Umstieg auf Nachhaltigkeit erfolgreich gestalten

Transformationsporzesse anhand praktischer Erfahrungen ÖPNV-Anbietern mit Wasserstoffmobilität in Europa

2022

BALLARD™

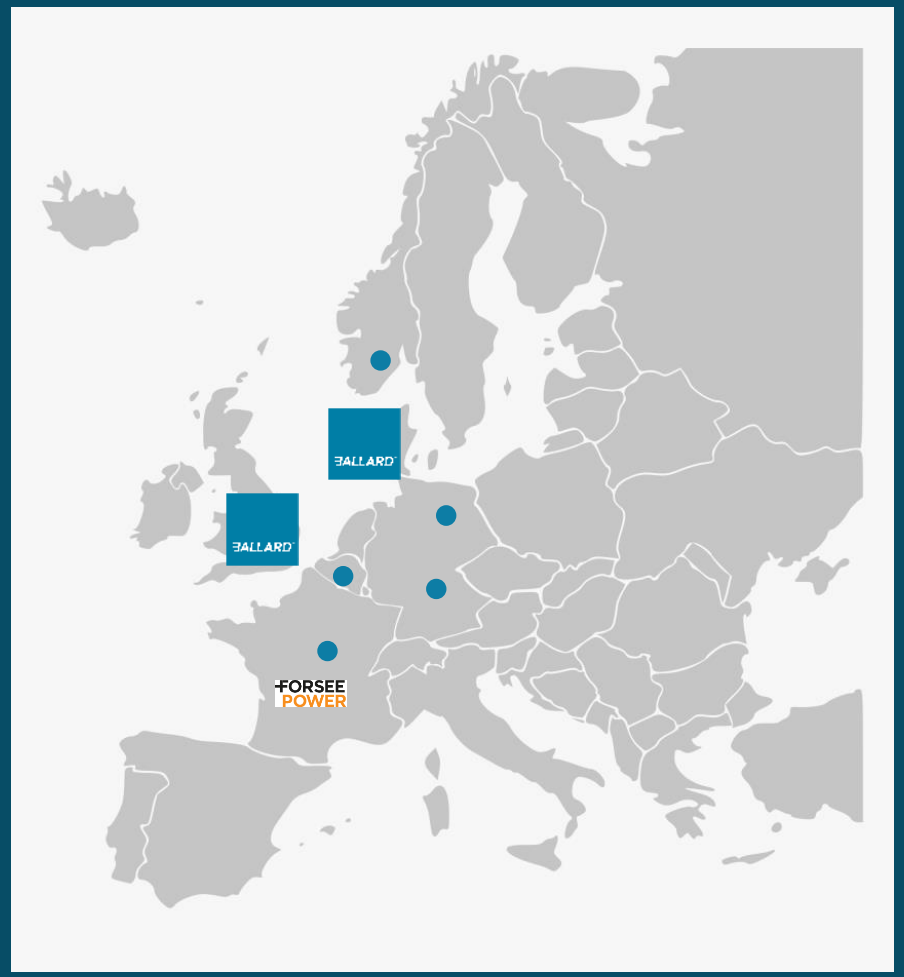
Global fuel cell company

40+ years

1,100+ employees

Technology leadership & customer care

A European company



A strong commitment to Europe supported by investments

- European HQ, **Ballard Power Systems Europe A/S** located in Hobro, Denmark
  - Location of Ballard's Marine Center of Excellence Center
  - Manufacturing capacity of 60 MW/year
  - Local manufacturing of Ballard's fuel cell product's for marine industry (FCwave™) and critical communication infrastructure (FCgen®-H2PM)
- **Ballard Motive Solutions Ltd**
  - Location of Ballard energy system and powertrain integration Center of excellence
- **240**+ employees in Europe dedicated to sales, market development, engineering, manufacturing, service, support and training
- Investment in Forsee Power (France)

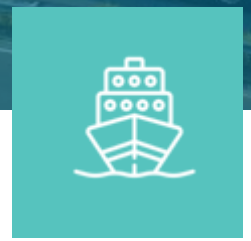
Hydrogen is most competitive in heavy duty motive applications

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

Busses & Coaches

Trucks

Trains



Vessels

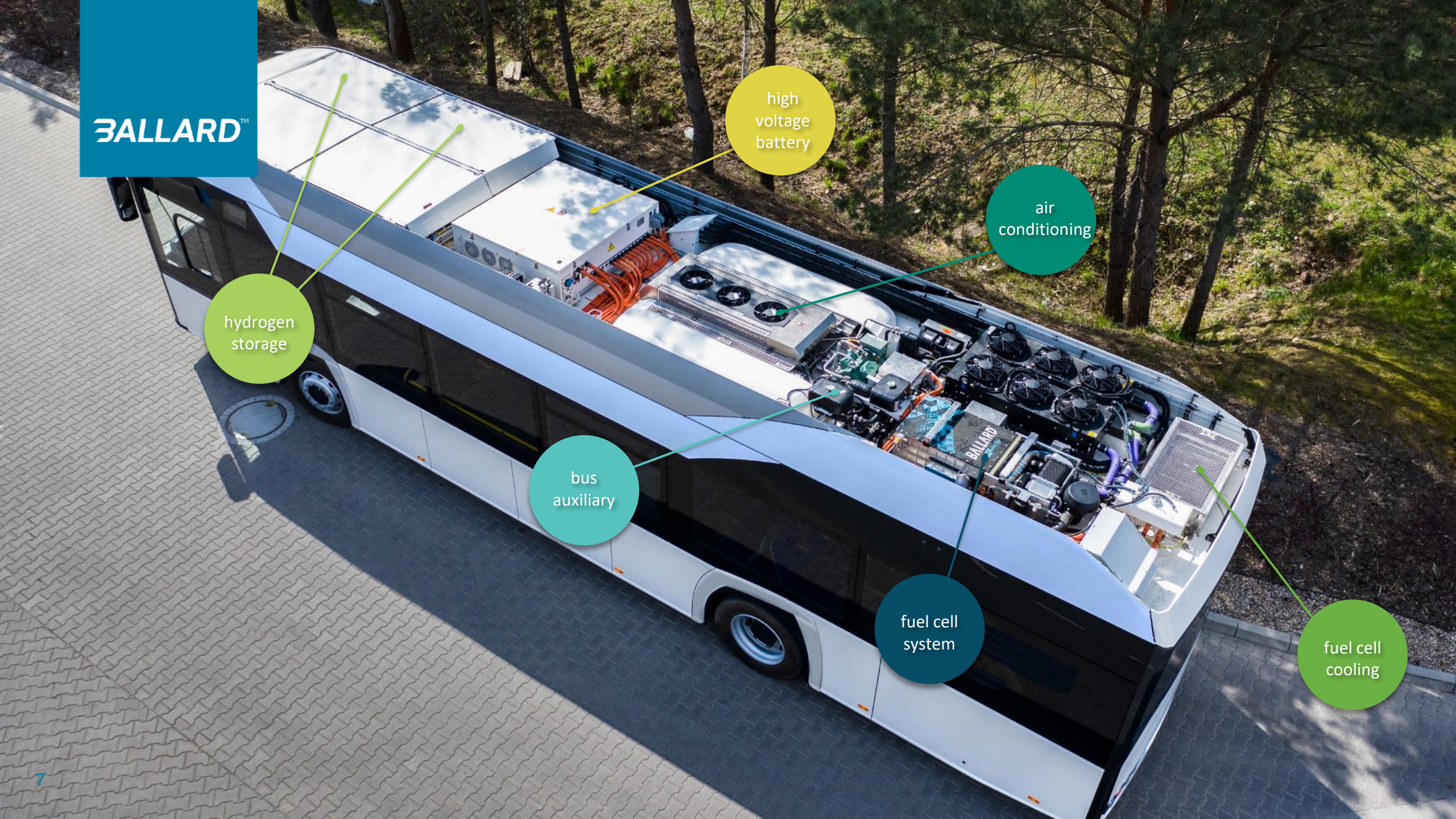
Fuel cell technology is needed to decarbonize the heavy duty transportation sector

Regulations are driving the adoption of zero emission Busses

- Low emission zones and corridors are been implemented in Europe, China and California
- Cities across the world are committed to deploy 100% ZEB fleets
- California Innovative Clean Transit Rule (ICT) is now in place
- China New Energy Vehicle policies support deployment of zero emission vehicles

The future of transit will be electric

- An electric powertrain is the efficient, quiet, zero-emission energy alternative to polluting diesel engines
- Electricity for the electric drive can be supplied from batteries or from an on-board fuel cell power generator or a combination of both – a hybrid architecture


high voltage battery
air conditioning
hydrogen storage
bus auxiliary
fuel cell system
fuel cell cooling

BALLARD™

Fuel cell electric Busses using renewable hydrogen are the most viable, true zero-emission option

Power to maintain speed on most demanding routes

Extended range for route and service flexibility

High energy density to maximize vehicle performance

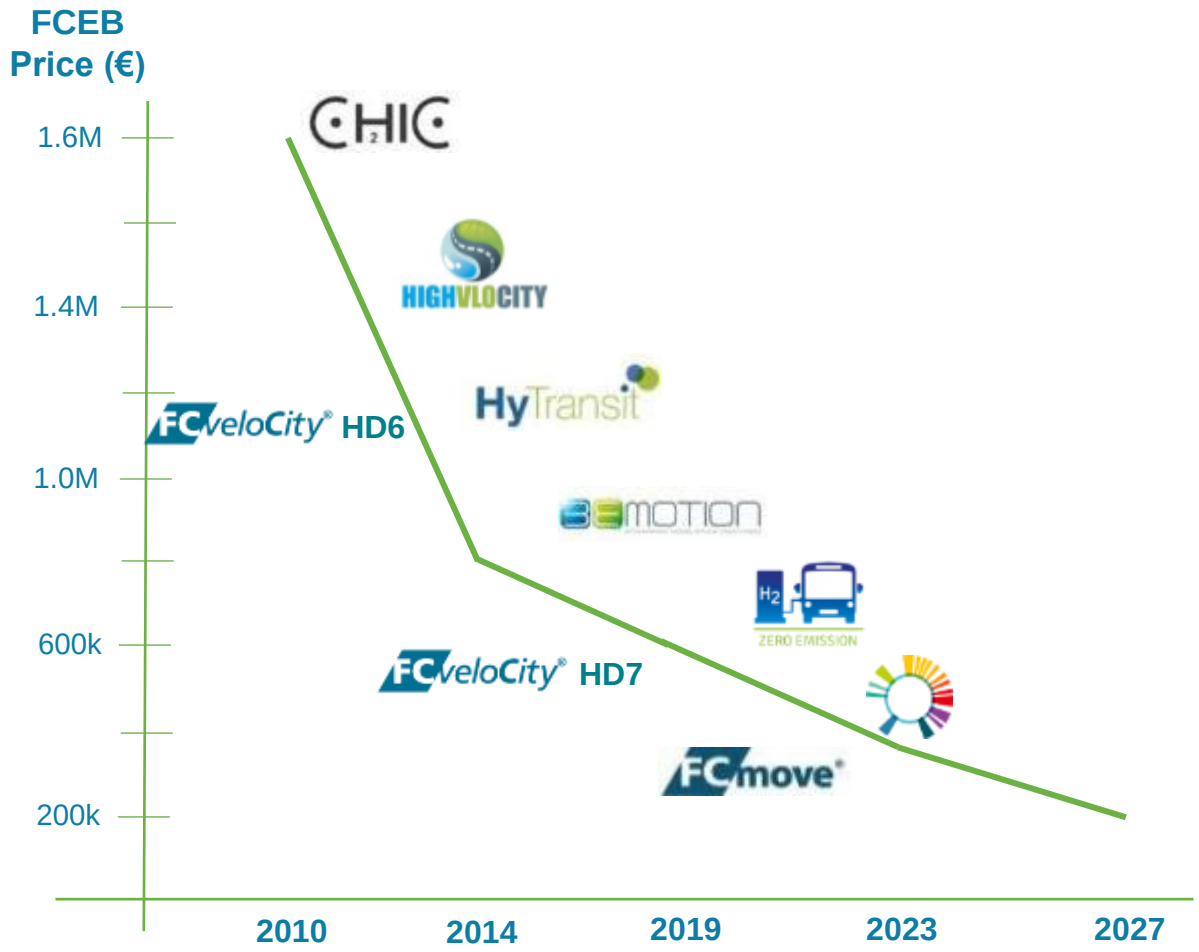
Rapid refueling ensures high utilization with scalable infrastructure

Today there are multiple offering for fuel cell electric Busses bus

Fuel cell electric Busses powered by Ballard

Fuel Cell Competitive Positioning

60% reduction in FCEB price over past 10 years



Key Drivers:

- ✓ Improvements in technology and products led to ~60% FCEB cost reduction in past 10-years (as well as ~50% service & maintenance cost reduction in just the past 5 years)
- ✓ Further lifecycle cost reductions going forward are expected to result from continued product innovation plus increased volumes, leading to –
  - Economies-of-scale in manufacturing (similar to diesel engines)
  - Lower cost of green hydrogen and lower cost hydrogen infrastructure

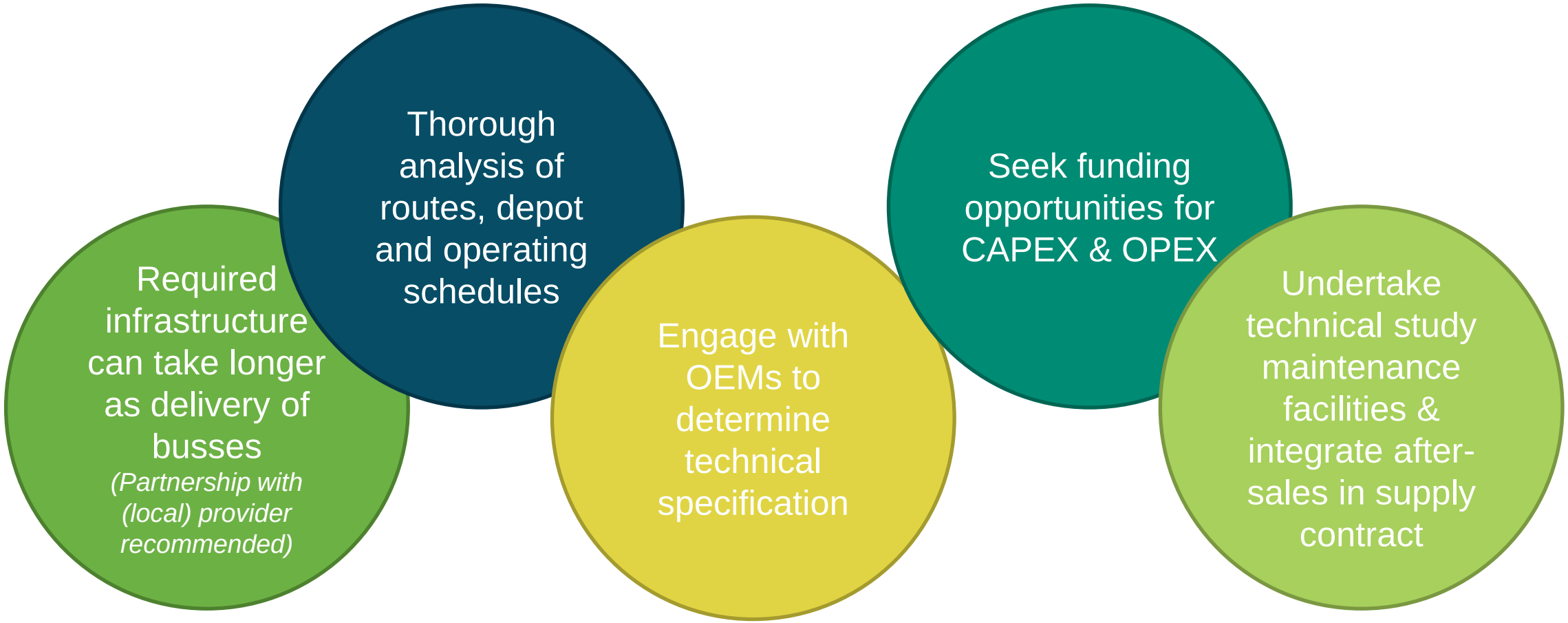
Service and Support

- Joint development with Bus OEMs to ensure optimal integration of technology
- Simulation and modeling software ensures the right fuel cell product is selected, based on vehicle drive cycle and operational requirements.
- Insights from our many years of experience with fuel cell systems to optimize design
- We provide support during powertrain integration, testing, certification and vehicle commissioning
- Our after sales team takes over once the bus is on the road with comprehensive customer care packages including training, onsite assistance, warranty support, diagnostic and spare parts management.

Recommended standardized process to shape transformation to zero emission operations

1. **Route Analysis**
2. **Depot Analysis**
3. **Refueling / Recharging Analysis**
   (+ Further users in vicinity?)
4. **Funding Analysis**
5. **TCO Analysis**
6. **Decision Paper**

Leasons learned from daily operations of over 1,300 Fuel Cell busses globally



Hydrogen is an attractive fuel for transit

Hydrogen offers a simple and fixed price per kg - same price at anytime of the day and of the year

→ **easy to budget operation cost**

From 5 Busses to 100+ Busses per depot with incremental CAPEX investment as fleet grows

→ **fully scalable**

H2 delivery options do not require off-site infrastructure investment (power substation, new power lines, recharging infrastructure…)

→ **faster deployment**

Existing mature supply chain with competitive infrastructure & fuel suppliers

→ **drive cost reduction**

Fuel service providers are offering turn-key supply contracts including operation & maintenance as well as financing for CAPEX equipment

→ **lower risk**

As volume of hydrogen demand and production increase, price is expected be less than **$5/kg**

→ **further reduction of operating cost**

Thank you

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