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TWAS-AREP Young Scientists Training Program
Path Ways to Green Transition in the Arab Region

Energy Transition Pathways in the Arab Region: Unleashing a Sustainable Future

Presented By

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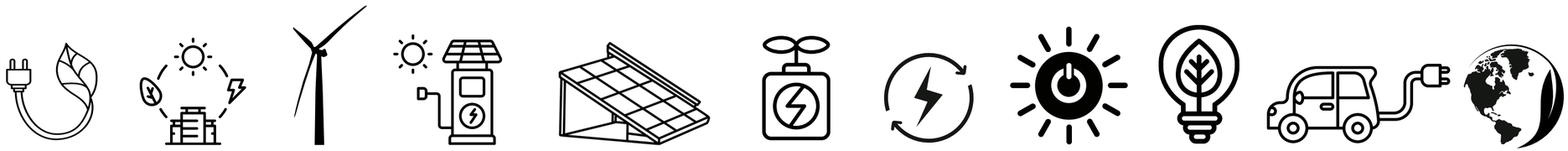
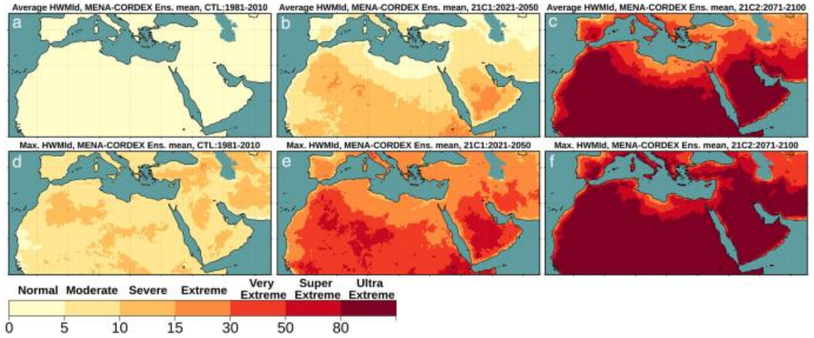


Arab region Context

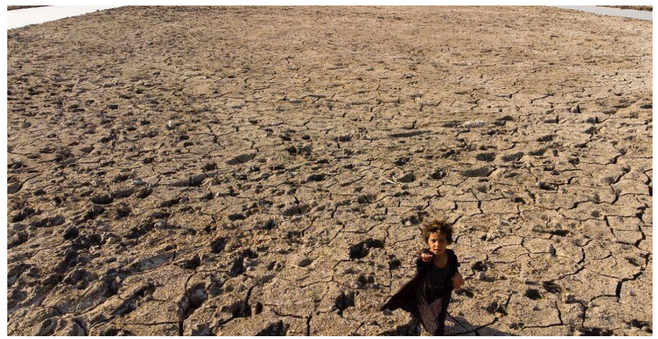
- 456 million inhabitants (5.6% of world population) - in 2021, with 3% annual population growth.
- 59% of the population are living in urban areas while the average urbanization growing rate is 1% between 2015 and 2020.
- 55% of oil reserves and 24% of gas reserves worldwide!
- 6.3% annual electricity demand growth (15 years average)
- 4.9% annual primary energy growth (15 years average)
- 4.5% annual GDP growth (15 years average)
- Electricity accounts for 17% of final energy consumption, of which the residential consumes 42%, and the industrial and commercial sectors consume 22% and 16%, respectively

Climate Change Vulnerabilities in the Arab region

The Arab region region is warming at a faster rate than the global average. This is due to a number of factors, including the region's location in the subtropical and tropical latitudes, its arid climate, and its reliance on fossil fuels.



Increased heat waves.



Drought.

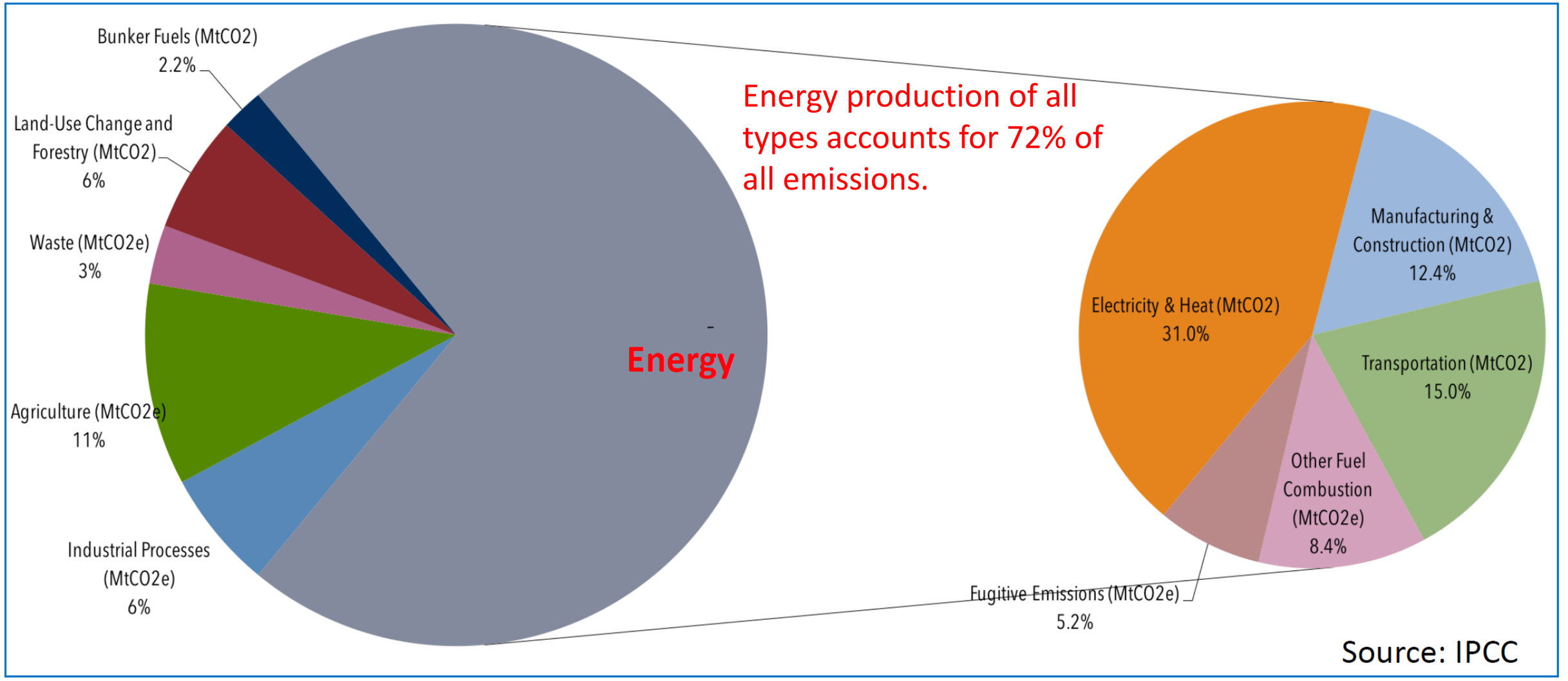
Floods.

Arab region's contribution to global greenhouse gas emissions

According to the Global Carbon Budget 2023, the Arab region was responsible for approximately 6.7% of global GHG emissions in 2021. This is an increase from 6.2% in 2020.

Sector	% of Total Emissions
Fossil Fuel combustion	75%
Industrial Process	15%
Agriculture	10%

Why is Energy Transition needed?



Energy is the main source of GHG emission in the world

Why is Energy Transition needed?

- Energy security
- Commercial balance
- Energy subsidy reduction
- Economic growth engine

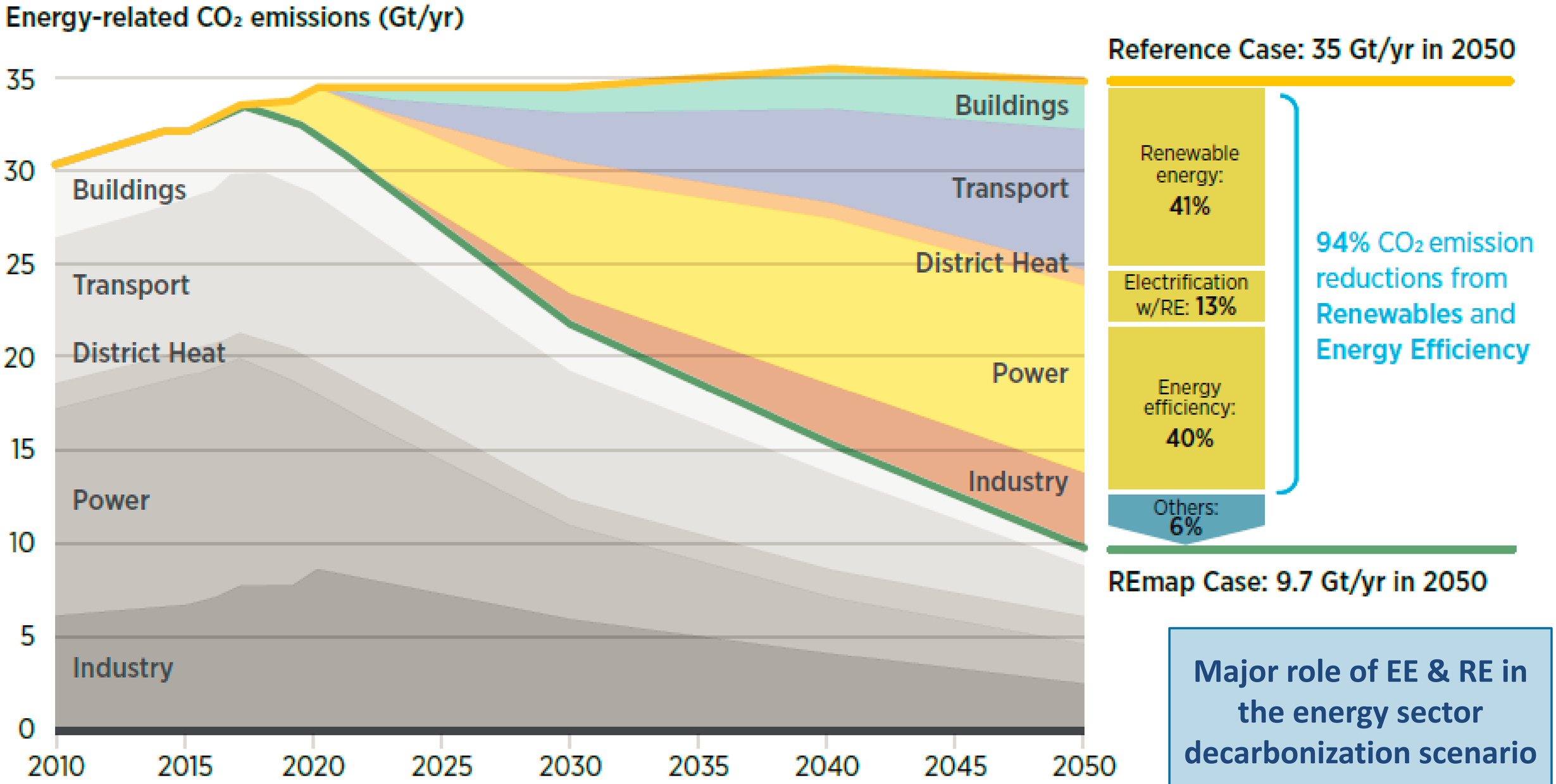
Need for Energy sector decarbonization to meet 2°C scenario of Paris Agreement

- Energy poverty fighting
- Energy access
- Job creation

Energy Transition lead to win-win situation for both:

- Energy net importing countries
- Energy net producer countries

World Energy Sector decarbonization scenario



Major role of EE & RE in the energy sector decarbonization scenario

Technology needs: key energy sector decarbonization drives

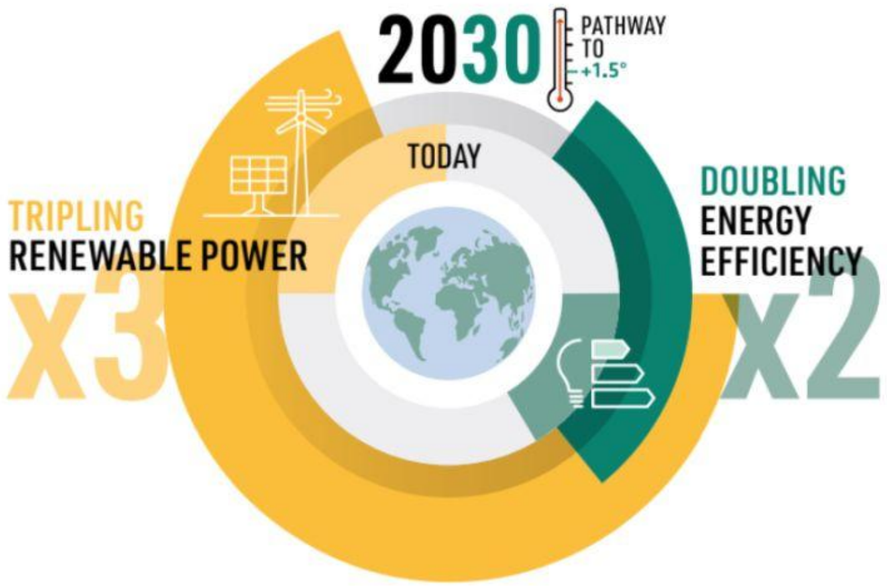
Sectors	Main drives energy decarbonisation in economic sectors
Transport	• Modal change: rail way, collective transport, soft transport, etc.) • EE in cars and all transport means • Massive introduction of electrical vehicles • Electrification of rail ways
Industry	• Energy efficiency in process • Efficiency of utilities (motors, compressed air, heat, cold..) • Thermal use of RE (Solar and biomass) • Electrification of uses
Buildings	• Energy efficiency of envelop and appliances • Solar thermal and biomass for heat (when available) • Electrification of residential use (heat pumps, etc.)
Agriculture	• Efficiency improvement of agriculture machineries • Solar thermal use • Electrification of water pumping
Power sector	• Losses reduction • Power generation specific consumption improve • Massive RE integration in the Power System

Large needs for:

- **Expertise and technology transfer**
- **Capacity building**
- **Sectors' reform**
- **Investments**

COP28 outcomes: tripling renewable power and doubling energy efficiency by 2030

COP28 UAE



RENEWABLE POWER

x3

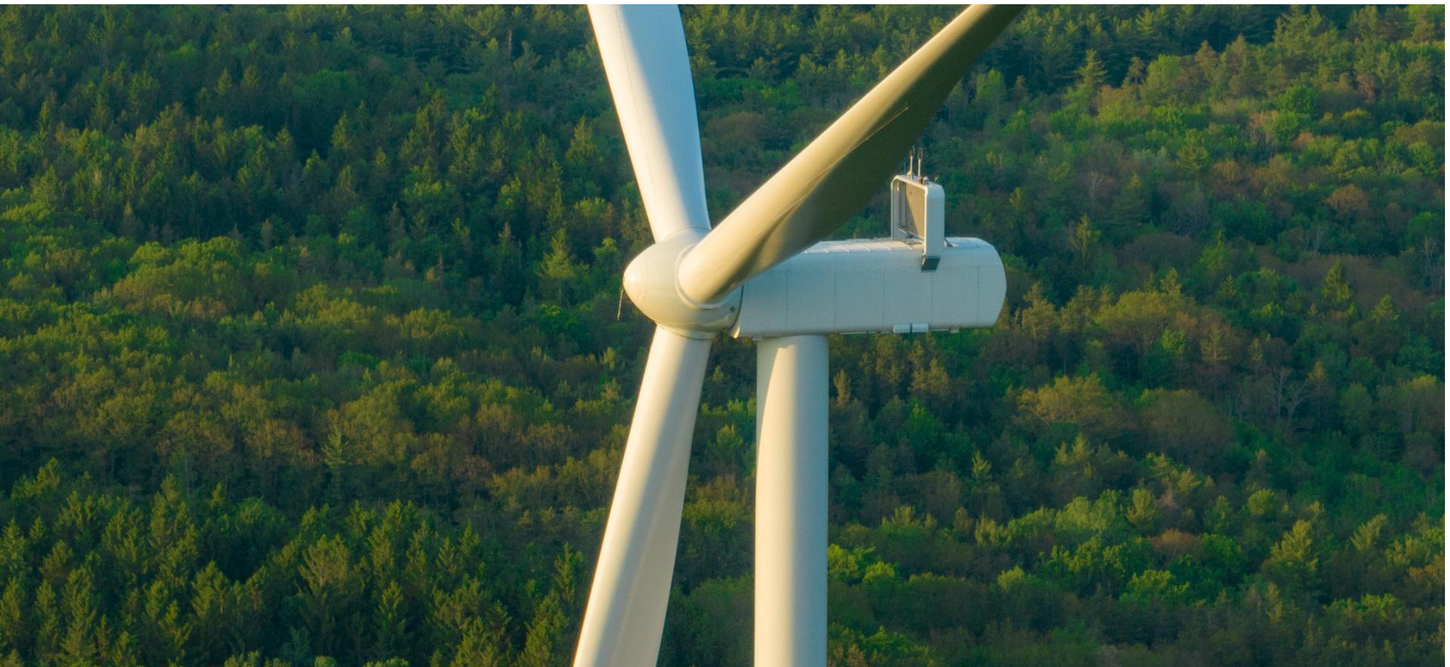
> 11 000 GW

ENERGY EFFICIENCY

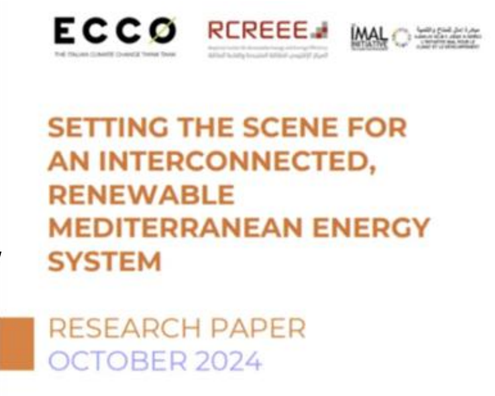
x2

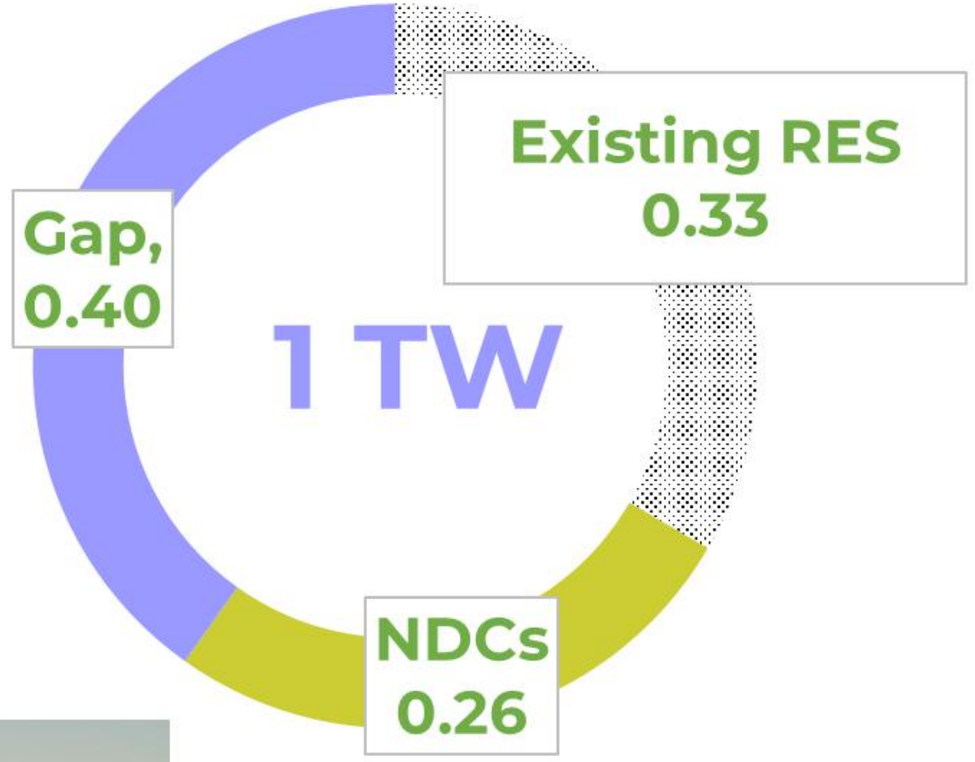
TOWARDS THE 1 TERAWATT BY 2030: THE GAP

•According to our preliminary elaborations (after calculating installed capacities and NDC targets by 2030, the gap to 1 TW is 400 GW.
•Investments to fill the gap: ~700 billion $
•Opportunities for around 3 million new jobs only in the solar and wind supply chains
•500 megatonnes of carbon dioxide equivalent reduction potential!



Potential of wind & solar:
•Southern shore: ~3.5 TW (1 TW wind, 2.5 TW PV)
•Northern shore: ~1.5 TW (0.8 TW wind, 0.7 TW PV)





From fossil flows to renewable cooperation - tripling renewables in the Med

Deployment of renewable power is accelerating across the Mediterranean, with the region on track to double renewable capacity by 2030 – but falling short of the TeraMed Initiative's objective of reaching 1 TW, highlighting the need to move faster, together.

Published date: 2 April 2025
Lead author: Elisabeth Cremona
Other authors: Sarah Brown

626 GW

Expected renewable power capacity in the Mediterranean by 2030

x2

Renewables deployment rate from 2023 to 2030 is double that of the previous seven year period

54 GW/yr

To reach 1 TW renewables by 2030, an additional 54 GW per year needs to be deployed over and above planned capacity expansion

TOWARDS THE 1 TERAWATT BY 2030

THE BENEFITS OF TERAMED

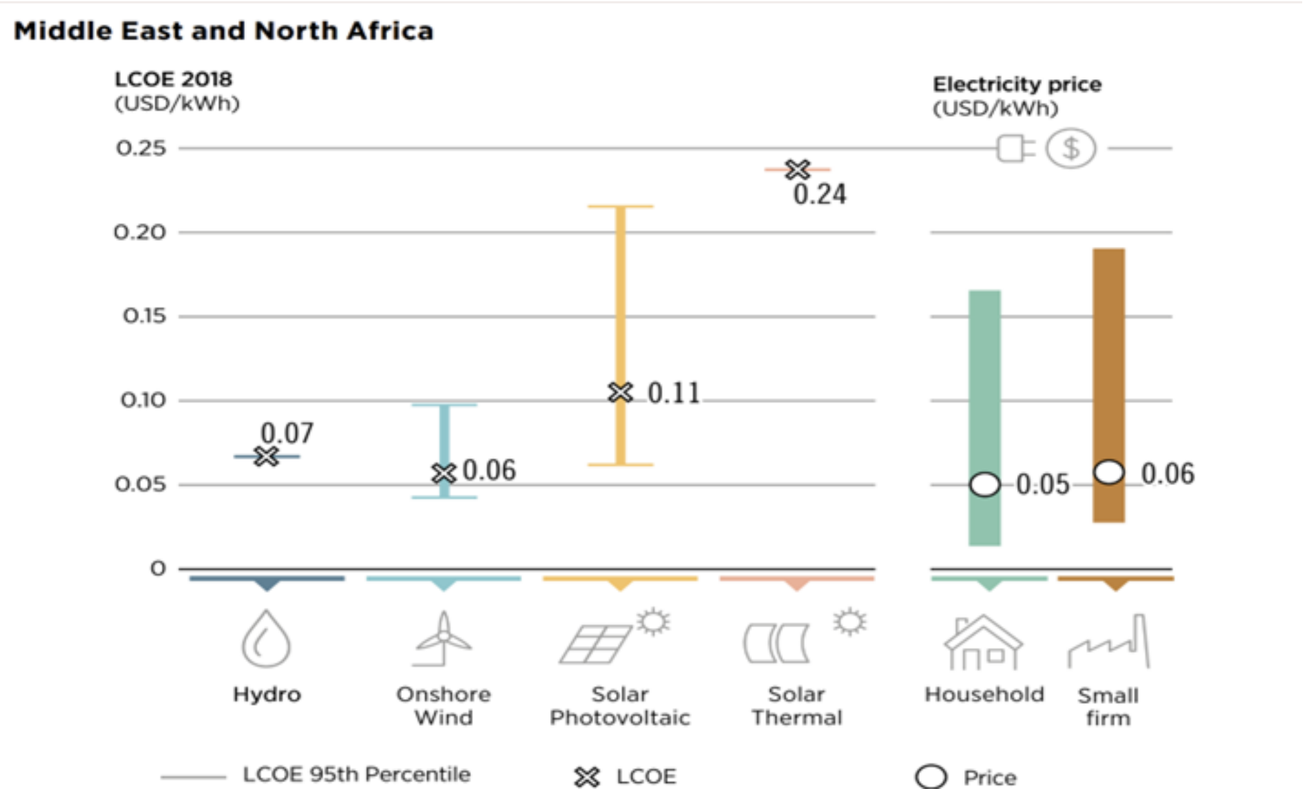
LONG TERM

- Strengthen regional security and prosperity through an accelerated energy transition.
- Industrialization and economic growth in the Southern shore by transforming the economy through improved infrastructure, decarbonized and more flexible supply chain.
- Increased competitiveness in Southern shore as feasible alternative to oil and gas production and “priority line” towards EU (CBAM).
- Optimized use of renewable energy capacity.

SHORT TERM

- Enhanced energy security and power system reliability.
- Reduced needs for investment in power generation capacity.
- Optimized use of renewable energy capacity.
- Reduced need for renewable curtailment.

TRANSFORMING THE MIDITERRANEAN INTO A GREEN ENERGY HUB



RENEWABLES: A RESPONSE TO CLIMATE, MARKET & INDUSTRIALIZATION

The fundamentals driving RE deployment have shifted and today renewables are a competitive response not to climate and market only, but also to the legitimate demands for industrialization and socio-economic development demand and energy security.

RENEWABLES IN NORTH AFRICA: AN ENABLING MARKET

Figure 4 Evolution of average installation cost for solar PV projects in North Africa

Source: IRENA, 2023a, based on Global Data (2020) and IRENA (2020).
Note: kW = kilowatt.

Figure 5 Evolution of average installation cost for onshore wind projects in North Africa

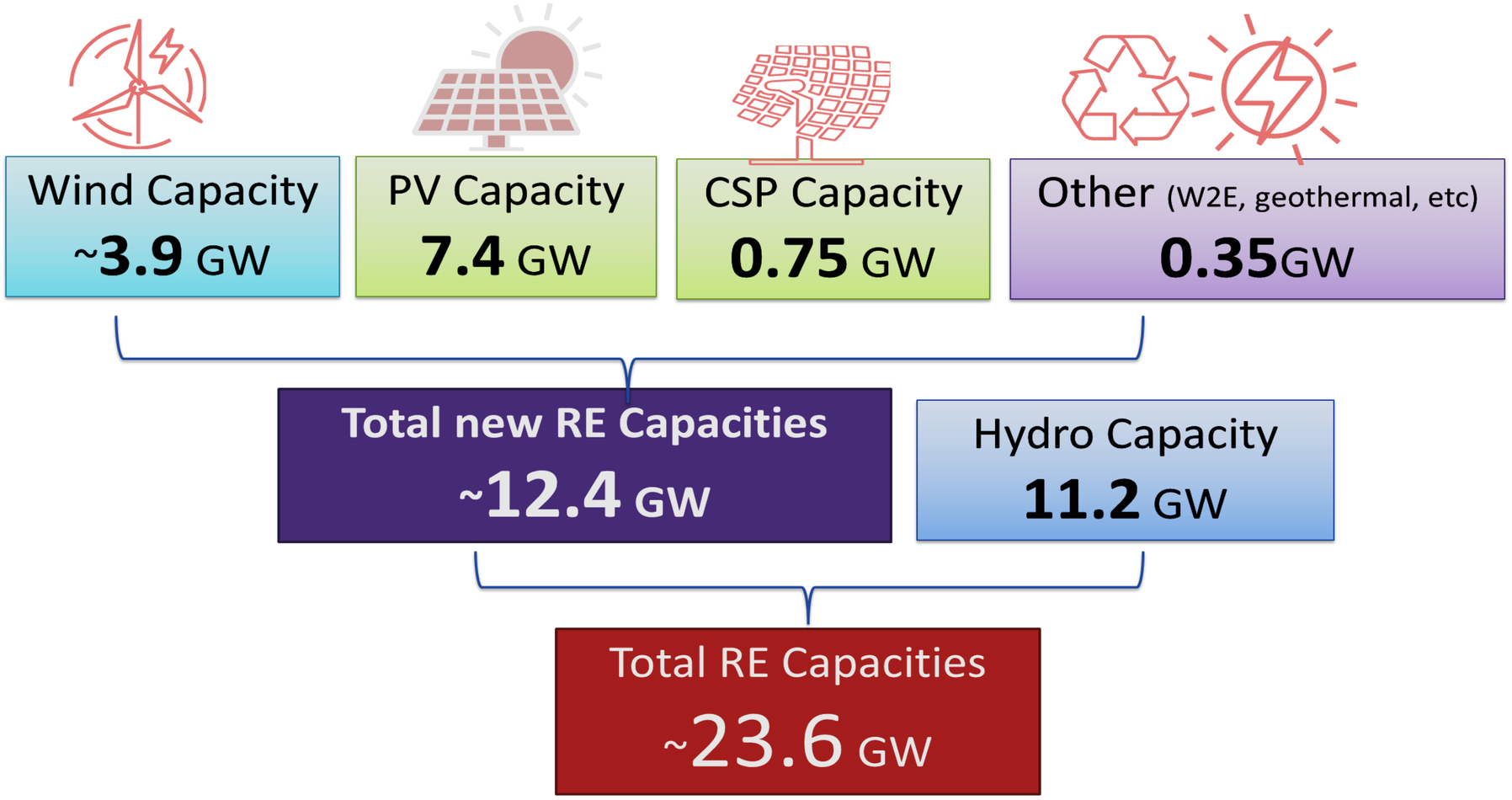
Source: IRENA (2023a) based on Global Data (2020) and IRENA (2020).
Note: kW = kilowatt.

RE Targets Update

- **One Arab country has 100% RE target: Djibouti** by 2035. **Morocco aims to achieve 52% of RE share by 2030.**
- **Algeria** changed its target to be 15GW of photovoltaic technology by 2035.
- **Jordan** raised its target in the updated Energy Strategy for the Energy Sector 2020-2030 from 21% in 2020 to 31% share for renewables in total power generation capacity and 14% of the total energy mix by 2030.
- In terms of **installed capacity, the highest are Saudi Arabia** target of 58.7 GW by 2030 and **Egypt** target of 59.7 GW by 2035. These targets represent 30% and 42% share of national installed power generation capacities, respectively.

Source: RCREEE- AFEX , 2019

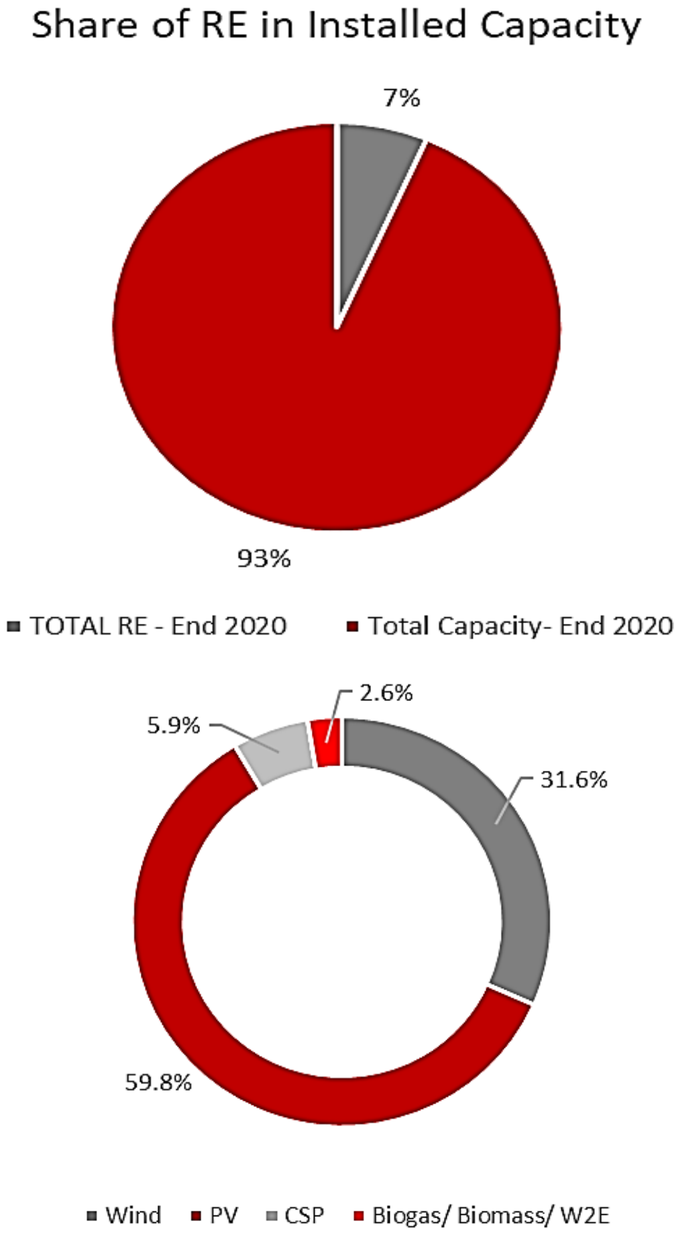
RE Installed Capacities



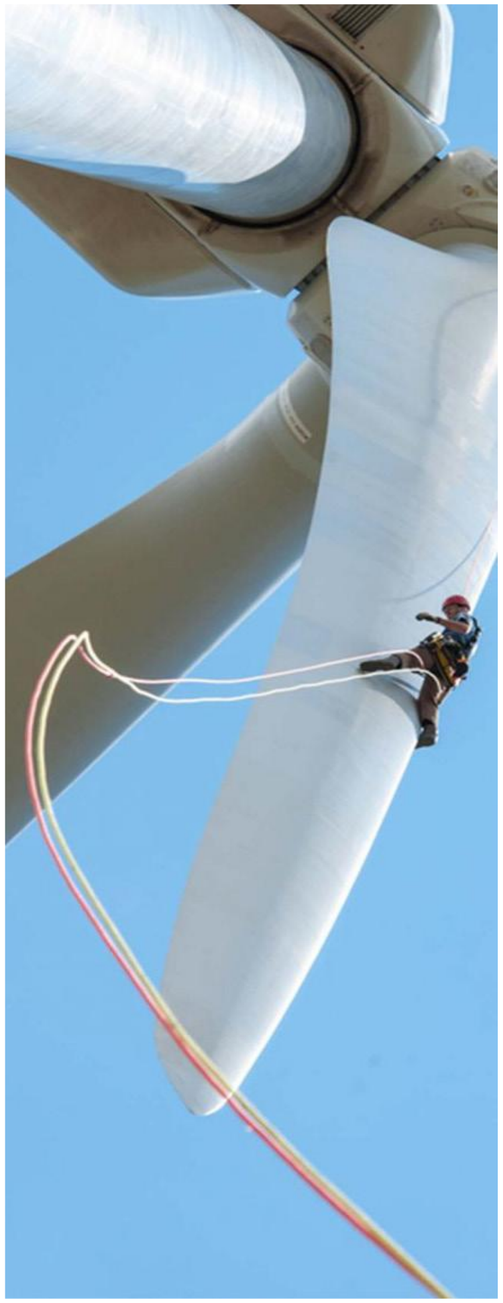
Source: RCREEE

Renewable Energy Share

- The RE share reached approximately **7%** in installed capacities.
- The dominated technology is still **photovoltaic followed by wind energy; ~60% and 32% respectively** (without accounting hydro power capacity).
- Hydro power has the largest installed capacity with approximate capacity of 11.1 GW. **Other technologies combined capacity** has surpassed the installed hydropower capacity for the first time in 2020.
- The installed capacity by 2020 was 12.4 GW, compared to the 7.2 GW in 2018. **Around 5 GW were added in 2 years.**
- PV capacity increased **from 3.2GW by the end of 2018 to 7.4GW** by the end of 2020.



Source: RCREEE



Independent Power Producer (IPPs) Projects Developments

- Several Gulf countries are leading in terms of the world lowest prices with several PPA price records achieved.
- In Saudi Arabia, a price level of 1.04$c/kWh was achieved for 600MW Fasiliyah PV independent power producer (IPP) project.
- In UAE, 1.35$c/ kWh was recorded for the 2GW Al Dhafra Solar PV project.
- Besides Gulf countries, Algeria, Egypt Jordan, Lebanon, Morocco, Palestine, and Tunisia, have shown a track record in IPP projects.
- Egypt have signed PPAs for several PV and wind energy IPP projects, for example, with prices 2$c/kWh for solar projects and 2.45$c/kWh for wind projects.
- Morocco has announced several hybrid projects combining PV and solar thermal technologies.
- Several countries started their IPPs journey, for example, Iraq tendered several PV projects with capacities between 30MW to 300MW on Build- Own-Operate (BOO) basis.

Policies for Mobilizing RE Investments in Arab Countries

Competitive Bidding/ Auctioning	Direct Proposal Submission	Feed-in Tariffs	Net Metering	EPC Contracting
16 countries	4 countries	3 countries	10 countries	More than 17 countries

RE Projects under Construction

- More than **13GW** are under construction. A massive amount of RE capacities that shows the commitment of Arab region towards the transition to cleaner energy production.
- **PV technology** is dominating the RE projects under construction accounting for approximately **80% of the projects.**
- **Wind projects** come second with approximately **13%.**
- Qatar, that has around 50MW of renewable power is developing 800MW solar projects.
- Iraq has more than 2GW of RE projects under development).

Progress Highlights

- Egypt, UAE, KSA, Morocco, Jordan, and Algeria leads Arab RE competitive markets, other countries are following with sizable project calls such as Tunisia and Kuwait
- The region has worldwide flagship solar and wind projects, with very competitive electricity prices, especially in KSA, UAE, Morocco and Egypt.
- International funding institutions are active in the region (WB, KfW, AFDB, EIB, IFC, EBRD, JICA, etc.)
- Six countries created public funds for SE deployment: Algeria, Jordan, Morocco, Palestine, Tunisia, and UAE.
- At least Four countries created state-backed private sector companies to invest in RE projects, such as Masdar in UAE and Masen/SIE in Morocco, SKTM in Algeria and lately Libya.
- 10 countries directed national petroleum companies to launch investment programmes in RE, such as Algeria, Bahrain, Egypt, Kuwait, Morocco, Qatar, Saudi Arabia, Syria, Tunisia and UAE.
- Public private partnerships and corporate sourcing of RE (captive markets) are getting increasing interest.

Energy Intensity

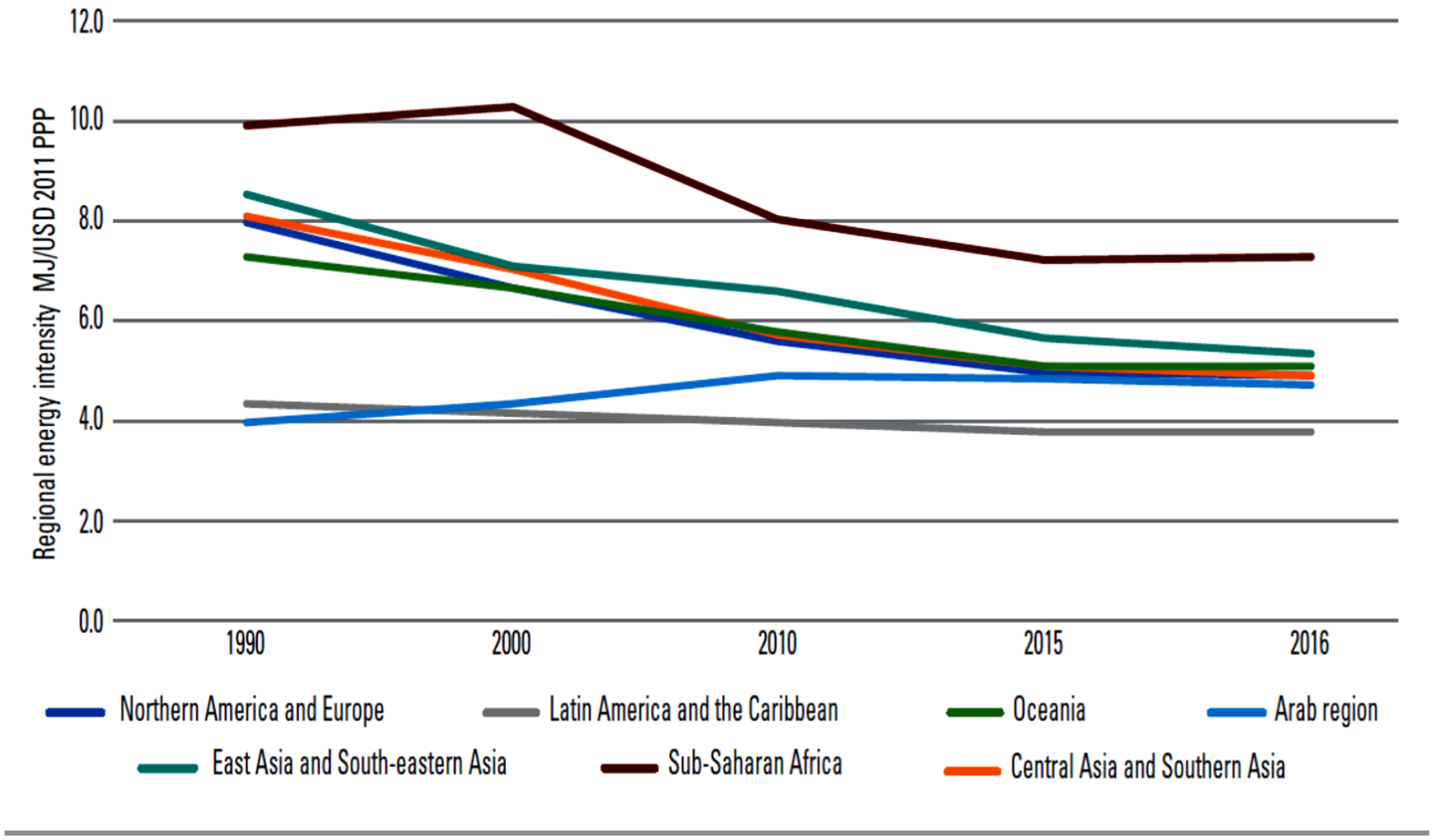
Energy intensity has increased since 1990 in most Arab countries and is still above the European average.

It is considered as relatively high.

Declines in energy intensity are a proxy for efficiency improvements, provided:

a) **energy intensity is represented at an appropriate level of disaggregation to provide meaningful interpretation, and**

a) **other explanatory and behavioral factors are isolated and accounted for.**



Source: International Energy Agency, 2018; United Nations Statistics Division, 2018; World Bank, 2019b. (accessed April 2019).
https://www.unescwa.org/sites/www.unescwa.org/files/publications/files/energy-progress-report-arab-region-english_1.pdf

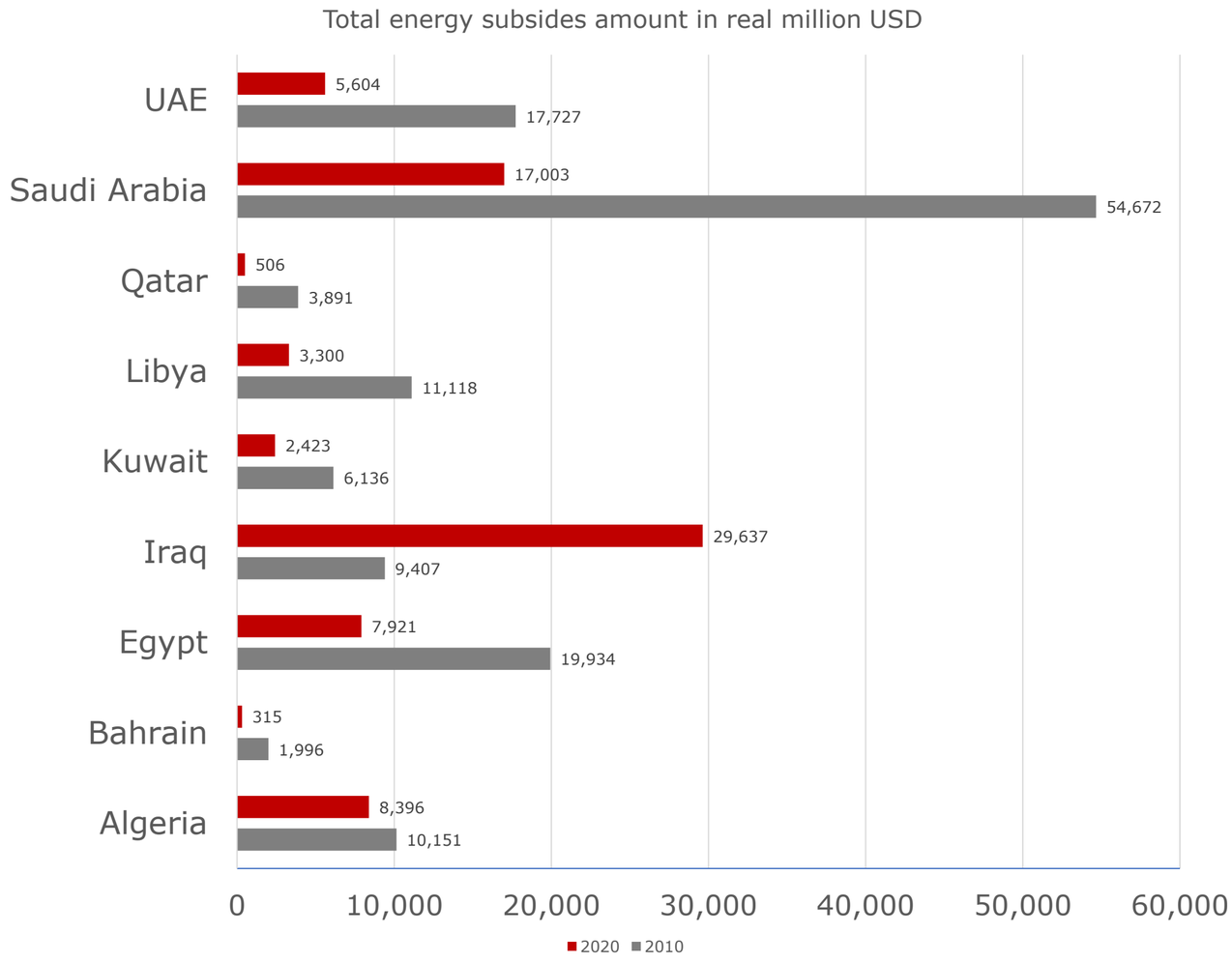
Energy Subsidy Reforms

- Several Arab countries conducted tariff **reform actions and made progress in reducing their energy subsidies**. The region witnessed an unprecedented wave of energy subsidy reforms in 2014.

- Many Arab countries managed to reduce the money spent on energy subsidies, but still spendings considerable financial resources. For example, **USD 75 billion** were spent by only **nine Arab countries** in 2020 on **energy subsidies**.

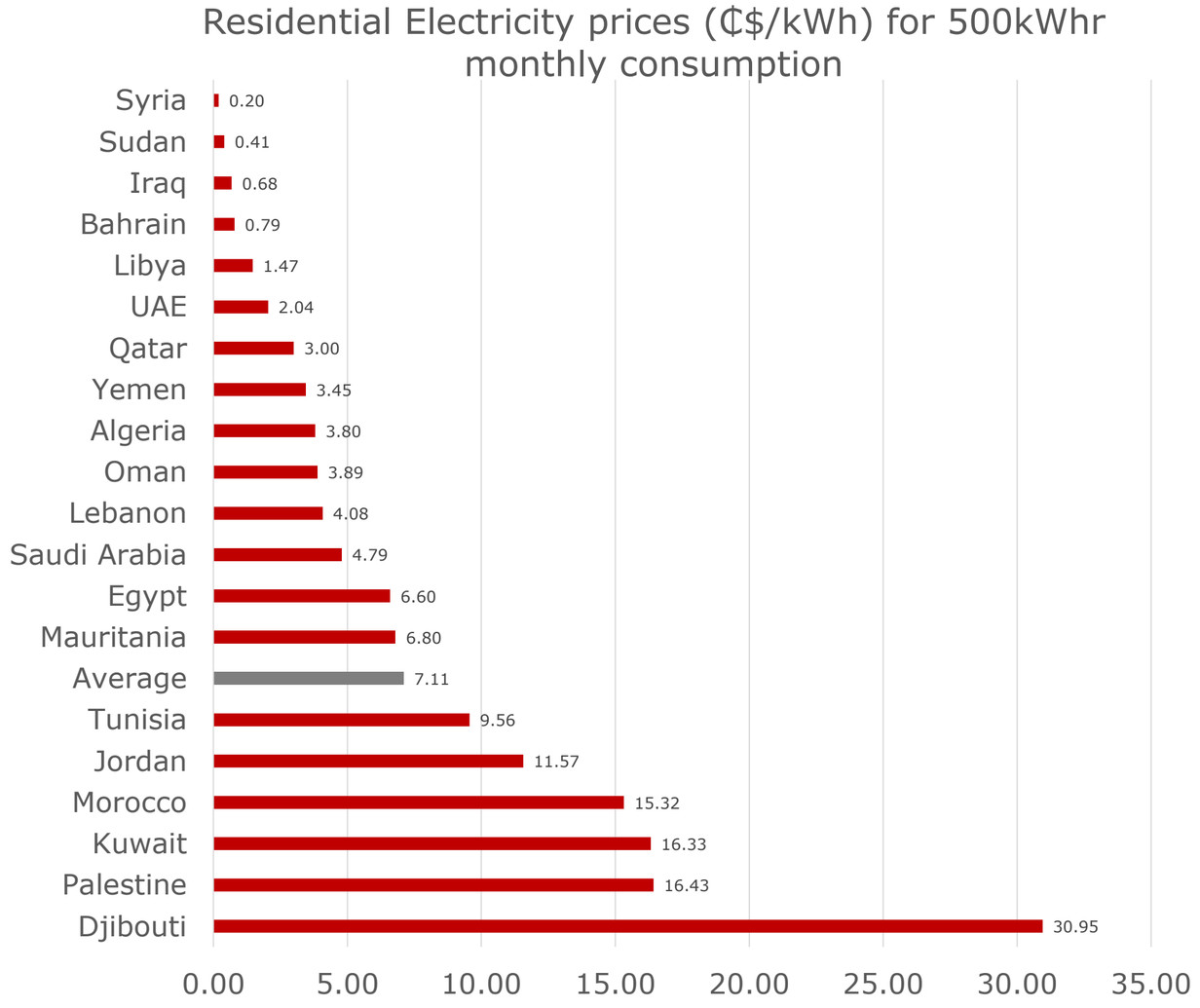
- **Bahrain, Libya, Qatar, Saudi Arabia, and UAE** reduced the electricity subsides dramatically from 2010 to 2020.

Energy subsidies



Electricity Prices

- In residential sector (considering monthly consumption of 500kWh) the electricity prices range from 0.2 ¢$/kWh in Syria to 30.95 ¢$/kWh in Djibouti which is nearly **20 folds more**.
- The average residential sector price in the region is 7.11 ¢$/kWh.
- For industrial sector (considering 30,000 kWh monthly consumption) the electricity prices stretch from 0.33 ¢$/kWh in Sudan to 25.32 ¢$/kWh in Djibouti.
- The average price for industrial sector is 9.26 ¢$/kWh which is higher than the residential sector.



EE Plans and Targets

- **21 NEEAPs in different stages**

Jordan, Bahrain, Algeria, Egypt, Tunisia, Sudan, Syria, Iraq, KSA, Palestine, Lebanon, Libya, Qatar, Kuwait, Morocco, Djibouti, Mauritania, Yemen

- **14 Arab Countries with NEEAP and National Targets**

Jordan, Bahrain, Egypt, Tunisia, Sudan, Syria, Iraq, Palestine, Lebanon, Libya, Qatar, Kuwait,

- **17 National Assigned Entities for EE**

Jordan, Bahrain, Algeria, Egypt, Tunisia, Sudan, Syria, Iraq, KSA, Palestine, Lebanon, Libya, Qatar, Kuwait, Morocco, Djibouti, Yemen.

11 Courtiers used the NEEAP template

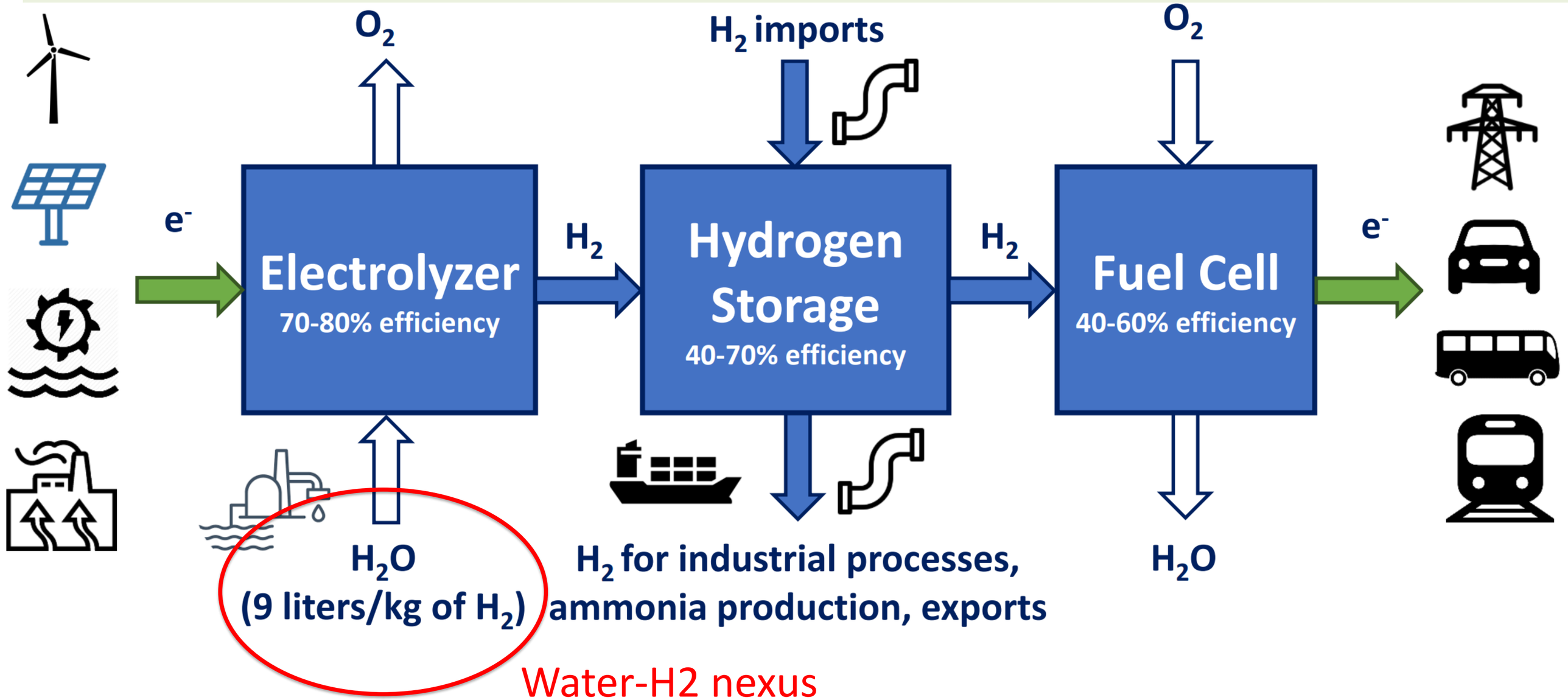
Jordan, Bahrain, Algeria, Egypt, Sudan, Syria, Iraq, Palestine, Lebanon, Libya, Qatar.

Common measures in Arab Countries NEEAPs

Source: RCREEE, 2020

Perspectives: Green Hydrogen production

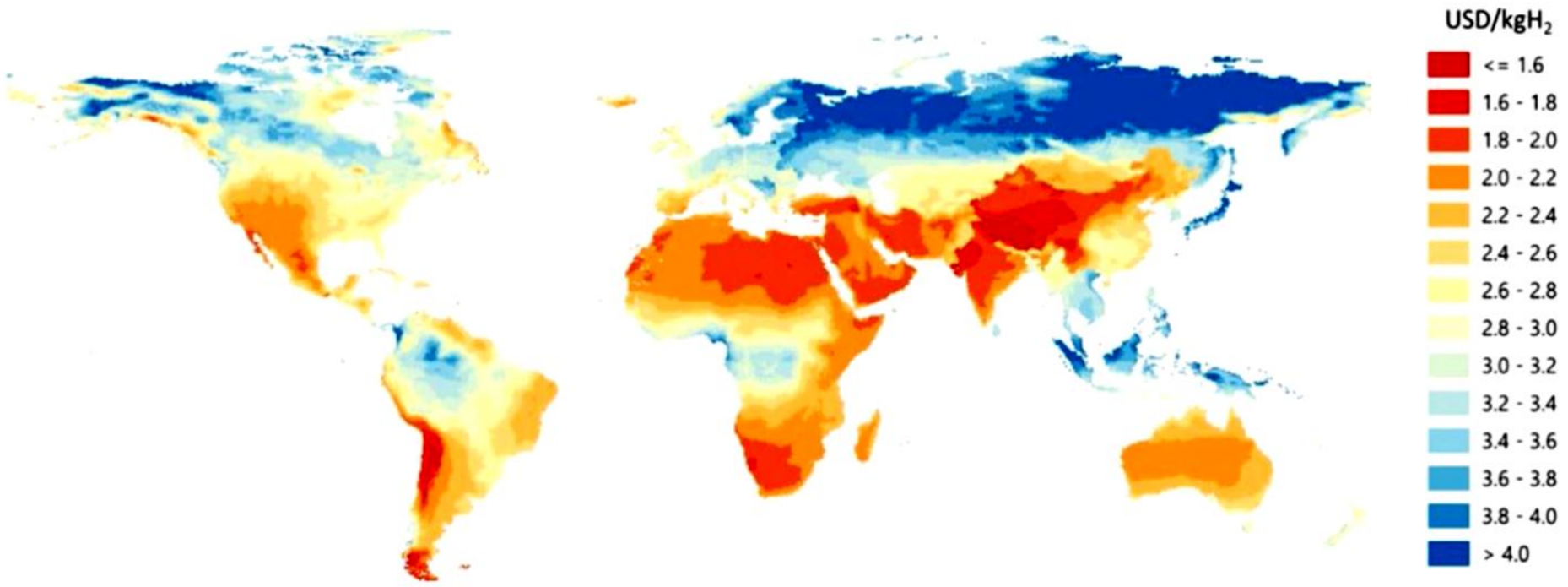
Synergy with the production of desalinated water for the production of green hydrogen using renewable energy (wind and solar)



Water-H2 nexus

Would Green Hydrogen Promise a Success Story for the MENA Region? similar to RE or Better? Most Probably!

Green hydrogen costs are projected to fall from US$ 3.5-7.5/kg in 2020 to US$ 1.6-2.2/kg by 2030 (still hypothetical!).



Hydrogen costs from renewable energy (solar PV and onshore wind systems) in the long-term Source: IEA, "The Future of Hydrogen", June (2019)

Would Green Hydrogen Promise a Success Story for the MENA Region? similar to RE or Better? Most Probably!

- Excellent solar and wind potential
- Available low-cost land for RE projects and H_2 facilities
- Relatively low cost of capital/PPPs/concessional finance
- Existing industrial capacity
- National, regional and global growing markets: Hydrogen exists mostly in refineries, steel factories and petrochemical facilities. It could be used in ammonia, methanol, steel, food and glass production, and possibly cement and aluminum. Also, for applications in electricity generation, transport and others.
- New jobs and mainstreaming climate actions
- Pipeline-transported hydrogen is feasible in some countries, especially North Africa, given the existing NG infrastructure nationally and with Europe, whether in pure form, or blended into natural gas.
- A number of suitably-located salt deposits exit in the region in which caverns could provide low-cost buffer storage of hydrogen.
- Geographical proximity to neighboring expanding “green” markets is a key factor.
- E.g., The EU hydrogen strategy was published in July 2020, setting a target of 40 GW of electrolyzers installed within its borders by 2030 and another 40 GW of capacity imported from other producers, mainly North Africa and Ukraine.

KEY MESSAGES

- **New power sector normal is revealed,** where RE&EE are increasingly competitive, and the **alternative opportunity** for oil and gas exports and/or utilization in petrochemical industries are financially and economically rewarding.
- **Lowest wind and PV price records are now found in MENA countries,** thanks to a well-designed competitive bidding and auctions schemes with strong public utilities- private partnerships and incentives**.**
- **Economics – rather than policy – will drive accelerated deployment of renewable technologies.**
- Oil to gas switching in power, residential and transportation sectors is getting increased momentum in the region.
- The **ESCO market** in the MENA region is **moving slowly** in recent years. The introduction of the Super ESCOs helped achieving better results in some countries.

KEY MESSAGES

- **Greater energy efficiency movement is a must**. National M&E systems should be enhanced to estimate the percentage of increased energy demand that has been met through gains in energy efficiency.

- **Global technology disruptions and innovations in business models and services will facilitate decarbonization (**Tech innovation: Green and blue hydrogen, energy storage, e-mobility, digitalization, smart systems and blockchain technologies… etc)

- **Blended energy financing is becoming a mainstream** (grants, soft/concessional/commercial loans, guarantees, and technical assistance, green bonds, sukuk, sovereign and pension funds, early-stage corporate finance, roll-out of phase of new build asset finance, and non-new investments such as corporate merge and acquisition, project equity buyouts, investors exits and asset refinancing and acquisitions, etc.).

Conclusions

- Energy transition leads to win-win situation for all types of countries
- Energy transition process is accelerating to fulfill COP28 goals of tripling RE and doubling EE by 2030
- Energy transition in the Arab region will need serious readiness process:
  - Energy transition visions and strategies
  - Technology transfer and capacity building
  - Energy sector reforms
  - Mainstreaming of energy transition in all economic sectors
  - Local financing sector upgrade
- It is important to capture the immense value of the sustainable energy business and effective public-private partnerships, especially for higher local content through local manufacturing, scaling-up decentralized solutions and commercializing emerging technologies
- To help advancing with the ecosystem, a careful design of the enabling frameworks, legal, regulatory, tariff, contractual and other supplementary frameworks is needed. Fragile and conflict-affected contexts will need more innovative approaches.

TERAMED:
A RISING MILESTONE IN THE GLOBAL ENERGY TRANSITION

- Mediterranean partner of **the Global Energy Transitions Forum**, launched in Davos 2025 by President Ursula von der Leyen.
- Recognized as a flagship initiative for **the EU New Pact for the Mediterranean**.
- A flagship initiative under UNEP-MAP's New **Mediterranean Strategy for Sustainable Development**.
- A flagship initiative in the COP30 High-Level Climate Champions Action Plan – **Activation Group 1 on Tripling Renewables & Doubling Energy Efficiency.**
- **TERAMED Declaration expected to be endorsed at COP30** (GRA Pavilion).

Towards
1 TW Renewables
in the Mediterranean
by 2030

THANK YOU!

[Learn more by visiting: https://teramedinitiative.com/](https://teramedinitiative.com/)

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MENA CLIMATE WEEK
RIYADH 2023

"Real Energy is human Energy, if the Human Energy is ambitious then the only thing that will block it is the sky"

– His Royal Highness Prince Abdulaziz bin Salman AlSaud