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The Geopolitics of Renewables: New Board, New Game

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Abstract

This policy perspective sums up the main input of four members of the Research Panel for IRENA's Global Commission on the Geopolitics of the Energy Transformation. The geographic and technical characteristics of renewable energy systems are fundamentally different from those of coal, oil, and natural gas. This has implications for interstate energy relations and will require early attention if states are to exploit opportunities and address challenges. We point to six clusters of renewables' geopolitical implications that will manifest themselves over different time horizons. Overall, a generally positive disruption is foreseen, but also one that raises new energy security challenges. Moreover, while renewables will eventually render energy relations more horizontal and polycentric, achieving a smooth transition will not be easy. Renewables alter arenas of energy interaction, transforming markets and shifting trade partners, and reshape patterns of cooperation and conflict among countries. One possible outcome is a world of continental-sized grid communities made up of prosumer countries that continuously strategize between secure domestic production and cheap imports. Political action is required to manage, *inter alia*, industrial competition, stranded assets, availability of electricity and storage capacity, critical materials, and rivalry over ownership of key infrastructure assets.

Keywords: Geopolitics; Renewable energy; Energy transition

1. Renewable energy: a game-changer

The report "A New World: The Geopolitics of the Energy Transformation" (IRENA, 2019) points out that the transition towards renewable energy will reshape energy relations. Where current energy markets and trade patterns are formed by the geographic and technical characteristics of fossil fuels, slowly but surely, the expansion of renewable energy will transform patterns of cooperation and conflict between countries. Compared to fossil fuel resources, renewable energy resources are abundant and variable rather than geographically concentrated and exhaustible. Renewable energy generation technologies lend themselves to decentralized generation and utilize critical minerals and metals, whereas coal, oil and gas optimize economies of scale in centralized installations for production and processing. The distribution of most renewables, finally, is electric in nature, involving stringent managerial conditions and long-distance losses, as opposed to the ease of storage and transportation of solids, liquids, and gases around the world.

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What do these changes imply? What existing political tensions might renewables alleviate and which new energy security challenges might they bring?

The geopolitical implications of renewable energy are starting to attract academic and political attention. Until recently, international relations scholars focused on oil and gas when investigating energy security, energy geopolitics, and the international political economy of energy. Their works are full of rich historical descriptive accounts that hardly address renewable energy (Yergin, 1991; Bromley, 1991; Clingendael, 2004; Pascual, 2015; O'Sullivan, 2017; Hoegselius, 2019). Their current focus on shale gas, unconventional oil, and the globally expanding LNG market are prime examples of this. Meanwhile, renewable energy experts have largely ignored renewables' international political ramifications. Their attention was focused on getting there, i.e. the potential, system integration and market diffusion of new technologies (Haas et al., 2004; Verbong and Geels, 2007; Ellabban et al., 2014). Political geography has probably fared best in relating notions of space and territoriality to renewable energy (e.g. Stoeglehner et al., 2011; Bridge et al., 2013), though its main focus has been on climate and environmental politics (e.g. Dalby 2013). In public discourse, finally, renewables have been cast as a panacea to fossil fuel related ills, such as import-dependence, transport bottlenecks, climate change, and local pollution, while the new challenges to energy security that they may bring have been largely ignored (e.g. Ölz et al., 2007; Verrastro et al., 2010).

A handful of studies have begun exploring renewables' impact on interstate energy relations (e.g. Rothkopf, 2009; Criekemans, 2011, 2018; Casertano, 2012; Westphal, 2012; Scholten and Bosman, 2013, 2016; Johansson, 2013; Overland, 2015, 2019; Hache, 2016; Paltsev, 2016; O'Sullivan et al., 2017; Bazilian et al., 2017; Scholten, 2018; Smith Stegen, 2018; Escribano, 2019; Proedrou, 2018; Goldthau et al., 2019; Buschle and Westphal, 2019). In addition, various geopolitical aspects of the transition towards renewable energy, such as e.g. stranded assets, industrial competition, rare materials, or HVDC interconnections, have been studied in isolation (Lovins, 2017; Freeman, 2018; Van de Graaf, 2018; Van de Graaf and Verbruggen, 2015; Sweijs et al., 2014; OECD, 2015; Pierri et al., 2017; Konstantelos et al., 2017). The report by the IRENA Global Commission on the Geopolitics of Energy Transformation, supported by Germany, Norway and the United Arab Emirates, has also given the topic international recognition (http://www.geopoliticsofrenewables.org/). Nevertheless, while the strategic aspects of oil and natural gas are well-documented, there still exists a great deal of uncertainty about how renewable energy will reshape countries' energy security (policies) and patterns of cooperation and conflict between them.

This policy perspective presents our view on the most likely consequences for interstate energy relations of a transition to renewable energy. We argue that the effects will be considerable and require early attention to exploit opportunities and address challenges. In doing so, we provide insights into an entirely new set of challenges to (energy) security and foreign policy, essentially inviting more research on this novel topic. Our perspective is supported by two pillars. First, our arguments build upon the many works that have shaped our view over the years, to which we are indebted but cannot all acknowledge here. Special mention should go to the edited volume by Scholten (2018), O'Sullivan et al. (2017) and our work for the Research Panel that provided input for the IRENA Global Commission on the Geopolitics of the Energy Transformation. While Scholten (2018) and O'Sullivan et al. (2017) provided us with numerous points that are summarized, updated and further developed below, the IRENA platform allowed us to exchange ideas with high level practitioners in industry and policy and to discuss our views and arguments

with them in a series of meetings. Second, it takes the geographic and technical characteristics of renewable energy systems as the point of departure in exploring implications for energy security within and among states. Moving from geography and technology to economics and politics helps to structure our reasoning and clearly showcase differences with the geopolitics of oil and natural gas. We proceed by discussing the main geopolitical implications of a transition to renewable energy (section 2) and putting them into a temporal perspective (section 3). We then move towards the implications for great power rivalry (section 4) before ending with a few policy suggestions (section 5).

2. Six clusters of implications

The geopolitical implications of renewable energy are centered around (at least) six clusters. Combined, they give the impression of a generally positive disruption, but also one that raises new challenges.

First, the abundant and geographically dispersed nature of renewable energy sources implies a shift towards less oligopolistic global markets. Most countries possess some form of renewable energy. This offers them the opportunity to reduce their dependence on foreign reserves and face a make-or-buy decision between secure domestic production and cheap imports. This fundamentally blurs the classical distinction between importers and exporters, creating a world of 'prosumer countries'. Moreover, the presence of many (potential) producers empowers consumers to more readily switch producers and limits the possibilities of producers to set prices. This has led some to consider current net-importing countries to be the 'winners' and oil and gas exporting countries to be the 'losers' of the energy transition. Nevertheless, countries will still have to ensure availability at the right time and deal with price volatility due to the intermittent nature of most renewable energy, for example by ensuring sufficient transport and storage capacity. In this setting, strategic leverage accrues to efficient producers, large consumers, and countries providing low-cost balancing services. In addition, energy security concerns shift from getting access to foreign resources, diversification policies, and strategic reserves to make-or-buy decisions, availability at the right time, and access to geographically bound renewable sources and services (such as geothermal hotspots, biomass, pumped hydro storage, and so on).

Second, renewable sources also help facilitate a shift to a two tier and more resilient energy system which includes centralized facilities run by large energy companies and decentralized modes of generation by and for a more varied set of local actors (households, businesses, and communities). The decentralized options add a new dimension to system operations, enable new business models and facilitate local empowerment. In terms of technical operations, the role of smart technologies (ICT), demand-side management, flexibility services, and spatial distribution are crucial to balance local and regional grids. Economically, as local generation increases, energy and revenue streams will stay within the area, power companies lose market shares, and electricity markets will increasingly become a business-to-business affair. Business models will change, either because value is accrued at end users by supplying devices and services rather than selling electricity to them or because the motivation of local actors to generate electricity is often to reduce costs, not to make profits. As shrinking residential markets reduce states' revenue streams, usually earned through network tariffs, governments will be forced to rethink their tax systems and energy market design. Politically, while local generation could democratize energy systems, as it empowers regions by providing energy access, employment, and revenues, it could also strengthen centrifugal forces within states, leading to civil unrest and potentially separatism.

Third, the use of critical minerals and metals and specialized know-how in clean tech may increase competition for access to these among countries that compete for industrial leadership in renewable generation technologies. Renewable energy technologies require cobalt, lithium, neodymium, and dysprosium, for example. Unlike renewable energy sources, these are not evenly spread across the globe, nor is the capacity to extract them. Conflicts over such minerals could erupt between net-importers while a new resource curse looms for countries exporting them. Some skepticism is in order, however. This implication may not materialize because materials can be recycled, alternative materials and technologies might be developed, materials need to be imported only once to build installations, new deposits may be discovered (like Japan's discovery near Minamitorishima Island), and mines can be (re)opened. Such measures provide opportunities to remedy the situation if these materials are used as political pressure. It is hence very questionable whether China will be able to capitalize on its more than 90% share of the rare earth materials market. It is, however, likely that intellectual property rights over cutting-edge clean tech patents will be a source of contention, especially as their enforcement in an increasingly multipolar world with rivalling nuclear powers may be challenging.

Fourth, as electricity is the energy carrier of most renewables, the electrification of energy systems is expected. One likely implication is the regionalization of energy relations, i.e. a shift from global networks to regional and/or continental ('super') grids due to the cost of long-distance losses in electricity transmission. This implies a major shift in trade routes and partners; energy relations with the near abroad intensify while overseas entanglements, mostly in the MENA and CACR, will lessen. The emergence of continental-sized 'grid communities' centered around great powers or economic blocks is likely, global interconnection less so. Especially in a setting where great powers perceive each other as rivals (e.g. China and Japan or the EU and Russia), fear of dependence is likely to result in little interconnection between grid communities. This might result in a fragmented multipolar electric world. First evidence is given by the de-linking the Baltic States and Ukraine from the old Soviet system and synchronizing their electricity grids with the European continental grid. These processes, however, might have geopolitical ramifications for the overall EU-Russian relationship. Another implication is an emphasis on infrastructure operations rather than commodity supply security due to electricity's stringent managerial requirements, storage limitations, and renewables' abundance. Control over grid asset development, operations, and regulation is of utmost importance to exert influence over electricity flows and ultimately ensure market access and availability of cheap energy at the right time. If electrification leads to a substantial de-diversification of transport modalities, control of assets may also prevent deliberate cut-offs in the absence of war and insofar as the digitization of electricity networks is met with adequate cybersecurity efforts.

Fifth, the increasing use of renewables changes the volume and nature of energy trade. Current power production knows essentially three markets: for feedstocks such as coal, oil, and gas, for generation technologies (power plants), and wholesale electricity markets. Renewables-based power production is different. Without the need to continuously import fossil energy sources for electricity generation (solar and wind being free goods) and due to increasing decentralized production, international trade is likely to decline (not counting global energy demand growth). Only trade volumes in generation technologies can be expected to remain roughly the same, even if trade is more modular instead of big power plants. Much of the remaining trade will hence be in generation technologies and energy services, rather than energy sources and carriers. Of course, biomass and nuclear material volumes could increase, but they are rather unlikely to offset the decline in fossil fuels. The growing use of electric vehicles and local heat sources will

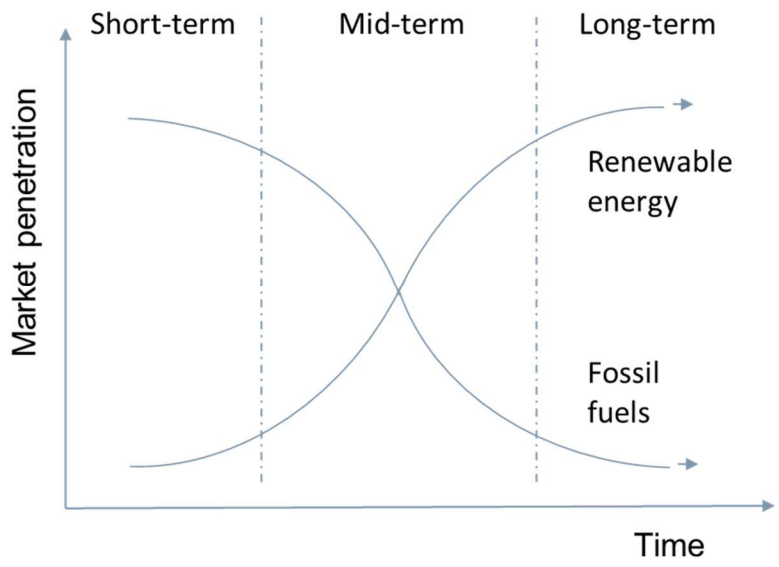
further intensify this trend, assuming that heat and electricity for vehicles will (at least partly) come from renewable sources. This raises the follow-up question: do reduced trade volumes imply a depoliticization of energy? Trade in (renewable) electricity may also require more short-term, intraday markets that handle intermittency rather than long-term, bilateral deals that secure supply. This affects (international) market design, regulation, and energy policy practices. Next to markets, the business case of renewable energy brings its own challenges. First, many renewables involve much lower marginal costs and relatively high capital expenditure per kWh. The practice of marginal cost pricing in power markets combined with high sunk costs makes investments riskier for those interested in selling electricity. Capacity guarantees seem a necessity here. Second, negative energy prices due to intermittency have also raised concerns about return on investments. The increasing use of renewables will only aggravate this effect if not handled via storage, interconnection, price signals, etc.

Sixth, and not directly related to renewables' geotechnical characteristics, we are already witnessing a process of creative destruction in global energy markets. There is intensifying industrial rivalry over market shares in clean energy generation technologies, most notably between Western high-end solar and wind technologies and Chinese mass-products. The global distribution of clean tech patents is testimony to the leading position of the US, EU, China and East Asia. Meanwhile, current net-exporting countries (and oil and gas companies) worry about stranded assets and the potential for political unrest. The fact that current net-importers are the frontrunners and current net-exporters the laggards indicates technical and institutional lock-in and path-dependence. Nevertheless, things can change: oil and gas revenues enable exporters to invest in renewables (or other capital-intensive industries), some of which they are well-positioned to exploit efficiently, like solar in the MENA region or biomass in Russia. Moreover, while investments shift from fossils to renewables, they do so in a context of growing global energy demand, ensuring that investments in fossil fuels, mostly natural gas, will remain profitable for a while. Then again, being an industrial frontrunner can result in the added benefit of a political leadership position within broader climate-oriented institutions.

3. A temporal perspective

The various geopolitical impacts of a large-scale deployment of renewable energy will materialize at different times. Figure 1 visualizes the interplay between the rise of renewables and decline of fossil fuels. The paragraphs that follow explore how this may shape energy geopolitics during the transition.

Figure 1. The energy transition from a temporal perspective



In the short run, renewables soften oil and gas related geopolitical tensions, while the forces of creative destruction set to work in the form of shifting investments from fossil fuels to renewables. The installed capacity of renewables is growing fast from a low base, but growing global energy demand keeps the share of renewables in the global energy mix low vis-à-vis fossil fuels. This prevents renewables from becoming a strategic factor at this stage (such as unconventional oil and shale gas have become). Nevertheless, renewable energy provides net-importers of fossil fuels means for diversification, and hence more autonomy in global energy markets. In general, the energy transition has a domestic orientation: governments are interested in what (central or decentralized) technologies to promote, where new industrial opportunities lie, or what the potential losses of stranded assets are. Renewables are already a matter of industrial rivalry; it would be prudent for countries with ambitions for industrial leadership in clean tech to realize their plans now. The same holds for means to overcome stranded assets and associated risks for economic development and political stability. Another important feature of this stage is that the system integration of decentral generation by local actors, intermittency effects, and demand for critical materials can be accommodated within the confines of existing energy systems; renewables' scale is still too limited for them to be more than a nuisance to the current modus operandi of energy systems and markets.

In the medium term, the energy map will be redrawn fundamentally. Due to increasing global energy demand, the simultaneous use of fossil fuels and renewable energy is required while the growth of renewables will necessitate the construction of both microgrids and supergrids. If the short term was about generation choices, this stage is about network and trade choices; as old capacity is dismantled and new infrastructure is built, it will create a highly dynamic setting in which countries are in a position to rethink energy priorities and readily switch trade partners. Put differently, while the abundance of energy depoliticizes markets, infrastructure developments render trade relations uncertain and complex. Energy markets will start to become more regional due to the forming supergrid and countries will need to find a new balance between long-term assurances (bilateral deals) and short-term flexibility (new regional electricity markets). In terms of industry, renewable generation technologies will enter the mass-market

phase, shifting emphasis from high-end clean tech by frontrunner companies to mass-market products and economies of scale. The scramble for critical minerals and metals will now be at its most intense. For current petrostates, stranded assets will be testing their social contract; their ability to ensure economic development and political stability will greatly determine energy price volatility and, consequently, the speed of the transition.

In the long run, renewables supply most energy needs. We enter a world of grid communities, the size of continental supergrids, where prosumer countries operate an integrated electricity network and balance between secure domestic production and cheap imports. Important parameters will be national generation capacity, reliability of energy partners and the political-economic capability to enforce agreements. 'Grid politics' will be the order of the day: to ensure service continuity and availability at the right time, countries compete for ownership of assets, operations and markets. Interconnectors will be of special interest to ensure exports or protect domestic markets from foreign competition. Strategic advantages lie with efficient producers, transit hubs, and areas endowed with cheap, large-scale storage. On a higher level, it is a struggle between the use of supergrids as tools of power projection by its bigger members and the taming of those through a web of complex interdependence by its smaller members. Grid communities will inevitably experience differences in economic wealth and political power among their participating countries. This raises some interesting questions. For example, how will the different positions of the US in North America (hegemonic) and Germany in Europe ('primus inter pares') play out? In general, energy is commodified rather than securitized, due to the ease of switching between trade partners among the many prosumers and fewer tensions over critical minerals and metals now that most generation capacity is installed. Technical issues, such as intermittency and storage, should have been resolved at this point, but digitization of electricity networks may still require measures to counter vulnerability to cyber-attacks.

There remains much uncertainty, of course. Other developments like technical breakthroughs in storage and digitization, great power rivalry between China, EU, India, Russia and United States, environmental urgency, business interests and lobbying, and socio-cultural and political-institutional lock-ins and path-dependencies will undoubtedly affect energy systems and markets and the speed of the transition. Such contextual factors will co-determine energy relations next to the geotechnical characteristics of renewable energy systems. It is telling in this light that those countries endowed with the most solar irradiation are currently eclipsed by their more northern counterparts when it comes to installed PV capacity. Another big question will be the role of gases and in particular hydrogen in future energy systems to provide storage, heat/cooling, and mobility. The success of these an energy carriers may well determine how much long-distance energy trade is retained. We should also not forget that fossil fuels will remain with us for the foreseeable future (EIA 2016), making energy geopolitics the result of both fossil fuels and renewables. Moreover, there is not even a consensus on the final destination of the energy transition, i.e. how big a share of energy supply should come from renewables.

4. Implications for great power rivalry

The geographic and technical characteristics of renewable energy systems are fundamentally different from those of coal, oil, and natural gas. In turn, the geopolitics of renewables will look very different from the geopolitics of fossil fuels. Great power relations will become less underpinned by access to and availability of energy sources and asymmetric trade and infrastructure interdependencies. Energy security concerns in general shift from a strategic emphasis on energy sources to a focus on distribution, while generation sees new challenges replace the old. All in all, international energy relations will become more symmetrical and stable as countries will essentially trade because they want to, rather than because they have to.

The fossil-fuels based energy system is fundamentally asymmetric and a driver of tension. Oil and natural gas have divided the world into 'haves' and 'have-nots', leaving the less well-off countries struggling for access to these resources. The struggle over hegemony in the Persian Gulf and the US' Carter Doctrine were intrinsically linked to oil, for instance. Moreover, Russia's weight as an international power builds on its position as an indispensable energy supplier, instrumentalizing energy supplies to Europe as a foreign and economic tool, and playing on energy in its relationships with China, Iran and Venezuela. In addition, fossil fuels serve as the corner stone for the social contract of petrostates (e.g. Saudi Arabia), whose frequent authoritarian nature has had its own impact on international politics.

International energy governance has developed slowly and the pace and direction have been set by fossil fuels. OPEC's role as a cartel and the reaction of the OECD countries which led to the creation of the International Energy Agency was a major governance outcome to deal with interdependencies and vulnerabilities in a world fueled by oil. The fossil fuel-based world has seen cyclical ups and downs of buyers' and sellers' markets, directly impacting on the balance of power in the (energy) world. Nuclear power has also been part of a number of package deals involving geopolitics, energy and military cooperation, e.g. between Russia and Middle Eastern states.

In a world dominated by renewables most countries become prosumers and transmitters, part of continental grid communities. In that world, the make-or-buy decision makes relationships inherently more symmetric, i.e. levelized, eye-to-eye, and service-based. Trade, interconnectivity, and regulatory convergence are initiated because countries want to reap the benefits of renewable energy, not because they need to get access to resources. The density of transborder interconnectivity and the size of grid communities is likely to be a result of political choice and geography. As a consequence, energy security will be defined in more cooperative and common terms.

Nevertheless, a number of uncertainties remain. First, will the formation of grid communities take energy out of great power rivalry? In the best case, grid communities are self-sufficient and centered around great powers and their backyards, making trade between grid communities (and hence great powers) voluntary. Energy would become a regular commodity and disputes confined within grid communities. Still, less dependence could also backfire; will EU–Russia relations be more stable if there is less (common interest in) energy trade? At its worst, there may exist a patchwork of semi-overlapping grid communities spearheaded by major and minor powers. This scenario is not unlikely on the Eurasian continent and one which would instrumentalize control over grid assets as political tools.

It is also not certain whether current net-exporters will be the losers and current net-importers the winners of this energy transformation. The real winners are those countries that will lessen their fossil import dependence and create revenue from renewable energy related exports. The true losers are those countries that do the opposite: lose current fossil fuel related export revenues and import renewable

energy generation technologies. Most countries, however, will be stuck in between. Many will be able to reduce their import dependence through the use of renewable energy, but fail to become global market leaders in clean tech. Finally, a few current fossil fuel exporters will manage to make the transition to renewable energy, though it is hard to imagine them earning the same amount of revenues from renewable energy related exports in the future as they have earned from fossil fuels in the past.

In addition, what will be the role of IEA and OPEC in a renewable world? Will they become redundant, be replaced by new alliances, or reinvent themselves, like NATO after the collapse of the Soviet Union? Will new energy alliances mostly overlap with grid community boundaries?

While the future seems bright(er), the transition period is accompanied by uncertainties. This is especially the case against the backdrop of an increasingly interdependent, but also multipolar world and the crisis of the liberal order. Industrial competition, stranded assets, shifting trade alliances, redeployment of military hardware to secure new energy bottlenecks etc. might well reinforce geopolitical rivalry and fierce geo-economic competition among states. Moreover, the world is going to face a multi-speed energy transition, producing frontrunners and laggards, and new grand initiatives like China's One Belt, One Road that may keep the Middle East and Indian Ocean as contested spaces, despite a declining oil trade. Hence, it remains to be seen whether renewables are able to depoliticize energy relations in a world that is also increasingly multipolar.

5. Policy suggestions

The geopolitical implications of renewable energy are considerable. With this in mind, it is prudent for policymakers to develop a long-term strategy to exploit opportunities and address potential challenges at an early stage.

A first point of attention for countries should be to investigate whether and how revenues can be generated from renewable energy. This not only concerns industrial leadership in clean energy generation technologies, but also other areas of the supply chain: material resources, transportation and storage services, on/offshore construction, supporting products and services, etc. Where do they possess the know-how, resources, and capital; where is their competitive advantage?

Energy security also has to be reimagined and reframed at different levels. Countries (and regional groupings such as the EU) need to investigate the national energy security effects of domestic and global efforts towards renewable energy and consider their likely role/position in future energy networks and markets. What is the domestic capacity to generate renewable energy, what is the potential for cheap and large-scale storage, and is there a strategic position as transport hub? How much energy should be generated centrally, decentrally or imported? How reliable are potential trade partners and what are political and economic capabilities to enforce agreements? Where are new dependencies and vulnerabilities? Can sufficient generation and network capacity compensate for a lack of strategic reserves? In the end it all revolves around the make-or-buy decision: is energy security best attained via isolationist self-reliance or via continental interconnection and trade.

Finally, how can a smooth global energy transformation be facilitated? While we foresee a generally positive end result of the disruption, the transition period may be a different story. How to

overcome the various challenges at different stages of the transition; how to ensure an inclusive process where all countries can reap the benefits; and considering this, how to be fast enough to limit the effects of climate change at the same time? This is where international governance and cooperation comes in to facilitate technological exchange while protecting property rights, create trust to establish shared control mechanisms, and handle interstate disputes. It also involves a regular dialogue with old energy powers as the divorce of long-term relations may be painful. Developing cooperative (and multilateral) partnerships that build on sustainable energy pathways may help to hedge risks at the international level, but also for rent-seeking economies themselves.

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