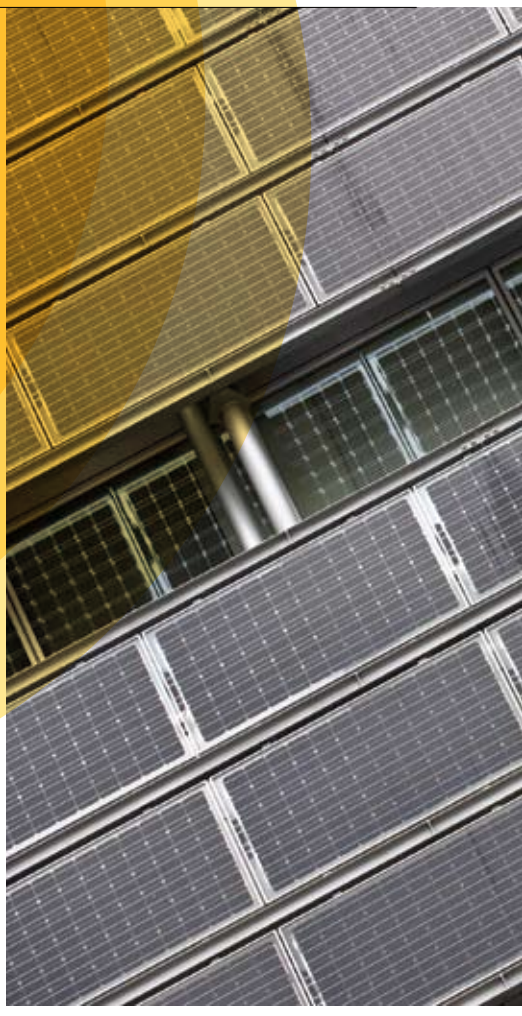
POWER SWITCH

The many downsides of dependency on fossil fuels necessitate a new way of thinking about electricity management



In most of the modern world, an uninterrupted supply of electricity is considered a given. To maintain that supply, however, demands a rethinking of how we generate, store and manage our electricity. Foremost among the necessary changes is a reduction of the dependence on fossil fuels, the continued availability of which is in doubt. Mass consumption of fossil fuels also, of course, results in the emission of CO_2, perceived as being largely responsible for climate change, which, according to UNESCO, is "an issue that already affects and will increasingly impact all nations," adding that "progress is required on effective mitigation." There is ample evidence of such progress already: More energy is available worldwide from renewable sources than from nuclear sources, according to the U.S.–based Worldwatch Institute.

In 2010, according to the World Economic Forum/Bloomberg New Energy Finance Report on Green Investing 2011, $243 billion was invested worldwide in clean energy—a 30 percent year-on-year gain that marks a return to the pre-recession growth of such investment.

A new approach to energy management

The new approach to maximizing the efficiency of renewable resources includes centralized management of the generation, storage and utilization of electricity at regional, area, community and household levels—the so-called "smart grid." Over 300 projects and pilots are currently underway worldwide to develop this concept, which is key in the field of energy management.

Generating electricity from solar or wind power is only a first step toward energy management, because much of this power is wasted through inefficient transmission methods. (Recently in the U.S., there has been a discrepancy of over 6 percent between the amount of power generated and that sold). Local energy production can minimize such losses, as is the case with solar power generation, which is typically seen on individual buildings. The implementation of photovoltaic (PV) installations can be scaled up, however, and many countries now have multi-megawatt PV installations. Germany, for example, had 17,790 GW of solar capacity online in 2010 (with nearly twice as much available from wind power). Already, many utility companies allow surplus home-generated PV electricity to be put back into the grid and resold to the utility (feed-in tariffs, such as are implemented in Japan, Germany, the Czech Republic, Italy and the U.K., among others). Some applications that are entirely self-contained (such as solar-powered street lighting integrating PV panels, storage and a lighting unit) require only centralized monitoring and control connections.

PV power generation is now more cost-effective than nuclear, according to a 2010 Duke University study, and its efficiency is also improving, as exemplified by the HIT PV (Heterojunction with Intrinsic Thin-layer) system developed by SANYO Electric Co. Ltd., a member of the Panasonic Group, where the reverse side of a wall-mounted panel can also generate electricity from reflected light. At Kasai, Hyogo, Japan, a system including this type of PV panel has over 1 MW potential, and even on a cloudy day it produces over 100 kW. This production facility, the Green Energy Park, has been designed to

As spending on clean-energy R&D continues to rise (a record $35.5 billion in 2010, up 24 percent over 2009), technologies that allow scalable, universal applications—from a wide-area grid, through community-sized services, to domestic and home use—will integrate the fields of generation, storage and usage to help significantly increase the efficiency of our electricity consumption.

ROBERT GILHOOLY/BLOOMBERG

HIT (Heterojunction with Intrinsic Thin-layer) double bifacial photovoltaic modules are affixed to the external walls of the administrative building at SANYO Electric Co.'s Green Energy Park in Kasai, Hyogo, Japan.

implement eco-friendly technology on a large, "real-world" scale, and to demonstrate the value of key concepts developed by the Panasonic Group, especially that of integrating power generation, storage and usage through a "Smart Energy Gateway."

Power where and when it is needed

Even when electricity is generated from renewable sources, there are still challenges. On sunny days, the demand for power may not be as high as when the sun goes down, and even the most efficient PV panels have limitations in poor weather. Massive investment in PV technology alone (3 GW installed worldwide in 2010, with Germany anticipated to have a 41.6 GW capacity by 2014) cannot guard against cloudy days.

Batteries are usually the backup plan against power loss, but the problems of charging and conditioning batteries have prevented their deployment on a scale larger than a building-wide basis. These installations (using lead-acid or sodium-sulfur technology) are often impractical for widespread use, and are typically used to replace, rather than augment, conventional power sources.

Linked cells, monitored, charged and conditioned centrally through a computer network, can reduce peak grid power demand in homes, and even larger installations. As a practical demonstration, SANYO has produced a 310,000-cell "battery pack" with over 1.5 MWh capacity. This megabattery, managed as a single battery, is composed of chained 1.6 kWh modules, each containing 312 cells, managed through Ethernet connections. Power from PV panels, as well as off-peak grid power, may be used to charge these cells. Though lithium-ion batteries are typically subject to risks of heat buildup and overcharging, Dr. Hiroshi Hanafusa, deputy general manager of SANYO's Smart Energy Systems division, emphasizes that the very design of the system and the centralized management facility incorporate many safety features.

Such battery-pack technology applies not only to mega-installations, but can also be used on a smaller scale to store home-generated power.

Making the most of what we have

Electricity from home outlets is AC, and batteries produce DC (at a lower voltage), presenting a conundrum for battery-pack technology. Conversion between DC and AC wastes power, and DC is needed to power lower-voltage, energy-sipping LED light fittings. These lights and many other domestic devices (laptop computers, for example) currently use adaptors to convert outlet power to a lower-voltage DC supply. One current idea is an alternate low-voltage DC wiring system for battery-equipped homes, specifically for such lighting and devices, and such a domestic infrastructure could form part of the home of the future.

Ideas such as a DC wiring system may one day assist in saving electricity, but the ultimate power savers are customers themselves. The home's gateway—linking lights, appliances, sensors and power sources (grid and locally produced), and managing the flow of power between them (a local "smart grid")—can inform customers of their consumption patterns through a TV or computer display. There is then a visible incentive to use less power, e.g., doing the laundry at times when power tariffs are lower.

Such technology is proposed for mass introduction in projects such as the planned Sino-Singapore Eco-City in Tianjin, China, a 25 million-square-meter (nearly 6,200 acre) development. The city's future 350,000 citizens will enjoy substantial power savings through the home energy management systems to be installed there, and the utilities supplying power will benefit from an increased stability of demand, and reduction of operating costs. Including China's 100 initiatives, 300 such eco-projects have been announced worldwide in over 17 countries, including the U.S., U.K. and Germany.

As spending on clean-energy R&D continues to rise (a record $35.5 billion in 2010, up 24 percent over 2009), technologies that allow scalable universal applications—from a wide-area grid, through community-sized services, to domestic and home use—will integrate the fields of generation, storage and usage to help significantly increase the efficiency of our electricity consumption without altering our basic lifestyles. *—Hugh Ashton*

Hiroyuki Amano, Corporate Division for Promoting Energy Solution at Panasonic Corp.

LIGHT BRIGHT, BIG CITIES

As urban areas worldwide grow, it's critical that they consume less energy. Creating, storing, saving and managing energy efficiently are all key factors in achieving this goal

The electrical giant Panasonic, founded in 1918, is fast approaching its centenary. A "Green Plan 2018" has been laid out to mark this milestone, with a focus on the development of energy management systems.

Panasonic sees intelligent energy management as vital to the future of cities. Hiroyuki Amano, of the Corporate Division for Promoting Energy Solution, comments that with the rapid rise in CO_2 emissions, he perceives an urgent need to assist the world's rapidly growing urban population reduce its energy consumption.

The goal for Panasonic, whose wide product range encompasses home appliances as well as electricity storage and generation equipment, is to become the world's "Number One Green Innovation Company in the Electronics Industry." Two major initiatives have been started to meet this goal: the "Green Life Innovation," which focuses on consumer lifestyles, and "Green Business Innovation," which seeks to reduce the environmental impact of businesses, including Panasonic's own operations. As one of the major contributors to CO_2 emissions, the global reduction of which is one of the objectives of the Green Plan 2018, the generation and transmission of electricity is a prime candidate for change, and Amano sees this in terms of a radical rethink of the way in which we manage electricity in our cities. A smart energy management system to achieve this end, such as is currently under development by Panasonic, integrates three major components: local energy creation; on-site energy storage; and energy saving, centrally monitored and controlled by a "Smart Energy Gateway." The system may be scaled up from individual houses to larger buildings, and eventually to area energy management.

With Panasonic's expertise in photovoltaic generation, and the use of lithium battery technology to store electricity, peak shaving techniques to reduce peak-time loads on the wide-area grid can be adopted at a local level to generate and distribute locally generated solar power, and at times of peak demand, to feed in off-peak electricity that has previously been stored in battery packs. Connecting to and controlling these devices over the Internet, Panasonic devices can gauge demand using an area energy management system, and channel power where it is needed, when it is needed.

To gauge demand, though, there must be a method of communicating with homes and buildings, and here the HEMS (Home Energy Management System) comes into its own. Amano explains that there are various approaches to help individual consumers cut down on electricity usage. First, smart appliances connected to a central controller—the Smart Energy Gateway—can be used to save power, taking their cues from sensors to detect movement, ambient lighting, temperature conditions and so on. "As a manufacturer of appliances, as well as of the controllers and sensors, Panasonic is in a unique position to assist users in saving electricity," says Amano. Augmenting these automated savings is the ability to show consumers on a TV or other display exactly how much electricity they are using and in what way, thereby providing them with practical information to help reduce energy consumption. Utilities benefit from increased stability and reduction of operating costs, and society as a whole benefits from a reduction in the use of resources, and reduced CO_2 emissions.

Below: *Green Energy Park in Kasai, Hyogo, Japan.*

Already great progress is being made in large-scale deployment of HEMS technology. For example, Tianjin in China, a Sino-Singapore Eco-City of 350,000, is being developed with the aim of making 100% of its buildings and 90% of its transportation "green." Similar efforts are being undertaken in various locations around the world, including a former Panasonic factory site in Fujisawa, near Yokohama, Japan, where a similar "sustainable smart town" is being developed.

Though it is early days to start forecasting precise numerical targets, Amano is confident that these developments will result in significant reductions in CO_2 emissions, a view obviously shared by many around the globe, as Panasonic technologies find ever-increasing utilization in the production, storage and management of energy at a local, community level. —*H.A.*

ROBERT GILHOOLY/BLOOMBERG

Panasonic has a dream for this planet and the everyday lives of people.

The World Heritage sites are natural and cultural wonders of the world that need to be preserved for future generations - and the joy we experience from our daily lives is a treasure just as precious. By reducing carbon emissions, more efficient use of resources, clean water efforts and preserving biodiversity, Panasonic has made conservation of the environment a priority for all its business activities worldwide.

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THE WORLD HERITAGE SPECIAL

Panasonic presents a monthly program on the National Geographic Channel

"The World Heritage Special" explores the natural and cultural wonders of the world and 'eco ideas' behind their conservation. Find out more on www.facebook.com/worldheritage.with.panasonic

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