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MATERIJALI, ENERGIJA, ZGRADE

Doc.dr.sc. Bojan Milovanović dipl.ing.građ.



Projekt je sufinansiran Evropskim unijom iz Evropskog socijalnog fonda.
Sadržaj objavljenog materijala isključivo je odgovornost korisnika/partnera

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KONKRETNO!



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ANKETA

Green building survey...

<https://designer.voxvote.com/Account/Login>

Vote on live.voxvote.com PIN: 85170



Login with your account



Your Username Email



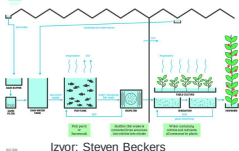
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Zelena gradnja? Da / Ne?

- **BIGH Farm** – Building integrated green house
- Staklenik na zgradi – uzgoj biljaka i ribe
- koristi otpadnu toplinu iz zgrade i CO2 za uzgoj biljaka i ribe koje prodaju u gradu i okolici
- Rekuperacija 60% otpadne topline – zapravo rooftop cooling tower
- 60 zaposlenih ljudi – „new chance in life people“
- Zero waste in terms of water
- U središtu Bruxelles-a – Midi station

Izvor: Steven Beckers
<https://bigh.farm/>

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Izvor: Steven Beckers
<https://bigh.farm/>






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Zelena gradnja? Da / Ne?

Gando Primary School

Ugrađena energija (Embodied energy) - info Izvor: https://en.wikipedia.org/wiki/Embodied_energy

Materijal	M3/kg	Materijal	M3/kg	Materijal	M3/kg	Materijal	M3/kg
Čelik	20,1	Armirani beton	1,9	Drvo sušeno na zraku	0,5	Glineni crijev	6,5
Aluminij	155	Opeka	2,5	Cementni mort (1:3)	1,33	Bale slame	0,91

Izvor:
https://www.moma.org/interactives/exhibitions/2010/small-scale-change/projects/primary_school.html




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20 Fenchurch Street, London - The Walkie Talkie

HIGHLIGHTS

- Thermographic surveys using the same technology as fire and rescue search teams, the thermal conductivity of the entire facade was checked and found to conform with existing heat loss performance standards.
- UK's largest green wall** providing a much-needed plant and insect ecosystem, an important habitat for nesting birds, and valuable green infrastructure.
- Low zero carbon (ZC) technologies. **Fixed mounted solar PV (photo voltaic) panels** are predicted to generate 27,300kWh of electricity per year.
- Certified **Sustainable Sourced concrete and structural steelwork** - all certified as Sustainably Sourced in accordance with the BRE Global Standard BES 6001 Responsible Sourcing of Construction Products.
- FSC certified timber - one of only 40 projects globally and 4th in the UK that have achieved this certification which recognises the **incorporation of wood products from responsibly managed forests** that provide environmental, social and economic benefits. 20 Fenchurch Street was a FSC Full Project for the shell, core and full fit-out of the Sky Garden and restaurants, common areas, the visitor suite, access building and levels 14, 15, 16, 17, 25, 26, 27.
- Recycling construction waste - 96.4%** all construction waste was diverted from landfill and either reused, recycled or recovered through a variety of onsite and offsite resource management processes. For example, all excavated material was reclassified under the CEMEX Code of Practice and was sent for use as fill material in an offsite land reclamation project. Unwanted timber pallets and packaging was re-used by an exporter of military memorabilia.
- Noise and air quality monitoring** - real time noise and dust monitoring stations were established during the construction process which were used to help the site team monitor and maintain noise and air quality within acceptable thresholds. The data was used to help inform a pioneering report on construction air quality within the City of London, in conjunction with City of London and Southbank University.

Additionally, 20 Fenchurch Street boasts the **first hydrogen fuel cell** to be installed in a commercial building in the City of London. The fuel cell, which will be switched on later this summer, produces heating cooling and electricity, generating 300kW of low carbon, low emissions electricity **reducing the building's carbon dioxide emissions by at least 270 tonnes per annum.**

Izvor: <https://www.breeam.com/case-studies/offices/20-fenchurch-street-london/>

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KOJI JE KRITERIJ ZA PROGLAŠENJE ZGRADE ZELENOM?

Znate li? Kratka diskusija...




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What makes a building green?

- The California Department of Resources Recycling and Recovery (CalRecycle)

A structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner.

Green buildings are designed to meet certain objectives such as protecting occupant health; improving employee productivity; using energy, water and other resources more efficiently; and reducing the overall impact to the environment.

- Izvor: Sam Kubba: Handbook of Green Building Design and Construction




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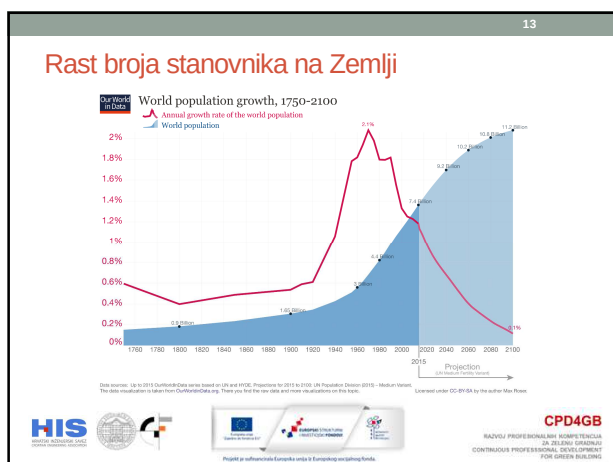
ZAŠTO?

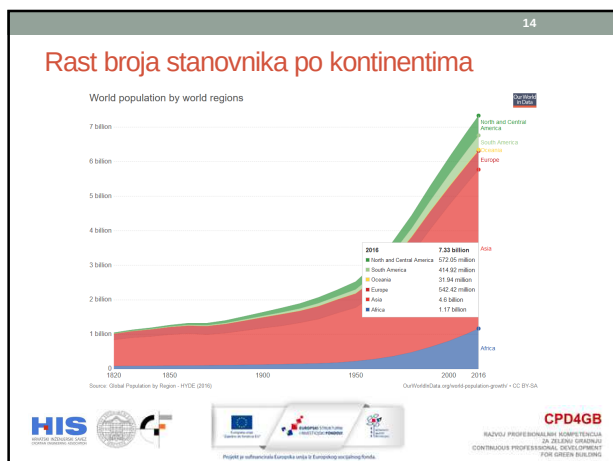



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Stanje u svijetu...

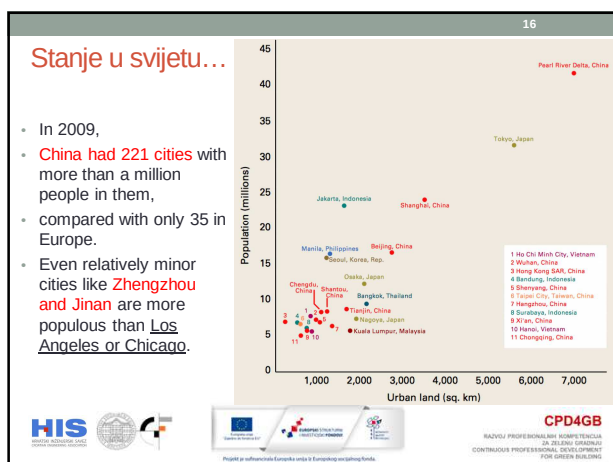
- By **2020**, China hopes to move **100 million people** from the country's farming regions into cities!!!
- By **2026**, it hopes to move **250 million!!!**
 - "National New-type Urbanization Plan (2014-2020)."
 - Izvor: Chris Weller; Aug. 4, 2015
- Što znači da cca 450000 ljudi tjedno dolazi u gradove!!!**
- The 2020 plan calls for:
 - major extensions to railways and expressways so that all cities with more than 200,000 people are connected.
 - High-speed rail will join cities with at least 500,000 people.
 - Housing

OurWorldData.org

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The King Abdullah Economic City, (KAEC, pronounced "cake")

- The new city will cost **\$100bn to complete**
- When completed KAEC will be **larger than Washington DC (2 million people)**
- due to be completed in 20 years
- Only 15% of the city has been finished so far

Izvor: Sylvia Smith BBC News, Saudi Arabia; 20.03.2015 (<http://www.bbc.com/news/world-middle-east-31867727>)



<https://www.kaec.net/>



Haramain railway station
Sir Norman Foster

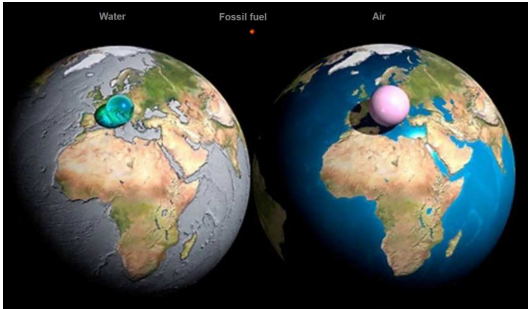


KAEC's Central Business District in November 2013

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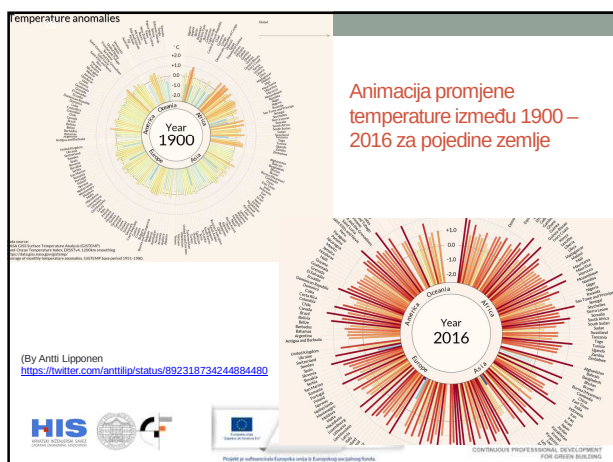
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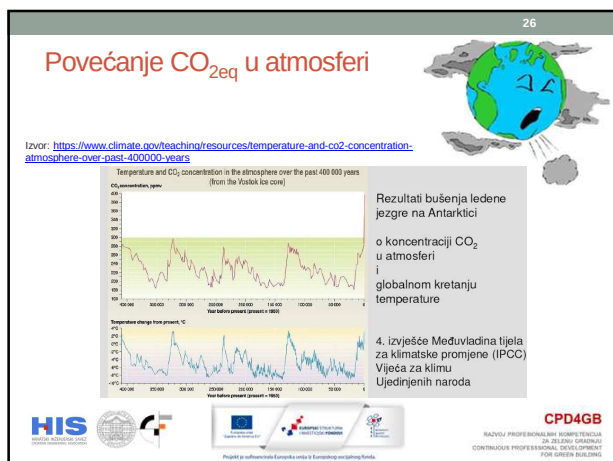
Dostupni resursi – voda, zrak, fosilna goriva



Water Fossil fuel Air

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Urban resilience

Izvor:

100 Resilient Cities—Pioneered by The Rockefeller Foundation (100RC)

“the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience.”

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Resilient buildings

- Kako se građevine (sadašnje ili buduće) mogu prilagoditi promjenama u njihovom okolišu?
- Resilience?
 - Tolerirati, prevladati... ispadi struje, klimatske extreme, promjene klime, itd.
- Resilient - Jesu li to i zgrade male potrošnje energije?
 - Ostat će tople danima, svakako iznad temperature pothlađivanja
 - Treba malo topline za dodatno grijanje

Izvor:
<https://www.timesunion.com/news/slideshow/The-Northeast-Blackout-of-2003-47515.php>



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ŠTO POKUŠAVAMO PODUZETI?

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PRINCIPI ZELENE GRADNJE



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Principi ocjenjivanja

- Ovisno o sustavu ocjenjivanja postoje razlike i različiti fokusi, ali okvir je zapravo isti...
 - Optimizirati potencijal prostora
 - Optimizirati korištenje energije
 - Zaštititi i očuvati vode
 - Koristiti proizvode s minimalnim utjecajem na okoliš
 - Povećati kvalitetu unutarnjeg okoliša
 - Optimizirati korištenje i održavanje

Današnje teme



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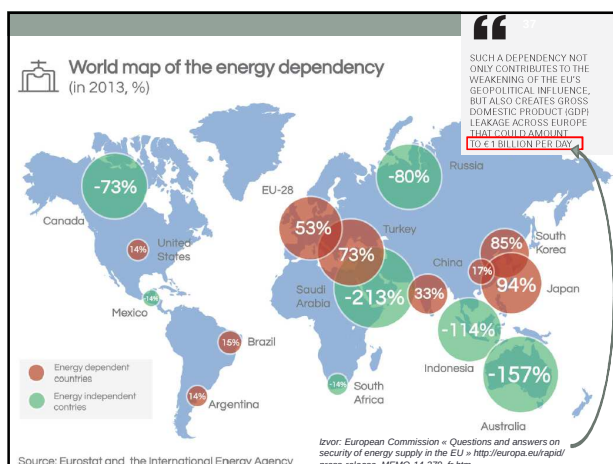
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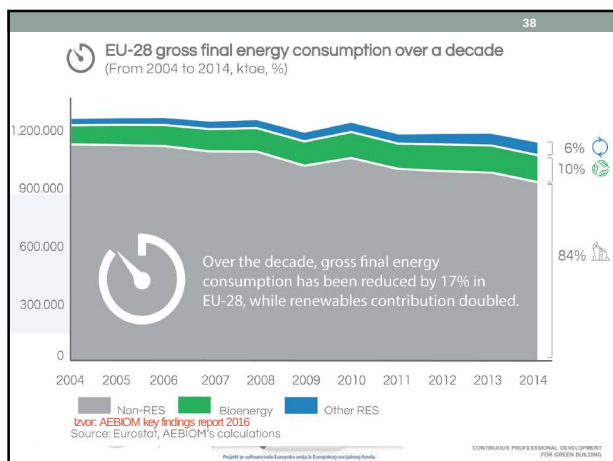
MOŽEMO LI TROŠITI MANJE ENERGIJE?

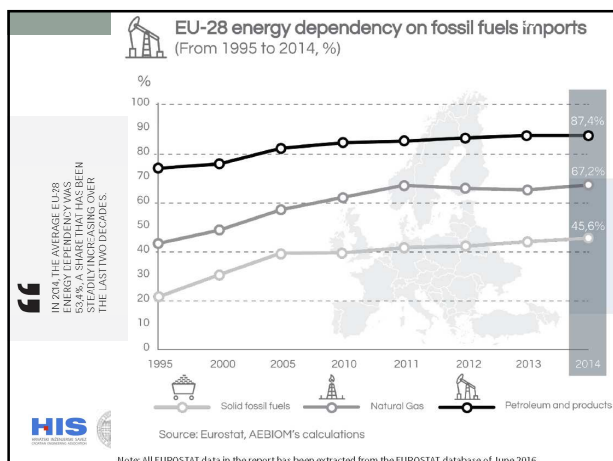


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Thomas A. Edison, 1916.

„Treba znati iskoristiti prirodne sile i na taj način dobiti svu potrebnu energiju.

Sunčeve zrake su oblik energije, vjetar i morske struje su također energija.

Koristimo li ih?

O, ne! Palimo šume i ugljen, kao da podstanari pale ulazna vrata naše kuće za grijanje.

Živimo kao divlji doseljenici koji ne shvaćaju da ova bogatstva pripadaju svima nama.“



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OIE

- Danska vlada je postavila cilj da do 2050. koristi samo obnovljive izvore u proizvodnji energije.

Are Denmark's renewable energy goals wishful thinking?

By Paul Moss
The World Tonight



Huge investment will be needed if the Danish government's goals are to be met.

The politician wanted to make one thing absolutely clear. "We are not," she said, "just hippies."

Related Stories



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Environment

Solar panels surpass coal-fired electricity in previously 'unthinkable' feat

For six months until September, more electricity came from sunlight than coal-fired power stations

via [Twitter](#) [Facebook](#) [LinkedIn](#) [Reddit](#) [StumbleUpon](#) [VK](#) [Email](#) [Print](#) [Share](#)

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Solar panels generated more electricity than coal in the past six months in a historic year for getting energy from the sun in the UK, according to a new analysis.

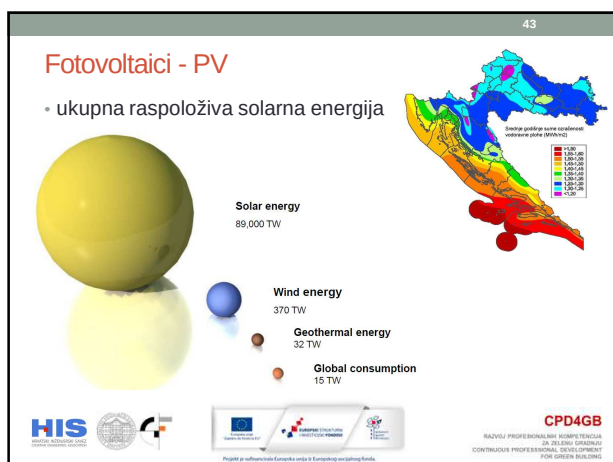
Research by the [Carbon Brief website](#) found that solar generated nearly 7,000 gigawatt hours of electricity between April and September, about 10 per cent more than the 6,300GWh produced by coal during the same period.

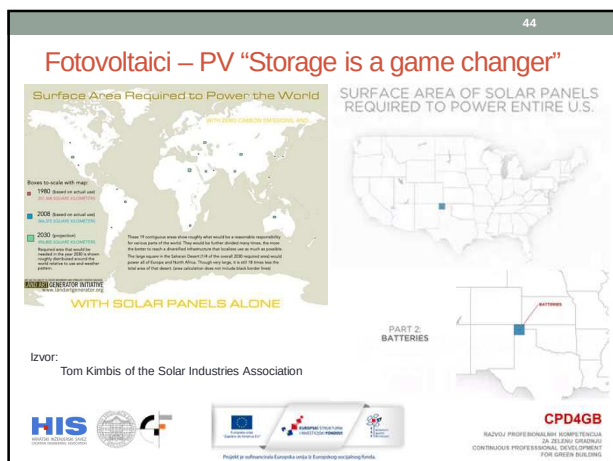
The figures represent a dramatic turnaround in the UK's electricity supplies.

The first ever day when solar produced more than coal was only on 9 April – when there was no coal-fired electricity for the first time since 1882. But then May became the first ever month when this happened.



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Baterija

- Elon Musk produced fireworks on May 1st, 2015, when he announced that Tesla, will soon start selling batteries to power homes and businesses.
- The products—which run about **\$3,500 (10 kWh)** for Powerwall home systems and about **\$25,000** for Power Pack business systems
- Kućanstva Dubrovačke županije troše najviše struje u RH,
 - u prosjeku **4.200 kWh/godišnje** → **11,5 kWh/dnevno**

Technology
Vital mounted, rechargeable lithium ion battery with liquid thermal control.

Model
15 kWh \$3,500
For battery applications
7 kWh \$2,000
For daily cycle applications

Warranty
10 years

Efficiency
92% round-trip DC efficiency

Power
2.0 kW continuous, 3.3 kW peak

Voltage
300–450 volts

Current
5.8 amp nominal, 8.8 amp peak output

Compatibility
Single phase and three phase utility grid compatible

Operating Temperature
-4°F to 113°F / -20°C to 43°C

Enclosure
Rated for indoor and outdoor installation. Requires installation by a trained electrician. DC-AC inverter not included.

Weight
225 lbs / 100 kg

Dimensions
61.2" x 12.4" x 7.1"
1500 mm x 860 mm x 180 mm

Certification
UL1973, listed to UL standards

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Primjer - Las Vegas

City of Las Vegas plans to go to 100 percent renewable energy

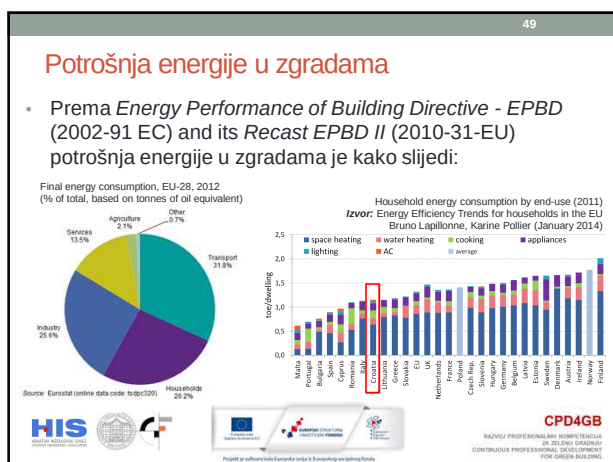
- Mayor Carolyn Goodman announced **Las Vegas** would be the first city of its size to be powered by 100 percent renewable energy.
 - "Every city light, city park, community center, fire station and service yard will be 100 percent covered by renewable energy."
- "It's cheaper than what we could build a new natural gas plant for."
- The city says new efforts will **save** the city an additional **\$250,000 a year** and will offset the cost for the new solar energy and the other existing renewables.



Mayor Carolyn Goodman speaks during a press conference with NV Energy at Las Vegas City Hall on November 24, 2015.

By Kyle Roerick (contact)
Tuesday, Nov. 24, 2015 | 1:35 p.m.

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US Green Building Council



90% do **100x**

vremena provodimo u zatvorenom prostoru veća koncentracija štetnih tvari u zatvorenom prostoru

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GRAĐEVINSKA FIZIKA

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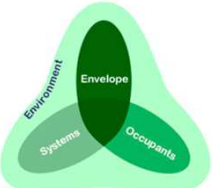
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Građevinska fizika

- primijenjena znanost o:
 - higrotermalnim,
 - akustičnim i
 - problemima povezanim sa osvijetljenjem
- kod građevinskih dijelova, prostorija i cjelokupnih građevina

• CILJ

- razumijevanje načina na koji **zgrada, korisnici, unutarnji okoliš te vanjski okoliš zgrade** međusobno djeluju.



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Građevinska fizika

*"Building physics is the **cornerstone** of designing, constructing, and operating **high performance buildings**, that is, buildings that are durable, comfortable, energy efficient, affordable and healthy."*

Izvor: www.buildingscience.com

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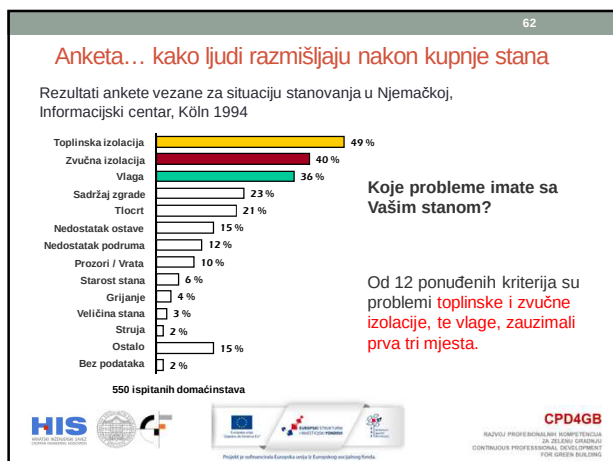
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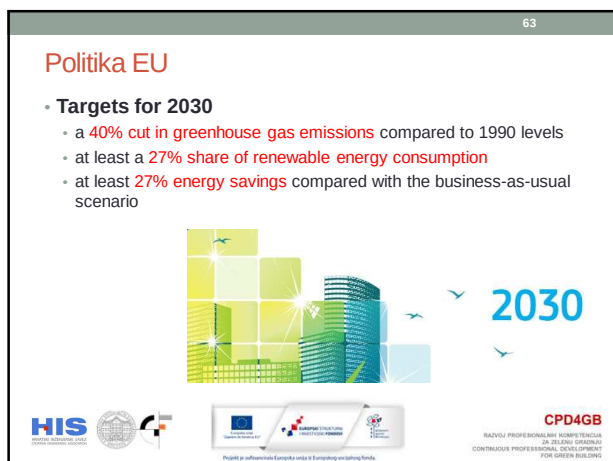
Green building survey...

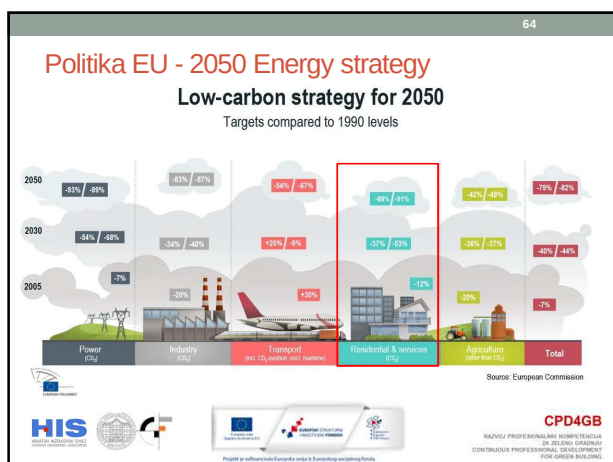
Samo pritisnite: **Reconnect**

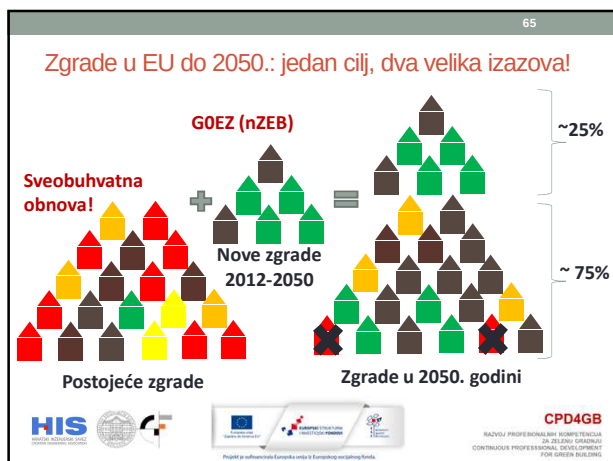
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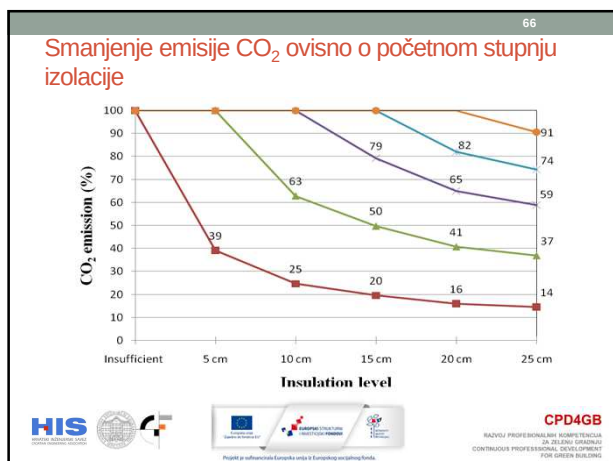








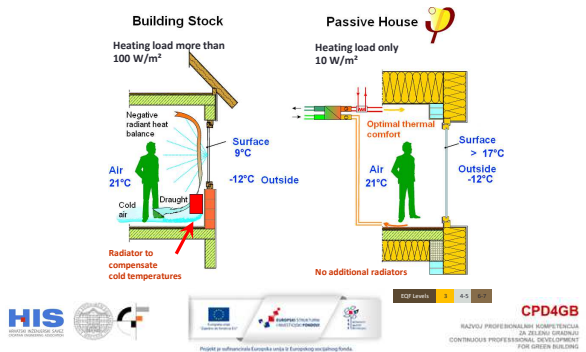




Toplinska ugodnost u zgradi

Tipična zgrada **vs** Pasivna kuća

Source: Passive House Institute



ENERGETSKA OBNOVA

Socijalni aspekti?



Problemi

- Izvođenje radova
 - Buka gradilišta
 - Trajanje radova
 - Ometanje života stanara
 - Ometanje života u okolnim zgradama
 - Potencijalna potreba izmještanja stanara
 - Potencijalno ponavljanje istih problema - step-by-step obnova
 - Zgrada iz registra kulturne baštine
 - Mogu li svi stanari financijski „podnijeti“ investiciju?
- Dvojba
 - je li gradnja zelena ako smanjim potrošnju energije, ali smanjujem socijalnu kvalitetu i sigurnost stanara tijekom izvođenja radova?



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Primjer - Wohnanlage Linz-Makartstrasse



Izgradnja 1957.
179 kWh/m²a
CO₂ = 160 t/a

Obnova 2005/06.
14,4 kWh/m²a
CO₂ = 14 t/a

Izvor: ARCH+MORE ZT GmbH, Arch.-Dipl.-Ing. Gerhard Koppenh
SUSTAINABLE REMEDIATION – OUR CHALLENGE AND OPPORTUNITY FOR THE FUTURE! CEI conference "Energy Efficiency in Buildings - for a Better Tomorrow"

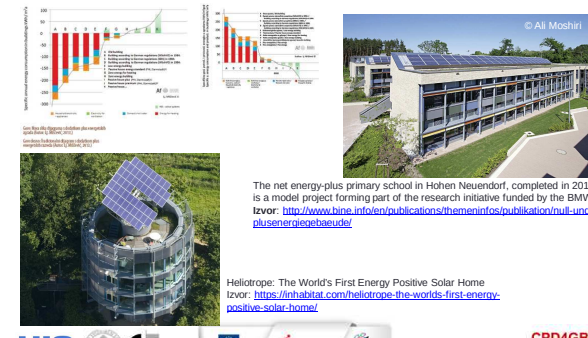
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Kuće postaju proizvođači – „energane“



The net energy-plus primary school in Hohen Neuendorf, completed in 2011, is a model project forming part of the research initiative funded by the BMWi.
Izvor: <http://www.bine.info/en/publications/themeninfos/publikation/null-und-plusenergiebaeude>

Heliotrope: The World's First Energy Positive Solar Home
Izvor: <https://inhabitat.com/heliotrope-the-worlds-first-energy-positive-solar-home/>

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Zgrada gotovo nulte energije - „ZG0E“

- jest zgrada koja ima vrlo visoka energetska svojstva.
- Ta gotovo nulta odnosno **vrlo niska količina energije podmiruje se iz obnovljivih izvora**, uključujući energiju iz obnovljivih izvora koja se proizvodi **na zgradi ili u njezinoj blizini**.
- Od 31. prosinca 2020. sve nove zgrade moraju biti „ZG0E“;
- a nakon 31. prosinca 2018. nove zgrade koje koriste tijela javne vlasti odnosno koje su u vlasništvu tijela javne vlasti moraju biti „ZG0E“.

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FOR GREEN BUILDING

Projekt je sufinansiran Europskim centrom za Europskoj razvojnoj fond.

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19th Century 20th Century 21st Century

HOUSE HEATING SYSTEMS: A BRIEF HISTORY
ALBERT, RIGHTER & TITTMANN ARCHITECTS, INC.

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OIE su šlag na tortu, ne torta!

Izvor: www.ic-group.org

- The 'Plus-Energie-Bürohochhaus' (plus-energy-office high-rise building) is the world's first office tower that can claim to feed more energy into the power grid than is required to operate AND use the building.

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Ne zaboraviti na druge aspekte...

- Npr...
- Proizvodnja PV sustava
 - Velika ugrađena energija
 - Otrovni spojevi
 - Problem recikliranja
- S druge strane...
 - Proizvedena energija poništi ugrađenu za manje od 2,5 g.

Embodied energy: Izvor: https://en.wikipedia.org/wiki/Embodied_energy

Photovoltaic (PV) Cells Type	Energy MJ per m ²	Carbon kg CO ₂ per m ²
Monocrystalline (average)	4750	242
Polycrystalline (average)	4070	208
Thin film (average)	1305	67

Fig. 4. Energy payback time of commercial crystalline silicon PV systems showing sensitivity to electricity mix, irradiation 1700 kWh/m²/year.

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