ERDF Project – PV Initiative

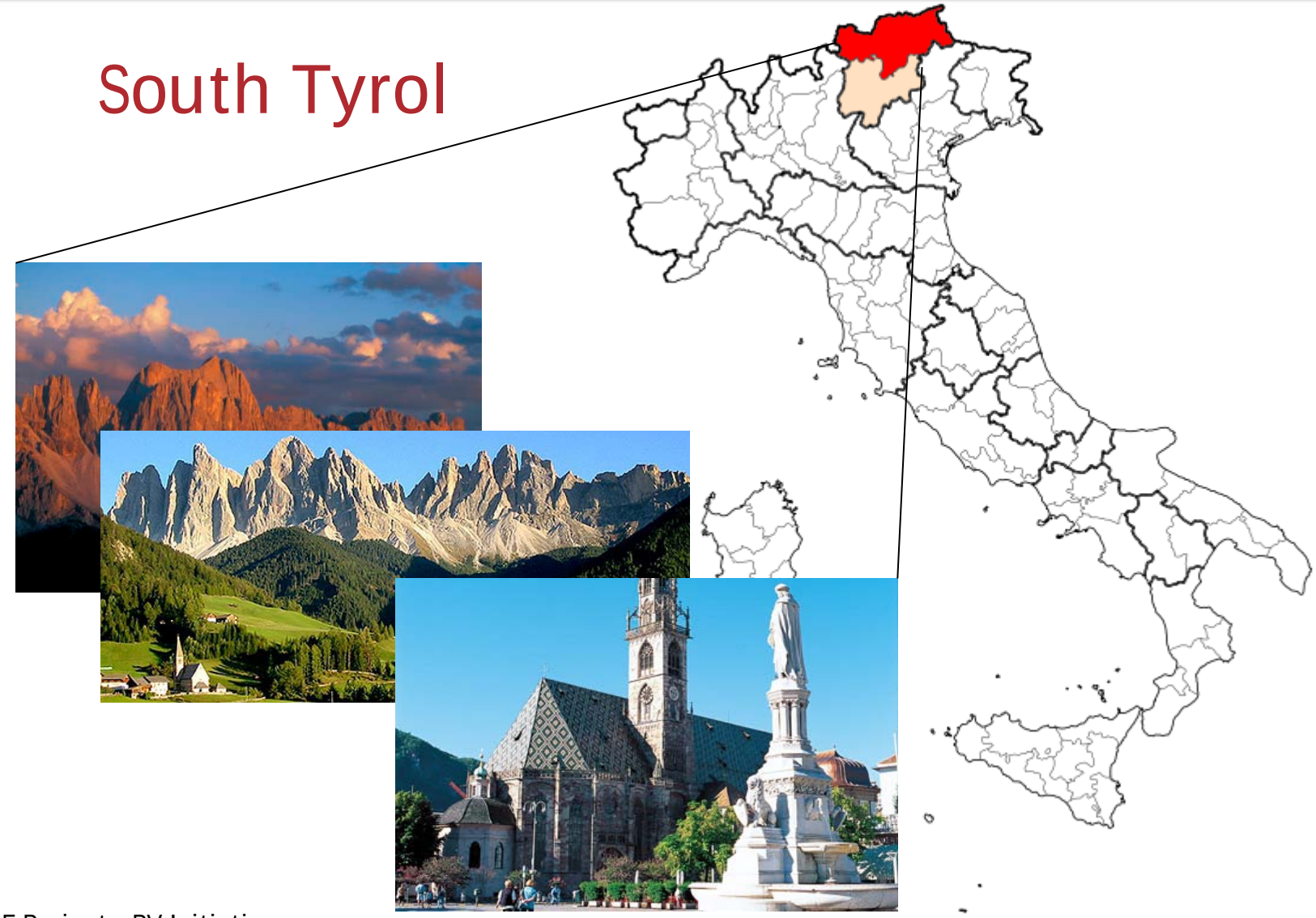
PRO-I3T Event

Nicosia, Cyprus, 11 September 2012

David Moser

Institute for Renewable Energy, EURAC

South Tyrol



Climate and Energy Package 2050

- CO_2 emission per capita reduced to 1.5 t (4 t in 2020)
- 90% energy need covered by renewables (75% in 2020)
- 2.2 kW annual continuous power per capita (2.5 kW in 2020)

Energia-Alto Adige-2050

Strategia per il CLIMA

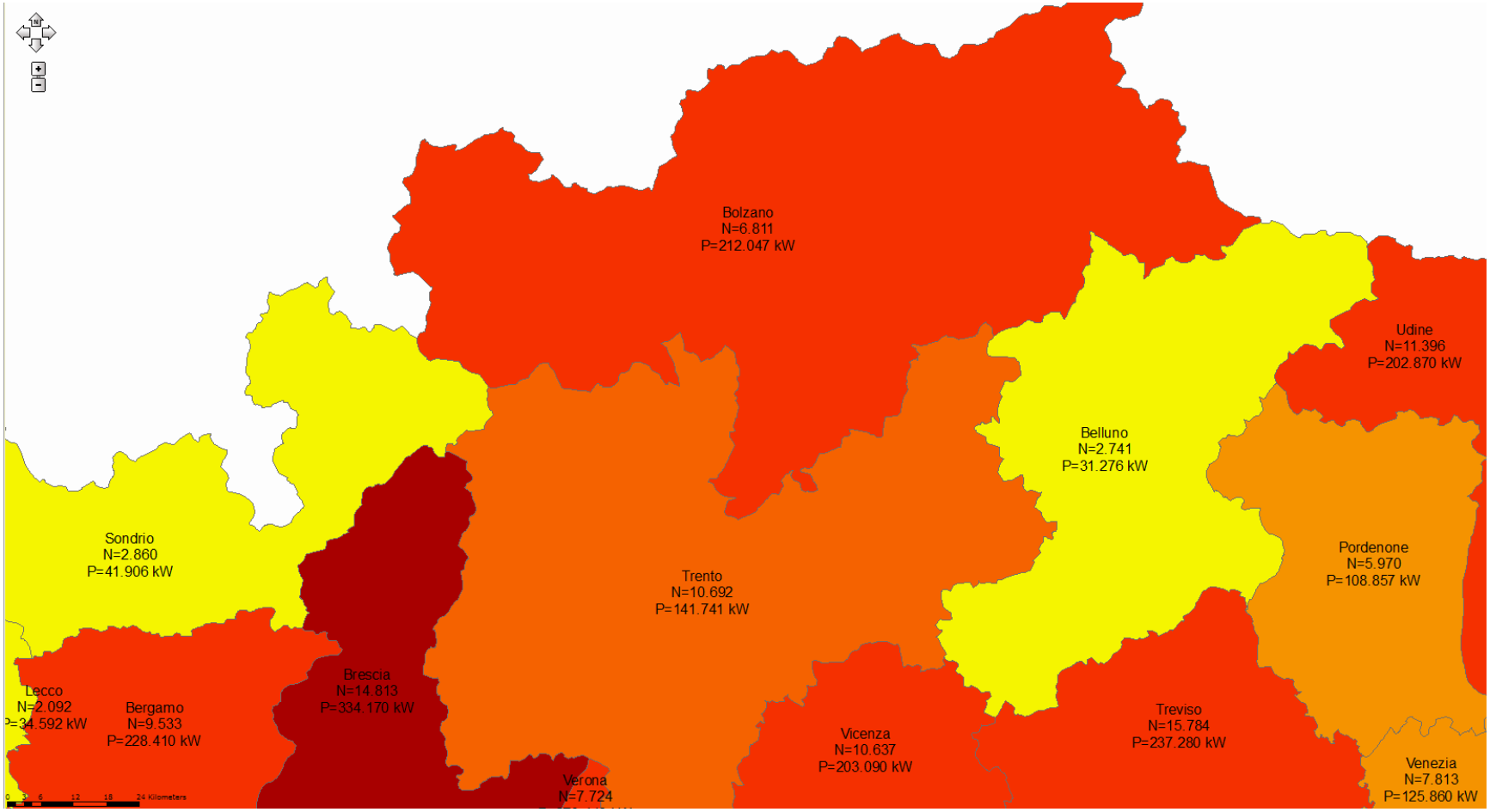
L'Alto Adige verso KlimaLand

AUTONOME PROVINZ BOZEN – SÜDTIROL
Ressort für Raumordnung, Umwelt und Energie

PROVINCIA AUTONOMA DI BOLZANO - ALTO ADIGE
Dipartimento all'urbanistica, ambiente ed energia

PV in South Tyrol

End of August 2012

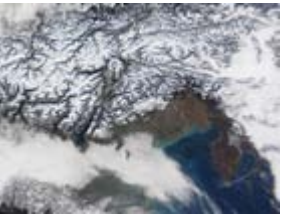


EURAC

Founded in 1982

11 Institutes

Autonomies (Minority Rights, Federalism and Regionalism, Public Management, Specialised Communication and Multilingualism)



Health (Biomedicine, Mountain Emergency Medicine, Mummies and the Iceman)

Mountains (Alpine Environment, Remote Sensing, Regional Development)

Technologies (Renewable Energy)

Institute for Renewable Energy

4 Groups

- Solar Thermal Heating and Cooling Systems
- Energy Management in Buildings
- Photovoltaic Systems
- Energy Strategies and Planning

Funding and collaborations

Europäische Union
Europäischer Fonds für regionale Entwicklung

Unione europea
Fondo europeo di sviluppo regionale

AUTONOME PROVINZ BOZEN SÜDTIROL

PROVINCIA AUTONOMA DI BOLZANO ALTO ADIGE

Investition in die Zukunft Investiamo nel futuro

COOPERATION

SEVENTH FRAMEWORK PROGRAMME

Interreg IV

Sei regioni un obiettivo • Sechs Regionen ein Ziel

INTERREG
ITALIA~SVIZZERA ITALIE~SUISSE ITALIEN~SCHWEIZ

gefördert von Stiftung Südtiroler Sparkasse Fondazione Cassa di Risparmio sostenuto da

International Energy Agency
Photovoltaic Power Systems Programme

Ongoing EU projects – ca. 55

Lead partner - 15

EU-funds managed at EURAC: ca. 26,5 Mio€

EURAC is participating in 55 EU funded projects, in FP7, Intelligent Energy, European Territorial Cooperation, Interreg IV, Europeaid and other EU programmes, either as Coordinator or partner and manages EU-funds for a total value of ca. 26,5 Mio €.

Why participate in EU projects

- Development of an International Standard
- Visibility in the EU and International dimension
- Access to advanced technology
- Collaboration with key players
- Development of new international partnership
- Training and increasing capabilities of staff
- Obtain funding for something you were planning to do

PV-Initiative

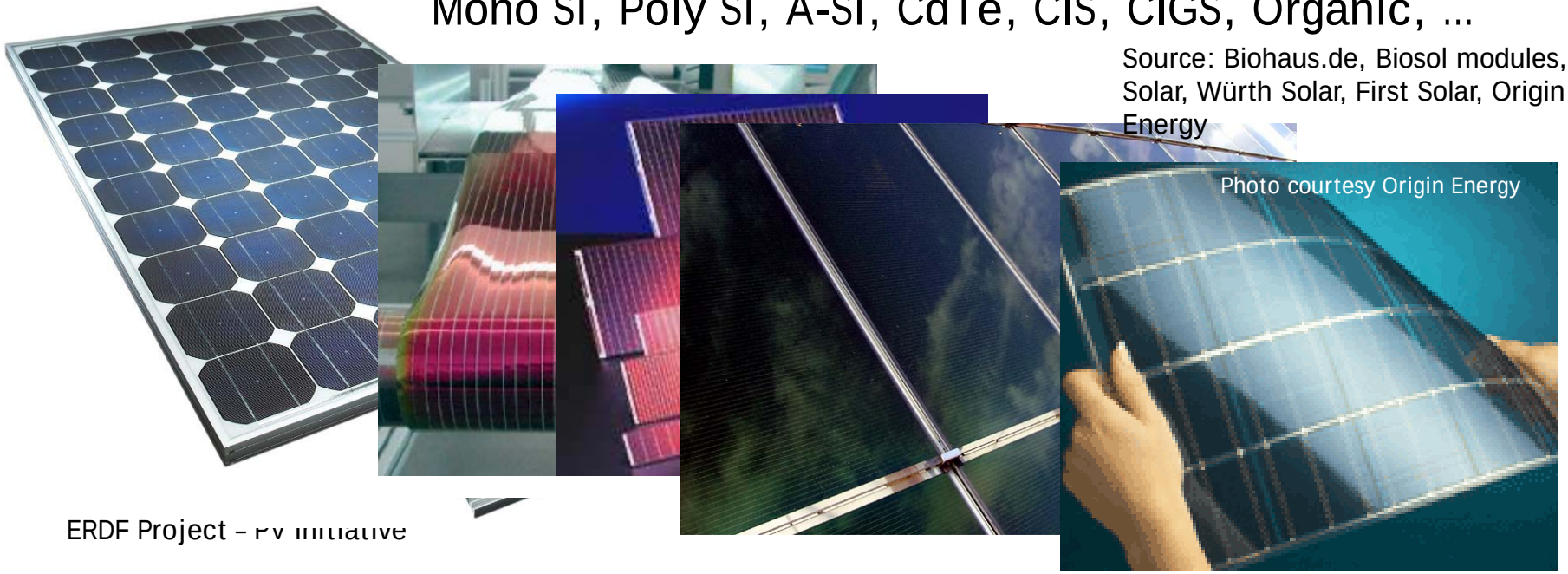
Introduction

- Project in the field of PV technologies and applications
- Written in cooperation with the Institute of Remote Sensing, EURAC
- Single Partner, EURAC
- Divided in 3 parts

Topic 1: PV Lab and module testing

- Module performance at different conditions of G,T (indoor and outdoor)
- Ageing test
- Materials for PV modules behave in different ways, e.g. Mono Si, Poly Si, A-Si, CdTe, CIS, CIGS, Organic, …

Source: Biohaus.de, Biosol modules, Uni Solar, Würth Solar, First Solar, Origin Energy



Topic 2: Building integrated PV

- Study of new building integrated PV solutions and indoor analysis

- Roof integrated and façade (ventilation, temperature, tilt angle, soiling, etc)

Topic 3: Analysis of Solar Potential

- PV potential/Solar Map of Brixen

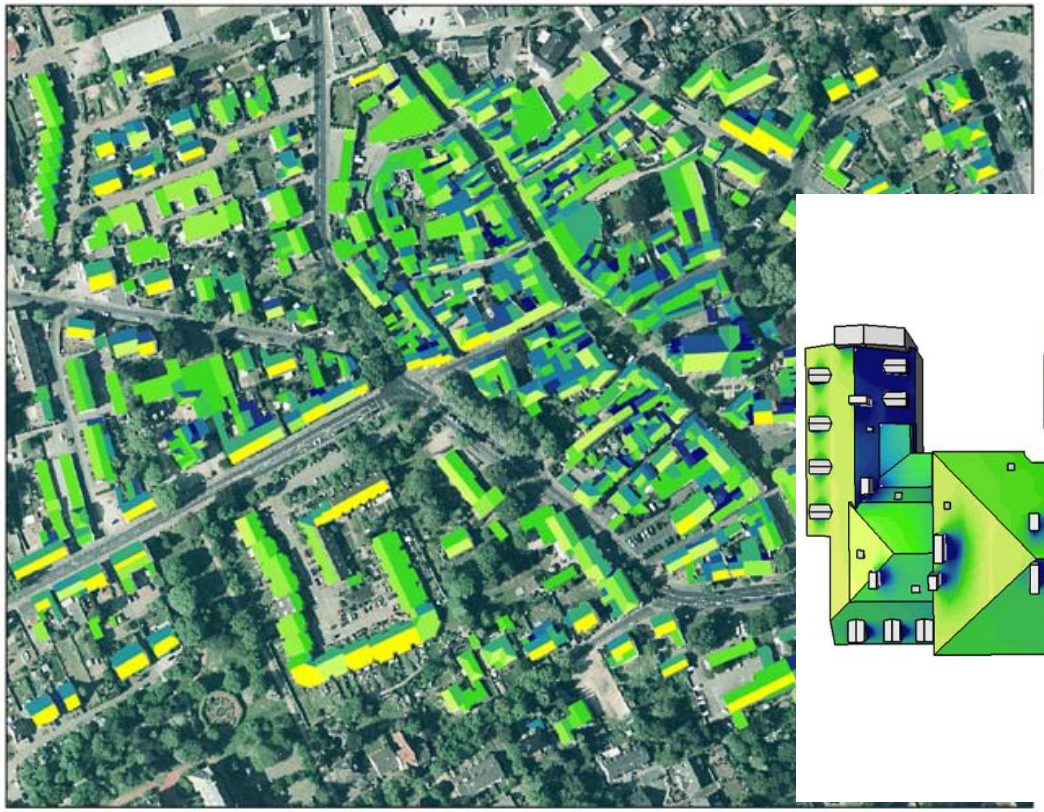
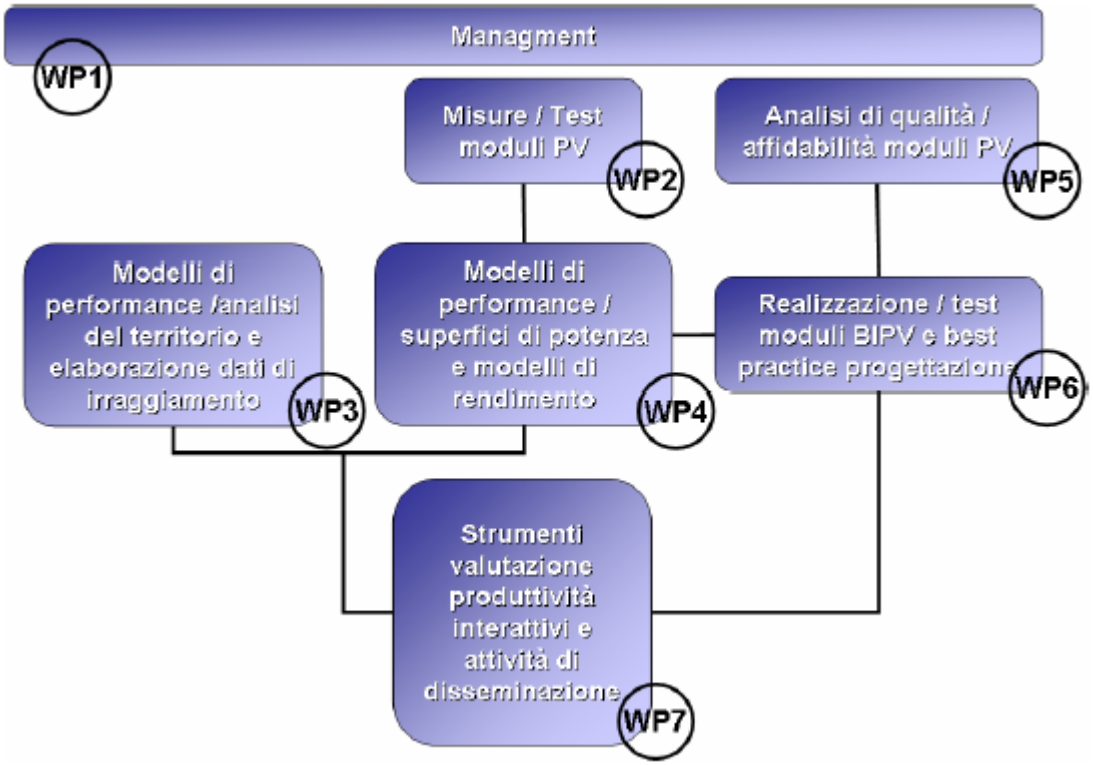


Abb.3: Jährliche Strahlungssumme

PV Initiative structure



Length: 36+12 months

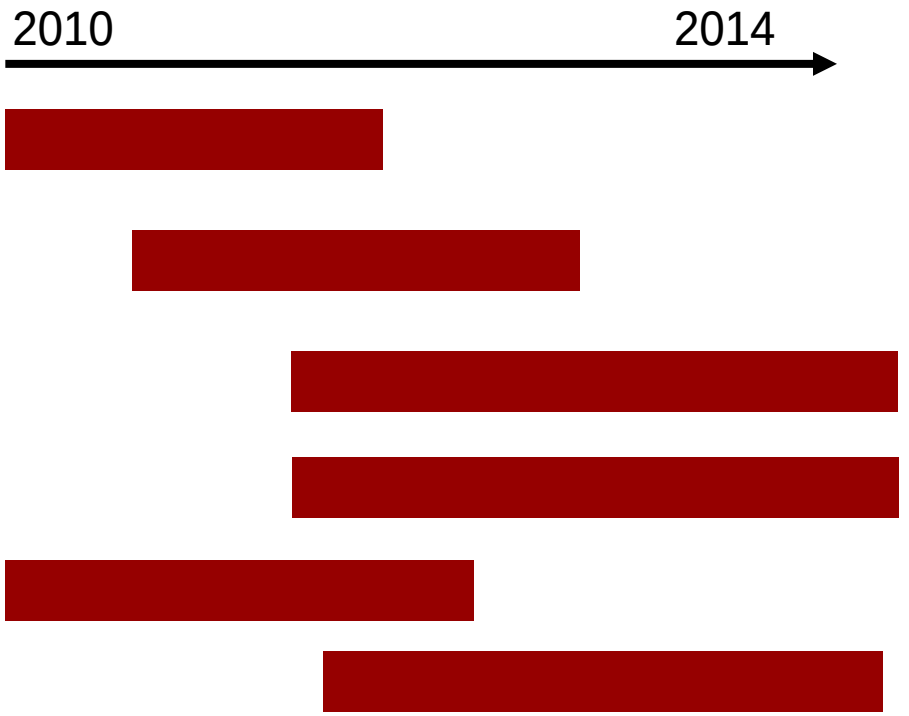
Budget: 804.850 €

Hardware: 415.000 €

Personale: 389.850 €

PV Initiative time chart

- Planning a PV lab
- Development of performance models
- Quality test
- BIPV products
- Development of radiation model and Solar Cadastre
- Website with PV potential at roof level



Example

Today:

- Somebody in Brixen would like to install PV modules
- Ask for different offers
- And installs the product offered to them
- !? Without knowing the product's behaviour in Brixen
- !? Production based on installer's estimation

At the end of the project

A website will be available for consultation (e.g. www.cittasolare.it)

How much power can be installed on their roof

Production from different technologies

Can contact installers with precise requirements

Project objectives

To create scientific know-how locally both on existing standard products and on innovative and emerging solutions

To study building integration – a sector with a high potential

To increase the awareness of the final consumer in PV technology in order to make educated choices

To make available to local companies neutral and detailed information about modules' behaviour

SoLaRE-PV Lab at EURAC

The leaflet for the SoLaRE-PV is translated in three languages – Italian, German and English

- Photovoltaic plant at Bolzano Airport (WP4)
  - General features
  - Second year of operation
- On-line Solar Cadastre (WP7)


Photovoltaic plant at Bolzano Airport

LOCATION

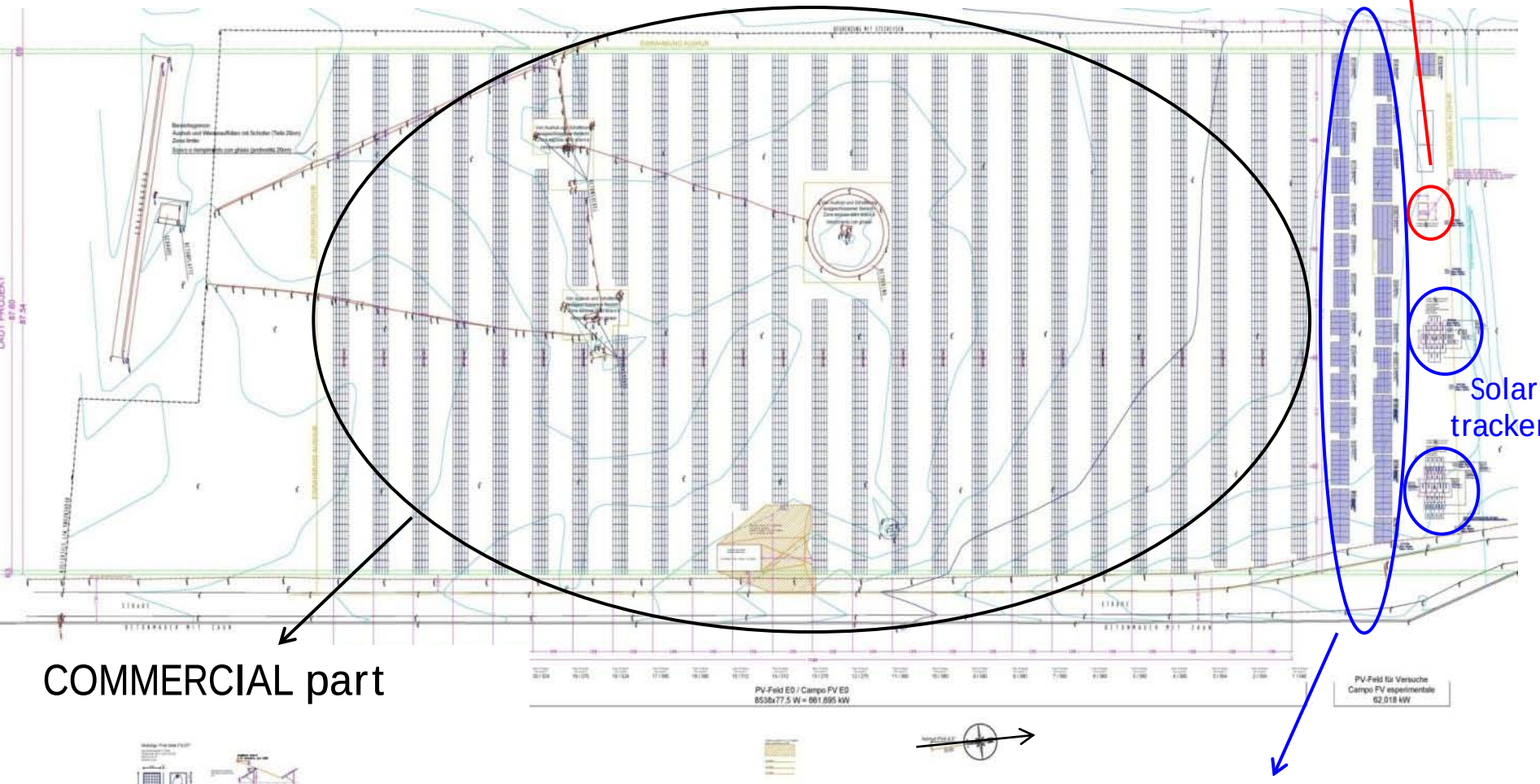
Installed within the **Aereoporto Bolzano Dolomiti (ABD)**

It covers an area of about 1.9ha (205x92m).

Owner: ABD

Co-funded by **Provincia BZ** through European Regional Development Found (**ERDF**)

PLANT SET-UP


METEO station
Solar trackers
COMMERCIAL part
MULTITECHNOLOGICAL part

COMMERCIAL PART

- 8538 modules each of 77.5 W_P in Cadmium Telluride (CdTe)
- Total power: 662k W_P
- 75 arrays each of 7-9kW_P
- Fixed tilt 30°

MULTITECHNOLOGICAL PART

- **Fixed tilt 30°**

  (53kW: c-Si, a-Si, CIS CIGS, HIT, ribbon, micromorph)

and more

- **Monoaxial solar-tracker**

  (4kW: c-Si)

- **Biaxial solar Tracker**

  (5kW: c-Si, CdTe)

2 MONITORING SYSTEMS - Devices

Commercial

(since August 2010)

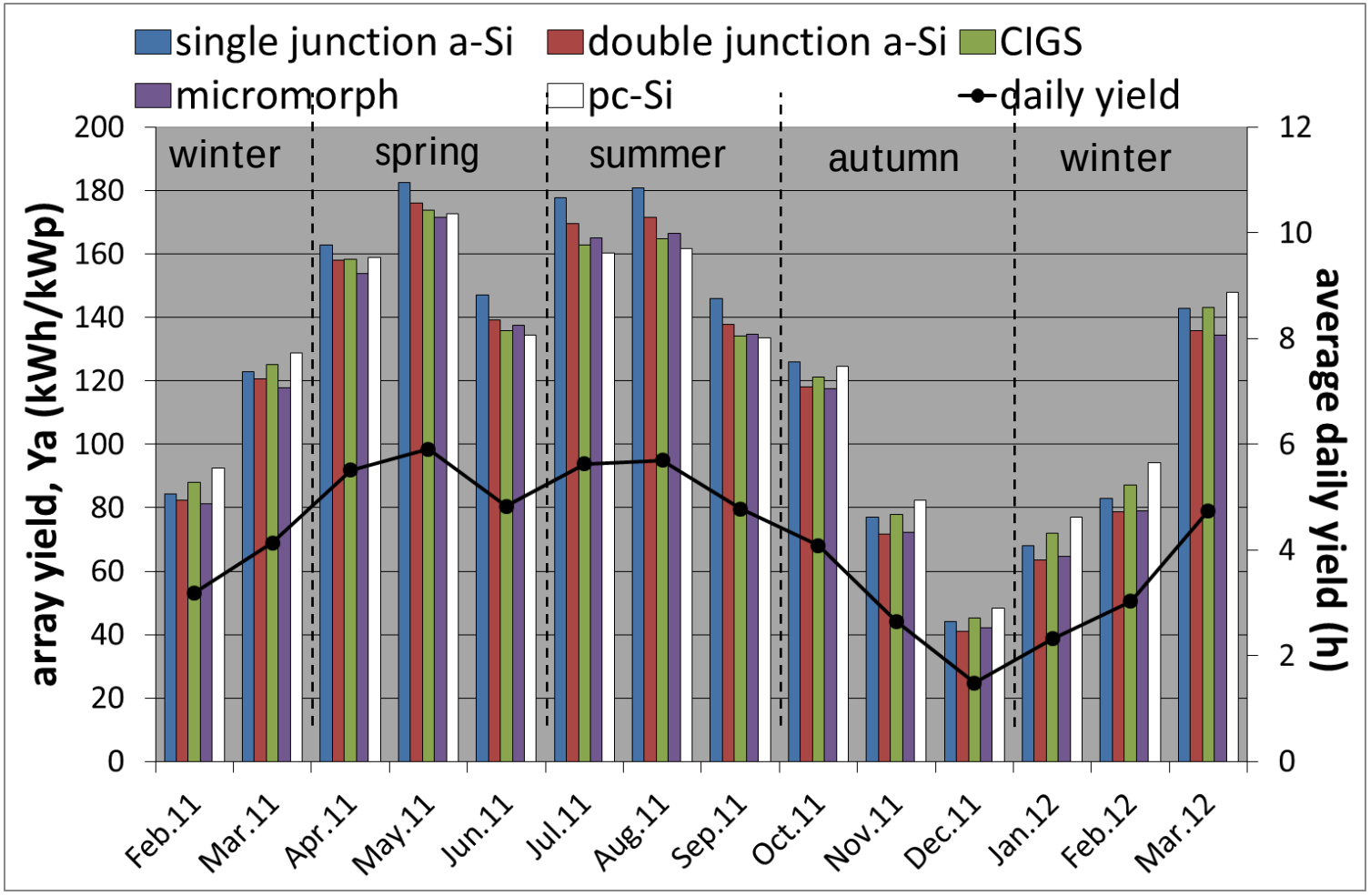
- PV-cells (a-Si)
- Pt100s as temperature sensors
- Mechanical anemometer

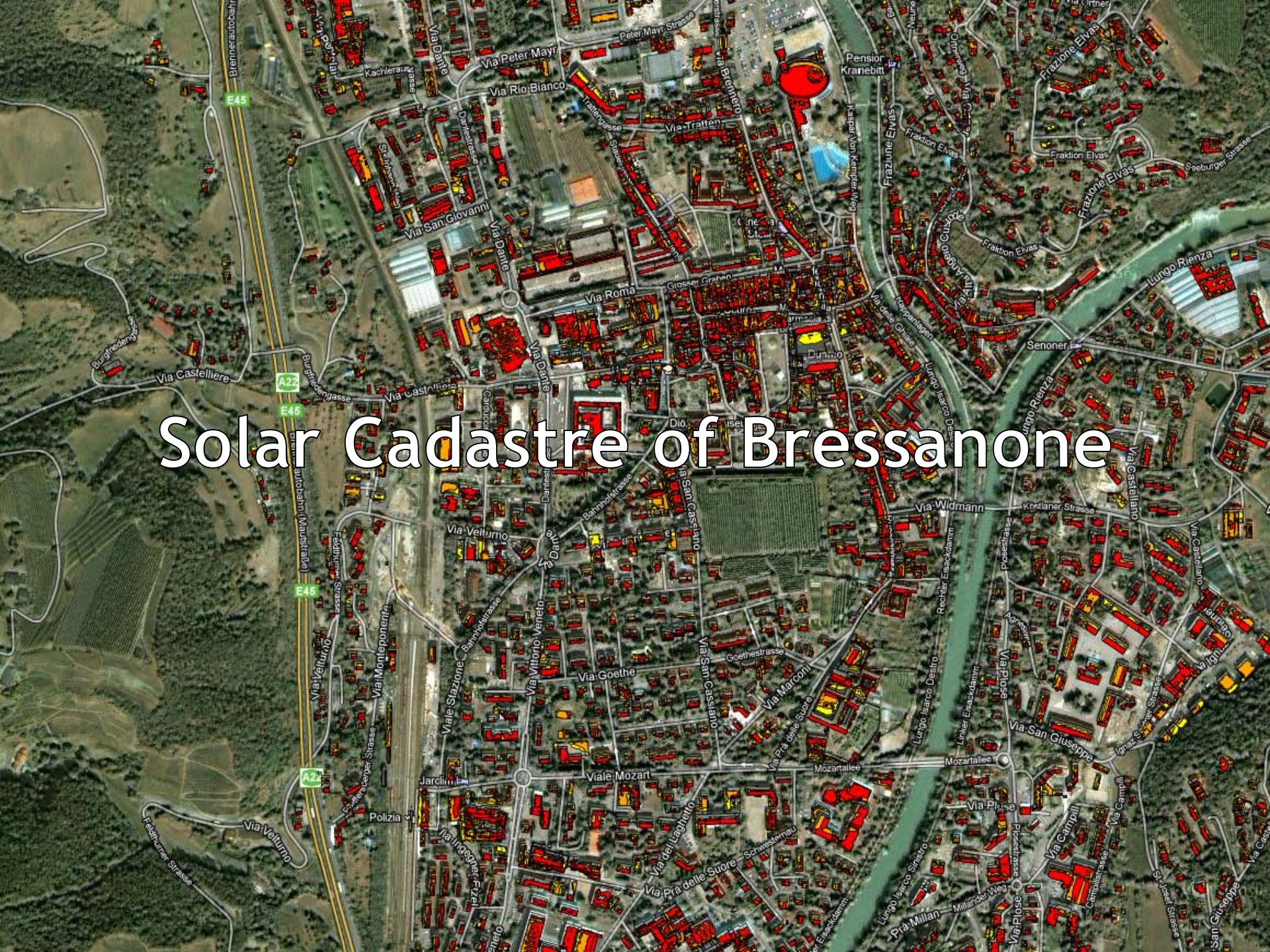
Multitechnological

(since February 2011 or June 2011)

- PV-cells (c-Si and KG5-filtered) and Pyranometers
- Pyrheliometer
- Pt100s and NTC-devices
- Ultrasonic anemometer
- Sunphotometer
- Dedicated I&V measurements with accuracy ~ 1%

Array yield


single junction a-Si
double junction a-Si
CIGS
micromorph
pc-Si
daily yield
winter
spring
summer
autumn
winter
array yield, Ya (kWh/kWp)
average daily yield (h)
0
20
40
60
80
100
120
140
160
180
200
0
2
4
6
8
10
12
Feb.11
Mar.11
Apr.11
May.11
Jun.11
Jul.11
Aug.11
Sep.11
Oct.11
Nov.11
Dec.11
Jan.12
Feb.12
Mar.12


Solar Cadastre of Bressanone

SOLAR CADASTRE

SOLAR CADASTRE is a map assessing the solar potential of a built area.

GOALS:

Spread the knowledge between the citizens regarding solar potential on roof level of their city

Tool for the municipalities useful for planning the exploitation of solar energy in their region

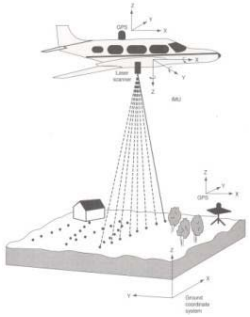
Many european municipalities developed a solar-cadastre available on-line for their own region, e.g. German cities:

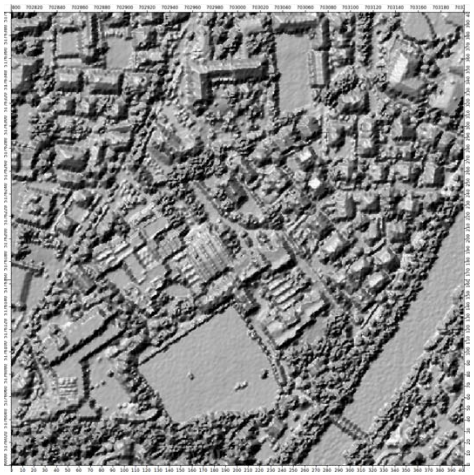
http://www.enbausa.de/solar-geothermie/fotovoltaik/staedte-mit-solarkataster.ht

SOLAR CADASTRE COMPUTATION

1. Assessment of the terrain model
2. Identification of the real building (e.g. distinguish between a flat roof and a parking area)
3. Calculation of the solar radiation incoming on the surface
4. Creation of the solar potential map

DIGITAL TERRAIN MODEL (DTM)



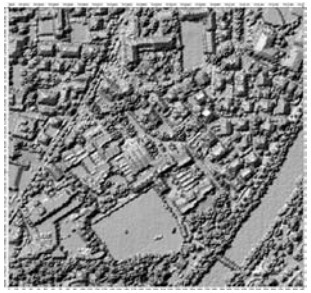


The Light Detection and Ranging (**LiDAR**) tool provides a **high resolution mapping of the terrain topography**.

To collect and combine topography and position information it uses Global Positioning System (GPS) and Inertial Navigation System (INS).

Scanned grid for Bressanone: 1x1m

IDENTIFICATION OF THE BUILDINGS



DIGITAL TERRAIN MODEL

buildings, roads, yard, walls, rivers, trees, …

MAP OF BUILDED AREAS

buildings, roads, yard, walls, …

MAP OF BUILDING ROOFS

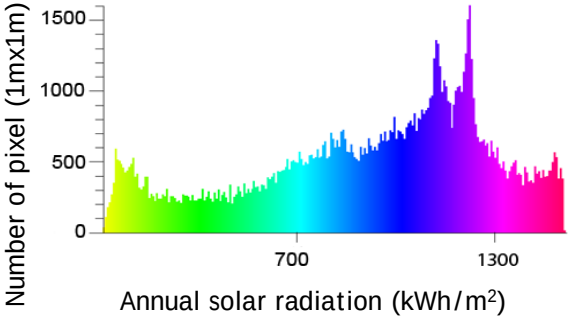
buildings

CALCULATION OF INCOMING SOLAR RADIATION

1. **ASTRONOMIC CALCULATION** (latitude, longitude and altitude)

+ **FAR SHADING** (surrounding mountains, horizon line)
+ **NEAR SHADING** (trees, buildings, …)
+ **CLOUDINESS.** Monthly correction through on-site irradiance measurements

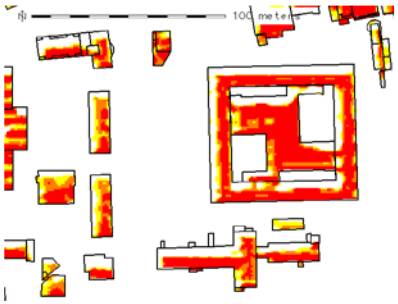
DEFINITION OF THE RADIATION LEVELS



Radiation distribution for the buildings of Bressanone

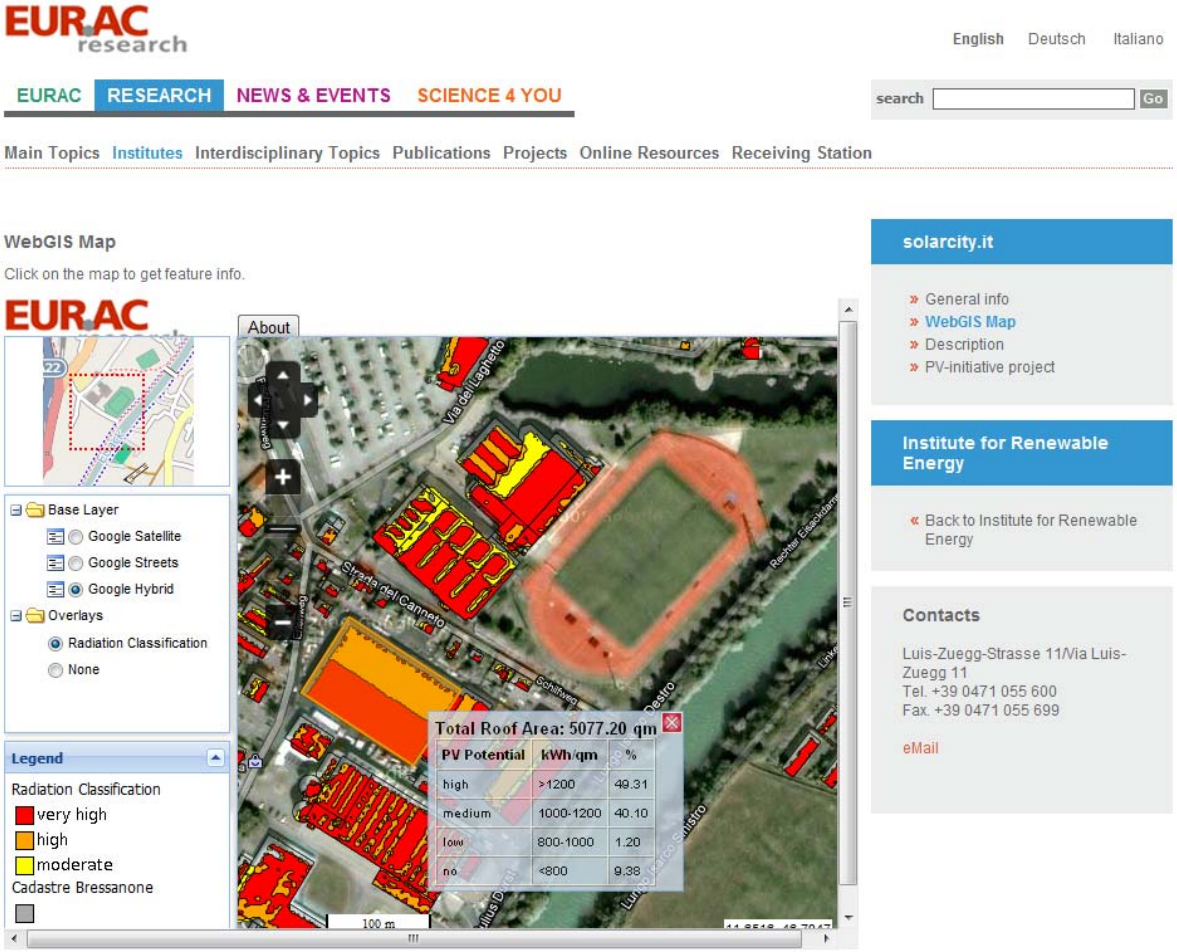
LEVEL	ANNUAL RADIATION	COLOR	DESCRIPTION
1	> 1200 kWh/m²		VERY SUITABLE
2	1000 - 1200 kWh/m²		ADATTO
3	800 - 1000 kWh/m²		MEDIAMENTE ADATTO
4	< 800 kWh/m²	no color	INADATTO

Definition of radiation levels



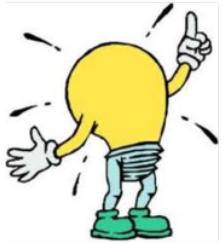
Filling the buildings on the map according the radiation levels defined

From November 30th 2011 **available on-line** at: www.cittasolare.it



www.cittasolare.it

> 1200 kWh/m2	
1000 - 1200 kWh/m2	
800 - 1000 kWh/m2	
< 800 kWh/m2	no color



FROM RADIATION TO PV POTENTIAL MAP

- ROOF SOLAR POTENTIAL
- SIZE OF THE ROOF
- MODULE TECHNOLGY

PV POTENTIAL

THE KEY POINT IS THE PROPER CHOICE OF PV MODULE TECHNOLOGY

Topic 1-2

Flexi-BIPV

- A fully flexible outdoor test field for the study of Building Integrated PV systems
- Roof integration
- Façade
- Island (off-grid)

Solar Design

- International cooperation in
- BIPV
- PIPV

Topic 3

PV-Alps

- Solar Potential of Province of Grisons (Switzerland) and South Tyrol (Italy)
- 100x100 m resolution
- Policies
- Improve radiation model for alpine regions

Solar Tirol

- PV Solar Potential of Tyrol
- 2x2 m resolution
- Roof level
- Solar Cadastre of Tyrol
- PV potential and economics

Thank you for your attention

David Moser

david.moser@eurac.edu

www.eurac.edu

Publication activity 2010 - 2011

1. "Comparative Performance of Various PV Technologies in Different Italian Locations" - **proceedings from the WREC 2011 May 2011** Alessandra Colli
2. **Renewable Energy World** – Italian's Renewable Energy Future – Renewable Energy World Europe 2011 7-9 June 2011 - Fiera Milano - Milano – Italy, Alessandra Colli

EU PV SEC – September 2011 proceedings :

4. "MAXIMUM PRODUCTION CONDITIONS OF A c-Si MODULE IN THREE DIFFERENT ITALIAN LOCATIONS" – Lorenzo Fanni ed all
5. "8 -MONTH PERFORMANCE OF THIN FILM TECHNOLOGIES DURING THEIR FIRST YEAR AT BOLZANO AIRPORT TEST INSTALLATION – ITALY" – M. Nikolaeva-Dimitrova ed all
6. "RADIATIVE MODELS AND SATELLITE DATA FOR ESTIMATION OF SOLAR IRRADIANCES AT ROOF LEVEL: A WEBGIS APPROACH FOR MOUNTAIN REGIONS" – M. Pepita ed all (Lorenzo Fanni)

International Journal paper:

7. "HOW ACCURATE IS A COMMERCIAL MONITORING SYSTEM FOR PHOTOVOLTAIC PLANT?" - Lorenzo Fanni, Miglena Nikolaeva-Dimitrova ed all, in press

Publication activity 2011 - 2012

The following abstract have been submitted:

1. **"1-YEAR PERFORMANCE OF CRYSTALLINE TECHNOLOGIES ON DIFFERENT TRACKING SYSTEMS " -** Giorgio Belluardo, Markus Pichler, David Moser , Miglena Nikolaeva-Dimitrova
2. **"What's the outdoor TCO of PV systems connected to the grid? Comparison of different modules technologies in three Italian locations" - Mattia Giussani, Markus Pichler, Miglena Nikolaeva-Dimitrova**
3. **"Translation of the PV modules performance from 30° to 90° tilt angle based on satellite radiation data for different technologies installed at ABD plant" -** M. Nikolaeva-Dimitrova, A. Skoczek, D. Moser , T. Cebecauer
4. **"One-year comparison of different thin-film technologies at Bolzano Airport Test Installation " -** M. Pichler, G. Belluardo David Moser and M. M. Nikolaeva-Dimitrova

Presentations with in 2012

1. "Preservare ed Innovare: Esperienze di ricerca internazionali" - Titolo dell'evento, organized by ENEA and held in Napoli on the 22nd of March 2012 (in the context of Energy Med):

"**Fotovoltaico e preesistente: spunti di discussione sull'impiego del fotovoltaico nelle cittá e nel paesaggio**" – Laura Maturi