H2 @ Off-road – seminar

Ismo Hämäläinen

AGCO Power

AGCO's leading brands

MASSEY FERGUSON®

AGCO's global brand

FENDT

Premium reputation for high tech solutions

VALTRA

Completely customized performance

Challenger

Serious machinery for professional producers

GSI

Grain storage and protein production solutions

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AGCO POWER
Four engine factories

Linnavuori, Finland

Changzhou,
China

Mogi das Cruzes,
Brazil

General Rodriguez,
Argentina

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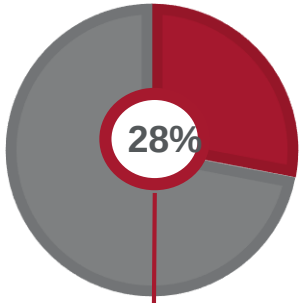
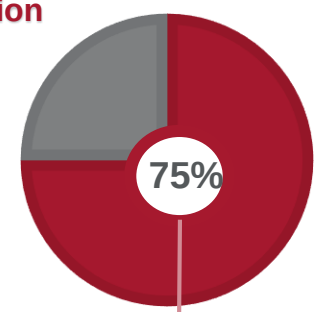
AGCO POWER
Engine share in AGCO vehicles

3- / 4- Cylinder
- 33 MD
- 44 MD

6- / 7- Cylinder Big Bore
- 84
- 98

47% Increase in vertical integration



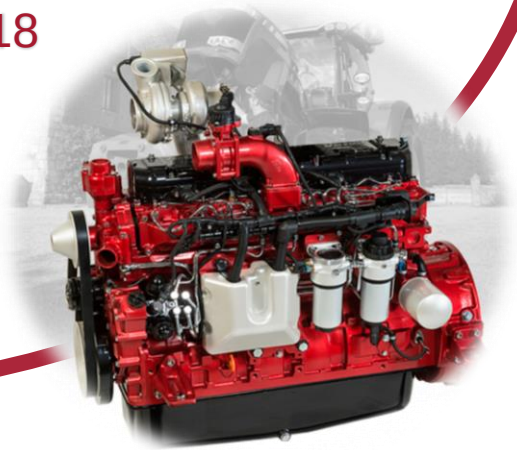


2005

13 Years

2018

3- / 4- Cylinder Heavy Duty
- 33
- 44
- 49



6- Cylinder Heavy Duty
- 66
- 74

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Challenges of Today's Farmers

- Difficult economics
- Climate volatility
- Complexity of mixed fleets
- More advanced equipment

Technology must enable machines to keep up with population growth

Despite downturn, farmers are willing to invest in productivity enhancing technology

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Power generation options for hydrogen

Hydrogen is 100 % CO_2 neutral fuel (Tailpipe emissions)

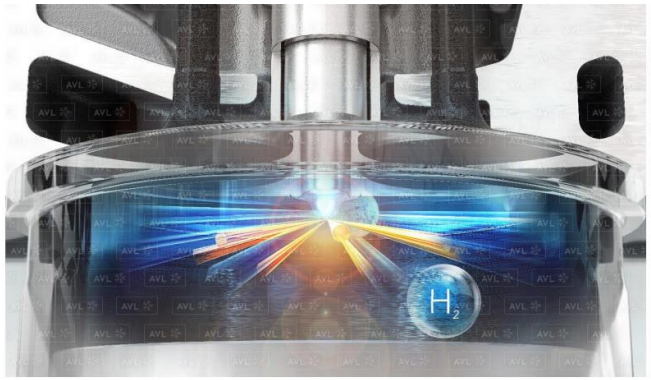
Fuel cell (700V +)
Efficiency 45 - 55 %
Electric powertrain in vehicle

Challenges
Maintenance and service
System price
Sensitivity on fuel purity

Source: PowerCellution

H2 ICE
Efficiency 40 - 45%
Conventional powertrain in vehicle

Challenges
EAT is required



Source: Westport

Challenges are amount of energy carried on-board and how to get that in farm

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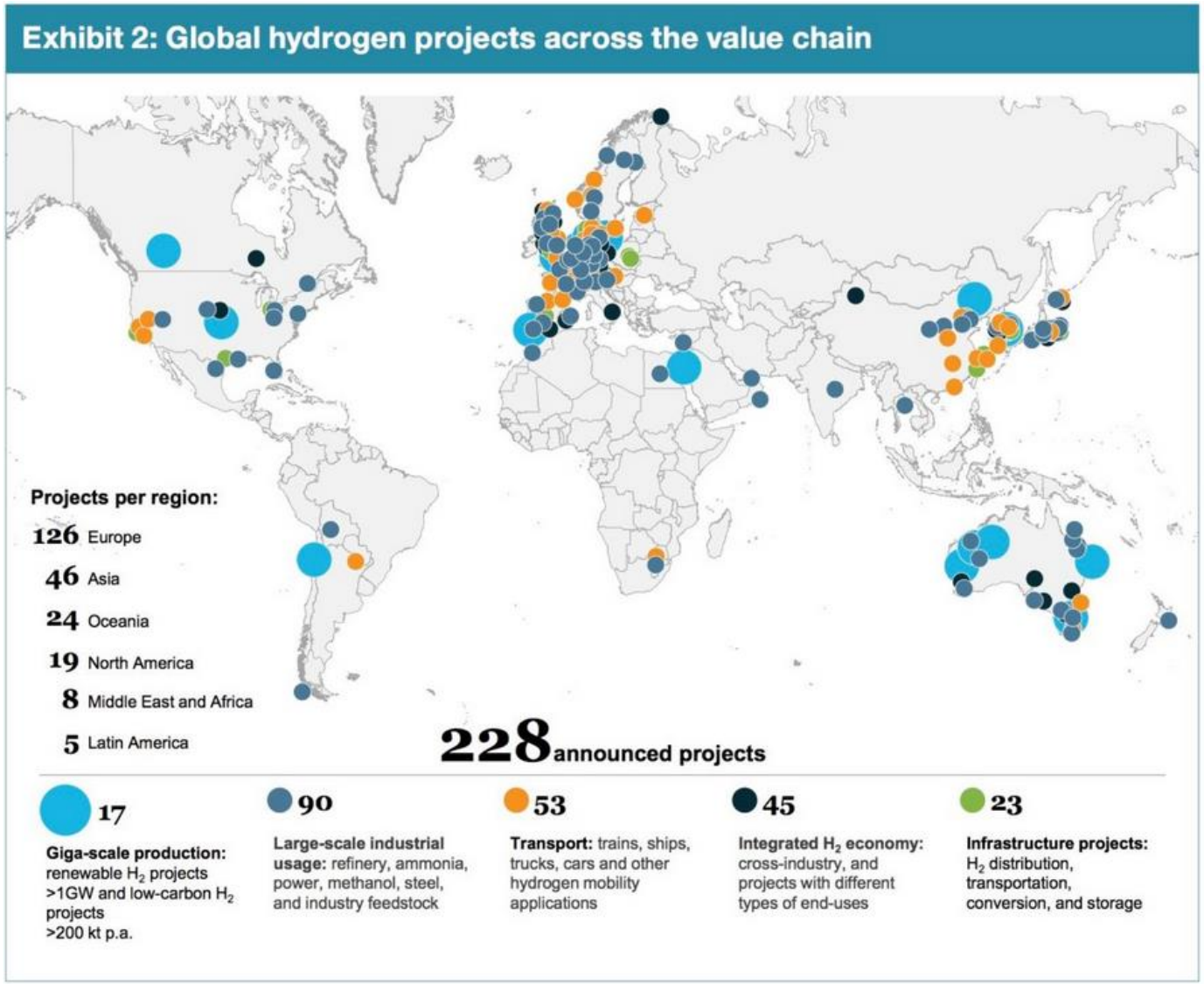
Global hydrogen infrastructure



Estimated value of planned hydrogen production projects in 2030 $300 billion

https://www.pv-magazine.com/2021/02/18/global-hydrogen-project-pipeline-expected-to-exceed-300-billion-by-2030/

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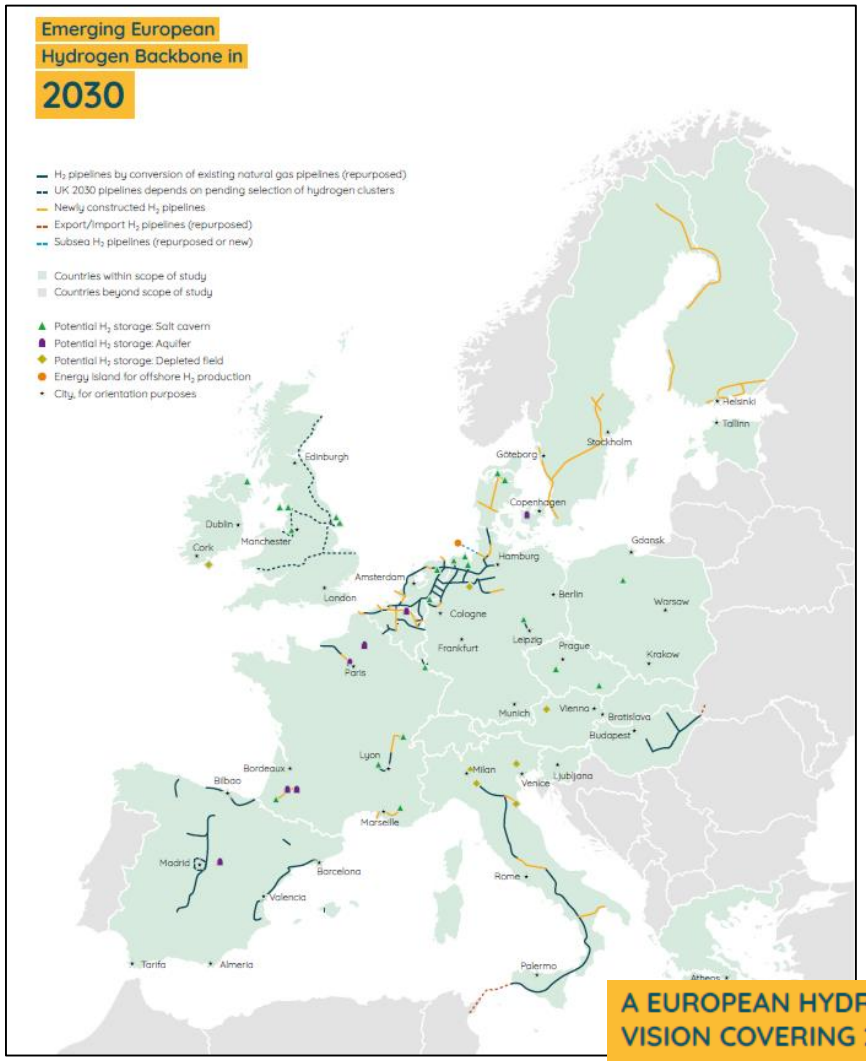
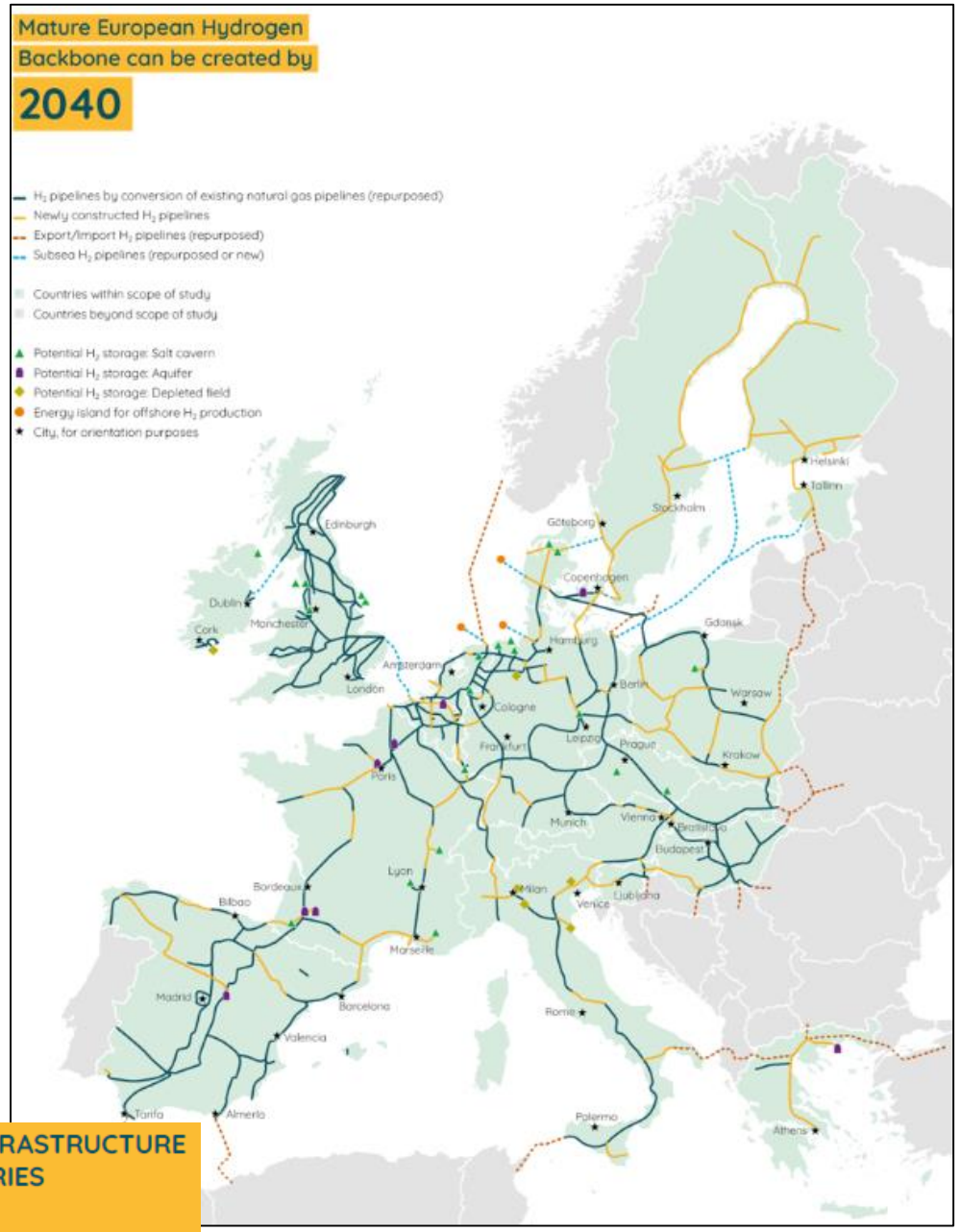
European hydrogen infrastructure





A EUROPEAN HYDROGEN INFRASTRUCTURE VISION COVERING 21 COUNTRIES

APRIL 2021

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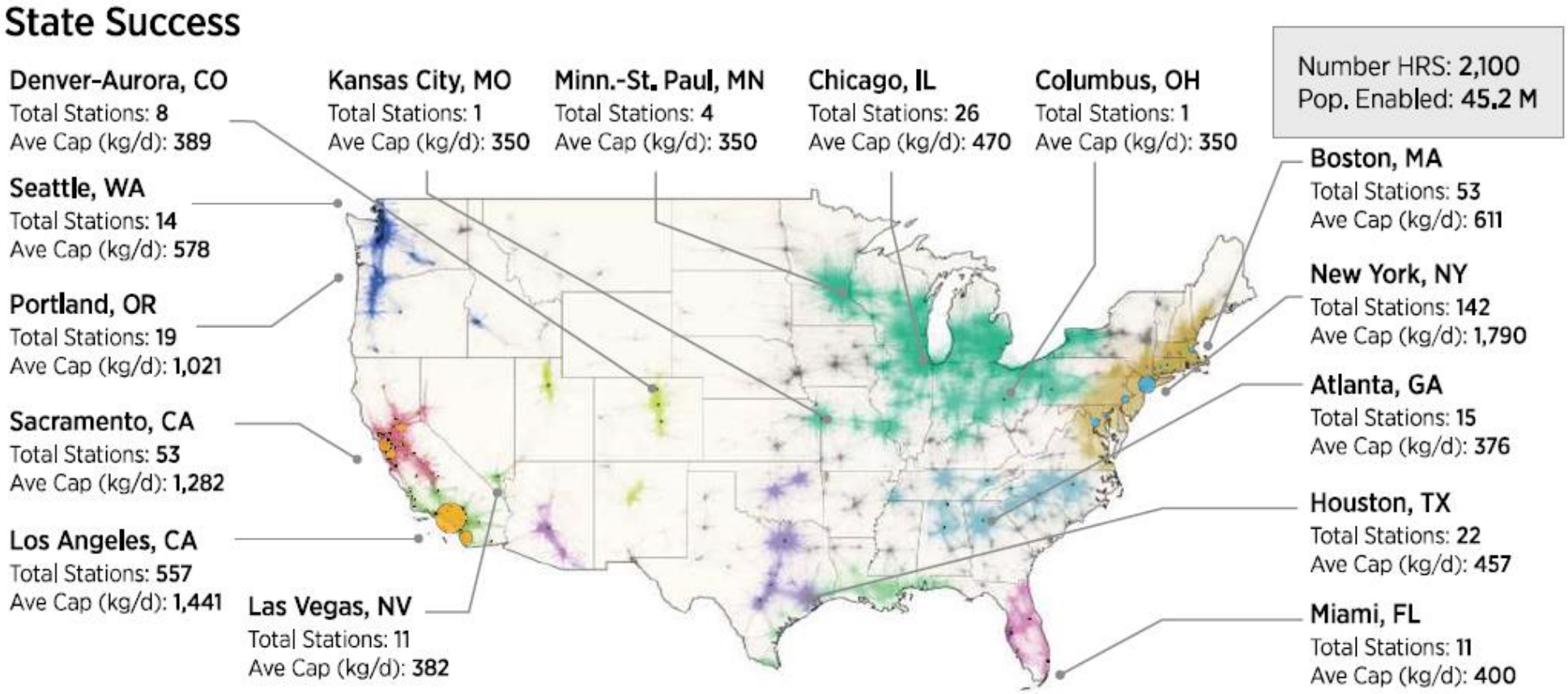
Depending on scenario, report predicts that number of filling stations varies between 1500 – 3300 in 2035.

Estimated number of H2 filling stations in USA in 2035



Melaina, M., B. Bush, M. Muratori, J. Zuboy and S. Ellis, 2017. *National Hydrogen Scenarios: How Many Stations, Where, and When?* Prepared by the National Renewable Energy Laboratory for the H_2USA Locations Roadmap Working Group. *http://h2usa.org/sites/default/files/H2USA_LRWG_NationalScenarios2017.pdf*.

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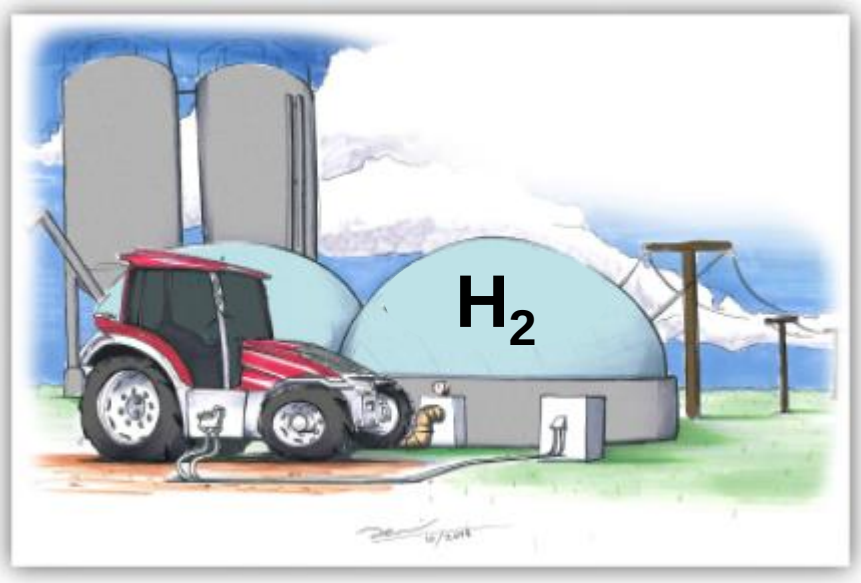
Hydrogen local production

H2 refilling station network will be established mainly in urban areas
Hydrogen local production possible i.e. electrolyzer container

Challenges:
Financial feasibility
Quality of locally produced hydrogen must be ensured
Safety

https://www.plugpower.com/hydrogen/hydrogen-electrolyzers/



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H2 storage space

Values are indicative

Power	kW	80	100	175	300
Hours/Day	h	4	6	12	12
Energy @50% load	kWh	160	300	1050	1800
H2	kg	10	18	64	110
Number of tanks	-	8	13	46	79
Total tank outer volume @700 bar pressure	m^3	0,7	1,2	4,2	7,3

Example tank:
Hexagon
Dimensions: D319 mm x 906 mm
Weight: 34 kg
Volume 36 l

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Summary

Hydrogen is CO_2 neutral fuel for AG purposes (tailpipe emission)

Fuel Cell or H_2 ICE as power source

Reliability, efficiency and ease of use are main drivers for farmer

Future challenges with hydrogen infrastructure and amount of hydrogen on-board

THANK YOU

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