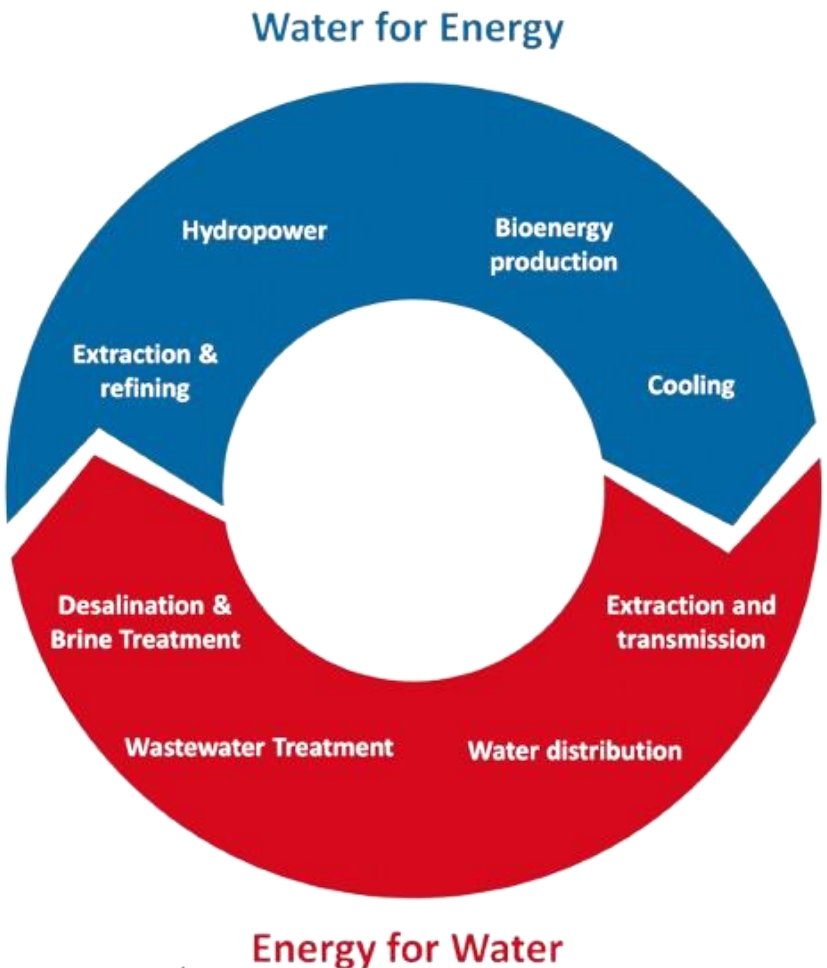
- 2015
  - ✓ The WEF published a report titled "Water, Energy, Food: A Nexus Approach to Sustainable Development" that provided a more comprehensive overview of the Nexus concept and its implications for sustainable development.
- 2016
  - ✓ The WEF launched the Nexus Platform, an online platform that provides information and resources related to the Nexus concept.
- 2018
  - ✓ The WEF published a report titled "Water, Energy, Food: A Nexus Approach to Resilient Development" that focused on the role of the Nexus in building resilience to climate change and other global challenges.



WATER IN NEXUS

Water in nexus





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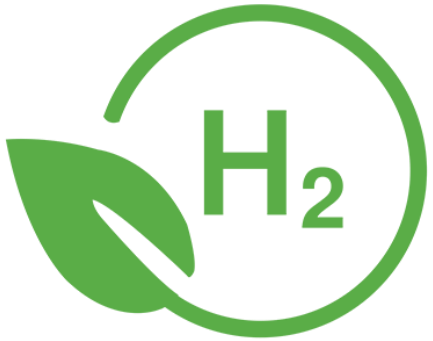
- Water in nexus
  - ✓ Earth's oceans, which make up 96.5 % of the total water reserve, are its largest water storage area.
  - ✓ 3.44 % of the overall water reserved is represented by the permanent snow covers and groundwater, which are essential freshwater sources.

WATER CHALLENGES IN THE MENA REGION

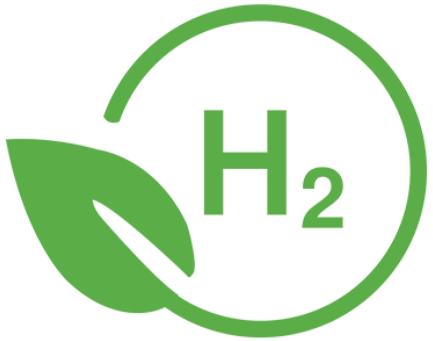
- Scarcity
  - ✓ The MENA region is the world's most water-scarce region, with many countries receiving less than 500 cubic meters of water per person per year. This is far below the global average of 1,000 cubic meters per person per year.
- Inequality
  - ✓ Water is not distributed equally within the MENA region. Some countries, such as Lebanon, have relatively abundant water resources, while others, such as Yemen and Somalia, face severe water shortages.

- **Pollution**
  - ✓ Water pollution is a major problem in the MENA region, due to factors such as industrial waste, agricultural runoff, and sewage. This pollution can make water unsafe to drink and can harm aquatic ecosystems.
- **Climate change**
  - ✓ Climate change is exacerbating the water crisis in the MENA region by causing more frequent and severe droughts. This is reducing the availability of water resources and increasing the demand for water.



WATER CHALLENGES IN EGYPT

- Egypt now has an annual water deficit of almost 7 billion cubic meters.
- The nation may run out of water by 2025, as it predicted that 1.8 billion people would live in absolute water scarcity worldwide.
- Children are less resilient to tolerate shocks like heat waves and droughts, They are also more susceptible to toxins physiologically.
- Children are more vulnerable than adults to lead and other types of pollution that may be present in untreated water.



ENERGY IN NEXUS

Energy's sources

Fossil fuel

Nuclear

Renewable Sources

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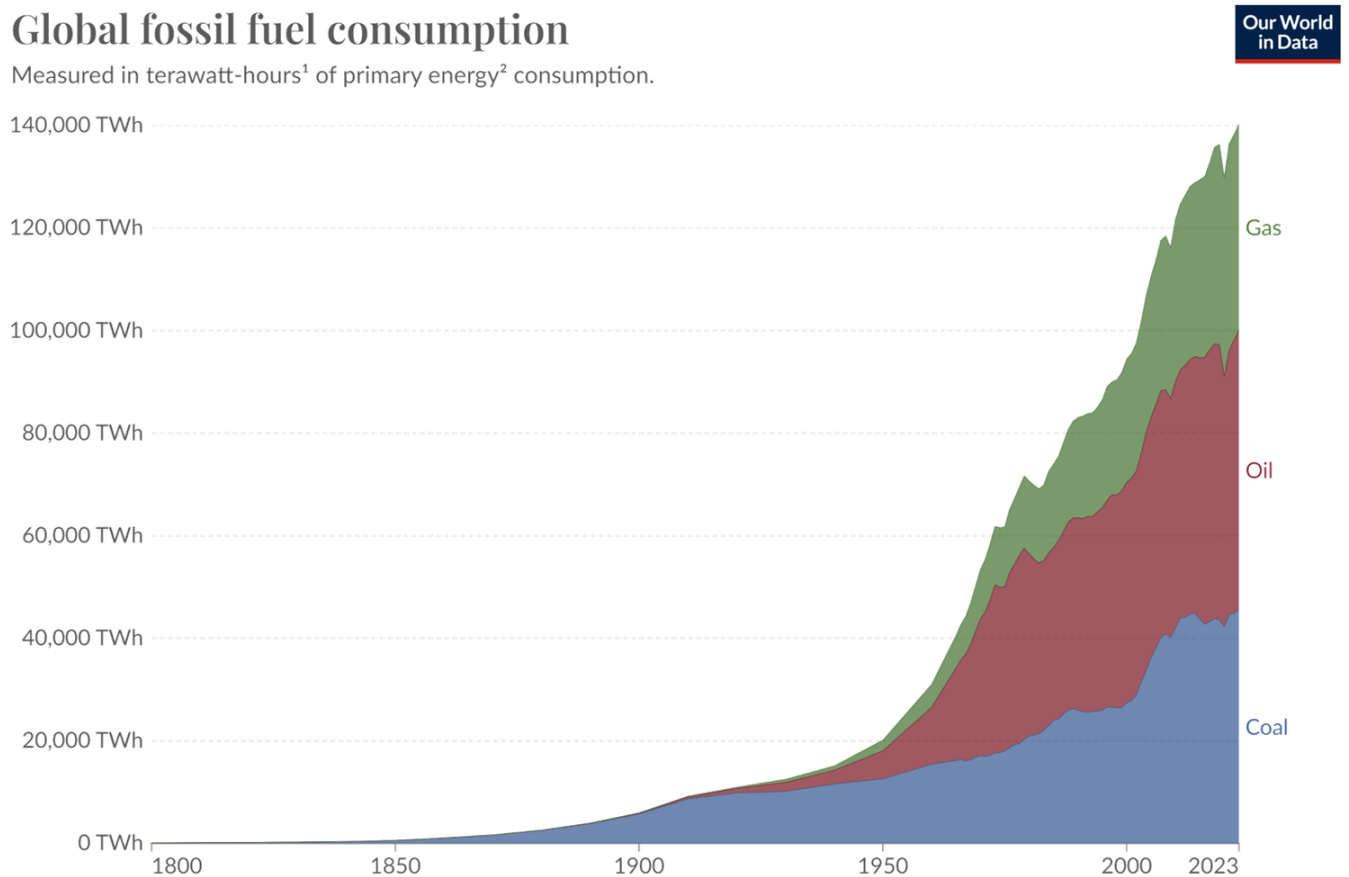
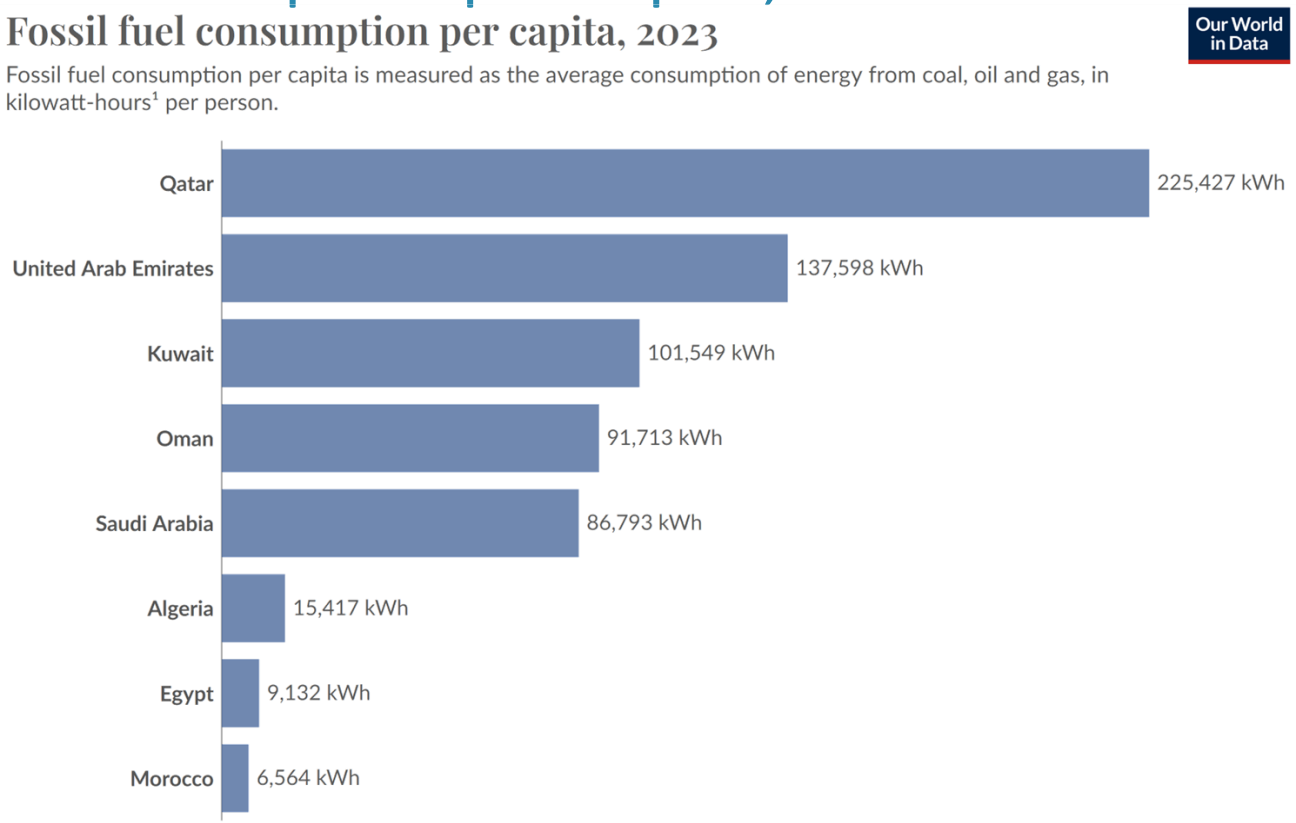
- Fossil fuels
  - ✓ Coal, oil, and gas are non-renewable resources that take hundreds of millions of years to form. Fossil fuels, when burned to produce energy, cause greenhouse gas emissions, such as carbon dioxide. Now using renewable energy creates lower emissions than burning fossil fuels.

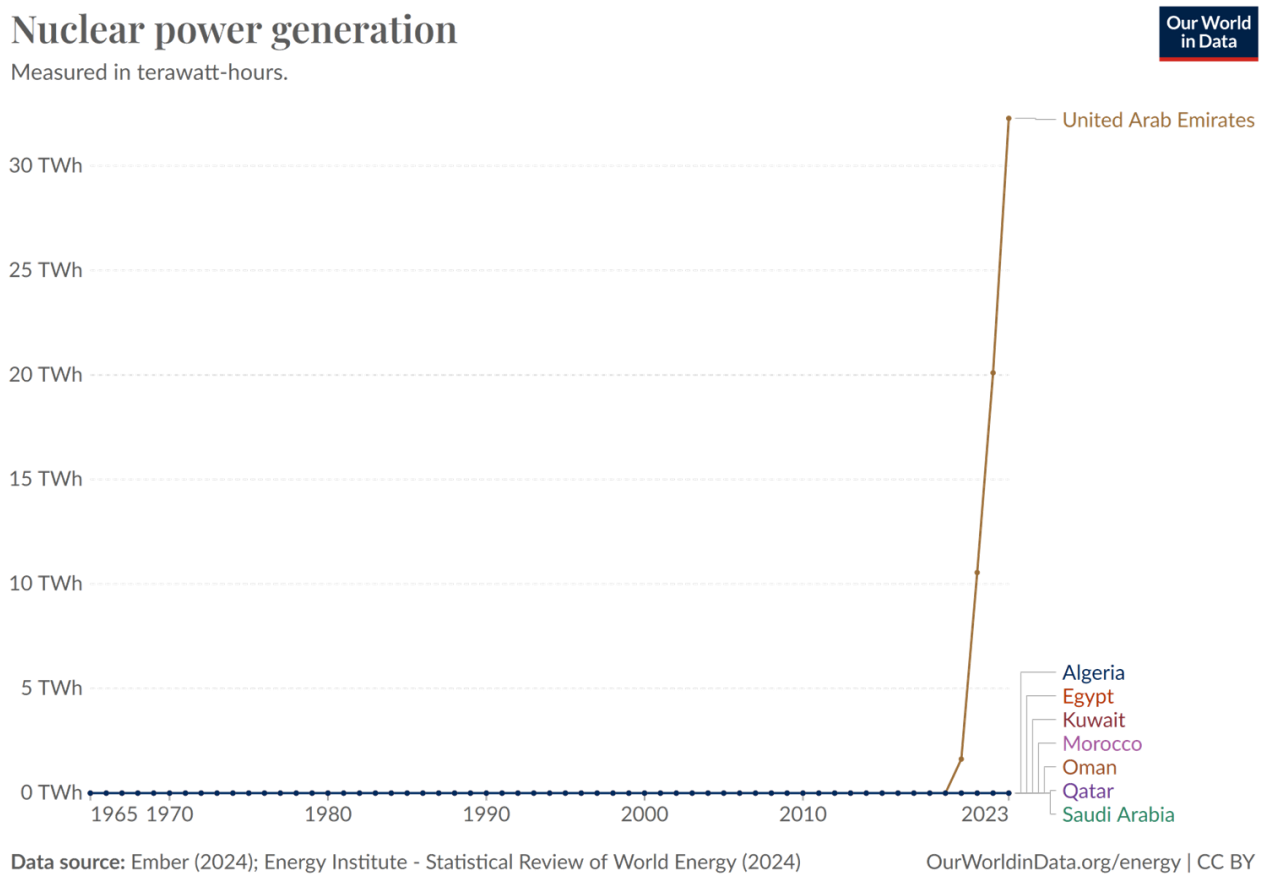
Global fossil fuel consumption



Fossil fuel consumption per capita, 2023

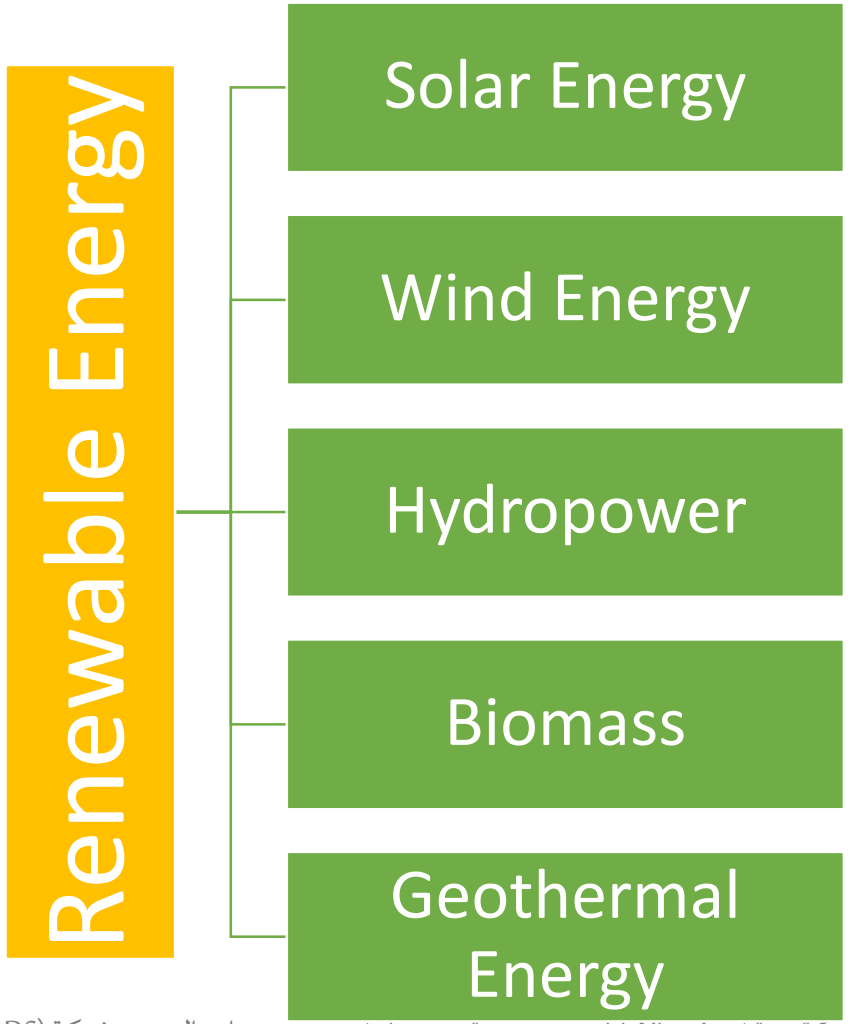


Nuclear power generation

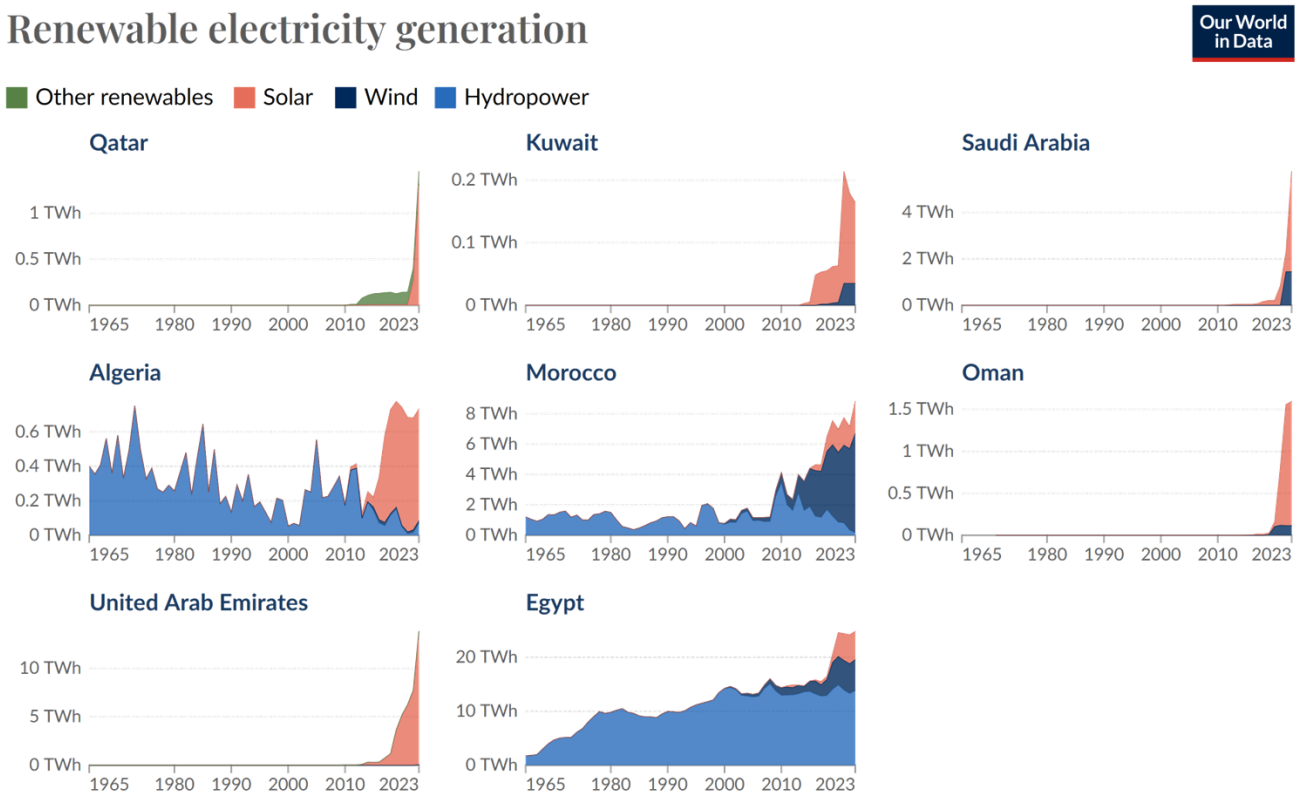


- Renewable Energy
  - ✓ Energy taken from natural sources that regenerate itself at a rate higher than it consumes.
  - ✓ It is still costly although they are all around us.

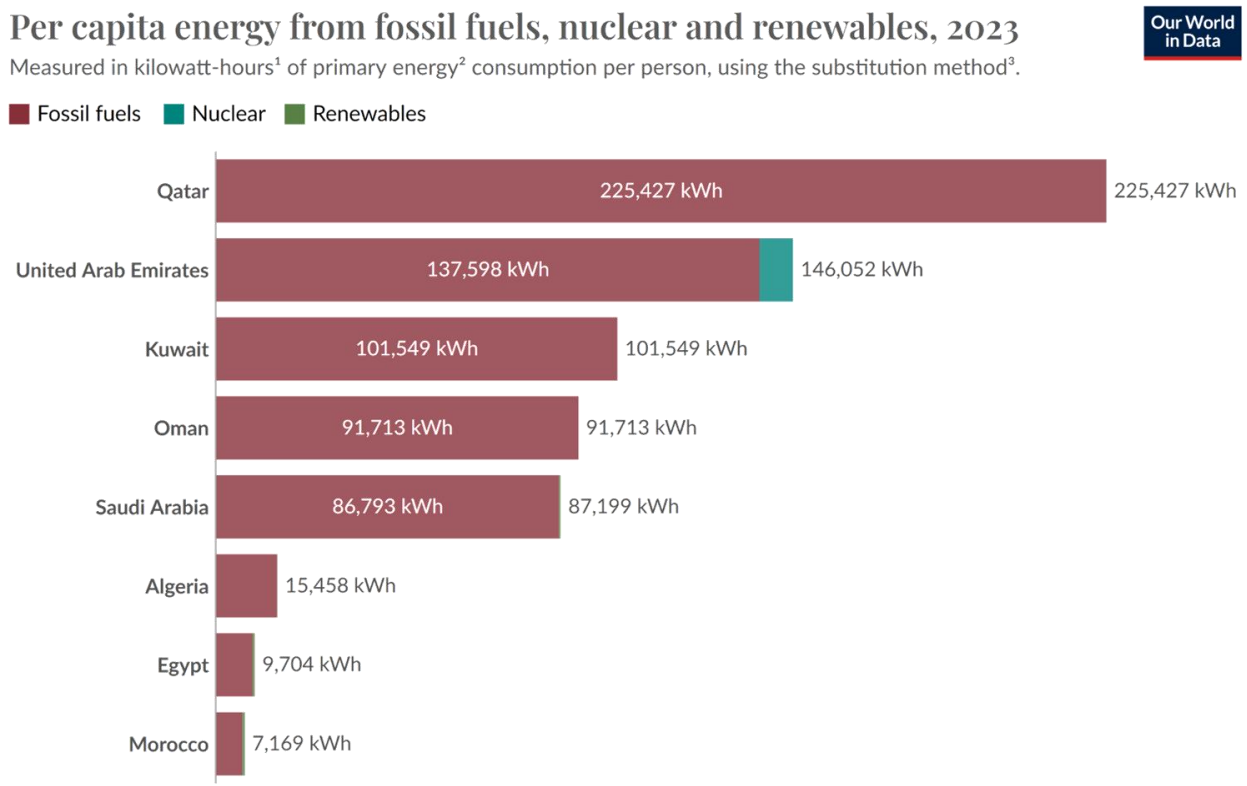
- Renewable Energy



Renewable electricity generation



Energy 2023 Per capita



ENERGY CHALLENGES IN THE MENA REGION

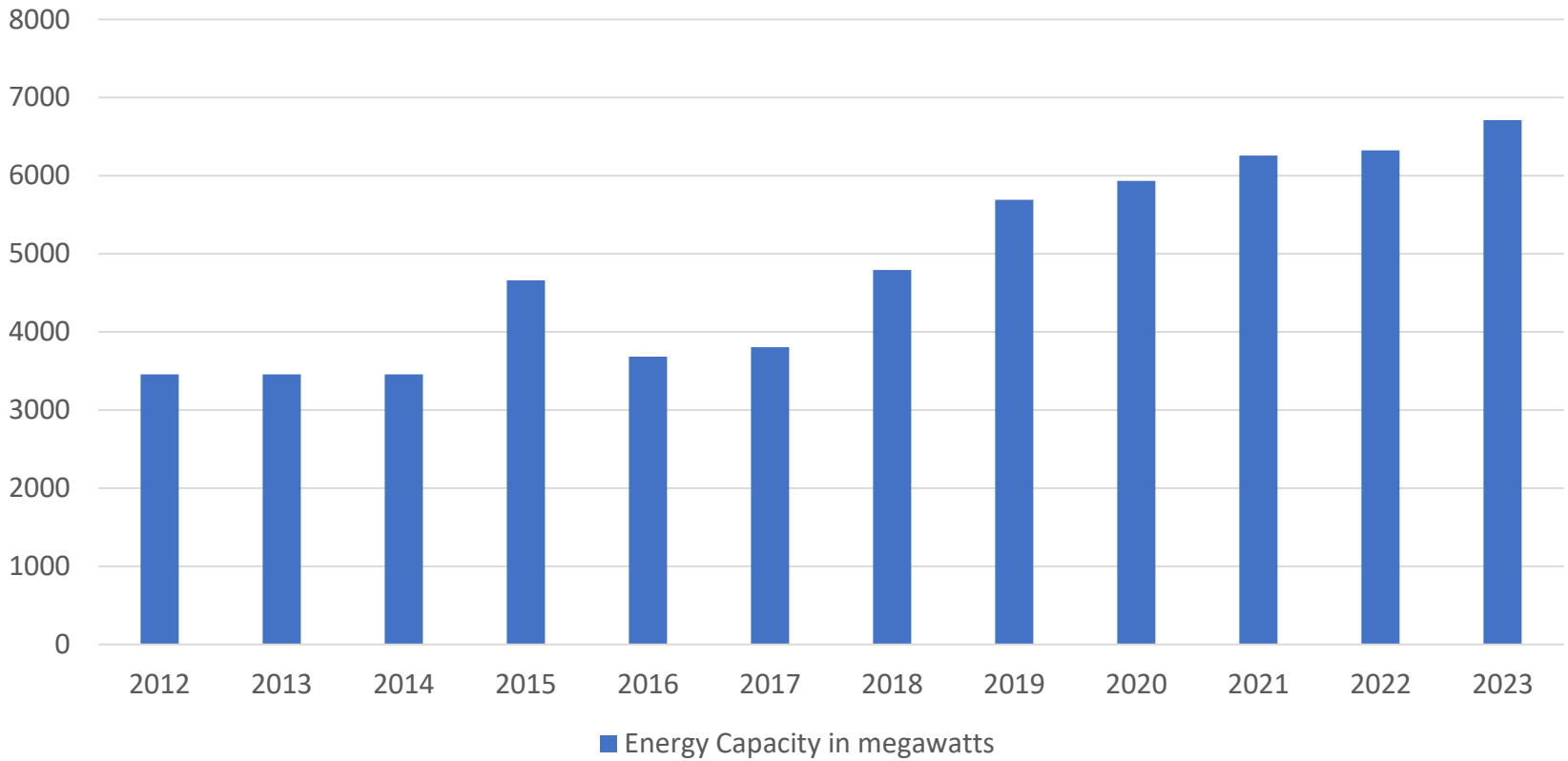
- Dependence on fossil fuels
  - ✓ The MENA region is heavily reliant on fossil fuels, particularly oil and natural gas, to meet its energy needs.
- Growing energy demand
  - ✓ The MENA region's population is growing rapidly, and its economies are becoming more industrialized. This is leading to a growing demand for energy, which is putting a strain on existing energy resources.

Climate change

- ✓ Climate change is exacerbating the energy challenges in the MENA region. It is causing more frequent and severe droughts and heat waves, which can reduce the availability of hydropower.
- ✓ It is also increasing the demand for energy for cooling, which can put a strain on electricity grids.
- ✓ The reliance on oil and gas is also a key producer of green house emissions.

ENERGY CHALLENGES IN EGYPT

Total renewable energy capacity in Egypt from 2012 to 2023



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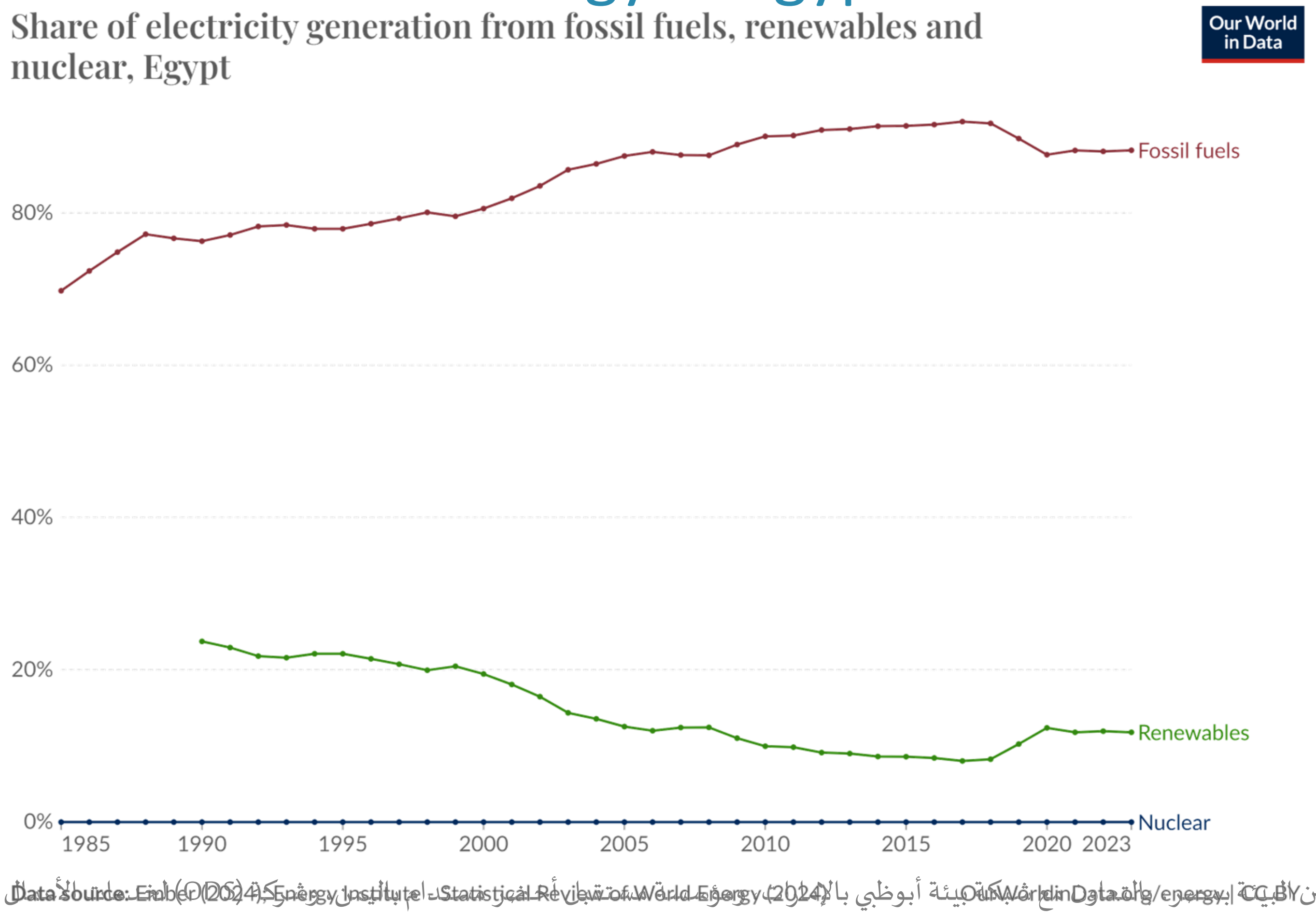
➢ Electricity generation from energy in Egypt



ODS DIGITAL BUSINESS SERVICES

Sustainable Green Future Foundation
مؤسسة مستقبل أخضر مستدام
شريك تنظيمي

جائزة خليفة الدولية لنخيل التمر والابتكار الزراعي
KHALIFA INTERNATIONAL AWARD FOR DATE PALM AND AGRICULTURAL INNOVATION
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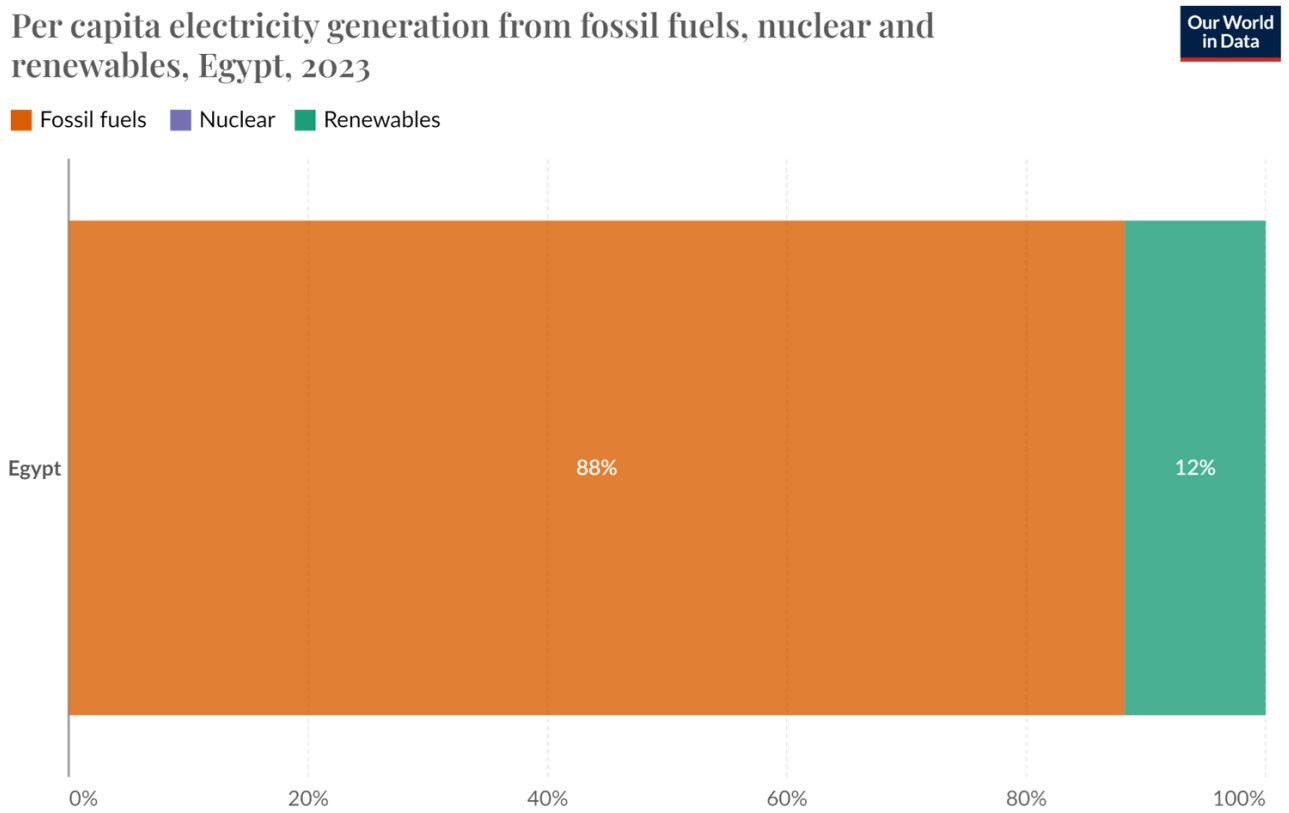
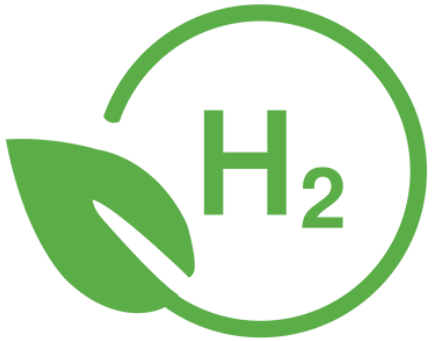
Electricity generation from energy in Egypt Per capita



Dependence on Fossil Fuels

- ✓ Natural gas
  - ❑ Egypt has made significant strides in natural gas production, but it remains heavily reliant on this fossil fuel for power generation.
- ✓ Oil
  - ❑ While oil production has declined in recent years, it still plays a role in Egypt's energy mix.
- ✓ Vulnerability to global prices
  - ❑ Egypt's reliance on fossil fuels makes it vulnerable to fluctuations in global energy markets.

- Environmental Concerns
  - ✓ Air pollution
    - ❑ The burning of fossil fuels contributes to air pollution, particularly in urban areas.
  - ✓ Climate change
    - ❑ Egypt is susceptible to the impacts of climate change, such as rising sea levels and changes in agricultural patterns, which can affect energy demand and supply.



FOOD IN NEXUS

- Food in nexus
  - ✓ Agriculture is a major consumer of water, and inefficient irrigation practices can exacerbate water scarcity.
  - ✓ Modern agriculture relies heavily on energy-intensive processes like fertilizer production, machinery, and food processing.
  - ✓ The transportation and storage of food products require significant energy inputs.
  - ✓ Climate change can exacerbate land degradation through increased erosion, salinization, and desertification.

FOOD CHALLENGES IN MENA REGION

Food challenges in MENA region

- ✓ Although agriculture plays a pivotal role in many of the MENA economies, it faces challenges such as limited water resources, climate change, and political conflicts.
  - ❑ According to the World Bank, MENA has the lowest per capita water availability globally.
  - ❑ Over 80% of the countries in the MENA region depend on imported food, making them particularly vulnerable to climate change, which directly threatens food access and stability through reduced agricultural productivity and increased price volatility. In response to these challenges, it is crucial to develop long-term drought management and climate change adaptation strategies.
- ✓ A lack of stable food production can lead to price increases and market instability, threatening food access for the region's poorest inhabitants.

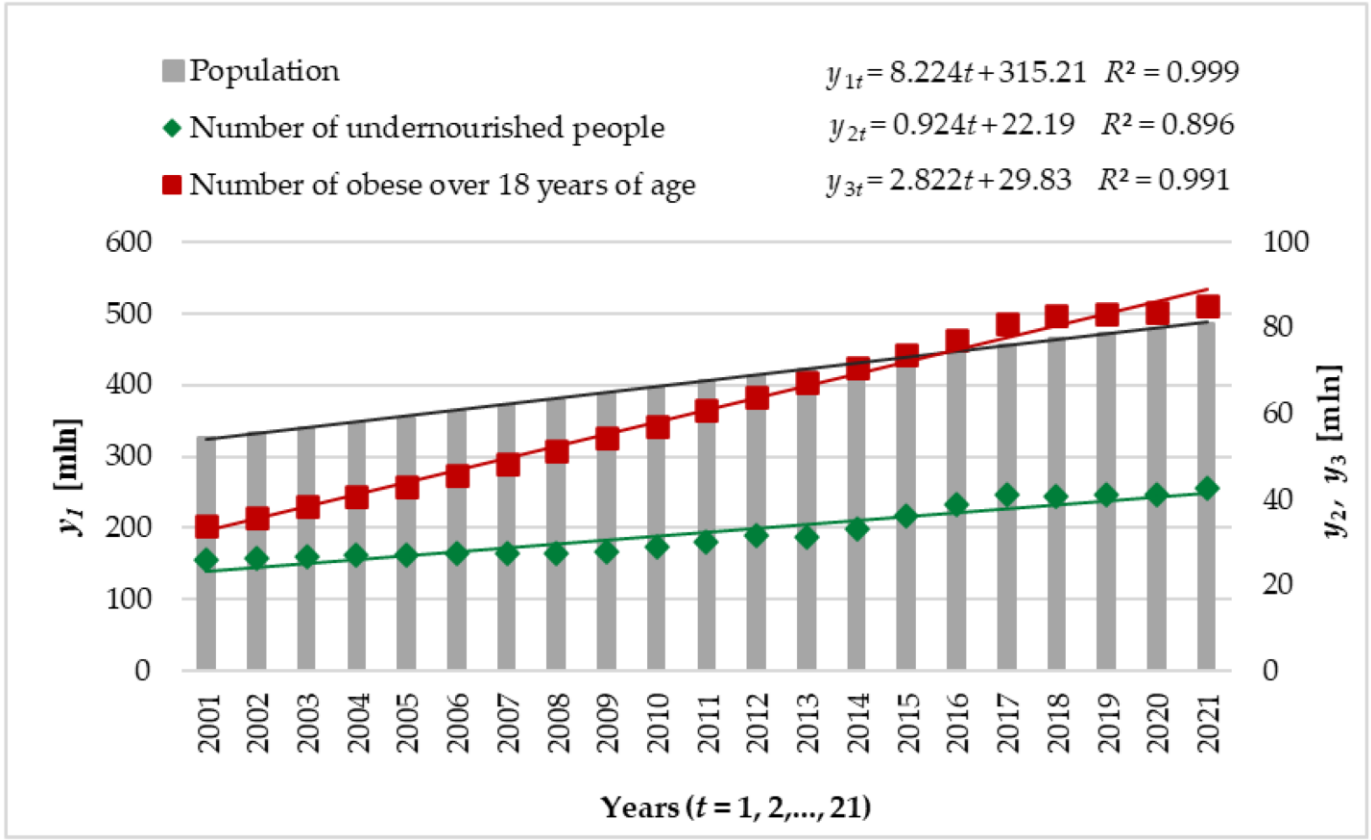
Food challenges in MENA region

- ✓ The Syrian conflict, beginning in 2011, which led to massive population displacement and infrastructure destruction, significantly hindering food production and distribution. By 2020, over 9.3 million people in Syria were suffering from food insecurity.
- ✓ The conflict in Yemen, which has led to the world's most significant food crisis, with nearly 17 million people suffering from food insecurity as of 2017.
- ✓ The prolonged Israeli–Palestinian conflict, which has impacted Palestinian food security in various ways, including restrictions on access to agricultural lands and difficulties in importing and exporting goods.

Food challenges in MENA region

✓ Map of Food Insecurity in MENA

Food challenges in MENA region



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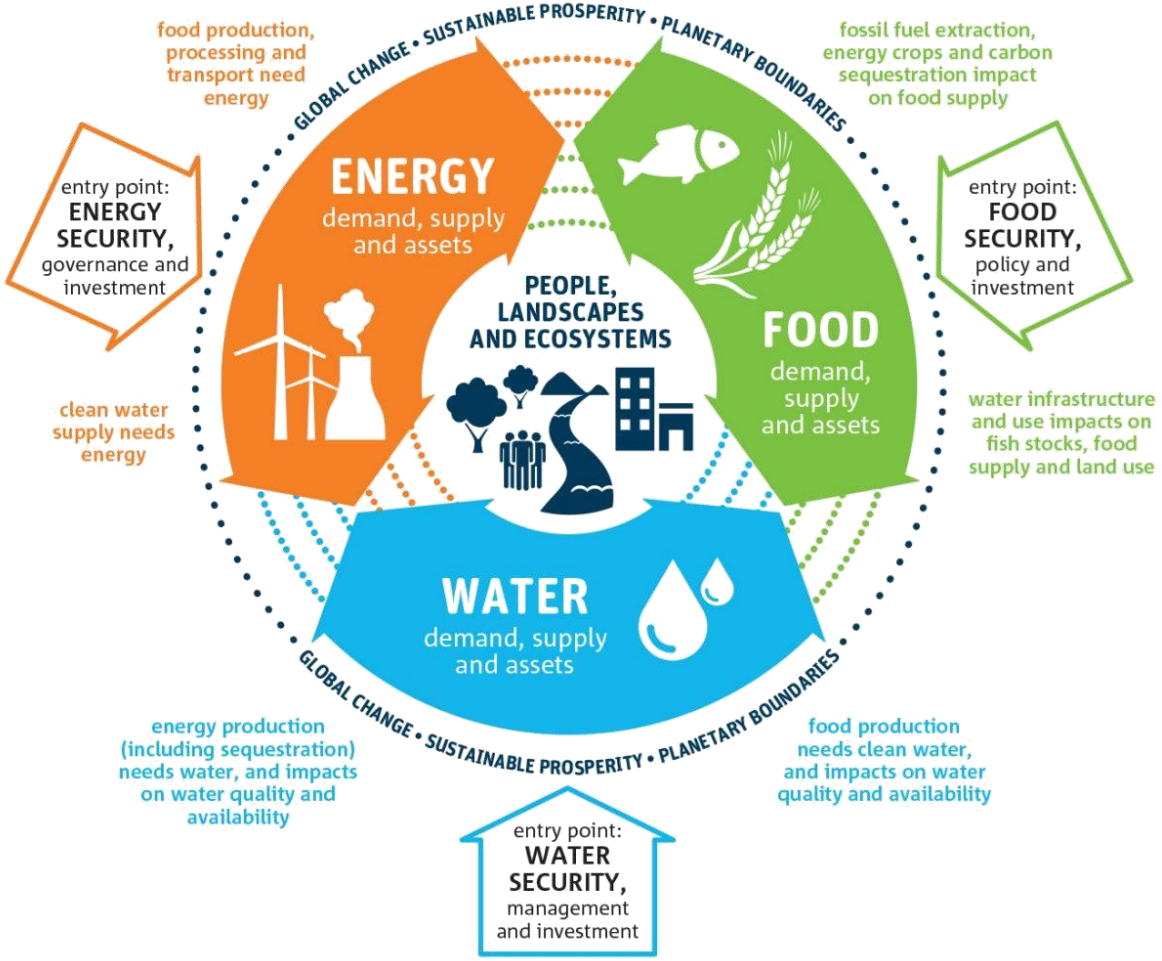
FOOD CHALLENGES IN EGYPT

Food challenges in egypt

- ✓ climatic changes, represented by higher temperatures and direct heat stress, and lower rainfall and increased water needs, bring harsher conditions for food production, particularly in the Nile Delta region where up to 60% of food is produced in Egypt.
- ✓ Recent projections show, for example, by 2050 climate change will significantly reduce crop yields, leading to about 6% decrease in total food production in Egypt, about 15 % decrease in wheat production, 22 % decrease in maize production, and around 24 % in pulses production.

WATER-ENERGY-FOOD NEXUS



- Sustainable Water
  - ✓ Access to water resources for different uses
  - ✓ Sustainable use and management of water resources
  - ✓ Resilient societies and ecosystems to water-related disasters
- Sustainable Energy
  - ✓ Access to modern energy services
  - ✓ Efficient use of energy
  - ✓ The energy produced and consumed is clean/renewable

- Food security
  - ✓ Food Availability
  - ✓ Food Access
  - ✓ Food Utilization & Nutrition
  - ✓ Stability of Food Prices and Supply

- Nexus examples
  - ✓ Green Belt of Algiers —Algeria
  - ✓ Al Khafji Solar PV-SWRO Desalination Plant—KSA
  - ✓ Seawater Greenhouse—Qatar
  - ✓ Kenana Sugar Company—Sudan

CASE STUDY:1 IN THE RABIA REGION LOCATED AT MATROUH GOVERNORATE

- The Rabia community lacks any source of water services and is not connected to the electric grid.
- It depends on existing wells that harvest rainwater for potable and non-potable purposes.

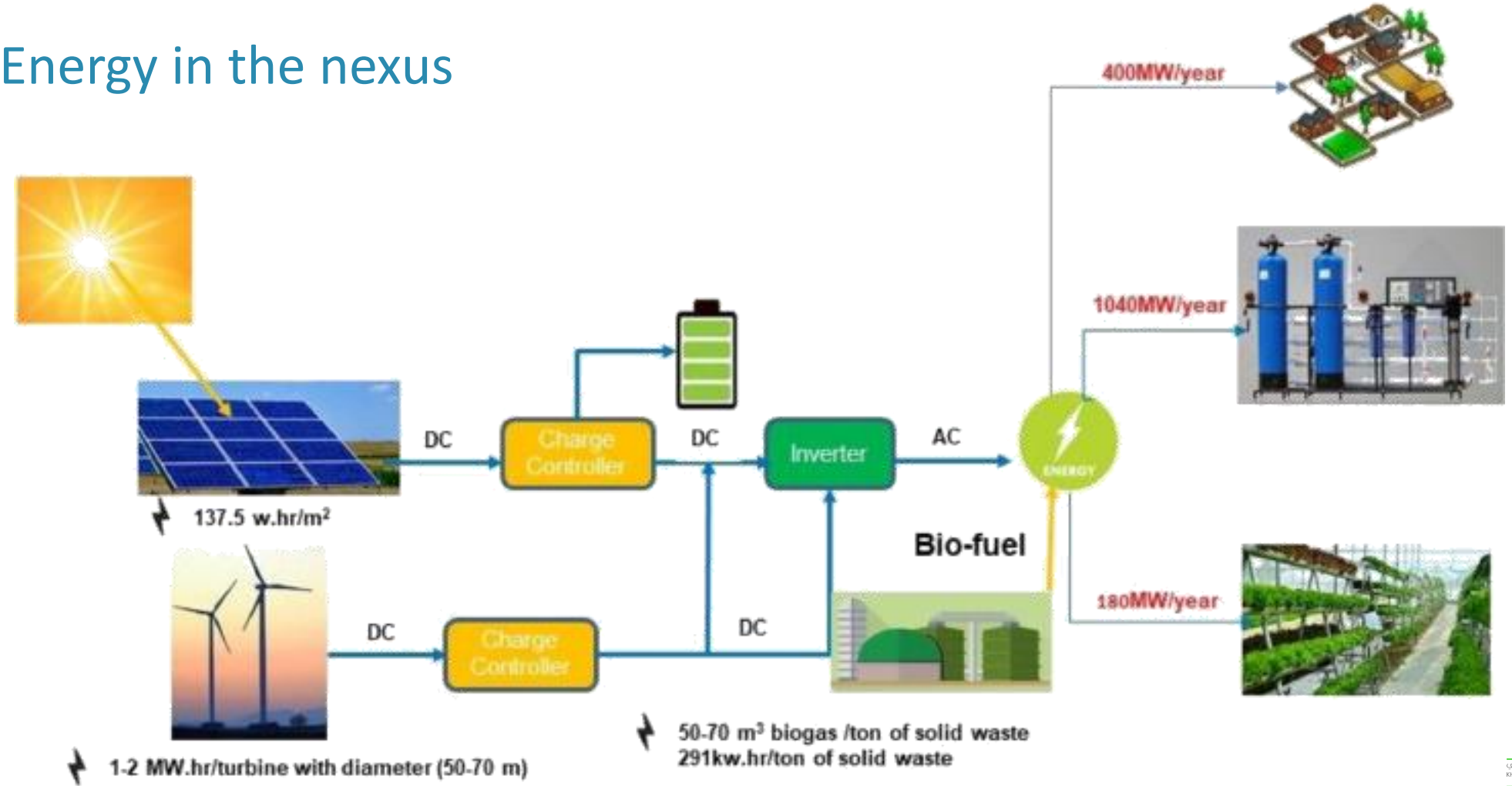
- The introduced WEF nexus scheme is based on the available resources in Rabia region to produce the required water for drinking, cultivation, and other purposes in addition to maximizing the productivity of water.
  - ✓ It also provided renewable energy resources and food security in the area.
  - ✓ The proposal also empowers women and provides job opportunities for the community.
  - ✓ Reducing carbon emissions to contribute to the efforts fighting climate change.

- The proposed scheme will save about 52 % of the required electricity and 54 % of the carbon emissions, through the use of renewable energy sources. It produces 2,096 t/yr of crops.
- It supports the achievement of many sustainable development goals and will promote the achievement of Egypt's National Vision 2030.

- Energy in the nexus
  - ✓ The Rabia Community is off-grid, so, we implemented an integrated renewable energy model based on solar and wind energy.
  - ✓ We found that the sun in most days in this area provides an average yearly PV energy production of 1815.02 kWh.

- Energy in the nexus
  - ✓ The total electrical energy needed for our project is 2091 MW/year. We will use it as follows:
    - ❑ 400 MW/year for lighting and electrical purposes in homes.
    - ❑ 1040 MW/year for seawater desalination using RO technology to produce fresh water.
    - ❑ 180MW/year in Hydroponic projects for the production of food.
    - ❑ The additional amount of electricity (471 MW) is set for 8 local crafts and products workshops that will be included in the development. Each workshop will require an average of 50–60 MW.

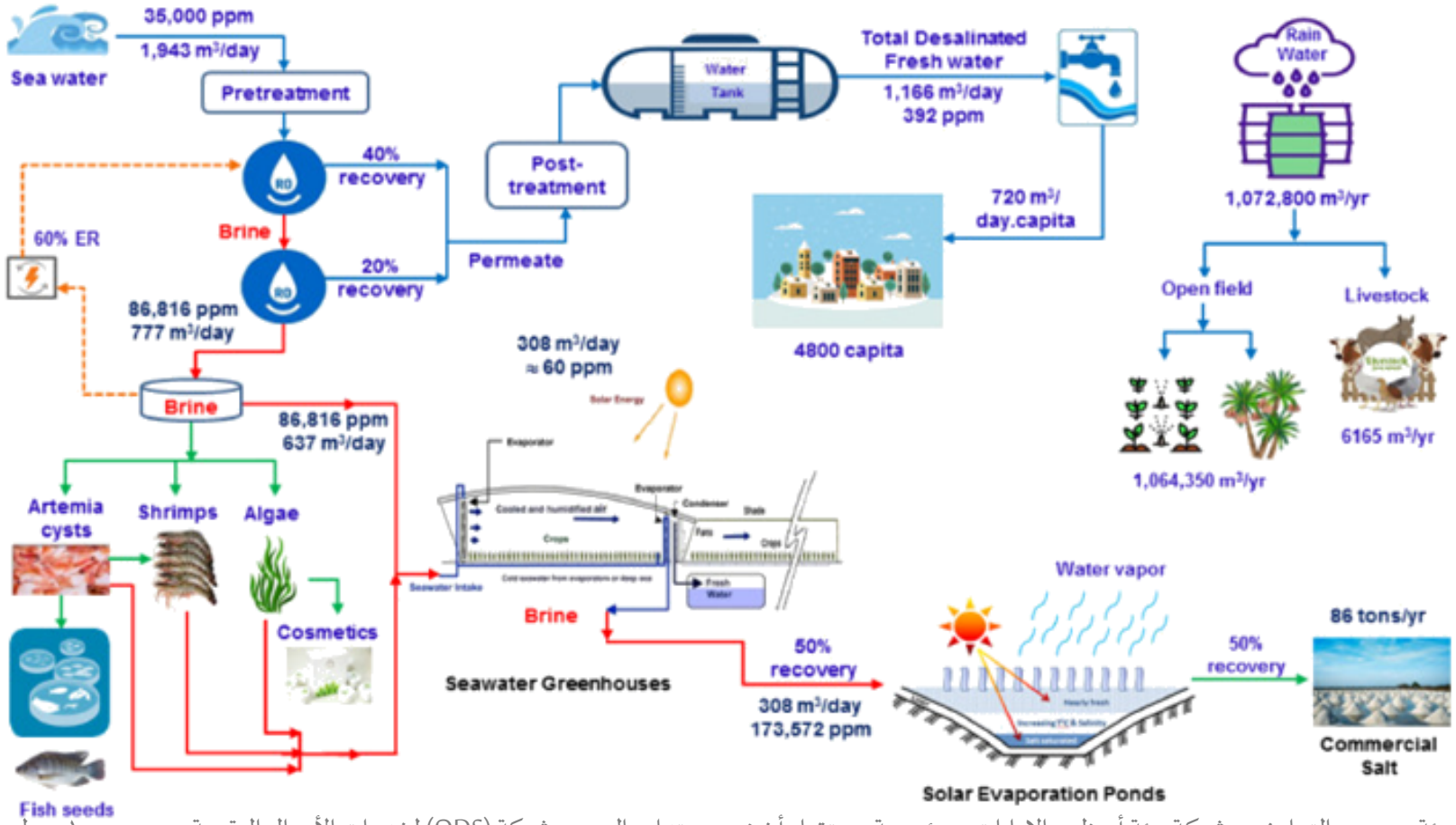
Energy in the nexus



- Energy in the nexus
  - ✓ The different sources we will use to produce sufficient energy for the project will be as follow
    - ❑ Photovoltaic "PV" solar panels with average production 137.5 Whr/m^2.
    - ❑ Wind Turbine with average production 1–2 MWhr/turbine with a diameter (50–70 m).
    - ❑ Solid waste to produce 50–70 m^3 biogas /ton.

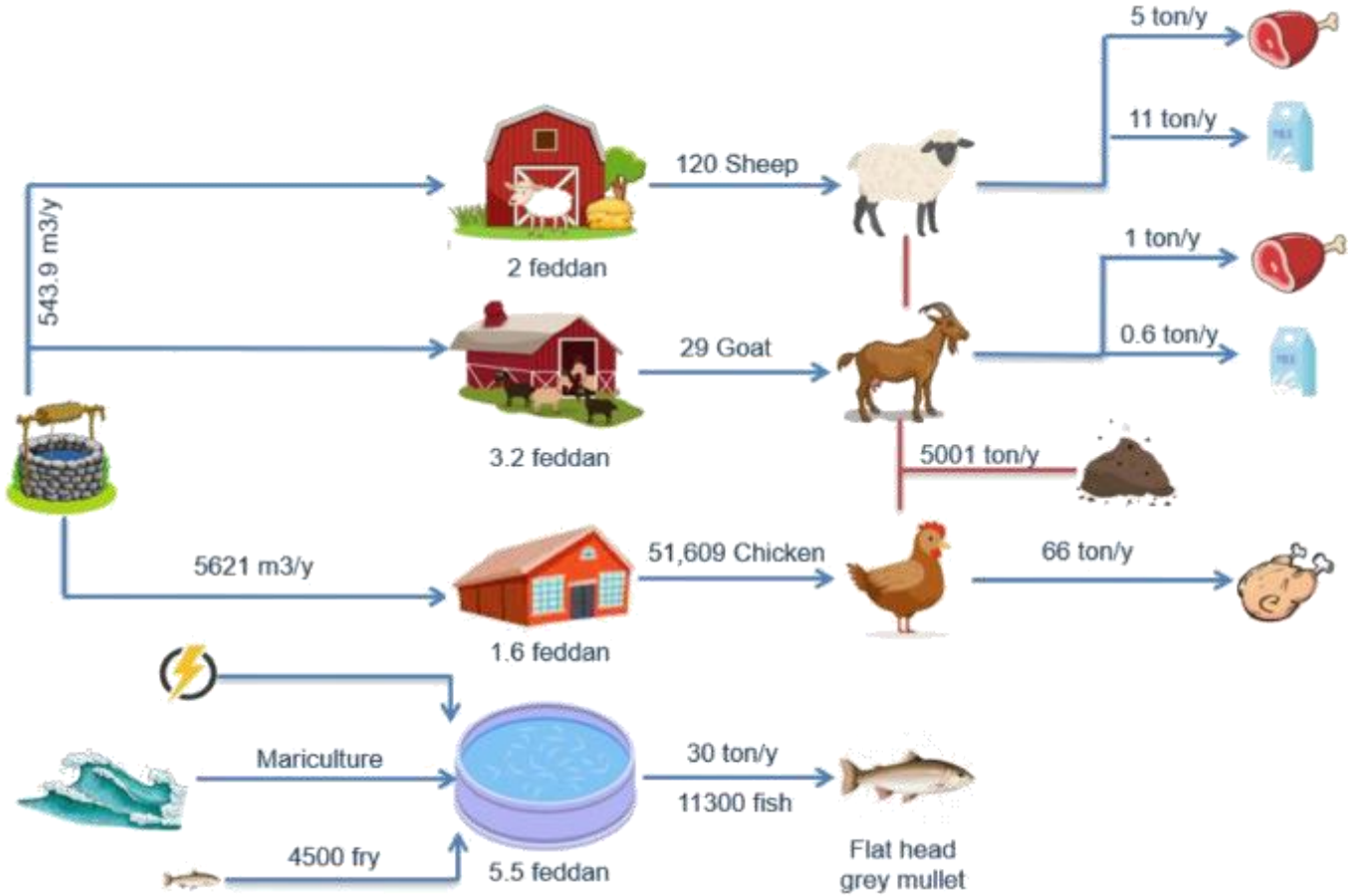
- Water in the nexus
  - ✓ Propose using the SWRO desalination system as the primary source of freshwater.
  - ✓ The SWRO system consists of 2 stages; where the first stage consists of 16 vessels (8 units × 2 rows) while the second one of 8 vessels (4 units × 2 rows), with 40 % and 20 % water recovery, respectively, and with 60 % overall water recovery.

Water in the nexus



- Food production in the nexus
  - ✓ This project aims to ensure food sufficiency for the Rabia community through sustainable practices for the projected population.
    - ❑ By calculating the required livestock to feed the community
      - 120 Sheeps
      - 50 Goats
      - 51,609 Chicken
  - ✓ Water needed 6165 m^3/y

Food production in the nexus



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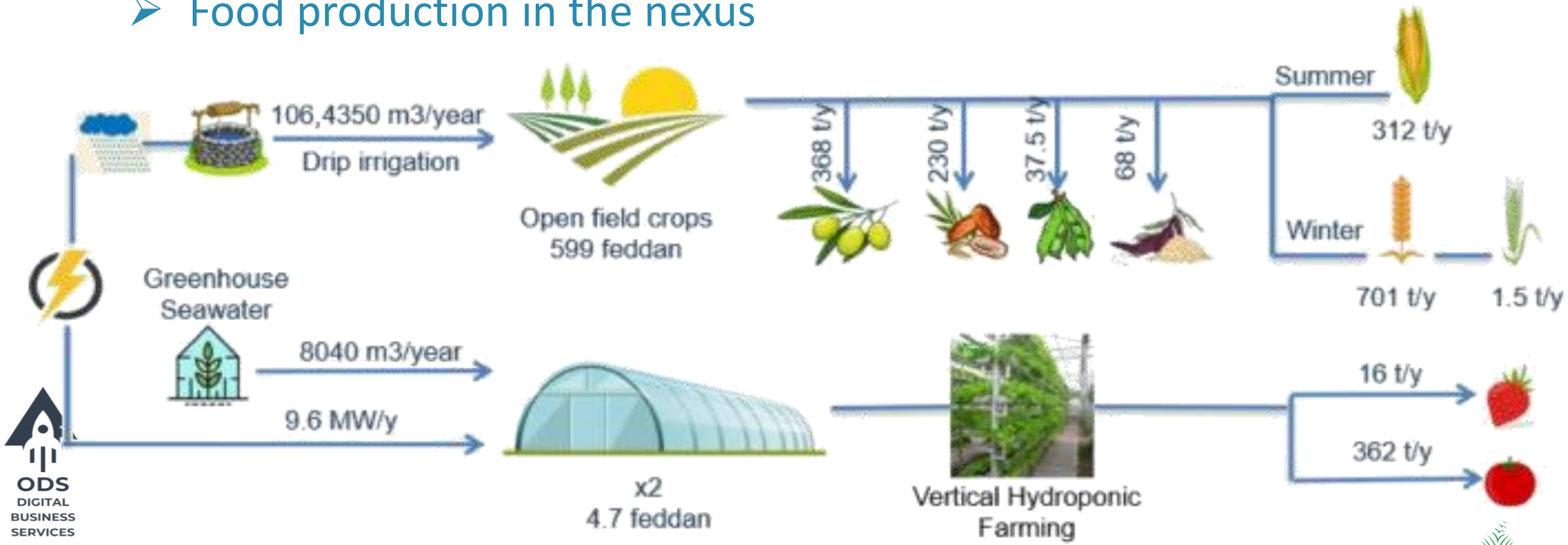
Food production in the nexus

- ✓ This project aims to ensure food sufficiency for the Rabia community through sustainable practices for the projected population.
  - ❑ Crops required to feed the community.
    - 701 t/y Wheat
    - 1.5 t/y Barley
    - 37.5 t/y Broad bean
    - 312 t/y Maize
    - 368 t/y Olives
    - 230 t/y Date
    - 68 t/y Quinoa
- ✓ Water needed 1,064,350 m^3/y.

Food production in the nexus

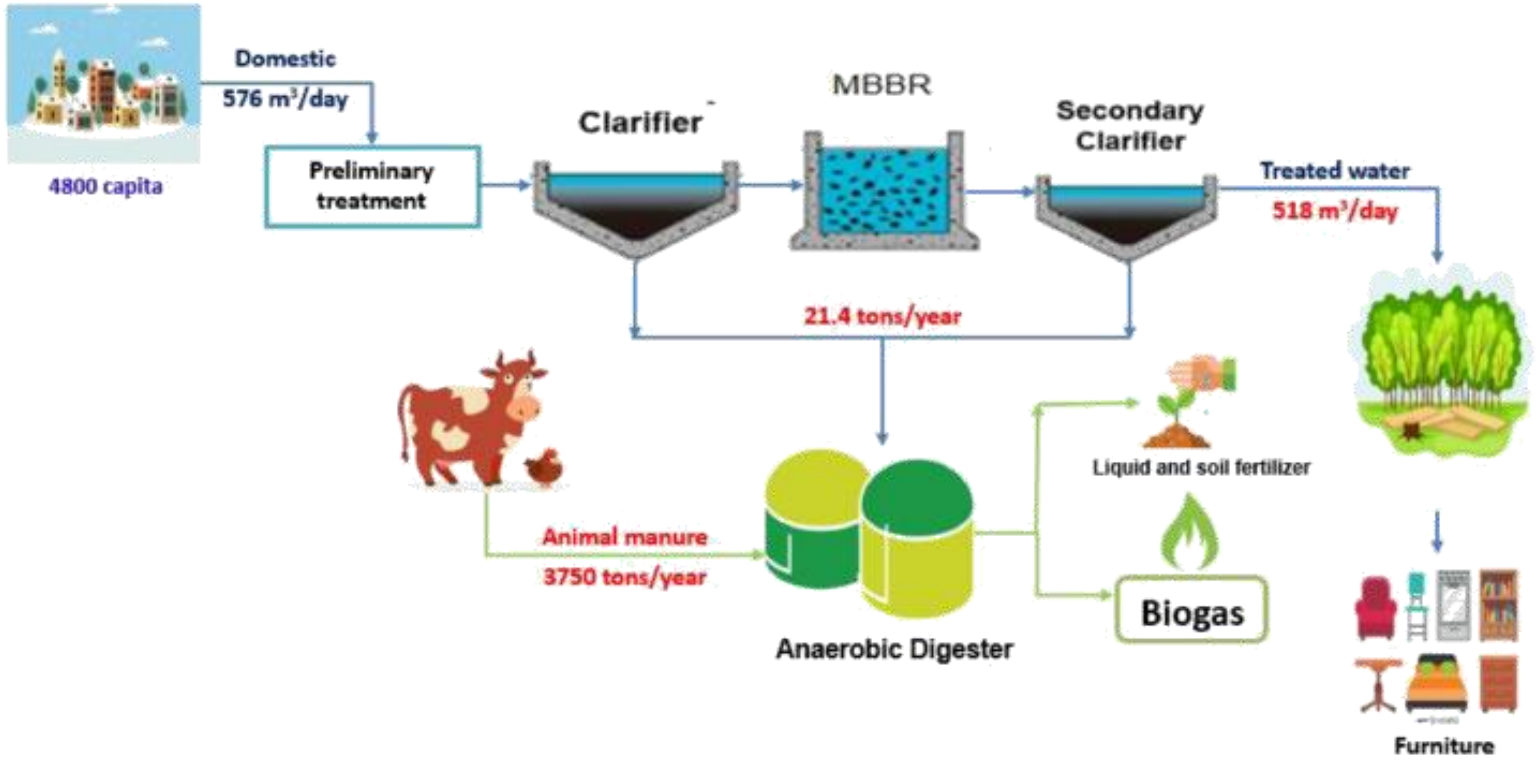
- ✓ This project aims to ensure food sufficiency for the Rabia community through sustainable practices for the projected population.
  - ❑ Hydroponics crop required to feed the community.
    - 362 t/y Tomatoes
    - 16 t/y Strawberries
- ✓ Water needed 8040 m^3/y.

➢ Food production in the nexus

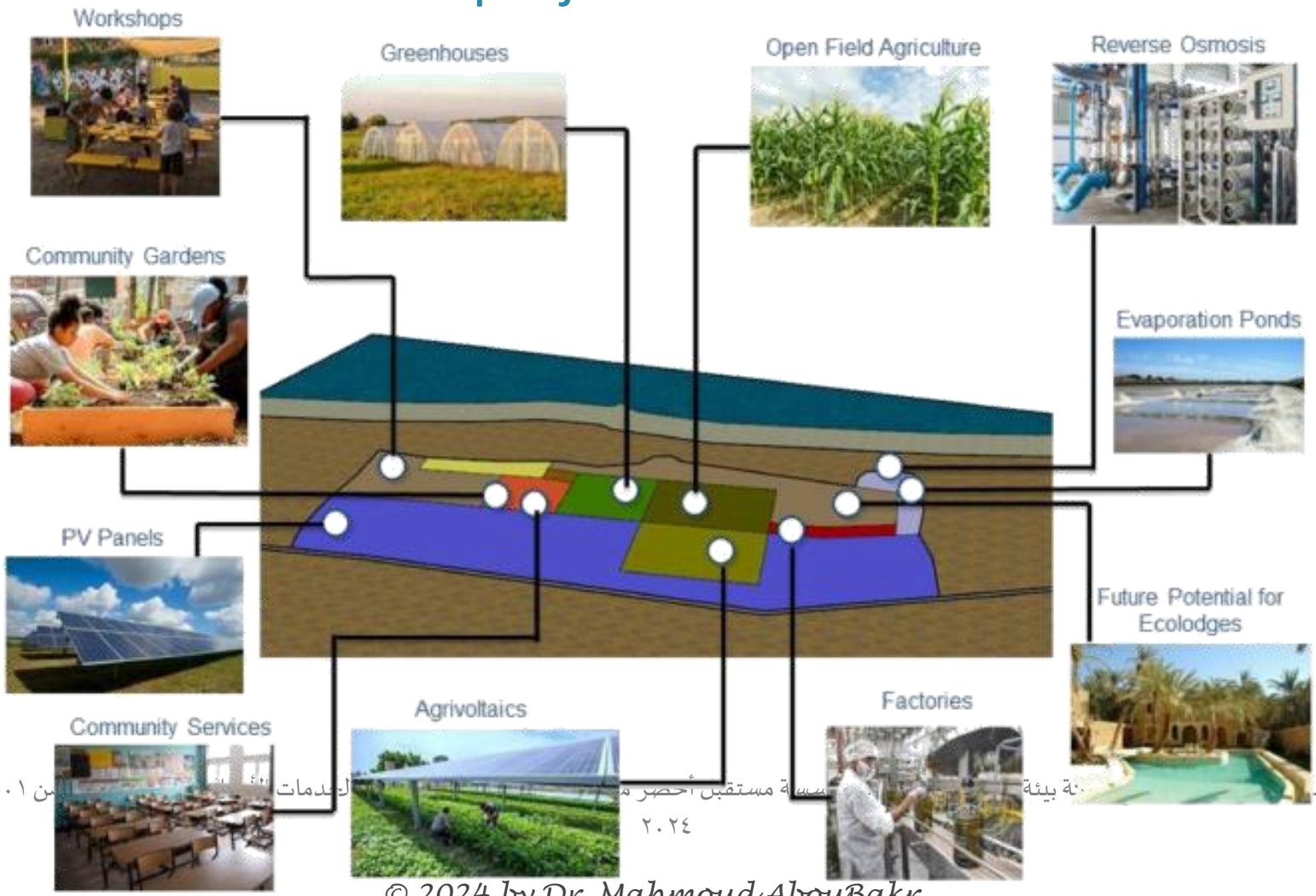


Waste management in the nexus

- ✓ Reducing overall waste production through recycling and waste reduction.



The entire WEF nexus project



CASE STUDY 2 :WEF BASED DECISION-MAKING FRAMEWORK TO GUIDE NATIONAL PRIORITIES IN QATAR

- WEF based Decision-making Framework to Guide National Priorities in Qatar
  - ✓ An integrative assessment tool, based on the Analytical Hierarchy Process (AHP) and WEF nexus is used to design a decision-making scheme that guides policymakers in establishing national priorities and sectorial strategies.

➢ WEF Nexus-based Decision-making Framework to Guide National Priorities in Qatar

Characterisation of the current state of EWF nexus system

↓

Integrated performance **assessment** of the EWF nexus system using **AHP** by designing:
1- **Sustainability** composite indicator
2- **Security** composite indicator
3- **Resilience** composite indicator
4- **Energy** composite indicator
5- **Water** composite indicator
6- **Food** composite indicator
7- **EWF** interlinkages composite indicator

↓

Implementation of composite indicators into informing future policy making in the EWF sectors

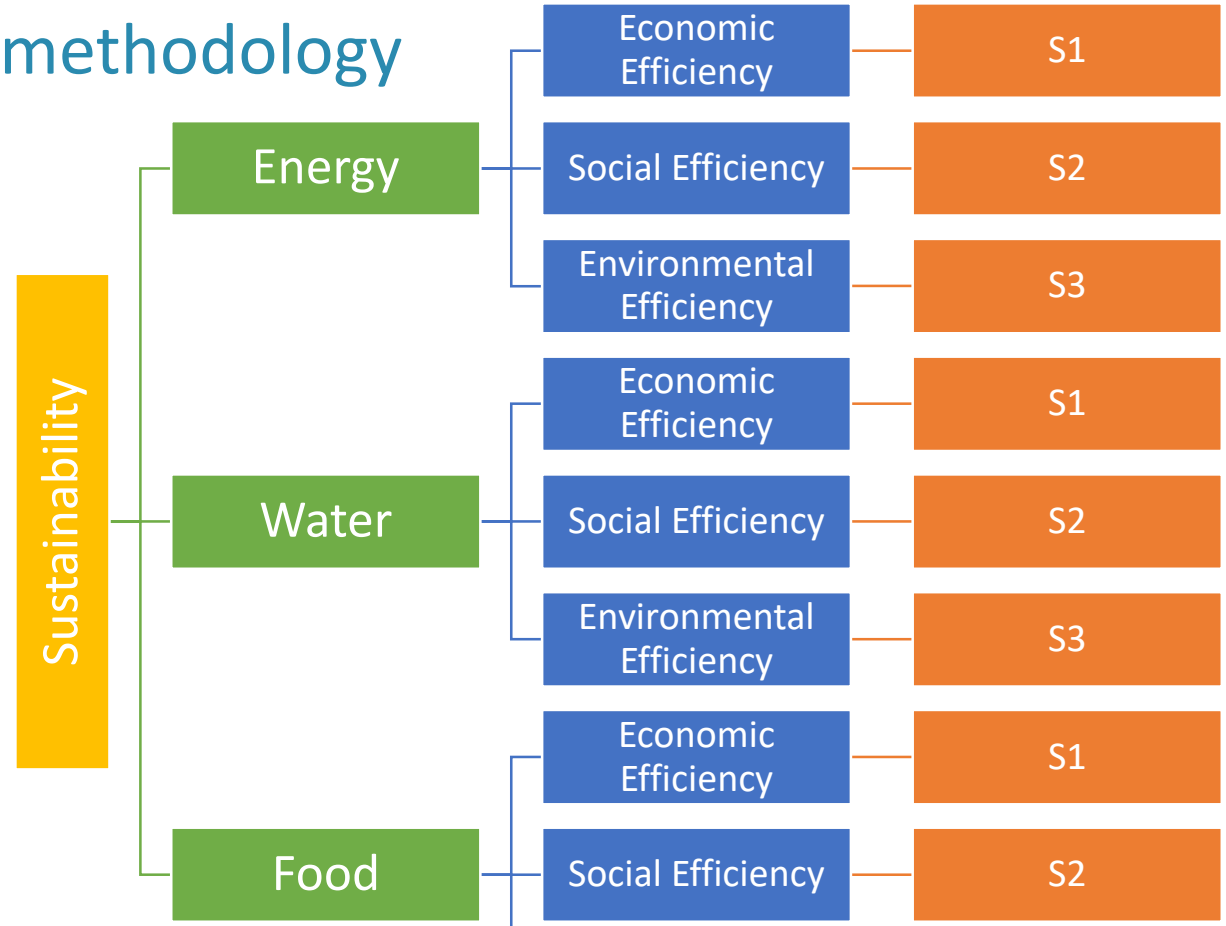
Challenges

- ✓ The country is suffering from scarce water resources manifested by an annual renewable rate as low as 58 Mm^3.
- ✓ The food system is affected due to the reliance on water for local agricultural activities, especially for irrigation and the raising of livestock.
- ✓ The food sector is also experiencing numerous internal limitations associated with the restricted area of arable land, that consists of 1.6% of the total available area, along with the arid climate that deters the cultivation of most crops

- The proposed methodology
  - ✓ Holistic assessment of the WEF nexus system based on the three performance measures
    - ❑ Sustainability (S)
    - ❑ Security (SE)
    - ❑ Resilience (R)
  - ✓ Assessment of the performance of each sector considering the three pillars combined
  - ✓ Assessment of the performance of interlinkages between WEF sectors.

The proposed methodology

✓ Sustainability



The proposed methodology

✓ Sustainability

❑ Economic efficiency

- is measured considering their contribution to the country's GDP.

❑ Social efficiency

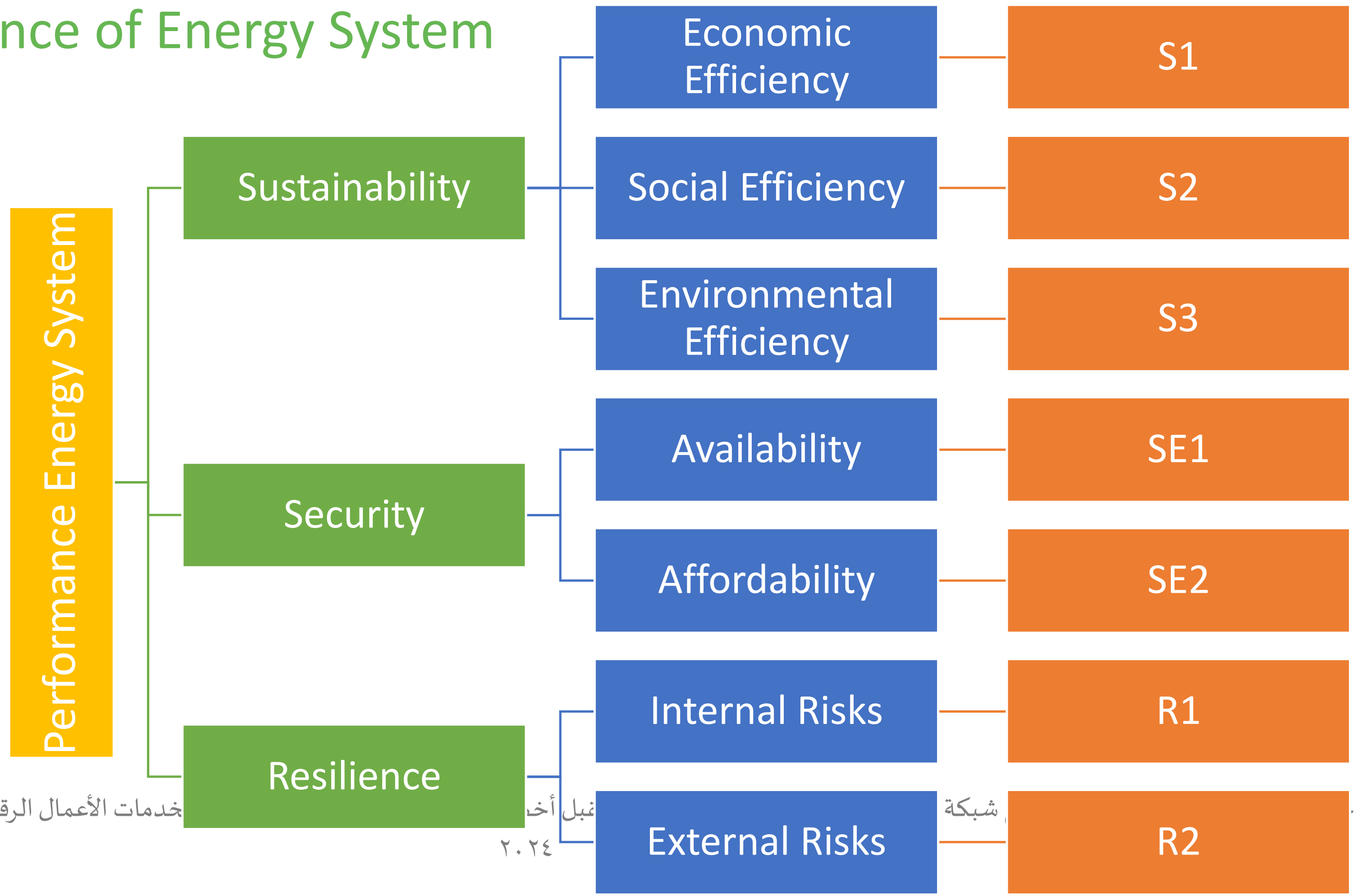
- the ability to meet local population's demand.

❑ Environmental efficiency

- the burden inflected by local EWF activities, i.e., GHG emissions from burning natural gas, groundwater depletion and food losses, being the most noticeable environmental impacts in Qatar.

The proposed methodology

✓ Performance of Energy System



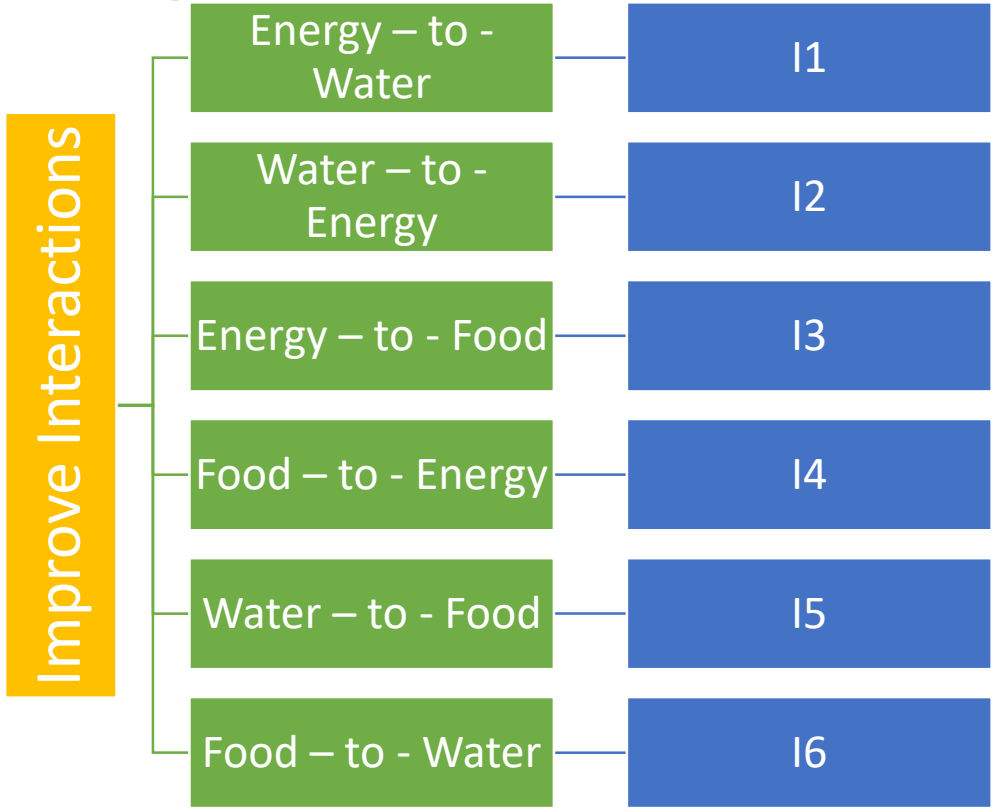
شريك تنظيمي

الراعي الذهبي

تنظمها ... شبكة ... قبل أخ... خدمات الأعمال الرقمية بمصر، من ٠١ يوليو حتى ٣٠ أكتوبر ٢٠٢٤

The proposed methodology

✓ EWF nexus interlinkages Performance



➢ Proposed national priorities to improve the EWF nexus performance

Pillar	Vulnerability	Suggested Action Plans
Sustainability	Food: Social	Enhance agricultural infrastructure to meet the local demands Establishment of food safety and quality programs
	Energy: economic	Expand production by diversifying the energy mix
	Water: social	Expand irrigation water by using alternative water sources for landscaping and industrial activities instead of groundwater and desalination

➢ Proposed national priorities to improve the EWF nexus performance

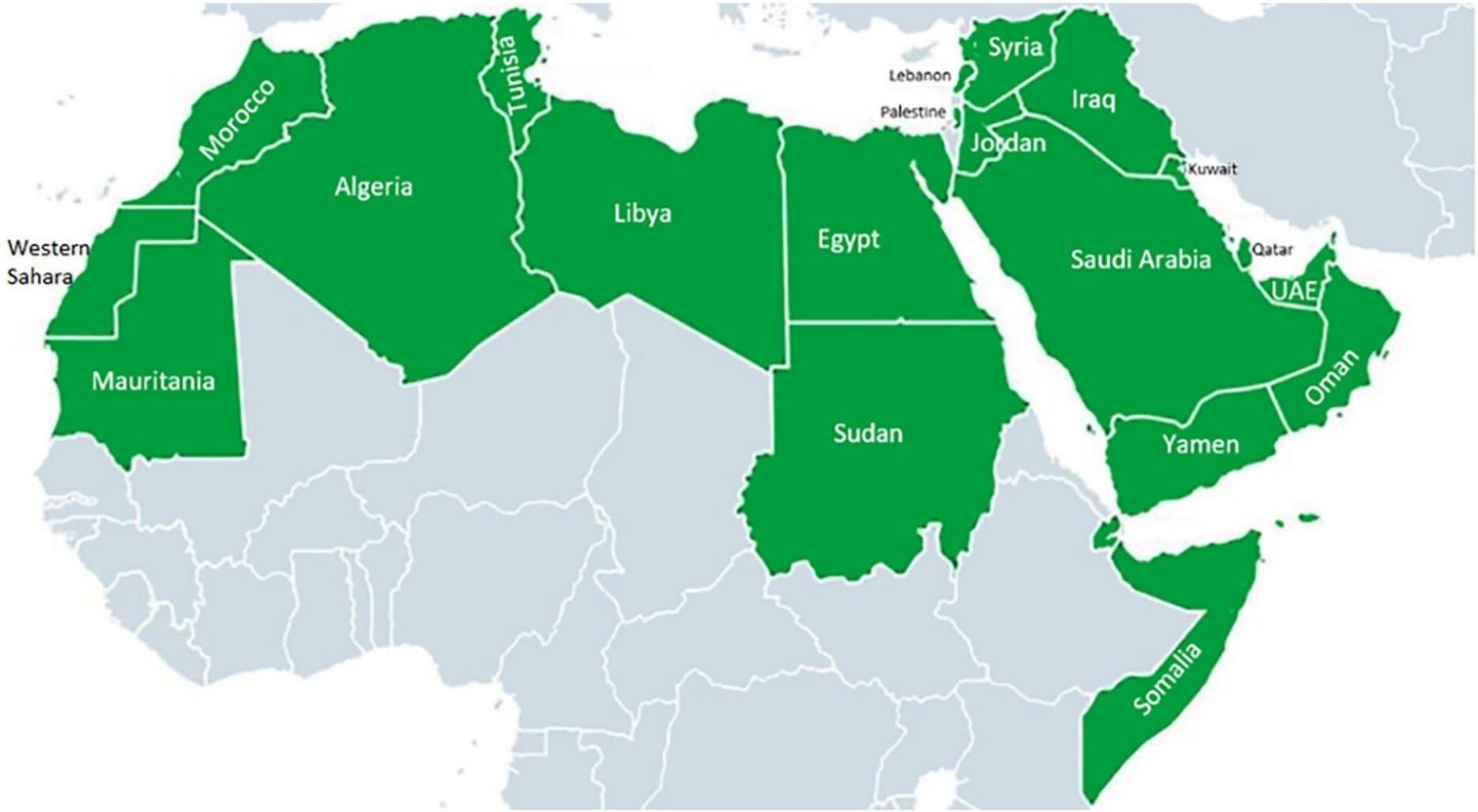
Pillar	Vulnerability	Suggested Action Plans
Security	Water: availability	Investment in alternative water sources and infrastructure
	Food: availability	Investing in greenhouse and vertical farming due to the limited land
	Energy: affordability	Improve the energy efficiency of downstream facilities

➢ Proposed national priorities to improve the EWF nexus performance

Pillar	Vulnerability	Suggested Action Plans
Resilience	Food: external risks (important Dependency)	Improve Internal Food Trade by diversifying exporting partners
	Water: internal risks (low recharge level)	Integrate alternative sources of water (desalination and wastewater)
	Energy: internal operational risks	Continuous monitoring Cyber security energy decentralization

CASE STUDY 3: WEF TACKLE FUTURE ARAB COUNTRIES WATER SCARCITY

Arab World

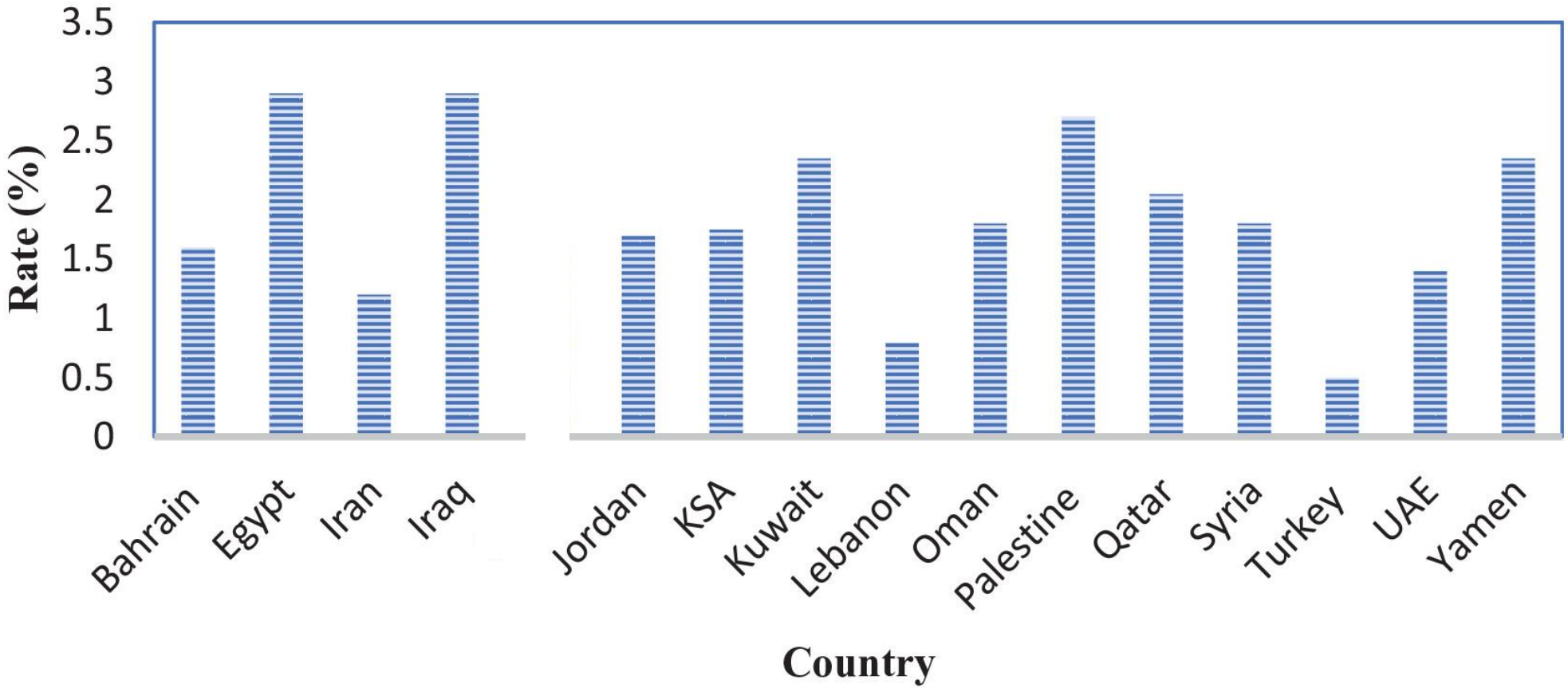


تنظمها جمعية عين البيئة بمصر، بالتعاون مع شبكة بيئة أبوظبي بالإمارات، ومؤسسة مستقبل أخضر مستدام باليمن، وشركة (ODS) لخدمات الأعمال الرقمية بمصر، من ٠١ يوليو حتى ٣٠ أكتوبر ٢٠٢٤

- Several Arab countries face Challenges
  - ✓ Climate change
  - ✓ Desertification
  - ✓ Water crisis

- The gap between increasing demand and decreasing supplies
  - ✓ According to a United Nations report, the amount of fresh water available to a person in the Arab world per year could drop to 460 m^3—less than half the 1,000 m^3 threshold for water shortages
  - ✓ Unsustainable water abstraction will continue to increase, and already limited resources will be depleted faster than ever
  - ✓ Governments respond with increased subsidies for water and other resources, increasing environmental challenges that exacerbate shortages and fuel unrest.

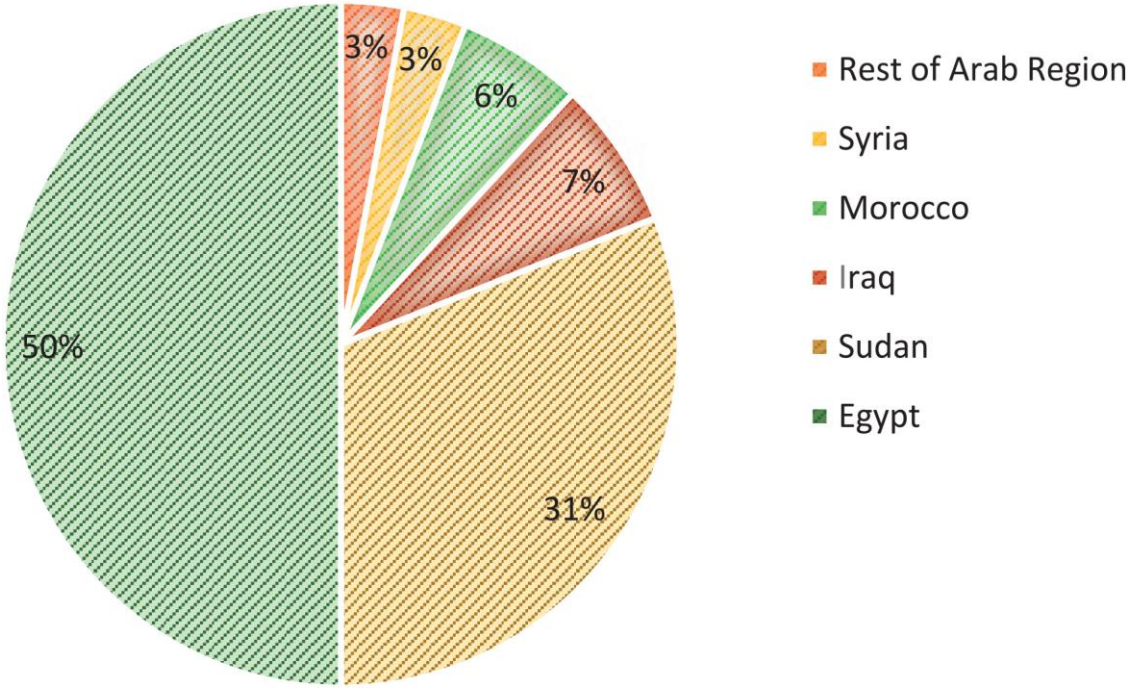
The gap between increasing demand and decreasing supplies



- The gap between increasing demand and decreasing supplies
  - ✓ The MENA region, which includes the majority of Arab countries, has the highest water scarcity in the world, with more than 60% of the population having little or no access to drinking water and more than 70% of the region's GDP subject to high or highly high-water stress

- Water, energy, and food sectors
  - ✓ The relationship between the water, energy, and food sectors is essential in ensuring human life remains safe and comfortable.

- Water, energy, and food sectors
  - ✓ Hydro energy consumption in the Arab World countries.



- Water, energy, and food sectors
  - ✓ The development of hydropower in the Nile region has faced several challenges, including limited water resources and the impacts of hydroelectricity projects on water availability.
  - ✓ The Nile River is a significant water source for the countries along its basin, and its water resources are already heavily used for agriculture, industry, and human consumption.
    - ❑ Developing hydropower projects on the Nile, such as the Grand Ethiopian Renaissance Dam (GERD), has further increased competition for the river's water resources.

- Water, energy, and food sectors
  - ✓ Development of hydropower projects in the Nile region is also influenced by climate change, population growth, and economic development.
  - ✓ Climate change can significantly impact water resources, affecting the availability and quality of water for hydropower production.

Water strategic stock

- ✓ Surface water sources include rivers, lakes, and wetlands, while groundwater sources include aquifers, springs, and wells.
- ✓ Groundwater exists as a renewable and non-renewable source.
- ✓ Groundwater is a strategic resource for the Middle East and the second traditional water source.
- ✓ In Arab region countries such as Bahrain, Jordan, Oman, and Yemen, groundwater contributes more than 50% of total water withdrawals
- ✓ More than 50% of Arab countries depend on groundwater as the primary freshwater resource

- Water strategic stock
  - ✓ With the introduction of unconventional water sources, mainly desalination, countries started to increase reliance on these resources to meet their water needs and decrease their dependency on non-renewable groundwater resources, as observed in Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates.

WEF nexus

- ✓ The Arab region's water industry relies on fossil fuels for treatment, transportation, and distribution.
  - ❑ This has resulted in excessive energy use, greenhouse gas emissions, and expenses.
- ✓ The food industry confronts similar challenges because of the extensive water and energy consumption for irrigation, food processing, and transportation.
- ✓ Resulting in trade-offs between water, energy, and food security.

- WEF nexus
  - ✓ Decreasing water losses through better water distribution infrastructure and encouraging water-efficient technology and practices in the agriculture and energy sectors.
  - ✓ There is also an increasing interest in employing renewable energy sources, such as solar and wind power, to reduce reliance on fossil fuels and improve regional energy security.

WEF nexus

- ✓ Minimizing food waste and improving supply chain efficiency can assist in reducing energy consumption and greenhouse gas emissions while boosting food security
- ✓ Addressing the WEF nexus in the Arab area is critical for maintaining sustainable management of water, energy, and food resources. Integrated and sustainable policies and practices, such as decreasing water losses, boosting renewable energy sources, and implementing sustainable agriculture methods, can assist in ameliorating the region's interconnected difficulties.

- WEF nexus
  - ✓ Water losses
    - ❑ Pumps in traditional pressurized systems run at a constant high pressure to guarantee enough water is available during peak hours
    - ❑ However, they have the drawback of consuming more power than necessary during off-peak hours, and the water pressure in the pipes is considerably greater than necessary at night, reducing pipe life

- WEF nexus
  - ✓ Water losses
    - ❑ Another research used a dynamic hydraulic model to plan and modify water systems.
      - They used sensor data to assess the network's present state and automatically send control signals to other components to improve network performance and efficiency.
      - A dynamic hydraulic model, an intelligent water network, and active network management make up the dynamic model.
    - ❑ Today, the primary technologies used in leak detection that provide economic benefits are ground-penetrating radars, optical, moisture, sound, pressure, and robotic cameras

- WEF nexus
  - ✓ Water harvesting
    - Water harvesting collects and stores rainfall, runoff, and other forms of precipitation for later use.
    - It is beneficial in arid regions with limited freshwater resources, such as rivers or lakes.
      - In these regions, water harvesting can provide a reliable water source for irrigation, livestock, and other purposes.
    - Water harvesting can improve soil fertility, increase crop yields, and provide additional income for farmers and rural communities.

WEF nexus

✓ Water harvesting

❑ Challenges

- In arid regions, water harvesting requires significant investment in infrastructure, such as storage tanks, pumps, and pipelines. Maintenance and repair of these systems can also be costly.
- Storing water in tanks and other systems can lead to the growth of harmful microorganisms, such as bacteria or algae, which can compromise the water quality.

WEF nexus

✓ Wastewater treatment

- Water quality has deteriorated, and pollution has increased, mainly due to human activities, population growth, unplanned urbanization, rapid industrialization, and the misuse of natural water resources
  - For these reasons, obtaining the plant nutrients needed for agricultural processes, such as phosphorous and nitrogen, is essential from wastewater.
- It is essential to encourage investments in urban wastewater treatment and reuse in agriculture to ensure an adequate water supply for peri-urban agriculture in the context of increasing urbanization

WEF nexus

✓ Wastewater treatment

❑ Techniques

- Activated carbon is the most common adsorbent
- Furthermore, there is a group of agricultural residues capable of absorbing various pollutants for wastewater treatment, including hemicelluloses, lignin, lipids, proteins, simple sugars, water, hydrocarbons, and starch

- WEF nexus
  - ✓ Solar energy for water desalination
    - ❑ Desalination removes minerals and salts from saltwater water to generate freshwater for human consumption or irrigation
    - ❑ It is used to treat seawater and brackish water according to various parameters.
    - ❑ Seawater desalination is accomplished on a large scale in Saudi Arabia and the Gulf countries, mainly using electricity.

WEF nexus

✓ Solar energy for water desalination

- ❑ Solar desalination is an environmentally friendly technology that can help to address water scarcity and improve water security.
  - This technology involves using solar energy to power the desalination of seawater or brackish water into fresh water.
  - The use of solar energy makes this technology both sustainable and renewable, as it reduces the reliance on traditional sources of energy, such as fossil fuels, which emit greenhouse gases and contribute to climate change.

WEF nexus

✓ Solar energy for water desalination

- ❑ Solar desalination is an environmentally friendly technology that can help to address water scarcity and improve water security.
  - Solar desalination effectively improves water security in regions with limited access to freshwater resources.
  - solar desalination systems can be designed and implemented modularly, allowing for their deployment in remote locations.
  - This makes them particularly useful in rural communities, where access to water and energy is often limited.

WEF nexus

✓ Solar energy for water desalination

❑ Challenges

- The initial cost of setting up a solar desalination system can be high
- Maintenance and repair of these systems can also be complex and costly

❑ Solar desalination is a promising solution for sustainable water savings and improving water security in regions facing water scarcity.

WEF nexus

✓ Solar-powered groundwater pumping systems

- The technology for pumping water from its source to the place of demand has been used in remote areas where water is unavailable and cannot be easily used.
- Traditionally, the electricity generated has primarily been supplied by burning fossil fuels from national grids.

WEF nexus

✓ Networks for monitoring water development

- ❑ A Wireless Sensor Network (WSN) is suitable for monitoring the physical and chemical properties of water and water quality and has low cost and human resources requirements
  - Its portability
  - Obtain data almost instantaneously
  - Record and publish data as quickly as possible

- WEF nexus
  - ✓ Water software production
    - Software modeling and production in different fields help to verify the proposed theories and reduce risks and costs during project implementation.
    - Modeling can be applied to architecture, aviation, renewable energy, etc.
    - In the field of water, there is an abundance of software that collects and analyzes data to reach different results and then uses these to run the project with the least possible time, effort, and cost.

WEF nexus

✓ Water software production

- In order to study the hydraulic effect of leakage, MATLAB-based educational software (UAleaks) has been developed.
  - evaluate the impact of water loss and leakage in cases where manual calculations cannot address real network leaks.
  - sizing small solar water heating systems by allowing the sizing of natural and forced circulation systems and modifying the input parameters at any time, making it possible to simulate different situations and identify optimal technical and financial solutions

WEF nexus

✓ Water software production

- Some GIS software is free and open-source.
  - GIS programs help water management systems by collecting, transmitting data, and conducting an inventory of water locations in the region and then presenting it as a map, thereby organizing a large body of information in a way that makes it easy to manage and understand
- Instrumentation Control and Automation (ICA) are becoming increasingly prevalent in water, and wastewater treatment plants that depend on ensuring treatment systems run efficiently, achieve desired performance at a reasonable cost, and manage large fluctuations in loading

WEF nexus

✓ Water software production

- Today, there is a greater focus on using ICA to improve the ability of existing systems to handle the increased load due to overpopulation and urban growth.
- conventional planning for the increased demand for drinking water and wastewater services involves designing large treatment plants.
  - ICA can help lighten the load, temporarily shift operational goals, and temporarily or even permanently reduce load.

- The following are some ways in which the nexus can help to solve water scarcity in the Arab region:
  - ✓ Integrated Water Management: Integrating the management of water, energy, and food resources can help optimize their use and increase the system's overall efficiency. This can result in a more sustainable and resilient water supply and help to address water scarcity in the Arab region.
  - ✓ Climate-Smart Agriculture: Climate-smart agriculture involves using sustainable and resilient practices to climate change's impacts. This can help to reduce water use in agriculture and increase the efficiency of water use in the sector.

- The following are some ways in which the nexus can help to solve water scarcity in the Arab region:
  - ✓ Renewable Energy for Water Desalination: Renewable energy sources, such as solar and wind, can power water desalination plants, reducing the energy costs and greenhouse gas emissions associated with water production.
  - ✓ Water-Efficient Energy Production: The production of energy can also be made more water-efficient, reducing the amount of water required for energy production and helping to address water scarcity in the Arab region.

- The following are some ways in which the nexus can help to solve water scarcity in the Arab region:
  - ✓ Water-Saving Technologies: The development and implementation of water-saving technologies, such as drip irrigation systems, can help reduce water use and improve water use efficiency in various sectors.
  - ✓ Desalination: Desalination of seawater and brackish water is a standard solution for water scarcity in the Arab region, where access to fresh water is limited. Many Arab countries have already invested in desalination technology, and this trend will likely continue as the water demand increases.

- The following are some ways in which the nexus can help to solve water scarcity in the Arab region:
  - ✓ Reuse and Recycling of Water: Reusing and recycling wastewater can also help to address water scarcity in the Arab region. This involves treating wastewater to remove contaminants and using the treated water for non-potable purposes, such as irrigation or industrial processes.
  - ✓ Water Harvesting: Water harvesting involves collecting, storing, and using rainwater for various purposes. This method is beneficial in arid regions, where water scarcity is a significant challenge.

- The following are some ways in which the nexus can help to solve water scarcity in the Arab region:
  - ✓ Improved Water Management: Improved water management, including more efficient irrigation systems and better water allocation policies, can also help to address water scarcity in the Arab region.
  - ✓ Climate-Resilient Infrastructure: Building climate-resilient infrastructure, such as dams and water storage systems, can help to ensure a stable and reliable water supply, even in the face of changing weather patterns and increased water demand.
  - ✓ Conservation and Education: Raising awareness about the importance of water conservation and promoting water-saving practices can also significantly address water scarcity in the Arab region.

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Thank You

Welcome to questions, comments and suggestions

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