The Integration of Photovoltaics (PV) into Buildings

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CPD Seminar
A typical 3 bedroom house in Britain will produce 5.5 tonnes of CO₂ per year as a result of its energy consumption.

A 40,000m² warehouse will produce 3500 tonnes of CO₂ per year.

Which is the equivalent of driving the Mondeo to the moon and back 22 times.
Definitions

kWp (kiloWatt peak) – maximum PV power output, used to describe system size.

1kWp system size will generate approximately 800kWh of electricity every year in the United Kingdom.

kWh (kiloWatt hours) - units of electrical energy, as used in utility billing.

An average 3-bed homes uses approximately 3,300kWh of electricity every year (source: Energy Saving Trust).

An average energy efficient home uses approximately 1,960kWh every year. (source: AECB, sustainable building association silver standard)
Photovoltaics (PV)
Daylight hits the PV and is converted to clean electricity. There are no moving parts so this happens silently.
The electricity is d.c. (direct current). An inverter makes it a.c. (alternating current, in sync with mains electricity) so that it can be used normally.
The solar system is connected to the mains via your fuse box, for safety.
The PV roof generates electricity all day. Spare electricity automatically flows out to the grid. As an option we can fit an extra electricity meter that measures how much you export.
5. ELECTRICITY SOLD

Your spare clean electricity is sold back to your electricity supplier.
At night, the PV does not produce any electricity. Instead, your mains power is automatically supplied by the grid. Extra power is always available from the grid at times of high demand.
## Technologies

<table>
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<tr>
<th>Small surface areas</th>
<th>Monocrystalline (7m²/kWp)</th>
<th>Large surface areas</th>
<th>Polycrystalline (8m²/kWp)</th>
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<tbody>
<tr>
<td>Gleeson Homes – C21e roof tiles</td>
<td>CIS Tower, – Sharp modules</td>
<td>Good yield</td>
<td>Good yield</td>
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<tr>
<th>Good yield</th>
<th>Amorphous (15-20m²/kWp)</th>
<th>Small surface areas</th>
<th>Hybrid (6m²/kWp)</th>
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<tbody>
<tr>
<td>V.large surface areas</td>
<td>National Trust, Kaneka modules</td>
<td>V.good yield</td>
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Which PV technology?

Three factors need to be considered:

1. Energy requirement
then... 2. Area
finally... 3. Budget

Cost implications:

Cost is project specific.

As a rule of thumb:
1kWp system is approximately £7,500*
and a 200kWp is approximately
£4,000/kWp* fully installed.

* Using solar as a building product can offset this cost further
Policy Drivers
Total installed PV in Europe and UK

Yr 2005
370,000 Roofs (4kWp each)
1481 MWp total installed

Yr 2005
140,000 Roofs (3kWp each)
433 MWp total installed

Yr 2005
5000-6000 Roofs - with no new funding announcement
Policy Drivers: Carrots

2001: The Climate Change Levy (CCL):
Tax on energy - industry, commercial/public sector
Solar energy is exempt

2001-2003: Department for Trade and Industry (DTI)
Domestic Field Trial £5.4M

2003-2006: UK Major Demonstration Programme £25M
(up to March 2006)
2006-8: Low Carbon Building Programme

Phase 1: £78.5M - 8 renewables over 7 funding rounds.

- **Stream 1** (<5kWp PV): £15,000 or 50%; SHW: £400 or 30%
- **Stream 2** (>5kWp Commercial): £100k or 40-50%;
  Public sector: £30k or 50%

Phase 2: £50M – 5 renewables, rolling applications from framework suppliers only.

Public Sector Organisations

- Package: 4.2kWp generating 3,300kWh/yr
  <£5,000/kWp
- Package Price: £20,000
- Cost to Applicant: £10,000
Policy drivers: Sticks

European level
EPBD (European Performance in Building Directives)

National level
PPS22: Planning requirements
Part L Building Regulations: Energy

Local level
The Merton Rule
Energy performance of new buildings will need improve by between 23-28% against 2002 building performance figures.

Of which 15-20% improvement in energy efficiency depending on ventilation type.

Plus a benchmark provision of energy efficiency or on-site renewable energy systems to save a further 10% of carbon emissions.
Merton Borough Council UDP policy PE13:

Adopted Oct 2003

“All developments (either new build or conversion) with a floor-space of 1000m² or ten or more residential units to displace at least 10% of carbon dioxide emissions through on-site renewable energy, above and beyond Building Regulations requirement”

Department for Communities and Local Communities, DCLG

The Minister for Housing and Planning Yvette Cooper’s statement on 8th June announced that:

“The Government expect all planning authorities to include policies in their development plans that require a percentage of the energy in new developments to come from on-site renewables.”

TheMertonRule.org
Best Practice in Low Carbon Planning
Solar Energy in the Built Environment
Application: sunstation®

Retrofitted modules on surface of domestic roofs
Application: The Complete Solar Roof

Replaces conventional roofing tiles with monocrystalline C21 PV tiles
Application: SunSlates

Replaces conventional roofing tiles with polycrystalline PV SunSlates

Perthshire HA, 2003
Application: Energy Roof

Modules on large flat roofs

Eden Project, Cornwall, 2005

Foster + Partners

Bishops Square, Spitalfields 2005
Application: Solar Cladding

Replaces conventional rainscreen cladding with PV modules
Application: Solar Louvres

Replaces conventional louvres with PV modules as louvres

Environment Agency, Wallingford 2005
Application: Solar Glazing (bespoke)

Replaces conventional glazing/atria with PV cells

Eden Project, Cornwall, 2005
Design Considerations
Design issues: Orientation and tilt

“Facade”
- Direction
- 90°

“Optimum”
- Due South
- 30°

“Flat Roof”
- No aspect
- 0°

Fig. 5: PV efficiency with varying orientation and tilt.
“The oldest solar module in operation have now been generating for 30 years and no end is in sight.”
Doing the Sums
Displacing 10% of CO2

EXTRA BUILD COST

1% Industrial

3% Domestic (approx 5 dwellings)

2% Commercial

2% Domestic (VHB)
Re-coup capital costs

Solar adds value to your property

"The provision of C21e, an integrated solar photovoltaic tile, generated significant interest and helped the homes sell faster and at a significant premium”

Tom Whatling, Divisional Environmental Manager of Gleeson Homes

Townhouse with C21e solar tiles sold at a premium of 8.6%
PV summary

PV – Photovoltaics

• Tried and tested technology
• Highly reliable – “fit and forget”
• Ideal for urban environment
• Can be used as a building materials for life
• Couple with energy efficiency
• Maximum carbon offset per unit of electricity generated
• Additional revenue from electricity generated

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- Leading solar innovations company, specialising on photovoltaics

500 projects to date
Saving 1,500 tonnes CO₂ every year


- Renewables planning consultancy for The Merton Rule
We work with architects, developers and engineers to deliver renewable energy carbon solutions and low carbon building products.
“We could achieve a virtually zero carbon energy system in the long term ... this is technologically and economically feasible ...”

Tony Blair, Prime Minister, visiting solarcentury on 14/09/04
Government support

“...I’d like to see every South-facing roof in London covered with solar photovoltaics and solar thermal panels.”

Ken Livingstone, Mayor of London, visiting solarcentury on 27/07/06
Useful links and further reading

www.solarcentury.com

www.communities.gov.uk

www.themertonrule.org

www.est.org.uk/solar