



# 24<sup>th</sup> Session of the Committee on Sustainable Energy (CSE)

United Nations, Geneva, 18 - 20 November 2015

Salle VII, Palais des Nations

## Group of Experts on Energy Efficiency (GEEE)

### Best practices for energy efficiency

### Successful national initiatives

Full Prof. **Ljubomir Mišćević**, Mag. Eng. Arch. Urb.

University of Zagreb, Faculty of Architecture

Fra A. Kačića Miošića 26

HR-10000 Zagreb, Croatia

Phone/fax: +385 1 4639394

[miscevic@arhitekt.hr](mailto:miscevic@arhitekt.hr) [pass-net@arhitekt.hr](mailto:pass-net@arhitekt.hr) [ides-edu@arhitekt.hr](mailto:ides-edu@arhitekt.hr)

[www.arhitekt.hr](http://www.arhitekt.hr) [www.sunarh.hr](http://www.sunarh.hr) [www.pass-net.net](http://www.pass-net.net) [www.ides-edu.eu](http://www.ides-edu.eu)



Sveučilište u Zagrebu  
**Arhitektonski fakultet**  
University of Zagreb  
**Faculty of Architecture**



KONZORCIJ PASIVNA  
KUĆA HRVATSKA





# SUSTAINABLE DEVELOPMENT GOALS



# The Geneva UN Charter on Sustainable Housing

**Ensure access to decent, adequate,  
affordable and healthy housing for all**



UNITED NATIONS



LJUBOMIR MIŠČEVIĆ

SUNČANA ARHITEKTURA

SOLAR ARCHITECTURE

<http://www.arhitekt.hr/izlozbe/miscevic>

Centar za kulturu Trešnjevka  
Galerija MODULOR  
20. veljače 25. ožujka 2001. godine



LJUBOMIR  
MIŠČEVIĆ

ARHITEKTURA  
NISKOENERGETSKE  
I PASIVNE KUĆE

LOW ENERGY  
AND PASSIVE HOUSE  
ARCHITECTURE

Centar za kulturu Trešnjevka  
Galerija MODULOR  
za arhitekturu i dizajn  
9. - 20. svibnja 2006.



ARHITEKTURA  
KAO ENERGANA

OD PASIVNE KUĆE DO PLUS-ENERGETSKE ARHITEKTURE

ARCHITECTURE AS  
A POWER PLANT

FROM PASSIVE HOUSE TO PLUS-ENERGY ARCHITECTURE

LJUBOMIR MIŠČEVIĆ

Centar za kulturu Trešnjevka  
Galerija MODULOR  
za arhitekturu i dizajn  
29. 10. - 9. 11. 2009.



ENERGETSKI  
GOTOVO NULTA  
ARHITEKTURA

NEARLY ZERO  
ARCHITECTURE

LJUBOMIR MIŠČEVIĆ

Centar za kulturu Trešnjevka  
Galerija MODULOR  
za arhitekturu i dizajn  
14. 3. - 29. 3. 2013.





## Energetski gotovo nulta zgrada

Od vrlo niskoenergetske i emisijske do energetski samodostatne i plus-energetske zgrade

Početak 21. stoljeća obilježavaju nove energetske klasifikacije u graditeljstvu prema kojima su već izvedene pojedine novogradnje, ali i obnove kuća i zgrada različitih namjena. Zajedničko je obilježje svih suvremenih prijedloga energetskih modela vrlo mala – gotovo nulta energetska potrošnja koja je danas tehnološki ostvariva i financijski sve priuštivija i isplativija, a rezultati takve gradnje bitno su jamstvo ostvarenja održivog razvoja.

Energetski gotovo nulta arhitektura, zbog fizikalno-građevinskih značajki ovojnice zgrade osiguravaju vrlo nisku energetska potrošnju za zagrijavanje prostora, a preostale energetske potrebe (za rasvjetu, razne kućanske uređaje, hlađenje i dr.) vrlo lako može pokriti iz obnovljivih izvora energije kojih je uporaba zahvaljujući tehnološkom razvoju sve učinkovitija.

Direktiva o energetskim svojstvima zgrada (Energy Performance in Buildings Directive – EPBD) postaje temeljna smjernica razvoja energetske učinkovitosti u graditeljstvu, a prema njoj se vrlo niskoenergetski modeli gradnje i nazivaju gotovo nulti. Sve svake će država članica Europske Unije zasebno odlučiti koja je energetska potrošnja granična za taj naziv.

Pridruživanjem Republike Hrvatske Uniji 1. srpnja 2013. scenarij energetske potrošnje EU 3 x 20 do 2020. postaje iznimno važan za energetska strategiju. Scenarijem su predviđena ostvarenja tri temeljna cilja: smanjenje energetske potrošnje za 20%, smanjenje emisija CO<sub>2</sub> i drugih stakleničkih plinova za 20% te uporaba obnovljivih izvora energije od 20% udjela u sveukupnoj energetskoj potrošnji.

Kako bi se scenarij ostvario u što većoj mjeri do 2020. EU je odredila da se sve zgrade javne namjene od 2018. moraju izvoditi upravo kao gotovo nulte! Štoviše, zgrade koje su predviđene za zahtjevniju obnovu također od 2018. moraju udovoljiti istim energetskim kriterijima. Od 2020. i sve ostale zgrade morat će se izvoditi kao gotovo nulte energetske.

Velika Britanija donijela je odluku po kojoj već od 2016. počinje izvođenje zgrada javne namjene bez emisija stakleničkih plinova.

Uz pojam *energetski gotovo nulte* zgrade, koji je prihvaćen u propisima Europske Unije, danas susrećemo i sljedeće nove modele energetski učinkovite gradnje i pri-mjerenje razine zaštite okoliša:

### From very low energy and emission buildings to energy self-sufficient and energy-plus buildings

The beginning of the 21<sup>st</sup> century has been marked with new energy classifications in building construction according to which some new buildings have been built, and houses and buildings used for various purposes have been renovated. The common feature in all contemporary energy model drafts is a very low – nearly zero energy consumption which is now technologically feasible, financially more affordable and cost effective, whilst the results in such construction are an important guarantee in achieving sustainable development. Because of the physical and constructional features of the building envelope which provide very low energy consumption for space heating, *nearly zero energy* architecture can easily cover other energy needs (for lighting, various household appliances, cooling etc.) from renewable energy resources, which can be used more efficiently due to technological development.

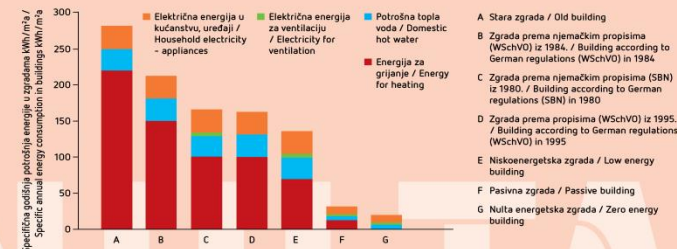
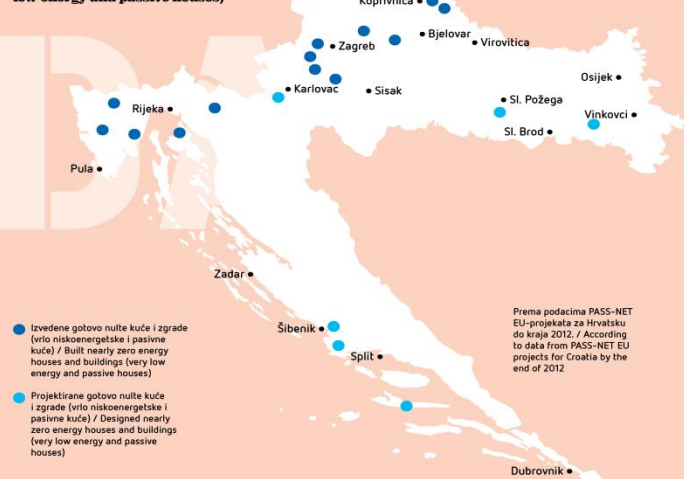
The Energy Performance in Buildings Directive – EPBD, has become a fundamental guideline for energy efficiency development in construction. Very low energy building models are now called nearly zero after the directive's instructions. Each of the EU member states will individually decide on which energy consumption is the borderline for that title.

After the accession of the Republic of Croatia into the European Union on July 1, 2013, the scenario that has been developed for the EU '3 x 20' energy consumption by 2020 will be extremely important for the country's energy strategy. The scenario is designed to achieve three fundamental objectives: a reduction of energy consumption by 20 %, reduction of CO<sub>2</sub> and other greenhouse gas emissions by 20 %, as well as the use of renewable energy resources from the 20 % share of total energy consumption. In order to achieve this goal by 2020 to the full extent, the EU has decided that as of 2018, all public buildings will have to be built as nearly zero energy buildings! Furthermore, the buildings which have been opted for the more demanding renovations will also have to comply in accordance to the same energy criteria by the year 2018. In addition, from 2020 and on, all other buildings will also have to be run as nearly zero energy.

Great Britain has decided to start building no-emission public buildings as early as of 2016.

Together with the term *nearly energy zero* building which has been adopted in European Union regulations, the following new models of energy efficient construction and their corresponding levels of environmental protection are encountered today:

### Gotovo nulta energetska arhitektura (vrlo niskoenergetske i pasivne kuće) / Nearly zero energy architecture (very low energy and passive houses)



### Energetski nulta zgrada

Zgrada u kojoj je, kao rezultat vrlo visoke razine energetske učinkovitosti, ukupna godišnja potrošnja primarne energije jednaka energiji (proizvedenoj iz obnovljivih izvora energije) koja je dostavljena zgradi (engl. *net zero energy house*, njem. *Nullenergiehaus*).

### Emisijski nulta zgrada (neto ugljičnoemisijski nulta zgrada)

Zgrada koja, na temelju materijala od kojih je izgrađena i činjenice da proizvodi višak energije iz obnovljivih izvora, osigurava da tijekom svog životnog vijeka kompenzira sve ugljične emisije povezane s izgradnjom i uporabom zgrade (*net zero carbon building*, *Nullemissionshaus*).

### Karbonski nulta zgrada

Zgrada s godišnjom nulom neto energetskom potrošnjom i nulom ugljičnom emisijom (*zero carbon building*).

### Energetski pozitivna zgrada (plus-energetska zgrada)

Zgrada u kojoj je kao rezultat vrlo visoke razine energetske učinkovitosti ukupna godišnja potrošnja energije manja od energije (proizvedene iz obnovljivih izvora energije) koja je dostavljena zgradi (*positive energy building*).

### Zero energy building (Net zero energy house, Nullenergiehaus)

A building in which, as a result of its very high level of energy efficiency, the total annual primary energy consumption is equal to the energy (produced from renewable energy resources) that is distributed to the building.

### Zero energy emissions building (Net zero carbon building, Nullemissionshaus)

A building which, based on its building materials and the fact that it produces a surplus of energy from renewable energy resources, compensates all carbon emissions during its life span which are associated with the construction and use of the building.

### Zero carbon building

A building with annual net zero energy consumption and zero carbon emission.

### Positive energy building (Energy-plus building)

A building in which, as a result of its very low level of energy efficiency, its total annual energy consumption is lower than the energy (produced from renewable energy resources) delivered to the building.



3D-crtež vrlo niskoenergetske kuće drvene i betonske konstrukcije M6 (arhitekt prof. Ljubomir Mišević), Gornji Stupnik, Hrvatska

3D drawing of a timber-frame and concrete very low energy house M6, (architect Prof. Ljubomir Mišević), Gornji Stupnik, Croatia



Detalji izgradnje vrlo niskoenergetske kuće drvene i betonske konstrukcije u Gornjem Stupniku, Hrvatska

Detail of the construction of a timber-frame and concrete very low energy house in Gornji Stupnik, Croatia



Detalji izgradnje vrlo niskoenergetske kuće drvene i betonske konstrukcije u Gornjem Stupniku, Hrvatska

Detail of the construction of a timber-frame and concrete very low energy house in Gornji Stupnik, Croatia



Detalji izolacije drvenog zida vrlo niskoenergetske kuće drvene i betonske konstrukcije u Gornjem Stupniku, Hrvatska

Detail of the wooden wall insulation of a timber-frame and concrete very low energy house in Gornji Stupnik, Croatia



Vrlo niskoenergetska kuća M6 (arhitekt prof. Ljubomir Mišević) drvene i betonske konstrukcije u Gornjem Stupniku, Hrvatska, u izgradnji

Timber-frame and concrete very low energy house M6, (architect Prof. Ljubomir Mišević) structure in Gornji Stupnik, Croatia, under construction



# Defining the Nearly Zero Energy Building

Passive House + renewables



Co-funded by the Intelligent Energy Europe  
Programme of the European Union



PassREg  
Municipalities lead the way



## > Beacon: Croatia

### M6 House | Zagreb County Area

M6 is a single-detached Passive House building in the Zagreb County Area, designed by architect Ljubomir Mišćević. Located in the Gornji Stupnik area, south-west to the city centre of Zagreb, it has a usable floor area (TFA) of 334 square metres.

M6 was one of the first structures built with a reinforced concrete base plate to achieve very high standards of thermal insulation. The basement and ground level floors are made of reinforced concrete. The stairs and all remaining vertical wall constructions were made using layered wooden columns and beams.

The building envelope was conceived as a wooden door system ensuring integration and easy access to the central chambers. This Passive House building is an exemplary project as it demonstrates how well the plan and systems of a building can be adjusted to meet Passive House requirements. M6 already complies with the EU Directive on the Energy Performance of Buildings (EPBD).



Photos: Detached single family house M6 | Ljubomir Mišćević | Zagreb | Croatia  
© Dubravko Martinic

"In a time of recession and crisis, rational use of energy, energy efficiency, the application of new green technologies and renewable energy sources is an imperative but also a challenge and impulse for economic development, opening new workplaces and a brighter perspective for our young generations."

Marijan Maras, M. Electrical Engineer  
City of Zagreb, Head of Office for  
Energy, Environment  
and Sustainable





	nZEB definition for NEW building				nZEB definition for EXISTING buildings	
	Eprim		share of renewable energy	other indicators	Eprim	
	residential buildings	non-residential buildings			residential buildings	non-residential buildings
austrija	160	170 ( od 2021)	u Propisu za sve zgrade	EP, CO"	200	250 (od 2021)
belgium- brussels	45	90 (2)	qualitative	EP, OH	54	108
belgium - flanders	30%PE (5)	40%PE (5)	Quantitative (4)	EP, OH		
belgium - walonia			qualitative	EP		
bulgaria	30-50	40-60	qualitative	EP	30-50	40-60
croatia	30-80 (3)	25-200 (3)	30% Eprim	EP	/	/
cyprus	100	125	qualitative	EP	100	125
chech republic	75-80% (2;5)	90% (5)	qualitative	EP, TS	75-80%	90%
denmark	20	25	qualitative	EP, OH, TS	20	25
estonia	50-100 (2)	90-270 (2)	qualitative			
finland						
france	40-65 (2;3)	70-110 (2;3)	Quantitative (4)	EP, OH, TS	80	60%PE
germany	40% PE (5)			EP	55% PE	
greece						
hungary	50-72 (2)	60-115 (2)	qualitative	EP		
ireland	45	60% PE (5)	Quantitative (4)	CO2	75-100	
italy			qualitative	EP TS		
latvia	95	95	qualitative	EP	95	95
lithuania			qualitative	EP		
luxemburg			qualitative	EP, CO2		
malta	40	60	qualitative	EP		
netherlands	energy performance coefficient=0			EP		
norway				CO2, EP, TS		
poland	60-75 (2)	45-70 (2)				
portugal						
romania	93-217 (2;3)	50-192 (2;3)	qualitative	CO2		
slovakia	32-54 (2)	34-96 (2)	qualitative	EP		
slovenia	45-50 (2)	70		EP	70-90	100
spain				CO2		
sweden	30-75 (2;3)	30-105 (2;3)	qualitative			
UK	44 (2)			CO2, EP, TS		

izvor: nZEB definitions across Europe, BPIE



*Passive House is not only energy efficient - it is affordable for the broad market, very comfortable and it leads to high construction quality and so to long lasting buildings. All these points are important for sustainability. And: It is already proven in practice - and thereby can be fully implemented.*

The foundation for energy-efficient construction, rewarded *the passive house concept* with the first "Award for Sustainable Construction". The award was handed to the initiators of the standard Prof. em. Bo Adamson and Wolfgang Feist.

Lund, 2014-09-18

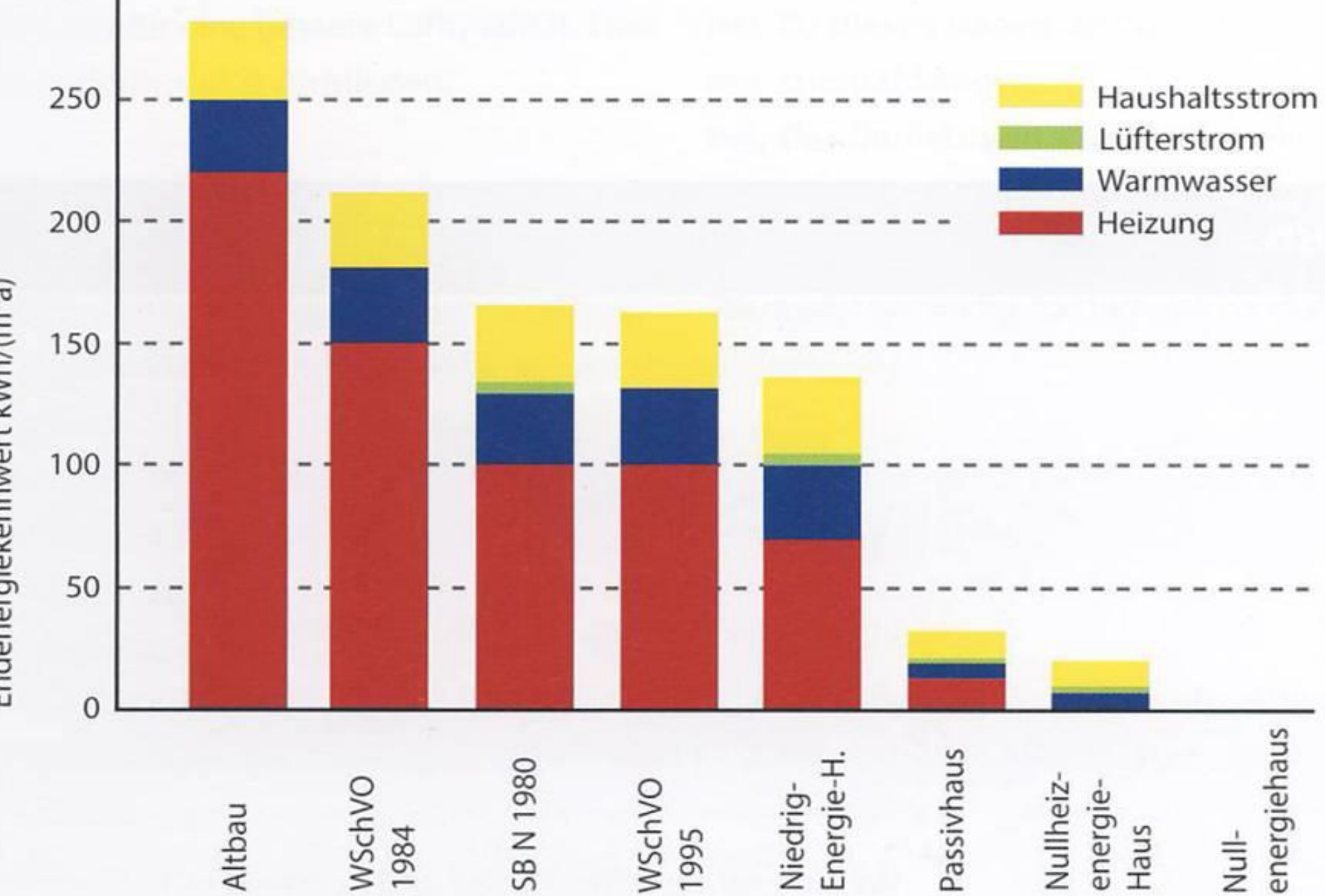
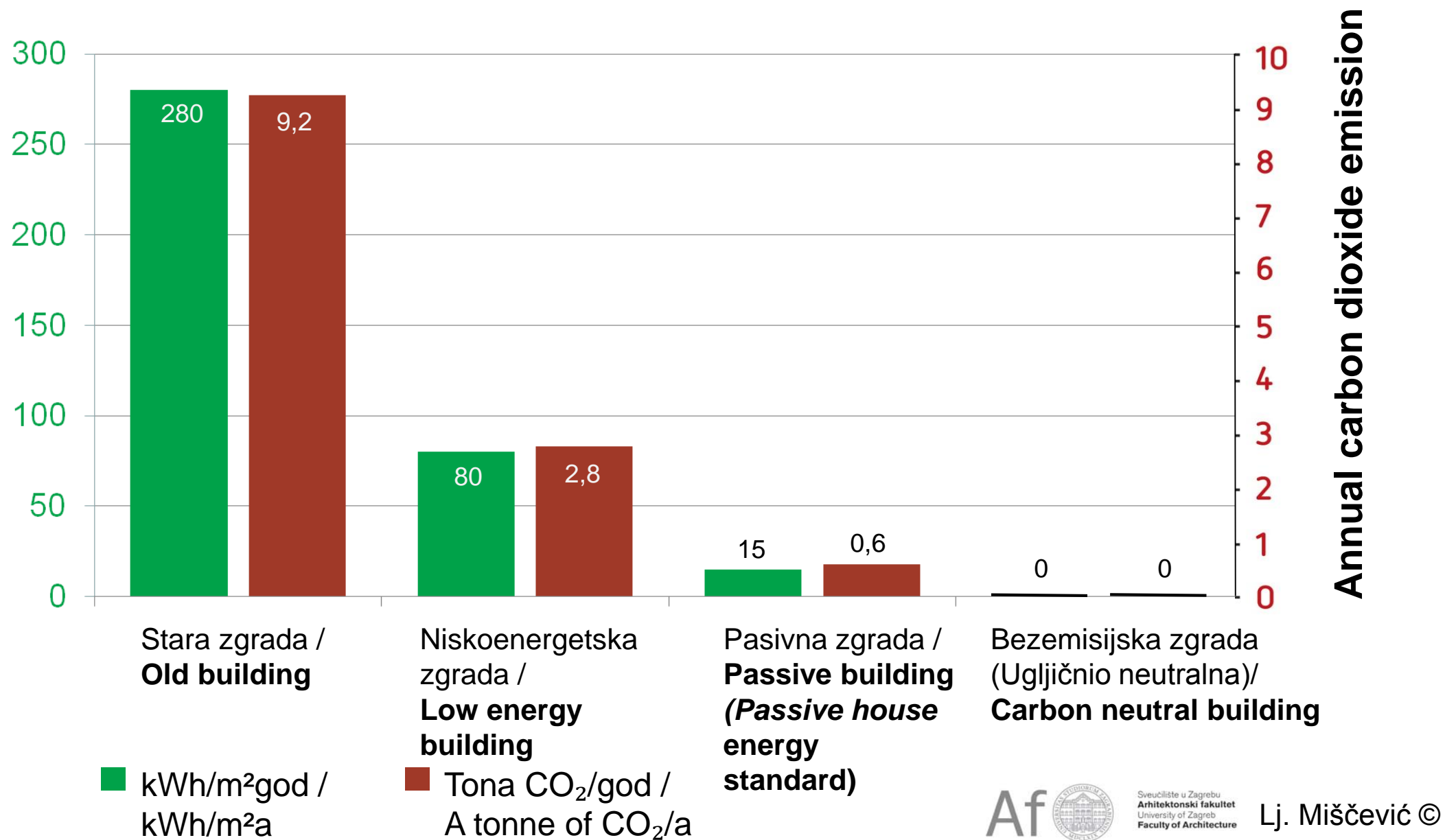


Abbildung 1: Endenergiekennwert und Verteilung des Energieeinsatzes  
verschiedenen Wärmeschutzstandards und Baukonzepten

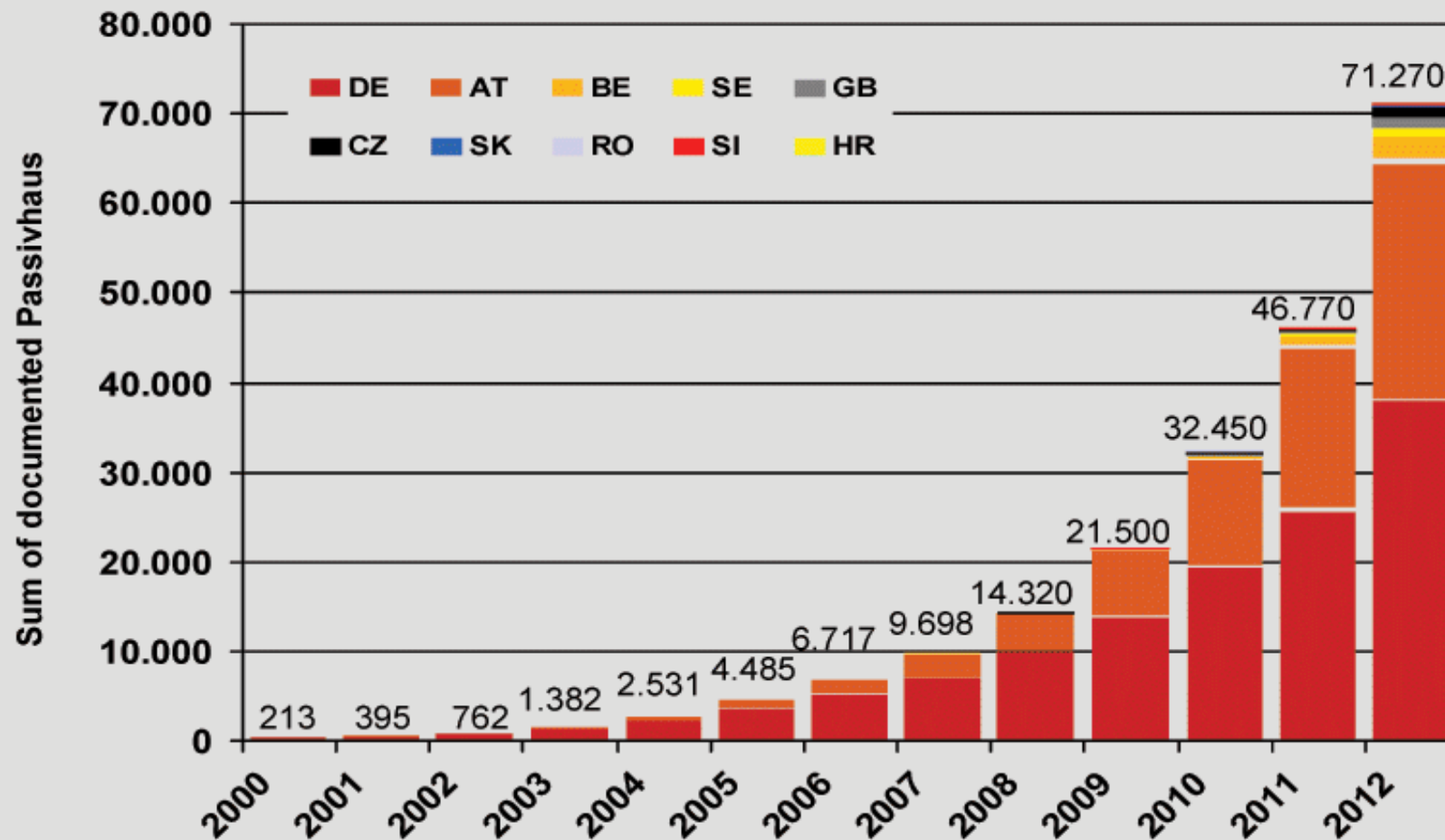


# Annual required thermal energy for heating





## Passivhaus trends in the 10 PASS-NET countries



Stand 25.05.2009

# [www.passivehousedatabase.eu](http://www.passivehousedatabase.eu) Croatia / Hrvatska

PassiveHouseDatabase - Search result - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.passivehousedatabase.eu/search\_detail\_result.php

Most Visited Getting Started Latest Headlines

PassiveHouseDatabase - Search res...

**PASSIVHAUS DATENBANK**

Home Search Statistics PH-information Sponsors

Search result summary

Search parameters: Country: Croatia

Result details: 10 match(es)

Single-family detached house: 9

Two-family house / single family house + separate apartment: 0

Semi-detached house: 0

Terraced house: 0

Multi-family dwelling / apartment house: 0

Residential- and commercial building: 1

Nursing home / retirement home: 0

Residential school / hall of residence: 0

Hotel / hostel / holiday dwelling: 0

Urban settlement / housing colony: 0

Model house / example house: 0

Kindergarten / day care: 0

School / campus / university: 0

Sports centre / recreation centre: 0

Public swimming pool: 0

Public building / church: 0

Office / administration building: 0

Office / commercial building: 0

Factory / industrial building: 0

Archive: 0

Fire station: 0

Hospital: 0

Workshop / atelier / garage / depot: 0

Others (please note in field: 'project description!'): 0

Options

Detail search

Quick search

Geographical search

Statistics

Refine search parameters

Show marked only

Show all



[Detail search](#)  
[Quick search](#)  
[Geographical search](#)  
[Statistics](#)

## Options

[Refine search parameters](#)  
[Show marked only](#)  
[Show all](#)

## Search result summary

Search parameters: Country: Croatia

Result details: 10 match(es)

Single-family detached house: 9

Two-family house | single family house + separte apartment: 0

Semi-detached house: 0

Terraced house: 0

Multi-family-dwelling | apartment house: 0

Residential- and commercial building: 1

Nursing home | retreat home: 0

Residential school | hall of residence: 0

Hotel | hostel | holiday dwelling: 0

Urban settlement | housing colony: 0

Model house | example house: 0

Kindergarten | day care: 0

School | campus | university: 0

Sports centre | recreation centre: 0

Public swimming pool: 0

Public building | church: 0

Office | administration building: 0

Office | commercial building: 0

Factory | industrial building: 0

Archive: 0

Fire station: 0

Hospital: 0

Workshop | atelier | garage | depot: 0

Others (please note in field: "project description"): 0

## Search result list

Sort by: [Country](#) | [Postcode](#) | [Town](#) | [Type](#) | [Construction period](#) | [Construction](#) | [Floor area](#) || [Rev. order](#)

	<b>HR-10257 Kupinečki Kraljevec (Zagrebačka županija)</b> ČV1   Architect: Ljubomir Mišćević, dipl. ing. arh Single-family detached house   Timber construction   m <sup>2</sup> Construction period: 2006 - 2009 Number of apartments: 1   Number of units: 1	HR-0001
	<b>HR-10437 Bestovje (Zagrebačka županija)</b> M4   Architect: Ljubomir Mišćević, dipl. ing. arh Single-family detached house   Masonry construction   m <sup>2</sup> Construction period: 2004 - 2005 Number of apartments: 1   Number of units: 1	HR-0002
	<b>HR-42000 Varaždin (Varaždinska županija)</b> Ilčić   Architect: Lidiya Ilčić, dipl. ing. arh. Single-family detached house   Masonry construction   m <sup>2</sup> Construction period: 2005 - 2007 Number of apartments: 1   Number of units: 1	HR-0003
	<b>HR-51315 Begovo Razdolje (Primorsko-goranska županija)</b> L2   Architect: Ljubomir Mišćević, dipl. ing. arh Single-family detached house   Timber construction   m <sup>2</sup> Construction period: 2006 - 2009 Number of apartments: 1   Number of units: 1	HR-0004

# 11<sup>th</sup> INTERNATIONAL CONFERENCE ON PASSIVE HOUSES

Bregenz, 14<sup>th</sup> April 2007

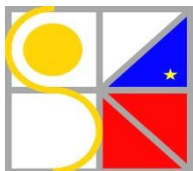
## Passive houses in Croatia - projects and realizations

Ljubomir Miščević

University of Zagreb  
Faculty of Architecture

Kačićeva 26, HR-10000 Zagreb  
miscevic@arhitekt.hr [www.arhitekt.hr](http://www.arhitekt.hr)

CROATIAN SOLAR HOUSE (CSH)  
[www.solar-house.hr](http://www.solar-house.hr)



Sveučilište u Zagrebu  
**Arhitektonski fakultet**  
University of Zagreb  
**Faculty of Architecture**

+385 1 4639394, fax: +385 1 4828079  
[www.sunarh.hr](http://www.sunarh.hr)

CENTRE FOR RENEVABLE  
ENERGY SOURCES (CERES)





# 11. INTERNATIONALE PASSIVHAUSTAGUNG 2007

## Fortschritte in Europa



[www.sei.ie](http://www.sei.ie)



[www.lavenergiboliger.no](http://www.lavenergiboliger.no)



[www.passiefhuisplatform.be](http://www.passiefhuisplatform.be)  
Roel De Caninck WG 16



Sverige / Ulla Janson



[www.altompassivhuse.dk](http://www.altompassivhuse.dk)  
Henrik Tommerup WG 8



Ljubomir Miscevic WG12



[www.passive-on.org/it/](http://www.passive-on.org/it/)  
Franzelin WG 7 Schmitt WG 16





# 13<sup>th</sup> INTERNATIONAL PASSIVE HOUSE CONFERENCE

Frankfurt, 17<sup>th</sup> April 2009

**Experience in architectural design, construction and utilization of passive houses and a start of PASS-NET IEE project in Croatia**

Prof. **Ljubomir Mišćević**, M.Arch

University of Zagreb

Faculty of Architecture

Kačićeva 26, HR-10000 Zagreb +385 1 4639394, fax: +385 1 4828079

miscovic@arhitekt.hr [www.arhitekt.hr](http://www.arhitekt.hr) [www.sunarh.hr](http://www.sunarh.hr)

[pass-net@arhitekt.hr](mailto:pass-net@arhitekt.hr)

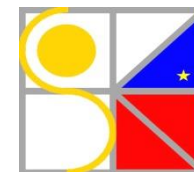
CROATIAN SOLAR HOUSE (CSH) [www.solar-house.hr](http://www.solar-house.hr)

CENTRE FOR RENEVABLE ENERGY SOURCES (CERES)

with the support



Sveučilište u Zagrebu  
**Arhitektonski fakultet**  
University of Zagreb  
**Faculty of Architecture**



# 13. INTERNATIONALE PASSIVHAUSTAGUNG 2009

## Europe



[www.sei.ie](http://www.sei.ie)



[www.lavenergiboliger.no](http://www.lavenergiboliger.no)



[lamaison passive.fr](http://lamaisonpassive.fr)  
E. Vekemans  
WG VIII



<http://passivhus.dk/>  
Søren Pedersen WG VII



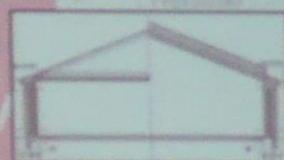
[www.passiefhuisplatform.be](http://www.passiefhuisplatform.be)  
Christophe Marrecau WG VIII



Michael Tribus AG XV  
[www.casepassive.it](http://www.casepassive.it)



Sverige / Ulla Janson WG VII  
<http://www.passivhuscentrum.se/>



[http:// www.passivhus.fi](http://www.passivhus.fi)



Ljubomir Miscevic WGVIII



Nikola





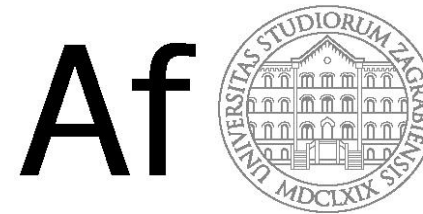
# 14<sup>th</sup> INTERNATIONAL PASSIVE HOUSE CONFERENCE

Dresden, 28-29 May 2010

## Passive House in South-Central Europe

Prof. **Ljubomir Mišćević**, M.Arch

University of Zagreb  
Faculty of Architecture



Sveučilište u Zagrebu  
**Arhitektonski fakultet**  
University of Zagreb  
**Faculty of Architecture**

Kačićeva 26, HR-10000 Zagreb +385 1 4639394, fax: +385 1 4828079

[miscevic@arhitekt.hr](mailto:miscevic@arhitekt.hr) [pass-net@arhitekt.hr](mailto:pass-net@arhitekt.hr)

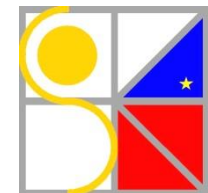
[www.arhitekt.hr](http://www.arhitekt.hr) [www.sunarh.hr](http://www.sunarh.hr) [www.oegut.at](http://www.oegut.at)

CROATIAN SOLAR HOUSE (CSH) [www.solar-house.hr](http://www.solar-house.hr)  
CENTRE FOR RENEVABLE ENERGY SOURCES (CERES)

with the support

Intelligent Energy  Europe

**passnet** Croatia



# 16<sup>th</sup> INTERNATIONAL PASSIVE HOUSE CONFERENCE

Hannover, 4-5 May 2012

**Working Group VII: Costs and cost efficiency**

## **The first ten realizations of passive houses in Croatia**

**Prof. Ljubomir Mišćević, M. Arch**



Sveučilište u Zagrebu  
**Arhitektonski fakultet**  
University of Zagreb  
**Faculty of Architecture**

University of Zagreb

Faculty of Architecture

Kačićeva 26, Zagreb, Croatia

+385 1 4639394, fax: +385 1 4828079

[miscevic@arhitekt.hr](mailto:miscevic@arhitekt.hr)

[pass-net@arhitekt.hr](mailto:pass-net@arhitekt.hr)

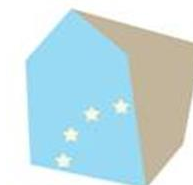
[www.arhitekt.hr](http://www.arhitekt.hr)

[www.sunarh.hr](http://www.sunarh.hr)

CENTER FOR RENEVABLE ENERGY SOURCES (CERES)



**SUN ARH** d.o.o.



**IDES-EDU**  
MASTER AND POST GRADUATE EDUCATION  
AND TRAINING IN MULTIDISCIPLINARY TEAMS



# 18<sup>th</sup> INTERNATIONAL PASSIVE HOUSE CONFERENCE

Aachen, 25-27 April 2014

## The first twenty passive houses in Croatia

Prof. **Ljubomir Mišćević**, Mag. Eng. Arch. Urb.

University of Zagreb, Faculty of Architecture  
Kačićeva 26. HR-10000 Zagreb, Croatia

Af



Sveučilište u Zagrebu  
**Arhitektonski fakultet**  
University of Zagreb  
**Faculty of Architecture**



Tel./fax: +385 1 4639394

[miscevic@arhitekt.hr](mailto:miscevic@arhitekt.hr) [pass-net@arhitekt.hr](mailto:pass-net@arhitekt.hr) [ides-edu@arhitekt.hr](mailto:ides-edu@arhitekt.hr)

[www.arhitekt.hr](http://www.arhitekt.hr) [www.sunarh.hr](http://www.sunarh.hr) [www.pass-net.net](http://www.pass-net.net) [www.ides-edu.eu](http://www.ides-edu.eu)





# EU PASS-NET (IEE) projekt

Lj. Mišćević

Af



Sveučilište u Zagrebu  
Arhitektonski fakultet  
University of Zagreb  
Faculty of Architecture



KONZORCIJ PASIVNA  
KUĆA HRVATSKA



The first 10 passive houses till the end of 2011

The first 20 passive houses till the end of 2013





Author: V. Bralić, Mag.Eng.Arch.Urb. The plan shows airtight zone marked with red line. Photograph shows a Blower-Door testing of the house.

The price for m<sup>2</sup> netto surface is about **600,00 €**

Energy concept and certification consultant Lj. Mišćević Mag.Eng.Arch.Urb.

## Single-family passive house “L2” in Čazma, Croatia

Single-family detached house “L2” in Čazma (Bjelovarsko – Bilogorska County) is **developed from type “Y” house project for “three litres house”** (40,0 kWh/m<sup>2</sup>a) energy consumption.

The price for m<sup>2</sup> netto surface is about **700,00 €**

This is the first example of increasing of type project for low-energy standard house to passive house energy efficiency level.



Author: prof. Ljubomir Mišćević, Mag.Eng.Arch.Urb. Design 2009, realized in 2011



# Single-family passive house “L2” in Čazma, Croatia

Single-family detached house “L2” in Čazma (Bjelovarsko – Bilogorska County) is **developed from type “Y” house project for “three litres house”**.

In the final phase when the house will be supplied with active thermal and photovoltaic system **it will achieve zero or passive plus energy standard**.  
The price for m<sup>2</sup> netto surface is about **700,00 €**



North-west view.

Author: prof. Ljubomir Mišćević, Mag.Eng.Arch.Urb. Design 2009, realized in 2011

# The first residential building from the social housing program (POS) in Koprivnica, Croatia, 2011

## Energy certificate for A+ class. Author: Tehnika d. d.

Residential building in Koprivnica is the second realized passive house residential building in Croatia. **The first one financed in the frame of the Social housing programe** so called POS. The price for m<sup>2</sup> netto surface is **897,00 €**



Energetski certifikat za stambene zgrade		<b>Zgrada</b> <input checked="" type="checkbox"/> nova <input type="checkbox"/> postojeća																
	prema Direktivi 2002/91/EC	Vrsta zgrade: Stambena zgrada s više stanova - A																
		K.č.: 5497/7 upisana u z.k.ul.br. 10974 k.o.: Koprivnica																
		Adresa: Zvonimira Goloba b.b.																
		Mjesto: 48000 Koprivnica																
		Vlasnik / investitor: Agencija za društveno poticajnu stanogradnju Grada Koprivnice, Zrinski trg 1, 48000 Koprivnica																
		Izvođač: Tehnika d.d., Ulica grada Vukovara 274, 10000 Zagreb																
		Godina izgradnje: 2011.																
		<b>Q<sup>+</sup> H<sub>nd,ref</sub></b> kWh/(m <sup>2</sup> a) <b>Izračun 14,91</b>																
		<table><tr><td>A+</td><td>≤ 15</td><td rowspan="7"><b>A+</b></td></tr><tr><td>A</td><td>≤ 25</td></tr><tr><td>B</td><td>≤ 50</td></tr><tr><td>C</td><td>≤ 100</td></tr><tr><td>D</td><td>≤ 150</td></tr><tr><td>E</td><td>≤ 200</td></tr><tr><td>F</td><td>≤ 250</td></tr><tr><td>G</td><td>&gt; 250</td></tr></table>	A+	≤ 15	<b>A+</b>	A	≤ 25	B	≤ 50	C	≤ 100	D	≤ 150	E	≤ 200	F	≤ 250	G
A+	≤ 15	<b>A+</b>																
A	≤ 25																	
B	≤ 50																	
C	≤ 100																	
D	≤ 150																	
E	≤ 200																	
F	≤ 250																	
G	> 250																	
<b>Podaci o osobi koja je izdala energetski certifikat</b>																		
Ovlaštena fizička osoba:																		
Ovlaštena pravna osoba: Energetski institut Hrvoje Požar																		
Imenovana osoba: Željka Hrs Borković																		
Registarski broj ovlaštene osobe: P-23/2010																		
Broj energetskog certifikata: 022																		
Datum izdavanja/rok važenja 10. 08. 2011. / 10. 08. 2021.																		
Potpis																		
<b>Podaci o zgradi</b>																		
A <sub>v</sub> [m <sup>2</sup> ] = 1.726,65																		
V <sub>v</sub> [m <sup>3</sup> ] = 5.395,77																		
f <sub>0</sub> [m <sup>-1</sup> ] = 0,50																		
H <sub>0,00</sub> [W/(m <sup>2</sup> K)] = 0,31																		



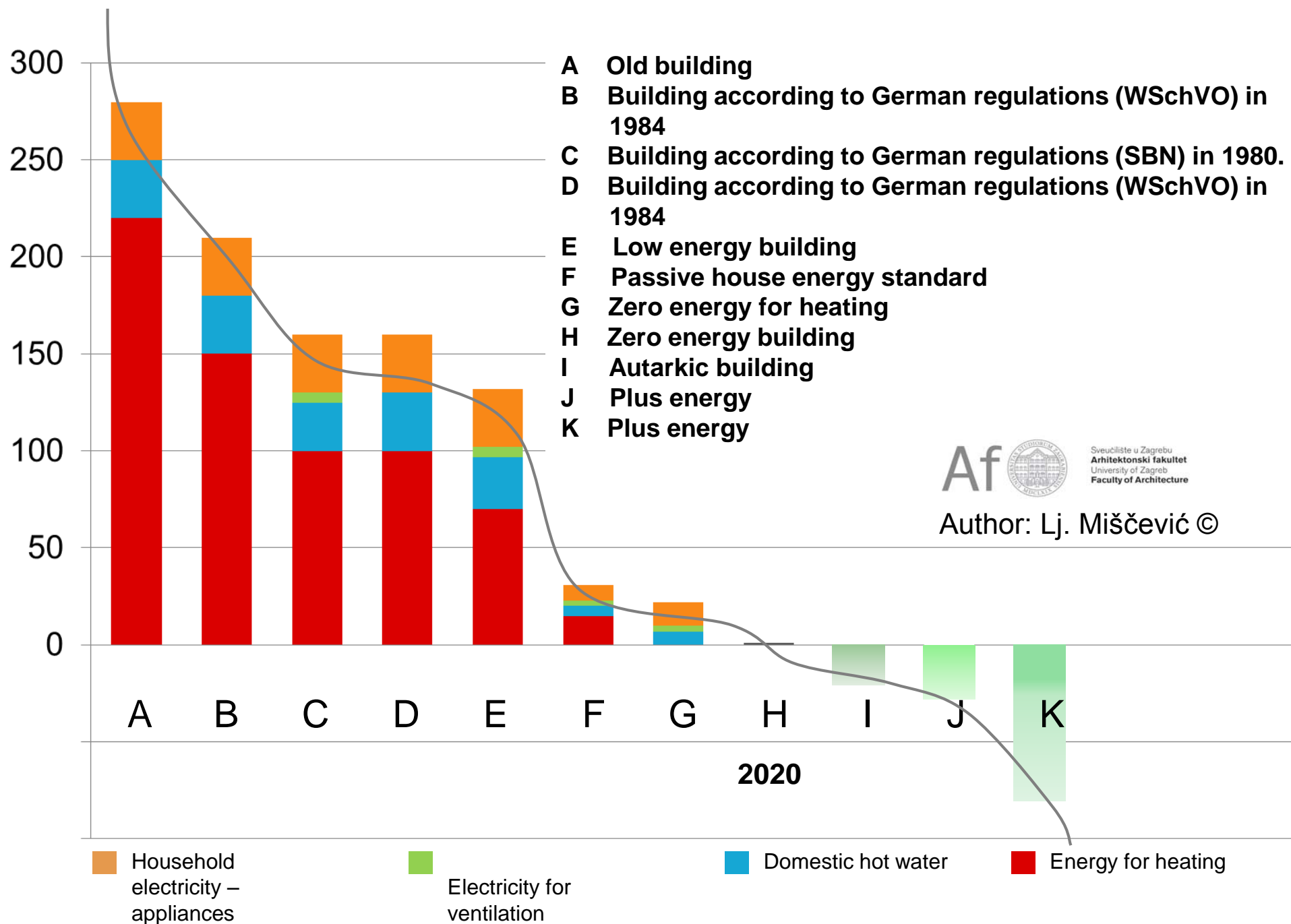
# **The first office - residential passive house in Croatia**

Žminj, Istria. Completed in 2014



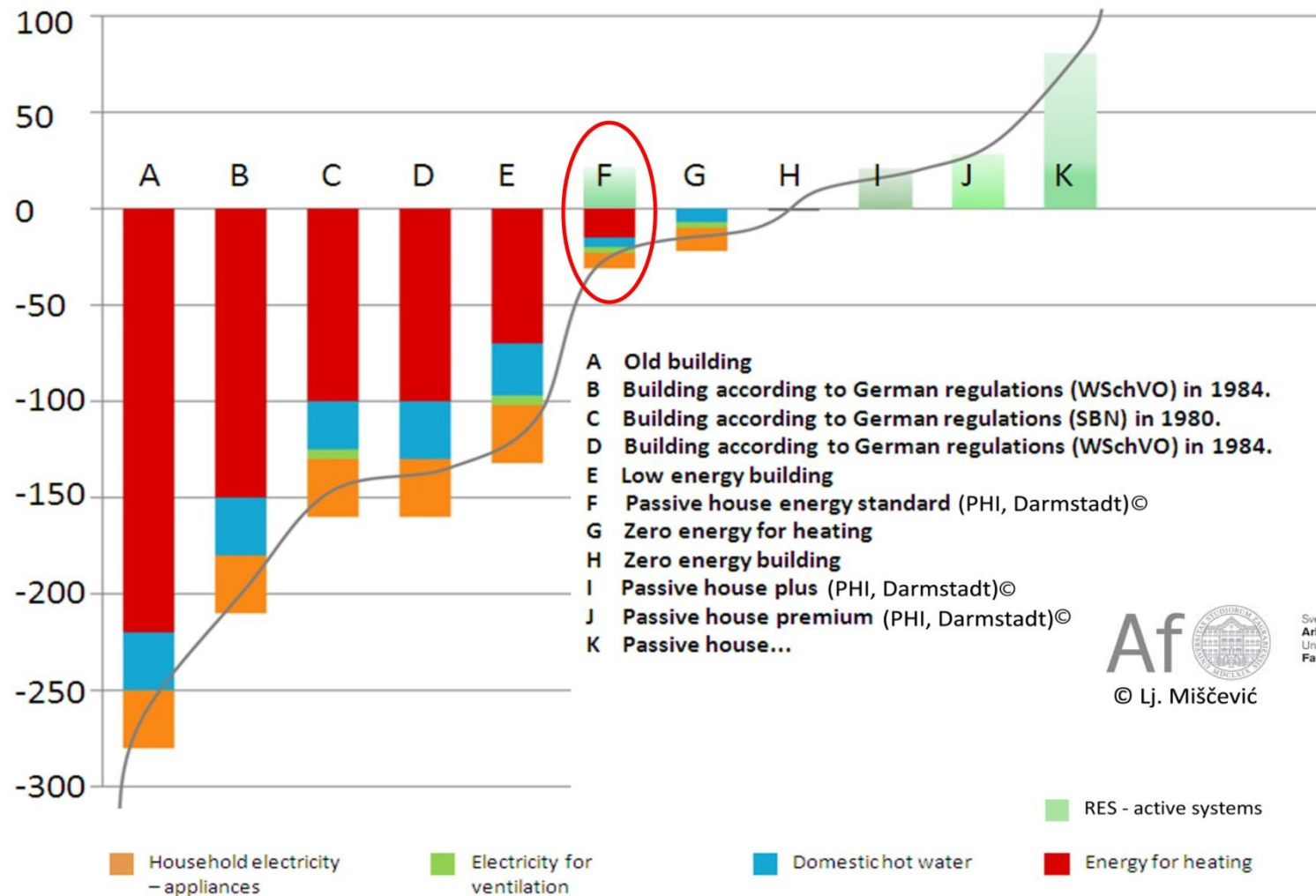
The first office-residential passive house, Rudan d.o.o. Author: Darijan Čekada, M. Arch-, AGM PROJEKT d.o.o., consultant prof Ljubomir Mišćević, M. Arch.

Specific a. energy consumption in buildings kWh/ m<sup>2</sup>a





Specific annual energy consumption in buildings kWh/m<sup>2</sup>a



Af  
© Lj. Mišćević

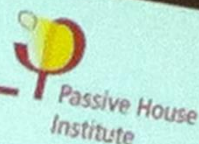
Sveučilište u Zagrebu  
Arhitektonski fakultet  
University of Zagreb  
Faculty of Architecture

## The new perception diagram with addition of plus energy buildings

Author: Lj. Mišćević, 2013

Column „F“ on diagram shows passive house data with addition of RES where is a huge amount of solar radiation as in south region of Croatia (according to REHVA it is in zones 1 & 2 for nZEB) that easily secure the jump over zero level and becomes „+ energy“ or „Passive house plus“ or „Passive house Premium“ as it is defined by Passive House Institute in Darmstadt.

# Old or new? | Alt oder neu?



PHI introduces a new rating system for passive houses. It will be still possible to certify Passive Houses according to the old system. It is your choice!

Das PHI führt ein neues Bewertungssystem für Passivhäuser ein. Zertifiziert werden kann weiterhin nach dem alten System. Sie haben die Wahl!

## Old system | Altes System

## New system | Neues System

Heating, cooling demand: 15 kWh/(m<sup>2</sup>a),  
Heating, cooling load: 10 W/m<sup>2</sup>,  
Air tightness: 0,60 1/h

Overall energy demand:  
Primary energy, not renewable (PE)  
120 kwh/(m<sup>2</sup>a)

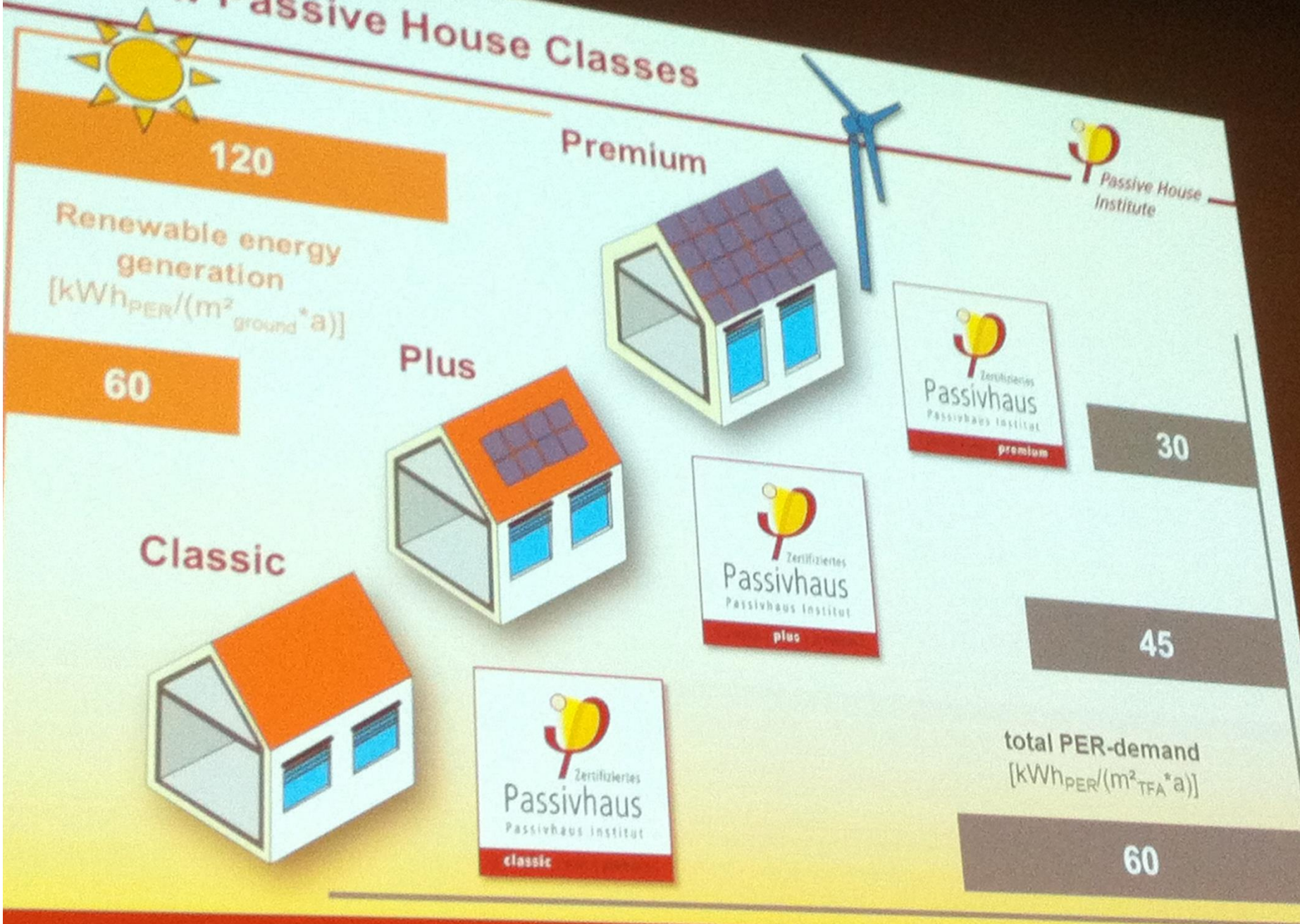
Overall energy demand:  
Primary energy, renewable (PER)

Energy generation

It is your choice! | Sie haben die Wahl!



# The new Passive House Classes

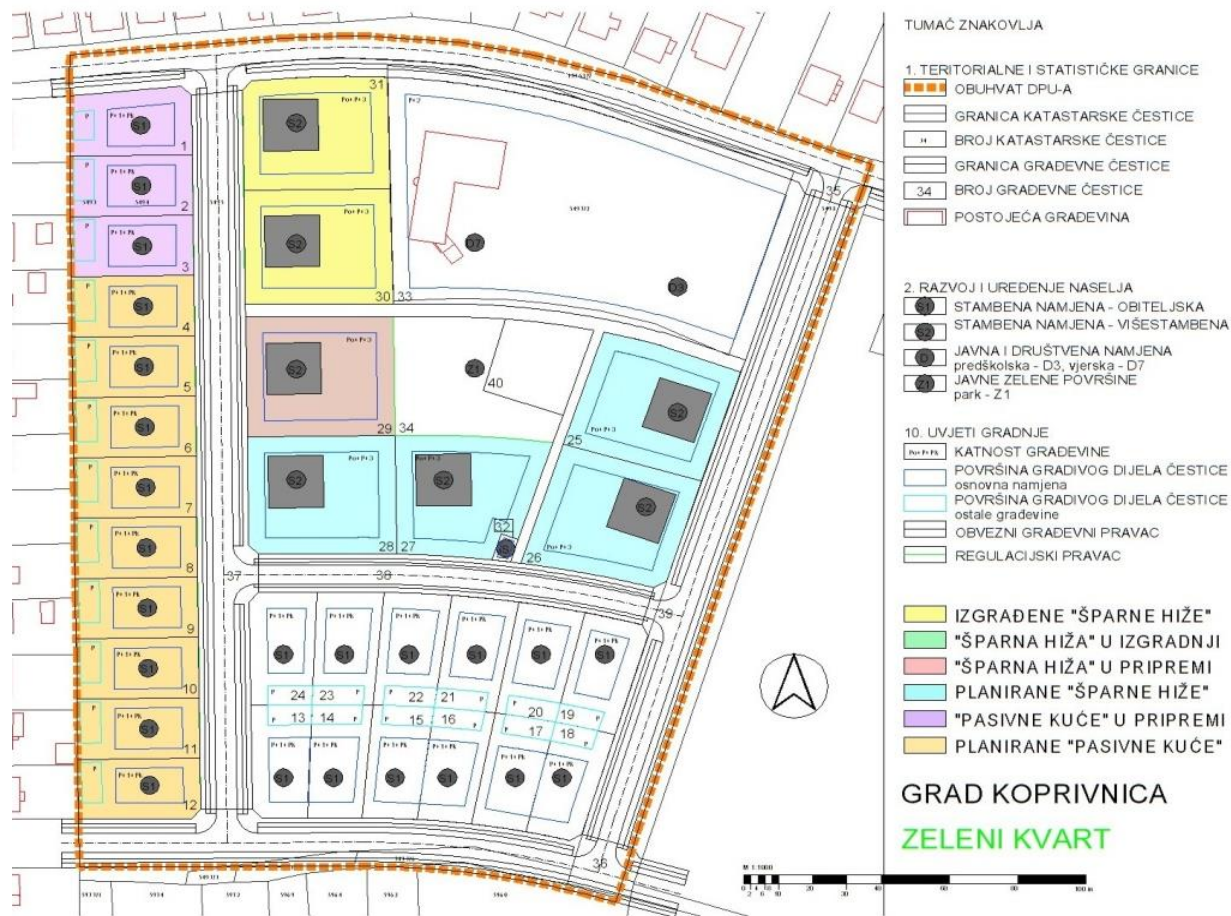


Die neuen Passivhausklassen



# Green Quartier „Lenišće east”, Koprivnica, Croatia

## Housing zone “Lenišće east”



**Demonstration project for housing.**

**The first Green Quartier in the city**

Ukupno planirano 7 zgrada višestambene izgradnje i 12 manjih stambenih građevina (2-3 stana) – Agencija za društveno poticanu stanogradnju Grada Koprivnice (APOS)



## Green Quartier „Lenišće east”, Koprivnica, Croatia





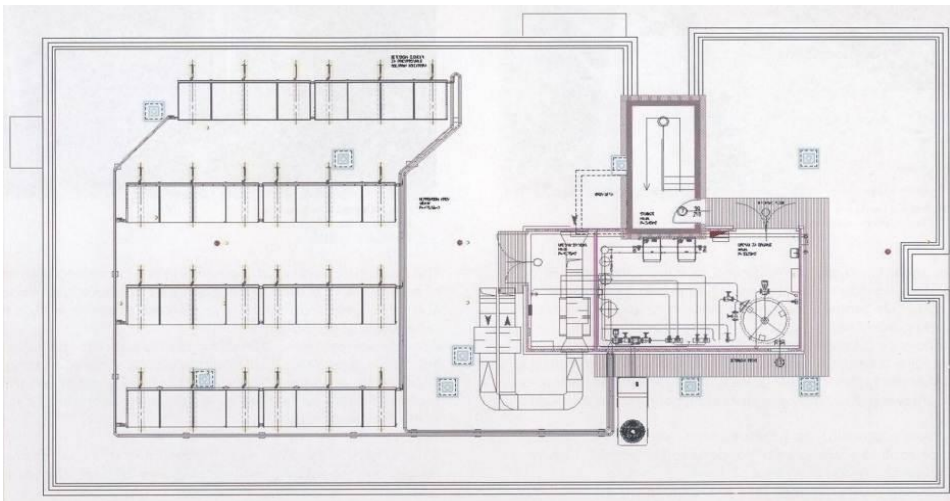
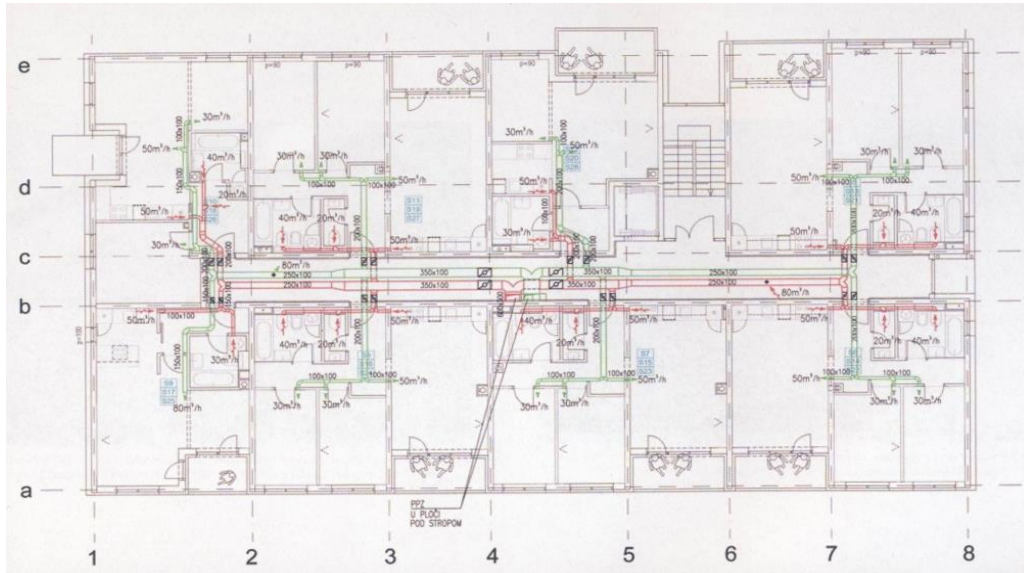




# The first residential building from the social housing program (POS) in Koprivnica, Croatia, 2011

Energy certificate for A+ class. Author: Tehnika d. d.

The price for m<sup>2</sup> netto surface is **897,00 €**









# University Campus in Koprivnica, Croatia

## Central Building with Conference Hall

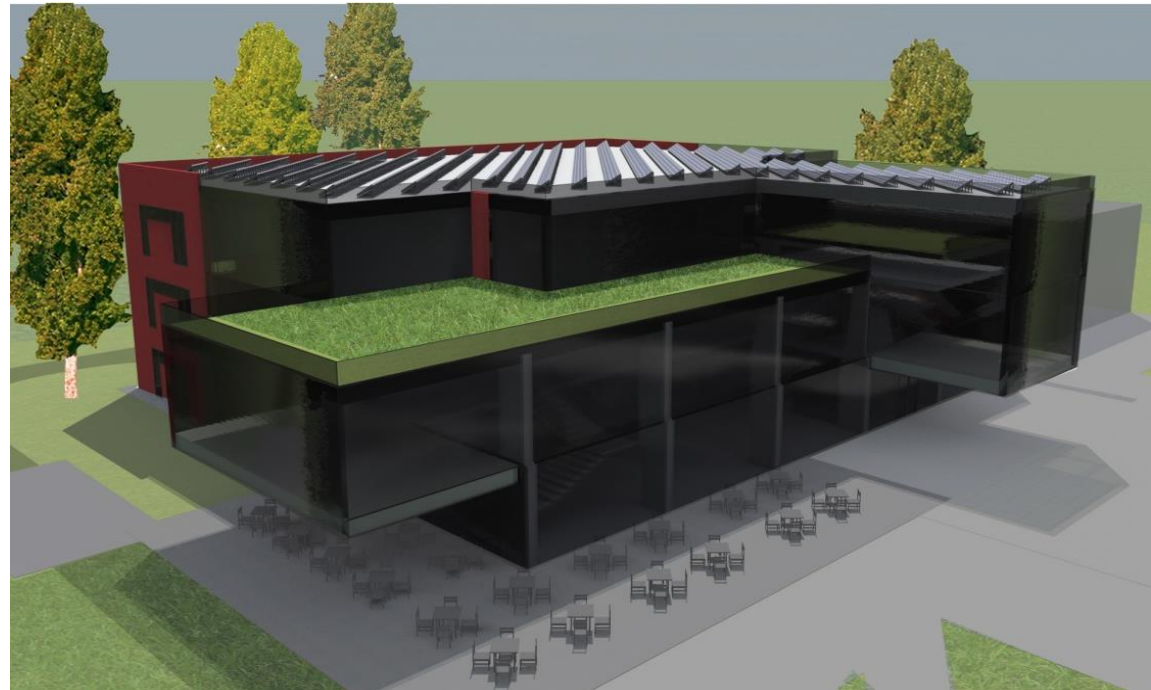
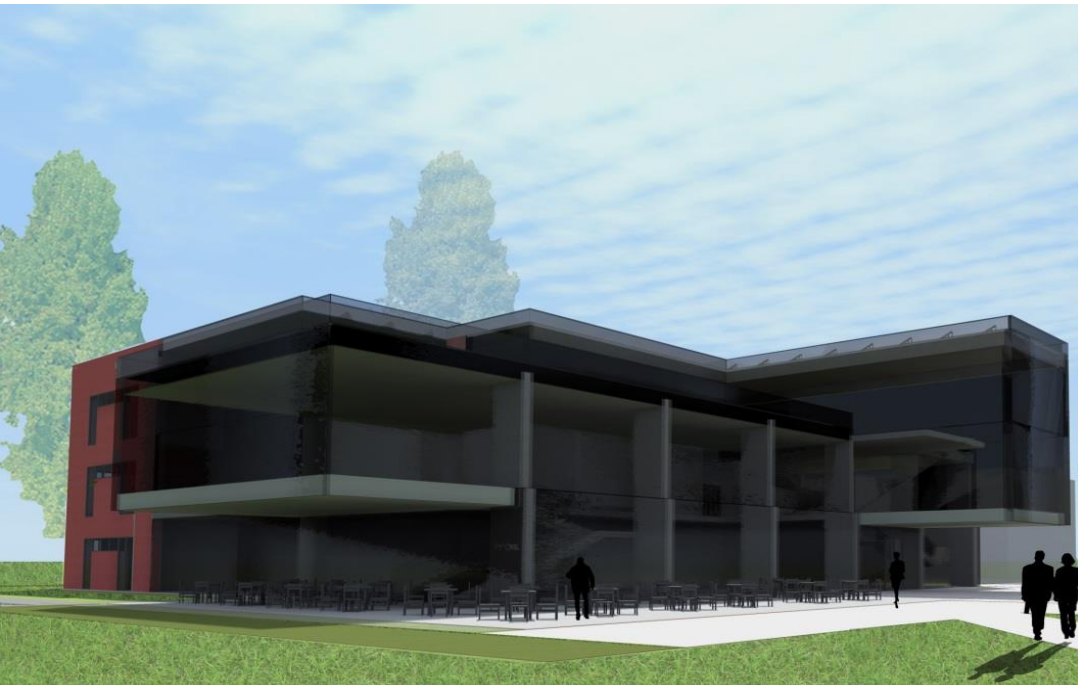
Idea project, author: Ljubomir Mišćević, 2013



# University Campus in Koprivnica, Croatia

## Central Building

Idea project, author: Ljubomir Mišćević, 2013





# THE FIRST ECO-SANDWICH A+ family house, Koprivnica, Croatia

Author: Lj. Miščević

**ECO-SANDWICH®**





# THE FIRST ECO-SANDWICH A+ family house, Koprivnica, Croatia

Author: Lj. Miščević

**ECO-SANDWICH®**





# THE FIRST ECO-SANDWICH A+ family house, Koprivnica, Croatia

Author: Lj. Mišćević

**ECO-SANDWICH®**







## **THE FIRST ECO-SANDWICH A+ family house, Koprivnica, Croatia**

Author: Lj. Mišćević



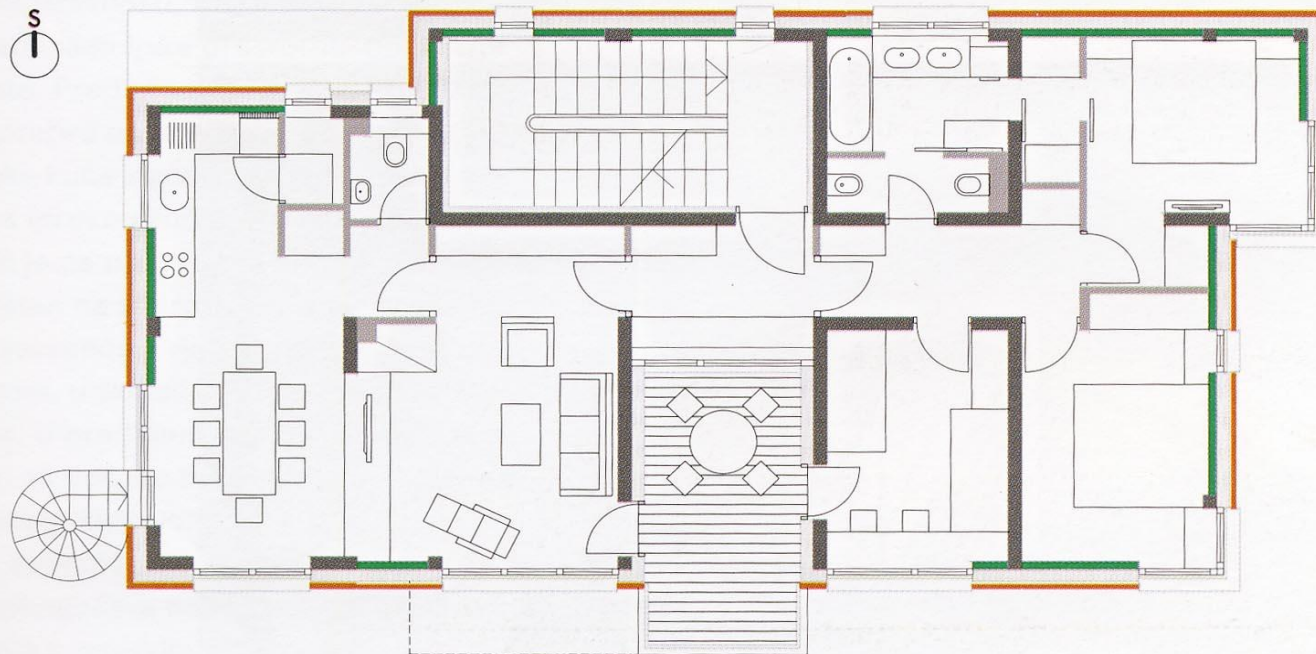




# THE FIRST ECO-SANDWICH A+ family house, Koprivnica, Croatia

Author: Lj. Mišćević

tlocrt kata



**ECO-SANDWICH®**



# Prefabricated ventilated facade pannels of recycled building material **ECO-SANDWICH**

Author: ECO-SANDWICH Consortium

Production, Beton Lučko d.o.o., Lučko, Croatia





# Prefabricated ventilated facade pannels of recycled building material **ECO-SANDWICH**

Author: ECO-SANDWICH Consortium

Transportation to the first implementation building site, Koprivnica, Croatia



# Prefabricated ventilated facade pannels of recycled building material ECO-SANDWICH

Author: ECO-SANDWICH Consortium

The first implementation building site, Koprivnica, Croatia

**ECO-SANDWICH®**





# THE FIRST ECO-SANDWICH A+ family house

Building site, Koprivnica, Croatia, 13th November 2015, 13:16

**ECO-SANDWICH®**

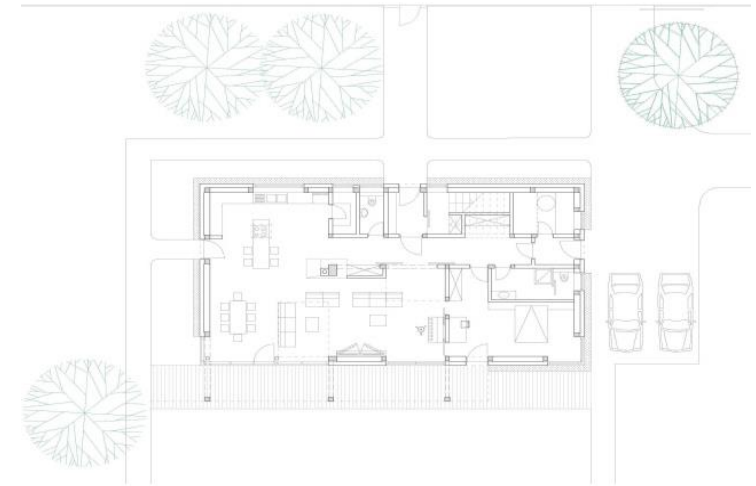
**what'sup**  
cams



# Family passive house “V2”

Strizivojna, Croatia

Author: Ljubomir Mišćević, project 2011-2012, under construction

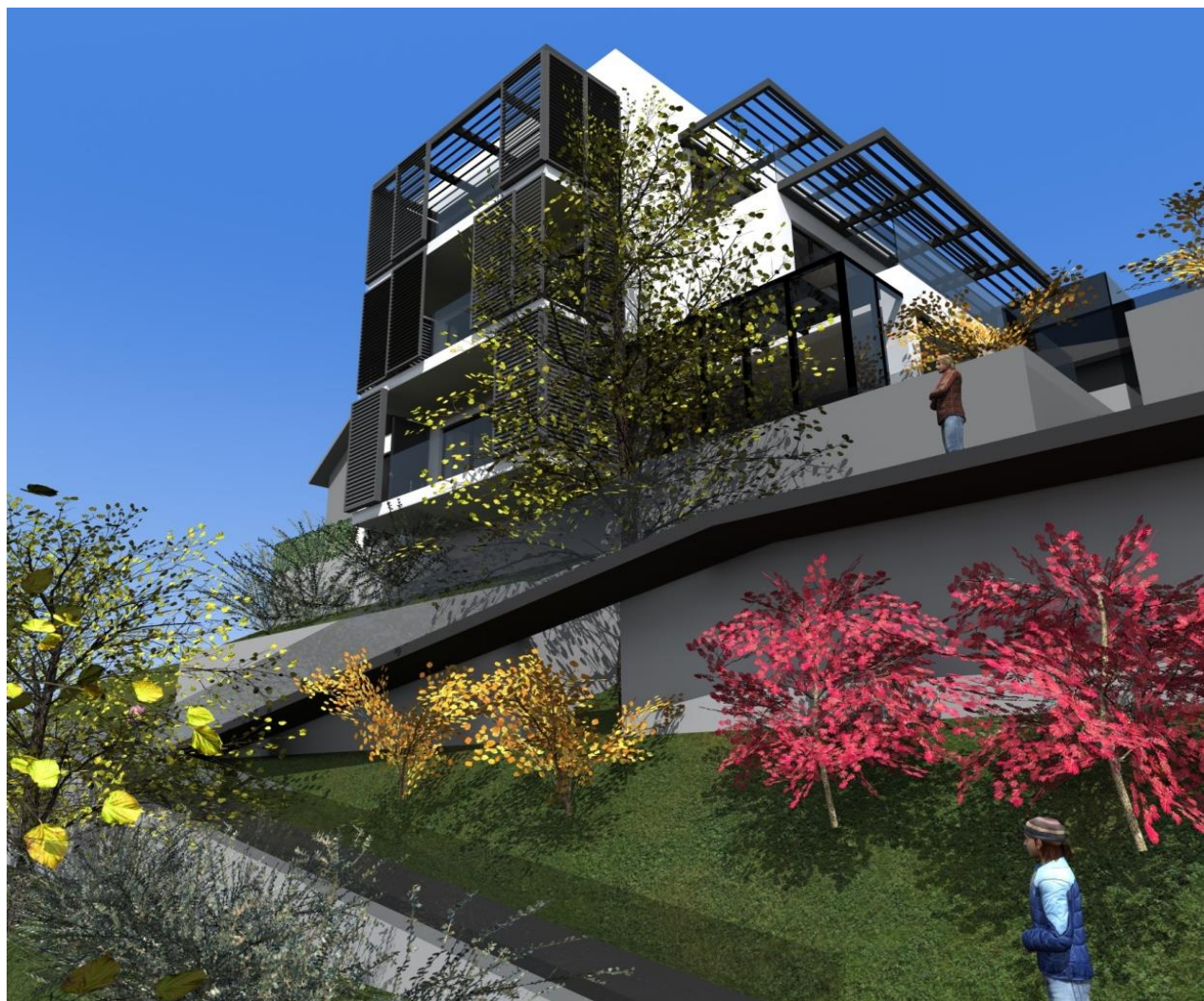




# Family passive house plus „H2“, Zagreb, Croatia

Project 2014-2015

Author: Lj. Mišćević

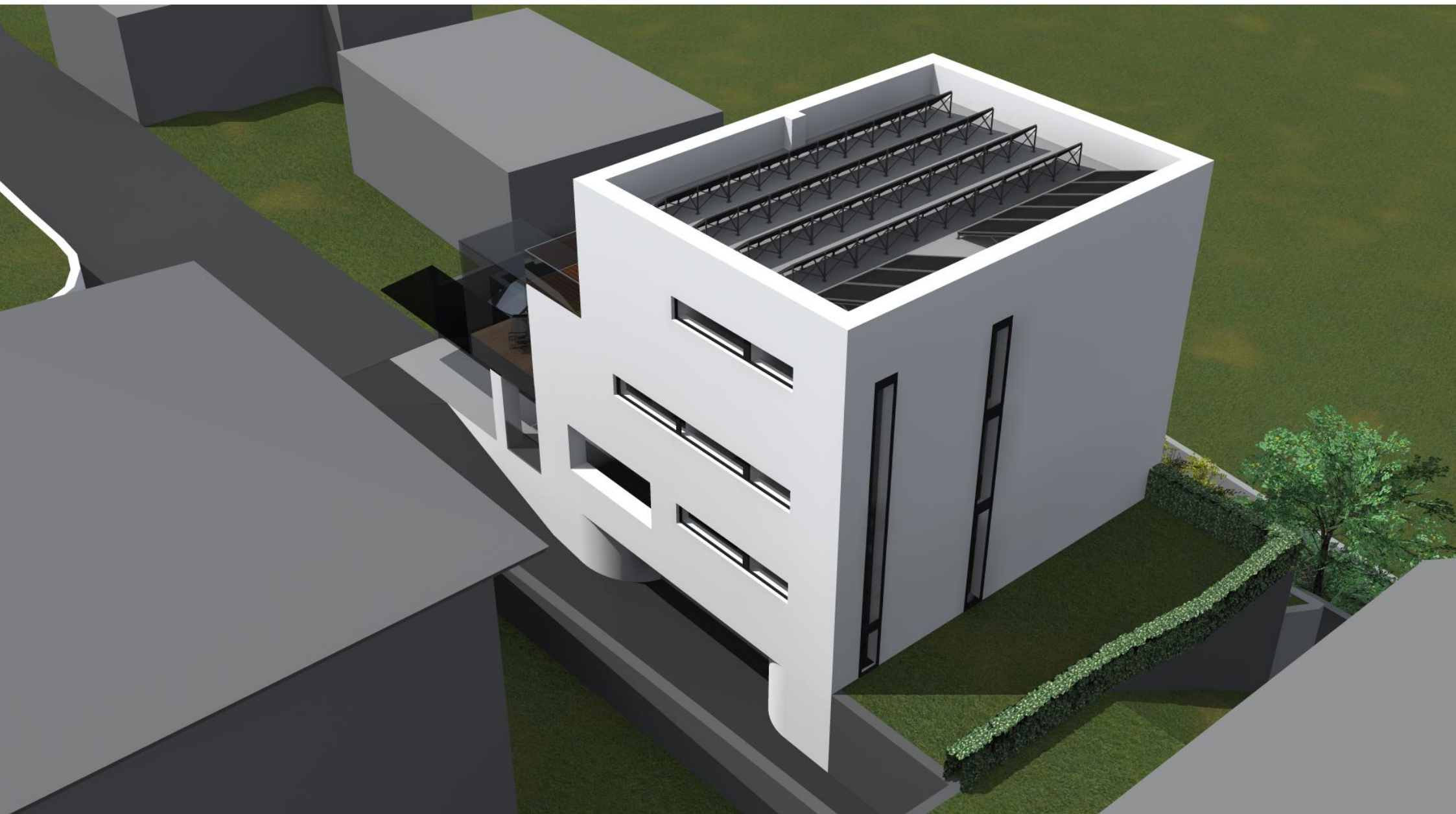




# Family passive house plus „H2“, Zagreb, Croatia

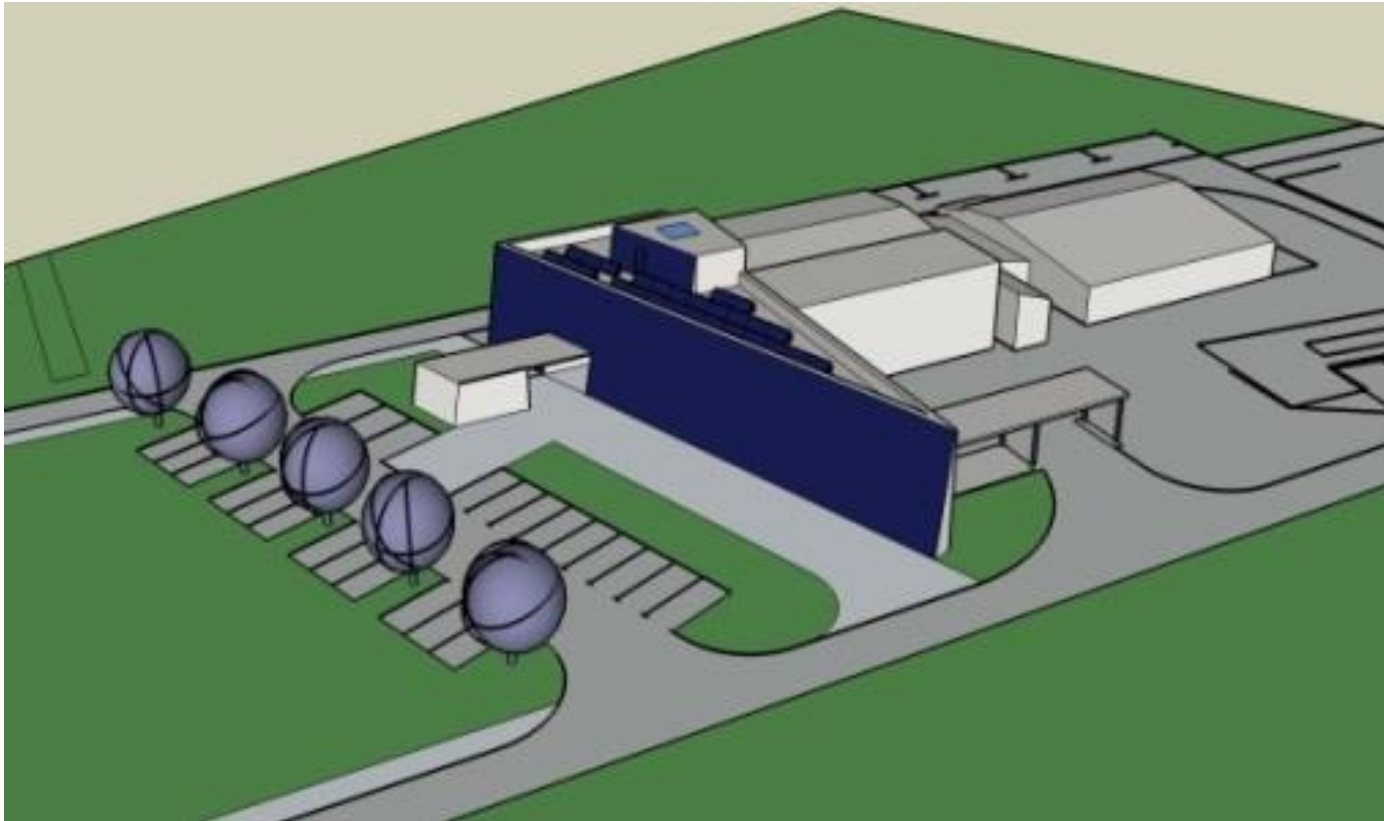
Project 2014-2015

Author: Lj. Mišćević





## The new projects and realizations



Passive office building A+, ČAKOM, Čakovec, project 2012  
Author: Lj. Mišćević





# Covenant of Mayors

Committed to local  
sustainable energy





PassREg

# Building for the energy revolution

Passive House Regions with Renewable Energies



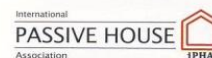
An informational pamphlet

Coordinator:



Passive House Institute | Germany | [www.passivehouse.com](http://www.passivehouse.com)

Partner:



International Passive House Association | Germany | [www.passivehouse-international.org](http://www.passivehouse-international.org)



IG Passivhaus Tirol | Austria | [www.igpassivhaus-tirol.at](http://www.igpassivhaus-tirol.at)



Passiefhuis-Platform VZW | Belgium | [www.passiefhuisplatform.be](http://www.passiefhuisplatform.be)



Environmental Investment Fund Ltd | Latvia | [www.lvif.gov.lv](http://www.lvif.gov.lv)



Plate-forme Maison Passive asbl | Belgium | [www.maisonpassive.be](http://www.maisonpassive.be)



Municipality of Cesena | Italy | [www.comune.cesena.fc.it](http://www.comune.cesena.fc.it)



EnEffect Group | Bulgaria | [www.eneffect.bg](http://www.eneffect.bg)



Nobatek | France | [www.nobatek.com](http://www.nobatek.com)



DNA - De Nieuwe Aanpak | Netherlands | [www.dnaindebouw.nl](http://www.dnaindebouw.nl)



Building Research Establishment Wales | United Kingdom | [www.bre.co.uk](http://www.bre.co.uk)



City of Zagreb | Croatia | [www.zagreb.hr](http://www.zagreb.hr)



proKlima GbR | Germany | [www.proklima-hannover.de](http://www.proklima-hannover.de)

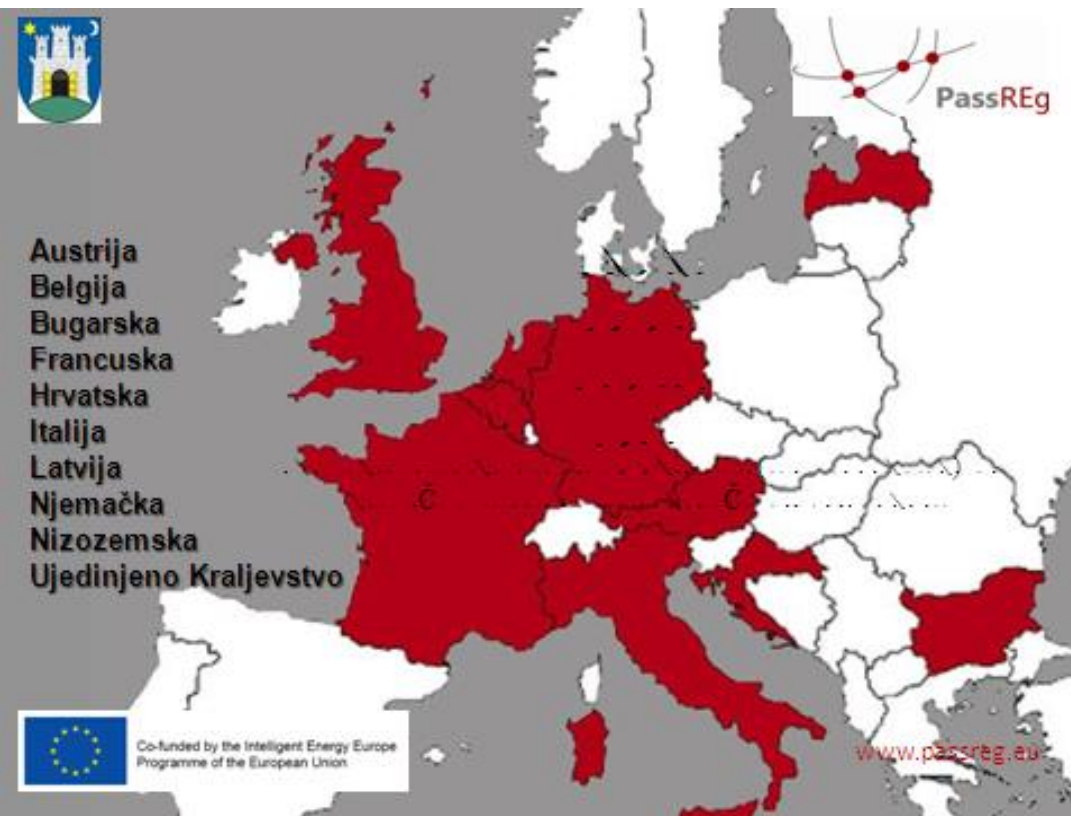


End Use Efficiency Research Group, Politecnico di Milano | Italy | [www.eerg.it](http://www.eerg.it)




Burgas Municipality | Bulgaria | [www.burgas.bg](http://www.burgas.bg)

Cover photo: Nieuw Zuid development in Antwerpen | Belgium © Studio Associato Secchi-Viganò



[www.passreg.eu](http://www.passreg.eu)



[THE PROJECT](#)
[MODELS](#)
[BEACONS](#)
[SOLUTIONS](#)
[EVENTS](#)
[NEWS](#)
[PASSIVE HOUSE + RENEWABLES](#)

## PassReg

### Passive House Regions with Renewable Energies

*A project supported by Intelligent Energy Europe triggering the successful implementation of Nearly Zero Energy Buildings (NZEBS) throughout the EU.*

14 Partners, 11 Countries, 3 Years, 1 Goal

**To show the way to EU goals for energy performance in buildings**

By considering successful models in regions throughout the EU, examining individual construction projects that arise within them and distilling and disseminating viable solutions, PassReg will

- Increase awareness
- Make best practice solutions accessible
- Build capacity and the necessary infrastructure
- Improve availability of suitable products and technologies
- Boost the numbers of buildings based on PassReg concepts


#### UPCOMING EVENTS ▶

**Upcoming Events**

☐ Int'l Passive House Conference  
2–6 May 2012

Int'l Passive House Days ▶  
9–11 November 2012


#### ☐ BEACON PROJECTS




#### JOIN THE PASSREG NETWORK ▶

Network Search ▶

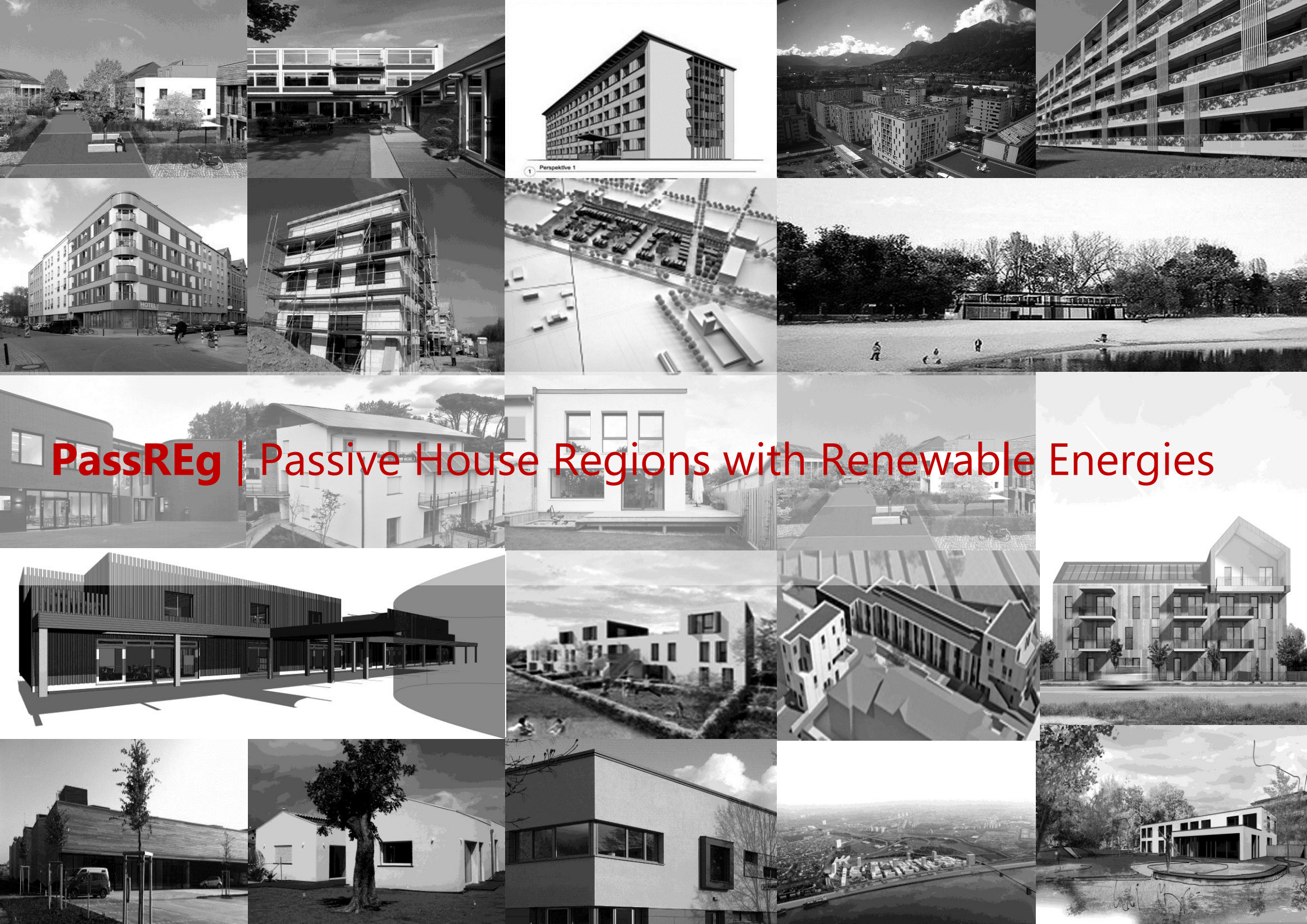
Login ▶

PassReg admin area 



**9–11 November 2012** PASSIVE HOUSE RESIDENTS OPEN THEIR HOMES:  
*International Passive House Days*







# Multi - functional public use passive house "Sunny" On the Lake Bunderk in Zagreb is choosed as referent Beacon project

2<sup>nd</sup> phase project, 2009 - 2012

Author: Lj. Mišćević





# Second International Contest **PASSIVE HOUSE AWARD** **2014**



**Organizer:**  
Passive House Institute  
Rheinstrasse 44/46  
6464 Darmstadt



Co-funded by the Intelligent Energy Europe  
Programme of the European Union





# Urban Development



Passive City District Bahnstadt,  
Heidelberg, Germany



# Urban Development

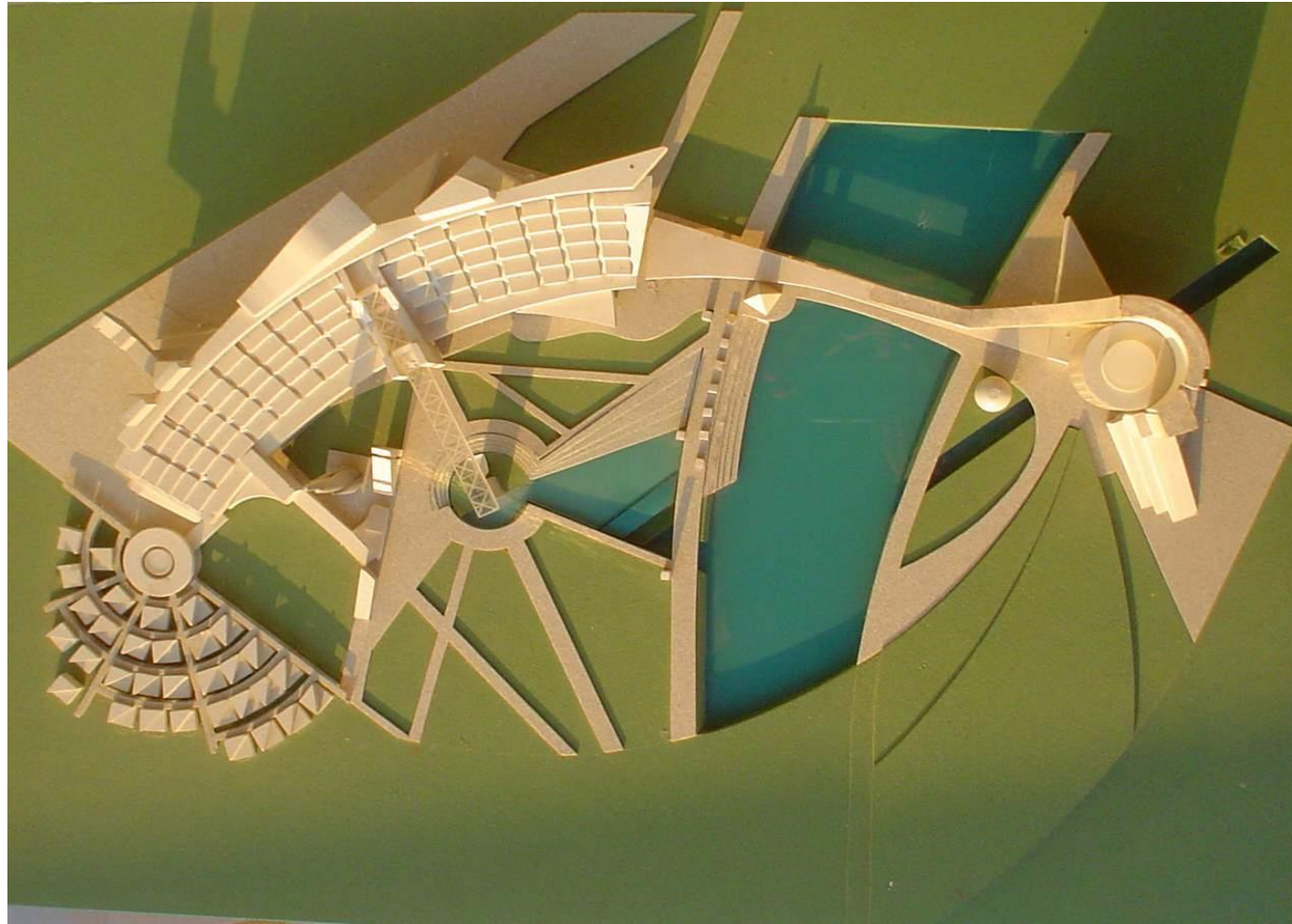


Passive City District Bahnstadt,  
Heidelberg, Germany



Special PassREg Award

# Intelligent and energy self-sufficient sustainable housing and office buildings complex **FUTURA INOVA**



International competition

Authors: Radovan Miščević and Ljubomir Miščević

The sign of the future, Haus der Architektur, Graz, 1993



# Solar city Zapresic

Project 2004 - 2005

Author of urban and architectural project:  
Prof. Ljubomir Mišćević, M. Arch.





# Energy and environmental rehabilitation of dwellings

Trnsko, Zagreb, 1985

International USA-HR project  
(DOE No. PN 777)

Coordinator: (UNI ZG AF):

Prof PhD Grozdan Knežević, M. Arch

Cooperators: (UNI ZG HR):

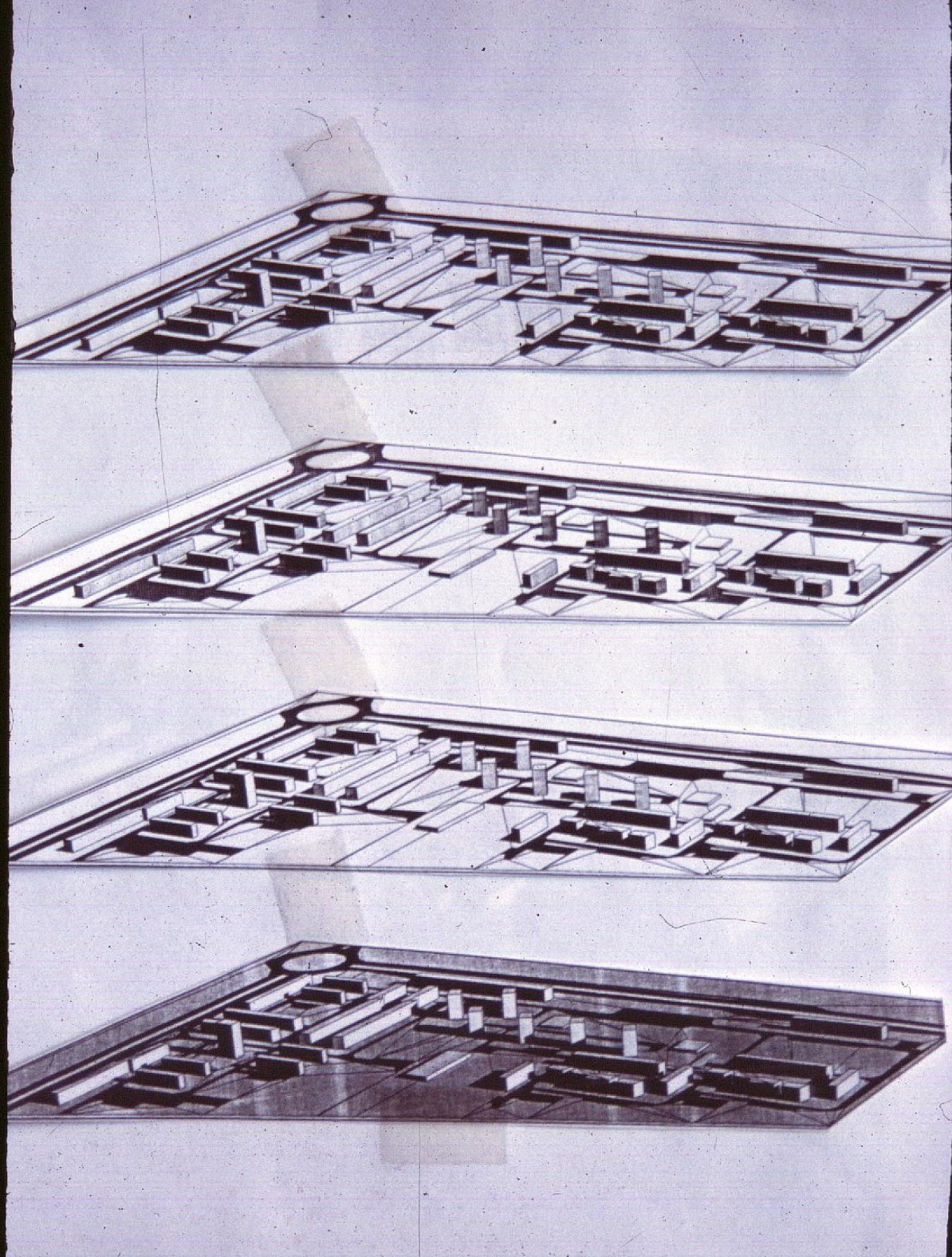
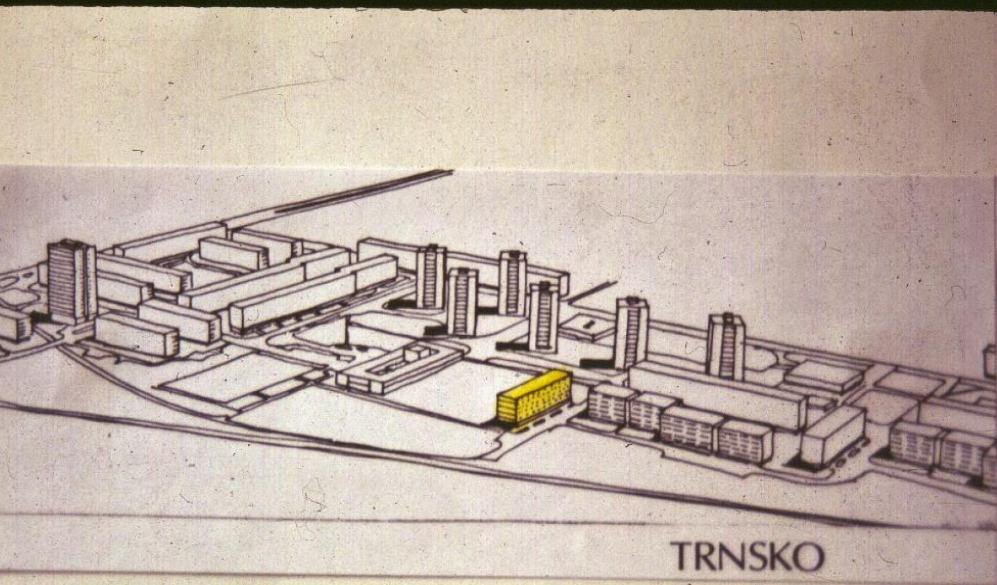
Prof. Ljubomir Mišćević, M. Arch

Prof PhD Bojan Baletić, M. Arch

Supervisor:

Prof PhD Vladimir Bazjanac, M. Arch

Lawrence Berkeley Nat. Lab, Ca, USA





Special Edition  
for the CEC DGXVII  
Solar Business Seminar  
Budapest, 24-25 August 1993

# SUN AT WORK IN EUROPE

Vol. **8** No. **3**  
August 1993

## PROJECT REPORTS

# Bioclimatic rehabilitation of dwellings in Croatia

Ljubomir Miscevic

*University of Zagreb, Faculty of Architecture, Kaciceva 26, 41000 Zagreb, Croatia*

### Introduction

Croatia is lacking in conventional sources of energy, but at the same time enjoys a virtually optimal climatic predisposition for the utilisation of solar energy through passive design, according to the estimates of the Commission of the European Community (1) and through an active installation system. Typical passive solar architectural elements were investigated: sunspaces, air collectors, heat storage, thermal storage walls of the Trombe-Michel type and so forth, on the basis of computer simulation of original software.

The first generation of contemporary passive solar architecture has confirmed the expected results of energy savings. The gap between applied architectural concepts, elements and systems, investment and execution levels for various functional types of architecture and the settings of locations, climate, urban regulation and research into the values of traditional and contemporary building is a solid foundation for further development, and use in both new building and rehabilitation.

### Passive solar family houses

Family housing in Croatia in which there has been practically no control over thermal insulation, takes around 70-80% of the total housing funds of the Republic. In the course of the war, over 220,000 housing units have been destroyed and damaged. Energy rational building, energy efficient architecture, ecological building and rehabilitation, the use of healthy materials and the application

of latest technologies are the obligation of each professional which must be accepted, solved and carried out.

The coming rehabilitation and further building requires prompt changes and improvement of the existing regulations concerning thermal insulation and building physics. New instructions, guidelines and regulations must bring thermal storage to the European level of standard for rational use of energy in buildings and must also draw on the experience of passive solar architecture. The present experiences of energy rational and efficient architecture in Croatia, based on professional research, software, architectural and technological solutions, may prove useful in renewal.

The passive solar family houses which are described here were designed by the author between 1985 and 1990. These four houses, identified as "P2", "V1", "M2", and "P3" differ in terms of their location, program and cost. They are situated between 45°48' and 46° 11'N, 15°55' and 16°50'E and between 100 and 175m elevation.

The passive solar performance of the buildings is simulated with computer programs BUMP 1 and BUMP 2. All designs demonstrate an attempt to maximise the benefits from insulation without sacrificing the formal and spatial characteristics of the particular site and the building design.



Fig. 1 House "P2" in Marija Bistrica 1985. South-east elevation and detail of the sunspace with massive stone wall







# Energy and environmental rehabilitation of dwellings

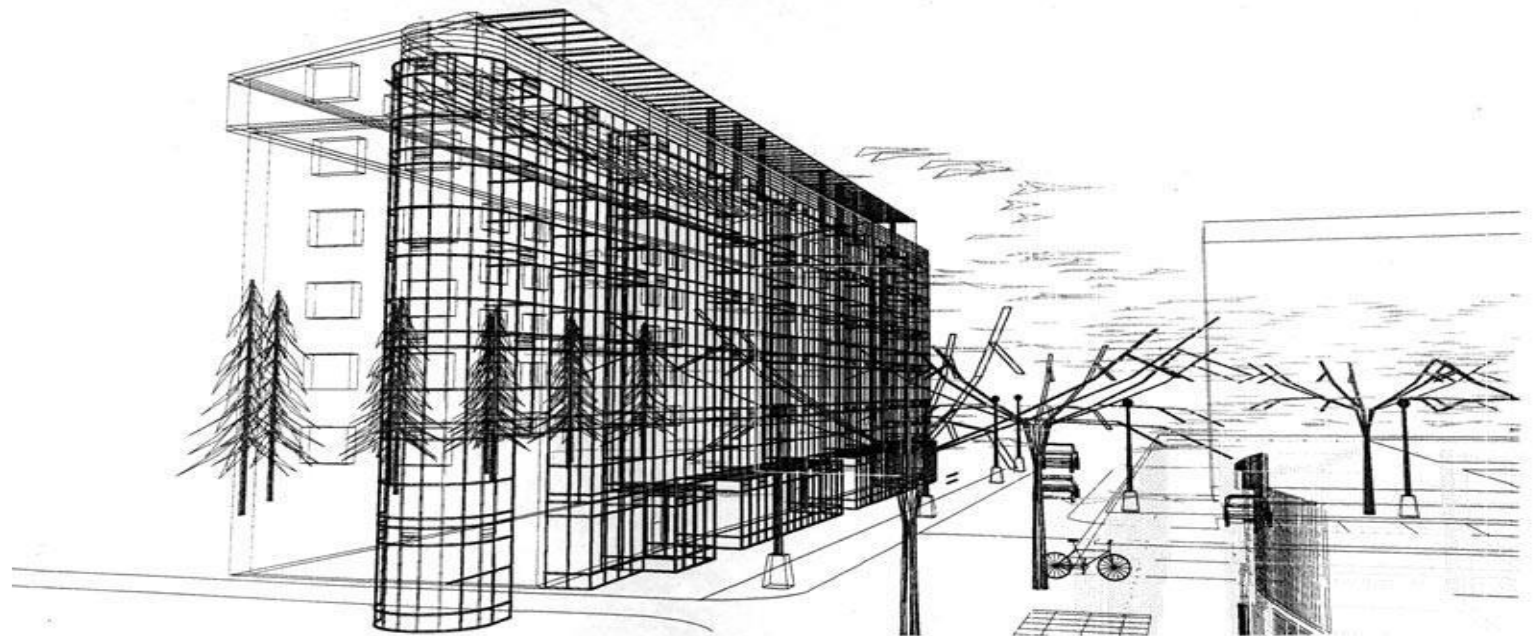
Trnsko, Zagreb, 1985

**International USA-HR project (DOE No. PN 777)**

University of Zagreb, Faculty of Architecture, Croatia &  
Lawrence Berkeley National Laboratory, USA,CA

**Author of design**

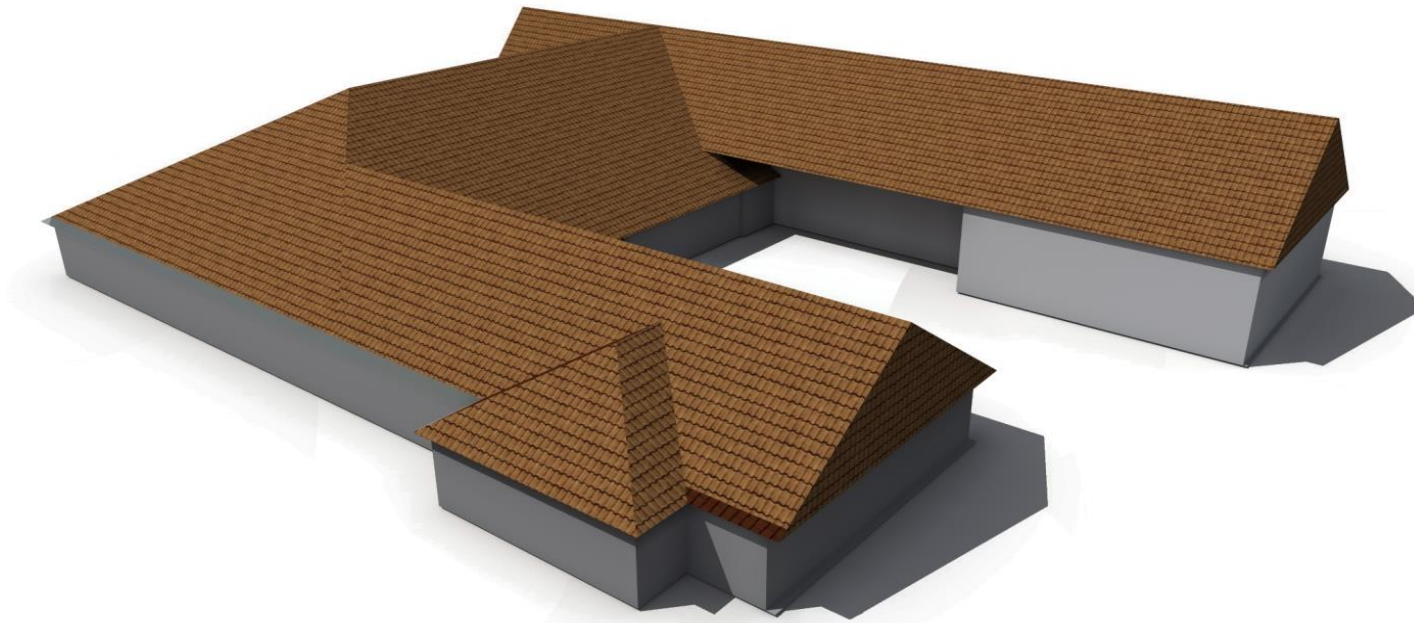
**prof. Ljubomir Mišćević. M. Arch**



# Sveučilišna knjižnica i ogranak knjižnice i čitaonice “Fran Galović”











13.-15.  
studen  
2015.

Arhitektonski  
fakultet

Fra Andrije  
Kačića  
Miošića 26

Zagreb

## 2. REGIONALNI

ZAGREB  
OSIJEK  
KOPRIVNICA  
ZADAR  
ŽMINJ  
SVETA NEDELJA  
STUPNIK

ZAJEDNIČKI  
SKYPE PROGRAM,  
PREDAVANJA,  
RADIONICE, IZLOŽBE  
I STRUČNI OBILASCI

# 8. DANI PASIVNE KUĆE U HRVATSKOJ

## 8<sup>th</sup> DAYS OF PASSIVE HOUSE IN CROATIA

[www.kpk.hr](http://www.kpk.hr)

[info@kpk.hr](mailto:info@kpk.hr)  
[pass-net@arhitekt.hr](mailto:pass-net@arhitekt.hr)  
[miscevic@arhitekt.hr](mailto:miscevic@arhitekt.hr)  
[www.arhitekt.hr](http://www.arhitekt.hr)  
01 4639-394  
01 4639-628





Sveučilište u Zagrebu  
**Arhitektonski fakultet**  
University of Zagreb  
**Faculty of Architecture**

**pass**net



Gradski ured za energetiku,  
zaštitu okoliša i održivi razvoj



# 8th PASSIVE HOUSE DAYS IN CROATIA

13th-15th November 2015

University of Zagreb, Faculty of Architecture  
Zagreb, Kačićeva 26

Info:

pass-net@arhitekt.hr miscevic@arhitekt.hr

[www.arhitekt.hr](http://www.arhitekt.hr) [www.kpk.hr](http://www.kpk.hr)

Phone/fax: (+385 1) 4639394







University in Zagreb, Faculty of Architecture

Full Prof. Ljubomir Mišćević, M. Arch.



Sveučilište u Zagrebu  
**Arhitektonski fakultet**  
 University of Zagreb  
**Faculty of Architecture**



KONZORCIJ PASIVNA  
 KUĆA HRVATSKA

[www.arhitekt.hr](http://www.arhitekt.hr) [miscevic@arhitekt.hr](mailto:miscevic@arhitekt.hr)

[www.kpk.hr](http://www.kpk.hr) [info@kpk.hr](mailto:info@kpk.hr)

# EU Targets

2020: 20% reduction in CO<sub>2</sub> (1990) and 20% renewables

2050: 80-95% reduction in CO<sub>2</sub>

## 2030 Targets (27<sup>th</sup> March 2014)

Reducing greenhouse gas emissions by 40%

GREEN PAPER  
A 2030 framework for  
climate and energy  
policies



Increasing the share of renewable energy to at least 27%

Continued improvements in energy efficiency



# Treća radionica – izrada i provedba Strategije niskougljičnog razvoja Republike Hrvatske za razdoblje do 2030. i s pogledom do 2050.

Hotel International Zagreb, 29.5.2015.

## Radionica ZGRADARSTVO

# Perspektive energetski gotovo nulte gradnje (Nearly Zero Energy Buildings – NZEB)

Red. prof. **Ljubomir Mišćević**, dipl. ing. arh.

Sveučilište u Zagrebu, Arhitektonski fakultet

Tel./fax: +385 1 4639394

**[miscevic@arhitekt.hr](mailto:miscevic@arhitekt.hr)**

**Af**



Sveučilište u Zagrebu  
**Arhitektonski fakultet**  
University of Zagreb  
**Faculty of Architecture**

[www.arhitekt.hr](http://www.arhitekt.hr)



Intelligent Energy Europe Programme  
of the European Union



KONZORCIJ PASIVNA  
KUĆA HRVATSKA

[www.kpk.hr](http://www.kpk.hr)



## BUILD UP Skills Croatia CROSKILLS



National roadmap  
for a lifelong learning of construction  
workers in the field of energy  
efficiency

[www.buildupskills.eu/hr](http://www.buildupskills.eu/hr)



INTELLIGENT ENERGY  
EUROPE



## BUILD UP Skills Croatia CROSKILLS



Energy training  
for builders

An initiative to boost the energy skills of Europe's  
building workforce

[www.buildupskills.eu](http://www.buildupskills.eu)



INTELLIGENT ENERGY  
EUROPE

### CROSKILLS, BUILD UP Skills Croatia

EC funded project, CIP IEE  
IEE/12/BWI/457/SI2.623227

Starting date: 7th June 2012

Project duration: 18 months

Coordinator:

University of Zagreb, Faculty of Civil  
Engineering

Project coordinator:

Prof.dr.sc. Ivana Banjad Pečur

Address:

Fra Andrije Kačića Miošića 26  
HR – 10000 Zagreb

Email:

[banjadi@grad.hr](mailto:banjadi@grad.hr)

Phone:

+385-1-4639-162

### Partners:



University of Zagreb, Faculty of Civil Engineering  
Fra Andrije Kačića Miošića 26, HR-10000 Zagreb



Ministry of Construction and Physical Planning  
Ulica Republike Austrije 20, HR-10000 Zagreb



Regional Environmental Center  
Ferde Livadića 35, HR-10000 Zagreb



Croatian Chamber of Trades and Crafts  
Ilica 49/II, p.p.166, HR-10000 Zagreb



School of Building and Crafts  
Sportska 1, HR-40000 Čakovec



University of Zagreb, Faculty of Architecture  
Fra Andrije Kačića Miošića 26, HR-10000 Zagreb



Knauf Insulation Ltd.  
Varaždinska 140, HR - 42220 Novi Marof



United Nations Development Programme Croatia  
Radnička 41/8, HR-10000 Zagreb

INTELLIGENT ENERGY  
EUROPE





## BUILD UP Skills - CROATIA CROSKILLS

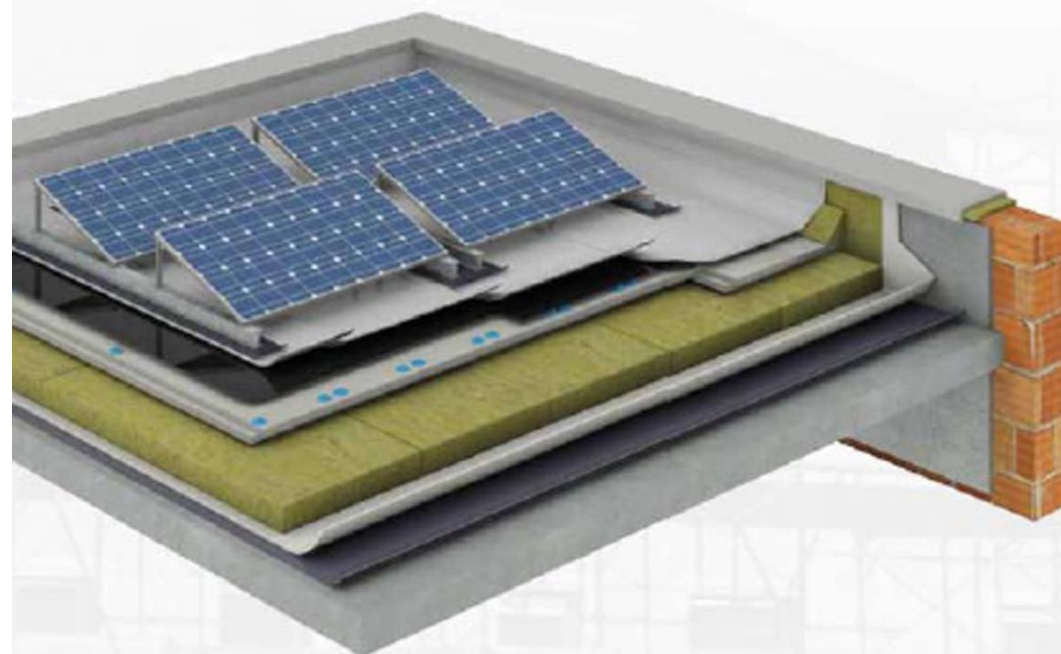


### STATUS QUO ANALYSIS OF THE BUILDING SECTOR IN CROATIA AND SKILLS OF CONSTRUCTION WORKERS IN THE FIELD OF ENERGY EFFICIENCY AND RENEWABLE SOURCES OF ENERGY

February 2013



## BUILD UP Skills - CROATIA CROSKILLS



### NATIONAL ROADMAP FOR A LIFELONG EDUCATION OF CONSTRUCTION WORKERS IN THE FIELD OF ENERGY EFFICIENCY

June, 2013