

## Introduction

Plasma Kinetics will enter commercial markets with a technology which rapidly collects and safely stores hydrogen. This follow-on technology, from a U.S. Department of Defense application, captures hydrogen, stores it for long periods, and releases it for stationary and transportation applications.

Plasma Kinetics proprietary nano-photonic material absorbs hydrogen at standard atmospheric pressure and temperature. The material absorbs metric tons of hydrogen in minutes. Hydrogen is released by controlled light at 99.99+% purity.

Plasma Kinetics employs a layered nano-photonic structure with proprietary shape memory alloy that interacts with light. Individual layers are only angstroms thick, and nanolithography provides surface structures which support release of hydrogen with light.

Planned introduction of 19L containers with 500 g of H<sub>2</sub> for mobile applications (aircraft, vehicles, and boats) and containers of 67 m<sup>3</sup> and 76 m<sup>3</sup> will have 500 kg and 1000 kg of H<sub>2</sub>. The large containers are used for hydrogen production, storage, and delivery to stationary or large mobile (ship and rail) applications. The technology is zero-carbon, reusable, and recyclable.

Plasma Kinetics captures gas from smokestacks. Hydrogen is extracted from the gas and stored in solid form. Carbon free capture lowers green-house-gas and produces hydrogen. Plasma Kinetics technology also captures green solar-to-hydrogen or wind-to-hydrogen from electrolysis without pressure.

Storage is 30% lighter, 7% smaller, and 17% less expensive than Lithium-ion battery per kWh. Plasma Kinetics Energy Systems are heavier and larger than compressed gas above 350 bar. Plasma Kinetics technology is more ecological and economical than compressed H<sub>2</sub> without needing reforming energy, pump energy, pressure or carbon-fiber tanks.

Plasma Kinetics technology does not require a compressed gas infrastructure to produce, move, distribute or deliver hydrogen. 19L containers provided at convenience stores allow customers to return empty containers in exchange for recharged containers. Non-flammable hydrogen storage allows transported via air, truck, rail, or ship without restriction. Swapping containers takes less than 5 minutes and recharging of containers takes 5 to 30 minutes. Vehicles and aircraft can be hot-swappable (without engine shut-off) to allow more time on the road or in the air.

## Plasma Kinetics Figures of Merit

- ✓ Safe, non-flammable, hydrogen storage in dense solid form.
- ✓ No energy or pressure required to collect and store zero-carbon hydrogen.
- ✓ Nanophotonic structured film material recharges through 150 cycles and is fully recyclable.
- ✓ No pipelines or fixed structure pumping stations required.
- ✓ Materials are non-toxic and elements are readily available worldwide.

### Comparative Storage Technologies

Plasma Kinetics hydrogen storage is a reversible solid-state which differs from compressed, liquid and metal hydride storage systems.

Green plants use chlorophyll to store light energy in a process called photosynthesis. The central atom of chlorophyll is magnesium. Magnesium is used in both Plasma Kinetics energy storage systems and metal hydride storage systems. Plasma Kinetics storage interacts with light. Metal hydrides do not interact with light. The table below demonstrates differences between Plasma Kinetics and other hydrogen storage methods.

Storage/Feature	Plasma Kinetics	Compressed	Liquid	Metal Hydride
Temperature $K_d$	25°C	25°C	-252.87°C	175+°C
Pressure $K_d$	1 bar	350-700 bar	1 bar	20 bar
Energy $K_d$	0.05 kWh/kg	1.8-6.5 kWh/kg	11.5 kWh/kg	10.4 kWh/kg
Temp/Press stored	25°C/1 bar	25°C/350-700 bar	-252.87°C/1bar	25°C/1 bar
Temperature $\alpha$	25°C	25°C	-252.87°C	287+°C
Energy $\alpha$	8.6 kWh/kg	0 kWh/kg	0 kWh/kg	24.4 kWh/kg
Energy Total	8.7 kWh/kg	1.8-6.5 kWh/kg	11.5 kWh/kg	34.8 kWh/kg
Storage Rate	1 kg/min	1 kg/min	1 kg/min	0.1 kg/min
Flammability	Non-Flammable	Flammable	Flammable	Flammable
Explosive in air	Non-Explosive	Explosive	Explosive	Non-Explosive
Stored Molecule	MgHX Hybrid	H <sub>2</sub> Covalent	H <sub>2</sub> Covalent	MgH <sub>2</sub> Covalent

### Excitement

- Large Volumes of hydrogen produced daily (metric tons): from low-cost distributed sources of hydrogen (wastewater treatment, incineration, flue gas, bio-gasification) without energy and without signification infrastructure and **without producing carbon dioxide**.
- **Produces no carbon dioxide** which is unlike other processes such as steam reformation of natural gas. Can make a solar-to-hydrogen and wind-to-hydrogen greener and more efficient by integrating electrolysis and removing the requirement to compress or liquefy hydrogen.
- **Light weight, no pressure, and non-flammable**

Plasma Kinetics is poised to offer one of the safest and cleanest round-trip energy solutions.

## **Sales and Market Introduction**

Plasma Kinetics anticipates starting public sales in the fourth quarter of 2021, with deliveries in the second quarter of 2022. Plasma Kinetics is developing relationships and partnerships for delivery of commercial applications. Consideration, feedback and collaboration on hydrogen opportunities or solutions would be appreciated. Plasma Kinetics wishes to understand the needs of the market and how to provide optimal solutions that support clean energy customers.

## **Contact**

Please contact Plasma Kinetics to arrange an introduction to economical solutions for clean energy. Please provide background on you company and the nature of your interest in Plasma Kinetics hydrogen solutions. Be aware that an ITAR (International Trade in Arms Regulations) screening questionnaire and PIA (Proprietary Information Agreement) may be required before initiating discussions. If your company is located outside of the United States, then please provide the name and address of the closest U.S. diplomatic post when contacting us.

Kind regards,

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