Part 06

Developing Technologies for Operation and Maintenance Services

Visualizing V2X System Operation Status

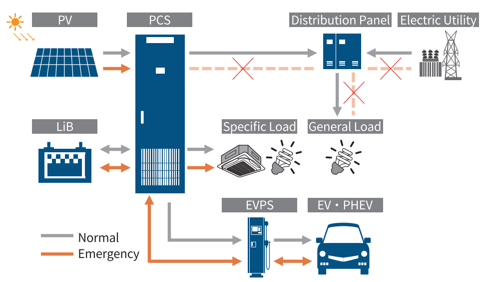
In 2020, the Japanese government set a goal of the country becoming carbon neutral—essentially having zero greenhouse gas emissions-by 2050. Decarbonization demands wider use of renewable energy sources, such as solar and wind, and securing dispatchable power to absorb the fluctuations in these variable renewable energy sources.
That said, sector integration (sector coupling) is gaining attention as a means of integrating energy supply and demand across sectors such as electric power, transport, and industry in order to secure this dispatchable power. One approach to sector integration is Vehicle to Everything (V2X), where the power stored in an electric vehicle(transport sector) is employed in other sectors.
In 2021, GS Yuasa released the EVOX System[1] which bridges power between an electric vehicle (EV), and a building or an electric utility. The EVOX System makes use of the remote monitoring and visualization technologies[2,3] that GS Yuasa has been cultivated over the years. This article overviews the EVOX System, and introduces the user interface which provides an easy-to-understand visual representation of its operation status.

1. EVOX System Overview

Our EVOX System (exterior shown in ●Fig.1) includes a storage battery-connected power conditioner (PCS) in which an industrial lithium ion battery (LiB) is installed, and an EV charger-discharger (EVPS).
A LiB and solar panel (PV) can be connected in parallel with the PCS as shown in ●Fig. 2. Under normal conditions the power generated by the PV charges the storage battery installed in the EV via the PCS and the EVPS. This makes it possible to realize zero emissions mobility where no CO_2 is emitted during travel.
Under normal conditions, when little PV power is generated, energy is discharged from the LiB to assist in charging the EV and thereby minimizes the power pulled from the electric utility. The peaks in demand that occur when charging the EV are pared down or reduced by discharging from the LiB. In times of surplus power under normal conditions, such as at holidays, the PV power is used to charge the LiB or the EV (e.g., a company vehicle, etc.).
Under emergency conditions, such as a power outage, as a part of business continuity planning (BCP), the electrical loads (specific loads) necessary for continuing business operations, such as commercial air conditioning or lighting may be supplied electricity from the storage battery installed in the EV, the PV, and LiB via the PCS. A different EV may then be connected to the EVPS prior to all the electricity being drawn from the connected EV, to ensure business continuity.
The PCS and EVPS each have a built-in network card (●Fig. 3) which allows them to communicate with each other. The network card built into the PCS acquires various information such as the PV power generation and the LiB power discharge, computes a discharge-power command value for the EVPS, and sends the discharge-power command value to the EVPS. The network card built into the EVPS sends the state of charge (SOC) of the storage battery installed in the EV, and the output power of the EVPS to the PCS.

●Fig. 1 Exterior of an EVOX System

●Fig. 2 EVOX System Configuration



2. Visualizing the System's Operation Status

The built-in network card of an EVOX System PCS functions as a web server, and serves a web interface to a client device, such as a PC or tablet if the client device is on the same local network. The client device accesses the web interface via a web browser.

The home screen (●Fig. 4) of the web interface is designed so that it is possible to verify, at a glance, the EVOX System's components or the operating condition of a load, and the flow of power in the system.

Area information is displayed in a rectangular frame beneath a circle mark indicating a (three-phase AC) electric utility. Additionally, a graphic indicating the direction of the current (with a downward arrow indicating that an area is receiving power from the electric utility) and a received-power power level are displayed between the electric utility mark and the area information.

Displayed below the area information (from the left) are: (1) an icon representing the PV, the PV generated-power level, and a graphic indicating the direction of current (with an upward arrow indicating that the area is receiving power from the PV); and (2) an icon representing the LiB, the LiB discharge-power level, the LiB SOC, and a graphic indicating the direction of current (with an upward arrow indicating that the area is receiving power from the LiB). The upward arrow above the PV icon is no longer displayed once the area is no longer receiving power from the PV. The graphic above the LiB icon changes to a downward arrow once the area is supplying power to the LiB.

Additionally, below the area information are also displayed: (3) an icon representing the EV, the EV charge-power level, the EV storage battery SOC, and a graphic indicating the direction of current (with a downward arrow indicating that an area is supplying power to the EV via the EVPS); and (4) an icon representing an electrical load, a load-consumption power level, and a graphic indicating the direction of current (with a downward arrow indicating that an area is supplying power to a load). When no EV is connected to the EVPS, no EV icon is displayed. The graphic above the EV icon changes to an upward arrow once the area is receiving power from the EV.

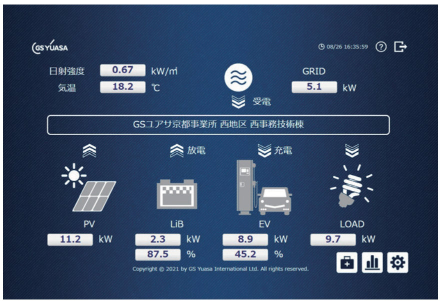
This kind of user interface makes it possible to easily and intuitively understand the flow of current, such as whether the PV is generating power, whether an EV is connected, and whether the LiB is being charged or discharged.

Finally, the graph display page (●Fig. 5) shows: a load consumption amount, LiB charge amount, and EV charge amount which indicates daily power usage in an area; and a PV generation amount, LiB discharge amount, and EV discharge amount which indicate the power supply amount. The graph display page presents each of these data in a stacked bar chart and a month's worth of data on a single screen. This kind of display allows for understanding actual day- or weather-based power usage conditions, thus making it possible to ascertain periods when power demand increases, and to suitably decide when to charge the EV or LiB, or make proposals for optimizing a system operation schedule, or the like.

This article overviewed our EVOX System, which integrates key decarbonization technologies—renewable energy (solar panels), storage (batteries), and electrification (electric cars)—and introduced the visualization technology used in this system for visualizing operation status. Offering our EVOX System and our remote monitoring services, which increases the value added by the EVOX System, are ways in which GS Yuasa contributes today to the Japanese government's goal of carbon neutrality.

●Fig.3 Exterior of the Network Card

●Fig.4 Home Screen [5]



●Fig.5 Monthly Power Trend Chart [6]

1.https://www.gs-yuasa.com/en/technology/technical_report/pdf/vol18_2/018_02_008.pdf
2.https://www.gs-yuasa.com/en/technology/making_history/pdf/no19.pdf
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