The US Transportation Sector contributes 29% of all US greenhouse gas emissions

Our technology enables sustainable mobility and clean air for everyone
Market driving forces and current trends

Macro Trends
- Urbanization
- Climate change
- Digital World

Market Drivers
- Air pollution impact
- GHG Emission Reduction targets
- Freight increase (+40% by 2040)

Technology evolution
- New Vehicle Utilization (car share, autonomous)
- Electrification of Transport (battery technology)
- Autonomous vehicles
More and more restrictions are driving electrification of transportation

Europe has taken a lead with city level regulations and bans

Note: red bubbles indicate the implementation of low emission zones and the size of the bubble corresponds to the density of low emission zones in that country

Source: Hybrid and Electric Trucks and Buses, Interact Analysis
Battery electric and hydrogen vehicles are complementary
Fuel cells delivers significant value proposition to heavy duty vehicles

Zero emission mobility with no operation compromise:

Range - Asset Utilization - Payload

1. FCEV powertrains for trucks are cost competitive with BEV from 100 km range

2. Hydrogen refueling is 15 times faster than fast charging
   - After 10 minutes refueling/recharging time
     - 90% for FCEV truck
     - 10% for BEV truck
   - Energy capacity converted to range, km

3. Recharging infrastructure...
   - Requires 10-15x less space
   - Creates flexible instead of peak load

Power to Change the World®
Focus on heavy duty transportation where fuel cells have the best value proposition
Fuel cell value proposition will be strengthened by current transportation technology trends

- Asset utilization is becoming more and more important (less downtime per vehicles)
- Improve data collection and optimization of hybrid powertrain performance
- Battery and fuel cells are the only two zero-emission alternatives today
- Increase range requirement
Fuel cell technology is needed to achieve complete decarbonization of transportation.
Current market trends:
growing interest for heavy duty fuel cell solutions

- Deployment of larger fleets of fuel cell electric vehicles
- Fuel cell trains and trams are now on the tracks
- More OEMs are developing FC trucks and buses
- Growing demand for marine applications
- Energy Utility companies are investing in electro-mobility
- Growing demand for renewable hydrogen driven by industry
- Automotive Supply Chain is investing in fuel cell technology
- Renewable energy is opening a path to low cost green hydrogen
Fuel cell mobility from lab to space to the road....

1839
Sir William Grove invents the first fuel cell

1966
First fuel cell passenger car series - Daimler Necar4 (Powered by Ballard)

2000
Toyota launched Mirai fuel cell car

1950s
General Electric invents PEM Fuel Cell

1993
First fuel cell bus on the road (Ballard)

2014
First fuel cell train and trams on tracks

1960s
First Fuel Cell Vehicle – GM Van

2008
20 fuel cell buses at Winter Olympics (Ballard)

2018
Fuel cell operates for >30,000 hrs in a bus – London (Ballard)

2008
Fuel cell buses at Beijing Summer Olympics (Power by Ballard)

2010
20 fuel cell buses at Winter Olympics (Ballard)

2018
First fleet of fuel cell trucks (500) – Shanghai (Ballard)

Power to Change the World®
Our vision:
We deliver fuel cell power for a sustainable planet
Renewable hydrogen and fuel cell technology will deliver affordable zero emission mobility.
We are vertically integrated from component design to complete fuel cell system integration and services.

<table>
<thead>
<tr>
<th>MEAs and bi-polar plates</th>
<th>4 kW to 20 kW Liquid cooled stacks</th>
<th>400 W to 3 kW Air cooled stacks</th>
<th>4 kW to 50 kW Liquid cooled stacks</th>
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<tbody>
<tr>
<td>Fuel Cell Stacks</td>
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<tr>
<td>Fuel Cell Modules</td>
<td>30 kW</td>
<td>60 kW, 80 kW &amp; 100 kW</td>
<td>100 kW, 200 kW</td>
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<td>Fuel Cell Systems</td>
<td>2 kW to 50 kW Modular solution Indoor (rack-mountable) &amp; outdoor use</td>
<td>600 W to 1200 W</td>
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<td>Customer services</td>
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Ballard in numbers

Our team

650 people

Patents & Applications

2,000

Publicly listed Company

Company

24 years

26 years

4 Strategic shareholders

4 train projects on track

3 ships in development

14 million km of service for modules operating in buses

12,000 Forklifts in operation

>30,000hrs Operation for fuel cell stack in London BUSES

99 (494)* Transit buses in service

300 (903)* Trucks delivering goods

Delivered 850MW of Fuel Cell products

Produced 5 million MEAs

$80m automobile stack development program

Passed 14 million km of service for modules operating in buses

Produced 5 million MEAs

Passed 14 million km of service for modules operating in buses

In construction or commissioning phase

1979-2019

Celebrating 40 years
Fuel cell electric buses have demonstrated performance in service

- More than 15 years of road-experience
- Over 14M km in service
- Bus availability: 85-90%
- FC module availability > 97%
- >30,000hrs stack durability
- Operation in challenging routes and climates
There will be more than 2,000 FCEB on the road by 2020.
500 fuel cell delivery trucks are in operation in Shanghai

- 500 x Dongfeng 7.5T trucks built and licensed
- 30kW Refire power module (Ballard stack) with 9 kg of H2 storage (Furui)
- New Energy Vehicle Subsidy (€150k)
- Hydrogen price @ €5.5.kg
- Trucks are owned by STNE and leased to logistic companies like JD.com
Some of our current fuel cell marine projects

- *HySeas III* hydrogen fueled ferry in Orkney Is, (UK) Ballard fuel cells for primary propulsion (700kW) Fergusson Marine & Kongsberg (18 cars/120 passengers)
- Integration of Ballard’s fuel cell system into Yanmar’s hybrid power train for Japan’s NMRI boat
- *Shippinglab* with Danish shipping industry
  - 300 kW FC in a container for zero emission port stay.
- *Norled Ferry (Norway)*
  - Ferry - 299 passengers and 80 cars
- *Flagship Project (FCH-JU funding)*
  - Ferry (600kW) with Norled - Norway
  - Barge (400kW) with ABB - France
Some of our current fuel cell Rail projects

Development of a new generation of hydrogen powered EMU with Siemens

Development of an Electric or Hydrogen powered EMU (retrofit)

CRRC Tangshan tram in testing

CRRC Sifang tram expected to enter service in 2019
What's next?

2018
- 10,000 fuel cell cars on the road
- 1,000 fuel cell buses and trucks in service

2020
- >350 FCEBs on the road in Europe (JIVE)
- 2,000 fuel cell buses and trucks in Shandong Province (Weichai)
- 100 FCEBs at Tokyo 2020 Olympics

2025
- +600 FCEB on the road in Europe (H2Bus Project)
- 1000 FC trucks in Switzerland
- 1000 FC trucks in Norway
- 1000 FCEBs in Korea (Hyundai)

2030
- 1 million FC vehicles on the road in China by 2030 (China road map 2018)
- 10 to 15 million fuel cell cars and 500,000 trucks on the road (Hydrogen Council vision)

- 50,000 FCVs in service, in China, among which 10,000 units are FC commercial vehicles, and 40,000 units FC passenger cars by 2025 (China road map 2018)

- 40,000 vehicles on the road in Japan (Japan roadmap)

- 5,000 FC vehicles on the road in China by 2020 (China road map 2018)

- 10,000 fuel cell vehicles
- 10,000 Fuel Cell Vehicles
Fuel cell technology is following adoption curves of Solar and Wind.
The vision of the Hydrogen Council is achievable.
We deliver fuel cell power for a sustainable planet

Alan Mace
www.ballard.com