

## Current Topics in the Energy Sector #11

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# A Glance at Small Modular Reactors (*SMR*)

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Energy sector is transforming rapidly to achieve its current sustainability goals. Small Modular Reactor ("SMR") technology, which offers a smaller, safer and more flexible alternative to traditional nuclear reactors, may play an important role in this transformation. In this article, we review the developments regarding SMRs around the globe and in Türkiye.

### 1. Small Modular Reactor ("SMR")

SMR is a reactor with a power capacity of up to 300 Megawatts ("MW"), approximately one third of the capacity of a conventional nuclear reactor, and it consists of multiple modular reactors.<sup>1</sup> Some of the reasons why SMRs are becoming popular are as follows:

- Conventional nuclear reactors are designed for a specific project area, which brings high design and construction costs. In comparison, due to their pretty much standard designs, SMRs can be constructed relatively faster in smaller areas and with lower costs.
- SMRs' modular structure is suitable for subsequent capacity increases by integrating additional reactors when needed. The modular structure also reduces the labor costs by facilitating the production, transport and assembly of the reactor core, cooling systems and other components.
- A conventional nuclear power plant may require additional infrastructure investment if the existing grid is not suitable to handle the high energy generated in the power plant. On the other hand, an SMR with a lower power capacity usually allows easier grid connection without the need for additional costs for infrastructure investment.
- Thanks to their flexibility, SMRs can also be used to back up renewable energy sources in hybrid power plants to provide sustainable energy generation and grid stability.

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<sup>1</sup> International Atomic Energy Agency (IAEA) "Small Modular Reactors: A New Nuclear Energy Paradigm" report, p. 1-3, URL: <https://nucleus.iaea.org/sites/smr/Shared%20Documents/Small%20Modular%20Reactors%20a%20new%20nuclear%20energy%20paradigm.pdf>.

Due to their practical and economic advantages, SMRs may provide an accessible substitute to fossil fuels and help to diversify energy production and achieve carbon emission reduction goals.

## 2. Global Developments Regarding SMRs

As a result of energy demand, carbon emission and energy safety concerns, global efforts in SMR technology have accelerated and governments started to promote SMR projects. According to the data published by the International Energy Agency, in 2022, approximately 70 different SMR designs have been developed globally with different levels of technology and suitability for a license.<sup>2</sup>

In its policy note published in 2023, Sustainable Economy and Finance Research Association reported that there are currently two operational SMRs worldwide.<sup>3</sup> The first one is Akademik Lomonosov, a floating nuclear power plant in Russia. Akademik Lomonosov was connected to the grid in December 2019 and reached full capacity in May 2020. It consists of two small nuclear reactors, each having a capacity of 35 MWe and is built on a 140 meter-long and 30 meter-wide vessel.<sup>4</sup> The plant is designed to supply energy to inaccessible areas in the arctic region. The second operational reactor is the HTR-PM reactor at the Chinese Shidao Bay Nuclear Power Plant. The HTR-PM, which started commercial operation in December 2023, is also the world's first modular high-temperature gas-cooled reactor.<sup>5</sup>

In Europe, the European Commission organized its first workshop on SMRs in June 2021 to gather key players in the European industry for developing alternative SMR designs in Europe. On 4 April 2023, the Commission declared that it will continue to lead research, innovation, education and training for the safety of SMRs.<sup>6</sup> Furthermore, the Commission seeks to establish a European industry alliance with the aim of conducting studies on SMR technologies and ensuring the installation of SMRs in the early future.<sup>7</sup>

In the United Kingdom, six companies, including Rolls Royce and GE-Hitachi, were shortlisted in the first phase of the government's competition to choose an SMR manufacturer, and the government announced that it will launch the next phase of the competition in the spring of 2024.<sup>8</sup>

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<sup>2</sup> International Energy Agency (IEA) "Nuclear Power and Secure Energy Transitions" report, p. 79, URL: <https://www.iea.org/reports/nuclear-power-and-secure-energy-transitions>.

<sup>3</sup> Sürdürülebilir Ekonomi ve Finans Araştırmaları Derneği "Küçük Modüler Reaktörler (SMRs)" report, p. 9, URL: <https://sefia.org/wp-content/uploads/2023/11/sefia-kucuk-moduler-reaktorler-SMRs-1.pdf>.

<sup>4</sup> "Akademik Lomonosov Floating Nuclear Co-Generation Plant", URL: <https://www.power-technology.com/projects/akademik-lomonosov-nuclear-co-generation-russia/?cf-view>.

<sup>5</sup> "China's demonstration HTR-PM enters commercial operation", URL: <https://www.world-nuclear-news.org/Articles/Chinese-HTR-PM-Demo-begins-commercial-operation>.

<sup>6</sup> "Commission Declaration on EU Small Modular Reactors (SMRs) 2030: Research & Innovation, Education & Training", URL: [https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/commission-declaration-eu-small-modular-reactors-smrs-2030-research-innovation-education-training-2023-04-04\\_en](https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/commission-declaration-eu-small-modular-reactors-smrs-2030-research-innovation-education-training-2023-04-04_en).

<sup>7</sup> "European Nuclear Energy Forum 2023 discusses benefits of European Small Modular Reactors (SMRs) initiative" URL: [https://energy.ec.europa.eu/news/european-nuclear-energy-forum-2023-discusses-benefits-european-small-modular-reactors-smrs-2023-11-07\\_en](https://energy.ec.europa.eu/news/european-nuclear-energy-forum-2023-discusses-benefits-european-small-modular-reactors-smrs-2023-11-07_en).

<sup>8</sup> "Rolls-Royce" among six firms shortlisted for British small nuclear plants, URL: <https://www.reuters.com/business/energy/rolls-royce-shortlisted-uk-seeks-small-nuclear-plant-developers-2023-10-02/>.

### 3. SMRs in Türkiye

Türkiye has ambitious goals for renewable and nuclear energy to reduce its dependency on foreign energy and fossil fuel consumption. Turkish National Energy Plan aims to raise the nuclear sources in the total energy production to 11.1% in 2035 and to 29.3% in 2053.<sup>9</sup> In order to achieve these targets, Türkiye has to install more than 20 Gigawatts of capacity within a 30-year period.

Under national energy targets and to reduce carbon emissions, SMR technology has attracted attention in Türkiye in addition to conventional nuclear projects. In 2020, a memorandum of understanding was signed between EUAS International ICC, a subsidiary of Elektrik Üretim Anonim Şirketi (the State-owned electricity generation company), and Rolls-Royce to evaluate the technical, economic and legal feasibility of SMRs and their production capabilities.<sup>10</sup> Türkiye is also seeking for cooperation with American, British and French companies regarding SMRs and there are ongoing studies on business models, field research and legal framework for the SMR investments in Türkiye through the private sector with domestic contribution.<sup>11</sup> Additionally, Justin Friedman, Senior Advisor for Nuclear Energy at the US Department of State, stated that there have been productive discussions between US and Türkiye regarding SMR technology and that Turkish market is appealing for the US companies.<sup>12</sup>

### 4. SMRs from Legislative Perspective

Turkish legislation does not include any specific regulation on SMRs yet. In general terms, nuclear activities in Türkiye fall under the Nuclear Regulatory Law<sup>13</sup> and are carried out under the supervision of the Nuclear Regulatory Authority. In addition, electricity generation activities using nuclear resources are subject to license obligations under the Electricity Market Law.<sup>14</sup>

In the absence of a specific regulation, SMR projects in Türkiye will be subject to the general provisions applicable to conventional nuclear power plants. However, setting aside practical and economic advantages, SMR technologies come with their own risks. Since the current regulations are drafted based on conventional nuclear power plants, it may be necessary to introduce new rules to prevent a legislative roadblock against the practical advantages of SMR technology, especially in

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<sup>9</sup> Enerji ve Tabii Kaynaklar Bakanlığı Türkiye Ulusal Enerji Planı, URL: [https://enerji.gov.tr/Media/Dizin/EIGM/tr/Raporlar/TUEP/T%C3%BCrkiye\\_Ulusal\\_Enerji\\_Plan%C4%B1.pdf](https://enerji.gov.tr/Media/Dizin/EIGM/tr/Raporlar/TUEP/T%C3%BCrkiye_Ulusal_Enerji_Plan%C4%B1.pdf).

<sup>10</sup> "Rolls-Royce ile EÜAŞ mini nükleer santral geliştirecek", URL: <https://www.enerjigunlugu.net/rolls-royce-ile-euas-mini-nukleer-santral-gelistirecek-36592h.htm>.

<sup>11</sup> "Sarı: 4. nükleer santral projesi için saha araştırmalarımız devam ediyor", URL: <https://www.enerjigunlugu.net/sari-4-nukleer-santral-projesi-icin-saha-arastirmalarimiz-devam-ediyor-54595h.htm>.

<sup>12</sup> "ABD'li uzman, SMR teknolojisinde Türkiye piyasasını cazip bulduklarını bildirdi", URL: <https://www.aa.com.tr/tr/bilim-teknoloji/abdli-uzman-smr-teknolojisinde-turkiye-piyasasini-cazip-bulduklarini-bildirdi/3094360>.

<sup>13</sup> Published in Official Gazette dated 8 March 2022 and numbered 31772.

<sup>14</sup> Published in Official Gazette dated 30 March 2013 and numbered 28603.

terms of permitting and licensing procedures, and at the same time to take appropriate safety measures against the specific risks of this new technology.

## 5. Conclusion

SMRs offer several practical and economic advantages, thus becoming an attractive option for economical and sustainable energy production. SMRs can represent an important opportunity for the Turkish market, which is open to alternative resources to diversify its energy production and reduce the share of fossil fuels.



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