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R&D on 1,000kW Level FCs Using Solid Hydrogen Fuel

Arranged by T. HOMMA

1. Governmental Measures

(1) METI

The Ministry of Economy, Trade and Industry, METI, will show at the 2020 Tokyo Olympics and Paralympics, a new social infrastructure model using at its core hydrogen energy and an innovative energy demand and supply management system. The system will be developed to control demand response, DR, used by users, a renewable energy facility and storage battery for optimum electricity and heat operation. The ministry will deploy the system nationwide including Olympic related facilities. Regional renewable energy facilities will produce CO_2 free hydrogen, and this hydrogen will be a fuel for fuel cell, FC, buses and fuel cell vehicles, FCVs, for the facilities in Tokyo and other cities. The ministry plans to provide a sufficient budget for infrastructure preparation from FY2016. This was revealed at a meeting of the "Working Group for 2020 Future Development" of the Industrial Structure Council held on October 30th. The system for demand and supply management is called virtual power plant, VPP, and is one of energy management technologies to make power generation/storage facilities and energy-saving method such as DR work as a single a power station. Other anticipated effects are a storage battery to expand renewable energy use, stabilizing power supply by small-scale utility supplier and reduction in utility costs of users. The ministry intends to start a demonstrational project to establish VPP in FY2016. A budget of just under ¥4 billion is allocated in the request. Another study group will be launched to sort issues to promote a negawatt power market this month. Hydrogen use will be at its core. A model will be established to produce hydrogen from power of renewable energy in provincial cities in order to send it to urban areas where the fuel will be in high demand. To be shown as a model, this "hydrogen society" will connect provincial and urban areas for supplying hydrogen refueling stations and FC buses. METI will support facility, technology and experiments to quickly spread hydrogen use technology including stationary FCs, and FCVs. Also, the growth roadmap of FCs compiled in 2013 will be revised, and the expert conference was reassembled in June. The ministry will use the CO_2 free hydrogen supply chain and innovative energy demand and supply management system to expand and spread use of related technologies after the Olympics. Additionally, DR service will be promoted to universalize it in the society. (The Denki Shimbun, November 2, 2015)

2. Local Governmental Measures

(1) Tokyo

On November 6th, Tokyo revealed the budget bill outline for FY2016 of its bureaus. Cultural promotion for the 2020 Tokyo Olympics requests ¥3.2 billion, and ¥4.4 billion is demanded for promotion for hydrogen society including subsidy for FCV purchase. The total of the general account is ¥6,978.5 billion, a 0.4% increase of that of FY2015. The governor will assess the bill after New Year, and then it will be submitted to the metropolitan assembly. The clean hydrogen society area is one of the key measures. As well as supporting FCV purchase, the local government will work on preparation of hydrogen refueling stations in Tokyo. Haneda airport will be investigated for hydrogen use. (The Nikkei, November 7, 2015)

(2) Kanagawa Prefecture & Yokohama & Kawasaki Cities

A unique project started in Kanagawa Prefecture this autumn. In this project, hydrogen is produced by

splitting water using electricity from "Hama-Wing", wind turbines built offshore of Minato Mirai 21. Hydrogen allows the adjusting of the demand and supply of renewable energy produced by wind and using the power without waste. The project focused on this function, which is the key. The local governmental project members are Kanagawa Prefecture, and Yokohama and Kawasaki Cities. Toyota Motor, Toshiba and Iwatani join in the project which provides hydrogen to FC forklifts. (The Nikkei Business Daily, November 10, 2015)

(3) Tokushima Prefecture

Tokushima Prefecture has revealed the outline of the hydrogen refueling station to be installed at its office. Being self-contained, the station splits water to produce hydrogen using power from a photovoltaic generator, and emits no CO_2 from generation. According to the Renewable Energy Office, this type of hydrogen refueling station will be installed in the Shikoku area for the first time. The operation will start in March, 2016. The construction cost ¥181 million, and ¥114 million is subsidized by the Ministry of the Environment, MOE. The station will be installed in front of the office entrance. The station will make 1 kg of hydrogen from 32 L of water which allows a FCV to drive about 100 km. The annual hydrogen production is to be about 500 kg, which can supply five official FCVs to drive 50,000 km each year. Electricity of 10 kW for electrolysis will be supplied from solar panels to be newly installed on the roof of the office. Also, the prefecture plans to purchase FCVs to use hydrogen, and allocated ¥40 million in the budget to buy five FCVs. (The Chemical Daily, November 19, 2015)

3. FC Element Technology Development & Business Plans

(1) Nisshinbo

On October 27th, FC producer Ballard Power Systems, Canada, announced at the local time that Nisshinbo Holdings would strategically finance it with $5 million. This will strengthen the partnership between Ballard and Nisshinbo which produces carbon separators and carbon alloy catalysts for FCs. With this fortified partnership, Ballard plans to achieve a reduction in FC production to develop the market fully. The finance will be completed in early November. (The Chemical Daily, October, 29, 2015)

Nisshinbo Holdings will invest in major Canadian FC producer Ballard Power Systems to jointly develop a FC material for automobiles. Nisshinbo produces separators for home FCs, and will develop a product for automobiles by this alliance with Ballard for the developing FCV market. (The Nikkei Business Daily, November 5, 2015)

(2) Iwatani

Iwatani is investigating commercial hydrogen use other than FCVs. Hydrogen business for FCVs is expected to be unprofitable for a while, which is the reason for the firm to start an experiment to directly supply home FCs with hydrogen. As well as the operation of hydrogen refueling stations, they plan to provide facilities and knowhow to make the business profitable. In March, 2015, a joint experiment of pure hydrogen FCs started with cooperation of Toshiba. Common FCs use natural gas or liquefied petroleum gas, LPG, and both require reforming for the use. On the other hand, hydrogen can be directly supplied to pure hydrogen FC systems, which is the difference. The system was installed at a zoo and wholesale market in Shunan City, Yamaguchi Prefecture. Additionally, two convenience stores of Seven Eleven will be installed with the system by March, 2016. (The Nikkei Business Daily, October 30, 2015)

(3) Kyushu University

A study group of Prof. Seiji Ogo at Kyushu University has developed a method to use a catalyst using hydrogenase, an enzyme, produced by microbes for both electrodes in collaboration with Kumamoto University. Previously, this type of catalyst can only be used for one electrode due to the production of harmful substances. This method is likely to raise the possibility to produce FCs without platinum which is the main catalyst material, but expensive. With automakers' cooperation, the aim is for highly functional FCs to be commercialized early as possible. The target is polymer electrolyte fuel cell, PEFC, which is used for automobiles. Last year, the group discovered that a catalyst using oxygen resistant hydrogenase, an enzyme living in microbes, could the increase electromotive force to 1.8 times of that of platinum one. However, when the catalyst is used for both the cathode and anode in a FC, hydrogen peroxide is produced at the cathode. Hydrogen

peroxide corrodes metal, which is a problem. When electrons are supplied to iron atoms, oxygen sticks to the atoms. In the joint research with Kumamoto University, the group focused on this property. By using the mechanism, water is produced at the cathode instead of hydrogen peroxide. This solves the problem of hydrogen peroxide. The group plans to improve the method to keep oxygen longer. (The Nikkei Business Daily, November 4, 2015)

(4) Kyocera

Kyocera will work more seriously on battery related business. In the FC area, the development of solid oxide fuel cell, SOFC, will be strengthened using expertise from cell stack production. They plan to introduce a 3 kW level SOFC into the market in 2016 aimed at commercial facility use. Their cell stacks have been supplied for home SOFC systems since FY2011. The firm produces very durable stacks using knowhow from fine ceramics, and will fortify the development structure for its own SOFC. A SOFC system for business with its own stack use will be brought out as early as possible. Currently, a trial product is being tested for commercialization, and the firm aims to sell the product for shopping malls and gyms from FY2016. Their sales activities will be expanded to Europe and the US in the future. The sales are targeted at the level of a couple of ¥10 billion. (The Chemical Daily, November 4, 2015)

(5) Toshiba

On November 4th, Toshiba announced that the Port and Harbor Bureau of Yokohama City placed order for "H_2One", a FC system to generate power using hydrogen. Being a self-contained and independent system, this product produces its own hydrogen for power production, which is the key feature. To increase the sales, the manufacturer will try to sell the product to local governments which were affected by the disaster. Firstly, H_2One splits water into hydrogen and oxygen using electricity, and then hydrogen is stored in the tank. Secondly, the FC unit uses hydrogen from the tank to generate power. To start its operation from March 2016, a system will be built in two containers as a business continuity plan for disasters to be installed at Yokohama Port Cargo Center in Daikoku Pier. This system supplies power to communication tools such as phones and computers for three days once the power grid is cut by a disaster. Additionally, hot water is provided at the same time for public health purposes. The manufacturer has also received order for the same system from Huis Ten Bosch, Sasebo City in Nagasaki Prefecture. (The Nikkei Business Daily & The Denki Shimbun, November 5, 2015)

(6) Aquafairy

FC developer Aquafairy, Kyoto City, has developed a FC system to produce hydrogen in-situ for power generation. The key feature of this product is portability, which is achieved by eliminating a need of a large tank to store hydrogen required for conventional FC systems. The firm aims to sell the product mainly to local governments for emergency use at evacuation centers. In the system, hydrogen is produced by adding water to calcium hydride in the fuel cartridge. This low pressure hydrogen production reduces the fire risk. Then, electricity is generated using the reaction of hydrogen and oxygen in the air. The product outputs 30 W, and can supply small appliances such as light emitting diodes, LEDs, laptops and electric fans with power. There is also a USB outlet. The capacity becomes 1,200 Wh with two fuel cartridges. The product can supply a large LED floodlight with power for two days, and fully charge over 100 smart phones and tablet computers. The product will sell for ¥500,000 from January. The manufacturer aims at an annual 1,000 unit sales. As well as emergency use, the product is expected to be used at mountain cabins which have no power connection. The firm will also try to sell the product for emergency use to abroad, the areas where the power supply is unstable. Because the product requires no tanks, it weighs about 7 kg. High pressure hydrogen is use in conventional systems, and is prone to catch fire. Due to this nature, storage tanks need to be strong and have to be designed for high safety standards. This increases in weight of these systems. (The Nikkei, November 23, 2015)

(7) Asahi Soft Drinks

Asahi Soft Drinks will deploy vending machines with FC generators for disasters from January, 2016. Tatsumi Chuo Management Laboratory, Tokyo, and Recyclable Energy Tohoku, Sendai City, have been working on the "Installation Project of Beverage Vending Machines with Magnesium Air Batteries", and Asahi Soft Drinks has joined in the project. A total

of 100 units of vending machines with magnesium air batteries for independent operation during disasters will be installed mainly in evacuation centers such as schools and hospitals in Fukushima Prefecture. From 2017, the project will consider installation outside Fukushima Prefecture. The battery uses magnesium, water and air as fuel, and emits no CO_2 or harmful substances. The power supply can operate a vending machine for 72 hours, and can also be used for communication tools such as computers, cell phones and TVs. The FCs are produced by Tatsumi Chuo Management Laboratory. (The Nikkan Kogyo Shimbun, November 16, 2015)

(8) Biocoke Lab

Biocoke Lab, a venture of environmental technology development in Tokyo, aims to develop a large FC system using own solid hydrogen as fuel by 2020. The system is planned to be built in a container and to output 1,000 kW. The manufacturer developed its own technology to make hydrogen which requires special care for processing into a solid form. Using this technology, the system will be designed as a distributed generator. The laboratory developed "Mag Hydrogen" which is hydrogen stored in magnesium (a metal) tablets and produces the chemical in Shizuoka Prefecture. Mag Hydrogen can be handled with bare hands, and stored at normal temperatures. These properties give easier handling than liquid hydrogen, which is the key feature. This solid hydrogen releases hydrogen by a reaction with a citric acid solution. The manufacturer aims to develop a device to continuously react solid hydrogen with the solution and a 1,000 kW level FC system in a 40 feet container. The development cost is estimated about ¥2.4 billion, and the firm is asking industrial gas manufacturers and chemical producers which produce hydrogen either as a primary or by- product to join in the development. Biocoke Lab plans to test the system in 2019 to commercialize it for the Tokyo Olympics and Paralympics. (The Nikkei Business Daily, November 20, 2015)

4. Hydrogen Infrastructure Development & Business Plans

(1) Flat Field

Flat Field, Kanagawa Prefecture, will develop a FC garbage truck. After New Year, a manufacturer of special purpose vehicles will provide a base vehicle, and Flat Field will develop a truck using a FC unit from oversea supplier by summer of 2016. The truck will have a test operation from autumn of 2016 in Shunan City which is working on a hydrogen energy use concept in Yamaguchi Prefecture. The test operation is to ensure no CO_2 emissions during driving in the city, and to collect data including fuel efficiency and noise. This development was selected for the "Projects of Technological Development to Reduce CO_2 Emissions and Demonstration for FY2015" of MOE, and will be jointly carried out with Waseda University Academic Solutions and Techmation in Tokyo. They aim to achieve 1.75 times fuel efficiency of that of a standard medium size diesel truck and about 1.3 km/kWh fuel consumption as well as a CO_2 free driving garbage truck. (The Nikkan Kogyo Shimbun, November 4, 2015)

(2) Laboratory in Germany

A study group of Dr. Seigo Shima, a group leader at Max Planck Institute for Terrestrial Microbiology in Germany, has developed a "semisynthetic" enzyme which activates hydrogen gas under normal temperature and pressure. Genetically engineered Escherichia coli, E. coli, was used to produce a large amount of the protein part constituting the enzyme. The function of hydrogen production and break down was achieved by incorporating the proteins into chemically synthesized iron compounds. With further research, this semisynthetic enzyme may be able to replace expensive platinum catalysts used for chemical reaction such as FC. "Hydrogenases" are enzymes in microbes, and can work as catalysts. The enzyme can activate hydrogen at normal temperature and mediate hydrogen production and breakdown. Iron hydrogenase in methanogen is one of the easier to handle enzymes; on the other hand, methanogen is difficult to culture in large amounts. This time, the structure of iron hydrogenase was separated into a protein and iron compound which is the center of the active site. The protein was produced by using the genetically engineered E. coli, and the iron compound was created by chemical reaction. Both materials do not individually have a catalytic property. However, the group ensured that the catalytic reaction was activated by giving the iron compounds to protein. Although the activation level is 1% which is lower

than natural enzymes, the semisynthetic enzyme outruns the level of existing synthetic enzymes. (The Nikkan Kogyo Shimbun, November 5, 2015)

(3) LIXIL Housing Research Institute & Honda

On November 11th, LIXIL Housing Research Institute which is a member of LIXIL Group and operates the franchise chain of "Eyeful Home" in Tokyo, and Honda unveiled a model of next generation homes. This next generation home can be supplied power from Honda's FCV. This show house is to mainly test the energy side of the correlation between house and car. The firms named the show home built in Katsushika-ku, Tokyo, "Next Generation Resilience Home Ie Plus X Powered by Honda", and introduced it. The house is installed with equipment to connect itself and car by the entrance. This equipment can charge EVs, and also send power from a FCV or an EV to home. Additionally, gas cogeneration and photovoltaic generator can be controlled for optimum operation, which saves utility bills. (The Nikkei Business Daily, November 12, 2015)

(4) Chiyoda

Chiyoda Corporation has been speedily proceeding with development to establish a hydrogen supply chain. They propose a supply chain using methylcyclohexane, MCH, as a hydrogen carrier, and a number of experiments are in progress for the commercialization. This time, a decision was made to examine a supply chain for hydrogen produced by wind power, and to develop a dehydrogenation plant in a size for in-situ use at hydrogen refueling stations. The firm plans to choose a location for the plant of the experiment project for hydrogen transport in a large volume from abroad in FY2016. (The Chemical Daily, November 12, 2015)

(5) Toyo Kanetsu

Toyo Kanetsu has started technological development to build a new tank for liquid hydrogen in cooperation with Prof. Hirotsugu Inoue and Prof. Akira Todoroki at the Graduate School of Science and Engineering Mechanical and Control Engineering of the Tokyo Institute of Technology. The tank is to be a cylindrical shape with flat bottom rather than conventional sphere form, and to be installed vertically. This can achieve a capacity of 10,000 m^3 which is the world's largest level while saving space. The project aims to establish the technology in three years. Currently, the world's largest liquid hydrogen tank is in a sphere shape with a capacity level of 3,000 m^3. This shape tank requires a larger installation area as its capacity increases. On the other hand, a vertically installed cylindrical one can adjust its capacity by height, which gives a big financial advantage specifically in Japan. (The Nikkan Kogyo Shimbun, November 18, 2015)

5. ENE-FARM Business Plans

(1) Toho Gas & Saibugas

On October 26th, Toho Gas & Saibugas announced that "Home Eco Check Program" promoted by MOE certified the "Home Generation Thorough Diagnosis", a service menu of their "e Gokochi Check, Home Energy-Saving Diagnosis Software" trilaterally developed in September 2014. This diagnosis software developed by gas suppliers is the first one certified by that program. Toho Gas and Saibugas use it as a sales tool of their products such as ENE-FARM. Toho Gas believes that "the credibility of the software is extended by the certification". The software has three menus of "Home Generation Thorough Diagnosis", "Energy-Saving Evaluation" and "Quick Check". The software installed tablet computers estimate utility bills including water, if ENE-FARM is used, by entering information such as family members of customers, appliances used in their houses and their state of use. Additionally, it says what actions can be taken to reduce energy consumption and CO_2 emissions as well as the effects of these actions. Toho Gas started to use the software in September 2014, and has used it to talk business with 11,000 prospective customers who considered buying or replacing gas equipment since then. Home Eco Check Program of MOE has also certified the Kansai Electric Power Company and JX Nippon Oil & Energy as operators. (The Denki Shimbun, October 27, 2015)

(2) Osaka Gas

On November 12th, Osaka Gas announced that an energy-saving effect of a maximum of 31% was exhibited in its ENE-FARM experiment in an apartment house. ENE-FARM produces electricity and hot water using natural gas. In this experiment, electricity was shared among the units for better generation efficiency to save energy, which reduced 51% of CO_2 emissions. The gas supplier uses the data

from the experiment to find out better ways to use gas equipment for its sales activity. The data was collected with an experimental apartment house in Tennoji-ku, Osaka City. Excess power was sent to households which are short of electricity. Although gas bills still need to be paid, the firm ensured that electricity purchase could be decreased by 91% in the whole apartment house. (The Nikkei, November 13, 2015)

6. Cutting Edge Technology of FCVs and EVs

(1) Honda

On October 24th, in a technological explanatory meeting held in Haga-machi, Tochigi Prefecture Honda announced that it has developed a plug-in hybrid vehicle, PHV, system in which the driving range of the EV mode has been extended to 110 km, a triple of that of the previous range. This system will be used in the PHV to be released in the US by 2018. They increased energy density of the battery as well as the capacity, means that the vehicle can drive a longer distance in the EV mode on express roads. The current PHV version of "Accord" can drive 37 km in the EV mode, but the new system is triple the distance. The majority of current competitors' PHVs can drive about 50 km solely on their batteries. Honda will appeal the longer driving range in the EV mode to consumers as a strategy. "PHV can effectively be a transitional bridge to zero-emission cars such as FCVs to be able to lead the industry", said Mr. Keiji Otsu, a Managing Director of Honda R&D, a research and development subsidiary of Honda. Also, he considers the PHV development is a key. (The Nikkan Kogyo Shimbun, October 28, 2015)

Honda will start the first general sales of an electric motorbike by 2017. Previously, their electric motorbike was on limited lease. The new electric motorbike will be installed with LIB and motor on the body of a "Super Cub", it is Honda's small motorbike, and will have double the driving range of the current electric motorbike on a single charge. As well as the Japanese market, the product will be introduced into the Chinese market where air pollution is a serious problem. The competition in this kind of development will be furious as environmental regulations are getting stricter globally. The firm is developing a higher output motor and LIB for the commercialization by 2017. The electric motorbike will be the Honda's first non-lease sales in Japan. "EV-neo, the lease product, was available from 2010 to 2013, and sold for about ¥500,000. The driving range is about 30 km on a single charge. On the other hand, the new motorbike is to drive over 50 km. Conventional electric motorbikes have shorter driving range than their gasoline engine models, and sell for higher prices. Due to these reasons, these motorbikes have not become popular. However, the fuel cost is significantly cheaper. Once the driving range becomes over 50 km, certain demand can be anticipated for commuting to and from offices and schools. The annual sales of electric motorbikes are about 6,000 vehicles which is approximately 1% of that of the whole motorbike market. In August, Yamaha Motor introduced "E-Vino", an electric scooter, into the market, but fewer products are available in the market. Honda's full entry will hopefully revive the electric motorbike market. One of the reasons why Honda has got in gear in this development is tightening environmental regulations in Asia including China. Electric motorbikes can accommodate the regulation changes. (The Nikkei, November 18, 2015)

On November 17th, Honda announced that its new "Clarity Fuel Cell" running on hydrogen would be released in March, 2016 in Japan, and then available in the US in the same year. The sales in the US will be limited to California where preparation of hydrogen refueling stations is in progress. (The Nikkei, November 19, 2015)

(2) LG Chem

South Korean-based LG Chem is moving into the final stage of the discussion on LIB supply with US-based EV manufacturer Tesla Motors. Prior to production increase of its EVs, Tesla is considering changing its strategy to use Panasonic as its sole supplier of batteries. (The Nikkei, October 28, 2015)

(3) Tokyo Motor Show

On October 29th, the 44th Tokyo Motor Show 2015 will be open with participation of automakers around the world at the Tokyo Big Site. The automakers will display cars with the most advanced technologies such as FCVs and automatic driving to show off their environmental and safety performances. Since consumers are not as interested in cars in developed countries, the automakers will bring more cars for

enjoyable driving. The industry aims for continuous success in sales by showing the aspects of environmental/safety technologies and pleasure. On 28th, FCVs were introduced to the media prior to the public exhibition. Toyota will introduce a concept car of "LF-FC" expected to be a flagship model of "Lexus", the luxury range of Toyota, for the first time. They officially announced that a FCV is planned to be available in the Lexus range after 2020 following MIRAI's release in 2014. Additionally, their concept FCV which can supply other cars with electricity will be displayed. This clearly shows Toyota's commitment in FCVs as a core for the future eco car strategy taking over hybrid vehicles, HVs. The commercial version of Honda's FCV "Clarity Fuel Cell" will make it the world's first debut. Clarity Fuel Cell will be available on lease to governmental bodies from March 2016, and its general sales will start once the production capacity is ready for the increase. Honda made FCs, the power unit, 33% smaller than that of conventional FCVs to accommodate five adults comfortably seated. Mr. Takahiro Hachigo, the president, explained that Clarity Fuel Cell gave fun and pleasure to drive as well as environmental performance. He also showed an intention to introduce it to the European and US markets. (The Nikkei, October 29, 2015)

(4) Kyoto University

Kyoto University has developed a "rechargeable zinc-air battery" which uses zinc, a low-cost material, and oxygen in air to produce power. This battery can store 32 times the amount of electricity of a LIB of the same weight. Zinc can transport twice the number of electrons as lithium, and can more easily make a battery high capacity. However, zinc becomes uneven during charging, which is a problem for repeated charging and discharging cycles. Zinc's behavior is improved by adding an additive to the solvent. The study group ensured that the battery could perform over 100 cycles of charging and discharging. They aim at over 1,000 cycles by improving the additive's performance. Zinc is cheaper than lithium, and does not need harmful organic solvents. A high capacity and output system can be achieved at same time by charging a high output nickel–metal hydride battery using a high capacity zinc-air battery. This system is expected to be used for EVs. (The Nikkei, November 2, 2015)

(5) China

The Communist Party of China will work on advancing industries and environmental measures full tilt as the "13th five-year plan" starting from 2016. The key industrial areas to be developed are IT, robot, aerospace, ship, railway, agricultural machinery, new materials and new drugs. The environmental measures cover expansion of renewable energy, increase in the number of nuclear power stations, and the development of shale gas. As the transport area, new energy cars such as PHVs and EVs will be promoted aiming at 2 million vehicle sales in China by 2020. (The Nikkei, November 4, 2015)

(6) Nissan etc.

An EV to drive over 300 km on a single charge may be available in an affordable range in 2016 which is earlier than currently expected. Battery performance is improving rapidly, and automakers such as Nissan and German-based Audi are trying to introduce new EVs with a significantly greater driving range. A driving range of 300 km is considered the level to achieve for EVs to become popular. Google is also attempting to enter the market, and EVs are developing at a faster speed. (The Nikkei, November 10, 2015)

Nissan has added a new model of EV "LEAF" using a newly developed high capacity battery of 30 kWh which extends the driving range to 280 km, 20% longer than of that of previous model on a full charge. With the additional choices of orange and blue, the model offers nine colors. Forward Emergency Braking and Lane Departure Warning are featured in the standard specifications. The new EV is eligible for purchase subsidy of maximum ¥0.51 million. (The Nikkei, November 11, 2015)

(7) Tokyo University of Science

The team of Prof. Shinichi Komaba at Tokyo University of Science has advanced the technology of potassium-ion batteries which are expected to be the next generation storage battery. Once commercialized, this battery can be recharged at over 10 times the speed of LIB. Because the battery is capable of accommodating a high current, it can be used for sports EVs which require acceleration. (The Nikkei, November 11,2015)

(8) WSCOPE

On November 10th, WSCOPE, a producer of separators for LIBs, announced that its consolidated net earnings for the term ending December 2015 were to be ¥1.7 billion, 3.2 times of that of the previous term. This figure goes over the best previous estimation of ¥1.4 billion, 2.7 times of that of the previous term. Their business is expanding abroad including China for batteries of EVs and smartphones. (The Nikkei, November 11, 2015)

(9) Audi Japan

Audi Japan has released small size car "A3 Sportback e-tron", and this added the first PHV to the key small car range in Japan. A combination of 1.4 L engine and electric motor are used in the car which allows powerful driving. The car can be recharged through a domestic wall socket, and drives up to 52.8 km in the EV mode. The price is ¥5.64 million. (The Nikkei, November 19, 2015)

7. FCV Parts Development & Business Plans

(1) Toyota Boshoku

Toyota Boshoku has expanded its business to core components of FCVs by using its own highly precise stamping technology. They produce FC stacks, a core component, which is used in MIRAI released last year by Toyota. Each set of membrane electrode assembly is divided by separator to be a cell. Hundreds of these cells constitute the cell stack. They also produce stack manifold and ion exchangers. The stack manifold is a piping part made of aluminum and resin to supply hydrogen, air and coolant to the FC stack. The ion exchanger removes ion impurities in the coolant supplied to the stack in order to keep the efficiency and insulation performance of the stack. To be made thin, large aluminum and resin parts are stuck together by insert molding for these products, which contributes to the reduced size of the FC stack. Specifically, the separator, a plate, uses precise stamping, the firm's own technology, which produces micro channels for hydrogen in FCs. This contributes to improvement in generation efficiency. (Dempa Shimbun, November 16, 2015)

8. Hydrogen Refueling Station Development & Business Plan

(1) Sumitomo Precision

Sumitomo Precision Products will seek a new application of its heat exchanger. In Japan, the majority of heat exchangers are for airplanes and bullet trains. The firm has developed a product for hydrogen refueling stations for FCVs. For oversea sales, the product will be commercialized for high speed trains in Europe by FY2016. The manufacturer aims at the sales of heat exchangers of ¥25 billion, double of that of FY2014. This product takes about a 30% share in the whole sales of the company. Their new heat exchanger was developed to keep hydrogen temperature down to supply FCVs. This product uses a bonding technology of stainless steel plates with channels. A pair of the heat exchangers is expected to sell for about ¥10 million. Iwatani will build hydrogen refueling stations at four locations, and has placed an order for the heat exchangers for these stations. (The Nikkei, November 11, 2015)

(2) SMFL

Sumitomo Mitsui Finance and Leasing, SMFL, will lease a hydrogen refueling station for FCVs to Saitama Prefecture. The station is planned to be installed in the prefectural office in March 2016. This is the first project to use the subsidy scheme of the "Installation Project of Hydrogen Station to Supply Renewable Energy in Community" of MOE, and the lease user can compress their own investment to a quarter. This time, SMFL will use "Smart Hydrogen Station" which requires a small installation area and can be installed in a short period. Saitama Prefecture signed an eight-year contract with the lease operator. High pressure hydrogen is produced using electricity and water. Because a photovoltaic generator provides power for operation of the hydrogen refueling station, the whole system barely emits CO_2. The station will supply hydrogen to FCVs to be purchased by the prefecture. (The Nikkei, November 10, 2015)

(3) JX Nippon Oil & Energy

JX Nippon Oil & Energy has opened its first mobile hydrogen refueling station for FCVs in Naka-ku Yokohama City. In the same Kanagawa Prefecture, hydrogen refueling stations will also be open in Kawasaki-ku, Kawasaki City, and Chuo-ku, Sagamihara City on November 17th. The firm will operate a total of three stations. The business days are; Monday, Thursday and Friday for the station in Yokohama City, Tuesday and Wednesday for the one

in Kawasaki City, Tuesday and Thursday for the one in Sagamihara City. The firm plans to open hydrogen refueling stations at a total of 40 locations including Tokyo using a subsidy of the Next Generation Vehicle Promotion Center. Their 12 stations are already in operation in the greater Tokyo area and Aichi Prefecture. (The Nikkan Kogyo Shimbun, November 16, 2015)

9. Hydrogen Leak Detection Technology Development

(1) Miyaki Electric

Miyaki Electric has worked on industrial safety products since its start. Currently their focus is on explosion proof cameras for the coming hydrogen society. They offer three types of surveillance cameras for wide angle, close-up and far-site, and all the products are compact, lightweight and explosion proof. Additionally, a wireless LAN version will be added. Their explosion proof cameras play a role in safety operation for production facilities, warehouses of dangerous goods, chemical tankers and explosion risk areas. Since hydrogen is expanding its use as clean energy as FCV development is in progress, the explosion proof cameras keep working environments safe for workers. (The Nikkan Kogyo Shimbun, October 27, 2015)

(2) FIS

FIS, Itami City of Hyogo Prefecture, will expand the sales of its originally developed hydrogen detector to the European and US markets using support of the Osaka Chamber of Commerce and Industry. In mid-November, members from the firm and the chamber of commerce will visit members of local industrial clusters in North America to look for business opportunities. Their target is sample sales to over five companies in the term ending March 2016. Coordinators of the chamber with connections to the areas give advice as support to explore the European and US markets as METI's project carried out by the organization. In the US, they will visit hydrogen/FC related business conferences and organizations in places such as San Francisco, California, to make appointments for meeting with individual businesses in couple of months. The chamber has a network of the oversea chambers of commerce, and can provide a shortcut for business opportunities. FIS uses this advantage to get deals. Being highly durable, the hydrogen detector of FIS quickly responds to hydrogen leaks as a key feature. Since the firm established a good relationship with domestic automakers, it supplies its product for Toyota's "MIRAI". (The Nikkan Kogyo Shimbun, November 6, 2015)

— This edition is made up as of November 23, 2015 —

A POSTER COLUMN

Which Next Generation Eco Car is Budget Friendly?

EVs and clean diesel cars get more attention due to their good fuel efficiency and environmental performance.

The initial cost is one thing coming into consumers' mind when they buy these cars. EVs require high capacity batteries, which pushes the price up. For example, "LEAF" available from Nissan since 2010 offers the lowest range S grade of ¥2,663,280, sales tax included suggested retail price. This is 80% more of that of a compact gasoline car. Mitsubishi Motors set the price of i-MiEV about a double of that of its Kei Class car, of less than 660 cc engine.

Subsidy and tax relief reduce financial impacts. The "Clean Energy Vehicle Promotion Subsidy" provides financial support, and the acquisition and tonnage taxes can be exempt. Depending on a type and price of cars, around ¥300,000 can be saved with these schemes combined in total for some cases. However, this does not fill the price gap.

On the other hand, daily running cost can be reduced more than gasoline cars. The diesel price for clean diesel cars is 20 to 30% cheaper than of that of gasoline. EV LEAF requires electricity worth about ¥300 to be fully charged at home. On a full charge, the car can drive about 220 km. According to Nissan's estimate, this is a fifth of that of the fuel cost to drive a similar class gasoline car. "Longer the distance you drive, the cheaper the running costs get. Once consumers buy our EVs, they tend to drive more" says Mr. Honsho in the Marketing Division of Nissan. Car critic Mr. Mitsuhiro Kunisawa advices that 60,000 km driving is the threshold of filling the difference of the car price by cheaper diesel or electricity cost.

There is a small point to keep in mind. Diesel engines tend to get fine particles contamination, and require more frequent engine oil replacement. Also, EVs need

to be charged every day. This means that a home has to have car ports with space for chargers. (The Nikkei, October 28, 2015)