

# **Science, Technology, Innovation in the Gulf: Security, Institutions, and Agents of Change in the GCC**

by

**Kaori Mita**

**National Graduate Institute for Policy Studies (GRIPS)**

## **Extended Summary**

### **Introduction**

Technological innovations and international efforts to achieve carbon neutrality are changing the conventional energy market's landscape. This global energy transition brings various challenges to developing economies and fossil fuel exporting countries. Fossil fuel-producing countries in the Arab Gulf region are encountering challenges in this world's energy transition to departure from a natural resource-dependent economic structure. The biggest challenge for the GCC is to thrive, not just survive, in the socioeconomic changes triggered by the global energy transition.

There are three key aspects to understanding the energy transition in this region: the role of natural resources in socioeconomic development, international relations and security, politics and domestic institutions. The drivers of the energy transition are primarily external pressures from the international community. However, Gulf Cooperation Council (GCC) countries tie their economic diversification agenda to this energy transition. The region was developed based on the export of natural resources, without a strong presence of secondary sectors to build capabilities that are pivotal to innovation and development. Furthermore, natural resource dependency is not only due to the rentier state structure but also shaped by the region's security environment and international relations. The region had been the main energy producer for the U.S. and advanced countries, in turn, the security of the region was maintained by those international powers (Krane 2019). That structure has been changing since the shale revolution in the U.S. followed by the global energy transition (Fattouch 2014). As the U.S. interest in the region decreases, the region's necessity to build innovation capability for economic diversification, and strengthen national security increases. Thus, a glance at the background of the energy transition of GCC indicates that 1) the external security environment has affected economic policy and in turn, the science,

technology, and innovation (ST&I) development of the region, and 2) changes in international systems such as energy transition have triggered the formulation of policies to shift from existing public sector-led development to private sector expansion, so as to maintain economic growth and national security. The energy transition of the region is a complex issue involving natural resources, security, and ST&I.

The background indicates the need for GCC to securitize ST&I policy to achieve transition and maintain future economic growth. In recent years, as the complexity of the global production system increases and technologies grow at an unprecedented pace, international relations and ST&I policy have been discussed together. Though geopolitical and unexpected events such as the COVID-19 pandemic or the war in Ukraine were detrimental to some countries, there have also been instances where reorganization within a GVC has provided a “window of opportunity” for new countries to enter. A country entering a GVC in replacement of existing suppliers needed a certain level of technological sovereignty to have certain control over the technology to be able to specialize in economic activities, according to Edler et al., 2023. Furthermore, new opportunities could open as a result of shifts in international relations. This thesis investigates the influence of international relations and threats (domestic and external) on ST&I policy, and thus the rate of innovation in the Persian Gulf region and a mechanism that allows the region to leverage the energy transition to build innovation capability.

## **Methodology**

This thesis seeks to answer two central questions: how do international relations and threats (domestic and external) influence ST&I policy, and thus the rate of innovation in the Persian Gulf area, and how can private sector firms in the region leverage the energy transition to catch up? The thesis combined methodologies to derive answers to the above questions. First, to frame the generalized theory for the region, Chapter 2 chose a country-level study. A quantitative method was used 1) to identify the correlation between ST&I variables and security variables; 2) to examine causal inference between the variables. Specifically, index correlation analysis was conducted to observe correlational relations between ST&I indicators and security indications. Next, regression analysis was conducted to examine causal inference between those variables to complement the indexed method. Both ST&I and security variables are drawn from previous studies and literature reviews (Schmid et al., 2017; Brummer 2022; Taylor 2012) with

consideration of regional characteristics (e.g. natural resource export as the main economic activity) to measure the level of ST&I output and input and security threats. In addition, a comparative case study was conducted to trace the causal mechanism and to see how those interactions between security variables and ST&I played out over a 30-year period. A methodology combining statistical analysis and process tracing case study compensates for the weaknesses of the two methods and allows for the triangulation of the results. Next, Chapter 3 chose an in-depth firm-level case study, which allows for a detailed examination of the process and affords deep insights. The firm-level study would contribute to the crafting of explicit policy implications in other countries that are in similar situations, i.e., resource-rich countries and/or emerging economies in transition and catching up.

Case selection is as follows. To derive a generalized theory for the region, Chapter 2 collected data from the resource-rich countries surrounding the Persian Gulf, Iran, Iraq, Kuwait, Saudi Arabia, Bahrain, Qatar, UAE, and Oman. Results of the quantitative analysis show Iran to have the highest ST&I output and input, and Iraq to be the opposite in the region; the two are extreme cases of ST&I activity in the region. Thus, a comparative case study of Iran and Iraq is chosen to observe the causal mechanisms in the actual case. In Chapter 3, ACWA Power was chosen for the in-depth case study as it is an influential case in the region. Competitors in the region are government-owned firms (e.g. Masdar of UAE, Nebras of Qatar), whereas ACWA Power started as a private-sector firm in Saudi Arabia and has now become an internationally known firm in the industry. The case of ACWA Power represents a viable case at this time when the region is striving to grow the private sector for the future. Finally, Chapter 4 draws policy implications from the studies presented in the previous two chapters.

## **Results**

Chapter 2 explored the variance in the rate of innovation in the Persian Gulf region. Quantitative analysis of data on external and domestic threats, and on ST&I measures suggests that Iraq has been in a high internal threat environment and Iran is just the opposite, a high external threat environment (2000–2020). Analysis of the case studies illustrated how increased internal threats and decreased external threats after the invasion of Kuwait hindered ST&I in Iraq. Conversely, how increased external threats such as economic sanctions and rivalries in the region prompted Iran to engage in indigenous development policy to accelerate Iran's ST&I. Additionally,

these findings point to the importance of the international relations perspective in ST&I policy, following Edler et al (2023): thus, the state's action at the international system level to engage in 124 specific economic activity and specialization. In the case of GCC, it was the natural resource export in exchange for national security. However, a country, such as Iran, disconnected from the international systems pursued technological sovereignty by engaging in autarkic policy and looking to collaborate with like-minded allies to maintain its competitiveness. International relations and threats prompt countries to collaborate, not necessarily in a ruled-based liberal economic sense, but surely in terms of security-motivated cooperation that influences the trajectory of ST&I policy. After identifying the dynamics of international relations and the rate of innovation in the region, Chapter 3 examined the case of a firm (ACWA Power of Saudi Arabia) in a latecomer country enabling catch-up by taking advantage of energy transitions. Renewable energy development is considered as complex products and systems (CoPS) that are economic activities involving the production of sophisticated, high-value, and engineering-intensive capital goods in the form of projects (Davies and Brady 2000; Hobday 2000). The firm was able to catch up by venturing into the new market and expanding its areas of capability while utilizing accumulated experience and knowledge from the past in project-based activities. The findings indicate a pathway for latecomer country firms to build CoPS related capabilities through complex economic activities in the form of projects leveraging exogenous green windows of opportunity (EGWO). A key argument in this study is that the CoPS capabilities cultivated by the firm were organizational, which is different from previous CoPS catch-up studies that focused on technological capabilities built by leveraging the domestic market setting. The contribution of the study is its analytical framework, which enables the identification of overlapping areas of CoPS catch-up studies (Majidpour, 2016; Ren & Yeo, 2006; Safdari Ranjbar et al., 2018; and more) and sociotechnical transition studies (Bergek et al., 2008; Geels, 2002, 2004, among others) in critical functions of government that support firm catch-up during the transition. The finding adds an important perspective: that technological sovereignty can be a means of cultivating competitiveness in relevant technologies through project-based CoPS activities, and of achieving transformation during energy transitions. More specifically, in contrast to studies of cases from advanced countries with their technological advantages, this case sheds light on the organizational capability of non-technology leader countries to catch up by leveraging energy transitions, and on their financial capability to access the technologies.

## Conclusion

Finally, the thesis makes two main original contributions. First, it identifies another critical explanation for the variation in ST&I performance in resource-rich countries in the Persian Gulf. Numerous studies have examined the resource-rich Middle East region through the lens of natural resource curse and rentier state theory, but security and international relations have rarely been taken into consideration together in studies of ST&I policy. However, just as in other regions of the world seen in previous studies, threats do affect the rate of innovation in the Persian Gulf region. Furthermore, this thesis introduces security as a key factor of ST&I development; this is an underexplored factor that influences ST&I policy formation. Second, this thesis presents policy implications for securitization of ST&I policy and technological sovereignty, which are emerging topics of debate at present. Energy is highly political, sensitive to geopolitical changes, and an extremely valuable resource for global economic activities. GCC is in a unique position where diverse energy sources are abundant, both fossil fuel and renewables, that could be used strategically to gain access to knowledge and resources from technologically advanced energy-importing countries. However, at the same time, GCC countries must build innovation capability through the deployment and development of renewable energy to reduce dependence on fossil fuel-based economic activities and maintain national security for the post-carbon era. Therefore, the resource-rich GCC countries need an autonomous ST&I policy that responds to external environmental changes and enables them to leverage energy transition and catch up. The findings highlight the importance of aligning national security and ST&I policy to achieve sustainable development in the post-carbon era.

The findings of this thesis point to the need for states to form autonomous ST&I policy while responding to changes in international relations and meeting economic and physical security needs. Furthermore, conversely, from the perspective of international relations and security, it is suggested that external threats and the need for access to technologies may lead previously ideologically incompatible states to form alliances, as seen in the Abraham Accords and the Gulf regions-EU green connectivity strategy regarding the Red Sea. This type of challenge is particularly relevant for the Gulf region, but it is now also a global challenge for all countries as rapid technological development and complexity of global production systems increase the probability of disruption in international systems (OECD, 2023). This thesis investigated changes

in the security (threats) environment and the rate of ST&I development. Taking the characteristics of the Gulf region's international relations into account— habitual changes in alliances, relationships among all three variables of threats, alliances, and innovation could be investigated in the future. Additionally, the feasibility of the application of CoPS organizational capability to small manufacturing sectors was not explored in this thesis. The organizational capabilities associated with CoPS are for low-volume, capital-intensive, client driven projects whose needs are different from the function-based organizational capability of manufacturing mass products and services, which requires a particular knowledge structure and systematic improvement of routine work. Future policy research on this reverse development from CoPS to manufacturing could helpfully inform work to advance the Gulf region's ST&I development. The GCC region requires bottom-up policies to support private sector firm activities and top-down policies to target building technological sovereignty that would in turn enable energy transition and socioeconomic transformation. The findings presented in Chapter 3 reveal a unique aspect of the GCC region: CoPS-type activities may better meet those needs than manufacturing type activities. Since the discovery of oil there, the GCC region has attracted foreign workers; most GCC countries have been integrating and optimizing foreign workforce into their economic activities. A top-down policy could target renewable and clean energy deployment and development.

## References

- Bergek, A. et al. (2008) 'Analyzing the functional dynamics of technological innovation systems: A scheme of analysis', *Research Policy*, 37(3), pp. 407–429. doi: 10.1016/j.respol.2007.12.003.
- Brummer, M. (2022). Innovation and Threats. *Defence and Peace Economics*, 33(5), 563–584. <https://doi.org/10.1080/10242694.2020.1853984>
- Davies, Andrew, and Tim Brady. 2000. "Organisational Capabilities and Learning in Complex Product Systems: Towards Repeatable Solutions." *Research Policy* 29 (7–8): 931–53. [https://doi.org/10.1016/s0048-7333\(00\)00113-x](https://doi.org/10.1016/s0048-7333(00)00113-x).
- Edler, J., Blind, K., Kroll, H., & Schubert, T. (2023). Technology sovereignty as an emerging frame for innovation policy. Defining rationales, ends and means. *Research Policy*, 52(6), 104765. <https://doi.org/10.1016/j.respol.2023.104765>
- Fattouch, B. (2014). The US Shale Revolution and Geopolitical Implications. Oxford Institute for Energy Studies. <https://www.jstor.org/stable/resrep32372.6>

Geels, F. W. (2002) 'Technological transitions as evolutionary reconfiguration processes: A multi level perspective and a case-study', *Research Policy*, 31(8–9), pp. 1257–1274. doi: 10.1016/S0048-7333(02)00062-8.

Geels, F. W. (2004) 'From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory', *Research Policy*, 33(6–7), pp. 897–920. doi: 10.1016/j.respol.2004.01.015.

Hobday, Mike. 2000. "The Project-Based Organisation: An Ideal Form for Managing Complex Products and Systems?" *Research Policy* 29 (7–8): 871–93. [https://doi.org/10.1016/s0048-7333\(00\)00110-4](https://doi.org/10.1016/s0048-7333(00)00110-4).

Krane, J. (2019). *Energy kingdoms: Oil and political survival in the Persian Gulf*. Columbia University Press.

Majidpour, M. (2016) 'Technological catch-up in complex product systems1', *Journal of Engineering and Technology Management - JET-M*, 41(November 2013), pp. 92–105. doi: 10.1016/j.jengtecman.2016.07.003.

OECD (2023) *OECD Science, Technology, and Innovation Outlook 2023*.

Ren, Y. T. and Yeo, K. T. (2006) 'Research challenges on complex product systems (CoPS) innovation', *Journal of the Chinese Institute of Industrial Engineers*, 23(6), pp. 519–529. doi: 10.1080/10170660609509348.

Safdari Ranjbar, M., Park, T. Y. and Kiamehr, M. (2018) 'What happened to complex product systems literature over the last two decades: progresses so far and path ahead', *Technology Analysis and Strategic Management*, 30(8), pp. 948–966. doi: 10.1080/09537325.2018.1431390.

Schmid, J., Brummer, M., & Taylor, M. Z. (2017). *Innovation and Alliances*. *Review of Policy Research*, 34(5), 588–616. <https://doi.org/10.1111/ropr.12244>

Taylor, M. Z. (2012). *Toward an international relations theory of national innovation rates*. *Security Studies*, 21(1), 113–152. <https://doi.org/10.1080/09636412.2012.650596>