Comparative assessment of batteries vs. in the electrification of mobility

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BALLARD
Powering the Future
with Hydrogen

We are the leading independent proton exchange membrane (PEM) fuel cell developer and manufacturer

More than $1.5B invested in our proprietary PEM technology

BALLARD'S TECHNICAL ACHIEVEMENTS:

STACK POWER	POWER DENSITY	PLATE THICKNESS
>100kW	▶4.0kW/L	▶1.0mm (TWO PLATE ASSEMBLY)

Strong intellectual capital and IP with over 1,400 patents and applications

Global decarbonization is putting the focus on hydrogen

The fight against climate change and air pollution is driving the demand for fuel cell technology that converts hydrogen in clean electricity

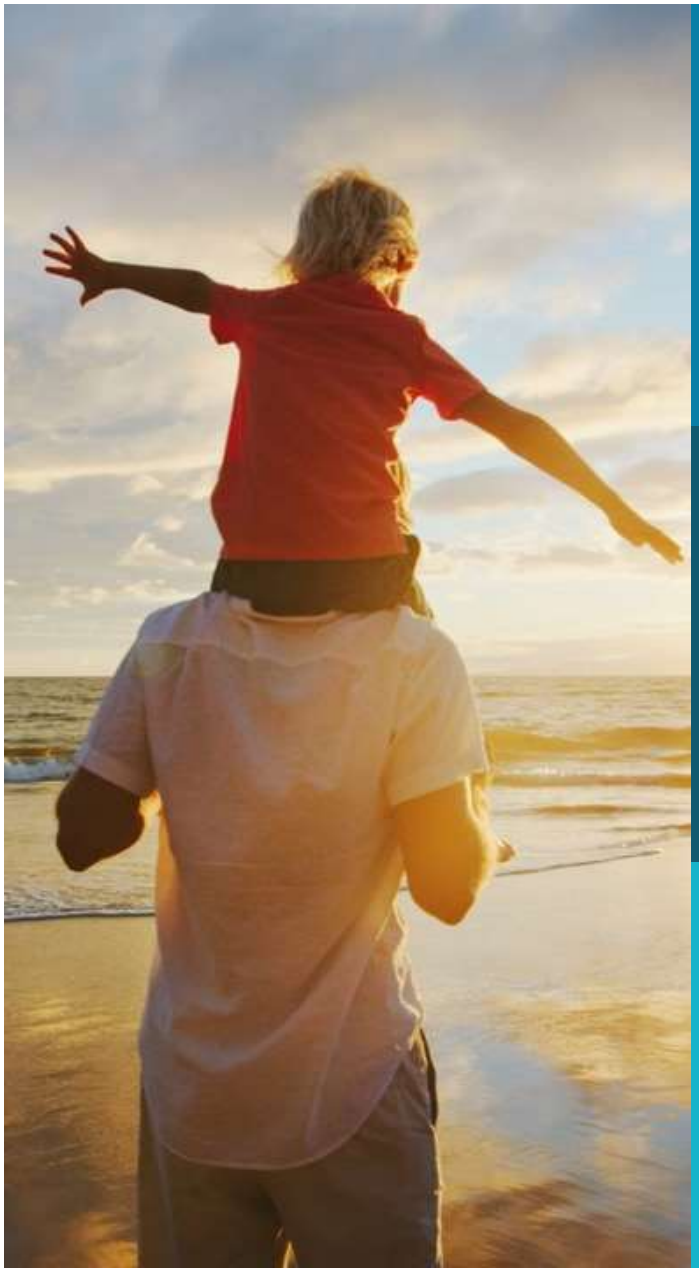
Hydrogen is a flexible energy carrier and fuel:

in cars, trucks, buses, trains and ships

in industry and critical infrastructure

Hydrogen is key to the decarbonization of our economy

Hydrogen can decarbonize sectors that are difficult to abate. Governments are recognizing it.



18 countries

have developed hydrogen roadmaps

70%

these countries account for 70% of global GDP

92 members

the Hydrogen Council formed in 2017 has now 92 members

Today there are already 25,000 fuel cell vehicles on the road.

Hydrogen Council Vision for 2030

Our industry will deliver on this vision through:

- economical, low carbon hydrogen
- fuel cell cost reduction

10 million

fuel cell cars on the road

500,000

fuel cell buses and trucks

Hundreds

of trains and marine vessels

Hydrogen is most competitive in heavy duty motive applications

Our focus is on applications where hydrogen fuel cells have a clear advantage

Buses & Coaches

Trucks

Trains

Vessels

Fuel cell technology is needed to decarbonize the heavy duty transportation sector

The advantages of fuel cells over battery electric vehicles

Only fuel cell vehicles can directly replace diesel, route for route

All weather performance

Range and payload

Refueling time

Fuel cell vehicles are more adaptable

- Hybrid, scalable power system, optimized for vehicle performance
- Higher energy density enables longer routes, and heavier payloads and hotel loads
- Scalable infrastructure enables rapid deployment and scaling of EV fleets

Hydrogen fuel is widely available today. Expansion of renewable hydrogen, and advancements in hydrogen conversion are increasing renewable options.

Costs are trending down

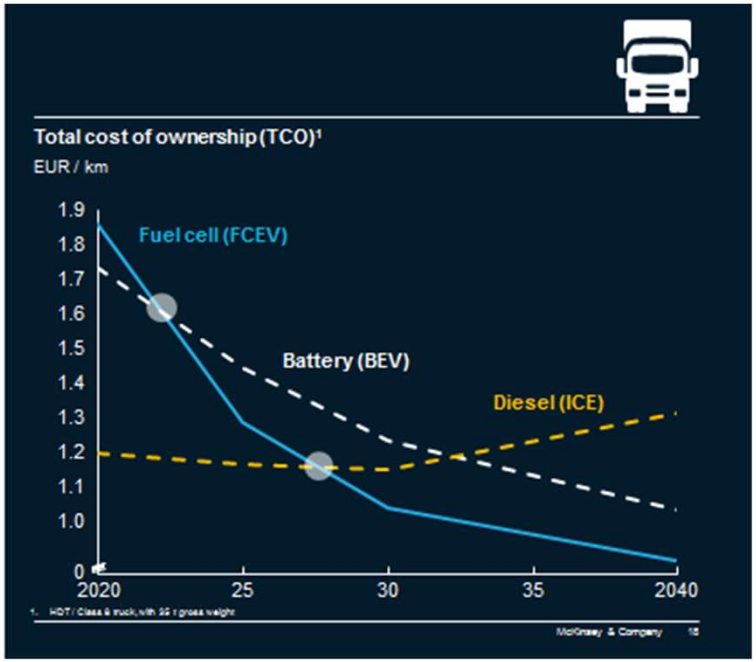
Hydrogen fuel cell transport's path to cost competitiveness

- Fuel cell system cost will drop by 70%
- Hydrogen distribution & refueling cost will drop by 40%

HDT: Commercial heavy duty transport can become cost competitive by 2030

-70%
Fuel cell system

-40%
Distribution and refueling infrastructure



McKinsey - Path to Hydrogen Competitiveness report 2020

"In less than 10 years, it will become cheaper to run a fuel cell electric vehicle (FCEV) than it is to run a battery electric vehicle (BEV) or an internal combustion engine (ICE) vehicle for certain commercial applications."
McKinsey - *Path to Hydrogen Competitiveness* report 2020

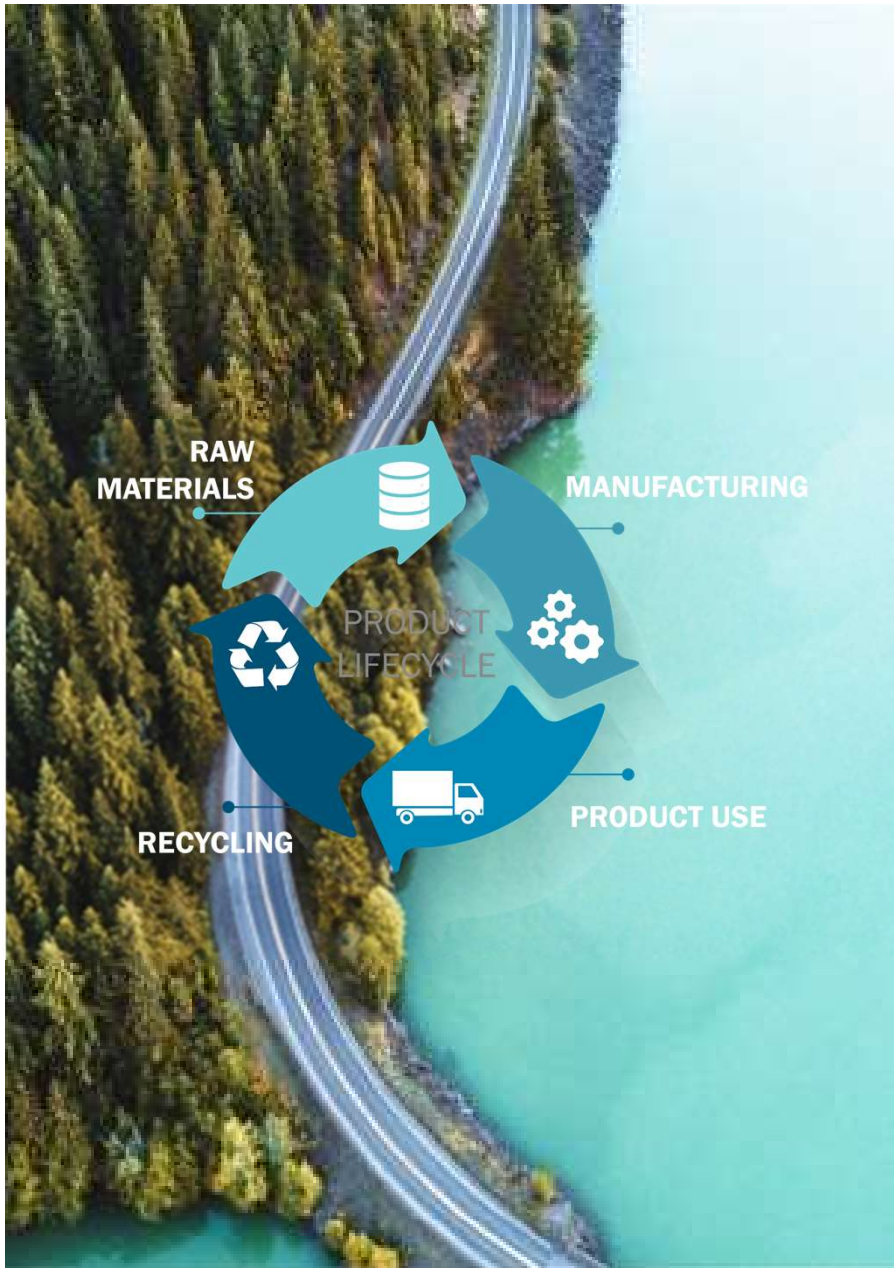
Fueling the Future of Mobility, Deloitte-Ballard 2020 https://info.ballard.com/deloitte-vol-1-fueling-the-future-of-mobility

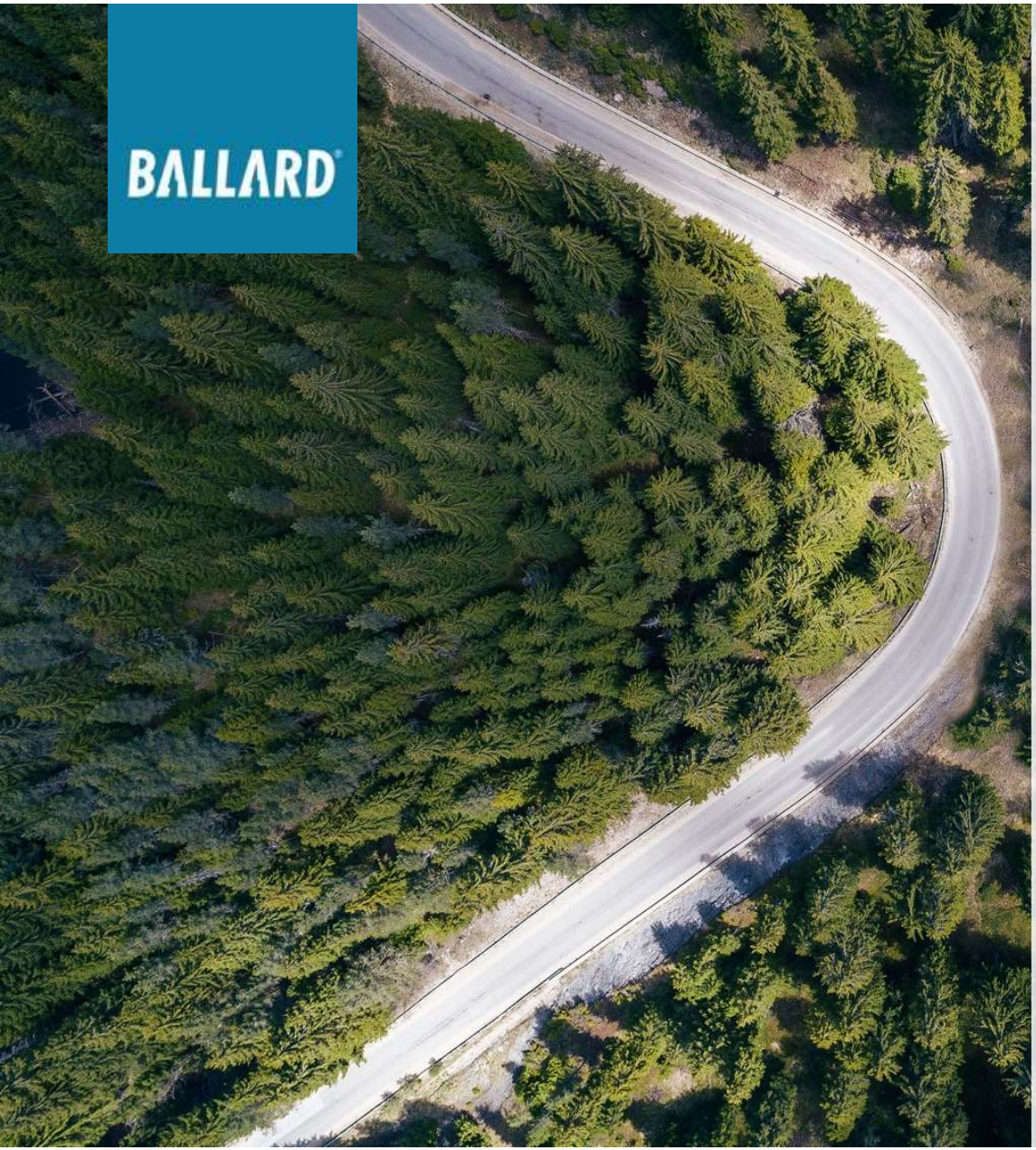
Fuel cells are sustainable

- Minimal energy intensity and environmental impact of production
- Efficient recycling processes are in place

Pt 95%

Used MEAs are send to a specialized facility that re-claims 95% of the platinum





Thank you