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PNNL-38340

Modeling Small Modular Reactors in GCAM

September 2025

Nazar Kholod
Anastasiia Zagoruichyk
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U.S. DEPARTMENT of ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Executive Summary

This study uses a state-of-the-art modeling tool to examine the future role of nuclear energy in the global energy system, with a focus on the United States. We also analyzed the U.S. government's new strategic vision for the nuclear energy sector.

The analysis is conducted using the Global Change Analysis Model (GCAM). We enhance GCAM's modeling capabilities by incorporating small modular reactors (SMRs) as a technology for 32 geopolitical regions. GCAM enables the assessment of various scenarios for deploying large reactors and SMRs, including their interactions with other energy sources, cost implications, impacts on global markets, and interactions with other sectors.

The research highlights the potential for expanded nuclear energy capacity globally and in the United States by 2050 by utilizing data from the 2024 Annual Technology Baseline (ATB) database developed by the National Renewable Energy Laboratory (NREL). We model three distinct cost scenarios in GCAM – *conservative, moderate, and advanced* – based on the cost data for new large reactors and SMRs.

The analysis shows that the deployment of SMRs will have significant global implications. Globally, 204 large reactors and 492 SMRs are projected to be built by 2050 in the moderate scenario. In the conservative scenario, 99 large reactors and 154 SMRs are projected to be constructed. However, in the advanced scenario, which assumes a significant reduction in capital costs, 376 large reactors and 1,948 SMRs by 2050 are projected to be built globally.

In the United States, the findings indicate that under the moderate scenario, 29 large nuclear reactors will be constructed by 2050, while the conservative and advanced scenarios project 14 and 53 new reactors, respectively. Similarly, there are 69 SMRs in the moderate scenario and 22 and 273 SMRs in the conservative and advanced scenarios, respectively. By 2050, newly constructed reactors, including both large and SMRs, are projected to contribute 48% to the total nuclear power capacity in the moderate scenario (28% and 72% in the conservative and advanced scenarios). The corresponding electricity generation from these new reactors in 2050 is estimated at 170 terawatt-hours (TWh) – 397 TWh and 1072 TWh, respectively.

Furthermore, the study examines a policy scenario that aims for 400 gigawatts (GW) of nuclear capacity in the United States by 2050. The U.S. administration announced plans for 400 GW of nuclear capacity in 2025. The modeling results show that this strategy necessitates the construction of 226 large reactors and 535 generic SMRs, each with a capacity of 300 megawatts electric (MWe) in the next 25 years.

Overall, these results underscore the significance of energy systems modeling, emphasizing the need for comprehensive evaluations of nuclear energy within the national energy system, including its cost dynamics and interactions with global markets and other sectors. Enhanced modeling efforts are crucial for effective planning and ensuring the robustness of the energy sector in addressing future demands.

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1.0 Importance of Nuclear Energy Globally

Nuclear energy is one of the pillars of modern energy systems, accounting for approximately 9% of global electricity supply (IEA, 2025a). There are 416 nuclear power reactors operating in 31 countries, with a combined capacity of about 476 gigawatts electric (GWe) (WNA, 2025b). The countries with the largest number of nuclear reactors include the United States (94), France (57), China (57), Russia (36), and South Korea (26). These countries account for 71% of the world's nuclear energy capacity (EIA, 2025).

Concerns about energy security and grid reliability have been significant drivers of renewed interest in nuclear power over the past few years, with output from nuclear plants projected to reach record levels in 2025 (IEA, 2025a). In addition, global electricity demand is expected to more than double by 2050 (IAEA, 2024). The demand will be largely driven by population growth, electrification of industrial activities, the expansion of electric vehicles, and advancements in Artificial Intelligence (AI) and Machine Learning (ML), which require substantial energy to power data centers. Therefore, nuclear energy will play a significant role in meeting the growing demand.

The nuclear "comeback" is already evident worldwide. As of August 2025, around 30 countries were considering, planning, or starting nuclear power programs, while another 20 countries have expressed interest (WNA, 2025a). Bangladesh, Egypt, and Turkey are all constructing their first nuclear power plants.

The investment potential for nuclear power is also being unlocked. The World Bank has ended its long-standing ban on providing funding for nuclear energy projects and will now be open to supporting efforts to extend the life of existing reactors and accelerate the potential of small modular reactors (SMRs) in developing countries (WNN, 2025b). SMRs can play an important role in meeting growing power demand, enhancing grid resilience, and providing adaptable solutions for diverse applications.

The Nuclear Energy Agency (NEA) identified 30 SMR designs being pursued in North America, 20 designs in Europe, 10 designs in Asia, 5 designs in China, 5 designs in Russia, 2 designs in Africa, and 1 design in South America and the Middle East (OECD, 2025). Most of them are in various developmental stages. The U.S. emerges as a leader in building SMR supply chains, with the largest number of siting activities for SMRs, which involve specific SMR vendors, site owners, and customers. Cumulative global investment in SMRs can reach as high as $900 billion by 2050 (IEA, 2025a).

Recognizing the importance of nuclear energy, particularly in the context of first-of-a-kind technologies, further research is needed to explore its nexus with other sectors, such as water, land, economics, and critical materials. Conducting modeling to assess the perspectives and development scenarios for SMRs is essential to identify market opportunities and ensure long-term demand. Such modeling can also inform planning for U.S. nuclear expansion by examining interactions with global markets and other sectors, evaluating potential economic benefits, and assessing how SMRs can contribute to balancing and stabilizing the energy system.

2.0 Global Change Analysis Model

2.1 GCAM overview

Global Change Analysis Model (GCAM) is a global model that represents the behavior of the five following systems and interactions between them: energy, land and agriculture, water, the economy, and emissions (Fig. 1.). GCAM has been used to produce scenarios for national and international assessments (Calvin et al., 2019). GCAM is an open-source, community model with detailed model documentation and assumptions available online. GCAM is increasingly being used in multi-model, multi-scale analysis, in which it is either soft- or hard-coupled to other models with different focuses and often greater resolution in key sectors (JGCRI, 2025). GCAM has been used to investigate the role of nuclear energy (Kim, 2022; Kim et al., 2022). A regional GCAM model was used to analyze the role of nuclear energy in China (Yu et al., 2020).

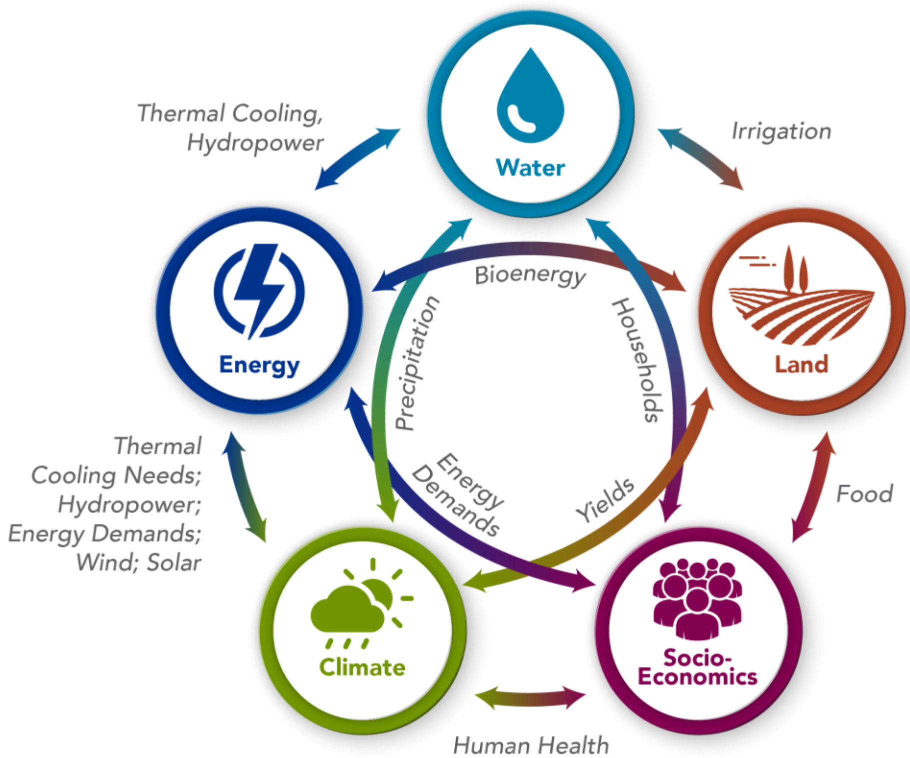

Figure 1. Interlinkages of GCAM systems

GCAM divides the world into 32 geopolitical regions, with several large countries (like the U.S. and China) represented as independent regions. The model runs through 2100 in 5-year time steps, solving for market equilibrium in each period and determining the prices at which supply equals demand in all markets. The 1990 to 2021 modeling time periods are calibrated to historical datasets (namely, IEA World Energy Balances (IEA, 2025b)) and provide a consistent context from history to future projections.

The energy sector includes energy resource supply, transformation (which includes electric power generation and hydrogen production), and final demand in the buildings, industry, and transportation sectors (Fig. 2). The electricity supply sector for each region is represented as a single balancing authority, and electricity trade within a region or between regions is not modeled. Both depletable (e.g., oil, natural gas, coal, and uranium) and renewable (e.g., solar, wind, geothermal) resources are represented by regions using supply curves that reflect the quantities of resources available at a given extraction cost. GCAM employs a discrete choice model – specifically, the Logit choice model – to determine the market share of alternative technologies. The market share is based on the probability that a technology has the lowest cost for its application, and this prevents one technology from dominating the market ("winner take all").

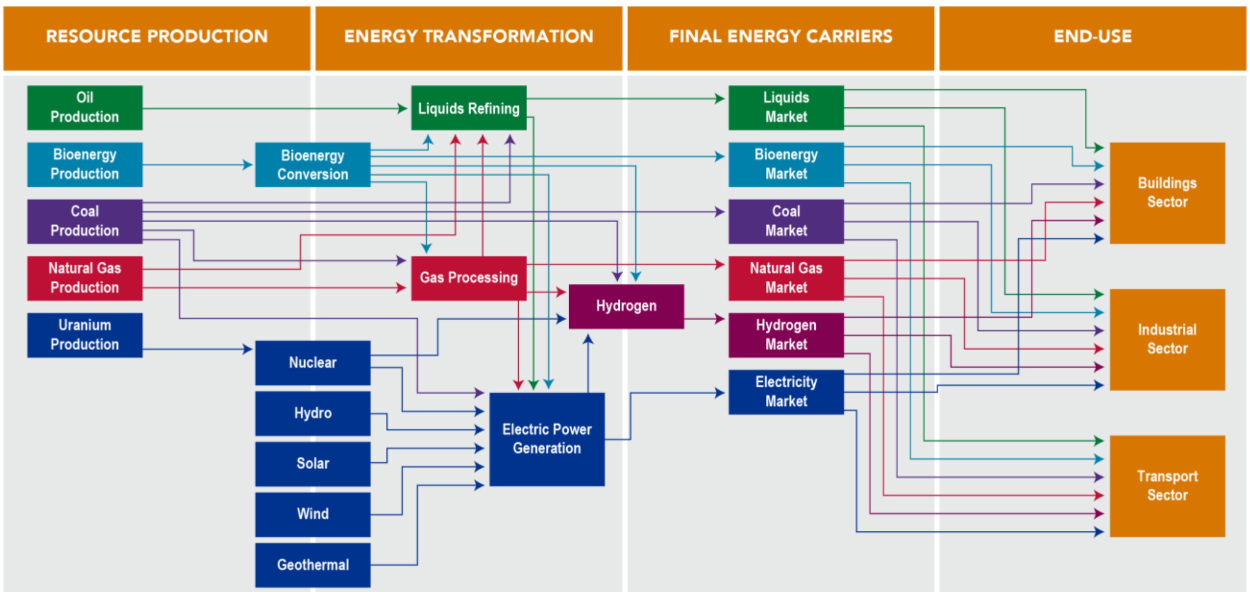

Figure 2. Energy system in GCAM

All technologies in GCAM, including electric power technologies, compete based on their economic costs. Technology costs are categorized into resource, fuel, energy costs, and non-fuel costs, including capital and operations & management (O&M) costs. The most recent GCAM version 8.3 includes data on the electricity cost from the NREL ATB for 2022.

Table 1. Assumptions on technology costs for large nuclear reactors in GCAM

	2020	2030	2040	2050
Overnight capital cost, $2020/kW	6809	6383	5958	5532
Fixed O&M cost, $2020/kW-year	114	114	114	114
Variable O&M cost, $2020/MWh	4	4	4	4

Source: (NREL, 2022).

The database includes information about small modular reactors and large nuclear reactors (AP1000). However, though this information is available in the database, the SMR data is not used in GCAM up to version 8.3.

2.2 Modeling nuclear in GCAM

GCAM version 8.3 includes two types of nuclear reactors: currently operational conventional light-water reactors (Gen II) and advanced reactor designs with improved economics and safety features (Gen III).

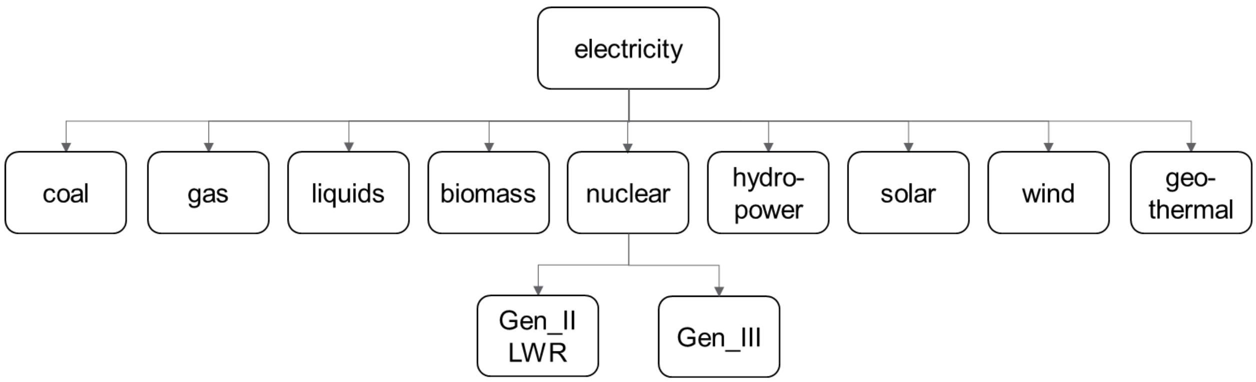

Figure 3. Default GCAM v8.3 electricity sector structure

Legacy Gen II reactors do not compete for new capacity, and no new investments in Gen II reactors can occur (the shareweight is set to zero from 2025 on). Gen II reactors have a 60-year lifetime, and with no new Gen II reactors built after 2015, this technology will remain in the United States until 2075. GCAM uses an S-curve which gradually retires existing Gen II capacity.

Gen III reactors compete with other electricity generation technologies based on their economic costs. GCAM simulates a mix of reactor types based on levelized technology cost (inclusive of capital costs, fixed and variable operations and maintenance, fuel costs, and cooling water costs) using a logit choice model. It is worth noting that GCAM does not impose limitations on nuclear deployment due to concerns about reactor safety, capacity for waste storage, and proliferation.

The latest GCAM release does not include small modular reactors.

2.3 Adding small modular reactors to GCAM

We replace the Gen III reactor with technology “large reactor” and added “SMR” as a new technology in GCAM (Fig. 4).

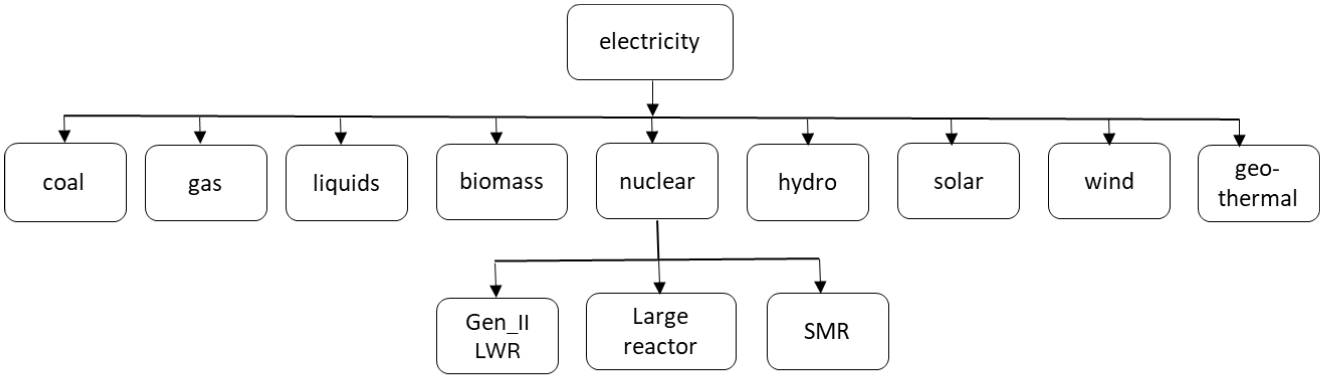

Figure 4. New electricity sector structure (this study)

We use parameters for new large reactors and SMRs based on the three scenarios available in NREL ATB 2024. The cost estimates are design-agnostic (are not tied to specific reactor types), where only the size of reactors is the defining factor. A large reactor has a capacity of 1,000 megawatts electrical (MWe) (equivalent to 1 GW), and an SMR has a capacity of 300 MWe. The default GCAM capacity utilization rate for Gen II and Gen III reactors is 90%, and we maintain this rate for new large reactors and SMRs, although the ATB 2024 value is 93%.

2.4 GCAM scenarios for SMR deployment

The 2024 ATB projections are based on a compilation of historical cost estimates for various advanced nuclear energy technologies. Additional detail on the methodology for providing the estimates is provided in Abou-Jaoude (2024). The 2024 ATB database includes three cost scenarios – conservative**,** moderate, and advanced. The **conservative** nuclear deployment projections were based on an average of two references: Kim (2022) and EIA (2022). Under this scenario, nuclear technology is deployed depending only on its cost and grid needs at a given time. No underlying assumption is made about potential innovations or government investments in technology. The projections for nuclear deployments in the **moderate** scenario were primarily based on current announcements for both contracted and potential deployments in public documents before 2024. The **advanced** scenario assumes government support and incentives in nuclear will continue, and private investment will be encouraged to achieve technological improvements. This will reduce long-term costs for new nuclear technologies and help achieve broader market penetration.

Figure 5 shows the overnight capital costs for large reactors and SMRs under the three scenarios. In conservative and moderate scenarios, the capital cost of SMR is higher than that of large reactors during the period from 2025 to 2050. However, in the advanced scenario, the overnight cost of capital for SMRs is lower than for large reactors after 2031 (NREL, 2024).

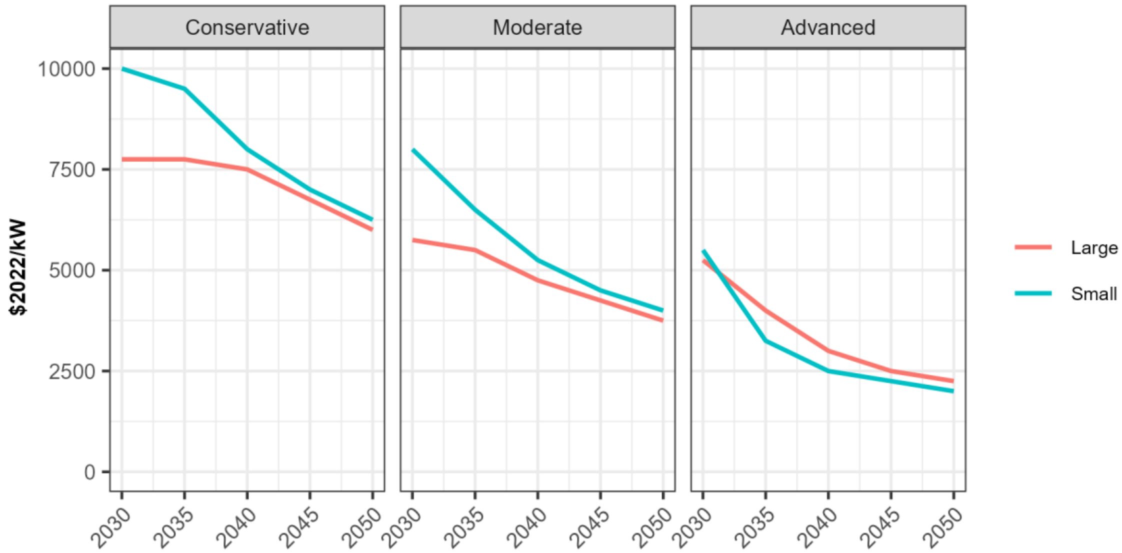

Figure 5. Technology overnight capital cost in the ATB 2024

The levelized cost of energy (LCOE) ($/MWh) for SMRs is lower than that for large reactors in all three scenarios (after 2037 in the conservative scenario and after 2035 in the moderate scenario) (Fig. 6). It is important to acknowledge that one of the factors SMRs show a lower LCOE in the ATB, despite their higher capital costs, is the longer construction timelines and associated interest costs incurred during the build-out of large reactors.

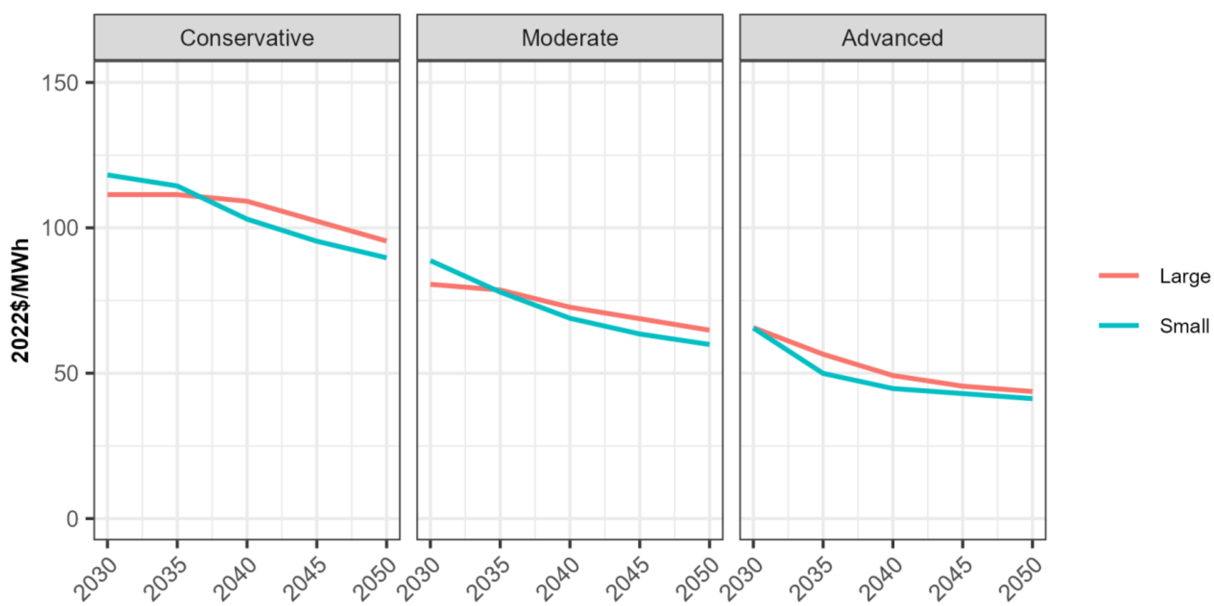

Figure 6. Levelized cost of energy ($/MWh) in the 2024 ATB

It should be noted that GCAM does not use the LCOE directly from ATB, as the model calculates it based on capital costs, fixed O&M costs, variable O&M costs, fuel costs, and cooling water costs, without accounting for differences in interest payments that arise from varying construction periods.

Figure 7 shows costs by technology in GCAM. In the conservative and moderate scenarios, electricity costs for large reactors and SMRs are higher than those for conventional coal and gas, which are the two dominant electricity generation technologies globally. However, in the advanced scenario, the electricity cost from SMRs in 2040 is lower than that of any technology presented in Fig. 7, and SMRs compete for a larger share of electricity generation (data for the U.S.). (Converted from the original GCAM unit of $1975/GJ).

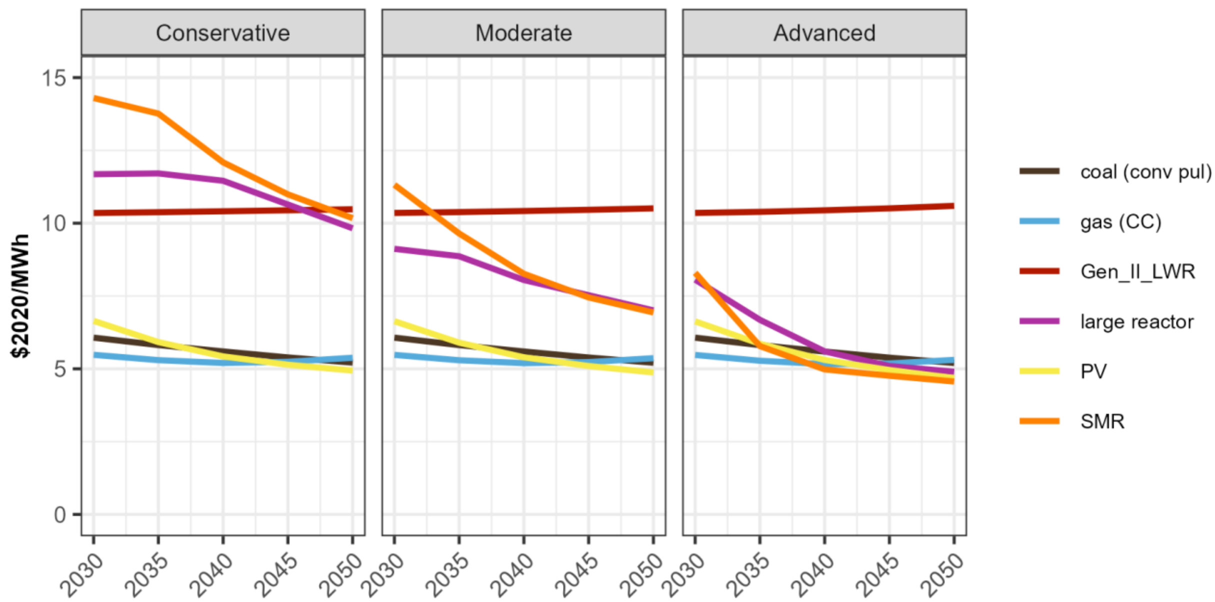

Figure 7. Energy costs in GCAM ($2020/MWh)

As ATB 2024 contains data up to 2050, GCAM uses ATB 2024 values from 2030 to 2050 to calculate improvement rates and maximum improvement for each nuclear technology. These parameters are then used to fit an exponential decay function to extrapolate ATB data out to 2100 that smoothly transitions from ATB values to extrapolated values. However, we present the modeling results up to 2050 to focus on the medium-term prospects of nuclear energy development.

Another important parameter for modeling nuclear in GCAM is water, which is critical for cooling the reactors. Gen II LWR reactors use four types of cooling: once-through, cooling pond, recirculating, and seawater. However, some regions do not use once-through cooling. For example, in the U.S., large reactors and SMRs are assumed to use recirculating cooling (80%), cooling pond (10%), and seawater (10%). The same cooling technologies are used for new reactors. As we use a generic SMR concept, the model does not account for new cooling technologies for SMRs. In general, water consumption for SMRs is expected to be in the range of 100-500 gallons per megawatt-hour (gal/MWh), similar to traditional nuclear power plants (Sustainability Directory, 2025).

3.0 Global Modeling Results

3.1 Global electricity production by technology

Figure 8 shows global electricity generation by technology from 2021 to 2050. The three scenarios presented here do not account for any new policy or targets (reference cases). Coal remains the most important fuel in the analyzed period. Shares of solar and wind energy grow rapidly globally, while the shares of natural gas and hydro remain relatively stable throughout 2050.

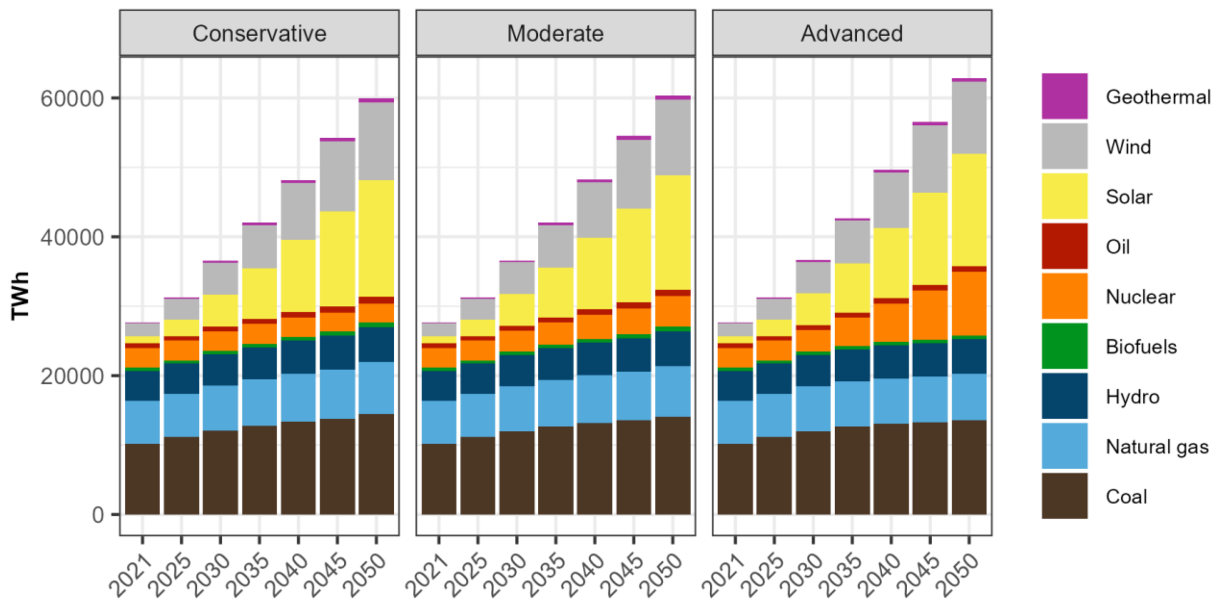

Figure 8. Global electricity production in 2021-2050

The share of nuclear energy in the global electricity mix was 10.15% in 2021. The results of the moderate scenarios show that this share decreases to 7.3% in 2050. In the conservative scenario, the share decreases to 4.6% in 2050. However, the role of nuclear energy is higher in the advanced scenario, as nuclear delivers 14.6% of all electricity in 2050.

The share of legacy reactors in power generation globally decreases from 100% in 2021 to 33.5% in 2050 in the moderate scenario. In the conservative and the advanced scenarios, this share is 53.5% and 16.0%, respectively.

3.2 Global nuclear capacity and electricity production by nuclear

Figure 9 shows the number of new nuclear reactors globally. In 2050, the number of SMRs is projected to be 154 in the conservative scenario, 492 in the moderate scenario, and 1,948 in the advanced scenario. The regions with the largest number of SMRs in the advanced scenario in 2050 include China (507), EU-15 (309), U.S. (273), Russia (130), and India (87). The number of new large reactors is 99, 204, and 376 in the conservative, moderate, and advanced scenarios, respectively.

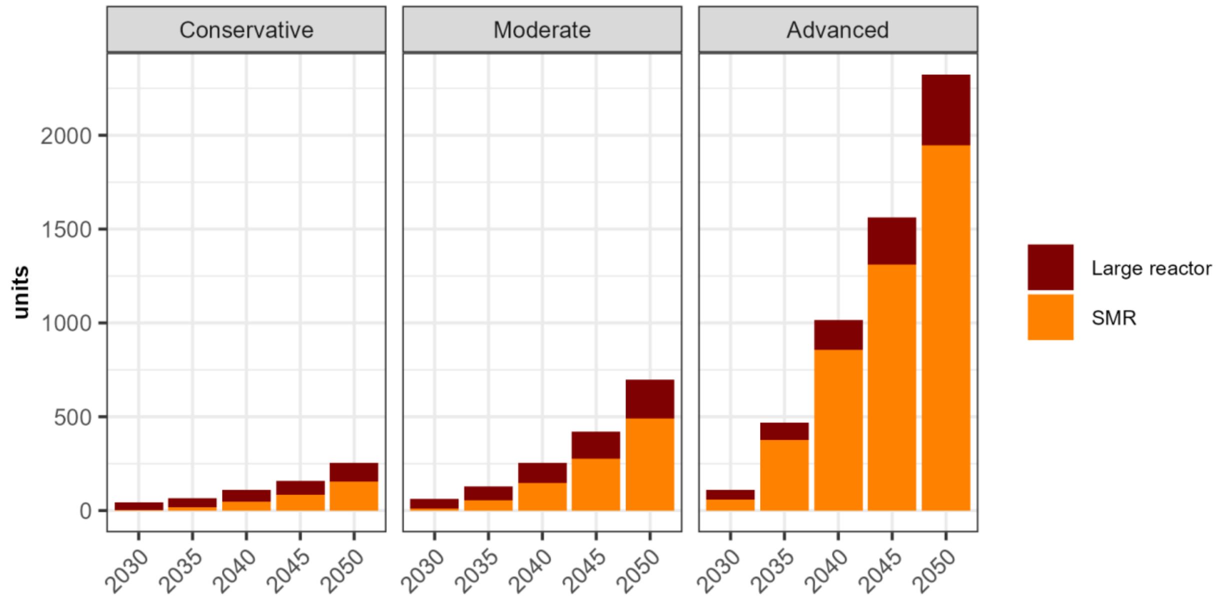

Figure 9. Number of new nuclear reactors in the world

The global total new nuclear capacity in 2050 reaches 162 GW in the conservative scenario, 370 GW in the moderate scenario, and 980 GW in the advanced scenario (Fig. 10).

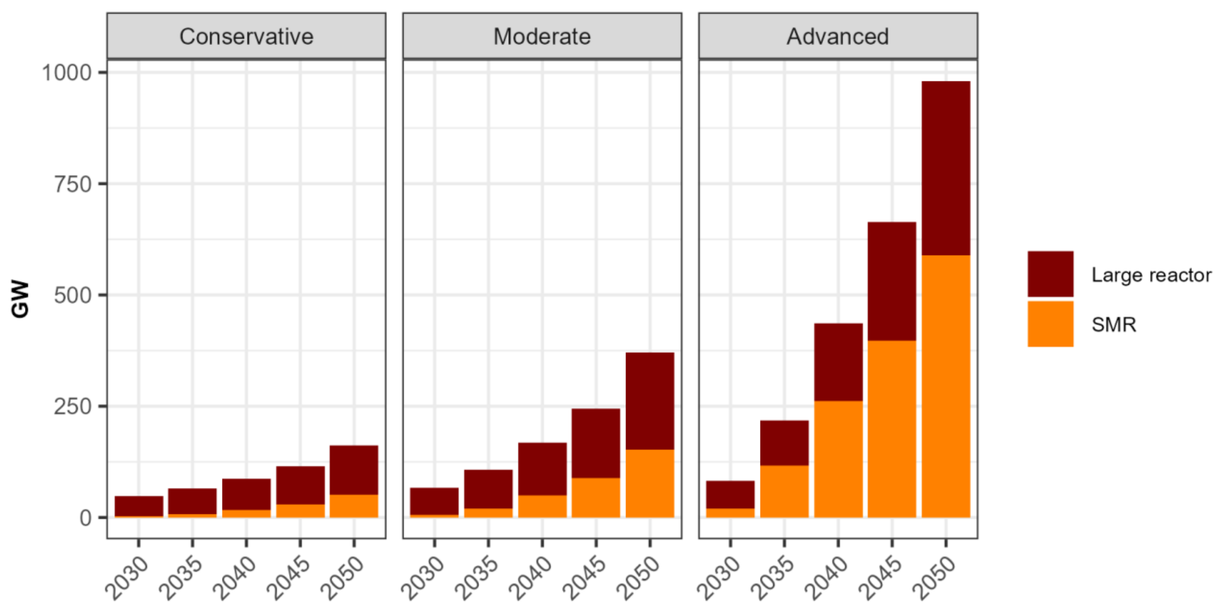

Figure 10. Global installed new nuclear capacity

In the base year (2021), the only nuclear technology is Gen II (legacy reactors). The first new large reactors begin to deploy in 2025, while SMRs appear in 2030. Gen II reactors are projected to generate 1,474 TWh globally in 2050; however, their share in global electricity production depends on the deployment of new large reactors and SMRs.

The share of SMRs in global electricity production by nuclear reaches 14%, 27% and 50% in 2050 in the conservative, moderate, and advanced scenarios, respectively (Fig. 11).

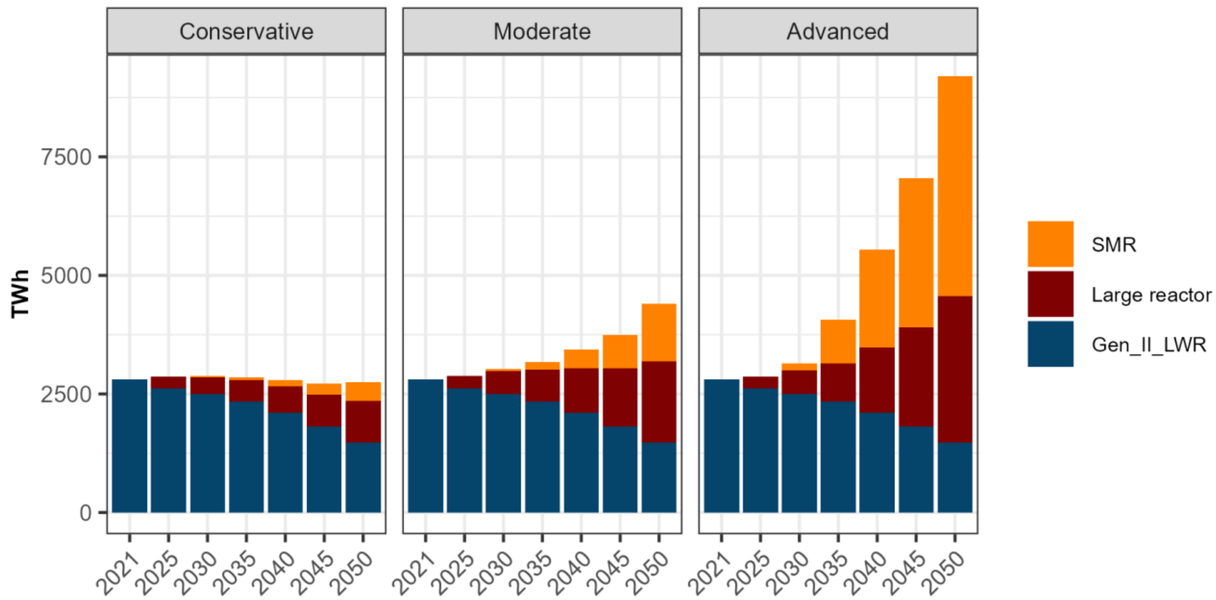

Figure 11. Global electricity production by nuclear in 2021-2050

Thus, in the advanced scenario, where SMR costs improve, which may be driven by government support, incentives, and private investment to boost technological improvements, SMRs could produce about half of all nuclear energy by 2050.

4.0 Modeling Results for the United States

4.1 Electricity production by technology

The United States is one of the 32 regions in the standard global GCAM configuration and is modeled within the global framework. This section presents results for the United States as one of the standard GCAM regions.

Figure 12 shows the results for electricity generation in the United States under the three scenarios.

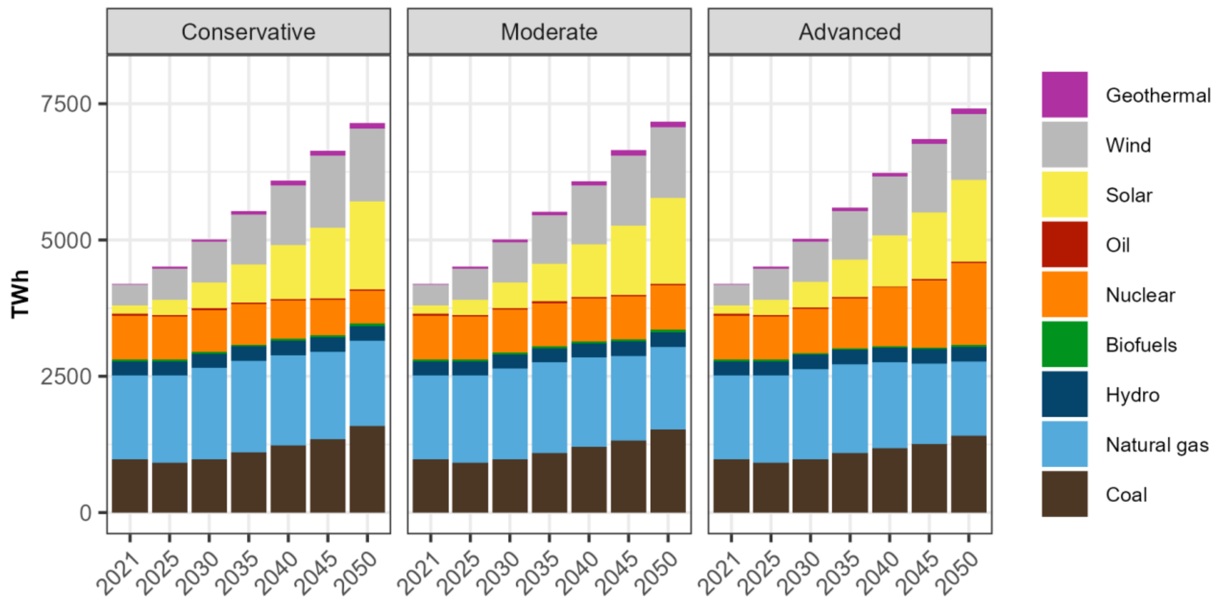

Figure 12. Power generation by technology in the United States

Natural gas remains the most important fuel for electricity generation in 2021 and continues to hold this leading role in all three scenarios. The role of coal, the second most important fuel in 2021, remains significant in the three scenarios, providing between 19 to 21% of electricity generation in 2050.

Nuclear provided 19% of all electricity generation in the United States in 2021. The role of nuclear generation throughout the analyzed period varies across the scenarios. By 2050, the share of nuclear power decreases to 8% in the conservative scenario and to 11% in the moderate scenario. In the advanced scenario, the role of nuclear is slightly higher in 2050 than in 2021 (20.2% vs 19.3%, respectively).

Compared to the rest of the world, the share of nuclear power in the U.S. is slightly lower in 2050 in the advanced scenario (26.5% globally vs. 20.2% in the U.S.), which is explained by the abundance of other energy resources in the United States, first of all, natural gas and coal.

4.2 Capacity and electricity production by nuclear in the U.S.

By 2050, 29 new large nuclear reactors are built in the United States in the moderate scenario (14 and 53 in the conservative and advanced scenarios, respectively) (Fig. 13). As SMRs are smaller and can be built faster, the number of SMRs in the U.S. increases to 69 (22 and 273, respectively).

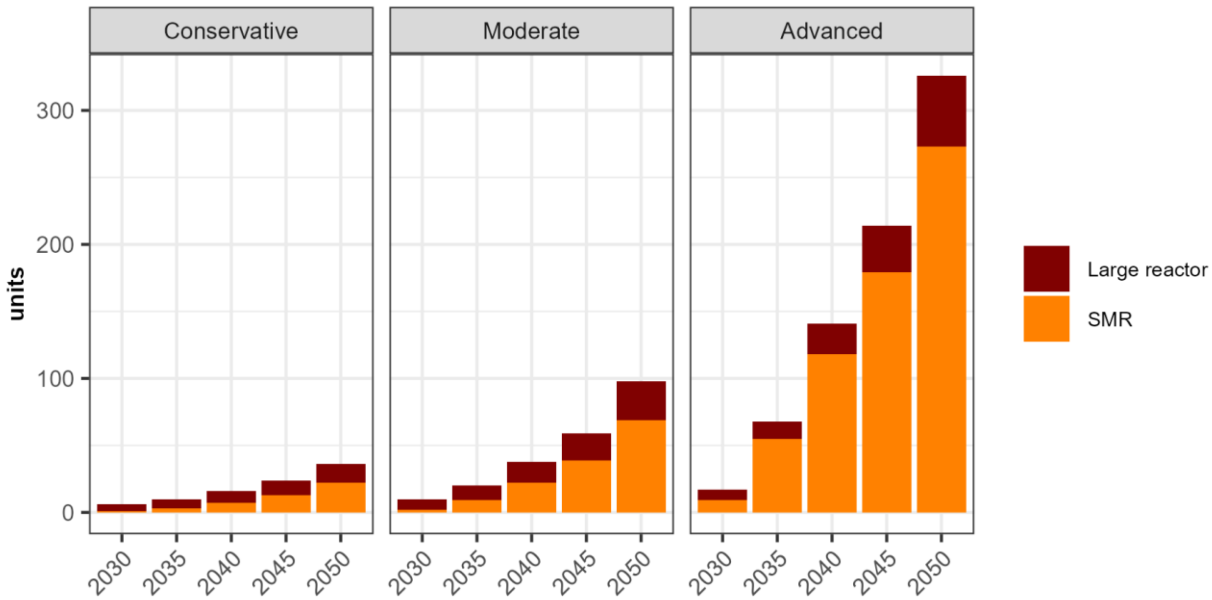

Figure 13. Number of new nuclear reactors in the United States

In 2050, the new reactors (large and SMRs) constitute 28% of the installed nuclear power capacity in the conservative scenario, 48% in the moderate scenario, and 72% in the advanced scenario (Fig. 14).

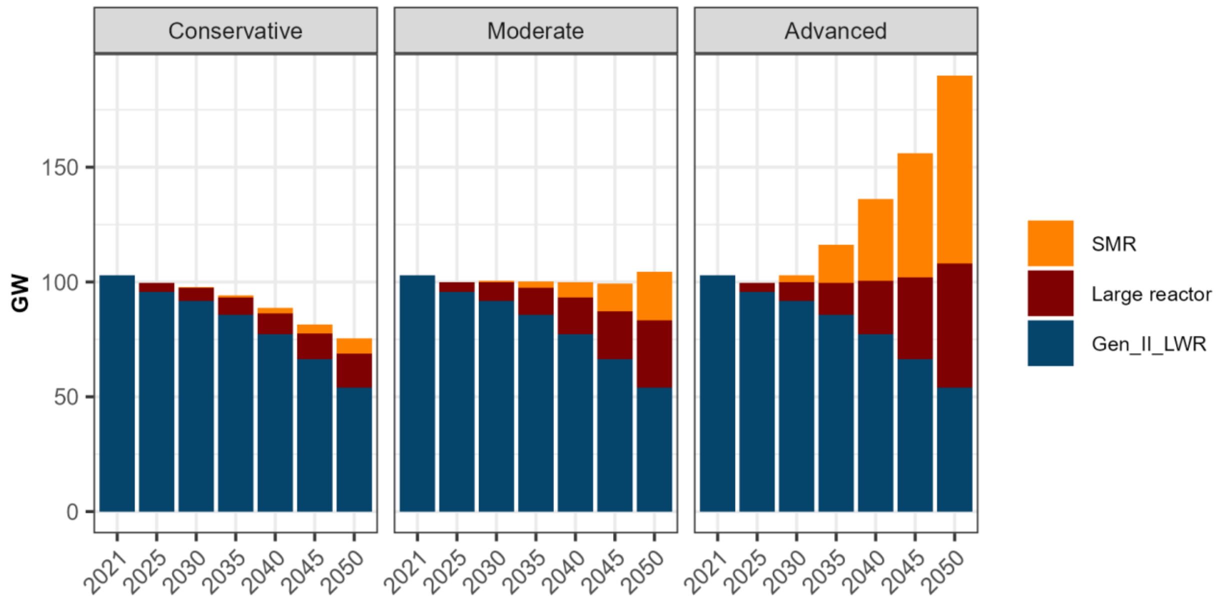

Figure 14. Installed capacity of new nuclear reactors in the United States

New nuclear reactors (large and SMRs) are projected to generate 170, 397, and 1072 TWh of electricity in the United States in the conservative, moderate, and advanced scenarios, respectively, in 2050 (Fig. 15).

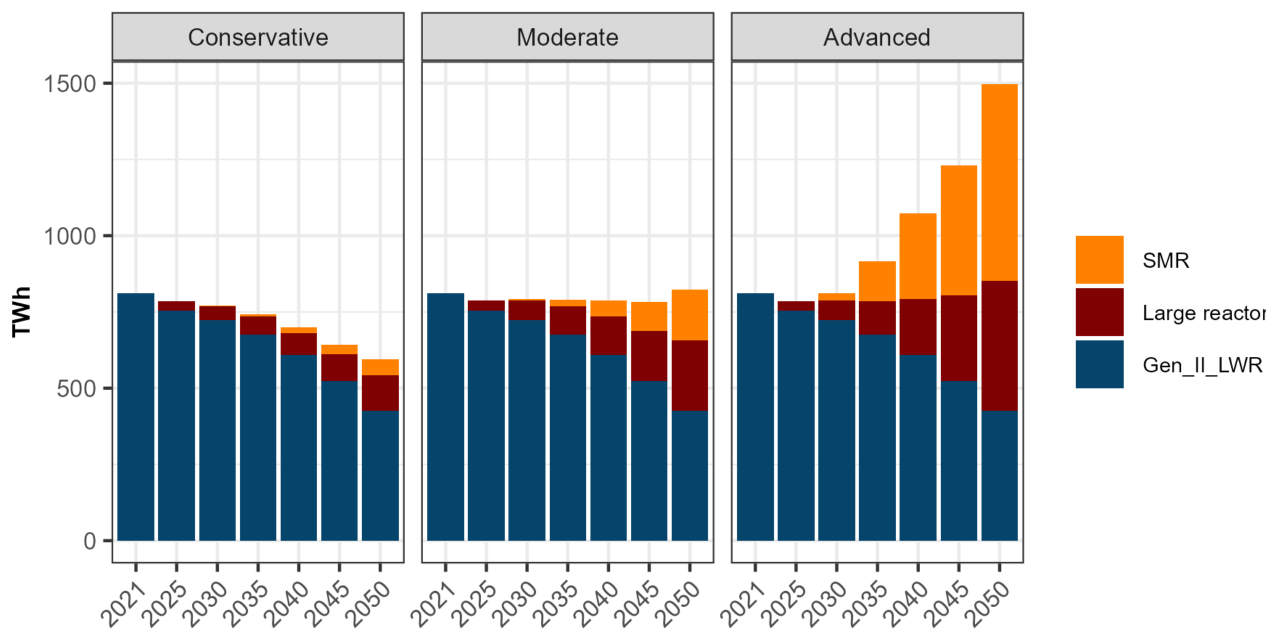

Figure 15. Power generation by type of nuclear reactors in the United States

5.0 Accelerated Deployment of Nuclear Energy in the U.S.

5.1 New nuclear priorities

As we described in Section 2.3, the 2024 ATB cost estimates are based on a compilation of historical cost estimates for various advanced nuclear energy technologies as well as historical U.S. costs for nuclear plant construction. The data for the advanced scenario includes 35 bottom-up, detailed cost estimations for the reactors, along with two data sets compiling historical observed U.S. costs for nuclear power plants.

However, significant changes have occurred in the past few years. In December 2023, the United States joined many other countries in the goal of tripling nuclear energy capacity by 2050 (DOE, 2024a). In November 2024, the U.S. set new deployment targets to add 35 GW of new nuclear energy capacity by 2035 and achieve a sustained pace of 15 GW per year by 2040 (DOE, 2024b). The U.S. Department of Energy's (DOE) goal of 35 GW in 2035 is higher than the result from the advanced scenario, where GCAM estimates about 30 GW of new nuclear capacity in 2035.

Under the new U.S. administration, the DOE has established a renewed goal to support U.S. energy security, abundance, reliability, and affordability, with a focus on near-term actions and decisions (White House, 2025b). The U.S. administration set a new goal of reaching 400 GW of nuclear capacity by 2050 (White House, 2025a).

This tectonic shift in nuclear energy policy in the United States has several goals: to unleash America's affordable and reliable energy, enhance national security, and meet the energy demands of AI, cloud computing, and data centers.

5.2 Scenario of 400 GW of nuclear capacity

We used GCAM with the new nuclear sector representation to model a scenario in which the goal of 400 GW of nuclear capacity (including large 1 GW reactors and 300 MWe SMRs) is reached by 2050. To achieve this, we employed a linear constraint from 2030 to 2050 to increase nuclear energy capacity to 400 GW by 2050 (Fig. 16). The model then determines the electricity mix from other energy sources.

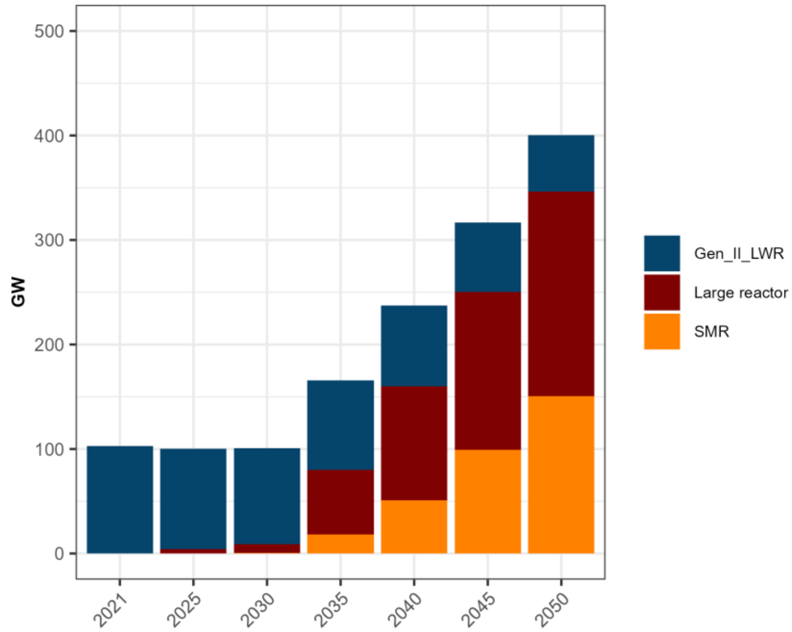

Figure 16. Installed nuclear capacity in the United States under the 400 GW scenario

The scenario illustrates a significant increase in power generation in the United States (Fig. 17). Country's electricity demand is projected to grow from 4,200 TWh in 2021 to 8,300 TWh by 2050. In the 400 GW scenario, the share of nuclear increases from 19% in 2025 to 32% in 2040 and 43% in 2050. Between 2021 and 2050, the share of natural gas is reduced from 37% to 11% and coal from 23% to 14%.

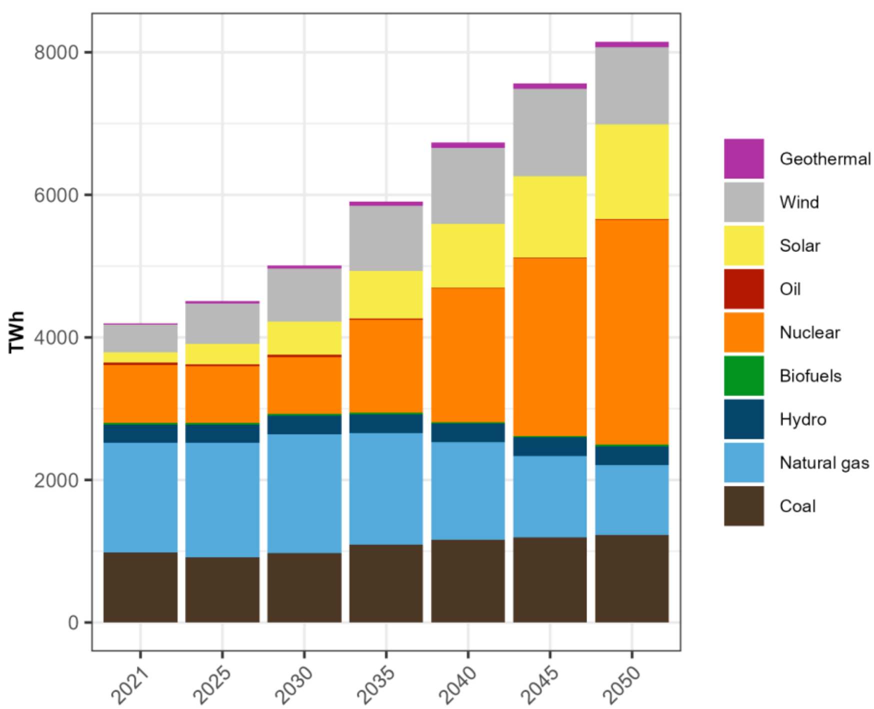

Figure 17. Power generation by fuel in the United States under the 400 GW scenario

The modeling results suggest that achieving 400 GW of nuclear energy capacity by 2050 could involve the construction of 226 large reactors and 535 SMRs (300 MWe capacity each).

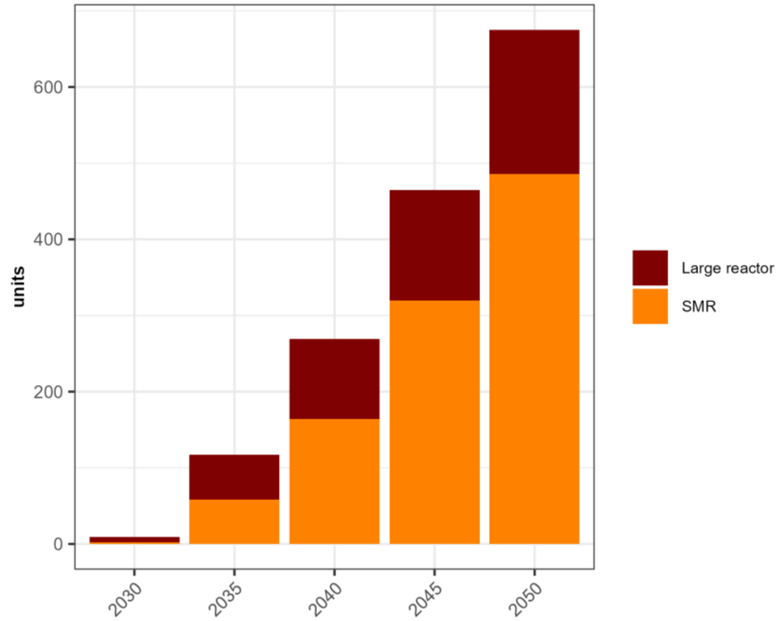

Figure 18. Number of new nuclear reactors in the United States under the 400 GW scenario

In 2050, in the 400 GW scenario, large reactors produce 1850 TWh while SMRs generate slightly above 1300 TWh. The role of the already built Gen II reactors remains unchanged from the scenarios described in Section 4.2. (Fig. 19).

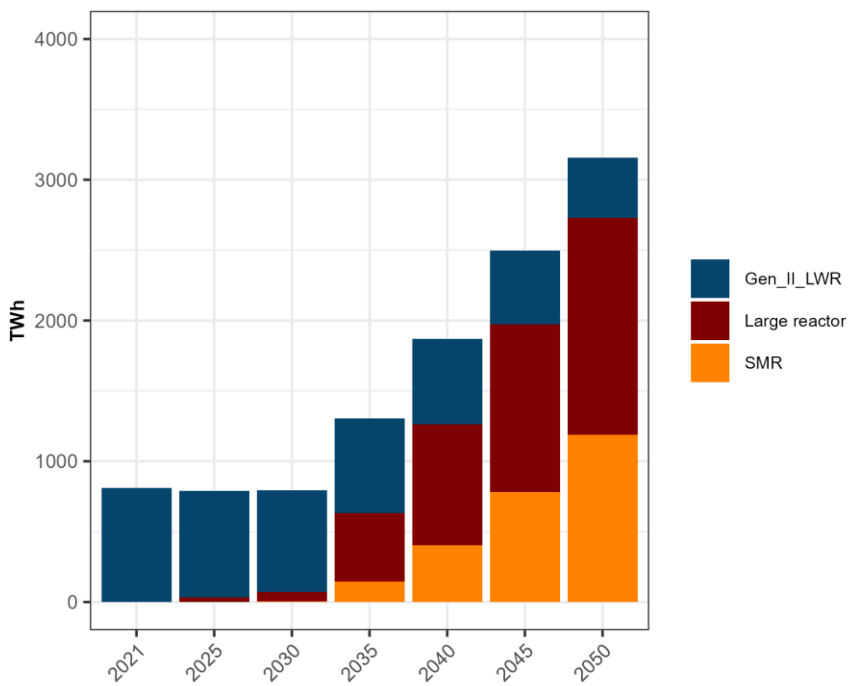

Figure 19. Power generation by all nuclear reactors in the United States under the 400 GW scenario

5.3 New technological developments and next steps

The U.S. government has prioritized the advancement of nuclear technologies, emphasizing that “abundant and affordable energy is key” to the nation’s economic prosperity and security (DOE, 2025a). This intent is reinforced by a statement from U.S. Secretary of Energy Chris Wright: *“America’s nuclear energy renaissance starts now. Abundant and affordable energy is key to our nation’s economic prosperity and security.”* (DOE, 2025a).

Numerous U.S. companies have announced plans to support the deployment of SMRs, and some have already disclosed anticipated completion years for construction:

- Google has partnered with Kairos Power to deploy 500 MW of SMRs for its data centers by the mid-2030s.
- Amazon selected X-Energy for an immediate 320 MW SMR project to enable over 5 GW of new nuclear capacity by 2039.
- In February 2025, Holtec launched “Mission 2030”, a program to build America’s first SMRs – Holtec’s SMR-300 – at the Palisades site in Covert Township, Michigan, with a target of 2030 for first commercial operation (Holtec, 2025).
- In May 2025, NuScale Power Corporation announced that it received design approval from the U.S. Nuclear Regulatory Commission (NRC) for its uprated 77 MWe NuScale Power Modules (NuScale, 2025). NuScale remains the only SMR technology company with design approval from the NRC, and the company remains on track for deployment by 2030.

The U.S. federal agencies have also officially announced support programs for SMR deployment:

- In March 2025, DOE announced $900 million solicitation to support the deployment of SMRs to de-risk the deployment of Generation III+ light-water small modular reactors (DOE, 2025a).
- On May 23, 2025, President Trump signed an executive order to facilitate the expansion of American nuclear energy capacity from approximately 100 GW in 2024 to 400 GW by 2050 (White House, 2025a).
- On August 12, 2025, the U.S. DOE officially kicked off President Trump’s *Nuclear Reactor Pilot Program*, announcing that DOE will initially work with 11 advanced reactor projects to move their technologies towards deployment (DOE, 2025b). DOE selected Aalo Atomics Inc., Antares Nuclear Inc., Atomic Alchemy Inc., Deep Fission Inc., Last Energy Inc., Oklo Inc., Natura Resources LLC, Radiant Industries Inc., Terrestrial Energy Inc., and Valar Atomics Inc. to unlock private funding and provide a fast-tracked approach to future commercial licensing activities.

Elsewhere in the world, SMR projects are also gaining momentum:

- The United Kingdom has selected Rolls-Royce SMR to build the country’s first SMR, as part of the government’s modern Industrial Strategy “to revive Britain’s industrial heartlands” (UK Government, 2025).
- In Canada, regulators approved the construction of a four-unit SMR project at the Darlington nuclear site (NucNet, 2025). The project will use the light-water BWRX-300 reactor from GE Vernova Hitachi Nuclear Energy.
- In Korea, the SMART100 SMR design has been granted standard design approval by South Korea’s Nuclear Safety and Security Commission (WNN, 2025a).
- China National Nuclear Corporation (CNNC) developed the Linglong One, the world’s first multipurpose pressurized water SMR, which will be operational by the end of 2025. The 125 MW Linglong (also known as ACP100) is suitable for a diverse range of applications, including seawater desalination, heat, electricity, and steam production. The CNNC plans to compete in overseas markets, as part of China’s “One Belt, One Road” initiative.

Technological advancements, policy changes, and learning-by-doing effects will impact the future cost estimates for SMRs. As deployment scales up, learning curves are expected to drive cost reductions (CNBC, 2025; McDonald and Schrattenholzer, 2001). The results presented in this report are based on nuclear technology costs from ATB 2024. It is essential to update the costs and other model inputs regularly as new data becomes available, so that GCAM can continue to provide useful information about the potential future role of nuclear power in the global energy system.

6.0 Conclusions

Nuclear energy is undergoing a renaissance, with governments investing billions of dollars into both large-scale reactors and small modular reactors. While SMR construction will take time, costs are expected to decline as deployment scales up. SMRs hold significant potential to meet the anticipated surge in U.S. electricity demand driven by data centers, as they can provide stable, localized power without placing additional burden on the central grid (BNP Paribas, 2025). Beyond data centers, SMRs can also serve industrial applications, such as steel, cement, or paper production, where reliable and affordable energy is essential (Lam and MacRosty, 2025; Saeed et al., 2025).

To secure future energy supply and strengthen U.S. competitiveness in global markets, strategic planning is critical. Many countries are actively exploring SMR deployment, but the U.S. currently leads in both engineering capabilities and the development of a supporting legislative framework (OECD, 2025). Modeling results suggest that by 2050, newly constructed reactors, both large and small, could account for 72% of total nuclear capacity in the advanced scenario. Achieving this vision requires careful planning, investments, and policies that foster innovation.

Moving forward, ongoing modeling efforts should expand to incorporate more tailored reactor designs, assess policy incentives that can accelerate nuclear deployment, and evaluate the broader economic benefits. The results presented in this report are based on ATB 2024. It is essential to update the model to reflect the latest ATB cost estimates, ensuring the accurate representation of nuclear technology costs in GCAM.

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Pacific Northwest
National Laboratory

902 Battelle Boulevard
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