National Technical University of Athens

Research Team:

Raw Materials Exploitation & Sustainable Energy Solutions

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NTUA is the oldest and most prestigious technical university in Greece. Today NTUA has more than 7000 students, employs 700 persons as academic staff and more than 2500 researchers.

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Athens
Zografos Campus

Lavrion
Technological Park

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NTUA is ranked **3rd on "Energy" FP7 Thematic priority**

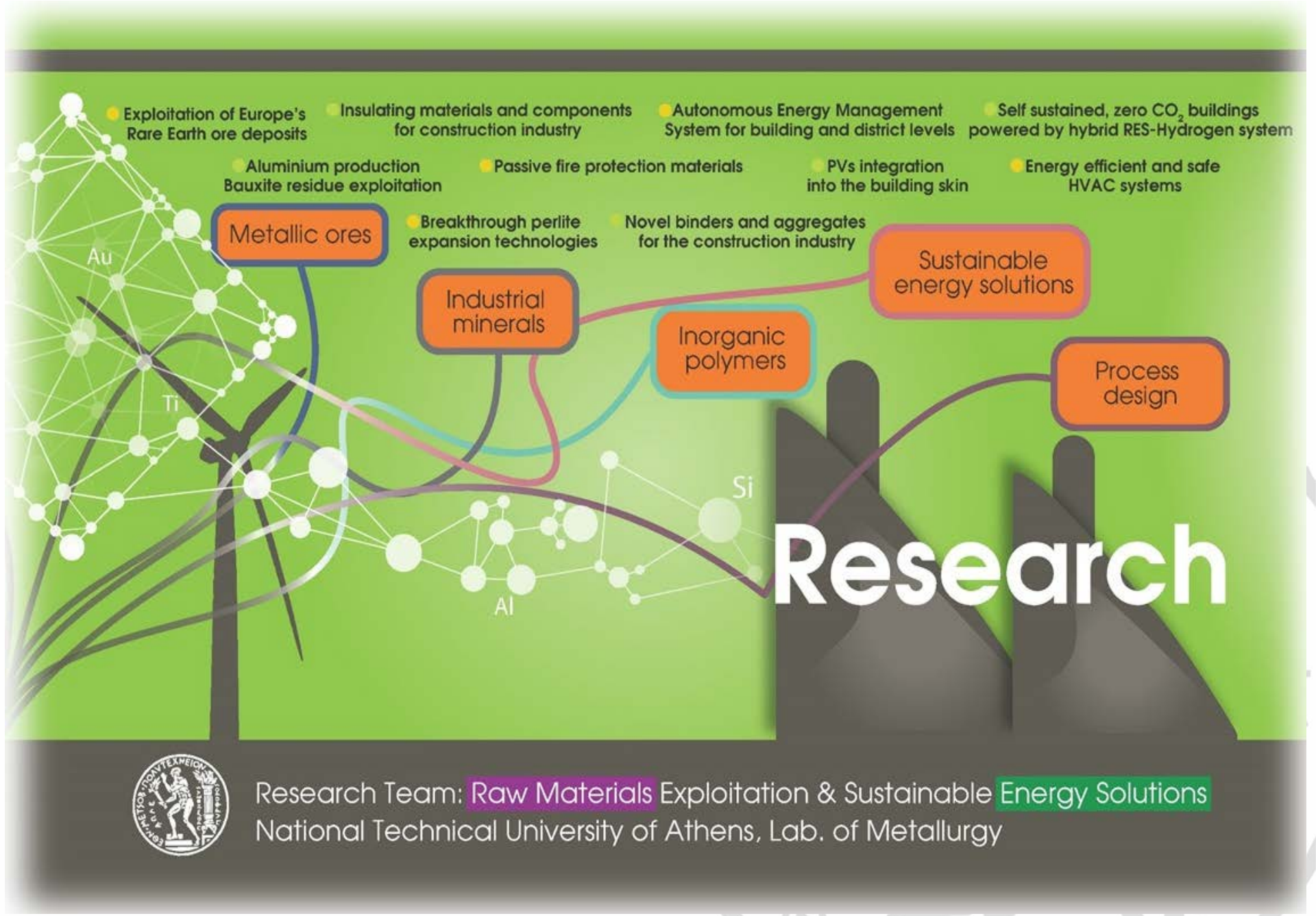
- ✓ Has a notable performance with strong overall scores but particularly for **Specialisation Index [SI]** (an indicator of research intensity in a given research area)
- ✓ Has one of the **highest ARIF scores (1.69)** a field-normalised measure of the scientific impact of publications produced based on the impact factors of the journals in which they were published and is clearly specialised in energy

Table XXXV Scientific performance as measured in Scopus for the selected 25 ERA universities in Energy (2007–2011)

University	CC	Pubs (FULL)	Pubs (FRAC)	Con by Univ Hosp (%)	SI	ARC	ARIF	Top 10 (%)
World		237,368	237,368	n.c.	1.00	1.00	1.00	10.0
Total ERA		58,969	51,788	n.c.	0.68	1.40	1.33	14.6
Univ of London, Imperial Coll London	GB	889	579	0	1.19	1.68	1.45	17.0
DTU-Technical University of Denmark	DK	783	540	0	2.96	2.82	1.69	30.4
TUDelft - Delft University of Technology	NL	702	461	0	1.85	0.75	1.19	7.9
Royal Institute of Technology	SE	692	426	0	2.38	1.42	1.44	16.4
University of Manchester	GB	643	409	0	0.98	1.68	1.44	14.0
NTNU - Norwegian Univ of Sci and Tech	NO	564	345	0	1.95	1.45	1.28	13.5
École polytechnique fédérale de Lausanne	CH	551	292	0	1.36	1.83	1.47	19.0
Chalmers University of Technology	SE	512	328	0	3.01	2.39	1.62	23.8
Polytechnic University of Milan	IT	509	359	0	2.19	1.15	1.16	11.9
Politehnica University of Bucharest	RO	493	368	0	3.54	0.42	0.46	2.1
Katholieke Universiteit Leuven	BE	471	193	0	0.50	1.37	1.18	11.1
NTUA - Natl Tech University of Athens	GR	462	343	0	3.01	1.85	1.69	16.1
ETHZ-Swiss Federal Inst of Tech Zurich	CH	439	245	0	0.73	2.05	1.55	27.1
University of Cambridge	GB	410	267	0	0.52	2.28	1.78	25.8
Polytechnic University of Turin	IT	408	278	0	2.20	1.21	1.28	10.5
Technical University of Lisbon	PT	404	215	0	1.41	1.90	1.44	25.1
Pierre and Marie Curie University	FR	388	179	0	0.46	1.55	1.67	17.1
Polytechnic University of Valencia	ES	368	269	0	1.78	1.27	1.50	10.3
Aristotle University of Thessaloniki	GR	332	228	0	1.16	1.71	1.51	21.5
RWTH Aachen University	DE	329	190	0	0.79	1.19	1.42	11.9
UNIROMA1 - Sapienza University of Rome	IT	319	191	0	0.63	2.02	1.66	28.6
University of Leeds	GB	287	195	0	0.78	1.91	1.55	19.7
Uppsala University	SE	283	171	0	0.77	1.77	1.71	20.9
Aalto University	FI	282	178	0	1.26	1.77	1.56	18.7
Joseph Fourier University	FR	281	159	0	1.02	2.30	1.66	26.4

Note: *Ibid.*
Source: Computed by Science-Metrix using Scopus

Data extracted from "Scientific Output and Collaboration of European Universities"
European Commission, 2013


Exploitation of Europe's Rare Earth ore deposits
Insulating materials and components for construction industry
Autonomous Energy Management System for building and district levels
Self sustained, zero CO_2 buildings powered by hybrid RES-Hydrogen system
Aluminium production Bauxite residue exploitation
Passive fire protection materials
PVs integration into the building skin
Energy efficient and safe HVAC systems
Metallic ores
Breakthrough perlite expansion technologies
Novel binders and aggregates for the construction industry
Sustainable energy solutions
Industrial minerals
Inorganic polymers
Process design
Au
Ti
Si
Al
Research
Research Team: Raw Materials Exploitation & Sustainable Energy Solutions
National Technical University of Athens, Lab. of Metallurgy

National Technical University of Athens

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Based on the same statistical data, Laboratory of Metallurgy (NTUA.LM) is ranking in the 1st position between NTUA Laboratories.

Energy efficiency and management systems

Energy efficiency in buildings through innovative construction materials

Life cycle assessment

Development of energy efficient processes, Energy efficiency in the built environment, Processing technologies for ores and industrial minerals, Modelling and computer simulation of industrial production processes, Life Cycle analysis and environmental assessment

Demonstration sites operated from the team

Athens Campus

Lavrion Technological Park

Demonstration site (Technological Park)

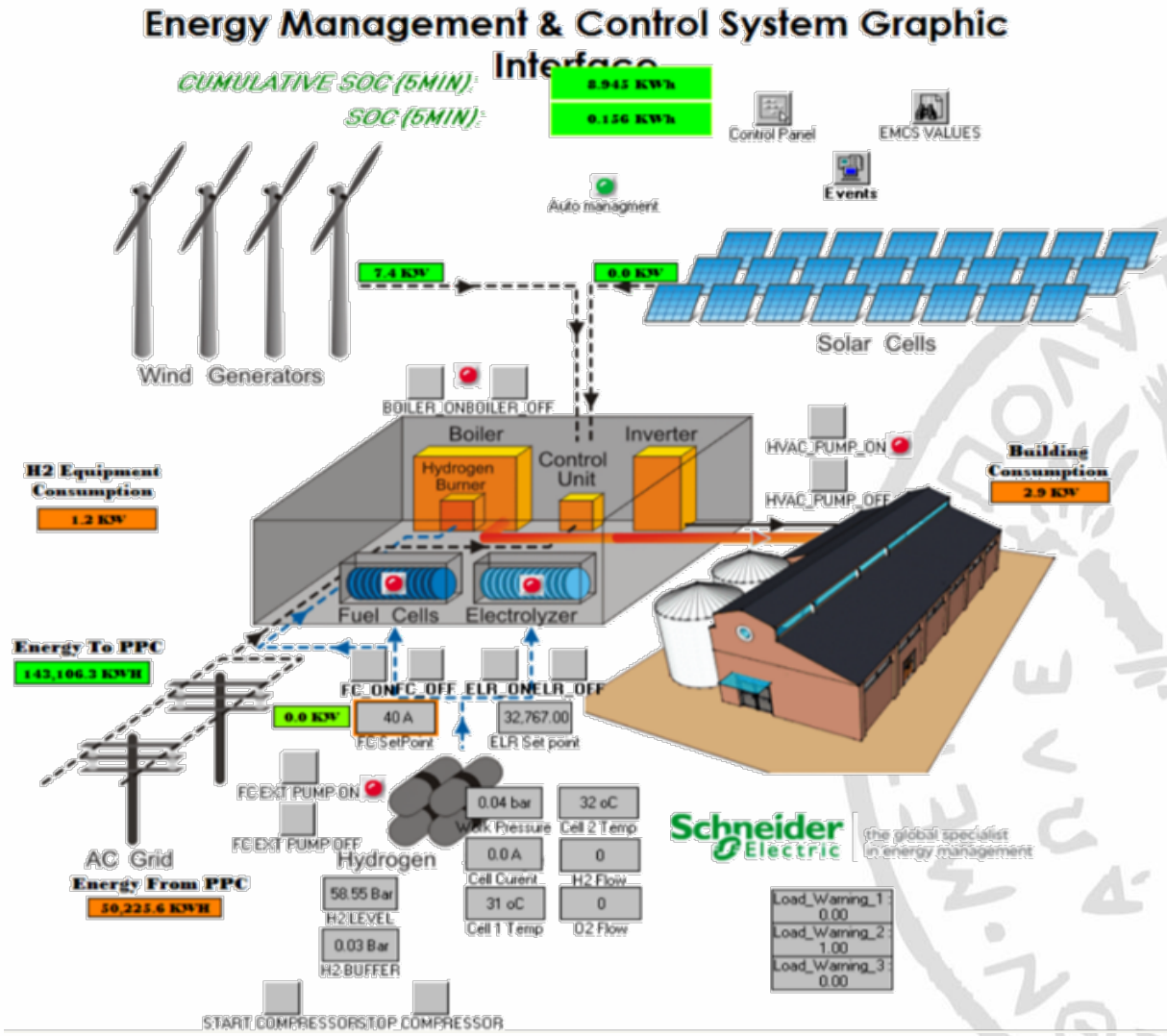
A total of **34 smart power** metering devices deployed at five buildings (smart grid)

- Two buildings operated through BMS
  - Advanced sensors and actuators network (occupancy, CO_2, lighting, temperature, humidity etc.)
  - HVAC controllers, water and air temperature measurements at distribution network
- Intelligent monitoring of energy flow at building and district level (3years collected data)
- Dedicated **Wireless Local Area Network (WLAN)** for data exchange
- Integrated RES technologies
  - Two solar parks [(47+15) kWp]
  - Wind generator 6x6kW
  - Battery bank (1364Ah) supervised by cutting-edge PLC technology
- Meteorological conditions (outdoor air temperature, solar radiation, humidity, barometric pressure, wind speed)

Demonstration site (Technological Park)

Energy self sustained building with zero CO_2 emissions

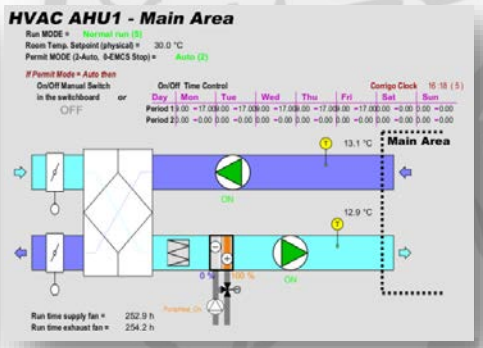
Demonstration site (Technological Park)



Real time GUI for energy flow monitoring, equipment control and operational status

Demonstration site (Technological Park)

- ✓ Powered by a RES Park and a CHP Fuel Cell (40kW)
- ✓ Equipped with an advanced Building Management System, sophisticated HVAC, on-line continuous monitoring system (for all the energy and environmental performance parameters)
- ✓ Stores energy in compressed Hydrogen
- ✓ Intelligent operation based on customers requirements (algorithms developed from NTUA)



Intelligent BMS
and monitoring system
adapting system requirements

Prototype H_2 burner with a condensing boiler (60 kWth)

Energy storage capacity*: 1MWh

*Equivalent Electrical Energy ready to be delivered to the building through the Fuel Cell (Hydrogen storage at 200bar)

Intelligent Safety and Protection System

User friendly and fully automated Energy Management and Monitoring System

40 kW CHP for residential applications (PEM Fuel Cell)

Enhancing cooperation and future perspectives

- ✓ The developed RES-H_2 hybrid energy system can be used as a full-scale research, development and testing facility of:
  - H_2 production, storage and consumption technologies
  - Energy management systems
- ✓ Existing demonstration site presents a great opportunity to attract interested parties for direct knowledge exchange, consultancy and joint initiatives
- ✓ Contribute to standardization activities at system level for residential buildings or districts of buildings

Public awareness

- ✓ TV documentaries broadcasted to more than 130 countries in 10 languages (Euronews, RAI, TV5 and others)
- ✓ More than 25 articles published in Newspapers and Social Magazines
- ✓ Educational visits for students (more than 2000 students already hosted on site)
- ✓ Wide interest from Scientific, Governmental and investors representatives

Demonstration Site at GREECE

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Autonomous Management System

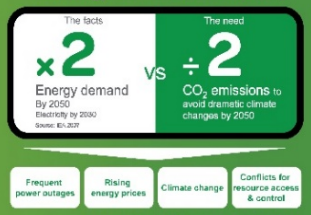
Developed for Building and District Levels

Ambassador

To solve the energy dilemma, research effort was concentrated on stand-alone buildings weakly tight to their immediate environment. Specifically in each building only key sub-systems were considered individually. Such individual systems were made more effective by becoming pervasive into any building area (the reign of "boxes" and "controllers"). Importing parameters from other sub-systems allowed better regulations (Access or Occupancy management systems). Energy Usage Analysis tools are fairly new on the market. They provide the capability to analyse energy rofiles of scattered buildings of large corporations. Energy usage analysis and planning on a district level is inexistent. Neither is Energy Usage Modelling leveraged in control schemes.

This leaves an unexplored area for more effective building control schemes and suggests a potential of each smart building to contribute to District level energy optimization schemes, thanks to appropriate behavioural and stochastic models. In parallel, efforts made many more renewable and cogeneration energy sources available as high capacity energy storage systems. Such systems now increasingly enter into the planning of large districts, but still timidly penetrate individual buildings. Thus, energy flows (electrical or thermal) can be managed through energy usage schemes, planned in time for significant savings.

The energy dilemma is here to stay



Source: IPCC 2007, figure (vs. 1990 level)

The project AMBASSADOR receives funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 314175.

SEVENTH FRAMEWORK PROGRAMME

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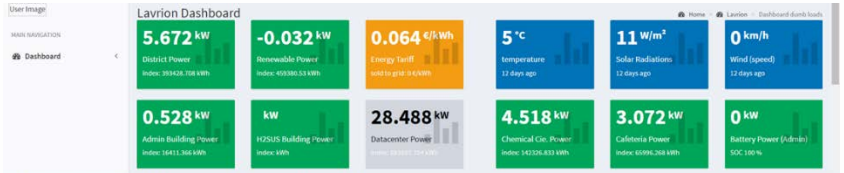
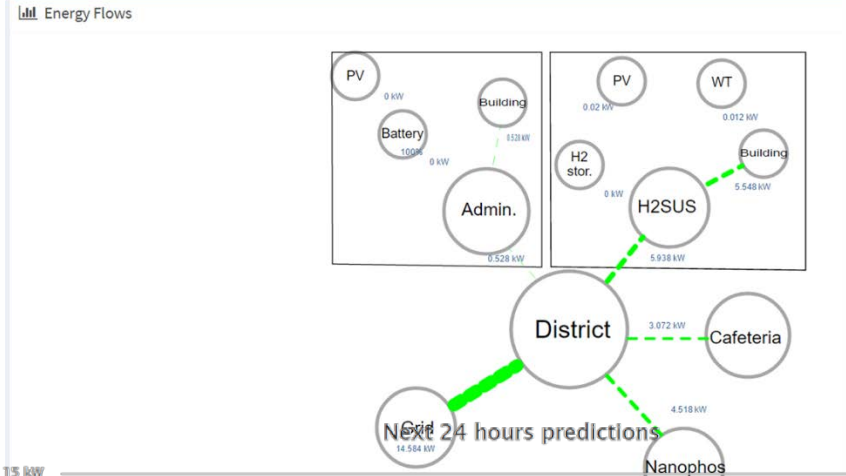
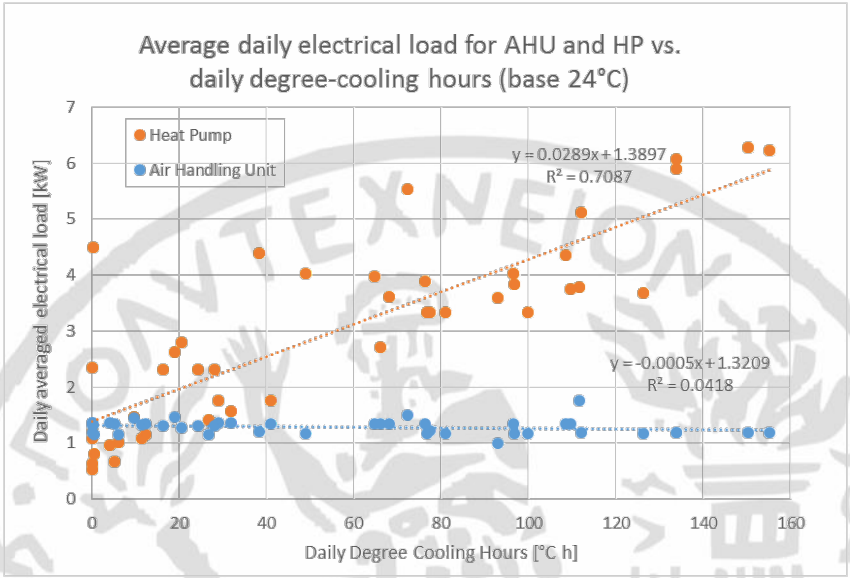


Lavrion Energy Flows monitoring Dashboard





District monitoring & forecasting

Project Overview

Construct-PV is developing new *customizable*, *efficient*, and *low cost* Building Integrated PV elements for *opaque surfaces of buildings*. This new technologies is also demonstrated in real scale projects. Opaque surfaces are selected because they represent massive wide-area spaces of untapped harvesting potential across Europe.

Different multifunctional technologies have been developed with the specific goal of enhancing the global energy efficiency of the building. The different products have been tested according EN standards in order to give the proper information enhancing the reliability of the system, to architects, designer and final users.

Attractive to the market

To be attractive to the market, Construct-PV systems are *multifunctional*. By further developing and integrating the most promising technologies, the project will cover the last kilometre to market while keeping a pre-competitive nature. Construct-PV defines an integrated approach that streamlines the value chain by introducing *BIM* and CAD/CAM tools that enables customizable mass production by providing all the actors in the value chain with access to the same information.

Thus, Construct-PV will be friendly for the majority of SMEs in the building value chain. Demonstration activities will cover each aspect of the value chain.

The project involves 12 European partners covering the whole value chain of construction.

The project partners during the meeting in Lugano. Two small roof demonstration test stands have been developed

The Consortium

Coordinator

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Partners

SMA

D'APPOLONIA
consulting, design, operation & maintenance engineering

ADVANCED MANAGEMENT SOLUTIONS

TEGOLA CANADESE
innovation in building

UNS
UNITED NETWORK STUDIO

MEYER BURGER

Fraunhofer ISE

ENEA
Italian National Agency for New Technologies, Energy and Sustainable Economic Development

TECHNISCHE UNIVERSITÄT DRESDEN

ZÜBLIN

Scuola universitaria professionale della Svizzera italiana
SUPSI

National Technical University of Athens
School of Mining & Metallurgical Engineering
Laboratory of Metallurgy

IWIS

CONSTRUCT PV

Collaborative Project
Call identifier: ENERGY.2011.2.1 – 4
Grant agreement n° 295981

CONSTRUCTING BUILDING WITH A CUSTOMIZABLE SIZE PV MODULES INTEGRATED IN THE OPAQUE PART OF THE BUILDING SKIN

Web-site:
www.constructpv.eu

Project Duration: 5 years
Starting date: 2012
SEVENTH FRAMEWORK PROGRAM THEME
FP7-ENERGY-2011-2

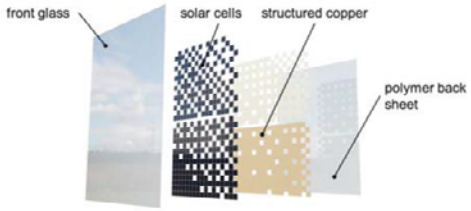
Funded by the European Union

Objectives

Construct-PV will develop and demonstrate customizable, efficient and low cost BIPV modules and systems for opaque surfaces of buildings. The consortium involves selected partners, leaders in the industry and research sector and more in particular in the fields of PV technology and building construction connecting all the actors in the value chain.

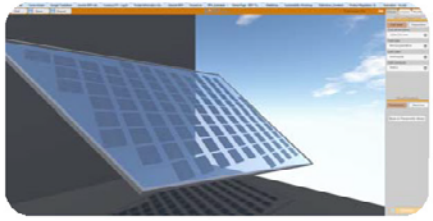
New PV Technology

A new module concept (Mosaic module) based on an electrical conductive back sheet and back-contact solar cells has been developed. The module concept is based on an electrical conductive back sheet and back-contact solar cells. The mosaic module concept breaks up the typical 6 by 6 inch pattern by using solar cells flexible in size in the range from 2 x 2 cm^2 up to 156 x 156 cm^2 full wafer size. This concept allows new design possibilities making the PV module attractive as façade element .



Web Based Tool for the design of BIPV module

A **BIPV design platform** has been created by developing different software tools with the goal to support the design of customizable BIPV modules within an integrated design process. The tool has been developed to be BIM ready thanks to a Autodesk Revit plug-in.



The large Demonstration Sites

The Athens roof

The building of School of Mining and Metallurgical Engineering is located in Zografou campus of the National Technical University of Athens (NTUA), near to the center of Athens. The building, constructed in 1992, consists of 5 levels mainly hosting offices, teaching rooms and laboratory facilities.

In the framework of the project a completely new roof installation has been built to demonstrate the new BIPV modules and system developed within the Construct PV project. The building is unshaded from the surrounding and has a proper orientation for PV applications. Within the project a number of solutions regarding the integration of PVs to the roof have been developed talking into consideration the different perspectives of the owner/operator, the user, the designer/architect as well as the construction.

The Stuttgart Facade

The Z3 Head Quarter of Züblin AG is an office building that was built in 2012. It has 5 storeys with 1 basement parking level. The building has offices for 200 to 250 employees. The design targeted a building envelope of passive house standard, aimed for a sustainability label level DGNB Gold Standard. Construct PV BIPV modules will replace the existing facade panels in order to help to reach the goal for Z3 to become a nearly net-zero-energy building.

Ed. Züblin AG is the owner, operator and user of Z3 as well as the construction company responsible for its construction. Thus Ed. Züblin AG will be in the unique position to test the newly developed modules from four different perspectives: owner/operator, user, designer/architect as well as construction company.

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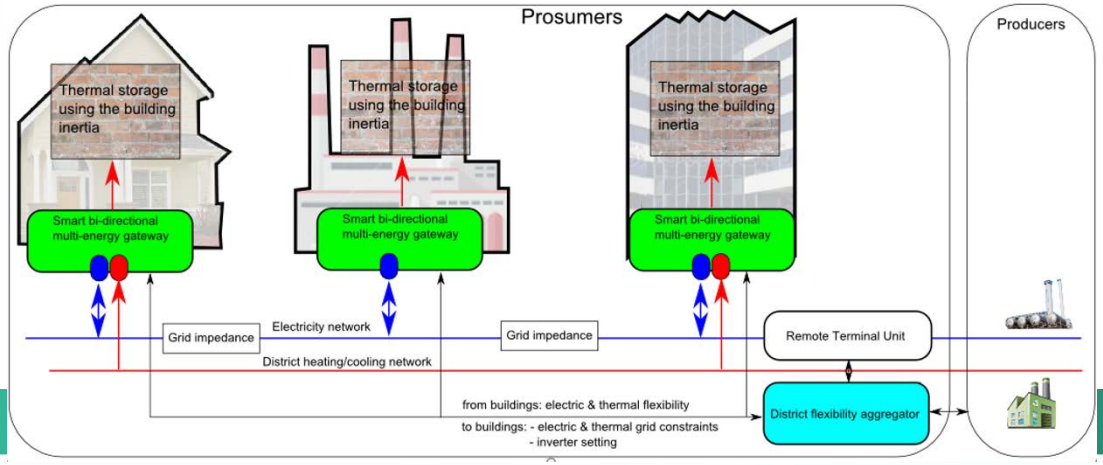

SABINA

SmArt BI-directional multi eNergy gAteway

SABINA - SmArt BI-directional multi eNergy gAteway

SABINA aims to develop new technology and financial models to connect, control and actively manage generation and storage assets to exploit synergies between electrical flexibility and the thermal inertia of buildings.

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Project Website:

http://www.nanohvac.eu/

Cost - effective, Safe Nanotechnology Insulating Duct Layers

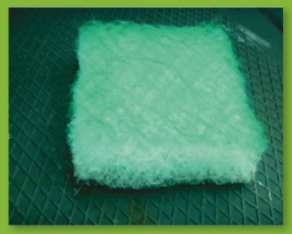
Research project funded under Collaborative Project Scheme

COOPERATION

Novel Nano-enabled Energy Efficient and Safe HVAC ducts and systems contributing to an healthier indoor environment

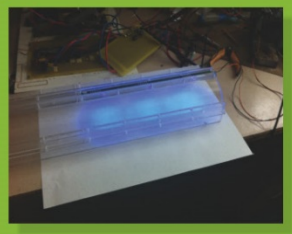
www.nanohvac.eu

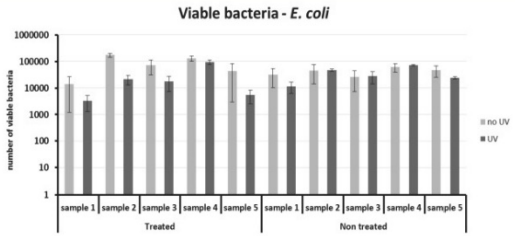
Indoor air quality



PROTOTYPE FILTERS WITH PHOTOCATALYTIC COATING:

Glass fiber filters coated with TiO_2 were used for inhibition and removal of pathogens and allergen via photocatalytic reaction. The photocatalytic coating has been applied by immersion of the filters into photocatalytic solution and curing at ambient conditions. Initial lab test have shown high antimicrobial activity and further evaluation will be done in the demo HVAC system.





ANTIBACTERIAL AND ANTIFUNGAL ACTIVITY:

Initial lab tests in TiO_2 coated filter specimens has been performed according to ISO 27447. The results have shown a significant antibacterial and antifungal activity after exposure of TiO_2 coated filters to UV irradiance. The lab test results will be further evaluated in the demo system.

PROTOTYPE UVA LIGHTING SOURCE FOR ACTIVATION OF PHOTOCATALYTIC REACTION:

A UVA lighting source provides irradiance on the TiO_2 coated filter. The innovative design of the UVA lighting source provides a robust, low-consumption and low-cost system that can be easily installed to any HVAC system without affecting the ducts airstream.

nano HVAC

NANO-HVAC project aims at developing an innovative approach for ducts insulation while introducing new cleaning and maintenance technologies, all enabled by cost-effective application of nanotechnology.

Full scale demonstration site:

A full scale demonstration site deployed in Spain. The energy performance as well as the inhibition and removal performance will be evaluated under real HVAC operating conditions.

INSULATED DUCTS AND BENDS:

During 2014 the first duct and bend insulated prototypes were made. After further formulation and process optimization the first series of prototype parts are constructed and are ready to be used in demo HVAC system for further evaluation. Their advanced insulation will enable minimization of cool/heat losses in HVAC systems in a cost-effective way.

Safe, high insulating HVAC-ducts