Design common professional framework and Training methodology

*List of good examples of PV installations*  
*(WP2 - D2.8)*
**PVTRIN:** The PVTRIN project scope is the development of a training and certification scheme for technicians, according common accepted criteria and standards, focused on the installation and maintenance of small scale PV.

The expected results are: Accredited training courses and an operational certification scheme for PV installers in 6 participating countries; Practical training material/tools for installers and their trainers; Web portal with access to technical information on PV installation/integration; 8 pilot training courses implemented, a pool of skilled/certified PV installers; A roadmap for the adoption of the certification scheme across Europe.

Long term, PVTRIN will contribute to the PV/BIPV market growth in the participating countries, provide a supporting instrument for EU MS to meet their obligations for acknowledged certifications for RES installers till 31/12/2012 and enforce the MS efforts to achieve the mandatory target of a 20% share of energy from RES in overall Community energy consumption by 2020. The PVTRIN is co-financed by the Intelligent Energy - Europe (IEE) programme.

**PROJECT COORDINATOR**
Associate Professor Theocharis Tsoutsos, Renewable and Sustainable Energy Systems Lab.
Environmental Engineering Dpt., TECHNICAL UNIVERSITY OF CRETE (TUC)

**PROJECT PARTNERS**
Agency of Brasov for the Management of Energy & Environment (ABMEE) Romania
Building Research Establishment Limited (BRE) UK
Energy Institute Hrvoje Požar (EIHP) Croatia
European Photovoltaic Industry Association (EPIA) EU
Scientific and Technical Chamber of Cyprus (ETEK) Cyprus
Sofia Energy Centre (SEC) Bulgaria
Technical Chamber of Greece – Western Crete (TEE) Greece
Tecnalia Robotiker (TECNALIA) Spain

**WP2 LEADER**
Renewable and Sustainable Energy Systems Lab.
Environmental Engineering Dpt., TECHNICAL UNIVERSITY OF CRETE (TUC)

**DELIVERABLE EDITOR**
Renewable and Sustainable Energy Systems Lab.
Environmental Engineering Dpt., TECHNICAL UNIVERSITY OF CRETE (TUC)
Work Team: Theocharis Tsoutsos, Stavroula Tournaki (TUC)

**CO-AUTHORS**
ABMEE, ETEK, EIHP, TECNALIA

**LEGAL NOTICE**
The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that may be made of the information contained therein.
Reproduction is authorised provided the source is acknowledged.

pvtrin@pvtrin.eu, www.pvtrin.eu
Contents

1 Introduction .............................................................................................................................................. 4

2 List of Good Examples of PV Installation in the PVTRIN countries ..................................................... 5

2.1 Greece ............................................................................................................................................... 5
  2.1.1 Athens Metro Mall ......................................................................................................................... 5
  2.1.2 Papapolitis Warehouse ................................................................................................................ 6
  2.1.3 Bali Paradise Hotel ..................................................................................................................... 7
  2.1.4 House in Paros Island .................................................................................................................. 8
  2.1.5 ZOGRAFOU Municipality Park ................................................................................................... 9
  2.1.6 Green Roof at Athens Trolley Main Station ............................................................................... 10
  2.1.7 Stilmet S.A. .............................................................................................................................. 11

2.2 Cyprus .............................................................................................................................................. 12
  2.2.1 Cyprus Good Example 1 ............................................................................................................. 12
  2.2.2 Cyprus Good Example 2 ........................................................................................................... 13

2.3 Croatia ............................................................................................................................................. 14
  2.3.1 PV Plant “Elementary Scholl Čavle” ....................................................................................... 14

2.4 Spain ................................................................................................................................................. 15
  2.4.1 The Pompeu Fabra library .......................................................................................................... 15
  2.4.2 FORUM II Solar Photovoltaic Pergola .................................................................................... 16
1 Introduction

This document provides a short list of good examples of PV installations on buildings at the countries where the PVTRIN training was implemented. These examples were presented and discussed during the training and also were proposed to trainees for visits.

Examples of good PV installations were not located to Bulgaria and Romania in areas with proximity to the training courses location due to the immaturity of the PV market at those countries.
2 List of Good Examples of PV Installation in the PVTRIN countries

2.1 Greece

2.1.1 Athens Metro Mall

Basics

City/Location: Athens, Ag.Dimitrios
Latitude/Longitude: 37.941363 /23.739974
Type of application: BIPV
1st Year of operation: 2010

Description of the solution

Designed with the aim of saving resources and being environmentally friendly, Athens Metro Mall combines various characteristics that make it a bioclimatic building with very low energy consumption. Solar panels cover 400 m² on the south side of the building achieving a reduction in energy consumption of up to 5%.

Site / building type: The BIPV consists of two façades and the south side of the commercial center “Athens Metro Mall”.
Duration of installation works: 20 days.

Technical description

Total installed power: 51 kWp
Area needed per kW: 7.72 m²
PV technology used: Crystalline silicon

Economic aspects

Total cost: €142,000, (PV: 2.78 €/Wp)
Feed-in tariffs, subsidies, grants: The system feeds into the public grid and paid 0.394€/kWh by the Public Power Corporation (PPC). The system is estimated to produce approximately 39.9MWh/year which means that the total investment will be paid back in 9 years.

Results

Energy production: 39,900 kWp/year
CO₂ emissions savings: 23.94 t/year

Contacts:
Ms. Eirini Komessariou (ekomessariou@schellas.gr), Mr. Ioannis Aggelos (service@acepower.gr)
2.1.2 Papapolitis Warehouse

Basics

City/Location: Markopoulo, Attiki
Latitude/Longitude: 37.862700 /23.930120
Type of application: ON-ROOF
1st Year of operation: 2012

Description of the solution

The main aim by the installation of the PV system at Papapolitis Warehouse was to reduce the electricity expenses and at the same time improve the warehouse environmental characteristics as most of the produced energy is fed back to the warehouse power station. Solar panels cover 660 m² on the south facing roofs of the building.

Site / building type: The On-Roof system is installed at the South facing sides of the metallic roof of the "Papapolitis" warehouse

Duration of installation works: 15 days

Technical description

Total installed power: 100kWp
Area needed per kW: 6.6 m²
PV technology used: Polycrystalline silicon with "Stay-Powerful" grid interconnection technology

Economic aspects

Total cost: €180,000, (PV: 1.8 €/Wp)
Feed-in tariffs, subsidies, grants: The system feeds into the public grid and paid 0.441€/kWh by the Public Power Corporation (PPC). The system is estimated to produce approximately 144MWh/year which means that the total investment will be paid back in 3 years.

Results

Energy production: 144 MWh /year
CO₂ emissions savings: 86.4 t/year

Contacts:
Mr. Theodoros Bafaloukas (t.bafaloukas@green-way.com.gr), www.greenway.gr
2.1.3 Bali Paradise Hotel

Basics

City/Location: Bali, Rethymno, Crete
Latitude/Longitude: 35.408015, 24.782321
Type of application: ON-ROOF
1st Year of operation: 2012

Description of the solution
The main concept of Bali Paradise Hotel from the initial design was the preservation of the natural environment including forestry, gardens and plants throughout the hotel area, and the use of environmental friendly technologies such as electric cars and solar energy. The main aim of the installation of the PV system was to further improve the environmental characteristics of the hotel and to reduce its emissions. The system was installed in several roofs of the hotel with low inclination so as to minimize the optical disturbance from the Solar panels.

Site / building type: The On-Roof system is installed on both flat concrete roofs and tilted metallic roofs
Duration of installation works: 18 days

Technical description

<table>
<thead>
<tr>
<th>Total installed power: 80kWp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area needed per kW: 5.2 m²</td>
</tr>
<tr>
<td>PV technology used: Monocrystalline silicon and rear-point contact cells</td>
</tr>
</tbody>
</table>

Economic aspects

| Total cost: €203,500, (PV: 2.54 €/Wp) |
| Feed-in tariffs, subsidies, grants: The system feeds into the public grid and paid 0.441€/kWh by the Public Power Corporation (PPC). The system is estimated to produce approximately 112MWh/year which means that the total investment will be paid back in 4 years. |

Results

| Energy production: 112 MWh /year |
| CO₂ emissions savings: 67.2 t/year |

Contacts:
Mr. Dimitrios Chasapis (dchasapis@dclab.gr), www.dclab.gr

PVTRIN WP2_D2.8_List of good example PV installations, TUC ReSEL, Nov 2012
2.1.4 House in Paros Island

Basics

City/Location: Krotiri, Paros
Latitude/Longitude: 37.103483 / 25.149740
Type of application: ON-ROOF
1st Year of operation: 2012

Description of the solution

The PV system was installed in the framework of the program "Photovoltaic Systems on Buildings" with main aim the increase of the use of RE production and to reduce the distribution network loading and losses by localized energy production.

- Site / building type: The On-Roof system is installed on a wooden shading construction using slide-in mounting base in order to improve the aesthetic of the system

Duration of installation works: 2 days

Technical description

Total installed power: 4.8kWp
Area needed per kW: 6.87m²
PV technology used: Polycrystalline silicon with "Stay-Powerful" grid interconnection technology

Economic aspects

Total cost: €12,700, (PV: 2.65 €/Wp)
Feed-in tariffs, subsidies, grants: The system feeds into the public grid and paid 0.55€/kWh by the Public Power Corporation (PPC). The system is estimated to produce approximately 6.19MWh/year which means that the total investment will be paid back in 4 years.

Results

Energy production: 6.19 MWh /year

CO₂ emissions savings: 3.7 t/year

Contacts:
Mr. Dimitrios Chasapis (dchasapis@dclab.gr), www.dclab.gr
2.1.5 ZOGRAFOU Municipality Park

Basics

City: Athens
Latitude/Longitude: Not available data
Type of application: Roof Mound
1st Year of operation: 2006

Description of the solution

Designed from Photovoltaic for Zografou municipality Goudi Park.

The design is focusing to maximize the energy efficiency and introduce renewable Energy system to public and visitors of the park.

Site / building type: The system consists of one roof intergraded solar system in the south-south east roof side side of big kiosk in Goudi park area.

Duration of installation works: 7 days.

Technical description

- Total installed power: 19,95 kWp
- Area needed per Kw: 5.42 m²
- PV technology used: Crystalline silicon

Economic aspects

- Total cost: 120,000€ (PV: 6€/Wp)
- Feed-in tariffs, subsidies, grants: The system feeds into the public grid and paid 0.46€/KWh. The energy production estimated is approximately 26,2 MWh/year.
- Payback period: 9,9 years not including state’s subsidy.

Results

Energy production: 26,200 kWp /year

Contacts:
www.Photovoltaic.gr info@photovoltaic.gr
### 2.1.6 Green Roof at Athens Trolley Main Station

**Basics**
- **City:** Athens
- **Latitude/Longitude:** Not available data
- **Type of application:** Roof Mound
- **1st Year of operation:** 2009

**Description of the solution**
Designed from Photovoltaic together with PPCR for PPCR.

The design is focusing to maximize the energy efficiency for PPCR owner of the PV system.

**Site / building type:** The system consists of two ground mound lines in the south roof side side of the Athens Trolley Main Station

**Duration of installation works:** 7 days.

**Technical description**
- **Total installed power:** 19.95 kWP
- **Area needed per Kw:** 5.42 m²
- **PV technology used:** Crystalline silicon

**Economic aspects**
- **Total cost:** 80,500€ (PV: 4 €/Wp)
- **Feed-in tariffs, subsidies, grants:** The system feeds into the public grid and paid 0.45€/KWh. The energy production estimated is approximately 29,50 MWh/year (real measurements).
- **Payback period:** 5,9 years not including state’s subsidy.

**Results**
- **Energy production:** 29,500 kWP /year

**Contacts**
- www.Photovoltaic.gr
- info@photovoltaic.gr
2.1.7 Stilmet S.A.

Basics

City: Athens
Latitude/Longitude: Not available data
Type of application: Roof Integrated
1st Year of operation: 2001

Description of the solution

Designed from Photovoltaic for Stilmet S.A..

The design is focusing to maximize the energy efficiency as well to integrate frameless modules to standard aluminum frames.

Site / building type: The system consists of one roof intergraded solar system in the south roof side side of Stilmet’s parking kiosk.

Duration of installation works: 10 days.

Technical description

Total installed power: 8,5 kWp
Area needed per Kw: 7,6m²
PV technology used: Crystalline silicon

Economic aspects

Feed-in tariffs, subsidies, grants: The system feeds into the public grid and paid 0.46€/KWh. The energy production estimated is approximately 12,4 MWh/year.

Results

Energy production: 12,400 kWp /year

Contacts:
www.Photovoltaic.gr info@photovoltaic.gr
2.2 Cyprus

2.2.1 Cyprus Good Example 1

Basics

City/Location: Cyprus, Limassol
Latitude/Longitude: Not available data
Type of application: On the roof of a house (Tilt angle - 16°)
1st Year of operation: 2012

Description of the solution

The aim of the owner of this house was to produce green energy using photovoltaic panels, in order to save resources and to reduce the energy consumption and gas emissions of the building. Solar panels cover the majority of the south area of the roof of the building.

Site / building type: Residential building

Technical description

Total installed power: 5.04 kWp
Area needed per kW: 8 m²
PV technology used: Crystalline silicon

Economic aspects

Total cost: €11,000
Feed-in tariffs, subsidies, grants: The system feeds into the public grid and the electric energy is paid for 0.383€ per kWh. The system is estimated to produce approximately 8820 kWh/year which means that the total investment will be paid back in 3.25 years.

Results

Energy production: 8820 kWh/year  CO₂ emissions savings: 7 t/year

Contacts:
Conergy (Cyprus) www.conergy.com.cy

PVTRIN WP2_D2.8_List of good example PV installations, TUC ReSEL, Nov 2012
2.2.2 Cyprus Good Example 2

Basics

**City/Location:** Tseri, Nicosia

**Latitude/Longitude:** Not available data

**Type of application:** On the roof of a house (Tilt angle - 25°)

**1st Year of operation:** 2011

Description of the solution

The aim of the owner of this house was to produce green energy using photovoltaic panels, in order to save resources and to reduce the energy consumption and gas emissions of the building. Solar panels cover the majority of the south area of the roof of the building.

**Site / building type:** Residential building

Technical description

<table>
<thead>
<tr>
<th><strong>Total installed power:</strong></th>
<th>6,24 kWp</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area needed per kW:</strong></td>
<td>8 m²</td>
</tr>
<tr>
<td><strong>PV technology used:</strong></td>
<td>Crystalline silicon</td>
</tr>
</tbody>
</table>

Economic aspects

<table>
<thead>
<tr>
<th><strong>Total cost:</strong></th>
<th>€17,000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feed-in tariffs, subsidies, grants:</strong></td>
<td>The system feeds into the public grid and the electric energy is paid for 0.383€ per kWh. The system is estimated to produce approximately 9984kWh/year which means that the total investment will be paid back in 4,5 years.</td>
</tr>
</tbody>
</table>

Results

<table>
<thead>
<tr>
<th><strong>Energy production:</strong></th>
<th>9984 kWh /year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CO₂ emissions savings:</strong></td>
<td>7,9 t/year</td>
</tr>
</tbody>
</table>

Contacts:

Gesolar(Cyprus) [eleni.s@gesolarcyprus.com](mailto:eleni.s@gesolarcyprus.com)
2.3 Croatia

2.3.1 PV Plant “Elementary School Čavle”

Basics
City/Location: Čavle, Primorje Gorski kotar County
Latitude/Longitude: 45°21’, 14°29’
Type of application: Building applied PV
1st Year of operation: estimated 33 000 kwh

Description of the solution
As part of wider initiative for promoting use of solar energy, Regional Energy Agency Kvarner launched project of six PV plants on roofs of public building in Primorje-Gorski Kotar County. One of them is PV plant “Elementary school Čavle”, installed on the roof of Sports hall building in Elementary school Čavle. These projects are to be “model solutions” for PV systems within County. PV plant “Elementary school Čavle” is building applied PV plant, with modules place alongside with pitched roof, and connected to the grid.

Site / building type: Sports hall in Elementary School
Duration of installation works: 15 days

Technical description
Total installed power: 30 kW
PV technology used: Polycrystalline silicon modules

Economic aspects
Total cost: cca. 90,000 €
Feed-in tariffs, subsidies, grants:
Feed-in tariffs: 3.0 kn/kWh (cca 40 c€) on 12 years

Results
Energy production: 34032 kWh in first year of operation

CO₂ emissions savings: around 20 tons/year

Contacts:
Regional Energy Agency Kvarner, Ciottina 17b, HR-51000 Rijeka
http://www.reakvarner.hr, Darko.jardas@reakvarner.hr
2.4 Spain

2.4.1 The Pompeu Fabra library

Basics

City/Location: Mataró/Barcelona
Latitude/Longitude: 41.5333/2.45
Type of application: BIPV
1st Year of operation: 1995

Description of the solution

The Pompeu Fabra library in Mataró promoted by the City Council of Mataró (Barcelona) was designed with the twin aim of producing solar and thermal energy and ensuring maximum comfort. The use of different photovoltaic modules is defined by the need to provide transparency, opacity, or character to the façade.

Site / building type: The BIPV in the Pompeu Fabra Library (Mataró - Barcelona) consists of a curtain wall with semitransparent polycrystalline silicon solar cells in the façade (300m2) allowing indoor visibility, and 4 skylights (300m2) with different technologies opaque monocristaline and polycrystalline silicon solar cells. The central part of the skylights is made by semitransparent amorphous silicon cells.

Duration of installation works: 6 months

Technical description

Total installed power: 52.7 kWp
Area needed per kW: an average of 7.5 m²
PV technology used: Crystalline silicon (mono, poly and amorphous)

Economic aspects

Total cost: 471.000 €
Feed-in tariffs, subsidies, grants: The system had a subsidies of about 75%. The system estimated to produce approximately 52.7 kWp feeds into the public grid and it was initially paid the cost of electricity (0.1€/kWh), thanks to a special agreement with the utility ENHER, now inside ENDESA. In 2000, with the first law of FITs the price rose to a 0.24€/kWh. In 2004 the law was again amended and the FITs went to 0.45 €/kWh. This same price, with the update of the CPI, is now about 49 or 50 cents € / kWh. The return on investment was more quick thank than expected due to the unexpected FIT (11 years aprox.7yrs). Actually the yearly updated FIT is approx. 0.49€Kwh.

Results

Energy production: 50MWh/year
CO₂ emissions savings: 11.5 t/year

Contacts:
TFM ENERGIA SOLAR FOTOVOLTAICA S.A. – Pol. Ind. Pla d’En Coll – Carrer del Mig, 1
Montcada i Reixac 08110 (Barcelona) www.tfm.es Laura Roca Subirana (laura.roca@tfm.es)
2.4.2 FORUM II Solar Photovoltaic Pergola

Basics

City/Location: Zona Forum /Barcelona  
Latitude/Longitude: 41.41388 / 2.21666  
Type of application: BIPV  
1st Year of operation: 2008

Description of the solution

Redevelopment of the Besos River mouth: use of industrial space to create an area for cultural event and leisure activities, with a commitment to the Renewable Energies through 3 Photovoltaic Pergolas in the Forum Zone of Barcelona: Photovoltaic Pergola over Sailing School (Forum I), and two arcaded photovoltaic pergolas (Forum II) over the EDAR.

The two arcaded photovoltaic pergolas (Forum II) have a dual function: to generate shadow over a large area of the esplanade, reducing the incidence of direct solar radiation and improving the temperature in the summer, and to protect from the rain to perform public and private events. The location is ideal for a photovoltaic installation as the topography does not present any kind of shade, and the sea breeze provides ventilation of the PV modules.

- Site / building type: The Photovoltaic Pergola consist of specially laminated glass-glass 268W modules with polycrystalline technology: a photovoltaic field of 600KW. This technology allows the passage of light between cells causing a showy effect when the PV array is observed backlit from the esplanade. Curtain wall structured anchored on primary structure of galvanized iron and a secondary structure of studded steel

- Duration of installation works: 1 year

Technical description

- Total installed power: 600kW (657,404 kWp)  
- Area needed per kW: 8.62 m2/kW  
- PV technology used: specially laminated glass-glass modules with polycrystalline technology

Economic aspects

- Total cost: 3.495.865,00 €  
- Feed-in tariffs, subsidies, grants: The system of 600 KW feeds into the public grid and is paid 0.4175€/kWh. The system is estimated to produce approximately 739MW/year which means that the total investment will be paid back approximately in 11 years

Results

Energy production: 739 MWh  
CO₂ emissions savings: 364.91t/year

Contacts:
TFM ENERGIA SOLAR FOTOVOLTAICA S.A. – Pol. Ind. Pla d’En Coll – Carrer del Mig, 1 Montcada i Reixac 08110 (Barcelona), www.tfm.es  Laura Roca Subirana (laura.roca@tfm.es)

PVTRIN WP2_D2.8_List of good example PV installations, TUC ReSEL, Nov 2012