# PLANIRANJE SOLARNIH ELEKTRANA I ŽIVOTNA SREDINA

## SOLAR POWER PLANT PLANNING AND THE ENVIRONMENT

Boško Josimović

dr Boško Josimović, naučni savetnik,
Institut za arhitekturu i urbanizam Srbije,
ORCID: 0000-0003-1986-3087

**PLANIRANJE SOLARNIH ELEKTRANA I ŽIVOTNA SREDINA**

***Posebna izdanja br. 94***
ISSN 0352-2180
Naučna monografija

IZDAVAČ:
Institut za arhitekturu i urbanizam Srbije (IAUS), Bulevar kralja Aleksandra 73/II, 11 000 Beograd, tel: (+381 11) 3207-307, faks: (+381 11) 3370-203, www.iaus.ac.rs

ZA IZDAVAČA:
dr Saša Milijić, direktor



RECENZENTI:
dr Saša Milijić, naučni savetnik, Institut za arhitekturu i urbanizam Srbije
prof. dr Aleksandar Jovović, redovni profesor, Univerzitet u Beogradu - Mašinski fakultet
prof. dr Marina Ilić, redovni profesor, Univerzitet Union - Nikola Tesla

UREDNICI:
dr Božidar Manić
dr Sanja Simonović Alfirević

LEKTURA:
Bojana Dodić

PREVOD NA ENGLESKI:
Goran Stanić

GRAFIČKI PRELOM:
Iva Lokas

DIZAJN KORICA:
dr Sanja Simonović Alfirević

TIRAŽ: 500 primeraka

ŠTAMPA: Planeta print, Beograd

Beograd, 2024. godine
ISBN 978-86-82154-03-7

Sredstva za realizaciju istraživanja koje je prikazano u ovoj monografiji su obezbeđena od strane Ministarstva nauke,

Dr Boško Josimović, Principal Research Fellow
Institute of Architecture and Urban & Spatial Planning of Serbia,
ORCID: 0000-0003-1986-3087

**SOLAR POWER PLANT PLANNING AND THE ENVIRONMENT**

***Special Editions no. 94***

ISSN 0352-2180
Scientific publication

PUBLISHER:
Institute of Architecture and Urban & Spatial Planning of Serbia (IAUS), Bulevar kralja Aleksandra 73/II, 11 000 Belgrade, tel: (+381 11) 3207-307, fax: (+381 11) 3370-203, www.iaus.ac.rs

FOR PUBLISHER:
Dr Saša Milijić, Director



NUMBER OF COPIES: 500

PRINTED BY: Planeta print, Belgrade, Serbia

Belgrade, 2024
ISBN 978-86-82154-03-7

The funds for the realization of the research presented in this book were provided by the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia, registration number: 451-03-66/2024-03/200006.

**S A D R Ž A J**

## TABLE OF CONTENT

## PREDGOVOR

Nakon knjige „Prostorni apekti uticaja vetroelektrana na životnu sredinu" (2017, engl. izdanje 2020), prve koju sam posvetio „zelenoj" energiji, a usled ekspanzije u korišćenju obnovljivih izvora energije (OIE), osetio sam potrebu i želju da napišem knjigu čija tema će biti solarna energetika. Sagledavanju ovog aspekta primene OIE posvetio sam mnogo pažnje i vremena u prethodnih nekoliko godina, primenjujući naučna i stručna znanja u realizaciji nekoliko velikih projekata solarnih, agrosolarnih i tzv. hibridnih elektrana u Republici Srbiji. Zato je moja želja bila da svoja iskustva kroz ovu knjigu podelim sa svima kojima je ova oblast predmet interesovanja. Iskustva se baziraju na prostornim (planerskim) aspektima realizacije solarnih elektrana i njihovom uticaju na životnu sredinu.

U duhu predgovora iz knjige posvećene vetroenergetici, ovu knjigu takođe započinjem citatima poznatih, u kojima se ističe značaj primene energije sunca za dobijanje energije.

Autor

## FOREWORD

After my previous book, The Spatial Aspects of the Impact of Wind Farms on the Environment (2017, Eng. 2020), the first one dedicated to "green" energy, and due to the expansion in the use of renewable energy sources (RES), I felt the need and desire to write a book on the topic of solar energy. I have devoted much attention and time to examining this aspect of RES application over the past few years, applying scientific and professional knowledge in the implementation of several large solar, agro-solar, and so-called hybrid power plant projects in the Republic of Serbia. Therefore, my desire was to expand my experiences through this book to all those interested in this field. The experiences are based on spatial (planning) aspects of solar power plant implementation and their impact on the environment, which is analyzed through the process of Strategic Environmental Assessment.

In the spirit of the preface from the previous book, which was dedicated to wind energy, I also begin this book with quotes from renowned figures emphasizing the importance of solar energy application for energy production.

The Author

„Sunce održava sav ljudski rod i daje svu ljudsku energiju."

(Nikola Tesla)

"The sun maintains all human life and supplies all human energy"

(Nikola Tesla)

„Treba znati iskoristiti prirodne sile i na taj način dobiti potrebnu energiju. Sunčevi zraci su oblik energije, vetar i morske struje su takođe energija. Koristimo li ih? O, ne! Palimo šume i ugalj, kao što podstanari pale ulazna vrata gazdinjske kuće da bi se ogrejali. Živimo kao divlji doseljenici koji ne shvataju da ova bogatstva pripadaju svima nama."

(Tomas A. Edison)

"We should utilize natural forces and thus get all of our power. Sunshine is a form of energy, and the winds and the tides are manifestations of energy. Do we use them? Oh, no; we burn up wood and coal, as renters burn up the front fence for fuel. We live like squatters, not as if we owned the property."

(Thomas Edison)

„Mi smo kao farmeri koji seku ogradu oko kuće da bi dobili gorivo umesto da koristimo nepresušne prirodne izvore energije – sunce, vetar i plimu… Ja bih svoj novac stavio na sunce i sunčevu energiju. Kakav izvor snage! Nadam se da nećemo čekati da nafta i ugalj nestanu pre nego što se pozabavimo tim."

(Tomas A. Edison)

"We are like tenant farmers, chopping down the fence around our house for fuel, when we should be using nature's inexhaustible sources of energy—sun, wind, and tide.I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait till oil and coal run out before we tackle that.."

(Thomas Edison)

„Pošto nam ponestaje gasa i nafte, moramo se brzo pripremiti za treću promenu, striktno očuvanje i korišćenje uglja i trajnih obnovljivih izvora energije, poput solarne energije."

(Džimi Karter)

"Because we are now running out of gas and oil, we must prepare quickly for a third change--to strict conservation and to the renewed use of coal and to permanent renewable energy sources like solar power."

(Jimmy Carter)

„Upotreba solarne energije ima ogroman potencijal za očuvanje prirodnih resursa i klime, kao i za širu upotrebu obnovljivih izvora energije ako želimo snabdevanje energijom okrenuto ka budućnosti."

(Margareta Vulf)

"The use of solar energy offers huge potential for natural resource and climate protection, and for the expansion of renewable energies on the road to a future-oriented energy supply."

(Margareta Wolf)

„Svaka 24 sata na Zemlju stiže dovoljno sunčeve svetlosti da energijom opskrbi planetu za naredne 24 godine."

(Marta Maeda)

"Every 24 hours, enough sunlight touches the Earth to provide energy for the entire planet for 24 years."

(Martha Maeda)

„Imamo taj zgodan fuzioni reaktor na nebu koji se zove sunce – ne moramo ništa da radimo, on radi sam. Izgreva svaki dan."

(Ilon Mask)

"We have this handy fusion reactor in the sky called the sun, you don't have to do anything, it just works. It shows up every day."

(Elon Musk)

„Budućnost će biti zelena ili je neće ni biti."

(Bob Braun)

"The future will either be green or not at all."

(Bob Brown)

„Sva energija se na kraju dobija od sunca, a njeno direktno prikupljanje u vidu solarne energije izgleda da je najbolji način za prelazak na obnovljive izvore."

(Piter Rajv)

"All energy is ultimately derived from the sun, and harvesting it directly through solar power seems to be the best way to transition to renewable energy."

(Peter Rive)

## LITERATURA / REFFERENCES


Adhikari S, Mithulananthan N, Dutta A, Mathias A.J. (2008). Potential of sustainable energy technologies under CDM in Thailand: Opportunities and barriers. Renewable Energy Volume 33, Issue 9, 2122–2133. https://doi.org/10.1016/j.renene.2007.12.017

Ananda J, Heralth G. (2009). A critical review of multi-criteria decision-making methods with special reference to forest management and planning. Ecological Economics, Vol 68 (10), pp. 2535–2548. https://doi.org/10.1016/j.ecolecon.2009.05.010.

Bennun L, van Bochove J, Ng C, Fletcher C, Wilson D, Phair N, Carbone G. (2021). Mitigating biodiversity impacts associated with solar and wind energy development: guidelines for project developers. IUCN Publication. ISBN: 978-2-8317-2101-9. https://doi.org/10.2305/IUCN.CH.2021.04.en.

Brown AL, Therivel R. (2000). Principles to guide the development of strategic environmental assessment. Impact Assessment and Project Appraisal, Volume 18, Issue 3. pp. 183–189. https://doi.org/10.3152/147154600781767385.

Campo A.G.D. (2017). Mapping environmental sensitivity: A systematic online approach to support environmental assessment and planning. Environmental Impact Assessment Review, Volume 66. Pages 86–98. https://doi.org/10.1016/j.eiar.2017.06.010.

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

CEC (1984a), European Solar Radiation Atlas, Vol. I Horizontal Surfaces. Commission of the European Communities, (Gburčik, V. saradnik za područje Jugoslavije).

CEC (1984b), European Solar Radiation Atlas,- Vol. II Inclined Surfaces. Commission of the European Communities, (Gburčik, V. saradnik za područje Jugoslavije).

CEC (2000a), The European Solar Radiation Atlas, Vol. I Fundamentals and maps. Commission of the European Communities CEC (2000b).

Chaker A, El-Fadl K, Chamas L, Hatjian B. (2006). A review of strategic environmental assessment in 12 selected countries. Environmental Impact Assessment Review, Volume 26, Issue 1, pp. 15–56. https://doi.org/10.1016/j.eiar.2004.09.010.

Crnčević T, Marić I, Josimović B. (2011). Strategic Environmental Assessment and Climate Change in the Republic of Serbia – Support to Development and Adjustment Process. SPATIUM No 26, IAUS, Belgrade, pp. 14–19. https://doi.org/10.2298/SPAT1126014C.

Dalal-Clayton B, Sadler, B. (2005). Strategic environmental assessment: a sourcebook and reference guide to international experience. OECD, UNEP and IIED in association with Earthscan Publications.

Depuydt L. (1998). Gnomons at Meroë and Early Trigonometry. The Journal of Egyptian Archaeology, Vol. 84, pp. 171–180 (10 pages). https://doi.org/10.2307/3822211.

Direktiva br. 2001/77/EC Evropskog parlamenta i Saveta od 27. septembra, 2002. godine, o promociji električne energije proizvedene iz obnovljivih izvora energije.

Direktiva br. 2009/28/EC Evropskog parlamenta i Saveta od 23. aprila, 2009. godine, o promociji upotrebe energije iz obnovljivih izvora.

Direktiva br. 2018/2001/EC o promicanju uporabe energije iz obnovljivih izvora.

Dobričić M, Josimović B. (2018). Sinergija prirodnog i kulturnog nasleđa (Synergy of Natural and Cultural Heritage). Arhitektura i urbanizam, 46, 39–45. https://doi.org/10.5937/a-u0-16268.

Dobričić M, Kesić Ristić S, Josimović B. (2016). The spatial planning, protection and management of world heritage in Serbia. Spatium Vol. 2016, No 36. https://doi.org/10.2298/SPAT1636075D.

Dobričić M, Sekulić N, Josimović B. (2017). Spatial planning and ecological networks in Serbia. Spatium 38, 18–26. https://doi.org/10.2298/SPAT1738018D.

Doing Business, 2020. http://www.doingbusiness.org/.

EIA Directive (85/337/EEC). http://ec.europa.eu/environment/eia/eia-legalcontext.htm.

Ember (2023), Globalna studija o potrošnji električne energije. https://ember-climate.org

Energy Saving Company – ESCO (2017). www.esco.rs.

European Strategic Environmental Assessment Directive 2001/42/ EC.

European Landscape Convention (2000). Council of Europe, Florence.

Fischer T. (2002). Strategic Environmental Assessment in Transport and Land Use Planning, Earthscan Publications, London. ISBN 9781853838118.

García-Ayllón S. (2017). Diagnosis of complex coastal ecological systems: Environmental GIS analysis of a highly stressed Mediterranean lagoon through spatiotemporal indicators. Ecological Indicators, Volume 83. Pages 451–462. https://doi.org/10.1016/j.ecolind.2017.08.015.

Grieken M, Dower B. (2017). Chapter 23 – Wind Turbines and Landscape. Wind Energy Engineering – A Handbook for Onshore and Offshore Wind Turbines. pp. 493–515. https://doi.org/10.1016/B978-0-12-809451-8.00023-0.

Hugh C. (1911). Socrates. Encyclopædia Britannica. Cambridge University Press.

Izveštaj o strateškoj proceni uticaja Plana detaljne regulacije za realizaciju agrosolarnog projekta „Agrosolar Kula" na životnu sredinu (2024). Investitor: Agrosolar d.o.o. Obrađivači: Projektura d.o.o, EKO-PLAN, RE-ECO, Beograd.

Izveštaj o strateškoj proceni uticaja Plana detaljne regulacije solarne elektrane Brebeks na životnu sredinu (2023). Ivestitor: Sage Solutions d.o.o. Obrađivači: Projektura d.o.o, EKO-PLAN, RE-ECO, Beograd.

Jay S, Jones C, Slinn P, Wood C. (2007). Environmental impact assessment: Retrospect and prospect. Environmental Impact Assessment Review, Volume 27, Issue 4. pp. 287–300. https://doi.org/10.1016/j.eiar.2006.12.001.

Jarčuška B, Gálffyová M, Schnürmacher R, Baláž M, Mišík M, Repel M, Fulín, Kerestúr D, Lackovičová Z, Mojžiš M, Zámečník M, Kaňuch P, Krištín A. (2024). Solar Parks Can Enhance Bird Diversity in Agricultural Landscape. Journal of Environmental Management, Vol 351. https://doi.org/10.1016/j.jenvman.2023.119902.

Josimović B. (2008). Implementation of Environmental Management System in Spatial Planning; University of Belgrade: Belgrade, Serbia, 2008. Available online: http://raumplan.iaus.ac.rs/handle/123456789/544

Josimović B. (2017). Prostorni aspekti uticaja vetroelektrana na životnu sredinu, IAUS, Beograd. https://raumplan.iaus.ac.rs/handle/123456789/542.

Josimović B, Bezbradica L, Manić B, Srnić D, Srebrić N. Cumulative Impact of Wind Farm Noise. Applied Sciences. 2023; 13(15):8792. https://doi.org/10.3390/app13158792.

Josimović B, Crnčević T. (2009). Impact Evaluation Within Strategic Environmental Assessment: The Case Study of the Waste Management Regional Plan for Kolubara region in Serbia. Environmental Engineering and Management Journal No. 3, Vol. 8, IASI, pp. 457–462. https://doi.org/10.30638/eemj.2009.062.

Josimović B, Crnčević T. (2010). Implementation of Strategic Environmental Assessment in Serbia with Special Reference to the Regional Plan of Waste Management. Environmental Management, edited by Santosh Kumar Sarkar, book published by SCIYO, pp. 95–113, ISBN 978-953-307-133-6. https://doi.org/10.5772/10101.

Josimović B, Crnčević T. (2012). The development of renewable energy capacities in Serbia: Case Study of three small hydropower plants in the Golija biosphere reserve with special reference to the landscape heritage. Renewable Energy Journal, Vol. 48, pp. 537–544. http://dx.doi.org/10.1016/j.renene.2012.06.015.

Josimović B, Cvjetić A, Furundžić D. Strategic Environmental Assessment and the precautionary principle in the spatial planning of wind farms – European experience in Serbia. Renewable and Sustainable Energy Reviews 2021, 136, 110459. https://doi.org/10.1016/j.rser.2020.110459.

Josimović B, Cvjetić A, Manić B. Strategic Environmental Assessment in the Application of Preventive Protection for Wind Farm Noise – Case Study: Maestrale Ring Wind Farm. Energies. 2021; 14(19):6174. https://doi.org/10.3390/en14196174.

Josimović B, Krunić N. (2008). Implementation of GIS in selection of locations for regional landfill in the Kolubara region. SPATIUM 17/18, IAUS, Belgrade. pp. 72–77. https://doi.org/10.2298/SPAT0818072J .

Josimović B, Krunić N, Gajić A. (2021)a. Multi-criteria Evaluation in Strategic Environmental Assessment in the Creation of a Sustainable Agricultural Waste Management Plan for Wineries: Case Study: Oplenac Vineyard. J Agric Environ Ethics 34, 4 (2021). https://doi.org/10.1007/s10806-021-09846-3.

Josimović, B., Krunić, N., Gajić, A. (2021)a. Multi-criteria Evaluation in Strategic Environmental Assessment in the Creation of a Sustainable Agricultural Waste Management Plan for Wineries: Case Study: Oplenac Vineyard. J Agric Environ Ethics 34, 4 (2021). https://doi.org/10.1007/s10806-021-09846-3.

Josimović B, Bezbradica Lj, Manić B, Srnić D, Srebrić N. (2023)b. Cumulative Impact of Wind Farm Noise. Applied Sciences 13, no. 15: 8792. https://doi.org/10.3390/app13158792.

Josimović B, Krunić N, Nenković-Riznić M. (2016)a. The impact of airport noise as part of a Strategic Environmental Assessment, Case Study: The Tivat (Montenegro) Airport

expansion plan. Transportation Research Part D: Transport and Environment, Volume 49, pp. 271–279, https://doi.org/10.1016/j.trd.2016.10.005 .

Josimović B, Manić B, Krunić N. (2022). Strategic Environmental Assessment as a Support in a Sustainable National Waste Management Program – European Experience in Serbia. Energies 2022, 15, 4568. https://doi.org/10.3390/en15134568.

Josimović B, Marić I, Manić B. (2011). Metodološki pristup u određivanju lokacije deponije komunalnog čvrstog otpada – studija slučaja: Regionalna deponija za Kolubarski region (Methodological approach to the determination of landfill location for municipal solid waste: Case study: Regional landfill in Kolubara region). Arhitektura i urbanizam, 55–64. https://doi.org/10.5937/arhurb1132055J.

Josimović B, Marić I, Milijić S. (2015). Multi-Criteria Evaluation in Strategic Environmental Assessment for Waste Management Plan, A Case Study: The City of Belgrade. Waste Management 36, pp. 331–342. https://doi.org/10.1016/j.wasman.2014.11.003.

Josimović B, Nenković-Riznić, Milijić S. (2016). Strategic Environmental Assessment as an Instrument for Sustainable Development of the Danube Corridor Through Serbia. Energy and Environment Research, Vol. 6, No. 1, ISSN 1927-0569, E-ISSN 1927-0577. https://doi.org/10.5539/eer.v6n1p1.

Josimović B, Petrić J. (2006). First regional landfill in Serbia – location choice. Environmental engineering and management, No. 3. pp. 391–399, ISSN 1582-9596. https://doi.org/10.30638/eemj.2006.029.

Josimović B, Petrić J, Milijić S. (2014). The Use of the Leopold Matrix in Carrying out the EIA for Wind Farms in Serbia. Energy and Environment Research, Vol. 4, No. 1. pp. 43–54. ISSN 1927-0569. doi: 10.5539/eer.v4n1p43.

Josimović B, Pucar M. (2010). The Strategic Environmental Impact Assessment of Electric Wind Energy Plants: Case Study Bavaniste (Serbia Renewable Energy Journal, Vol. 35, Issue 7, pp. 1509–1519, https://doi.org/10.1016/j.renene.2009.12.005.).

Josimović B, Srnić D, Manić B, Knežević I. Multi-Criteria Evaluation of Spatial Aspects in the Selection of Wind Farm Locations: Integrating the GIS and PROMETHEE Methods. Applied Sciences. 2023a; 13(9):5332. https://doi.org/10.3390/app13095332.

Josimović B, Todorović D, Jovović A, Manić B. Air pollution modeling to support strategic environmental assessment: case study – National Emission Reduction Plan for coal-fired thermal power plants in Serbia. Environment, Development and Sustainability 2023, https://doi.org/10.1007/s10668-023-03186-0.

Kalnins S.N, Gusca J, Pubule J, Borisov A, Blumberga D. (2016). Applicability of Combined Project Evaluation Methodology to EIA Projects. Energy Procedia, Volume 95, September 2016, pp. 424–428. https://doi.org/10.1016/j.egypro.2016.09.052.

Kangas J, Kanga, A. (2005). Multiple criteria decision support in forest management – approach, methods applied, and experiences gained. Forest Ecology and Management, Vol. 207, pp. 133–143. https://doi.org/10.1016/j.foreco.2004.10.023.

Ko I. (2023). Perspective Rural opposition to landscape change from solar energy: Explaining the diffusion of setback restrictions on solar farms across South Korean counties. Energy Research & Social Science 99(2023)103073. https://doi.org/10.1016/j.erss.2023.103073.

Konvencija o očuvanju evropske divlje flore i faune i prirodnih staništa („Službeni glasnik RS", br. 102/2007).

Krunić N, Josimović B, Gajić A, Nenković-Riznić M. (2019). Territorial analysis as support to the Strategic Environmental Assessment process for agro-waste management planning. Spatium, Vol. 2019, No 42. https://doi.org/10.2298/SPAT1942016K.

Krunić N, Josimović B, Milijić S, Ristić V (2017). Strategic Environmental Assessment as an instrument for sustainable spatial planning of water accumulation basins. Fresenius Environmental Bulletin (FEB), Vol. 26, No. 2, pp. 1281–1290, ISSN 1018-4619. https://doi.org/10.5539/eer.v6n1p1.

Latinopoulos D, Kechagia K. (2015). A GIS-based multi-criteria evaluation for wind farm site selection. A regional scale application in Greece. Renewable Energy, Volume 78. pp. 550–560. https://doi.org/10.1016/j.renene.2015.01.041.

Liou ML, Yeh SC, Yu YH. (2006). Reconstruction and systemization of the methodologies for strategic environmental assessment in Taiwan. Environmental Impact Assessment Review, Volume 26, Issue 2, pp. 170–184. https://doi.org/10.1016/j.eiar.2005.08.003.

Marsden S. (2002). Strategic environmental assessment: an international overview. In: Marsden S, Dovers S, editors. Strategic environmental assessment in Australasia. NSW7 The Federation Press. pp. 1–23.

Maričić T, Josimović B. (2005). Pregled sistema strateške procene uticaja (SPU) u zemljama Jugoistočne Evrope, Arhitektura i urbanizam 16–17, Institut za arhitekturu i urbanizam Srbije, Beograd, str. 66–71, ISSN 0354-6055.

Mercier J, Ahmed K. (2004). EIA and SEA at the World Bank. Paper presented to Proceedings of the 8th Intergovernmental Policy Forum on Environmental Assessment in association with the IAIA, Vancouver, Canada.

Mirasgedis S, Tourkolias C, Tzovla E, Diakoulaki D. (2014). Valuing the visual impact of wind farms: An application in South Evia, Greece. Renewable and Sustainable Energy Reviews, Volume 39. pp. 296–311. https://doi.org/10.1016/j.rser.2014.07.100.

Muhammad K. A, Muhammad M, Qaiser A, Imran S. (2020). Assessing the integration of solar power projects: SWOT-based AHP-F-TOPSIS case study of Turkey. Environmental Science and Pollution Research 27(34). https://doi.org/10.1007/s11356-020-10782-4

Muralikrishna I.V, Manickam V. (2017). Chapter Six – Environmental Impact Assessment and Audit. Environmental Management Science and Engineering for Industry. pp. 77–111. https://doi.org/10.1016/B978-0-12-811989-1.00006-3.

National Renewable Energy Laboratory-NREL (2015). https://www.nrel.gov.

Needham J. (1959). Science and Civilisation in China. Vol. 3. C.U.P. p. 302.

Nenković-Riznić M, Josimović B, Milijić, S. (2014). SEA as Instrument in Responsible Planning of Tourism Destinations – Case Study of National Park Đerdap, Serbia. Journal of Environmental and Tourism Analyses, Vol. 2. pp. 5–18. ISSN 2286-2838. https://doi.org/10.15244/pjoes/61851.

Nilsson M, Björklund A, Finnveden G, Johansson J. (2005). Testing a SEA methodology for the energy sector: a waste incineration tax proposal. Environmental Impact Assessment Review, Volume 25, Issue 1. Pages 1–32. https://doi.org/10.1016/j.eiar.2004.04.003.

Nilsson M, Dalkmann H. (2001). Decision Making and Strategic Environmental Assessment. Journal of Environmental Assessment Policy and Management, Volume 03, Issue 03, pp. 305–327. https://doi.org/10.1142/S1464333201000728.

Noorollahi Y, Yousefi H, Mohammadi M. (2016). Multi-criteria decision support system for wind farm site selection using GIS. Sustainable Energy Technologies and Assessments, Volume 13, February 2016, pp. 38–50. https://doi.org/10.1016/j.seta.2015.11.007.

Oudesa D, Stremke S. (2021). Next generation solar power plants? A comparative analysis of frontrunner solar landscapes in Europe. Renewable and Sustainable Energy Reviews 145(2021)111101. https://doi.org/10.1016/j.rser.2021.111101.

Partidário M. R. (1996). Strategic environmental assessment: Key issues emerging from recent practice. Environmental Impact Assessment Review, Volume 16, Issue 1. pp. 31–55. https://doi.org/10.1016/0195-9255(95)00106-9.

Partidario MR. (2000). Elements of an SEA framework – improving the added-value of SEA. Environmental Impact Assessment Review, Volume 20, Issue 6. pp. 647–663. https://doi.org/10.1016/S0195-9255(00)00069-X.

Pedro J, Silva C, Pinheiro M.D. (2017). Scaling up LEED-ND sustainability assessment from the neighborhood towards the city scale with the support of GIS modeling: Lisbon case study. Sustainable Cities and Society. In Press. Available online 1 November 2017. https://doi.org/10.1016/j.scs.2017.09.015.

Perlin J. (2004). Solar Energy, History of. Encyclopedia of Energy. pp. 607–622. https://doi.org/10.1016/B0-12-176480-X/00035-8.

Podimata M. (2016). Methodological approach to EIA due to gas pipeline failure after an earthquake. The case study of the Trans Adriatic Pipeline. Journal of Natural Gas Science and Engineering, Volume 35, Part A, September 2016, pp. 1200–1206. https://doi.org/10.1016/j.jngse.2016.09.043.

Pravilnik o nacionalnoj listi indikatora zaštite životne sredine („Službeni glasnik RS", br. 37/2011).

Pravilnik o proglašenju i zaštiti strogo zaštićenih i zaštićenih divljih vrsta biljaka, životinja i gljiva („Službeni glasnik RS", br. 5/2010, 32/2016, 98/2016).

Pravilnik o kriterijumima za izdvajanje tipova staništa, o tipovima staništa, osetljivim, ugroženim, retkim i za zaštitu prioritetnim tipovima staništa i o merama zaštite za njihovo očuvanje („Službeni glasnik RS", br. 35/2010).

Protocol on Strategic Environmental Assessment, UNECE, 2003.

Renewables global status report, 2022. REN21 (http://www.ren21.net).

Salhofer S, Wassermann G, Binner E. (2007). Strategic environmental assessment as an approach to assess waste management systems. Experiances from an Austrian case study. Environmental Modelling & Sofware, Volume 22, Issue 5, pp. 610–618. https://doi.org/10.1016/j.envsoft.2005.12.031.

Saraji M. K, Streimikiene D, Suresh V. (2024). A novel two-stage multicriteria decision-making approach for selecting solar farm sites: A case study. Journal of Cleaner Production Volume 444. https://doi.org/10.1016/j.jclepro.2024.141198.

Sheate W, Richardson J, Aschemann R, Palerm J, Stehen U. (2001). SEA and integration of the environment into strategic decision-making, vol. 1. Main Report to the European Commission, London.

Strategija razvoja energetike Republike Srbije do 2025. godine sa projekcijama do 2030. godine („Službeni glasnik RS", br. 101/15).

Studija energetskog potencijala Srbije za korišćenje sunčevog zračenja i energije vetra (NPEE, Evidencioni broj EE704-1052A). Univerzitet u Beogradu, Centar za multidisciplinarne studije, Beograd, novembar 2004.

SOlARGIS, 2021. https://solargis.com/

Therivel R, Partidario MR. (1996). SEA methodology in practice. The practice of strategic environmental assessment. London/Earthscan Publications. pp. 30– 44.

Tomić Z. (2016). Arhimedov blistavi um. www.svetnauke.org. Pristupljeno 25. jula 2023. godine.

Uredba o graničnim vrednostima zagađujućih materija u površinskim i podzemnim vodama i sedimentu i rokovima za njihovo dostizanje („Službeni glasnik RS", broj 50/2012).

Uredba o kategorizaciji državnih puteva („Službeni glasnik RS", broj 105/13, 119/13 i 93/15).

Uredba o načinu i postupku upravljanja otpadom od građenja i rušenja („Sl. glasnik RS", br. 93/2023 i 94/2023 – ispr.).

Uredba o Programu ostvarivanja Strategije razvoja energetike Republike Srbije do 2025. godine s projekcijama do 2030. godine („Službeni glasnik RS", br. 104/17).

Uredba o utvrđivanju Liste projekata za koje je obavezna procena uticaja i Liste projekata za koje se može zahtevati procena uticaja na životnu sredinu („Službeni glasnik RS", br. 114/08).

Vodolazhskaya L, Larenok P, Nevsky M. (2014). Ancient Astronomical Instrument from Srubna Burial of Kurgan Field Tavriya-1 (Northern Black Sea Coast). Archaeoastronomy and Ancient Technologies, 2(2), pp. 31–53.

White L, Noble B.F. (2013). Strategic environmental assessment for sustainability: A review of a decade of academic research. Environmental Impact Assessment Review, Volume 42. pp. 60–66. https://doi.org/10.1016/j.eiar.2012.10.003.

World Bank, 2020. http://www.worldbank.org/.

World Population Review, 2023. https://worldpopulationreview.com/

www.adtsolar.com/renewable-energy/history-of-solar-energy-part-5/, pristupljeno 25. jula 2023. godine.

www.sciencephoto.com/media/813943/view/archimedes-heat-ray-siege-of-syracuse-212-bc, pristupljeno 25. jula 2023. godine.

www.solartribune.com/the-history-of-solar-energy/, pristupljeno 27. jula 2023. godine.

Zakon o planiranju i izgradnji, „Službeni glasnik RS”, br. 72/2009, 81/2009 – ispr., 64/2010 – odluka US, 24/2011, 121/2012, 42/2013 – odluka US, 50/2013 – odluka US, 98/2013 – odluka US, 132/2014, 145/2014 83/2018, 31/2019, 37/2019 – dr. zakon, 9/2020, 52/2021 i 62/2023).

Zakon o potvrđivanju Konvencije o biološkoj raznovrsnosti – Rio konvencija („Službeni list SRJ”, broj 11/2001).

Zakon o potvrđivanju Konvencije o očuvanju evropske divlje flore i faune i prirodnih staništa – Bernska konvencija („Službeni glasnik RS”, br. 102/2007).

Zakon o potvrđivanju Konvencije o očuvanju migratornih vrsta divljih životinja – Bonska konvencija („Službeni glasnik RS”, br. 102/07).

Zakon o proceni uticaja na životnu sredinu („Službeni glasnik RS”, br. 135/04 i 36/09).

Zakon o strateškoj proceni uticaja na životnu sredinu („Službeni glasnik RS”, br. 135/2004 i 88/2010).

Zakon o zaštiti prirode RS („Službeni glasnik RS”, br. 36/2009a, 88/2010, 91/2010 – ispravka, 14/2016, 95/2018 – drugi zakon, 71/2021).

Zakon o zaštiti životne sredine („Službeni glasnik RS”, 135/04, 36/09 72/09, 43/11 –Ustavni sud, 14/2016, 76/2018, 95/2018 – dr. zakon i 95/2018 – dr. zakon).

Zionts S. (1979). MCDM – if not a Roman numeral, then what? Interfaces 9, pp. 94–101.

Zionts S, Wallenius J. (1976). An interactive programming method for solving the multiple criteria problem. Management Science 22, pp. 652–663.

Zárate-Toledo E, Paul Wood P, Patiño R. (2021). In search of wind farm sustainability on the Yucatan coast: Deficiencies and public perception of Environmental Impact Assessment in Mexico. Energy Policy, Volume 158. https://doi.org/10.1016/j.enpol.2021.112525.

https://nationalgeographic.rs/proizvedi-energiju/a27928/Koriscenje-energije-sunca-kroz-istoriju.html

## SPISAK SLIKA

## LIST OF FIGURES

## SPISAK TABELA

## LIST OF TABLES

## REZIME

Globalni trend smanjenja ugljeničnog otiska uticao je na dinamičan razvoj projekata koji koriste OIE, uključujući i razvoj solarne energetike u velikim solarnim elektranama, zbog čega se javila potreba za sagledavanjem uticaja koje ovi projekti imaju na prostor i životnu sredinu.

U knjizi je konstatovano da uticaji projekata koji koriste OIE, uključujući i solarne elektrane, mogu imati i pozitivne i negativne uticaje na prostor i životnu sredinu, a koje neizostavno treba utvrditi u cilju izbora optimalnih prostornih/teritorijalnih rešenja kojima se obezbeđuje preventivna planska i aktivna zaštita životne sredine. U tom procesu do izražaja dolazi primena strateške procene uticaja na životnu sredinu (SPU) u planiranju i prostornoj organizaciji solarnih elektrana.

SPU karakteriše holistički pristup, u kom je u najranijoj fazi razvoja projekta (u procesu planiranja) moguće sagledati kompleksne interakcije i korelacije u prostoru u kom se planira realizacija solarne elektrane, a zatim primeniti princip preventivne zaštite kako bi se negativni uticaji eliminisali ili umanjili, a pozitivni uticaji utvrdili. Na taj način moguće je predupredити sve potencijalne rizike koji mogu nastati u kasnijim fazama realizacije projekta, što je povoljno i sa aspekta efikasne zaštite životne sredine i iz ugla investitora koji ulažu u projekte solarnih elektrana.

Optimalna rešenja kojim se ostvaruje osnovna uloga SPU traže se prvenstveno u analizi prostornih odnosa solarne elektrane prema zemljištu, biodiverzitetu, predelu i osnovnim činiocima životne sredine. Kako je u knjizi prikazano, ovaj proces se, u metodološkom smislu, ostvaruje kombinacijom različitih metodoloških pristupa i metoda za procenu uticaja, kao deo jedinstvenog semikvantitativnog metoda višekriterijumske evaluacije planskih rešenja.

Teorijska saznanja primenjena su u knjizi na studiji slučaja kompleksa solarne elektrane Brebeks, što je prikazano u drugom (aplikativnom) delu knjige, na osnovu čega je zaključeno da primenjeni pristup SPU predstavlja pogodnu podršku u proceni uticaja solarne elektrane na životnu sredinu, preventivnoj zaštiti životne sredine na području na kom se planira izgradnja solarne elektrane i procesu donošenja optimalnih odluka o prostornom razvoju na području planirane solarne elektrane.

## SUMMARY

The global trend of reducing the "carbon footprint" has influenced the dynamic development of projects utilizing renewable energy sources (RES), including the expansion of solar energy in large-scale solar power plants. This has led to the need for assessing the impacts these projects have on the space and the environment.

The book notes that projects using RES, including solar power plants, can have both positive and negative impacts on the space and the environment, which must be determined to choose optimal spatial/territorial solutions ensuring preventive planning and active environmental protection. In this process, the application of Strategic Environmental Assessment (SEA) in the planning and spatial organization of solar power plants becomes significant.

SEA involves a holistic approach where complex interactions and correlations in the space where the solar power plant is planned for implementation can be considered in the earliest stages of project development (in the planning process). The principle of preventive protection can then be applied to eliminate or mitigate negative impacts and ascertain positive impacts. This approach enables the anticipation of all potential risks that may arise in later stages of project implementation, which is beneficial both in terms of efficient environmental protection and from the perspective of investors investing in solar power projects.

Optimal solutions to fulfill the primary role of SEA are primarily sought in the analysis of spatial relationships of the solar power plant with land, biodiversity, landscape, and basic environmental factors. As demonstrated in the book, this process, methodologically, is achieved through a combination of various methodological approaches and impact assessment methods, as part of a unified semi-quantitative method of multicriteria evaluation of planning solutions.

Theoretical knowledge applied in the book is exemplified in a case study of the "Brebex" solar power plant complex, as shown in the second (applicative) part of the book. It is concluded based on this case study that the applied SEA approach provides suitable support in: assessing the impact of the solar power plant on the environment; preventive environmental protection in the area where the construction of the solar power plant is planned; and the process of making optimal decisions on spatial development in the area of the planned solar power plant.

## BIOGRAFIJA AUTORA

Boško Josimović rođen je 1974. godine u Zemunu gde je završio osnovnu i srednju školu. Diplomirao je 2000. godine na Geografskom fakultetu Univerziteta u Beogradu, na odseku za prostorno planiranje. Magistrirao je 2003. godine, a doktorirao 2008. godine takođe na Geografskom fakultetu Univerziteta u Beogradu, na smeru istraživanje i planiranje prostora.

U periodu 2002.-2003. godine bio je angažovan u Institutu za arhitekturu i urbanizam Srbije (IAUS) kao stipendista Ministarstva za nauku, tehnologije i razvoj Republike Srbije, a od septembra 2003. godine zaposlen je u IAUS-u gde i danas radi. U martu 2009. godine izabran je u zvanje naučni saradnik, 2013. godine u zvanje viši naučni saradnik, a 2018 godine u zvanje naučni savetnik. Od 2017. Godine je koordinator nacionalne i međunarodne naučne i stručne saradnje u oblasti životne sredine i prostornog razvoja u IAUS-u.

Uža naučnoistraživačka specijalnost usmerena je na razvoj metodološkog pristupa u proceni uticaja strateških razvojnih politika i projekata na životnu sredinu u oblastima: prostornog i urbanističkog planiranja, energetike (posebno vetroenergetike i solarne energetike), upravljanja vodama, itd. U okviru navedenih tema objavio je preko 100 naučnih radova od kojih značajan broj u vrhunskim međunarodnim časopisima. Autor je i prvi koautor u tri naučne monografije. Pored toga, bio je učesnik u realizaciji: 7 naučnoistraživačkih projekata koji su finansirani od strane resornog Ministarstva za oblast nauke; rukovodilac (ispred IAUS-a) jednog međunarodnog naučnog projekta (HORIZON 2020); autor preko 20 tehnoloških razvojnih rešenja koja su verifikovana od strane nadležnog Matičnog naučnog odbora Ministarstva nauke, tehnološkog razvoja i inovacija Republike Srbije.

Profesionalna aktivnost Boška Josimovića usmerena je na rukovođenje u izradi: strateških procena uticaja razvojnih sektorskih politika na životnu sredinu; studija o proceni uticaja projekata na životnu sredinu; priloga o zaštiti životne sredine u prostornim planovima; itd. Značajno je i njegovo angažovanje kao konsultanta na projektima u oblasti infrastrukture koji se realizuju u Republici Srbiji, a finansiraju se iz sredstava Evropske unije.

Član je: Skupštine Alumnija Univerziteta u Beogradu, međunarodne naučne asocijacije SCIYO-a, organizacije SEEFED; nekoliko strukovnih udruženja; republičke Tehničke komisije za ocenu studija o proceni uticaja na životnu sredinu pri Ministarstvu za zaštitu životne sredine Republike Srbije; Naučnog veća i Izdavačkog saveta IAUS-a; Uredništva časopisa Arhitektura i urbanizam.

Oženjen je i ima dvoje dece.

## ABOUT THE AUTHOR

Boško Josimović was born in 1974 in Zemun, where he completed his elementary and high school education. He graduated in 2000 from the Faculty of Geography, University of Belgrade, Department of Spatial Planning. He obtained his master's degree in 2003 and his Ph.D. in 2008, also at the Faculty of Geography, University of Belgrade, specializing in spatial research and planning.

From 2002 to 2003, he was engaged at The Institute of Architecture and Urban & Spatial Planning of Serbia (IAUS) as a scholarship holder of the Ministry of Science, Technology, and Development of the Republic of Serbia. Since September 2003, he has been employed at IAUS, where he still works today. In March 2009, he was appointed as a Scientific Associate, in 2013 as a Senior Scientific Associate, and in 2018 as a Scientific Advisor. Since 2017, he has been the coordinator of national and international scientific and professional cooperation in the field of environmental and spatial development at IAUS.

In terms of scientific research, he specializes in developing a methodological approach to assessing the impacts of strategic development policies and projects on the environment in the fields of spatial and urban planning, energy (particularly wind and solar energy), water management, etc. He has published over 100 scientific papers about these topics, many of which in top-tier international journals. He is the author and co-author of three scientific monographs. Additionally, he participated in the implementation of seven research projects funded by the Ministry of Science; he led (on behalf of IAUS) an international scientific project (HORIZON 2020); he authored over 20 technological development solutions verified by the relevant Principal Scientific Committee of the Ministry of Science, Technological Development, and Innovation of the Republic of Serbia.

Boško Josimović's professional activities focus on leading the development of strategic environmental impact assessments of sectoral development policies, project environmental impact assessment studies, contributions to environmental protection in spatial plans, etc. His involvement as a consultant on infrastructure projects implemented in the Republic of Serbia and funded by the European Union is also significant.

He is a member of the Alumni Assembly of the University of Belgrade, the international scientific association SCIYO, the SEEFED organization, several professional associations, the State Technical Commission for Environmental Impact Assessment Studies at the Ministry of Environmental Protection of the Republic of Serbia, the Scientific Council and the Editorial Board of IAUS, and the Editorial Board of the journal Architecture and Urbanism.

He is married and has two children.

CIP - Каталогизација у публикацији

Народна библиотека Србије, Београд

711.554:621.472

502.1:621.472

ЈОСИМОВИЋ, Бошко, 1974-

Planiranje solarnih elektrana i životna sredina = Solar power plant planning and the environment / Boško Josimović ; [prevod na engleski, translation to english Goran Stanić]. - Beograd : Institut za arhitekturu i urbanizam Srbije [i. e.] (IAUS) = Belgrade : Institute of Architecture and Urban & Spatial Planning of Serbia [i. e.] (IAUS), 2024 (Beograd = Belgrade : Planeta Print). - 243 str. : ilustr. ; 25 cm. - (Posebna izdanja / Institut za arhitekturu i urbanizam Srbije ; br. 94 = Special editions / Institute of Architecture and Urban & Spatial Planning of Serbia ; no. 94, ISSN 0352-2180)

Uporedo srp. tekst i engl. prevod. - Tiraž 500. - Biografija autora = About the author: str. 242-243. - Bibliografija: str. 226-233. - Rezime ; Summary.

ISBN 978-86-82154-03-7

а) Сунчева енергетска постројења -- Животна средина б) Сунчева енергетска постројења -- Просторно планирање

COBISS.SR-ID 145545225