The Integration of Photovoltaics (PV) into Buildings

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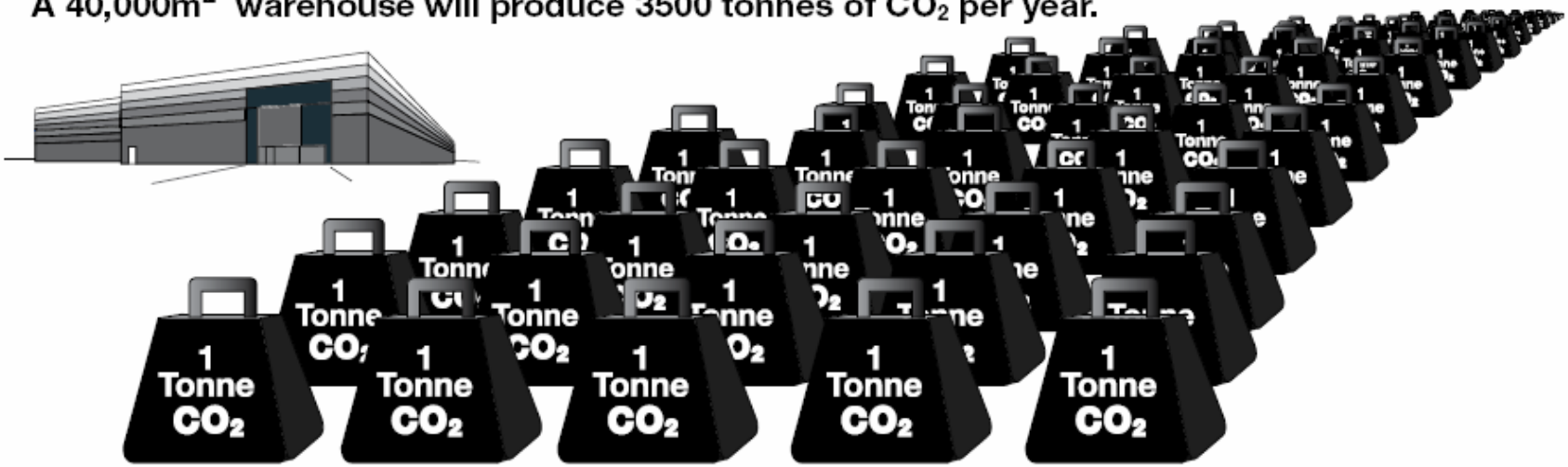
CPD Seminar

Carbon explained

A typical 3 bedroom house in Britain will produce 5.5 tonnes of CO_2 per year as a result of it's energy consumption.

A 40,000m^2 warehouse will produce 3500 tonnes of CO_2 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)

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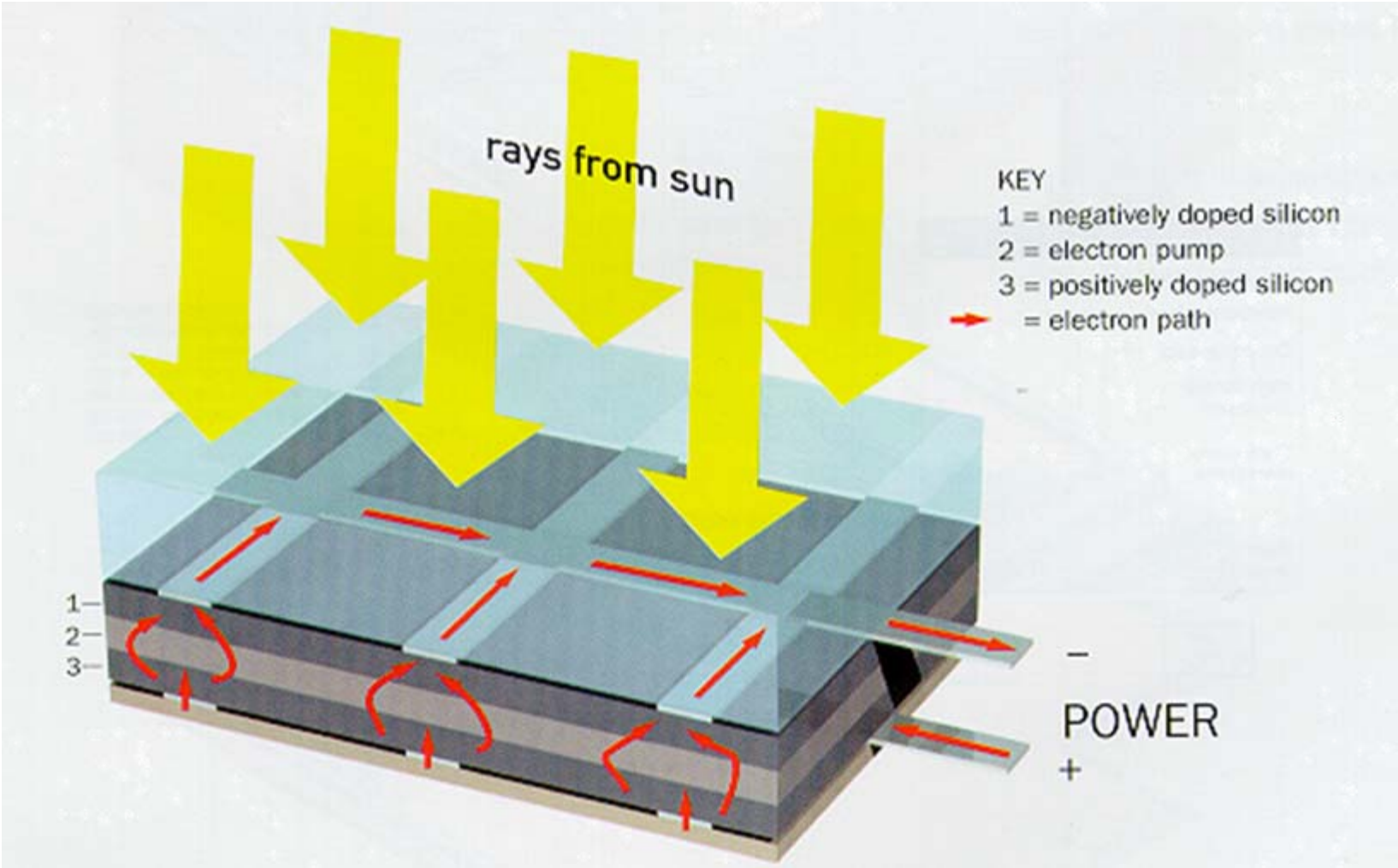
Photovoltaics (PV)



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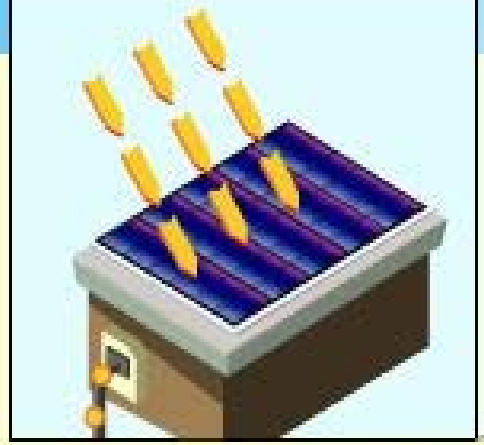
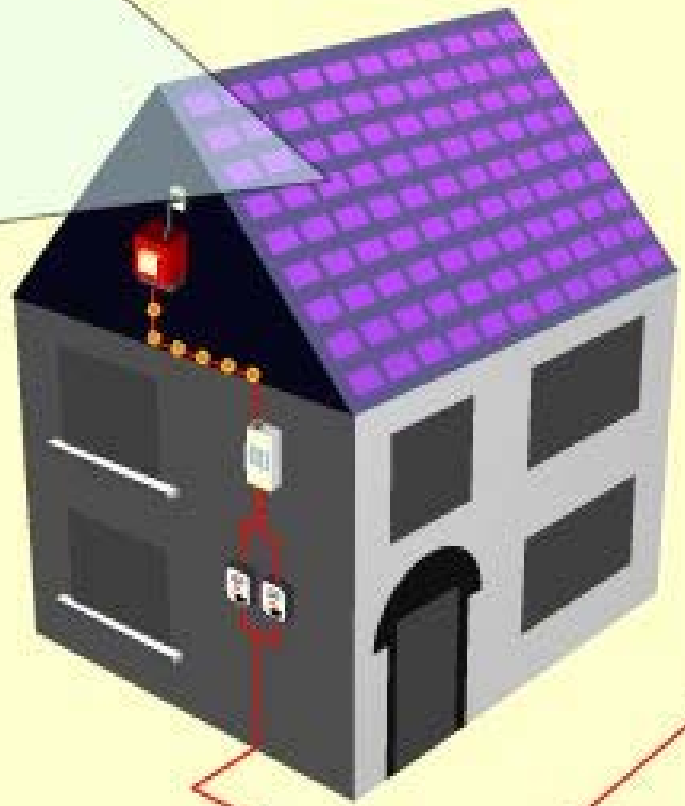
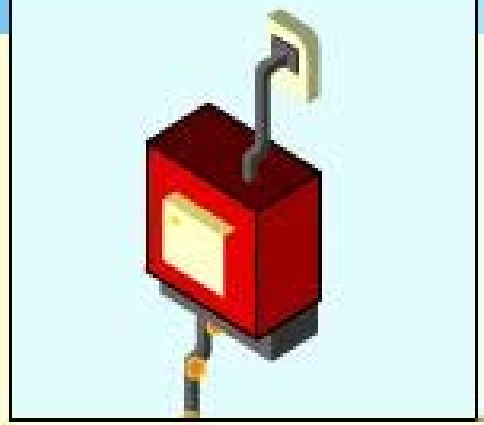
1. PV



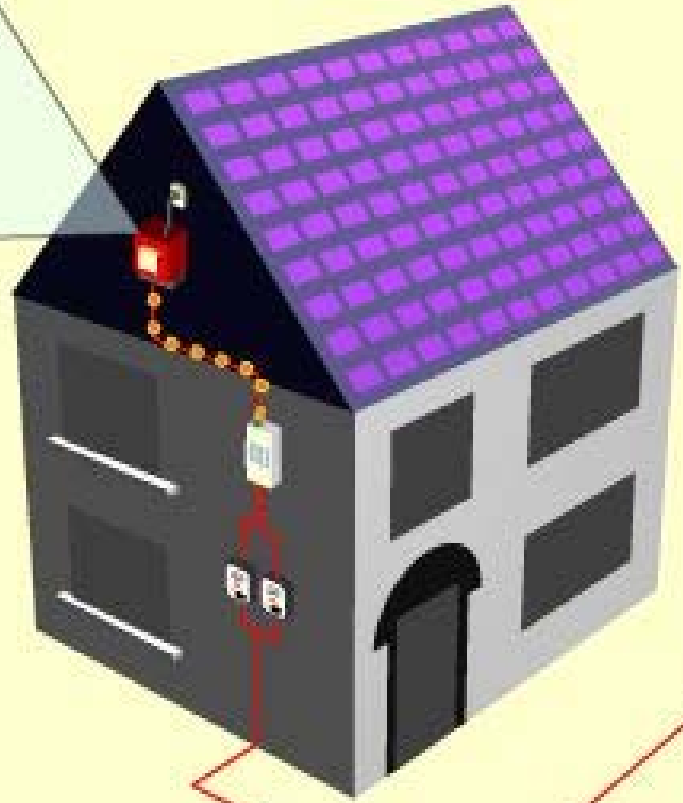
Daylight hits the PV and is converted to clean electricity. There are no moving parts so this happens silently.



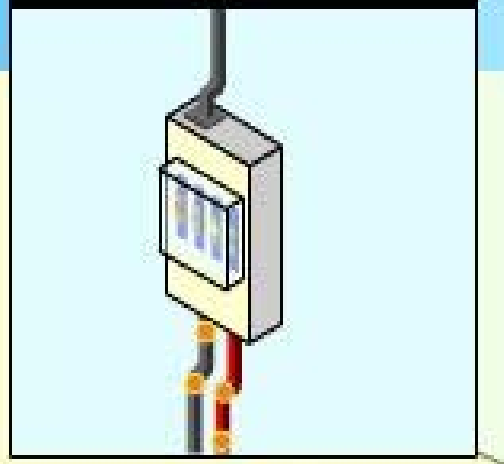
2. INVERTER



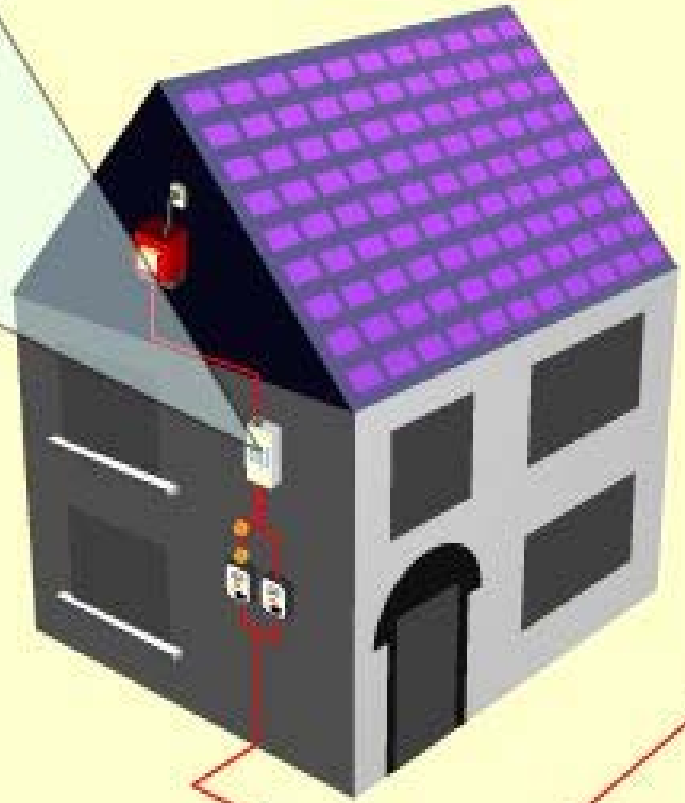
The electricity is d.c. (direct current). An inverter makes it a.c. (alternating current, in sync with mains electricity) so that it can be used normally.



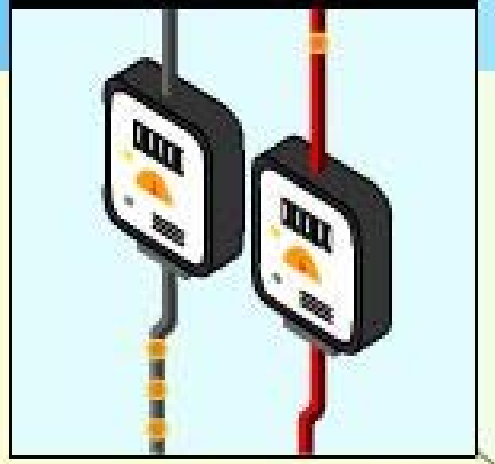
3. FUSE BOX



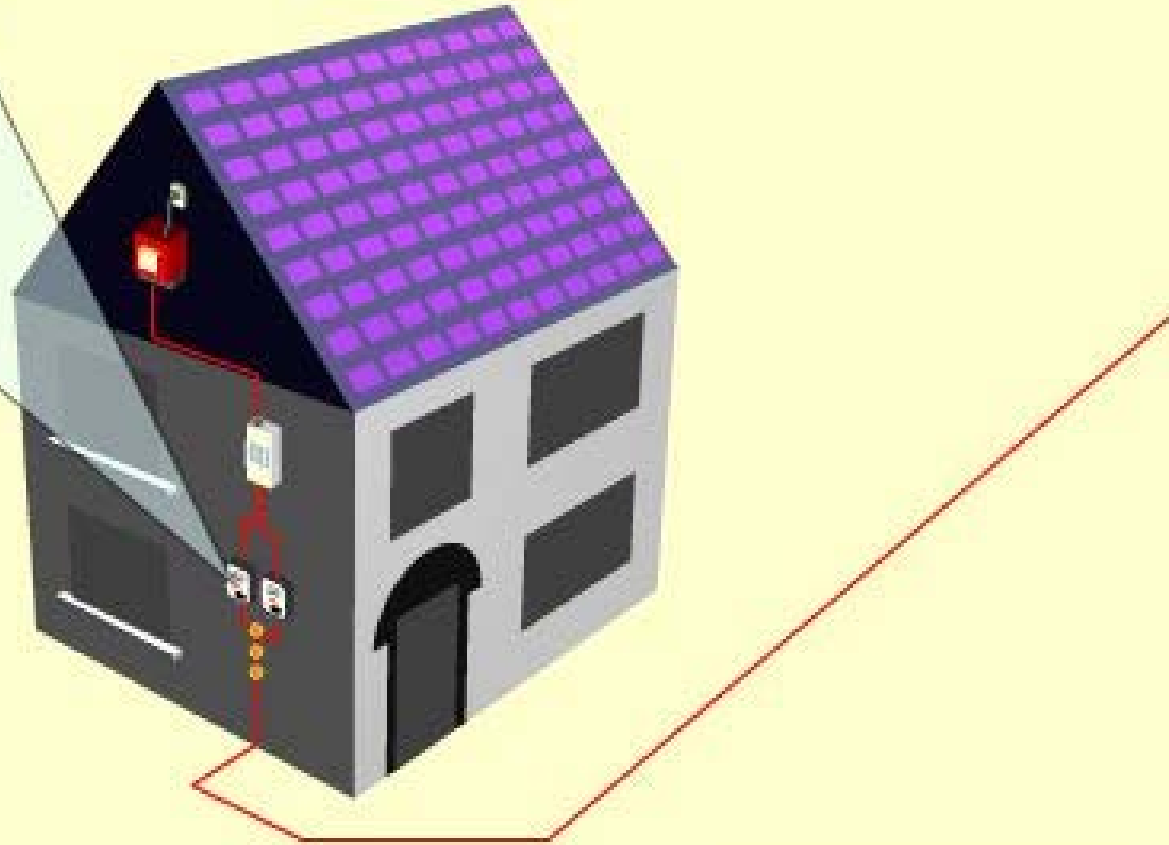
The solar system is connected to the mains via your fuse box, for safety.



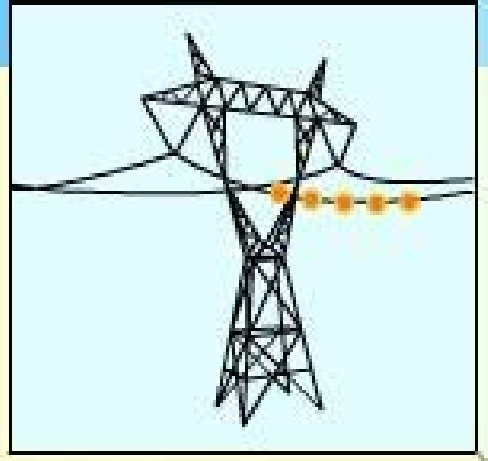
4. METERS



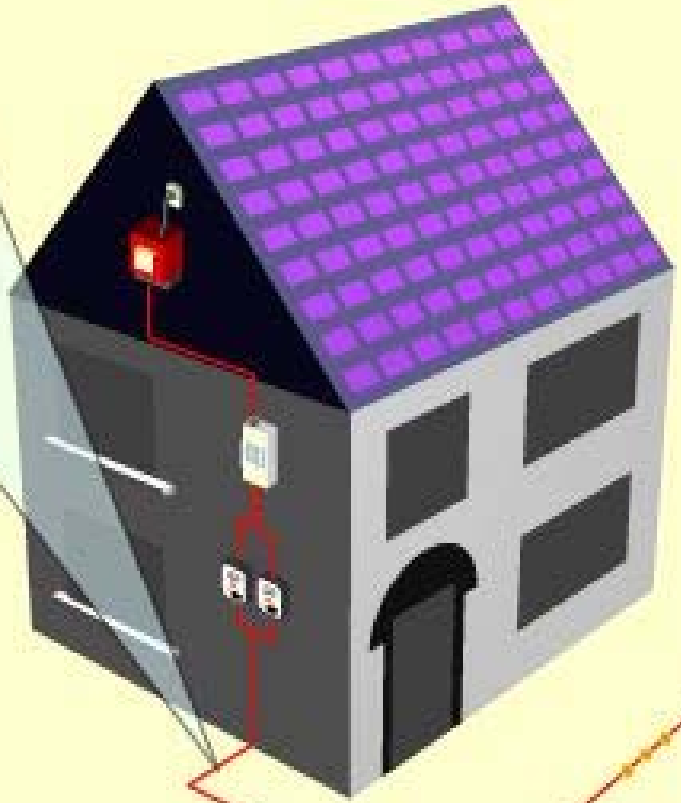
The PV roof generates electricity all day. Spare electricity automatically flows out to the grid. As an option we can fit an extra electricity meter that measures how much you export.



5. ELECTRICITY SOLD

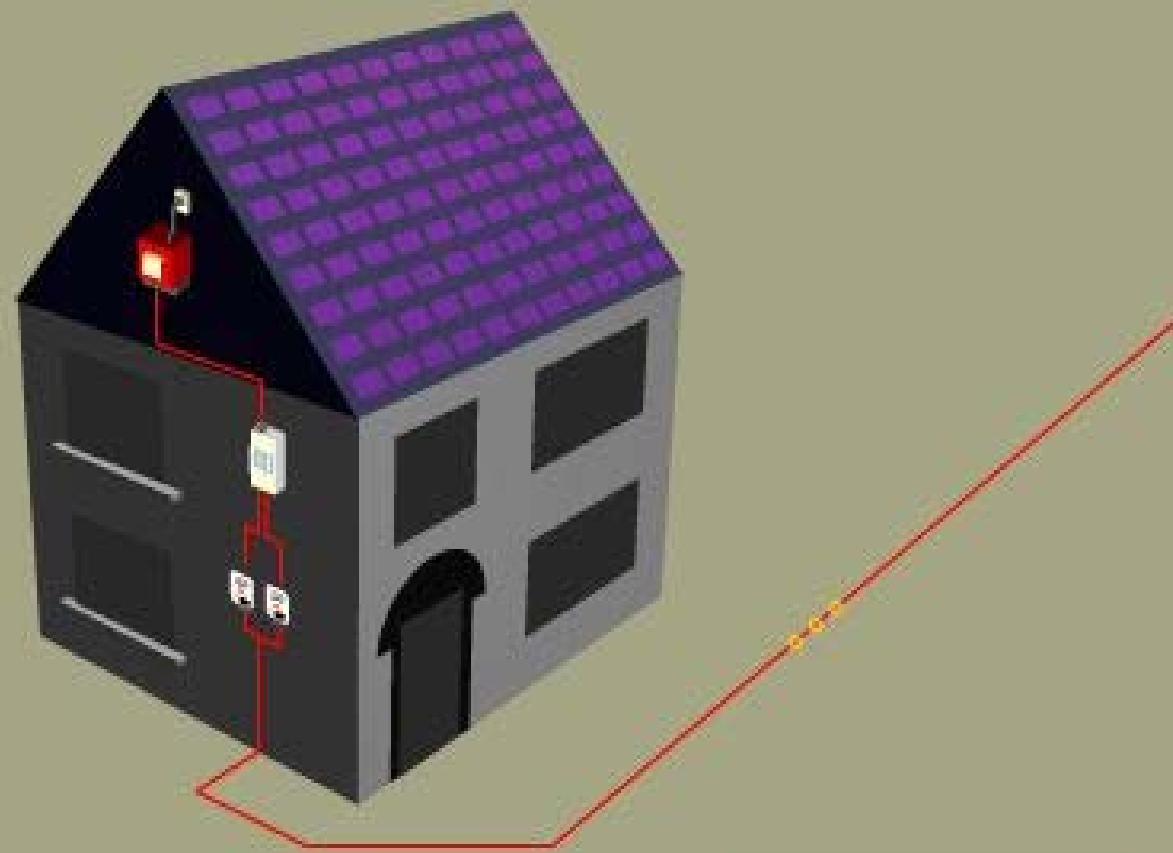


Your spare clean electricity is sold back to your electricity supplier.



6.NIGHT-TIME

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.



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Technologies

Small surface areas

Good yield

Large surface areas

Good yield

Cloudy conditions

V.large surface areas

Small surface areas

V.good yield

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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.

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*** Using solar as a building product can offset this cost further**

Policy Drivers

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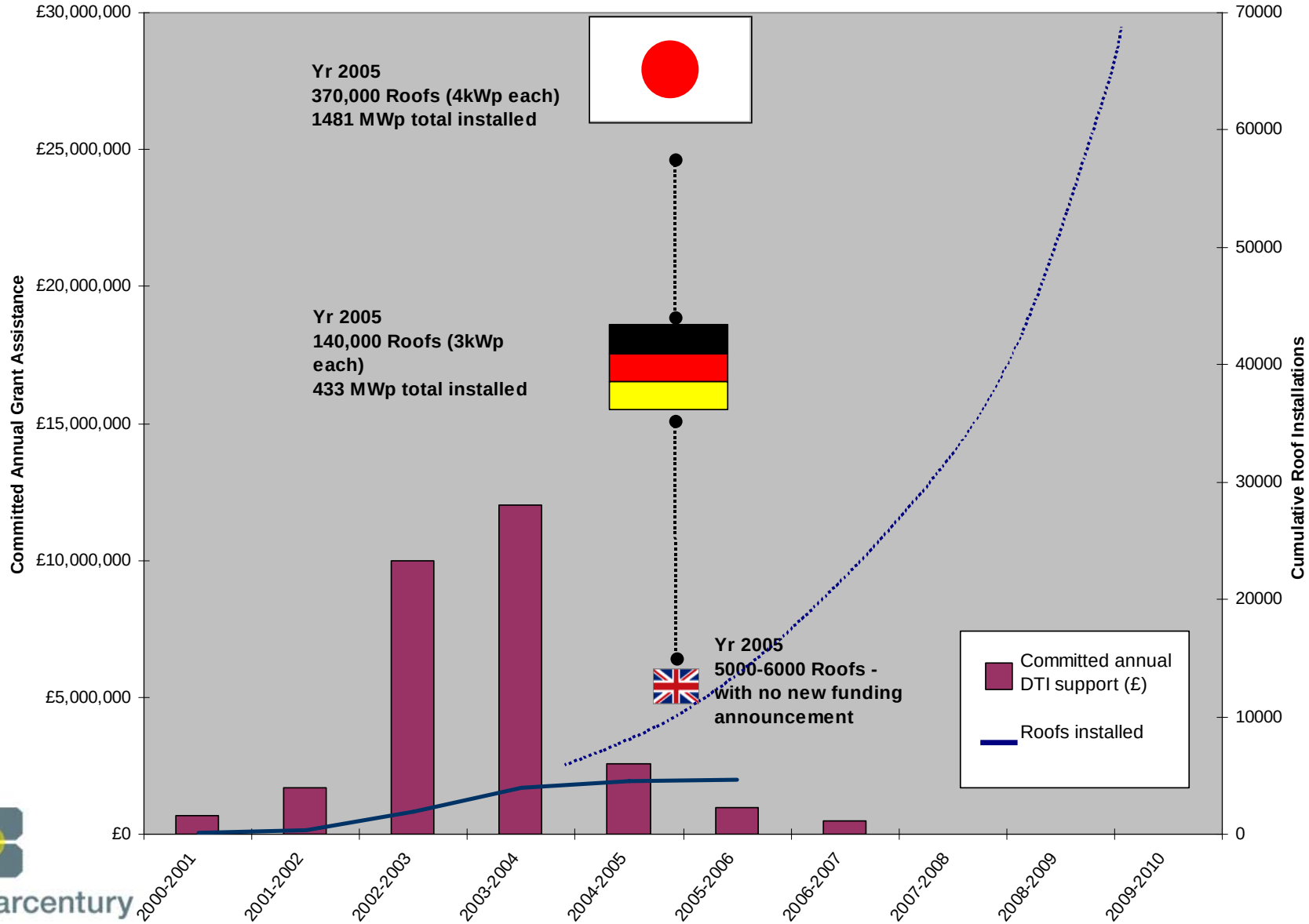
Total installed PV in Europe and UK



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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)

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Current government programme

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

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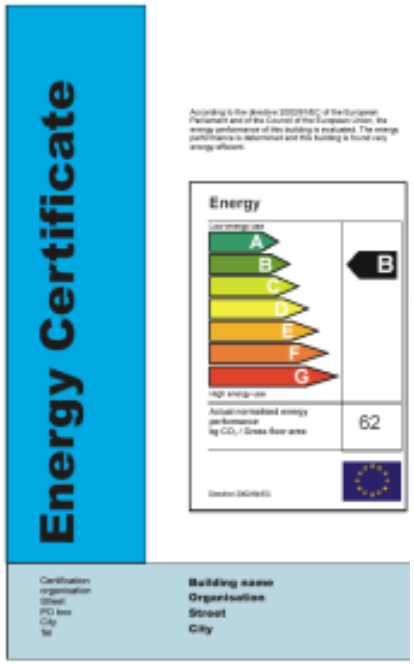
Policy drivers: Sticks



European level

EPBD (European Performance in Building Directives)

National level

PPS22: Planning requirements

Part L Building Regulations: Energy

Local level

The Merton Rule

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TheMertonRule.org

Part 2 L - Building Regulations

- 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

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Local Planning Policy drivers

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."

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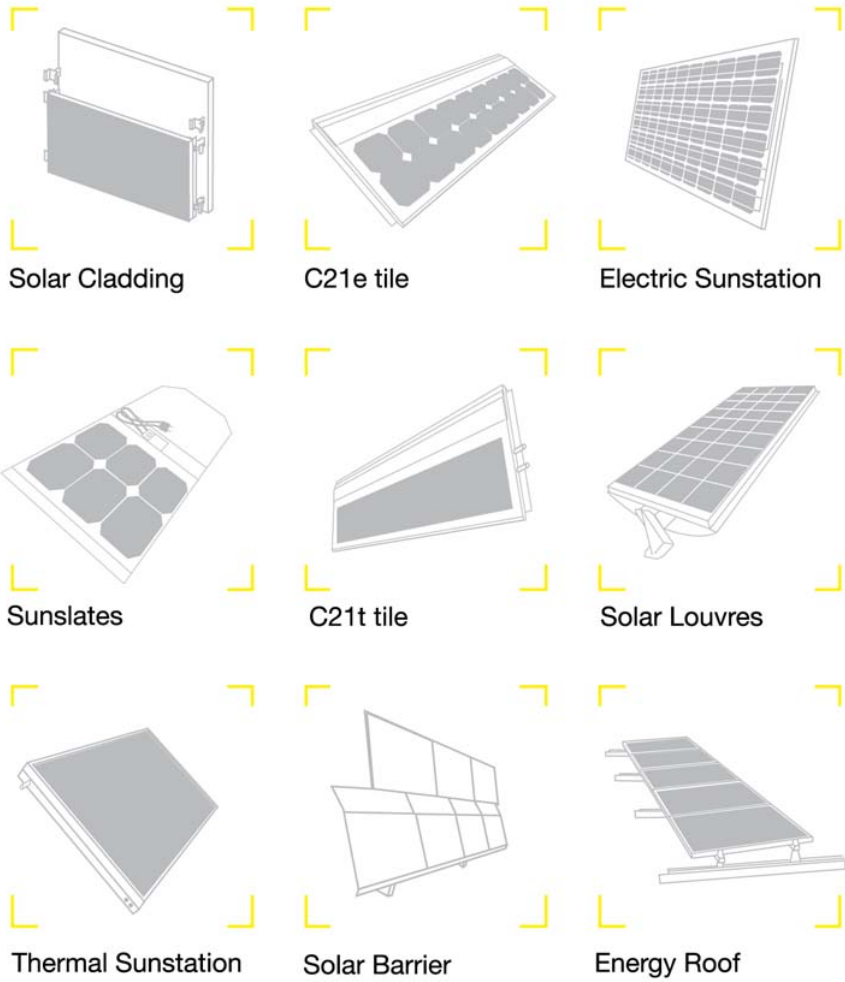
Solar Energy in the Built Environment



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Low Carbon Building Products™

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Application: sunstation®

Retrofitted modules on surface of domestic roofs

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Application: The Complete**Solar**Roof

Replaces conventional roofing tiles with monocrystalline C21 PV tiles

Gleeson Homes, Sheffield, 2006

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Application: SunSlates

Replaces conventional roofing tiles with polycrystalline PV SunSlates

Perthshire HA, 2003

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Application: Energy Roof

Modules on large flat roofs

Foster + Partners

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Application: Solar Cladding

Replaces conventional rainscreen cladding with PV modules

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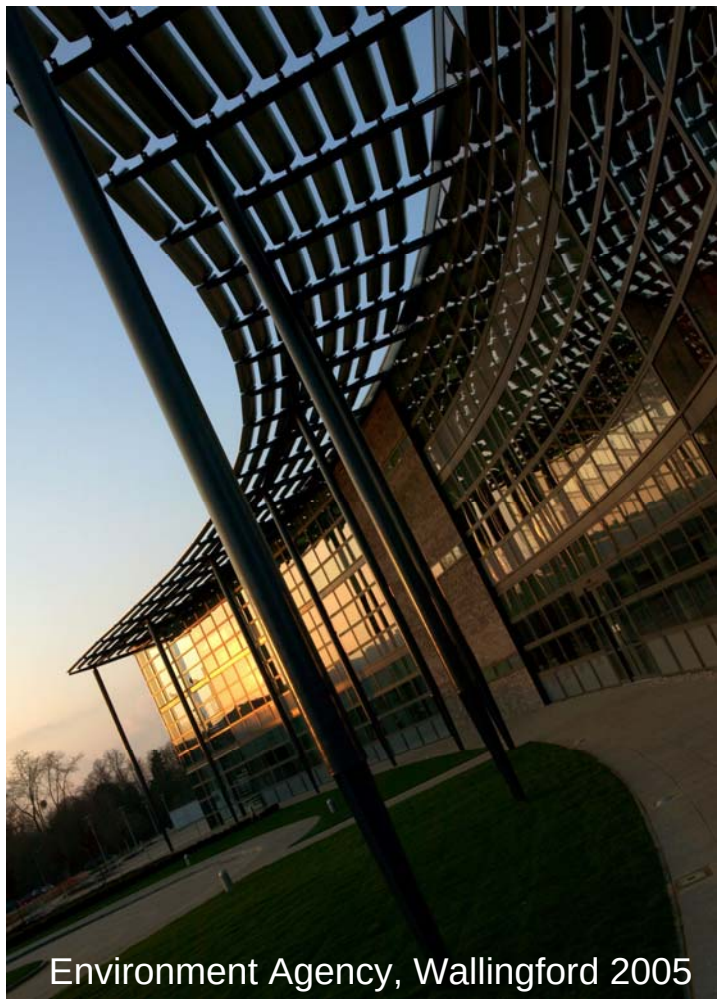
solarcentury CIS tower, Manchester, 2006

Application: Solar Louvres

Replaces conventional louvres with PV modules as louvres



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Application: Solar Glazing (bespoke)

Replaces conventional glazing/atria with PV cells

Eden Project, Cornwall, 2005

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Design Considerations

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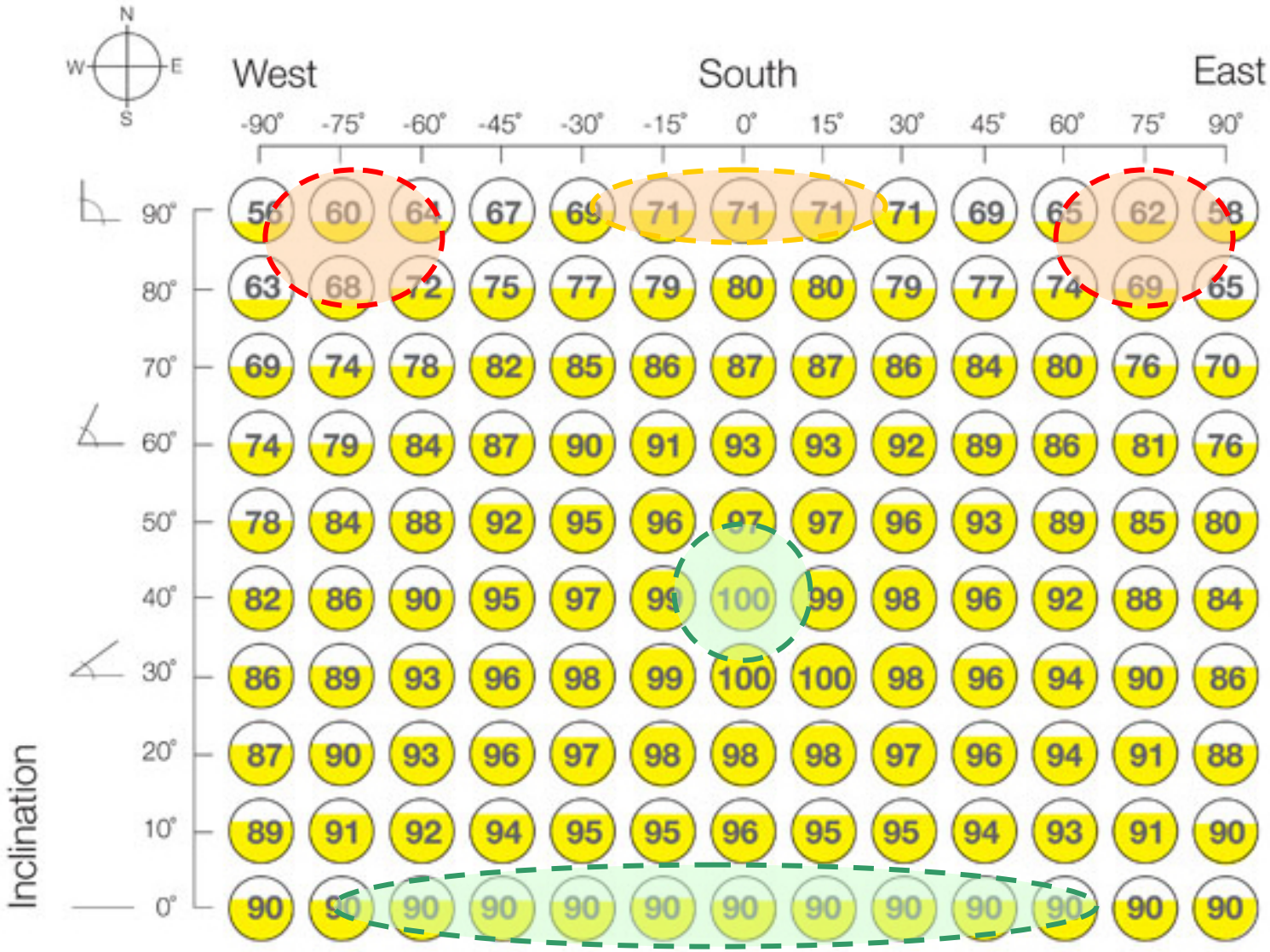
Design issues: Orientation and tilt



“Facade”

- Direction
- 90°

“Optimum”

- Due South
- 30°

“Flat Roof”

- No aspect
- 0°

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Fig. 5: PV efficiency with varying orientation and tilt.

Solar life expectancy

PHOTON International
The Photovoltaic Magazine
Your global navigation system through the PV industry

September 2006, p.74

“The oldest solar module in operation have now been generating for 30years and no end in sight.”

technology

Right down to the last electron

The oldest solar modules in operation have now been generating electricity for 30 years – and no end is in sight

Science and industry are almost surprised by the yield from old solar modules that simply don't just cease operation. In the past, costs were calculated based on 20 years of service – and now it has to be conceded that this was a rough estimate. There seems to be a complete lack of knowledge about the life expectancy for solar modules. What is the limit to a module's lifespan?

Solar modules have a very long guarantee period in comparison to other products – 20 years on 80 percent of the nominal or minimum power rating is somewhat of a lower limit. That eases the minds of customers – but there are skeptics. Last year's outline for the »Reliability of PV modules« project supported by the German Federal Ministry of the Environment stated: »It should be taken into consideration that these long guarantee periods are not scientifically founded, but rather emanate from the marketing departments of the companies. There is no certain insight available with regard to the long-term reliability of module technology based on operating experience with PV systems so far.«

Theoretically, a thoroughly encapsulated solar cell should deliver electricity indefinitely. But as is so often the case, practice defies theory: modules deliver less electricity over the years or fail completely. Of course, manufacturers and customers would like to know more precisely when this will happen and what the performance curve will look like at this point. The truth is, nobody knows how long a solar module will last. Experts can't even agree on what constitutes the »end of a module's product life.« Is it when the performance falls short of 80 percent of the nominal power? Less than 70 percent? Or 50? Or perhaps when it has no power at all? There are many ways to define the term »end« in this light, and

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Doing the Sums

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Displacing 10% of CO2

EXTRA BUILD COST

Industrial

Domestic (approx 5 dwellings)

Commercial

Domestic (VHB)

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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

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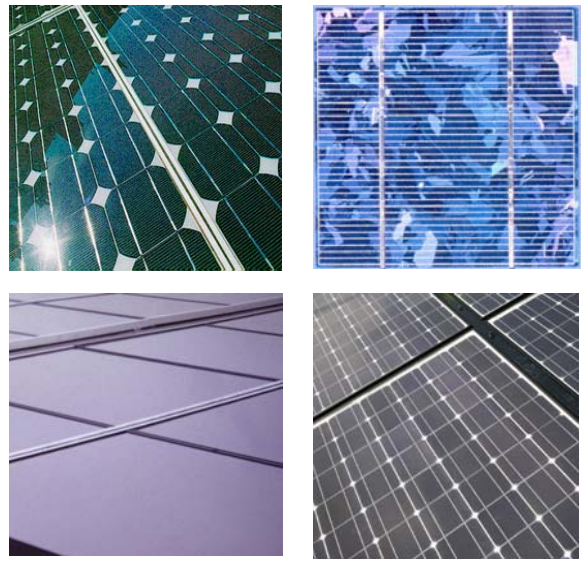
Townhouse with C21e solar tiles sold at a premium of **8.6%**

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 CO_2 every year

- Designed & installed 1st Merton Rule project (2004) www.themertonrule.org

- Renewables planning consultancy for The Merton Rule

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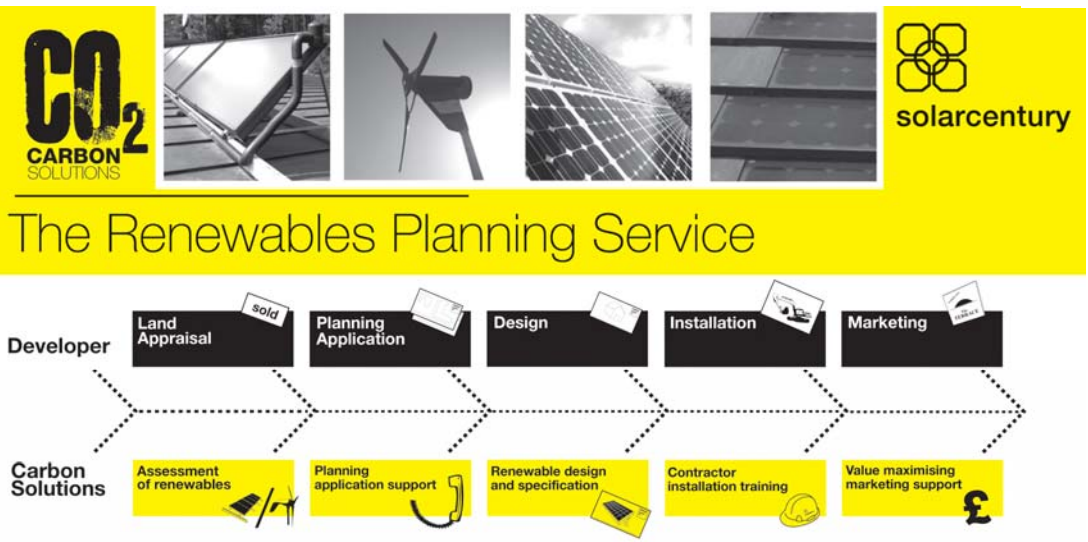
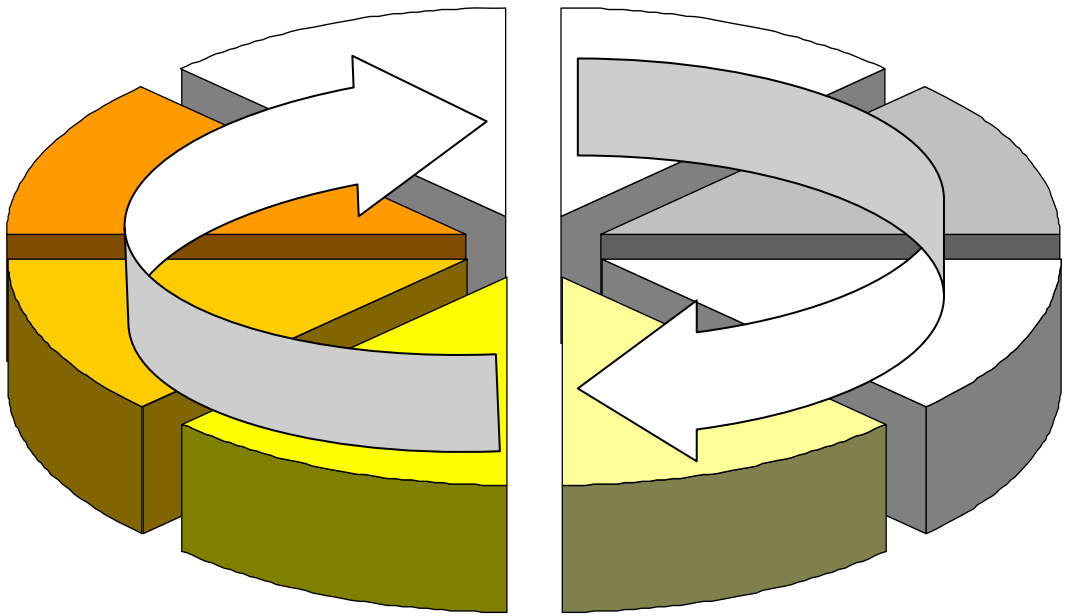


Our services

We work with architects, developers and engineers to deliver renewable energy carbon solutions and low carbon building products.



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Government support

"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

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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

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Useful links and further reading

www.**solarcentury**.com

www.**communities**.gov.uk

www.**themertonrule**.org

www.**est**.org.uk/solar

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