NEEST

NEW ENERGY & ENVIRONMENTAL SOLUTIONS AND TECHNOLOGIES

TETHYS WEBINAR – GREEN HYDROGEN PRODUCTION

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MAJOR ISSUES FOR A WIDE MARKET DEPLOYMENT OF H2

The Infrastructures Issue

Intl. Cooperation - Legal Framework

Regulations, Codes & Standards (RCS)

UNDERSTANDING RISKS AND OVERCOMING BARRIERS

Main issues to be addressed

- Fuel and refuelling infrastructure: Location and accessibility of site and fuel supply. Security of fuel source.
- Vehicle supply: Currently few commercial models exist and slightly more variants of buses and trucks
- Cost competitiveness: Driven by the limited number of suppliers currently manufacturing FCEVs. Costs are expected to be lowered as more manufacturers enter the market

  - In transport, the competitiveness of hydrogen fuel cell cars depends on fuel cell costs and refuelling stations while for trucks the priority is to reduce the delivered price of hydrogen. Shipping and aviation have limited low-carbon fuel options available and represent an opportunity for hydrogen-based fuels.

Hydrogen as Energy Carrier

- All components of the technology (Hydrogen & Fuel Cells) exist.
- Further R&D priorities related to H2 include issues in production, storage and distribution, compression…
- The issue of infrastructures remains open…

Hydrogen Fueling and Electric Charging of Vehicles in Germany

2018, JULY, 12TH | JOCHEN LINSSEN, MARTIN ROBINIUS, THOMAS GRUBE, MARKUS REUSS, PETER STENZEL, KONSTANTINOS SYRNANIDIS, DETLEF STOLTEN

6th Hellenic Forum for Science Technology and Innovation, Athens Greece

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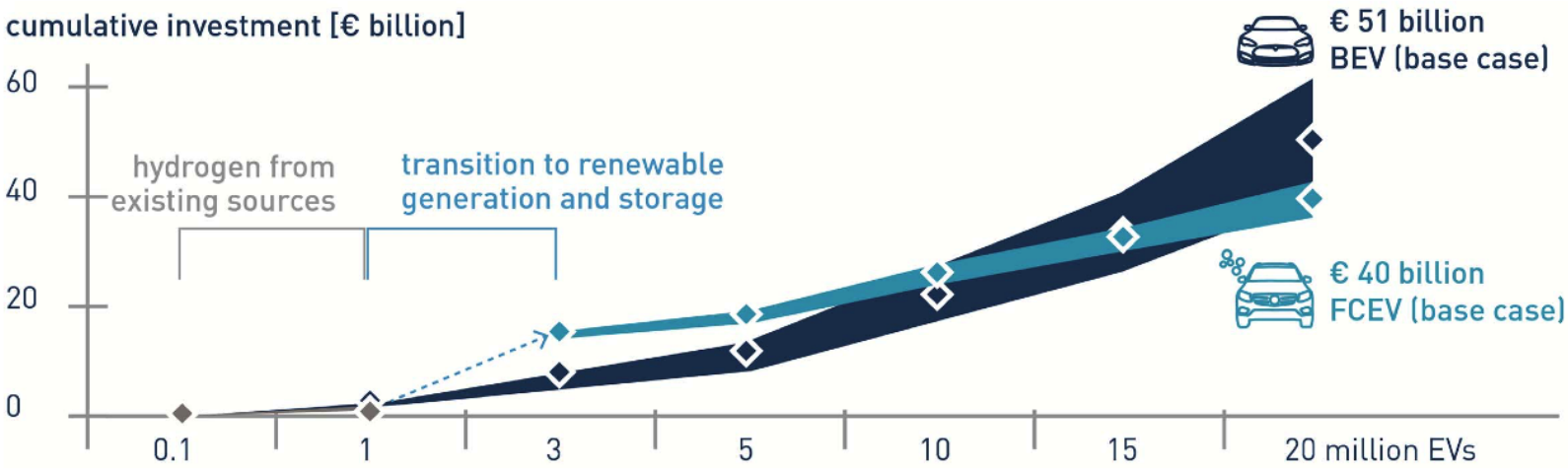
Institute of Electrochemical Process Engineering (IEK-3)

Cumulative Investment

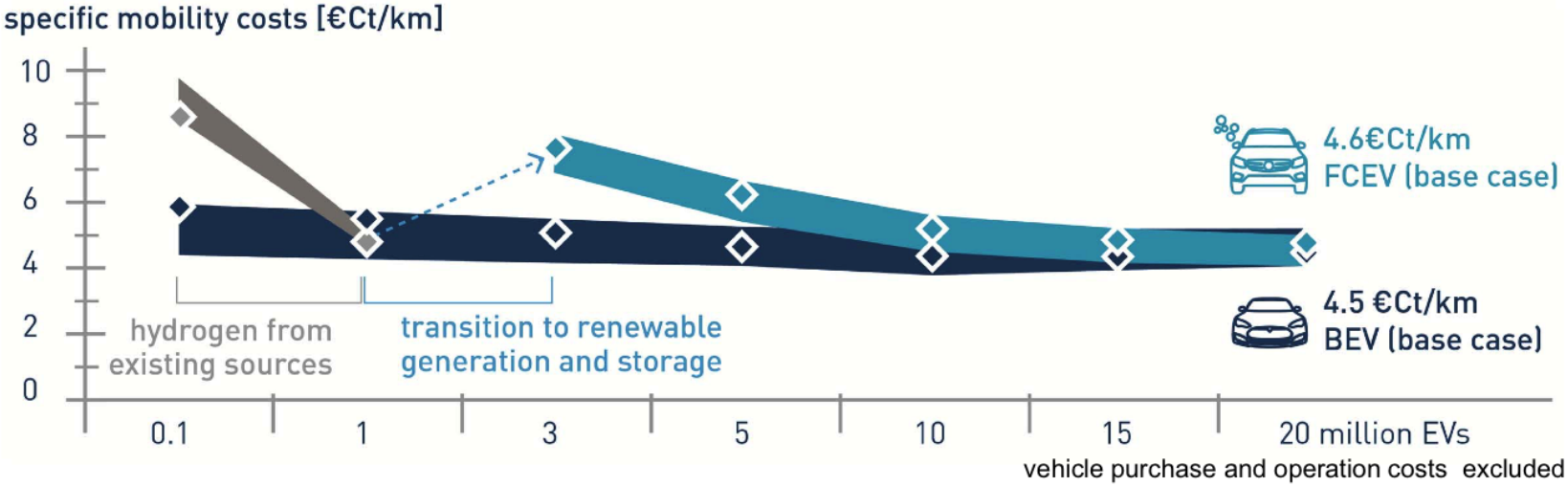
Infrastructure Roll-Out



- Hydrogen more expensive during the transition period to renewable electricity-based generation
- High market penetration: battery charging needs more investment than hydrogen fueling
- For both infrastructures investment low compared to other infrastructures

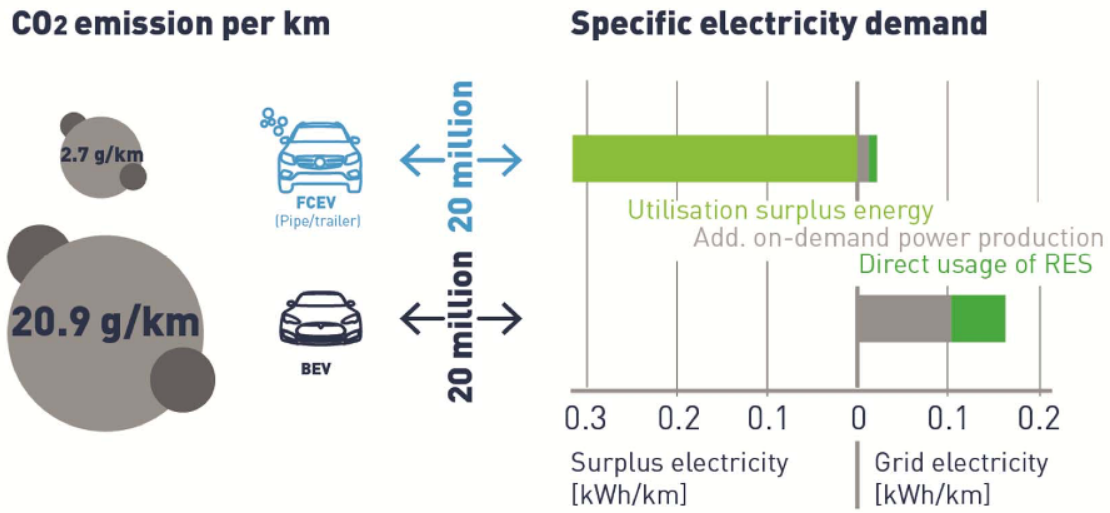
	Investment [€ billion]
Renewable electricity generation scenario	374
Electric grid enhancement plan 2030	34
Federal transport infrastructure plan 2030	265
Hydrogen fueling infrastructure	40
Electric charging infrastructure	51

Comparison of Mobility Costs



- For small vehicle fleets, i.e. 0.1 million cars, BEV fuel costs are significantly lower compared to FCEVs.
- Increase for hydrogen between 1 and 3 million cars results of switching to exclusive utilization of renewable energy for hydrogen production via electrolysis
- Mobility costs per kilometer are roughly same in the high market penetration scenario at 4.5 €ct/km for electric charging and 4.6 €ct/km → the lower efficiency of the hydrogen pathway is offset by lower surplus electricity costs.

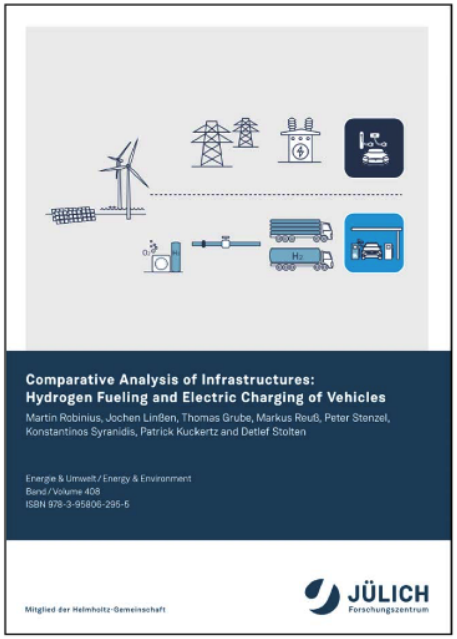
CO_2 Emissions & Electricity Demand



- Efficiency of charging infrastructure is higher, but limited in flexibility and use of surplus electricity
- Fueling infrastructure for hydrogen with inherent seasonal storage option
- Low specific CO2 emissions for both options in high penetration scenarios with advantage for hydrogen, well below the EU emission target after 2020: 95 g_{CO2}/km

Full Report Available

http://hdl.handle.net/2128/16709



Project team:

Martin Robinius, Jochen Linßen, Thomas Grube, Markus Reuß, Peter Stenzel, Konstantinos Syranidis, Patrick Kuckertz and Detlef Stolten

Funded by

H_2 MOBILITY
FUELLING HYDROGEN

EU Regulatory Framework: Fit for 55

European climate law sets the reduction targets for net greenhouse gase emissions

- Ultimate goal: climate-neutrality by 2050
- Intermediate goal: reduce net GHG emissions by at least 55% by 2030, compared to 1990 levels

Fit for 55

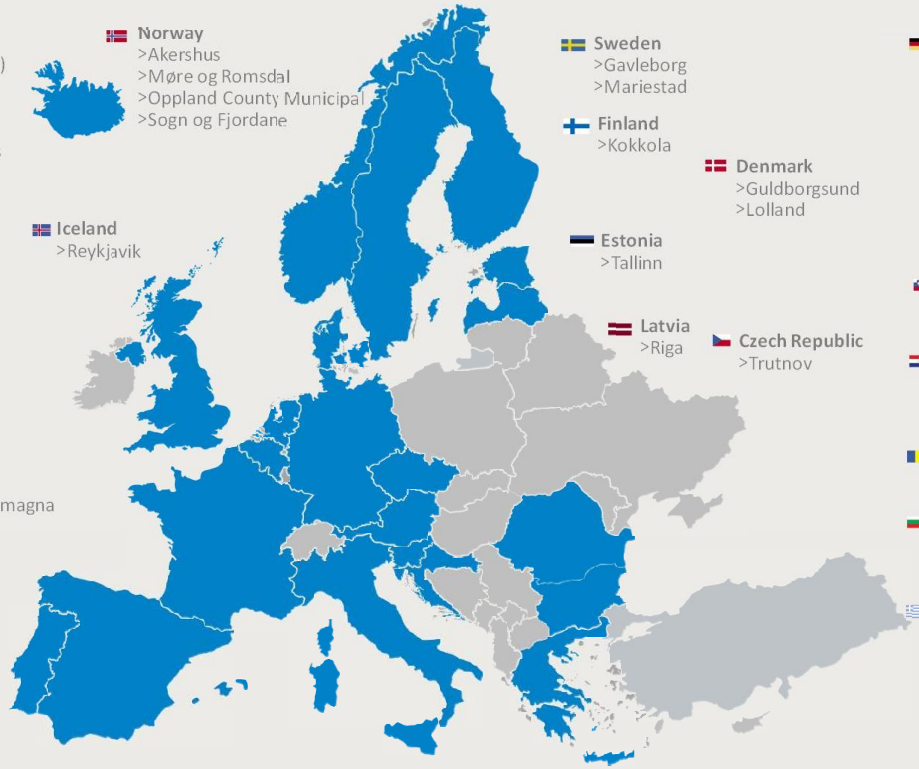
- Proposals to revise and update EU legislation
- Framework for achieving the climate targets

–New cars and vans on the market as of 2035 should have zero-emissions. Creation of a new, separate emissions trading system for road transport and building sectors

–Hydrogen filling stations on main roads at least every 200 km (end of 2030) – denser network expected in urban areas

Fuel cells and hydrogen for green energy in European Cities and Regions

91 Regions/Cities from 22 countries representing ca. one quarter of Europe participate



Belgium
>Flanders
>Pom West-Vlaanderen

United Kingdom
>Swindon and Wiltshire
>Aberdeen
>Birmingham
>Cornwall
>Dundee
>Fife
>Leeds
>London (Greater London Authority)
>Newcastle
>Orkney Islands
>Oxfordshire
>Perth and Kinross
>Manchester
>Tees Valley

Norway
>Akershus
>Møre og Romsdal
>Oppland County Municipal
>Sogn og Fjordane

Sweden
>Gavleborg
>Mariestad

Finland
>Kokkola

Denmark
>Guldborgsund
>Lolland

Germany
>Baden-Württemberg
>Bremerhaven
>Hamburg
>HyCologne-Hydrogen Region Rhineland
>Kreis Steinfurt
>North Rhine-Westphalia
>Heide region
>HYPOS (East Germany)
>Recklinghausen
>Saxony-Anhalt

France
>Auvergne Rhone-Alpes
>Bourgogne-Franche-Comté
>Centre-Val de Loire
>Grenoble
>Grand Dole
>La Roche sur Yon
>Normandie
>Occitanie-Phyrenees
>Orléans
>Pays de la Loire
>Pays de St Gilles

Spain
>Aragón
>Barcelona
>Cantabria
>Castilla – La Mancha
>Murcia
>País Vasco
>Port of Valencia
>Puertollano
>Valladolid

Iceland
>Reykjavik

Estonia
>Tallinn

Latvia
>Riga

Czech Republic
>Trutnov

Slovenia
>Velenje

Croatia
>Split
>Split-Dalmatia County

Italy
>Lazio
>South Tyrol
>Favignana
>Torino
>Venice
>Toscana
>Emilia-Romagna

Romania
>Constanta

Bulgaria
>Bulgarian Ports
>Sofia

Portugal
>Torres Vedras
>Médio Tejo

Netherlands
>Assen
>Drenthe
>Emmen
>Groningen
>Helmond

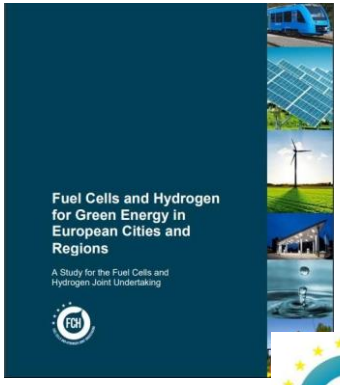
Austria
>Tirol

Greece
>Alimos
>Agia Paraskevi
>Ierapetra
>Kozani
>Milos
>Vrilissia
>Kalymnos
>Heraklion
>Western Macedonia
>Papagoou-Halargos
>Region of Crete

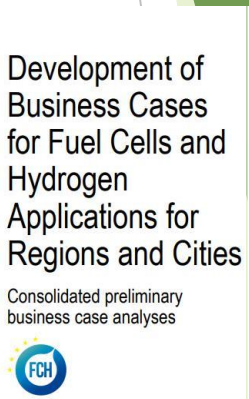
Work through the initiative has produced valuable material

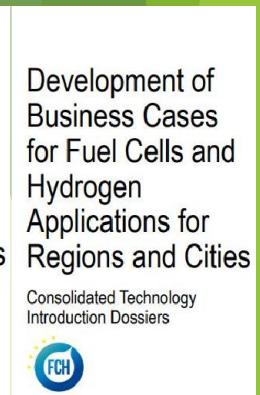
Available at FCH JU website

Full report with results and conclusions: https://fch.europa.eu/publications



Technology Intro and Business Cases for 26 applications: https://fch.europa.eu/page/presentations-2





Communication package for stakeholders: https://fch.europa.eu/page/presentations-2

Business case tool: https://www.fch.europa.eu/page/exploitation-results

Funding and Financing navigation tool: https://www.fch.europa.eu/page/combining-funds

Study Conclusions: Proposed Specific Actions for Coalition Members

Scope and workstreams of a continued FCH project support framework

1 H_2 Valley Support

>Prepare and bring to financing stage fully integrated valley projects to start implementation from 2019 onwards

>Provide individual support for each valley

2 FCH Project Implementation Support

>Prepare demo projects (for 1-2 appl.)

>Support detailed business cases, project organisation, joint procurement etc.

>Potentially, help to launch large-scale pan-European projects on selected applications

3 Joint Platform Work

>Networking, exchange, information sharing (e.g. in regular meetings)

>Outreach, communication and visibility (e.g. through communication campaign, letter of intent)

>Development of general concepts and tools (e.g. business cases, cost assessment, funding/financing)

>Technology discussions and dialogue with industry

Coordinated action needed to deploy infrastructure and vehicles

Conclusions of meeting of 6 November 2018 at FCH JU with MS

CHALLENGES:

- ✓ Recognise both FCEV & BEV as ZEV
- ✓ Address the Chicken-egg dilemma – HRS vs. Vehicles
- ✓ Coordination of deployment of HRS across the EU (TEN-T corridors)
- ✓ Find right Funding instruments
- ✓ Aggregate demand to faster achieve cost drop of deployment

PROPOSAL is to discuss with EC/FCH JU and coordinate efforts to finance deployment:

- ✓ Agree on standard topic applicable to all (local, regional or national)
  - ✓ Eligibility rules – for HRS (density of the network?), Electrolyser (?), Vehicles (car, bus/coach, van, truck ?), H2 distribution (?)
  - ✓ Co-funding rules – fixed or % grant on CAPEX?; on the basis of the funding/financial viability gap (e.g. 40%EC/FCHJU + 10%National + 50%Private)
- ✓ Explore possibility of adding National funding programs to help co-fund
  - ✓ Check availability and ensure commitment beforehand

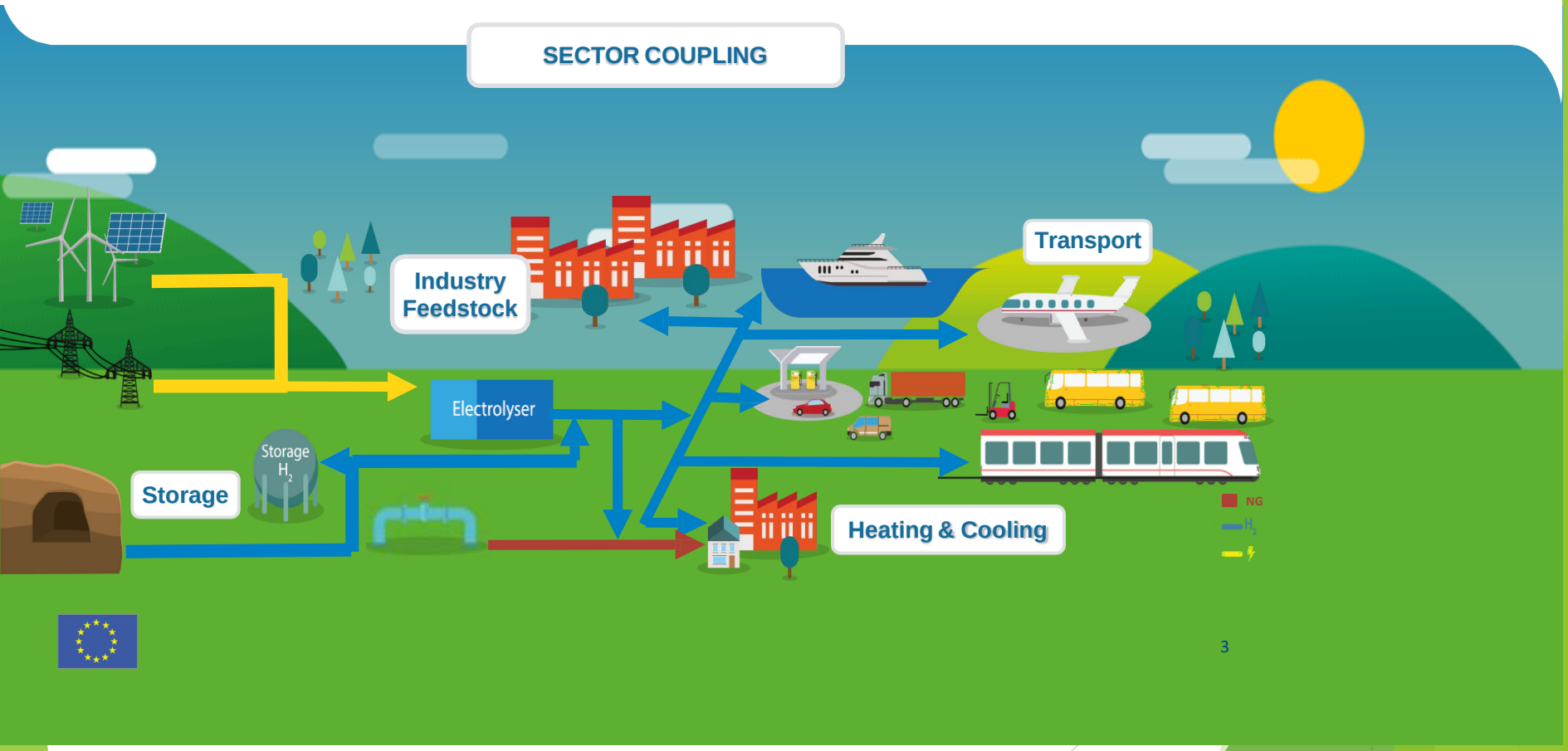
EC - FCH JU Regions & Cities Initiative
Application Packages for:

Buses, Heavy Duty Trucks, Trains
Bikes, Scooters, Garbage Trucks, Sweepers
Boats, Ferries, Ships, Port Operations Equipment
Commercial Buildings, Residential mCHP, Off-grid Power, Industrial Use Cases
P2H: Green H2, Electric Grid Services, H2 in NG Grid

Alternative Fuels Based on H2: Ammonia, Methanol, Synthetic Fuels…

The hydrogen economy

Hydrogen allows more renewables in the energy system and enables sector-coupling



Speed of change

- New York 1900
- First car in 1885, petrol from the pharmacy

- New York 1913

And safety is important, but so is fear of change…

"A new source of power… called gasoline has been produced by a Boston engineer. Instead of burning the fuel under a boiler, it is exploded inside the cylinder of an engine…

The dangers are obvious. Stores of gasoline in the hands of people interested primarily in profit would constitute a fire and explosive hazard of the first rank. Horseless carriages propelled by gasoline might attain speeds of 14, or even 20 miles per hour. The menace to our people of [vehicles of] this type hurtling through our streets and along our roads and poisoning the atmosphere would call for prompt legislative action even if the military and economic implications were not so overwhelming… the cost of producing [gasoline] is far beyond the financial capacity of private industry… In addition the development of this new power may displace the use of horses, which would wreck our agriculture."

US Congressional Record, 1875

THANK YOU