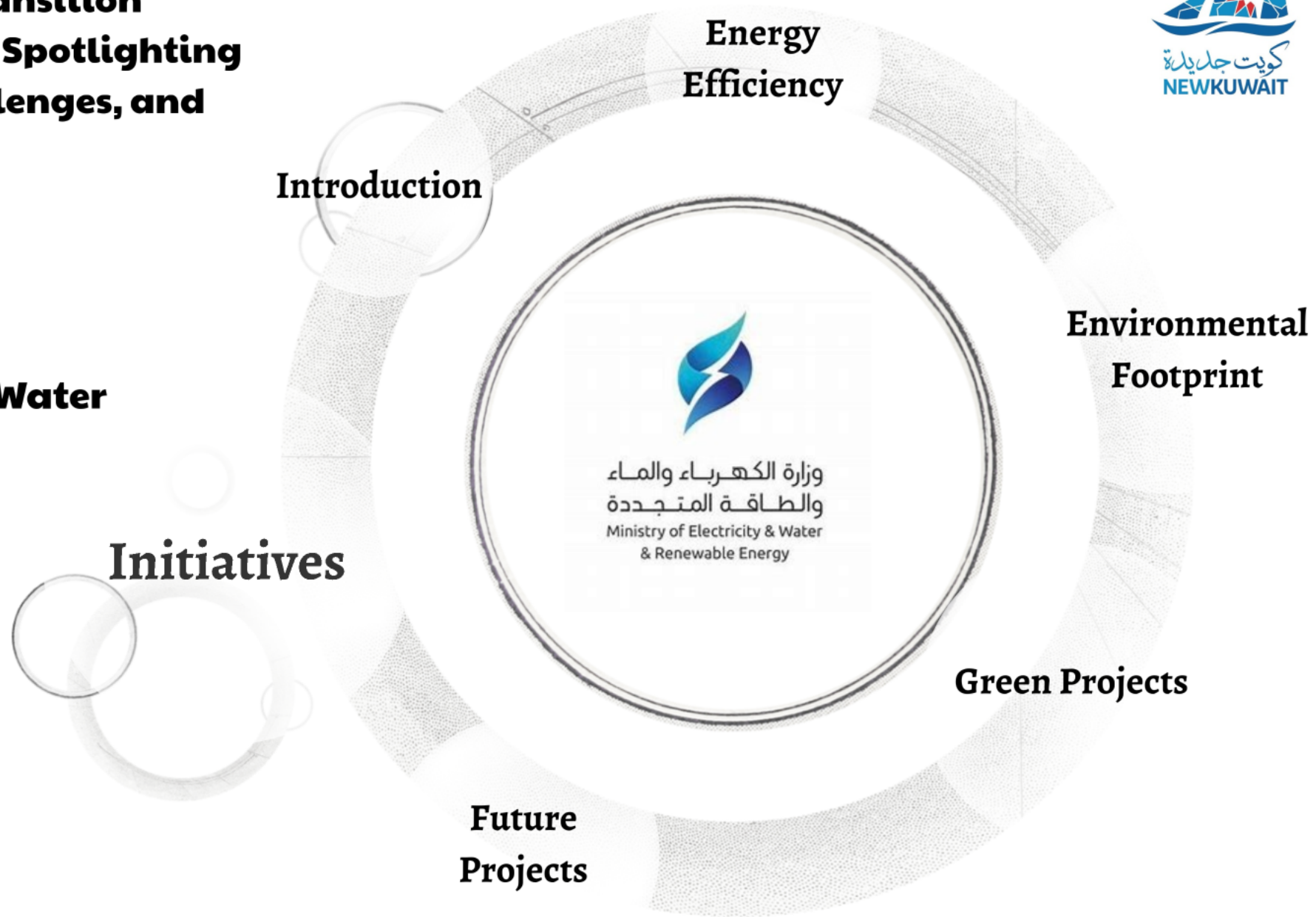


Pathways for Energy Transition Towards Sustainable Energy: Spotlighting of Recent Innovations, Challenges, and Future Insights

Ministry of Electricity and Water
Eng. Asma Alsallal





وزارة الكهرباء والماء
والطاقة المتجددة
Ministry of Electricity & Water
& Renewable Energy

Kuwait aims a cleaner energy source to increase production efficiency at lower cost and reduce the overall environmental effect of power plants.

**Efficiency
Improvement**

**Enviromental
Impact**

**Renewable
Energy**

Power Generation

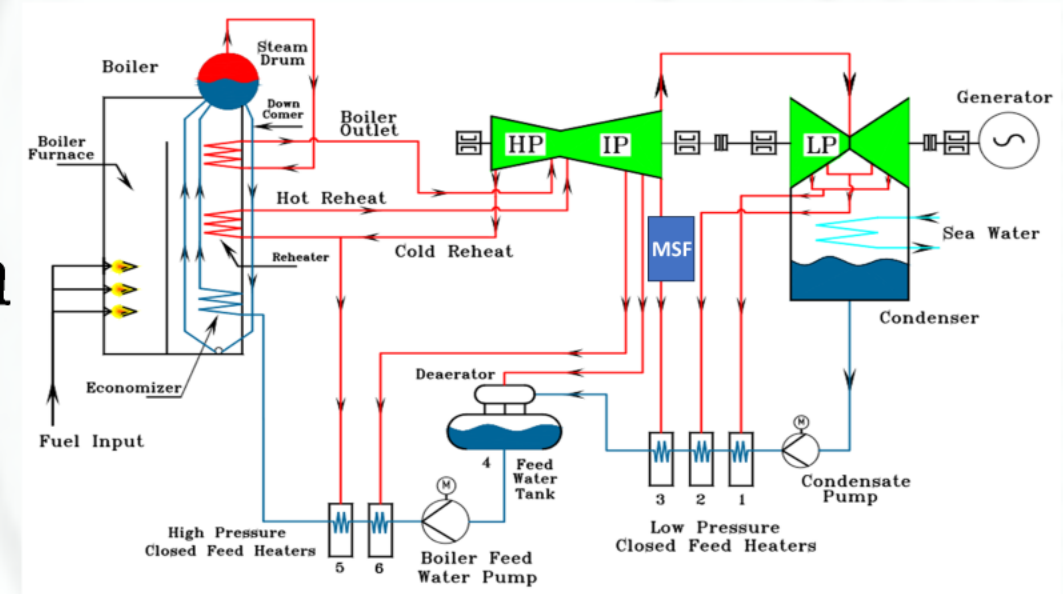
High-efficiency technologies:

- Cogeneration technologies with expanding the gas fuel quotas.
- Combined-Cycle Gas Turbine technologies with natural gas.

Power Generation

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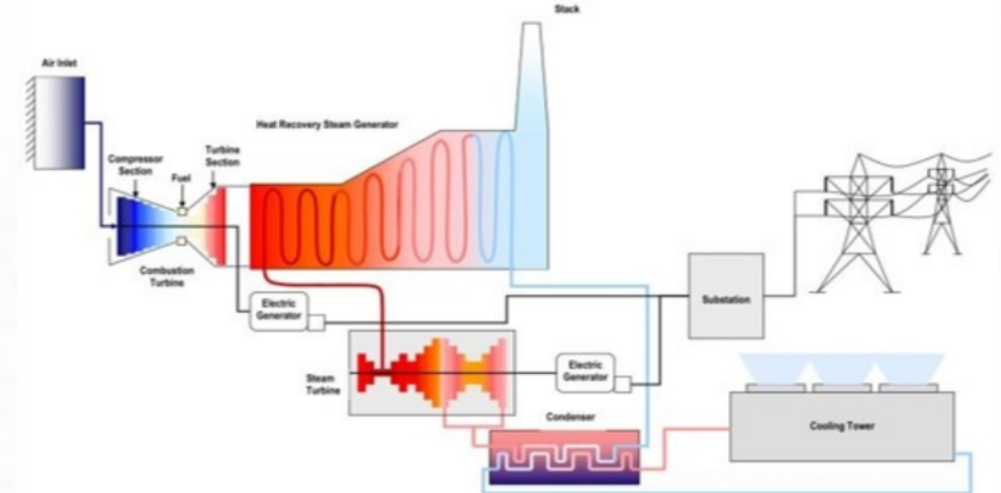
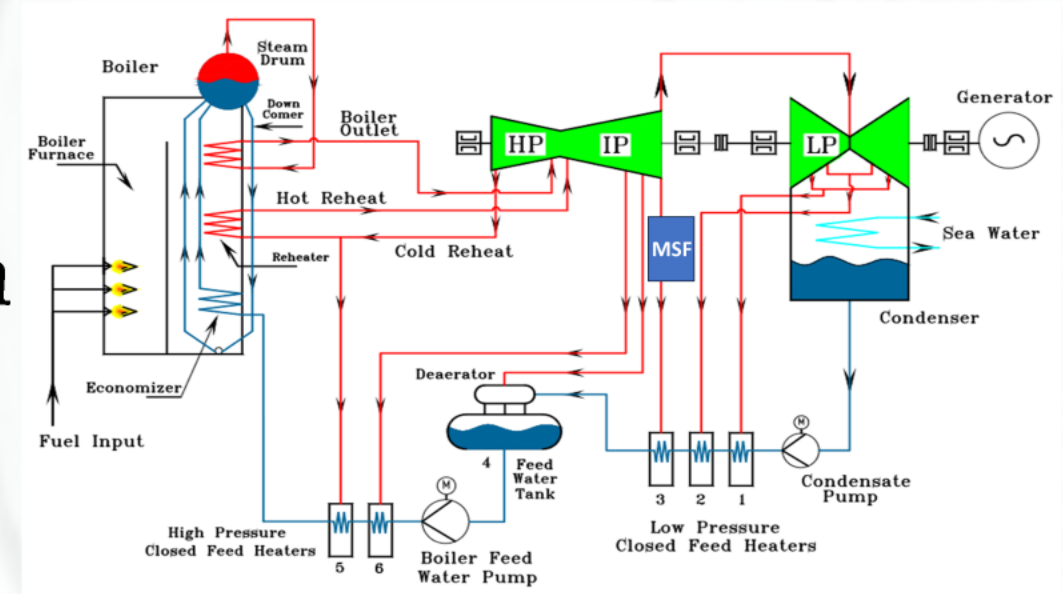
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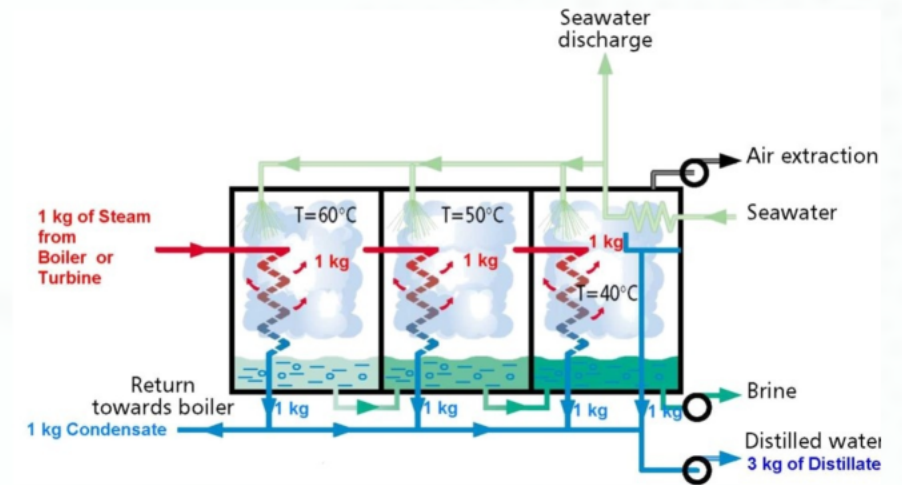
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- Power/Water cogeneration plant
- MED (Multi Effect Desalination)
- RO (Reverse Osmosis)

Water Production

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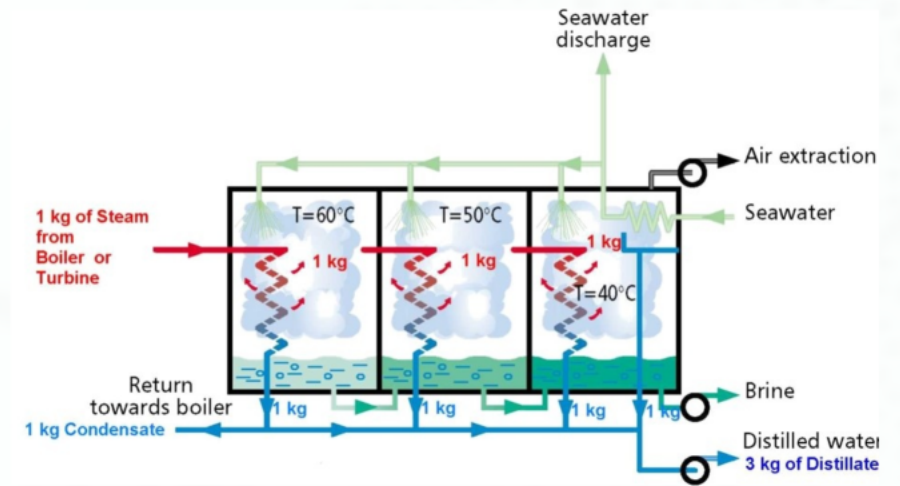
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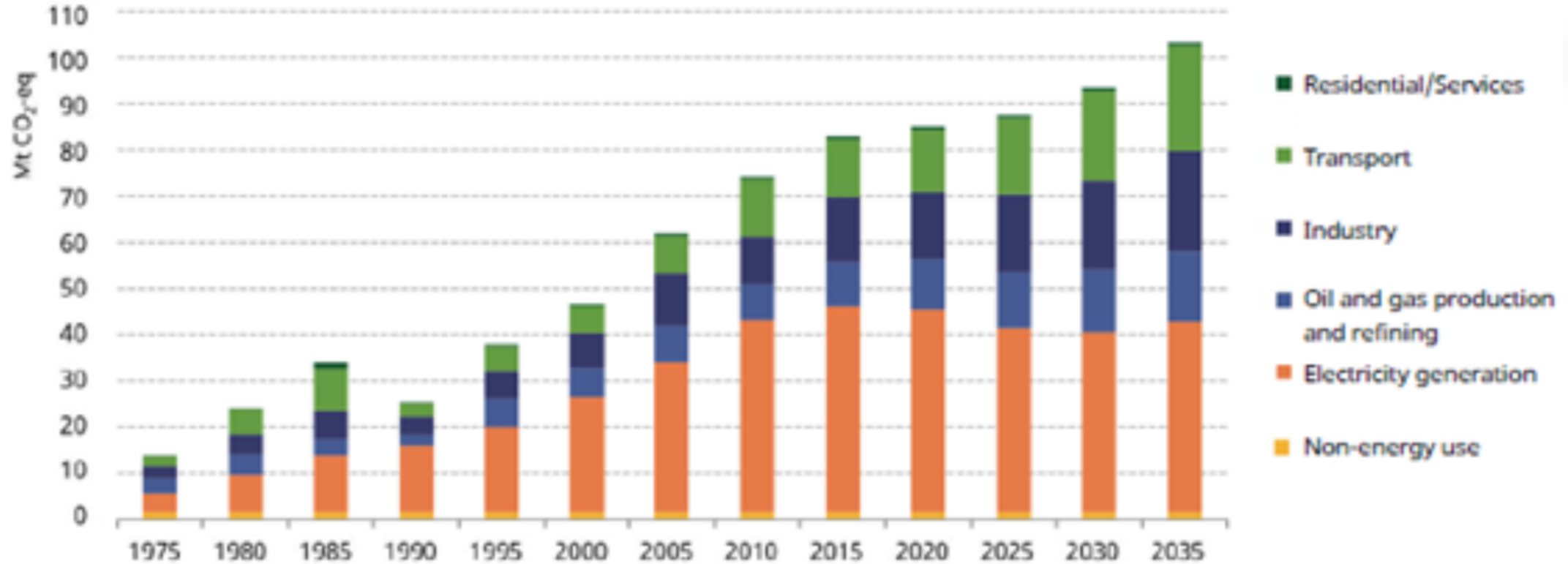
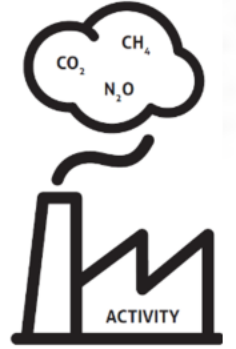
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Improvement**

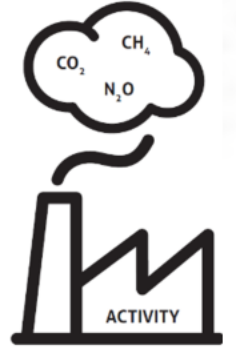
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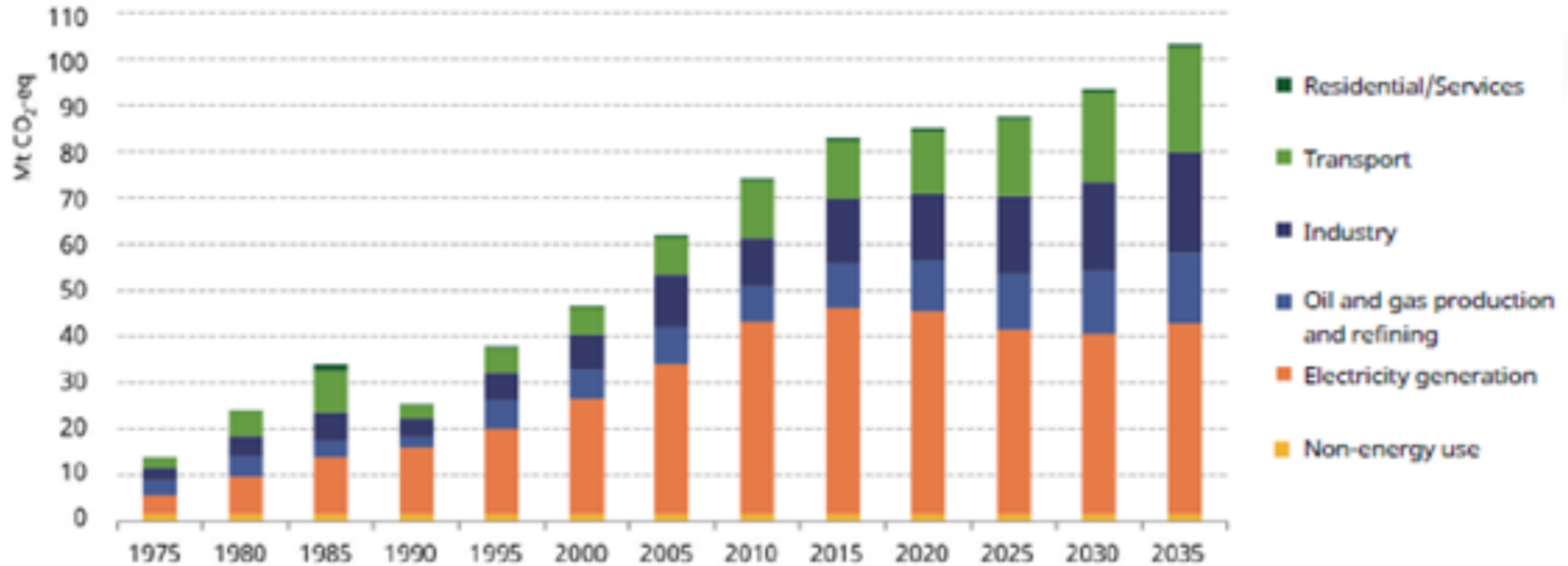
Reducing Green House Gases



Reducing Green House Gases



CO₂eq reduced 5MT from 2020 to 2030





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**Renewable
Energy**

RE Projects

Al-Shagaya Renewable Power Plant Phase I& II & III



Carbon Capture project



Green hydrogen production project





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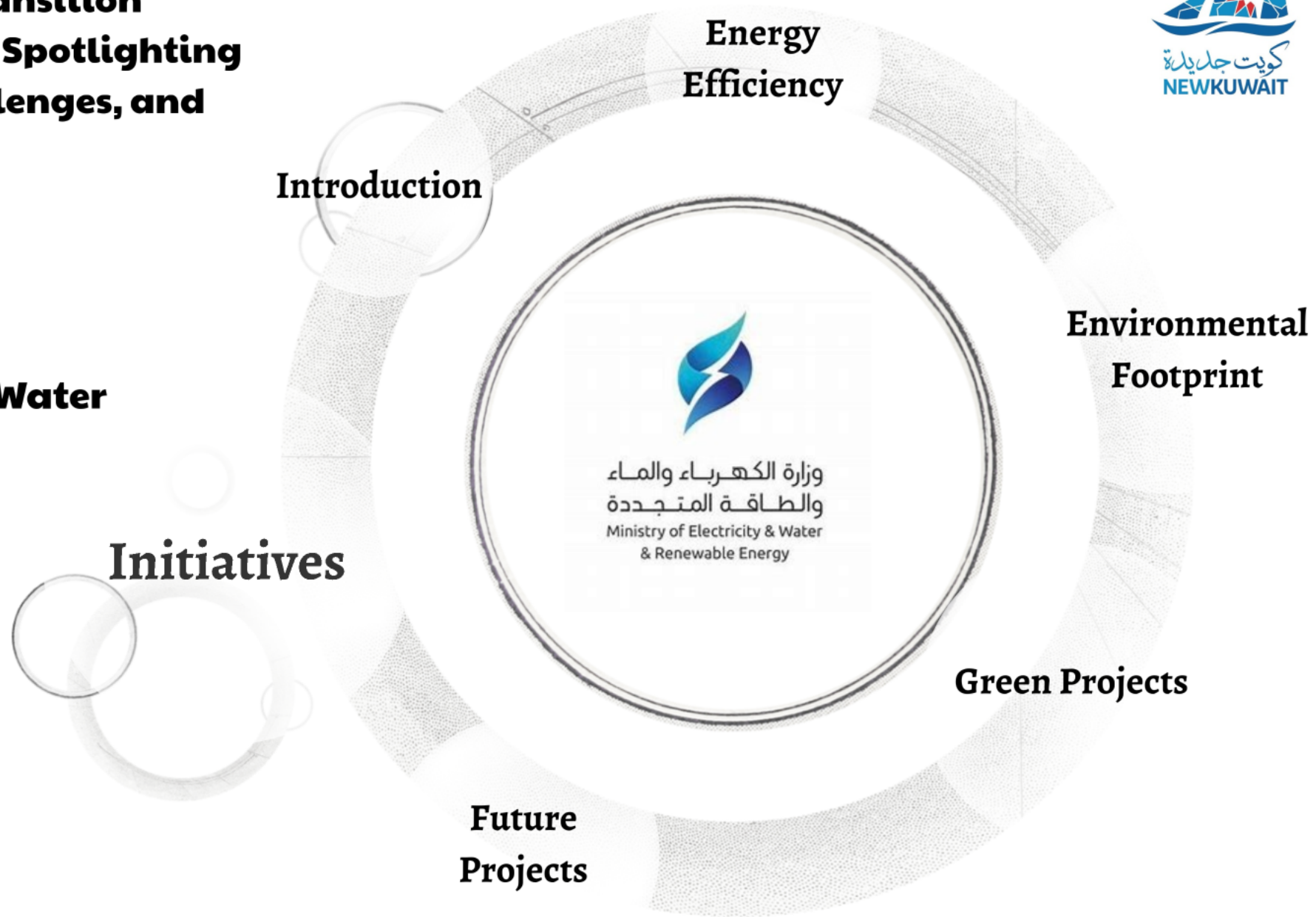
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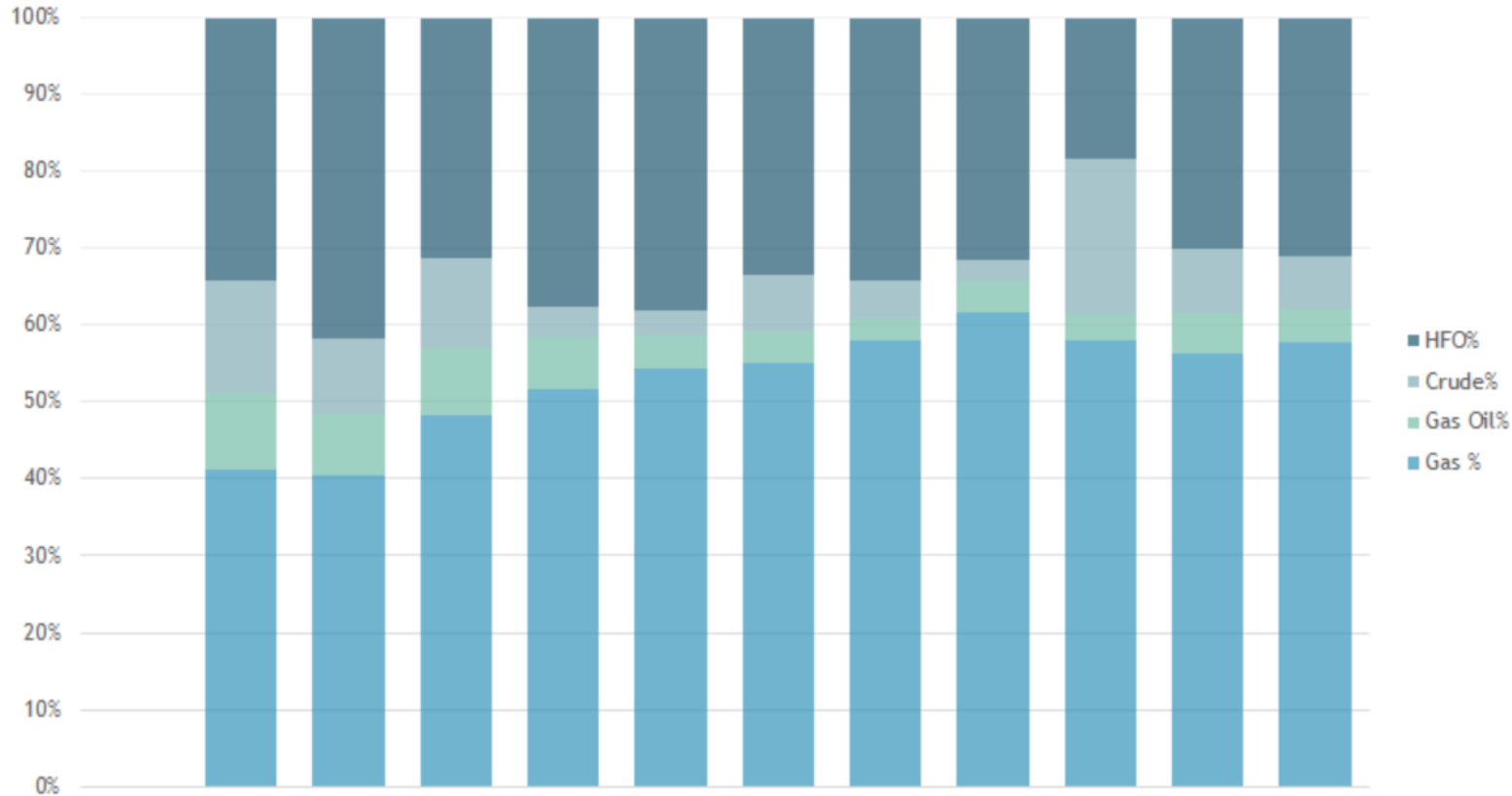
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Eng. Asma Alsallal



Existing Cogeneration Plants

Increase the efficiency of the cogeneration plants by increasing natural gas consumption.

GAS CONSUMPTION (2016-2022)



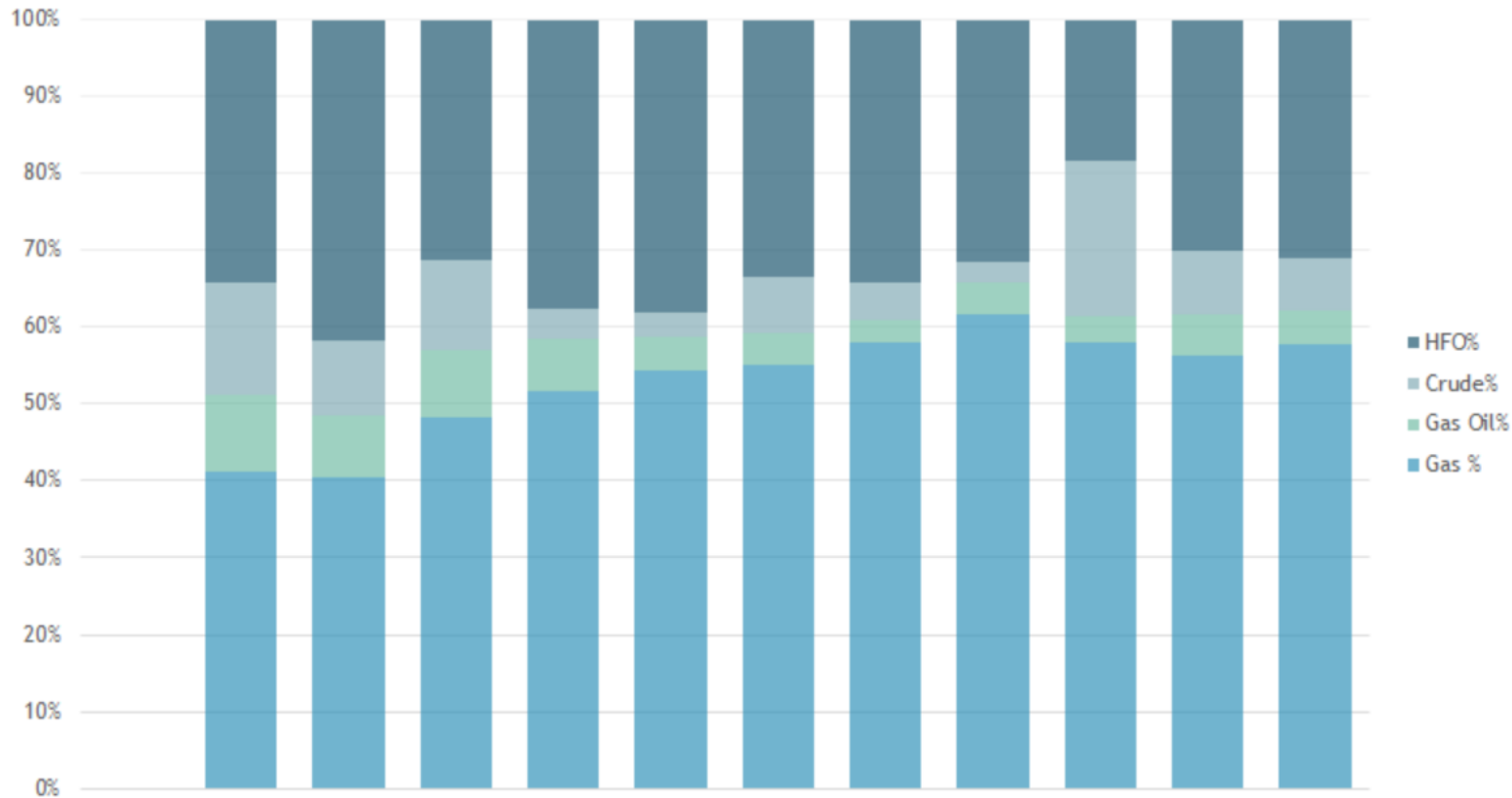
power

water

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GAS CONSUMPTION (2016-2022)



Fuel Gas consumption reached 58% of the total fuel consumption and Kuwait aim to reach 70% by 2035

power

water

Power Generation

CCGT existing projects

- Sabiya west CCGT(1,966.5 MW)
- SN CCGT(cogeneration)(875.5MW)
- ZN CCGT stage -I(1,540MW).

Upgrade existing units to combined cycle (CCGT)

- **Sabiya:**

- I. CCGT-III (930 MW)
- II.CCGT-I (750 MW)

- **ZSPS:**

- I. CCGT-1 (1,600 MW)
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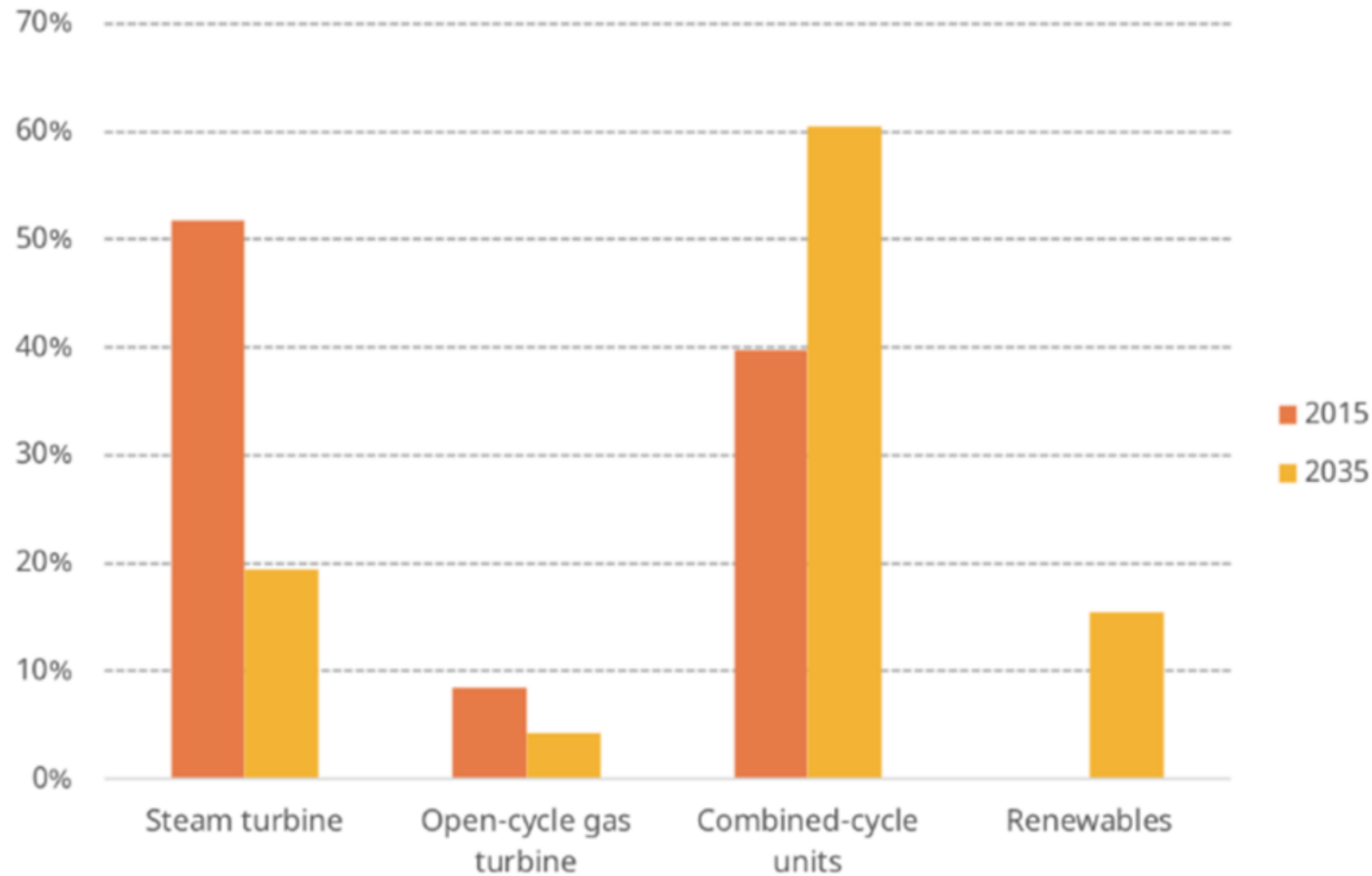
CCGT units can achieve combustion efficiencies of up to 50%

Steam Plant normally achieves combustion efficiencies of between 30% and 34%.

Upgrade exiting boilers to increase the efficiency

Kuwait target to reach 60% efficiency in CCGT

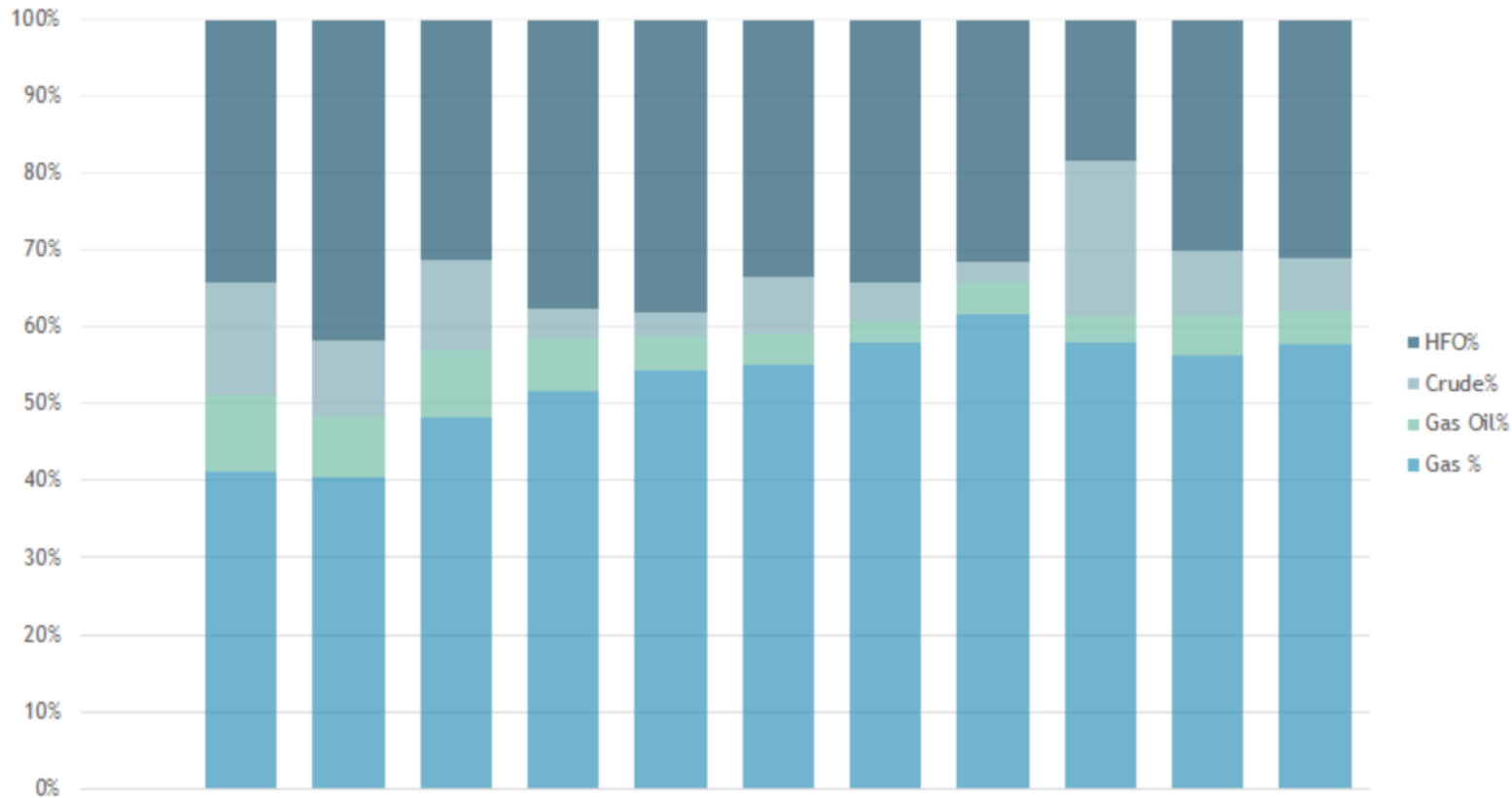
Kuwait Outlook to 2035 for Power Generation



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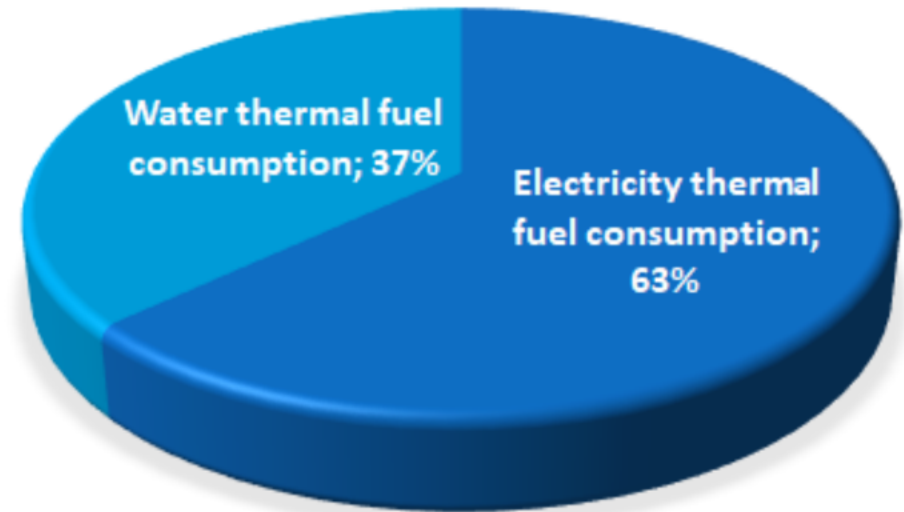
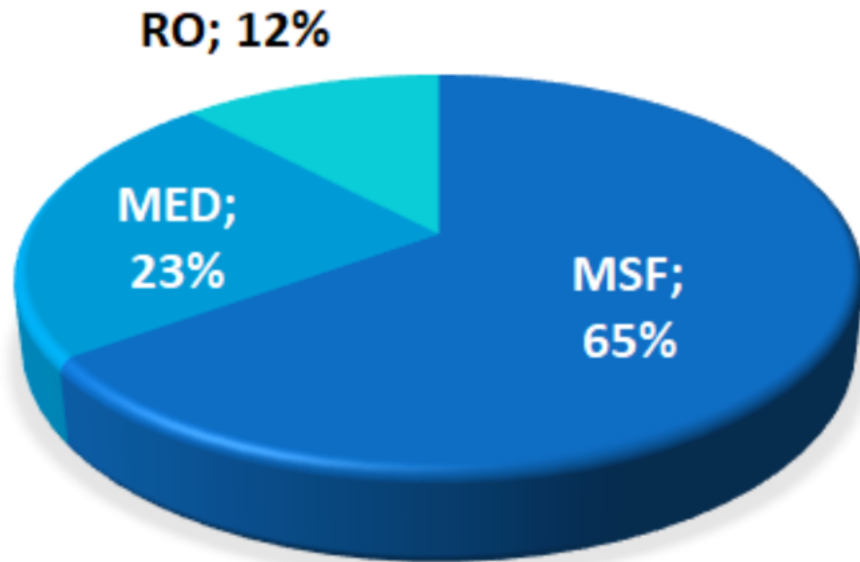
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power

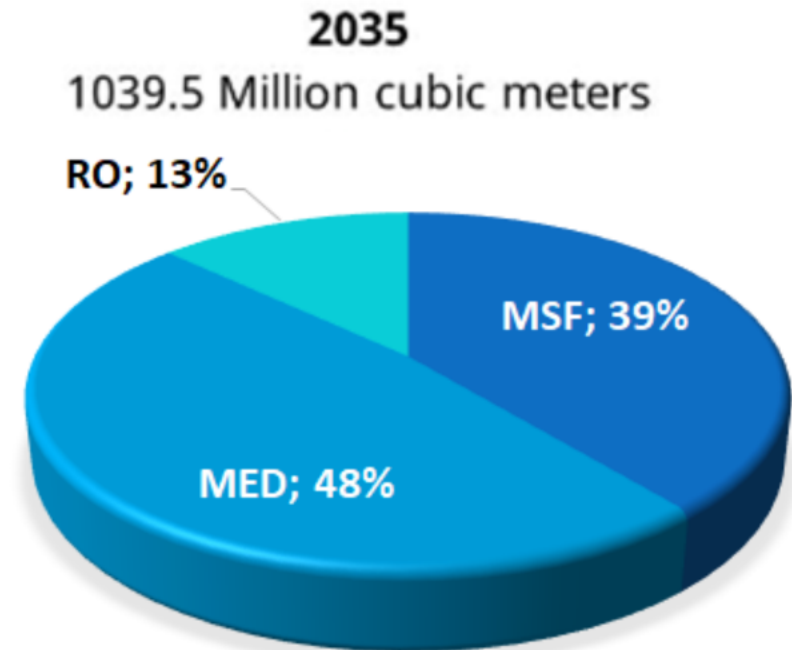
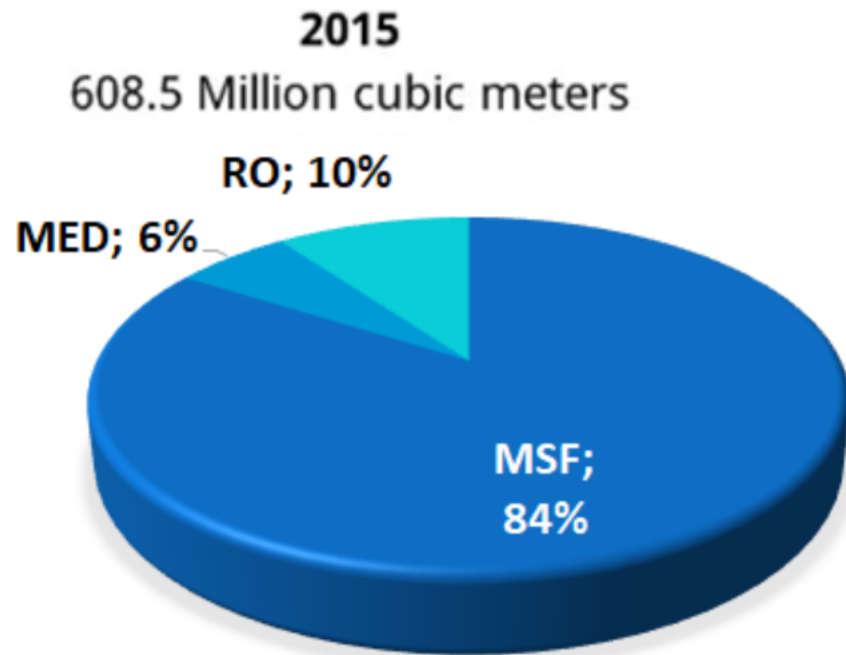
water

Water Production

Improving operation efficiency of cogeneration plants
(MSF, MED, RO)



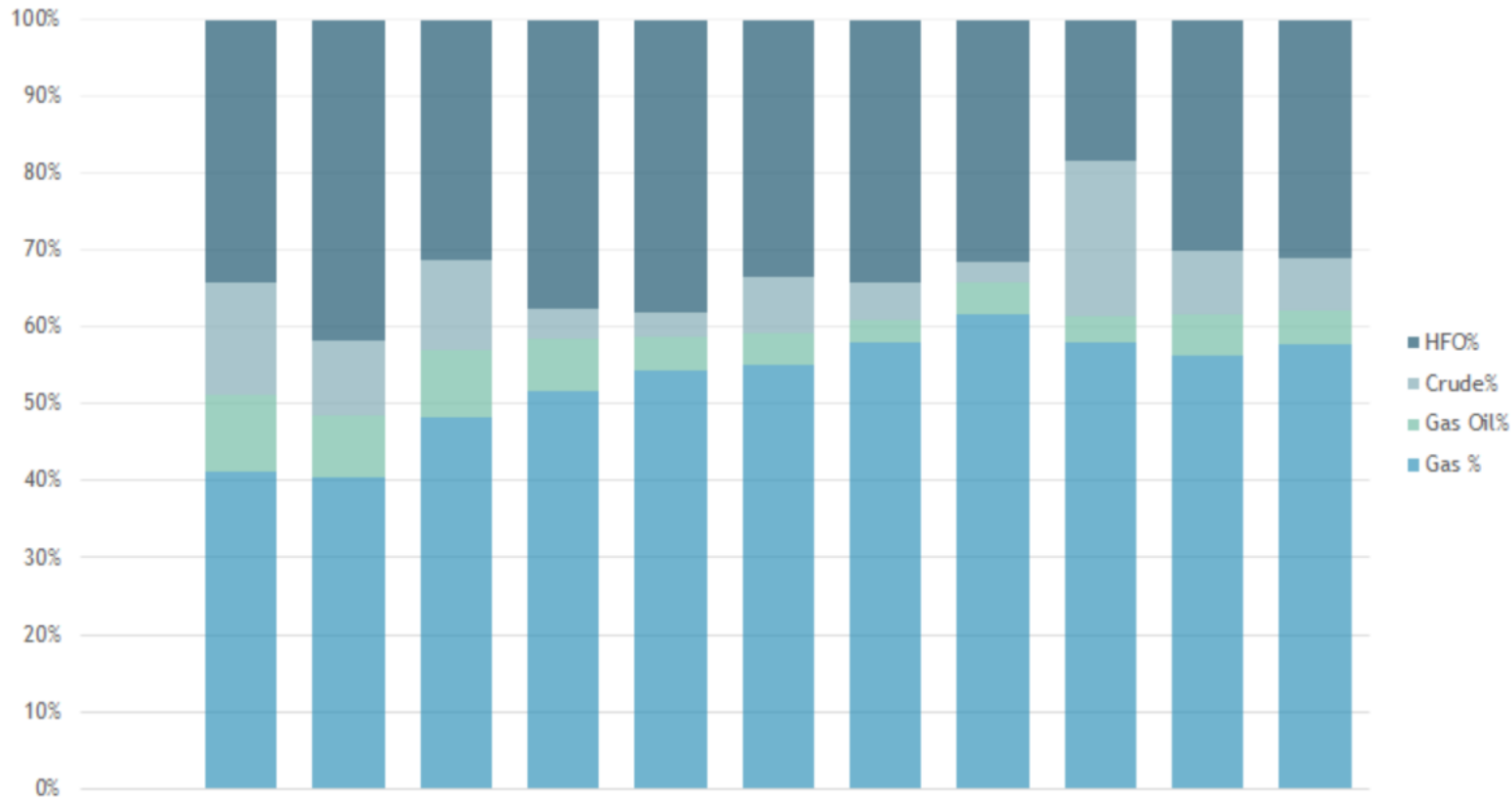
Kuwait outlook to 2035 for water production



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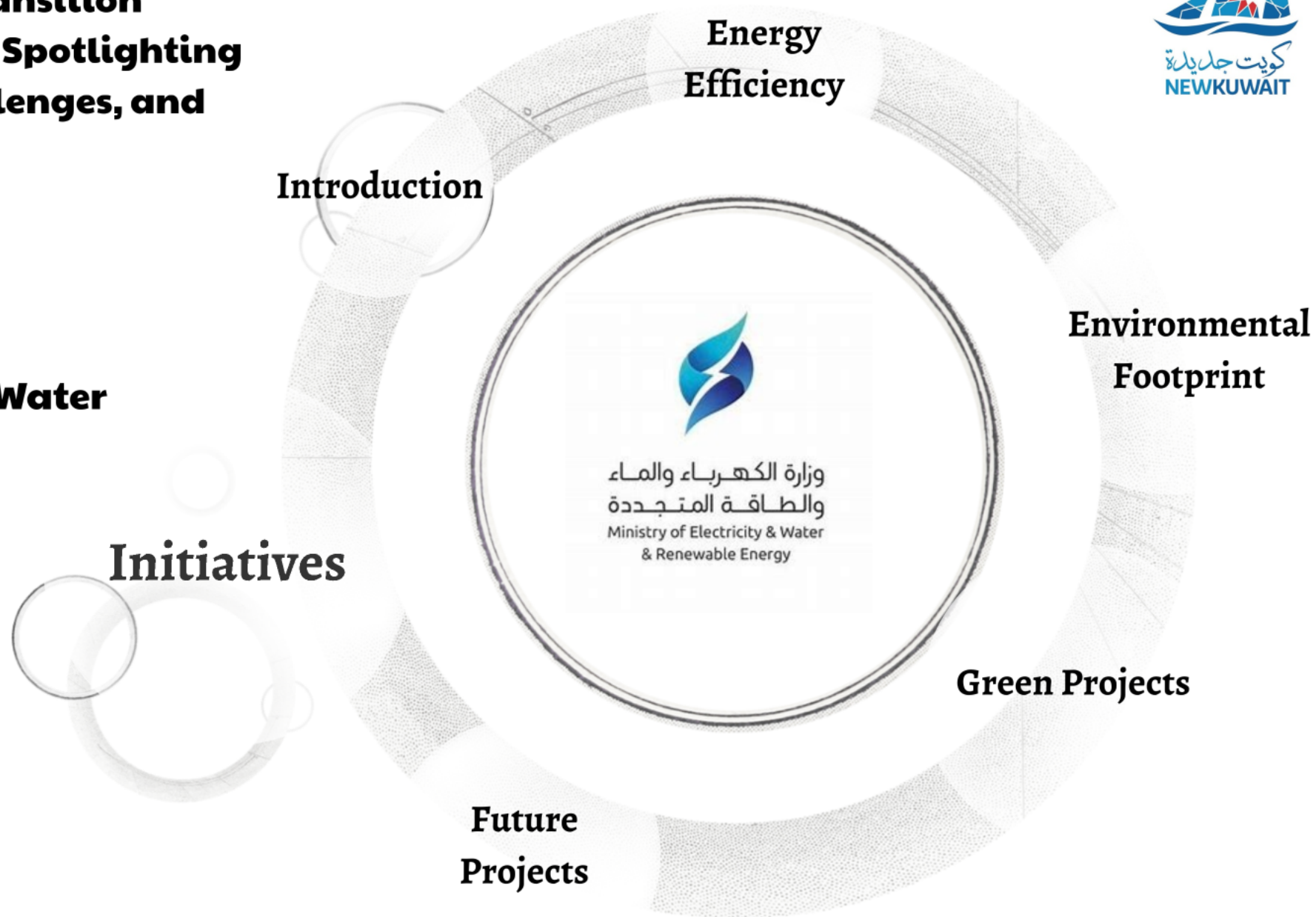
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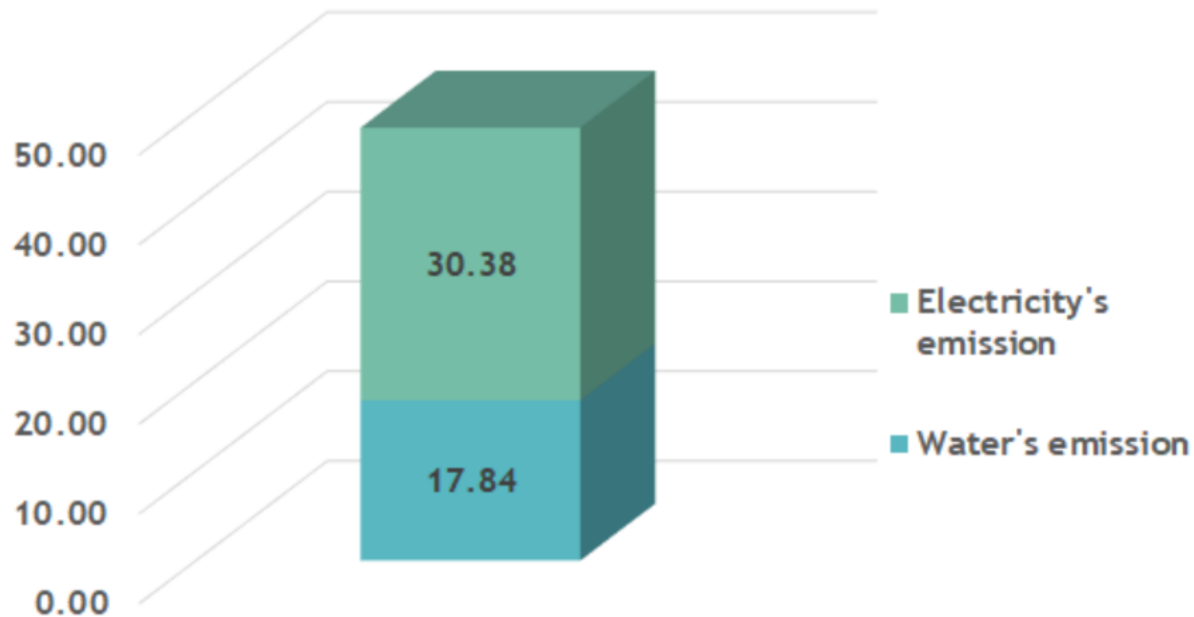
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Total Emissions from Water production and Electricity generation

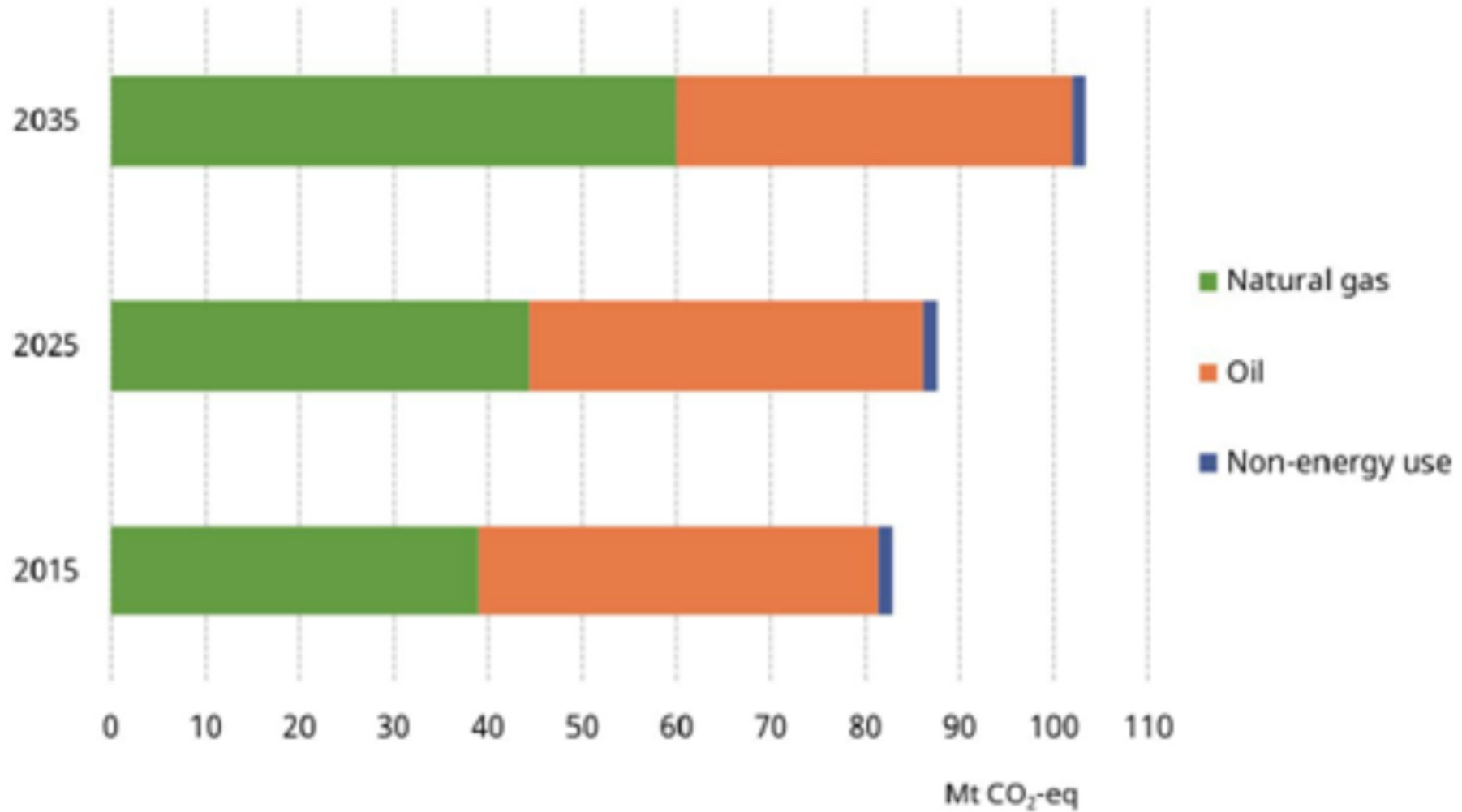
CO₂e total emissions in 2022 = 48 Million Tonnes

Total water and Electricity CO₂ Emission (Million tonnes)



Outlook to
2035

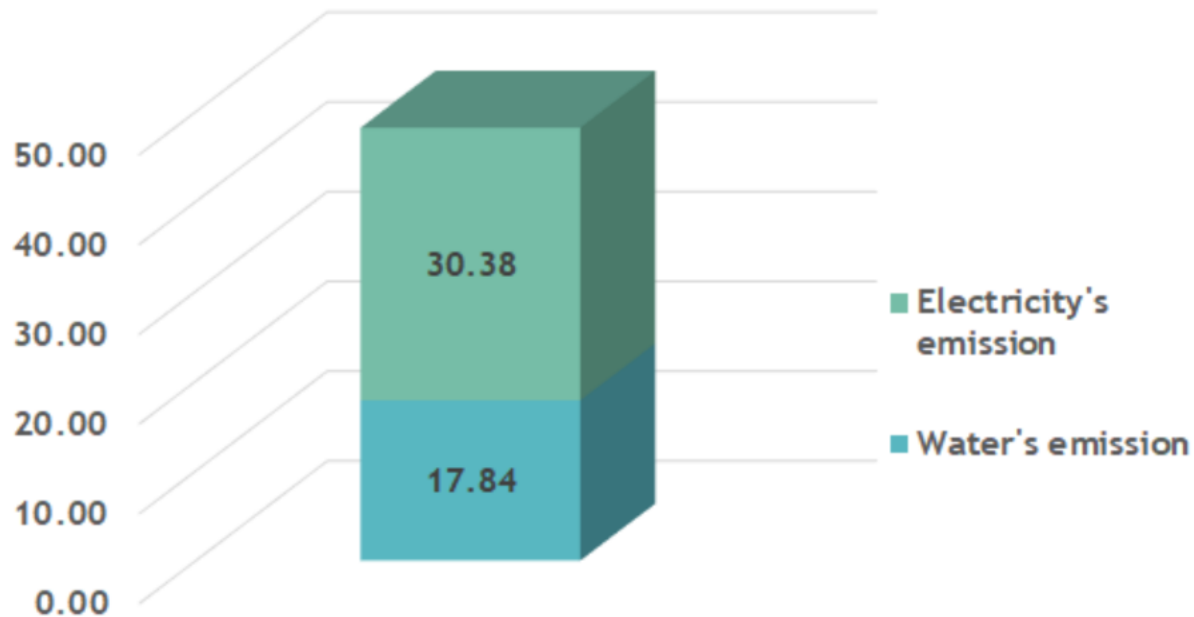
Kuwait's Energy Outlook to 2035



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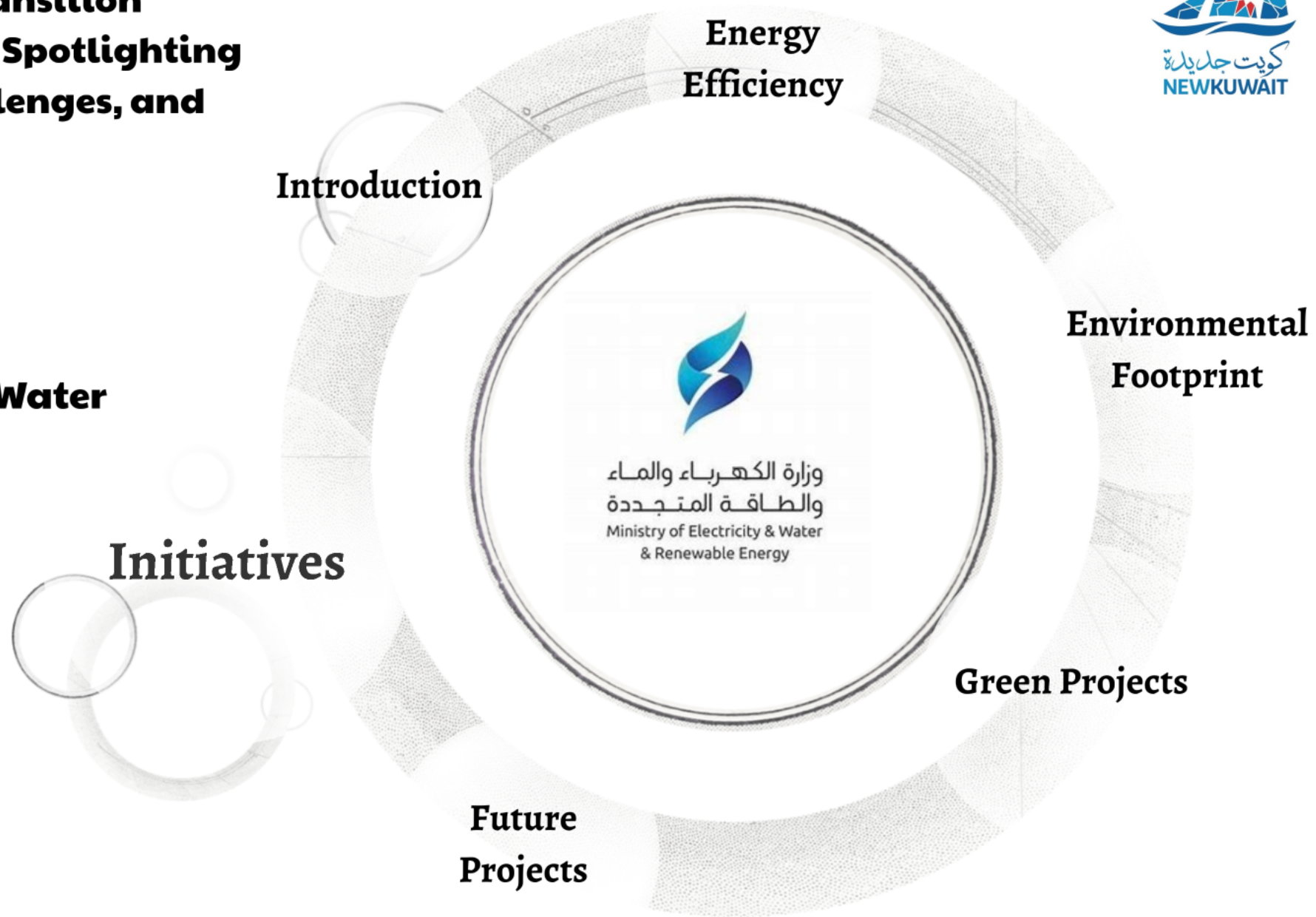
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Outlook to
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Green Hydrogen

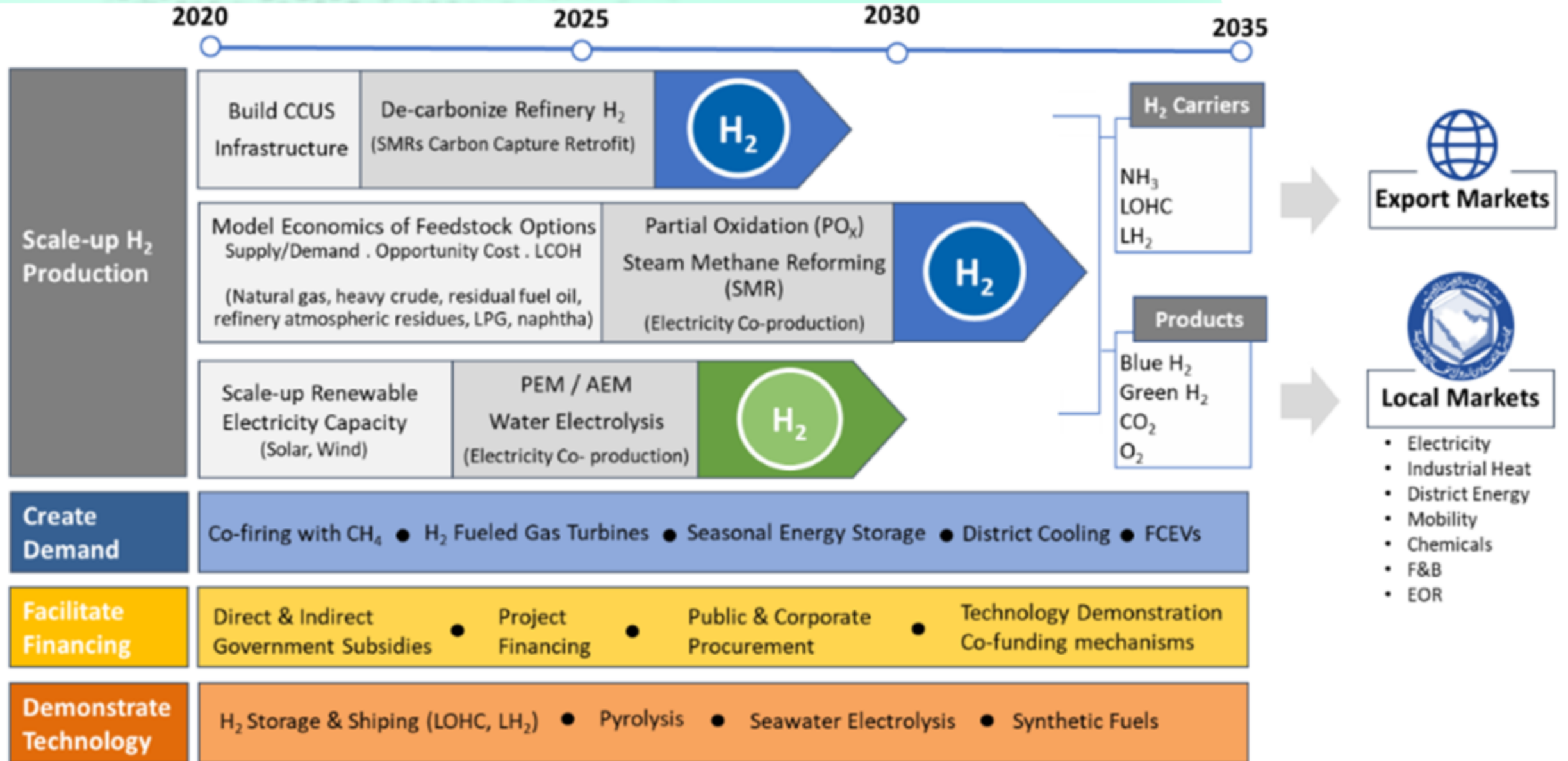
Kuwait is an excellent option to produce low-carbon H₂ at low cost with its substantial hydrocarbon and solar energy resources

A white paper on Kuwait's hydrogen policy has been published on JAN 2021 explained Hydrogen Strategy to energy transition .



H₂
roadmap

H2 roadmap for kuwait



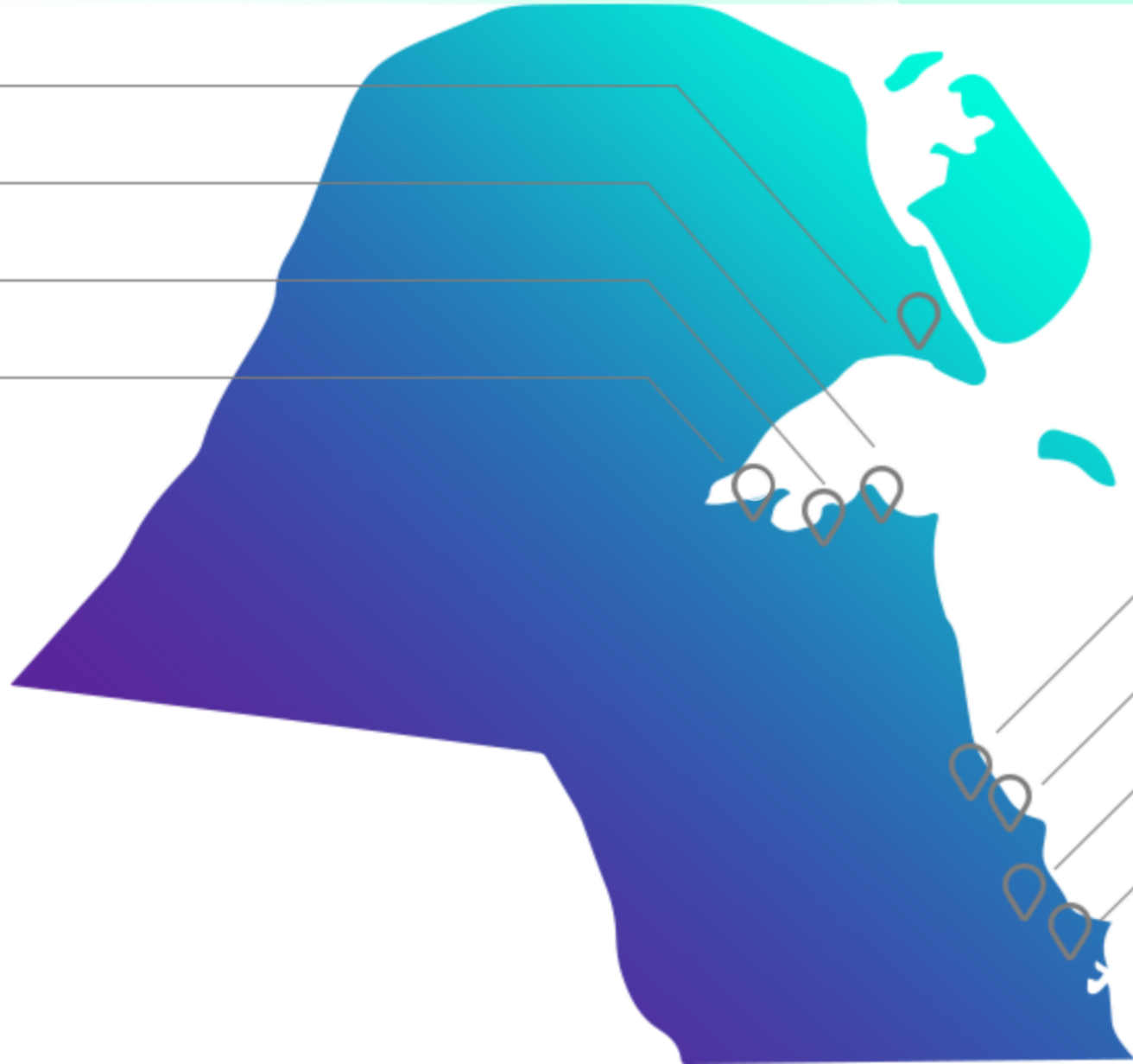
production of green H₂ in MEW

Al Sabiyah Station

Al Shuwaikh Station

Al Doha East Station

Al Doha West Station



Al Shuaiba North Station

Al Shuaiba South Station

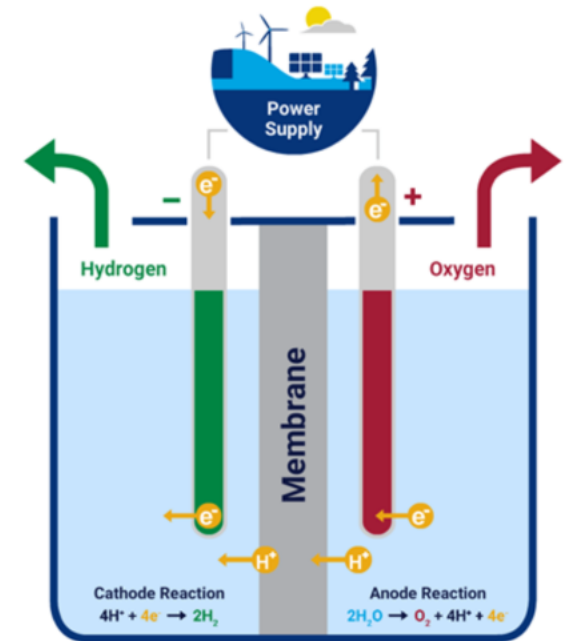
Al Zour North Station

Al Zour South Station

Green hydrogen production strategy in MEW

Chlorine is produced by saltwater electrolysis at the Doha West Power Station and the hydrogen created there is released into the atmosphere as gray hydrogen

Switch the power source used in the chlorine plant to a renewable energy source from the Shagaya power station



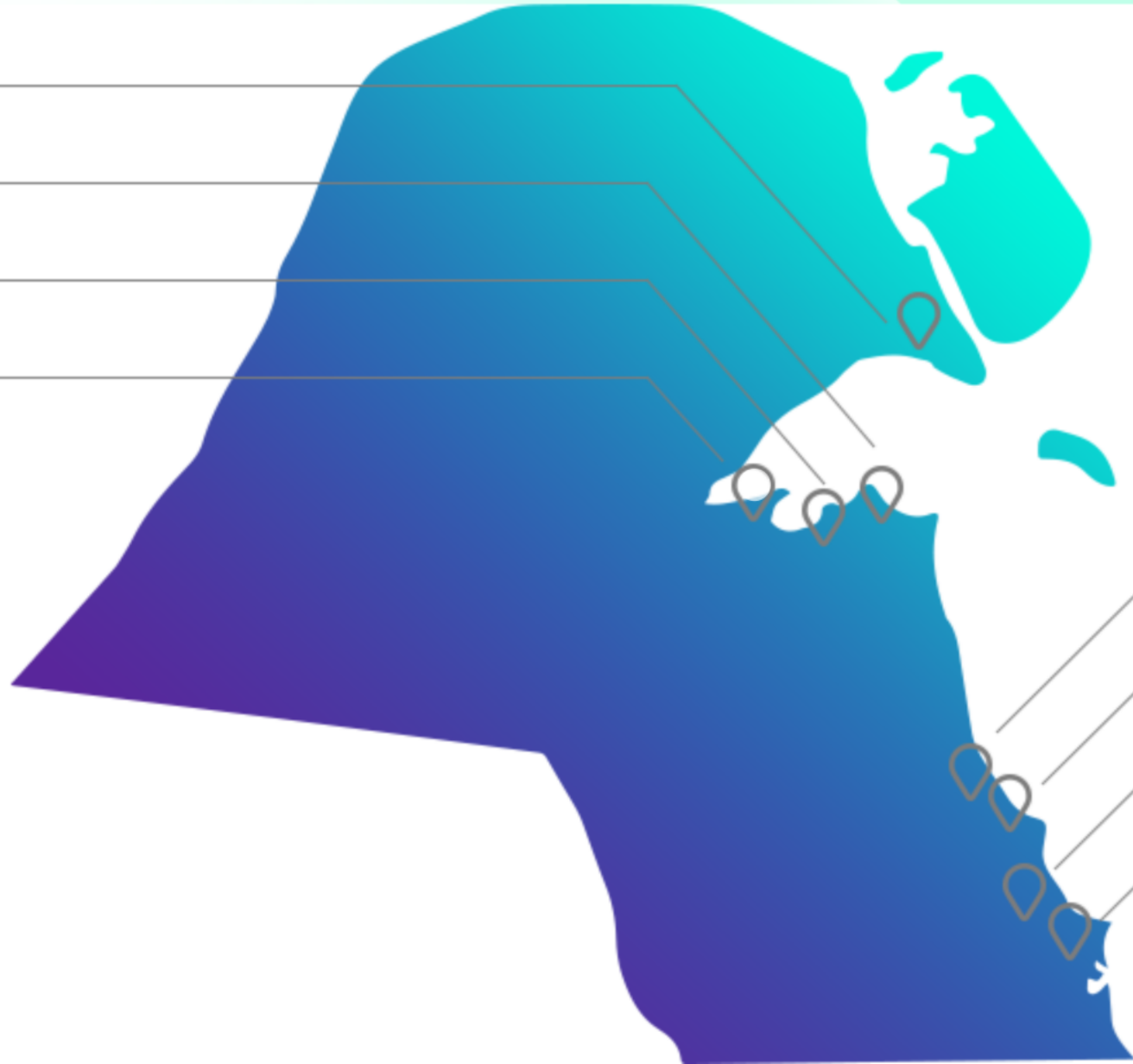
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Al Shuwaikh Station

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Al Doha West Station



Al Shuaiba North Station

Al Shuaiba South Station

Al Zour North Station


Al Zour South Station

	Grey Hydrogen	Blue Hydrogen	Green Hydrogen
<i>Description</i>	Produced from fossil fuels via SMR, ATR, PO _x and gasification	Same as Grey + carbon capture and storage (CCS)	Produced via electrolysis using renewable electricity
<i>Production Cost</i>	\$1.0-\$1.4/kg	\$1.34-\$1.9/kg	\$3.1-\$6.8/kg
<i>CO₂ Emissions Intensity (Inc. upstream emissions)</i>	11.3 -12.1 kg CO ₂ e/kg H ₂ 98.8 – 101.4 g CO ₂ e/MJ	2.3 -4.1 kg CO ₂ e/kg H ₂ 19.6 – 34.5 g CO ₂ e/MJ	0-0.6 kg CO ₂ e/kg H ₂ 0 – 5.3 g CO ₂ e/MJ
<i>Typical Plant Capacity</i>	100,000 ton/year	100,000 ton/year	1,300 ton/year (typical) 20,000 ton/year (expected)
<i>Pros</i>	Low production cost	Low production cost & scalability	Strong synergies with electricity, decentralized, modular, simpler supply chain, produced closer to demand centers, nearly emission free
<i>Cons</i>	High carbon footprint	Requires substantial policy support mechanisms to scale up CCS investment, high capital intensity and barriers to entry, not 100% emission free	Currently expensive and requires availability of large low-cost renewable electricity capacity

Green Hydrogen

Kuwait is an excellent option to produce low-carbon H₂ at low cost with its substantial hydrocarbon and solar energy resources

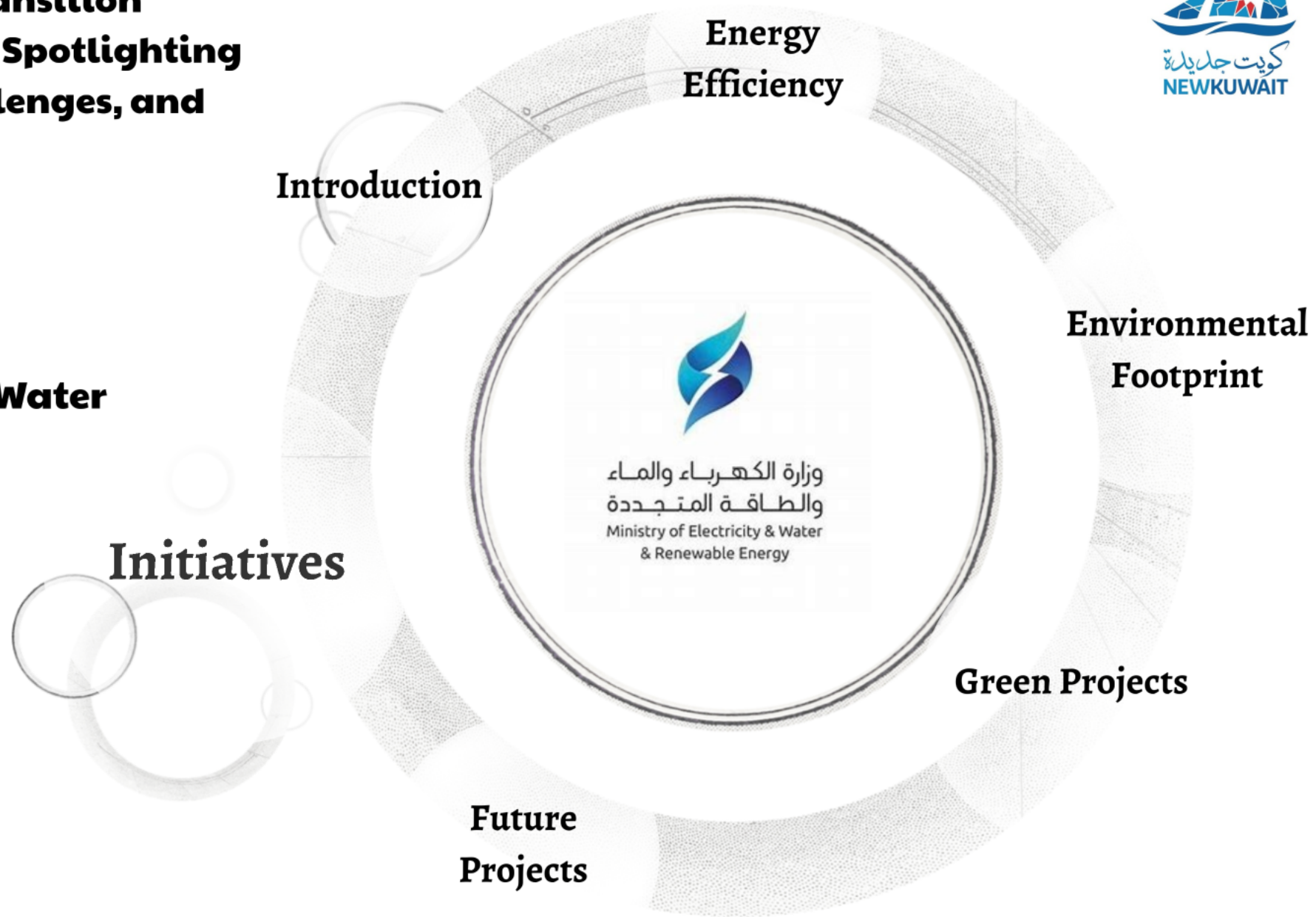
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H₂
roadmap

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Future Projects

Power
Generation

Water
Prouction

CCS

Future project

(ST+GT)

- **SB Stage-II (upgrade)(750MW)**
- **SB Stage-III (900MW) (2026)**
- **ZN Stages II&III(1,800/900MW) (2027)**
- **Alkhairan Stag-I(1,800MW) (2028)**
- **AlNuwiseeb Stage-I(3,600MW) (2028)**

RE project

RE project



**Al-Shagaya
Renewable
PowerPlant
stage II&III**

- **PV (4,300 MW) (2027)**
- **CSP (200 MW) (2028)**

**Al-Shagaya
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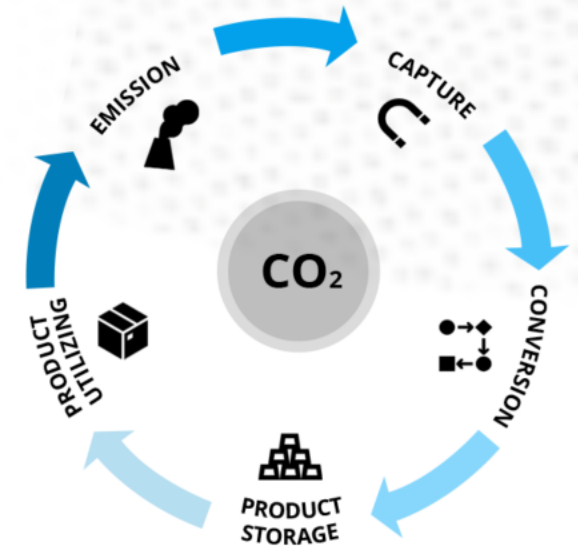
Power
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Water
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CCS

Carbon Capture Project

Separate the CO₂ from other gases and store it to be used in the power/water stations plants or combined with green hydrogen to create green fuel.

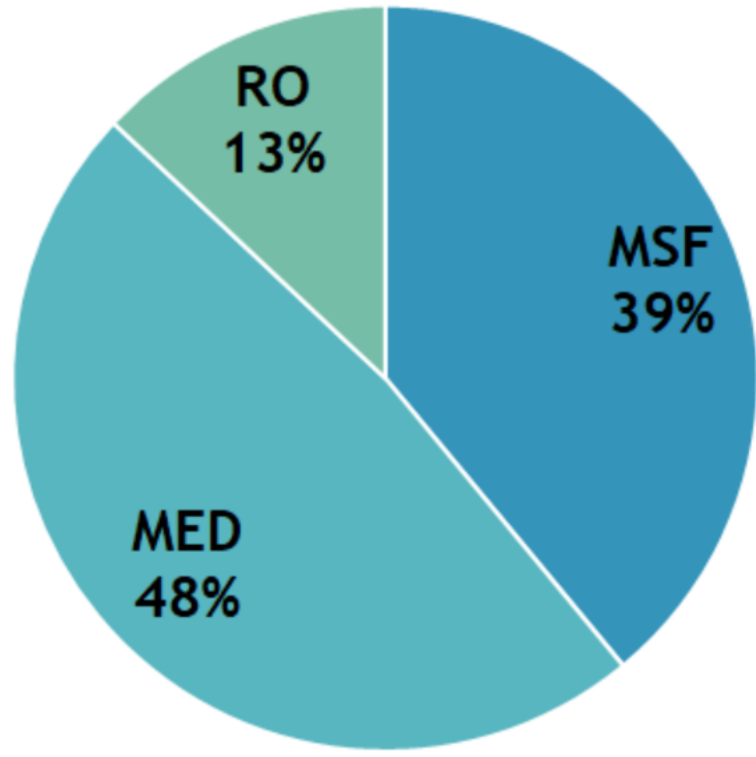


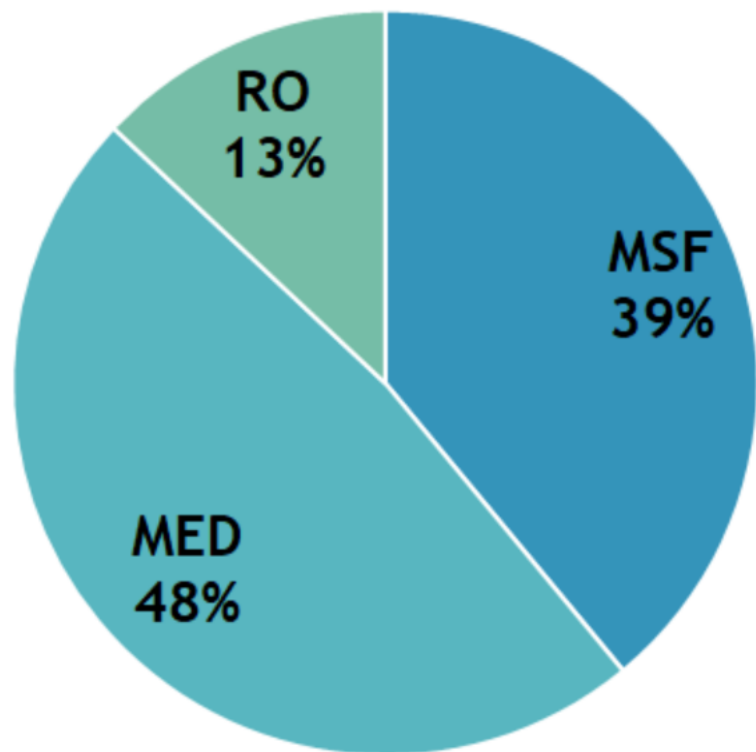
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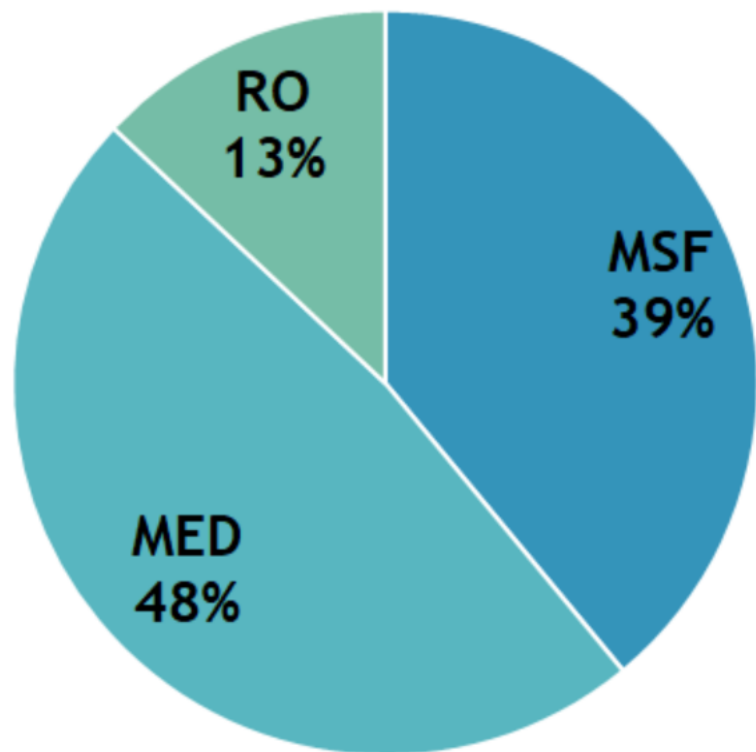
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- **Multi-stage flash distillation (MSF): 39%**
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 - Al-Khairan Phase 1 (2029)
 - Az-Zour North Phase 1&2 (2028)
- **Multi-effect distillation (MED): 39%**
 - Doha west Phase 2 (60 MIG/day – 2025)
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- **Reverse Osmosis (RO): 13%**



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*Al-Khairan = 33MIG/day (MED+RO)

*Az-Zour North = 120 MIG/day (MED+RO)

Future Projects

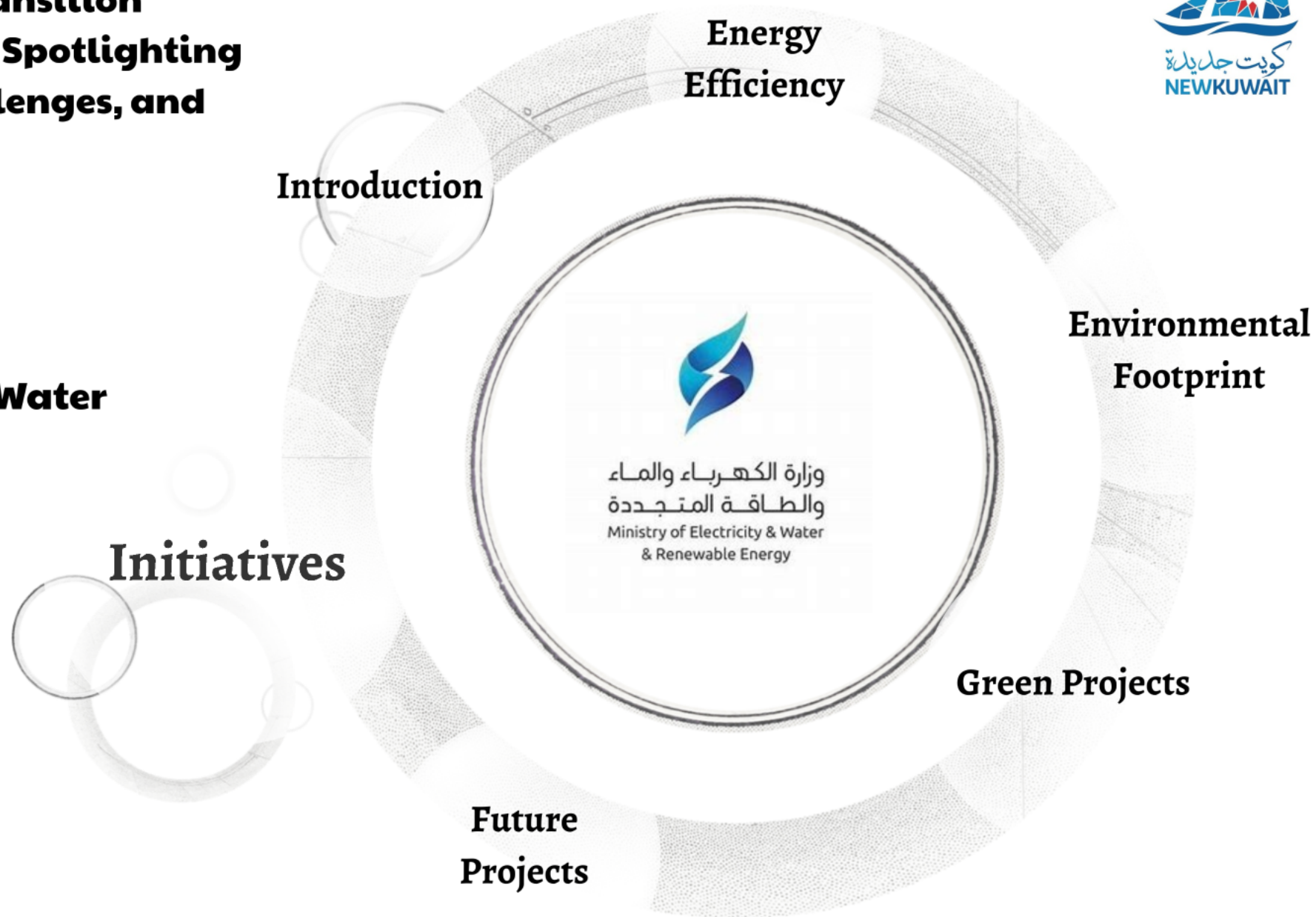
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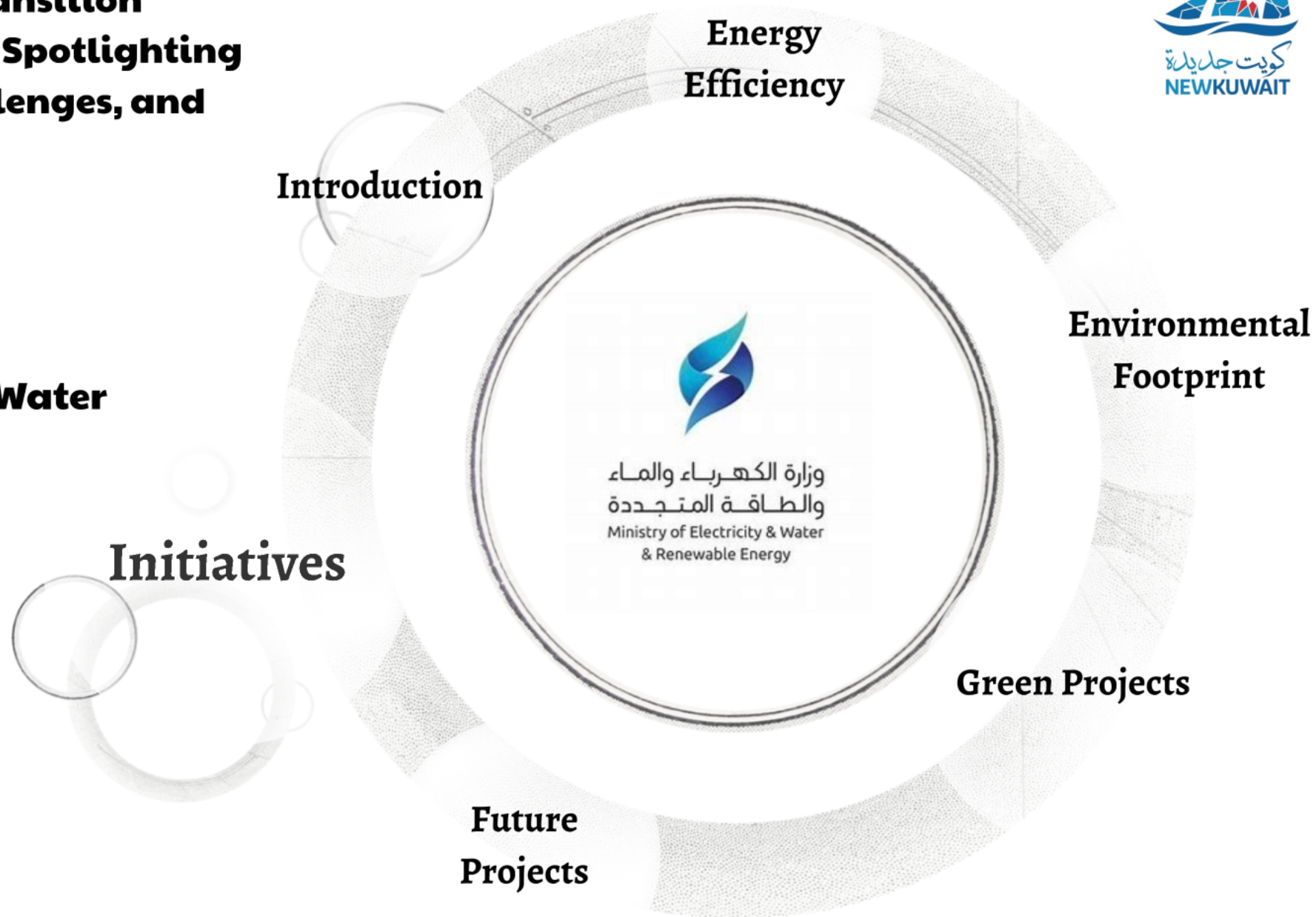
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Initiatives (*Governmental Side*)



1. Improve energy efficiency in new building project.



2. Energy Conservation Code.



3. Initiatives (consumer side)

1. Improve energy efficiency in new building projects:



Low Energy Model House for Public Authority for Housing Welfare in Jaber Al-Ahmed City:

- **House 2035 is a project managed by National Technology Enterprises Company (NTEC).**
- **Project aim to develop and implement a smart eco-house with high-efficiency technologies that lowers energy consumption on Kuwaiti residents.**

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2. Energy conservation Code

- R-6/2018 (provide minimum requirements for the energy efficient design of government and commercial buildings in Kuwait.
- There are several codes from the Public Authority for Industry.



Initiatives (*Governmental Side*)



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3. Initiatives (consumer side)

3. Initiatives (Consumers Side):

1. Using Smart Meters.
2. Incentives for consumers.
3. Rationalization campaigns.
4. Revising tariff supports for industrial, commercial sectors.



1. Using Smart Meters



- **Phase I: 130,000 electrical meters was installed**
- **Phase II: 500,000 electrical meters & 200,000 Water Meters**
- **Future Cities: Full smart**

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