THE LATEST NEWS NUMBER 246, 2016 FCDIC

Large-Scale Hydrogen Energy Use Starting in Community

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1. Governmental Measures

On April 19th, the Agency for Natural Resources and Energy of the Ministry of Economy, Trade and Industry, METI, has compiled the "Innovative Energy Strategy" to aim for expansion of investment in energy to promote energy saving and renewable energy use. The keys are more energy saving measures, expansion of renewable energy use and development of new energy system. For the automobile area, they plan to achieve automatic driving technology and to promote fuel cell vehicles (FCVs) and electric vehicles (EVs) as well as infrastructure preparation for these cars. These measures aim to achieve a combination of strong economy and reduction in CO_2 emissions. The expected economic effects is ¥28 trillion from energy related measures, including ¥1 trillion from hydrogen related measures, such as energy saving and renewable energy by 2030. The ministry will make an effort to save energy specifically at smaller businesses, and in the housing and transport industries. As transport measures, automatic driving technology is aimed to be commercialized, and purchase of next generation vehicles will be subsidized as a measure to create initial demand. Platooning for trucks is expected to reduce energy by over 10%, and is planned to be established by 2030 as a measure. To expand renewable energy use, the feed-in tariff, FIT, will be revised, and procedure period of environmental impact assessment will be halved. Also, other projects will be promoted in cooperation of various governmental bodies. The ministry aims to establish a system to use locally produced energy and a combined system to use renewable energy while reducing energy consumption. (Nikkan Jidosha Shimbun & The Denki Shimbun, April 20, 2016)

METI will reassemble the "Committee for Early Achievement of Next Generation Thermal Power Generation." A technology roadmap was compiled last July, and the progress will be reviewed at the conference. Also, the committee will investigate whether hydrogen power generation should be included in the schedule. The committee will hold two meetings to revise the schedule. Highly efficient next generation thermal power is more environmentally friendly, and expected to be used more. However, its high cost is an obstacle. At the same time as technological development, the committee will discuss steps to introduce the power generation. On May 11th, the fifth meeting will be held. Prof. Takayuki Takarada at the Gunma University will stay as the chairperson. The committee will add two more members who are familiar with hydrogen technology, which is to make 20 members in total. Next generation thermal power includes various technologies such as integrated coal gasification fuel cell combined cycle (IGFC), integrated coal gasification combined cycle (IGCC) and 1700 °C class gas turbine combined cycle (GTCC). In last year's meeting, the New Energy and Industrial Technology Development Organization (NEDO) was chosen to manage progress of technological development. The committee will carry out hearing investigation on manufacturers of advanced ultra-supercritical (A-USC) power generation and advanced humid air turbine (AHAT) which are close to be technologically achieved. Hydrogen power generation will be discussed in the sixth meeting to be held at the end of May. Since the Hydrogen/FC Strategic Road Map was revised this March, and the committee will compile a schedule of comprehensive next generation thermal power including hydrogen power generation. (The

Denki Shimbun, May 11, 2016)

2. Local Governmental Measures

(1) Muroran City

A hydrogen era has started in Hokkaido. Muroran City has purchased Toyota's FCV MIRAI as an official car which is the first in Hokkaido, and prepared a mobile hydrogen refueling station. The city has compiled "Muroran Green Energy Town Concept", and is accelerating development of society to use hydrogen. FCV has drawn attention entire Hokkaido. In the northern and eastern areas of Hokkaido, a number of projects have been launched to use hydrogen produced by renewable energy such as wind turbine, photovoltaic generator and biomass, which spotlights FCV. However, FCV has an issue of refueling infrastructure preparation. Hokkaido has no stationary hydrogen refueling stations in the Sapporo urban area, and the progress of the infrastructure preparation is left behind compared to the rest of Japan. The issue has become clear, and a solution should be sought in cooperation of public and private sectors. (Nikkan Jidosha Shimbun, April 20, 2016)

(2) Tokyo

On April 22nd, Tokyo, Keisei Bus and Toyota Motor signed a memorandum of understanding on a plan of bus rapid transit (BRT) system to connect the center and the coastal area. The system is planned to operate from 2019, and the three organizations will cooperate for commercial operation of FC buses with automatic driving system. (The Nikkei, April 23, 2016)

(3) Yamanashi Prefecture

Yamanashi Prefecture has opened a FC Evaluation Laboratory at its Industrial Technology Center. The laboratory is installed with 16 pieces of evaluation equipment for power generation to analyze performance and durability of FC materials developed by universities and businesses. The objective is to standardize evaluation methods that each developer is currently using own system in order to support material development and to make an industrial center in the prefecture. The local government has been inviting FC related manufacturers and research institutes, and is encouraging local businesses to enter the industry. They are also participating a FC project of NEDO. In the prefecture, Yamanashi University is researching on the most advanced technology at its FC Nanomaterials Center. "We want to make the prefecture to be FC Valley in the future." Mr. Hitoshi Goto, the Governor of Yamanashi, said at the opening ceremony. (The Nikkei, April 27, 2016; The Nikkei Business Daily, April 28, 2016)

3. FC Related Technology Development & Business Plans

(1) Fuji Electric

Fuji Electric will operate an energy saving plant factory which is to use exhaust gas and heat from FCs to grow vegetables and fruits at its Tokyo Factory, Hino City, from May. In FCs, oxygen is reduced by reacting with hydrogen. Exhaust gas has a higher concentration of CO_2, and will be used to grow plants. As energy costs can cause reduction in profit of plant factories, efficient use of energy can promote these factories. The new plant will collect data on energy consumption and interior environment, and then will grow strawberries from this autumn. The manufacturer will establish a technology to improve efficiency of plant factories. They will use own FC system of 100 kW output. This system is operating as a power source for research and development building of which construction was finished at the end of 2015 in the Tokyo Factory. The system will supply exhaust gas and heat to plants. An absorption chiller will take high temperature waste heat to cool the plant factory down in summer. In winter, low temperature waste heat will be used to warm the plant factory. Common plant factories use air with high concentration of CO_2 and air conditioning which consume a large amount of energy. An estimation technology using calculation system of solar power generation and demand will be put in practice to estimate yield. The technology calculates an amount of solar radiation from weather forecast to estimate yield seven days ahead. This estimation system will learn the actual yield to improve its accuracy in order to plan a number of workers for efficient harvesting. (The Nikkan Kogyo Shimbun, April 19, 2016)

(2) Sumitomo Metal Mining

On April 28th, Sumitomo Metal Mining announced that it would start business to collect scandium, one of the rare earth elements used in FCs, and signed a long-term sales agreement of scandium oxide with American firm. The amount and period of the sales

are closed. For this deal, Sumitomo Metal Mining will build a new plant at the smelter of the subsidiary in the Philippines. The production capacity will be 7.5 tons (calculated in scandium oxide) each year, the plant will start operation in 2018. The plant in the Philippines will produce an intermediate product of scandium oxide, and the Harima Refinery will make a final product. The total investment is about ¥4 billion. Scandium is found in nickel ore, and is produced about 10 to 15 tons each year mainly in China and Russia. However, the amount of production is low, which is an issue. Sumitomo Metal Mining will use own technology to efficiently collect scandium during production process of mixed nickel-cobalt sulfide to dominate the promising market by this commercial production. (The Nikkan Kogyo Shimbun, April 29, 2016)

(3) Kyocera

Kyocera will put more effort in environment and energy related business. Solid oxide fuel cell (SOFC) and photovoltaic generator are two important businesses. As the FC business, the firm will develop own SOFC system using new SOFC stack which is commercially produced to supply Osaka Gas for ENE-FARM. The new FC system is planned to be commercialized by the end of FY2016 targeting restaurants, cafes and convenience stores. For the photovoltaic generation business, a system will be proposed more for energy independence using power produced by solar panels. Their new power storage system and home energy management system (HEMS) will be introduced into the market this financial year, which is to support development of zero-energy house (ZEH). The manufacturer aims at 1.3 GW of photovoltaic generation modules, 100 MW increase of that of the previous year, for FY2016 by stabilizing product supply for solar power plants and exploring the housing market at faster speed. (The Chemical Daily, May 6, 2016)

4. Hydrogen Infrastructure Technology Development & Business Plans

(1) Honda

On April 18th, Honda held a test ride of its new FCV running on hydrogen. Their target of hydrogen society was indicated by displaying a small hydrogen refueling station which can be installed in a day and power supplier which can be used as a large-scale power source in emergency. Hydrogen infrastructure is expensive, which is the bottle neck of hydrogen society. The firm tries to catch up with Toyota, the leader in the area, by suggesting a solution for the issue. The test ride was held in Wako City, Saitama Prefecture, where Honda R & D is located. Their "Smart Hydrogen Station (SHS)" was introduced this time as well as the FCV. SHS requires 1/20 to 1/30 the installation area of conventional one, and the installation cost is about 1/10. It can be transported by truck and ready to use in a day. Being able to be easily removed, it can be sent to a demanded area quickly. The station produces hydrogen by electrolyzing water using renewable energy such as solar power. The dispenser can fully fill FCV in three minutes through its nozzle in the fuel inlet. Their plan is to operate the stations in at least eight locations by the end of 2016. They will carry out preparation in smaller cities in the Tohoku and Shikoku areas as well as big cities to fortify the hydrogen supply chain. To promote FCVs, Toyota's MIRAI will be able to use these stations. Furthermore, external power supplier was developed to provide home and medical instruments with electricity. The product has several times higher output of EVs, and can supply an average household with electricity for seven days with a full tank of hydrogen. Honda expects FCVs to be "driving power source" at emergencies. FCV's competitor is EV which expands its number of range and manufacturers. The number of quick chargers has reached 6,500 locations in Japan. FCVs have a large disadvantage in infrastructure. Because FCV production is almost handwork, reduction in cost to half is also far. To compete in eco car war, FCVs need to be widely used by continuously developing innovative technologies. (The Nikkei, April 19, 2016)

(2) Toshiba

On April 21st, Toshiba announced that its independent hydrogen energy supply system "H_2One™" had been delivered to the Yokohama Port International Cargo Center under the jurisdiction of the Port and Harbor Bureau of Yokohama, and started the operation. Yokohama City placed an order for the system to be a part of business continuity planning, and this is the first independent hydrogen energy supply system operated by a local government

They will test the system to reduce peak power usage and as an emergency power source at disasters. The system consists of equipment to produce hydrogen by electrolyzing water using power from photovoltaic generator, a hydrogen storage tank, FCs, a storage battery, and a hot water tank. During disasters, the system can independently operate to supply the disaster center with power for 72 hours. The city will install solar panels on the warehouse roof of the cargo center in FY2016 to make the power system CO_2 free. (The Nikkan Kogyo Shimbun & Dempa Shimbun, April 22, 2016)

(3) NITE

The National Institute of Technology and Evaluation, NITE, has developed a technology to produce hydrogen using iron pieces and microbes in cooperation with Nippon Steel & Sumitomo Metal. The technology uses microbes having an enzyme to produce hydrogen. They aim to make efficient use of old bridges with hydrogen production technology. An experimental production facility is planned to be built in five years. They use microbes found in the bottom of a petroleum tank in Japan to produce methane. This microbe mixed with iron pieces in water takes electrons from iron and give them to hydrogen ions in water to create hydrogen gas. The by-effect of methane production is stopped by reducing the amount of carbonate ions, and hydrogen was produced for four weeks. The team is currently testing the microbes in tubes, and will make genetically modified escherichia coli to produce the enzyme of the microbe for improvement in production rate. The technology is expected to use the microbes and a part of steel frames from demolished bridges in a large tank. The team will develop the technology to produce hydrogen for FCVs. (The Nikkei, April 25, 2016)

(4) Alhytec

On April 22nd, Alhytec in Takaoka City, Toyama Prefecture, and NEDO announced that construction of an evaluation plant to produce hydrogen from waste containing aluminum was completed and the operation started. The hydrogen production will be increased to maximum 5 kg/h. This amount let a FCV to drive about 700 km. Alhytec developed an own system to separate aluminum from waste to produce hydrogen for power generation. This plant development has been carried out to use aluminum waste as a part of the "Strategic Energy Saving Technology Innovation Program" of NEDO since December 2014. The group aims to use this technology at printing, packaging and metal factories in the future. As a part of this project, Alhytec built the evaluation plant at Toyama Plant of Asahi Printing in Toyama City to produce hydrogen from aluminum mixed waste. The completed plant consists of a pulper separator, a pyrolysis furnace and hydrogen production equipment. The firm has ensured the operation using factory waste containing aluminum, and succeeded production of 2 kg/h hydrogen. The hydrogen production is planned to increase to 5 kg/h. Pulp, oil and aluminum hydroxide come out during the process, and the firm will investigate effective use of them. Other technological issues will be examined. (The Denki Shimbun & The Chemical Daily, April 25, 2016)

(5) Obayashi & KHI

Obayashi Corporation and Kawasaki Heavy Industries, KHI, will start a project to supply a part of Kobe City with electricity generated using hydrogen as fuel in 2018. This is the world's first community project using hydrogen power generation as the power source. This system can reduce CO_2 emissions, the main part of greenhouse gases, by over 20% of that of conventional thermal power generation. This project is working on hydrogen energy use in community at large-scale as well as fuel for cars and individual homes. Once a large amount of hydrogen is used at power stations, the price of hydrogen will go down, which is to lead to expansion of related businesses. In cooperation of the Kansai Electric Power Company (KEPCO) and Kobe City, the project will supply power to about 25 ha. of the Port Island area where the Kobe Portopia Hotel and the Kobe Convention Center are situated. By granting governmental subsidy, power will be provided to the hotel and convention center at almost the same price level as the current tariff from the grid. The capacity level is for an office complex with about 10,000 workers, and hydrogen use is to be an equivalent of fuel for 20,000 FCVs to use each year. The details of the project will be decided by the four organizations. KHI's gas turbine of 1MW level output will be installed in the area. Power will be generated using mixed fuel of 20% hydrogen and 80% natural gas to start with. Because hydrogen emits no CO_2

during power generation, the CO_2 emissions can be reduced by 20%. The group will consider power generation to solely use hydrogen. The construction will start in 2017, and the system is planned to operate from 2018. The investment is estimated to be about ¥2 billion. KHI already developed a dedicated turbine which requires a system to adjust speed and amount of hydrogen feed, and the turbine is being tested in a plant. This project will be developed as a model collecting knowhow in order to expand hydrogen use globally. Heat coming out during power generation will be sent to the hotel to use to heat water. An information technology will centrally control electricity and heat use, and the project plans to supply half the power and heat consumption in the area using hydrogen power generation. The grid will supply power when the demand exceeds output of the generator. Obayashi is trying to establish this town development using hydrogen power generation into a new business. KHI is working on a plan to build an import base in the Port of Kobe for hydrogen which is produced abroad at a cheaper price by FY2020. They also aim to expand sales of power generation facilities. (The Nikkei, May 2, 2016)

(6) Chugoku Kogyo

Chugoku Kogyo announced a joint development of a hydrogen tank for FCs to drive a space probe in cooperation with Japan Aerospace Exploration Agency (JAXA) and Kyushu Institute of Technology. The tank will be made with carbon-fiber–reinforced polymer (CFRP), and the team will develop the tank to hold hydrogen without leak at between a high temperature of 120°C and a low temperature of -200°C to keep the product performance for five years. The Japan Science and Technology Agency (JST) is supporting this project, and the project will last until March 2019 the latest. Chugoku Kogyo received ¥13 million expense for this research and development for the first year. The tank is to hold 45 L of hydrogen at 35 MPa. The weight is to be 12 kg or less. The inner dimension is to be 30 cm diameter and 86 cm long. The probe will be powered by FCs. A photovoltaic generator will generate electricity to split water to separate oxygen and hydrogen which is to be stored in the tank. The FCs will produce power when the photovoltaic generator cannot operate. (The Nikkei Business Daily, May 12, 2016)

5. ENE-FARM Business Plans

(1) Daiwa House

Daiwa House has been entrusted with the contract of the "Safe & Environmental Smart Model Area Development Project" of Toyama City. After the project proposal, the firm was given preferential negotiating rights. Then, the basic agreement was signed with the city. The firm will construct public facilities such as community and area centers to sell them to the city as well as 21 houses for sale. The construction will start from the end of 2016, and the housing sales will begin in May 2017. The public facility is planned to be built from October 2017. This project will use about 848 m^2 of land which was used as Toyota Elementary School of Toyata City to aim to have public facilities and the residential area to closely work together for disasters and reduction in energy and CO_2 emissions by using environmental technology. All the houses will be installed with photovoltaic generators, home lithium-ion batteries (LIB) of 6.2 kWh and ENE-FARM. There will be a system to show energy production and consumption of the whole community and a photovoltaic generator of 10 kW communal in the community to achieve net-zero energy town. (The Chemical Daily, May 6, 2016)

(2) Hiroshima Gas

Hiroshima Gas has received an order for ENE-FARM for apartment units. Marimo, Nishi-ku in Hiroshima City, is constructing "Pole Star Ujikaigan Harbor View" which is a condominium to be completed by March 2018 in Minami-ku of Hiroshima City, and this development will use the FCs. This is the first order of ENE-FARM for apartment units for the gas supplier. The firm already had orders for 320 units for houses. Since the component manufacturers reduced the size of power unit and hot water tank for apartment units, the market has been expanding. Due to the reason, 32 units of the condominium will be installed with the power system. Hiroshima Gas will try to sell more FC systems for apartment units. (The Nikkan Kogyo Shimbun, May 9, 2016; The Denki Shimbun, May 10, 2016)

6. Cutting Edge Technology of FCV & EV

(1) Yaskawa Electric

On April 18th, Yaskawa Electric, a major industrial

robot manufacturer, announced that it would produce driving components such as a motor for EVs in China. A joint venture will be launched with Chery Automobile, a local major automaker in Anhui, China, in June to develop a motor. The Chinese government has been promoting EV, which is expanding the market. To explore the automobile industry, Yasukawa Electric will use its motor controlling technology from its robot development. The venture is named "Chery New Energy Automobile Technology". 100 million CNY will be invested, and Yasukawa will contribute 40% of it. (The Nikkei, April 19, 2016)

(2) Toyota

On April 24th, Toyota Motor announced that its plug-in hybrid vehicle (PHV) would be released in the Chinese market in 2018. Their small class "Corolla" and "Corolla Levin" will be locally produced. This is to be the first PHV for a Japanese automaker to introduce into the Chinese market. Toyota will seriously explorer the expanding eco car market to accommodate the environmental regulations tightened by the Chinese government. Their eco car strategy was revealed prior to the "Beijing International Automobile Exhibition" to start from 25th in Beijing, China. Previously hybrid vehicles, HVs, were the key in their eco car strategy, and they have been locally produced and sold in China. Last autumn, the firm introduced HV version of Corolla and Corolla Levin with their first core components produced in China. However, the Chinese government promotes only "new energy cars" which are EV and PHV. Although each new energy car which is produced in China is eligible for the subsidy of over ¥ 1 million at the most, HV is excluded in the subsidy list. The firm will reduce actual consumer purchase cost by adding its locally produced PHV on the list of the new energy cars to aim for a fast growth in the eco car market. "The PHV release truly shows our enthusiasm for the Chinese market" said Mr. Hiroji Onishi, a senior managing officer in charge of operation in Chine, said at the press conference in Beijing on 24th. In China, the sales of new energy cars shot up to 330,000 vehicles, four times of that of the previous year, for 2015 due to generous support of the governmental subsidy. Specifically, the growth is evident in PHV sales. The Chinese government intends to continue the subsidy scheme for the new energy cars until 2020. Honda is also considering in introducing PHV by 2020 after starting sales of locally produced HV version of "Accord", its core product, in China this summer. Previously, the Chinese eco car market was completely dominated by local firms, including BYD, which have many certified products as the new eco cars by the government. The market will experience more competition by entry of foreign firms including these Japanese automakers which have advantages in environmental technology. (The Nikkei, April 25, 2016)

(3) Beijing International Automobile Exhibition

On April 25th, the Beijing International Automobile Exhibition started in China, and global major automakers such as German-based VW and Honda revealed plans to introduce their latest eco cars into the Chinese market. Because China is tightening environmental regulations due to severe air pollution, car makers are press to invest more in development and production. Since uneasy sentiment has been spread in demand because of slowing down Chinese economy, the key to win the eco car competition is endurance. "We will invest over €4 billion (¥500 billion) to fortify environmental and safety technology", Dr. Jochem Heizmann, the director in charge of VW operation in China, said. The most eye catching exhibition is VW in the huge venue with nearly 1,200 new cars displayed and over 1,600 firms of participants from all over the world. China is the most important market for VW which is suffering from the emission fraud. From 2017, the Chinese government will adopt the latest European level of the regulations for emissions which is the strictest standards. To accommodate this circumstantial change, VW will introduce 15 eco cars over three to four years. From 2018, they plan to produce PHV using small class "Golf" at full-scale. GM, the leader in the market, will also invest 100 billion CNY (about ¥1.7 trillion) over five years to expand sales of its EVs. 24.59 million vehicles were sold in 2015, which puts China in the first place for the global sales for seven years in sequence. Although the market growth has slowed down, the penetration rate of cars is just over 10% of the population. Hence, a lot of market estimations still indicate room for growth. The Chinese government generously provides subsidy of ¥1 million for each eco car, and automakers will

release new cars into the market to aim for expansion of their shares quickly as possible. However, the business environment has been worsened. "The tax reduction for small cars started from the last October. This largely supports steady demand, but the circumstance is very tough." Mr. Nobuhiko Watabe, an executive officer of Mazda, spoke their consideration. Discounts are often applied at actual sales, which create price competition. Because of this, the profit of the automakers tends to be damaged. (The Nikkei, April 26, 2016)

(4) Electric Vehicle Japan

In July, Electric Vehicle Japan, a joint venture in Toyonaka City of Osaka Prefecture launched by four automobile servicing businesses, will release an electric cart which is expected to be driven in a facility, and to take 11 passengers. Although the electric cart will not be allowed to drive on public roads, the manufacturer targets leisure facilities, airports and factories for product use. A resort hotel in Nagano Prefecture is already interested in the cart. The dimensions of this small electric cart are 4.5 m long, 1.6 m wide and 2.4 m high. The maximum speed is about 20 km/h. The cart with doors will sell for ¥6.5 million, and the price for open specifications without doors is ¥5.5 million. It can be recharged through a domestic wall socket, and drives about 30 km after 6 hour charge. The firm is considering in sales of powertrain without body, and plans to produce 50 vehicles each year. Small electric cart were produce and sold to be use in Huis Ten Bosch in Sasebo City of Nagasaki Prefecture and in Universal Studios Japan in Osaka City. "Electric busses will be more in demand at hotels and local airports for foreign tourists." Mr. Chotaro Nishida, the president, said. (The Nikkei, May 2, 2016)

7. FCV Material Development

(1) NGK Insulators

NGK Insulators will commercially produce beryllium copper alloy for FCVs and hydrogen refueling stations. In cooperation with Kyushu University, they evaluated performance of the alloy for hydrogen related products, and the metal exhibited no change in strength under high pressure of 1,000 atm. Product samples have already been shipped, and the manufacturer will introduce the product into the market in two years. By expanding usage as leverage, ¥30 billion (¥21.5 billion for the term ending March 2015) is targeted for their metal business. The firm has the largest share of beryllium copper alloy in Japan. The alloy has an advantage of high conductivity while being strong, and used in a wide range of products such as underwater cables, airplane parts and connecters of cable harnesses and switches for automobiles. However, the alloy had to be tested its strength and ductility for safety to be used for the high pressure hydrogen area, which was a high bar to be cleared. Because of this, the firm examined changes in strength and ductility of the alloy under high pressure hydrogen with the Research Center for Hydrogen Industrial Use and Storage of Kyushu University. As a result, the alloy showed no changes in its strength and ductility under high pressure hydrogen, and the two parties have jointly filed a patent application for the new usage of the alloy. Internal parts for FCVs and hydrogen refueling stations are exposed to high pressure hydrogen, and strength is required for them to stand high pressure of over 700 atm. Currently, pressure vessels for this type of use are made thicker or coated by expensive CFRP to meet the safety requirements. Beryllium copper alloy allows making pressure vessel thinner or reducing the amount of CFRP. Heat exchangers for hydrogen refueling stations are another expected usage. According to the New Business Planning Office of NGK Insulators, "beryllium copper has high potential to reduce product size and to improve performance." The alloy is estimated to reduce the cost of accumulator to half. (The Nikkei Business Daily, April 20, 2016)

(2) GS Yuasa

On April 21st, GS Yuasa Corporation announced that its LIB was used in Honda's "CLARITY FUEL CELL". The battery is "EHW5", and is produced at Blue Energy, a subsidiary of GS Yuasa in Fukuchiyama City of Kyoto Prefecture. The product reduced its weight by 17% and size by 7% while keeping high power output. Blue Energy has produced LIB at a commercial level since 2011, and shipped a total of over 500,000 units for automobiles until the end of FY2015. (The Nikkei & The Chemical Daily; April 22, 2016)

(3) Lanxess

German-based Lanxess sells composite material of resin and glass fiber, and the material is used as rear bumper of "CLARITY FUEL CELL" released by Honda in March. The product is highly tough and stiff, and allows reducing weight to 50% of that of steel plate. Its easy shaping capability can contribute to reduction in production process and costs. BMW's sport PHV "i8" also uses this material. This glass fiber reinforced thermo-plastic that Honda uses is a composite of "Durethan" which is high-tech plastic and "Tepex" which is glass fiber reinforced thermoplastic, such as polypropylene and polyurethane, composites. Because materials of some automobile parts cannot solely be made with resin, composite materials which are highly performing resin fortified by glass fiber are more in demand. (The Nikkan Kogyo Shimbun & The Chemical Daily, April 25, 2016)

(4) Bridgestone

Bridgestone has delivered its "ECOPIA EP160" for factory set tires of Honda's "CLARITY FUEL CELL" which was introduced into the Japanese market in March. ECOPIA EP160 has specifically reduced rolling resistance while keeping safety and driving performance, and achieves both comfortable and silent driving. (The Nikkan Kogyo Shimbun, May 5, 2016)

8. Hydrogen Refueling Station Element Technology Development & Business Plan

(1) Toho Gas

Toho Gas was constructing "minato AQULS Eco Station" in the land which was used as its plant in Minato-ku, Nagoya City, and it announced the completion of the construction on April 19th. As well as refueling facilities of natural gas and liquefied petroleum gas (LPG), the station is installed hydrogen filling equipment which is the third facility for the gas supplier. Full operation will start from early May. Hydrogen will be produced at the Technical Research Institute of the gas supplier in Tokai City, Aichi Prefecture, and be transported by a dedicated vehicle to the station. (The Denki Shimbun & The Nikkan Kogyo Shimbun; April 21, 2016)

(2) JFE Steel

JFE Steel, Tokyo, has reached close to commercialization of a multi material container to store high pressure hydrogen which is a seamless steel pile wounded by carbon fiber. A commercial production method will be established in FY2017, and the commercialization is aimed by FY2018. The main expected usage is stationary containers for hydrogen refueling stations of which preparation is in progress for FCV growth. The new container is under development in cooperation of the JFE group and Mitsubishi Rayon, and designed by JFE Container which produces and sells accumulators as its key product. Mitsubishi Rayon's carbon fiber is wounded around the side of seamless steel pile produced by JFE Steel to improve pressure resistance in the inflating direction. Because the maximum steel thickness of the pipe is about 60 mm, the pipe without any changes may break when high pressure of 70 MPa is applied. On the other hand, the fortified pipe with carbon fiber withstands very high pressure of over 80 MPa. The new container can reduce the amount of expensive carbon fiber compared to an aluminum liner fortified by CFRP. Seamless steel pipes can be supplied at a low cost by using production facilities such as Chita Works of JFE Steel in Chita City, Aichi Prefecture. The weight is heavier than an aluminum based container, but that is not disadvantage for stationary use. The JFE has already made a pilot multi material container of 40 L capacity, and plans to increase capacity up to 200 L for commercial level. (Nikkan Jidosha Shimbun, April 26, 2016)

(3) Iwatani

On May 9th, Iwatani held an opening ceremony of hydrogen refueling station for FCVs in Osaka City. They rend the land near JR Morinomiya Station from Osaka Prefecture to install the first stationary refueling station in Osaka City. Liquid hydrogen is used to supply high pressure hydrogen gas. The station also has explanation of hydrogen use in diorama and video forms. "Hydrogen is very important as an emergency energy source." Mr. Masao Nomura, the president of Iwatani, laid emphasis. "We are happy to have this base to promote necessity of hydrogen society." Mr. Ichiro Matsui, the governor of Osaka Prefecture, said. (The Nikkei, May 10, 2016)

(4) Hiroshima Toyopet

Hydrogen refueling stations are decided to be open

in Hiroshima. Since the applications for the subsidy for installations of hydrogen refueling stations that Hiroshima Toyopet and another firm sent to the Next Generation Vehicle Promotion Center (NEV) were approved, hydrogen refueling stations will be open in Higashihiroshima City and Kure City. This installation of hydrogen refueling stations in Hiroshima will advance the progress of hydrogen energy society in the Chugoku region. On April 27th, NEV revealed winning projects of the "Subsidy for Hydrogen Refueling Facilities for FCVs for FY2016". Support will be given to nine projects including two projects which are the first for Hiroshima. Hiroshima Toyopet will prepare a mobile hydrogen refueling station in Higashihiroshima City, and Hiroshima Toyota Trading will also prepare mobile one in Kure City. Supply capacity of both facilities is from 100 to 300 Nm^3/h, and the facilities can supply two FCVs in an hour. The subsidy is up to ¥180 million. (Nikkan Jidosha Shimbun, May 10, 2016)

(5) Takamatsu Teisan

Takamatsu Teisan produces and sells various high pressure gases in Takamatsu City, and will start business to prepare hydrogen refueling stations for FCVs. As the start, a refueling base is planned to be installed in Takamatsu City by next spring, and this is to be the first one in Kagawa Prefecture. The firm will organize business of hydrogen refueling facilities by using its experience of high pressure gas in the Shikoku area to backup FCV promotion. A mobile facility on trailer will be completed in FY2016 to be installed next April. The project cost is about ¥300 million, and a total of ¥45 million will be subsidized by Kagawa Prefecture and Takamatsu City. The facility is expected to have capacity to supply three FCVs in an hour, and can be transported to operate in places which are cleared the requirements and registered for the use prior to operation. However, the firm will operate the facility on its premises in the city for now. Although, the Japanese government targets at 100 locations for preparation of hydrogen refueling stations in Japan, the actual figure stays about 80 locations mainly in urban areas due to the high installation costs. In the Shikoku area, Tokushima Prefecture led to prepare the first stationary station in the prefectural office in March, and mobile refueling stations have been installed only in two locations in Tokushima City since. (The Nikkei Business Daily, May 11, 2016)

(6) Shizuoka Gas

Shizuoka Gas has announced that the first stationary hydrogen refueling station for the Shizuoka Prefecture would be constructed in the center of Shizuoka City to supply FCVs. The construction will start in August, and the facility will operate from April 2017. The gas supplier considers in installing more facilities in the prefecture in 2020 when Tokyo Olympics is to be held. The firm has rented a piece of land of about 1200 m^2 in Magarikane 2 Chome, Suruga-ku, Shizuoka City for the new facility named "Hydrogen Station Shizuoka". The construction cost is ¥700 million. Subsidies of ¥290 million from Japanese government and ¥100 million from the prefecture have been already decided for this project. Shizuoka City will also join the support with ¥100 million in May. (The Nikkei Business Daily, May 12, 2016)

(7) Mitsubishi Kakoki

On May 11th, Mitsubishi Kakoki announced that an on-site production hydrogen refueling station would be constructed for experiment in its Kawasaki Works. The station will be used for test operation of a hydrogen dispenser package under development and for more efficient operation method of "HyGeia-A", a small hydrogen production unit for on-site production system. The firm will work on optimizing the specifications and reducing construction costs. The construction will start in June, and its completion is planned in November. The firm has sold small hydrogen production units for refueling stations and constructed hydrogen filling facilities since the Japan Hydrogen & Fuel Cell Demonstration Project (JHFC) started in FY2002. Over 20 units of hydrogen production equipment have been delivered, and the firm has worked on building 15 refueling stations including still under construction. Since last year, hydrogen dispenser package "CAR-100" of Danish-based H2 Logic has been used for development of a dispenser integrated refueling package, and is been modified to meet the Japanese legal requirements. (The Chemical Daily, May 12, 2016)

— This edition is made up as of May 14, 2016 —