The Dark Side of Renewable Energy Transition: A Critical Analysis of Solar Power in Morocco

Zhang, Pengyu

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Pengyu Zhang
Supervisor: Christian Henderson
Second Reader: Crystal Ennis
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Introduction: Renewable Energy Transition Under Crises

From 2020 onwards, our human society unexpectedly entered an era of turmoil and instability. The COVID-19 pandemic imperiled our public health severely, having caused 500 million infections by June 2022 and more than 6 million deaths.[1] Moreover, it dragged the global economy into a severe recession. To prevent large-scale and uncontrollable infections, most governments – although tough to proceed in some places and easier in others – put an unprecedented lockdown on their countries. The restriction on physical and spatial mobilities also restrained the speed and frequency with which notes changed hands on both the domestic and international levels, stifling the economic vitality in this era of international trade and investment. For the first time since the 2008 global financial crisis, the world economy shrunk by 3.3% in GDP.[2] The global central banks then pumped enormous liquidity into the market to shore up confidence. The US government alone has approved and pumped almost 6.5 trillion dollars in 2020 and 2021 to help combat COVID-19 and stimulate the bleak economy.[3] This monetary fetishism consequently led to the untamable inflation we are faced with in 2022.

However, this economic recession also provides a precious opportunity to promote sustainable energy transition globally. Since production, consumption, and investment always stagnated or even slumped in the crisis, both fossil fuel consumption and carbon emission would collapse dramatically in industrialized countries, rendering our economies greener for a short period. In the barrage of both the 'great lockdown' and the COVID recession, this slump in fossil fuel consumption and emission was more palpable than ever. "In April 2020, almost 54% of the global population were subject to complete or partial lockdowns and, as such, the share of energy use exposed to

[1] "COVID-19 Dashboard," Center for Systems Science and Engineering, Johns Hopkins University, accessed June 5, 2022, https://www.arcgis.com/apps/dashboards/bda7594740fd40299423467b48e9ecf6.

[2] "GDP growth (annual %)," Data, World Bank, accessed June 5, 2022, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG.

[3] "List of COVID-19 pandemic legislation – United States," Wikipedia, last modified March 15, 2022, https://en.wikipedia.org/wiki/List_of_COVID-19_pandemic_legislation#United_States.

containment measures reached 50%."[4] The traditional fossil fuels were then exposed to a dramatic market crash. The price of paper oil has once plummeted to unbelievably minus $37 per barrel.[5] As a result, "daily global CO_2 emissions fell by 17% in April 2020, compared to April 2019."[6]

Another critical problem is what scenario we can expect in the post-COVID and post-recession time. Will retaliatory consumption and emission come as encouraged by all government bailouts, or could we expect a greener and more sustainable recovery? Many scholars gave a positive answer to this question, saying that "given relative economic performances between fossil fuels and sustainable energy during the pandemic, there appears to be a greater chance of green stimulus this time around."[7] The EU spearheads a way to this green recovery. Early in December 2019, when the COVID-19 pandemic erupted in China at its very first stage, the European Green Deal has been presented to the EU Commission and signed off by its leaders with the overarching aim of making the EU climate neutral by 2050.[8] After the EU also slipped into the COVID recession, the deal was first marginalized and then proposed to be integrated as part of the recovery program. In the Next Generation EU and 2021-2027 Multiannual Financial Framework to cope with the unpresented socio-economic challenge of the pandemic, 30% expenditure of the 2 trillion euros budget will be expected to go to the climate-related sectors,[9] which is the most tremendous among the packages of the leading economies.

A black swan event, the Russian invasion of Ukraine in early 2022, accelerated this pace and reaffirmed the EU's determination to move to a renewable energy

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[4] Caroline Kuzemko et al., "Covid-19 and the Politics of Sustainable Energy Transitions," *Energy Research & Social Science* 68 (2020): 2.

[5] "U.S. crude oil futures for May plummet to minus $37 – lowest price in history," Lucy Bayly, NBC News, updated April 20, 2020, https://www.nbcnews.com/business/markets/oil-prices-tumble-lowest-level-1980s-n1187716.

[6] Kuzemko et al., "Sustainable Energy Transitions," 2.

[7] Kuzemko et al., "Sustainable Energy Transitions," 5.

[8] "The European Green Deal sets out how to make Europe the first climate-neutral continent by 2050, boosting the economy, improving people's health and quality of life, caring for nature, and leaving no one behind," The European Green Deal, European Commission, accessed June 5, 2022, https://ec.europa.eu/commission/presscorner/detail/en/ip_19_6691.

[9] "Recovery Plan for Europe," European Commission, accessed June 5, 2022, https://ec.europa.eu/info/strategy/recovery-plan-europe_en#the-largest-stimulus-package-ever.

transition as fast as possible. Once again, Russia wields its 'gas weapon' to coerce the EU when facing the barrage of sanctions and embargos put by the Western bloc. As Russia cut off its gas supplies to the European market, global energy prices skyrocketed from their record lows in the first days of the pandemic to a historical peak. The price of paper gas has ever spiked to 340 euros per MWh with a subtly price increase in paper oil to $120 per barrel.[10] The energy-poor Europe is then facing a supply dilemma and can barely find reliable, adequate, and affordable alternatives immediately. Although the EU may backtrack on its commitment in the short term,[11] it is, in fact, more committed to phasing out coal, oil, and presumably gas in its energy mix. In May 2022, the EU Commission presented a new plan: REPowerEU, to materialize its goal. The plan provides policy and financial tools (around 250 billion euros[12]) to reduce its dependence on volatile fuels and fast forward the green transition. Accordingly, the EU 2030 target for renewables will be improved from the present 40% to 45%, with a total generation capacity of 1236GW.[13] Renewable energy will be indispensable in the EU's future energy scenario.

However, this scenario can only be materialized by building an as inclusive and transnational industry of renewables as fossil fuels. Despite renewables' relative decentralization trait vis-à-vis coal, oil, and gas, there are still some places where renewables are much more abundant to capture and others where water is scarce, sunlight is shorter, and the wind is more impotent. The efficiency with which they can be utilized differs from place to place. Therefore, just like how people figured out moving coals, oils, and gas from colonies to metropoles, from mining and drilling peripheries to industrialized cores, and from producers to consumers, people also envisioned an electrified world connected by cables, pylons, and convertors where

[10] "Natural Gas EU Dutch TTF (EUR/MWh)," EU Natural Gas, Trading Economics, accessed December 19, 2022, https://tradingeconomics.com/commodity/eu-natural-gas.

[11] Countries like Norway, Germany, and the Netherlands have announced production increases or new drilling operations in the North See.

[12] "REPowerEU: affordable, secure and sustainable energy for Europe," The European Green Deal, European Commission, accessed June 5, 2022, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en.

[13] "REPowerEU," accessed June 5, 2022.

green electricity can be delivered from renewable-rich places to the renewable-poor.

Accordingly, several renewable 'super grids' have been proposed to render it feasible, including 'Asia Super Grid,' China's 'Global Energy Interconnection,' 'SuperSmart Grid,' and 'North Sea Offshore Grid,' most of which were presented and implemented by the Japanese, Chinese, and EU-based institutions. Once again, the surrounding regions of these energy-thirsty behemoths are integrated into their strategic deployment in the post-fossil fuel regime. Among them, the Middle East and North Africa (MENA) regions stand out as one of the most critical non-EU cooperators in the EU's future energy scenario. In some EU-based proposals like 'DESERTEC' and 'Megrid', this region is expected to use its limitless solar power on the 'barren' lands of the Sahara and Arabia Peninsula to power their Northern neighbors. The endogenous energy transition of the EU can then have spillover effects over its surroundings where the transition is considered, engineered, deployed, or even imposed externally from the very beginning. These relations, however, are largely overlooked by the previous research that puts their focus only on renewable transition at a local scale. This research then aims to expose this dark side of renewable energy transition and asks:

- How is this transnational cooperation of renewable energy transition envisioned and implemented?
- How does it reconfigure the asymmetrical power relations between Europe and the MENA region?

To answer the above questions and understand renewables' implementations and their influence at both local and transnational scales more comprehensively, this research will adopt a geographical framework of energy transition posited by a group of energy geographers working at the forefront of this topic to research the well-known renewable project, 'DESERTEC', and the most representative non-European country that goes furthest in this project – Morocco. It aims to argue that while Morocco's solar power potential is envisioned as critical in a trans-Mediterranean renewable transition by both the Moroccan government and European developers, it can be implemented only through accumulation by dispossession in Morocco's South Eastern periphery. By

resorting to specific sociotechnical practices, renewable projects serve not only to replicate the centralized governance of the fossil fuel regime and territorialize the country's marginalized lands and population. It also reconfigured the ecologically unequal exchange between Morocco and Europe and furthered their asymmetrical power relations in history.

Methodology: The Scale Question and Geographical Understanding of Renewable Energy Transition

Literature Review and Research Gap:

On the African continent, Morocco is one of the fastest countries in forwarding the renewable energy transition and is always high-profile to brag about what has been achieved. Its ambitious Quarzazate Solar Power Station, in particular, attracts so much attention from both the public and academics.

While most of the coverages and academic articles tend to give compliments, several scholars from human geography and anthropology background are skeptical and critical about the transition.[14] Among them, Rignall leads the way in disclosing the nuanced relations between the construction of the Quarzazate Solar Power Station and Morocco's opaque land tenure that can be traced to the colonial strategies for dispossession in the French mandate. She argues that although the lands are collectively owned by the locals, at least nominally, they were sold by the representatives at an over-low price to the Moroccan government to construct the solar plant. However, people there did not financially benefit from this selling or the development programs promised by the government. The whole process can be seen as a land appropriation by dispossession but camouflaged by the alleged green ends.[15]

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[14] Karen E. Rignall, "Theorizing Sovereignty in Empty Land: The Land Tenure Implications of Concentrated Solar Power in Pre-Sahara Morocco" (paper, The International Conference on Global Land Grabbing II, Ithaca, NY, October 2012). https://cornell-landproject.org/download/landgrab2012papers/rignall.pdf.

Karen E. Rignall, "Solar Power, State Power, and the Politics of Energy Transition in Pre-Saharan Morocco," *Environment and Planning A: Economy and Space* 48, no. 3 (2016): 540-557.

Roberto Cantoni and Karen Rignall, "Kingdom of the Sun: A Critical, Multiscalar Analysis of Morocco's Solar Energy Strategy," *Energy Research & Social Science* 51 (2019): 20-31.

Sarah Ryser, "The Anti-Politics Machine of Green Energy Development: The Moroccan Solar Project in Quarzazate and Its Impact on Gendered Local Communities," *Special Issue: Does Commons Grabbing Lead to Resilient Grabbing? The Anti-Politics Machine of Neo-Liberal Development and Local Responses* (June 2019): 1-21.

Atman Aoui, Moulay Ahmed El-Amrani, and Karen E. Rignall, "Global Aspirations and Local Realities of Solar Energy in Morocco," *Middle East Report* 296 (Fall 2020).

Zakia Salime, "Life in the Vicinity of Morocco's Noor Solar Energy Project," *Middle East Report* 298 (Spring 2021).

Joanna Allan, Mahmoud Lemaadel, and Hamza Lakhal, "Oppressive Energopolitics in Africa's Last Colony: Energy, Subjectivities, and Resistance," *Antipode* 54, no. 1 (2022): 44-63.

[15] Rignall, "Theorizing Sovereignty in Empty Land."

Rignall, "The Politics of Energy Transition in Pre-Saharan Morocco."

Cantoni and Rignall, "Kingdom of the Sun."

Ryser and Salime reiterated the same argument in their respective research but moved further to the project's disproportionate impact on local women. They argued that the solar plant's construction displaced many people who had been living on these appropriated lands. However, while men were removed from traditional grazing activities and entrapped in precarious employment, it was primarily women who were re-employed in the newly developed agricultural sector and started to bear the burdens of social production and reproduction simultaneously.[16] The project's impact on the local community is thus highly gendered.

Despite this primary difference, all the above works discussed how the Moroccan government and other international stakeholders create a new energy space on the 'barren' lands of the Southeast and then put it under their jurisdiction, namely territorializing space in the renewable energy transition. However, by implementing transition, the government can also re-enhance its political control over space. Cantoni and Rignall, for example, elaborate on how the technical choice of the Quarzazate Solar Power Station serves the political ends of the government. By choosing the more centralized technology of CSP (Concentrated Solar Power) rather than the more decentralized PV (Photovoltaics), the administration can remain in total control of the energy production process.[17] All the facilities built to secure energy production can also keep a watch on the 'restless' population of the periphery.[18] In the most extreme conditions, they can even create a governable space *ex nihilo* on the colonized lands and be wielded as a weapon to suppress local discontent and rebellions. This is exactly what happened to the Morocco-controlled West Sahara.[19]

Indeed, the above literature exposed how the implementation of renewable energy transition in Morocco is built upon new frontiers of accumulation by dispossession and how the government utilized this greening opportunity to render its sovereignty in the

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Aoui, Ahmed El-Amrani, and Rignall, "Solar Energy in Morocco."

[16] Ryser, "The Anti-Politics Machine of Green Energy Development."
Salime, "Life in the Vicinity."

[17] Cantoni and Rignall, "Kingdom of the Sun."
Aoui, Ahmed El-Amrani, and Rignall, "Solar Energy in Morocco."

[18] Salime, "Life in the Vicinity."

[19] Allan, Lemaadel, and Lakhal, "Oppressive Energopolitics in Africa's Last Colony."

peripheral areas and discipline the restless populations there. However, there is still some research lacuna to fill and help think about renewables in a more comprehensively critical way.

First, they disclosed some dark sides of how a specific renewable project like the Quarzazate Solar Power Station is implemented at the local scale but stopped going further to a grander critique about how the transition differentiates the energy space transnationally. Although Cantoni and Rignall critiqued in their work that "an exclusive focus on energy transition at larger geographical scales can obscure the local governance implications of large-scale renewable projects." [20] Having some reservations on this point, I argue instead that the renewable energy transitions at local and transnational scales can produce variegated energy spaces. However, these spaces can never be separated but interact with each other deeply. The smaller are constitutive elements of the larger. The larger reversely acts on the smaller. It would then be problematic to dichotomize these two types of research. Thus, the renewable energy transition at the local scale should be studied in the totality of the regional and global energy transition, the whole of the transition that arises through the interaction of its local parts.[21] The Moroccan case should then also be understood in the panorama of the trans-Mediterranean and larger-scale transition and their interactions with the former.

Second, the above critiques at only the local scale will also hinder us from understanding the nature of renewables and recalibrating their position in achieving the sustainable development of our human society. Although renewables like solar and wind power seem limitless in contrast to the concentrated but unrenewable fossil fuels, the construction of the medium through which renewables can be collected, conversed, delivered, and deposited cannot be limitless. Solar panels, for example, can only be manufactured by using crystalline silicon. The rare-earth magnets are an indispensable component of wind turbines. Copper cables and lithium batteries will be ubiquitous if we keep electrifying our energy system. All these critical materials are as concentrated,

[20] Cantoni and Rignall, "Kingdom of the Sun," 20.
[21] Hanieh, *Money, Markets, and Monarchies*, 16.

unrenewable, and scarce as traditional fossil fuels and even more. Its physical finitude will massively limit the scale at which renewables can be implemented to power our daily life and annul the promise to achieve sustainable development through the energy transition. Therefore, it is also essential to analyze renewables at a transnational scale, namely on the global production chain of the renewable industry, to expose the nature of these new energy sources behind our techno-fetishism.

In general, the renewable energy transition has a conspicuous geographical feature. "Energy systems are constituted spatially: the components of the system are embedded in particular settings, and the networked nature of the system itself produces geographies of connection, dependency, and control."[22] When it comes to the energy transition, the geography of the incumbent energy system will also change concomitantly and develop into new geographies of producing, living, and working with new forms of energy. What the above literature is aiming for is to expose these unequally developing geographies in Morocco's renewable energy transition. However, since they narrowed their critical analyses to the local scale, only partial dimensions of these emerging geographies were thoroughly researched. To fill this lacuna, we need an alternative geographical framework to comprehensively understand these emerging geographies of energy transition in Morocco and a larger region and re-evaluate renewables and their implementations therein accordingly.

Theoretical Framework and Research Method:

Here, the scholars of energy geography contributed much intelligence. In 2013, Bridge, Bouzarovski, Bradshaw, and Nick posited a conceptual framework to describe and assess the geographical implications of renewable energy transition in their co-authored article "Geographies of Energy Transition."[23] In this framework, they introduced and explained six classical concepts from geography, namely location, landscape, territory, scale, spatial differentiation, and spatial embeddedness,[24] and each

[22] Gavin Bridge, Stefan Bouzarovski, Michael Bradshaw, and Nick Eyre, "Geographies of Energy Transition: Space, Place, and the Low-Carbon Economy," *Energy Policy* 53 (2013): 333.

[23] Bridge et al., "Geographies of Energy Transition."

[24] Bridge et al., "Geographies of Energy Transition," 331.
Bridge and Gailing, "New Energy Spaces," 1043-1045.

represents an endeavor to understand the space-making process of the renewable energy transition comprehensively.

Besides, they also found that the contemporary patterns of socio-economic activity are also spatially constituted and rest on the geography of energy capture and conversion and the ability to displace the environmental costs of energy use over time and space.[25] The patterns and scales of this socio-economic activity will then be influenced by the spatial reconfiguration of the energy transition. Therefore, they reworked the six concepts by introducing a political economy dimension into the framework. The aim is to augment its capacity to do analytical work and provide a toolkit for unpacking the spatial elements of transition and thinking systematically about what transition might mean for the spatial organization of energy systems and socio-economic activity more generally.[26] (Table 1)

Table 1:

Spatial elements	Conventionally conceptualized as	Reworked in this geographical framework of energy transition as
Location (Location of energy production and consumption in the analytical context)	Spatial particularity and singularity of the place	Place as generative space of energy-related socio-technical and political economic possibility
Landscape (Energy landscape)	Assemblage of socio-material features across a broad space	Processes of infrastructuring, resource-making and other socio-material practices associated with energy production, distribution, and consumption over a given space
Territory (Energy territory)	Space where social and political power is organized and exercised (Usually being put under	Organization of social and political power over space in and through energy systems, and at a variety of

[25] Bridge et al., "Geographies of Energy Transition," 333.
Bridge and Gailing, "New Energy Spaces," 1038.
[26] Bridge and Gailing, "New Energy Spaces," 1043.
Bridge et al., "Geographies of Energy Transition," 334.

	the jurisdiction of a state or other powerful stakeholders)	local, national, and supranational scales
Scale (Scale of energy landscape and territory)	Material size and areal extent of phenomena	Rescaling of different geographical forms in which different energy technologies can be deployed and different political governance and economic organization can be implemented
Spatial differentiation (Spatial differentiation in energy systems)	The production of spatial convergence and divergence between places	Dialectical interaction between spatial differentiation and equalization in energy transition, generating new patterns of uneven or combined development
Spatial embeddedness (Spatial embeddedness of the incumbent energy system)	None	The material, economic, and cultural aspects of the incumbent energy system are spatially embedded

* The table is an information combination from both "Geographies of Energy Transition" and "New Energy Spaces."

To comprehensively critique the renewable energy transition in Morocco, I have organized four chapters in the following content to discuss one or two geographical dimensions of the energy transition in this table each chapter. These discussions further proceed in conversation with other relevant theories like 'green grabbing', 'governmentality', and 'ecologically unequal exchange'.

In the first chapter, the first two dimensions – location and landscape, will be discussed. It aims to explore why Morocco is considered a suitable place to implement solar transition, in specific to build the flagship project – the Quarzazate Solar Power Station in its South East; and how this solar transition reconfigures the energy landscape at a national and transnational scale.

The second and third chapters will then move to discuss the energy transition's territory and scale. The second chapter aims to exemplify how the solar transition is

implemented in Morocco through a detailed analysis of the Quarzazate project. The intent is to argue that the feasibility of scaling up renewable transition is also based upon predation, fraud, and violence traced to the archaic enclosure and colonization in the past centuries. Thus, there is no significant difference between renewable energies and traditional fossil fuels in their exploitative nature. The emerging space of renewables can also be seen as a frontier of accumulation by dispossession. However, scaling up is not indispensable to implementing the renewable energy transition. In the third chapter, I will discuss why some specific types of technologies are preferred among all sociotechnical possibilities in Morocco's solar transition and how they help territorialize the emerging space in this process.

The last chapter will step back a little bit from the Moroccan case and try approaching a panorama of renewable energy. Based on the framework's reflection on spatial differentiation of energy transition, I will first discuss how the uneven development under the incumbent fossil fuel regime has been reproduced into a new but much invisible pattern in the renewable energy transition. The analysis will accordingly span from the uneven development in the Moroccan case to the uneven development along the regional and global industrial chain of renewables. Based on the above reflections, this chapter also aims to critique whether we can circumvent the embeddedness of the incumbent fossil fuel regime in our human society to generalize renewable energies as effortless and far as expected; whether renewable energies are truly green as declaimed; and in what socioeconomic scenario they can be used to achieve the sustainable development goal we desperately need and unremittingly pursue.

Aside from secondary literature, I will adopt documentary research and discourse analysis as the primary methods to dig for relevant information and data to support my arguments. These data come from the public websites, existing research reports, and white books of the governmental agencies, non-governmental organizations, and companies directly involved or indirectly precipitating the implementation of the 'DESERTAC' project and renewable energy transition in Morocco. They include the European Commission, DESERTEC Foundation, the Moroccan Agency for Solar

Energy (MASEN), the German Aerospace Center, the World Bank, the African Development Bank, and the German Agency for International Cooperation (GIZ). All other data are primarily collected from databases of the International Energy Agency (IEA), World Bank, Our World in Data run by the University of Oxford, and Trading Economics.

Chapter 1 – A Brief History of 'DESERTEC': Morocco in a Trans-Mediterranean Landscape of Renewable Energy Transition

All energy systems, here including the associated components of production, distribution, consumption, and waste disposal, will occupy some specific locations in space. For oil, these could be the space where oil wells, refineries, pipelines, tankers, and the consuming market locate, and even the atmosphere where emissions will be finally dumped. When all these locations are strung together, they will become the landscape where materials interact with humans – our labor, technologies, and other sorts of non-material production. Therefore, "the implementation of a low-carbon energy transition will involve several significant shifts in the location of key components of the contemporary energy system…and the re-appraisal of the form, function, and value of some contemporary and familiar landscapes."[27] Since we are still in the very beginning of this transition and there are plural and even contesting futures we can expect, we would better not treat them as a finished but generative process where location and landscape shifts are still happening. The two spatial elements of the transition I will discuss in the following part can then be both factual and imaginary. Even in this case, they have already been considered, felt, and perceived by the people and are the most visible in the renewable energy transition. In this chapter, I will discuss why Morocco is considered an important location of the renewable energy transition and how it consists a part of an emerging energy landscape.

Under the incumbent energy system, Morocco could be seen as a very poor and vulnerable country. "Nearly all fossil fuels have to be imported, and the last coal mine in the country, Jerada, has been closed in 2001."[28] Even until 2020, when the national renewable strategy had been implemented for around a decade, 82% of the electricity it produced was still coming from the imported fossil fuels (59.3% from coal, 12.1% from gas, and 10.8% from oil).[29] Moreover, the electricity production in this country

[27] Bridge et al., "Geographies of Energy Transition," 334-335.
[28] Cantoni and Rignall, "Kingdom of the Sun," 22.
[29] "Electricity Mix," Hannah Ritchie and Max Roser, Our World in Data, accessed June 10, 2022, https://ourworldindata.org/electricity-mix.

has climbed from 12.13 TWh in 2000 to 37 TWh in 2020[30] and is expected to keep its upward momentum in its future development. It is thus questionable to see whether Morocco can sustainably continue its economic development (with a 3-4% GDP growth annually in recent years[31]) that co-relates with energy production and consumption a lot if most of these energies are imported. The most alarming is that the CO_2 emissions of the country have skyrocketed from 3320 million tons in 2000 to its pike, 6822 million tons in 2019,[32] which could be disastrous to its already-vulnerable environment. All these factors prompted the Moroccan government to move at a bold pace to renewable energy transition, especially in the case that the country is poor in fossil fuels but extremely rich in some renewables like sun irradiations in its deserts and wind around the coast.

In 2009, the Moroccan government was determined to move away from the above bothersome and announced an ambitious New Energy Strategy (NES) and a flagship solar energy project. The initiative aims to "reduce Morocco's dependency on imported fossil fuels, to develop a key national resource (the sun), and to create a global competitive advantage in renewable energy over the long term."[33] Accordingly, "it called for developing 2000MW of solar energy capacity in five sites throughout Morocco's Saharan fringe, one in Ain Bni Mathar, one in Quarzazate, and the other three in contested Western Sahara."[34] If everything goes smoothly, the project will finally bring the percentage of energy supplied by domestic, renewable sources from the current 5% to 42% in 2020.[35] Till today, the Quarzazate Solar Power Station has been built into the world's largest CSP plant, with an added 70MW PV affiliation. The complex's energy capacity has exceeded what had been initially planned and reached 580MW in its total.[36] (Figure 1) In this way, Morocco, its underdeveloped Saharan

[30] "Electricity Mix," accessed June 10, 2022.

[31] "GDP growth (annual %) – Morocco," Data, World Bank, accessed June 10, 2022, https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=MA.

[32] "Morocco: CO_2 Country Profile," Hannah Ritchie and Max Roser, Our World in Data, accessed June 10, 2022, https://ourworldindata.org/co2/country/morocco.

[33] Rignall, "Theorizing Sovereignty in Empty Land," 4.

[34] Rignall, "Theorizing Sovereignty in Empty Land," 4.

[35] Rignall, "Theorizing Sovereignty in Empty Land," 4.

[36] "Noor Quarzazate Solar Complex," Praveen, Power Technology, updated March 6, 2020, https://www.power-technology.com/projects/noor-ouarzazate-solar-complex/.

peripheries in specific, have been considered the new and strategic locations of renewable energy transition and been integrated into the national energy landscape where electricity can be produced in these fringes and delivered to the whole country.

Figure 1

*Quarzazate Solar Power Station Phase I, II, and III from the bottom up, and Phase IV on the right side (Source: Wikipedia)

However, Morocco's rush to renewable energy transition is driven not only by its domestic needs but also by some external factors like the energy transition in Europe. Back in the early 2000s, the country and the region where it is located, namely the Middle East and North Africa (MENA), had already been considered into the imagination of a trans-Mediterranean landscape of renewables. Among all, the 'DESERTEC' initiative is the most representative and influential one.[37] The preliminary idea was first posited by the Trans-Mediterranean Renewable Energy Cooperation (TREC) in 2003 as a partnership of the German section of the Club of Rome, the Hamburg Climate Protection Foundation, and the National Energy Research Center of Jordan.[38] It is hard to see whether the German government had engaged in this process at that time point. However, the government[39] had shown enough interest without doubt and drove the German Aerospace Center (DLR) to conduct "pioneered research on CSP technology, seawater desalination, and trans-Mediterranean interconnections."[40] In the successive reports they published in 2005, 2006, and 2007, the research group of DLR commented highly on the feasibility of implementing the MED-CSP system (The multi-effect desalination and concentrated solar power system, a combined system of electricity, heat, and water generation) on this trans-Mediterranean landscape, deeming it a scenario that could guarantee the energy, water, and climate security of both Europe and the MENA region.[41] The solar potential of the

[37] Others include Medgrid, a project that could be seen as the French-led version of DESERTEC. In 2011, a memorandum of understanding was signed between Medgrid and DESERTEC Industry Initiative (Dii). The two serve as the backbone of the trans-Mediterranean landscape of renewables between Europe and the MENA region.

[38] Cantoni and Rignall, "Kingdom of the Sun," 22.

[39] Here indicating the German Ministry for the Environment, Nature Conservation, and Nuclear Safety.

[40] Cantoni and Rignall, "Kingdom of the Sun," 22.

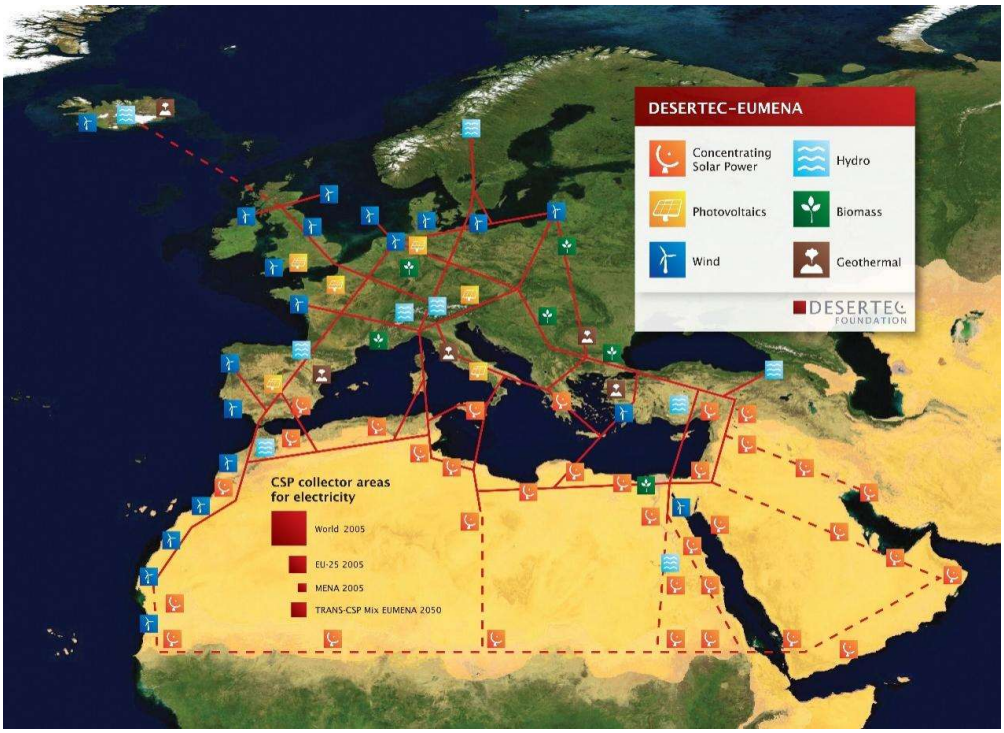
[41] Institute of Technical Thermodynamics, "Concentrating Solar Power for the Mediterranean Region" (Executive summary, German Aerospace Center, Stuttgart, April 2005), https://www.dlr.de/tt/Portaldata/41/Resources/dokumente/institut/system/projects/MED-CSP_Executive_Summary_Final.pdf.

Institute of Technical Thermodynamics, "Trans-Mediterranean Interconnection for Concentrating Solar Power" (Executive summary, German Aerospace Center, Stuttgart, April 2006), https://www.dlr.de/tt/Portaldata/41/Resources/dokumente/institut/system/projects/TRANS-CSP-Executive_Summary_Final.pdf.

Institute of Technical Thermodynamics, "Concentrating Power for Seawater Desalination" (Executive summary, German Aerospace Center, Stuttgart, November 2007), 19, http://solarec-egypt.com/resources/AQUA-CSP-Executive-Summary-English-01.pdf.

MENA region, in particular, has been given much exposure. They believe "only 1% of the area of global deserts would be sufficient to produce the entire annual primary energy consumption of humankind as electric power."[42] In other words, if a CSP complex of that huge is constructed in the desert of this region, it will not only guarantee the energy demand for use and water desalination there but can also "supply 10-15% of Europe's demand of clean electricity by 2050."[43] This trans-Mediterranean landscape of energy transition that the TREC was trying to imagine and create can be best exemplified by its iconic map: "a vast network of solar and wind farms stretching right across the MENA region and connecting to continental Europe via special high voltage, direct current transition cables."[44] (Figure 2)

Figure 2



* A trans-Mediterranean landscape of renewable energy transition (Source: DESERTEC Foundation)

[42] DESERTEC Foundation, "Clean Power from Desert: The DESERTEC Concept for Energy, Water and Climate Security" (White book, Bonn, February 2009), https://chemtrailsgeelong.com/uploads/DESERTEC.pdf

[43] DESERTEC Foundation, "Clean Power from Desert," 54.

[44] Rignall, "Theorizing Sovereignty in Empty Land," 6.
Rignall, "The Politics of Energy Transition in Pre-Saharan Morocco," 545.

To materialize this ambitious landscape, a range of international political and financial platforms have been established to provide necessary political coordination, financial support, and regulatory framework. In 2009, for example, twelve German enterprises signed on to establish the DESERTEC Industrial Initiative (Dii) – a public-private consortium to help financially put the idea to the ground.[45] Almost the same year, an inter-governmental organization of 42 countries – the Union for the Mediterranean, was also founded. One of its most important tasks is to promote the Mediterranean Solar Plan (MSP), effectively improving the member states' energy efficiency and deploying an additional 20GW to their renewable energy capacity by 2020.[46] Besides, many international investment banks and development agencies have also participated and poured enormous amounts of money into the project, where Morocco is always targeted as the top destination.

Accordingly, Morocco also established some agencies[47] to first respond to its domestic needs and international expectations, second raise indispensable funds from the society, and last deploy the project in a concrete way. Among all these agencies, the Moroccan Agency for Solar Energy (MASEN) stands out as the most critical one. First, the MASEN was established as a state-owned enterprise to provide funds for the implementation of the NES – the construction of five CSP power stations in the pre-Saharan region and other types of renewable plants. It was "initially capitalized with MAD 500 million (approximately US$62 million) from, in equal measure, public funds through the Ministry of Energy, Mines, Water and Environment, Hassan II Fund for Economic and Social Development (a public investment vehicle), the National Office for Electricity (a public utility), and the Society of Energy Investment (a public renewable energy investment fund)."[48] Nevertheless, this amount is still far less than

[45] Rignall, "Theorizing Sovereignty in Empty Land," 6.
Rignall, "The Politics of Energy Transition in Pre-Saharan Morocco," 545.
Cantoni and Rignall, "Kingdom of the Sun," 22.

[46] "The Mediterranean Solar Plan at the European Parliament," Union for the Mediterranean, accessed June 10, 2022, https://ufmsecretariat.org/the-mediterranean-solar-plan-at-the-european-parliament/.

[47] Others include Research Institute for Solar Energy and New Energy, the Ministry of Energy, Mines, Water, and Environment, the National Agency for Renewable Energies and Energy Efficiency, the State Investment Company, and the Office for Energy and Drinking Water.

[48] Rignall, "Theorizing Sovereignty in Empty Land," 5.

the expected for the plants' construction (estimated to be MAD 70 billion, equivalent to US$8.8 billion[49]) and can only be the seeding fund to raise more money from the private sector and international society. Under the 'DESERTEC' rubric, this is where most of the investment from the international agencies I mentioned went. The construction of the flagship project, Quarzazate Solar Power Station, for example, has consistently collected 884 million dollars from KfW Bankengruppe since its first proposal, 706 million from the World Bank Group, 473 million from the European Investment Bank, and 238 million from the Clean Technology Fund. In total, the funds collected from these international donors have accrued to 2.3 billion dollars, up to 87% of the total project cost.[50] By financially engaging with specific projects, these European-based and -dominated agencies entrenched Morocco in the trans-Mediterranean landscape of renewable energy transition and asserted their dominance on how to implement the transition in the country and for whom and what ends.

Unexpectedly, this momentum of the 'DESERTEC' initiative soon came to its waning in the 2010s and finally "abandoned its strategy of exports to Europe in 2013,"[51] against the backdrop of the global economic recession. Until 2015, Morocco still imported 15% of its electricity from Spain,[52] the country that shared two intercontinental cables by that time and is a critical connection in the trans-Mediterranean landscape of renewable energy transition in 'DESERTEC.' While the most critical group attributes the fiasco to the unequal relations of power and exchange between the EU and the MENA countries,[53] some others choose an eclectic standpoint and put it down to the mistrust between the two. They blame the EU for its overemphasis on energy security and the MENA region for its perennial political

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Rignall, "The Politics of Energy Transition in Pre-Saharan Morocco," 544.

[49] Rignall, "Theorizing Sovereignty in Empty Land," 5.

Rignall, "The Politics of Energy Transition in Pre-Saharan Morocco," 544.

[50] "Morocco: Noor Solar Power Project," Projects and Operations, World Bank, updated December 13, 2022, https://projects.worldbank.org/en/projects-operations/project-detail/P131256.

[51] Cantoni and Rignall, "Kingdom of the Sun," 23.

[52] "Renewable projects reshape energy landscape in Morocco," Oxford Business Group, accessed June 10, 2022, https://oxfordbusinessgroup.com/overview/preparing-future-ambitious-renewables-projects-should-reshape-energy-landscape.

[53] Rignall, "Theorizing Sovereignty in Empty Land," 8-9.

Rignall, "The Politics of Energy Transition in Pre-Saharan Morocco," 547-548.

Cantoni and Rignall, "Kingdom of the Sun," 23.

instability.[54] The collapsing oil price in 2013 and 2014 also put much pressure on the burgeoning market of renewables and tried forcing it out of the incumbent energy system. Cantoni and Rignall then summarized this as that "a project fundamentally transnational in nature was reduced to a nation-centered one, illustrating the diplomatic and economic challenges of coordinating a regional renewable energy transition."[55]

However, according to the recent development, it is too early to rush to the final judgement and deem it the end of the trans-Mediterranean landscape of renewable energy transition. First, Morocco does not shrink from its renewable ambition. On the 2015 COP21 occasion, Morocco, as the next holder of this important event, declared an upgraded NES. The country pledged to increase 42% of its total installed power capacity from renewable energy in 2020 to a 52% level in 2030.[56] To achieve the goal, the country is expected to increase 10GW capacity between 2018 and 2030, among which 4560MW will be solar, 4200MW will be wind, and only 1330MW will be hydropower.[57] But it is hard to say to whom these capacities will be built. Since 2018, for example, the electricity trading between Morocco and Spain has been reversed for the first time. Morocco exported 20558GWh of electricity and had an almost 10000GWh surplus of electricity trade against Spain for the whole year.[58] Morocco has gradually become a net exporter of green electricity as it is envisioned in the 2000s. Besides, other mechanisms have also emerged to replace the old 'DESERTEC' and are continuously materializing the landscape. For example, Xlinks, a UK-based energy start-up, has proposed a Morocco-UK power project in 2021. The project aims to build a combined electricity generation facility of 10.5GW and high-voltage direct current

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[54] L. E. de Souza et al., "Postcolonial Theories Meet Energy Studies: 'Institutional Orientalism' as a Barrier for Renewable Electricity Trade in the Mediterranean Region," *Energy Research & Social Science* 40 (June 2018).

Sharlissa Moore, *Sustainable Energy Transformations, Power, and Politics: Morocco and the Mediterranean* (London: Routledge, 2018).

[55] Cantoni and Rignall, "Kingdom of the Sun," 23.

[56] "Morocco Renewable Energy Target 2030," IEA/IRENA Renewables Policies Database, International Energy Agency, updated October 10, 2019, https://www.iea.org/policies/6557-morocco-renewable-energy-target-2030.

[57] "Morocco Renewable Energy Target 2030," updated October 10, 2019.

[58] "Morocco Becomes Net Exporter of Electricity to Spain," Kawtar Ennaji, Morocco World News, updated August 6, 2019, https://www.moroccoworldnews.com/2019/08/279844/morocco-net-exporter-electricity-spain.

(HVDC) subsea cables of 3800km to render the electricity delivery between Morocco and the UK possible in 2027. Therein, 3.6GW of the total capacity is planned to be transmitted to the UK to meet up to 8% of its electricity demand (nearly 7 million UK homes).[59] The whole project looks like the British version of 'DESERTEC,' but is envisioned and implemented at a more feasible scale and in a more concrete way. Therefore, the trans-Mediterranean landscape of renewable energy transition cannot be seen as fading away from the possible geographical future we would have. Instead, it chose a diversified way to be materialized and has become an important constituent of a larger global landscape.

[59] "Morocco-UK Power Project, Morocco," Hemanth, Power Technology, updated May 4, 2022, https://www.power-technology.com/projects/morocco-uk-power-project-morocco/.

Chapter 2 – Green Grabbing: Environmentalist Discourse, Colonial Specter, and Land Acquisition in the Quarzazate Project

Although the renewable transition in Morocco was envisioned in the first place as part of the more significant trans-Mediterranean transition, the most noticeable change spatially happens in Morocco. Considering the dispersive nature of renewables in contrast to the concentrated fossil fuels and the massive land acquisition we need to capture them, it drives us to think about where people acquired lands to implement them, who owns these lands for what ends, and how the whole property or concession transaction happened. The problem here is that the unsustainable energy use in Europe could be repaired by the dubbed sustainable but unjust renewable practices in Morocco.[60] To answer the above puzzles and worrisome, the following two chapters intend to adopt the flagship renewable project in the country – Quarzazate solar power station, as a case and research how renewable projects were implemented explicitly in Morocco and what geographical and socio-economic impacts they have brought. By exposing these dark sides of renewable transition on the local scale, these two chapters will lay a foundation for further discussion of the reconfigured ecologically unequal exchange and asymmetrical power relations between Europe and Morocco in Chapter 4.

Indeed, Marx had far earlier recognized and discussed socio-economic activities and their private occupation of space, lands, and other forms of natural constitutions in the capitalist society. He defines it as primitive accumulation – "the historical process of divorcing producers from the means of production,"[61] in which the appropriation of natural resources, especially lands, constitutes an important part. However, he and a large cohort of his successors relegate "this accumulation based upon predation, fraud, and violence to an 'original stage' that is considered no longer relevant or as being somehow 'outside of' capitalism as a closed system – 'primitive' or 'original'

[60] James Fairhead, Melissa Leach, and Ian Scoones, "Green Grabbing: A New Appropriation of Nature?" *Journal of Peasant Studies* 39, no.2 (2012): 242.

[61] Karl Marx, *Capital: A Critique of Political Economy*, trans. Ben Fowkes, vol.1 (London: Penguin Classics, 1990), 875.

accumulation has already occurred, and accumulation now proceeds as expanded reproduction, albeit through the exploitation of living labor in productivity."[62] However, this understanding would be too weak to explain the reoccurred enclosures and exploitations of the public-owned terrestrial and subterrestrial resources for capital accumulation in history. Therefore, David Harvey posited 'accumulation by dispossession'[63] to replace the narrowly-understood 'primitive accumulation' and argued that "the 'organic relation' between expanded reproduction on the one hand and the often-violent processes of dispossession on the other have shaped the historical geography of capital."[64]

These spatiotemporal dynamics of continuous capital accumulation can be better defined by another notion – 'frontier'. Based on his historicist research on the sugar cane industry in the 16th-century Madeira – a Portuguese-settled island, Jason Moore defines 'frontier' as "the encounter zones between capital and all kinds of nature-humans included."[65] As far as there remains uncommodified lands, labor, and other kinds of ecological surplus that can be enclosed, plundered, or dispossessed, further expansion of capitalism is possible 'along' and 'beyond' the frontier.

Energy extractions are not an exception in this regard. Exemplified by the development of the oil industry, as far as onshore oil resources are depleted and the profit margins of their extractions have been attenuated, the frontier of oil discovery and exploitation has gradually moved from onshore sedimentary basins through shallow offshore basins and into the deep and ultradeep-water basins.[66] In the Gulf of Mexico, where the US offshore drillings are most concentrated, for example, offshore oil production has risen from almost net zero in the 1960s to accounting for 15% of

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[62] David Harvey, *The New Imperialism* (Oxford and New York: Oxford University Press, 2005), 143-144.

[63] Harvey, *The New Imperialism*, 145-146.

[64] Harvey, *The New Imperialism*, 141-142.

[65] Jason W. Moore, "Sugar and the Expansion of the Early Modern World Economy: Commodity Frontiers, Ecological Transformation, and Industrialization," *Review (Fernand Braudel Center)* 23, no.3 (2000): 409-433.

Raj Patel and Jason W. Moore, *The History of the World in Seven Cheap Things* (Oakland: University of California Press, 2017), 17.

[66] Michael J. Watts, "A Tale of Two Gulfs: Life, Death, and Dispossession along Two Oil Frontiers," *American Quarterly* 64, no.2 (September 2012): 445-446.

total US crude oil production in 2021. The drilling depth accordingly raised from 100-200 feet first to 1000-2000 feet in the 1980s. At present, there are thousands of platforms operating in waters up to 6000 feet deep, with a few hitting 10000 feet or more.[67] If we pinpoint these drilling activities on a map, it is clear to see how the production frontier extends beyond the coastline and is sprawling to the center of the sea. (Figure 3) After implementing new technologies to increase oil yield and counter the skyrocketing oil price, these energy frontiers further extended to where tar sands and oil and gas shales can be extracted on a large scale. In this sense, the renewable implementations in countries like Morocco can be seen as the latest emergent frontiers of the energy sector.

Figure 3

* Map of the sprawling offshore oil drilling in the Gulf of Mexico (Source: William E. Mcnulty, National Geographic)

[67] "Oil and Petroleum Products Explained – Offshore Oil and Gas," U.S. Energy Information Administration, updated October 4, 2022, https://www.eia.gov/energyexplained/oil-and-petroleum-products/offshore-oil-and-gas-in-depth.php.

However, as a new practice of frontier creation, renewables are not as controversial as fossil fuels. For long, fossil fuel frontiers have been customarily seen as violence-producing spaces where land and property rights are contested, the rule of law is in question, and frontier populations are displaced for coercive capital accumulation.[68] Notorious events like the Niger Delta's humanitarian disaster, the Deepwater Horizon oil spillage, and the Enron scandal only deepened people's impression of the rapacious, speculatory, and detrimental industry. Renewable energies, on the other hand, are always described as fossil fuels' antipode. Despite the same necessity of land acquisition and engagement with local populations, they are always perceived as a fabulous and inexhaustible alternative to repair the ecological disasters left by fossil fuels. Entrapped in this environmentalist discourse, even if the frontier populations are mistreated in implementing renewable projects, they will find it difficult to voice for the injustice they are going through. This discursive practice can be the significant factor that shapes people's differentiated encounters along the frontiers of renewables and traditional fossil fuels.

Recognizing both similarities and differences between these green practices and their predecessors, James Fairhead developed Harvey's notion of 'accumulation by dispossession' into 'green grabbing' – "the appropriation of land and resources for environmental ends, whether through biodiversity conservation, biocarbon sequestration, the protection of ecosystem services, ecotourism or offsets related to any and all of these."[69] In this process, green notions, as a robust globalizing discursive manifestation, "come to be defined and mobilized in particular ways to help with new forms of appropriation, whereby lands and other resources are alienated from their prior claimants, or, at least, the rules and authority over their access, use, and management are restructured."[70] The historical legacy of accumulation by dispossession is clearly sustained here in a new way.

The construction of the Quarzazate Solar Power Station in Morocco can well

[68] Watts, "A Tale of Two Gulfs," 446.
[69] Fairhead, Leach, and Scoones, "Green Grabbing," 239.
[70] Fairhead, Leach, and Scoones, "Green Grabbing," 239,247.

exemplify how a predatory green project can be justified by overwhelming environmental and legal discourses with their technical complexity. In general, the Moroccan government aims to utilize this showcase project to exhibit its renewable ambition in an emergent energy and economic regime and reposition the country in its transnational relations with the EU, Sub-Saharan Africa, and a grander international community. As the Moroccan King Muhammad VI has reiterated on different occasions, the Moroccan solar plan and its flagship project, Quarzazate, reveal "Morocco's will to ensure the durability of its economic and social development through an efficient, environment-friendly energy policy to shield future generations from economic and ecological threats…It can also be a real lever for South-North and South-South cooperation through sharing green energy with European countries and institutional and operational cooperation with Sub-Saharan African countries with solar potential."[71] Therefore, the project's implementation is proceeding under a panoramic international witness and should be "impeccably legal, professional, and efficient."[72]

Involvers of the project made a lot of technical and discursive endeavors to hit the above goal. The implementer and supervisor of the Quarzazate project, MASEN, with its contracted developer ACWA Power, belongs to the first batch to take action. They commissioned an environmental consulting company based in Dubai to launch a comprehensive study on the project's environmental and social impacts. The research was divided into four parts to cover each four construction phases of the grandiose project. Its assessment results were all published before each phase's kick-out and can still be available on MASEN's website nowadays.[73] The most critical investors of this

[71] "HM The King Chairs Working Sessions on Progress of Moroccan Solar Plan Noor," Kingdom of Morocco, updated March 17, 2014. https://www.maroc.ma/en/royal-activities/hm-king-chairs-working-session-progress-moroccan-solar-plan-noor.

[72] Rignall, "Theorizing Sovereignty in Empty Land," 15.

[73] Five Capitals Environmental & Management Consulting, "NoorO I CSP Plant, Quarzazate, Morocco" (Non-Technical Summary, ACWA Power, Dubai, December 2012), https://www.masen.ma/sites/default/files/documents_rapport/Masen_NOORoI_SESIA_NTS_English_xPkadZt%20%281%29.pdf.

Five Capitals Environmental & Management Consulting, "NoorO II CSP Plant, Quarzazate, Morocco" (Non-Technical Summary, ACWA Power, Dubai, March 2015), https://www.masen.ma/sites/default/files/documents_rapport/Masen_NOORoII_SESIA_NTS_1FK69tp.pdf.

Five Capitals Environmental & Management Consulting, "NoorO III Tower CSP Plant, Quarzazate, Morocco" (Non-Technical Summary, ACWA Power, Dubai, March 2015),

project audited these preliminary research outcomes as a supplement to the precaution. Among them, the World Bank uploaded the same documents as part of their registration records.[74] The African Development Bank, on the other hand, conducted and reviewed its own assessment in accordance with the policies and procedures of other donors, especially the French Development Agency, the European Investment Bank, the World Bank, and KfW Bankengruppe.[75]

Although these assessments came from different-layered administrations relevant to the project, they all adopted the same information and argument from the commissioned consulting company and promised in chorus a green, innoxious, and prosperous future for the project's implementation. By and large, the project would be located in a wasteland of perfectly nobody, nothing, and no value to extract, known as 'Tamzaghten Izerki'. It belongs to the Ghessat Ogrour Toundout rural commune area, approximately 10 km northeast of the city of Quarzazate.[76] For this natural trait, the almost non-existent flora and fauna can barely be bothered by the project's minor and, sometimes, negligible impacts on the site's ecology, which technical mitigation measures can further eradicate. In water usage, where people hold most doubts about the concentrated solar power station, the assessments also gave a satisfactory answer. In specific, the water used for each phase will only be 0.3 Mm^3, 0.43 Mm^3, 0.2 Mm^3, and 0.01 Mm^3, respectively, and only need an extra 1.75 Mm^3, 0.36 Mm^3, 0.2 Mm^3, and

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https://www.masen.ma/sites/default/files/documents_rapport/Masen_NOORoIII_SESIA_NTS_S1B1xAA.pdf.

Five Capitals Environmental & Management Consulting, "NoorO IV Quarzazate 70MW Photovoltaic Power Project, Kingdom of Morocco" (Non-Technical Summary, ACWA Power, Dubai, December 2016), https://www.masen.ma/sites/default/files/documents_rapport/Masen_NOORoIV_SESIA_Volume1_NTS_March_2017_0.pdf.

[74] World Bank, "Morocco – Quarzazate Concentrated Solar Power Project: Environmental and Social Impact Assessment Framework" (Non-Technical Summary, Washington, from 2011-2013), https://documents.worldbank.org/en/publication/documents-reports/documentlist?repnb=E2644.

[75] African Development Bank, "Morocco – Quarzazate Solar Power Station Project – ESIA Summary" (Executive Summary, Abidjan, October 2011), https://www.afdb.org/en/documents/document/morocco-ouarzazate-solar-power-station-project-esia-summary-25035.

African Development Bank, "Morocco – Quarzazate Solar Power Station Project II – ESIA Summary" (Executive Summary, Abidjan, August 2014), https://www.afdb.org/en/documents/document/morocco-ouarzazate-solar-power-station-project-ii-esia-summary-49229.

[76] Five Capitals Environmental & Management Consulting, "NoorO I CSP Plant," 1.

0.08m³ per year for each block's operation. The average contribution to the Mansour Ed Dahbi Reservoir, which is 420 Mm³, will dwarf this quantity even in total.[77]

The most unreasonable point in these assessments is their analysis of the project's socioeconomic impacts. Although the surveyors have recognized that the project's realization should occupy almost 2000 hectares of land and sever 8300 villagers' grazing route from the High Atlas Mountains to the lower altitude steppe, (Figure 4) they only include this socioeconomic impact in the secondary issues they should consider in the reports.[78] Furthermore, they arbitrarily argue that the project will require no destruction of habitat and no displacement of communities or economic activities. By contrast, it will create jobs and new income-generating opportunities through renewable-relevant productions and contribute to a promising future for the site locals.[79] However, these agency technicians are always vague and uncertain about how many jobs the project can create (from dozens to thousands), in contrast to their accurate calculation of the occupied lands. The information these words deliver is clear: these lands are not efficiently utilized by subsistence pastoral production and should be re-rendered for new and much-improved use, like the production of solar power. In this discourse, an archaic mode of production dominating this land for centuries has to be subordinated to a modern or even '*avant-garde*' production under the emerging renewable regime. As the villagers in the vicinity complained, "the project deprived their communities of ancestral pasture, disrupting old paths of circulation between our villages, and extending out travel time to Quarzazate."[80] The local people, as a result, are forced to abandon the culture, habits, and lifestyle upon which they and their ancestors lived and thrived for millennia and passively conform to the social and human-ecological relations imposed by a corporate institute consisted of the

[77] Five Capitals Environmental & Management Consulting, "NoorO I CSP Plant," 4.
Five Capitals Environmental & Management Consulting, "NoorO II CSP Plant," 6.
Five Capitals Environmental & Management Consulting, "NoorO III Tower CSP Plant," 6.
Five Capitals Environmental & Management Consulting, "NoorO IV Quarzazate 70MW Photovoltaic Power Project," 5.
[78] African Development Bank, "Morocco," 7, 16.
Five Capitals Environmental & Management Consulting, "NoorO I CSP Plant," 2.
[79] African Development Bank, "Morocco," 15-16.
[80] Salime, "Life in the Vicinity."

government, European investors, and Gulf-based developers and consultants.

Figure 4

* Map of Morocco (Source: Diana K. Davis, "Neoliberalism, Environmentalism, and Agricultural Restructuring in Morocco," *The Geographical Journal* 172, no.2 (2006): 97.)

This narrative to marginalize aboriginal production and land use is at least two centuries old, stretching back to the French colonization in North Africa. As the French colonizers endeavored to appropriate lands and resources from the colonized and, most importantly, to promote modernization projects to serve their trading cause, they adopted an Orientalist tactic to dichotomize their 'normal and productive' environment

compared to the latter's 'strange and defective' one.[81] In this narrative, local nomads were always blamed for the alleged environmental degradation caused by their overgrazing. The consequent need to improve or repair the environment then provided justifications to build roads, railways, dams, irrigations, and other imperial projects and sedentarize the restless nomads. After the independence of these North African countries, their governments inherited this colonial tradition to promote mega projects in the name of modernization and development and further their control over the peripheral lands and population.[82] Especially in the case of Quarzazate province, as narratives of overgrazing, land degradation, and desertification are very pervasive there,[83] the words surveyors used to justify the construction of solar power station in Quarzazate can be the latest manifestation of this colonial conception.

Besides, another colonial legacy helps legally realize the Quarzazate Solar Power Station and is more relevant to the physical appropriation facet of the green grabbing – the land tenure in Morocco. Indeed, all the environmental and social assessment reports I mentioned above have explicitly noticed that the project will have to occupy the communal lands of approximately 2500 hectares belonging to the Ait Oukrour Toundout ethnic group. The purchase of the designated land has already been completed by MASEN in October and November 2010, with the Ait Oukrour Toundout community and its supervisory council giving their approval in advance, and in accordance with statutory terms of sale and for the price set by a dedicatedly-established review commission.[84] Following the same procedure, MASEN completed the second purchase of 543-hectare land adjacent to the initial site in 2014.[85] The whole process looks perfectly compliant with all relevant laws in Morocco, including its land tenure.

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[81] Edward Said, *Orientalism* (London: Penguin Books, 2019).

Diana K. Davis, "Introduction: Imperialism, Orientalism, and the Environment in the Middle East," in *Environmental Imaginaries of the Middle East and North Africa*, eds. Diana K. Davis and Edmund Burke III (Athens: Ohio University Press, 2011), 4.

[82] Davis, "Introduction," 4-6.

[83] Diana K. Davis, "indigenous Knowledge and the Desertification Debate: Problematizing Expert Knowledge in North Africa," *Geoforum* 36, no.4 (2005): 511.

Diana K. Davis, "Neoliberalism, Environmentalism, and Agricultural Restructuring in Morocco," *The Geographical Journal* 172, no.2 (2006): 96.

[84] African Development Bank, "Morocco," 16.

Five Capitals Environmental & Management Consulting, "NoorO I CSP Plant," 9.

[85] African Development Bank, "Morocco II," 2.

However, people rarely critique how this tenure was established in the first place and whether it is as legitimate as expected.

In fact, the Moroccan government still relies on the juridical framework inherited from the French mandate to govern its communal lands. To maintain a delicate balance between European speculators' interests and to appease the locals' rages or even struggles against their alienation, the French protectorate administration endowed a decree in 1919 to establish a preliminary land tenure in Morocco and expected to sprawl its influence to the restless peripheries. By this land tenure, the nominal ownership of 12 million hectares of communal lands was given to the colonized people, though, divided into innumerable pieces to the scattered ethnic collectivities, or, let's say, local tribes. However, in the name of tutelage and protection, only the Office of Indigenous Affairs and the alleged representatives of the ethnic collectivity, but mostly co-opted notables, can have the right to decide the allocation and use over these lands. They colluded with each other to concede swaths of communal lands to French agriculture, private business of colonial settlers, and infrastructure construction to serve the imperial trade.[86] The 64,000-hectare lands Ait Oukrour Toundout owns were also demarcated against this backdrop.[87]

Although the Office of Indigenous Affairs dissolved after Morocco's independence in 1956, its tutelary authority was handed over to the incumbent Directorate of Rural Affairs in the Ministry of Interior.[88] The land tenure remains intact to continue governing the countries' communal lands, most of which are concentrated in its far fringes like the Quarzazate province.[89] Therefore, it is precisely by resorting to the same vested ownership and 'black-boxed' land transaction that the land acquisition for the construction of the Quarzazate Solar Power Station can be realized in such an ideally compliant way as described in various environmental and social

[86] Rignall, "Theorizing Sovereignty in Empty Land," 15-16.
Rignall, "The Politics of Energy Transition in Pre-Saharan Morocco," 548-549
Robin Bidwell, *Morocco Under Colonial Rule: French Administration of Tribal Areas 1912-1956* (London: Routledge, 1973).
[87] Rignall, "Theorizing Sovereignty in Empty Land," 11.
[88] Rignall, "Theorizing Sovereignty in Empty Land," 17.
[89] Davis, "Neoliberalism, Environmentalism, and Agricultural Restructuring in Morocco," 96.

impact assessment reports.

In specific, an assessment conducted by the National Bureau of Electricity (ONE) in 2007 confirmed the site's suitability to build a solar plant. Whether any socio-political consideration was integrated, the site choice was described as a purely technical decision, without any need for pre-engagement and consultation with the local inhabitants who can barely understand the technical complexity therein.[90] In 2011, three collective land representatives of the different fractions of Ait Oukrour constituted a committee to approve the sale of the 2500 hectares of land to MASEN without consulting the collectivity members beforehand. These representatives are usually life-long and occupied by the notables in each tribe and can be pressured or co-opted by the administration as easily as their predecessors in the colonial era.[91] At last, this deceptive representation, with a deliberate depreciation of the land as an unproductive rocky plateau, reduced the two procurement proceeds to 30.5 million dirhams (3 million US dollars) in total, at 1 dirham (0.1 US dollars) per square meter.[92] After the deal was settled, both "local inhabitants and some officials of the regional Directorate of Rural Affairs agree that the amount was paltry, a symbolic payment rather than meaningful compensation for the land's value."[93]

Moreover, the purchase gains will not be distributed to the locals directly but are deposited into a special account at the Ministry of Interior and managed by the Directorate of Rural Affairs for developmental ends on behalf of the Ait Oukrour Toundout Collectivity.[94] The governmental agency, with its international counterparts, thus replaced the old colonial agency to 'teach' and 'supervise' indigenous people how to put the 'underused' lands into a replicated but efficient mode of development, regardless of their locally-contingent knowledge, habits, and history. According to their arrangements, the project itself can create more than a thousand job opportunities for

[90] Cantoni and Rignall, "Kingdom of the Sun," 29.
African Development Bank, "Morocco," 3.
[91] Rignall, "Theorizing Sovereignty in Empty Land," 18-19.
[92] African Development Bank, "Morocco II," 27.
[93] Aoui, El-Amrani, and Rignall, "Global Aspirations."
[94] Five Capitals Environmental & Management Consulting, "NoorO I CSP Plant," 9.
African Development Bank, "Morocco," 16.

the local communities (although the number is uncertain and spans between dozens and thousands) and, meanwhile, boost the commercial and small industrial business at the neighboring villages. The land acquisition compensation, on the other hand, will be committed to a variety of welfare projects, including electricity, irrigation, and drinking water supply. Inspired by the success of adjacent municipalities becoming noted film-shooting locations, they even aspired to build the grandiose solar complex into a tourist attraction.[95]

However, most of these lip services are too vague to tell when and how these projects can be materialized. In this case, even if 26 million dirhams are said to have been spent on the above projects in 2014, and the remaining funds would be exhausted in 2015,[96] the social commitments are not fulfilled as MASEN and the Directorate of Rural Affairs planned and promised. Despite this newly-constructed power plant, the people living in its vicinity are still paying a prohibitive price for their electricity use. The employments it created are also slim and volatile. Once the plant's construction is completed, its operation will only need 40-50 highly trained technicians and engineers, not the locals used to make a living by herding.[97] As local inhabitants doubt, "why do they have to pay for their own development?"[98] It is also problematic to see that the lack of investment in infrastructure, state services, and local livelihoods in this long-marginalized region since the 1930s can only have to be repaired by their land-selling proceeds.[99]

Through these exposures, it is hard to contend that the local inhabitants in the vicinity of the Quarzazate Solar Power Station benefited fairly from the plant's construction. By contrast, the excitement and optimism of development at the project's first envisioning finally diminished to a collective disillusionment about green grabbing. After all, "fuzzy legal frameworks and markets are often the most profitable means of

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[95] Five Capitals Environmental & Management Consulting, "NoorO I CSP Plant," 9-10.
African Development Bank, "Morocco," 15, 19-20.
African Development Bank, "Morocco II," 20, 28-29.
[96] African Development Bank, "Morocco II," 29.
[97] Aoui, El-Amrani, and Rignall, "Global Aspirations."
Salime, "Life in the Vicinity."
[98] Aoui, El-Amrani, and Rignall, "Global Aspirations."
[99] Rignall, "Global Aspirations and Local Realities of Solar Energy in Morocco."

enclosing land and eroding the property rights of marginalized groups."[100] Like the Orientalist discourse about the environment, the land tenure that the French colonizers enacted to justify their imperial enclosures was rejuvenated in post-independent Morocco, especially in this neoliberal era, to continue conspiring to private accumulation with state agencies. The colonial specter is still haunting this country from various facets of technology, wealth, discourse, conception, and legal framework, entrenching Morocco's asymmetrical relations with its Northern neighbors since the old.

[100] Rignall, "The Politics of Energy Transition in Pre-Saharan Morocco," 544.
Tania M. Li, "What is Land? Assembling a Resource for Global Investment," *Transactions of the Institute of British Geographers* 39, no.4 (October 2014): 589-602.

Chapter 3 – Concentrated or Dispersive? Territorializing the Emerging Energy Space

The green-grabbing activities enclosed a physical space for the production of renewable energy on a land of 3000 hectares in Quarzazate province. However, some other endeavors should also be paid to declare the subsequent ownership and maintain control over this space and all activities happening in it, a process where the construction of social space will be integrated into the physical space and enhance the latter's existence. Human geographers define it as 'territorialization' – a process where social and political power is organized and exercised over space to achieve geographical ends of partition and integration.[101] In the energy sector, this territorialization always unfolds around the energy source's 'materiality' – is it solid or liquid, concentrated or dispersive, deep-buried or shallow-buried? All these material traits will determine in which way energies can be extracted, collected, packaged, and transferred and further determine which space and conduit should be territorialized and rigorously controlled by the power. Only in this way "energy production networks can be organized geographically to generate and capture value."[102]

Timothy Mitchell sharply noted this 'materiality' and explained how it would be maneuvered by different powers in a variety of sociotechnical possibilities to achieve their different sociopolitical ends, including state territorialization. In *Carbon Democracy*, for example, he attributed the democratic movements in 19th and 20th century Europe and America from "the movement of concentrated stores of carbon energy that provided the means for assembling effective democratic claims."[103] "Since specialized bodies of workers were concentrated at the end-points and main junctions of these conduits…that allowed stores of energy to move along them, their position and concentration gave them opportunities to forge a new kind of political power…by employing the ability to slow, disrupt or cut off the energy's supply."[104] Similar points

[101] Bridge et al., "Geographies of Energy Transition," 336.
[102] Bridge et al., "Geographies of Energy Transition," 336.
[103] Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (London and New York: Verso, 2012), 8.
[104] Mitchell, *Carbon Democracy*, 19.

of vulnerability can also be found in the oil industry, including its wells, pipelines, refineries, docks, and shipping lanes, at which a series of claims for political freedoms and more egalitarian forms of life would be fought for.[105]

Nevertheless, Mitchell's perception of the oil industry and its influence on democratization is far more pessimistic than that of the coal industry. He believes, "unlike the movement of coal, the flow of oil could not readily be assembled into a machine that enabled large numbers of people to exercise novel forms of political power."[106] The reasons could be variegated. By and large, the fluidity and lightness of oil render transporting a large quantity of energy by pipelines and transoceanic shipping feasible. These methods of transport do not require as many labors as in the coal industry, thus massively undermining the power of organized workers to paralyze energy production.[107]

However, this attribution is still too superficial to explain how the positive correlations between concentrated energy sources and democratization have been reversed under the oil regime. As Mitchell argued in the following section, for example, without introducing metal shipping containers of standard dimensions developed in the American war against Vietnam into the oil industry, we cannot make oil passage over great distances such a fluid and uninterrupted process. Therefore, besides oil's fluidity and lightness in its physical nature, technological innovations like containerization are essential to render these natures their utility. They gradually eliminated the unionized workers and eradicated their capacity to exercise power through their control of oil production conduits.[108]

In piling and scaling up these sociotechnical practices, the as vulnerable oil industry as coal mining has finally evolved into the oil assemblage, a totality where material circumstances, populations, and technology intertwine and interact in a compatible way. Critical geographers and anthropologists borrowed Michel Foucault's

[105] Mitchell, *Carbon Democracy*, 103.
[106] Mitchell, *Carbon Democracy*, 38-39.
[107] Mitchell, *Carbon Democracy*, 36-39.
[108] Mitchell, *Carbon Democracy*, 154-155.

'governmentality' [109] to theorize this oil assemblage as a 'governable space', 'technological zone', or 'modular capitalist project'.[110] These variegated notions all indicate a space upon which a coordinated set of regulations, calculative arrangements, and infrastructural and technical procedures that render oil sites territorialized and oil flow governable is imposed.[111] It includes the innumerable turnstiles and checkpoints of the oilfield, the standardized safety and security regulations, and the state's violent agencies like oil police and military, but all for the unified and premiere ends of state control and capital accumulation in the oil frontiers.

After entering the energy transition, however, as renewables are more dispersive and volatile in contrast to traditional fossil fuels, it is more difficult to impose territoriality and governmentality over their uncontrollable materiality. There are, thus, more possibilities and differentiated scenarios in which renewable transition can be implemented, renewables can be produced and consumed, and socio-political life can be re-organized around energy, one of the most critical materials in our human society. According to a set of deconstructed spatial factors of renewables, namely contiguity (dispersion/density), centralization, and connectivity, human geographers pinpointed several contending spatial organizations at work in the evolution of a renewable energy regime. They are primarily differentiated by the technologies and scales the renewable transition will resort to and will render the emerging energy space territorialized and governable in different and sometimes opposite ways.[112]

Exemplified by different solar power technologies, these scenarios can be divided into two. In the first scenario, the more decentralized solar production by photovoltaic

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[109] It refers to a more or less calculated and rational set of ways of shaping conduct and securing rule through a multiplicity of authorities and agencies in and outside the state and at a variety of spatial levels. Please read:

Michel Foucault, *Power/Knowledge: Selected Interviews and Other Writings, 1972-1977*, ed. Colin Gordon (New York: Patheon Books, 1980).

[110] Michael J. Watts, "Resource Curse? Governmentality, Oil and Power in the Niger Delta, Nigeria," *Geopolitics* 9, no.1 (2004): 53, 55-57.

Watts, "A Tale of Two Gulfs," 442-443.

Andrew Barry, "Technological Zones," *European Journal of Social Theory* 9, no.2 (2006), 239-240.

Hannah Appel, "Offshore Work: Oil, Modularity, and the How of Capitalism in Equatorial Guinea," *American Ethnologist* 39, no.4 (2012): 697.

[111] Watts, "A Tale of Two Gulfs," 443.

[112] Bridge et al., "Geographies of Energy Transition," 337.

panels can produce a more decentralized energy and sociopolitical space. Thinking about the independent solar modules installed on the roof of people's houses and generating electricity for self-sufficiency, this dispersive organization can potentially disintegrate the private or state-owned giants' monology over energy production and distribution and unprecedentedly empower small energy consumers. As long as the government's control over energy is undermined, it can also help promote more decentralized and democratic governance at both local and national scales. However, in the second scenario, the concentrated solar power technologies, whether indicating solar towers or parabolic trough collectors, are more inclined to produce as centralized and regimented energy and sociopolitical space as the fossil fuels produced. In this scenario, the political and economic power of the government and investors can be centralized through these concentrated installations to consolidate their control over energy production, distribution, and capital accumulation.[113]

When looking at the construction of the Quarzazate Solar Power Station, the Moroccan government obviously shows a keener interest in the concentrated sociotechnical practices rather than the dispersive ones. Both phase 1 and phase 2 of the solar complex were built into a concentrated solar installation using parabolic solar power concentration technology, with a 160MW and 200MW capacity, respectively. Phase 3 is built to produce 150MW by using tower solar power concentration technology. Even if phase 4 adopted photovoltaics to build, the Moroccan government did not kindly install the panels on the houses of the people living in its vicinity. Instead, they eradicated the dispersive trait of this technology and pieced 223440 panels together to make a colossal solar collector with a 70MW capacity.[114] (Figure 1)

The Moroccan government described their preference for concentrated solar power technologies as a decision of completely technical concerns rather than

[113] Cantoni and Rignall, "Kingdom of the Sun," 21.

[114] Five Capitals Environmental & Management Consulting, "NoorO I CSP Plant," 1.
Five Capitals Environmental & Management Consulting, "NoorO II CSP Plant," 1.
Five Capitals Environmental & Management Consulting, "NoorO III Tower CSP Plant," 1.
Five Capitals Environmental & Management Consulting, "NoorO IV Quarzazate 70MW Photovoltaic Power Project," 1.

integrated with other sociopolitical calculations. As the outputs of several commissioned research by the Moroccan agencies reiterates, the reasons can be primarily summarized as the following three. First, as the most dominant concentrated solar power technology, the parabolic trough can not only easily cover the high-power irradiation in the region but meanwhile benefit from great economies of scale. As far as the plant size meets 100 to 200MW, the power block will be used more efficiently to lower some specific investments. Second, in this technical practice, the sun's rays are concentrated in a combustion chamber to evaporate a heat-conveying fluid, and its vapor then drives the turbo-generator unit to produce electricity. For this reason, the extra thermal energy can be wisely stored in eutectic salts to work the generator even at night. This industrial design also makes it easy to integrate other energy sources like gas into this system to complement and ensure the stability of electricity production and delivery. Last, in contrast to other technical practices, especially photovoltaics, the parabolic trough solar plant can create more job opportunities in both its construction and operation phases. It can also help develop the local economy by building there a relevant production chain of mirrors, pylons, metal support structures, and other low-technical accessories.[115] All these shreds of evidence are robust enough to convince people to stick to the parabolic sun power concentration technology.

However, when MASEN was implementing phase 3 and phase 4 of the Quaerzazate project and other solar projects in Morocco, it jumped over to other technologies like solar tower, photovoltaics, and even linear Fresnel without any explicit reason. This sea change heavily struck the authenticity of the above sayings. The malleable words they used to justify these alternatives only make everything worse.[116] This messy arrangement can be attributed to the entangled cooperative and

[115] Fraunhofer Institute for Solar Energy Systems ISE, "Solar Technologies in Morocco – Industry and Value Chain Assessment" (Executive Summary, GIZ and MASEN, Freiburg, November 2012), https://www.giz.de/de/downloads/giz2012-en-solar-plan-morocco.pdf.

African Development Bank, "Morocco I," 8-10.

African Development Bank, "Morocco II," 13-14.

[116] For example, when proposing the photovoltaic phase 4 of the Quarzazate project, only the peaceful, non-pollutant, and water-saving traits of photovoltaics were highlighted. On the other hand, all previous praises about the parabolic trough were not mentioned. Please read:

Five Capitals Environmental & Management Consulting, "NoorO IV Quarzazate 70MW Photovoltaic Power Project," 2-3.

contending influence of the international society, especially Europe, on Morocco's renewable transition. As the largest investor in both Morocco's local and trans-Mediterranean energy transition, Germany and its financial, developmental, and technological agencies dwarf all other international institutes with their unparalleled influence on Morocco's renewable cause throughout. In 2011, the German Agency for International Cooperation (GIZ) commissioned Fraunhofer Institute for Solar Energy Systems to research the market potentials of different solar technologies in Morocco. According to Karolin Steinbacher's interviews with relevant parties, this research's chant about the Parabolic trough technology played a determinant role in adopting it to put up phases 1 and 2 of the Quarzazate project.[117] This technical implementation can also perfectly cater to the German-dominant 'DESERTEC' project and produce a stable and huge enough solar power capacity to deliver to Europe. In 2015, France, as Morocco's second-largest source of export revenues, also signed an agreement with the country to export its dominant linear Fresnel design.[118] Nowadays, South East Morocco has been rendered an experimental field for implementing different solar technologies. It is a 'crystal palace' of the solar expo where different European countries, by their technological penetration and financial investment, compete to exert their influence, dominate the solar transition in this country, and profiteer from the process massively.

Despite Morocco's indiscriminative adoption of these solar technologies, the most fundamental principle cannot be transgressed: all technical practices, regardless of their traits and suitability, must be implemented centralized to help territorialize the peripheral lands and population in the South East. The most representative province in this region, Quarzazate, for example, "is one of the frontier zones of Morocco, bordering the contentious, ill-defined Algeria border across which the group fighting

[117] "Research Projects – Study on Potential of Local Manufacturing of Solar Technologies in Morocco, Industry and Value Chain Assessment," Fraunhofer Institute for Solar Energy Systems ISE, accessed June 10, 2022, https://www.ise.fraunhofer.de/en/research-projects/local-manufacturing-of-solar-technologies-in-morocco.html.

Fraunhofer Institute for Solar Energy Systems ISE, "Solar Technologies in Morocco."

Karolin Steinbacher, "Drawing Lessons When Objectives Differ? Assessing Renewable Energy Policy Transfer from Germany to Morocco," *Politics and Governance* 3, no.2 (2015): 34-50.

[118] Cantoni and Rignall, "Kingdom of the Sun," 28.

for the independence of Western Sahara, the Polisario, are active…For hundreds of years, nomadic tribes from the South threatened and occasionally successfully invaded governments in Morocco…Thus, there is a long legacy of mistrust and surveillance of this frontier area."[119] In recent years, because of this region's long-standing repression and economic marginalization, unrest and other forms of social struggles also erupted from time to time, hastening the political pressures on the central government.[120] A concentrated sociotechnical implementation of solar power can not only build a material link between this region to the populated central and North Morocco. It also builds a highly securitized military space where energy production and distribution can be easily manipulated under the renewable regime, and local unrest can be promptly and efficiently pacified. In this sense, Europe's chant of some specific sociotechnical possibilities can help justify the Moroccan government's political consolidation and illegal occupation in its periphery.

[119] Davis, "Neoliberalism, Environmentalism, and Agricultural Restructuring in Morocco," 96.
[120] Aoui, El-Amrani, and Rignall, "Global Aspirations."

Chapter 4 – Ecologically Unequal Exchange Reconfigured: The Spatial and Developmental Differentiation of Renewable Energy Transition

Energy resources are geographically distributed, with them concentrated in some places but scarce in others. Even though renewables like solar and wind could be seen as ubiquitous, the efficiency with which they can be utilized is still different from place to place. Therefore, we can see how the Gulf region has become the 'oil barrel' of the global market, and hydropower is dominant in the riparian Alps and Norway. Even in the 'DESERTEC' map of chapter 1, the European continent is expected to become a hub of wind farms in the future energy scenario, while the vast Sahara and Arabian Peninsula are more suitable for implementing solar power. This geographical distribution of resources then leads to differentiated paths for development. However, according to what we learned from some energy-rich countries like Venezuela, Nigeria, or Iraq, the abundant energies do not lead to the inevitable affluence in these regions. By contrast, they are beset by conflicts, violence, underdevelopment, and other social pathologies reiterated by the 'resource curse' school.[121]

Affected by both the world-systems and ecological Marxist perspective,[122] Stephen Bunker gives a convincing explanation of these unreasonable social pathologies. He believes "structures of social and environmental inequality between the Global North and Global South are founded in the extraction of materials from, as well as the displacement of hazardous production processes and wastes, to the Global South."[123] In other words, the crux can be traced to not only the unequal exchange of

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[121] Michael Ross, *The Oil Curse: How Petroleum Wealth Shapes the Development of Nations* (Princeton and Oxford: Princeton University Press, 2012).

Hazem Beblawi and Giacomo Luciani ed., *The Rentier State* (London and New York: Routledge, 2016).

[122] James O'Connor, *Natural Causes: Essays in Ecological Marxism* (New York and London: The Guilford Press, 1998).

John B. Foster, "Marx's Theory of Metabolic Rift: Classical Foundations for Environmental Sociology," *American Journal of Sociology* 105, no. 2 (1999): 366-405.

Paul Burkett, *Marx and Nature: A Red and Green Perspective* (New York: St. Martin's Press, 1999).

[123] R. Scott Frey, Paul K. Gellert, and Harry F. Dahms, "Introduction: Ecologically Unequal Exchange in Comparative and Historical Perspective," in *Ecologically Unequal Exchange: Environmental Injustice in Comparative and Historical Perspective*, eds. R. Scott Frey, Paul K. Gellert, and Harry F. Dahms (Cham: Palgrave Macmillan, 2018), 1.

labor value between the Global North and Global South but the unequal exchange of the volatile value we attached to our natural resources, including energies, between these two types of societies.

To further explain, nature cannot enter the economic circulation of our human society as resources when they are still lying under the ground or floating in the water and air but are not necessarily exploited by our humans. Only when we render them useful or valuable in some way can nature become resources in our economy. "It depends on the way they are related to other things, to the opportunity to realize value by exchange, and to other materials that can fulfill the same functions."[124] Therefore, it could be seen that "we live in a material world in which 'the economy' is fundamentally (although not exclusively) a process of material transformation through which natural resources are converted into a vast array of commodities and by-product wastes."[125] However, this value of nature and the extent to which our economies depend have been systematically undervalued, only including nature's utility but not the incalculable existential value it contains and the ecological prices paid during extractions.

The market price of fossil fuels can sufficiently prove the above presumption. Like other finished and semi-finished products, fossil fuels are being traded off in the market, with their pricing conforming to the market's law of supply and demand in the short term. However, when putting it in the long run, this pricing mechanism is very problematic. Although these fossil fuels are extracted at an unprecedentedly prodigious rate and their quality has declined so much in their depletion, especially in the case of coal mining, their general price is still maintained low over a long historical period and does not skyrocket to reflect their scarcity.[126] The crude oil price, for example, spanned from $3 per cubic meter to $20 per cubic meter from the recordable 1861 until the pre-1973 oil crisis. For most periods, the price was even restricted below $10, with only

[124] Gavin Bridge, "Material Worlds: Natural Resources, Resource Geography and the Material Economy," *Geography Compass* 3, no.3 (2009): 1220.

[125] Bridge, "Material Worlds," 1218.

[126] Bridge, "Material Worlds," 1228.

mild oscillation.[127] After the watershed of the 1973 oil embargo and OPEC's decision to raise the oil price by their yield leverage, the oil price skyrocketed but became highly volatile in front of the competing decisive factors. It can be easily hit down by the bleak economic expectation or recession and is now beset by the promising scenario of renewables' large-scale implementation.[128] However, this plunging price is always achieved by the creative destruction of market demand. It can never change the reality that fossil fuels have been gradually depleted in an incredibly short period of our human civilization.

The undervaluation of these natural resources also means that, while processing these extractive commodities creates colossal additional value in other economies, only low proportions of capital and labor can be incorporated in the underestimated value created in those whose economic ties to the global market are based exclusively on the exchange of extracted commodities.[129] This limited incorporation cannot effectively "enhance human productivity or social complexity, do not engender local production-consumption accelerators, and do not remain embodied in physical infrastructure and complex social organization there."[130] This precariousness has gradually emerged in the fossil fuel producer regions against a renewable transition backdrop. As the whole world was troubled by the climate crisis and set a 'carbon budget' to lock the temperature rise within 1.5℃, more and more oil giants started to withdraw their investment from the fossil fuel sector out of their worries about their investment becoming 'stranded'.[131] The energy transition will then directly result in plunging investment or even divestment in these regions' relevant industries. More importantly, when international demand shifts away from fossil fuels, their socioeconomic and

[127] "Crude Oil Prices," BP Statistical Review of World Energy, Our World in Data, accessed June 10, 2022, https://ourworldindata.org/grapher/crude-oil-prices.

[128] Blondeel et al., "The Geopolitics of Energy System Transformation: A Review," *Geography Compass* 15, no.7 (2021): 5.

[129] Stephen G. Bunker, "Toward a Theory of Ecologically Unequal Exchange," in *Ecologically Unequal Exchange: Environmental Injustice in Comparative and Historical Perspective*, eds. R. Scott Frey, Paul K Gellert, and Harry F. Dahms (Cham: Palgrave Macmillan, 2018), 17-18.

[130] Bunker, "Ecologically Unequal Exchange," 21.

[131] The capital investment in fossil fuel infrastructure could end up failing to be recovered over the operating lifetime of the assets because of reduced demand and prices. Please read:
Blondeel et al., "The Geopolitics of Energy System Transformation," 6.

infrastructural organizations, which at one time respond to fossil fuel demand, are likely to lose their utility and can barely help them move forward to the next industrial upgrade.[132] As a result, these extractive economies will not only benefit disproportionately from the undervalued nature they are exporting but be entrapped in the systematically subordinate position in global value chains. Their differentiated paths for development are then not decided by themselves but by the exogenous powers of the industrialized producers.

On the other hand, when the world comes to an energy transition, the materials that we put this fallacious value on and devote our production, distribution, and consumption to will also come to a great recalibration. Since all these materials and socio-economic activities are just as spatially embedded as fossil fuels and all other natural resources, the energy transition can then reproduce the spatial differentiation of the incumbent energy system, generating new patterns of uneven development between sites of energy production and consumption or even along the industrial chains of renewable energies in general.[133]

The construction of the Quarzazate Solar Power Station and its prerequisite land acquisition I discussed in Chapter 2 is a good example. In the renewable energy transition of Morocco or a larger trans-Mediterranean region, Quarzazate, a socially and economically marginalized self-sufficient place in history, was brutally integrated into the national and transnational economy through green grabbing and imposed a specific role in it – to produce cheap but 'green' electricity for a wider region, primarily for the metropolis of Morocco and Europe. In this sense, these places are replacing the status of oil producer regions to become energy hubs in the emerging renewable regime.

However, the value expected to be attached to this industry is even slimmer than traditional fossil fuels. While hydrocarbons are relatively concentrated, the ubiquity and immateriality of renewables like wind and solar can only render them cheaper in the value system discriminatory with natural resources. Indeed, the renewable prices were firstly underpinned by the limited output of their installations, like photovoltaic panels

[132] Bunker, "Ecologically Unequal Exchange," 21.
[133] Bridge et al., "Geographies of Energy Transition," 337.

and wind turbines. As the relevant industries found cheap enough sources and labor reserves to expand their reproduction, the marginal effect is gradually emerging. The price of solar modules, for example, has declined by 99.6% in the past four decades, from the recordable price of 106 dollars per watt in 1976 to 0.38 dollars per watt in 2019. Especially under the collapsing price of solar installation in the past ten years, the price of electricity from solar accordingly declined by 89%, from 359 dollars per MWh in 2009 to 40 dollars per MWh in 2019.[134] From the market perspective, it is also rational to see renewable energies become cheap enough, most importantly, cheaper than fossil fuels, to gradually phase the latter out of the energy market. Although some people would deem it a good opportunity to ensure that these cheap renewables can be supplied to poor regions and help them with their industrial development and economic growth at a low cost, they usually ignore that it is precisely these poor regions that are framed as new suppliers of these energies and can benefit little from the meager values attached. Considering the more automatic procedure of production and delivery of renewable-powered electricity than the fossil fuel industries, it is also unpractical to expect that the former can absorb as many labors as the latter. As a result, these renewable production regions will be directed to a development path of 'extreme periphery', where only low proportions of capital and investment can be incorporated. The ecologically unequal exchange between fossil fuel producers and consumers is then replicated and reconfigured between renewable producers and almost the same energy consumers in the long history of industrial production.

Besides, it is also naïve to think that the reconfigured unequal exchange will only differentiate places and their development models in a dichotomous way, for example, with Morocco as the totality where the value of renewables is extracted and Europe as the other totality where it is absorbed. Instead, spatial production is sprawling along the production chains of renewables, differentiating spaces and their development at various scales, from local and regional to transnational and global. When Alexander Dunlap pinpoints the local struggles along a 400kv high-tension power line going

[134] "Why did renewables become so cheap so fast?" Max Roser, Our World in Data, updated December 1, 2020, https://ourworldindata.org/cheap-renewables-growth.

across France, Catalonia, and Southern Spain, stretching into Morocco and occupied Western Sahara,[135] (Figure 5) he also uncovered a corner of the sprawling space and development differentiations in the trans-Mediterranean renewable transition between Morocco and Europe. To realize the delivery of renewable-powered electricity between two continents, not only Morocco but all places where high voltage power lines are set up should also be included in the renewable landscape. The transformation of these lands from their original use is accompanied by as much fraud, expropriation, and violence as in the Quarzazate province, Western Sahara, and other renewable locations in Morocco. As peripheral regions of France, Catalonia, and Southern Spain, they are also incorporated into the reconfigured ecologically unequal exchange with Paris, Lyon, Barcelona, and Madrid under the emerging renewable regime.

The ecologically unequal exchange in the renewable energy regime does not only exist between energy producer and consumer regions along the delivery route. As McNeill disclosed, all types of energies share the same genesis – they are unexceptionally harvested from the sun (probably except nuclear, which is connected to uranium atoms). But their modes of conversion, storage, and use under different regimes are sometimes far from close.[136] Especially in the renewable case, the medium that collects the discrete amount of sun or wind power, converts them into usable electricity, and delivers and stores the electricity plays a much more palpable role than in traditional fossil fuels. Solar panels, for example, can only be manufactured by using crystalline silicon; rare-earth magnets are an indispensable component of wind turbines; copper cables and lithium batteries will be ubiquitous if we keep electrifying our energy system. According to the International Energy Agency (IEA), the total mineral demand for clean energy technologies is set to quadruple if Paris Agreement goals are to be met

[135] Alexander Dunlap, "Spreading 'Green' Infrastructural Harm: Mapping Conflicts and Socio-Ecological Disruptions within the European Union's Transnational Energy Grid," *Globalizations* 18 (November 2021): 9.

Alexander Dunlap and Louis Laratte, "European Green Deal Necropolitics: Exploring 'Green' Energy Transition, Degrowth and Infrastructure Colonization," *Political Geography* 97 (August 2022): 12.

[136] J. R. McNeill. *Something New under the Sun: An Environmental History of the Twentieth-Century World* (New York and London: W. W. Norton & Company, 2000), 259.

by 2040 and sextuple if the net-zero goal is to be met by 2050.[137] By contrast, all these critical materials are as concentrated, unrenewable, and scarce as traditional fossil fuels.

Figure 5

* Energy contests along transnational high voltage power lines stretching from the West Sahara and Morocco to South Europe (Source: Alexander Dunlap, Contesting Energy Transition Map)

Here, people researching global value chains or global commodity chains, their reflections on lengthening the chain to the extractive frontiers are highly valued.[138] Through this reflection, we should recognize that the reconfigured ecologically unequal

[137] "Total mineral demand for clean energy technologies by scenario, 2020 compared to 2040," IEA, updated October 26, 2022, https://www.iea.org/data-and-statistics/charts/total-mineral-demand-for-clean-energy-technologies-by-scenario-2020-compared-to-2040.

[138] Paul Ciccantell and David A. Smith, "Rethinking Global Commodity Chains: Integrating Extraction, Transport, and Manufacturing," *International Journal of Comparative Sociology* 50, no.3-4 (2009): 361-384.

Elena Baglioni and Liam Campling, "Natural Resource Industries as Global Value Chains: Frontiers, Fetishism, Labor and the State," *Environment and Planning A: Economy and Space* 49, no. 11 (2017): 2437-2456.

exchange between extractive frontiers of these critical materials, the renewable hubs, and terminals of renewable energy delivery is covered by the fantasy of renewables' immateriality. The unequal exchange and corresponding spatial differentiation have started with, perhaps, the Andean highlands, where much of the world's copper and lithium potential is concentrated, going through their processing in Chinese factories, and finally flowing into the Moroccan market to achieve the first step of the ambitious trans-Mediterranean renewable landscape.

In fact, governments of the dominant industrialized countries have recognized renewables' 'materiality' very early. In 2011, the European Commission produced its first list of critical raw materials, most of which are linked to renewables' implementation. This list has been updated every three years to expand from including 14 types at first to the present 30.[139] When the President of the European Commission, von der Leyen, addressed the 2022 state of the European Union, she announced the 'Critical Raw Materials Act' as the EU's latest step to ensure its secure and sustainable access to these renewable-relevant mines. In her address, she explicitly analogized these mineral commodities to oil and gas and exhibited the EU's wild ambition to be embroiled in the global race for their supply and recycling.[140] By the same token, the US government also announced its list of critical minerals in 2018 and reiterated, between lines, the similar urgency to join the race.[141] Behind these policy papers, the technocratic agencies have paid a lot of endeavors to figure out the geological distribution of these resources,[142] (Figure 4) concomitant with mining corporations' colossal investment, brutal land grabbing, and furious extraction preceding. These

[139] "Critical Raw Materials Act: Securing the New Gas & Oil at the Heart of Our Economy I Blog of Commissioner Thierry Breton," European Commission, accessed September 14, 2022.

[140] "Critical Raw Materials," Internal Market, Industry, Entrepreneurship and SMEs, European Commission, accessed June 5, 2022, https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en.

[141] U.S. Department of the Interior, Office of the Secretary, *Final List of Critical Minerals 2018*, 83 FR 23295, https://www.federalregister.gov/documents/2018/05/18/2018-10667/final-list-of-critical-minerals-2018.

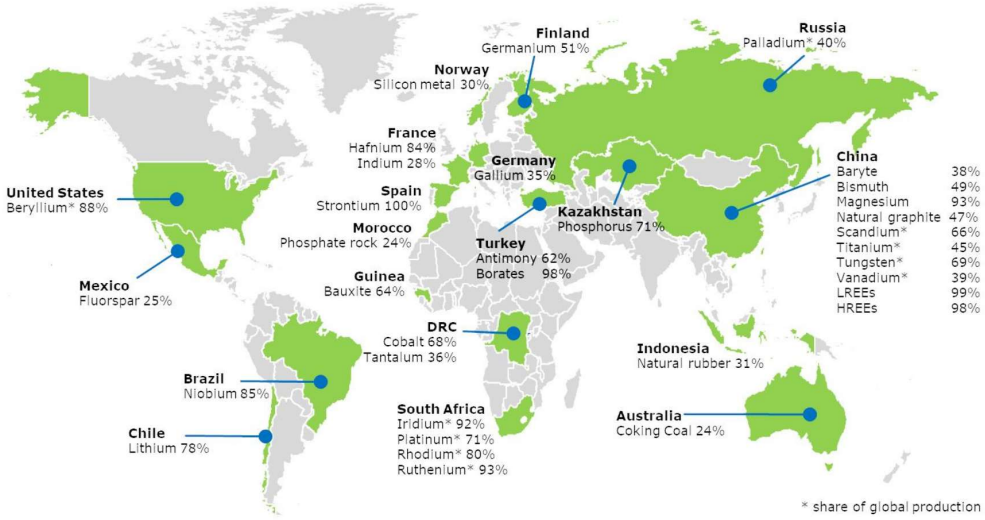
[142] European Commission, "Critical Raw Materials for Strategic Technologies and Sectors in the EU: A Foresight Study" (Report, Luxemburg, September 2020), https://ec.europa.eu/docsroom/documents/42882.

Tetra Tech, "Mining and the Green Energy Transition" (Report, U.S. Agency for International Development, Washington, November 2021), https://www.land-links.org/wp-content/uploads/2021/11/Green-Energy-Minerals-Report_FINAL.pdf.

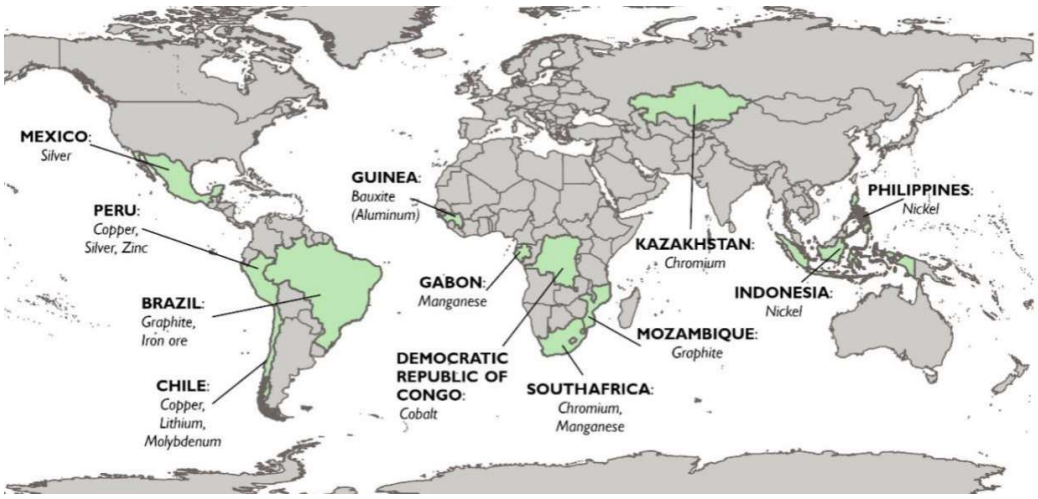
technopolitical and business activities have already built an as bloody but more invisible ecologically unequal exchange as in traditional fossil fuels.

Besides this wishful thinking on renewables' immateriality and benignity, it is essential to consider whether we can phase out fossil fuels from our energy mix as easily as expected and, on the other hand, achieve our sustainable goals by only implementing renewables regardless of any socioeconomic scenario.

Figure 6



* Biggest supplier countries of critical raw materials to the EU (Source: European Commission)



* Top-USAID-presence producers of green energy minerals (Source: USGS data / Tetra Tech)

The first but easily ignored challenge we should face is, besides energy, the dominant fossil fuels in our incumbent energy regime – oil and gas, also play an irreplaceable role in producing synthetic products, from plastics and fertilizers that are indispensable for our packaging industry and agricultural production, to pharmaceuticals to save lives. The oil and gas consumption of these petrochemical industries accounts for almost 14% (13 million barrels per day) and 8% (300 billion cubic meters) of the total primary demand for oil and gas, respectively. These demands are expected to increase massively and account for more than a third of the growth in oil demand by 2030 and nearly half by 2050.[143] Behind these astonishing data, as Adam Hanieh argued, "the very substance of daily life was transformed, alchemy-like, into various derivatives of petroleum. Here is oil not as an energy source, but as feedstock, the literal raw material of commodity production itself."[144]

However, this tremendous demand for petrochemicals does not emerge *ex nihilo*. It comes from the fairy-like 'American-style life' since 1945. The cheap and 'abundant' enough oil becomes a biopower to turn out a particular living regime of hyper-consumption, unlimited transportation, wildly sprawling property ownership, and highly liberated sociopolitical life, in the post-war United States.[145] This regime then becomes a model for modernized society and is arduously chased by people and governments around the globe. It can be further attributed to the infinite expansion of production and capital accumulation in this Capitalocene. To circumvent the periodic crisis of overproduction, an illusory consumer demand was created after the war and gradually incorporated into people's living habits. This social-scale consumption was forcefully bolstered by the unreasonably undervalued oil. Even after the oil price surged in 1973, this consumption capacity was still sustained by the full-gear financialization

[143] International Energy Agency, "The Future of Petrochemicals: Towards more Sustainable Plastics and Fertilizers," (Report, Paris, September 2018), 11-25, https://iea.blob.core.windows.net/assets/bee4ef3a-8876-4566-98cf-7a130c013805/The_Future_of_Petrochemicals.pdf.

[144] Adam Hanieh, "Petrochemical Empire: The Geo-Politics of Fossil-Fuelled Production," *New Left Review* 130 (July/August 2021): 27.

[145] Matthew T. Huber, *Lifeblood: Oil, Freedom, and The Forces of Capital* (Minneapolis and London: University of Minnesota Press, 2013).

Watts, "A Tale of Two Gulfs," 438-439.

of the consumer societies like the US. However, the cost is extremely high, namely our overwhelming addiction to petroleum and dangerous exposure to the climate change in the 21st century.

Therefore, we should not take it for granted that these production-consumption accelerators of the capitalist society under the fossil fuel regime would dissolve automatically. By contrast, the vested interests that played such a critical role in the development of capitalism over the last century and profiteered massively from it will not easily give up their prerogative position under the fossil fuel regime;[146] people whom the hyper-consumption social habits tamed can also not quit their extravagant life easily. From 2000 to 2010 and further to 2019, for example, the share of global energy from fossil fuels increased from 76.8% to 79.4% first and then dropped, with a minor range, to 78.1%. On the other hand, the share of the primary energy from low-carbon sources only increased from 14.46% to 16.57% to barely counter fossil fuel increases. And most of this base number was created before the 1990s when nuclear energy emerged as a robust alternative. However, in the following thirty years, we've only increased by 2% share by promoting renewables like solar, wind, and biofuels.[147] Indeed, some developed countries have achieved a much more impressive increase to more than 50% share of renewables in their energy mix and even, more or less, decoupled their GDP growth from ever-increasing energy consumption or carbon emissions. However, since the ecologically unequal exchange between them and other less developed countries along the global production chains is not fully considered, we can only treat them as individual cases that cannot be easily replicated around the globe.[148] These conundrums will be the first hindrance to overcome when we move to the renewable energy transition.

In this unsatisfactory condition, it is not only necessary but urgent to consider

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[146] Peter Newell, "Trasformismo or Transformation? The Global Political Economy of Energy Transition," *Review of International Political Economy* 26, no.1 (2019): 27.

[147] "Energy Mix," Hannah Ritchie and Max Roser, Our World in Data, accessed June 10, 2022, https://ourworldindata.org/energy-mix.

[148] "Energy Mix," https://ourworldindata.org/energy-mix.

Jason Hickel and Giorgos Kallis, "Is Green Growth Possible?" *New Political Economy* 25, no.4 (2020): 469-486.

which socioeconomic scenario we should implement renewables. Suppose we keep our overproduction, overconsumption, and overaccumulation business as usual, is there any chance we can lock the global warming trend below the Paris agreement's 1.5℃ goal at a fast enough rate? Or, renewables will only be used to promote a 'trasformismo' – to accommodate pressure for more sweeping transformation, ensure that socio-technical configurations do not disrupt prevailing social relations and distributions of political power under the capitalist regime, or even rapaciously aligns responses to climate change with a reconfigured capital accumulation.[149] The latter will only contribute, without doubt, to a bleaker ecological future we would face.

Here, our predecessors' contemplation in the 1973 energy crisis and people's burgeoning consciousness of climate change can be very instructive. In his *Small is Beautiful*,[150] E. F. Schumacher enshrined a philosophy of 'enoughness'; namely, by advancing small and appropriate technologies, policies, and polities as a superior alternative to the mainstream ethos of 'bigger is better', we can remake our economies and social relations of production in a way that human-ecological relations can develop more sustainably. Against the interim period of the energy crisis and transition nowadays, the 'degrowth school' resorts to similar advocacy. They believe material consumptions and emissions reductions in line with the 1.5 ℃ goal of the Paris agreement are only feasible in a degrowth scenario – a planned reduction of the material and energy throughput of the stalled or recessionary global economy.[151] Although their overarching argument sounds going too far, and more detailed work should be done to solve the possible socioeconomic issues in degrowth, their suspicion of the correlations between GDP-measured growth, human progress in well-being, and happiness should be valued.[152] We need to deconstruct the ever-growing but never satisfying economic

[149] Newell, "Trasformismo or Transformation?" 27-29.

[150] E. F. Schumacher, *Small is Beautiful: A Study of Economics as if People Mattered* (London: Vintage Books, 2011).

[151] Jason Hickel, "Degrowth: A Theory of Radical Abundance," *Real-World Economics Review* 87 (2019): 54.

Hickel and Kallis, "Is Green Growth Possible?" 471-481.

[152] Hickel, "Degrowth," 57-58.

Giorgos Kallis, Christian Kerschner, and Joan Martinez-Alier, "The Economics of Degrowth," *Ecological Economics* 84 (2012): 174-175.

indicators powered by fossil fuels over the past century[153] and ask: if they are the things we should unremittingly pursue, even in the upcoming renewable epoch.

[153] Timothy Mitchell contributed his relevant intelligence in Chapter 5: Fuel Economy of *Carbon Democracy*. Please read:
Mitchell, *Carbon Democracy*, 109-143.

Conclusion

In this research, I adopted a comprehensive geographical framework of the energy transition as an overarching instruction to conduct a multi-scalar critique of the renewable energy transition in Morocco and a broader region. Spanning my analyses between traditional fossil fuels and renewables, between energy transition in Morocco and a trans-Mediterranean landscape, the research tries to argue that, unlike the promising future people generally expect, the renewable energy transition requires the same fraud, dispossession, and control as under the fossil fuel regime to be materialized. In this process, the technological advantage, financial investment, environmentalist discourse, and the colonial conception and legal framework of Europe constitute a type of 'hegemony'. This hegemony is maneuvered to reshape the ecologically unequal exchange between Morocco and Europe under an emerging renewable regime and further their asymmetrical relations since the old. More unfortunately, the renewable transition tends to be used to prolong the overproduction, overconsumption, and overaccumulation *cliché* that will doom humans rather than build more sustainable social and human-ecological relations in the future. It drives us to ask in which socioeconomic scenario we should implement the renewable energy transition.

Despite my endeavors to disclose these fabrics of renewable transition's dark side by digging out data from governmental notes, reports, databases, and other researchers' ethnographies, some defects could still be better solved by further research. First, it is a pity not to conduct fieldwork on solar plants and their vicinities in South East Morocco. The first-hand information collected by participatory observations, interviews, or surveys can serve to better understand people's life of dispossession, control, resistance, and repression under the emerging regime of renewable energies. Second, as Foucault argued, and Mitchell reiterated in his perception of the coal and oil industry, power and resistance are mutually constitutive. However, in this research, I only exposed how power is maneuvered when implementing renewable energy transition but did not mention how resistance is organized around these activities accordingly. Ordinary people's agency is then hugely ignored. Thus, I want to leave this

lacuna to future field research. Third, considering the space of this thesis, it is not feasible but highly worthy to conduct multi-sited research, for example, on the production chains from crystalline silicon mining, to photovoltaic panels and finally to the solar plants like the Quarzazate Noor IV project in Morocco. This type of research can more explicitly exhibit how the ecologically unequal exchange is reconfigured in the energy transition and forcefully challenge people's techno-fetishism on renewables' immateriality.

These questions are urgent to be researched. After all, at this very beginning of the renewable energy epoch, the geographical and socioeconomic implications of the 'new energy paradigm' are not well defined, and a range of divergent and contending future scenarios are currently possible.[154] It is, therefore, extraordinarily meaningful to research the renewable energy transition from a critical and comprehensive perspective and contribute to a benign energy future where ecological and social justice at multiple geographical scales will be fully considered.

[154] Bridge et al., "Geographies of Energy Transition," 331.

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