

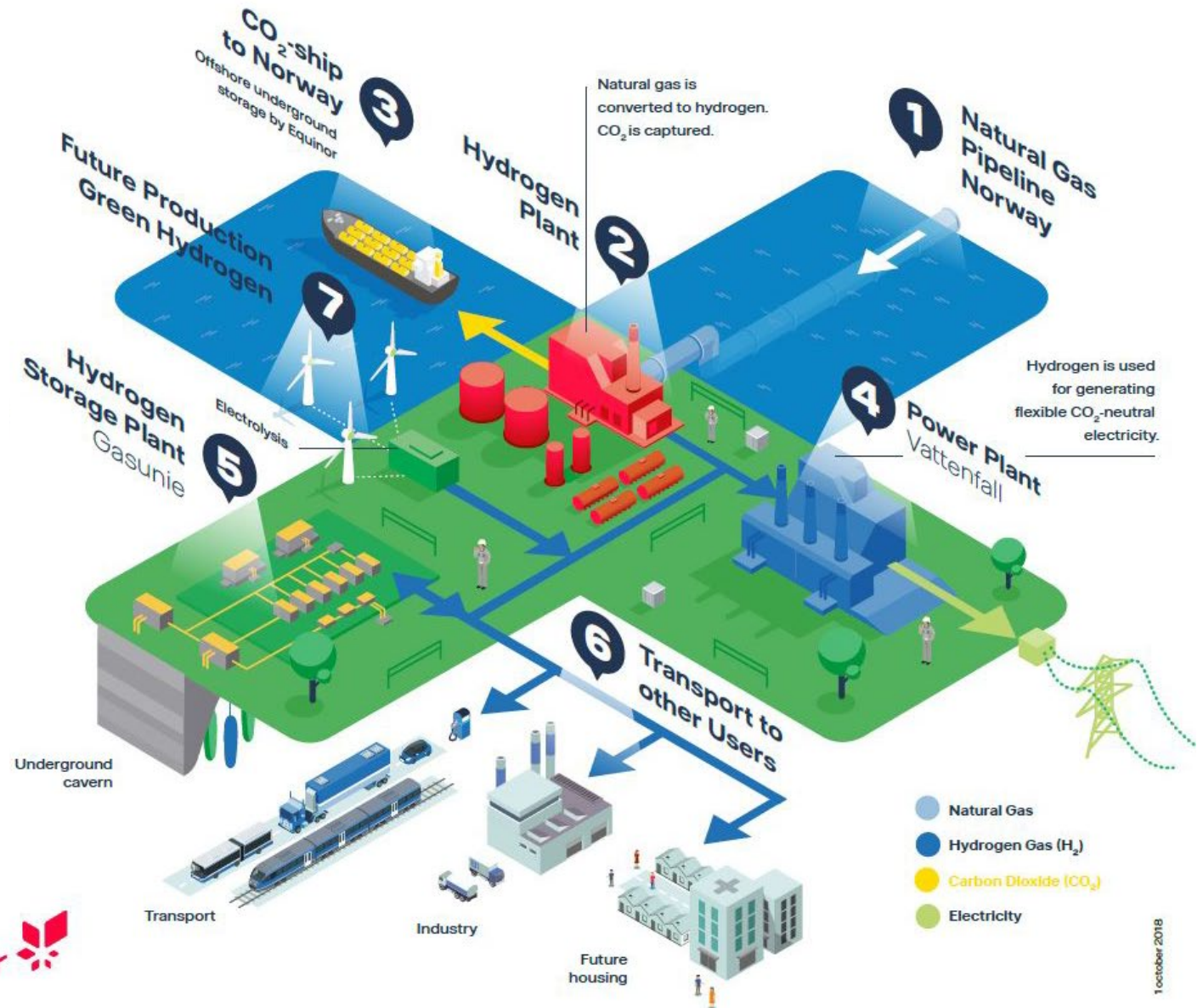


Hydrogen
Europe

H2MAGNUM

H2Magnum – General project idea

- **Plant:** Magnum power station (CCGT)
 - Output: 3x470 MW, ~2 million households
- **Innovative technology:** multi-technology integration concept based on turbine conversion & carbon capturing fitted ATR
- **Final products:** flexible production of clean H₂ for dispatchable power production, heating, transport, industry
- **High TRL:** system prototype demonstration in operational environment
- **How innovative compared to state-of-the-art:** first-of-a-kind power plant to combust H₂ for large-scale application



H2Magnum – Participants and location



The Netherlands

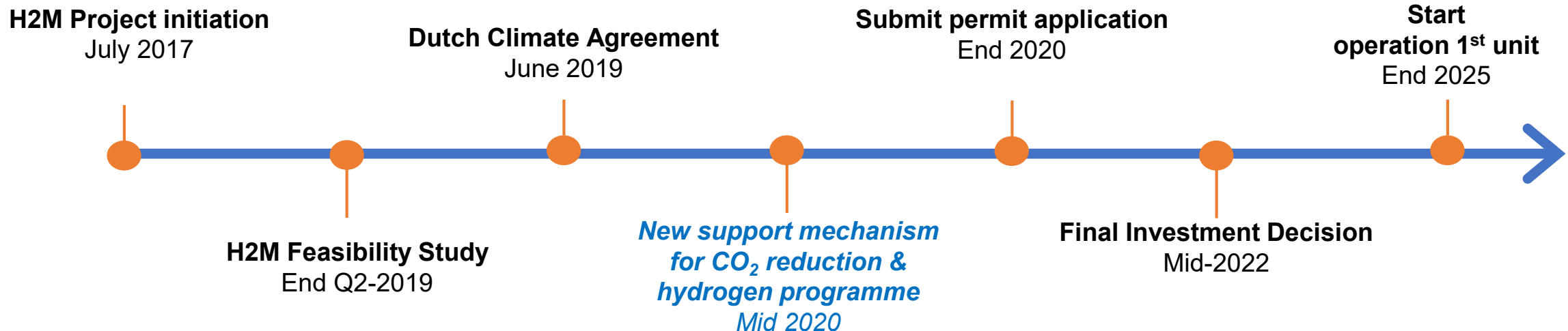


- **Geographical location:** Eemshaven
 - 25% of installed power generation capacity in NL
 - Landing point for offshore wind
 - Electricity connections to NO & DK
 - Gas infrastructure (pipelines & storage)
 - Province of Groningen: ca. 30 H2 projects with €2.8bn planned investments by 2030
- **Partners involved:**
 - Equinor – H2 production, CO2 removal, CO2 transport & storage
 - Gasunie – H2 transport and storage
 - Vattenfall – H2 off- taker, Magnum power plant conversion and operation

H2Magnum – Budget and maturity



- **CAPEX:** €1bn
- **Key variables (conditions for FID):**
 - Support mechanisms to cover the financial gap
 - Reliance on CO₂ transport projects (e.g. Northern Lights)
 - EU and international legislative issues: issues pertaining to the CO₂ transport projects (e.g. Northern Lights) – CEF, EU ETS, London Protocol
 - National permits for construction in the Netherlands



- **GHG emission reduction potential:** 1.8 million tons of CO₂ annually

In context: total GHG emissions in the Netherlands amounted to 193 Mt CO₂e in 2018. Emissions from natural gas-based power production were 24.7 Mt CO₂e.

- **Products and their market potential:**

- Dispatchable low carbon power for capacity, daily and seasonal flexibility
- H₂ as low carbon fuel and feedstock for industrial purposes in industrial clusters in the Netherlands and Germany
- Hydrogen as clean alternative for natural gas in all market segments, including domestic heating segment
- Large scale storage of H₂ for both natural gas-based H₂ as well as H₂ production from renewable energy

- **Scalability and replicability of the project:**

- Replicable in other European industrial clusters, in particular with existing natural gas infrastructure
- Enhanced use of ATR technology: H2M as first-of-a-kind implementation of ATR technology for large scale conversion of natural gas to hydrogen with CO₂ capture
- Combustion of H₂ at scale in existing commercial power plants
- H2M as showcase for optimisation of dispatchable clean power plant operations

- H2M added value:
 - Dispatchable clean power production
 - Daily / seasonal flexibility
 - Clean large-scale energy storage
- Recommendations:
 - The IF should be open to complex H2 projects, thus need for flexible selection criteria
 - Clarity on rules for rewarding flexible clean energy production is required
 - The State Aid rules should allow for support of large-scale H2 projects