High Energy Density Fuel Cell Systems:
Up to 8 times higher than existing battery technologies

PARC and its partners are developing a reformed hydrogen fuel cell power system that could yield energy storage densities at least 8X those of existing rechargeable batteries such as Lithium ion, and up to 4-5X that of current state-of-the-art fuel cell approaches.

With their significantly higher energy storage densities, fuel cells open up opportunities in a wide range of markets such as:

Portable consumer electronics – The increased power of today’s mobile electronic devices has led to greater energy demands and much shorter run-times between recharging (charging itself takes 2-3 hours).

Stationary energy generation – While solar power may enable grid-connected and off-grid energy generators, this is not sufficient for the extensive power demands of commercial or military sensing equipment such as that used for environmental monitoring in remote areas.

Auxiliary power – APUs for commercial trucks and recreational vehicles needlessly consume extra energy when idling and emit greenhouse gases.

Yet despite the progress made to date, a robust, reliable, and fully integrated fuel cell power system that can realize the performance required for a variety of applications has remained elusive.

The solution is a reformed hydrogen fuel cell power system that yields higher energy storage densities.

Key Features:

- Novel radial design minimizes pressure losses
- 10,000+ hours lifetime with minimal performance degradation
- Requires minimal startup time and can be easily transported or refueled at the point of use
- Is orientation independent

PARC’s partner for this application, Lehigh University, has already demonstrated micro-reactor reforming technology that converts 98% methanol (a promising fuel due to the ease of reforming it at relatively lower temperatures) to hydrogen. The proprietary radial flow micro-reactor reformer design is key to providing the 18-20X improvement in throughput versus pressure-drop performance – improving overall system power density by an order of magnitude.

The reformer also enables unique integration approaches with high-temperature (up to 200 °C) PEM fuel cells. These cells have significant advantages over traditional Nafion®-based designs due to their higher CO tolerance and simplified water management (producing steam and no liquid water).

The overall system will be a hybrid fuel cell – battery system that satisfies the startup and fast response required for peak load / varying power demands. It can be implemented to the optimal breakdown of system weight and size, depending on application.

We are interested in partners who have entrenched investments in fuel cell technologies, or would like to bring to market alternative energy approaches.
References


Additional Resources


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from RESEARCH to MARKET

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**Technology** | **Energy storage**
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Ni / Cd battery | 60 WH/kg
Ni/metal hydride battery | 65 WH/kg
Li/LixMn2O4 battery | 130 WH/kg
LiC6/LixCoO2 battery | 90 WH/kg
Future battery technologies | up to 275 WH/kg
**Our reformed fuel-cell technology** | 800-1000 WH/kg base level and up to 1500+ WH/kg (with system integration and optimization)

Demonstrated performance of the methanol-reforming radial microreactor [1]