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Nissan Developing Versatile Van for Business Using SOFCs Running on Bio Ethanol

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1. Governmental Measures

(1) METI

The Ministry of Economy, Trade and Industry (METI) will ease the regulations for ENE-FARM installed in apartment buildings under single package contracts for high voltage electricity that the building energy service provider instead of the residents signs the contract with grid power supplier to provide each household of the apartment building with electricity. Currently, these ENE-FARMs need to be inspected once every one to six months depending on the facility scale, but METI will change this regulation to once every four years with conditions. The law specifies the inspection period of electric facilities for private use, and the category for these fuel cells (FCs). The FC systems have to be checked more often than ones for apartment buildings under low voltage electricity contract and houses, and the ministry will adjust the imbalanced regulation. On July 13th, the Electric Power Safety Subcommittee of the Industrial Structure Council will hold a meeting, and the office will propose the change. Because ENE-FARMs installed at apartment buildings under low voltage electricity contract and houses fall in the category of the electric facilities for general use, there are no legally set inspection periods for these systems. Voluntary inspections are carried out by operators every 42 (three years and six months) to 126 (10 years and six months) months. The requirements for longer inspection period are as follows; 1) system to automatically stop when operating abnormally, 2) suitable operator such as product seller must inspect before restart from abnormal operation, 3) earth leakage circuit breaker must be installed in ENE-FARM and power panelboard and 4) back current from apartment units to other part of the apartment building must be prevented. Once the subcommittee agrees the proposal, opinions will be collected for revision draft in August before revising related announcement in September. Apartment buildings under low voltage contract and single package contract for high voltage electricity are obligated to have a checkup of interior wiring every four years. By the new amendment, ENE-FARM inspection of apartment buildings under single package contract for high voltage electricity can be carried out at the same time as checkup of interior wiring. According to METI, the failure rate of ENE-FARMs installed in apartment buildings under low voltage contract is going down to an average of once every seven years for each unit in FY2015. These failures occurred in electric substrates and communication between units, but no serious accidents such as electric shock or fire have taken place. (The Denki Shimbun, July 13, 2016)

METI will launch an organization to connect industry, academia and government of 10 Kanto prefectures and Tokyo to promote hydrogen energy use in August. About 200 organizations including Toyota Motor, Honda, Kawasaki Heavy Industries (KHI), Tokyo, and University of Yamanashi plan to join the new framework. This framework will promote preparation of testing facilities for hydrogen and FCs in the area and network between smaller producers of related parts/components and large firms for new product development. The Kanto Bureau of Economy, Trade and Industry will set up "Greater Kanto Area Hydrogen/FC Partnership", and will invite businesses and universities in the Kanto-Koshinetsu area and Shizuoka Prefecture. The new organization plans to

compile a supply and demand estimate and promotional roadmap for the area in this fiscal year. The framework will support connections between smaller business and large corporations and universities to provide better research environment for reduction in costs of hydrogen related products in the area. (The Nikkei, July 16, 2016)

Projects will start to develop and test "virtual power plants (VPPs)" that storage batteries, photovoltaic generators and FCs work as small power plants. METI chose seven testing plants by July 29. These projects with 38 organizational participants aim to achieve VPPs which are to allow increasing renewable energy use and instantaneously power shortage solutions. The ministry allocated about ¥3 billion in the budget for FY2016 to support these tests. Individual technologies to constitute VPP were developed in previous experiments of smart community, and the new projects will evaluate business models. (The Nikkan Kogyo Shimbun, August 2, 2016)

(2) MOE

On July 15th, the Ministry of the Environment (MOE) selected four projects of the area including Fukushima and Okinawa for the second invitation of the "Hydrogen Station Projects to Use Renewable Energy in Community". Included the first invitation of the project, hydrogen refueling stations will be constructed in 13 locations. This subsidy scheme promotes refueling stations which are to supply fuel cell vehicles (FCVs) with hydrogen produced using solar power and excess electricity. The projects in Oirase-cho (Kamikita-gun, Aomori Prefecture), Miyakojima City (Okinawa Prefecture), Minamisoma City (Fukushima Prefecture) and Hiroshima City (Hiroshima Prefecture) were selected for the second round. (Nikkan Jidosha Shimbun, July 16, 2016)

(3) MLIT

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) have started the second invitation of the Community Green Transport Project". This subsidy scheme will provide automobile transport operators with half the purchase cost of FC buses and taxis and one third of the purchase cost of electric taxis and trucks, including chargers. Plug-in hybrid vehicles (PHVs) and micro mobility are also subject to the scheme. The ministry will take applications until the end of August, and select projects for the subsidy. The application requirements are published in MLIT website. (Nikkan Jidosha Shimbun, August 9, 2016)

2. Local Governmental Measures

(1) Yamanashi Prefecture

Yamanashi Prefecture is developing technologies to store renewable energy by providing businesses with advanced testing environment combining the three power storage methods of capacitor, lithium-ion battery (LIB) and hydrogen for new technological development. Participants can carry out experiment of the new technology in a real environment for further development. Panasonic installed a pure hydrogen FC system, and has started a test operation of the system aiming for product release in 2020 or later. A solar power plant of 10,000 kW is located in Yonekurayama, the lowest mountain of 380 m height in the prefecture, and has 80,000 solar panels jointly installed by the prefecture and Tokyo Electric Power Company (TEPCO). Furthermore, Yume Solar-kan Yamanashi is located by the entrance of the power plant, and solely runs on combined power system of 20 kW solar panels on the building roof and 1.5 kW small hydro power generation using rain water. This facility is the testing environment for power storage technologies. The issue of being energy self-sufficient using renewable energy is the fluctuation of solar power production by weather. Mr. Sakamoto, a manager of the Electric Power Generation Division of prefectural Public Enterprise Bureau explained that different devices would be used for each type of fluctuation. Electric double-layer capacitors in the circuit work for instantaneous output change, fluctuation in short periods. Capacitors characteristically charge and discharge in an instance, which moderates output change on the spot. LIB is suitable for a large amount of power storage and will take mid-and long-term changes in power production. Once the LIB is fully charged, hydrogen will be produced by water electrolysis to convert renewable energy into hydrogen for storage. During power shortage, hydrogen will be sent to FCs for power production. This combination of storage battery and hydrogen is unusual for a method to moderate output fluctuations. Additionally, a project is underway to test

one of the world's largest scale flywheel energy storage near the testing facility. An improved 1,000 kW photovoltaic generator rotates the wheel to store renewable energy as kinetic energy. When more electricity is in demand, kinetic energy is used for power generation. One of the project members is the Railway Technical Research Institute which wants to use flywheel energy storage system for train operation to save energy. Yamanashi Prefecture aims to vitalize its economy by increasing the number of local businesses to join projects of power storage technologies. In the prefecture, electricity price has been discounted for these businesses, and these power storage projects are a trigger to revitalize the local economy. (The Nikkan Kogyo Shimbun, July 13, 2016)

(2) Osaka Prefecture

Mr. Ichiro Matsui, the governor of Osaka Prefecture, will visit Canada to have meetings with businesses and governmental officials related to FC and hydrogen energy in September. On September 15th, the prefecture will hold a seminar to introduce businesses of the prefecture in Toronto to promote hydrogen energy business through networking with North American businesses. On the same day, the governor will visit Hydrogenics, a producer of FCs in Ontario, with governmental officials of Ontario, and will go to Ballard Power Systems, a major hydrogen business in British Columbia, with officials of British Columbia on 16th. He will request these governments to support firms of the prefecture which want to start businesses in these states and the two Canadian companies to consider businesses with firms in the prefecture. In November, firms from the prefecture will make a visit for business meetings in North America. Requests of cooperation to the two Canadian firms and the governments at the visits in September are a preparation for the later business meetings in November. The businesses will be touring around North American cities of Vancouver, Los Angeles and Washington DC to hold the meetings. The prefecture will invite businesses to join the tour soon. The "International Conference on Battery and Hydrogen /Fuel Cell" will be held from 6th to 8th at Osaka International Convention Center. As well as the international conference, the prefecture aims to encourage business in Osaka to explore oversea markets. (The Nikkei, July 29, 2016)

(3) Aichi Prefecture

Aichi Prefecture announced that its application to propose self-service hydrogen refueling station that drivers fill their cars with hydrogen to the "Governmental Strategic Special Zone" that the Cabinet is currently inviting. Their aim is to promote FCVs. According to the prefecture, hydrogen must be filled by staff of the certified operators, but not users, at the moment. If users can refuel their FCVs, operating costs of these refueling stations will be reduced. This will also promote preparation of hydrogen refueling stations. The "regulatory reform plan" approved by the Cabinet in June 2015 indicates measures will be taken for self-service hydrogen refueling station as soon as a conclusion is made by 2018. The prefecture will request to practice self-service hydrogen refueling stations in a special zone to start with, if general reformation is difficult. (The Nikkei Business Daily, July 29, 2016)

Aichi Prefecture set up its own subsidy scheme for the purchase of FC forklifts to be commercialized this autumn, and has started to take applications. This subsidy supports one quarter to half of the price difference, maximum ¥5 million, from combustion engine cars, and will be added on top of the subsidy of MOE. These subsidy combined enables smaller businesses to purchase FC forklifts at the same price level as combustion engine ones. Aichi's scheme is the first local governmental subsidy for FC forklifts. Applicants must be operators which purchase FC forklifts in the prefecture, and be applicants of MOE's subsidy. The scheme will provide a quarter the difference for large firms and half the difference for smaller businesses. Planning to support five organizations, the prefecture expects a port and wholesale market with hydrogen refueling facilities for the winners. (The Nikkan Kogyo Shimbun. August 5, 2016)

(4) Tokyo

Tokyo will start making an operation plan of hydrogen infrastructure to be installed at the Olympic village for the 2020 Tokyo Olympics and Paralympics. The infrastructure is planned to continue the operation after the event, and this is a part of city planning to redevelop a whole town as a hydrogen community by preparing hydrogen refueling station, hydrogen pipelines, and FCVs in the Harumi area.

The local government will compile a draft of the "energy planning" in this year aiming to complete the project in FY2024. The study group for the "discussion on energy for Olympic village" has held the first meeting. (Nikkan Jidosha Shimbun, August 6, 2016)

3. FC Element Technology Development & Business Plans

(1) Brother

On July 8th, Brother announced that its first FC was developed. The FCs use hydrogen storage alloy to reduce degradation of fuel and the size and weight of the system. The firm expects the product to be a small emergency power source for urban areas, and has already started shipping sample products. A higher output FC system using a high pressure hydrogen tank will be developed in cooperation with a partner, and Brother plans to enter the market of products providing heat and power. The developed product is 700 W output polymer electrolyte fuel cells (PEFCs) using hydrogen storage alloy of the Japan Steel Works, fluoropolymer electrolyte membrane and platinum catalyst. The power generation and fuel units are separated, and the operation hours can be extended by adding fuel units. Each fuel unit can store 2 m^3 of hydrogen, and six units allow the system to operate one day. A water-cooling system is used to avoid voltage drop during long operation. The system can be one sixths of the volume and one quarters of the weight of a LIB at the same power output. Additionally, it can be fixed on a pillar to avoid flood damage. The operation temperature is set between -15 and 40 degrees. Although samples have been shipped, the firm also offers higher pressure hydrogen tanks. They will provide hydrogen supply and product maintenance with the partner. Their FC development has been underway for over 10 years through their subsidiary, and they are working on a system to provide heat and power in cooperation with Seiryu Power Energy which supplies pure hydrogen and Morimatsu Industry which provides building facilities. The product under development is planned to be developed into 1 kW level FCs with high pressure hydrogen tank. (The Chemical Daily, July 11, 2016)

(2) Seiryu Power Energy

On July 26th, Seiryu Power Energy in Gifu Prefecture signed the "Industry, Academia and Government Partnership to Realize Hydrogen Society" to develop a FC system to supply power and hot and cold water during emergencies in cooperation with Brother, Gifu Prefecture, Gifu University. The group aims to begin a demonstrational experiment in Yaotsu-cho by the start of 2017. Seiryu Power Energy, an energy venture, will work on the product plan. Morimatsu Industry will be in charge of the whole system including heat and water supply units. Brother will develop the FC unit. As support, Gifu University will give financial assistance, and Yaotsu-cho will provide the experiment location. The project plans to commercialize the system two to three years after the experiment in the town to be used at evacuation center such as governmental buildings. (The Nikkan Kogyo Shimbun, July 27, 2016)

(3) Tohoku University

Associate Prof. Hirotomo Nishihara and Prof. Takashi Kyotani at the Institute of Multidisciplinary Research for Advanced Materials of Tohoku University, has developed graphene sponge. The new product has 1,940 m^2 surfaces per 1 g, and has excellent conductivity and corrosion resistance. Even if it is squashed, it comes back in the shape. The team made a capacitor with it as an electrode, and the material showed double the energy density of activated carbon. They will try to sell the product as a material for platinum catalyst for FCs. Graphene is a sheet of a single carbon atom thickness. Carbon coats the surface of closely packed 5 nm diameter aluminum oxide particles to make a porous carbon sponge. Aluminum oxide particles are dissolved by sodium hydroxide, and the porous material is heated at 1,800 °C to make the graphene sponge. (The Nikkan Kogyo Shimbun, August 2, 2016)

(4) Shibaura Institute of Technology

On August 3rd, Shibaura Institute of Technology announced that it had succeeded in synthesizing carbon composite materials which lead to a reduction in FC costs. Nitrogen-doped carbon nanoparticles (NCNP) and carbon nanofiber (CNF) were made using a solution plasma processing. These materials exhibited a catalytic performance close to platinum doped carbon. The materials can be produced in normal temperatures at a low cost without using rare metals or special large facilities. The team expects a reduction in costs of domestic FCs and electric

vehicles (EVs) by using the materials as a cathode catalyst for next generation FCs and metal–air electrochemical cells. Further research will be carried out for product application and commercialization with businesses. (The Denki Shimbun, August 4, 2016)

(5) Toshiba

Toshiba has received an order for pure hydrogen FC system of 100 kW from Tokuyama, a general chemical producer. This is the first large scale pure hydrogen FC system of 100 kW for Toshiba to build to order. This FC system will be installed at a swimming pool in Shunan City, Yamaguchi Prefecture, operated by Tokuyama in February 2017. The operation will start in March. Because pure hydrogen FCs use hydrogen directly and efficiently generates electricity without emitting CO_2 unlike ENE-FARM which extracts hydrogen from natural gas. Toshiba previously used phosphoric acid fuel cells (PAFCs) in the system. However, the ordered system will use pure PEFCs which operate at low temperatures. This allows easy startup and stop and shorter startup time than PAFCs. The ordered system of 100 kW is the highest output in Toshiba's range, and can almost supply the entire facility with electricity including lighting and pump of the swimming pool. Hot water produced from power generation process will be used as supplemental heat for hot water of the shower. Tokuyama produces hydrogen in its sodium hydroxide plant, but hydrogen is currently unused. The system will use this hydrogen as fuel for its power generation. (Dempa Shimbun, August 9, 2016).

(6) Sumitomo Corporation

Sumitomo Corporation will start selling FCs for business which uses vehicles such as trucks and buses. They will sign a partnership with US Hybrid (USH), a FC manufacturer in California (USA). Being environmentally friendly, FCV, are already commercialized as consumer cars, and are expected to extend their use to business purpose. Sumitomo Corporation will advertise excellent durability of USH's FCs, and try to sell them to Japanese automakers. Their sales target is a couple of thousand units for vehicles by 2025. Business use vehicles are driven longer than consumer cars, and are required to last longer and be stronger. USH's FCs have withstood over 20,000 hour operation in a test in the US. Sumitomo evaluated that the FCs can operate in cold environments of −30 °C by optimally controlling water as the deciding factor for the partnership. Their stresses have been laid on automobile business, and a joint venture is operated in Mexico with Mazda. Expecting growth of the FC market, they aim for contract of battery sales with automaker producing vehicles for business use in Japan. USH group has about 30 years of experience in FC development, and has already supplied FCs for buses and truck in the states aiming for commercial production. Tokyo plans to use 100 FCVs for its bus operation, and the market of FCVs for business use is expected to expand. METI aims to increase the number of FCV in use in Japan from current 500 to about 800,000 by 2030. (The Nikkei, August 11, 2016)

4. Hydrogen Infrastructure Technology Development & Business Plans

(1) Toshiba

Toshiba has developed alkaline water electrolysis equipment which can produce hydrogen of 100 Nm^3, a fuel equivalent of two FVCs, in an hour. This hydrogen production capacity is the largest for alkaline water electrolysis systems in Japan. The manufacturer plans to start the sales in this fiscal year, and to sell the product for various hydrogen infrastructures by advertising the advantage of high hydrogen production capacity. Because an alkaline water electrolysis system uses no precious metals in the electrode material, the new product can use large electrodes at lower costs than the systems using precious metals. This makes the new product suitable for large scale operations. The manufacturer succeeded in optimizing whole energy efficiency while increasing the system size by combining its own technologies for rectifier and hydrogen refinement with alkaline water electrolysis. In fact, the system can operate in cold environment. High concentration of potassium hydroxide solution is used as the electrolyte to split water in the system, and does not freeze under sub-zero environments. Recently, hydrogen has expanded its use to including stationary FCs, FCVs, hydrogen power generation, and is expected to be produced on a large-scale to be used at facilities such as hydrogen refueling stations. The firm will try to accommodate a variety of hydrogen use by

providing production equipment using alkaline water electrolysis method which is suitable for larger scale systems. Also, a system to produce hydrogen at 35 Nm^3/h using the same method will be installed at Shoro dam in Hokkaido as a part of the "Community Low-carbon Hydrogen Technology Demonstration Project" that Toshiba contracted from MOE. In this project, the system will produce hydrogen using small hydroelectric power generation at the dam, and hydrogen will be used in Kushiro City. The firm will investigate convenience and reduction in environmental impacts by hydrogen supply chain through the experiment project. Apart from alkaline water electrolysis, a hydrogen production system is under development using steam electrolysis (SOEC) as a NEDO project. The firm is preparing suitable hydrogen production equipment for different purposes. (Dempa Shimbun, July 15, 2016)

(2) Showa Denko & Others

On July 19th, Hiroshima University, Showa Denko, National Institute of Advanced Industrial Science and Technology (AIST), Toyota Industries and Taiyo Nippon Sanso announced that they succeeded to develop technologies for production of high purity hydrogen for FCVs from ammonia. This is the world's first technology at a commercial level. The group is now investigating a process for system evaluation at Kawasaki Plant of Showa Denko. The technologies were developed for hydrogen refining, and production of a ruthenium catalyst for ammonia cracking and material to remove ammonia. Then, the group produced each piece of equipment using these technologies at a tenth the scale of commercial system to achieve the world's first production facility of hydrogen made from ammonia for FCVs. The system basically split ammonia into hydrogen and nitrogen mixture gas through a cracking unit. A trace of ammonia gas stays, and another equipment removes ammonia and nitrogen to make high purity hydrogen. The group aims to build a testing system to produce hydrogen at 10 Nm^3/h speed at the Kawasaki Plant by FY2018. Commercial hydrogen refueling stations using ammonia require a 300 Nm^3/h production level. Because hydrogen is found in a gas form under normal temperatures, its storage and transport is a big issue. On the other hand, a single molecule of ammonia has three hydrogen atoms, and stays in a liquid form under normal temperatures. This property makes ammonia to be a promising hydrogen energy carrier. (The Nikkan Kogyo Shimbun & The Chemical Daily, July 20, 2016)

(3) Tohoku Electric Power Company

On July 19th, Tohoku Electric Power Company announced that it started construction of a hydrogen production system to expand renewable energy use at its research and development center. The land work started on the day. In October, equipment for the hydrogen production system will be delivered and installed. The hydrogen production research will start using a photovoltaic generator in March. The research project will last for two years until March 2019. The firm is carrying out an experiment on the grid with a large scale storage battery installed for expansion of renewable energy use. As well as storage battery, they will study hydrogen production expecting similar effect. Power from photovoltaic generator will be used to produce hydrogen to be stored. Hydrogen will be used as fuel for power generation to be consumed in the research and development center. The system will be installed on the premises of the research and development center, consisting of photovoltaic generator on the roof, storage battery in a container outside, water electrolysis hydrogen producer, tank made of hydrogen storage alloy and FCs. The installation area is about 400 m^2. (The Denki Shimbun, July 20, 2016)

5. ENE-FARM Business Plan

The Japan Gas Association has compiled the total generation capacity of the installed natural gas cogeneration facilities for FY2015 which is 5,147 MW, a 2.0% (101 MW) increase of that of the previous year. The accumulated number of installation was 260,579, a 12.9% (29,843). Domestic use is 217 MW, an 8.1% (16 MW) increase of that of the previous year. ENE-FARM was installed more in newly built houses and apartments. (The Denki Shimbun, August 2, 2016)

6. Cutting Edge Technology of FCVs & EVs

(1) Sapporo Toyopet

On June 30th, Sapporo Toyopet brought Toyota's "MIRAI" to Sapporo Science and Technology College, a vocational school for auto mechanics, to show FCV

technology to the students. Their aim is to offer an opportunity for direct experience of FCV to understand the latest technology better. This is the first time for the car dealer to give a visiting lecture using FCV at this type of vocational colleges. The lecture was open to the students in the second-class mechanics course. The manager of the Service Group of the Service Division gave the lecture explaining MIRAI's characteristics including Toyota FC System (TFCS) combining hybrid and FC technologies, power generation system of FCs and usage as emergency power supply during disasters. Students asked typical questions as young future auto mechanics such as "how to service FC stacks". They were also surprised, and gave impressions such as "bigger than expected" and "heavy looking car". The car dealer lent the FCV for display at open campuses of the Hokkaido Automobile College and the Junior College of Hokkaido University of Science in June for free. The vehicle will be lent for the open campus of the Sapporo Science and Technology College to be held on July 31st. (Nikkan Jidosha Shimbun, July 6, 2016)

(2) Toyota

On July 12th, Toyota Motor announced that three FCVs of MIRAI will be in experimental use in Australia. Their aim is to promote and advertise FCV in the country through the test driving. They will prepare a mobile hydrogen refueling station which can be installed on the ground or rear deck of a truck at the end of this year, and will bring the cars to a variety of locations to make more people know FCV. MIRAI is sold in the US and Europe as well as Japan, and its market is expected to grow faster in the areas where the environmental regulation is tighter in the world. Australia is likely to go greener in the near future. Toyota plans to draw opportunity of infrastructure preparation by rising publicity. (The Nikkei Business Daily, July 13, 2016)

(3) Tesla

US-based EV producer Tesla Motors、Inc. is preparing quick chargers to refuel its products for free in Japan in haste. On July 17th, a charging station started its operation at the service area of the expressway in Hamamatsu City. The number of their charging stations is 11 in total. The new station has connected the network of quick recharging facilities from Morioka to Okayama, "which enables their EVs to drive the whole of Honshu solely using these quick chargers". The charging facilities are named "Super Charger", and have been prepared in places including the US. The charger installation started in Japan in September 2014. The charger can recharge an empty battery to the level that the EV can drive 250 km in 20 minutes. The firm already installed these chargers in four locations including the one in Hamamatsu City this year. "Installation will be carried out at two more locations in this year", said Mr. Nicolas Villeger, the president of the Japanese arm. (The Nikkei, July 18, 2016)

On July 20th, Tesla Motors revealed the intention to "expand its range to major types of EVs" including buses and trucks. While there are no prevailing eco cars in the market, the firm aims to take a lead in the EV market by expanding the range. The details of their electric bus and truck will be announced next year to start taking orders. Their development will also expand to pickup trucks and small sport utility vehicles (SUV). The bus will be designed to fit as many passengers as that of a conventional bus while remaining reasonably small; for example, seats are to be installed in the center where the aisle normally is allocated. Also easy access to the exit from back seats by optimizing the position and opening of the door is estimated to be realized. EV has a simpler structure and a significantly smaller number of parts/components than engine driven car. This is the enabling factor for the firm to expand their range in a short term. The basic design will be shared among their EVs, and they will produce the core components such as storage battery on their own. Mr. Elon Musk, the CEO, says that "their production is planned to become five to ten times more efficient every two years by volume effect and automation." They produced about 50,000 passenger EVs last year, and aim for 1 million EVs by 2020. (The Nikkei, July 22, 2016)

On August 3rd, Tesla Motors revealed the sales result for the term from April to June which is $1.27001 billion (about ¥128 billion), a 33% increase of that of the same term of the previous year. The sales of SUV "Model X" shipped from the end of last September gave a push. However, upfront investment for product development and production facility ate up the profit, and the final profit and loss ended $0.29318

billion ($0.18422 billion in red for the previous term) in red. The profit margin increased by adding Model X with its higher price, and their total number of orders rose by 67%. Model X takes about one third of the whole orders. There was a concern that the production speed of Model X was possibly stunted, but the estimate for the annual production is about 84,000 EVs which fits in with the previously announced shipping estimate of 80,000 to 90,000. They successfully increased the production for the quarter by 18% of that of the previous term. On the other hand, the shipping went down by 15% of the previous plan. They aim for an annual 500,000 vehicle production by 2018. (The Nikkei, August 4, 2016)

(4) Research & Development Cost of Japanese Automakers

The research and development costs of seven Japanese passenger vehicle manufacturers is expected to be ¥2.8 trillion for FY2016, a record high. These automakers have added autopilot and next generation eco cars (EV/FCV and PHV rechargeable at home are promising eco cars) to their research and development targets to accommodate tightening environmental regulations. The total expense will increase by nearly ¥1 trillion from FY2009, shortly after the market crush caused by Lehman Brothers. The amount of investment difference between large and medium firms is expanding, and investment margin may be the key for reorganization opportunity. The investment in research and development of automobile industry takes one quarter of the manufacturing industry, and significantly affects to the trend of next generation technologies. The development costs of Toyota including consolidated subsidiaries such as Daihatsu is expected to be ¥1.08 trillion, a 2.3% increase, which is higher than oversea car producers such as US based GM and German-based Daimler which spend ¥0.8 to 0.9 trillion each year. Toyota is also working on PHVs which are rechargeable through domestic wall sockets to accommodate stricter environment regulations as well as FCV which is determined its key eco car. Their research and development budget has increased by about 20% of that of FY2006. On the other hand, their facility investment is reduced to ¥1.35 trillion for FY2016, about 10% decrease. Having changed their strategy, they are shifting more of their operation resource to the intellectual property area. Nissan Motor will increase the development cost by 5.3% of that of FY2015 to solve the current issue of rechargeable electric cars by adding FCs using bio fuel to them to extend the driving range. Honda's development cost will go down by 4.1% due to the effect of new car development. However, they will launch a laboratory to research artificial intelligence (AI) for autopilot in the center of Tokyo to expand partnership with external research organizations. (The Nikkei, July 18, 2016)

(5) Toyota Industries

On July 25th, Toyota Industries announced that the first Japanese FC forklift would be released this autumn. They made the cells of Toyota MIRAI smaller for the forklift which takes 2.5 tons. Refueling takes three minutes. The forklift will sell for ¥14 million excluding sales tax. Governmental subsidy will support purchasers with a maximum of ¥5 million until FY2018. Aichi prefecture will also provide subsidy separately. In this fiscal year, the manufacturer aims to sell 20 to 30 FC forklifts to businesses which have hydrogen refueling facilities. The development of this FC forklift started in 2004 in cooperation with Toyota, but is now carried out solely by Toyota Industries. The forklift manufacturer has reduced the cost of FC forklift by using the design of its rechargeable forklifts as much as possible except cells. The continuous output is 8 kW, and the maximum output is 32 kW. The forklift can operate eight hours continuously, which is the same as their rechargeable version. The hydrogen filling pressure is 35 MPa, and the tank takes 1.2 kg of hydrogen. The FC forklift can be used as a power source of AC 100 V, and is subject to the "Promotion of Industrial Use FCV to Realize Hydrogen Society" of MOE and MLIT. In the US, rechargeable forklifts have been converted into FC forklifts, and already 9,000 FCVs are in operation in large warehouses. The manufacturer will study the oversea market for a while for global sales of its FC forklift. (Nikkan Jidosha Shimbun, July 27, 2016)

(6) Daimler

On July 27th, German-based Daimler, the world's largest commercial vehicle producer, revealed a large truck solely running on electricity for the first time in Stuttgart in southern Germany. The truck weighs 26

tons, and can drive 200 km with the maximum load. Mitsubishi Fuso Truck and Bus, a group member of Daimler, is testing a small electric truck of six tons in Europe, but the new one is the first large electric truck revealed in the world. Passenger vehicle is leading in electrification. Environmental regulations are getting stricter for diesel cars in urban areas to reduce air pollution, and Daimler aims for commercial production of the truck for large scale transportation in urban areas in 2020 or later. The truck is named "Urban eTruck" and has 2.5 tons of LIB which outputs 100 kW. It takes two to three hours to recharge the battery fully. (The Nikkei, July 28, 2016)

(7) Nissan

Nissan plans to end its automobile battery business for EVs. They have started discussing with battery producers in Japan and China to sell their joint venture with NEC. Their strategy has changed to purchase batteries from other manufacturers, and they determines this would reduce the price more than producing own batteries. Since automobile batteries are more in demand for full growth of electric powered car market, the structure of battery industry seems to be reorganized at a faster speed. The venture to be sold is Automotive Energy Supply (AESC) which was established in cooperation of Nissan and NEC in 2007. The venture produces LIBs for Nissan's EV "LEAF" and hybrid vehicles (HVs), and has the second largest share in the global automobile LIB market after Panasonic. Their sales were ¥36.6 billion for the term ending March 2016. At the time Nissan started to develop EV, the number of automobile battery manufacturers is limited, and they needed to develop and produce their own battery. "LEAF" has sold about 230,000 vehicles in total at the end of June 2016 from its release in 2010. To be fully fledged in the market, Nissan needs to reduce the cost of the battery. However, supplying batteries solely to Nissan only creates a limited volume effect to the venture. The automaker decided to leave the battery production to highly specialized external suppliers. (The Nikkei, August 6, 2016)

On August 4th, Nissan announced that a prototype of a car running on electricity generated using bio ethanol was developed. This prototype uses "e-Bio Fuel Cell" which is a FC system developed by Nissan. This system uses a solid oxide fuel cell (SOFC) which achieves a highly efficient electricity production using reaction of oxygen and a variety of fuels including ethanol and natural gas. The system is the world's first to power automobiles using this type of FCs. The automaker will carry out a field test of the prototype on public roads in Brazil to evaluate the technology and to study marketability of the product. This prototype uses "Nissan e-NV200" which is a van for multi-business purpose solely running on electricity as its base, and adds power generation system using ethanol as the fuel to be a special model. Electricity generated by SOFCs is stored in a battery with 24 kWh capacities to achieve over 600 km driving range. The manufacture aims to commercialize this FC system by 2020. Bio ethanol produced from sugar cane and corn is widely available and used in many regions including the US, South America and Asia. Supply infrastructure is prepared in Brazil. "The infrastructure for this type of car is less limited, and the market of these cars is highly likely to grow in the future." Mr. Carlos Ghosn, the chairman of Nissan, says (The Denki Shimbun, August 8, 2016)

7. FCV Parts & Components Development

Sanno will commercialize hydrogen permeable membranes under development for fuel reforming equipment, and expand the usage to hydrogen detection sensors of FCVs. The commercial production of the product is planned to start by FY2020 as a material of sensors to improve safety of FCVs. The firm is working on a reduction in cost and durability improvement of the permeable membrane which extracts high purity hydrogen from methane gas and ammonia, and plans to start shipping samples to equipment producers in this year. Reductions in costs and pressure resistance improvement were achieved by using porous nickel to support palladium. The firm will use the technology for hydrogen detection sensors which monitor temperature changes using an oxidation catalyst and high thermal conductivity. High precision is required to detect a very small quantity of hydrogen in air. Because noise and degradation of sensor element can disturb the performance to detect a slight hydrogen leak, sensor design is recently getting more complicated. However, a hydrogen leak can be directly detected by coating the sensing part with a hydrogen permeable

membrane. This system allows the detection of very small leaks, which leads to reduction in cost of sensors. (Nikkan Jidosha Shimbun, July 11, 2016)

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