

Commercialization of Train and Ship Using FCs as well as FCV

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1. Governmental Measures

(1) MLIT

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) will ease the regulations on micro electric vehicles (EVs) for two people. This will change the rule that only local governments can apply for driving of these cars on public roads, so that businesses can explore the market. The ministry will revise the regulations on vehicle examination to make the planning of volume production easier. Micro EVs for one to two people are easy to drive and energy saving. MLIT plans to expand from operational usage such as small-scale delivery operation and home care service to others such as sightseeing, shopping and trip to doctors' for micro EVs. These cars consume a sixth of energy of that of normal cars, which gives them a higher environmental performance. The ministry already applied the existing regulations for these cars. Currently, single-seater EVs fall into the same category as motor cycle under 50 cc engine, and the regulations on small cars under 660 cc, Kei Class, were relaxed for two-seater EVs. There are 5,000 micro EVs in use nationwide. The reason for the ministry to ease the regulations in this year is the fact that two-seater EVs have not been used much and the number of these certified cars is 200. Under current regulations, local governments need to apply to be able to use these two-seaters, and very few who are enthusiastic about applying the permission including Kamisato-cho of Saitama Prefecture and Takamatsu City. The amendment will allow businesses to apply for the permission with the understanding of local government in order to promote carsharing and use for travel between sightseeing spots. Also, the examination for these vehicles will be revised. (The

Nikkei, October 4, 2016)

MLIT has decided to impose installation of "pedestrian alarms" which warn of approaching hybrid vehicles (HVs), EVs and fuel cell vehicles (FCVs) to pedestrians with artificial noise. They set the guideline for these alarms in 2010, and are promoting the use. Currently, cars from all these manufacturers have this alarm as a standard feature without exception. Because this function, however, can be manually switched off, many users of these cars do not use it. People with visual impairment say that these cars scare them by going pass all of a sudden. For FY2015, Japan Automobile Manufacturers Association (JAMA) estimated 5,739,000 HVs (about 7% of total), 84,000 EVs (0.1% of total) and 900 FCVs are in use. (The Asahi Shimbun, October 6, 2016)

MLIT has started testing a ship run by fuel cells (FCs). This project will be used to set safety guideline for FC ships. The ministry aims to commercialize FC ships as a part of building hydrogen society. Tokyo University of Marine Science and Technology and Toshiba group members participate in the experiment. The ship has polymer electrolyte fuel cells (PEFCs), lithium-ion batteries (LIBs) and a motor to drive screws. The maximum speed is 11 knots, 20km/h. The ministry will compile a safety guideline as early as FY2017 using experiment results in order to promote commercialization of FC ships by businesses. (Nikkan Jidosha Shimbun, October 17, 2016)

MLIT has chosen 11 projects for 53 FC buses and electric taxis in total for the second invitation of the "Community Green Transport Project". This is the first subsidy for FC buses. The scheme promotes micro mobility and community transport to move onto

the next generation. The Bureau of Transportation Tokyo Metropolitan Government applied for two FC buses, and half the vehicle price, about ¥100 million, will be supported. The decision of subsidy was made for three electric taxis and two quick chargers of Hinomaru Limousine and three electric trucks of Yamato Transport and three micro mobility vehicles and five normal chargers of “Yuimo Promotion Committee” of Okinawa. (Nikkan Jidosha Shimbun, October 24, 2016)

(2) Agency for Natural Resources and Energy

The Agency for Natural Resources and Energy has launched Advanced Energy Systems and Structure Division in the Energy Conservation and Renewable Energy Department, and changed the Hydrogen and Fuel Cell Promotion Office to Hydrogen and Fuel Cell Strategy Office. The agency aims to prepare systems such as technological development and deregulation for full-scale use of energy management and hydrogen energy use. (The Chemical Daily, October 13, 2016)

2. Local Governmental Measures

(1) Shunan City

Shunan City of Yamaguchi Prefecture has started a test project to commercialize FC garbage trucks. This is the first garbage truck running on hydrogen in Japan, and the project will collect garbage four times a week for one year. Also, the city will start a carsharing operation of Honda’s FCV for residents to use free of charge from November. Promoting “city planning using hydrogen, they are in the actual use phase from this fiscal year. The truck was under development from last year using project of the Ministry of the Environment (MOE). The truck is quiet, which is another deciding factor for the development. Honda’s “CLARITY” will be used for the carsharing operation. Residents and people who work or study in the city may use the FCV from 9:00 to 16:00 on weekdays except bank and New Year holidays. The city office will take applications on a first-come and first-served basis. The vehicle will be borrowed for the Minatomachi office. The city will offer the service for free until next March. (The Nikkei Business Daily, October 13, 2016)

(2) Osaka Prefecture

On October 3rd, Osaka Prefecture decided projects of smaller businesses which aim to develop technologies

related to EVs and FCVs for its subsidy scheme. They had five proposals from firms in the prefecture, and chose four of them as the result of examination. The subsidy amount is ¥17.988 million in total. The prefecture is subsidizing especially the EV and FCV area of which markets are expected to be expanded by organizing project to develop next generation electric powered cars as a key of the “Active Osaka Promotion Fund”. This time, they examined marketability, novelty, feasibility and contribution to the community on prototype development of EV or FCV related component or system in total to choose the projects to support. (Nikkan Jidosha Shimbun, October 13, 2016)

(3) Tsukuba City

Tsukuba City has held a delivery ceremony of FCV “MIRAI” as the official car at the Kasuga Hydrogen Station in the city. The hydrogen refueling station was opened this March, and is the first mobile filling facility using trucks in the prefecture. It refuels for two hours on Wednesday and Friday. (Nikkan Jidosha Shimbun, October 19, 2016)

(4) Minato-ku

On October 19th, Minato-ku, Tokyo, held a delivery ceremony of the first FCV as an official car as a part of realization of low carbon society in Shiba Park. Minato-ku emits the most greenhouse gas among local governments in Tokyo, and plans to advertise and promote hydrogen energy use such as FCVs. The body of the FCV is decorated with logo of “Minato, Environmental Capital” and blue waves for environmental events as promotion. Honda which has its head office in the area will lease the FCV to Minato-ku for five years. The price is about ¥7.66 million. The Japanese and Tokyo Metropolitan governments have subsidized about ¥2.08 million each. The specifications say that three minutes of hydrogen refuel allows about 750 km of driving. (The Asahi Shimbun, October 22, 2016)

3. FC Element Technology Development & Business Plans

(1) Asahi Glass

On October 3rd, a debriefing was held in Tokyo to report results of the Impulsing Paradigm Change through Disruptive Technologies Program (ImPACT) that the Cabinet has organized. To achieve next generation cars, the program is working on

development of clear resin to replace the battery separator and automobile glass using a “Flexible and Tough Polymer” which is an innovative resin being strong without being brittle. Asahi Glass is developing a thin polymer material of electrolyte membrane for FCs. Their electrolyte membrane of perfluoro sulfonic acid polymer is used in FCs of Toyota Motor’s “MIRAI”, and the project is trying to make the membrane thinner and to increase battery capacity. A highly tough polymer is combined to prevent strength loss caused by reducing thickness, and they plan to develop the membrane to withstand high temperature of 96°C which is unbeatable for conventional products. (The Chemical Daily, October 4, 2016)

(2) NGK Insulators

NGK Insulators aims to introduce a module of ceramic solid oxide fuel cells (SOFCs), chip type ceramics secondary cell and zinc secondary cell into the market soon. They are working on a “ceramics battery project” without sectional borders. As well as Corporate R&D Department which has been researching the products for long time, other project members are both the Power and Electronics Businesses which are in charge of building business, the Corporate Manufacturing Engineering, Intellectual Property and Purchasing Departments from headquarters. The firm uses its all resources to achieve early commercialization. Their SOFC module is being evaluated at a major fuel manufacturer, and it achieves both high generation efficiency and durability while being compact by design using originally developed ceramic materials. The product is used as a core power generation component for FCs to be installed at houses or apartment units. The manufacturer aims to commercialize these in FY2018. (The Denki Shimbun, October 7, 2016)

(3) Noritake

Monodzukuri Nippon Conference and the Nikkan Kogyo Shimbun has chosen “ceramics cell” and “sealing glass” as parts of FCs using fuel directly, carbon free fuel, of Noritake as the “13th Monodzukuri Parts Award 2016”. Noritake developed the cell and sealing glass which do not corrode or degrade when directly using ammonia as fuel, which achieves carbon free FCs. The panel highly appraised the achievement. (Nikkan Jidosha Shimbun, October 20, 2016)

(4) Toho Gas

On October 20th, Toho Gas held open a lab to show the latest technology related to energy including natural gas at its Technical Research Institute in Tokai City, Aichi Prefecture. Specifically in the hydrogen area, they introduced “Hydrogen Supply Center” which operates hydrogen production, compression and shipping, FCs for business use to be commercialized by FY2017 and a cogeneration system which boasts generation efficiency at the world’s highest level. “The market environment changes quickly, and we want to get up to the speed to catch customers’ need” said Mr. Masaki Yamada, the manager of the laboratory.

(The Denki Shimbun, October 21, 2016)

(5) Fuji Keizai

Fuji Keizai, a research firm, released its estimate that the global FC system market is to expand to ¥4.9063 trillion, 46 times of that of FY2015, for FY2030. According to the firm, the market size is ¥106.4 billion for FY2015. Measures to reduce greenhouse gasses are to be progressed rapidly, and more FCVs are also to be used globally. The shipping is estimated at 780,000 FCVs by FY2030. Also, FCs are expected to be extensively used at home, and the entire FC market is anticipated to widely expand. (The Yomiuri Shimbun, October 24, 2016)

4. Hydrogen Infrastructure Element Technology Development & Business Plans

(1) Toyota, Honda, Toshiba & Tokuyama

Projects including infrastructure preparation have been booming for realizing hydrogen society. For the FCV area, Honda started sales of “CLARITY FUEL CELL” in March following Toyota Motor. Honda achieved a driving range of 750 km on a single charge, and tries to sell it as a “driving battery” by advertising the ability to supply an average household with power for about seven days. Also, FC systems are building momentum for business users. Toyota Motor has started operation of pure hydrogen FC system outputting 3.5 kW. The system is installed at the energy management building in Honsha Plant, and the building uses electricity generated by the system using hydrogen and hot water produced during the process for its lighting and air conditioning. Tokuyama will install pure hydrogen FC system of

100 kW output at a swimming pool operated by it in Shunan City, Yamaguchi Prefecture. The operation will start in March 2017. The system will supply the majority of electricity to the equipment such as the lighting and pumps for the swimming pool. These systems installed at the two firms were produced by Toshiba. Toshiba will support realizing hydrogen society through suggesting all sorts of systems for business continuity planning, office use and smart community. (The Chemical Daily, September 30, 2016)

(2) Chiyoda Corporation

Chiyoda Corporation has developed a technology to store and transport a large amount of liquid hydrogen. The technology allows transport at normal temperature and to use tankers for other chemical products also reducing investment by eliminating the need of special storage tanks. Power generation using hydrogen as fuel and transport network will help realizing “hydrogen society”. Hydrogen is made during crude oil production, but is often released in air. The gas has volume and prone to catch a fire. These properties make storage and transport difficult to use the chemical. Hydrogen becomes liquid under -253 °C and its volume is reduced to 1/800. This makes transport easier, but requires preparation costs for liquefaction facility, transport vessel and storage tank. Chiyoda Corporation developed a method to mix hydrogen in toluene, an organic solvent, to make liquid chemical product of “methylcyclohexane” to reduce the volume to 1/500. Once transported, methylcyclohexane is separated into hydrogen and toluene by using originally developed catalyst at consuming country. The firm started operation of demonstrational plant in Yokohama City in 2013 to collect data for keeping stable operation. They are considering to supply hydrogen for FCVs as well as power generation in the future. (The Nikkei Business Daily, October 14, 2016)

(3) Air Products

Air Products will form a partnership with Beijing National Institute of Clean-and-Low -Carbon Energy (NICE) of China Shenhua Group. As a part of the partnership, they signed a memorandum of understanding (MOU) to work on hydrogen energy. This agreement is for a joint project of hydrogen energy business, and these organizations will work on the details of the partnership as quickly as possible.

Having representatives from both sides, the signing ceremony of MOU was held in California, USA. Having a scope of hydrogen energy project in China, these organizations agreed for joint research and commercialization project related to reduction in cost of hydrogen production and supply. They will work together in the hydrogen energy area for now, but will consider expanding the partnership to other products such as oxygen in the future. China is also interested in hydrogen energy. Specifically in the eco car area, EV is leading significantly. However, use of FCV including FC bus has been considered, and these vehicles are already in operation in some places. In this circumstance, Air Products, a major global hydrogen gas producer, focuses on the Chinese hydrogen market. Expecting a large-scale hydrogen energy plan in the future, they aim to efficiently explore the market by forming cooperation with China Shenhua Group. (The Chemical Daily, October 21, 2016)

5. ENE-FARM Business Plans

(1) Saibu Gas

Mr. Toshio Sakemi, the president of Saibu Gas, said “our sales will face fiercer competition since Kyushu Electric Power’s sales of package for sole electricity users is recovering to the previous state, but will try to beat the competitor” at the press conference on September 29th. Kyushu Electric Power temporary stopped offering the package, “All Electricity”, but started offering the package again. Saibu Gas plans to build steady sales of ENE-FARM as its strategy while the electricity supplier has been working on full-scale sales activity of the sole electricity user package. Saibu Gas aims for 2,600 unit sales of ENE-FARM. Mr. Kozaburo Hirashima, vice president, said that ENE-FARM could beat the package price for sole electricity users”. He also emphasized the advantage of the FC system. (The Denki Shimbun, October 3, 2016)

(2) Toho Gas

On October 12th, Toho Gas held “2016 Toho Gas Group Proficiency Competition” to tests accurate skill to connect gas to ENE-FARM in its Sales Human Development Center in Nagoya City. Being the fifth event this year, this proficiency competition is held every year from FY2012. This time, young employees

contested accuracy of gas connecting operation and easy to understand explanation of advantages of ENE-FARM to customers. The contestants were 12 certified operators who got through 1,600 employees of Toho Gas Group or 2,200 employees of the distributors. The contestants operated gas connection of installed ENE-FARM as if they were at one of the residential customers' places. The completion tested their connection operation of gas and explanation on the advantages and power generation system of ENE-FARM. As well as accuracy and speed of the operation, the panel checked whether the contestants replaced jargons with easy-to-understand words for explanation. Separately from the competition, boiler repair techniques were performed. Toho Gas wants to "improve technology and service" through the competition for the coming expansion of ENE-FARM use. (The Denki Shimbun, October 13, 2016)

(3) Hokkaido Gas

Hokkaido Gas has started experiment for new service to buy electricity produced by gas power generators installed at home. Required equipment to sell electricity was installed at employee's house in Sapporo City to test usability in everyday life. The firm plans to buy electricity generated by home gas power generator "Coremo" or ENE-FARM which are sold by it to residential customers. (The Nikkei Business Daily, October 14, 2016)

(4) Tokyo Gas

On October 19th, Tokyo Gas announced that its accumulated ENE-FARM sales reached 70,000 units on the previous day. The sales started in May, 2009, which were the first commercial sales of the FC system in the world. The figure was achieved in seven years and six months. The factors of this achievement are expansion of product range and product improvement such as development of a system for apartment units, reduction in costs of the system for houses, flexibility improvement for installation and addition of independent operation function during power cuts. They aim for 18,000 units by FY2016. The sales started in FY2009, and resulted in 1,500 units for the year. The sales have successfully taken off, and the accumulated sales number reached 10,000 units in FY2012. The sales reached 12,200 units solely for FY2013. They started the sales of the world's first ENE-FARM for apartment units in FY2014. The price

of their system for houses was reduced to ¥1.6 million. Additionally, they improved installation flexibility, and released a new system for apartment units with independent operation function during power cuts in 2016. (The Denki Shimbun, October 20, 2016)

6. Cutting Edge Technology of FCVs & EVs

(1) Toyota Group

Toyota Commemorative Museum and Technology which is in Nishi-ku, Nagoya City, jointly operated by 17 Toyota Group members announced that it would hold a special exhibition of "We all together will make new MIRAI – Hydrogen era is coming" from October 8th to December 4th. The exhibition will focus on hydrogen which gets attention as energy and automobile fuel, and introduce projects of Toyota Group members including FCV "MIRAI". Toyota Group members' technologies used in MIRAI will be shown as well as work on hydrogen and FC technologies. The admission for the normal exhibition is ¥500 for adults. However, the special exhibition will take place at the entrance lobby, and the admission is free. The museum is closed on Mondays, but not on bank holiday Mondays. Instead, it is closed on the next day after bank holiday Monday. (Nikkan Jidosha Shimbun, October 8, 2016)

(2) Honda

On October 7th, Honda announced the start of a joint experiment of V2H to supply electricity from FCV to home with Kitakyushu City of Fukuoka Prefecture. For this project, Honda delivered CLARITY FUEL CELL and "Power Exporter 900", power supply equipment for external devices to the city. The automaker and city have carried out the first V2H experiment in Japan at Eco House of Kitakyushu City using FCX CLARITY since April, 2013. They will test with commercial models by bringing these two products in. The two organizations previously tested hydrogen production using wind and solar power and an independent system to operate smart hydrogen refueling station using electricity which is produced and stored in "FIT EV". (Nikkan Jidosha Shimbun, October 12, 2016)

(3) Toyota Motor

On October 21st, Toyota Motor announced a bus using FCs to be released in 2017. This will be the first commercially available FC bus in Japan. Toyota is

leading in the global FCV sales, and is trying to step forward to establishing hydrogen society by adding bus to its FCV range. The price is expected to be about ¥100 million. The bus will be added to the list of the subsidy scheme “Community Green Transport Project” organized by MLIT, and the purchase can be subsidized by the ministry. Toyota will deliver two FC buses to the Bureau of Transportation Tokyo Metropolitan Government, and the bureau plans to use the busses for its public transport operation from March. The manufacturer aims to provide over 100 FC busses to be used in areas including Tokyo by 2020 when Olympic is to be held in Tokyo. “FC stack” is the core component to produce electricity, and the bus shares the component with MIRAI. Toyota uses a large high pressure hydrogen tank for the bus to be able to drive over 200 km on a single charge. The bus can be used as a power source for evacuation centers and households during power cuts in emergency (The Nikkei, October 22, 2016)

7. Train, Ship & Other Transportation Means Running on Hydrogen

(1) Tokyo University of Marine Science and Technology

Promotional Research Institute of Battery Powered Ship which works on technological support and research and development to stimulate electric powered ship held a symposium at Tokyo University of Marine Science and Technology on October 7th in Echujima, Tokyo. This is the second time following last year. The symposium provided three talks for its subject of “future prospect of vehicles and ships using FCs. The participants were about 110 peoples from research, development and building of electric powered ships. Specially-appointed Prof. Tsuyoshi Ode at Tokyo University of Marine Science and Technology gave an explanation about statues of hydrogen FC ship. The university takes governmental policy to promote commercialization of FC ships and safety guideline that MLIT is working on into account, and is researching FC ship aiming to commercialize by 2020 in cooperation of NREG Toshiba Building. In July 2016, the university installed a hydrogen FC system of maximum 8 kW output to “Raicho N”, a testing ship. Data on impact, vibration and salt damage will be collected and analyzed for

improvement to aim to build a new ship. (The Denki Shimbun, October 12, 2016)

(2) Alstom

An international trade fair of railway transport technology was held in Berlin in September having about 3,000 railway related firms from 60 countries of exhibition. The product caught visitors eyes was “Coradia iLint” which is a FC train produced by Alstom, a French major heavy electric manufacturer. On the first day, Mr. Alexander Dobrindt, Federal Minister of Transport and Digital Infrastructure, visited the fair. “It is not economical to install power lines for regional railways. FC trains emit no exhaust gas, and achieve high energy efficiency. Moreover, it is cost effective.” he spoke very highly. The FC train continuously drives 600 to 800 km on a full tank of hydrogen, and goes up to 140 km/h. The maximum passenger capacity is 300. “The train performs at the same level as a diesel one.” MR. Stefan Schrank, Product Manager of Alstom, said with confidence. Two of the train will be used in Lower Saxony in northern Germany first, then the number of trains will be increased to 14 by 2020. The train is produced in a plant in the same state. The German government subsidized the development with €8 million, ¥900 million. The railway runs 38,000 km in total in Germany, and 46% of it does not use electric locomotives. Due to this circumstance, FC trains have the potential to pick up large demand. “Old railways have technical difficulties to retro fit electric cables, and this is an expensive job. On that point, the new train is a brilliant idea.” said Mr. Zimmer, who works for a firm of railway electrical equipment and visited the fair from Austria. “Piping for hydrogen supply in the train body is longer than of that of cars, and design of the piping is hard. The train was developed in two years while securing safety. This is amazing.” an engineer of a Japanese train producer praised. Construction of hydrogen refueling stations is required for FCV to be used more, which is an issue for the cars. On the other hand, hydrogen is stored at rail yards for FC trains. Because trains come with a hydrogen dispensing facility and access to a hydrogen supply system, refueling is not a problem. However, greenhouse gases come out during hydrogen production, and which is criticized as an “environmental drawback”. “Because we use

hydrogen produced during chlorine production, operating the train does not give any additional impacts to the environment.” Mr. Schrank gave the detail to the point. He also expressed an intention of the firm that it would consider using hydrogen produced using electricity from wind turbines as fuel to bring the train operation to be “zero-environmental impact” in the future. (The Tokyo Shimbun, October 9, 2016)

(3) Aquafairy

Aquafairy, Kyoto City, and Prof. Kazuyuki Hirao at Kyoto University have developed an electric wheelchair with lifting functions using FCs. Being for indoor use, this wheelchair can raise its seat by 35 cm for users to adjust their eyesight. The sales have not been decided, but they are looking for demand at exhibitions. They developed FCs using a cartridge to produce hydrogen by giving a dribble of water to a solid hydrogen source. The cartridge is used in their portable FCs of 30 W output for emergency use which is currently available. The wheelchair uses the same FCs and storage battery of 200 Wh capacity. Its control system automatically switches to charge the storage battery from FCs, to use both power sources at same times for high power operation or to prioritize use of one over the other. Kishi Engineering, Izumo City of Shimane Prefecture, helped the wheelchair development. The development was supported by the Center of Innovation Stream of Kyoto University. The team is considering experimental use for visitor assistance at an art gallery to find demands, and then aims to commercialize the product. (The Nikkan Kogyo Shimbun, October 14, 2016)

8. FCV Part & Component Development & Business Plans

(1) Toray

Toray unveiled concept car “TEEWAVE” which fully uses its lightweight materials at “Toray Advanced Materials Symposium 2016” which was held in Tokyo International Forum in Chiyoda-ku, and showed the latest lightweight technology of a car body using advanced materials. They developed super lightweight sport model concept car “TEEWAVE ART” in September, 2011 which uses carbon fiber reinforced plastic (CFRP) for its body structure, and they increased CFRP parts in the new concept car to

reduce weight further. Safety and comfort are improved by using properties of high function resin. Also, forming process of large CFRP parts is cut down to tenth or less of that of conventional method by using fast process to achieve high cycle for commercial models. In the automobile area, the manufacturer introduced product ranges for both EV and FCVs such as carbon paper and automobile battery and electrode materials using “Trelina”, a polyphenylene sulfide film (Nikkan Jidosha Shimbun, October 12, 2016)

(2) Toyoda Gosei

Toyoda Gosei announced that a technology was developed for rubber material to restore its shape after being pressurized at high temperatures for a long period. The technology gives rubber about double the performance to restore the shape while enabling stretching to four times of the original shape. Next generation cars such as EV, plug-in hybrid vehicle (PHV) and FCV uses sealing material for their battery units, and they are required to last a long time. The manufacturer plans to make the sealing thinner, lighter and longer-lasting. Rubber loses elasticity when compressed at high temperatures for a long period, and decreases in sealing performance by permanent distortion. On the other hand, higher plasticity rubber is hard with less stretching ability, which may cause difficulty to assemble in the unit when sealing. The manufacturer newly selected a chemical which contributes to resisting heat to optimize rubber mixture in order to establish material ratio designing technology to reduce by half the compression permanent strain of conventional products for rubber to be able to go back to original shape more easily. (The Chemical Daily, October 24, 2016)

9. Hydrogen Refueling Station R&D & Development

(1) Kobe Steel

Kobe Steel will develop technology for a system using water electrolysis equipment which produces high pressure hydrogen for refueling stations for FCVs without emitting CO₂. Experimental production for commercialization will start in October. The Machinery Business is running the project in cooperation with University of Tsukuba and Kobelco Eco-Solutions and Shinko EN&M of Kobe Steel group members which have hydrogen related technology.

The project is carried out as a part of the “Technology Development and Experiment Projects for Reducing CO₂ Emission” for FY2016 contracted from MOE. Currently, fossil fuel is used to produce hydrogen for refueling stations. This production system produces CO₂, and how to produce hydrogen using renewable energy is the key now. CO₂ free hydrogen can be made by the electrolysis equipment that Kobe Steel is working on, and a commercial system can provide more environmentally-friendly hydrogen. The project will use electrolysis equipment of 20 Nm³/h production out of 340 Nm³/h which is a standard capacity for hydrogen refueling stations to test whether hydrogen produced from fossil fuel and water split hydrogen can be mixed for use. Shinko EN&M already commercialized technology to produce hydrogen by water electrolysis in HHOG, hydrogen production equipment. However, hydrogen was mainly for factory use, and the required task is how to increase the capacity for refueling station use. Methods to use, even if partially, can lead to commercialization of CO₂ free hydrogen, and then investment of solar and wind power generation for water electrolysis can be reduced. This will promote the system. Kobe Steel has sold equipment for hydrogen refueling stations such as “HyAC mini”, a package of the Compressor Division and “DCHE”, a heat exchanger of the Industrial Machinery Division. Adding CO₂ free hydrogen production equipment will improve their range for a total solution. (Japan Metal Daily, September 30, 2016)

(2) Honda

On October 24th, Honda announced an experiment of small hydrogen refueling station started. This is the world's first refueling station using high pressure water electrolysis system to produce hydrogen. The manufacturer installed “70 MPa Smart Hydrogen Station” in Aomi, Koto-ku, Tokyo. They will also use FCV in the experiment to find out the effect of the reduction in CO₂. The experiment is carried out as a part of “Technology Development and Experiment Projects for Reducing CO₂ Emission” of MOE. The small refueling station produces hydrogen using solar power to evaluate its operational effect. The station requires 6 m², one step smaller than the conventional product. Their own technology of high pressure water electrolysis system allows producing a maximum of

2.5 kg of hydrogen at 77 MPa of production pressure without a compressor in 24 hours. Also, the system can store about 18 kg of produced hydrogen. Furthermore, the experiment plans to use Honda's FCV “CLARITY FUEL CELL” and portable external power supplier as well as the station. The manufacturer will evaluate the CO₂ reduction effect and operation for emergency power supply systems. (The Chemical Daily, October 25, 2016)

(3) Air Liquide Japan

Air Liquide Japan will open a hydrogen refueling station in Fukuoka. The construction is aiming for completion in February and operational start in March 2017. The facility to be open is “Fukuoka Miyata Hydrogen Station”, Miyawaka City. Toyota Motor Kyushu has lent a piece of land in its Miyata Plant to install the facility. Being an off-site production system of compressed hydrogen, high pressure hydrogen gas will be transported from plants of Air Liquide or other producers to the station which will adjust it to the required pressure to supply FCVs. Being between Fukuoka City and Kitakyushu City, the facility is close to Miyata Smart Interchange of Kyushu Expressway, which gives convenient access. The special economic zone scheme will be used for investment in the facility. The project has given subsidy from the Ministry of Economy, Trade and Industry (METI) and Fukuoka Prefecture, and has obtained a tax advantage of “Green Asia International Strategic Comprehensive Special Zone”. Air Liquide group installed hydrogen refueling stations at 75 locations worldwide as of the end of 2015. In Japan, they have these facilities at two locations in Aichi Prefecture and one location in Saga Prefecture, and operate commercial hydrogen refueling stations. (The Chemical Daily, October 27, 2016)

10. Hydrogen Measurement, Observation & Explosion Proof Technology Development & Business Plans

(1) Sato Shoji

Sato Shoji, a measuring instrument trading house in Kawasaki City of Kanagawa Prefecture, will enhance its range of gas measuring devices. A new hydrogen gas detector was added to their range. The needle of the product indicates the level of detected hydrogen concentration, and has advantages

of lightweight and analog output compatibility. The trading house expects the product to be used for servicing and inspecting sites of FCVs. The new hydrogen gas detector is called “XP-311FCV”. The detection range is at a concentration of 0 to 100% lower explosion limit (LEL), and the meter displays the level. The sampling method is extractive and catalytic combustion is used at the detecting method. The operating temperatures are between -10 and 40 °C. The detector is small and lightweight, and designed to fit in a hand. It operates using a battery continuously for 10 hours. The buzzer and light indicate sensor and pump errors and low battery. Detected analog levels can be output though external output cable, an accessory. (The Chemical Daily, September 30, 2016)

(2) Miyaki Electric MFG

Miyaki Electric MFG has produced products for industrial safety area since its establishment. Currently, they are trying to sell explosion proof surveillance cameras. The camera range is wide angle, close up and far sight. All the products are compact, lightweight and hydrogen explosion proof. The manufacturer is preparing wires LAN connection version. Their explosion proof cameras are used in explosion risk areas such as production facilities, warehouse of dangerous goods and chemical tankers, and play a role in safety operations. FCV development is progressing, and hydrogen is expected to be used more as energy. The new product helps for workers' safety. (The Nikkan Kogyo Shimbun, October 27, 2016)

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