Pokrovitelj

REPUBLIKA HRVATSKA
Ministarstvo gospodarstva i održivog razvoja

Organizator

LIDER

Partner

SIEMENS energy

Hrvatska energetska tranzicija – Prilika za održiv energetski sustav

dr.sc. Goran Krajačić, izvanredni profesor, Fakultet strojarstva i brodogradnje Sveučilišta u Zagrebu

HRVATSKA ENERGETSKA TRANZICIJA

UNIVERSITY OF ZAGREB
FACULTY OF MECHANICAL ENGINEERING AND NAVAL ARCHITECTURE
DEPARTMENT OF ENERGY, POWER AND ENVIRONMENTAL ENGINEERING

plinacro

Apsolon
e·on
Marsh
MOLGROUP
PPD
HEP
INA
JANAF
PEUGEOT

Pogled u prošlost!

forum
TJEDNIK OD RIJEČI

Pretraga

Nema senzacionalizma. | Bez tračeva. | Bez šutila. | Činjenice, a ne spinovi. | Nema neododirljivih ni tabu tema. | Pišemo, ne prepisujemo.

Energija

Čovjek s vizijom Hrvatske 2050. koju pokreću samo vjetar, sunce i voda

Piše

Sergej Žunanić

fotografija

Jurica Galoić/Pixell

Četvrtak 12.Travanj 2012.

Model koji je već primijenjen u Danskoj, pokazuje da naftno doba neće nestati tek kad nestane nafte

ELSEVIER

Energy
Volume 73, 14 August 2014, Pages 875-889

A roadmap for repowering California for all purposes with wind, water, and sunlight

Mark Z. Jacobson [a], Mark A. Delucchi [b], Anthony R. Ingraffea [c, d], Robert W. Howarth [e], Guillaume Bazouin [a], Brett Bridgeland [a], Karl Burkart [f], Martin Chang [a], Navid Chowdhury [a], Roy Cook [a], Giulia Escher [a], Mike Galka [a], Liyang Han [a], Christa Heavey [a], Angelica Hernandez [a], Daniel F. Jacobson [g], Dionna S. Jacobson [g], Brian Miranda [a], Gavin Novotny [a], Marie Pellat [a], Patrick Quach [a], Andrea Romano [a], Daniel Stewart [a], Laura Vogel [a], Sherry Wang [a], Hara Wang [a], Lindsay Willman [a], Tim Yeskoo [a]

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[b] Institute of Transportation Studies, U.C. Davis, 1605 Tilia St, Davis, CA 95616, USA
[c] Department of Civil and Environmental Engineering, Cornell University, 220 Hollister Hall, Ithaca, NY 14853, USA
[d] Physicians, Scientists, and Engineers for Healthy Energy, Inc., 436 14th Street, Suite 808, Oakland, CA 94612, USA
[e] Department of Ecology and Evolutionary Biology, Cornell University, E145 Corson Hall, Ithaca, NY 14853, USA
[f] K2B Digital, 2658 Griffith Park Blvd., Suite 612, Los Angeles, CA 90039, USA
[g] H.M. Gunn Senior High School, 780 Arastradero Rd, Palo Alto, CA 94306, USA

Received 16 December 2013, Revised 21 June 2014, Accepted 26 June 2014, Available online 22 July 2014.

Možemo li bez fosilnih goriva i nuklearne energije?

Contents lists available at ScienceDirect

Applied Energy

journal homepage: www.elsevier.com/locate/apenergy

Zero carbon energy system of South East Europe in 2050

D.F. Dominković [a,*], I. Bačeković [b], B. Ćosić [c], G. Krajačić [c], T. Pukšec [c], N. Duić [c], N. Markovska [d]

[a] Technical University of Denmark, Department of Energy Conversion and Storage, Frederiksborgvej 399, Roskilde, Denmark
[b] Aalborg University, Aalborg, Denmark
[c] Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Zagreb, Croatia
[d] Macedonian Academy of Sciences and Arts, Skopje, Macedonia

HIGHLIGHTS

- 100% renewable energy system of the South East Europe has been achieved.
- Sector integration makes the zero carbon system cheaper compared to the base year.
- Numerous renewable technologies needed to achieve zero carbon in the year 2050.
- Energy efficiency is a crucial part in a transition to the zero carbon energy system.
- No technology has a larger share than 30%; increased security of energy supply.

ARTICLE INFO

Article history:
Received 23 November 2015
Received in revised form 26 February 2016
Accepted 14 March 2016
Available online 19 March 2016

Keywords:
Smart energy system
Renewable energy system
Zero carbon
South East Europe
Sustainable biomass
Energy efficiency

ABSTRACT

South East Europe is the region in a part of Europe with approximately 65.5 million inhabitants, making up 8.9% of Europe's total population. The countries concerned have distinct geographical features, various climates and significant differences in gross domestic product per capita, so the integration of their energy systems is considered to be a challenging task. Large differences between energy mixes, still largely dominated by fossil-fuel consumption, make this task even more demanding.

This paper presents the transition steps to a 100% renewable energy system which need to be carried out until the year 2050 in order to achieve zero carbon energy society. Novelty of this paper compared to other papers with similar research goals is the assumed sustainable use of biomass in the 100% renewable energy system of the region considered. It is important to emphasize here that only the sustainable use of biomass can be considered carbon-neutral. The resulting biomass consumption of the model was 725.94 PJ for the entire region, which is in line with the biomass potential of the region. Modelling the zero-carbon energy system was carried out using the smart energy system concept, together with its main integration pillars, i.e. power-to-heat and power-to-gas technologies. The resulting power generation mix shows that a wide variety of energy sources need to be utilized and no single energy source has more than a 30% share, which also increases the security of supply. Wind turbines and photovoltaics are the main technologies with shares of 28.9% and 22.5%, followed by hydro power, concentrated solar power, biomass (mainly used in cogeneration units) and geothermal energy sources. To keep the biomass consumption within the sustainability limits, there is a need for some type of synthetic fuel in the transportation sector. Nevertheless, achieving 100% renewable energy system also promises to be financially beneficial, as the total calculated annual socio-economic cost of the region is approximately 20 billion euros lower in the year 2050 than in the base year. Finally, energy efficiency measures will play an important role in the transition to the zero-carbon energy society: the model shows that primary energy supply will be 50.9% lower than in the base year.

PV: 65 GW
Wind: 50 GW
CSP: 11 GW
Dammed hydro: from 18.8 to 23.5 GW

Joule

Volume 1, Issue 1, 6 September 2017, Pages 108-121

Article

100% Clean and Renewable Wind, Water, and Sunlight All-Sector Energy Roadmaps for 139 Countries of the World

Mark Z. Jacobson [1,5], Mark A. Delucchi [2], Zack A.F. Bauer [1], Savannah C. Goodman [1], William E. Chapman [1], Mary A. Cameron [1], Cedric Bozonnat [1], Liat Chobadi [3], Hailey A. Clonts [1], Peter Enevoldsen [4], Jenny R. Erwin [1], Simone N. Fobi [1], Owen K. Goldstrom [1], Eleanor M. Hennessy [1], Jingyi Liu [1], Jonathan Lo [1], Clayton B. Meyer [1], Sean B. Morris [1], Kevin R. Moy [1], Patrick L. O'Neill [1], Ivalin Petkov [1], Stephanie Redfern [1], Robin Schucker [1], Michael A. Sontag [1], Jingfan Wang [1], Eric Weiner [1], Alexander S. Yachanin [1]

[1] Atmosphere/Energy Program, Department of Civil and Environmental Engineering, Stanford University, Stanford, CA, USA
[2] Institute of Transportation Studies, University of California at Berkeley, Berkeley, CA, USA
[3] School of Planning, Building, and the Environment, Technical University of Berlin, Berlin, Germany
[4] Centre for Energy Technologies, BTECH, Aarhus University, Aarhus, Denmark

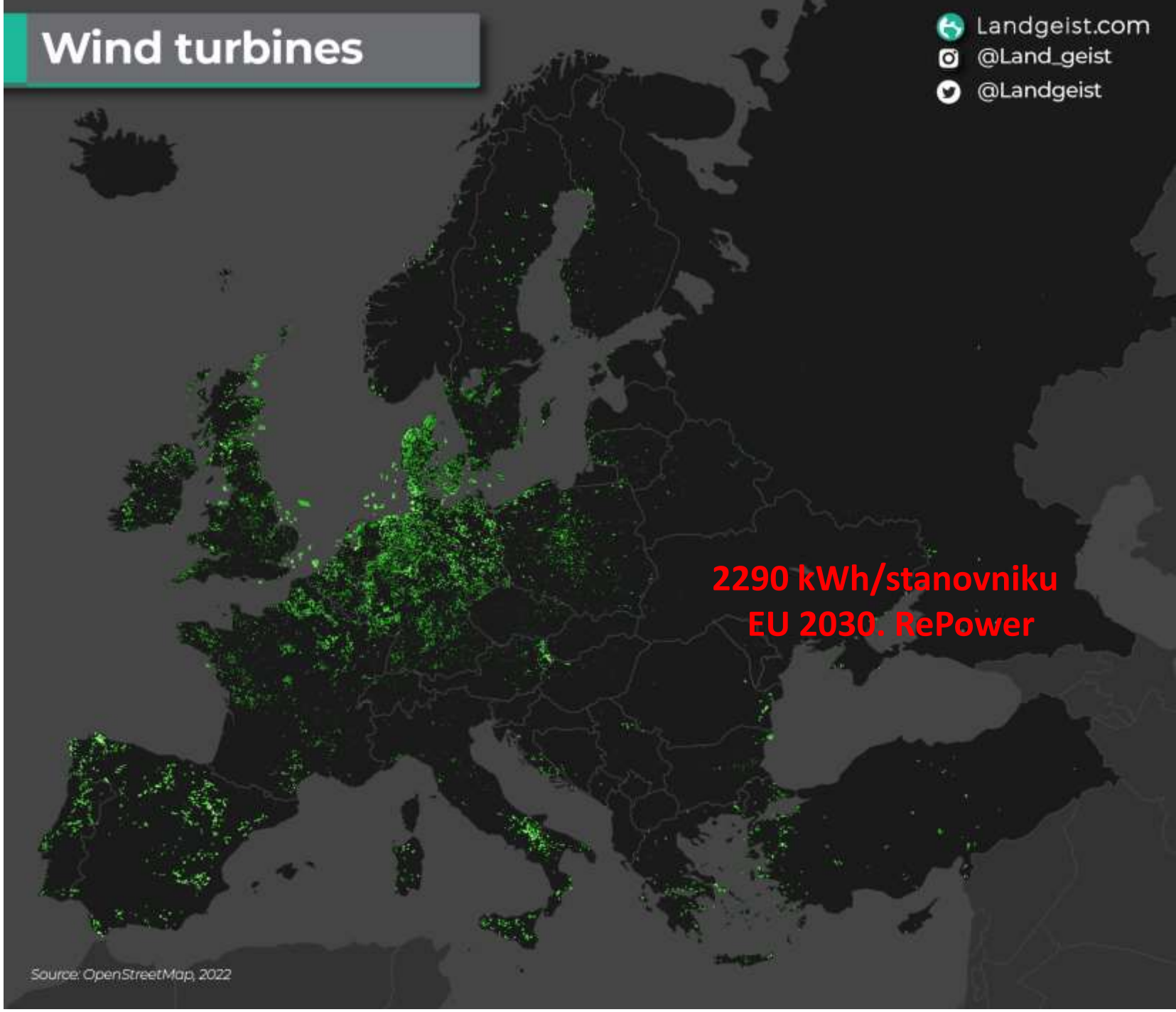
Received 13 February 2017, Revised 11 April 2017, Accepted 7 July 2017, Available online 23 August 2017, Version of Record 6 September 2017.

Published: August 23, 2017

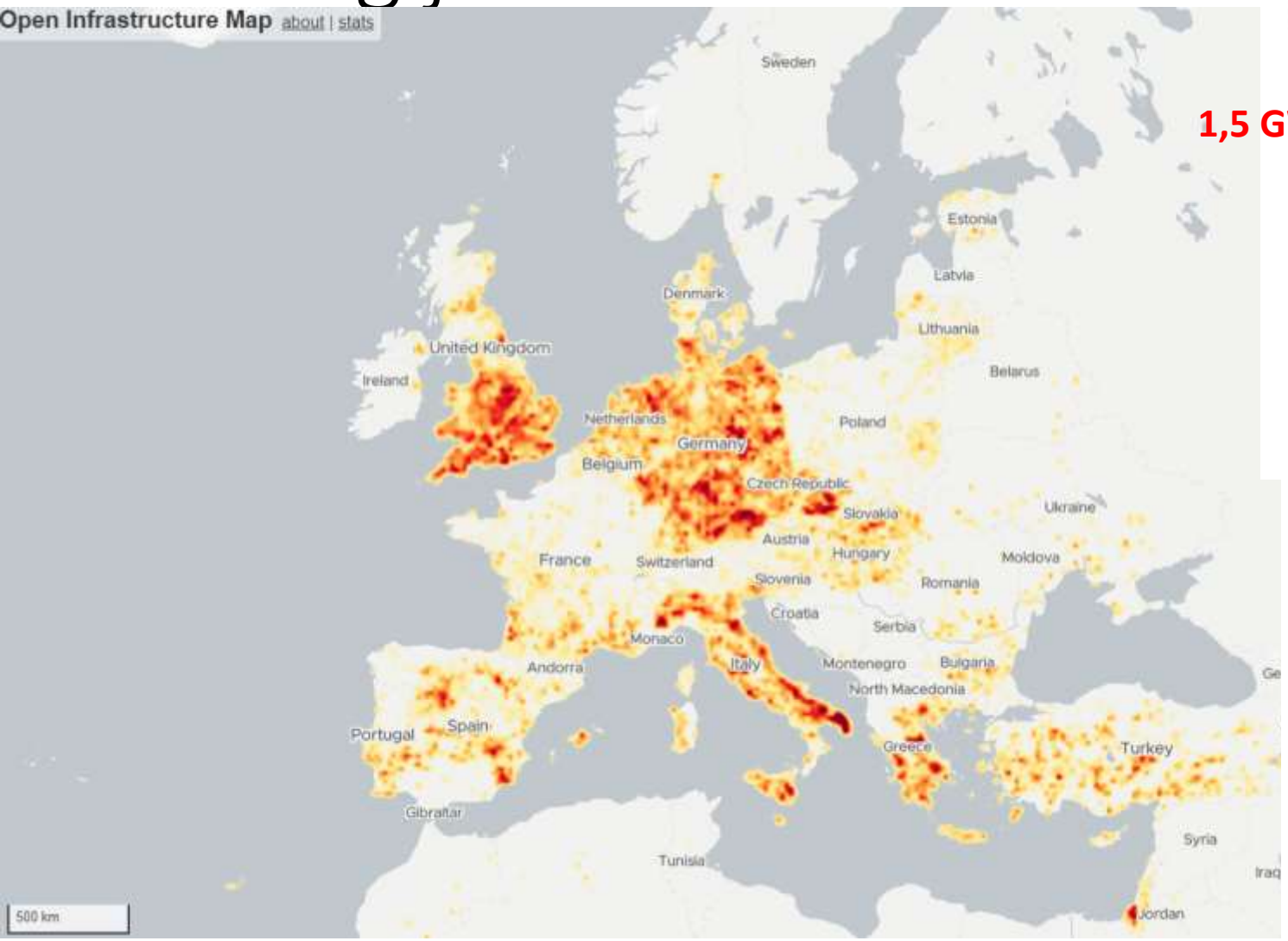
Vjetroelektrane 2021.

Gledano statistički u 2021. godini je u vjetroelektranama proizvedeno električne energije:

Danska 2749 kWh/stanovniku,
Irska 2019 kWh/stanovniku,
Njemačka 1381kWh/stanovniku
Portugal 1295 kWh /stanovniku,
Austrija 719 kWh/stanovniku.
Hrvatska 514 kWh/stanovniku,
Mađarska 70 kWh / stanovniku
Slovenija 5 kWh / stanovniku



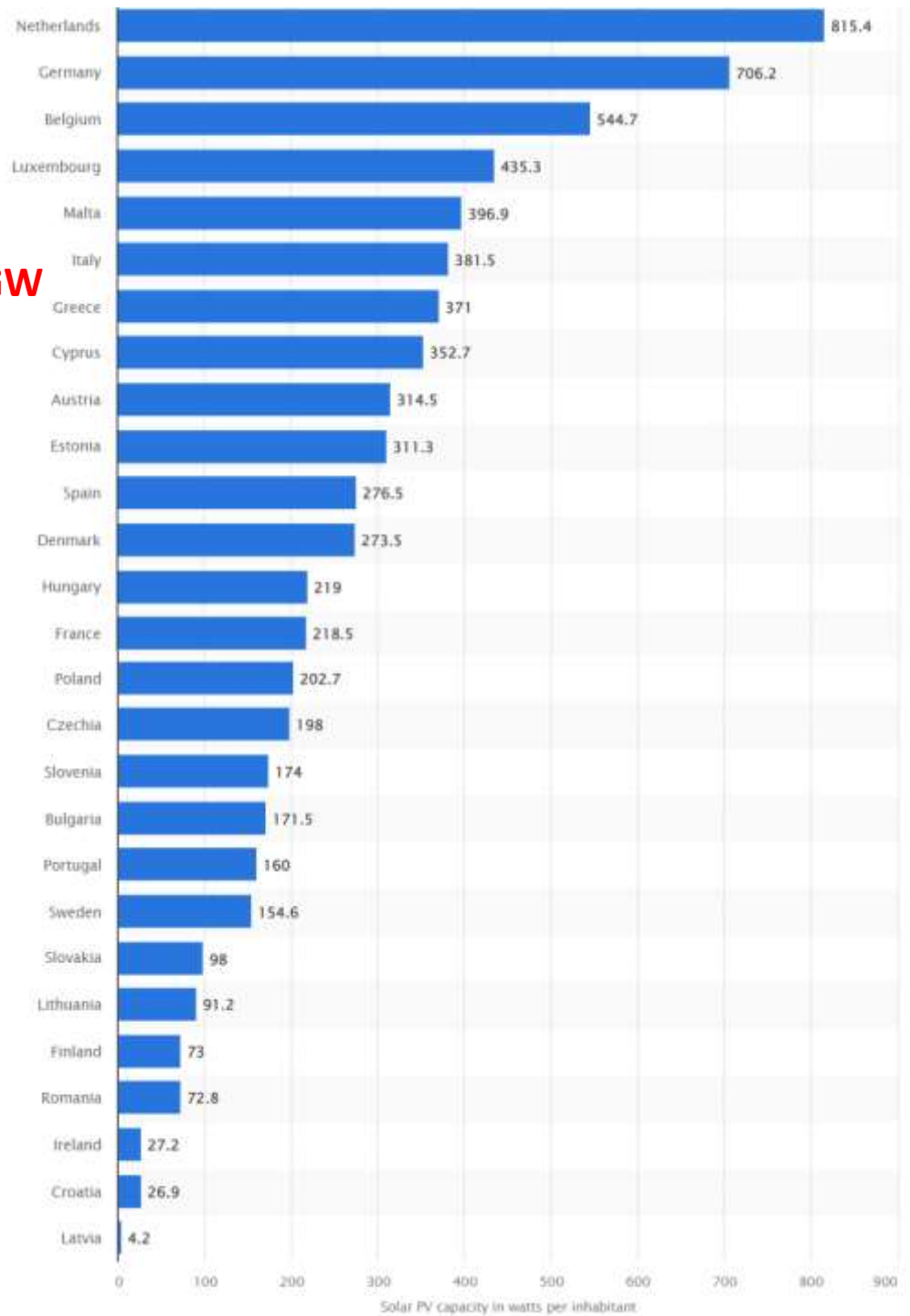
Energija Sunca:



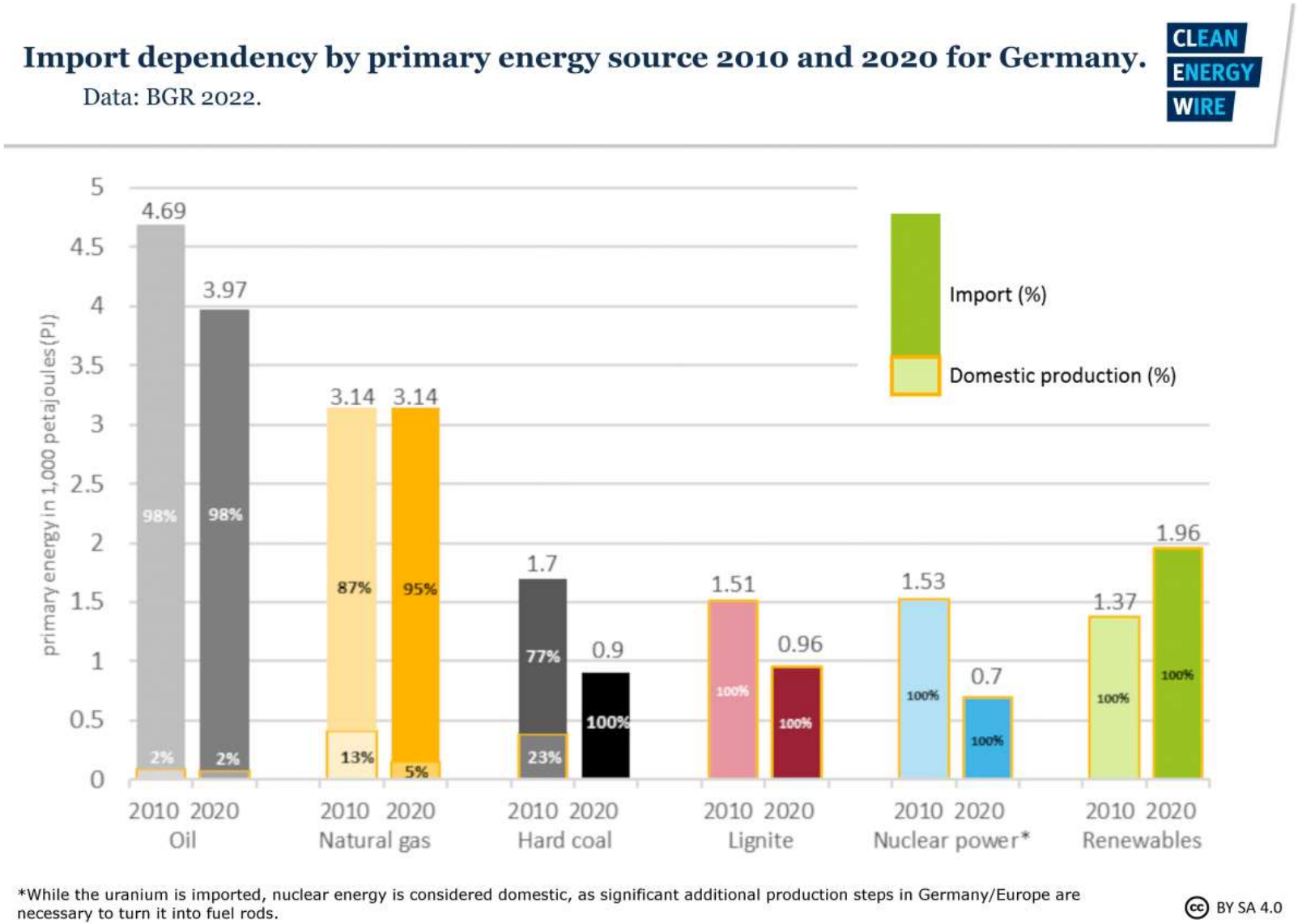
3,6 GW

2,7 GW

1,5 GW



Uvoz energije je izdaja nacionalnih interesa!

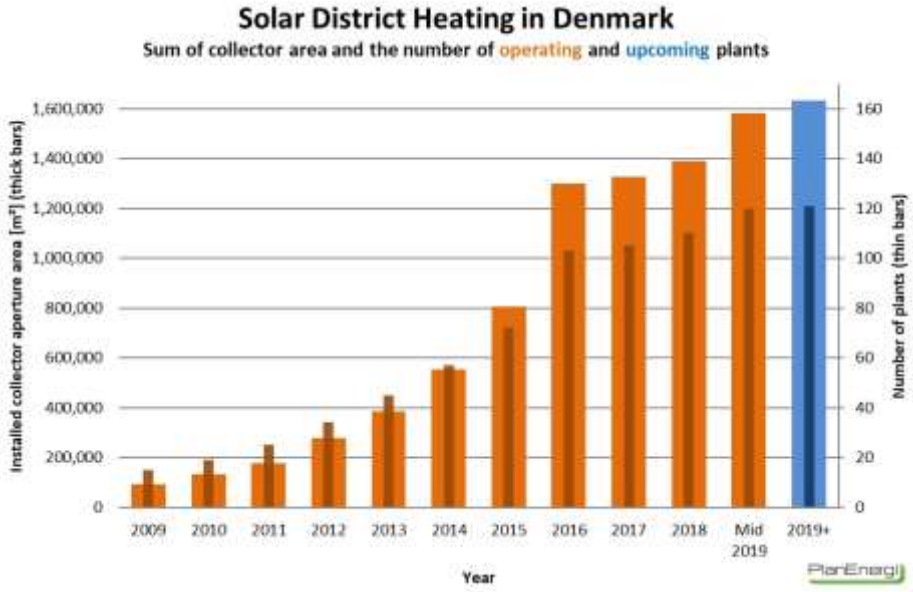


Strateško planiranje zagrijavanja tople vode u Danskoj, solarne toplane sa sezonskim spremnicima toplinske energije

- 1100 MW solarnih toplinskih kolektora
- 1600000 m^2
- 5,792,202 stanovnika → 0.276 m^2 po stanovniku

2020. cilj 4065253 ppl x 0,225 m^2/ppl = 914681 m^2 (640 MW)

2020.U HR, 201 MW / 287286 m^2
2021. 0.074 m^2/stanovniku



Solarna toplana u Dronninglundu, instaliranog toplinskog kapaciteta 26 MW

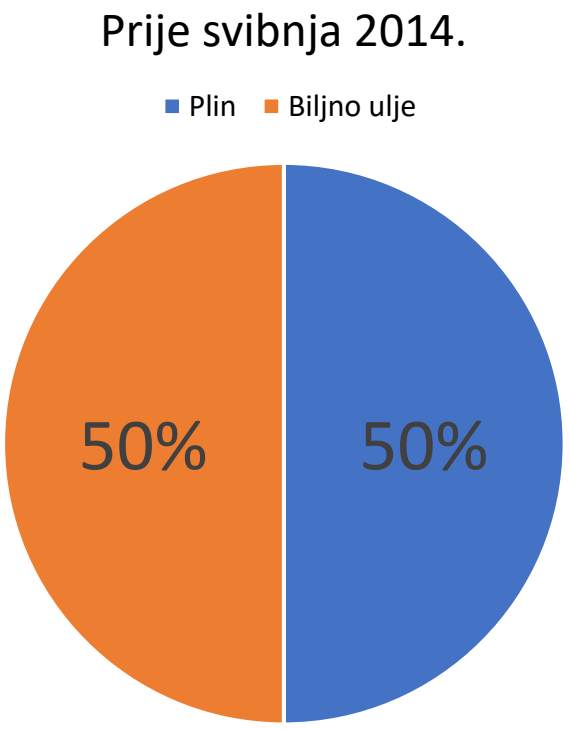
Solarna toplana u Dronninglundu, investicijski trošak

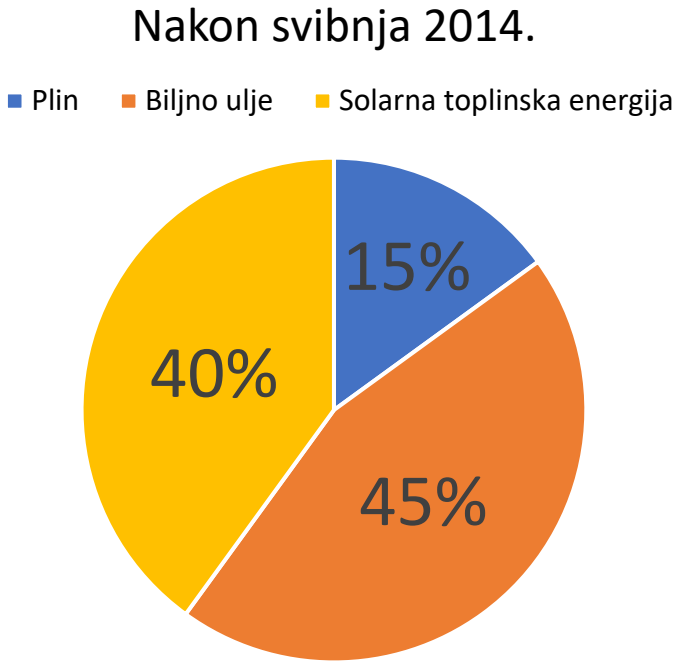
	Veličina	Jed.	Jedinični trošak		Ukupni trošak [EUR]
Toplinski spremnik	62000	m^3	38,7	EUR/m^3	2.400.000
Zgrade					2.400.000
Solarni kolektori	37573	m^2	162,4	EUR/m^2	6.100.000
Cjevovodi CTS					1.340.000
Kotlovnica i dizalica topline					920.000
Troškovi financiranja (kamata), najam zemljišta					800.000
Ukupno troškovi opreme					13.960.000
Konzultanti/projektanti					673.000
EUDP subvencije					-2.953.000
Neto investicija					11.680.000

Solarna toplana u Dronninglundu, uštede za potrošače

	2013.-2014.	2014.-2015. 1. godina sa solarnim kolektorima	Smanjenje troškova za prosječnu kuću
Cijena energije [€/MWh]	75,83 €	66,77 €	171,84 €
Fiksni troškovi [€/m^2]	2,81 €	2,55 €	33,80 €
Porez (energetska učinkovitost)	6,71 €	0,00 €	6,71 €
		Ušteda (PDV):	53,09 €
		Ukupna ušteda:	**265,44 €**
Površina prosječne kuće u Danskoj iznosi 130 m^2, a potrošnja energije 18,1 MWh godišnje.			

Promjena u proizvodnji energije u Dronninglundu





Elektrifikacija transporta

Renewable and Sustainable Energy Reviews 82 (2018) 1823–1838

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

The future of transportation in sustainable energy systems: Opportunities and barriers in a clean energy transition

D.F. Dominković[a,*], I. Bačeković[b], A.S. Pedersen[a], G. Krajačić[c]

[a] Department of Energy Conversion and Storage, Technical University of Denmark (DTU), Frederiksborgvej 399, Roskilde, Denmark
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[c] Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Zagreb, Croatia

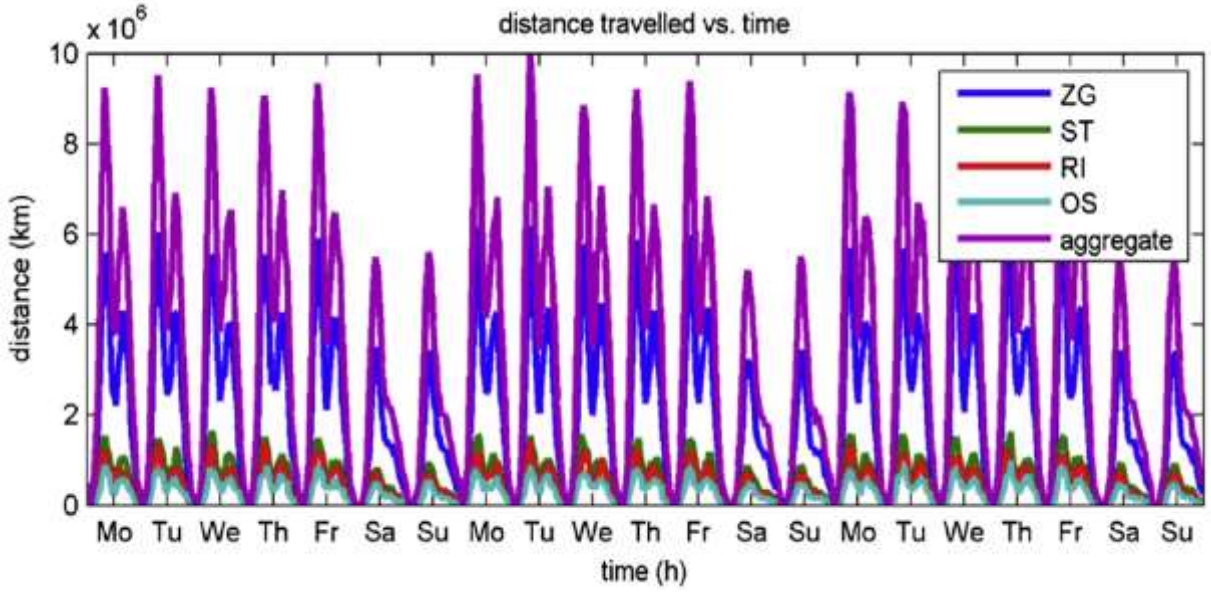
ARTICLE INFO

Keywords:
Renewable transport
Electric vehicles
Biofuels, hydrogen
Electrofuels
Synthetic fuels

ABSTRACT

Energy demand of a transport sector has constantly been increasing in the recent years, consuming one third of the total final energy demand in the European Union (EU) over the last decade. A transition of this sector towards sustainable one is facing many challenges in terms of suitable technology and energy resources. Especially challenging transition is envisaged for heavy-weight, long-range vehicles and airplanes. A detailed literature review was carried out in order to detect the current state of the research on clean transport sector, as well as to point out the gaps in the research. In order to calculate the resources needed for the transition towards completely renewable transport sector, four main alternatives to the current fossil fuel systems were assessed and their potential was quantified, i.e. biofuels, hydrogen, synthetic fuels (electrofuels) and electricity. Results showed that electric modes of transport have the largest benefits and should be the main aim of the transport transition. It was calculated that 72.3% of the transport energy demand on the EU level could be directly electrified by the technology existing today. For the remaining part of the transport sector a significant demand for energy resources exists, i.e. 3069 TWh of additional biomass was needed in the case of biofuels utilization scenario while 2775 TWh of electricity and 925 TWh of heat were needed in the case of renewable electrofuels produced using solid oxide electrolysis scenario.

✓ It is technically possible today to shift 72.3% of the fossil fuel demand in the transportation sector to the electricity. Following this transition, increased efficiency of the electrically driven transportation means will reduce the final energy demand in transportation sector for 50.6% or 2051 TWh.



Contents lists available at ScienceDirect

Energy

journal homepage: www.elsevier.com/locate/energy

Agent based modelling and energy planning – Utilization of MATSim for transport energy demand modelling

T. Novosel [a,*], L. Perković [a], M. Ban [a], H. Keko [b], T. Pukšec [a], G. Krajačić [a], N. Duić [a]

[a] University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture, Department of Energy, Power Engineering and Environment, Ivana Lučića 5, 10002 Zagreb, Croatia
[b] Energy Institute Hrvoje Požar, Department for Energy Generation and Transformation, Savska 163, 10001 Zagreb, Croatia

Proizvodnja i razvoj električnih vozila?

Novi hrvatski električni auto kreće u serijsku proizvodnju

Piše Auto start magazin/24sata, četvrtak, 9.3.2017. u 16:13

Foto: Davor Puklavec/PIXSELL

Pionir u našoj pa i svjetskoj industriji električnih automobila kani svijetu, osam godina nakon prvog modela, predstaviti DOK-ING YD, gradski automobil budućnosti koji se rađa na zagrebačkom Žitnjaku

Rimac Grupa prikupila 3,78 milijardi kuna od investitora, ove godine planira zaposliti 700 ljudi

– U nas je uložio sada i najveći tehnološki investitor u svijetu - SoftBank te Goldman Sachs, jedan od općenito najvećih investitora. Riječ je ukupno o više sredstava negoli smo prethodno prikupili, dakle, doista golema stvar za nas. Pri tome je Porsche već četiri puta uložio u našu tvrtku, što govori o povjerenju i produbljenju suradnje - rekao je Mate Rimac.

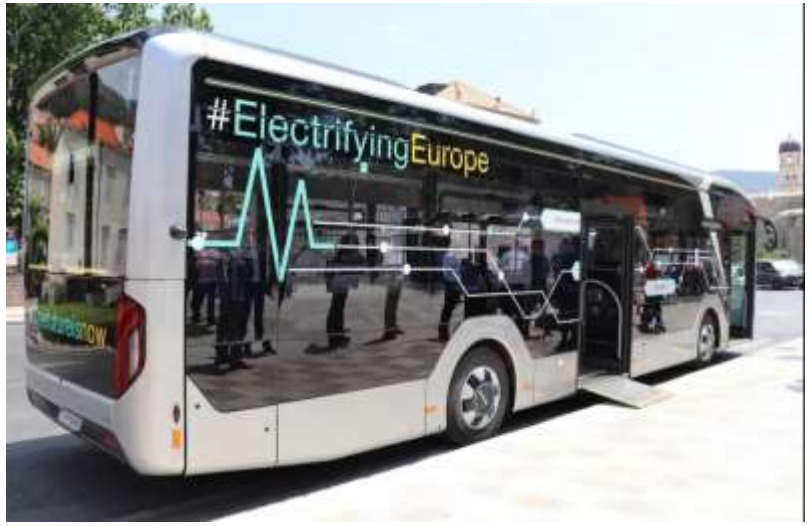
Proizvodnja i razvoj električnih brodova

Projektna inicijativa: Autonomni elektro-brodovi za pametne otoke i gradove

https://www.icat.hr/hr/

https://morski.hr/2022/05/18/jadrolinija-pokrenula-postupak-javne-nabave-tri-broda-na-elektricni-pogon-koji-ce-zamijeniti-poznate-oldtimere/

Elektrifkacija transporta autobusi i željeznica, dronovi?



SNIMIO: VEDRAN KARUZA

Helsinki to test the role of electric drones in emergency care services in 2023

Izgradnja Giga-tvornica za PV?

NEWS | April 4, 2022

Enel Green Power to build 3GW solar panel factory in Italy

The company plans to bring 400MW of the facility's capacity online by next September.

Italian renewable energy firm Enel Green Power (EGP) has signed a grant agreement with the European Commission to build a solar panel gigafactory in Italy.

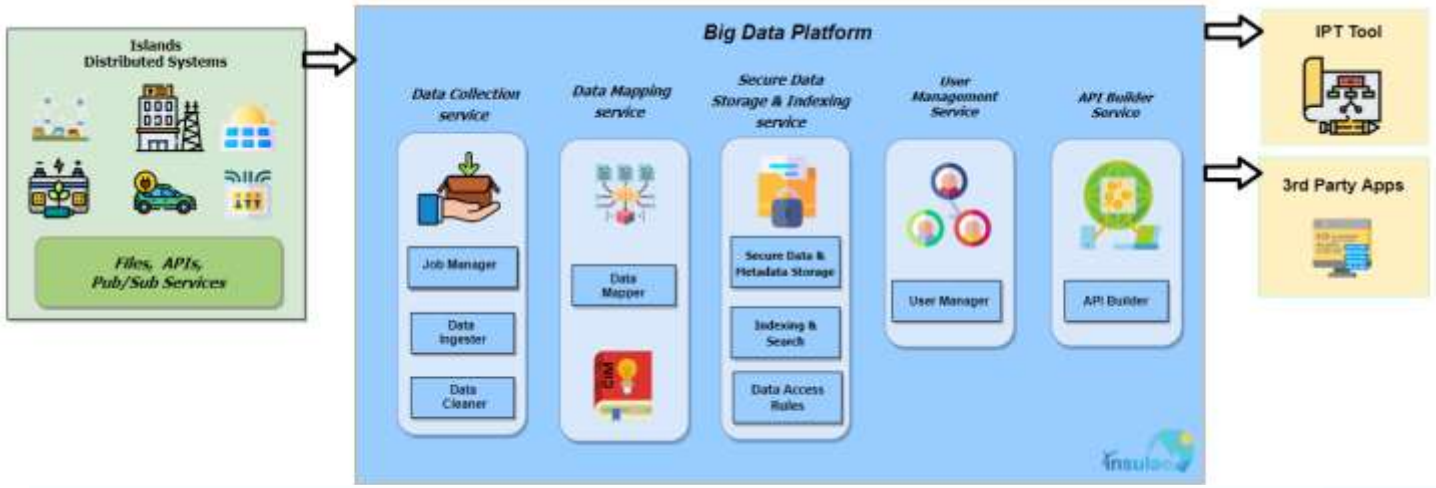
The grant will be offered under the European Union's (EU) first Innovation Fund to build an industrial-scale bifacial photovoltaic (PV) module production facility.

Named the Italian PV Giga Factory (TANGO), the facility will be built at EGP's 3Sun solar panel factory in Catania, Sicily.

The EU's grant will increase EGP's total solar module manufacturing capacity from 200MW to 3GW.

https://www.power-technology.com/news/enel-green-power/

INSULAE Big data platforma

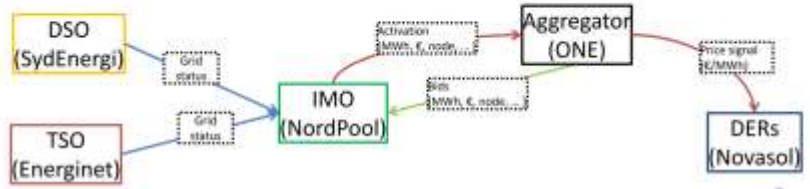


SmartNet

Balancing market – 5 mins before operation

Local activation – Central optimization

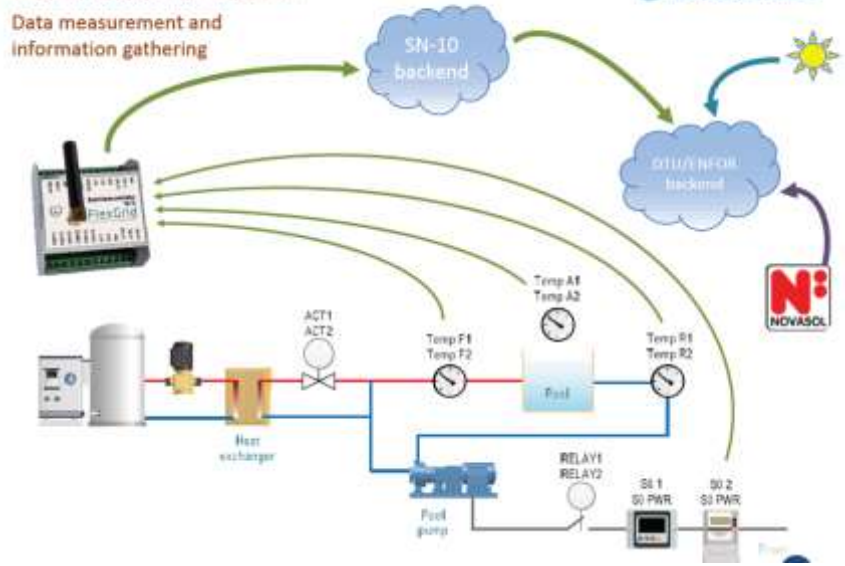
1. TSO/DSO send current grid load to IMO
2. Aggregators send bids to IMO (MWh, €, node, …)
3. IMO calculates imbalance and activates necessary bids with the objective of minimizing activation costs + marginal grid costs.
4. Activation prices are passed on to DERs



How does it work?

SmartNet

Data measurement and information gathering



http://insulae-h2020.eu/

Greenscape Energy Ltd

Who Are Greenscape?

Your Local Solar PV Installer

Following on from being the chosen installer for the Suffolk, Nofolk and Cambridge contract. We are delighted to have been accepted as the Solar Together installer for the Essex Region and we look forward to helping even more of our neighbours to go green.

Our Story

It all began in a small shed back in March 2012. A small team with many years of combined experience in the solar PV industry, driven to create a dynamic new renewable energy business.
The vision: an eco-conscious, customer-focused, green energy hub; providing an honest service and impartial advice to support home and business owners in going green.

Following a rescue operation on a former car showroom, including renewable heating, solar PV, energy efficient lighting and plenty of insulation, the Energy Shop was born. A place where you can come to experience renewable technology first-hand and receive support in reducing your CO2 emissions, whilst saving money at the same time!

Still striving to provide nothing short of the perfect service and sourcing a large amount of work through personal recommendations, we have helped over 1,500 customers across the region with the supply and installation of solar PV Panels, air / ground source heat pumps and electric vehicle charge points.

We passionately believe that by taking responsibility for our environment, we are taking responsibility for our future.

Visit The Energy Shop

Our renewables experts are on hand to answer your questions from Monday - Friday each week. Call us on 01473 655 655 to arrange your visit.

We are located 1 minute drive from Ipswich Hospital, on the main Woodbridge Road- just key IP4 4PN into your SatNav!

Star Service

Which? Trusted traders

Checkatrade 9.8/10

Google 4.9/5

Get In Touch

01473 655 655

SolarTogether@GreenscapeEnergy.co.uk

Which? Trusted traders | MCS | Norfolk Trusted Trader Member | Suffolk Trading Standards Approved Checkatrade | solar together | RECC

01473 655 655
SolarTogether@GreenscapeEnergy.co.uk

Greenscape Energy Ltd, The Energy Shop,
544 Woodbridge Road, Ipswich, IP4 4PN

Solar Together | Essex County Council

Dear Resident,

I am writing to you about an opportunity to save on your energy bill and contribute to a greener more sustainable future for Essex. Having your own solar panels can be an intelligent investment; not only can you reduce your energy bills, but you will be powering your home with clean energy.

Working in partnership with independent experts, Essex County Council is making it easier for you to purchase high quality solar panels for your home at a competitive price.

Solar Together Essex - buying solar panels and battery storage made easy.
Solar panels can seem complicated but buying a solar system doesn't need to be daunting. Solar Together is a group-buying scheme that helps you through the process, keeping you informed at every stage.

Do you already have solar panels installed? You can also register to have battery storage added to your existing solar panels to maximise the benefits of your system. For more information please see the leaflet accompanying this letter.

How does it work?

1. Registration: you can register before 23 March for free and without obligation at **www.essex.gov.uk/solartogether** To register you simply provide details about your roof, such as its size and orientation.

2. Auction: a supplier 'auction' will be held on 23 March, when our approved solar suppliers will bid for the work. The more people that register, the better the deal should be for each household.

3. Personal recommendation: from 12 April you will be contacted with a personal recommendation, based on the specifications of your roof. This includes your costs and specification of your solar panel installation.

4. You decide: the decision is then yours as to whether you want to accept your recommendation. There is no obligation to continue. You will have until 21 May to decide and will be invited to an online information session.

5. Installation: if you accept, the winning supplier will contact you to survey your roof and set an installation date. All installations are planned to be completed by the end of October 2021.

For detailed information about likely costs, the amount of energy you can expect to generate, and lots more go to **www.essex.gov.uk/solartogether**

We trust this initiative will be of interest to you. The more people that participate, the better the price we can secure and the more renewable energy will be generated by Essex residents.

Kind regards,

Councillor Simon Walsh
Cabinet Member for Environment & Climate Change Action

Essex County Council
in partnership with Solar Together Essex

www.essex.gov.uk/solartogether
essex@solartogether.co.uk
0800 048 8639 (Mon-Fri, 8am-5pm)

Interreg North Sea Region EMPOWER 2.0 | European Union

Solar Together

Solar Together Essex

Buying solar panels & storage made easy

Interreg North Sea Region EMPOWER 2.0 | Essex County Council

Tehno-ekonomska analiza odabranog rješenja

Odabrano:

- Potpuna energetska obnova
- Primjena visoko temperaturne dizalice topline zrak-voda
- Korištenje fotonaponskog sustava (4 kW)

Ukupna investicija:

- 221.110.500,00 HRK

Godišnje uštede i zarada:

10.960.747,76 HRK

Godišnji trošak električne energije:

- 3.299.769,93 HRK

Co-funded by the Horizon 2020 programme of the European Union

Predloženi model financiranja

1) Udio bespovratnih sredstava u baznom iznosu od 50%

2) Udio vlastite investicije kućanstava u iznosu od 5%

3) EUCF-1 Kooperativni fond u iznosu od 45% (ESCO-like)

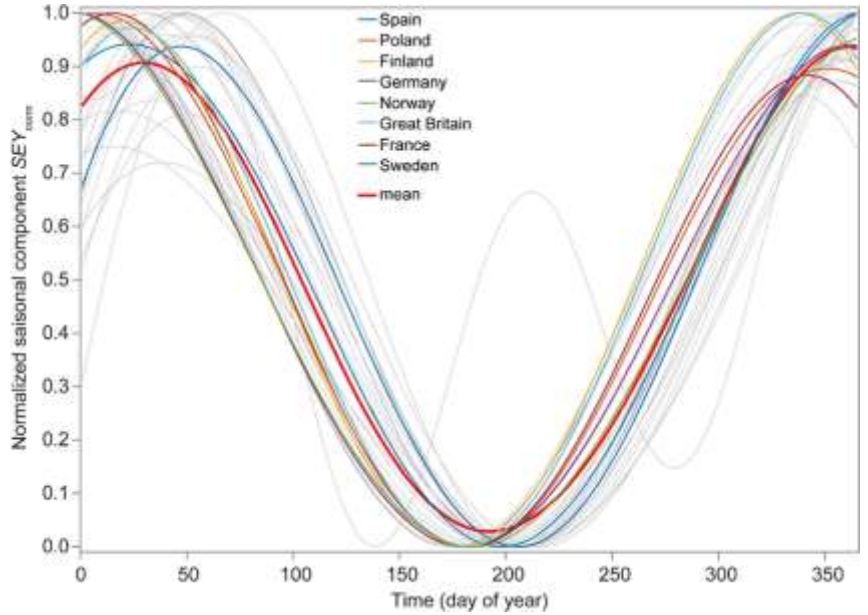
Co-funded by the Horizon 2020 programme of the European Union

Vršna opterećenja / TYDP HOPS

Slika 3.1. Prikaz minimuma i maksimuma opterećenja u 2019. godini te desetogodišnjeg prosječnog udjela maksimuma opterećenja pojedinog prijenosnog područja u maksimumu opterećenju EES-a

Proizvodnja električne energije u Hrvatskoj 22/05/2021 ENTSO-E provider.

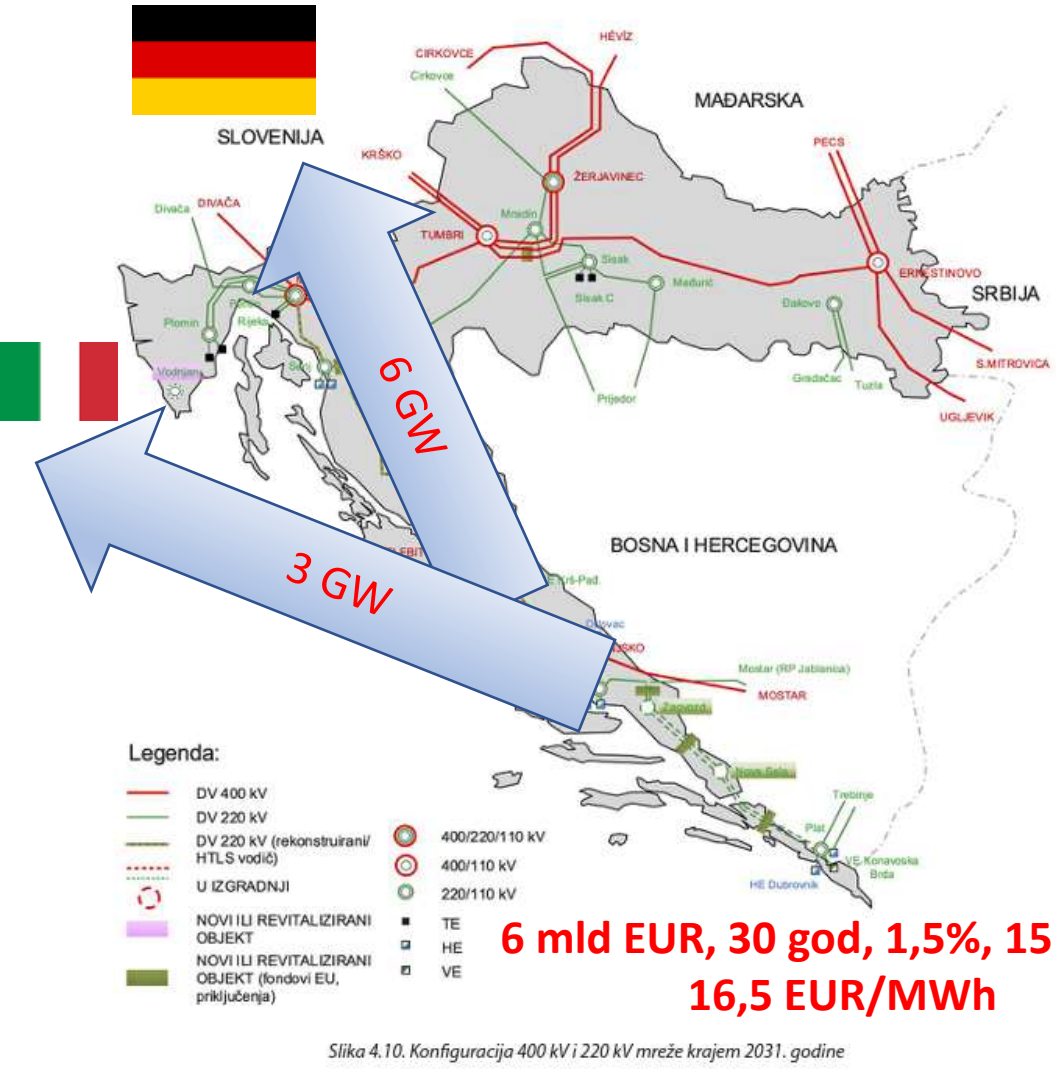
EU = Energetska unija?



Dirk Schindler, Sophia Schmidt-Rohr, Christopher Jung,
On the spatiotemporal complementarity of the European onshore wind resource,
Energy Conversion and Management, Volume 237, 2021, 114098, ISSN 0196-8904,

https://doi.org/10.1016/j.enconman.2021.114098.

HOPS? HVDC vodovi prema Njemačkoj – Italiji?



6 mld EUR, 30 god, 1,5%, 15 TWh
16,5 EUR/MWh

Slika 4.10. Konfiguracija 400 kV i 220 kV mreže krajem 2031. godine

HVDC Cables Along with Highway Infrastructures: the "Piedmont-Savoy" Italy-France Intertie

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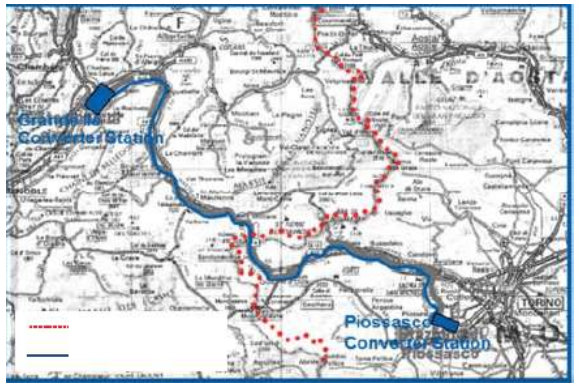

NE, NI DA NI NE?

- Nuklearna energija broj reaktora i instaliranog kapaciteta stagnira ili opada.
- Obnovljivi izvori su preuzeli vodeću ulogu i novoinstalirani kapacitet nuklearnih elektrana je irelevantan za tržišta.
- Klimatske promjene i energetska kriza zahtijevaju jeftina i brza rješenja, a nuklearna energija je skupa i spora.
- Postojeća postrojenja se približavaju kraju životnog vijeka. Produljenje ne znači nužno pouzdanost.
- Produljenje rada neće osigurati dovoljno tržišta te je pitanje preživljavanja sektora.
- Nuklearna energija povlači pitanje demokratizacije energetskog sektora.

Prilika za održiv energetski sustav

- EU suradnja
- Solarizacija
  - Gigatvornice za solarne toplane (domaća industrija staklo, aluminij, građevina itd.)
  - Gigatvornice za PV
  - Sustavna solarizacija, a ne najbrži prst
- Elektrifikacija
  - Električna vozila (domaća industrija, giga tvornice?)
  - Električni brodovi (domaća industrija, giga tvornice?)
  - HVDC vodovi (domaća industrija?, giga tvornice?)
  - Sustavna elektrifikacija , a ne najbrži prst
- Digitalizacija
  - Prilika za domaći IT sektor

HRVATSKA ENERGETSKA TRANZICIJA

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HVALA NA PAŽNJI!

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Pokrovitelj

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HEP | INA | JANAF | plinacro