Cummins' role in a decarbonised world

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Cummins is a global power leader and engine manufacturer headquartered in Columbus, Indianapolis in the United States. In 2019, as part of Cummins' 100th anniversary, chairman and CEO Tom Linebarger launched PLANET 2050. This environmental sustainability strategy has eight quantifiable goals for 2030 along with three visionary longer-term aspirations timed to 2050:

- Reducing greenhouse gas and air emissions in line with experts' recommendations.
- Using natural resources in the most sustainable way possible.
- Helping communities address their major environmental challenges.

Referred to as Destination Zero, the strategy aims to reduce carbon emissions for a sustainable world. It includes investing in technologies and power solutions that reduce emissions, consider the economic impact to customers and advance technology so that it can be broadly adopted because it is affordable at the same time. To support these goals, a New Power business unit was created in addition to the four existing ones: Engine Business unit, Power System Business units, Components Business unit and Distribution business unit.

The New Power Business develops technologies and products that are not based on conventional internal combustion engine technology to help our customers transition into the future with zero emission technologies. The hydrogen economy is an ecosystem of products and solutions that commences with hydrogen generation (upstream), to hydrogen and energy storage (midstream) to downstream applications and business segments powered or enabled by hydrogen. It also means powering economic activities in a decarbonised manner to eliminate carbon emissions.

Currently, New Power Business offers electrolyser products to generate hydrogen from water in the upstream, hydrogen storage solution and battery in the midstream, and the downstream of fuel cell for stationary power, fuel cell for mobility, battery and electrified components and power train for heavy duty transportation such as businesses, heavy duty trucks and mining equipment.

On the upstream side, Cummins has some of the best-in-class electrolyser hydrogen generation products. It deployed the world's largest 20 MW proton exchange membrane (PEM) electrolyser three years ago while most of the players in this sector were still at the concept stage. On the midstream side, Cummins has extensive energy and hydrogen storage solutions, while downstream it has fuel cells for stationary power and mobility applications.

For example, Cummins' fuel cell technology is behind Alstom's hydrogen-powered zero-emission train in Germany. Cummins has announced the release of fuel-agnostic engine platforms, with major customers such as Werner Enterprise ordering hydrogen combustion engines for its delivery trucks. "As you can see, Cummins is innovating and deploying our destination zero technologies into economical critical applications," highlights Alan Zhao, who heads up the New Power business in Cummins Africa Middle East region.

Cummins understands that successful energy transition requires massive innovation and collaboration from the entire ecosystem of willing partners. Friendly competition is a key ingredient to drive critical and continuous improvement towards sustained impact. So, while competing to offer the best, together we can realise a decarbonised world.

Cummins has over 70 years of experience in the field of electrolysers with over 1500 electrolysers in operation and over 2000 fuel cells powering hundreds of vehicles globally. The growing manufacturing capacity of Cummins in electrolyser footprint is significant. Our new plants in China and Spain and our growth in Canada (all by 2025) indicate our commitment to this growing hydrogen sector. Cummins has successfully implemented the world's largest 20 MW PEM electrolyser, producing green hydrogen in Canada (commissioned in 2019), the world's first 100% hydrogen-powered passenger train fleet in Lower Saxony, Germany, and the world's first hydrogen refuelling station for ships, cars, trucks and industrial customers in Antwerp, Belgium.

Hydrogen plays a key role in Cummins' mission to help decarbonise the economy and power a future with zero carbon emissions. Cummins has the technology and real-world experience to fuel the future.

Electrolysers address one of the most significant dilemmas in the renewable energy industry: how to carry abundant renewable energy where it exists to where it lacks.

Cummins PEM HyLYZER proprietary technology is the latest in hydrogen development technology and is the result of more than 20 years of research and development.

Cummins' PEM electrolysers are some of the most efficient electrolysers in the industry, which means more renewable energy will be carried to the demand via larger quantities of hydrogen produced with a given unit of renewable electricity available. The technology can decarbonise multiple sectors, including zero-emission transportation, industrial processes, and the green chemicals sector.

<u>PEM technology:</u>

Proton exchange membrane (PEM) is the most robust and efficient technology for pure hydrogen generation at scale. Cummins is the industry benchmark for safe, widely proven PEM systems, delivering productivity and return on investment beyond our competitors. Our 'plug-and-play' systems arrive onsite ready to safely and reliably produce very high purity hydrogen, continuously or flexibly, indoors, or out. High efficiency aligns with low maintenance needs, delivering low capital and operational expense, with modularity that allows for simple scaling. Cummins systems connect to standard power and water connections and come equipped with standard water purification, power conditioning, hydrogen purification and remote servicing.

CUMMINS HyLYZER

Cummins HyLYZER PEM technology is state-of-the-art.

With the most efficient and compact solution on the market, HyLYZER delivers to market

leading operational expense and low levelised cost of hydrogen. Exceptionally compact systems deliver hydrogen at 30 bar without compression at extremely high purities.

Operating flexibly at higher current densities, HyLYZER is perfectly suited to projects where dynamic operation is valuable, such as in combination with renewables. And where megawatt scale matters, HyLYZER scales up to meet the highest output needs.

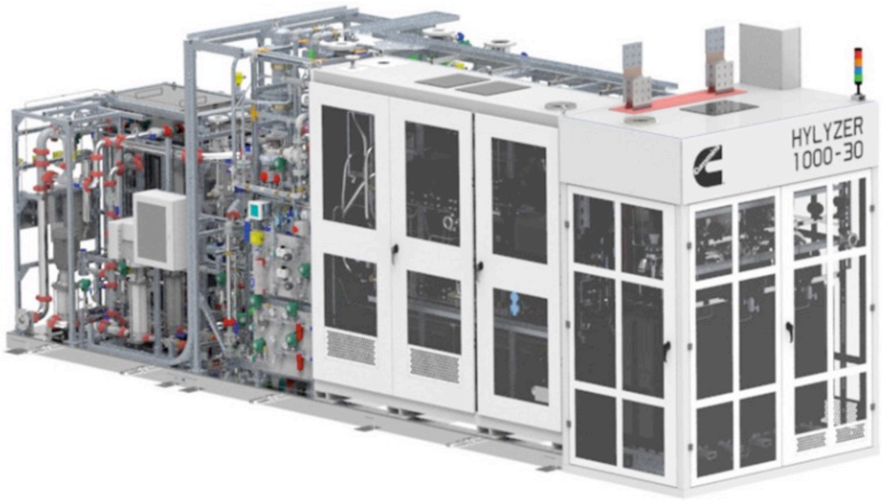

Figure 1. Cummins HyLYZER.

<u>Alkaline technology:</u>

Megawatt scale stacks

- Industry-leading 2.5 MW stacks, highly scalable for larger demands.

Exceptionally compact

- Industry-leading design – lower land, site preparation and building costs and shorter installation time.

Responsive

- Ultrafast responses to changes in hydrogen demand or power input.

Long, maintenance-free lifecycle

- Limited and optimised maintenance, minimal degradation, 80,000 hours between stack membrane refurbishments; fast stack swap-out when required.

High efficiency and advanced control systems

- Lower power usage and low annual maintenance costs, with integrated safety sensors for safe plant operations.

This long-standing technology is based on Cummins proprietary IMET membrane, offering best-in-class systems with the strongest safety record and reliability in the market.

CUMMINS HySTAT

HySTAT is Cummins globally proven modular alkaline electrolyser system designed for easy onsite installation inside or out, with simple interconnectivity to scale up, and an unrivalled record for reliability, low maintenance and onsite safety.

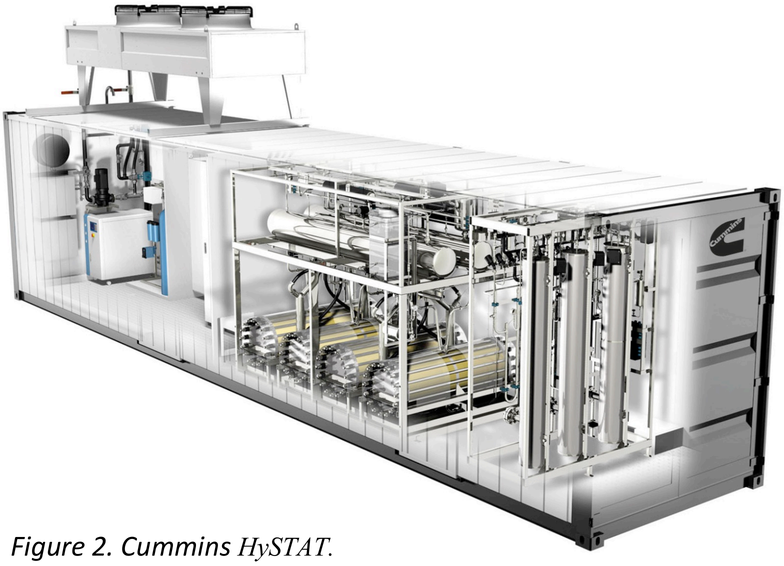

Figure 2. Cummins HySTAT.

Proven durability

- Robust technology and long lifetime with minimal maintenance.

Modular and flexible

- Stack configurations available in 1,2, 4 and 6 stacks with nominal hydrogen outputs from 10 to 100 Nm^3/h, easily scalable to future needs.

Robust proven technology

- Over 500 pressuriszed alkaline installations worldwide.

Safe

- Flawless safety record over decades.

Stationary PEM Fuel Cell Power:

Hydrogen-fuelled PEM fuel cells are poised to play a key role in decarbonisation. By generating combustion-free and carbon-free electricity from hydrogen, they promise to deliver the clean and cost-effective power needed by producers wanting to integrate hydrogen into stationary backup and auxiliary power that can support a variety of activities from peak shaving to demand management and response. Our solutions consist of high power-density fuel cell power modules that allow for scalable system solutions. These power generation systems, which run on hydrogen, result in efficient and resilient power with no carbon emissions.

Figure 3. Hydrogen-fuelled proton.

Find out more about Cummins applications and our long list of world firsts in energy transition at www.cummins.com and www.cummins.com/new-power.

About Cummins Inc.

Cummins Inc., a global power leader, is a corporation of complementary business segments that design, manufacture, distribute and service a broad portfolio of power solutions. The company's products range from diesel, natural gas, electric and hybrid powertrains, hydrogen power solutions including filtration, aftertreatment, turbochargers, fuel systems, controls systems, air handling systems, automated transmissions, electric power generation systems, batteries, electrified power systems, hydrogen generation and storage, and fuel cell products.

Headquartered in Columbus, Indiana (U.S.), since its founding in 1919, Cummins employs approximately 59,900 people committed to powering a more prosperous world through three global corporate responsibility priorities critical to healthy communities: education, environment, and equality of opportunity.

Cummins serves customers in approximately 190 countries and territories through a network of approximately 10,600 Cummins certified dealer locations and 500 distributor locations. The company earned about $2.1 billion on sales of $24.0 billion in 2021.

Alan Zhao

Director – Hydrogen & Fuel Cell, Africa Middle East Region
Cummins Inc

- Alan started his career working for Cummins more than 20 years ago in Engine Product Development, Controls and Cummins China JV business operation, and then left to work for Motorola, where he led the first development and deployment of their 4G solution. He returned to Cummins in 2011 to lead the Telecom Power start-up business for Power Generation. He then joined Cummins Digital Organization, where he was engaged in Product Planning, Product Development, System-Level Engineering and IoT technology. Alan has a computer science degree, a mechanical engineering degree and a program management certificate.
- During his time leading Global telecom power business, Alan's experience in leading the development and the release and deployment of Cummins 1st battery-genset hybrid product into Telecom cell sites in Myanmar.
- Since 2011, Alan has been a proponent of renewable energy with Cummins customers, partners and inside Cummins where he has done strategic project work in fuel cell and hydrogen generation. He is now leading Cummins new power business for Africa Middle East Region.