

Fuel cell powered cargo-bikes and other smaller scale applications

– a mini demo project

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**RI-
SE**

Classification of electric bicycles

L-categories	Max power (W)	Max pedalassist speed (km/h)	Type approval required?
Common electric bike (pedelec)	250	25	No
L1e-A (cargobike)	1000	25	Yes
L1e-B (speed-pedelec)	4000	45	Yes

Cargobikes – last mile delivery

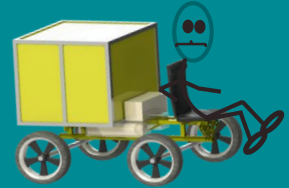
Bicycles for heavy loads, up to 500 kg!

Potentially 51% of city transport could be replaced by cargobikes!



The fuel cell offering...

Today: low load and long range



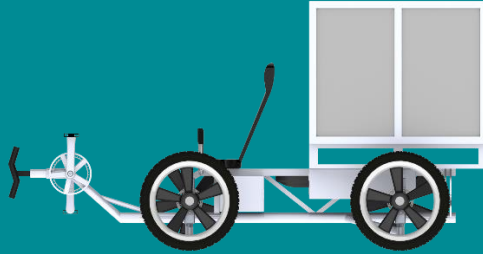
Tomorrow with L1e-A: high load but short range



But with fuel cells!



Designing the fuel cell solution?



Hymera fuel cell,
150 -200 W,
45x20x18 cm, 8 kg,

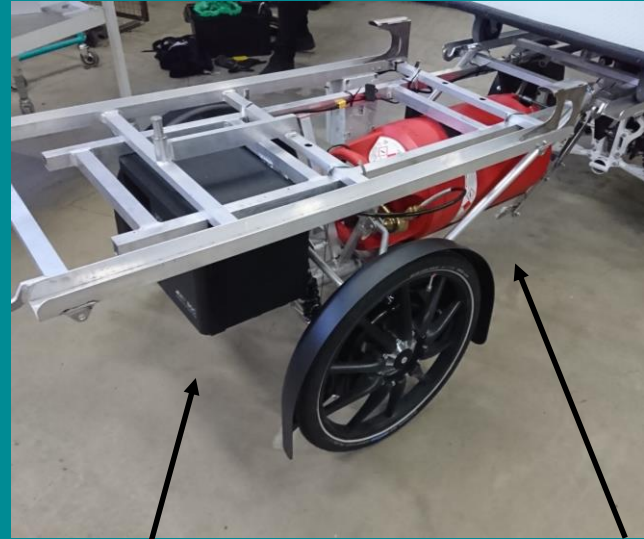


Genie H₂-cylinder,
32x66 cm, 22 kg,
420 g H₂, 7 kWh

Mounting of the fuel cell system



Velove cargobike with semitrailer



Hydrogen cylinder (Genie)
Hymera fuel cell

Ready for demonstration!



Litium ion Battery pack

Power electronics for voltage
boost from 24 to 54 V.

Demonstrator testing

Test track

1 lap = 1,2 km

30 km = 25 laps

Work

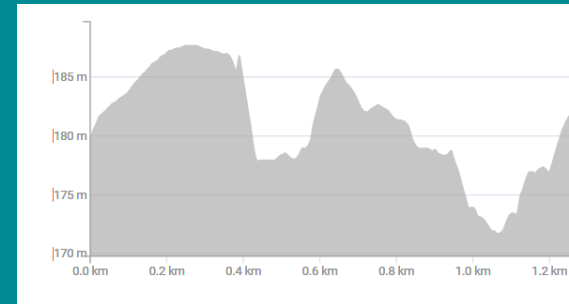
Elevation per lap: 21 m

Cargoweight: ca 50 kg

Total weight of vehicle: over 300 kg

Energy measurements

- 1) Generated electricity, before and after booster.
- 2) Weighing of H2 cylinder, before and after test (and after restoring battery voltage)



Results of measurements: 300 km range!

Parameter	Mätresultat
Weight H ₂ -cyl. before	23830 gram
Weight H ₂ -cyl. after	23788 gram
Weight difference	42 gram
Energy logg in från FC (24 V)	634 Wh
Energi-logg ut till batteri (48-54 V)	579 Wh
Verkningsgrad	91%



Film from the test was shown more than 700 ktimes on youtube!

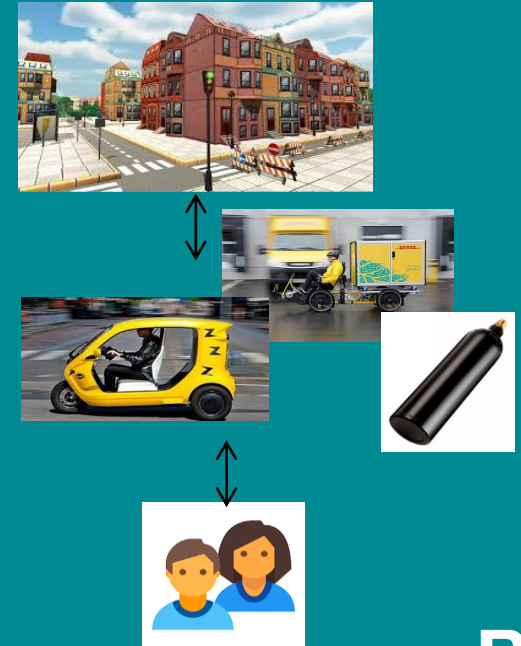
Tabell 2: Measurement data from pedal-assist cykling 30 km and 525 elevation metres.

Next step?

The objectives of next project is:

- 1) to bring a fuel cell powered cargobike prototype from TRL 6 (testing in restricted area) to TRL 7-8 (test and performance verification in real traffic and work conditions).
- 2) to estimate/evaluate the practical and commercial potential of applying fuel cells to an electrical cargobike. How much larger service distance and market (increase in payload etc) can be achieved?
- 3) to estimate/evaluate how/if this hydrogen and small fuel cells solution can be applied also to other city transport applications (eg: goods transport, personal transport/taxipod, private transport).

Fuelcells for Light Urban Transport -
Business Opportunities



Other fuel cell bike projects



<https://www.reuters.com/article/us-france-bicycles-hydrogen-idUSKBN1F52AP>

http://www.the-linde-group.com/en/clean_technology/clean_technology_portfolio/hydrogen_energy_h2/experience_h2/h2_bike/index.html (datum: 161111)

https://www.dlr.de/dlr/en/desktopdefault.aspx/tabid-10081/151_read-28717/#/gallery/31293 (datum: 181002)

<https://www.electrive.com/2019/04/02/fraunhofer-presents-fuel-cell-bicycle/>

Another small fuel cell application



HES Energy systems

<https://www.hes.sg/hycopter>

https://blog.ballard.com/commercial-uav-flight-times?CID=mvbrieff_chfca

<http://www.hydrogenfuelnews.com/intelligent-energy-to-launch-new-fuel-cell-drone-module/8537351/>



Ballard



Intellegent Energy –
12 hour fly time!

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Tack!

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