

# Decarbonisation of the energy system - the Magnum case

CIEP-NOGEPA Gas Day

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7 September 2017



**Paris  
Agreement**



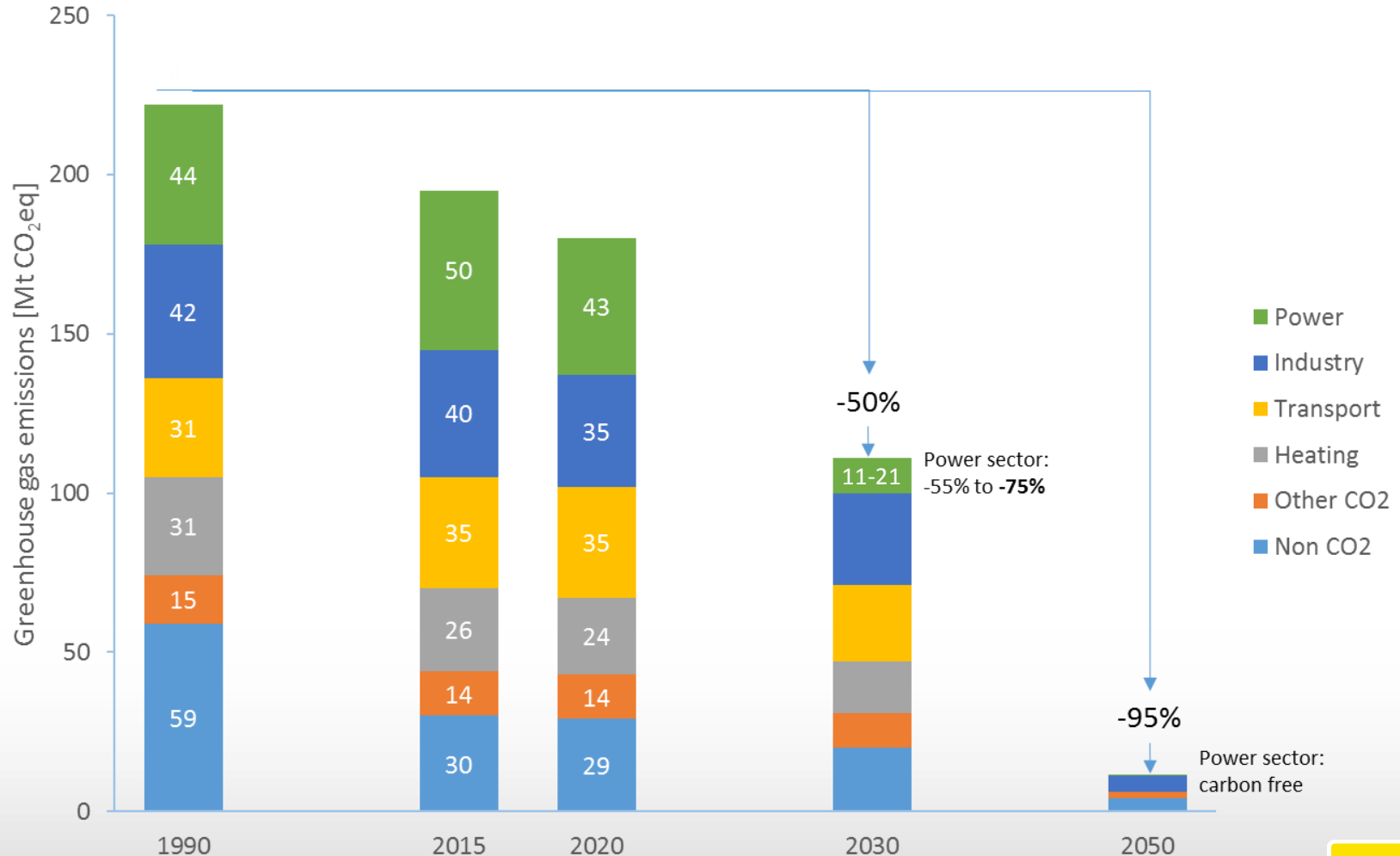
**Decarbonisation of the  
energy system**



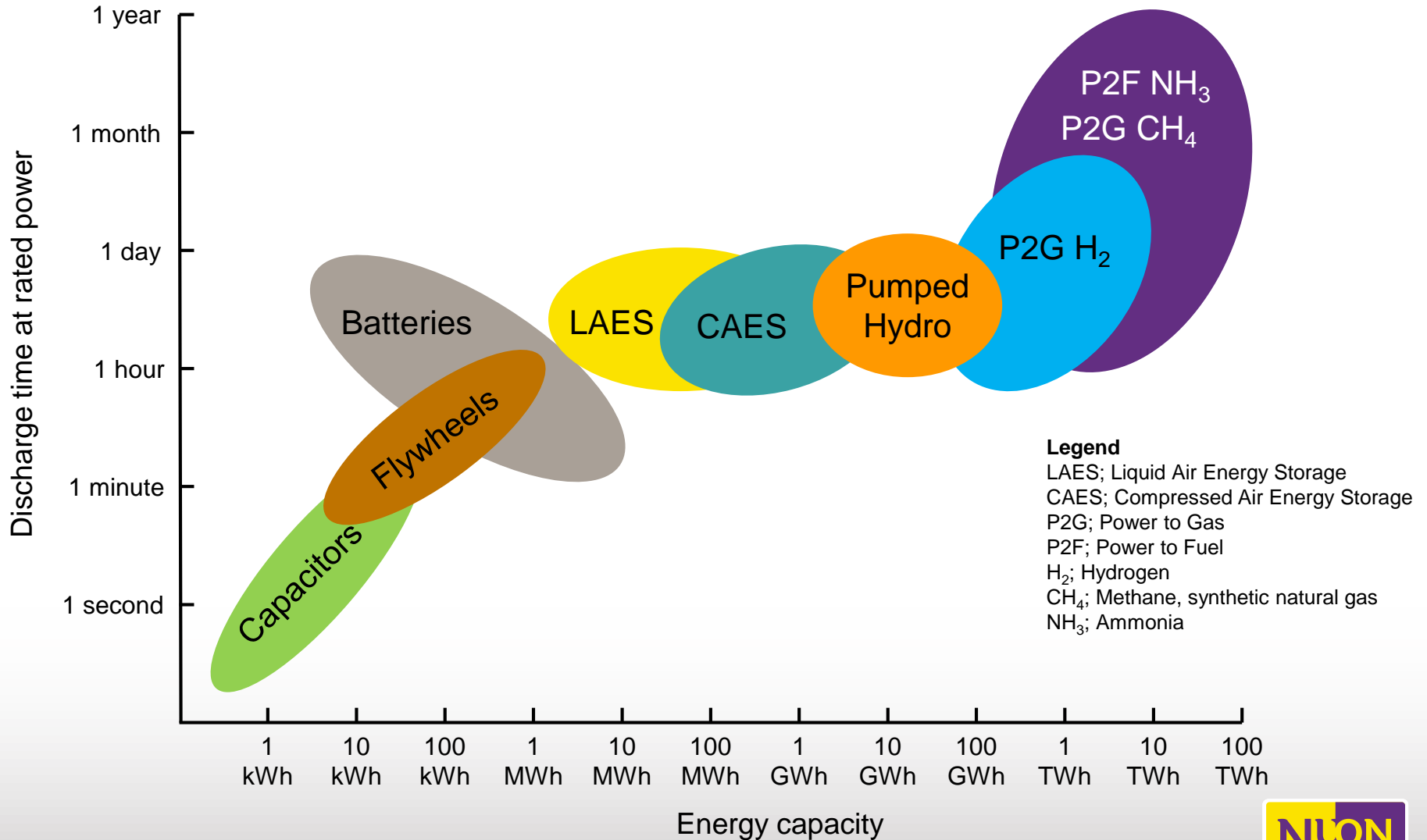
Ambition: increase globale average temperature well below 2°C, strive for 1.5°C

# Towards a carbon free energy system in NL

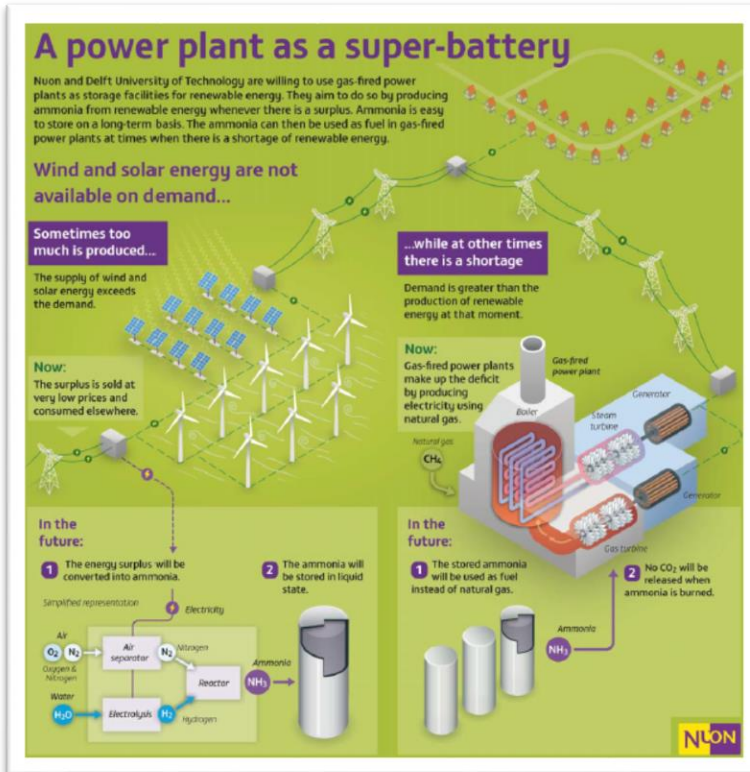
Development greenhouse gas emissions NL



# Energy storage – techniques and scale



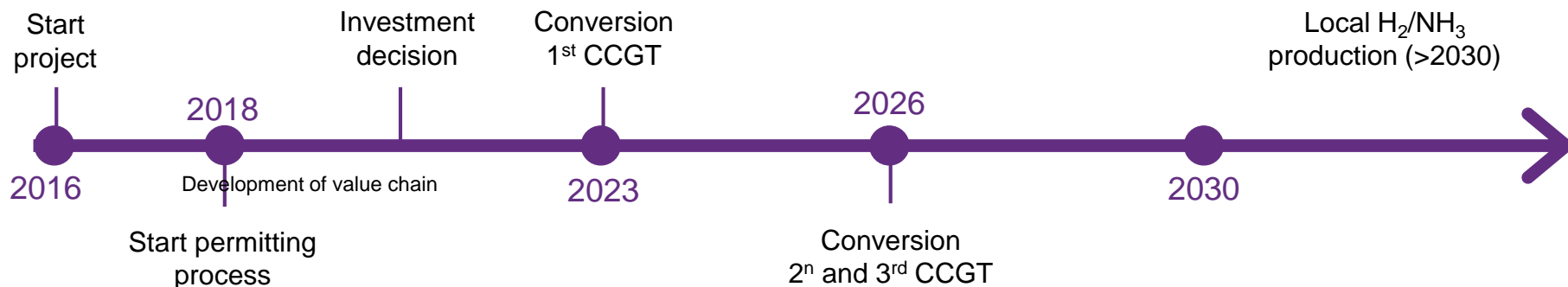
# Nuon Magnum as 'super-battery' - Use of H<sub>2</sub> (and NH<sub>3</sub>) instead of CH<sub>4</sub>



## Nuon Magnum facts

- 3x MHPS 701F4 gas turbine combined cycles (CCGT)
- Output 3 x 437 MW<sub>e</sub>, (ca. 2 million households)
- State of the art, year of commissioning 2013
- Flexible (daily start/stop) and highly efficient
- Good logistic and spatial options

# High-level timelines Magnum project



First step: H<sub>2</sub>/NH<sub>3</sub> from CH<sub>4</sub> + pre-combustion CCS

Second step: H<sub>2</sub>/NH<sub>3</sub>: from renewable sources (NL and imports)

# Cooperation Statoil – Gasunie – Nuon

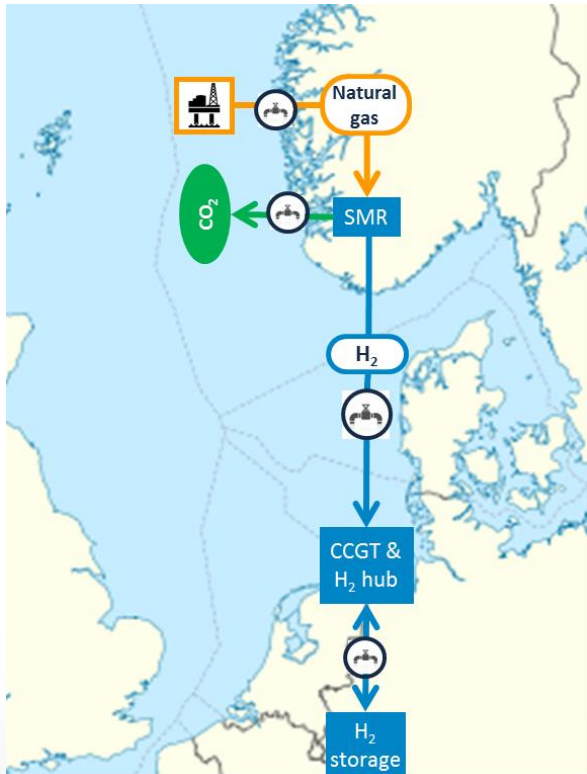
Joint project to evaluate the possibilities to use carbon free hydrogen in Magnum power station



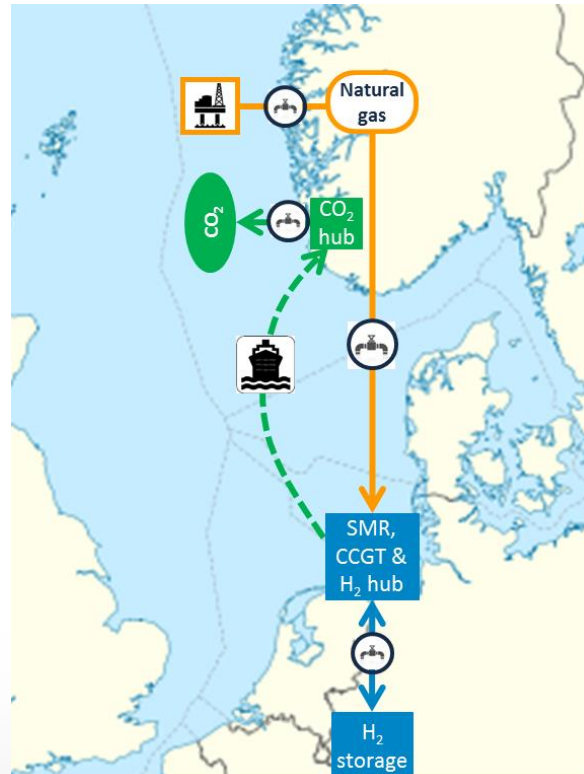
- Production of hydrogen by converting natural gas into hydrogen with CCS + storage of CO<sub>2</sub> in underground facilities offshore Norway
- Transport of hydrogen to Magnum power station and possible temporarily storage
- Dispatchable and carbon free power generation using hydrogen instead of natural gas in Magnum power station

# Supply options H<sub>2</sub> from CH<sub>4</sub> + CCS

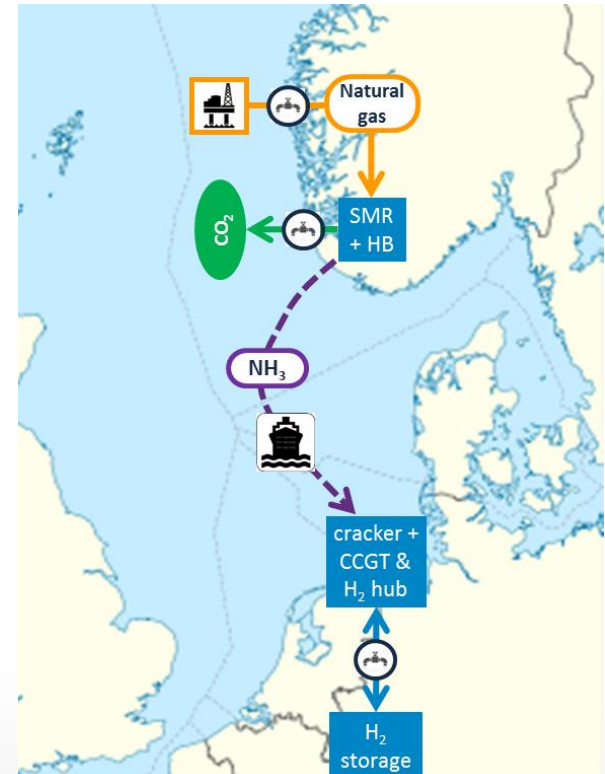
**Option 1:**  
H<sub>2</sub> production in Norway



**Option 2:**  
H<sub>2</sub> production in NL



**Option 3:**  
NH<sub>3</sub> production in Norway



Abbreviations; CCGT = Magnum power plant; SMR = steam methane reforming plant to split natural gas into hydrogen and CO<sub>2</sub>  
HB = Haber Bosch process to convert hydrogen into ammonia





# Magnum project: catalyst decarbonisation energy system in other sectors



- Heating built environment



- Transport

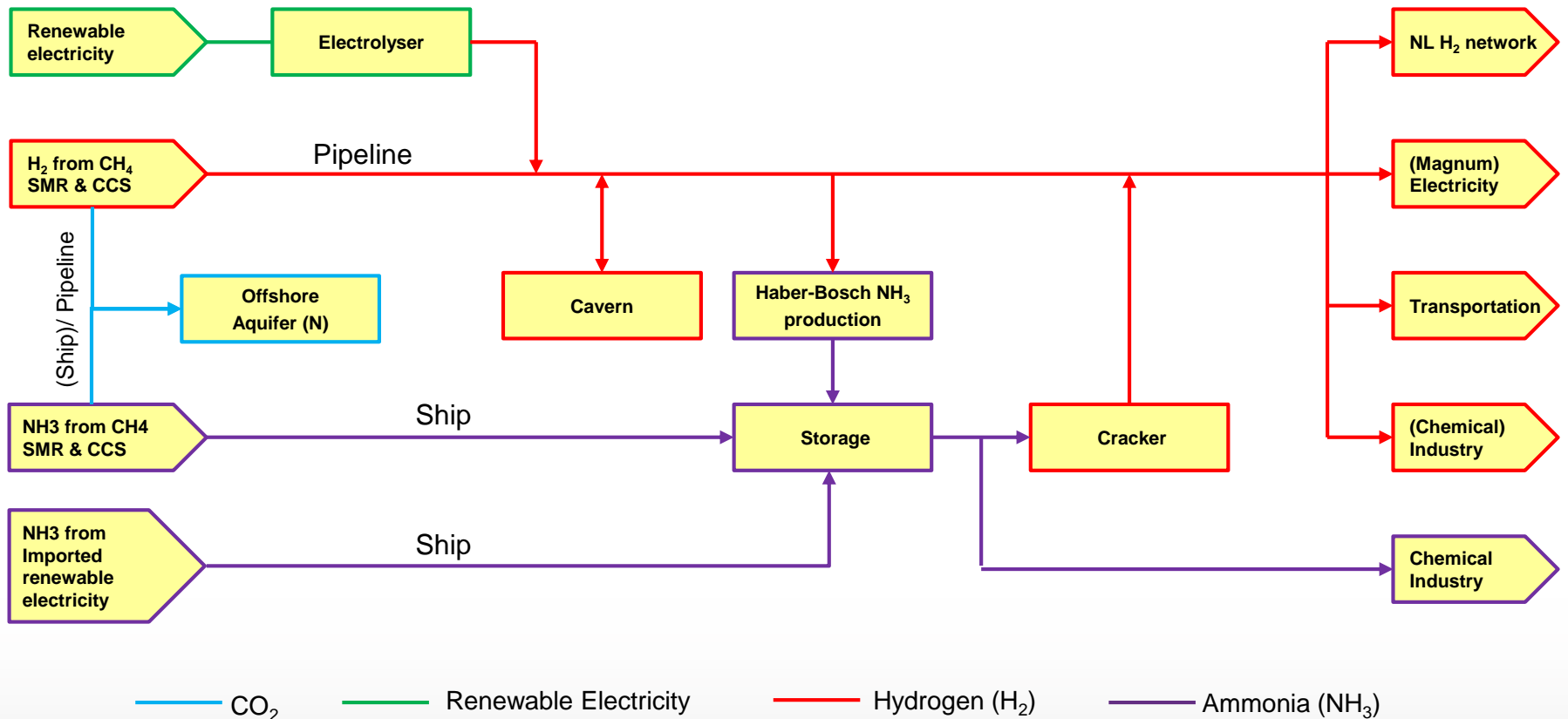


- Industry

Backup



# Routes for supply and use of CO<sub>2</sub> neutral H<sub>2</sub>/ NH<sub>3</sub>



# Industry example: HYBRIT - fossil free steel

- Joint venture

**SSAB**

**LKAB**

**VATTENFALL**

- Eliminate CO<sub>2</sub> emissions from blast furnace by replacing coal with hydrogen as reduction agent

