PURE
Promotion of Building Integrated Photovoltaics

Intelligent Energy Europe

Banska Bystrica 25th September 2008

PV systems in Greece - Crete

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TUC

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The Technical University of Crete, was established in 1977 in Chania Crete. Today, TUC comprises 5 academic engineering departments

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Energy problems in the European islands. The case of Crete

- High energy dependence on oil (86%)
- High rates of increase of energy demand (6%/year)
- High cost of conventional power generation
- High seasonal fluctuation in the load demand
- Significant problem in the power supply- low based load due to the absence of big industrial units

There is though

- large (unexploited) RES and Energy Saving potential

PV systems

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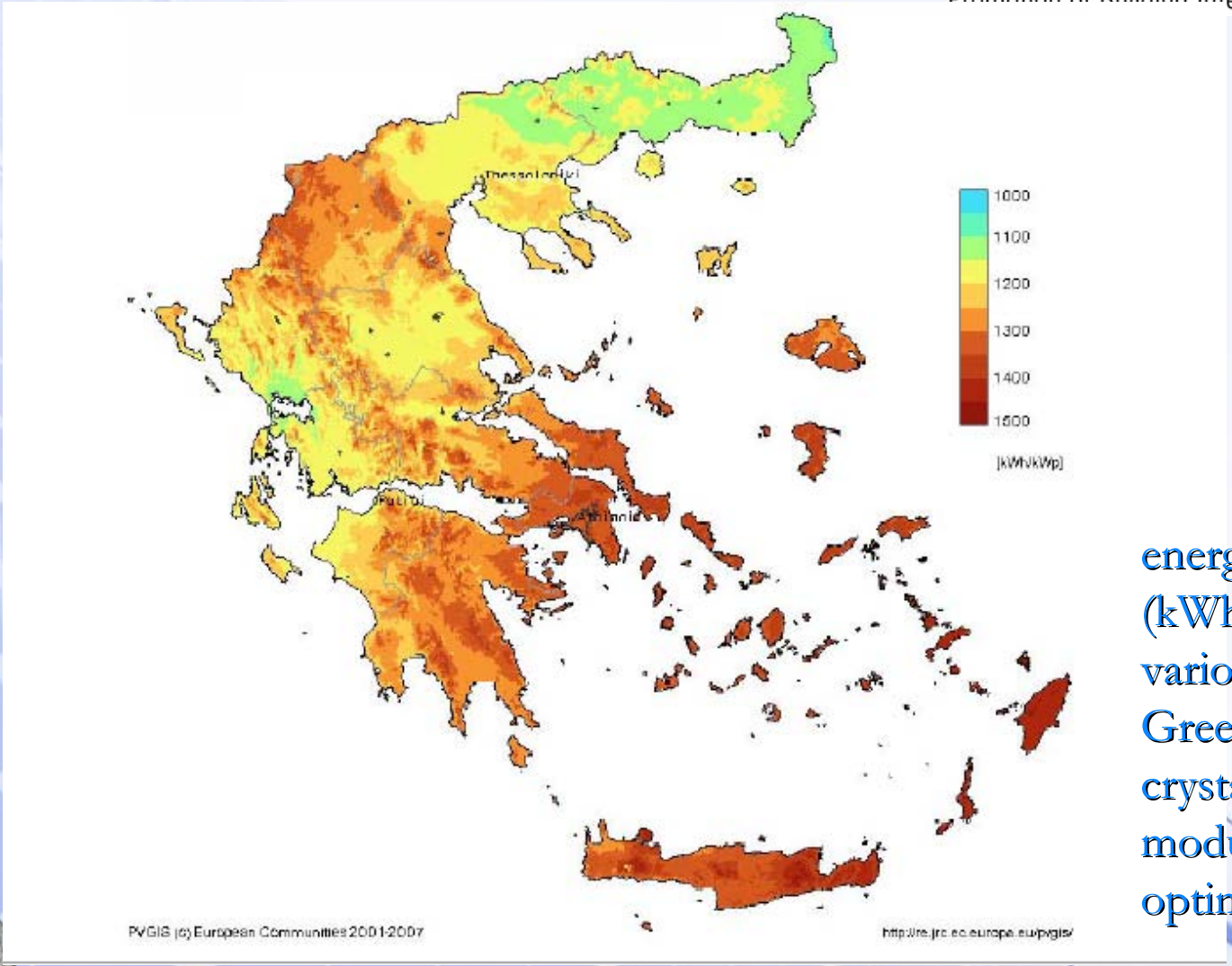
A PV system 3 kW_p installed in a domestic roof:

- provides 4.500 kWh/year,
- is equivalent to the average annual electricity, consumption of a 4-member family
- saves ~1.200 L oil/year
- avoids 3tn of air pollutants in the environment

Energy production



energy production (kWh/kWp/year) in various parts of Greece for crystalline modules mounted at optimal inclination

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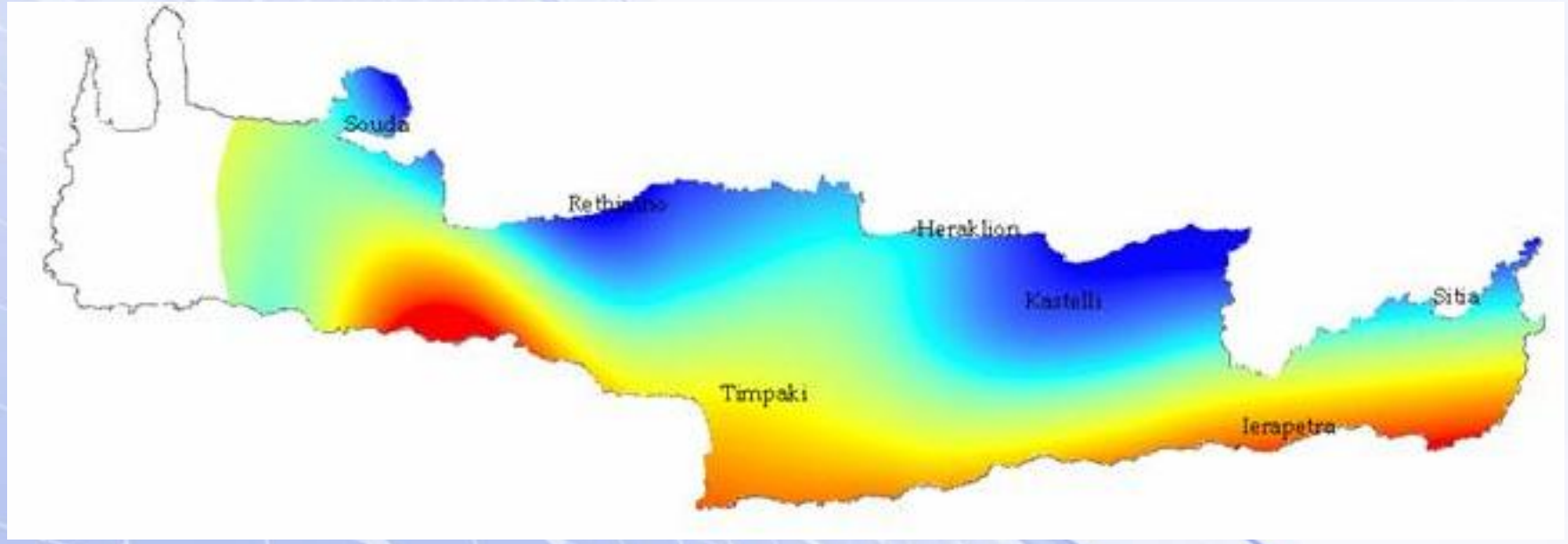
PV potential in Crete



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The Greek Market

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The Greek market

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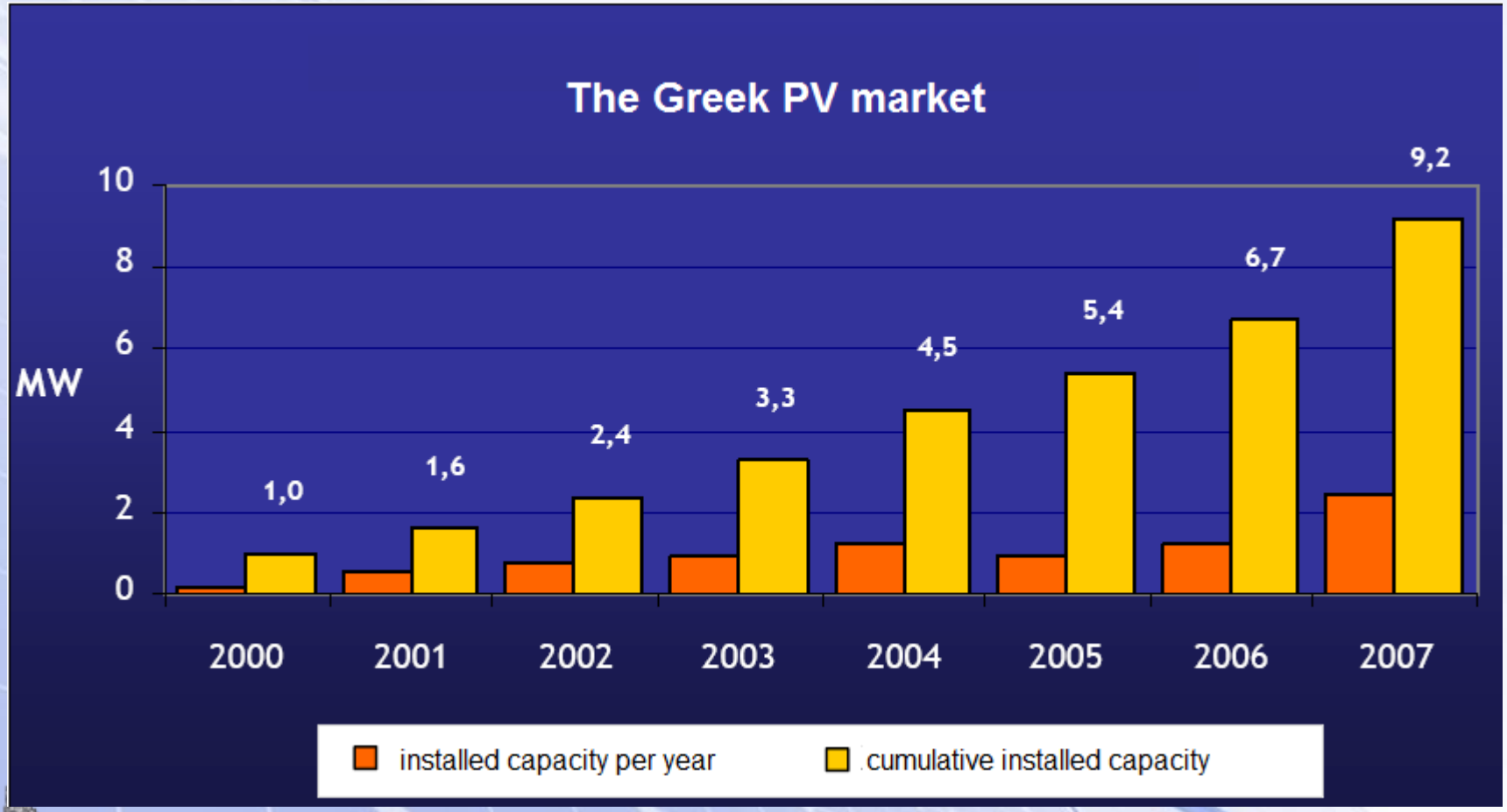

Source: Greek PV Association

The Greek market

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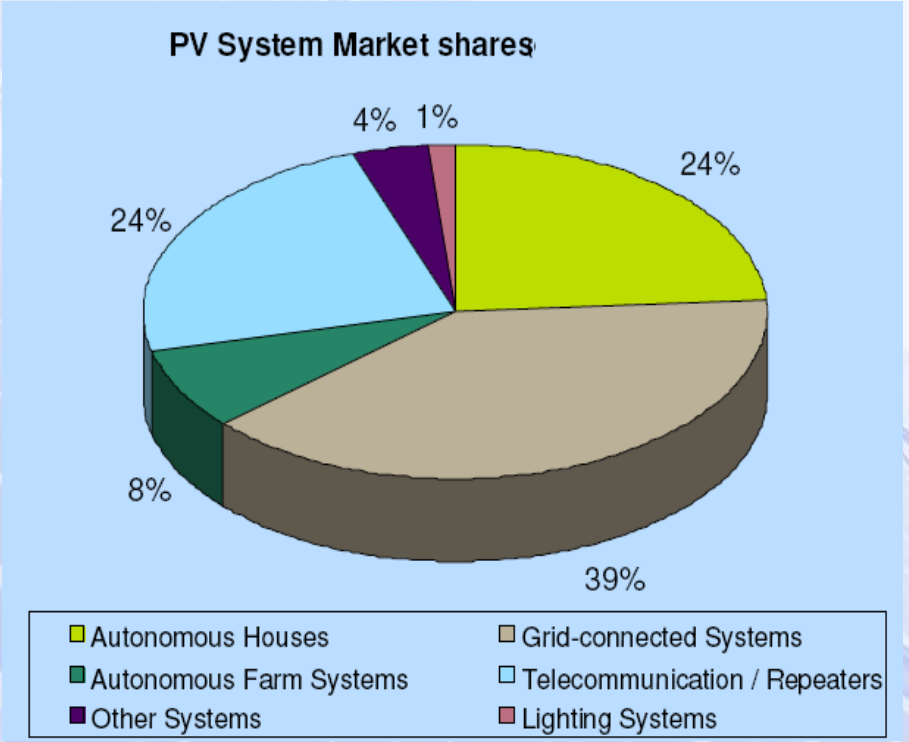

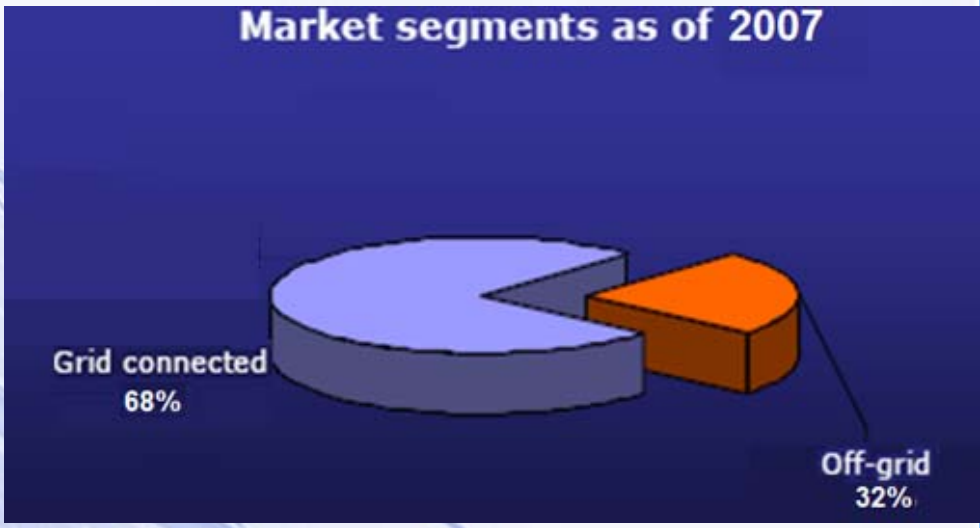

PV market until 2006 was marginal and mainly based on offgrid systems. 2007 was the first year that grid connected systems were dominant.

	Inter-connected	Off grid	Total
Installed PV in 2007	1,69 MW (68%)	0,785 MW (32%)	2,475 MW

Source: Greek PV Association

Legislation

The adoption of Law 3468/06 for RES in June 2006, was the beginning of a new era for PV in Greece. With this law, Greece got into the "club" of countries that provide more generous aid of a solar kWh. The result of this initiative was the unprecedented interest shown for investment in the field of photovoltaics.

Legislation

Price of solar kWh: 0,40-0,50 €, depending on power and site. Greater in islands and lesser in mainland.

Guaranteed sale of electricity produced to Public Power Corporation (P.P.C.-Δ.E.H.), for 20 years, adjusting the price of kWh in line with inflation or increases of P.P.C.- tariffs.

Great investment interest

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Until the end of January 2008 more than 7800 applications for PV installations had been submitted for approval, (total power 3430 MW).
When according to the Ministry of Development plan, by 2010 should have licensed projects total power 790 MW.

The authorities didn't expect such a huge interest and thought they could control and dictate the market trends. They were taken by surprise by the huge number of potential projects and consequently they are now trying to find out ways to make things work better.

The Greek market

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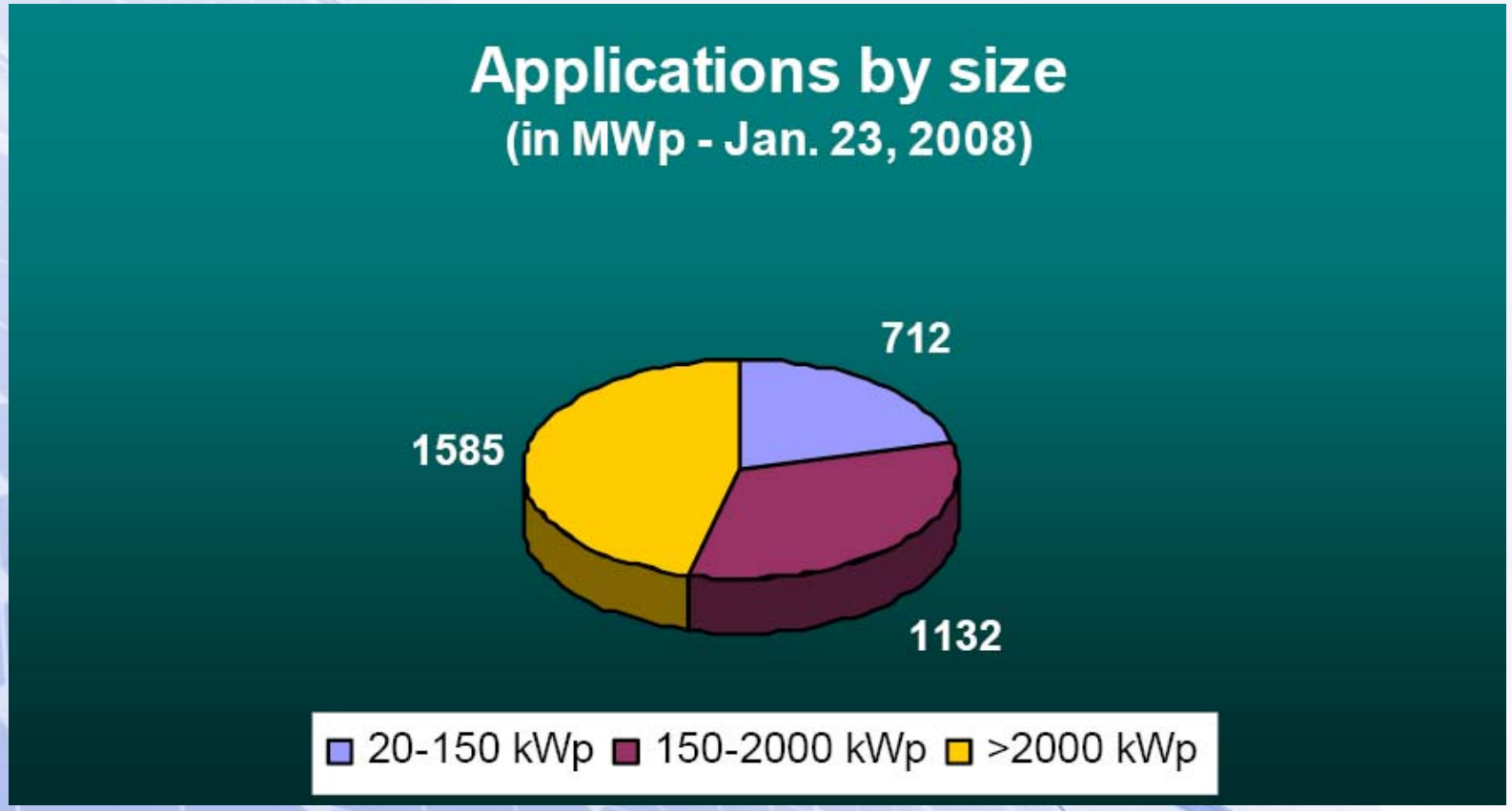

Source: Greek PV Association

The Greek market

Most regions are already overbooked till 2010. A few more applications will be accepted for some islands.

- Investors who want to enter the Greek market can do so only when the politicians clarify the second phase of PV development (2010-2020).

Such decisions are expected during 2008.

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Main barriers

- Restrictions on land use (prime agricultural land is excluded but…unclear definition of 'prime agricultural land')

- Permitting procedures are time consuming

-Unclear regulations for building integration

This point is expected to be overcome by

A separate program for rooftop PV that will be introduced during 2009. Rooftop systems will receive a higher tariff for 20 years.

PV market prospects

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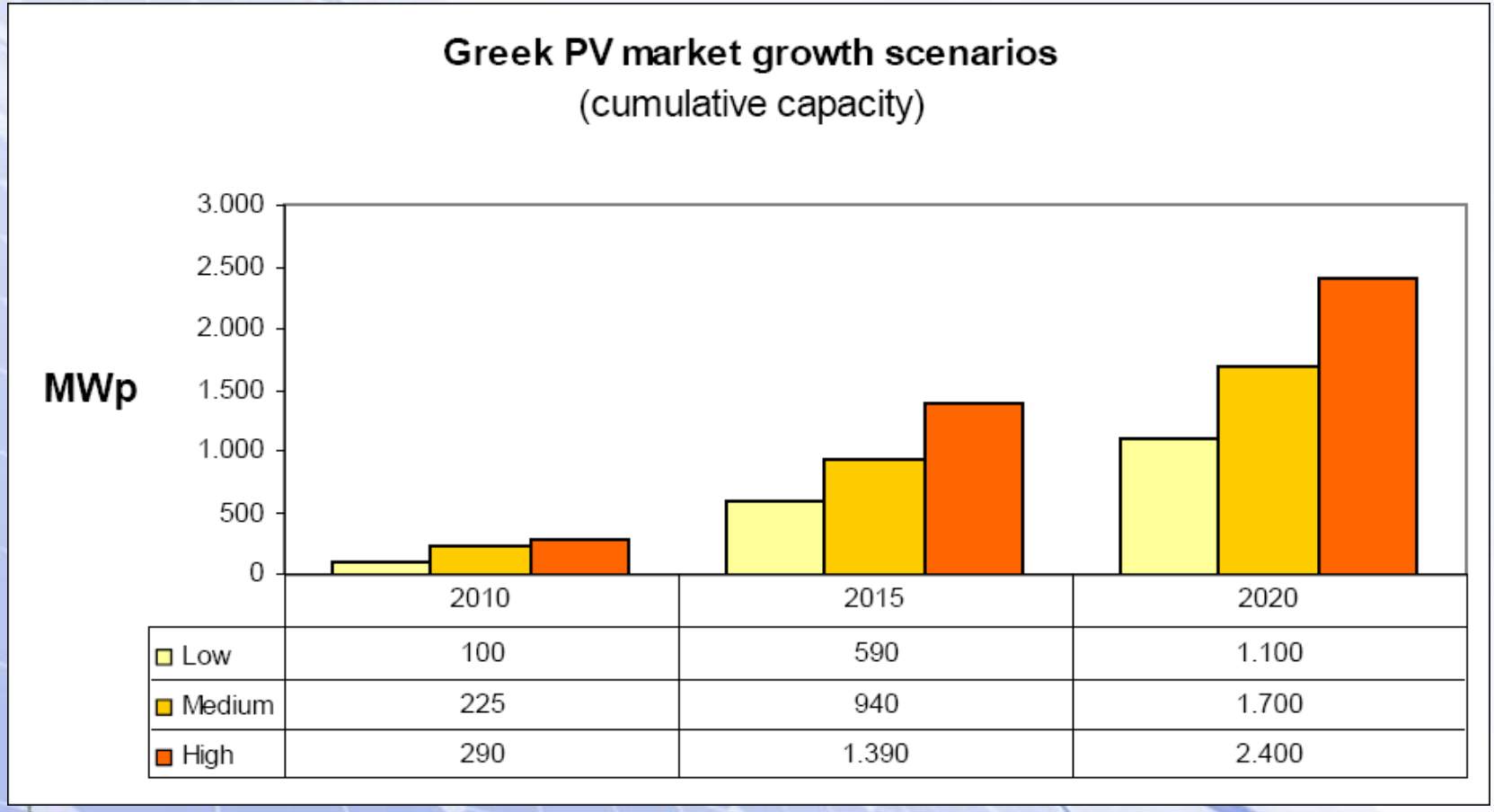

	2010	2015	2020
Low	100	590	1.100
Medium	225	940	1.700
High	290	1.390	2.400

Source: Greek PV Association

EPBD

Implementation of "Energy Performance in Buildings" Directive

Finally with a delay Greece has adopted EPBD with the new Law 3661/2008 (18 May 2008).

Still waiting for further regulations during 2008 or first semester of 2009.

It is expected that this law will give an extra push to BIPV technologies.

PV manufacturing plants

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- Wafer & Cells industry is built in Patra (30+30 MW/a) is already in operation (mid-2008)
- PV assembly unit (10 MW/a) operating in Bulgaria by a Greek company.

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Examples of PV applications in Crete & Greece

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PV applications

Several PV applications are nowadays in more use than in the past

- Water pumping in rural areas
- Lighting&signals
- Mobiles
- Garden lighting
- Gadgets
- Mobile appliances

PV applications

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Sunergy A.E. / **Phoenix Solar AG**
Kilkis, N. Greece, 944 KW

Soon
2nd Larger in Europe
Megalopoli (50 MW)

Public Power Corporation

Many small scale applications in Crete

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Viannos - Herakleio
1350 W

Rousospiti - Herakleio 380 W

Kokkini Chani - Herakleio 330 W

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PV applications in Crete

Lighthouse in Gavdos island

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ROKAS-Sitia

Xirolimni - 171,6kW

PV applications in Crete

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SUNLIGHT - Heraklion

Area Mesochori Asterousion – 168 kW

PV applications in Crete

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Lefkosidirourgia Kritis

Industrial Area of Heraklion - 130kW

PV applications in Crete

Meat craft

Karteros Kritis, 140 kW

BIPV applications, only in Athens…

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Experimental office building

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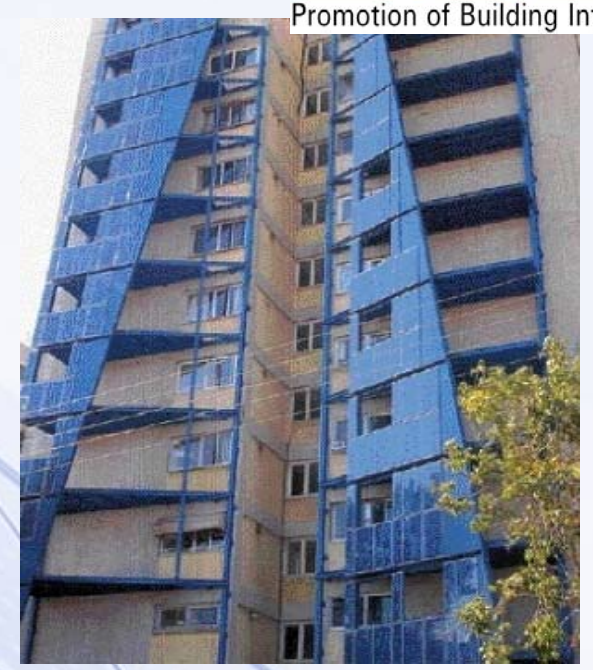

Several blocks of flats

Building of Chemical Engineers department

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Our lab has made several proposals to the authorities to install BIPV systems to public buildings so that people can be familiar with the technology

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Integration of PV systems in the Old Market of Chania

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Old market of Chania

Old market of Chania

Old market of Chania

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Some of the assumptions made

- PV integration in the roof
- Grid-connected
- No batteries
- ≈ 50 kWp
- Optimum decline 28°
- PV Poly-Si, 12 V, 85 Wp
- Inverters 2,5 kWp
- LCD Display and control system

Old market of Chania

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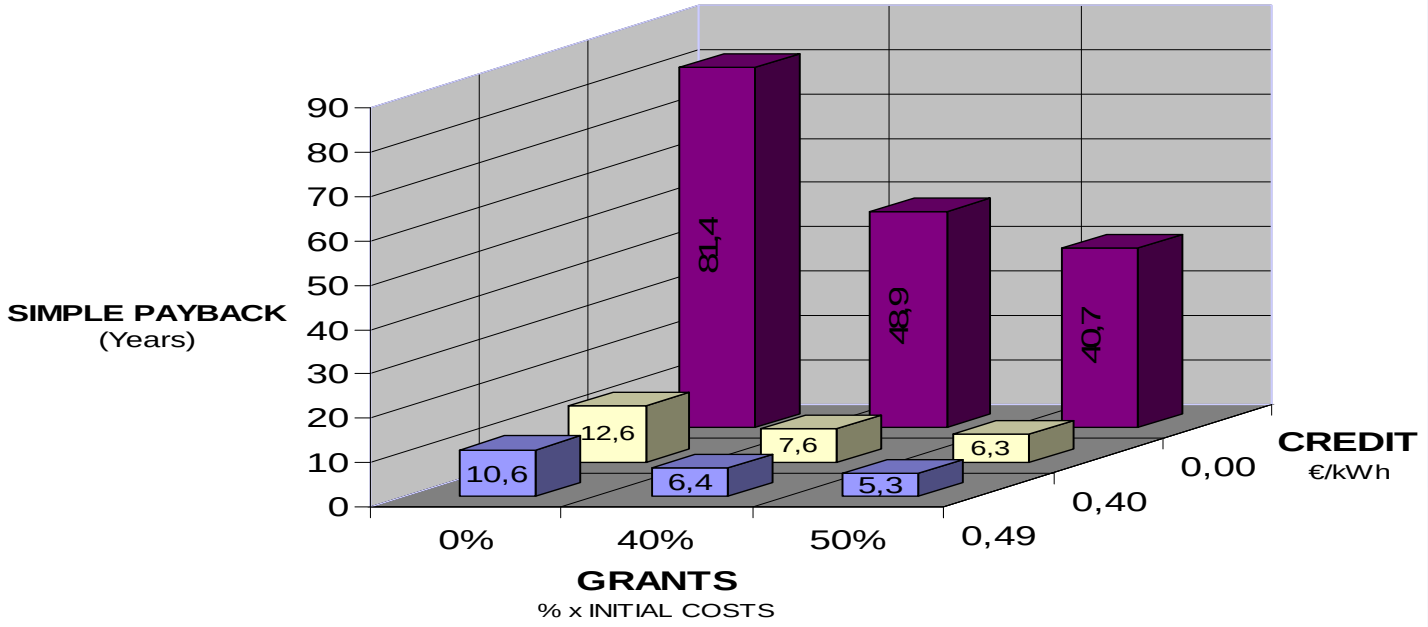
System Characteristics		Estimate
Application type	-	On-grid
Grid type	-	Central-grid
PV energy absorption rate	%	100,0 %
PV Array		
PV module type	-	poly-Si (semi-transparent)
PV module manufacturer / model #		Tenesol
Nominal PV module efficiency	%	12,8 %
NOCT	°C	45
PV temperature coefficient	% / °C	0,40 %
Miscellaneous PV array losses	%	10,0 %
Nominal PV array power	kWp	47,60
PV array area	m²	371,9
Power Conditioning		
Average inverter efficiency	%	90 %
Suggested inverter (DC to AC) capacity	kW (AC)	42,8
Inverter capacity	kW (AC)	50,0
Miscellaneous power conditioning losses	%	0 %

Old market of Chania



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Integration of PV systems in the Building of the Environmental Engineering Department, TUC

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Building of the Environmental Engineering Department, TUC

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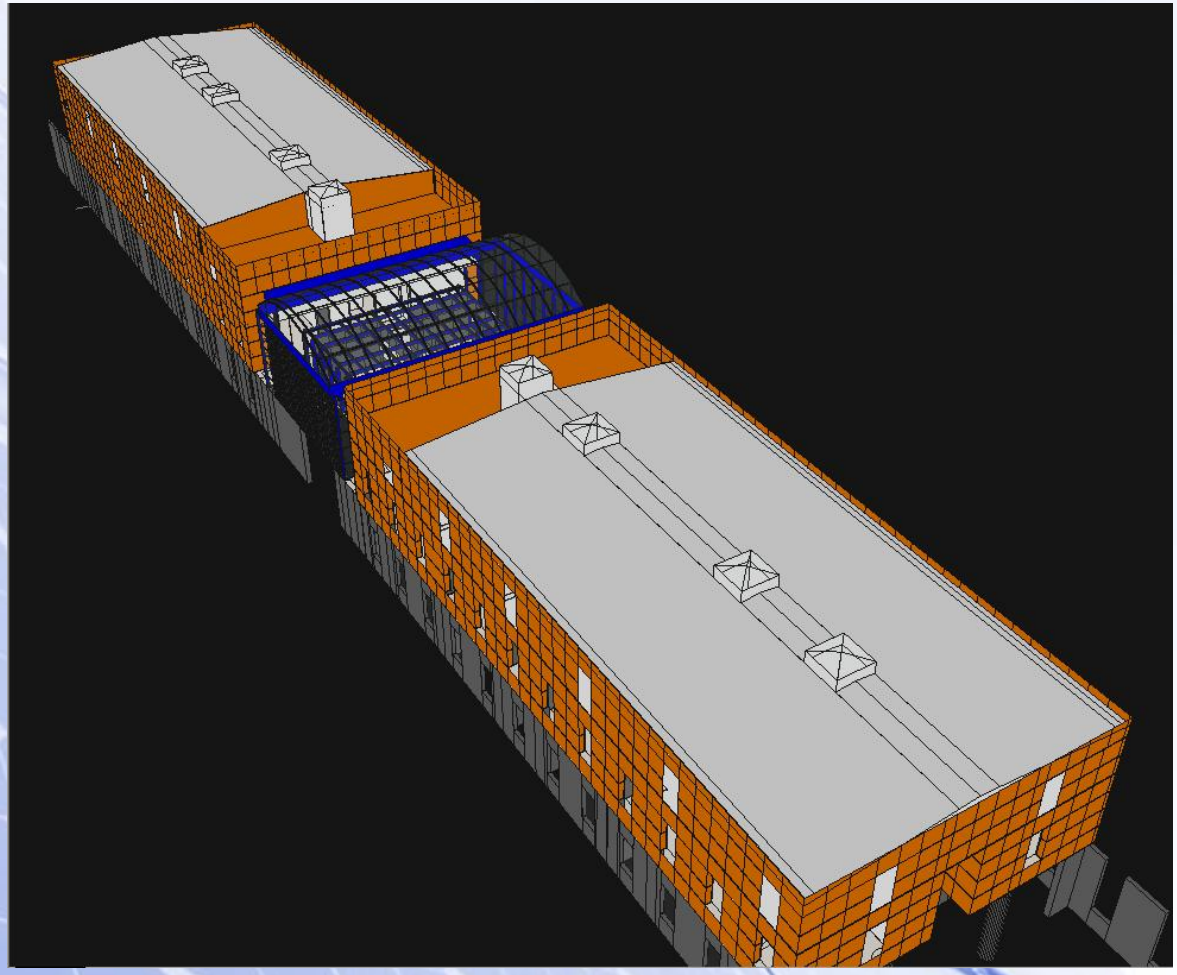
The building has a large sun lounge, and the purpose was to check the effect of its orientation in the energy production from BIPV.



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Building of the Environmental Engineering Department, TUC

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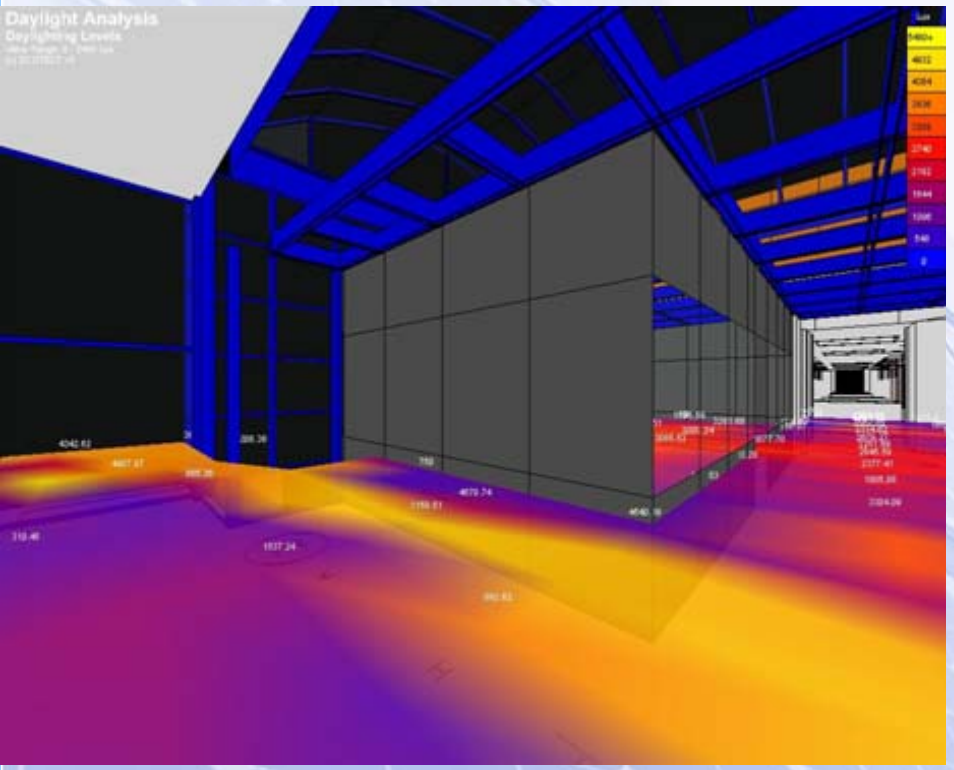

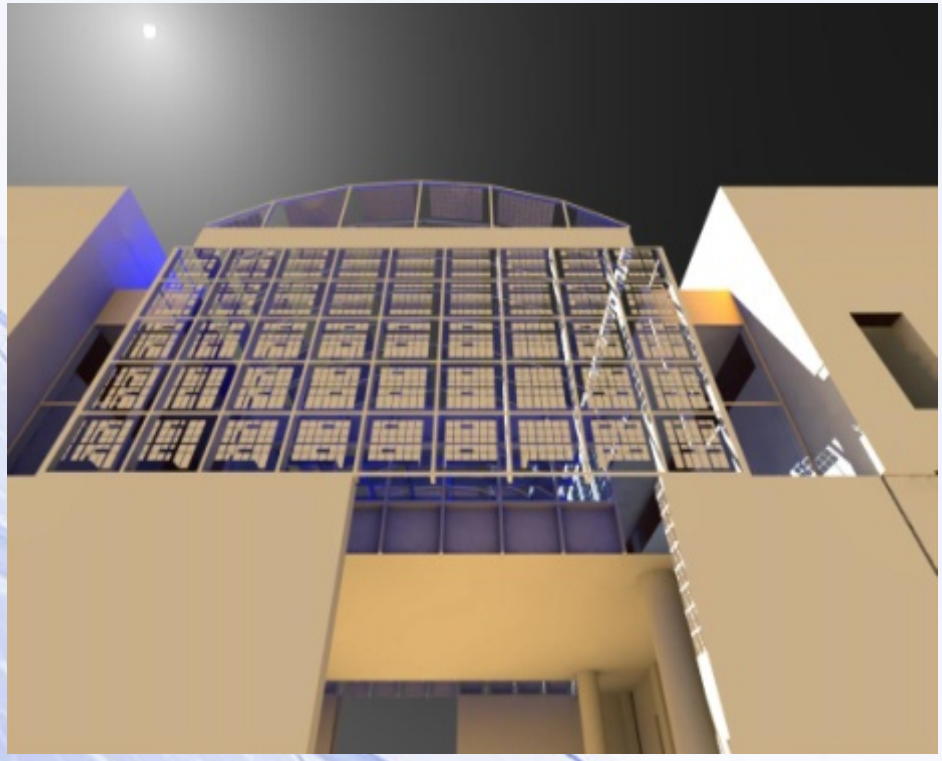

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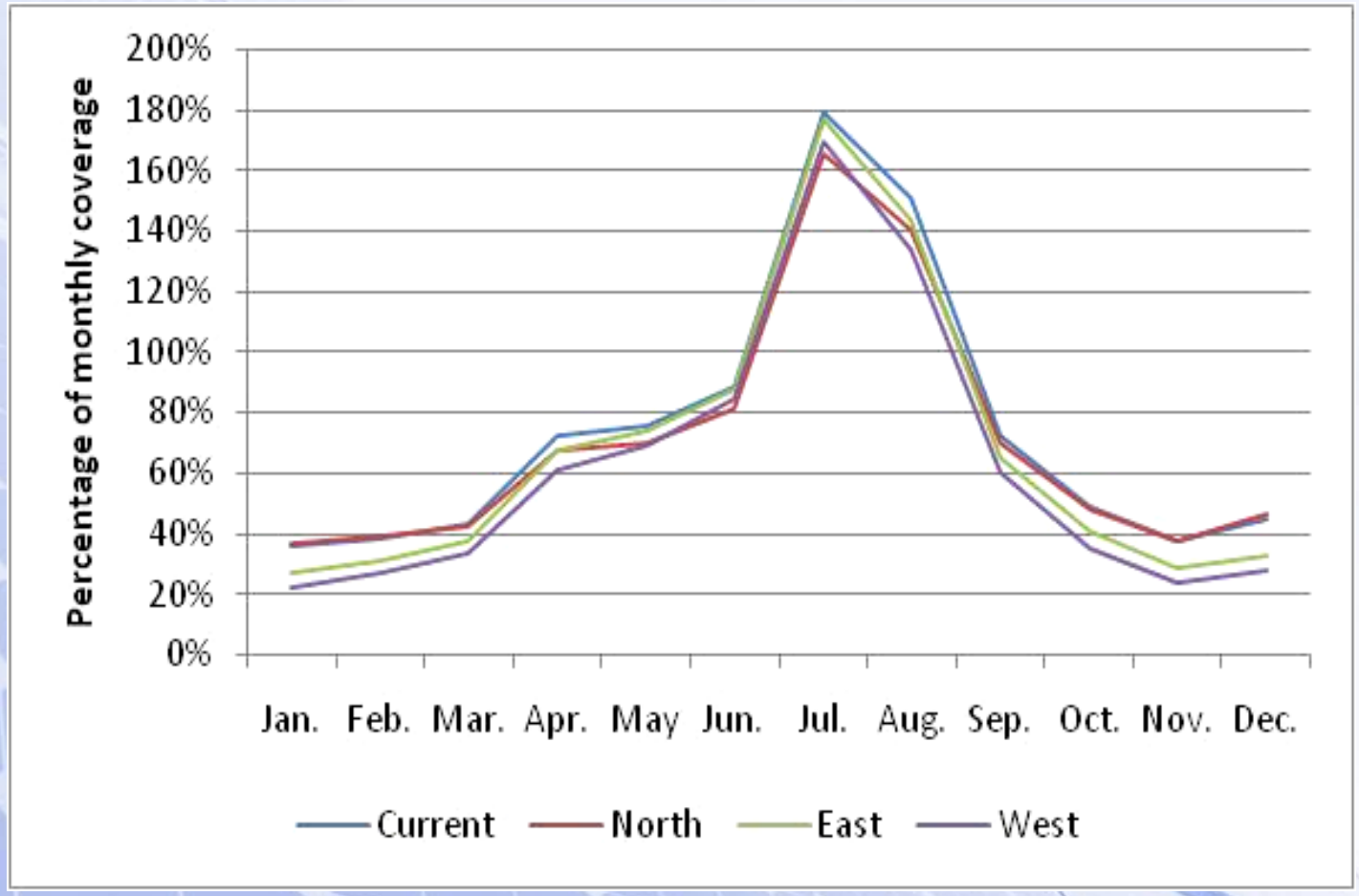

Percentage of monthly coverage depending on the orientation of the building

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Building of the Environmental Engineering Department, TUC

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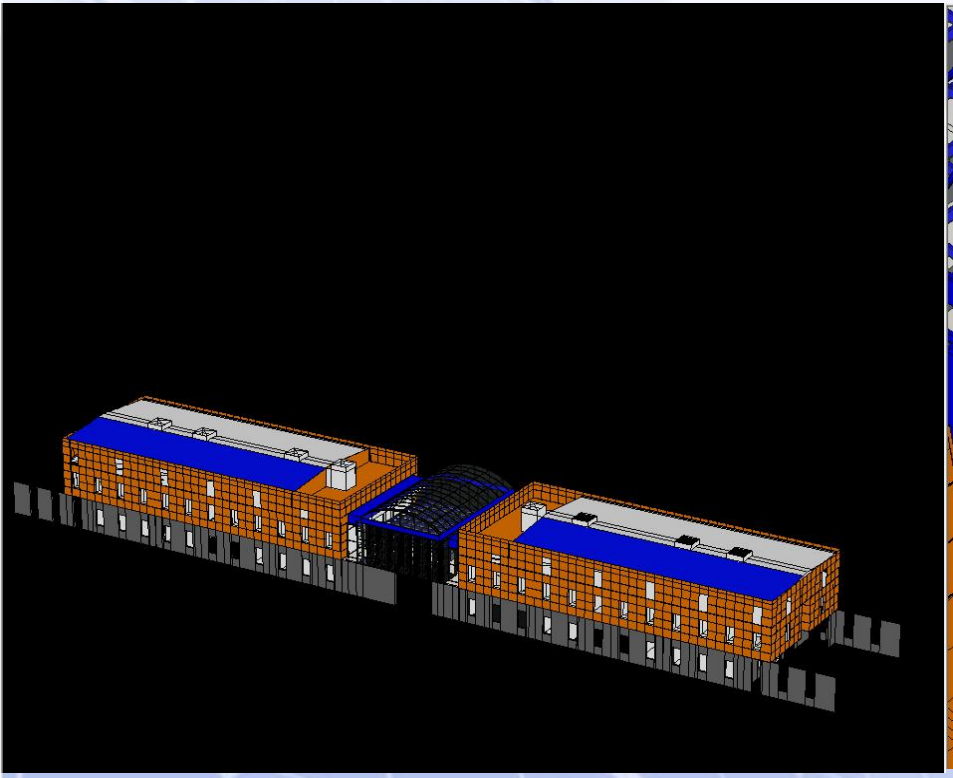

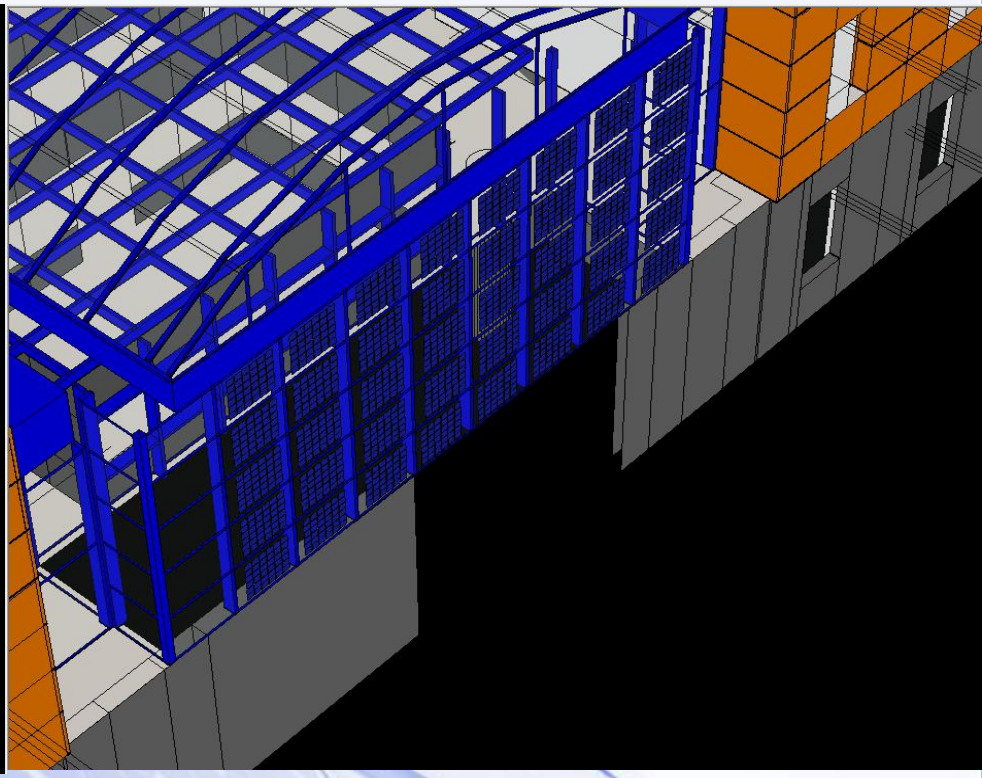

PV can be integrated in a building without any aesthetical problems, but, in contrary, the result improves the appearance of the existing building

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Greek PV-DRN

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Greek PV-DRN

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Located in the campus of TUC close to the city of Chania

Greek PV-DRN

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Exhibition Samples

Stands with different kind of PV samples

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Greek PV-DRN

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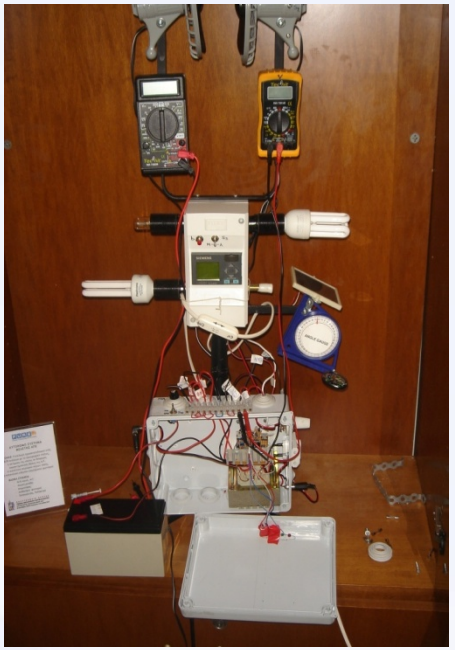

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Greek PV-DRN

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Training / Meeting Room

Multimedia Room

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Thank you for your attention!

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Environmental Engineering Dept
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