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Agrivoltaics:

Harvesting Sun and Crops

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THE PROBLEM

Climate Change

- Extreme Weather Events
- Water Scarcity
- Rising Temperatures
- Land Degradation



World Population Trend

- Increasing Population
- Energy Consumption
- Increasing Food Demand
- Housing and Urbanization

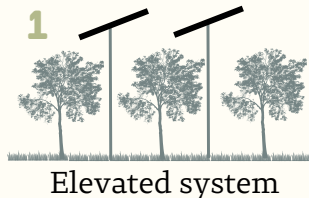
Land Use Competition

THE SOLUTION

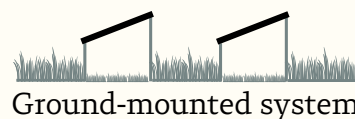
Agri culture + Photo voltaics

co-developing the same area of land for both solar power as well as for conventional agriculture^[1]

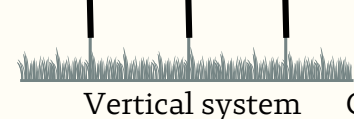
- 1 Open Field Photovoltaics
 - 2 Greenhouse integrated Photovoltaics
- Adapted from [3]



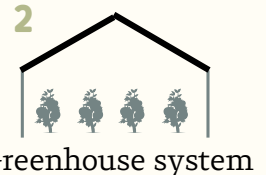
Elevated system



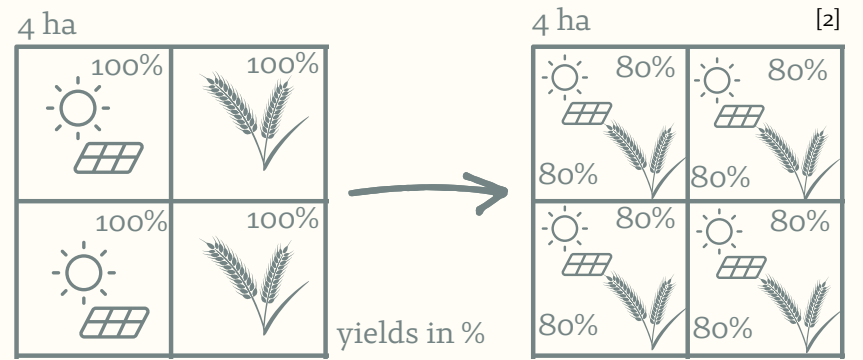
Ground-mounted system



Vertical system



Greenhouse system



THE ADVANTAGES



Reduced water evaporation and evapotranspiration
Integrated water capture and collection systems



Increased land use efficiency
Reduced erosion by wind
Crop protection against extreme weather conditions



Significant increase in renewable energy
Diversification of income
Energy self-sufficiency

THE CHALLENGES



Legislative hurdles,
Current subsidies: 1.2 cent/KWh (GER)^[5]

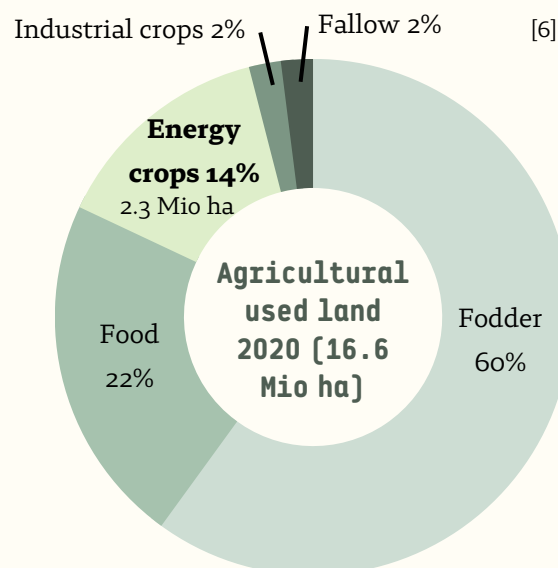


Crop compatibility (shade tolerance)
Solar radiation dictates location-specific design
Technical and engineering complexities



Public backing for agrivoltaics
Lack of education and available information
High investment costs

THE POTENTIAL



Electricity consumption 2022: 491.8 TWh^[7]

Solar energy: ~ 57.6 TWh (12 %) $\hat{=}$ 66,5 GWp installed capacity^[6]

Energy crops (biofuel): 42.2 TWh (9 %)^[7]



EEG Targets (Renewable energies act 2023) 215 GWp \rightarrow 2030
400 GWp \rightarrow 2040

1GWp = 1 TWh
annual electricity turnover
(laboratory conditions)



Scenario: Replacing energy crops with agrivoltaics

2.3 Mio ha would amount to 1380 TWh

32 x more efficient than growing maize as biofuel^[6]

References

- [1] Dinesh, Harshvardhan; Pearce, Joshua M. (2016). "The potential of agrivoltaic systems" (PDF). Renewable and Sustainable Energy Reviews. 54: 299–308. doi:10.1016/j.rser.2015.10.024.
- [2] Fraunhofer-Institute for Solar Energy Systems ISE (2022): Agrivoltaics: Opportunities for Agriculture and the Energy Transition - A Guideline for Germany.
- [3] Agrivoltaic Systems Design and Assessment: A Critical Review, and a Descriptive Model towards a Sustainable Landscape Vision (Three-Dimensional Agrivoltaic Patterns) by Carlos Toledo ORCID and Alessandra Scognamiglio Sustainability 2021, 13(12), 6871; <https://doi.org/10.3390/su13126871>
- [4] Geospatial assessment of elevated agrivoltaics on arable land in Europe to highlight the implications on design, land use and economic level; DOI: [10.1016/j.egyrs.2022.06.076](https://doi.org/10.1016/j.egyrs.2022.06.076)
- [5] <https://www.pv-magazine.de/2023/01/30/eeg2023-unbefriedigend-netzwerk-fordert-bessere-bedingungen-fuer-agri-photovoltaik/> [accessed on July 3rd 2023]
- [6] Aktuelle Fakten zur Photovoltaik in Deutschland, Harry Wirth, Fraunhofer ISE, Download from www.pv-fakten.de, version from 17.05.2023
- [7] <https://www.ise.fraunhofer.de/de/presse-und-medien/presseinformationen/2023/nettostromerzeugung-in-deutschland-2022-wind-und-photovoltaik-haben-deutlich-zugelegt.html> [accessed on July 3rd 2023]

Video abstract:

