

EDC COMMUNIQUE



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The Fourth Element—Power Utilities

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Disruptions from Distributed Renewable Energy (DRE), digital technologies and opportunities for peer-to-peer transactions are challenging the business models of power utilities around the world. Nepal is no exception. Power utilities adapting to these “disrupt or be disrupted” phenomenon is emerging as the winners. This disruption offers Nepal Electricity Authority (NEA) an opportunity to leap frog into a modern utility.

Past few decades has showed us the importance of adapting to changes. Companies like Kodak, Nokia and RIM that could not keep up with the changes have gone obsolete. Such companies, that were once the face of innovation, struggled due to their lack of vision to foresee the disruptive changes. The power sector is going through a

similar stage of change and power utilities all over the world are on the spotlight. Renewable and digital disruption has put immense pressure on power utilities to change. Technology change alone is not enough, utility providers need a 360-degree overhaul of operations and business models.

Traditionally, utility business model has been predictable and risk free. It is safeguarded by long term infrastructure investment and suitable regulatory milieu, resulting in captive customers without alternatives. Utilities were the sole providers of power. But in recent times DRE, behind the meter storage, net metering systems and data analytics capacity, have added an additional layer of complication (opportunity) for the utilities. Now the customers have a choice, in some instances these choices are more reliable and cheaper.

An urban customer can fully go off grid and manage its own power supply or be an exporter of energy. Utilities are used to one dimensional consumers, in today's context the consumer has become a prosumer, one that is capable of bidirectional energy management. Utilities are also behind in utilizing the biggest power of our times, the power of data. Data analytics could help utilities better understand customer needs and manage demand in an efficient manner to optimize profit.

A combination of cleantech, fintech and Internet of Things (IoTs) is transforming the energy world. Power utility is the fourth element in this dynamic disruptive force. Whether they want it or not, the change is coming, and it is coming faster than anticipated. Most power utilities around the world have embraced this new norm. They have accordingly started planning and implementing infrastructure, operational and business model

changes to cater to the changing ecosystem. A customer-oriented approach is a must now, it is no longer sales of commodity, it is sales of service. The change should be contagious around the world.



In our part of the world, the feeling from the utilities is that of resentment, unlike other utilities that are now adapting to the disruptive changes. A sense of fear is in the air, a fear of change and a fear of being redundant. Rather than looking at it as an opportunity to better manage utilities and provide better service to their clients, the inevitable disruption is seen as a threat.

I heard a very young entrepreneur from the Philippines at Asia Clean Energy Forum (ACEF) in Manila this past week. He said, if utilities are unwilling to change, there will come a time when innovative energy companies will buy utilities. Though far-fetched, we might witness it in our lifetime especially in the Indian subcontinent.

India is making forward strides in renewable energy deployment. It has set a mammoth target of 175GW by 2022 of which it has already achieved 62GW (35%). Of the 175GW target, 40GW was set for rooftop solar. Only 1GW (2.5%) of roof top solar has been deployed till date. Why is there such a huge difference between large scale grid connected solar achievement versus small distributed rooftop achievement? The key is the fourth element, the

power utilities.

Power utilities have made it as hard as possible for people to connect their system to the grid. The application process for net metering is so gruesome and lengthy, only a very few are willing to go through with it. Power utilities fear their customers becoming their suppliers.

The primary argument presented by power utilities against DRE is of technical issues, intermittencies and failures. A recent grid integration study in Nepal was used to argue that that only 10% DRE/RE could be injected to the grid without hampering critical technical indicators and components.

I would like to differ. In Germany, studies have shown that even 150% of DRE injection has been successfully accepted by the grid, not even a smart grid. This could be because Germany's transmission infrastructure is well connected with the rest of the European grid. But a more recent study communized by GIZ of DRE integration in Delhi showed that up to 75% of DRE injection was well absorbed by the grid without additional investment in distribution infrastructure. The DRE injection did not make the system go out of voltage range and all other indicators remained stable. Only injection of greater than 75% resulted in some bounds for parameters being breached.

Nepal presents a unique case. It is well poised to plan and implement its energy strategy. It is in a nascent stage of growth. It does not have any coal or gas generators that it must replace. It has one monopolistic state-run utility which can easily adopt to changes, if it wanted to. Last year Nepal purchased 2,175 GWh (billion units) of electricity from India, approximately 50% of total consumed in

the country that year. The sole utility company, NEA reported net loss of 978 million Nepalese rupees. With Transmission and Distribution (T&D) losses at 25%, the net loss figure is very believable. There is no real time data that NEA can track, no fiber optic cables, no remote monitoring facilities. Without data analytics, it is impossible for NEA to take instantaneous decisions to better manage supply and demand.

With over million roofs in Kathmandu alone, more than a GW of electricity could be generated from roof top solar systems. To manage peak load, distributed storage systems could be implemented which could be either after the meter or before the transformer. Why should we wait at least ten years for a storage hydro to be ready? If the environment is bit more conducive, private sector is ready to launch a roof top revolution. Why are they underestimating the power of DRE? With hydro as our main source of electricity, we are technically well controlled to implement a huge percentage of RE. Hydro is considered the most flexible of all energy sources compared to coal, gas or nuclear when it comes to ramping, startup time and integrating intermittent electricity generation into the grid. The main source of energy being very flexible is a key factor to increase RE in the energy mix.

We are at the threshold of building a new Nepal. To build it, a massive supply and management of energy is essential. NEA needs all the backstopping and support from private sector, government and development partners. It needs injection of fresh talents with innovative ideas, not only electrical engineers but also software engineers, block chain developers, management experts, customer service people, people who can drive

change. A work force which is visionary and who will lead us through our journey of prosperous Nepal, driven by technology.

NEA is at the forefront of catalyzing Nepal's transformation. NEA needs to be the medium through which all energy providers, whether that be

hydro power, RE, DRE or any other source of energy, can contribute their share to power Nepal's development movement. NEA need not fear new technologies, it needs to welcome it with arms wide open. Without the fourth element, the energy revolution is incomplete.



EDC ACTIVITIES

3rd January, 2020

Consultative Meeting on Draft Electricity Bill 2076



EDC was invited to the consultative meeting on Electricity Act 2076 bill organized by Ministry of Energy, Water Resource & Irrigation at Yellow Pagoda, Kantipath. Present in the meeting were Honorable energy minister Mr. Barsha Man Pun, Honorable minister of Physical Infrastructure Province 2, secretaries, under - secretaries and various representatives from private, government, NGOs and INGOs. EDC provided the following suggestions:

- Issuance of uniform license to the hydro project with license term of 50 years. The institution receiving the license should initiate the construction within 5 years of receiving the license. This ends the practice of multi licensing autonomy and shortens time to bring the project into construction.
- Calculation for energy royalty to start from commercial operation date (COD) date (currently formula erroneously calculates from generation license date).
- Lease of all the land within the area of hydropower projects for 50 years at the rate determined by the government. This reduces the time of the construction and over valuation and displacement of the land owners.
- Provision of penalization of imprisonment for 5 years to 10 years to the person creating hindrances on the construction of the projects via blocking site construction activities, blocking operational project activities etc.
- The local government of the project implementation area should be made responsible for the distribution of local shareholdings; if local groups are provided with 10% shareholdings. The local community should sign the binding paper for all responsibilities as a shareholder if the project fails. In the case the issuance of share is required after the construction of the project, the developer can issue the share at the premium rate. In the case the local community attains the share of the project, the royalty to be paid to the government should be reduced to 50%, as currently 50% of royalties paid to the government is passed to



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the local community.

- VAT on hydro mechanical equipment fabricated within Nepal to be waived. Currently, it is waived for overseas fabricated parts but not domestic ones thereby promoting foreign productions over domestic production.
- VAT on construction materials for the hydro power projects during the construction period to be waived. A general estimate of per MW construction material requirement to be calculated and this portion should not attract VAT.
- Issuance of the license should be made for guaranteeing availability of transmission line within 5 years.
- The onus is on developer to design a project they feel is optimal for them and this way the government receives more generated electricity.
- Release of the imported electromechanical and hydro-mechanical equipment within 7 days of arrival of the equipment from the Boarder Custom Department.
- Transmission line land from powerhouse to substation to be leased for the developer per decision of the local government for the entire period of 50 years.
- All land provided to the developer for the lands leased from the government should be returned to the developer after the successful handover of the project to the government.
- Introduce the provision of practice of commercial generation and distribution of electricity by any person; using alternative energy through captive plants for the purpose of any person, firm, institution, company or industry.
- Ensure the identity of the small electricity project operating from alternative energy sources and issuance of absolute license for such projects.
- Section 52 of the bill “Use and limitation of land”; has prohibited using the land provided for the purpose of electricity generation from solar project for any other purpose, hence the provision should be amended in accordance to the provision of procedures of providing such lands.
- As electric vehicles are being popular in whole world, the bill also needs to address the provision regarding installation of charging station of such vehicles.
- The state and the developer, both should share the impact caused by the hydrological risk on the generation of electricity and the economic loss incurred during the operation of the project.
- The provision of cost of electricity of NRs. 100 (one hundred rupees) per kilowatt for 15 year of starting commercial generation and 2% of normal per unit sales is not sustainable and the provision should be



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amendment as such.

- This bill has established changes on the provision of issuance of license. The new law has stated that the license shall be issued on free competition and separate license shall be required for different nature of works as commercial generation, distribution and transmission. For all these there is possibility of arising different natured disputed for which a separate tribunal is also required. Therefore, the bill should incorporate the provision of establishment and functions of a tribunal named as Electricity Tribunal.
- The developers are facing problem of low electricity generation due to low flow of water caused by irrigation and rampant urbanization in the upstream. The bill should address such issues and find ways to solve it.
- Due to various reasons, hydropower projects license are being cancelled and deposited in the basket of the government. Till the situation, developers work process would not get any benefit. The provision should be amended with reasonable compensation to the time and resources invested in the project.
- The validity of license should be amended for 50 years. In addition, the department should also consider adding extra term during the renewal of license caused by various unexpected incidents that caused delay in the commercial operation date and operation of the project.
- The bill should incorporate the provision of storage of electricity at least 10-15% so as to substitute the possible reduced flow of electricity generation.
- The punishment should be defined as per the offence.
- The bill states that the project should be handed over to the government after certain fixed time. In the context, there would be no reward of the shares issued to the public during the implementation of the project. This message should be clearly informed to the general public.
- The Bill aims to prohibit electricity project companies from selling more than 25 percent of the share acquired by its promoter prior to the commencement of commercial generation. This provision may incur huge loss in the economy by diverting the foreign investment. Therefore, this provision should be removed and a separate provision should be established for the sale of local promoters share.



EDC ACTIVITIES

7th January, 2020

Visit of Counsellor of Embassy of Japan in Nepal to EDC



We were glad to receive Mr. Yuzo Yoshioka, Counsellor of Embassy of Japan in Nepal and Ms. Sakiko Kurosaka, Advisor, Economic Section of the Embassy who paid a courtesy visit to Mr. Sujit Acharya, Chairman of EDC at its office, Kamaladi.

16th January, 2020

Invitation to Chairman of EDC from Ambassador of Japan



Mr. Sujit Acharya was invited by H.E. Mr. Masamichi Saigo, Ambassador of Japan to Nepal in honor of Mr. Norihiro Nakayama, Parliamentary Vice Minister, Ministry of Foreign Affairs, Japan for dinner reception at Hotel Yak & Yeti. They conversed about renewable energy and information technology. They were excited to learn that Nepal's hydropower is a major source for producing hydrogen and hydrogen fuel that is going to power the world. They expressed Japan's interest in procuring hydrogen from Nepal.



EDC ACTIVITIES

31st January, 2020

EDC Executive Committee Meeting



On 31st January 2020, EDC Executive Committee Meeting was held at EDC office, Kamaladi. The discussion was about the upcoming quarterly interaction program planned for February, 2020 and EDC's Annual General Meeting (AGM).

Present in the meeting were Mr. Uttar Kumar Shrestha, CEO, Butwal Power Company, Mr. Kushal Gurung, CEO, WindPower Nepal Pvt. Ltd., Mr. Sushil Pokharel, Chairman, Sushmit Energy Pvt. Ltd., Mr. Semanta Dahal, Advocate & Partner, Abhinawa Law Chambers, Mr. Anjal Niraula, CEO, Ghampower Nepal Pvt. Ltd. and Ms. Itnuma Subba, CEO, EDC.



NEPAL PERSPECTIVE

15th January, 2020

NEPALI STARTUP TO ROLL OUT COUNTRY'S FIRST ELECTRIC MOTORBIKE

Yatri Motorcycles, a Nepali startup, is set to launch its first electric motorbike "after the summer" this year as the country aims to accelerate the implementation of electric vehicles.

In December, the startup, founded and led by Ashim Pandey, unveiled its V2 model, which it claims is the country's first home-built electric two-wheeler.

The motorbike's specifications are fairly simple, running off a 30 kW engine, with a 6 KWh battery that charges in two hours and gives the bike a mileage of 230km and a top speed of 120km per hour. The motorbike has minimal design, with a carbon fiber body for weight reduction. It also comes with a 7-inch full HD dashboard linked to the Yatri Hub app, which has features including GPS and speed monitoring.

The price tag for the motorcycles has yet to be determined but it is likely to be in the high range for the country.

Nepal's market for fuel-run two-wheeler vehicles in the Kathmandu valley area stood at 750,000 units in April 2019, which contributes to poor air pollution. Although electric cars have made up about 10% of sales in Nepal since 2019, electric motorbikes have not taken off.

Pandey believe that his company has emerged at the right time as the country is moving towards having an electricity surplus.

Yatri came about due to the efforts of several Nepali engineers. The company aims to tap the country's electricity reserves and solve its pollution problem, especially in the capital city of Kathmandu.

The company aims to sell its electric motorbikes in the wider Asian market, after first promoting the product in Nepal. Most of the motorcycle's parts are imported, and subject to 35% import charges, but it was designed locally.

Pandey believes there is a slight cost advantage for electric vehicles as they benefit from various incentives. Electric vehicles, both two and four-wheelers, are exempt from road tax, and customers only pay a 10% import tax on an electric vehicle, against a 240% import tax on non-electric.



However, the lack of charging stations and parking lots, topographical challenges and the low market appeal makes selling electric vehicles a challenge.

The Nepal government recently made it mandatory for customers to register their electric vehicles. The current government aims to have 20% of the country's public vehicles battery powered but there is little industrial or policy support for startups to produce electric vehicles for consumers. The country also does not have strong automobile, design and engineering industries.

Pandey, an aerospace graduate of Delft University of Technology in the Netherlands, returned to Nepal to establish Yatri Motorcycles in 2017. Yatri has been backed primarily by Kalika Group, one of the most respected business conglomerates in Nepal.

"We plan to work on the next model which will be much more practical [for commuters] in terms of design, ergonomics and pricing for the

Nepal mainstream market," Pandey told the Nikkei Asian Review. In the longer term, Yatri Motorcycles is aiming to tap the European market.

Pandey said the biggest challenge for Yatri to roll out its electric bikes was a shortage of highly skilled engineers in Nepal. "Besides, a lack of local industrial support means we have to either be a very vertically integrated company or outsource some of our design to manufacturing companies overseas," he said.

As part of Yatri's effort to overcome these challenges, the startup is planning to manufacture parts within Nepal using 5-axis CNC technology, which uses versatile manufacturing machines with five axes that can operate simultaneously.

Following a seed funding round in 2018, Yatri plans to raise series A funding in late 2020.

"We aim to raise \$10 million. We are in a new segment in Nepal and see ourselves as the only player in this high performance electric motorcycle segment," Pandey said.

12th January, 2020

RECORD USD 105 MILLION OF FUNDING APPROVED BY ADFD UNDER THE IRENA/ADFD PROJECT FACILITY

The Abu Dhabi Fund for Development (ADFD) today confirmed the allocation of approximately USD 105 million for eight renewable energy projects in developing countries in the seventh cycle of the IRENA/ADFD Project Facility.

The announcement marks a record level of funding for any cycle since the facility was launched and will provide funding for projects in Antigua and

Barbuda, Burkina Faso, Chad, Cuba, the Maldives, Nepal, Saint Lucia and Saint Vincent and the Grenadines.

The announcement was made during the 10th IRENA Assembly and brings cumulative funding to date to US\$350 million, in line with the commitment made by ADFD across seven funding cycles to IRENA recommended projects.

“Overcoming investment needs for energy transformation infrastructure is one of the most notable barriers to the achievement of national goals,” said Francesco La Camera, Director-General of IRENA. “Therefore, the provision of capital to support the adoption of renewable energy is key to low-carbon sustainable economic development and plays a central role in bringing about positive social outcomes.

“The record levels of funding announced in this cycle of the facility will not only support the eight chosen countries in their pursuit of energy and climate plans but will also further global ambitions to build a sustainable future,” he continued. “This facility is a true reflection of the transformational outcomes that organisations with shared goals can deliver when they come together and provides a blueprint effective cooperation in the future.”

His Excellency Mohammed Saif Al Suwaidi, Director General of ADFD, said: “In cooperation with IRENA, ADFD is proud to have supported the deployment of renewable energy solutions worldwide over several years. In its efforts to boost the implementation of the United Nations’ Sustainable Development Goals (SDGs), specifically Goals 6,7,11, 12 and 13 – ADFD-funded projects over the seven cycles of the Facility have led to the widespread adoption of scalable, clean, and sustainable energy alternatives in 26 countries.”

He added: “Today’s announcement re-affirms the UAE’s and ADFD’s leading efforts to combat the effects of climate change by stimulating robust development across the global renewable energy sector. The Fund’s commitment to this priority has enhanced long-term growth prospects

and yielded socio-economic benefits for millions of lives in line with the national objectives of the beneficiary countries.”

In **Antigua and Barbuda**, an 8 MW hybrid power plant (solar and wind) will receive an ADFD investment of **US\$15 million**. The project is expected to benefit 5,500 households and allows for large reductions in the import of fossil fuels.

In **Burkina Faso**, an ADFD loan of **US\$5.5 million** will contribute to the construction of a 3 MW solar PV power plant in the country. The project is expected to extend electricity to approximately 40,000 people in rural areas.

In **Chad**, the ADFD loan of **US\$15 million** will contribute to the construction of a six MW solar power plant. The project is expected to benefit more than 215,000 people in six cities.

In **Cuba**, a project will receive an ADFD loan of **US\$20 million** to install 8.5 MW of solar PV capacity, supported with 2 MW of energy storage, in Isla de la Juventud. The project will benefit 32,300 people, aims to support the energy sector, decrease fossil fuel consumption, reduce the level of carbon emissions and secure energy consumption from renewable and sustainable sources.

In the **Maldives**, a waste-to-energy plant project in the city of Addu will receive an ADFD



loan of **US\$14 million**. The 1.5 MW renewable energy project will utilise waste in generating electricity and reduce dependence on imported fuel benefitting 35,000 people.

In **Nepal**, a project will receive an ADFD loan of **US\$10 million** to support a total of 20 biogas digesters which will serve as demonstration units to 270 municipalities. The digesters will convert organic waste into useful energy and offset the use of fossil fuels by replacing it with renewable natural gas.

In **Saint Lucia**, the 10 MW Troumassee solar power station, battery storage and setting up

solar energy systems in the country, will receive an ADFD loan of **US\$15 million**. The venture will support the whole population, economic development, advance the implementation of Saint Lucia's national energy policy and reduce diesel fuel consumption.

In **Saint Vincent and the Grenadines**, an ADFD loan of **US\$10 million** will support the installation of a 7 MW solar PV project and benefit 2,444 households. The renewable energy venture aims to reduce carbon emissions, fossil fuel consumption and operating costs.



GLOBAL PERSPECTIVE

20th December, 2019

NEL ASA: ESTABLISHES JOINT VENTURE TO SUPPLY GREEN HYDROGEN TO HYUNDAI TRUCKS IN NORWAY

Nel Fuel AS, a subsidiary of Nel ASA (Nel, OSE:NEL) today announces the establishment of Green H2 Norway, a joint venture (JV) together with H2 Energy AS (H2 Energy), Greenstat AS (Greenstat) and Akershus Energi Infrastruktur AS (Akershus Energi). Green H2 Norway will establish renewable hydrogen production facilities in Norway to supply hydrogen to Hyundai trucks which are expected in Norway from 2020.

“We are very excited to establish Green H2 Norway together with H2 Energy, Greenstat and Akershus Energi. Our plan is to build several facilities for renewable hydrogen production across Norway, and serve the market with true, zero-emission hydrogen. Hyundai has indicated that they are looking into supplying hydrogen trucks already from 2020, and high numbers from 2021 and beyond. We believe the timing for this is correct, as we also see hydrogen trucks and buses becoming available in large numbers and car manufacturers scaling up the production volumes,” says Jon André Løkke, CEO of Nel.

“Akershus Energi, Greenstat AS and Nel ASA are true pioneers in the field of green hydrogen and we are very pleased having such

experienced and strong partners on our side to work towards decarbonisation. Hydrogen trucks are not just new trucks. They require an entirely new ecosystem and to implement such an ecosystem in less than 12 months it is essential to have partners you can build on,” says Rolf Huber, Chairman of H2 Energy.

“We are excited to be a part of this initiative that will accelerate the market for hydrogen trucks, and renewable hydrogen in Norway,” says Vegard Frihammer, Green Executive Officer of Greenstat.

“Akershus Energi are very pleased with establishing this joint venture together with Nel, H2 Energy and Greenstat. Together we have ambitious growth plans for large scale hydrogen production and distribution in Norway. By establishing this company we hope to contribute to our owners, Viken County, ambition of achieving fossil free transportation in the future. We look forward to working towards establishing a large hydrogen production facility in our region in 2020,” says Eskill Lunde Jensen, CEO of Akershus Energi.

Green H2 Norway is equally owned by the parties, and will in dialogue with other potential partners as well as national authorities initiate the

first project in 2020, which will include exploring sector coupling aspects of large scale electrolysis based hydrogen production. Green H2 Norway is intended to be the exclusive supplier of renewable hydrogen for Hyundai trucks in Norway.

“The sites for producing renewable hydrogen

will be capable of delivering green hydrogen not only to Hyundai trucks, but also to a number of other applications like buses, cars, ferries and fast ferries. The parties intend to establish the first production site just outside Oslo to serve the Oslo/Akershus region,” Løkke concludes.

20th January, 2020

AMAZON INDIA TO ADD 10,000 ELECTRIC VEHICLES TO ITS DELIVERY FLEET BY 2025

Amazon India on Monday said its fleet of delivery vehicles in the country will include 10,000 electric vehicles (EVs) by 2025.

The move follows successful pilots across different cities last year, learnings from which have helped Amazon India create scalable and long-term EV variants to build this fleet, the online retailer said.

These EVs are in addition to the global commitment of 100,000 electric vehicles in the delivery fleet by 2030, announced in the Climate Pledge signed by Amazon. Amazon India aims to reduce carbon emissions and the environmental impact of delivery operations with the introduction of the electric vehicles.

The fleet of 10,000 EVs will include 3- and 4-wheeler vehicles that have been designed and manufactured in India. This year, these vehicles will operate in over 20 cities including Delhi NCR, Bengaluru, Hyderabad, Ahmedabad, Pune, Nagpur, and Coimbatore.

Amazon India has been working with several Indian original equipment manufacturers (OEMs) to build a fleet of vehicles that ensures sustainable and

safe deliveries of orders, the company said.

Akhil Saxena, vice president, customer fulfillment - APAC and Emerging Markets at Amazon, said, “At Amazon India, we are committed to building a supply chain that will minimize the environmental impact of our operations. The expansion of our Electric Vehicle fleet to 10,000 vehicles by 2025 is an integral milestone in our journey to become an energy efficient leader in the industry. We will continue to invest in the electrification of our delivery fleet, thereby reducing our dependence on non-renewable resources.”

In September, last year, the company announced its plan to eliminate single-use plastic in its packaging from Amazon India’s Fulfilment Centers by June 2020, among other initiatives to reduce packaging waste. Amazon India has also invested in energy conservation and solar power generation in its Fulfilment Centers and Sort centers, the statement added.

Last week, Amazon.com Inc. founder Jeff Bezos, during his three-day visit to India, said the company would invest an incremental \$1 billion to digitise micro and small businesses in India.

30th January, 2020

HYDROGEN FUEL CELLS AND THE ZERO-EMISSION SUPPLY CHAIN OF TOMORROW

If this year's headlines are to be believed, hydrogen fuel cells are poised to become one of the defining renewable energy solutions of the future. Since January 2019, the technology has captured remarkable levels of interest from some of the world's most important economies, energy leaders and corporations.

However, much of the conversation surrounding future applications for fuel cell technology tends to ignore the areas where it might make the greatest impact. As the CEO of a company that designs and manufactures hydrogen fuel cell systems, I've witnessed this firsthand. Most often, we often find ourselves distracted by the enduring allure (and endless theatrics) of the consumer automotive sector.

That's unfortunate, because while fuel cells certainly have the potential to transform our global economy, it won't be the rise of fuel cell electric vehicles (FCEVs) that does it. It's much more likely that fuel cell technology will change the world through its impact on the global supply chain, forever altering the flow of goods and resources around the planet and transforming the way we do business.

A Good Year For Fuel Cell Technology

This isn't just some sanguine flight of fancy. Today's rapidly maturing fuel cell technology is showing enormous promise — enough to drive significant investments from some of the world's

biggest economies. In March, the Chinese government announced plans to promote the development and construction of fueling stations for hydrogen fuel cell cars. In June, the International Energy Association (IEA) released its monumental hydrogen report, which precipitated the signing of a joint statement of future cooperation on hydrogen and fuel cell technologies by national energy agencies from the U.S., E.U. and Japan. In November, the Fuel Cell and Hydrogen Energy Association issued its Road Map to a U.S. Hydrogen Economy, highlighting the critical importance of hydrogen in achieving a low-carbon energy mix.

The excitement surrounding hydrogen fuel cells shouldn't come as a surprise. Fuel cells are a remarkably versatile technology with a wide array of applications, and they offer numerous practical advantages over other renewable energy solutions. Once the hydrogen and fuel cell technology ecosystem is fully mature, it could have the potential to transform each link in the global supply chain. Let's take a look at a few examples:

Manufacturing And Distribution

Hydrogen fuel cells aren't just the technology of tomorrow; they're also the technology of today. While we're still very much in the early stages of seeing consumer FCEVs take to the streets, fuel cells are making a real impact in nontraditional transportation applications like forklifts and other material handling equipment.

In fact, there are already over 25,000 hydrogen fuel cell forklifts and the number of hydrogen fueling stations deployed in warehouses, stores and manufacturing facilities across the globe continues to increase.

With fuel cell adoption growing in the manufacturing sector and FCV infrastructure continuing to scale, I think it won't be long before hydrogen technologies take on a more prominent role in the distribution phase of the supply chain as well.

Fuel cell-powered freight trucks, ships and planes being used in the distribution process would eliminate another significant source of GHG emissions and once again lead to dramatically lower operating costs. Incorporate advances in autonomous vehicle technology, and it's easy to envision a future in which fleets of autonomous, hydrogen-fueled freight trucks, ships and planes create a constant flow of consumer goods around the planet, rendering words like "exotic" all but obsolete.

Shipping And Freight Forwarding

In 2018, the United States alone exported goods and services worth \$2.5 trillion and imported \$3.1 trillion, and much of that was transported between countries via ships. The use of traditional diesel-powered port equipment creates an environment for high GHG emissions. Hydrogen fuel cells can be used for the loading and unloading of ships. It's no surprise that business leaders in the freight forwarding industry are already looking at hydrogen fuel cells as a solution for achieving carbon-free trucking over the long term.

Last-Mile Delivery

But perhaps the most exciting (and even perplexing) potential application of fuel cells in the supply chain is in the realm of last-mile delivery. Today, most of these deliveries are carried out via traditional diesel-powered trucks, which in many cases must travel miles between stops on ever-changing delivery routes. This makes last-mile delivery incredibly inefficient.



As a result, a company's efforts to deliver products to the end user has become by far the costliest part of all supply chain shipping, so much so that last-mile delivery can easily account for over 50% of all supply chain shipping costs. Hydrogen fuel cells could change that forever.

Imagine a future in which solar-powered hydrogen fuel production enables a company like Amazon to create a fleet of airships that take up permanent residence in the skies above every major city. These airships could house thousands of fuel cell-powered drones capable of delivering packages to our doorsteps within minutes of receiving an order.

Such an innovation would make last-mile delivery significantly more efficient for consumers, who would receive shipments more quickly, and also for retailers, who would spend less money on fuel.

More importantly, these innovations could greatly reduce the supply chain's overall carbon footprint, forever eliminating one of the world's biggest sources of carbon emissions.

The Supply Chain Of Tomorrow

As thoughtful consumers, we are encouraged to temper our consumption due, at least in part, to the threat of climate change. However, advances in fuel cell power and automation technologies could

obviate those concerns altogether. How might such a shift affect our consumption patterns, our communities or our relationships with one another? It's hard to say.

One thing is for certain, though: The fuel cell revolution is coming to the global supply chain, and these are exactly the questions we should be thinking about as we work to build the energy economy of the future.

MEMBERS





MEMBERS

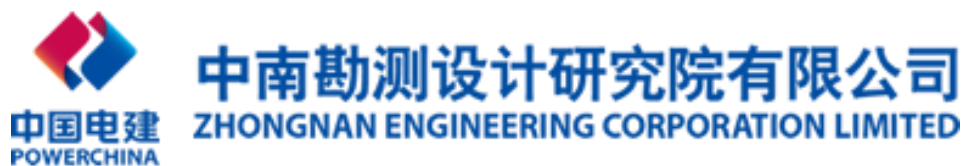




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Energy Development Council (EDC) is a non-profit umbrella organisation of the entire energy sector of Nepal established to ensure every Nepali has access to energy and energy security by promoting favourable policies and investments. EDC consists of Energy Developers, Energy Associations, Energy Consumers, Energy Financiers and other funds, Consumer Institutions, Energy Contractors from both private and government sectors involved in hydropower, solar, wind and other renewables, generating more than 80 percent of the nation's total electricity.



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