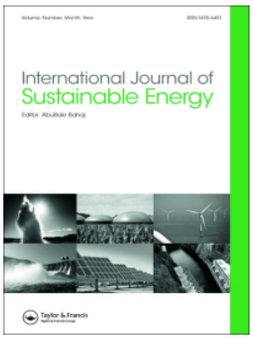

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The solar rush: invisible land grabbing in East Germany

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ABSTRACT

The article presents an ethnographic analysis of the planning and implementation of open-field photovoltaic (PV) plants on agricultural land in East Germany. Employing qualitative methods, the study delves into the multifaceted dynamics surrounding the expansion of Germany's renewable energy sector, particularly in the considered 'energy state' of Brandenburg. Despite Germany's commitment to renewable energy, the absence of a comprehensive legal framework governing conflicts over land use for solar energy installations poses significant challenges. Large-scale solar parks, designed for mass energy generation, often necessitate significant land acquisition, which sparks conflicts, particularly when the potential land serves agricultural purposes. The study underscores the shifting perception of land from socioecological wealth to a mere economic resource. The urgency of addressing ecological tipping points through energy transitions contrasts with the current scenario of unchecked investor and developer land acquisitions in pursuit of economic gains. This phenomenon, characterised as 'invisible land-grabbing,' has engendered a lack of trust in large-scale PV projects and potentially hampers solar PV approval processes. In conclusion, the article highlights the intricate interplay between energy transitions, land management, and socioecological well-being. It calls for a holistic approach to address the ethical, ecological, and economic implications of renewable energy expansion and land use.

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Introduction

A new conflict for energy transitions is emerging as mega-parks for solar energy production are being built on arable land in Germany. With little guidelines for unsubsidised solar park installations, the market rules result in brokers and investors looking for lucrative places, especially in East Germany. This rush for the largest possible areas for solar projects in the context of Germany's energy politics remains highly invisible. We aim with this article to alter this, by uncovering and analysing what we call the solar rush. We define the solar rush as a profit-driven, largely unregulated acquisition of rural land for large-scale solar parks. We will unveil the solar rush's invisibility: how planning and land acquisition for large solar parks target local stakeholders, how a politically unregulated field allows the market to rule, leaving little to no regional value adding or benefits for local communities, and that mega solar parks are not yet visible but about to materialise. With reference

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to green grabs and land grabbing, we will in the following further unpack and analyse the solar rush in more detail, contributing to a better understanding of what impedes energy transitions and what consequences a solar rush will have.

In March 2022, 2.2 million photovoltaic systems with a total rated output of 58,400 MW were installed on roofs and open fields in Germany (German Federal Statistical Agency 2022), and the number is likely to increase further. While fossil energy sources retain the largest share in primary energy consumption with 79% in 2022 (German Federal Environmental Agency 2023), renewable energy's share in fed-in electricity production rose to 46% (German Federal Statistical Agency 2023). As regards electricity consumption, photovoltaics (PV) with an installed capacity of 66.5 GW_p account for 11%, or 60.8 TWh in 2022 (Fraunhofer and Wirth 2023, 6). With an anticipated gross electricity consumption of 658 TWh in 2030 and a targeted 30% PV share, the installed capacity of PV would need to more than triple within the next seven years to reach 215 GW_p (Fraunhofer and Wirth 2023, 7). This implies adding 21 GW_p each year, instead of the 7.2 GW_p added in 2022, or the average of 1.9 GW_p in the years from 2013 to 2018 (Fraunhofer and Wirth 2023, 6).

These enormous installation goals obviously need space and project developers seem to find it in Brandenburg. Brandenburg is a federal state located in north-eastern Germany and is characterised by its relatively flat terrain, with some hilly areas in the southern and south-eastern parts. The state is situated in the North German Plain and is crisscrossed by several major rivers, including the Elbe, Havel, Spree, and Oder. These rivers and their tributaries have contributed to the agricultural potential of the region.

Agriculture is an important economic activity in Brandenburg. The state boasts expansive agricultural land, which includes fields, meadows, and farmland. Crops commonly cultivated in Brandenburg include cereals (such as wheat, barley, and oats), potatoes, sugar beets, and rapeseed.

The state's agriculture is characterised by both large commercial farms and smaller family-owned enterprises. Traditional farming methods and modern agricultural technologies coexist, contributing to the state's agricultural productivity. Like many other regions, Brandenburg's agricultural sector faces challenges such as climate change, sustainable resource management, and the need to balance production with environmental preservation. Efforts are being made to promote sustainable farming practices, reduce greenhouse gas emissions, and protect biodiversity. Additionally, the planning of open-field PV plants is now another force, putting pressure on the land.

This pressure comes with a moral reasoning of climate and environmental protection, while being executed with little socioecological moral standards. Engaging with land grabbing theory and the concept of green grabs, we argue that the existing track record of land acquisition in East Germany contributes to understanding the current push for large-scale PV plants as a rush for land rather than unanimously welcoming it as a form of sustainable energy generation. By relating the solar rush – comprising financial investments, industrialisation of agrarian land, and only limited regional value creation – to (insufficient) political regulation for large-scale PV power plants, we show that decentralised decision making is no warranty for confining what we understand as a form of land grabbing.

We base our analysis on policy analysis and ethnographic research in southern Brandenburg, comprising regular participant observations in community council meetings since 2018, visits to current and future renewable energy production sites, nine formal qualitative interviews with project developers, administrative staff, farmers, local stakeholders and politicians, as countless informal conversations with the same. This study employs a qualitative research approach, combining in-depth interviews and ethnographic field research to explore the intricate dynamics of open-field PV plant installations. Qualitative methods are particularly suited for capturing the rich and contextualised experiences, meanings, and interactions that are in place here. Qualitative interviews are a cornerstone of this research, providing a means to elicit detailed insights and perspectives from individuals directly involved in or affected by open-field PV. Through semi-structured interviews, participants were invited to share their personal narratives, opinions, and reflections, thereby

contributing to a nuanced understanding of the research topic. The open-ended nature of these interviews allows for flexibility in probing and exploring emerging themes, while also permitting participants to express themselves in their own words. We interviewed key stakeholders, including community members, practitioners, and experts within the field. We thus collected our data through face-to-face, online, and telephone interviews, depending on the Covid19 measurements at the time of the study. The interviews were audio-recorded, with participants' consent, and supplemented with detailed field notes to capture non-verbal cues, emotions, and contextual observations. The transcribed interview data underwent thematic analysis, a process that involves identifying patterns, themes, and connections within the data. Through iterative coding, commonalities, and variations in participants' responses were identified, contributing to the development of comprehensive themes. By analysing both the informants' take on green field PV in the area as well as the relevant laws, regulations, and development, we argue that it is not envy that impedes large-scale solar PV, as some of our interlocutors suggest, but previous experience and critical position towards large-scale land acquisitions and land use transformation that argue on moral grounds but act with little.

Land grabbing theory and the concept of 'green grabs'

The growing pressure on agricultural land is not unique to East Germany. Globally, there has been a rapid increase in purchases and leases of large areas of land by foreign investors since 2007 (Edelman, Oya, and Borras 2013). The crash in the financial markets and the increasing demand for food and biomass are considered to be the main triggers (Exner 2016). Conflicts over land address questions of ownership, usage, type of production, and distribution (Bernstein 2021). Accordingly, land is not only a natural category, but above all a means of production and a non-proliferable resource. Analyses of land grabbing agree that neither the transformation of land ownership into common ownership nor the appropriation of land through large-scale expropriation is new developments (Exner 2016; McMichael 2014). However, the land grab taking place today globally has new characteristics including the involvement of states as well as the current context of ecological limitations and stressors, which have no equivalent in the nineteenth and early twentieth centuries (Exner 2016, 474). Land grabbing is also part of a new form of internationalised and multilateral rule (Exner 2016), since the liberation of land markets worldwide has made it possible to buy or lease land internationally (Bunkus and Theesfeld 2018, 4).

As Bunkus and Theesfeld (2018) argue, the concept of land grabbing, which means large acquisition of land with negative effects, has been mainly employed in the context of the Global South and it needs thorough consideration to decide whether or not land grabbing is a suitable term to describe large-scale land acquisition in Europe or other parts of the Global North. Bunkus and Theesfeld develop six criteria to conceptualise large-scale land acquisition as land grabbing in Europe, namely legal irregularities, non-residence of landowners, centralisation in decision-making structures, land as investment objects, decision power concentration, and de-facto limited land market access (Bunkus and Theesfeld 2018, 10–14). We will analyse in the discussion section inasmuch these criteria apply to the East German solar rush.

Developers and governments describe solar PV projects as beneficial or even necessary for climate change mitigation and environmental protection (see below). The appropriation of land and resources for solar PV bears semblance to green grabs, a concept that has gained attention in recent years. Green grabs often involve powerful actors, such as governments, corporations, or international organisations, exploiting environmental or climate narratives to justify land acquisitions, displacing local communities, and altering existing resource management practices. Scholars and activists have criticised green grabs from various angles, uncovering its implications for social equity, human rights, and conservation effectiveness, exploring both the underlying dynamics and their implications for local communities and ecosystems (e.g. Brock, Sovacool, and Hook 2021; Cox 2015; Dunlap 2020, 2023; Lunstrum, Bose, and Zalik 2016; Siamanta 2017). The historical

antecedents of green grabs can be found in colonial practices of land dispossession and resource extraction. This historical context provides crucial insights into the power dynamics that continue to shape contemporary environmental governance.

Many researchers emphasise the social dimensions of green grabs, highlighting how these processes disproportionately affect marginalised communities, including indigenous peoples and rural populations (e.g. Johnson 2014; Lunstrum 2016; Woods 2019). Green grabs can lead to displacement, loss of livelihoods, and erosion of cultural heritage. Such social impacts raise important ethical and human rights concerns, prompting discussions about justice and the need for more inclusive and participatory forms of environmental decision-making.

Critiques of green grabs extend to the realm of conservation effectiveness. Scholars have questioned whether large-scale land acquisitions and top-down conservation initiatives truly lead to positive ecological outcomes (e.g. Blomley et al. 2013; Devine 2022). The focus on pristine wilderness and exclusionary conservation practices may actually fail to consider the intricate relationships between local communities and their environments. As a result, conservation efforts might inadvertently lead to ecological degradation, especially when traditional resource management practices are disrupted.

The concept of green grabs has also triggered debates about the role of market mechanisms and financialisation of nature (e.g. Dunlap 2023; Ervine 2013; Moore 2015). The commodification of ecosystem services and biodiversity can contribute to the expansion of green grabs, as financial interests intersect with environmental narratives. This highlights the tension between conservation goals and profit-driven motives, calling for critical assessments of market-based conservation approaches. This is also a point for the solar rush in East Germany, where the conservation of soil and biodiversity is an argument employed to justify land acquisition for solar parks, as the following nuanced ethnographic insights demonstrate.

The state of solar

The nature protectionist says:

> Hey, there can't be anything better than doing away with this monoculture landscapes [and installing greenfield PV] so that the soil can recover and some biodiversity can develop there, because it is some form of quietness if the soil is not fertilized. […] There is agrarian land that is not extremely valuable, that has low marking in the soil index and in case of doubt they plant maize or rapeseed for biodiesel. I am convinced that this crop never gets on the table, but into the tank and burned! There are different studies to look at, saying how many percent of Brandenburg's land is bad soil being used for agriculture that has nothing to do with food production or animal feed production, but is for producing fuel. There is nothing more stupid than this! […] And hence I say let's take parts of this land and build PV parks. It makes sense, as I don't do anything else, I produce energy, with a higher energy density. And I have the possibility so to say to convey this land to a natural circuit, to create small biotopes in these vast areas. That is a giant issue, requiring advertisement. (Interview Schellenberg, January 2021)

Andreas Schellenberg[1] has been developing rooftop and greenfield solar projects in the German state of Brandenburg since 2009, for private contractors and for communities. He recalls his early years of PV planning as 'very, very exciting' and 'due to the renewable energy law very, very easy, not really very discerning' (Interview Schellenberg, January 2021). He never constructed the PV fields himself, but sold them to investors. In 2012, he realised that 'there is more mass being moved': large PV fields were being sold and resold, with investors and traders making more and more profits. Hence Schellenberg together with a partner developed an online platform, which brings investors and PV project developers together, cutting out some of the middlemen and making it easier and more convenient for developers to find creditors for their PV parks.

Schellenberg argues here for PV parks on the basis of its advantages for biodiversity and soil quality, as well as the efficiency of energy production. He rightly claims that electricity produced from solar has the clear advantage that it uses less area for electricity production than agriculture

does. Currently, about 14% of the agricultural area in Germany is being used for energy crops like rapeseed or maize, for the production of biogas or biodiesel. The efficiency per acreage energy crops is significantly lower than for PV systems, with about 980 MWh_p/ha for large-scale solar vis-à-vis 19 MWh_p/ha for maize, or an efficiency of about 16–18% for large-scale solar vis-a-via less than 1% for energy crops (Fraunhofer and Wirth 2023, 39ff). Furthermore, the sun is not a commodity but freely available, so that sunlight becomes electricity from a source that is practically inexhaustible and free of costs. Solar energy production causes comparatively little greenhouse-gas emissions.[2] In solar energy, production lies enormous potential for climate protection: the German Federal Environmental Agency calculates the greenhouse-gas potential for PV-electricity with 56 g CO_2e/kWh, including its production and disposal, which compares to more than 1000 g CO_2e/kWh for lignite electricity, more than 400 CO_2e/kWh for natural gas and about 170 CO_2e/kWh for bio gas from energy crops, with the usage of installed PV in Germany accounting for a net saving of 34.9 million tons greenhouse-gas emissions in 2020 (Fraunhofer and Wirth 2023, 50f.).

For the German climate protection targets of net zero by 2045 and a 65% emission reduction by 2030 (as compared to 1990), solar electricity production plays a central role. The German government has ratcheted up its renewable energy development goals to 80% of the electricity consumption by 2030, setting a target of tripling installed solar capacity by then. As mentioned above, German PV systems generated 60.8 TWh of electricity in 2022, and in order to meet a targeted 30% share in electricity consumption in 2030 would need to add another 148.5 GW_p to the currently 66.5 GW_p installed capacity. Since the latest amendment of the Renewable Energy Act in 2022, the German government therefore speaks of adding 22 GW_p of solar systems each year (Bundesregierung 2023). Based on contemporary PV systems' efficiency, this would roughly mean covering an additional 148,000 ha surface area with PV, equalling three times the size of Berlin or 0.4% of Germany's surface area. It also equals converting about 10% of the agricultural land in Brandenburg, which covers half of the state's surface.

However, these plans are not unanimously supported, especially not in the way developers currently aim to execute them: through large-scale solar parks, acquisition of hundreds of hectares of agricultural land and a concentration of capital, production sites, and profits (rather than e.g. smaller, distributed panels on rooftops and already sealed grounds with diversified owner structures and regional value creation). In practice, Germany added only an average of 1.9 GW_p in the years from 2013 to 2018 and 7.2 GW_p in 2022, instead of the now envisioned 22 GW_p. This discrepancy, according to Schellenberg, is based on local envy and anti-posture:

> With photovoltaics, the big issue is, well, no one has anything against photovoltaics. Because generally you don't see it. But you can find potential for envy relatively quickly in municipal council meetings, that's simply: Sure, nobody has anything against it, everyone wants photovoltaics, but if one farmer alone or one institution earns money with it and everyone else doesn't! I think that's the great tension, where the community also says: Yes, why should we do anything? Why should we do something now, if it only takes away our time? There are always also some people who are fundamentally against anything, you have to deal with them, that's also legitimate. Or maybe they have real reasons why they are dealing with it in such a planning process. (Interview Schellenberg, January 2021)

The German government tries to foster solar PV installations, but pays little attention to large-scale PV parks' socioecological effects. Solar electricity production is encouraged and regulated through the Renewable Energy Act (EEG), which has been amended several times since its introduction in 2000. Essentially, the EEG defines feed-in tariffs for renewable energies and guarantees that the generated electricity can be fed into the grid. The various amendments have attempted to both promote and hinder the expansion of PV, depending for example on the size of the system, its location, or share in self-consumption. A cap has been installed for limiting the subsidised annual expansion, which the latest amendment changed from 1.65 GW to 5.85–9.9 GW newly installed capacity (Bundesminsterium der Justiz 2023). With the EEG 2023, the feed-in tariffs for small-scale solar PV systems of up to 15 kW_p have increased, ranging between 7.1 and 13 cents/kWh, yet the average EEG-

based remuneration for PV electricity since the EEG 2000 decreased by 80–90% (Fraunhofer and Wirth 2023, 11).

Yet, more importantly for large-scale PV parks are the fact that the EEG regulations do not apply when systems are built and run without subsidies. PV systems installation and operation at a large scale is now possible according to market rules only. With the price for solar panels decreasing, it becomes lucrative to install PV systems even without guaranteed feed-in tariffs, given that land prices remain low and planning costs are minimised through scale. The EEG aims at fostering a solar economy that is competitive, which turns out to be the one that punts on large-scale solar fields. As Schellenberg, the solar developer and investment facilitator describes it, the 2017 EEG and its 2021 amendment has shifted solar energy production towards a market economy:

> I mean really a free market. I like that they expanded the areas where you can install green field solar quite a bit. The volume for tender [for subsidized, feed-in tariffed PV energy production] is still way to small. The instrument of tender has proved its worth internationally, hence I quite like it. I'm sceptic if the changes made for rooftop solar are quite right. The limitation from 750 kW_p to 300 kW_p and the forced installation consumption is problematic. That could have been solved better […] than just choking it off. […] In sum, there will be no large impairment, because there will be in parallel [to choking off installations on commercial roof tops] an expansion of very large parks being developed and build. (Interview 2021)

The turn towards the free market implies an aversion to subsidising regulated PV installations, but it simultaneously releases those PV systems from rules and regulations as regards size or designation of areas. According to the EEG, only already sealed grounds, conversion sites, areas along autobahns, and railway tracks qualify for tender. For large-scale green-field solar installed and operated without EEG subsidies, these rules do not apply. Given that the investment costs, as the dominant cost component of PV power plants, decreased significantly (with PV module prices falling by 90% between 2010 and 2020 (Fraunhofer and Wirth 2023, 8)), contemporary calculations see an accounting profit through size: even if the margins for solar electricity projects without subsidies are small, projects of 80 MW and above (roughly equalling 80 ha and above) promise a revenue of 7 or 8%, because planning and operation costs can be minimised. The market hence pushes towards land, especially farmland, where the restrictions on land qualifying for tender are irrelevant, but size matters. The solar rush thus commences, entailing conflicts that have little to do with envy or anti-posture.

The state of land

The concrete example of a solar park project in planning illustrates the point that size matters and the concerns local people voice. We asked the current project developer of a solar park-to-be in Werbig, a place about 70 km south of Berlin, how he got to this particular project. Theodor Grünberg-Heide, who was previously also in the online business of bringing together investors and land owners for solar parks, replied:

> Access to property owners already existed due to a wind park. That's why. In the end, it is a large connected area, we're talking about more than 100 hectares. You have to find this in a reasonable owner structure in the first place, as you don't want to deal with too many owners, because it gets unhandy when someone has a plot in between and is against it. That makes it problematic. […] And in the end, it is relevant that you have access to one person, to get into the region at all … to be able to ask. There are quite different channels that can establish access.

Next to size, aspects such as social contacts, personal relationships, as well as attitudes towards projects play a pivotal role. Grünberg-Heide grew up in West Germany, but moved to the outskirts of Berlin some years ago. He said, living nearby helped him to gain access as well as to gain trust on the ground as he would be close by in case issues arise. Additionally, he explained, some of the land owners and other stakeholders involved bonded with him over the fact that he is not just a solar project developer, but a hunter. Therefore, he could talk to stakeholders on the basis of concerns and solutions for wild life crossings and being readily available and close by if needed.

Due to the wind park already in operation in Werbig, conditions for connecting the solar park to the grid are beneficial, and contacts to owners were already established through the developer from which Grünberg-Heide took over. As with wind park installation, Brandenburg is favourable for PV as a place for energy production: not necessarily with regard to technical qualities of wind intensity or insolation, but as regards the size of the plain and the distance to settlements. In southern Brandenburg, as in the state in general, population density is 85 inhabitants per square kilometre comparatively low. At the same time, due to collectivisation in the 1960s and the only partial disaggregation of large-scale farming associations after 1990, as well as the buy up of vast lands through large investors in the aftermath of a degrading rural economy in the 1990s and 2000s, Brandenburg and the other East German states have comparatively large estates, where it is not unlikely that companies own or cultivate 1000 hectares and more. Grünberg-Heide explains that his case is a bit unusual or more difficult than one might assume in the East German context,

> I have quite a bit of work to do [with this project]. Due to the land reform we sometimes find land here being owned in individual hectares. With 100 hectares there is a bit more work to be done. Hence, it is a strong argument when identifying areas that there really aren't too small-sized ownership structures, otherwise it simply isn't manageable.

He ended up with more than two dozen owners on the 100 hectares, with the largest piece of land being owned by just one of them. The land is cultivated by three different farming companies, which lease the land from the various owners. They would, if the park is being installed, lose out, to large extents. One of the farmers, Jens Richter, puts it like this:

> The whole energy transition has been going on for years. There was always the debate 'from agriculturist to energyculturist'. Nothing happened. Which farmer build his own wind turbine? Maybe he gave the plots he cultivated, but that was it. And now, there is the run for PV areas. And I told the people, who also came to me, I told them, 'You take away our base for production.'
>
> Interviewer: For agricultural production?
>
> Yes. Either *with* the farmer or not at all! If you take away 50 hectares from us now, it is like we have nothing, it is gone completely if we're not even owning the plot underneath but only rent it. So there are 50 hectares gone, or 100 hectares gone and I get nothing in return. It should be done in a way that politics steer it, that politics say, 'Okay, whoever wants to consume land for PV or wants to build PV – especially the big ones, E.ON or the like – has to do it together with the farmer.' Get them on board! Either he participates with ten percent or the like. So that he can at least compensate the loss of farmland. (Interview Richter, April 2021)

Richter, with his son and several employees, farms 810 hectares of land in the area, and like many of his colleagues owns only parts of it. He leases the land mostly from local owners or the church with contracts usually valid for a period of twelve years. After twelve years, the owners decide anew if they want to rent out the land, and to whom. While often social relationships and formed bonds facilitate a renewal of the contracts, the rent owners generate also plays a role: The average lease rate in southern Brandenburg is about 200 Euros per hectare, that the agricultural companies large and small pay. From a solar developer, in contrast, the rent per hectare reaches currently between 2000 and 3000 Euros, with a price guarantee for 20 to 30 years. Hence not only are owners inclined to lease out their land for a considerable larger profit, but financial incentives are there to find ways out of contracts with current farming tenants. Or, as Jens Richter explains,

> if the owner, who rents it out now to me, signs a second rent contract with someone, who wants to do energy production and he gets a land development plan from the municipality, meaning that he gets the construction permission, then the agrarian land falls out, it is no longer agrarian land. And in this very moment they can immediately annul my contract. I'm a has-been.

At the same time, Richter, as everyone we spoke to, shows total understanding for owners who want these high revenues, earning them for pretty much doing nothing, as developers come with the offer of full planning, installation, and operation. Solar energy generation on fields is hence also attractive for farming companies themselves as a form of diversifying their modes of income generation and

buffering possible crop failure and the dependency on weather and the international market prices for crops, but only if they are the owner of the targeted piece of land. Richter, too, thinks about installing PV on about 40 hectares of his own plots where the soil quality reaches 16 to 18 only (out of a 100). The harvest is usually below average on these plots and Richter makes here, as he says, a profit of about 400 Euros. With PV on this land, these profits would multiply. If one assumes a moderate generation of 400,000 kWh per hectare and a moderate price of 0.04 Euro per kWh, he could generate 16,000 Euros on the same plot, leaving a multiplied profit even after subtracting installation and operation costs.

Additionally, the market for agricultural land has seen an increase in prices since 2007, in both renting and buying, after a longer, relatively stable period (Tietz 2018, 54). Between 2010 and 2020, renting prices increased by 62% (German Federal Statistical Agency 2021). Competition among farming companies as well as an increasing distance between land owners and agriculture (combined with high revenue expectations) are main reasons for rent increases (Tietz 2018, 55). For selling and buying, reasons lay also outside the agrarian sector, as agrarian land has been and continues to be transformed, primarily into settlement and transport areas, with about 1.2 million hectares of agricultural land being lost between 1992 and 2013 (Hoymann et al. 2021, 36). In East Germany, in particular, land prices and competition are furthermore pushed by enterprise groups and large investors, which have their main business outside the agrarian sector. They currently control 11% of the German agrarian land, of which 94% lies in East Germany. In Brandenburg, enterprise groups control 52% (426,000 hectares) of the agrarian land (German Federal Statistical Agency 2021). Enterprise groups not only own and till significantly larger estates than small and medium-sized agrarian businesses, but can usually also financially outbid the latter. Overall, non-agrarian and nonlocal investors already have significant meaning in East German agrarian companies, and their influence is likely to increase further (Tietz 2021).

Governing the invisible

The pressure on agricultural land is increasing and open-field PV plants are yet another competitor in an already tense sector. We understand this newly emerging competition as one that is as of now invisible, for two reasons. Firstly, many of the vast PV projects on farm land are in their planning or pre-planning stage only. In Brandenburg, there are just two finished PV plants on agricultural land as well as one currently under construction, which started in Summer 2022. In Werneuchen near Berlin are two finished open-field PV plants on agricultural land, which are 150 and 180 MW, respectively, on 164 hectares the two largest in Germany to date. The same company is currently building two other large-scale PV projects, each with 150 MW, not far from the Werneuchen solar park in the towns of Alttrebbin and Gottesgabe. In June 2022, in the Brandenburg municipality of Boitzenburger Land the construction work began on a solar power plant with an output of 180 MW on an area of around 170 hectares.

Yet, many more are in the pipeline, are planned and pre-planned, with lease contracts singed, land-use plans being changed and permissions requested. The number of accumulated inquiries in Brandenburg since 2019 amounts to at least 366 projects with a total area of more than 9600 hectares. For 55 projects with more than 2800 hectares, installation procedures are now underway, some of which have already been decided. Forty-nine projects with about 930 hectares were rejected. According to the statements of the municipalities, the Prignitz, which alone accounted for 40 inquiries with almost 1500 hectares, and the Uckermark with 29 requests (more than 1000 hectares) were the most affected in terms of quantity. The district of Spree-Neisse registered only 14 requests, but with a total of 1300 hectares, they are particularly large.[3] These PV parks will be built, but as a future landscape and in their combined gigantism remain as of now invisible.

The other aspect of invisibility is the lack of awareness of this rush for agricultural land on federal and especially national level. Currently, the solar rush is only felt in municipal offices, local council meetings, and by individuals with lease contract offers. On a state or national level, there is no

regulation. The Renewable Energy Sources Act (EEG) does not regulate solar parks that do not require subsidies. In contrast to wind energy, there is no federal law setting binding targets for the expansion of this energy form, nor state bodies designating areas for it (May 2023). Neither does a central register regarding PV installations exist. Even though official state institutions list open-field photovoltaic units, they also state that ground-mounted systems for PV are counted according to power connections, so the numbers are only estimates.[4]

An independent investigative journalist collective, however, took to the issue in Brandenburg in 2021,[5] asking all municipalities in Brandenburg about the number of applications and requests for PV systems on agricultural land. Within six months alone (between February and August 2021), the number of PV installation applications submitted rose by 70% from 119 to 204. At least two out of five municipalities in Brandenburg received inquiries or applications. The approval of solar parks remains subject to the planning sovereignty of the municipalities. As explained above, for large-scale PV without subsidies, municipalities alone are responsible for granting building permissions. As a consequence, no centralised control of size or location for PV power plants exists. These points towards increasing stress and tasks municipalities are confronted with when investors rush for land, and discloses a lack of coordinated governing of PV installations.

Andreas Schellenberg, in the abovementioned quote, claimed that municipalities do not act faster or not at all in granting permission for PV installations due to a notion of not profiting; he also claims that envy is involved. However, we would like to stress that one reason is the invisibility of the solar rush, and municipalities' occasional overburdening with its complexities. Combined with the history and presence of the state of land in East Germany, there is reason to understand the solar rush here as a form of green grabbing. The ecological and climate reasoning is inherent in solar energy production and used by developers for precise projects, as well as by governments for justifying solar development targets. Carefully revisiting Bunkus and Theesfeld allows us to pinpoint the grabbing side of it.

Discussion

Bunkus and Theesfeld's (2018) six criteria for land grabbing in Europe are applicable to the East German solar rush with some limitations.

The first criterion of land grabbing is, according to Bunkus and Theesfeld, 'legal irregularities.' It describes contracts that are aiming at finding 'solutions to legal restrictions' (Bunkus and Theesfeld 2018, 10), that might be agreed upon before they can actually be legally in place. For the solar rush, there is a clear strategy of investors to approach landowners and to sign contracts with them even before the local authority has decided that the agricultural land can be in fact rededicated to PV installations. Such agreements are necessary for the project developers in order to minimise the risk of a competitor outrivalling them in what is today a contested market. Contracts with owners before community approval and repurposing agricultural land also allow project developers to increase pressure on municipalities, as these in turn ideally also base their local area development decisions on the interests of their voters.

'Non-residence of landowners' is a second aspect of land grabbing, potentially leading to various social tensions (Bunkus and Theesfeld 2018, 12). The enterprise groups and large investors in the agrarian sector driving up land prices (German Federal Statistical Agency 2021; Tietz 2018) are often not residential, but have their headquarters elsewhere. There are about 2200 large enterprise groups in the German agrarian sector, with 94% of their farmed land in East Germany. Only 38% of these company's headquarters are in East Germany, 36% in West Germany, and 25% not in Germany (Federal and State Statistical Offices 2021). Requests from PV plant investors are also not locally limited, but reach land owners and municipality offices from all over Germany as well as from abroad. With a long trajectory of outside control over land, investors in PV plants also understand proximity to landholdings as an advantage. As we have seen in the interview with Grünberg-Heide above, the fact that he lives not too far from his envisioned PV plant, was

by him perceived as a decisive aspect in order to gain trust needed to acquire the land and to come to an agreement with local authorities.

Large-scale agrarian and PV investment does, however, not necessarily comprise landownership. Farming companies only own about half of the land they till, while renting the other half. With land for PV plants we see mostly lease contracts rather than land sales, and hence this form of acquiring land rather feeds into Bunkus and Theesfeld's third aspect of 'centralisation of decision-making structures.' When land is not sold but rented for PV plants, it implies that land lease, land use, value creation and decision making will not be in the hand of residents. With lease contracts for a minimum of 20 years – the average life span of a PV plant – and of about 100 to 1000 hectares – the size necessary for economically viable non-subsidised PV projects – this means a concentration of decision-making through giving away control over large plots and their use for a significant amount of time.

However, the land owners and PV developers do not have sole control over land, but the state is involved in land development, too. Here, the current system for large-scale PV without subsidies puts municipalities in charge of granting permissions. With the EEG regulations not applicable here, there is no centralised control of size or location for PV power plants. Instead, as noted above, the market rules and size matters. Other than with wind installation, where sub-state authorities, so-called regional planning bodies, dedicate areas for wind parks and an expert monitoring (at times an impediment) of wind development is in place, solar PV development is left to the municipalities and planning authority of the local councils. It is a decentralised decision-making structure, but – and here we divert from Bunkus and Theesfeld (2018) – this is not preventing large-scale land acquisition, quite on the contrary. Local councils in rural areas have the advantage of closeness and potential involvement of local residence, individual, and customised decision-making. However, they also easily get into a stage of overburdening and limited resources, in consequence lacking oversight and expert knowledge. The current solar rush definitely bears the potential of developers taking advantage; and during our fieldwork mayors of small municipalities have been voicing concern over a repetition of exploitation as experienced during the initial phases of wind farm installations. Some municipalities and regional planning bodies hence developed guidelines and recommendations for other local councils to help and advise them, partially based on their own experiences (e.g. Regionale Planungsgemeinschaft Oderland-Spree 2020; Regionale Planungsgemeinschaft Uckermark-Barnim 2011). They list positive and negative criteria as well as aspects of assessments that municipalities should consider when approached by investors, and comprise next to 'hard facts' resulting from the German renewable energy law, planning law, and environmental protection law also guidance as regards a municipality's precise options for planning procedures and local value creation. The guidelines also list various legal contract forms for communities including their potential content as well as possible legal forms for solar parks that would allow communal and local (co-)decision making and profit. Eventually, the state of Brandenburg followed in 2021 after discussions with representatives of cities and municipalities with its own recommendations, but not laws, such as preferably using highly sealed surfaces or conversion sites or individually checking the quality of soil and its yield (Ministerium für Landwirtschaft, Umwelt und Klimaschutz des Landes Brandenburg 2021). Brandenburg aligns in many respects with the guidelines published by the planning bodies, but also refrains from any legislation that would steer the development. It rather states that it supports the expansion of PV in light of implementing the Paris Agreement and the state's aim of climate neutral economy and life by 2050 (Ministerium für Landwirtschaft, Umwelt und Klimaschutz des Landes Brandenburg 2021, 2).

Brandenburg, like many regions, exhibits variation in soil quality within its borders. The soil quality can differ based on factors such as soil type, drainage, topography, land use history, and agricultural practices. It is important to note that detailed soil assessments would be necessary for a comprehensive understanding of soil quality in specific areas. The state's agricultural land is characterised by various soil types, including loamy soils, sandy soils, and clay soils. Some parts of Brandenburg have fertile soils suitable for agricultural production. These areas benefit from a

combination of factors such as good drainage, adequate organic matter content, and favourable climate. These regions can be comparable to fertile agricultural areas in other German states.

In certain areas of Brandenburg, particularly in the eastern and north-eastern parts of the state, sandy soils are common. While sandy soils can have good drainage properties, they may have lower water and nutrient-holding capacities, requiring careful management and irrigation for agricultural purposes. It is important to recognise that soil quality assessments are site-specific and can vary significantly within relatively small geographical areas. Agricultural practices, conservation efforts, and land management practices also play a significant role in determining soil health and quality.

The last two aspects of European land-grabbing 'land as investment object' and 'de-facto limited land market access' apply to the East German solar rush. The non-reproducibility of the land factor with the simultaneous lack of alternatives for low-risk, interest-bearing non-agricultural investment options. This means that ownership of agricultural land has become attractive to a large group of people in the past decade (Federal and State Statistical Offices 2021), with the rush for land intensifying with PV investors being able to pay 10 times higher rents than farmers can. In investment terms, green-field PV parks not only promise revenues of 6–8%,[6] but also limit access to land for farmers in SMEs, be it in leasing or purchasing. High prices for land dominate the development, therefore, market economy is a decisive factor for power relations in terms of who has the capital, monetary as well as social, to participate in this market economy.

In consequence, we do see in the contemporary solar rush a clear tendency for land grabbing as regards legal irregularities, land as investment object, de-facto limited land market access, and decision power concentration. Instead of a non-residence of landownership, the solar rush generates a weaker characteristic of land grabbing in the form of non-residence of land-users and profit generation. We deem it fit to speak here of a form of land grabbing, despite the fact that the criterion of centralisation in decision-making structures does not apply, leading us to opt for an amplification of the criteria of European land grabbing processes in the light of renewable energy production: a decentralised decision-making structure that is not based on sufficient expertise knowledge might as well foster land grabbing – or lead to a reluctance in decision making altogether, leading to project developers' speculating over reasons for slow development of large-scale greenfield PV. At the same time, Brandenburg's solar rush also qualifies as a green grab, as not only our interlocutors used climate protection as a moral justification for transforming farm land into solar parks, but so do the German climate protection and emission reduction targets.

Conclusion

Society's support of renewable energy projects and its expansion is in Germany generally at a high level of about 83% (Renn, Wolf, and Setton 2020, 9), and if opposition occurs it sees a multitude of often relational reasons, such as concerns about project impacts on local jobs, property values, the landscape, natural habitats, or identity formation, as well as perceived injustices or lack of trust (see Moore et al. 2022; Nilson and Stedman 2022). However, this support is at stake, when renewable energy projects are not regulated and exclusively ruled by the market. What we call the solar rush, the profit-driven, largely unregulated acquisition of rural land of hundred hectares and above for solar park installation, is a case in point. Anticipating infringement and competition with prevailing agricultural land use and the socioecological consequences of large-scale solar in rural environments, the current solar rush causes criticism if not opposition. Other than some project developers might assume, the largely invisibility of the solar rush and its land-grabbing aspects are 'real reasons' for a perceived slowness of large-scale green field PV development in East Germany.

Since Germany is determined to expand its renewable energy sector and Brandenburg, in particular, describes itself as an 'energy state', a recent initiative by the Ministry of Economics, Labor and Energy of the state of Brandenburg has decided to map the state's potential for PV plants – and thereby also take to some form of governing what as of now remains largely invisible and

ungoverned. The state mapped and displays in an open-source map potentially usable areas for solar technology systems in Brandenburg, including the potential for open-field PV systems outside of the EEG-eligible areas, also on agricultural land.[7] The map offers guidance, but is no form of binding regulation.

Nation-wide, no such guidance exists, and a mapping of installed and plant open-field PV plants as well as measured, proven statistical numbers of PV's share in energy production remain open tasks.[8] Germany lacks a clear legal, national framework for the insinuating conflicts over land use for solar energy installation. Rules exist as regards the financially subsidised PV power plants, where ground-mounted PV systems with a nominal output of more than 1 MW_p and up to 100 MW_p are allowed on sealed grounds, conversion sites, along autobahns, as well as on arable land and grassland in so-called 'agriculturally disadvantaged areas' – subject to the states defining the latter. The EEG, however, does not apply to the largest-scale solar parks that go for mass. They draw on cost efficiency of production and require large-scale land acquisition of hundreds of hectares of what is currently also used as farmland.

Every construction of open-field PV is accompanied by changes in the landscape, which can generate conflicting parties especially if the areas are initially used for food and animal feed production. The solar rush turns land into 'an economic resource rather than [seeing it] as socioecological wealth' (McMichael 2014, 51). This shift in understanding land increasingly draws scholarly attention (Campos, Brito, and Luz 2023; Moore et al. 2022; Nilson and Stedman 2022) and local resistance across the globe (e.g. Stock 2022, Hu 2023). The ecological tipping point requires energy transitions, comprising an increase in solar PV-based energy generation. However, the current solar rush as a run on agricultural land by investors and project developers subject to a free market system shows a lack of land management, and is as of now a largely invisible, ungoverned development. One consequence of the concomitant land grabbing is a lack of trust in large-scale PV plants and arguably a deceleration of solar PV approval procedures.

Notes

1. All names have been changed.
2. Mostly during production, depending on the energy source used here. The Energy Payback Time is about 1.3 to 2 years for modern PV modules (Fraunhofer and Wirth 2023, 53). Furthermore, some thin-film module production emits nitrogen trifluoride, which is 17,000 times more climate-wrecking than CO_2 (Fraunhofer and Wirth 2023).
3. https://correctiv.org/aktuelles/klimawandel/2021/10/08/darum-gefaehrden-solar-investoren-natur-und-landwirtschaft-in-brandenburg/ (last accessed on 30 March 2023).
4. https://www.energiemanagement-brandenburg.de/regionen.html (last accessed on 1 June 2023).
5. https://correctiv.org/aktuelles/klimawandel/2021/10/08/darum-gefaehrden-solar-investoren-natur-und-landwirtschaft-in-brandenburg/
6. See for instance https://www.milkthesun.com/files/images/PV-Projektbewertung.pdf (last accessed 12 June 2023).
7. https://energieportal-brandenburg.de/cms/inhalte/tools/solaratlas-brandenburg/freiflaechen (last accessed 12 June 2023).
8. https://www.energiemanagement-brandenburg.de/regionen.html (last accessed on 1 June 2023).

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