

**BALLARD™**

# Charging EV Fleets Independent of Grid with Clean Power-On Demand using MW scale PEM FC

Presented by: Roy T. Segev  
Thursday, June 15, 2023, 1:00 pm

Part of  
**THEsmarter**  
EUROPE



**ees**  
electrical energy storage



# Agenda

- About Ballard
- Where is the problem ?
- Why PEM FC most suitable for EV charging ?
- Ballard's EV charging FC options

The Ballard logo consists of the word "BALLARD" in a bold, white, sans-serif font, positioned on a solid blue square background.

## Ballard Power Systems

We are dedicated to accelerate the adoption of fuel cell technology



## Proven

8 MW successfully deployed

Products certified to stationary fuel cell power generator requirements per EU, ATEX and CSA standards

## Performance

99.9% reliability

50% efficiency

Excellent availability

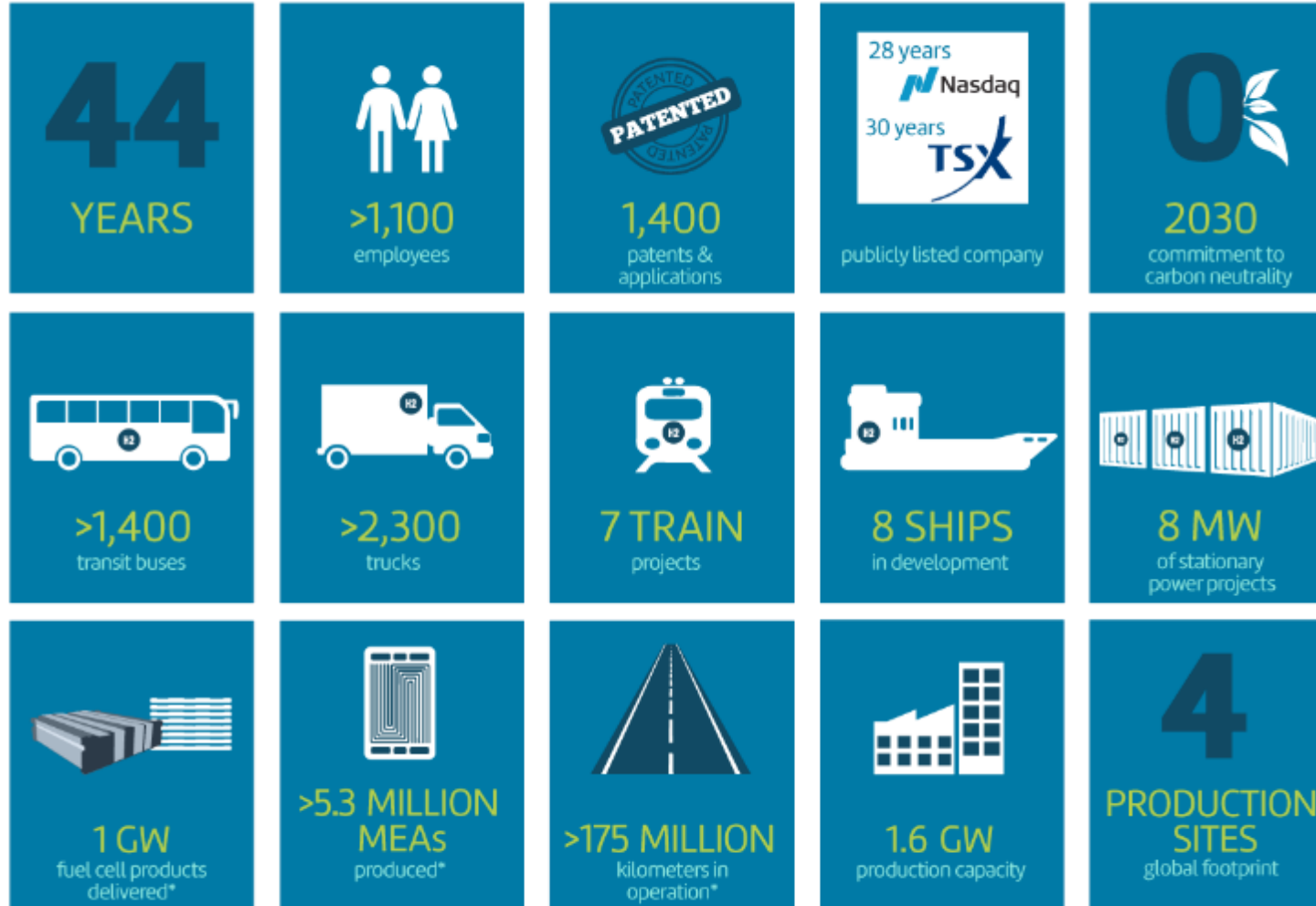
Exceptional durability

## Promise

End to end support throughout the whole customer journey

Sustainable zero-emission solutions from stack supply to turnkey power solution for the end users

# Ballard by the numbers



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Our Markets:

Applications  
powered by Ballard

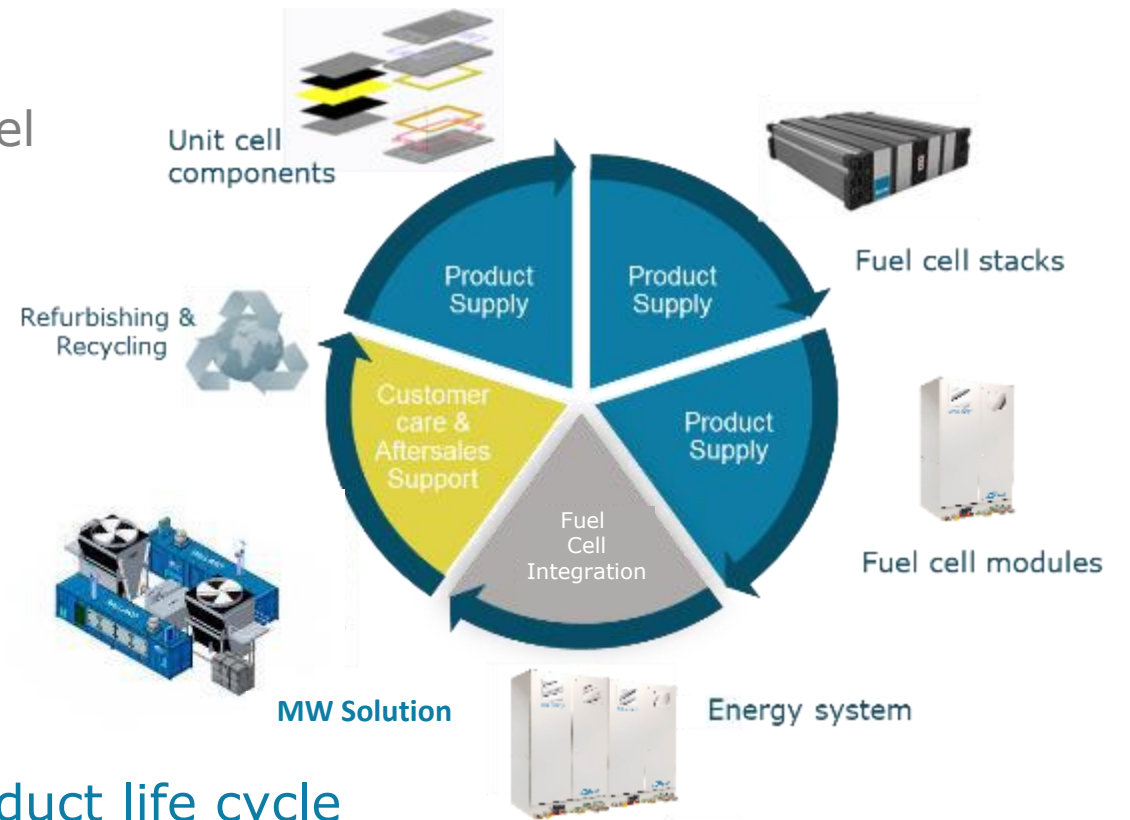


# We are a vertically integrated manufacturer throughout the fuel cell value chain





We design, build and test proprietary core technology components to produce optimized fuel cell products for each application

- Unit cell components (MEAs, plates...)
- Fuel cell stacks
- Balance of plant component integration
- Fuel cell module & system
- Energy systems and powertrain integration

Supporting our customers throughout the product life cycle

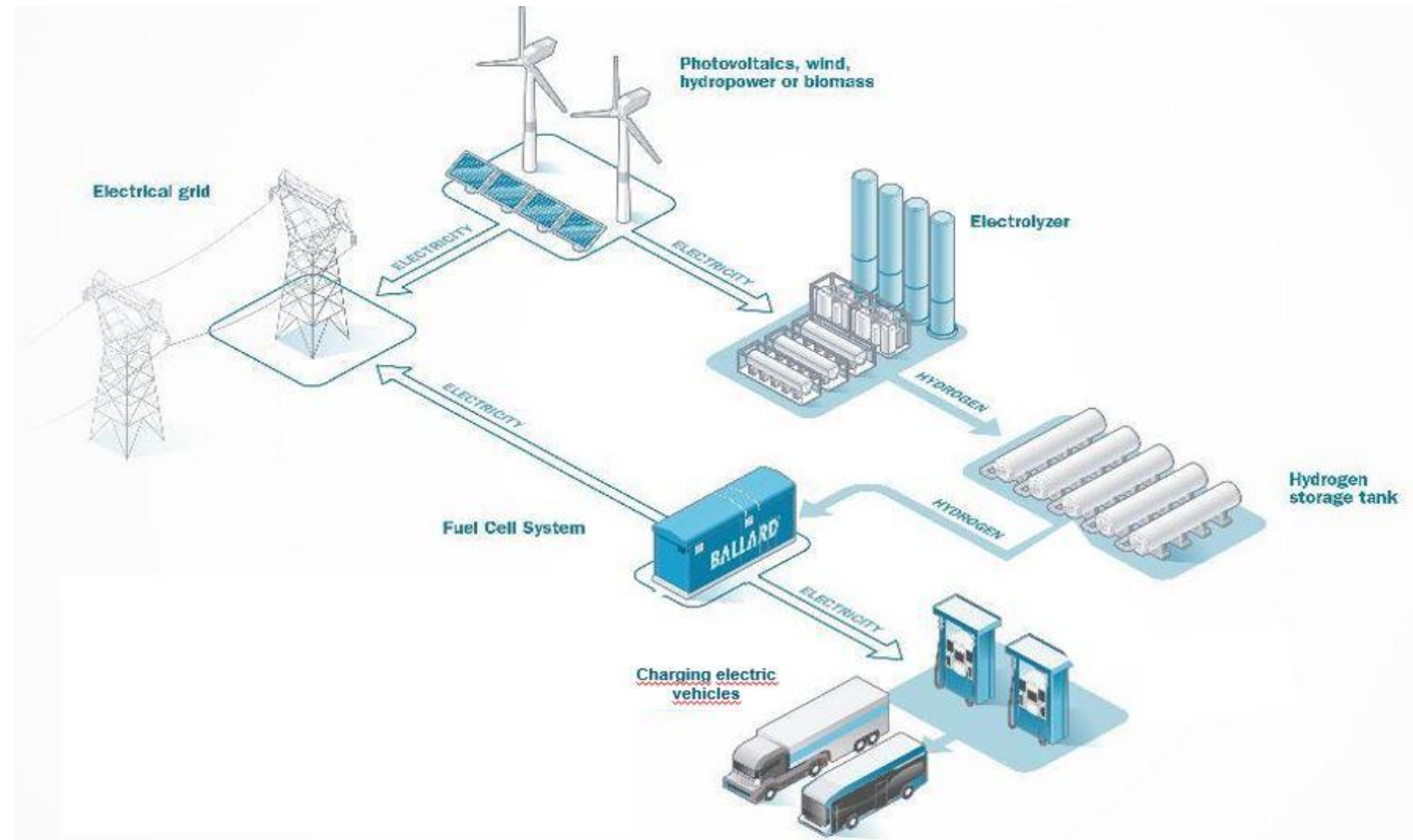


# We have a comprehensive range of fuel cell products to address multiple applications

		Product Line	Specifically designed for the application
From low to high level integration	Fuel cell <b>components</b>	MEAs and bipolar plates	 Buses, trucks, cars
	Fuel cell <b>stacks</b>	Air and liquid cooled stacks from 400W to 140kW	 Mobile (buses, trucks, industrial vehicles, cars) And infrastructure power backup
	Fuel cell <b>modules</b>	Heavy duty power modules from 45kW to 200kW	 Heavy duty mobile (buses, trucks, ships, trains)
	Complete fuel cell <b>systems</b>	Stationary systems from 2.5 to 5kW and 200kW to MW's	 Infrastructure power backup Distributed scalable power generation systems
	Energy <b>System</b>	Controller	Intelligent energy systems for bus & truck powertrain

# Hydrogen is key to the decarbonization of our economy

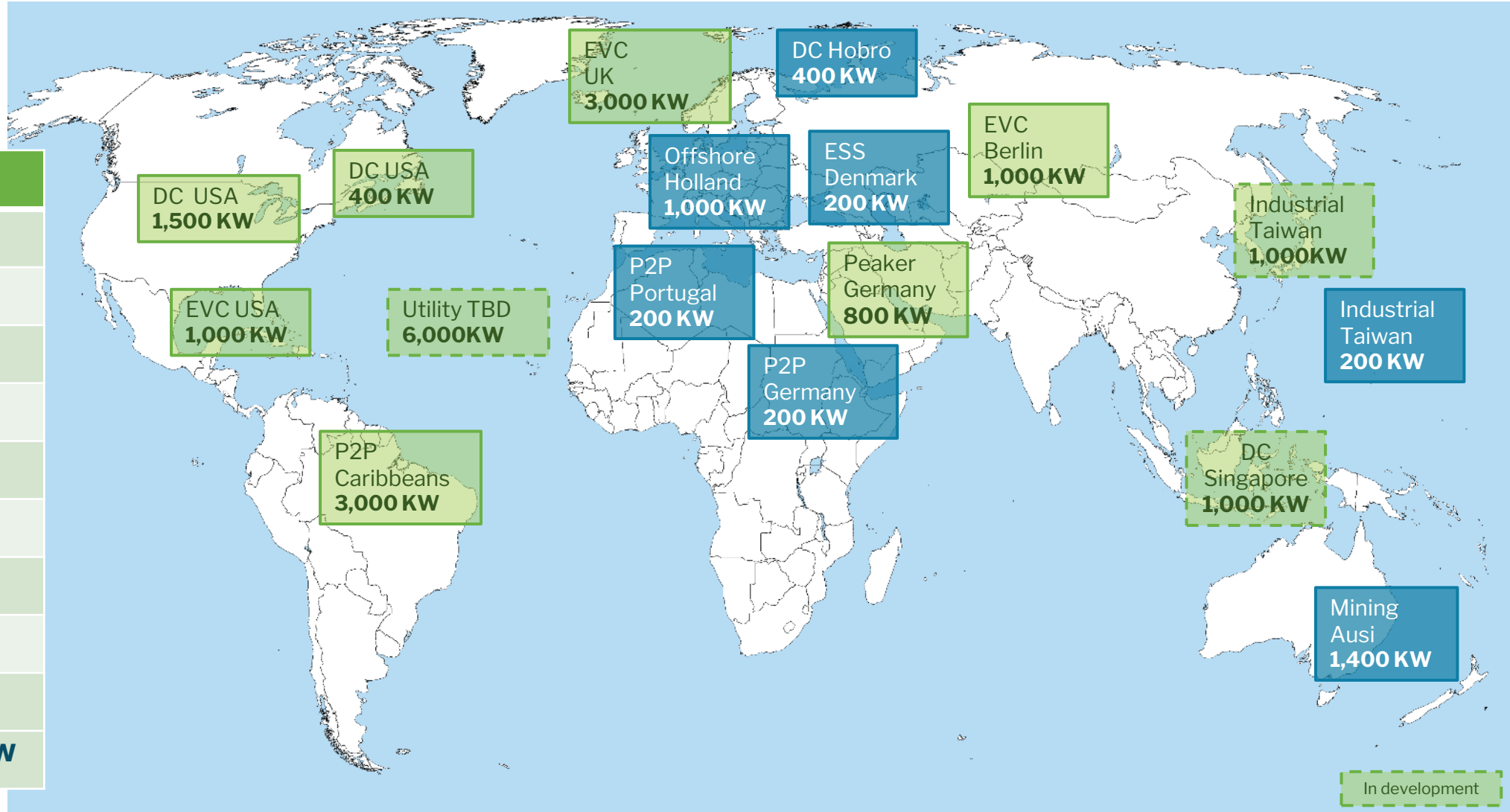
- Hydrogen is the **energy carrier** to decarbonize multiple sectors and change the future industry
- Supported by electrolyzing technology hydrogen is an important **storage solution** for renewable energy that cannot be distributed by the grid
- Hydrogen is a flexible **low or zero carbon fuel** for mobility
- Stationary hydrogen fuel cells provide **energy on demand** for various sectors, e.g., backup power, grid balancing or power to power





# Stationary Business 2022-2023

2022	2023
1,000	6,000
400	3,000
200	1,500
200	1,000
200	1,000
200	1,000
200	1,000
1,400	1,000
	400
	800
<b>3.6 MW</b>	<b>15,7MW</b>

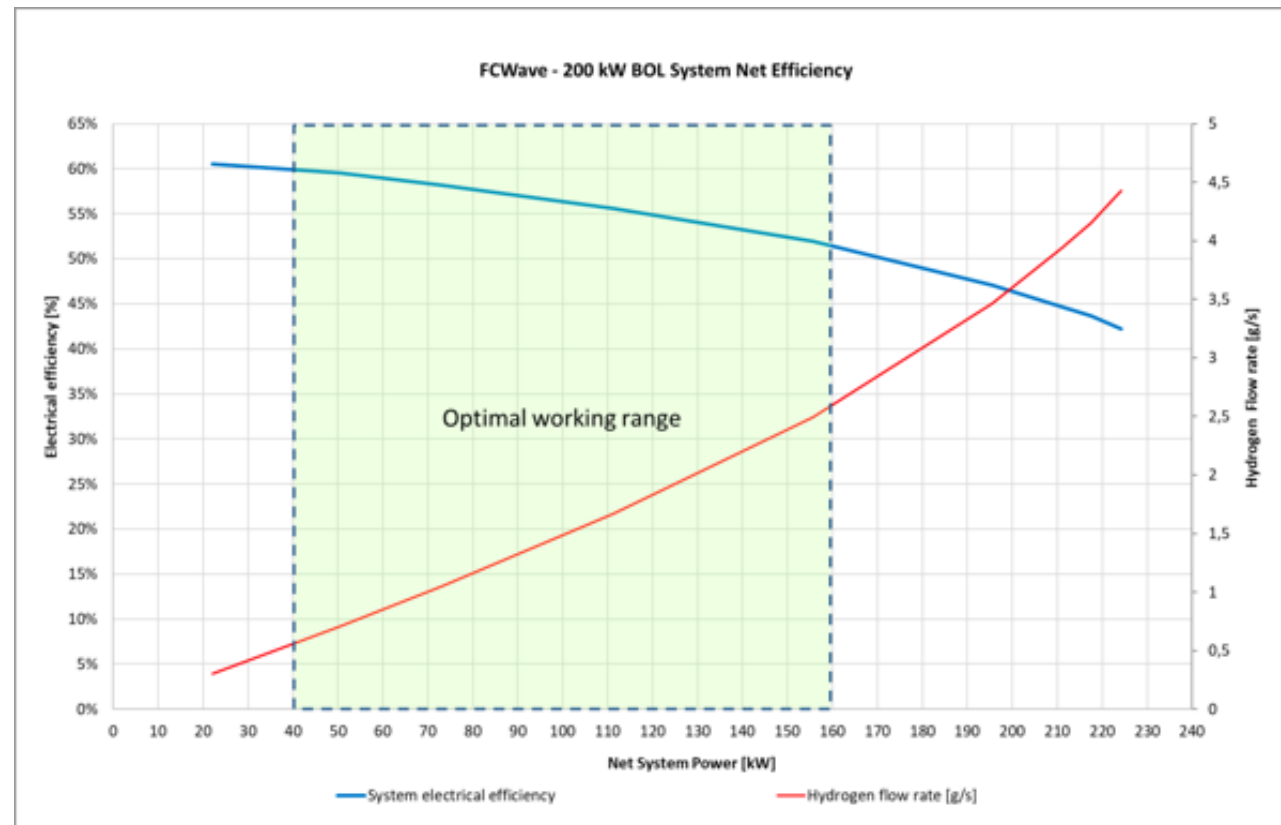


# Why PEM fuel cells for EV charging?

- Using hydrogen fuel cells to fuel EV charging stations will ensure access to zero-emission reliable power for EVs
- Will avoid costly and timely grid delays
- 50-60% efficiency at part power
- Ramp 100% in 10 sec
- Clean DC power 350-720 Vdc
- 96% Recyclable (MEAs)
- 65°C Operating Temperature



Zero Emissions  
 99.9% reliability  
 50% efficiency  
 exceptional durability



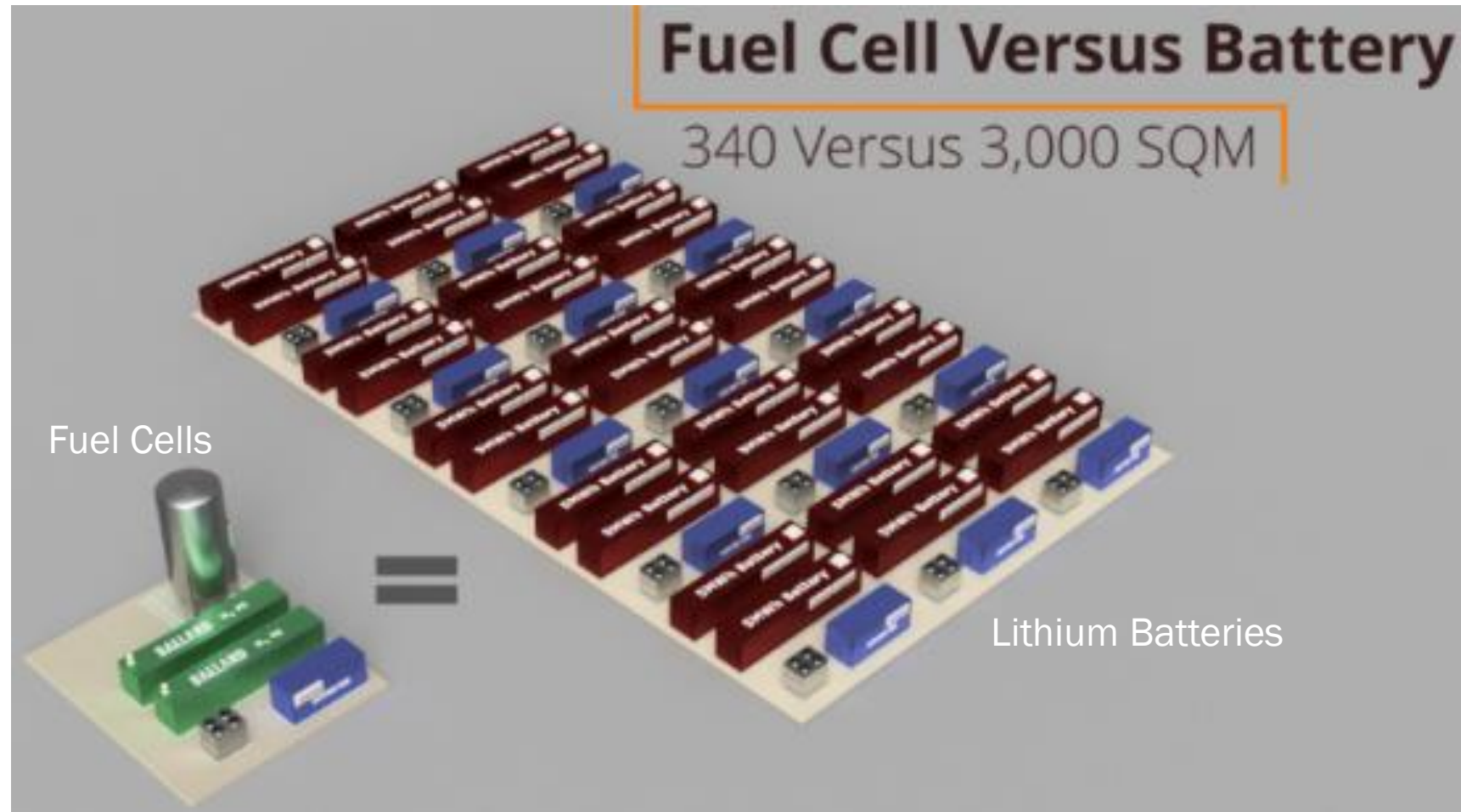
200KW FCwave

## Hydrogen fuel cells for EV charging

- It is estimated that 20-25% of depots don't have sufficient grid power to support the fleet charging!
  - Fedex – 100% of its fleet will become EV by 2040
  - UPS – 10,000 EV as a start
  - DHL – 20% of its fleet already EV
  - Amazon – 100% of its fleet will become EV ~ 100,000 EV
- Price of electricity are highly volatile, makes the economics hard to manage and predict - it's like going to a gas station and it could be 1.80 €/l or 7.50 €/l
- In California, for example, planners expect the transition to EV will require an additional 10-12GW of electric generation. This represents roughly 25% increase relative to the 2019 peak demand of 44GW

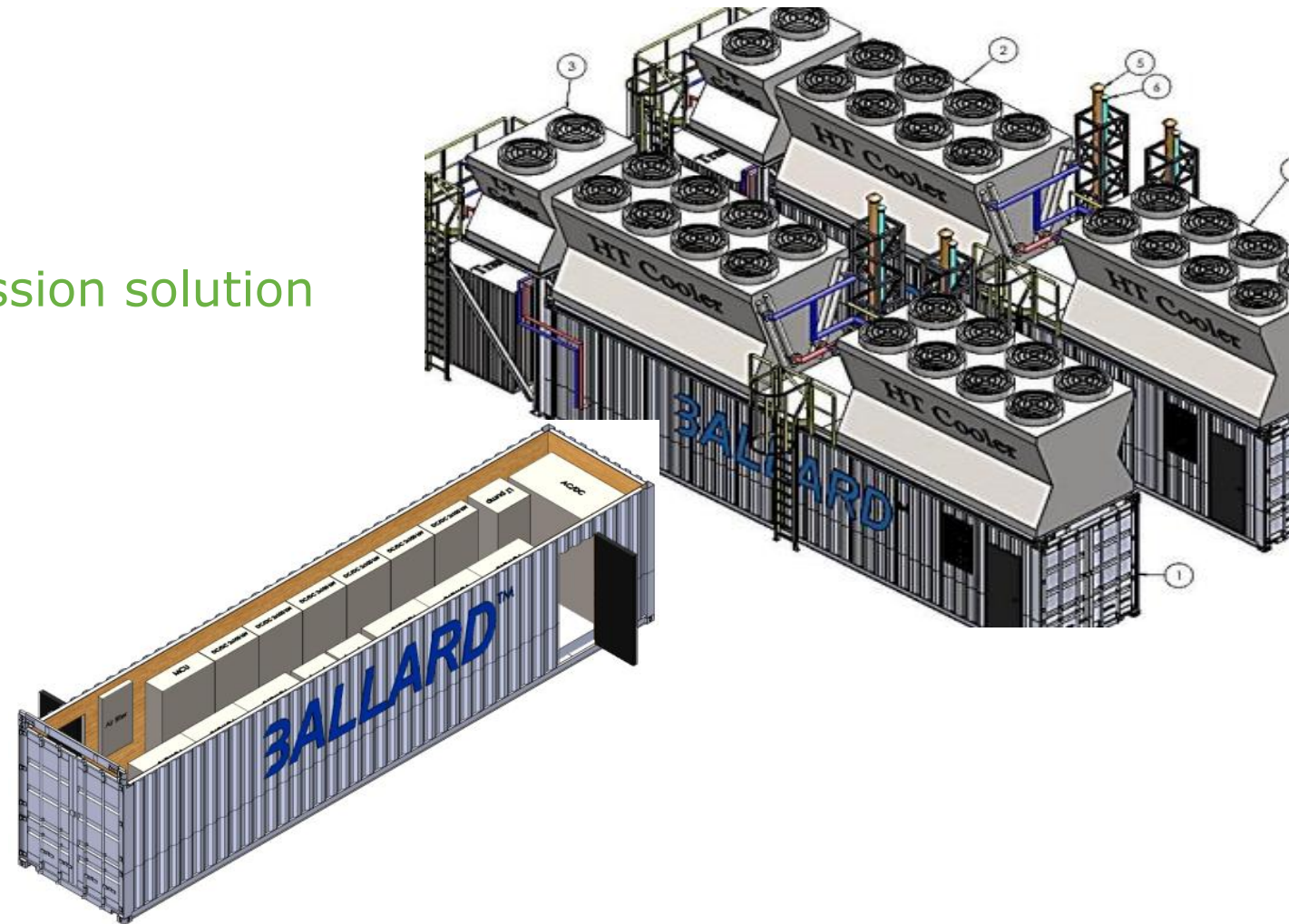


# Fuel Cell vs. Battery 144MWh



## PEM Fuel Cell Value Proposition

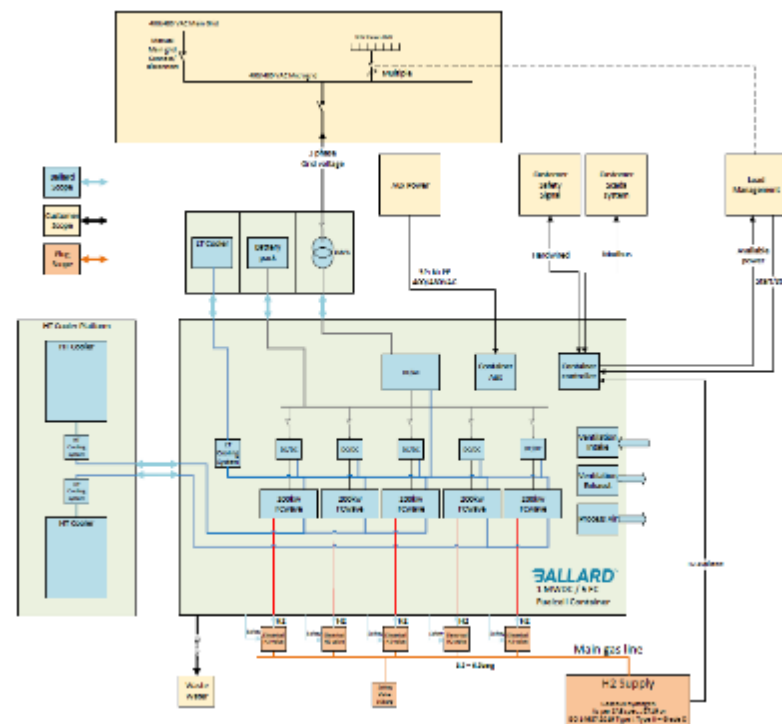
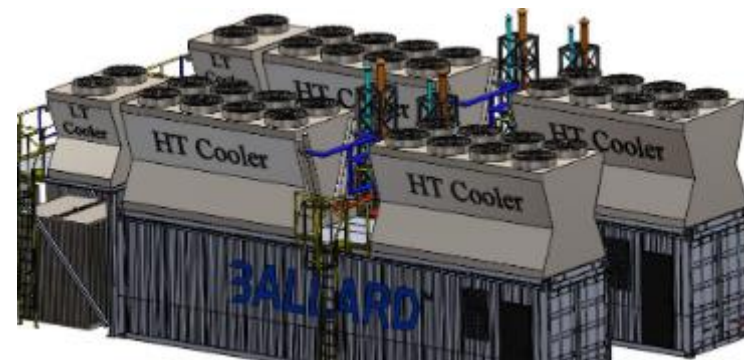
- The Only viable 100 % Zero emission solution
- Smaller footprint than batteries
- Lower CAPEX than batteries



# FCgen<sup>®</sup> MW solution

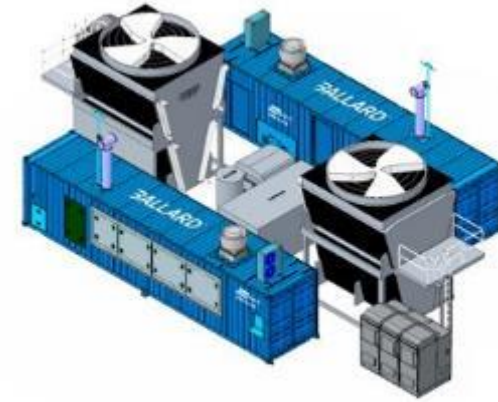
Modular 1MW block containers based on 5\*FCgen for outdoor turnkey installations incl. cooling and power management.

- Short installation time on site (turnkey)
- 36 stacks per MW (96% recyclable stack components)
- Scalability KW/MW
- 9-12 months timeline for delivery
- 6 X 3 humidifier per MW
- 6 X 2 compressors
- Heat management subsystems included
- Battery subsystems included
- Product with full supply Service and spare parts support
- Certified to stationary fuel cell power generator requirements



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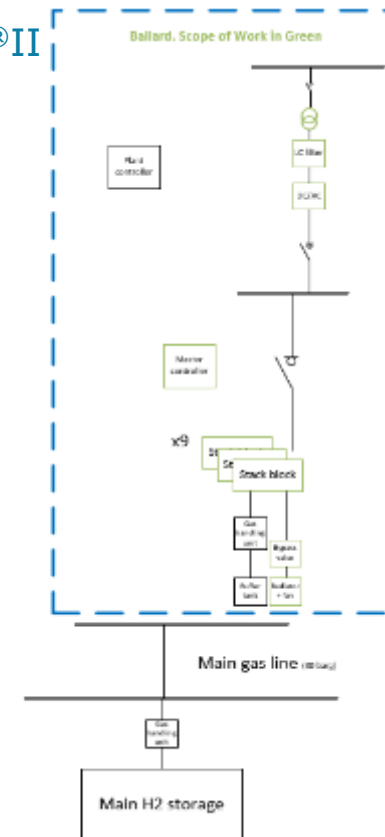
# ClearGen®II



Modular 1.5MW block containers for outdoor turnkey installations incl. cooling and power management.

- Short installation time on site (turnkey)
- 44 stacks per MW (96% recyclable stack components)
- Scalability MW/GW
- ~18 months timeline for delivery
- 1 humidifier per MW
- 2 compressors
- Heat management subsystems included
- New service setup
- Certified to stationary fuel cell power generator requirements

## ClearGen®II 1,5MW





**BALLARD™**

*Here for life™*

Thank you

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