

## Advanced Technology Consortium for Solid State Energy Conversion Launched

Arranged by T. HOMMA

### 1. Governmental Measures

#### (1) METI

The Ministry of Economy, Trade and Industry (METI) has compiled its budget request of a total of ¥1,445.7 billion for FY2017. This is a 9.5% increase of that of the initial budget for FY2016. The budget request for the new fiscal year includes operation support for smaller businesses and promotion for next generation cars and development such as autopilot and robot technologies which are to back up the fourth industrial revolution. The ministry allocated ¥14 billion for the “Subsidy for Clean Energy Car Purchase” as a promotion of next generation cars such as fuel cell vehicles (FCVs), electric vehicles (EVs) and plug-in hybrid vehicles (PHVs). The subsidy for charging infrastructure is ¥ 2.3 billion, and ¥5.2 billion is allocated for the subsidy for installation and operation of hydrogen refueling stations. (Nikkan Jidosha Shimbun, September 1, 2016)

The Agency for Natural Resources and Energy of METI said that the renewable energy certificate market which gives a value to zero emission energy is an effective option to promote CO<sub>2</sub> emission free hydrogen which is produced using renewable power in the future, in a meeting of the “CO<sub>2</sub> Free Hydrogen Working Group” held from August 8<sup>th</sup>. The agency brought up an opinion that business “can produce and supply CO<sub>2</sub> free hydrogen, but there is no incentive for them to do unless the environmental value of the energy is added.” On the other hand, the certificates market is shrinking, and those involved think that the market needs financial support such as tax exemption to be recognized more. This opinion was also raised by the agency. They aim to commercialize the technology of “Power to Gas (P2G)” which converts renewable

power into hydrogen for energy storage and transport. The working group was launched to study economic, technological and legal issues in May under “Hydrogen/FC Strategic Committee”, and the agency plans to publish a roadmap to achieve a full-scale commercialization in the 2020’s in late January 2017. In the third meeting of the working group held last week, the current state of the renewable energy certificates market was explained, and opinions of three related businesses including Fuji Electric were introduced. Some measures in Germany are introduced there. Hydrogen is experimentally produced using renewable energy through an independent power line, and the certificate scheme is used in some cases. Having studied these projects in Germany, the agency intends to apply P2G technology to use excess electricity from photovoltaic generation in order to reduce the load to the power grid. Furthermore, produced hydrogen is expected to be used as an industrial gas and fuel for fuel cells (FCs) /FCVs. A P2G system is planned to operate for the 2020 Tokyo Olympics and Paralympics, and the agency will make an actual plan to produce hydrogen using a 10 MW level renewable energy plant in Fukushima Prefecture. (The Denki Shimbun, August 16, 2016)

#### (2) MLIT

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) will start research on the full-scale operation of hydrogen production from sewage sludge. Miyagi, Shizuoka and Nara Prefectures will carry out experimental projects to evaluate economic feasibility and environmental effect. The production and property level of sewage sludge is stable. According to MLIT, there is methane gas

produced from sewage treatments currently unused nationwide, which is fuel equivalent of 2.6 million FVCs in total. However, sewage treatment facilities are getting older, which causes a budgeting issue. The ministry encourages local governments to widen the catchment area for each sewage treatment work. At the same time, a demonstrational project is carried out to produce hydrogen from sewage sludge to supply FCVs in Fukuoka Prefecture. Taking these results into account, full-scale operation will be examined in the projects at the three prefectures. The research result will be published as a guideline for local governments as reference. (Nikkan Jidosha Shimbun, August 17, 2016)

### (3) MOE

The Ministry of the Environment (MOE) requested ¥386.7 billion, a 27.3% increase of that of the initial budget for FY2016, for the general and special accounts for energy measures combined budget bill for FY2017. They will work on more counter global warming measures such as promotion of energy saving and renewable energy, and carry out measure to use waste to realize a recycling society. For the transport field, ¥3.965 billion is requested for subsidy of low-carbon emission buses and trucks purchase as a joint project with MLIT and METI. The “Promotional Subsidy for Purchase of Advanced Environmentally-Friendly Trucks and Buses” is given ¥1 billion in the bill to support purchasers of FCVs, EVs, hybrid vehicles (HVs) and compressed natural gas vehicles. For the hydrogen area, the ministry requested for ¥9 billion for the “Hydrogen Society Promotion Project Using Renewable Energy”. (Nikkan Jidosha Shimbun, September 2, 2016)

### (4) WTO

46 countries and regions including Japan, the US and China have been discussing about abolishing or reducing import duty on environmentally-friendly products in the negotiation of the Environmental Goods Agreement (EGA) of World Trade Organization (WTO), and basically agreed on 304 items including solar panels and FCs for the list according to those involved. (The Denki Shimbun, September 2, 2016)

## 2. Local Governmental Measures

### (1) Osaka Prefecture, Osaka City & Iwatani

“H2Osaka Vision Promotional Committee”

consisting of 20 organizations including Osaka Prefecture, Osaka City and Iwatani held the first meeting to discuss strategy to promote industries by hydrogen energy in Osaka City. They revealed a plan to start scheduled operation of FC busses running on hydrogen in the Kansai International Airport as early as FY2019. The airport operator, the Kansai Electric Power Company (KEPCO) and Panasonic also participated in the meeting. Two groups were launched to study FC buses and FC ships in the committee. Having Toyota Motor and Hino Motors as its members, the FC bus study group will investigate possibility to purchase FC buses currently under development by these firms in order to operate them between the terminals in the airport. The FC ship study group will research on using FC boats for pleasure cruises on rivers in Osaka City. (The Nikkei Business Daily, August 12, 2016)

### (2) Osaka Chamber of Commerce and Industry

The Osaka Chamber of Commerce and Industry and METI Kansai will invite four hydrogen and FC related firms from the UK and Canada, and hold a conference to explain technologies in demand and to offer opportunity to have individual business meetings in Osaka City on September 5<sup>th</sup>. The conference is an open innovation method to draw technology and ideas from outside, and the goal of the conference is to encourage businesses in the Kansai area to provide demanded technology and products. The two British participants are ITM Power which manufactures hydrogen production systems and Intelligent Energy which jointly develops FCV with Suzuki. Hydrogenics a manufacturer of hydrogen production system and Tugliq Energy, a power generation operator, will join the conference from Canada. The explanation of demanded technology will start 9:30 on 5<sup>th</sup>, and consulting will take place from 13:30 both in City Plaza Osaka. (The Nikkei, August 19, 2016; The Nikkei Business Daily, August 22, 2016)

## 3. FC Element Technology Development & Business Plans

### (1) AIST

The Advanced Industrial Science and Technology (AIST) has launched the “Advanced Technology Consortium for Solid State Energy Conversion (ASEC)” which aims to develop energy conversion

devices using solid oxide as electrolyte. An agreement for joint development will be signed among businesses, universities and research institutes which develop technologies such as solid oxide fuel cell (SOFC) which operates at high temperatures for highly efficient power generation, and scenarios for actual use will be discussed. The consortium consists of 14 organizations including Osaka Gas, Tokyo Gas, Toho Gas, Hitachi Zosen and the University of Tokyo. SOFCs are used in “ENE-FARM type S” which achieves 52% power generation efficiency. To succeed full-scale use of SOFC in the future, electrode materials for solid oxide electrochemical devices and cell stack technology are need to be developed to increase current density, power output density and the speed of electrode reaction to a couple of dozen times of that of conventional one. The consortium will pick up required technological subjects that businesses currently cannot work on, and use projects of AIST to solve the issues. The organization will last until March 31<sup>st</sup>, 2021. Being a voluntary organization run by AIST, they will have operation meetings and expert committees, and will cooperate with participants for their operation. The members are businesses, universities and research institutes which study or develop solid oxide electrochemical devices. The research and development projects will be either open or closed. In a closed project, each business will carry out the development needed in cooperation with AIST. In an open project, two or more organizations will work together on development of innovative materials and cell stacks as well as technological scenarios. Furthermore, human development of businesses and universities will be considered. An open symposium will be held each year to publish their results. Additionally, they plan to hold seminars for young researchers and university students as a part of human development of the related technology area. (The Denki Shimbun, August 16, 2016)

#### (2) Toyota Tsusho

On August 18<sup>th</sup>, Toyota Tsusho announced that a sales distributor agreement was signed between Ballard Power Systems, a Canadian major FC producer in British Columbia. The trading house will try to sell manufacturer’s products for base stations of cell phones and transport equipment in Japan. They aim for annual ¥5 billion sales by 2021 with Ballard’s

products to expand their hydrogen related business for growing FCV market. Ballard Power Systems was established in 1984, and has cooperated with major German automaker VW for FCV development. The firm previously had a partnership with Ebara in Japan, but withdrew from the Japanese market by dissolving the partnership in 2009. This is the first entry to the Japanese market for them after the withdrawal in seven years ago. Toyota Tsusho will try to sell the products as an emergency power source for base stations of cell phones, and this usage is already in demand. Also, the product is planned to be sold for buses, trucks and trains. Toyota Motor, their main partner, is working hard on FC development. However, Ballard has a wider range of products which is suitable for variety of products, and these products can supplement Toyota’s product. Toyota Group has been working on this area by selling “MIRAI” from Toyota Motor from 2014 and using hydrogen as a power source. Toyota Industries, a group member, has commercialized forklift using FCs, and other members are working on more in FCV parts and components. Toyota Tsusho has experience in this area by operating hydrogen refueling stations. (The Nikkei, The Nikkan Kogyo Shimbun & The Nikkei Business Daily, August 19, 2016)

#### (3) Osaka Gas

Osaka Gas has revealed that it would start to sell business use FCs for smaller operation in FY2017. Their home FC systems sold 50 thousand units in total as of the end of March. The current range for business use is mainly large-scale applications such as office buildings and factories. The natural gas consumer market will be liberalized from April, and they plan to keep their smaller business customers such as restaurants and offices. The new product for business purpose uses the advanced technology, SOFC, which uses the chemical reaction of oxygen in air and hydrogen extracted from natural gas for power generation. Previous business FC system starts from 5 kW output, which is too much and harder for small operations such as restaurants. However, the new system’s power output will be reduced to around 3kW. Kyocera is developing the new FC, and aims for over 50% power generation efficiency. The experiment of product validation is carried out in cooperation with Osaka Gas for commercial sales to start in FY2017.

Once the consumer natural gas market becomes fully open, competition is likely to be fierce between new comers over profitable customers using more gas. The competition is expected to be especially severe over restaurants and offices which use over 400 m<sup>3</sup> of gas. Osaka Gas is considering to offer a discounted package plan for electricity and gas for customers using FC systems. They will try to stop their smaller business customers switching to new suppliers by introducing a suitable FC system. (The Nikkei, August 27, 2016)

#### (4) Hitachi Zosen

Hitachi Zosen will start validation of 20 kW output level SOFCs for industrial use in actual usage environments with external users. Because their demonstrational product achieved an average of over 50% power generation efficiency in a continuous operation for seven days, they will evaluate safety and reliability in longer continuous operations. The development of the commercial product is carried out at a faster pace for market introduction in FY2017. The demonstrational SOFC system is installed at the Chikkou Works of Hitachi Zosen in Taisho-ku, Osaka City, and operates at around 600 °C using natural gas as fuel. The manufacturer has been testing the system to achieve over 50% which is considered a high level of power generation efficiency since early May. The highest 53% efficiency was achieved in a continuous operation, which opened the door to hit the target. They will carry out a 2,000 hour continuous operation in October, and then the evaluation of 4,000 hour continuous operation at external users is planned in FY2017. Two or more experimental systems will be produced for external users in FY2016. The manufacturer is looking for installation sites, and asking local governments for cooperation. The experimental system operates manually, but new ones will have operation programs and safety systems for automatic operation. (The Nikkan Kogyo Shimbun, September 5, 2016)

### 4. Hydrogen Infrastructure Technology Development & Business Plans

#### (1) Hitachi Zosen

Hitachi Zosen has started the development of hydrogen production equipment in a container which can produce hydrogen at double the amount of

conventional products for FCVs. Toyota Motor and Honda sell FCVs which are expected to expand their market around 2020, and Hitachi Zosen is working on development of larger-scale hydrogen supply facility. Expanding the size can extend application to stable use of solar power plants. The new equipment under development uses a water electrolysis system to produce hydrogen. It is planned to be stored in a large rectangular container 12 m long to be used as a hydrogen refueling station for FCVs. An electrolysis chamber to split water and storage space for water and gas will be placed in the container. The manufacturer has finished the basic product design. The hydrogen production facility developed by the manufacturer is already in the market. The current product can produce up to 100 Nm<sup>3</sup>/h in volume. They aim to increase the production capacity to double by improving performance and expanding the size of equipment. The new system can convert a large amount 1,000 kW of electricity into hydrogen, which allows stable hydrogen supply all the time. The price of the system is expected to be a couple of ¥100 million. The system would be one of the few facilities in the world to be able to stably convert 1,000 kW of electricity into hydrogen. All the devices require no weatherproofing by being stored in a container, which enables easy installation. The manufacturer will make sure that air circulate in the system during operation, and the system will be repeatedly evaluated for commercialization. Solar power plant is expected to expand its use. FCV is likely to be used more in Japan from 2020 when the Tokyo Olympics and Paralympics are to be held. These are reasons for the manufacturer to increase the scale of hydrogen production facilities. Also, hydrogen refueling stations will be prepared more in places. To accommodate the demand, there is a plan to establish environmentally-friendly hydrogen infrastructure which uses renewable energy of excess power from photovoltaic generation. To develop the infrastructure system, hydrogen production facilities need to operate at a larger-scale than current ones to stably supply fuel using photovoltaic generation and to make photovoltaic generation as source of fuel for filling facilities. The new product was wanted to be commercialized. Hydrogen production equipment is being considered to be used at thermal power plants

in the future. Furthermore, there is a plan of an environmentally-friendly system to produce biogas using hydrogen and CO<sub>2</sub> coming from a thermal power plant to fuel the power plant. (The Nikkei Business Daily, August 22, 2016)

## (2) Siemens

On September 1<sup>st</sup>, German-based Siemens revealed that a hydrogen production system using excess power from wind power generation is planned to be tested in Japan. Although the time and location are still undecided, this experiment will be carried out in cooperation with engineering firm and trading house. The product uses excess power to operate water electrolysis system to produce hydrogen. Siemens owns a gas turbine which uses hydrogen as its fuel and water electrolysis system, and aims to develop a supply chain to use hydrogen by asking cooperation to other firms for storage and transport. They have wind turbine and gas turbine for thermal power plants as the twin core for their energy business. Wind power generation is estimated to grow by 2.2% each year globally by 2030, and the main market is the Middle East, Africa and Asia. However, the utility firms limit wind farms to send electricity to the grid in some cases. According to Mr. Kenichi Fujita, a senior operating officer of Siemens, wind power generation can only send half the amount of electricity production recently. Excess production is thrown away at wind farms without power storage facilities such as storage battery. Siemens will evaluate usage of excess power in the experiment. A water electrolysis system will produce hydrogen by splitting water. Promising usage plans of hydrogen are hydrogen power generation to turn it back into electricity and fuel for FCVs. They will cooperate with engineering firm and trading house for commercialization. Power storage system has issues of initial costs and natural discharge which makes difficult for long-term storage of excess power. On the other hand, hydrogen can be stored and transported in a large amount, and converting power into hydrogen allows stable use of power. The manufacturer started a similar experiment in Mainz in July, 2015. This project uses facility to produce hydrogen at 1,000 m<sup>3</sup>/h, an equivalent of fuel for 2,000 FCVs, and provides hydrogen as fuel for gas turbine and FCVs. (The Nikkan Kogyo Shimbun, September 2, 2016)

## (3) FC Expo

On September 7<sup>th</sup>, the first “FC Expo” in the Kansai area started at Intex Osaka. In the venue, medium-size firms which aim to enter the hydrogen related market in the Kansai area are having their displays as well as Iwatani which operates hydrogen refueling stations. Fujikin, produces valves in Osaka City, and shows a piping system to allow reducing installation area of hydrogen refueling stations. The product combines a highly strong material and a coupler which is used for semi-conductor production process, which enables reduction in piping area by 60%. Chiyoda Seiki produces gas equipment in Kobe City, and brought out products including “vacuum insulating piping” which can efficiently supply liquid at ultra-low temperatures from a tank. This product is specifically designed for liquid hydrogen of which boiling point is -253°C, lower than liquid nitrogen, and is displayed in the event as reference. Their manual gas cutoff device for hydrogen mixed fuel gas is shown there as a commercial product, and boasts its high quality cut surface of metal and reduction in CO<sub>2</sub> emissions. Their anticipation is that more manufacturers will use their products when a hydrogen import base built in Kobe. They explain that they can expect market growth and more business opportunities as hydrogen society develops in Kobe where they are local. Okazaki Manufacturing produces temperature sensor in Kobe City, and brought out a thermometer for high pressure hydrogen. Ohnoha is a manufacturer of industrial packing and gasket in Kobe City, and displays high precision gasket for hydrogen refueling stations. An exhibition for new energy is held at the same time, and the total participants of both events are 310 firms. During the event period by 9<sup>th</sup>, 30,000 visitors are expected. (The Nikkei, September 8, 2016)

## 5. ENE-FARM Business Plan

Tokyu Land Corporation has started applying the concept of “Smart Wellness House” to “Branz Garden Seta”, ready-built houses for sales in Setagaya-ku, Tokyo. This concept aims to improve residents’ wellbeing and safety including energy saving and emergency preparation in cooperation of industry and academia. A show house will be open in early October. Branz Garden Seta project will have nine wooden

two/three-story houses in total. Tokyo City University and Juntendo University will cooperate in the project by providing experts' expertise for physical and optional products. The houses will have higher earthquake resistant frame and insulation. Other advantages are drinking water filters for all the houses and around the clock ventilation as well as "ENE-FARM". The optional products are offered by Tokyu group members using their knowhow. They are emergency provisions of Tokyu Hands for disasters such as large earthquake, house or children watch service by Tokyu Security and health programs by Tokyu Sports Oasis. (The Nikkan Kogyo Shimbun, August 19, 2016)

## 6. Cutting Edge Technology of FCVs & EVs

### (1) Times Mobility

On August 10<sup>th</sup>, Times Mobility Networks, Hiroshima City, started renting operation of Toyota's FCV "MIRAI" at "Times Car Rental Kyoto Shinkansen Entrance Branch. This is the first rental service of FCVs in Japan. The firm is contracted this operation as the "Project of Paid Carsharing Using FCVs" of Kyoto City, and the operation period is limited until March 24<sup>th</sup>, 2017. Three FCVs owned by the city will be used for the renting operation run by the firm. There are two hydrogen refueling stations, and the operation of these FCVs for hiring is expected to expand users. Because of these, the operation is likely to get more attentions from a broader range of people. (Nikkan Jidosha Shimbun, August 16, 2016)

### (2) EV Japan

EV Japan, a venture operated by four automobile service providers in Toyonaka City of Osaka Prefecture, will sell small carrier vehicles using an EV frame from this autumn. The EV can take 200 to 1,200 kg, and its smaller body than diesel car allows maneuver on narrow roads. The venture will explore the market with the vehicle by advertising advantages of quiet driving and low-emission in exhaust gas. The developed EV has five width range between 0.9 to 1.2 m, and can drive three to six hours. It is rechargeable through domestic wall sockets, and its fuel cost is about a third of that of diesel car. Its loading platform can lift or rotate for transporting fresh concrete or harvested fruits. The price is between ¥0.6 to 2 million. Because more older and

female employees work at agriculture and construction industries, physical support is more in demand. However, a diesel car produces exhaust gas and noise, which is unsuitable for indoor work such as harvesting in greenhouse. The EV will be sold to lease operators and automobile service providers to start with. The venture has produced and sold electric carts to move around in a hotel and for mobile stalls in entertainment parks such as Universal Studio Japan. Mr. Chotaro Nishida estimates that "small and conveniently rechargeable electric carrier is needed more. (The Nikkei, August 17, 2016)

### (3) Daimler

On August 19<sup>th</sup>, German-based Daimler revealed an EV concept car of super luxury class Mercedes-Maybach which was brought back last year. The concept car is a large coupe of 5.7 m long, and the driving range on a single charge reaches 500 km in the European standard measurement mode. The automaker tries to compete with US-based Tesla Motors which is establishing presence in the global luxury EV market. "Vision Mercedes-Maybach 6" was unveiled in an event in California. All the four wheels have small motors for better acceleration, and the gull wing doors open upwards. The price and sales start have not been disclosed. In Europe, Volvo in Sweden and German-based Audi and Porsche, both subsidiaries of VW, have announced that introduction plans of their 500 km driving range EVs. Currently Tesla leading the market of EV with long driving range, European producers are also shifting their strategies to EVs since the battery performance and cost are being achieved. The Mercedes-Maybach brand currently offers sedan and limousine using "S-Class" which is the highest model for Mercedes-Benz. The new EV is a resurrection of coupe produced under Maybach brand. (The Nikkei, August 20, 2016)

### (4) Gree

On August 19<sup>th</sup>, Gree, the largest Chinese producer of air conditioners in Guangdong announced that it would merge Yinlong Energy, a medium-sized manufacturer of EVs and lithium-ion batteries (LIBs) in Guangdong for 13 billion CNY (approximately ¥196 billion). Since the Chinese home appliance market passed the peak in growth, its growth speed is likely to become slow. Because of this, Gree is entering

the EV market which is expected to grow in the future for its survival. The merger will be carried out by swapping newly issued Gree's share with Yinlong Energy's share held by 21 investing banks. Gree will issue 834.938974 million shares at 15.57 CNY to obtain all the Yinlong Energy share. Yinlong Energy was established as an EV related venture at the end of 2009 in Zhuhai, Guangdong, where Gree's headquarter is located. The venture has two plants in Zhuhai and Hebei, and they can produce 33,000 electric buses each year. Their production was 3,189 electric buses for 2015, which makes the firm the seventh largest electric bus manufacturer in China. Their sales were 3.86185 billion CNY (approximately ¥58 billion) for the term ending December 2015. Gree is the largest air conditioner producer in China, but its sales of air conditioners has been struggling. The sales result went down to 49.18282 billion CNY (approximately ¥740 billion), a 1.9 % decrease, for the term from January to June. (The Nikkei, August 20, 2016)

#### (5) Mitsuoka Motor

On August 22<sup>nd</sup>, Mitsuoka Motor, Toyama City, announced the start of its commercial EV production. Their EV is three-wheeler "Like-T3", and will be produced at commercial level under a new brand. Electric three-wheelers are inexpensive, and suitable for short-distance travel, which is expected to be used more in sightseeing places and delivery operations. The firm aims for 1,000 EV sales in three years, and has signed contracts with about 20 distributors mainly in the Kansai area. Taking two people, Like-T3 was introduced into the market in 2012. Drivers are not required to wear helmet, but the EV needs driver's license for standard car, not motor cycles. LIB is used for the power, and the 40 km driving range model will sell for ¥1.3986 million. The price for the 60 km one is ¥1.5066 million. (The Nikkei, August 22, 2016)

#### (6) Honda & VW

Honda will downsize the development of its four-wheel cars driven by diesel engines. Environmental regulations are getting stricter worldwide, and the firm plans to accommodate the change by expanding electric powered vehicle ranges such as PHVs by shifting its development resource from diesel. German-based VW also intends to shift

the core of its development from diesel to electric technology. These make changes in the competition of diesel engine cars. In February, Honda revealed a plan to increase the ratio of electric powered cars (PHV, HV and FCV) to take two thirds of the whole sales. VW announced its mid-term business plan to sell up to 3 million EVs each year by introducing over 30 EVs by 2025. Automakers are clearly moving away from diesel engine. (The Nikkan Kogyo Shimbun, August 22, 2016)

#### (7) Tesla Motors

On August 23<sup>rd</sup>, US-based EV manufacturer Tesla Motors announced a market introduction of new version of "Model S" which would be the first EV to be able to drive over 500 km. The price starts from \$134,500 (¥13.5 million). Although European automakers including German-based Audi have revealed their plans to introduce EVs with around 500 km driving range, Tesla is leading in commercialization of this kind of EVs. Tesla's new model uses battery with larger capacity of 100 kWh, and the driving range is extended by 7% to 315 miles, 515 km, measured in the standards of the United States Environmental Protection Agency. Once the battery is fully charged, the new model can supposedly drive between Tokyo and Osaka without recharge. In the US, 300 miles, about 480 km, is said to be the range for EVs to be fully used. Tesla will also add a version of 289 mile (about 460 km) driving range to sports utility vehicle (SUV) "Model X". They brought the performance close to the theoretical limit by optimizing material composition and allocation, while keeping battery size unchanged. Their small sedan "Model 3" is planned to be commercially produced from next year, and its battery will have improved performance by changing to better materials and composition. New Model S can reach 96 km/h in 2.5 seconds, 0.3 seconds shorter than current fastest model. "This is the world's fastest acceleration in the currently available cars. EV is the future." Mr. Elon Musk, the CEO, said his confidence in a telephone conference. (The Nikkei, August 24, 2016)

#### (8) Daido Steel

Daido Steel will build a new plant to produce "neodymium magnet", strong permanent magnet, in the US. The production is planned to start in 2019. The investment is estimated about ¥10 billion. This

magnet is rapidly expanding its use for HV and EV motors, and the firm will try to catch the demand by the new plant. (The Nikkei, August 26, 2016)

#### (9) Toshiba

Toshiba has developed a technology to control interference of wireless charging systems for electric buses. Wireless charging is expected to be used more as a safe and convenient recharging system. However, interference is produced while charging, which may affect broadcasting and other radio communications. This is an issue to be solved. The firm developed a system to use two transmitting pads buried in road to charge electric bus with receiver pads parked on the road. To control interference, they use an effect that two signals negate each other. The pads has 2 channels, and they found the pad allocation effectively negate unwanted signals. (The Nikkei, September 4, 2016)

#### (10) GLM

EV venture GLM, Kyoto City, will increase the number of staff to 50, a double that of the current figure, by next spring. They will recruit experienced engineers from major automakers to accelerate research and development of new model of electric sports car. To accommodate increasing workforce, a building in Fushimi-ku, Kyoto City, will be purchased, and the head office and research and development center will be located in the same place. Their main hiring target is experienced engineers of automobile parts manufacturers and major car producers. They will also look for workers in the greater Tokyo area at their recruiting office newly-setup in Minato-ku, Tokyo, this month. “Our new model of electric sports car will be developed at a faster speed by knowhow and knowledge of experienced engineers. We also want to sell EV production package including chassis and motor as a base of EV.” Mr. Tomohisa Tanaka, a director of GLM, says. The new head office will be open in March 2017, and the investment is expected to be a couple of ¥100 million. The building has four floors, and the gross floor area is about 2150 m<sup>2</sup>. They bought the building this September. The third and fourth floors function as the head office, and the research and development center will be on the first and second floors. Their current head office is located in Kyoto University, and the research and development center is situated in “Venture Nursery

Plant” in Uji City, Kyoto Prefecture. However, both places have been too crowded. The new research and development center will be equipped with 3D measuring instrument to scale car body, and have visitors’ space for parts and component suppliers to have a look. (The Nikkei, September 10, 2016)

## 7. FCV Parts & Components Development

### (1) Renesas Electronics

Major semiconductor producer Renesas Electronics has moved to the final stage of merging Intersil which also manufactures semiconductor in California, USA. The acquisition is estimated a ¥300 billion at most, and the basic agreement will be signed as early as in August. Renesas aims to take a lead in the automobile semiconductor market, which expects expansion due to technologies such as autopilot, by acquiring the Intersil specialized in energy saving semiconductor. The American firm has a large share in the power controlling semiconductor market, and is lucrative with a high operating income margin of about 20%. Their products are essential for cars, industrial machines and smartphones, and are used for function to keep voltage in circuits at a certain level to reduce power. They have sales channels of automakers in the US, Europe and Asia, and their products are expected to be increasingly used in EVs and FCVs. Their product range also includes semiconductors for communications, and Renesas will expand its product range for automobiles at once by this acquisition. The global automobile semiconductor market is at annual ¥3 trillion level. Renesas Electronics started in 2010 by management merger of NEC Electronics and Renesas Technology which was another merger of the semiconductor departments of Hitachi and Mitsubishi Electronic. Since their sales were suffering due to too strong yen and the Great East Japan Earthquake, the Innovation Network Corporation of Japan (INCJ), a public-private partnership fund, and Toyota Motor were financially supporting. In the term ending March 2015, Renesas finally turned in black by large-scale layoff. Their sales decreased by 40% of that of five years ago due to disposal of underperforming business. (The Nikkei, August 22, 2016)

## 8. Hydrogen Refueling Station Elemental Technology Development & Business Plans

### (1) Alone Co.

Alone Co. is expanding its business by metal parts made using photo chemical etching and its own diffusion bonding. They works on semiconductor related parts using super fine processing and heat exchanger for hydrogen refueling stations. Hydrogen refueling stations use pre-cooler to refrigerate hydrogen to -40°C, and heat exchangers are used as a part of this component. In the manufacturer process, 0.5 mm thick stainless steel sheets are photo chemically etched, and then 90 sheets of them are layered and stuck together by diffusion bonding. The process creates hollow structure to make very small channels for hydrogen gas, coolant and air. “Since FCV is expected to expand its use, heat exchangers are likely to be more in demand.” Mr. Susumu Yamada, the chairman of the firm, says. (Dempa Shimbun, August 19, 2016)

### (2) Mitsubishi Kakoki

Mitsubishi Kakoki has carried out an experimental project to produce hydrogen from biogas derived from sewage sludge processing, and won “MLIT Minister Award of 14<sup>th</sup> Person of Merit for Industry-Academia-Government Cooperation”. This project extracts hydrogen from biogas to supply FCV with fuel carried out in cooperation of Fukuoka City, the International Research Center for Hydrogen Energy of Kyushu University and Toyota Tsusho. A hydrogen refueling station is installed at Fukuoka City Central Sewage Treatment Center as a part of the project, and is open to public for hydrogen refueling since November 2015. (The Chemical Daily, August 23, 2016; The Nikkan Kogyo Shimbun, August 26, 2016)

### (3) Kitamura Manufacturing

Kitamura Manufacturing produces special vehicles, communication/industrial machines in Niigata City, and won the second order for mobile hydrogen refueling stations after the first one in last year. Their refueling facility is installed on a loading platform of a truck to make its installation area small. This gives flexibility to accommodate needs of actual refueling locations. The price of this product is half of that of stationary hydrogen refueling stations, which supports FCV use to realize hydrogen society in Japan where the world's most advanced technology such as Toyota MIRAI and Honda CLARITY FUEL CELL are

found. Hino Motors placed the order on Kitamura Manufacturing for delivery to energy related firm and local government. Currently, about 20 mobile hydrogen refueling stations operate in Japan, the total number of these stationary and mobile stations in operation are estimated to be 100. The refueling infrastructure is developing more in urban areas in Tokyo, Nagoya and Osaka and Chugoku, Shikoku and Kyushu regions. The vehicle part of this refueling station is produced in cooperation of a number of firms, and Kitamura Manufacturing is in charge of the body work. The station is a special vehicle of which legal category was previously undecided. Now, it falls in category number 8, the same as lorries, for the registration. The station consists of a number of heavy components such as hydrogen cylinder, refueling tank, piping and wiring, which was a large problem in layout and fortification to solve for producers. Kitamura Manufacturing spent hard time deciding the position of vent holes of the container. Because the outer shell container stores pressurized containers which tend to get warm, the firm increased ventilation points from the initial drawing for cooling the equipment by external air. Mobile refueling stations have to clear requirements for operation, and only visit pre-registered locations. They are expected to be used for hydrogen energy promotion events and emergency refueling stations during disasters in the future. (Japan Metal Daily, August 30, 2016)

— This edition is made up as of September 15, 2016 —