

Hydrogen-based Strategy, Cabinet Decided within the Year for Promoting Rationalization of Regulation

Reported by K. Onda

1. Governmental Measures

(1) METI

METI (The Ministry of Economy, Trade and Industry) started reconsidering for energy master plan and studying additional policies, to achieve 2030 targets including keeping outline of the plan and increasing zero emission power source ratio and energy self-sufficiency rate. The point is about handling nuclear power plant. For transportation sector, there is a possibility to make direction for accelerating the spread of electric related eco-car and FCV. The Minister of METI, attended basic policy subcommittee meeting of Advisory Committee for Natural Resources and Energy, told "I think we are not in the step for changing frame of the plan, however, it's important to study what we should do for the future, for achievement of 2030 targets steadily, based on 6 years' status change after earthquake disaster, and policy and results until now. The energy master plan is revised every 3 years with latest information, and the subcommittee is going to conclude direction of reconsideration within this FY.

METI pointed out falling oil price, declining renewable energy costs, concluded Paris Agreement and U.S.A. withdrawal, and accelerated EV shift for automobile industry as situational changes from 2011. Based on such change, METI will frequently discuss about targets for 2030 including zero emission power source ratio 44% (renewable energy 22-24% and nuclear power 20-22%), energy self-sufficiency rate 24% and electric power costs reduction.

One of the points is nuclear power energy. Only 5 nuclear reactors reached re-run among domestic nuclear power plants. Signal changed to yellow for 20-22% of the 2030 target. If not progressed re-run

and renewal, national wealth may be drained away to foreign countries continuously due to dependence on expensive thermal power generation. Sales ratio of next generation car will be promoted to 70 percent from 50 percent in 2030, and proceeding traffic flow measure including advanced transportation systems, and energy saving measure for logistics sector, are listed in the master plan. For starting study of additional policy to achieve existing target certainly, increasing the next generation car ratio, positioning for EV shift of automobile industry may be a major key point for Japan. (Daily Automotive News, August 12, 2017)

(2) Agency for Natural Resources and Energy

Agency for Natural Resources and Energy at METI started study for expansion of CO₂ free hydrogen use, to minimize CO₂ emission from production to use. While referring European cases, METI investigates domestic usage potential, discusses mechanism for CO₂ free definition linked to bond dealings and mechanism of offering incentive program and so on. The interim summary may be concluded by October. CO₂ free hydrogen working group started the study again in August 8, first time in 5 months and a half, and the member reformed, too. Secretariat organized European measure for the meeting. Based on Paris Agreement came into effect in last November, also evaluated how much hydrogen contributes to greenhouse gas reduction. Outcome will be reported to upper Hydrogen and Fuel Cell strategy conference, after interim summary in October and held regular meeting at the beginning of next year. With roadmap for hydrogen and fuel cell strategy revised in March 16, aiming to realize CO₂-free hydrogen supply system around 2040. (The Electric Daily News, August 14,

2017)

(3) Government

The government will formulate hydrogen basic strategy and approved by the cabinet within the year. The direction is, summarizing master plan after several Hydrogen and Fuel Cell strategy conference of METI, and approved by the cabinet. Studying to accelerate set up of hydrogen station and rationalizing related regulations at conference. For achieving the target to reduce greenhouse effect gas emission 80 % by 2050, the government emphasized building hydrogen society. The government placed renewable energy and hydrogen related cabinet meeting, and held the first meeting in April this year. In this meeting, the prime minister declared Japan would realize hydrogen society first in the world, and ordered to create basic master plan to relevant government offices.

In addition, for spreading about 40,000 FCVs in 2020, the prime minister requested 1) building system for accelerating hydrogen station set up, 2) reviewing all related existing regulations for rationalizing regulations related hydrogen station. As movements of cooperation by private companies, automobile companies including Toyota and Nissan, and large energy companies including Tokyo Gas and Idemitsu Kosan, signed memorandum including establishing new company. The framework for the promotion is being complete with public-private sectors collaboration. (The Electric Daily News, August 22, 2017)

(4) METI

METI started review for related regulations reducing costs for set up and operation of hydrogen station. Rationalization of safety inspection, unmanned operation of station with remote monitoring are studied. First study meeting by knowledgeable person held on August 24. In Japan, regulations of Hydrogen station, fuel supply base of FCV, are very severe compared with Europe and U.S.A. That the reason why increasing set up costs and being difficult to proceed facility set up. In Japan, always using special steels and equipment based on regulations and standards, however, in U.S.A., costs are 30% lower because designed based on responsibility of company and can be used general purpose materials. With the situation, many related people pointed out reconsideration comparing domestic gas station with

Europe and U.S.A regulation. Deregulation is necessary for achieving cost cutting target of 50% including set up and operation costs in 2020, stated in action plan, compare to 2014. Based on regulatory reform action plan, study meeting discuss regulation reconsideration using scientific knowledge with keeping safety. Within 37 items listed on the plan, 10 items in FY 2017, 13 items in FY 2018-19, for conclusion and execution, and starting study 14 items from 2017. (The Chemical Daily-News, August 25, 2017)

(5) Kanto Bureau of Economy, Trade and Industry / METI

Kanto Bureau of Economy, Trade and Industry (METI) supports entry of small and medium enterprises to hydrogen and fuel cell related parts field, Kanto wide area cooperation organization (about 600 members) as core members, in the area including 11 prefectures. For cost reduction for ENE FARM and hydrogen station, researching for requirement of major equipment manufacturers including weight saving and high efficiency, and find small and medium size companies with corresponding seeds. Efficient high-precision of material manufacturing technologies and part processing and weight saving may be targeted field. Scheduled matching meeting on January 25 and 26, 2018, and having about 3 market entering related seminars in the area by spring 2018. Having seminar in Kanagawa prefecture and Yokohama city on September 8, including Dainichi Kikai Kogyo, developed small on-site type hydrogen producing machine, will attend the meeting. When company in the area develops hydrogen related products, remind actively utilization of national support program including strategic generic technology advancing support program. (The Nikkan Kogyo Shinbun, August 29, 2017)

(6) Ministry of the Environment

Shunan City and Shimonoseki City in Yamaguchi Prefecture, wide area cooperation model in the area, jointly utilized unused byproduct hydrogen occurred in sodium hydroxide factory, started from September 15 as proofing program of Ministry of the Environment. Liquefied byproduct hydrogen occurred in Shunan area electrolysis facility, and transport with tank lorry to Shimonoseki City, 100 km away, and supply for mayor official business car FCV at hydrogen supply facility (hydrogen station) for

proofing, set up in Shimonoseki fishing port, and use for FC forklift in the fishing port, supply for welfare facilities, hundred and tens m away, in the fishing port with pipes, and supply for 3.5kW hydrogen FC. In hydrogen station, stored liquefied hydrogen 10kl with 35MPa.

Ministry of the Environment will conduct proofing tests of local production for local consumption type hydrogen supply chain, collecting low carbon unused hydrogen from electrolysis facility, storage, transportation, and use. (The Chemical Daily-News, September 12, 2017)

(7) METI

METI accelerates policy for expansion of regenerated energy and requests 1398 billion Yen of 16% increased budget estimate for FY 2018. The priority budget allocated focused on cost reduction and self-reliance R&D including solar, wind power, and biomass, and developing transmission network used for regenerated energy. Hydrogen energy related budget estimated 302 billion yen with increased 34 billion, including ENE FARM introduction support, hydrogen station set up support, step-up proofing tests of developing hydrogen supply chain using unutilized energy. (Chemical industry newspaper September 15, 2017)

2. Policy by local government

(1) Saitama Prefecture

Saitama prefecture conducts running test for Toyota FC bus rented from Toyota Motor with free of charge until September 5, (the first trial in the prefecture). It aims for visitor transportation of Rugby World Cup held in Kumagaya City in 2019 and Tokyo Olympics and Paralympics in 2020 and so on or utilization for fixed-routed bus and promotes FC bus introduction for bus companies in the prefecture, and proceeding introduction of hydrogen station. Saitama prefecture aims for spreading 6000 FCVs by 20 by 2020, existing 130 FCVs in the prefecture, No.4 in Japan, 8 hydrogen stations in the prefecture, No.5 in Japan. (The Nikkan Kogyo Shinbun September 4, 2017)

3. FC elemental technology development and business development

(1) Tokyo Institute of Technology, etc.

Tokyo Institute of Technology developed long-lived life catalyst for FC with Kanagawa Prefectural

Institute of Advanced Industrial Science and Technology. Carbon, cause of degradation, is not required. Using 5nm diameter particle made by alloy of platinum and iron etc., create 300nm capsule, and flow oxygen and hydrogen etc. to hollow inside. Even repeating electricity generation and stop 10,000 times with the experiment, performance can be maintained, and suggested urging reactions efficiency is about 10 times of existence catalyst, and reducing expensive platinum usage and material costs may be reduced. They aim to put into practical use after 5 years with cooperation of enterprise. (The Nikkei August 21, 17)

(2) NF Corporation

NF Corporation released 2 models of measuring instrument for measurement of the frequency response with high accuracy which use sine wave sweep signal of maximum 600 V and can be used for higher voltage inverters for FCV and EV, on August 22. The new mode frequency response analyzer (2.85 million yen, without tax), can cover from 10μHz to super-low frequency with impedance measurement. Gain fuse analyzer (1.98 million yen, without tax) specialized in gain fuse characteristics measurement including loop gain of switch power supply and mechanical servo etc., and 10 μ-2MHz frequency. Both models have sequence function etc. (The Nikkan Kogyo Shinbun, August 22, 17)

(3) Sumitomo Metal Mining

Sumitomo Metal Mining announced introducing demonstration facility for mass production of nickel oxide, electrode material for SOFC, on August 21 by assuming increase in demand of nickel oxide with spread of home and business use FC. For candidate of facility, listed company own land in Niihama City, Ehime prefecture, introduction targeted on April to September, 2018. Productive capacity is tens ton per year, and planed total hundreds million-yen investment. The facility composed of raw material nickel sulfate drying machine, baking machine, and grinder etc. Produced nickel sulfate delivered to SOFC manufacturers and conducted quality evaluation again. Grain-size made finer about 0.4μm from conventional 0.7μm, and developing impurities sulfur removal technologies. Sumitomo Metal Mining producing oxidation nickel for electronic components tens ton per year, and used for FC. (The Nikkan Kogyo Shinbun, August 22, 2017)

(4) UC San Diego

University of California, San Diego announced development of expansible wearable bio-fuel cell on August 22, electricity generated with sticking on human body skin and oxidizing lactic acid including sweat by enzyme.

Using structure connecting with spring like dot lines so called bridge and island, solving expansibility obstacles, and 3D printed carbon nanotube structure arranged in dot line upper part, and achieved about 10 times output of conventional wearable bio-fuel cell. With mounting the bio-fuel cell, lighted blue LED 4 minutes by exercise and sweating. (Fuji-Sankei Business Alley, August 28, 17)

(5) Unicharm

Unicharm developed microbial fuel cell using wastewater occurred during recycling process of used paper diaper. Planned to improve efficiency of electricity generation through proof test for several years from now on, and utilize obtained electricity for recycle plant operation etc. The company aims to spread paper diaper recycling in Japan and reduce environmental load of whole recycling process through energy saving of plant. Developed technology in conjunction with Hiroshima University and Unicharm patented. When used-paper-diaper decomposed water and ozonized, excellent quality pulp to be reused for paper diaper is obtained, fiber and organic substances such as excretory substance are contained in waste water. The organic substances in waste water are decomposed with microorganism, and electricity is generated by microbial fuel cell. Most of used paper diaper incinerated in Japan, but Unicharm started demonstration experiment for collection and recycle in Kagoshima prefecture. (The Nikkei, September 1, 2017)

(6) Ministop

MINISTOP Co., Ltd. started demonstration experiment of SOFC system for business first in the convenience store industry with Aeon and Tokyo Gas for store energy saving for Ministop Aeon Tower Annex store (Chiba-City) end of June. For 2-year test period until June, 2019, introducing SOFC system developed by Kyocera, and verifying the effects for store. Electricity generation efficiency of the system is 52% of highest of 3-5kW class, and low CO₂ emission amount and total efficiency including electric power and waste heat management is 90%. Using ceramics

for cell electrolyte to have high electricity generation efficiency with reforming high temperature waste energy to town gas, and electricity is supplied to store with adjusting load ratio. When electricity went out, also having function to supply electric power, and can be supplied electric power to simple illumination and charging cellular phone from dedicated outlet, and also conducted demonstration experiment for increasing function of convenience store as disaster center. Gas used for the experiment is town gas 13A, but most of store is using propane gas, suitable system for propane gas is needed. For energy saving store, LAWSON provided 60 percent reduced electric power amount for convenience store, and development competition continued. (Nikkei Sangyo Shimbun, September 4, 2017)

(7) Nisshinbo

Nisshinbo Holdings Inc. succeeded to develop practical use catalyst for PEFC without using platinum first in the world. Using carbon instead of platinum, bottleneck of PEFC price, the material costs can be reduced to about 1/1000. Possibly accelerating delayed spread of FCV compared with EV. Nisshinbo succeeded replacing platinum, indispensable for electrode catalyst with oxygen deoxidize, with carbon catalyst called carbon alloy. Created molecule structure for activating oxygen deoxidize, with improving baking carbon process. Nisshinbo supplies catalyst for 30W (charging capacity for 6 smart phones) battery of Canadian Ballade Power Systems at first. Ballade explained reduced 80 % of platinum usage for stack, and launch as battery for portable electronic devices in December, 2017. (The Nikkei, September 13, 2017 and The Nikkan Kogyo Shinbun, September 14, 2017)

4. Hydrogen infrastructure element technology development and business expansion

(1) Fukuoka Strategy Conference for Hydrogen Energy

Fukuoka Strategy Conference for Hydrogen Energy held general meeting, lecture and study subcommittee meeting in Hakata district, Fukuoka City recently, and total 270 members attended. The council established with 140 members aiming for realization of hydrogen energy society in August, 2004, and currently joining 806 companies and institutes. Chairperson (Nippon steel & Sumitomo Metal)

addressed, "Accelerated spread of ENE FARM compared with the council founded year, and increased usage of forklift and bus etc., and has been contributed consumers starting to use clean energy of hydrogen safely and conveniently daily. Using experiences and strong points until now, expecting to proceed activities with collaborative relationship among government and academia further". According to business report in FY 2016, there are 10 stations including newly opened 2 hydrogen stations in Fukuoka prefecture, 87 FCVs including 5 taxis drive, and projects for ENE FARM spreading at rental apartment house progress in Fukuoka City. Opened Institute of Advanced Industrial Science and Technology and Kyushu University hydrogen related material strength laboratory in January, and held hydrogen advanced world forum in February. FY 2017 business plan newly includes FC bus workshop and FC two-wheeled vehicles running on public roads from June. (Dempa Shimbun, August 21, 2017)

(2) Japan Energy Association

Japan Energy Association held power talk to discuss domestic and overseas various energy subjects on September 30 in Tokyo, and chairman of association and former vice chairman of Tokyo Gas (program director of Cabinet Office strategic creation innovation program) exchanged opinion about technology using directly burning NH_3 for electricity generation and spread of hydrogen energy with less CO_2 emission. NH_3 including much hydrogen, and taking out hydrogen at consumption area, and can be used directly. In addition, NH_3 can be burned mixing in coal firepower or industrial furnace to reduce CO_2 emission, and generates electricity directly by fuel cell. With Cabinet Office energy carrier program, achieving practical use of ammonia technology from first half of 2020's to around 2030. Recently, ammonia mixing fuel burning test were conducted at Chugoku Electric Power Mizushima power plant in July. For building value chain for ammonia, explained started consortium with power companies and manufactures in July. On the other hand, Tokyo Gas etc. participating for project of Tokyo Olympics and Paralympic in 2020, Harumi hydrogen town placed for supplying hydrogen to FC of housing and commercial facilities and FB buses. Concluded for ammonia and hydrogen energy, diversification of energy technology and overseas expansion were

important, and also cost reduction and support with national policy were most important to practical use. (The Electric Daily News, September 1, 2017)

(3) Chofukosan

Chofukosan Co.,Ltd, kerosene hot-water manufacturer, set up demonstration experiment equipment of hydrogen energy in the grounds of the company, visualized outcome of support program joining the company, and preparing for future hydrogen society. Support program of Yamaguchi prefecture "First in the world, development of pure hydrogen fuel cell cogeneration system and expansion of hydrogen demands" conducted from summer from 2014 to the end of 2017, and joined 4 companies including Yamaguchi liquid Hydrogen, Chofukosan, Toshiba Fuel Cell System, and Iwatani International Corp. In the site of Chofukosan, setting up hydrogen storage tank, FC power generation unit, and boiler type hot water storage unit etc., planned also setting up EV, and visualizing the flow of electric power supply made from hydrogen or solar, to EV. (Dempa Shimbun, September 6, 2017)

(4) Hitachi

Hitachi developing a system, controlling and absorbing power fluctuation of regenerated energy, using hydrogen, for proceeding practical use of hydrogen usage technology to achieve introduction expansion of regenerated energy, as proof project of NEDO. In addition, developing high-efficient dehydrogenation process of methylcyclohexane(MCH) with Institute of Advanced Industrial Science etc., and starting sales of MCH dehydrogenation reactor etc. around FY 2020, and control system after FY 2025. Hitachi proposed "Maximizing effective use technology of regenerated energy electric power using cooperative control in Hokkaido Wakkanai area" with Hokkaido Electric Power and Institute of Applied Energy in FY 2016, adopted as basic study theme of NEDO, and decided moving to system technical development and conducting real demonstration in August this year. The project develops of an absorbing and controlling system for generated electricity power fluctuation and surplus power by weather condition with regenerated energy of wind and solar. The system is composed with storage battery, water electrolysis equipment, hydrogen storage tank and mixed fuel burning engine using light oil and hydrogen. The equipment is cooperatively controlled

with original algorithm to absorb and control electricity power fluctuation and surplus power. Electric power generated electricity by storage battery and hydrogen mixed fuel burning engine, sent to system and consumer as needed. Low-cost system is built with combination of less expensive equipment. Hydrogen mixed fuel burning engine is different from FC, not required hydrogen purity and already established technologies, and exhaust heat is used for air conditioning. The company develop MCH dehydrogenation reactor with hydrogen mixed fuel burning engine with Institute of Advanced Industrial Science Fukushima etc., and using engine exhaust heat for source heat required for MCH dehydrogenation. A 100kW electrical generating system has been developed and currently designing 500kW system is in progress. MCH dehydrogenation reactor and engine generator is planning to launch from FY2020. The firm plans commercialization of absorbing and controlling system for regenerated energy after FY 2025. (The Chemical Daily-News, September 11, 2017)

(5) Obayashi Corp.

Obayashi Corp. announced building hydrogen energy system electrolyzing water with regenerated energy at the Technical Research Institute of the company, and proving each process of production, storage and use. Completing the facility in April next year, considering entering hydrogen supply business combination with regenerated energy power generation business. Hydrogen stored with gaseous stat, and generating electricity by pure hydrogen FC on demand, and supplying in Technical Research Institute. The system including electrical storage system, and verified best matching for water electrolysis equipment and battery capacity independent from weather changes, and most suitable control for each equipment. Generation of electricity by regenerated energy is separated from the system, and supplying to water electrolytic equipment, even if electricity goes out with business electric power, independent operation is available, and also inspected corresponding to business continuation plan at disaster. The proofing teste supported by Tokyo City as business-oriented, regenerated energy origin hydrogen utilization equipment introduction promotion program. (The Electric Daily News September 12, 2017)

(6) Asahi Kasei

Asahi Kasei entering hydrogen plant business, generate hydrogen from alkali water using surplus power of wind power and solar electric power, and selling as green hydrogen without generating CO₂. Using "separator" of insulation film used for lithium ion battery, achieving world highest level energy efficiencies for changing to hydrogen. Generated hydrogen supplied to hydrogen station for various production facilities, hydrogen electric generating facilities and FCV just as it is. In addition, reacting CO₂ and hydrogen, and changing to methanol, and also linked to building comprehensive hydrogen system supply. Methanol having advantages compare to hydrogen, difficult handling due to explosive danger etc., can be used for fuel mixed with gasoline, and storage safely. The firm plans to join hydrogen generation project in Germany with other companies in this fiscal year, and building facility of hydrogen resolving 140kW. The firm has run demonstration facility in Yokohama City from November, 2015, and confirmed stable hydrogen generation. (Sankei Newspaper, September 14, 2017)

5. ENE FARM business expansion

(1) Yano Research Institute

Yano Research Institute Ltd. announced declining trends of smart housing related facility market, using energy efficiently, in August 18. Predicted 30 percent less of 5074 billion yen in FY 16 compare to FY 20, due to influence of declining introduction of solar panel for housing. The firm analyzed market volume of 7 items including solar panel, storage battery and smart meter for housing. Solar panel will possibly shrink due to declining selling price of generated electric power in every year. On the other hand, with 5 items except solar panel and smart meter, 40% increasing of 1784 billion yen in FY 2020 compare to FY 16. Government supporting introduction of zero energy housing, actually zero energy balance, and expecting increasing FC. Reduction of introduction cost for equipment is indispensable for expansion of the market, and analyzed introduction planning limited for relatively wealthy household. (The Nikkei, August 19, 2017)

6. FCV

(1) Toray Industries

Toray announced introduction of innovation process development facility to create next generation high-performance carbon fiber on August 10 in Ehime factory. The firm aims for development of world most high-strength system over the strength of T1100G, highest-performance currently, and development of innovative productivity improvement technologies. It is scheduled to start running in beginning of 2019, and planed investment of 70-80 billion yen including building. Carbon fiber is produced from precursor to baking, and the facility has certain level of production capabilities even as development facility. Global carbon fiber market is expected growing more than 10 % annually, and demand for EV and FCV also growing, required performance and cost performance more than past, and contributing to sustainable society and hydrogen society. (The Chemical Daily-News, August 14, 2017)

(2) Toyota

Local governments hold trial riding events for FC bus developed by Toyota. These events were conducted including Kansai International Airport, Nagoya City and Sendai City up to now. The firm aims to introduce more than 100 FC buses for Olympic and Paralympic Games in 2020. The FC buses, the firm begun to sell in January this year, go around for local trial riding event. Mounted the system, developed for world's first FCV (MIRAD), and having delivery record of two buses for shuttle bus of Tokyo city transportation authority. With excellent calmness and running without CO₂ emission, and can be run 200 km with full filled hydrogen. Passenger capacity is 77. About 850 people tried test ride with FC bus, running one round in the airport for about 1 hour, and also visited hydrogen station set up by Iwatani International Corp. Participants talked "Riding quality is very good and quiet, with smooth start and acceleration" Annual hydrogen consumption of one FC bus is 3850kg correspond to 45 FCVs. Government estimated 1227 FC buses spread in Japan as of FY 30, and 2% of fixed-route buses replaced by FC buses. (The Electric Daily News, August 18, 2017)

(3) Daimler

Daimler of Germany announced and exhibited world first plug-in FCV, can be charged from outside, on Frankfurt International Motor Show on August 21, September 12. It is possible to run 500 km with full filled hydrogen. Developed the FC with Ford Motor

and succeed in downsizing, and will be launched within this year at the earliest. Considering circumstances, delayed set up of hydrogen station, developing the market with plug-in type. Daimler equipped own FC system to SUV of Mercedes-Benz "GLC". Positioning with a series of electric car sub-brand EQ started last year, and named GLC F cell EQ power. Daimler developed FCV independently for a long time and also having proof ran achievement of 200 vehicles on public road, based on Mercedes-Benz B class. Daimler cooperates with Nissan and Ford aiming for FCV mass production, for plug-in FCV may be developed independently. Daimler announced EV shift on Paris Auto Show in last autumn, and planning to sell electric car including EV maximum 25 % of new car sale in 2025. (Nikkei Sangyo Shimbun August 23, 2017 and The Nikkan Kogyo Shimbun September 14, 2017)

(4) Akamatsu Electric, Honda

Akamatsu Electric (Iwata City, Shizuoka prefecture) and Honda cooperate for spread and sale of vehicle to home (V2H) system supplying electricity to housing from FCV. Akamatsu Electric signed consignment contract of sales agency with Honda for portable external power supply, and selling with own power supply conversion system at power failure. For Honda, first time consignment for the product, and decided for high compatibility with power supply conversion system. Honda external power supply connected to FCV or EV, and cooperated with power supply conversion system, and supplying electricity to household etc. smoothly, and can be adopted for using in local government office or public facilities during disaster. When using Honda clarity fuel cell, can be supplied power about 7 days with average ordinary home. (The Nikkan Kogyo Shimbun, August 30, 2017)

(5) Plug Power

Plug Power agreed with US Amazon for trial use of FC forklift at 10 sites of distribution facilities in April, and Plug Power agreed with US Walmart Stores similarly in July. Increased number of Plug Power battery users to 58 warehouses. According to investigation of National Renewable Energy Laboratory in US in 2013, price of hydrogen FC forklifts is highest of 58,000 dollars and about 2 times of average lead storage battery forklift, but when considering 10 years of average durable years, FC forklift is 10 % inexpensive. Filling hydrogen in

several minutes, and saving battery charge time, personnel expenses, and warehouses space can be distributed goods efficiently with the system 24 hours. Toyota, world largest forklift manufacturer, develops hydrogen FC forklift, and starts test of prototype at in-house factory. US Hyster-Yale Materials, major forklift manufacturer, also acquired FC manufacturer in 2014, and starting to introduce technologies to own products. Hard to replace lead storage battery, durable, possible to recycle perfectly, and having historical experience. Federal government tax credit for FC ended at the end of 2016, but Plug Power developed smoothly increasing income, and planned to become profitable at the earliest in next year. (Sankei Business Eye, September 4, 2017)

(6) Toyota

Delivery date of Toyota FCV MIRAI is shortened to about 1 to 2 months. It is good news for individuals and companies, waiting and giving purchase up due to long delivery, with same one as usual vehicles. MIRA were sold 3857 in worldwide until July 17, and were produced only 3 vehicles per day at first, but the firm covers for order volume because of expanded to total 3000 vehicle production capabilities per year in worldwide. Toyota plans to sell 30,000 vehicles per year in worldwide until 2020. Government targeted placing about 160 until 2020, and 320 hydrogen stations until 2025. (The Nikkan Kogyo Shimbun, September 7, 2017)

(7) Kyoto Toyopet

Kyoto Toyopet donated one FCV MIRAI to Kyoto Prefecture on September 8. Cooperating with Kyoto Prefecture for realization of hydrogen society, it is to be used for Governor's official car and so on. The vehicle had been used for demonstration car, Kyoto Prefectural Governor commented " Had been promoted hydrogen station placement without FCV, and able to throw chest a little with this." He considers other usage such as for disaster besides official car. (Daily Automotive News, September 13, 2017)

7. Hydrogen station technical development and business expansion

(1) The Nikkei

Set up of hydrogen station necessary to FCV is not proceeding. High set up costs compared with gas station due to severe safety regulations, and difficult

to keep profits. Small number of station existing compare with EV charge spot. Five month after the opening, more than 830 people visited to Yokohama Tsunashima Hydrogen Station operated by JXTG Energy, providing experience programs including hydrogen filling simulation, providing showroom for visual presentation for the company measures in the same site. As of the end of June, existing 91 hydrogen stations in the whole country, concentrated in 4 major urban conurbations including metropolitan area, but 22 prefectures have no station. As of July 2017, number of EV charge spot set up about 29,000 (summary of Zenrin, major map company), and difference is clear. FCV price is very expensive, including Toyota Mirai , 7 million yen for 1 vehicle, even using subsidy the price is 4, million-yen price level, and number of sales is stayed about 2000. For spread of FCV, to cross the barrier of small number of station, adding stations. No major companies declared when become profitable with operating station. Most severe regulation for safety in the world leads to high construction costs. Hydrogen supply equipment required to separate 8m from road, and needed large land. In Germany, allowed self-filling by the driver, but continuously existing qualified and experienced supervisor required in Japan, and increasing labor costs. The construction costs of hydrogen station estimated as 4-5 billion yen with usual type, and largely different from Europe and U.S.A. of about 2 billion yen, and clearly higher than gas station of about 1 billion yen.

Different from gas station, it is also hurdle of set up to be difficult to expect other incomes including car checkup and maintenance than fuel sale . (The Nikkei, August 20, 2017)

(2) Showa Denko

Showa Denko announced supplying used plastic origin low carbon hydrogen produced by Kawasaki plant to Shinsuna Hydrogen Station of Tomoe trading from August. Showa Denko adopted for "Regional circulation type hydrogen local production for local consumption model proofing project", and conducting the project of refining hydrogen suitable for FCV, and providing through pipeline to coastal region for 5 years until March, 2020. In this time, supplying hydrogen to Shinsuna Hydrogen Station operated by Tomoe trading. With used plastic as raw material for producing hydrogen, reducing consumption of fossil

fuel, and CO₂ occurred during production process recycled to dry ice, by-product can be used as resources. (Daily Automotive News, August 30, 2017)

—Reported from Aug. 12 to Sept. 15, 2017—

Greetings:

“The Latest News” which was arranged from newspapers related with fuel cell, energy and environment in Japan by Dr. Takuya Homma (Executive Director of FCDIC, Professor Emeritus, Tsukuba University) was started to be published at the website in 1996 in Japanese and the English version was started in 2001.

We decided to close the publication of the Latest News based on the situation that it has been easier to get information by internet. We will start to publish “FCDIC News” next year.

Thank you for using our service for a long time.