WINERCOST SHORT TERM SCIENTIFIC MISSION – A REPORT

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1. Topic

A comparative analysis of planning regulation and policy constrains and incentives for the siting of wind turbines in the urban context: preparing the "ground" for new technologies

2. Introduction

Zooming on the similar and different characteristics of Spain and Israel, this STSm was conducted with the aim of initiating a comparative study of the regulatory planning and land/building -related constrains and incentives of small-scale wind energy facilities siting. In different countries, diverse approaches are combined to promote or constrain renewable energies according to national targets or environmental goals, but they are often not sufficient to achieve either of these. As has been argued by comparative planning research, each country has been developing its own planning, regulative and public-policy approach (Alterman, 2001). Yet, while countries differ both in their administrative structure and cultures, these institutions are crucial to understanding how wind energy (or other renewable energies) and other spatial-related consideration - can better reconcile (Terrados, Almonacid, & Pérez-Higueras, 2009). Comparative study of the ways different planning systems regulate small scale wind turbines may yield interesting models or some "good practices".

In the WINERCOST workshop entitled "Trends and Challenges for Wind Energy Harvesting", that took place last year in Portugal, several researchers, Paul Borg & Huber (2015) Norton (2015), Efstathiades (2015), and Hamza (2015) among them, have laid down some of the main non-technical knowledge gaps existing with relation to the installation of small scale wind turbines in the built environment. According to this theoretical mapping, while the potential installation of small scale wind turbines in cities co-exist well with current trends urban transition ("smart cities"), they might also face technic, economic, environmental, and social challenges. Many questions, broadly related to sustainability and planning factors, require further research and more case-studies would further deepen our understanding of these challenges.

This paper report on the study conducted in Barcelona as part of the author's STSM funded by this COST action with the aim to contribute to the socio-environmental perspective on small-scale wind turbines in the built environment. The comparative analysis will be published in a peer-reviewed journal.

3. Literature review

Countries worldwide have set national targets of energy production from renewable sources, primarily involving hydropower, solar, wind, bioenergy and geothermal power. These goals are part of global efforts to combat climate change and concerns regarding depletion of fossil energy resources and their local risk to human health and environmental sustainably. Current policy and regulative initiatives, however, have not yet produced a complete transition to a low-carbon regime, and renewable energy technologies have yet to be mainstreamed (Midttun, 2012; Teschner & Paavola, 2013).

Clearly, various constraints play a role in the slow uptake of renewable energy on a larger scale. There are non-regulatory barriers to renewable energy development. These derive from high transaction costs of small and medium facilities due to the economies of scale, information deficiencies, institutional objections to grid interconnection, or perceptions of risk (Outka, 2010). Additionally, barriers to the construction of renewable energy facilities are often related to the lack of broad social acceptance regarding the associated issues, including competing aims such as land conservation vs. climate change mitigation, and conflicting environmental paradigms e.g. (Wolsink, 2012). Above all, spatial considerations (e.g. scale of land consumption, location, proximity) are considered fundamental in shaping dynamics in the energy sector (Coutard & Rutherford, 2010)

Tendencies toward a distribution of large-scale renewable energy infrastructure from centralized mega-infrastructures to small technologies at urban or household scales have potential to dissolve this lock-in situation in the renewable energy sector (Salkin, 2009) and several have already partially studied the socio-environmental contribution potential of small-scale energy applications (Alanne & Saari, 2006; Burton & Hubacek, 2007) or institutional barriers (Carley & Andrews, 2012).

While it has been recognized that there is a strong link between the geographic distribution of costs and benefits of renewable energy e.g. (Joss, 2015), research has generally neglected land-use regulatory frameworks and land-use questions of siting for renewables. At the same time, decentralization of RE technologies and their integration within the urban setting is a new research arena, and related implications are only now starting to surface e.g. (Norton, 2015).

4. List of interviewees in Barcelona

Affiliations
• Director General for Environmental Policy and Sustainability at the Government of Catalonia's Environment and Housing Ministry (former)
• A renewable energy expert, former energy consultant to the Municipality of Barcelona
• Researchers, Energy and Sustainability group, Universitat Autònoma de Barcelona
• A planner and lawyer in Barcelona, expert on urban planning law and environmental law
• Founder and president of the Associació de Municipis Eòlics de Catalunya (Catalonia Municipalities Wind Association) and Mayor of one of the small villages in west Catalunya
• Senior consultant in renewable energy technologies company, and former planner in the Energy Division in Barcelona Regional

Photo 1: Interviewing

5. Policy documents, plans and legislation review

- Plan de l'energia I del canvi climatic de catalunya 2012-2020
- Balanç energetic de Barcelona 2012 [Energy balance of Barcelona 2012]
- The energy, climate change and air quality plan of Barcelona (PECQ 2011-2020)
- International Energy Agency, Energy policies for IEA countries: Spain, 2015 review
- Código Técnico de la Edificación (CTE), Document HE [Spain Building Technical Code, 1.1.2002]
- DECRET 147/2009, de 22 de setembre, pel qual es regulen els procediments administratius aplicables per a la implantació de parcs eòlics i installacions fotovoltaiques a Catalunya [Catalan Wind and Photovoltaic Regulation Decree]
- Real Decreto 900/2015, de 9 de octubre, por el que se regulan las condiciones administrativas, técnicas y económicas de las modalidades de suministro de energía eléctrica con autoconsumo y de producción con autoconsumo [Royal Decree 900/2015 , of 9 October , laying down conditions governing administrative, technical and economic arrangements of energy self-production and consumption]
- Map of Wind Energy Resources

6. Overview of the findings

In what follows, we present in a nutshell the Spanish renewable policy. We then zoom into key-points in wind turbines planning regulation and finally discuss some of the findings with respect to small scale wind turbines in the built environment, as collected through in-depth, semi-structured interviews with experts in these topics, combined with the analysis of policy documents and relevant legislation.

Planning and infrastructure in Spain

The post-Franco constitution (1978) distribute planning authority to the autonomous communities and regional government institutions. While, in principle, infrastructure crossing more than one autonomous community is under the responsibility of the national government, including electricity links. Regarding the energy sector, the autonomous communities have legal competences, primarily in authorizing power generation plants of less than 50 MW, that is, most renewable energy facilities, and distribution networks of electricity and natural gas. They are also strongly involved in designing and implementing climate change, energy efficiency and renewable energy policies at the regional level (IEA, 2015). As a result, policy, planning and regulation with respect to siting of wind turbines vary between the regions, with little transparency and no consistent comparative data base (personal communication, February 2016).

Importantly, the autonomy of the municipalities with respect to land-use planning and building authorization is even more strongly exercised (Marshall, 2014).

Renewable energy in Spain and Catalonia

According to the IEA, Spain's Electricity generation mix is composed of: nuclear (20.9%), wind (19.1%), natural gas (17.2%), coal (16.3%), hydro (14.3%), oil (5.2%), solar (5%), biofuels and waste (2%). The commercial services and agriculture sectors were the largest consumers of electricity (35.9%), followed by the residential sector (30.6%), industry (29.5%), energy sector (2.1%), and transport (1.8%). During a decade 2004-2014, there was a sharp decline in the use of fossils fuels for electricity production while wind and solar generation rapidly grew. Yet, it is estimated that the use of natural gas will increase dramatically and by 2025 will become the main fuel in electricity generation (27%) (IEA, 2015). Large electricity utility companies are generating electricity in combined cycle power plants (gas and a steam turbine together), in fact, much more electricity than local demand, thus making Spain a large exporter of electricity to Portugal, France and Morocco.

Spain has sighed Kyoto Protocol in 2002 and the Catalonia government had to limit emissions during 2008-2012 period to a 15% increase compared to 1990 levels. The Spanish government have also set a 20% renewable energy target (and 10% of renewables in the Transportation sector) by 2020, in line with European Union targets.

Since the 1980s, during the 1990s, and intensively up to the year 2012, the Spanish government has promoted renewable energies through a generous Feed-In-Tariff (on top of the market price) and with a quota that was almost unlimited. This have led to a boom of large wind farms and solar field installation across the countries by international corporations. In 2012, however, feed-in-tariffs were canceled for new facilities via Royal Decree 1/2012 and for all renewable generators via Royal Legislative Decree 9/2013 (Colmenar-Santos, Campíñez-Romero, Pérez-Molina, & Mur-Pérez, 2015; de Alegría, Basañez, de Basurto, & Fernández-Sainz, 2016).

The approval of the Energy Plan of Catalonia 2006-2015 has set goals in the field of wind energy establishing a goal of reaching 3,500 MW in the year 2015.

Large and small scale wind energy in Catalonia

The installed capacities of wind energy in Catalonia are detailed in Figure 1:

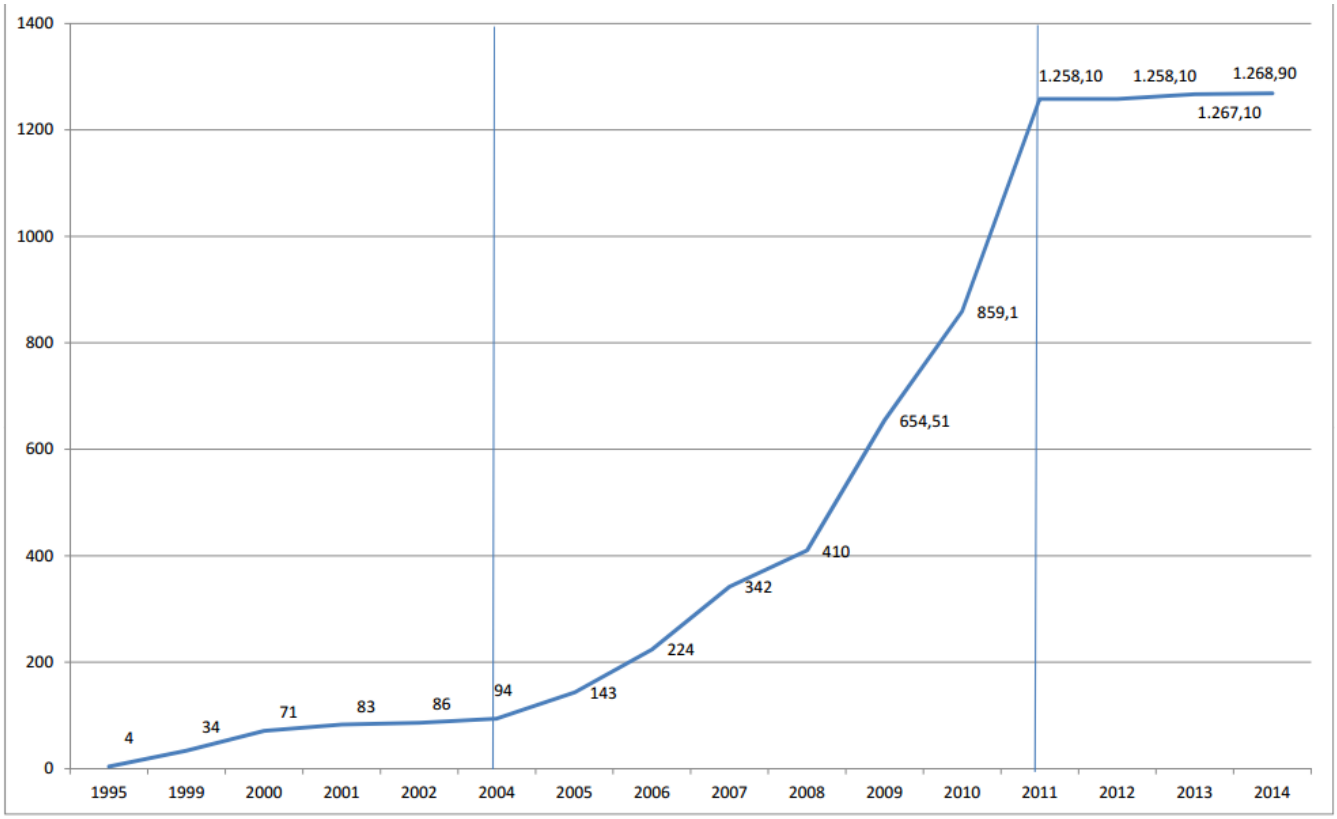

Figure 1: Installed wind power in Catalonia (MW). Source: Mr. Frederic Ximeno, ERF - Estudi Ramon Folch & Associats S.L

Territorial disputes in Catalonia around electrical systems appear in the late 1990s, especially in the southern comarcas (sub-regions), where the first large wind farms were sited: Tortosa (1995) Pradelll'Argentera (1998) and Perello (1999). While the first wind power projects did not raise excessive social opposition, seen as unique and isolated phenomena, it has slowly evolved into strong local oppositions to the projects that followed and, in general, to the process of planning and implementing wind farms. According to (Saladié-Gil, 2011), the local opposition movement was not against wind power itself, but their perceived impacts on the environment. Local citizens' frustration has increasingly intensified when uneven distributional costs and benefits became apparent. Zografos & Martínez-Alier (2009) have argued that with a significant impact on their landscape, the local population of Terra Alta (rural Catalonia) objected to the plans that envisioned the generation of 40% of total wind energy in Catalonia in this relatively small territory. As Saladié-Gil (2011) commented, the main opposing argument was that wind energy is good but concentration in one area will cause landscape degradation, not only by the wind turbines, but not less importantly, the high voltage electricity lines. Local citizens found themselves alone in-front the wind companies; Their local government, which facilitates siting decisions as well compensation agreements between the affected parties, did not protect the interests of the landowners (Zografos & Martínez-Alier, 2009).

Photo 2: Wind farms with turbines located 500 meters from the houses in La Granadella

As a response to the wide public objections, the Catalan government have issued the Decree 174/2002 of 11 June, regulating the implementation of wind power in Catalonia [DECRET 174/2002, d'11 de juny, regulador de la implantació de l'energia eòlica a Catalunya]. The regulation include a Map of Wind Energy Resources, which guide wind turbines siting (see Figure 2) that was published at the same year. The Map is a legally-binding document, as a Territorial Plan, based on Urban and Land Planning Law of Catalonia. This map is the major spatial tool that directs siting of wind turbines. It evaluates wind availability across the region, and mark compatible, conditioned and non-compatible areas for the siting of turbines. Wind turbines are not allowed to be installed in declared nature reserved, this being the major and almost single pre-determined limitation to their installation.[1]

[1] Government Agreement 112/2006 of 5 September, designates special protection areas for birds (SPAs) and approved the proposal Sites of Community Importance (SCI), which are part of the NATURA 2000 network. It requires further investigation to see if and how these are incorporated in the Wind Map.

Based on the binding Wind Map, the 147/2009 of 22 September Decree was enacted, regulating administrative procedures applicable for the implementation of wind farms (10-50 MW) and photovoltaic installations (exceeding 100 kW) Catalonia. According to interviewees, this Decree was published in order to: 1) define priority areas (ZPD) and public tender mechanism for wind farms applications; 2) Set the conditions for small wind farms[2]; 3. Promote integrated administrative process of energy, land and environment considerations. The Decree was published and Public Tender was made, however, results are suspended because the courts determined that the process should also have to include an Environmental Strategic Assessment. The Generalitat de Catalunya are in the process of revising the Wind Map according to the new environmental requirement, but the public has not been consulted yet regarding the criteria for siting (personal communication, February 2016).

Some evidence suggest that there might be a thin yet strong connection between the emphasis of central governments and planning institutions on large scale wind farms and the regulatory preparedness to micro-generation. Similar to traditional sources of energy production (i.e. nuclear/natural-gas/coal based power-plants), centralized production is easier to plan and manage. It is also the structure energy sectors are used to. Small-scale technologies, indeed require much more than technological feasibility; "these require a mind shift….." (Personal communication, February 2016). Part of a current objection process of local residents to existing agreements/contracts between wind companies and small rural municipalities in Catalonia contains also the claim that these massive infrastructures preclude the adoption of small-scale wind energy installations by local residents. The Associació de Municipis Eòlics de Catalunya is making efforts to lobby a bill, which will a compulsory "compensation tax" the wind companies will have to pay the local municipality. However, the bill suggests this tax will only apply to wind turbines larger than 3 MW in order "to encourage self-supply through the installation of small-scale turbines" (personal communication, February 2016)

[2] The law defines small plants as 5 wind turbines and a maximum power of 10 MW and is located at a minimum distance of 2 km from another wind farm. The details of the siting regulation in this law were not examined in-depth because it is still under revision and also not relevant to micro-generations.

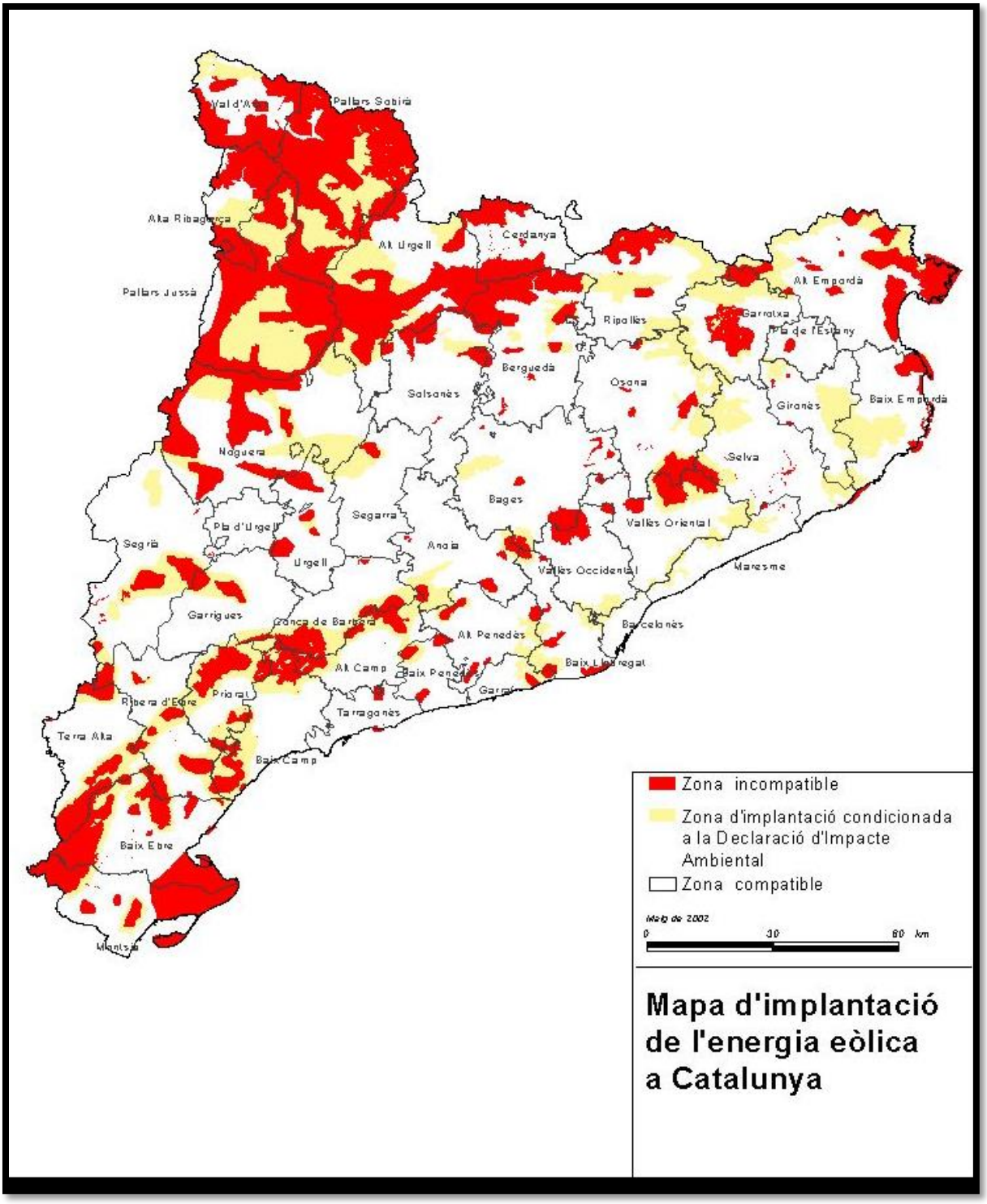

Figure 2: Wind Map of Catalonia, 2002. Source: Cataln Government website

Scaling down, and focusing on Barcelona, we found four major renewable energy technologies currently in use: Biogas, Solar PV, Solar thermal, and a small amount of mini-hydraulic. As far as I could find, official data is a bit out of date (published in 2012 and presents data up to 2008), but according to interviewees the balance between sources did not change significantly. In the following table it can be noticed that solar thermal is the largest renewable source, and its total energy production was doubled between 2001 and 2002, following the Solar Thermal Ordinance (In 2002, Barcelona's city council established a target of reaching 96,300 square-meters of solar collectors installed in the city).

Renewable energies [GWh]	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Electricity with biogas (Garraf + Ecopark)	0.00	0.00	0.00	2.66	28.40	54.95	36.08	32.58	35.57	35.04
Mini-hydraulics Trinitat	6.22	5.71	5.16	6.30	6.13	5.11	5.11 (*)	5.11 (*)	3.34	1.47
Photovoltaic	0.003	0.024	0.046	0.130	0.158	0.758	1.009	1.227	1.453	7.620
Solar Thermal	0.464	0.664	6.410	12.633	16.560	20.846	26.842	34.155	43.299	52.405
Total renewables production	**6.68**	**6.40**	**11.62**	**21.72**	**51.25**	**81.66**	**69.03**	**73.07**	**83.66**	**96.53**
Renewable energies [m²]	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Solar Thermal	580	830	8,013	15,791	20,700	26,058	33,552	42,694	54,123	65,506

Table 1: Energy production from renewable sources in Barcelona 1999-2008 (source: The energy, climate change and air quality plan of Barcelona 2011-2020)

Catalan government has some allocation for small wind turbines (1-2 MW) but there are no installations across the built areas in the region. Wind turbines are not used in the city and there are only 6 small scale-wind turbines, coupled with small solar panels that operates six street lamp on the promenade along the beach (Photo 3). This was an experimental installation and it was not developed further (personal communication, 2016). In the industrial area of the city, there is a private installation of a small scale wind turbine on the ground, which charges electric vehicles, and a few integrated on the adjacent industrial structure (Photo 4).

Photo 3: Street light powered by solar panels and small scale turbines in Barcelona northern beach. Source: Reuters

According to our interviewees, the wind potential in Barcelona is low. Coupled with the natural conditions of Barcelona and high solar energy potential, urban planners do not see wind energy as a significant source for renewable energy for the city (personal communication, February 2016). However, most of the interviewee expressed a great support of small scale wind production for other built areas in Spain.

Photo 4: Small-scale wind turbines in Zone Franca, Barcelona's industrial site. On the left, the wind turbine (4kW) charges electric vehicles. Pictures from: CESPA presentation, 2012

The Spanish laws or spatial plans, however, do not include a clear and consistent classification of different scales of wind turbines (the law mostly refer to small or large wind farms according to the amount of MW production). In addition, as far as the expert we talked with are aware of, legislation which regulate planning and permission procedures of small scale wind energy installations on rooftops does not exist (personal communication, February 2016). The Spanish Building Code from the year 2002 refers only to: limitation of energy demand, thermal efficiency, lighting efficiency, solar thermal contribution, and solar energy contribution. However, according to a Lawyer expert in this field, any installation on rooftops in Barcelona will require a building permit (the same goes for wind turbines and television antenna) (personal communication, February 2016).

Nevertheless, the Spanish government has recently put in effect a new Royal Decree which regulate self-consumption. This is the Real Decreto 900/2015, de 9 de octubre, por el que se regulan las condiciones administrativas, técnicas y económicas de las modalidades de suministro de energía eléctrica con autoconsumo y de producción con autoconsumo [Royal Decree 900/2015, of 9 October, laying down conditions governing administrative, technical and economic arrangements of energy self-production and consumption]. This decree has a

significant impact small-scale installations of renewable energy because it determines a tax on the energy produced, and the use of batteries or storage systems; it also cancels the FIT incentives to install small scale renewable energy technologies and to receive compensation for any unused electricity which transfers to the grid.

There are many who oppose this new decision of the central government. The municipality of Barcelona, for example, has submitted a challenge against its draft in June 2015, stating that self-production through PV and small-scale wind turbines is crucial in meeting CO2 reduction commitments of the City of Barcelona, and supplying clean energy needs: "...demand would also be complemented by boosting self-consumption through several technologies, not just with co-generation but also with the use of solar panels and micro wind turbines, which can make as much sense, if not more, for a city like Barcelona. The Royal Decree would lead to a total lack of any incentive for distributed generation" (Municipal Information Consumer Office website, Barcelona City Council, 23.6.2015). Also one of the interviewee believe that "this is a mere political decision, which supports the big electricity companies... and that efforts are made in the city to find ways to bypass it".

7. Intermediate insights

There are several important findings which will be analyzed in-depth for the purpose of the planned comparative study.

- In general, siting of renewable energy in Catalonia is very project-specific. There is a lack of regulatory framework, norms or detailed laws. This is true for both large and small scales wind energy facilities.
- What we see is that technical improvements are necessary and are defiantly drivers of policy and regulatory change. However, we can also see that some larger dynamics in the energy sectors and structural lock-ins (such as decentralization challenges) may affect the paste of small-scale wind energy technologies.
- The perception of renewable energy experts in Barcelona is that the technologies of small-scale wind turbine are not compatible with urban limitations. That they are not developed enough and that in any case, the PV technology is much more suitable to use in urban areas in the climatic conditions of Barcelona. Also, wind turbines are competing with the decreasing cost of PV. Nevertheless, most stakeholders expressed a support in small-scale wind turbines once these are applicable and affordable.
- The integration of small wind turbines in the built environment requires an experimental approach of planning systems and the ability of the system to engage with technological innovations. There is a need to further investigate appropriate regulatory tools to promote technological niches.

- Barcelona may provide other cities/countries their contractual model for shared energy installations on the rooftops of condominiums (in terms of property rights or shared responsibility of maintenance) for the purpose of wind turbine installation on roofs – the city's Solar Thermal Ordinance have already defined set such a model. This is important for countries such as Israel, where there are individual solar thermal panels for water heating for each apartment and the "condominiums community" does rarely deal with shared energy facilities on the roof. An interesting initiative in Barcelona was an attempt to examine the potential of using rooftops for "social purposes" and one of the alternatives was renewable energy production. A policy guideline was published, but it was not developed any further.

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