

Difference in FCV Business Plan between Toyota and Honda

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1. Governmental Measures

(1) MLIT

The Ministry of Land, Infrastructure, Transport and Tourism, MLIT, has decided to support busses and taxis in a subsidy scheme of the “Green Community Transport Project”. The project will subsidize the purchase of 12 fuel cell vehicles (FCVs) in total for eight taxi operators including Kokusai Motorcars in Minato-ku of Tokyo and Hinomaru Kotsu in Bunkyo-ku of Tokyo, and also four plug-in hybrid vehicles, PHVs, for two taxi operators including Orient Transport Service in Ube City, Yamaguchi Prefecture. Furthermore, Northern Iwate Transportation in Sendai City will be supported for the purchase of a plug-in hybrid bus. (Nikkan Jidosha Shimbun, October 5, 2015)

MLIT will investigate a model system to produce hydrogen from sewage sludge. A new commission will be launched to study technologies and feasibility, and will compile a report to be a reference for local governments. It is said that unused methane gas from sewage treatment works is estimated to be an equivalent of approximately 2.6 million FCVs. The ministry plans to encourage local governments to produce hydrogen and to cooperate widely. The first meeting of the “Investigative Commission for Sewage Resource Use for Hydrogen Society” will be held on October 22nd to start discussion. This commission has Toyota Motor and Honda as its members as well as experts and local governments. Discussions will take place on technology and regulations as well as feasibility issues, and the results will be compiled in a report in 2015. The commission plans to make guidelines at the same time. The ministry is already testing hydrogen production technology under the Breakthrough by Dynamic Approach in Sewage High Technology Project, B-DASH Project, in collaboration with Fukuoka Prefecture. In this project, a membrane

separator removes methane gas from biogas derived from sewage sludge fermentation. Then high-purity hydrogen is produced from methane gas by reforming. The daily production capacity is an equivalent of 60 FCVs. For this project, the ministry will evaluate the technology, regulations for the system and feasibility issues using a number of sewage treatment works in Aomori and Saitama and Kanagawa Prefectures, which are members of the commission, as a model, and will report actions and referential cases. (Nikkan Jidosha Shimbun, October 19, 2015)

(2) METI

The Ministry of Economy, Trade and Industry, METI, will start two new projects to prepare infrastructure required for hydrogen energy society in FY2016. The projects will focus on the preparation of hydrogen refueling stations in four urban areas and areas around major roads for growth and expansion of the facility. The ministry is aiming at 100 locations of hydrogen refueling station by the end of this financial year, although this target does not seem to be achievable. Because of this, the ministry will subsidize the costs to meet the goal in the next financial year. The sales of home fuel cells are targeted at 1.4 million units by 2020, and the support will also go towards the products for the market to be fully developed. Despite the target for hydrogen refueling stations in 100 locations by the end of this financial year, the number of hydrogen refueling stations built and planned is still at 81 locations. For FY2016 budget, ¥6.2 billion has been requested to achieve this goal. On the other hand, the “Ene-Farm Purchase Subsidy” provides consumers with financial support to create for market growth and the establishment of a fully-fledged market. The sale of the FCs for established houses is specifically slow, and the ministry will promote the product in this area. This

scheme subsidizes purchasers or lease providers of Ene-Farm with prices including purchase and installation costs, lower than the governmental standard. The support is a quarter of the difference between the actual equipment and installation costs and governmental target price. The government plans to reduce the current price of ¥1.4 million by setting standard and target prices. Both polymer electrolyte fuel cell, PEFC, and solid oxide fuel cell, SOFC, are supported in the scheme, but the support will be higher for SOFC of which commercialization is two years behind the PEFC. For FY2016, 17 billion was requested. Ene-Farm's commercial sales started in 2009, and over 0.14 million units are currently used. Japan targets at 1.4 million units by FY2020, and will provide more persuasive support. (The Chemical Daily, October 21, 2015)

(3) NEDO

The New Energy and Industrial Technology Development Organization, NEDO, has started a project of technological development on a system to transport hydrogen produced overseas in order to generate power in Japan. Projects to demonstrate hydrogen production to use in a community have been launched in Hokkaido and Kanagawa Prefecture. However, this one is the first "hydrogen supply chain" connecting overseas. NEDO aims to test the supply chain in 2020. (The Nikkan Kogyo Shimbun, October 26, 2015)

2. FC Element Technology Development & Business Plans

(1) Okayama University & the University of Tokyo

A study group of Okayama University and the University of Tokyo has mapped the genome of an actinomycete which produces sinefungin, a nucleoside antibiotic. This research sequenced genome 8.9 ×10⁶ base pairs long. Although sinefungin is a lead compound for drug development showing effective reactions which are not found in common antibiotics, the microbe produces this compound in extremely small amount. This genome sequencing is expected to contribute to developing strains for better nucleoside antibiotics production. This research also found selenium containing formate dehydrogenase in the actinomycete which is useful for microbial fuel cells, MFCs. Sinefungin has antiviral, antimalarial and

anticandidal effects. However, this strain is hard to cultivate by common breeding methods, which is preventing its commercialization. On the other hand, selenium containing formate dehydrogenase is expected to be an enzyme for the cathode of MFC. Research on an enzyme oxidizing hydrogen for MFCs has been progressed, but not on enzymes for cathodes. (The Chemical Daily, September 29, 2015)

(2) Atsumitec

Atsumitec which produces and sells engine mechanical parts in Hamamatsu City, will strengthen development of a power generation system using exhaust gas and heat. SOFCs and thermoelectric conversion element are combined to achieve better generation efficiency. An experimental product using unused fuel in exhaust gas succeeded generating a performance of over 1 W/cm³. The product was installed in the exhaust of a motorbike as a test, and showed that it was capable to supply lighting with power. The firm will explore the possibility to apply the system to plants as well as automobiles while optimizing the materials of the system. This system produces power with originally developed tubular SOFCs using hydrogen, unused components of fuel in exhaust gas. At the same time, thermoelectric conversion element collects electricity from heat of exhaust gas and the FCs. The firm focuses on the development of a new generator for effective use of heat from car and unused fuel. (The Chemical Daily, September 30, 2015)

(3) Mitsubishi Hitachi Power Systems

On September 30th, Mitsubishi Hitachi Power Systems, MHPS, announced that its FC combined generation and control system "DIASYS Netmation 4S" were given a Good Design Award for 2015 hosted by Japan Institute of Design Promotion. The product visualizes its innovation while high reliability and safety are pursued, which persuaded the panel. FC combined generation system is a combination of SOFC and micro turbines to achieve highly efficient generation and significant reduction in CO₂ emissions. The MHPS aims the new system to be able to replace large-scale thermal power plants. DIASYS Netmation 4S is a distributed control system to maximize performance of plants and to fulfill high reliability and operation rate. Complying with IEC 61508 (2010) (SIL3) international functional safety standards, the

product monitors rocket launching facilities, liquefied natural gas tankers, factories and office buildings as well as thermal and geothermal power stations. (The Denki Shimbun, October 1, 2015)

(4) The University of Electro- Communications

A study group led by the Innovation Research Center for Fuel Cells of the University of Electro- Communications has developed a highly functional and durable catalyst for cathodes of PEFCs. Tin dioxide particles are bonded on surfaces of platinum cobalt nano particles to control the surface structure and electronic state at the same time. The reaction occurs at the interface as well as platinum surfaces. The catalyst exhibits five to eight times more catalytic reaction in mass than conventional platinum catalysts, and over double of that of platinum cobalt catalysts. Also, test results hardly show particle growth or destruction of surface structure which are factors of performance degradation. The developed catalyst uses carbon to support platinum cobalt particles of 5.7 nm diameter. On the surfaces, a shrunken lattice of platinum skin layer and small tin dioxide particles of 0.8 to 1.3 nm are bonded. The platinum skin layer on the platinum cobalt particles has asperities at an atomic level, which doubles the area of platinum surface for catalytic reactions. The catalytic reaction on the platinum skin bonded to tin dioxide particles improved to eight times of that of the platinum skin of common catalysts. One part of tin to nine to 11 parts of platinum works the best. Durability is also improved by this structure. A structural analysis was carried out using an X-ray absorption fine structure, XAFS, beam line installed by the University of Electro- Communications and NEDO at SPring-8. The catalyst showed minimal changes in surface structure and electron state by potential fluctuation which are signs of catalyst degradation. Additionally, the group ensured that the catalytic reaction remained at nearly the initial state after 10,000 time voltage load test. (The Chemical Daily, October 23, 2015; Dempa Shimbun, October 26, 2015)

3. Hydrogen Infrastructure Technology Development & Business Plans

(1) Iwatani

On October 6th, Iwatani announced that ¥30 billion would be raised by issuing a Euro-denominated bond

with stock acquisition rights, also known as a convertible bond, CB. This is a zero-coupon bond which gives no interests, and the due date for payment in is October 22nd in Greenwich Mean Time. The bond becomes due in 2020, and will finance facility preparation and acquisition related to hydrogen. The fund will support ¥13 billion for hydrogen business to strengthen liquid hydrogen production facilities, ¥11 billion for total energy business including cassette canister production of liquefied petroleum gas, LPG, and ¥6 billion to fortify industrial and gas machinery businesses including transporting containers for helium gas. Because hydrogen business is a long-term investment which takes time to become profitable, the firm decided to issue CB for the investment rather than borrowing from banks. (The Nikkei, October 7, 2015)

(2) Toshiba

On October 7th, Toshiba announced that a hotel to be opened in Huis Ten Bosch in Sasebo City, Nagasaki Prefecture, had placed an order for an independent energy supply system using hydrogen “H₂One™”. The order price has not been revealed. This system generates power with solar panels during the summer when the sun stays out longer, and the excess power is used to produce hydrogen to be stored in a tank. In winter, electricity is generated by FCs using hydrogen from the tank. The system is expected to supply one building of the hotel with electricity all year around. The purchaser is Huis Ten Bosch. This system uses hydrogen storage alloy which can store hydrogen at a high concentration for the storage tank. This allows reduction in the storage tank size which came down to a tenth of that of existing systems. By this downsizing, the system can be installed at a limited area. The firm started the sales of the product in April, and is selling the product as a locally produced hydrogen usage solution in a form of business continuity planning, remote-island and business models as well as a resort model. A demonstration test of this system is in progress in cooperation with Kawasaki City. Toshiba targets at ¥100 billion sales in the hydrogen business by FY2020. (The Denki Shimbun, October 8, 2015)

4. Ene-Farm Related FC Business Plans

(1) Tokyo Gas

On September 28th, Tokyo Gas announced that it

would develop a system for a large-scale redevelopment in the Shibaura area, Tokyo, to share energy with adjacent area. The system will use information and communication technology, ICT, to supply and control heat and electricity efficiently to facilities in the redevelopment area. Heat and electricity will be shared between the adjacent area installed with a similar system which can work together with the other system. This is the first project that energy management systems are to operate together in Japan, and the operation will start in 2018. This project is a part of the redevelopment in Shibaura area in cooperation with Mitsui Fudosan and Mitsubishi Estate Company starting in October. The system to control and optimize energy supply will be developed for the area, and will work together with the control system installed in the adjacent area by Tokyo Gas. As well as supplying both areas with heat for efficiency, the systems are to share electricity during emergencies such as power cuts. The power source is gas cogeneration, photovoltaic generation system and FCs. Including the energy sharing effect, this project targets at a 45% reduction in CO₂ emissions from both areas combined of that of FY1990. (The Nikkan Kogyo Shimbun & The Denki Shimbun, September 29, 2015)

(2) Shizuoka Gas

On September 29th, Shizuoka Gas, Toray Construction (Osaka City) and Nagaizumi-cho (Shizuoka Prefecture) have signed a trilateral partnership for environmentally friendly town planning for Nagaizumi-cho. Shizuoka Gas and Toray Construction developed an “electricity sharing system of Ene-Farm in an apartment building”, and the system will be used to reduce CO₂ emissions. The participants of this project plan to find a way to effectively use the reduced amount of CO₂ through the governmental “J-Credit scheme”. Shizuoka Gas and Toray Construction have been working on the “Nagaizumi Eco Life Town Project” since January 2014. “T-Grid System” was developed with cooperation of these two firms to combine electricity from the power supplier in a single contract and Ene-Farm to share among all the apartment units. This product contributes to reduction in power purchase from the grid and CO₂ emissions. The three parties will launch a liaison investigative commission

for community development in environmentally friendly town planning. The objectives are 1) reduction in environmental impacts and usage promotion of benefit from the reduction, 2) promotion of advanced energy use, 3) promotion of community energy resource and 4) community establishment and vitalization. (The Denki Shimbun, September 29, 2015)

(3) Toshiba FC Power Systems

On October 15th, Toshiba Fuel Cell Power Systems, Yokohama City, announced that the first natural gas Ene-Farm for apartment units was delivered for Yamaguchi Gohdoh Gas. Including this first delivery of 24 units, a total of 54 units will be delivered to be installed at all the units of “Arden Kamihara IBUKI”, an apartment house being built by Akamatsu Kosan Kensetsu in Ube City by January 2016. This is the first delivery of products for apartment units for Toshiba FC systems. The firm started the commercial sales of Ene-Farms for houses in 2009, and has brought out products with new functions leading the industry. A total of 69,000 units were delivered from them. Also, they have worked on the system for apartment units. This product for apartment units is compact, so that it fits in an area of 1.2 m². The features are 95% total efficiency, the world’s highest level, which was achieved with the product for houses, the best durability in the industry of 80,000 hour operation and an independent operation function, the first in the industry, which allows continuing the operation during power cuts. (The Denki Shimbun, October 16, 2015)

5. Cutting Edge Technologies of FCVs & EVs

(1) Renault

On September 28th, French-based auto giant Renault announced that EV would be produced in China in cooperation of Chinese automaker Dongfeng Motor from 2017. According to Renault, the EV is to use electric four-door sedan Renault Fluence as its base, and will be sold in the Chinese market under the Dongfeng brand. The actual production capacity has not been revealed. In 2013, the French automaker signed for the venture with Dongfeng to enter the Chinese market. A plant is under construction in Wuhan, Hubei, to start a production of a small sports utility vehicle, SUV, from 2016. The firms plan to

produce the EV from 2017. (The Nikkei, September 29, 2015)

(2) China

On September 29th, the State Council of China, the central government, held General Office (chairperson: Premier Li Keqiang). “New energy cars with less environmental impact such as FCV should not be restricted to be purchased or drive in cities. Also the current restriction should be removed for these cars” said the chair. In China, some cities limit car purchase as an air pollution measure. However, he clearly showed the governmental intention to remove new energy cars from the restriction and promote the use of them. (The Nikkei, September 30, 2015)

(3) Honda

Honda will sell its first commercial FCV from March, 2016. The driving range is over 700 km, which is greater than “MIRAI” brought out by Toyota Motor last year. Honda’s full entry to the market will drive the competition further. This will encourage vitalizing the market of next generation eco cars including infrastructure. The FCV will be introduced to the public at Tokyo Motor Show 2015 to be open at the end of October. On September 30th, the automaker unveiled the outline of this new commercial FCV. It takes about three minutes to fully fill the new FCV with hydrogen. The vehicle outruns MIRAI of which the driving range is 650 km by over 50 km. Boasting its roomy inside, the car has five seats which is more than of that of MIRAI. The power unit including the FC generation system is made small to be stored under the hood. Primary version of the FCV has been leased in Japan and the US since 2008, and the product name of “Clarity” is expected to be passed on to the new product. The price is likely to be at a ¥7 million level, which would compete with MIRAI. It seems that Toyota received orders for 3,000 vehicles of MIRAI by the end of August. Deloitte Tohmatsu Consulting, Tokyo, estimates the FCV market to reach a 50,000 vehicle level by 2020. As well as infrastructure such as hydrogen refueling stations, FCVs can widely affect industries such as material producers. The consulting firm evaluates a ¥770 billion of economic ripple effect for 2020. (The Nikkei & Nikkan Jidosha Shimbun, October 1, 2015; The Denki Shimbun, October 2, 2015)

Honda and US-based GM are considering an

expansion of their partnership. As well as the joint development of FCV currently in progress, they are seeking development of new technology. The industry has been keen on development of environmental and safety technologies, and is becoming more competitive. In this circumstance, these two automakers are likely to get closer. “The cooperation between GM is going very well, and we are talking about expanding the area of technological collaboration” said one of Honda’s executives. They say that “nothing has been decided at this moment, but they will investigate areas which fit the current demand”. The scope is most likely to be environment and safety technology which is the center of competition in the industry. (The Nikkan Kogyo Shimbun, October 5, 2015)

On October 7th, Honda revealed its commercial version inverter to supply external appliances with electricity from a FCV. This product will be available nationwide by the end of March, 2016. The maximum output is 9 kVA which is large, and can supply three average households. The product has improved its connection compatibility with cars made by other automakers. The advantages are no exhaust gas emission, very little noise and vibration and ease of use during disasters. Also, the product is expected to be used for outdoor leisure. Named “Power Exporter 9000”, it was brought to CEATEC Japan 2015, an IT and electronics exhibition. There were no standards set for inverters using hybrid vehicles, HVs, and EVs. However, this model complies with the guidelines of the Electric Vehicle Power Supply System Association, EVPOSSA, and is planned to be able to connect to FCVs produced by other automakers. Honda will start selling commercial FCVs in March, 2016. The inverter can supply power to an average household for seven days when connected to the FCV with a full tank of hydrogen. Although power output is large, the inverter of about 52 kg weight can fit in a boot. There are six 100 V and one 200 V sockets. The automaker produces 420,000 generators each year. The technologies of the generators are used to reduce the noise of the inverter. The inverter was tested in cooperation with Tottori University Hospital. “X-ray machine and oxygen suppliers were operated in the joint experiment, and the inverter supplied good quality power” said Prof. Masaru Ueki at the Tottori University Hospital. The price and sales plan will be

revealed at Tokyo Motor Show to be held at the end of October. (The Nikkei Business Daily, October 8, 2015)

(4) Tesla

On September 29th, US-based EV manufacturer Tesla Motors started delivery of a new electric SUV “Model X”. This is the third product after a roadster and a sedan. To accommodate this product range expansion, the firm has increased the production capacity by launching a second plant in the Netherlands in Europe. Their worldwide production capacity is getting ready for 100,000 vehicles each year. (The Nikkei, October 1, 2015)

(5) GM

On October 1st, US-based GM revealed its mid-term business plan with car development using next generation technology. The plan includes the introduction of a “Cadillac” which drives autonomously on highways into the US and Chinese markets by 2017 and the test of an automatic driving system for urban travel. FCVs jointly developed with Honda are to be commercialized by 2020. (The Nikkei, October 2, 2015)

(6) LG Chem

LG Chem announced that an agreement for an EV battery supply had been signed with Chery Automobile. The first delivery is planned as early as this year. A few ₩ 100 billion (a few ¥10 billion) sales are expected. (The Nikkei, October 2, 2015)

(7) Nissan

On October 5th, Nissan Motor announced its exhibition vehicles for the Tokyo Motor Show to be held at the end of October. The world’s first concept EV of Kei class, less than 660 cc engines, and a small SUV concept will be introduced for the first time in Japan. Also, their automatic driving function and advanced safety technology will be shown. The firm is developing Kei class electric concept car TEATRO for DAYZ, and targets young people who will newly get their drivers’ license from 2020 for the product. The body and interior is all white, and can be changed as users want. Gripz Concept, a small SUV, uses the same motor as Nissan EV “LEAF” and a new system to run on electricity produced from the engine. The product is designed by Japanese and European designers together. (The Nikkei, October 6, 2015)

On October 20th, Nissan revealed that its EV sales ratio was to be raised to 10 % of the total sales in

Japan by FY2020. For infrastructure preparation, 2,000 units of EV chargers will be installed at its plants and car parks of their sales bases by the end of March 2016. (The Nikkei, October 21, 2015)

On October 23rd, Nissan unveiled a test car for automatic driving on public roads. The test car uses EV “LEAF” as its base and a prototype of a highly performing laser scanner to accurately measure the distance between the car and surrounding objects. This allows the vehicle to do complicated operations such as turning at junctions and stopping at red lights during automatic driving. A test on public roads will be carried out in Japan and abroad for commercialization by 2020. (The Nikkei, October 24, 2015)

(8) Toyota

By October 8th, major automakers revealed their key products for Tokyo Motor Show to be held at the end of October. Toyota will bring out a FCV concept which can generate power when it is parked. Including “FCV Plus” concept, three vehicles will make their world debut. As well as functioning as a generator during parking, FCV Plus can feed its power to the grid in community. Even after the car has passed its time, the FCs can be removed and used as a generator. Toyota started the world’s first commercial FCV sales in 2014. “This time, our aim is to show the extent for hydrogen society” a Toyota’s officer said. (The Nikkei, October 9, 2015)

On October 22nd, Toyota Motor revealed a power generation system which uses a PHV, Prius, rechargeable at home to supply power during emergencies, at the industrial estate in Ohira-mura, Miyagi Prefecture. This system allows satellite phones and PCs to be used as an initial response using the generation function of the Prius and its storage battery. Excess power can be sent to the village office through the grid of Tohoku Electric Power. The industrial estate has businesses from the Toyota groups and outside the group such as Toyota Motor East Japan, Toyota Boshoku Tohoku and Skylark. This project is used during a large-scale disaster which has shut down the power grid. Employees of the industrial estate will connect photovoltaic generators and storage battery systems to power facilities of the disaster control headquarters. Toyota’s system supplies PCs, satellite phones and video

conference equipment with power for about 10 hours. During the initial response, gas supply will be sought for independent gas engine generation. (The Nikkei, October 23, 2015)

Toyota Motor has started to consider sales of a FCV version of its luxury brand Lexus. The sales launch is aimed at 2020 when Tokyo Olympics are to be held. Lexus boasts its high environmental performance, and plans to raise the brand value by adding a FCV, the most advanced technology, to the range. Toyota has told its parts suppliers the monthly production of next generation cars is planned to be increased to 3,000 aiming to sell over 30,000 FCVs each year by 2020. Toyota's FCV is currently sold at their 1,900 dealers, and Lexus dealers will join in to accelerate the sales. Toyota has started developing a successor of "MIRAI" which is the world's first commercial FCV introduced into the market in 2014. The core components will be developed to be shared between both brands for easy production at a low cost. A FCV version is most likely to be added to the range of large sedan "LS" under the Lexus brand. The price of MIRAI is approximately ¥7.2 million. Lexus LS is from ¥8.5 million, but the FCV price has not been set. Lexus has wealthy users, and appeals to environmentally conscious consumers. The successor will use a FC stack with reduced platinum, and will allow increasing the production by speeding up the process to prevent hydrogen leakage. (The Nikkei, October 23, 2015)

(9) Hino Motors

On October 8th, Hino Motors announced that its FC bus concept "Fuel Cell Bus" would make its world debut at the 44th Tokyo Motor Show to be open to the public from 30th. The bus emits no CO₂ during driving, and this highly environmentally-friendly performance will be introduced at the event. FC buses running on hydrogen can supply external devices with power, and is expected to contribute to hydrogen society to be realized in the future as a transport measure. The automaker will also propose a transport system for next generation buses using the FC bus. Using a hybrid technology "Profia", a large truck, will show an improved fuel efficiency to be used for electric refrigeration systems when not driving. Also, the automaker will introduce advanced environmental and safety technologies in a small truck "Hino Dutro

Hybrid" which is installed with a brake to reduce crash impacts. (The Nikkan Kogyo Shimbun, October 9, 2015)

(10) Mitsubishi Motors

Mitsubishi Motors will display a new EV at the Tokyo Motor Show. The electric SUV "Mitsubishi eX Concept" is installed with a motor to drive both at the front and rear, and achieves 400 km driving range on a single charge with a high performance battery. (The Nikkei, October 9, 2015)

(11) Mitsubishi Rayon

A member of Mitsubishi Chemical Holdings, Mitsubishi Rayon, will construct a plant to produce an intermediate material of carbon fiber in Bavaria, Germany, where a subsidiary of Mitsubishi Rayon is located. The material is suitable for molding parts for automobiles, and the annual production capacity of the plant is expected to be 6,000 tons. With investment between ¥0.5 to 1 billion, the plant will operate from September 2016. The new plant will produce a sheet molding compound, SMC, which is an intermediate material of carbon-fiber reinforced plastic, CFRP. This material is well suited to form automobile parts of complicated three dimensional shapes, and also for large scale production. Currently, Toyohashi Production Center of Mitsubishi Rayon produces 3,000 tons each year. The carbon fiber is expanding its industrial application to air planes and wind turbines. Also, carbon fiber use is expanding to improve fuel efficiency by cutting down weight in the automobile area, mainly in luxury ranges. Mitsubishi Rayon supplies the carbon material for EV "i3" of German-based auto giant BMW. Carbon fiber is a quarter of the weight of steel to make lightweight and shows over 10 times the strength. Previously, the product is mainly used for bodywork, but is expected to be used for structural parts to contribute to a reduction in weight. The firm will accommodate the rising demand of the intermediate material for structural parts by producing it in Germany.

(12) VW

Having had the diesel car emission fraud, the largest European automaker VW will shift its eco car strategy. The core of their eco cars was previously diesel, but they will now move on to development of EVs. The reason is that their investment is unavoidably narrowed down as well as their

worsening sales and the image of diesel cars. VW did not put much weight on EVs, but its strategy change could lead to a new strategic partnership for technological development and scale benefit. This may have an effect on competitors and component manufacturers. The automaker will develop a new platform exclusively for small EVs. This is planned to be shared among the models of the group members such as luxury brand Audi and popular brand Skoda and is expected to be able to 250 to 500 km solely on battery. The same core components such as motor and storage battery will be used in these EVs to reduce the development and production costs. Also, the firm will focus on development of PHV. On October 13th, German newspaper Handelsblatt reported that the firm planned to reduce expenses by approximately €3 billion by requesting cost cuts to component manufacturers. VW's investment will preferentially go to research and development of EVs. The firm has EV and PHV versions of its key small car "Golf", but the sales take a small share in the whole group. Progressing the product development, Audi plans to bring out an SUV to drive 500 km on a single charge by 2018. Since European countries, their main market, are tightening up environmental regulations, the firm is clearly trying to move from diesel cars to EVs. Being still pricy, EVs are struggling to expand their market, and largely rely on governmental subsidies. (The Nikkei, October 14, 2015)

(13) BYD

Chinese major automaker BYD has started operation of a new plant for electric buses in Guangzhou, Guangdong, in cooperation with Dongfeng Automobile Group. The city already posted order for 400 vehicles, and both firms aim for fully developing the market for electric busses. (The Nikkei, October 17, 2015)

(14) Ford Motors

US-based major automaker Ford Motors will spend 11.4 billion CNY (about ¥210 billion) over five years in China. The investment will accelerate in PHV and EV development to bring out new cars targeting the Chinese market. (The Nikkei, October 21, 2015)

(15) ABB & MS

On October 20th, Swiss engineering firm ABB and US-based Microsoft, MS, announced their partnership for charging service for EVs. ABB's quick chargers will

be managed using MS's cloud service Azur. As EVs getting bigger, the two firms will make charging spots are to use more IT in order to flexibly accommodate electricity demand and use in the operation. (The Nikkei, October 21, 2015)

(16) Eliiy Power

Eliiy Power, Tokyo, capitalized by Daiwa House Industry has developed lithium-ion battery, LIB, which can be recharged at six times the speed of common products. The LIB can work in a cold climate of -30°C, and the firm targets the product to be used for industrial vehicles, robots and HVs. The production will start by March, 2016. This "high rate battery" can be fully charged in 10 minutes. A material with high current density is used for the anode, which enable it to reduce the charging time to sixth of that of existing products for home use sold by the firm. The battery is useful for vehicles such as forklifts and HVs which require a short recharging time. (The Nikkei, October 22, 2015)

(17) Fuji Heavy Industries

Fuji Heavy Industries will add PHV to SUV "XV", and PHV will be the first rechargeable product at home for the firm. Their Gunma Main Plant, Ota City, plans to start production in the autumn of 2017 to introduce the PHV into the US which is their main market. The firm tries to accommodate tightening environmental regulations in the states. In 2013, XV HV was brought into the Japanese and US markets. PHV version will be developed using a system of Toyota Motor which is the largest shareholder of the firm as its base. The Zero Emission Vehicle regulations will be made strict in the states including California which takes a large part of the market in 2018. HVs are exempt from the regulations, and automakers have to sell a certain proportion of PHVs, EVs and FCVs. Otherwise, they will be fined. (The Nikkei, October 25, 2015)

6. FCV Component Development & Business Plans

(1) NGK Spark Plug

NGK Spark Plug will commercialize a hydrogen leak sensor for FCVs. Their Komaki Plant, Aichi Prefecture, has prepared a commercial production line for this product. Hydrogen has no smell or color, and the sensor detects slight temperature change when hydrogen leaks to prevent catching fire. Honda is

developing FCV following Toyota Motor, and NGK estimates the market for related parts to expand. This product characteristically does not use catalyst, and operates at temperatures from 100 to -30 °C. The reason is that the product has to accommodate FCV operation from very cold to very hot climates. Low concentrations of 0.2 to 2% hydrogen are detected with very small error. (The Nikkei, October 10, 2015)

(2) Keihin Corporation, Yachiyo Industry & Aisan Industry

Automobile parts manufacturers will expand development and production for FCVs. Keihin Corporation, manufacturer of automobile engine parts affiliated with Honda, has installed a production facility for FCV parts capitalizing its plant in Miyagi prefecture with a few hundred million yen. The plant will produce a total of 16 to 17 parts including controllers of hydrogen gas and motors to supply Honda for FCV production. Starting with Honda, Keihin will approach manufacturers which are developing FCVs in Europe and the US.

Yachiyo Industry aims for commercial production of hydrogen tanks by 2020. Producing fuel tanks, the firm started the development of hydrogen tanks for FCVs. A test product is planned to be certified by 2018 to be produced on a commercial scale by 2020.

Producing fuel injectors and pumps, Aisan Industry aims to expand sales for the next generation of Toyota's FCVs. Currently their hydrogen supply parts including injectors controlling hydrogen pressure and flow are used in FCs for Toyota's FCV "MIRAI" introduced at the end of 2014. The firm will try to sell parts for oxygen supply and cooling system using its gas controlling technologies.

Currently Toyota MIRAI is the only commercial FCV available in the market. However, Honda's FCV is planned to be introduced into the market in March 2016, and Nissan and German-based Daimler are also trying to do it by 2017. Honda and GM are jointly developing core components for next generation FCV to be commercialized by 2020. (The Nikkei, October 20, 2015)

7. Hydrogen Station Related Technology Development & Business Plan

(1) Bridgestone

On September 29th, Bridgestone announced a hose

for hydrogen dispenser to withstand 82 MPa pressure. The product is expected to be used for a hydrogen refueling stations. Currently the maximum pressure for dispensing hydrogen at refueling stations is set at 70 MPa. However, the government may revise the maximum pressure to 82 MPa, and the hose is designed for the higher pressure. High tensile steel wire is used for the reinforced layer in the inside of the hose, and this reinforced layer has six layers to withstand the high pressure. The burst pressure is over 410 MPa, five times of that of the operating pressure. The firm estimates this product can fit to the standards even if the operating pressure increased from 82 MPa in the future. The inner layer of the hose is made of resin that hydrogen does not easily permeate. The permeation rate is held down to 50 mL·m per hour. The hose is sufficiently flexible to be able to be bent by hand for easy dispensing operation. A higher dispensing pressure supplies more hydrogen in a shorter time. The firm estimates hydrogen refueling stations at 3,000 locations by 2030 and 15,000 locations by 2050. One dispenser commonly uses one or two dispensing hoses, and the firm expects high demand. (The Nikkan Kogyo Shimbun & The Nikkei Business Daily, September 30, 2015)

(2) Takaishi Industry

Takaishi Industry, rubber packing manufacturer in Ibaraki City, Osaka Prefecture, will try to sell O-rings for hydrogen refueling stations. Their plan is to propose and supply O-rings suitable for each device to constitute a hydrogen refueling station. The firm wants to supply fluoro-rubber (FKM) O-ring for hydrogen compressors and ethylene-propylene rubber (EPDM) for dispensers. Suitable O-rings for operation environments will be suggested to boost the presence of the firm in the growing market. A hydrogen compressor compresses produced hydrogen, and is required to withstand 150°C temperature. FKM can accommodate pressures up to 90 MPa to ensure safety. Also, EPDM can be used at -40 °C, and the manufacturer wants to supply this product for dispensers to fill FCVs with hydrogen. In a test, the product proved its safety performance with no hydrogen leak after 430 pressure cycles from 0 to 90 MPa in an actual device. The same material will be targeted for O-rings for the emergency detaching coupler of dispenser. The manufacturer will propose

more hydrogen resistant rubber materials suitable for operation environments of each instrument. Evaluation data will be used to prove the quality to expand sales. (The Chemical Daily, October 13, 2015)

(3) Nippon Seisen

Nippon Seisen, Osaka City, has received the first order for stainless wire for the springs of hydrogen refueling stations. This product shows better strength and spring properties than conventional stainless steel SUS304. The purchaser has not been revealed. Test products have been supplied since 2009. The price is set at 2.5 times of that of SUS304. The manufacturer aims for annual orders of 50 to 60 tons by FY2025. Austenite stainless wire “Hybrem” for springs is suitable in instruments used under high pressure hydrogen environment. The material reliability was improved for hydrogen environment by controlling very small quantity of additive elements such as carbon and nitrogen to prevent the crystalline structure changing after cold forming. In tensile testing at a slow strain rate under a high pressure hydrogen environment, SUS304 loses 64% of its ductility which shows brittleness compared to under normal atmospheric pressure. On the other hand, Hybrem only loses 3%. Opening with the first order, the manufacturer will try to sell the product for hydrogen dispensers for controlling flow, valves and FCVs. (The Nikkan Kogyo Shimibun & Japan Metal Daily, October 15, 2015)

— This edition is made up as of October 26, 2015 —

A POSTER COLUMN

Toyota to Stop Engine-Car Sales

On October 14th, Toyota Motor revealed a long-term target to almost stop sales of cars solely driven by engines by 2050. The ratio of HV and FCV is planned to be increased to reduce CO₂ emissions of new cars during driving by 90% of that of 2010. The center of competitive development may make a shift from engines to “electric technology” such as battery and control software, which would affect the industrial structure.

Having set a five-year environmental plan, Toyota has worked on promoting HV. On 14th, a new plan for the term ending March 2021, and “Toyota Environmental Challenge 2050” was revealed as a

long-term target for 2050 for the first time. In the long-term target, the automaker intends to reduce CO₂ emissions of their new cars by 90%. The CO₂ emissions during the production of each car will be gradually reduced aiming at zero. Working on further energy-saving, their plants will use renewable energy such as wind turbines and hydrogen.

“Making cars with only engines is not good enough to survive the competition. However, the disappearance of cars solely using engines is extraordinary for automakers.” Mr. Kiyotaka Ise, a Senior Managing Officer, said at a press conference. Toyota aims to shift all its sales to FCV, HV, PHV or EV by 2050 worldwide.

To hit the target, sales of FCV and HV will be expanded in the sales, which is the core for the five-year plan. Toyota released “MIRAI” in December 2014, and has gradually increased the production. By 2017, the production is planned to be brought to an annual level of 3,000 vehicles. Additionally, the sales target has jumped annually to 30,000 sales which is 10 times the production. The domestic sales are set at 1,000 vehicles each month which is the same level as Nissan’s EV “LEAF”. Toyota can use technologies such as control software gained from HVs to a wide range of products such as FCV and EV.

“FCVs do not emit CO₂, and can drive long distances. The refueling time is a similar level as gasoline cars” said Mr. Ise at the press conference on 14th. He also showed the prospect that the FCV is most likely to be the eco car. Honda and US-based GM also plan to sell FCVs. However, the problem for full market growth of FCV is hydrogen filling facilities. Installation of hydrogen refueling stations cost about ¥500 million, five times of that of a gasoline one.

EV also has an issue. Nissan will release a new model of “LEAF” in December. The EV can drive 280 km, 20% greater than that of previous one, on a single charge. However, the driving range is nowhere near that of gasoline cars. The sales are also unevenly spread across to the areas some of which set strict environmental regulations such as California. Automakers are working on improving batteries, and making progress. The Toyota’s executive pointed out that a technology to reduce recharging time was not likely to be established soon. (The Nikkei, October 15, 2015)

Honda's Eco Cars to Same Share Platform

Honda will use the same platform for FCV, EV and PHV. Their first FCV will be introduced to the Japanese market in the spring of 2016, and the platform of FCV will be used for development of EV and PHV in order to release these in Japan, US and Europe by 2018. The automaker aims to shorten the development period and reduce price by using common platforms and a large amount of parts.

The power unit of the commercial FCV to be released in next March is small to enable it stored in the front of the car. The driving range is 700 km on a full tank, which is 50 km longer than that of Toyota's MIRAI. The price is expected to be ¥7.66 million.

These three eco cars will be produced on a small-scale in Automobile R&D Center of Honda R&D, and the full-scale production is planned to move to Sayama Automobile Plant, the core production center, by FY2018. Their plan is set an annual 400 FCVs to start with, and about 1,500 FCVs by 2020. The target for EV and PHV combined is about 35,000 vehicles. The automaker plans to export 70% of the production to the US.

These three eco cars will use the same platform, with power units such as a large capacity battery for EVs and FCs for FCV being the only difference. Using a common structure allows the sharing of many parts and components, and enables the automaker to use the same production line. This gives benefits in both development and production.

Honda's FCV is expected to be ¥0.4 million higher than that of MIRAI, ¥7.23 million. MIRAI stores its power unit under the body, which requires dedicated platform for it. On the other hand, Honda will use the common platform, and this makes development of other eco cars easy. In the future, the price will be very competitive by cutting down the costs of development and production for EVs and PHVs by sharing a platform. (The Nikkei, October 24, 2015)