

A Review of the Electric Vehicle Use as a Electricity Supplier in a Disaster in Japan

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Executive Summary

Since Japan is prone to natural disasters such as typhoons and earthquakes, AC100V outlets installed in passenger cars of hybrid electric vehicles/plug-in hybrid electric vehicles/electric vehicles/fuel cell electric vehicles are expected to be a tool for securing power during power outages in the event of disasters. Meanwhile, in addition to personal use, activities are underway to use these vehicles as power supply vehicles at evacuation centers and other places during power outages in the event of a disaster through disaster relief agreements between automobile manufacturers and local governments. It is also expected to be widely used as a tool to support mutual aid. This study outlines these activities in Japan.

Keywords: power supply, disaster relief assistance, electric vehicle (EV), HEV (hybrid electric vehicle), PHEV (plug in hybrid electric vehicle).

1 Introduction

Hybrid vehicles and plug-in hybrid vehicles that can supply 100V-AC power (Figure1) have been developed[1]. Their use is being promoted [2] in response to comments that they were useful during the Great East Japan Earthquake that occurred on March 11, 2011. Due to the Hokkaido Eastern Iburi Earthquake that occurred on September 6, 2018, the whole of Hokkaido fell into a blackout. As a result of a questionnaire survey target to those who own an electric vehicle equipped with a 100V-AC outlet and who have experienced this Hokkaido blackout, about 75% of respondent answered affirmatively that the in-vehicle outlet was useful based on the actual experience of blackout despite the most common usage was charging smartphones. The importance of securing electricity in the event of a disaster is increasing in lifestyles dependent on electricity[3]. On the other hand, not only for personal use, activities to utilize the electric vehicles as power supply vehicles at evacuation centers, etc. during disaster power outages are progressing due to disaster support agreements between automomobile manufacturers and local governments. It is also expected to be widely used as a tool to support mutual assistance. In this study, these activities in Japan are reviewed.










給電方法	電源	給電器	その他	最大出力	備考
① 100V電源用コンセントから給電	 100V電源用コンセント			AC100V 1.5kW	<ul style="list-style-type: none"> ・車本体のみで給電可 ・設置・配線工事不要 ・出力が比較的小さい ・EV, PHV, FCV, HV (メーカーオプション等により、100V電源用コンセントを持つ車)が対応可能
② 給電端子から給電 (EV・PHVの場合はCHAdemo急速充電端子を給電用に共有)	 給電端子 (CHAdemo)			AC100/ 200V 1.5~ 9kW (機器による)	<ul style="list-style-type: none"> ・可搬型給電器が必要 ・可搬型でどこでも給電可 ・設置・配線工事不要 ・給電端子を持つEV, PHV, FCVが対応可能
③	 給電端子 (CHAdemo)		 (本接続は一例です)	AC100/ 200V 3~9kW (機器による)	<ul style="list-style-type: none"> ・V2H(充放電設備)が必要 ・建物への直接給電可 ・設置・配線工事必要 ・給電端子を持つEV, PHV, FCVが一定の条件下で対応可能

Figure1: External power supply function for electric vehicles [2]

2 Review of Various Activities

Examples of electric vehicles used as power supply vehicles in past power outages in Japan and activities to prepare for future disasters are reviewed.

2.1 Automobile Manufacturers' Activities

Nissan Motor Co., Ltd. provide support for long-term power outages in Chiba Prefecture caused by Typhoon No. 15 in September 2019, and supply electricity power to a volunteer center in Tsuno, Nagano City, Nagano Prefecture during Typhoon No. 19 in October 2019 using the electric vehicle "Leaf." Electricity was used for charging power tools, copiers, hot water supply, lighting, etc. (Figure2 (a)) [4]. As part of "Nissan Blue Switch", they are promoting the conclusion of disaster cooperation agreements with local governments. As of November 30, 2021, 150 disaster cooperation agreements have been concluded [5].

Mitsubishi Motors Corporation used the electric vehicle "i-Miev" and the plug-in hybrid vehicle "Outlander PHEV" as power supply vehicles to provide support during the 2019 Boso Peninsula Typhoon (Typhoon No. 15) in September 2019 (Figure2 (b)) [6]. In addition, "Outlander PHEV" excels in drivability on off-road, and is in high demand from the perspective of supporting means of transportation in disaster. They have launched the DENDO (electric drive) community support program and announced that "By concluding disaster cooperation agreements with local governments nationwide, we will promptly and reliably deliver PHEVs to areas with power outages in the event of a disaster, and use them for power supply activities." As of November 2022, the disaster cooperation agreements with 222 local governments have signed [6].



(a) Supply power for electric fan [4]



(b) Supply power for washing machine [6]

2019年9月 令和元年房総半島台風

 アウトランダーPHEV

千葉県南部を中心に長期に亘る大規模停電が発生した令和元年房総半島台風の折には、君津市や巖手町の高齢者福祉施設を中心にアウトランダーPHEVを貸与。電子レンジや冷蔵庫、電動ベッドなど、さまざまな電化製品に電気を供給しました。特に、台風一過で非常に臭く、洋服を頻繁に着替えていたことから、入居者や施設職員などの洗濯物が大量にたまっていました。そこで、約200人分の洗濯物を一晩で洗濯・乾燥し、たいへん喜んでいただきました。

Figure2: Examples of electric power support at evacuation centers, etc.

Toyota Motor Corporation has a lineup of more than 20 models of hybrid vehicles, plug-in hybrid vehicles, and fuel cell vehicles that are equipped with 100V-AC outlets and capable of supplying power of 1,500W or more [7]. They also provided power supply support during the large-scale blackout caused by Typhoon No. 15 in September 2019. In a non-disaster, they are conducting activities aimed at popularizing vehicles that can be powered externally and raising awareness of the power supply function among owners of vehicles that can be powered externally [8]. In comprehensive cooperation agreements with local governments, Toyota dealers are building power supply support networks with local governments across the country. As of November 2020, they have concluded comprehensive partnership agreements including disaster support with about 60 local governments. As a new attempt, they plan to use IT tools to match support[9]. In addition, as an initiative to expand the power supply vehicle, jointly developed with Honda R&D Co., Ltd., a mobile power generator / supplier system "Moving e" and jointly developed with Denyo Co., Ltd., a fuel cell power vehicle[10].

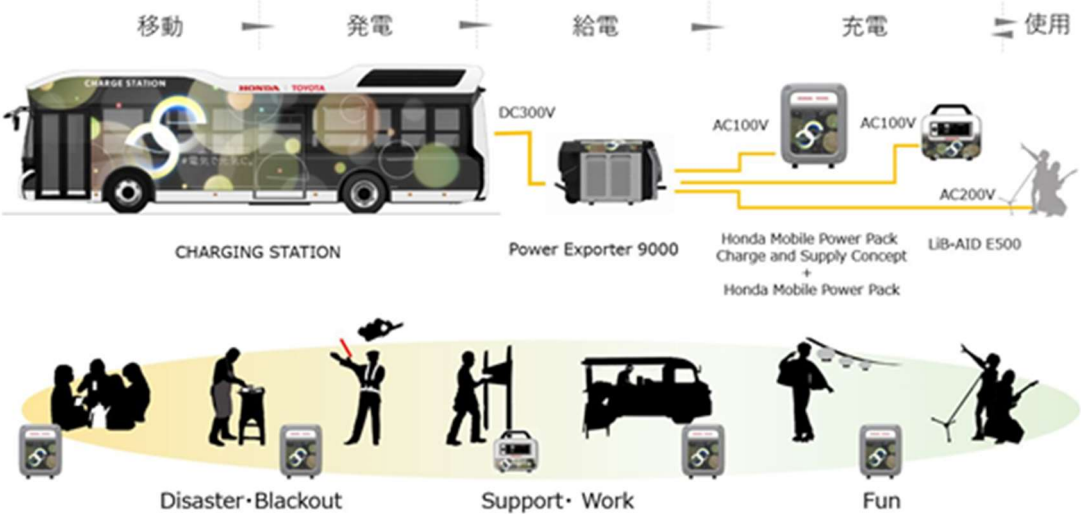


Figure1: A mobile power generator and supplier system [10]

2.2 Municipalities' Activities

In September 2019, Tottori Prefecture introduced a system called "Tottori Prefecture EV Cooperation Volunteers" to supply electricity from electric vehicles. Residents of the prefecture who have registered as volunteers gather in response to requests from the prefecture when a disaster strikes or an event is held[11].

In Nerima Ward, Tokyo, they have "system of cooperation registered vehicles in a disaster" assuming the occurrence of a large-scale disaster. Electric vehicles owned by residents are used as power supply vehicles to supply electricity to evacuation centers[12].

3 Conclusions

In Japan, automobile manufacturers and local governments have widely concluded disaster agreements on the provision of power-supply vehicles, and it is expected that power sources will be secured at evacuation centers in the event of a disaster. However, with various disaster situations assumed, individual agreements and utilization efforts do not function effectively in every situation. It is necessary to recognize the range that each approach can cover and prepare for various situations by preparing multiple approaches.

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Presenter Biography



Dr. Hideki Kato is a Principal Research Engineer at Toyota Transportation Research Institute (TTRI). He received the B., M. and D. engineering degrees from Hokkaido University. He joined TTRI in 2011 after around five-year experiences in NIES. His principal areas are environmental engineering, automotive engineering and traffic engineering. Currently, his concerns widely range from the use of electric vehicles to countermeasures against traffic accidents.