How can rewetted peatland contribute to energy supply?

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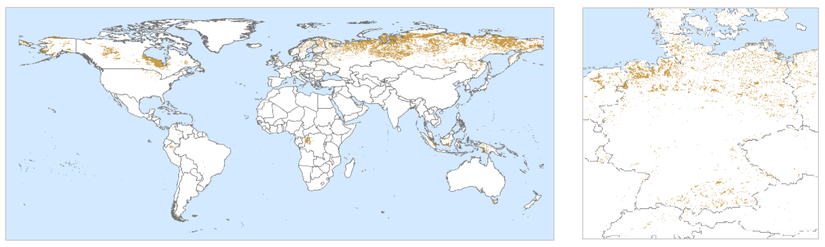
Drained peatland accounts for around 4 % of global anthropogenic greenhouse gas emissions[1]. Rewetting degraded peatland can reduce the emissions, but agricultural incomes may be impacted. Paludiculture, i.e., growing wetness-tolerant crops such as reeds, can be an alternative, but the revenues are usually lower than before and can even be negative[2]. To investigate how peatland areas in Germany can best be used from the energy system perspective, we compare the energy potential of common reed on rewetted peatland as an energy crop with the power generation potential of wind turbines and photovoltaics on the same areas.

Data



- Global Peatland Map 2.0[3]
- Yield and calorific values for common reed (Phragmites australis)[4,5] in moderate climate

	low	medium	high
yield in t_{TM}/ha/a	3,6[4]	9,3	15[4]
Calorific value in MJ/kg	14,5[5] (15% moisture)	16,5	18,5[4]

- ERA5 reanalysis data[6]

Method

- Peatland map: Pixel area calculation of a window
- Calculation of low, medium an high
  - (a) common reed biomass yield (losses = 15%),
  - (b) power (η=0.2)[7] and heat (η=0.6)[7] potentials of combined heat and power generation (CHP)
- Calculation of photovoltaic (PV) and wind power generation potentials on the same areas with EnDAT[7] for comparison

Results

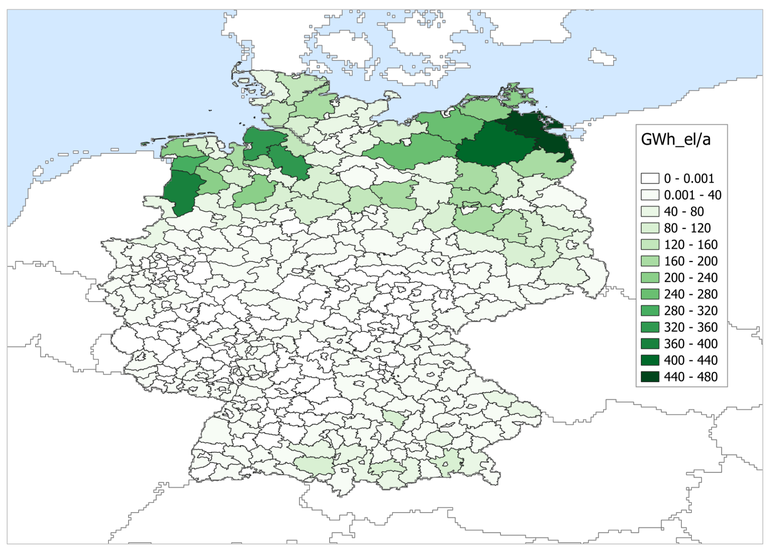


Fig. 1: Spatial distribution of common reed CHP potential on peatland in Germany.

Table 1: Energy potential of common reed, wind turbines and PV on peatland in the German federal states.

	Peat-land	Common reed (phragmites australis)		PV	Wind onshore
	Area in km2	CHP power generation potential in GWh_el/a	CHP heat generation potential in GWh_th/a	Power generation potential in GWh_el/a	Power generation potential in GWh_el/a
Baden-Württemberg	399	289	867	16072	2380
Bavaria	1940	1406	4217	77033	10471
Berlin	3	2	7	80	29
Brandenburg	2163	1568	4703	58783	21213
Bremen	55	40	120	1341	686
Hamburg	31	22	67	733	375
Hessen	63	45	136	2048	469
Mecklenburg-West Pomerania	2318	1680	5039	57083	31477
Lower Saxony	5681	4117	12350	140566	76729
North Rhine-Westphalia	392	284	852	10602	4855
Rhineland-Palatinate	47	34	102	1617	452
Saarland	13	9	28	435	131
Saxony	242	175	526	7506	2400
Saxoy-Anhalt	757	549	1646	20614	7552
Schleswig-Holstein	1327	962	2885	30679	19746
Thuringia	5	4	12	166	43
Sum	15436	11186	33557	425359	179011

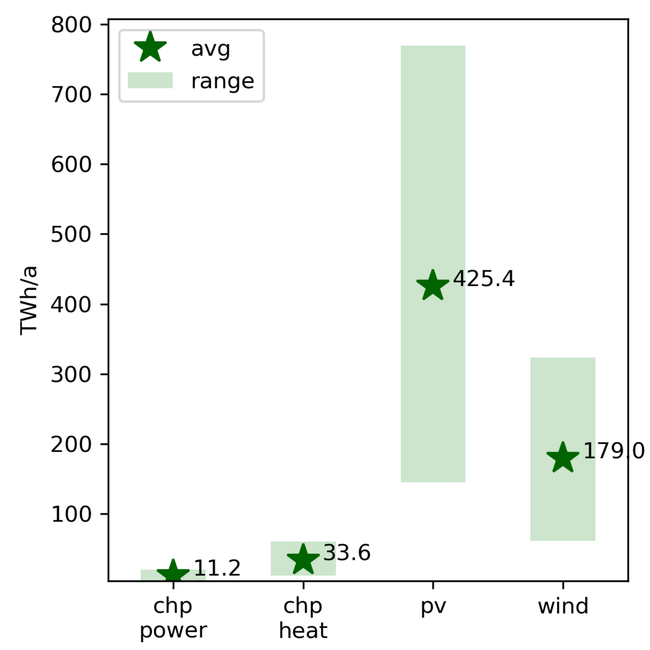


Fig. 2: Comparison of common reed, wind and solar energy potentials on peatland in Germany.

- PV on rewetted peatland in Germany could yield around 9.5 times as much energy as CHP with reed
- Wind turbines on rewetted peatland in Germany could yield around 4 times as much energy as CHP with reed
- The German gross electricity consumption is around 550 TWh/a. Power from
  - reed combustion in CHP plants could satisfy between 0.7 % and 3.7 % of it
  - PV on the same areas could satisfy between 26 % and 140 % of it and
  - wind turbines on the same areas could satisfy between 11 % and 59 %.

Conclusion and outlook

- On the same area, PV and wind could provide a multiple of the energy from common reed as an energy crop
- Further research is needed to compare paludiculture, solar and wind energy (and combinations) concerning
  - CO2 emission savings
  - economic perspectives for farmers
  - resulting implications for incentives or subsidies

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References

1 UNEP 2022: Global Peatlands Assessment: The State of the World's Peatlands, https://www.unep.org/resources/global-peatlands-assessment-2022
2 Wichmann, S., 2017: Commercial viability of paludiculture: A comparison of harvesting reeds for biogas production, direct combustion, and thatching, Ecological Engineering, https://doi.org/10.1016/j.ecoleng.2016.03.018.
3 Greifswald Mire Centre (2022): Global Peatland Map 2.0, https://wesrmapportal.unep.org/portal/apps/experiencebuilder/experience/?id=33b49f8757c441faae975671c2425241&page=Page
4 Moorwissen.de, 2019: Schilfröhricht 2.0, https://moorwissen.de/files/doc/paludikultur/imdetail/steckbriefe_pflanzenarten/Schilfr%C3%B6hricht%20(Phragmites%20australis)%20spontan%20oder%20im%20Anbau.pdf
5 Moorwissen.de, 2019: Paludikultur auf Niedermooren, https://moorwissen.de/paludikultur-auf-niedermoor-standorten.html
6 Copernicus Climate Change Service (C3S) (2023): ERA5 hourly data on single levels from 1990 to present. 10.24381/cds.adbb2d47 (accessed in July 2021)
7 Scholz, Y: Renewable energy based electricity supply at low costs: development of the REMix model and application for Europe, Dissertation, University of Stuttgart, 2012, http://dx.doi.org/10.18419/opus-2015