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Hydrogen supply scenarios for heavy transport

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Lundblad Therese[1], Taljegard Maria[1], Johnsson Filip[1]

[1]Chalmers University of Technology, 412 96 Gothenburg, Sweden, therese.lundblad@chalmers.se

CONTEXT

For hydrogen to be an environmentally and economically sustainable fuel, its production and distribution must be cost and energy-efficient, while having a low environmental impact. This work examines the cost of three hydrogen production systems that supply hydrogen to refueling stations for heavy transport. The purpose is to study the difference between centralized and decentralized hydrogen production systems, as well as the difference between standalone and grid-connected systems for hydrogen supply.

METHOD

A cost-minimizing optimization model was developed that meets a hydrogen demand at the lowest total cost. In addition to current conditions, an analysis is performed for an electricity system with a higher share of variable renewable electricity supply.

Table 1. Summary of the studied hydrogen supply systems

System no	Electricity source	Geographical scope	Large-scale hydrogen storage	Average transport distance
(1)	Dedicated wind power	Decentralized	No	0 km
(2)	Grid connection	Decentralized	No	0 km
(3)	Grid connection	Centralized	Yes	150 km

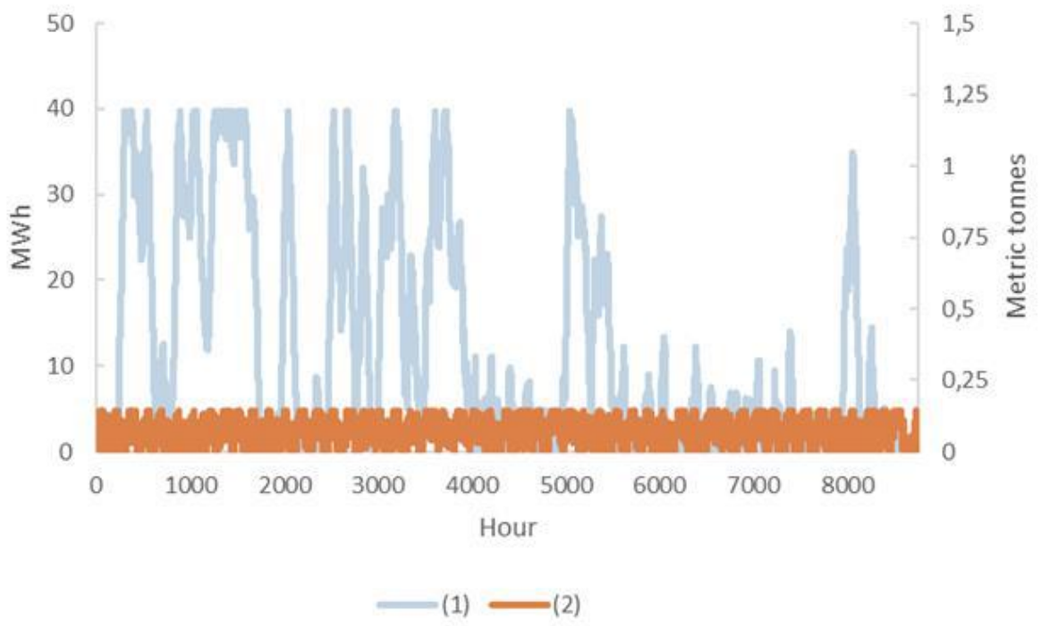

Figure 1. Hydrogen level in storage for hydrogen supply systems (1) and (2)

RESULTS

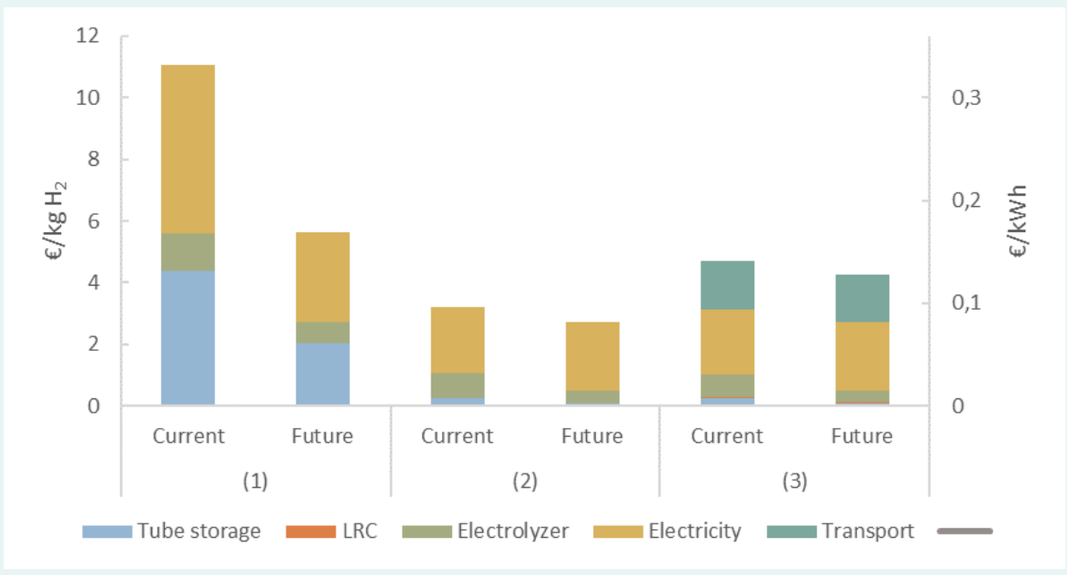

Figure 2. The levelized cost of hydrogen delivery for the studied systems

- The lowest total cost is achieved through decentralized hydrogen production with a grid connection (2) while a stand-alone solution (1) gives the highest production costs
- Centralized hydrogen production (3) gives slightly lower costs for production and storage but adding the cost for hydrogen transport makes the total cost slightly higher
- Lower costs are achieved in future cases. This is due to a combination of decreased specific costs and increases in energy efficiency

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