Development of an integral climate-neutral energy concept for the village of Rodder

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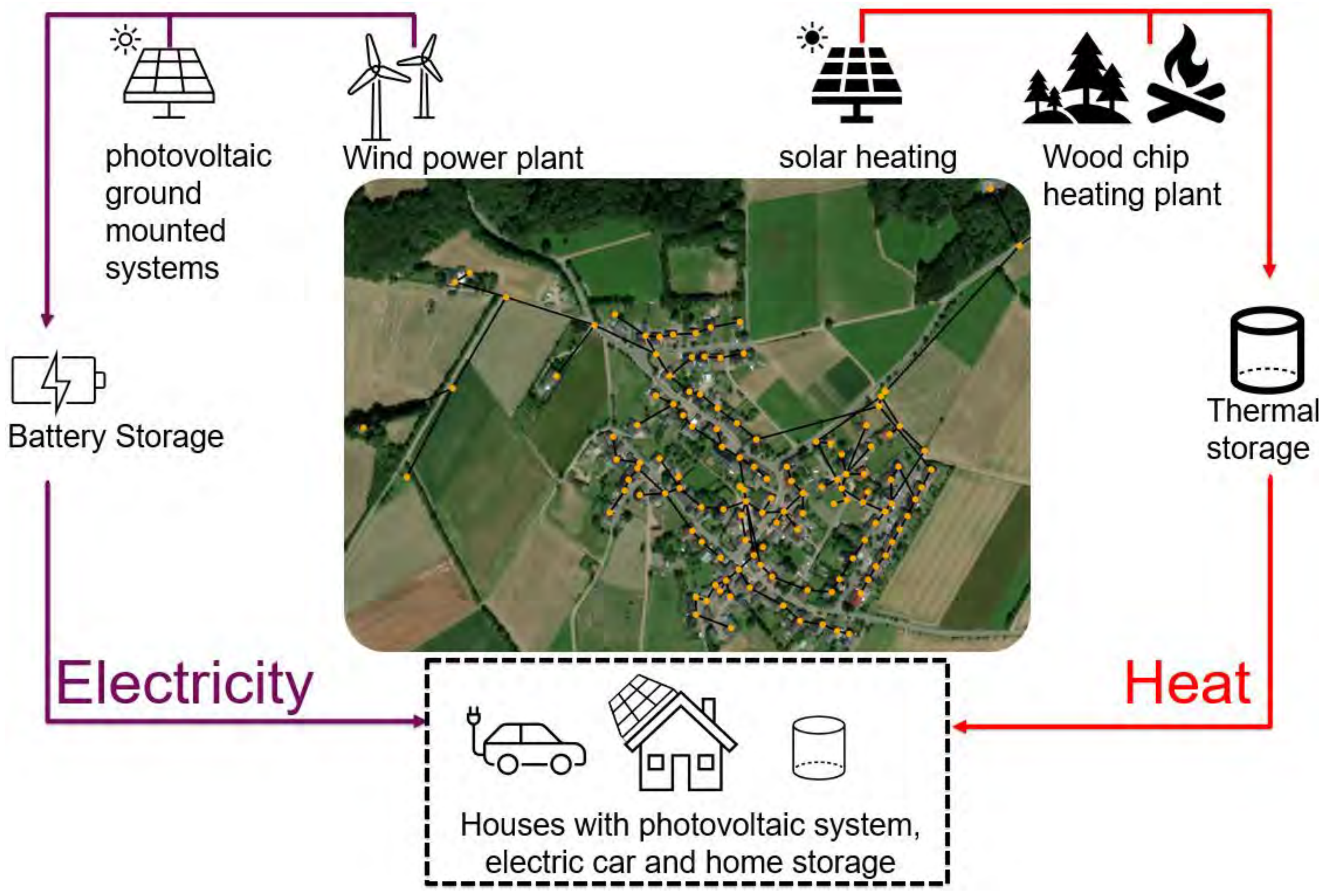
The aim of the project is to analyse possible climate-neutral energy supply concepts in order to decarbonise the electricity, traffic and heat sectors for the village of Rodder. The project has shown that a significant expansion of photovoltaics in the distribution grid is only possible with battery storage. In addition, an photovoltaic ground mounted system or a wind power plant with coupled battery storage is needed to achieve a electricity autarky rate of 100%. For a climate-neutral supply of the heating sector, a combination of solar heating, a wood chip heating plant and buffer storage is a possible solution.

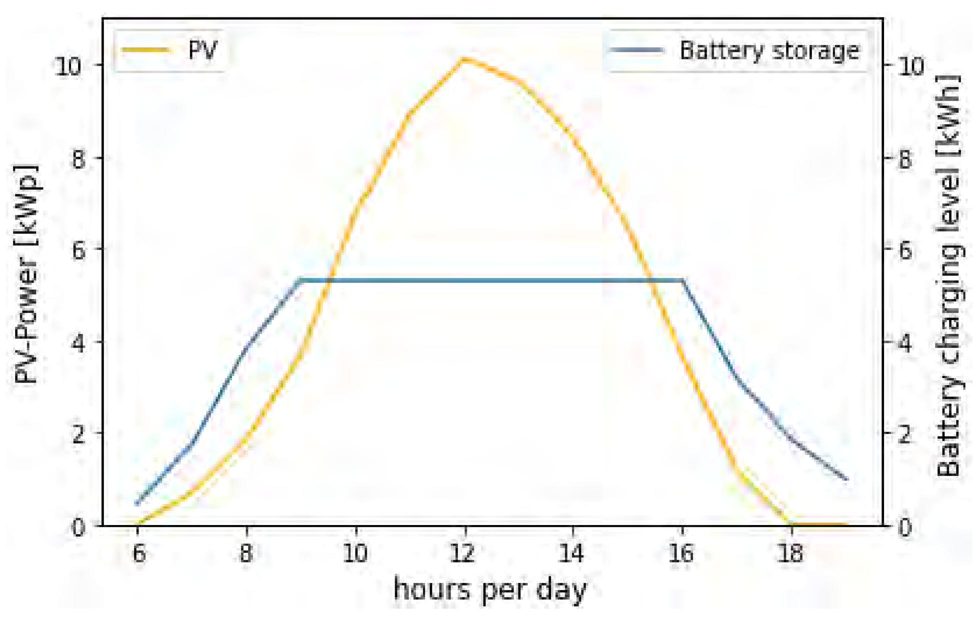
1. Climate-neutral energy concepts



- Rural village; no industrial consumption
- Modelling of electrical & thermal load profiles
- Electricity consumption: **597 MWh / year** (incl. e-mobility)
- Heat consumption: **1,977 MWh / year**

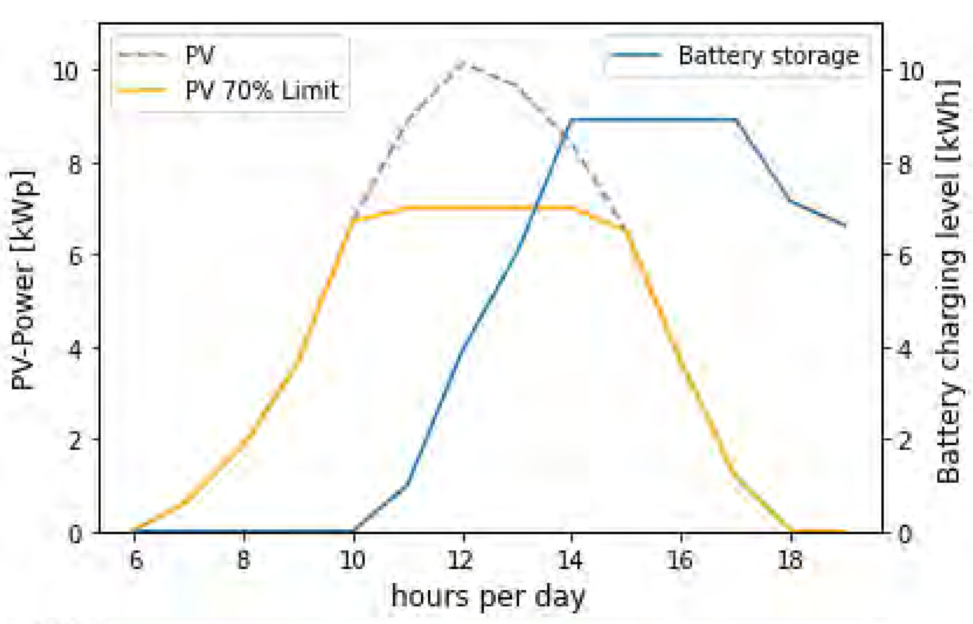
2. Electricity: Distribution grid

Scenarios	power	Voltage deviation	Transformer utilisation	Line utilisation	Energy losses due to limitation
No storage	540 kWp (50%)	+ 8 %	110 %	68 %	18,900 kWh (2.85%)
Conventional	540 kWp (50%)	+ 7 %	105 %	65 %	12,700 kWh (1.91%)
Grid-serving	810 kWp (75%)	+ 6 %	no critical condition	no critical condition	No energy losses



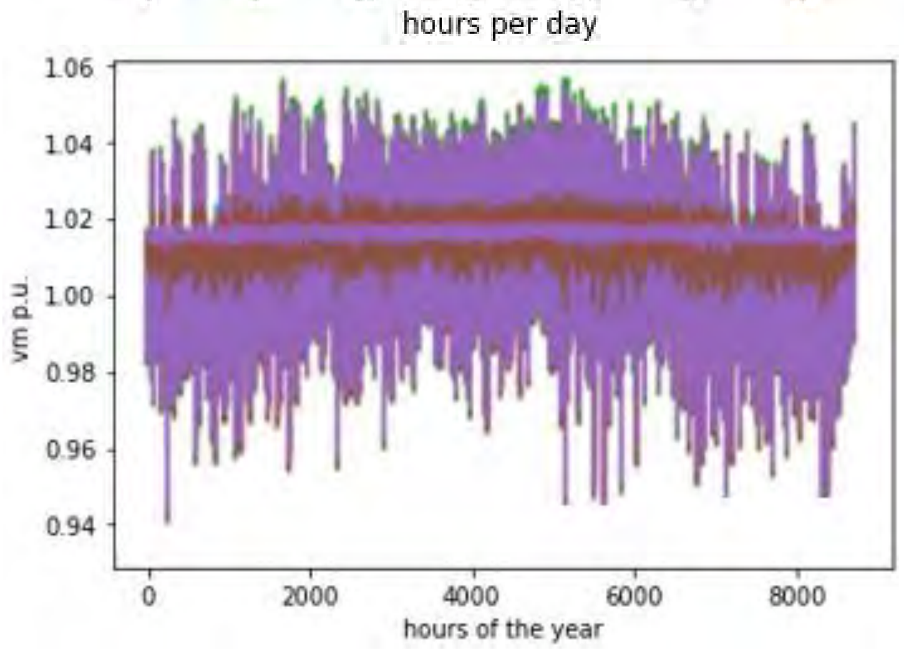
Conventional storage operation mode:

- Aims to maximize self-consumption and autarky
- No benefit for electricity grid
- The PV-peak continues to burden the electricity grid



Grid serving storage operation mode:

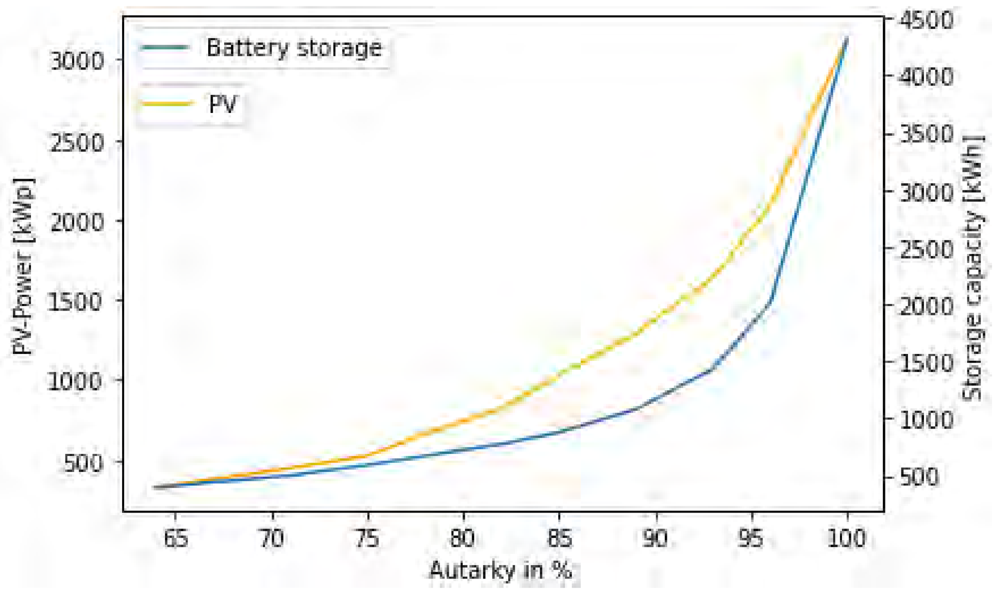
- Limiting the PV feed-in power
- Charge storage when max. feed-in power reached
- Benefit for electricity grid
- Combined hybrid operation mode is recommended



Voltage deviation with grid serving storage

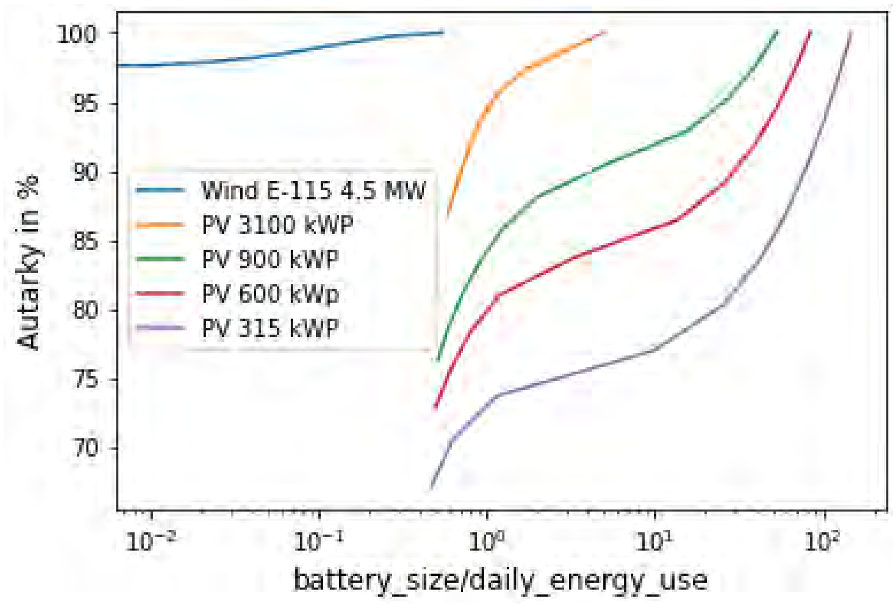
- Grid serving storage leads to less voltage deviation
- Use of e-mobility does not lead to grid overloads
- Demand response can help to relieve the grid

3. Electricity: Medium volted grid



PV ground mounted system

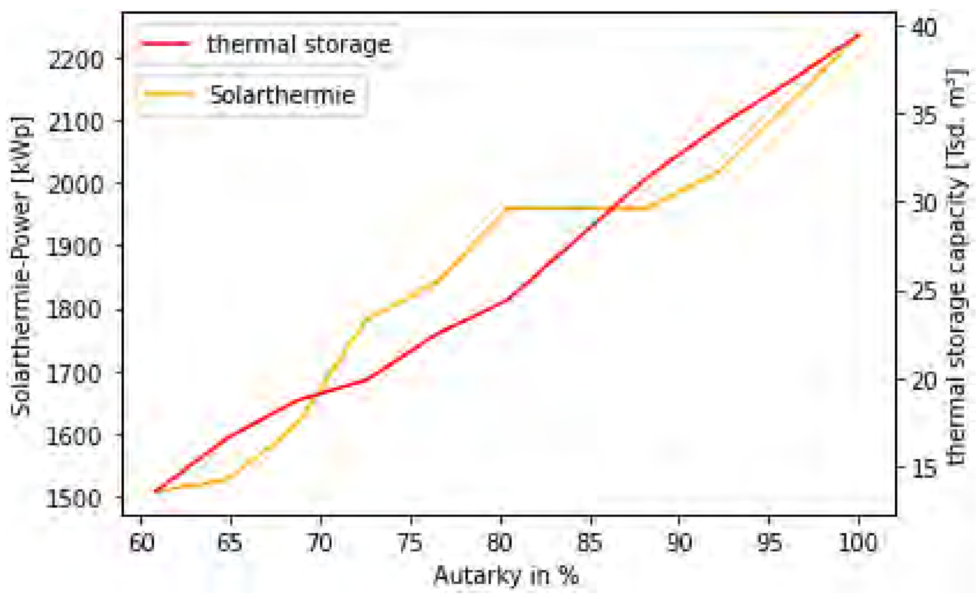
- PV power and storage capacity increase with growing autarky
- To reach 100% autarky: 3.1 MWp PV and 4.3 MWh Storage



Autarky for different renewable energies and storage capacities

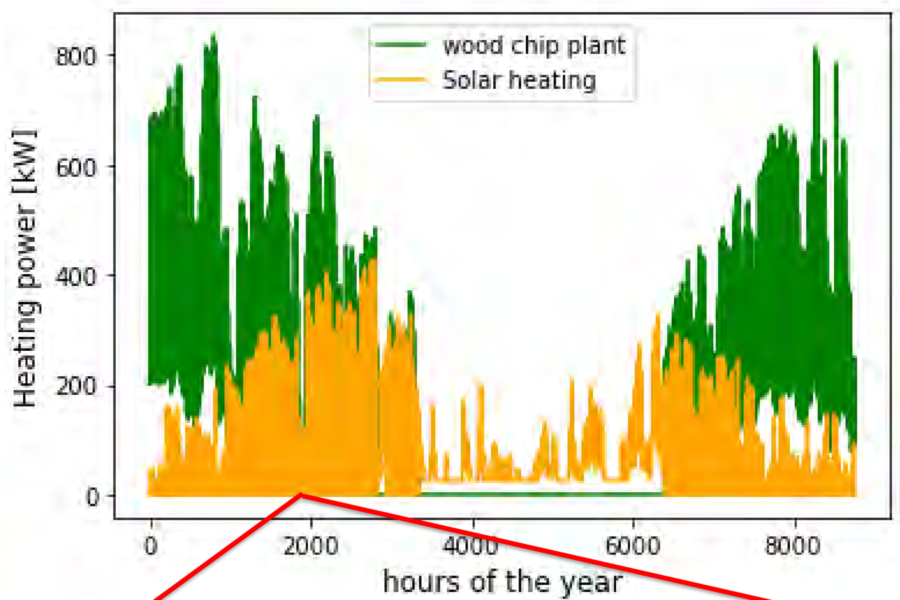
- With increasing nominal power, the required storage capacity decreases
- The use of a wind turbine can achieve a high level of autarky with small storage capacities

4. Heat: Local heating grid



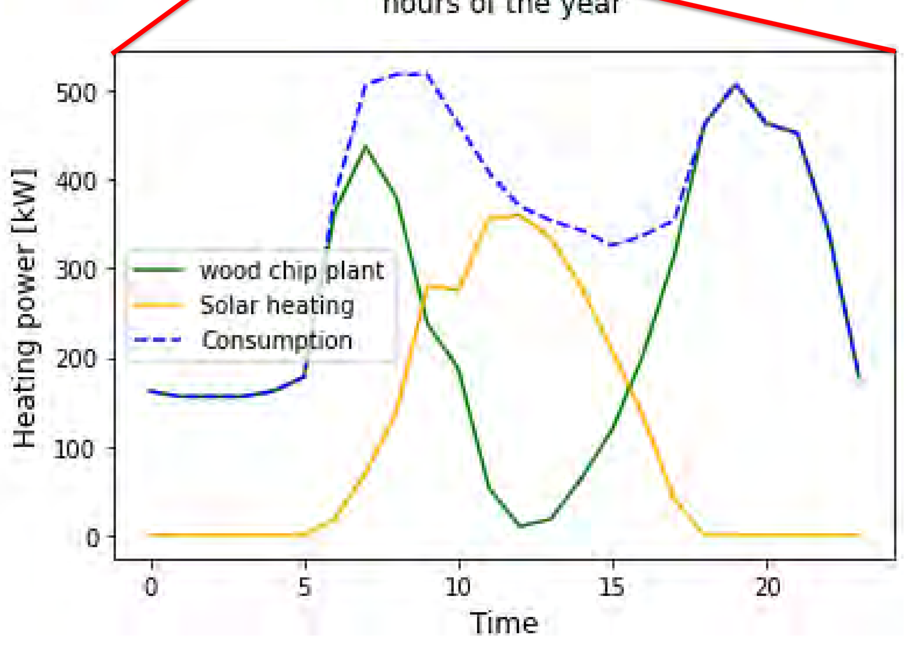
Solar heating and seasonal storage

- Solar heating power and storage capacity increase with growing autarky
- To reach 100% autarky: 2.2 MWp solar and 40,000 m³ (1,152 MWh) thermal seasonal storage



Solar heating, wood chip plant and buffer storage

- In summer the solar heating supplies the thermal consumption
- Wood chip plant has to be dimensionised for max. required thermal load
- solar coverage rate 22% (435 MWh)



Operation mode solar heating and wood chip plant

- Thermal consumption covered by solar heating and wood chip plant
- Buffer storage is empty
- Solar heating and wood chip plant complement each other

5. Conclusion

Scenario	Power R.E.	Storage capacity
	Electricity	
PV ground mounted system	3.1 MW	4.3 MWh
Wind power	4.5 MW	0.89 MWh
	Thermal	
Solar heating	2.2 MW	40,000 m³
Solar heating + wood chip plant	0.7 MW (Solar) 0.83 MW (wood)	100 m³

- 100% autarky possible with different renewable technologies
- Volatile generation resulting in increased storage capacities

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