GROUND-MOUNTED SOLAR AND THE IMPACT OF LAND-USE PLANNING: EVIDENCE FROM FRANCE

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Overview

Access to suitable land will be critical to achieve the energy transition. The roll-out of solar and wind power requires 10 times more space than conventional technologies for the same installed capacity. In densely populated countries, like in the European Union, the allocation of land to renewable energy may conflict with other environmental policy objectives such as preserving land for agricultural activities and natural spaces. This has started to emerge as a significant constraint. Across EU countries, permit-granting procedures take 2–5 years for ground-mounted solar and up to 7 years for wind power installations, leading to a bottleneck in permit applications (European Commission, 2023).

With its Repower EU Plan (2022), the European Commission has adopted new spatial planning policy initiatives to overcome this shortcoming. Whether these policies can improve the cost-efficiency of the deployment of renewable energy is thus a critical question to address. However, little research is available so far on the effects of existing spatial planning policies (Lehmann et al, 2024; Delafield et al, 2024).

I provide novel evidence of the impact of spatial planning regulation on the deployment of ground-mounted solar photovoltaic installations in France. France has a joint regulatory setting involving top and local administrative levels to authorize the development of ground-mounted solar. The national energy regulator sets eligibility criteria in solar energy auctions to only allow in the bidding process projects that are located on certain types of land plots. In turn, eligibility criteria are defined based on regulations in place in municipalities, namely land-use planning frameworks. However, all municipalities do not have the same land-use planning framework. As of today, 40% of French municipalities use land-use planning that only allows them to differentiate between land that can be developed or land that must be kept in its natural state. The other 60% use detailed land-use planning with more than ten categories to discriminate between different types of land-uses. Land-use planning frameworks also change with the scale at which they are implemented, either integrating grouped municipalities (i.e. inter-municipality) or a single one. They were also approved at different years.

I show that such heterogeneity in land-use planning frameworks distorts the spatial deployment of ground-mounted solar. First, more detailed land-use planning enable better targeting and access of public subsidies – solar projects participating in public auctions – to suitable land. This is explained by a regulatory effect. The national energy regulator favours solar projects in land plots allowed for construction. Eligibility criteria are thus better aligned with more detailed land-use planning, which can discriminate between different categories of land developments. Second, more up-to-date land-use planning – those designed in recent years and integrated at the inter-municipality level – present more constraints to the siting of ground-mounted solar facilities. This is likely because more up-to-date land-use planning incorporates stricter restrictions on new land developments and must balance between different environmental objectives, such as land conservation and renewable energy deployment.

Methods

I uncover a causal impact of spatial planning regulations by exploiting the heterogeneous transitions in land-use planning frameworks that took place during the last decade in France. I construct a data-set on staggered changes of land-use planning at the municipality level matched to the history of commissioning of solar installations. I use several *staggered difference-in-difference* specifications to assess the impact of a type of land-use planning on the amount of land allocated to ground-mounted solar several years after its approval. More specifically, I leverage the lengthy and uncertain delay between the beginning of the elaboration and the approval of a new land-use planning framework: I compare municipalities that updated their land-use planning (treatment group) to their counterparts that are in the process of updating their land-use planning to a similar framework (control group). I use propensity score matching based on land-use patterns to ensure that treated and controlled municipalities follow similar

conditional parallel trends. I further ensure that my groups of municipalities do not follow divergent trends in socio-economic characteristics – namely income levels, value of land and local tax revenues.

Results

I find that land-use planning frameworks impact the commissioning of solar installations along three key dimensions: (1) frameworks with more detailed land-use categories increase the amount of land allocated to ground-mounted solar by an average of 100 m² per km², (2) more up-to-date frameworks reduce the amount of land by -50 m² per km², (3) integrated land-use planning at the inter-municipality level reduce the amount of land by -100 m² per km². Estimates become significant starting from 5 years after the approval of a new land-use planning framework, while inconclusive for rooftop solar installations.

These findings are robust to different threats to the identification of a causal impact. First, both land-use planning and the permitting of ground-mounted solar involve different levels of governance, which reduces the risk of reversed causality. Land-use planning is first elaborated by the municipality. Once approved, the project developer asks for a building permit to the central government's devolved authority (*préfet*). The decision of devolved authorities is independent of the municipality and is taken on the basis of a centralized administrative process. Second, I check whether the spatial diffusion of ground-mounted solar installations is explained by other channels not initially covered by my empirical strategy. I run alternative specifications to investigate if my treatments have spillovers on neighboring municipalities. I also study the spatial auto-correlation of ground-mounted solar, which could be explained by push-back attitudes (NIMBYism) or peer-effects. Preliminary results show that these other channels are not threats in this context.

Conclusions

This paper shows that joint regulation – between top and local administrative levels – can generate inefficiencies in the spatial allocation of renewable energy installations. There are several research avenues currently being explored.

First, I plan to examine the contents of land-use planning to investigate why regulations are more stringent in more up-to-date frameworks. Potential mechanisms are as follows. Land conservation objectives were gradually passed through at the local level over the past decade, requiring municipalities to reduce the rate of new land takes within their territories. Recent land-use planning may have already internalized new legislation. Alternatively, it is likely that rules specifically to hinder the siting of renewable energy projects are present in recent land-use planning. In the latter case, I shall investigate if this is driven by local NIMBYism or if it can be rationalized by local economic efficiency. For example, municipalities may trade-off clean energy targets with local amenity losses.

Second, an assessment at the national level should be conducted to assess the magnitude of inefficiencies. This would consist in estimating the net social value of the realized deployment of solar, compared with a counterfactual deployment that would have occurred under an alternative spatial planning regulation. In this context, different counterfactuals could be defined to study upcoming policies, such as "renewable go-to-areas", and the extent to which they can be more efficient at deploying ground-mounted solar than existing ones.

References

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