Universitat Autònoma de Barcelona

Decarbonizing the South.
Space, justice and politics at the renewable energy frontiers

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PH.D. DISSERTATION BY
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DECARBONIZING THE SOUTH

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Supervisors:
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Doctoral Program on Environmental Sciences ICTA-UAB
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Preface

In 2017 I traveled to India with my Professor Joan Martínez-Alier, and my friend Brototi Roy. We visited the Timbaktu Collective, a grassroots initiative located in a distant region of Andhra Pradesh aimed at restoring wastelands and empowering local communities through cooperatives and self-governance initiatives. We went there to primarily understand the conflict arising against the expansion of wind farms in the area. Later on, we traveled to West Bengal, crossing the coal mines at Dhanbad, Asansol, and Raniganj. This is a tremendous coal region with many coal cycle wallahs: men cycling to sell or consume coal at home. Probably an illegal activity, and indeed a risky endeavor for their health. There is an absolute difference between the environmental impacts of wind turbines and coal mines. Yet, there are questions for the mega-renewable energy plants that are not being fully discussed.

When I asked the Director of Timbaktu's Conservation Program why they were against the deployment of wind power turbines, he quickly replied: *"we don't want to turn this space into an industrialized landscape, and that industrialization forces us to go to the city, to become modern slaves."* His words were striking and directly related to what I had previously learned about the resistance against wind power in Oaxaca, Mexico. In Oaxaca, communal and indigenous lands across the Isthmus of Tehuantepec region were distributed into different land plots for energy corporations. Zapotec and Huave communities have been resisting these plans, denouncing a neo-colonization process led by multinational companies and their elite national allies. In opposing the corridor, grassroots organizations mobilized to defend the indigenous territories, livelihoods, and identities. And when doing so, they openly questioned the means and ends of a transition based on the promises of green capitalist development. **What underlies the expansion of renewable energies is a matter of politics. At stake are the competing visions around different socio-ecological projects, spatial organizations, and ways of distributing power.**

This thesis is inspired by the communities that, in different peripheries of the global economic system, have been bold enough to state that they are not against renewable energies but against how these are being framed, deployed, and appropriated. This is certainly not a straightforward statement to make. We are facing an anthropogenic climate crisis,

mostly driven by the use of fossil fuels. Yet, the argument that opposition towards renewables is simply a "selfish" attitude against the "good for all" seems analytically insufficient and politically vague.

On a personal level, mobilizing this research has not been easy either. Surrounded by environmental scholars, mostly from the Global North's privileged realities, my initial seminars discussing conflicts against wind power were taken as "doubtful" or "unusual". I often heard reactions like: *In my country, we have fields with turbines, people keep harvesting, and we can cycle around.* Or: *your research seems to go against our aims as environmentalists*…. I realized I had a great challenge ahead. As my study took form, however, the conversation started to shift as well.

Many social and political debates towards renewables also evolved throughout these years, increasing space in critical academic circles. Today, renewables are seen beyond their technical aspects: they are being politicized. This thesis is a reflection of such evolving intellectual considerations and emergent political process.

Abstract

Renewable energies are expanding globally due to the increasing concerns over anthropogenic climate change and concomitant calls to decarbonize the world economy. In this process, international agencies, developing banks, and private investors are progressively shifting attention towards the "developing world," promoting a rapid deployment of large-scale projects. This momentum, however, brings a paradox to the fore. The idea of "slowing-down" climate change while "speeding-up" green development encounters increasing resistance at local scales. These emerging processes bring new questions for both Political Ecology and Environmental Justice studies: How is the expansion of renewable energies envisioned? Under which assumptions? How is this process taking place (where, by whom, and for whom)? How are local territories being rearranged for such purposes, and how are rural communities involved, actively or passively, in such processes?

This dissertation studies the ongoing expansion of mega wind and solar power projects across the Global South and the local contestations emerging in response. The work starts from a biophysical perspective, highlighting that the required phaseout from fossil fuels and towards renewable energies implies spatial reconfigurations at different scales. This process, it shows, involves deep rearrangements of political, economic, and cultural dimensions, shifting attention to how renewable energies might reinforce or revert existing power structures. In positioning the study of environmental conflicts as the central subject of analysis, the dissertation sheds light on the emerging voices of dissent that challenge dominant approaches to renewable energy implementation stemming from the Ecological Modernization Paradigm and its growth-based development formulas.

The work rests on the Environmental Justice Atlas and other critical cartography exercises, providing a multi-scalar analysis of renewable energy investments and conflicts. It presents different case-studies from Mexico as core examples of such processes, yet it offers parallel insights from different experiences across the Americas, Asia, Africa, and Europe. Spanning from the regional, national, and global scales, the thesis provides insights on the common patterns and diverse narratives of communities claiming their rights for recognition, democratic participation, and redistribution in envisioning a low-carbon future.

The thesis highlights six transversal findings that shed light on how space, justice, and politics intersect in the study, planning, and imagination of (just) energy transitions:

1.Renewable energies' biophysical nature, more dispersed and less productive than fossil ones, ***combined*** with the imperative of sustaining the growing industrial metabolism, translates into new forms of environmental change and conflict.

2.-The expansion of renewables under a growth-based development paradigm, produces new energy frontiers. These frontiers shift attention to its "horizontal" character: vast tracts of land are required to harness the flows of solar radiation and wind currents at an industrial scale.

3. Neoliberal policies are playing a central role in "breaking the barriers" for these frontiers to expand. The deregulation of land transactions and the liberalization of electricity markets facilitate the rapid implementation of large-scale, centralized, and corporate facilities, commonly supplying electricity to different extractive activities, industries and cities.

4. Shifts in land tenure, land uses, and land cover are favoring private energy corporations while disproportionally affecting peasant, indigenous, and other rural communities across the Global South. In this process, public and communal approaches for an energy transition seem to be foreclosed.

5. Land becomes the central political subject of emerging conflicts. Local communities mobilize concerns, claims, and discourses around the lack of recognition, participation, and distribution in changes over access, control and valuation of their territories. At larger scales, conflicts unveil how mega-renewable projects reinforce the center-periphery, rural-urban, north-south dynamics that have characterized the fossil energy system.

6.- As a framework for analysis and as a discourse of political action, Environmental Justice reveals new insights and sets important political questions in the energy transition. Rather than only negotiating the benefits of low-carbon development, popular environmental struggles are increasingly opening spaces to configure alternative approaches to more sufficient, egalitarian, and commons-based metabolic transformations.

Keywords: social metabolism, renewable energies, low-carbon development, environmental conflicts, popular environmentalism, neoliberalism, the commons.

Resumen

Las energías renovables se están expandiendo globalmente como respuesta al cambio climático antropogénico y al imperativo por de-carbonizar la economía mundial. En contexto, se observa un creciente interés por parte de organizaciones internacionales, bancos de desarrollo e inversores privados para promover la rápida implementación de megaproyectos de energía renovable a lo largo del Sur Global. El ímpetu hacia una transición verde se encuentra, sin embargo, con una aparente paradoja: la idea de "desacelerar" el cambio climático "acelerando" el capitalismo verde encuentra una creciente resistencia a escala local. El paulatino aumento de conflictos en torno a megaproyectos de energía renovable sugiere, así, nuevas preguntas para la Ecología Política y la Justicia Ambiental. ¿Cómo se está concibiendo la transición hacia las energías renovables? ¿Bajo qué supuestos? Cómo se desarrollan estos proyectos: ¿en dónde, por quién, para quién? ¿Qué tipo de transformaciones desatan estos proyectos y cuál es el rol de las comunidades rurales en definir tales cambios?

La presente tesis doctoral estudia los fenómenos arriba apuntados y se enfoca en el caso de la energía eólica y solar. El trabajo pate de una perspectiva biofísica, enfatizando que la necesaria salida de las energías fósiles y hacia las energías renovables necesariamente implicará reconfiguraciones espacio-territoriales en distintas escalas. Estos procesos, cuestionan el cómo las energías renovables podrían revertir o, por el contrario, reforzar, las desiguales estructuras de poder existentes. Al posicionar el estudio de los conflictos ambientales como tema central de análisis, la disertación arroja luz sobre las voces de disidencia que desafían los enfoques dominantes para la implementación de las energías renovables que se derivan del Paradigma de Modernización Ecológica y sus fórmulas de desarrollo basadas en el crecimiento.

El trabajo se basa en el Atlas de Justicia Ambiental y otros ejercicios de cartografía crítica, proporcionando un análisis multi-escalar sobe las inversiones y los conflictos. La tesis presenta diferentes estudios sobre México, pero ofrece perspectivas empíricas paralelas sobre diferentes experiencias en las Américas, Asia, África y Europa. Cubriendo las escalas regional, nacional y global, el trabajo delinea patrones comunes y diferencias entre casos, dando visibilidad a las voces que reclaman mayor reconocimiento, participación democrática y redistribución en la transición energética.
El análisis conjunto de los distintos estudios de caso, arroja seis resultados transversales que enfatizan cómo el espacio, la justicia y la política se interpelan en el análisis crítico, la planificación y la imaginación de transiciones energéticas más justas y sustentables:

1. La naturaleza intrínseca de las energías renovables -más dispersas y menos productivas que las fósiles- ***combinada*** con el imperativo por mantener la expansión del metabolismo industrial, se traduce en nuevas formas de cambio y conflicto ambiental.

2.-Bajo el imperativo del "crecimiento como desarrollo", la expansión de energías renovables empuja a la creación de nuevas fronteras energéticas. Estas fronteras se caracterizan por su naturaleza "horizontal": se requieren grandes extensiones de tierra para aprovechar, a escala industrial, los flujos de radiación solar y las corrientes de viento.

3. Las políticas neoliberales están jugando un papel central en "romper las barreras" para la rápida expansión de estas fronteras. La desregulación de las tierras rurales y la liberalización de los mercados eléctricos van facilitando la rápida implementación de infraestructuras corporativas, centralizadas y a gran escala; mismas que tienden a suministrar electricidad para distintas actividades extractivas, industrias y nodos urbanos.

4. Los cambios en la tenencia y usos de la tierra, así como en la cobertura vegetal de los territorios están favoreciendo a corporaciones energéticas privadas, mientras afectan de manera desproporcionada a las comunidades campesinas, indígenas y otros grupos rurales del Sur Global. En este proceso, los enfoques públicos y comunitarios para una transición energética parecen quedar eliminados.

5. La tierra se convierte en el tema político central de los conflictos emergentes. Las comunidades locales movilizan discursos en torno a los cambios sobre el acceso, control y valoración de sus territorios. A mayor escala, los conflictos revelan cómo los megaproyectos renovables refuerzan la dinámica centro-periferia, rural-urbana, norte-sur que ha caracterizado al sistema de energía fósil.

6.- Como marco de análisis y como discurso de acción política, la Justicia Ambiental revela nuevas percepciones y plantea importantes cuestiones políticas en la transición energética. En lugar de solo negociar los beneficios de un "desarrollo bajo en carbono", las luchas ambientales populares están abriendo espacios cada vez más amplios para configurar enfoques alternativos a la transición, considerando transformaciones sociales que apuntan a la configuración de metabolismos basados en la suficiencia, la equidad y los bienes comunes.

Palabras clave: metabolismo social, energías renovables, desarrollo bajo en carbono, conflictos ambientales, ambientalismo popular, neoliberalismo, los comunes.

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Chapter 1
Introduction

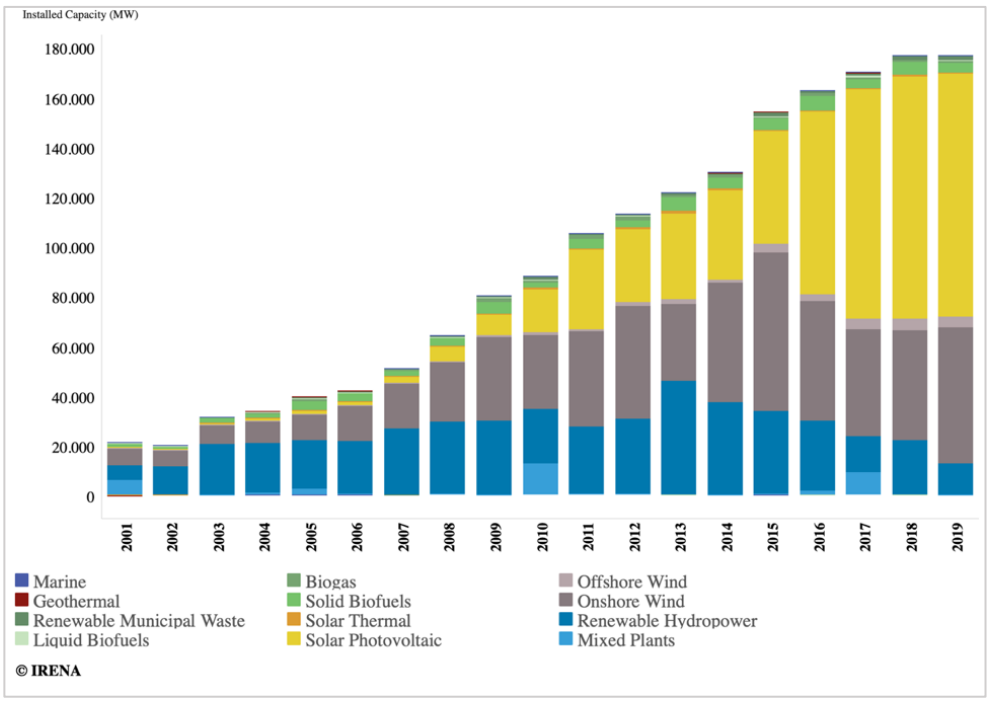
1.1 Background

Renewable energy facilities are expanding globally due to the increasing concerns over anthropogenic climate change and concomitant calls to decarbonize the world economy. Since 2004[1], the global installed capacity, production, and investment across all renewable technologies, has increased substantially, particularly within the electricity sector (REN21, 2014; FS-UNEP/BNEF 2018) (Figure 1.1).

The geographical *locus* of this new energy frontier is, however, noticeably shifting from the "North" to the "South" (Figure 1.2). While a decade ago, the world's wealthiest countries accounted for the bulk of renewable investment and deployment activity, developing nations are now taking the lead (Bloomberg NEF 2018, 2019). In 2020, developing and emerging economies outweighed developed countries in renewable energy capacity investment for the fifth year running, reaching USD 152 billion (REN21, 2020). International agencies, governments, and private corporations are actively promoting this trend through different initiatives that range from new development programs and regulatory frameworks, emission reduction compromises, "flexible mechanisms" (i.e., carbon permits and trading), assistance programs, assessment reports, and a growing number of maps to identify investment opportunities. As a result, the so-called "developing countries" show increasing investments in large scale projects, adding new capacity to their grids (Bloomberg NEF, 2018).

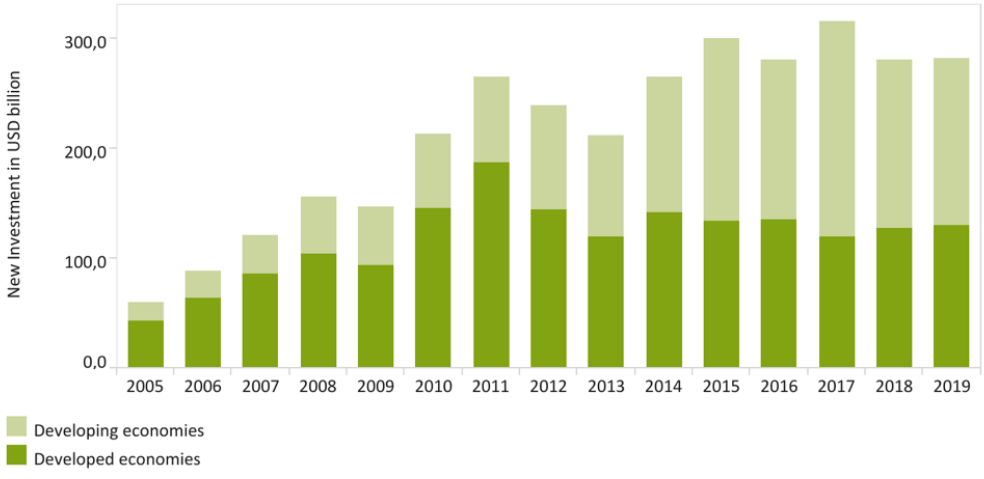
[1] Throughout 2004-2014, cumulative global investment reached $2.4 trillion. This figure excludes large hydro-electric projects of more than 50MW (FS-UNEP/BNEF 2018).

Figure 1.1 –Renewable electricity capacity: global net additions per year



Source: IRENA, Renewable energy capacity statistics 2020

Figure 1.2 –Global trends in renewable energy investments



Source Frankfurt School-UNEP Centre/BNEF. 2020.Global Trends in Renewable Energy Investment 2020, http://www.fs-unep-centre.org. Note: Investment volume adjusts for re-invested equity. Total values include estimates for undisclosed deals. Developed volumes are based on OECD countries excluding Mexico, Chile, and Turkey.

At first glance, this momentum appears promising. Renewable energies are not only an excellent opportunity to halt our dependency on fossil fuels but also opens space to build more equitable and sustainable societies. However, the expansion of renewable energies is a multi-dimensional process that involves major socio-environmental reconfigurations, and multidisciplinary approaches are needed to promote genuinely democratic, equitable, and sustainable transition projects. In this light, the common approaches to energy matters stemming from economics and engineering appear insufficient. Instead, this thesis adheres to the growing call to develop new approaches informing energy-related dynamics by integrating insights from critical social sciences (e.g., Araújo, 2014; Trainer, 2014; Sovacool, 2014; Huber, 2015). In the 21st century, it is not only vital to understand the variegated dimensions and intersecting dynamics involved in the expansion of renewable energies *but also* imperative to critically discuss the role that renewable energy technologies will play in sustaining or transforming the social, economic, and political structures established in the fossil-fuel era.

A general overview of the energy markets brings some light in this regard. Periodic reports show that renewable energies are expanding *together with* the continuous extraction of coal and gas at both global and regional scales (BP, 2019; Roy & Schaffartzik, 2021), while 1 billion people remain without electricity across India, Africa, Asia, and Latin America (IEA, 2017). Simultaneously, the increasing flow of capital for deploying renewable energies in the Global South is mostly concentrated in utility-scale electricity production, while distributed electricity projects remain relatively marginal (REN21, 2019). This outlook shows that while renewables are not necessarily substituting or preventing the expansion of polluting energy industries, the control and access of renewable energy resources remain highly unequal.

On the other hand, renewable energy sources require vast amounts of space to generate the energy that fossil and nuclear resources can produce in focal points of extraction (Huber 2015). This biophysical condition highlights a critical fact: if the level of energy flows continues to increase under a low-carbon system, area coverage of renewables will have to increase in large magnitudes (Scheidel & Sorman, 2012). Such forecast applies to biofuels, hydropower, wind, and solar radiation (see: Smil, 2008). This spatial dimension highlights the potential competition for land between industrial-scale renewable energy production and other uses such as agriculture, forestry, and conservation.

These processes are particularly relevant for countries in the Global South, where rural communities' livelihoods and cultural identities depend on the recognition of land rights and the access to resources attached to them[2]. The spatial rearrangements triggered by large-scale renewables call for nuanced scholarly attention and democratic political intervention, paying attention to the power relations, land tenure regimes, populations, and land uses at stake in different contexts. For countries in the Global South, where the narratives of development permeate over policy design, the expansion of renewables is likely to play a central role in the design of green development strategies and the ongoing industrialization of the rural world (Haberl et al., 2010; REN21, 2014).

The close relationship between energy and the social production of space, on one side, and energy and the reproduction of life - and the economy itself-, on the other, poses key political questions on the types of societies that renewables can and will sustain. How is the expansion of renewable energies envisioned? Under which assumptions? How is this process taking place (where, by whom, and for whom)? How are local territories being rearranged for such purposes? Furthermore, most notably: how are rural communities involved, actively or passively, in such processes?

There are no simple and straightforward answers to these complex dilemmas. While there is a clear scientific consensus that limiting global warming to 1.5°C requires a far-reaching transition in energy and other interrelated systems (IPCC, 2019), less debate occurs on the pathways to achieve such needs in equitable and sustainable ways. For example, the most ambitious scientific endeavors developed have focused on modeling the financial and technical feasibility of a 100% renewable-energy mix at both national and global scales (e.g., Jacobson et al., 2017; Clack et al., 2017). While scientifically rigorous and highly informative, these efforts tend to reduce the problem into a techno-economic one: i.e., how available technologies and efficiency improvements will automatically decarbonize our current economic systems. As this thesis addresses, these perspectives are rooted in the ecological modernization paradigm, a long-lasting tradition within the environmental sciences sustaining that economic growth and industrial development are both compatible and desirable ways to achieve environmental protection and sustainability.

[2] According to FAO, for example, approximately 2 billion people (26.7% of the world population) derive their livelihoods from agriculture, mostly in Asia, Africa, and the Americas (FAO, 2013, 2018).

Under the ecological modernization paradigm, renewable energy technologies are framed as an effective way to solve the climate crisis and as the solution to meet the ever-growing energy demands required for the constant expansion of the economy. However, scientific efforts framed within this paradigm seem to skip vital questions on the biophysical and socio-political dimensions of the required transition. Full decarbonization is more than a technical endeavor to add renewables into the energy mix. It involves a total phase-out of fossil fuels, a process that requires a full-scale transformation of the energy and material demands bound to modern societies (see: Chevallerau, 2017). These changes will, in turn, entail profound reconfigurations on the economic, social, and political spheres, all of which will bring new contestations over the distribution of power and resources at different scales.

The second line of debate growingly emphasizes that, while the expansion of large-scale renewables is in itself a strongly desirable pathway towards decarbonization, there is a need to address the justice dimensions involved in their deployment. Mostly rooted under the new concept of "energy justice," scholarly efforts aim to systematize the tenets of a framework that gathers the distributional, procedural, and recognition aspects of the energy transition (e.g., Jenkins et al., 2016; Sovacool et al., 2016).

Many NGOs and civil society organizations align with such views, arguing for establishing better instruments assuring transparency and justice in the expansion of renewable energy investments. However, most of these approaches tend to overlook the underlying causes of energy-related injustices and, instead, propose policy-oriented formulas that reaffirm the economic and political structures rooted in modern energy systems. As such, they offer "reformist" solutions to the trade-offs that come with the continual expansion of energy infrastructures and the technological developments proposed by the ecological modernization project (see: Scoones et al. 2015; Healy and Barry, 2019). As highlighted elsewhere, "without attention to power, political economy and politics, tensions between *decarbonization* and *justice* will continue" (Finley-Brook and Holloman, 2016).

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This thesis sustains that there is both a theoretical and empirical gap in these dominant debates. On one side, these new energy frontiers are not yet fully tracked and critically understood. It appears vital to address the underlying assumptions driving the

current expansion of renewables and the broader politico-economic structures shaping renewable energy deployment. On the other side, the growing number of conflicts around renewable energies calls for deeper scholarly engagements with the local experiences facing the socio-environmental transformations triggered by these projects. While global and national narratives tend to frame renewable energies as win-win solutions, local experiences of rural communities might vastly differ from such visions.

Mobilizations from the peasant, indigenous, and other communities analyzed in this thesis suggest that the expansion of mega renewable energy projects is an uneven and unequal process. As such, the well-known promises of "sustainable" and "low-carbon" development are being challenged in multiple ways. As argued throughout this thesis, the growing number of environmental conflicts emerging along these new energy frontiers places renewable energies as an increasingly important concern for Environmental Justice. Beyond the *Not-in-my-backyard* interpretations commonly mobilized by literature, these movements shed light on the challenges and limitations of a transition project driven by the ecological modernization paradigm. Most importantly, these movements inform broader debates toward building more just energy and climate futures.

1.2 Research questions and scales of analysis

This thesis explores the expansion of large-scale renewable energy projects in the Global South[3] and the local responses from rural communities that have emerged in response. It presents a multi-scalar approach with studies focusing on local, national, and comparative global scales.

Empirically, the work focuses on wind power and solar PV, being the two leading technologies in terms of investment and installed capacity across emerging and developing economies (REN21, 2019). The dissertation analyses the growing number of environmental conflicts arising in Mexico but provides complementary case studies from different countries of the Americas, Africa, Asia, and Europe, proving that observable patterns on both investments and local responses emerge across different contexts.

[3] The terms "Global North" and "Global South" are commonly understood as geographical designations, but they also have historical, economic, and political trajectories. "'Global North' therefore may describe both historically dominant nations as well as colonized but wealthy ruling elites in the South. Similarly, for new alter-globalization alliances, 'South' can be a metaphor for exploited ethnic minorities or women in affluent countries, as much as the historically colonized or 'poorer' countries as a whole." (Kothari et al., 2019: XXII).

Theoretically, the work aims to advance into a Political Ecology of renewable energies, intersecting insights from Ecological Economics and Human Geography. In threading the evidence with the theory, the thesis develops a critical approach to the Ecological Modernization paradigm and advances in building alternative visions for a transition, one that is informed by the principles and transformative views of Environmental Justice.

The thesis compounds a compilation of different original publications (Table 1.1). It firstly opens with a literature review and conceptual proposal of this work (Avila & Sorman, 2018; Avila, 2019). Then, it presents three independently readable, peer-reviewed articles (Avila-Calero 2017; Avila et al., forthcoming; Avila 2018). Finally, a closing Chapter discusses these results in a single transversal reflection. Overall, the thesis follows a shared set of objectives and questions guiding the research process:

Overarching questions

What are the patterns observed in the implementation of renewable energies across the Global South? How do these patterns shed light on the spatial, political, and justice dimensions involved in the energy transition?

Specific questions

How is the expansion of renewable energies taking place in different places of the Global South?

What are the discourses commonly mobilized by public and private actors?

How do these discourses materialize across space?

Through which political arrangements and infrastructures?

How are these new arrangements being contested on the ground?

What are the perceived impacts triggered by wind and solar power megaprojects?

What are the common claims mobilized by affected communities?

How do mobilizations politicize debates on the energy transition, and to what extent?

As described in the next section, each chapter of this dissertation addresses these questions distinctively, according to their own empirical, methodological, and theoretical emphasis.

1.3 Dissertation structure

Chapter 2

Energy, society, and transitions

This Chapter revises some of the critical debates and conceptualizations on energy and transitions that inform this dissertation's narrative. While the theoretical pillars presented later in this introduction pertain to two disciplines (Ecological Economics and Human Geography) and two fields of critical studies (Political Ecology and Environmental Justice), Chapter 1 provides a rather dynamic dialogue between these fields of inquiry.

The first part of the Chapter revises three interrelated vectors on the study of *energy-society interactions*: social metabolism, resource frontiers, and environmental conflicts. This review highlights the concept of "metabolic configuration" to explain how, in any given society, institutions and power relations shape the qualitative and quantitative character of energy and material flows. The Chapter exemplifies this process by pinpointing the main biophysical features and social interactions of the capitalist industrial society and its fossil-energy resource base. In doing so, the review situates a starting point to discuss ongoing attempts of transitioning towards a renewable energy-based society.

The second part of the Chapter outlines the different dimensions involved in studying *energy transitions:* biophysical, geographical, and political. It again takes the case of industrial development and fossil-fuels as a reference point, revising the historical transition from agrarian to industrial societies (i.e., from solar to fossil societies). Without aiming to be exhaustive, this review seeks to provide a reference point to understand ongoing renewable energy transition attempts. Again, this follows a specific rationale: understanding the different dimensions involved in renewable energy deployment requires a reference understanding of the material, spatial, and political dimensions of fossil energy systems.

The conceptual and historical review of Chapter 2 leaves an open question that guides most of the reflections in this dissertation: if fossil energies have been fueling a particular "metabolic configuration," the call for a low-carbon transition raises critical questions on the extent that renewables will sustain or transform such arrangements and, most importantly, in favor of whom?

Chapter 3

The winds of Mexico: a new energy frontier.

This Chapter presents the first results exploring conflicts around renewable energy deployment. The Chapter provides an in-depth analysis of one of the first conflicts registered against wind power facilities in the Global South, located in the Isthmus of Tehuantepec region in Oaxaca, Mexico. This work entailed documentary research, data systematization through the Environmental Justice Atlas, and a short fieldwork conducted in 2016.

The Chapter firstly explores how State, international agencies, and private corporations envisioned and implemented an ambitious Wind Power Corridor in the Isthmus region, misrecognizing the rights and existence of *Zapotec* and *Huave* communities. Relevant for this analysis is the neoliberal policies enabling such a process, mostly expressed in the spatial rearrangements triggered by the deployment of the Corridor and the distribution of electricity to large corporations and urban regions across Mexico. With this analysis, the Chapter highlights the launch of a new energy frontier in the country. This frontier represents energy *additions* to the country's ongoing "metabolic configuration" and reproduces the unequal relations shaped by neoliberal approaches to development.

Secondly, the Chapter provides a systematic analysis of the local contestation against the Wind Power Corridor. Here, the work identifies the actors mobilizing, the discourses of resistance, and the mobilization process. The research highlights how communal institutions play a central role in articulating discourses and praxis of resistance, a process that unfolds in variegated and productive ways. Here, the work discusses the dynamic dialogue between a *reactive phase* of resistance (with visible mobilizations, blockades, and legal claims to cancel projects) to a *proactive phase* (in which different forums and alliances led to a cooperative wind power proposal).

This research's findings provide a reference example of how emerging conflicts become a critical force in politicizing the energy transition. As specified in Table 1, the results were published in the *Journal of Political Ecology* in 2017 and disseminated in different conferences. This work has become an essential reference for numerous research efforts around renewable energy conflicts that have since then been taking place. At the same time, these results became the backbone of my dissertation.

Chapter 4

Countermapping renewables:

Exploring the expansion of wind and solar power in Mexico

This Chapter provides a more granular reading on the politics of the low-carbon transition by exploring the role of renewable energy mapping. The research takes the case of Mexico as the central focus of analysis. Fourteen years have passed since the first mobilizations against mega wind power projects in the Isthmus of Tehuantepec (Oaxaca), and investments are now diversifying both geographically and technologically throughout the country. Key questions remain of critical concern: how and where are investments taking place? What are the discourses, regulations, and cartographic representations enabling such a process? How can a critical mapping exercise counteract potential injustices?

The Chapter presents the most salient results of a countermapping initiative conducted in alliance with the Gecomunes Collective and the Environmental Justice Atlas. This project involved a one-year process of data gathering and mapping on the evolution and expansion of wind and solar power projects across the country. The aim of this initiative was to make visible some of the critical dimensions that appear "invisible" in the State's cartographic tools promoting investments in the sector. The maps produced in our collaboration include data for land tenure, land uses, land cover, and emergent cases of conflict.

This work highlights how neoliberal regulations in the country are further shaping the discourses and practices around the "low-carbon development" strategy. Maps for renewable energy investments are playing as a crucial device in this strategy, particularly by rendering different territories of the country as seemingly "empty" spaces to be developed. The results of our countermapping show, however, that the strategy is triggering the erosion of communal land tenure across the country, along with an increasing shift from agriculture and forestry to energy production.

In understanding the emergent geographies of the energy transition, this research dives into the states of Oaxaca and Yucatán, two regions in which communities mobilize claims of injustice against wind and solar infrastructures. The analysis illustrates how the defense of land, livelihoods, cultural identity, and biodiversity become central in claims for justice in the transition. The research concludes by outlining some aspects of an alternative transition

agenda based on restoring the commons and Environmental Justice Principles. By working with different collectives and communities participating in ongoing debates around the renewable energies in Mexico, the "counter-maps" produced in this collaboration are not only sought as an academic outcome but as a tool of activist-research for a just transition.

As detailed in Table 1, the research is currently under review in *Environment and Planning E* as part of a themed issue entitled "Critical Renewabilities: Political Ecologies of Renewable Energy," edited by Ingrid Behrsin, Sarah Knuth, Anthony Levenda, and James McCarthy. The research will be discussed in the forthcoming Meeting of the American Association of Geographers (April 2021). Simultaneously, the maps and their results will be disseminated in Mexico through different formats and platforms during 2021.

Chapter 5

Environmental Justice and the expanding geography of wind power conflicts

This Chapter takes the analysis to a global scale and presents a comparative analysis of 20 wind power conflicts located in different countries of the Americas, Africa, Asia, and Europe. The purpose of this Chapter is to bring further systematic evidence on the movements and narratives emerging against wind power facilities, locating these voices into broader debates on the politics of the low-carbon transition.

The first part of this work is devoted to understanding the discursive and material configuration of mega wind power projects. It highlights how the Ecological Modernization paradigm permeates over debates around the transition, promoting a rapid expansion of large-scale and centralized facilities, mostly controlled by private investors. In this process, the research highlights an increasing pressure over rural lands, along with a progressive differentiation between spaces of energy production and spaces for consumption.

In tracing these patterns, the research dives into the variegated responses from rural communities affected by such facilities. The work presents an inventory of 20 different conflicts analyzed through the Environmental Justice Atlas methodology. It shows how the standard interpretation of conflicts as "Not-in-my-backyard" attitudes that dominate in literature appears insufficient to grasp the variety of political concerns mobilized by

communities. These include the defense of indigenous territorial rights, local livelihoods, and community projects for local development. In broader perspectives, communities also bring explicit concerns around the imperative of economic growth and industrialization that characterize the Ecological Modernization such a project.

The contribution of this Chapter is two-folded. On one side, it covers a geographical gap by shedding light on how wind power investments and conflicts are evolving across the Global South. It also brings evidence on how Environmental Justice narratives emerge at the new energy frontiers. By placing Environmental Justice as a critical force in debates around renewables, this work contributed to go beyond the "a-political" interpretations on the matter, placing a spectrum of political imaginaries around the transition.

As specified in Table 1, this research was published in the Journal of Sustainability Science in 2018 as part of a special issue on Ecological Distribution Conflicts as Forces for Sustainability (edited by Leah Temper, Federico Demaria, Arnim Scheidel, Daniela del Bene, and Joan Martínez-Alier). The dissemination of this research on different seminars and conferences has led to broader research discussions and inquiries. These results have inspired the design of a more extensive discussion on energy conflicts and mitigation strategies within the Envjustice research group. As a collective, we have recently published these results in Environmental Research Letters (see: Temper et al., 2020).

Chapter 6
Transversal findings and concluding remarks

This concluding Chapter outlines the main transversal findings gathered throughout the dissertation. It discusses how the empirical insights gathered in previous chapters shed light on the spatial, justice, and political dimensions involved in expanding renewable energies. In presenting such reflection, the Chapter highlights five main contributions that this thesis makes to the Political Ecology of renewable energies and transitions in the Global South.

The Chapter closes by identifying some areas that require further research, public debate, and policy engagement. Here I highlight some empirical and theoretical avenues to continue developing an activist-research agenda for a just transition.

Table 1.1 – Aims, methods and dissemination of results

CHAPTER	RESEARCH AIMS	METHODS	PUBLICATION(S)	DISSEMINATION OF RESULTS
2. Energy, society and transitions	Articulating different conceptualizations of energy and transitions	Literature review	Avila S, Sorman A (2018). Transición energética (energías renovables). En: Dalisa, G., Demaria, F., Kallis, G. (eds). Decrecimiento: vocabulario para una nueva era. Icaria Editorial.[4] Avila S (2019) Transición energética y justicia socio-ambiental. Aproximaciones desde el Sur global. En: Tornel, C (coord.). *Alternativas para limitar el calentamiento global en 1.5°C. Más allá de la economía verde.* Fundación Heinrich Böll - México y El Caribe. [5]	Energy and environmental justice: a multidisciplinary workshop (Co-organized with Tristan Partrige at ICTA-UAB)
3. The winds of Mexico: a new energy frontier	Tracing the political economy of wind power in Mexico. Tracking the evolution of conflicts against the wind power corridor of Oaxaca.	Environmental Justice Atlas Documental research Field-work in Mexico	[6]Avila-Calero S (2017) Contesting energy transitions: wind power and environmental conflicts in the Isthmus of Tehuantepec. *Journal of Political Ecology.* 24: 993-1012. https://doi.org/10.2458/v24i1.20979	1st International Conference of the European Network of Political Ecology (Sweden, 2016) 5th International Degrowth Conference (Hungary, 2017) Latin American Studies Association Conference (USA, 2019)
4.Countermapping renewables: Exploring the expansion of wind and solar power in Mexico	Scrutinizing the politics of maps in the expansion of renewable energies. Contribute to a new research agenda on the political ecology of renewables.	Construction of a database through a collaboration with activists in Mexico Mapping different layers with GIS	Avila S, Deniau Y, Sorman A, McCarthy J. Countermapping renewables: space, justice and politics in Mexico's energy transition strategy. *Environment and Planning E: Nature and Space.* Under first round of review.	1st North-South Degrowth Conference (Mexico 2018) Seminar at Clark University. Geography Department (USA, 2019)
5. Environmental Justice and the expanding geography of wind power conflicts	Tracing the pattern of investments and discourses in the global expansion of wind power. Develop an inventory of wind power conflicts emerging in different countries. Identify commonalities and differences among cases.	Environmental Justice Atlas Documental research Field-work in India	[7]Avila S (2018) Environmental Justice and the expanding geography of wind power conflicts. *Sustainability Science.* 13 (3): 599-616. https://doi.org/10.1007/s11625-018-0547-4	Seminar at Lund University (Sweden, 2017) Conference of the Indian Society of Ecological Economics (India, 2017) Seminar at the Basque Center of Climate Change (2018)
6. Transversal findings and concluding remarks	Articulate the conceptual and empirical findings of the dissertation			Seminar at the University of California, Santa Barbara (USA, 2019)

[4] Publication under the license of Creative Commons
[5] Publication under the license of Creative Commons
[6] This research was firstly published in the Journal of Political Ecology https://doi.org/10.2458/v24i1.20979
The Journal of Political Ecology follows a Radical Open Access Policy.
[7] This research was firstly published in the Journal of Sustainability Science https://doi.org/10.1007/s11625-018-0547-4
Sustainability Science's Copyright Transfer Agreement includes the Author's Retained Rights "to reproduce, or to allow a third-party Assignee to reproduce the Article in whole or in part in any printed volume (book or thesis) written by the Author(s)."

1.4 Theoretical foundations and key arguments

Being a compilation of three independently readable research papers, the particular concepts and methods employed in this thesis are introduced in each chapter. Nevertheless, the dissertation is threaded through a common theoretical ground on Ecological Economics, Human Geography, Political Ecology, and Environmental Justice studies. In order to gather a cohesive discussion on the empirical material gathered in this dissertation, this section briefly introduces the key components of such disciplines along with the main arguments that I build upon them.

Ecological Economics

The field of Ecological Economics (from now on EE) was founded at the end of the 1980s, providing an integrated and biophysical perspective on environment-economy interactions (see: Røpke 2004). The fundamental aim of EE is to untangle the roots of modern environmental problems and contribute to articulate solutions that are both ecologically sustainable and socially equitable.

The epistemological foundation of EE is rooted in the understanding that the economy is a physical system embedded in the finite, complex planetary ecosystem (Daly, 1993, for a review see: Gomez Bagetthun and Naredo, 2015). In this view, the economy is an "open" system in which energy and materials enter and exit. At the same time, the Earth is a "closed" system -meaning closed to material entries, but open to solar energy (Martinez-Alier and Schüpmann, 1987). If the social metabolism -the use of energy and materials- increases too rapidly, the Earth cannot sustainably reproduce its cycles (Georgescu-Roegen 1971; Odum 1971; Commoner 1971; Daly 1973[8]).

The vision of sustainability deriving from EE differs substantially from the traditional views promoted by Environmental Economics: an opposition that is also known as the "strong" v.s. "weak" sustainability (Neumayer, 2013). While Ecological Economics places the issue of sustainability on the physical scale of the economy, Environmental Economics focuses on

[8] The biophysical approach to economics as well the acknowledgment on the limits to growth covers a wide range of political positions, including those of communists (Harich, 1975).

the optimal allocation of resources and externalities through market and other substitution mechanisms (i.e. monetary or in-kind compensation) (Daly, 1992; van den Bergh, 2001).

The "weak" sustainability paradigm stems from the 1970s as an extension of the neoclassical theory of economic growth. It took a mainstream position in the context of the sustainable development discourse during the 1990s as a framework through which economic growth, social welfare, and environmental protection could be harmonized (see: Asara et al., 2015). Weak sustainability assumes that human capital -land, labor, technology and, knowledge- can substitute for natural capital -natural resources, ecosystem functions and, biodiversity- (Hartwick, 1978; Solow, 1986). As such, natural resources and services can decrease as long as sufficient compensation is provided by increases in other resources and services. It is in this view that the theories of ecological modernization have flourished, sustaining that economic growth can be achieved by 1) decoupling energy and material use -through technological developments and improvements in efficiency-, and 2) establishing the optimal allocation of resources and externalities -through pricing mechanisms and state/market interventions-(Mol & Sonnenfeld 2000).

In the opposite direction, ecological economists argue that the harmonization between economic growth, social equity, and environmental protection has proved elusive. While four out of the nine planetary boundaries have been crossed[9] (Steffen et al., 2015), concentration and inequality have increased, particularly over the last 50 years (Piketty 2014) (cited from Asara et al., 2015: 375). The strong vision of sustainability mobilized by Ecological Economics relies on the understanding that there are functions that the environment performs that cannot be duplicated by humans or human-made capital. Thus, this view is not committed to a unique type of value expressed in a single unit of account (e.g., monetary). Instead, it introduces multiple values and measures that are incommensurable (Martinez-Alier & Muradian, 2015: 9). For instance, money gained by wind or solar power production cannot be commensurable with other territorial values (e.g., indigenous land rights, cultural values of land).

[9] In 2009, Johan Rockström led a group of 28 internationally renowned scientists to identify the nine processes that regulate the Earth system's stability and resilience. Crossing these boundaries increases the risk of generating large-scale abrupt or irreversible environmental changes. The nine planetary boundaries identified are: (1) Climate change; (2) Changes in biosphere integrity; (3) Ocean acidification; (4) Stratospheric ozone depletion; (5) Ocean Biogeochemical flows; (6) Land-system change; (7) Freshwater use; (8) Atmospheric aerosol loading; (9) Introduction of novel entities -e.g. chemicals, engineered materials and organisms, natural occurring elements mobilized by anthropogenic activities-. Anthropogenic perturbation levels of four of the Earth System processes/features (climate change, biosphere integrity, biogeochemical flows, and land system change) exceed the proposed Planetary Boundaries.

Solutions to environmental problems framed within the objectives of economic growth, sustained by new technologies and pricing mechanisms are seen, therefore, as highly problematic: they not only intend to substitute the earth's functions but they also obscure uneven political relationships among places and people (e.g., Kosoy & Corbera, 2010; Gómez-Baggethun & Ruiz-Pérez, 2011). By placing the scale of the economy at the core of its research, EE mobilizes a future vision of sustainability in which there is an equitable level of welfare distribution among societies, and the precautionary principle is applied when dealing with resource use and environmental protection.

Throughout this dissertation, I sustain that debates over renewable energies are ultimately shaped by the tension between these two visions of sustainability. From a "weak" sustainability perspective, the rates of economic growth experienced with the abundance of fossil fuels can be replaced sustainably by a combination of modern technologies (i.e., large-scale wind and solar) and efficiency improvements (i.e. better technologies for consuming less). However, from a "strong" sustainability perspective, this project disregards both the biophysical and social dimensions that are vital to envision a just and sustainable transition. The following points summarize such dimensions.

The transition is material.

The idea that economic growth can be "decoupled" from the use of energy and materials largely prevails in the "weak" sustainability paradigm and its resonance in Ecological Modernization theories (e.g., Solow, 1973, 1993; Pearce, 2012). Yet, ecological economists have proved that the argument in favor of the economy's dematerialization is both partial and elusive. Studies have shown that reducing domestic material consumption does not account for the raw materials extracted outside domestic borders, nor for the materials embedded in imported goods (e.g., Kallis, 2017; Gutowsky et al., 2017). Therefore, the argument of dematerialization obscures the continual material extraction that still takes place in the global economy's peripheries (Martinez-Alier, 2002; Hickel & Kallis, 2020). The case of renewables will not be an exception in this regard. Renewable energy flows require technologies to be harnessed and transformed. These technologies use energy and other materials (rare metals, cement) and demand high amounts of space, all of which create new frontiers of resources to be exploited.

Growth-based transition and negative externalities.

Attempts to sustain the growing economic system with renewable energies not only appear challenging to achieve in a small amount of time (Hickel, 2020). Moreover, it would trigger negative externalities and distributive questions across different scales. Mining extraction frontiers would continue to expand to manufacture the required technologies at the necessary scale and phase (Lèbre et. al. 2020). The continually growing energy demand of cities and industries would trigger unprecedented land demands over the rural world, triggering potential land grabs and competition. Even further, new frontiers of waste will eventually displace the energy and materials involved in such a process. Market mechanisms and monetary compensation would appear insufficient to overcome the socio-environmental impacts triggered by such a project and the unequal process that would reinforce the cores and the peripheries of the current economic system.

Efficiency gains in the transition and the Jevons paradox.

The idea that gains in efficiency lower consumption and negative environmental impact is at the core of Ecological Modernization narratives. For ecological economists, however, efficiency holds a paradox (Jevons, 1865): efficiency gains immediately lower consumption of material and energy; yet this makes resources become cheaper and trigger an increase in demand as a response. In other words, efficiency "rebounds," causing higher production and consumption (Alcott, 2005). While technological improvements can contribute to consuming less, these changes need to be accompanied by a reorganization in the economy. "If we remain within a growth economy, efficiency and conservation simply mean capital accumulation plowed back to further growth." (Kallis, 2018: 15). The transition does not escape this paradox: gains in energy efficiency must be compensated with physical caps like quotas or rationing (see Alcott, 2005).

These basic premises in Ecological Economics inform, therefore, about the constraints, contradictions, externalities, and uneven distributions of gains and losses of a transition framed under the Ecological Modernization Paradigm. This dissertation articulates further reflections on the spatial, political, and justice dimensions involved in renewable energy deployment, taking this vantage point of analysis.

Human geography

Human Geography (from now on GH) is commonly defined as a field of study concerned with "the ways in which space, place and the environment are both the condition and in part the consequence of human activities" (Gregory, 2009: 350). From this broad definition, multiple sub-disciplines and approaches unfold to *describe, assess, and intervene* in the social, economic, and political life across geographical space (Bridge & Gailing, 2020).

For human geographers, space is the focal point of inquiry from which other concepts usually are articulated[10]. HG explicitly rejects understandings of space as a fixed and frozen ground on which events take place or processes leave their marks (Gregory, 2009:709). Instead, HG explores how space is socially *produced, transformed, and contested over time* (May and Thrift, 2001; Massey, 2005). Space, therefore, is not a canonical grid, but the result of a constant dialectical process between society and its environment (Lefebvre, 1970, 1974; Soja, 1980, 1985). While biophysical features condition human activities over space, human activities simultaneously intervene in the environment, producing space in multiple ways. These processes are ultimately defined by political, economic, and cultural relations (e.g., physical borders, conceptual boundaries, lived practices, etc.). From this analytical lens, this dissertation engages with the following approaches:

The politics over space

In HG, the so-called production of space is seen as historically contingent and deeply political. Space is produced both materially and discursively through a series of technologies and power arrangements, becoming a field of integration and differentiation in favor of specific social groups and interests. Therefore, as much as space can sustain power, it is also subject to juxtapositions, transformations, and contestations throughout time (see Massey 2005). In this sense, HG is not only concerned about accounting for socio-environmental arrangements over space. But also, in planning and intervening spatial change for social and environmental justice.

Critical and Radical strands of HG are particularly committed to understanding and intervening in the politics over space. Critical HG pays particular attention to how spatial

[10] Core concepts in Human Geography include place, scale, region, and landscape (see Gregory et.al. 2009). This, however, does not exclude the interest that Human Geographers have had in understanding the relations between energy metabolism and space (see: Brunhes 1910).

arrangements and representations reinforce power relations, producing inequality, and oppression (Blomley, 2009). With a more transformative-activist perspective, Radical HG instead focuses on "overturning relations of power and oppression and constructing more socially just, egalitarian and liberating geographies and ways of living (Pinder, 2009: 619)".

Throughout this dissertation, I engage with both Critical and Radical HG by:
1) explaining how space is being rendered and arranged in specific ways to expand renewable energies (e.g., discourse articulations, cartographic representations, and technologies).
(2) producing alternative mapping practices to make visible what so far appears "invisible" in such processes (e.g., people, land uses and land cover, conflicts, and claims of injustice).

The role of energy in the production of space.
Different modes of energy production, distribution, and consumption shape the spatial organization of social activities, underpinning both material and symbolic relations (a review in: Calvert 2016). From these lenses, the unprecedented availability of energy in fossil fuels based societies defined distinctive spatial patterns of economic, political, and cultural activity. Among others, such spatial patterns include an increasing separation between spaces of production and consumption (Chisholm, 1990), the consolidation of a culture of consumption (Nye, 1999), and its correlations with notions of individual freedom (Huber, 2013) and democracy (Mitchel, 2011).

The shift from a fossil-based society to one that is based on renewable energies would, therefore, imply new ways of organizing all dimensions of society and its relations over space. As highlighted by Bridge et al. (2013), "the low-carbon energy transition is fundamentally a geographical process that involves reconfiguring current spatial patterns of economic and social activity." This transition is, however, not yet defined and opens a wide range of different spatial projects: "a low-carbon energy system can be achieved by large, remote entities (nuclear, large-scale wind and solar) and long-distance transmission lines; via local mini-grids, or through highly decentralized micro-generation" (331). These spatial projects are ultimately driven by a different political economy and would have largely different implications on the social and environmental spheres.

In addition to these insights, human geographers are increasingly paying attention to the fact that "energy does not only 'produce' space; its production *requires* space" (Huber &

McCarthy 2017: 4). The spatialities of energy production are particularly relevant for debates on the low-carbon transition. In contrast with fossil resources stocks (located in holes and specific points of extraction), renewable energy flows need to be harnessed through space, and most specifically through *the land*. A shift from a "vertical" energy regime to a "horizontal" one would not only trigger significant rearrangements in the spatial configuration of industrial capitalism (Huber & McCarthy 2017). Even more, these processes will lead to an increasing "land rush" to keep up with the energy demands that the system requires (Scheidel & Sorman, 2012).

This thesis sustains that the land demands and consequent spatial transformations triggered by an industrial-scale expansion of renewable energies hold deeply political and justice implications. Questions on who owns these lands, and who claims access and control over these lands become essential in analyzing the expansion of renewable energies conflicts across the Global South.

Political Ecology

Political Ecology seeks to unravel the political forces at work in environmental access, management, and transformation (Robbins, 2004). The term itself emerged in the 1970s in various academic contexts (anthropology, geography, human ecology) engaged with the wake of the environmental movement and the consequent politicization of environmental matters (Watts, 2009). For political ecologists, "(…) politics are inevitably ecological and ecology is inherently political." (Robbins, 2004).

Early political ecology studies' core empirical concern focused on rural, agrarian, and third world dynamics (e.g., Watts, 2009; Bryant and Bailey, 1997, Peet and Watts, 1996). In particular, researchers implemented dialectical approaches to understand the processes of marginalization and environmental degradation (Hecht, 1985; Blaikie and Brookfield, 1987). Political ecologists challenged colonial accounts of soil erosion, proving that poverty and degradation were not a "natural" condition caused by overpopulation but the result of the social relations of production (Blaikie, 1985).

This foundational approach led, over time, to a more complex field of *political ecologies*, addressing nature-society interactions in different geographical contexts and analyzed through a variety of lenses[11]. While today, Political Ecology is considered an approach rather than a theory in itself, studies within the field follow a standard set of aims and modes of explanation. In a nutshell, Political Ecology aims two things at once: it seeks to critically explain what is wrong with dominant accounts of environmental change, while at the same time explore alternatives, adaptations, and creative human action in the face of mismanagement and exploitation" (Robbins, 2004:12).

Political ecologies seek to unveil the distribution of costs and benefits of particular processes revealing winners and losers, hidden costs, and the differential power that produces social and environmental outcomes. In doing so, it follows a mode of explanation that evaluates the influence of variables acting at several scales, each nested within another, with local decisions influenced by regional policies, which are in turn directed by global politics and economics. From this perspective, the uneven distribution of environmental gains and benefits, expressed as disputes on plural values, inevitably reinforces or reduces existing social and economic inequalities. In turn, this process holds political implications in terms of the altered power relations between different actors (Robbins, 2004:11, citing Bryant and Bailey, 1997).

This dissertation studies the emergent wave of environmental conflicts around renewable energies by engaging with the following approaches:

Challenging a-political ecologies amid climate change.

Political ecology challenges Ecological Modernization as the dominant paradigm to tackle contemporary environmental problems. It questions the idea that "efficient solutions, determined in optimal economic terms, can create "win-win" outcomes where economic growth (sometimes termed "development") can occur alongside environmental conservation, simply by getting the prices and techniques right" (Robbins, 2004:10). To say that these accounts are "a-political" does not imply that they are empty of political content or consequences, but that they obscure the political-economic structures that are at the core

[11] This includes works that stem from environmental history, Marxist political economy, gender studies and discourse analysis (e.g., leff 1986, Escobar, 1995; Leff, 1995; Agarwal, 1998), and a broader set of themes that include: conservation initiatives and control over specific environments (Sletto, 2008); the analysis of environmental identities, conflicts and movements (Guha and Martinez-Alier, 1997; Martinez-Alier 2002); and more recently, matters such as urban political ecology, and the political ecologies of health, risk and governmentality (e.g., Peluso and Watts, 2001; Heynen et al., 2006; Li, 2007).

of environmental problems and injustices (e.g., Bridge, 2001; Martinez-Alier, 2002; Kothari et al., 2019). **This thesis discusses how the Ecological Modernization approach to renewable energies derives into specific socio-environmental outcomes, calling to unravel its political implications.**

The commitment of PE in *politicizing* environmental matters has become particularly relevant in the context of climate change. Political ecologists argue that, while the climate has become the central concern of many policy agendas and debates, technocratic and managerial solutions tend to foreclose genuine political debates and imaginations (Swyngedow, 2010; Chatterton et al., 2013; MacGregor, 2014). This sort of consensus around the origins of the problem and its solutions make climate change an ultimate expression of the a-political ecologies (Robbins,2004) and the post-political condition (Zizek, 1999, 2006; Mouffe, 2005) of contemporary societies. Erick Swyngedouw's work (2010; 2011; 2013) critically articulates this in the following three points:

1)The idea that climate change is a universal threat for humankind dissolves the uneven socio-environmental responsibilities and burdens of the privileged and the non-privileged. Furthermore, it progressively builds an "ecology of fear" (Davis 1999) and narratives of "urgency" (Whyte, 2019) that pave the way for fast-track, authoritarian and non-consensual solutions.
2) Current hegemonic climate change policies ultimately reinforce the socio-political status quo rather than achieving socio-ecologically more egalitarian transformations. "This post-political frame is structured around the perceived inevitability of capitalism and a market economy as the basic organizational structure of the social and economic order, for which there is no alternative" (Swyngedow, 2010: 215).
3) To rethink the properly political, to re-establish the horizon of democratic environmental politics" (Swyngedow, 2010: 214) implies giving space to dissensus and conflict.

The study of environmental conflicts.
The study of conflicts explored in this thesis follows three main premises in Political Ecology.
First. Social systems are structured around divisions of labor, race, gender, and ethnicity that differentially distribute access and responsibility over different resources, environmental benefits, and burdens. While these power divisions vastly differ from society to society,

political ecology emphasizes that no single distribution of these is natural or inevitable (Robbins, 2004). Unfair distributions on environmental benefits and burdens become, therefore, the source of political struggle (Robbins, 2004): processes commonly termed as "environmental conflicts" or "Ecological Distribution Conflicts" (Martínez-Alier and O'Connor, 1996).

Second. Property systems and bundles of rights play a central role in defining access and responsibility over resources (Robbins, 2004). Resource access mechanisms include property rights sanctioned by law, custom, or conventions, and other forms of access defined by technology, capital, labor, knowledge, authority, and social relations (Fuchs, 2003; Ribot and Peluso, 2003; Koch 2008). Understanding the bundles of rights and changing access dynamics is critical in analyzing who benefits from a specific resource, how, and why. As larger political economic forces transform rural resources of material or cultural value, access to these resources is often contested and rife with conflict at many levels simultaneously (Sikor & Lund, 2009:1). Such dynamics are particularly relevant in traditional societies, where the complex bundles of rights confront development efforts that increasingly push towards the establishment of "rational" systems based on private property. Privatization of rights commonly leads to resource conflicts, production losses, and increasing inequality (Robbins, 2005). This thesis discusses how such dynamics enter at play with the implementation of renewable energies, paying particular attention to how facilities trigger changes in the access and control over lands and other resources.

Third. Environmental conflicts shed light on the competing visions of which socio-ecological order should be collectively pursued (Scheidel et al., 2018; Akbulut et al., 2019). Conflicts represent voices of dissent facing the a-political narratives and practices around the environment. They challenge the dominant consensus around ecological solutions and open space of political heterogeneity and transformation (Swyngedouw, 2010).

Environmental Justice

Environmental Justice (from now on, EJ) is considered both a social movement and a field of academic study, commonly working together through the co-production of knowledge and creating activist research agendas (Sze and London, 2008; Schlosberg, 2013; Temper et

al. 2018b). EJ takes social justice and environmental politics as fundamentally inseparable (Kosek, 2009: 201), mobilizing intellectual debates, political discourses, and social action.

The first generation of EJ

The origins of the EJ movement are rooted in different struggles arising in the United States during the 1960s-1980s against the use and dump of toxic chemicals disproportionally affecting marginalized communities across the country (Kosek, 2009). Such struggles led to the first generation of EJ studies paying attention to the unequal exposure to risk and hazards through policies and practices discriminating individuals and communities based on ethnicity, gender, and class (Bullard, 1990; 1993; Pellow 2004, 2007; Mohai et al., 2009). Key to this first generation was the launch of the EJ Principles (1991); a manifesto endorsing anti-racism, anti-militarism, and anti-imperialism while providing a vision of human and non-human justice.

The second generation of EJ

The geographical expansion of the EJ movement beyond the US has led to a more profound articulation of EJ theories, methods, and concerns. Many cartographic initiatives reflect on such expansion, showing how multiple place-based struggles lead to the creation of broader alliances between local movements and organizations[12]. In this process, the material and sociological themes of concern have extended far beyond the local distribution of pollution, risk, and race to include many other socio-environmental matters (Carruthers, 2008; Walker, 2009b; Martinez-Alier et. al., 2016; Whyte, 2020).

The diversity of concerns within the second generation of the EJ movement led to a broader and pluralistic definition of justice. While distributional justice -who gets what in the environment- continues to be the dominant mode of representing EJ's claims, both movements and theorists acknowledged the need to understand matters of equity along with those of recognition and participation of excluded communities or aggrieved groups. The "trivalent" approach of EJ -equity, recognition, participation- (Schlosberg 2004, 2007) has become a key guiding approach in Environmental Justice studies, allowing to make more granular understandings of the (in)justices produced at different temporal and spatial scales (Walker, 2009a).

[12] These include the Environmental Justice Atlas, and other regional cartographic initiatives such as *Fundacao Oswaldo Cruz* (FIOCRUZ) with its work on health and environment with the *Rede Brasileira de Justiça Ambiental* in Brazil, the *Centro di Documentazione sui Conflitti Ambientali* (CDCA) in Rome who has documented emblematic ecological conflicts since 2007, the *Observatorio Latino-Americano de Conflictos Ambientales* (OCMAL), GRAIN, the World Rainforest Movement (WRM), and Oilwatch.

Critical Environmental Justice.

Insights and paths of social transformation deriving from these first two generations of EJ have recently inspired a more radical approach identified as Critical Environmental Justice Studies (Pellow, 2016; 2018; Newell & Mulvaney, 2013). Critical EJ does not intend to debunk the valuable contributions that have made EJ ideas and practices but instead seek to address some of the limitations and tensions within earlier generations of EJ studies. Pellow (2018) summarizes some of these points and setting a new agenda on the matter:

- Addressing multiple and intersecting forms of inequality.
- Introducing multi-scalar analysis in both spatial and temporal scales. Comparing a larger number of case-studies into a single analysis.
- Reframing the relation with the state. Some EJ activists and scholars look to the state to accommodate demands via legislation, institutional reforms and other policy concessions. Yet, more research is needed to shed light on the multiple paths for radical transformations that challenge the structural political and economic relations producing injustices.
- Engaging with the largely unexamined question of the expendability of the human and non-human population facing socioecological threats.

This thesis engages with such evolving studies and dives into a new topic in the field. By dissecting the justice dimensions emerging in the expansion of wind and solar power facilities, the dissertation contributes to five particular developments on EJ:

1.-A focused attention to the growing number of popular movements emerging in the Global South, in which communities mobilize to defend their livelihoods, territorial rights, and cultural values (Martinez-Alier, 2002).

2.-Developing critical cartography exercises for Environmental Justice (e.g., Peluso, 1995; Drozdz, 2020). This dissertation largely relies on the methodology of the Environmental Justice Atlas, a collaborative database fostering systematic and comparative research on environmental conflicts at a global scale (see methods in Chapters 3-5). Additional exercises include the countermapping initiative for research and activism in the energy transition (Chapter 4).

3.-An increasing need to go beyond the single-case study approach dominating in the literature, providing instead a multi-scalar analysis of EJ struggles (e.g. Sikor and Newel, 2014; Robbins, 2014; Temper et. al, 2015). Multi-scalar approaches are critical to identify patterns of injustice and its connections with the larger political economy of the energy transition.

4.-An increased discussion around the intersection between Environmental Justice and the global challenges of climate change and sustainability (Agyeman and Evans 2003; Bond, 2012). Addressing renewable energy conflicts as a spectrum of political instances mobilizing both reformist and radical transformations in the energy transition.

Chapter 2
Energy, society, and transitions

History is made not through the separation of humans from nature
but through their evolving, diverse configurations.
(Raj Patel and Jason Moore, 2018:20)

This dissertation approaches the expansion of wind and solar power as an ongoing process with spatial, political, and justice dimensions. However, before diving into the specific case studies, a broader contextualization is deemed relevant. This Chapter aims to provide such a starting point, situating the work in both conceptual and historical terms.

The Chapter follows a fundamental premise: socio-environmental changes (such as those triggered by an ongoing transition towards renewable energies) are part of broader processes in long-term history[13]. (Braudel, 1995). Understanding history not only responds to the need of "making sense" of the present but, more importantly, it helps to acknowledge the possibilities of human agency in shaping alternative futures (Guldi and Armitage, 2014). Looking at ongoing attempts for a renewable energy transition from a historical perspective helps to understand, thus, where we are coming from, where are we now, and where are we heading -what the historians of the Annales could call *going forward by looking back*-.

[13] One could argue, however, that the approach of the *long durée* does not always apply to socio-environmental changes. For example, the rapid depopulation of the Americas after 1492 was the result of a process of colonization and biological introduction of new diseases. A similar reasoning can be applied to Global Warming: the last decade of the 20th century and the beginning of the 21st have been the warmest period in the entire global temperature record, starting in the mid 19th century.

The first section of this Chapter revises three interrelated vectors on *energy-society interactions:* social metabolism, resource frontiers, and environmental conflicts. As argued, these categories are fundamental in understanding how societies integrate different energy resources into their economic systems and how power relationships shape and govern such processes. In illustrating this "metabolic" approach, the section outlines the main biophysical and political features of the capitalist industrial society and its fossil-energy resource base. The second section outlines the multilayered dimensions of energy transitions and reviews the main aspects of the historical transition from agrarian to industrial societies (i.e., from solar to fossil fuels-based societies). Again, this follows a specific rationale: understanding the multilayered dimensions in expanding renewable energies requires a historical reference on the different dimensions of fossil energy systems in the first place.

Together, these sections lay a broader analytical frame to discuss the ongoing transition debates. If fossil energies have been fueling a particular "metabolic configuration", the call for a low-carbon transition raises critical questions on the extent that renewables will sustain or transform such arrangements and, most importantly, in favor of whom?

2.1 Energy-society interactions

2.1.1 Energy as a key element of social metabolism

In Ecological Economics, *social metabolism* or *societal metabolism* is a crucial analytical category to study the biophysical interactions between socio-economic systems and the environment (Scheidel et al., 2018). As a concept, "social metabolism" draws from the original understanding of the metabolic processes in biology to explain how societies require a continuous flow of energy and materials to self-organize, maintain and develop their internal functions and structures (Giampietro et al., 2014; Sorman, 2015).

Social metabolism represents "the flow of energy and materials from the environment, through the society, and back to the environment in the form of waste, something that will be called the *throughput* of the metabolic flow" (Ramos-Martín, 2005:36, see also: Daly, 1992). Different schools of thought have developed accounting methods and indicators to quantify such energy and material inputs and outputs, capturing the biophysical processes that

maintain societies' functioning and the sustainability challenges throughout history (Fischer-Kowalski 1998; Fischer-Kowalski and Hüttler, 1999; Fischer-Kowalski and Haberl, 2015).

In the study of social metabolism, the distinction between "endosomatic" and "exosomatic" uses of energy is fundamental (see: Lotka, 1922, 1956; Georgescu-Roegen, 1971). "Endosomatic" uses of energy refer to the physiological conversions of different types of energy inputs that take place inside the human body (i.e., food items converted inside the human body to perform its biochemical functions). Therefore, it is the use of energy needed to maintain the internal metabolism of a human being. "Exosomatic," on its turn, refers to the technical conversions of different types of energy sources for end-uses outside the human body (i.e. wood to produce heat; coal, gas, and oil to produce fuels, electricity, and heat). Exosomatic energy is the energy carriers operated under human control and feeding the societal metabolism, a process typically referred to in terms of energy throughput. (For both definitions, see: Giampietro et al., 2001; Giampietro and Mayumi, 2009).

Exosomatic energy can express different things for different societal metabolisms. It represents how a given society transforms different energy resources through a set of specific technologies. For example, for agricultural societies and many economic sectors in developing countries, exosomatic energy could be equivalent to traditional sources of power such as animal power, wind, water-falls, and fire. Instead, exosomatic energy is equivalent to "commercial energy" such as electricity, heating, and fuels for developed countries. The relation (or ratio) between exosomatic and endosomatic energy used in a given society varies considerably. In agrarian or subsistence societies, for example, the ratio is about 5/1 (related basically to the use of biomass for fire and animal power as exosomatic conversions); while in industrial societies, this ratio reaches average values as high as 90/1 (Ramos-Martin, 2005:34 citing Giampietro et al. 2001). As discussed in the next section, the vast differences between these ratios ultimately show the energetic jump of agrarian to industrial societies (fueled by fossil sources of energy and powered by new technologies).

The elements outlined above provide a biophysical starting point in understanding energy-society interactions. These elements ultimately highlight the inherent paradox of economic growth (quantitative increase in the physical scale of production and its consequent measure in monetary terms) and its correlated understandings of development (raise in the standard of living measured in terms of consumption capacity). As a given economy grows and

develops, it increases its energy and materials consumption, leading to a greater organization necessary to keep the system working and allow it to grow further. Yet the higher the throughput, the higher the impact upon the environment. These impacts can be expressed as the degradation or depletion of the earth's systems capacity to regenerate; or as the saturation of the earth's systems capacity to absorb waste (e.g., degraded materials and energy[14]).

Socio-metabolic characterizations have further evolved to integrate the study of energy and material flows (Martinez-Alier 2009), analyzing the institutions and power structures configuring them (Demaria and Schindler 2016). The socio-metabolic approach highlights how and why energy and materials are increasingly metabolized. It also questions how these resources are extracted, consumed, and disposed of unevenly across different scales and social groups (Hornborg, 2003).

By integrating a political perspective, socio-metabolic characterizations become a fundamental tool in understanding contemporary dynamics in the extraction, distribution, and consumption of energy resources and disposal of waste and degraded energy, both in material and political ways. On one side, they highlight the energy flows embedded in economic processes, tracking energy resources' trajectory from their extraction and transportation to their consumption and final disposal (i.e., heat and emissions to the atmosphere). They address, on the other, how, *where* and *by whom* these energy resources are metabolized, as well as the interests, laws, and institutions that govern such processes (see: Scheidel et al., 2018).

The socio-metabolic perspective allows to debunk the idea that industrial economies are dematerializing. Even when industrialized regions of the global economic system are increasingly oriented to the service sector, they continue to depend on the energy-intensive, largely machine-operated, and ecologically destructive extraction of food, minerals, and raw materials that are located in "less developed" regions of the world (Martinez-Alier, 2002. See also: Hornborg, 1998).

[14] In thermodynamic theory, the process of dissipation of energy and resource degradation is commonly referred to as "entropy". As summarized by Ulgiati (2015): "While driving a process of transformation, energy loses its ability to do it again, i.e., energy is conserved (in the form of heat), but some of the characteristics that made it capable to support the process are irreversibly lost (e.g. gradients of concentration, temperature, pressure, height, information). A similar definition and behavior also apply to material resources, not only energy, that are capable of supporting process thanks to the dissipation of their gradients relative to the natural background. During a (transformation) process, the gradient is lost, not the matter or the heat, which are, instead, conserved". As a given economic system uses energy and materials, the entropy increases (in the form of heat released into the environment, increasing pollution due to waste of materials and chemicals, and decreasing availability of high-quality resources).

2.1.2 Energy as a resource: the making of commodity frontiers

Energy and materials required to sustain a given metabolism are fundamentally constructed by society as *resources*. In other words, while the biophysical components of the environment are the product of geological, hydrological, and biological processes, such elements *become resources* when they perform a valuable function to society (see: Zimmerman, 1951). Natural resources involve the human "identification, appropriation and management of biophysical processes" (Bakker and Bridge, 2006:6). In order to be "metabolized", energy, land, and other resources are socially "assembled[15]" through a series of technologies, discourses, and practices (Bridge, 2009; Li, 2014;); all of which align to a specific political economy (see: Harvey, 1974).

The primary distinction of natural resources is between exhaustible (stock) and renewable (flow) resources, based on different biophysical materials' potential to regenerate. For stock resources, a secondary distinction is between materials consumed by use and cannot be recovered (such as oil, gas, and coal) and those that may be -partially- recycled (most applications of metals). Flow resources subdivide between resources which its use does not degrade its amount or quality (e.g., solar radiation, wind, waves), and those having a threshold-use in order to regenerate (e.g., fisheries, groundwater)" (see: Bridge, 2009).

The constant demand for resources (energy, minerals, and other raw materials) bound to industrial economies' growing metabolism raises various analytical questions. How are biophysical entities assembled and rendered as "exploitable resources"? What values are assigned to them? How and by whom are these resources extracted, commodified, and commercialized? Where and who consumes them? Where are they later disposed of as waste? For political ecologists, the concept of "commodity frontier" provides a vantage point of analysis to explore such questions.

Commodity frontiers refer to the locus where extraction of resources occurs and expands geographically, colonizing new lands searching for energy, minerals, and other raw materials (Conde & Walter, 2015). Initially coined by Moore (2000; 2011), the concept of "commodity frontier" allowed to describe how the modern capitalist system initiated its expansion with

[15] Li (2014) summarizes this in the following terms. Resources "are the cultural category into which societies place those components of the non-human world that are considered useful or valuable in some way' (Bridge 2009, 1218–19). Their 'resourceness' has no essential or intrinsic quality. It has to be assembled or 'made up' (Hacking 1986). It always includes a discursive element that 'acts as a grid for the perception and evaluation of things' (Foucault 1991b, 82). It can wax and wane or morph as technologies are added, values change, and material qualities shift. Thought of this way, what we call a resource, or a 'natural resource' is a provisional assemblage of heterogeneous elements including material substances, technologies, discourses and practices (…)" (p.589).

the sugar complex in the fifteenth century. Extractive frontiers continued expanding with other raw materials vital in sustaining industrialization processes germinating in Europe (e.g., ore minerals in Potosí and Zacatecas, cotton in the United States).

By analyzing the consolidation of the sugar industry in Africa and America, Moore showed how the dispossession and commodification of land and slave labor in the "new world", enabled unprecedented exploitation of resources not only for sugar production, but also for the development of transport infrastructure for its commercialization overseas. While sugar became an essential source of endosomatic energy for the industrial working class in importing countries (Mintz, 1985), ecological exhaustion (deforestation and soil erosion) was triggered at the production point. Moore argued that the environmental destruction that followed pushed capitalist expansion through the conquer of other lands through a process of cyclical fluctuations (see: Conde and Walter, 2015).

What happened with the expansion of the sugar frontier in Africa and America later happened with cotton, coal, oil, gas, minerals, and other manifold resources that have been essential to the maintenance and expansion of the capitalist industrial metabolism. Commodity frontiers are produced and shaped by uneven power relations at different scales. From global interactions between the North and South (e.g., Shell Dutch corporation operating in the Niger Delta to export oil to the global markets), to national and regional dynamics (e.g., Vedanta Indian corporation planning to operate a large-scale solar power project to provide electricity to an aluminum factory in the State of Odisha). Frontiers become mere supplying zones, responding to the growing demand of distant places.

In this process, Larry Lohman writes, frontiers become "geographical features" that "overlie, overlap or even obliterate other geographical features such as cultivated land, indigenous territories, water sources, grazing grounds or customary property of political boundaries" (Lohman, N/D). As such, the social production frontiers "takes place as a simultaneous process of erasure and reimagination, such that these spaces are simultaneously emptied *and* full" (Bridge, 2001: 2155). On one side, regions become depicted as "barren" or "unproductive", with "low population densities and limited development". On the other, regions are reshaped as landscapes of resource abundance, geological potential and investment opportunities. Landscapes are reconstructed as "commodity-supply zones" by symbolically and physically "clearing the space" for business and development.

2.1.3 Energy frontiers and environmental conflicts

The constant expansion of energy and other commodity frontiers foster conditions for socio-environmental degradation and conflict (Martinez-Alier et al., 2010). From a political ecology perspective, the interwoven processes of enclosure, extraction, and commodification occurring at these frontiers are at the core of the analysis of environmental conflicts and claims for justice.

Environmental conflicts or "ecological distribution conflicts" (Martinez-Alier and O'Connor, 1996) imply a clash over how to value the environment, raising the question of *who has the power to impose particular languages of valuation* (Martinez-Alier, 2002: viii). These conflicts manifest when different actors mobilize divergent values over particular places and resources: economic values, livelihood values; indigenous territorial rights; cultural values (such as sacredness), or ecological values (Martinez-Alier, 2009; Temper and Martinez-Alier 2013). Ecological Distribution Conflicts or environmental conflicts shed light on how specific investments and development plans trigger uneven distributions of impacts and benefits. These struggles also contain what Escobar also calls "cultural environmental conflicts" (2008), showing that the unequal distribution of power in resource use is not only expressed in material terms but also in symbolic ways (e.g., Whyte 2016; Hanaček & Labajos, 2018).

The expansion of resource frontiers and conflicts is systematically studied through the Environmental Justice Atlas, supporting the hypothesis that, as the industrial metabolism changes and grows, an increasing number of environmental conflicts emerge in response (Martinez-Alier et al., 2016). The increasing number of environmental struggles arising at the frontiers of energy and material extraction shed light on the perceived impacts, claims, concerns, demands, and discourses mobilized by affected communities and supporting EJ organizations (Temper et al., 2015). Furthermore, in organizing against environmental injustices, conflicts may become a transformative force whereby the very notions of sustainability and development are questioned and reimagined (Temper et al. 2013; Scheidel et al. 2020).

In light of these arguments, the industrial expansion of renewable energies opens new spaces of research inquiry. While common aspects on the study of commodity frontiers remain constant (i.e., the colonization of new spaces for resource extraction triggering socio-

environmental degradation and further expansion), some differentiations might occur depending on the resources and geographies at stake.

There is a particular analytical highlight on the "subterranean" nature of oil, gas, and mining frontiers that have shaped the industrial capitalist society (see: Bebbington & Bury, 2013). The landscapes of energy extraction and violence produced by such frontiers (e.g., Watts, 2008) are well reflected in the EJAtlas, with more than 669 cases documenting the socio-environmental impacts in the expansion of coal (270), oil (315), and gas (191). At the core of these frontiers is a "scattered geography of holes" (Huber, 2015), connected into the global commodity chains through larger infrastructures (Bridge & Le Billion, 2012; Cardoso & Turhan, 2018; Healy et al., 2019). As the EJAtlas shows, resistance to such process arises at the extraction, transportation, and consumption ends, and unveil how struggles not only seek to "blockade" the fossil frontier (Klein, 2014) but also advance into the transformative politics of "leaving oil under the soil[16]" (see: Temper et al, 2013; Vallejo et al, 2015).

As discussed in this Chapter's remaining sections, maintaining the industrial metabolism with alternative energy resources is likely to trigger new trajectories of both frontiers and conflicts. What are the particularities of the emerging "renewable energy" frontiers? Do these frontiers foster conditions for conflict? If so, in which ways? A certain starting point is that renewable energies' biophysical nature -more dispersed and less productive than fossil energies-, involves a fundamental shift in the way energy is extracted, distributed, and consumed. Renewable energy frontiers will be less about "subterranean" politics and more about "horizontal" ones: hydropower requiring large-scale diversion of water bodies; vast tracts of fertile soil required for the production of biofuels; entire landscapes with solar radiation and wind currents turning into the new power facilities, and so forth.

Local struggles emerging as a response to these new frontiers certainly change the conversation as well. In the case of fossil-fuels, EJ struggles powerfully highlight the need to stop the extractive violence that comes with the high energy-consumption societies, shifting the costs to marginalized communities, non-human beings and the atmosphere. In the case

[16] As largely documented by Environmental Justice researchers, the claim to *leave oil under the soil* was born in the 1990s out of the struggles in the Niger Delta and articulated by different networks and organizations such as ERA, Acción Ecológica and Oilwatch (Temper et al, 2013). As a direct consequence of such alliances, the idea of leaving oil under the soil materialized in a revolutionary proposal against oil extraction in the Ecuadorian Amazon, known as the Yasuní-ITT Initiative (see: Vallejo et al, 2015). This slogan is today adopted by anti-shale gas fracking, tar sands and open cast coal-mining movements, becoming one of the most powerful claims in the vocabulary of the global Environmental Justice movement (Martinez-Alier et al, 2016).

of renewable energies, this dissertation will show, EJ struggles become the spearhead for democratizing the energy transition, shifting the question from how to sustain the ongoing metabolism, to how to reimagine our collective metabolism and its energy base.

2.2 Energy transitions: a multidimensional process

2.2.1 Key elements of energy transitions

The term "energy transition" can be defined as the structural and long-term changes that occur within an energy system: be it at local, regional or global scales. An energy transition involves changes in the type of primary energy resources, the conversion technologies, as well as in the supply patterns of a given society (Smil, 2010).

From this foundational definition, transition is employed analytically to assess major historical shifts in energy systems at different scales (Bridge, 2013: 333). This *temporal* approach is commonly articulated with both a *biophysical* and a *social* perspective; providing a broad understanding on how energy systems are associated with long-term social change (e.g. Jiutso, 2009; Podobnik, 2006, Fouquet and Pearson, 1998).

From the lens of Ecological Economics, for example, the "great" energy transitions that have taken place throughout human history have also been part of larger transformations, allowing to explain the historical jumps between one "socio-metabolic regime" to another: that is, from hunter-gatherers to agricultural societies, and from agricultural societies to industrial societies (Haberl et. al., 2010). Each of these regimes represent a socio-political and economic configuration with its own particular features in terms of energy and material use, land use patterns and technological developments (Tainter et al, 2006; Fischer-Kowalski and Haberl, 2007).

The metabolic perspective on energy transitions provides a vantage point from which to understand how societies are structured in biophysical terms: what are the qualities and quantities of a system's energy and material flows, what are the challenges that each system faces (e.g. soil fertility in agricultural societies; the capacity of the earth's sinks to regenerate in industrial societies), and what are the limitations that each entails (e.g. the amount of land available for agricultural societies; the availability of fossil fuels in industrial societies). This

perspective, in sum, provides a useful basis to understand how socio-metabolic configurations confront breaking points and transformations throughout history. As such, it becomes a guiding route in analyzing ongoing attempts to transition towards renewables.

Research in Human Geography and related fields have, on its turn, increasingly developed an approach to transitions in both *geographical* and *political* terms. Bridge et. al. (2013) highlight, for example, that transitions are not just temporal processes with biophysical and social dimensions; they are also geographical processes. This means that energy transitions involve major reconfigurations on the spatialization of economic and social activities. For example, a transition towards renewable energies "not only requires societies to commit massive investment to redesign infrastructure, buildings and equipment, but also to make choices from a range of possible spatial solutions and scales of governance." (Bridge et. al., 2013: 333). The ways in which such reconfigurations take place, geographers emphasize, is the direct result of intersected and contested social processes. A geographical approach to transitions, therefore, takes into account how different institutions, infrastructures and resources are contested by different groups with divergent politic-economic projects (Calvert, 2016).

The intersected dimensions that come at play in energy transitions (temporal, spatial, biophysical and social) are key for understanding two major processes contextualizing this dissertation. First, how the transition from solar to fossil-based systems took place with the industrial revolution. And second, how the ongoing attempts for a renewable transition would sustain, or rather transform, the metabolic configurations of industrial development.

2.2.2 The transition from agrarian to industrial societies

The historical transition from agricultural societies (fundamentally based on the use of solar energy through biomass) to industrial societies (based on the use of tapped solar energy from the past through fossil resources) represents the fundamental starting point to contextualize current debates on the energy transition.

From a metabolic perspective, agrarian societies can be characterized by an energy regime of "active solar energy utilization" (Sieferle, 2001). They contrast with hunter-gatherer societies (commonly identified as "passive solar energy systems") insofar agrarian societies made an

active intervention to transform solar radiation for human use. The fundamental energy input of agrarian societies consisted, therefore, in solar energy, that was transformed or "colonized" by humans through agroecosystems and managed forests (Fischer-Kowalski & Haberl 1997). The active utilization of solar energy of agrarian societies allowed to provide endosomatic energy to humans and animals (through food, wood and fiber), which became the fundamental source of work[17]. In addition, solar energy was also leveraged through the intermittent flows of wind and water currents that powered exosomatic mechanical energy, including waterwheels in industry and sailing ships in colonial expansion (Huber & McCarthy, 2017).

The technological transformation of terrestrial ecosystems driven by agrarian societies allowed the control of solar radiation through the monopolization of land and created an area-dependent energy system (Scheidel & Sorman, 2012). As such, the agrarian regime was subject to strict limitations with respect to physical growth and spatial differentiation (Haberl et al, 2010). The challenges faced by agrarian societies, therefore, mostly pertain to the delicate balance between population growth, agricultural technology, labor force needed to maintain productivity of agro-ecosystems, and the maintenance of soil fertility (Fischer-Kowalski & Haberl, 2007). Together, these factors prohibit physical growth of socioeconomic systems beyond a certain threshold and determine the basic characteristics of the metabolic profile of the agrarian regime (Haberl et al 2007).

The substitution of biomass by fossil stocks as the primary source of energy represents the breaking point that triggered the progressive transition from agrarian to industrial societies. From an energetic perspective, the industrial revolution can be seen as the transition from an "organic" economy (dependent on the annual flows of solar energy over the surface of the earth) to an "inorganic" one (dependent on the extraction of fossil deposits under the surface of the earth) (see: Wirgley, 2010). Yet the industrial revolution also implied a major shift in material terms. While agrarian societies gained most materials through agriculture and forestry, industrial societies rely heavily on mineral resources -such as iron, copper and aluminum.

The origins and development of industrial societies at the end of the 18th century in Europe is, therefore, the result of the extraction of both energy and materials that enabled an

[17] Cheap agrarian inputs coming from the colonies played an essential role in the process of European industrialization. For instance, cotton was produced by slave labour in stolen lands of North America, enabling to develop the British textile industry (Beckert, 2015).

unprecedent development of conversion technologies and mechanics. This, in turn, triggered fundamental rearrangements in both the societal organization of the economy and the interactions of society with the environment. Three interrelated implications are relevant for this dissertation:

- The extractive (subterranean) energy regime

Fossil fuels allowed for a de-linking of energy provision and area (Haberl et al 2007). This meant a partial and temporal "emancipation of land" (Mayumi, 1991) as great amounts of space were previously used for the harvesting of biomass were "freed" for alternative uses and changes in land cover (i.e. food production, urban development, recreational spaces and so on). For example, "Wirgley (1998, 54-5) estimates that '1 million tons of coal provided as much heat as could have been obtained from 1 million acres of forested land'." (Cited in Huber & McCarthy, 2017:6). Relevant for this spatial transformation is the configuration of energy systems themselves: in contrast with the energy system of agricultural societies, energy provision in industrial societies unfolds through highly centralized systems, in which subterranean resources are extracted in specific geographical points and later distributed through different infrastructures (Grubler and Cleveland, 2008).

- High energy density: unprecedented productivity and consumption

The extreme energy density of fossil fuels resides in the fact that these resources are millennial deposits of past solar energy (see: White 1943; Cottrell 1955; McNeill 2000 -cited in Huber and McCarthy, 2017). The use of fossil fuels has therefore been translated in drastic increases in energy consumption, unprecedented development of machineries and consequent raises in labour productivity. "Prior to the emergence of the coal-fired steam engine, mechanical work was mostly done by human and animal muscles. The industrial age is an age of fossil-fuelled automatic machinery performing tasks once reserved for muscular toil." (Huber & McCarthy, 2017:6. See also: Johnson, 2014).

Simultaneously, the development of new technologies in agriculture (through machinery and fossil-based fertilizers) triggered spectacular improvements in food production, enabling population growth and meeting the growing demand of human labor power in manufacturing and services consolidating in cities. Together, these processes largely contribute to the consolidation of modern capitalist societies, as well as the imaginary of

development and material wellbeing that is bound to them (e.g., Mitchell, 2013; Huber, 2013; Nye, 1998).

- Spatial differentiation and uneven development

The increasing availability of higher quality energy sources has also enabled a progressive spatial differentiation of economic activities. Technological improvements in transportation and the fall of relative costs of energy contributed to such process to a large extent (Bridge et. al., 2013). At local and regional scales, this has been translated in a progressive separation between rural and urban spaces (e.g., agricultural, supplying areas vs. increasingly industrialized or finance-centered regions); while at larger scales this has been reflected in the progressive organization of the global economy (e.g., peripheral and semi-peripheral vs. central countries and regions) (see: Smith, 1990; McCarthy, 2009). Central to this spatial differentiation or patterns of "uneven development" (Smith, 1990) has been the ability to displace (socially, temporally and geographically) many of the social and environmental costs of the industrial metabolism, a process that is well reflected in the expansion of the commodity frontiers (see also: Patel and Moore, 2019). For instance, South American exports in tons have increased enormously in the last 120 years, with terms of trade structurally unfavorable (Infante-Amate et al, 2020)

2.2.3 Phasing out fossil-fuels: an industrial endeavor?

As outlined in the previous section, practically all the limitations of the agrarian societies have been overcome by the transformation of the energy system during industrialization (Haberl et al. 2010). However, the presently dominant industrial socioecological regime faces different limits that are key in framing the ongoing challenge towards a low-carbon transition.

From a pure metabolic perspective, the industrial regime not only faces a progressive decrease in the availability of its energy resource-base[18]; but most importantly, it has drastically -and in some cases irreversibly- transformed various life-sustaining systems on Earth (Haberl et al 2010). Today, global change research provides ample evidence that significant anthropogenic changes can be found at any spatial scale (Turner et al. 1990:

[18] For debates on peak-oil, the end of cheap oil, and unconventional fossil fuels, see Campbell and Laherrere 1998; Kerschner et al. 2013; Ferrari, 2020.

Vitousek et al. 1997), including climate change and the crossing of other three planetary boundaries (Steffen et al. 2015). These limitations highlight that this socio-ecological regime is bound to change as it has eroded the very life-conditions on which it has been sustained (Fischer-Kowalski and Haberl 2017).

In contrast to previous regime-changes in history, the juncture we currently experience is one tainted by universality and urgency. The exponential increase of energy and material flows that has sustained the globalized capitalist society confronts today that, if modern civilization is to avoid significant drastic changes in the earth system, global warming should be constraint in the following years. The critical scientific consensus on the need for this transition positions, therefore, the temporal dimension as one of the key elements in the analysis and debates on the transition (see: Sovaccol, 2016).

A second juncture comes from how this transition will take place and how different metabolic configurations will be at play. Phasing out fossil-fuels and transitioning towards a renewable energy system can be seen as a mere technological fix to sustain the ongoing industrial metabolic regime (eco-modernist positions), or else, as the spearhead of a broader process of social and metabolic transformations. As this thesis argues, this is a contested process in which space, justice, and politics come into play.

As outlined below, these three dimensions can be approached as separated analytical entities with their research questions and practical implications but are better seen as retrofitting each other in multiple ways. In analyzing the interplay of these three dimensions, this thesis has a threefold objective: First. It argues for the analytical and political significance of space in the energy transition, and most specifically, of access and control over land (as being the fund for harnessing the flows of wind and solar currents). Second. It outlines a preliminary set of questions for the political ecology of wind and solar power expansion (as being the two most promising technologies for propelling an electric transition). Third. It discusses how these elements converge with agrarian, indigenous and EJ struggles in the Global South (considering here countries of the "developing world" as well as the peripheries of the "developed world").

Space

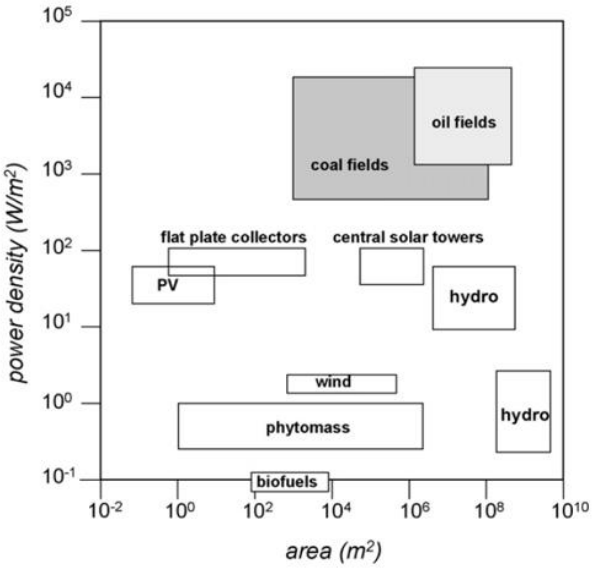
One of the fundamental questions that come with the required transition towards renewables is returning to an area-dependent energy system. If, as Mayumi (1991) articulated, the fossil fuel era can be described as one in which the economy has temporally emancipated from the land; an era of renewables would unavoidably be described as an energetic return to the earth's surface[19].

Recent estimations on the biophysical requirements on the transition from a "subterranean" to a "horizontal" energy regime (Huber and McCarthy, 2017) provide some key elements to contextualize such analysis. Using the metric of power density, Scheidel and Sorman (2012) highlighted that if the current energetic metabolism levels are to be maintained, areal coverage for renewable energies would have to increase in large magnitudes. The metric of power density provides the relation between the number of watts that can be generated in a particular area (W/m2). It is formally defined as the energetic flow per horizontal area (either land or water). With this indicator, it is possible to compare the productivity and spatial requirements of different primary energy resources (Smil, 2010). As illustrated in Figure 2.1, the power density of fossil energy resources is two orders of magnitude higher than solar and hydro and three orders higher than wind and biomass. How is this "horizontal energy regime" progressively taking place? Which institutions and power arrangements are defining such a change?

Scheidel and Sorman's estimations included both conservative and ambitious scenarios for expected global energy capacity, including ranges such as 11.5-160 million hectares for wind power; 12-27 million hectares for solar PV; 8.6-122.3 for solar CSP; 123.9 for hydroelectric; and 5.3 -12.7 for liquid-fuel, commercial biomass. Estimations are bound to change with the development of technologies and the quality of the resources harvested in different locations. Nevertheless, they give a glimpse of the scale of transformations over land uses and land cover that will potentially trigger new frontiers in rural areas across the world.

[19] A key element to consider in these debates is the role that nuclear and other "subterranean" forms of energy (i.e., geothermal) could play in the transition. In The Ecomodernist Manifesto, nuclear energy plays a vital role in compensating for the lower yields of renewables. Nuclear is seen as a key driver for maintaining high rates of energy consumption and a technological alternative for mitigating climate change, spare nature, and alleviate global poverty. Multiple transition strategies, including the Mexican one analyzed in Chapter 4, include nuclear energy as part of its "clean" energy portfolio.

Figure 2.1 Power density and areal requirements of different energy resources[20]



A more specific study on countries in the European Union shows that if domestic energy consumption levels continue at current rates, renewable technologies will trigger a considerable increase in land competition (Capellán et al., 2017). The study focuses on solar power technologies, estimating that EU-27 countries would require around 50% of their available domestic land (i.e., the land not already used for human activities) to fulfill their current energy demands[21]. The study argues this situation will be particularly challenging for countries located in northern latitudes with high population densities and high electricity consumption per capita.

These estimations show that a shift from a "subterranean energy regime" to one that relies on the "horizontal" flows of renewable resources over land, will have large-scale transformations over the earth's surface, raising questions on where and who will bear these costs at different scales. The spatial rearrangements that are bound to occur in the expansion of renewable energies pose questions at different scales: from global patterns on investments and the configuration of supply-consumption chains; to national strategies for territorial development; to local transformations in land use and territorial management. These considerations include a range of questions around the political and justice aspects of the transition, which leads to broader conversations around the need to make structural transformations on modern societies' metabolic trajectory.

[20] Source: Scheidel & Sorman, 2012 based on Smil, 2003, 2008
[21] These estimations are made without considering the energy embedded in their consumption from international trade.

Politics

While the concept of *space* serves well to identify renewable energies' biophysical features, *land* works as a more accurate category for its political ecology analysis. In the energy transition, the land is the fund from which flow resources will be harvested (e.g., wind and solar currents). As such, those having access and control over lands will have access and control over the flows of energy (see: Ribot & Peluso, 2003). If land becomes a fundamental aspect in the energy transition, the Political Ecology of renewable energies will explore how spatial representations and territorial transformations will reinforce or revert unequal power relations at different scales. When laying these questions for the Global South case, some particular aspects appear to be of central relevance.

- How renewable energy implementation becomes part of broader discourses around development and sustainability.

Throughout its various mutations (e.g., sustainable development, globalization, green economy), the notion of development has been working as a hegemonic discourse permeating the political, economic, and cultural program of the post-colonial era (Esteva, 1992; Sachs, 1992; Esteva & Escobar, 2017). This program includes many modernization strategies promoting urbanization, industrialization, agricultural intensification, and other formulas prescribed by international and national institutions (Escobar, 1995). In the words of Nigerian environmentalist Nnimmo Bassey, development is the linear pattern etched by the Global North, stacking nations into developed and underdeveloped categories: "development suggests growth, expansion, enlargement, and spread, none of which captures the sense of justice or equity or considers the ecological limits of a finite planet" (Bassey, 2019: p.3-4).

As will be discussed in the following Chapters, narratives around green growth and low-carbon development frame the ongoing expansion of renewable energies, emphasizing the "ecological" character of "modernization" through new technologies and large-scale infrastructures. Contemporary notions of development in the green economy remain within a capitalist rationality in which economic growth is the primary focus. However, critics of the green economy highlight that the increase in resource extraction required to sustain economic growth inevitably displaces environmental problems rather than solving them (Brand & Lang, 2019). By shifting the costs both socially and geographically, development

and low carbon updated narratives tend to obscure the energy transition's social dimensions. Case studies presented throughout this dissertation provide different examples, showing how communities challenge and revert such processes in multiple ways.

- How these discourses materialize over space.

This thesis argues that in the expansion of renewable energies, the fundamental question of politics and justice revolves around how land is assembled as a new energy frontier. a process in which maps play a fundamental role. Assembling land as a resource available for some purposes implies excluding others (Li, 2014). On one side, this process requires a great deal of symbolic work. The land has to be rendered as a *frontier* available for development throughout a series of strategies that include statistic, metrics to adjudicate "efficient" land uses, mapping resources, and deploying technologies (Li, 2014). This process, Bridge argues, is a simultaneous movement "of erasure and reimagination, such that these spaces are simultaneously emptied *and* full" (2001: 2155).

The biofuel "boom" that took place over the early 21st century under the discourse of a green energy transition for fuels serves as a useful reference point in this regard. As analyzed by Larry Lohman (n/d), the expansion of biofuel plantations has come with the colonial traditions of rendering lands as *terra nullius* through renewed notions such as "marginal" and "waste" lands. In the making of these frontiers, many other features of the land become erased: from in-place land uses such as natural medicine and subsistence farming, to other cultural values that are incommensurable with those assigned by investors (see also: Martinez-Alier, 2002; Nalepa and Bauer, 2012. Baka, 2013). Therefore, these patterns set a vital reference of analysis when approaching how, where, and under which conditions wind and solar power projects are expanding across the Global South.

Throughout the following Chapters, this work will show how maps play a central role in rendering lands investable for mega wind and solar power projects, overlooking the complex relations of territories at stake. Chapter 4 shows, however, that as much as maps have been a unique source of power for the powerful (Harley, 1989: 278, cited in Peluso 1995), maps also become useful ways to contest capital accumulation and purposes of the State (Crampton 2010). In providing a series of "counter-maps" for the energy transition in Mexico, I provide some empirical evidence on critical cartography's potential in shaping an alternative transition agenda. Mapping through the Environmental Justice Altas and the

Geocomunes platform demonstrate how land is not simply a matter of management but also one of policy and politics (Drodz, 2020: 372).

- How renewables promote spatial differentiation or new opportunities for spatial integration.

The case studies presented in this dissertation show that, as vertical frontiers progressively materialize over space, they become the green supply zones for an industrial transition. The frontier becomes the prime place of shaping the transition's geography, triggering further spatial differentiation at larger scales. As these processes occur, new questions arise on how electricity from renewable energies is being generated, how such energy is flowing within societies, and how specific power structures shape these flows' trajectory.

In Global South contexts, spatial differentiation triggered by renewables can be seen as a two-fold pressure. On one side, "developing countries" would face an increasing external demand for energy and materials required to sustain developed nations' transition ambitions. On the other, the pressure to implement a "low-carbon development" model sustained by renewables would replicate such dynamics domestically. In this thesis, I am particularly interested in exploring how the latter triggers particular spatial and distributive questions. The case of the DESERTEC project illustrates such dynamics in a nutshell: envisioned by different stakeholders of the European Union, Desertec foresees to implement a set of large-scale solar energy infrastructures throughout the deserts of North Africa to provide green electricity to the European demands.

- The ways in which regimes over land and resource management are transformed by such changes, distributing wealth and political power in different ways.

Cases discussed in this dissertation show how different tenure regimes come at play with the expansion of renewable energies. This analysis shows how a variety of property and management arrangements over land (public, private and communal) are affected by and respond to the expansion of industrial renewable energies. Of particular relevance is the increasing number of cases of communal lands (regulated by formal and/or customary institutions and often sustaining agricultural and pastoralist communities) are affected by the implementation of mega wind and solar power facilities, shedding light on broader patterns of enclosure and privatization on the transition. Yet these spaces, the dissertation argues, become at the same time the spearhead of alternative transition projects in which the

commons appear as the pivotal node of social transformation, raising the open political question around the possibility of shaping alternative geographies for the energy transition.

Justice

The push towards a renewables-based system sustaining current levels of -uneven- energy consumption is expected to trigger different forms of land and resource grabs. Therefore, it is likely that a solar industrial regime will shift the socio-environmental costs to peripheral regions through the expansion of energy and other resource frontiers. These processes will potentially affect rural communities within domestic contexts (triggering a land competition between energy and food production, energy and biodiversity conservation) or else, affecting larger scales by implementing new resource frontiers in other countries. If the oil frontiers' question demands a solution in keeping oil under the soil, the renewables frontiers could claim to keep the land with whom it belongs.

Case studies in this dissertation will show that, as the wind and solar power frontiers expand globally, new forms of EJ struggle sprout in response. Land becomes the central political subject of these struggles. Communities mobilize various concerns, claims, and discourses about the lack of recognition, participation, and distribution in changes over access and control over their territories. This thesis emphasizes the "South" in such global analysis in order to shed light on patterns that have previously been overlooked in the literature (a review in Chapter 5) and even mass-media debates around the energy transition (see: Cabaña & Roy, 2020; Gibbs, 2020).

Many historical trajectories, forms of action, and environmental consciousness that are central to the "developing world" re-emerge in the face of the mega wind and solar power expansion. The popular environmental movement in Mexico and Latin America, for example, has been primarily defined by the struggles of indigenous and peasant communities defending their territories as the material and cultural basis of their existence. As summarized by Carruthers (2008:10): "struggles for indigenous recognition and autonomy are often inseparable from environmental and resource claims" while historical *campesino* struggles for agrarian justice take broader platforms against the "despoiled landscapes, poisoned watersheds, agricultural chemicals, and other rural environmental problems".

Similar experiences take place in many other contexts of the Global South, where the long-lasting struggles against colonialism, neocolonialism, and development intersect with the defense of livelihoods and cultural identities of multiple communities (Martinez-Alier, 2002; Avci, 2008). In India, for example, the popular environmental movement is strongly connected to the struggles of Adivasi territorial rights and many other ethnically discriminated communities facing the environmental pressures of a rapid career towards economic growth (Martinez-Alier et al. 2016b).

How land becomes central for the quest of social and environmental justice in the developing world becomes then central for the analysis and intervention in a just transition. Essential for this point, nevertheless, is that cases presented in this dissertation show a broader understanding of the Global South, not only encompassing the well-defined "developing nations", but also the peripheries of some of the most "developed" ones (see Chapter 5 for cases of injustice against Saami communities in North Sweden; mobilizations of Native Americans in Massachusetts, USA; and the growing number of rural communities in South Europe claiming for alternative approaches to energy and development). As different struggles around the defense of land and place-based commons take a new environmental turn, novel forms of "popular environmentalism" (Martinez-Alier, 2002) emerge, challenging dominant accounts around the transition.

Throughout the following Chapters, this dissertation provides empirical reflections on how environmental conflicts become vital political forces in promoting more egalitarian and environmentally-sound approaches to the transition. Grasping the transformative force of conflicts involves questioning "whether, when and how these struggles challenge the meanings, discourses and identities that reproduce and legitimize unequal power relations and construct alternative ones that are conductive to more egalitarian, just and sustainable social and environmental relations" (Avci, 2018: 2). When looking at the case of renewable energies, conflicts shed light on the maldistribution of costs and benefits associated with an industrial-based, growth- oriented approach to the transition. However, conflicts also thread new political spaces in which sustainability goes beyond greening modern energy systems and instead seeks to transform the societal configurations of the metabolism itself. As such, conflicts become a seed from which alternative transition agendas could scale up in debates for just climate futures (Temper et al., 2020).

Chapter 3

The winds of Mexico: a new energy frontier[22]*

3.1 Introduction

In the southeast region of Mexico, a conflictive process unfolds against one of the most ambitious renewable energy investments currently deployed in the Global South: The Wind Power Corridor of the Isthmus of Tehuantepec (Oaxaca State). The Corridor encompasses more than 15 large-scale projects owned and operated by multinational companies. Both government and international agencies have supported the Corridor as a milestone to promote the Mexican Climate Change Policy, which foresees reaching a share of at least 40 percent of renewable electricity production by the year 2033 (ENCC, 2013). However, *Binnizá* and *Ikoots* groups historically inhabiting the region continually resist the implementation of the project, claiming impacts on their territories, livelihoods and identities. After more than ten years of local struggle, the Wind Corridor is still a space of contestation between national discourses and indigenous vindications.

This Chapter presents a historical review on the implementation of mega wind power projects in the Isthmus region and the process of local contestation that have emerged in response. In particular, this work seeks to identify the drivers and pathways of local resistance to discuss how energy transitions are being contested by those affected by renewable infrastructure deployments. The research is based on a systematization of official documentation, media releases and documents of social movements between 2005-2015.

[22] This research was firstly published in the Journal of Political Ecology https://doi.org/10.2458/v24i1.20979 The Journal of Political Ecology follows a Radical Open Access Policy. Avila-Calero S (2017) Contesting energy transitions: wind power and environmental conflicts in the Isthmus of Tehuantepec. *Journal of Political Ecology*. 24: 993-1012.

The study follows a political ecology perspective, and therefore, approaches issues of environmental change and conflict from the lens of power relations (Peet & Watts, 2004; Bryant and Bailey, 1997). As defined by many researchers, political ecology entails a political motivation to open debates of issues previously framed as uncontested (Swyngedow, 2010; Heynen *et al.*, 2006; Robbins, 2004). Consequently, this study focuses in two central themes: first, it seeks to analyze the environmental inequalities created by dominant ways of implementing wind energy projects. Secondly, it intends to unveil the underrepresented voices that are contesting such processes at the local scale.

The analysis is represented per two different scales. The larger scale of analysis examines the national policies shaping the ways on which wind energy is being implemented. At the local scale, the analysis resolves to grasp the political content of local resistance. The central hypothesis of the study is that neoliberal policies configuring the expansion of wind energy in Mexico are playing a crucial role in creating emergent forms of environmental inequality. It will show how overlapping processes of privatization and empowerment of corporations in Mexico are defining an uneven distribution of gains and losses associated with wind energy projects. Here, an emphasis is made to demonstrate how the agrarian counter-reform enacted in 1992 has facilitated the expansion of wind energy throughout the enclosure of communal lands in the rural landscape of the country. Deriving from this, a second hypothesis is that communal and territorial identities are bringing diverse forms of resistance and possible pathways to open the energy transition debate in Mexico. The latter includes new imaginaries of "energy sovereignty" and a proposal to build a cooperative wind farm in the region of the Isthmus.

An increasing amount of literature is critically approaching the social dimensions entailed in renewable energy production. Some authors are advancing in this realm by deconstructing dominant narratives of particular technologies and its impacts at the local scale (Huber *et al.*, 2016; Ariza-Montobbio *et al.*, 2010). A growing interest is also arising to address the spatial dimension of renewable energies and discuss its relation with social power and justice (Rignall, 2016; Yenneti *et al.*, 2016). Furthermore, scholars are looking to grasp the political motivation of grassroots initiatives promoting alternative schemes for renewable energy production (Powell, 2015; Becker and Kunze, 2014; Seyfang and Haxeltine, 2012). This research aims to contribute to such discussions by presenting empirical evidence of a local conflict that reflects two interrelated processes: the emergence of social resistance against

corporate wind energy projects, and the development of alternative pathways to promote sustainable transitions.

The following section presents a brief theoretical framework sustaining the study's approach. Section 3.3 describes the case study and methods used to systematize the gathered information. Sections 3.4 and 3.5 present the results about wind energy projects and pathways of conflict. Section 3.6 discusses these results under the hypothesis of a rising movement against neoliberal energy transitions in Mexico and elsewhere. The last section highlights the salient outcomes of this analysis.

3.2. Theoretical framework

From the lens of political ecology, environmental conflicts are understood as a result of socially unequal and geographically uneven distribution of gains and losses related with economic activities (Temper *et al.*, 2015). This includes not only the unjust burdens of externalities, but also the uneven access to natural resources (Martinez-Alier and O'Connor, 1996). Within this theoretical framework, a particular research field has studied the relationship between changes in the socio-metabolic patterns of human economies and the environmental conflicts deriving from them (Martínez-Alier *et al.*, 2010; Martínez-Alier, 2009; 2002). Social-metabolism is a concept that draws from the original understanding of the metabolic processes in biology to explain how societies interact with nature in terms of the physical throughput (flow of energy and materials) associated with economic activities (Sorman, 2014). Throughout production-to-consumption chains, ecological distribution conflicts arise as a result of the uneven allocation of gains and burdens among geographical regions and social groups.

Unequal relations between center and peripheral regions of the world are thus crucial to understand how rich areas of the economic system appropriate cheap energy and materials coming from distant regions that suffer disproportionately from negative socio-environmental impacts (Hornborg, 2005, 1998). Whether from state-driven or market-lead institutions, the socio-metabolic perspective emphasizes how economic growth and the consequent expansion of the "commodity frontiers" (Moore 2011; 2000) leads to an increasing number of ecological-distribution conflicts. There is currently substantial empirical evidence of environmental justice struggles, as well as a vast number of cases of

popular environmentalism, particularly located in the Global South (see Martinez-Alier *et al.*, 2016; Angelovski and Martinez-Alier, 2014).

From a different research perspective, critical geography scholars have emphasized the human metabolization of the environment under the economic institutions of a given historical context. In this regard, literature is increasingly discussing the ways of which neoliberalism has been reshaping global capitalist dynamics, and thus, environmental issues and conflicts (Heynen & Robbins, 2005). Following Castree's review on the literature (2010), neoliberalism took force in the 1970s as a term describing a worldview, a policy discourse and a set of policy measures that liberate individual entrepreneurial activities from state control and regulation. Strong private property rights, free trade and financial flows are at the core of capital accumulation under neoliberal arrangements (McCarthy, 2015; Harvey, 2005). As current studies demonstrate, the decades driven by neoliberal processes coincide with a wider connection of global exchanges and unprecedented levels of physical throughput (Dittrich *et al.*, 2012; Krausmann *et al.*, 2009), but also with the emergence of forceful and novel forms of capital accumulation (Prudham, 2007; Glassman, 2006; Harvey, 2004). The approach to nature and the concept of sustainability is also consistent with private property rights and markets, leading to processes of privatization, enclosure of common goods and the commodification of nature (Heynen & Robbins, 2005). Such processes are thus critically analyzed in terms of its distributional effects and interpreted as the main drivers of emerging forms of socio-environmental contestation, including territorial struggles, revival of the commons and alter-globalization movements (see Bakker, 2007; McCarthy, 2005; Klein, 2001).

When exploring the political ecology of wind energy conflicts, both of these approaches appear to answer partial parts of the same analytical problem. Recent contributions in political ecology are addressing how changes in energy production, distribution and consumption are driving (or potentially creating) an uneven distribution of gains and losses among geographical regions and social groups (Hornborg, 2014; Zografos and Martinez-Alier, 2009). An increasing interest is also arising to address the distributional effects of neoliberal agendas in energy transition strategies and renewable energy deployments (Newell & Phillips, 2016; Newell & Mulvaney; 2013; McDonald, 2009). Recently, McCarthy (2015) has advanced the latter discussion by pointing out how neoliberal agendas lead to potential enclosure processes in large-scale renewable projects, particularly in contexts of the global

south where land rights remain as historically contested. The Mexican context and the empirical evidence of the Isthmus of Tehuantepec offers an opportunity to reflect how both perspectives are complementary.

3.3 Case study and methods

The Isthmus de Tehuantepec is the narrow section of southern Mexico, spanning across the states of eastern Veracruz, eastern Oaxaca and southwest Chiapas. In Oaxaca, the Isthmus extends from north to south approximately 60 km and 60-80 km from east to west (Elliot *et al.*, 2004). From an administrative standpoint, the Isthmus is one of the eight political regions of Oaxaca with a population of 595,433 (INEGI, 2014). Its territory comprises traditional lands of Binnizá and Ikjoots groups (Zapotecos and Huaves in Spanish), most of them organized through communal land regimes and customary law. Indigenous communities in the area heavily depend on traditional livelihoods rooted to the territory, including fishing and farming activities. A majority of the region's localities fall on the upper scale of marginalization, indicated by low income, access to basic services and education (INEGI, 2014).

Gathering the data for this research was organized in three parts. First, information about each wind project encompassing the Corridor was researched via various governmental sources including databases of investment in renewable energies and permits for developing projects. Existing publications regarding wind energy in the Isthmus (Juárez and Leon, 2014; Castillo, 2011) served as a guide for gathering information, though additional cross-referencing of sources was required to actualize data and fill in gaps.

The second part encompassed a thorough research of wind power conflicts in the Isthmus of Tehuantepec. Statements of local and external organizations published between 2005-2015 where retrieved from web sources, including those of the Assembly in Defense of the Land and Territory of the Indigenous People in the Isthmus of Tehuantepec (quoted as APIITDTT); the Union of Indigenous Communities of the North region of the Isthmus of Tehuantepec (quoted as UCIZONI); the Tepeyac Human Rights Centre and the Organization for a Consultation Process in Juchitán. Additional information included published interviews with local leaders, as well as media sources (documentaries and videos) made by activists in the region. The retrieved information was then systematized with Atlas

TI, which was utilized to code the actors along with their claims mobilized in the processes of restistance.

In the final part of this process, information was organized chronologically and cross-referenced with local and national media (2005-2015), delineating relevant moments and the evolution of conflicts. Three different phases were identified and organized according to the research questions of the study. Phase 1: the articulation of local claims against the Wind Corridor (1995-2005). Phase 2: the emergence of reactive mobilizations against the Corridor (2005-ongoing). Phase 3: the rising of proactive proposals as an alternative to the Corridor (2010-ongoing). Throughout these phases I refer to the general conflict developing in the region. However, in order to better answer the research questions, I focused on two particular cases: the San Dionisio del Mar community against Mareña project (a reactive conflict) and the Ixtepec Community Wind Farm (a proactive proposal that emerged within this context). The general information of these two conflicts was also uploaded in the Environmental Justice Atlas.

3.4 Structural reforms and wind energy in Mexico

Since the consecutive economic crises of the 1980s, Mexico has been immersed in a profound shift towards a neoliberal program, integrating the country in a dynamic of globalized capitalism. After a long phase of state-lead development, changes in monetary, trade and institutional spheres guided by "structural adjustments" have stimulated a rapid privatization of public and common goods, an increasing flow of foreign investments, as well as the creation of new markets in the natural and social spheres. This has coincided with a new economy of industries and services with high use of energy and materials (Gonzalez-Martinez & Schandl, 2008; Russi *et al.*, 2008), high concentration of benefits, and the consequent intensification of inequalities (Harvey, 2005, Székely, 2005).

In this context, changes over the electricity and land tenure systems have determined the expansion of wind power as a private and profit-driven industry. In the electrical sector, dismantling the state monopoly began in 1992, when legal reforms began promoting private participation in power-generation activities (Vargas, 2010). At that time, transmission and distribution remained as an exclusive right of the state, regulated by the Federal Electricity Commission (CFE by its acronym in Spanish). However, this trend reached a crucial point

with the ratification of the 2014 Energy Reform, extending the possibilities of private participation in generation, transmission, distribution and commercialization activities (Padilla, 2016), including particular measures to promote private actors in the renewable electricity sector (PwC, 2014).

Simultaneous changes to Mexico's land tenure regime enacted the introduction of private investment in the rural landscape of the country, previously organized through the "social" forms of property. The Agrarian (counter) Reform of 1992 produced a change to *ejidos* – founded after the Mexican Revolution and *comunidades agrarias* (indigenous institutions) by allowing rural communities to legally sell, rent and subdivide the communal land rights which were obtained after decades of social struggle (Rivera-Herrejón, 2007). Such reform represented the end of land distribution processes initiated in the country after the 1917 Constitution, and more than eight decades of state protection over peasants and indigenous livelihoods (Toledo, 1996). Since the reform, there has been a partial return of agribusiness (Herrera, 2012) as well as private opportunities for other land-uses, including forestry (DiGiano *et al.*, 2013), and more recentrly, large-scale wind farms. However, these changes do not indicate the complete disappearance of the communal system.

Since the 1980s, technical studies held by the U.S. and Mexican government indicated the Isthmus of Tehuantepec as one of the most attractive regions in the country to implement commercial wind farms (see Elliot *et al.*, 2004). After structural reforms on land and electricity were approved, the Federal Government then developed a wind farm pilot project (La Venta I) that successfully attracted private investments to the region. Government institutions, research foundations, private companies, multi/bi-lateral funding agencies, and experts within the sector then organized several ad hoc meetings from 2000 to 2008 that aimed to eliminate investment obstacles, boost financial support and enhance "market certainty" in the sector (Polycarp *et al.*, 2014). Such meetings were thus the privileged space to envision an ambitious Wind Corridor covering 1,200 km2 and capable to reach an installed capacity of at least 6,000 MW (Elliot *et al.*, 2004). With these conditions established, several foreign companies formalized their interest in developing large-scale projects, nudging the government to propose an appropriate territorial division of the region. A new simplified geometry of blocks was superimposed on the existing intricate maps of agricultural fields, forests, rivers, wetlands, villages, small roads and peasants' collective or private properties. This also occurs in areas newly appropriated for oil or mining concessions. As Map 3.1

indicates, the Isthmus region was distributed into land plots for private wind energy companies, without consulting or gaining permission from the local communities who owned the land. Throughout the initial phase of negotiations, the rights of indigenous communities were ignored (Oceransky, 2010), with a few exceptions of informal meetings with some landowners (SEGEO,n/d).

Map 3.1 Territorial distribution for wind energy projects in the Isthmus of Tehuantepec (c/2004)

Secretaría de Economía del Estado de Oaxaca

The first transaction for a large-scale project in the Isthmus occurred in 2006, when the construction of La Venta II was commissioned from Iberdrola and Gamesa, two major Spain-based companies in the sector. That same year, the Mexican government launched a public-private initiative to expand transmission infrastructure to connect wind farms to the national grid, and the CFE started accepting tender from private companies. As of 2016, the Mexican government has approved 17 large-scale projects encompassing the installation of approximately 1,780 turbines throughout the Isthmus region (see Table 3.1). Excluding one

project which was cancelled in 2012 (further details in the following section), all the projects presented in this table remain in stages of construction and operation. Altogether the Wind Corridor has reached an installed capacity of 2,317 MW.

Competitive tenders were guided by the liberalization changes in the electrical sector, including two attractive modalities for private companies: self-supply (SS) and independent power production (IPP). In the first case, the energy produced is supplied to a cluster of industrial, commercial or service companies associated with the project itself, while the surplus is sold to the CFE. Under this modality, private producers might have their own transmission lines connecting with the national grid, or they might use the public transmission lines. In the second case, all the energy produced is sold to the CFE (SENER, 2013a). Although both of these modalities contribute to the privatization of electricity production, the self-supply modality is of particular relevance as both generation and consumption phases favor private interests. As acknowledged by the Rocky Mountain Institute, self-supply schemes (known in the U.S as "corporate purchase agreements") help big corporations to "green" their business while creating additional financial benefits (Penndorf, 2015).

Table 3.1[23] shows that 12 out of the total projects (66.5 percent of total installed capacity) follows the self-supply modality. Private consumers in this category encompass big national and transnational firms including retailers (Wal-Mart, Chedraui, Soriana), food and beverage producers (Bimbo, Jugos del Valle, Nestlé), cement manufacturers (Cemex, Cementos Moctezuma), mining companies (Peñoles), oil refineries (Pemex) and other industrial clusters (Nissan, Alpla). It is remarkable that some of these companies (Nestlé, Jugos del Valle and Coca-Cola) are also the biggest private extractors and consumers of water in Mexico, which have been similarly favored by liberalization measures since 1992 (Delgado-Ramos *et al.*, 2014). Meanwhile, the remaining five projects (33.5 percent of the total installed capacity) are directed to public distribution (independent power producers plus the Electrica del Valle de México Project, destined to supply municipal consumption in the center region of the country). However, public supply coming from these projects do not necessarily respond to the needs of local communities, where marginal households face expensive electricity bills (APIITDTT, 2008) and over four percent of families remain without electricity supply (INEGI, 2014).

[23] Own elaboration. Data from Comisión Reguladora de Energía

Table 3.1 – Wind energy projects in the Isthmus of Tehuantepec (2016)

CONTRACTOR (PROJECT NAME)	MANUFACTURER / DEVELOPER	INSTALLED CAPACITY (MW)	NUMBER OF TURBINES	PRODUCTION MODALITY	SUPPLY DESTINATION
La Venta II	Vestas/Gamesa Ibedrola	85	104	IPP	CFE
Energías Renovables Venta III (La Venta III)	Gamesa/ Ibedrola	103	121	IPP	CFE
CE Oaxaca (Oaxaca II,III, IV)	Acciona	306	204	IPP	CFE
Energías Ambientales de Oaxaca (Oaxaca I)	Vestas/EYRA	102	51	IPP	CFE
Fuerza y Energía Bii Hioxio (Bii Hioxio)	Gamesa/Gas Natural Fenosa Renovables	227	252	SS	Cementos Moctezuma, Tiendas Chedraui ; Crown Plaza Hotels; Union Fenosa Natural Gas Producer.
Desarrollos Eólicos de Oaxaca (Piedra larga II)	Gamesa/ Renovalia Energy	137	69	SS	Nueva Wall Mart de México; Operadora Vips; Suburbia
Eólica el Retiro (Eólica el Retiro)	Gamesa/Grupo CISA/Grupo México	74	37	SS	Industrial Minera México; Operadora de Minas e Instalaciones Mineras; Ferrocarril Mexicano; Latin America Movie Theatres; Cinemex ; Cinemas Lumiere; Mexicana de Cobre; Ferrosur;
Elioatec del Pacífico (Elioatec del Pacífico)	Gamesa/EDF energies nouvelles	160	N/A	SS	N/A
Eurus (Eurus)	Acciona	250	300	SS	Cemex México
Elioatec del Istmo (Bii Sintu)	Gamesa/Mistui and EDF energies nouvelles	164	124	SS	Compañía Siderúrgica de California; Eoliatec de México;; Hewlett Packard de México; Parque de Tecnología Electrónica; Productos Gatorade de México; Sánchez y Martín; Siemens.
Parques Ecológicos de México (La Ventosa)	Gamesa/ Ibedrola	102	82	SS	Pemex (refinerías y complejos petroquímicos) Cementos Apasco; Volkswagen
Desarrollos Eólicos Mexicanos de Oaxaca (Piedra Larga I - II)	Gamesa/ Renovalia Energy	227	152	SS	Renovalia Wind International; Grupo Renovalia de Energía; Caleras de Guanajuato; Corporativo Bimbo; Operadora Vips; Calidra de Occidente; Suburbia; Nueva Wal-Mart de México.
Fuerza Eólica del Istmo (Fuerza Eólica del Istmo)	Clipper/Grupo Industrial Peñoles	30	60	SS	Cooperativa Manufacturera de Cementos Portland; Fuerza Eólica; Procesos Electrónicos de México;
Stipa Nayaa (Bii Ne Stipa II Stipa Nayaa)	Gamesa/Enel Green Power	74	37	SS	Gamesa ENERGÍA; Jugos del Valle; Nestlé Mexico; Nissan Mexicana; Productos Gerber; Raiston Purina México.
Eólica Zopiloapan (Bii Ne Stipa III)	Gamesa/Enel Green Power	70	35	SS	Nissan Mexicana; Alpla Mexico; Nestlé México; CPW México; S.C Johnson and Son
Eléctrica del Valle de México (Not Available)	N/A	180	120	SS	122 Municipalities of different States.
Bii Nee Stipa Energía Eólica (Bii Nee Stipa)	Gamesa/ Ibedrola	26	31	SS	Gamesa Energía; Cableados Industriales; Cervecería Cuauhtémoc Moctezuma; Panamco Bajío; Panamco Golfo; Propimex,; Inmuebles del Golfo, S.A. de C.V.

3.5. Local resistance and conflict pathways

Articulating claims and networks (1995-2005)

Local concerns towards wind farms in the Isthmus started with the territorial allocation for private wind farms and the initial construction of projects. During this first phase, local opposition was articulated throughout existing organizations along with the creation of new spaces of dialogue, including well-established institutions for decision-making (communal and *ejido* assemblies), social organizations, and emergent movements against particular wind power projects. Other local supporting actors included a Catholic organization defending indigenous rights (Tepeyac Centre of Human Rights) and communitarian radio stations. Such efforts were further reinforced through wider resistance networks, such as the Assembly in Defense of the Land and Territory of the Indigenous People in the Isthmus of Tehuantepec (from now on "the Assembly").

External actors were also supportive through a series of events developed in the region, as happened in 2005 with the celebration of an ambitious forum gathering support of 34 local organizations and national social movements, as well as 16 international associations (see: Forum, 2005). This included an important presence of organizations against neoliberal policies in Mexico, including the Mexican Action Network Against Free Trade, the National Front of Resistance Against the Privatization of the Electric Industry, and the Mexican Alliance for the People's Self Determination. The combination of such instances led to different actors mobilizing common claims against the Wind Corridor, including the following:

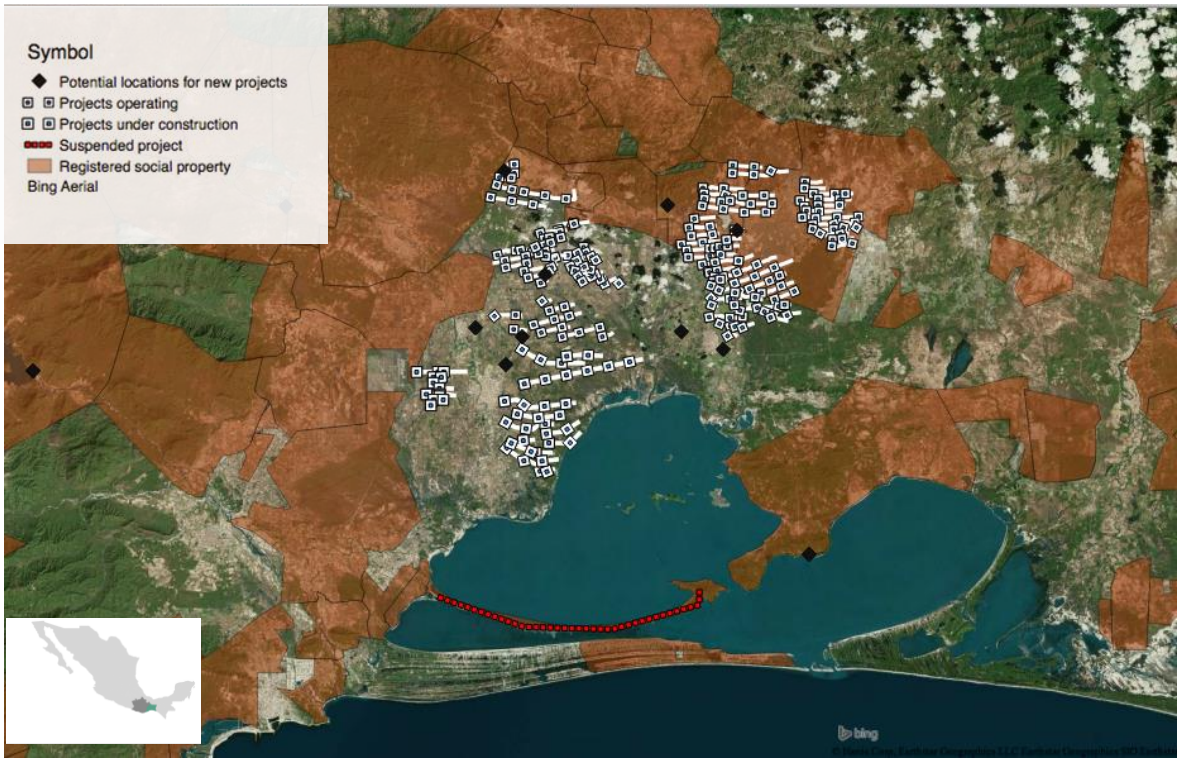
Lack of formal consultation: Mexico's legal framework encompasses a series of instruments protecting indigenous communities, including the 169 ILO Convention, Constitutional articles and secondary laws. However, since the initial negotiations between companies and the government, indigenous communities suffered from a lack of information and formal consultation. As early as 1995, the Tepeyac Human Rights Centre started to demand comprehensive information about the projects; to wich the government did not reply (Oceransky, 2010). Meanwhile, local communities started to be aware of how private companies were planning wind farms in their territories, offering low amounts of money for land leasing contracts (Juárez and León, 2014). In this regard, opposing groups stated clear demands to 1) stop all projects and permissions until formal consultations were made; 2) prohibit any project where agrarian and territorial conflicts exist; 3) socialize access to

information about the context, impacts and risks related with projects; and 4) respect whatever decision of local communities regarding the projects (Forum, 2005).

Illegal and unfair leasing contracts: After the initial territorial allocation made by government and companies, negotiations with landowners were signed through confusing processes, leading to legal controversies (Nahmad *et al.*, 2011). This is part of the uncertainty derived from the agrarian counter-reform and the subsequent voluntary program to certify and alienate communal lands (PROCEDE, by its acronym in Spanish). Smith *et al.* (2009) have shown that hundreds of communities sharing communal land rights in Mexico have not participated in PROCEDE fearing the privatization of their lands, while the outcomes of those who participated vary enormously from one region to another (Herrera, 2012). In the particular case of the Isthmus there is confusing situation about the property status of land combined with long historical struggles for restituting communal territories to indigenous communities (Nahmad *et al.*, 2011).

Map 3.2 indicates that while there is an important part of the territory formally certified as "common property" (orange zones), other zones are not part of the cadastral information (non-orange zones). As observed, most windmills have been positioned in the latter category, which could be unregistered common property or private property areas. It is in this heterogeneous and rather unclear context that 126 legal demands of communal landowners were registered to nullify land lease contracts made with foreign companies (APIITDTT, 2008). In such instances, communities argued that companies offered unclear information about the project's characteristics, manipulated and falsified negotiation processes, corrupted local and communal authorities and benefited from the disadvantaged position of indigenous people. This included a lack of translation of contracts to indigenous languages and an absence of oral meetings with illiterate people (Guijarro *et al.*, 2009; SEGOB, n/d;). Several projects were delayed; companies offered financial compensations, but most claimants refused to accept them (Oceransky, 2010).

Map 3.2 Wind turbines and land tenure status in the Isthmus of Tehuantepec (2016)



Own elaboration with Bing Satellital Map, Inventario Nacional de Energías Renovables and Registro Nacional Agrario.

Although some contracts were cancelled outside courts, legal demands were never formally processed. Most contracts remained, awarding 30 to 60 years of land use and access rights to private companies, retaining a large share of revenues from wind power production. The Mexican government itself has acknowledged that while the international average of payments to landowners fluctuates worldwide between 1 and 5 percent of wind farms gross income, Isthmus projects show the averages of payments between 0.025 and 1.53 percent in Spanish companies, and 3.38 percent in France based companies (SEGOB n/d). Since there is no public agency regulating land leases in the country, the general trend is therefore that companies offer relatively low payments to poor rural landowners.

Against privatization, commodification and enclosure: After coding the documents of local organizations, the most recurrent and articulated claim against wind farms in the Isthmus appear to be related with the enclosure and privatization of natural resources. Here, "dispossession of the territory" (*despojo del territorio*) has been a notion recurrently used by indigenous communities who regard the Wind Corridor as an expression of "neo-colonialism" (APIITDTT/UCIZONI, 2013; CDHT, 2008). Therefore, land issues not only emerged in terms of leasing contracts, but also regarding the close relation between territory, culture and local livelihoods and autonomy. In this regard, communities have claimed that

the installation of windmills will generate different environmental impacts leading to the disruption of local economies and social identities.

Bettina Cruz, a prominent indigenous leader of the Assembly, has insisted that they are not against wind power, but against land grabbing and its impacts over local communities (Chávez, 2014; Oceransky, 2010). Such impacts include an increasing biodiversity loss in the areas of infrastructure deployment, soil and water contamination derived from windmills lubricants, and a reduced hydrological connectivity from the enclosure of the region's lagoons (Levy *et al.*, 2015; Forum, 2005). In a similar vein, the Assembly has stated that, "by waving the clean energy flag, private companies have turned wind into a commodity, while the wind, sun, sea and land have shaped the life and culture of our Binnizá and Ikjoots people" (APIITDTT, n/d). As one opponent further declared: "we don't need money from the government or the windmills, we want our resources free" (Dell'Umbria, 2013).

Reactive mobilizations (2005-ongoing)

Conflicts were triggered when local resistance started to directly confront the construction of private wind farms. In this second phase, focal points of tension and social mobilization emerged, involving cases of corruption, criminalization and repression (Petersen, 2013). But while it is difficult to analyze conflicts by differentiating one resistance case from the other, it seems that conflicts have evolved in a rather regional dynamic. To some degree, this responds to local dynamics of the Isthmus territory, where communitarian institutions and practices prevail over state and private property arrangements (Smith *et al.*, 2009). To the extent that local inhabitants share and use parts of the territory regardless of formal land titles, several communities bear the multiple burdens of the impacts of a single project (enclosure of common agricultural and coastal lands; pollution of water bodies affecting livelihoods). The political organization against the Wind Corridor's projects also supports such interpretation, insofar the formation of several coalitions and resistance networks have reached a regional scale.

In San Dionisio del Mar, for example, the proposal to install 132 turbines through the two coastal bars of the "Mareña Area" directly impacted three different communities inhabiting the area (San Dionisio, Santa María del Mar and San Mateo), but also another 13 nearby communities that would be affected by the enclosure of the inner sea, disturbing fishing and local commerce (PRCMESM, 2012). The Mareña Renovables Project was granted in 2006

to Preneal, expecting to reach an installed capacity of 396 MW. This was considered the largest wind farm in Latin America, financed by the Inter-American Development Bank and designed to provide electricity to a large beverage company (IDB, 2011). Opposition against the Mareña project was primarily led by the San Dionisio community, where landowners filed a lawsuit to nullify leasing contracts with Preneal (Rojas, 2013; SEGOB, n/a). But the struggle was strongly supported by the Assembly and the rest of the affected communities. Except for Santa María del Mar, which accepted the contract with Preneal, local groups started an organized opposition against the project in 2011, when they demonstrated outside the Federal Electricity Commission office in Oaxaca (APIITDTT, 2014b), the state capital. Further mobilizations took place, including railway blockades, street protests and the occupation of the San Dionisio Municipality.

All of these actions created political pressure and hindered the entrance of machinery in the region, delaying the project construction (Rojas, 2014; 2013). Given the unfavorable conditions, Preneal sold the project to another transnational consortium that spurred additional corruption scandals linked with the local mayor (Manzo, 2015; Preneal, 2011). Controversies and tensions lead to stronger local mobilizations triggering criminalization and repression of protesters (Petersen, 2013). Violence increased against the members of the Assembly who were struggling against the Mareña project and other planned projects such as Bi-Hioxio (SEGOB, n/a). Cases of harassment and persecution, as well as illegal detentions were registered (APIITDTT, 2014a). An emblematic case was the arrest of Bettina Cruz in 2012, in a process that, according to the International Service for Human Rights (2015) was based on unfounded and baseless accusations. Although Cruz was released on bail and acquitted of all charges after a few years, accusations against her were viewed as a clear message to the opposition. At the end of 2012, however, pressure finally succeeded when a Federal Judge ordered the suspension of the project in San Dionisio, arguing the violation of communal property rights (Petersen, 2013). Although most of the wind power projects are still under construction and operation, the Assembly recognized the suspension of Mareña Renovables project as a successful outcome for local communities (Rojas, 2013).

Reaction and proaction in dialogue (2009-ongoing)

While reactive opposition against Mareña and other private wind farms was spreading throughout the Isthmus, new spaces of dialogue were also organized. One of the most

salient moments in this context occurred in August 2009, when the Assembly and other local organizations held a Forum in Juchitán called "Indigenous communities, self-determination and energy sovereignty" (APIITDTT, 2009). As many other instances at the time, the Juchitán Forum was geared to strengthening communities' struggles by establishing wider networks with external actors (APIITDTT, 2009). But the uniqueness of this forum resided in its proactive content: it represented one of the first instances in the world in which the term "energy sovereignty" was used, aiming to link indigenous peoples' rights, territorial struggles and alternatives to energy production and consumption (Oceransky, 2010; López, 2009).

During the Juchitán Forum, the proposal to promote community windfarms was extended as a concrete alternative towards energy sovereignty. The idea became particularly salient throughout the active participation of a foreign foundation (The Yansa Group) looking to build wind farms owned and controlled by local communities. By learning from the experiences of Denmark, Germany and the U.S, Yansa proposed to develop a pilot project in the region (Oceransky, 2010). Along with commune members of Ixtepec, the Yansa Foundation prepared a proposal to include a wind farm within the community's new territorial plan, which was accepted by the communal general assembly at the beginning of 2009. By exercising direct decision-making with the community, two other extraordinary assemblies followed, in which the project was discussed and approved unanimously (Hoffman, 2012). Additional enabling activities were conducted by Yansa, including community meetings and working groups, environmental assessments, contract negotiations, and siting logistics (Hoffmann, 2012; Oceransky, 2010).

The community wind farm was projected to comprise of 44 wind turbines with a 1000 MW installed capacity (Hoffman, 2012). This large wind farm would operate as an Independent Power Producer (IPP), where electricity would be sold to the CFE over a 20-year period at a fixed price. The project shared similarities with private windfarms in terms of scale (number of windmills and installed capacity) and amounts of investment required. However, as Table 3.2 indicates[24], there were important differences in terms of ownership, decision-making and revenue distribution aspects.

[24] Own elaboration with information from Hoffman, 2012.

In order to sign the contract with the CFE, the Yansa-Ixtepec project needed to participate in the 2012 call for tender (Hoffman, 2012). However, the CFE dismissed the project arguing that the Community Interest Company was not an existing legal entity in Mexico (Vargas, 2012). After this, the CFE opened two different tenders in the Ixtepec location. The conditions of both tenders were denounced by the community and Yansa as favoring big firms while establishing additional "padlocks" for their project (Manzo, 2012). Different political reactions were manifested against CFE's decision, including claims from left and right representatives of the National House of Congress, urging congress members to follow national and international laws protecting indigenous communities and supporting alternatives to renewable energy production (Méndez and Garduño, 2012; Parliament Gazette, 2012).

Political pressures led the CFE to announce a temporary suspension of the tender (Juárez and León, 2014). As of 2016, controversy over the case remains open; the Yansa and Ixtepec community still struggle to implement their project, while international media suggest there are intentions of implementing a private project in thus location (Vargas, 2015; Reve, 2014).

Table 3.2: Community windfarm project (Ixtepec-Yansa)

ASPECT	DETAILS	DIFFERENCES WITH PRIVATE PROJECTS
Ownership	The Yansa-Ixtepec Community Interest Company (CIC)	The community remains communal ownership of land. Assets and revenues owned by the CIC: Yansa and the Community
Financing	Loan scheme provided as debt by social or development banks (70-80% of total costs) Sub-ordinated debt given by investors seeking for "social returns" rather than high economic revenues (20-30% of total costs)	No specific difference. Credits with low-interest rates.
Revenue distribution	Ixtepec community 50% Yansa Foundation 50%	25% to landowners and 25% to community programs. Revenues to replicate the project elsewhere
Decision-making instances	Special committee ruled by the community by-laws	Democratic representation including: Communal assembly (formed by communal representatives) Existing peasant organizations Youth and women forums

3.6. Discussion

Wind energy, neoliberalism and conflict

The expansion of wind energy in the Isthmus of Tehuantepec has been embedded in the neoliberal agenda shaping the Mexican economy since the 1980's. A point of departure for such analysis is that *private participation in power generation activities* and *public-private partnerships in infrastructure development* are leading to an increasing presence of transnational corporations in the Mexican electricity sector. While the distributional impacts of such partial privatization are not the focus of this research, the link of such processes with the appropriation of benefits coming from wind power production are thus relevant. As observed, the *strong reliance on market forces* shaping wind energy policies has enabled the creation of competitive tenders defining the way in which such corporations operate. Throughout "independent power producer" and "self-supply" modalities, transnational companies are able to either sell the electricity for public supply or making corporate agreements with other big companies operating in the country. Center-periphery relations, or perhaps more accurately rural and urban relations, are thus evidenced when the electricity produced is destined to supply new energy inputs for the Mexican economy, where private corporations receive the most benefits (both in production and consumption).

A growing *appeal to private property rights* in the rural landscape of the country emerges as the third, and probably most important dimension of neoliberalism in wind power production. Certainly, wind is appropriated as the primary resource for wind energy production, however, land remains as a crucial pre-condition for its operation (Sheidel & Sorman, 2012; Smil, 2010). Although wind power projects do not always lead to changes in land tenure arrangements, this case study suggests that neoliberal policies might trigger such processes. As McCarthy and Prudham have pointed out (2004), the foundations of neoliberal approaches draw fundamentally on classical liberalism, where the restructuring of social relations with nature is associated with enclosing the commons to facilitate capital accumulation. This, in turn, is resonant with what Harvey has termed "accumulation by dispossession" (2004). It is not a coincidence that indigenous communities in the Isthmus appeal to their communal property to claim resistance against a "territorial dispossession" by private companies. Parallel denunciations of "neo-colonialism" also reflect how communities acknowledge the echoes of experiences from the past in a new context where both government agencies and corporations enable the cultural and material dispossesion of their territories.

While the contemporary economic forces drive the expansion of wind power in Mexico, claims of indigenous communities are part of much longer historical strife. The revolutionary struggles of Zapata's movement in 1910 were, indeed, fought in the defense of communal property in land, but also against privatization of water by sugar companies in Morelos (Womack, 1970). Recurrent struggles of peasants and indigenous groups throughout the 20th and 21st centuries continue to expand, defending the commons and pressuring the state to support them (Bartra, 2012). As the Zapatista movement and the neo-zapatistas initiatives reflect, the commons are still central in the political imaginary of rural Mexico, perhaps stronger in the more peripheral region. Oaxaca is a state with a deeply rooted indigenous and peasant population, with their own history of struggles for autonomy and communal identity (Pasqualetti, 2011). These are all contributing factors to resistance to corporate windmills, and further analysis in other countries of the South could explore such constituencies in a wider set of examples.

Conflicts against corporate wind power projects might thus be seen as agrarian historical struggles re-emerging throughout current environmental issues. Scholars have described such processes as the "environmentalization of social struggles" (Acselrad 2010, Robbins, 2004), where ecological issues are increasingly important in themselves but are also used to contest power structures and practices (Temper *et al.*, 2015, p.273). Previous sections in this Chapter have shown how indigenous communities in the Isthmus use their land rights as the main argument against the expansion of private wind farms.

In this same regard, it is possible to assert that the overall resistance process in the Isthmus relays in a strong communal identity of indigenous groups (expressed through land property, assembly organization, radio stations), which in turn is linked to the territorial organization of the region. Throughout *ejido* and communal assemblies, indigenous groups opened a space of political organization which enabled the creation of resistance networks using different divergent "valuation languages" (Martínez-Alier, 2002) in comparison to the language used by government and companies. As Howe asserted in her own study on the region "local people voice concerns about land, fish, work, and culture" (Howe, 2014, p.398). The latter includes a variety of meanings, including traditional livelihoods and attachments to the local environment. Additionally, external actors strengthened local claims and contributed to the articulation of a contesting discourse against the Wind Corridor. This form of collective action can be explained as the result of shared common values and interests among different

actors (Foyer and Dumoulin, 2015) struggling against the neo-liberalization of the economy, defending indigenous autonomy and human rights.

Valuation languages of people in the Isthmus thus help to understand why some local communities refused or neglected compensation offered by private companies. Such happened in the San Dionisio case, where values placed on land (for subsistence and work), water and culture were not commensurate and not substitutable by the compensations offered by private companies. In other communities, where such "benefits" might be sought as attractive bids to improve the marginalized conditions of place, the promised payments are seen "as a pittance in comparison to the profits the companies are making" (Howe, 2014, p.390). Following O'Connor and Spash (1999), these examples illustrate how environmental conflicts are fought sometimes over the monetary or other compensations offered to affected communities, or at other times over a plurality of values which are not commensurable by a single standard of value (including biodiversity loss, loss of cultural patrimony, territorial rights, damage to human livelihoods, infringement on human rights or loss of aesthetic or sacred values).

Contesting transitions: exploring a hypothesis

The post-political condition framing dominant discourses on climate change has led to the technical and apolitical implementation of green economy approaches in both mitigation and energy transition policies (Berglez and Olausson, 2014). In this regard, the perceived inevitability of the market economy has pushed to the dilution of democratic disputes that might emerge upon the reproduction of unequal social relations (Swyngedouw, 2010). This attempt can also be observed for the particular case of renewable energies, where scientific expertise, institutions and policies widely support their deployment (Barry *et al.,* 2008), disregarding its potential impacts in the global peripheries. In the case of the Wind Corridor, a strong support from national and international agents contrast with the negative impacts at the local scale. The absence of acknowledgment for those inhabiting the area reflects the historical denial of indigenous peoples as political entities (Bonfil, 1990), while perpetuating unequal characteristics of the current production and consumption system.

Contrasting with these dynamics, struggles against the Corridor unveil the emergence of forces that potentially re-politicize the debate on energy transitions. Even when claims and mobilizations might not deliberately allude to environmental and climate justice, their

struggles represent dissent to the uneven character of the business-as-usual model involved in current mitigation and renewable energy strategies (see also: Chatterton *et al.,* 2013). By visualizing social dissent, conflicts therefore push towards the democratization of the debate on energy transitions, while opening the possibility of other "socio-ecological futures" (Swyngedouw, 2011). When analyzing the temporal process of the conflict in the Isthmus of Tehuantepec, it is possible to observe that reactive and proactive movements reinforce each other in a dialectical and productive way. Rather than linear conflictive patterns, there appears to be a continuum between periods of mobilization, opposition and participation processes. The conflict in San Dionisio highlights these aspects, as it emerged in a moment where resistance and organization networks were becoming increasingly robust, which helped to strengthen local claims against Mareña Renovables. Simultaneously, those same networks organized the political spaces where the "energy sovereignty" term was coined, and from which the cooperative project in Ixtepec emerged.

Even though the proposed community wind farm in Ixtepec can be further problematized, the project clearly differs from private wind farms in terms of ownership, revenue distribution and decision-making processes. At the same time, the Ixtepec project entailed an active participation of the community both through existing communal institutions (assembly and peasant's organizations) and new spaces of decision-making (women and youth forums). The nature of this project therefore suggests a potential reinforcement of collective identity and relations, recurrently threatened by market forces and large-scale investments. The re-emergence of communal relations through territorial struggles is being widely studied by scholars in Latin America, who stress that practices and institutions of indigenous and popular communities entail a potential path to resist hegemonic forces while building alternative futures (Escobar, 2014; Esteva, 2012). Regarding wind mills, similar conclusions have been drawn by Mackenzie (2010) when studying how community buyouts of lands in Scotland led to the proposal of building community wind farms in their territory.

The allusion to the "energy sovereignty" term is also a relevant aspect in the politicization of energy transitions. As Ariza-Montobbio (2015) explains, "energy sovereignty" was initially inspired by the "food sovereignty" concept coming out from La Vía Campesina in the 1990s and then adapted by collective movements against the marketization of the energy sector. The Constitution of Ecuador of 2008 mentions briefly as one objective of economic policy to achieve "food and energy sovereignty" (art. 284). In a similar respect, the Catalan Network

for the Energy Sovereignty defined the term as "the right of individuals, communities and peoples to make their own decisions on energy generation, distribution and consumption in a way that it is appropriate for their ecological, social, economic and cultural circumstances, as long as these do not affect others negatively" (XSE, n/d). Similar notions have emerged throughout Europe and Latin America, linking renewable energies and/or the implementation of different energy mixes to issues ranging from local autonomy, solutions to energy poverty, municipalization of energy supply, direct citizen participation, and different roles of the State on the matter (Ariza-Montobbio, 2015).

In Mexico, "energy sovereignty" has been increasingly used at a national scale against the progressive privatization of the oil industry in favor of foreign companies (see: FTE, 2007). A strong anti-neoliberal call to recover the nation's ownership and state control of the most strategic resource of the country is at the core of such appeal. But as the case of the Isthmus suggests, there are also local mobilizations and cooperative scheme proposals favoring processes of direct democracy on renewable energy production. Rather than seeing both movements as excludable, its simultaneous existence suggest that a multi-scalar perspective might be useful to achieve both the direct participation of communities in the everyday energy politics, and a reformed role of the state in organizing national energy matters in a more redistributive way. This aligns with Bakker's (2007) analysis of the "water democracy" movement, where alternative local water management schemes could potentially advance in hand with a reformed role of the state in such matters.

Certainly, "energy sovereignty" is still a recent term and its progressive articulation into different movements is to be sought in the near future, both in Mexico and elsewhere. A potential articulation with "food sovereignty" initiatives could create fruitful alliances to address energy, food and territorial matters from the bottom up. This is particularly relevant for contexts such as Mexico, where attempts to secure adequate nutrition are held by collectives relying on tested agricultural systems such as the *milpa* and a variety of local seeds; a movement that simultaneously opposes the imports of maize from the U.S and the legalization of transgenic maize (Toledo, 2013).

3.7. Conclusions

In analyzing the expansion of wind energy projects and the emergence of conflicts at the local scale, this research aimed to discuss the role of neoliberal processes in driving contemporary struggles over energy transition strategies. By taking the case of Mexico and the Isthmus of Tehuantepec, the study showed how partial privatizations in strategic economic sectors, an increasing reliance on market forces and growing appeals to private property in land appear to be crucial dimensions of neoliberalism in the growth of wind energy in the country. Despite the potential of this technology to promote a low-carbon energy system, this research highlighted the spatial, political and justice dimensions disregarded in its deployment. Central aspects of this problem relate with the enclosure of communal territories, the private appropriation of benefits and the lack of direct democratic procedures embedded within the implementation of projects. Claims of indigenous communities reflect a reaction against these uneven outcomes, which reveal historical struggles in the defense of the territory, identity and autonomy. The resulting discussion invites further research to address the role of power relations and economic arrangements in energy transition strategies, particularly regarding to its implications for the global peripheries.

The hypothesis of a rising movement against neoliberal energy transitions has been discussed by analyzing the political meaning of the concept of "energy sovereignty" and the cooperative wind farm project proposed in Ixtepec. It has been argued that these proposed alternatives potentially alleviate the uneven imprint of the Wind Corridor. Simultaneously, productive outcomes in the Isthmus align with movements in Latin America and Europe that are building on an idea of a different energy future. In such regard, the binary options between the state and the market in energy issues, encounter a third pathway inspired on the commons and includes processes of direct democracy. The relevance of such processes can be sought in future discussions regarding renewable energies and energy transition strategies.

Chapter 4

Countermapping renewables: tracing the expansion of wind and solar power in Mexico[25]*

4.1 Introduction

In the global imperative towards decarbonization, maps become crucial to plan and implement renewable energy development. Of particular relevance is the growing number of mapping initiatives produced by international agencies and national governments to identify renewable resources and promote investments across the Global South. From the lens of political ecology, however, several questions arise regarding what type of information is prioritized in these maps, how territories are depicted for potential investors, and the socio-environmental implications of such cartographic representations (Li, 2014; McCarthy and Thatcher, 2019).

Critical work across different disciplines highlight that any industrial transition away from fossil fuels and toward renewable energies will be spatially extensive in form and nature (Smil, 2008; Trainer, 2014). As such, an increasing body of research highlights how such transition will potentially contribute to the ongoing global land rush and emergent forms of green grabbing (Borras et al., 2011; Corbera et al., 2017; Fairhead et al., 2012; Howard et al., 2009; Scheidel & Sorman, 2012;). These concerns complement growing evidence of large-scale renewable energy facilities triggering instances of injustice across the developing world's rural landscapes (e.g., Avila-Calero 2017; Del Bene et al., 2018; Rignall, 2016; Yenneti et al., 2016;).

[25] This Chapter is an adapted version of the manuscript under consideration for publication in Environment and Planning E. Avila S, Deniau Y, Sorman A, McCarthy J. Countermapping renewables: space, justice and politics in Mexico's energy transition strategy. *Environment and Planning E: Nature and Space.* Under first round of review. Not for distribution.

Calls for environmental justice in the expansion of renewables include the well-established formula of equity, recognition, and participation articulated by scholars and researchers in the field (Jenkins et al., 2016; Schlosberg 2009; Sovacool et al., 2016). However, they also entail critical approaches addressing the root of injustices in how economic production is organized and social relations are constituted (Newell and Mulvaney, 2013; Pellow, 2018). The political character of these emerging movements (Swyngedouw, 2010 *sensu*) and the plurality of claims they mobilize pinpoint that renewable energies increasingly become a key subject for environmental justice scholarship and activism (Avila, 2018; Neville, 2020; Temper et al., 2020).

While the contested nature of renewable energy deployment is increasingly articulated, further engagements are needed to understand and intervene in the spatial politics shaping and directing such processes. As discussed in this research, spatial politics draws from critical works highlighting the deeply geographical and political character of energy transitions (Bridge et al., 2013; Bridge and Gailing, 2020; Calvert 2016; Juisto, 2009). This analysis mainly adheres to Bridge et al.'s (2013) approach in highlighting that the implementation of new energy technologies, infrastructures, and scales of governance is a contested process in which divergent -and contending- potential futures are in play. Thus, the spatial implications of one transition project or the other will reflect a specific set of discourses and power relations in terms of what, who, and how things count when making decisions for materializing such transition.

This research focuses on the role of maps as critical moments in shaping the spatial politics of renewables. As powerful representations of space, maps are filled with political content: they produce useful abstractions over territories and the relations within, favoring specific actors, interests, and purposes (Wainwright and Bryan, 2009). There is no question that maps have been a unique source of power for the powerful (Harley, 1989: 278, cited in Peluso 1995). However, cartographic tools have also become useful ways to contest capital accumulation and purposes of the State (Crampton 2010). Therefore, the contingent character of maps and their outcomes is a key aspect to explore the emergent research agenda of the political ecologies of renewables.

To ground these reflections, this Chapter takes the case of Mexico's "low-carbon development" strategy. It presents the results of a critical mapping initiative conducted

through an alliance between researchers and activists. The aim here is to critically dissect the mapping efforts shaping the expansion of wind and solar power in the country while advancing into an alternative agenda for the transition. For this purpose, the Chapter firstly provides a systematic analysis of the State's discourses, regulations, and cartographic tools promoting renewable energy investments. It highlights how such devices produce a seemingly neutral representation of space in which territories appear as flat spaces to be developed. The Chapter then presents a set of counter-maps surfacing some of the critical dimensions obscured by the State's devices, directing a critical discussion into the spatial politics for a just transition.

The countermapping project presented in this Chapter is the result of an alliance between two platforms on critical cartography. The basic layers of the counter-maps were made and published with Geocomunes, a collective of activist geographers based in Mexico working with communities and grassroots organizations affected by the privatization of the commons. The maps were then complemented by cases of social mobilization registered on the Environmental Justice Atlas, a platform created to track environmental injustices and struggles emerging from the expansion of different commodity frontiers. In tune with recent scholar observations, this project aims to address deeper understandings on "how sites, scales and spatialities of energy systems are key contemporary sites of struggle, through which broader questions of political economic governance (and the social relations of capitalism) are being worked out." (Bridge & Gailing 2020: 4).

By critically dissecting Mexico's low-carbon development strategy and "filling" the spaces and relations otherwise obscured by its cartographic tools, this research highlights the following findings. First, that the geographies of renewable energy in Mexico are part of a larger political economic project to expand the scope of neoliberal capitalist relations in Mexico. Second, that the State's cartographic tools are playing a key role in implementing such project while producing multiple *spatialities of environmental injustice* (Walker 2009a) across rural Mexico. Third, that this spatial neoliberal project faces an increasing resistance from agrarian and indigenous communities defending the commons. These movements highlight key points of political intervention and research inquiry promoting wider debates on the just transition.

The next section provides an overview of the potential dialogues between renewable energy mapping, critical geography, political ecology, and environmental justice. Section 4.3 analyses the neoliberal configuration of Mexico's "low-carbon development" strategy and the cartographic tools supporting such vision. After presenting the countermapping methods, the Chapter outlines the most salient results on both national and regional scales. The regional analysis on the states of Oaxaca and Yucatan shed light on the geographies of maldistribution and how injustices are spatialized in the expansion of wind and solar power projects. The concluding section discusses these results and highlights the political value of a transition project based on the defense of the commons and principles of environmental justice.

4.2. Maps and the contested politics of representation

Over the last decades, critical cartography has proliferated within and outside academia, emphasizing mapping's political and contingent character. To say that maps are political implies that maps are useful means to organize and produce knowledge about the world. However, it also follows that such knowledge is situated within specific power relations that are subject to change across time (Crampton 2010).

A long research tradition in critical cartography has proved that maps have been uniquely sources of power for the powerful (Harley, 1989: 278, cited in Peluso 1995), facilitating capital accumulation and state purposes (Giddens, 1984; Harley, 1989; Kain and Baigent, 1992; Li, 2014; Scott, 1998; Wood, 1992). Maps facilitate strategic protection or production measures over territories, by including or excluding people within these spaces, and increasing territorial control over areas that are either politically sensitive or hold valuable resources (Harley, 1992; Peluso, 1995; Sack, 1983; Vandergeest and Peluso 1995).

A more recent research line highlights that mapping exercises are also crucial in rendering land as socio-technical objects, subject to negotiation and investment (Li 2014). In her seminal work, Li articulates that maps -along with laws, statistics, categories, and storylines-, work together as "inscription devices" in which land is assembled as a *resource,* making it available for specific actors, interests, and intentions. In this light, specific spatial conceptualizations and representations rendering land as "waste", "empty", and "available"

become key devices in multiple development and production strategies (Baka 2013, 2014; Gidwani and Reddy, 2011; Gidwani, 2013; Ferguson, 2014).

What stems from such critical insights is that spatial representations are not a neutral or objective act of cartography, but instead are part of larger assemblages and political choices (Li 2014; Fogelman and Basset, 2016). Far from being neutral depictions of objective realities; maps are inscribed in a larger political economy that mobilizes a series of political decisions in the selection, analysis, and representation of the information used to make them by those who make them. Therefore, the social, economic, and political forces behind what is represented in the map and the drivers behind how such decisions were made, are unavoidably political moments that need to be critically examined.

In general, critical cartography and countermapping are seen as vital interventions to counterbalance lucrative, top-down narratives and produce alternative spatial knowledge (Elwood 2006; Iliadis and Russo, 2016; Schuurman and Kwan, 2004). These exercises contend that if maps actively construct knowledge and exert power, they can also be a powerful means of leading to social change (Crampton 2010; Drozdz, 2020). Multiple efforts developed by researchers and activists have been key in challenging the omissions of human settlements from specific maps; in contesting the homogenization of space on political zoning or property maps; in altering the categories of land and forest management; and in expressing social relationships in space rather than depicting abstract space in itself (for a review see: Crampton, 2010).

Critical mapping practices have strongly developed since the late-twentieth century by appropriating technological developments and the push toward participatory politics and management strategies (Elwood 2010; Wood 2010). Countermapping operates from the ground up and diffusely, spanning within and outside academia (Crampton, 2010). As such, critical mapping proves that maps can travel -being accessible to, legible to, and used by- much wider actors than those within State, corporate, and academic circles. The community and network of practices that spread maps and cartographic tools for such purposes include multiple tendencies such as Public Participation Geographic Information Systems (PPGIS); indigenous cartography; activist and radical cartography (Cobarrubias, 2010).

Maps and the political ecologies of renewable energy

Energy geographers have discussed the role of energy in the production of space. Different modes of energy production, distribution, and energy use shape the spatialization of social activities and underpin both material and symbolic relations (Calvert 2016). More recently, research has shifted attention to the spatialities required for energy production itself and its implications in understanding historically changing energy regimes (e.g., Huber & McCarthy 2017; Sieferle, 2001; Wrigley 2010).

Renewable energy sources require vast amounts of space to generate the energy that conventional fossil and nuclear resources can produce from focal points of extraction (Huber 2015). Power densities (W/m2) of conventional fossil and nuclear resources are two to three orders of magnitude greater than those of renewables (Smil 2008); showing that if the level of energy flows is to be maintained or increased under a low-carbon system, area coverage of alternative energy sources will have to increase in large magnitudes (Scheidel and Sorman 2012).

The land demands and consequent spatial transformations triggered by an industrial-scale expansion of renewable energies hold deeply political and justice implications. In the expansion of renewables, those having access to and control over lands will have access and control over energy flows. This draws attention to aspects of property and tenure over targeted lands for renewable energy development, *but also* illicit actions, relations of production, entitlement relations, and the histories of all of these (see: Ribot and Peluso, 2003: 157). As investments in renewables expand across the Global South, these aspects become particularly relevant for areas where land values are lowest and existing users often have less power and fewer formal land rights (McCarthy, 2015).

Recent research highlights that the expansion of renewable energy technologies across the developing world is facilitated by specific representations of territories as "waste", "unproductive" and "empty" leading to variegated forms of enclosures, land grabs and territorial dispossessions (Baka 2014; 2017; Rignall 2016; Yenetti et al., 2016). Changes in the access, use, and control over lands are also observed in the shifts from agricultural uses to energy production ones, raising concerns on the local implications for vulnerable rural communities (Ariza-Montobbio et al., 2010; Partridge, 2020). Together, these patterns come

with a growing number of communities claiming multiple instances of injustice on the ground (Avila-Calero, 2017; Avila, 2018; Del Bene et al., 2018).

Mapping and countermapping exercises become key moments to examine and intervene in such a process critically. As highlighted before (McCarthy and Tatcher, 2019), top-down maps for renewable energy resources are key tools in making territories more legible for investments (e.g. detailed data on locations and suitability for utilities), while also in making other things less legible (e.g., existing tenure regimes, land uses, biodiversity and populations). Therefore, renewable energy mapping will play a central role in defining who and what counts when rendering territories suitable for renewable energy production and how benefits will be distributed socially and geographically when envisioning a low-carbon future.

Countermapping renewables: bridging critical cartography and environmental justice

Challenging dominant spatial orders in the ongoing expansion of renewable energies necessary involves exposing how maps and data are produced (McCarthy and Tatcher, 2019). More critically, the emergent political ecologies of renewables should also involve a re-appropriation of mapping technologies to scrutinize dominant ways of producing cartographic knowledge and contest the spatial politics that produce new instances of environmental injustice on the ground. The countermapping exercise here presented aims to advance into such vision. First, by contrasting the technical representations and allegedly neutral solutions developed by state agencies; and second, by developing a series of collaborative-activist maps in which land appears as a key political question (see: Drozdz, 2020).

The connections between critical cartography and environmental justice are certainly not new. From its origins, Environmental Justice has developed as a community-led science emphasizing how environmental injustices are not just unequally distributed across society but also unevenly distributed across space (see: Temper et al., 2015). More recently, EJ scholarship has also been giving greater attention to how environmental justice and space are co-constituted (Kurtz 2002; Towers 2000; Walker 2009a), demanding deeper understandings on how specific investments are not isolated objects, but are rather connected spaces where value flows, accumulation occurs, and injustices expand (Robbins 2014). Key geographical references on these debates are Soja's articulations on spatial justice

(2009, 2010) and Harvey's contribution to the geographies of capitalism and injustice (1996; 2004).

Building on such perspectives (see: Yenneti et al. 2013), this research emphasizes the *spatialities of environmental justice*, extending the understanding of what justice means and how it is reclaimed (see: Walker, 2009a). Following Harvey's (1996) argument that "justice and geography matter together" (629), Walker points out that the politics of space are significant for EJ in two ways. First, on how environmental injustices are produced, and second, on how claims for justice are put forward through different means and in different contexts. Therefore, the spatialities of environmental (in)justice include well-established articulations on the unequal spatial distribution and disproportionate proximity of risks and impacts of specific investments. However, it goes beyond this approach by introducing nuanced understandings of the spatialities of participation, recognition, responsibilities, and vulnerabilities produced and contested in specific contexts and time frames.

In the emergent political ecologies of renewable energies, multiple spatialities of environmental (in)justice are potentially produced, reproduced, and contested. Countermapping practices appear useful in this regard. Critical mapping allows tracing the spatial patterns of renewable energy siting through an analysis of the "inscription devices," that render land an investible space prone to development (Li, 2014). In doing so, countermapping exercises help to shed light on how such processes might reinforce or revert injustices at different scales. As such, countermapping initiatives become a vital tool in open alternative ways to imagine the geographies for the transition.

The countermapping project presented in this Chapter stems from such reflections and builds collaboration between two activist research platforms: Gecomunes and the Environmental Justice Atlas (from now on the EjAtlas).

Geocomunes is a collective that works in Mexico with communities and researchers to systematize information on privatization and dispossession of the commons. It produces bottom-up maps to support peoples, grassroots movements, and organizations in building maps about specific investments and infrastructures while making claims for social and environmental justice. Once published, all the information is available in different formats (e.g., shape and google earth) with free-software programs (QGis). Relevant examples of this

work include cartographic projects on the expansion of electric infrastructure in Central America and expanding urban and touristic developments in Southern Mexico (Geocomunes, 2019 a,b).

The EjAtlas is a global collaborative project coordinated at the Autonomous University of Barcelona, aimed to study and shed light on cases of environmental injustices and conflicts arising across different commodity frontiers (Martinez-Alier et al. 2010; Martinez-Alier et al. 2016). As a critical cartography project, the EjAtlas works as a shared platform, repository, and database. Researchers, activists, and communities contribute to filling cases of environmental justice struggles across the globe (see: Temper et al., 2015). The platform provides a concise and codified structure to systematize stories of struggle, constituting the most extensive existing inventory of EJ claims (with 3, 320 cases documented by December 2020). This methodology provides a useful research tool to identify patterns, reveal relationships among multiple cases and actors, and describe how such conflicts are shaped by the larger political economy (Temper et al., 2018a).

4.3. Mexico: renewable energies and "low carbon development"

The National Government propelled the expansion of wind and solar power in Mexico since 2008 through a comprehensive set of climate change laws, energy policies, and development programs. Three components have been critical driving elements in this regard:

The discursive component

From the State's narrative, low-emission development is conceptualized as an economy that grows sustainably, is competitive and socially inclusive, especially for the most vulnerable (NCCS, 2013). The "low-emission development" vision is articulated in a strategy with short-medium- and long-term objectives, placing "an accelerated transition towards clean energy sources[26]" as one of its basic axes. This derives into a set of goals to reach a share of at least 50% of clean energy sources in the national electric sector by the year 2053.

Low-emission development is articulated through a vision in which private capital plays a critical role in accelerating the opportunities of renewable energies, covering for high initial

[26] Clean energies are divided into a) Renewables: wind energy, solar energy, ocean energy, geothermal energy, biomass, hydropower, organic waste. B) Non-renewable energies: hydrogen, nuclear power, non-contaminant fossils (cogeneration and carbon capture, utilization and storage).

investment costs and overcoming the inefficiencies of public management. As stated in the National Climate Change Strategy: "Mexico has a great potential in energy generation through clean and renewable sources, and even when new possibilities have emerged for the exploitation of such resources with the participation of the private sector, such mechanisms have not been enough." The strategy therefore aims "(…) to focus efforts in overcoming the main barriers that have stopped the complete immersion of renewable energies into the national energy system" (NCCS, 2013: 49).

The Energy Reform (2013) further articulated this narrative, by establishing that: "(…) the slow phase in which the country is transitioning from fossil to renewable energy electricity production largely responds to the exclusivity of the Federal Commission of Electricity (CFE) to provide the public electricity service (…) that was preventing to develop at "maximum speed" the potential sources to generate low-cost electricity." (SENER, 2013b: 20).

The regulatory component

Through the narratives of public inefficiency and urgency, the Energy Reform established a new model in the electricity sector. The planning and control remain exclusively to the nation but opens opportunities for private capital in the generation, transmission, distribution, and commercialization of electricity (SENER, 2013b). The Reform included measures to promote private participation in the renewable energy sector, such as:

1. Allowing private capital to finance, install, maintain, manage, and operate transmission and distribution lines interconnecting regions with high potential on renewable energy resources.
2. Allowing private companies to generate and commercialize electricity through a Wholesale Electricity Market, including measures for "qualified users" to participate in the "self-supply scheme" -investing in renewable projects and consuming large amounts of electricity from such market.
3. Creating a Clean Energy Certificate Program in which all the electricity providers and qualified users should comply with the proportion of clean energies established by the SENER.

Changes in the electricity sector established by the Energy Reform have defined how renewable energies will increase in the national energy mix. These measures, however, have only been possible by the previous liberalization of rural lands in Mexico.

The Agrarian Reform, enacted in 1992, established constitutional changes to transform communal tenure regimes regulating land across the country. This Reform enabled drastic changes to *ejidos* –founded after the Mexican Revolution and *agrarian communities* (indigenous institutions) by allowing their collective owners to sell legally, lease, and subdivide[27] the communal land rights which were obtained after decades of social struggle (Rivera-Herrejón, 2007). In practical terms, the Agrarian Reform represented the end of land distribution processes initiated in the country after the 1917 Constitution and more than eight decades of state protection over peasants and indigenous livelihoods (Toledo, 1996). As a result, this Reform has also triggered a progressive suppression of communal autonomies in using and managing natural resources (Merino, 2006).

An essential mechanism facilitating such a process has been the State's cadastral survey, also known as PROCEDE. While in the State's discourses, such a program would benefit communities by providing certainty and protection to their land rights, PROCEDE has been key in enabling land transactions required for various private investments to take place (Maldonado, 2010). While in some regions, communities contested the Agrarian Reform by denying their participation in the cadaster (De Ita 2003), PROCEDE has succeeded in practice. The progressive erosion of communal tenure is observed by the great number of land transactions that have materialized since the implementation of the program and the complex political dynamics unfolding between local elites, communities, and corporations seeking to invest in such lands (Fernández-Moya, 2012).

The cartographic component

In resonance with the discourse and regulations supporting the low-carbon development strategy, the Mexican Energy Secretary (SENER) developed two cartographic platforms on renewable energy resources: the National Inventory of Clean Energies (INEL) and the National Atlas of Zones with High Potential for Clean Energies (AZEL).

[27] By registering common lands into the cadaster, communities have been allowed to divide the common property into three different figures: land plots for community uses, land plots for individual uses (also known as parceled lands), and land plots for human settlements.

The INEL provides cartographic information on the potential and ongoing development of clean energy resources to produce electricity. It is an online platform with national maps for solar, wind, geothermal, tidal, and biomass potential and an inventory of projects operating and in construction-phases. According to its official description, the INEL is a vital tool to facilitate information to investors; promote research to harness renewable sources; measure renewables' role in expanding the electric sector (particularly through the self-supply scheme); and support public decision-making process.

The Mexican State finances the INEL, yet a diverse set of public and private organizations appear to be involved in constructing the platform and its databases. This includes the National Renewable Energy Laboratory (NREL), directed by the United States Department of Energy. While the role that the NREL is not exact in the available information, an alliance between the Mexican State and USA public agencies has been running since 2004, among others, through the development of a Geospatial Toolkit to develop large-scale wind power projects (Elliot et al. 2004; NREL, 2005). A similar alliance between the Mexican Government and US Agencies is reflected in a document of public access, providing a series of recommendations for attracting investments in the renewables sector. These include the importance of defining *priority regions* to develop large-scale facilities and identifying the significant barrier that comes with access to rural lands (Watson et al., 2015).

The AZEL has been developed in a seemingly resonant way. This platform provides a series of interactive maps identifying regions with different potential to develop large-scale projects. What differentiates AZEL is that the platform includes a set of layers for evaluating "areas of exclusion" following technical-economical; environmental; social; and associated risks. Yet, and as further discussed below, both INEL and AZEL provide inaccurate, disconnected or even absent information on some key aspects of space and the socio-ecological relations within.

4.4 Countermapping: aims and methods

While the INEL and AZEL have been designed as tools promoting the rollout of renewables in Mexico, they so far appear to be top-down mechanisms hindering democratic participation of communities, organizations and society in designing, negotiating and distributing the risks and benefits of a low-carbon future. In particular, our countermapping initiative identified the following limitations:

INEL

- The information available in the platform is not updated and provides inaccurate locations of projects.
- Renewable energy projects are only represented by points. There is no georeferenced information available on the polygons occupied by such facilities, obscuring tenure, property, populations and livelihoods.
- The platform provides basic technical information of projects. However, it lacks data on specific companies and investors, socio-ecological dimensions of places targeted for facility development, and end-users of electricity produced.

AZEL

- No layers for communal property and their subdivisions.
- Indigenous groups are only recognized by layers indicating states with a majority of such populations, with no further details available at municipal scales.
- No layers included for Areas of Importance for Bird Conservation, nor further information on the territorial management strategies of specific regions.
- Absence of land uses and vegetation cover.

In order to overcome some of the limitations of the INEL/AZEL, we developed a comprehensive mapping process tracking the expansion of wind and solar power projects in the country. As an activist-research project, the maps and data produced will be available in open access at the Geocomunes and Ejatlas platforms. This ensures that relevant information will become accessible to non-state and non-private actors such as rural communities, organizations, and citizens in general.

Table 4.1 summarizes the methods, materials, and outcomes into four stages. Stages 1-3 show that much of the information was gathered from the government's sources themselves. Our purpose here was to condense information that is otherwise scattered in different databases, permits, and Ministries, but mostly, to make visible the cartographic information that is so far absent in the INEL and AZEL. In the case of Stage 4, our work was conducted through a network of activist-researchers tracking cases of environmental injustice involved in the expansion of wind and solar investments. Each case of conflict is published in the EjAtlas, including a detailed description of the case, features of the project triggering conflict, perceived and potential impacts, affected populations, actors mobilizing, and outcomes of the conflict. The Ejatlas has its standardized methodology in which cases are revised by an

internal board assuring accuracy before its publication (further details in Temper et al. 2015; Temper et al. 2018a). Each case included is referenced as *Ejatlas, year*, and all authors are listed in the reference section.

Table 4.1 Countermapping materials and methods

Stage	Purpose	Sources	Outcome
1	Identifying wind and solar power investments across Mexico Systematize the information available from 2008-2019	-National Inventory of Clean Energy (INEL) -Permits issued by the Energy Regulatory Commission (CRE) -Environmental Impact Assessments (EIA) issued by the Ministry of the Environment (SEMARNAT) -Mexican Association of Wind Power (AMDEE) -Mexican Association of Solar Power (ASOLMEX).	A list with a total of 150 projects on wind power and 243 on solar power. The list includes all the projects operating, under construction and planned until the end of 2019.
2	Georeferencing the projects. Map coordinates and polygons for each of the projects identified.	EIA and CRE permits	A national map with all the projects identified
3	Building an attributes table in GIS with 26 variables for all the projects identified	-EIA and CRE permits -National Agrarian Register (RAN) -National Institute of Statistics, Geography and Informatics (INEGI)	A comprehensive database with: 1.-Technical and financial information of projects 2.-Details of companies involved 3.-Resolutions of regulatory procedures 4.-Land tenure and land use change.
4	Tracking cases of environmental injustice by identifying conflicts emerging against wind and solar power projects in Mexico.	Documents from activist and civil society organizations, newspaper articles and official documents from companies, governments and investors.	Georeferenced sites of conflict, standardized information on the perceived impacts, actors mobilizing, claims and outcomes of conflict.

4.5. Results

National overview

Progressive investments across territories

The expansion of wind and solar power in Mexico has followed a pattern of saturating regions with high potential to develop large-scale, private-led facilities. These emerging geographies are favoring an increased concentration of rural lands and the control over renewable energy production in favor of private developers, with only 15 multinational companies holding the great majority of projects[28]. Figure 4.1 illustrates that this pattern has been enabled by and accelerated through the consolidation of neoliberal policies, particularly after the Energy Reform and the promotion of auctions in the sector. Under this new regulatory system, by the end of 2019, Mexico reached a total installed capacity of 5,847 MW of wind power and 5,859 MW of solar power.

Figure 4.1 Evolution of wind and solar installed capacity (Mexico 2008-2019)

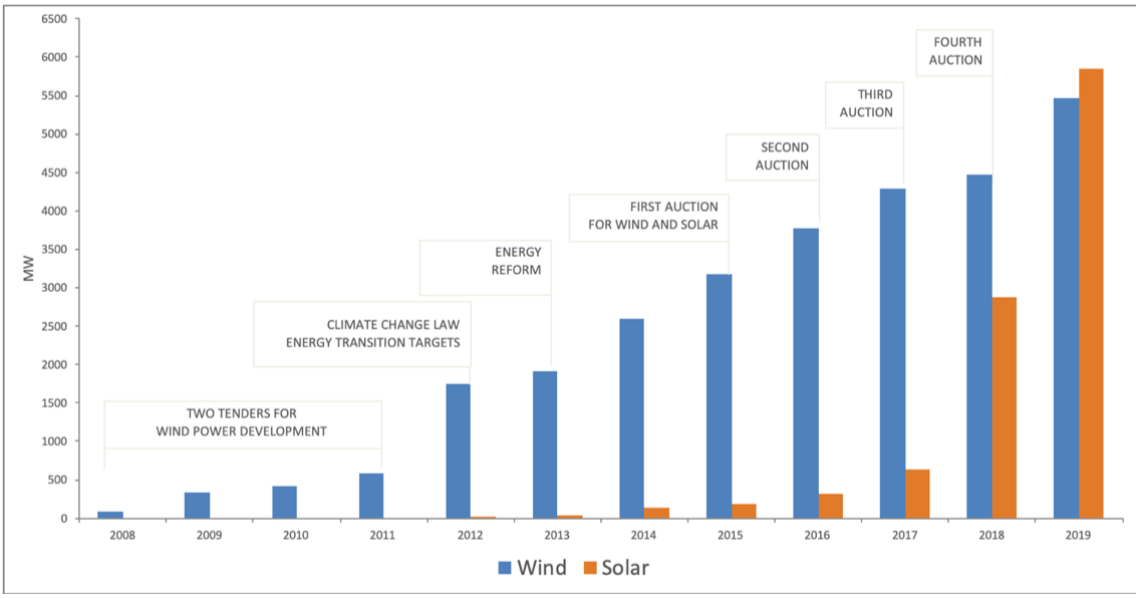


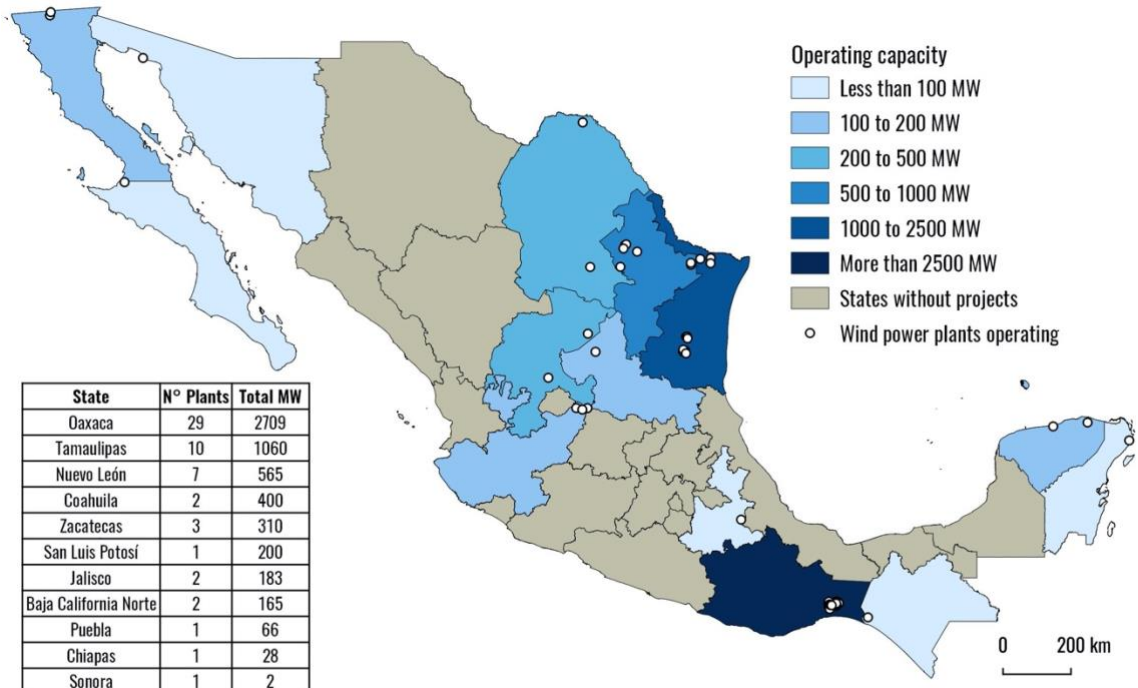
Figure 4.1 highlights the early deployment of wind power projects in comparison to solar ones. Such development mainly responded to Mexico's wind resources' attractiveness for utility-scale and profit-making facilities, particularly in the Isthmus of Tehuantepec region. In over just a decade (2008-2019), the expansion of wind power projects in the Isthmus

[28] This list is leaded by Enel Green Power (holding 4577 MW of the total installed capacity in wind and solar), Iberdrola (2617 MW), Acciona (1914 MW), Engie (1466 MW), and Actis/Zuma (1466 MW).

matured to take on its ambitious character as a wind corridor, appearing so far as the most saturated region in terms of number of facilities and turbines. With this expansive process, the Isthmus became the pilot region to develop renewables in the country, and the thermometer of social responses to such a transition model (see regional analysis).

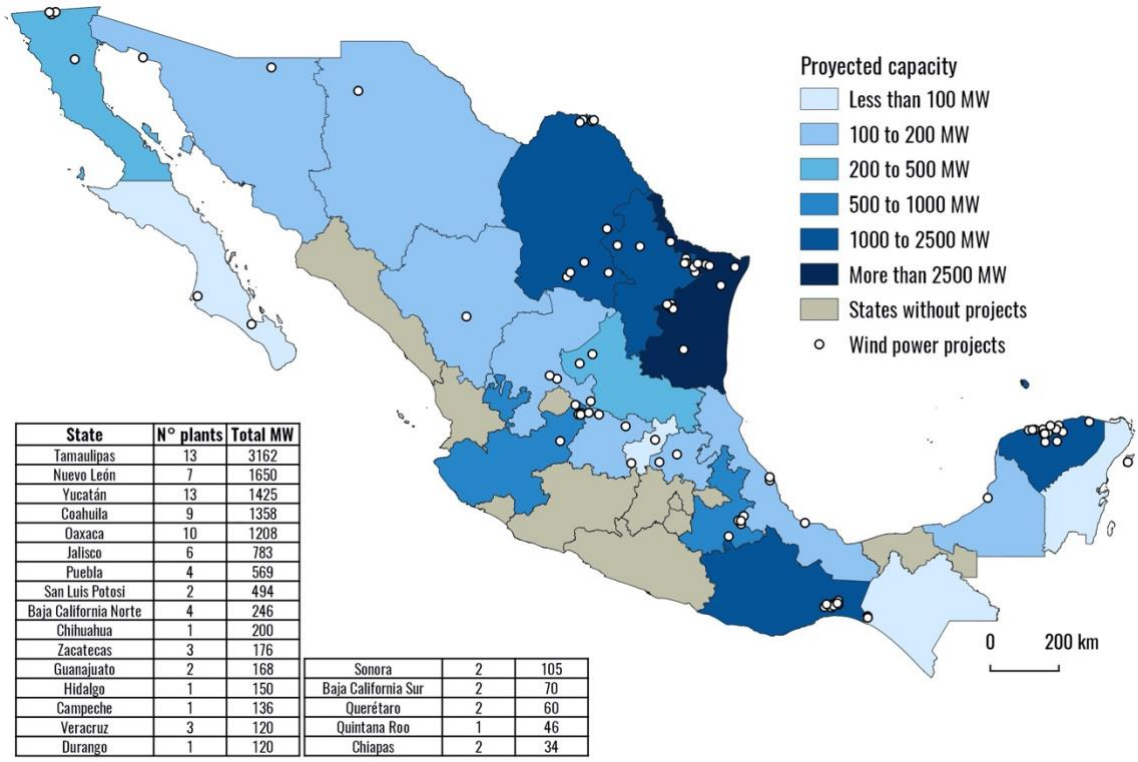
Countermapping interventions appear here to track where and how further investments are taking place and what type of impacts are experienced at the local scales. As Map 4.1 shows, wind power investments are already shifting from Oaxaca to other states like Yucatán, Tamaulipas, Nuevo León, and Coahuila. With relatively less potential in technical terms (i.e., lower density in the wind flows) but still attractive for profit-making, these regions have become the new development hotspots that demand further political scrutiny.

Map 4.1 Wind Power operating capacity per state (Mexico 2019)



State	N° Plants	Total MW
Oaxaca	29	2709
Tamaulipas	10	1060
Nuevo León	7	565
Coahuila	2	400
Zacatecas	3	310
San Luis Potosí	1	200
Jalisco	2	183
Baja California Norte	2	165
Puebla	1	66
Chiapas	1	28
Sonora	1	2
Quintana Roo	1	1
Baja California Sur	1	0.6

Map 4.2 Wind Power projected capacity per state (Mexico 2019)[29]



State	N° plants	Total MW
Tamaulipas	13	3162
Nuevo León	7	1650
Yucatán	13	1425
Coahuila	9	1358
Oaxaca	10	1208
Jalisco	6	783
Puebla	4	569
San Luis Potosi	2	494
Baja California Norte	4	246
Chihuahua	1	200
Zacatecas	3	176
Guanajuato	2	168
Hidalgo	1	150
Campeche	1	136
Veracruz	3	120
Durango	1	120
Sonora	2	105
Baja California Sur	2	70
Querétaro	2	60
Quintana Roo	1	46
Chiapas	2	34

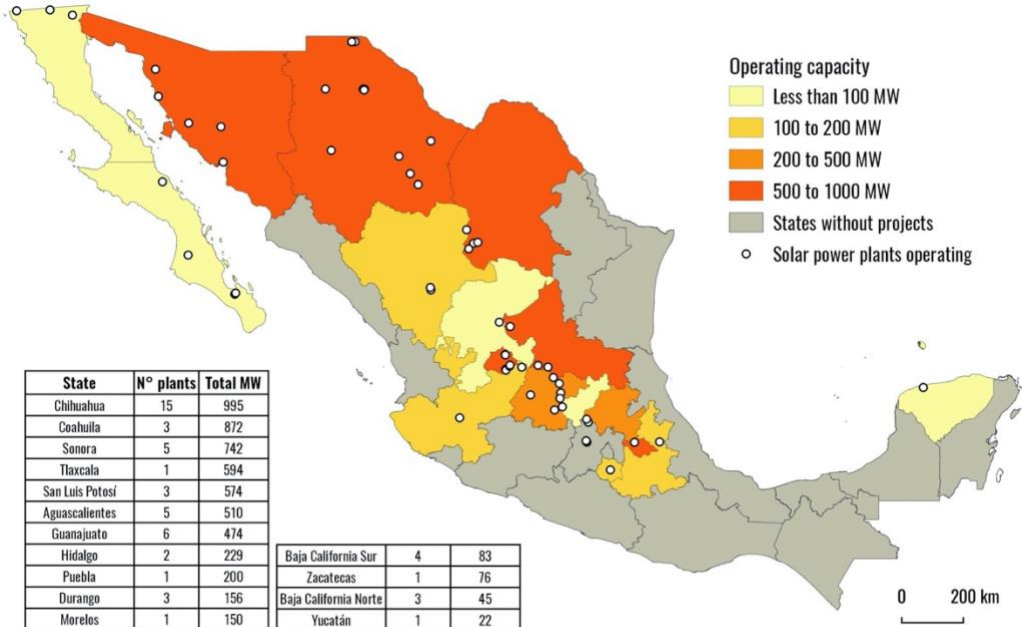
The deployment of mega solar power projects has, in its turn, taken off since 2014. However, investments in solar have rapidly expanded, reaching a higher installed capacity by 2019. During this period (2014-2019), solar power projects have mainly sprawled across the central and northern regions of the country (Map 4.3), and planned projects are expected to saturate other areas in the following years (Map 4.4). Projections based on the auctions and permits granted show that solar power will continue to increase the overall renewable installed capacity in the country, highlighting the need to systematically understand the specificities of these technologies and track such expansion from both a justice and political lens.

Map 4.4 shows that several states of the country will augment their solar installed capacities in varying degrees according to their resource potential. Most of these projects are expected to be located in the country's northern states, characterized by arid ecosystems with a combined degree of communal and private property regimes over land. The spatial, political, and justice implications of such projects are expected to be observed in the following years. As discussed in the regional analysis, however, the deployment of mega solar power projects.

[29] All projections shown in these results are based on the auctions and permits granted until the end of 2019.

in the tropical region of the Yucatan Peninsula is already triggering important mobilizations from communities and organizations concerned by the irregular land acquisitions and deforestation processes triggered by such projects.

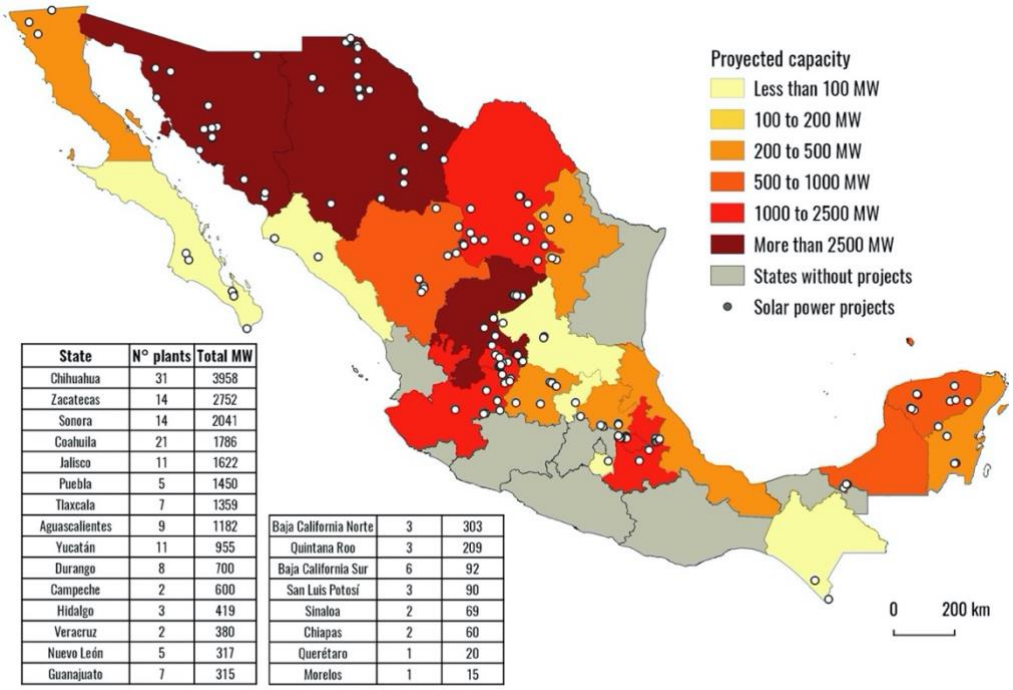
Map 4.3 Solar Power operating capacity per state (Mexico 2019)



State	N° plants	Total MW
Chihuahua	15	995
Coahuila	3	872
Sonora	5	742
Tlaxcala	1	594
San Luis Potosí	3	574
Aguascalientes	5	510
Guanajuato	6	474
Hidalgo	2	229
Puebla	1	200
Durango	3	156
Morelos	1	150
Jalisco	2	108

Baja California Sur	4	83
Zacatecas	1	76
Baja California Norte	3	45
Yucatán	1	22
Querétaro	1	1

Map 4.4 Solar Power projected capacity per state (Mexico 2019)



State	N° plants	Total MW
Chihuahua	31	3958
Zacatecas	14	2752
Sonora	14	2041
Coahuila	21	1786
Jalisco	11	1622
Puebla	5	1450
Tlaxcala	7	1359
Aguascalientes	9	1182
Yucatán	11	955
Durango	8	700
Campeche	2	600
Hidalgo	3	419
Veracruz	2	380
Nuevo León	5	317
Guanajuato	7	315

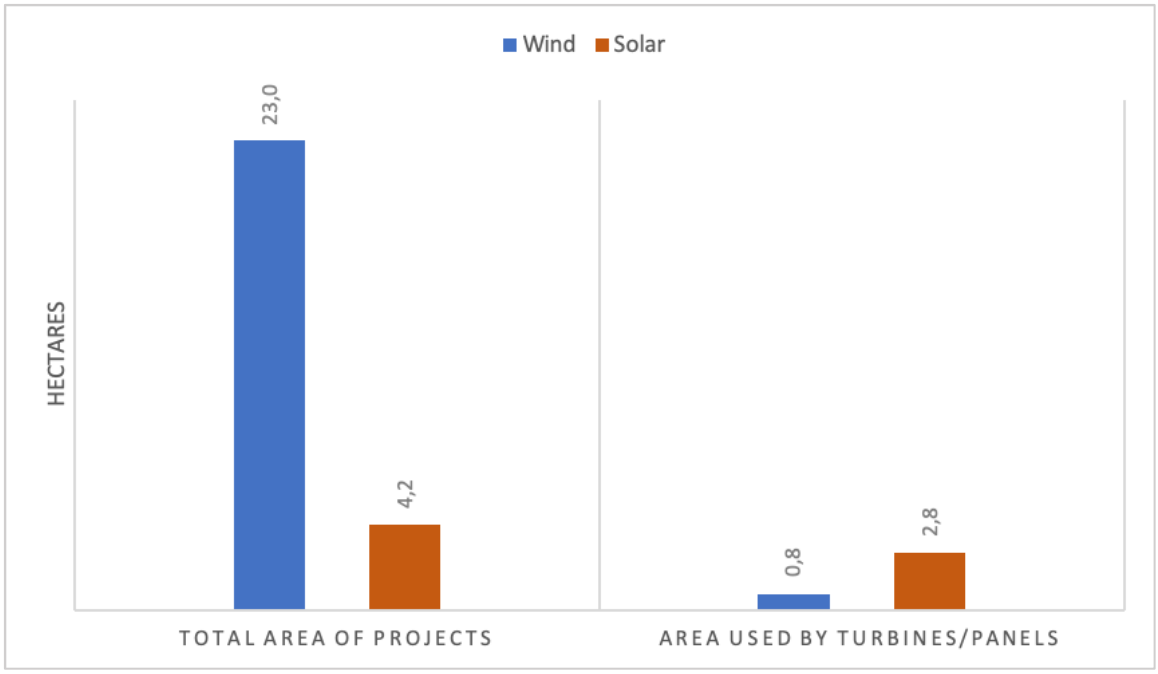
Baja California Norte	3	303
Quintana Roo	3	209
Baja California Sur	6	92
San Luis Potosí	3	90
Sinaloa	2	69
Chiapas	2	60
Querétaro	1	20
Morelos	1	15

Growing demand for rural lands

The low-carbon development strategy is bound to produce major spatial transformations across rural territories in Mexico. Land requirements of large-scale wind and solar power plants vary, however, on the technologies available and the resource potential of different locations. As discussed below, the impacts of such spatial transformations are also contingent on the socio-ecological conditions of different territories and the institutions regulating property, access, and land uses.

Land requirements are measured in terms of the total surface area of a project and terms of the surface occupied by turbines for wind and panels for solar projects. Our data indicate that the total surface area of wind power projects tends to be larger in comparison to solar power plants, as a certain distance between each turbine is required in order to properly harness the resource (Figure 4.2, left side). However, in terms of the actual land that is covered by technologies, turbines are covering considerably less land in comparison to solar panels (Figure 4.2, right side)[30].

Figure 4.2 Average land requirements of wind and solar projects -operating and planned. (Mexico 2019)

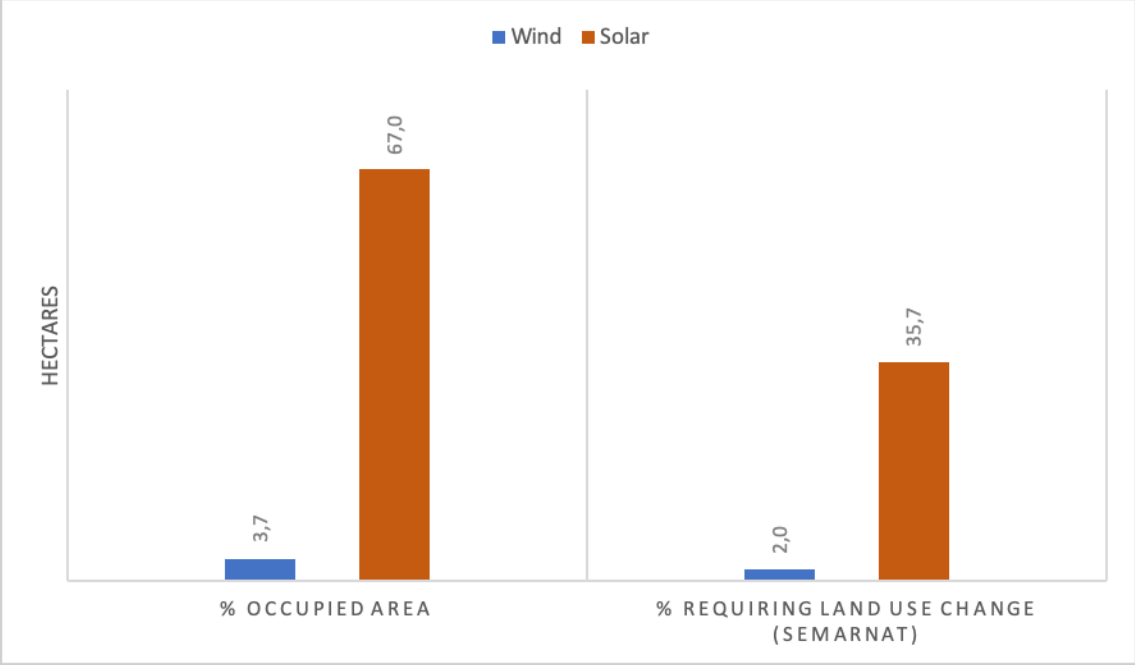


[30] The area used by turbines and panels is presented as the average number of hectares required to produce 1 MW of power output.

Therefore, wind power's technical aspects provide opportunities for land-use coordination by combining the deployment of turbines with agricultural and other land uses over the same polygon. Such provisions require further regulations and more inclusive approaches that are so far absent in Mexican regulations. The case of solar power is different, as total and occupied surface areas tend to be almost the same.

While mega solar power projects demand less surface than wind farms, these investments raise essential concerns on the land-use changes required for their deployment. The Ministry of the Environment (SEMARNAT) defines land-use change as "the transformation or degradation of forests, rainforests and forest vegetation in arid zones by modifying its original vegetal density and the composition of species within" (SEMARNAT, n/d; SEMA, n/d). Figure 4.3 highlights that 67% of the total land demanded by solar facilities in Mexico is covered with panels. Based on this definition, almost 36% of such lands involve or will involve a formal request for land-use change with SEMARNAT. This means transformations for social and ecological dynamics, particularly in those areas where both local livelihoods and biodiversity depend on current uses and territorial management strategies.

Figure 4.3 Occupied area and land use change of wind and solar projects -operating and planned (Mexico 2019).

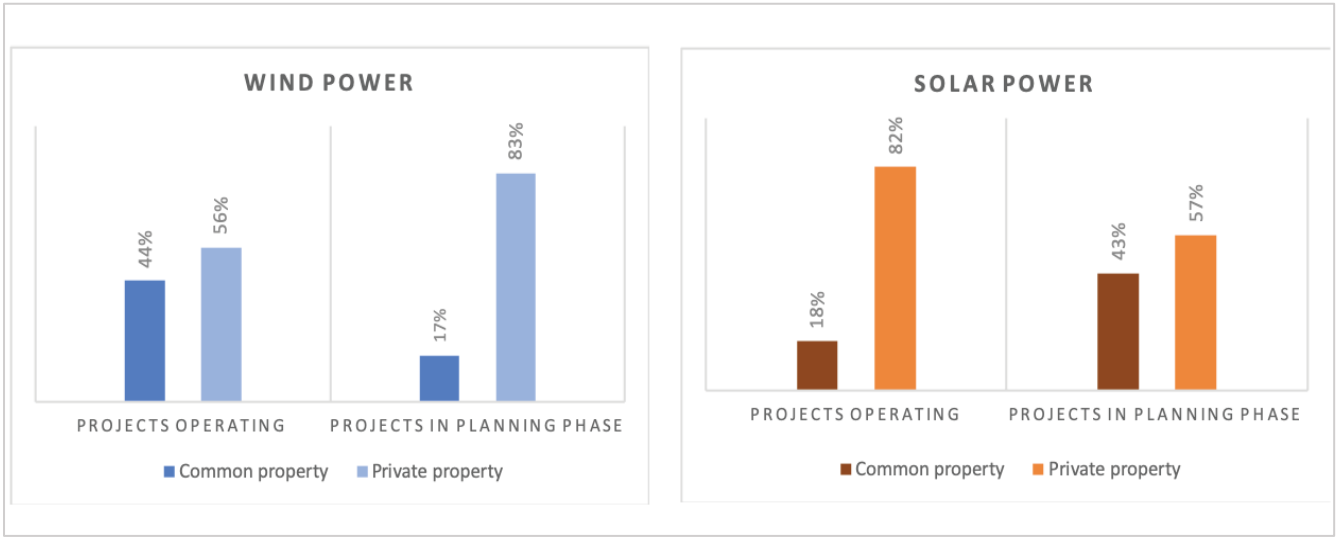


Land tenure and uses

Land tenure and land uses are key aspects in expanding renewables, yet these elements are so far absent in the INEL and AZEL platforms. Figure 4.4 shows that 44% of operating facilities have been located in communal lands for the case of wind power, with most projects triggering important mobilizations from communities claiming irregular leasing contracts, unfair rental payments, and the privatization of the commons (see regional analysis). As observed, the proportion of wind power facilities located in communal lands is expected to continue increasing yet to a lesser extent than projects located in private properties.

The expansion of solar power plants follows a similar but inverted pattern. By 2019, the majority of solar power plants had been located in private property. However, those located in communal lands (corresponding to 18% of all solar expansion land tenures) have antecedently triggered mobilizations from communities due to irregular negotiations and leasing contracts (see regional analysis). With projects in the pipeline to be executed, this percentage in terms of land tenure is expected to increase to 43%.

Figure 4.4 Land tenure in wind and solar projects (Mexico 2019

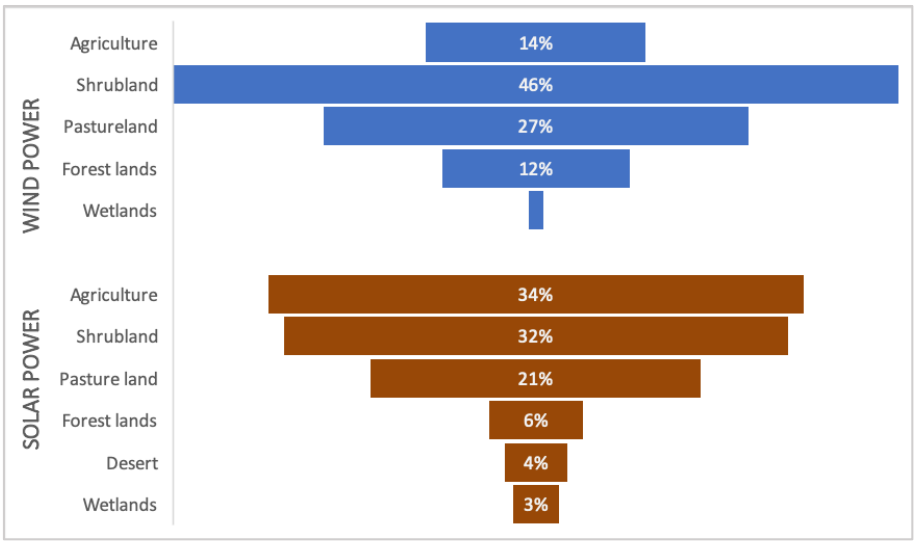


Ongoing demands from communities and private landowners highlight the need to address procedural justice in the foreseen wind and solar power facilities. Much of the land acquisition conflicts so far observed revolve around the fact that contracts do not follow regulatory frameworks in this matter. This includes provisions for *ejidos* and *communidades agrarias* to approve leasing contracts through the participation of *asambleas duras* (75% of the electoral register), instead of just approval from some local representatives (LIE, 2014;

Aguilera-Hernández, 2018). Procedural aspects appear of vital importance as land leasing contracts for wind and solar are established for an initial period of 30 years with the possibility of extending it into a second period.

In terms of land uses, wind and solar power plants are also triggering significant spatial transformations (Figure 4.5). Two aspects appear particularly relevant in this regard. On the first hand, wind and solar investments trigger significant shifts from agricultural land uses to energy production ones. This implies deep transformations of local livelihoods with potential negative impacts if wind and solar projects are not envisioned and negotiated with communities themselves. For example, if subsistence agriculture is erased by corporate facilities, if the leasing contracts do not provide stable and dignified incomes for individual and community landowners, and if the implementation of projects does not involve the participation of communities in the ownership, management and operation of facilities (see also: Partridge, 2020).

Figure 4.5 Land covered by wind and solar projects -operating and planned (Mexico 2019)



On the other hand, an important yet varied degree of land-use change from forestlands (shrublands, forests, and rainforests) to energy production is triggering controversies from environmental and social perspectives. Groups mobilizing against the poorly planned expansion of wind and solar in the country highlight that many EIA are plagued by irregularities favoring the land-use change in the forests, rainforests, and forest vegetations.

This is particularly relevant for the case of solar power deployment, as we will illustrate in our regional analysis.

Regional analysis

Wind power in the Isthmus of Tehuantepec (Oaxaca)

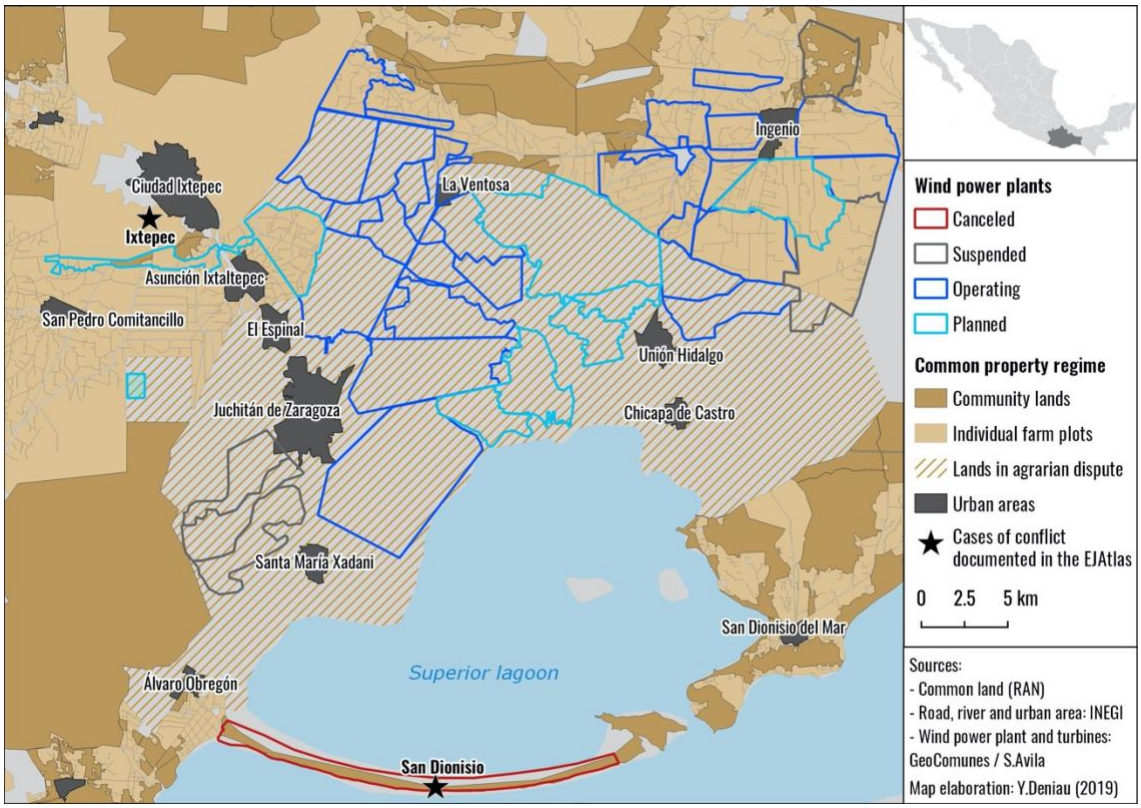
As a highly productive region, plans to install an ambitious wind power corridor in the Isthmus started to be articulated in the 1990s. Regional maps developed for such purposes have shown that land was rendered as empty and unproductive and ready to be distributed into different plots for wind power companies (Avila-Calero, 2017). In particular, early mapping efforts and negotiations to develop the wind power corridor largely ignored the complex configuration of land tenure and indigenous struggles for autonomy that characterized the region in the last century. In contrast, wind power was promoted as a win-win formula in which rural communities, State agencies, and private investors would be primarily benefited (Howe et al., 2015).

Since the envisioning of the corridor, however, the region has experienced unprecedented pressure over indigenous lands' acquisition. A progressive transformation of the territory has taken place in favor of large corporations. The Isthmus had shifted from being a rural region depending on farming activities at different scales to an industrialized wind-energy landscape (Alonso and Mejía, 2019). Our data shows that by the end of 2019, this region had 29 operating wind power facilities (1564 wind turbines deployed across 32,639 hectares) and eight projects in the planning phase. In addition, five projects have been suspended, and one project has been canceled.

As observed in Map 4.5, wind power projects in the Isthmus are located in both lands under agrarian dispute and lands under common property regime (including subdivided plots for community use and parceled plots for individual farming). Our data indicates that 67% of the surface occupied by wind power projects are lands under agrarian dispute. These lands have been historically considered the commons of Zapotec communities who explicitly refrained from registering in the PROCEDE program. Local elites, however, maintained a *de facto* control over such lands, enabling an obscure process of individual negotiations with wind power companies (Alonso and Mejía, 2019). The remaining surface occupied by wind power facilities coincides with registered communal lands. Registered communal lands

provide communities with the formal right to approve or deny rental agreements with developers. Negotiation between wind power companies, communities, and holders of individual parcels has been shadowed by illegal means, as denounced by local organizations (Forum, 2005; Oceransky, 2010; Juárez and León, 2014).

Map 4.5 Wind power, land tenure and conflicts in the Isthmus of Tehuantepec



The overlapping institutions -formal and informal- regulating land tenure, and the intervention or omission of State authorities in such processes have shaped an unjust rollout of wind power projects in the area. These processes have encountered *Zapotec* and *Huave* communities' long-standing struggles in defending their right to self-determination and autonomy. As such, the Isthmus communities relied on pre-existing spaces of communal decision making to create different assemblies that have been crucial to mobilize against the corridor and sparing information across the region.

Discourses mobilized by assemblies and other organizations highlight the multiple dimensions of injustice intersecting in wind farms' deployment. On one side, organizations denounce that land acquisitions have taken place both through the lack of proper consultation processes and through the illegal signing of individual contracts between local

elites and companies. Thus, territorial dispossession appears as the common element in most narratives concerning the misrecognition of indigenous lands and populations, with the consequent lack of just procedures in deploying projects. But conflicts in the region have also shown a clear emphasis on the uneven distribution of benefits in wind power production, as 75.8% of operating facilities are granted to provide electricity to large industries[31], while average rent per hectare largely differs from those registered in other countries (see: SEGOB, n/d , Manzo, 2019).

Map 4.5 highlights the resistance of San Dionisio del Mar, located in the coastal bar, as a paradigmatic case of struggle in this regard (Ejatlas, 2017a). San Dionisio was targeted to deploy one of the largest wind farms of the Corridor and granted to supply electricity to large multinational companies operating in the country. Multiple stages and forms of mobilization were triggered by the lack of procedural justice in planning the project and land leasing by the *Mareña Renovables* company. The San Dionisio case became key as community resistance achieved to stop the construction of the project, triggering larger debates on the transition's politics. As documented elsewhere (Avila-Calero 2017), the political character of local struggles against corporate wind power evolved into multiple assemblies and the proposal to implement a cooperative scheme to deploy wind power in the Ixtepec community (Ejatlas, 2017b). The cooperative, however, was not granted by the government in turn. However, these examples are just two illustrative cases of the dynamics that have characterized the progressive implementation of wind power in the region. For more than 13 years, the Isthmus has experienced a more extensive mobilization process in different municipalities, mostly with confrontations, blockades, and barricades (Castillo, 2011; Howe et.al, 2015; Dunlap, 2017a,b).

Wind and solar power in Yucatan

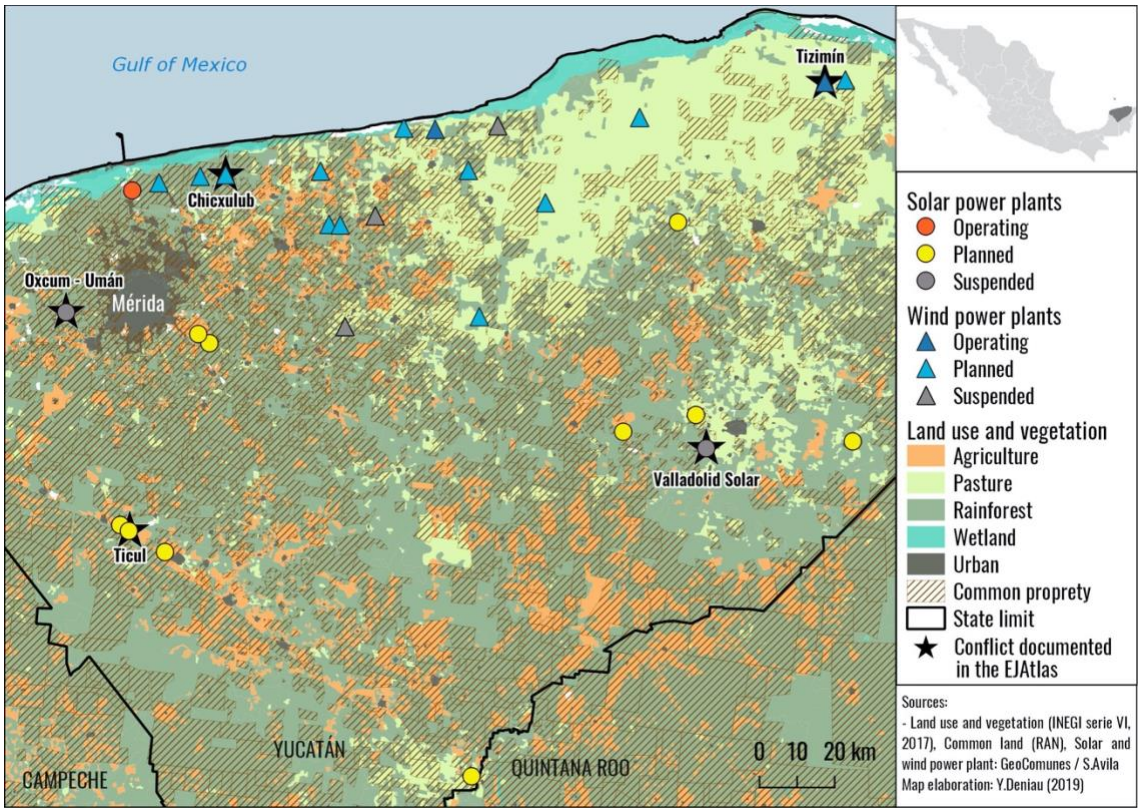
Since the launch of auctions in 2015, the State of Yucatan became one of the most attractive spots for wind and solar investments in Mexico. However, the region's features also make it particularly vulnerable to the expansion of industrial-scale renewable energies. Yucatan has the second-largest extension of rainforest in the country and is the ancestral territory of *Maya* communities, who hold communal lands and the institutions deriving from them.

[31] The main industries include mining, cement, industrial food produces and retailer. Details in: Geocomunes, 2017.

Yucatan is also a state with incredible biodiversity, with a unique hydrological system of *cenotes* and mangrove areas.

By the end of 2019, Yucatan's state has two wind power projects operating, 12 under construction or planned and 3 suspended. Also, Yucatan has one solar power project operating, ten under construction/planning, and two suspended. Data of Map 4.6 indicates that 45% of the surface covered by wind power projects in this state are located in forestlands, and 53% of the surface covered by projects are located in common lands. For solar power projects, numbers are even higher, as 86% of the surface covered by projects in the state are located in forestlands, and 19% of these facilities are also located in common lands. These figures suggest that mapping efforts from the Mexican government have translated into a poor integral planning for the transition, leading to spatial disproportionate impacts in regions with bot social and ecological vulnerabilities[32].

Map 4.6 Wind and solar power in Yucatan.



[32] Percentages of land use change in Yucatán surpass national averages for all criteria considered: National average of wind power projects located in forestlands is 11% and common lands is 35%. National average of solar power projects located in forestlands is 5.4% and common lands is 38%.

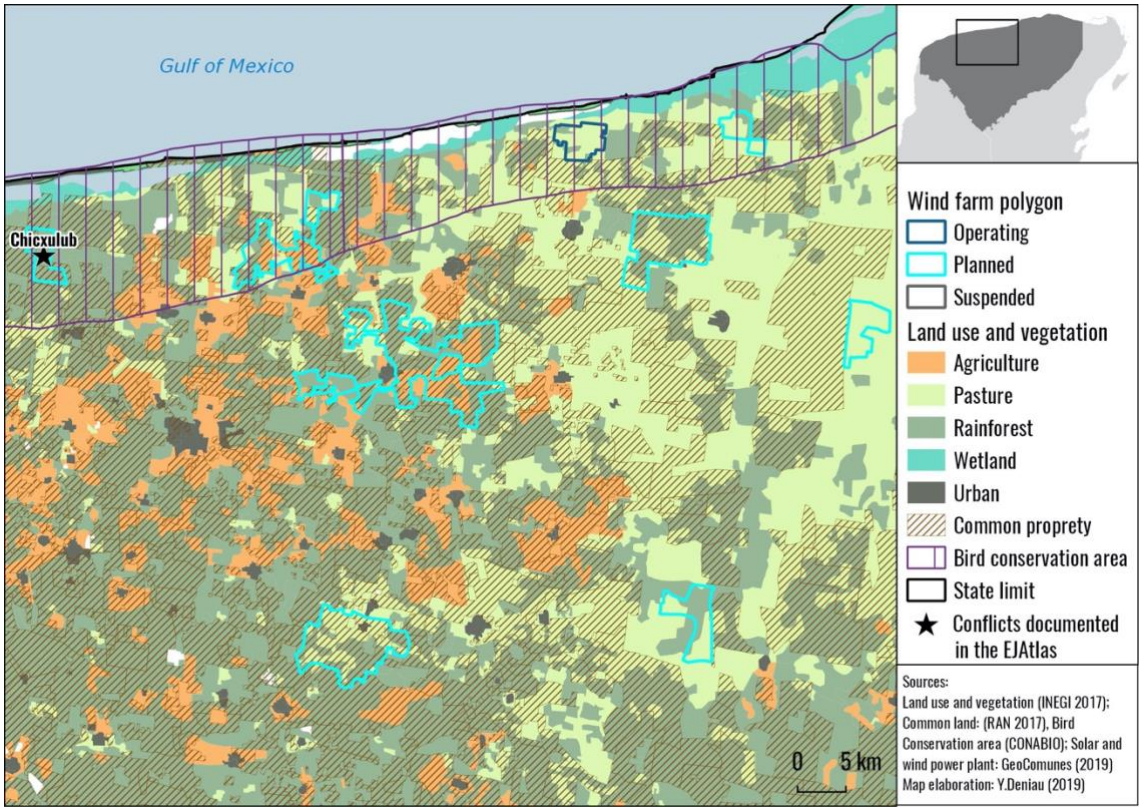
Local responses to the ongoing expansion of wind and solar power highlight the territorial dimension that compounds both agrarian controversies and threats to biocultural conservation (details in Maps 4.7 and 4.8). Different actors such as community assemblies, civil society organizations, and scientists are leading such responses by stressing the lack of proper consultation processes following the ILO 169 Convention and national regulations, the lack of unified and transparent processes for both Environmental and Social Impact Assessments (EIA and SIA), as well as the increasing need for an integral and democratic approach defining the transition agenda (see: Sánchez et al., 2019).

Regarding the agrarian question, the expansion of wind and solar power has presented similar patterns as those observed in the Isthmus. As speculation toward land increases with renewable energy auctions, community institutions become highly exposed to external pressures and internal divisions. Also, some communities and individual landholders have signed leasing contracts without having accurate information on the nature of projects and their distribution of risks and benefits. Local groups denounce a strong presence of intermediaries (*coyotes*) who are manipulating community and individual decisions in favor of illegal leasing contracts, affecting access and control over lands for 30 years or more. Local protests registered in Map 4.6 provide examples in this regard, including the Chicxulub wind power project (Ejatlas, 2019a) and the Ticul solar power project (Ejatlas, 2019b). Increasing responses to these territorial dispossessions are led by *ejidatarios* and *Maya* indigenous communities organized through assemblies. The most visible face of such collectives is the *Asamblea Múuch Xíinbal*, which emphasizes land as the central axis for sustaining both livelihoods and the continuation of *Maya* traditions. With a direct learning process from the Assemblies in the Isthmus, *Múuch Xíinbal* specifies that "the land is not for sale or rent", suggesting that collective institutions are vital for the protection of their lands and cultural identities (ADTMMX, 2020; López-Gómez et al., 2019).

In terms of biocultural conservation, Yucatan's case sheds light on the varied dimensions obscured by the State's cartographic tools. Civil society organizations and local scientists provide a systematic analysis of Social and Environmental Impact Assessments, highlighting their structural deficiencies and claiming revisions before projects are constructed. Concerns regarding SIAs, include the explicit misrecognition of communities affected by both the siting of facilities and the transmission lines associated with them (Tizimin Project in Map 6, Ejatlas 2020a). In a similar vein, concerns over the EIAs are observed in wind power projects

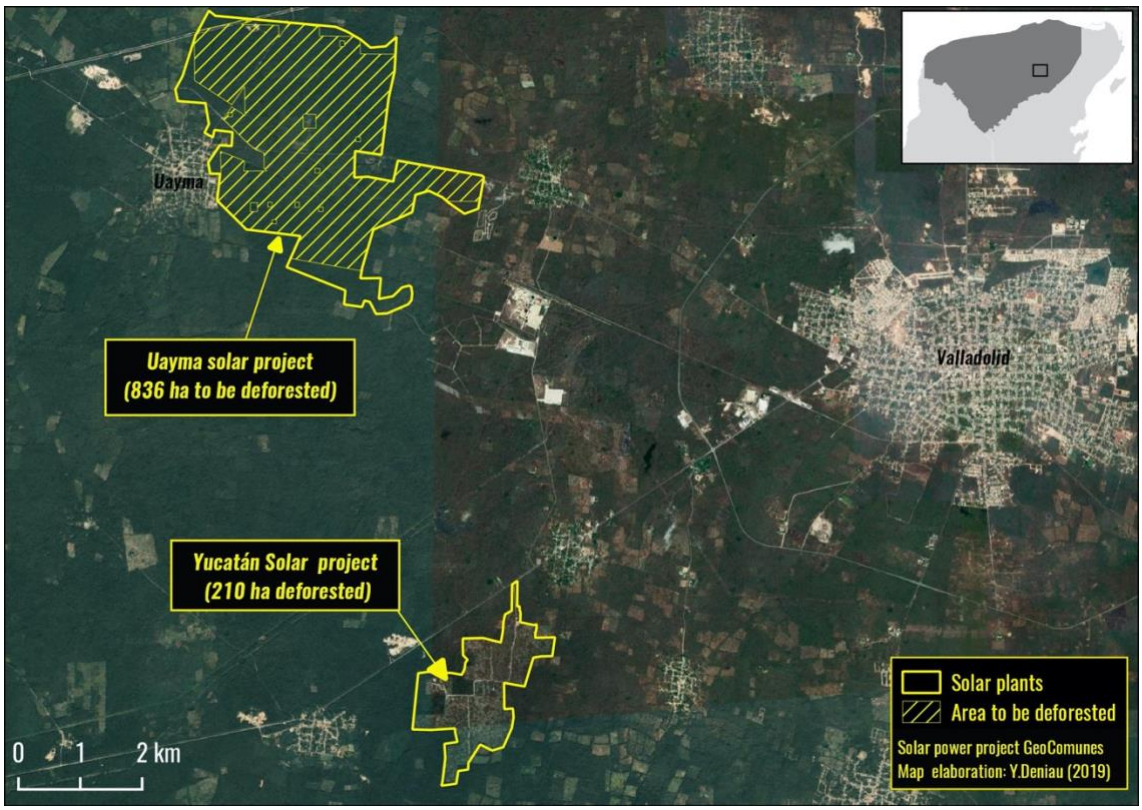
located along the coastline (Map 4.7). As detailed in the case of the Chicxulub Wind Power Project (Ejatlas 2020b), these facilities are to be sited, despite these are both mangrove and bird conservation areas.

Map 4.7 Wind power in Yucatan: agrarian and biocultural aspects.



The increasing socio-ecological vulnerabilities claimed by local groups are also observed in the case of solar power. Map 4.8 shows the scale of deforestation triggered in the region by illustrating the Yucatan Solar Project (South of Map 4.8). In this case, *Asamblea Múuch Xíinbal* and other supporting organizations claimed irregularities in the EIA and SIA documents, including the forest's misrecognition, the cenotes, and their bio-cultural importance; as well as the erasure of nearby localities in the social impact assessment (Ejatlas, 2020c). While this project has been successfully suspended, Map 4.8 shows that the forest is already deforested. The Map highlights that similar impacts could be trigger with the Uyama Solar Project (Northwest of Map 4.8). Communities and organizations claim that these impacts will be cumulative, affecting more extensive time and spatial scales (Sánchez et al., 2019).

Map 4.8 Details on solar power and deforestation in Yucatan.



4.6 Concluding discussion

The spatially extensive nature of renewable energies brings new theoretical and empirical concerns on the energy transition's justice and political dimensions. The role of maps in shaping the expansion of renewable energies is particularly relevant for countries in the Global South, where rural and indigenous communities have historically claimed recognition over land rights and continue to resist the expansion of enclosures and resource extraction from both States private corporations. This goes in hand with cartography development in general, as a practice inextricably linked with colonial and capitalist spatial orders (Li 2014; Ferguson 2014; Rignal, 2016).

Critical cartography and countermapping initiatives are placed, in this context, as powerful approaches to track, dissect and challenge dominant spatializations of renewable energy expansion. This Chapter grounded such reflection by presenting a countermapping initiative on Mexico's "low carbon development" strategy. This collaborative project is an activist-research one, bringing together two platforms on critical cartography to trace and intervene

in the expansion of wind and solar power in Mexico. The results highlighted six points of conceptual and political relevance.

First. Renewable energy maps developed by the Mexican State are not isolated objects and neutral exercises of cartography, but part of a larger assemblage of political choices aiming to expand the scope of neoliberal relations in rural Mexico. As highlighted in the results, the neoliberal approach to renewables entails a pattern of saturating regions with high potential to develop large-scale, private-led facilities under the control of an oligopoly of corporations. These emerging geographies favor an increased concentration of rural lands, largely shifting the access, uses, and control over territories and their resources. In particular, this pattern is enabled by the erosion of communal tenure regimes and large-scale shifts from agricultural uses and forest vegetation cover in favor of corporate renewable energy production.

Second. In Mexico, renewable energy maps work as useful "inscription devices" (Li 2014) to make rural lands investable for large-scale, private-led facilities. Maps do not work alone, however, but in alignment with discourses and regulations envisioning the "low-carbon development" future. These include narratives on the need to overcome investment "barriers" and public management inefficiency and the prominent role of private capital in tackling the urgency of climate mitigation. More critically, they also entail a series of constitutional reforms enabling the mercantilization of communal lands and the privatization of electricity production.

Third. State mapping efforts on renewable energies largely contribute to defining what information will be available and for whom, hence which are the legitimate actors in shaping the energy transition. Mexico State's cartographic tools are of public access, yet they provide inaccurate, disconnected, or absent information on territories' key dimensions. This suggests a deficiency in both democratic participation and integral decision-making processes in the transition. However, our countermapping project aims to show that maps are contingent and travel to reach much wider actors than those within State, corporate, and academic circles.

Fourth. Countermapping practices unveil those territories are not empty spaces to be developed but instead hold complex configurations of political, environmental, and cultural dimensions. In the energy transition, critical mapping exercises are crucial to shed light on the spatialities of environmental injustice (Walker 2009a) potentially produced. When

mapping wind and solar power in Mexico, this countermapping initiative shed light on the (mis)recognition of places, people, and their rights over land; the uneven and disproportionate distribution of benefits and burdens across space; and the consequent production of socio-ecological vulnerabilities. Cases of conflict show that communities and organizations mobilize both spatial (cumulative impacts) and temporal (intergenerational justice) concerns.

Fifth. Oaxaca and Yucatan's analysis shows that the neoliberal expansion of renewable energies faces increasing resistance from rural communities defending the commons. Resistance processes in these regions are based on traditional institutions of *ejidos* and *communidades agrarias,* but also larger community assemblies. These groups mobilize the defense of communal rights over land, communal institutions for resource management, communal traditions sustaining their identities, and the non-mercantilization of land and its resources. Further research will be needed to analyze contexts in which other property and management institutions over land are at stake (private or public land).

Sixth The countermapping initiative presented in this Chapter identifies some points of intervention for an alternative agenda on the transition:

- Building cartographic tools with participation and recognition of citizens and communities across the country. Democratic inclusion of social, economic, and environmental cartographic layers. These all would be key in the planning and implementation of facilities under the principle of procedural justice.
- Protecting communal property via different legal mechanisms. The spatial and political relations of communal tenure should be at the center of the transition project.
- Provisions to implement cooperative schemes for centralized and decentralized facilities in which communities are directly involved in the management of their territory, and in the harnessing and consumption of resources.
- Developing new regulatory provisions for land cooperation to protect agrarian livelihoods, vegetation cover, and ecological connectivity.
- Establishing regulatory mechanisms on leasing prices for private lands according to international standards and principles of distributional justice. These provisions will be key in the expansion of renewables across the north part of the country.

Chapter 5

Environmental Justice and the expanding geography of wind power conflicts[33]*

5.1 Introduction

In the context of climate change and energy concerns, the need to shift towards a low-carbon energy system has become one of the central challenges for achieving sustainability. The means to achieve these goals and the ends of such a transition is, however, a contested space disputed by divergent interests, values and prospects of future (Bradley and Herdén 2014). The growing number of conflicts emerging against renewable energy projects reflects an important part of such tensions, offering an opportunity to address the multiple voices and power rearrangements that have emerged towards this major societal transformation. This Chapter focuses on the case of wind power and introduces an inventory of 20 new cases of conflicts emerging in different socio-geographical contexts of Africa, the Americas, Asia and Europe.

Much of the literature addressing social attitudes against wind power since the late 1980s has given central attention to assessing the adequacy of Not-In-My-Backyard (NIMBY) interpretations of social opposition and the consequent policy measures to improve acceptance of projects (Thayer and Hansen 1991; Wolsink 2000; Smith and Klick 2007; Petrova 2013). With a geographical focus on the most developed countries, these studies

[33] This research was firstly published in the Journal of Sustainability Science https://doi.org/10.1007/s11625-018-0547-4
Avila S (2018) Environmental Justice and the Expanding Geography of Wind Power Conflicts. Sustainability Science 13 (3): 599–616.
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tend to share a particular interest in closing the "social gap" that still blocks the growth of the wind industry (Agterbosch et al. 2007; Brown 2011; Bell et al. 2013). New perspectives are, however, slowly moving beyond this problem-solution perspective in order to address the dominant storylines supporting the rapid expansion of large-scale facilities, and to systematize the heterogeneous claims coming from different social groups (Ellis et al. 2006; Szarka 2007; Jessup 2010).

The wind power debate that draws from such literature illustrates how controversies generally splits into a dual tension between those who support the rapid expansion of industrial wind power as a means to solve the energy-climate crisis (generally framed as part of the Ecological Modernization paradigm), and those who are concerned with the protection of local landscapes and environmentally sensitive places (generally framed within Environmental Conservation narratives). In contrast to the former academic convention, these new insights place the wind energy expansion as an actual political issue, shaped by different worldviews, interests and values. But while such emerging literature provides rich insights into outlining the wind energy debate, both a geographical and theoretical expansion is needed. Firstly, because wind power investments are rapidly covering new locations around the world. Secondly, because the land uses, power structures and potentially affected populations of these new locations might differ significantly from those analyzed by the existing literature.

In an attempt to cover these unexplored spaces, the inventory of conflicts presented in this Chapter is taken as an empirical basis to analyze two relational issues: (i) what are the configurations of the current wind power expansion; and (ii) how such expansion is expressed and contested in different socio-geographical contexts. By using the Environmental Justice Atlas platform as the guiding methodology of research, this research offers systematical evidence of the land pressures and patterns of uneven development deriving from the global expansion of large-scale wind power projects. Such patterns are, in turn, used to interpret the increasing instances of contestation along the rural spaces of the world. In addition to the imaginaries of "landscape" and "wildlife protection" addressed by existing literature, this Chapter sheds light on the rural contexts where new narratives emerge throughout the defense of territories, livelihoods and community-based development projects. As I will argue, these "emerging storylines" embrace an Environmental Justice

perspective, when challenging the socially unequal and geographically uneven patterns derived from the Ecological Modernization paradigm.

The combination of these processes suggests a changing path in the scope and content of the wind energy debate. In particular, this research contributes to place the wind energy expansion as embedded in the politics of truth, rule and accumulation (Scoones 2016) of the low-carbon transition; while opening possibilities of discussing alternative energy futures. The analytical approach of this work combines cross-disciplinary literature of critical human geography, political ecology and Environmental Justice theories. It takes critical perspectives over energy development (Harrison 2013; McCarthy 2015; Huber 2015), and more broadly, over framings of sustainability (Asara et al. 2015; Gómez-Baggethun and Naredo 2015) to discuss low-carbon transitions beyond its technical aspects (Trainer 2014; Scoones 2016). This includes addressing the structures and transformations that different paths of change could entail; considering issues of power, patterns of production-consumption and environmental rearrangements at different scales (Brand 2016; Gillard et al. 2016; Scoones 2016).

In the following section I present a review of the current "wind energy debate", discussing the narratives at stake as well as the larger environmental and political paradigms where they are inserted. I then proceed to describe the conceptual and methodological approach of the Environmental Justice Atlas, as well as the roadmap for researching the 20 conflicts presented in this work. The empirical results of the inventory are presented in two different moments. The first one (*Features of large-scale projects*) unpacks the social and biophysical configurations of large wind farms, including aspects of ownership, installed capacity, land intensity, type of infrastructures and end uses of the electricity produced. This aggregated criterion helps to inform how land pressures and patterns of uneven development appear as the common byproducts of the current wind power expansion. The second part of the results (*Features of conflicts*) analyzes how these patterns manifest and are contested in different socio-geographical contexts around the world. Based on this roadmap, I discuss the hypothesis of an emerging Environmental Justice narrative in the wind energy debate. Finally, the concluding section reflects on how this extended debate contributes to approaching the transition in its spatial, political and justice implications.

5.2 The wind energy debate

The "wind energy debate" is understood as the multiple worldviews, interests and values expressing a stance in relation to the expansion of modern wind farms, which in turn are part of wider efforts to promote low-carbon transitions. Active voices in this discussion include those of international organizations, governments, environmental groups, scientists, technocrats, social movements and local communities. Different approaches and case studies have been used to classify the plurality of story-lines and themes along this spectrum (Ellis et al. 2006; Szarka 2007; Jessup 2010). Within the complex roadmap these studies portray, a similar common pattern still tends to reflect a dual tension between those who support the rapid expansion of large-scale wind farms and those who oppose to particular deployments due to concerns over landscape and wildlife conservation. In the following paragraphs, I present these tensions as being sub-themes of wider environmental debates; the first stance as embedded in the Ecological Modernization paradigm, and the second as part of the Environmental Conservation one. As I will argue, these two "factions" certainly inform and give shape to the current wind energy debate. However, emerging narratives are increasingly opening new lines of theoretical and empirical discussion. I cluster these emerging narratives within the Environmental Justice perspective.

Ecological Modernization

The first faction embeds the vision of international agencies, governments, corporations and environmental groups supporting the expansion of industrial wind power as one of the most effective ways to tackle climate change and energy concerns (Ellis et al. 2006). Under this framing, modern wind power appears as a technological solution, but also as an opportunity to promote green business and economic growth (Jessup 2010). As such, it tends to hold that "the commercial exploitation and development of wind energy is a means (private profit making via technological innovation and government support) to an end (the public interest in security of energy supply, tackling the threat of climate change and benefiting future generations)" (Ellis et al. 2006 p.9).

This narrative derives from the Ecological Modernization paradigm, where the premises of environmental protection and economic growth are compatible via the development of modern technologies, improvements in efficiency, competitive markets and state interventions (Weale 1992; Mol 1996; Mol and Sonnenfeld 2000 Osland 2016). The major role that this paradigm plays in the quest for a low-carbon transition can be observed in

multiple instances of the debate. In the prelude of the UN-COP 21 in Paris (2016), for example, an unprecedented mobilization of business networks stated that climate objectives are "compatible with continued economic growth and human development if all actors work together" (UN Global Compact 2016). In a similar vein, international agencies, public policies and private investors celebrate the rapid expansion of commercial renewable energy projects as a clear step to promoting green growth and achieving sustainable development goals (OECD/IEA 2014; REN21/UNEP 2016).

From an Ecological Modernization perspective, wind turbines are seen as one of the most powerful images of nature and modernity working in harmony (Toke and Strachan 2006; Smil 2016). As such, social opposition to wind energy projects is generally described as an obstacle in the development of an energy system that is "cost-effective, environmentally desirable and technically reliable" (Bosley and Bosley 1992:1). Wind is seen as an endless resource to be harvested, transformed and commodified as electricity (Hawken et al. 1999), providing new possibilities to meet increasing global energy demands (REN21/UNEP 2016). Whereas this "dominant storyline" (Jessup 2010) seeks to create scientific consensus of a "technological neutrality providing unlimited economic growth" (Ellis et al 2006; Brey 2017), local groups increasingly appear as questioning the viability of such win-win scenario in terms of it spatial, political and justice dimensions.

Environmental Conservation

Wildlife conservation and landscape protection groups lead the second faction of the debate around modern wind energy development. In contrast with the Ecological Modernization narratives, where the economic and scientific rationale dominates the discourse, this second faction tends to prioritize eco-centric and cultural values over affected local environments, although some utilitarian values are also present (Jessup 2010). Discourses within this faction generally acknowledge climate change as one of the great challenges of the 21st century. However, localized wind farms tend to be depicted as the drivers of turning "wilderness" or "the rural" into an outdoor industrial energy production plant (Ellis et al. 2006: 6).

Regional coalitions (such as the European and North American Platforms Against Wind Energy), and well-established conservationist organizations (such as Birdlife International and the Royal Society for the Protection of Birds) are powerful representatives of this faction, as they question the risks of wind turbines on localized landscapes. Literature has also shown

how rural and suburban communities in the Europe, Australia and the US, oppose wind farm deployments due to the visual imposition of turbines and the consequent impacts on aesthetics and cultural values (Thayer and Freeman 1987; Thayer and Hansen 1991; Pasqualetti et al. 2002, Toke and Strachan 2006, Zografos and Martinez-Alier 2009). Opposition sometimes also include claims on how the visual or cultural intrusion of turbines creates economic impacts over properties and tourism (e.g., Szarka 2007; Pasqualetti 2011).

The aggregated narratives within this faction fairly met with the traditional paradigm of Environmental Conservation, where much of the discourses and efforts are focused in preserving imaginaries of "wild" and "pristine" environments (Martinez-Alier 2002). Under this vision, environmental problems (pollution, degradation and depletion) are recognized as challenges for sustainability but are generally isolated from their wider socio-economic dynamics (Martínez-Alier 2002). As such, conservation initiatives tend to establish shelters and protection measures to save certain spaces from modern human intervention, including markets and technologies. The case of wind energy clearly reflects such spectrum of stances, as conservationist narratives tend support the expansion of wind farms (Jessup 2010), but seek to protect sensitive rural landscapes through, for example, better siting decisions.

Environmental Justice

As wind power investments expand globally, the wind energy debate appears to go beyond the binary tension between Ecological Modernization and Environmental Conservation. One of the sources of such development derives from the Environmental Justice narratives and its alternative visions of sustainability, which are both co-constructed by grassroots activism and critical social theory.

The Environmental Justice movement emerged since the early 1980s in the U.S. against a background of uneven distribution of environmental burdens in terms of class, gender and ethnicity (Bullard 1990; Bryant and Mohai 1992). Instances of environmental injustice and conflict have been largely analyzed in "third" and "first" world societies (Bryant and Bailey 1997; Martinez-Alier 2002; McCarthy 2005; Anguelovski and Martínez-Alier 2014), making visible the socially unequal and geographically uneven profile of the modern industrial economies (Temper et al 2015). In the most recent years, the Environmental Justice movement and theory has expanded to include an array of perspectives, concepts and

political positions some of which will play a crucial role in debating low-carbon transitions (Bryant 2015; Perreault et al. 2015; Holifield et al 2018).

A good example of these contributions comes from the growing number of studies on the field of energy justice (Sovacool and Dworkin 2015; Bouzarovski and Simcock 2017); which are part and parcel of the "equity-recognition-participation" framework broadly proposed by Schlosberg (2013). In an effort to further understand –and challenge- the power relations embedded in the low carbon transition, Critical Environmental Justice narratives also increase its voice in this debate. For example, when analyzing the trade-offs between sustainable transitions and issues of social justice, Newell and Mulvaney (2013) highlight that "(…) the uneven exposure to environmental benefits and harm is often not accidental and unintentional, but rather a product of a particular way of organizing production and its constitutive social relations". From this critical lens, pure technological-fixes appear to reinforce (rather than revert) the uneven power relations that characterize current social structures (Swyngedouw 2010; 2011), while diluting the possibility of alternative energy futures (Huber 2015; Calvert 2016).

The analysis of environmental conflicts and claims for justice related to the expansion of renewable energies here raises a new spectrum of questions and paths of inquiry: how this transition is taking place (Dunlap 2017, Del Bene et al. 2018); by whom and for whom (Newell and Mulvaney 2013; Calvert 2016); how these new energy flows are configured by particular economic institutions and power relations (Avila-Calero 2017); and how renewable energies interlink with issues of capital accumulation, spatiality and land grabs (McCarthy 2015; Fairhead 2013; Yenneti et al 2016). The inventory of conflicts analyzed in this research seeks to provide an empirical basis to approach these set of theoretical questions.

5.3 The inventory of conflicts: methods and conceptual approach

Each case encompassing the inventory of wind energy conflicts was first filed in the Environmental Justice Atlas (Ej-Atlas). The Ej-Atlas acts as a shared platform and database to study and disseminate cases of grassroots activism emerging from the uneven distribution of environmental burdens along the commodity chains (Temper et al 2015). From a conceptual perspective, it works as an empirical tool helping to understand how changes in

socio-metabolic configurations redefine the distribution of environmental benefits and burdens, socially and geographically (Scheidel et al. 2018; Perez-Rincon et al. 2017). We define "socio-metabolic configurations" as the flow of energy and materials in the economy (Martinez-Alier 2009), as well as the institutions and power structures configuring them (Demaria and Schindler 2016; Avila 2017; Špirić 2017). As such, the study of environmental conflicts is placed as an effort to grasp the social struggles that contest those configurations, and (sometimes) revert them in favor of more socially just and environmentally sustainable arrangements (Scheidel et al. 2018).

The Ej-Atlas database collects qualitative and quantitative data of each conflict including description of the case, features of the project triggering conflict, perceived and potential impacts, affected population, actors mobilizing, outcomes of the conflict and sources of information. Once a case-study is completed, an internal board revises the content and sources to assure accuracy before its publication (further methods details in: Temper et al., 2015; Temper et al, 2018a). For researching the 20 wind power conflicts presented in this research, two criteria were established in advance. 1) Covering those countries of the "Global South" that are experiencing increasing investment in large-scale wind energy projects. 2) Including some cases in the "Global North" contributing to our understanding of new actors, claims and values in the wind energy debate. The set of 20 cases was also defined by the available information, including activist communications, newspaper articles and official documentation from companies, governments and investors. Sources of information for each case are listed on their respective entry at the Ej-Atlas website (see Table 5.1 and Figure 5.1).

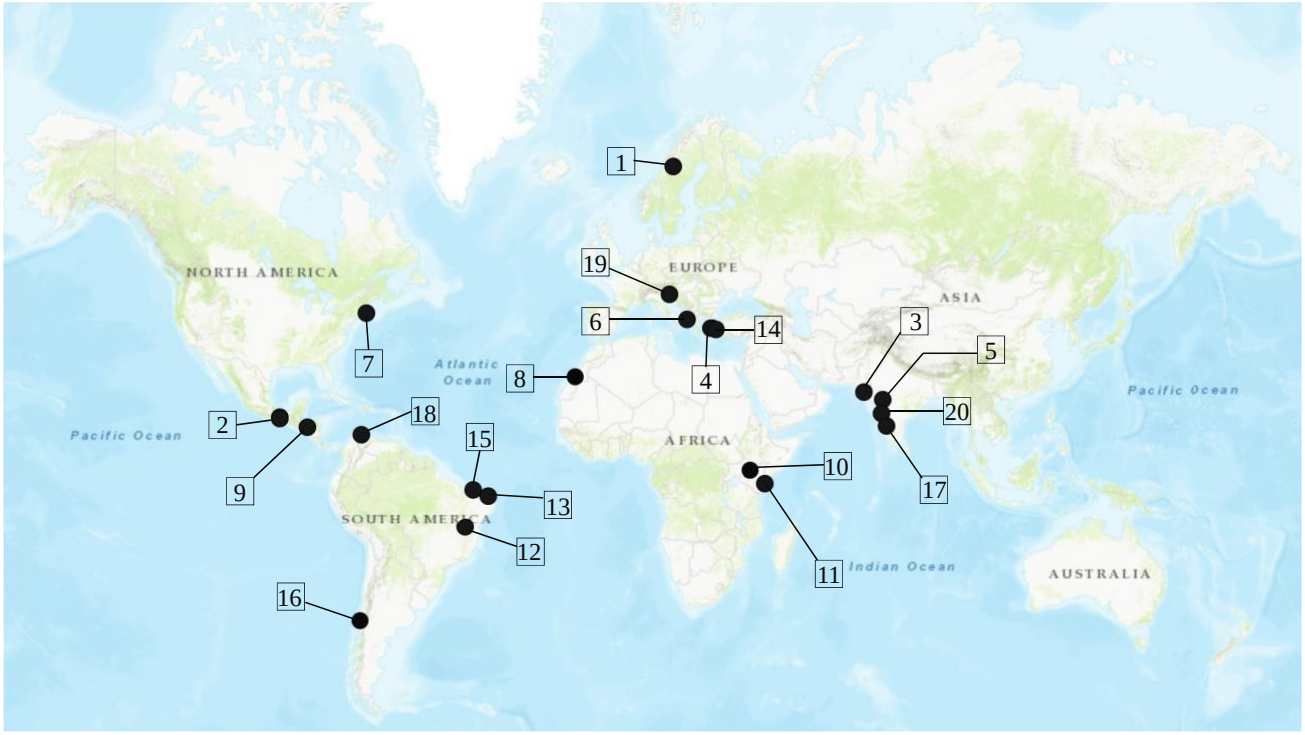
When following the same analytical categories for each of the 20 cases, a systematic evidence-based inquiry was provided to explore the determinants of wind power expansion as well as the dissent voices emerging at the local scales. The Ej-Atlas also provided a well-defined analytical perspective, helping to explore the relationship between wind energy conflicts and Environmental Justice narratives. The display of results presented in the following sections will show that beyond the Ej-Atlas database, additional categorization and some further research was needed to answer the specific questions of this research. For example, the first section of results (*Features of projects*) is based on the Ej-Atlas information but enriched by literature and displayed under specific categories and estimations. The second section

(*Features of conflicts*) is also based on the Ej-Atlas entries but digested and clustered into five different "socio-geographical contexts".

Table 5.1 Inventory of conflicts – basic data and links to entries

Number in map	Location	Name of project	Reference in text (link to entry)
1	Sweden, Norrbotten	Markbygden	Ejatlas, 2016f
2	Mexico, Oaxaca	Wind Corridor of the Isthmus of Tehuantepec	Ejatlas, 2017a Ejatlas, 2017b
3	India, Gujarat	Suzlon Wind Farm	Ejatlas, 2015
4	Greece, Chios	Seven different projects	Ejatlas, 2016e
5	India, Maharashtra	Suzlon Wind Farm	Ejatlas, 2017l
6	Albania, Vlorë	Moncada Construzioni	Ejatlas, 2017i
7	United States, Massachusetts	Cape Code	Ejatlas, 2017e
8	Western Sahara, Boujourd/Tiskard	Boujourd and Tiskard	Ejatlas, 2017g
9	Honduras, Fransisco Morazán	Cerro de Hula	Ejatlas, 2016a
10	Kenya, Marsabit	Lake Turkana	Ejatlas, 2016d
11	Kenya, Lamu	Lamu Cordisons	Ejatlas, 2017f
12	Brazil, Bahía	Alto Sertão	Ejaltas, 2016b
13	Brazil, Rio Grande do Norte	Alegria	Ejatlas, 2017d
14	Turkey, Izmir	Lodos Electricity	Ejatlas, 2017h
15	Brazil, Ceará	Baleia Complex	Ejatlas, 2017c
16	Chile, Chiloé	Chiloé	Ejatlas, 2016c
17	India, Andra Pradesh	Nallakonda	Ejatlas, 2017m
18	Colombia, La Guajira	Jepirachi	Ejatlas, 2014
19	Slovenia, Ilirska Bistrica	Elektro Primorska	Ejatlas, 2017j
20	India, Maharashtra	Suzlon Wind Farm	Ejatlas, 2017k

Figure 5.1 Inventory of conflicts – geographical location



5.4 Results

5.4.1 Features of projects: unpacking large-scale wind farms

According to the Global Renewables Status Report (REN21 2016), the current expansion of renewable energies, both in general and for wind power in particular, is mainly owed to the deployment of large generators (megawatt-scale and up), owned by utilities or large investors. The 20 wind power projects analyzed in this inventory fall in this large-scale category. However, additional elements of analysis remain crucial to interrelate the scale of projects with their socio-political implications, and thus shed light on the drivers and nature of conflicts. In the following paragraphs, three additional criteria are included in order to widen our understanding of a large-scale project: 1) the associated land requirements; 2) the type of infrastructures they entail; and 3) the end users of electricity produced. Each of these criteria is conceptually described, including a brief description of such features in the inventory. This extended analysis based on the 20 cases argues how land pressures and patterns of uneven

development are derived from the ongoing expansion of large-scale wind farms. Table 5.2 summarizes this information into a single chart.

Land requirements

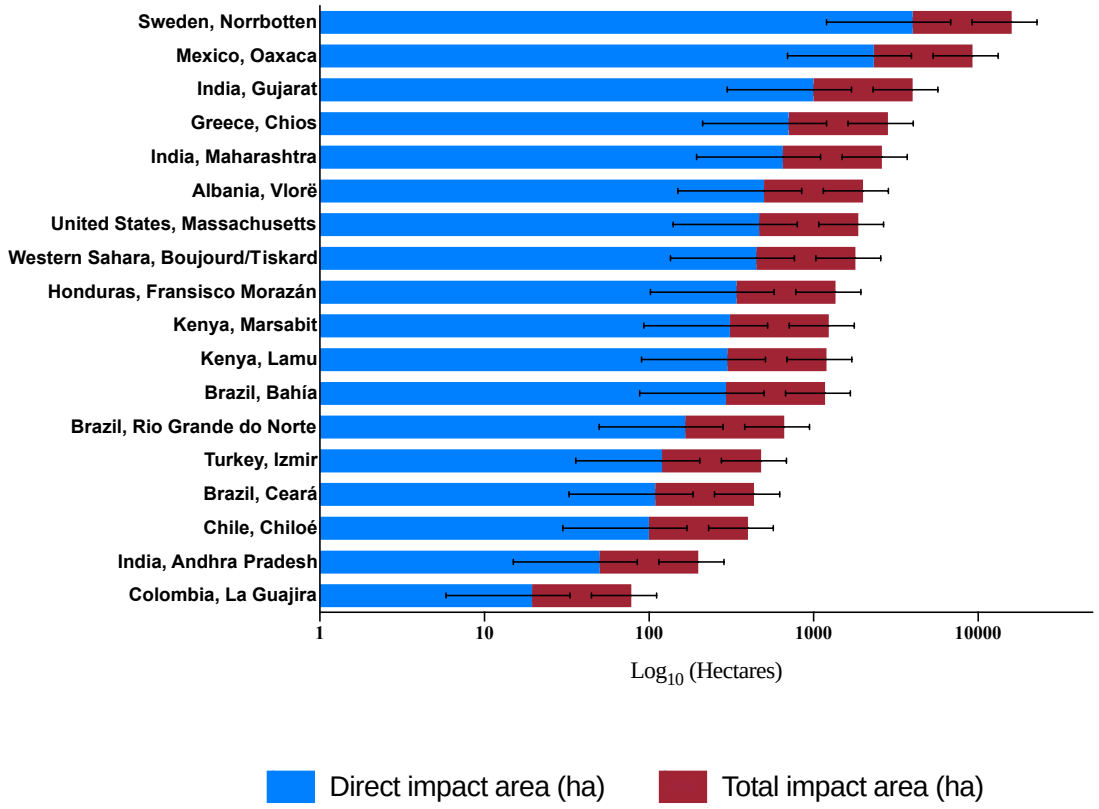
Alternative energy sources require vast amounts of space to generate the energy that conventional fossil and nuclear resources can produce in focal points of extraction (Huber 2015). The high-land intensity related with renewables is a consequence of differential power densities, where the quantity of power that can be generated from a certain area depends on the resources available and harvesting technologies (Smil 2008). Power densities (W/m2) of conventional fossil and nuclear energy sources are two to three orders of magnitude greater than those of renewables; showing that if the level of energy flows is to be maintained or increased under a low-carbon system, area coverage of alternative energy sources will have to increase in large magnitudes (Scheidel and Sorman 2014: 591).

In the case of wind energy, power density ranges from 0.5 to 1.5 W/m2 (Smil 2008). However, estimating the specific power density of an individual wind farm requires considering place-specific variables and constraints (e.g., Fyrippis et al. 2010). An alternative metric to estimate land use for wind power plants is to consider two primary indices: the direct impact area (land disturbed by road development, turbine pads and electrical support equipment); and the total impact area (overall area leased or bounded as a whole) (Denholm et al. 2009). Figure 5.2 presents approximate ranges of direct impact area and total impact area of the projects encompassing the inventory, as an illustrative example of such land use pressures.

Whereas these land areas are not necessarily translated into environmental impacts on the ground (especially for total impacted area estimations), such figures help to illustrate the socio-environmental rearrangements that renewable energy landscapes will entail (see for instance: Calvert 2016). In the inventory of conflicts analyzed here, this spatial dimension appears crucial for understanding emergent cases and discourses of contestation towards wind power. With the exception of the offshore wind farm in the US, all of the cases in the inventory (95%) are catalogued as "land acquisition conflicts"; while some of them of them also span categories such as fishery/coastal conflicts (20%) and deforestation (10%).

The type of impacts, claims and values mobilized in each case vary, however, depending on the specificities of the socio-geographical context at stake. Table 5.2 presents the aggregated analysis of each of these contexts, while next section describes them in further detail.

Figure 5.2 Proxy averages of direct and total impacted areas



Own elaboration based on the installed capacities of each project and average figures from Denholm et al. 2009. Averages and their respective standard deviations are: 1) Direct impact area: 1 ± 0.7 hectare/MW. 2) Total impact area: 3.0 ± 1.7. Note that this figure is presented as a proxy and illustration of land uses, with still a wide variation in each of these indices. Also note that the cases of Slovenia (Ejatlas 2017j) and India (Ejatlas 2017k) are not included as there is no information available on the installed capacity of projects.

Type of infrastructures

The second relevant criterion has to be with the type of infrastructures necessary for large-scale power production and supply. Large-scale electricity developments are usually centralized facilities providing power to distant end-users through high-voltage transmission lines (EPA n/d). These systems are both capital and technology intensive (Momoh et al. 2012), as well as highly dependent on concentrated property and management schemes

(Kallis et al. 2014). This centralized paradigm has enabled and powered modern industrial societies, as systems have relied on the highly productive, localized sources of energy (Momoh et al. 2012). Such schemes and its complex networks have been, however, deeply implicated in the reproduction of political and economic power, when differentiating spaces of production and consumption; while creating concentrated nodes of profit and control (Harrison 2013; Huber 2015).

In the low-carbon transition, a shift towards a decentralized power system appears as a concrete alternative; not just because renewables are dispersed by nature, but also because their lower productivity will require changes in production and consumption at different scales (Scheidel and Sorman 2014). However, the centralized paradigm is still dominating in the expansion of renewables and has become the strongest model in the wind and solar sector (REN21/UNEP 2016). The implications of such infrastructures in potentially reproducing energy poverty and injustice have been addressed as a central aspect to critically approach energy landscapes (Harrison 2013; Huber 2015). As illustrated in Table 5.2, cases in the inventory constitute examples of such large centralized facilities, suggesting that the uneven geographies reinforced by these schemes contribute into the emergence of local forms of contestation.

End uses of electricity produced

Closely related to the landscapes of extraction and infrastructure deployment, energy consumption patterns also reflect larger social and political patterns of inequality (Huber 2015). Understanding the macro-structural processes of energy consumption requires going beyond the analysis of residential consumption behaviors to address, in turn, large organizational consumers (Huber 2013; Mitchell 2011). From this perspective, three categories of consumers are defined to analyze the cases of the inventory: 1) developed/urban regions of hosting countries; 2) demanding regions of neighboring countries; and 3) the so-called "corporate end users". This latter category refers to the growing number of bilateral agreements made between corporations, on one side, and large electricity generators, on the other (Penndorf 2015). Under this scheme, corporations invest in large-scale renewable projects in order to receive, among others, "green" electricity supply at preferential rates.

In the inventory of conflicts, the first type of sectorial end users represents the great majority of cases, as 80% of projects are deployed to supply electricity for developed/urban regions of hosting countries. In a very similar direction, two other cases illustrate examples of electricity produced to supply neighboring countries (Albania and Western Sahara). The uneven geographies created by such consumption patterns are, in many cases, explicitly addressed and contested by affected communities. Cases in India are illustrative in this regard, but also cases of Sami communities in Sweden (Ejatlas 2016f); island communities in Greece (Ejatlas 2016e); Saharahui people in Western Sahara (Ejatlas 2017g), and farmer communities in Albania (Ejatlas 2017i). Other cases in the inventory illustrate how these uneven geographies are also shaped by private-corporate consumers. Projects in the inventory representing "corporate end users" include wind farms in Western Sahara supplying electricity to the Moroccan Phosphate Company (Ejatlas 2017g), the wind corridor in Mexico supplying several multinational corporations (Ejatlas 2017a), and the project in India supplying multiple big companies (Ejatlas 2017k). In such cases, the distributional implications play a very important role in the emergence of local mobilizations and conflicts. Table 5.2 presents this aggregated analysis into a single chart.

Table 5.2 Aggregated analysis of large-scale projects.

Number in map	**Project** Name (Location)	**Ownership** Developer Investor	**Installed capacity** (MW)	**Direct impact area** (Ha) (standard deviation)	**Geographical context**	**Type of Infrastructure**	**Sectorial end-uses**
1	Markbygden Sweden, Norrbotten	Private developer Private investors	4000	4000 (2800)	Indigenous and ethnic territories (*Sami* herding lands)	Centralized	National grid (Urban and populated regions in the country)
2	Wind Corridor (Mexico, Oaxaca)	Private developers Private investors	2317	2317 (1622)	Indigenous and ethnic territories (*Zapoteco* and *Huave* coastal and agricultural areas)	Centralized	Corporate end users (Multiple national and transnational corporations)
3	Suzlon Wind Farm (India, Gujarat)	Private developer	1000	1000 (700)	Indigenous and ethnic territories (Traditional fisheries and pasturelands)	Centralized	National grid (Communities claim poor supply in the region)
4	Seven different projects (Greece, Chios)	Private developers Public investors	706	706 (494)	Rural and peri-urban communities (North Aegean Islands)	Centralized	National grid (Supply to continental Greece though submarine cables)
5	Suzlon Wind Farm (India, Maharashtra)	Private developer Private investors	650	650 (455)	Indigenous and ethnic territories (*Adivasis* forestlands)	Centralized	Corporate end users (Communities claim poor supply in the region)
6	Moncada Construzioni (Albania, Vlorë)	Private developer	500	500 (350)	Nature conservation area (*Karaburuni* peninsula)	Centralized	Neighboring countries (Supply to northern Italy)
7	Cape Code (United States, Massachusetts)	Private developer	468	468 (328)	Affluent residencies and tribal territories (Mashpee Wampanoag scared landscape) (Residential and touristic coastline)	Centralized	National grid
8	Several projects (Western Sahara)	Private developers	450	450 (315)	Indigenous and ethnic territories (Saharaui contested territories)	Centralized	Corporate end users Morocco's national grid
9	Cerro de Hula (Honduras, Fransisco Morazán)	Private developers Public investors	340	340 (238)	Indigenous and ethnic territories (*Lenca* communities)	Centralized	National grid
10	Lake Turkana (Kenya, Marsabit)	Private developers Public and private investors	310	310 (217)	Indigenous and ethnic territories (*Turkana, Randile* and *Borana* communities)	Centralized	National grid

11	Lamu Cordisons (Kenya, Lamu)	Private developers	300	300 (210)	Nature conservation area	Centralized	National grid
12	Alto Sertão (Brazil, Bahía)	Private developers Public investors	294	294 (206)	Indigenous and ethnic territories (*Quilombola* communities)	Centralized	National grid
13	Alegria (Brazil, Rio Grande do Norte)	Private developers Public investors	166	166 (116)	Community managed reserve (Traditional fisheries)	Centralized	National grid
14	Lodos Electricity (Turkey, Izmir)	Private developer Public investors	120	120 (84)	Rural and peri-urban communities (Agricultural lands)	Centralized	National grid
15	Baleia Complex (Brazil, Ceará)	Public-private developer Private investor	109	109 (76)	Indigenous and ethnic territories Traditional fisheries	Centralized	National grid
16	Chiloé (Chile, Chiloé)	Private developer	100	100 (70)	Indigenous and ethnic territories (*Mapuche* communities)	Centralized	National grid
17	Nallakonda (India, Andra Pradesh)	Private developer	50	50 (35)	Community managed reserve (Kalpavalli Community Forest)	Centralized	National grid
18	Jepirachi (Colombia, La Guajira)	Public and private developers	20	20 (14)	Indigenous and ethnic territories (*Wayuu* communities)	Centralized	National grid
19	Elektro Primorska (Slovenia, Ilirska Bistrica)	Public-private developer	Unknown	Unknown	Nature conservation area (Volovja reber)	Centralized	National grid
20	Suzlon Wind Farm (India, Maharashtra)	Private developer Private investor	Unknown	Unknown	Nature conservation area (Koyna Sanctuary, traditional pasturelands)	Centralized	National grid (Communities claim poor supply in the region)

5.4.2 Features of conflicts: claims and actors at different contexts

Land pressures and patterns of uneven development are perceived and contested differently, depending on the specific context where wind power projects are deployed, or planned to be installed. In the inventory of conflicts, five socio-geographical contexts have been identified as general categories of analysis (see also Table 5.2). This section summarizes the most salient patterns in terms of actors, claims and values mobilized towards the wind energy expansion in each one of these contexts:

Indigenous and Ethnic Territories

At least 50% of cases in the inventory unfold in contexts of indigenous and ethnic territories around the world; most of them located in the Global South but not exclusively (see: Ejatlas 2016 f). In these cases, land pressures deriving from the wind power expansion are directly translated into the struggles of local communities claiming territorial rights against state and corporate powers. Cases in Mexico and Kenya are illustrative in this regard, as the privatization of indigenous lands without adequate previous consultations remain the central issue of the conflict (Ejatlas 2016d; Ejatlas 2017a;b). Many other cases unfold in a similar direction: Quilombola communities in Brazil facing the wind power expansion and doubling efforts to certify their lands (Ejatlas 2016b), or Adivasis in India denouncing the private diversion of forestlands for installing large turbines (Ejatlas 2017l). Records also indicate how Lenca communities in Honduras denounce the forced expropriation of ancestral territories (COPINH 2011), while private tenure in Sweden's forests facilitates the expansion of windmills in detriment of Sami herding activities. Likewise, examples in Colombia, Chile, Brazil (Ejatlas 2017c) and India (Ejatlas 2015) illustrate the disruption of ancestral territories, while the installation of industrial turbines remains potentially problematic for different land uses in Lamu, Kenya (Ejatlas 2017f). The case of Western Sahara appears as well as an illustrative example, as Saharaui people claim that the installation of three projects reinforces the illegal Moroccan occupation of their territory.

This large set of examples illustrate how land use and tenure changes occurring with the wind power expansion create new forms of environmental change, unevenly affecting the access to resources and signifiers of territories. In this regard, claims of local communities strongly focus on the challenges to maintain both their livelihoods and cultural identities, including communal institutions, self-determination, and cultural autonomy. Public statements about communities not being against renewable energies but rather the ways in which projects are

deployed are also recurrent in these conflicts. In Mexico, for example, a woman indigenous leader insists that *Zapotecos* and *Huaves* are not against wind power but are opposed to land grabbing and its impact on local communities (Chávez 2014). In Brazil, communities state that they are not against wind energy but are against the violation of their territorial, political and environmental rights (Ejatlas 2017c). Sami representatives refer to the project as "the latest chapter in a longstanding struggle between Sámi reindeer herders and industrial interests," and then declare "we're not against wind power, but we are opposed to big wind farms since (…) local Sámi herders will lose about a quarter of their winter grazing land" (Sullivan 2010). The critical views these stances reflect, seem to place industrial wind power as external forces enhancing historical patterns of inequality and injustice.

Community Managed Reserves

Two cases in the inventory illustrate the deployment of large-scale project inside community-managed reserves. In such instances, land pressures and patterns of uneven development have been manifested in challenges to maintain environmental restoration efforts sustaining livelihood security. The first case unfolds in the area of the Kalpavalli Community Forest, located in the state of Andra Pradesh, India. Kalpavalli is widely known as a grassroots restoration initiative that transformed a barren territory through forest management, watershed development and the creation of sustainable forest livelihoods. Despite its successful outcomes, the area of Kalpavalli formally remained as "wasteland", allowing a private company to purchase part of its land to develop a project inside the forest. As with many other cases in India, the political construction of the concept of "wasteland" has facilitated land acquisitions that reshape agrarian livelihoods to promote the industrial expansion in the country (see for instance: Baka 2013). Additionally, the expansion of wind energy in India does not follow any environmental norms, and land deforestation required for wind power deployments is somehow tolerated (CSE 2013). The deployment of a project inside the Kalpavalli forest has therefore triggered legal claims against the degradation of productive lands and water sources that previously sustained the local project.

A similar situation occurred in the reserve of Ponta do Tubarão, located in the state of Rio Grande do Norte, Brazil. Ponta do Tubarão was established in 2003 after a decade of activist and local communities' struggles against attempts to develop infrastructure and extractive projects in the area. The recent installation of different windfarms inside the reserve created tensions between local communities, reserve administrators and federal government

agencies. While the formers have claimed that the project would have a huge impact on local livelihoods and economic activities, the Technical Director of the reserve has argued that wind farms are in accordance with the rules governing the conservation unit as it "is considered clean" (Araújo 2012).

Both of these cases illustrate that land purchases or leasing contracts do not necessarily displace local communities, but that changes in the rights to use and manage parts of the territory do affect existing grassroots initiatives. Interestingly, the legal and institutional mechanisms encouraging the development of windfarms inside these community managed reserves, are tightly related with national aims of modern industrialization throughout sustainable development initiatives. Paradoxically, patterns of uneven development are reinforced as such national efforts imply the partial clearance of alternative local models for sustainable management and community reproduction.

Rural and peri-urban communities

Two conflicts in southeastern Europe constitute cases of rural and peri-urban communities mobilizing against the impacts of large-scale wind energy projects. In such cases, impacts at local scales appear to be addressed by a combination of "landscape conservation" narratives and critical perspectives over the implications of the industrial and uneven expansion of wind power. The first case unfolds in the island of Chios, Greece, where seven wind farms led to the organization of a local movement: Chios' Citizens against Windmills. The movement denounced the potential impact of projects over natural protected areas and archeological sites. However, these well-known concerns were complemented by a strong position against the uneven character of the project: electricity produced would not promote a progressive shift in the electricity system of the island (which currently depends on a hydropower plant), but instead would supply continental Greece through expensive submarine cables. Chios' Citizens then established a coordination network with the rest of the northern Aegean Islands to discuss the expansion of industrial wind energy projects and the consequent concerns deriving from uncontrolled economic growth (Eyploia n/d). The network proposed alternative development projects for the islands considering their autonomous character and its socio-natural limits. Alternatives included plans for renewable energy projects, with medium-small voltage supply for local consumption (Eyploia n/d).

The combination of conservationist values and critical narratives were also expressed within communities of the Karaburun region, Turkey. In this case, local residents initiated a court case against a project to be located on public lands forested with olive trees. Land pressures and patterns of uneven development appeared to be addressed both in terms of the "aesthetic impacts over the local landscape" as well as on the "threats to grazing lands and the local development project". This aggregated narrative was also illustrative in a public statement where opponents claimed: "this about our nature, all living beings, the health of the people and our future. We will not allow them to turn our beautiful peninsula into an industrial energy zone in the name of 'green energy' in this illegal way" (EPAW 2015).

Nature Conservation Areas

Four cases in the inventory represent examples of wind energy projects installed (or planned to be installed) inside nature conservation areas. In these cases, land pressures and patterns of uneven development are addressed in rather distinctive ways. Some of these cases illustrate the traditional "conservation" perspective, where eco-centric values over "landscapes" are mobilized by local authorities and environmental organizations. In Slovenia, for example, an NGO coalition was established to protect what is considered "the natural patrimony of the country" (volovjareber.si). Similarly, the Ekolevizja Network in Albania opposed a project that was to be installed in the Karaburuni Peninsula, considered "one of the most pristine sites of the Mediterranean". In this latter case, however, conservationist values were also accompanied by critical narratives challenging the fact that the electricity produced would supply northern Italy through a 145-km submarine power cable (Likmeta and Erebara 2008). Opposition in the Albanian case aligned then with wider campaigns against the expansion of foreign investments in the country. Patterns of uneven development where therefore addressed as part of a larger movement against the development of large-scale energy facilities for export purposes (see: Bankwatch Network 2010).

Cases unfolding outside Europe also illustrate the combination of different actors, values and claims when nature conservation areas are potentially affected by wind energy projects. In the Western Ghats of Maharastra, India, the installation of thousands of turbines around the Koyna Sanctuary triggered different local reactions. On one side, land pressures and patterns of uneven development were addressed by local residents who denounced irregular land purchases and encroachments, affecting grazing activities sustaining communities in the surroundings of the Sanctuary. On the other side, conservationist organizations raised public

concerns on deforestation and biodiversity loss caused by the installation of wind turbines inside the Sanctuary. Seemingly, this case gained major attention when the latter faction mobilized public denounces and leaded the narrative against the project. In a similar way, a project proposed in Lamu, Kenya, triggered opposition from Africa's oldest environmental society and member of the Royal Society for the Protection of Birds. Claims of Nature Kenya included the need to carry out detailed biodiversity surveys, to adopt avian-safe wind farm design, as well as to implement a monitor biodiversity framework. In this case, land pressures over local communities appeared in a seemingly secondary place, even when territorial controversies also constituted a potential impact of the project.

Affluent suburbs in coastal areas

Cases of affluent communities opposing the installation of wind energy projects have already been covered in the existing literature (e.g. Szarka 2007; Pasqualetti 2011). In the inventory of conflicts presented here, only the Cape Wind Project is an example of this type of context and opposition, although it evolves in a rather sui generis way. This is the first offshore wind farm proposed in the US, involving the installation of 130 turbines along the coast of the Nantucket Sound, Massachusetts. As such, land pressures appear to be closer to a spatial pressure over the coastal area, while patterns of uneven development are not explicitly addressed as a local problem.

Widely known as an affluent suburb, the Nantucket Sound community has developed a long-standing opposition throughout the defense of conservationist and utilitarian values over the area. The narrative has focused on claiming that such an "industrial installation" would create negative impacts on a landscape sustaining business, tourism, leisure and spiritual aesthetics. Although Massachusetts' prosperous communities have mobilized since 2002, it was until 2010 that the conflict gained major attention as the Mashpee Wampanoag Tribe raised their voice requesting the Sound be declared eligible for listing on the National Register of Historic Places. Allusions to landscape values were therefore made by different social groups, although these groups likely had different interests. This unexpected coalition, however, was institutionalized through the creation of The Alliance to Protect Nantucket Sound, an organization providing alternative developments for Massachusetts communities. Chambers of commerce, fishermen, native American tribes, ferry operators, airport commissions, business trade groups, municipalities and homeowners aligned to develop a cohesive discourse stating that the indiscriminate expansion of renewable projects was not

contributing to reduce oil dependence. As such, they proposed new policies in the transport sector and proceeded with renewable sources of energy only where deemed appropriate, responsible and efficient, including both large and small-scale technologies (saveoursound.org).

5.5 Discussion

Broadening the wind energy debate

The global expansion of wind energy and the increasing number of conflicts emerging against large-scale wind farms suggests a changing path in the scope and content of the wind energy debate. This scenario has both a conceptual and empirical basis, as cross-disciplinary literature increasingly discusses renewable landscapes, while new conflicts point out emergent narratives of contestation and alternatives. In this growing debate, it has become clear that questions are not about wind power itself, but instead about the ways wind power is being portrayed, arranged and deployed around the world. In particular, these new insights contribute to place the wind energy expansion as embedded in the politics of truth, rule and accumulation (Scoones 2016) of the low-carbon transition. Grasping this growing conversation requires a relational analysis, paying attention to both the configuration of wind farms, as well as to the specific contexts and power relations where these technologies are deployed. This research proposed an explorative effort to approach such emerging issues using 20 cases of wind power projects and conflicts emerging in different locations across the globe.

When analyzing the configuration of modern wind farms, a "socio-metabolic" approach was proposed to understand how wind power production is taking place; how such energy flows within societies; and how these production-flows are being shaped by specific power structures. As observed, the intrinsic nature of wind and renewables –more dispersed and less productive than conventional sources- combined with the aims of maintaining –or increasing- current patterns of energy consumption, is deriving into inconvenient socio-environmental arrangements. On one side, this is expressed in great extensions of land use, involving major new productions of space in the rural areas of the world (McCarthy 2015). On the other, such arrangements associate with the reproduction of centralized schemes in terms of ownership, control and distribution of electricity; with similar distributional effects as those created by conventional energy systems (Harrison 2013; Huber 2015). I refer to

these aspects as the "land pressures" and "patterns of uneven development" in the global expansion of wind power.

Contemporary configurations of wind power are seen as an essential part of the Ecological Modernization paradigm, where the low-carbon transition appears as an effort to "green" energy systems, rather than transforming the societal structures behind them (Fauset 2010; Bradley and Hedrén 2014). These global trends are expressed in the Global North and South alike, as investment flows into the rural spaces, unevenly integrating them into the circuits of capital accumulation (Rignall and Atia 2016). The idea of a "global rural" in the wind power expansion does not dilutes, however, the specific context and power relations where projects are sited (see also: Rignall and Atia 2016). A contextual approach to wind power conflicts then appears as the second part of the analysis, helping to understand how land pressures and patterns of uneven development are expressed and contested in different locations of the world.

The five socio-geographical contexts analyzed in the inventory reflect a wider roadmap of actors, values and political implications of the "wind energy debate" (Ellis et al. 2006; Szarka 2007; Jessup 2010). In this scenario, a spectrum of Environmental Justice narratives appears as variable forms of collective action on socio-environmental concerns related with the current wind power expansion (see: Walker 2009b). Such narratives appear in dynamic dialogue with the specific power structures and land uses of each context at stake, reflecting how uneven patterns of wind power are contested. As previously observed, conservation narratives are also present in this scenario as forms of "wildlife" and "landscape" protection. This has been particularly clear in contexts where land pressure is perceived as a threat to spatial shelters protecting "nature" from the industrial world. However, an interesting source of "hybrid coalitions" (Jessup 2016) emerges when critical Environmental Justice perspectives are combined with the "green credentials" of conservation initiatives, contesting the patterns of uneven development derived from the expansion of large-scale wind farms.

In the inventory, the spectrum of Environmental Justice narratives opens in contexts of indigenous and ethnically discriminated territories. As previously observed, land pressures are crucial in these cases, as acquisitions for wind power development disproportionally affect populations with less power and fewer formal land rights (McCarthy 2015). Long-standing resistance to protect these territories from state and corporate powers take here a

new "environmental dimension" (Robbins 2004); insofar communities experience the expansion of wind energy as forces enhancing historical patterns of injustice. In contrast with the concept of "land" (subjected to fragmentation and commercial exchange), the notion of "territory" appears as the set of complex relationships between the economic, cultural and ecological spheres of placed-based social groups (Sawyer 2004; Rocheleau 2015a,b). Whereas indigenous and ethnic groups analyzed here openly express that they are not against wind energy per se, they do stand against projects that reorganize local territories in ways that reinforce political, economic and cultural inequalities (see also: Fairhead et al. 2012). Territorial advocacy therefore emerges as a matter of defending the material basis of community existence (Martinez-Alier 2002), but also as a question of holding their political autonomy to reproduce alternative socio-natures (Escobar 2008).

Similar situations unfold within community managed reserves, as Environmental Justice narratives appear along the challenges to maintain restoration efforts sustaining livelihood security (see also Avila & Rao, 2018). When national aims to promote low-carbon industrial transitions encounter grassroots initiatives for livelihood sustainability, affected communities openly question the technical standards of appropriation of the territory and its resources (Acselrad 2010: 103). What is at stake, therefore, is the question of who owns the power to impose particular understandings of sustainability and who benefits from it at different geographical scales. Environmental Justice narratives also appear in the context of rural and peri-urban communities in the south of Europe, although in differing ways. In contrast with the territorial content of indigenous and ethnic struggles, these instances illustrate a combination of "landscape conservation" narratives and critical perspectives the expansion of industrial wind power. As observed, land pressures are manifested as concerns over natural areas, archeological sites, and aesthetical landscapes; but also, as challenges to maintain the common productive and political projects of local communities. In the North Aegean Islands, there is an explicit stand to defend a small-scale sustainable project based on the natural limits of the area, while the Karaburun community defends reforestation initiatives as part of local development plans. When explicitly challenging the uneven patterns of industrial renewable energies, these cases illustrate clear denunciation against uncontrolled economic growth and the consequent harm of communities' futures. Analogous to what happens with the spatial requirements of large-scale projects, the distributional dimension related with the end uses of electricity appears as a recurrent issue in the analyzed conflicts, both in northern and southern contexts. As such, the inventory suggests that uneven

relations in energy matters are not just expressed at a global scale (e.g. Hornborg 2014) but also at lower regional dynamics (e.g. between the urban and the rural, as well as between high and low-income regions).

Some cases of nature conservation areas affected by the expansion of large-scale wind farms also incorporate Environmental Justice dimensions to their "eco-centric" claims. Whereas the case in Slovenia represents an example of clear "wildlife conservation" narratives; in the case of Albania these concerns are combined with Environmental Justice perspectives. As previously observed, the Ekolevizja Network is not just concerned with the protection of "the last unspoiled places of the Mediterranean", but also with the distributional implications of a project destined to supply bulk power to its powerful neighbor country. Within this category, examples unfolding in India and Kenya also illustrate that potential alliances between Conservation and Environmental Justice narratives gives further strength to promote changes in the ways under which wind power is being deployed. Whereas Conservationist narratives provide the "green credentials" to question the deployment of industrial installations, Environmental Justice stances mobilized by surrounding communities render the critical stream to challenge the wider social implications of such facilities.

Alliances between different narratives are also present in the context of the coastal area of Massachusetts. Due to the specificities of the context in this case, land pressures and patterns of uneven development to not appear to be clearly addressed by affected populations. However, a "landscape conservation" alliance was made between radically different groups. It is worth noting how this case gained major attention when tribal communities placed their cultural claims over state courts. An interesting "productive outcome" (Merlinski 2005) emerged afterwards, as the explicit alliance between different groups enabled further discussions about the ways under which the low-carbon transition should take place in the region.

Conflicts as sources for alternatives

The perception of what is a successful outcome in wind energy conflicts might be rather different to perceptions in other instances of environmental injustice. Whereas in oil, gas or nuclear energy-related conflicts, the cancellation of projects is normally framed as the expected outcome for attaining Environmental Justice, what seems to be more relevant in

the case of wind energy is the institutional, technological or political alternatives that these conflicts might bring about. From this perspective, cases of local opposition are not interpreted as regressive forces blocking the possibility of an energy transition, but instead are understood as political instances that enable a wider discussion to occur on the ways such transition should take place.

From a broad perspective, the very existence of local mobilizations helps to shed light on the emergent forms of environmental change and injustices that could be prevented. Some other cases also illustrate how local opposition has enabled a progressive institutional reform in the wind power sector, either by promoting the implementation of previous environmental impact assessments (for the case of India see: CSE 2013) or by reclaiming formal consultation processes for indigenous and other discriminated groups (for the case of Colombia see: Rojas 2012). These are examples of conflicts with "productive" outcomes (Merlinsky 2015), as local opposition promotes new public debates on the way institutions should regulate the expansion of wind energy facilities. The spectrum of these narratives covers issues of equity, recognition and participation widely discussed within Environmental Justice scholarship (Schlosberg 2013).

The spectrum of Environmental Justice narratives also illustrates the presence of more challenging perspectives, where the technological fixes and its possible negotiated outcomes are seen as insufficient sources to build alternative energy futures. The defense of "energy sovereignty" (Mexico), "territorial autonomy" (Mexico and Western Sahara), "energy decentralization" and "limits to economic growth" (Greece), are strong examples in this regard. Equivalent importance is placed on the local initiatives deriving from such perspectives: the defense of maintaining previous communities' projects as a source of local sustainability, the promotion of wind power cooperatives in Mexico (Ejatlas 2017b), as well as the proposal of deploying medium-scale windfarms for electricity supply in Greece.

In a similar direction, the increasing number of instances where "hybrid coalitions" take place (Jessup 2010), appear as a potential source for re-configuring the wind power expansion. These alliances could be built not just between Environmental Justice and conservationist narratives (e.g. Foyer and Dumoulin 2015), but also between these movements and emerging paradigms for social transformation (Martínez-Alier 2012; Kothari et al. 2014; Temper et al, 2018b). As energy systems need to be taken beyond a matter of technological change or

resource switch, the intervention of plural socio-political visions is placed as a crucial element for transformative action. Rather than a technological transition, transformation paradigms appear to shed light on the need to cover the social, cultural and political dynamics of alternative energy futures (Brand, 2016; Gillard et al., 2016; Scoones, 2016). The pathways of conflicts and potential alliances that could be enabled in the following years, will play a crucial role in this changing and rich debate.

5.6. Conclusions

Dominant narratives supporting a pure technological fix towards large-scale renewables are increasingly questioned by multiple forms of social dispute and agency. The study of environmental conflicts related with the expansion of wind power appears as an illustrative example of these processes. When approaching the current expansion of wind power from a relational perspective, new insights shed light over the socio-environmental implications of such deployments at the local scales. As outlined in this research, the configuration large scale wind farms increasingly derive into land pressures and patterns of uneven development throughout the global rural. The growing presence of Environmental Justice narratives at different contexts of the world, contribute to unveil and contest these inconvenient arrangements in multiple ways.

Rather than framing opposing voices as selfish expressions blocking the cultural change needed to move towards renewables, the political value of these movements resides in their capacity to expand the possibilities of imagining alternative energy futures. Even when modern technologies deliver partial solutions for the climate/energy crisis, social and spatial issues are expected to arise if they are not accompanied by changes to demand, all of which requires economic and social transformations (Fauset 2010; Trainer 2014; Scheidel and Sorman 2012). Plural voices emerging at the local scale bring novel directions for imagining such transformations, including issues of technological ownership and scale, as well as different infrastructures and the final uses of electricity. In this regard, local mobilizations and novel alliances contribute to discuss energy transitions as a societal matter, rather than a technical and managerial issue.

Chapter 6

Transversal findings and concluding remarks

The progressive shift from a "subterranean" to a "vertical" energy regime (Huber & McCarthy, 2017) raises new questions on the spatial, political and justice dimensions involved in the transition toward renewable energies. This thesis has examined such dimensions for the case of wind and solar power expansion across the Global South. In tracing the deployment of large-scale facilities around different geographical locations, this work outlined the main features of a new energy frontier and its social and EJ implications. By doing so, it has positioned the study of environmental conflicts as a critical matter in politicizing dominant narratives around decarbonization and its correlated practices on renewable energy deployment.

The dissertation presented a multi-scalar analysis of renewable energy deployment and conflicts, spanning from the regional, national, and global scales, and providing insights on an emerging quest for socially just and environmentally sound transitions. This analysis aligns with recent developments in EJ studies, where global challenges around sustainability and climate change become the central concern for both activism and research (e.g., Agyeman and Evans 2003; Bond, 2012; Temper et. al., 2020). Tracing global patterns of renewable energy conflicts while engaging with the heterogeneous realities of local contexts, this thesis provides a nuanced analysis of the impacts, repertories of action, and discourses mobilized by communities facing a new wave of green growth and "low-carbon development" strategies. This concluding chapter discusses the transversal findings gathered across previous chapters and highlights five concluding remarks.

First, wind and solar power conflicts emerge as a consequence of and response to the expansion of the global industrial metabolism, a process in which renewable energies are expected to play an increasing role.

Second, wind and solar power conflicts are mostly determined by the spatial aspects bound to the progressive transition toward a "horizontal" energy regime. Property, access, and control over lands play a central role in distributing the benefits, burdens, and risks of this transition.

Third, these conflicts raise critical distributional questions on the local scales and reproduce geographies of injustice at larger scales. In these processes, neoliberal policies play a central role: not only in facilitating land grabs but also in terms of privatizing resources and their benefits.

Fourth, conflicts shed light on the instances of environmental injustice emerging at the renewable energy frontiers, positioning questions on recognition, participation, and distribution in both social and spatial terms. These questions are particularly relevant for the Global South, where agrarian, indigenous and ethnic communities depend both materially and culturally on their territories.

Fifth, by breaking the binary interpretations about opposition toward renewables, this dissertation sheds light on a spectrum of politicized narratives revolving around renewable energies and transitions.

In what follows, these findings are discussed in more extensive detail.

6.1 "Slowing down" climate change, "speeding up" green development

> "In an era of accelerating change, the imperative to limit climate change and achieve sustainable growth is strengthening the momentum of the global energy transformation. (…) The energy system, consequently, requires rapid, immediate and sustained change. The deployment of renewables must increase at least six-fold compared to the levels set out in current plans. (…) Fortunately, this is also the path of opportunity. It would enable faster growth, create more jobs, create cleaner cities and improve overall welfare. (…)"
>
> (Adnan Z. Amin. Director-General, IRENA. 2018)

In facing the pressing concerns of climate change, renewable energies are increasingly positioned as a technological solution, providing win-win formulas for the economy, the environment, and society. The above statement, made by the International Renewable Energy Agency (IRENA) director, reflects such vision in a nutshell: the urgency of slowing

down climate change *comes* with the opportunity of speeding up a profitable business, leading to a greener version of economic growth and its correlated vision of development. This dissertation has framed such discourses as a representative example of the "weak sustainability" perspective and its policy-oriented counterpart: The Ecological Modernization paradigm (EM).

The idea that modern renewable energies can sustain the ever-growing energetic demands of industrialized societies is at the core of such vision. The vision stems from one of the basic premises of "weak sustainability" on the interchangeability between natural (resources, biodiversity, and ecosystem functions) and human capital (land, labor, technology, knowledge). From a "weak sustainability" perspective, the rates of economic growth experienced with the abundance of fossil fuels can be replaced sustainably by a combination of modern technologies (i.e., large-scale wind and solar) and efficiency improvements (i.e., better technologies for consuming less). Under such terms, the low-carbon transition is framed as an effort to "green" energy systems, rather than transforming the societal structures behind them (**Chapter 5**).

Taking the case of wind power, **Chapter 5** mapped some of the critical aspects of such a paradigm, highlighting how international agencies, governments, corporations, and mainstream environmental groups endorse it. This analysis showed that in the EM paradigm, wind flows tend to be discursively framed as "an endless resource to be harvested, transformed and commodified as electricity" (Hawken et al. 1999), providing the imaginary of a *bountiful resource* (Bridge, 2013) that is required to meet the increasing global energy demands. Simultaneously, wind turbines are seen as "one of the most powerful imaginaries of nature and modernity working in harmony". This image provides the "green credentials" to legitimize the massive roll-out of turbines as an economically optimal and politically neutral opportunity to exit the climate crisis.

From an EM perspective, the harnessing and commercialization of wind flows (and solar radiation) are also pragmatically framed as a means to an end. Here, concepts such as "business opportunity", "green growth" and "sustainable development" are recurrent elements linked to other notions such as "public interest", "climate mitigation" and "energy security" (**Chapters 4 and 5**). By universalizing the promises of wind and solar power, the

EM framing creates a consensual setting in which any opposition should be seen as "against the public good" (see: Swyngedow, 2010).

This thesis has argued that the "weak sustainability" approach to the transition tends to reduce the challenge into a techno-managerial project, positioning renewables as a technological solution to sustain the industrial metabolic regime and its correlated socio-economical structures. Drawing from the biophysical perspective rendered by Ecological Economics, this work adheres instead to a "strong sustainability" approach. From this normative perspective, renewable energy infrastructures are not seen as solutions on their own. Instead, they are positioned as part of broader structural transformations that include a redefinition of the economy's scale and a democratic redistribution of its resources.

6.2 Breaking the barriers to a global imperative: neoliberal geographies in the energy transition

The second transversal finding highlights how neoliberalism plays a central role in defining the EM approach to the energy transition. As the "ideological software for competitive globalization" (Peck and Tickel, 2002), neoliberalism is inspiring far-reaching programs for market liberalization and corporate control in the road towards decarbonization (see also: Guðmundsdóttir et al., 2018; Neville, 2020).

The empirical evidence discussed in this dissertation shows that discourses aiming to "accelerate" green development are intimately related to the imaginary of "clearing" the barriers for renewable energy investments. These barriers are identified as the "public inefficiency" to lead an energy transition and the "market uncertainty" that derives from communal institutions protecting territorial rights and collective resource management strategies (**Chapters 3-5**).

Chapter 3 discussed the significant role that neoliberal policies and discourses have played in deploying the wind power corridor in the Isthmus of Tehuantepec (Mexico). In particular, this analysis highlighted the progressive liberalization of two critical sectors for renewable energy deployment: electricity and land. Both the Agrarian counter-reform (enacted in 1994) and the Energy Reform (enacted in 2014) have been foundational to the neoliberal approach to wind power development in Mexico (see also Chapter 4). This analysis showed how

structural reforms paved the way for a progressive dismantling of the communal institutions for land tenure and increased private capital participation in the electricity sector. In making this new energy frontier, strong appeals to private property and market certainty in land transactions were fundamental to advance in the locations of wind power polygons. Simultaneously, the firm reliance on "competitive markets" led to the establishment of tenders and corporate hubs at both production and consumption end.

Chapter 4 upscaled Mexico's analysis, showing how these initial configurations have been further expanded and refined throughout new regulations and policy strategies. As discussed, the vision for a "low-emission development" in the country mostly relies on the role of private capital to "accelerate" the "opportunities" of renewable energy expansion. Policy and laws enacted over recent years converge the narratives of "urgency" with those of "public inefficiency", arguing for the need to overcome the main barriers to deploy renewable energy projects at "maximum speed". Neoliberal regulations over land and the electricity sector continue to be critical for such a project, which is now enabled by a series of cartographic tools for renewable energy resource assessment.

How neoliberal discourses and policies drive the expansion of renewables is not minor. They progressively shape the new geographies of the energy transition (Bridge et al., 2013), both at the production and consumption ends. On the side of production, Mexico's case (**Chapters 3-4**) shows that the emerging geographies of renewable energies favor an increased concentration of rural lands, largely shifting the access, uses, and control over territories and their resources. In particular, this pattern occurs with the erosion of communal tenure regimes and large-scale shifts from agricultural uses and forest vegetation cover in favor of corporate renewable energy production. **Chapter 5** provides complementary evidence in this regard from different geographical contexts globally. The inventory of wind power conflicts highlights that the corporate and centralized character of facilities is reflected both in the significant number of private developers owning projects and the implications that such configurations have for managing technologies and territories.

Similar evidence has been traced for the case of consumption. Wind and solar power projects studied throughout this dissertation showed that facilities are connected through high-voltage transmission lines to supply either large corporations or distant regions at different scales. The Isthmus of Tehuantepec's case is paradigmatic in this regard, as 74% of the

installed capacity is regulated by the "self-supply" modality, favoring large corporations and specific economic sectors such as mining, industrial food production, and large retailers (**Chapter 3**). Other illustrative examples in **Chapter 5** include the wind power facilities in Western Sahara powering the Moroccan phosphate company, the windfarms in Albania supplying the increasing demand of Italy, and projects in the Mediterranean islands powering continental Greece. This diverse evidence highlights that renewable resources are "metabolized" as additional energy inputs to the preexisting metabolic configurations while foreclosing the possibilities of redistributing energy carriers for alternative development purposes.

In bringing together these insights, this dissertation shows that the forging geographies of the transition tend to reproduce the patterns of spatial differentiation that have characterized the fossil-based metabolism and its capitalist-industrial relations (Smith, 1990; Haberl et al., 2007). Renewable energy projects are deployed as centralized "nodes of energy production" supplying electricity to distant end-users, reinforcing the rural-urban, center-periphery divides of modern economic systems. Understanding how specific metabolic configurations shape the landscapes of energy production and consumption appears, therefore, as a critical aspect in analyzing larger patterns of social and political structures of (in)equality (Huber, 2015).

When discussing these patterns, this research has argued that the neoliberal agenda not only shapes an uneven distribution of energy flows. Furthermore, it progressively forecloses the possibility of promoting alternative geographical and political projects for the transition. As McCarthy and Prudham (2004) have pointed out, the foundations of neoliberal approaches draw fundamentally from classical liberalism, where the restructuring of social relations with nature is associated with enclosing the commons to facilitate capital accumulation and proletarization. This, in turn, is resonant with what Harvey has termed "accumulation by dispossession" (2004). It is not a coincidence that indigenous communities defend communal property and management over land as a form of resistance against the "territorial dispossession" driven by private companies (**Chapter 3-4**). Parallel denunciations of "neo-colonialism" also reflect how communities acknowledge the echoing of experiences from the past in a new context where both government agencies and corporations enable the cultural and material dispossession of their territories (**Chapter 5**).

Alternatives to neoliberal approaches to renewables might include a range of public and communal schemes for territorial management, technological control, and decision-making processes. Some examples emerging as alternatives discussed in this thesis include the cooperative project proposed by Yansa and the Ixtepec community in Oaxaca, Mexico (**Chapter 3**); the communitarian project for rural autonomous development in Andhra Pradesh, India (**Chapter 5;** Avila & Rao, 2018); the medium-scale and local approach to renewables in the Greek Islands (**Chapter 5**); and the proposal for an integral transition project for Mexico (**Chapter 4**).

6.3 Horizontal energy frontiers:

Changing access and control over lands

Attempts to decarbonize the industrial metabolism and its current neoliberal configurations bring new concerns for both Political Ecology and EJ. If the key socio-ecological question of the "subterranean" energy regime revolves around the extractive nature of a system that drills holes and displace its costs to people, ecosystems and the atmosphere, the green transition shifts attention to a different set of questions. This dissertation has focused on renewable energy deployment as one of the main vectors of such a process.

The third transversal finding of this dissertation highlights that, in the industrial expansion of renewable energies, those having access and control over lands will have access and control over energy flows**.** The attractiveness of wind and solar power projects in the new quest for low-carbon development and green growth leads to new enclosure processes, dispossession, and changes in land use that unevenly affect rural and indigenous communities across the globe. Therefore, renewable energies' spatial dimension calls for further attention to how the new arrangements over horizontal expansions of energy frontiers are taking place. As the spatial dimension becomes central in the transition, new questions over the access and control over lands are posed at the center of the analysis.

This dissertation has dissected the emergence of new energy frontiers by paying particular attention to the inscription devices (Li, 2014) that render different territories of the Global South as investable spaces to be developed through renewable energy technologies. The role of cartography has emerged as a critical element in such a process, as maps start to play a central role in representing particular elements while diluting others (see: McCarthy & Tatcher, 2019). **Chapter 3** provided a detailed examination of how the launch of a new wind

energy frontier took place in Mexico during the 1990s, materializing today the largest wind power corridor in Latin America. A key aspect in such a process is the "juxtaposition" of different conceptions of space over the Isthmus of Tehuantepec. Rationalized polygons for private investment were imposed over the complex ecologies of the territory. As observed, the Isthmus's preliminary map produced by the local government and private corporations diverts profoundly from the counter map presented in **Chapter 4**. While the former map presented the region as an empty "mat" to be subdivided for the purposes of green development, the latter showed a complex constellation of communal institutions regulating access to land, different land uses, and land covers. These profound differences highlight the politics over space that are fought in the energy transition across the Global South, highlighting how the top-down neoliberal agenda misrecognizes rural territories' plural values and tenure regimes.

Similarly, **Chapter 4** highlighted that the National Inventory of Clean Energies (INEL) and the National Atlas for Zones with High Potential for Clean Energies (AZEL), are doing specific symbolic work in rendering different territories of Mexico as strategic regions for renewable energy investment. However, these national maps do not work alone but are part of larger assemblages that include specific discourses, policies, and regulations. By identifying the so-called "priority regions" to develop large-scale facilities, these maps simultaneously obscured other vital realities of the territories at stake -land tenure, indigenous populations, ecologically sensitive areas, and land uses-. While these symbolic representations work as great tools for attracting investments, the countermapping exercise discussed in this chapter showed how new voices emerge from the ground-up.

Chapter 5 showed that the EJAtlas enables to track this emerging pattern, not only by identifying what is happening with the uniquely strong winds and solar radiation currents in rural Mexico; but also, with other attractive regions for commercial renewable energies, such as the coastal areas of Brazil; the island territories of Greece; the desserts of Kenya and Western Sahara; and the arid lands of central India. These cases bring additional evidence to how territories' socio-ecological relations are "obscured" in different ways. The example of the wind power project in Andhra Pradesh (India) is illustrative in this regard, as the narratives of "wastelands" played a central role in the implementation of a project in a region that was far to be "unproductive". Other subtle ways of obscuring relations include disregarding preexisting land users, land uses, and land covers.

The emergent energy frontiers entail different implications for justice and sustainability. In cases where territories are managed through formal or informal communal regimes, projects tend to trigger large territorial dispossessions burdening communities in both material and symbolic ways. These cases represent the most examples in this dissertation and are certainly those raising the most significant concerns in renewables' emergent political ecologies (see McCarthy, 2015). Research on Mexico shows that the patterns of territorial dispossession observed in the Isthmus of Tehuantepec are being replicated throughout the country's southeast region as wind and solar power investments expand (**Chapter 3-4**). As highlighted in **Chapter 4**, 45% of the solar mega solar power projects that are still in the pipeline in Mexico are expected to be deployed in communal territories across the country.

The additional cases presented in **Chapter 5** show that while the land is not necessarily owned collectively, the institutions that govern access and use over land tend to be managed by local communities, citizens, and organizations. In such instances, there is a clear opposition to the implementation of large-scale, corporate infrastructures that hamper the socio-ecological projects governing territories. In all of these cases, different values appear to be incommensurable to those mobilized by the logic of private property, capitalist development, and profit maximization. Values defended by affected communities include their rights to livelihood, cultural attachment to the land, and territories' correlated socio-ecological integrity.

A separate reflection takes place for cases where land is owned and managed by private or public actors. Some cases in **Chapter 5** show that conflicts tend to move to the economic or ecological values of landscapes and the distribution of their benefits (e.g. wind power projects in Nature Protected Areas or in affluent regions affecting landscapes). These conflicts tend to differ from those taking place at indigenous, ethnic, or other territories governed by communities, raising questions on how different actors value the land/territories and who will benefit in such a process. **Chapter 4** showed that part of the permits for wind and solar power development in Mexico would be located in private property, bringing attention to the type of responses and negotiations these investments will trigger. These cases, thus, raise further avenues of research (e.g., how rents for renewable energy production will be regulated, how different actors will protect biodiversity, and how land-use shifts will trigger changes in agriculture and biodiversity conservation).

6.4 Environmental Justice struggles around wind and solar power

The intrinsic nature of renewable energies -more dispersed and less productive than fossil resources- *combined* with the imperative of economic growth and neoliberal development translates into new forms of environmental changes and conflict. This thesis's fourth transversal contribution reflects on this finding by tracing the emergent wave of EJ discourses and struggles emerging in various social and geographical contexts.

Going beyond the single case-study allowed a deeper understanding of the causes, consequences, and possible resolutions of these emerging EJ struggles (Pellow, 2018: 14). In this regard, the in-depth research conducted in the Isthmus of Tehuantepec has worked as a fundamental axis to explore further evidence in other locations (**Chapter 3**). Taking such insights further, the inventory of cases presented in **Chapters 4-5** allowed a more extensive understanding of the ongoing patterns and political, economic forces involved in expanding large-scale renewables (for further plans to expand the database, see: Avenues for future research).

Table 6.1 gathers these findings into a single matrix, providing transversal evidence on how mega wind and solar power projects increasingly become a matter for EJ. The table takes us across the three fundamental dimensions commonly considered in EJ scholarship: recognition, participation (procedure), and distribution (Schlosberg, 2007). However, it also identifies additional areas that are relevant both in analytical and political terms. One of the central findings that derive from this matrix is that, in the expansion of renewables, EJ concerns are intimately related to the transition's spatial dimension. EJ struggles arising in the renewable energy frontiers show that conflicts are fundamentally triggered by the land acquisition and spatial rearrangements that derive from such processes. This calls for a more in-depth analytical engagement in unveiling how unjust geographies are produced, reproduced, and contested (Soja, 2010).

Aspects of (mis)recognition include the violation of communities' fundamental rights in having a say about the implementation of energy facilities and the erasure of entire territories in maps produced for attracting investments. These elements highlight how expendability is involved in the transition project mobilized by Ecological Modernization narratives and neoliberal development strategies. Expendability raises larger questions on who gets to decide what is sustainable and how to implement such a vision at different scales. However,

a critical approach to these matters would shift the conversation to how rural communities and territories are *indispensable* for imagining alternative energy futures (see Pellow, 2018).

In a similar vein, procedural justice is not only about the transparency and effectiveness of consultation and assessment of social and environmental impacts. Participation also involves communities' active involvement in envisioning and deciding how to manage their immediate spaces of "living, working and playing" (Novotny, 2000). This brings new questions on how participation plays at the expansion of renewable energies and how state and corporate powers interact with communities and individuals experiencing the very immediate transformations derived from such facilities.

Distributional questions -who gets what in the energy transition- show that EJ concerns go way beyond infrastructure deployment sites and question how electricity flows across larger scales. At sites of energy production, the spatialities of EJ (Walker, 2009a) include questions on how an industrial and corporate vision of the transition "burdens" the costs to "attractive locations" and its populations. Such impacts include increasing speculation over land, the enclosure and commodification of land and resources, and cumulative impacts over land-cover and land-uses. As these "supplying zones" are established, other consuming regions and groups consolidate, shaping an uneven distribution of benefits.

Table 6.1 Dimensions of Environmental Injustice at the renewable energy frontiers

	Recognition	Participation (Procedure)	Distribution of Impacts	Distribution of Benefits
CHAPTER 3 Wind power Corridor (Oaxaca, Mexico)	Exclusion of indigenous communities in envisioning the wind power corridor. Erasure of communal land tenure in the distribution of land plots for private companies. Obscuring the complexity of agrarian controversies derived from PROCEDE program.	Lack of proper consultation: -Unclear information about the projects -Lack of translation of contracts to indigenous languages -Absence of oral meetings with illiterate people. -Informal negotiations with some landowners -Disregard to communal-decision making processes. -Leasing negotiations manipulated or falsified. Although some contracts were cancelled outside couts, legal demands were never formally processed.	Low payments per hectare leased (averages below international standards) Changes in access and control over lands affecting the relation between territory, livelihoods, cultural identity and autonomy. Biodiversity loss in the areas of infrastructure deployment. Soil and water contamination derived from windmills lubricants Reduced hydrological connectivity from the enclosure of the region's lagoons	Changes in access and control over lands in favor of large transnational corporations. Leasing contracts: 30-60 years of land use and access rights to private companies. Large share of revenues derived from projects are privatized. Distant end-users of electricity: 74% of installed capacity for corporations 26% for national grid

CHAPTER 4 Wind and solar power projects in Mexico (national and regional scales)	National maps obscuring the complex realities of territories: land tenure, land uses, land cover, biodiversity conservation areas.	Lack of participation of communities and citizens in the design and implementation of the transition. Lack of proper consultation at local scales. Strong presence of intermediaries in land deals, obscuring decisions of individual and collective landowners. Structural deficiencies in the Environmental and Social Impact Assessments (no accountability for communities potentially affected by infrastructures, no recognition for biodiversity).	Tensions within communities due to land speculation. Disproportionate impacts in vulnerable regions. Yucatan example: -45% of the surface covered by wind power projects are located in forestlands and 53% of the surface covered by projects are located in common lands. -86% of the surface covered by solar power projects are located in forestlands and 19% of these facilities are also located in common lands.	National scale Oligopolist control over financial, political and managerial aspects of the transition. Concentration of lands 44% of wind power facilities already located in communal lands 43% of foreseen solar power projects will be located in communal lands. Large-scale land use changes: -Agriculture to energy -Forests to energy
CHAPTER 5 Global comparative analysis of wind power projects.	Misrecognition of: -Indigenous and ethnic territorial rights -Local/grassroots management strategies -Non-human species and biodiversity conservation initiatives -Landscapes with cultural or economic value	-Lack of proper consultation processes and negotiations for leasing, buying or accessing lands. -Lack of environmental regulations for the deployment of green facilities -Lack of integral territorial planning -Lack of integral vision for a transition	Recurrent impacts: -Land acquisition conflicts 95% of cases. -Fishery/coastal conflicts 20% cases -Deforestation 10% cases -Loss of livelihoods -Loss of cultural identity -Loss of autonomy and sovereignty -Loss of ecological and economic values	Centralized facilities owned and controlled by private developers with or without public investment. Distant end users: -Developed/urban regions (15 cases) -Neighboring countries (2 cases) -Corporations (3 cases)

6.5 Renewable energies: a spectrum of political debates

As a framework for analysis and as a discourse of political action, EJ reveals new insights about the expansion of renewable energies and poses important political questions involved in the energy transition.

As environmental conflicts around renewables expand globally, the common Not-In-My-Backyard approach to understanding local opposition proves to be analytically insufficient and politically ambiguous. Research across **Chapters 3-5** has shown that questions around renewables are less about being "against" or "in favor" a green transition and more about the political, environmental, and socio-economic drivers that shape their implementation into specific directions. As such, renewable energy conflicts reflect a clash of visions around sustainability, shedding light on how different interests, values, and prospects of the future come into play (Bradley & Hedren, 2017). This, in turn, calls for deeper understandings of the different eco-political projects mobilized by different groups at stake (see Calvert, 2016).

The emergence of EJ struggles around wind power shows that tensions around renewables go beyond the divide between Ecological Modernization and Environmental Conservation (**Chapter 5**). Conflicts emerging at the renewable energy frontiers shift attention to how renewable energies produce and reproduce social and environmental injustices across different scales. The analysis presented in **Chapters 3-5** shows that, despite their rich diversity, most of these struggles share common grounds. Communities and organizations express a clear stance against the "industrialization" of rural territories and explicitly defend the bio-cultural aspects of place. These conflicts represent contention forces against new forms of land and resource control deriving from state and corporate actors working in the global imperative for a growth-based transition. These struggles include a clear stance against the commons' privatization, whether it is land or access to electricity.

EJ struggles emerging at the renewable energy frontiers re-politicize debates around the transition in various ways and through different degrees. As argued in Chapters 3 and 5, the very existence of conflicts sheds light on the socially unequal and geographically uneven character of ongoing attempts for a growth-based transition. However, these expressions of dissent (Swyngedow, 2010) also show that movements open new spaces to advance into more egalitarian approaches to the required transition. The diversity of narratives and

outlooks of place-based movements shows that these spaces are not homogenous and rather articulate at least two main forces contributing to a just transition.

EJ as a reformist force in the transition

The first political force in the transition aligns with what David Pellow identifies as the "reformist" approach to Environmental Justice (2018). Movements, concepts, and narratives focus on improving existing institutions to get more egalitarian outcomes for recognition, participation, and distribution.

As argued in **Chapter 1** of this dissertation, much of the burgeoning literature on Energy Justice tends to rely on this vision, focusing its analytical attention on how Ecological Modernization and its correlated visions of development can perform socially just outcomes. However, a sympathetic critique would highlight that efforts in this direction might overlook the structural questions behind the configuration of modern energy systems, holding the risk of reinforcing or legitimizing the power structures that produce inequalities in the first place.

Cases in this dissertation show that reformist concerns in the expansion of wind and solar power include issues of recognition and participation and the urgent need for implementing better regulations in the renewable energy sector. Some particular demands include the following:

> 1.-Implementation of prior consultation processes following international and national regulations. This includes following the ILO 169 Convention under the principles of prior, informed, and culturally adapted consultation to indigenous communities.
>
> 2.-Implementation of Environmental Impact Assessments following the principles of transparency and democratic participation of communities and scientists. Calls for assuring a binding nature to the resolution of assessments.
>
> 3.-Implementation of Social Impact Assessments following the principles of transparency and democratic participation of communities and scientists. Calls for assuring a binding nature to the resolution of assessments.

4.-Developing cartographic tools for renewable energy deployment with the participation of rural communities whose lands hold valuable amounts of renewable energy flows.

5.-Regulating land transactions to reduce speculation and lack of transparency when negotiating land deals. Renewable energy developers should offer rents by equaling prices per hectare in the Global North and South.

As observed, most of these proposals seek to work "within" the system, as communities and activists aim to create a counterbalance to the political-economic forces currently driving the energy transition. These political spaces tend to promote larger alliances with local scientists and NGOs concerned with conserving biodiversity and local environments. Examples of these alliances can be observed in Yucatan, Mexico (**Chapter 4**), the case of Massachusetts, USA, and some conflicts in India (**Chapter 5**).

EJ as a transformative force in the transition

EJ struggles around wind, and solar power megaprojects also embrace critical positions in which the question of redistribution involves radical transformations in the political economy of the transition. Instead of promoting better regulations, these approaches seek to promote mechanisms of direct democracy, cultural justice, and territorial autonomy, shifting the very scope of recognition and participation in the deployment of renewable energies.

Following Pellow (2018), direct democracy pertains to "the practices, relationships, and institutions based on cooperation, mutual assistance, and grassroots initiatives". In its turn, cultural justice goes beyond liberal definitions of justice and embrace contextual understandings of authority, legitimacy, and cultural-political organization. In resonance with such dimensions, autonomy stresses the different degrees of self-government and self-sufficiency reclaimed by historically marginalized communities. The analysis of **Chapters 3-5** shed light on how these aspects emerge in the politicization of the transition:

1.-The recognition of rural communities is directly connected with recognizing their material and symbolic attachment to territories. It is about acknowledging the right for alternative worldviews and practices around sustainability and development. In

this light, state authorities should assure the right to consultation and the self-governing processes of indigenous and other rural communities.

2.-Participation implies decision-making processes defined and led fundamentally by community members themselves and based on the communities' political agency. This is translated into communities' and citizens' involvement in co-planning a transition strategy, co-designing cartographic tools for territorial management, negotiating the means and ends of energy infrastructures.

3.-Aspects of distribution include at least three main spheres.

a) Access and management over land and its resources: either via securing communal institutions or securing regulation of public lands (e.g., enabling land coordination schemes instead of land competition).

b) Direct participation of communities in the ownership, management, and control of energy facilities (e.g., cooperative management schemes).

c) Energy redistribution: shifting concerns from the supply to the demand side and promoting regional-municipal approaches to local sustainability and electricity provision.

Elements listed above show that the transition's political spectrum also entails a rather transformative approach. EJ struggles challenge the vision of decarbonization promoted by states and corporations, creating new ways of negotiating and leading the energy transition. Instead of focusing on policies, these movements embrace a focus on politics (Pellow, 2018), whereby politically motivated communities propel socio-environmental changes beyond the modern social constructs (e.g., Kothari et al., 2019). Cases of conflict presented in this thesis have shown that the energy transition's politicization not only involves negotiating the benefits of "green development". Furthermore, they also raise new political questions in several domains: from how we organize the scale and flows of our metabolism to how we redistribute political and electric power both socially and geographically.

Mapping such political instances and experiences are undoubtedly at an initial stage (see: Avenues for future research). However, the study of conflicts presented in this dissertation

has brought some preliminary elements into such direction. When looking at the challenge of decarbonization through the lens of EJ struggles, one pattern appears to be emerging.

Renewable energy conflicts are less about "blocking" climate mitigation solutions and more about "opening" political spaces to build egalitarian and transformative approaches towards a low carbon future.

Research limitations and avenues for future work

This dissertation has sought to contribute to the emergent agenda on the political ecologies of renewable energies. The transversal findings across the different chapters outlined in the previous section indicate some possible routes for refining and expanding upon this research, including the following:

Deeper understandings of the political economies of the energy transition

This dissertation has argued that renewable energies' biophysical nature combined with the imperative of sustaining an industrial metabolism translates into new forms of environmental change and conflict. Evidence throughout this work has shown that neoliberal institutions are currently playing a central role in shaping such a process, particularly in Mexico, although not exclusively. From an Ecological Economics perspective, however, it appears relevant to question how other metabolic configurations (e.g., Keynesian/state-led type of energy transition) might raise similar socio-environmental pressures as long as the growing industrial metabolism remains unquestioned. This calls for expanding the study on the political economies of renewable energy transitions in the light of the ongoing research promoting a sustainable downscale of the economic throughput.

Empirically, further research is needed to identify the political economy of renewable energy implementation in different contexts, both historically and at present. For example, in Mexico's case, the recent consolidation of a Leftist national government (with Andrés Manuel Lopez Obrador as president) has triggered an unprecedented wave of political debates around renewable energies. With a strong and overt narrative "against

neoliberalism", this administration attempts to revert some of the most abusive corporate practices in the renewables sector enabled during the last governments. The path that this new administration will take regarding renewables is, however, not completely defined. For example, some sectors of this administration might favor a developmentalist approach to the transition led by a strong central state, while other groups in the country are increasingly promoting a decentralized approach favoring municipal planning, local participation, and a structural redefinition of energy needs. Multiple public debates, academic interventions, and community initiatives are currently taking place in the country, showing that the energy transition is, indeed, a strongly contested process and its outcomes yet to be determined.

Another central research question pertains to the political economy of renewable energies and transitions in China. How is the economic giant of Asia envisioning its energy transition (if any)? What role is China playing in mobilizing investments and supplying technologies for a global energy transition? How are state and private corporations interplaying in such processes? How are communities in China experiencing such changes and responding to them?

Finally, what are the political, ecological, and social trajectories of other renewable energy developments in history, and what type of lessons do they bring to the present? For example, the different "developmentalist" projects led by National States (e.g., dams in Nehru's India and Nasser's Egypt), the implementation of decentralized, community-led energy facilities (e.g., renewable energy cooperatives and municipal schemes).

Tracing the politics of renewables in light of the Green New Deal(s)

In close relation to the previous point, research on the political ecologies and economies of renewable energies brings attention to the new map of environmental politics around debates on the Green New Deal and *Pacto Ecosocial del Sur*. These debates are mobilized in different settings by various actors (e.g., politicians, grassroots movements, academics, and NGOs). As a result, multiple and often divergent viewpoints have been put forward. Some research questions around the political ecology and economy of renewable energies include the following: How is the state, private capital, and the commons positioned in different visions of the Green New Deal and *Pacto Ecosocial*? How are renewable energies being envisioned in such plans? How is the extraction of minerals for producing renewable energy technologies

playing out in such plans? What is the role of grassroots movements in building North-South dialogues for alternative approaches to the energy transition?

Expanding the inventory of conflicts around wind and solar power in the EjAtlas

The inventory of conflicts presented in this dissertation has provided a preliminary outlook on the type of analysis we can develop with the Environmental Justice Atlas (see our most recent collective publication on the matter in Temper et al., 2020). However, as renewables' investments rapidly expand globally, further evidence is needed to understand the patterns and responses in different contexts.

Geographically, this research agenda calls for further systematic coverage on the evolution of wind and solar power conflicts in China and other major countries and regions attracting investments in the sector. This analysis includes the configuration of new clusters where renewable energy resources are abundant (e.g., the Mojave Desert in the USA, Solar Corridors in North Africa, Wind corridors in coastal areas).

Expanding this database would also enable us to analyze why some investments are more conflictive than others. This thesis has outlined a preliminary hypothesis by posing that changes in the land's access and management are a decisive factor for triggering injustices and conflict. However, this work has also shown that conflicts over rent are also present when private property regulates land. Further research is needed to map these patterns and understand citizens' and different communities' concerns regarding a just transition.

Broader alliances between activism and science for a just transition

The implementation of renewable energies calls for the recognition and participation of rural communities in shaping an energy transition integrating livelihood security and ecological continuity. An activist research agenda on renewable energies could contribute to promote alternative socio-ecological projects for the transition. How does food and energy sovereignty intersect in envisioning and implementing renewable energies? How does a commons approach to the transition could contribute to alleviating land competition and socially produced scarcities?

References

Acselrad H (2010) The "environmentalization" of social struggles, the environmental justice movement in Brazil. *Estudos Avançados* 24(68): 103-119.

ADTMMX (2020) Official website of the Asamblea de Defensores del Territorio Maya MúuchXíinbal (accessed 14th April 2020)

Agarwal, B (1998) The Gender and Environment Debate. In R. Keil, D.V.J. Bell, P. Penz and L. Fawcett (Eds.) Political Ecology: Global and Local, pp. 193-219. New York: Routledge.

Agterbosch S, Glasbergen P & Vermeulen WJV (2007) Social barriers in wind power implementation in The Netherlands. *Renewable and Sustainable Energy Reviews* 11 (6): 1025–55.

Aguilera-Hernández F (2018) La reforma energética en los ejidos y comunidades. *Revista Estudios Agrarios. Procuraduría Agraria*. México: Gobierno Federal.

Agyeman J & Evans B (2003) Just sustainability: The emerging discourse of environmental justice in Britain. *The Geographical Journal* 170(2):155–164

Akbulut B, Demaria F, Gerber JF & Martínez-Alier J (2019) Who promotes sustainability? Five theses on the relationships between the degrowth and the environmental justice movements. *Ecological Economics* 165, 106418.

Alcott B (2005) Jevons' paradox. *Ecological Economics* 54(1):9-21.

Alonso L & Mejía A (2019) Rentas eólicas y nuevos procesos de diferenciación social en el Istmo de Tehuantepec. Oaxaca. In: Tornel, Carlos (coord) *Alternativas para limitar el calentamiento global en 1.5°C. Más allá de la economía verde*. México: Heinrich Boll Stiftung México y el Caribe. Pp. 280-305.

Anguelovski I & Martinez-Alier J (2014) The "environmentalism of the poor" revisited: Territory and place in disconnected global struggles. *Ecological Economics* 102: 167–76.

APIITDTT (2008) Asamblea en Defensa de la Tierra y el Territorio, Protesta en Juchitán en contra de las empresas eólicas, Last consulted:01/11/2016

APIITDTT (2009) Asamblea en Defensa de la Tierra y el Territorio de Juchitán, Foro Comunidades Indígenas, Autodeterminación y Soberanía Energética, Published: 08/ 15/ 2009. Last consulted:01/11/2016

APIITDTT (2014a) Asamblea de los Pueblos Indígenas del Istmo de Tehuantepec en Defensa de la Tierra y el Territorio, Resolución sobre la situación legal de la defensora Lucila Bettina Cruz Velázquez, Published 11/5/2014, Last consulted:01/11/2016

APIITDTT (2014b) Asamblea de los Pueblos Indígenas del Istmo de Tehuantepec en Defensa de la Tierra y el Territorio, Intentan asesinar a compañero de la APIIDTT a la salida de proceso de consulta previa en Juchitán, Oaxaca. Published: 11/05/2014, Last consulted:01/11/2016

APIITDTT (n/d) Asamblea de los Pueblos Indígenas del Istmo de Tehuantepec en Defensa de la Tierra y el Territorio, Quiénes somos, Last consulted:01/11/2016

APIITDTT /UCIZONI (2013) Asamblea en Defensa de la Tierra y el Territorio y Unión de Comunidades Indígenas de la Zona Norte del Istmo; Las eólicas son un robo. Cómic realista sobre los parques eólicos, Oaxaca. Last consulted:01/11/2016

Araújo R (2012) Moradores regaem a usinas eólicas. Tribuna do Norte. Published 08/01/2012 Last access 01/03/17. Available at:
http://www.tribunadonorte.com.br/noticia/moradores-reagem-a-usinas-eolicas/208373

Araújo K (2014) The emerging field of energy transitions: Progress, challenges and opportunities. *Energy Research & Social Science* 112-121.

Ariza-Montobbio P, Lele S, Kallis G & Martinez-Alier J (2010) The political ecology of Jatropha plantations for biodiesel in Tamil Nadu, India. *The Journal of Peasant Studies* 37 (4): 875-897.

Ariza-Montobbio P (2015) Energy sovereignty: politicising an energy transition. In: Temper, L. and T. Gilbertson (eds). *Refocusing resistance for climate justice. COPing, COPing out and beyond Paris*. EJOLT Report 23.

Asara V, Otero I, Demaria F & Corbera E (2015) Socially sustainable degrowth as a social–ecological transformation: Repoliticizing sustainability. *Sustainability Science* 10 (3): 375–384

Avci D (2018) Transformative Politics in Environmental Struggles: A Comparative Analysis of the Mining Conflicts in Intag, Ecuador and Mount Ida, Turkey. ISS PhD Theses. Erasmus University Rotterdam.

Avila-Calero S (2017) Contesting energy transitions: wind power and conflicts in the Isthmus of Tehuantepec. *Journal of Political Ecology* 24:993-1012

Avila S (2018) Environmental Justice and the Expanding Geography of Wind Power Conflicts. *Sustainability Science* 13 (3): 599–616.

Avila S & Sorman A (2018). Transición energética (energías renovables). En: Dalisa, G., Demaria, F., Kallis, G. (eds). Decrecimiento: vocabulario para una nueva era. Icaria Editorial.

Avila S & Rao S (2018) Frente al crecimiento verde: visiones de lo común desde el Colectivo Timbaktu. Ecología Política. 55.

Avila S (2019) Transición energética y justicia socio-ambiental. Aproximaciones desde el Sur global. En: Tornel, C (coord.). *Alternativas para limitar el calentamiento global en 1.5°C. Más allá de la economía verde.* Fundación Heinrich Böll - México y El Caribe.

Baka J (2013) The political construction of wasteland: governmentality, land acquisition and social inequality in South India. *Dev Chang.*44(2):409–428.

Baka J (2014) What wastelands? A critique of biofuel policy discourse in South India. *Geoforum* 54: 315–323.

Baka J (2017) Making Space for Energy: Wasteland Development, Enclosures, and Energy Dispossessions. *Antipode* 49 (4): 977–96.

Bakker K & Bridge G (2006) Material worlds? Resource geographies and the `matter of nature'. *Progress in Human Geography* 30(1):5-27.

Bakker K (2007) The "Commons" Versus the "Commodity": Alter-globalization, Anti privatization and the Human Right to Water in the Global South. *Antipode* 39 (3):430–455.

Bankwatch Network (2010) Over the edge: Enel's plans to export its pollution to Porto Romano, Albania. Last access: 03/29/17. Available at:
http://bankwatch.org/documents/PortoRomanoOverTheEdge.pdf

Barry J, Geraint E & Robinson C (2008) Cool rationalities and hot air: a rhetorical approach to understanding debates on renewable energy. *Global Environmental Politics* 8(2):67-98.

Bartra A (2012) *Los nuevos herederos de Zapata Campesinos en movimiento 1920-2012*. México: Partido de la Revolución Democrática.

Bassey N (2019) Breaking the chains of development. In: Kothari A, Salleh A, Escobar A, Demaria F, Acosta A (eds). Pluriverse: A Post-Development Dictionary, New Delhi: Tulika Books, AuthorsUpFront. Pp.3-5.

Bebbington A & Bury J (eds) (2013) *Subterranean Struggles: New Dynamics of Mining, Oil, and Gas in Latin America*. University of Texas Press.

Becker S & Kunze C (2014) Transcending community energy: collective and politically motivated projects in renewable energy (CPE) across Europe. *People, Place and Policy* 8(3):180-191.

Beckert S (2015) *Empire of Cotton: A Global History*. New York: Vintage Books.

Bell D, Gray T & Haggett C (2005) The "social gap" in wind farm siting decisions: explanations and policy responses. *Environmental Politics* 14: 460-477.

Berglez P & Olausson U (2014) The post-political condition of climate change: an ideology approach. *Capitalism Nature Socialism* 25 (1): 54-71.

Birdlife International (2017) Migratory Soaring Birds Project, Last access: 01/03/17. Available at: http://migratorysoaringbirds.undp.birdlife.org/en/

Blaikie P & Brookfield H (Eds) (1987) *Land Degradation and Society*. London: Routledge.

Blomley N (2009) Critical Human Geography. In: Gregory D, Johnston R, Pratt G, Watts M, Whatmore S (eds) *The Dictionary of Human Geography*. 5th Edition. Wiley-Blackwell. United Kingdom: 123-124.

Bloomberg NEF (2018) Climatescope: Emerging Markets Outlook 2018. Energy transition in the world's fastest growing economies. UKAid. Report available at: https://global-climatescope.org/assets/data/reports/climatescope-2018-report-en.pdf

Bloomberg NEF (2019) Climatescope: Emerging Markets Outlook 2018. Energy transition in the world's fastest growing economies. -UKAid. Report available at: https://global-climatescope.org/assets/data/reports/climatescope-2019-report-en.pdf

Bond P (2000) Economic growth, ecological modernization or EJ? Conflicting discourses in post-apartheid South Africa. *Capitalism Nature Socialism* 11(1).

Bond P (2012). Politics of Climate Justice: Paralysis Above, Movement Below. University Of KwaZulu-Natal Press.

Bonfil GB (1990) *México profundo: una civilización negada*. México: Grijalbo.

Borras S, Hall MR, Scoones I, White B & Wolford W (2011) Towards a better understanding of global land grabbing: an editorial introduction. *The Journal of Peasant Studies* 38 (2): 209-216.

Bosley P, Bosley K (1992) Risks and Benefits of Wind Generated Electricity. *Energy Sourc*es 14:1-9.

Bouzarovski S & Simcock N (2017) Spatializing energy justice. *Energy Policy*. 107: 640-648.
BP (2019) British Petroleum Statistical Review of World Energy 2019.

Bradley K & Hedrén J (2014) Utopian Thought in the Making of Green Futures. In: Bradley K, Hedrén J (eds), *Green Utopianism: Perspectives, Politics and Micro-Practices*. New York: Routledge, Oxon, pp 1-20.

Brand U (2016) "Transformation" as a New Critical Orthodoxy. The Strategic Use of the Term "Transformation" Does Not Prevent Multiple Crises. GAIA 25(1): 23–27.

Brand U & Lang M (2019) Green Economy. In: Kothari A, Salleh A, Escobar A, Demaria F, Acosta A (eds) Pluriverse: A Post-Development Dictionary. New Delhi: Tulika Books, AuthorsUpFront. Pp.56-59.

Braudel F (1995) *The Mediterranean and the Mediterranean World in the Age of Philip II*. University of California Press.

Brey P (2017) Sustainable Technologies for Sustainable Lifestyles. In: Kaplan M.D, *Philosophy, technology and the environment*. MIT Press Scholarship Online.

Bridge G (2001) Resource Triumphalism: Postindustrial Narratives of Primary Commodity Production. *Environment and Planning A: Economy and Space*, 33(12):2149-2173.

Bridge G (2009) Natural resources. In: Gregory D, Johnston R, Pratt G, Watts M, Whatmore S (eds). 2009. *The Dictionary of Human Geography*. 5th Edition. Wiley-Blackwell. United Kingdom: 350-354.

Bridge G & Le Billon P (2012). *Oil*. Cambridge: Polity Press.

Bridge G, Bouzarovski S, Bradshaw M & Eyre N (2013) Geographies of energy transition: Space, place and the low-carbon economy. *Energy policy* 53 (2013): 331-340.

Bridge G & Gailing L (2020) New energy spaces: Towards a geographical political economy of energy transition. *Environment and Planning A: Economy and Space*, 52(6): 1037–1050.

Brown KB (2011) Wind power in northeastern Brazil: Local burdens, regional benefits and growing opposition. *Climate and Development* 3:344-360.

Brunhes J (1910) La géographie humaine. Paris: Alcan.

Bryant B & Mohai P (1992) *Race and the incidence of environmental hazards: A time for discourse*. USA: Westview Press.

Bryant RL & Bailey S (1997) *Third World Political Ecology*. London: Routledge.

Bryant RL (ed.) (2015) *The International Handbook of Political Ecology*. UK-USA: Edward Elgar.

Bullard RD (1990) *Dumping in Dixie: Race, class, and environmental quality*. Boulder, CO: Westview.

Bullard RD (ed) (1993) *Confronting Environmental Racism: Voices From the Grassroots*. Boston: South End Press.

Cabaña G & Roy B (2020) Decoloniality must be at the core of all climate justice debates. Movie review of Gibbs, J.(dir.). 2020. Planet of the Humans. 100 minute documentary film. USA. Available at https://planetofthehumans.com/

Calvert K (2016) From 'Energy Geography' to 'Energy Geographies': Perspectives on a Fertile Academic Borderland." *Progress in Human Geography* 40 (1): 105–25.

Campbell C & Laherrere J (1998) The end of cheap oil. *Scientific American*, 278(3): 78–84.

Capellán-Pérez I, de Castro C, Arto I (2017) Assessing vulnerabilities and limits in the transition to renewable energies: land requirements under 100% solar energy scenarios. *Renew. Sust. Energ. Rev.* 77, 760–782.

Cardoso A & Turhan E (2018) Examining new geographies of coal: Dissenting energyscapes in Colombia and Turkey. *Applied Energy*, 224: 398-408.

Carruthers David (2008) Popular Environmentalism and Social Justice in Latin America. In Carruthers David (ed) *Environmental Justice in Latin America. Problems, Promise, and Practice*. USA: Massachusetts Institute of Technology Press. Pp 1-22.

Castillo E (2011) Inequidad en torno al uso de la energía eólica en México. *Estudios Internacionales Contemporáneos, Energía y Ambiente*. 1-14.

Castree N (2010) Neoliberalism and the Biophysical Environment. A Synthesis and Evaluation of the Research. *Environment and Society: Advances in Research* 1: 5–45.

CDHT (2008) Centro de Derechos Humanos Tepeyac, Boletín de Prensa, Oaxaca, de Juárez, Oaxaca, 13 de agosto de 2008. Last consulted:01/11/2016

CSE-Centre for Science and the Environment (2013) EIA Guidelines Wind Power Sector, New Delhi.

Chatterton P, Featherstone D & Routledge P (2013) Articulating climate justice in Copenhagen: antagonism, the commons, and solidarity. *Antipode* 45 (3): 602–620.

Chávez A (2014) Resistencia a las eólicas en Oaxaca. Donde el viento vale oro. Entrevista con Bettina Cruz Velázquez. En: La Jornada, Ojarasca, Published: 2014/10/11, Last consulted:01/11/2016

Chevallerau FX (2017) 100% Renewables – A Few Remarks about the Jacobson/Clack Controversy. Biophysical Economics Policy Center. Last consulted October 7 2020. Available at: https://biophyseco.org/2017/06/26/100-renewables-a-few-remarks-about-the-jacobsonclack-controversy/

Chisholm M (1990) *Regions in recession and resurgence*. London: Unwin Hyman.

Clack CTM, Qvist SA, Apt J, Bazilian M, Brandt AR, Caldeira K, Davis SJ, Diakov V, Handschy MA, Hines PDH, Jaramillo P, Kammen DM, Long JCS, Granger Morgan M, Reed A, Sivaram V, Sweeney J, Tynan GR, Victor DG, Weyant JP & Whitacre JF (2017). Evaluation of a proposal for reliable low-cost grid power with 100% wind, water, and solar. *Proceedings of the National Academy of Sciences*, 114 (26) 6722-6727.

Cobarrubias S (2010) Countermapping. In: B. Warf (Ed.), *Encyclopedia of geography*. Thousand Oaks, CA: SAGE Publications, pp. 596-596.

Commoner B (1971) *The Closing Circle: Nature, Man, and Technology*. New York: Knopf.

Conde M & Walter M (2015) Commodity frontiers. In: D'Alisia G, Demaria F & Kallis G (Eds.) *Degrowth: A Vocabulary for a New Era*. New York, London: Routledge. pp. 98–100.

COPINH Consejo Cívico de Organizaciones Populares e Indígenas de Honduras-(2011) Proyecto Eólico del Cerro de Hula destroza nuestras tierras y afecta nuestras vidas, agua y comunidades. Published: 03/11/2011. Last access: 03/29/17. Available at: https://copinh.org/article/proyecto-eolico-del-cerro-de-hula-destroza-nuestra/

Corbera E, Hunsberger & Vaddhanaphuti C (2017) Climate change policies, land grabbing and conflict: perspectives from Southeast Asia. *Revue Canadienne d'Études du Développement/Canadian Journal of Development Studies*. 38 (3): 297-304.

Cottrell F (1955) *Energy and society: the relation between energy, social change, and economic development*. New York: McGraw Book Company.

Crampton WJ (2010) *Mapping. A Critical Introduction to Cartography and GIS*. New Jersey: Wiley-Blackwell.

Daly HE (1973) *Toward a steady-state economy*. San Francisco, W.H. Freeman.

Daly HE (1992) Allocation, distribution, and scale: towards an economics that is efficient, just and sustainable. *Ecological Economics* 6:185-193.

Daly HE (1993) Steady-State Economics: A New Paradigm. *New Literary History*, 24(4), 811-816.

Davis M (1999*) Ecology of Fear. Los Angeles and the Imagination of Disaster*. New York: Vintage Books.

De Ita A (2003) México: Impactos del Procede en los conflictos agrarios y la concentración de la tierra. *Centro de Estudios para el Cambio en el Campo Mexicano*, SECAM.

Del Bene D, Scheidel A, and Temper L (2018) More dams, more violence? A global analysis on resistances and repression around conflictive dams through co-produced knowledge. *Sustainability science* 13(3): 617-633.

Delgado-Ramos GC, Ávila S, Chávez-Mejía A, Meza Velarde A, Navarro González I (2014). *Apropiación de agua, medio ambiente y obesidad: los impactos del negocio de bebidas embotelladas en México*. México: UNAM.

Dell"Umbria A (2013) Istmeño:viento de rebeldía, Documentary.

Demaria F & Schindler S (2016) Contesting Urban Metabolism: Struggles Over Waste-to-Energy in Delhi, India. *Antipode* 48:293–313

Denholm P, Hand M, Jackson M & Ong S (2009) Land-Use Requirements of Modern Wind Power Plants in the United States. National Renewable Energy Laboratory, USA.

DiGiano M, Ellis E & Keys E (2013) Changing Landscapes for Forest Commons: Linking Land Tenure with Forest Cover Change Following Mexico's 1992 Agrarian Counter-Reforms. *Human Ecology* 41: 707.

Dittrich M, Bringezu S & Schütz H (2012) The physical dimension of international trade, part 2: indirect global resource flows between 1962 and 2005. *Ecological Economics* 79: 32–43

Drozdz M (2020) Maps and Protest. Int. Encycl. Hum. Geogr. 367–378.

Dunlap A (2017) Wind Energy: Toward a "Sustainable Violence" in Oaxaca. NACLA Report on the Americas 49(4):483-488

Dunlap A (2017a) Counterinsurgency for wind energy: the Bíi Hioxo wind park in Juchitán, Mexico. *The Journal of Peasant Studies*. 1–23.

Dunlap A (2017b) "The town is surrounded:" From climate concerns to life under wind turbines in La Ventosa, Mexico. *Human Geography*. 10(2): 16–36.

Ejatlas (2014) Parque eólico Jepirachi, Colombia, in: Atlas of Environmental Justice, Last access: 03/29/17. https://ejatlas.org/conflict/parque-eolico-jepirachi-colombia

Ejatlas (2015) Suzlon Energy windfarms in Kutch District, India, in: in: Atlas of Environmental Justice, Last access: 03/29/17. http://ejatlas.org/conflict/suzlon-energy-in-kutch-district

Ejatlas (2016a) Proyecto eólico del Cerro de Hula, Honduras, in: Atlas of Environmental Justice, Last access: 03/29/17. https://ejatlas.org/conflict/proyecto-eolico-del-cerro-de-hula-honduras

Ejatlas (2016b) Quilombola communities affected by wind power projects in Caetité region, Brazil, in: Atlas of Environmental Justice, Last access: 03/29/17. https://ejatlas.org/conflict/quilombola-communities-affected-by-wind-power-projects-in-caetite-region-brazil

Ejatlas (2016c) Chiloé wind power project in Mapuche territory, Chile. in: Atlas of Environmental Justice, Last access: 03/29/17. http://ejatlas.org/conflict/chiloe-wind-power-project-in-mapuche-territory

Ejatlas (2016d) Lake Turkana Project in Indigenous Territories, Kenya, in: Atlas of Environmental Justice, Last access: 03/29/17. http://ejatlas.org/conflict/lake-turkana-project-in-indigenous-territories

Ejatlas (2016e) Movement against industrial Renewable Energy Resources (RES) in Chios, Greece, in: Atlas of Environmental Justice, Last access: 03/29/17. https://ejatlas.org/conflict/movement-against-industrial-renewable-energy-resources-res-in-chios

Ejatlas (2016f) Large-scale Wind Farm in Sami reindeer land, Sweden, in: Atlas of Environmental Justice, Last access: 03/29/17. http://ejatlas.org/conflict/large-scale-wind-farm-in-sami-reindeer-pastures

Ejatlas (2017a) Mareña Renovables in San Dionisio del Mar, Oaxaca, Mexico. Atlas of Environmental Justice. Contributor: Sofia Avila (accessed 14 April 2020)

Ejatlas (2017b) Corporate Wind Farms in Ixtepec vs community's inititiative, Oaxaca, Mexico. In: Atlas of Environmental Justice. Contributor: Sofia Avila (accessed on 14 April 2020)

Ejatlas (2017c) Baleia Wind Power Complex in Ceará, Brazil, in: Atlas of Environmental Justice, Last access: 03/29/17. https://ejatlas.org/conflict/baleia-wind-power-complex-in-ceara-brasil

Ejatlas (2017d) Wind Farms in the Sustainable Development Reserve of Ponta do Tubarão, Brazil, in: Atlas of Environmental Justice, Last access: 03/29/17. https://ejatlas.org/conflict/wind-farms-in-the-sustainable-development-reserve-of-ponta-do-tubarao-brasil

Ejatlas (2017e) Tribals and wealthy residents against Cape Wind Farm, Massachusetts, USA, in: Atlas of Environmental Justice, Last access: 03/29/17. http://ejatlas.org/conflict/tribal-opposition-against-cape-wind-farm

Ejatlas (2017f) Lamu Cordisons Wind Power Project, Kenya, in: Atlas of Environmental Justice, Last access: 03/29/17. https://ejatlas.org/conflict/lamu-cordisons-wind-power-project-kenya

Ejatlas (2017g) Wind Power Plants in occupied territories of Western Sahara, in: Atlas of Environmental Justice, Last access: 03/29/17. http://ejatlas.org/conflict/wind-power-plants-in-occupied-territories-of-western-sahara

Ejatlas (2017h) Unlawful removal of olive trees and wind energy project in Karaburun, Turkey. in: Atlas of Environmental Justice, Last access: 03/29/17. https://ejatlas.org/conflict/unlawful-removal-of-olive-trees-and-wind-energy-project-in-karaburun-turkey

Ejatlas (2017i) Wind Farm Installation in the Protected Area of Karaburuni Peninsula, Albania, in: Atlas of Environmental Justice, Last access: 03/29/17. https://ejatlas.org/conflict/wind-farm-installation-in-the-protected-area-of-karaburuni-peninsula-albania

Ejatlas (2017j) Wind farm at Volovja reber, Slovenia, in: Atlas of Environmental Justice, Last access: 03/29/17. https://ejatlas.org/conflict/wind-farm-at-volovja-reber-slovenia

Ejatlas (2019a) Parque Eólico Chicxulub en ejido de Ixil, Yucatan, Mexico. Atlas of Environmental Justice. Contributors: Articulación Yucatán and Yannick Deniau. (accessed 14 April 2020)

Ejatlas (2019b) Tikul A y B, megasolar project, Yucatan, Mexico. Atlas of Environmental Justice. Contributors: Carlos Tornel, Ana Sofia Tamborrel, Rafael Fonseca (accessed 14 April 2020).

Ejatlas (2020a) Parque Eólico Tizimín, Yucatán, México. Atlas of Environmental Justice. Contributors: Articulación Yucatán / EJAtlas Team (accessed June 24 2020)

Ejatlas (2020b) Parque fotovoltaico Oxcum-Umán, Yucatán. Atlas of Environmental Justice (accessed June 24 2020).

Ejatlas (2020c) Parque Fotovoltaico Yucatán Solar, Valladolid, México. Atlas of Environmental Justice. Contributors: Articulación Yucatán and Yannick Deniau (accessed 14 April 2020)

Elliott D, Schwartz M, Scott G, Haymes S, Heimiller D & George R (2004) Wind Energy Resource Atlas of Oaxaca. USA: National Renewable Energy Laboratory.

Ellis G, Barry J, Robinson C (2006) Renewable energy and discourses of objection: towards deliberative policy making. Report of ESRC research project by Queen's University, Belfast.

Elwood S (2006) Critical issues in participatory GIS: Deconstructions, reconstructions, and new research directions.*Transactions in GIS*. 10(5): 693-708.

Elwood S (2010) Geographic Information Science: Emerging Research on the Societal Implications of the Geospatial Web. *Progress in Human Geography* 34(3): 349–357.

ENCC (2013) Estrategia Nacional de Cambio Climático. Visión 10-20-40. Mexico: Gobierno de la República.

Escobar A (1995) *Encountering Development: The Making and Unmaking of the Third World*. Oxford: Princeton University Press.

Escobar A (2008) *Territories of Difference: Place, Movements, Life, Redes*. Durham, NC: Duke University Press.

Escobar A (2014) *Sentipensar con la tierra. Nuevas lecturas sobre desarrollo, territorio y diferencia.* Medellín: Ediciones UNAULA.

Esteva G (1992) Development. In: Sachs, W. (ed.) (1992) The Development Dictionary: A Guide to Knowledge as Power, London: Zed Books, pp. 6–25.

Esteva G (2012) Los quehaceres del día. En: Massuh G. (Ed.). *Renunciar al bien común. Extractivismo y (pos)desarrollo en América Latina*, Buenos Aires: Mardulce.

Esteva G & Escobar A (2017) Post-Development @ 25: on 'being stuck' and moving forward, sideways, backward and otherwise. Third World Quarterly 38:12, 2559-2572.

Eyploia (n/d) Last access: 03/29/17. Available at: http://www.eyploia.gr/index.php?option=com_content&view=article&id=76&Itemid=203

Fairhead J, Leach M & Scoones I (2012) Green grabbing: a new appropriation of nature?. *Journal of peasant studies* 39(2): 237-261

FAO (2013) Food and Agriculture Organization. Statistical Yearbook 2013.

FAO (2018) Food and Agriculture Organization. Statistical Pocketbook 2018.

Fauset C (2010) The Techno-Fix Approach to Climate Change and the Energy Crisis, Issues and Alternatives. In: Abramsky K, *Sparking a worldwide energy revolution: social struggles in the transition to a post-petrol world*. USA: AK Press, pp 300-310.

Ferguson JM (2014) The Scramble for the Waste Lands: Tracking Colonial Legacies, Counterinsurgency and International Investment through the Lens of Land Laws in Burma/Myanmar. *Singapore Journal of Tropical Geography*. 35 (3): 295–311.

Fernández-Moya E (2012) La gestión de los comunes en México: hacia un modelo de análisis de los ejidos. *Revista Periferia* 16.

Ferrari L (2020) Una mirada retrospectiva: pico del petróleo y fin del crecimiento. *America Latina en Movimiento*. 5050. P. 15-18.

Finley-Brook M & Holloman EL (2006) Empowering Energy Justice. *Int. J. Environ. Res. Public Health*, 13, 926.

Fischer-Kowalski M (1998) Society's metabolism: The intellectual history of material flow analysis, Part I, 1860–1970. *Journal of Industrial Ecology* 2(1), 61–78.

Fischer-Kowalski M & Hüttler W (1999) Society's metabolism: The intellectual history of materials flow analysis, Part II, 1970–1998. *Journal of Industrial Ecology* 2(4), 107–136.

Fischer-Kowalski M & Haberl H (eds) (2007) *Socioecological Transitions and Global Change: Trajectories of Social Metabolism and Land Use*. Edward Elgar.

Fischer-Kowalski M & Haberl H (2015) Social metabolism: a metric for biophysical growth and degrowth. In: *Handbook of Ecological Economics*. Cheltenham, UK: Edward Elgar.

Fogelman C & Bassett TJ (2017) Mapping for investability: Remaking land and maps in Lesotho. *Geoforum* 82: 252-258.

Forum (2005) Pronunciamiento Del Foro Regional Parque Eólico del Istmo: Impactos ambiental, económico, social y cultural de los proyectos privados de energía eólica, Published: 03/05/2015; Last consulted:01/11/2016

Fouquet R & Pearson PJG (1998) A thousand years of energy use in the United Kingdom. *The Energy Journal* 19(4) 1-41.

Foyer J & Dumoulin KD (2015) The environmentalism of NGOs versus environmentalism of the poor? Mexico's social-environmental coalitions. In: Almeida P, Cordero UA (Eds.) *Handbook of Social Movements across Latin America*. New York-London: Springer, pp 223-235.

FTE-México. Frente de Trabajadores de la Energía (2007) Defensa de la soberanía energética. Puntos Programáticos.

FS-UNEP/BNEF (2018). Global trends in renewable energy investment 2018. Frankfurt School-UNEP Centre/BNEF.

Fuchs DA (2003) *An Institutional Basis for Environmental Stewardship. The Structure and Quality of Property Rights*. Dordrecht: Kluwer Academic Publishers.

Geocomunes (2017) Amenaza neoliberal a los bienes comunes. Panorama Nacional de Mega Proyectos Eléctricos. México: Fundación Rosa Luxemburgo.

GeoComunes (2019a) Geovisualizador de la Infraestructura eléctrica en Centroamérica. Website: http://geocomunes.org/Visualizadores/Centroamerica/. (Accessed 31 July 2020).

GeoComunes (2019b) Herramienta de visualización y análisis de amenazas al territorio en la Península de Yucatán.
Website: http://geocomunes.org/Visualizadores/PeninsulaYucatan/ (Accessed 31 July 2020).

Georgescu-Roegen N (1971) *The Entropy Law and the Economic Process*. Cambridge, Massachusetts: Harvard University Press.

Giampietro M, Maumi K & Bukkens SGF (2001) Multiple-Scale Integrated Assesment of Societal Metabolism: An Innovative Approach to Development and Sustainability, mimeo.

Giampietro M & Maumi, K (2009) *The Biofuel Delusion. The fallacy of large-scale agro-biofuel production*. London: Earthscan.

Giampietro M, Aspinall RJ, Ramos-martin J & Bukkens SGF (2014) *Resource accounting for sustainability: the nexus between energy, food, water and land use*. Routledge, London.

Gibbs, J.(dir.). 2020. Planet of the Humans. 100 minute documentary film. USA. Available at https://planetofthehumans.com/

Giddens A (1984) *The Constitution of Society*. Berkeley: University of California Press.

Gidwani V & Reddy R.N (2011) The Afterlives of "Waste": Notes from India for a Minor History of Capitalist Surplus. *Antipode* 43: 1625-1658.

Gidwani V (2013) Six Theses on Waste, Value, and Commons. *Social & Cultural Geography* 14 (7): 773–83.

Gillard R, Gouldson A, Paavola J, Van Alstine J (2016) Transformational responses to climate change: beyond a systems perspective of social change in mitigation and adaptation. *WIREs Climate Change* 7:251-265.

Glassman J (2006) Primitive accumulation, accumulation by dispossession, accumulation by "extra-economic' means. *Progress in Human Geography* 30(5):608–625.

Gómez-Baggethun E & Ruiz-Pérez M (2011) Economic valuation and the commodification of ecosystem services. *Progress in Physical Geography: Earth and Environment*, 35(5):613-628.

Gómez-Baggethun E & Naredo JM (2015) In search of lost time: The rise and fall of limits to growth in international sustainability policy. *Sustainability Science* 10: 385-395.

Gonzalez-Martinez AC & Schandl H (2008) The biophysical perspective of a middle income economy: Material flows in Mexico. *Ecological Economics* 68: 317–327.

Gregory D & Urry J (eds) *Social relations and spatial structures*. London: Macmillan, 90–122.

Gregory D (2009) Human Geography. In: Gregory D, Johnston R, Pratt G, Watts M, Whatmore S (eds). 2009. *The Dictionary of Human Geography*. 5th Edition. Wiley-Blackwell. United Kingdom: 350-354.

Gregory D, Johnston R, Pratt G, Watts M, Whatmore S (eds) (2009) The Dictionary of Human Geography. 5th Edition. Wiley-Blackwell. United Kindom, 1072 Pages

Grubler A & Cleveland CJ (2008) Energy transitions. In: Cleveland, C.J. (Ed.), *The Encyclopedia of Earth*. National Council for Science and the Environment: Environmental Information Coalition. Washington D.C.

Guðmundsdóttir H, Carton W, Busch H & Ramasar V (2018) Modernist dreams and green sagas: The neoliberal politics of Iceland's renewable energy economy. E*nvironment and Planning E: Nature and Space* 1(4):579-601.

Guha R & Martínez-Alier J (1997) *Varieties of environmentalism: essays North and South*. London: Earthscan.

Guijarro A, Lumbreras J, Habert J & Guereña A (2009) Impacto de los proyectos MDL sobre el desarrollo humano. Análisis de experiencias en Marruecos, Guatemala y México. Intermón Oxfam.

Guldi J & Armitage D (2014) Going forward by looking back: The rise of the longue durée. In: *The History Manifesto* (pp. 14-37). Cambridge: Cambridge University Press.

Gutowski T, Cooper D, Sahni S (2017) Why we use more materials. *Phil. Trans. R. Soc.* A 375, 20160368.

Haberl H, Heinz EK, Krausmann F, Gaube V, Bondeau A, Plutzar C, Gingrich S, Lucht W, Fischer-Kowalski M (2007) Quantifying and mapping the human appropriation of net primary production in earth's terrestrial ecosystems. *Proceedings of the National Academy of Sciences* 104 (31) 12942-12947.

Haberl H, Fischer-Kowalski M, Krausmann F, Martinez-Alier J, Winiwarter V (2010) A sociometabolic transition towards sustainability? Challenges for another Great Transformation. *Sustainable Development* 19(1):1–14.

Hanaček K, Rodríguez-Labajos B (2018) Impacts of land-use and management changes on cultural agroecosystem services and environmental conflicts—A global review. *Glob. Environ. Chang* 50, 41–59.

Harley JB (1989) Deconstructing the Map. *Cartographica* 26: 1–20.

Harley JB (1992) *History of Cartography*. Vol. 1. Chicago: University of Chicago Press.

Harrison C (2013) The historical–geographical construction of power: electricity in Eastern North Carolina. *Local Environment* 18(4): 469–486.

Hartwick JM (1977) Intergenerational equity and the investing of rents from exhaustible resources. *The American Economic Review* 67: 972-974.

Harvey D (1974) Population, Resources, and the Ideology of Science. *Economic Geography* 50(3), 256-277.

Harvey D (1996) J*ustice, Nature and the Geography of Difference*. Oxford: Blackwell.

Harvey D (2004) The 'new' imperialism: accumulation by dispossession. *Social Register.* 40: 63–87.

Harvey D (2005) *A brief history of neoliberalism*. Oxford: Oxford University Press.

Hawken P, Lovins A & Lovins H (1999) *Natural Capitalism: Creating the Next Industrial Revolution*. Little, Brown & Company, Boston.

Healy N & Barry J (2017) Politicizing energy justice and energy system transitions: Fossil fuel divestment and a "just transition". *Energy Policy* 108: 451–459.

Healy N, Stephens JC & Malin S (2019) Embodied energy injustices: Unveiling and politicizing the transboundary harms of fossil fuel extractivism and fossil fuel supply chains. *Energy Research & Social Science* 48: 219-234.

Hecht SB (1985) Environment, development and politics: Capital accumulation and the livestock sector in Eastern Amazonia. *World Development* 13(6):663-684.

Herrera RM (2012) Social change and land tenure regimes in Mexico. A critical review. *GeoJournal* 77: 633.

Heynen N, Kaika M & Swyngedouw E (2006) *In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism.* London: Routledge.

Heynen N & Robbins P (2005) The neoliberalization of nature: Governance, privatization, enclosure and valuation. *Capitalism Nature Socialism* 16(1): 5-8.

Hickel J & Kallis G (2020) Is Green Growth Possible? *New Political Economy* 25:4, 469-486.

Hickel J (2020). *Less is more: How degrowth will save the world*. Penguin Random House.

Hoffmann J (2012) The Social Power of Wind: The Role of Participation and Social Entrepreneurship in Overcoming Barriers for Community Wind Farm Development.

Lessons from the Ixtepec Community Wind Farm Project in Mexico, Master Thesis. Lund University.

Holifield R, Chakraborty J & Walker G (2018) The Routledge Handbook of Environmental Justice. Routledge.

Hornborg A (1998) Towards an ecological theory of unequal exchange: articulating world system theory and ecological economics. *Ecological Economics* 25: 127–136.

Hornborg A (2003) The Unequal Exchange of Time and Space: Toward a Non-Normative Ecological Theory of Exploitation. *Journal of Ecological Anthropology* 7(1): 4-10.

Hornborg A (2005) Footprints in the cotton fields: the industrial revolution as time–space appropriation and environmental load displacement. *Ecological Economics* 59: 74-81.

Hornborg A (2014) Why Solar Panels Don't Grow on Trees: Technological Utopianism and the Uneasy Relation between Marxism and Ecological Economics. In: Bradley K and Hedrén J (eds) *Green Utopianism: Perspectives, Politics and Micro-Practices*. Routledge, pp 76 – 97.

Howard DC, Wadsworth RA, Whitaker JW, Hughes N & Bunce RGH (2009) The impact of sustainable energy production on land use in Britain through to 2050. *Land Use Policy*, 26 (1): 284-292.

Howe C, Boyer D & Barrera E (2015) Wind at the margins of the state: autonomy and renewable energy development in Southern Mexico. In: McNeish JA, Borchgrevink A and Logan O (eds). *Contested Powers. The Politics of Energy and Development in Latin America.* Chicago: The University of Chicago Press. pp. 92–115.

Howe C (2014) Anthropocenic ecoauthority: the winds of Oaxaca. *Anthropological Quarterly* 87(2): 381-04.

Huber A, Gorostiza S, Kotsila P, Beltrán MJ & Armiero M (2016) Beyond "Socially Constructed" Disasters: Re-politicizing the Debate on Large Dams through a Political Ecology of Risk. *Capitalism Nature Socialism* 28(3):48-68.

Huber M (2013) *Lifeblood: Oil, Freedom, and the Forces of Capital*. Minneapolis, MN: University of Minnesota Press.

Huber M (2015) Theorizing Energy Geographies. *Geography Compass* 9(6): 327–38.

Huber M & McCarthy J (2017) Beyond the subterranean energy regime? Fuel, land use and the production of space. *Transactions of the Institute of British Geographers* 42(4): 655-668.

IDB (2011) Eólica del Sur to build biggest wind farm in Mexico with IDB support, Published 11/24/11: Last consulted:01/11/2016

Iliadis A & Russo F (2016) Critical data studies: An introduction. *Big Data & Society* 3 (2).

INEGI (2014) *Perspectiva estadística: Oaxaca*. Instituto Nacional de Estadística y Geografía, México.

Infante-Amate A, Urrego Mesa A & Tello Aragay E (2020) Las venas abiertas de América Latina en la era del Antropoceno: Un estudio biofísico del comercio exterior (1900-2016). *Diálogos. Revista Electrónica de Historia*, 21(2). DOI 10.15517/DRE.V21I2.39736

International Service for Human Rights (2015), Mexico: Court dismisses baseless charges against Bettina Cruz Velazquez, Published: 02/16//2015, Last consulted:01/11/2016

International Energy Agency (2017). Energy Access Outlook 2017: from poverty to prosperity. Available at: https://webstore.iea.org/weo-2017-special-report-energy-access-outlook

Ioannis Fyrippis I, Axaopoulos PJ, Panayiotou G (2010) Wind energy potential assessment in Naxos Island, Greece. *Applied Energy* 87: 577–586

IPCC (2018) Special Report on Global Warming of 1.5 °C. https://www.ipcc.ch/sr15/

IRENA (2018) Global Energy Transformation: A roadmap to 2050, International Renewable Energy Agency, Abu Dhabi. This report is available for download from www.irena.org/publications.

Jacobson M, Mark AD, Zack AFB, Savannah C.G, William EC, Mary AC, Cedric B, Liat C, Hailey AC, Peter E, Jenny RE, Simone NF, Owen KG, Eleanor MH, Jingyi L, Jonathan L, Clayton BM, Sean BM, Kevin RM, Patrick LO'N, Ivalin P, Stephanie R, Robin S, Michael AS, Jingfan W, Eric W, and Alexander SY (2017) 100% Clean and Renewable Wind, Water, and Sunlight All-Sector Energy Roadmaps for 139 Countries of the World. *Joule* 1, 108–121.

Jean F & Dumoulin DK (2015) The environmentalism of NGOs versus environmentalism of the poor? Mexico's social-environmental coalitions. In: Almeida, P. and A.U Cordero (eds.), *Handbook of Social Movements across Latin America*. New York-London: Springer.

Jenkins K, McCauley D, Heffron R, Stephan H & Rehner R (206) Energy justice: a conceptual review. *Energy Research & Social Science.* 11: 174-182.

Jessup B (2010) Plural and hybrid environmental values: a discourse analysis of the wind energy conflict in Australia and the United Kingdom. *Environmental Politics* 19: 21-44

Jevons WS (1865/1965). In: Flux, A.W. (Ed.), The Coal Question: An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of Our Coal-mines, 3rd edition 1905. Augustus M. Kelley, New York.

Jiusto S (2009) Energy transformations and geographic research. In: Castree, Demeritt, Rhoads & Liverman (eds). *A Companion to Environmental Geography*. Blackwell.

Johnson R (2014) *Carbon nation: fossil fuels in the making of American culture*. University of Kansas Press, Lawrence.

Juárez HS & León G (2014) Energía eólica en el istmo de Tehuantepec: desarrollo, actores y oposición social. *Revista Problemas del Desarrollo* 178 (45).

Kain RJ & Baigent E (1992) *The Cadastral Map in the Service of the State: A History of Property Mapping.* Chicago: University of Chicago Press.

Kallis G, Demaria F, Dalisa G (2014) Introduction. In: D'alisa G, Demaria F, Kallis G. *Degrowth: a vocabulary for a new era*. Routledge, Oxxon, pp 28-45.

Kallis G (2015) For a radical environmentalism. In: Kallis G, In Defense of Degrowth. Opinions and Minifestos. Edited by Aaron Vansintjan.

Kallis G (2017) Radical dematerialization and degrowth. *Phil. Trans. R. Soc.* A 375: 20160383.

Kerschner C, Prell C, Feng K & Hubacek K (2013) Economic vulnerability to Peak Oil. *Global Environmental Change* 23: 6, 1, 424–1, 423.

Klein N (2011) Reclaiming the Commons. *New Left Review* 9.

Klein N (2014) *This Changes Everything: Capitalism vs. the Climate*. New York: Simon & Schuster.

Koch J (2008) Perspectives on access to and management of natural resources. A discussion of selected literature. DIIS Working Paper 2008/8

Kosek J (2009) Environmental Justice. In: Gregory D, Johnston R, Pratt G, Watts M, Whatmore S (eds). 2009. *The Dictionary of Human Geography*. 5th Edition. Wiley-Blackwell. United Kingdom: 201-202.

Kosoy N & Corbera E (2010) Payments for ecosystem services as commodity fetishism. Ecological Economics 69(6): 1228-1236.

Kothari A, Demaria F & Acosta A (2014) Buen Vivir, Degrowth and Ecological Swaraj: Alternatives to sustainable development and the Green Economy. *Development* 57(3): 362–375.

Kothari A, Salleh A, Escobar A, Demaria F & Acosta A (eds) (2019) Pluriverse: A Post-Development Dictionary. New Delhi: Tulika Books, AuthorsUpFront.

Krausmann F, Gingrich S, Eisenmenger N, Erb KH, Haberl H & Fischer-Kowalski M (2009) Growth in global materials use, GDP and population during the 20th century. *Ecological Economics* 68: 2696–2705.

Kurtz HE (2002) The politics of environmental justice as the politics of scale: St James Parish, Louisiana and the Shintech siting controversy. In: Herod A and Wright MW (eds) *Geographies of Power: Placing Scale.* Oxford: Blackwell, pp.249–273.

Lèbre É, Stringer M, Svobodova K. et al. The social and environmental complexities of extracting energy transition metals. Nat Commun 11, 4823 (2020).

Lefebvre H (1970) Reflections on the politics of space. Antipode 8(2): 30–7.

Lefebvre H (1991) [1974]: *The production of space*, trans. D. Nicholson-Smith. Oxford: Blackwell.

Leff E (1986) *Ecología y capital: hacia una perspectiva ambiental del desarrollo*. México: Universidad Nacional Autónoma de México.

Leff E (1995) *Green production. Towards an environmental rationality*. New York: Guilford Publications.

Levy K, Quintana RSD, Roberto Q, Robinson S; Saynes A, Tapia García M, Castañeira Yee Ben A, Cordoba Tapia F (2015) Versión preliminr del informe del Grupo Asesor de las Organizaciones de la Sociedad civil en la Consulta Indígena en Juchitán de Zaragoza, Last consulted:01/11/2016

Li TM (2007) *The will to improve: governmentality, development and the practice of politics*. Durham, NC: Duke University Press.

Li TM (2014) What Is Land? Assembling a Resource for Global Investment. *Transactions of the Institute of British Geographers* 39(4): 589–602.

LIE (2014) Ley de la Industria Eléctrica. Cámara de Diputados del H. Congreso de la Unión. México.

Liverman D & Rhoads B (eds) *A Companion to Environmental Geography*. Hoboken: Wiley.

Lohmann L(N/D). Bioenergy, Thermodynamics and Inequalities, in M. Backhouse and C. Rodriguez (eds.), Bioeconomy and global inequalities: knowledge, land, labor, biomass, energy, and politics. New York: Palgrave Macmillan.

Lopez-Gomez AL, May ER, Tabaco RML (2019) Transición energética, neoextractivismo y resistencia en una comunidad maya: una experiencia para la educación ambiental. *Revista Eletrônica do Mestrado em Educaçao Ambiental*.

Lotka AJ (1922) Contribution to the Energetics of Evolution. *Proceedings of the National Academy of Sciences* 8 (6).

Lotka AJ (1956) *Elements of Mathematical Biology*. New York: Dover Publications.

MacGregor S (2014). Only Resist: Feminist Ecological Citizenship and the Post-politics of Climate Change. *Hypatia* 29(3).

Mackenzie AFD (2010) A common claim: community land ownership in the Outer Hebrides, Scotland. *International Journal of the Commons* 4 (1): 319–344.

Maldonado S (2010) Nuevas ciudadanías en el México rural. Derechos agrarios, espacio público y el Estado neoliberal. *Liminar. Estudios Sociales y Humanísticos* VIII (1): 46-63.

Manzo D (2012) Acusan comuneros a CFE de vender al Istmo a transnacionales; proponen eólica comunitaria, Página3, Published:10/15/2012, Last consulted:01/11/2016

Manzo D (2015), Mareña cambia razón social para retomar proyecto eólico en Oaxaca, La Jornada, Published 02/22/2015, Last consulted:01/11/2016

Manzo D (2019) Energía limpia y contratos sucios. Así operan las eólicas en Oaxaca. (accessed 16 July 2020).

Martinez-Alier J & Schupmann K (1987) Ecological Economics: Energy, Environment and Society. Oxford: Basil Blackwell.

Martinez-Alier J & O'Connor M (1996) Ecological and economic distribution conflicts. In: R. Costanza, J. Martinez-Alier and O. Segura (Eds.) Getting down to Earth: Practical Applications of Ecological Economics. Island Press/ISEE, Washington, DC.

Martínez-Alier J (2002) *The environmentalism of the poor: a study of ecological conflicts and valuation*. Cheltenham: Edward Elgar.

Martínez-Alier J (2009) Social metabolism, ecological distribution conflicts and languages of valuation. *Capitalism Nature Socialism* 20(1):58-87.

Martínez-Alier J, Kallis G, Veuthey S, Walter M & Temper L (2010) Social metabolism, ecological distribution conflicts and valuation languages. *Ecological Economics* 70(2): 153-158.

Martínez-Alier J (2012) Environmental Justice and Economic Degrowth: An Alliance between Two Movements. *Capitalism Nature Socialism* 23(1): 51-73

Martínez-Alier J & Muradian R (2015) Taking stock: the keystones of ecological economics. In: Martínez-Alier J & Muradian R (eds). Handbook of Ecological Economics. Cheltenham, UK: Edward Elgar.

Martinez-Alier J, Temper L, Del Bene D & Scheidel A (2016a) Is there a global environmental justice movement?. The Journal of Peasant Studies 43:3, 731-755.

Martinez-Alier J, Demaria F, Temper L, Walter W (2016b) Changing social metabolism and environmental conflicts in India and South America. Journal of Political Ecology, vol. 23, p. 467-491.

Massey DB (2005) For space. London, UK: Sage Publications.

May J & Thrift N (EdS)(2001) Timespace. London: Routledge.

Mayumi (1991) Temporary emancipation from land: from the industrial revolution to the present time. *Ecological Economics* 4(1): 35-56.

McCarthy J & Prudham S (2004) Neoliberal Nature and Nature in Neoliberalism. *Geoforum*, 35(3):275–283.

McCarthy J (2005) Commons as counter-hegemonic projects. *Capitalism Nature Socialism* 16(1):9–24.

McCarthy J (2009) Uneven Development. In: Gregory D, Johnston R, Pratt G, Watts M, Whatmore S (eds). 2009. *The Dictionary of Human Geography.* 5th Edition. Wiley-Blackwell. United Kingdom: 780-782.

McCarthy J (2015) A socioecological fix to capitalist crisis and climate change? The possibilities and limits of renewable energy. *Environment and Planning A* 47 (12): 2485-2502.

McCarthy J & Thatcher J (2019) Visualizing New Political Ecologies: A Critical Data Studies Analysis of the World Bank's Renewable Energy Resource Mapping Initiative. *Geoforum* 102 (June): 242–54.

McDonald D (Ed.) (2009) *Electric Capitalism: Recolonising Africa on the Power Grid*. Cape Town: HSRC Press.

McNeill JR (2008) Global environmental history in the age of fossil fuels (1800-2007). In: Mizoguchi K (ed) *The environmental histories of Europe and Japan*. Nagoya University Press, Kobe 1–11.

Méndez E & Garduño R (2012) Proponen plan eólico alterno para Oaxaca, La Jornada, Published: 10/19/2012. Last consulted:01/11/2016

Merino L (2006) Apropiación, instituciones y gestión sostenible de la biodiversidad. *Gaceta Ecológica:* 11-27.

Merlinsky MG (2015) Los conflictos ambientales y el debate público sobre el desarrollo en Argentina. Ciencia e Investigación 65 (3): 5-17

Mintz S (1985) *Sweetness and Power: The Place of Sugar in Modern History*. New York: Viking-Penguin.

Mitchell T (2011) *Carbon democracy: political power in the age of oil*. London: Verso.

Mohai P, Pellow D & Timmons RJ (2009) Environmental Justice. *Annual Review of Environment and Resources* 34:1, 405-430.

Mol A (1996) Ecological modernisation and institutional reflexivity: environmental reform in the late modern age. *Environmental Politics* 5: 302–323.

Mol A & Sonnenfeld D (2000) Ecological modernisation around the world. *Environmental Politics* 9(1).

Moore J (2000) Sugar and the Expansion of the Early Modern World- Economy: Commodity Frontiers, Ecological Transformation and Industrialization. *Review: Fernand Braudel Center* 23: 409– 433.

Moore J (2011) Transcending the metabolic rift: a theory of crises in the capitalist world-ecology. *The Journal of Peasant Studies* 38 1–46.

Moore J (2011b) Madeira, Sugar, & the Conquest of Nature in the 'First' Sixteenth Century, Part II: From Local Crisis to Commodity Frontier, 1506-1530. Review (Fernand Braudel Center) 33(1), 1-24.

Mouffe C (2005) On The Political. London: Routledge, 2005.

Nahmad S, Nahón A & Langlé R (2011) *El impacto social del recurso eólico*. Informe final para el Consejo Oaxaqueño de Ciencia y Tecnología. CIESAS-Unidad Pacifico Sur.

Nalepa RA & Bauer DM (2012) Marginal lands: the role of remote sensing in constructing landscapes for agrofuel development. *Journal of Peasant Studies* 39(2), 403-422.

NCCS (2013) National Climate Change Strategy. 10-20-40 Vision. Mexico, Gobierno Federal.

Neville KJ (2020) Shadows of Divestment: The Complications of Diverting Fossil Fuel Finance. *Global Environmental Politics* 20(2): 3-11.

Newell P & Mulvaney D (2013) The political economy of the 'just transition'. *The Geography Journal* 179(2): 132–140.

Newell P & Phillips J (2016) Neoliberal energy transitions in the South: Kenyan experiences, *Geoforum* 74: 39–48.

Novotny P (2000) *Where We Live, Work, and Play: The Environmental Justice Movement and the Struggle for a New Environmentalism*. Westport, CT: Praeger.

NREL (2005) Advancing Clean Energy Use in Mexico. Optimizing energy resources, growing markets, sharing knowledge. National Renewable Energy Laboratory. Website: https://www.nrel.gov/docs/fy05osti/38628.pdf (accessed 31 July 2020).

Nye D (1999) Consuming Power: A Social History of American Energies. Cambridge, MA: MIT Press

O'Connor, M & C. Splash. 1999. Introduction. In: O'Connor, M. and C. Splash (eds), *Valuation and the environment: theory, method and practice*. Cheltenham: Edward Elgar Publishing.

Oceransky S (2010) Fighting the Enclosure of Wind: Indigenous Resistance to the Privatization of Wind Resources in Southern Mexico. In: Abramsky K (ed) *Sparking a worldwide energy revolution social struggles in the transition to a post-petrol world.* California: AK Press, pp.505-522.

Odum HT (1971) Environment, power and society. Wiley, New York.

OECD/IEA (2011) OECD Green Growth Studies: Energy.

Osland O (2016) Ecological Modernisation Revisited in Norway. *World Political Science* 12: 347–371.

Padilla RV (2016) Industria eléctrica en México: tensión entre el Estado y el mercado. *Revista Problemas del Desarrollo* 185(47).

Parliament Gacette (2012) Con punto de acuerdo, por el que se exhorta a la CFE a detener las licitaciones sobre contratos de parques eólicos en curso y las programadas para el futuro próximo, Número 3627-III, México.

Partridge T (2020) "Power farmers" in north India and new energy producers around the world: Three critical fields for multiscalar research. *Energy Research & Social Science* 69: 101575.

Pasqualetti MJ, Gipe P & Righter RW (2002) A landscape of power. In: Pasqualetti MJ, Gipe P, Righter RW (eds) *Wind Power in View: Energy Landscapes in a Crowded World*. Academic Press, pp 3-16

Pasqualetti MJ (2011) Opposing energy landscapes: a search for a common cause. *Annals of the Association of American Geographers* 101(4).

Patel R & Moore JW (2018) *A History of the World in Seven Cheap Things A Guide to Capitalism, Nature, and the Future of the Planet*. University of California Press.

Pearce F (2012) Peak planet: are we starting to consume less? *New Scientist* 214, 38–43.

Peck J & Tickell A (2002) Neoliberalizing Space. *Antipode* 34: 380-404.

Peet R & Watts M (1996) Liberation Ecologies: Environment, Development, Social Movements. Routledge, London.

Pellow DN (2018) *What is critical environmental justice?* Cambridge: Polity Press.

Pellow DN (2016) Toward a critical environmental justice studies: Black Lives Matter as an Environmental Justice Challenge. Du Bois Review-Social Science Research On Race, 13(2), 221-236.

Pellow DN (2005). Environmental Racism: Inequality in a Toxic World. In M. Romero, & E. Margolis (Eds.), *The Blackwell Companion to Social Inequalities* (pp. 147-164). Blackwell Publishing Ltd.

Pellow DN (2007) *Resisting Global Toxics: Transnational Movements for Environmental Justice*. Cambridge, MA: MIT Press.

Peluso NL (1995) Whose Woods are these? Counter-mapping forest territories in Kalimantan, Indonesia. *Antipode* 27(4): 383–406.

Peluso NL & Watts M (Eds.) (2001) Violent Environments. Ithaca, NY: Cornell University Press, Pp. ix, 453.

Penndorf SB (2015) *The Renewable Energy Market is Evolving. Here's How*. Rocky Mountain Institute. Published: 11/02/2015. Last consulted: 06/01/2017.

Pérez-Rincón M, Vargas-Morales J, Crespo-Marín J (2017) Trends in social metabolism and environmental conflicts in four Andean countries from 1970 to 2013. *Sustainability Science*, 13 (3):1-14.

Perreault T, Bridge G, McCarthy J (2015) *The Routledge Handbook of Political Ecology*. Routledge, Oxon-NY.

Petersen R (2013*)* México: un tribunal federal detuvo controvertido parque eólico, Global Voices, Published:02/08/2013, Last consulted:01/11/2016

Petrova AM (2013) NIMBYism revisited: public acceptance of wind energy in the United States. *Wiley Interdisciplinary Reviews: Climate Change* 4:575–601.

Piketty T (2014) Capital in the twenty-first century. Belknap Press, Cambridge.

Pinder D (2009) Radical Human Geography. In: Gregory D, Johnston R, Pratt G, Watts M, Whatmore S (eds). *The Dictionary of Human Geography*. 5th Edition. Wiley-Blackwell. United Kingdom: 619-620.

Podobnik B (2006) *Global Energy Shifts: Fostering Stability in a Turbulent Age*. Philadelphia: Temple University Press.

Polycarp CL & XF Bertaux (2013) *Mobilizing Climate Investment*. Washington: World Resources Institute.

Powell DE (2015) The rainbow is our sovereignty: Rethinking the politics of energy on the Navajo Nation. *Journal of Political Ecology* 22.

PRCMESM (2012) Pueblos en Resistencia Contra el Megaproyecto Eólico en San Dionisio del Mar. Fuera Mareña Renovables, no más imposición y despojo en el Istmo de Tehuantepec, Published 11/28/2012. Last consulted:01/11/2016

Preneal (2011), Preneal cierra la venta de dos proyectos eólicos en Oaxaca (México), Last consulted:01/11/2016

Prudham S (2007) The fictions of autonomous invention: accumulation by dispossession, commodification, and life patents in Canada. *Antipode* 39(3): 406-429.

PwC, PricewaterhouseCoopers (2014) Transformación del sector eléctrico mexicano. Implicaciones de la Ley de la Industria Eléctrica y la Ley de la CFE. Last consulted:01/11/2016

Ramos-Martín J (2005) *Complex systems and exosomatic energy metabolism of human societies*. PhD Thesis. Institute of Environmental Sciences and Technology. Autonomous University of Barcelona. Spain.

REN21(2014). Ten years of renewable energy progress. REN21 Secretariat, Paris, France.

REN21 (2016). Renewables 2016 Global Status Report. REN21 Secretariat, Paris, France.

REN21(2019). Renewables 2019. Global Status Report. REN21 Secretariat, Paris, France.

REN21(2020). Renewables 2020. Global Status Report. REN21 Secretariat, Paris, France.

Reve (2015) Nuevo parque eólico de Enel Green Power, REVE. Revista Eólica y del Vehículo Eléctrico, Published 07/19/2015, Last consulted:01/11/2016

Ribot JC & Peluso NL (2003) A Theory of Access. *Rural Sociology* 68: 153-181.

Rignall K & Atia L (2016) The global rural: Relational geographies of poverty and uneven development. *Geography Compass* (11)

Rignall KE (2016) Solar power, state power, and the politics of energy transition in pre-Saharan Morocco. *Environment and Planning A* 48(3): 540–557.

Rivera-Herrejón G (2007) *La reforma agraria de 1992: impactos en ejidos y comunidades del Estado de México*. México: Universidad Autónoma del Estado de México.

Robbins P (2004) *Political Ecology: A Critical Introduction*. Malden: Blackwell.

Robbins P (2014) Cries along the Chain of Accumulation. *Geoforum* 54 (July): 233–235.

Rocheleau DE (2015a) Roots, rhizomes, networks and territories: reimagining pattern and power in political ecologies. In: Bryant RL (ed.) *The International Handbook of Political Ecology*. Edward Elgar, UK-USA, pp 70-89.

Rocheleau DE (2015b) Networked, rooted and territorial: green grabbing and resistance in Chiapas. *The Journal of Peasant Studies* 42:695-723.

Rojas GJC (2012) Conflictos ambientales por medidas de mitigación al cambio climático en territorio Wayuu: el Parque Eólico Jepirachi, 1999-2011, Colombia. Tesis de Magister en Medio Ambiente y Desarrollo. Universidad Nacional de Colombia-Instituto de Estudios Ambientales. Colombia.

Rojas R (2013) No instalará Mareña Renovables parque eólico en Dionisio del Mar. La Jornada, Published 02/18/2013, Last consulted:01/11/2016

Rojas R (2014) Muerto, proyecto eólico en San Dionisio, Oaxaca: De Telegraaf. La Jornada, Published 01/09/2014, Last consulted:01/11/2016

Røpke I (2004) The early history of modern ecological economics. *Ecol. Econ*. 50: 293–314.

Roy B & Schaffartzik A (2021) Talk renewables, walk coal: The paradox of India's energy transition. *Ecological Economics*, Volume 180, 106871.

Russi D, Gonzalez-Martinez AC, Silva-Macher JC, Giljum S, Martínez-Alier J, Vallejo MC (2008) Material Flows in Latin America A Comparative Analysis of Chile, Ecuador, Mexico, and Peru, 1980–2000. *Journal of Industrial Ecology* 12 (5/6).

Sachs W (ed.) (1992) The Development Dictionary: A Guide to Knowledge as Power. London: Zed Books.

Sack RD (1983) *Human Territoriality: Its Theory and History*. Cambridge: Cambridge University Press.

Sánchez J, Reyes I, Patiño R, Munguía A & Deniau Y (2019) *Expansión de proyectos de energía renovable de gran escala en la península de Yucatán*. México: GeoComunes, Articulación Yucatán y Consejo Civil Mexicano para la Silvicultura Sostenible.Website (accessed 1 June 2020).

Sawyer S (2004) Crude Chronicles: Indigenous Politics, Multinational Oil, and Neoliberalism in Ecuador. Duke University Press.

Scheidel A & Sorman A (2012) Energy transitions and the global land rush: ultimate drivers and persistent consequences. *Global Environmental Change* 22: 588-595

Scheidel A, Temper L, Demaria F, Martínez-Alier J (2018) Ecological distribution conflicts as forces for sustainability: an overview and conceptual framework. *Sustain. Sci.* 13: 585–598.

Scheidel A, Del Bene D, Liu J, Navas G, Mingorría S, Demaria F, Avila S, Roy B, Ertör I, Temper L, Martínez-Alier J (2020) Environmental conflicts and defenders: A global overview. *Global Environmental Change* 63,102104.

Schlosberg D (2004) Reconceiving Environmental Justice: Global Movements And Political Theories. *Environmental Politics* 13(3):517-540.

Schlosberg D (2007) *Defining Environmental Justice: Theories, Movements, and Nature*. UK: Oxford Scholarship.

Schlosberg D (2013) Theorising environmental justice: the expanding sphere of a discourse. *Environ Politics* 22:37–55.

Schuurman N & Mei-Po K (2004) Guest editorial: Taking a walk on the social side of GIS. *Cartographica: The International Journal for Geographic Information and Geovisualization* 39(1): 1-3.

Scoones I (2016) The Politics of Sustainability and Development. *Annual Review of Environment and Resources* 41:293-319.

Scoones, I, Leach M & Newell P (Eds.). (2015) *The politics of green transformations*. London: Routledge.

Scott JC (1998) *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed.* New Haven: Yale University Press.

Secretaría de Economía del Gobierno del Estado de Oaxaca (SEGEO n/d), *Corredor Eólico del Istmo de Tehuantepec.*

SEGOB (n/d) La Energía Eólica en México. Una perspectiva social sobre el valor de la tierra. México: Comisión para el Diálogo con los Pueblos Indígenas de México.

SEMARNAT (n/d) Glosario. México: Gobierno Federal. Website (accessed July 20 2020). http://dgeiawf.semarnat.gob.mx:8080/ibi_apps/WFServlet?IBIF_ex=D3_GLOS_RFORESTA&IBIC_user=dgeia_mce&IBIC_pass=dgeia_mce

SENER (2013a) *Prospectiva del sector eléctrico 2012-2017*. Mexico: Gobierno Federal

SENER (2013b) *Reforma Energética. Resúmen Ejecutivo*. Mexico: Gobierno Federal

Seyfang G & Haxeltine A (2012) Growing grassroots innovations: exploring the role of community-based initiatives in governing sustainable energy transitions. *Environment and Planning C: Government and Policy* 30: 381 – 400.

Sieferle RP [1982] (2001) T*he subterranean forest: energy systems and the industrial revolution*. White Horse Press, Cambridge.

Sikor T & Lund C (2009) Access and property: a question of power and authority. *Development and Change* 40(1): i-22.

Sikor T & Newell P (2014) Globalizing environmental justice? *Geoforum* vol. 54.

Sletto B (2008) The Knowledge that Counts: Institutional Identities, Policy Science, and the Conflict Over Fire Management in the Gran Sabana, Venezuela. *World Development* 36:1938-1955.

SMA (n/d) Sistema Integral de Información Ambiental del Estado de Coahuila. Website: http://www.sma.gob.mx/SRN-SIIAECC-USO-CAMBIO.php (accessed July 20 2020).

Smil, V (2003) *Energy at the Crossroads: Global Perspectives and Uncertainties*. The MIT Press, Cambridge.

Smil V (2008) *Energy in Nature and Society: General Energetics of Complex Systems.* Cambridge: The MIT Press.

Smil V (2016) *What I See When I See a Wind Turbine*. IEEE Spectrum.
Available at: http://www.vaclavsmil.com/wp-content/uploads/15.WINDTURBINE.pdf

Smil V (2010) *Energy transitions. History, requirements, prospects*. United States: Praeger.

Smith E & Klick H (2007) Explaining NIMBY Opposition to Wind Power. Annual Meeting of the American Political Science Association, Boston. Available at: http://www.polsci.ucsb.edu/faculty/smith/wind.pdf

Smith N [1984] 1990 *Uneven development: nature, capital and the production of space.* University of Georgia Press, Athens.

Smith DA, Herlihy PH, Kelly JH & Viera AR (2009) The Certification and Privatization of Indigenous Lands in Mexico, *Journal of Latin American Geography* 8(2): 175-207.

Soja EW (1980) The socio-spatial dialectic. Annals of the Association of American Geographers 70: 207–25.

Soja EW (2009) The city and spatial justice. *Justice Spatiale/Spatial Justice* 1(1): 1-5.

Soja EW (2010) *Seeking Spatial Justice*. Minneapolis: University of Minnesota Press.

Solow RM (1973) Is the end of the world at hand? *Challenge* 16, 39–50.

Solow RM (1986) On the intergenerational allocation of natural resources. *Scand J Econ* 88: 141-149.

Solow R (1993) An almost practical step toward sustainability. *Resources Policy* 19(3): 162-172.

Sorman A (2014) Societal Metabolism. In: D'Alisa, G., F. Demaria, F., G. Kallis (eds). *Degrowth: A vocabulary for a new era*. UK: Routledge.

Sovacool KB (2014) What are we doing here? Analyzing fifteen years of energy scholarship and proposing a social science research agenda. *Energy Research & Social Science* 1: 1-29.

Sovacool B & Dworkin MH (2015) Energy justice: Conceptual insights and practical applications. *Applied Energy* 142 (2015) 435–444

Sovacool BK (2016) How long will it take? Conceptualizing the temporal dynamics of energy transitions. *Energy Research & Social Science* 13: 202-215.

Sovacool BK, Heffron RJ, McCauley D, et al. (2016) Energy decisions reframed as justice and ethical concerns. *Nature Energy* 1(5): 16024.

Špirić J (2017) Ecological distribution conflicts and sustainability: lessons from the post-socialist European semi-periphery. *Sustainability Science* 13 (3):1-16.

Steffen W, Richardson K, Rockstrom J, Cornell SE, Fetzer I, Bennett EM, Biggs R, Carpenter SR, de Vries W, de Wit CA, Folke C, Gerten D, Heinke J, Mace GM, Persson LM, Ramanathan V, Reyers B, Sorlin S (2015) Planetary boundaries: guiding human development on a changing planet. *Science* 347:6223.

Swyngedouw E (2010) Apocalypse forever? Post-political populism and the spectre of climate change. *Theory, Culture and Society* 27: 213–232.

Swyngedouw E (2011) Whose Environment? The end of nature, climate change and the process of post-politization. *Ambiente & Sociedade* XIV(2):69 -87

Swyngedouw E (2013) The Non-political Politics of Climate Change. *ACME: An International Journal for Critical Geographies* 12(1):1-8.

Szarka J (2007) *Wind power in Europe: politics, business and society*. Palgrave, New York.

Sze J & London JK (2008) Environmental Justice at the Crossroads. *Sociology Compass* 2: 1331-1354.

Székely M (2005) Pobreza y desigualdad en México entre 1950 y 2004. *El Trimestre Económico* LXXII (4): 913–931.

Tainter AJ, Allen TFH & Hoekstra TW (2006) Energy transformations and post-normal science. *Energy* 31(1): 44-58.

Temper L & Martínez-Alier J (2013) The god of the mountain and Godavarman: Net Present Value, indigenous territorial rights and sacredness in a bauxite mining conflict in India. *Ecological Economics*, 96(C):79-87

Temper, L., Yánez, I., Sharife, K., Ojo, G., Martinez-Alier, J., CANA, Combes, M., Cornelissen, K., Lerkelund, H.,Louw, M., Martínez, E., Minnaar, J., Molina, P., Murcia, D., Oriola, T., Osuoka, A., Pérez, M. M., Roa Avendaño, T., Urkidi, L., Valdés, M., Wadzah, N., Wykes, S. (2013). *Towards a Post-Oil Civilization: Yasunization and otherinitiatives to leave fossil fuels in the soil*. EJOLT Report No. 6.

Temper L, Del Bene D and Martinez-Alier J (2015) Mapping the frontiers and front lines of global environmental justice: the EJAtlas. *Journal of Political Ecology* 22(1): 255-278.

Temper L, Demaria F, Scheidel A and Martínez-Alier J (2018a) The Global Environmental Justice Atlas (EJAtlas): Ecological Distribution Conflicts as Forces for Sustainability. *Sustainability Science* 13: 573–584.

Temper, L., Walter, M., Rodriguez, I; Kothari A; Turhan E (2018b). A perspective on radical transformations to sustainability: resistances, movements and alternatives. *Sustain Sci* 13, 747–764 (2018).

Temper L, Avila S, Del Bene D, Gobby J, Kosoy N, Le Billon P, Martinez-Alier J, Perkins P, Roy B, Scheidel A and Walter M (2020) Movements shaping climate futures: A systematic mapping of protests against fossil fuel and low-carbon energy projects. Environmental Research Letters 15(12).

Thayer RL & Freeman C (1987) Altamont: public perceptions of a wind energy landscape. *Landscape and Urban Planning* 14: 379–398.

Thayer RL & Hansen H (1991) *Wind Farm Siting Conflicts in California: Implications for Energy Policy*. Center for Design Research, University of California, California.

Toke D & Strachan PA (2006) Ecological modernization and wind power in the UK. *European Environment* 16:155-166.

Toledo VM (1996) Ecological consequences of the 1992 agrarian law of Mexico. In: Laura Randall (ed), *Reforming Mexico's Agrarian Reform*. United States: Columbia University Press, pp.247-260.

Toledo VM (2013) Transgénicos: los pueblos de maíz sí incendian al país. *La Jornada*. 15, marzo, 2013. *http://www.jornada.unam.mx/2013/03/15/opinion/027a1pol*

Towers G (2000) Applying the Political Geography of Scale: Grassroots Strategies and Environmental Justice. *The Professional Geographer,* 52: 23-36.

Trainer T (2014) Some inconvenient theses. *Energy Policy* 64:168–174.

Turner BL, Kasperson RE, Meyer WB, Dow KM, Golding D, Kasperson JX, Mitchell RC, & Ratick SJ (1990). Two types of global environmental change. Definitional and spatial-scale issues in their human dimensions. *Global Environmental Change* 1(1):14-22.

Ulgiati S (2015) Entropy. In: D'Alisia G, Demaria F & Kallis G (Eds.). *Degrowth: a Vocabulary for a New Era*. London: Routledge. pp. 125–127.

Vallejo MC, Burbano R, Falconí F & Larrea C (2015) Leaving oil underground in Ecuador: The Yasuní-ITT initiative from a multi-criteria perspective. *Ecological Economics* 109: 175-185.

Van den Bergh JCJM (2002) Ecological economics: themes, approaches, and differences with environmental economics. *Regional Environmental Change* 2: 13–23.

Vandergeest P & Peluso N (1995) Territorialization and State Power in Thailand. *Theory and Society* 24: 385–426.

Vargas M (2012) Proyecto del Parque Eólico Comunitario en Ixtepec. Tribuna informativa, Published: 10/2012, Last consulted:01/11/2016

Vargas R (2010) El sector eléctrico mexicano: ¿nuevos espacios para las corporaciones trasnacionales? *Acta Sociológica* 54: 119-139.

Vitousek PM, Mooney AH, Lubchenco J & Melillo JM (1997) Human Domination of Earth's Ecosystems. *Science* 494-499.

Wainwright J & Bryan J (2009) Cartography, territory, property: postcolonial reflections on indigenous counter-mapping in Nicaragua and Belize. *Cultural Geographies* 16(2): 153–178.

Walker G (2009a) Beyond Distribution and Proximity: Exploring the Multiple Spatialities of Environmental Justice. *Antipode* 41(4): 614–83.

Walker G (2009b) Globalizing environmental justice: the geography and politics of frame contextualization and evolution. Global Social Policy 9:355-382

Watson A. Bracho R, Romero R, Mercer M (2015) National Renewable Energy Laboratory Renewable Energy Opportunity Assessment For USAID Mexico. EC-LEDS (USAID, U.S Department of State, U.S. Department of Energy, U.S. Environmental Protection Agency, U.S. Department of Agriculture, and U.S. Forest Service).

Watts M (2008) *Curse of the black gold: 50 years of oil in the Niger Delta*. New York: Powerhouse.

Watts M (2009) Political Ecology. In: Gregory D, Johnston R, Pratt G, Watts M, Whatmore S (eds). 2009. *The Dictionary of Human Geography*. 5th Edition. Wiley-Blackwell. United Kingdom: 545-547.

Weale A (1992) New Politics of Pollution. Manchester University Press, Manchester.

White L (1943) Energy and the evolution of culture. *American Anthropologist* 45 335–56.

Whyte K P (2016) Indigenous Experience, Environmental Justice and Settler Colonialism. In: Bannon B. *Nature and Experience: Phenomenology and the Environment*. Rowman and Littlefield. 157-174.

Whyte K (2020) Too late for indigenous climate justice: Ecological and relational tipping points. *WIREs Clim Change* 11(1).

Wolsink M (2000) Wind power and the NIMBY-myth: institutional capacity and the limited significance. *Renewable Energy* 21:40-64.

Womack J (1970) *Zapata and the Mexican Revolution*. New York: Vintage Books.

Wood D (1992) *The Power of Maps*. New York: Guilford Press.

Wood D (2010) *Rethinking the Power of Maps*. New York: The Guilford Press.

Wrigley EA (1988) *Continuity, chance and change: the character of the Industrial Revolution in England.* New York: Cambridge University Press.

Wrigley EA (2010) *Energy and the English Industrial Revolution*. Cambridge: Cambridge University Press.

Xarxa per la Sobirania Energètica (XSE, n/D) *Defining energy sovereignty*. http://www.odg.cat/sites/default/files/energy_sovereignty_0.pdf

Yenneti K, Day R & Golubchikov O (2016) Spatial Justice and the Land Politics of Renewables: Dispossessing Vulnerable Communities through Solar Energy Mega-Projects. *Geoforum* 76 (November): 90–99.

Zimmermann EW (1951) *World Resources and Industries: A Functional Appraisal of the Availability of Agricultural and Industrial Resources*. New York: Harper and Brothers (2nd ed).

Zizek S (1999) Carl Schmitt in the Age of Post-Politics. In: Mouffe C (ed.) *The Challenge of Carl Schmitt*. London: Verso.

Zizek S (2006) Against the Populist Temptation. *Critical Inquiry* 32: 555.

Zografos C & Martinez-Alier J (2009) The politics of landscape value: a case study of wind farm conflict in rural Catalonia. *Environment and Planning* 41:1726-1744.