European Association for Storage of Energy

Sector coupling with Power-to-Gas

23 November 2016

FCH JU Stakeholder Forum
Brussels, Belgium

Dr K. Peter Röttgen

EASE President

Vice President Market interface management,
Uniper Innovation

European Association for Storage of Energy

Energy system

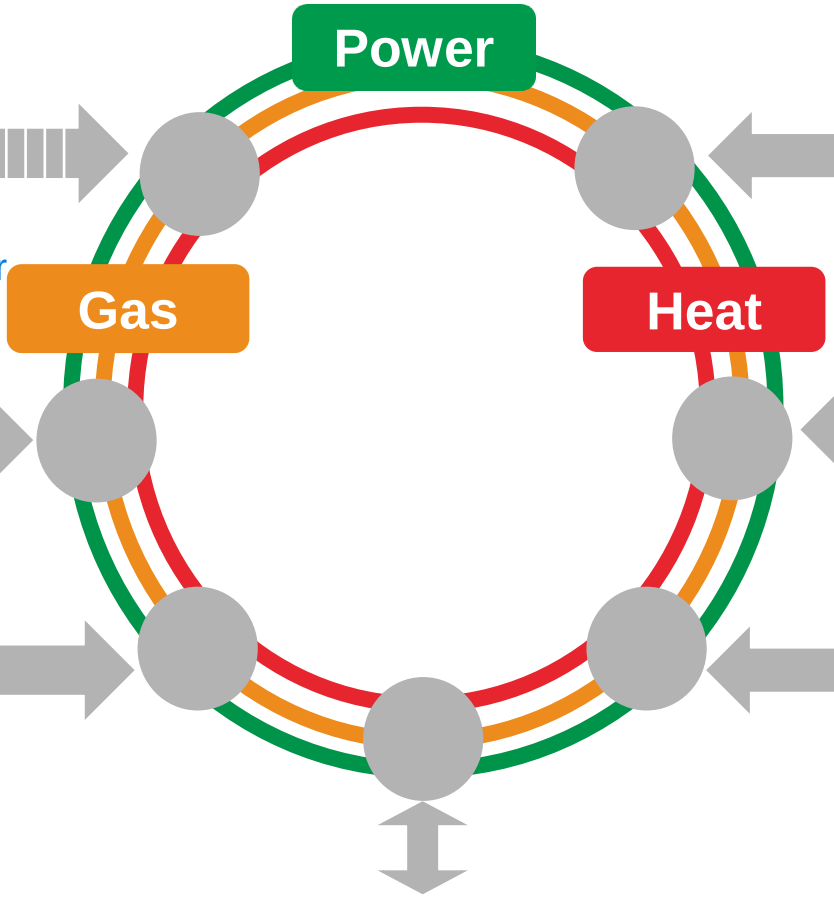
Generation

Wind/Solar to Power

Gas to Power/Heat

Coal to Power/Heat

Grids



Demand

Residential | Mobility | Industry

Storage

Power to Power

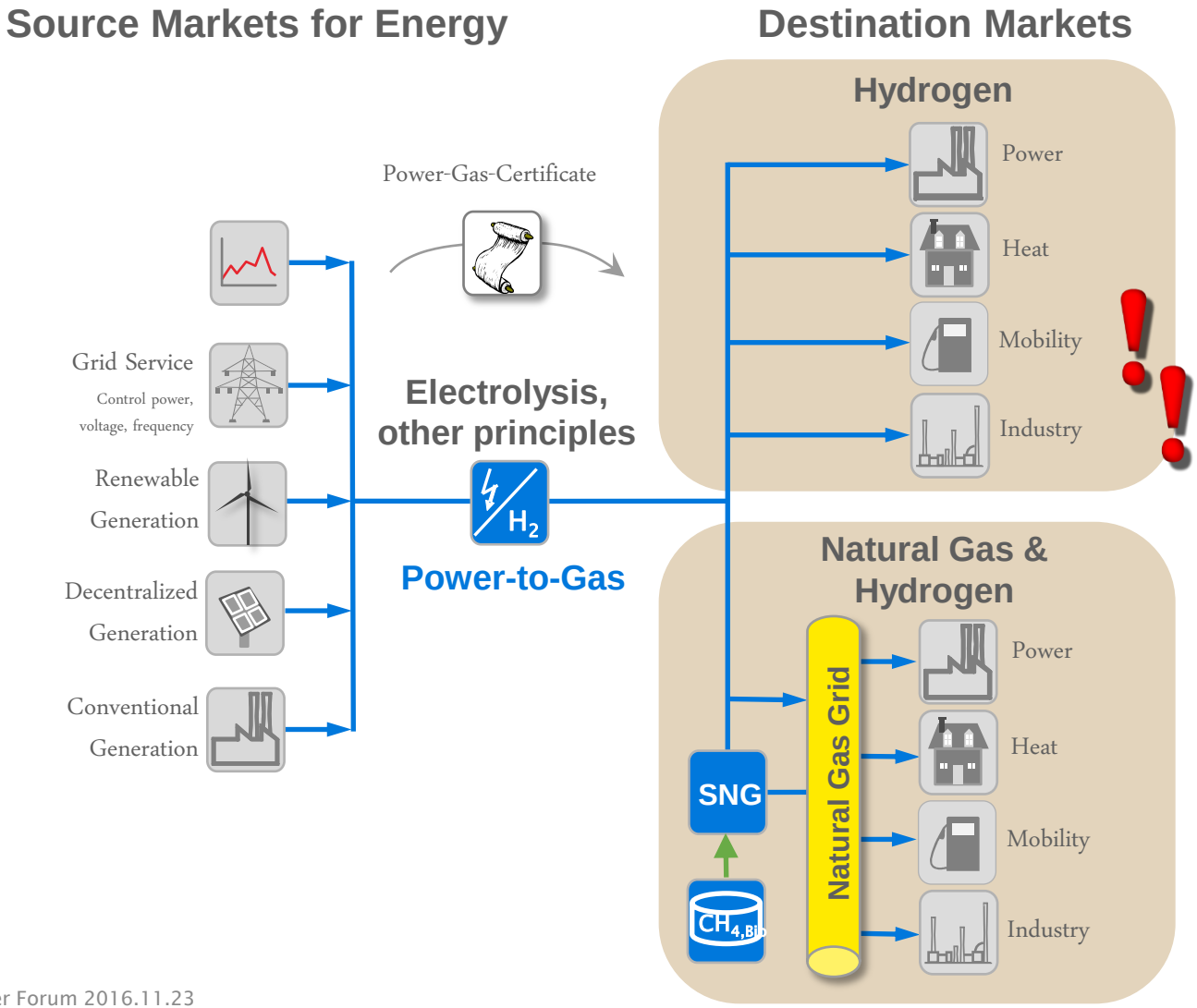
Power to Gas

Power to Heat

Source: uniper

European Association for Storage of Energy

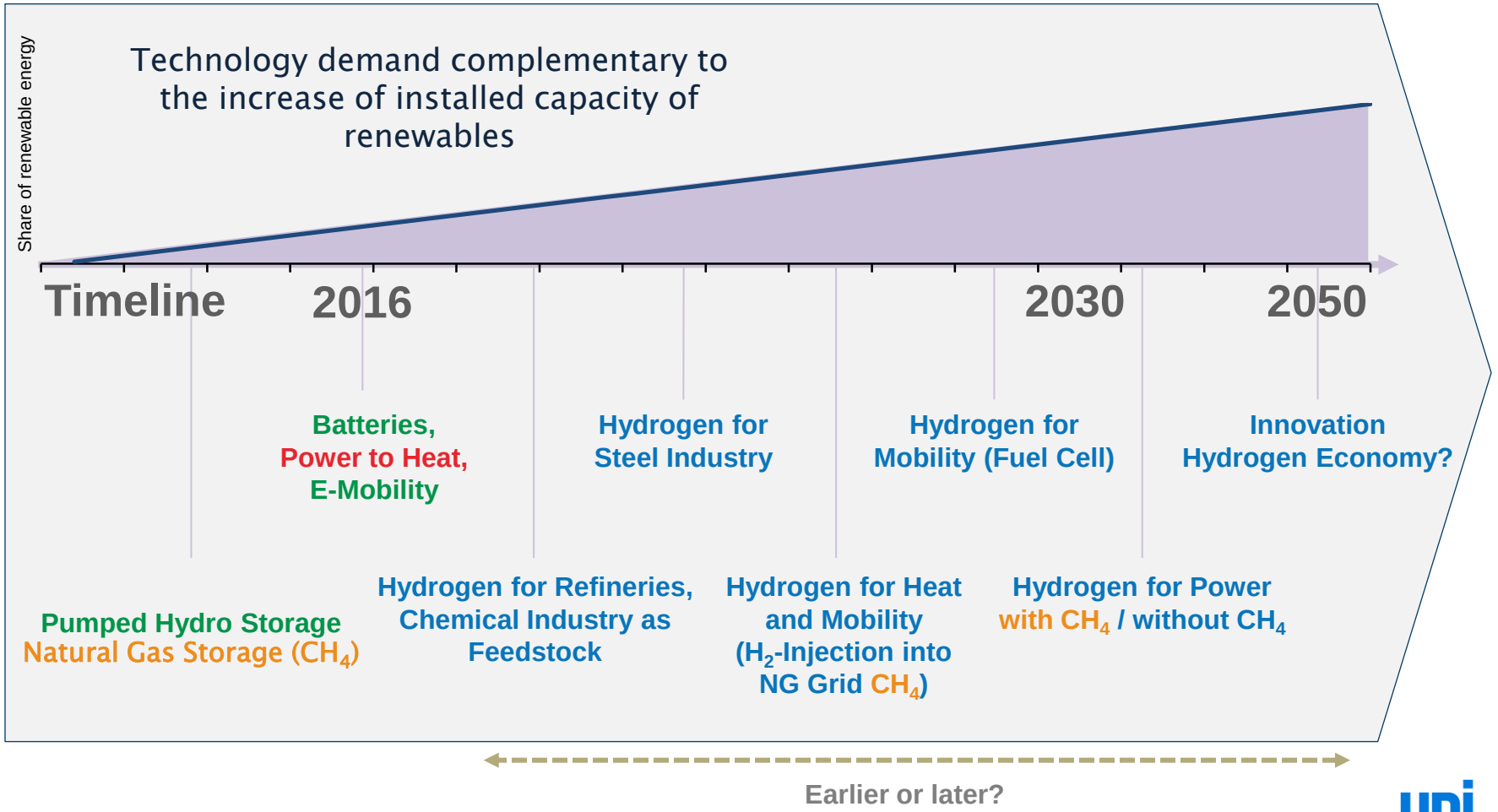
Sector coupling



Source: uniper

"Merit-Order"

Possible Commercial Market Entry of power-to-gas technologies



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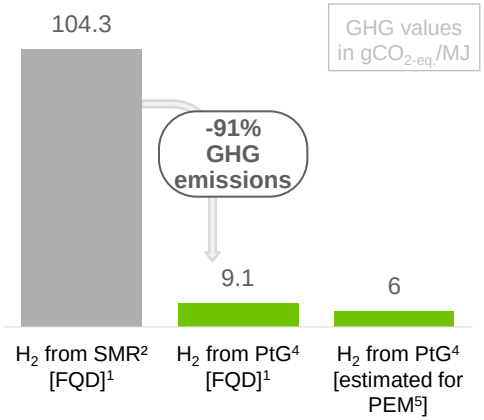
Backup

Green Hydrogen from Power-to-Gas can directly lead to significant Greenhouse gas (GHG) reductions

Hydrogen (H_2) GHG-Emissions



GHG count for Green Hydrogen is **reduced by 91%** compared to hydrogen produced via SMR² out of natural gas.

CO_2 reduction total for a 20 MW PtG-installation

SMR²

31.527 $tCO_2$³

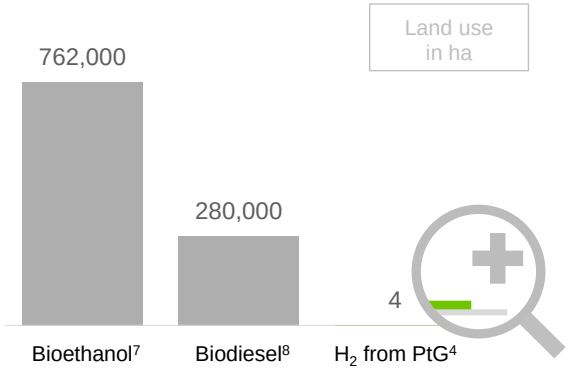
20 MW PtG⁴

2.751 $tCO_2$³

28.776 tCO_2 reduction per year

28.776 tons of CO_2 will be reduced by using a 20 MW Power-to-Gas electrolysis.

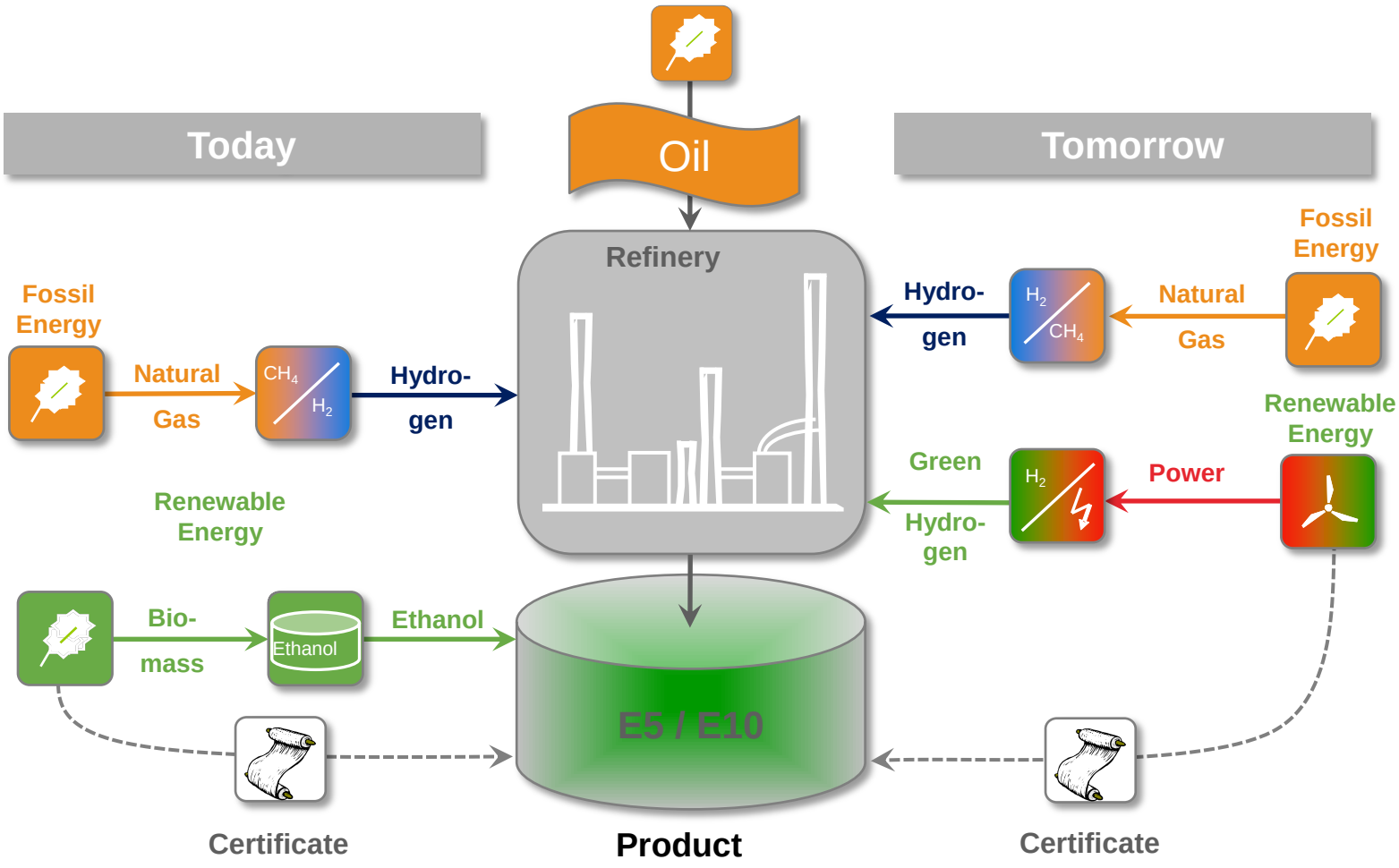
Land Use⁶



Green Hydrogen requires significantly less land than other biofuels.

[1] Default value of the life cycle GHG intensity according to Annex I of Council Directive COM (2014) 617 [FQD].
[2] Steam Methane Reforming - Conventional production process for hydrogen out of natural gas.
[3] Total emission for the production of 3,43 Mio. Nm^3H_2 per year. That equates the amount of hydrogen produces with a 20 MW Power-to-Gas installation at 80% availability per year. CO_2 default value according to Annex I of the Council Directive COM (2014) 617 [FQD].
[4] Power-to-Gas. [5] Proton Exchange Membrane.
[6] Required surface for the production of 0.5 % of final energy consumption of German road transport (= 3.09 x 10^6 MWh)
[7] average of absolute land use of sugar beets, wheat and corn basis respectively: sugar beets basis 40 GJ/ha = 11.1 MWh/ha, wheat basis 8.8 GJ / ha = 2.44 MWh / ha, corn basis 15 GJ / ha = 4.17 MWh / ha
[8] on raps basis: 1000 kg/ha with 40 MJ/kg = 40 GJ/ha = 11.1 MWh/ha; [5] GHG = Green House Gas Emissions

Power-to-Gas for Refineries



Storage effect = Integration of Renewable Energies

Green Hydrogen for refineries can open doors to hydrogen economy

1 Cost efficient rollout

Green Hydrogen for refineries

- ✓ Reduce emissions and provide flexibility for the electricity grid
- ✓ No need for infrastructural investments
- ✓ Cost reductions for electrolyzers
- ✓ Efficiency improvements
- ✓ Kick-start for a Power-to-Gas industry in the EU

2 Spill-over to other applications

Green Hydrogen for industries

- ✓ Substantial emission reductions
- ✓ Limited infrastructure changes

Green Hydrogen mobility

- ✓ Scaling up hydrogen mobility (fueling stations, cars, trains)
- ✓ Alternative to battery vehicles

3 Industrialization – new economy emerges

Green Hydrogen economy

- ✓ Utilization of natural gas infrastructure – directly or after methanation
- ✓ Re-electrification makes from PtG a flexible back-up for Renewables
- ✓ Development of hydrogen infrastructure in form of grids and storage

2018 ←2025→ ←2050?→

Usage of PtG in refinery process will accelerate technology development, reduce cost and enable deployment in other industries and in transport