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9 April 2018

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Cross-Sector

Push for alternative-fuel vehicles presents challenges for Japan Inc.

» **The push toward alternative-fuel vehicles poses a credit challenge for multiple sectors in Japan.** Over the next decade, Japanese auto manufacturers and associated industries, which we refer to as Japan Inc., will make sizable upfront investments in alternative-fuel vehicle technologies while bearing risks around the scale and speed of this vehicle take-up. The risks of miscalculating this transition are substantial.

» **Electrification will have widespread effects on key industries.** The credit impact on Japan Inc. is weighted to the negative because of the challenges facing the large auto sector, and the direct impact on sectors such as steel and refining. Lower gasoline consumption will also reduce a meaningful source of government tax revenue, which funds road construction and public works programs.

» **Ramping up of alternative-fuel vehicles may squeeze automakers' already thin margins.** R&D costs and capital investment will increase, but the return is uncertain. In addition, the entry of new carmakers increases competition, while emerging technologies take automakers beyond their core competencies and toward new business models.

» **Growth in alternative-fuel vehicles, however, will create new demand for electronics, chemicals and integrated-utility companies**. Demand for new electric devices, motor and battery-related businesses will play to the technological strengths of some electronics and chemical companies, and for others, offset the revenue declines in their mature products. Chemical companies that manufacture components used in lithium-ion batteries will benefit from increased demand. Incremental demand for electricity to charge vehicles will partly mitigate a demand decline from a shrinking population, energy conservation and customer losses from deregulation.

» **Effect on auto-parts suppliers is mixed.** Suppliers of parts related to conventional gasoline engines will see a large decline in demand. But companies that provide essential parts to leading global automakers, such as glass, tires and air-conditioning units, will see little effect.

» **Steel-makers face potential reduction in demand and more competition.** Steel, the key material in automaking, will face increased competition from aluminum and carbon fiber as automakers seek lighter-weight options to offset the weight of an electric battery.

» **More alternative-fuel vehicles will exacerbate already falling demand refiners are seeing for gasoline.** The steady decline in refined oil demand will accelerate with an increase in fuel-efficient vehicles and a decrease in Japan's driving population.

Alternative-fuel vehicles will have significant effects on key Japanese industries

The push toward alternative-fuel vehicles[1] poses a credit challenge for multiple sectors

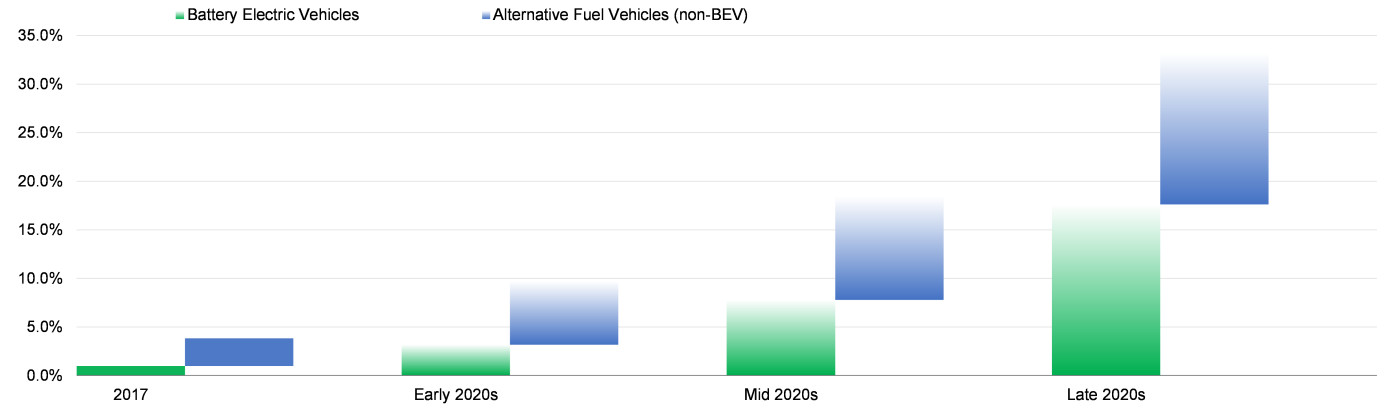
Over the next decade, Japanese automobile manufacturers and associated industries will make sizable upfront investments, hedging their bets on an array of alternative-fuel vehicle technologies – hybrids, electric batteries, fuel cells – while bearing the risk that these vehicles may ultimately not be taken up by the market. Automakers need to enhance their offerings of alternative-fuel vehicles to comply with tightening emissions requirements around the world.[2] Changes in consumer preferences amid growing concerns around climate change, and technological innovation related to electrification and charging infrastructure are also driving the push for alternative-fuel vehicles.[3]

We estimate battery electric vehicles (BEVs) and other alternative-fuel vehicles such as hybrids, plug-in hybrids and fuel-cell vehicles could account for around 35% of new vehicle sales globally by 2030, increasing from less than 5% in 2017[4] (Exhibit 1). However, automakers and their suppliers face risks over the scale and speed at which such vehicles may be taken up. Both a slower and faster than expected take-up rate would have negative implications for these companies, depending on their own strategy.

Exhibit 1

BEVs could be a small portion of vehicle sales through the mid-2020s, then ramp up

Estimates of BEV and non-BEV alternative-fuel vehicles as a percentage of global sales



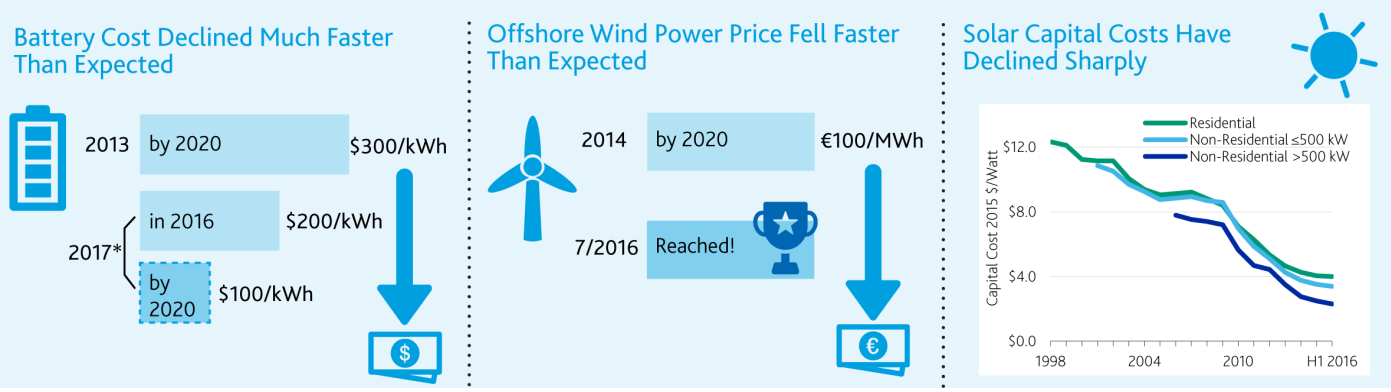
Source: Moody's Investors Service estimates based on regional estimates of penetration rates, weighted by the region's current relative contribution to total automotive sales

Penetration rates of BEVs and other alternative-fuel vehicles vary by region. For example, we estimate all alternative-fuel vehicles will account for about 60% of total unit sales in Japan by 2030, with BEVs representing roughly 10%. Nonetheless, Japanese automakers need to adapt to trends in global markets given domestic sales account for only 10%-20% of total unit sales.

At the same time, one of the biggest risks is of the uncertainty in the forecasting itself, which makes it very challenging for automakers to adopt a strategy that ensures they remain competitive and profitable. The speed of adoption of renewable power, for example, has consistently exceeded forecasts and the same could occur with BEVs (Exhibit 2).

Exhibit 2

Forecasting technology trends is extremely difficult[5]



Note: Battery costs for 2017 are for GM and Tesla.

Source: Battery Cost - IEA Global EV Outlook; Offshore Wind Power - Dong Energy[6]; Solar Capital Costs - Lawrence Berkeley National Laboratory, Tracking the Sun IX: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States

Move toward electrification will have widespread effects on Japan's economy

Japan is home to nine major passenger carmakers, including some of the largest corporates in Japan: Toyota Motor Corporation (Aa3 stable) and its fully owned subsidiary Daihatsu Motor Co., Ltd.; Nissan Motor Co., Ltd. (A2 stable) and its 34%-owned affiliate Mitsubishi Motors Corporation; Honda Motor Co., Ltd. (A2 stable); Suzuki Motor Corporation; Subaru Corporation; Mazda Motor Corporation and Isuzu Motors Limited.

These automakers are a bellwether sector that has significant influence on suppliers upstream and distributors and service providers downstream. Although the automotive and related industries represent only 2%-3% of the national GDP because much of their production is located overseas, they are associated with many other industries such as car dealers, shipment providers, and suppliers such as auto parts and steel-makers. Those associated industries collectively account for nearly 10% of the Japanese work force, 20% of shipment by value and capital spending, and 25% of R&D expense and export by value, within all manufacturing industries in Japan.[7] That said, parts of the supply and customer chain will be largely unaffected by the switch to EVs as we explain below.

Credit impact could be negative for many Japanese sectors

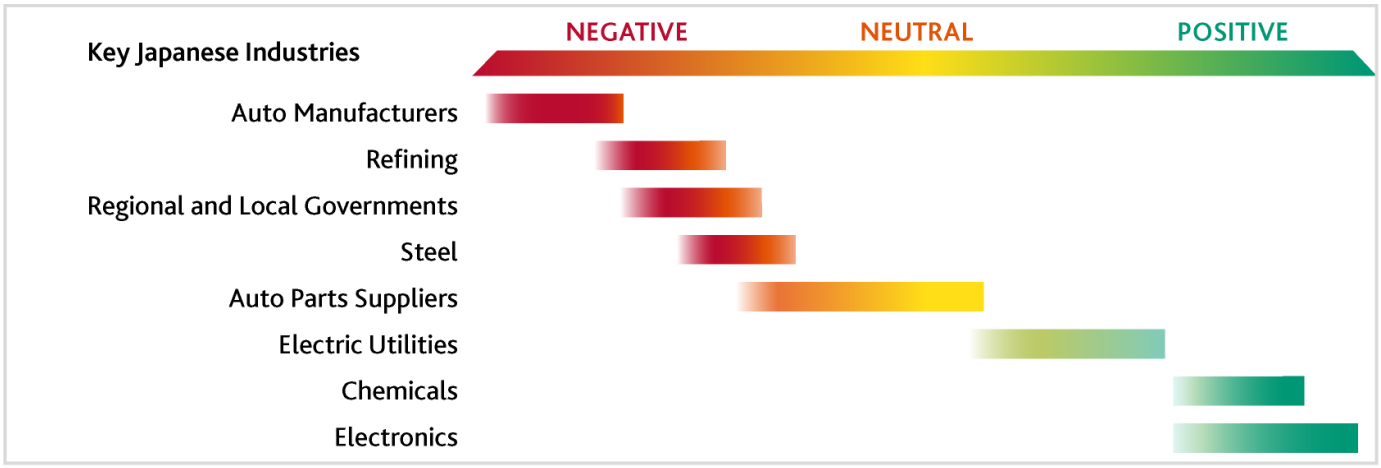
The shift toward alternative-fuel vehicles presents significant challenges to Japan Inc. particularly because of the pressures on the dominant auto industry and the negative impact on sectors such as steel and refining, as well as an indirect ripple effect on others such as the regional and local governments. The more immediate risk is the need to increase investments in an array of technologies and new businesses that may not produce an appropriate return for a while, if ever. Some sectors stand to lose if demand for their products or services declines because of electric vehicles and emerging mobility trends, such as ride-sharing.

Event risk and leverage levels could rise if companies turn to acquisitions to stay competitive. Operational risk could also increase as automotive technologies, such as automatic driving systems, advance and require an increased level of tie-ups and cooperation among automakers, auto-parts producers and technology companies, making business models more fluid.

For certain other sectors, the push for alternative-fuel vehicles is credit positive

Demand for new electric devices, motor and battery-related businesses will play to the technological strengths of electronics and chemical companies, and for others, may offset the revenue declines in their mature products (Exhibit 3).

Exhibit 3
Effects of alternative-fuel vehicles are biased toward the negative
Illustrative credit impact by sector in Japan



Source: Moody's Investors Service

Auto manufacturers – credit negative

Ramping up alternative-fuel vehicles may squeeze automakers' already thin margins

Rising R&D costs and capital investment needed[8] to transition from conventional gasoline-engine vehicles to alternative-fuel vehicles may stress the already thin profit margins of Japanese automakers. The average margin for the automotive business of rated Japanese automakers has been a single-digit percentage during the past several years, which is already low for their ratings (single-A and above).

Automakers are making costly investments to expand their offerings of alternative-fuel vehicles while bearing the risk that these vehicles may not be taken up by the market. These investments include R&D in next-generation batteries to guard against market adoption of a competing technology that would disrupt the automakers' franchises. These companies must also customize their alternative-fuel car product lines to meet various emissions standards around the world. Rated Japanese automakers have increased their R&D and capital spending at a pace in line with their sales growth thus far. But increased spending would require offsetting steps such as further cost cuts or increased production efficiency, both of which would be challenging.

Japanese automakers have a technological head start in mass marketing alternative-fuel vehicles, and their sunk R&D costs help to lower their cost base. Toyota and Honda have sold hybrids for about 20 years, while Nissan has been selling battery electric cars for about a decade. These companies can apply their existing battery and motor technologies toward developing new battery electric vehicles.

Toyota and Honda lagged their European counterparts in embracing battery technology, having focused instead until recently on fuel cells. But Toyota in 2017 announced its aim to sell more than 5.5 million alternative-fuel vehicles by around 2030, up from 1.5 million in 2017, with more than 10 battery electric vehicle models to be introduced by the early 2020s. The plan brings it in line with Volkswagen Aktiengesellschaft's (A3 stable) target of 3 million battery electric cars by 2025. Honda aims to raise alternative-fuel vehicles to two-thirds of its unit sales in 2030, from less than 5% we estimate for fiscal 2017. Nissan aims to develop eight new BEV models and sell one million electrified vehicles, including pure BEVs and those with e-POWER – its unique hybrid powertrain, annually by the fiscal year ending March 2023. Alternative-fuel vehicles[9] now account for about 5% of Nissan's current global unit sales or roughly 300 thousand units per year.

Alliances like Nissan's abound as automakers seek to spread the costs and risks of these investments with their peers or technology companies. Toyota has established a battery electric vehicle joint venture with Denso Corporation and Mazda in September 2017, which is then joined by Daihatsu, Suzuki Motor, Subaru and Hino Motors. Honda and Hitachi, Ltd. (A3 stable) established a joint venture to manufacture and sell electric vehicle motors in Japan, China and the US.

The field is getting more competitive with nontraditional carmakers like Tesla, Inc. (B3 negative). In China, passenger vehicle makers are ramping up their BEV investments and product introductions and BEV-focused start-ups and joint ventures are being established, intensifying competition in the world's largest automotive market. This trend is reinforced by the regulation that comes into effect in April 2018, which incentivizes passenger vehicle makers to increase the production of fuel-efficient vehicles and "new energy passenger vehicles" including plug-in hybrids, pure battery electric and fuel cell passenger vehicles[10]. These new BEV-focused passenger vehicle makers can enter the market because making electric passenger vehicles has a lower barrier to entry, needing far fewer parts than internal combustion engine passenger vehicles. These new entrants are challenging the established automotive business model in Japan and the value proposition of the traditional automakers' products.

Car electrification is not the only technology shift automakers face

In addition to propulsion technology, automakers are compelled to invest in ancillary technologies to stay competitive and to hedge against disruptive technologies that could change their business models, such as autonomous driving, connectivity applications and ride-sharing.

Advances in autonomous driving require additional high-tech features involving artificial intelligence and connectivity. These technological requirements take carmakers beyond their core competency and encourages alliances with technology companies. Advances in autonomous driving can also facilitate the take-up of ride-sharing services. As a hedge against ride-sharing reducing future car demand, the three rated Japanese automakers are investing in ride-share services, joining the ranks of tech companies like SoftBank Group Corp. (Ba1 stable). Such nontraditional investments can affect the automakers' business profiles and credit quality over time, possibly increasing credit risk.

In addition, higher adoption rates of alternative-fuel vehicles including BEVs can cause a decline in demand for traditional combustion engine cars and pressure used-car prices for these cars when adoption rates accelerate in the mid-2020s.[11] This could lead to losses on the residual value (RV) of leased cars and cars sold with lease-like contracts – a key factor affecting the margin of an automaker's captive finance business. In the domestic market, Toyota transfers a large part of its RV risk to car dealers outside the group, but declines in residual value could affect Nissan and Honda's domestic captive operations.

Increased RV risk can also affect balloon payment auto loans backing asset-backed securities (ABS) in Japan. Alternative fuel vehicles, especially BEVs, have higher uncertainty on their RV owing to lower predictability of their value proposition relative to internal combustion engine vehicles and short sales records. BEV's value proposition is harder to predict due to the range anxiety, their reliance on government supports and the technology advancement that could significantly affect the price of existing BEV models[12]. This could lead to higher risk for the auto loan with balloon payment using BEVs as underlying assets as sales of BEVs grow in future, although BEV-backed auto loans have constituted only a very small portion of pools in ABS we rate to date.

Auto-parts suppliers – mixed credit impact

Gasoline-engine parts face a decline, while non-propulsion parts will see little effect

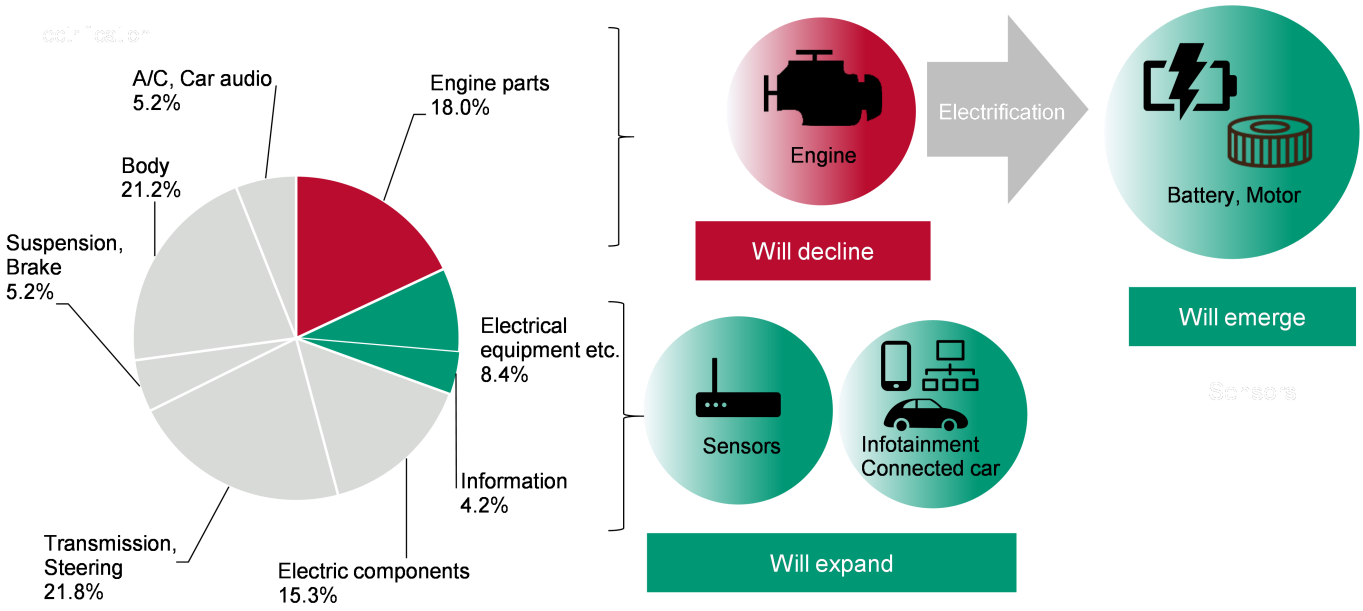
Suppliers whose business are concentrated on gasoline-engine parts will see a large decline in demand. The conventional gasoline-fueled internal combustion engine requires a huge number of complex parts which account for a meaningful portion of the overall auto-parts industry (Exhibit 4). BEVs have a more simplified structure and certain parts used in traditional engines will become unnecessary.

Still, companies we rate that provide other essential auto parts will be little affected by electrification. Examples include Asahi Glass Co., Ltd. (A2 stable), an automotive glass supplier, Bridgestone Corporation (A2 stable), the world's largest tire manufacturer, and Toyota Industries Corporation (A1 stable), a leading maker of car air-conditioning compressors.

Exhibit 4

Demand for gasoline-engine parts, which accounted for nearly 20% of shipment value, will decline, while demand for batteries and motors for electric engines is emerging

Gasoline auto-parts sales breakdown in Japan, fiscal 2016



Source: Moody's investors Service, based on "Trend of Japanese Auto-Parts Shipment Value" by the Japan Auto Parts Industries Association

Electronics – credit positive

Electronics companies are the clearest beneficiaries of auto electrification

Electronics companies are finding an entree into the auto-parts sector, as their sensor and camera technologies find new applications in car electrification and autonomous driving. Increased demand for electronic devices, motor and battery-related components will play to the electronics companies' technological strengths and offset the revenue declines in their mature products.

This emerging auto-parts business will be credit positive for electronics companies that forge successful tie-ups with automakers. Contracts with these investment-grade customers are long-term and produce stable cash flow. Compared with many consumer products, auto parts have a longer product life cycle, starting with the respective design-in periods for the development of a car model. Once launched, a car model remains in production for at least two to three years, requiring the associated auto parts over that time.

The global auto-parts industry will become increasingly competitive in the next decade with suppliers needing to show the quality of their technology and reliability of their supply chains to establish relations with automakers. Japan's electronics companies can improve their market position, based on the high quality of their products and substantial resources capable of providing a stable supply of materials to the major Japanese automakers.

We expect electronics companies to enhance their presence in three categories: powertrain, autonomous driving and infotainment.

Powertrain. Panasonic Corporation (A3 stable) is one of the most aggressive electronics companies entering the auto-parts business with a focus on car batteries. The company is already the world's largest automotive-battery manufacturer, thanks to its partnership with Tesla. Hitachi, Ltd. (A3 stable) has also established its auto-parts businesses, such as motors, inverters and lithium-ion batteries. Nidec Corporation (A3 stable) has been leveraging its motor technology for traction motors, a core part of electric vehicle powertrains. In December 2017, Nidec announced a joint venture with Groupe PSA, parent of Peugeot S.A. (Ba1 stable), for the electric vehicle traction motor business.

Autonomous driving. Hitachi plans to increase sales of autonomous-driving products and strengthen its market position as an auto-parts supplier. Sony Corporation (Baa2 stable) is trying to expand the uses of its image sensor technology that it had originally developed for smartphone cameras. Although auto parts is still a nascent business for Sony, a successful diversification from its current

reliance on smartphones will be credit positive. TDK Corporation (A3 stable) is also focusing on its sensors businesses with a wide range of products such as magnetic, temperature and pressure sensors.

Infotainment. Panasonic has developed in-vehicle infotainment, e-cockpit and advanced driver assistance systems using digital technology, building on its strength in digital consumer electronics. Increasing demand for driver connectivity will be positive for manufacturers of wiring harnesses, electronic components and devices, such as Sumitomo Electric Industries (A1 stable) and TDK.

At the same time, we expect vehicle electrification will promote a gradual weakening in the relationship between automakers and their long-standing auto-parts suppliers. Automakers rely on specific suppliers often affiliated with the same group of companies with intertwined business relationships, known as the "keiretsu" system. These established supply chains formed a high barrier to entry and helped to ensure demand for the suppliers' businesses. These ties will erode if the need for these parts declines and car companies form new ties with companies that make electronics and other supplies for electric cars.

Steel – credit negative

Steel-makers face potential reduction in demand and more competition

Steel is an essential material for autos, accounting for around 70% of the total weight of Japanese-made vehicles. The shift from the conventional gasoline engine to an alternative-fuel-powered electric motor will reduce the amount of steel needed for engine-related parts, although the decline will be partially mitigated by new demand for steel sheets in electric motors.

Steel-makers like Nippon Steel & Sumitomo Metal Corporation (Baa1 stable) and JFE Holdings, Inc. (Baa2 stable) also need to respond to automakers' requirement to reduce the weight of steel in cars, while dealing with intensifying competition from alternative materials. Automakers are seeking to lighten vehicle frames to save energy and lower emissions. Alternative materials, such as aluminum and carbon fiber, while lighter than traditional steel, are currently much more costly.

We believe changes in materials used in vehicle production will be gradual, as automakers replace materials part by part. For the near future, Japanese steel-makers will maintain a cost advantage and reputation for reliability especially with Japanese automakers. In the meantime, Nippon Steel & Sumitomo Metal and JFE are expanding their offerings of lightweight, high-tension steel designed to optimize motor efficiency.

Chemicals – credit positive

Chemical companies see growth opportunities in components for cars of the future

Japanese chemical companies have revenue growth potential from materials and small components for rechargeable batteries and electronic devices used in electric vehicles. Asahi Kasei Corporation (A2 stable) is the world's leading supplier of separator film used in rechargeable batteries for battery electric vehicles. Sumitomo Chemical Company, Limited (Baa2 stable) is also a major supplier of such separators. In addition, Sumitomo Chemical is expanding production of cathodes, an important component in lithium-ion batteries.

Vehicle electrification is also a boon for small components suppliers. Growing use of semiconductors and motors installed in electric vehicles will increase demand for silicon wafers and rare-earth magnets, respectively. Shin-Etsu Chemical Co., Ltd. (Aa3 stable) is the world's leading provider of silicon wafers and a major producer of rare-earth magnets.

Another positive aspect is the growing demand for high performance synthetic resins used in car components as a replacement for heavier metals. Lightweight materials are an important property for automakers, which are seeking ways to offset the heaviness of an electric car battery. DIC Corporation (Baa2 stable) is one such beneficiary.

Refining – credit negative

More alternative-fuel vehicles will exacerbate the already falling demand refining companies are seeing for gasoline

Demand for refined products has been falling steadily in Japan because of a declining population combined with the increasing use of fuel-efficient vehicles and the government's push to expand alternative-energy sources. More alternative-fuel vehicles would further reduce demand, which is credit negative for refining companies including JXTG Holdings Inc. (Baa2 stable).

Oil refineries around the world[13] face weakening demand for gasoline as a result of an increase in alternative-fuel vehicles. But Japan's refining companies are also seeing a structural decline in demand from a decreasing and aging population. Japan's population has been steadily shrinking after peaking in 2010 at 128 million, and the government estimates the population will fall to 92 million in 2055. Japan is also aging rapidly. An estimated 39% of the population will be more than 65 years old by 2055, up from 23% in 2010.[14] We expect the demographic trend will cause a decline in Japan's driving population, exacerbating the decline in gasoline demand.

The Japanese government has stepped up the pressure on refiners to collectively deal with the problem of refinery overcapacity. With a 55% share of Japanese refining capacity, JXTG is in a position of strength compared with its smaller peers to trim its capacity without impairing its economies of scale. It is also seeking new business opportunities such as selling hydrogen for fuel-cell vehicles, electrical conducting materials for EVs, and electricity.

Regional and local governments – credit negative

Lower gasoline consumption will reduce a meaningful source of tax revenue for Japanese regional and local governments

Taxes related to car and gasoline sales are an important source of income, accounting for about 8% of regional and local governments' (RLGs) total tax revenue in fiscal 2017. These taxes, particularly gasoline-related fees, fund the RLGs' public works programs, including roughly 80% of their annual toll-free road construction costs. If the gasoline tax receipts decline, the government will be compelled to find other tax sources, but the aging and declining population limits alternatives, while a lengthy political process to change the tax regime will cause a lag in recouping lost revenue.

Fewer sales of conventional gasoline-fueled vehicles will reduce not only the related sales tax, but also the tax receipts that helped to subsidize the government's incentives for alternative-fuel vehicles. Car sales receipts will also decline if ride-sharing services like Uber become widespread. Public funding could also be required to increase the number of electric-car charging stations, adding another item to RLGs' budgets, which are already constrained by the aging taxpayer base.

Electric utilities – credit positive

Electric vehicles will create incremental needs for electricity, partly offsetting the secular decline in demand

Over the next decade, new demand from the charging of electric vehicles will partly mitigate the secular decline in energy demand from a shrinking population, energy conservation and customer attrition as a result of deregulation.

Japanese integrated electric utilities are facing a decline in demand with customers switching to various new competitors following the deregulation of retail electricity sales, combined with population decline and a push for energy conservation following the 2011 Fukushima accident.

While we expect the pace of customer losses will gradually slow and plateau, demand for electricity will generally trend down with the declining population and technology advancements in energy efficiency. As a result, any incremental load growth from electric vehicles is credit positive for the integrated utilities. Japan's 10 integrated utilities expect electricity volume sales to decline by 16% to 757 TWh in the fiscal year ending March 2018 from 906 TWh in the year ending March 2011, with Tokyo Electric Power Company Holdings, Inc. (Ba2 stable), Kansai Electric Power Company, Incorporated (A3 stable) and Hokkaido Electric Power Company, Incorporated (A3 stable) seeing more than 20% declines over the same period. Twelve percent or 109 TWh of this decline came in the six years to 31 March 2016 with the nation's push for energy efficiency and conservation following the March 2011 Fukushima nuclear accident and the subsequent mothballing of the nuclear fleet, combined with ongoing population decline. The 10 utilities collectively lost another 40 TWh since retail electricity sales were fully deregulated on 1 April 2016 based on their earnings guidance for fiscal 2017.

With BEVs expected to be a small portion of vehicle sales through the mid-2020s, the impact on overall electricity demand will nevertheless be minimal over much of the coming decade. The eventual ramp-up in the late 2020s will be credit positive, but may not sufficiently offset the recent and ongoing decline in demand.

The take-up of electric vehicles will require new car charging stations, and utilities may need to make incremental capital investments to allow the power grid to accommodate it. Such investment in regulated assets would be credit positive, assuming the utilities will be able to recover those costs in their regulated rates.

Moody's related publications

Sector in-Depth

- Steel & Specialty Metals - Global: Carbon transition raises risk for steelmakers but effects will vary widely, March 2018 (1099398)
- Oil and Gas Industry – Global: Global oil refining faces weakening demand, tighter regulation due to carbon transition, February 2018 (1099394)
- Auto Finance - Global: Changing consumer preference and new technology pose challenges for auto finance, February 2018 (1092744)
- Automotive Industry - Global: Automakers fully engaged on battery electric vehicles, but the transition will pressure returns, January 2018 (1093401)
- Auto ABS - US: Residual Value Risk is Amplified for Battery Electric Vehicles, December 2017 (1071237)
- Electric Utilities - Japan: Slow nuclear restart & coal-fired plant build challenge CO2 reduction for utilities, October 2017 (1085800)
- Automotive Parts Suppliers - Europe: Electrification to Be Modestly Positive for Some European Auto Suppliers, June 2017 (1071739)
- Infrastructure, Autos, State Government - California: Electric Car Growth Boosts Utilities; Mixed Implications for Autos and State Finances, October 2016 (1032157)
- Environmental Risks: Automotive Sector Faces Rising Credit Risks from Carbon Transition, September 2016, (1038590)
- Environmental Risks: Moody's to analyse carbon transition risk based on emissions reduction scenario consistent with Paris Agreement, June 2016 (1029574)

To access any of these reports, click on the entry above. Note that these references are current as of the date of publication of this report and that more recent reports may be available. All research may not be available to all clients.

Endnotes

1 In this report, we use the following definitions for various types of electric vehicles. **Alternative-fuel vehicles** encompass a range of electrification technologies that do not rely on oil, including hybrid, battery electric and fuel-cell electric vehicles. **Hybrids** use both electric motors and conventional internal combustion engines. One such type is the **plug-in hybrid** that has rechargeable batteries. **Battery electric vehicles** use all-electric motors. **Fuel-cell vehicles** run on hydrogen that is converted to electricity.

2 See Exhibit 6 (P6) in Sector In-Depth: Global oil refining faces weakening demand, tighter regulation due to carbon transition, 20 February 2018

3 Sector In-Depth: Automotive Sector Faces Rising Credit Risks from Carbon Transition, 20 September 2016; Sector In-Depth: Automakers fully engaged on Battery Electric Vehicles, but the transition will pressure returns, 23 January 2018

4 Sector In-Depth: Automakers fully engaged on Battery Electric Vehicles, but the transition will pressure returns, 23 January 2018

5 Sector In-Depth: Falling cost of renewables reduces risks to Paris Agreement compliance, 6 September 2017

6 https://orsted.com/en/Media/Newsroom/News/2016/07/DONG-Energy-wins-tender-for-Dutch-offshore-wind-farms

7 Kakinuma and Higashida (July 2016), *Current state of Japanese automotive industries and issues in the future* (p1), "Rippo to Cho-sa" (Legislature and Research), Planning and Coordination Office, House of Councillors, National Diet of Japan

8 Sector In-Depth: Automakers fully engaged on Battery Electric Vehicles, but the transition will pressure returns, 23 January 2018

9 Alternative-fuel vehicles include BEVs, e-Power and hybrid vehicles for Nissan.

10 Sector Comment: Fuel efficient and new energy passenger vehicle point system will drive volumes, 29 September 2017

11 Sector In-Depth: Changing consumer preference and new technology pose challenges for auto finance, February 2018

12 Sector In-Depth: Residual value risk is amplified for battery electric vehicles, 15 December 2017

13 Sector In-Depth: Oil and Gas Industry – Global: Global oil refining faces weakening demand, tighter regulation due to carbon transition, 20 February 2018

14 National Institute of Population and Social Security Research

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