



## The Economics of BiPV in the Portuguese Context

A Value-Added Approach

**Maria João Rodrigues**

Centre for Innovation, Technology and Policy Research, IN+, IST



FUNCTION : : electricity

DL 33-A/2005

■ Limits feed-in tariff application: 150 MW cumulative installed capacity

■ Nominal power tariff-differentiation for PV systems

$P_{\text{nominal}} < 5 \text{ kW}$  : : ~ 55 c€/kWh

$P_{\text{nominal}} > 5 \text{ kW}$  : : ~ 39 c€/kWh

■ Feed-in tariff timeframe guarantee

Maximum number of years : : 15

Electricity delivered : : 21 GWh/MW

■ Remuneration after applicability of feed-in tariff

Electricity market price

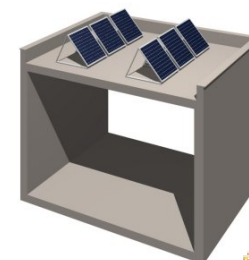
Green certificates



FUNCTION :: electricity

CASE - STUDY

- Location :: Lisbon
- Geometry :: Azimuth :: South  
:: Tilt :: 30°  
:: Mounting :: Roof stand-off
- System specs ::  $P_{\text{nominal}}$  :: 1 kW  
:: Technology :: mc-Si
- System cost :: 6600 €



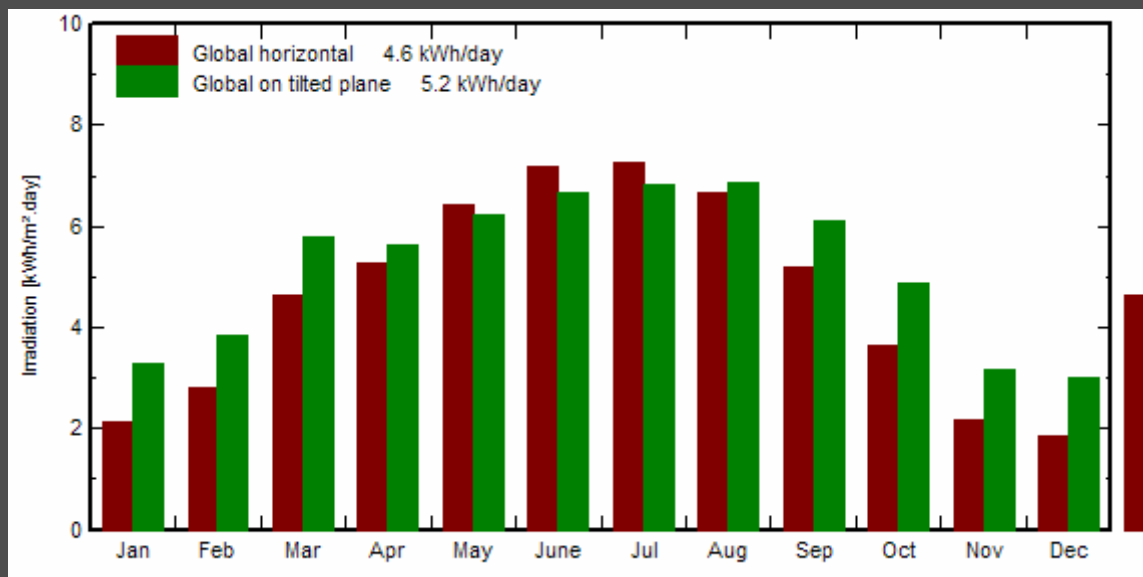
Source: IEA-PVPS-Task 7



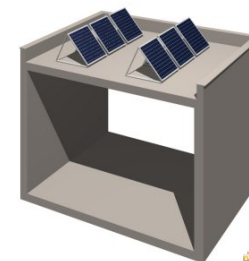


FUNCTION : : electricity

CASE - STUDY



Source: PVSYST V3.30



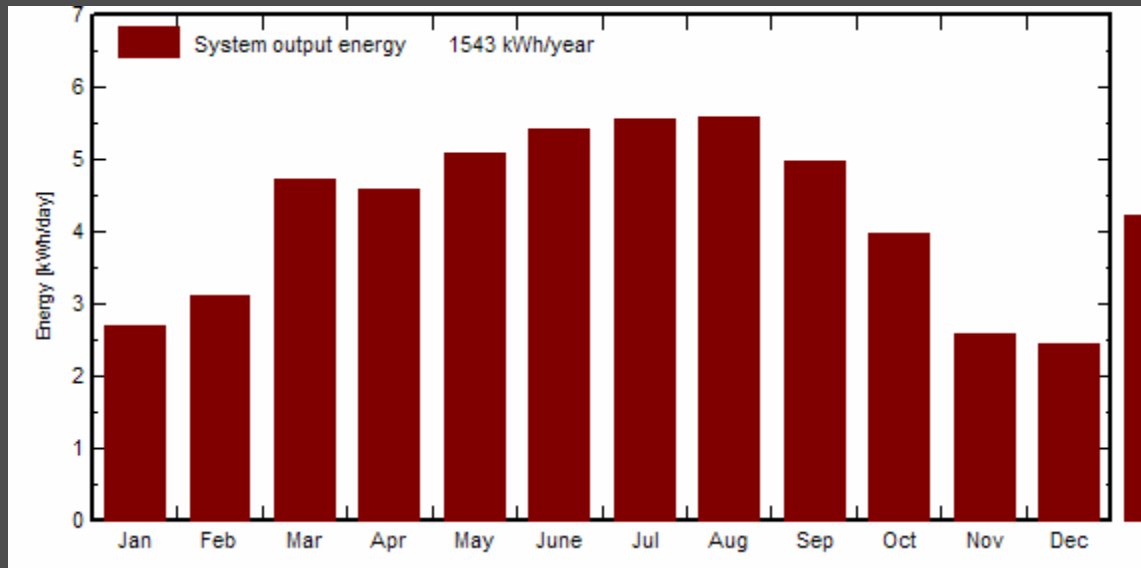
Source: IEA-PVPS-Task 7





FUNCTION : : electricity

CASE - STUDY



Source: PVSYST V3.30



Source: IEA-PVPS-Task 7





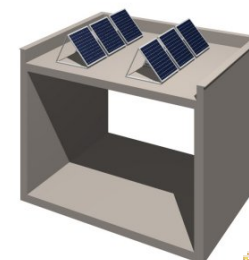
FUNCTION :: electricity

CASE - STUDY

- PBT ::  $P_{\text{nominal}} < 5 \text{ kW}$  :: 7,8 years

::  $P_{\text{nominal}} > 5 \text{ kW}$  :: 11 years
- Number of years to 21 GWh :: 13,6 years
- Feed-in Tariff over PBT ::  $P_{\text{nominal}} < 5 \text{ kW}$  :: 5,8 years

::  $P_{\text{nominal}} > 5 \text{ kW}$  :: 2,6 years



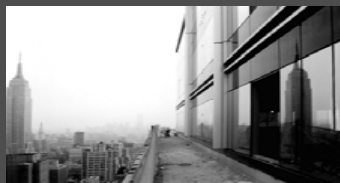
Source: IEA-PVPS-Task 7





FUNCTION : : other utilitarian

EXAMPLES



4 Times Square, New York, USA 1999



Academie Mont-Cenis, Herne, Germany, 1999



Zurich Airport, Zurich, Switzerland, 2003



ECN Building 42.1, Peten, The Netherlands, 2001



**Location:** NYC, USA

**Year of Completion:** 1999

**Architect:** Kiss + Cathcart

**BiPV Concept:** Curtain wall façade

**PV Technology:** Amorphous Silicon

**Nominal Power:** 14 kWp

**Projected output:** 13.8 MWh/year

**Type of Building:** Office

### Functions Performed

- Electricity production (fed into utility grid)
- Spandrel curtain-wall element: weather-protection layer

Source: US DOE (2001)



**Location:** Herne, Germany

**Year of Completion:** 1999

**Architect:** Jourda and BDA

**BiPV Concept:** Structural glass façade  
Overhead glazing

**PV Technology:** Multicrystalline Silicon

**Nominal Power:** 1 MWp

**Projected output:** 700 MWh/year

**Type of Building:** Public, Mixed

### Functions Performed

- Electricity production (fed into utility grid)
- Integral part of the structural glazing system: watertight and insulation layer
- Daylighting
- Shading

Source: IEA-PVPS [www.iea-pvps.org](http://www.iea-pvps.org)



**Location:** Zurich, Switzerland

**Year of Completion:** 2003

**Architect:** Arge Zayetta

**BiPV Concept:** Awning shading system

**PV Technology:** Monocrystalline Silicon

**Nominal Power:** 290 kWp

**Projected output:** 264 MWh/year

**Type of Building:** Airport

### Functions Performed

- Electricity production
- Shading

Source: Arge Zayetta



**Location:** Petten, The Netherlands

**Year of Completion:** 2001

**Architect:** Bear

**BiPV Concept:** Conservatory glazing

**PV Technology:** Monocrystalline Silicon

**Nominal Power:** 23,73 kWp

**Projected output:** ?

**Type of Building:** Office & Laboratory

### Functions Performed

- Electricity production
- Shading
- Daylighting system
- Watertight and insulation layers





FUNCTION :: architectural

CONSIDERATIONS

*Architecture is the most public of arts*

Worpole, 2000

*Most people judge architecture by its external appearance*

Rasmussen, 1991

*Architecture is a fine art, i.e., concerned with the beautiful and appeal to the eye*

Rasmussen, 1991



FUNCTION :: architectural

CONSIDERATIONS

- **Aesthetic value at PV product and architectural design concept levels**
- **Optimal, holistic-based, combination of utilitarian and aesthetical values should deliver maximum value**
- **Holistic-based approaches will most probably be sub-optimised for electricity generation**



# BiPV ECONOMICS

Value-added approach

