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Working Paper

Blowing in the wind: The infiltration of Sicilian Mafia in the wind power business

Working Paper Series, No. 04

Provided in Cooperation with:

Bocconi University, GREEN – Centre for Research on Geography, Resources, Environment, Energy and Networks

Suggested Citation: Checchi, Valeria Virginia; Polo, Michele (2019) : Blowing in the wind: The infiltration of Sicilian Mafia in the wind power business, Working Paper Series, No. 04, Bocconi University, Centre for Research on Geography, Resources, Environment, Energy and Networks (GREEN), Milan

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**BLOWING IN THE WIND:
THE INFILTRATION OF
SICILIAN MAFIA IN THE
WIND POWER BUSINESS**

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Blowing in the Wind: the Infiltration of Sicilian Mafia in the Wind Power Business

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June 2019

Abstract: *Public policies in the last 20 years have promoted in Italy the investment in renewable energy sources within the framework of climate change policies. Investment in renewables received generous incentives, leading to a rapid expansion in the capacity installed. Judicial inquiries have uncovered several episodes of involvement of Mafia families in the rich wind power business in Sicily. We test whether such involvement can be confirmed looking at the overall investment in the region. Using data on wind farm installations at the municipality level we show that the probability of observing a wind farm in a municipality is higher if in the local territory there is a mafia family, whereas wind speed is (surprisingly) not significant. Plants of small size, that require a simplified procedure managed by the local administration, are the predominant pattern of investment. Hence the episodes unveiled by courts are paralleled by a wider correlation of mafia family entrenchment in a territory and wind farm investment. We compare this result with the case of Apulia, the other Southern region where there has been a large investment in wind farms, supported by an environmental friendly regional government and apparently immune from criminal infiltrations. Applying the same econometric model in the case of Apulia we find that wind speed matters whereas the presence of the local criminal organizations does not affect the probability of observing a wind farm.*

Keywords: mafia, wind farms, infiltration in legal businesses, Sicily

JEL Classification numbers: Q20, L94, K23, K32, K42

1. Introduction

Climate change policies strongly promoted by the European Union¹ have pushed the Italian government to introduce incentives for renewable power plants in the electricity sector since the initial reform of the Bersani Decree that liberalized and reshaped the industry. Green certificates and later incentivized tariffs for energy from renewable sources have led to a significant

¹ Looking at the last decade we can mention the *Renewable Energy Directive* (2009/28/EC) who set the targets for 2020 in the development of renewables and required Member countries to draft *National Renewable Energy Plans*. A further step in December 2018 was the release of the *revised Renewable Energy Directive* (2018/2001) with new binding targets for 2030, requiring the Member States to draft a 10-year *National Energy and Climate Plan*. See also <https://ec.europa.eu/energy/en/topics/renewable-energy>.

development of new plants both in photovoltaic and wind plants, leaving generous rents to the producers.

Several judicial investigations have unveiled an involvement of criminal organizations in Sicily in particular in the wind farm business. Indeed, there are several good explanations why a mafia family may easily enter the wind business, exploiting its control of the territory and local administrations, its large liquidity and the involvement in the construction industry.

Judicial inquiries, although very useful for the evidence and documents that they uncover, cannot give a full picture of how wide the infiltration of organized crime in the wind business is. In the words of empirical analysis, they offer point observations more than an analysis of the entire population of cases.

The aim of this paper is to complement the evidence coming from the judicial inquiries by analysing the full range of investments in wind farms in Sicily and to test whether the involvement of criminal organizations could have affected to a large extent the investment in the region rather than being a significant but episodic phenomenon.

To this end we have collected the data on wind farms for all the 390 municipalities in the region recording whether at least a wind farm is active and its power capacity. We have then tested with a linear probability model whether the likelihood of observing a wind farm may depend on a set of controls. A first group is related to the characteristics of the territory, like surface, altitude and wind speed, that make a location suitable to a wind farm. Secondly, we have used the classification released by the National Department of enforcers for investigations on criminal organization (Direzione Investigativa Antimafia: DIA) on the presence by municipality of criminal organizations, distinguishing those with an established mafia family from the others. Finally, since the administrative process to build a wind farm requires several steps and interactions with the public administration and local political representatives, we have tested whether the presence of strong social capital may have contrasted and slowed down the infiltration process.

The results we obtain show that the probability of observing a wind farm in a municipality in Sicily is positively affected by the presence of a criminal organization whereas wind speed, that should matter to locate the construction of wind towers, is not significant. Social capital and political control are not significant either.

We observe from descriptive statistics that wind farms are over-represented in municipalities where a mafia family is active. The size of the plants is relatively small, following the trend observed at the national level once tariff incentives have been introduced. Quantile regression considering the distribution of plant capacity shows that when moving towards the tail with the larger plants wind speed becomes more significant, although below the usual thresholds, while the presence of mafia families loses grip.

Finally as a further robustness check we have applied the econometric model to the other Southern region with a significant investment in wind farms, Apulia. The development of the wind business in this region has been strongly supported by the local policies of the regional government, that was

run by politicians with a strong environmental commitment. At the same time judicial inquiries have not unveiled an involvement of the local organized crime, Sacra Corona Unita, in the wind business. Our estimates confirm this picture, showing that the probability of observing a wind farm in a municipality depends in Apulia on wind speed but not on the presence of organized crime, a pattern opposite to the one observed in Sicily.

Overall, our results suggest that the evidence emerging from a number of different and distinct judicial investigations on the involvement of Sicilian Mafia, but not of the Apulian Sacra Corona Unita, in the wind farm business is confirmed also when considering the overall investment in the two regions. Along with the episodes, often related to large investments, that have attracted the attention of the enforcers, we show in Sicily a widespread and parasitic diffusion of small plants to capture the regulatory rents of wind farm businesses in the areas where mafia controls the territory.

The rest of the paper is organized as follows. Section 2 reviews the evolution of regulation and the characteristics of the administrative process related to the wind farm business, presenting some data on the development of the industry over time and in the different regions. Section 3 analyzes the motivations of a criminal organization to invest in legal activities and the advantages that it can exploit in these new businesses, identifying the drivers that lead to select certain specific activities. Section 4 presents the data and section 5 reports the results. The comparison with Apulia is discussed in section 6. Conclusions follow.

2. The wind farm market and regulation

Incentive regulation. The Bersani Decree (DM 16/3/1999 n.79), that set up the liberalization plan for the electricity industry, provided also the first incentives for renewable energy production. It stated it was mandatory for producers and importers of electricity generated from non-renewable sources to produce and introduce in the national electricity system a minimum share of 2% of the total amount of energy from renewable sources. In case of impossibility of directly producing energy from renewable sources, the requirement could be satisfied also through the purchase of CV (*certificate verdi* – green certificates) from renewable energy producers. Every Green Certificate was equivalent to 1 MWh, issued by the Gestore Servizi Energetici SpA.

The price of green certificates moved from 99 €/MWh in the initial phase to 142.9 €/MWh in 2006, making the investment in renewable plants quite convenient. In 2008 a second source of revenues was introduced through the comprehensive tariff (TO: Tariffa Onnicomprensiva), available for renewable power plants with a capacity lower than 200 Kw built after 2008.

The CV system was dismissed for new plants in 2012 (DM 6/7/2012). The new regulation reshaped the electric energy system introducing for new installations a feed-in tariff regime. The tariff was defined as the sum of a tariff base (TB) and a possible premium plants can be entitled (PR): $TO = TB + PR$. For the wind power the following table reports the tariff adopted:

Table 1 – Incentives recognized to wind energy production, DM 6/7/2012

Type of plants	Power of plant	Period of incentive	Tariff [€/Mwh]
Onshore	1<P≤20	20	291
	20<P≤200	20	268
	200<P≤1000	20	149
	1000<P≤5000	20	135
	P>5000	20	127
Offshore	1≤P≤5000	25	176
	P>5000	25	165

Source: GSE website

The mechanism to access the incentives depended on the size (capacity) of the plant. Micro plants (<50 kW) had direct access to the incentive, while small plants (50 kW-5 MW) were required to be recorded in specific registers. Once admitted the plants had to enter into operation within 12 months in the case of on-shore farms or within 8 months in the case of off-shore. Larger plants (>5MW) were subject to the Dutch auction mechanism. In order to be admitted to the auction the bidders were required to meet some financial prerequisite: a guarantee of a bank for the financial solidity of the bidder, minimum capitalization of 10% of the investment cost and a guarantee of 10% of the intended investment. The DM 6/7/2012 introduced also a ceiling of €5.8 billion in public funds to support renewable plants, putting a cap on the budget that in previous years had increased significantly.

More recently (D.M. 23/6/2016) the tariff recognized to electricity produced by wind plants has been further refined² for plants larger than 0,5 MW of capacity adding to the previous scheme (defined by the sum of a tariff base (TB) and a possible premium each plant can be entitled to receive (PR)) a second option. In this latter case the incentive is defined as the difference between a fixed revenue and the zonal hour price, related to the location of the plants ($I = TB + PR - ZP$). For the on-shore wind source of energy, the tariff is presented in Table 2 below.

The different rules to access the incentives according to the capacity of the plant (direct incentive, registration, Dutch auction) were maintained.

The regulation has defined at the national level the remuneration of electricity production for wind farms once built, with a long period in which revenues were guaranteed. Legislative decree 387/2003 states further that regions can adopt independent measures to promote the production of energy from renewable sources, in addition to national laws. Moreover, the regional Burden sharing indicates the regional repartition of the energy production in order to achieve the European

² See

https://www.gse.it/documenti_site/Documenti%20GSE/Servizi%20per%20te/FER%20ELETTRICHE/DOCUMENTI/PA%20DM%20FER-E%202016%20Procedure%20Applicative%202016%2007%2015.PDF

energetic targets for 2020. The Decree issued on March 15th,2012 by the Ministry for Economic Development states targets for each regions, starting from the national level of renewable sources.

Table 2 – Incentives recognized to wind energy production, DM 23/6/2016

Type of plants	Period of incentive	Tariff [€/Mwh]
1<P≤20	20	250
20<P≤60	20	190
60<P≤200	20	160
200<P≤1000	20	140
1000<P≤5000	20	130
P>5000	20	110

Source: GSE website³

Administrative process. The administrative process to build a new wind farm involves also regional administrations and municipalities. For plants of capacity larger than 60 kW the D.Lgs.n. 387/03 requires a single authorization document (Autorizzazione Unica AU) together with the evaluation of environmental impact (Valutazione di impatto ambientale VIA), that takes into account the visual and acoustic impact, the impact on flora and fauna and possible electromagnetic interference. The regional administrations are responsible to manage the process and release the authorizations. For smaller plants (20-60 kW) a simplified document (Procedura abilitativa semplificata PAS) is required. The developer has to submit a detailed report of the projects to certify the compatibility of the project with local building regulations in force. Finally, micro-plants (<20kW) are authorized by the municipalities with a single act (Autorizzazione libera AL).

Market development. Given the generous incentives⁴ the wind power segment has experienced in Italy a significant increase in the last 20 years. In the first phase up to 2009 in which the CV incentives were used the investments have focused on relatively large plants. At the turning point in 2009 the average installed capacity was equal to 16,7 MW and the new plants (294) built in 2009 had an average size of 26.2 MW per year. In 2010 the new plants (487) were much smaller (4,7 MW) driving down the average size of existing plants to 11.9 MW. ⁵ Compared with the total installed capacity in 2002 (780 MW) in 2012, when the feed-in tariff replaced the CV mechanism, there were 1054 plants with a total capacity of 8119 MW. In 2016, when the DM 23/6/2016 was introduced, the number of plants was 3598 but the total capacity only slightly increased to 9410 MW.⁶ A similar trend, with micro-plants leading the process, continued with the new regulation. In

³ Incentivazione della produzione di energia elettrica da impianti a fonti rinnovabili diversi dai fotovoltaici, PROCEDURE APPLICATIVE DEL D.M. 23 giugno 2016, GSE, 2016

⁴For plants of 200 kW the incentives for wind plants in the Italian regulation (both the DM 6/7/2012 and DM 23/6/2016) are by an large the highest in the European Union while for plants of 10 MW capacity the Italian regulation (6/7/2012 ranks third after Wallonie and Romania. See GSE (2017).

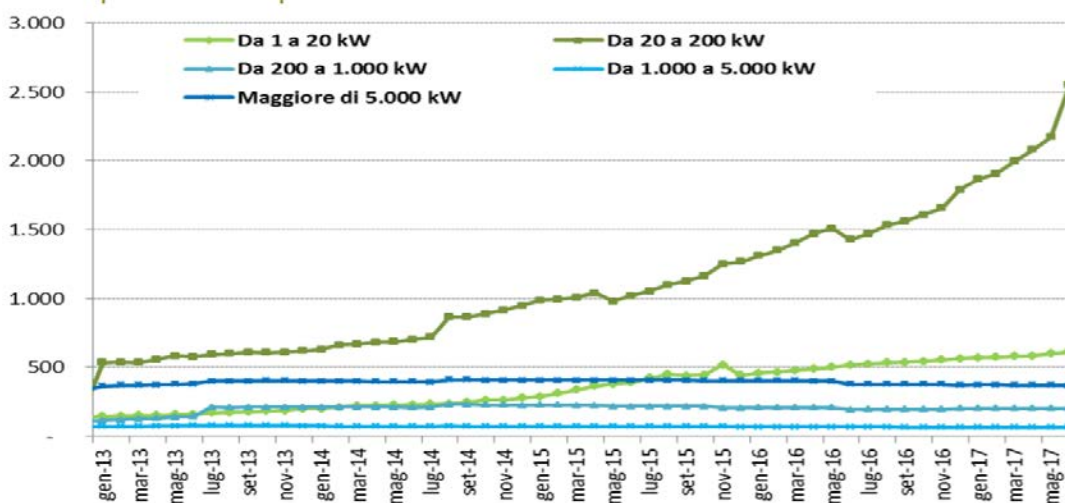
⁵ Rapporto Statistico FER 2017, energia da fonti rinnovabili, in Italia: settore elettrico, trasporti e termico. GSE, p.55

⁶ See GSE (2017).

2018 the wind capacity reached 10.310 MW, with a potential energy production 41 TWh, and the energy produced has covered around 5% of total demand.⁷ The wind capacity and production are mainly located in the Southern regions: Sicily (19%), Apulia (26%), Basilicata (11%) Calabria (11%), Campania (14%) and Sardinia (10%).⁸

Compared to other European countries, Italy does not present a strong wind potential (WP). The Italian region with the highest WP potential (Apulia) according to ESPON ReRisk ranks only 72nd out of the 277 EU NUTS-2 regions for which this measure is available. Despite this, when looking at national level Italy ranked fifth for wind power installed capacity.

Figure1 : evolution of installed power capacity that have required an incentive



Hence, the evolution of the wind sector is characterized by an initial phase with large plants installed and a tendency to invest in smaller plants when the new regulations were introduced in 2008, 2012 and 2016. Figure 1, referred to the period covered by the new regulations, clearly illustrates the prevalence of plants in the 20-200 kW size.

Sicily, that is the core of our analysis, ranks second in terms of installed capacity and in 2017 the electricity produced by the wind source accounts for 15.8% of total wind production in Italy.⁹ As shown in Figure 2, the production of wind sources exhibits a significant increase after 2005. The main production is realized in the Agrigento province.¹⁰ If we look at this evolution taking into account the previous discussion on the national trend in plant size in the different periods, we may conjecture that also in Sicily the initial phase of the industry was characterized by the instalment of

⁷ See Terna (2018)

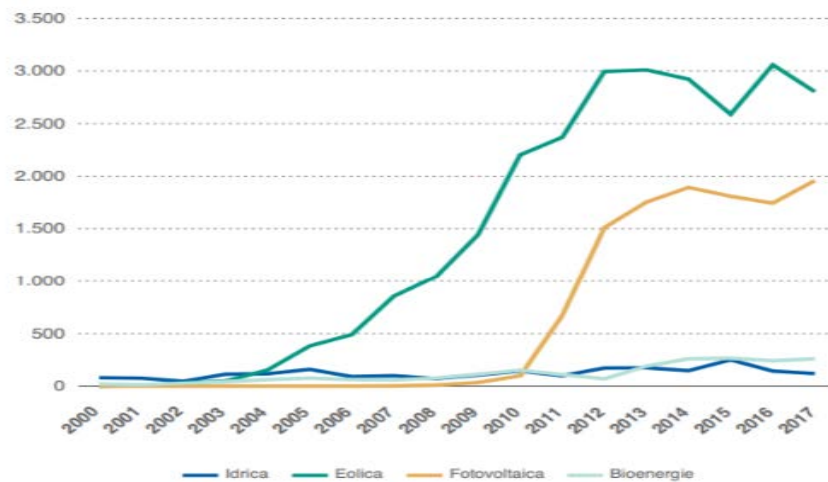
⁸ These data refer to 2017, the latest available on <http://www.terna.it/it-it/sistemaelettrico/statisticheeprevisioni/datistatistici.aspx>

⁹ <http://www.terna.it/it-it/sistemaelettrico/statisticheeprevisioni/datistatistici.aspx>

¹⁰ As a consequence of this increase in wind energy production, in Sicily there is currently a risk of occurrence of “Mancata produzione eolica”, meaning the limitation or even the shutdown of some wind-parks to avoid the overproduction of energy. The

large plants, followed in later years after 2008 by a progressive fall in the plant size of new investments.

Figure 2 . Plant capacity of renewable energy sources, Sicily



Source: Terna regional statistics¹¹

3. The expansion of criminal organization in the regular economy

Judicial inquiries and research in the field have established a clear picture of how and why the criminal organizations, starting from their core business of illegal activities, progressively expand into legal sectors. We briefly summarize in this section the main features of this pattern.¹²

The core business of criminal organizations as Cosa Nostra, 'Ndrangheta, Sacra Corona Unita and Camorra, just to mention the main domestic ones, refers to a wide and ever-evolving range of illegal activities that include trafficking of drugs, arms and human beings, extortion, usury, prostitution, smuggling. Although secrecy and the risk of prosecution impose extra-costs in the management of these activities, the rates of return are extremely high. The gains can be reinvested to a certain extent in expanding the business in the same or new illegal activities. There are, however, at least two constraints to a continuous expansion within the boundaries of illegal businesses. First, it can create frictions and disputes with rival criminal organizations in overlapping markets. Secondly, the rate of returns on illicit businesses is much higher than the potential rate of growth of demand for such activities, with the risk that reinvestment would saturate the market squeezing the margins.

Then the criminal organizations have to move their attention also to investments in businesses that for their own nature belong to the legal side of the economic system, bringing their specific features

¹¹ Statistiche regionali 2017, Terna, p.235

¹² See Polo (2013).

in competition with regular operators. A mafia family that reinvests the provisions of its background criminal activities in legal sectors can rely on a huge liquidity. Moreover, the legal activity may also work as a tool for money laundering that helps avoiding the attention of enforcers. The criminal background brings into the legal activities the tendency to disregard fiscal and social security duties as well as labour and environmental regulations, artificially creating a cost advantage with respect to regular competitors. The use of violence and intimidation adds additional weapons in the distortion of the competitive process. Finally, the command on the territory that characterizes the criminal organizations allows controlling packages of votes, influencing the local administrations. This creates an advantage in all activities where public institutions play a direct role as buyers or contractors or an indirect role as rule setters and administrators. The criminal organization, therefore, if not adequately contrasted by public enforcement, enjoys a favourable position and tends to expand in legal activities to the expenses of regular competitors, distorting the market and gaining progressively a dominant position.¹³

Criminal organizations, however, are subject to constraints that prevent such mechanism to develop in each and every legal sector. Some activities are more fit to exploit the advantages than others, directing the pattern of expansion in the regular economy to certain sectors more than others. Businesses that require very specialized competencies and technologies are usually not attractive for the criminal organization, whereas relatively low tech activities, in which an initial huge investment is required, that are intermediated by public institutions and financed through public funds may be a very convenient way to expand in the regular economy. If some professional competences are needed, the organization can rely on a range of professionals that are ready to cooperate, although not formally members of the “cosca”.¹⁴

Indeed, the judicial inquiries have unveiled that sectors as construction, retail and wholesale trade, cafes and restaurants, waste disposal, provisions to hospitals and local administrations are among the industries that more frequently are infiltrated by criminal organizations not only in the traditional Southern regions but also in the Northern part of Italy.¹⁵

3.1 Wind farms and Mafia families: a fatal attraction?

Following the discussion in the previous section, the administrative process needed to build a wind farm and the generous incentives given to renewables in Italy may have created a very favourable environment to attract the interest of criminal organizations for entering this business. To this end it is useful to recap the sequence of steps of an investment in wind plants, from the initial project to the final construction and management of a wind turbine.

The first step of the process requires identifying the area where the wind farm could be built. It may be a spot that the criminal organization already owns, or that can be purchased or granted as

¹³ See S.Mocetti, L. Mirando and L.Rizzica (2019).

¹⁴ See R.Sciarrone (2011).

¹⁵ The presence of criminal groups belonging to Mafia, ‘Ndrangheta and Camorra has been discovered in cities in Val d’Aosta, Piedmont, Lombardy, Liguria and Emilia Romagna. See R.Sciarrone (2019).

concession in case of public property. In all these cases the implicit threat of violence or the milder way of corruption may make it easy for the criminal organization to control the site of the new wind farm.¹⁶

The second stage requires obtaining an administrative approval, for larger plants in the form of a single authorization (*Autorizzazione Unica*) released by the regional administration and for smaller plants by the municipality (*Autorizzazione Libera*). The process is organized in several steps, including a one-year anemometry survey and an analysis of the environmental impact. Overall the administrative procedure may take several years and involves numerous professionals and public agencies. The proximity of a criminal organization with the local administration that manages the different stages, both at the regional and municipality level, may greatly help in speeding up and smoothing the process and preventing competing projects from been approved.¹⁷ In some cases the entire administrative process is organized and managed by particular figures, known as facilitators or developers (*facilitatori*) that, thanks to their network of relationship with the local administration, can provide the full service to the candidate projects and can adjust any problem that can arise through false declarations and measurements, in order to formally pass the compelling set of regulations. This role is quite often carried out by individuals in close connection with the criminal organizations, that through their involvement may take the control of initiatives from independent investors.¹⁸ The picture that emerges from reading the investigation documentation is a textbook example of how red tapes can increase the possibility of manipulating the administrative process through corruption and collusion of public officers with criminal organizations.

Once the project is approved the next step requires setting up a financial plan. Bank loans and other instruments in the capital markets can be combined with public grants offered by the European Union or by national subsidies. The large liquidity, the opaque relationship with the local banking sector and the ability to manipulate the assignment of public funds make the criminal organizations a crucial player both when directly involved in the project and when acting as financial advisor of the entrepreneur. As noticed by Europol in their 2013 annual report, *“such projects offer attractive opportunities to benefit from generous Member States and EU grant and tax subsidies, but apart from effectively exploiting eco-friendly incentives for their financial gains, they also create possibilities to launder proceeds of crime via legal business structures”*.¹⁹ The Renewable Energy

¹⁶ In Sicily the investigations have unveiled that in some case wind farms have been constructed also in areas that, according to the regional legislation, were classified as protected, for heritage or natural reasons, and therefore banned for wind plants.

¹⁷ For instance both Suwind and Enerpro srl submitted a project for a wind farm in the municipality of Mazara del Vallo (Trapani). Although Enerpro initially obtained the environmental authorization from the local council administration, the mafia representative intervened manipulating the documents and ultimately making Suwind win the project.

¹⁸ The investigation named “Eolo” unveiled that a single individual, Vito Nicastro, was involved as facilitator in a very large number of projects. He was known as “the king of the wind”, procuring authorizations for wind farms and being a bridge between entrepreneurs and public administrations. The prosecutors confiscated personal properties for an overall value of 1.3 bln €, and Mr. Nicastro was then condemned as supporter of the Mafia chief Matteo Messina Denaro.

¹⁹ Europol, (2013), p.15.

and Energy Efficiency Operational Programme for Apulia, Campania, Calabria and Sicily had a total budget of around 1.6 bln € for the period 2007-2013.²⁰

The execution of the project includes the site construction and the assembly of the wind farm. As already discussed, the construction industry is traditionally one of the main legal activities in which the criminal organizations reinvest the illicit proceeds. The infiltration of the criminal organization can take very different forms at this stage, from direct involvement in the construction to the supply of construction materials or transportation services to the assignment of sub-contracts by the main contractor. When the construction firm tied to the cosca moves in, hardly competitors dare to submit their own proposals.²¹ For instance, the construction of the wind park “Vino del Vento”, that belongs to Repower Italia and Fabbrica Energie Rinnovabili Alternative with a total of 24 MW power was assigned to the firm Filardo-Messina Denaro, controlled by one of the most important bosses of Cosa Nostra.

The final stage of the project is activation, when the plant starts operate. The criminal group can require the hiring of its affiliates in the company and the payment of a fee for the protection of the site. Indeed wind towers in isolated spots are extremely exposed to the threat of damages. Extortion allows then to capture part of the rents that the generous incentives provide to renewables.²² The criminal organization can also intervene to soften the periodic controls on the wind farm.

Our discussion highlights that the business of constructing and managing wind farms offers very favourable opportunities of involvement to the criminal organizations, attracted by the significant rents that public policies have granted to renewables. Mafia families are able to exploit their competitive advantage in finding the sites for wind farms, in dealing with public administrations, adjusting the application of red-tape regulations, granting finance and providing construction services and materials in the realization stage. The ambiguous relationship with front man entrepreneurs allows the criminal organizations to extract a substantial fraction of rents even when not formally participating in the business.

Our prediction is therefore that the investment in wind farms should be more widespread in areas controlled by the criminal organizations than in others. In the following sections we test these predictions in the two regions where the investment in wind farms has been more relevant, Sicily and Apulia. The judicial inquiries have highlighted that the involvement of criminal organizations in the wind business has been different in the two regions, with Sicilian Mafia as an active player, contrary to the Apulian Sacra Corona Unita. Applying our econometric test to the two regions, therefore, offers an interesting opportunity to add evidence to what the investigations have

²⁰ https://ec.europa.eu/regional_policy/en/atlas/programmes/2007-2013/interregional/operational-programme-renewable-energy-and-energy-efficiency

²¹ In a telephone tapping within the Eolo investigations the boss of the Tamburello family, that controls a firm specialized in the construction of wind parks, claimed: “In the municipality of Mazara del Vallo no one can construct a wind turbine without my permission” (<http://www.malitalia.it/2010/02/mazara-ancora-un-sequestro-ai-mafiosi-complici-di-messina-denaro>).

²² In 2012 Santo Sacco, former town city councillor, was arrested and convicted for mafia association and racketeering following the request of a kickback (*pizzo*) to the Danish company Baltic Wind.

unveiled and to verify whether data referred to all the municipalities in the region confirm what the point observations stemming from the judicial inquiries suggest.

4. Data Description

In this section we present our database that covers three sets of variables: those referred to the investment in wind farms, those related to the physical features of the territory that matter for the operations of a wind farm and those that capture the presence of criminal organizations. We display descriptive statistics for Sicily, our main case study, and for Apulia, that offers an interesting comparison.

4.1 Organized crime data

To measure the presence and control of the territory of mafia groups we rely on the report published twice a year by the DIA (Direzione Investigativa Antimafia), a department of the Ministry of Interiors committed to contrast illegal activities from mafia-type organisations. The report indicates the municipalities where criminal families are present: from this report we have created a dummy variable indicating the presence/absence of a Mafia family in a specific municipality. This variable has several advantages: it provides information at a very disaggregated geographical level, corresponding to the territory that a criminal organization typically controls. In addition, being the result of a deep knowledge of the phenomenon deriving from a long stream of investigations, it avoids the risk of under-reporting or reporting bias that other indicators on committed crimes from judicial statistics typically suffer. In 193 out of 390 Sicilian municipalities (49,5%) the DIA identifies at least one active mafia family.

A second possible set of indicators relies on denounced activities as a proxy for the presence and intensity of mafia organizations in a territory. Data are published by ISTAT (Istat, “Statistiche Giudiziarie Penali”) and include extortions, threats, damages, fencing, laundering and usury. However data on denounced criminal infringements suffer from under-reporting, in particular in areas where a criminal organization exerts a tight control of the territory. Moreover, some of the illegal activities may be undertaken by organized groups, the target of our measurement, as well as by individual criminals, thus introducing a measurement error. Third, different criminal organizations may specialize on specific illegal activities included in the vast array recorded by judicial activities. Hence, single indicators focussed on specific kinds of illegal activity may provide a distorted view of the presence of mafia families.

A further drawback in using judicial statistics on denounced crimes is that ISTAT releases these data at the province rather than municipality level. In order to test the correlation between the judicial data on reported crimes and the DIA indicator we have aggregated the latter by province (thus defining the share of infiltrated municipalities) and then computed its correlation with an aggregate index of reported crime obtained through factor analysis. The share of municipalities in a province

with a positive value of DIA indicator is strongly correlated with the combination of denounced activities as obtained from the first principal component (correlation index 0.85).

Finally, when investigating the relationship between the wind plant investments and the presence of criminal organizations there is an issue of causality to be considered. It may be that the rich business of public incentives collected helps creating and consolidating a criminal organization, with causality running from the investment to the establishment of a gang. Or instead, it may be that the control of the territory makes it easier for a criminal organization to manage and implement all the administrative steps and construction activities to build a wind farm, with causality going from the presence of the criminal organization to the investment in wind plants.

It is quite evident that the presence of mafia-type associations in a given municipality pre-exist the relatively recent policies to boost renewable energy sources. Indeed a very wide literature traces the emergence of Mafia back to the beginning of XIX century. The origins of Cosa Nostra have been repeatedly studied, mostly analyzing its roots connected to an original activity of protection (Franchetti 2001, Dimico et al. 2017, Gambetta 1996). In addition, building a criminal organization requires time, but, once established, a criminal organization remains in command for a long time in its own territory. Although the surnames of the bosses may change over time, the geographical structure of mafia families is quite stable over time.²³ Hence, we consider the establishment of a criminal organization in a given territory as predetermined with respect to the investments in wind plants. Although we do not pretend to provide an estimation of the causal impact of mafia presence, and we limit ourselves to interpret our results in terms of correlations, if any causality should be invoked we argue that it is more likely to read the results from the presence of a criminal organization to the investment in wind plants.

4.2 Wind farms and wind speed data

Wind farms data are obtained from a platform of GSE (Gestione Servizi Energia), AtIImpianti, which provides information on the location, power capacity (expressed in kW) and size of the existing wind farms for each municipality.²⁴ "*Presence windfarms*" is a dummy variable, indicating that at least one wind farm is present, at municipality level. In addition we have considered the total wind farm capacity installed (calculated as the sum of the plant power capacity of all the wind farms located in a municipality) and the number of wind towers in a municipality. Table 3 presents descriptive statistics of these variables

²³ See M.Polo (1995).

²⁴ Hence the data refer to the stock of wind farms by municipality. The time series by year is not available from the GSE website.

Table 3 – Sicily and Apulia: wind farms capacity

	Obs	Mean	Std. Dev.	Min	Max
Sicily	143 (36,7%)	12269	23223	2	123893
Apulia	116 (45%)	21395.4	39211	1	202505

Comparing Sicily and Apulia we can observe that the diffusion of wind power plants is larger in the latter (36,7% of the municipalities vs. 45%) and the average capacity of the wind farms is much smaller in Sicily (12.269 kW) than in Apulia (21.395 kW).

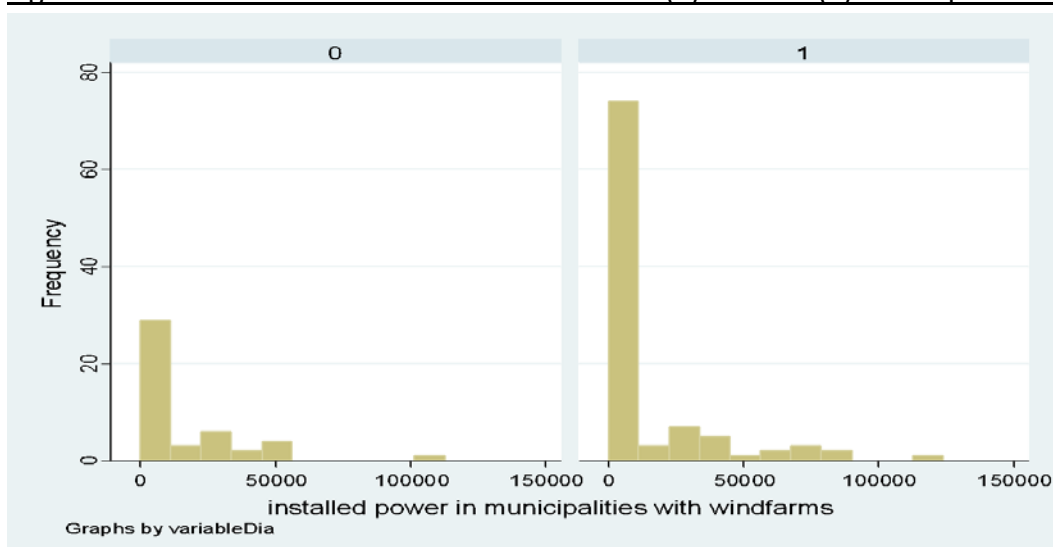
It is interesting to look at the presence of wind farms and the distribution of capacity in Sicily distinguishing the municipalities where mafia families are active from the others. Table 4 shows these data.

Table 4 – Number and capacity of wind farms: DIA and non DIA municipalities, Sicily 2018

	Munic. (%)	Munic. Wind farms (%)	Average capacity (kW)
DIA	193 (49,5%)	98 (50,8%)	11.695
Non DIA	197 (50,5%)	45 (22,7%)	13.519
Total	390	143 (36,7%)	12.269

We observe at least one wind farm in around half of the municipalities where a mafia family is active, compared with slightly more than one fifth of those where there is no criminal organization. Moreover, the relatively low capacity of the Sicilian wind industry is further pronounced for wind farms in mafia municipalities, as figure 3 shows.

Figure 3 – Size distribution of wind farms: non DIA (0) and DIA (1) municipalities 2018



4.3 Additional controls

The set of additional controls includes a list of variables related to the characteristics of the territory that may affect the feasibility of constructing wind farms, including the population in the municipalities, the territorial extension (that affects the number of different locations available for installing a wind plant) and the wind speed.

The wind information is obtained from the platform AtlanteoEolico, which provides for the whole territory of the island the average wind power/ km² at 25 mt over the ground on a yearly average base. Overlapping the maps reporting the geographical coordinates of municipalities given by Istat, we have obtained the value of wind speed for each municipalities. This has been done using ARGIS software

We have also considered a control that refer to the presence of parties or associations that may contrast mafia families, limiting their power. This variable refer to the importance of social capital. We use the number of volunteers per habitants as proxy for the level of social capital.

Table 5: Sicily: population, surface wind speed and social capital

	Obs	Mean	Std. Dev.	Min	Max
Log(habitants)	390	8.53	1.23	5.22	13.41
Surface	390	66.23	80.24	1.17	554.99
Windspeed	143	4.822	0.3547	4.13	6.93
N. volunteers	390	0.05	0.03	0	0.24

Table 6: Apulia: population, surface

	Obs	Mean	Std. Dev.	Min	Max
Log(habitants)	258	8.95	1.16	5.05	12.68
Surface	258	75.73	90.93	3.18	593.93
Windspeed	116	5.06	0.60	4.5	6.8

5. Results

We first report our baseline linear probability model and then we check for robustness of the results.

5.1 The baseline model

In the baseline model we estimate for 2018 the correlation between the presence of at least one wind farm (dummy windfarms) and the existence of criminal association (variable DIA) and, controlling for the measure of wind speed and the (logarithm of) number of inhabitants. We expect that, other things constant, the presence of a mafia family should be correlated with a higher

probability of observing wind farms in a municipality. We have the following baseline specification (with subscript i referring to municipalities)

$$Dummy\ windfarms_i = \alpha + \beta_1 Dia_i + \beta_2 Windspeed_i + \beta_3 \log \log (inhabitants_i) + \gamma X_i + \delta_j + \varepsilon_i$$

where X_i contains a vector of municipality level information (size, altitude, ect) and δ_j are province fixed effects. The error component ε_i is estimated with robust methods against heteroscedasticity. In all regressions we introduce province fixed effect δ_j , in order to capture unaccounted heterogeneity across territories and to take into account any unobservable characteristics that municipalities within the same province may have in common. The results are reported in table 7.

The variable DIA is positive and significant at 5%, with an estimated increase in probability of observing a wind farm of 11,8% in the municipalities where there is an established criminal organization. The variable surface is significant at 1% level among potential controls, which is not surprising given the fact that installing a wind plant requires land and the larger the territory the larger the number of feasible spots.

Table 7: Linear probability model for windfarms presence (Sicily 2018)

	(1) Presence windfarms	(2) Presence windfarms
windspeed	0.024 (0.058)	0.024 (0.057)
Dia	0.118** (0.057)	0.120** (0.057)
Log(inhabitants)	-0.025 (0.022)	-0.023 (0.021)
Surface	0.002**** (0.000)	0.002**** (0.000)
N.Volunteer		0.419 (0.596)
N	390	390
R ²	0.288	0.289

standard error robust to heteroscedasticity - including provincial effects

What is striking is the absence of statistical significance of the coefficient of wind speed, a factor that one would expect to be strongly correlated with the decision of installing a wind farm. While the unconditional correlation between the presence of windfarm and wind speed is 0.18, it is quite peculiar that the location of wind parks emerges as uncorrelated to average wind speed when

controlling for mafia. This result is surprising, especially when taking into account that in order to obtaining an authorization the applicant had to measure the wind potential for an entire year.

Overall our baseline specification suggests that the location of wind plants seems not driven by the favourable wind conditions but rather by the active role of criminal organizations in the territory they control, possibly manipulating the administrative process for approvals and then collecting the rich incentives for renewables. This result is in line with the over-representation of wind farms in the municipalities where an established mafia family is active (see Table 5).

Given the opaque relationships of wind investors and local administrations suggested by the previous results we have checked whether some sort of resistance to the penetration of the criminal organizations, such as local human capital. However, the relevance of volunteering do not come out to affect significantly the probability of observing a wind farm in the municipality.²⁵

5.2- Further evidence: plant size

We consider also the effect of organized crime indicator on the number of wind towers and on the total capacity installed on each municipality. We have already commented on the tendency in municipalities with a mafia family to have plants of smaller size. Descriptive evidence shows that criminal organization tends to build wind plants characterized by smaller installed power.

There are several reasons why we may observe this feature in the data. The tendency to build wind plants of smaller size is observed also in other regions from 2008 on. There is a clear effect of the evolution in the incentives for renewables, when the comprehensive tariff (TO) and then the feed-in tariff were added to the green certificates, replacing them from 2012.²⁶ Hence, the incentives for renewable have become more attractive also for relatively small investments. Moreover the wind power after 5 years of development became at the end of the decade a more well known technology and opportunity compared with the start up phase. Hence, once the opportunities offered by the generous incentives to renewables attracted the attention of criminal organization, the incentive schemes in place were very fit to apply to small plants.²⁷

Additional interpretations of this evidence may be suggested: first of all, smaller plants capture lower public attention. So, it can be easier for criminal organizations to hide their illicit traffic. Moreover, as commented in Section 2, for small power plants the administrative process is simpler and managed at the local level (provincial or municipal), making easier for organized crime to exploit their networks to obtain all the legal permissions.

²⁵We also tried to interact this variable with the presence of mafia, without finding any significance.

²⁶The average size of new plants dropped after 2009 from more than 20 kW to less than 5 kW per plant.

²⁷Unfortunately data by year are not yet available from GSE to reconstruct the time profile of the investment at the municipality level.

Our discussion suggest that the parasitic logic behind the investment in small plants may be different from the rationale for a large investment, where wind speed conditions should play a more relevant role. We have therefore run a quantile regression to verify whether some effects are detectable in the top part of the distribution of the wind plants by capacity. We consider only the upper tail²⁸ from the 75th percentile on to capture the effect of the variable DIA and wind speed for larger plants.

The results show (last column) that considering the whole sample neither DIA nor Wind speed explain the wind plants when measured by capacity. However considering the quartile regression in the upper tail that includes the larger plants the wind power obtains some significance, although below the usual standards, whereas the DIA indicator remains insignificant (though exhibit a negative sing for higher level of capacity). Jointly taken, the quantile regression suggest that the impact of mafia organizations on the location of larger plants vanishes whereas bigger plants tend to be located in windy areas.²⁹

Table 8: quantile regression of installed power

	q75 Power=80	q90 Power=15467	q95 Power=35002	for comparison: OLS
Wind power	212.16 (132.37)	2251.83 (1355.93)	9353.99* (5265.56)	-66.72134 (1309.3)
DIA	82.44 (249.39)	40.47 (1428.45)	-586.94 (5948.84)	878.62 (2023.4)
log(inhabitant)	-36.88 (67.16)	-926.83 (796.72)	-3626.73* (2030.88)	-887.55 (666.21)
surface	45.57 (28.95)	259.65*** (34.16)	303.22*** (94.30)	68.203*** (19.59)
constant	-899.41 (13241.28)	7083.45 (26935.33)	-12250.76 (28918.17)	14201.7 (9067.9)
Pseudo R ²	0.01	0.33	0.35	0.13

While the extraction of public rents from small wind farms is clearly a relevant issue, there are other important channels, that our data cannot capture, that allow the criminal organizations to extract at least part of the regulatory rents even outside their established territory, exploiting their influence on the regional administration. As said before, mafia organizations can play the role of facilitators, especially in the case of big plants, more exposed to public attention and requiring more stringent controls for the construction and the management of involved funds. In recent years,

²⁸ Up to the 60 percentile the distribution is populated of zero's in two third of the observations. We tested different subset of quantile regression and the results are similar to the regression presented.

²⁹ We also implement this method for the number of wind plants present in each municipalities, but the results are not statistically relevant.

judicial cases have shown direct involvements of managers affiliated to mafia families who facilitated and accelerated the process for obtaining the construction permissions.³⁰

6. Apulia vs Sicily: another model of project selection

To test the robustness of our findings, we replicated our analysis for a different Southern region, Apulia, where investments in wind farms have been quite relevant. In this region mafia-like organizations, as Sacra Corona Unita, exist although they are less diffused and less powerful when compared to Sicilian Mafia, as they are concentrated around big cities and along the coastal strip, where the traditional smuggling activities took place. In the case of Apulia installations of windfarms have been supported and stimulated by the local governor, Nicola Vendola, who based his political campaign on the promotion of eco-sustainable policies. At the same time, investigations have not unveiled a significant involvement of criminal organizations in this business. Hence, Apulia seems an interesting control case to replicate the analysis, testing whether the specific (and negative, in this case) evidence of the investigations is confirmed also at the aggregate level of the overall investment in wind farms in the region.

We start by noticing that the correlation between the average wind power and wind farms presence is positive and higher than in the case of Sicily (correlation coefficient 0.39). In order to apply our econometric test to this region we replicated an equivalent database for Apulian municipalities. As in the Sicilian case we have the information on whether the local municipality is affected by the presence of criminal organizations (indicator DIA). We also retained the logarithm of inhabitants and the extension of the municipality as additional controls. Table 8 below reports the result of our baseline econometric model.

We obtain in Apulia different results compared to the Sicilian case. Notably, the indicator of wind-speed (and the surface of the municipality) is positively and significantly correlated to the number of wind plants in the territory, while the presence of crime (DIA indicator) is not significant.

Hence, comparing the results in Table 7 and in Table 9 we find a very different pattern of local investments, where in the case of Sicily the probability of having a wind plant in a municipality does not depend on the windy conditions of the territory while it is positively affected by the presence of a local criminal organization in the territory. In the case of Apulia, the other Southern region where significant investments in wind plants have been undertaken, we find a different pattern of investment that positively depend on the local favourable windy conditions whereas the

³⁰ A specific example is the investigation Eolo in 2013, that has led to a confiscation of a value of 1300 million of Euros and to the arrest of Vito Nicastrì for his involvement in several inquiries on mafia and renewable sources. He was a facilitator, known as the “King of the wind”, procuring authorizations for wind farms and being a bridge between entrepreneur and public administration. Another investigation, called Broken wings, focused on the figure of Salvatore Moncada, one of the most important entrepreneurs in the wind sector. He denounced the request of payment of 70.000 euros for 7 projects for obtaining the necessary authorization for the realization of same parks by Vincenzo Nuccio. Vincenzo Nuccio was found to be a figure linked to Vito Nicastrì and has been arrested.

involvement of local criminal organizations does not emerge from the data. These findings at the aggregate level of the regions are therefore coherent with the involvement in the wind business of criminal organizations in Sicily but not in Apulia that emerged in specific investigations of the enforcers.

Table 9: Apulia: linear probability model windfarms presence 2018

	(1)
	Presence Windfarm
	(standard error)

Wind power	0.140** (0.066)
Dia	0.029 (0.057)
Log(inhabitans)	0.012 (0.040)
Surface	0.001*** (0.000)

N	258
R ²	0.371

standard error robust to heteroscedasticity - include provincial effects

7. Conclusions

This paper has analysed the infiltration of criminal organizations in Sicily in the wind power business. In the last 20 years the Italian governments, sustained by the European policies, have introduced several and generous incentives for renewable energy sources, within the wider set of policies on climate change. As a result we have observed a very rapid growth in renewable sources, that are today among the main technologies in energy production. Such a rapid development has been realized with a set of policies that have not been always coordinated nor targeted to minimizing the costs of intervention. As a result, generous rents have been left to renewables, including wind power plants.

Judicial inquiries have uncovered the involvement of mafia families in several investment projects as direct developers or through intermediation services. The aim of our analysis is to complement the evidence on specific episodes stemming from judicial inquiries with a more complete evaluation of the investments in wind farms in the whole region, considering a disaggregated set of data at the municipality level. We find that the probability of observing a wind farm is higher in municipalities where there is an established mafia family, whereas the local wind speed conditions do not matter. Additional evidence shows that the kind of investment observed in such municipalities is biased towards smaller plant size. We have compared these results with the investment in the wind

business in the other Southern region, Apulia, where the industry has significantly developed, supported by a very active and committed regional administration, but where inquiries have not uncovered episodes of involvement of organized crime. The pattern of investment in this case is driven by wind speed conditions while the presence of organized crime in the territory does not matter.

Hence, our results referred to the overall investment at the regional level are coherent with the specific evidence that judicial inquiries have shown regarding the involvement, in Sicily, or the absence, in Apulia, of criminal organizations in the wind business.

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