

More Demonstrational Hydrogen Filling Stations

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1. Governmental Measures:

(1) Ministry of Economy, Trade and Industry, METI

On July 18th, METI revealed its plan to increase the number of hydrogen filling stations from currently about 20 to 100 by 2015 as a promotion for hydrogen fuel cell vehicles (FCVs). As the project cost, approximately ¥6 billion will be requested for the budget for the fiscal year 2013. (The Yomiuri Shimbun, July, 19, 2012)

METI will amend the High Pressure Gas Safety Act by this autumn to ease the current installation regulations for hydrogen filling stations. The regulations will be revised to accommodate 70 MPa high pressure hydrogen vessels for FCVs. On July 18th, a draft plan including the revision of the ministerial ordinances of the High Pressure Gas Safety Act, related to installation of hydrogen filling stations, was shown at the meeting of Study on Energy Business Strategy. (The Nikkan Kogyo Shimbun, the Tokyo Shimbun, the Chunichi Shimbun, July 19, 2012; Nikkan Jidosha Shimbun, July 20, 2012)

On July 27th, METI started a hearing on taxation reform for the fiscal year 2013. Considering the environmental change after the Great East Japan Earthquake, Keidanren (Japan Business Federation) requested a drastic change of the tax for global warming countermeasure (environment tax) including an abolishment of the environment tax. Additionally an extension of the tax system to allow writing off the whole amount in the same fiscal year of the purchase for generation facilities such as photovoltaic and wind power generators was demanded to expand the tax reduction for green investment as well as adding fuel cells (FCs) and storage batteries to the subject equipment. Other organizations such as the Japan Electrical Manufacturers' Association (JEMA) also made a similar request. (The Denki Shimbun, July 30, 2012)

(2) Advisory Committee on Energy and Natural Resources

On July 5th, the Fundamental Issues Subcommittee, of the Advisory Committee on Energy and Natural Resources, inquired about the state of storage batteries and FCs to NGK Insulators and Toyota Motor at the meeting. When a large volume of renewable energy is introduced, the grid may experience a problem. Storage batteries are the most effective measure to avoid this problem. Both firms claimed that deregulation and political assistance were required to increase the popularity of storage battery. Taro Kato, the president of NGK Insulators, explained its NAS battery, a sodium-sulfur battery, which has high charge and discharge efficiency and is capable of operating for a long time on a large scale. On the other hand its high cost was pointed out as a down side.

“The production cost has been reduced and reached nearly the limit. Once the storage batteries' political importance is shown, we will put more effort into investing in production facilities.” said Kato.

Takeshi Uchiyamada, the vice chairman of the board of Toyota Motor, described the development state of fuel cell vehicles (FCVs). The firm intends to introduce sedan hydrogen fed FCV from 2015, emphasizing it as “the powerful candidate of automobile energy in the future”. Deregulation for the installation of hydrogen supply infrastructure was indicated as a requirement to make FCVs widespread as well as a promotion measure for purchase encouragement. (The Nikkan Kensetsu Kogyo Shimbun, July 13, 2012)

2. Local Governmental Measures:

(1) Fukuoka Prefecture

Aiming to be a production base of hydrogen FCVs, Fukuoka prefecture will display Toyota's concept car “FCV-R” from July 14th to 15th in the JR Fukuoka station with an intention to make FCVs known widely.

Auto giants such as Toyota, Nissan and Honda aim to start commercial FCV sales by 2015, and the installation of 100 hydrogen filling stations in total is planned in four urban areas of Tokyo, Osaka, Nagoya and Fukuoka. The prefecture has been preparing a research facility and hydrogen filling stations with the industry and academia cooperation. (The Nishinippon Shimbun, July 14, 2012)

(2) Mitaka City

Mitaka city, Tokyo, has re-advertised the procedure for “Sustainable City Mitaka Eco Town Shinkawa Icchome Area Project Proposal” to invite private businesses which want to buy approximately 0.8 ha of city's land and build environmentally conscious houses. The concept of the project is a desirably environmentally conscious resident area over the long term. The requirements are 1) using light emitting diodes (LEDs) for lighting, 2) installation of efficient insulation, 3) setting up a photovoltaic generator, FC or/and electricity storage system, 4) utilization of highly efficient water heaters, and 5) providing security and disaster control systems. (The Nikkan Kensetsu Kogyo Shimbun, July 19, 2012)

(3) Kumamoto Prefecture

On July 27th, Kumamoto prefecture started to invite households and business who want subsidies for installation of energy saving equipment. The requirements are three pieces of equipment a smart meter, LED lighting and a selectable facility. The selectable facilities for households are a geothermal utilization system, storage battery and EneFarm. For businesses, a geothermal utilization system, storage battery and photovoltaic generator are the choices. (Kumamoto Nichinichi Shimbun, July 27, 2012)

3. Research & Development of Key Technology for FCs:

A study group, consisting of researchers from Japan Synchrotron Radiation Research Institute (JASRI), Kyoto University and National Institute for Materials Science (NIMS), has successfully produced a strong nanoscale thin film, a highly oriented three-dimensional (3-D) porous pillared-layer type metal-organic framework (MOF). This achievement will be a key technology to make layers of MOF with different functions. A gold evaporated monocrystalline silicon substrate was soaked in an ethanol solution to

create a monolayer. After that, the substrate was soaked in series of ethanol solutions with metal ions to be compositions of MOFs. 30 cycles of soaking procedure were carried out to fabricate a nanofilm with a strong 3-D structure. Also, the film exhibited a behavior of adsorbing and desorbing benzene. MOFs have various functions such as gas separation, gas concentration and reaction in interlayers, which attracts attention as a material. Although it was a known fact that layering different functional MOFs gave higher efficiency to FCs, the current technology was limited to making highly oriented two dimensional (2-D) layered MOF thin films. This ability, to create highly oriented 3-D nano-structure of MOF, leads to a technology to layer different functional MOFs. (The Nikkan Kogyo Shimbun, July 26, 2012)

4. Development of Technologies for PEFC Related Elements:

(1) Tokyo Metropolitan University

Prof Hiroyoshi Kawakami of Tokyo Metropolitan University has found that nanofibers, made from a polymer having a part of a sulfonate group, had nearly 100 times the proton conductivity of nonwoven fabric made from the same polymer. The fibers allow improving electrolyte membranes of polymer electrolyte fuel cells (PEFCs). A complex membrane with 50% of the fibers mixed may improve a couple of dozen times more in performance than existing membranes. The actual method is to make nanofibers from sulfonated polyimide by electrospinning. The fibers are positively charged, and the direction of the fibers are oriented on a substrate whose ends are negatively charged. Having oriented fibers, the polymeric molecules are orderly positioned inside, which allows protons to easily go through the structure, improving the conductivity. Currently the smallest fiber's diameter is 70 nm, and the proton conductivity is 30 S/cm at high temperature and in high humid condition. The membrane is harder to decompose than a nonwoven fabric, and the amount of solvent is about a hundredth of the membrane. The expansion rate is less than a third at high temperature, which gives durability. Dr Kawakami aims to commercialize the membrane by 2020. (The Nikkan Kogyo Shimbun, July 5, 2012)

(2) KRI

KRI, Kyoto city, will apply its material analysis technology, developed for core parts of PEFC, to analyze other functional material such as clothing. Cells of PEFC are structured with porous layers of electrode catalyst and gas diffusion, and performance loss occurs by pore blockage with water. In order to solve that, the firm developed an analyzing method focusing on a capillary action that a liquid surface becomes higher or lower inside a fine tube in liquid than the outside surface, and has conducted contracted researches in the FC industry. Contact-porosimetry, an analysis method developed by KRI, examines wettability of the inside of a material, with water and octane as solvents, whether the surface repels or interacts with water. The method has an advantage over conventional methods such as weight measuring and mercury press-in due to the ability to determine water content by radius size. To expand the usage of the method to whole functional material, KRI marketed itself to the textile industry and has contracted researches from some of them. Applying the analysis methods to wide range of materials, the firm plans to develop technologies for materials of next generation FCV with the expertise gained from the application. (The Nikkan Kogyo Shimbun, July 2026, 2012)

5. Development and Business Plan of SOFC:

LG Corp announced its intention to buy 51% share of Rolls-Royce Fuel Cell Systems, a FC R&D subsidiary of Rolls-Royce of the UK, to fully move into the industry and develop a natural gas fed solid oxide fuel cell (SOFC). Rolls-Royce has concentrated on engines for aircrafts and ships and next generation energy development since its automobile division was sold in 70s; specifically it has researched and developed FCs for over 20 years and has a cell production technology as the core.

"LG Corp has knowledge on system design in generators through the development of photovoltaic generators and energy storage systems developed by LG Electronics and LG Chemical. Rolls-Royce has the most advanced technology in large FCs. We decided this investment with an expectation of a huge synergetic effect by combining the knowledge and technology." States LG. (Dempa Shimbun, July 3, 2012)

6. Business Plans for Ene Farm:

(1) Mitsui Home

Mitsui Home will sell its new housing package "Phil Court" from July 7th. This sophisticatedly designed smart house package includes a photovoltaic generator, EneFarm, highly efficient water heater, home energy management system (HEMS), storage battery and socket for electric vehicle (EV). (Jutaku Shimpō, July 3, 2012)

(2) Sumitomo Forestry

On July 2nd, Sumitomo Forestry announced that a series of next generation energy saving smart houses will be available with five options: V2E which is a power supply system from a battery on an EV connected to home, a photovoltaic generator, Ene Farm, a storage battery and HEMS. (The Nikkei, July 3, 2012)

(3) Toho Gas

On July 10th, Toho Gas announced that a demonstrational experiment of domestic FCs for apartments would start from August. Data will be collected for three years to develop FC systems for apartments. The experiment will be at two apartment houses with 8 rental units built by Sekisui House in Gifu city, and two types of FCs, SOFC and PEFC, will be install in each apartment house. The system is to use SOFC, a highly efficient generator, to supply the basic power for whole apartment, and to cover shortage during higher demand with PEFC which starts up quickly. Also, photovoltaic generator and storage batteries will be installed to share within each apartment, and a saving of 50% electricity and gas usage is estimated. (The Sankei Shimbun, the Denki Shimbun, the Chunichi Shimbun, Gifu Shimbun, July 11, 2012; the Nikkan Kogyo Shimbun, July 12, 2012; the Nikkei Business Daily, July 18)

(4) JX Nippon Oil & Energy

JX Nippon Oil & Energy has revealed its intention to increase the EneFarm sales from the current 4,000 to 50,000 units by the fiscal year 2015. Because petrol sales are expected to go down due to population decline, the firm aims to expand into new business. The refinery in Sendai city will build a photovoltaic generator from this summer on the premise. (The Asahi Shimbun, July 19, 2012)

(5) Major Gas & Oil Suppliers

EneFarm has been increasing in sales. EneFarm

sales and numbers of orders from April to June largely overtook the same term in the last year at the leading firms. Tokyo Gas had approximately 1,400 units installed which is 1.5 times of the last year's term. Osaka Gas had 2,962 units of orders which is about 3.6 times of the last year's term. JX Nippon Oil & Energy had 1,200 units of orders which is about 2.5 times of the last year's term, and approximately 600 units, triple last year's term, were delivered from April to June due to a rise of SOFC which has better generation efficiency than PEFC. Having sold SOFC since this spring, Osaka Gas expects 700 to 800 units of SOFCs, out of total target 6,000 units, to be sold for the fiscal year 2012. Toho Gas contracted 900 units from April to June, and Seibu Gas installed 153 units which is triple the last year's term. Every firm has been acquiring customers at a much faster pace than last year. (The Nikkan Kogyo Shimbun, July 19, 2012; the Nishinippon Shimbun, July 28, 2012)

(6) Itochu Enex

Itochu Enex has practiced "E-koto Project" to propose an optimal mix of energy including new energies since the fiscal year 2011 apart from its core business, sales of fossil fuels. In January, 2012, "E-koto Shop Yotsukaido (Yotsukaido city, Chiba prefecture)" opened to offer an experience of new energy at home and in the community as the frontline. A photovoltaic generator and FC are installed as well as lithium-ion storage battery system which is currently under a demonstrational experiment to supply electricity to the shop. Additionally, a liquefied petroleum gas (LPG) tank is equipped on the premise for emergency, and EVs are used for their sales activities. Similar showrooms are planned to be opened in Niiza city, Saitama prefecture and Machida city, Tokyo. (The Chemical Daily, July 30, 2012)

7. Cutting Edge Technologies of FCV & EV:

(1) Nissan Motor

On July 3rd, Nissan Motor announced that mutual power supply systems between home and its Leaf would be lent to Osaka prefecture and city until the end of March, 2012 for free. A total of 250 units will be used by the local governments and the residences. The firm offers an extra value function of storing cheaper electricity at night and using it in a day. Without charge, Leaf and an electricity control unit will be

provided as a "Leaf to Home" system which supplies average households with electricity for two days. (The Nikkei, July 4, 2012)

(2) Tesla Motors

Tesla Motors, an EV producer of the US, has started mass-production. The vehicle is assembled with a motor from Taiwan and a general purpose battery which can be found in Akihabara, Tokyo. However, the unique technology of Tesla controls the parts precisely for stable cruising, which gives the impression of an IT company making vehicles. As PCs and TVs have been becoming drastically cheaper by emerging manufacturers, Tesla is ready for EV's popularization. (The Nikkei, July 5, 2012)

(3) Honda Motor

On July 23rd, Honda Motor announced that "Fit EV (for Japan)" to be introduced from this summer had achieved the most efficient performance as an EV in Japan. With 106 Wh/km consumption rate of alternating current (energy efficiency) in the JC08 mode, the EV cruises 225 km on a single charge with a lithium-ion battery (LiB) capacity of 20 kWh, and its energy efficient performance was approved by Ministry of Land, Infrastructure, Transport and Tourism (MLIT). Aerodynamic performance and electric servo brake system, an energy collecting technology, contributed to the improved efficiency. CHAdeMO, a quick charge system, allows charging of 80% in 20 minutes, and it takes approximately six hours to charge fully with a normal charger. The vehicle will be leased to local governments and private corporations from late August. (Nikkan Jidosha Shimbun, July 24, 2012)

(4) Asahi Danke

Having converted a normal car into an EV, Asahi Danke, Asahikawa city, has tested running on it, aiming to move into new energy such as FCs and the photovoltaic generator industry. With a Honda's small commercial vehicle as its base, the vehicle has a lithium-ion battery instead of the engine. With an ability to cruise on expressways, it runs for approximately 120 km on a flat road on a single charge. It takes about eight hours to charge with domestic 100 V power supply. The vehicle was completed in December, 2011, and the firm has been using it for sales activities to investigate the battery performance for about six months. (The Hokkaido

Shimbun, July 24, 2012)

(5) EV Chargers at Expressways

Japan Highway companies will install quick chargers for EVs. To be able to travel long distance without the battery running out, approximately 100 chargers are planned to be installed by 2020 at Expressways throughout the country. Central Nippon Expressway Company (NEXCO Central Japan) will install a quick charger at more than 30 out of its 58 rest areas of Chuo Expressway which connects the greater Tokyo area and the Chubu region. The fee is ¥100 per charge. NEXCO East Japan and NEXCO West Japan will install some dozens of chargers at their rest areas. NEXCO East Japan will equip several chargers at Kan-Etsu Expressway linking Tokyo and Niigata as early as next year. More than several chargers are planned for Hanshin Expressway within five years. Also, chargers will be available in the areas of Shuto Expressway and Honshu-Shikoku Bridge Expressway Company. More than 1,000 quick chargers are available in Japan; however, most of them are at public offices, car dealers and car parks. (The Nikkei, July 29, 2012)

8. Technology Developments & Business Plans of Hydrogen Filling Station:

(1) Kitz

Kitz will sell valves for hydrogen stations for FCVs from September. The valves allow the supplying of hydrogen 10 times the volumetric flow rate of that of conventional pressure, which fills a FCV as fast as petrol filling of a conventional vehicle. The prices are ¥350,000 with automatic valve control and ¥300,000 with manual control, which is half the price of existing products. (The Nikkei, July 10, 2012)

(2) JX Nippon Oil & Energy

On July 18th, JX Nippon Oil & Energy announced its estimation that 10 to 20% of JX's 10,000□ affiliated filling stations were capable of installing hydrogen supplying facilities. The industry organization aims for 100 hydrogen filling facilities by 2015 and 1000 by 2025, and JX Nippon Oil & Energy can provide most of them. With deregulation and governmental assistance, the firm will work out an investment plan. (The Nikkan Kogyo Shimbun, July 19, 2012)

(3) Air Liquide

Air Liquide Japan will invest more operating

resources, emphasizing the hydrogen filling station business. Preparing for FCV growth anticipated from 2015, they plan to install at least two hydrogen supply facilities on their premises by the end of the fiscal year 2013 and 20 or more facilities within three years. Also, a special team will be established on August 1st, and dedicatedly research hydrogen production with wood biomass and EneFarm as well as FCVs. The Air Liquide group has an advantage on hydrogen businesses with over 50 hydrogen filling stations worldwide. To lead the market by bringing in the expertise, the group plans to introduce international standards and promote deregulation by providing oversea information with the Fuel Cell Commercialization Conference of Japan (FCCJ) and the Research Association of Hydrogen Supply/Utilization Technology (HySUT). (The Chemical Daily, July 20, 2012)

(4) Iwatani & Toho Gas

On July 25th, Iwatani and Toho Gas announced that a hydrogen filling station would be installed in Toyota city, Aichi prefecture, to find out a commercial archetype. As a joint research with HySUT and New Energy and Industrial Technology Development Organization (NEDO), hydrogen extracted from liquefied natural gas (LNG) will fill FCVs, and specifications and construction of the facility will be examined for further improvement. The construction is planned to start from October and to be finished by the end of March, 2013. The station will extract hydrogen from coal gas on-site and supply FC buses running in the city and FCVs of local firms. Aiming to reduce construction time and cost, Iwatani and Toho Gas will cut down the equipment by using higher filling pressure 70 MPa. (The Nikkei Business Daily, the Chunichi Shimbun, the Chugoku Shimbun, July 26, 2012; the Nikkan Kogyo Shimbun, the Denki Shimbun, the Nikkan Kensetsu Kogyo Shimbun, July 27, 2012; Architectures, Constructions & Engineerings News (Daily), the Chemical Daily, July 30, 2012)

(5) HySUT

HySUT will operate three hydrogen filling stations designed for commercial use as the first in Japan, by the end of the fiscal year 2012. Prior to the installation of 100 hydrogen filling stations throughout Japan by the fiscal year 2015, data will be collected to reduce

installation and operational cost. In June the preparation of two facilities started in Nagoya city, Aichi prefecture and Ebina city, Kanagawa prefecture. The third facility will be constructed to provide commuter buses with hydrogen in a shorter time in Toyota city, Aichi prefecture. In Nagoya, hydrogen will be produced from liquefied petroleum gas (LPG) and stored at high pressure in an accumulator to supply a vehicle using pressure difference. In Ebina, a vehicle will be filled with compressed hydrogen either directly with a compressor or the pressure difference system. In Toyota, hydrogen will be produced on-site from coal gas to supply compressed hydrogen directly with a compressor. HySUT will examine the initial costs, effects of shortening construction time and operation costs. (Nikkan Jidosha Shimbun, July 27, 2012)

9. Direct Methanol Fuel Cell, DMFC, Technology Development

(1) Uewaki

Uewaki, a towel producer of Imabari city, has developed a bendable direct methanol fuel cell (DMFC) having carbon fiber electrodes with its towel weaving technology with Shinshu University and Ehime Institute of Industrial Technology. The Ehime Institute of Industrial Technology confirmed that the DMFC bended into a cylindrical shape had properly generated electricity without any troubles such as fuel leaks. In the DMFC, gelatinous methanol on the anode side provides hydrogen, and the cathode side contacts with air. Uewaki developed a special loom to produce the electrodes with carbon fiber and spent ¥20 million which is roughly double the price of a loom for towel production. Taking advantage of flexibility of fibers, the firm expects the product to be applied to power supply on curved surface such as "Powered Exoskeleton" which aids human limbs. However, the output is currently only 3.9 mW/cm², and it needs to be tripled to five times for commercial use. The firm aims to commercialize the product by 2015. (The Nikkei Business Daily, July 4, 2012)

(2) Fujikura

Developing a DMFC to be used on aircrafts together, Fujikura and Boeing, USA, have successfully improved the current density of the membrane electrode assembly (MEA) to 134 mA/cm². The DMFC is to output 1 kW, and its dimensions are 400 mm

width, 500 mm height and 150 mm depth. Fujikura mixed a catalytic agent into platinum, a conventional catalyst, and applied the mixture on the MEA evenly. The current density was enhanced by combining a process method to coat catalyst on Nafion (an electrolyte membrane) directly with concentration controlling techniques of a methanol solution and printing technology. With this achievement, the two firms made a plan for a test operation as a power source for the kitchen and lighting of an aircraft. The development of the DMFC will be completed by December, 2012, and 14 units of the FC will be produced and evaluated by March, 2013 prior to the onboard test in August, 2013. To use on an aircraft taking 200 to 300 passengers, DMFC needs a 1 to 10kW output level. (The Nikkan Kogyo Shimbun, July 17, 2012)

10. Developments of FC Related Measuring & Observation Technologies

(1) Tokyo Institute of Technology

A study group of Prof Yashima of Tokyo Institute of Technology has developed an observation technology helpful for advancing FCs. The technology allows observing a path of oxygen ions which transport electrons in an electrode at an atomic level. The observation is beneficial to develop a material with wider paths for ions, which leads better generation efficiency. The study group observed the path of oxygen ions with a SOFC electrode made from lanthanum, cobalt and barium. However, a path was not confirmed with strontium instead of barium to give wider space between atoms even when the temperature was raised more than 1,200°C. Since paths can be confirmed, the study group aims to develop a more efficient electrode with an electrode material producer. Paths of an electrode may be widened by adjusting ratio and type of materials. Also, the observing method is advantageous for improvement of PEFCs which uses hydrogen ions' electrons. (The Nikkei Business Daily, July 5, 2012)

(2) Shimadzu

To meet demands for an observation of a gas diffusion layer and evaluation of a secondary battery material, Shimadzu announced on July 18th that the "inspeXio SMX-100CT" a microfocus X-ray computed tomography (CT) system to examine a soft material

three dimensionally would be available from July 24th. Using weaker permeability X-ray to be able to detect resin and organic substance, the product is largely improved in processing speed with a graphics processing unit (GPU). The range of field of view is made wider to 1.5 to 99 mm from older models' 5 to 70 mm, and the image was made clearer with their own image processing technology. The image process after scanning is reduced to five seconds from older models' about 10 minutes. Additionally, positioning can be carried out with the 3-D image displayed on the screen to be user friendly. The price is ¥57.75 million. (The Nikkan Kogyo Shimbun, the Nikkei Business Daily, the Kyoto Shimbun, July 19, 2012; Dempa Shinbun July 23, 2012)

(3) JEOL

JEOL announced that characteristic x-ray from a single atom had been successfully detected with the latest aberration corrected electron microscopy, a function correcting objective magnetic lens aberration, with Kyushu University and National Institute of Advanced Industrial Science and Technology (AIST). The method allows element analysis at an atomic level by drastically improving detection efficiency of energy-dispersive X-ray (EDX) spectrometry. This will have a large impact on a variety of material related researches because the method can be applied to detect an element of a rare metal at a single atom level which has been hard, as well as an infinitesimal detection for wide range of elements. Capable of precisely detecting a single atom of a rare metal, the technique is expected to contribute to advancing green technology such as catalytic chemistry and identifying function of FC specifically with a platinum and gold catalyst. (Denpa Shinbun, July 25, 2012)

(4) HIOKI

HIOKI will introduce a chemical impedance analyzer "IM3590" (¥700,000 excluding tax) to target the electrochemical industry such as material, component, corrosion and anticorrosion, plating and surface finishing for a primary and secondary cells, FC and electrical double layer capacitor. The product is a powerful tool for characteristic analysis at research and development with Cole-Cole diagram and equivalent circuit analysis functions, and measures invisible chemical properties of an electrochemical object. (Dempa Shimbun, July 30, 2012)

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2013 Fuel Cell Symposium

20th Anniversary

Date: **28-29, May, 2013**

Site: **Tower Hall Funabori**

Edogawa_ku, Tokyo, Japan