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Gulf Hydrogen Horizons

**Why are Gulf oil and gas producers so
keen on hydrogen?**

Natalie Koch



Summary

This paper examines the recent interest in hydrogen energy among political and economic leaders in the oil and gas producing states of the Gulf Cooperation Council (GCC). Although key stakeholders continue to reinforce the fossil fuel systems that have defined the region's political economy for decades, they increasingly recognize that the hydrocarbon era is drawing to a close. This has led to an increase in various "post-oil" energy investments, which most recently include hydrogen energy. This discussion paper examines why this is the case – that is, why the GCC's political and corporate leaders are keen on promoting hydrogen energy systems in the region. It shows that the aspiration to produce "green" hydrogen – originating in Europe and Germany in particular – is increasingly seen as a way to broadcast the region's green credentials, while simultaneously supporting the investments in "blue" hydrogen promoted by the state-owned hydrocarbon giants in the UAE and Saudi Arabia.

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1. Introduction

The oil- and gas-producing countries of the Gulf Cooperation Council (GCC) are famous for their economic dependence on the hydrocarbon system. Having modernized and developed their contemporary political systems through oil and gas exports, local leaders are loath to admit it, but they understand that the hydrocarbon era is drawing to a close. They also recognize the financial challenges that a “post-oil” energy transition will present and have accordingly engaged in various economic diversification programs in the past decades. But even this recognition does not mean that political and business leaders welcome a shift away from a carbon-intensive energy system.

Indeed, it is abundantly clear that the GCC states will not abandon the domestic production of oil and gas in the near future. This disinterest was succinctly illustrated in the now infamous words of Saudi Arabia’s Energy Minister Prince Abdulaziz bin Salman, “We are still going to be the last man standing, and every molecule of hydrocarbon will come out” (quoted in Blas 2021). And these comments were made even before the surge in demand for hydrocarbons following Russia’s February 2022 invasion of Ukraine, which has sent global prices soaring and Gulf oil and gas producers reaping huge financial and political rewards.

The fact that exporting oil and gas is still the most lucrative enterprise for the well-endowed Gulf countries is a key reason for the region’s broad resistance to moving away from oil and gas economies in the Gulf. Alternative energy aspirations are nonetheless spreading in the region. Solar power has received the most attention and funding in the GCC in the past decade, but hydrogen energy is quickly gaining prominence in the Arab Gulf region. Local leaders have a both an economic and a political interest in joining the hydrogen hype – or rather, as the Dubai Future Foundation describes it in a recent report, in actively helping to transform hydrogen energy “from hype to reality” (DFF 2021). But why? Why are the GCC’s political and corporate leaders increasingly keen on hydrogen? What is it about hydrogen production and markets, as they are currently being imagined and built in the Gulf, that makes them so appealing to the region’s oil and gas producers?

2. The promise (and reality) of “green” hydrogen

In addressing the recent Gulf interest in hydrogen, it is important to acknowledge that hydrogen production today is not “green.” As it is produced in the Gulf and nearly everywhere else in the world, the energy-intensive process is not yet fueled by renewables. Of course, many policymakers and climate champions in the industrialized West hope that hydrogen will be produced with renewable energy – allowing it to become the great clean energy source of the future – but that is a distant prospect. Rather, 96 percent of hydrogen is currently produced from fossil fuels – primarily from natural gas through a process called “steam methane reforming” (SMR). Described as “gray hydrogen,” the process for generating this hydrogen is similar to “brown hydrogen” derived from coal gasification. Both gray and brown hydrogen have significant greenhouse gas emissions per unit of stored energy.

So-called “blue hydrogen” is also derived from natural gas SMR. But it is differently categorized because the production process is paired with carbon capture and storage (CCS) or, more commonly, carbon capture, utilization, and storage (CCUS). CCS and CCUS are often used interchangeably in energy discussion, but they refer to different activities. The sole goal of CCS is storage – storing CO₂ underground so that it remains there forever. CCUS, by contrast, is a broader term that extends the CCS idea to include processes that “upcycle” captured carbon. This can include the production of alcohol products like methanol or commercial products including plastics or concrete. CCUS can also include enhanced oil or recovery, where the captured carbon is injected into oil fields to make them more productive – a favored practice in the few GCC cases where CCUS is now being developed.

The blurring of CCS and CCUS terminology may seem trivial, but the elision between the two is used strategically by oil and gas companies and government leaders in the Gulf. For example, in the “Sustainability” portion of Aramco’s corporate website, they describe their “CCUS” activities and the broader possibilities of storage, but their actual projects in this sphere only include utilization (Aramco 2022). Like other companies picking up the CCUS term as the justification for their claim to the “blue hydrogen” label, the CCS/CCUS blurring allows Aramco to describe their activities as resulting in supposedly “cleaner” blue hydrogen.

CCS itself is not without controversy – it continues to be fraught with massive industry failures and significant scientific skepticism that it would ever actually work (Baxter 2017; Morton 2021; Sekera and Goodwin 2021). Even if CCS worked, critics suggest that this process of producing hydrogen would still not be climate-friendly. A recent report in Energy Science & Engineering suggested that blue hydrogen’s greenhouse gas footprint was only marginally better than gray hydrogen – and perhaps even worse than the direct use of natural gas (Howarth and Jacobson 2021, 1683). This led to a flurry of critiques from the oil and gas industry, scientists with ties to the industry, and other advocates of CCUS and the hydrogen energy industry (e.g. IOGP 2022; Romano et al. 2022).

The debates have largely centered on technical questions about CO₂ capture rates and heat recovery in the SMR process, but given the lack of a real world demonstration plant, estimates remain largely theoretical. So while the various reports are highly detailed and based on sound math, the basic assumptions are contested – making it impossible to concretely estimate costs for blue hydrogen, both in financial and ecological terms. Raising further challenges for the economic viability of natural gas-produced hydrogen (blue and gray) is the skyrocketing prices for natural gas in the wake of the 2022

Russian invasion of Ukraine (Nanji 2022). Together, the diverse questions about the cost of natural gas and carbon capture schemes are calling into question the widespread assumption that blue hydrogen is cheaper than green hydrogen.

Because almost no hydrogen produced today is green, blue hydrogen is commonly framed as a bridge to the green future. This was vividly illustrated when Germany's Energy Minister Robert Habeck visited the UAE in March 2022 to sign a series of agreements on cooperation to build up a "comprehensive hydrogen value chain" between Germany and the UAE. The official government press release explained the projects for piloting blue hydrogen transport through ammonia transport chains stating: "Initially, 'blue' hydrogen is to be used; this will quickly be replaced by 'green' hydrogen. [...] The pilot project for the blue ammonia transport chain to Germany lays an important foundation stone for medium-term imports of green hydrogen" (BMWK 2022). Such hopes are common to hydrogen investments all over the world, but they are built on significant assumptions about how realistic this transition actually is (de la Garza 2021; Frazier 2022; Morris 2021).

3. Selling blue hydrogen in the name of a green hydrogen future

Governments of the UAE, Saudi Arabia, and Oman are all giving special support to blue hydrogen production at present – both directly through their energy ministries and indirectly through their state-control oil companies. In Oman, this includes foreign cooperation, such as the Petroleum Development Oman (PDO) deal with Shell to develop CCUS in Oman. The region’s two most important national oil companies, ADNOC (Abu Dhabi National Oil Company) in the UAE and Aramco in Saudi Arabia are also starting to take more interest in CCUS, though actual operations are rather limited. ADNOC’s only functioning CCUS project is at the Al Reyadah Emirates Steel plant just outside the city of Abu Dhabi, which they advertise as being “the world’s first fully commercial carbon dioxide (CO₂) facility for the iron and steel industry, and the first commercial-scale carbon capture, utilization, and storage (CCUS) facility in the Middle East” (ADNOC 2022). The carbon dioxide from the steel facility is captured and then “compressed, dehydrated, and transported through a 43 km buried pipeline before being injected into the Rumaitha and Bab onshore oil fields to boost oil recovery” (ADNOC 2022).

Saudi Aramco is also promising an increase in CCUS investment in the future, but to date, they only have a demonstration project at their Hawiyah gas plant that also equates utilization with enhanced oil recovery. Like ADNOC, Aramco openly describes this process on their website, saying that after carbon is captured at the facility, it is then “piped 85 kilometers and pumped into the Uthmaniyah oil reservoir, sequestering the gas while also helping to maintain pressure in the reservoir and recover more oil. Since the initial injection of CO₂ in 2015, we have doubled oil production rates from four of our wells” (Aramco 2022). Theoretically, oil companies should be welcomed as partners in combating climate change, but critics of CCUS have warned that it should not be considered climate-friendly if it is only working to “enhance” oil recovery (Briscoe 2022; Krauss 2019; Roberts 2019). But it is precisely these projects that ADNOC and Saudi Aramco – and the Emirati and Saudi governments that own and control them – are pointing to as evidence that they have the CCUS facilities to produce blue hydrogen.

CCUS projects are an important part of the blue hydrogen promise because carbon capture is imagined as a technological solution to more immediately greening hydrogen production, when renewables cannot match the capacity or price of natural gas. But as they gain more interest in the GCC’s oil and gas industry, it is important to note the risk that hydrogen development in the region will become subject to a lock-in effect whereby blue hydrogen is not a bridge but the endpoint. This highlights an important assumption built into the March 2022 German hydrogen agreements with the UAE: that if only blue hydrogen is available at present, it is nonetheless appropriate to push forward on infrastructural development now, so that the facilities are available when green hydrogen becomes a reality. This assumption might not be so problematic if the Gulf was not so far away from being able to produce green hydrogen.

For example, in Saudi Aramco’s recent announcement that its Jafurah Field would move to development, the company emphasized that it will include “significant capital investments to support the development of green and blue hydrogen production” (Ackerman 2022). But so far, the availability of

the renewable energy and water resources required to produce green hydrogen at this site is a distant and unlikely prospect. If hydrogen is to be produced here, it will be blue or, more likely, gray. Meanwhile, Crown Prince Mohammed bin Salman's favored Neom "giga-project" – a vast development scheme in the northwest of the Kingdom – is planned to include a large green hydrogen plant that aims to be operational by 2026 at the cost of \$5 billion (Al-Atrush 2022; Nakano 2022; Nereim 2022). Here again, the significant renewable energy resources required to make hydrogen production "green" are planned for but absent for the time being.

Indeed, the uncertain development of adequate renewable energy capacity to realize green hydrogen ambitions at Neom and Jafurah are indicative of a much larger problem across the GCC member states. Although they have all increased investment in increasing their renewable generation potential in the last decade, the scale of non-fossil energy production remains very low:

At the end of 2020, the region had 146 GW of installed power capacity, of which renewable energy accounted for 3271 MW. Of that, solar PV technologies remain the most dominant technology (71%), followed by solar CSP (23%), biomass and waste (4%), and wind (2%). The UAE can be considered a regional leader in renewable energy adoption, accounting for 68% of total regional renewable energy installed capacity, followed by Saudi Arabia (16%) and Kuwait (9%). (Al-Sarihi and Mansouri 2022, 4)

So at the end of 2020, the total installed power capacity of the entire GCC bloc consisted of only 2.24 percent renewable energy sources. A major problem with these publicly available statistics, however, is that they almost uniformly fail to disclose whether the "installed capacity" matches actual production, and this aporia is reflected in available academic surveys (e.g. Al-Sarihi and Mansouri 2022; Al-Sulayman 2021; Elrahmani et al. 2021). Based on my own field visits to large utility-scale projects in the UAE in 2022, however, it is clear that there is a stark mismatch between the supposed capacity of these facilities and the actual production. The country's two mega-solar projects – the Al Maktoum Solar Park in Dubai and the Noor Abu Dhabi Park in Abu Dhabi – both have major problems with keeping the solar arrays clean from dust, leading them to operate at minimal capacity or not at all for extended periods of time (Koch 2022b).

Likewise, media and industry publications frequently hail the Gulf region's up-and-coming solar potential by citing its "record-breaking" low solar costs, while systematically neglecting the fact that these record costs are only possible because they are directly subsidized by GCC governments and their diverse sovereign wealth funds and state-owned utilities (e.g. ADQ FWD 2021; Dudley 2020; Wouters and van Wijk 2019). The UAE's Al Maktoum and Noor Abu Dhabi solar parks were funded largely by state money: the government, government-owned utilities, sovereign wealth funds, etc. In Saudi Arabia, solar is also directly subsidized by the government or via subsidies to private companies. This means that its "record-breaking" low solar costs in GCC states reflect a significant degree of government subvention – which itself is not sustainable, nor is it comparable to other parts of the world. Since the Gulf's much-touted solar parks have serious difficulties producing energy at all, the costs plugged into the economic question of whether green hydrogen will become financially competitive all seem suspiciously speculative. But for now, local governments are eager to count them as "installed capacity" and point to the low tariff rates to help sell the story of the Gulf going green.

The limited capacity of renewables in the Gulf is significant for the story that blue hydrogen production will just be a short build-up to the ultimate goal of green hydrogen production because there will be no green hydrogen without vast renewable energy capacities. At present, these simply do not exist in the GCC. Even if local leaders are wont to exaggerate their gleaming new solar parks as far more, they are little more than a drop in the bucket of their overall energy mix – which continues to be dominated by oil and gas. But if the myth that blue hydrogen is a minor detour on the road to green hydrogen takes hold internationally – as it seems to have done in some parts of the world – then these privileged

industries are especially well positioned to tap into their existing infrastructures to produce blue hydrogen for potentially decades. As energy insiders from around the world know, once the infrastructure is in place, path dependency has an astonishing power to keep people buying even after they realize that the myth of a “green” future has been a lie all along.

4. Hydrogen and the hope for business as usual in a post-oil GCC

The GCC states are similar to many other rapidly developed places, where dramatic social transformation in the past 50 years has resulted in stark generational divides (Gray 2019; Thompson and Quilliam 2017). Even where obvious social and economic changes are needed, stasis tends to prevail because older generations retain a larger share of the political, economic, symbolic, and cultural capital that is needed to effect any significant shift in priorities. But a dramatic shift in social organization is precisely what would be needed to end the GCC's dependence on oil and gas revenues, such that it might have an impact on the rapidly compounding effects of climate change. Continuing "business as usual" has long been a leading priority among oil and gas industry beneficiaries, however, in no small part because the older generations that presided over the rise of hydrocarbons in the region retain an important role in industrial and economic policy. And of course, the oil and gas industry as a whole is overwhelmingly conservative. It is also defensive: a rethinking of their primary business model around oil and gas extraction, plain and simple, would appear to be a retreat or a surrender to the industry's vocal critics.

Yet GCC leaders clearly understand that an energy transition, which significantly reduces the share of oil and gas in global energy systems, is inevitable. These countries are all developmental states – that is, countries where the legitimacy of political leaders is tied to economic performance (Woo-Cummings 1999). Since the social and political order in these places has been built on revenues from hydrocarbon extraction – and they continue to be heavily reliant on these revenues today – a jointly economic and political crisis looms on the post-oil horizon. Some among the older generations continue to be in denial, but there is a growing sense of urgency to act among younger generations, who are now advancing through the oil and gas firms and the state bureaucracies of Saudi Arabia, Qatar, Oman, Bahrain, Kuwait, and the UAE. They understand that they need to be strategic about reconfiguring the relationship between energy, economics, and politics in the near term – and they are increasingly eager to find a path that allows them to continue providing progress and prosperity into the future, while also burnishing their environmental credentials (Koch 2022b; Zumbärgel 2022b). As the region's generational tensions continue to play out in the bureaucratic spaces of companies and governments, it is clear that those recognizing the need for change are desperate for new ideas – and ideas that can convince the hydrocarbon-holdouts. Hydrogen here appears to be a golden opportunity.

In part, the GCC's political and economic leaders are increasingly eager to build a new hydrogen economy because it would allow them to use much of the oil and gas infrastructure that already exists in their countries (Ansari 2022; Van de Graaf et al 2020, 4). Through my ethnographic research since 2018 at oil and gas industry events in the UAE, which are attended by political and business representatives from all over the Gulf and abroad, I noticed a significant increase in the past few years in anxiety about "stranded assets" resulting from the global shift away from oil and gas. Whether these assets were refineries, pipelines, depleted reservoirs, or even untapped reservoirs, the concern was that the countries and companies would lose huge sums of money on investments that were suddenly worthless in a post-oil world. Many in this community recognized this as inevitable, but there were differences in terms of how fast people imagined it would happen, and in terms of how they sought to

address the situation.

Hydrogen is appealing because there is already an established practice of producing hydrogen at oil refineries, and it can be stored and transported through many of the same infrastructures that the industry is expert at building and maintaining. Meanwhile, domestic production of hydrogen in the Gulf is also seen as a way to maintain other local industries that are only economically viable today because of their access to cheap, subsidized fossil energy, including steel, aviation, shipping, etc. These carbon-intensive sectors are now being prioritized for new hydrogen energy infrastructure development, as they are seen as economic drivers that are essential for maintaining local prosperity in a post-oil era. But these too remain tied to the national oil giants. ADNOC's ownership of the CCUS project at the Emirates Steel facility is a useful illustration – by owning this facility, they are able to fold it into their operational landscape, such that they can claim the environmental “benefits” of the carbon capture for their big picture accounting.

Likewise, in the splashy announcement that Saudi Arabia had completed the first shipment of blue ammonia to Japan in 2020, Aramco positioned it as a testament to their ability to pioneer hydrogen energy (Aramco 2020). It was actually the result of a joint project with the country's chemical manufacturing giant, SABIC (Saudi Basic Industries Corporation), to produce the ammonia. The blue label was given by linking it to Aramco's Hawiyah enhanced oil recovery carbon capture operations mentioned above, combined with SABIC's CCUS operation – where “utilization” means funneling captured carbon back into producing other chemicals (urea, methanol, and liquefied CO₂) (SABIC 2022). In both cases, the fluid boundaries between state-owned enterprises allow for an equally fluid accounting of who can claim credit for the CCUS operations. Leaving aside the complex web of Gulf state and parastatal entities, suffice it to say that this system ambiguity spills over into the way that hydrogen supply cycle processes can loosely be labeled as “blue.”

In addition to supporting business operations as usual through support offered to oil and non-oil industries alike, building new hydrogen energy systems in the Gulf has the added benefit of leaving established social and political patterns in place. GCC leaders are eager to promote the repurposing of oil and gas infrastructure for a future hydrogen economy because it allows them to frame these efforts as innovative strategies introduced by a generation of new, climate-informed leaders. This is especially visible in the United Arab Emirates, where a flurry of hydrogen-related investments and activities are part of a coordinated, government-backed effort to cast Abu Dhabi as a “green hydrogen hub.”

In January 2021, for example, various actors in the UAE's oil and gas sector and sovereign wealth funds (funds that derive their wealth from oil revenues) announced the Abu Dhabi Hydrogen Alliance, with the goal “to establish Abu Dhabi as a trusted leader of low-carbon green and blue hydrogen in emerging international markets” and “to build a substantial green hydrogen economy in the UAE” (ADQ 2021). This was followed by another splashy announcement in late 2021 that Abu Dhabi National Oil Company (ADNOC) and the Abu Dhabi National Energy Company (TAQA) would be assuming large stakes in the state-owned Masdar Future Energy company's hydrogen portfolio, giving ADNOC a controlling share (Masdar News 2021). The news was celebrated by ADNOC's CEO, Sultan Al Jaber:

Today's strategic partnership between two Abu Dhabi energy giants future-proofs ADNOC's business model, creating compelling business and commercial opportunities, as we fully embrace the energy transition. This innovative and collaborative venture is a bold new initiative, as it combines both companies' respective areas of expertise and paves the way for our viable entry into the clean energy space. This platform will enable ADNOC to capitalize on the many renewable energy and hydrogen opportunities, both locally and globally. (quoted in ADNOC 2021)

In addition to celebrating his company's supposedly visionary leadership, and commitment to

“embracing” the energy transition, the announcement also highlights how hydrogen and renewable energy investments are increasingly being framed as a way to “future-proof” ADNOC’s business model (Koch 2022a). Indeed, the discussions about hydrogen in the UAE are not just about future-proofing the state oil giant, but about future-proofing the country’s entire economy. In various state-issued and state-controlled publications, hydrogen is hailed as having the ability to generate hundreds of billions of dollars in revenue for the country, and potentially creating almost 1 million jobs in the future (e.g. ADQ FWD 2021; Al Ramahi 2022; DFF 2021).

As anxieties about the post-oil future deepen in the Gulf, and as a younger generation of leaders assume power in both state and corporate roles, hydrogen seems to be a tidy solution to the interlocking economic, political, and climate crises on the horizon. Of course, there are no silver bullets, but leaders can use these hydrogen initiatives to show that they recognize their countries’ challenges and that they are “doing something” and demonstrate the paternalist care that is an important part of their local legitimacy.

5. The geopolitics of hydrogen: Does it matter who is keen on hydrogen?

Domestic political and economic concerns are unquestionably the main impetus for GCC oil and gas producers recent interest in hydrogen energy, but “business as usual” has important geopolitical implications. In the Gulf region, economics is geopolitical, and geopolitics is economic. Gulf leaders have long understood that their oil and gas exports are valuable not just for the financial profits, but also for the leverage they offer in their countries’ international relations (Hertog 2010; McFarland 2020; Vitalis 2020). The existential angst that leaders in so many countries around the world attach to oil and gas supplies has always been an important driver of energy geopolitics, but it has been especially visible in panicked responses following the February 2022 expansion of Russia’s war in Ukraine, ongoing since 2014. The recent invasion prompted uncommon resolve in Europe and other parts of the West to end reliance on Russian oil and gas, but with that resolve came a scramble to find replacement energy sources explicitly defined in the European Commission’s (2022) REPowerEU plan.

The REPowerEU plan emphasizes the need to invest in green energy within Europe, but individual European countries saw a more immediate prospect for solving the coming energy crisis – procuring more supplies from the Gulf (Abu Sneineh 2022; Bianco 2022). This was the broader goal of Germany Energy Minister Habeck’s trip to the UAE in March 2022 noted above, which was preceded by a stop in Qatar to sign LNG deals. The visit appeared to confirm a statement that I heard Qatar’s Energy Minister, Saad Sherida al-Kaabi, make to a group of students at Georgetown-Qatar in 2019 – in the middle of a diplomatic crisis in the Gulf, when Qatar was subject to an air, sea, and land embargo from Saudi Arabia and the UAE and their allies. Minister al-Kaabi expressed his confidence that Qatar would ultimately prevail because the country ships natural gas to dozens of important countries all around the world – and those countries cannot live without Qatari gas. This dependence, he opined, was the country’s ticket to preserving its sovereignty (see also Al-Eshaq and Rasheed 2022). The “accuracy” of his claim aside, Qatar did indeed prevail and the embargo ended several years later in 2021.

In this context, Minister Habeck’s March 2022 trip to Qatar, followed by the Qatari Emir Tamim bin Hamad Al Thani visiting Germany’s Chancellor Scholz in Berlin in June 2022, and Chancellor Scholz visiting Qatar in September 2022, must be understood as a continuation of long-standing Gulf policies of thinking about hydrocarbon exports as a source of security. Where the Germany-Qatar deals that resulted from the Russian war may be part of an established pattern of ensuring Gulf state security through energy exports, the Germany-UAE deals point to something new in Gulf energy geopolitics because of their focus on hydrogen (Zumbrägel 2022a).

If local leaders want to preserve the status quo of guaranteeing security through offering indispensable energy supplies to the rest of the world, this would not be possible in the post-oil era if those energy exports are not diversified. Leaders in the UAE are clearly thinking of hydrogen diplomacy as a realm of foreign policy that is worth investing in, especially as they attend to the growing trend of major industrial states, like Germany and Japan, investing in hydrogen infrastructure and hydrogen diplomacy (Nagashima 2018; Schäuble et al., 2020). In fact, they had already signed a declaration of intent

to establish an Emirati-German Hydrogen Task Force in November 2021, through the Emirati-German Energy Partnership established in 2017.

It is too early to speculate about the role of hydrogen in reshaping geopolitics more broadly, but many actors are betting large sums of financial and political capital on the fact that it will (IRENA 2022; Schäuble et al. 2020; Westphal et al. 2020). But does it matter who is keen on hydrogen? Does it matter if these actors are advocates of energy transition, or rather the profiteers of oil and gas extraction? Here it is important to note that hydrogen itself is not good or bad. Like any resource, it just is. Rather, the moral and ethical themes implicit in these questions draw our attention to the specific actors and how they use that resource. Whereas some actors may see hydrogen as a catalyst for a greener energy future, the view from the Gulf looks rather different – for stakeholders there, investing in hydrogen futures looks more like investing in preserving the social, political, and economic status quo.

The endemic paradox of developmental regimes is that they build their legitimacy through promises of progress and modernization, but they are deeply conservative in that they work in the service of autocratic leaders. For this reason, it is important who is keen on hydrogen. In the GCC, there is a risk that the hydrogen dream will be appropriated as a strategic tool in preserving authoritarianism. As Ansari argues, hydrogen provides Gulf states the chance to “largely maintain economic and political power structures despite a global energy transition” (Ansari 2022, 7). But in this respect, the Gulf is not unique: the risk of authoritarianism runs nearly all political and corporate spaces where decisions are made about the post-oil future. Whether or not this future includes expansive new hydrogen energy systems, questions of energy justice are bound to remain.

6. Literature

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7. About the author

Natalie Koch is currently Professor of Human Geography at Heidelberg University. She was a Fellow at the IASS Potsdam from March to July 2022. She is a political geographer who works on geopolitics, authoritarianism, identity politics, and state power in hydrocarbon-rich countries, primarily in the Arabian Peninsula. She is author of "The geopolitics of spectacle: Space, synecdoche, and the new capitals of Asia" (Cornell University Press, 2018) and "Arid empire: The entangled fates of Arizona and Arabia" (Verso, 2023), and editor of "Spatializing authoritarianism" (Syracuse University Press 2022).



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Contact:

Natalie Koch: natalie.koch@uni-heidelberg.de

Address:

Berliner Strasse 130
14467 Potsdam

Tel: +49 (0) 331-28822-340

Fax: +49 (0) 331-28822-310

Email: media@iass-potsdam.de

www.iass-potsdam.de

ViSdP:

Prof. Dr Mark G. Lawrence,
Managing Scientific Director

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