N.B. techs crack code for 'very-low' carbon 'teal H2'

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A Fredericton-based startup, Nu:ionic Technologies (NU) has cracked a new code at producing an extremely low carbon intensity (CI) synthetic gas called teal hydrogen, an innovation achieved by blending green (electricity) energy feedstock with blue (natural gas) energy feedstock. And it's partnering with Liberty Utilities to accelerate this innovation from a nascent commercial operation to aspirations for eventually scaling up to industrial level distribution.

Citing a 2023 Deloitte CICE report: Carbon Intensity of Hydrogen Production Methods Supporting the BC Hydrogen Strategy, Jan Boshoff, CEO at Nu:ionic Technologies, explained,"Electric steam methane reforming (ESMR) - as it was outlined in this CICE report - what we're developing is a form of electric steam reforming. And, according to the CICE report, EMSR is one of the lowest forms, or lowest carbon intensity forms, of making hydrogen. And, so, it's a very clean pathway to net zero, or decarbonization."

What's so special about using steam reforming? The innovative approach of NU's proprietary discovery is it's taking steam reforming to an elevated heat and volume for production by using industrial microwaves. Employing its first-of-its-kind microwave reformer process, NU utilizes industrial microwave technology to eliminate combustion of natural gas, producing low-carbon hydrogen from natural gas with 100 per cent capture of the associated carbon dioxide and no need for combustion carbon capture. The conversion process also requires almost five times less electricity when compared to electrolysis.

Its groundbreaking innovation has caught the attention of Liberty Utilities. NU entered a Memorandum of Understanding commercial agreement with Liberty Utilities (Gas New Brunswick) LP for development of a 2.4 tpd (2,400 kg/d) H2 production system. Liberty will

utilize the facility to pilot blending of H2 into natural gas. The proposed facility is scheduled to be operational by late-2025.

Nu:ionic's technology will be used to generate low-carbon H2 at low cost, for blending into Liberty's natural gas distribution system and clean power generation and fuel production for zero-emission fuel cell electric vehicles. The Microwave Catalytic Reformer's design includes a carbon capture system to produce readily transportable liquid carbon dioxide (CO2). NU will also provide equipment commissioning, maintenance, and remote monitoring support for the components.

Boshoff cites Atlantic Canada's "relatively new natural gas grid" infrastructure and Nu:ionic's low capex business case as rationale for investing in advancing the project regionally.

"We have a local distribution pipeline that can accommodate hydrogen as a low carbon fuel source. So, we have the infrastructure ready on a local level to accommodate hydrogen as a gas," he said.

He also commends Liberty Utilities progressive approach to investing in, and pioneering, low-carbon energy sources and for partnering with startups like NU.

"Utilities tend to be highly conservative and are usually the last ones to move... (Liberty) is a utility company that's willing to learn 'how do we accommodate hydrogen in our gas network'. They're showing commitment to meeting their sustainability goals," he said. "What we offer is an economical way to produce hydrogen at a small scale. Right now, the economy of scale is the only path available to produce affordable hydrogen...we have found a way to provide low-carbon distributed hydrogen at a low-price," explained Arturo Puigbo, chief commercial officer at Nu:ionic Technologies.

Teal hydrogen, with its promise of impressively low emissions, and its ability to distribute across existing infrastructures, may prove its commercial viability as an intermediate and immediate source for solutions in meeting Paris Climate commitments. NU's (website) claims "teal hydrogen technology would eliminate more than 50 million tpa (tons per annum) of CO2 if blended up to 20% into natural gas used as heating fuel in the US and Canada."

It's a development garnering positive impressions with a leading New Brunswick environmental NGO. Teal hydrogen is considered a progressive development, according to Moe Qureshi, manager of climate solutions with Conservation Council of New Brunswick.

“It is interesting to see this new form of H2. It is important to make the distinction between H2 as a fuel and H2 as a chemical. For me, H2 as a chemical (to make steel, fertilizers, other industrial purposes) is the priority and should be made locally on site,” he said.

A striking distinction about this new energy source and NU’s 100 per cent carbon capture — and its capacities to attract other sustainability-committed partners and innovators — is it aligns with both Qureshi’s “chemical” and “local” preferences.

Yet, Qureshi says “transporting H2 is difficult and inefficient.” He feels H2 as a fuel should not be a priority.

“In fact, I think it is a distraction as H2 is less efficient than electricity,” he said.

Equally, however, Boshoff counters that NU’s technology ideally enables localized hydrogen production and distribution. And, thus, eliminates and addresses challenges posed by H2 transportation.

As for blending with natural gas, Qureshi would prefer pure green hydrogen. And, eventually, he’d like to see natural gas phased out.

“But I understand the difficulties. It may be reasonable in the short term to blend to fill supply gaps. Teal is better than grey hydrogen in my opinion,” he said.

But is using massive amounts of green energy (electricity) to produce hydrogen to produce green ammonia really that efficient and economical an exercise?

Conflicting energy analysis and recent studies citing rising costs of electricity; analysis of Atlantic Canada’s existing electrical grid infrastructure; and realizing the enormous amounts of electricity and other finite resources required in the electrolysis process to produce green hydrogen, as net zero clean energy, might not support claims producing H2 from any other means than green energy are the best alternatives.

A recent Canadian Steel Producers Association industry decarbonization study found it would require an unfeasible seven gigawatt-hours of electricity per day as “green” energy – the climate neutral version – to fuel Hamilton-based ArcelorMittal Dofasco’s ambitious low-carbon steel making plans.

Also, a 2007 US-EIA report stated: “Electricity has been the only commodity group with price volatilities consistently higher than those of natural gas.”

Producing hydrogen from electrolysis only is extremely expensive. It requires 50-55 kWh of electricity to produce 1kg (2.20462 lbs) of H2. So, to produce one metric tonne (1,000 kilograms) of H2 requires 55,000 kWh of electricity.

Dr. Lance Mortlock, managing partner energy and resources with Ernst Young, has senior business analysis and energy sector experiences spanning the globe. He has been engaged with more than 50 energy organizations and in engagement within all parts of the power chain, private sector, and with energy regulators. He's an expert on Canada's complex energy landscapes.

Mortlock is not as inflexible as Qureshi about hydrogen and natural gas. He's encouraged by innovations startups are pitching, explaining "technology, whether looking at new tech to invest, explore, or exploit" must be a major driver in the transition to net zero objectives across many sectors. But he cautions "before it can be scaled, it needs to be proven" that it can accomplish what it claims it can do.

"It cannot be an either-or solution. We need all solutions. We need to invest in electricity, and green solutions," he said. "We need to explore LNG. We need to explore and invest in H2 (blue, grey, and green). And we need to invest in developments with SMRs (small nuclear reactors) in two of Canada's provinces (ON, N.B). It's not that crude oil or natural gas will go away anytime soon."

It's going to be a hard and long transition, he noted, adding it will require a diverse energy mix whereby "Canada can take a leadership role. It's going to involve a difficult transition to reach net zero climate objectives."

Mortlock's assessment matches Boshoff's view.

"We're not the only solution… It can't be an either-or. We're past that point. We're on the beachhead in advancing solutions to address the climate challenge. So, it has to be an all in approach," he noted.

Mortlock openly admits "there's still a lot of challenges ahead with LNG, natural gas and hydrogen," but he also foresees resourceful renewable solutions and innovations coming forward in addressing many arduous climate challenges.

"As more and more pilot projects will scale up into meaningful changes it's going to help," he said.

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