



ExxonMobil

# Unlock Hydrogen's Power

April 17, 2024

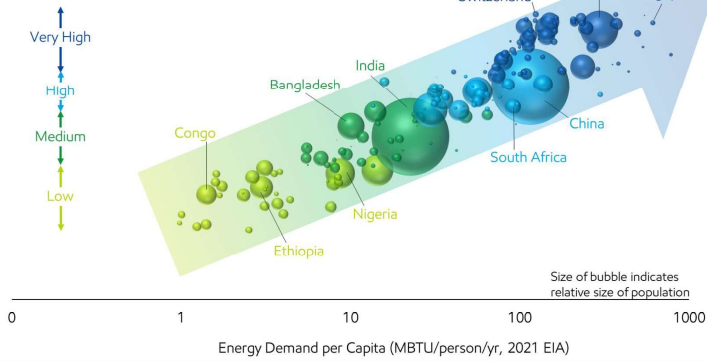
Dr. Prasanna V. Joshi  
Vice President, Low Carbon Solutions Technology  
ExxonMobil Technology and Engineering Company

# The "AND" Equation

Produce the products societies need and lead in reducing greenhouse gas emissions, both our own and others

## Energy is essential to improve quality of life

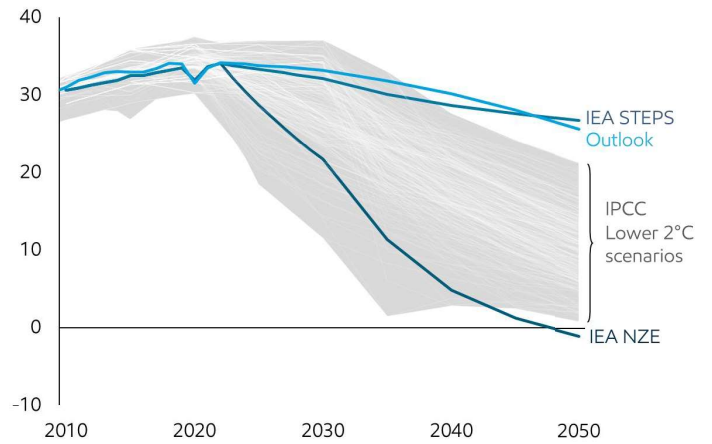
U.N. Human Development Index  
2021 Index



Source U.N. Human Development Reports, EIA, EM analysis

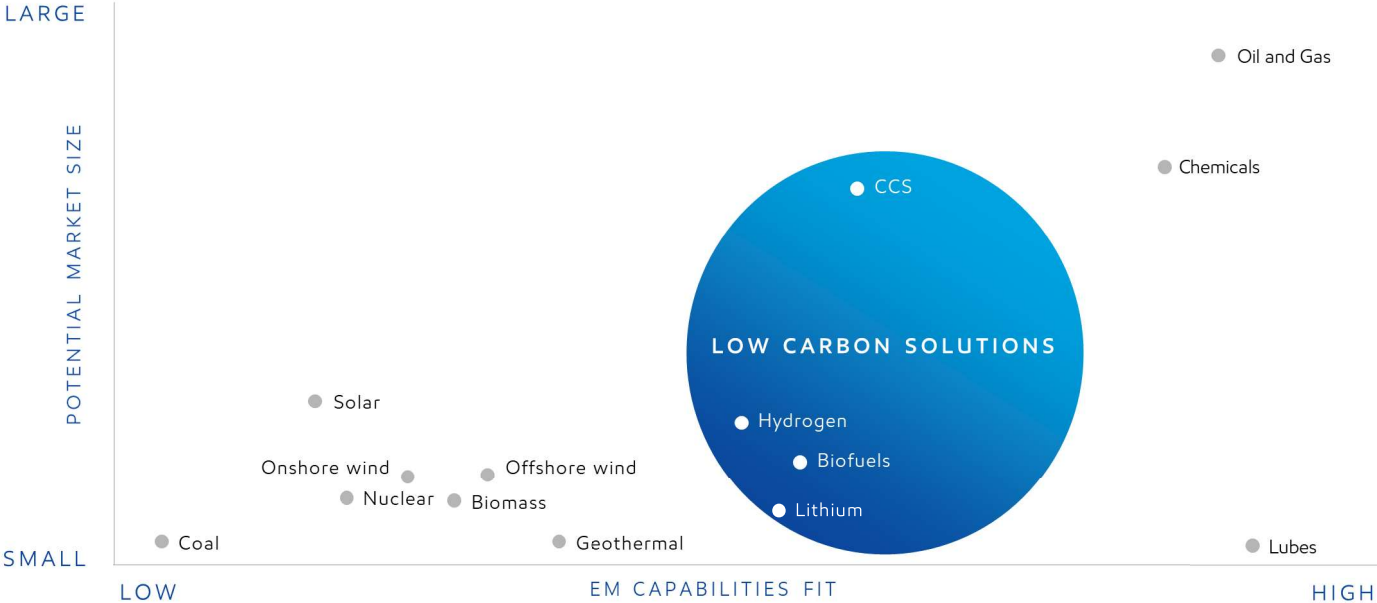
## Global energy-related emissions

CO<sub>2</sub> Billion metric tons

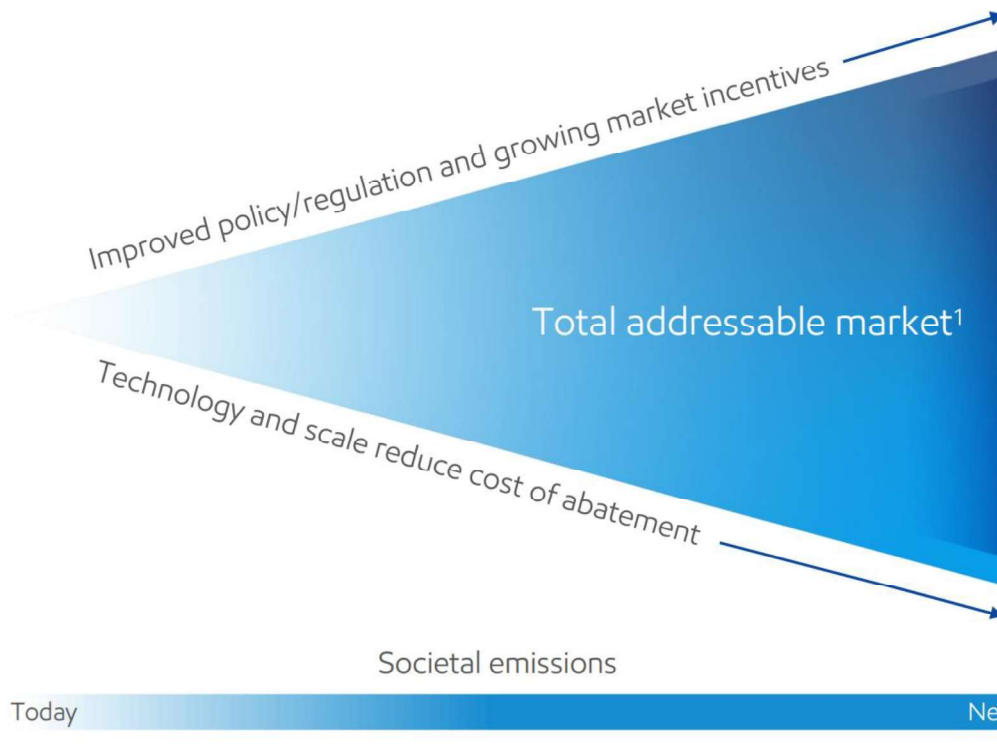


# Leveraging ExxonMobil's strengths

ExxonMobil Low Carbon Solutions focus deploys ExxonMobil's deep expertise and leverages our own asset CO2 abatement externally to drive large-scale market solutions: in CCS, Hydrogen, Lithium, and Biofuels



## Unlocking the opportunity



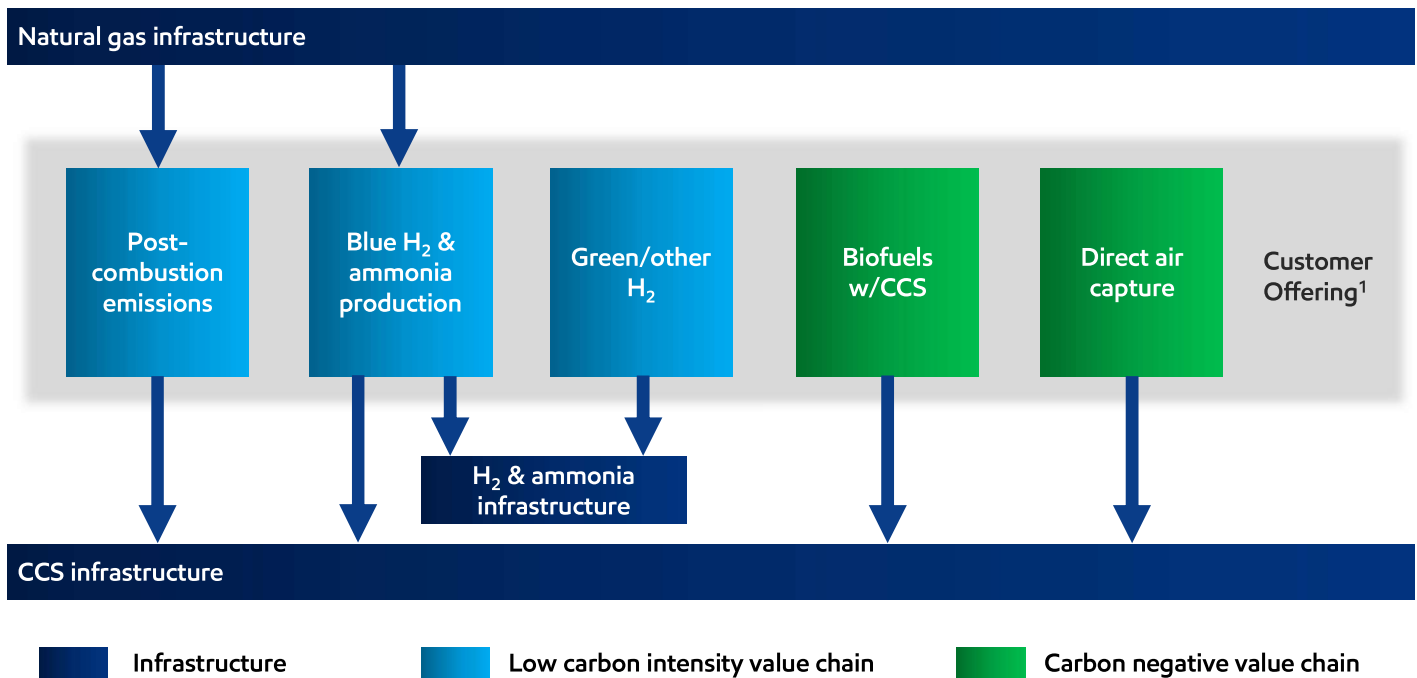
~\$20 billion

in lower-emission investments  
from 2022 to 2027

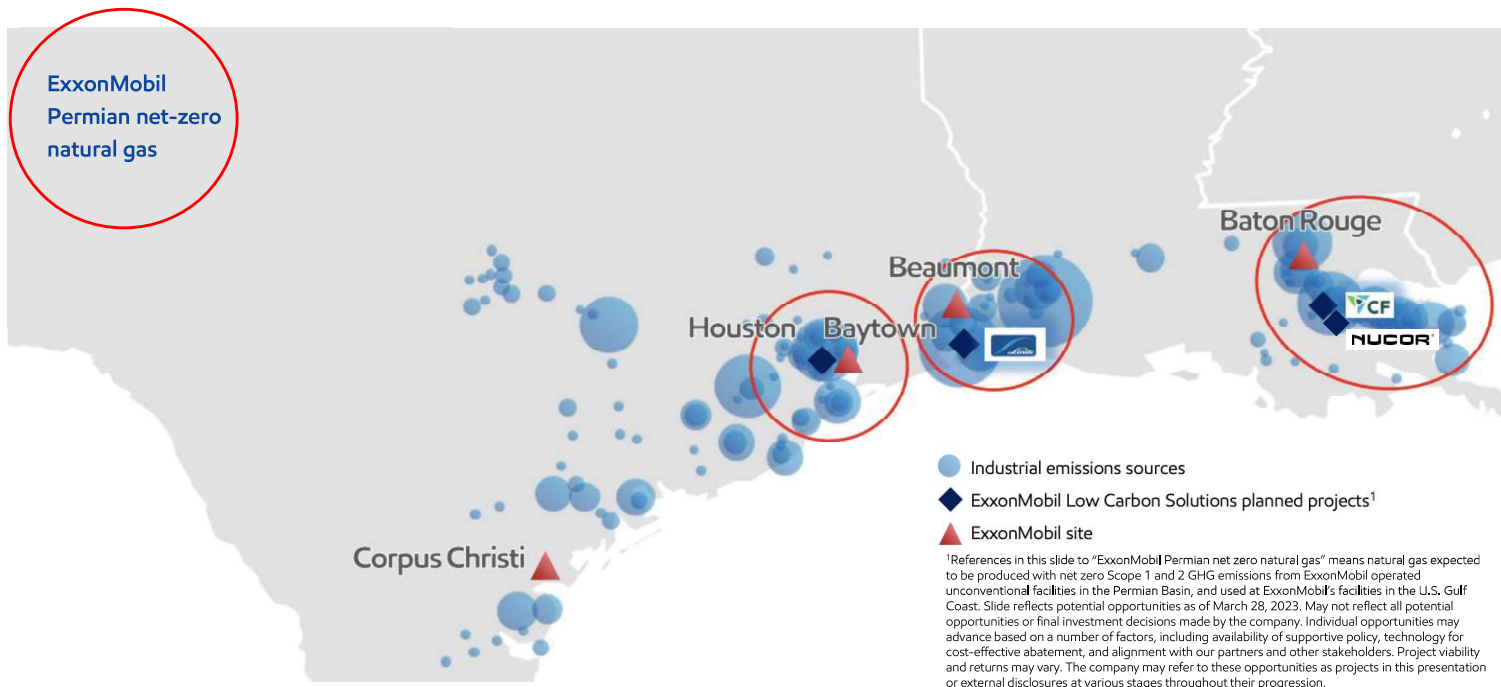
~60% of total focused on reducing  
our own emissions

~40% focused on reducing others'  
emissions

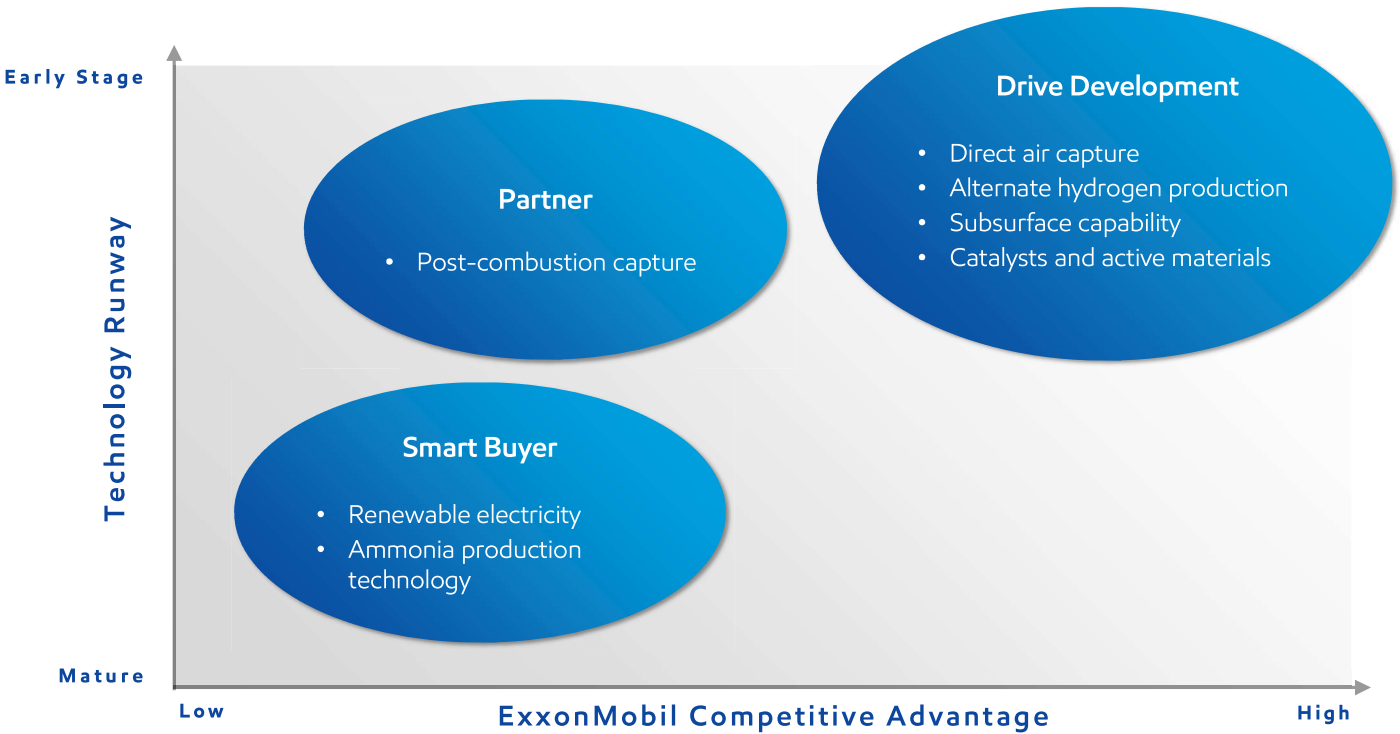
## Expanding our advantage through integrated value chains



## Building integrated value chains on the U.S. Gulf Coast – The Hub and network concept

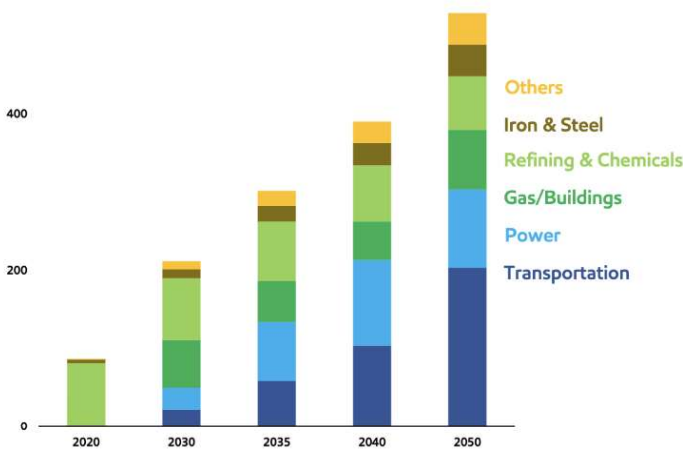


# Expanding our advantage through technology



# H<sub>2</sub> is an energy carrier that can support GHG emissions reduction in hard-to-electrify end-uses

IEA NZE H<sub>2</sub> Global Demand



Source: IEA Data, with IEA end-use categories aggregated into above categories

Hydrogen potentially the lowest-cost option to significantly reduce emissions in sectors including:



Industry



Heavy Duty Transportation



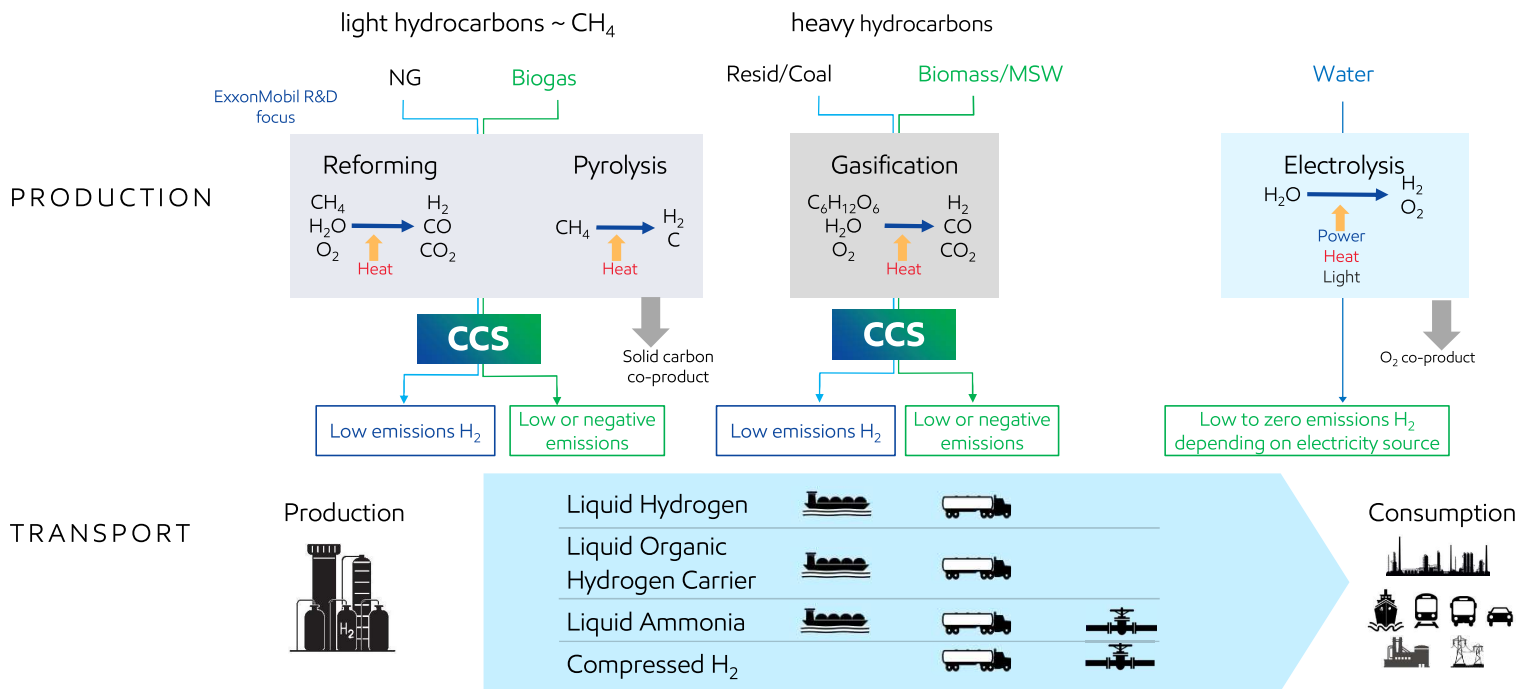
Iron and Steel



Power



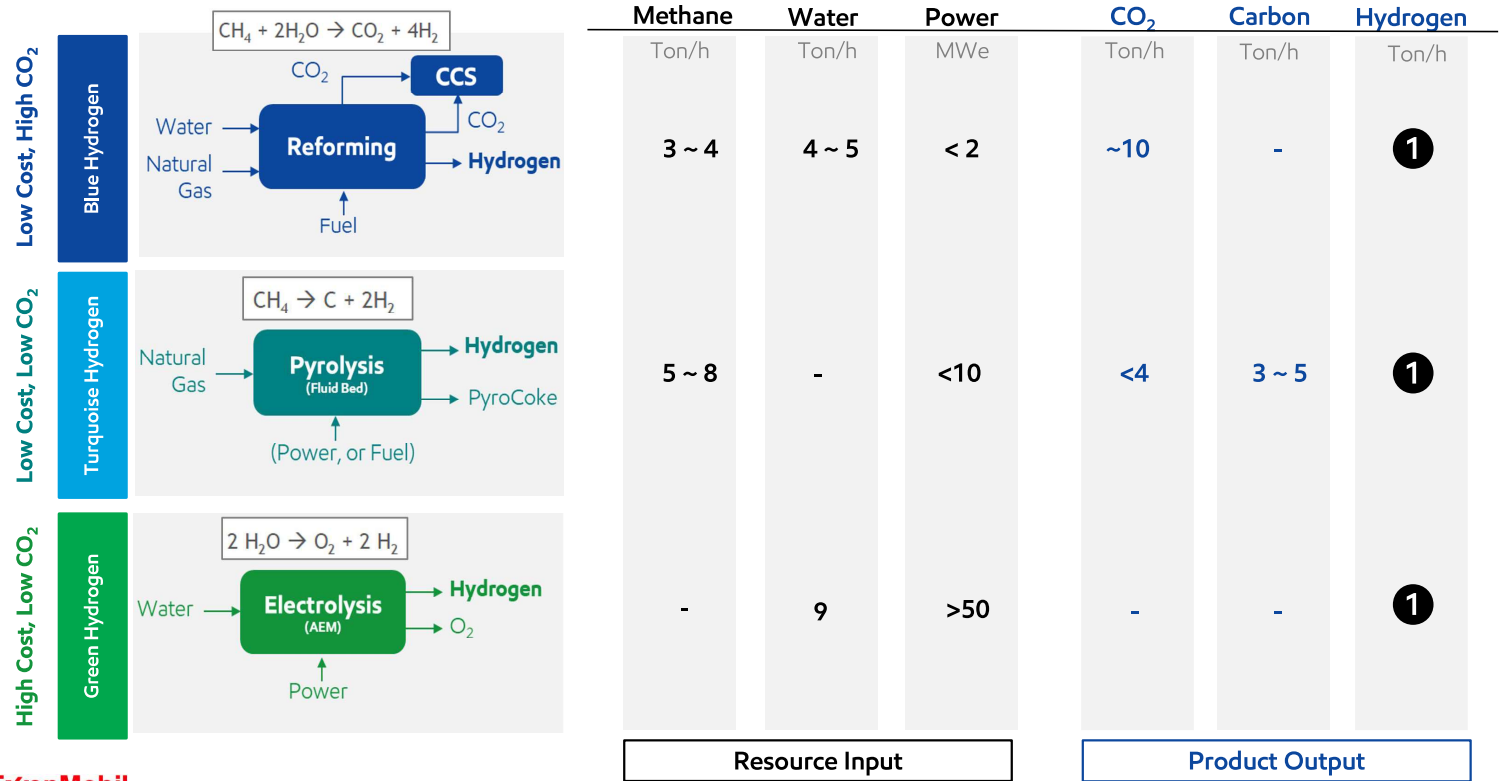
# Various routes to low emissions hydrogen show potential



**Example Publications**

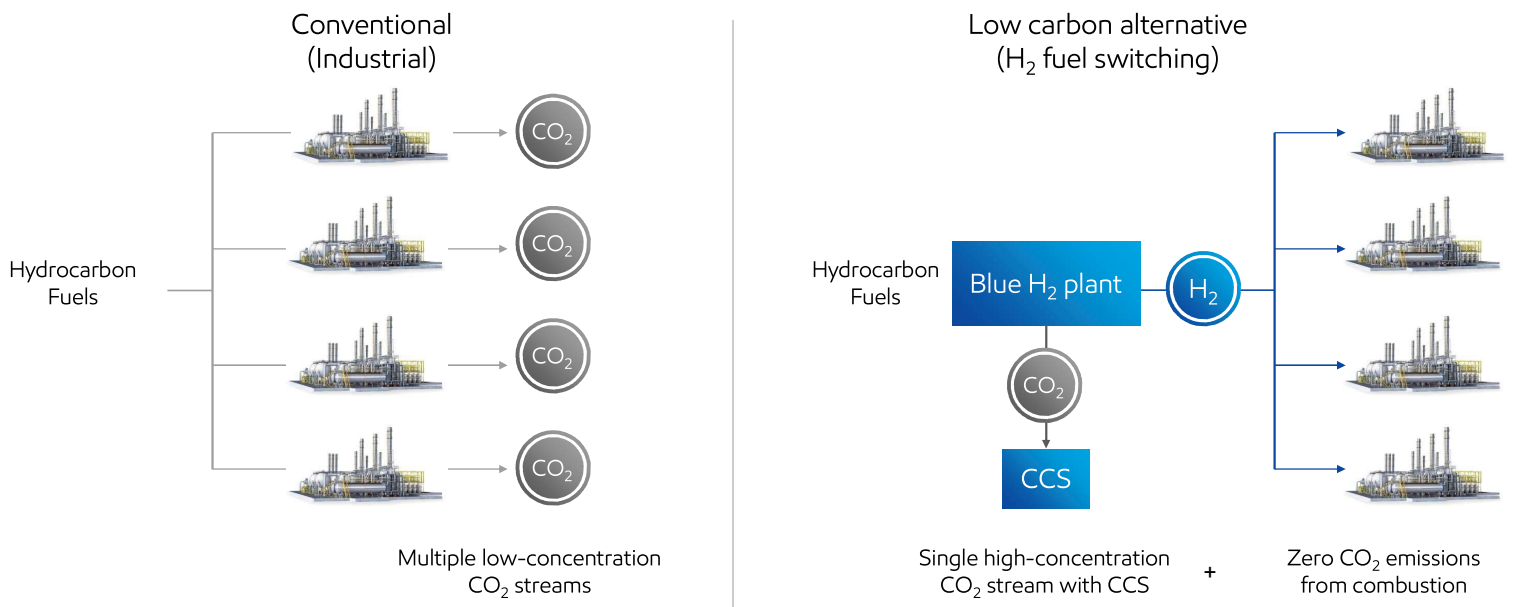
- Methane pyrolysis in monovalent alkali halide salts: Kinetics and pyrolytic carbon properties, Int'l Jnl of Hydrogen Energy, 46, 9, <https://doi.org/10.1016/j.ijhydene.2020.11.150>
- Techno-enviro-economic analyses of hydrogen supply chains with an ASEAN case study, Int'l Jnl of Hydrogen Energy, 46, 65, <https://doi.org/10.1016/j.ijhydene.2021.07.138>

# Comparison of Hydrogen Production Methods



# Growing market for hydrogen fuel switching

Fuel switching offers an alternative solution to abate multiple low-concentration CO<sub>2</sub> streams



# ExxonMobil Baytown blue hydrogen

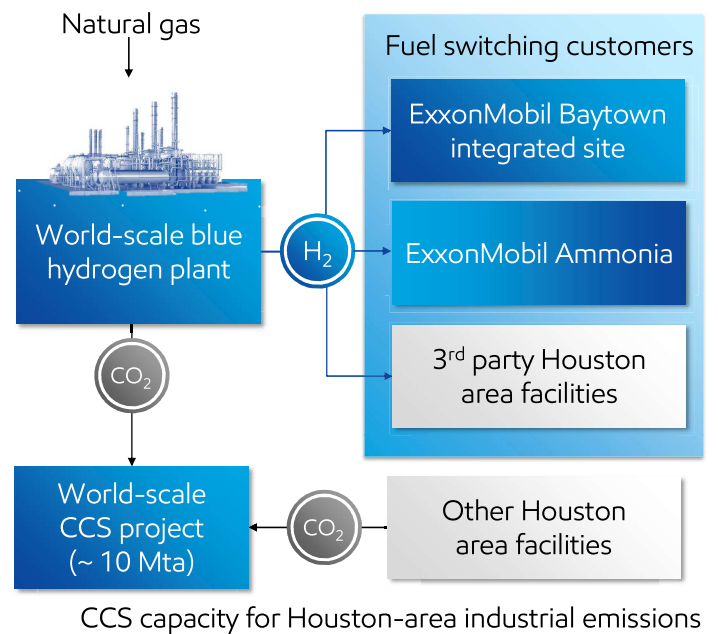
Provides emission-reduction opportunities and forms initial contribution to Houston CCS Hub

## Project Scope

- New blue hydrogen plant, 1 billion cubic feet per day
- Capability to capture over 98% of CO<sub>2</sub> scope 1 emissions

## Opportunities

- Reduce ExxonMobil Baytown site emissions by up to 30%
- Accessible low-cost natural gas
- Close proximity to quality underground storage
- Leverages existing capabilities



# Industrial heat application – Burner technology

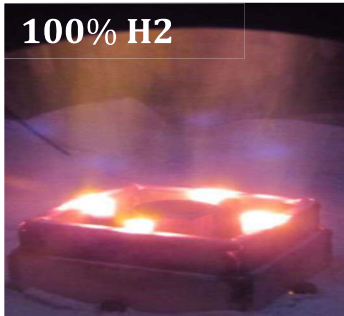
**Zeeco alliance** - A groundbreaking solution putting industry on the path to net zero

### Alliance objectives

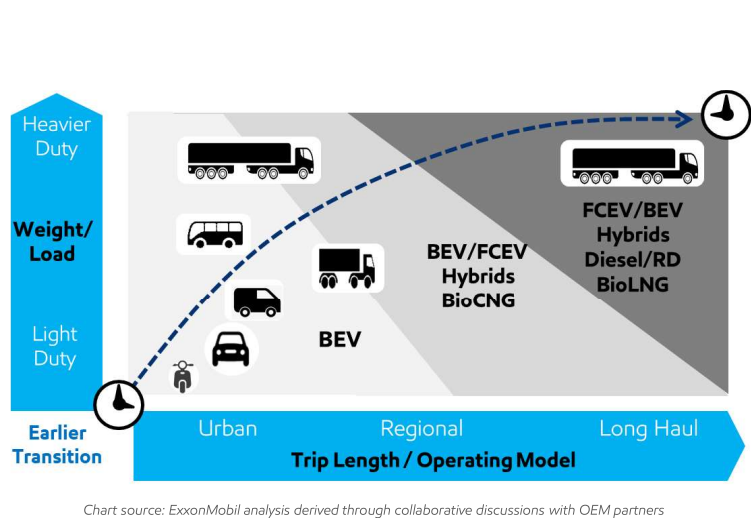
- Significantly lower emissions for industrial manufacturers
- Ultra-low NOx, 100% hydrogen ready industrial burners

### Value Chain Opportunities

- Reduce emissions at manufacturing operations worldwide
- Enable to offer customers end-to-end solution
- Support growth / development of low-carbon H<sub>2</sub> market



## Opportunities and challenges for H2 mobility



- Powertrain/fuel roadmap still evolving for commercial fleets
- Limited infrastructure is a barrier to growth for electricity/hydrogen-powered commercial fleets

# Hydrogen sensing

## Industry needs

- Safely produce and transport/store hydrogen
- Detect and mitigate leaks and losses

## Opportunities

- New technologies with lower detection limits needed
- Analytics needed for locating/sizing emissions source



# Collaboration critical to a successful innovation pipeline

— DISCOVERY —————> DEVELOPMENT —————> 1<sup>ST</sup> DEPLOYMENT —————> DEPLOYMENT AT SCALE

 SINGAPORE ENERGY CENTRE

 INSTITUTO DE TECNOLOGÍA QUÍMICA

 The University of Texas at Austin Energy Institute

 Stanford Strategic Energy Alliance  
Precourt Institute for Energy

 MIT Energy Initiative

 Università di Genova

 IBM Quantum

 NATIONAL ENERGY TECHNOLOGY LABORATORY

 NATIONAL CARBON CAPTURE CENTER

 NREL  
Transforming ENERGY

 INL

 ZEECO

 fuelcellenergy

 MITSUBISHI HEAVY INDUSTRIES

 ExxonMobil

Integrating affordable and scalable technology solutions



# Unlock Hydrogen's Power

## Key Takeaways



Significant  
investments  
necessary



Smart policies  
accelerate  
deployment



Increased  
technology  
innovation and  
collaboration



Large, complex  
capital projects



Thank You!

ExonMobil