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Lessons from Hydrogen Valley Mid-Sweden

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Case study – Mid-Sweden Hydrogen Valley

Scope

— Examination of how current and future hydrogen value chains can be established focusing on the Mid-Sweden region (where a partnership around hydrogen has been formed, more than 5 years ago – Mid-Sweden Hydrogen Valley - MSHV).

Key questions evaluated in this case study

— Which actors are involved in MSHV at present?

— What opportunities and challenges exist in relation to establishing hydrogen projects in mid-Sweden?

Method

— Literature review and semi-structured interviews with relevant actors.

MSHV actors

Company	Business area
Alleima	Steel manufacturer
AirLiquide	Supplier of gas and services
DalaVind	Owner of windpower plants
Fortum	Energy company
Green Iron	Sponge iron manufacturer
Gävle Hamn	Port owner and operator
Gävle kommun	Municipality
Hitachi Powergrids (Hitachi Energy)	Energy technology & service provider
Hofors kommun	Municipality
Högskolan i Gävle	University
Inlandsbanan	Trains
Linde gas	Gas supplier
Länsstyrelsen Dalarna	County board
Länstyrelsen Gävleborg	County board
MaserFrakt	Carrier and haulage provider
Mellansvenska Handelskammaren	Business organisation
NITIU	Hydrogen storage research center
Njordr	Windpower provider
Outokumpu	Steel manufacturer
Ovako	Steel manufacturer (steel scarp recycling)
Powercell	Fuel cell manufacturer
Region Dalarna	County council
Region Gävleborg	County council
RISE	Research institute
Sandvik	Manufacturer of industrial products and services
Sandvikens kommun	Municipality
Scania	Manufacturer of heavy lorries, trucks and buses
Skyborn Renewables	Developer of offshore wind power
St1	Energy company
Statkraft	Power generation with hydro-, wind- and solar power
Svea Vind Offshore	Provider of windpower of hydrogen production
Vattenfall	Power company
Volvo Group	Manufacturer of trucks, buses and construction equipment

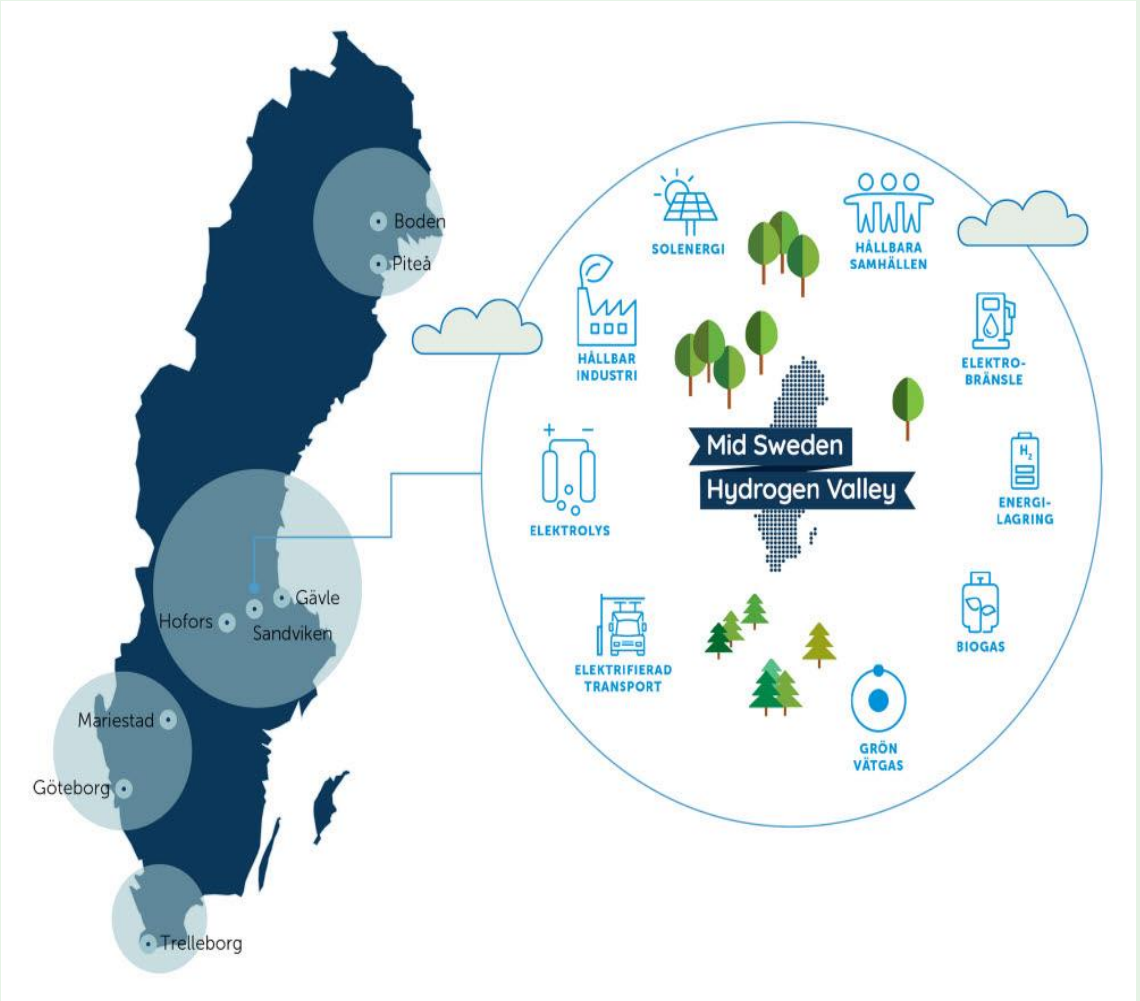
Apart from actors in MSHV, interviews was also made with: Researchers, Local actors, Grant providers, and Authorities.

Actor groups	Actors interviewed
Renewable energy providers	Skyborn renewables, Dalavind, Statkraft
Hydrogen producers	Ovako, Plagazi, Statkraft
Storage and distribution	Nordion Energi, Hydri, Nitiu, Gävle hamn
Hydrogen userd	Alleima, Sandvik, Maserfrakt, Green Iron, Ovako
Grant providers	Energimyndigheten, Naturvårdsverket
Incubators and research organisations	Sandbacka Science Park, Luleå tekniska universitet (Cecilia Wallmark)
Authorities	Region Gävleborg (Anders Lundell – MSHV coordinator), Länstyrelsen
OEMs	Volvo, Powercell, Nitiu

Conclusions - opportunities

What are the biggest opportunities to develop hydrogen projects in this region?

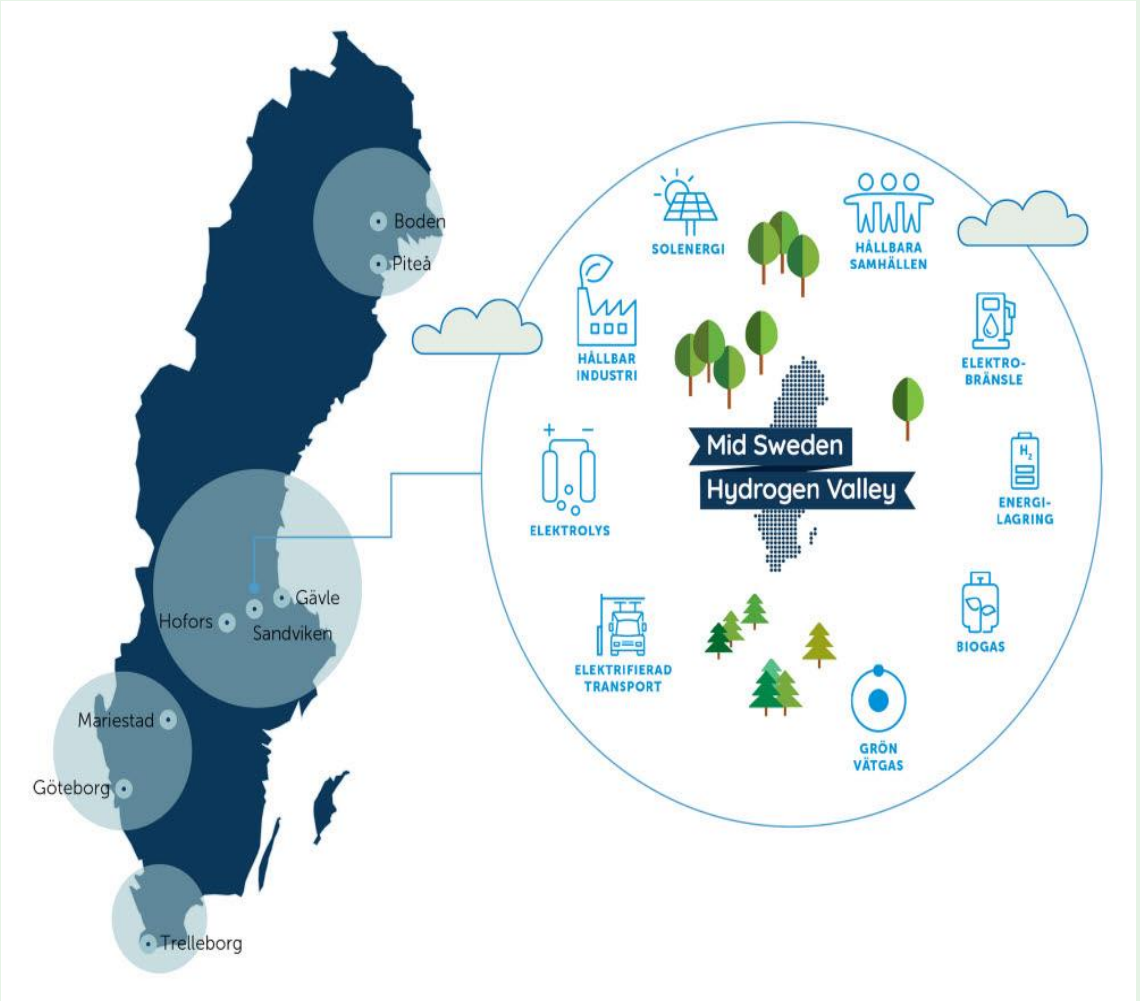
- Actors with ambitions and possibilities to use hydrogen for decarbonization, e.g., MSHV partnership organization, which can support collaboration.
- Access to potential off-takers for excess oxygen (pulp and paper industry for e.g., bleaching)
- Access to hydrogen users (e.g., steel production, H2 replaces LPG for high temp process heat).
- Access to users of excess heat (existing and potential extension of the district heating network).
- Access to logistical hub for potential hydrogen infrastructure (mainly port of Gävle but also Borlänge).
- Actors with possibilities to provide less electricity-intensive hydrogen production (e.g., gasification of waste).



Conclusions - challenges

Challenges when developing hydrogen projects in this region

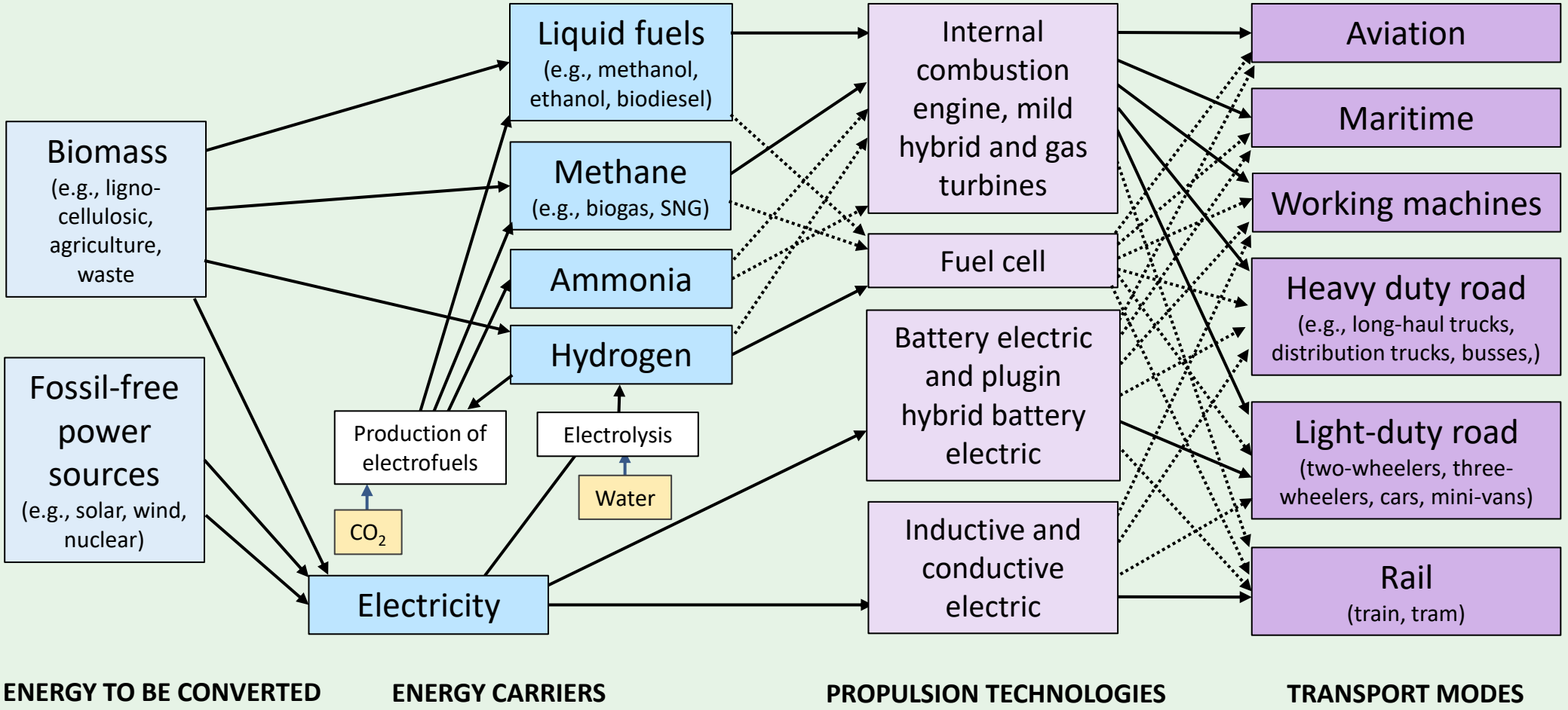
- Hydrogen production cost, which is high in relation to fossil-based alternatives (affecting the overall value chain business case).
- Developing the hydrogen value chain in sync, i.e., the classic chicken and egg challenge.
- In present time, lack of local electricity and transmission capacity which could hinder electrolyzer installations.
- Lack of hydrogen transportation infrastructure (e.g. pipelines, liquefaction facilities, LH2 ships).
- Difficulties for smaller actors to realize hydrogen development projects.
- The current focus on electrolyzer technology, may hinder or delay the development of other H2 production options (e.g., options that can be combined with BECCS as gasification, or steam reforming of biogas).



I’ll take the opportunity to zoom out

Various types of fuels and vehicle technology options

which are differently well suited for the different transport modes, where the dashed arrows indicate pathways that currently are more complex or less mature.



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General insights on future fuels

There is no silver bullet

Three types of energy carriers have the potential to substantially reduce the fossil CO_2 emissions from the transportation sector. No option is perfect.

Type of energy carriers	Challenges when produced at large scale
Fuels including carbon atoms (biofuels and electrofuels)	Land, water, biodiversity, food, acceptance for large scale electricity generation from solar and wind.
Fuels without carbon atoms (hydrogen and ammonia)	Acceptance for large scale electricity generation from solar and wind.
Electrons (battery-electric propulsion)	Critical minerals and metals, geopolitical risks

To avoid creating new problems, parallel solutions are needed, my research points towards:

— There are many advantages for electric solutions (battery electric and hydrogen used in fuel cells) in cities. Issues related to noise and local air quality can be improved when using propulsion technologies and energy carriers generating low or no NOx, soot, and noise. Thus, different electric solutions is well suited in cities (electric buses, cars, ferries, delivery trucks, trams, metro, micromobility etc).

— There are several challenges for electrifying long-distance transport (especially ships and aircraft where liquid fuels with high energy density are difficult to substitute). Electrofuels may complement biofuels for these transport modes.

— Irrespective of fuel type, CO_2 emissions can be reduced by more energy efficient vehicles and measurements towards reduced transport demand.