6th IEEJ/APERC International Symposium

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Session 3

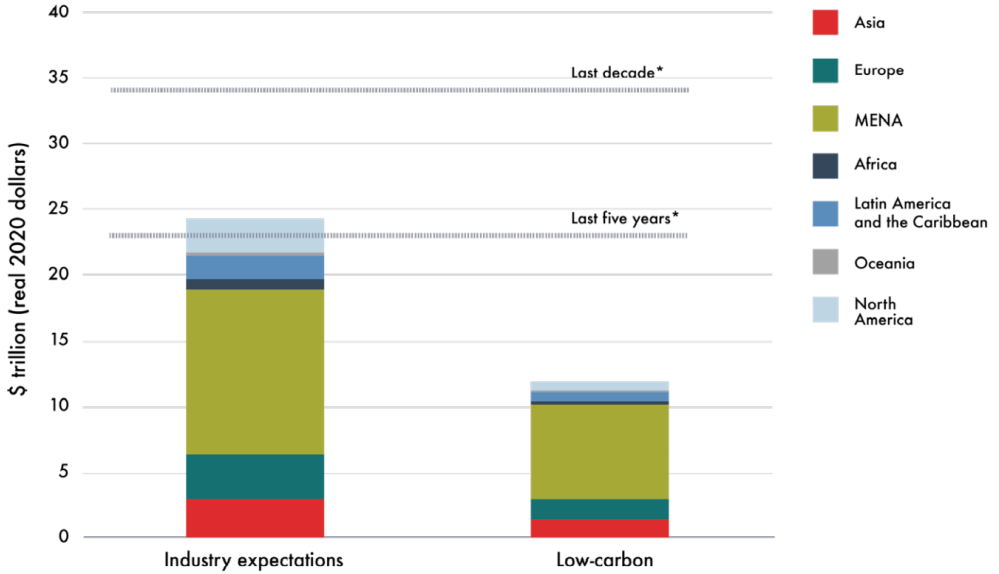
How will the ME respond to the Global Carbon Neutral movement?

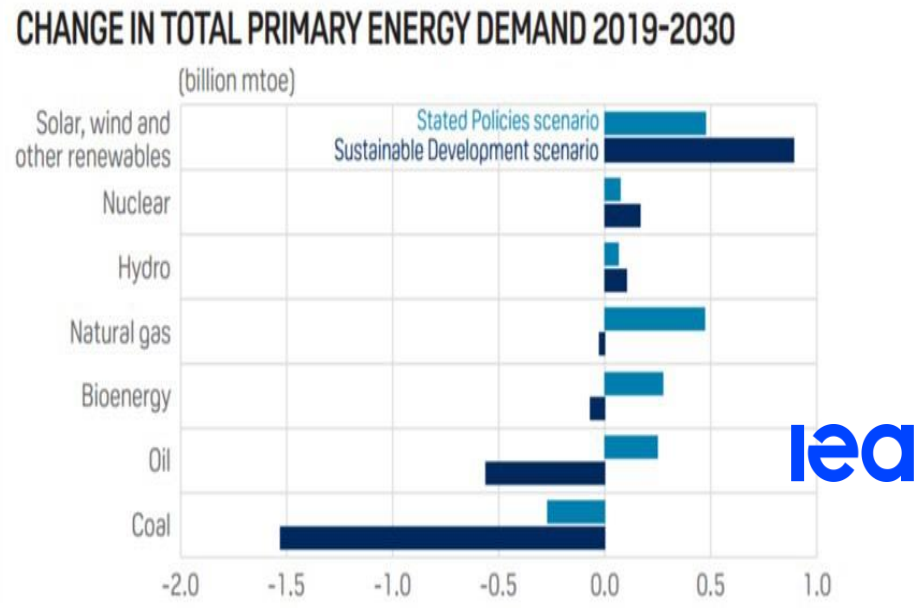
- What effects on the Middle East are resulting from the global Carbon Neutral movement?
- What challenges for ensuring stability in the Middle East are ahead of us while the World moves towards Carbon Neutral?

Declining O&G Export Revenue in MENA/GCC: A Triple Challenge

- **A mega energy transition is posing critical challenges for countries heavily dependent on oil & gas revenues.**
- **O&G producers' revenues are estimated to decline, at a combined $13 trillion in period to 2040 – most in MENA**
- **Decline in revenues for GCC is due to Triple Challenge:**
  - Large demand decline(e.g., COP 26, net zero emissions targets, national climate commitments) – with large uncertainty
  - Increased domestic consumption
  - Expectation of consistently low oil price
- **The push for NZE or" Carbon Neutrality" calls for urgent changes in strategies & business models.**
- **Production cost advantage, while welcomed, not sufficient to shield the countries from large revenue declines**

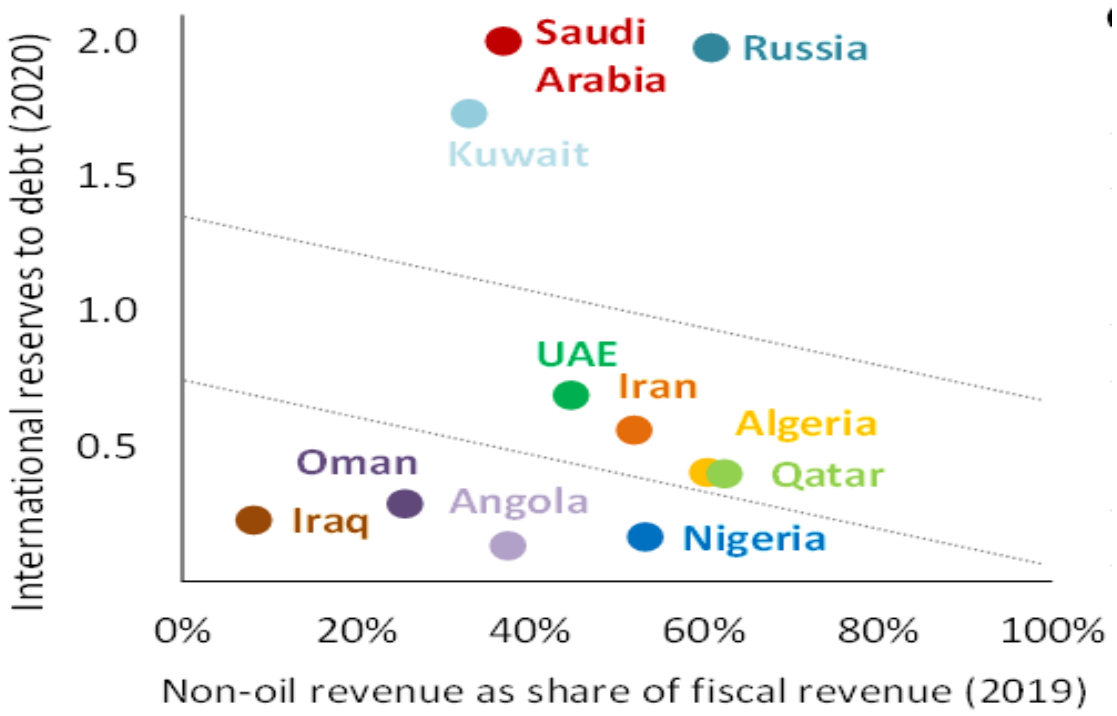
2020-2040 Government Revenue under different Demand/Price Scenarios
Carbon Tracker Initiative (2021)





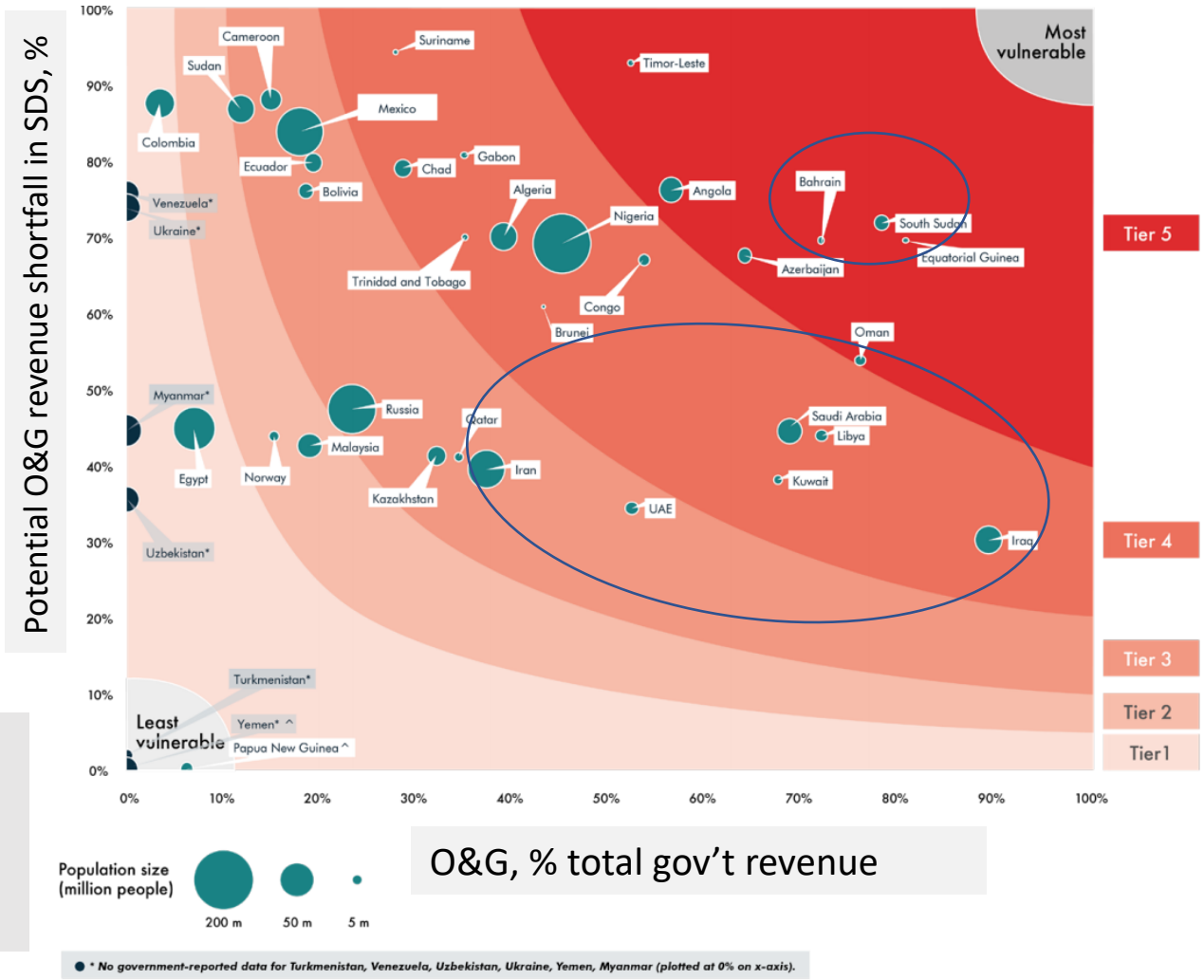
Vulnerability and Resilience of O&G MENA States –
All vulnerable to varying degree

Indicators of financials for selected producer economies in the Stated Policies Scenario (IEA – WEO 2020)

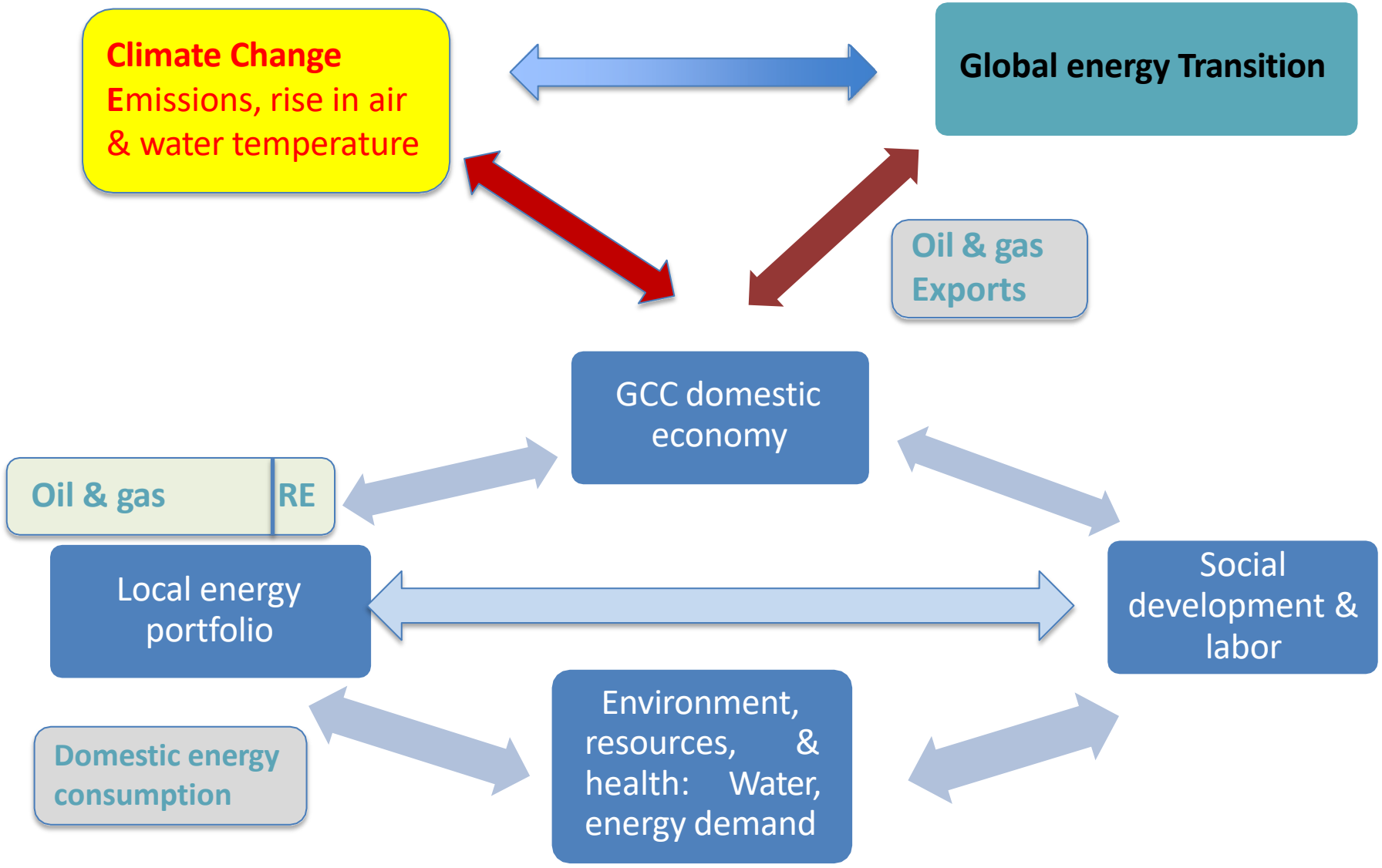


Among the most vulnerable globally" e Bahrain, Oman (Tier 5), Kuwait and KSA (Tier 4), and UAE and Qatar (Tier 3), all to experience revenue shortfalls of between 30-40% over the period

Vulnerability of Petrostates to Low O&G demand & price scenarios (shortfall in SDS & $40 vs STEP)
(source: Carbon Tracker Initiative – 2021)



GCC/MENA O&G Producers: Must Rethink Energy Transition-Economy Linkages & pathway to Sustainability



Source: SHEHABI & DALLY- HYDROGEN VIABILITY IN KUWAIT (OIES/KFAS Workshop (April 7, 2021)

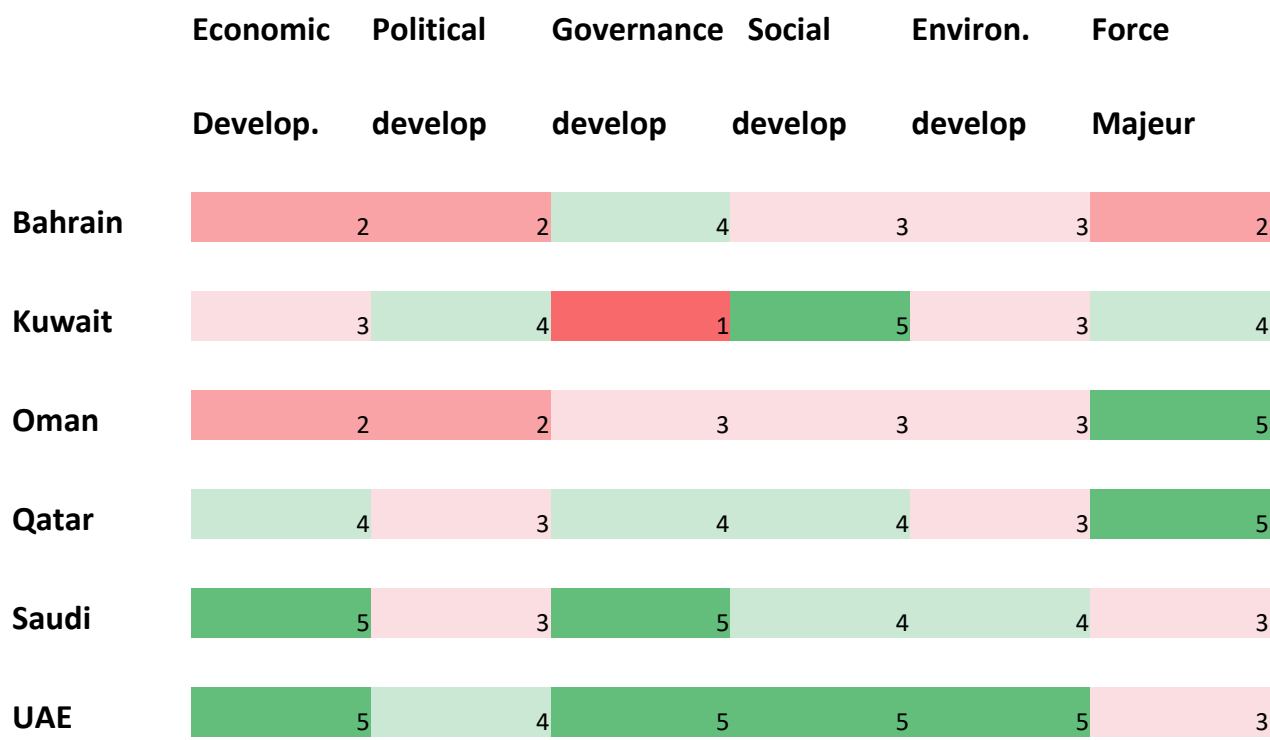
- **Need to Act now ….** to transition away from over dependance on O&G revenues towards *sustainability*
- **The transition needs to be orderly, with a proactive collective supply restraint,** to avoid disorderly transition, leading to greater shortfall
- ***Sustainability*** needs to form the basis of successful economic, energy, and social policy ..& reflect (and benefit from) the energy transition
- A key to orderly transition is to accelerate transition to low carbon O&G export

Diversification, Sustainability & the Energy Transition in GCC/MENA:

How to maximize benefits while minimizing costs in Resource & Climate -constrained world

- Assess **SUSTAINABILITY** …. taking into account economic growth principles incorporating volatility & depletion perspectives, labor, capital, innovation & resource
- Reassess **NATIONAL WEALTH & ASSETS** .. compared with savings for future generations
- Undertake ECONOMIC ASSESSMENT of **ENERGY POLICY alternatives,** domestic & exports) alternatives, … taking account economy-wide and sectoral effects, Include environment, health, and other externalities
- Design **ENERGY** (& other) policies.. to achieve multiple sustainability objectives simultaneously at the lowest costs
- **e.g., Energy efficiency , renewables, Hydrogen**

- **Road to Diversification & Sustainability in GCC constrained by:**

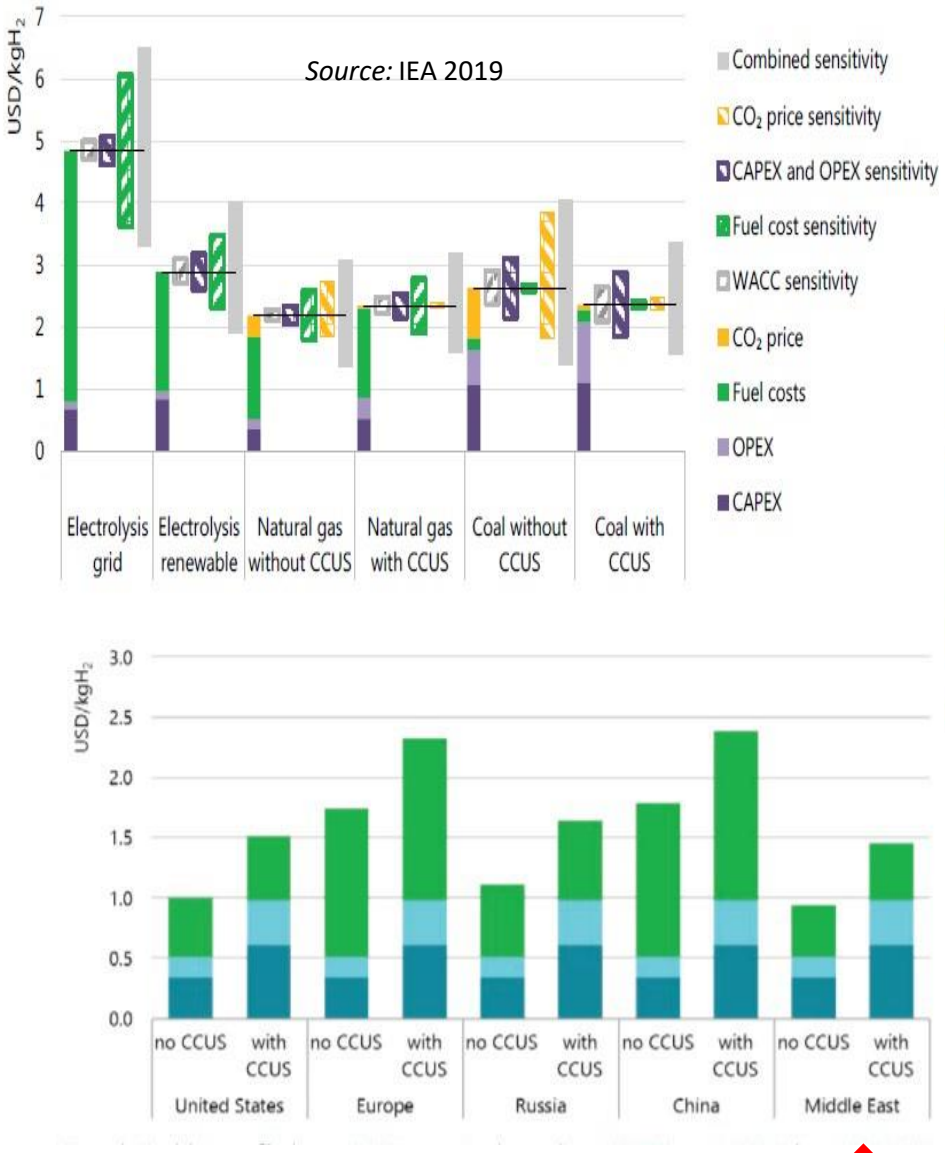


Adopted from: SHEHABI - KUWAIT (OIES/KFAS Workshop (April 7, 2021)

Opportunities for MENA/GCC

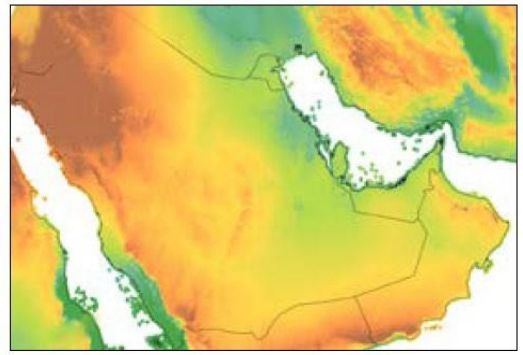
Potential opportunity for capturing lost oil export demand through:

1. Ccomparative advantage in blue hydrogen
   - **Comparative advantage in HCs**
   - **Well-established** export trade in energy
   - **Synergies** and cost savings via retention of O&G skills, infrastructure, & assets
   - **Proximity to hydrogen markets**:
   - **Access to low cost natural gas**
   - **Access to depleted oil wells for CCUS**
2. Ccomparative advantage in green hydrogen
3. Potential nuclear-hydrogen nexus; (least competitive)
4. Opportunity for CCUS, including, with DAC, to offset carbon footprint of O&G exports

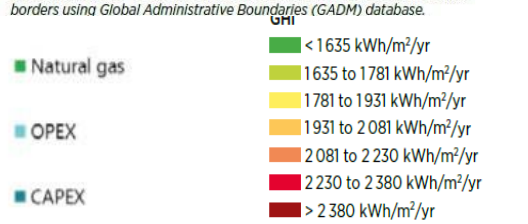


Source: IEA (2019)

Direct normal irradiation (kWh/m2/yr)



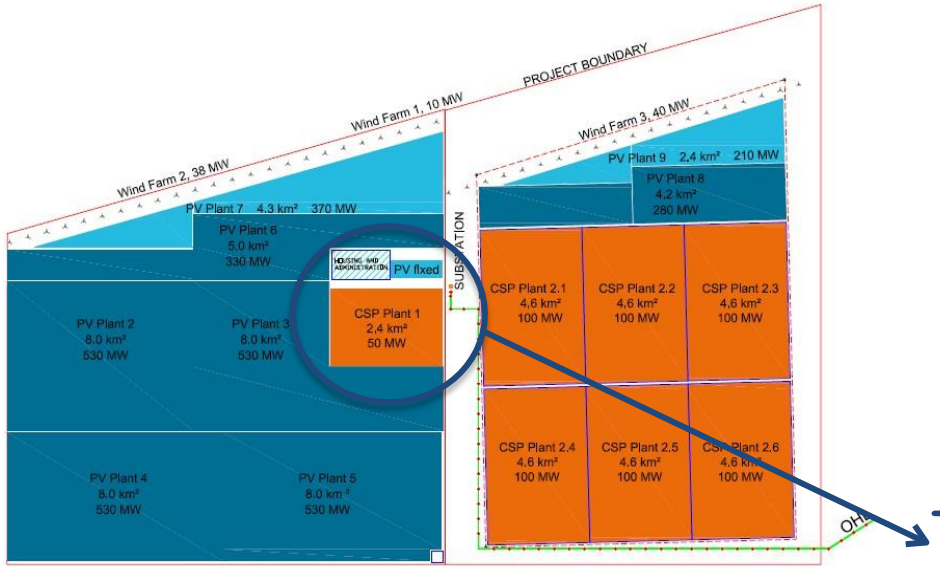
Source: IRENA (2019b): Global Atlas, Map Data: World Bank, 2018, Direct Normal Irradiation kWh/m² World 1km 1994/1999/2007-2015 WBG, World country borders using Global Administrative Boundaries (GADM) database.

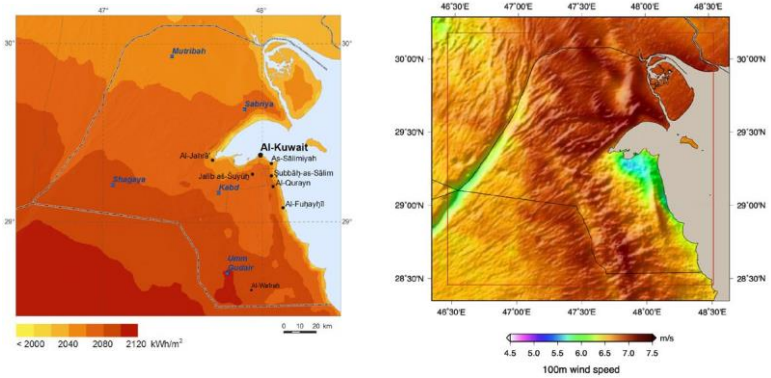


Source: IRENA (2018)

Source: SHEHABI & DALLY- HYDROGEN VIABILITY IN KUWAIT (OIES/KFAS Workshop (April 7, 2021)

Example of potential for Green Power: Shagaya Renewable Energy Park - KUWAIT





Solar and wind resource forecasting system.
Source: KISR, RE&EE.

Source: SHEHABI & DALLY- HYDROGEN VIABILITY IN KUWAIT (OIES/KFAS Workshop (April 7, 2021)

Hydrogen Strategies and Road maps: Are GCC States still Lagging Behind?

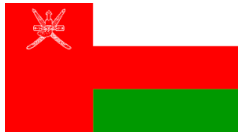
By 2021, 20 countries adopted national hydrogen strategies

Domestic (China, France, Germany, Japan, Norway, South Korea, UK, the EU); **Export** (Australia, Brunei, China, Netherlands).

KSA Green Initiative!

- 2017: Air Liquide purification plant supplies hydrogen to oil refinery
- Aramco and Air Products to build the first hydrogen fuel cell vehicle fueling station in KSA
- 2018: Jazan Greenfield Integrated Gasification Combined Cycle (IGCC) power plant project producing power, "grey" hydrogen, and utilities for Saudi Aramco
- 2020: shipped its maiden blue ammonia cargo to Japan to burn possibly together with coal and natural gas for zero-carbon power generation
- 2020: **Neom:** Helios Green Fuels Project $5 b plant owned by Air Products, Saudi's ACWA Power and Neom; to power a green hydrogen plant using 4 GW of renewable electricity; produce 650 tons of green hydrogen and 3,000 ton of ammonia daily
- 2020: Neom: Germany to supply a 20 megawatt (MW) electrolysis plant

- 2019: MoU between Dubai Electricity and Water Authority (DEWA), Expo 2020 Dubai and Siemens for the first solar-driven hydrogen electrolysis facility
- 2020: Announced investments in green and blue hydrogen projects including a fledgling fuel cell electric vehicles (FCEVs) fleet
- 2020: Hydrogen alliance (ADNOC, sovereign wealth fund Mubadala Investment Co., and ADQ)
- 2020: UAE's NDC to the UNFCCC confirmed standards for electric, hydrogen and autonomous vehicles are under development. Reduction of 23.5% in GHG emissions by 2030.



- 2020: A national hydrogen economy strategy
- 2020: Signed a Hyport Cooperation Agreement with DEME Concessions and OQ Alternative Energy to develop a green hydrogen plant in Special Economic Zone at **Duqm**
- 2021: ACME Group to invest $2.5bn for a facility to produce 2,200 m tonnes of green ammonia/day in Duqm.

- 2018-2019: KISR earned patent for enhancing magnesium's hydrogen storage for use in fuel cells; launched 1st prototype electric vehicle fueled by hydrogen stored in magnesium hydride (MgH2) MgH2), a nanoscale metal hydride.
- 2020: White Paper for National Hydrogen Strategy

Source: SHEHABI & DALLY- HYDROGEN VIABILITY IN KUWAIT (OIES/KFAS Workshop (April 7, 2021)

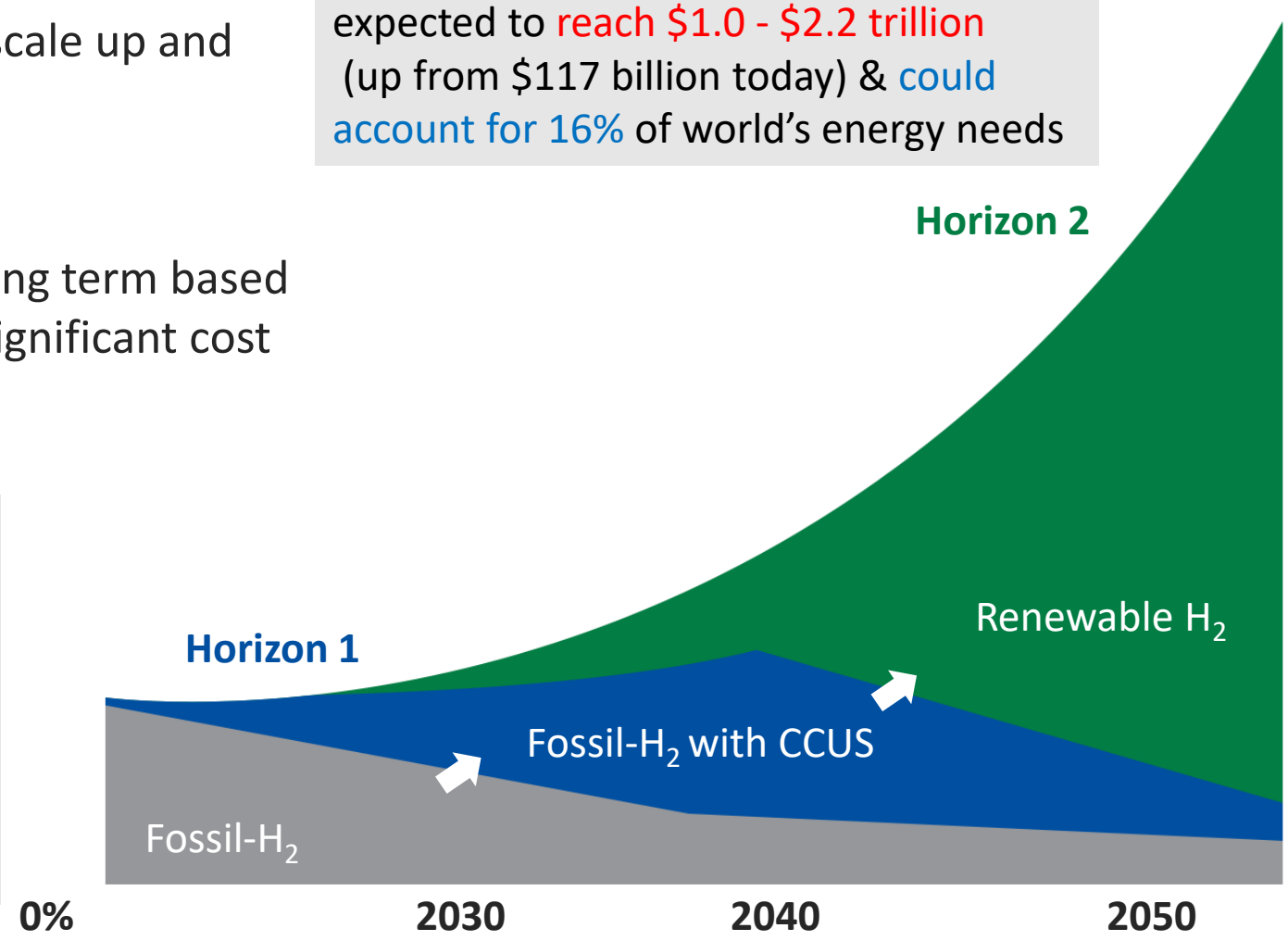
Window of Opportunity within Challenges ahead for MENA/GCC in capturing a share of future large & exponentially growing clean Hydrogen markets

Horizon 1:
Blue hydrogen is needed to kickstart the scale up and prepare the infrastructure.

Horizon 2:
Green hydrogen will dominate over the long term based on successive/disruptive innovation and significant cost reduction.

By 2050, value of the H_2 market is expected to reach $1.0 - $2.2 trillion (up from $117 billion today) & could account for 16% of world's energy needs

- Large uncertainty about share of Blue Hydrogen through 2050 (and beyond), stemming from large uncertainties of technological innovation, maturity & cost competitiveness of blue vs. green
- Policy bias (ideology?) favoring only green H by some (EU) creating challenging obstacles against MENA realizing its potential



Challenges & Opportunities

CHALLENGES:

- **Low R&D Budgets & Innovation:**
  - However, much more R&D investment needs to be allocated to drive cost down, create an infrastructure network and refine export business models – including how to make competitive blue hydrogen from oil liquids.
- **Limited water resource**,
- **Decarbonization policy gap**
- **Funding and financing**
- **Domestic energy subsidies**

(Based on: SHEHABI - KUWAIT (OIES/KFAS Workshop, April 7, 2021)

OPPORTUNITIES:

- **Low-carbon hydrogen** is probably the most cost-effective means for O&G producers to transition - could be realized via a alignment of interests of both sides in the push to attaining NZE by 2050.
- **Many stakeholders** and countries have a vested interest in assisting O&G producers to transition to a low-carbon future; but without coordinated action is achieved, they may feel obliged to impose sanctions on NOC projects
- While Europe's hydrogen strategy mainly focusses on green hydrogen, it (Japan & others) will require large quantities of lower-cost blue hydrogen at least in the medium term.
- GCC National Oil Companies (NOCs) can target these markets, but need to engage to achieve supportive regulations and pricing for low-carbon material exports.

Policies, Approaches & Implications

- Decarbonization policies, particularly in Europe, pose a risk to the GCC's exports of hydrocarbons and energy-intensive materials.
- The EU's potential carbon border tax could cut the profits from exports of oil, steel, etc.. by a significant amount (~ 10-65%), impacting both EU and non-EU
- GCC are amongst the most exposed and least resilient to such EU carbon pricing scheme.
- Global demand for green hydrogen is expected to grow rapidly, displacing potentially more than 10 billion boe by 2050 This could induce Gulf countries to target low-carbon export products.
- The ammonia value chain appears the most practical ocst-effective approach to transporting GCC hydrogen over long distances (e.g. NEOM project).

GCC should aim to :

i. include hydrogen economy in the revision of Nationally Determined Contributions (NDCs)

ii. build International collaboration (e.g. EU, Japan, China) on technologies & co-ordination on harmonizing regulations and standards, including measurement, reporting and certification of services and products,

iii. develop carbon pricing mechanisms, and/or links to other carbon pricing schemes to encourage hydrogen use and boost demand, creating opportunities to expand the H2 market.

International companies interested in GCC H have to:

- initiate & develop projects in partnership with large Gulf state energy companies – focus on strategic investment vehicles.
- promote supportive policies from governments on both sides.

Interested partner countries (e.g. EU), should:

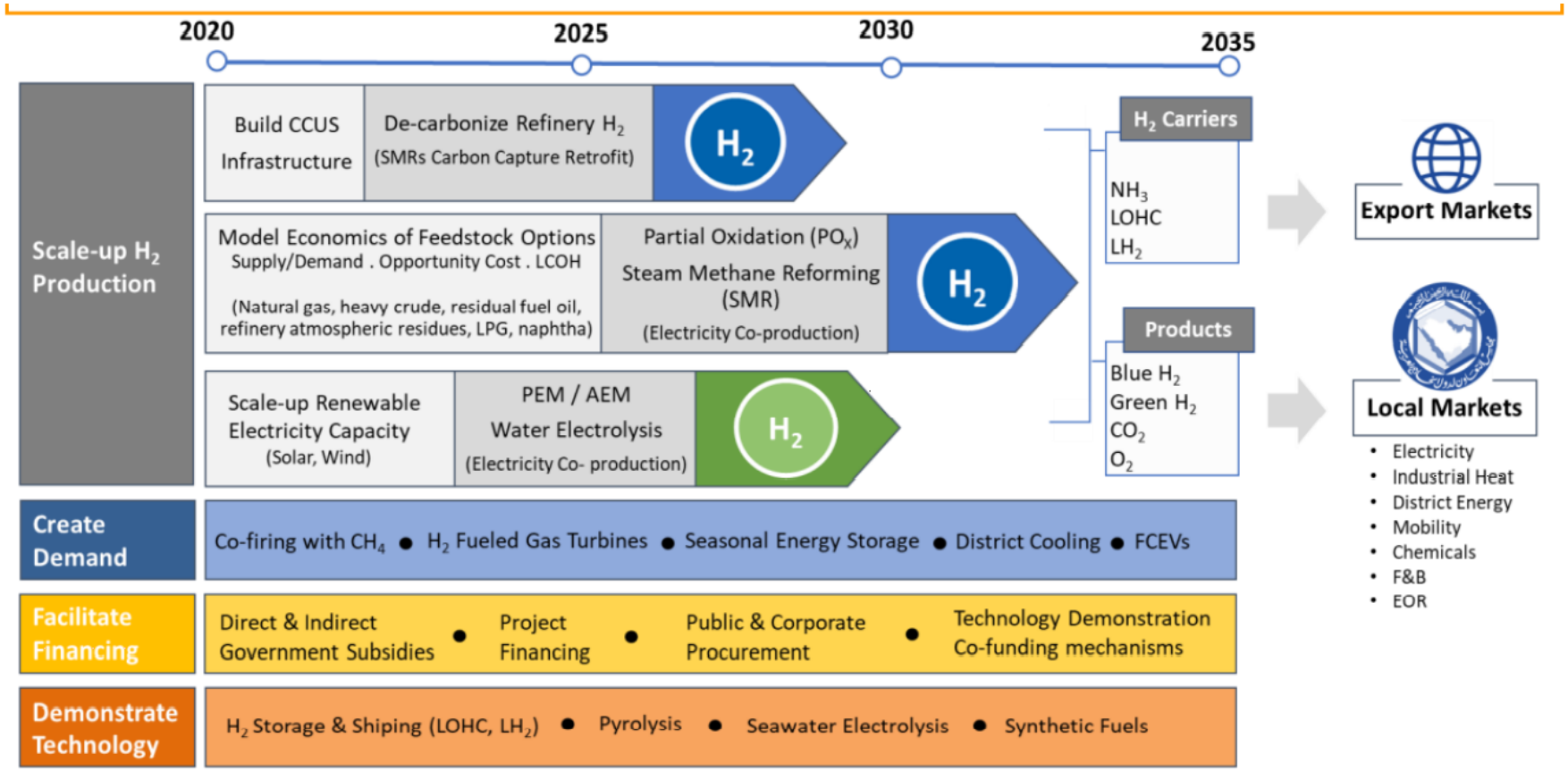
- adopy policies to promote partnerships & participate joint investments (with GCC/MENA) in all low carbon technologies(not just green) – at least not oppose or place obstacles against, e.g. blue hydrogen, DAC, etc..

Thank you

Supplementary Slides

Kuwait Hydrogen Strategy
White paper

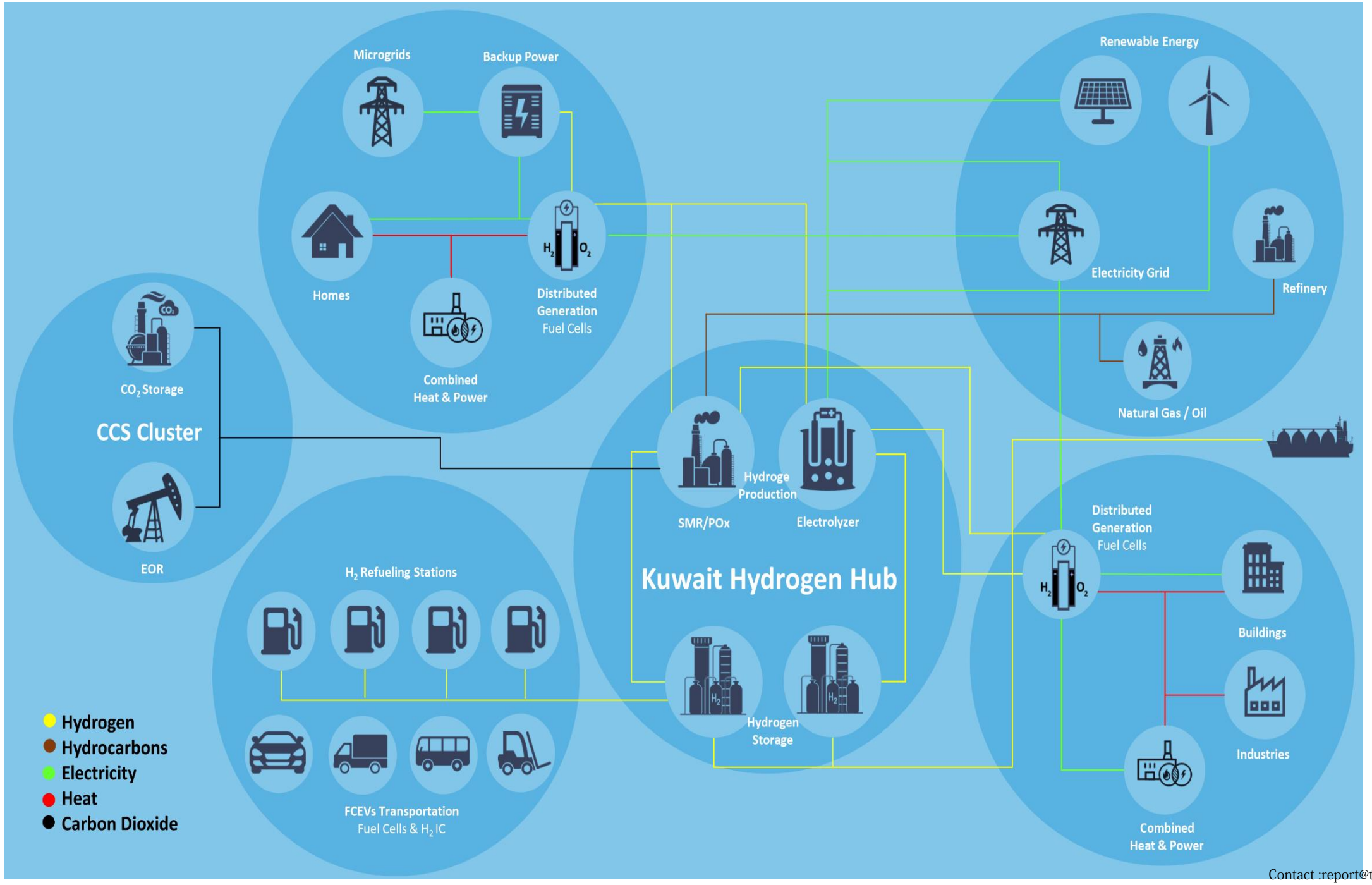
Proposed Hydrogen Roadmap - Kuwait Hydrogen WP (HWP)



Legend: CCUS: Carbon Capture Utilization & Storage / SMR: Steam Methane Reforming / POx: Partial Oxidation / RE: Renewable Energy / LCOH: Levelized Cost of Hydrogen / LOHC: Liquid Organic Hydrogen Carriers / LH_2: Liquid Hydrogen / FCEVs: Fuel Cell Electric Vehicles / EOR: Enhanced Oil Recovery / F&B: Food & Beverage / CH_4: Methane / NH_3: Ammonia / CO_2: Carbon Dioxide / NG: Natural Gas

Hydrogen's Value proposition of Kuwait HWP)

- Supply, to the extent possible, low-carbon or carbon neutral energy products to enduse energy consumers around the world, reducing the aggregate carbon footprint of its energy exports.
- Incentivize investments in carbon capture, utilization and storage (CCUS) and kickstart the use of captured CO2 in enhanced oil recovery (EOR), which would:
  - Maximize recovery of its oil reserves - Extend the life of its oilfields. o
  - Attain (potentially) carbon-neutrality for its petroleum exports (provided a disproportionate amount of CO2 is injected for every barrel of oil recovered).
  - Facilitate its participation in the circular carbon economy (CCE). –
- Reaffirm its commitment to addressing climate change challenges and potentially achieve net zero emissions targets ahead of its peers. – Invigorate its nascent renewable energy industry. –
- Transform the role of the private sector in the economy and potentially create worldclass companies that can compete on the global stage. – Carve a proactive role for itself in the ongoing energy transition. –
- Create job opportunities for its citizens in the emerging hydrogen and CCE economy.



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