ERF Working Papers Series

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Economic Research Forum
منتدى البحوث الاقتصادية

Working Paper No. 1724
September 2024

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This paper was originally presented during the ERF 30th Annual Conference on "Tragedies of Regional Conflicts and Promises of Peacebuilding: Responding to Disruptors and Enablers of MENA Development Pathway", April 21-23, 2024.

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First published in 2024 by
The Economic Research Forum (ERF)
21 Al-Sad Al-Aaly Street
Dokki, Giza
Egypt
www.erf.org.eg

Abstract

This paper investigates how the comparative power of various state and society actors and their collective utilities from the green transition—as reflected in their perceived losses or gains from the transition—affect the prospects of the energy transition in the Arab region. The paper begins with a theoretical discussion that maps out the important actors related to the green transition and their comparative power, identifying them as the state, labor, big business tycoons, and small and medium enterprise (SME) entrepreneurs. Then, the various actors' utilities from the green transition are considered, where the sources of the different utilities are derived from the effect of industrial policies that impact the green transition. The main focus here is on the development of linkages, structural transformation, and energy subsidization policies. This discussion leads to the formulation of a theoretical mathematical model, from which several hypotheses are derived. After the theoretical model is translated into a regression model, the paper discusses the results and how they compare to the hypotheses, followed by a brief analysis of some case studies to better understand the results. The paper concludes that in countries with a more dominant state and weaker social actors, the green transition is more likely to primarily follow the interests of the state regardless of social actors' interests. In more balanced state-society relations, however, the higher the interests of the various social actors, the more likely the green transition will proceed. In these settings, the green transition should be supported by tycoons and entrepreneurs through more innovation-fostering policies, labor through better structural transformation policies, and both tycoons and labor through lower energy subsidies.

Keywords: Green transition, Energy transition, State-society relations, Arab world, Industrial policy, Innovation, Training, Energy subsidy.
JEL Classifications: O38, O14, O15, L52.

ملخص

تبحث هذه الورقة في كيفية تأثير القوة المقارنة لمختلف الجهات الفاعلة في الدولة والمجتمع ومرافقها الجماعية من الانتقال الأخضر - كما يتضح من خسائرها أو مكاسبها المتصورة من الانتقال - على آفاق انتقال الطاقة في المنطقة العربية. تبدأ الورقة بمناقشة نظرية ترسم خرائط للجهات الفاعلة المهمة المتعلقة بالانتقال الأخضر وقوتها المقارنة، وتحددها على أنها الدولة والعمل وأصحاب الأعمال الكبيرة ورجال الأعمال من الشركات الصغيرة والمتوسطة (SME). بعد ذلك، يتم النظر في المرافق المختلفة للجهات الفاعلة من الانتقال الأخضر، حيث يتم استخلاص مصادر المرافق المختلفة من تأثير السياسات الصناعية التي تؤثر على التحول الأخضر. ينصب التركيز الرئيسي هنا على تطوير الروابط والتحول الهيكلي وسياسات دعم الطاقة. تؤدي هذه المناقشة إلى صياغة نموذج رياضي نظري، تستمد منه عدة فرضيات. بعد ترجمة النموذج النظري إلى نموذج انحدار، تناقش الورقة النتائج وكيفية مقارنتها بالفرضيات، يليها تحليل موجز لبعض دراسات الحالة لفهم النتائج بشكل أفضل. وتخلص الورقة إلى أنه في البلدان ذات الدولة الأكثر هيمنة والجهات الفاعلة الاجتماعية الأضعف، من المرجح أن يتبع التحول الأخضر في المقام الأول مصالح الدولة بغض النظر عن مصالح الجهات الفاعلة الاجتماعية. ومع ذلك، في العلاقات الأكثر توازناً بين الدولة والمجتمع، كلما ارتفعت مصالح مختلف الجهات الفاعلة الاجتماعية، زادت احتمالية استمرار الانتقال الأخضر. في هذه البيئات، يجب دعم التحول الأخضر من قبل رجال الأعمال ورجال الأعمال من خلال المزيد من سياسات تعزيز الابتكار، والعمل من خلال سياسات تحول هيكلي أفضل، وكلا من رجال الأعمال والعمالة من خلال دعم أقل للطاقة.

1. Introduction

Located at a close distance from the Tropic of Cancer and by major oceans and seas, the Arab world is richly endowed with abundant solar and wind energy. The green transition presents an opportunity to diversify energy production sources, create linkages, establish new industries and more jobs, reduce the burdensome oil imports of oil-poor Arab countries, and provide more electricity coverage, in addition to addressing growing global warming concerns.

The ratification of international agreements should be followed by the enactment and implementation of matching national regulations and legislations. Nevertheless, big gaps often exist, where the enactment of different regulations and legislations and their actual implementation are subject to the power dynamics of state-society relations (Sabry, 2023c). Accordingly, powerful actors and coalitions could foster or block the energy transition according to their perceived gains or losses. A big body of literature points to the need for having a supporting power coalition so that a major transformation could happen (Doner and Schneider, 2016; Hochstetler, 2020; Nem Singh and Camba, 2020).

This paper investigates how the comparative power of various state and society actors and their collective utilities from the green transition—as reflected in their perceived losses or gains from the transition—affect the prospects of the transition in the Arab world. The research focuses on the industrial sector, specifically the manufacturing and energy production sectors. Accordingly, the main actors relevant to the green transition are identified as the state, big business tycoons, small and medium enterprise (SME) entrepreneurs, and labor. These actors do not always have the same interests with regard to the transition. Rather, their interests are shaped by the existing policies. In this context, three policy spheres relevant to the interests of the various actors are identified. These are (a) policies that encourage the development of the local suppliers (whether tycoons or entrepreneurs) of multinational firms investing in the renewable energy sector, (b) structural transformation policies such as professional training and active labor market policies (ALMPs), and (c) fossil energy subsidies. On the other hand, the actors' relative power vis-a-vis each other is shaped by the existing settings of state-society relations. Actors' relative power, interests, and their ability to coordinate with each other are what shape coalitions with and against the transition and consequently impact the prospects of the green transition's success or failure.

Hypothesizing these dynamics with the help of a theoretical mathematical model and testing the presented hypotheses using a regression and short case study analysis, this research reaches important conclusions. In state-society relations characterized by a more dominant state and weaker social actors, the green transition is more likely to largely follow the interests of the state regardless of social actors' interests. In more balanced state-society relations, however, the higher the interests of the various social actors, the more likely the green transition will proceed. In these settings, the green transition should be supported by tycoons and entrepreneurs through more innovation-fostering policies, labor through better structural transformation policies, and both tycoons and labor through lower energy subsidies.

The research done in this paper is novel given the focus placed on the different actors and the dynamics governing their interaction based on power, interests, and coordination. Such research hardly exists in the literature on the Arab world or even globally.

The paper starts with a theoretical discussion leading to the formulation of a theoretical mathematical model that provides several hypotheses. The methodology section translates the theoretical model into a regression model. Then, the paper discusses the results and how they compare with the hypotheses. A brief analysis of some case studies follows to offer a better understanding of the results. Finally, the paper ends with a conclusion and policy recommendations.

2. Theoretical Perspectives

Renewable energy offers great opportunities for countries suffering from energy shortages and substantial burdens in the balance of payments because of oil imports. The ever falling costs of renewable energy technology due to the improvement in the learning curve and the relative cheapness of generating electricity from renewables in many countries are both remarkable (Griffiths, 2017; Mathews, 2020). This makes it plausible for renewables to supersede oil as the main source of energy before the middle of the 21st century (Mathews, 2020). On the other hand, oil-exporting countries are faced with a major challenge that urges them to diversify their energy sources to minimize the consequences of the expected fall in revenues in the long run as the global drive toward renewable sources of energy proceeds further.

In this context, many Arab countries—remarkably, some North African countries and many West Asian countries other than the oil-rich Gulf states—committed themselves to moving toward the clean energy transition, (Griffiths, 2017, p. 252). There are even some ambitious plans for investing in renewable energy in the Gulf area (Olawuyi, 2021), with the United Arab Emirates (UAE) being an important player (Hafner and Tagliapietra, 2020; Mills, 2020). Morocco remains a pioneer in the region, with renewables already becoming the first source of energy generation in the country in 2018 (Mills, 2020; El Ghazi, Sedra, and Akdi, 2021). Energy demand and consumption are rapidly increasing across the region, accompanying its major demographic changes (Griffiths, 2017, p. 259; Krupa, Poudineh, and Harvey, 2019; Olawuyi, 2021). Moreover, the region's oil and natural gas resources—even for the oil-rich countries—are expected to be totally depleted by 2064, with some estimates suggesting that this will happen in 2044 (Olawuyi, 2021). Another major concern is the environmental hazards that are already affecting the region because of its high consumption of fossil fuels (El Ghazi, Sedra, and Akdi, 2021; Olawuyi, 2021). These and other factors should lead to a dramatic expansion of Arab countries' production and use of renewable energy and their ultimate reduction of fossil fuel reliance.

Arab countries are richly endowed with renewable energy resources such as solar, wind, geothermal, hydro, and bio-based energy sources. The region, for instance, has high levels of Direct Normal Radiation (DNR), which makes it among the best in the world for concentrated solar applications (Griffiths, 2017, p. 255). For oil-rich Arab countries, the green transition offers an opportunity to diversify energy production sources (Tagliapietra, 2019), create linkages, and establish new industries. The gains are expected to be more substantial for oil-poor countries. The current and prospective renewable energy plans promise to reduce the oil imports that burden their trade balance and result in more electricity coverage and job creation. For North African countries, there is the additional potential of exporting energy to Europe. The European Union's (EU) ambitious objectives to reduce greenhouse emissions and dramatically increase renewable energy consumption—with Germany's *Energiewende* (energy change) being one of the most ambitious (Schiffer and Trüby, 2018)—is a driving force behind creating such potential. The EU has already set objectives for a lower carbon emissions-oriented "strategic energy partnership" with Arab countries (Olawuyi, 2021). With geopolitical tensions between Russia and the EU escalating due to the war in Ukraine, neighboring North African countries are likely to play a major role in meeting the expected accelerating EU economies' drive toward renewables in search of 'strategic autonomy' from other great powers.

Nevertheless, the presence of major opportunities is not enough for successful and rapid structural change. As in other major transformations, the role of industrial policy is crucial. Industrial policy is generally any sort of state intervention or policy that tackles the restructuring of the economy toward higher growth activities or increased societal welfare (Warwick, 2013). Yet, the state is not operating in a vacuum and the influence of major actors shapes its decisions to formulate, enact, and implement policies; gaps often exist between the three. This makes state-society relations crucial for industrial policy, with the main actors besides the state being the two who are involved in industrial relations (i.e., businesspeople and labor), thereby narrowing the focus to one on state-business-labor relations (SBLR) (Sabry, 2023c). Accordingly, the success of the energy transition could be supported or hindered by industrial policy, which itself is subject to state-society relations and, more specifically, SBLR. Understanding the dynamics of SBLR is important to comprehend how green industrial policy is formulated and implemented and the chances of its success.

The comparative power of the different actors and the possible policy coalitions among these actors in support or resistance to the energy transition are especially important. Powerful actors and coalitions could foster or block the enactment and implementation of energy transition policies according to their perceived gains or losses. A powerful coalition is one that is made up of comparatively powerful actors or whose collective power is considerable enough to overcome the power of opposing coalition(s). A big body of literature points to the need for a supporting power coalition for a major transformation to happen (Doner and Schneider, 2016; Hochstetler, 2020; Nem Singh and Camba, 2020). Thus:

$$P(G) = \sum_{k,n} W_k U_n - \sum_{k,n} A_k U_n \qquad (1)$$

P(G) is the probability of the green transition, (W) is the power of the supporting (with) coalition, (A) is the power of the resisting (against) coalition, (U) is the utility of those actors from different policies, and subscripts (k) and (n) refer to the actors forming up each coalition and policies, respectively.

The power of a policy coalition is not likely to be exactly equivalent to the summation of its constituting actors' power given social groups' fragmentation in middle-income countries (Doner and Schneider, 2016), coordination failure (Di John, 2020, p. 334), or lack of trust among the different actors (Sabry, 2023a).

Realizing this, it is important to map out the key actors related to the green transition as well as their comparative power, utilities, and ability to coordinate. Having identified the three major actors as the state, labor, and businesspeople, a subdivision of the latter into big business tycoons and SME entrepreneurs should be conducted. Sectoral sub-divisions among these collective social actors should also be considered based on their gains/losses from the transition, while divisions often exist inside the state between the executive, administration, and legislative. The power dynamics among these actors are largely country-specific and must be investigated through variables, such as the level of government dominance vis-a-vis social actors and the ability of the social actors to independently organize and defend their interests vis-a-vis the state and one another. Generally speaking, social actors are more powerful whenever they have independent and less fragmented organizations representing their interests, which are business associations in the case of entrepreneurs and labor unions in the case of labor. However, tycoons have different sources of power, where they would benefit from their control over business associations or exercise their individual power relying on the economic and political resources at their disposal. The state, on the other hand, is more dominant in relation to social actors when it is capable of preventing the independence of its organizations and when it is more cohesive with less friction among its constituents (Sabry, 2023c). Finally, the ability of the various actors to coordinate and build powerful policy coalitions depends on mutual trust and their ability to coordinate their actions.

To estimate actors' utilities as represented in their benefits and gains from the green transition, a better understanding of the multifaceted nature of the transition is needed. Starting with the state, the structural transformation accompanying the energy transition presents broad opportunities and poses major challenges. The MENA region, which is dominated by Arab countries, currently possesses about 48.3 percent and 38.4 percent of the world's oil and natural gas reserves, respectively; yet, its potential for renewable energy generation is also strong (Mills, 2020). With the proceeding energy transition, new jobs would be created but others would be lost. Substantial investments in infrastructure, training, and capacities are needed to accomplish this transformation. This represents a big financial burden and causes significant social pressures. It might also diminish the substantial oil rents that have been enjoyed by many Arab MENA countries for decades (Griffiths, 2017; Tagliapietra, 2019). Yet, given the ability of the state in the Arab world to sustain the rentier state despite challenges (Beck and Richter, 2021), the renewable energy industry could develop new rents for other Arab countries or change the source and nature of such rents for different countries in the region. Major opportunities also exist, such as reducing the energy import burden for many oil-poor MENA countries that would turn into energy producers, in addition to chances to export energy to EU countries.

Businesspeople, whether tycoons or entrepreneurs, have other different concerns that would shape their utilities from the green transition. Tycoons have the opportunity to invest in public-private partnerships that would handle renewable energy projects. Tycoons could also benefit from providing inputs to the renewable energy industry, possibly in partnership with multinational corporations (MNCs). Entrepreneurs are also likely to benefit from this opportunity, given that linkages between the renewable energy industry and the manufacturing sector could develop due to the industry's less capital-intensive technology characteristics (El-Katiri, 2016). Currently, renewable energy industry inputs, equipment, and technology are likely to be imported in many Arab countries (e.g., turbine controllers, electrical wires, and photovoltaic (PV) cells) (Ben Rouine and Roche, 2022). Nevertheless, as many studies by the International Renewable Energy Agency (IRENA) have assessed, many Arab countries have high existing or potential capacities as local suppliers for the industry in its various value chain stages (European Investment Bank (EIB) and IRENA, 2015; IRENA and ESCWA, 2018). Therefore, opportunities for creating linkages and backward integration are present for both entrepreneurs and tycoons. Moreover, in the oil and natural gas-rich Gulf countries, the potential of generating eco-friendly blue hydrogen, which is generated from fossil fuels, is being considered (Mills, 2020, pp. 130-132), opening further chances for local producers in cooperation with MNCs. These opportunities, however, should be weighed against the generous energy subsidies that the states in many Arab countries provide for their industrial sectors. This is additionally relevant for more energy-intensive industries, such as heavy industries in which tycoons and public enterprises are more likely to exist. Energy subsidies are considered among the factors that improve the competitiveness of some industrial sectors even in Arab countries that aren't comparatively rich with fossil resources, such as Egypt (Adly, 2012).

Labor interests are related to the prospects of job creation in green sectors and loss in fossil-fuel-connected sectors. Moreover, it is often the case that public enterprises have monopolies or big market shares in the sectors related to the extraction, production, and distribution of energy from fossil fuels. Public sector employment still offers job security (and likely more welfare privileges) than jobs in the private sector, especially with the increasing flexibility in the job market in many Arab countries (Cammett and Posusney, 2010). The green transition paves the way for major private sector investment and raises fears of energy sector privatization, as is the case in Tunisia where this prospect led to organized labor resistance to renewable energy projects by the *Union Générale Tunisienne du Travail* (UGTT), the major trade union organization in the country (Ben Rouine and Roche, 2022). Furthermore, fossil energy subsidies lower the living expenses of the poorer segments of society, with labor being among their significant beneficiaries.

Accordingly, in terms of utility, the potential gains of entrepreneurs and tycoons from creating linkages with the renewable energy industry would increase with policies fostering innovation and startup creation, including facilitating access to credit, especially venture and angel capital. These horizontal policies would enable domestic producers to provide less costly inputs matching the resources of the country. They would also encourage MNCs in the sector to enter partnerships and alliances with local producers and increase the latter's financial resources and absorption of foreign technology. Other more vertical policies such as local content requirements have been used in developing countries (e.g., India) seeking to create linkages between the renewable sector and the rest of the industrial sector (Mathews, 2020). Some Arab countries, such as Saudi Arabia and Morocco, have already started to implement this policy in the renewable energy sector (Mills, 2020). Another relevant vertical policy is the involvement of government investment promotion agencies (IPAs) in linking MNCs with local SMEs (World Bank Group, 2020). Such policies should increase the utility of businesspeople, whether tycoons or entrepreneurs, from the green transition. On the other hand, labor's utility from the transition would be boosted by the presence of active labor market policies (ALMP) that provide adequate unemployment compensation and retraining. The Scandinavian flexicurity model, for instance, has been widely promoted as one that entails policies facilitating structural transformation. These policies provide hiring and firing flexibility and balance it by providing generous welfare policies that compensate unemployed workers and involve them in training programs that should quickly reintegrate them into the job market (van den Berg, 2009; Viebrock and Clasen, 2009; World Bank Group, 2020). However, fossil energy subsidies are expected to work in a different direction by disincentivizing tycoons, especially managers and investors in energy-intensive sectors, as well as labor whose wages' purchasing power would diminish significantly with the abandonment of this policy.

This presents linkage development, ALMP, and energy subsidization as fundamental policies that shape the utilities of the main actors in SBLR for the green transition. Government resources are used to finance these policies and, reasonably, the spending to support these policies is subject to budget constraints. If maximizing the probability of the green transition as presented in Equation 1 is the objective function, spending on the three highlighted policies would be the constraint. Hence, the constrained objective function is given by:

$$Max\ P(G) = \sum_{k,n} W_k U_n - \sum_{k,n} A_k U_n$$
$$s.t.\ 1 \geq i + l + e \quad ; where\ U = f(i, l, e) \qquad (2)$$

Where P(G), (W), (A), (U), (k), and (n) are as in Equation (1), while (i), (l), and (e) are the shares of government expenditure directed to linkage development policies, ALMP, and energy subsidization, respectively.

The utilities of the three considered players: tycoons (T), entrepreneurs (E), and labor (L), depend on the utilities that these actors get from the three policies. Each of these actors represents a set for which different subsets exist. For instance, tycoons could be subcategorized into tycoons in energy-intensive sectors, tycoons who could invest in public-private partnerships, tycoons in high-tech sectors…etc. If (α_k), (γ_k), and (θ_k) are the utilities obtained by actor (k) from linkage development, training, and energy subsidies, respectively, then:

$$U_i = \alpha_k i;\; U_l = \gamma_k l;\; U_e = \theta_k e$$
$$where\ i, l, e, \alpha, \gamma, \theta \in [0,1]\ \ and\ k = \{T, E, L\}$$

Linkage development and training policies should encourage renewable energy production and increase the utility from the green transition, while higher fossil energy subsidies would do the opposite and increase the utility from resisting the transition. Thus, the constrained objective function becomes:

$$Max\ P(G) = \sum_{k} W_k(\alpha_k i + \gamma_k l) - \sum_{k} A_k(\theta_k e)$$
$$s.t.\ 1 \geq i + l + e \tag{3}$$

The Lagrangian function would then be:

$$\mathcal{L} = \sum_{k} W_k(\alpha_k i + \gamma_k l) - \sum_{k} A_k(\theta_k e) - \lambda\,(i + l + e - 1)$$

Taking the first-order conditions with respect to the three policies (i, l, e) would give us:

$$\frac{\partial \mathcal{L}}{\partial i} = \sum W_k \alpha_k - \lambda = 0$$
$$\frac{\partial \mathcal{L}}{\partial l} = \sum W_k \gamma_k - \lambda = 0$$
$$\frac{\partial \mathcal{L}}{\partial e} = -\sum A_k \theta_k - \lambda = 0$$
$$\frac{\partial \mathcal{L}}{\partial \lambda} = i + l + e - 1 = 0$$

Using these equations, we get:

$$\sum W_k \alpha_k = \sum W_k \gamma_k = -\sum A_k \theta_k = \lambda\ and\ \ i + l + e = 1$$

Thus:

$$\alpha_k = \gamma_k = -\frac{\sum A_k}{\sum W_k}\theta_k \tag{4}$$

Considering the concerns of each of the three main actors, the substitution into the main objective function is done. For tycoons, linkage development and energy subsidies matter, while training does not directly affect their utility from the green transition. Thus, maximizing the probability of the green transition, P(G), would mean:

$$P(G) = \sum_{k} W_k(\alpha_k i + \alpha_k(1 - i - e) - \sum_{k} A_k(\theta_k e) = \alpha_k \sum_{k} W_k(1 - e) - \theta_k \sum_{k} A_k(e) \tag{5}$$

The previous equation shows that an increase in the magnitude of tycoons' support for the energy transition is caused by higher elasticity from linkage development policies and lower energy subsidization and the elasticity from this subsidy. This support also increases with a higher capability of forming a strong 'with' coalition and a lower capability of forming an 'against' coalition.

As for labor, what matters are the utilities they would get from training and energy subsidies as a part of the general consumer public. Thus:

$$P(G) = \sum_{k} W_k(\gamma_k i + \alpha_k(1 - l - e) - \sum_{k} A_k(\theta_k e) = \gamma_k \sum_{k} W_k(1 - e) - \theta_k \sum_{k} A_k(e) \tag{6}$$

Therefore, an increase in the magnitude of labor support for the green transition is caused by a fall in energy subsidization and lower elasticity for labor from this subsidy. It also increases with a higher elasticity of training, a stronger capability to form a 'with' coalition, and a lower capability to form an 'against' coalition.

Entrepreneurs, on the other hand, are mainly concerned about linkage development and are comparatively less concerned about energy subsidization since they are less likely to have their enterprises in energy-intensive technologies or be as sensitive as labor to such subsidies as part of their consumption. Therefore:

$$P(G) = \sum_{k} W_k(\alpha_k i + \alpha_k(1 - i - e) - \sum_{k} A_k\left(-\frac{\sum W_k}{\sum A_k}\alpha_k e\right) = \alpha_k \sum_{k} W_k \tag{7}$$

As the previous equation shows, an increase in the elasticity of entrepreneurs from linkage development policies and their ability to form a supporting coalition (with) to energy transition would increase the strength of their support of the green transition.

Finally, for the state, its constituent collective actors could be a part of either the 'with' or 'against' coalitions, depending on their perceived interests and regardless of the implemented policies. The earlier discussion suggested that in the Arab world, state actors are likely to have more gains from the transition. Thus, and due to exogenous factors independent from implemented policies, state actors are more likely to be in the coalition that supports the green transition. This is particularly true for the executive branch, which is more likely to benefit from developmental aid and from a reduction in the budget deficit because of a fall in energy imports. While the bureaucratic apparatus could be neutral, some parliamentarians could be against the transition based on the interests they are representing. Thus, a more dominant executive role over the bureaucracy and the parliament would make the state lean more toward the coalition supporting the green transition, and this condition of executive dominance is likely more common in the Arab world given the predominance of authoritarianism.

As for the policy coalitions, the power of each coalition is a factor in the strength of its constituents. However, the power of the coalition is not simply the summation of its constituents' respective power. Coordination is crucial for creating a coalition, to the extent that lower levels of coordination and higher levels of rivalry or mistrust could diminish the power of the resultant coalition to levels that might fall below the power level of each single constituent. Conversely, higher coordination could magnify the power of the coalition beyond the mere summation of its constituent actors' power. Thus, if (Π) stands for power and (C) for coordination:

$$W_k = f(\Pi_k, C) = \sum_k \Pi_k (1 + C)\,; where\ \Pi_k \epsilon\ [0, 1]\ and\ C\epsilon\ [-1, 1] \tag{8}$$

The presence of broad-based and strong business associations would enable the development of higher coordination and the evolvement of a powerful coalition among tycoons and entrepreneurs. Similarly, an effective public-private dialogue (PPD) that incorporates representatives of the four actors: the state, tycoons, entrepreneurs, and labor, would also produce a powerful coalition.

The model and previous discussion suggest the following hypotheses concerning Arab countries:

- H1: In Arab countries with high state dominance, the higher the benefits of the state from the green transition, the higher the production of renewable energy production, regardless of social actors' interests.
- H2: In Arab countries with comparatively more independent and less fragmented business associations, more linkage development policies would lead to more renewable energy production.
- H3: In Arab countries with comparatively more independent and less fragmented labor unions, more structural transformation and training policies would lead to more renewable energy production.

- H4: In Arab countries with comparatively more powerful tycoons, higher energy subsidies would lead to less renewable energy production.
    - H4a: In Arab countries with comparatively more powerful tycoons with an active presence in more energy-intensive industrial sectors, higher energy subsidies would lead to less renewable energy production.
- H5: In Arab countries with comparatively more powerful labor organizations, higher energy subsidies would lead to less renewable energy production.

3. Methodology

In this section, a fixed-effects regression equation is derived from the theoretical mathematical equation and tests the different presented hypotheses. The use of this model reduces the omitted variable bias. The use of the model is also justified given that the endogeneity concern is assumed here to be minimal. It is not likely that the level of renewable consumption affects the power of the different actors or policies rather than the other way around. The general form of the conducted regressions is:

$$G_t = \beta_0 + \beta_1 \Pi_{it} + \beta_2 P_{jt} + \beta_3 (\Pi_{it} * P_{jt}) + \beta_4 (Control) + \beta_5 (Country\ Dummies) + \mu_t \quad (9)$$

The dependent variable (G) is the renewable energy produced by an Arab country, (Π) is the power of actor (i) at time (t), and (P) is policy (j) at time (t).

The various indicators are collected from different datasets, including the Varieties of Democracy (V-Dem) (University of Gothenburg, n.d.), World Development Indicators (World Bank, n.d. a), Worldwide Governance Indicators (WGI) (World Bank, n.d. b), the Global Competitiveness Indicators (GCI) (World Economic Forum, n.d.), the International Energy Agency (IEA) (IEA, n.d.), and Our World in Data (Our World in Data, n.d.). A full description of the used proxies is reported in the Appendix. The collected dataset runs between the years 2000-22, and the summary statistics of the different variables are listed in Table 1.

Table 1. Summary Statistics

Variable	Mean	Median	Min	Max	Std. Dev.	Skew	Ex. kurtosis
Solar-Wind Consumption (TWh per million)	0.074	0.004	0	1.921	0.24	5.485	33.45
Renewable Energy Consumption	16.473	2.950	0	95.520	25.999	1.796	2.109
Dominant State	71.166	69.982	43.936	93.935	9.847	0.225	-0.542
Favoritism	61.553	60.572	21.447	100.000	19.905	0.155	-0.698
CSO Consultation	35.872	36.424	0	96.622	16.065	0.065	0.605
Large CSO (Large Encompassing Organizations Dominate)	25.525	25.000	0	75.000	15.883	0.540	0.275

Table 1. Summary Statistics (contd.)

Variable	Mean	Median	Min	Max	Std. Dev.	Skew	Ex. kurtosis
Trade Unions	47.640	57.917	4.116	83.773	20.874	-0.693	-0.748
Availability of Training	47.978	48.297	20.408	75.154	12.819	-0.044	-0.647
Innovation	34.392	33.730	11.270	64.613	10.672	0.365	0.624
Total Energy Subsidy per Million Inhabitants	14048	7566.200	0	79021	18012	2.226	4.495
Industrial Energy Intensity	2.873	2.646	0.625	9.647	1.736	1.515	2.898
Large CSO*Innovation	846.73	745.620	0	2836.000	612.240	0.757	0.508
Trade Union * Training	2181.8	1942.900	170.45	4865.800	1262.300	0.191	-1.167
Favoritism*Innovation	1940	1958.700	973.07	3311.500	476.900	0.109	-0.022
Energy Subsidy per Manuf. VA	0.458	0.252	0	4.608	0.640	3.710	17.169
Trade Union*Energy Subsidy Per Manuf. VA	16.790	6.254	0	194.360	28.037	3.566	15.629
CSO Consult*Innovation	1115.1	1042.8	0	3816.200	634.720	0.646	1.356
CSO Consult*Training	1619.5	1449.9	0	5529.900	1028.700	0.859	1.333
Energy Subsidy per Manuf. VA*Industrial Energy Intensity	0.865	0.763	0	5.444	0.755	1.983	8.077
Favoritism*Energy Subsidy per Manuf. VA	19.424	13.542	0	90.167	19.000	1.334	1.32
Favoritism*Energy Subsidy per Manuf. VA*Industrial Energy Intensity	43.505	33.542	0	148.550	36.970	1.012	0.377

Two indicators are used as dependent variables. The first is the sum of solar and wind energy consumption TWh per million inhabitants, which is calculated from the solar and wind energy TWh indicators of the Our World in Data dataset adjusted by population levels from the WDI (see the Appendix). The second is the renewable energy consumption (% of total final energy consumption) obtained directly from the WDI. The first dependent variable is more relevant to the paper's analysis given the focus on solar and wind energy generation, while the second indicator includes other forms of renewable energy generation such as hydroelectrical energy generation, which is of less relevance.

For linkage development policies, a focus is placed on innovation policy given its more horizontal intervention nature, while vertical policies such as the creation of IPAs and the effectiveness of these IPAs would be neglected given the difficulty of finding relevant proxies. For innovation policy, training, and fossil energy subsidization, the proxies used, respectively, are GCI's innovation pillar, availability of training, and IEA's energy subsidies adjusted to measure the share of the subsidy per manufacturing value added (using the WDI's indicator of manufacturing value added as a percentage of the GDP, calculation reported in the Appendix).

As for various actors' power, the degree of state dominance is calculated as the reciprocal of the WGI's voice and accountability (V&A) indicator. The V&A indicator measures how democratically officials are chosen and the freedom of association and the press. A state that does not provide sufficient levels of these political rights is one that is authoritarian but also largely autonomous from social actors' influence. This suggests that the reciprocal of the V&A is a good indicator of state power vis-a-vis social actors (Sabry, 2023b). As a proxy for tycoons' power, the adjusted GCI's favoritism of government decisions (henceforth, favoritism) is used. Favoritism (after adjustment so that higher levels reflect higher favoritism) is a good indicator of how tycoons could have privileged access to government resources, hence their relative power in relation to the other social actors. The V-Dem's "large encompassing organizations dominate" indicator is used as a proxy for entrepreneurs' power since they need broad-based business associations to represent their interests, as the literature presented in the theoretical section suggests. It is to be noted, however, that entrepreneurs might be overshadowed by tycoons in terms of interest representation, even in broad-based business associations. However, these associations would still represent much of their constituent entrepreneurs' interests and might induce tycoons to use them in lobbying their interests instead of resorting to individual means of influence (Sabry, 2017, 2019). In other words, the used proxy could be used as an indicator for both the relative power of entrepreneurs and the representation of businesspeople's general interest away from the influence of individualized tycoons. Finally, the V-Dem's "engagement in independent trade unions" (henceforth, trade unions) is used as a proxy for the relative power of labor. Intuitively, labor power is better represented by engagement in independent trade unions since independence from state manipulation is important for labor's organizational power.

On the other hand, V-Dem's CSO consultation is used as an indicator of coordination among the different actors. CSO consultation reflects how the different actors (both state and social) interact and their ability to coordinate. A variable measuring the energy intensity of the industrial sector is obtained from the Our World in Data dataset. This indicator is mainly used to test the effect of its interaction with energy subsidization, where supposedly higher energy intensity would augment the effect of energy subsidization on the industrial sector. As is the case with other indicators of the regression model, the resultant interaction would then be used in a further interaction, once with favoritism and another with trade unions, in order to test the effect of the combination between actors' power and interest in renewable energy production.

Given the low number of observations, imputations are used to estimate the values of some of the missing data.[2] The "sequential elimination of variables" is run manually in the Gretl statistical program on the conducted regressions to dispose of insignificant independent variables where an F-test is run to check that the consistency of the conducted regressions was not altered (see the Appendix). The results of the conducted regressions are reported in Table 2.

[2] For every studied country, the average of the values in the years in which data is available is used to estimate the missing data. For only two variables, favoritism and industrial energy intensity, another technique was used, where the relation between the used proxies and other related indicators was used in estimating missing values of the former. For favoritism, the strong relation between the proxy and the WGI's control of corruption indicator is used in estimating the missing values for the favoritism indicator between the years 2000-06 (a very high correlation of 0.811 exists between the two indicators for the studied countries). As for the industrial energy intensity, the relation between this indicator and the "energy intensity level of primary energy (MJ/$2017 PPP GDP)" is used to estimate the missing values of the former for the years between 2013-19. In both cases, the average ratio between the related variables in each country is used to estimate the missing values.

To measure the overall effect on the dependent variable of the various independent indicators (given their involvement in interaction terms), the following equation is used in calculating the values reported in Table 3. Depending on Equation 1:

$$\frac{\partial G}{\partial P} = \beta_2 + \beta_3 \bar{\Pi}$$
$$\frac{\partial G}{\partial \Pi} = \beta_1 + \beta_3 \bar{P} \qquad (10)$$

Where $\bar{\Pi}$ *and* $\bar{P}$ are the mean values of the studied actor's power and policy, respectively.

Table 2. Regressions Using the Fixed-Effects Panel Model

Dependent Variable	Solar and Wind Consumption		Renewable Energy Consumption	
Const	-0.136	**	-0.324	
	(0.062)		(0.632)	
Dominant State			0.029	***
			(0.007)	
Favoritism	0.002			
	(0.001)			
Large CSO			-0.024	***
			(0.007)	
Trade Unions			-0.035	***
			(0.006)	
CSO Consultation	0.004	**	0.038	***
	(0.002)		(0.006)	
Innovation	0.007	***	-0.019	***
	(0.002)		(0.007)	
Availability of Training	-0.002	***	0.016	***
	(0.001)		(0.004)	
Favoritism*Innovation	-0.0001	**	-0.0002	***
	(0.000)		(0.000)	
Large CSO*Innovation			0.001	***
			(0.000)	
CSO Consultation*Innovation	-0.0001	**		
	(0.000)			
Trade Union*Training	0.0001	***		
	(0.000)			
CSO Consultation*Training			-0.0004	***
			(0.000)	
Trade Union*Energy Subsidy per Manufacturing			-0.008	*
			(0.004)	
Favoritism*Energy Subsidy per Manufacturing	-0.001			
	(0.001)			
Energy Substitution per Manufacturing*Indust. Energy Intensity	-0.033	***		
	(0.011)			
Favoritism*Energy Subsidy per Manufacturing*Indust. Energy Intensity			0.004	***
			(0.001)	
n	75		94	
LSDV R-squared	0.770		0.998	
Within R-squared	0.636		0.623	
LSDV F-test	F(15, 59)= 13.133		F(19, 74)= 1609.8	
Durbin-Watson	0.778		1.448	

Table 3. The Overall Effect of Various Variables Based on Regression Results

	Solar and Wind Consumption	Renewable Energy Consumption
Dominant State	..	0.0292
Favoritism	-0.0022	-0.0041
Large CSO (Large Encompassing Organizations Dominate)	..	-0.0003
Trade Unions	..	-0.0390
CSO Consultation	-0.0002	0.0189
Innovation	-0.0010	-0.0143
Availability of Training	0.0009	0.0163
Energy Subsidy per Manufacturing	-0.0940	0.2733
Energy Subsidy per Manufacturing*Indust. Energy Intensity	-0.0327	0.2436

4. Results and Discussion

The following analysis depends on the results of both Tables 2 and 3. The analysis focuses only on statistically significant variables. Whenever the sign of the effect is the same in both conducted regressions, the obtained results are regarded as robust. Otherwise, the results of the first regression are considered more reliable since it tackles (more specifically) levels of solar and wind consumption, while for the second regression, the dependent variable also includes hydroelectrical power generation, which is less relevant to the dynamics of the theoretical model introduced in this paper. Thus, the results of the second regression are referenced as long as they do not have a contradictory sign with the results of the first regression.

Table 2 shows that only two variables are robust and have the same sign of effect on the dependent variables. These are CSO consultation (positive) and the interaction term between favoritism and innovation (negative). For the latter, the interaction term between favoritism and innovation, a one-unit increase (one percent since both constituent variables use percentage scales) reduces solar and wind consumption by 0.0001 TWh per million inhabitants, suggesting that powerful tycoons are not motivated by higher levels of innovation policy (and backward integration) to support the emerging renewable energy sector. The first regression provides other results that are more consistent with the earlier introduced hypotheses. Providing evidence supporting H3, the interaction between trade union and training is positive, where a unit change in the interaction term (one percent since both variable constituents are measured with a percentage scale) leads to an increase in solar and wind energy consumption of 0.0001 TWh per million inhabitants. This suggests that the presence of training services motivates labor to support the green transition, especially when they have strong labor unions. A one-unit change in the interaction term between energy subsidy per manufacturing value added and industrial energy intensity decreases solar and wind consumption by 0.033 TWh per million inhabitants, and this is regardless of the power of either tycoons or labor unions. This provides evidence that partly supports H4 (especially H4a) and H5. Table 3 provides further supporting evidence to the mentioned hypotheses by showing the overall negative effect of favoritism, energy subsidy per manufacturing value added, and the interaction between the latter and industrial energy intensity on the one hand, and the positive effect on the availability of training on the other hand, on solar and wind consumption.

A result that is contradictory to the hypotheses is the negative effect of the interaction between CSO consultation and innovation. This result should be interpreted in the Arab context, suggesting that stronger consultation, policy coordination, and innovation policy in Arab countries do not necessarily boost backward integration for the renewable sector and could, surprisingly, harm the green transition. Table 3 further points out that the overall effect of both CSO consultation and innovation on solar and wind consumption is negative. This might suggest that green innovation is rather weak, innovation efforts focus on other sectors, and consultation might actually be in favor of the maintenance of fossil fuel consumption.

The results of the second regression, having renewable energy consumption as a percentage of total energy consumption as the dependent variable, suggest that higher levels of state dominance relative to social actors lead to a higher share of renewable energy consumption, where a one percent increase in the former leads to an increase of 0.03 percent in the latter. This provides some evidence supporting H1. Table 3 reports overall negative effects for large CSOs and trade unions and a positive effect for CSO consultation (the latter would be disregarded since it contradicts with the results of the first regression) on renewable energy consumption share. This suggests a resistance to the green transition by stronger unions and business associations whose representation is less fragmented, while a more dominant state is more likely to push things through the transition in the Arab world—especially if it engages in consultation with social actors, probably less powerful actors. Concerning policies, the overall effect of innovation is, again, negative as in the first regression while the effect of availability of training is positive, suggesting their robustness. As for interaction terms, the interaction between trade union and energy subsidy per manufacturing has a negative effect on renewable energy consumption share (a one percent rise leads to a 0.008 percent decrease in the share) while the interaction term between large CSOs and innovation leads to higher renewable energy consumption share (a one percent rise leads to an increase of 0.001 percent in the share). The last two results match the hypotheses derived from the theoretical model, H2 and H5, respectively. Contradictory to the hypotheses, however, is the negative effect of the interaction between CSO consultation and training (a one percent increase leading to a fall in renewable energy consumption share of 0.0004 percent).

Overall, the results suggest that the state is likely the most supportive actor for the green transition in the Arab world and that the higher its power, the more likely the green transition will take place (H1). The negative effect of the other major actors whenever they are powerful—through labor unions or business associations—suggests that the energy transition is not yet integrated into the interests of social actors. The presence of a good experience with structural transformation as represented in the presence of good training facilities enhances the chances for the success of the green transition and motivates stronger labor unions to support the transition (H3). The strength of labor unions seems to be necessary for the realization of this outcome, given that the availability of these training facilities does not seem to induce support for the green transition at higher levels of state-society consultation. Fostering innovation, however, could only motivate businesspeople (whether tycoons or entrepreneurs) to endorse the transition whenever innovation policies are matched by the presence of broad-based and less fragmented business associations (H2). Innovation policy will not motivate powerful tycoons to endorse the green transition when their power rests on higher levels of favoritism, rather than on broad encompassing and less fragmented business associations. Furthermore, the innovation policy would not induce the green transition when state-CSO consultation is high, where, again, the power of business associations seems to be crucial. Finally, the presence of high levels of energy subsidization discourages the support of more powerful labor unions for transition (H5) and generally increases the resistance to the transition when the industrial sector is more energy intensive (partially, H4).

Table 4 reports data on the UAE, Morocco, and Egypt, which are leading in terms of solar and wind production per million inhabitants among the studied Arab countries for which data for this indicator is available. Comparing figures from the first half of the last decade (2010-14) to those of the present decade (2020-22) and the performance of the three countries, the UAE is clearly leading with an average of 1.71 TWh per million inhabitants (with a wide margin) and that the country's production has witnessed an impressive growth of 5,600 percent between the two periods. This is although the UAE had significantly lower levels than either Morocco or Egypt in the first half of the 2010s. In the same period, Morocco's production grew by 487.5 percent, while Egypt's grew by 380 percent. During 2020-22, Egypt had both the lowest levels and the lowest growth rate. A different perspective is presented when looking at the renewable energy consumption (as a percentage of total final energy consumption) indicator. Here, Morocco is leading with 10.92 percent (which fell in comparison to the 2010-14 figure), Egypt is second (6.51 percent), and the UAE comes last with only 0.92 percent, reflecting a still very high reliance on fossil fuels. Nevertheless, the UAE had an incomparable impressive increase in renewables' share by 736.4 percent between 2010-14 and 2020-22. It is once again worth noting that the variable reflects other forms of renewable energy, including hydroelectric energy generation, which Egypt has a long history of given the significant contribution of the Aswan High Dam. Generally, the performance in both indicators reflects a relative success in the energy transition—especially solar and wind energy—in the UAE, followed by Morocco.

Table 4. SBLR Actors' Power, Interests, and Policies Related to the Energy Transition

Country	Egypt			Morocco			UAE		
Time	2010-2014	2015-2019	2020-2022	2010-2014	2015-2019	2020-2022	2010-2014	2015-2019	2020-2022
Solar-Wind Consump. (TWh per million)	0.05	0.09	0.24	0.08	0.30	0.47	0.03	0.36	1.71
Renewable Energy Consumption (% of Total Final Energy Cons.)	5.35	5.31	6.51	11.89	10.84	10.92	0.11	0.29	0.92
Dominant State	71.30	74.25	..	63.60	62.71	..	69.53	71.73	..
Favoritism	69.55	53.68	..	59.80	59.11	..	35.93	25.69	..
CSO Consultation	24.75	14.74	19.95	55.30	52.35	50.75	17.41	17.41	25.59
Large Encompassing Organizations Dominate	30.76	22.22	12.70	16.28	38.90	50.00	25.00	25.00	25.00
Engagement in Independent Trade Unions	37.28	36.98	36.98	68.28	68.71	68.71	13.93	13.93	13.93
Availability of Training Services	47.37	32.40	..	53.00	51.02	..	68.51	72.57	..
R&D (% of GDP)	0.55	0.68	0.68	0.71	..	..	0.59	0.88	0.85
Innovation	31.57	29.55	..	32.55	35.35	..	50.43	58.68	..
Energy Subsidies per Manufacturing VA %	17.50	12.85	8.72	..	..	..	47.32	15.17	16.33
Industrial Energy Intensity (MJ/$2011 PPP)	2.87	..	..	2.45	..	..	4.26	..	..

The remarkable feature of state-society relations in Egypt in the 2010s, as confirmed by Table 4, is the dominance of the state (74.25 percent in 2015-19) and the weakness of all social actors, with the exception of tycoons' power, as reflected in the relatively high favoritism. Agreeing with the weakness of social actors' organization power is the very low level of the large encompassing organizations dominate indicator that drastically fell by 58.7 percent between 2010-14 and 2020-22 to 12.70 percent, indicating the fragmentation of civil society representation, including business associations. Engagement in independent trade unions is in a middle position between the UAE and Morocco. CSO consultation is the lowest (19.95 percent in 2020-22) among the three countries and significantly fell between 2010-14 and 2020-22. The medium level of engagement in independent trade unions relative to the other two Arab countries is matched by the lowest levels of availability of training services among the three countries, which also fell between 2010-14 and 2015-19 by 68.4 percent, reaching 32.4 percent. Similarly, the medium level of favoritism is matched with the lowest level of innovation (among the three countries), 29.55 percent in 2015-19 (also lower than the previous period). This suggests the presence of negative incentives for both labor and tycoons against the green transition and a possible failure to rally their power in support of the transition. The only positive development is the significant fall of energy subsidy per manufacturing value added by 50.2 percent between 2010-14 and 2020-22, reaching 8.72 percent (about half the corresponding figure of the UAE), and the medium level of industrial energy intensity of the country. Generally, it could be said that Egypt's green transition is likely more dependent on the state, which largely dominates state-society relations, and that fewer policy incentives exist for social actors—even the ones with some power such as tycoons and labor. This might explain why Egypt's pace of energy transition is slower than the other two countries.

The UAE has comparable state-society relations to that of Egypt. The UAE has the second highest dominant state level (71.73 percent in 2015-19), which is not far from Egypt's level but shows a relatively wide margin from Morocco (62.71 percent). Moreover, the country has the lowest levels of engagement in independent trade unions and favoritism, but a medium level of CSO consultation and a large encompassing of dominating organizations. The most remarkable is the level of engagement in independent trade unions, where the country has a very low level of only 13.93 percent. It is also worth noting that the UAE has, by a wide margin, the lowest level of favoritism among the three countries, and the level of the indicator significantly fell between 2010-14 and 2015-19, reaching 25.69 percent. Contrary to Egypt, the UAE has the highest levels of innovation (58.68 percent) among the three countries, which has also grown between 2010-14 and 2015-19 by about 16.36 percent. Energy subsidies per manufacturing value added, although much higher than that of Egypt, have sharply fallen by 65.49 percent in a country that has the highest level of industrial energy intensity (4.26 MJ/$2011 PPP) among the three countries and with a wide margin from the other two. The UAE also has the highest levels among the three countries of availability of training services (72.57 percent in 2015-19) with wide margins from the other two countries. This all suggests the presence of stronger incentives for the various social actors to support the green transition despite their relative weakness and the great dominance of the state. The presence of encouraging policies distinguishes the case of the UAE from that of Egypt. The remarkable growth of CSO consultation between 2010-14 and 2020-22 by about 46.98 percent is also striking. Even if the level of the indicator reached only 25.59 percent in the latter period, it surpassed the level of Egypt, which significantly fell (19.39 percent) between the same two periods (although it improved in 2020-22 in comparison to 2015-19). The difference in the pace of the green transition between the UAE and Egypt to the advantage of the former could be thus attributed to better policy incentives that the UAE provides for the various social actors.

Morocco represents a significantly different case. The state is still dominant (62.71 percent in 2015-19) but the level of dominance is the lowest, with a significant margin. Social actors' higher power is reflected in the highest level among the three countries of favoritism (59.11 percent in 2015-19), a large encompassing of dominating organizations (50 percent in 2020-22), and engagement in independent trade unions (68.71 percent in 2020-22). CSO consultation is also the highest (50.75 percent in 2020-22), with a large margin. The level of policies for the availability of training services and innovation is medium in comparison with the other two countries (51.02 percent and 35.35 percent in 2015-19, respectively). Given the more balanced state-society relations in Morocco in comparison with both Egypt and the UAE, policy incentives are expected to be more important in encouraging the green transition, since the transition in Morocco seems to depend more on social actors' support. Therefore, the medium level of these policies seems to correspond well with and explain the medium level of solar and wind production in the country.

Table 5. Fields of High and Very High Local Capabilities in the Renewable Industry Value Chain

Country	Present Capabilities	Future Possibilities	Presence of Active Local Enterprises and/or Suppliers	R&D and/or Industry Innovation	Availability of Skilled Labor
Solar PV					
Egypt	Electronics and cable, steel support structure, and construction.	Electronics and cable, steel support structure, and construction.	Electronics and cable, steel support structure, and construction.	Steel support structure, and construction.	Electronics and cable, and construction.
Morocco	Electronics and cable, steel support structure, and construction.	Raw material, Electronics and cable, steel support structure, and construction.	Electronics and cable, and construction.	Electronics and cable, steel support structure, and construction.	Electronics and cable and steel support structure.
UAE	Electronics and cable, steel support structure, and construction.	Electronics and cable, steel support structure, and construction.	Electronics and cable, steel support structure, and construction.	Electronics and cable, steel support structure, and construction.	Electronics and cable, and construction.
Solar CSP					
Egypt	Mirrors, mounting structure, balance of plant piping electronics, gird connection, and construction.	Mounting structure, balance of plant piping electronics, storage system, grid connection, and construction.	Mirrors, mounting structure, balance of plant piping electronics, grid connection, and construction.	Mounting structure, balance of plant piping electronics, storage system, grid connection, and construction.	Mirrors, balance of plant piping electronics, grid connection, and construction.
Morocco	Mounting structure, grid connection, and construction.	Raw material, mirrors, mounting structure, and construction.	Raw material, storage system, grid connection, and construction.	Mounting structure, storage system, grid connection, and construction.	Mounting structure and grid connection.
UAE	Mounting structure, balance of plant piping electronics, storage system, grid connection, and construction.	Mounting structure, balance of plant piping electronics, grid connection, and construction.	Mounting structure, balance of plant piping electronics, grid connection, and construction.	Balance of plant piping electronics, grid connection, and construction.	Mounting structure, balance of plant piping electronics, storage systems, grid connection, and construction.
Wind					
Egypt	Wind tower, wind turbine blade, electronics and cable, and construction.	Wind tower, wind turbine blade, electronics and cable, and construction.	Wind tower, wind turbine blade, electronics and cable, and construction.	Wind turbine blade and construction.	Wind tower, wind turbine blade, electronics and cable, and construction.
Morocco	Wind tower, wind turbine blade, electronics and cable, and construction.	Raw material, wind tower, electronics and cable, and construction.	Wind tower, wind turbine blade, electronics and cable, and construction.	Raw material, wind tower, wind turbine blade, electronics and cable, and construction.	Wind tower, wind turbine blade, electronics and cable, and construction.
UAE	Electronics and cable, and construction.	Raw material, electronics and cable, and construction.	Raw material, electronics and cable, and construction.	Raw material and construction.	Raw material, wind tower, electronics and cable, and construction.

Source: Self-summarized and organized based on data from IRENA reports (EIB and IRENA, 2015; IRENA and ESCWA, 2018).

Based on data from IRENA (EIB and IRENA, 2015; IRENA and ESCWA, 2018), Table 5 reveals the local capabilities of the three countries in the value chain of solar PV cells, concentrating solar power (CSP), and wind energy generation industries, focusing on only high and very high capabilities (as assessed by IRENA). With regard to solar PV cells, the three countries have comparable capabilities that are mainly concentrated in electronics and cables, steel support structures, and construction. The availability of skilled labor varies among the three countries, which share high capabilities in electronics and cables. On the other hand, Egypt comparatively has the best existing and potential capacities in CSP among the three countries. Morocco's potential is comparable to the UAE, but its more unique potential compared to both the UAE and Egypt is in the raw material sector. Egypt is also comparatively the best in terms of the presence of local enterprises and/or suppliers as well as R&D and/or industry innovation while the UAE's high capacity in terms of availability of skilled labor covers more sectors than the other two countries. Finally, in the wind generation industry value chain, both Egypt and Morocco have comparable present and potential capacities which are relatively superior to the UAE. The same is true in terms of the presence of active local enterprises and/or suppliers. Yet, in terms of R&D and/or industry innovation, Morocco has higher capacities in more sectors than the other two countries. For the availability of skilled labor, comparable but different capacity profiles exist for the three countries.

In summary, it could be said that Egypt seems to have the relatively highest capacities compared to Morocco and the UAE, especially with regard to CSP and wind energy. In other words, the utility of the different actors from the energy transition should be higher in Egypt than in the other two Arab countries. Nevertheless, the earlier discussion on the weakness of the various social actors in Egypt seems to deny the materialization of this high utility into a strong supportive force for the transition. This, again, suggests that the relatively lower level of renewable energy production might be attributed to social actors' weakness, despite the presence of a relatively strong local capacity. On the other hand, Morocco's highest capacity in R&D and/or industry innovation—especially in wind energy—added to the presence of relatively more powerful social actors could explain the country's higher production of renewable energy and its higher pace of green transition. The dataset used for calculating the solar and wind consumption per one million inhabitants (Our World in Data, n.d.) reveals that wind energy consumption was responsible for about 75.87 percent of the total solar and wind consumption in Morocco in the 2020-22 time period. This provides additional evidence for H2.

5. Conclusion, Policy Implications, and Limitations

This paper argues and provides supporting empirical evidence that the green transition in Arab countries depends on maximizing the interest of important state and society actors, especially more powerful ones. Focusing on policies, the interest of state actors is likely to be exogenous, while social actors' interests are shaped by policies such as linkage development, ALMP, and energy subsidization. The relative power of these actors is shaped by the prevailing state-society relations in each country. Given the great opportunities offered by the green transition, Arab state actors are likely to have a big interest in the transition and, aided by their dominant position vis-a-vis social actors in most of the Arab world, they are likely a big force for accomplishing the transition. Nevertheless, the transformation could be realized at a faster pace when the right policies that capture the interest of various social actors are implemented and even more when those actors are powerful thanks to their organizational power and their ability to coordinate among themselves and with the state.

Therefore, the paper suggests fostering innovation, linkage development policies, and professional training of a structural transformational nature, especially in Arab countries where business associations and labor unions are relatively independent, less fragmented, and more representative of their respective actors. Fossil fuel subsidization should be minimized or even replaced with a carbon tax, while subsidization should instead target energy produced from renewable sources. On the other hand, empowering social actors and having more balanced and collaborative state-society relations would augment the positive effects of the suggested policies. It is still important to provide Arab states with various incentives through development aid aimed at capacity building, increasing green finance credit, and facilitating the flow of foreign direct investment (FDI) into the renewable energy sector. However, a more accelerated and sustainable green transition could be accomplished when the interests of more empowered and powerful social actors are being addressed.

It is worth mentioning that the research faced some limitations concerning the empirical data. The use of imputation and sequential elimination were deemed necessary given the limited data, despite the possible risks that they might have on the validity of the results. Future research will benefit from richer data on the different indicators. There is also a need for more qualitative research that studies the individual countries of the region. Such research, which is currently in short supply, is very important for providing a more precise assessment and would help build a more concrete theory on the relationship between state-society relations and the green transition.

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Appendix

Table A.1. List of the Used Proxies and Their Definition in Their Original Datasets

Variable	Definition and Calculation	Original Source
Solar Wind Consumption TWh per Million Inhabitants	Solar consumption TWh + Wind Consumption TWh.	Our World in Data
Renewable Energy Consumption	Renewable energy consumption (% of total final energy cons.).	World Development Indicators (WDI)
Dominant State	100- (Percentage adjusted Voice and Accountability indicator), where Voice and Accountability measures: “Perceptions of the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.”	Worldwide Governance Indicators (WGI)
Favoritism	“To what extent do government officials show favoritism to well-connected firms and individuals when deciding upon policies and contracts?”	Global Competitiveness Indicators (GCI)
CSO Consultation	“Are major civil society organizations (CSOs) routinely consulted by policymakers on policies relevant to their members?”	Varieties of Democracy (V-Dem)
Large CSO	“Large Encompassing Organizations dominate”: “characterize the relative influence of large mass constituency civil society organizations (CSOs) versus smaller, more local, or narrowly construed CSOs. The government and CSOs are linked formally through a corporatist system of interest intermediation; or, due to historical circumstances, particular large CSOs are highly influential. The voice of such organizations is recognized by the government and is accorded special weight by policymakers.”	Varieties of Democracy (V-Dem)
Trade Unions	“What share of the population is regularly active in independent trade unions?”	Varieties of Democracy (V-Dem)
Availability of Training	Local availability of specialized training services: “In your country, how available are high-quality, professional training services?”	Global Competitiveness Indicators (GCI)
Innovation	A composite of the following indicators: capacity for innovation, quality of scientific research institutions, company spending on R&D, university-industry collaboration in R&D, government procurement of advanced technology, availability of scientists and engineers, and PCT patents.	Global Competitiveness Indicators (GCI)
Industrial Energy Intensity	Energy intensity of industrial sector (MJ/2011 USD PPP).	Our World in Data
Energy Subsidy per Manuf. VA	[Total Energy Subsidies ($ million Real 2021)/GDP constant 2010 USD)]/Manufacturing Value Added % GDP.	* Total Energy Subsidies ($ million Real 2021): the International Energy Agency (IEA) * GDP and Manufacturing VA: World Development Indicators (WDI)

Table A.2. The Sequential Elimination Process on the Conducted Regressions

Regression	Eliminated Variables	F-Test
Reg. 1	Dominant State, Large CSO, Trade Unions, Large CSO*Innovation, Trade Unions*Energy Subsidy Per Manufacturing VA, Industrial Energy Intensity.	F(6, 50) = 0.083, p-value 0.998
	Energy Subsidy Per Manufacturing VA, CSO Consult*Training, Favoritism*Energy Subsidy Manufacturing*Industrial Energy Intensity.	F(3, 56) = 0.834, p-value 0.481
Reg. 2	Favoritism, Energy Subsidy Per Manufacturing VA, CSO Consult*Innovation, Trade Unions*Training, Favoritism*Energy Subsidy per Manufacturing VA, Industrial Energy Intensity, Energy Subsidy per Manufacturing VA*Industrial Energy Intensity.	F(7, 67) = 0.67, p-value 0.697

Table A.3. SBLR Power Relations and Renewable Energy Production in the Arab World

Country	Time	Solar-Wind Consump. (TWh per million)	Renewable energy consumption (%)	Dominant State	Favoritism	CSO Consultation	Large CSOs	Independent Trade Unions
Algeria	2005-2009	0.00	0.40	68.54	55.48	27.38	35.30	58.70
	2015-2019	0.03	0.13	67.26	65.62	30.17	60.62	58.70
Bahrain	2005-2009	..	0.00	66.65	55.56	40.30	50.00	65.80
	2015-2019	..	0.00	77.15	46.55	22.05	13.34	62.16
Comoros	2005-2009	..	68.78	57.48	..	49.10	35.00	59.66
	2015-2019	..	57.67	55.59	..	51.65	14.06	61.49
Djibouti	2005-2009	..	33.23	73.33	..	53.22	20.00	41.85
	2015-2019	..	26.18	77.94	..	52.86	24.06	47.82
Egypt	2005-2009	0.03	6.06	72.81	61.67	23.67	34.98	30.47
	2015-2019	0.09	5.31	74.25	53.68	14.74	22.22	36.98
Iraq	2005-2009	0.00	1.87	73.35	..	50.57	39.42	42.18
	2015-2019	0.01	0.77	71.29	..	42.59	38.82	42.51
Jordan	2005-2009	..	2.36	63.72	55.13	42.94	12.00	67.77
	2015-2019	..	5.75	64.70	53.71	50.25	13.52	67.77
Kuwait	2005-2009	0.00	0.00	60.55	65.57	48.61	20.00	57.92
	2015-2019	0.03	0.03	62.66	68.54	46.67	26.30	57.92
Lebanon	2005-2009	..	6.33	57.65	83.20	48.33	14.64	67.70
	2015-2019	..	4.40	60.40	83.40	48.25	24.88	67.70
Libya	2005-2009	..	2.73	88.58	68.46	6.09	10.00	21.27
	2015-2019	..	2.97	78.09	77.85	41.83	35.72	35.75
Mauritania	2005-2009	..	36.55	67.19	62.21	36.97	29.00	59.85
	2015-2019	..	27.31	66.42	67.98	45.01	10.00	59.85
Morocco	2005-2009	0.02	16.71	64.44	58.67	48.81	17.14	66.57
	2015-2019	0.30	10.84	62.71	59.11	52.35	38.90	68.71
Oman	2005-2009	0.00	0.00	71.15	36.71	33.99	13.30	37.40
	2015-2019	0.01	0.01	71.18	49.91	37.04	13.52	37.40
Qatar	2005-2009	0.00	0.08	67.78	36.53	26.64	33.30	4.12
	2015-2019	0.01	0.06	73.16	25.52	25.16	24.90	4.12

Table A.3. SBLR Power Relations and Renewable Energy Production in the Arab World (contd.)

Country	Time	Solar-Wind Consump. (TWh per million)	Renewable Energy consumption (%)	Dominant State	Favoritism	CSO Consultation	Large CSOs	Independent Trade Unions
Saudi Arabia	2005-2009	0.00	0.01	84.30	47.14	28.23	15.02	11.28
	2015-2019	0.01	0.01	84.98	43.99	36.23	10.36	11.28
Somalia	2005-2009	..	93.36	87.21	..	30.56	14.00	16.27
	2015-2019	..	94.83	87.94	..	43.17	19.72	30.65
Sudan	2005-2009	..	66.75	83.74	..	36.50	14.30	64.72
	2015-2019	..	59.90	86.20	..	37.40	26.66	73.21
Syria	2005-2009	..	1.52	83.86	67.04	3.80	33.30	46.70
	2015-2019	..	0.97	89.18	69.70	0.00	36.52	41.16
Tunisia	2005-2009	..	14.70	75.34	36.81	31.01	40.00	68.82
	2015-2019	..	12.16	45.17	61.44	82.10	40.60	75.85
UAE	2005-2009	0.00	0.11	67.46	43.76	17.41	25.00	10.15
	2015-2019	0.36	0.29	71.73	25.69	17.41	25.00	13.93
West Bank and Gaza	2005-2009	..	19.60	64.33	..	53.98	15.54	59.68
	2015-2019	..	12.08	70.75	..	53.54	26.66	56.74
Yemen	2005-2009	..	0.74	73.37	88.41	29.89	38.50	65.02
	2015-2019	..	2.69	82.71	81.34	13.44	11.10	61.17

Table A.4. Policies Relevant to Energy Transition in the Arab World

Country	Time	Availability of Training	ALMP	R&D (%GDP)	Innovation	Technology Readiness	Energy Subsidies per Manufacturing VA %	Industrial Energy Intensity (MJ/$2011 PPP)
Algeria	2005-2009	35.24	..	0.07	31.59	23.38	7.27	1.84
	2015-2019	39.09	..	0.53	30.39	33.49	9.71	..
Bahrain	2005-2009	40.56	..	..	28.37	49.63	35.50	4.43
	2015-2019	63.41	..	..	41.82	70.76	9.53	..
Comoros	2005-2009	..	9.21	..	..	..	..	..
	2015-2019	..	9.21	..	..	..	..	..
Djibouti	2005-2009	..	..	..	..	..	..	1.92
	2015-2019	..	..	..	..	..	..	..
Egypt	2005-2009	43.51	..	0.29	34.63	30.20	22.06	3.52
	2015-2019	32.40	..	0.68	29.55	38.49	12.85	..
Iraq	2005-2009	..	5.50	0.04	..	..	313.26	0.87
	2015-2019	..	..	0.04	..	..	84.19	..
Jordan	2005-2009	50.08	..	0.43	38.37	36.04	..	3.63
	2015-2019	58.71	..	0.33	44.22	49.48	..	..
Kuwait	2005-2009	50.35	..	0.09	33.91	41.56	74.87	..
	2015-2019	42.93	..	0.09	32.18	51.63	43.49	..
Lebanon	2005-2009	..	..	..	27.53	37.34	..	2.87
	2015-2019	58.26	..	..	36.40	49.22	..	..
Libya	2005-2009	34.05	..	..	28.03	22.55	55.35	0.77
	2015-2019	25.72	..	..	16.32	25.96	63.09	..
Mauritania	2005-2009	24.96	..	..	25.70	27.46	..	1.00
	2015-2019	30.01	..	..	21.88	23.68	..	..
Morocco	2005-2009	48.24	..	0.61	35.00	32.47	..	2.32
	2015-2019	51.02	..	..	35.35	44.87	..	..
Oman	2005-2009	48.79	..	..	43.76	35.50	0.26	4.19
	2015-2019	43.31	..	0.24	37.85	56.42	1.02	..
Qatar	2005-2009	49.55	..	..	40.53	48.45	30.26	4.23
	2015-2019	73.18	..	0.51	63.52	71.81	9.47	..
Saudi Arabia	2005-2009	52.54	..	0.05	41.42	41.49	66.70	1.37
	2015-2019	52.67	..	..	45.64	63.83	21.61	..
Somalia	2005-2009	..	..	..	..	..	..	8.25
	2015-2019	..	..	..	..	..	..	..
Sudan	2005-2009	..	..	0.30	..	..	..	1.62
	2015-2019	..	..	..	..	..	..	..
Syria	2005-2009	39.59	..	..	31.66	25.43	..	4.26
	2015-2019	..	..	0.01	25.81	34.76	..	..
Tunisia	2005-2009	61.34	..	0.68	48.19	38.65	..	3.19
	2015-2019	45.34	..	0.62	33.98	43.52	..	..
UAE	2005-2009	52.60	..	..	39.19	53.45	46.89	2.93
	2015-2019	72.57	..	0.88	58.68	78.37	15.17	..
West Bank and Gaza	2005-2009	..	..	0.26	..	..	..	..
	2015-2019	..	..	..	..	..	..	..
Yemen	2005-2009	..	..	..	11.27	23.52	..	1.53
	2015-2019	30.11	..	..	20.45	20.28	..	..