Energy Economics - Energy Sector Modeling (EW-MOD)

Summer Semester 2024

Course Details

Instructors: Prof. Dr. Christian von Hirschhausen, Dr. Konstantin Löffler, Dr. Karlo Hainsch
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Time and location: Mondays, 16:15 - 19:15; Room: MAR 0.002
Registration: Fill out the registration survey **here**.

Course Description

This course provides a comprehensive introduction to the fundamentals of energy system modeling, guiding participants through the basics and offering a detailed, step-by-step approach to model expansion. It delves into the techno-economic aspects of energy and power systems, shedding light on the driving forces behind their development and operation. Throughout the course, students will engage in hands-on exercises and discussions, equipping them with the analytical skills necessary to tackle contemporary challenges in the energy sector.

Adding to the rich learning experience, the course features guest lectures from distinguished practitioners in both research and industry, bringing diverse perspectives and insights into the real-world applications of energy system modeling. Collaborative learning is emphasized through group homework assignments, encouraging students to work together and apply theoretical knowledge to practical problems. The course concludes with a final term paper, where students will have the opportunity to conduct an in-depth analysis of a specific aspect of energy system modeling.

Course Schedule

Date	Topic	Literature
15. April	Introduction and julia installation	[1]
22. April	Fundamentals of OR and julia	[1]
29. April	Introduction to energy system modeling	[2], [3]
06. May	Renewable energies and timeseries	[4], [5]
13. May	Flexibility and storage	[6], [7]
20. May	Public holiday!	—
27. May	Transportation of energy in general	
03. June	DC load-flow	[8]
10. June	Guest Lecture I	
17. June	Pathways and emissions	[9], [10]
24. June	Discussion of term paper topics	
01. July	Guest Lecture II	
08. July	Presentation of term paper ideas	
15. July	Guest Lecture III	

Literature

[1] *The Julia REPL · The Julia Language*. URL: https://docs.julialang.org/en/v1/stdlib/REPL/ (visited on 03/28/2024).

[2] Andrea Herbst et al. "Introduction to energy systems modelling". In: *Swiss journal of economics and statistics* 148.2 (2012), pp. 111–135. URL: http://www.irees.de/irees-wAssets/docs/publications/journal-reviewed/Herbst-et-al-2012_Introduction-to-Energy-Systems-Modelling_SJES.pdf (visited on 01/30/2017).

[3] Konstantin Löffler et al. "Designing a Model for the Global Energy System—GENeSYS-MOD: An Application of the Open-Source Energy Modeling System (OSeMOSYS)". In: *Energies* 10.10 (Oct. 2017), p. 1468. DOI: 10.3390/en10101468. URL: https://www.mdpi.com/1996-1073/10/10/1468 (visited on 02/08/2019).

[4] Mark Z Jacobson. *100% Clean, Renewable Energy and Storage for Everything*. 1st ed. Cambridge University Press, July 31, 2020. ISBN: 978-1-108-78671-3 978-1-108-47980-6 978-1-108-79083-3. DOI: 10.1017/9781108786713. URL: https://www.cambridge.org/highereducation/books/100-clean-renewable-energy-and-storage-for-everything/26E962411A4A4E1402479C5AEE680B08#contents (visited on 09/18/2022).

[5] Leonard Göke and Mario Kendziorski. "Adequacy of time-series reduction for renewable energy systems". In: *Energy* 238 (Jan. 1, 2022), p. 121701. ISSN: 0360-5442. DOI: 10.1016/j.energy.2021.121701. URL: https://www.sciencedirect.com/science/article/pii/S0360544221019496 (visited on 09/07/2022).

[6] O. M. Babatunde, J. L. Munda, and Y. Hamam. "Power system flexibility: A review". In: *Energy Reports*. The 6th International Conference on Power and Energy Systems Engineering 6 (Feb. 1, 2020), pp. 101–106. ISSN: 2352-4847. DOI: 10.1016/j.egyr.2019.11.048. URL: https://www.sciencedirect.com/science/article/pii/S2352484719309242 (visited on 05/19/2023).

[7] J. Mitali, S. Dhinakaran, and A. A. Mohamad. "Energy storage systems: a review". In: *Energy Storage and Saving* 1.3 (Sept. 1, 2022), pp. 166–216. ISSN: 2772-6835. DOI: 10.1016/j.enss.2022.07.002. URL: https://www.sciencedirect.com/science/article/pii/S277268352200022X (visited on 03/28/2024).

[8] Anselm Eicke and Tim Schittekatte. "Fighting the wrong battle? A critical assessment of arguments against nodal electricity prices in the European debate". In: *Energy Policy* 170 (Nov. 1, 2022), p. 113220. ISSN: 0301-4215. DOI: 10.1016/j.enpol.2022.113220. URL: https://www.sciencedirect.com/science/article/pii/S0301421522004396 (visited on 03/28/2024).

[9] Karlo Hainsch et al. "Emission Pathways Towards a Low-Carbon Energy System for Europe: A Model-Based Analysis of Decarbonization Scenarios". In: *The Energy Journal* 42.1 (Sept. 1, 2021). ISSN: 01956574. DOI: 10.5547/01956574.42.5.khai. URL: http://www.iaee.org/en/publications/ejarticle.aspx?id=3730 (visited on 01/11/2021).

[10] Konstantin Löffler et al. "Modeling the low-carbon transition of the European energy system - A quantitative assessment of the stranded assets problem". In: *Energy Strategy Reviews* 26 (Nov. 2019), p. 100422. ISSN: 2211467X. DOI: 10.1016/j.esr.2019.100422. URL: https://linkinghub.elsevier.com/retrieve/pii/S2211467X19301142 (visited on 03/31/2021).