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1,200 kW Level SOFCs, the Largest System in Japan, in Operation

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1. Governmental Measures

(1) MLIT

On February 18th, a related advisory committee of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) published a report, and making suggestions to sewage treatment operators that a system should be organized to use sewage as potential energy source. According to the ministry, there are approximately 300 sewage treatment works which produce biogas from sludge in Japan, and unused hydrogen containing gas released to the atmosphere could power approximately 2.6 million fuel cell vehicles (FCVs). The ministry aims to use energy hidden in urban areas by supporting technological development and concentrating sewage treatment works. "HyLec Fukuoka Hydrogen Station" will open in March in Fukuoka City, and it will provide hydrogen which is produced from biogas derived from fermented sewage sludge at the Central Sewage Treatment Center in Chuo-ku, Fukuoka City. The refueling facility can supply 60 FCVs each day, and is a part of the Breakthrough by Dynamic Approach in Sewage High Technology Project (B-DASH Project) organized by MLIT. Sewage has plenty of organic matter, and is warm. This was previously pointed out as a potential energy save. Approximately 14.5 billion m^3 and 224 tons of sewage sludge are produced each year.

The heat coming from sewage would potentially be used for heating and air conditioning for approximately 18 million households, and the sewage sludge would be able to supply approximately 1.1 million households with power. However, sewage heat is currently used at 11 areas, and sludge use for energy is only 13% in the 2012 survey results. One of the reasons is that sewage treatment is usually too small to be financially viable. Also, many local governments replied to the survey saying "insufficient human resources and technology to order and manage such systems". To solve this problem, MLIT is considering making "sludge to be used as energy" obligatory to sewage treatment operators as well as reduction of sludge. The ministry will also encourage prefectures to include this point in their plan to expand sewage treatment areas. Their aim is to get an advantage of scale by expanding the area for each treatment work in order to improve profitability. The ministry will investigate a system which can also process biological materials other than sewage sludge such as food waste and wood biomass. (Nikkan Jidosha Shimbun, February 21, 2015)

(2) MOE

Goto Islands, Nagasaki Prefecture, will start producing hydrogen using wind turbines. Electricity is hard to store at a large-scale, but hydrogen can be reserved as energy to generate electricity with fuel cells (FCs) as required. The Goto's project will lead locally produced energy use in practice. The Ministry of the Environment (MOE) will start the experiment with wind turbines operating 1 km off the coast of Kabashima Island, Goto City. The wind generator is connected to the grid of Kyushu Electric Power Co. with underwater cables. However, the grid capacity of the remote islands is small, which only takes 30% electricity of the wind generator. The surplus power will produce hydrogen by splitting water on the island. (The Asahi Shimbun, February 26, 2015)

(3) METI

The Ministry of Economy, Trade and Industry (METI) will ease safety examination standards for "hydrogen refueling stations" to fill FCVs. Prefectures examine the equipment and the examination period often takes about one month. However equipment produced by certified manufacturers will be shortened to two weeks. Currently hydrogen filling facilities are only in nine locations in Japan, which is a barrier for FCV market growth. The ministry aims to prepare these facilities in 100 locations by the end of FY 2015 by promoting installation of cheaper small hydrogen filling facilities as well as larger ones. Although private businesses such as JX Nippon Oil & Energy and Seven-Eleven Japan are getting into the hydrogen refueling market, the prefectural safety examination slows up the preparation process. At the moment, the examination takes about one month for checks, such as strength of valves, once an operator applies for a new filling equipment installation. The process requires considerable amount of paper work and post assembly inspection of equipment, which is a factor to increase costs. On March 12th, METI will indicate a measure to relax the examination process at the "Sectional Committee on High Pressure Gas". This will allow manufacturers certified by the government to be able to skip certain prefectural examinations once their internal test is completed. The ministry will also revise regulations of the High Pressure Gas Safety Act to be able to certify manufacturers after March. The expected certified manufacturers include component producers of the filling facilities such as Kobe Steel. As well as shortening the examination process, the amendment will also reduce paper work to a fifth, which gives less work for businesses. Currently hydrogen filling facilities are open only at nine locations mainly in urban areas such as Ebina City, Kanagawa Prefecture. For this fiscal year, hydrogen refueling stations are planned to be decided for 45 locations, which is nowhere near the governmental target of 100 locations in FY 2015. METI will prepare an environment which allows FCVs to be refueled easily. As a start, smaller hydrogen refueling stations will be promoted to be installed. A full size station costs around ¥500 million to construct. On the other hand, a small one requires around ¥100 million. However, there are no safety standards for small refueling stations, which is a bottleneck for installation. To solve this, the ministry will set standards for these refueling stations in FY 2015. Honda and Iwatani have already developed small hydrogen refueling stations which produce hydrogen by splitting water using solar power. A system should also be organized to rescue FCVs which have run out of gas. Although a FCV can drive about 700 km on a full tank, there is an insufficient number of filling facilities available for the vehicles. This gives a concern to consumers who consider purchasing FCVs. METI will request the related industrial organization to establish a system that Japan Automobile Federation (JAF) can supply FCVs with hydrogen in an emergency. When a fire breaks out near a hydrogen tank, the pressure goes up inside the tank. This may cause explosion. The ministry will also get technical standards ready to release hydrogen to reduce the pressure in an emergency to make the vehicles safer. (The Nikkei, March 11, 2015)

(4) Agency for Natural Resources and Energy

The Agency for Natural Resources and Energy of METI will cooperate more with local governments to promote FCVs and hydrogen refueling stations. A new conference has been set up to adjust policies and advertise and deploy good projects among local government. The agency will announce and publicize information on a website for people to understand hydrogen and FCVs better. METI held the first meeting of the "Liaison Conference of Local Governments for FCV Promotion". The Road Transport Bureau and Road Bureau of MLIT joined the meeting as well as METI. Officers attended the meeting from the 11 prefectures and seven designated cities by government ordinance which are constructing or operating hydrogen refueling stations using governmental subsidy. Any prefectures which want will be accepted to the meeting. The conference provides opportunity to explain the progress of governmental policy development and deregulations and to exchange information on local governmental subsidy schemes for preparation. METI plans to find out how local governments actually put into practice the regulations to make standardized guidelines for all of them. Local governments will also coordinate the locations of hydrogen refueling stations through meetings. The central government and local governments will cooperate to provide information on features and safety of hydrogen energy and bring out new measures. (Nikkan Jidosha Shimbun, March 4, 2015)

(5) NEDO

New Energy and Industrial Technology Development

Organization (NEDO) will start developing a system to produce hydrogen fuel using renewable energy such as hydroelectric and wind power to efficiently generate power as required. This project aims to realize "Power to Gas" society which uses hydrogen made by electricity. The electrolysis of water produces hydrogen which then can be converted into an organic hydride by mixed in toluene or liquid by cooling it down to make the transport and storage easier. Hydrogen can be taken out from the organic hydride, and used as fuel or for FC power generation. Yokohama National University will develop a method to store and use hydrogen energy in a form of an organic hydride. Hrein Energy, Sapporo City, and Toyota Tsusho will research a social system to use hydrogen extracted from the organic hydride. Additionally the National Institute of Advanced Industrial Science and Technology (AIST) and Toray will join the project. Germany has carried out research and development on Power to Gas, and it is the leading country. NEDO aims to carry out a promotional experiment of organic hydride and liquid hydrogen by 2020. Their plan is to develop a commercial hydrogen distribution channel in Japan, and to start commercial hydrogen power generation at a full-scale by 2030. (The Nikkei Business Daily, March 4, 2015)

NEDO will start developing a technology to produce FCs at a large scale in FY 2015. The project aims to develop basic technologies to reduce amount of precious metal to a tenth that of the current amount in catalyst and to increase durability by 10 times. FCVs are expected to be widely used in 2020, and the organization plans to back this up. The point of the project is to achieve a FC which is highly durable at a low cost. This five-year project has been granted ¥3 billion in the budget request for FY 2015. NEDO will choose business operators for the development through tender. While developing basic technology to reduce costs, the project will also carry out mass-production technology development to increase productivity to over 10 times that of the current one. (The Nikkei Business Daily, March 11, 2015)

2. Local Governmental Measures

(1) Osaka Prefecture

On February 16, Osaka Prefecture revealed its initial budget bill for FY 2015 including ¥113.83 million for promotion measures for the new energy industry. The measures aim to create and gather businesses in the storage and hydrogen/FC areas, and to encourage smaller businesses to get into these areas. The prefecture allocated ¥72.78 million to create hydrogen related business as a new project. (The Nikkan Kogyo Shimbun, February 17, 2015)

(2) Aichi Prefecture

Aichi Prefecture has included measures for next generation industries such as support for costs of preparation of hydrogen refueling stations for FCVs and for the aerospace industry and promotion to make a robot industry center in its budget bill for FY 2015. A subsidy scheme will be established to support installation and operation of hydrogen refueling stations with ¥876.83 million as its project cost. The Japanese government already has a scheme to subsidize a half the cost of preparation. The prefecture will top up another quarter, and give financial support of ¥5.5 million for operation each year. (The Nikkan Kogyo Shimbun, February 23, 2015)

(3) Kanagawa Prefecture

Kanagawa Prefecture has revealed the initial budget bill for FY 2015 including ¥1.56778 billion for promotion of the "Kanagawa Smart Energy Plan" in ¥1,949.5 billion of the general account. The promotion has been allocated ¥0.08862 billion less than that of the initial budget bill for FY 2014, but contains two new measures. One is to promote FCV use, and the other is to carry out a model project to use EVs in a community. The project to subsidize FCV purchase and to promote use takes ¥0.05357 billion. As a part of the energy industry growth and promotion, energy related businesses will be invited to the prefecture, and Kanagawa Academy of Science and Technology will carry out development of a highly efficient FC. For these projects, ¥0.07833 billion is allocated. (The Denki Shimbun, March 4, 2015)

3. FC Element Technology Development and Industrial FC Business Plans

(1) Kyoto University

Kyoto University will carry out research and development of technology to use ammonia in cooperation with chemical plants and research institutes including national universities. This project consists of three subjects which are an efficient hydrogen production and hydrogen separation and refining method of from ammonia, a FC technology to use ammonia as a direct or indirect fuel and a thermal energy conversion technology for direct combustion of ammonia. The project members from the chemical industry will conduct development of a catalyst, separation membrane and decomposing technology of ammonia. The project plan is to start investigating commercialization of these technologies by FY 2018. Prof. Koichi Eguchi at the Department of Energy and Hydrocarbon Chemistry, Graduate School of Engineering of Kyoto University will lead the whole project. Eguchi's group will specifically lay weight on development of solid oxide fuel cell (SOFC). Ammonia breaks down at 600 °C, and SOFCs operate at 750 °C which are suitable to use ammonia as fuel. The development team will investigate whether ammonia fuel can give sufficient generation performance and has characteristic problems such as corrosion and degradation. The project targets for over 45% of generation efficiency which is the level of the efficiency using natural gas as fuel. FCs with electrolyte membrane, an anion-exchange membrane, go well with ammonia, and the development of this system is also planned as well as usage investigation. (The Chemical Daily, February 18, 2015)

(2) Metawater

Metawater was installing FCs using biogas from sewage sludge in Matsumoto City, Nagano Prefecture, and the FC system has started its operation. The system efficiently generates power using urban resources, and emits no unwanted gas. The manufacturer aims to expand sales of the product. The FC generation system was delivered to the Ryoshima Sewage Treatment Center operated by Matsumoto City. In the sewage treatment center, an annual 110 m^3 of biogas comes out from the sludge process. Three 105 kW output generators produce power at an annual level of 1,680 MWh which can supply 490 households each year. The installation cost is ¥440 million, and the sewage treatment plant plans to reduce its maintenance costs by selling electricity. (The Nikkei Business Daily, February 18, 2015)

(3) Sumika Chemical Analysis Service

Sumika Chemical Analysis Service has developed a new technology for analyzing storage batteries. The technology consists of a combination of dispersity analysis on the electrode binder and an analysis on the formation of the electron-conductive network, and determines accurate dispersity of the conductivity supporting agent using an image analysis technology. Pyrolysis gas chromatography accurately measures the mass of binder materials. This is expected to contribute to optimizing battery performance. The firm aims at annual ¥2 billion sales for analysis and evaluation service in the energy related area including FC and hydrogen infrastructure in three years. (The Chemical Daily, February 23, 2015)

(4) FC-R&D

FC-R&D, a start-up FC developer in Kanagawa Prefecture, will sell a FC generation system which uses an originally developed hydrogen storage alloy which eliminates the need of a compressor. The system consists of a photovoltaic generator, hydrogen production and storage equipment and polymer electrolyte fuel cells (PEFCs), and allows an area without a power source to be completely energy self-sufficient. The firm has already delivered 50 systems to local governments and private research laboratories. Without emitting CO_2, the system "ZEEP 24" produce hydrogen by splitting water using surplus electricity from photovoltaic generator in the day, and generates power using PEFCs in the night. A deionizer in the system allows the use of tap or rain water. Hydrogen production and storage equipment and the FC power generator are originally developed whereas the photovoltaic generator is supplied by another manufacturer. (The Chemical Daily, March 6, 2015)

(5) Bloom Energy Japan

On March 9th, Bloom Energy Japan, a power supplier of the SoftBank group in Tokyo, started operating a FC system at Osaka Prefectural Wholesale Market, Ibaraki City. Approximately ¥1.3 billion was spent on the SOFC system which outputs 1,200 kW and the largest scale in Japan. The system provides a half the annual energy consumption of the wholesale market facilities such as refrigerators. The generation efficiency is over 60%, and CO_2 emissions are 40% less than a common thermal power plant. Bloom Energy Japan installed the new facility and operates it. Osaka Prefecture buys electricity from them at a similar tariff to that of the Kansai Electric Power

Company. The system also works as a backup power during emergencies as well as daily usage. An opening ceremony was held on March 9th, and Mr. Ichiro Matsui, the governor of Osaka Prefecture said "the FC uses technologies developed by smaller firms in Osaka, and we want to advertise this project to sell these technologies worldwide. (The Nikkei & The Denki Shimbun, March 10, 2015)

(6) Toshiba

On March 9th, Toshiba FC Power Systems, Yokohama City, announced that a next generation pure hydrogen FC system developed in cooperation with Iwatani would be tested from 21st in Yamaguchi Prefecture. The system will be installed in Tokuyama Zoo and Shunan Local Market in Shunan City. Lighting and air conditioners will use energy produced by the FCs using hydrogen. Hot water comes out during generation and will be used for showers to wash animals and vegetables. The project will collect operation data until 2017 to investigate an operational method and advantages. (The Denki Shimbun, March 10, 2015)

4. Hydrogen Production & Infrastructure Related Technology Development

(1) KHI

Kawasaki Heavy Industries (KHI) has committed to the hydrogen turbine business, and has tried to sell large-scale turbines burning mixed fuel containing hydrogen as an independent power supply for industrial purposes since 2014, aiming to introduce into the market in FY 2015. Also a small turbine burning only hydrogen for cogeneration of office buildings is planned to be tested in FY 2015. The manufacturer developed a technology to reduce NOx during hydrogen combustion, which has been commercialized. Hydrogen power generation consumes a large amount of hydrogen, and is hoped to be widely used. This will bring hydrogen cost down, which is essential to realize a hydrogen society. Hydrogen burns at higher speed and temperature. This creates hotspots, which causes NOx emissions. The firm developed a technology to reduce the amount of NOx to less than 25 ppm which is the level of natural gas burner for the system burning mixed gas containing 60 % hydrogen per volume by using its own dry low emission (DLE) combustion system having duct burners. The turbine system can burn the fuel which contains 0 to 60% hydrogen, and the firm has been selling "L30A", a 30 MW class highly efficient turbine since 2014. (The Chemical Daily, February 27, 2015)

(2) Press Kogyo

Press Kogyo is developing a prototype of a fuel reformer for hydrogen refueling stations. The development will complete this spring, and the performance of the reformer will be tested. The firm aims to commercialize the product to extract hydrogen from organic hydride for FCVs in a couple of years. The first product will work at a lower reforming speed to focus on storage. For example, a mobile product prepares a required amount of hydrogen in advance, but produces hydrogen at a low rate. The manufacturer determines hydrogen refueling infrastructure for FCVs as an emerging market from 2015, and is developing a reformer to extract hydrogen from methylcyclohexane (MCH), an organic hydride. Their core business is components such as an axle for large vehicles, which is a largely different area. However, the manufacturer works with Hrein Energy, Sapporo City, which has a wide range of experience in the hydrogen refueling infrastructure, and they aim to commercialize a mobile reformer which can be transported among refueling stations. The prototype is expected to finish in May and to start an experimental operation. It extracts hydrogen from MCH at 30 m^3/h under the standard atmospheric pressure. A two hour operation is estimated to produce the amount of hydrogen to fill a tank of FCV "MIRAI". Although this product therefore is not suitable for a large production in a short period, it can be flexibly used to refill a storage tank at refueling station after hours. The firm will consider developing the second product with a higher production capacity. (Nikkan Jidosha Shimbun, March 3, 2015)

(3) RITE

The Research Institute of Innovative Technology for the Earth (RITE) will promote the development of a hydrogen separation system used in hydrogen production equipment for refueling stations. The system extracts hydrogen using separation membranes and a membrane reactor, and efficiently produces hydrogen from MCH. The project aims to achieve a system which produces hydrogen with a sufficient purity to be a fuel for FCVs and small enough to be installed in hydrogen refueling facilities. A number of universities such as Kogakuin University, Yamaguchi University, Utsunomiya University and Hiroshima University participate in the project. The Cabinet Office organized the Cross-ministerial Strategic Innovation Promotion Program (SIP)/Energy Carrier, and the project has been carried out as a part of SIP since FY 2014. Because hydrogen separates from MCH at over 200°C, organic materials are not suitable for the process. Chemical vapor deposition (CVD) silica membranes and zeolite membranes are considered for this usage. Basically, membranes with 0.3 to 0.5 nm fine pores only let hydrogen through, which is 0.29 nm, but not toluene which is 0.6 nm. Silica is vaporized to deposit on a porous aluminum oxide base with good reproducibility to be the membrane to evenly form fine pores in order to let solely hydrogen go through. Although the pore size of a zeolite membrane is basically determined by bonding type, it is adjusted after the process. Palladium membranes are used for hydrogen production and the separation process from ammonia. Firstly, hydrogen molecules are dissolved once captured by the membrane, and ionized. Secondly, protons and electrons spread in the membrane, and then bond together again on the other side of the membrane to form molecules. This process allows solely for the separating of hydrogen. Palladium is coated on an aluminum oxide tube, and RITE will investigate a method to reduce an amount of palladium. FCVs require very high purity hydrogen of 99.999%, and impurities must be a ppm level. (The Chemical Daily, March 4, 2015)

(4) Japan Sport Council

On March 11th, the Japan Sport Council revealed its concept to use the most advanced technologies such as hydrogen energy and visitors' face recognition at the admission of the New National Stadium Japan, the main venue for 2020 Tokyo Olympics and Paralympics in Shinjuku-ku, Tokyo, to make it one of the best in the world. In their plan, the stadium is to function as the world's largest shelter with hydrogen power generator during emergencies, and vehicle access in the neighborhood is to be limited to FCVs. The cooperating firms are Canon, Tokyo Gas, Toshiba, Toray, Toyota Motor, NTT and Panasonic. The council will encourage more businesses to join in the project. (The Mainichi Newspapers & The Nikkei, March 12, 2015)

5. Ene-Farm Business Plans

(1) Tokyo Gas

Ene-Farm sold by Tokyo Gas will be installed in all 380 units of "Wellith Urawa Misono South Terrace" which is under construction by NTT Urban Development and Kawaguchi Construction in Midori-ku, Saitama City and the condominium will be for sale from late May. This development is the first condominium sold with Ene-Farm for apartment units in the prefecture. (The Saitama Shimbun, February 20, 2015)

Tokyo Gas and Panasonic will introduce a new model of the fourth generation Ene-Farm in April, and the FCs will sell for ¥1.6 million without tax and installation, ¥0.3 cheaper than the current model. The actual retail price is expected to be lower than this suggested retail price, and the consumer cost possibly goes below ¥1 million including subsidy. This should create a trend for other manufacturers and gas providers to follow. The first Ene-Farm was released in 2009, and sold for ¥3.46 million. According to METI's survey, the actual retail price went down to ¥1.49 in April, 2014. "Construction firms and urban developers set actual retail price. So, we cannot comment on the price, but hope consumer cost will get close to ¥1 with subsidy", Mr. Takashi Anamizu, the General Manager of the Residential Fuel Cell Business Development Department, anticipates. (The Nikkan Kogyo Shimbun, February 23, 2015)

(2) Saibu Gas

Saibu Gas, Fukuoka City, has announced that a new Ene-Farm would be available from April 1st. The FC will sell for ¥1.6 million excluding tax, ¥0.35 million cheaper than the current model, and the firm wants to expand sales with this. The product is made by Panasonic who achieved the lower price by reducing the number of parts. Also the area required for install has reduced by14%. The governmental subsidy likely brings down the consumer cost to around ¥1.3 excluding installation. (The Nishinippon Shimbun, March 10, 2015)

6. Cutting Edge Technology of FCVs and EVs

(1) TEPCO & CEPCO

Tokyo Electric Power Company (TEPCO) and Chubu Electric Power Company (CEPCO) invested in Nippon Charge Service which was launched by four automakers to prepare charging infrastructure for EVs by February 18th. To promote EVs, charger installation will be supported. CEPCO sank money into the venture on 18th, and so did TEPCO on 17th. Both contributions are about 0.5%. The venture operates subsidy for charger installation and issues charging member ship cards for EVs and PHVs to be widely used. (The Nikkei, February 19, 2015)

(2) Asahi Kasei & Others

On February 23rd, Asahi Kasei announced that it would acquire US-based Polypore International which produces separators, a core material for lithium-ion batteries (LIBs) in North Carolina for $2.2 billion (approximately ¥260 billion). Currently Asahi Kasei holds a foremost position with 35% share in the global separator market. This acquisition will push up its share to 50%, and outdistance Toray in to second place. Supplying its separators for smartphones, Asahi Kasei will strengthen its operation base by expanding application of the products to EVs of which market is expected to grow in near future. Polypore sells approximately $0.04 billion (¥ 53 billion) of separators. Asahi Kasei mainly supplies its separators for digital devices such as smartphones and computers. "Polypore, on the other hand, has advantages in automobile technologies which are a growing market", says Mr. Toshio Asano, the president of Asahi Kasei. The Japanese firm has not explored the automobile market much, but will commit to the area by developing a new product in cooperation with the American manufacturer. LIB sales for EVs have been struggling against the expectation of automakers for last few years. However, US-based Tesla Motors will introduce new EVs into the market, and the fuel regulations will be tightened in Europe and China. These factors will help the global EV market to expand. According to Asahi Kasei, the demand of separators for automobiles is expected to increase up to four to five times that of current figure worldwide by 2020. Expecting LIB market growth, Japanese manufacturers of separator materials have started to seriously invest in the production. Sumitomo Chemical will triple the production capacity for 2015 of its separators by 2020 to supply Panasonic for LIBs which are used in Tesla's EVs. Teijin doubled the production capacity of its separator plant in South Korea in December, 2014. Asahi Kasei will fortify the environment and energy area, and add to its core business which previously consisted of petrochemicals and fibers. (The Nikkei, February 24, 2015)

(3) Samsung

On February 23rd, South Korean-based Samsung SDI announced that it would acquire the battery pack division for EVs from a group member of Magna International, a major Canadian manufacturer of automobile components. However, the acquisition payment has been unrevealed. Samsung SDI is a major producer of cells, a key component of batteries, and aims to be more competitive in the market by adding a related business to its structure. On April 1st, Magna Steyr Fahrzeugtechnik, Austria, will sell its battery pack division to Samsung SDI. The division has approximately 260 employees and a turnover of € 40 million (approximately ¥5,400 million) for 2014. Cells and cell modules are supplied by other manufacturers, and they are combined with chillers to be battery packs which are then supplied to US-based GM. Being the largest in the global LIB market, Samsung SDI currently supplies its products mainly for cell phones, but only a limited amount for automobiles for German-based BMW. LIBs are often supplied in a cell form for automobiles. The firm decided on the acquisition expecting battery packs will be demanded more as the EV market expands. (The Nikkei, February 24, 2015)

(4) Toyota

On February 24th, Toyota Motor opened the production site of its FCV "MIRAI" to the media. Without a mass-production line, three vehicles are made each day in the Motomachi Plant, Toyota City of Aichi Prefecture. The assembly is conducted by 13 specially chosen employees who have excellent technical skills, and the automaker emphasized the high quality product made with the engineers' workmanship. (The Nikkei, February 25, 2015)

On March 13th, Toyota signed for The Olympic Partner (TOP) Programme with the International Olympic Committee (IOC). Although globally well-known firms such as Coca-Cola use this program, no automakers previously went into the partnership.

Toyota is believed to have paid about ¥200 billion for the contract which remarkably exceeds the previously thought standard price of ¥30 billion. They will take the opportunity to showcase its advanced technologies such as FCV at 2020 Tokyo Olympics. (The Nikkei, March 14, 2015)

(5) Yamaha

Yamaha Motor, the producer in second place in the world motorbike market, plans to start the four-wheeler business in Europe by 2019. With a couple of tens of billion investments, a dedicated plant will be built to produce and sell two-seater cars. They will make a small car to drive in cities or short distance, and both 1,000 cc gasoline engine and EV versions will be available. The motors and battery, the power components of EVs, are expected to be supplied by component manufacturers. (The Nikkei, February 27, 2015)

(6) Mitsubishi Motors

On February 26th, Mitsubishi Motors revealed its new charger tariff for users of eco cars such as EVs. Their monthly plan is between ¥500 to 1,500 and ¥5 to 10 per minutes for quick chargers from April 1st. The point is that users can choose from three plans to suit their usage. This service is for selected vehicles including three vehicles of "MiEV" series and PHV "Outlander". (The Nikkei, February 27, 2015)

(7) California, USA

Because California, USA, which is a highly motorized society, is trying to reduce emissions, EVs are attracting attention. The state targets a high figure of 1.5 million EVs, and the accumulated sales went over 0.1 million EVs in August, 2014. One of the successful promotional measures is the carpool lane on highways as an advantage for EV users. In a survey on EV owners, just fewer than 60% of them replied the advantage was a "large decision factor". (The Nikkei, March 10, 2015)

(8) Changan Automobile

Changan Automobile, a major automaker in China, has revealed its sales target of 0.4 million next generation eco cars such as EVs and hybrid vehicle (HVs) by 2020. Also 2 million vehicle sales are aimed by 2025. To achieve these goals, 18 billion CNY (approximately ¥350 billion) will be invested in next generation eco car business to 2025. The automaker is developing next generation eco cars in Beijing, the US, and UK as well as Chongqing. A total of 34 models including 27 models of EVs and five models of PHVs are planned to be introduced into the market by 2025. The firm will also work on the development of FCV using hydrogen. Their sales result for January and February was 0.527 million vehicles, a 25% increase of that of the same period for the previous year. In the figure, 0.2158 vehicles were passenger vehicles of their own brand, 40.9% in the total and a 64% increase. (The Nikkan Kogyo Shimbun, March 11, 2015)

(9) Tesla Motors

Tesla Motors, an American EV venture, will reduce the total number of personnel by around 30% in China. The actual figure is estimated at about 180 employees. The firm deployed its Chinese arm at the end of 2013, and their products became popular in urban areas such as Beijing and Shanghai. However, after that their sales started struggling there. (The Nikkei, March 9, 2015)

Tesla Motor announced that it would offer a service to buy back its luxury range EV "Model S" sold in Japan. The buyback price becomes 45% of their standard price of ¥8.71 million after approximately four months, which gives average ¥0.1 million monthly costs to use for the period. Options will also be purchased back at 33%. (The Nikkei, March 13, 2015)

7. FCV Component Development

On March 4th, "FCV Component Structure Workshop" started at Hydrogen Energy Test and Research Center for local businesses in Fukuoka Prefecture to learn about FCVs in order to enter the component market. A total of 120 people are participating the two-day workshop until 5th. The participants were taken around to have a look at a hydrogen transport trailer and the facility to test hydrogen tanks by highly pressurizing tanks, and given a talk by one of the engineers to have developed Toyota's FCV as well as test ride on FCV owned by the prefecture. (The Nishinippon Shimbun, March 5, 2015)

8. Commercial Hydrogen Refueling Station Business Plans

(1) JX Nippon Oil & Energy

On February 16th, JX Nippon Oil & Energy announced that its fifth commercial hydrogen refueling station opened in Yokohama City. The Yokohama-Asahi Hydrogen Station uses an off-site supplying system, and compressed hydrogen is brought there by trailer. The supply capacity is 300m^3 per hour, which fully fills five to six FCV tanks every hour. The firm will open commercial hydrogen refueling stations at 11 locations including this Yokohama one by the end of March. (The Denki Shimbun, February 18, 2015)

On February 18th, JX held an opening ceremony of the hydrogen refueling facility for FCVs at Miyoshi City, Aichi Prefecture. The facility was already in operation, and is the first hydrogen refueling station in Aichi Prefecture for the firm. The hydrogen supply equipment is installed in an established refueling station. The fuel costs about ¥5,000 to fill a FCV tank fully. (Gifu Shimbun, February 19, 2015)

On February 19th, JX held an opening ceremony of the commercial hydrogen refueling facility in Minuma-ku, Saitama City. This is the first hydrogen refueling facility in Saitama Prefecture. The hydrogen supply equipment is installed in an established refueling station, and the station now sells hydrogen as well as gasoline and diesel. Although hydrogen business will need some time to reach break-even due to the low number of FCVs used in the area, Mr. Tsutomu Sugimori, the president, said "we are committed to develop a hydrogen supply chain". This hydrogen refueling facility is installed in "Doctor Drive Owada", a refueling station operated by ENEOS-NET, a subsidiary of JX. (The Nikkan Kogyo Shimbun, February 20, 2015)

(2) Suzuki Shokan

Suzuki Shokan, Tokyo, and US-based Air Products have signed partnership for designing, constructing and operating hydrogen refueling stations. A licensing agreement was also signed for equipment and engineering, which allows combining Air Products' technology and Suzuki Shokan's advanced engineering. With this partnership, both firms plan to develop a hydrogen refueling facility which fits in with Japanese law and to sell it successfully. Their business aims to expand nationwide, and to install their products at five locations in five years. Being a specialized trading company, Suzuki Shokan sells industrial gases and chemical products as its core business, and also industrial equipment, air conditioners and cryogenic systems. With their long-period of experience in high pressure gas since the start of business in 1905, they produce and sell analysis instruments for components used at wide range of pressures from low to over 100 MPa for the FCV area. Related performance and endurance tests are offered as well as safety tests. On the other hand, Air Products is a major industrial gas producer. They have worked on over 180 hydrogen refueling stations worldwide, and supply hydrogen widely. An estimated 6,000 FC forklifts are used in the US, and the firm installed hydrogen refueling facilities using its "Smart Fuel Technology" in logistic facilities at over 20 locations there. Over 70 dispensers are used to fill over 2,500 forklifts with hydrogen each day. The new hydrogen refueling equipment will be sold nationwide through the industrial gas sales channel developed by Suzuki Shokan which has more business bases in eastern Japan. (The Chemical Daily, February 19, 2015)

(3) Nippon Steel & Sumikin Engineering

Nippon Steel & Sumikin Engineering has started construction of a hydrogen refueling station through its subsidiary Nippon Steel & Sumikin Pipeline & Engineering. Their partner, a major American gas equipment manufacturer, will provide the refueling facility and the facility will be modified for Japan. (The Nikkei & The Nikkei Business Daily, February 25, 2015)

(4) Kobe Steel

Kobe Steel will fortify package sales for hydrogen refueling stations aiming at 50% share in the stationary hydrogen supply facility market in Japan. Their advantages are a smaller installation area achieving about half the size of conventional products and 20% reduction in costs to attract more hydrogen refueling operators to place orders. The manufacturer will strongly advertise its advantages such as new micro-channel heat exchangers and high pressure piping technology as well as its existing high pressure hydrogen compressors. Six of their high pressure hydrogen compressors were delivered to hydrogen refueling stations of JX Nippon Oil & Energy and Tokyo Gas. From this fiscal year, Kobe Steel added accumulators, chillers and control panels to its range, and also started offering "HyACmini" which consists of these units and is a hydrogen supply package enabling saving of both installation space and initial costs. The manufacturer will deliver their package systems to two refueling stations after FY 2014, but these are actually a small part of its proposals. At the moment, refueling facility operators tend to choose mobile refueling systems that Kobe Steel does not offer. The reason behind this is that these operators do not want to install large equipment for a business with currently limited earning due to a low number of FCVs in operation. On the other hand, stationary hydrogen refueling facilities can supply on a larger-scale, and may be the main stream once a larger number of FCVs are in use. The firm only uses components and peripheral equipment supplied in Japan for hydrogen related systems. They believe that if they reply on oversea suppliers for FCV infrastructure, this will not benefit Japan but only foreign businesses once the FCV market gets bigger. (Nikkan Jidosha Shimbun, March 3, 2015)

9. Measuring/Observation Technology Development and Business Plan

SiMICS, a venture of a semiconductor producer and developer in Nagano Prefecture, will start taking orders for hydrogen detectors this summer. Once a leak is found, the product can notify its user via wireless. The firm developed it in cooperation with a manufacturer of gas sensors in another prefecture. The product is expected to be in hydrogen production plants and refueling stations for FCVs. The system consists of a hydrogen gas sensor and a wireless transmission unit, which allows centralized monitoring by sending information to PCs or tablets. The firm estimates tens of thousands of detectors can be used in a hydrogen production plant. The detector uses green power such as solar, heat pump and vibration, which eliminates the need of batteries or replacement of batteries and continuously operates for five years. The firm also aims for FCVs for the product usage. The wireless unit of the system can send information to devices within 300 m, the manufacturer plans to introduce a product with maximum transmission range of 7 km into the market by this autumn. (The Nikkei Business Daily, March 13, 2015)

—This edition is made up as of March 14, 2015—

A POSTER COLUMN

Is FCV Ultimate Eco Car?

Toyota Motor's FCV "MIRAI" is selling well. The only thing it emits is water, and the Japanese government has been promoting FCV as an "ultimate eco car". However, there is a question about FCV been environmentally friendly. The issue is that CO_2 is produced during hydrogen production. The Japanese government subsidizes a large amount on FCV purchase and hydrogen refueling facility installation and plans to bring FCV to be the key of the next generation car in cooperation with the private sector.
However, Mr. Elon Musk, the CEO of US-based EV venture "Tesla Motors" is critic of these movements. In January, he played on the word calling "fool cell" for "fuel cell" and criticized that hydrogen requires a lot of energy during its production and is suitable for rocket fuel but not for cars at the North American International Auto Show. He is not the only one skeptical about the green effect of FCVs. The CO_2 emissions of FCVs are not far from that of HVs. This comparison is from "Well to Wheel (WTW)", an indication of an environmental impact of cars from fuel mining to driving. According to the estimate published by the Japan Automobile Research Institute in 2011, FCV emits 79 g of CO_2 to drive 1 km, which is a half that of 147 g of gasoline car or 132 g of diesel car. HV produces 95 g of CO_2, and this means FCV only saves slightly under 20%. Hydrogen is produced from natural gas, a fossil fuel, which makes the difference so small.
The Institute of Energy Economics (IEE), Japan's evaluation in 2009 is 168 g for FCV and no difference from 170 g for a gasoline car. This calculation is more severe, but can change by factors such as driving distance. Mr. Harumi Hirai, a Senior Coordinator at IEE, points out that the key for hydrogen is how to get over the disadvantage of it being a secondary energy.
The lowest CO_2 emissions for FCV are when driven on hydrogen produced by renewable energy. According to the Japan Automobile Research Institute's estimate, hydrogen produced by a photovoltaic generator gives 14 g of CO_2 emissions, less than fifth that of natural gas. This is a tenth that of gasoline car, which makes FCV very close to an ultimate eco car.
The Hydrogen/fuel Cell Strategy Council of METI has

drawn the “Hydrogen/FC Strategic Road Map” to concentrate on expanding hydrogen use first, and then to establish a system to supply hydrogen produced by renewable energy by 2040. The environmental impact of FCVs is expected to stay large for a while. On the other hand, in FY 2015, MOE will investigate how much FCVs can reduce their CO_2 emission in the WTW measurement by using hydrogen produced by renewable energy. Will FC or rechargeable battery vehicles take a lead in the next generation? The Japan Automobile Research Institute’s estimates 77 g of CO_2 emissions for EV, which is the same level of FCV. However, recharging an EV from a photovoltaic generator gives a CO_2 emission of 1 g, a lower value than that of FCVs, which gives EVs a better position than FCVs. (The Nikkei, February 28, 2015)