



Circular Carbon Economy, Challenges and Opportunities

The 40th International Symposium - Oil and Gas Industry Looks to a Sustainable Future: New Challenges and International Cooperation
Panel 3 Energy Transition: Technology-driven Future Vision
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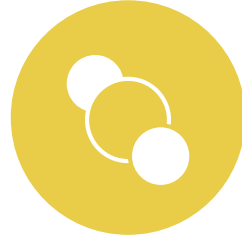
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Circular Carbon Economy (CCE)

a holistic, pragmatic and all-inclusive approach to safeguarding the planet



Reduce



Reuse



Recycle



Remove



Energy Sustainability

- Improved energy access
- Increased energy reliability

Climate Stewardship

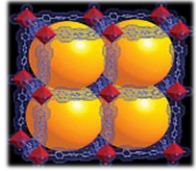
- Cost effective GHGs management
- Options for hard to abate sectors

Socio-economic Benefits

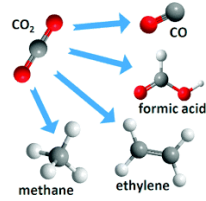
- Jobs & GDP
- Optimal infrastructure use

Saudi Aramco CCE R&D Programs

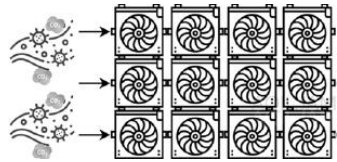
Spillover Reduce, Reuse, Recycle, and Remove CCE Technologies



Advanced materials



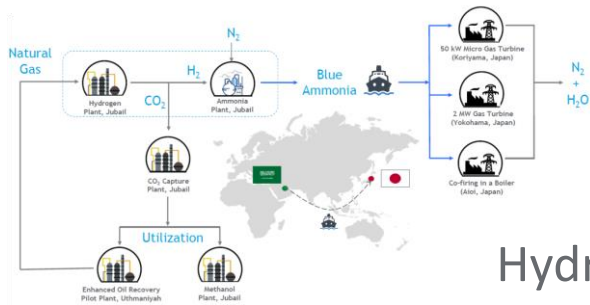
CO₂ Conversion



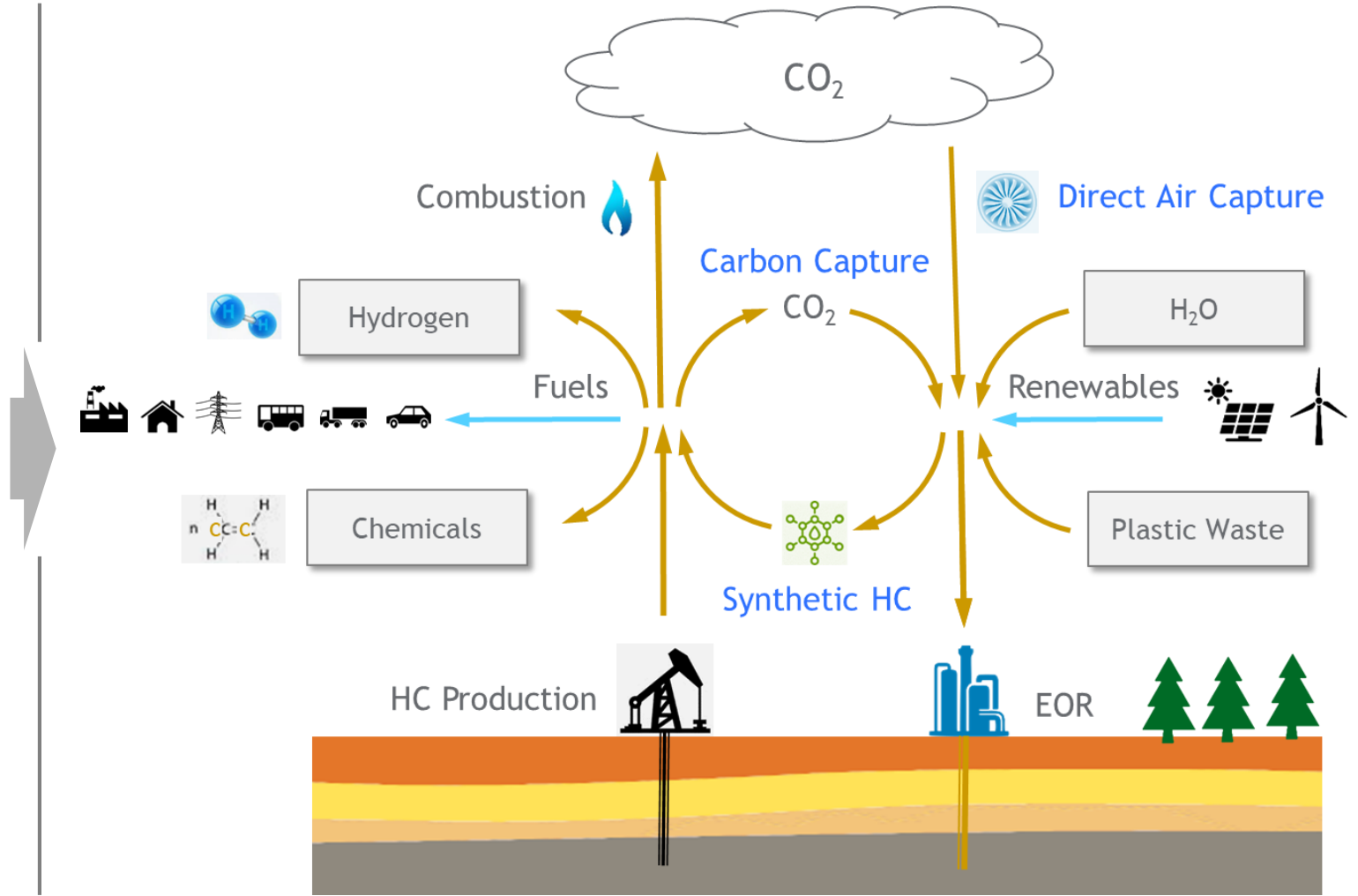
CO₂-DAC



E-fuels

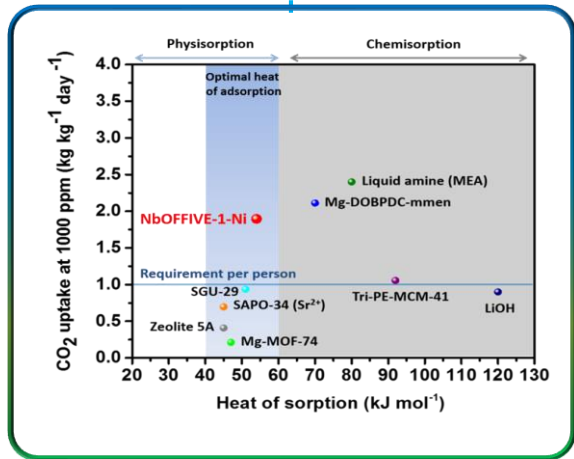
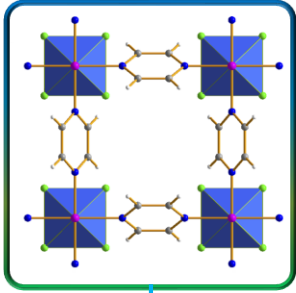


Hydrogen



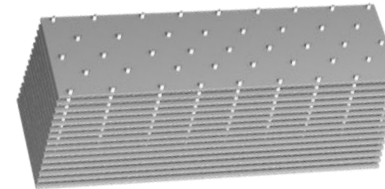
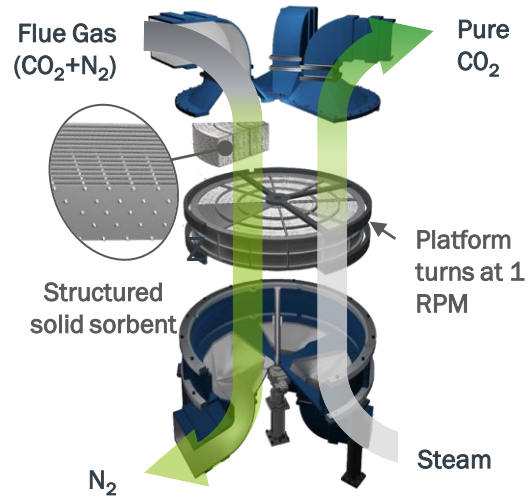
CO₂ Capture from Flue Gas using Novel Aramco-KAUST MOF Material

Aramco - KAUST MOF



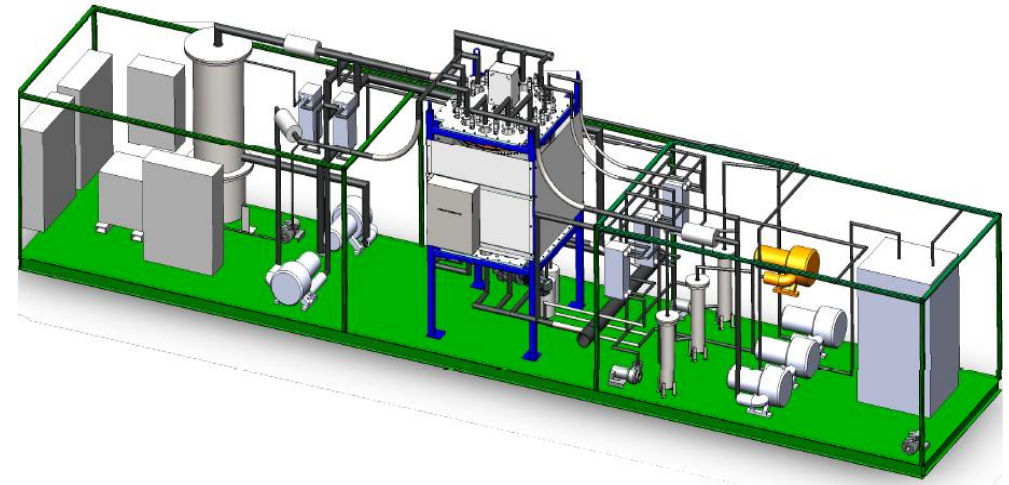
Aramco - KAUST MOF powder

Svante's Rotary Contactor



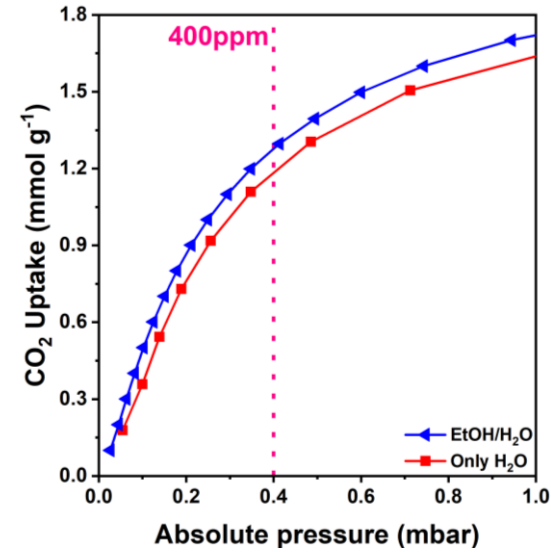
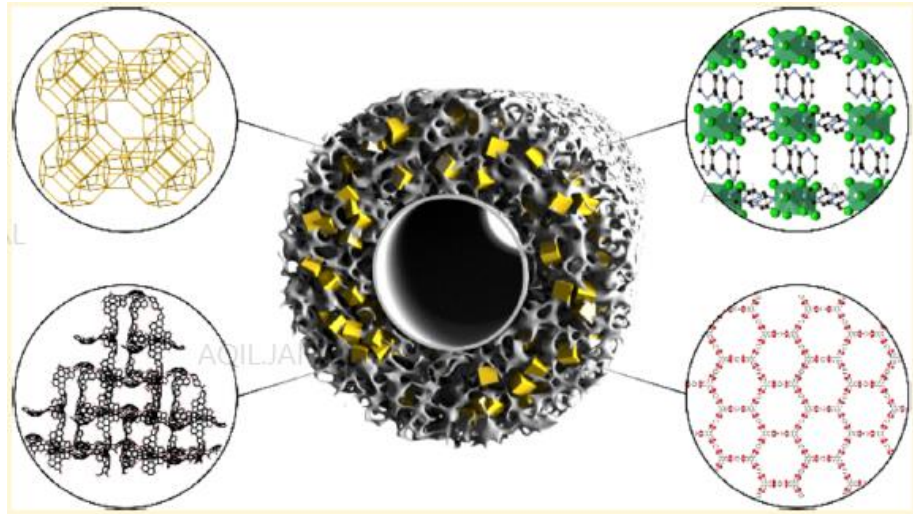
Structured adsorbent beds

1 tpd CO₂ capture pilot plant



- ✓ Testing and validation of Aramco - KAUST-7 MOF at Svante with promising results
- ✓ Material scaled-up to 10's of kg level
- ✓ Ongoing optimization of MOF material
- ✓ 1 TPD plant at one of Aramco's gas treating facilities

Metal-Organic Frameworks (MOFs) in Scalable Open-Porous Contactor Concept

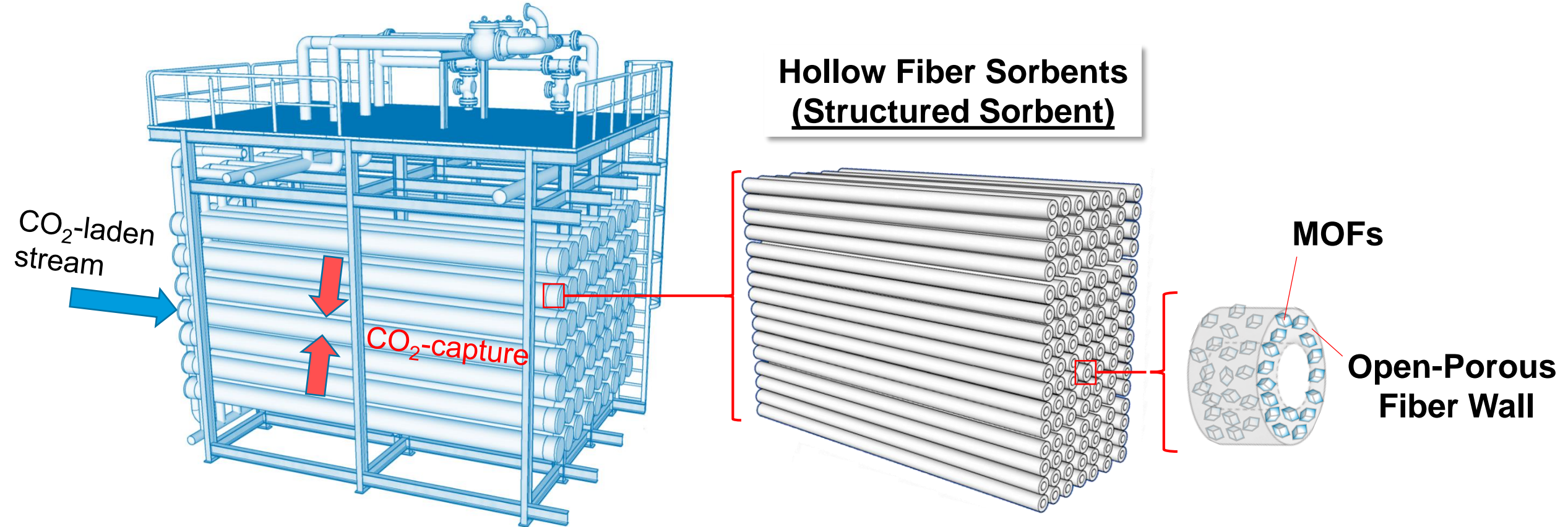


- High CO₂ uptake at 400ppm CO₂
→ (1.3 mmol/g at 400ppm)
- Controlled MOF crystal size
- Target: loading amount 75 wt%
→ CO₂ uptake of the fiber sorbent: 0.9mmol/g

CM CHEMISTRY OF MATERIALS

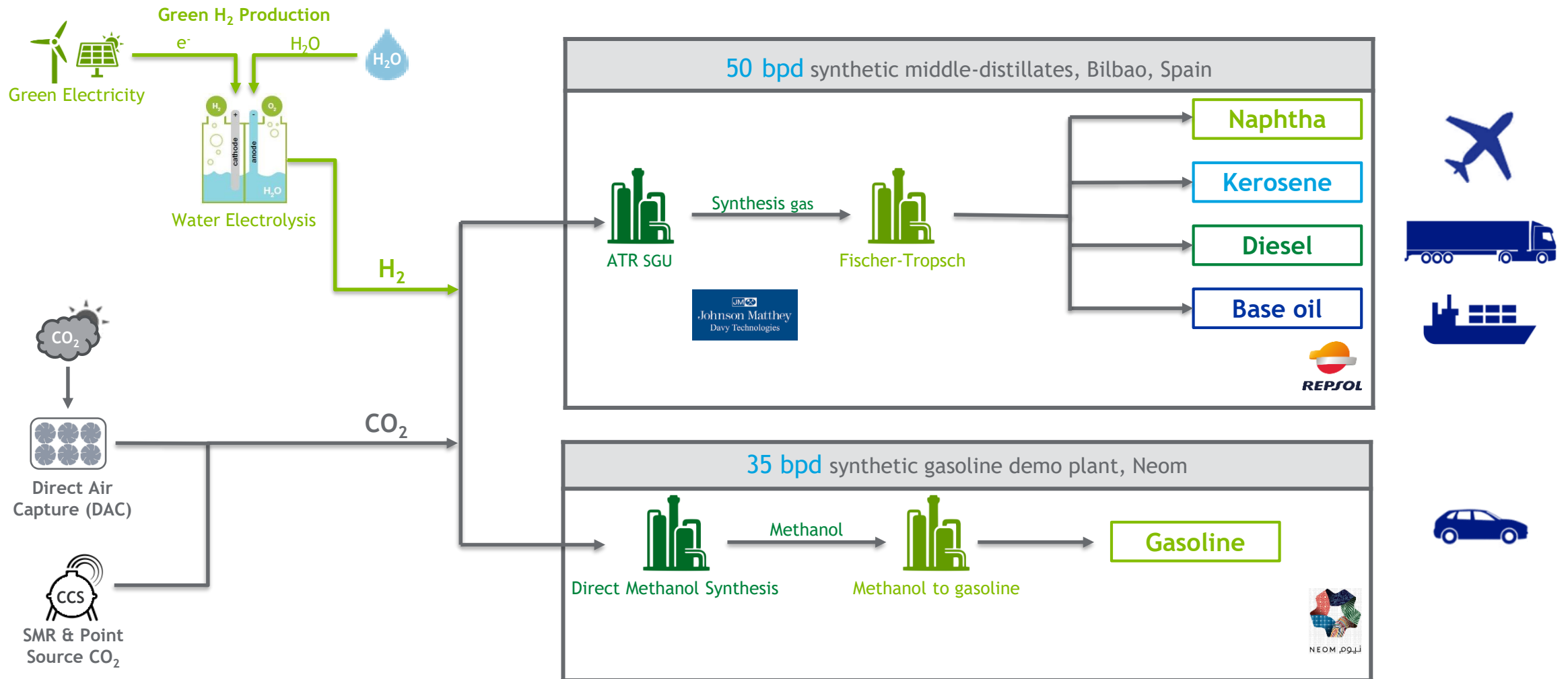


Fiber Sorbent can be a Scalable Path for CO₂ Capture from Air

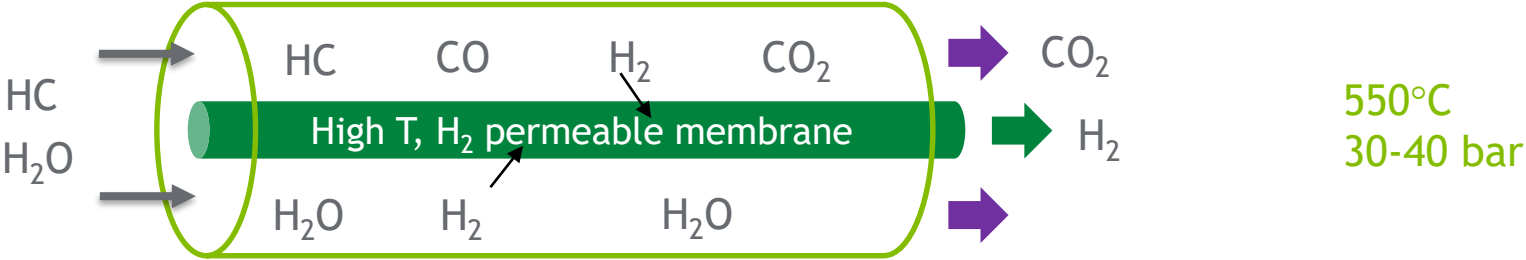
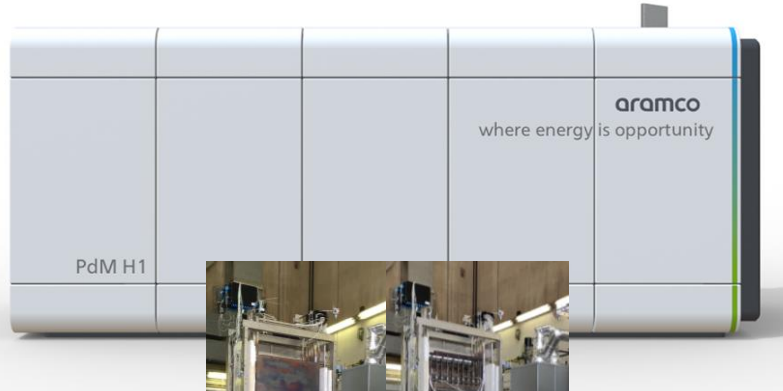
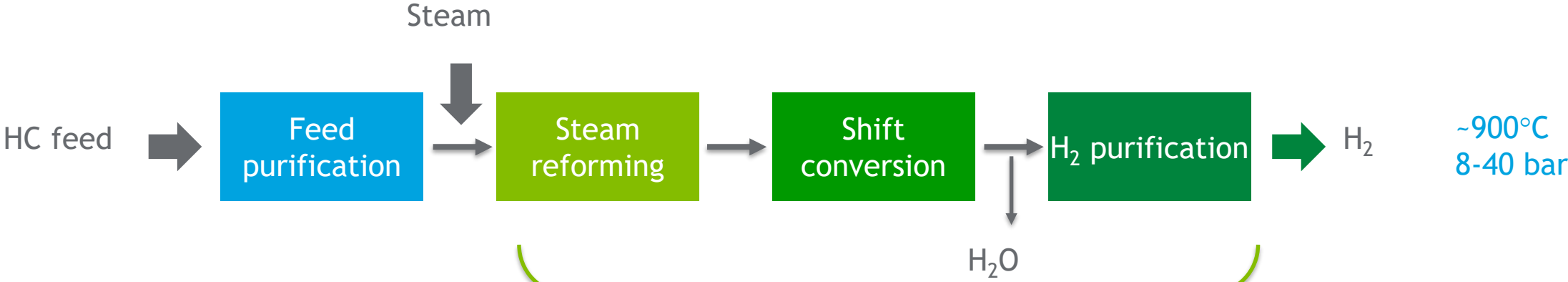


- Unique combination*
 1. **Scalability** = Low cost fabrication
 2. **High surface area per volume**
= Miniaturization of the unit (5 – 10x decrease)
 3. **High mass transfer rate**
= Bed utilization up (less sorbent usage)
 4. **Low pressure drop**
= 10 – 40x decrease → High flow rate processing

Piloting synthetic fuels production with partners



Membrane reformer for hydrogen production with CO₂ capture



Compact reactor

Efficient CO₂ capture

High conversion efficiency

Thank you