



NET-ZERO INDUSTRIES

MISSION



Project Title

Si+ Low Carbon Hydrogen Genset

Industry Partner

EPRO Advance Technology Ltd.

Industry Sector

Chemicals & Refining
Other Energy Intensive & Hard to Abate

Technology Pathway (Primary)

Low-carbon hydrogen

NIM Pillar

Technology Demonstration

Source

NIM Awards 2025

Description

Hydrogen (“H2”) is the envisaged low carbon future however, adoption of H2 will not come to fruition until safety and cost concerns are properly addressed regarding storage and distribution of the gas.

In lieu of the above, we have developed and obtained patent rights from major jurisdictions, a nano-porous silicon material “Si+” that generates 14.28 wt% pure H2 on-demand and ~24kWh of heat / kg H2 with spontaneous reaction when introduced to a basic solution and a simple stirring device between -33 to 70C via a chemical reaction. Si+ is produced via conventional metallurgical methods, and has been certified as a non-Dangerous Good (DG), thus qualifying it as the world’s 1st distributable Long Duration Energy Storage Material with grid parity. Electricity generated from Si+ is near carbon neutral following ISO protocols. Sodium silicate is the byproduct of the reaction, and structural grade geopolymer concrete (GPC) has been produced by mixing the byproduct silicate with ground granulated blast furnace slags. GPC is one of many uses of sodium silicate.

Diesel usage in construction industry is extremely inefficient due to intermittent power usage such as welding and tower cranes which when used, requires large currents translating to large gensets. Si+ address the industry’s issues where H2 generated is immediately converted to electricity via fuel cells (“FC”) for direct usage, buffered through battery energy storage systems (BESS) for power amplification, thereby allowing electrification of one of the ‘hard-to-abate’ sectors. Si+ H2 genset will have commercial landing with Able Engineering Ltd in Nov 25 in Hong Kong subject to receiving regulatory approval, to replace inefficient and costly diesel gensets used in the construction as the beginning.

Innovations Employed

Battery Energy Storage Systems (“BESS”) is decarbonizing the construction industry by amplifying power output of a small diesel genset to increase combustion efficiency. A 20” container carrying 25T Si+ generates 3.5T H2 on-demand which is immediately converted into electricity by FCs.

Our H2 generation reaction replaces high temperature hydrothermal processes for producing $\text{Na}_2\text{O}\cdot x\text{SiO}_2$ where $1 < x < 2.9$, saving costs and carbon emissions. Silicate is a chemical used in lithium mining wastewater treatment, binder of Geopolymer Concrete and paper and pulping industries etc.

Lastly, Si+ genset can be configured as a decentralized water (and power) system by:



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1. H₂ converted to electricity by FCs powering commercial desalination systems such as NF and RO;
2. Exothermic heat of reaction and FCs to enable thermal desalination such as Membrane Distillation, resulting in superior water recovery
3. Hyper concentrated brine is valorized as feedstock for chloralkali factories producing NaOH and HCl

Dimension of Novelty

New on the international market

Innovation Collaboration

In-house

Hong Kong SAR

Intellectual Properties

"PRODUCTION OF SILICON NANO-PARTICLES AND USES THEREOF", granted in EU (validated in 14 jurisdictions), US, JP, KR, TW, HK

"A Process and Apparatus for the Production of Hydrogen", filed internationally in 11 regions and jurisdictions, pending approval

"A Method and System for Storing Grid Electricity and Dispensing the Stored Electricity on Demand" filed in 7 regions and jurisdictions, pending approval

IP Links

Timetable & Progress

Development commenced in 2022

We have performed HAZOP and undergoing QRA currently, with a tentative landing date in HK at a construction site to replace diesel in Nov/Dec 2025.

Financing (Public/ Private)

Private funding

Finance Links

Project Phase TRL

TRL 7

Problems to be Solved and Risks to be Managed

'Connecting the dots' of the Si+ universe making it into an end-to-end solution was the biggest challenge, from inventing a foundry process in making Si+ that can store excess/curtailed energy, certifying Si+ by testing agencies to be a non-DG in order to distribute that safe solid via conventional logistics, to producing electricity via hydrogen produced on-demand. Finally, tailoring the silicate byproduct for this vast chemical market.

We took the leap of faith in engaging a reputable oil and gas ("O&G") engineering company to develop the Si+ genset according to the most stringent O&G standards, followed by obtaining regulatory approvals where currently no single set of rules directly applies to Si+. Using Si+ genset in commercial context to replacing diesel for example, shall 'demystify' the technology, facilitating the possibilities of mass scale adoption.

Lastly, we have completed HAZOP and currently undertaking QRA (both studies by Meinhardt) in order to receive final approval from regulatory bodies to land Si+ genset commercially in Hong Kong



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Preliminary or Final Results Achieved

We have independently tested the Si+ genset in HKSAR, completed HAZOP and currently undertaking QRA (both studies by Meinhardt) awaiting final approval from regulatory bodies to commercially land the Si+ genset at a HK Housing Authority project with Able Engineering Holdings Ltd (building contractor). Si+ genset is used to replace diesel genset, tentatively landing late Nov 2025.

Like-on-like costs of electricity produced by Si+ for construction sites, i.e. intermittent high power output, is projected to be significantly cheaper than its diesel counterpart in European markets at Si+'s infancy, alongside substantial CO₂e reductions following ISO protocols, estimated to be saving ~1kg CO₂e per kWh abated from diesel.

CO₂ Emissions Reduction Potential – Implementation and Future Market

On-demand guaranteed energy market opportunities:

1. Distributed H₂ Refuelling Station (“HRS”) for 9 Ton city logistics trucks where traffic causes low diesel mileage, UAV, or airport tow tractors (high gear ratios increases fuel consumption) etc. enables fleet owners to install HRS at their depot. Si+ HRS has minimal CAPEX due to low H₂ storage, and reduced OPEX from H₂ delivery and insurance etc.
2. Infrastructure-light water and power supply for inhabited islands, drought prone regions with brackish underground water (“BUGW”) source etc. Water produced can be ‘multiplied’ when mixed with untreated BUGW as remineralization for irrigation

When credited with products produced/recovered plus any offsets, Si+ system is expected to be carbon neutral and/or negative, accounting for emissions of Norwegian made met-grade silicon, processed at a hypothetical Si+ foundry in Sichuan PRC using regional grid electricity, plus transportation emissions from Norway to Sichuan, then to Hong Kong.

Market Positioning

As Si+ is a non-Dangerous good, providing safe and guaranteed on-demand power, has a larger operating window than diesel plus zero emissions at point of use, this shall become the platinum standard of off-grid power generation. We aim to be the ‘new diesel’ to support the energy transition.

Project Location

China

Project & Technology Links

EAT Si+ Mission Innovate 2025, pdf, Introduction to Si+ and its applications
<https://www.epro-atech.com/media-assets/5bacd8a7-3a2b-4cd4-831c-37260f27e083>

Technology Links

www.epro-atech.com
[Si+ Application Process](#)