RE-FIRE TECHNOLOGY INTRODUCTION

Hydrogen Fuel Cell

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In recent years, hydrogen has been in the spotlight around the world as a clean, safe and versatile energy carrier.

The hydrogen mobility market is ready to scale up - a few global OEMs have advanced the technologies to maturity through passenger vehicle application; meanwhile, the shift to apply fuel cell technologies on commercial vehicles has gathered attention globally.

In China, fuel cell vehicle development has seen an important window of opportunity. Government policy guidelines such as “Made in China 2025”, “National Strategy Innovation Driven Development Outline”, “Innovation Plan for Energy Technology Revolution (2016-2030)” and “Fuel Cell Vehicles Development Roadmap” are a few examples published in the last few years, bolstering the momentum to commercializing fuel cell vehicle technology to unforeseen heights.

By promoting commercial vehicles, the early customer adoptions will gradually drive the construction of refueling infrastructure and the improvement of fuel cell vehicle technologies.

The commercial deployment of hydrogen fuel cell technologies in the transportation sector present a potential to lead the paradigm shift in the global energy transition - toward a cleaner, better, sustainable future.
RE-FIRE TECHNOLOGY COMPANY INTRODUCTION

In 2014, Re-Fire was founded with the vision to commercializing hydrogen fuel cell technologies by building value chain and bringing fuel cell products to market. We believe in the positive impact the hydrogen economy will bring to our environment, and we are committed on this path to reinvent the evolution of fuel cell application through innovation and engineering excellence.

Re-Fire is a market leader on fuel cell engines and fuel cell vehicle (FCV) powertrain engineering. By April 2019, Re-fire completed over 40 FCV prototypes with more than 40 vehicle OEMs partners, such as FAW, Dongfeng, Yutong, and Zhongtong. At present, more than 50 percent of all operating FCV in China are equipped with Re-Fire fuel cell engines inside.

Re-Fire currently employs about 400 people, of which PhDs and Masters degree holders account for 40 percent of the research and development (R&D) team. The core team members have 10 to 18 years of experience on fuel cell engine and FCV powertrain engineering. We maintain a growing portfolio of international patents, and our development efforts follow the standardized automotive processes.

While product engineering, validation and prototyping are centered in Shanghai, mass production takes place in Re-Fire factories, including a first-of-its-kind fuel cell engine factory in Yunfu city, Guangdong province. Commissioned in July 2017, the Yunfu factory is now able to produce 5,000 units of engines per year; if required, the production capacity is expandable to 20,000 units yearly. To safeguard the FCV operations, dedicated Re-Fire after-sales service centers and telematics big data platform are in-place 24/7 to track the real-time status of the vehicles and to provide preventative maintenance services to our customers.

Over the years, Re-Fire joined force with top universities, such as Beijing Institute of Technology, Tongji University, and other international institutes to implement pioneering research programs through our joint laboratories.

In March 2018, Re-Fire was appointed to chair the Fuel Cell Association of China Power Battery Industry Innovation Alliance under the guidance of the Ministry of Industry and Information Technology (MIIT). In May 2018, Re-Fire was the first company chosen for the Fuel Cell Industry Whitelist by the China Association of Automobile Manufacturers (CAAM). In June 2018, Re-Fire became a member of the Hydrogen Council.
FUEL CELL ENGINE

Re-Fire currently has a three proprietary fuel cell engine models designed for commercial vehicle applications.

1. **CAVEN 3** - 32kW Fuel Cell Engine

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Power</td>
<td>32 kW</td>
</tr>
<tr>
<td>Dimension (L<em>W</em>H)</td>
<td>890<em>480</em>375 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>135 kg</td>
</tr>
<tr>
<td>Peak Efficiency</td>
<td>55 %</td>
</tr>
<tr>
<td>Durability</td>
<td>≥ 12,000 hr</td>
</tr>
<tr>
<td>Freeze Start</td>
<td>-30°C</td>
</tr>
<tr>
<td>IP Rating</td>
<td>IP67</td>
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</tbody>
</table>

*In serial production*

2. **CAVEN 4** - 46kW Fuel Cell Engine

<table>
<thead>
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<th>Specification</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Rated Power</td>
<td>46 kW</td>
</tr>
<tr>
<td>Dimension (L<em>W</em>H)</td>
<td>926<em>550</em>408 mm</td>
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<tr>
<td>Weight</td>
<td>160 kg</td>
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<tr>
<td>Peak Efficiency</td>
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</tr>
<tr>
<td>Durability</td>
<td>≥ 12,000 hr</td>
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<tr>
<td>Freeze Start</td>
<td>-30°C</td>
</tr>
<tr>
<td>IP Rating</td>
<td>IP67</td>
</tr>
</tbody>
</table>

*In production 3Q 2018*

3. **CAVEN 7** - 80kW Fuel Cell Engine

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Rated Power</td>
<td>80 kW</td>
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<tr>
<td>Peak Efficiency</td>
<td>60 %</td>
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<tr>
<td>Durability</td>
<td>≥ 12,000 hr</td>
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<td>Freeze Start</td>
<td>-30°C</td>
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<tr>
<td>IP Rating</td>
<td>IP67</td>
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</tbody>
</table>

*In production 2020*
BALANCE OF PLANT (BOP) COMPONENT DEVELOPMENT

On engine BOP components, Re-Fire has been developing proprietary Fuel Cell Vehicle Control Unit (VCU), Fuel Cell Control Unit (FCU), and Hydrogen Management System (HMU) with the standardized automotive development and product validation processes.

MASS PRODUCTION

Re-Fire fuel cell engines are designed, engineered, validated, and prototyped in Shanghai. Engine production currently takes place in our factory in Yunfu city of Guangdong province.

Commissioned in July 2017, the production factory is the first-of-its-kind in China with a phase one capacity of 5,000 units of fuel cell engines per year.

The factory is equipped with digitalized manufacturing processes and advanced quality management systems to ensure the processes are in check to deliver excellent products to our customers.
By the end of April 2019, Re-Fire has completed the integration of 40 fuel cell commercial vehicle prototypes and 4 fuel cell passenger vehicle prototypes.

**MARKET DATA**

- **2016**
  - Completed 2 prototype Vehicle Integration projects
  - Supplied 15 units of Fuel Cell Engines

- **2017**
  - Completed 14 prototype Vehicle Integration projects
  - Supplied 550 units of Fuel Cell Engines

- **2018**
  - Completed 30+ prototype Vehicle Integration projects
  - Supplied 1000 + units of Fuel Cell Engines
In September 2016, the first hydrogen fuel cell public transportation fleet in China consisting of 12 11-meter buses was launched in Foshan city of Guangdong province. Re-Fire was in charge of the design and integration of the fleet’s powertrain and control systems. The total combined service mileage for this fleet of buses has now surpassed 540,000 kilometers.

In 2017, 530 7.5 tonne delivery trucks, equipped with Re-Fire’s CAVEN 3 fuel cell engines, were delivered to our customers. Of the 530 delivery trucks, 25 are being operated in Foshan city for e-commerce packages and local produce delivery, 5 are being operating in Shiyan city, the remaining 500 fuel cell trucks are being deployed in Shanghai.

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MARKET PERFORMANCE

Approximately 1,500 fuel cell commercial vehicles were deployed globally in 2017; of which the Chinese market accounted for 1,272. This number has risen to more than 1,600 in 2018.

At present, more than 50% of all operating fuel cell commercial vehicles in China are equipped with fuel cell engines and powertrain solutions provided by Re-Fire.

By April 2019, 20+ e-commerce logistics and distribution companies in China have integrated Re-Fire powered zero-emission, long-range, high-load ratio fuel cell logistics vehicles to their delivery service fleets. The total fleet mileage accrued from January 2018 has exceeded 7,000,000 kilometers.
Re-Fire’s subsidiary company, Shenzhen Suyun Technology Co., Ltd. builds and manages a cloud-based telematics monitoring platform to enable the real-time data tracking capability of powertrain and vehicle components for all Re-Fire fuel cell vehicles deployed in the field. This data package is available to fleet operators as an added service option.

Furthermore, information about partnering refueling stations are also collected through the platform to better serve our end users. To name a few, current hydrogen price, nearest stations, the maximum driving radius relative to the closest refueling point are among the features displayed through an mobile app on drivers’ end.

IN 2018, Re-Fire initiated fuel cell powertrain after-sales services to safeguard the FCV operations, dedicated service center locations and telematics big data platform are in-place 24/7 to track the real-time status of the vehicles and to provide preventative maintenance services to our customers.
2015
Re-Fire’s first fuel cell UAV took flight.

2016
China’s first fuel cell bus fleet integrated by Re-Fire deployed in Guangdong;
Re-Fire released the first fuel cell engine CAVEN 3 for commercial vehicle application.

2017
China’s first fuel cell engine mass production factory commissioned by Re-Fire;
530 fuel cell vehicles equipped with Re-Fire fuel cell engines delivered to customers.

2018
Established China’s first fuel cell vehicle operation and maintenance service system;
China’s first dedicated fuel cell vehicle aftersales service centre built and operated by Re-Fire to support the fuel cell delivery trucks in Shanghai;
Re-Fire was appointed the Committee Chair for Fuel Cell Committee of China Power Battery Industry Innovation Alliance under the guidance of the Ministry of Industry and Information Technology;
Re-Fire named one of China’s first fuel cell White List companies by China Association of Automobile Manufacturers;
A member of the Hydrogen Council.
FUEL CELL
Committed to commercializing fuel cell technologies for a better future.

Our Vision

Bringing Fuel Cell Applications to Life

Creating a Sustainable Future