RES-TMO

ASSESSING AND MAPPING THE TECHNICAL GENERATION POTENTIALS FROM RENEWABLE ENERGY SOURCES IN THE UPPER RHINE REGION

A Project by the Upper Rhine Cluster for Sustainibility Research

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What is the Upper Rhine Cluster?

- It is a network whose members include the universities of the EUCOR alliance such as: Basel, Freiburg, Karlsruhe, Mullhouse, Strasburg, & the University of Koblenz and Landau as well as partnerships with a number of universities of applied sciences and research institutes
- The cluster has collaborated with policy makers, economic actors, citizens, and other territorial stakeholders
- Main goal of the cluster is to develop cross-border and interdisciplinary research and innovation strategies and projects in which actors from science, business, politics and civil society work together
- The URC for SR has contributed to many projects such as RES-TMO, the project that will be presented today

Definition taken from: https://www.nachhaltigkeit-oberrhein.info/de/home/

Presentation Outline

I. Definitions

- The Upper Rhine Region (URR)
- The Potentials

II. Methodology

- Wind
- Solar

III. Conclusion

I. Definitions

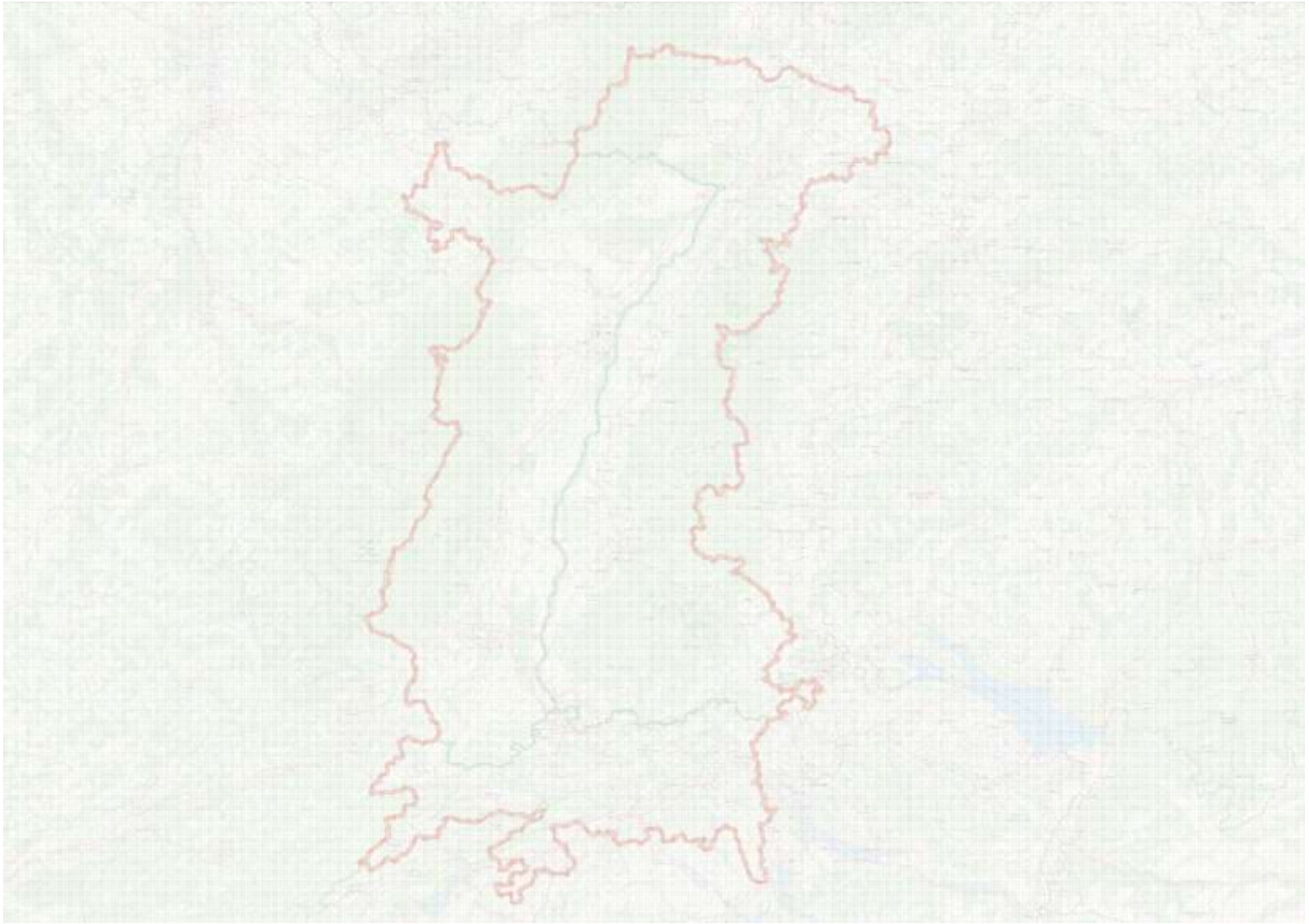
The Upper Rhine Region

Covers an area of 21.000 km^2 and is home to around 6.000.000 inhabitants

Definition derived from Schumacher et al. (Eds.) (2017)

The Upper Rhine Region

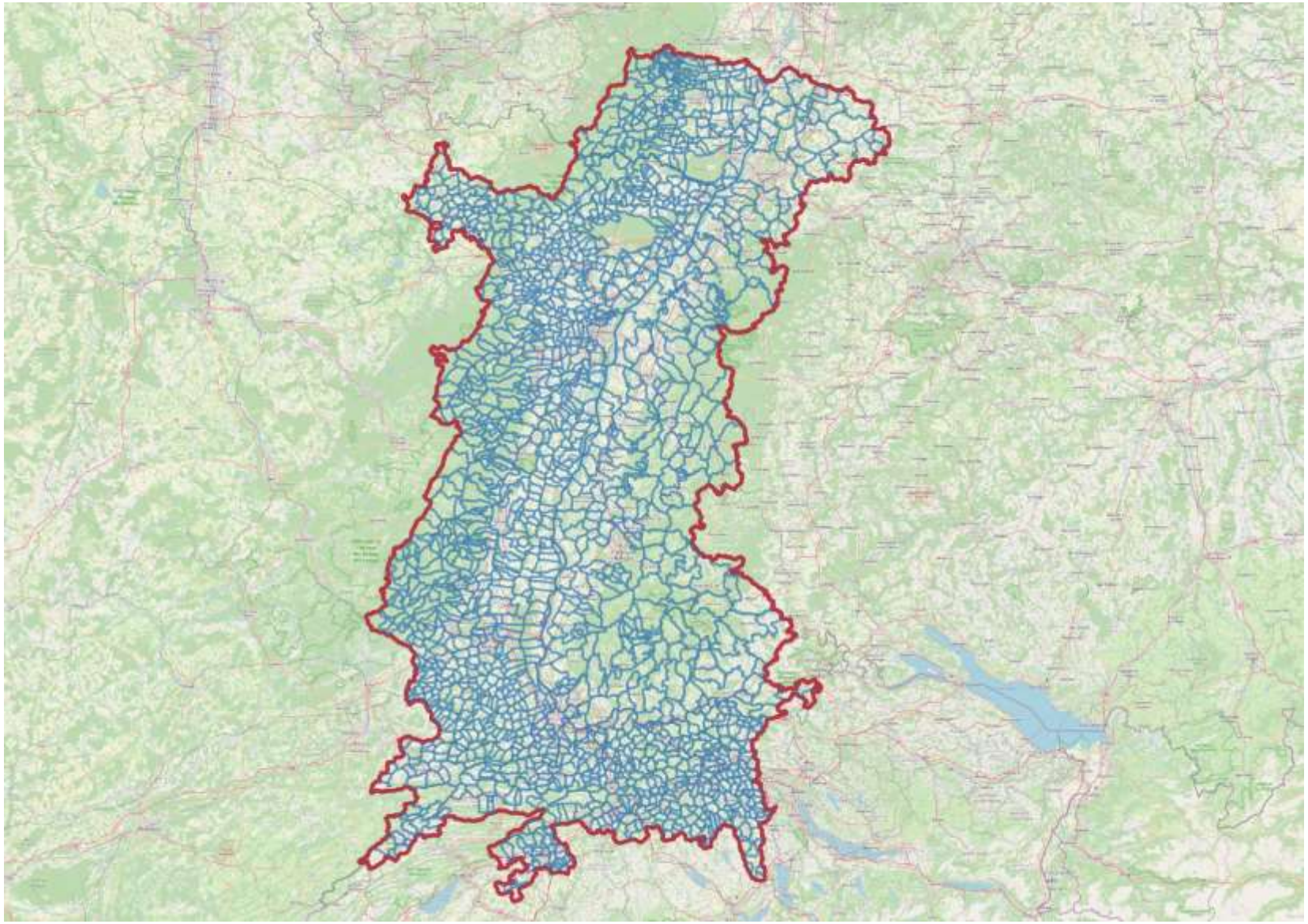
Includes 3 countries: France, Germany, and Switzerland



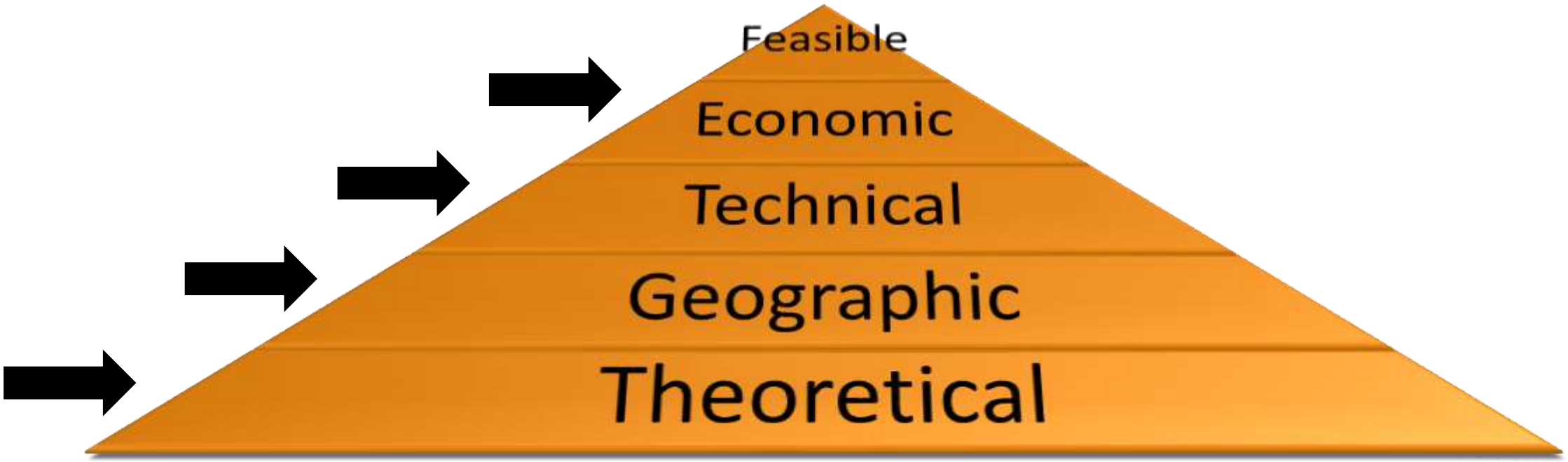
Definition derived from Schumacher et al. (Eds.) (2017)

The Upper Rhine Region

Includes more than 1.700 municipalities



What are the Different Types of Potentials?



Definition adapted from Jäger et al. (2016)

II. Methodology

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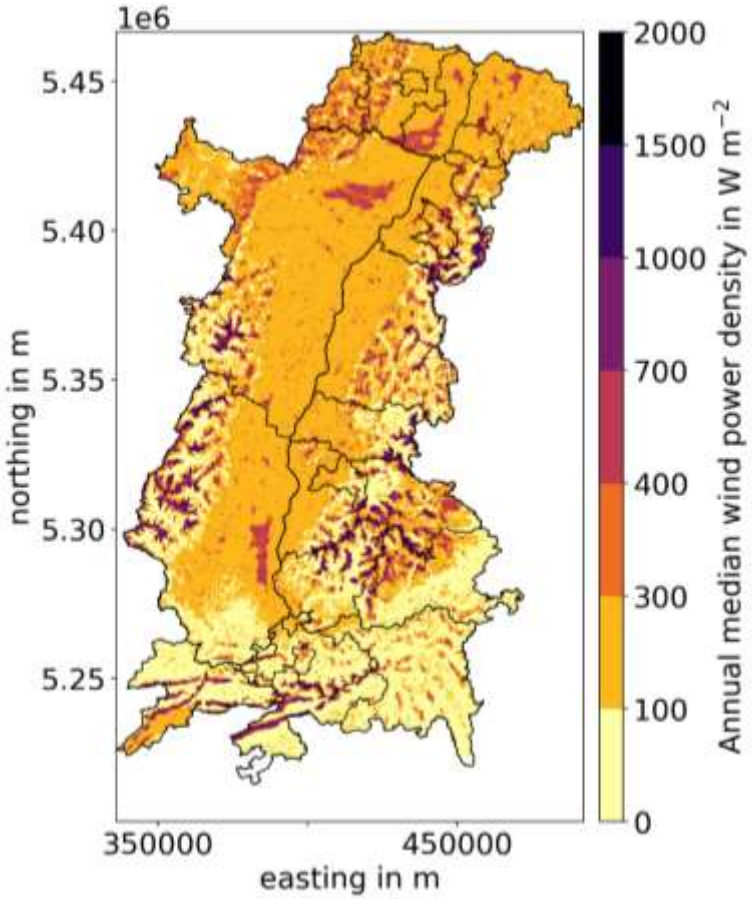
Wind

Wind Energy: Theoretical Potential

- The theoretical potential depicts the "available kinetic energy contained in the atmosphere over an area" (Grau et al, 2017)
- It is assessed by calculating the Wind Power Density (WPD in W/m^2) which is mathematically related to wind speed
- Wind speed data is compiled using data from different weather stations
- The long-term median wind speed is mapped over the study area using the WSWS model developed by Jung & Schindler (2017)
- The median wind speed values are then extrapolated to the different hub heights



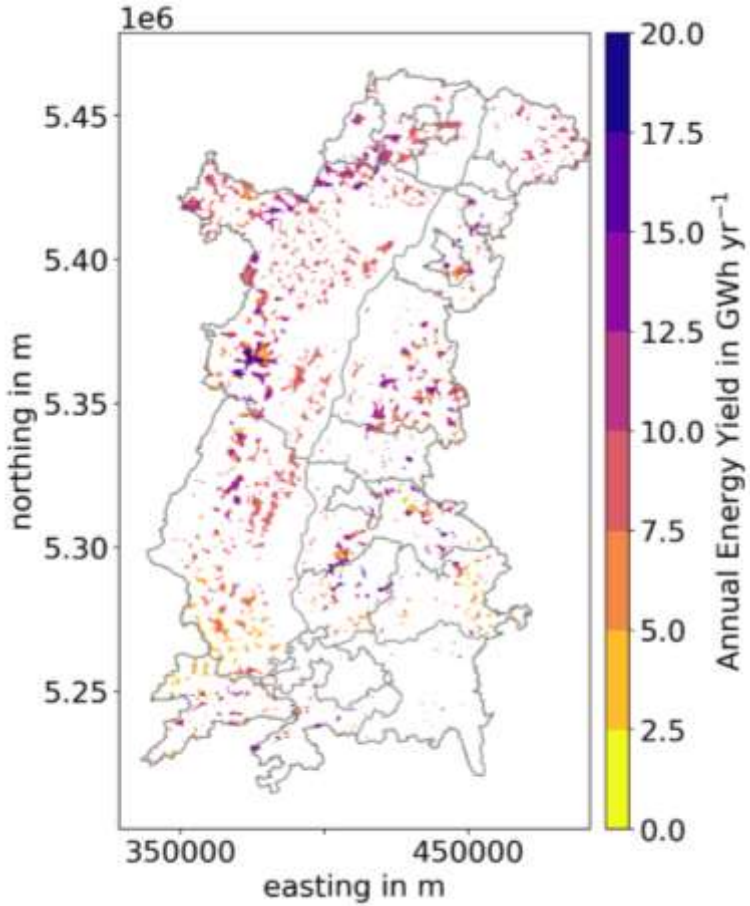
Wind Energy: Geographic Potential

- In this step, the area where the theoretical potential can be utilized is calculated
- Geographic restrictions such as: orography (steep slopes, high elevation) and competing land use (cities, protected areas) that are protected by legislation are removed from the study area
- The usable area that can be used for wind energy propagation remains on the map

https://upload.wikimedia.org/wikipedia/commons/3/34/Freiburg_017.650.n.jpg

Wind Energy: Technical Potential

- The technical potential factors in the wind turbine efficiency for the conversion of the kinetic energy (calculated in the theoretical potential step) on the usable area (calculated in the geographic potential step) to electrical energy (kWh/yr)



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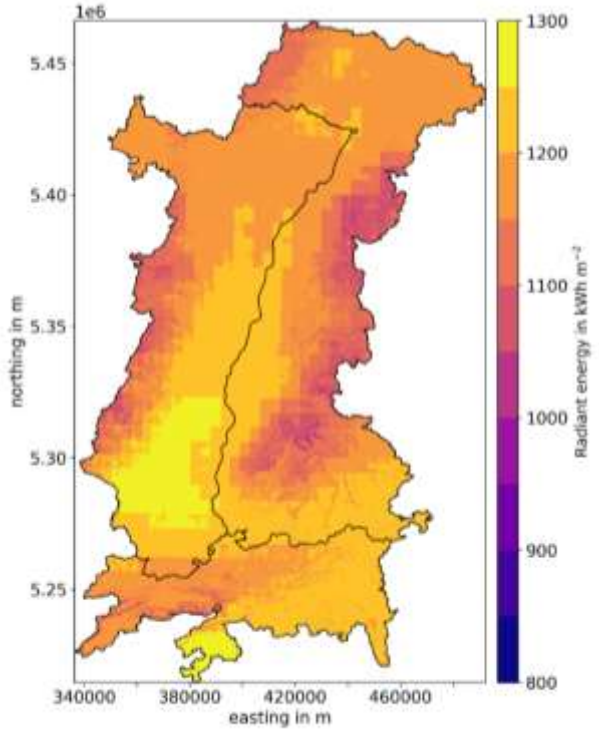
Solar PV

Solar PV: Theoretical Potential

- The theoretical potential can be calculated by using the average yearly global irradiation (in Wh/m^2) received in the URR by using the software PVMAPS



Solar PV: Geographic Potential (1)

1) Solar PV

2) Free-range PV

3) Rooftop PV

4) Agro (Agriculture)-PV

5) Ground Mounted (GM)-PV

1) https://www.power-technology.com/wp-content/uploads/sites/7/2021/01/solar.jpg
2) https://www.foenpv.com/uploadfile/201806/28/54b1b009d895898eccbd5688905d96f0_medium.jpg
3) https://www.dailymaverick.co.za/wp-content/uploads/solar-PV-distributed-DirkDeVos.jpg
4) https://www.solarserver.de/wp-content/uploads/OEKO-HAUS_Agrophotovoltaik_Althegnenberg.jpg
5) https://www.bsg-ecology.com/wp-content/uploads/2014/12/Solar-Farm_RW_small.jpg

Solar PV: Geographic Potential (2)

❖The geographic potential entails the calculation of the usable area for the propagation of each of the three solar PV types:

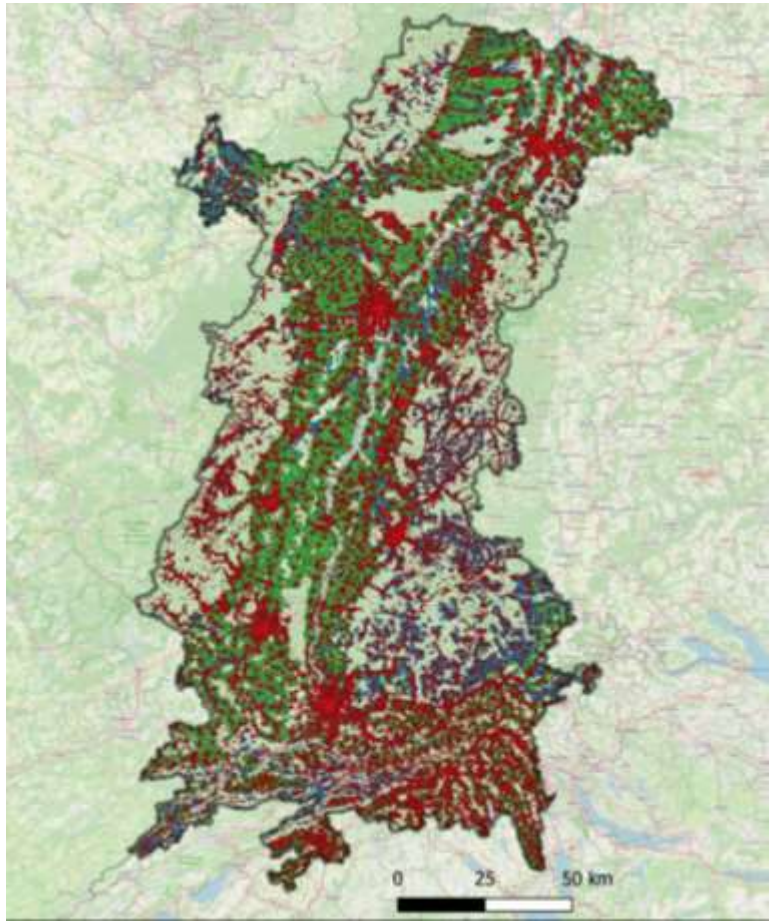
1) Rooftop PV
2) Agro-PV
3) GM-PV

❖ The usable area for rooftop PV consists of the rooftop surfaces

❖The usable area for Agro-PV and GM-PV is found by:

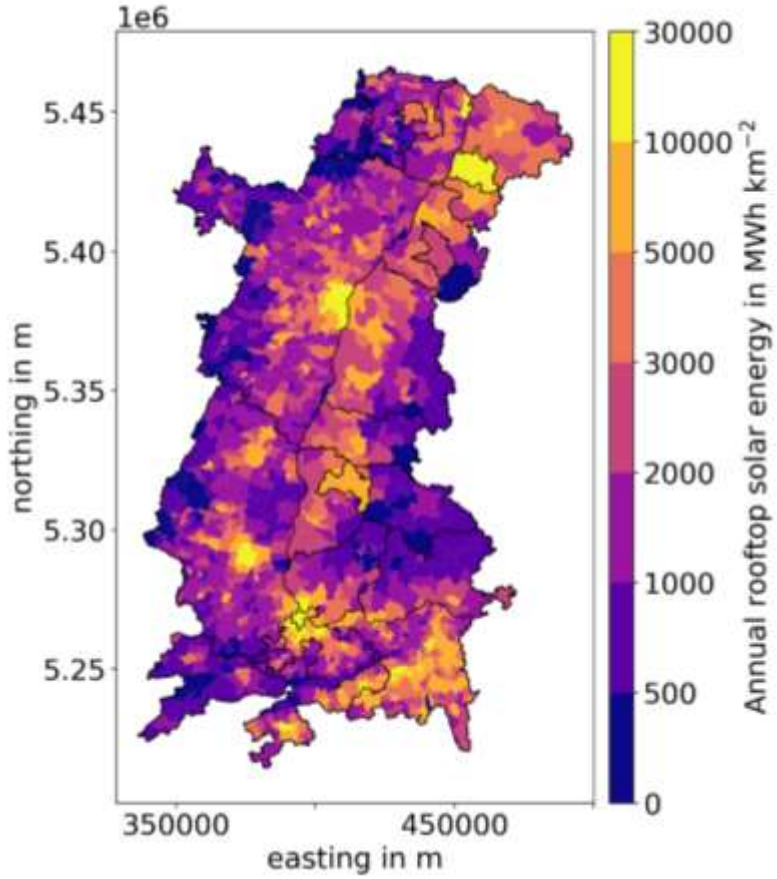
a) Excluding competing land uses (cities, water bodies, protected areas…) that are protected by legislation and are common for both

b) Differentiating between land where agricultural activities take place (Agro-PV) and pastures (GM-PV)



Solar PV: Technical Potential

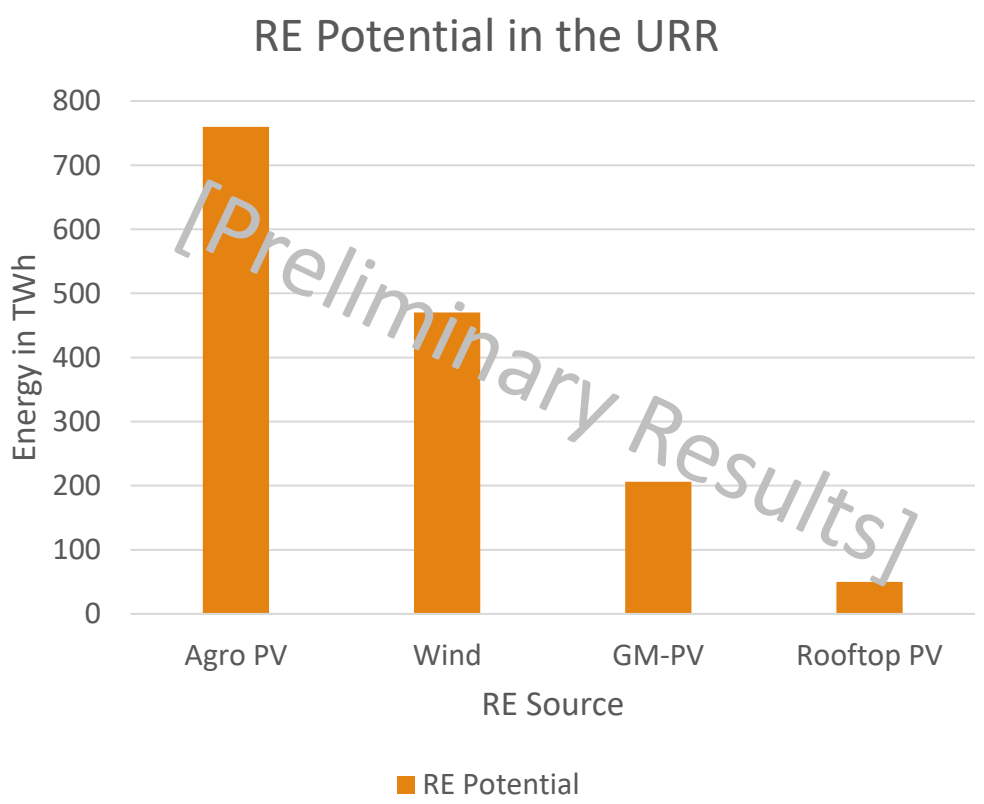
- The technical potential is calculated by factoring in the technical parameters of the polycrystalline silicon solar cell installations, the most used type so far, such as average module efficiency and performance ratio (Mainzer et al., 2014)
- The rooftop potential is depicted in the adjacent figure per municipality to show which municipalities have the biggest potential (and another template of result presentation)



III. Conclusion

Preliminary Results

- The total electricity demand of the Upper Rhine Region in 2018 was 41 TWh
- The preliminary results for the technical potential of wind and solar PV in the URR are presented in the adjacent figure
- They show that the existing potential is much larger than the electricity demand of the region



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