"Renewable Energy & Clean Hydrogen: Status and Next Steps"

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European Union's targets for climate & energy

European Commission

2020

-20 % GHG Emissions

20% RES

20 % Energy Efficiency

2030

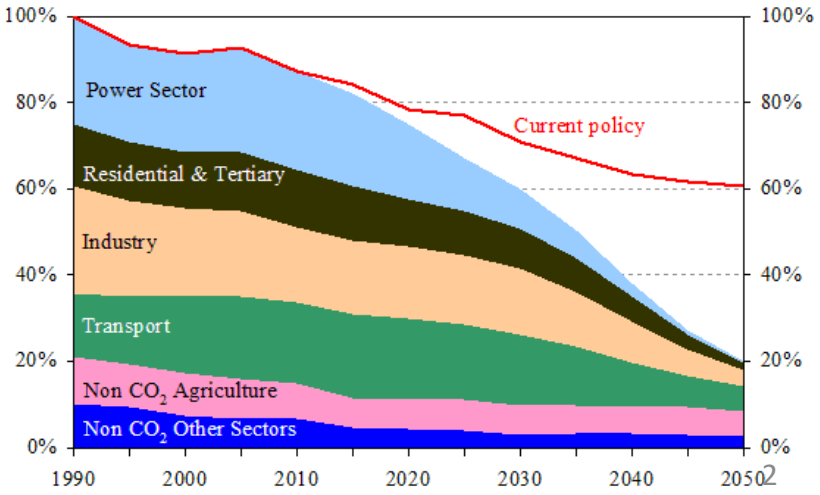
-40 % GHG Emissions

27 % RES

27%* Energy Efficiency

2050

-80 to 95% GHG Emissions



EU GHG emissions reductions towards an 80% target (1990=100%), EU 2050 Roadmap for energy

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

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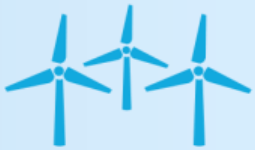
Europe is on the move towards a flexible power market based on RES

THE ENERGY SYSTEM OF TOMORROW WILL LOOK DIFFERENTLY

2030

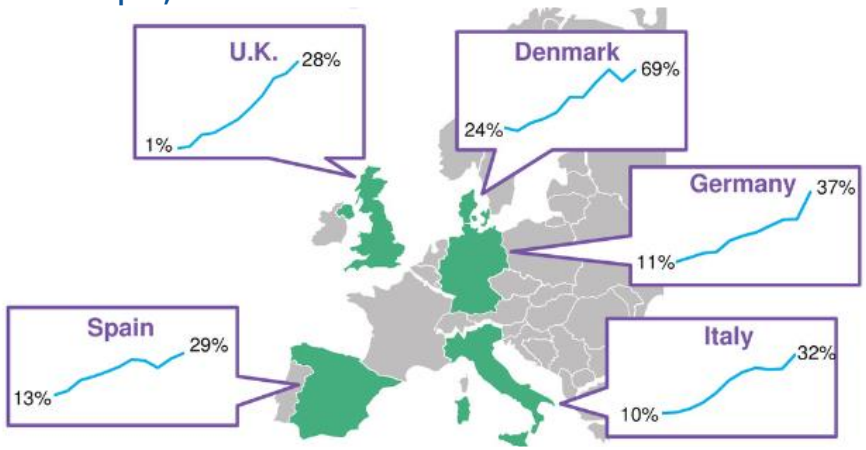
50% of electricity to come from renewables



2050

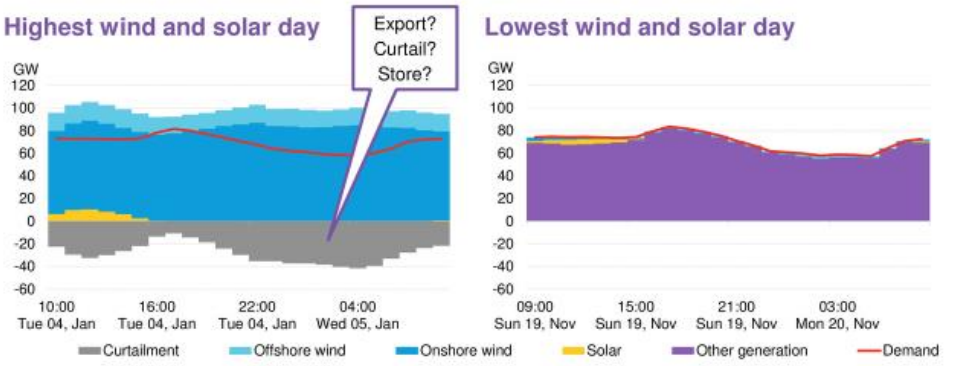
Electricity completely carbon free

Renewable energy* share of power generation in Europe, 2007-2017:



*Source: Bloomberg New Energy Finance, respective country sources. Note: *Excludes large hydro.*

Extreme days, Germany at 50% variable renewables:



Source: Bloomberg New Energy Finance. Note: 24-hour periods, not calendar days.

Power market transformation is a race for flexibility & electricity storage is an enabler

The Challenge: All sectors need to be decarbonised

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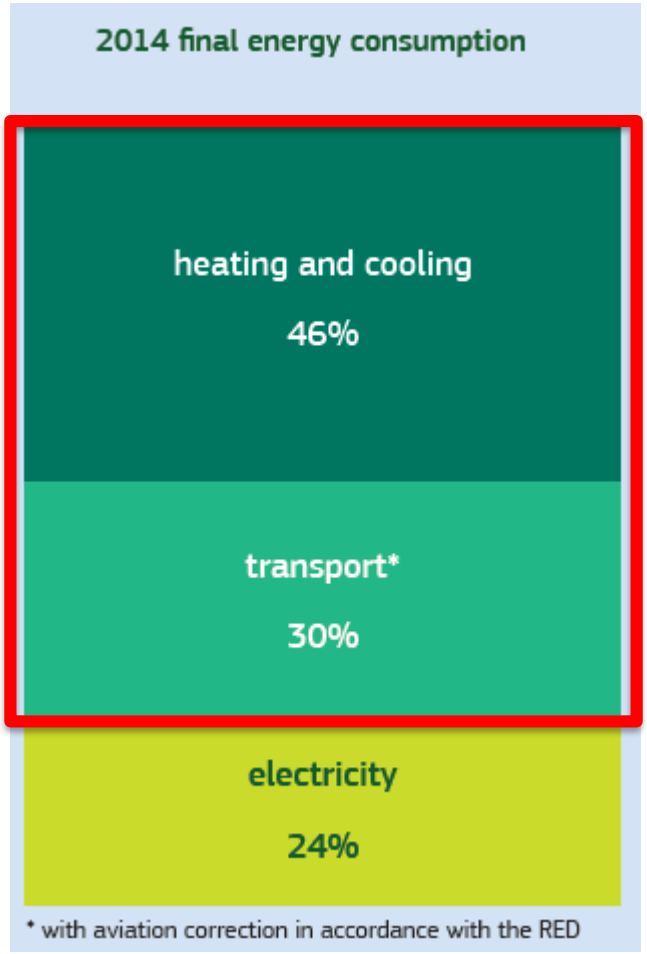
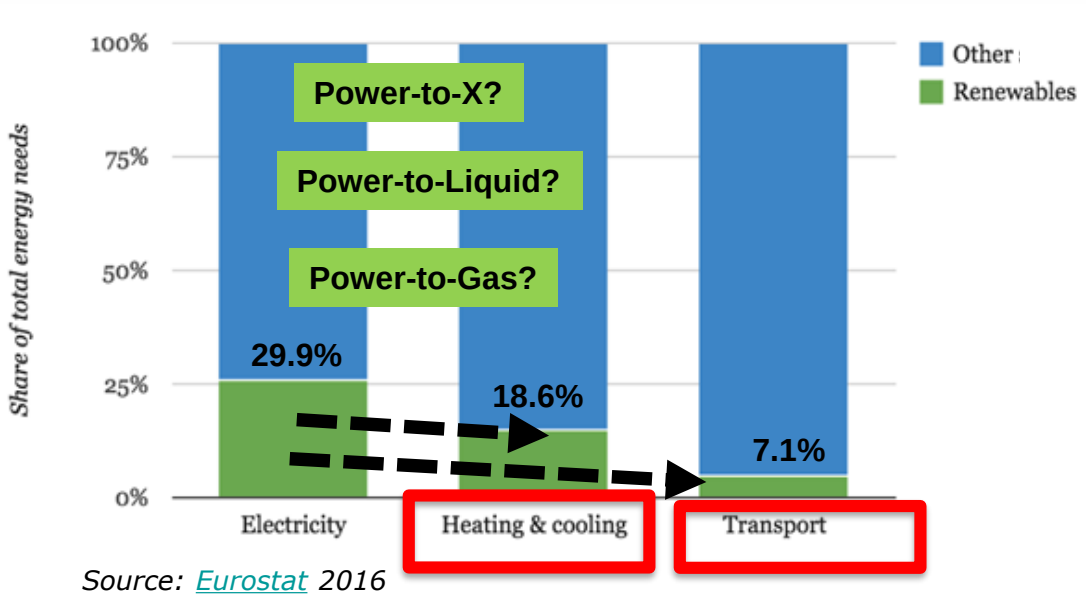


Source: EC, 2015 renewable energy progress report

Renewable share of the EU energy mix for electricity, transport, heating and cooling:



Source: Eurostat 2016

Need to:

- **Channel renewable electricity into transport, industry & buildings**
- **Exploit synergies between RES & fossil resources**
- **Design right incentives for low-carbon tech**
- **Lower technology costs**

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Hydrogen: Connecting Electricity, Gas & Mobility

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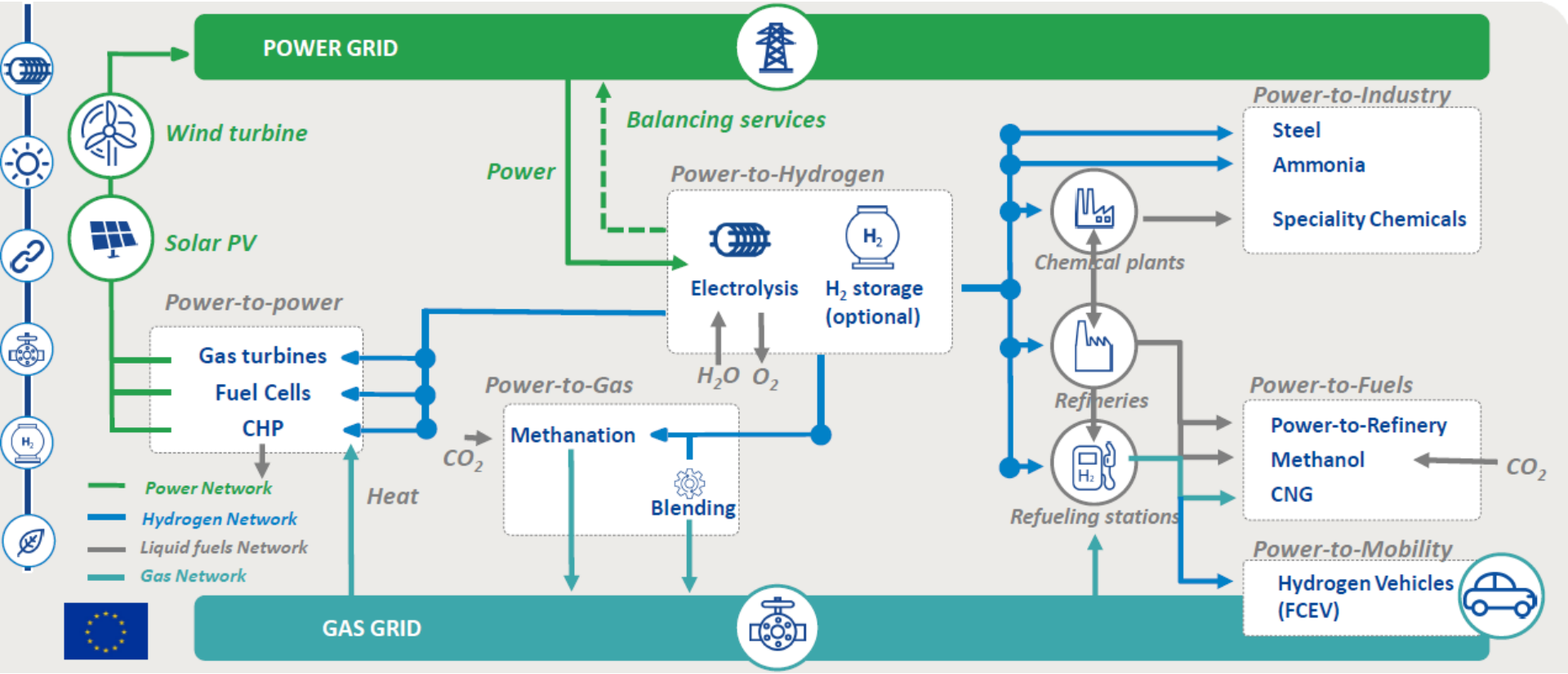
Hydrogen allows for more renewables & enables sector-coupling for a more efficient and greener energy system



FCH JU – key EU instrument for hydrogen related R&I funding

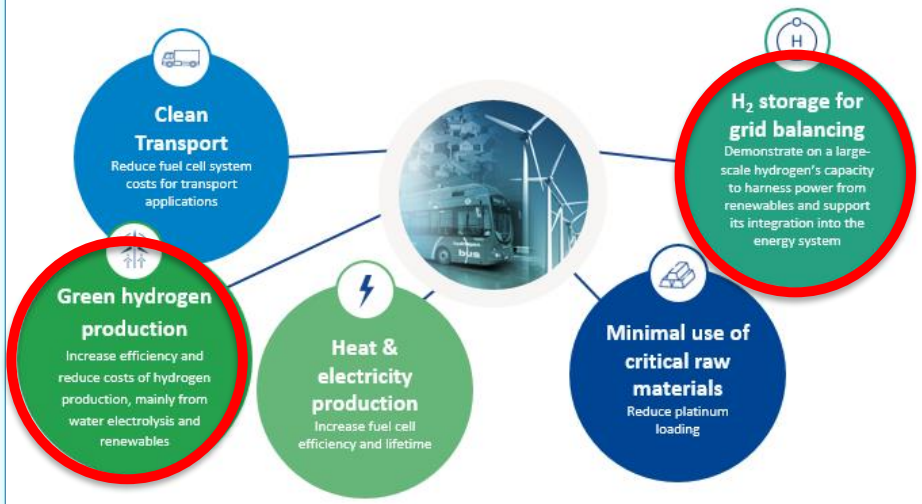
Fuel Cells & Hydrogen Joint Undertaking (FCH 2 JU)

Hydrogen Europe
Industry Grouping
Over 130 members
~ 50% SME

European Commission

Hydrogen Europe Research
Research Grouping
~70 members

Strategic objective:
to bring FCH technologies to the point of market readiness by 2020



Budget 2014-2020:
~ 1.3 B €
EU contribution: 665M€

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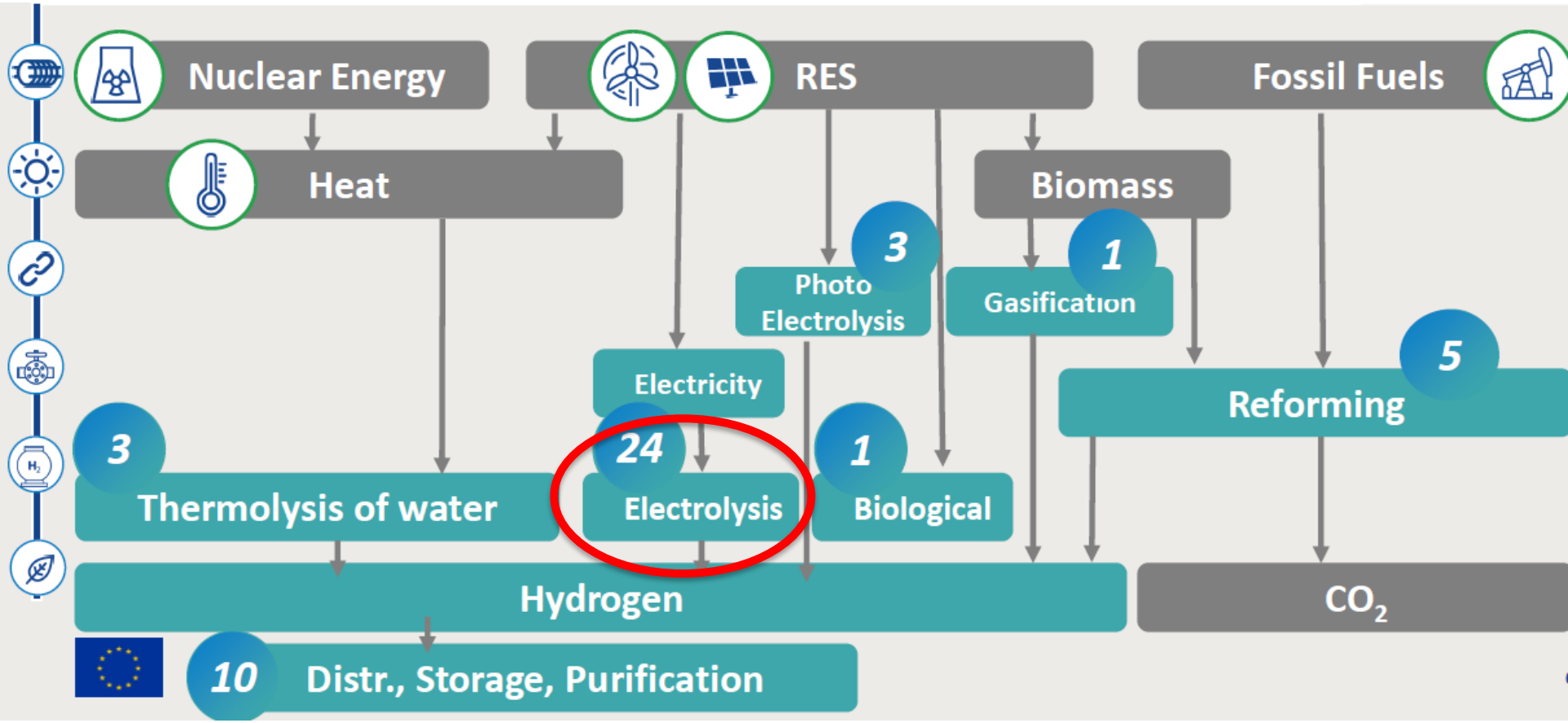
FCH JU'S hydrogen production portfolio

95% of FCH JU's support goes to green hydrogen production



Electrolysis: key enabling technology for energy storage & greening of industry

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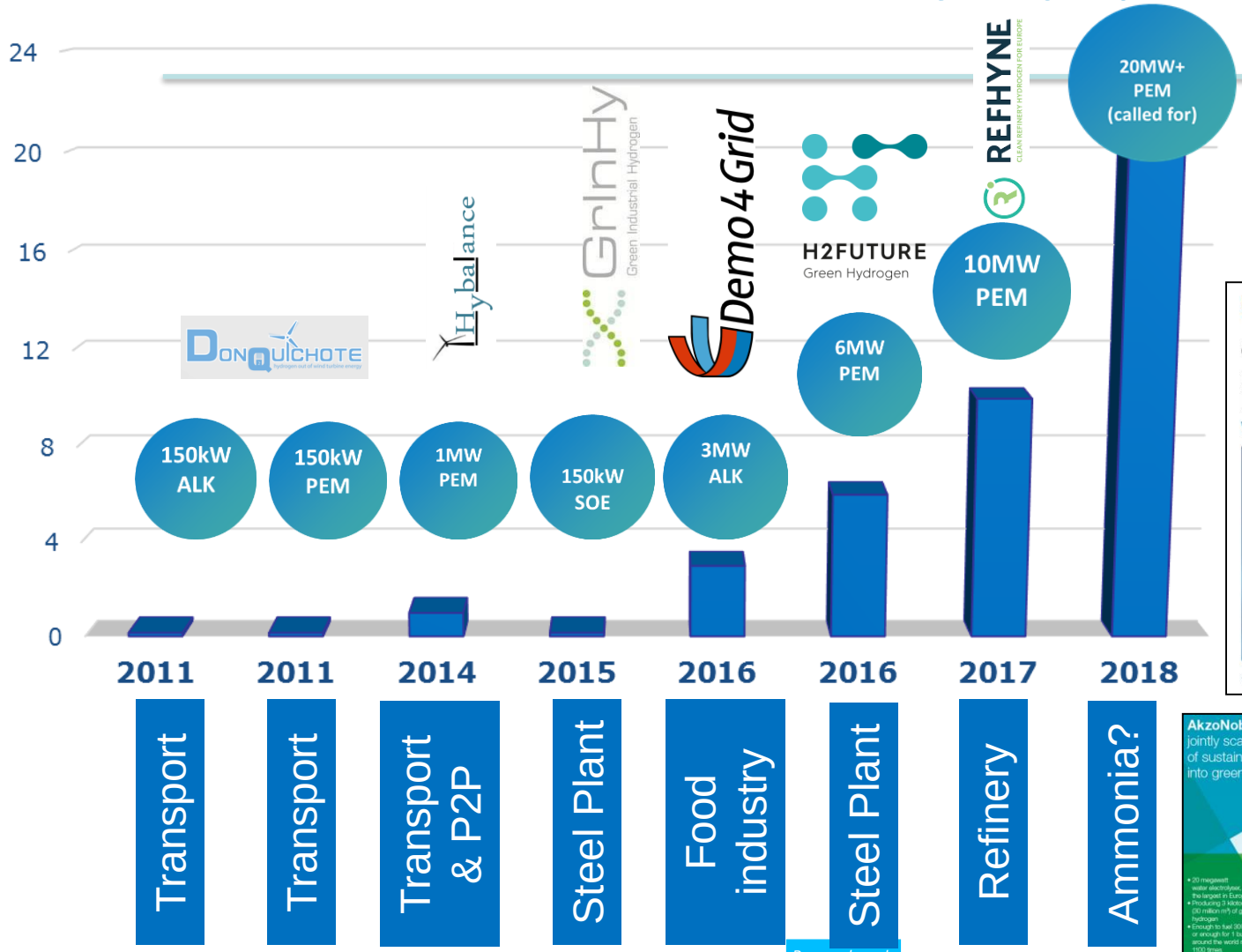
Evolution of FCH JU's electrolyser projects



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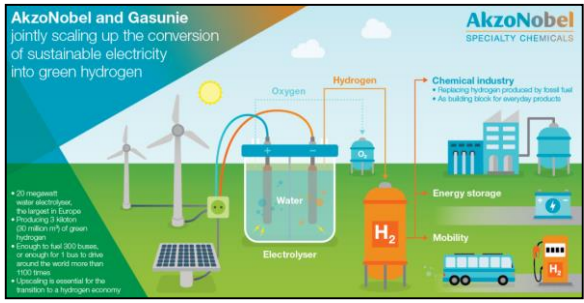
Industry also has ambitious plans for upscaling:



Creating a market for green hydrogen

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FCH JU's EARLY BUSINESS CASE STUDY

WACC on CAPEX: 5% Project lifetime: 20 years	SC mobility (Albi, France)		Food industry (Trige, Denmark)		Large industry (Lubeck, Germany)	
	2017	2025	2017	2025	2017	2025
Primary market H2 volume (t/year)	270	950	900	900	3 230	3 230
Average total electricity price for prim. market (€/MWh)	44	45	38	47	17	26
Net margin without grid services (k€/MW/year)	39	71	228	248	-146	30
Net margin with grid services (k€/MW/year)	159	256	373	393	-13	195
Share of grid services in net margin (%)	75%	72%	39%	37%	-	85%
Payback time without grid services (years)	11.0	9.0	4.6	3.7	-	8.4
Payback time with grid services (years)	8.0	4.5	3.4	2.7	-	3.5
Key risk factors	• Taxes & Grid fees • H2 price • Size of fleets • Injection tariff • FCR value		• H2 price • Taxes & Grid fees • FCR value		• Taxes & Grid fees • FCR value • Carbon price	

Specific conditions must be met to enable bankability of Power-to-Hydrogen.

Key factors determining business case:

- **Access to curtailed RES at a price discount >60%**
- **(Partial) exemption from grid fees, taxes & levies**
- **Recognition of green H2 as compliance option in EU CO2/RES legislation**

EU-28 market potential	Cumulative market size	Market value	H2 Volume
2017	1500 MW	2.6 B€	200 ktons/year
2025	2800 MW	4.2 B€	400 ktons/year

Power-to-Hydrogen can become an attractive downstream market for RES generators in a context where the added cost of intermittency will be increasingly borne by producers themselves

Study available at: http://www.fch.europa.eu/sites/default/files/P2H_Full_Study_FCHJU.pdf

Creating a market for green hydrogen – guarantee of origin (GoO)

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Green Hydrogen Certificates

- GoO for renewable gases are foreseen in the Revision of Renewable Energy Directive (RED)
- Based on EU experience with renewable electricity GoO
- Key for connecting electricity grid, gas & heat networks
- Accurate & reliable accounting must be ensured:
  - Calculations of renewable energy share per Member State
  - Conversion between energy carriers must also be addressed (e.g. electricity GoO – hydrogen GoO)
  - Share of renewable content in fuels etc.
  - Avoid double accounting & ensure accuracy
- Need to limit the administrative burden of the system
- Ensure compatibility with existing support schemes

CertifHy - developing the 1st EU-wide GoO scheme for green & low-carbon hydrogen (1)

European Commission

CertifHy

Objectives:

- Develop a widely acceptable definition of **green** & **low-carbon** H2
- Design a robust GoO scheme for green hydrogen
- Propose a roadmap to implement the initiative throughout the EU

GUARANTEE OF ORIGIN FOR GREEN H2

Roadmap:

- Establish a stakeholder platform
- Implement a pilot

2014 2016 2017 2018/9 2020s..

Phase 1

1. Define a widely acceptable definition of green hydrogen
2. Determine how to design and implement a robust EU wide GO scheme

Affiliated partners: TOTAL, MACHIELS, AkzoNobel, colruyt, Shell, AIR PRODUCTS, AREVA H_2Gen, BMW, EDF, AIR LIQUIDE, THE LINDE GROUP, HYDROGENICS, uniper, OMV

Phase 2

1. Set-up a hydrogen GO Stakeholder platform
2. Finalise the scheme design ensuring it can be the main route to guarantee the origin of green & low carbon hydrogen across EU Member States
3. Run a pilot scheme to test the proposed design
4. Identify actions which need to be undertaken after the completion of the study to achieve an EU wide deployment of the scheme

Phase 3

1. Prepare EU wide deployment: Implement key elements
   - Competent authority
   - Issuing Body
   - Registry operator
   - Accreditation body
2. Finalise Regulation, Codes and Standards:
   - CEN Standard
   - EU and national regulation
   - CertifHy scheme docs

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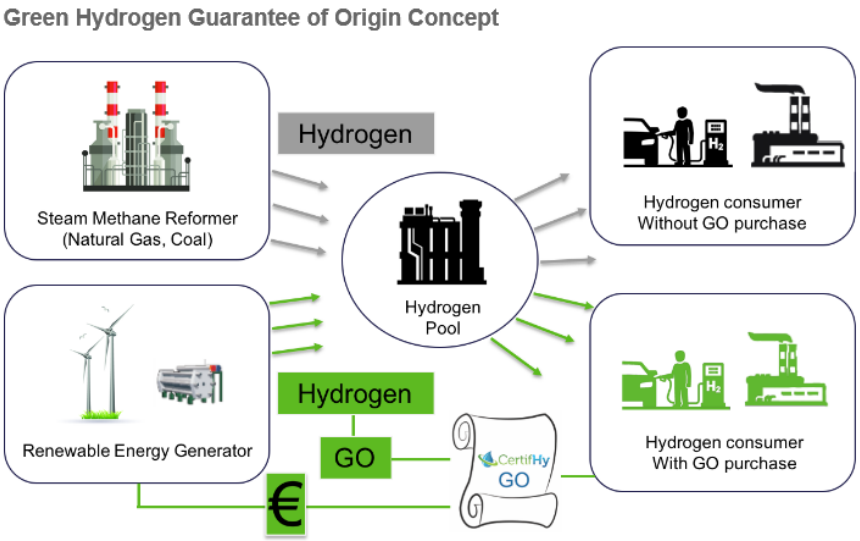
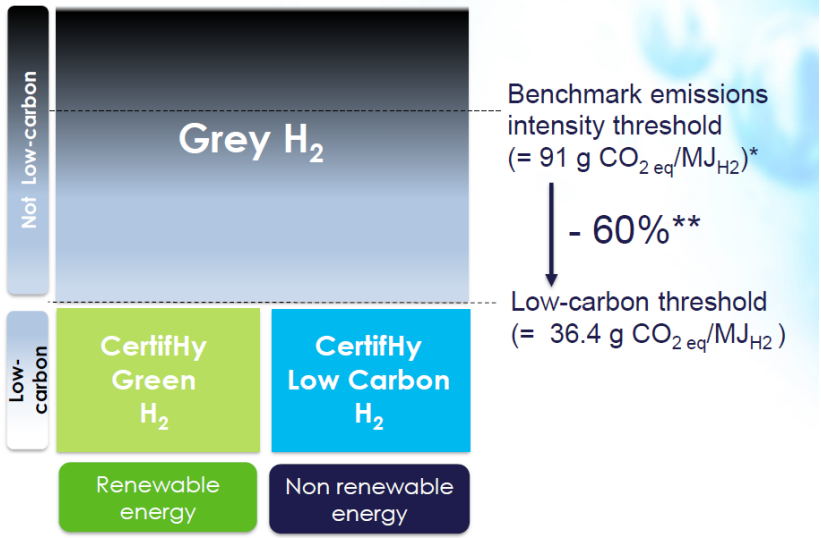
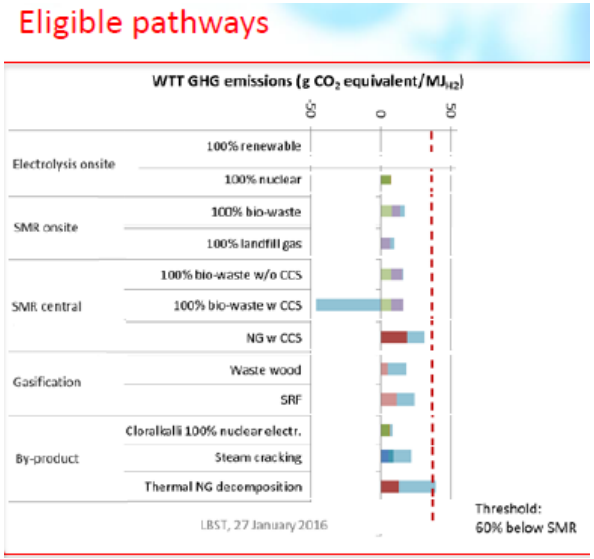
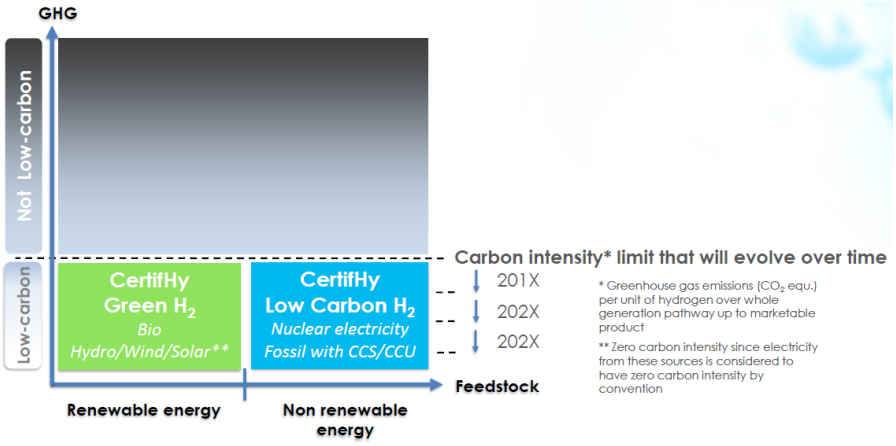


CertifHy - developing the 1st EU-wide GoO scheme for green & low-carbon hydrogen (2)







CertifHy phase 2 pilots:

SMR with CCU - Port Jérôme (France)

Electrolyser + Wind - Halle (Belgium)

Up to 900 tons of Low Carbon H2

Chlor Alkali - Botlek (Netherlands)

Electrolyser + grid - Falkenhagen (Germany)

Up to 88 tons of Green H2

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Thank you very much for your attention !

More info:

- European Commission: https://ec.europa.eu/
- FCH JU : www.fch.europa.eu
- Hydrogen Europe: www.hydrogeneurope.eu
- N.ERGHY : www.nerghy.eu