H2 TECHNOLOGY WHITE PAPER

WATER TO HYDROGEN - INTRODUCTION ONLY

Technology is still under research and development
Not yet commercialized, expected by third quarter 2021

Aria Global Ventures in JV with H2 Fuel Technology Desennvolvimento Tecnologico De Energia Spe Ltda Brazil

OUR OBJECTIVE

With **H2** highly disruptive green energy solution many energy and environmental problems around the world can be solved while working towards the goal of a zero carbon global footprint. Our water to hydrogen energy production solution will eliminate fossil fuel electricity generation in every fossil fuel based power plant and generator we convert to hydrogen.

Our **H2** generator along with other systems can convert polluting power producers into efficient low–cost green energy producers. Our business plan includes converting to clean **H2** energy as many as possible of the world's 20,000+ polluting Coal, Oil, Natural Gas and Gasoline Power Plants and countless Diesel Generators around the world. **H2** will greatly reduce the largest operating cost of hydrogen compatible power plants and power generators, namely fuel, and increasing Power Plant efficiency by using Hydrogen gas which has a much higher caloric output than fossil fuels, while increasing environmental benefits through a near zero carbon footprint.

Many of the target power plants are shut down or on the list to be shut down because of EPA no longer allowing fossil fuels to be used as the source for generating electricity.

We've established working relationships with major power plant OEM's and Power Producers. Hydrogen compatible gas turbines, boiler burners, gensets are all readily available now to transform the natural gas, coal, diesel and cement kiln markets to hydrogen powered applications. It is clear the hydrogen economy is emerging with vigor and is being increasingly supported by the key players with the necessary infrastructure.

CAN INTERNAL COMBUSTION ENGINES AND THERMOELECTRIC FOSSIL FUEL POWER PLANTS EVEN RUN ON 100% ON HYDROGEN?

Yes they can. Engines can be modified to operate on 100% H2 and most thermoelectric power plants can be retrofitted to run on Hydrogen with minimal disruption and favorable economics. This is proven through numerous tests, actual use cases and numerous research papers. The issue isn't whether IC engines and Thermoelectric Power Plants can be made to operate on H2, but rather the issue is the production and supply of H2 fuel.

Nearly all industrial H2 is produced by a very 'dirty' process known as steam reforming that breaks down hydrocarbon molecules, such as methane (CH4). This process generates CO2 in large quantities, which is self-defeating from an environmental perspective. Here's the reaction: $2H20 + CH4 \rightarrow 4H2 + CO2$.

The alternative to date has been to split water (H2O), which creates Hydrogen and Oxygen. The O2 can be kept or released into the environment. The H2 is of very high purity with this process (99.99 %+). There are several processes for splitting water, but electrolysis is relatively easy and thus has been the traditional method. It requires that a low voltage (about 1.5 Volts) be passed between electrodes through water. Hydrogen bubbles off of the negative pole, and Oxygen from the positive. This has high utility because the gases are already separated so they can be piped off to separate destinations.

However, splitting water with an electrolyzer requires a large amount of electricity, in the range of 40 to 50 kilowatt hours of energy per kilogram of H2 produced. That electricity must come from somewhere and has a cost. Furthermore if it came from any

non-renewable source (let's say a power plant operating on fossil fuels), then there is no environmental advantage.

Therefore, the Hydrogen must be created using some form of renewable energy and the source must have a production process that consumes a low enough amount of energy that justifies trying to produce the Hydrogen in the first place.

THE H2 SOLUTION AND WHAT EXACTLY IS IT?

H2 Brazil has developed a groundbreaking base-load power generation system "**H2**" (Water to Hydrogen Gas) that produces environmentally friendly and low-cost energy using fuel from an inexhaustible source that will help address the environmental, economic, and social-cultural aspects of the earlier mentioned challenge currently faced by the power generation industry all over the world with the following salient points:

A. **H2** uses a proprietary 4-stage hydrogen generation system that produces hydrogen gas from fresh water (including river/lake water & desalinated seawater). **H2** uses these 4 technological instruments in the following order:

- ***Neodymium Magnet***
- ***Radio Frequency Transmitter***
- ***Laser Quantum Processor and***
- ***Thermoplasma Injector Unit.***

SUMMARY OF THE 4 STAGE H2 PROCESS

STAGE 1: The system consists of a neodymium magnetization channel, primary magnetization, in which the concentric magnetic field acts on the spin of the electrons of the atoms that make up the water molecule in a particular waythat will be favorable for destabilizing the oxygen and hydrogen bond when conditions permit.

STAGE 2: Water molecules remain magnetized by the magnetic channel at this stage and converge to a resonant channel where the water is directed to a resonant nucleus. In the resonant nucleus, the radiofrequency resonator operates at a frequency equal to

the natural frequency of water molecules, causing them to vibrate at higher amplitudes, resulting in the pre-collapse of their covalent connections.

STAGE 3: Water molecules that remain magnetized and in molecular resonance proceed to the modulated laser channel, where molecules receive photons that allow quantum leaps with the release of electrons, resulting in the breakdown of molecular bonds between the hydrogen atoms and their corresponding oxygen atoms.

STAGE 4: In the thermoplasma injector unit, an ultra-high temperature resonant condition is provided in the plasma to promote water molecule disruption.

Magnetic, resonant, quantum and thermoplasma injection processes contribute to the release of hydrogen from water on demand. Integrated magnetic generator.

In the thermoplasma system water is injected via the thermoplasma unit and hydrogen is obtained in the combustion chamber of thermal equipment/applications.

All 4 stages occur in rapid succession, and their combined effects to dissociate the water molecules into their element constituents of hydrogen and oxygen H2 require much less energy than electrolysis.

The **H2** system consumes of less than 2.5kWh of electrical energy to produce 1kg of H2 versus 40-50kWh for electrolysis. Electrolysis relies 100% on electrical current to do the heavy lifting of splitting the hydrogen and oxygen.

H2 divides the heavy lift of what an electrolyzer would normally do (being 100% dependent on electric current) into 4 much smaller lifts which are much less dependent on electrical current in totality. Among the **H2** innovations is a neodymium magnetization channel which is set at precisely the correct frequency which then causes the molecules to vibrate, to prepare them for final separation via laser beam and finally a thermoplasma process.

Furthermore **H2** electrical input requirements are reduced as there is no need for **H2** to convert AC into DC.

Once split the hydrogen and oxygen atoms remain separated and cannot be rebounded without the deliberate use of a catalyst, particularly in the controlled **H2** temperature environment (Exceptions exist in some fuel cell types).

H2 is also able to produce greater volumes of hydrogen when compared to electrolysis resulting in the production of low cost energy, namely hydrogen gas at approximately $0.40 per kg. Unlike other H2 production technologies **H2** does not require storage thus it's highly safe. Since H2 production is done in real time according to actual power production demands there is no requirement for hydrogen storage, which is one of the greatest challenges in using hydrogen gas as a renewable fuel source. **H2** has been designed with a safety first mentality. ***For more information refer to separate H2 Safety System Overview Document**

B. Since the Power Generation System burns hydrogen, it produces "zero" carbon emissions and instead produces environmentally friendly water vapour emissions with controlled amounts of NOx emissions which are created during the combustion process. The water vapour emissions then go to the Earth's atmosphere where they undergo the various steps of the Earth's Water Cycle enabling them to eventually, in various amounts, replenish the water resources in the land and the abundant water resources in the sea and because this process will be repetitive during the course of the power plant's operation, this form of power generation can then be considered relatively clean and sustainable.

C. When fresh water or desalinated seawater is the source of hydrogen, there will be no concerns with the security of energy supply as fresh water is nearly free or free and sea water which is free and abundant in many countries and available for the use of all for the very long term., abundant in many countries and available for the use of all for the very long term.

D. Finally, the **H2** Power Generation System utilizes either a diesel genset or a compatible gas turbine to burn the low cost hydrogen gas to produce low cost electricity for the end-users at a high degree of reliability and availability unlike other green energy power generators such as wind and solar that have variable energy outputs.

As **H2** has been tested with diesel generators to date and is due for product launching in 2022, AGV_H2 Energy is seeking partners/clients for Pilot and Commercial Demonstration Projects. AGV_H2 is offering turnkey contract services for small capacity **H2** power plants using either the diesel genset option with sizes ranging from 0.5MW to 14MWand gas turbine options for larger applications, capable of burning 100% hydrogen, with sizes of 5MW, 9MW, 10.5MW, 12MW and 16MW and for larger aeroderivative gas turbine capacities with sizes of 32.5MW, 44MW and up to much higher capacities consisting of multiple power generation units of the earlier mentioned larger sizes for its **H2** Hydrogen-fired power generation systems at a discounted price to early adopter clients who wish to finance and operate one of these green energy power generation solutions. AGV_H2 is open to the option of entering into a Joint Venture with these early adopter clients by further reducing its turnkey price by a certain percentage and using this corresponding amount as its equity contribution to the project.

It can also be arranged that AGV_H2 can operate and maintain the power plant at a specified rate per kWh. AGV_H2 is fully capable of providing turnkey services for **H2** power plant projects all over the world since it has numerous partnerships in place around the world with major equipment producers, power plant manufacturers/OEMs, engineering firms and more than 30 authorized AGV_H2 distributors globally, now serving over 50 countries.

H2 PATENTS TO PROTECT THE INTELLECTUAL PROPERTY

3 approved patents exist on the technology and are controlled globally by Innovators 1 for thermoelectric use, 1 for Internal Combustion Engines/Gensets, 1 for Fuel Cell Applications. These patents are detailed in the full version of our *Confidential Whitepaper.*

H2 POWER GENERATION SYSTEM FACTS AND FIGURES SUMMARY:

For every liter/kg of water fed into the **H2** System 111.1 grams of H2 is produced. Thus 9 liters of water equals 1kg of H2. Per kg H2 has 3-7x the kcal value of fossil fuels. Each kg of H2 produced (extracted from 9 liters of water) has 39.4kWh HHV (1 liter of water = 4.4kWh HHV). Approximately 360L-700L* (varies by application) of water per hour is required as feedstock per 1MWh of electricity production and up to 10% of the electricity the system generates it consumes for its own operation.

Specifically, each KG of H2 production consumes less than 2.5kWh of input electricity energy but generates hydrogen production equivalent to 12.5kWh to 20kWh of electrical energy output. 40-80KG of H2 is required to produce each MW of electrical energy output, it varies based on the efficiencies involved in the application such as genset, gas turbine or boiler or kiln heating.

Each kg of H2 production has an average OPEX of approximately $0.40 (USD) or approximately $0.03kWh.

For each 1MWh of electricity produced by a **H2** Power Generation System the system requires a fresh water source of 360L-700L* (varies by application) liters per hour.

For every kg of water the **H2** system consumes it produces 0.111kg of 99.9% H2 which possesses 3765 kcal Gross Heating Value or 33889 kcal/kg versus 10000 kcal/kg for diesel. H2 possesses more than 3x the kcal value per KG than diesel does. Each kg of H2 produced (extracted from 9 liters of water) has 39.4kWh HHV versus diesel at 12.67kWh/kg HHV, thus only 3 liters (3kg) of water is needed to outperform 1 kg (1.2L) of diesel (as 9 liters of water becomes 39.4kWh/3 = 13.13kWh compared to one kg (1.2L) diesel at 12.67kWh).

An optional water vapor condensing recovery system can be added to form a closed loop system so that the amount of water required as a feedstock can be reduced by approximately 75%.

H2 SYSTEM DIMENSIONS & CAPACITIES, (CONTAINERIZED)

- **H2 MAX: 45'L x 8'W x 9.5'H. Up to 44MWh of H2 Production**
- **H2 STANDARD: 20'L x 8'W x 9.5'H. Up to 20MWh of H2 Production**
- **H2 MINI: 10'L x 8'' W x 8.5'H. Up to 8MWh of H2 Production**

OPEX CONSIDERATIONS FOR A H2 POWER GENERATION SYSTEM (including feedstock/replacement parts/consumables/electricity consumption):

1. **Local regional cost and availability of fresh water, assumed at $.001 per liter here**
2. **The H2 system consumes less than 3kWh of electrical energy to produce 1kg of H2.**
3. **Consumables (lubricants etc)**
4. **Spare/replacement parts (air/water filters etc)**
5. **O&M Service contract including all manpower $0.006kWh on average**

Total OPEX of 1-5 above estimated at approximately $0.03 per kWh (varies per power generation application and per geographic region) when measured over a ten year period, there will be variance in this number depending on the costs of sourcing the water supply and as the cost per kWh reduces when power plant capacity in MW increases, through the economies of scale principal.

The **H2** hydrogen power generation system produces 1 MWh of electricity at a total OPEX cost of approximately $25MWh for gensets or $30/MWh for gas turbine applications. This translates to a H2 production cost of approximately $0.40 per Kg based on the 77Kg gas turbine requirement, (a diesel generator requirement is closer to 60kg pr MWh) of H2 needed by the power plant to produce 1MWh of electricity.

Based on the earlier mentioned calculation, the **H2** power generation system is estimated to produce and utilize a kg of hydrogen at an approximate value of $0.40 per kg as an approximate amount of 77kg gas turbine, (lower for diesel generator, closer to 60kg) of H2 (extracted from 693L/hr. of water for gas turbine and 540L of water for diesel generator) is needed to produce 1 MWh Gross Electricity (minimum of 0.9MWh net after **H2** system

energy consumption). **There will be some variation in amount of H2 production needed per MWh based on efficiency percentage of the generator/turbine being powered.**

H2 KEY SAFETY FEATURES

- **Hydrogen production is in real time, no storage of hydrogen is needed for H2 operation.**
- **Sensors are present to detect hydrogen leakage and if any leak is detected the system stops immediately.**
- **Block valves are installed in different stages to prevent the back flow of hydrogen.**
- **Upgraded tighter fittings and seals in all equipment that hydrogen passes through to prevent leakage and the introduction of new injectors and/or nozzles. Threaded fittings (Swagelok/Autoclave) till 1".**
- **Alloy steel piping & all Metallurgy consistent to prevent Hydrogen embrittlement at the welded joints**
- **CO2 / Nitrogen shall be used as a purge gas in the system before the generation of Hydrogen or feeding Hydrogen to the DG set.**
- **Site supervisor ensures correct ventilation of the space to eliminate the need for a flare.**
- **No lighters or any welding operations shall be allowed until a complete inspection is performed.**
- **Dismantling of the hardware shall follow safety and operational procedures.**

DETAILED H2 SYSTEM DESCRIPTION AND SCHEMATICS

Private and Confidential, available only in the full version of the WHITEPAPER