The Griffith Microgrid

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The problem

The traditional market arrangement for energy is already broken. The distributed generation of electricity by solar, wind and other alternatives as well as storage, such as lithium ion batteries, are being manufactured on a scale that will accelerate their market penetration.

At the moment, the electrical power industry operates within what's termed a Just-in-Time (JIT) framework. That means there is no electricity stored so it must generate what it needs to meet the demand at the time. It is reliant on variable customer demands and other factors such as the weather.

But if there was adequate storage in the grid from homes with batteries, engineers could design grids and power plants for a relatively consistent base load power generation. This would result in a much lower average wholesale electricity price.

The team

In 2012, Griffith was awarded $1 million from the Queensland Government for its part in a total $5.7 million Smart Future Partnership Project to investigate how future electrical grid systems could be designed to minimise capital expenditure and energy losses.

The Griffith team was led by Professor Junwei Lu and scientists from Griffith University's Research Engineering Centre (GUREC). Private partners included power electronics company Elevare Energy and renewable energy engineers Sun State Solar, who contributed much of the projects hardware, technology and commercial perspective.

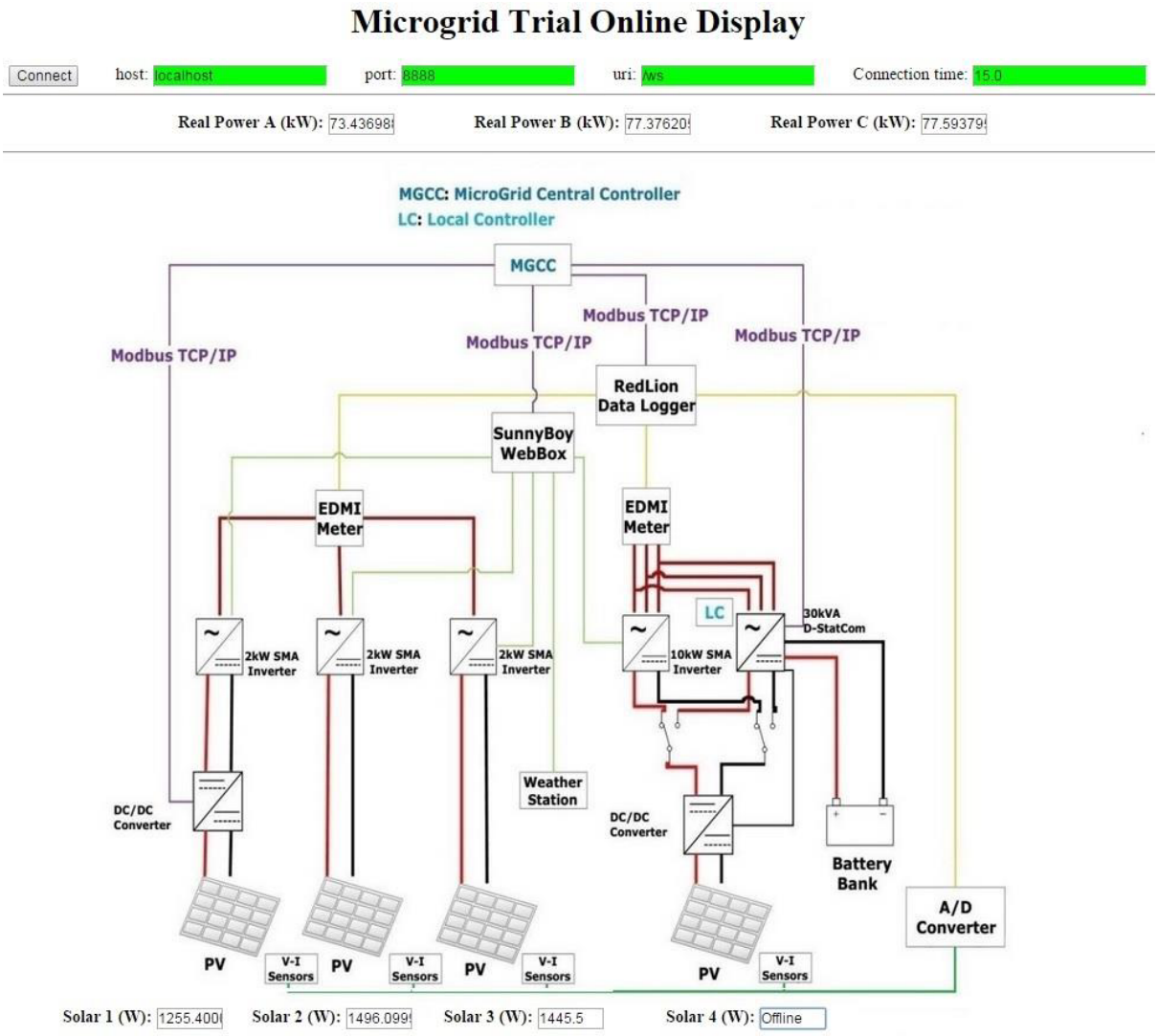
The solution

Professor Lu's team designed a novel inductor and transformer (for better grid connection) and DC/DC convertor hardware (for efficient solar energy conversion) that support the innovation's new "smart invertor" or d-StatCom invertor which allows for the two-way household-battery-grid power transfer.

Through smart invertors linked to solar panels it also allows the integration of intermittent renewable energy sources into the grid for the first time, and through advanced electronic metering, monitors energy usage and distributes power from low-use to high-use locations.

The result was the installation of a Peak Demand Energy Management Facility, or MicroGrid testing facility on the roof of Technology Building N44 at Nathan. The MicoGrid was opened at the Nathan campus in December 2014.

The MicroGrid is connected to the University's state-of-the-art Sir Samuel Griffith Centre (N78) which includes 1124 solar panels, 2x200kW DC-AC inverters, 2x160kW solar inverters, 8x400V DC lithium batteries, 200kW electrolyser hydride storage system. The building is self-sufficient for power but produces excess power which it feed to the MicroGrid.



Results

The MicroGrid significantly reduces peak demand charges and reduces overall volume charges. The system is able to take advantage of tariff differences through the use of off-peak charging and peak discharging. It also improves the quality of power available to buildings, making appliances more efficient reliable and reducing servicing costs.

This is especially relevant to organisations whose power use can fluctuate, or who run very sensitive equipment. Power from grids, with capacitors located at stations, can often run "dirty" at

peak demand times. By placing capacitors closer to the equipment being operated, users can run “cleaner” power.

There is also the not insignificant issue of the reduction in greenhouse gas emissions and improvement in clean air. Professor Lu’s group have calculated a 60kw system will produce roughly 100,000 kWh of electricity per year and reduce CO2 emissions by around 81 tonnes per year.

Commercial potential

The Griffith MicroGrid has the potential to be installed by any significant users of energy with the space to install solar panels. This could include local councils, manufacturing, rural towns, hospitals, universities and hotels. Its consequent commercial potential is almost limitless.

“The MicroGrid’s technology combination of power electronics with solar photo-voltaic cells and energy storage is game-changing. By allowing traditional power to connect with new and renewable energies, I believe MicroGrids are the building blocks for the smart power grids of the future,” said Professor Lu.

The race to develop the best and smartest grids is on and their success will lead the world to its next phase of power supply. Systems like the MicroGrid will also help inform energy policy and will be a key technology in transferring from fossil fuels to renewables. Griffith University will be one of its leaders.