

# Realize a Sustainable Society

## Energy recycling and saving for a low-carbon society

The realization of a low-carbon society is an important issue facing the world. Mitsubishi Electric is contributing to creating a sustainable society by engaging in the development and application of technologies that contribute to reducing environmental burden. For example, these include storage batteries and control systems that are useful for the utilization of renewable energies such as wind and solar power generation, and inverters that significantly reduce power consumption by railways.



Odakyu Electric Railway's renewed 1000 Series railcar

## Solutions that significantly reduce railway power consumption

Toward the realization of a low-carbon society, much is expected of railways themselves. If power consumption by railways could be significantly reduced, it would be possible to accelerate the railways' contribution to a low-carbon society.

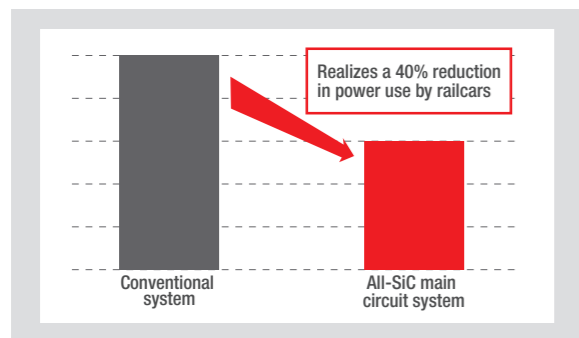
Mitsubishi Electric has thus developed the "all-SiC main circuit system." To drive the train motor, the system incorporates a VVVF inverter that converts direct current from the overhead wiring to alternating current, and a high-efficiency motor that is optimized by the use of all-SiC modules. By employing all-SiC (silicon carbide) semiconductor modules in a railcar inverter for the first

time in the world, power conversion loss has been reduced compared to conventional Si (silicon) modules. Furthermore, by increasing the regenerative power that is generated when braking, the system is able to reduce total power consumption by approximately 40%.

The system was delivered to Odakyu Electric Railway Co., Ltd., and was placed in commercial operation in January 2015. In November 2015, Odakyu Electric Railway and Mitsubishi Electric jointly received the Promotion Council Chairman's Prize (Excellent Prize) as an Eco-Products Award. The METI Minister's Award for Outstanding Energy-Efficiency Machinery, and the Achievement Award of the Ichimura Industrial Award have also been received in recognition of the expanded application of the system.

As of June 2016, the all-SiC system has been delivered to railway companies in Japan including Odakyu Electric Railway. Mitsubishi Electric wishes to expand the all-SiC system's scope of application in the future as its contribution to realizing a low-carbon society.

The power module was developed in part as a study funded by the New Energy and Industrial Technology Development Organization (NEDO).



Power consumption

## VOICE



Manager, System Design  
Power Electronics Systems  
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Yoshinori Yamashita

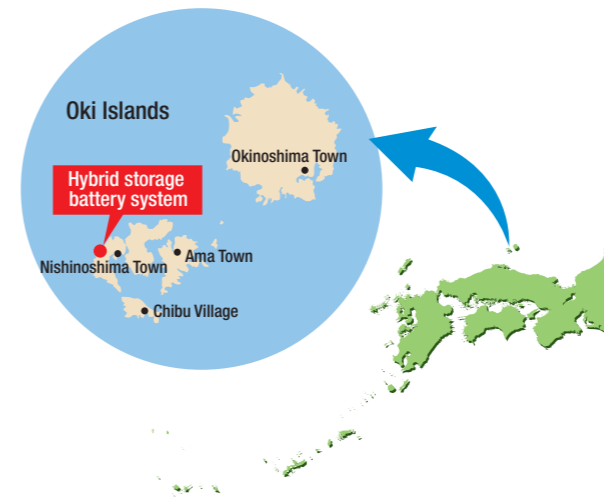
### It is my role to expand our customer base both in Japan and overseas

I think the reason why we were able to realize the world's first all-SiC inverter is because personal exchanges were held between the research institute and our semiconductor plant, and also because a forum was in place in which officers from various fields within Mitsubishi Electric could mutually share their knowledge and engage in discussions.

As a public transportation company, Odakyu Electric Railway Co., Ltd. must not, at all costs, stop traffic due to a malfunction. Thus, numerous reliability assessments had been conducted prior to introducing it as a world-first technology, and test runs of actual railcars were held over a total distance of 5004 kilometers before commencing commercial service.

Odakyu Electric Railway posted an introduction of our initiative to contribute to a low-carbon society inside the railcars, much to our delight.

The "all-SiC main circuit system" has a large impact also from the social aspect of minimizing environmental burden. I thus believe it is my role to expand the recognition of the technology's high energy-saving effect to as many railway operators as possible both in Japan and overseas.



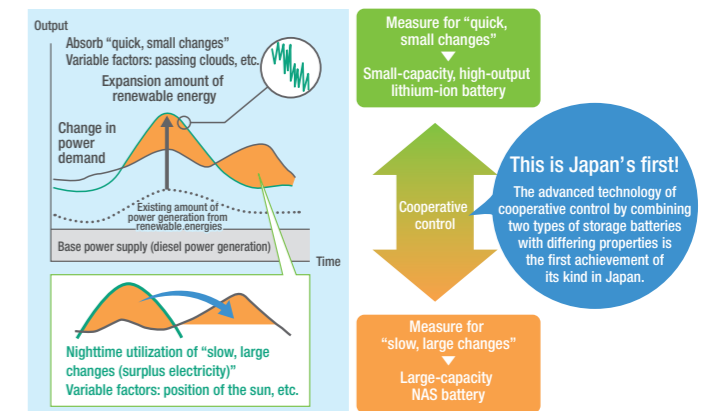
Substation storage battery installation (Nishinoshima Island, Oki Islands)

## Oki Islands Hybrid Project : Aiming to promote the utilization of renewable energies

The Chugoku Electric Power Co., Inc. launched the Oki Islands Hybrid Project in the Oki Islands of Shimane Prefecture in September 2015 as a three-year demonstration project that aims to create a sustainable society by expanding the introduction of renewable energies such as solar and wind power generation and reducing CO<sub>2</sub> emissions.

At present, approximately 10,000 to 24,000 kilowatts of electricity is needed in the Oki Islands. Over the three years of the demonstration test period, wind and solar power generation will be sequentially increased, to ultimately introduce 11,000 kilowatts of renewable electricity, to more than satisfy the minimum demand amount.

With solar and wind power generation and other such renewable energies, the amount of power generation changes according to weather conditions. To absorb such "quick, small changes," a small-capacity, high-output lithium-ion battery is used. On the other hand, since solar power is used to generate electricity during the daytime and no power is generated during the night, "slow, large changes" are absorbed by a large-capacity NAS battery, to allow the surplus electricity that is generated during the daytime to be used at night. This hybrid storage battery system combines two types of batteries with differing properties as the first attempt of its kind in Japan. Mitsubishi Electric plays a role in developing this system by undertaking its design and construction.



Source: "Hybrid Storage Battery System" on the website of Chugoku Electric Power Co., Inc.

## VOICE



Manager  
Power Grid Engineering Section 1  
Power System Solution Department

Tsuneo Shimizu

### From Oki to the world, I wish to spread the utilization of renewable energies

I participated in the smart grid demonstration project that Mitsubishi Electric conducted in the Itami district in 2010, followed by the project for the development of a lithium-ion battery power control system for remote islands in Iki in 2013 and in Tsushima in 2014. In 2015, I was assigned to the Oki Islands Hybrid Project and placed in charge of overseeing the hybrid system.

We commenced a demonstration test in September 2015. I am relieved above all that the system is so far supplying stable power without any interruption. I keep a fatherly eye on it as though it were my child.

For continued success of the project, we hold frequent study meetings with members of Chugoku Electric Power Company, and are directing our efforts to developing an optimal system.

Demand for such a hybrid system is expected to grow overseas as well. To widely disseminate our product, the technology for constructing a power control system that delivers both stability and economic efficiency of renewable energies is indispensable.

By harnessing the experience that I acquired in the Oki project and accumulated through the demonstration test in Itami, I wish to propose an optimal combination of storage battery and power system in response to diverse needs.