OPINION: Is hydrogen the next state-of-the-art ancillary fuel in the server legion?

By Vengdhanathan S

Every day, about 2.5 quintillion bytes of data are generated globally, which would ideally require 98 lakh smart phones with 256 GB ROM for storage!

Over the past decade, digitalisation has been expedited across all industries. This has enabled businesses to store, manage, and remotely retrieve large amounts of both critical and non-critical data. In addition, improvements in the precision of global navigation systems, expansion of trade and commerce, increased access to quality education, and other data-intensive procedures have contributed to an elevated quality of life and heightened productivity. Consequently, there is a crucial need for specialized infrastructure called data centres that can accommodate large amounts of data, employing servers and related equipment.

Data centres operate continuously and are supported by backup systems/generators as well as cooling systems for uninterrupted operations, thus being highly energy intensive. For instance, the biggest data centre in India located in Noida has an installed capacity that is almost half of the peak power demand of the state of Goa! Because 3/4 th of our current energy demands are met by coal and data centres are reliant on coal-powered plants for their primary energy requirements, these enormous 'data banks' contribute significantly towards global emissions. Considering the collective efforts worldwide to meet climate goals, it is essential to integrate data centres with green technologies to reduce or nullify their emissions.

Since April 2022, there has been a surge in prolonged power outages across several parts of the country, mainly because of the decline in coal reserves in coal-based thermal power plants. Moreover, the electricity boards of individual states schedule planned outages to undertake load balancing, maintenance, and construction operations. Most data centres heavily rely on the primary power distribution systems. Thus, even few milliseconds of power outages can severely interrupt their operations, resulting in significant financial losses. To ensure uninterrupted operations, these data centres often have dedicated utility lines and are also supported by strong backup power systems, typically in standby mode, for handling their critical load.

To provide the necessary backup during power outages, most data centres use diesel generators, which operate at an efficiency of only 35 per cent to 40 per cent. In addition, this contributes to increased emissions as one litre of diesel generates 2.4–2.7 kg CO 2 (in-situ emissions). However, unlike diesel generators, hydrogen fuel cells (proton exchange membrane fuel cells) can offer 50 per cent to 65 per cent efficiency. They are silent in operation and have a constant efficiency irrespective of the load. It is also worth noting that hydrogen is a cleaner fuel and has a longer shelf life than diesel.

With MNCs like Microsoft and Google looking to go carbon neutral, especially for their data centre operations, the backup systems might provide the necessary means to facilitate this transition. In addition, hydrogen fuel cells, instead of diesel generators, as the backup might be the most ideal application of hydrogen so far.

A data centre with an area of 80,000 sq ft is comparable to a soccer field. Hosting about 52,000 1U servers, it can have a critical load of about 8.1 MW. Adding the load requirement for the cooling system and utility power systems, which are integral parts of a data centre, the backup requirement

is estimated to be around 33 MW. A hydrogen fuel cell system with this capacity will cost about Rs 8 crore to Rs 9 crore per MW, which is 25 per cent more than that of a similar diesel generator system. If the data centre stores enough fuel to provide backup for two days, it would require about 11 cubic metres of diesel for every MW capacity, which costs about 9–10 lakhs. In contrast, the fuel cell counterpart will require about three tonnes of green hydrogen, which costs about Rs 15 lakhs. Taking into account the transport and storage costs, a transition to fuel cells as backup is likely to cost about 20 per cent to 22 per cent more than a diesel generator system.

India currently hosts about 138 data centres, accounting for a total power capacity of 737 MW, which is equal to the power consumed by 74 typical shopping malls. With the digital economy in the country growing rapidly, it is projected that the power capacity will double by 2025, according to a report by CRISIL. This will create significant opportunities for hydrogen-based backup systems. Cities like Delhi, Mumbai, Hyderabad, Bengaluru, and Chennai are crucial data hubs in the country and host most of the data centres. Thus, such cities need to prioritize their efforts in this regard.

However, one of the biggest challenges for hydrogen fuel cell-based back up is the fact that India does not have a commercial plant producing such large quantities of green hydrogen.

The largest plants in the country are in the pilot stage and only have few kilowatts of installed capacity. Of note, the production cost of grey hydrogen is only one third that of green hydrogen today, and India produces about six million tonnes of grey hydrogen annually. However, fuel cells require very pure hydrogen for power generation. This requires additional infrastructure for purification like a pressure swing adsorber, which for mere data centre applications may not be a feasible option. However, as fuel cell prices are expected to drop to competitive levels over the decade, the potential of this green technology should be further explored.

The need to shift to green technologies is apparent, particularly in large-scale sectors. At the same time, it is important to identify and develop small-scale applications of hydrogen, example, for diesel abatement in commercial and service sectors. These efforts can be aided through production-linked incentive schemes. Such measures will not only attract more investments for the development and adaptation of the technology but also boost the National Green Hydrogen Mission, taking India one step closer to becoming ‘Aatma Nirbhar’.

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