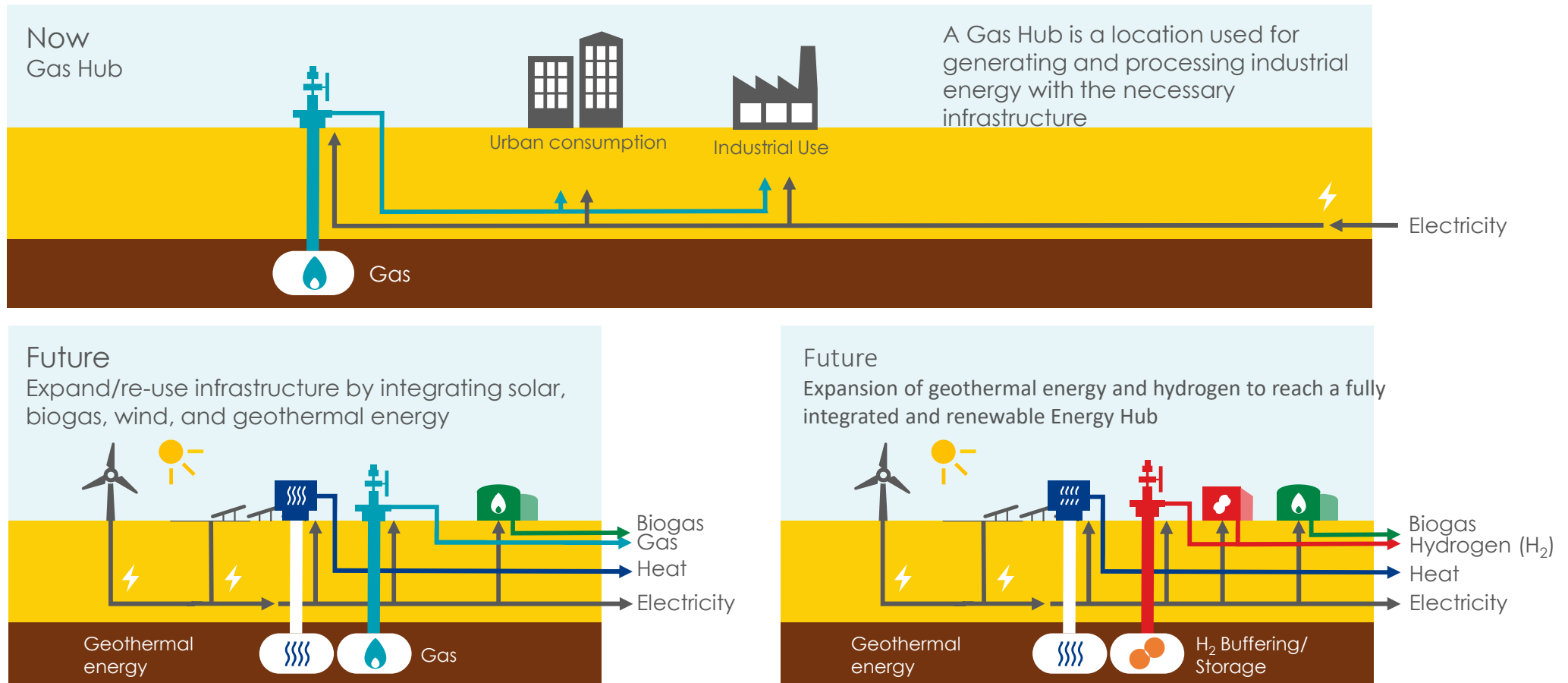


SEREH 14 JAN 2021

NAM WORKPACKAGES REPORT OUT

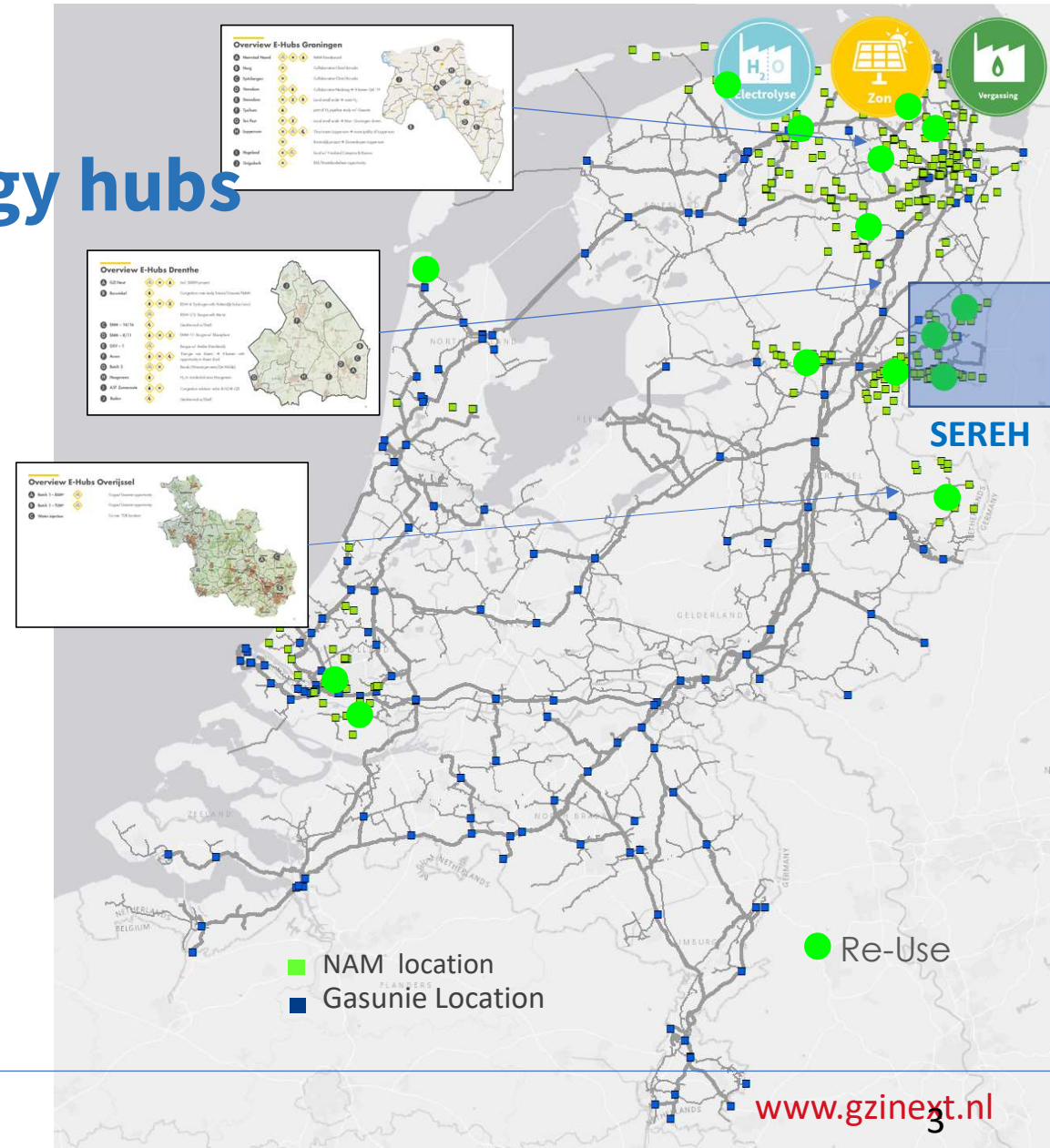
Harry Eshuis (on behalf of NAM)

Gas production location to regional Energy hub



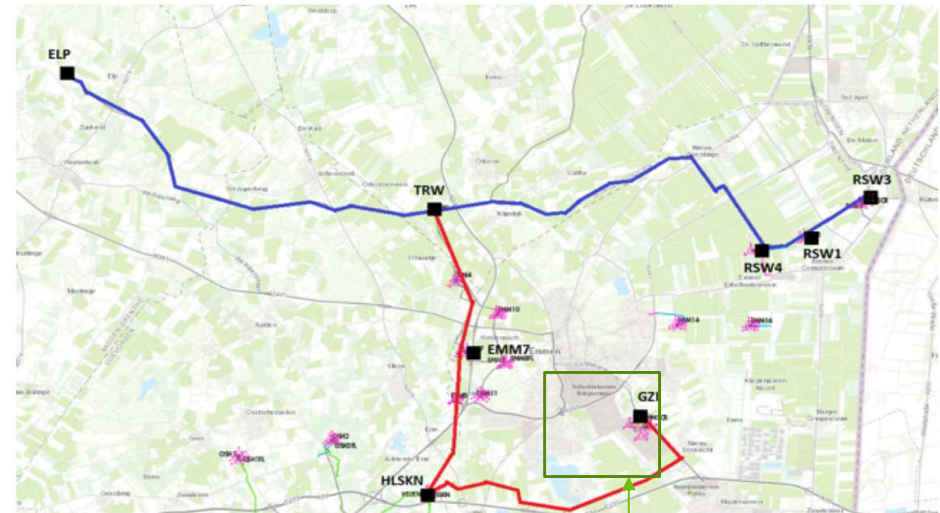
Energy hubs

- **Energy hubs:**
 - **Re-use** of existing infrastructure
 - **Collaboration** with partners
 - **Integration** of sustainable energy theme's
- **Re-use** of locations, pipelines and e-cables
- **Collaboration:** municipality, province, government, commercial partners, R&D, MKB and local cooperation's
- **Integration** of heat, electrons and molecules
- The **regional position & connection** of the NAM and Gasunie locations are unique and play an important role
- **Decommission, unless** realistic Energy hub opportunities are welcome and possible



SEREH WP: CONCEPTS FOR HYDROGEN-BASED CROSS-BORDER ENERGY SYSTEM (1)

- NAM studied re-use pipeline system
 - No “blockers” for H₂ transport & buffering
 - Further studies needed on e.g. “soft parts”
 - Permitting & regulatory impact to be discussed
 - Transport capacity: >100MWh hydrogen eq. (>3 ton/h)
 - Buffering: >15-75 ton hydrogen (0,5-2,5GWh)
 - Depends on acceptable pressure fluctuation (tbd)
 - Business case for buffering unclear
 - Connect to GZI Next energy hub
 - Industry offtake (GETEC.Emmen industry)
 - Heavy Duty Hydrogen Refuelling Station (Shell)
 - Connection to National Hydrogen grid (Gasunie)
- Further opportunities: expand re-use natural gas grid to get hydrogen to Germany (via Gasunie), Hoogeveen (hydrogen village) and potentially even further West (Meppel?)

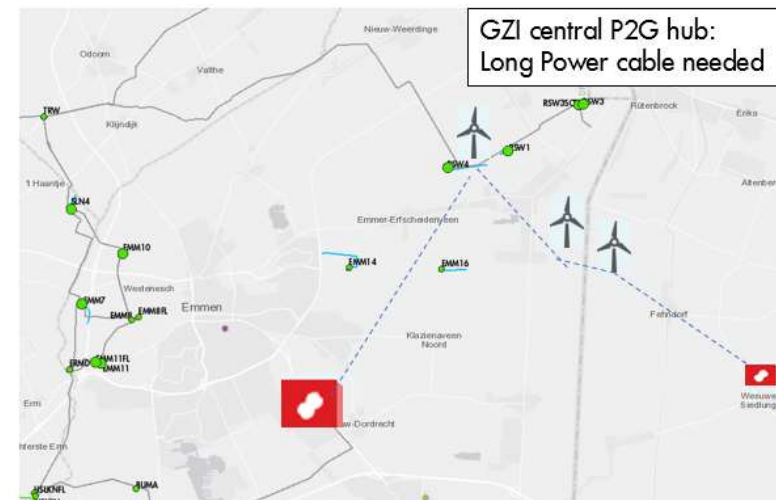


GZI Next Energy Hub

SEREH - WP: CONCEPTS FOR HYDROGEN-BASED CROSS-BORDER ENERGY SYSTEM (2)

- Options for evacuation surplus power to Emmen industry by cross-border connections
 1. Power cable Fehndorf to P2G at RSW-4, NAM pipeline GZI Next energy hub
 2. Power cable Fehndorf to P2G GZI Next energy hub, already connected to Emmen industry
 3. Hydrogen production in Fehndorf, with pipeline to NAM grid RSW-4


SEREH - WP: CONCEPTS FOR HYDROGEN-BASED CROSS-BORDER ENERGY SYSTEM (3)




Q: is there large flexible E-demand?

Hydrogen opportunities:

- Buffer H₂ in NAM grid
- Extend grid to Germany
- Connection to Gasunie H₂-grid

 Wind / Solar with surplus

 Green Hydrogen

----- New electricity cable

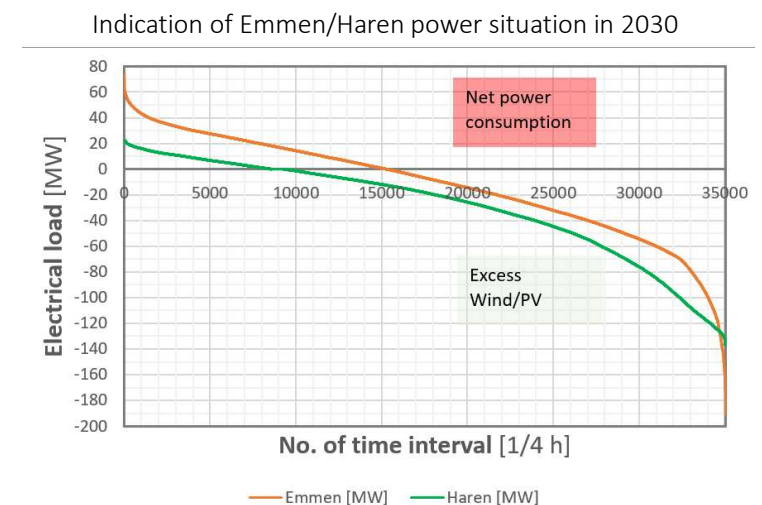
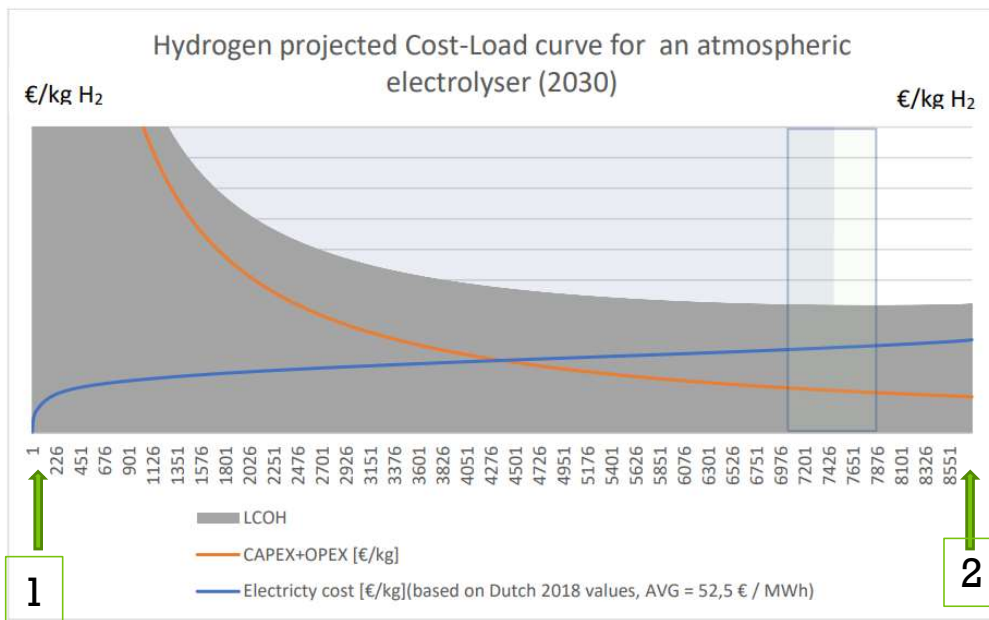
— New hydrogen pipeline

— Available pipeline



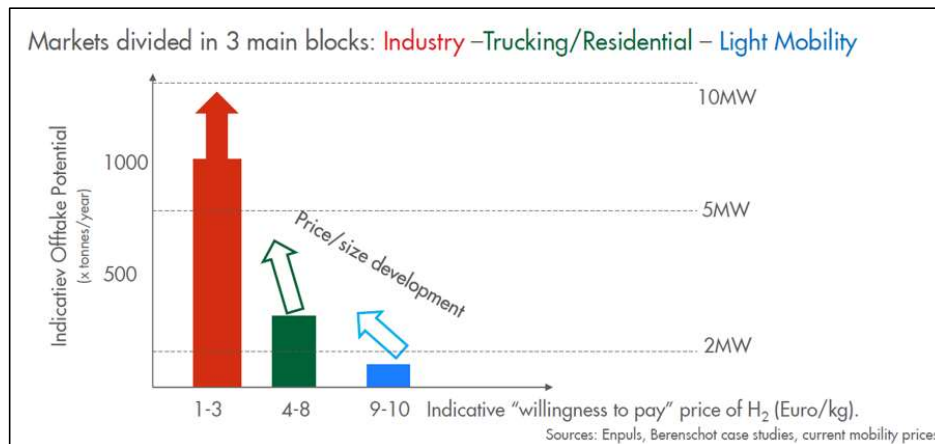
SEREH - WP: CONCEPTS FOR HYDROGEN-BASED CROSS-BORDER ENERGY SYSTEM (2)

- Business case for evacuation surplus power, or all power from Renewable Sources via hydrogen
 1. Surplus power (for free/very low cost) to H₂
 1. Limited amounts now, might grow in future
 2. Intermittent → low utilisation electrolyser, resulting in high cost for hydrogen
 2. All power to H₂ = green hydrogen competing with power market: volatile and in current energy system not competitive as alternative for natural gas + CO₂ tax. (low power prices ↔ low gas prices).



OUTLOOK IN NORTH NETHERLANDS

- Although green hydrogen is not (yet) competitive, several initiatives are maturing to explore the future with green hydrogen
 - Production: Electrolyser developments in Eemshaven/Delfzijl and Emmen
 - Storage & transport: Cavern storage of hydrogen, pipeline grids
 - Market: Public transport, logistics, residential areas, industry
- 1. Scale-up is needed to get cost reduction for green hydrogen, e.g. by developing cross-border green hydrogen economy and renewable power projects.
- 2. Together with increasing cost of fossil fuels and CO₂ emission, this will lead to a competitive pricing for green hydrogen in specific sectors.
- 3. Starting with heavy duty mobility, transport and industry.



Copyright of NAM

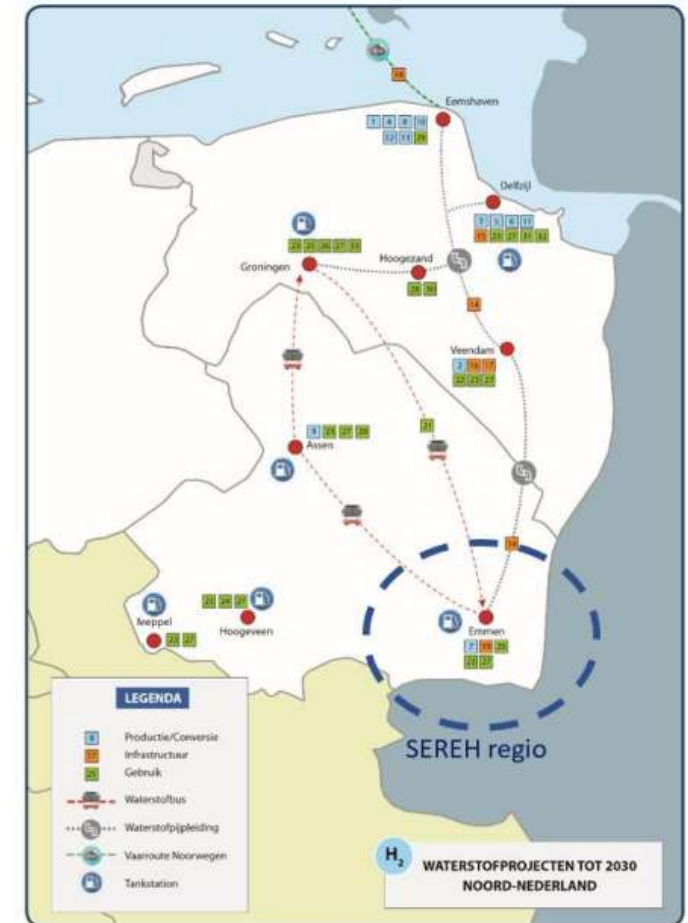


Figure 7: Hydrogen initiatives in Northern Netherlands

