

## **Independent Start-up Function Available for Ene-Farm**

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### 1. Governmental Measures

#### (1) MOE

On August 5<sup>th</sup>, the Ministry of the Environment (MOE) revealed its environmental conscious policy designated for 2020 Tokyo Olympics. The international sports event will be a show case of environmental technologies. The ministry will discuss actual measures with other related ministries and Tokyo metropolitan government. To reduce CO<sub>2</sub> emissions, the announced policy includes promoting the use of electric vehicles (EVs) and fuel cell vehicles (FCVs) as well as the purchase of renewable energy from outside Tokyo such as areas which were damaged by the Great East Japan Earthquake. (Nikkan Jidosha Shimbun & The Nikkan Kensetsu Kogyo Shimbun, August 6, 2014)

MOE will start a model project to produce hydrogen using excess electricity from renewable sources such as wind and solar power to fuel FCVs. The aims are to avoid wasting renewable energy and to support the hydrogen supply infrastructure for FCVs. The ministry will allocate ¥3 billion for expenses in the budget request for FY 2015. (The Yomiuri Shimbun, August 25, 2014; The Denki Shimbun, August 28, 2014)

#### (2) MLIT

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) will accelerate promotion of electrically powered vehicles. The subsidy scheme of these vehicles for business purposes will be expanded, and more new cars including FCVs will be introduced into the market from this autumn. The ministry will start the second subsidy scheme to back up purchases of EVs for business purpose, the sales of which have been slow. (The Hokkoku Shimbun, August 5, 2014; Fuji Sankei Business i & The Chemical Daily, August 6, 2014)

#### (3) Japanese Government & METI

The Japanese government has decided to support each FCV purchase with ¥2 to 3 million. The subsidy scheme will start this year to fit in with the first general sales of FCVs. They aim to be a global leader in the areas of the related technologies by promoting FCVs. A budget of ¥30 billion is allocated for the subsidy scheme of the next generation vehicles such as EVs. FCVs will be added on to the scheme, and the subsidy amount will be notified once vehicle and hydrogen fuel prices are set. The Ministry of Economy, Trade and Industry (METI) will request a similar amount to this year of budget for the subsidy scheme of next generation vehicles for FY 2015. (The Yomiuri Shimbun, August 7, 2014; The Sankei Shimbun, The Chunichi Shimbun & Kanagawa Shimbun, August 8, 2014)

The government has started investigating deregulation of the standards for hydrogen filling station sites to promote FCVs. Currently some hydrogen storage facilities are not certified for use in Japan, but the government also aims to legalize these facilities. The governmental growth strategy was approved in a cabinet meeting in June, and it contains promotion of FCV usage. For FCVs to be used widely as fast as possible, they decided that deregulation was required to support building hydrogen refueling facilities. On August 16<sup>th</sup>, a government official disclosed that an examination would be carried out on the distance between a facility and public road to ensure safety, and the distance might be shortened by 2020. The government will also carry out on investigation into the legalization of cheaper accumulators which are already approved in the US and Europe to store high pressure hydrogen. Hydrogen refueling operators avoid urban areas which are high in price and harder to buy a piece of

land, and prefer to build a new facility in suburban areas. An official of the Agency for Natural Resources and Energy points out that those facilities should be suitably situated in an area with increasing FCV users for their convenience. (The Mainichi Newspapers, The Chunichi Shimbun, & The Japan Maritime Dairy, August 17, 2014)

#### (4) MOD

The Ministry of Defense (MOD) and The United States Navy have decided on joint research and development of an unmanned underwater vehicle (UUV) which is to survey submerged continually for one month. A highly functional fuel cell (FC) will be studied as a start. The future goal is to collect underwater information of People's Liberation Army Navy of China which is modernizing its submarines. An important part of the UUV development is a highly functional FC which is to operate for a long period without air. MOD will study FC from this fiscal year to FY 2018 with a capital of approximately ¥2.6 billion. The development of a trial cell is planned to start this fiscal year by selecting a developer. The ministry was going to develop the vehicle on its own. However, the US Navy was very interested in the development, so both sides started discussing the joint development. (The Yomiuri Shimbun, August, 8, 2014)

#### (5) METI & Agency for Natural Resources and Energy

The Agency for Natural Resources and Energy of METI will accelerate preparation of hydrogen filling stations for FCVs. At the end of this month, they will ask for a larger budget for FY 2015 to achieve target that 100 hydrogen filling stations are opened in the fiscal year. For FY 2014, ¥7.2 billion was allocated for the “Subsidy for Preparation of Hydrogen Supply Facilities”, and the agency is working on a rise in the budget for FY 2015. The subsidy scheme supports each project such as preparation of hydrogen production facilities up to ¥0.28 billion. Hydrogen filling facilities can be static or mobile. A stationary hydrogen filling station costs ¥0.4 to 0.5 billion to build, and takes over a year to finish its construction. On the other hand, a mobile hydrogen filling station uses a large trailer to carry hydrogen and filling facility to users, and its preparation of the cost of its equipment is about half that of static filling station according to the agency. The preparation period is also shorter than a year. Already 45 applications for the

subsidy have been received, and 17 projects, just less than 40% of the total applications, are mobile filling stations. Due to the cost saving effect, preparation projects of mobile filling stations are more likely to increase. (The Denki Shimbun, August 14, 2014)

METI plans to raise the amount of subsidy for projects to build hydrogen facilities in less prepared areas. The current network of hydrogen filling stations still has large holes even in the three biggest urban areas, which may cause slow sales of FCVs. The subsidy scheme supports at the moment half of the installation costs which are around ¥0.5 billion for each station. The ministry plans to increase the ratio of the subsidy to two thirds. The Japanese government aims to prepare 100 hydrogen filling stations in 2015. Currently construction projects of 45 filling stations have been decided. However, there are, for example, no hydrogen filling stations or plans to be in Setagaya-ku in the Greater Tokyo area. To promote hydrogen refueling facilities, METI intends to give larger support for areas which have more car users without hydrogen filling stations. As well as installation costs, operation costs will be supported from FY 2015. The subsidy scheme will provide up to ¥0.022 billion each year for five years. The ministry will request a total of ¥11 billion, a 52% increase on that of the previous year, for the subsidy of hydrogen filling stations for FY 2015. (The Nikkei & The Sankei Shimbun, August 29, 2014)

#### (6) METI & Advisory Committee on Energy and Natural Resources

The Advisory Committee on Energy and Natural Resources for the Minister of Economy, Trade and Industry will hold a meeting on August 19<sup>th</sup> to give a report on the state of making a road map for energy related technological developments. The road map will include about 30 items in areas such as electricity generation by fossil fuel, renewable energy and energy storage. In the hydrogen usage area, the price range of domestic FCs is set to go down by 2030 to the level that the initial investment will be recovered in about five years. For hydrogen generation, it is planned that independent generators are introduced into the market by 2020, and the industrial scale generation aims to be introduced into the market by 2030. (The Denki Shimbun, August 19, 2014; The Chemical Daily, August 21, 2014)

## 2. Local Governmental Measures

### (1) Fukuoka Prefecture

Fukuoka Prefecture will subsidize by ¥1 million each FCV purchased as a taxi for the promotion of these vehicles. This month, the “Fukuoka FCV Club” will be established to encourage the use of the vehicles by the prefecture, a local economic organization and major businesses, and it will set into action a subsidy scheme. The promotional organization will employ FCVs as its official car to advertise, and ask local businesses to use FCVs. (The Nikkei Business Daily, August 7, 2014; The Nikkan Kogyo Shimbun & The Nishinippon Shimbun, August 15, 2014)

On August 19<sup>th</sup>, the Fukuoka FCV Club (chairpersons: Mr. Yutaka Aso, the chairman of the Kyushu Economic Federation, and Mr. Hiroshi Ogawa, the governor of Fukuoka Prefecture) held a ceremony of its launch at Tenjin Elgala Hall, Fukuoka City with approximately 400 participants from businesses and governmental organizations. (The Nishinippon Shimbun, August 20, 2014)

### (2) Fukuoka City

Fukuoka City and the Port of Hakata Development asked for public tenders, and have selected a group of four companies including Sekisui House as the leader for the operators of the Island City Development Project. The rest of the operators are Nishi-Nippon Railroad, Fukuoka Shoji and Saibu Gas Kosho. Four high-rise apartment buildings will be constructed as the project with an investment of approximately ¥32.6 billion including approximately ¥4 billion for land lots. The project land has two lots and is located in an environmentally conscious area of Higashi-ku, Fukuoka City. According to the proposal, the apartment buildings will use photovoltaic and wind generators, FCs for apartments, and advanced environmental technologies such as solar heat and geothermal, and they aim to reduce 80% of the CO<sub>2</sub> emissions from those of 1990. (Architectures, Constructions & Engineerings News (Daily), August 11, 2014)

### (3) Aichi Prefecture & Others

On August 25<sup>th</sup>, Aichi Prefecture announced that four prefectures and three cities of Tokai region would apply the status of the Super Special Zone to Strengthening the Manufacturing Industry, a special

economic zone of the governmental strategies. These local governments are Aichi, Gifu, Mie and Shizuoka Prefectures and Nagoya, Shizuoka and Hamamatsu Cities. They will try again the same proposal which failed in FY 2013. Their proposal requests deregulation to promote the next generation vehicles such as EVs and FCVs and the reduction in corporation tax for the “Special Zone to Create Asia's No.1 Aerospace Industrial Cluster” which has operated since 2011. (The Nikkan Kogyo Shimbun, August 26, 2014)

### (4) Yamaguchi Prefecture

On August 27<sup>th</sup>, Yamaguchi Prefecture Industrial Technology Institute held an open experiment of electricity generation using hydrogen and Mazda's rotary engine (RE). The system consists of an evaporator to gasify liquid hydrogen, a tank to store gas and the RE borrowed from Mazda free, as well as a muffler to remove steam while RE operates. The maximum output is 50 kW. Mazda has leased a car with a hydrogen operated RE, and the institute will use the local technology. The institute organized a sub-group (a total of 25 members) for liquid hydrogen energy in its study group in April, 2013. The experiment was operated by three member firms of the sub-group with ¥15 million from the prefecture as subsidy. (The Chugoku Shimbun, August 28, 2014)

### (5) Hokuriku Green Energy System Society

On September 2<sup>nd</sup>, the Hokuriku Green Energy System Society, which researches environmental technologies in Takaoka City, will light seven lanterns using FCs with hydrogen produced by using processed aluminum waste at Owara Kazenobon Festival in Yao Town, Toyama Prefecture. The organization has developed a system to take high purity aluminum from aluminum waste, and to mix it with a special alkali solution to produce hydrogen by a chemical reaction. Then, hydrogen is sent to FCs at normal temperature and under normal pressure to generate electricity. Aiming to promote the system at various events in the Hokuriku region, the society will illuminate the festival using light emitting diodes (LEDs) in the lanterns. In 2009, local businesses, governments and community groups formed the organization. (The Kitanippon Shimbun, August 28, 2014)

### (6) Osaka Prefecture

Osaka Prefecture will give more support for smaller firms to enter FCV related businesses. The prefecture will hold lectures by leading firms in the new energy industry to support smaller companies. Workshops will be held for these firms to draw up their new plans for FCV related businesses and to sell their proposals to larger companies. The prefecture will set up “Osaka Smart Energy Partners” to pass technological proposals from smaller to larger businesses. Potential clients for smaller businesses are 79 firms including automakers such as Nissan Motor and Daihatsu Motor as well as Toyo Tire & Rubber and Nippon Paint. (Nikkan Jidosha Shimbun, August 29, 2014)

### 3. SOFC Research & Development

#### (1) Kyushu University

On August 19<sup>th</sup>, Kyushu University announced that an empirical research on solid oxide fuel cells (SOFCs) would start in FY 2014. The aim is to improve efficiency, durability and reliability as well as reduction in cost. The experiment will be carried out at the “Next-Generation Fuel Cell Research Center” of the university with more than three industrial SOFC systems of 250 kW level output. The cells will be observed through an electron microscope during operations in order to establish a method to make degradation factors clear. The project cost is ¥1.75 billion which comes from the adjusting budget of the “Green Asia International Strategic Comprehensive Special Zone” carried out in cooperation with Fukuoka Prefecture, Kitakyushu City and Fukuoka City. The university will also test hydrogen production using renewable energy and storage as well as an experimental operation of an FCV. Prof. Kazunari Sasaki, the head of the research center, showed their enthusiasm to work on more joint research with businesses to commercialize technologies. (The Nikkei & The Nikkan Kogyo Shimbun, August 20, 2014)

#### (2) Nistec

Nistec, a surface finishing operator in Kofu City, has developed heat-resistant plating for FCs which does not oxidize at a high temperature of 700°C. Previously plating could cope up to 500 °C, but the firm successfully improved heat-resistance by using special metal and bonding technology with base metal. The technology is expected to be used for SOFC development, and some manufacturers are already

interested in it. (The Yamanashi Nichinichi Shimbun, August 22, 2014)

### 4. New FC System Development

#### (1) Toshiba FC, Iwatani & Others

On August 6<sup>th</sup>, Toshiba FC Systems, Yokohama City, announced that development and experiment of an FC system using only hydrogen as fuel would start in late August with Yamaguchi Liquid Hydrogen, a subsidiary of Iwatani in Osaka City, in Shunan City, Yamaguchi Prefecture. The system is to use hydrogen as the only fuel and to be highly efficient and durable. The firms aim to achieve the world’s first purely hydrogen FC cogeneration system. Yamaguchi Prefecture advertised for the “Yamaguchi Subsidy for Industrial Strategic Research and Development for FY 2014” in April, and selected the project. Yamaguchi Liquid Hydrogen leads the project and it will carry out the experiment. Toshiba FC Systems will develop a pure hydrogen FC. Chofukosan, Yamaguchi Prefecture, will make a hot water unit with a purely hydrogen fed boiler. Iwatani will carry out development of a hydrogen burner. The experiment lasts four years to FY 2017. (The Denki Shimbun, August 7, 2017; The Nikkei Business Daily, August 8, 2014; The Chemical Daily, August 11, 2014)

#### (2) Mantra Energy Alternatives of Canada

Canadian-based venture Mantra Energy Alternatives are developing and commercializing technologies to make a new FC, and chemical products using CO<sub>2</sub> as their material. The “electro-reduction of carbon dioxide (ERC) process” uses CO<sub>2</sub> as a material to produce chemical materials such as formic acid and CO electrochemically. The “mixed-reactant fuel cell (MRFC)” is a new FC without a membrane, which can significantly save costs compared to conventional fuel cells. The firm believes efficient energy storage will be achieved by combining the two technologies. A pilot plant will be built at a plant of Lafarge, a Canadian-based major cement producer, and able to process 100 kg of CO<sub>2</sub> each day to test practicality over one year from 2015. The firm will also start finding licensees of the technologies. (The Chemical Daily, August 11, 2014)

#### (3) Furukawa Battery & Toppan Printing

Furukawa Battery and Toppan Printing have announced that they have developed magnesium-air

fuel cells as emergency power sources using paper containers to reduce the weight of the product and would introduce it into the market in mid-December. The battery lasts unused for a long period, and generates electricity once water or sea water is added. Furukawa Battery will sell the product to local governments for around ¥10,000 with a target of 1,000 units each month. (The Nikkei, August 30, 2014)

## 5. Ene-Farm Business Plans

### (1) Hitachi Maxell

On August 6<sup>th</sup>, Hitachi Maxell announced that they would take orders for the world's smallest and lightest lithium-ion storage battery system "Energy Station Type C" compatible with home energy management system (HEMS) as well as the dedicated controller "ES Controller" from August 18<sup>th</sup>. The energy storage is more efficiently managed with the controller and HEMS. The controller is compliant with ECHONET Lite which is a communications protocol for smart houses, and measures household energy consumption and production of Ene-Farm and photovoltaic generator as well as remaining storage battery level. The dimensions of the battery system are 65 cm wide, 13 cm high and 38 cm deep. With a weight of approximately 29 kg, the firm achieved the smallest and lightest storage battery system working with HEMS in the world which can be installed in a small space. A dedicated shelf is also offered to store the system in a higher place, such as the free space above a refrigerator. As well as working as an emergency power source during power cuts, the system also detects a power failure and provides near-instantaneous protection from input power interruptions using the stored electricity in the battery functioning as an uninterruptible power supply. (The Denki Shimbun, August 7, 2014)

### (2) Hankyu Realty

Hankyu Realty will build an environmentally conscious condominium "Geo Seishin Chuo" of which each unit is to be installed with "Osaka Gas's SOFC Ene-Farm Type S" with a function to start up without power supply during power cuts in Nishi-ku, Kobe City. This plan was selected for the Second FY 2014 Advanced CO<sub>2</sub> Emission Reduction Projects of buildings by MLIT. The condominium will have 202

units in total. Haseko Corporation and the Design & Development Architect Associates have designed the building and are managing the project. Haseko Corporation will also carry out the construction aiming to finish in the spring of 2016. The showroom will be open in late September. The condominium offers the advantage for residents to reduce utility bills by approximately 30% each year. (The Nikkan Kensetsu Kogyo Shimbun, August 25, 2014; Jutaku Shimpō, August 26, 2014)

### (3) Tokyo Gas & Panasonic

On August 7<sup>th</sup>, Tokyo Gas and Panasonic announced that an optional unit had been developed to enable Ene-Farm to start using a storage battery during power cuts. Ene-Farm needs electricity to start up. If the system is not in operation during a power cut, it cannot start up without this optional unit. The unit will sell for ¥615,000 and be available from October 1<sup>st</sup>. (The Nikkei, The Nikkei Business Daily, The Chugoku Shimbun & Kumamoto Nichinichi Shimbun, August 8, 2014; The Chemical Daily, August 12, 2014; The Denki Shimbun, August 13, 2014; Dempa Shimbun, August 19, 2014)

On August 27<sup>th</sup>, Tokyo Gas announced that new houses in Kumagaya City, Saitama Prefecture, would use its optional product the "Switching Unit for Continuous Generation" for Ene-Farm to provide electricity during power cuts. When Ene-Farm is in operation during a power cut, the optional unit allows the cells to provide up to 700 W power through a dedicated socket for up to four days (96 hours). (The Denki Shimbun, August 28, 2014)

## 6. Cutting Edge Technologies of FCVs & EVs

### (1) YP System

YP System, a plating operator in Saitama Prefecture, has developed an extinguishing system for EV chargers. Being able to be retro-fitted to an installed charger, the system detects smoke from a short circuit in wiring, and injects CO<sub>2</sub> gas to put fire out. Additionally, a communication device is supplied to enable the system to notify a person in charge of the charger. The firm aims to commercialize the product in 2015. (The Nikkei, August 14, 2014)

### (2) BMW, Daimler, VW, Volvo & ABB

Automakers have got together to promote EVs in Europe. German-based BMW and Daimler signed a

partnership for technological development of a wireless charging system in July, and will share their charging infrastructure. The CO<sub>2</sub> emission regulation has become stricter in the EU, which motivates manufacturers of luxury range cars to put effort into EVs more than other automakers. A user parks his/her car in a wireless charging spot, and presses the button. The charger then starts charging the car battery using a magnetic field of coils which eliminates the need of cables. BMW has succeeded in developing a trial wireless charging system of 3.6 kW output, and aims to commercialize a 7 kW level product in cooperation with Daimler. BMW released its first commercial EV “i3” last November, and has received orders for over 11,000 vehicles. A plug-in hybrid vehicle (PHV) of the firm was also introduced into the market in June. Daimler also tries to attract consumers with an EV version of the Mercedes-Benz “B Class”. Volkswagen (VW) plans to introduce 40 electrically powered vehicles such as EVs and PHVs by 2018. Automakers also help each other for cars for business use. Swedish-based Volvo signed the joint development of an automatic charging system for electric buses with ABB, a major Swiss charger manufacturer. The system is to provide a bus with electricity quickly from a roof of the bus stop, and to charge the bus fully in six minutes. Volvo has sold 1,600 hybrid buses operating on diesel and electricity, and it plans to introduce an all-electric bus into the market next year. ABB has sold EV charger infrastructure in Europe. Both European firms aim to establish a standard system of electric buses. (The Nikkei, August 28, 2014)

### (3) China

The Chinese government is considering investing up to 100 billion CNY (approximately ¥1,690 billion) in the preparation of EV chargers in order to encourage consumers to use cars which have less impact on the environment. As well as environmental measures, they support the development of Chinese EV manufacturers such as BYD and Kandi Technologies Group, and the investment can lead to another backup for the industry. As a part of environmental measures, the Chinese government announced last month that new energy vehicles such as EV, PHVs and FCVs would be exempt from vehicle purchase tax from next month. (Fuji Sankei Business i, August 28,

2014)

### (4) Tesla

On August 29<sup>th</sup>, US-based EV venture Tesla Motors and China United Network Communications Group (China Unicom), a Chinese state-owned telecommunications operator in Beijing, announced that they would together prepare EV chargers at 400 places in 120 cities in China. The preparation will mainly use China Unicom’s shops. Charging infrastructure preparation has been an issue for Tesla Motors’ sales. With this cooperation, Tesla should expand its sales. As well as small chargers, both firms will arrange quick chargers in 20 cities. (The Nikkei, August 30, 2014)

### (5) Toyota

On August 29<sup>th</sup>, Toyota Motor announced that METI approved it as a manufacturer of fuel tanks to store high pressure hydrogen for FCVs. This approval of the manufacturer is the first for 70 MPa high pressure hydrogen tanks. The firm now does not need experts’ inspection for production, which will contribute to reduction in cost and time. They will prepare commercial production of FCVs which is to be available from FY 2014. Previously, the High Pressure Gas Safety Institute of Japan had to inspect all the high pressure tanks of Toyota once produced as well as during production, which sometimes caused interruptions of the trial production and hold it up due to inspection arrangements. (The Nikkei, The Nikkei Business Daily, Nikkan Jidosha Shimbun, The Chunichi Shimbun & Fuji Sankei Business i, August 30, 2014)

## 7. Developments, Tests & Business Plans of Hydrogen Filling Station Technologies

### (1) Mitsubishi Kakoki

On August 8<sup>th</sup>, Mitsubishi Kakoki announced that the construction of the hydrogen filling station “HyLec Fukuoka Hydrogen Station (provisional name)” started to test hydrogen production and supply technology using bio gas made from sewage. This experiment is a part of the Breakthrough by Dynamic Approach in Sewage High Technology (B-DASH) Project, and it will examine pre-process technologies of sewage bio gas by membrane separation and technologies of a highly efficient and steady hydrogen supply for FCVs. On July 31<sup>st</sup>, a groundbreaking

ceremony was held at the construction site in the Fukuoka City Central Sewage Treatment Center. This plan was selected for the B-DASH Project for FY 2014 by MLIT, and has been operated by a research consortium of Mitsubishi Kakoki, Fukuoka City, Kyushu University and Toyota Tsusho. (The Chemical Daily, August 11, 2014)

#### (2) Orion Machinery

Orion Machinery, Suzaka City, will start producing its own chillers which are required for hydrogen filling stations and fully entering the market. Currently heat exchangers are bought from another manufacturer to chill hydrogen by refrigerant, and the firm will produce this component on its own to reduce costs. Shinshu University and Nagano National College of Technology will cooperate in downsizing the equipment in order to be a more competitive product. (The Shinano Mainichi Shimbun, August 23, 2014)

#### (3) Osaka Gas

Osaka Gas aims to start selling a system to produce hydrogen from liquefied petroleum gas (LPG) for domestic use to supply FCVs by finishing the development of the product this year. The system is to be installed in a hydrogen filling station, and will eliminate the need for special vehicles to deliver hydrogen and storage tanks. This will be another means of hydrogen supply, and support preparation of hydrogen infrastructure which is essential for FCVs to grow in the market. LPG is supplied to approximately 25 million households, a half of all the households in Japan, and it is also used by some taxis as a fuel. LPG in cylinders is more common in rural areas where the natural gas grid is less prepared. More hydrogen filling stations can be prepared by using the LPG supply network nationwide. Osaka Gas has developed its own catalyst to extract hydrogen from LPG. The system produces hydrogen at a 300 m<sup>3</sup>/h production level which is enough for eight FCV. The price is expected to be ¥200 million. Last year, the utility firm developed a hydrogen production system using natural gas, and it will sell the system to hydrogen filling stations as well as the one using LPG under development. The target is 100 filling stations by FY 2025. To prepare hydrogen supply infrastructure, the firm will open its first hydrogen filling station with the system in Ibaraki City, Osaka Prefecture. Their production systems use the natural gas supply grid or

LPG to extract hydrogen, which negates the need of hydrogen transport costs. Currently the hydrogen price is double that of gasoline for the same driving range, but the system potentially bring it down. (The Nikkei, August 26, 2014)

#### (4) Kaji Technology Corporation

Kaji Technology Corporation has received an order for one compressor for a hydrogen filling station from Toho Gas. A compressor pressurizes gas to reduce the size, and is a part of the core equipment for hydrogen filling stations. The product is designed to stand high pressure hydrogen being forced out while reducing the size by 30%. Kaji Technology Corporation assumes smaller facilities will be preferred in urban areas where land price is high. (The Nikkei, August 29, 2014)

#### (5) Fuel Cell Commercialization Conference of Japan

The Fuel Cell Commercialization Conference of Japan investigated prices of equipment for hydrogen filling station of Japan and Europe. A facility package of a hydrogen filling station in Japan costs ¥280 million, approximately ¥150 million higher than that in Europe. Europe has less strict regulations for handling hydrogen than Japan, which enables businesses to use generic products and to reduce costs. The Energy Policy Division of the Kansai Bureau of Economy, Trade and Industry says that deregulation of the High Pressure Gas Safety Act is under consideration to support cost reduction. (The Nikkei, August 29, 2014)

#### (6) Iwatani

On August 28<sup>th</sup>, Iwatani announced its plan to build a hydrogen filling station near Tokyo Tower in Minato-ku Tokyo. As well as supplying FCVs with hydrogen, the station will exhibit the latest FCV and hydrogen related technologies. With ¥400 to 500 million costs, the construction will start in September aiming to finish in March 2015. (The Nikkei, The Nikkan Kogyo Shimbun, Nikkan Jidosha Shimbun, The Nikkei Business Daily & The Chemical Daily, August 29, 2014)

### 8. Development and Business Plans of Hydrogen Production/Refining Technologies

#### (1) Mitsubishi Gas Chemical

Mitsubishi Gas Chemical will strengthen its energy and resource business. The hydrogen fuel market is

expected to expand as FCVs get popular, and the firm will work on the development of a new hydrogen production technology to meet the demand. They have established a production process (MH-MD process) of hydrogen from methanol using their own methanol related catalyst technology. The process consists of steam reforming which provides methanol and water vapor to the catalyst to break them down, and a gas purification method (pressure swing adsorption). The firm will make the process system more versatile, and research another hydrogen production method in its Niigata Research Laboratory. (The Chemical Daily, August 6, 2014)

## (2) Hokkaido University

A team of Prof. Hiroaki Misawa and Assistant Prof. Tomoya Oshikiri at Hokkaido University has developed a technology to produce ammonia from nitrogen gas using visible rays of sunlight. A similar technology using ultraviolet rays has already been researched, but sunlight contains a smaller amount of ultraviolet rays. On the other hand, visible rays take about half of sunlight. Ammonia can be used as fertilizer or fuel of FCVs, and is produced as an industrial material by a high temperature and pressure method. Because the production process uses a large amount of energy, a new synthesis method has been sought. Previously a synthesis method was researched using a photocatalyst and ultraviolet rays. However, the synthetic efficiency was low, because ultraviolet rays form 5% or less of sunlight. The team placed gold particles on the surface of a metal plate as a base to absorb visible rays efficiently, and a metal catalyst of ruthenium on the back of the metal plate to make an electrode. The gold particle side was in contact with an alcohol mixed solution, and nitrogen gas was used in the ruthenium catalyst side. Ammonia was produced on the catalyst side. The team aims to commercialize the technology by 2015. (The Nikkei Business Daily, August 6, 2014)

## 9. FC Hydrogen Related Measuring/Observation Technology Development

Horiba has developed an instrument to analyze the structure and chemical composition of a material at a 10 nm of molecular level. As the product, Raman spectroscopy to observe structure and composition of substance by laser, and atomic force microscope

(AFM) are combined to be analyzed to 100 times finer than a conventional product. Preparation period for observation can also be drastically shortened. The instrument can be used to evaluate and develop nano materials such as carbon nanotubes in lithium-ion batteries and FCs. The price starts at ¥50 million, and will be available from September 3<sup>rd</sup>. (The Nikkei Business Daily, August 27, 2014)

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