schoolgen
Power to the next generation

CASE STUDY ONE

HELLO SUNSHINE

HOW GENESIS ENERGY'S SCHOOLGEN PROGRAMME IS WORKING FOR SCHOOLS IN NEW ZEALAND

Ministry for the Environment
Manatū Mō Te Taiao
Sustainable Management Fund

genesis ENERGY | HELLO TOMORROW PROGRAMME

SCHOOLGEN

GENESIS ENERGY'S SCHOOLGEN PROGRAMME ASSISTED SIX SCHOOLS IN THE GREATER AUCKLAND REGION DURING 2006/2007 TO INSTALL A 2 KILOWATT (kW) PHOTOVOLTAIC (PV) SYSTEM. GENESIS ENERGY WILL BE ROLLING OUT SCHOOLGEN TO OTHER PARTS OF THE COUNTRY OVER THE NEXT THREE YEARS.

SCHOOLGEN IS SUPPORTED BY THE MINISTRY FOR THE ENVIRONMENT'S SUSTAINABLE MANAGEMENT FUND, SHARP CORPORATION (NZ) AND THE ENVIROSCHOOLS FOUNDATION.

GOALS OF THE SCHOOLGEN PROGRAMME:

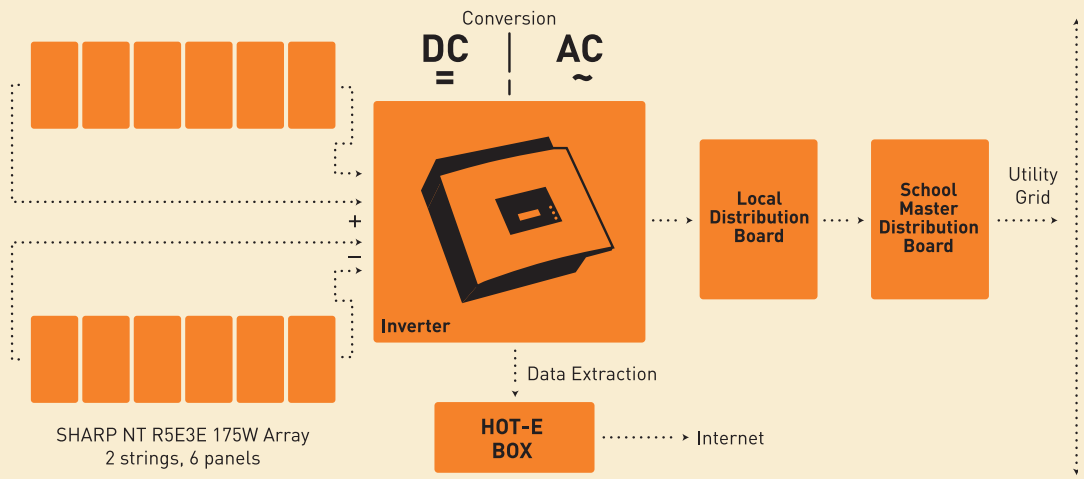
- To educate students about PV technology with practical hands-on operation and inspire young minds by raising students' interest in renewable energy.
- To demonstrate the educational, economic and environmental benefits of PV technology.
- To inform the wider community about how renewable energy can help meet energy demand.
- To raise public awareness of climate change and global warming.
- To promote the development of renewable energy by linking schools, community, government and industry.

CASE STUDY:

Westlake Girls High School in Takapuna, Auckland, was chosen as the pilot school for the Schoolgen programme. The PV panels were mounted on the existing Science Block roof, a relatively new single-storey building which faces approximately due north along Shakespeare Road.

12 PV panels mounted on Science Block, Westlake Girls High School, Auckland

HOW IT WORKS



Circuit diagram of the 2kW PV system installed at Westlake Girls High School

SYSTEM OVERVIEW

The solar array at Westlake Girls High School consists of 12 SHARP NT-R5E3E 175W solar panels connected in two strings, with six panels on each string to limit the input voltage to the inverter. The solar array has a combined generation capacity of 2.1kW.

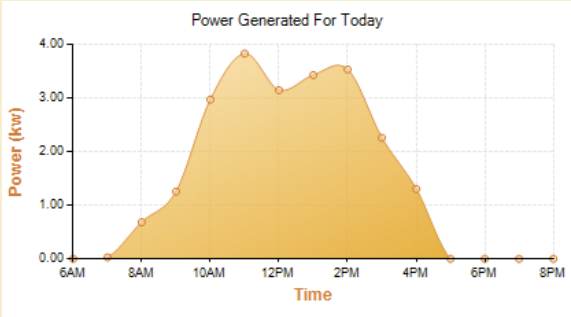
The positive and negative terminals of the strings were terminated at the DC side of the SunnyBoy (SB1700) inverter, the device which converts DC power produced by the array to mains 230V, 50Hz AC power. The AC side of the inverter is connected and synchronised with the local distribution board in the Science Block, meaning that during daylight hours the system produces electricity for use within the school.

The SB1700 is a grid connected type inverter and is equipped with an isolating transformer to prevent system islanding (i.e. if the mains fails, the system automatically shuts down preventing back-feeding into the mains system). Electricity generation data from the inverter is captured and uploaded to the internet by a purpose-designed interface device called the Hot-E box.

The Hot-E box is connected to the School's LAN (local area network) and data is pushed to the remote Schoolgen FTP server where it is converted into daily, weekly, monthly and yearly generation graphs on the Schoolgen website (www.schoolgen.co.nz).

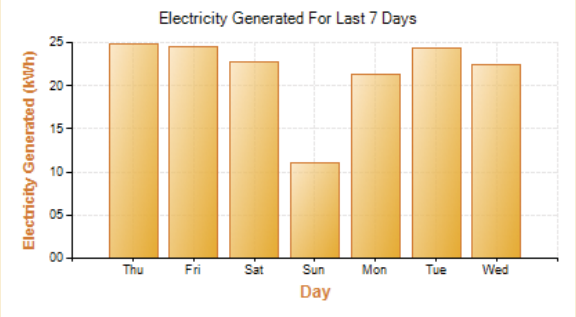
Students are able to view and download the electricity generation data directly from the Schoolgen website as part of in-class experiments and projects. Samples of the electricity information and data available on the Schoolgen website are shown over the page.

TYPICAL DAILY GENERATION GRAPH



Example graph from the Schoolgen website

TYPICAL WEEKLY GENERATION GRAPH



Example graph from the Schoolgen website

TYPICAL GRAPHS

The typical daily graph shows how much electricity is being generated throughout the day. Data is uploaded to the Schoolgen website every two hours. This daily data is displayed in weekly and monthly graphs for both students and teachers to learn from.

A Schoolgen wall has been installed in the main foyer of the arts block and includes an LCD screen which displays real-time system information from the Schoolgen website. The purpose of the Schoolgen display is to further engage students and teachers with the programme. The Schoolgen wall also consists of a pin-up board on which students can display their Schoolgen projects.

During January and February 2007, the PV system at Westlake Girls High School generated approximately 9.54 kWh/day on average.
On a number of days, the system generated in excess of 12 kWh/day with a peak of 15kWh/day. Further system performance analysis will be undertaken in early 2008, once the system has been installed for a full year.

Schoolgen display wall at Pakuranga College

TECHNICAL AND LEGAL CONSIDERATIONS

ANGLE OF INCLINATION

Through careful site analysis, it was decided at Westlake Girls High School to install the PV panels flat to the roof so there was no need for a secondary support structure. The PV panels are installed at approximately 15 degrees from the horizontal, facing north. Whilst the optimum angle for PV installation in New Zealand is 27 degrees for peak summer performance, it was decided that the cost to install a secondary support structure outweighed the benefits. In the process of installing panels at five more schools, the Schoolgen programme has found that Ministry of Education roofs are typically in the range of 10-15 degrees. For new schools being constructed, Schoolgen recommends that a north-facing roof be set aside to install PV panels in the future. This roof should be pitched at the optimum angle for the school's location (typically the school's latitude minus 10 degrees for summer peak performance).

SITE SELECTION PROCESS

The schools for Schoolgen were selected on the following basis:

- Genesis Energy customer
- Participating or willing to participate in the Enviroschools programme
- Suitable roof facing approximately due north; with means of access to install panels but with limited access for vandalism; clear from any shading such as trees or adjacent buildings; PV panels visible from within the school
- Suitable location to install the Schoolgen wall and LCD screen, ideally close to the science or maths classrooms in high schools to provide education linkage and close to libraries in the selected primary schools
- Secure location to install the inverter adjacent to the school's distribution board plus a LAN connection for the Hot-E box.

Expression of Interest letters were sent out to approximately 20 schools in the Greater Auckland area. Based on the school's response to this EOI, a detailed questionnaire was sent out to each of the shortlisted schools. A selection panel was formed which included representatives from Genesis Energy, Enviroschools and Connell Wagner.

The following schools were selected for the 2006/07 Schoolgen programme:
– Westlake Girls High School
– Northcote College
– Greenhithe Primary School
– Tirimoana Primary School
– Pakuranga College
– Silverdale Primary School

CONSENTS AND APPROVALS

A planning assessment was undertaken for each of the selected schools. It was determined that because the PV system was being installed primarily for education purposes, the act of installing a PV array on the roof of the existing school was in keeping with the school's existing designation. All appropriate approvals were sought and obtained from the Ministry of Education. In all cases, the PV panels were installed within the existing height in relation to boundary constraints of the underlying development controls.

Connell Wagner Limited, in their role of technical and engineering advisors in the Schoolgen programme, determined that building consent would be required for the PV panel installation. Connell Wagner undertook all of the structural design required to lodge and obtain a building consent for each school. The system installers, Reid Technology, were responsible for obtaining all Codes of Compliance certificates.

Approval is also required from the local power authority, in this case Vector Networks. A formal 'Distributed Generation' application needs to be submitted for each school. This ensures that Vector are aware that a PV system has been installed, in the event maintenance work needs to be carried out near the school. All schools are provided with a comprehensive Operation and Maintenance Manual for the system.

THE INSTALLATION PROCESS

Once all consents and approvals have been obtained, the installation of the PV system takes approximately two days, weather dependent. This involves mounting the PV panels to the existing roof, installing the inverter and Hot-E box, wiring up the system followed by testing and commissioning.

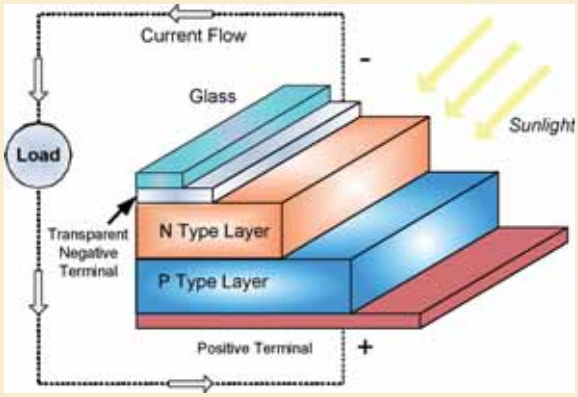
ELECTRICITY METERING

It was decided by the Schoolgen design team that reverse electricity metering was not required given there would always be a base load of at least 2kW within the school at all times. Based on the current generation capacity, the system is unlikely to export power, thus reverse power metering is not necessary. Should the schools wish to install additional panels in the future, reverse metering may be required.

WHY GRID CONNECTED?

Given the size of the system, it was decided that installing battery storage would not be of any benefit to the schools. Even during the weekend and school holidays, the system still produces electricity which the school can use to power its base load (e.g. lighting, computer equipment etc). By connecting to the grid, batteries are not needed for continuous supply. The grid is able to provide power during times when sufficient sunlight is not available for the load. This reduces the system cost and the maintenance required for batteries.

PHOTOVOLTAIC



The word photovoltaic literally means light-electricity. The PV panel uses the energy within sunlight to generate electricity.

A typical PV cell consists of two or more thin layers of semi-conducting material, which is most commonly silicon. PV cells are connected together and encapsulated, usually behind glass, to form a module or panel and any number of modules can be connected together. When light strikes the silicon it produces electrons within the silicon that are conducted away by a metallic grid as direct current (DC).

BENEFITS OF PV

Most PV panels have long life spans (35 years for the type used in Schoolgen schools) and can withstand rigorous operation conditions. Once set up, operation is fully automatic and very little maintenance is needed (regular cleaning depending on location, e.g. between three and 12 months). No pollutants are generated by the system during operation. The system will keep generating power as long as the sun shines.

It is estimated that each system installed will contribute to a reduction in CO_2 emissions of 80 tonnes over it's 35 years service period.[1] Further forecasts will be provided once the systems have been installed for at least a year.

Installation of solar panels at Tirimoana Primary School

[1] Based on an emission factor of 625 tonnes CO_2/GWh

EDUCATIONAL VALUES

Schoolgen is an invaluable education resource to schools and the wider community. Students at all levels, including their parents, are given the opportunity to see and learn about PV and other means of renewable energy. Schoolgen provides a link between the Ministry of Education, the schools, the PV industry, Genesis Energy and the wider community to enhance the development of renewable energy within New Zealand. Moreover, data collected by systems will aid property developers for future housing and building designs. By incorporating solar power into future homes and buildings it is possible to greatly improve energy generation and usage.

Genesis Energy believes that the resulting education value which will be enjoyed by the participating schools and their students over the life of the installation is priceless. If Schoolgen can educate the next generation of decision makers about the importance of renewable energy and the need to reduce our reliance on fossil fuels, then Schoolgen will have succeeded in its key objectives.

Genesis Energy acknowledges the contribution of Connell Wagner Ltd in the preparation of this case study.

schoolgen
Power to the next generation

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ENERGY

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