*THE LATEST NEWS NUMBER 226, 2015 FCDIC*

# FCV & Hydrogen Infrastructure Hit Headlines

Arranged by T. Homma

1. Governmental Measures

(1) METI

In FY 2015, the Ministry of Economy, Trade and Industry (METI) will start a demonstrative project to build a hydrogen supply chain in three phases, oversea hydrogen production, transport to Japan and hydrogen power generation in Japan. Technological development for hydrogen transport and storage has been given particular weight in the project, and liquid hydrogen and organic hydride are expected to be the methods. The ministry plans a quick move towards commercialization of the technology by forming groups with participating firms in the two methods. The project will continue for six years, and ¥3.8 billion has been allocated in the budget request for FY 2015. One of these target methods, liquefying hydrogen is promoted by Kawasaki Heavy Industries (KHI), and the other is developed by Chiyoda Corporation forming with methylcyclohexane as a carrier. Using the two methods as the core, the project will test a supply chain combined with hydrogen procurement from abroad and hydrogen power generation in Japan. (The Chemical Daily, November 5, 2014)

METI and auto giants such as Toyota and Honda will develop a system to reduce the price of hydrogen for fuel cell vehicles (FCVs) to the level of gasoline. Hydrogen price currently costs double that of gasoline, and will be subsidized by the public and private sectors to provide cheaper hydrogen. The world's first retail sales of FCV will start in December, and these organizations plan to compete with the rest for the leading position in the world. An organization for FCV users will be launched by operators of hydrogen filling stations such as JX Holdings and Japanese-based major automakers including Toyota, Honda and Nissan within this year. The automakers and the ministry plan to contribute a total of ¥13 billion over five years through the FCV users' organization to support operation costs of the filling stations in order to provide cheaper hydrogen. The FCV users' organization will offer its members hydrogen at the gasoline price level. The automakers will decide the ratio of the contribution towards the users' organization among themselves by the end of 2014. The membership fee will also be discussed. A gasoline car with a fuel efficiency of 20 km per 1 L requires approximately ¥80 to drive 10km. A fuel efficient hybrid vehicle (HV) needs approximately ¥45 for the same distance. Those businesses and METI aim at the average fuel price of gasoline as a start, and at the HV level by 2020 by supporting operational costs of the filling stations. Construction of a hydrogen filling station costs approximately ¥0.5 billion, five times that of gasoline filling station. A decision on subsidizing the operational costs was made because supporting 50% of construction costs is not likely to bring consumer hydrogen price sufficiently down to the gasoline level. The ministry submitted its budget request including ¥11 billion for preparation of hydrogen filling stations for FY 2015. (The Nikkei, November 14, 2014)

On November 20th, METI announced that the ministerial ordinance for the High Pressure Gas Safety Act was amended for liquid hydrogen to be stored at hydrogen filling stations for FCVs on the same day. Hydrogen gas shrinks to 1/800 in volume once it is liquefied, and this makes its transport and storage more efficient. The amendment allows hydrogen filling stations to store liquid hydrogen with appropriate safety measures. The ministry also eased the regulation on installation of chillers, accompanying equipment, and accumulators. Chillers stop the hydrogen temperature increasing in order to supply hydrogen efficiently. However, they were previously required to keep a certain distance from the dispensing units. This may have been difficult in urban areas where land is limited. The ministry

eliminated the condition on the clearance for the accompanying chillers which meet the requirements. (The Nikkei, The Nikkan Kogyo Shimbun, The Denki Shimbun, Nikkan Jidosha Shimbun & The Chemical Daily, 20 & 21 November, 2014)

(2) MOE

The Ministry of the Environment (MOE) will examine the $CO_2$ reduction effect of each technology for hydrogen production, transport and storage. Hydrogen can be produced from a variety of energy sources such as solar and biomass as well as conventional fossil fuels, and is expected to be used for consumption of locally produced energy. On the other hand, production and transport of hydrogen require energy, which releases $CO_2$. Examination of $CO_2$ reduction effect of each technology makes it easy to calculate counter global warming effects of a whole system from production to use in order to improve the viability of using locally produced energy. (Nikkan Jidosha Shimbun, November 20, 2014)

2. Oversea Governmental Measure

The government of Singapore will promote more clean energy technology. The Energy Innovation Programme Office (EIPO) of Singapore has decided to award S$ 15 million (approximately ¥1.27 billion) of research and development grants to the National University of Singapore (NUS) and Nanyang Technological University (NTU). The subjects of the grant are wind, tidal and geothermal power, fuel cell (FC), micro gas turbine, clean hydropower and micro grid. (The Chemical Daily, October 28, 2014)

3. Local Governmental Measures

(1) Tokyo

On October 24th, a meeting of the "Tokyo Strategy Committee for Hydrogen Society" was held. The committee consists of the Tokyo Metropolitan Government and businesses including Toyota Motor, and brought up targets of 6,000 FCVs to be owned and 35 hydrogen filling stations to be installed in Tokyo by 2020. The Tokyo will promote these to advertise itself as an environmentally advanced city during the Olympic Games. FCVs will be used for operations of the local government and businesses, and taxi operators will be encouraged to use FCVs. Also the local government plans to use FC buses for its public transport system to lead the way to FCV growth. The committee targets at 100,000 FCVs to be owned in the area by 2025. The initial target for hydrogen filling stations is 35 locations mainly in the area where Olympic facilities are concentrated. The committee plans to allocate hydrogen filling stations accessible in 15 minutes in Tokyo, and 80 locations by 2025. Faster preparation is planned to be achieved by using land owned by Tokyo Metropolitan Government. In addition, the committee targets domestic FC installation of 150,000 units by 2020, and 1,000,000 by 2030. Currently the majority of domestic FCs has been installed in newly built houses. The organization will promote the product to established houses and apartments. (The Nikkei Business Daily, October 27, 2014; The Nikkei, November 14, 2014; The Asahi Shimbun & Nikkan Jidosha Shimbun, November 19, 2014; The Nikkan Kensetsu Kogyo Shimbun, November 20, 2014)

On October 29th, Mr. Yoichi Masuzoe, the governor of Tokyo gave a talk in Berlin, Germany, and said that no gasoline cars would be seen in any facilities and at athletes' village at 2020 Tokyo Olympics. He also showed an intention to use FCVs using hydrogen and oxygen in the air for the Olympics. (The Asahi Shimbun, October 30 & 31, 2014)

On November 6th, the finance department of Tokyo revealed budget requests for the next fiscal year from each bureau of Tokyo. A total of ¥6.8336 trillion was requested for the general account, and this is an increase of ¥0.1666 trillion (2.5%) from the initial budget for this fiscal year. The budget request includes ¥0.015 trillion for the hydrogen energy area to promote use, and ¥0.008 and ¥0.0067 are allocated for the FCV purchase subsidy scheme and financial support for hydrogen filling station construction respectively. (The Yomiuri Shimbun, The Asahi Shimbun, The Mainichi Newspapers, The Nikkei, The Sankei Shimbun & The Tokyo Shimbun, November 7, 2014)

On November 18th, Tokyo revealed its hydrogen related targets. They are 6,000 FCVs and over 50 FC buses to be used by 2020 Tokyo Olympics, and hydrogen filling stations in 35 locations by 2020 and 80 locations by 2025. Supporting FCV use, Governor Masuzoe spoke of Tokyo's intention to develop a hydrogen usage model in Tokyo ahead of the Japanese

government. The local government plans to subsidize operators so that operators' preparation cost for hydrogen filling stations is reduced to around ¥100 million. Also, Tokyo targets 100,000 FCVs to be owned in Tokyo by 2025 by subsidizing purchase. (The Sankei Shimbun, The Nikkei Business Daily, Nikkan Jidosha Shimbun, Nikkan Kensetsu Sangyo Shimbun November 19 & 22, 2014)

(2) Sapporo City

Sapporo City revealed an energy vision which is the guideline for its energy policy. The vision targets a 15% reduction of thermal energy and 10% reduction of electricity consumption of that of FY 2010 by FY 2022. Half the amount of nuclear power production of FY 2010 is offset by energy saving at home and businesses and is to be replaced by a distributed power supply such as renewable energy and FCs. Sapporo will work on developing a low carbon city and becoming less dependent on nuclear power. (The Nikkei Business Daily, October 29, 2014)

(3) Osaka Prefecture

On November 19th, Osaka Prefecture revealed the initial budget request for FY 2015 including FCV promotion. The request of governor's priority project is approximately ¥7 million to establish a promotional committee for the FCV related industry in the prefecture and FCV purchase for official cars. Two vehicles of Toyota MIRAI are planned to be bought as official cars. The total amount requested of ¥5.068 million includes fuel costs, insurance premiums and ¥3.71 million for the lease charge of two FCVs. (Nikkan Jidosha Shimbun, November 25, 2014)

## 4. FC Element Technology Research & Development & Business Plans

(1) NAIST

A research group of Prof. Shun Hirota at the Nara Institute of Science and Technology (NAIST) has discovered the switch mechanism of hydrogenase which controls the decomposition reaction of hydrogen in cooperation of Prof. Yoshiki Higuchi at University of Hyogo. The research figured out that "Iron (Fe) – sulfur (S) clusters" in the hydrogenase controlled the catalytic reaction. Because hydrogenase can cleave hydrogen molecules more efficiently than platinum which is used in FCs, it is expected to lead to a new FC and hydrogen synthesis catalyst. The research group examined molecular structure using Fourier-transform infrared spectroscopy, and found that the hydrogenase under light irradiation is an intermediate state of catalytic reaction. An Fe–S cluster near an active site of nickel and Fe catalyzed only while it was oxidized, but stopped catalyzing when it was reduced. The group believes that these Fe–S clusters act as a switch to control the synthesis reaction of the catalytic hydrogenase. (The Nikkan Kogyo Shimbun, October 27, 2014; The Nikkei, October 28, 2014)

(2) Philtech

Philtech, a production technology developer of semiconductors in Tokyo, has developed a core component without using platinum catalyst to extract hydrogen from natural gas for Ene-Farm and hydrogen filling stations. Their own injection technology makes the reaction more efficient. Ene-Farm uses hydrogen produced by natural gas and steam reacting on platinum catalyst. Heat-Beam Cylinder developed by Philtech is just under 9 cm diameter and just over 20 cm long, and does not require extensive conversion. Natural gas and steam are injected at the internal heat exchanger at a high speed to heat them up to 1,100 °C in an instant. This enables an efficient reaction. The product can be used in hydrogen filling stations, and this usage allows filling stations to use the natural gas grid to produce hydrogen on site. This eliminates the need for additional infrastructure preparation. Sales activities of the product have started aiming for large scale businesses of Ene-Farm and hydrogen filling stations. The firm targets a few hundred thousand yen by volume production to reduce the costs of the product. They develop production technology of semiconductors and liquid crystal panels, and the new product uses their technology to inject vaporized silicon compound on a glass substrate to make a film. (The Nikkei Business Daily, October 31, 2014)

(3) NEC Schott Components

NEC Schott Components has started selling strontium and barium free glass. This product is targeted for solid oxide fuel cells (SOFCs) which will hopefully be used for cogeneration systems. It can be used with metal alloys containing chromium and is optimized for sealing SOFCs which operate at low- to mid-range operation temperatures. Excellent

durability also allows functioning at high temperatures. The product is available in variety of forms such as powder, paste, glass sintered and glass sheet to give it flexibility. (The Nikkan Kogyo Shimbun, November 3, 2014)

(4) Teijin

On November 11th, Teijin announced that a carbon alloy catalyst (CAC) was developed as a new material for FC catalyst, using PAN, material for carbon fiber. This material enables stable and cheaper supply than platinum, which may lead to cost reduction in FCVs. The PAN and iron are made into fine particles and mixed as a particle catalyst. A cell using the catalyst can continually operate for over 5,000 hours. The manufacturer aims to commercialize it by 2025. (The Asahi Shimbun, The Nikkei Business Daily, Nikkan Jidosha Shimbun & The Chemical Daily, November 12, 2014; The Nikkan Kogyo Shimbun, November 14, 2014)

5. Ene-Farm Business Plans

(1) Japan Prefabricated Construction Suppliers and Manufacturers Association

On November 4th, the working group for houses of the Japan Prefabricated Construction Suppliers and Manufacturers Association revealed the survey results for environmental action plan "Eco Action 2020" for FY 2013. The actual $CO_2$ emissions of new houses decreased to 1,924 kg, a 17.6% decrease that of 2020, due to growth of photovoltaic generators and FC cogenerations. A number of houses with home energy management systems (HEMSs) significantly rose by 36.4%. The plan aims to reduce $CO_2$ emission of newly built houses to half that of 2010. The subjects of the survey were 10 house manufacturers which are members of the subgroup for environment of the working group. (The Nikkan Kensetsu Kogyo Shimbun, November 5, 2014)

(2) Hiroshima Gas

From December 1st, Hiroshima Gas will sell new Ene-Farm for apartment units generating electricity from natural gas. The product is manufactured by Panasonic, and the firm aims for larger sales growth by expanding the range of its FCs which was previously available only for houses. (The Chugoku Shimbun, November 11, 2014; The Denki Shimbun, November 13, 2014; The Nikkan Kogyo Shimbun, November 18, 2014)

6. Cutting Edge Technology of FCV & EV

(1) Toyota

On October 26th, Toyota's brand new FCV sedan made appearance at the "4th Osaka Marathon" (the organizers; Osaka Prefecture, Osaka City and Osaka Association of All Athletics). The vehicle drove the chief official of the race alongside the runners in Osaka City. On 24th and 25th, Toyota Motor displayed the vehicle in a booth at "Osaka Marathon Expo 2014" in Intex Osaka where runners registered for the race to introduce their activities for hydrogen society to the public through a visitors' photo session of the FCV. (Nikkan Jidosha Shimbun, October 28, 2014)

Toyota Motor will introduce its FCV into the market in December. The FCV appeared in a rally race prior to its rollout. Mr. Akio Toyoda, the president of Toyota, who has a racing license in a name of "Morizo", drove the car to show its advantages, and said that it was not only environmentally friendly but also fun to drive. The vehicle came out to demonstrate the safety inspection of the course, and was wearing special tires. However, the drive system was the same as the retail version. The car showed its reliability to the audience by driving on the rally course which requires sudden braking and quick acceleration repeatedly. Because FCV emits only water while driving, it is also called an "ultimate eco car". However, hydrogen refueling infrastructure has not been sufficiently provided yet, which is one of many issues and a key for market growth. Mr. Toyoda with a racing license highlighted the vehicle's enjoyable driving experience to expand the target consumer range. (Nikkan Jidosha Shimbun, November 1, 2014; The Yomiuri Shimbun, The Nikkei, The Tokyo Shimbun, The Sankei Shimbun & The Nikkan Kogyo Shimbun, November, 4, 2014)

On November 18th, Toyota Motor announced that its FCV "MIRAI" would be available from December 15th in Japan. The vehicle will sell for ¥7.236 million (including tax), and the price with governmental subsidy will be approximately ¥5.2 million which is the same level as their luxury range "Crown". Releasing the vehicle in December in Japan, they aim at approximately 400 vehicle sales by the end of 2015. The market introduction into Europe and the US is planned in the summer of 2015. METI has decided to

support ¥2.2 million for each purchase, which allows users to buy FCVs for around ¥5.2 million. The range of MIRAI is solely a four-seater sedan, and drives approximately 650 km on a full tank which can be filled with hydrogen fuel in three minutes. The advantage of the vehicle is instant acceleration once the accelerator is on the floor, which is contrast to the gasoline cars. The FCV reaches the driving range, on a single charge, of that of gasoline cars while EVs have shorter cursing range on a single charge. "MIRAI is to outperform HV Prius, and will be introduced into the market as a representation of an innovation of Toyota" says Mr. Mitsuhisa Kato, an Executive Vice President. Production of 700 vehicles is planned by the end of 2015 in Motomachi Plant in Toyota City. The manufacturer has already received orders for 200 vehicles mainly from public organizations and businesses. The order made at this moment is expected to be delivered in mid-2015 or later. (The Yomiuri Shimbun, The Asahi Shimbun, The Mainichi Newspapers, The Nikkei, The Sankei Shimbun, The Nikkei Business Daily, The Nikkan Kogyo Shimbun, The Denki Shimbun, Dempa Shimbun, Nikkan Jidosha Shimbun & The Chemical Daily, November 18 & 19, 2014)

(2) Hyundai Motor

Hyundai Motor disclosed that its first HV was under development to compete with Toyota's key HV "Prius". This HV will expand the environmentally friendly product range of Hyundai to meet exhaust gas regulations in the core markets. The manufacturer also puts more effort into FCV development than other automakers, and its dealers started FCV sales in California this year. Also their EV sales are planned to start in 2016. "We will be leading the market of environmentally friendly cars by developing competitive HVs, plug-in hybrid vehicles (PHVs) and FCVs" said Mr. Choong Ho Kim, a CEO, at a rollout event of their new luxury range sedan "Aslan". (The Nikkan Kogyo Shimbun, November 3, 2014; The Nikkei, November 7, 2014)

(3) Nichicon

Nichicon will put more effort to sell systems to provide electricity from vehicle to home (V2H). Although their "EV Power Station (EVPS)" was previously compatible only with Nissan's EV "Leaf", it was adapted to Mitsubishi's EV this summer. Since the compatibility expanded, the sales have gone up. EVPS has been sold since August, 2012, and supplies a home with electricity from a large capacity lithium-ion battery (LIB) of 24 kWh when connecting to Leaf. (The Chemical Daily, November 4, 2014)

On November19th, Nichicon announced that its EVPS adapted Toyota's FCV "MIRAI". The product was previously compatible with Nissan's Leaf and three Mitsubishi Motors' EVs, and its connection range was expanded to FCV. The FCV can be used as an emergency power source via EVPS to supply a building or home appliances with electricity. (The Denki Shimbun & Dempa Shimbun; November 20, 2014)

(4) Sumitomo Metal Mining

Sumitomo Metal Mining will build a new plant for a core material of LIB for EVs in Naraha Village, Fukushima Prefecture. The investment is estimated at ¥3 to 4 billion, and subsidies from Japanese and local governments are expected for the plant. Naraha Village still has the evacuation directive for almost of whole area which is to be removed in future due to the accident of Fukushima Daiich Nuclear Power Station of Tokyo Electric Power Company, and this new plant by the large business should support residents of the village for their recovery by employing many of them. The manufacturer will produce an intermediate material of lithium nickel oxide which is a core material of LIB cathodes. The intermediate material manufactured at the plant will be shipped to their Isoura Plant, Niihama City, Ehime Prefecture, to be a cathode material in order to be delivered to Panasonic. Then Panasonic will provide LIB for EVs of US-based Tesla Motors. Due to expanding demand of EV batteries, Sumitomo Metal Mining decided to increase monthly production capacity of the cathode material to 1,850 t, over double that of current capacity. (The Nikkei, November 5, 2014)

(5) Edion

On November 5th, Edion announced that the number of its shops equipped with EV chargers would be increased from current 7 to 37 by early December. The chargers are free of charge until early March 2015. After that, users will need charging cards issued by "Nippon Charge Service (NCS)" for the service. The retailer started installing EV charger in 2011 to attract more consumers by increasing the level of

convenience for them. (The Nikkei, November 6, 2014)

(6) Panasonic

On November 6th, Panasonic decided joint development of a separator (insulator), a core part of LIB, with US-based major material producer Polypore International. The separator is to be used for next generation LIB for EVs, and this development is expected to be mainly for LIB production with Tesla Motors in the US. Panasonic signed an agreement on development with Celgard, a subsidiary of Polypore. However, the investment plan and product users have not been disclosed. A separator is a key part to divide cathode and anode of LIB to improve safety. Celgard is roughly in the fourth place in the global separator market, and Ube Industries and Asahi Kasei produce separators in Japan. In the end of July, Panasonic agreed to build an EV battery plant in principle in the US with Tesla. With the investment of ¥150 to 200 billion, Panasonic will develop and produce cylindrical LIB for Tesla's EVs. (The Nikkei, November 6, 2014)

(7) Tesla

On November 5th, EV manufacturer Tesla Motors revealed its financial result for July to September, and the sales were $851.8 million (approximately ¥98 billion), a 97% increase that of the same period in previous year. However, the bottom line was a net loss of $74.7 million ($38.49 net loss for the same period in previous year) due to ballooning costs for development of the next models. (The Nikkei, November 6, 2014)

(8) Nissan

Nissan is extending its product range for the South Korean market. Their diesel sport utility vehicle was introduced into the market on November 11th, and sales of EV "Leaf" will also start in South Korea in December. They will deliver Leaf to Jeju Island first, and will move onto nationwide sales as charging infrastructure is being prepared. Jeju Island is enthusiastic about using more EVs, and the number of EVs was 619 and 815 chargers by the end of September according to the provincial office. The office plans to replace 30% of cars with EVs on the island by 2020. (The Nikkei, November 12, 2014)

Nissan Motor will develop a large capacity power storage system to adjust power demand using used storage batteries of its EV "Leaf". The system is planned to be installed at one of their facilities by June 2015 to reduce utility costs. They are considering developing an energy saving support service which allows businesses to reduce electricity costs by 10%. If a secondary usage of EV batteries is well established in the energy area, recycle costs of EV users may be cut down. Their subsidiary 4R Energy for storage batteries was established in cooperation with Sumitomo Corporation in Yokohama City to develop and operate power storage systems. A power storage system with 250 kW output and 400 kWh capacity will be installed to connect LIBs from 24 vehicles of Leaf at Nissan's Advanced Technology Center in Atsugi City, Kanagawa Prefecture. Although capacity of used batteries is 20 to 30% less than that of a new battery, used batteries are sufficient to adjust electricity consumption. The system can store electricity 1.3 times that of monthly consumption of an ordinary household at once. It will store electricity at night when the tariff is low in order to use the power in the day, high tariff, to reduce utility cost. By using a storage system during the peak demand period, the standing charge which is the basic charge of electricity can be lowered. Also the system has a demand response function which allows a reduction in electricity use on the request of a utility firm, and can be used as backup power source in emergencies. 4R Energy will evaluate the reduction effect of electricity costs at Nissan's facility, and plans to start an energy saving support service by the autumn of 2015. The firm aims at plants, restaurants and car dealers as service users. (The Nikkei, November 13, 2014)

Leaf was released in 2010, and has sold 142,000 vehicles since then in approximately 40 countries including Japan, the US and Europe. As home use, the battery capacity of the EV goes down to approximately 70% in 10 years (estimated with 200,000 km drive), and reduces faster when driving long distance such as a taxi. Nissan will reuse used batteries for a while. If secondary usage of the battery is established in the electricity area, development of a new collecting system will be under consideration ahead of schedule. The firm is trying to enhance EVs' presence by establishing a model of multiple usages of EV batteries. (The Nikkei, November 13, 2014)

Nissan Motor plans to increase the driving range of an EV on a single charge to approximately 400 km, double that of Leaf. The automaker has set out a course to achieve to double the driving range while

keeping the existing LIB size. They have changed the cathode's active material from manganese to three elements to significantly increase energy density. The three-element material for cathodes contains manganese, cobalt and nickel, and has balanced performance of energy density, voltage and safety. The rollout is expected to be early, within few years if everything goes smooth, though it depends on whole vehicle development. The automaker aims to expand the market by introducing an innovative battery. (The Nikkan Kogyo Shimbun, November 17, 2014)

Nissan aims to introduce its FCV which is currently under development in cooperation with German-based Daimler and US-based Ford Motor to release the vehicle in 2017. (The Nikkei, November 19, 2014)

On November 21st, Mr. Toshiyuki Shiga, a vice chairman of Nissan, pointed out in an interview that FCVs had many issues which need to be solved in order to expand the market. These issues include the price of hydrogen fuel which is currently higher than gasoline and electricity. He also said that the firm is not rushing into a rollout. The automaker has focused on expanding the global sales of its EV, the leading product in the market. "We have already introduced zero emission EV "Leaf" into 40 countries, and can adapt the emission controls of the US and China." he emphasized. (The Kobe Shimbun, The Hokkoku Shimbun, The Toyama Shimbun & Iwate Nippo, November 22, 2014; The Hokkaido Shimbun, November 23, 2014)

(9) Hitachi

On November 14, Hitachi announced that a new technology for LIB of EVs had been developed. This technology allows extending driving range on a single charge to double that of current figure by increasing the amount of lithium ions. The manufacturer aims for commercialization by 2020. In the technology, the cathode has double the thickness, and the anode uses a silicon material to increase amount of lithium ions. The firm plans to reduce costs and to establish a commercial production technology to complete the product ready for the market. (The Nikkei, November 15, 2014)

(10) German-based ZF

ZF, a major German-based manufacturer of automobile components, will develop a drive unit for EVs in Japan. The firm acquired US-based TRW Automotive, another automobile component manufacturer in September, and ZF will launch a development center near TRW Automotive Japan. (The Nikkei, November 17, 2014)

(11) Honda

On November 17th, Honda revealed the latest prototype of its FCV. The FCs, the core of the vehicle, have been reduced in size by 30% that of the previous version to take five adults. For FCVs, reduction in size of FC systems and hydrogen tanks was difficult, but their FCV stores the FCs in the hood to solve the issue. A sedan type is planned to be released in 2015. The automaker plans to set the price at the same level as Toyota's FCV. Honda has been in cooperation with US-based GM for FCV development. (The Yomiuri Shimbun, The Asahi Shimbun, The Mainichi Newspapers, The Nikkei, The Sankei Shimbun, The Nikkan Kogyo Shimbun, The Denki Shimbun, The Nikkei Business Daily & Nikkan Jidosha Shimbun, November 18, 2014)

(12) Toray

On November 19th, Toray announced that its carbon fiber was employed for Toyota's FCV MIRAI. Carbon fiber weighs a quarter that of iron, and is 10 times stronger. The product can be used for core components such as high pressure hydrogen tanks and electrode materials for FCs, and can contribute to the reduction in weight of cars to improve fuel efficiency. In collaboration with Toyota Motor, the manufacturer developed a sheet of carbon fiber resin which can be molded in a shape by heat in a short time of one minute, and Toyota uses the product for a floor component of MIRAI. This is the first time in the industry that a sheet of carbon fiber resin, which can be made into a shape in a short time, is being used in a structural part of commercial vehicles. Toray has supplied its carbon fiber for aircrafts and wind turbines. With the aim of more use of their products in the automobile industry, their plan is to double the production capacity of their subsidiary carbon fiber manufacturer in the US by 2020 by investing approximately ¥30 billion. (The Asahi Shimbun, The Mainichi Newspapers, The Nikkei, The Nikkei Business Daily& The Chemical Daily, November 20, 2014; Nikkan Jidosha Shimbun, November 21, 2014)

(13) Marubeni

Marubeni has started the sales of an electrode material for LIBs. They signed a partnership agreement with US-based venture EnerG2, a manufacturer of carbon and activated carbon for electrodes, to supply LIB producers in South Korea and China with product using EnerG2's technologies. Marubeni is aiming at EV and smart phone batteries by offering the potential for improvement in durability and a reduction in size. (The Nikkei, November 22, 2014)

(14) Daimler

German-based Daimler plans to start selling FC buses in Japan by 2020. Their decision was made based on the fact that infrastructure such as hydrogen filling stations is expected to be more prepared by that time, and local governments were interested in these buses due to the environmental concern. Although the price of FC buses are expected to be ¥50 to 100 million, about double that of normal bus, local governments are highly interested. Daimler is developing a FC bus which drives 150 to 200 km on a full tank, and will target local governments and bus operators. Sales and maintenance of their buses will be carried out in Japan by Mitsubishi Fuso Truck and Bus, their group member. (The Nikkei, November 24, 2014)

(15) Hino Motors

Hino Motors plans to start FC bus sales in 2016. Hydrogen fuel will be more used for buses as well as FCVs. (The Nikkei, November 24, 2014)

## 7. Research, Development & Business Plan of Hydrogen Power Generation System

On November 13th, Toshiba and Kawasaki City announced that they would start a joint verification test of a hydrogen power generation operating on only water and sunlight in April 2015. The system use hydrogen produced by splitting water, and its photovoltaic generator supplies the required energy. A hydrogen storage facility is included in the system to provide power and hot water for 300 people for a week during disasters. Toshiba plans to commercialize the system in FY 2015. The system produces hydrogen from water with renewable energy, and does not emit $CO_2$. This will be the first commercialization of a system which stores fuel for FCs to generate power. The product is movable. "We plan to grow the product a ¥100 billion level business as early as possible", said Mr. Hisao Tanaka, the president. The firm targets disaster measures of local governments as a start. (The Asahi Shimbun, The Nikkei, The Denki Shimbun, The Nikkei Business Daily, The Nikkan Kogyo Shimbun, Dempa Shimbun, The Nikkan Kensetsu Kogyo Shimbun, The Tokyo Shimbun, Kanagawa Shimbun & The Chemical Daily, November 14, 2014)

## 8. Hydrogen Infrastructure Technology Development & Business Plans

(1) High Pressure Gas Safety Institute of Japan

The High Pressure Gas Safety Institute of Japan will work on research and development and technical standards to promote hydrogen infrastructure preparation such as hydrogen filling stations. A draft will be drawn up for standards on safety of hydrogen dispensers and containers, and cheaper material such as general stainless steel will be examined for building material of hydrogen filling stations. Also, they will study safety inspection methods for carbon fiber reinforced plastic (CFRP) as a cheaper material for high pressure storage containers (accumulators). These tasks are given to the institute by METI and New Energy and Industrial Technology Development Organization (NEDO) to pursue governmental targets to ease regulations to achieve hydrogen society. (The Nikkan Kogyo Shimbun, November 5, 2014)

(2) KHI

KHI has developed gas turbines using mixed fuel containing hydrogen. Hydrogen burns at a 1.5 times higher temperature than that of natural gas, which increases NOx production. However, the manufacturer developed a dry low emissions (DLE) combustor using its own technology to keep the NOx emission to the natural gas level, 25 ppm, when burning mixed fuel containing 60% hydrogen gas in volume. The technology may attract many users as it allows to fully make use of excess hydrogen coming out of the oil refinery and other chemical processes. In Japan, extra hydrogen is produced a total of approximately 180 million $Nm^3$ each year at oil refineries, petrochemical plants, ironworks, plants for salt electrolysis, and ammonia production facilities. This is approximately 5% equivalent of liquefied natural gas (LNG) imports for 2012 on a calorie basis. (The Nikkan Kogyo Shimbun, November 6, 2014)

On November 19th, KHI announced that a hydrogen liquefaction facility had been developed. The facility compresses hydrogen, a fuel for FCV, to 1/800 in volume to make volume transport easier. The product will be commercialized by FY 2016 to be sold to petrochemical and LNG plants which produce hydrogen. This is the first hydrogen liquefying facility developed by a Japanese manufacturer. The firm prepared a test facility in its plant in Harima Village, Hyogo Prefecture. The new system can turn approximately 5 t of hydrogen into liquid each day by cooling it down to -253 °C. An amount of 5 t of hydrogen can fill 1,000 FCVs. The commercial version will have the same production level, but the price is undetermined. Hydrogen can be easily transported by special tank trucks in a large volume, if it is turned into liquid at its production place by using a liquefying facility. The manufacturer is also developing tanker ships for hydrogen transport, and aims to liquefy cheap hydrogen oversea and ship it to Japan. (The Yomiuri Shimbun, The Asahi Shimbun, The Mainichi Newspapers, The Nikkei, The Sankei Shimbun, The Nikkei Business Daily & The Chemical Daily, November 20 to 22, 2014)

(3) JX

On November 12th, JX Nippon Oil & Energy announced that its first commercial hydrogen filling facility would be available in late December. The first facility will be installed in an established gasoline filling station in Ebina City, Kanagawa Prefecture. JX plans to increase the number of facilities to 23 locations in this fiscal year, and to 40 locations by the end of FY 2015. Already 11 locations have been chosen for the preparation in the greater Tokyo area and Aichi Prefecture. Out of 11, hydrogen filling facility will be installed in eight established gasoline filling station, and a new hydrogen filling station will be built at three locations. (The Nikkei, The Denki Shimbun & The Nikkei Business Daily, November 13, 2014; The Chemical Daily, November 14, 2014; Nikkan Jidosha Shimbun, November 15, 2014)

(4) Iwatani

On November 14th, Iwatani revealed its hydrogen price for FCVs which was ¥10 per 1 km drive. Their hydrogen will be sold for ¥1,100/kg. The price range makes a running cost of FCV at the same level as luxury sedan HVs. This is the first time in the industry that the retail price of hydrogen has been set for FCVs. FCVs potentially drive approximately 110 km with 1 kg of hydrogen, and approximately 10 km on 1 $m^3$ in volume which will be sold for ¥100. The price does not include tax or subsidy. Automakers and METI will support hydrogen filling stations by subsidizing operation costs to reduce the price. (The Yomiuri Shimbun, The Asahi Shimbun, The Mainichi Newspapers, The Nikkei, The Sankei Shimbun & Nikkan Jidosha Shimbun, November 15, 2014; The Denki Shimbun, The Nikkei Business Daily, The Nikkan Kogyo Shimbun & The Chemical Daily; November 17, 2014)

(5) Toyota

Toyota Motor will start supplying hydrogen as a fuel for FCVs. A venture will be established through Toyota Tsusho, a group member, to operate mobile hydrogen filling stations this year. Toyota Motor is considering direct investment in the venture. Although their first FCV will be released in December, they decided to prepare refueling facilities due to there being an insufficient number of hydrogen filling stations. A mobile filling station carries a tank to dispense hydrogen on a trailer, and can be placed in a small place, such as car parks of public and commercial facilities, for refueling. The operator will be capitalized in cooperation with Toyota Tsusho, Iwatani and Taiyo Nippon Sanso which produce mobile filling stations and Sumitomo Mitsui Finance and Leasing. The capital is expected to be a couple of ¥100 million. Sumitomo Mitsui Finance and Leasing will buy facilities from Iwatani and Taiyo Nippon Sanso, and then lease them to the new operator. Toyota Tsusho will secure locations for refueling facilities, and the operator will start its business in FY 2014. They plan to place refueling facilities in Tokyo and Nagoya areas as a start, and to open about three stations in the first year, preparing more afterwards. A mobile station costs ¥200 to 300 billion which is half that of a stationary one. The government subsidizes hydrogen filling stations including mobile facilities, and the operator will use the scheme. (The Nikkei, November 16, 2014)

In the spring of 2014, Toyota invested in a hydrogen filling station operator in the US. This is a part of their infrastructure preparation in the key markets such as Japan and the US. (The Nikkei, November 16,

2014)

(6) Honda

Honda will support First Element Fuel which prepares hydrogen filling station in California, USA with $13.8 million (approximately ¥1,600 million. First Element Fuel will use Honda's fund and subsidy from the state of California to install 12 hydrogen filling stations there. (The Nikkan Kogyo Shimbun, November 25, 2014)

—This edition is made up as of November 25, 2014—