

Major Photovoltaic demonstration programme

Case study: Vauxhall Cross Transport Interchange

The Vauxhall Cross Transport Interchange is a striking landmark building in the heart of London. It is an excellent showcase for how photovoltaics (PV) can both enhance a structure and produce electricity in an urban environment.

Vauxhall Cross is part of a major improvement programme to deliver an integrated public transport system in London, allowing easier access to, and change between bus, underground and rail. It is located on the southern boundary of the Mayor of London's congestion charging zone.

The interchange has a photovoltaic array incorporated into a canopy which provides shelter to the bus station. The canopy takes the form of a sculptural ribbon running the length of the bus station, with PV installed on the upper surface of the cantilevered ends.

The interchange handles 2000 buses, 712 London Underground services, 730 rail services and 45,000 commuters daily.

The PV system provides up to 30 per cent of the energy required to power the bus station area over the course of the year. The system was commissioned in August 2004.

Team

The project was put forward by Transport for London (TfL) as a 'Towards an environmental action plan' initiative, the first stage of their environmental reporting process. It was developed in partnership with Lambeth Council.

The architects, Arup Associates, designed the canopy roof and oversaw its construction. Installation of the PV array was managed by Solarcentury, an accredited Energy Saving Trust Installer, using Sanyo hybrid PV modules.

Key photovoltaic data

- Total area of PV: 198 m²
- Peak output: 30.24 kWp
- Type of module: Sanyo HIP-H54B Hybrid silicon modules
- Cost of PV including installation: £159,975
- Annual energy production: 23.76 MWh





Image courtesy of Solarcentury



Image courtesy of Arup Associates

Building type

The 'Ribbon Canopy' provides people using buses at Vauxhall Cross with shelter from the rain over the circulation area, and shelter from the wind at the seating areas. It was designed to combine functionality with its sculptural form. The Mayor of London announced Vauxhall Cross as one of ten pilot projects of his Public Regeneration Spaces programme.

An accommodation unit is located under the canopy and provides facilities for the bus controller, drivers' mess, area traffic controller office and public toilets. There is also a lift to improve the link between the bus station and the underground station below.

Each 'fork' of the canopy is provided with a walkway to allow inspections and maintenance work to be carried out.

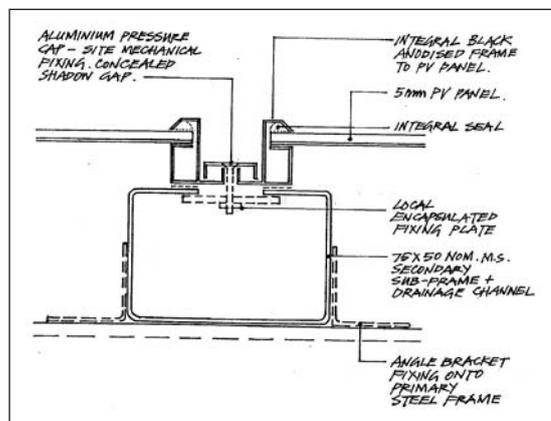
PV integration

The PV array comprises high efficiency hybrid crystalline and thin film technology. It is installed on the upper surface of two cantilevered forks at the northern end of the canopy. The modules are mounted over stainless steel metal roof cladding fixed to the forks, which are angled at 20 degrees to the horizontal and orientated 5 degrees west of south-facing.

Technical Information

- Module power rating: 180 Wp
- Number of modules: 168
- Type of inverter: SMA SWR2500
- Inverter nominal power: 3 kW
- Number of inverters: 8

Figure 1: Module attachment structure



The mounting method was designed by Arup Associates to allow flexing of the cantilevered canopy. The modules are held in a black anodised aluminium frame and mounted off the cladded roof using a 'slotted' bolting arrangement to the vertical rails (see 'Figure 1: Module attachment structure').

General building innovation

Vauxhall Cross has been built as a fully integrated transport interchange.

The materials used to construct the canopy were selected for both their robustness and ease of maintenance in addition to artistic inspiration. The design enabled prefabrication and rapid construction. In addition, the structure and fabric of the building were chosen to be appropriate for the harsh urban environment.

The canopy is an eye catching design which is highly visible to passing traffic, pedestrians, occupants of surrounding buildings and passengers on passing trains.

Grid connection

Each of the canopy's forks carries four sub-arrays of 21 modules, which are connected to the mains distribution system at Vauxhall Cross via a dedicated three-phase feeder on the main distribution board.

The PV modules are connected together in strings of seven, which are connected into DC isolators located adjacent to each inverter in the electrical plant room. The eight PV inverters mounted in the electrical plant room, provide a single phase output at 230V, 50Hz. If the voltage or frequency strays beyond the prescribed limits, a "G59 relay" and four pole connector located on the PV distribution board is used to disconnect the PV generator from the grid. This will also disconnect the inverters from the grid in the event of a loss-of-mains failure, preventing the PV system operating as an "islanded" generator (where 'islanded' generation is a hazardous situation of the PV system feeding the network or local distribution system during a planned or unscheduled loss of mains).

Transport for London has a net metering contract and connection agreement with EDF Energy.

Installation hurdles

Installation work at Vauxhall proceeded smoothly, with Solarcentury, Transport for London, Arup Associates and Norwest Holst, the principal contractor, all working together to integrate the PV into a complex structure.

The installation of the PV onto the stainless steel clad structure was intricate, with a large amount of flashing details and a requirement for the electrical cabling to run underneath the cladding. However, the use of PV was introduced early in the design, allowing work to proceed around its installation, removing it from the critical construction path.

The funding from the Major Photovoltaic Demonstration Programme was awarded some time after design had started. Although this caused some uncertainty, the major benefit was that it allowed Solarcentury to source an upgraded version of the module that was intended for installation.

Performance monitoring

An LED display is integrated into the public information panel. It shows the general public how much power the system is producing, the cumulative energy generation, and how many tonnes of CO₂ emissions have been saved. The display is integrated into the public information panel located close to the lift in the accommodation unit. The installation had produced almost 40,000kWh by June 2006, nearly two years since it was first commissioned. This compares favourably with the predicted output of the system of 23.8MWh per year.

System performance is monitored via a Sunny Boy Control Plus data logger mounted in the electrical plant room on the first floor.



Image courtesy of Transport for London



Image courtesy of Christian Richters

Non-technical information

The grant from the Major Photovoltaic Demonstration Programme funded 65 per cent of the PV installation. The remaining 35 per cent of the installation was funded from the overall project budget for the regeneration of Vauxhall Cross.

Contractual and management aspects

Installation of the PV modules and support structure was carried out by ECL Contacts Ltd and electrical connections by McMillan & Co. Both companies were contractors working on the rest of the Vauxhall Cross construction. They were trained by Solarcentury, which supported the government's aim to educate the building industry in PV. Early cooperation between the contractors allowed the design to sympathetically integrate the PV and avoid any significant contractual issues.

Solarcentury's nearby offices improved the management of the installation process by giving timely access to the site.

Project uncertainties

There were some uncertainties for Transport for London regarding the arrangement of a contract to sell excess energy back to the grid, as the level generated at Vauxhall Cross was such that they were larger than a domestic generator but smaller than a commercial supplier. This problem was resolved by negotiation with an energy supplier.

Promotion

The PV system is being promoted to both raise public awareness of renewable energy technologies and demonstrate commitment to the Government and Greater London Authority policies.

There is a live display showing the power the system is generating and the total energy generated to date. The live display aims to maintain awareness and understanding of the PV technology with those using the bus station and in the surrounding area.

The incorporation of PV in the scheme has been further publicised by press releases from Transport for London, London Buses Limited, Arup Associates and Solarcentury. Each of these stakeholders also display information on their respective web sites. See 'Further information' for more details.



Image courtesy of Arup Associates



Image courtesy of Solarcentury

Further information

To find out more about the PV at Vauxhall Cross Transport Interchange please see the following websites:

- Transport for London: www.tfl.gov.uk/tfl
- Solarcentury: www.solarcentury.com
- Arup Associates: www.arupassociates.com

The installation of the PV system at Vauxhall Cross Transport Interchange was supported as part of the DTI's Major Photovoltaic Demonstration Programme.

For more information, please visit The Energy Saving Trust www.est.org.uk/solar