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High-Tech Alliances: South Korea, the G7 and the Future of AI and Nuclear Innovation

by **Kayla Orta**

Rapid advances in artificial intelligence (AI) and nuclear energy are redefining global competition and cooperation. As the G7 expands efforts to safeguard technological innovation and energy security, South Korea's rise as a "G7 Plus" partner underscores its growing role in shaping global trajectories for emerging technologies. Demonstrating strengths in semiconductors, AI governance and civil nuclear technology, South Korea could play leading role in bridging regulation and industry-forward innovation for emerging technology ecosystems. Enhanced G7–ROK collaboration – expanding AI innovation alongside advanced nuclear technology development – will bolster resilient supply chains, enhance low-carbon energy reliability and reinforce democratic governance standards. Aligning G7 and ROK efforts within a shared strategic S&T framework offers a pathway to sustain technological competitiveness while advancing a stable, rules-based order in the era of digital and energy transformation.

The 50th anniversary of the Group of Seven (G7) presents a timely opportunity to rethink the role of strategic technology partnerships in shaping global economic and security outcomes. South Korea, also known as the Republic of Korea (ROK), though not a formal G7 member, increasingly acts a de facto "G7 Plus" nation. Across global partnerships, South Korea's leadership in semiconductors, civil nuclear energy and digital governance positions Seoul as a critical partner in shaping multilateral frameworks that link innovation, energy security and geopolitical stability.

Today, the G7 and South Korea have an opportunity to establish pivotal technopolitical partnerships, especially in the interlocking domains of (1) artificial intelligence (AI) and (2) civil nuclear energy. South Korea's nationwide AI transformation – anchored in semiconductor innovation and AI global norms-setting – underscores Seoul's strategic role in contributing to advanced technical component supply chains and advancing responsible AI governance. Moreover, the AI-energy nexus highlights the need to link technological innovation to energy security, especially through advances in civil nuclear energy cooperation, including advanced and small modular reactors (SMRs). As energy is the backbone of industrial competitiveness, G7-ROK frameworks on AI regulation linked with multilateralised energy security policies could serve to

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strengthen cross-regional digital and economic resilience.

Ultimately, South Korea's integration into and support for G7-centred technology frameworks offers a pragmatic pathway to strengthening democratic competitiveness in the face of intensifying geopolitical and advanced technology rivalries. Aligning under a shared vision offers the G7 and South Korea a strategic opportunity to build secure, innovative and sustainable technology-energy ecosystems that reinforce democratic leadership in the global economy.

1 THE G7'S EVOLVING TECHNOPOLITICAL LEADERSHIP

Historically rooted in the global oil crisis in the mid-1970s, the Group of Six, later expanded to today's G7 – encompassing Canada, France, Germany, Italy, Japan, the United Kingdom, the United States, and in a non-enumerated member capacity, the European Union – was established as a forum for economic and political discussions among the world's leading economies. By its very nature of its formation, the G7 is a concise leadership "club" with large-scale geoeconomic and geopolitical influence.[1]

Built on high-level leader-to-leader discussions, the G7 provides a coordinated platform for cross-regional engagement, through close-door meetings and public-facing summitry, on far-reaching issues of global governance in finance, economic prosperity, sustainable development, climate change, and, increasingly, advanced and emerging technologies, such as AI regulation.

While driven by economic issues, the G7 has focused increased attention on emerging technology and digital innovation, mainly due to the understanding that the evolution of technical innovation is an often-cited driver for sustained economic growth.[2] Clearly, advances in emerging technologies present the capacity for transformative economic opportunities, yet must be harnessed safely and responsibly. To address these challenges, the G7 has drawn attention to "human-centric"[3] strategies for emerging markets from digital infrastructure and cybersecurity to low-carbon technologies as a means to promote global economic prosperity. Looking to the future

[1] Smith, Gordon S., "G7 to G8 to G20: Evolution in Global Governance", in *CIGI G20 Papers*, No. 6 (May 2011), https://www.cigionline.org/sites/default/files/g20no6-2.pdf.

[2] For an academic review of innovation and economic growth as it relates to the G7, see Zhylinska, Oksana and Olena Bazhenova, "Innovation Driven Economic Growth: Evidence for G7 Countries", in *Advances in Economics, Business and Management Research*, Vol. 95 (2019), p. 29-32, https://doi.org/10.2991/smtesm-19.2019.7. Also see, Grossman, Gene M. and Elhanan Helpman, "Endogenous Innovation in the Theory of Growth", in *Journal of Economic Perspectives*, Vol. 8, No. 1 (Winter 1994), p. 23-44, https://doi.org/10.1257/jep.8.1.23.

[3] G7, *Carbis Bay G7 Summit Communiqué*, 13 June 2021, https://g7.utoronto.ca/summit/2021cornwall/210613-communique.html.

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of critical technologies, such as these, the G7 nations collectively aim to align cross-national policy agendas towards a "values-driven digital ecosystem for the common good that enhances prosperity in a way that is sustainable, inclusive, transparent and human-centric".[4] To accomplish this, technology industry-centred policy frameworks have been featured under consecutive G7 presidencies.

During G7's 2021 UK Presidency, the Future Tech Forum emphasised the need to "design frameworks that protect societal and individual interests, and nurture thriving digital and tech sectors".[5] Following this, the G7 Research Compact committed members to "promoting international research cooperation and the conditions of freedom, independence, openness, reciprocity and transparency".[6] Most recently, the revolutionary nature of AI-enabled technology and infrastructure has driven G7 nations to pursue cross-national alignment between governments and tech industry leaders on regulation frameworks.

Importantly, under Japan's leadership, the G7 announced the Hiroshima AI Process in 2023,[7] later expanded to the Reporting Framework for the Hiroshima Process International Code of Conduct for Organizations Developing Advanced AI Systems.[8] The following year, during Italy's presidency, the G7 built upon these milestones, announcing a Toolkit for AI in the Public Sector as a guide to the further development for "safe, secure, and trustworthy" AI innovation.[9] Carrying regulatory momentum forward, the 2025 G7 Summit in Canada pushed forward the question of AI innovation in the Leader's Statement on AI for Prosperity, targeting an AI Adoption Roadmap across all G7 nations and likeminded partners.[10] However, in the United States, which under former President Joseph Biden followed an AI policy centred upon a "strategy for responsible innovation",[11] the return of President Donald J. Trump to the White House has

[4] Ibid.

[5] UK Government, *Future Tech Forum Chair's Report*, 8 June 2022, https://www.gov.uk/government/publications/future-tech-forum-chairs-report/future-tech-forum-chairs-report.

[6] G7, *G7 Research Compact*, Carbis Bay, 13 July 2021, https://g7.utoronto.ca/summit/2021cornwall/210613-research.html.

[7] G7, *G7 Hiroshima Leaders' Communiqué*, 20 May 2023, https://g7.utoronto.ca/summit/2023hiroshima/230520-communique.html.

[8] Japan's Ministry of Foreign Affairs, *Hiroshima Process International Code of Conduct for Organizations Developing Advanced AI Systems*, 30 October 2023, https://www.mofa.go.jp/files/100573473.pdf.

[9] OECD and UNESCO, *G7 Toolkit for Artificial Intelligence in the Public Sector*, Paris, OECD Publishing, 15 October 2024, https://doi.org/10.1787/421c1244-en.

[10] G7, *G7 Leaders' Statement on AI for Prosperity*, Kananaskis, 17 June 2025, https://www.g7.utoronto.ca/summit/2025kananaskis/250617-ai.html.

[11] White House, *Fact Sheet: President Biden Issues Executive Order on Safe, Secure, and Trustworthy Artificial Intelligence*, 30 October, 2023, https://bidenwhitehouse.archives.gov/briefing-room/statements-releases/2023/10/30/fact-sheet-president-biden-issues-executive-order-on-safe-secure-and-trustworthy-artificial-intelligence.

heralded a stark political shift. Following Trump's re-election, the US government has put forth strategies to secure US "AI leadership", leaned into narratives of de-regulation, and praised fast-paced, industry-centric development timelines.[12] Clearly, despite rising attention to AI regulation across the G7 nations, the main challenge to these initiatives is the fragmented nature of AI regulation both within and outside of the Group.[13]

Furthermore, cooperation in multinational science and technology (S&T) research is complicated not just in regulatory and procedural environments but also as integrated within intricate global infrastructure systems and supply chains. Moving forward, the G7 should look outward to key likeminded partners, such as South Korea, to further global advancement on strategic S&T cooperation.

2 South Korea as "G7 Plus" partner in AI innovation

Over the past several decades, South Korea has emerged as a leading nation for science and technology development

Over the past several decades, South Korea has emerged as a leading nation for S&T development – punching well above its weight in strategic industries, including semiconductors and next-generation civil nuclear energy. Once a beneficiary of the G7's Technology Transfer support programme, South Korea has shifted from a fast-follower S&T industry framework to a first-mover policy leader[14] – reaping the benefits of the nation's large-scale 'mission-oriented' national research and development (R&D) programmes.

Moreover, South Korea's rising role in convening international leaders, organisations and industry to discuss critical technology governance has led foreign policy experts to push for greater recognition of Seoul's endeavours.[15] Within a conceptualised "G7 Plus" framework, South Korea seems well positioned to be a strategic 'middle power' player in establishing multilateral, cross-regional S&T cooperation, especially in new and emerging fields of AI and civil nuclear energy technology.

[12] For an expert overview on shifts in US policy, see Mallaby, Sebastian et al., "The Opportunities and Risks of Trump's AI Action Plan", in *CFR Articles*, 25 July 2025, https://www.cfr.org/node/259522. Also, see White House, *Fact Sheet: President Donald J. Trump Takes Action to Enhance America's AI Leadership*, 23 January 2025, https://www.whitehouse.gov/fact-sheets/2025/01/fact-sheet-president-donald-j-trump-takes-action-to-enhance-americas-ai-leadership.

[13] Maremonti, Francesca, "The G7 and AI Governance: Towards a Deeper and Broader Agenda", in *IAI Papers*, No. 24|28 (November 2024), https://www.iai.it/en/node/19177.

[14] Oh, Sea-Hong et al., "Strategy to Promote the Effectiveness of Technology Transfer of National R&D Programs in Korea: Seen through the G7 Leading Technology Development Program", in *Procedia Computer Science*, Vol. 91 (2016), p. 221-229, https://doi.org/10.1016/j.procs.2016.07.061.

[15] Cha, Victor and John J. Hamre, "A Reimagined G7", in *CSIS Commentaries*, 14 June 2024, https://www.csis.org/node/111057.

2.1 Building an AI-centred industry

At the 2025 G7 Summit, ROK President Lee Jae-myung's participation in Kananaskis, Canada signalled the launch of the ROK government's "pragmatic" foreign policy agenda, emphasising South Korea's rising strength as a middle-power nation.[16] On 17 June, President Lee delivered remarks at the G7 Outreach Session, highlighting the importance of energy and artificial intelligence and calling for the establishment of a resilient global AI ecosystem based on close public-private partnerships.[17]

Since taking office, President Lee has advanced an ambitious vision for South Korea to play a leading role in the global AI race. Following in the regulatory footsteps of the EU's AI Act,[18] South Korea's legislature passed the Development of Artificial Intelligence and Establishment of Trust (AI Basic Act) in January 2025 (entering into force January 2026).[19] South Korea's Basic AI Act places the nation not only at the forefront of national regulation policy on AI, but also stresses the near-term necessity for industry incentives and investment to bolster R&D and implementation.

Aiming to expand AI-enabled infrastructure, South Korea's June 2025 economic plan underscored an assertive fiscal strategy aimed at stimulating domestic growth, with a strong emphasis on top-down "AI transformation" across key industries

Aiming to expand AI-enabled infrastructure, South Korea's June 2025 economic plan underscored an assertive fiscal strategy aimed at stimulating domestic growth, with a strong emphasis on top-down "AI transformation" across key industries.[20] Economically, South Korea is uniquely positioned to support international collaboration for the stability of AI-related semiconductor supply chains, holding roughly 13 per cent of the global market for advanced packaging.[21] Companies such as Samsung and SK Hynix dominate memory chip production, particularly High-Bandwidth Memory (HBM), which is indispensable hardware for AI infrastructure. Importantly, South Korea's industry offers 'full-stack' capabilities for localised AI R&D,

[16] Orta, Kayla T., "A 'Pragmatic' Foreign Policy Agenda: What's Next for South Korea's New President?", in *38 North*, 12 June 2025, https://www.38north.org/2025/06/a-pragmatic-foreign-policy-agenda-whats-next-for-south-koreas-new-president.

[17] See Kim, Sarah, "President Lee Stresses Energy Supply Chains, AI Integration in Multilateral Diplomatic Debut at G7", in *Korea JoongAng Daily*, 18 June 2025, https://koreajoongangdaily.joins.com/news/2025-06-18/national/diplomacy/2332908; Kim, Eun-Jung, "Lee Outlines Vision for Energy Security, AI at G7 Summit", in *Yonhap News Agency*, 18 June 2025, https://en.yna.co.kr/view/AEN20250618004600315.

[18] European Parliament and Council of the EU, *Regulation (EU) 2024/1689 of 13 June 2024 Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act)*, http://data.europa.eu/eli/reg/2024/1689/oj.

[19] South Korea, *Framework Act on the Development of Artificial Intelligence and Establishment of Trust*, 21 January 2025, https://cset.georgetown.edu/publication/south-korea-ai-law-2025.

[20] Choi, Ji-won, "Government Aims for 3% Potential Growth with AI Push", in *The Korea Herald*, 29 August 2025, https://www.koreaherald.com/article/10559781.

[21] Mckinsey, "Semiconductors Have a Big Opportunity—But Barriers to Scale Remain", in *Mckinsey Insights*, 21 April 2025, https://www.mckinsey.com/industries/semiconductors/our-insights/semiconductors-have-a-big-opportunity-but-barriers-to-scale-remain.

covering hardware, infrastructure, software and consumers adoption and testing.

While South Korea's semiconductor industry has drawn interest from leading US AI tech firms such as Open AI,[22] this has not stopped the South Korea government from pursing its own sovereign AI model. In August 2025, the ROK Ministry of Science and ICT announced a two-year flagship AI initiative to foster R&D at five domestic technology firms: LG's AI Research, Naver Cloud, SK Telecom, NCSOFT Corp's NC AI and Upstage.[23] During the initiative, the selected firms will obtain critical access hardware, including nearly 114 million dollars' worth of 512 to 1,024 graphic processing units (GPUs) and training datasets. Producing GPUs at home, South Korea stands ready to expand domestic AI capabilities at-pace with competing Euro-Atlantic companies.

Overall, the Lee administration intends to harness South Korea's technological edge by driving S&T innovation across AI and cybersecurity fields[24] as a means to reinvigorate the country's slowing economy. Importantly, South Korea's top-down drive towards global AI leadership presents interesting opportunities for public-private engagement and emphasises a mission-oriented technology sandbox approach.

Looking forward, the G7 and South Korea share an opportunity to develop industry-forward regulatory cooperation in AI that prioritises joint investment in secure cloud systems, AI-powered smart grids and public-private testbeds, ensuring innovation is tied to real-world industrial competitiveness.

Internationally, South Korea has emerged as a key player in shaping norms for the safe and trustworthy development and application of AI systems within civil and defence industry domains

2.2 Shaping global AI regulation

Internationally, South Korea has emerged as a key player in shaping norms for the safe and trustworthy development and application of AI systems within civil and defence industry domains. During the March 2024 third international Summit for Democracy (S4D), a Biden initiative which President Trump has not apparent interest in continuing, the ROK government emphasised the potential risks of AI and digital technologies, such as "fake news and disinformation", for democratic nations.[25]

[22] Jie, Ye-eun, "OpenAI Doubles Down on Korea with New Seoul Office", in *The Korea Herald*, 10 September 2025, https://www.koreaherald.com/article/10572602.

[23] Ko, Eun-yi and Young-ae Lee, "Naver, LG, SK, NC, Upstage Named to Build S. Korea's Sovereign AI Model to Challenge ChatGPT", in *The Korea Economic Daily*, 4 August 2025, https://www.kedglobal.com/artificial-intelligence/newsView/ked202508040010.

[24] Orta, Kayla T., "Securing the Future: US-ROK Cybersecurity Cooperation, in *Korea On Point*, 6 September 2025, https://koreaonpoint.org/articles/article_detail.php?idx=451.

[25] Park, Ju-min and Jack Kim, "South Korea Hosted Summit Warns of AI Risks to Democracy", in *Reuters*, 18 March 2024, https://www.reuters.com/world/asia-pacific/south-koreas-yoon-warns-tech-threat-democracy-summit-2024-03-18.

Building upon the United Kingdom's 2023 AI Safety Summit,[26] the ROK government later re-emphasised the important roles of safety, inclusivity and responsibility in AI deployment during the co-hosted 2024 AI Seoul Summit on 21-22 May 2024. The Indo-Pacific region's first AI-focused summit, the event highlighted South Korea's growing leadership on AI policy and featured important G7 participation and buy-in. The resulting Seoul Declaration for Safe, Innovative and Inclusive AI – concluded by Australia, Canada, the EU, France, Germany, Italy, Japan, South Korea, Singapore, the United Kingdom and the United States – acknowledged the need for multilateral cooperation and collaboration to guarantee the "safe, secure, and trustworthy design, development, deployment, and use of AI".[27]

Building on this effort, Seoul earned further international recognition for its expanding role in AI rule-setting and governance by co-hosting the Responsible AI in the Military Domain (REAIM) Summit later the same year. During the opening remarks, ROK Foreign Minister Cho Tae-yul described the ROK government's close attention to the "three A's" – Assessment, Application and Anchoring of military AI usage.[28] Recognising the inherent risks of AI, South Korea, alongside co-host the United Kingdom, expanded discussions on maintaining adequate 'human in the loop' policies for military applications of AI systems. The 2024 REAIM Summit convened more than ninety nations, calling on government and military leaders to "discuss implementation of responsible applications of AI in the military domain; and to envision future governance of AI in the military domain with multiple stakeholders".[29]

Now, under the direction of President Lee, South Korea is seeking to cement its technical leadership by rolling out comprehensive support programmes designed to accelerate AI research, strengthen industrial capacity and scale domestic innovation. Yet, the challenges in best practices for incorporating built-in safeguards for AI systems remains.

Aaddressing the future of AI technology will require multinational, multi-stakeholder approach based on agile governance – neither the G7 nor South Korea can go forward alone

Even more importantly, addressing the future of AI technology will require multinational, multi-stakeholder approach based on agile governance – neither the G7 nor South Korea can go forward alone.

[26] UK Government, *The Bletchley Declaration by Countries Attending the AI Safety Summit*, 1-2 November 2023, https://www.gov.uk/government/publications/ai-safety-summit-2023-the-bletchley-declaration/the-bletchley-declaration-by-countries-attending-the-ai-safety-summit-1-2-november-2023.

[27] AI Seoul Summit, *Seoul Declaration for Safe, Innovative and Inclusive AI*, 21 May 2024, https://www.mofa.go.kr/eng/brd/m_5674/view.do?page=1&seq=321007.

[28] South Korea Ministry of Foreign Affairs, *Opening Remarks by H.E. Cho Tae-yul, Minister of Foreign Affairs of the Republic of Korea REAIM Summit 2024*, 9 September 2024, https://www.mofa.go.kr/eng/brd/m_5689/view.do?seq=319642.

[29] South Korea Ministry of Foreign Affairs, *The Responsible AI in the Military Domain (REAIM) Summit 2024 Opening Session*, 9 September 2024, https://overseas.mofa.go.kr/eng/brd/m_5674/view.do?seq=321055.

3 G7-ROK cooperation: Nexus of AI and civil nuclear

Increasingly, policy discussions are shifting to 'new' nuclear technologies as the solution to the industry-driven advances in energy-hungry AI technology

Both G7 nations and South Korea recognise the complicated nature of S&T industry policy. Though often overlooked in the technopolitical debate on AI innovation, energy security will play an imperative role in each nation's scale, speed and sustainability of development. Like other energy-intensive industries, AI infrastructure will require robust energy security and stability – the future of the 21st century AI race rests largely on national-level constraints for stable electricity production.

Because of this, many G7 nations are re-evaluating long-term policy planning for baseload power, including advanced nuclear energy. Increasingly, policy discussions are shifting to 'new' nuclear technologies as the solution to the industry-driven advances in energy-hungry AI technology.[30] As mindsets across the transatlantic shift towards pro-nuclear energy stances, there is an opportunity for G7 leaders and South Korea to cooperate on the future of nuclear-powered AI infrastructure.

3.1 Powering AI on nuclear infrastructure

Ensuring stable electricity will be a core necessity in the future of AI competitiveness. Under President Donald Trump's agenda to unleash American nuclear energy, US Secretary of Energy Chris Wright has emphasised US scientific and energy innovation in the global AI race. While many nations support an "all of the above" energy mix solution, civil nuclear power is gaining traction as a competitive energy source to meeting the massive energy requirements of data centres driving AI and machine learning.[31]

As G7 technology companies race to expand AI infrastructure, the global electricity demand from data centres is expected to more than double by 2030, reaching potentially 945 TWh annually.[32] Such rapid increase will require long-term and effective energy strategies at both national and regional levels. Since data centres rely on a steady baseload energy supply, major technology companies are turning to nuclear energy – and the potential for large-scale traditional and new SMR nuclear power plants – as a consistent and dependable round-the-clock solution to sustain AI's power needs.

[30] Silverstein, Ken, "AI's Energy Crisis: Why Nuclear Power Could Be the Missing Link", in *Forbes*, 17 September 2025, https://www.forbes.com/sites/kensilverstein/2025/09/17/ais-energy-crisis-why-nuclear-power-could-be-the-missing-link.
[31] Donovan, Jeffrey, "Data Centres, Artificial Intelligence and Cryptocurrencies Eye Advanced Nuclear to Meet Growing Power Needs", in *IAEA Bulletin*, Vol. 65, No. 3 (October 2024), p. 12-13, https://www.iaea.org/node/191090.
[32] International Energy Agency (IEA), *Energy and AI*, Paris, IEA, April 2025, https://www.iea.org/reports/energy-and-ai.

SMRs – which would generate up to 300 megawatts of electricity – are increasingly viewed as a more desirable choice compared to their traditional gigawatt counterparts

3.2 Advancing next-generation reactors

Next-generation nuclear reactors include new designs for advanced, small and micro modular reactors (AMRs, SMRs and MMRs respectively). In particular, SMRs – which would generate up to 300 megawatts of electricity (MWe) – are increasingly viewed as a more desirable choice compared to their traditional gigawatt counterparts. Presently, nuclear-experienced G7 nations – including the United States, United Kingdom, Canada, France and Japan – are tagging nuclear energy as a low-carbon, sustainable solution to AI's high-intensity energy demands.

As an example, in April 2025, the UK government tasked the newly-established AI Energy Council to identify "opportunities to accelerate investment in the development of renewable and innovative energy solutions, including small modular reactors (SMRs)".[33] During the February 2025 AI Action Summit, French President Emmanuel Macron championed the potential for France's nuclear industry – the G7's second largest nuclear reactor fleet – to play a critical role in energy supply needs for localised AI data centres.[34] Even G7 countries recently or traditionally hesitant on nuclear energy – like German and Italy – are vocalising debates on new or limited commercialised nuclear reactor restarts and construction. These policy shifts are driving G7 nations to consider national-level development of advanced nuclear technology.

In North America, the United States is home to globally recognised nuclear companies: Westinghouse, GE-Hitachi, NuScale Power, Holtec International, X-Energy and Kairos Power among others. Under President Trump's ambitious nuclear agenda, the United States aims to quadruple domestic nuclear energy production from 100 GWe to 400 GWe by 2050 through reduced regulatory and approval processes.[35] At the same time, Canada is exploring SMR projects through its Darlington New Nuclear Project – championed by Ontario Power Generation (OPG) as "G7's first small modular reactor"[36] – and plans for first-of-a-kind SMR demonstration by 2030.[37] At least seven SMR R&D projects are underway in Canada, including the BWRX-

[33] "UK Government Considering Role for SMRs in AI Expansion", in *World Nuclear News*, 13 January 2025, https://www.world-nuclear-news.org/articles/uk-government-considering-role-for-smrs-in-ai-expansion.
[34] Caroli, Laura, "France's AI Action Summit", in *CSIS Critical Questions*, 14 February 2025, https://www.csis.org/node/114718.
[35] White House, *Reinvigorating the Nuclear Industrial Base*, Executive Order, 23 May 2025, https://www.whitehouse.gov/presidential-actions/2025/05/reinvigorating-the-nuclear-industrial-base.
[36] Ontario Power Generation (OPG) website: *Darlington SMR*, https://www.opg.com/?p=16678.
[37] Canadian Nuclear Safety Commission, *Darlington New Nuclear Project*, last updated 13 August 2025, https://www.cnsc-ccsn.gc.ca/eng/resources/status-of-new-nuclear-projects/darlington.

Policy shifts are driving G7 nations to consider national-level development of advanced nuclear technology

300, ARC-100, Xe-100, Stable Salt Reactor – Wasteburner (SSR-W), Integral Molten Salt Reactor (IMSR), eVinci MMR and SMR-160. With the United States representing nearly 37 per cent of SMR designs worldwide[38] and Canada's Darlington initiative, both nations are dominating the R&D field for in-development advanced reactors.

Within Europe, France's "Plan France 2030" includes 1 billion euros for advanced nuclear technology R&D, as the nation works to develop indigenous SMR technology.[39] Establishing a national nuclear consortium in 2019, the French government has targeted the completion of its first domestic SMR, the NUWARD, a 340 MWe plant, by the mid-2030s. In January 2024, the United Kingdom released the Civil Nuclear: Roadmap to 2050 to promote investment and expansion of domestic civil nuclear energy capacity. Building upon consistent government policies, the UK government recently selected Rolls-Royce SMR for the nation's first SMR development and construction.[40]

Germany and Italy's nuclear energy policies tell a different story. In the aftermath of the Fukushima Daiichi nuclear accident in Japan, the German government began to phase out its nuclear reactor programme, shutting down simultaneously the last three reactors – Isar 2, Emsland and Neckarwestheim 2 in April 2023.[41] Recently, however, intra-governmental clashes between German political parties are re-introducing political discussion on nuclear reactor restarts and investments in "new" nuclear innovation, including SMRs and fusion technology.[42] Similarly, Italy seems to be developing a renewed interest in building domestic civil nuclear capabilities, despite the nation's 1987 referendum on nuclear energy and subsequently nuclear shutdown spurred by the Chernobyl nuclear disaster. In October 2025, Italy's Council of Minister approved for final consideration legislation on the reintroduction of a domestic nuclear energy programme – focusing on SMRs and AMRs – into Italy's planned energy security mix by 2027.[43]

[38] Nuclear Energy Agency (NEA), *The NEA Small Modular Reactor Dashboard*, 3rd ed., Paris, OECD Publishing, July 2025, p. 17, https://oecd-nea.org/jcms/pl_108326.
[39] France Permanent Mission in Vienna, *Nuclear Power and SMR are Central to the 'France 2030' Investment Plan*, 13 October 2021, https://onu-vienne.delegfrance.org/Nuclear-power-and-SMR-are-central-to-the-France-2030-investment-plan.
[40] "Rolls-Royce SMR Named as UK's Selected Technology", in *World Nuclear News*, 10 June 2025, https://www.world-nuclear-news.org/articles/rolls-royce-smr-named-as-uks-selected-technology.
[41] German Federal Office for the Safety of Nuclear Waste Management, *The Nuclear Phase-out in Germany*, last updated 31 January 2024, https://www.base.bund.de/en/nuclear-safety/nuclear-phase-out/nuclear-phase-out_content.html.
[42] Thurau, Jens, "German Government Shows Cracks over Nuclear Energy", in *Deutsche Welle*, 28 June 2025, https://www.dw.com/en/a-73067507.
[43] See "Italian Government Introduces Draft Bill on Nuclear Energy", in *World Nuclear News*, 3 October 2025, https://www.world-nuclear-news.org/articles/italian-government-introduces-draft-bill-on-nuclear-energy; also, "Italy's Plan for Return to Nuclear Power Ready by End-2027, Minister Says", in *Reuters*, 23 January 2025, https://www.reuters.com/business/energy/italys-plan-return-nuclear-power-ready-by-end-

As the G7's only Indo-Pacific member, Japan's recent reversal of the post-Fukushima nuclear freeze has witnessed the restart of fourteen nuclear reactors, with eleven reactors presently pending approvals.[44] While domestic development has halted, Japan's extensive civil nuclear expertise continues to advance. Developing new reactor technology, GE Hitachi Nuclear Energy – a joint venture by the United States and Japan – has shifted focus to international export market, signing a deal with Canada to export the BWRX-300 reactor.[45] Alongside G7 counterparts, Japan is reaffirming its commitment to furthering the commercial advanced nuclear technology development, though, mainly through strategic international partnerships.

Globally, South Korea is ranked as the fifth largest nuclear energy producer

Under President Lee, the ROK government, while expressing a renewed focus on renewable energy, remains interested in exploring the nexus of AI and civil nuclear energy. President Lee emphasised this point, stating that, "as demand for electricity surges due to the advancement of AI technology, the energy supply chain is threatened by climate volatility and geopolitical instability".[46] Globally, South Korea is ranked as the fifth largest nuclear energy producer – generating more electricity from nuclear than Canada and Japan combined in 2024. Nationally, South Korea's civil nuclear industry leaders include key R&D institutions and companies: Korea Atomic Energy Research Institute (KAERI), Korea Hydro & Nuclear Power (KHNP), Doosan Enerbility and Hyundai E&C, among others.[47] Within this context, South Korea's leading work on advanced civil nuclear – such as KHNP and KAERI's i-SMR and SMART 100 reactors – offers scalable options for energy security at home and export markets abroad.

What does this mean for the G7 and South Korean nations? As global demand for clean, resilient energy grows – driven in part by the energy-intensive requirements of artificial intelligence – deeper collaboration between the G7 and South Korea presents a strategic opportunity to accelerate the safe deployment of advanced nuclear technologies. Next-generation nuclear technology, including AMRs and SMRs, offer low-carbon solutions ideally suited to meet the high-density, always-on power needs of AI data centres. By aligning technical expertise, export strategies and shared innovation goals, an

2027-minister-says-2025-01-23.

[44] World Nuclear Association (WNA), *Nuclear Power in Japan*, last updated 5 August 2025, https://world-nuclear.org/information-library/country-profiles/countries-g-n/japan-nuclear-power.

[45] "OPG Gets Go-ahead to Build First SMR in Canada", in *World Nuclear News*, 8 May 2025, https://www.world-nuclear-news.org/articles/opg-gets-go-ahead-to-build-first-smr-in-canada.

[46] Kim, Sarah, "President Lee Stresses Energy Supply Chains", cit.

[47] Orta, Kayla T., "US-South Korean Civil Nuclear Exports Are a Winning Strategy", in *The National Interest Blog*, 29 September 2025, https://nationalinterest.org/blog/energy-world/us-south-korean-civil-nuclear-exports-are-a-winning-strategy.

expanded G7-ROK civil nuclear partnership can help shape the future of both global decarbonisation and the secure, sustainable growth of AI infrastructure.

4 Policy recommendations: "Future-oriented" shared visions

For cooperation to succeed, G7 nations and likeminded partners such as South Korea must institutionalise a modernised S&T cooperation framework – covering research memorandums of understanding, cross-border R&D and technology trade agreements – designed for applied innovation and built upon the G7's diplomatic leadership.

4.1 Public-private partnership on AI innovation

As the G7 and South Korea further national agendas on AI innovation, there is a unique opportunity to establish top-down regulatory frameworks while simultaneously sharing bottom-up industry experiences.

G7 nations and South Korea can work to establish knowledge-sharing platforms for public-private partnerships on human-centred AI development and deployment

To date, the G7 has leveraged its international platform to propagate diplomatic statements on the transformative nature – risks and rewards – of global AI expansion. Despite shared visions, the pathway forward, however, is fractured and embroiled in a highly competitive, tech-driven landscape as allies and partners race toward national sovereign AI models. How, then, do likeminded nations work cooperatively on AI innovation? Beyond summit diplomacy, the G7 nations and South Korea can work to establish knowledge-sharing platforms for public-private partnerships on human-centred AI development and deployment.

At the national-level, regulatory 'sandboxes' – also termed 'innovation facilitators' within EU policy frameworks – can be established to support AI-developers navigate new regulation and national laws. Importantly, through this approach new AI-enabled systems can be tested within safeguarded and controlled environments.[48] Serving to foster innovation, while simultaneously enforcing corporate accountability, regulatory sandboxes can balance risk mitigation with innovation promotion.[49] Additionally, such environments can offer regulator-industry feedback, channelling industry knowledge back to national authorities.

Across G7 nations, leading national authorities are moving

[48] Truby, Jon et al., "A Sandbox Approach to Regulating High-Risk Artificial Intelligence Applications", in *European Journal of Risk Regulation*, Vol 13, No. 2 (June 2022), p. 270-294, https://doi.org/10.1017/err.2021.52.

[49] Novelli, Claudio et al., "Getting Regulatory Sandboxes Right: Design and Governance Under the AI Act", EU Regulatory Sandboxes for AI (EUSAiR)", in *SSRN*, 30 June 2025, https://ssrn.com/abstract=5332161.

South Korea makes for a logical industry partner, especially in the advancing market for semiconductors and GPUs

quickly to establish pro-innovation initiatives to further domestic advancement of AI-enabled systems. In the EU, the European Digital Innovation Hubs (EDIH) Network, established through the Digital Europe Programme in 2021,[50] support AI innovation and sandbox testing at the level of individual EU member states. Similarly, the United States, the United Kingdom and Canada are implementing AI-relevant regulatory legislation respectively, and Japan's AI Promotion Act came into force in July 2025.[51] As fractured as AI legislation is across the G7, so too is the question of best industry strategies for design, testing and early public deployment of AI-enabled systems.

Interestingly, the ROK government launched the nation's first sovereign AI initiative, pledging to raise a 100 trillion-won (approximately 735 billion dollars) fund to support AI development in strategic sectors.[52] In August 2025, the ROK Ministry of Science and ICT announced five technology firms as South Korea's "AI champions" to lead its AI innovation. Interestingly, the initiative aims to incorporate early-on public engagement to further spur domestic-level competition among the selected companies.[53] While a short-term project, the initiative stands to serve as South Korea's first AI-driven innovation strategy to bring together government, regulatory authorities and the general public through pre-market testing – establishing a fast-paced innovation sandbox.

Furthering the G7 and South Korea's global leadership on AI governance, knowledge-sharing on AI regulation and innovation sandboxes holds the opportunity to discuss methods to "bake in" ethical guidelines into the early R&D stages of AI models and, later, full-scale deployment. Overall, sharing best practices gleaned for these regulatory "sandboxes" may be a suitable first step to establishing G7-ROK S&T cooperation on AI innovation, keeping industry problem-solving foremost. South Korea, additionally, makes for a logical industry partner, especially in the advancing market for semiconductors and GPUs.

4.2 Multilateral cooperation on advanced reactors

Faced with the energy-intensive future of AI development, the G7 and South Korea share the same problem of generating low-carbon,

[50] European Parliament and Council of the EU, *Regulation (EU) 2021/694 of 29 April 2021 Establishing the Digital Europe Programme*, http://data.europa.eu/eli/reg/2021/694/2025-02-04.

[51] Japan, *Act on the Promotion of Research, Development, and Utilization of AI-related Technologies* (Act No. 53 of 2025), 4 June 2025, https://www.kojimalaw.jp/wp/wp-content/uploads/2025/09/Japan-AI-Promotion-Act-KOJIMA-LAW-OFFICES-jp-en-reference-translation.pdf.

[52] Byun, Hee-won and Kim Mi-geon, "South Korea to Pour $735 Bn into Developing Sovereign AI Built on Korean Language and Data", in *The Chosun Daily*, 17 June 2025, https://www.chosun.com/english/industry-en/2025/06/17/SRAB6HCZXJHM3NCJPZ3VALO6XU.

[53] Ko, Eun-yi and Young-ae Lee, "Naver, LG, SK, NC, Upstage Named", cit.

The G7 is building a collation of nuclear producers, away from Russian (and, to a lesser extent, rising Chinese) influence

baseload energy at-scale. To advance shared energy security and climate goals, G7 nations and South Korea should deepen cooperation across key areas of civil nuclear development. At the cutting-edge of nuclear technology, coordination on the deployment of Generation III+ reactor designs – such as Korea's APR1400 and France's EPR – can accelerate implementation projects in domestic and export markets, particularly in regions seeking clean baseload power.

Additionally, the nuclear fuel cycle is complex, reliant on global supply chains and increasingly intertwined with geopolitics. In April 2023, five members of the G7 – Canada, France, Japan, the United Kingdom and the United States – proved this point by agreeing to collectively boycott Russia's relative monopoly on nuclear fuel during the G7 Ministers' Meeting on Climate, Energy and Environment.[54] Actions by these nations, later dubbed the Sapporo Five, built upon the G7's 2022 Leaders' Communique, which aimed to "reduce reliance on civil nuclear and related goods from Russia".[55] As the G7 builds a collation of nuclear producers, away from Russian (and, to a lesser extent, rising Chinese) influence, South Korea stands as a logical partner in ensuring nuclear supply chain resiliency.

The G7 and South Korea could work together to enhanced joint R&D on the nuclear fuel cycle, especially in light of geopolitical constraints on uranium mining, enrichment and conversion services. There is an opportunity to invest in resilient, transparent supply chains for low-enriched uranium and advanced fuels, while also supporting long-term waste disposal solutions – including deep geological repositories and recycling technologies. Additionally, though enthusiasm for AMRs and SMRs are rising globally, the question of adequate, efficient and sustainable waste containment and disposal remains. Any advances in domestic civil nuclear technologies should also investigate the backend of the nuclear fuel cycle, including spent nuclear fuel recycling and storage. As a whole, more R&D is needed to understand the potential risks and long-term implications of advanced reactors.

Finally, cooperation must ensure that non-proliferation and safeguards-by-design are fully integrated into all stages of new nuclear technology development. Embedding digital safeguards tools, optimised sensor placement and real-time monitoring capabilities from the design phase onward will strengthen both International Atomic Energy Agency (IAEA) and domestic verification regimes – ensuring that the global expansion of nuclear energy remains

[54] UK Government, *New Nuclear Fuel Agreement Alongside G7 Seeks to Isolate Putin's Russia*, 16 April 2023, https://www.gov.uk/government/news/new-nuclear-fuel-agreement-alongside-g7-seeks-to-isolate-putins-russia.
[55] G7, *G7 Leaders' Communiqué*, Elmau, 28 June 2022, https://g7.utoronto.ca/summit/2022elmau/220628-communique.html.

peaceful, secure and accountable.

4.3 AI & nuclear: Safety, security and safeguards

As civil nuclear technologies advance, the dual-use nature must also be taken into consideration. Today's digital technologies, including large language models (LLMs) and AI, may serve to support the future of nuclear reactor monitoring, non-proliferation regulation, and enhance IAEA safeguards – looking forward, digital solutions for nuclear operators are rapidly on the horizon.

Nuclear power plant operators, with support of national-level R&D laboratories, are developing 'digital twin' systems – a data-driven virtual representation of a nuclear reactor

Nuclear power plant (NPP) operators, with support of national-level R&D laboratories, are developing 'digital twin' systems – a data-driven virtual representation of a nuclear reactor.[56] Based on data from physical reactors, digital twin systems can allow for real-time monitoring and, with the integration of AI-enabled modelling, has the ability to run simulations forecasting NPP operations and maintenance (O&M) and detecting reactor anomalies. Such digital integration could benefit from multinational collaboration and cooperation with careful considerations about AI monitoring and regulation.[57]

Moreover, the utilisation of digital engineering, including the creation of digital twin systems, can embed safeguards-by-design into reactor development, enabling early diversion-pathway analysis and continuous real-time monitoring.[58] This technology could enable IAEA safeguard inspectors to virtually simulate and assess anomalies before deploying in the field, thereby focusing inspections on high-risk points and reducing intrusion. Integrating twin data streams would also support automated detection of misuse or diversion and strengthen both international and domestic safeguard regimes with more comprehensive and timely insights into facility operations.

Within the G7, the United States, France, Japan and Canada are actively pursuing advances in digital twin technologies as a means of enhancing the safety, reliability and efficiency of nuclear reactors. In 2020, the French government launched the Digital Nuclear Reactor initiative to digitally clone its entire 57-reactor fleet.[59] In the United States, the Advanced Reactor Projects Agency-Energy's (ARPA-E) Generating Electricity Managed by Intelligent

[56] Huber, Marguerite, "Virtual Models Paving the Way for Advanced Nuclear Reactors", in *Argonne National Laboratory Articles*, 28 May 2025, https://www.anl.gov/node/455451.

[57] He, Jingjie and Nikita Degtyarev, "AI and Atoms: How Artificial Intelligence is Revolutionizing Nuclear Material Production", in *Bulletin of the Atomic Scientists*, Vol. 79, No. 5 (September 2023), p. 316-328, https://doi.org/10.1080/00963402.2023.2245251.

[58] Stewart, Ryan et al., *Utilizing Digital twins for Nuclear Safeguards and Security*, paper for the 63rd Annual INMM Meeting, March 2023, https://resources.inmm.org/node/73008.

[59] "Project Launched to Digitally Clone All French Reactors", in *World Nuclear News*, 23 September 2020, https://world-nuclear-news.org/Articles/Project-launched-to-digitally-clone-all-French-rea.

South Korea's advanced capabilities, exemplified by its MMIS system, position it as a strategic partner in shaping the future of digital nuclear operations

Nuclear Assets (GEMINA) provided 27 million dollars to nine leading nuclear firms – including Kairos, Xe-100, BWRX-300 and the SSR-W – kickstarting domestic development on digital twin technologies for next generation nuclear reactors.[60] In early 2025, Japan's Hitachi Ltd announced plans to develop the Metaverse Platform for Nuclear Power Plants, which aims to streamline NPP O&M, enhance safety and support digital information sharing.[61] While still in development, such initiatives underscore a broader shift among G7 nations toward leveraging digital innovation to modernise nuclear infrastructure and ensure long-term energy resilience.

Not to be left behind, South Korea announced this year the completion of its own indigenous digital twin system centred on KHNP's APR1400 reactors, aptly titled the Man-Machine Interface System (MMIS). The MMIS system, according to KHNP, enables the "various scenarios possible in a power plant can be simulated to test various control systems, and problem-solving ability and maintenance efficiency can be improved through smart engineering functions, real-time monitoring of controllers, and data analysis functions".[62] Additionally, digital twin virtualisation facilities hold the potential for cross-regional monitoring of civil nuclear technologies, such as in the case of KHNP's current APR-1400 reactor export project to the Czech Republic.

As a whole, South Korea's advanced capabilities, exemplified by its MMIS system, position it as a strategic partner in shaping the future of digital nuclear operations. Continued cooperation between G7 nations and South Korea will be essential in setting global standards for the safe and secure application of digital technologies in the nuclear sector. Joint R&D initiatives and regulatory collaboration can ensure that emerging technologies, including LLMs and AI, are effectively harnessed to support both operational excellence and international security. By aligning efforts on digital twin systems, AI-enabled monitoring and safeguards-by-design, these countries can accelerate innovation while reinforcing global non-proliferation objectives.

[60] US Department of Energy, *DOE Announces $27 Million for Advanced Nuclear Reactor Systems Operational Technology*, 13 May 2020, https://www.energy.gov/node/4445534; Patel, Sonal, "Advanced Nuclear Reactor Designs to Get Digital Twins", in *POWER Magazine*, 14 May 2020, https://www.powermag.com/advanced-nuclear-reactor-designs-to-get-digital-twins.

[61] Hitachi, *Hitachi Develops 'Metaverse Platform for Nuclear Power Plants' to Enhance Efficiency in Construction and Maintenance Operations*, 9 July 2025, https://www.hitachi.com/New/cnews/month/2025/07/250709.html.

[62] KHNP, *KHNP Successfully Implements Digital Twin of Korean MMIS for APR1400*, 26 September 2024, https://www.khnp.co.kr/eng/selectBbsNttView.do?key=565&bbsNo=84&nttNo=58711.

G7 and South Korea stand at a pivotal moment to define the future of responsible digital and energy innovation

Conclusion

As the global nexus between technology and security grows more intertwined, the G7 and South Korea stand at a pivotal moment to define the future of responsible digital and energy innovation. Building upon their shared democratic values and complementary strengths, deeper G7-ROK cooperation across AI and advanced nuclear energy offers a powerful means to safeguard energy resilience, technological competitiveness and international stability.

Without a doubt, South Korea's emergence as a "G7 Plus" leader – anchored in its semiconductor, AI and civil nuclear expertise – has well positioned Seoul as an indispensable G7 partner in crafting global norms, governance mechanisms and industrial partnerships across these critical industries. The G7 should work with likeminded partners, such as South Korea, to implement a future-oriented framework for S&T cooperation – through public-private AI innovation and regulatory platforms, joint R&D on advanced reactors and digital safeguards-by-design.

Seizing this moment requires the G7 and South Korea to align on AI and advanced nuclear strategies under a shared vision: to build resilient, innovative and secure technology ecosystems that reinforce democratic leadership in the global economy. By advancing this partnership, joint G7-ROK cooperation stands to shape a global order where cutting-edge technological progress, democratic values and critical safeguards advance together.

Acronyms

AI	Artificial intelligence
AMR	Advanced modular reactor
ARPA-E	Advanced Reactor Projects Agency-Energy
EDIH	European Digital Innovation Hub
EU	European Union
GPU	Graphic processing unit
GWe	Gigawatts of electricity
HBM	High-Bandwidth Memory
IAEA	International Atomic Energy Agency
ICT	Information and communications technology
IMSR	Integral Molten Salt Reactor
KAERI	Korea Atomic Energy Research Institute
KHNP	Korea Hydro & Nuclear Power
LLM	Large language model
MMIS	Man-Machine Interface System
MMR	Micro modular reactor
MWe	Megawatts of electricity
NPP	Nuclear power plant
O&M	Operations and maintenance
OPG	Ontario Power Generation
REAIM	Responsible AI in the Military Domain
ROK	Republic of Korea
R&D	Research and development
S4D	Summit for Democracy
S&T	Science and technology
SMR	Small modular reactor
SSR-W	Stable Salt Reactor – Wasteburner
TWh	Terawatt hours
UK	United Kingdom
US	United States

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