

IRENA INNOVATION WEEK **20**  
**23**

# Solutions to decarbonize the chemical and petrochemical sector

Organized in partnership with



**DECHEMA**

Gesellschaft für Chemische Technik  
und Biotechnologie e.V.

11:30 - 13:00 | 26 September 2023

#IIW2023

# IRENA INNOVATION WEEK <sup>20</sup><sub>23</sub>



**Francisco Boshell**

Head – Innovation and End-Use Applications  
IRENA Innovation and Technology Center

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# Pathways to decarbonize the Chemical sector

## Estimated emission reductions share per solution by 2050 in planned energy scenario

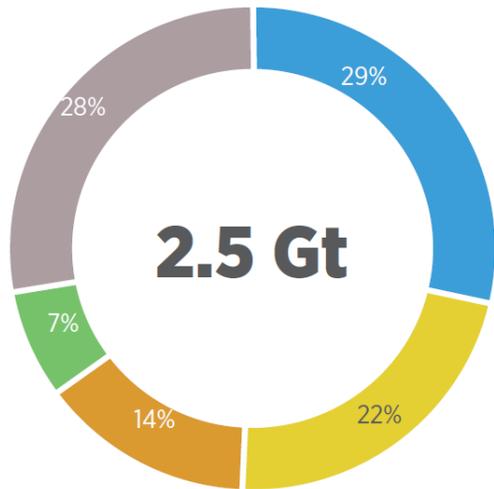
In a PES **demand for chemical may grow ~ 70%** from 2020 to 2050, main markets Asia and North America

Emissions from the sector to increase from ~ 1.6 Gt CO<sub>2</sub> today to ~ **2.5 Gt CO<sub>2</sub> in 2050**

Circularity and carbon removal complemented by **three key renewables-based** pathways:

- Use of **biomass** heat and feedstock
- **Direct electrification** of processes
- **Indirect electrification** via synthetic fuels and feedstock.

Estimated role of key CO<sub>2</sub> emission reduction measures to reduce chemicals and petrochemicals Planned Energy Scenario emissions to zero



Reduced demand and improved energy efficiency



Direct use of clean electricity



Direct use of renewable heat and biomass



Indirect use of clean electricity via synthetic fuels & feedstocks



Use of carbon dioxide removal measures

# Renewable Pathway - Biomass

## Main barriers to scale-up biomass-based solutions



Source: IRENA survey

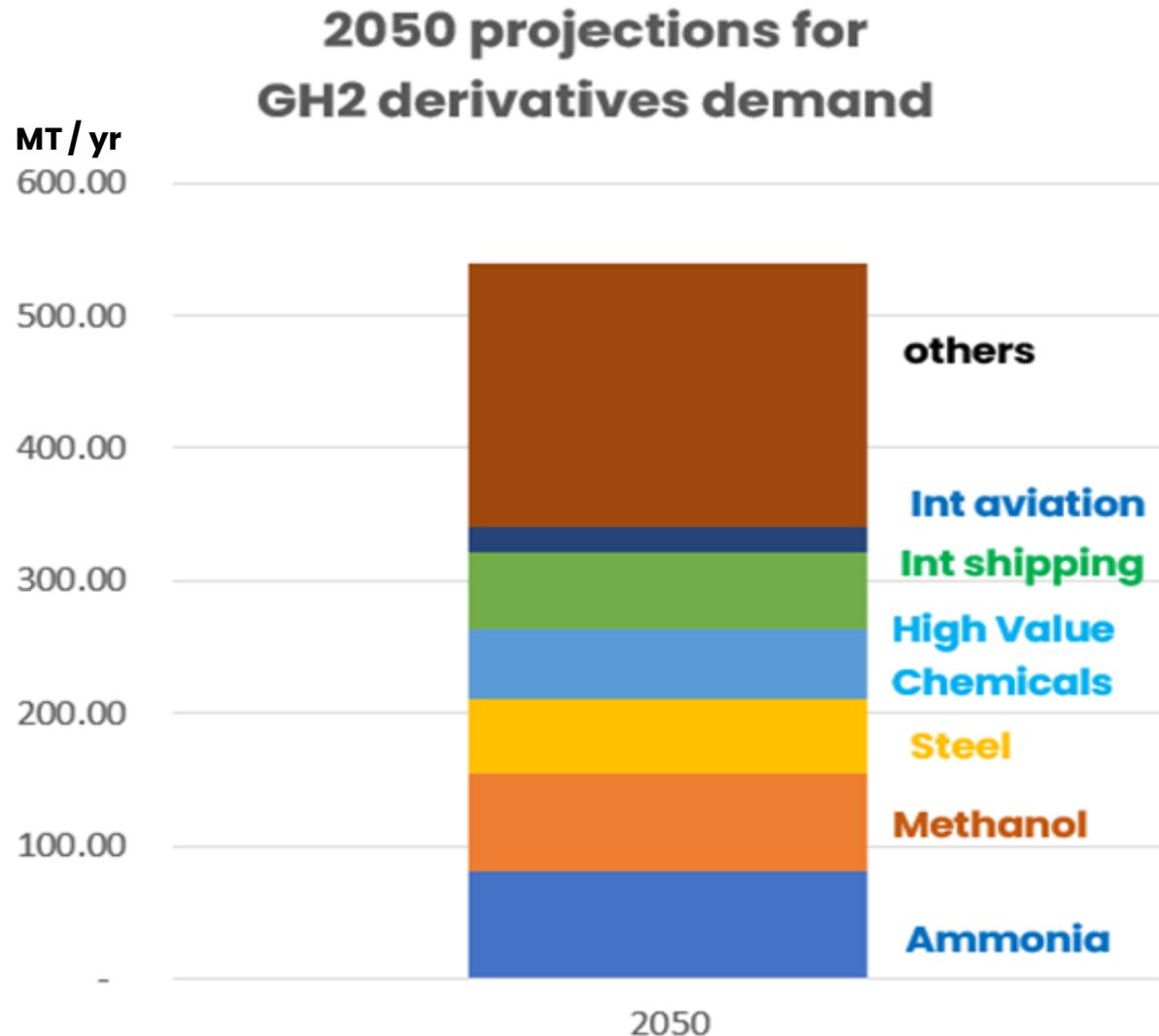
Area is in relation to perceived importance.

**Stability of regulation is the most important** barrier to investments followed by the cost and availability of financing and level of conversion efficiency & capex. **Lower barrier is technology.**

### *Innovation areas*

- **Regulatory frameworks** – more carrots and less sticks?
- Enhance methods to **ensure and prove sustainability**
- **Business models** – connecting bioindustries and synthetic fuels
- **Feedstock** value chains

# Renewable Pathway – Indirect electrification via green hydrogen



Potential demand for synthetic fuels and feedstock in a 1.5°C aligned scenario may demand ~ **250 MT GH2/y**

## ***Innovation areas***

- Increased RE electricity generation capacity in the order of ~ **5,000 GW RE**
- **Sourcing carbon molecule** for sustainable synthetic fuels
- **Location of facilities** – where abundant RE / where bio-C / where infrastructure for use
- **Infrastructure** required – electrical, production, trade.
- What to do with **brownfield** plants?

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# Renewable Pathway – Direct electrification

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BASF, SABIC and Linde start construction of the world's first demonstration plant for large-scale electrically heated steam cracker furnaces

Source: (BASF, 2022)

Shell and Dow have installed an electricity-powered experimental heat steam cracker furnace unit at the Energy Transition Campus in Amsterdam (the Netherlands). This is a key milestone in the effort to decarbonise one of the most carbon-intensive processes of petrochemical manufacturing. The solution could be scaled up by 2025 if tests in 2023 show that it can successfully replace today's gas-fired steam cracker furnaces.

Source: (Shell, 2022).

**Emerging technologies** including HT heat pumps, electric resistance furnaces, induction furnaces, electric arc furnaces or e-crackers to reach temperatures between 200°C up to above 1000°C

## ***Innovation areas***

- **Technology development** and commercialization
- Management of **peak load**
- Manage of **variability** of RE sources

# E.g., of systemic innovation approach for heating applications in industries

## HEATING FOR INDUSTRY



### TECHNOLOGY AND INFRASTRUCTURE

- **3** High-temperature heat pumps
- **4** Waste heat-to-power technologies
- **5** High-temperature electricity based applications for industry
- **7** Medium- and high-temperature thermal storage



### MARKET DESIGN AND REGULATION

- **15** Flexibility provision by thermal loads
- **16** Flexible power purchase agreement



### SYSTEM PLANNING AND OPERATION

- **26** Smart operation of industrial heating



### BUSINESS MODELS

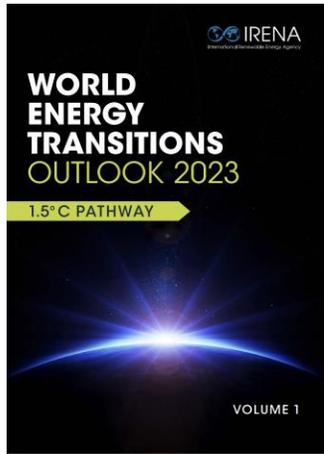
- **30** Heating and cooling as a service
- **32** Eco-industrial parks and waste heat recovery from industrial processes



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# Every sector is different and needs specific analysis

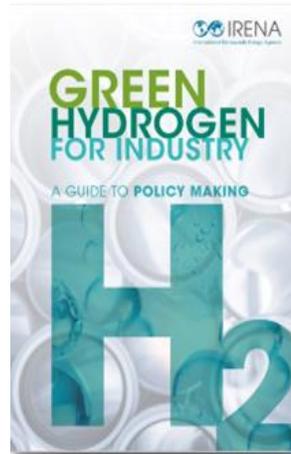
## End Use Sectors



## Electrification



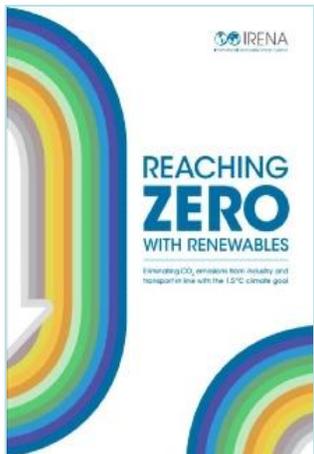
## Hydrogen



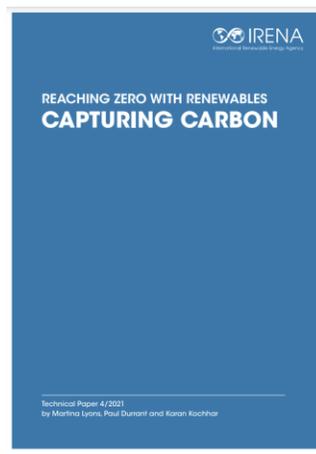
## E-fuels



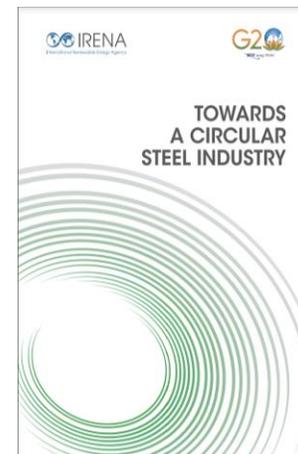
## Hard to Abate Sectors



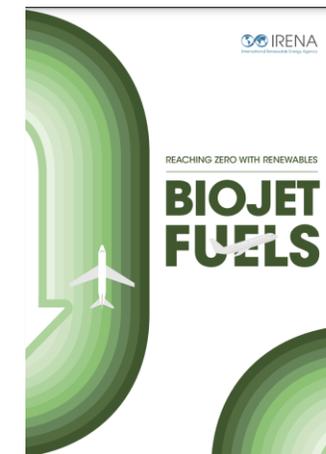
## CCS and BECCS



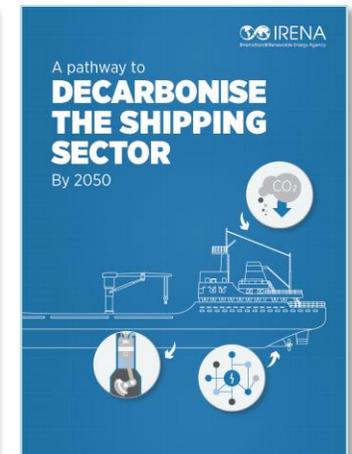
## Iron and Steel



## Aviation



## Shipping



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# International and sectoral collaboration is crucial

## IRENA Alliance for Industrial Decarbonization

The **objective** of the **Alliance** is to **enhance dialogue** and **coordinated action** among the members towards:

- » **Raising aspiration** for decarbonization, aligned with **global** and **national decarbonization ambitions**.
- » **Support the development and implementation of decarbonization strategies**, leveraging **renewable energy**.
- » **Stimulating the exchange of knowledge and best practices** among practitioners.
- » **Engaging with global and regional energy and climate platforms to foster action for decarbonizing end-use sectors**, particularly **industry**.



**Total 55 members and partners with IRENA as Alliance Secretariat host**



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## Panel discussion

Moderator



**Florian Ausfelder**  
Dechema

Panellists



**Lars Börger**  
Neste



**Jörg Unger**  
BASF



**Rossella di Virgilio**  
Versalis -ENI



**Dharik Mallapragada**  
DC-MUSE



**Martijn de Graaff**  
Voltachem

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## Closing remarks



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