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# Local governance and renewable energy projects: local impact perception

*Fátima Lima, Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), University of Aveiro; Margarita Robaina, Research Unit on Governance, Competitiveness and Public Policies (GOVCOPP), DEGEIT, University of Aveiro; José Vilar Centre for Power and Energy Systems, INESC TEC, Campus da FEUP; Mara Madaleno, GOVCOPP, DEGEIT, University of Aveiro; Marta Ferreira Dias, GOVCOPP, DEGEIT, University of Aveiro; Mónica Meireles, ISCTE-Instituto Universitário de Lisboa, Business Research Unit (bru_iscte); Anabela Botelho, GOVCOPP, DEGEIT, University of Aveiro; Celeste Varum, DEGEIT, University of Aveiro; Peter Roebeling, CESAM, DAO, University of Aveiro; Edimar Ramalho, DEGEIT, University of Aveiro; Max López-Maciel, CESAM & Department of Environment & Planning (DAO), University of Aveiro; André Oliveira, Centre for Power and Energy Systems, INESC TEC, Campus da FEUP.

* Corresponding author: Fátima Lima, DEGEIT, lima.mfatima@gmail.com

**KEYWORDS**

local municipality; social acceptance; wind power; solar power

**ABSTRACT**

Renewable energy sources (RES) projects play a crucial role in transitioning away from fossil fuel-based energy production and use, and Portugal is at the forefront of renewable-based electricity generation, at European Union level. Social acceptance and impact perception of RES projects have been focused on overall or affected populations, often disregarding other stakeholders, such as local municipalities.
The present study addresses this gap in the case of Portugal. Central Region was chosen due to its relevance in the national energy sector and its potential to make a positive contribution to Europe's energy efficiency and RES commitments. Namely, 70% of its final electricity consumption is based on renewable generation, while the national average is 59.1%. For this purpose, a series of semi-structured interviews have been developed for the top 10 municipalities with the highest presence of RES projects, located in the Central Region of Portugal. The survey was designed based on existing literature regarding social acceptance and attitudes towards RES. Expected results should emphasize, among socio-economic and environmental aspects, which are the main benefits or barriers towards project acceptance or rejection, from a municipality perspective.

## INTRODUCTION

Climate change mitigation comes across as a global subject of interest, however, municipalities have been at the forefront of the climate change combat. Efforts to promote the use of renewable energy sources and energy efficiency at the city level are critical since cities have been considered large-scale energy consumers and greenhouse gas (GHG) emitters at the worldwide level [1]. The development of energy community projects (e.g. solar PV) has been seen as a way to foster the adoption of RES. However, opposition can arise at the local community level and become a serious holdup for the project [2]. At the national level, Portugal has conducted studies that focused on different stakeholders both at national and community levels. National surveys seem to convey that the general population is favourable to RES deployment, showing the largest support is for solar power projects, and that hydropower is the most well-known technology in contrast to lesser known biomass projects [3]. Solar power was later surveyed at the local community level to better understand the impacts on residents using the contingent valuation method, and also at national level to assess the adverse impacts of electricity generation through photovoltaic energy [4]. Results highlighted that the nearby impact from solar power farms is not negligible at the local level and that the resource-to-stated preference methods provide a more realistic understanding of general public opinion on the trade-offs between benefits and costs associated with solar power projects. A mixed-method approach was also undertaken by combining both qualitative and quantitative approaches to assess regional and local community perceptions, complementing prior impact perception on wind farms in a particular region [5]. Research findings emphasize that opinions regarding wind farm deployment are mainly driven by the perceived socio-economic benefits by local communities, which include “community funds”, “benefits in kind” and “indirect local employment”, denoting the key role of benefit sharing in public acceptance of RES projects.

Yet, according to[6], social acceptance of solar, wind or biomass projects is a complex subject, that also implies political and regulatory aspects, besides public acceptance. This draws attention to other relevant stakeholders, involved in the social acceptance of RES projects, namely local governance. Therefore, it becomes crucial to understand the role of municipalities, their drivers and barriers to successfully overcome local opposition and promote RES deployment and local acceptance.
The present study provides an overview of the research methods regarding social research in RES projects and proposes a research design, while also providing an insight into the role of different stakeholders in the development of RES projects in Portugal. To our knowledge, this gap of the municipality perception taking into consideration energy justice (procedural and distributional dimensions), has not been addressed for the case of Portugal, and in particular for the Portuguese Central Region which holds municipalities with some of the highest rates of deployment/number of wind and solar power projects at the national level.
The current study is organized as follows: section 1 introduces the subject of study; section 2 describes the research methods, section 3 describes and discusses obtained results, and section 4 presents main conclusions.

## 1. METHODS

### 1.1 Proposed research outline and main steps to describe the research area: the case of Portugal

To assess the perception drivers and barriers of local stakeholders associated to RES projects, namely of local municipalities, an overview of literature related to this research scope was conducted, with the 'purpose of tracking the development of research over time'[7], taking into consideration identification of main research questions (RQ), stakeholders, impacts, and research methodology. The aforementioned steps are aligned with the '*Economic and Externalities Valuation of Renewable Energies in Portugal' (R3EA Project)* [8] goals, and are illustrated in Figure 1. The R3EA Project aims to assess the socioeconomic and environmental impact of new investments in solar and wind power, for the Central Region of Portugal, promoting an holistic persptective, by considering all sustainability dimensions.

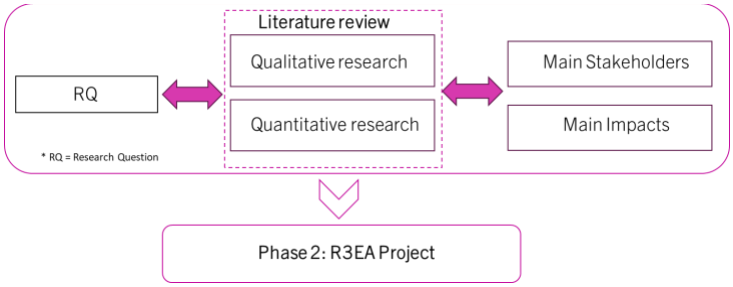


Figure 1: Methodology steps

Meanwhile, Phase 1 concentrates on data collection and scenario building, for model development and validation; Phase 2 of the Project promotes the identification and review of existing impacts and associated methodologies with wind and solar power projects [9]. The key target stakeholder is, in this particular case, the local governance or local municipality. The selection of this stakeholder follows a pre-established criterion (see [5]):

- All participants are elected representatives of the local community, knowledgeable of the community's needs and interests to safeguard. Also, key actors in promoting a better understanding of socioeconomic and environmental local impacts, by identifying positive and negative impacts, as well as experienced good practice standards;
- All participants closely follow different phases of the wind farm or solar farm development, from construction to decommissioning, and therefore establish a 'bridge' between the local community and other stakeholders, namely the promoters and governmental agencies;
  As members of the local community members, they may have both 'benefits and complaints regarding project deployment'.

To this end, the following research questions (RQ) are addressed:

- RQ1: What are the advantages and disadvantages of implementing RES projects, from a local municipality perspective?;
- RQ2: What is the role of local municipalities in the development of the RES projects, to overcome potential barriers to RES deployment, from a local municipality perspective?

Furthermore, although the proposed research methodology focuses on both qualitative and quantitative approaches, such as interviews and surveys, the present study will resort to a qualitative approach to address comprehensively the perception of local municipalities, as a focal stakeholder in RES deployment. The advantage of using these methods to assess public perception has been highlighted in prior studies (e.g. [10]), as enabling to exploration of the complexities of public opinion. Moreover, a preliminary review is presented in result section, to establish the main impacts and stakeholders.

We characterized the case study based on the objectives of the project, focusing on the central region of Portugal. We identified municipalities with renewable energy projects using data from the INEGI database E2P, which contains information from 2023. Subsequently, we organized the data by district and municipality and compared them to determine the top 10 municipalities with the highest number of projects in either wind or solar energy generation power plants.

## 2. RESULTS

### 2.1 Proposed sections for the interview guideline based on the preliminary literature review and detailed characterization of the top 10 Municipalities

A preliminary review, based on the following combination of keywords: "local municipality" OR "local governance" AND "renewable energy externalities" OR "renewable energy impacts" AND "wind power" OR "solar power" AND "social acceptance", enabled to gather a total of n=43 studies on Scopus database. From these, a set of filters were applied to discard studies: 1) exclude studies considered out of scope (n=17) (e.g. that focus specifically on other RES alternatives, dismissing wind and/or solar power); or 2) studies that do not contemplate qualitative or quantitative methods of interest, i.e. that dismiss interviews and/or surveys (n=8). In addition, given the low number of final research articles, the snowball technique has been adopted (see [11]), enabling to consideration of supplementary studies in this research area (n=14).

Table 1 describes the impacts, stakeholders identified, and geographic distribution of the studies in the final sample, as illustrated in Table 1. Concerning the impacts, we consider the main impact areas (socioeconomic and environmental). For the stakeholders identified, two categories were emphasized: residents, and local municipality. The last is the continent where the research was carried out.

Table 1. Final sample description

| **Studies** | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] | [5] | [4] | [3] | [2] | [20] | [21] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Project typology** | | | | | | | | | | | | | | |
| wind | X | X | X | X | X | X | X | X | X | | X | X | X | |
| solar | | X | | | X | | | | | X | X | X | X | X |
| **Methodology** | | | | | | | | | | | | | | |
| Qualitative | | | X | X | | X | X | X | X | | | | X | X |
| Quantitative | X | X | | | X | X | | | X | X | X | X | | X |
| Other | | | | | X | | | | | | | | | |
| **Impacts** | | | | | | | | | | | | | | |
| socioeconomic | | X | X | | X | | X | X | X | | X | X | X | |
| environmental | X | X | X | X | X | X | X | | X | X | X | X | X | X |
| other | | | X | X | X | | X | X | | | | X | | |
| **Stakeholders identified** | | | | | | | | | | | | | | |
| Residents | X | X | X | | X | X | | X | X | X | X | | X | |
| Local Municipality | | X | X | X | | | X | X | | | | X | | X |
| **Continent** | | | | | | | | | | | | | | |
| Europe | | X | X | | X | X | X | X | X | X | X | | X | |
| America | X | | | X | | | | | | | | X | | |
| Africa | | | | | | | | | | | | | | |
| Asia | | X | | | | | | | | | | | | X |

Preliminary results show that 7 out of 14 studies focus on solar power, yet in these studies only 2, focus exclusively on solar power, and the remaining 5 studies assess both alternatives. This result is somewhat expected given that solar

power, despite the greatest growth potential, is more recent and less deployed than utility-scale onshore wind power projects (see [22]). In terms of methodology, a total of 3 out of 14 studies, resort to mixed methods, i.e. complementing both interviews with survey, enabling to reinforce or contrast points of view according to stakeholder type. For instance, Ferreira et al. (2019) [5] ascertained the main impact perception of wind power at the parish level in Portugal, resorting to interviews with residents versus surveys with residents from other parishes from the same municipality. Surveys and interviews were also conducted in Finland, to better understand the perception of two local stakeholders (residents and tourism service providers), at the municipality level [17]. These studies support the multi-faceted nature of impact perception resulting from multiple stakeholders at differing scales. Additionally, it should be noted that none of the studies that resort to a mixed methods approach contemplate solar power alternatives. Also, only one study has complemented traditional surveys with scenario, lifecycle and multi-criteria analysis, to assess the sustainability of energy scenarios that include wind or solar power at the municipality level [16].

As expected, the perception of impacts tends to focus on environmental aspects (n=13) in contrast to socioeconomic (n=9) and other (e.g. regulatory) aspects (n=6). Of these, fewer studies (n=4) focused simultaneously on environmental, economic and social aspects, promoting a more holistic perspective of wind and solar power development. Among environmental impacts, visual (n=6), followed by, noise and biodiversity impact (n=4) ex æquo, and climate change (n=3) are the most concerning for all stakeholders identified, i.e. these impacts are common for the local community and local municipality perspective. Overall, a total of 10 different environmental impacts have been identified: visual, noise, biodiversity impacts; climate change and air pollution; land use; shadow flicker effect; glint effect; solid waste; and water depletion.

Regarding social impacts, job creation (n=5) has been the most mentioned impact, followed by community funds (n=4) and impact on other economic activities, such as agriculture or tourism sectors (n=4), all mostly among residents. The energy justice issue has also been largely mentioned (n=4), and in contrast to prior social impacts, it has been focused on by local municipality stakeholders. This result is somewhat expected given that prior studies have pointed out that local communities based on their negative perception can become project opposers/barriers (e.g.[2], [14]). A total of 9 socioeconomic impacts have been identified, affecting different stakeholders: community funds and project ownership, energy justice, job creation, impact on other economic activities (e.g. agriculture or tourism), new infrastructure, impact on health, electricity bills or land value.

Other impact categories identified in the literature, include regulatory (e.g. lack of technical expertise or budget or gaps at the policy level) as well as technology-related aspects (e.g. acknowledgement, satisfaction or acceptance of the technology) these concerns have been identified in studies that feature mostly local governance stakeholders, i.e. local municipality perspective. Also, only one study focused on municipality led energy community projects (e.g. carbon footprint reduction as a reason to develop these projects).

It should also be highlighted that the abovementioned studies are mostly focused on Europe, and studies that focused on Portugal (e.g.[3]) only concern residents and do not approach the local municipality perspective comprehensively. For instance, [11] focus on a specific segment of residents that are directly involved in wind power project developments, the communal land committee, that represents the interests of the local community where the project is implemented. [10] assess the perception of residents who experience closely solar power projects in Portugal, to national residents not necessarily exposed to environmental impacts of project operation. Meanwhile, [20] have interviewed other local stakeholders including former politicians linked to local parishes and municipalities to ascertain the impacts of the renewable energy projects on the environment, landscape and local development. Yet, the context for the investment of renewable energy projects has changed considerably since these studies, given the recent possibility of developing energy communities (see [23]) and the emerging concept of energy quadrilemma that contemplates the need to consider energy justice in addition to energy security; energy sustainability and energy affordability issues (see [24]).

Furthermore, the role of different stakeholders, including local municipalities in planning and permitting/licencing these projects is complex and often seen as a barrier to its deployment ([25]). Therefore, based on the preliminary literature review the interview guideline began to be devised focusing on key environmental and socioeconomic impacts as well as key stakeholders that could help identify main motivations and barriers for project development.

In this sense, the interview guide has been divided into three stages: the first part is i) to understand the knowledge and personal experience regarding renewable energy; the second part is ii) to understand the municipality's profile in terms of renewable energy projects, their main advantages and disadvantages, the prospective investments and the main motivations and barriers; and the third part concerns iii) the regulatory aspects and the role of the municipality. This guideline structure is aligned with the proposed research questions, described previously in the Methods Section. The municipality's role as a stakeholder in the energy planning process is further developed in the next section.

From a national perspective, Portugal has seen an increase in RES projects, particularly regarding wind and solar power deployment. At the regional level, the Centro Region is known to have a substantial number of renewable energy projects, namely wind and solar plants, as illustrated in Table 2, which describes the top 10 municipalities.

Table 2: Top 10 municipality RES projects

| **Wind energy** | | | **Photovoltaic Projects** | | |
|---|---|---|---|---|---|
| **Municipality** | **District** | **Wind Power Plants** | **Municipality** | **District** | **Photvoltaic Power Plants** |
| Torres Vedras | Lisboa | 14 | Mangualde | Viseu | 6 |
| Cinfães | Viseu | 10 | Oliveira de Frades | Viseu | 3 |
| Pampilhosa da Serra | Coimbra | 6 | Ílhavo | Aveiro | 2 |
| Guarda | Guarda | 6 | Ovar | Aveiro | 2 |
| Oleiros | Castelo Branco | 5 | Castelo Branco | Castelo Branco | 2 |
| Sobral de Monte Agraço | Lisboa | 5 | Sobral de Monte Agraço | Lisboa | 2 |
| Lamego | Viseu | 5 | Aveiro, Estarreja | Aveiro | 1 |
| Sabugal | Guarda | 4 | Condeixa-a-Nova, Figueira da Foz,Montemor-o-Velho | Coimbra | 1 |
| Mação | Santarém | 4 | Alcanena, Ferreira do Zêzere, Tomar, Torres Novas | Santarém | 1 |
| Castro Daire | Viseu | 4 | | | |

In Table 2 we observe notable concentrations of both wind and photovoltaic energy projects in some of the municipalities. In terms of wind energy, Torres Vedras leads with 14 power plants, followed by Cinfães with 10, and Pampilhosa da Serra and Guarda with 6 each. On the other hand, Mangualde stands out in photovoltaic energy with 6 projects, followed by Oliveira de Frades with 3, and several municipalities with 2 projects each, including Ílhavo, Ovar, and Castelo Branco. This distribution showcases a diversified landscape of renewable energy initiatives across the central region. The prominence of certain municipalities in either wind or photovoltaic projects could suggest an approach to renewable energy development based on local geographical and environmental factors, or not. It is important to notice that, in the case of photovoltaic power, several municipalities have only one plant (Aveiro, Coimbra, Santarém).

## 2.3 DISCUSSION

The development of renewable energy projects (REP) is complex and involves several stakeholders at different levels of governance, from local to regional and national levels, as well as private and public entities. In Portugal, the licencing/permitting process implies five stages (1-pre-licensing; 2-environmental licencing; 3-electrical licencing (electricity generation); 4-construction licensing; and 5-electrical licencing (electricity use). Local municipalities are directly involved in two stages known as the pre-licensing and construction licencing stages ([25]). On the other hand, England has concentrated decision-making at a local level, determining that all projects, except “small-scale domestic wind turbines”, must be approved by local planning authorities (LPA). If the area has been identified as suitable for the local development plan and if the impacts identified by the local community during project planning have been addressed and the proposal has local community support ([26]). This aims to promote more agile identification of possible location alternatives and impacts, further involving local communities in the planning process. Despite this, it should be noted that Portugal has, in its environmental impact assessment process, public participation as a mandatory step, which is crucial from the energy justice perspective. Yet, despite the efforts developed to make permitting processes and entities involved more approachable in the case of Portugal, the relationship between local municipalities and the local community needs to be further explored, since studies tend to focus them separately, although they seem to be interconnected, disabling the opportunity to understand their roles and interaction. In contrast to other countries, for instance, Ireland which has a six phases onshore wind deployment scheme, based on its lifecycle (from concept to decommissioning), recognizes that throughout the development process local community is always contemplated, and has developed several guidelines for this purpose (e.g. [27]). This might be the way to further inform and integrate different stakeholders to overcome barriers towards onshore wind development. However, the transfer of permitting process to local scale, might also imply careful consideration in terms of human and financial resources to futher avoid regulatory concerns, that ultimately might jeoperdize flexible RES deployment. Regarding

the case study, the Central Region of Portugal is a focal point for renewable energy projects, particularly in wind and solar power deployment. Analysis of the top 10 municipalities reveals a diverse landscape of initiatives. For instance, Torres Vedras leads in wind energy with 14 power plants, while Mangualde stands out in photovoltaic energy with 6 projects. This distribution underscores the significance of local factors in shaping renewable energy development. At the national level, Portugal has witnessed a marked increase in renewable energy projects, with the Central Region contributing significantly becoming the focal objective of the R3EA goals. However, challenges remain in optimizing energy production and consumption, as highlighted by discrepancies in the energy balance analysis. Addressing these challenges requires a comprehensive approach that leverages the region's diverse renewable energy potential and adopts innovative solutions to advance Portugal's renewable energy goals ([22]) for that the public participation and the involvement of different stakeholders is crucial, especially at the local level.

## 2.4 CONCLUSIONS

This study highlights the local municipality perspective regarding the development of wind and solar power projects, an existing research gap. It identifies its main advantages and disadvantages and calls attention to role of municipality, as a stakeholder. While in the European Union, national or regional programmes often aim at producing favourable conditions for renewable energy, the decisions and actions for the infrastructure takes place at the local level. Overall, a larger number of studies focus on wind in contrast to solar energy. Similarly, studies focusing on local municipality stakeholders are less common than those on other types of stakeholders. Fewer studies consider combining qualitative and quantitative approaches, and most studies focus primarily on one of the approaches to assess the perception of environmental impacts, in comparison to socio-economic impacts.

Besides the most common environmental and social impacts, energy justice and regulatory issues seem to be main concerns for local municipalities, and pertinent issues that should be taken into consideration in the proposed interview guide, to be applied in R3EA Project. The role municipalities play in the planning and permitting process differs across countries, yet, it is clear that changes need to be carefully considered to avoid energy injustice and regulatory barriers, in a fast forward energy transition context. A more local level centered permitting and planning process would require additional human and financial resource allocation. In the case of Portugal, municipalities are involved in different stages of the permitting process, yet it is still considered complex and involving multiple levels of governance. Notwithstanding, Portugal already has in its legal framework, public participation, a crucial step to ensure procedural justice, in the development of RES projects.

The present study is limited by the scarce number of countries considered for comparison with the Portuguese context. Despite its limitations, the study provides valuable insights regarding the need to consider perceptions of local impacts and its assessment. Likewise, it establishes a clear trajectory to develop further research to advance understanding on how different stakeholders interact with the local community in the process to promote a more flexible and socially acceptable process.

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