



Hybrid modeling of the energy system for development of renewable energy roadmap for Kazakhstan with high spatial, temporal and technical disaggregation

Principal investigator (PI): Nurkhat Zhakiyev
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Implementation period: 2021 - 2023

Aim

- To develop an integrated hybrid modeling tool of the energy system, which includes a long-term planning model of the energy system and an operational model of the electric power system;
- To develop Roadmap of RE deployment 2030/2050, which corresponds to optimal performance parameters, ensuring reliability, economic feasibility and environmental friendliness of the energy system.

Tasks

- Update of the long-term energy system model
- Creation of an operational power model with high spatial, temporal, technical disaggregation
- Linking of modeling tools
- Development of a renewable energy roadmap for Kazakhstan
- Sensitivity analysis and uncertainties estimation

Research Methods

Soft-linking is a method of hybrid linking of models iteratively using the results of calculating one model in another as input parameters. The study uses The TIMES model (The Integrated MARKET-FORM System), which allows to model an energy system with detailed technical and economic parameters with a complete chain of fuel and energy balance across all sectors of the economy.

PyPSA modeling tool used for operational modeling of an electric power system by calculating the optimal power flow, analyzing the potential for integrating renewable energy sources, optimizing the operation of existing power plants, and identifying opportunities for energy efficiency improvements.

Partners

National partners



International partners



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Project Team



Nurkhat Zhakiyev

Principal investigator, PhD in Physics. Head of the Department of Science and Innovation



Aidyn Bakdolotov

Senior Researcher, Master's degree in Nuclear Engineering (Purdue University, USA). Director of Climate change Center – Economic Research Institute



Bayandy Sarsembayev

Senior Researcher, PhD in Electrical Engineering and Electronics Research (Brunel University, UK).



Bekzhan Mukatov

Senior Researcher, PhD in Power systems (Novosibirsk State Technical University). Independent expert



Yerbol Akhmetov

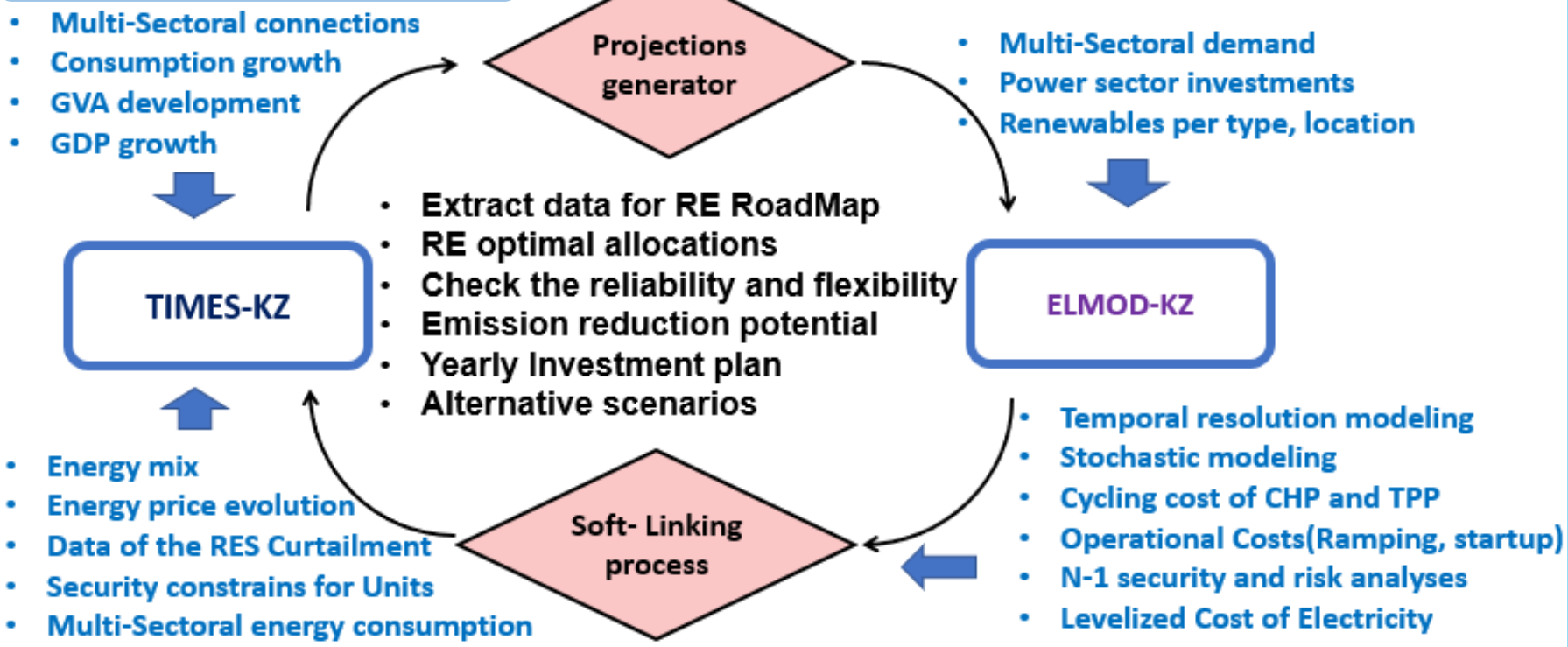
Researcher, MS in Electrical and Electronics Engineering (Nazarbayev University, KZ)



Alexandr Ten

Researcher, Meng in Electrical and Computer Engineering (University of British Columbia, Canada)

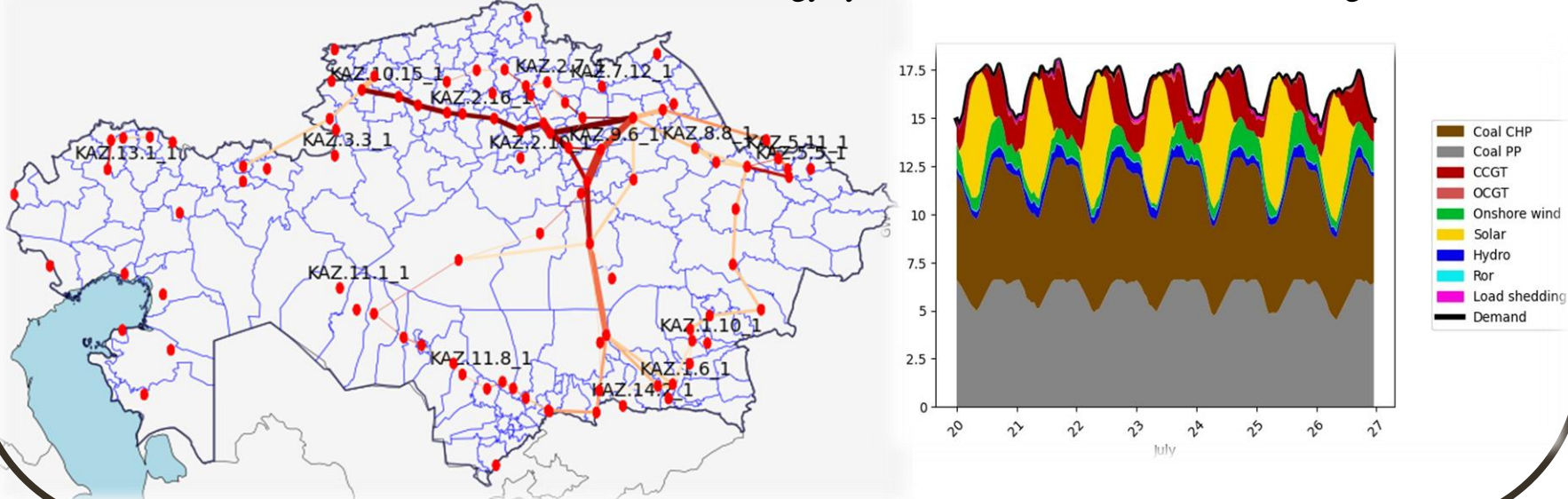
Graphical Abstract



Current results

Published:

- S. Zhakiyeva, M. Gabbassov, Y. Akhmetbekov, G. Akybayeva and N. Zhakiyev, "The Development of a Risk Assessment Modeling for the Power System of Kazakhstan," 2021 IEEE International Conference on Smart Information Systems and Technologies (SIST), 2021, pp. 1-4, doi: 10.1109/SIST50301.2021.9465892. (indexed in IEEE, Scopus)
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- A. Zhanbolatov, S. Zhakiyeva, N. Zhakiyev, K. Kayisli (2022) "Blockchain-Based Decentralized Peer-to-Peer Negawatt Trading in Demand-Side Flexibility Driven Transactive Energy System" *International Journal of Renewable Energy Research (IJRER)*, 12(3), 1475-1483. doi:10.20508/ijrer.v12i3.13195.g8530 (Cite score-3.7, Scopus percentile 58, Q2)
- B. Sarsembayev, N. Zhakiyev, A. Akhmetbayev and K. Kayisli, "Servomechanism based Optimal Control System Design for Maximum Power Extraction from WECS with PMSG," 2022 10th International Conference on Smart Grid (icSmartGrid, june 27-29, 2022 Istanbul/Turkiye), 2022, pp. 309-313,
- A. Zhanbolatov, N. Zhakiyev, S. Zhakiyeva, K. Kayisli, B. Azibek, T. Dushayeva. "A Multi-carrier Energy Method for Self-Consumption Enhancement in Residential Buildings" in 11th international conference on renewable energy research and applications. September 18-21, 2022, Istanbul/Turkiye
- G. Abdi, N. Zhakiyev, and S. Toilybayeva "Decarbonization Opportunities and Emerging Carbon Pricing Instruments in Central Asia" (2023) Chapter in "Climate Change and Decarbonization in Central Asia", Springer, Berlin (Apr, 2023, Chapter in Springer's eBook).
- Aidyn Bakdolotov, Rocco De Miglio, Nurkhat Zhakiyev. Optimization modelling of the decarbonization scenario of the total energy system of Kazakhstan until 2060. *Energies*. 2023.



Expected results

- Modeling tool with high quality input data.
- Scenario analyses;
- The roadmap for renewable energy in Kazakhstan with data on the optimal geographical location, construction time and investments, taking into account the renewable energy potential and energy demand of the region.