A Leading Company in Fuel Cell Technology

- Built on 20 years of research, IP and patents developed within the Volvo Group
- Established as an independent company in 2008; listed on NASDAQ during 2014
- Strong ownership – Volvo Group, Midroc, Fouriertransform, Finindus
- Unique, patented fuel cell and reformer technologies
- Northern Europe’s largest state-of-the-art fuel cell and reformer laboratories

**Mission**

Our mission is to offer customers efficient environmentally friendly power products and systems with leading fuel cell and reformer technology for existing and future fuel infrastructure.

**Vision**

To be the world's leading innovative fuel cell company by:
- creating value for customers in selected segments
- innovative products and systems for existing and future fuels
- providing efficient products that reduce the environmental impact
PowerCell Product & Prototype Range

- **PowerCell S1**
  - 1-5 kW

- **PowerCell S2**
  - 5-25 kW

- **PowerCell S3**
  - 20-100 kW (prototype)

- **PowerCell PowerPac**
  - 3 kW (prototype)

- **PowerCell PS-5**
  - 1-5 kW

- **PowerCell MS-20**
  - 20 kW (prototype)

- **PowerCell MS-100**
  - 100 kW (prototype)
Fuel Cell Platforms Serving a Wide Range of Applications

- Fuel Cell stack PowerCell S1 (in production)
  - 1-5 kW power
  - Runs on pure hydrogen or reformate
  - Suitable for smaller back-up systems

- Fuel Cell stack PowerCell S2 (in production)
  - 5-25 kW power
  - Runs on pure hydrogen or reformate
  - Suitable for continuous power or back-up solutions
  - Can be operated in multiples for larger systems (MW)

- Fuel Cell stack S3 (in development)
  - 20-100 kW power
  - Runs on pure hydrogen
  - Suitable for propulsion or industrial systems
  - Can be operated in multiples for larger systems (MW)
S2 Designed with Fuel Flexibility & Used in Multiple Applications

- Hydrogen
- Methanol
- Natural Gas
- Biogas
- LPG
- Diesel

- Smart Homes
- Micro-CHP
- Telecom
- Range Extender

Property of PowerCell Sweden AB
PowerCell S3 – Establishes Best-in-Class Power Density

- 20-100 kW power range
- High-quality fuel cell stack for meeting automotive industry requirements
- PowerCell S3 (ASC Evolution 2) - may be the industry’s most advanced!
- State-of-the-art benchmark is 3.1 kW/l (Toyota)

**kW/l-Evo 2**

<table>
<thead>
<tr>
<th></th>
<th>kW/l-Evo 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nissan</td>
<td>2.5</td>
</tr>
<tr>
<td>Honda</td>
<td>3.1</td>
</tr>
<tr>
<td>Toyota</td>
<td>3.1</td>
</tr>
<tr>
<td>S3</td>
<td>3.8</td>
</tr>
</tbody>
</table>
H₂ - Based Power System

- **PS-5**
  - 1-5 kW Net
  - UPS functionality
  - Primarily runs on hydrogen
  - Designed for long-term use
  - Usable heat generated by liquid cooling

- **Module suitable for multiple applications:**
  - Belgium (traffic systems back-up)
  - Germany (telecom back-up)
  - China (micro-grids)
  - Sweden (smart homes)
Smart Home /Off-grid

Powered by solar energy and fuel cells using stored hydrogen
Micro-Grid X00kW Fuel Cell systems

- Micro-grid project:
  - Wallenstam
  - Midroc
  - Vätgas Sverige
  - Västragötalandsregionen
PowerPac: A Complete System for Clean Power Generation

Unique diesel reformer

Diesel based 3kW fuel cell system (prototypes available)

Fuel Cell stack designed for H₂ or reformate gas

PowerCell addresses the market with cost effective power supply solutions using current fuel infrastructure

Property of PowerCell Sweden AB
One million telecom towers are outside of reliable electrical grids and another 200,000 are expected to be added by 2020 (GSMA)

Traditional alternative is a diesel power unit, but global players are under strong pressure to find environment-friendly renewable alternatives

Currently testing together with Vodacom in South Africa and Telia in Sweden
Field test of PowerCell PowerPac B-prototype during 2016
- Up to 90% reduction in fuel consumption (ca 1,800 liters per year)
- Up to 90% reduction of CO₂ emissions (ca 5 tons per year)
- CO, NOx and particulates eliminated
- Opens the door to up new opportunities for PowerPac
Fuel Cells in Electric Power Trains

- FCEV range is a function of \( H_2 \) storage tank only
- Solves the range anxiety issue
- Generates ”free” heat as a by-product, does not need to sacrifice range
- Two fuel cell types are mainly used, PEMFC and SOFC
20kW Range Extender (prototype)

[Diagram showing the components of the range extender: DC/DC converter, hydrogen (H₂) source, and the range extender unit with a car and truck image in the background.]
## PowerCell S3 based 100kW Propulsion system (prototype)

<table>
<thead>
<tr>
<th>Technical target</th>
<th>SHA-100-C</th>
<th>SHA-100-E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cells</td>
<td>335</td>
<td>455</td>
</tr>
<tr>
<td>Max. continuous net power</td>
<td>100 kW</td>
<td>100 kW</td>
</tr>
<tr>
<td>DC net out at max. cont. power</td>
<td>225V, 445 A</td>
<td>332 V; 300 A</td>
</tr>
<tr>
<td>System pressure (at full load)</td>
<td>2.6 bar$_{\text{abs}}$</td>
<td>2.6 bar$_{\text{abs}}$</td>
</tr>
<tr>
<td>Voltage range (Peak Power EOL .. OCV BOL)</td>
<td>184 .. 368 V</td>
<td>250 .. 500 V</td>
</tr>
<tr>
<td>Coolant flow (pump integrated)</td>
<td>150 l/min</td>
<td>150 l/min</td>
</tr>
<tr>
<td>Coolant outlet temperature</td>
<td>80°C</td>
<td>80°C</td>
</tr>
<tr>
<td>Waste Heat</td>
<td>97 kW</td>
<td>82 kW</td>
</tr>
<tr>
<td>System Efficiency (LHV H2 in to DC stack out)</td>
<td>47 %</td>
<td>52 %</td>
</tr>
<tr>
<td>Dimensions (H x W x D) $^1$</td>
<td>630x 750 x 520 mm</td>
<td>750 x 750 x 520 mm</td>
</tr>
<tr>
<td>Weight $^2$</td>
<td>89 kg</td>
<td>98 kg</td>
</tr>
<tr>
<td>Durability (PV-automotive duty cycle)</td>
<td>&gt; 4000 h</td>
<td>&gt; 5000 h</td>
</tr>
</tbody>
</table>

1) Not included: brackets, covers, heat shields, coolant reservoir
2) All included (but Radiator and DC/DC converter not within system content)
Thank You for Your Attention!

PowerCell, a Leading Fuel Cell Company

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