BUSES

1 The Japanese Bus Industry in the Throes of the Pandemic

"1,494,264". According to NHK, that is the number of newly cases of COVID-19 infection over one year as the disease spread in Japan, counting from January 1st, 2020. The severe impact of the pandemic that began in early 2020 continued to make itself felt over the entire year and into 2021. The modern automotive industry depends on international distribution, and the global spread of COVID-19 drastically disrupted not only imports and exports of completed vehicles, but also the supply of parts as well as of semiconductors and other electronic components. At the same time, the social trends strongly reflected in motor vehicles are especially prominent in the bus industry.

Measures to limit the spread of COVID-19 include limiting the movement of people and avoiding close contact with others. Commuting demand dropped as people were asked to refrain from going out except for urgent or essential matters. A drop in the number of passengers poses a threat to bus operator viability due to the loss of passenger fare revenue. The failure of the work-from-home and staggered commuting time policies promoted by the government to mesh well with the working patterns that support bus operations turned the spotlight on the extent of bus industry fixed costs taken up by vehicle maintenance, insurance, loan repayments, and similar expenses. Annual statistics for the bus industry as a whole are making it clear that lower usage rates and reduced travel distances mean fewer orders for tires and other consumable parts which, in turn, leads to revising plans to replace vehicles, highlighting a drop in orders for new vehicles and the consequent decrease in vehicle production.

Similarly, as in the previous year, there was a remarkable slowdown in charter bus demand due to COVID-19. However, the one year delay in holding the Tokyo Olympic and Paralympic Games (Tokyo 2020) originally scheduled for 2020 spurred major demand for transportation during the event as well as shortly before and after. For charter bus operators, this could only be described as special demand (Fig. 1).

In contrast the completion of response to environmental regulations has limited the launch of new Japanese-made buses to the addition of specifications. Nevertheless, buses are expected to evolve in response to social expectations, and active developments were observed in the area of carbon neutrality, exemplified in electrification. Successive launches of electric buses, mainly among import vehicles, drew a lot of attention, calling for a shift in perception concerning electric buses, despite their short history compared to the diesel vehicles that have been used in the bus industry for many years. On the technical side, the maturing of automated driving technologies, a promising component of urban transport operation technology, was also a prominent topic in 2021. The steady advance of digitalization, illustrated by the spread of transit IC cards, contactless payment, social needs in the cashless era, and the exchange of information via smartphones must also be monitored closely. The post-pandemic era is yet to come, and the general consensus is that policies for living with COVID-19 will continue for the foreseeable future. This article looks back on the bus industry of the past year in that context.

Fig. 1 The 2020 Tokyo Olympic and Paralympic Games Provided Welcome Relief for Charter Bus Operators

2 The Japanese Bus Industry in Statistics

2. 1. Passenger Numbers

The total number of bus passengers in 2020 was 3 billion, 261.843 million, consisting of 3 billion 120.552 million passengers riding transit buses and 141.291 million riding charter buses (Fig. 2). Compared to the figures of the previous year, this represented 73.3% for transit buses, 51.5% for charter buses, and 72% overall. After peaking at over 10 billion between 1967 and 1970, the number of bus passengers in Japan has continued to decrease, dropping to 4 billion passengers, approximately 40% of that peak, after 50 years. The rapid rise in personal vehicle ownership and the establishment of railway networks were the main factors in that decline. However, a slight increase in the number of passengers has been observed in the vicinity of large cities over the last several years. Given these circumstances, the 26.7% drop compared to the previous year is extreme. The 2020 figures for the number of passengers are equivalent to the 1954 figures from over 60 years ago for transit buses, and to those of 1963 for charter buses. They are a throwback to an era when the scope and means of transportation of people, and the demand for tourism, was limited. Whether this is a temporary decline due to COVID-19, and whether the figures will recover to their previous levels, are the most important questions for the bus industry.

The decrease in the work or school commuting demand that constitutes the backbone of transit bus demand is significant, but varies by region. It is less pronounced in the regions, where there are few alternative means of transportation, than in large cities.

Fewer passenger directly leads to less fare revenue, but the authorities nevertheless called for the same number of buses to remain in operation to avoid crowding. Operator burden consequently increased as they were unable to cut costs even as fare revenue dropped. Although government subsidies to maintain regional route operation were provided as a measure against rising operation costs, the scope of those subsidies varied from one prefecture to another, and are not reflected in passenger numbers.

At the same time, restrictions placed on tourist entry led to a drastic drop in the number of air travelers, and people entering the country were asked not refrain from using public transportation. This forced a prolonged halt

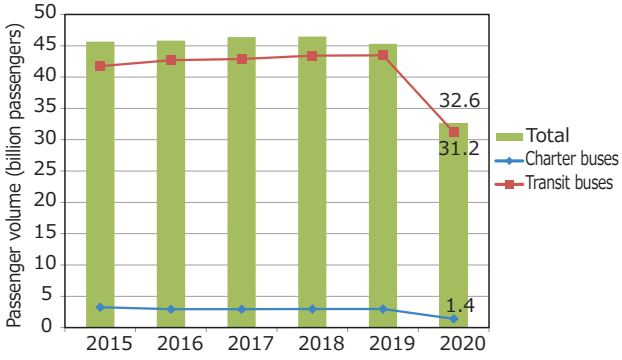

Fig. 2 Passenger volume (number of passengers)

in operation for airport bus services. As theme parks remained closed in response to the request to avoid non-essential, non-urgent outings, many inter-city buses relying on demand from young people had to suspend operations. In contrast, despite reductions in the number of trips, operation continued on routes, such as those in Hokkaido, where inter-city bus routes are also essential to daily life, highlighting the differences in the role of buses between regions.

In addition, there was no longer any demand for charter buses dependent on inbound and domestic tourism demand, resulting in the extremely unusual scenario of buses disappearing from sightseeing areas and expressway service areas. Nevertheless, operations remained relatively stable for charter buses relying on shuttle service contracts for corporations or schools. Once again, differences stemming from the type of business were brought to the fore.

After the ordeal of 2020, charter buses were given an opportunity to operate during the 2020 Tokyo Olympic and Paralympic Games held between July and September 2021, after a one year delay. Transporting the athletes and other people involved had been forecast to require up to 2,000 vehicles per day during the Olympics and 1,000 per day during the Paralympics, and arrangements had been made in 2019, before COVID-19 became a factor. At that time, meeting that demand using only charter buses from the Tokyo metropolitan area was expected to be difficult, and plans to procure vehicles from operators throughout the nation were made. In reality, it turned out that even in the Tokyo metropolitan area, charter buses barely operated during the 2020 Tokyo Olympic and Paralympic Games, but charter buses from 600 operators all over Japan, except Hokkaido, were mobilized.

For the Paralympics, notably, the need for buses equipped with lifts or elevators to enable boarding or alighting in a wheelchair was anticipated, but only 260 such vehicles were procured, and 70 non-step buses were put into operation for short trips. Normal charter bus operation is subject to business distract restrictions, but extra-legal measures were put in place for the national event., For charter bus operators who had seen business dry up during the pandemic, the payment of fares and fees based on the time and distance required to return to the station provided welcome relief.

2. 2. Passenger Kilometers

Mirroring the drastic drop in bus demand, the passenger kilometers figures indicating how much individual passengers traveled fell by more than half, to 40.4% of the previous year (Fig. 3). The figures reflect both the long-awaited bus travel for excursions or school trips, and government and administrative policies including the shortening of schedules and narrowing of the scope of activities, as well as the elimination of long-distance inter-city travel. The suspension of expressway bus operations providing transportation between cities also had a significant impact.

2. 3. Production Volume and Number of Bus Registrations

According to Ministry of Economy, Trade and Industry (METI) statistics, heavy-duty bus production in 2021 was 2,201 vehicles, representing 47% of the previous year. Light-duty bus production was 71,458 vehicles, amounting to 109.7% of the previous year. The production of heavy-duty buses fell considerably, by more than half.

The Japan Auto-Body Industries Association Inc. (JABIA) has reported a production volume of 1,413 medium- and heavy-duty buses for the Japanese market (75% of the previous year) in 2021, marking a two consecutive years of decrease. By vehicle type, there were 918 route buses (81%), 131 sightseeing buses (31%), and 364 private-use buses (92%). While some public operators followed already established plans to purchase new vehicles, it was the revision of plans to purchase new vehicles made by many private operators reacting swiftly to the major drop in demand that stood out. This illustrates the drastic decrease in orders by the charter bus operators supporting businesses operating on a somewhat smaller scale than transit (Fig. 4).

The figures for sales volumes are from 2020 and

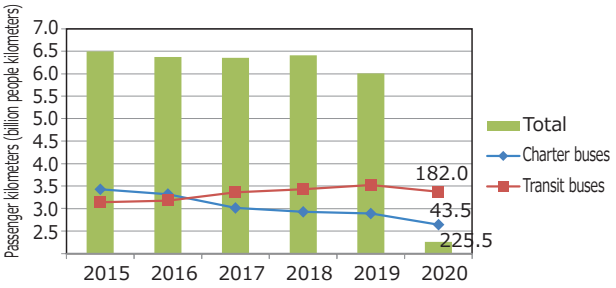

Fig. 3 Passenger volume (passenger kilometers)

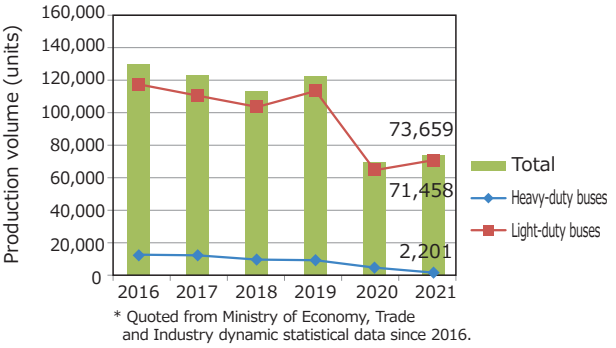

Fig. 4 Bus production in Japan

amount to 3,113 heavy-duty buses (64% of the previous year), and 6,221 light-duty bus (71% of the previous year). Since buses normally operate on order-based production with a guaranteed sale, the 2021 sales figures are expected to reflect a record-breaking drop.

2. 4. Imports and Exports

Although 120,000 Japanese buses were exported in 2019, that figure fell significantly to 72,954 buses in 2020 and remained essentially the same in 2021, at 72,313 buses. In terms of destination, exports to Asia, the primary market, dropped by half compared to 2019, and decreases of 30% for Africa and 58% for Central and South America also stood out. The global impact of the pandemic points to a decline in demand per se. Light-duty buses take up the lion's share of exports, and in the main markets of Asia, Africa, and Central and South America, where durability, reliability, and cost competitiveness are required, the rising quality of buses from Chinese, Korean, and other Asian manufacturers is also seen as a factor (Fig. 5).

In 2019, 194 buses were imported, and that figure fell by half to 83 vehicles in 2020, and even further to 49 vehicles in 2021. Although imports center on Korean sightseeing buses and on double-decker or electric buses not offered by Japanese manufacturers, diesel buses accounted for 46 vehicles, and only three buses used an alterna-

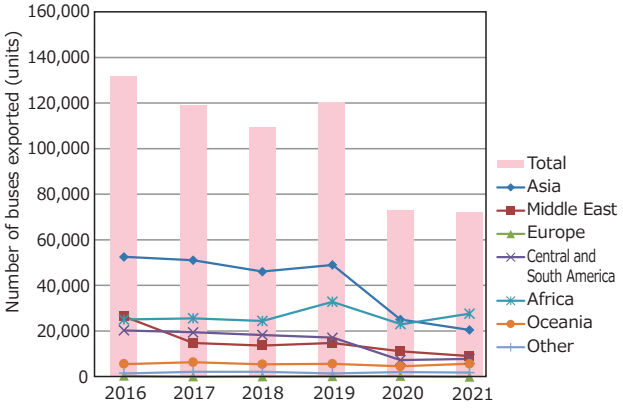

Fig. 5 Main Export Destinations

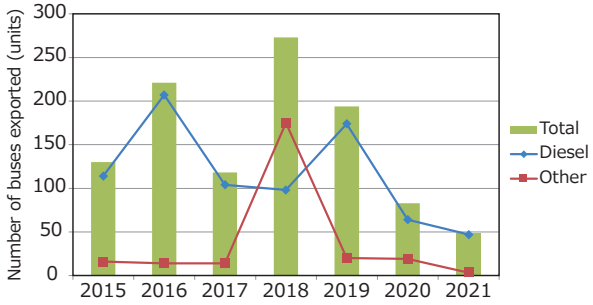

Fig. 6 Number of Imported Bus Registrations

tive power source. Even if all three are electric buses, that is a very small number. The number of imported electric buses is predicted to rise due to the lack of electric bus development in Japan, but that is entirely dependent on the purchasing interest of bus operators, who are unlikely to simply decide to increase their fleet size while demand and operating revenue remain low.

The never experienced demand situation caused by COVID-19 is leading operators to wait with bated breath to see if demand will recover within a short time.

3 New Buses Announced by Japanese Manufacturers

3. 1. Light-Duty Buses

Emissions regulations for diesel and gasoline buses with a GVW between 1.7 t and 3.5 t (the 2018 emissions regulations) came into effect in September 2020. This led to the release of new models of the Toyota Hiace Commuter light-duty bus and the Nissan Caravan Microbus (both 14-passenger capacity models). The Caravan line was consolidated into gasoline buses, eliminating the diesel variants. A 2021 model of already emissions regulations-compliant Mitsubishi Fuso Rosa light-duty bus, featuring the integration of telematics service adaptations

Fig. 7 2021 Model of the Mitsubishi Fuso Rosa

along with functional enhancements such as LED lighting and setting automatic lighting as standard equipment (Fig. 7).

In other news, Nissan ceased production of the Civilian light-duty bus. First released in 1959 as the Caball Microbus light-duty truck derivative, this model was renamed Civilian in 1971 and has been exported all over the world. Since 1993, it has also been offered as the Isuzu Motors Junior OEM light-duty bus, filling a role in the light-duty bus market. Its 60-some year history has now come to a close.

3. 2. Trends in Medium-Duty Buses

Currently, medium-duty buses are effectively limited to two types: route and sightseeing, represented by the Isuzu Erga Mio (Hino Rainbow) route bus, and the Hino Melpha (Isuzu Gala Mio) sightseeing models. In October, the safety systems of the latter were enhanced with features such as a collision mitigation braking system, lane departure warning, an emergency driving stop system (EDSS) and automatic lighting.

3. 3. Trends in Heavy-Duty Buses

(1) Specifications Added

Mitsubishi Fuso added specifications to its heavy-duty bus line. Specification options that had become unavailable over the last several years due to standardization were restored at the request of bus operators. The additional options are the front folding door on the Mitsubishi Fuso sightseeing series, and the front door on its heavy-duty route bus series.

The front folding door in the sightseeing series opens and closes more quickly than the standard swivel door, and does not project outward as far when open. The rear-hinged folding door in the front and the handrails on both sides secure ingress/egress on short distance expressway route buses that call for rapid boarding and alighting. Measures have also been taken to reduce the

Fig. 8 Mitsubishi Fuso Aero Ace with Front Folding Door

Fig. 9 Mitsubishi Fuso Aero Star with Front Door

Fig. 10 Toyota Sora

Fig. 11 Toyota Coaster FC Variant for Disaster Preparedness

wind noise folding doors are prone to generate. It is the first time this specification has been used in 14 years (Fig. 8).

The front door specification on route buses makes a first return in four years. In route buses, front doors are usually installed on two-step vehicles aimed at shuttle and private-use operators, which is a limited market. This addition installs front doors on one-step buses. Raising the floor of the front wheelhouse by one level makes the interior floor flat, simultaneously facilitating boarding and alighting, and providing roominess. A 12 m variant with many seats is also offered (Fig. 9).

(2) Fuel Cell Buses

Production of the Toyota Sora, the only fuel cell bus made in Japan, has been increasing. In addition to the Bureau of Transportation of the Tokyo Metropolitan Government ordering 70 buses for the 2020 Olympic and Paralympic Games held in its city, bus operators at major private railways have also purchased one or two buses, and the total number of buses in operation has exceeded 100 vehicles. Vehicle performance is the same as that of the model introduced in 2019 (Fig. 10).

Although not a mass-produced model, Toyota has developed a medical vehicle model of the Toyota Coaster fuel cell bus (Fig. 11), which also continues to be registered as a shuttle bus. Equipped with the Toyota Fuel Cell System used in the Mirai fuel cell passenger car, officially announced with a motor output of 134 kW, 7.2 kg of mounted hydrogen, and a cruising range of 210 km.

4 Imported Buses

4. 1. Electric Buses

The appearance of new electric bus models drew attention in 2021 even though only new variations were added in the case of Japanese-made buses. Since first introducing its 12 m long K9 urban bus to Japan in 2015, the Chinese BYD has expanded the variations it offers with the 9.48 m K7RA in 2019 and the launch of the 7 m J6, which targets community buses and other small-scale demand, in December 2020. The light-duty Japanese Hino Poncho bus, which has drawn considerable attention in China as well, served as a benchmark for the J6. The 7 m long and 2.08 m exterior design was newly developed for the Japanese market. It mounts a motor a maximum output of 100 kW and an iron phosphate battery with a capacity of 105.6 kWh, and boasts a cruising range of 150 km on a single charge. It aims to expand its market to areas such as community buses for regional governments. The K8 (Fig. 12), a new 10.5 m long variation of the K9, was announced in February 2021, and delivered to Heiwa Kotsu in Chiba.

Similarly, one year following its announcement, the Alfabus Japan Ecity, which focuses strictly on the 10.5 m mainstream size for Japanese-made buses, has been delivered to customers such as the Shikoku Electric Power

Fig. 12 BYD K8

Fig. 13 Alfabus eCity L10

Fig. 14 Onoen Star EV 7 m Model

Company, Nikko-koutsu Co., Ltd., and Yamanashi Kotsu Limited (Fig. 13). It distinguishes by offering variations adapted to Japanese driver-only bus standards.

Following the cab-behind-engine bus operated around the city of Kawagoe by Eagle Bus Co., Ltd. (Saitama), Ono Engineering, the third entrant in the Japanese electric bus market, has also reached a deal with Rescre (Aichi) to deliver a 7 m model (Fig. 14). Variations with overall lengths of 9 m and 10.5 m have also been announced.

EV Motors Japan Corp. has unveiled a lineup featuring not only a 7 m light-duty bus equipped with an inverter designed in Japan and a market-proven CATL-made battery, a corresponding 10.5 m heavy-duty bus, and a truck for collections and deliveries, but also electric trikes and three-wheel motorcycles. Each model is characterized by collaboration with body manufacturers such as the Chinese Wisdom, and combining a high-durability stainless

Fig. 15 EV Motors Japan F8

Fig. 16 Hyundai Universe

steel frame with exterior panels made of composite materials results in a long-lasting lightweight body offering significant benefit to electric bus performance (Fig. 15).

4. 2. Diesel Buses

Despite the stagnant sightseeing bus market, Hyundai revealed a new EDSS-equipped version of its Universe sightseeing model at the Bus Tech in Shutoken event in November. It is just as appealing as the various EDSS-equipped Japanese-made buses (Fig. 16).

Eight of the Japanese-made articulated bus model launched in 2019 had begun operation in 2021, and the parallel adoption of imported articulated buses resulted in a 13 vehicle increase in 2021.

New double-decker buses acquired from the British Bamford Bus Company (formerly Wrightbus) by Hato Bus, which operates regular urban open-top double-decker sightseeing bus routes, went into operation in April. This model newly build for the Japanese market replaces the original model (a remodeled Japanese-made double-decker bus). The use of aluminum and FRP exterior panels on aluminum structural material made it possible to build an 11.46 m double-decker bus with a single rear axle. It features a Scania-made engine (Fig. 17). Imported open-top double-decker buses have started to diversify following the adoption of a UNVI-made model by the Hinomaru Limousine Group in 2018.

In that vein, the various JR Bus companies have in-

Fig. 17 Eclipse Double-Decker Open-Top Made by Newcomer Bamford

Fig. 18 DMV Operating in Tokushima since December 2021

creased the number of remodeled Scania-engine equipped, Belgian Van Hool-built Astromega double-decker buses used on inter-city routes.

One unique bus to make headlines is the dual-mode vehicle (DMV) that began operation along the coast of Tokushima prefecture. This light-duty bus equipped with steel wheels that can run on railroad tracks was built for regions where compact railroad vehicles alone struggle to make a profit. Although DMV technology itself has a long history, this represents the first regular commercial operation in Japan. Local municipalities are backing the project in the hopes that its rarity will attract visitors and revitalize the region (Fig. 18).

5 How Can Electric Bus Adoption Be Increased?

As stated above, the selection of electric buses increased notably in 2021. The government's November announcement of its policy to achieve carbon neutrality by 2050 has imparted momentum to the adoption of not only electric buses, but also electric vehicles (EVs and fuel cell vehicles) in general. At the same time, there are undeniable questions surrounding how carbon neutrality principles is perceived by the bus industry, which plays the most important role in the adoption of electric buses.

In December, the Busrama International magazine, which is dedicated solely to buses, conducted a survey of bus operators and bureaus (collectively, operators) perception of electric buses to analyze the current status of such buses in Japan. The survey targeted 31 operators from Hokkaido to Kyushu who do not own electric buses, and collectively own 24,000 vehicles. This represents an appropriate sample size to identify national trends given the total of 61,000 transit buses owned in Japan. Operators were asked a wide range of questions covering ten topics, including their interest in electric buses, test drive experiences, future adoption projections, obstacles to the purchase of electric buses, and how they kept informed about electric buses.

The answers revealed that practically all 31 operators have interest in electric buses, with almost half of them having taken test rides or test drives at Bus Tech or other events targeting the bus industry as a whole. Projections for electric bus adoption in ten years were less than 10% of buses owned, with only one operator predicting a 50% ownership ratio in that timeframe. Moreover, electric bus adoption is contingent on subsidies, with many operators noting adoption would start with community buses, which are expected to receive governmental support. Few operators discussed their own efforts despite expressing their expectation for support from the government and citizens for the adoption of electric buses. At the same time, operators based in large cities can no longer afford to hold off on electric buses, and are envisioning their introduction on a per depot basis.

Is the scope of the electric bus market actually understood correctly? Based on the current level of non-step bus adoption, Busrama International estimates a market of 46,000 buses. Under the assumption that all buses will be electric in 2050, and assuming an average service life of twelve years for buses in Japan, the last new diesel buses will be introduced in 2038. Dividing by the average service life for transit buses in Japan indicates that 3,800 electric buses have to be introduced every year. The current level of subsidy bus operators hope to rely on is nowhere near enough. It's a considerable quantity even if the pace of electric bus adoption starts picking up. Even if it is possible to procure that many electric buses, it will take a national government-level initiative to secure sufficient facilities and electric power to charge such a large number of buses within a limited time.

The Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is promoting electrification in the context of the Green Growth Strategy and is aiming for the early adoption of 5,000 8-ton or greater heavy-duty trucks and buses by the end of the 2020s. Targets for 2040 will be set in 2030. In terms of the subsidies bus operators are hoping for, a sum of 1.042 billion yen was earmarked in the fiscal 2021 supplementary budget to subsidize the focused introduction of electric commercial vehicles. The stipulations for buses are one-third of the price of the vehicle and one-third of the price of charging facilities (of half if introduced at the same time as the buses), but the actual portion of the budget allocated to buses in either case has not been made clear.

Another option for accelerating the adoption of electric buses is to remodel (convert/retrofit) existing diesel buses into electric ones. There are already cases where aged Japanese-made bus diesel buses have been remodeled and put into service. However, having to work on a per-vehicle basis drive up remodeling costs. Moreover, working from existing Japanese-made buses imposes weight-related restrictions that limit the amount of installable battery capacity, resulting in a low cruising range on a single compared to new models. Putting them in operation requires frequent recharging. Bus operators long familiar with diesel buses will move into uncharted territory involving, for example, combining bus operation with charging between route trips. Balancing the costs of a practical cruising distance and the commensurate mounted battery capacity represents the internationally accepted key to electric bus operation.

Many completed electric buses registered from outside Japan are equipped with a large battery capacity enabling them to operate for a full day on a single charge. However, the cost of charging infrastructure, the relationship between frequent rapid charging and battery life, as well as contracts with power companies that address issues such as operation schedules that avoid recharging congestion, must all be taken into consideration.

A desire for a greater range of options was also voiced by operators in the above-mentioned survey. That desire presumably reflects hope for the introduction of Japanese-made bus completed electric buses. Not only would that bring confidence in after-sales service, it would enable manufacturers to use connectivity to monitor the condition of vehicles running in Japan in real time. In short, it leads to the possibility of recovering from failures remotely. The conventional approach of having service staff coming over with their toolbox to deal with a failure will also have to be revamped.

The development of Japanese-made electric buses has been announced in response to the strong demand from bus operators. However, their performance is strongly affected not just by components such as the batteries and inverters and their layout, but also by the need for lightweight bodies suited to electric buses. Bus manufacturing lines will have to address these issues.

As noted above, the necessity of electric buses has been communicated to Japanese bus operators. From the standpoint of the energy issues driving that necessity, however, promoting ways to increase options and adoption are the purview of government policy. Compared to other countries, the current state of information is lacking in maturity. At the same time, this situations repre1sents an opportunity to completely reinterpret bus technology, which has evolved around diesel engines until now. The government is being called upon to offer bus operators easy to understand milestones concerning that necessity and its attendant factors.

6 Other Promising Technologies

As production goods, buses are viewed through the lenses of both vehicle technology, as with electric buses, and of technologies related to operational management, fare payments, and even work management. Greater convenience is essential to boosting ridership, while total safety underpins reliability. This section describes ongoing research on technologies that will be commercialized at various levels.

6. 1. Automated Driving

The bus driving environment consisting of a fixed route and schedule makes them attractive for automated driving researchers. Bus operator expectations of a solution to the lack of driver and crew members are spurring research efforts. Thanks to the growing body of experience accumulated in various areas such as operating larger vehicles, moving from private to public roads, and even collecting fares from ordinary users, the most recent development feature high precision mapping technology, smooth acceleration and deceleration on par with those of a veteran driver, and other features with a level of sophistication suitable for commercialization (Fig 9). The next challenge will be to reach a social consensus on driverless bus operation. The bus industry is anxiously

Fig. 19 Automated Driving is Gaining in Maturity

caught between expectations generated by the rational approach represented by driverless buses and doubts about the actual feasibility of doing so. The low likelihood of being able to handle the private space of personal vehicles and the public space of mass transit in the same manner is the source of that anxiety.

6. 2. Cashless Payments

The COVID-19 pandemic helped increase the adoption of cashless forms of payment, setting expectations for both enhanced user convenience and the rationalization of payment systems in actual buses were the use of cash, and especially small change, is prevalent. Accepting contactless credit cards has begun to spread on inter-city or sightseeing routes with a large number of passengers.

6. 3. Digitalization of Operational Management Tasks

Systems enabling operations managers to monitor the state of vehicles in a remote location from their office in real time are already common, and roll call-related tasks are being reexamined in preparation for a future transition to driverless vehicle operation. While the law stipulates in-person roll calls in principle, field tests that involve putting robots in charge of pre- and post-operation roll calls have begun. At the same time, emergency driving stop systems (EDSS) that help prevent accidents caused by a driver health condition are becoming more commonplace not just on new vehicles, but also as retrofitted installations.

7 Buses outside Japan

7. 1. Electric Buses Remain the Forefront of the Next Generation

Drops in passenger numbers and bus drivers losing their jobs due to the impact of COVID-19 has also been reported in other countries. With respect to vehicles, a succession of electric (electric and FC) buses has been announced, and the number of available options continues to grow.

The Western European market represented by Poland in addition to other Western European nations saw the arrival of 2,062 new battery electric bus (BEB) registrations in 2020, despite the impact of COVID-19. There were 1,685 vehicles in 2019, which means a 122% increase over the previous year. Similarly, 2,733 new bus registrations were reported for hybrid buses, 2,636 for CNG buses, and 47 for FC buses. A little under 40% of urban buses were BEBs in 2019. In 2020, that proportion rose above half for the first time, reaching 53%.

Each of the various European nations has established an energy strategy designed to curb global warming, and buses running on CNG, also a form of clean energy, retained a large share of the market. However, at the time this article was written in 2022, the supply of natural gas had become problematic due to the economic sanctions triggered by the Russian invasion of Ukraine. Energy must be sustainable, and should not normally have such an impact on buses, which are a tool of everyday life for ordinary people.

As noted earlier, electric buses are the mainstream outside Japan. In the U.S., heavy-duty buses operating over long distances are also making the transition to electric or FC vehicles. In the past, manufacturers (VDL, Solaris) that procured engines and components from third parties to build a completed bus led electrification efforts. More recently, however, proactive electrification by diesel engine manufacturers has become prominent. These market conditions have also resulted in a large number of startups. Safety and reliability are immutable conditions in all cases. Electric buses have comparatively fewer parts than their conventional counterparts, but there are occasional reports of electrical bus fires. The broader range of options is welcome by operators, but society must be offered correct options that do not undermine reliability.

7. 2. Buses Expected to Come to Japan

Double-decker and articulated buses have been the main imported buses, but as stated earlier, a wider range of electric buses has become available. The introduction of imported buses matching the sizes and roles dominated by Japanese-made buses, as well as genres unseen in those buses, has been announced. One case involves plans to import completed models of a British-made ur-

Fig. 20 Switch Mobility-Made Electric Bus Planned for Import as a Completed Vehicle

Fig. 21 Karsan-Made Light-Duty Electric Bus Measuring Less Than 6 m

ban bus from the UK, which has highly compatible regulations, because the development of a Japanese-made model is expected to take time (Fig. 20). Similarly, there plans to import light-duty buses with an overall length of less than 6 m (Fig. 21). Both buses have a proven track record in their country of origin, and are likely to draw the interest of bus operators in Japan. At the same time, advanced heavy-duty urban BEBs gaining attention in Europe are also subject to concrete development targeting the Japanese market. There will probably be news on that front in 2022. The impact of the policy of adopting 5,000 electric buses during the 2020s announced by the government on the increase in options provided by imported remains to be seen.