

## Introduction:

The purpose of this work is to analyze the role of renewable gases within the Austrian national climate-neutral energy system and to identify bottlenecks of the existing gas grid which may appear.

## Research questions:

- What are the potential contributions of renewable gases as alternatives to established fossil fuels in the process of transitioning to sustainable energy sources?
- How does the existing gas grid in Austria accommodate the integration of renewable gases, and what potential bottlenecks or limitations exist?

## Methodology:

This work develops an OEMOF [1] based multi-node model (Figure 3.) to optimize the energy flows of a multi-sector energy system at a province scale, under the objective of maximal efficiency and minimal primary energy consumption. Every node has an exogenous demand and has the potential to support local generation. The energy demand is converted to useful exergy demand (Figure 2.) which is defined as the theoretical minimum exergy requirement to fulfill all current energy services [2].

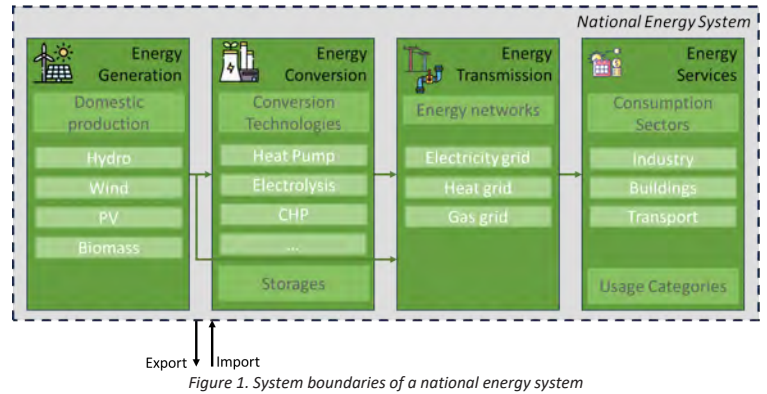


Figure 1. System boundaries of a national energy system

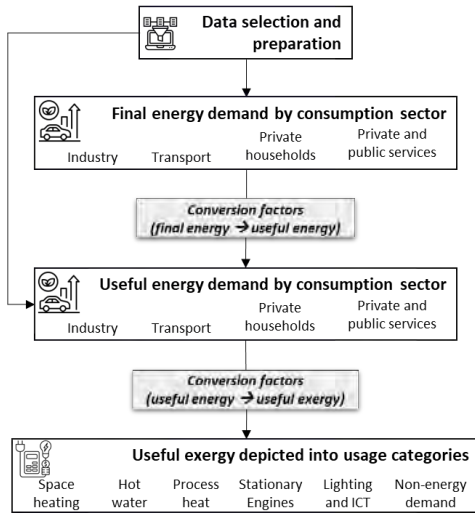


Figure 2. Methodology for calculating the exergy demand of each sector depicted in use categories

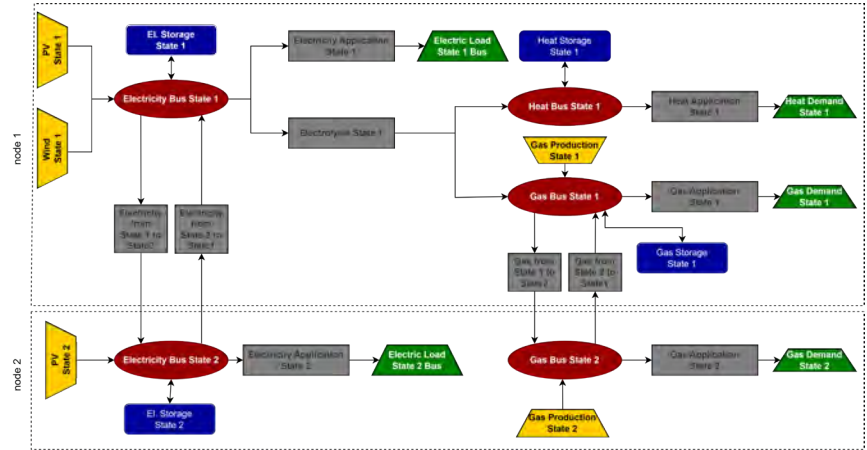


Figure 3. Simplified schematic representation of energy flows of two interconnected nodes

Each node of the modeled energy system represents one Austrian province



## Results

### Energy Supply

The future generation of renewable electricity was determined for each province, based on RES-specific technical potentials. Three provinces (Lower Austria, Upper Austria, Styria) emerge as the prominent leaders in renewable power generation.

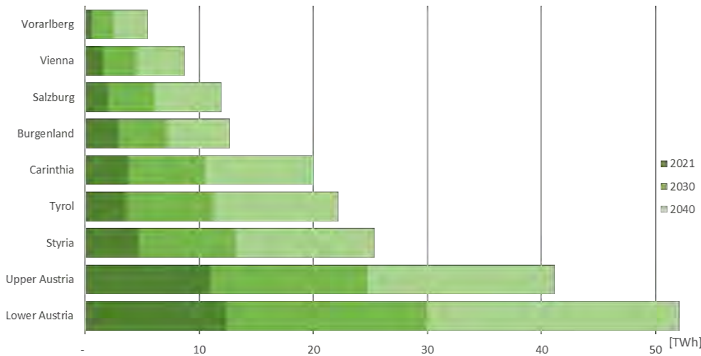


Figure 4. Renewable electricity generation for each Austrian province for three points in time

### Energy Demand

The energy demand is based on scenario-specific calculations and carried out for each sector, useful category and Austrian province. The gas demand in Lower Austria (Figure 5) is dominated by the non-energetic demand of the industrial sector (~70%) and the refinery (~27%) [3].

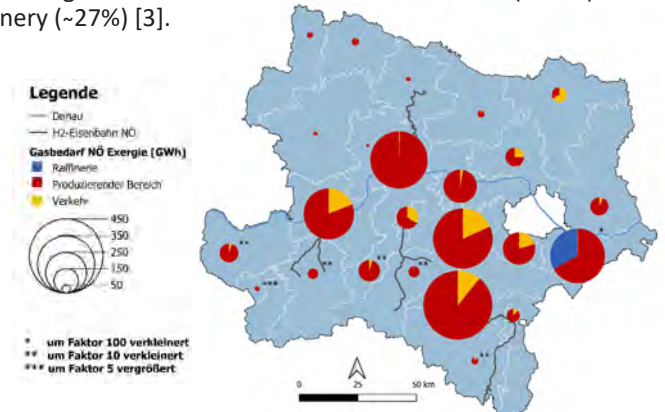


Figure 5. Renewable gas demand in 2040 of each district in Lower Austria [3]

## References:

- [1] OEMOF. 2023. A modular open-source framework to model energy supply systems. <https://oemof.org/about-oemof/>.
- [2] Sejkora, C., Kühberger, L., Radner, F., Trattner, A., and Kienberger, T. 2020. Exergy as Criteria for Efficient Energy Systems—A Spatially Resolved Comparison of the Current Exergy Consumption, the Current Useful Exergy Demand and Renewable Exergy Potential. *Energies* 13, 4, 843.
- [3] Cvetkovska, R. and Indinger, A. 2022. Hy2NÖ – Wasserstoffinitiative Niederösterreich. [https://news.wko.at/news/niederoesterreich/Indinger\\_HY2NOe-Vorstellung-der-Wasserstoffinitiative-NOe\\_05.pdf](https://news.wko.at/news/niederoesterreich/Indinger_HY2NOe-Vorstellung-der-Wasserstoffinitiative-NOe_05.pdf). Accessed 27 June 2023.