

**2021 Energy PMP Meeting
World Federation of Scientists**

Topic A: Transition to Net-Zero focusing on IEA's recent report *Net Zero by 2050*.

Overview of the IEA Report: Key issues and Controversies

Adnan Shihab-Eldin

**18 August 2021, 13.30 GMT to 16.00 GMT
(10 minutes)**

IEA's NZE2050: Roadmap for decarbonizing the global Energy Sector: Background

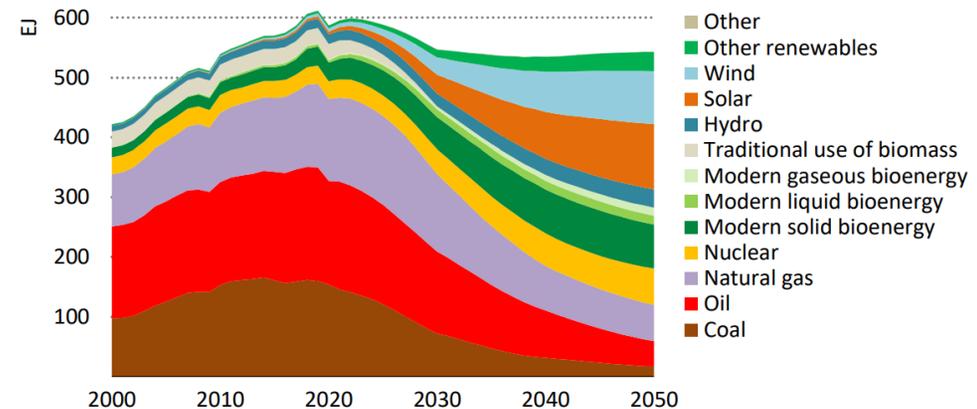
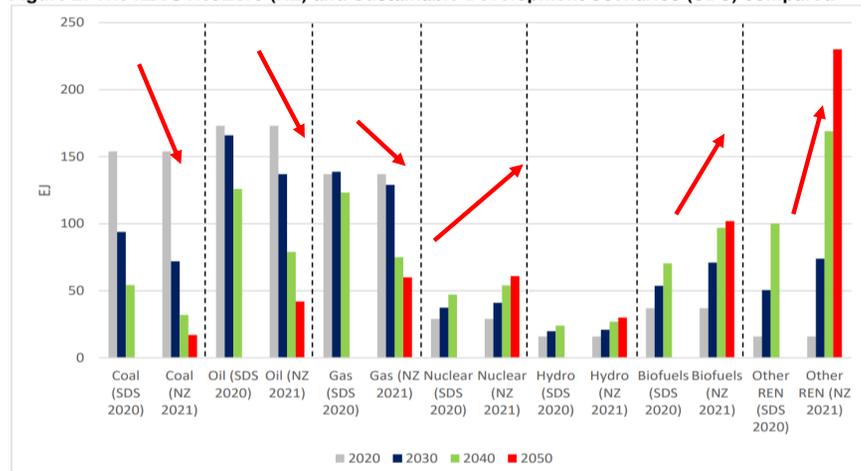
- The IEA report: NZE 2050 – A roadmap for the global Energy Sector, released 18 May, 2021, was produced upon request from UK (Chair of COP26), to come up with a modelling run of a scenario that leads to NZE by 2050 and limit global T rise to 1.5 C.
- Following a Summit, co-hosted by IEA and President of COP26 (March 2021), 7 key Principles were adopted. The reports' analysis examined 3+ scenarios:
 - STEP, (Stated Policies Scenario – all policies backed by robust implementation legislation/regulation
 - APC (Announced Pledge Case – in addition all national net-zero pledges are realized fully, on time
 - NZE, Net-zero emissions by 2050
 - (Also analyzed is Low International Cooperation Case)
- NZE, backed by 22+ member governments of IEA, is likely to become main Ref. scenario for years
- NZE is a scenario along a “narrow pathway” to the desired target (limiting the global temperature rise to 1.5, without overshoot) at 50% probability. It was announced as the:
 - “the world’s first comprehensive study of how to transition to a net zero energy system by 2050, while ensuring stable and affordable energy supplies, providing universal energy access, and enabling robust economic growth”. ?
 - most technically feasible, cost-effective and socially acceptable – Is it?
- “The Pathway remains narrow & extremely challenging, requiring all stakeholders: governments, business investors & citizens to take action this & every year after so that the target does slip out”

The Seven Pillars of the IEA's Roadmap for NZE2050 & 2050 Energy mix lead to huge increase of Re & dramatic reductions in fossil fuels use, especially coal & oil

1. Energy efficiency
2. Behavioral changes
3. Electrification
4. Renewables
5. Hydrogen & hydrogen-based fuels
6. Bioenergy
7. Carbon capture and storage (CCS)

- IEA's projected energy mix in 2050 to achieve NZE is:
 - 20% fossil fuel, from ~80% in 2020;
 - 66% renewables, from ~12% in 2020
(wind, solar, hydroelectricity, bioenergy and geothermal)
 - about 15% nuclear. From ~4% in 2020

Figure 2: The IEA's Net Zero (NZ) and Sustainable Development Scenarios (SDS) compared



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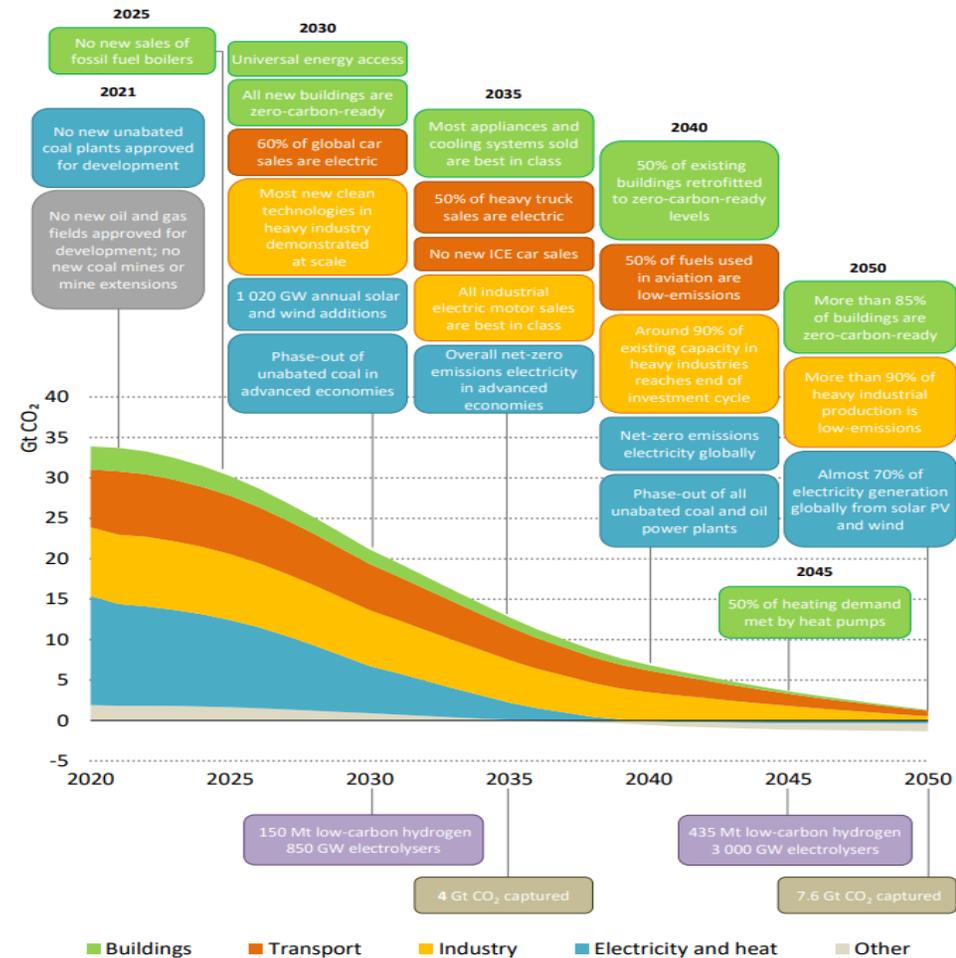
Renewables and nuclear power displace most fossil fuel use in the NZE, and the share of fossil fuels falls from 80% in 2020 to just over 20% in 2050

IEA's NZE2050: Roadmap for decarbonizing the global Energy Sector: **key milestones**

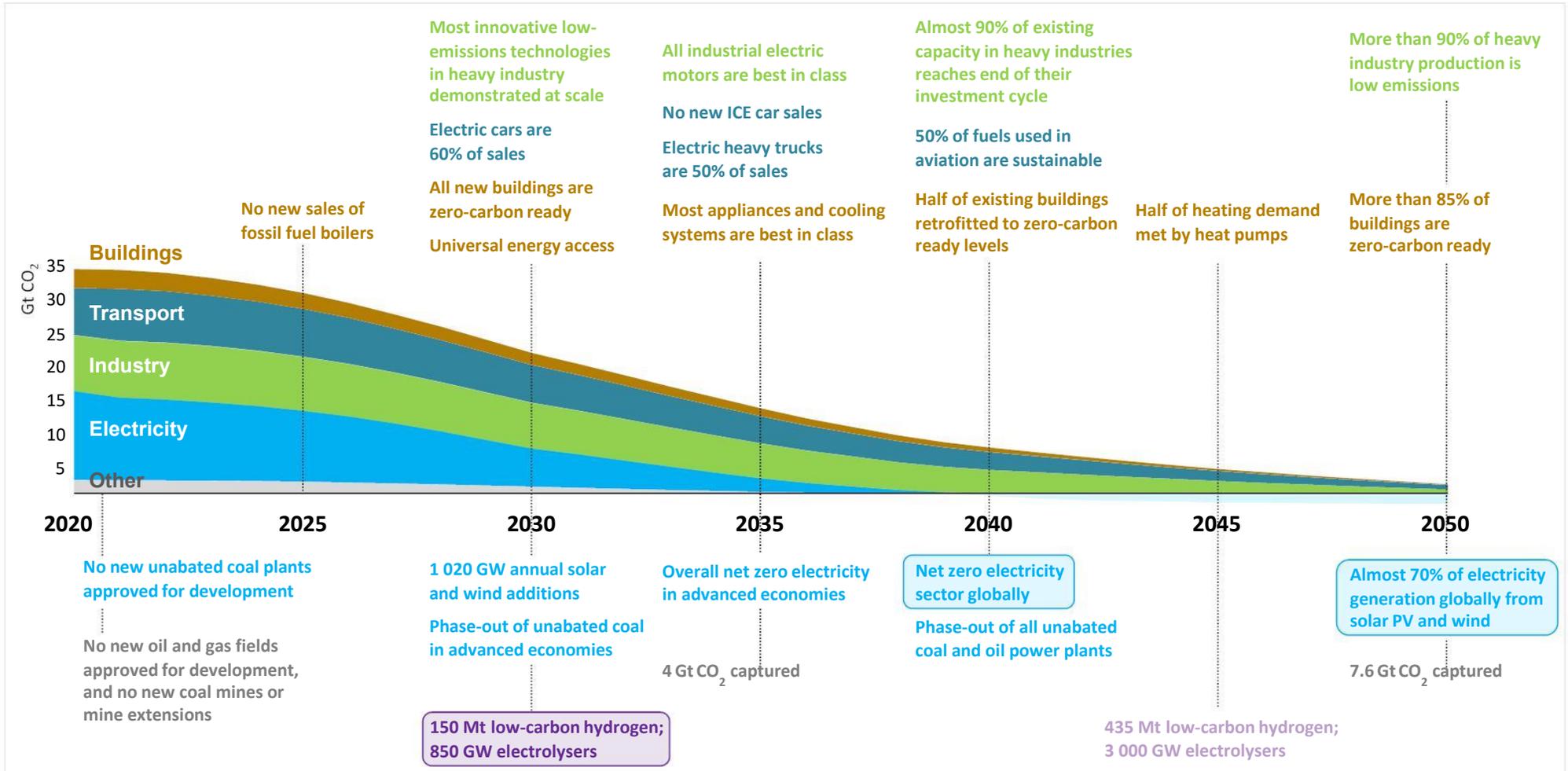
- **2020**: The pathway to net-zero emissions is narrow – starting at **33.9 Gt Co2**
- **2025**: A surge in clean energy investment can bring jobs and growth – **30.2 Gt Co2**
- **2030**: Need to drive huge leaps in clean energy innovation – **21.1 Gt Co2**
- **2035**: A rapid shift away from fossil fuels – **12.8 Gt Co2**
- **2040**: Electricity becomes the core of energy system – **6.3 Gt Co2**
- **2045**: New low-emission industries flourish – **2.5 Gt Co2**
- **2050**: A clean energy World! ~ **NZE**

Achieving net-zero emission by 2050 will require nothing short of complete transformation of global energy system: Thus IEA also explored Low International cooperation case

Key milestones in the pathway to net zero



400+ detailed sectoral and technology milestones: crucial to reaching the targets – setting short term milestones helps traction



Key issues and questions (of NZE findings & messages) - !

- **IEA's NZE scenario** was presented as "the world's **first** comprehensive study of how to transition to NZE by 2050:
 - **ensuring** stable & affordable energy supplies, **providing** universal energy access, & **enabling** robust economic growth".
 - **the most** technically feasible, cost effective & socially acceptable" --- IS IT??
 - **IPCC, others, provided scenarios (>90)** to limit T rise to 1.5 C
 - **Uncertainty** is much larger - in all NZE pathways.
- The Energy Supply Mix** : is dramatically changed – but:
- **Regional differences** in economic factors & energy mix will remain large. NZE does not provide regional breakdown like SDS. **Some regions, e.g. China, SE Asia will need more time to NZE** (2060-2070 & **have more nuclear and clean HC** (blue hydrogen)
 - A **significant level of minimal demand** for fossil fuels remains in 2050 - (but compared to last 30 y, demand next 30 y is similar)
 - But **lack of investments in new fossil projects** will lead to supply shortages w/o rapid scaling of production from alternatives
 - **Also, IEA NZE is low on CCS** (fully decarbonized fuels), & **nuclear** compared to others (& potential value on equal LCA)
- Key Drivers of NZE** **Must all work to get us there!**
- **Government Policy and regulation: the most important driver of the transition**
 - **Technology: pace & costs (Supply, Demand)**
 - **Finance: \$ 5 trillion needed by 2030 & thereafter!**
 - Will it lead to ~ **+0.4% to GDP** growth, for decades? **What about other NZE scenarios, with more nuclear, clean HC?**
 - To what extent banks & other financial institutions are prepared to take **dual risk**:
 - **financing new technologies**, while also
 - **responding** to investors & societal pressure to **withdraw from HC funding?**
 - **Energy Networks: Issues of Scale, performance, of new infrastructure etc.**
 - **Impact on consumer,s Justice, and access?**
 - **New business models: are needed**
 - **Sectoral development: How?**
 - **Consequences** for geopolitics & security

IEA's NZE2050: Key Issues, questions -II

1. **Will the total global energy use drop ~8% by 2050?** (serving x2 world economy & 2 b more population)
 - 3 more billion more people are born, needing, an additional 10 trillion KWh/year - alone!
2. **How realistic the huge drop in fossil fuels use to 25% of its present value, (20% share vs. 80% now) – [see IEEJ report: Energy Supply/Demand up to 2050]**
3. **How realistic is & what are the implications of the milestone of no investment in new fossil fuel supply projects as of 2021!**
 - IEA has consistently, until 2020, called for increased investments in O&G supply & warned of supply disruptions, price volatility resulting from inadequate level of investments in oil and gas E&P projects
 - ED Fatih Birol has previously called for increased investment in oil and gas, particularly liquefied natural gas exports, as well as carbon capture technologies. But now IEA is calling to abandon oil and gas development? (G. Caruso, former EIA/ED, & Pres. Biden call?)
4. **Is it feasible (technically & cost effectively) global electricity become all Re by 2040?**
 - How many giga solar fields and wind farms are needed every year. Re is not easily available in many regions (e.g. Japan, SE Asia- need all colors of hydrogen)
5. **Who will provide the ~ \$5 Trillion annual investments by 2050? (tax & rate payers?)**
6. **Is the NZE2050 a Just transition?** Will those responsible for the legacy CO2 in the atmosphere pay their fair share to help DCs and fossil exporters in making the painful transition? (e.g. India & O&G calls)

Other Key issues and challenges:

- In many parts of the world, **the Energy Transition is not as high on the governments' and people's Energy Agenda** as **affordability, security**, etc..
 - In Europe the urgency is there but the pace is not enough yet, despite all people and governments efforts
 - If so in EU, how can other regions where ET is not as urgent, move fast
- **Energy transition is not happening yet as it should certainly not fast nor just enough**
 - E.g. the EU allocated 700 billions for next decade for 27 countries! Europe need to spend much more, like 10s of billions each year in each country
- **Energy Transition will cost a lot :**
 - huge amounts (much more than people think or say, in order to move it fast as NZE2050 move fast, including huge transfers
 - **Will international transfer be enough (what India says: you created the problem, you want us to solve it, give us the money**
- **Many countries are not likely to meet their 2030 targets** let alone the 2050
- **Enforcements! can it be expected?**: will the courts step in to force governments and companies to meet legally binding commitments and pledges?
- **What about the people?** Will they vote for governments to spend huge amounts or vote them out?
 - Reference: People & governments, actions and funding, to deal with more imminent catastrophe: **COVID19**
- **how fast it will Electrification, hydrogen** on the supply side and **digitization** on demand side (to control demand) be done?

Source: based in part on: J. Stern, OIES podcast

Some controversial assertions of NZE2050

- **The assertion “there** is no need for investment in new fossil fuel supply in the NZE pathway beyond projects already committed as of 2021”, **stands in stark contrast with conclusions often expressed in other IEA reports and could be the source of potential instability in oil markets if followed by some investors**
- **The reaction of fossil industry** to IEA’s NZE findings and recommendations was expected and understandable; However it is only fair to point up that so far:
 - No one has come up with another **comprehensive** scenario that achieves same outcome with different outcome to nuclear & fossil fuel, (or just transition, economic growth - but reaction was predictable).
 - So, Likely to see many alternative NZE scenarios, with more contributions from Nuclear, clean fossil (decarbonized like in blue hydrogen, with CCS, DAC, etc.)
- **The NZE pathway relies on unprecedented international co- operation** among governments, especially on innovation and investment.
 - **For many developing countries, the pathway to net zero without international assistance is not clear if not likely.**
 - **Huge technical and financial support is needed to ensure deployment of key technologies and infrastructure. Without greater international co-operation, global CO2 emissions will not fall to net zero by 2050**
- **Perhaps the most controversial** parts are the key questions of **affordability**, **Just** (equitable burden sharing) and **behavioral changes** (sections towards the end of the report)

View from O&G exporters

(if time permits)

Adam Siemanski, former President of KAPSARC

OPEC analysis, miscellaneous reports

Narrow focus on only reducing fossil fuels will result in significant, undesirable socio-economic consequences, especially in the MENA region

Inefficient utilization of existing infrastructure



- Inadequate utilization of **infrastructure investments already committed** e.g.:
 - Ports
 - Pipelines
 - Power plants
- Significant **cost and time in premature switching to new energy sources**

Reduced energy access and reliability



- **Increase in overall energy costs** since renewable energy and low carbon fuel sources are not always commercially viable
- **Deterioration of energy reliability** as a result of depending heavily on renewable sources
- **Major impact on developing countries** that require affordable and reliable energy access

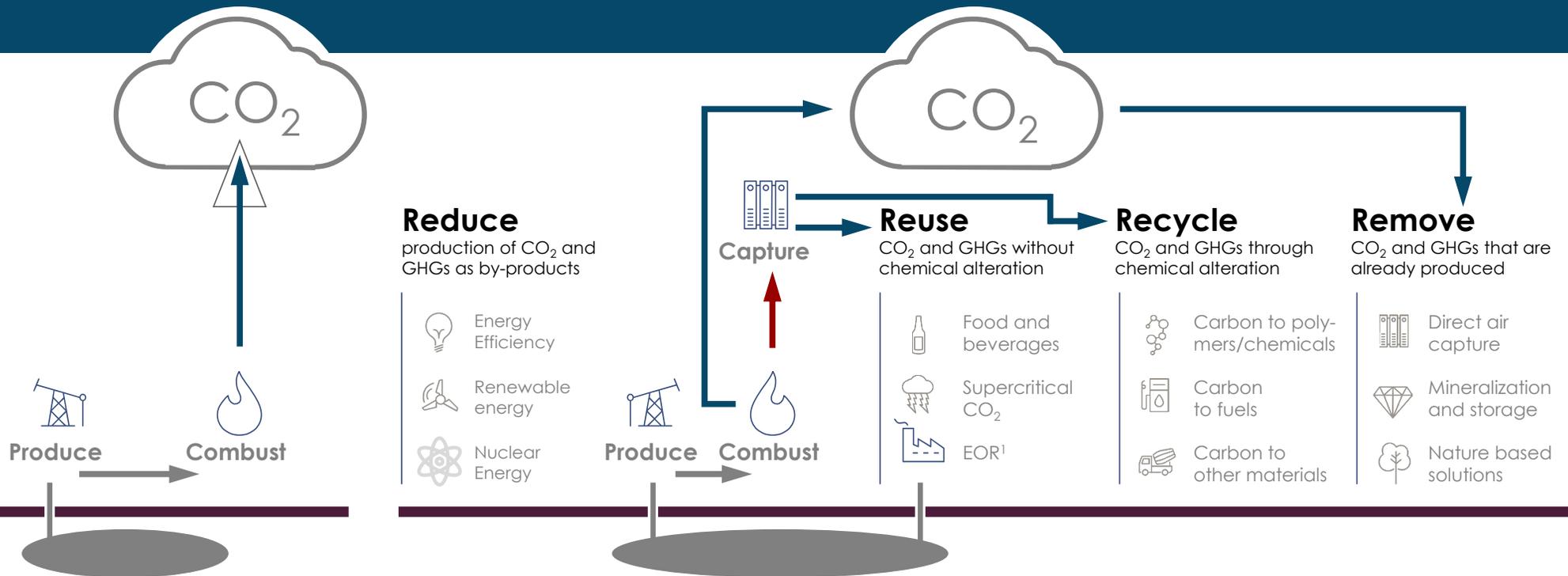
No practical solutions for hard to abate sectors



- Few cost efficient **emissions reduction solutions** for energy-intensive, **hard to abate sectors** e.g.:
 - Aviation
 - Shipping
 - Cement
 - Aluminum

CCE is an alternate holistic approach, that utilizes all available levers to address CO₂ emissions while generating value

From a Linear Economy... to a Circular Economy... to a Circular Carbon Economy (4 Rs)



Reduce

production of CO₂ and GHGs as by-products

-  Energy Efficiency
-  Renewable energy
-  Nuclear Energy

Capture

Produce Combust

Reuse

CO₂ and GHGs without chemical alteration

-  Food and beverages
-  Supercritical CO₂
-  EOR¹

Recycle

CO₂ and GHGs through chemical alteration

-  Carbon to polymers/chemicals
-  Carbon to fuels
-  Carbon to other materials

Remove

CO₂ and GHGs that are already produced

-  Direct air capture
-  Mineralization and storage
-  Nature based solutions

Note: [1] EOR: Enhanced Oil Recovery

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 to 2040** – (in SDS) **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)

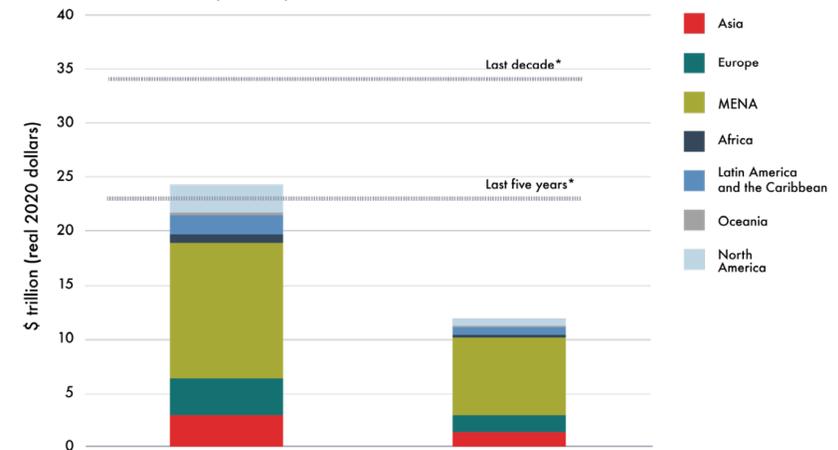
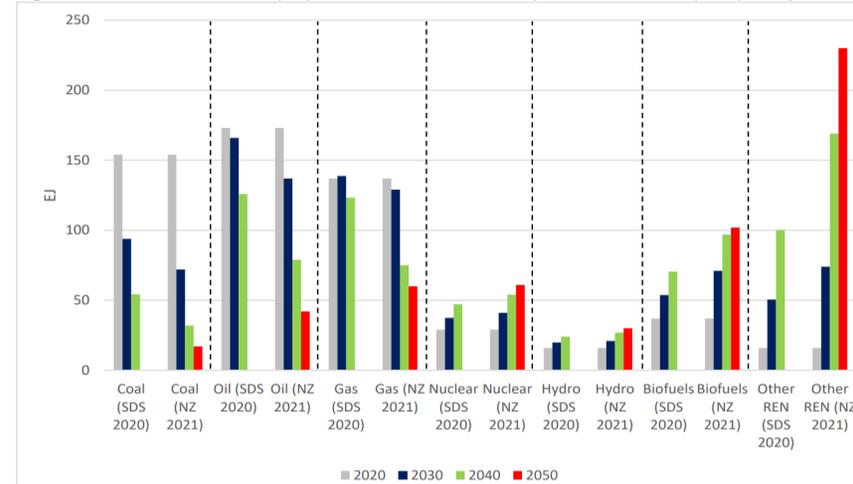
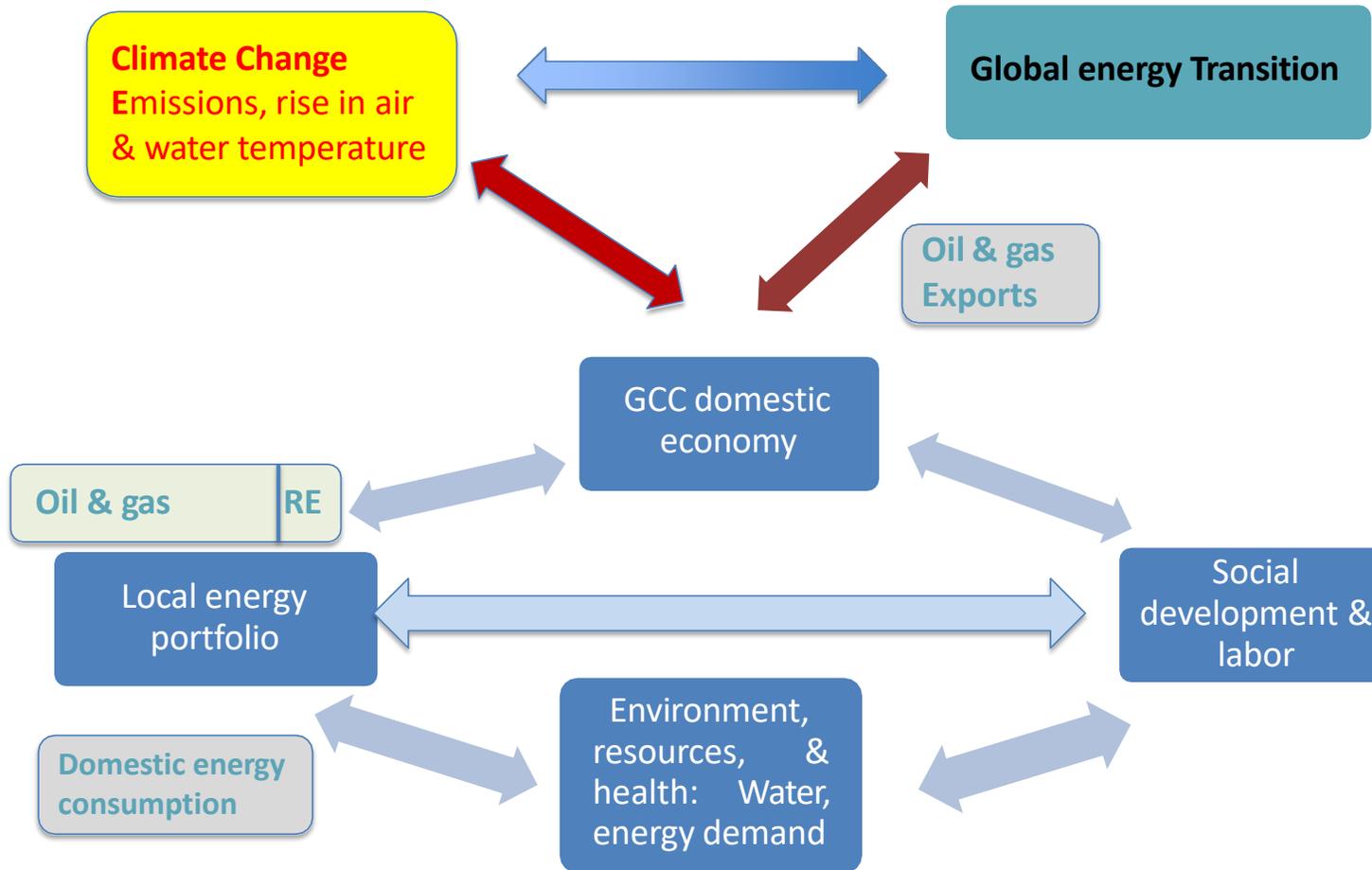


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GCC/MENA O&G Producers: Must Rethink Energy Transition-Economy Linkages & pathway to Sustainability



- **Need to Act now** to transition away from over dependence 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
- **accelerating transition to low carbon O&G exports**: key to orderly & timely transition

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

End of Main Slides

Sources: IEA, OIES, KAPSARC IEA & IEEJ reports as well as several industry energy/oil periodical publications and newsletters (Carbon Tracker, Forbes, etc..)

Supporting slides