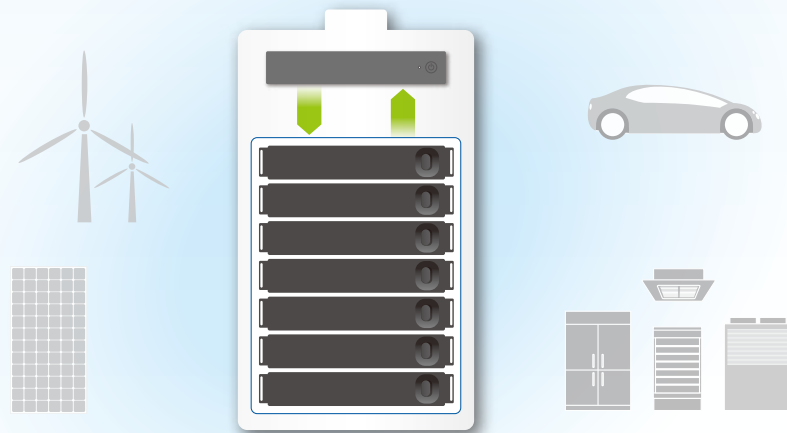


Storage Battery System Using Lithium-ion Batteries



Worldwide Expansion of Storage Battery System Applications



The Smart Energy System combines our technologies for energy creation (photovoltaic modules), energy storage (rechargeable batteries), and energy saving (efficient energy usage). The system stores electricity generated by photovoltaic modules as well as low-cost late-night power in lithium-ion batteries. By controlling electrical usage in the most efficient way possible, the Smart Energy System reduces facility CO₂ emissions and power consumption.

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SANYO North America Corporation
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Smart Energy Systems Department
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【Other area】
SANYO Electric Co., Ltd.
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email: info_ses@jp.panasonic.com

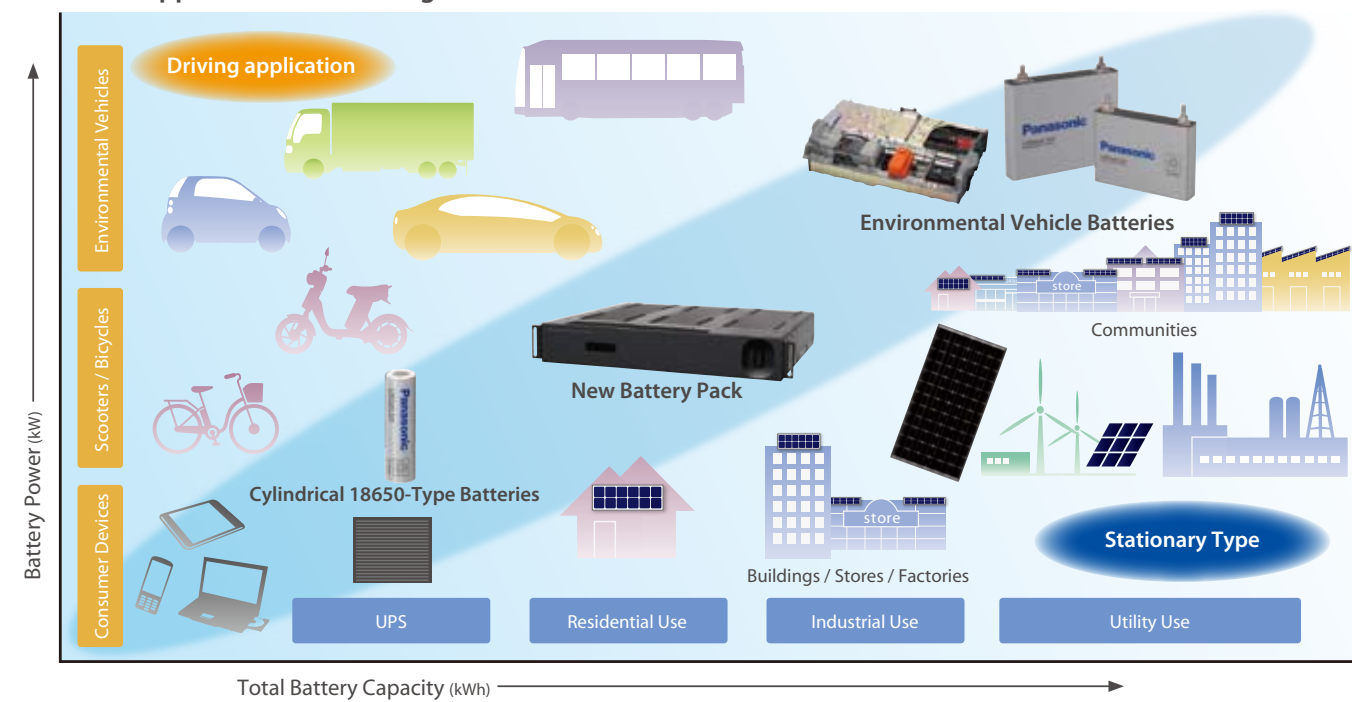


Smart Energy Storage System: A scalable power storage system for multiple energy storage applications





Based on Panasonic's unique technology development abilities, production technology, and global supply chain, the company has achieved and maintained a major share of the global lithium-ion battery market. Offering an extensive lineup of lithium-ion batteries ranging from small applications such as consumer batteries for laptop computers, to larger applications such as the batteries used in environmental vehicles, Panasonic is a leading company in battery technology for various applications.

In addition, Panasonic is a leader in the development and production of photovoltaic modules. Now, based on this foundation, Panasonic has entered the market for Smart Energy Storage Systems, adding a fourth key product area to already established presence in photovoltaic modules, rechargeable batteries, and batteries for electric and hybrid electric vehicles. Looking forward to future expansion in the renewable energy storage market, Panasonic will use its leading Smart Energy Storage System to maximize customer satisfaction with "coordination and integration" technologies actively tailored to meet customer needs.

Various applications for rechargeable batteries



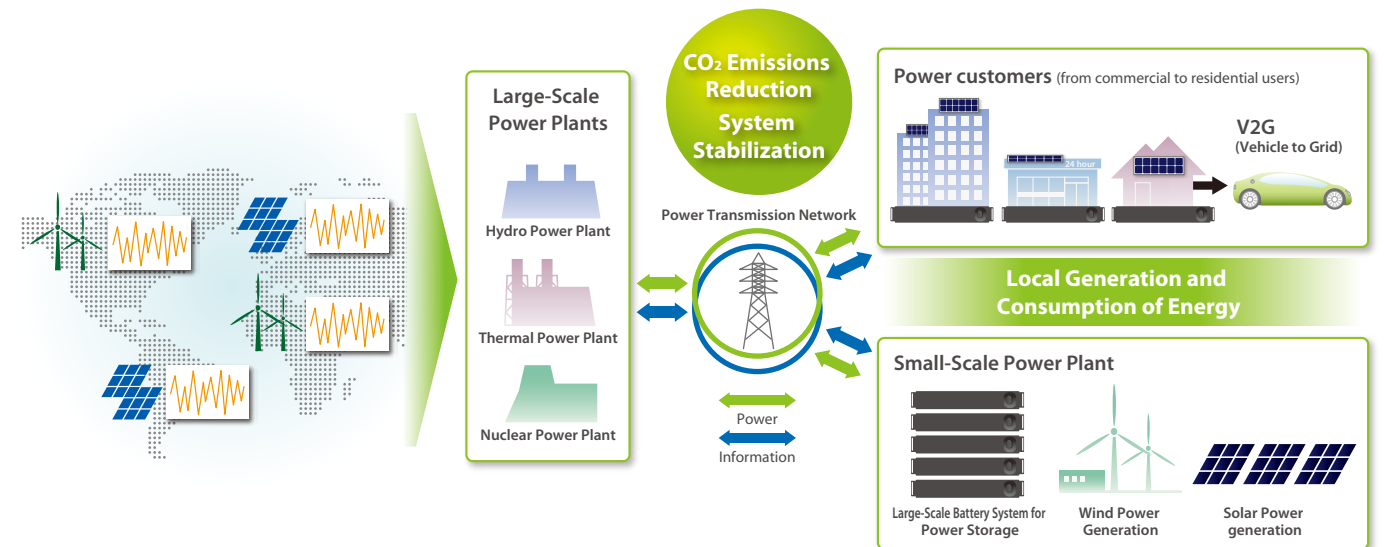
Panasonic's Energy Business

<p>Photovoltaic Modules</p> <p>HIT® Photovoltaic Modules</p>  <p>Modules with global top-level conversion efficiency. Unique technology offers optimum power generation in smaller spaces as well as better production in hotter environments.</p>	<p>Rechargeable Batteries</p> <p>Conventional Rechargeable Batteries</p>  <p>Batteries with high performance and reliability have earned the confidence of customers around the world. Panasonic has a leading share of the global market.</p>	<p>Rechargeable Batteries for Environmental Vehicles</p> <p>Batteries for HEVs / PHEVs / EVs</p>  <p>Panasonic is developing and expanding the business for rechargeable batteries for electric and hybrid electric vehicles.</p>	<p>Large-Scale Battery Systems for Stationary Applications</p> <p>System Development</p> <p>Battery Management System</p>  <ul style="list-style-type: none"> ● Battery Protection Unit (BPU) and Battery Protection Module (BPM) for small scale systems ● Battery Management Unit (BMU) for mid to large scale systems ● Standard battery modules for energy storage
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*HIT® is a registered trademark of SANYO Electric Co., Ltd. The name "HIT" comes from "Heterojunction with intrinsic Thin-layer" which is an original technology of SANYO Electric Co., Ltd.

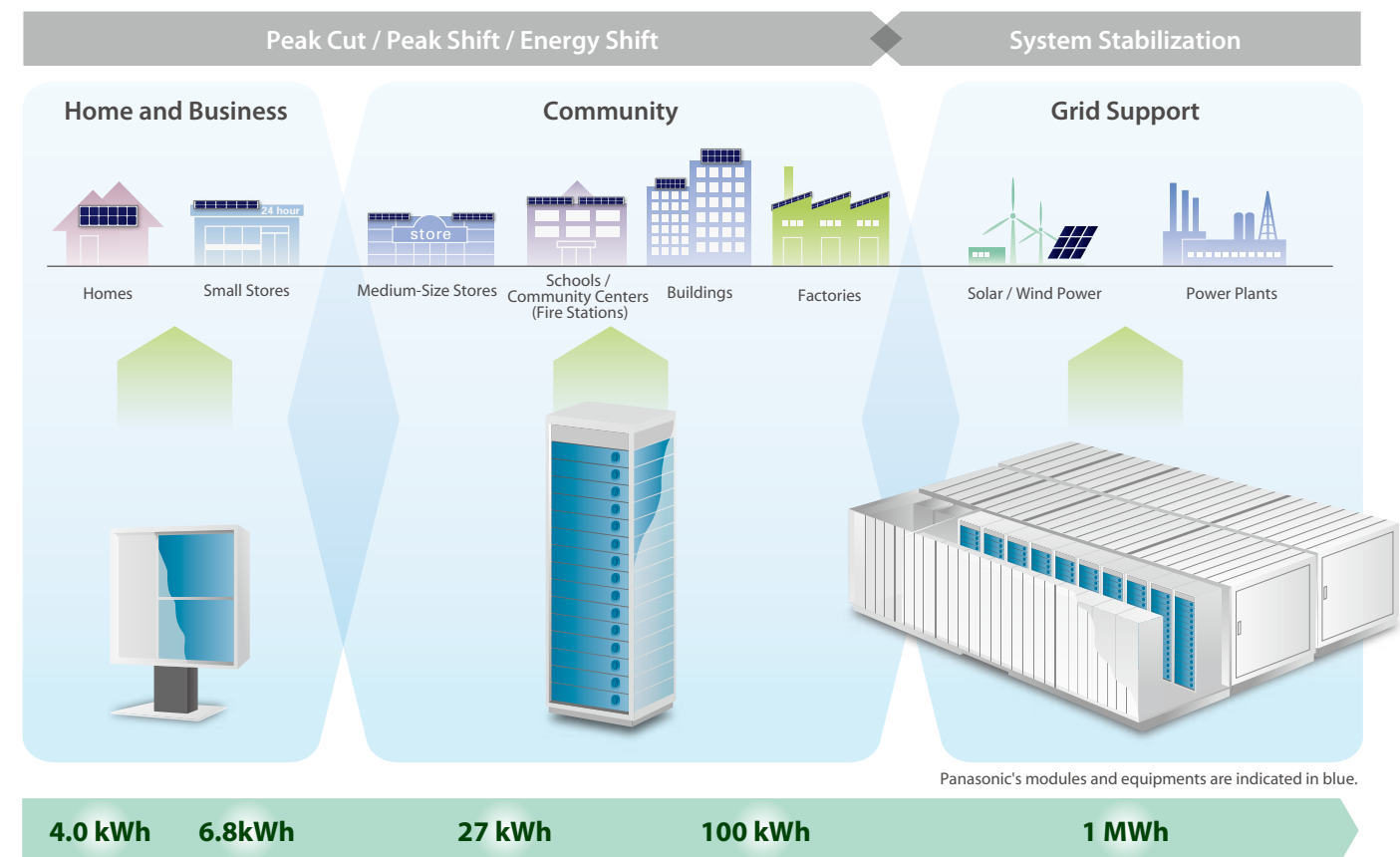
To realize a low-carbon society of the future

As utility companies begin the large-scale introduction of renewable energy to the grid, Smart Energy Storage Systems will become a key component. This is because renewable energy sources can cause instability with fluctuations in the power they produce. Acting as a stabilizer for renewable energy, the Smart Energy Storage Systems will serve as an energy storage source and play a critical role in the low-carbon society of the future.



Scalable solutions for various needs in the utility grid

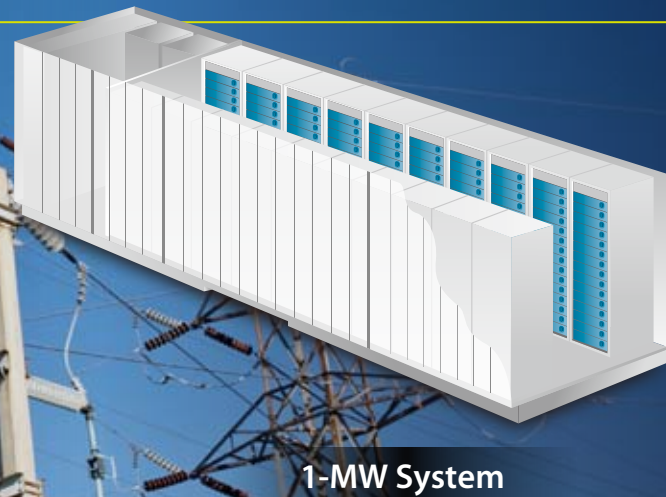
Comprised of storage batteries and control units to manage charging and discharging, Panasonic's Smart Energy Storage System is suitable for various applications (e.g. Residential Energy Storage, Community Energy Storage, Utility scale ancillary services, etc.). Through the unique control method and know-how of managing energy storage, the system can control systems with over 1,000 storage batteries as part of a 1-MWh or greater system.



Grid Support

Solutions for the large-scale introduction of renewable energy!

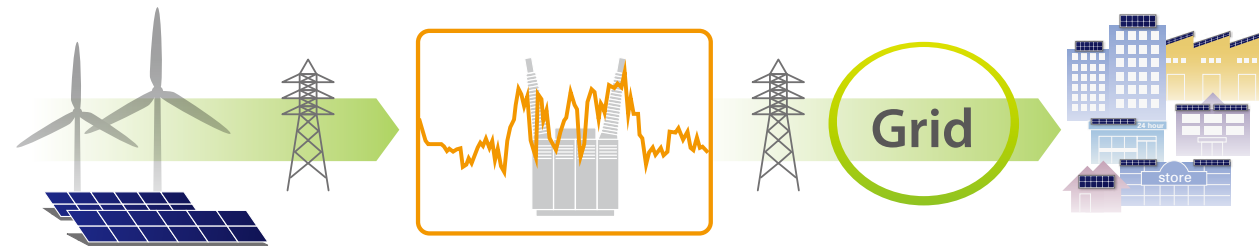
- Solutions for severe power fluctuations
- Solutions for frequency regulation
- Solutions for peak-power demand



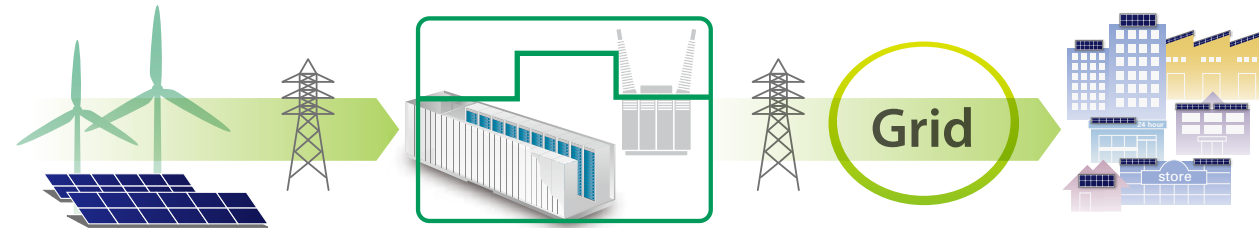
1-MW System

Employing Smart Energy Storage System for utility scale

Power fluctuations caused by renewable energy



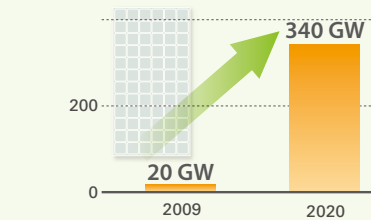
Power stabilization using Smart Energy Storage System



Stabilizing Power from Renewable Energy Sources

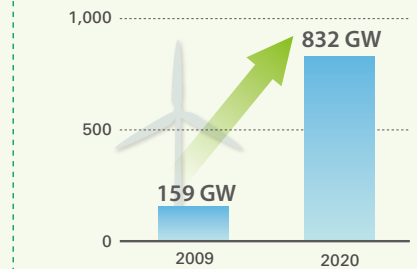
Fluctuating power and severe output changes from wind and solar energy sources can be stabilized with energy storage, providing high quality power to the grid.

Amount of installed Solar (World)



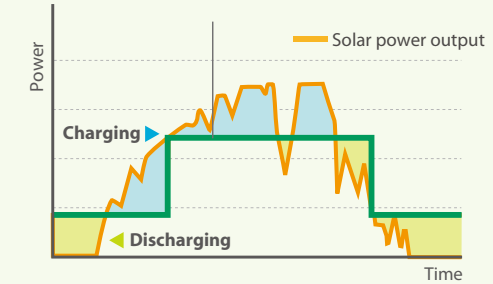
2009: [TRENDS IN PHOTOVOLTAIC APPLICATIONS Survey report of selected IEA countries between 1992 and 2009] (IEA PVPS)
2020: [JPEA PV Outlook 2030] (JPEA)

Amount of installed Wind (World)

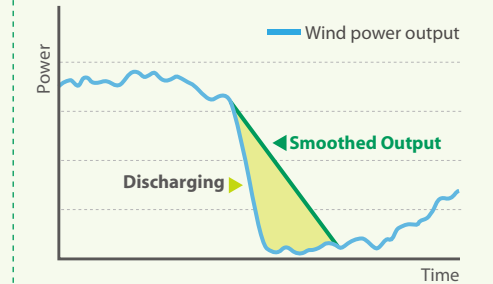


2009: [GLOBAL WIND 2009 REPORT] (GWEC)
2020: [GLOBAL Wind Energy Outlook 2010] (GWEC)

Solar Power + Storage Battery System

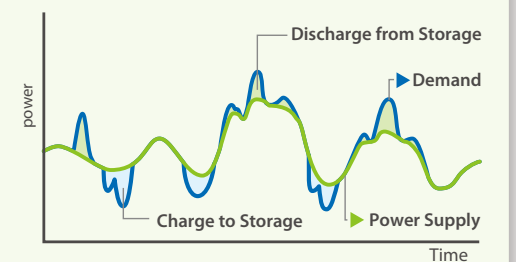
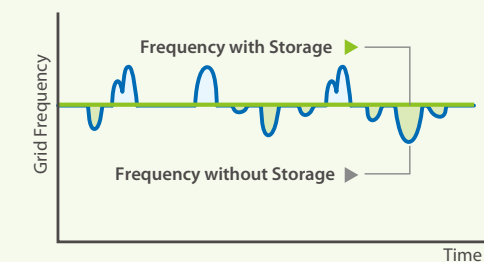


Wind Power + Storage Battery System



Instant Power Fluctuation Control (Frequency Control) Utilizing the high-rate characteristics of lithium-ion batteries

When demand rises, the Smart Energy Storage System instantly begins discharging, and frequency drop is controlled. Also when demand declines, frequency rise is controlled by charging.



Grid-Scale Battery System Example

Project SIESTORAGE (Siemens Energy Storage)

Panasonic's 500 kWh battery system, consisting of 280 battery modules and battery management systems, is being used in field test as an integral part of Siemens's new SIESTORAGE module energy storage container. The SIESTORAGE is directly connected to the medium voltage grid in South Europe.



Storage Battery Capacity/Output	500kWh/1MW
Application	This storage system serves as a variety of applications such as Smoothing the natural fluctuations of solar and wind power to stabilize power supply and prevent power outage.

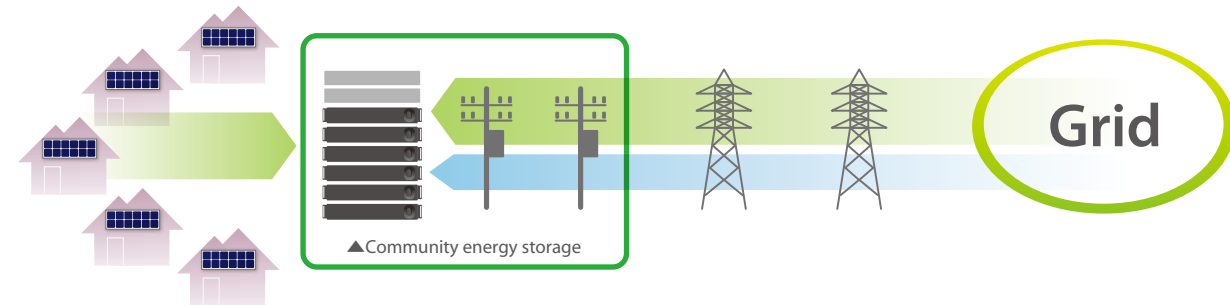
Community Grid

Solutions to minimize capital investment by using distributed energy storage on the grid.

- Solutions for severe power fluctuations
 - Solutions to stabilize distribution system's voltage
- Employing Distributed Energy Storage System for a power grid (Community energy storage)

27-kWh System

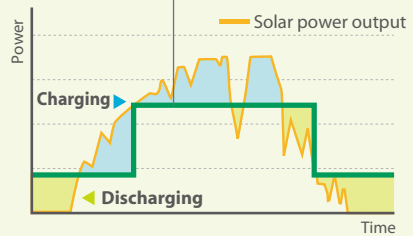
Employing Smart Energy Storage System for a power grid (Community energy storage)



Stable Power Output

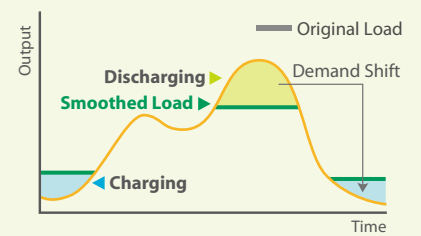
Use fluctuating power from wind and solar sources to charge storage batteries, effectively stabilizing power to the grid.

Solar Power + Storage Battery System



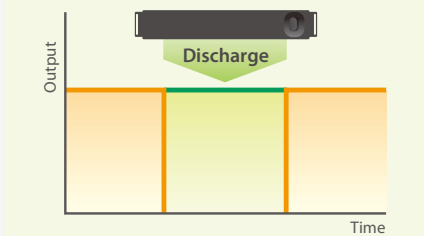
Peak Demand Shift

Power generated at night charges the Smart Energy Storage System, and is discharged during the daytime, shifting the peak demand and stabilizing the grid.



Backup Power Source during Outages

Power from the battery storage system can also serve as a backup power source in the event of a power outage.



Medium-Scale Power System Example

University (USA)

Panasonic is conducting a demonstration project with a University in the United States, where we combine the Smart Energy Storage System with a technology to forecast the output of solar generation. This demonstration project is aiming to contribute to the stable and reliable supply of electricity in an area with high level renewable penetration.



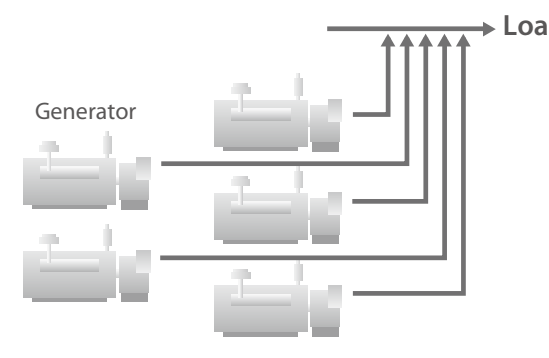
Community Off-Grid

Solutions to reduce the use of natural gas or other fueled generators for Micro Grids!

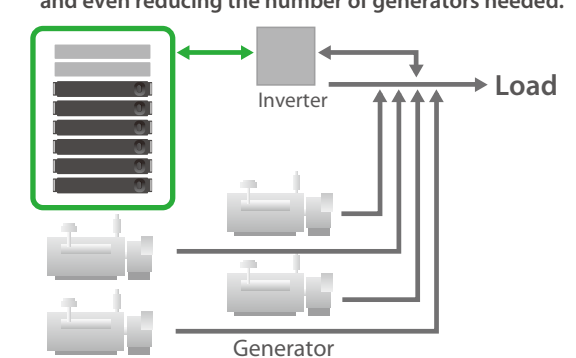
27-kWh System

Employing Smart Energy Storage System in combination with natural gas or other fueled generators

► Natural gas or other fueled generator output used to meet fluctuations in power demand



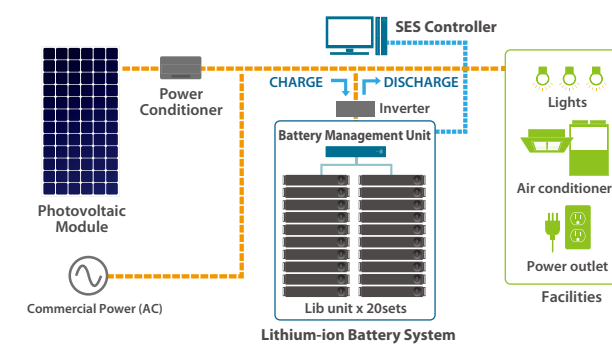
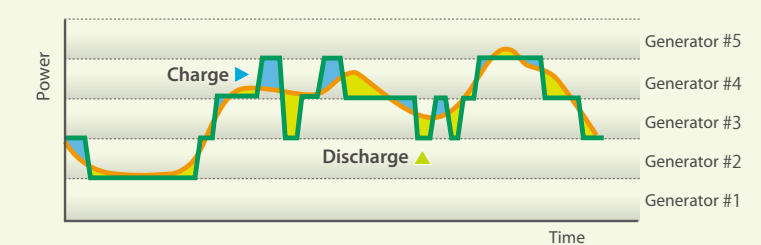
► By introducing energy storage, natural gas or other fueled generators can operate at a constant rate, minimizing the fuel usage and even reducing the number of generators needed.



Generator with Battery Management & Load Profile

Load averaging is achieved by adding Smart Energy Storage System, reducing diesel fuel consumption. This can realize reduction of the number of natural gas or other fueled generators.

— Energy usage
— Generator operating capacity



Storage Battery Capacity/Output	32 kWh / 7.2 kW
Photovoltaic Modules	30 kW
Application	Charges the electricity generated by PVs, and uses it for peak load cut and backup power supply. Jointly demonstrating a system to forecast solar power output with a University.
	In operation since June 2011

Industrial/ Commercial

- Reduces electricity bills by reducing contracted power (peak shifting)
- Can be utilized as UPS function
- Also can act as a valuable asset for Energy Arbitrage/Demand response and other applications



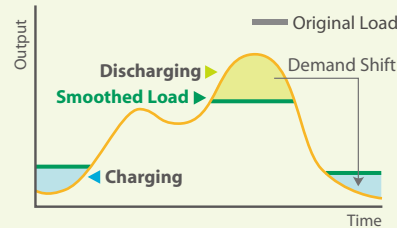
27-kWh System

Employing Smart Energy Storage System for buildings, factories, and schools



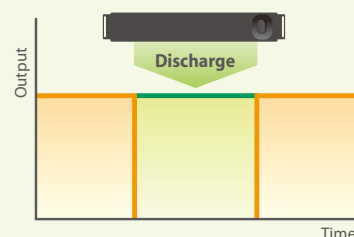
Peak Demand Shift

Power stored during off-peak, late-night hours in the battery storage system is discharged during daytime peak demand, effectively shifting the peak demand.



Backup Power Source during Outages

Power from the storage system can be used as a backup power source in the event of a power outage.



Facility UPS

When there is a power outage, the lithium-ion battery storage system can operate as a UPS system to bridge the operation of critical systems until the power returns or a backup generator starts.

Installation example:

TV and radio stations operating during severe weather conditions
Fire and rescue dispatch systems



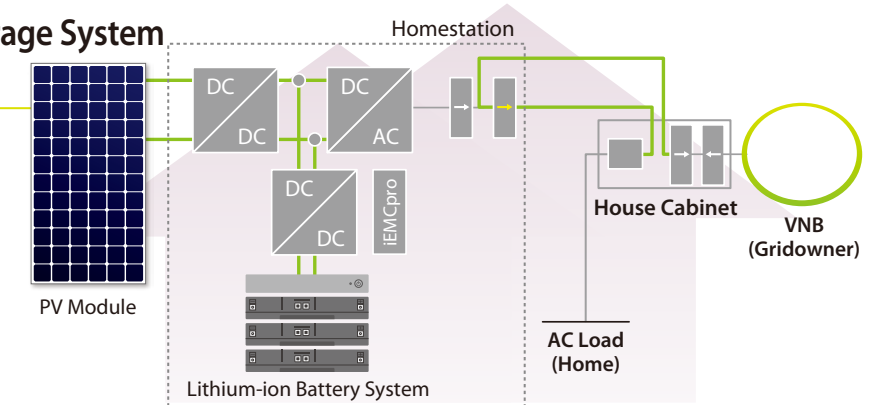
Homes and Small Stores

- Reduces power bills through self-consumption of photovoltaic electricity
- Contributes to the reduction of CO₂ emissions
- Serves as an emergency power source in the event of a disaster

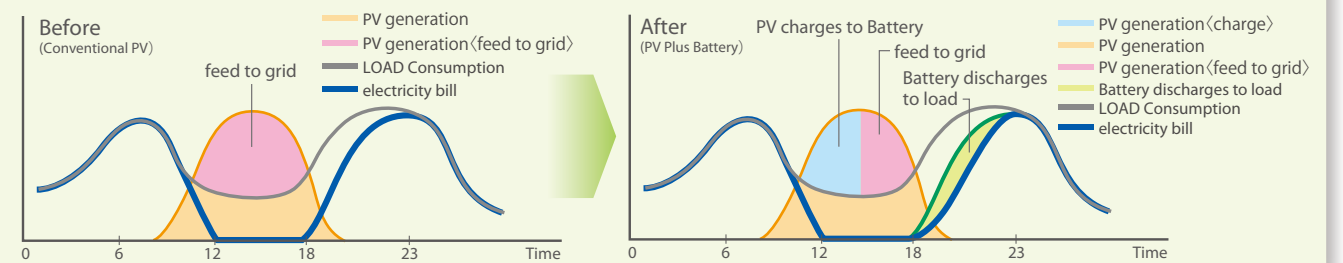


4.0/ 6.8-kWh System

Employing Smart Energy Storage System in a home or small store



Shifting peak demand usage by combining photovoltaic modules and Smart Energy Storage System; maximizing consumption of photovoltaic module power



Residential Storage Battery System Example

Adoption for Home System (Germany)

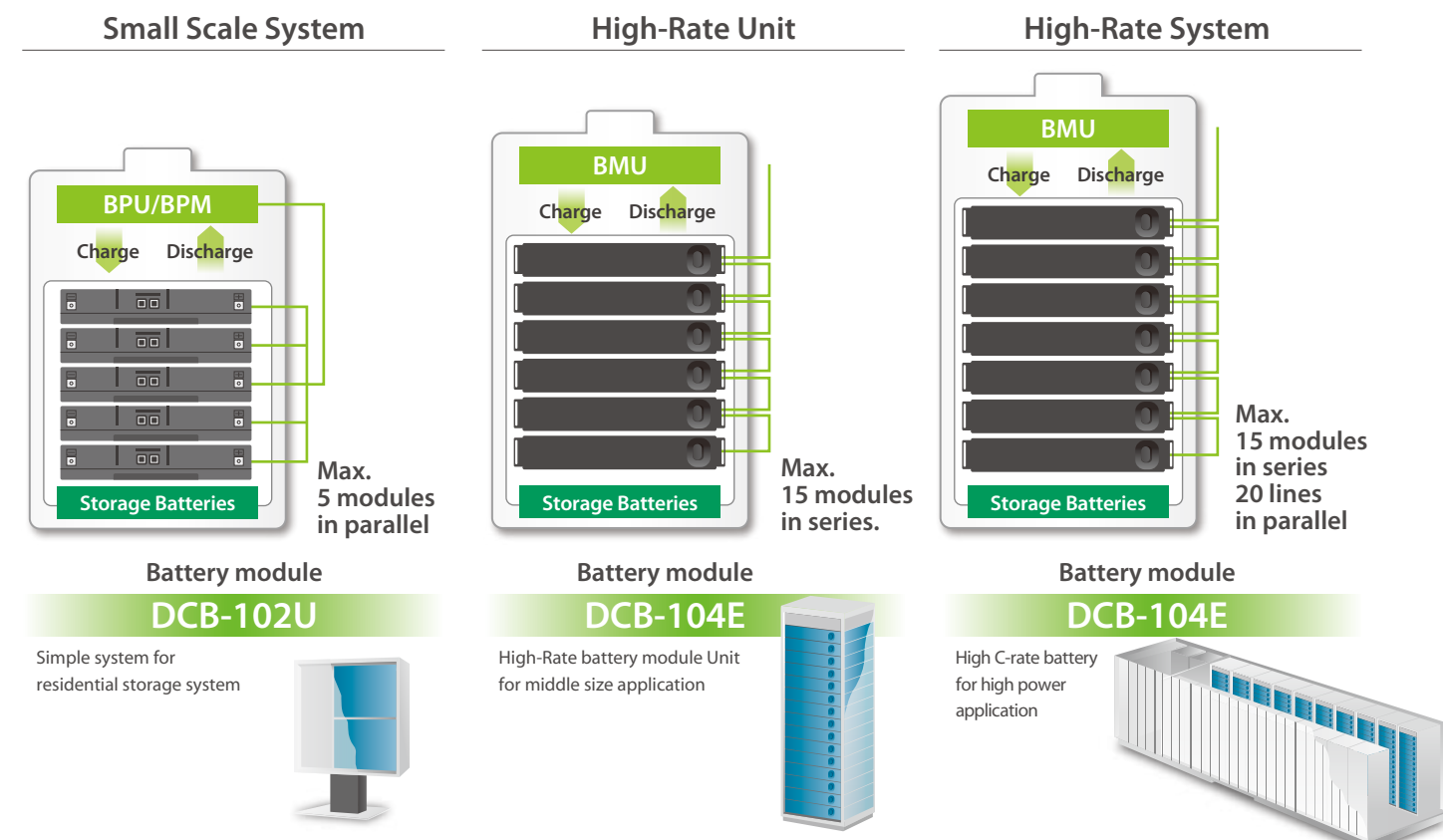
Storage Battery Capacity	4.05kWh
Photovoltaic Modules	4.6 kW
Application	Storage batteries are used to maximize the use of solar power, which leads to higher self consumption. The stored energy is used during the period without solar radiation.
	Under operation



Configuration of Smart Energy Storage System



Technology Features



Panasonic's Kasai Green Energy Park (Japan)

In the power storage building at the Kasai Green Energy Park, there are more than 800 standard battery modules, each with an output of 1.6kWh. Panasonic has developed one of the world's top level power systems with the Lithium Mega Storage System at the site. Efficiently controlled energy generated from photovoltaic modules, as well as energy provided through off-peak, late-night grid power stored in these storage batteries, is utilized through optimal energy management.



Storage Battery Capacity/Output	1.5 MWh / 288 kW
Photovoltaic Modules	1 MW
Application	Peak shaving: Store late-night power from the grid and surplus solar power for daytime use in the Kasai Green Energy Park
	In operation since October 2010



Accomplishment of average 17% peak shaving in July, 2011

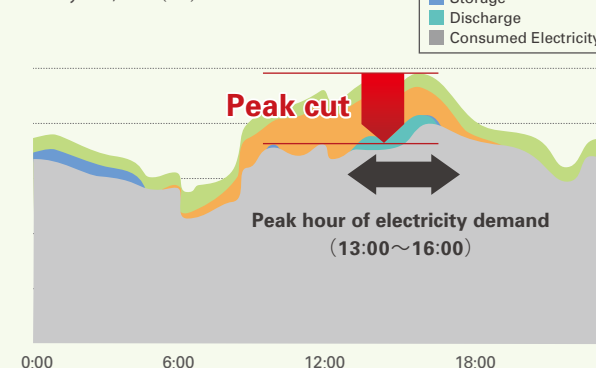
- Average peak shaving rate is 17% in Peak hour of electricity demand (13:00 ~ 16:00)
- Annual utility charge reduction effect (preliminary calculation) is about 3.5 million yen

Peak cut ratio for each day

7/5	7/6	7/7	7/8	7/11	7/14	7/15	7/18	7/19	7/20	7/21	7/22	7/25	7/26	7/28	8/1	8/2	8/3	Average
Tue	Wed	Thu	Fri	Mon	Thu	Fri	Mon	Tue	Wed	Thu	Fri	Mon	Tue	Thu	Mon	Tue	Wed	
20%	16%	11%	18%	20%	23%	22%	19%	11%	18%	12%	18%	14%	18%	17%	17%	19%	20%	17%

The day in big result of PV

July 15th, 2011 (FRI)



The day in small result of PV

July 19th, 2011 (TUE)

