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Osaka Gas Developed IoT Base to Manage a Couple of 100,000 ENE-FARMs

Arranged by T. HOMMA

1. Governmental Measures

(1) NEDO

On March 23rd, the New Energy and Industrial Technology Development Organization, NEDO, announced that a demonstrational project started to reduce electricity consumption of a building of the State University of New York Polytechnic Institute to half. Being a contractor, Shimizu Corporation will use power generation and energy saving technologies such as photovoltaic generator, fuel cells (FCs), energy management system for the building to evaluate efficiency. The building will be installed with a human detection system which counts people in the building to adjust lighting and a blind control system which manages light from outside as sunlight changes by time and whether as an optimal energy saving technology. NEDO will use the results of this project to promote Japanese technology to reduce energy consumption for buildings in the US. (The Nikkan Kogyo Shimbun & The Chemical Daily; March 24, 2016)

(2) Japanese Government

On March 27th, the Japanese government held the first meeting of "Fukushima Concept for a New Energy Society" in Fukushima City that private and public sectors discuss development and promotion of new energy to replace nuclear power. The committee indicated the outline of the concept to develop Fukushima Prefecture as a pioneer of new energy after the accident of the Fukushima Daiich Nuclear Power Station of the Tokyo Electric Power Company, TEPCO. The framework will be made in between May and June to finish the concept in this summer. The committee consists of Fukushima Prefecture, the electricity provider and related ministries including the Ministry of Economy, Trade and Industry, METI. "Renewable energy promotion is a significant key for recovery of Fukushima Prefecture. We want to show Fukushima's steady recovery to the world at the 2020 Tokyo Olympics." Governor Masao Uchibori emphasized. The concept consists of three cores; (1) a model concept to realize hydrogen society, (2) expansion of renewable energy use, and (3) creation of smart community. To realize hydrogen society, a cycle of hydrogen production, storage and use in a community will be established to use renewable energy such as wind power generation. The prefecture aims to produce hydrogen for 10 MW which is the world's largest level by 2020. (The Nikkei, March 28, 2016)

(3) MLIT & MOE

On April 12th, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Ministry of the Environment (MOE) started subsidy scheme for purchase of FC forklifts. Because FC forklifts can operate for a long period without emitting exhaust gas, the market has already been expanded in Europe and the US. These ministries aim to expand the market in Japan which leads in passenger FCVs. Being the contractor of the ministries, the "Organization for the Promotion of Low Emission Vehicles" started taking applications for the subsidy on that day. Applicants must be businesses which have a stationary/mobile hydrogen refueling station nearby to be able to continuously use FC forklifts. The scheme will subsidize a half of price difference between engine operated forklifts. The budget is about ¥3.7 billion including subsidies for other low-carbon logistic projects such as purchase of 31 feet shipping containers which are highly efficient and better for joint distribution. The scheme will last for three years. The ministries have no specific target figures. (Nikkan

Jidosha Shimbun, April 13, 2016)

2. Local Governmental measures

(1) Tokyo

On March 29th, Tokyo started an experiment of "Winglet" which is a Toyota's electric three-wheeler for users to stand up and ride in Koto-ku which is in a coastal area in Tokyo. Since ordinances for enforcement of the Road Trucking Vehicle Act was amended last July, which now allows this kind of three-wheelers to be tested anywhere in Japan. On that day, Toyota's employee rode four vehicles of Winglet on a sidewalk, and checked whether any spots to make the vehicles fall over exist. The experiment will make sure safety of the vehicles for full use at the 2020 Tokyo Olympics and Paralympics. According to the Tokyo Metropolitan government, the experiment period is about one year. A riding experiment will be carried out by the local government and Toyota, and test rides will be offered to drivers' license holders twice a month for free of charge. Experiments have been carried out using electric two-wheeler scooters of which users stand and ride in Tsukuba City in Ibaraki Prefecture and Toyota City in Aichi Prefecture which were designated as special deregulation zones. (The Nikkei, March 29, 2016)

(2) Miyagi Prefecture

On March 29th, Miyagi Prefecture opened a hydrogen refueling station in Sendai City which is the first one in the Tohoku area. The station will be used mainly by the prefecture to fill three FCVs purchased as official cars, and it is located on the premises of the Miyagi Prefectural Health Center in Saiwai-cho, Miyagino-ku, Sendai City. The facility is "Smart Hydrogen Station (SHS)" which is a mobile and simplified package jointly developed by Iwatani and Honda. The dimensions are 3.3 m wide, 2.1 m deep and 2.1 m high. The hydrogen production capacity is 1.5 kg each day, and maximum 19 kg of hydrogen can be stored. The construction cost is ¥167 million, and ¥114 million was subsidized by the project to reduce CO_2 emissions of MOE. (Nikkan Jidosha Shimbun, April 5, 2016)

3. FC Element Technology Development & Business Plans

Metawater has completed construction of a power generation facility using digestion gas at the Kawada Water Treatment Center in Utsunomiya City, Tochigi Prefecture. This is the largest facility in Japan to generate electricity with phosphoric acid fuel cells, PAFCs, from digestion gas (biogas) which is produced during sewage treatment. On March 28th, the ceremony of operation start was held at the center. This center is the largest sewage treatment facility in the prefecture. The annual biogas production is 3,300,000 Nm^3. The water work bureau of Utsunomiya City developed the plan of the PAFC power generation to use biogas for efficient energy use. In 2014, a joint venture of Metawater, Kyosin Denko and Biko Denki won the contract of the construction. The FC system takes out hydrogen from methane which is the main material of biogas to generate power by chemical reaction of oxygen in air and hydrogen. PAFCs are highly efficient and easy for maintenance. Because the power generation uses the chemical reaction, the system essentially produces negligible noise and vibration and no exhaust gas. The generation capacity is 0.84 MW, eight of 0.105 MW units, and 7,140 MWh each year. The FC system has been certified for the Feed-in tariff, FIT, and the city will receive the payment for selling electricity to the utility firm as sewage resource usage. (The Chemical Daily, March 30)

4. Hydrogen Infrastructure Technology Development & Business Plans

(1) Toshiba

On March 24th, Toshiba announced that the East Japan Railway Company, JR East, had placed an order of an independent hydrogen energy supply system "H2One™". The system will be installed at Musashi-Mizonokuchi Station of JR Nambu Line in Kawasaki City, and it will start operation in the spring of 2017. The purchase price has not been disclosed. The system consists of a photovoltaic generator, a storage battery, hydrogen production equipment, a hydrogen tank and pure hydrogen FCs. Solar panels will be installed on the station roof to generate electricity in order to produce hydrogen which is to be then stored in the tank. During disasters, the FCs generate power using hydrogen to supply the station building with electricity required

for devices such as lighting. Power will be supplied every day. Toshiba's hydrogen energy management system can control hydrogen production, electricity storage and power generation. This is the first order placed by a train operator. JR East and Kawasaki City promote hydrogen energy use as "ecoste" which is a project to utilize environmental protection technology such as renewable energy. This order was placed, because Toshiba's work on hydrogen use is highly compatible with "Eco Station". The ordered system is a model sold for business continuity planning (BCP), and supplies electricity independently from the grid while the utility is cut off during disasters. As well as a BCP model, the firm offers models for resorts, remote islands, and a solution of locally produced hydrogen use. (The Denki Shimbun, March 25, 2016)

(2) Panasonic

On March 28th, Panasonic revealed an outline of the smart city, an environmentally conscious city to be developed in Kohoku-ku, Yokohama City. This project has nine organizations from all over the world as its members, and will invite a commercial facility, a university dormitory and a laboratory of US-based Apple. A system will be developed to share electricity and heat in the community using gas power generation and hydrogen energy. The project aims to reduce CO_2 emissions by 40 % of that of FY2005 by FY2018. "The Tsunashima Sustainable Smart Town (SST)" will be developed on the land where a cell phone factory had stood and was closed in 2011. The site area is 37,900 m^2, and the total cost is expected to be a couple of ¥10 billion level. This is the second environmentally conscious town project using idle land after Fujisawa City of Kanagawa Prefecture. In the town, a next generation energy supply system allows a large commercial facility and apartment house to share electricity. Panasonic will develop a system to generate electricity and heat using natural gas as fuel in cooperation with Tokyo Gas and JX Nippon Oil & Energy and a power generation system using hydrogen in the future. As well as using a photovoltaic generator, the project plans to produce 30% consumption of energy such as electricity and heat within the community. "We want to contribute our technologies to this community development at the world highest level" Mr. Kazuhiro Tsuga, the president of Panasonic, said at the press conference on the day. The firm also plans development of large-scale smart cities in China and the US, and aims to expand sales by proposing model packages which provide combination of a system and service rather than just sales of equipment. (The Nikkei, March 29, 2016)

(3) Chiyoda Corporation

Chiyoda Corporation will carry out an experiment of a supply chain using hydrogen produced from renewable energy. An experimental plant was being constructed in Yokohama City, and the construction has been completed. They will start an experimental operation in April. The plant uses a system combining a conventional hydrogen plant, electrolysis equipment of Asahi Kasei and solid oxide fuel cells (SOFCs). The experiment will last until the end of FY2017. Chiyoda is considering an experiment of power generation in a place where electricity is consumed using hydrogen produced by renewable energy in remote locations including overseas from FY2018, and plans to establish the system before the 2020 Tokyo Olympics. They promote a hydrogen supply concept using methylcyclohexane, MCH, as a hydrogen carrier, and are working on a number of projects for NEDO. (The Chemical Daily, March 29, 2016)

(4) HEPCO & the University of Tokyo

Hokkaido Electric Power Company (HEPCO) and Hokuden Sogo Sekkei, a group member of HEPCO, will start an experimental project of power generation using wood biomass at a small-scale in Kutchan-cho. Hokuden Sogo Sekkei jointly applied to a subsidy of the Forestry Agency with the University of Tokyo and Japan Forest Technology Association, and they awarded the subsidy. This project tries early establishment of technology for highly efficient power generation at a small-scale which produces power with FCs using hydrogen created by reforming gas from wood biomass. Majority of conventional power generation from wood biomass use a steam turbine system which is the same as coal power generation technology, but this system has a problem of low efficiency at a small- scale. In the experiment, wood chips will be steam roasted to produce CO in a fluidized bed gasifier, and CO and steam will be reformed by a catalyst to produce hydrogen. Then, FCs will generate electricity from hydrogen. All the

exhaust heat during power generation will be collected to heat the gasifier using FCs of high heat recovery rate of which technology is patented by the University of Tokyo. The project aims at over 50% for generation efficiency and over 70% for total energy efficiency for a small-scale system of 50 kW level. They have filed of a patent application for the system. Their plan is establishment of a fluidized bed gasifier by FY2016, a reformer by FY2017 and a FC system by FY2018. After gradual development, the whole system is planned to be tested by FY2019. (The Chemical Daily, April 7, 2016)

5. ENE-FARM Business Plans

(1) Mitsubishi Estate Home

Mitsubishi Estate Home released "WIZE-H" which is a net-zero energy house (ZEH) installed with a total air conditioning system. This product is targeted for families in 30's, and offers net-zero energy and comfortable living temperature all year around as well as reduction in initial costs. On top of saving energy, a ZEH has a generator such as solar panels to produce power more than use to achieve utility free house by offsetting consumption. The Japanese government aims to make average newly built houses to be ZEH by 2020, and the firm is working on more product release. WIZE-H uses Mitsubishi Electric's photovoltaic generator which boasts highly efficient performance in the industry and "Aero Tech" an air conditioning system for a whole building. Aero Tech ventilates a house to keep comfortable temperature while reducing electricity use for air conditioning by 30%. Also, home energy management system, HEMS, optimizes use of appliances including Aero Tech, and saves energy. Temperature and electricity consumption in each room are automatically controlled by examining environment through a tablet device. Furthermore, ENE-FARM and highly performing "resin sash" are used as standard features to achieve ZEH. (The Mainichi Newspapers, March 24, 2016)

(2) Osaka Gas

Osaka Gas has developed a base of internet of things, IOT, to manage home FCs at a couple of 100,000 unit level. This network is expected to collect information of power generation, electricity consumption and maintenance for product improvement and development of new services. This is the first large-scale IOT developed by gas supplier for FCs in Japan. Osaka Gas will offer package solutions from IOT development to data analysis to other operators. The network is for new home FC "ENE-FARM Type S" available from April. The FC system can be connected to internet to send and receive date between cloud computers through communication infrastructure at home. The IOT uses in "Amazon Web Services (AWS)" that US-based Amazon offers a highly extensive cloud computing service at low initial costs. The service has a system to protect personal information. When the gas provider tries to access users' data, a dedicated server asks for authentication. Collected data will be used for prompt emergency work and improvement of FCs and service. Also, the service offers continual monitoring of power generation state, visualized generation amount and outlook and remote control of gas equipment for consumers. Osaka Gas targets at 15,000 units for ENE-FARM Type S by the term ending March 2017. IOT solutions will be sold by OGIS-RI, a subsidiary of Osaka Gas. This firm will start sales of "IOT Simple Package", a service to easily start IOT on AWS. A number of templates will be prepared to offer solutions for precautionary measures in facilities and quality improvement for manufacturing businesses. Also, the service uses expertise of "Business Analysis Center", which is Osaka Gas's business improvement unit to analyze big data, and "Behavior Laboratory" of OGIS-RI. Data analysis of IOT will also be provided. (The Nikkan Kogyo Shimbun, March 29, 2016; The Denki Shimbun, April 8, 2016)

(3) Sumitomo Realty & Development

Sumitomo Realty & Development has started sales of a condominium of which power supply will last for a certain period while electricity from the provider is cut off. Power supply will last for maximum four days by using a combination of ENE-FARM and storage battery installed at each unit. The firm recognizes that condominiums prepared for emergency are in demand since consumers have become more aware of disasters after the Great East Japan earthquake. The real estate developer will consider expanding this product to other projects. This condominium with independent power supplies is named "City Terrace Shinagawa East (Shinagawa, Tokyo)". The building

has 254 units in total including 51 units having independent electricity supplies for power cuts. This is the first condominium project to have the facility for the firm. ENE-FARM and storage battery are installed in the exclusive area of each unit. This FC system requires power to start, and stops operation during power cuts. However, the storage battery installed as a part of the system allows the FCs in the new development to start operation during power cuts. This "uninterrupted power supply" system provides electricity with appliances for maximum 700 W in total for four days. TV, PC, cell phone charger and shower can be used with the supply. (The Nikkei Business Daily, April 6, 2016)

6. Cutting Edge Technology of FCV & EV

(1) Toyota

On March 23rd, Toyota announced that Prius PHV (plug-in hybrid vehicle) rechargeable from domestic wall sockets would be fully remodeled and released this autumn. The battery capacity will be enlarged to make the vehicle drive 60 km solely on the battery, over double of that of the current figure. Also, the body design will be changed from the exiting one to be more attractive for proliferation. (The Nikkei, March 24, 2016)

(2) BYD

On March 28th, BYD, a major Chinese automaker in Guangdong, revealed a construction plan of a new plant for EVs in Taiyuan, Shanxi. The total cost is estimated 4 billion CNY (about ¥70 billion), and the plant is planned to start operation this year. The Chinese government is strongly backing up eco car sales to advance the Chinese industry and protect the environment. BYD is the leader in this area, and working on further expansion of production capacity. The new plant will produce electric buses as the main function, and its annual capacity will be 5,000 units each for electric buses and EVs for special purposes such as construction. EVs for commercial and industrial purposes are more profitable than passenger EVs, and the plant will focus on production of these vehicles. The sales are expected to be 15 billion CNY (about ¥260 billion). The new factory is expected to be a core production center for EVs like the one in Shenzhen, Guangdong, where the headquarters is located. The eco car business such as EVs and PHV already takes a 20% share in the total sales of BYD, and is aimed to expand by adding the new factory. In 2015, the Chinese government announced a concept of "Made in China 2025" to shift its industrial status from manufacturing country to manufacturing power. For the automobile industry, they will raise the target of eco car share to over 20% in the whole market. To achieve the objective, various subsidy schemes have been brought out to promote eco cars. The new plant for eco cars is being built in haste, because BYD wants to receive subsidy early while the government is strongly supporting in order to expand its business. Other automakers also focus on eco cars due to the generous governmental subsidies. Although the whole automobile market in China grew only 5% in 2015 due to economic slowdown, the sales of eco cars (EVs and PHVs combined) rapidly expanded to 330,000 vehicles, 3.4 times of that of 2014. Leading the business, BYD achieved record high by selling over 60,000 vehicles, about 20% share of the market in China. (The Nikkei, March 29, 2016)

On March 29th, BYD announced that its eco car sales including EVs which have been selling very well were estimated to reach between 120,000 to 150,000 vehicles for 2016, over double of that of 2015. The result for 2015 was 58,000 vehicles, 3.1 times of that of 2014, and eco cars keep driving powerfully in the market. (The Nikkei, March 30, 2016)

(3) Tesla Motors

On March 31st, US-based major EV maker Tesla Motors unveiled new affordable vehicle "Model 3" with a price under ¥4 million in Hawthorne, California, and it announced that the sales will start by the end of 2017. US-based GM and Nissan are competing in the EV market which is experiencing a rush of product release. California already made a decision to expand compulsory sales of zero-emissions vehicles, ZEVs, to car producers from 2018. Model 3 has a similar body size of small luxury sedan such as "3 Series" by German-based BMW. The EV drives over 215 miles (about 345 km) on a single charge which goes over 200 miles which is the minimum comfortable driving range for American consumers. The EV reaches 60 miles/h in 6 seconds or less, and this acceleration performance is better than average luxury cars. The price is $35,000 (about ¥3.9 million)

and the vehicle is applicable for governmental income tax credit of $7,500, an equivalent of 20% of the vehicle price. The EV has driving assistance which can help changing lanes. This feature will be updated using communication function, which characterizes the car. This is the first model of a mid-range price for the manufacturer, and the firm aims to expand potential user range. Pre-sales orders were placed for over 130,000 vehicles on the first day. (The Nikkei, April 2, 2016)

On April 7th, Tesla Motors announced that pre-sales orders for the new product "Model 3" reached over 325,000 vehicles in a week after the start. Although delivery is expected to take nearly 2 years, the firm is having a flood of orders. The production of the firm has expended over 6 times of that of the previous year. If the delivery is carried out as planned, the sales will reach $14 billion (¥1,500 billion) at the most. (The Nikkei, April 9, 2016)

On April 12th, Tesla Motors renewed the design and features of its large sedan "Model S" which has been sold for about four years, and raised the price by $1,500. The price of the new sedan is from $71,500. The design is now closer to sport utility vehicle (SUV) "Model X" to show single image. The delivery of the new product will be late June. The car uses light emitting diodes (LEDs) for headlamps for easy driving on dark winding roads. Also, the air conditioning is improved. Radar for driving assistance is installed in the body to sustain driving performance on snowy roads. (The Nikkei, April 13, 2016)

(4) Nissan, GM & Toyota

Led by Model 3 of Tesla Motors, new EVs to drive about 200 miles will be rushing into the market around 2017. GM will releases "Bolt EV" at about $37,500 by the end of 2016, and Nissan will introduce next generation of "LEAF" into the market. The focus of the eco car competition is moving from HV to EV. The automobile market in the US marked the first record high of 17.47 million vehicles in 15 years, but EV only takes less than 1%. Nevertheless, carmakers are expanding investment in EV. The reason is tightening environmental regulations in a total of 10 states including California and New York from the autumn of 2017. These 10 states take about 30% in the new car sales in the US. The ZEV regulations enforce automakers to sell more cars which emit almost no NOx or particulates. California introduced the regulations in 1998, and this movement expanded to other nine states including New York. In the regulation, EV, FCV and PHV are defined as ZEVs, and the regulation obligates each automaker to sell ZEV in certain ratio in the sales. The certification standards will be stricter from 2018 models which are to be released from the autumn of 2017, and normal HVs will be removed from the ZEV list. This is a reason that Toyota speeded up the release of FCV which drives on hydrogen. However, more automakers focus on investing management resources in EV, which has a simpler system, in the industry. Because of infrastructure preparation issues, FCV will face difficulties in the US market. (The Nikkei, April 2, 2016)

7. FCV & EV Parts & Component Development

(1) Keihin

Keihin announced that its high pressure hydrogen supply valve for FCV hydrogen tanks was the first product to be certified in the world for "Global Technical Regulation (GTR) No. 13" for accessories of FCV fuel devices. The valve is used in Honda's FCV "CLARITY FUEL CELL". Honda uses high pressure hydrogen of 70 MPa, and the pressure is expected to go up to 87.5 MPa at the most due to factors such as temperature increase. The valve was ensured its airtightness under maximum 105 MPa in the temperature range between -40 and +80°C. This specification satisfies the GTR standards, which gave the certification. (Nikkan Jidosha Shimbun, March 26, 2016; The Nikkan Kogyo Shimbun, March 29, 2016)

(2) SPARX

SPARX Group, an independent management company, will invest in Exergy Power Systems, a venture of storage battery in Bunkyo-ku in Tokyo, through a joint fund with Toyota. Exergy Power Systems work on development of highly efficient hydrogen batteries. The investment will back up technological development of FCVs using hydrogen. Exergy Power Systems will allocate new shares of ¥500 million to the fund. SPARX established "Future Creation Fund" of about ¥23.5 billion in cooperation with Toyota and Sumitomo Mitsui Banking Corporation last autumn. The fund will choose investment destination in artificial intelligence (AI),

robot and hydrogen society. The fund has already invested in American IT ventures, and this is the fourth choice. Exergy Power Systems started as a venture from the University of Tokyo in 2011, and is developing powerful and highly durable hydrogen batteries. (The Nikkei, March 30, 2016)

(3) Kaneka & Aichi Institute of Technology

Kaneka and the team of Prof. Yasushi Morita at the Aichi Institute of Technology have developed a lithium-ion battery, LIB, to be charged at an over 100 time faster speed. The LIB uses originally developed organic material for an electrode, and a battery for cell phone is expected to be charged in 10 minutes. The group aims to commercialize the LIB for mobile and wearable devices and EVs in five years. The product uses Tri-oxo triangulene (TOTs), organic molecules, mixed in carbon nanotubes as a cathode material. The material can store large amount of electrons per volume, and is highly conductive. This allows the battery to be charged and discharge efficiently. A pilot coin LIB of 1 cm^3 volume was charged in 36 seconds, and did not reduce its performance after 5,000 charging and discharging cycles. The LIB of a capacity for cell phones can be charged in about 10 minutes. For EVs requiring a large capacity, the product can significantly reduce the charging time. Currently common LIBs use an oxide of cobalt, a rare metal, for cathode, and the same size product in coin shape takes about few hours to be charged. It is also difficult to produce high current with these conventional LIBs which use capacitors to store and send electricity at once for acceleration of EVs. The new battery can send high current, and will eliminate the need of capacitors. This is expected to contribute to reduction in costs and improvement of acceleration performance. Because the battery uses the organic material, it can be bent and stretched without being broken. Conventional LIBs have a risk of fire when going through too many cycles of charge and discharge, which requires layers of safety measures. The new battery has not experienced any accidents such as fire after being overcharged, and expected to be safer. The group will examine the battery for performance and safety in a large size for EVs. METI estimates ¥2 trillion for the global storage battery market for 2020 and ¥8 trillion for the automobile storage batteries in the market. Manufacturers and research institutes are competing in the development. (The Nikkei, April 4, 2016)

(4) Toray

On April 5th, Toray announced that its carbon fiber was used in Honda's FCV "CLARITY FUEL CELL". The carbon fiber winds around hydrogen tanks to fortify, which contributes to reduce FCV weight to improve fuel efficiency. Toray has supplied "Regular Tow" which is a highly functional product of carbon fiber with 24,000 or less number of filaments, and allows high pressure hydrogen safely stored. The firm also supplies carbon fiber sheets for base materials of electrodes in FC stacks. This sheet has advantages in gas diffusion and durability, and contributes to improving performance and reduction in space of FC stacks. The manufacturer has supplied its products for airplanes and wind turbines for power generation. Their products have recently expanded the use largely in Europe. For the FCV area, Toyota's MIRAI uses Toray's product. (The Nikkei Business Daily & The Chemical Daily, April 6, 2016)

8. Hydrogen Refueling Station Development & Business Plans

(1) Saibu Gas

On March 24th, Saibu Gas opened "Higashihama Hydrogen ST" in Higashi-ku, Fukuoka City which is the first hydrogen refueling station for the utility firm. TOENEC and Air Liquide Japan built the station. The station supplies FCVs and other refueling stations which have no production facilities. It will be able to supply FC buses with hydrogen by improving the facility. This is the first commercial refueling station which produces hydrogen from natural gas on-site in the Kyushu area. The facility can refuel five to six FCVs in an hour. The site is close to Fukuoka Urban Expressway and main roads in Fukuoka City. Hydrogen sells for ¥1,100/kg (excluding sales tax). The basic opening hour is 9:30 am to 5:00 pm on Monday, Tuesday and Thursday to Saturday. Because the gas supplier expects the station to be used by taxi operators, the station avoids closing two days in a row. "We will use the experience in preparation of new hydrogen refueling stations, and want to contribute to realization of a hydrogen society." Mr. Toshio Sakemi, the president of Saibu Gas, said. (The Nikkan Kogyo Shimbun & The Denki Shimbun, March 25, 2016)

(2) Mie Hydrogen Station

On March 21st, the first hydrogen refueling station opened in Mie Prefecture. Mie Hydrogen Station Godogaisha (MHS) was jointly established by four businesses which have head offices in the prefecture last year. A refueling facility is installed on a truck to be a mobile refueling station. The truck goes around two places of Yokkaichi City and Tsu City for a while to supply FCVs with hydrogen. A hydrogen refueling station is essential to promote FCVs, and the firms aim FCVs to be fully used since the first refueling station is now open in the prefecture. Having been launched on July 13th 2015, MHS is invested by Sumitomo Wiring Systems, total logistics firm Japan Transcity Corporation, and petroleum product seller Taniguchi Sekiyu which all have their headquarters in Yokkaichi City and Mie Toyota in Tsu City. Mie Toyota is the first car dealer involved in hydrogen refueling station business. "The group effort achieved this long-sought station to be open. We want to appeal this to the world in some way as an example of hydrogen energy use at the G7 summit to be held in Ise-Shima next month." Mr. Eikei Suzuki, the governor of Mie Prefecture, said with expectations. (Nikkan Jidosha Shimbun, April 5, 2016)

(3) Kobe Steel

Kobe Steel will start an experiment of a hydrogen refueling station using hydrogen produced by renewable energy. They plan to build a system with water electrolysis instrument of Kobelco Eco-Solutions, their group member. The system will be added in the product range of their hydrogen refueling station business of the steel manufacturer as a differentiated technology. The steel manufacturer supplies core components for hydrogen refueling stations, and has also commercialized package units. Their share is 30% in the market. In this project, a system will be tested to produce hydrogen using renewable energy such as sunlight and wind to supply refueling station with hydrogen. The firm aims for CO_2 emission free system. The key is the water electrolysis. They plan to develop technology to steadily produce hydrogen at a highly efficient rate and cheaper price by using highly pure hydrogen and oxygen producer "HHOG" developed by Kobelco Eco-Solutions. Their high pressure hydrogen compressor and pre-cooler have been commercialized, and the steel manufacturer achieved reduction in facility size by using own diffusion bonded compact heat exchanger "DCHE". Core components are packed in a hydrogen refueling station unit "HyAC mini" which achieves to reduce space by 50% and costs by 20%. Shinko Engineering & Maintenance, another group member, designs and builds hydrogen refueling stations. Kobe Steel newly opened the "Hydrogen Station Comprehensive Test Center" to simulate station operation and refueling in Takasago Works in March, 2016. The center will evaluate higher pressure refueling to extend FCV driving range, and the firm will work on product development to catch market needs. (The Chemical Daily, April 8, 2016)

(4) Air Liquide

Air Liquide will work on an installation plan of hydrogen refueling stations in Northeastern US. Locations were selected for the first phase. The firm aims for opening in early 2017. 12 hydrogen refueling stations are planned to be open in the area. Four locations chosen to be open in early 2017 are Hartford, Connecticut, Braintree and Mansfield, Massachusetts, and Bronx, New York. (The Chemical Daily, April 12, 216)

(5) JX Nippon Oil & Energy

JX Nippon Oil & Energy opened "Tsukuba Kasuga Hydrogen ST" in Tsukuba City, the first hydrogen refueling station in three northern Kanto prefectures in cooperation with Ibaraki Prefecture and Tsukuba City, and held an opening ceremony on April 6th. The facility is a mobile refueling station, and its opening hours are from noon to 2 pm on Wednesday and Friday. The station consists of a dispenser, accumulators, a compressor on a 25 ton vehicle and a utility vehicle carrying a generator. ENEOS Hydrogen Supply and Service, a subsidiary of JX, operates the station, and hydrogen is transported from a hydrogen production and distribution center in Yokohama City. (Nikkan Jidosha Shimbun, April 14, 2016)

(6) Chiyoda Corporation

Chiyoda Corporation will develop a hydrogen extraction facility from MCH to be installed in hydrogen refueling stations. They aim for a facility in a size and at a cost for hydrogen refueling stations with tight limitation in space and building cost. The experimental operation plans to be completed by the end of FY2017. From FY2018, they will develop a facility in an actual size. As well as liquid hydrogen,

MCH is a promising hydrogen carrier, and the firm is evaluating a transport technology of hydrogen at large-scale from overseas as a NEDO project. This project aims to establish a supply chain for hydrogen power generation of which commercialization is planned after 2030 in the Strategic Road Map for Hydrogen and FCs compiled by the METI. (The Chemical Daily, April 15, 2016)

—This edition is made up as of April 18, 2016—

A POSTER COLUMN

Various Firms Largely Expand FC Business for Professional Use

Manufacturers in Japan will release FCs to be used for business such as offices. Mitsubishi Hitachi Power Systems will introduce a system for large-scale facilities in the spring of 2017. Kyocera and Miura will start shipping of small systems for smaller stores. These systems have an advantage of reduction in utility costs by about 20% of that of purchase from the grid. The target is retailers which are pressed to reduce CO_2 emissions than manufacturers.

These manufacturers use SOFCs for their systems. SOFCs have 30 to 40% higher generation efficiency than polymer electrolyte fuel cells (PEFCs) used in FCVs and ENE-FARMs, and can steadily produce power required for large facilities. Although SOFCs reach 1,000°C during power generation, the firms improved durability of equipment for the product release. Heat is produced by the chemical reaction in the system, and the system allows reducing utility cost by 20% in total by using heat as well as electricity. CO_2 emissions of hydrogen extraction from natural gas are half the amount of that of thermal power generation using oil and coal.

Mitsubishi Hitachi Power Systems will release a FC system of 250 kW output which can mostly provide large-scale facility such as shopping center with power. The price is expected to be around ¥300 million. A dedicated team will be launched this autumn to start sales activity in cooperation with a trading house. The manufacturer plans a supersize system of over 1,000 kW to target plants which use large amount of electricity.

Miura, the largest boiler maker in Japan, will release a small system of 5 kW level in FY2017. An experiment of the system started in restaurants in cooperation with Tokyo Gas and Osaka Gas, and system has reduced utility costs by 20% in some of the restaurants. The boiler maker will try to sell the product to restaurants and welfare facilities using sales channels of gas suppliers.

Kyocera will introduce a small system of 3 kW level in FY2017. Fuji Electric plans to sell a medium-size system of 50 kW level expected to be used for supermarkets and hospitals from FY2018. The price is expected to be about ¥50 million. Hitachi Zosen also plans to release a midsize system.

It takes over 10 years to recover the investment of purchasing systems at the launch phase. These firms aim to reduce production cost to one third by promoting. The government is investigating a subsidy scheme for purchase of FCs for business use starting from FY2017, and the actual purchase expense is expected to decrease. For commercial facilities and offices, the government targets at 40% reduction in CO_2 emissions of that of 2013 by 2030. This objective is higher than of that of manufacturing businesses which is 7% reduction. Installation of FCs at commercial facilities and offices is expected to help hitting the target. (The Nikkei, April 13, 2016)