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## Sociotechnical imaginaries of nuclear newcomer countries – Insights from a comparative case study

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Becoming a nuclear operating country, defined here as connecting the first commercial power reactor to an electricity grid for electricity generation, requires the development of an extensive system of institutional as well as scientific and technological subsystems and infrastructures as well as the fulfilment of certain conditions (Wealer et al. 2026). This was historically determined through geopolitical associations and so-called “nuclear diplomacy” (Szulecki and Overland 2023). In the past, “entering” nuclear power production started in the 1950s and was facilitated through mostly light-water reactors, initially provided by the United States or the Soviet Union, which had been developing them in the context of the Second World War and were subsequently supplying allied nations during the Cold War (with the exception of India, Pakistan, and Argentina), and often further developed in national contexts (e.g., France, Germany, South Korea). This followed a rapid increase in the number of entrant countries, beginning in 1954 and ending in 1977, in which 24 countries began operating commercial power reactors. From 1985 to the present, the number of countries operating power reactors has remained almost constant (approximately 30) (Wealer et al. 2018; Schneider et al. 2025). However, many more countries have recently expressed their interest in operating their first nuclear power plants due to desires to decarbonize their energy systems. The World Nuclear Association (WNA) counts 28 of what we term nuclear newcomer countries (NNC) (WNA 2024). However, in-depth scrutiny reveals that many countries are far off from actual projects, and as of today, only three countries, i.e., Bangladesh, Egypt and Türkiye, are building their first commercial power plants (Schneider et al. 2025). This raises the question of which factors are needed to achieve their policy goal of connecting their first commercial power reactors to the grid and what motivations lie behind these goals. Drawing on a comparative case-study of eleven NNCs (Yin 2014), this paper sheds light on the development of the sociotechnical imaginaries (Jasanoff and Kim 2009; Hendriks et al. 2025) behind the creation of nuclear operation capacities. Drawing on Pistner et al (2024), this article divides policy pathways into three time periods (build-up, adjustment and current phase) to evaluate the evolution of invoked imaginaries and assess the extent to which the cases are like to become nuclear operating countries.

This study provides an in-depth analysis of eleven potential “entrants” regarding their prospects for building their first commercial power plants within the coming decades, and the underlying motivations. The cases are selected following the multiple-case study approach by Yin (Yin 2014, 105) to “predict contrasting results but for anticipatable reasons.” The countries therefore span the entire globe. The analysis follows a long-term gradual development approach in which we differentiate between three periodical development stages, as shown in Table 1, following Pistner et al. (2024). The analyzed countries are Chile, Colombia, Ghana, Rwanda, Norway, Poland, Türkiye, Egypt, Saudi-Arabia, Uzbekistan, and Indonesia.

Table 1 (see attached)

Interim results indicate the existence of the following motivations to build the first commercial nuclear power plant: 1) increasing energy supply security and/or replacing fossil fuels due to the need to decarbonize energy systems; 2) decentralized energy provision and energy access; 3) proactive innovation, industrial, and science policies; 4) international cooperation and geopolitical motivations; and 5) the nuclear energy system as an expression of “modernity.”

Among these, energy supply security, decarbonization of the energy mix, and interest in developing a modern innovation system dominate. Geopolitical aspects played a greater role in the past but still appear sporadically. The same applies to the perception of nuclear energy as an expression of “modernity.” Despite the stated motivations, efforts to improve energy efficiency (to enhance supply security) and to expand other CO<sub>2</sub>-free technologies (to accelerate decarbonization) are not particularly pronounced in these countries. In all cases,

foreign nuclear technology vendors exert significant influence on the process and discussion of reactor concepts as well as on political decision-making.

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