



POLICY REPORT

"Renovables sí, però així no?"

A defence of Catalonia's low-carbon
energy transition after 2019

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Institut Ostrom

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INTRODUCTION

“Renewables? Yes, but not like this” is a phrase that captures the two sides of the current discourse on Catalonia’s transition to renewable energy. The passing and revocation of two laws in the last decade significantly shaped Catalonia’s course towards a decarbonised energy grid. This article will defend how Catalonia’s low-carbon energy transition has proceeded post the approval of Decree-Law 16/2019 and the subsequent repeal of Decree-Law 147/2009 by the Government of the Autonomous Region of Catalonia in 2019. We will broadly respond to the two following objections and demands raised against the promotion of renewables under Decree-Law 16/2019:

- *The aggressive pace of implementation and an avalanche of solar and wind macro-projects post the approval of Decree-Law 16/2019 is unnecessary and irresponsible. Decree-Law 16/2019 should be repealed and a moratorium imposed on the solar and wind projects under its review (Diari de Tarragona, 2021; Tedó, 2021).*
- *It creates an energy model that restricts market competition and limits participation only to an oligopoly of large companies while excluding smaller entities such as MSMEs (Faneca, 2021, Morron, 2021; Palau, 2021). A moratorium should be imposed on Decree-Law 16/2019 to make way for a more decentralised energy model conducive to the involvement of citizens, MSMEs, and the community.*

Section 1 will give a comparative overview of Catalonia’s low-carbon energy transition programme (LETP) in the context of the decarbonisation targets. Here we will compare the performance of Catalonia’s LETP with that of Spain and the EU with the help of empirical evidence from the renewable electricity sector (RES-E).

After section 1, we will sharpen the focus of our answer and equate Catalonia’s LETP to the implementation of solar-PV and wind energy projects because this implementation is precisely what Decree-Law 147/2009 and Decree-Law 16/2019 were designed to affect. Our discussions will refer to Decree-Law 147/2009 as the old law and Decree-Law 16/2019 as the new law. Section 2 will analyse the technical features of Decree-Law 147/2009 and attempt to determine how its protocols stalled the implementation of solar-PV and wind installations and paralysed the progress of Catalonia’s LETP. In Section 3, we will unpack the content of Decree-Law 16/2019 to understand how it could have helped in getting Catalonia’s LETP back on the right track.

To support our arguments in sections 2 and 3, section 4 will present empirical evidence from a dataset containing observations on solar and wind projects applied after the revocation of Decree-Law 147/2009. Building on empirical

¹ Micro, Small and Medium Enterprise

inferences of section 4, section 5 will use a multiple regression model, which controls for confounding factors, to isolate the old law's causal role in slowing the pace of Catalonia's LETP. Our inferences from sections 1-5 will support our reply to those opposing the aggressive pace of Catalonia's LETP under the Decree-Law 16/2019 and calling for a repeal of the new law's protocols (Archyde, 2019; ACN, 2021; Palau, 2021). More specifically, sections 1-5 will build to the conclusion that the aggressive pace of solar-PV and wind project implementation under Decree-Law 16/2019 is a natural catch-up process necessary after years of stagnation to clear the bottlenecks and backlogs resulting from the obstacles and delays created by Decree-Law 147/2009.

Section 6 will use conceptual arguments and illustrative evidence to refute the claim that Decree-Law 16/2019 is creating a centralised energy model and an oligopoly in the RES-E (Faneca, 2021; Morron, 2021; Palau, 2021). The breakdown of solar-PV and wind project applications we provide here will reject the idea that the new law has facilitated the concentration of installed solar-PV and wind energy capacity in the hands of a few energy majors. Our evidence and reasoning will show that Decree-Law 147/2009 was responsible for restricting market competition and participation by local actors. The new law marked a paradigm shift that decentralised Catalonia's LETP by supporting the involvement of smaller actors and promoting self-consumption projects.

SECTION 1. OVERVIEW

Since the beginning of the 21st century, Catalonia has recognised the need to promote renewable energy. It has consistently aligned itself with targets such as the ones set by the EU for decarbonising the electricity grid (Generalitat de Catalunya, 2009). Like many other low-carbon energy transitions in progress worldwide, the recognition of the threat of anthropogenic climate change is the primary driver behind Catalonia's aim to decarbonise its electricity grid and shift to renewable energy sources (Generalitat de Catalunya, 2017). The energy cycle, starting at the extraction and production stage, is responsible for 76% of total GHG emissions and 93% of CO₂ emissions in Catalonia (Generalitat de Catalunya, 2017). As part of its latest National Agreement for Energy Transition, Catalonia has set ambitious decarbonisation targets for 2030 and 2050 as part of its PROENCAT2050 plan (Generalitat de Catalunya, 2017). This plan aligns with the EU's directives proposed under the "2030 Climate and Energy" package (Generalitat de Catalunya, 2017).

Catalonia, since 2002, has passed legislation to build and modify legal and administrative frameworks for processing renewable energy projects (Generalitat de Catalunya, 2009). However, Decree-Law 147/2009 and Decree-Law 16/2019 are the two noteworthy policies that have sparked controversy regarding the progress of Catalonia's LETP. In policy discourse, both these laws are believed to have had a decisive influence on the course of Catalonia's LETP. The old law was passed in 2009 and regulated solar-PV and wind farm project deployment during the 2010-2019 period. The consensus is that Decree-Law 147/2009 effectively put a decade-long moratorium on the deployment of renewable energy projects and paralysed Catalonia's LETP (Del Cerro, 2021; Morron 2021). Decree-Law 16/2019 was passed in November 2019 to supposedly put Catalonia's LETP back on track to achieve renewable energy supply and decarbonisation targets.

However, opponents of Decree-Law 16/2019 have raised concerns about two aspects of Catalonia's LETP post the old law's revocation. First, they have objected to the rapid pace at which renewable projects are being approved and implemented (Diari de Tarragona, 2021; ACN Barcelona, 2021). They want to repeal Decree-Law 16/2019 and impose a moratorium on renewable energy projects currently being reviewed under its framework until they can develop an energy model that allows for more balanced progress (ACN, 2021; Faneca, 2021). Second, they have criticised the new law for creating an oligopolistic market structure that restricts competition, excludes MSMEs and blocks the growth of self-consumption projects (ACN Barcelona, 2021; Morron, 2021; Palau, 2021). The opponents of Decree-Law 16/2019 have also raised territorial distribution, landscape integration, and environmental and cultural protection concerns (ACN Barcelona, 2021; Faneca, 2021;). However, I will only be focusing on addressing the rapid pace of solar-PV and wind farm deployment and the development of an oligopoly because these are the two fundamental objections to Catalonia's

LETP post the revocation of the old law. These two objections characterise what, according to the opponents of the new law, changed after 2019.

1.1. Comparing progress in context of decarbonisation targets

Although the report by Generalitat de Catalunya (2017) does not give us a yearly breakdown of emissions driven by the energy sector, the carbon emission statistics stated earlier give us a bigger picture and more long term trend going back to 2012. The bigger picture tracing emissions back to 2012 might look grim and gives us the first indication of the failure of Decree-Law 147/2009 in decarbonising the grid. However, a proponent of the progress of Catalonia's LETP under the old law might claim that we need to look at the annual fluctuations to identify the positive developments towards decarbonisation of the electricity grid under Decree-Law 147/2009. Figures 1.0-1.1, constructed from ²DATASET A, allows us to check for Decree-Law 147/2009's performance in decarbonising the electricity grid based on an annual trend. In figure 1.0, a higher % share of electricity consumption from renewables (%RE) implies declining GHG³ and CO₂ emissions. Even though the life cycle of renewable sources is not entirely carbon-free, their emission levels are much lower compared to electricity sourced from fossil fuels (Hertwich et al., 2015; García-Gusano et al., 2017). Therefore, the progress of Catalonia's LETP in decarbonising the energy sector under Decree-Law 147/2009 should show up as %RE similar to or better than Spain and the EU and sustained increase in this %RE share over the 2009-2019 period. However, we do not see any such positive trends. We observe that Catalonia's %RE considerably lags behind %RE for Spain and the EU in any given year. Our percentage point change computations show (Figure 1.1) that instead of a sustained increase in Catalonia's electricity consumption from renewable sources, we only observe an overall annual trend mainly consisting of zero or negative change. The sharp temporary upswings and predominant downswings in percentage point change in Catalonia's %RE are in contrast to Spain & EU's relatively stable pattern of generally positive percentage point growth in %RE. Percentage point change in %RE rarely goes below zero for Spain and not at all in the case of the EU in the 2009-2019 period. In stark contrast, for Catalonia, ever since Decree-Law 147/2009 was passed, patterns of declining growth, stagnation and fall in %RE have been predominant.

At the end of the 2009-2019 period, Catalonia's %RE was even further behind the %RE in Spain and the EU compared to when Decree-Law 147/2009 was implemented. Some of Catalonia's %RE gap with Spain and the EU could be attributed to factors and conditions unique to Spain and the EU that have helped

² Source of DATASET A: **Government of Catalonia, 2021. *Potència elèctrica bruta instal·lada a Catalunya y Balanç d'energia elèctrica de Catalunya***. [online] Institut Català d'Energia. Available through: Government of Catalonia Website

³ Greenhouse Gasses

better advance the integration of renewables into the electricity grid of these two regions. While other factors may have pushed Spain and the EU's renewables programme forward, we cannot overlook policies that held Catalonia back. Therefore, figures 1.0-1.1 indicate that the old law possibly regressed Catalonia's LETP instead of advancing it to reach decarbonisation targets. The fact that Catalonia's LETP has not gone in the right direction ever since the advent of Decree-Law 147/2009 gives us the motive to investigate its role in paralysing Catalonia's LETP. While it is too early to make conclusive causal claims, Figures 1.0-1.1 present an initial blow to opponents of Decree-Law 16/2019 who want to repeal the new law and impose a moratorium on renewable energy projects being processed under the new law. In calling the pace of Catalonia's LETP "aggressive" and criticising the "avalanche" of solar-PV and wind installations deployed under the new law, they fail to acknowledge Catalonia's dismal performance in advancing its LETP and keeping up with EU & Spain's %RE. Despite the favourable economic conditions created by the falling costs of renewables (Anne O), Catalonia fails to move its LETP forward in the years the old law was active. Instead of catching up with the EU & Spain's %RE, Catalonia ends up falling further behind at the end of the 2009-2019 period.

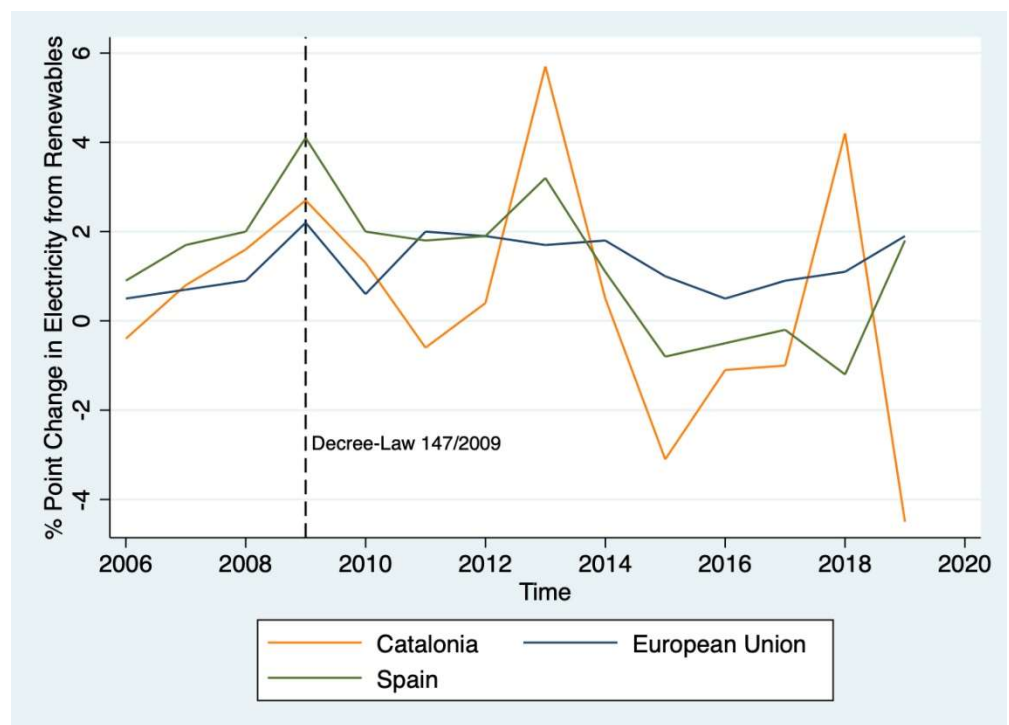


Figure 1.1

SECTION 2. TECHNICAL FLAWS OF DECREE-LAW 147-2009

The content of Decree-Law 147/2009 suggests some possible regulations and mechanisms that got Catalonia's LETP going backwards. Decree-Law 147/2009 intended to lay down the environmental, urban, and landscape criteria for regulating the installation of Solar-PV systems and wind farms (Generalitat de Catalunya, 2009). The old law sanctioned administrative bodies and procedures to enforce the stipulated guidelines for solar-PV and wind projects and execute its regulatory framework.

For wind farm projects, Decree-Law 147/2009 created a highly centralised framework that involved state intervention at all stages of the potential construction of a wind farm. Permissions from government departments were required at all stages, from selecting the development area to getting grid connectivity after project completion (Generalitat de Catalunya, 2009). Construction of wind farm installations was predominantly limited to areas known as Priority Development Zones (ZDP). Wind speed, urban viability and environmental risk were some characteristics considered in identifying a location as a ZDP (Generalitat de Catalunya, 2009). The ZDPs were determined by agreement among municipal authorities and government bodies responsible for energy, environment and cultural affairs (Generalitat de Catalunya, 2009). A commission, composed of eight members representing the departments of environment, territorial policy, energy policy, and the county councils in priority development zones, was created to scrutinise tender applications for wind farm projects (Generalitat de Catalunya, 2009).

Apart from tender selection, the permission to execute a wind project was contingent on approval from the department responsible for energy and the Territorial Commission of Urbanism (Generalitat de Catalunya, 2009). A review of documentation related to environmental impact, landscape integration, and territorial and cultural impact was required to receive the sanction from apex public agencies as part of the process. There were internal deadlines of 1-2 months set for public bodies such as the urban town planning body to review an application and provide the necessary approvals to proceed to the next stage (Generalitat de Catalunya, 2009). In the absence of an update from a public body within 1-2 months, a "positive administrative silence" was assumed (Generalitat de Catalunya, 2009). After the internal deadline passed without a response from the relevant public authority, the application moved on to the next stage. There were also deadlines set for resolving disputes between an applicant and the Selection Committee over a decision. However, there was no clear external deadline or time frame communicated to petitioners in which they could expect to receive a final decision on their application and implement a project.

Similarly, for approval on solar-PV installations, a petitioner had to go through the Business Management Office (Generalitat de Catalunya, 2009). Solar-PV

projects were mostly limited to degraded undevelopable land and areas contiguous in their use for industrial or agricultural purposes (Generalitat de Catalunya, 2009). Any project's viability is contingent on approval from the Territorial Commission of Urbanism, the body responsible for energy (e.g. Directorate-General for Energy Policy and Mines), the body responsible for culture, and the body responsible for the environment (Generalitat de Catalunya, 2009). With multiple public agencies involved, there was much internal back-and-forth and coordination required between these agencies to process relevant documents and grant appropriate permissions so the project could move along different stages in the bureaucratic pipeline. There were internal deadlines for government departments to produce and review documents so that the approval process could continue smoothly. However, almost all public bodies had as long as one month to sit on a solar-PV application. After the one month internal deadlines, a "positive administrative silence" was assumed on the application, and it moved along the conveyor belt of bureaucracy. Meanwhile, petitioners of Solar-PV and Wind projects were given no clear time frame to expect a final decision on their application.

From the description above, we can identify a technical flaw of Decree-Law 147/2009 in setting month-long internal deadlines for public bodies and the absence of a stated deadline for petitioners to receive a final decision on their application. Under the Decree-Law 147/2009 status quo, considering that 4-6 public agencies weighed in on a project and a one month long consideration period was granted to almost every agency, it could have been 4-6 months before a petitioner received a final decision on their application. The only deadlines petitioners received were to issue clarifications and additional paperwork on their application, ranging between 10-15 days (Generalitat de Catalunya, 2009). The petitioners did not receive any specific time frame by which they were likely to receive a decision on their application. In the absence of a transparent time frame, petitioners and their Solar-PV or wind farm project applications were at the mercy of tediously long bureaucratic procedures.

Moreover, it is unclear how the "positive administrative silence" helped to move things along. The draft of Decree-Law 147/2009 states that after a delay of one month without an update, an application can only move to the next stage if the documentation is complete (Generalitat de Catalunya, 2009). However, it is unclear how an application could have proceeded to the next step in the face of positive silence because each successive stage was likely to have depended on the provision or review of documents at a previous stage. Suppose the government department handling an application at a specific step could not proceed because it lacked the required documents from another department at an earlier stage. In that case, there was nothing in the law stopping it from sending the application back and continuing the back and forth of bureaucratic procedures. Right now, we are not introducing a relative benchmark for comparing the possibly 4-6 month-long processing times. However, simply on a conceptual level, **the reasoning above suggests that the month-long internal deadlines and the ambiguity of the "positive administrative silence" were**

flaws inherent to the design of Decree-Law 147/2009. These flaws were capable of stalling the deployment of solar-PV and wind farm projects and, subsequently, the progress of Catalonia's LETP.

The location-related restrictions for solar-PV and wind projects potentially limited the growth of Catalonia's LETP to more regions and added an additional layer of scrutiny and delay. With wind projects confined to ZDPs and solar-PV installations permitted only on undevelopable land, the location viability criteria likely discouraged applications. The blocking effect of the viability criteria was potentially exacerbated by the additional rules on environmental risk, landscape integration, and territorial and cultural compatibility.

SECTION 3. IMPROVEMENTS UNDER DECREE-LAW 16/2019

3.1 Simplification and expansion

After establishing that Decree-Law 147/2009 got so much wrong, the natural question that arises is how Decree-Law 16/2019 could have possibly set Catalonia's LETP back on the right track? The answer to this question broadly revolves around the fact that the passing of Decree-Law 16/2019 in 2019 repealed the protocols and provisions active under Decree-Law 147/2009 (Generalitat de Catalunya, 2019). Unlike Decree-Law 147/2009, the new law's provisions recognised the urgency of the climate emergency and the pressing need to accelerate the implementation of solar-PV and wind projects to achieve Catalonia's future decarbonisation targets (Generalitat de Catalunya, 2019). While Decree-Law 147/2009 set up tedious bureaucratic procedures, Decree-Law 16/2019 was set out to simplify the administrative process of approval. Instead of restricting the space available to build solar-PV and wind farm projects as the old law did, Decree-Law 16/2019 expanded the ambit of land on which a solar-PV or wind farm project could be built. In the following paragraph, we will look at improvements to specific measures regulating the development of solar-PV and wind farm projects in Catalonia.

Decree-Law 16/2019 simplified the urban planning requirements and expanded the area viable for implementing solar-PV and wind farm installations (Clifford Chance, 2019). Under the old law, the urban planning and territorial laws had strictly restricted the development of solar-PV projects to degraded undevelopable land and areas contiguous in their use for industrial or agricultural purposes (Generalitat de Catalunya, 2009). Under Decree-Law 16/2019, the urban planning law was changed to allow the implementation of solar-PV installations on roofs, pergolas of car parks and plots of urban lands not occupied by buildings, without the need to modify existing urban planning schemes in place (Generalitat de Catalunya, 2019; Osborne Clarke, 2020). According to the new law, only natural spaces with special protection status (ENPE) were considered off-limits for constructing solar-PV installations (Clifford Chance, 2019).

As far as wind farm installations were concerned, the priority development zones reserved for their development were scrapped. The construction of wind farm installations was permitted on most spaces complying with urban and environmental regulations (Archyde, 2019; Bolsa, 2021; Morron, 2021). Only the areas with natural protection status were off-limits for wind farm development (Clifford Chance, 2019). Likely, expansion of land considered viable for construction of solar-PV and wind installations encouraged more applications from petitioners who were earlier discouraged to apply due to restrictions set by the old law. The increase in space considered viable for construction of solar-

PV and wind farm projects potentially also helped in reducing decision delays as applications had to undergo less scrutiny regarding their construction location of choice.

3.2. Streamlined procedures

Decree-Law 16/2019 also streamlined the old law's tedious bureaucratic procedures and communicated a clear time frame to applicants. Instead of having two different apex bodies to initiate and control the application process, the new law created a "one-stop-shop" (Archyde, 2019; Clifford Chance, 2019). The new law set up the Renewable Energy Report committee, a collegiate body comprising eleven representatives from energy, environment, urban planning, climate change, and cultural matters (Generalitat de Catalunya, 2019). The Renewable Energy Report committee was the only body designated to determine the viability of solar-PV and wind project applications. The single committee under the new law replaced the bureaucratic rigamarole and the back-and-forth of applications among public agencies under the old law.

The new law brought the majority of the processing and review of an application under one roof of the Renewable Energy Report committee (Archyde, 2019; Clifford Chance, 2019; Generalitat de Catalunya, 2019). While individual government departments still had to be consulted, they were only needed for clarifications, advice, verifications and appeals in case of disputes (Generalitat de Catalunya, 2019). As far as deadlines were concerned, the petitioners were explicitly provided with a time frame. The Renewable Energy Report committee had to rule on the viability of a project application within three months (Generalitat de Catalunya, 2019). If no response was received after three months, the applicant could carry on with implementing their project. Although the law did not eliminate internal deadlines, they were only required for dispute resolutions and consultations. While the ambiguity of positive administrative silence remained, the new law considerably expedited the application process and provided the certainty of a clear time frame to applicants.

3.3. Summary

Because Decree-Law 16/2019 streamlined procedures, expanded viable areas and communicated a clear time-frame to solar-PV and wind project applicants, we have strong reason to believe that it reduced decision delays and put Catalonia's LETP back on track.

SECTION 4. EMPIRICAL EVIDENCE AND STATISTICAL ANALYSIS

4.1. Overall growth in wind and solar energy under Decree-Law 147/2009

We do have evidence (Figure 1.0 – 1.1) to show the stalling and reversal of progress regarding Catalonia's LETP. However, it is not strictly illustrative of the performance of Decree-Law 147/2009 in promoting renewables. The trend shown in Figure 1.0-1.1 and statistics cited and compared uncritically in news articles (Catalan News, 2019; Del Cerro, 2021) pertain to electricity from all renewable sources and not just solar-PV and wind. While we agree that numbers on electricity from all renewable sources can indicate the performance of Catalonia's LETP under Decree-Law 147/2009, these numbers do not focus on the promotion of the two renewable energy sources that the old law was supposed to affect. For an accurate evaluation of the performance of renewables during 2009-2019, the period during which Decree-Law 147/2009 was active, we need specific statistics on solar-PV and wind energy because the old law predominantly affected these two renewable energy sources.

Figures 2.0-2.3, devised from ⁴DATASET B, resemble the performances seen in figures 1.0-1.1. While Spain witnessed a sustained and predominantly positive growth in the share of electricity supply from solar and wind, the trend in Catalonia illustrates stagnation. The percentage of solar energy in Catalonia's electricity grid was stagnant throughout the 2010-2019 period. Catalonia's electricity supply from wind saw a brief increase between 2011 and 2013 before returning to the same trend of zero, near-zero or negative growth. Figure 2.2 illustrates how the stagnant growth trend in Catalonia's share of electricity from solar and wind leaves it far behind Spain. Catalonia's gap with Spain, in terms of total electricity supply from sun and wind, widens over the 2010-2019 period in which Decree-Law 147/2009 was active. Figure 2.3 shows the overall perspective regarding percentage point change in share of solar and wind in Catalonia and Spain's electricity supply. In the 2010-2019 period, Spain exhibits predominantly strong positive growth as its share of electricity from solar and wind increases in

⁴ Source: **Government of Catalonia, 2021. *Potència elèctrica bruta instal·lada a Catalunya y Balanç d'energia elèctrica de Catalunya***. [online] Institut Català d'Energia. Available through: Government of Catalonia Website http://icaen.gencat.cat/web/.content/20_Energia/28_estadistiques/01_resultat_estadistiques/02_estadistiques_energetiques_anuals/arxius/Balanc-2010-2020.xlsx [Accessed 22 June, 2021]

Source: **Our World in Data, 2021. *Electricity production by source, Spain***. [online] BP Statistical Review of World Energy & Ember 2021. Available through: Our World in Data Website <https://ourworldindata.org/grapher/electricity-prod-source-stacked?stackMode=relative&country=~ESP> [Accessed 24 June, 2021]

percentage points. In contrast, Catalonia has nearly zero growth and even decreased percentage points concerning its electricity supply from solar and wind.

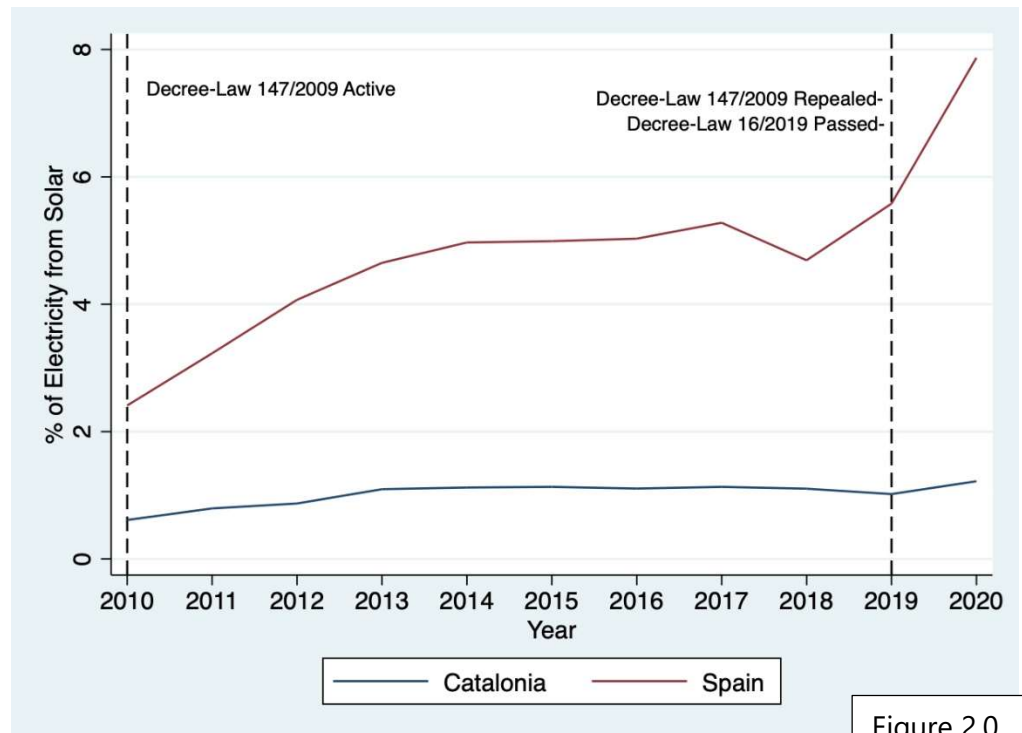


Figure 2.0

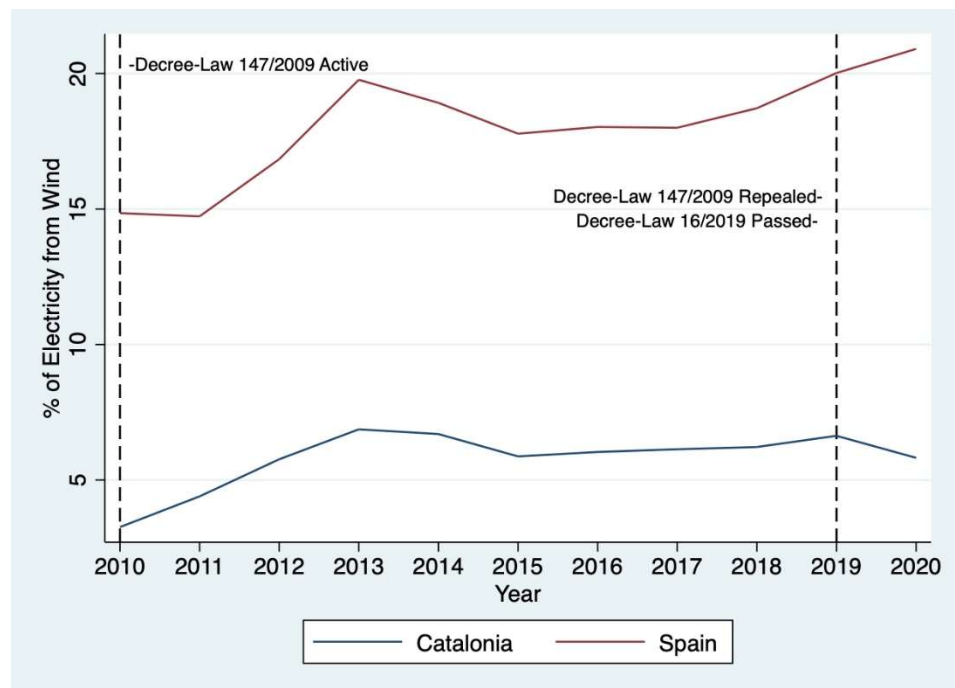


Figure 2.1

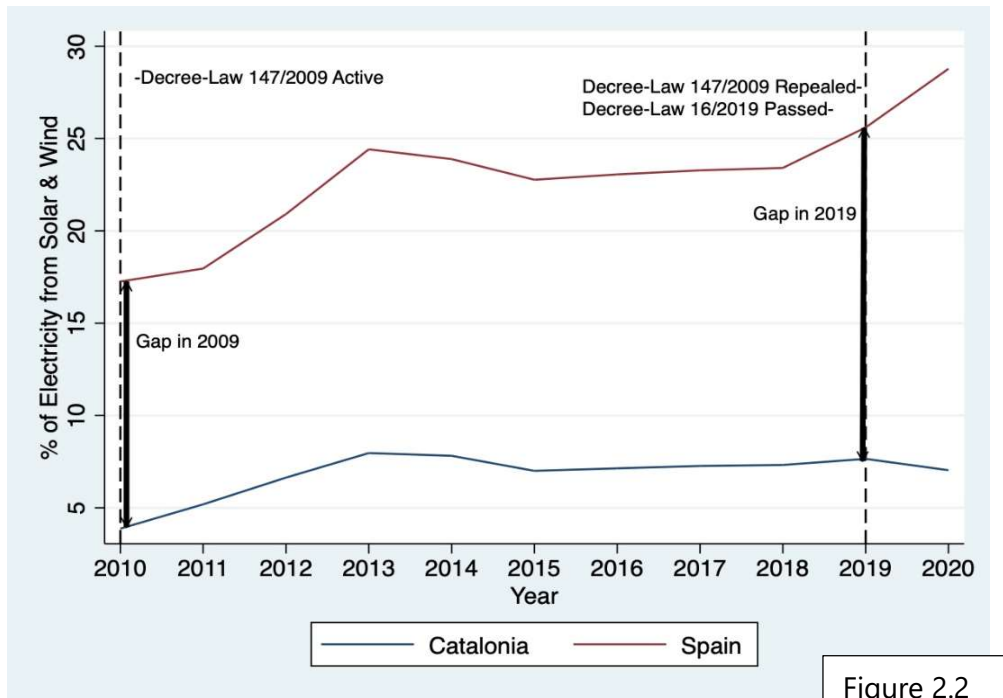


Figure 2.2

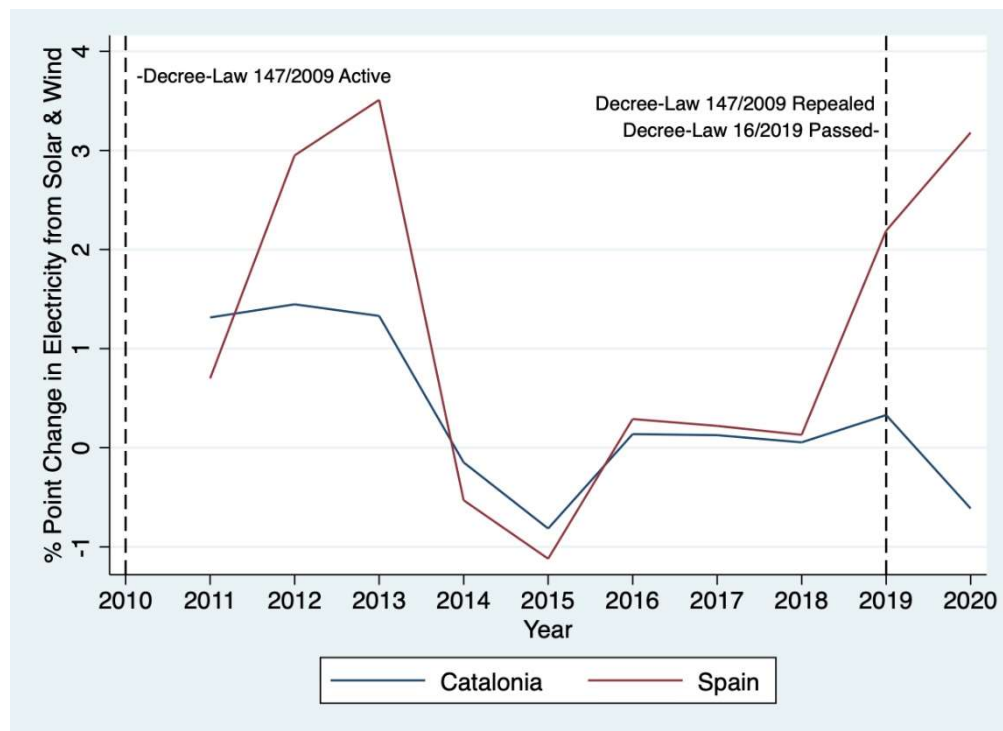


Figure 2.3

4.2. Objections and responses

However, a critic might find our analysis and assumptions to determine the delay in decision-making too pessimistic. Two objections arise to our discussion above. First, if the processing of applications across various stages were simultaneous rather than sequential, that would mean our estimate of decision delays, based on Decree-Law 147/2009's sequential design, are exaggerated. Our estimates of average delays on a solar-PV or wind project assume that each application passes through various stages sequentially. Simultaneous execution of two or more application process steps could considerably lower the waiting period because the processing deadlines of multiple departments have to be met simultaneously in that time frame of a month. However, the simultaneity of stages objection does not hold because the law's draft frequently uses phrases such as "continue with the corresponding procedure" when referring to gaps and delays between steps of the application process (Generalitat de Catalunya, 2009). Furthermore, the back and forth of paperwork among public bodies and between a public body and the petitioner in some cases makes rapid simultaneous processing of an application even more unlikely (Generalitat de Catalunya, 2009). Therefore, given the sequential processing and month-long internal deadlines part of Decree-Law 147/2009's design, our estimates on delays in decision-making do not seem to be exaggerated.

The second objection to our argument is that Decree-Law 147/2009's procedures were not as complex and cumbersome as they appear on paper. Maybe, in practice, its implementation was better with minimum delays, and its design flaws were ironed out over the 2009-2019 period. If this were the situation, then it would be futile to argue that Decree-Law 147/2009 was responsible for paralysing Catalonia's LETP, and we would have to look elsewhere for the cause of delays in renewable energy project deployment. Opponents of Decree-Law 16/2019 would have a much stronger case. A legal framework that covers the environmental, territorial and technical concerns of a renewable energy project while balancing the participation of multiple public bodies and ensuring the processing of applications at a pace consistent with Catalonia's energy transition targets sounds like the ideal policy.

However, we suspect this was not the case for Decree-Law 147/2009. We can clarify this by testing two implications. If our arguments against the design flaws of Decree-Law 147/2009 were limited to the legal text and not valid in practice, then we would likely observe a sustained positive growth trend in electricity supply from wind and solar in Catalonia. However, we do not see any such pattern in the empirical evidence. Figures 2.0-2.1 suggest that Decree-Law 147/2009 failed to fulfil its objective to promote electricity from solar-PV and wind energy sources, not only in theory but also in practice. The stalled growth trend of Catalonia's electricity supply from solar and wind is consistent with our arguments about design flaws and in contradiction of those defending the performance of Catalonia's LETP under Decree-Law 147/2009 and supporting the repeal of Decree-Law 16/2019.

While the stalled growth in electricity from wind and solar is necessary to reject the claim that Decree-Law 147/2009 was better in practice, it is insufficient to show that major decision delays discouraged applications for solar-PV and wind projects. To further substantiate our argument on the technical flaws of Decree-Law 147/2009, we computed average decision-making delays from a dataset of solar-PV and wind project applications in Catalonia in the 2019-2021 period (DATASET C) period. The delay or decision time we refer to was derived by calculating the time that passes (in days) between filing a solar-PV or wind project application and a decision on its viability.

4.3. Time-lagged effects

Before drawing any inferences from the figures ahead, we need to acknowledge that DATASET C only contains statistics for project applications filed three days after Decree-Law 147/2009 was revoked by the approval of Decree-Law 16/2019 (i.e. from 29 November 2019 onwards). Due to a lack of data on projects applied before 2019 (years in which Decree-Law 147/2009 was active), our calculations of average decision time for 2019 are based on projects filed three days after the old law was repealed. Hence, the computations for 2019 are limited to a relatively small sample of projects filed in November and December (Annex1A). However, the average decision time computed for 2019 from the projects filed after revocation of Decree-Law 147/2009 in November and December serves as an accurate proxy for decision-making delays under Decree-Law 147/2009. **There is often a lag between passing/revocation and the implementation of a policy and the observation of its impact in real-world data** (Lindman and Söderholm, 2016; Gutiérrez-Pedrero et al., 2020). Assuming there was a time lag of 2-3 months, applications filed from 29/11/2019 till the start or early months of 2020 are likely to have gone through the same cumbersome assessment procedure set by Decree-Law 147/2009.

Lindman and Söderholm (2016) and Gutiérrez-Pedrero et al. (2020) also incorporate time lags while analysing data at the Spanish and European levels. According to them, private or public sector **interventions in the energy sector are unlikely to have an immediate impact on metrics such as renewable energy patents and investment**. Morron's (2021) reporting on Decree-Law 16/2019 also suggests that few months passed before the time-lagged effect of the old law's repeal kicked in. Finally, given the complexity of procedures and the number of government agencies involved, it is reasonable to presume that there was a lag between the revocation of Decree-Law 147/2009 and any potential impact on decision making time for solar-PV and wind projects.

Our premise of a supposed time-lagged effect of Decree-Law 147/2009's revocation suggests two implications. First, the average delay of solar-PV and wind applications filed between 2019 and early 2020 would be roughly the same but start to gradually decrease from mid-2020 onwards and be at its lowest by 2021. Figures in Annex1B confirm the validity of the first implication. Second, the

persistence of delays would further discourage new applications and keep their numbers low till the time-lagged effect of Decree-Law 147/2009 kicks in by mid-2020. Figures 3.0-3.1, computed from ⁵DATASET C, further support the idea of a time-lagged effect. There is an apparent increase in the number of applications received and a fall in decision time as more and more days pass after Decree-Law 147/2009's revocation. Figures in Annex1B also show that this was roughly the month-wise picture for the wind and solar-PV project observations in DATASET C.

Therefore, there is intuitive reasoning, scholarly precedent and empirical evidence from DATASET C for our use of a time-lag to evaluate the potential causal effect of Decree-Law 147/2009's presence or absence on decision-making delays.

⁵ Source of DATASET C: **Government of Catalonia, 2021. *Sollicituds Parcs Eòlics, Sollicituds Fotovoltaiques, Parcs Eòlics En Funcionament y Resum Comarcal***. [online] Institut Català d'Energia. Available through: https://gencat-my.sharepoint.com/:x/g/personal/aferreres_llacer_gencat_cat/EYTZAhtCT8ghKpxDVh5BGp0MBV3GYV0V8BD1NiyYi8YwgHg?rttime=EYL6q1412Ug [Accessed 15 August, 2021]

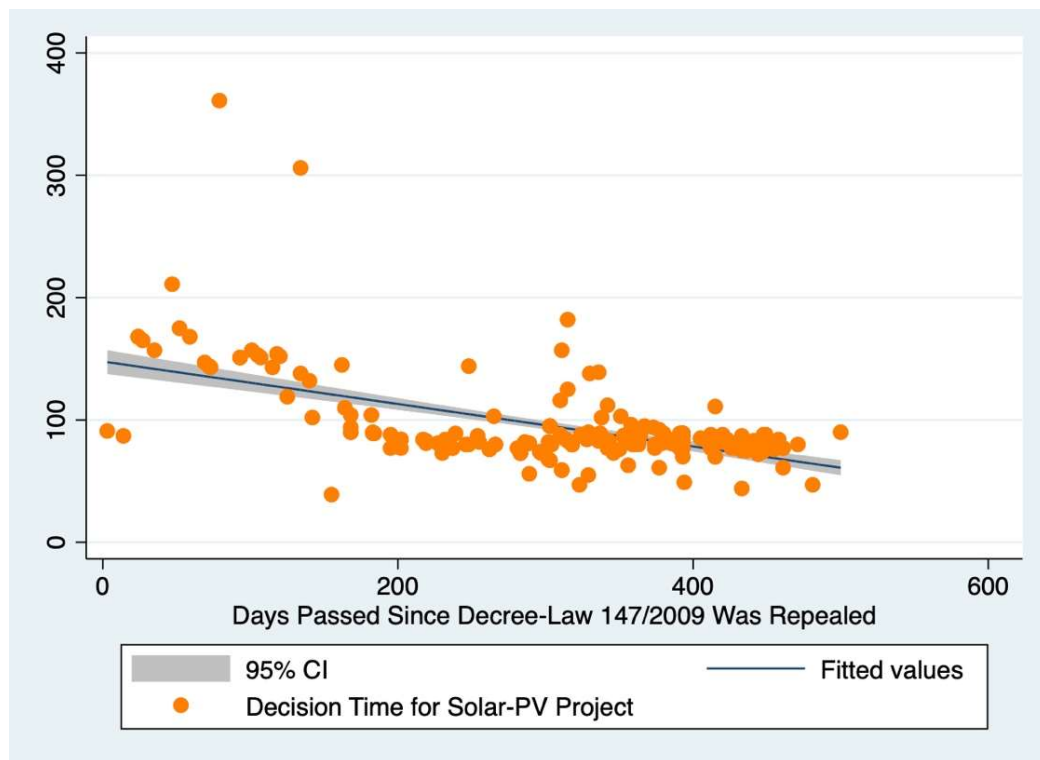


Figure 3.0

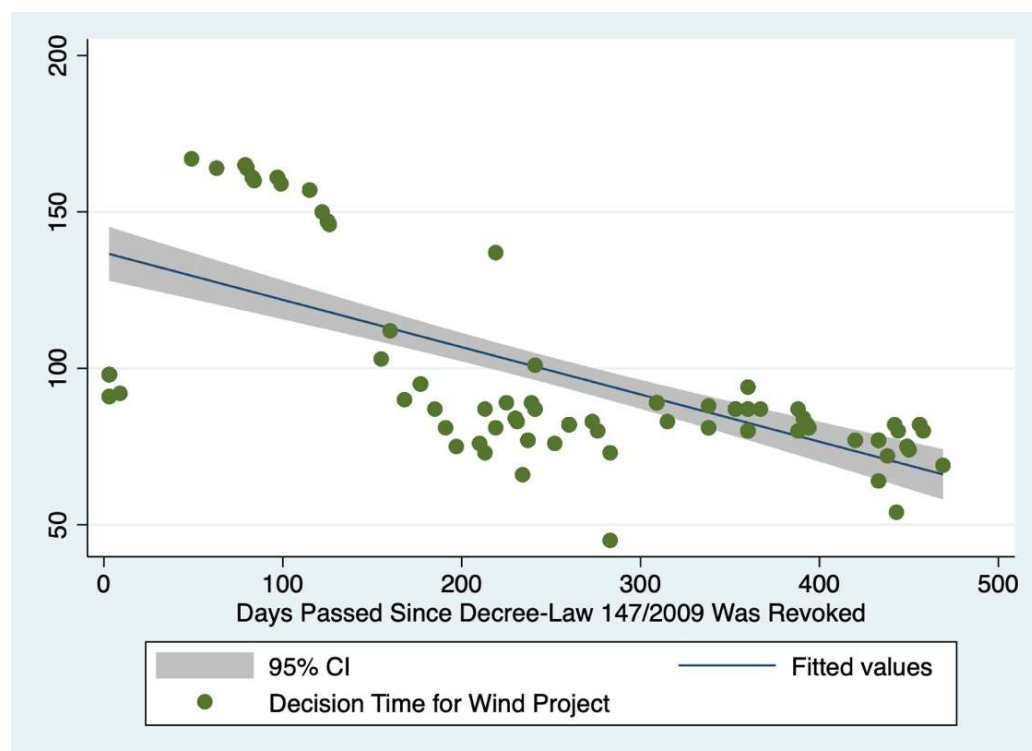


Figure 3.1

4.4. Decision delays for solar-PV projects

This section will report the statistical computations suggesting a relationship between Decree-Law 147/2009 and delayed decision time. Figure 4.0-4.3, devised from DATASET C, shows us that our estimates of delays in decision making (in days) under Decree-Law 147/2009 were not exaggerated. **The average decision time on a solar-PV project application filed in 2019, under Decree-Law 147/2009, was approximately 143 days, equivalent to five months.** For applications filed in 2020, we can observe the time-lagged effect of the scrapping of Decree-Law 147/2009. **The average time taken for decision-making falls from five months to nearly three months.** Even if a lag of 2-3 months meant that applications submitted in the early months of 2020 faced long delays in processing, we still observe the time-lagged effect of Decree-Law 147/2009's revocation kick in for applications submitted in the rest of 2020. As a result, the overall average decision-making time for 2020 falls considerably. The trend continues **in 2021 as the decision-making delay for solar-PV projects further falls to approximately 2.5 months.**

From a sample of 266 projects with records of application filing and decision date, we can draw some **general inferences about the delays in decision making for the entirety of solar-PV project applications filed in 2019 under the protocols of Decree-Law 147/2009 and after its revocation in 2020 and 2021.** As remarked earlier, although our 2019 observations were recorded after the old law's revocation, the average decision time for these observations is a good proxy for delays under the old law due to the time-lagged effects of the old law's scrapping. With some basic hypothesis testing assumptions met (Annex2A), we carried out pairwise comparison tests for the difference of means between groups with unequal variances (Tamhane, 1979) (Annex 2B). Figure 4.1 reports the test and illustrates two inferences. First, the average difference in decision time for solar-PV projects in 2019 was negative compared with 2020 and 2021. The negative sign implies that in our sample, the average decision time on solar-PV project applications in 2021 and 2020 was less when compared to decision time for applications in 2019. Second, the 95% confidence intervals of the average differences in decision time between 2019 and 2020, 2021 do not touch zero and are negative. Therefore, there is a statistically significant difference in average decision time when comparing 2019 with 2020 and 2021. Based on the sample, **average decision times are approximately 64 days shorter in 2021 than in 2019 (i.e. almost 1.5 years after Decree-Law 147/2009's revocation).** The 95% confidence interval for 2019 v 2021 estimates this difference somewhere in the range of 6 days shorter to 92 days shorter.

Similarly, **average decision times in 2020 are almost 49 days shorter than in 2019 (i.e. one year after Decree-Law 147/2009's revocation)**. The 95% confidence interval for 2019 v 2020 estimates this difference to be somewhere in the range of 21 days shorter to 108 days shorter. Concerning solar-PV projects, the statistical evidence backs our argument about the technical flaws of Decree-Law 147/2009 and the intuitions about the delays it caused in moving Catalonia's LETP forward.

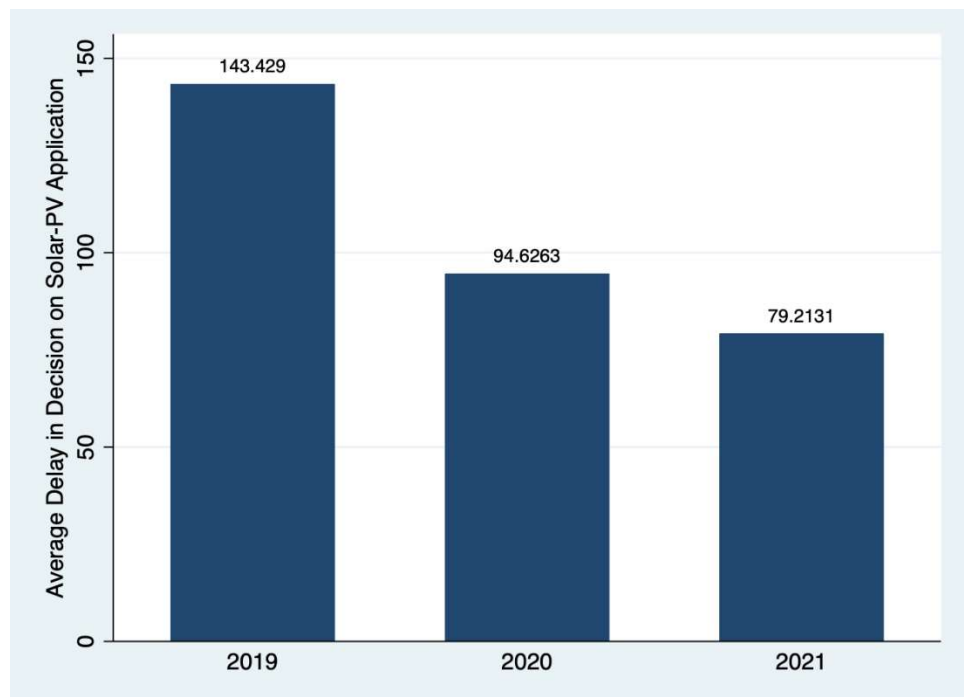


Figure 4.0

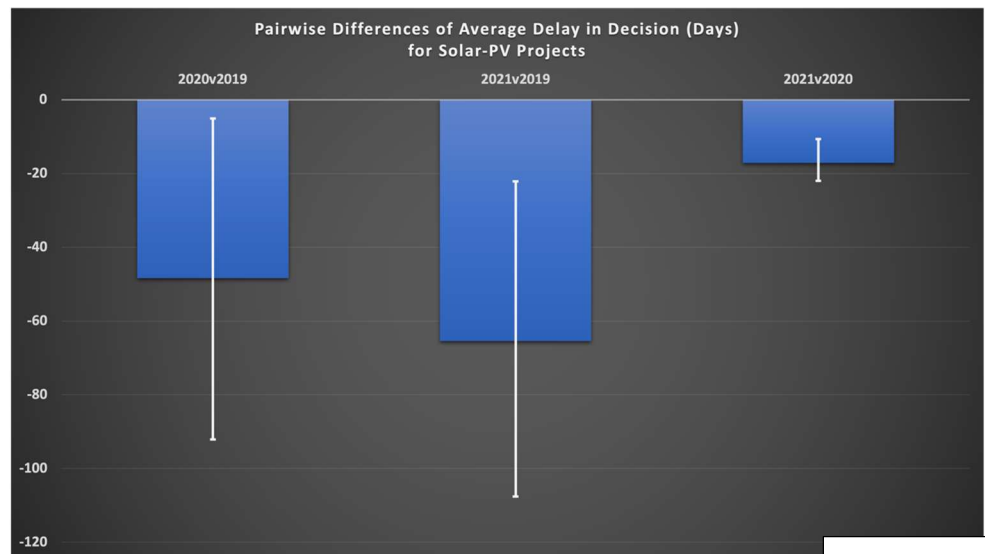


Figure 4.1

The small sample size for 2019 is a limitation inherent to our statistical analysis of decision-making delays for solar-PV projects. Can the comparison of average differences in delays be trusted when computed from a small sample size? The small sample size for 2019 does not invalidate our insight about differences in average decision time. Pairwise tests of difference of means by Games and Howell (cited in Tamhane, 1979) and other authors (Annex 2B) adjust for the small sample size and unequal variances in their formulas to calculate the size of confidence intervals. According to the formulas of these tests, a small sample size increases the size of confidence intervals. Subsequently, it decreases the precision with which average differences in delays can be determined. More importantly, wider confidence intervals arising from the small sample size can compromise the statistical significance of the differences between the years compared if the confidence intervals cross zero. However, despite test formulas adjusting for the small sample size for 2019, none of the confidence intervals crosses zero. Hence, the average differences in decision time in 2019 vs 2020 and 2021 described in the previous section are statistically significant and valid despite the small 2019 sample size.

The second response to the limitation of the small sample size for 2019 is to compare average differences in decision time between 2020 and 2021. The intuitively obvious reason for this is the larger sample size of 2020 and 2021 combined compared to 2019 and its paired comparison with 2020 or 2021 (Annex 1A). Moreover, the time-lag effect of Decree-Law 147/2009's revocation in 2019 means that solar-PV applications filed in early and mid-2020 are likely to have undergone the same processing delays as the old law. The longer processing times for applications filed in early and mid-2020 can push the average up for the whole year and obscure the reduced decision times post the revocation of the old law. Consistent with what we have suggested earlier about time-lagged effects, applications filed in 2019 and early and mid-2020 serve as a good proxy for processing delays under Decree-Law 147/2009. Therefore, a better way to verify the reduction in the average decision time after the revocation of Decree-Law 147/2009 would be to use 2021v2020 as the

benchmark comparison because this allows us to account for the time-lagged effect of Decree-Law 147/2009's revocation. **Even when using 2021 as a benchmark, we observe a statistically significant difference in average decision delays when comparing 2020v2021. On average, the decision time for applications filed in 2021 is approximately 15 days shorter than in 2020. The 95% confidence interval for 2020 v 2021 estimates this difference to be somewhere in the range of 241 days shorter to 9 days shorter**

4.5. Decision delays for wind projects

The picture is slightly more complex for wind farm projects, but it still affirms our arguments and intuitions about delays in application decisions. Derived from a sample of 124 non-missing observations, Figure 4.2 shows that the **average decision delay on a solar-PV project application filed in 2019, under Decree-Law 147/2009, was approximately 96 days, equivalent to three months.** As established earlier, the average delay in 2019 is a proxy for delays under Decree-Law 147/2009's protocols. Our arguments on the old law's technical flaws suggest that scrapping the policy in 2019 should imply lower average delays for 2020 compared to 2019. However, figure 4.2 instead shows an increase in average decision time for 2020 compared to 2019. Does this increase imply that Decree-Law 147/2009 did not cause processing delays for a wind project application, and revoking it lengthened the decision time? No, because similar to our analysis for solar-PV projects, it is necessary to look at pairwise differences in average decision time for 2019 relative to the time-lagged comparisons with the 2021 benchmark.

Like the solar-PV project sample, the wind farm project sample for 2019 is much smaller than the samples available for 2020 and 2021. Once again, we have used pairwise tests of difference of means by Games and Howell (cited in Tamhane, 1979) and other authors (Annex 2B) that adjust for the small sample size and unequal variances while calculating confidence intervals. Considering the small sample size for 2019, figure 3.4 shows no statistically significant difference in the average delays of 2019 and 2020 because the confidence interval touches zero for 2019v2020. Therefore, the increased decision time in 2020 compared to 2019 is not statistically significant at the 0.05 significance level.

The presence of time-lagged effects we described earlier and the larger sample size available provide us with sufficient justification for comparing 2020v2021 and 2019v2021. Because of the time-lagged effect of Decree-Law 147/2009's revocation, we should expect to see faster decision times only after mid-2020. The longer delays for applications filed in early and mid-2020 push up the average for the entire year. Therefore, we need to compare 2019 and 2020 decision times with 2021. This comparison allows us to wait for the time-lagged impact of the old law's repeal on decision processes and delays to be gradually implemented and appear in real-world data. **Figure 4.3 shows that average decision times on wind projects applications filed in 2021 were almost 21 days**

shorter than in 2019. The 95% confidence interval for 2019 v 2021 estimates this difference somewhere in the range of 25 days shorter to 17 days shorter. For the 2020v2021 comparison, **average decision delays in 2021 were approximately 30 days shorter compared to 2020.** The 95% confidence interval for 2019 v 2021 estimates this difference somewhere in the range of 40 days shorter to 21 days shorter.

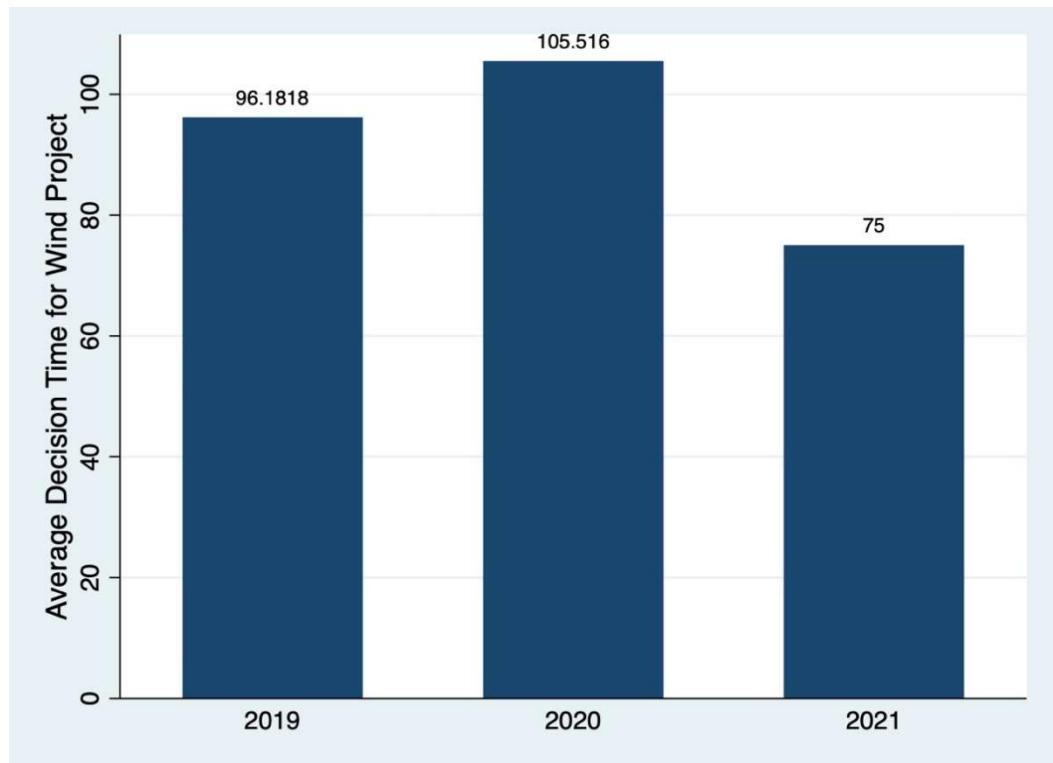


Figure 4.2

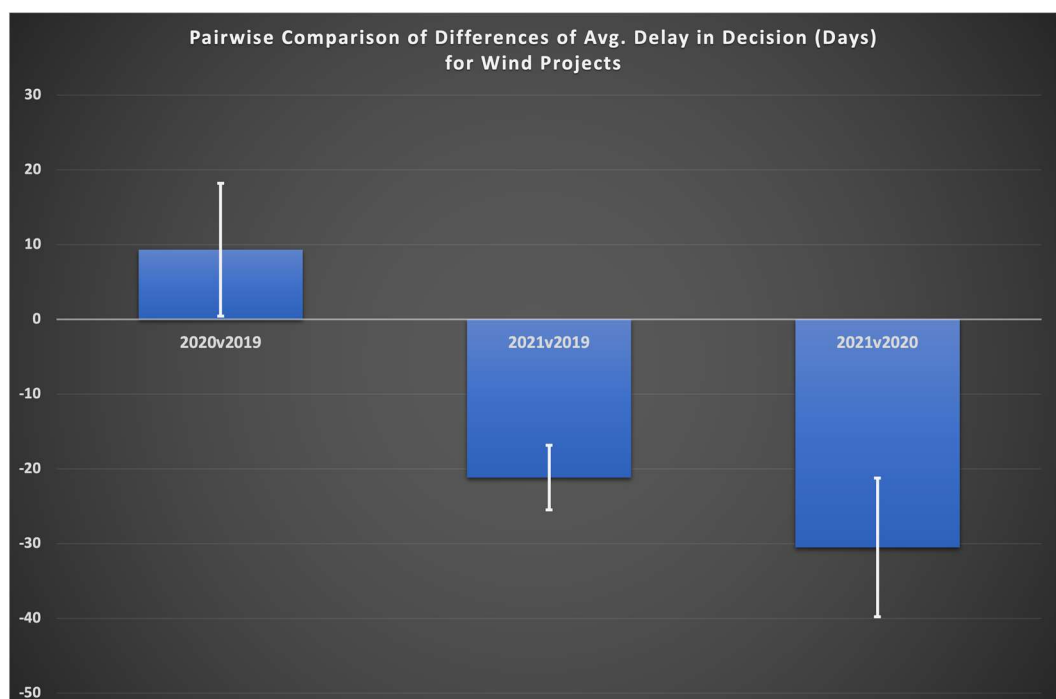


Figure 4.3

4.6. Summary

Therefore, after accounting for time-lagged effects and adjusting for the small sample size for 2019, there is strong statistical evidence to suggest that the protocols established by Decree-Law 147/2009 were behind the delays in the processing of solar-PV and wind farm project applications. Average decision delays faced by wind and solar-PV project Applications were much longer in 2019 than in 2020 and 2021. However, to test if the relationship between Decree-Law 147/2009's revocation and reduced decision times is more than just a spurious correlation, we need to devise an econometric model.

SECTION 5. ECONOMETRIC MODELLING

So far, we have provided empirical evidence and statistical analysis to hint at a possible causal relationship between the presence of Decree-Law 147/2009's and delayed processing times for wind farm and solar-PV project applications. However, an overview of average decision times as we have done above is not enough to establish causality. Multiple confounding variables must be controlled before isolating the causal effect of Decree-Law 147/2009's revocation on decision time. For technical reasons, factors such as power potential rating, location, number of turbines in operation, and land area requested could have causally influenced the delay in approving or rejecting a solar-PV or wind project application. These factors are part of the two fixed-effects regression models with a quadratic specification that we have devised to isolate the causal relationship between Decree-Law 147/2009 and delayed processing times for solar-PV and wind farm projects. We have also added dummy variables to account for the year an application was filed because our model is based on panel data. First, we will elaborate on the independent and dependent variables we have operationalised to establish a causal relationship. Then, we will justify the technical reasons behind the factors we are controlling for in our model and list their variable names in a table.

5.1. Operationalising dependent and independent variable

Our dependent variable is *deldec*. It measures the time that passes (in days) between filing a solar-PV or wind project application and a decision on its viability. *Deldec* is the same variable we used to compute average decision times in the previous sections of this paper. Our independent variable is *restrixlaw*, which we have used as a proxy to capture the causal effect of Decree-Law 147/2009's revocation on decision delays. The values for *restrixlaw* were calculated based on the days pass between the abolition of Decree-Law 147/2009 by the Generalitat de Catalunya and the filing date of a solar-PV or wind project application. If the *restrixlaw* value for an observation is 60, then this means that the application was filed 60 days after the scrapping of Decree-Law 147/2009. Since our model has a quadratic specification, we have included *quadrestrix* as the squared equivalent of *restrixlaw*. Ceteris Paribus, the coefficients on the *restrixlaw* and *quadrestrix* variable will highlight the non-linear marginal effect of Decree-Law 147/2009's revocation on decision delays.

5.2. Confounding factors and control variables

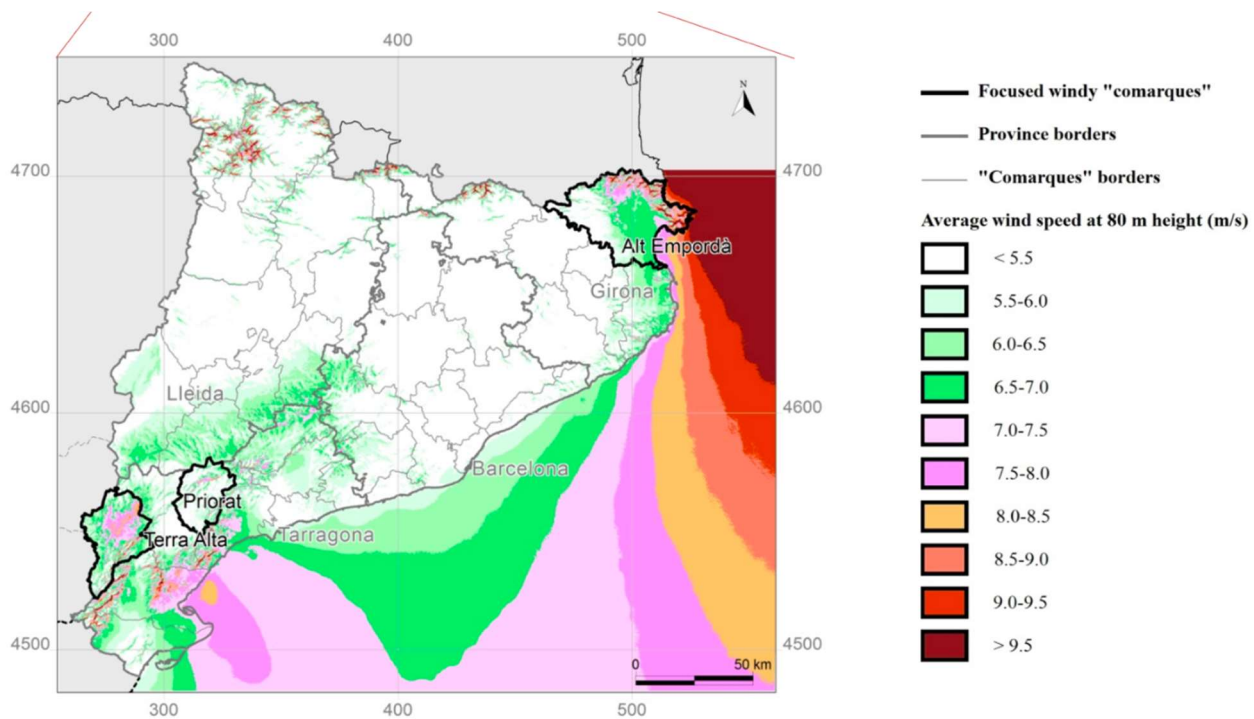
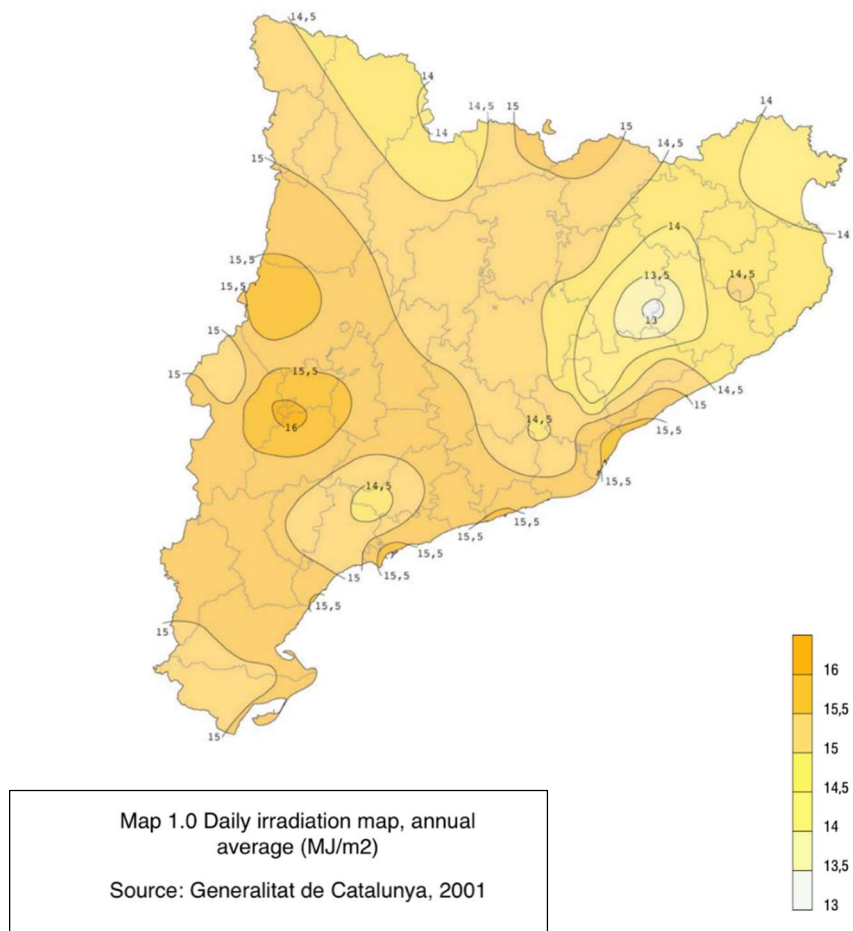
In our fixed-effects multiple regression model, we have controlled for the location of a project as a panel variable because of unobserved heterogeneity in factors that can potentially, in theory, affect the decision time for an application (Woolridge, 2012). Regions of Catalonia can be more or less suitable for a solar-PV project site based on geographical aspects such as their solar irradiation levels, wind speed elevation, terrain, and environmental impact from the project's construction. (Montobbio and Farell, 2012; Al Garni and Awasthi, 2018). Maps 1.0-1.1 confirm the variations in wind speed and solar irradiation levels based on location. While these maps do not cover the entire reference period during which Decree-Law 147/2009 was active, they indicate pre-existing regional variations in solar irradiation and wind speed. These location-specific variations in geographical characteristics are expected to be more or less consistent over time, barring any drastic climate changes or weather anomalies.

The scrutiny and processing time required for project application likely varies with how suitable the location is for its construction. Under Decree-Law 147/2009's protocols, scrutiny by multiple public agencies could have possibly taken longer or shorter depending on the suitability of the location for the project. The non-viability verdict was likely delivered quicker for regions unsuitable for a solar-PV or wind project. The opposite could also be the case. For example, suppose the Territorial Commission of Urbanism disputed the landscape integration reports and environmental impact assessments of a solar-PV project at a specific location. In that case, they could have stalled the process by sending the submitted documents back for clarification (Generalitat de Catalunya, 2009). Other public departments could also have disagreed with assessments on non-geographical factors of a location, such as a project's impact on cultural heritage. Even after the old law was revoked and new law instituted, the suitability of a location likely affected how quickly a project's viability was determined by the Renewable Energy Report committee (Generalitat de Catalunya, 2019).

For wind farm projects, if the body responsible for energy disagreed with the wind speed, environmental viability and landscape viability of a specific location or priority development zone, the body could have sent the application back to the Selection Committee step of the process for clarifications from the applicant. In the absence of conclusive evidence over location-specific geographical and non-geographical factors like wind speed, environmental impact and cultural heritage, the relevant public agency could have sat on the application to obtain more information before allowing the application to move further in the approval process.

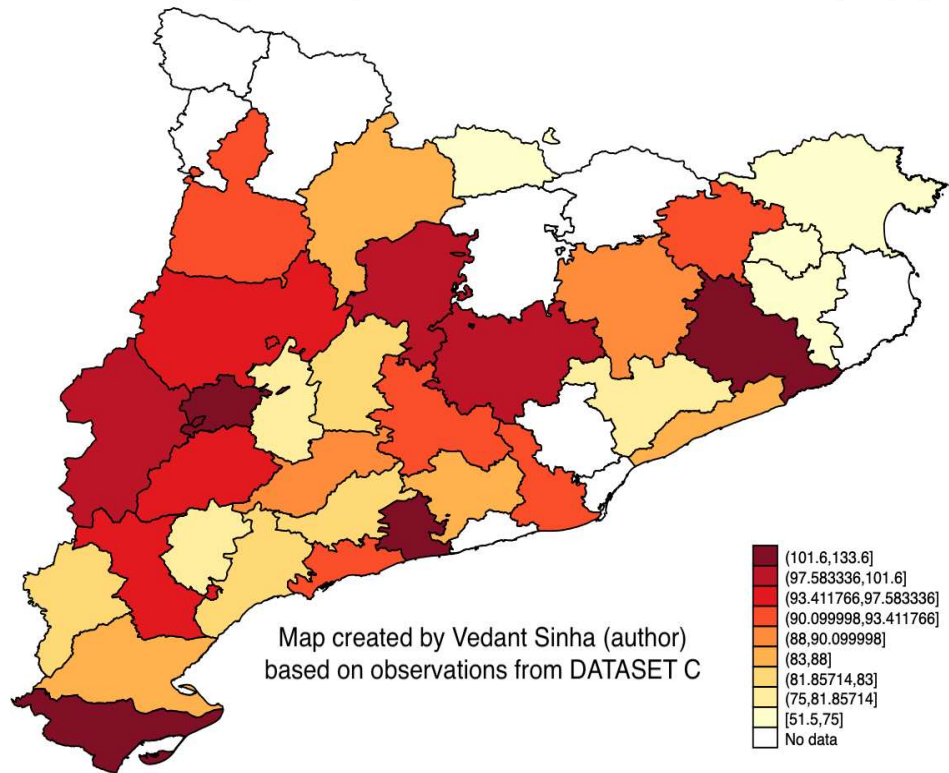
Regions with conditions more conducive to wind or solar projects could also face a bottleneck of applications, leading to backlogs and delays in processing time. Controlling for the location also accounts for the potential unobserved effect of this backlog on decision delays. As the viability status of different areas for the

construction of solar-PV and wind installations changed under the new Decree-Law 16/2019, it seems likely that this change affected the scrutiny and processing times faced by solar-PV and wind project applications. Multiple factors and sources of heterogeneity specific to regions of Catalonia had the potential to delay an application's approval process. The reasoning above is supported by the geospatial analysis in maps 1.2-1.3, showing variation average decision times across regions of Catalonia. Therefore, based on theoretical reasoning and geospatial evidence, it is justified to control location as a panel variable in our fixed-effects model.



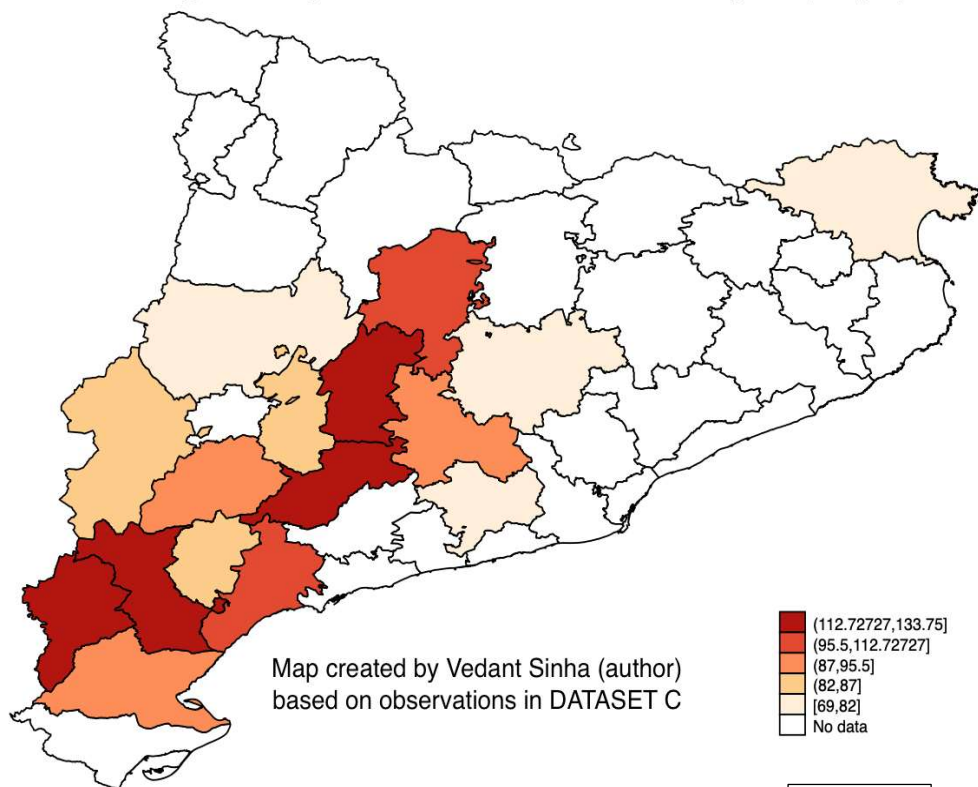
Map 1.1 Average Wind Speed at 80m height (m/s)

Average Delay In Decision On Solar Project (Days)



Map 1.2

Average Delay In Decision On Wind Project (Days)



Map 1.3

We have controlled for technical characteristics of a solar-PV or wind farm project such as production capacity, and land area required because Decree-Law 147/2009's set up restrictions and separate protocols for projects above or below a threshold of power rating or land area (Generalitat de Catalunya, 2009). Maps in Annex 3A show how there was variation in the average land area required for a project and its average production potential across the regions of Catalonia. It is likely that the specific restrictions and protocols, based on technical characteristics of a solar-PV or wind farm project, impacted the decision delays. For example, for wind farm projects of less than 10 MW permitted outside Priority Development Zones, the petitioner had to seek separate clarification on the requirement of environmental and cultural impact assessment reports. If these reports were not required, the application could proceed to more advanced stages and face shorter decision times.

Under the old law, the land area required for a Solar-PV installation potentially impacted its application's decision time. The old law stipulated that solar-PV installations requiring surface area greater than 6 Ha were limited to undeveloped regions not adjacent to industrial or agricultural land (Generalitat de Catalunya, 2009). Checking the consistency between a large-scale Solar-PV installation's surface area and its proximity to industrial or agricultural land could have led to longer decision times. Moreover, solar-PV installations requiring space greater than 6 Ha had to fulfil ambiguous criteria of "using advanced photovoltaic energy capture systems" and being of "interest to territorial strategy" (Generalitat de Catalunya, 2009). In the absence of clearly defined criteria for approval of solar-PV projects exceeding 6Ha, the public bodies involved could have sat on the application and caused long delays in decision time.

Even under Decree-Law 16/2019, it is likely that the land area required for a solar-PV and wind installations affected decision delays because projects occupying larger areas could have caused disputes that prolonged decision times. Examples of such conflicts are overlaps with existing urban planning measures and areas of natural protection.

Beyond the specific restrictions and protocols set up by Decree-Law 147/2009, the production capacity of wind and solar projects could have influenced application decision times because of more general renewable energy installed capacity and decarbonisation targets (Ariza-Montobbio and Farell, 2012; Generalitat de Catalunya, 2017; Generalitat de Catalunya, 2019). The rush to achieve these targets, common to projects processed under the framework of Decree-Law 147/2009 or Decree-Law 16/2019, could have meant shorter decision delays for projects with higher production capacity (Generalitat de Catalunya, 2009; Generalitat de Catalunya, 2019).

Therefore, our model includes the variables *powerinmw* and *landarea* and their squared equivalents to control the technical characteristics of production capacity and land area required.

Intuitively, controlling for the number of turbines already in operation in an area makes sense. Regulatory bodies part of Decree-Law 147/2009 and Decree-Law 16/2019's framework could have potentially been hesitant to decide on a project in an area that is already saturated with a large number of wind turbines. Prospective projects in locations with a high number of turbines could have faced relatively longer delays. There are more time-taking trade-offs to be considered regarding environmental impact, landscape integration and urban planning measures compared to projects applied in locations less saturated with wind turbines. Decree-Law 16/2019 took into account the "cumulative impact derived from the concentration of wind turbines in certain parts of the territories" when processing applications (Generalitat de Catalunya, 2019). The map in Annex 3A shows the variation in the number of wind turbines in operation across the regions of Catalonia. Therefore, our model includes the *turbinesinop* variable and its squared equivalent to control the number of turbines already operating in an area.

Finally, we have accounted for the year the application was filed because our setup is based on a panel dataset (Woolridge, 2021). A criticism of our approach could be that introducing indicators for the year of application overlaps with *restrixlaw*, which measures the days passed since Decree-Law 147/2009 revocation. However, this drawback of our model does not muddle any causal inferences we may draw from it. After controlling for confounding factors, we believe that the indicator variables for the year of application account for more general variation in decision delays over the 2019-2021 period. Whereas our independent variable *restrixlaw*, unlike the year dummies, is more focused on showing the time-lagged effect of Decree-Law 147/2009's revocation because it isolates the changes in decision time for applications with each passing day after the old law was repealed.

Confounding factors controlled	Variable name(s)	Included in Model
Power rating/production potential (in MW)	powerinmw, quadpower (powerinmw ²)	Solar-PV & Wind
Land area required	Landarea, quadlandarea (landarea ²)	Solar-PV
Location	location (controlled for as a panel variable in fixed-effects model)	Solar-PV & Wind
Year in which the project application was filed	datenew (controlled for as a time variable in fixed-effects model)	Solar-PV & Wind
Number of turbines already in operation in the region where the new project has been applied	turbinesinop	Wind

The regression equation we have estimated for our model is as follows.

$$\begin{aligned}
deldec_{it} = & \beta_0 + \beta_1 restrixlaw_{it} + \beta_2 restrixlaw_{it}^2 + \beta_3 powerinmw_{it} \\
& + \beta_4 powerinmw_{it}^2 + \beta_5 landarea_{it} + \beta_6 landarea_{it}^2 \\
& + \delta_0 d2020_t + \delta_1 d2021_t + location_i + u_{it}
\end{aligned}$$

5.3. Results

The table below shows our results after fitting our model through points in DATASET C (observations on solar-PV and wind farm project applications).

VARIABLES	(Wind) lag	(Solar-PV) lag
restrixlaw	-1.072*** (0.067)	-0.879*** (0.162)
quadrestrix	0.002*** (0.000)	0.001*** (0.000)
turbinesinop	0.447* (0.266)	
quadturb	-0.002 (0.002)	
powerinmw	-0.612 (0.423)	0.186 (0.826)
quadpower	0.009 (0.006)	-0.007 (0.011)
2020.datenew	138.063*** (5.483)	47.575** (23.525)
2021.datenew	102.989*** (6.314)	29.976 (22.486)
landarea		-0.065 (0.314)
quadlandarea		0.001 (0.001)
Constant	96.437*** (7.455)	179.122*** (21.179)
Observations	124	266
R-squared	0.927	0.560

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

[FOR FULL TABLE WITH LOCATION DUMMIES, CHECK ANNEX 3F]

As established earlier, the coefficient on our *restrixlaw* independent variable captures how filing an application x_i number of days post Decree-Law 147/2009's revocation reduces the decision time for that application. Ceteris Paribus, our model predicts that, on average, decision time reduces for both solar-PV and wind projects by nearly one day for applications filed each additional passing day post the revocation of Decree-Law 147/2009 (*restrixlaw*). The three asterisks on the coefficient for *restrixlaw* imply that the marginal effect of scrapping Decree-Law 147/2009 on reducing decision delays is statistically significant and different from zero at the 0.01 significance level. However, the negative coefficient on the *quadrestrix* variable, statistically

significant at the 0.01 level, indicates that Decree-Law 147/2009's scrapping has a non-linear effect on decision delays for solar-PV and wind project Applications (figure 4.4). The negative sign on the *quadrestrix* variable implies that the passage of time after the old law's revocation had a diminishing marginal effect in reducing decision delays for an application (Woolridge, 2012). Computations from our estimated models show that the turning point for wind projects is at 268 days after Decree-Law 147/2009's revocation, and for solar-PV projects, it is at 439 days (Woolridge, 2012). Solar-PV or wind applications filed after 268 and 439 days after Decree-Law 147/2009's revocation, respectively, will have no marginal effect on reducing decision time (Figure 4.4).

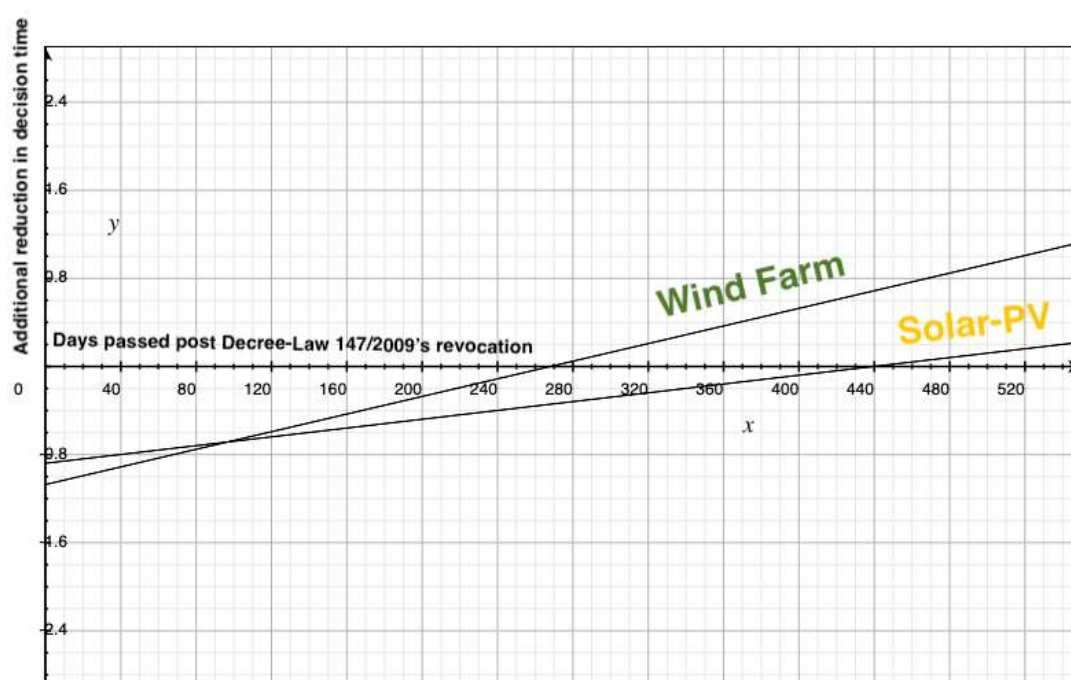


Figure 4.4

The presence of a quadratic relationship between the passage of time after Decree-Law 147/2009's revocation and decision delays is consistent with our intuition about the time-lagged effect of Decree-Law 147/2009's abolition. Solar-PV and wind project applications filed each passing day after Decree-Law 147/2009's revocation faced shorter and shorter decision times. Still, due to diminishing marginal effects, the reduction in delays got smaller and smaller with each passing day. Despite the diminishing decrease in delays, decision times gradually got shorter and shorter many months after Decree-Law 147/2009's revocation until the turning points in figure 4.4 were reached. But what explains the increase in decision delays beyond turning points when the curves enter the positive region of the graph? Does that mean Decree-Law 147/2009's revocation lengthened decision times after nearly a year of its scrapping?

No, because we do not have sufficient observations on decision times for solar-PV projects filed after the turning point. Therefore, we do not need to be concerned about predicting values after the turning point (Woolridge, 2012, p.195). For the 165 solar-PV projects filed after 439 days, we only have decision time data on 29 of these (Annex 3B). This available data implies that out of 266 non-missing values on decision delays, only 11% occur after the turning point of 439 days. Because many solar-PV project applications after the turning point are very recent, no decision time data was available for them.

For wind projects, only 44% of 124 observations occur after the turning point of 268 days (Annex 3B). While there is data on their decision times, it is also important to note that the additional delays after turning points that our model predicts are only marginal and potentially offset by other factors that we were unable to control in our model. Though our model loses explanatory capacity beyond the turning points, it successfully illustrates the causal relationship between the passage of time after the old law's revocation and shorter decision times for solar-PV and wind project applications. Also, the quadratic specification of our model successfully captures the time-lagged and diminishing effect of Decree-Law 147/2009's revocation in reducing decision delays.

5.4. Addressing limitations

Our model does suffer from some limitations. However, in the paragraphs below, we will clarify how our results remain valid despite these limitations. First is the issue of backlog. Earlier in our discussion, we explained how regions with conditions more conducive to wind or solar projects could also face a bottleneck of applications, leading to backlogs and delays in processing time. To account for the potential unobserved effect of this backlog on decision delays, we controlled projects' location as a panel variable in our fixed-effects model. But what if *restrixlaw* simply shows the effect of clearance of this backlog on decision delays and not the time-lagged causal effect of Decree-Law 147/2009's revocation on decision delays. Our inference from the model about a causal relationship between Decree-Law 147/2009's revocation, represented by *restrixlaw*, and the decision delays, represented by *deldec*, would be invalid. It would be the clearance of past backlog over the passage of time, helping to reduce the decision time and not the scrapping of Decree-Law 147/2009.

However, *restrixlaw* does not simply show the effect of clearance of this backlog on decision delays. Rather than a decrease over time, we infer an increase in the backlog because new solar-PV and wind project applications were coming in every 1-4 days (Annex 3E) on average, and nearly 90% of new applications were coming in every 4-13 days. The average decision times for any solar-PV or wind project applications were relatively much higher in 2019-2021 and too long to clear up the backlog of new applications. This combination of long decision time and the short gap between new applications means that for an application filed

any given date after the scrapping of Decree-Law 147/2009, the backlog behind it faced net increases rather than decrease with each passing day.

If the *restrixlaw* variable did indeed show the causal impact of backlogs on decision delays, we would expect to see increasing decision delays correspond to the growing backlog with the passing of time after Decree-Law 147/2009's revocation. The variable *restrixlaw* would then have a positive sign implying greater delays faced by applications due to the backlog growing with each passing day. However, both our models predict decreases in decision time with each passing day. The *restrixlaw* variable in both solar-PV and wind project models carries a negative sign implying decreasing decision delays with each passing day. Despite the growing backlog, it was potentially the time-lagged causal effect of Decree-Law 147/2009's scrapping that reduced decision delays. Therefore, *restrixlaw* does not simply show the impact of clearance of backlog on decision delays. Instead, it supports our causal claim that the revocation of Decree-Law 147/2009's protocols reduced decision time for solar-PV and wind project applications. An auxiliary regression model in Annex 3F supports our claim that the clearance of the backlog had no statistically significant causal effect in reducing decision delays.

The high R squared, a diagnostic indicator for our wind project model, raises doubts about our model's specification and validity and its findings. It is possible that we have overfitted our model or wrongly specified the form of our regressors. However, concerns about a high R squared can be dismissed because we have analysed panel data and used a fixed-effects model. The indicator variables we have included to account for the location of projects across regions of Catalonia are potentially responsible for the high R squared values in our wind project model (Schuberth, 2015).

Despite the doubts about the specification, R squared indicator, and the *restrixlaw* independent variable in our model, we have several reasons to believe in the robustness of the causal relationship between Decree-Law 147/2009's repeal and decision times for project applications. First, our model controls several confounding factors and introduces fixed-effect indicators to account for unobserved heterogeneity that could have impacted decision delays on solar-PV and wind projects. Our controls are not exhaustive, and there could be more omitted variables. However, we have accounted for all the confounding factors we could have with the statistics and computations possible via DATASET C. We have also included a quadratic specification to our models' variables to account for non-linear effects. Therefore, to the best of our capacity, we have minimised the chances of an omitted variable bias and violation of the zero-conditional mean assumption essential to regression analysis.

Second, the coefficient on our independent variable is statistically significant and different from 0 at the 0.01 significance level. Third, we have attempted to fulfil all the Gauss-Markov assumptions essential for regression analysis to a great extent. The error term for both solar-PV and wind farm project models is normally distributed (Annex 3C). While there is some correlation between

regressors such as `turbinesinop`, `powerinmw` and `landarea`, they are not perfectly multicollinear (Annex 3D). Finally, we have adjusted for the heteroskedasticity inherent to the samples from DATASET C by using robust standard errors (Woolridge, 2012). Therefore our causal inferences are valid despite the non-constant variance for the error term.

5.5. Conclusions from Sections 3,4 and 5

Through our analysis of the old law's design flaws, empirical evidence, and econometric modelling, we have made a strong case for the causal relationship between Decree-Law 147/2009 and delays in decision time for solar-PV and wind project applications. Applicants that had to go through Decree-Law 147/2009's complex and cumbersome bureaucratic procedures had to wait for months before hearing back on the viability or non-viability of their project. There was no clearly stated time frame for petitioners to expect a final decision on their application. In contrast, the multiple government bodies weighing in on each application had month-long internal deadlines to sit on an application and slow the process even further. The "positive administrative silence" mechanism did not help move things along any quicker when a public agency failed to meet its one-month deadline to process and send the application to the next stage. Applications passed on to the next step without review at a previous stage could simply be sent back. Public bodies at further stages, requiring documents or approval from an earlier step, had no obligation to process the application instead of sending it back to previous stages for scrutiny.

The potential impact of Decree-Law 147/2009's design flaws is visible in empirical evidence. **The average decision delay on a solar-PV project application filed in 2019, under Decree-Law 147/2009's protocols, was equivalent nearly to 5 months.** As the potential time-lagged effect of Decree-Law 147/2009's revocation started to kick in, we observed a gradual decline in decision delays. Average decision times fell from 5 months in 2019 to 2.5 months by mid-2021. On average, **decision delay for solar-PV applications became approximately 65 days shorter in 2021 compared to 2019. For wind projects, mean decision times fell from almost 105 days in 2019 and 2020 to 75 days in 2021.** On average, decision delay for wind project applications in 2021 was nearly a month shorter than in 2019. The comparisons of averages hinted at the possibility of a causal relationship between Decree-Law 147/2009 and decision delays. To make a stronger case for causality, we constructed an econometric model.

Our fixed-effects multiple regression model, controlling for numerous confounding factors, further supports our idea of causality. Solar-PV and wind project applications filed each passing day after Decree-Law 147/2009's revocation faced shorter and shorter decision times. According to our model, decision time reduces for both solar-PV and wind projects by nearly one additional day for applications filed each additional passing day post the

revocation of Decree-Law 147/2009. the quadratic specification of our model captured the time-lagged and diminishing effect of Decree-Law 147/2009's repeal in reducing decision delays. Despite the diminishing reduction in delays determined by the quadratic regressors, decision times gradually got shorter and shorter over many months after the old law's revocation. While our modelling is not exhaustive, we have minimised threats to the validity of our inferences to the best of our capacity.

Supporters of Decree-Law 147/2009 criticise the aggressive pace of processing and implementation of renewable energy projects under protocols set by Decree-Law 16/2019 (Bolsa, 2020; Faneca, 2021). They advocate for a moratorium on projects currently being processed under Decree-Law 16/2019's framework (Bolsa, 2020; Faneca, 2021). Despite their opposition, Decree-Law 16/2019's critics recognise the need to implement renewables and mitigate the environmental damage of fossil fuels (Faneca, 2021). However, their objection to Catalonia's LETP under Decree-Law 16/2019 contradicts their ambitions for the region's energy transition. Based on the discussion in the previous sections of this paper, we have strong reasons to believe that the old law was responsible for stalling and even reversing the progress of Catalonia's LETP because it caused major delays in the processing and approval of solar-PV and wind project applications.

Decree-Law 147/2009's set up administrative barriers and complex bureaucratic procedures that led to delayed decisions and subsequently discouraged new applications. The aggressive pace of Catalonia's LETP under Decree-Law 16/2019 is a catch-up process necessary to clear a decade of bottlenecks and backlogs that had built up because of the blocks and delays created by the old law. The framework of Decree-Law 147/2009 had paralysed and reversed the progress of Catalonia's LETP. A moratorium on Decree-Law 16/2019's protocols, which are helping to undo the paralysing effect of Decree-Law 147/2009, would again derail and stagnate Catalonia's progress toward achieving its decarbonisation targets set by the PROENCAT2050 plan (Generalitat de Catalunya, 2017). Given the urgency created by the climate emergency and energy transition goals, opposing Decree-Law 16/2019 is inconsistent with support for a greener future for Catalonia.

SECTION 6. AN OLIGOPOLY UNDER DECREE-LAW 16/2019?

6.1. Energy majors and the new law

According to its critics, Decree-Law 16/2019 has created an energy model where large companies are increasingly consolidating market power and building an electricity oligopoly. These critics claim that post the revocation of Decree-Law 147/2009, widespread and rapid deployment of solar-PV and wind projects has allowed Catalonia's LETP to be captured by large-scale projects owned and controlled by a few market players. Allegedly, the new protocols set up by Decree-Law 16/2019 have allowed large utility companies to maximise their installed capacity and profits. Opponents of Decree-Law 16/2019 argue that greater Solar-PV and Wind capacity "in the hands of large companies" would allow them to hijack Catalonia's LETP, restrict the participation of small organisations such as MSMEs (Catalan News, 2021; Faneca, 2021). With solar-PV installations owned and controlled by a few companies, the idea of self-supply would be compromised as more and more consumers become dependent on the oligopoly for their renewable electricity supply.

Concerns of an electricity oligopoly would be valid if the electricity market structure created by Catalonia's LETP post-2019 resembled that of limited competition in Spain's energy markets. "75% of electricity generation in Spain is controlled by five major companies", which poses implications for competitiveness, consumer interests, and vulnerability to regulatory capture of public interest programmes such as Catalonia's LETP (Sorman et al., 2019, p.130). Conceptually, electricity sectors are predisposed to an oligopolistic structure due to barriers such as large capital investments and infrastructure management issues (Kuzemko et al., 2016). Despite the falling installation and levelised costs of solar and wind projects (Annex), Decree-Law 16/2019 could have allowed Spain's energy majors to use their financial resources, technological expertise, and experiential knowledge of the energy sector to become dominant producers in Catalonia's RES-E sector. However, as we will see in the paragraphs below, the opposite was the case.

6.2. Response to the oligopoly objection

Critics of Decree-Law 16/2019 do not provide any empirical or conceptual evidence linking Catalonia's LETP post-2019 to the creation of an oligopolistic structure in renewable energy markets. While Angel (2019) cites statistics of energy poverty in Barcelona and instances of consumers unable to afford heat or electricity, he does make any causal claims about an oligopoly in Catalonia's renewable energy market. It is indeed possible that limited competition could hike prices and energy bills when large companies collude to control output and

a lack of alternatives to consumers leaves them in a weak bargaining position (Sorman et al., 2019). However, energy poverty is a multicausal situation. Angel's (2019) statistics make a weak case for interpreting instances of energy poverty in Barcelona to an oligopoly created by Decree-Law 16/2019's implementation. While opponents of Decree-Law 16/2019 decry energy poverty and oligopoly, their claims are not founded on how Catalonia's LETP has proceeded post-2019.

Using evidence from DATASET C, we will test the concentration of applications for installing solar-PV and wind capacity from a small number of producers or energy majors- a fundamental characteristic of an oligopoly. DATASET C only contains information on applications for installing solar-PV and wind capacity and not the actual or pre-existing installed capacity. We are checking for market concentration in the composition of applications for installing solar-PV and wind capacity post-2019 rather than pre-existing capacity. It focuses solely on showing the market structure that Decree-Law 16/2019 has incentivised and permitted to develop. We agree that oligopolies have other nuanced behaviours. Our analysis lacks data on traits such as strategic output and price manipulation, and concentration indices relating to the RES-E. However, our use of the number of producers filing for installing solar-PV and wind capacity as an indicator of an oligopoly is backed by academic precedent. In labelling an electricity market as an oligopoly, Sorman et al. (2019) and Kuzmin et al. (2019) have used the concentration of installed generation capacity in the hands of a small number of producers as an identifying trait. Similarly, our check for market concentration in the composition of application for installing solar-PV and wind capacity post-2019 serves as a leading indicator for the concentration of installed capacity in the hands of few players.

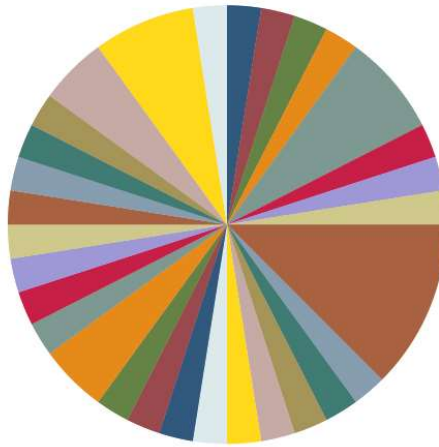
Figures 6.0-6.1 show the applicant wise breakdown of solar-PV and wind projects for a randomly selected sample of 40 applications from DATASET C. The overall composition is the complete opposite of what we would expect to see if Decree-Law 16/2019 permitted the development of an oligopoly. The applicant base for both solar-PV and wind was highly fragmented, with a large variety of applicants. In fact, the multitude of applicants in the entirety of DATASET C forced us to only to pick 40 observations for depiction on a pie chart. The composition of applicants was so fragmented that our statistical analysis software ran out of colours to differentiate between their respective shares of all filed applications. Therefore, empirical evidence indicates that post the old law's revocation, applications for installing solar-PV and wind energy capacity were not concentrated among a small number of major energy producers. Under Decree-Law 16/2019's framework, proposals for setting up solar-PV and wind projects came from many private companies and even individuals. Each company only had a small and roughly equal share of the total pool of applications. According to our analysis, the criticism that Decree-Law 16/2019 has allowed Catalonia's LETP to be captured by a few market players is unfounded.

A critic of the breakdown of applicants depicted in the piecharts below could ask for the breakdown of applicants whose projects were declared viable. While

many applications were received, it is possible that only the solar-PV and wind farm petitions by energy majors or an oligopoly were declared viable. In such a scenario, few large companies could have taken advantage of the new law's measure and used their lobbying resources to skew solar-PV and wind project application decisions in their favour while excluding MSMEs. If such a scenario were true, we would expect to see applications with a viable verdict concentrated amongst a few large companies. It would indicate that while various companies apply for approval, the viability of solar-PV or wind project applications is mainly granted to energy majors and a few large companies.

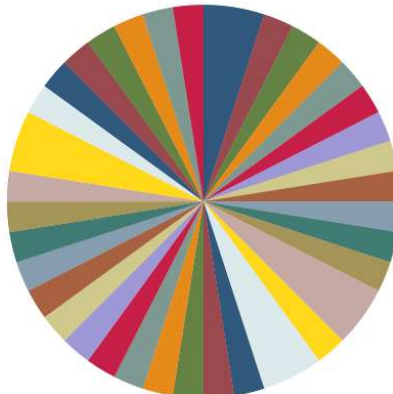
However, a breakdown of the applications declared viable shows that the oligopoly objection does not hold here either. The applicant breakdown solar-PV and wind applications deemed viable were also highly fragmented, with many applicants. In fact, the (viable) applicant pool was once again so fragmented that we were once again forced to only pick 40 random observations for depiction on a pie chart. The composition of viable applications was so fragmented that our statistical analysis software ran out of colours to differentiate between their respective shares of viable applications. Each company only had a small and roughly equal share of the total pool of viable applications.

Figure 6.0. Wind Project Applications Breakdown



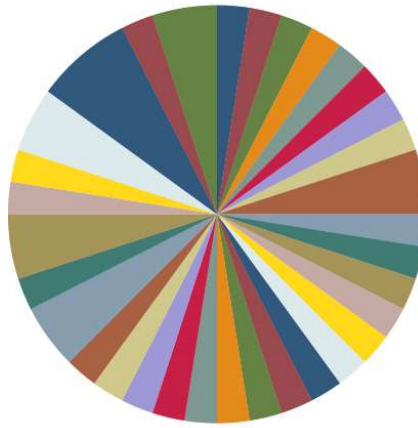
ARANORT DESARROLLOS SL	Anemos Ala Segarra, S.L	DESARROLLOS EÓLICOS TIVISSA I
DESARROLLOS EÓLICOS TIVISSA II	Desarrollos Eólicos Cuenca de Ba	Desarrollos Renovables Iberia Rh
EDP RENOVABLES ESPAÑA	EDP RENOVABLES ESPAÑA SL	EDP Renovables España, SLU
ENEL GREEN POWER ESPAÑA S.L.	ENEL GREEN POWER SL	ENERGIA EOLICA TRAMONTANA SOCIED
ENERGIA EÓLICA TRAMONTANA SOCIED	ENERGIA INAGOTABLE DE ALFA CENTA	ENERGIA INAGOTABLE DE FURUD, S.L
ENERGIAS RENOVABLES DE ISIS, S.L	ENERVENT S.A	EOLICA LA CONCA SL
Enel Green Power España,SL	Eolica Alta Anoia, SL	Eolica La Conca 3 SL
Eólica La Conca 2 S.L.	Eòlica La Conca S.L.	FRV ARROYADAS 2, SL
GIRONINA D'ENERGIES RENOVABLES,	Gerr Grupo Energetico XXI, SA	NATURGY RENOVABLES, SLU
Naturgy	REPSOL RENOVABLES, S.L.U.	ROMAN MONASTERIO

Figure 6.1. Solar-PV Applications Breakdown



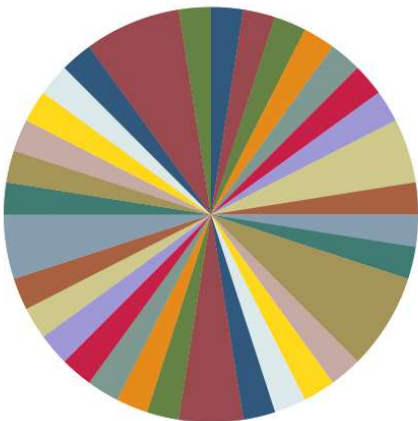
AITC EMPRESAS, S.L.	Alternatives Solars SL	BOCEGUILLAS SOLAR II S.L.
BORTE INVESTMENTS 2017 SLU	DISSENY I SOSTENIBILITAT, SL	EGUZKI SOLARCAT
ELECTRA CALDENSE, SA	ENERGIA INAGOTABLE DE CETI, S.L.	ENERGIA INAGOTABLE DE CHARA, S.L
ENERGIA INAGOTABLE DE CORONA AUS	ENERGIAS RENOVABLES DE GLADIATEU	ENERGIAS RENOVABLES DE GLADIATEU
ENERGIES RENOVABLES TERRA FERMA,	ENERGY INVESTMENTS AND POINT CON	ENERGÍA INAGOTABLE DE GALAXIA, S
ENERGÍA INAGOTABLE DE PAVENTIA,	FRANCISCO PIQUÉ RIUS	FUERZAS ENERGÉTICAS DEL SUR DE E
Forec 2018, S.L	HIDRODELTA, SA	KM0 FLIX 1 SL
LC PAPER 1881	LES FARRERAS SALELLES, S.L	MADRIGAL CORPORATE GROUP, S.L.
MEROIL SUNLIGHT 2, SLU	PARSOSY BAJO MARTIN, S.L.	PARSOSY BANNAS, S.L.
RESPIRA ENERGIA	ROMAN MONASTERIO	SOLARIA PROMOCION Y DESARROLLO F
SOLARIA PROMOCION Y DESARROLLO F	SOLVENTA6, SLP	SUBESTACIÓ ELÈCTRICA GURB AIE
Solaria Promocion y Desarrollo Fo	TALAVERA SOLAR SL	TEULADA DIRECTORSHIP SL

Figure 6.2. Wind Project Viable Applications Breakdown



AEWINDCAT 1 PAN, SL	ARANORT DESARROLLOS SL	DESARROLLOS EÓLICOS ANOIA I SEGA
DESARROLLOS EÓLICOS ANOIA Y SEG	DESARROLLOS EÓLICOS CUENCA DE BA	DESARROLLOS EÓLICOS TIVISSA II
DESARROLLOS EÓLICOS TIVISSA III	DESARROLLOS EÓLICOS TIVISSA IV	Desarrollos Eólicos Cuenca de Ba
Desarrollos Renovables Iberia Pi	Desarrollos Renovables Iberia Ra	EDP Renovables España, SLU
ENEL GREEN POWER ESPAÑA S.L.	ENEL GREEN POWER ESPAÑA SL	ENEL GREEN POWER SL
ENERGIA EOLICA TRAMONTANA SOCIED	ENERGIA EÓLICA TRAMONTANA SOCIED	ENERGIA INAGOTABLE DE CAELUM, S.
ENERGIA INAGOTABLE DE CASSIOPEIA	ENERGIA INAGOTABLE DE GEMINI, S.	ENERGIA INAGOTABLE DE HYDRA, S.L
ENERGÍAS RENOVABLES DE CENTAURO,	ENERVENT S.A	EOLICA LA CONCA 2 SL
Enel Green Power España,SL	Energías Renovables de Aker, SL	Eolica Alta Anoia, SL
GERR GRUPO ENERGETICO XXI, SAU	GIRONINA D'ENERGIES RENOVABLES,	NATURGY RENOVABLES, SLU
Naturgy	PARQUE EÓLICO MUNIESA, S.L.	REPSOL RENOVABLES, S.L.U.

Figure 6.3. Solar-PV Project Viable Applications Breakdown



AITC EMPRESAS, S.L.	ASPILLERA SOLAR S.L.	AULIVER SOLAR, S.L.
BRIGOLA SOLAR S.L.	ENERGIA INAGOTABLE DE CURSA SL	ENERGIAS RENOVABLES DE GLADIATEU
ENERGIAS RENOVABLES DE GLADIATEU	ENERGIAS RENOVABLES DE GLADIATEU	ENERGIAS RENOVABLES DE ONURIS, S
ENERGIAS RENOVABLES DE ORMONDE 5	ENERGIAS RENOVABLES DE POSEIDON,	ENERGIES RENOVABLES TERRA FERMA,
ENERGY INVESTMENTS AND POINT CON	ENERGÍA INAGOTABLE DE PAVENTIA,	ESTABANELL GENERACIÓ S.L.U.
FOTOVOLTAICA SIERRA ESTRELLA, S.	FREE POWER	Green Concept Management Ltd.
Hidrocardener, S.L.	IOSA GREEN ENERGY, S.L.	MALPICA DIRECTORSHIP SL
MATADERO FRIGORÍFICO DEL CARDONE	NATURGY RENOVABLES, SLU	NURSISER ENERGIA, SL
PHOTOVOLTAIC ENERGY HORIZON SL	RAFAEL MARTÍN RUEDA	RAPA SOLAR, S.L.
RIOS RENOVABLES SL	ROMAN MONASTERIO	SOLAR JUPITER
SOLAR PARK VALL DE COMA SL	SUBESTACIÓ ELÈCTRICA GURB AIE	TALAVERA SOLAR SL

6.3. Catalonia's new MSME, self-consumption and community-driven LETP

Rather than limiting competition and blocking the entry of SMEs, Decree-Law 16/2019 has enhanced and enabled it. The five major energy producers, which Sorman et al. (2019) identified as part of the Spanish electricity oligopoly, only contribute 6.84% of total solar-PV and wind project applications filed after the institution of Decree-Law 16/2019. A cursory look at the names on the pie charts shows that most of the remaining 93.16% of the applications have come from small scale utility companies, non-energy commercial firms, SMEs or private individuals. Statements by organisations representing the interests of MSMEs also contradict the claim that Decree-Law 16/2019 has helped create an oligopoly (Morron, 2021). PIMEC⁶, the union of MSMEs, ⁷UNEFCAT, the union of photovoltaic companies, and ⁸EolicCAT, the Wind Association of Catalonia, have all opposed a moratorium on the measures introduced by Decree-Law 16/2019 (Morron, 2021). Critics of Decree-Law 16/2019 fail to acknowledge the new renewable energy law's role in creating the "decentralised model" they aspire to establish (Faneca, 2021). PIMEC, EolicCAT and UNEFCAT all agree that Decree-Law 16/2019 has set up a framework "in favour of promoting citizen, community or cooperative-based projects, as well as energy self-consumption" projects (Morron, 2021).

Apart from our interpretations of figures 6.0-6.3, Data from Generalitat de Catalunya (Figure 6.4-6.5) ⁹and conceptual arguments also verify the claims made by PIMEC, EolicCAT, and UNEFCAT. The growth in self-consumption solar-PV projects is stagnant for the years in which Decree-Law 147/2009 was active and surges to high levels after Decree-Law 16/2019 was approved. As our analysis in the previous sections of this paper has suggested, the low number of self-consumption solar-PV project applications can be attributed to the bureaucratic barriers and application processing delays under Decree-Law 147/2009. Harkema et al. (2015) support our explanation for the low number of self-consumption project applications under Decree-Law 147/2009. For SMEs and utilities operating at a scale much smaller than energy majors, investing in renewable energy is not a priority (Harkema et al., 2015). While economic incentives and public opinion can compel SMEs to invest in renewable energy, the decision to set up a solar-PV or wind project for self-consumption is

⁶ Micro, petita i mitjana empresa de Catalunya

⁷ Unión Española Fotovoltaica

⁸ Associació Eòlica De Catalunya

⁹ Source: **Government of Catalonia, 2021. *Evolució de l'autoconsum FV***. [online] Institut Català d'Energia. Available through: Government of Catalonia Website <<http://icaen.gencat.cat/ca/energia/autoconsum/Observatori-de-lautoconsum-a-catalunya/evolucio-de-lautoconsum/>> [Accessed 9 August, 2021]

contingent on the uncertainties about returns and pay-out time created by the regulatory framework (Harkema et al., 2015). “Companies want to see results within five years, sometimes even after one year” (Harkema et al., 2015). Therefore, according to Harkema et al.’s (2015) reasoning, the uncertainty of jumping through bureaucratic hoops and facing decision delays under Decree-Law 147/2009’s was likely responsible for the low number of self-consumption project applications during the 2009-2019 period.

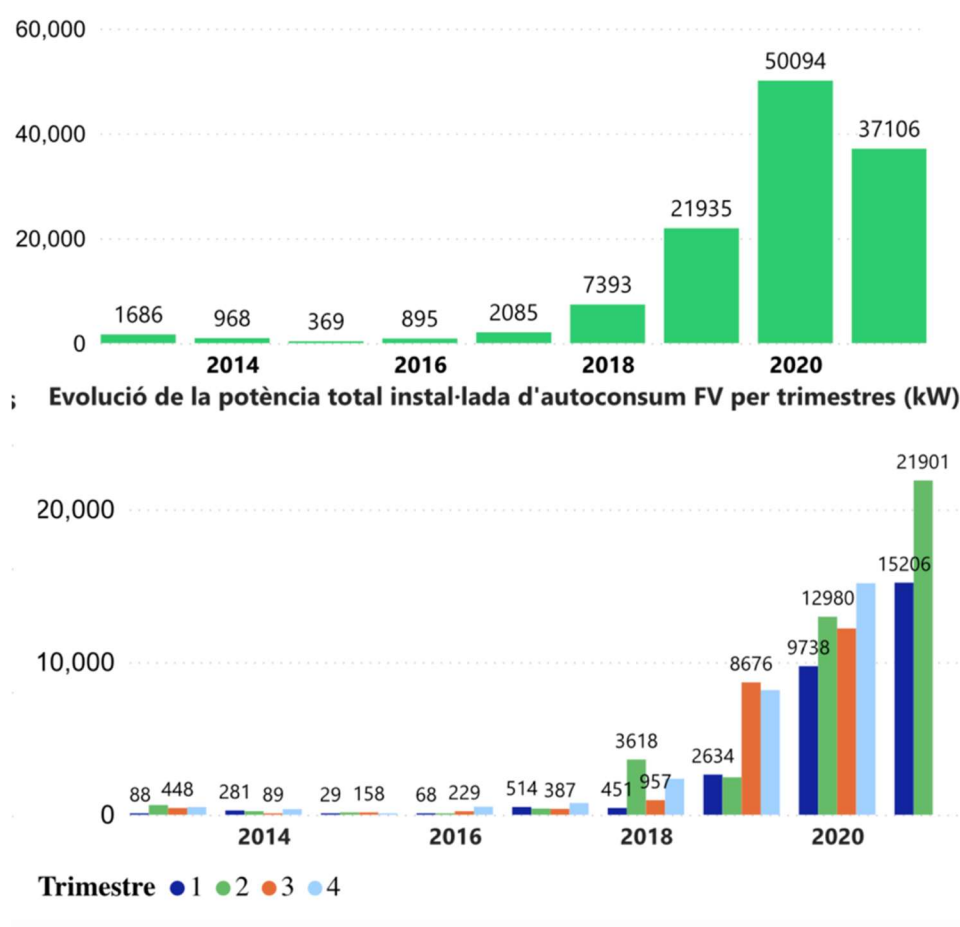


Figure 6.5. Evolution of self-consumption FV in number of installations (above) and year quarters (below)

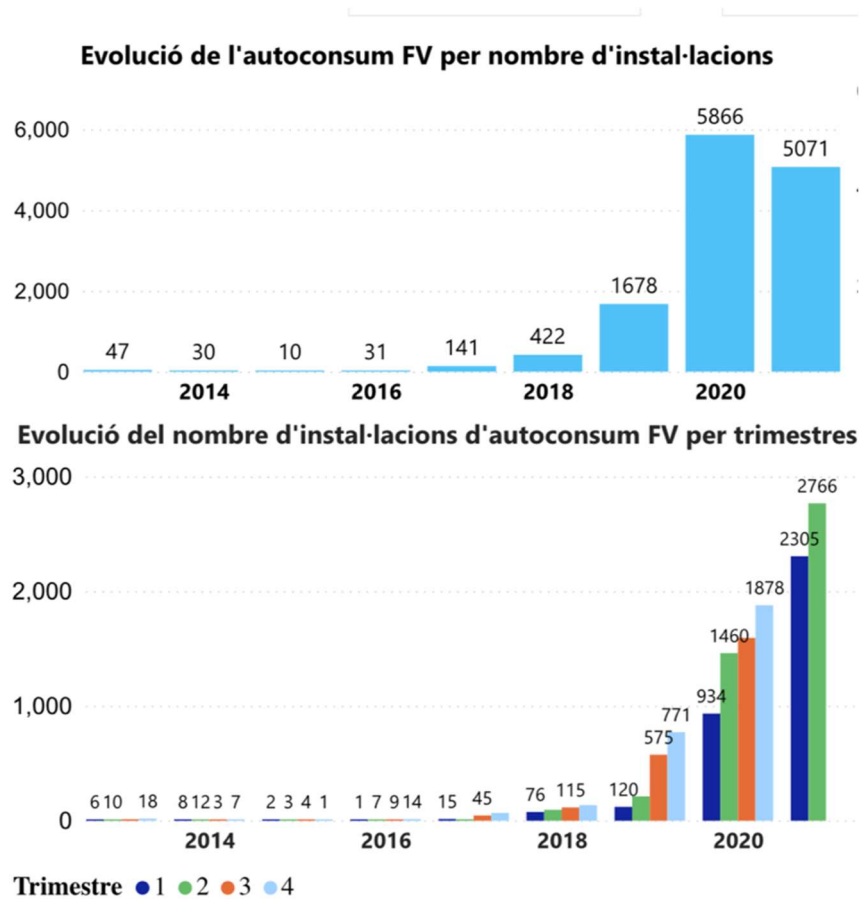


Figure 6.4. Evolution of the total installed self-consumption potency FV

Based on our discussion above, we conclude that Decree-Law 16/2019 has not permitted the development of an oligopoly in Catalonia's RES-E. The rapid pace of Catalonia's LETP post the scrapping of Decree-Law 147/2009 in 2019 has not made Catalonia's renewable energy market prone to capture by energy majors. The applications for solar-PV and wind projects processed so far under the measures of Decree-Law 16/2019 do not indicate a concentration of installed generation capacity in the hands of a small number of energy majors. Applications for setting up solar-PV and wind farm projects have come from a multitude of companies, including a large portion coming from various MSMEs. Using empirical evidence, conceptual arguments and statements from organisations representing MSMEs and smaller players in the renewable energy space, we have refuted the accusation that Decree-Law 16/2019 has facilitated the creation of a centralised energy model.

Contrary to opponents of Decree-Law 16/2019, Decree-Law 147/2009's heavy-handed approach and bureaucratic barriers were responsible for blocking the participation of smaller players in Catalonia's LETP. Instead of allowing the concentration of market power in the hands of few energy majors, Decree-Law 16/2019's passing and Decree-Law 147/2009's revocation has democratised Catalonia's LETP by promoting citizen, community or cooperative-based

projects, as well as energy self-consumption” projects (Morrón, 2021). Therefore, in arguing for a moratorium on its measures, opponents of Decree-Law 16/2019 contradict their objective of achieving a decentralised renewable energy model for Catalonia that enhances the participation of small firms and prevents the development of an oligopoly.

FINAL REMARKS

In sum, we have argued against a repeal of Decree-Law 16/2019 and opposed a moratorium on the solar-PV and wind project under the new law's review. We responded to broadly two objects that critics have levelled against the new law.

First, we explained that the aggressive pace of solar-PV and wind project implementation under the new law is a natural catch-up process necessary after years of stagnation to clear the bottlenecks and backlogs resulting from the obstacles and delays created by Decree-Law 147/2009. Our quantitative evaluation and conceptual analyses suggest that the old law's tedious and restrictive bureaucratic protocols severely retarded the deployment of solar-PV and wind energy projects in Catalonia.

Second, we discussed how the allegations about Decree-Law 16/2019 helping create an oligopoly in the renewable electricity sector are contradicted empirically and unfounded conceptually. The evidence we analysed did not suggest that the new law has aided in the development of an energy model that restricts market competition and limits participation only to large companies while excluding smaller entities such as MSMEs. Instead, our assessment showed that the regulatory conditions created by the new law have been more conducive to the growth of a decentralized energy model driven by MSMEs and self-consumption projects.

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