energy21 news

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Contents

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DG in Germany:

Heading into the Mainstream?

A new energy in Germany will be crucial in determining the future growth of distributed generation (DG). So too will the development of a robust regulatory regime to administer the law. If successful, DG production could reach 40% of the total by 2020.

Distributed generation (DG), if defined as electricity that is fed into the low- and medium-voltage grid and is produced near the end-users and the load, can be found in Germany in two market niches.

Renewables accounted for slightly more than 10% of total electricity production in 2004. For the first time, wind energy had the highest share with around 45%, followed by hydro power with 40%, and biomass with less than 10%. Since large hydro power cannot be considered as decentralised production, the renewables market niche roughly embraces 7% of total production. Cogeneration covered slightly less than 10% of total electricity production in 2004. Nearly half of it comes from industrial on-site production, while the other half is from municipal power production. All of the municipal, and the largest part of the industrial, production can be considered as decentralised generation.

Germany's decentralised plants currently contribute around 85 TWh to the country's electricity production, a market share of around 16%. If the CHP law remains unchanged, there will be no growth in cogeneration.

Both renewables and cogeneration are supported by state laws: renewables by the Renewable Energy Sources Act (EEG), and cogeneration by the CHP law. However, the remuneration mechanisms for EEG and CHP plants are quite different. While EEG plants get a fixed rate according to technology and plant size, the payment for CHP plants consists of three components:

- a price linked to the current market price (as a minimum, the average baseload wholesale price);
- an additional CHP premium that is legally fixed for different types of plant and technology, and which gradually

decreases over time; and

- the compensation for avoided network costs, discussed below.

A CHP plant at Wolfring uses biogas to fuel its gas engines. The existing CHP law requires distribution system operators to buy electricity from cogeneration. While distribution system operators (DSOs) are required to connect all these plants to the grid and to accept their entire output, plant operators are not required to sell their output to the DSO. Instead, plant operators can cover their own demand when prices are high, or can negotiate their own contracts at prices above the respective rate, if they can find buyers. Under the EEG, plants do not even need a contract with the DSO in order to sell their output.

Both renewables covered by the EEG, and CHP plants covered by the CHP law, have priority access to the grid. The remaining DG plants do not have priority and hence have to find a third-party customer by themselves for their output, to be supplied via the grid. Such grid access and electricity purchases must follow pre-conditions.

The EEG provides an obligation on all DSOs to buy power from well-defined renewables at rates fixed above market price. The CHP law requires all DSOs to buy electricity from well-defined CHP plants at a rate above the market price. Besides the EEG and the CHP law, there is no legal obligation for DSOs to buy electricity from on-site producers.

Saar Energie has taken part in one of the first approaches to develop marketable DG products in Germany. As both renewables and CHP plants sell their output directly to the DSO and not to a third party, they would not have to pay grid charges even if the charges for plants were not set to zero, as is the case in Germany. The EEG (amended in August 2004) has improved the conditions for plants using biomass, offshore wind and geothermal such that it guarantees adequate revenues. The share of decentralised renewables[1] might now increase up to 20%, with biomass as the most significant contributor to that growth.

Without changing the CHP law, there will be no growth in cogeneration. This is despite the fact that Germany has a CHP potential of half of the total electricity production. Under more favourable conditions, the market share of cogeneration could grow to 20% by 2020, in which less than 2% would be micro-CHP, and where gas-fired CHP would undoubtedly dominate.

Altogether, decentralised energy production in Germany could easily have a 40% share of the market by 2020.

First Steps to Market Participation

With a potential market share of 40%, decentralised energy cannot remain locked into niches but must participate fully in the markets, provided that they are liberalised with low barriers to market access and information.

DSOs are ‘passive’ in that they try to avoid going beyond their original ‘wires business’.

In Germany, the DG community has taken its first steps to develop marketable products and take part in the market:

In December 2004, the municipal utility of Unna in Northrhine-Westfalia launched a so-called ‘virtual power plant’, which integrates different decentralised plants. Among them are five small CHP plants, two wind parks, one small hydro plant and a photovoltaic facility. The integration tool is in addition to standard automation and control technology, specialised software which optimises the electricity supply according to customer demand. One of the goals of this project is to lower the procurement costs of the utility and to fully utilise the value of decentralised options, by balancing the intermittency of some of these options.

Saar Energie, a subsidiary of STEAG, one of the largest IPPs in Germany, has set up a ‘virtual power plant’ for the balancing market. Among its 31 partners are decentralised power plants, as well as large industrial customers who can switch off their load for a short period of time. Together, they currently combine 680 MW in a pool controlled by modern information and communication technology. Within one year, Saar Energie has gained a market share of more than 5% in a €1 billion market and is heading for more. According to one of the innovators of the approach, decentralised power plants and large industrial customers together could cover the whole balancing market in Germany.

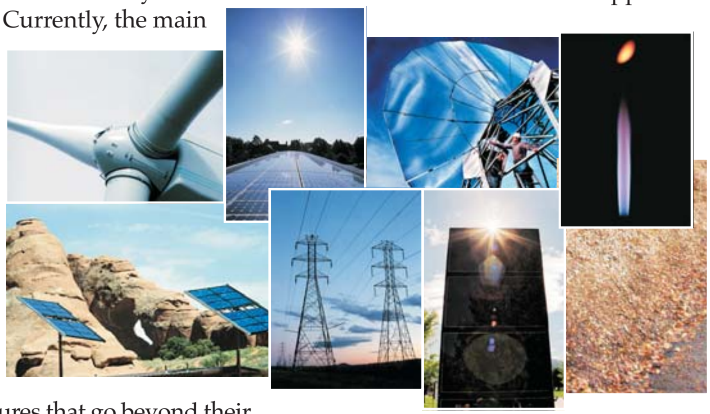
In the city of Hattersheim, the local parliament has decided to supply a CHP plant to a new development area of the city and to operate the district's low-voltage grid separate from the existing grid, which is owned by the regional utility. This so-called ‘area net’, or ‘power park’, has only one connection to the medium-voltage level and will be maintained by the local utility. The reasons behind this decision were mainly economic, and despite the efforts of the regional utility to fight against it, it was finally willing to co-operate.

These approaches may indicate that the

decentralised generation options are moving closer to the markets and are discovering their economic value, which can be exploited in liberalised markets. If this development proceeds with the help of the new energy law (discussed below), it could lead to a paradigm shift in the German electricity market.

DSOs as Key Players for a Level Playing Field

A fuel cell being tested in Hamburg by European Fuel Cells GmbH. Fuel cells produce electricity and heat in an environmentally friendly manner. Currently, the main purpose of Germany's 700+ DSOs is to provide distribution network services, mainly the transport of electricity. These DSOs are 'passive' in the sense that they try to avoid measures that go beyond their original 'wires business'. They clearly favour a situation in which they get their power from big suppliers, transport it to their customers, and ensure the security of supply through network maintenance and reinforcement. This is mainly due to the incentive structure that is determined by the current regulatory framework.



If DSOs stick to this role in the future, they are likely to regard decentralised electricity production as troublesome, a cause of additional costs that may not be totally recoverable through the network charges. All costs connected with distributed generation are then additional costs to the DSOs compared with when they still get centralised electricity.[2]

Unless the DSOs are compensated for the trouble they would have with DG, the playing field between centralised and decentralised generation will remain clearly biased in favour of centralised generation. Furthermore this compensation must be indicated beforehand in order to neutralise the 'natural' resistance against DG.

The use of fuel cells is well underway in Germany. A unit at the Rhön-Klinikum hospital in Bad Neustadt, Franconia, has reached well over 21,000 hours in operation.

As for renewables and decentralised CHP plants, there is an obligation on DSOs to connect them to the grid, accept their output, and pay a fixed rate for renewables or a rate above the market price for CHP plants, as discussed earlier.

However, despite this formal obligation, a DSO may try to make it more difficult or more costly for a DG plant to get grid access, making projects less profitable or even unprofitable. The weak regulation and the heavy reliance on court rulings has given DSOs significant scope for doing this.

DSOs can pass the remuneration for the renewables plants to the transmission system operators (TSO) to whom the DSOs are connected. TSOs in turn can pass it on to the supply companies, which will distribute it to all end-users. This burden-sharing mechanism, introduced by the EEG, has removed one of the former reasons for DSOs to oppose an increase in renewable generation. Although the remuneration does not affect the DSO's revenue stream once the plant is on-line, there are still a number of reasons for the DSO to be opposed to an increase of independent DG generation in the local area.

The higher the number of independent DG plants connected to the grid, the more difficult the operation of the grid. For example, if the grid needs to be taken off-line, the DSO would first need to inform all DG plants to stop generating. The DG operator represents an additional counterpart that the DSO has to deal with (in signing contracts, transferring money, etc.) — without any potential for making money out of this relationship.

Additionally, the DSO has to deal with the TSO, who has to make a refund to the DSO for payment made to the DG operator. This requires additional staff and thus increases the costs for the DSO.

The intermittent generation from DG plants can affect the DSOs when they need to provide more balancing energy. It is not yet clear how the DSOs can recover the costs for balancing. Creating an economically level playing field for decentralised electricity production with 'passive' DSOs would incentivise them to consider all additional costs, including transaction costs. This incentivisation therefore relies heavily on a sound regulatory regime that not only neutralises the undesirable incentives, but also gives positive ones.

The New German Energy Law

For the future of decentralised electricity production in Germany, the new energy law – and as an important part of it, the new regulatory regime – will play a crucial role. This law, Zweites Gesetz zur Neuregelung des Energiewirtschaftsrechts (Second law for the re-regulation of energy law), translates the European Electricity Directive to the national level and will end the long era of self-regulation, in which the large utilities have prevented newcomers from both the generation and supply market. The new law will end the long era of self-regulation

Besides the overall impact of a more competition-oriented framework, some specific aspects, both

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in the energy law and the corresponding orders[3], are very important for the future role of DG:

Compensation for avoided network costs:

- plants that are not connected to the high-voltage level – these will receive compensation for the avoided network costs. As grid charges for all power plants are set to zero, thereby exempting DG plants from paying for the avoided network costs via the lower grid charges, this compensation is the only way for DG plants to appropriate the benefits of avoided network costs. It can be an important source of income for DG operators.
- the calculation of grid charges – these are based on the assumption that all electricity is fed into the high-voltage transmission grid. The payment from the DSO to the TSO, however, is based on the actual annual peak load which the DSO gets from the TSO, reduced by a coincidence factor. As a result, if there are plants connected to the distribution network, the payment which the DSO receives from grid users would exceed the fee passed from the DSO to the TSO. The draft of the order for electricity network charges (Stromnetzentgeltverordnung, Section 18) fixes the compensation for these avoided network costs, especially for those CHP plants that do not receive them as part of the CHP law.[4]

System optimisation of the decentralised options – article 14 (7) of the European Electricity Directive states: `When planning the development of the distribution network, energy efficiency / demand-side management measures and / or distributed generation that might supplant the need to upgrade or replace electricity capacity shall be considered by the distribution system operator.' This article is also part of the draft of the energy law (Section 14 [3]) and is expanded by the government's authorisation to pass an order that can define adequate methods and criteria for the DSO planning process. This addendum is very important because without it, the DSOs could not be forced to consider decentralised options within their planning processes.

Disclosure and transparency of the electricity bills – Section 42 of the draft of the energy law obliged the electricity suppliers to inform their customers about the share of nuclear, coal, gas, renewables and cogeneration in their portfolio. With respect to the share of cogeneration, this regulation goes beyond the electricity directive and can be recognised as successful for the DG lobbying groups in Germany.

Unfortunately, there will be no adequate and transparent rules in the energy law for the design of the balancing and the reserve markets, but as a minimum, the government will have the possibility to pass orders that can solidify the conditions for both markets (Section 24). Since the balancing costs (which are very high in Germany) are an important part of the 'use of system' charges of the high-voltage grid, the regulator might especially urge the legislator to improve the balancing market's transparency, access and co-operation.

The new law came into effect on 1 July, 2005, but it will be at least another year before the new regulatory authority has enough staff, data and knowledge to start the regulatory process. The establishment of a level playing field, giving decentralised electricity production a fair chance of market participation, will depend heavily upon this new authority. It will also depend on the authority's ability to enforce a rational regulatory process against the market power of the incumbents and their associates in the Federal Ministry of Economic Affairs. Establishing a level playing field will depend upon the new regulatory authority.

Notes

1 Offshore wind is not considered to be a decentralised option.

2 Except the few cases in the short-run where it is cheaper for the DSO to connect a DG plant than to upgrade the network.

3 There may be more than 20 additional orders (Verordnungen) to the law from which four are already drafted.

4 Renewable plants that fall under the EEG do not get avoided network cost payments because the EEG remuneration does already include them.

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Otago Windfarm Plans

A $1.1 billion to $2 billion wind farm, possibly the biggest in the world, at Rocklands in the Otago's Lammerlaw Range, is being investigated by Meridian Energy Ltd.

The company has three monitoring wind towers on Rocklands Station and expects to know within a year if the project is feasible and to decide on whether to proceed with resource consent applications. Under the current concept, the site has the potential to generate between 600 MW and 1000 MW of electricity.

The project is estimated to cost between $1.1 billion and $1.2 billion to produce 600 MW, and up to $2 billion for 1000 MW.

Looking further ahead, the 300 square kilometer area could accommodate up to 300 wind turbines potentially producing 2500 GWh of electricity a year. In comparison, the Benmore hydro power station produces 2200 GWh.

If it goes ahead, the Lammerlaw wind farm would produce extra electricity for New Zealand, and would also make operation of the Waitaki system more flexible and improve security of supply. Water in storage within the Waitaki system could be saved while the wind farm was generating.

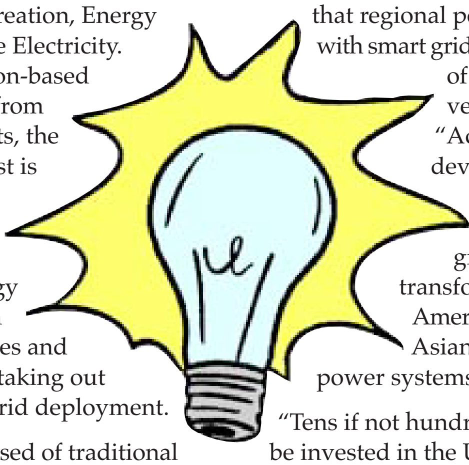
Stuff.co.nz 23 November 2005

Smart Grid: Fewer Blackouts, More Greenbacks for the Northwest

New Report Calls for Regional Smart Grid Acceleration

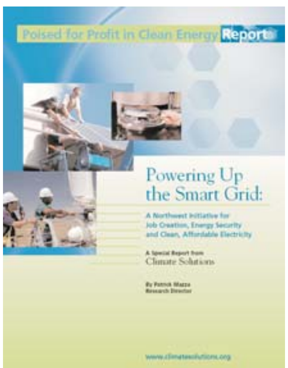
An emerging revolution in electricity holds tremendous potential for the Pacific Northwest economy and environment, a new report concludes.

The 'smart grid' uses computing technology to dramatically improve reliability, keep electric bills in check, make power use more efficient, and brings new renewable power on line more rapidly, says Powering Up the Smart Grid: A Northwest Initiative for Job Creation, Energy Security and Clean, Affordable Electricity. Issued by Olympia, Washington-based Climate Solutions with input from leading researchers and experts, the report notes that the Northwest is already a global leader in this smart energy industry. Regional companies hold a $2 billion share of the smart energy industry's global $15 billion in annual sales. Northwest utilities and research institutions are also staking out advanced positions in smart grid deployment.



"Today's grid is mostly composed of traditional technologies. Thomas Edison would recognise most of it," said Patrick Mazza, author of Powering Up the Smart Grid. "Meanwhile our economy is going digital while the stress on our electrical power system is growing. The smart grid can meet these challenges while providing substantial economic opportunities to regions and companies that lead in smart grid deployment."

The report calls for a Northwest Smart Energy Initiative to accelerate regional smart grid growth through a program of demonstration projects and regulatory reforms. It sets out recommendations for Northwest governors and congressional delegates to achieve those ends. The report is available for free download at www.climatesolutions.org.



The need for a smart grid is evidenced by the growing wave of power disturbances, including the infamous east coast blackout on August 14, 2003 that turned out the lights on 50 million people and cost an estimated $6 billion. Columbia University power grid researcher Roger Anderson notes that "since 1998, the frequency and magnitude of blackouts has increased at an alarming rate...blackouts in Chicago, Delaware, Atlanta, New Orleans and New York in 1999, San Francisco and Detroit in 2000...If present trends continue, a blackout enveloping half the continent is not out of the question."

"Without a major national effort, the U.S. economy will decay for lack of proper energy to power it for the potential growth ahead," said Steve Hauser, executive director of the GridWise Alliance, a national smart grid acceleration effort that includes smart grid leaders such as Areva, General Electric and IBM.

Local leaders say the smart grid is vital for our region. Port of Seattle Commissioner Lawrence Molloy notes, "It is hugely important for the Port that regional power networks are upgraded with smart grid technologies." Wayne Embree of Cascadia Partners, an Oregon venture capital firm, says, "Accelerating smart grid development in the Northwest will position us well to capitalise on the inevitable growth and market transformation underway in North America and especially the booming Asian economies expanding their power systems."

"Tens if not hundreds of billions of dollars will be invested in the U.S. power grid over coming decades. Sixty percent of our energy system's aging infrastructure will need to be replaced in the next 10- 15 years. A PNNL study shows that the smart grid's capability to smooth out peak power demands alone could eliminate the need for $46 billion-$117 billion in power plant and power line investments over the next 20 years. This and other smart grid economies will help keep the lid on power bills and preserve jobs in all industries dependent on reasonably priced electricity."

And the smart grid can do more than preserve jobs that would otherwise be lost because of unreliable and overpriced electricity. It can create brand new jobs creating brand new products for use in the Northwest and for sale to the rest of the world. Indeed, the Northwest is already taking a forward position.

Among its smart grid leaders are Spokane-based Itron, world's largest maker of digital power meters; Schweitzer Engineering Laboratories of Pullman, Washington, a global leader in digital power switches; and Areva T&D, Bellevue, operating around the world to automate power delivery networks. Public sector leaders include Pacific Northwest National Laboratory (PNNL), a major player in GridWise.

The Northwest Energy Efficiency Alliance is extensively demonstrating energy-saving digital control systems in local power distribution. And the Pacific Northwest GridWise Testbed, made up of PNNL, Bonneville Power Administration (BPA), Portland General Electric and PacifiCorp, has started up a series of smart grid demonstration projects. BPA is also engaged in one of the transmission industry's most advanced efforts to replace traditional line upgrades with digital information technologies.

The smart grid will also offer new capabilities to bring on-line varying power flows from wind farms, solar panels and other renewable power sources, and to integrate vast numbers of small-scale, localised generators such as fuel cells and microturbines.

The diversification of power sources plus the capability to manage end-use demands provides new security against blackouts. A RAND Corporation study found smart grid technologies could reduce power disturbance costs to the U.S. economy by $49 billion per year.

To find out more or help with accelerating the smart grid, please contact Barry Pfundt at Climate Solutions: barry@climatesolutions.org.

SOURCE: *Climate Solutions*

BP forms BP Alternative Energy

BP announced that it plans to double its investment in alternative and renewable energies to create a new low-carbon power business with the growth potential to deliver revenues of around $6 billion a year within the next decade.

Building on the success of BP Solar – which expects to hit revenues of $1 billion in 2008 – BP Alternative Energy will manage an investment programme in solar, wind, hydrogen and combined-cycle-gas-turbine (CCGT) power generation, which could amount to $8 billion over the next ten years.

“Consistent with our strategy, we are determined to add to the choice of available energies for a world concerned about the environment, and we believe we can do so in a way that will yield robust returns,” said BP chief executive Lord Browne.

“Our recent experience, particularly with solar, has given us the expertise and confidence to develop new products and markets alongside our mainstream business. We are now at a point where we have sufficient new technologies and sound commercial opportunities within our reach to build a significant and sustainable business in alternative and renewable energy.”

Browne said the first phase of investment would total some $1.8 billion over the next three years, spread in broadly equal proportions between solar, wind, hydrogen and CCGT power generation. Investment will be made step by step, and will depend on the nature of opportunities and their profitability.

“We are focusing our investment in alternatives and renewables on power generation because it accounts for over 40 per cent of man-made greenhouse gas emissions, the biggest single source. It is also the area where technology can be applied most cost-effectively to reduce emissions.

“As the pricing of carbon develops through trading schemes and other initiatives, the market will grow rapidly as low-emission technologies displace less clean forms of power generation.”

Investment in solar over the next three years is planned to boost BP's leading position as a leading manufacturer and supplier of photovoltaic systems. In a field where technology improvements and higher productivity are causing costs to decline, BP currently has 10 per cent of the global market which is growing at 30 per cent a year, faster than any other form of renewable energy.

BP currently has more than 100 megawatts of solar manufacturing capacity in the US, Spain, India and Australia, with a plan to double its capacity before the end of next year. BP recently signed a strategic joint venture to access China's expanding solar market and provide local manufacturing capacity and is exploring similar opportunities elsewhere in the region.

Investment in hydrogen fuels will include the world's first commercial project – at Peterhead, in Scotland – to turn natural gas into hydrogen by stripping out carbon dioxide and pumping it into depleted oil reservoirs.

The hydrogen will be used at a power station in Peterhead to generate 350 megawatts of ‘clean’ electricity, and the carbon dioxide re-injected into the offshore Miller field. BP is looking at a similar sequestration scheme to make hydrogen from low-value coke byproducts at a US refinery, which would be used to generate 500 megawatts at an adjacent new-build power plant.

Investment projected for wind represents a significant step up in this area of power generation for BP. The company currently runs two wind farms alongside existing oil plants in the Netherlands. It also owns industrial land in open, high-wind regions of the US, away from residential areas, providing the possibility to build the first large-scale US wind farm generating up to 200 megawatts in 2007. The company has identified enough US sites to accommodate wind turbines with a total capacity of 2,000 megawatts.

Projected investment in CCGT will be spent mainly in the US where the company already has significant co-generation capacity and is currently finalising plans for a new $400 million scheme at one of its major plants that will deliver 100 megawatts of power to the plant, and 420 megawatts to the local electricity grid.

Microgrids as Peer-to-Peer Energy

Small networks of power generators in 'microgrids' could transform the electricity network in the way that the net changed distributed communication.

That is one of the conclusions of a Southampton University project scoping out the feasibility of microgrids for power generation and distribution.

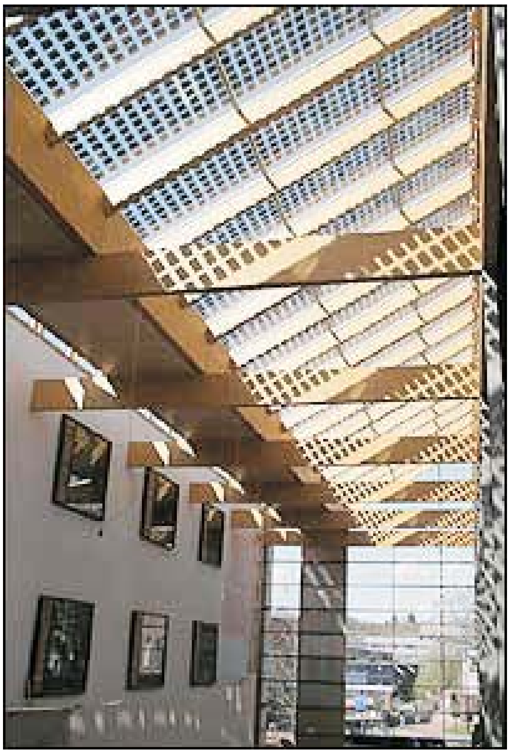
Microgrids are small community networks that supply electricity and heat. They could make substantial savings, and emissions cuts with no major changes to lifestyles, researchers say.

Electricity suppliers are aiming to meet the UK government's Renewables Obligation, requiring them to generate 15% of electricity from renewable sources by 2015.

Microgrids, say the researchers, could easily integrate alternative energy production, such as wind or solar, into the electricity network. They could also make substantial savings and cuts to emissions without major changes to lifestyles, according to lead researcher, Dr Tom Markvart.

"We wanted to look at what kind of energy system we would ideally construct today, in the 21st Century, in response to current pressures for higher energy use", said Dr Tom Markvart of Southampton University. "This would save something like 20 to 30% of our emissions with hardly anyone knowing it," he told the BBC News website.

"A microgrid is a collection of small generators for a collection of users in close proximity," explained Dr Markvart, whose research appears in the Royal Academy of Engineering's Ingenia magazine. "It supplies heat through the household, but you already have cables in the ground, so it is easy to construct an electricity network. Then you create some sort of control network."



That network could be made into a smart grid using more sophisticated software and grid computing technologies. As an analogy, the microgrids could work like peer-to-peer file-sharing technologies, such as BitTorrents, where demand is split up and shared around the network of 'users'.

Microgrids could exist as stand alone power networks within small communities, or be owned and operated by existing power suppliers. Campaign groups such as the Green Alliance have been pushing for micropower generation technologies, such as micro-CHP (combined heat and power) boilers - a vital part of microgrids - mini-wind turbines and photovoltaic (PV) solar arrays.

Micro-CHP units work by turning heat which would normally escape through flues into electricity. Homeowners then sell any surplus electricity back to the national grid.

The Green Alliance says the government should take micro-generation more seriously. Putting just six panels of solar PVs on a typical new three-bedroom house would reduce that household's carbon emissions by over 20%, according to the group.

Power pressures

Microgrids are designed for a smallish community - a typical UK housing estate for example. They deal much more efficiently with fluctuating power demands which the national grid is not flexible enough to cope with.

Dr Markvart's project was initiated in recognition that the UK's current electricity distribution system was built around the availability of fossil fuels.

But the 21st Century throws up some pressing questions about the use of fossil fuels. "We wanted to look at what kind of energy system we would ideally construct today, in the 21st Century, in response to current pressures for higher energy use," Dr Markvart said.

"We looked at something to which the technology energy sector could evolve in response to the need to reduce emissions." Dr Markvart and his team at Southampton University built a computer model to test out the viability of such small scale networks, combining micro-CHP units with PV solar arrays to convert sunlight into electricity.

"It is a little bit like comparing the old style telephone network with the network today," said Dr Markvart. Installing a microgrid would not need an entirely new network to be built, as some broadband networks have dictated. For developing countries, buildings could provide

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electricity without the need for vast infrastructures to be put in place.

Close to home

As the cost of alternative technologies falls and their efficiencies rise, they become much more of a viable option. Greenhouse gas emissions could also be reduced if micro generators were powered by hydrogen, sunlight or small wind turbines, said Dr Markvart.

Having generators close to demand also cuts down the cost of getting power from a remote power station to the household. Generator sizes are similar to loads - which is very different to traditional systems with huge power stations serving lots of small users.

Smaller networks mean ways to store unused power can be introduced, something that does not happen in large networks. "In a traditional system, you have the power station and electricity flows from power station to users - it is unidirectional. The whole network is constructed around that unidirectional power flow.

“There is also a tremendous amount of heat generated during the process. The heat is just waste and it is disposed of,” explained Dr Markvart. The huge ‘chimneys’ that have become a familiar part of many areas of the UK are the towers that cool down and then expel the heat waste.

“Only about 30 to 40% of the primary energy ends up as electricity; 60 to 70% goes up the chimney. You don't have any use for it because there is no one located around the station that needs heat.” Increasingly, micro-CHP units are being tested out in small communities to potentially replace conventional central-heating boiler units.

According to estimates, eight million micro-CHP units could be in homes by 2020, supplying a third of a household's power. But renewable power groups have called for clearer government policy targets for alternative power strategies. “We could have microgrids tomorrow; it can be done now. The technology is there,” said Dr Markvart.

The main barriers however, are institutional and regulatory. There are some moves afoot by regulators Ofgem, which is working on a registered power zones concept to convince the electricity companies of their potential. The cost of renewable energy devices has been recognised by the government, according to the Department of Trade and Industry (DTI). It wants to excite the industry so that the cost of individual units falls.

BBC News

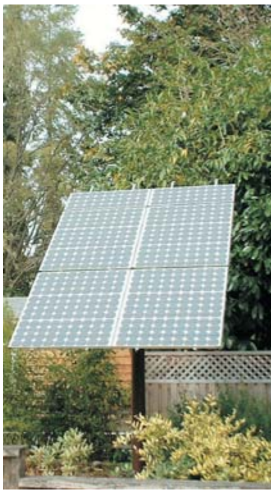
Smart Grids and Grid Computing

Moving to a post-fossil energy infrastructure is no small task. Leave aside the politics of the problem for a moment, and look at the logistics: replacing coal, oil and gas-fired power plants with cleaner, renewable technologies isn't simply a matter of unplugging one and plugging in the other. Renewable sources often requires wide spaces to generate useful amounts of power, and need to be situated in areas most conducive to their generation needs (sunny regions for solar, windy for turbines, the ocean for wave, etc.). Moreover, there is great value in adding in small, local generation (often referred to as micro-generation) to the mix, from wind micro-power, micro-hydro and rooftop solar panels to more exotic technologies like Stirling Engines, plug-in hybrids, and potential future developments like photovoltaic curtains.

Such a model of diverse, widespread sources of power generation is typically called ‘distributed energy,’ and it has some definite advantages over the current, largely centralised infrastructure. Distributed power can be more robust against accident or attack on the power grid: knocking down a 5 megawatt wind turbine would be bad, but not nearly as disastrous as abruptly taking a 1,000 megawatt coal power plant off the grid. Distributed power also allows greater resource flexibility: the more varied the resources used to generate electricity, the less likely are disruptions resulting from limited availability of one of them.

This latter is particularly important due to the variable nature of wind and solar. Output from a given wind or solar farm will rise and fall with local conditions, but the overall availability of electricity from multiple locations and resources can still be consistent.

But distributed energy is currently more costly than centralised power. Some of that cost comes from managing the complexity of variable power generation, changing usage patterns, and a multiplicity of sources. Distributed energy resources will have to be managed more like a computer network, complete with abundant routers and switches. The success of distributed energy is ultimately dependent upon the increasing availability of computer-enabled power networks, or "smart grids." And smart grids for distributed power, in turn, will increasingly rely upon the availability of distributed computing.



It's likely that smart grids are coming, even without an aggressive shift to renewable energy. On top of dealing with variable, dispersed inputs, smart grids allow more efficient routing of power, with fewer idle or wasted generators; smart grids would, in principle, allow an overall lower level of generation to support continued levels of use (or, more hopefully, a growing level of use of in turn more efficient buildings and devices). Smart grids are, in the end, a fundamental part of building post-oil, bright green communities.

Like computer networks, a successful smart grid will take advantage of "end to end" topology, where the real smarts of the system can be found close to the points of use, not centralised. Telecom researcher David Isenberg referred to this system in the information world as a 'stupid network' in a seminal 1997 article. A March 2004 article at Mechanical Engineering magazine, by Roger Anderson and Albert Boulanger, explored the potential value of stupid network-style smart grid development.

One implication of applying machine learning techniques to grid control is that the sensory intelligence has to be pushed to the 'last mile' of the grid - to the point where it meets the customer - in order to make it sufficiently smart.

Before the end of the decade, cheap silicon devices will be attached to most manufactured items—even inert things like steel plates. The sensors, computer, and communicator will be self-contained and operational for the life of the asset, from its creation to its destruction.

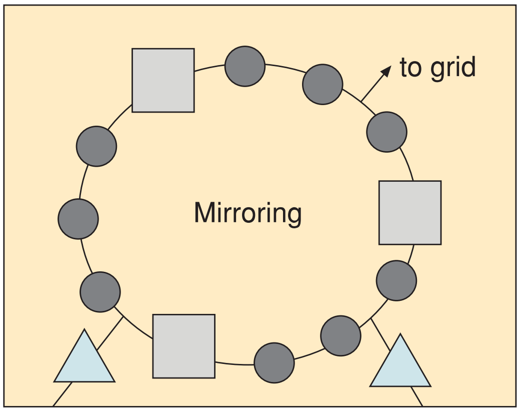
It is crucial to add this kind of real-time sensing and control if the future grid is to fully exploit synergies among various power sources, including wind and solar. We believe the key to exploiting these synergies is ubiquitous silicon associated with all critical assets in the electric grid, from generation to storage, transmission, distribution, and finally consumption.

Cheap silicon in the field will rewrite the way we manage the electric grid. Widespread wireless computing on every critical node of the Smart Grid will deliver business intelligence. It will incorporate self-healing, self-organising, Web services, and peer-to-peer computing among networks of connected assets. Each field computer will have enough memory so that it can capture its own best practices and be its own data historian.

What's needed, then, is more computing power, available in a manner which reflects the distributed power infrastructure. That is to say, what's needed is distributed (or grid) computing. E4Engineering reports that such a connection of smart grids and grid computing is already underway in the UK.

A European grid computing project worth £4.7m could solve the approaching problem of how to co-ordinate the electricity output of a proliferation of new wind farms and solar power stations.

'Today renewables contribute intermittently to the power grid, but in 15 years we're aiming for 30 per cent of our power from alternative sources



and it's not viable to have them leaping on and off unexpectedly. We need a way to handle the change from monitoring a few hundred power stations with private networks, to controlling 30,000 alternative energy generators.'

The project aims to develop the equipment and software needed to build a grid computing network that could autonomously process the instrument data from thousands of energy sources, and allow the power industry to optimise the ebb and flow of electricity on their national grids.

What those working on the power industry version of end-to-end networks may not realise is that these technologies are ripe for end-user exploration and exploitation -- hacking, if you will, but not the malicious kind. The more the smarts of the smart grid can be found in individual appliances and devices, not at the power company's central office, the more opportunities there will be for alternative networks to form over the grid. A few months back I suggested that BitTorrent might be a model for an open variant of distributed power; the growing consideration of distributed computing resources as a way of managing the distributed electricity grid makes this all the more possible.

As more renewable energy production is connected to the general power grid, the more we will need smart systems managing the result. While difficult, it will ultimately be for the good. The efficiencies of smart grid management coupled with the sustainability of renewable energy will be a big win for us all.

Jamais Cascio, Senior Contributing Editor, www.worldchanging.com

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Energy Management with Smart Agent Networks

Intelligent management of distributed energy resources is widely seen as an answer to the problems created by peak demand and price volatility. Most small-business and domestic loads are capable of optimal and price-responsive operation. Distributed generation less than 5 MW, placed close to loads, provides greater management flexibility and increased capacity without new power-station and network investment; it is also amenable to waste heat recovery which can double fuel efficiency compared with coal-fired generation.

Yet smaller consumers of electricity have lacked cheap, capable, user-friendly technology to manage their loads and generators intelligently in response to price signals and network constraints. Large consumers employ SCADA systems but generally these systems are not cost-effective to deploy into small-to-medium enterprises, commercial offices, hospitals, campuses, shopping centres, or ultimately individual households.

CSIRO's Energy Transformed Flagship is working on a solution that has opportunities for energy networks, energy retailers, and consumers with energy assets below 11 kV, where traditional centralised network control becomes uneconomic.

There are two key tasks. One is providing a low-cost processing and connectivity platform for small users, which has been achieved by using hardware that is either off the shelf, such as a personal digital assistant (PDA), or close to it. The other task is developing the distributed intelligence required to aggregate and control on-site energy assets in a way that suits energy retailers and network businesses but also allows consumers to control and choose how their supply is handled.

The platform and its capabilities are based on intelligent 'agent' technology. Distributed energy agents that sense, compute, switch, and communicate with each other could provide advantages for individual businesses and the entire network. System-wide benefits include the ability to aggregate supply and demand from groups of customers to flatten out peak demand and the formation of intelligent islands or mini-grids that can survive supply disconnections and that continue to provide services in the face of contingencies on the main grid.

Energy retailers could use aggregated supply and demand to manage their exposure to wholesale electricity prices, network businesses could defer capital expenditure, and SCADA companies could use agents as an affordable "last-mile" solution for smaller customers.

A key component of agent technology is the installation of software to create an intelligent device situated at the customers' premises. Designed to interact with other agents across the entire distribution network, this device can automatically switch loads and generators according to an energy savings policy decided by, and optimised for, each customer.

Working with US-based software developer Infotility, CSIRO has completed the first release of the GridAgents software framework and is building a demonstration system at the CSIRO Energy Centre in Newcastle, Australia, putting a gas micro-turbine, photovoltaic arrays, and a wind generator under agent control, along with two cool rooms and a zone of a building climate system.

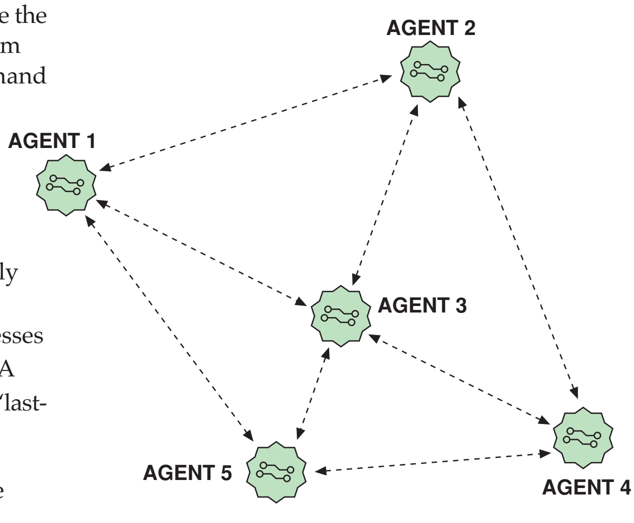
This will form a mini-grid coordinating supply and demand and reacting intelligently to electricity market or retail contract price signals.

The Australian electricity industry is struggling with ever-increasing summer demand peaks and fixed tariff structures are providing no incentive for demand-side initiatives. Forward-thinking utilities are trialling interval meters with market-linked tariffs and critical price signals.

Initial results show that consumers are hungry for direct information and willing to change usage patterns for financial and community benefits. Agent technology represents the next crucial step, enabling optimised energy management tailored to each customer's preferences, switching without direct hour-by-hour intervention by the user, and providing automatic aggregation across the network to give significant demand response capacity.

The first wide-scale deployment of CSIRO's agent technology could be as early as 2007 and will be in partnership with Australia's leading-edge utilities.

To explore opportunities for this technology please contact Terry Jones at Terry.Jones@csiro.au.



Strategic collaboration dedicated to ensuring grid reliability

ABB, the leading power and automation technology group, has recently signed a multi-year collaboration agreement to join the IntelliGrid Consortium, EPRI's collaborative public-private strategic partnership dedicated to making the 'grid of the future' a reality.

The IntelliGrid Consortium is an association of electric utilities, manufacturers, researchers and federal/state agencies, all working together to apply state-of-the-art communication and control technologies to the electric infrastructure. Their goal is to enable a grid that is self-healing, predictive and more secure.

After publishing the Integrated Communication Architecture Guidelines in 2004, the group is now focusing on the application of that architecture throughout the industry. ABB brings to the group its know-how in product innovation and manufacturing, a necessary ingredient as the Consortium works with its utility partners to implement the vision.

ABB has a long history of using collaborations with research and development organisations throughout the world to deliver state-of-the-art products to the electric utility industry.

"To transform today's electric grid into a sophisticated, integrated delivery system, all parties must work together from the beginning to understand the potential and needs of all those involved. EPRI's IntelliGrid program represents a unique opportunity for us to work side-by-side with leading utilities and industry groups to do just that," explained Dr. Bernhard Eschermann, ABB's head of power technology research.

"Working closely with those customers and technology developers who are committed to the IntelliGrid vision allows ABB to focus its own innovation efforts where they deliver the most value to its customers."

Source: ABB

South Canterbury lighting pilot saves 3.8 MW electricity

A pilot energy efficient lighting project has reduced the South Canterbury peak network load by an estimated 3.8 MW.

The November 2004 promotion was implemented in conjunction with Christchurch energy efficiency company Energy Mad, and Line Trust South Canterbury.

Every household received a voucher to purchase five heavily subsidised 20 W energy saving Ecobulbs for $10 from the local Pak'n Save, New World and Four Square supermarket stores.

energy mad

The Household Efficient Lighting Project (HELP) funding was provided by Line Trust South Canterbury.

project implementation was undertaken by Energy Mad, and included:

- Rigorous testing of approximately 100 energy saving bulbs, from which the Ecobulb was selected. The spiral shape Ecobulb is comparable in size to the incandescent bulb it replaces, lasts 10,000 hours, and has a light output 7% greater than the 100 W incandescent bulb.
- Independent pre-promotion market research in 50 randomly selected South Canterbury households to determine consumer price sensitivity, preferred energy saving bulb shapes and the barriers to be overcome to maximise the bulb uptake.
- Pre-promotion measurement of the five highest use incandescent bulbs in these 50 households through on/off data loggers installed on each of the 250 bulbs. Knowing the wattage of the bulbs, the power usage and peak load were able to be calculated for the 20,000 household South Canterbury region.
- Post-promotion measurement of the peak load and power savings achieved by the installed Ecobulbs for 50 further randomly selected households using the same methodology.

HELP achieved the following outstanding results:

- A sellout of the 62,000 Ecobulbs during the six week promotion.
- 62% of South Canterbury households purchased an average of 5 Ecobulbs each.
- 95% installation of the Ecobulbs, and predominantly in the high use areas.
- Power savings equivalent to the electricity used by 1,500 South Canterbury households.
- $6.2M of electricity will be saved over the life of the Ecobulbs.
- A peak network load reduction of 3.8 MW.
- A total project cost of $1.77 per Ecobulb.
- Customer satisfaction of 4.8/5 with their Ecobulbs.
- Less than 0.5% of Ecobulbs were returned, despite a one year guarantee.

The 62% participation rate is believed to be the highest achieved in a regional energy efficiency lighting project, with the project cost per bulb only 20% - 35% of typical projects.

HELP is now fully endorsed by the Energy Trusts of New Zealand, with Energy Mad's next project confirmed for July 2005 in the Tasman region. This will be held in conjunction with the Network

energy21

Tasman Trust.

Energy Mad's aim is to get five Ecobulbs into 55% of New Zealand's households. Based on the South Canterbury results, this would yield a peak load reduction of approximately 270 MW, this being greater than one year's peak network load growth for New Zealand.

The Canterbury launch was held at Rydges Hotel in Christchurch on 1st November. With a $5 investment, households can save more than $300 in power costs. Collectively, Christchurch and central Canterbury region could save 150 GWh – enough power to supply the annual requirements of 15,000 households. The campaign is a team effort between The Electricity Commission, Orion and Meridian Energy.

Enduring transmission charging arrangements for distributed generation in the UK

The Renewable Energy Association (REA) in the UK has responded to an Ofgen discussion document. Whilst a large number of interrelated matters were raised, including information flows, distribution and transmission system charging, planning and operational matters and the contractual relationships between all the parties involved, the REA felt that there is in fact one key issue to resolve and once that is decided the resolution of all other issues flows in accordance with the decision made.

The REA felt the key question is how to manage the relationship between parties connected to different networks and the "operators" of those networks. It based its conclusion on the following:

If two or more networks are connected together then the behaviour of generation and demand connected to one of the networks will, to a greater or lesser extent have an effect on the other network or networks.

Method 1 of managing this is to say that the generation and demand connected to one network has to have a contractual arrangement with the "operator" of the other network. In principle this would mean that all parties connected to a network would have a contractual relationship with the operator of another network.

Method 2, the alternative approach to managing two connected networks, is to appoint an agent or agents to be responsible for the effect that parties connected to one network have on another network connected to it. This recognises that the flow-related effects that parties connected to one network have on the other network are related to the net flow on the circuits that interconnect the two networks.

What matters to the owner of the other network is the net flow onto or off it from the first network, and it is that that must be managed and can be charged for by the owner of the other network.

This analysis can be applied to a number of situations including micro generation connected to end customer networks, larger 'on site' generators connected to "private" networks, two interconnected transmission networks (whether the interconnection is AC or DC) or indeed a transmission network and a distribution network.

In the context of a distribution network with embedded generation and a transmission network, there are two choices. The choice is between generation connected to the distribution network having a relationship with the transmission network operator (TSO), or the management of flows onto and off the transmission network being managed by an agent or agents that are accountable to the TSO for net flows, paying transmission charges on that basis.

The REA prefers the latter approach. Generators connected to the distribution network should have a contractual relationship only with an agent or agents associated with the distribution network and the relationship with the transmission system operator should be managed by that agent or agents.

Distributed Generation

Synopsis of a Lecture by Professor Nick Jenkins, University of Manchester, UK

Distributed Generation, from Renewables and small-scale CHP, will be an important component of any low-carbon electricity system. Considerable progress has been made in understanding how to integrate such generation with the power system but much remains to be done if the UK Government 2010/2015 targets for Renewables and CHP are to be met. Even more radical developments will be needed if progress is to be made towards the long-term goal of a 60% reduction in CO_2 emissions.

Distributed Generation is a wide-ranging term encompassing many emerging technologies. Hence it is convenient to subdivide the area as follows:

- Micro-generation, connected to Low Voltage networks;
- Generation connected to Medium Voltage networks; and
- Large Renewable Generation and the implications of large numbers of smaller generators for the Transmission and Central Generation Systems.

Of course, the boundaries of such arbitrary divisions are blurred and the impact of generation on the power system varies with scale, location and technology type.

The lecture started by summarising the state of Distributed Generation in the UK and reviewed likely developments to 2010. It then moved on to discuss more radical ideas for the integration of Distributed Generation including the concepts of Active Distribution Networks, MicroGrids and Virtual Utilities. It considered the new technologies that will needed to realise such concepts as well as the regulatory and commercial challenges that they will bring.