The Rockefeller Foundation | RADIANT ENERGY GROUP | Bayesian. ENERGY

The Role of Nuclear Energy in Powering Universal Energy Abundance for Emerging Economies

DECEMBER 2025

This report is produced by Bayesian Energy in collaboration with Radiant Energy Group and commissioned by The Rockefeller Foundation.

Foreword

It is with great pleasure that I bring you this report on the role of nuclear energy in scaling clean power in emerging markets and developing economies. The Rockefeller Foundation has a long history of supporting countries on the path to securing reliable, productive, and sustainable energy to spur economic opportunity and well-being. As we assess the landscape of energy technologies today, we see increasing signs of the potential for nuclear energy to take us on a path towards universal energy abundance.

This analytical study by Bayesian Energy and Radiant Energy Solutions offers an empirically grounded perspective on the conditions under which investing in nuclear power makes economic sense, and specific actions that philanthropy can take to spur the adoption of nuclear technologies, including small modular reactors (SMRs), within the global energy system.

In May 1960, our then Foundation President, Dean Rusk, brought together 22 leading experts in our Bellagio Center for a landmark convening. This followed the famous Atoms for Peace speech by President Eisenhower regarding peacetime uses of atomic energy, which led to the creation of the International Atomic Energy Agency. That Bellagio gathering sparked a new wave of collaboration between the US, UK, and European scientists for harnessing productive uses of nuclear energy, including new reactor designs, methods of sharing research, and securing fuel supplies in a safe, non-proliferating manner.

Today, just over 65 years later, the world finds itself at another critical juncture. Investment in renewables is booming, but the surge in demand for electricity as a result of economic growth in emerging markets and massive data center deployments globally means that we must explore a more diversified mix of energy technologies, including non-emitting, dispatchable power generation. Over the next 10 – 15 years, a new wave of nuclear reactors – alongside existing assets – may be capable of delivering on this need for more energy diversity in regions where other clean baseload technologies like geothermal or hydro are not physically possible.

This report explores the role of nuclear power under two main scenarios going out to 2050: an all-renewables pathway and an unconstrained one. While neither are meant to be realistic portrayals from a policy perspective, these are meant to serve as bookends for how the global energy system may evolve. As is the case for many such exercises, the truth is somewhere in-between, and this study offers compelling evidence that nuclear power has meaningful cost and systemic benefits to the energy systems of several Global South countries.

I invite you to engage with the findings in this report and to share your feedback. Together, we have an opportunity to shape an energy future that is abundant, equitable, and sustainable for generations to come.

Warmly,

Ashvin Dayal
Senior Vice President, Power
The Rockefeller Foundation

In Brief

We find nuclear can significantly contribute to scaling clean power for abundant energy in emerging and developing economies, even under conservative nuclear cost assumptions.

Nuclear power was seen as a cornerstone of clean energy expansion but this promise remains largely unfulfilled.

With projects in high-income countries often experiencing major cost overruns and construction delays, investment in nuclear power expansion has been diminishing. Only 11 countries are building new reactors. Yet, nuclear is regaining attention due to the growing need for clean and firm power. Countries such as China, India, and South Korea have all expanded nuclear capacity rapidly. The UAE has also shown the potential for fast deployment, expanding its nuclear capacity to deliver 23% of its demand in five years.

Global modelling points to a larger role for nuclear power.

The IEA's Net Zero Emissions scenario projects gross nuclear capacity to increase from 416 GW today to 1,017 GW by 2050 globally – a 2.5-fold rise. However, bottom-up national studies, especially in Emerging Markets and Developing Economies (EMDEs), often understate this potential due to cost assumptions based on high-income countries and a lack of granularity in modelling.

This study assesses nuclear's role in eight EMDEs.

Using Bayesian Energy's Convexity platform, we simulate power system operations from 2025 to 2050 in Brazil, Ghana, India, Indonesia, Nigeria, the Philippines, Rwanda, and South Africa. In each country, we assume that each country reaches the Modern Energy Minimum in 2050[0]: defined here as at least 1,000 kWh of electricity consumption per person per year. Four scenarios explore unconstrained, renewables-only, and nuclear-inclusive pathways under different cost assumptions, complemented

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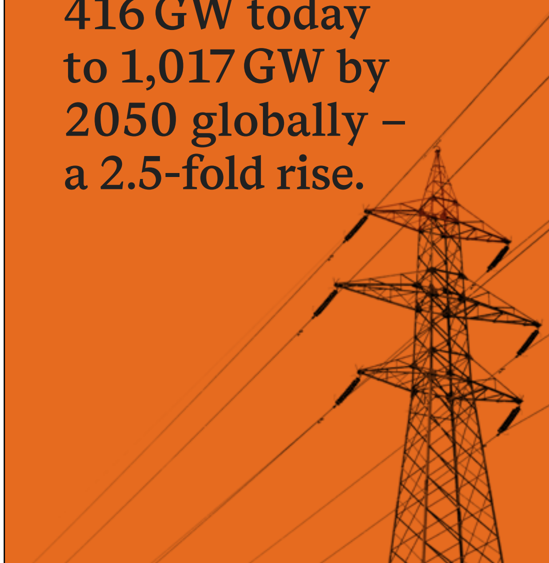


by qualitative analysis of enabling conditions and barriers to nuclear deployment.

Expanding nuclear power is a cost-effective way to meet emissions targets and improve energy abundance in all EMDEs studied.

Rather than solely focusing on Levelized Cost of Energy (LCOE), we use a comprehensive energy systems modelling framework that evaluates total system costs. Our modelling shows that by 2050 nuclear energy represents 10 – 20% of generation in cost-optimal pathways, lowering total system costs by 2 – 31% compared to renewables only trajectories.

Nuclear reduces the overall size of the power system.

The firm output of nuclear power lessens the need to overbuild solar and storage to reach a zero-carbon system. Compared with pathways that rely solely on renewables, scenarios with nuclear decrease the total rollout of solar, storage, and transmission by 9 - 26%, 19 - 38%, and 12 - 27%, respectively, across all eight countries. This is a critical point for EMDEs facing land, finance, and supply chain constraints.

Renewables and nuclear are complementary technologies rather than rivals.

Across all countries and scenarios where nuclear deployment is permitted, the model consistently shows substantial concurrent expansion of renewable generation. Cheap renewable generation works more cost-effectively alongside flexible nuclear which reduces the need to overbuild storage.

Beyond generation, nuclear energy offers economic benefits that improve lives.

These can include industrial heat cogeneration, long-term local job creation, and higher economic multipliers than renewables or fossil fuels, supporting sustainable economic development.

Significant barriers remain to deploying nuclear at scale.

Experts interviewed identified limited government capacity, public opinion, and challenges with financing for nuclear projects as the most critical domestic challenges, along with a broader need for international cooperation. Additional barriers include technology selection, infrastructure readiness, policy and regulatory gaps, geopolitical considerations, and coordination failures. The relative importance of these factors varies by country.

Philanthropy is well-positioned to catalyse growth.

Despite its historical absence from this sector, philanthropy is well-positioned now to can play a catalytic role through public engagement, informed decision-making support, financial de-risking, and convening international stakeholders.

Our modeling shows that by 2050 nuclear energy represents 10 – 20% of generation in cost-optimal pathways, lowering total system costs by 2 – 31% compared to renewables only trajectories.

Introduction

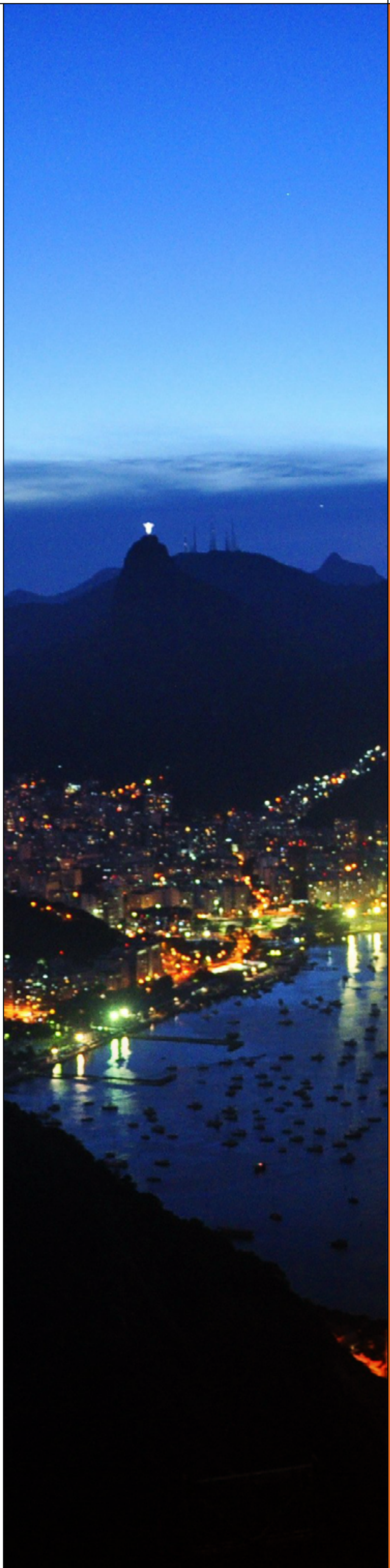
The number of people worldwide lacking access to electricity has been falling since 2000. Nevertheless, there are still an estimated 750 million people without access to reliable power, the majority of whom are in Sub-Saharan Africa[1]. There are 62 countries that sit below the Modern Energy Minimum of 1,000 kWh/year per-capita[2,3], many of which are not currently projected to reach this minimum by 2050. Per-capita energy consumption is tightly coupled to per-capita GDP[4], making this a critical issue for global development.

As underlined by the first Global Stocktake agreed to at COP28, all routes to universal electricity access require scaling up essential clean power generation infrastructure, including solar, wind, hydropower, nuclear, and other zero-carbon technologies. Reliable, accessible and affordable energy is the key enabler of wider economic modernisation and industrialisation for many Emerging Markets and Developing Economies (EMDE)[5]. At the same time, countries must align energy access objectives with broader climate and development goals, making the design of future power systems a central policy and investment challenge.

The optimal pathway to reliable, affordable, and zero-carbon power systems varies widely by country. Determining the right technology mix depends on each country's natural resource endowment, supply chains, economic structure, development priorities, and existing power system configuration. Long-term Capacity Expansion Planning (CEP) models provide a structured framework for exploring these pathways. By simulating investment and operational decisions over multiple decades, CEP models reveal which technologies are deployed, when they are built, and at what total system cost, enabling policymakers to assess trade-offs between different development strategies.

For EMDEs, the immediate priority is often to secure gigawatt-scale, firm and reliable electricity supply to drive economic growth, generally ahead of climate objectives. Renewable energy is most cost-effective in the early stages of its deployment, when there is no need for storage, and when fossil fuels offer a stable baseload and dispatchable backup. This reduces immediate economic incentives to explore more expensive clean baseload like nuclear power that will be more important towards the end of the energy transition of a particular country[6]. While renewable energy deployment has accelerated decarbonisation in many regions, large-scale integration and paths to entirely zero-carbon systems remain constrained by the limited availability and uncertain costs of long-duration storage, as well as grid flexibility challenges.

This growing reliability gap has renewed interest in nuclear power, particularly Small Modular Reactors (SMR). SMRs offer potential advantages for EMDEs: their lower upfront capital costs can make them more affordable and easier to finance, their modular design can reduce construction timelines and financing risks, their compact footprint can suit smaller grids, and their ability to provide stable, clean, and dispatchable generation makes them a natural complement to intermittent renewables in pathways toward sustainable, zero-carbon power systems.



Small Modular Reactors (SMRs) offer potential advantages for EMDEs: their lower upfront capital costs can make them more affordable and easier to finance, their modular design can reduce construction timelines and financing risks, their compact footprint can suit smaller grids,...

The role of nuclear power in the energy transition

Global trends

The role of nuclear power in the energy transition has diminished in many national strategies over recent decades[7]. Public concerns around safety, waste management, and the legacy of major accidents have contributed to premature plant closures and a loss of policy support in Europe, Japan and North America. In addition, high capital costs and long construction timelines have made nuclear projects less attractive to private investors, further weakening political and financial backing. As a result, nuclear capacity has declined in Europe and North America, and this retreat has influenced global development programmes.

By contrast, parts of Asia present a different trajectory. Since around 2012, nuclear capacity has been steadily increasing, driven primarily by new build programmes in China, South Korea, and India. Similarly, the United Arab Emirates (UAE) has demonstrated the potential for rapid deployment, with nuclear generation rising from zero to 23% of total electricity supply in just over five years.

Building on this recent experience of relatively rapid and cost-effective deployment, interest in nuclear technology is now growing among EMDEs. Rising power demand – driven by expanding industrial bases, digital infrastructure such as data Centers for AI, and the electrification of transport and manufacturing – is prompting governments to seek firm, low-carbon sources of generation that can underpin sustainable growth.

Macroeconomic modelling

It is widely recognised that renewable energy technologies and storage will form the bulk of generated energy in the global power sector's transition to net-zero emissions in the coming decades. However, global-scale modelling suggests nuclear power will also play a substantial role as a stable backbone.

The IEA's Net Zero Emissions (NZE) scenario shows bulk nuclear capacity to increase from approximately 416 GW in 2023 to 1,017 GW by 2050 globally – a 2.5-fold expansion[8]. Over the same period, nuclear electricity generation is shown to grow from around 2,765 TWh to 6,969 TWh. From 2030 onwards, the NZE requires roughly 45 GW of new nuclear capacity being added on average annually, a rate substantially higher than in any previous decade. Although the NZE scenario does not extend beyond 2050, sustaining this build rate after 2050 would result in global nuclear capacity tripling relative to today's level by around 2055 – 2056.

Modelling analyses of EMDEs often overestimate nuclear costs by using OECD data and underestimate renewable integration challenges by oversimplifying climate variability.

Global macroeconomic modelling provides valuable boundary conditions for understanding broad trends in the energy transition, but it offers limited guidance on how specific technologies should be deployed at the country level. To address this, bottom-up modelling is required. However, in many bottom-up studies in EMDEs, nuclear power often plays a smaller role than projected by global models. This discrepancy arises from several factors, including but not limited to:

1. Many country-level models rely on capital and operational cost curves derived from European or North American contexts rather than using EMDE-specific data[9–11], overlooking the potential for lower labour and construction costs, shorter project timelines, or alternative financing structures that have led to cheaper historical nuclear deployment in other regions. This can lead to significant overestimation of nuclear costs, making the technology appear less competitive.

2. Most long-term CEP models simplify the temporal resolution to reduce computational complexity and run times[12]. While this makes models more tractable, it can introduce systemic biases. In particular, inter- and intra-annual variability in renewable generation is often not fully represented. Meanwhile, others have used overly simplified models that do not properly characterise a power system's operational constraints[13]. As a result, systems dominated by renewable energy that appear technically feasible in simplified models may, in reality, be operationally infeasible when assessed using more detailed, high-resolution dispatch modelling.

This report describes a modelling study that addresses these issues by focusing on region-specific costs and financing, and simulates renewable generation with 26 consecutive different years of sub-daily climate data. It aims to provide a more realistic understanding of the relative strengths of different capacity expansion pathways in the studied countries.

Study Overview

The study assesses the potential for nuclear deployment across eight EMDEs: Brazil (BRA), Ghana (GHA), India (IND), Indonesia (IDN), Nigeria (NGA), Philippines (PHL), Rwanda (RWA), and South Africa (ZAF). These countries were selected as among the most promising EMDEs for initiating nuclear deployment by 2030 according to Energy for Growth's Nuclear Readiness Hub, based on their projected energy demand growth, industrialisation trajectories, and existing policy interest in low-carbon technologies[2].

The study has two main objectives. First, to derive full-system, cost-optimal power sector pathways for each country and evaluate the role that nuclear – both conventional reactors and SMRs – could play in achieving deep decarbonisation and energy abundance by 2050. Second, to identify the enabling conditions and barriers that shape nuclear adoption across different national contexts through qualitative analysis.

To meet these objectives, we combine detailed systems modelling with structured qualitative research. Using Convexity, Bayesian Energy's proprietary power-system modelling platform, we simulate power system evolution from 2025 to 2050 under multiple scenarios with and without nuclear deployment. The model performs both capacity expansion and dispatch optimisation to determine the lowest-cost mix of generation, storage, and transmission technologies under evolving demand, emissions, and technology cost conditions.

The quantitative analysis is complemented by literature reviews, more than 30 expert interviews, and comparative research on recent nuclear newcomer countries. This qualitative assessment identifies key financial, institutional, and social barriers, as well as enabling factors such as governance capacity, policy design, and coordination mechanisms. Together, these two strands provide an integrated understanding of the technical feasibility and practical readiness for nuclear deployment across EMDEs.

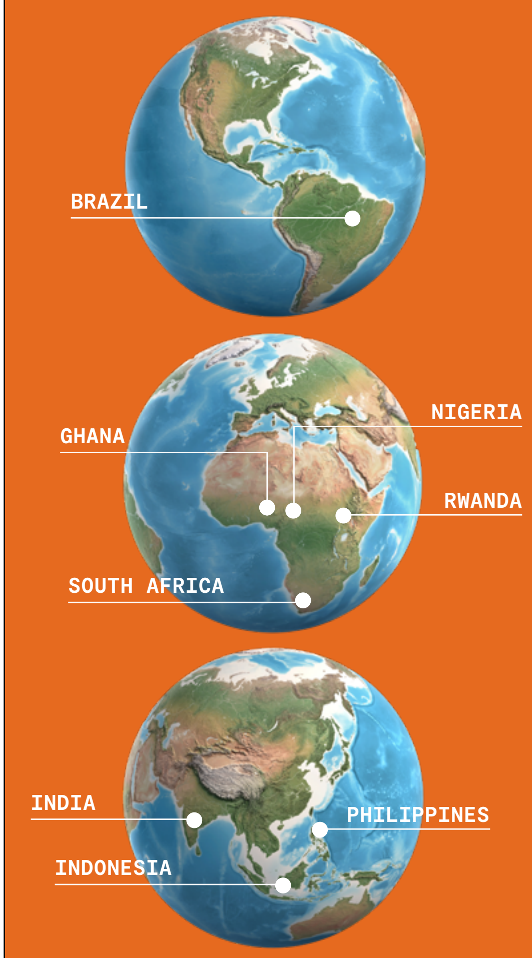
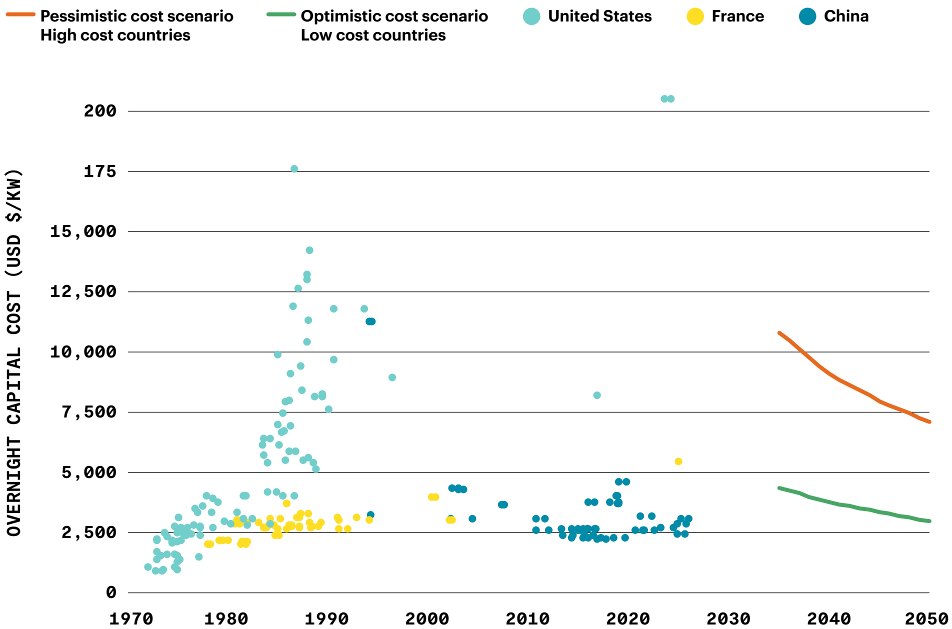


Exhibit 1
Input assumptions for nuclear overnight capital costs are above recent costs in China.

Overnight capital cost (2020 USD $/kW) by commercial operation date. Historic data: United States (turquoise), France (yellow), China (blue)



1 Input assumptions, based on NREL data: Pessimistic cost scenario for high cost countries – Brazil, Rwanda, Ghana, Nigeria, and South Africa (orange), Optimistic cost scenario for low cost county – India (green)

Power modelling and scenarios

We model eight countries toward a pathway to zero-carbon power by 2050. We use the Convexity software, Bayesian Energy's proprietary power systems modelling platform, to simulate system operations between 2025 and 2050 under multiple scenarios. This model builds and runs simulations across the generation, storage, and transmission system while accounting for demand growth, emissions limits, technology cost trends, and weather and climate conditions. The algorithm performs a capacity expansion at the same time as a dynamic dispatch optimisation. In other words, it optimises what needs to be built and how it should be operated, at the lowest possible total system cost.

While renewable generation is typically cheaper than nuclear generation on the basis of an idealised Levelized Cost of Energy (LCOE), achieving an entirely zero-carbon energy system with renewables alone requires an extensive buildout of storage and transmission. We hypothesise that when considering total system costs rather than LCOE alone, including some nuclear capacity is cost-effective up to a certain share of generation in zero-carbon power systems because its steady, reliable output reduces the need for costly short- and long-duration energy storage and backup when detailed dispatch dynamics are simulated.

We explore four scenarios to assess the role of nuclear power in decarbonising power systems (Table 1). The Unconstrained scenario serves as a control case, modelling least-cost power system development without any emissions limits.

We model eight countries toward a pathway to zero-carbon power by 2050.

The RES-only scenario represents a rapid decarbonisation pathway using only renewable energy and storage technologies, providing a benchmark for the costs and challenges of achieving net-zero power without nuclear energy. The Pessimistic Nuclear scenario introduces nuclear power under high-cost assumptions and lower build rate limits to test its competitiveness in less favorable conditions, while the Optimistic Nuclear scenario applies expected cost curves to evaluate the results of more realistic cost trajectories and higher build rate limits.

The Pessimistic Nuclear and Optimistic Nuclear scenarios differ in their assumptions about the Overnight Capital Cost (OCC), which is the cost of constructing a power plant excluding financing or interest, as well as in the maximum build rate of nuclear capacity per year in each country. The NREL Annual Technology Baseline (ATB)[14] defines three OCC trajectories for nuclear power and SMRs: conservative, moderate, and advanced, representing progressively lower cost assumptions. In our Pessimistic Nuclear scenario, we apply NREL's conservative SMR cost pathway to represent a high-cost, slow-learning, and slower-build outcome. In contrast, our Optimistic Nuclear scenario adopts the moderate pathway rather than the lowest cost advanced one, ensuring that any observed cost advantages of nuclear remain conservative (see Exhibit 1). NREL notes that more favourable cost outcomes are possible under conditions of sustained private investment and technological progress.

Box 1 provides additional detail on the methodology, including model setup and constraints, data sources for weather and demand, and the financial assumptions underpinning technology costs, discount rates, and Weighted Average Cost of Capital (WACC). The results of this study are primarily sensitive to the relative technology costs of different energy sources in different regions, which we source from the IEA's World Energy Outlook (2024)[8] and the aforementioned NREL ATB. The cost savings we project from including nuclear buildouts in future energy systems should therefore be understood as contingent on countries achieving the projected capital cost of nuclear energy, and achieving the build rates allowed in the model.

Analysing these scenarios shows: (1) The cost of decarbonisation with and without nuclear power; (2) How nuclear increases or decreases overall system costs; and (3) the lower and upper range of nuclear potential, under best- and worst-case cost assumptions.

Table 1
Scenarios for power system modeling

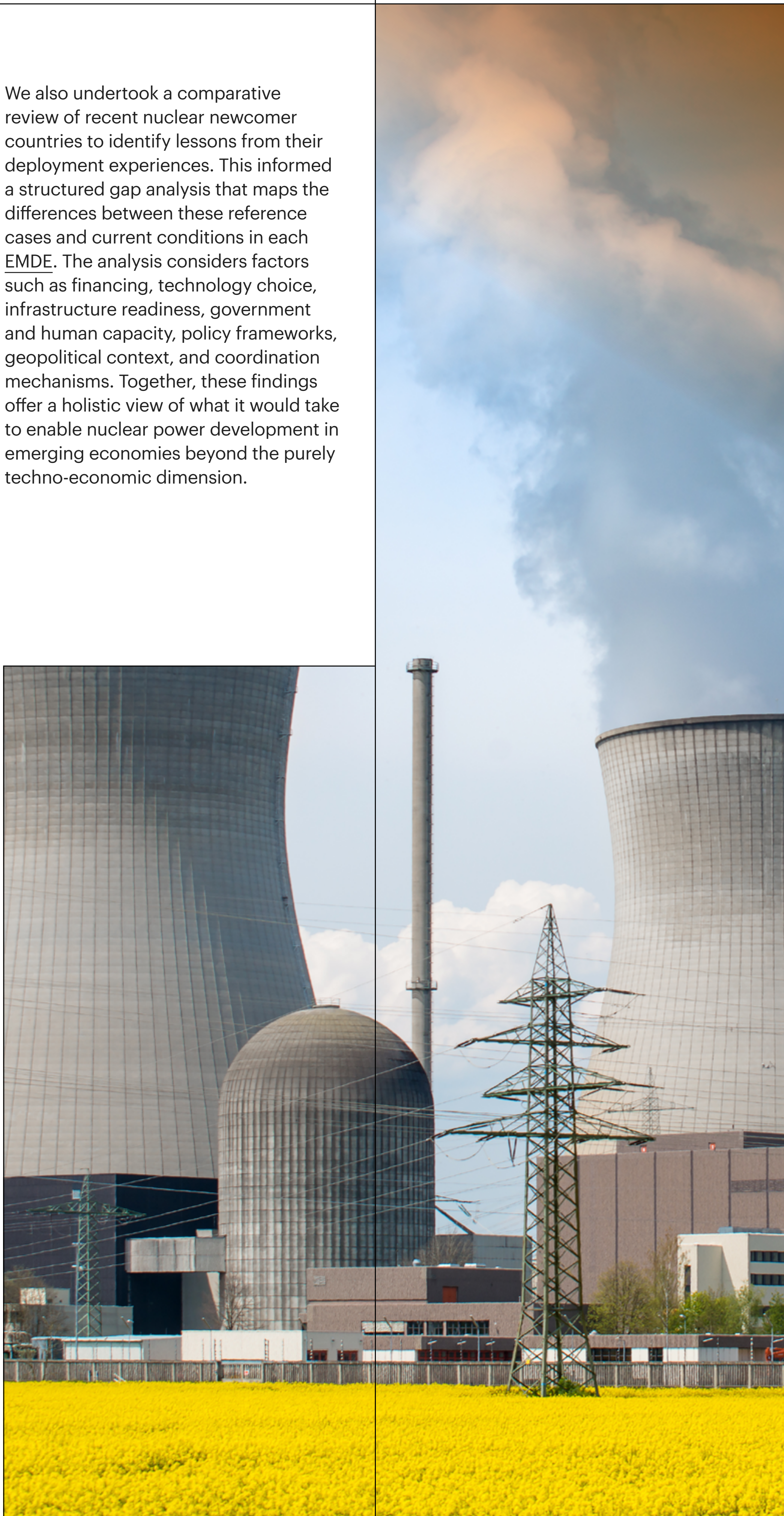
Scenario	Description
Unconstrained	A control case with no emissions limits. This scenario does not account for future carbon pricing, fossil fuel volatility, or the environmental and social externalities associated with the different generation technologies.
RES-only	Rapid decarbonisation using only renewables and storage.
Pessimistic Nuclear	Allows for nuclear expansion assuming "worst case" cost curves.
Optimistic Nuclear	Allows for nuclear expansion assuming "expected" cost curves.

Qualitative analysis

While the modelling provides quantitative insights into the system-level economics of nuclear deployment, it does not capture the institutional, social, and political realities that determine whether such deployment is feasible in practice. To complement the quantitative analysis, we therefore conducted a structured qualitative assessment aimed at providing practical guidance for policymakers, philanthropies, and development institutions. This qualitative work helps bridge the gap between modelled feasibility and real-world implementability.

The analysis draws on a combination of literature reviews, over 30 expert interviews, and targeted desk research across the eight countries modelled. Interviews were conducted with a diverse group of stakeholders – including energy planners, academics, regulators, and civil society representatives – to identify both the enabling conditions and barriers to nuclear deployment. These discussions explored themes such as public attitudes toward nuclear energy, institutional capacity, past policy experience, and national priorities for industrial development. The resulting insights were used both to inform the modelling assumptions and to contextualise the results.

We also undertook a comparative review of recent nuclear newcomer countries to identify lessons from their deployment experiences. This informed a structured gap analysis that maps the differences between these reference cases and current conditions in each EMDE. The analysis considers factors such as financing, technology choice, infrastructure readiness, government and human capacity, policy frameworks, geopolitical context, and coordination mechanisms. Together, these findings offer a holistic view of what it would take to enable nuclear power development in emerging economies beyond the purely techno-economic dimension.



BOX 1

METHODOLOGY FOR POWER SYSTEMS MODELLING TO 2050

The modelling in this study was conducted using Convexity, which is the proprietary energy modelling platform of Bayesian Energy. We use Convexity to carry out comprehensive systems modelling to evaluate pathways to achieve zero-carbon power by 2050 across eight countries. Using 2025 as the base year, we simulate the development of each country's power sector through 2050, assessing how external factors such as demand growth, renewable profiles, decarbonisation targets, and evolving price trends influence system evolution.

Model setup

Our model conducts both Capacity Expansion Planning and dynamic dispatch optimisation continuously across the 25-year planning horizon. Unlike most other long-term planning tools, this allows us to evaluate inter- and intra-annual variability throughout the full simulation period. The capacity expansion is formulated as a mixed-integer linear programme (MILP) with perfect foresight, with deployment of all assets every 2 years, apart from nuclear assets (traditional and SMR) which can be deployed on a 4-yearly cadence from 2035. All assets can inject power into the grid as soon as they are deployed. The model is optimised on a 3-hourly timestep from 2025 to 2050, then the dispatch is re-optimised on a 1-hourly timestep to resolve operational dynamics more precisely. Generation, demand, and storage are connected by expandable transmission capacities. Transmission costs account for the physical nature of the grid in each of the modeled countries.

Constraints

We limit the amount of nuclear (traditional and SMR) capacity that can be built per year in each country. In our Optimistic Nuclear and Pessimistic Nuclear scenarios, we limit India to build a maximum of 20 GW and 10 GW of nuclear capacity per year respectively, which corresponds to a maximum capacity of 320 GW and 160 GW by 2050 (compared to India's current 2047 target of 100 GW). We scale this by the energy demand of each country relative to India in 2050 (so for example, Indonesia can build a maximum of circa 1.6 GW of nuclear capacity per year). The new nuclear assets in the model can start dispatching to the grid in 2035 at the earliest in every country.

Supply

We set up a model of the existing power system in each of the eight countries by compiling an inventory of generation, storage, and transmission infrastructure. Our data assembly scrapes a combination of data sources including OpenStreetMap[15], Global Energy Monitor[16] and Ember[17]. Historical profiles of wind speed, and solar irradiance are taken from Bayesian Energy's internal Renewables Vision toolkit, which provides data derived from ECMWF's ERA5 data product[18]. We apply 25 unique years of historical weather patterns at the most suitable locations for solar and wind resource potential, to robustly characterise solar and wind variability.

Demand

We model the power demand of each country by starting with the most recent historical consumption data from Ember's Electricity Data Explorer[17], then extrapolating this to 2050 using growth rates from the IEA's WEO (2024)[8]. If these projections result in any country failing to meet the Modern Energy Minimum of 1,000kWh/year per-capita[2], we increase the growth rate to achieve this minimum value. We additionally model a single industrialisation case study for Ghana which reaches 3,500 kWh/year per-capita in 2050. We give all countries the same daily load profile normalised to their extrapolated values based on the historical profile of India in 2023, to avoid differences in cost from different assumptions about projected load profile shapes.

Technological parameters

We use technology, overnight capital, and operational costs projections to 2050 reported in the IEA's WEO (2024) data catalogue[8]. These numbers are reported by region (e.g., Africa, Middle East etc) as opposed to country-level. As the IEA does not separately model the relative costs of traditional nuclear facilities and SMRs, we extrapolate their current regional IEA costs using the relative cost pathways from the NREL Annual Technology Baseline[14], using their Moderate pathway for our Optimistic Nuclear scenario, and their Conservative pathway for our Pessimistic Nuclear scenario, discarding their lowest-cost scenario. We give traditional nuclear assets a minimum capacity of 800 MW, and an operational range of capacity factors from 70% to 90%. We give SMRs no minimum capacity and an operational range of capacity factors from 30% to 90%, but a higher capital cost following the NREL Annual Technology Baseline (ATB)[14].

Financial parameters

The annualised capital cost of each technology was calculated using the WACC by country, taken from the IEA's Cost of Capital Observatory[19] and the Clean Air Task Force[5]. To convert cumulative total system costs to net present value (which is the quantity optimised by our model) we assume a uniform Social Discount Rate (SDR) of 3%.

Emissions trajectories

Equitable and just pathways to a zero-carbon economy are uncertain and highly contested, falling beyond the scope of this work. We therefore assume that the power systems of all eight countries must reach zero emissions by 2050 in all scenarios except the Unconstrained pathway, where there are no emissions limits. The 2050 net-zero requirement can be interpreted as a bookend to be compared against the unconstrained scenario, helping illuminate the value and role of different technologies under varying climate ambitions.

Aspects not covered

As with all multi-country modelling studies, this analysis has limitations and excludes several important aspects, for reasons of interpretability and resource limitations. We chose to unify aspects like future daily demand profiles, relative nuclear build rate limits, and emissions pathways, to more clearly identify differences in outcome driven by key differences in technology cost, WACC, and renewable capacity factors. We did not impose constraints on the maximum rollout of renewable technologies such as solar, wind, hydropower, and geothermal. Demand-side factors such as demand response, energy efficiency measures, and other flexibility mechanisms were not included, which may lead to an overestimation of total generation requirements. Crossborder imports and exports via interconnection were also not modelled, as the focus was on exploring scenarios of domestic energy abundance in EMDEs. Within countries we account for the total transmission capacity, though not the exact topologies as is common with the majority of CEP models. Our analysis is limited to the power sector and does not encompass the broader dynamics of whole energy systems.

Exhibit 2

Nuclear deployment is cost-effective across all regions
Total annual generation (TWh) by technology in each country under the four scenarios

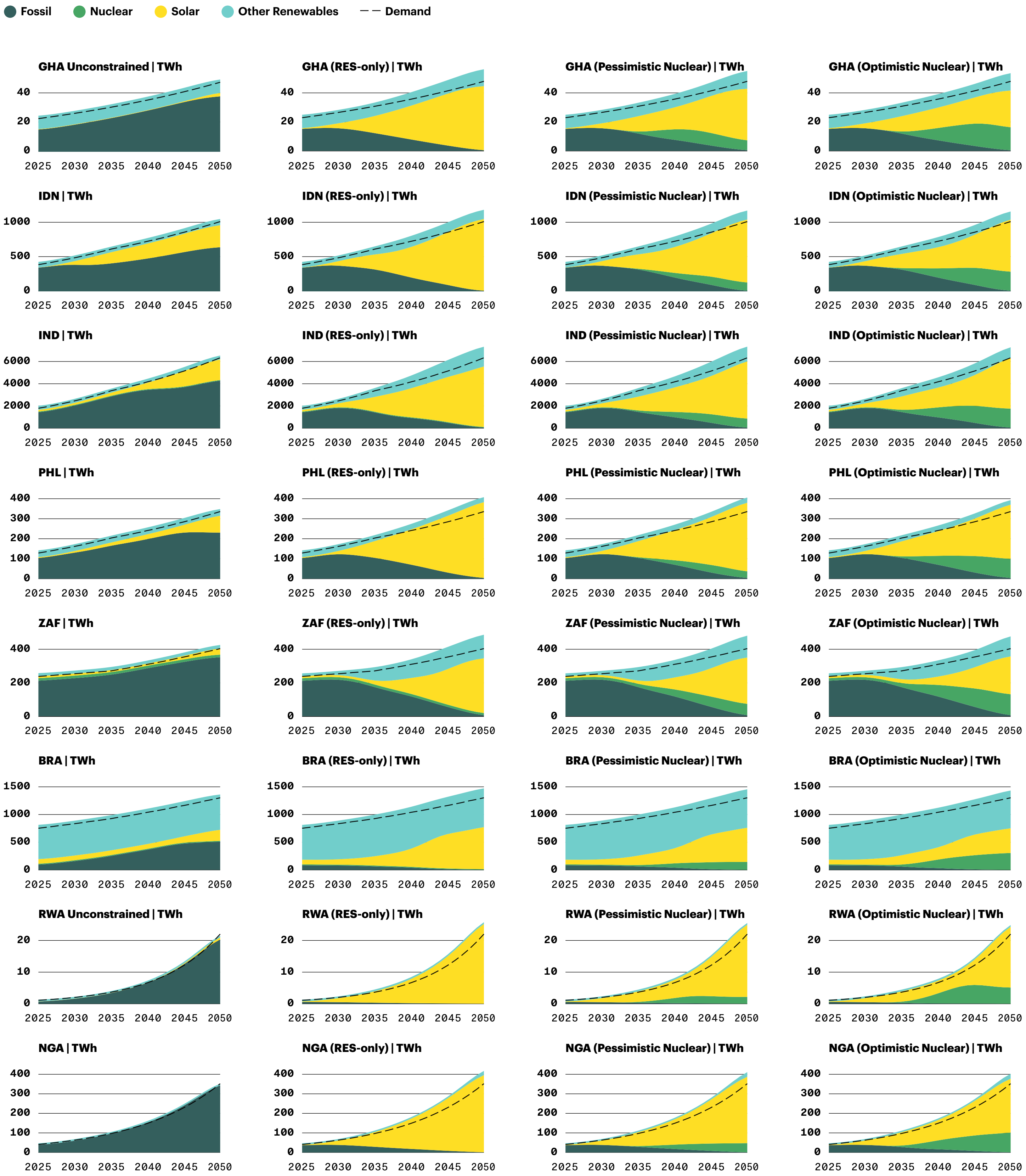


Exhibit 3
Global nuclear deployment reduces total system costs to 2050
Decrease in cumulative system costs between 2025 and 2050 in pathways with nuclear compared to a renewables only scenario (%)

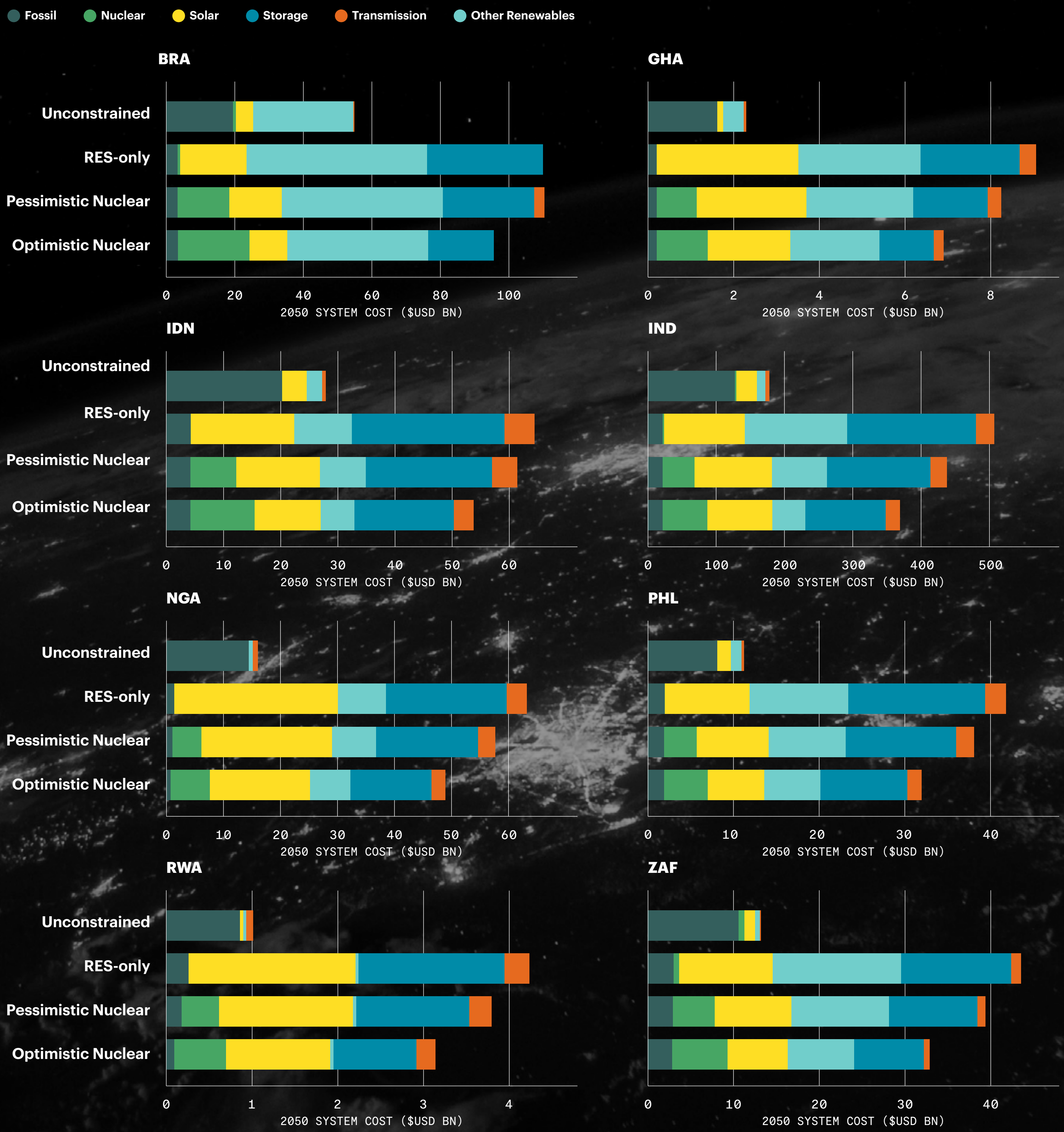
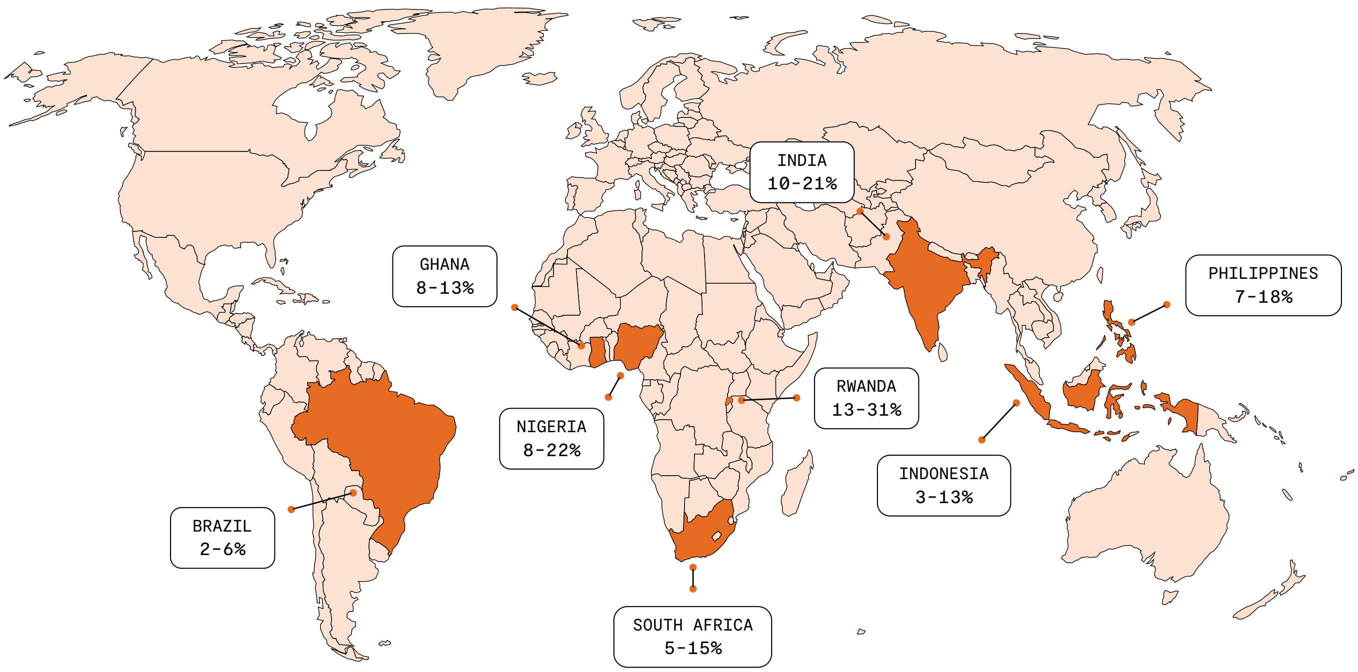


Exhibit 3
Nuclear deployment reduces total system costs by 2050

Bar chart shows the total annual system costs in 2050 in each country under the four scenarios. Map shows the decrease in total system costs in pathways with nuclear compared to a renewables only scenario (%).



1 Values in the map are presented as ranges (e.g., 5 – 9%) to indicate the change in system costs between the Pessimistic Nuclear and Optimistic Nuclear pathways, respectively. The first number corresponds to the Pessimistic Nuclear scenario, and the second to the Optimistic Nuclear scenario. Percentages are expressed relative to the RES-only scenario. A positive value (e.g., 5%) represents a cost reduction compared to RES-only, while a negative value indicates a cost increase.

2 All costs are reported in net-present value assuming a SDR of 3%.

Key modelling insights

Optimal nuclear deployment in EMDEs

In the model, nuclear power expands across all regions under emissions-limited pathways where its deployment is permitted, though the scale and timing of deployment vary significantly by region. Nuclear's role becomes more pronounced after 2040, as emissions constraints in the power sector tighten. Although total capacity additions vary by region, nuclear accounts for around 10 – 30% of total power generation by 2050 (Exhibit 2). It is important to note that the upper bound of nuclear deployment in these scenarios is constrained by assumed build rates (Box 1). When adopting more optimistic build and cost assumptions in the Optimistic Nuclear, the share of nuclear in the cost-optimal mix typically increases. Differences in capacity buildout, generation shares, and cost impacts reflect the resource endowment, demand growth, and policy environment of each country. The results are summarised below and detailed further in Exhibits 2 and 3, as well as Supplementary Tables 7 and 8.

GHANA

By 2050, Ghana reaches 1.2 – 2.4 GW nuclear capacity under the Pessimistic and Optimistic nuclear pathways, supplying around 14 – 32% of the generation mix, respectively. This contributes to overall system cost reductions of 8 – 13% relative to a renewables-only pathway. Ghana's strong hydropower base continues to provide a stable complement to both nuclear and renewable generation, supporting system reliability and flexibility through the mid-century.

INDIA

By 2050, India reaches 168 – 328 GW of nuclear capacity under the Pessimistic and Optimistic pathways, supplying around 13 – 28% of total generation. This results in system cost reductions of 10 – 21% relative to a renewables-only pathway. Solar power continues to dominate across all scenarios – reflecting India's exceptional solar resource potential – while wind also plays a major role under emissions-limited pathways. In the Optimistic case, India would require an average nuclear build rate of roughly 15 GW per year after 2030, a pace that might test current supply chains and infrastructure development capacity.

BRAZIL

By 2050, Brazil reaches 32 – 64 GW of nuclear capacity under the Pessimistic and Optimistic pathways, supplying around 11 – 24% of total generation. This results in system cost reductions of 2 – 6% relative to a renewables-only pathway. Brazil's substantial existing hydropower baseload reduces the cost benefits of additional nuclear baseload compared to other countries without similar renewable baseload.

INDONESIA

By 2050, Indonesia reaches 25 – 51 GW of nuclear capacity under the Pessimistic and Optimistic pathways, supplying around 12 – 27% of total generation. This yields system cost reductions of 3 – 13% compared with a renewables-only pathway. Indonesia's strong solar and wind resources provide a balanced mix of options, with nuclear emerging as a complementary technology that enhances reliability and reduces total system costs under emissions-limited pathways.

NIGERIA

By 2050, Nigeria reaches 8.9 – 17.7 GW of nuclear capacity under the Pessimistic and Optimistic pathways, supplying around 14 – 30% of total generation. This results in system cost reductions of 8 – 22% relative to a renewables-only pathway. With limited wind potential but strong solar resources, Nigeria exhibits dynamics similar to Rwanda, where nuclear serves as a stabilising complement to solar generation, reducing reliance on large-scale storage and easing land-use constraints.

RWANDA

By 2050, Rwanda reaches 0.6 – 1.1 GW of nuclear capacity under the Pessimistic and Optimistic pathways, supplying around 10 – 24% of total generation. This yields system cost reductions of 13 – 31% relative to a renewables-only pathway. With exceptionally low wind resources and few alternative renewable options, Rwanda would otherwise depend almost entirely on solar generation and storage, raising challenges related to land use and transmission infrastructure that nuclear power can help alleviate.

PHILIPPINES

By 2050, the Philippines reaches 8.5 – 16.9 GW of nuclear capacity under the Pessimistic and Optimistic pathways, supplying around 9 – 29% of total generation. This results in system cost reductions of 7 – 18% relative to a renewables-only pathway. The country's limited wind potential places greater reliance on land-constrained solar generation and short-duration storage, making nuclear an important contributor to reliability and system balance in emissions-limited scenarios.

SOUTH AFRICA

By 2050, South Africa reaches 12 – 22 GW of nuclear capacity under the Pessimistic and Optimistic pathways, supplying around 17 – 31% of total generation. This leads to system cost reductions of 5 – 15% relative to a renewables-only pathway. With strong wind resources and an existing nuclear foundation, South Africa is well positioned to develop a diversified and reliable generation mix under emissions-limited scenarios.

Across all regions, solar power supported by both short- and long-duration storage plays a central role in the future power mix. This reflects not only the high solar resource availability in mid-latitude regions but also the strong projected economics of solar generation. Under emissions-limited pathways, solar deployment is extensive, and real-world experience demonstrates that such expansion can occur rapidly due to solar's exceptional modularity. However, the sustainability of a solar-dominated future ultimately depends on continued progress in energy storage technologies across multiple timescales. Modelling considered baseload technologies such as geothermal and hydropower too. In countries where these alternatives are less geographically or geologically feasible nuclear emerges as particularly valuable.

Total system costs

Our analysis shows that even under Pessimistic cost assumptions, nuclear power expansion remains a cost-effective component of emissions-limited pathways. Across the eight countries analysed, total system costs between 2025 and 2050 decline by 2 – 31% in pathways that include nuclear power compared with RES-only trajectories (Exhibit 3). These savings reflect nuclear's ability to displace more expensive investments in short- and long-duration storage, as well as to stabilise system operation under increasingly stringent decarbonisation targets.

As discussed above, the magnitude of cost savings varies significantly by country, reflecting differences in existing power systems, renewable resource endowments, and demand growth trajectories, among other contextual factors. For instance, countries with limited wind resources or constrained land availability, such as Rwanda and the Philippines, see particularly strong cost advantages from integrating nuclear power. Conversely, countries with abundant hydropower or high-quality renewable resources such as Brazil experience smaller relative gains, though the inclusion of nuclear power still contributes to lower overall system costs and a more balanced generation mix.

Despite these differences, there are clear commonalities in the mechanisms driving cost reductions. Under RES-only pathways, the vast majority of expenditure is directed toward expanding solar, wind, and storage capacity to ensure system reliability. However, the introduction of even modest levels of nuclear capacity sharply reduces the need for large-scale storage investment.

We also observe notable reductions in transmission costs in scenarios with nuclear power. Systems with higher nuclear shares tend to be more spatially compact, with less total power flow across the grid. This occurs because nuclear generation can often be sited closer to demand Centers, reducing the need for extensive transmission build-out. As explored in the next section, this effect has important implications for the pace, cost, and political feasibility of power-sector transitions, especially in countries where grid expansion faces permitting, land-use, or financing challenges.

The majority of cost savings in the nuclear pathways occur during the final phase of decarbonisation (i.e., after 2040). At earlier stages, renewable generation remains significantly cheaper in terms of LCOE than nuclear power, particularly when dispatchable fossil power can still provide backup during periods of low renewable output. However, achieving a fully zero-carbon power system with renewables and storage alone requires substantial overbuilding of both generation and storage capacity to ensure reliability during prolonged periods of low resource availability. Our results indicate that it is more cost-effective to meet this final piece of the puzzle with stable, dispatchable nuclear generation, as illustrated in the discussion of daily dispatch dynamics below (Exhibit 4).

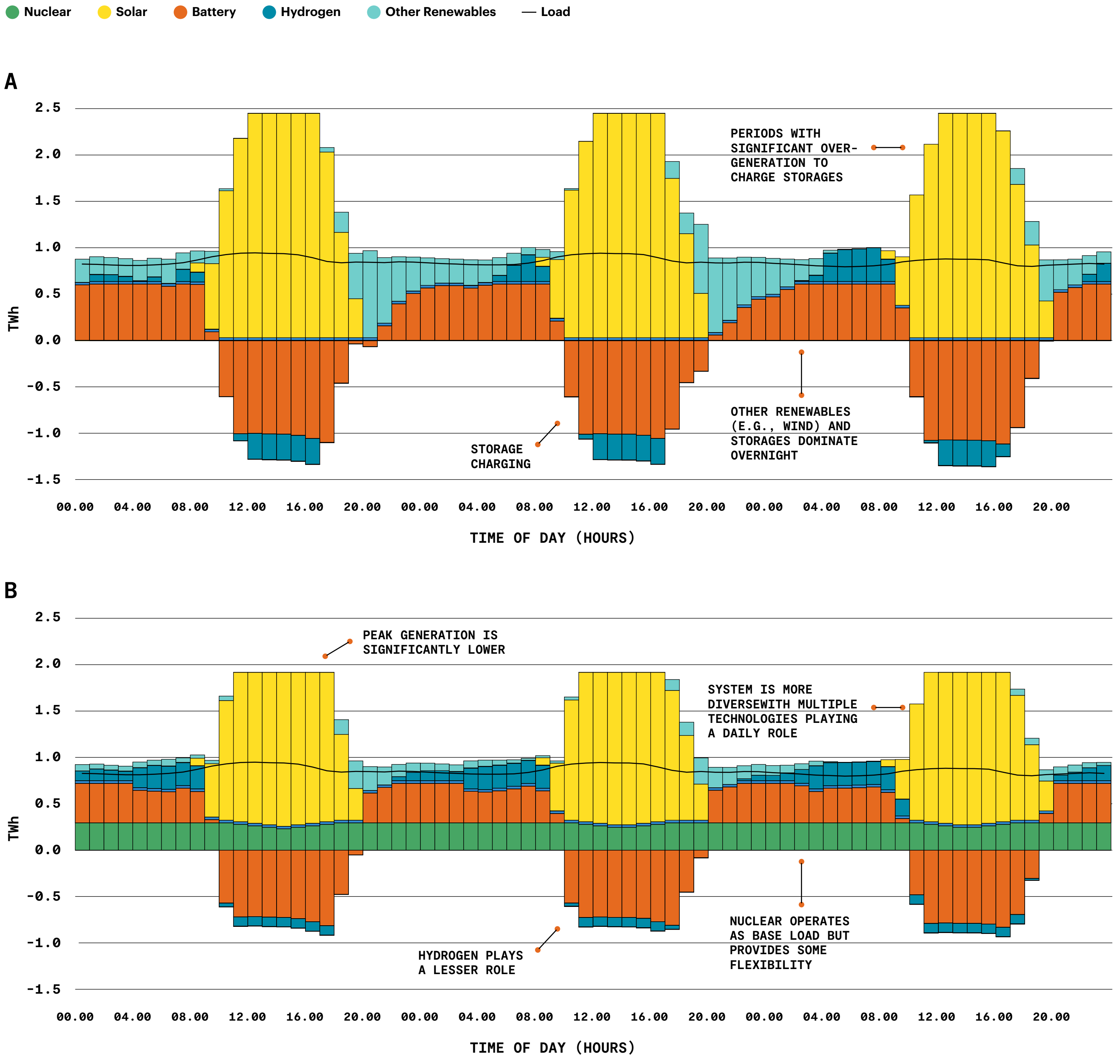
Our cost estimates do not incorporate climate resilience effects, which are already emerging as a significant issue in power systems. Climate resilience will be an important issue in system design: for example, wind power will contend with stilling events, solar power with extreme thermal events and changing cloud cover patterns, hydropower with changing hydrological patterns, and nuclear with increased thermal constraints[20]. Different average weather conditions can change generation patterns and hence cost curves, as well as adding to uncertainty in their optimal design[20].

Across the eight countries analysed, total system costs between 2025 and 2050 decline by 2 – 31% in pathways that include nuclear power compared with RES-only trajectories.

The Unconstrained pathway – a scenario without emissions constraints – is observed to be the lowest-cost across the board. However, it is important to note that this serves merely as a control scenario for the model rather than representing a truly least-cost development pathway. There are important limitations within this scenario that should be considered. Firstly, we do not incorporate any carbon pricing in our modelling, which effectively underestimates the long-term costs of continued fossil fuel use. Secondly, the model does not endogenously account for potential increases in fossil fuel prices that could arise from structural shifts in global supply and demand, such as resource depletion, peak oil dynamics, or geopolitical constraints – factors that would likely make fossil-based generation less competitive over time. Thirdly, our model does not include the cost of externalities and risks associated with continued fossil fuel use, such as exposure to volatile prices, reliance on imports, and effects on local air pollution. As such, the Unconstrained pathway should be interpreted as a technical baseline for comparison, rather than a realistic or desirable policy trajectory.

Exhibit 4
Nuclear power smooths daily dispatch and storage patterns

Dispatch (TWh) in September 2050 over a representative three-day period in India under (a) RES-only and (b) Optimistic Nuclear pathways at the hourly resolution.



1 Figure shows the dispatch over a three-day period in 2050 for India. While the model simulates the entire period from 2025 to 2050, only this subset is presented to illustrate key operational dynamics. The modelling was conducted using Convexity, Bayesian Energy's power systems modelling platform.

Daily generation patterns

The optimal capacity growth in the modelled countries over the 2025 to 2050 period ultimately depends on the cost of dispatching energy on an hourly basis over that entire period. Exhibit 4 shows three representative days of hourly dispatch in India in 2050 in the RES-only scenario (Panel A), compared to the equivalent days in the Optimistic Nuclear scenario (Panel B).

Panel A shows that the renewables-only zero-carbon system is mostly driven by a large predictable peak of solar generation in the day, with other renewable generation (mostly wind and hydropower) contributing intermittently. The mismatch between generation and demand requires a large amount of short-term battery storage to dispatch throughout the nights, as well as long-term hydrogen storage to step in to cover periods where the typical daily solar and battery cycle is insufficient.

Panel B shows the effect of allowing the model to build nuclear capacity. The overall pattern is similar to Panel A, with an additional continuous baseline of nuclear generation that flexes slightly in the daytime as solar generation peaks. While this nuclear generation is generally more expensive to build and operate per MWh than the renewable sources, it has the key advantage of being dispatchable and not requiring storage. So, while it provides circa 250 GW of generation at midday in Panel B, it reduces the concurrent solar generation peak by circa 500 GW and the storage charging peak by circa 500 GW compared to Panel A.

This effect applies across all of our modelled countries and is a large driver of the cost savings introduced by nuclear energy, despite its apparently higher LCOE than some renewable sources.

Exhibit 3 also illustrates the following effects which apply generally over our eight modelled countries:

→ Size

The RES-only case has larger peaks in generation and storage, which require a grid system with a higher bulk capacity. The nuclear scenarios reduce these peaks by a greater amount than their raw generation, reducing the total volume of energy passing through the system each year.

→ Cost

The RES-only case requires a high investment in storage and transmission to handle this larger volume of energy, and an expensive overbuild of renewables close to 2050 to achieve zero emissions. The nuclear scenarios reduce both of these investments, handling the final part of the zero-carbon buildout and reducing the inefficient overbuild of renewables and storage.

→ Diversity

The nuclear scenarios exhibit a more diverse generation mix. Multiple technologies contribute to meeting daily load, reducing the system's reliance on any single source and improving resilience and security of supply. The combination of flexible nuclear baseload, short-term battery storage, and long-term hydrogen storage would be more resilient to extreme events in supply and demand outside the typical patterns in these models.

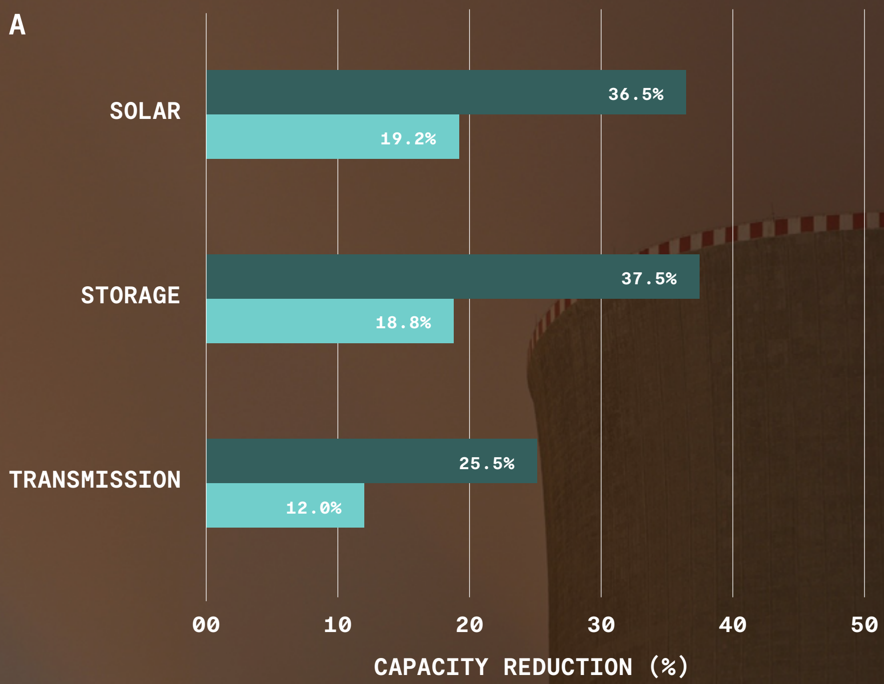
The figure shows why a combination of renewable and nuclear power provides the most cost-optimal daily generation mix. Renewables are the cheapest option when their dispatch can be put to immediate use, and then a dispatchable nuclear baseload reduces the storage burden in gaps in renewable generation.

Exhibit 5

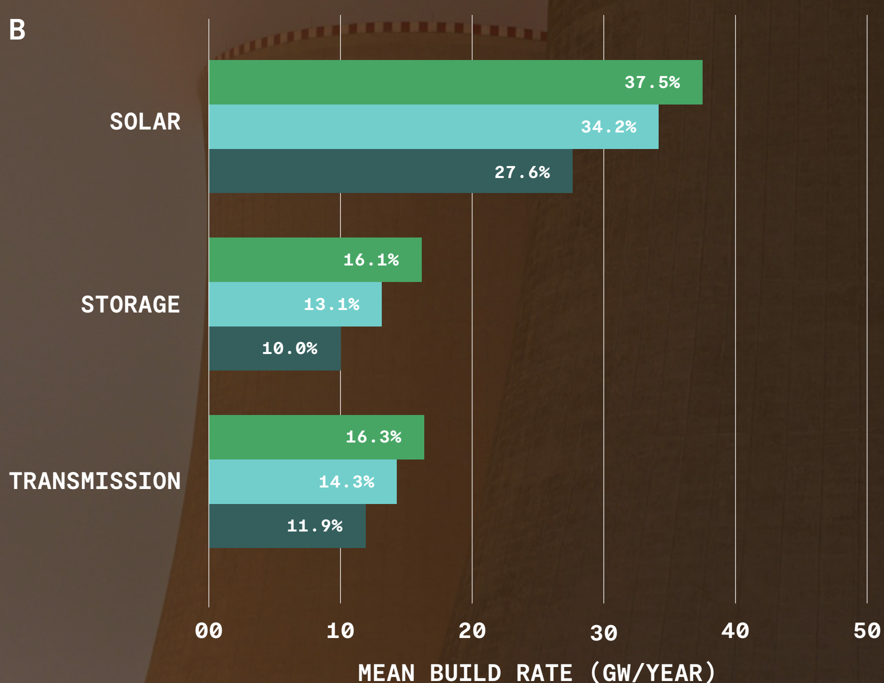
Nuclear buildout reduces need for renewables, storage and grids

Pathways with nuclear dramatically reduce need for solar, storage and transmission infrastructure deployment.

Optimistic Nuclear · Pessimistic Nuclear · RES-only



MEDIAN REDUCTION IN CAPACITY IN NUCLEAR PATHWAYS RELATIVE TO RES-ONLY SCENARIO.



AVERAGE ANNUAL DEPLOYMENT RATES BY SCENARIO. NUMBERS ARE AVERAGED ACROSS THE 8 COUNTRIES.

1 Chart A shows the median of total capacity reduction in the nuclear pathways relative to the RES-only path across all countries analysed. Meanwhile, Chart B shows the absolute annual build rates of different technologies in all three scenarios, averaged across all countries analysed.

Reduced infrastructure buildout

We found the expansion of nuclear power under emissions-limited pathways to be cost-effective across all regions. Another significant outcome is the reduction in overall system size: even modest nuclear deployment leads to substantial decreases in the solar storage (both short- and long-duration), and transmission capacity required to achieve clean power expansion goals (Exhibit 5). In particular, we find that:

- Under the Pessimistic Nuclear and Optimistic Nuclear pathways, approximately 19 – 36% less solar, 19 – 36% less storage, and 12 – 25% less transmission capacity are deployed when compared with the RES-only trajectory. These capacity reductions represent the median values calculated for all geographies we analysed in this report.

- Correspondingly, the required annual build rates also decline significantly. Under the RES-only pathway, solar, storage, and transmission capacities expand by an average of 37.5 GW, 16.1 GW and 16.3 GW per year, respectively. Under the Pessimistic Nuclear and Optimistic Nuclear pathways, these fall to 12.7 – 34.2 GW (a 9 – 26% reduction), 10.0 – 13.1 GW (19 – 38% reduction), and 11.9 – 14.3 GW (12 – 27% reduction), respectively.

The implications of this are significant. Grid expansion and transmission build-out are often among the most capital-intensive, time-consuming, and politically challenging components of power-sector transitions. By reducing the overall scale of infrastructure required, nuclear deployment can ease some of these pressures, making the transition to clean power more feasible from both cost and permitting perspectives. Recent analyses highlight that permitting and siting for new transmission lines are increasingly emerging as critical bottlenecks, particularly in regions where land-use competition and environmental approvals slow project timelines[21].

A more compact system enabled by nuclear generation also offers benefits for implementation speed and spatial planning. Large-scale solar and wind projects require vast areas of land, often in regions distant from major demand Centers, necessitating additional transmission investments and complex coordination across jurisdictions. Nuclear power, by contrast, provides high -capacity, high capacity factor, low-emission generation from a relatively small land footprint, typically located closer to demand hubs or existing grid infrastructure. This geographic flexibility can help countries balance energy expansion with competing land-use priorities such as agriculture, conservation, and urban growth. If scenario modelling had quantitatively factored in land use restrictions, the results would see more nuclear being built.

At the same time, reduced dependence on extensive renewable and transmission build-out lowers exposure to supply-chain and material constraints. For instance, minerals such as copper are a key input for grid infrastructure and are already facing supply shortfalls[22]. By moderating the demand for these inputs, nuclear integration can contribute to a more diversified and resilient transition strategy, mitigating risks associated with commodity price volatility and resource bottlenecks.

Beyond its system-level role in providing firm, low-carbon power, nuclear energy can also help reduce reliance on imported fossil fuels (e.g., liquefied natural gas) for firm generation. In countries with high exposure to volatile gas markets, this can strengthen energy security and reduce vulnerability to external supply disruptions.

However, nuclear deployment presents its own set of challenges. Unlike modular renewables and battery systems, nuclear projects involve complex engineering, regulatory, and financing processes that require strong institutional capacity and long-term policy stability. The high upfront capital costs, coupled with lengthy construction timelines, necessitate careful planning, skilled project management, and sustained political commitment. As such, while nuclear power can help relieve some systemic pressures on the path to decarbonisation, its successful deployment depends on addressing the distinctive technical, financial, and governance barriers that accompany it.

BOX 2

CASE STUDY: NUCLEAR AS A STEPPING STONE TO LARGE-SCALE INDUSTRIALISATION

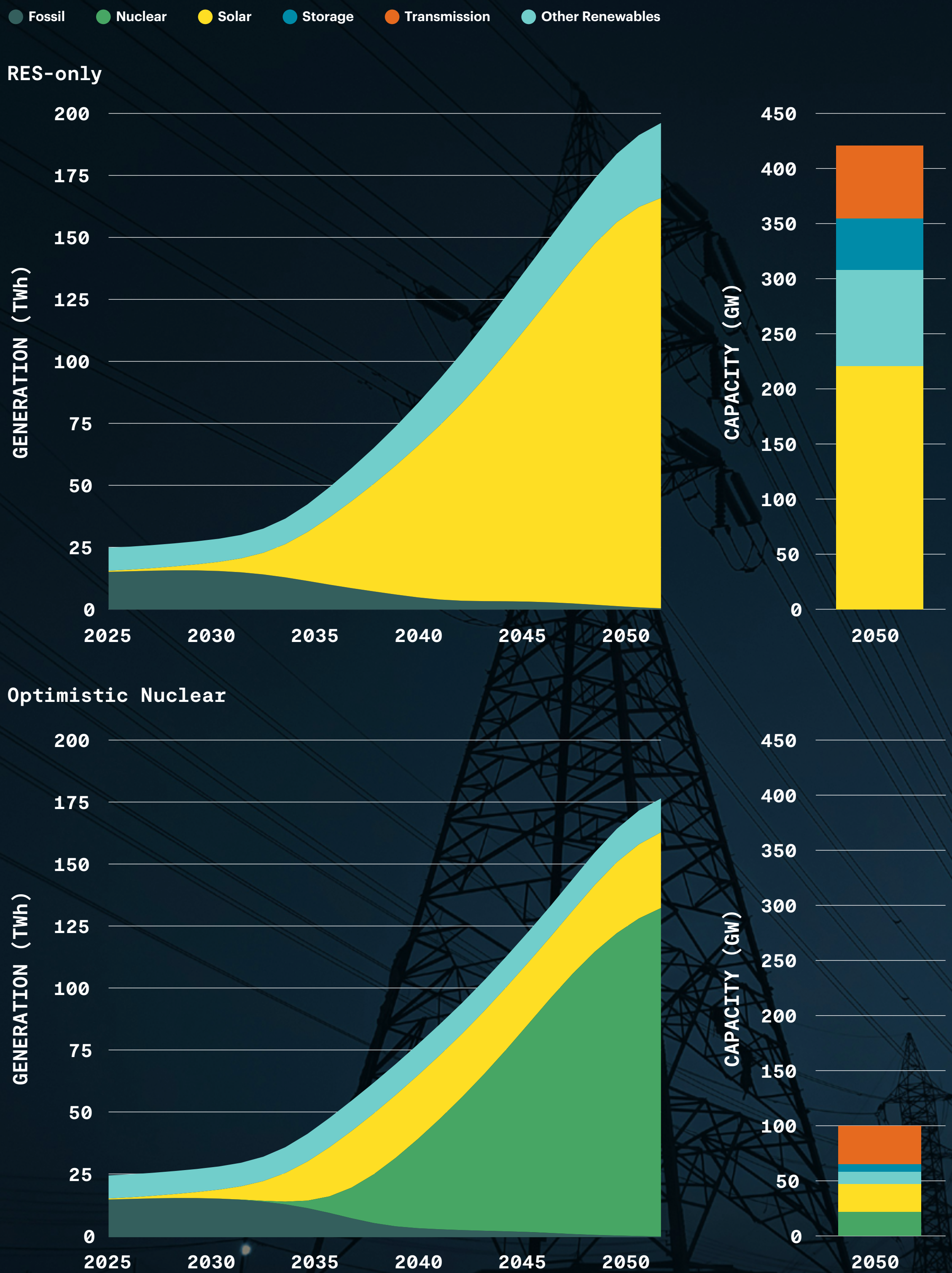
In the main analysis, demand growth for each of the eight study countries was modelled to reach either the IEA's projected 2050 electricity demand or the Modern Energy Minimum of 1,000 kWh per capita per year – a level still far below the consumption of industrialised nations. To explore the implications of rapid industrialisation, this case study simulates an additional pathway for Ghana, where electricity demand rises to 3,500 kWh per capita per year by 2050, comparable to India's projected demand in the same year.

To represent the phased build-out of power-intensive industries, the additional demand is introduced from 2035 in four-yearly steps on top of the baseline growth trajectory. This pattern could correspond to the development of domestic processing industries (e.g., domestic bauxite refining in Ghana) or new high-load sectors such as data Centers attracted by reliable solar or nuclear supply. This scenario also removes all nuclear build-rate limits to assess how a rapidly industrialising power system can evolve with accelerated nuclear deployment.

The figure below presents the results for this high-demand industrialisation case, comparing a RES-only pathway with an Optimistic Nuclear pathway (with unrestricted build rates). In the RES-only pathway, the system would need to grow to around 300 GW of generation, 40 GW of storage, and 50 GW of transmission by 2050. The Optimistic Nuclear scenario delivers the same power requirements with a far smaller system: approximately 60 GW of generation, 10 GW of storage, and 30 GW of transmission. This arises because firm nuclear capacity can serve demand directly, reducing the need for storage and transmission, and lowering system flexibility requirements.

While building 30 GW of nuclear capacity in 25 years represents an ambitious upper bound – especially alongside a fourfold increase in total demand relative to IEA projections – it illustrates the transformative potential of firm, low-carbon power in enabling industrial growth. Achieving similar outcomes with renewables alone would require vast expansions of solar and wind capacity, storage systems, and transmission infrastructure, raising challenges around land use and supply-chain feasibility. Historical precedents, such as the build-out of 5 GW of nuclear capacity in Taiwan within a decade (supported by international financing and engineering collaboration), suggest that such accelerated progress is possible under the right institutional and investment conditions.

Exhibit 6
Technology



Key qualitative insights

Benefits beyond electricity system costs

While the quantitative modelling demonstrates that nuclear power can significantly reduce total system costs, our qualitative research and expert interviews highlight a broader set of potential benefits for EMDEs. These benefits extend beyond power-system economics to encompass industrial transformation, employment, knowledge transfer, and social development outcomes.

Nuclear energy can play a catalytic role in supporting structural economic transformation, enabling countries to move up the value chain from resource extraction to higher-value manufacturing and processing. Experts noted that nuclear power could enable a value shift from oil extraction to petrochemical production in Nigeria, for instance through the application of high-temperature gas reactors, or from raw bauxite mining to aluminium manufacturing in Ghana using nuclear-powered electrolysers. Such applications can anchor domestic industrial growth and reduce dependence on commodity exports.

Experts also identified broader economic and social co-benefits. Once operational, nuclear plants create more numerous, higher-paid, and longer-lasting jobs than other clean energy technologies[38,39]. Some interviewees described the potential for an "inverse brain drain" where skilled members of the diaspora return home to contribute to advanced nuclear infrastructure projects. Evidence also suggests that the economic multiplier effect of nuclear energy may be several times higher than that of other clean or fossil-based sources, though the extent of this benefit depends on localisation rates and the delivery model adopted[40]. Nuclear deployment could also support a just transition for coal-sector workers: approximately half of jobs at coal plants are directly transferable to nuclear facilities, with additional employment created in plant operations and surrounding communities[41].

Experts further highlighted several ancillary and debated benefits. These include the contribution of a domestic nuclear industry to medical isotope production – supporting life-saving cancer diagnostics and treatment – the potential boost to national pride and technological self-image, and the resulting international perception of a more advanced, investable economy. Some interviewees also noted that nuclear power's rigorous safety culture may provide positive spill-over effects, strengthening safety standards across other industrial sectors.

Driven in part by its high energy density, nuclear energy also provides distinct environmental advantages. These include the lowest lifecycle greenhouse gas emissions of any clean energy source, minimal ecosystem impact, a relatively low requirement of scarce materials, and one of the lowest fatality rates per unit of generation[42]. Additionally, if designed robustly, nuclear power can be highly climate-resilient, designed to withstand severe environmental and weather-related challenges such as extreme heat, drought, and flooding events[43].

Experts also identified broader economic and social co-benefits. Once operational, nuclear plants create more numerous, higher-paid, and longer-lasting jobs than other clean energy technologies.

Table 2
Recent countries building their first nuclear plants have had similar enabling conditions

Country & Start	Technology	International Collaboration	Nuclear Skills & Leadership	Public Support[50]
Bangladesh[25] 2017 start of construction	2x large, Gen III + PWR Proven design Russian vendor	International collaboration on financing, tech, and skills Russia to finance 90% of project cost Bangladesh to finance 10% of project cost in advance	Nuclear skills from 1 test reactor in operation Government-led nuclear program	Support build: **79%** Oppose build: **5%** Local survey[26]
Belarus[27] 2013 start of construction	2x large, Gen III + PWR Proven design Russian vendor	International collaboration on financing, tech, and skills Russia lent at least $10bn Russian export credit facility used	Nuclear skills from 3 test reactors in operation Government-led nuclear program	Support build: **50%** Oppose build: **21%** Local survey[28]
Egypt[29] 2022 start of construction	4x large, Gen III + PWR Proven design Russian vendor	International collaboration on financing, tech, and skills Russia to finance 85% of project cost with state export loan	Nuclear skills from 1 test reactor in operation Government-led nuclear program	Support use: **49%** Oppose use: **21%**
Kazakhstan[30] 2026 planned start	2x large, Gen III + PWR Proven design Russian vendor	International collaboration on financing, tech, and skills Russia expected to finance large part of project	Nuclear skills from 4 test reactors in operation Government-led nuclear program	Yes (build): **73%** No (don't build): **27%** Local referendum[31]
Poland[32] 2028 planned start	3x large, Gen III + PWR Proven design US vendor	International collaboration on financing, tech, and skills 30% equity – Polish state financed 70% debt – expected from foreign (especially US) export credit agencies, backed by Polish state guarantees[33]	Nuclear skills from 1 test reactor in operation Government-led nuclear program 407 votes for vs 2 against in parliament	Support use: **55%** Oppose use: **16%**
Turkey[34] 2018 start of construction	4x large, Gen III + PWR Proven design Russian vendor	International collaboration on financing, tech, and skills Fully Russian-financed under world-first Build, Own, Operate model Power Purchase Agreement	Nuclear skills from 1 test reactor in operation Government-led nuclear program	Support use: **31%** Oppose use: **41%**
UAE[35] 2012 start of construction	4x large, Gen III+ PWR Proven design South Korean vendor	International collaboration on financing, tech, and skills 20% equity: 82% UAE state, 18% Korean state 80% debt: UAE state, Korean EXIM, and commercial banks Loan guarantees and PPAs	No test reactors Government-led nuclear program	Support use: **50%** Oppose use: **19%**
Uzbekistan[36] 2026 planned start of construction	2x large, 2x SMR, Gen III + PWRs Proven design, Russian vendor	International collaboration on financing, tech, and skills Russia is expected to finance a large part of the project	Nuclear skills from 1 test reactor in operation Government-led nuclear program	Support build: **70%** Oppose build: **30%** Local survey[37]

Construction start refers to the first concrete pour. Locally reported public support data may be subject to collection bias.

Table 3 **EMDE nuclear landscape – Expert-identified barriers and philanthropic opportunity areas. Key areas for consideration highlighted shown in orange.**

Country & Status	Politics	People
Brazil Current: 2 GW operation, 1GW construction Target: 8 – 10 GW by 2050	• Government deadlocked on Angra 3 completion/decommission ($4B either way) • Renewables remain policy priority • Law restricts nuclear to state ownership, blocking private SMR investment • Strict public-sector hiring rules limit talent renewal • Regulator viewed as overly rigid	• Public opposition at 41% (among highest internationally) • Widespread misinformation • Legacy distrust from corruption scandals • Safety fears after Fukushima and Goiânia • Strong anti-nuclear lobbying from renewable industry • Completing Angra 3 key to rebuilding confidence • Talent pipeline weakening
Financing	**International**	**Technical**
• Completing Angra 3 offers low cost per MW • Private investors show interest • High hydro capacity reduces nuclear's economic value	• Regulatory harmonisation would help but remains secondary • International partnerships could support uranium mining	• Angra 3 completion is political, not technical decision • Large light-water PWRs most suitable • Emerging discussions on microreactor and SMR concepts • Negative sentiment hinders waste storage development

Country & Status	Politics	People
Ghana Target: 1 GW by early 2030s Target: 30% nuclear by 2070	• Both major parties support nuclear since 2010 • Program driven by civil servants, not political leaders • Lack of top-level decision-making and ownership	• Public support appears high but data limited • Active anti-nuclear groups funded by external lobbies (DE, US, EU) • Local support strong where projects create jobs • Skilled engineers available but lack nuclear experience • Need for sustained technical coaching
Financing	**International**	**Technical**
• IMF program restricts new government borrowing • BOOT and PPP models under consideration • Potential industrial offtakers in aluminium sector	• Nigeria's progress could motivate Ghana • Multiple MOUs signed with international partners	• Interest in both large and SMR options • NuScale SMR performed well in RFI assessment • Several MOUs signed with vendors • Transmission infrastructure needs strengthening

Continued on next pages

Country & Status	Politics	People
India Current: 8 GW operation, 5 GW construction Target: 100 GW by 2047	• Broad cross-party support for nuclear expansion with ambitious target for 100 GW by 2047 to mark 100 years of independence. • Growth primarily constrained by legal limits on private and foreign participation. • Amendments needed to nuclear law and civil liability framework. NPCIL remains the sole authorized builder and operator. • Supreme Court reaffirmed nuclear energy as a public good. • Imported reactors must be licensed in their home countries, delaying first-of-a-kind technology adoption.	• Highest public support in peer group (49%) • Local opposition persists, driven by landuse and safety concerns (e.g., Jaitapur farmers concerned about radioactive mango crop). • Industry-led outreach limited in effectiveness; stronger NGO and community engagement needed. • Public communication must extend beyond elite stakeholders. Large base of skilled engineers but NPCIL monopoly on training and long training cycles creates manpower bottlenecks.
Financing	**International**	**Technical**
• Reforms required to ease foreign investment. • Absence of strong nuclear insurance pool. • Government guarantees needed to reduce borrowing costs with favorable long-term lending terms critical. • Government developing a Production Linked Incentive scheme to attract financing and bank participation.	• Active cooperation with France and Russia on nuclear builds. • Legal reforms on civil liability and investment rules needed to attract new intrenational vendors. • Historic sanctions and high U.S. tariffs have limited progress. • Non-signatory status to the nuclear nonproliferation treaty constrains international participation. • Strong potential for joint ventures, technology transfer, and regulatory harmonisation.	• Focus on proven PHWR technology with growing interest in large LWRs and SMRs. • Sites identified for up to 100 GW of new capacity. • Concern of fuel constraints persist despite the 123 Agreement and thorium program. • Gen-IV and fast breeder R&D progressing to improve fuel efficiency and selfsufficiency.

Country & Status	Politics	People
Indonesia Target: SMR by 2032 Target: 9 GW by 2040 Target: 42 GW by 2060	• Political consensus generally supportive; no significant party opposition • Presidential support strong but lacks actionable roadmap • Coal lobby highly influential, wary of nuclear diverting policy focus • Government establishing Nuclear Energy Program Implementing Organization • Regulatory framework outdated, requires modernisation • Knowledge gaps and resistance among mid-level officials	• High public opposition (37%) • Public engagement weak; need for proactive communication and transparency • Gradual approach (500 MWby 2032) prioritizes trust-building • Workforce shortages expected due to aging specialists • Limited training pipelines
Financing	**International**	**Technical**
• Government has experience structuring power projects with multilateral support • State utility heavily indebted, limiting equity provision • As 16th largest economy, vendor nations may see strategic value • Difficulty raising early-stage development capital ($20 – 50m)	• Flexible geopolitical alignment; Russia and US show strong interest • South Korea considered for advanced reactor collaboration • Opportunities for regional partnerships	• Contrary to small 2032 target, preference for proven large land-based PWRs • Interest in SMRs and floating reactors for islands • Vendor interest high but no technology selected • Concerns that waiting for SMR maturity could delay rollout • Private Gen-IV firm facing licensing delays • Conventional large NOAK reactors likely face fewer regulatory hurdles.

Country & Status	Politics	People
Nigeria Target: No clear target	• Limited government interest in nuclear energy • Leaders focus on short-term, politically visible projects • Plant siting driven by regional interests • Nuclear institutions distant from Presidency • Regulators competent, passed key legislation	• Public support appears high but data limited • As oil producer, understands value of reliable energy • Low trust in government capacity to manage complex projects safely • Human capital developed through local research reactor • Partnerships with South Korea, China, and Russia • Young experts face limited opportunities, often move abroad
Financing	**International**	**Technical**
• Nigeria's fiscal space tightening • Recent infrastructure projects succeeded with World Bank support • Domestic oil sector can contribute financing, project management, and PPAs	• Past agreements with Russia yielded little progress • Talks with China stalled due to limited export experience • Other vendors perceive Nigeria as unserious • West African Power Pool may offer regional support	• Interest in both large and SMR designs if risks reduced • Russia, China, and US seen as key technology partners • Grid remains weak with heavy decentralized diesel and rooftop solar • Transmission upgrades essential, could proceed alongside nuclear development

Country & Status	Politics	People
Philippines Status: 1 GW completed but never started (Bataan) Target: 1 GW by 2032 Target: 5 GW by 2050	• Political appetite is main barrier with internal resistance in key government departments • Historic anti-nuclear stance and limited technical understanding among politicians • Energy systems modeling required to demonstrate cost benefits • Slow bureaucracy delays site feasibility, geological, and environmental studies • Recent new nuclear law establishes independent regulator and development agency	• High national support (40%) aided by community-level campaigns, but fragile • Persistent well-established anti-nuclear forces, especially around Bataan site • Opposition reinforced by elite interests tied to fossil fuel imports • Historical mistrust from past political controversies and safety fears
Financing	**International**	**Technical**
• Severe capital constraints limit largescale project financing • Government exploring PPAs to secure long-term investor revenues • Foreign financing from Korean Exim Bank and reactor vendors under consideration • Sovereign guarantees proposed to mitigate political and policy risk	• Bataan completion historically hindered by IP issues with US and Korean vendors • South Korea considering financing and completing Bataan plant • US state engagement includes public opinion polling support • Widespread distrust of Chinese involvement • Potential for regional cooperation on nuclear new build	• Primary focus on restarting mothballed Bataan large PWR plant • Consideration for additional reactors at Bataan site • Transmission infrastructure upgrades essential and capital-intensive • Could proceed concurrently with nuclear deployment

Country & Status	Politics	People
Rwanda Target: First plant by 2030	• Low political risk given stable leadership • Clear government interest in nuclear energy • Two approved SMR sites with geological and environmental studies completed • Regulatory and licensing frameworks under development	• Public support reportedly low with limited data • Safety concerns amplified by country's small size • Notable gender gap in support and industry participation • Rwanda lacks research reactor to build domestic expertise • Some human capital developed for program implementation
Financing	**International**	**Technical**
• Ongoing uncertainty on liability and financing models • Financing required is large compared to GDP • Conflict with Congo limits access to foreign financing	• Regional cooperation with Uganda and Kenya essential for power exports • Potential to develop shared East African nuclear infrastructure	• Low domestic demand favors SMRs in near term • Long-term growth in industry and interconnectors could justify larger reactors • Local work on indigenous microreactor designs • Transmission bottlenecks constrain industrial expansion

Country & Status	Politics	People
South Africa Current: 2 GW in operation Target: 5 GW new nuclear by 2039	• Growing political support for nuclear development • Litigation by anti-nuclear NGOs delays progress and deters decision-makers • Renewables dominate policy due to strong lobbying • Past ties with Russia fuel opposition from Democratic Alliance • Regulator mature and experienced but small • Requires early engagement, training, and resourcing	• Public support relatively high (46%) • Countered by small, well-funded opposition groups • Public awareness of nuclear benefits remains low • Industry lacks coordinated professional advocacy • Experienced engineers risk being lost due to project delays • New talent pipelines and skill development needed
Financing	**International**	**Technical**
• State cannot independently fund new nuclear program • "Africa risk premium" raises borrowing costs • Green bonds, PPPs, and tokenisation of mineral reserves could support financing • Revenue adequacy remains concern • Major mining firms could be PPA offtakers • Government expectations for PPPs overly optimistic	• Engagement with Rolls-Royce (UK), Westinghouse (US), and Rosatom (Russia) • Potential to export power to neighboring countries • Coal lobby views nuclear as complementary • Regional leader in regulation and training for other African countries • Need for pan-African think tanks on nuclear policy	• Koeberg reactors remain profitable, serve as national benchmark • Future reactors likely large PWRs Significant expertise in pebble-bed • SMRs and isotope production • Transmission grid well-positioned for coal-to-nuclear transition • Established uranium mining base supports self-sufficiency

Enabling factors for nuclear deployment

Since 1990, eight countries, separate from the eight in the EMDE modelling research, have undertaken concerted efforts to establish their first nuclear power plants. These countries provide instructive examples for others seeking to initiate or revitalise their own nuclear power programs. Across these eight cases, shown in Exhibit 2, several common enabling conditions can be identified. Each country selected a well-established foreign vendor and pursued the construction of multiple large reactors based on proven Generation III+ pressurized water reactor designs. The vendor countries not only supplied the reactor technology but also assisted with financing and workforce development.

In all instances, the purchasing countries implemented government-led nuclear programs rather than privately developed ones. Most of these countries already possessed a well-established foundation of nuclear expertise, often derived from the operation of domestic research reactors. Additionally, the majority reportedly have high levels of public support for the use of nuclear energy.

Notable exceptions to these common enabling conditions include Uzbekistan's concurrent construction of both small modular reactors (SMRs) and large reactors; the United Arab Emirates and Poland assuming leading roles in financing, potentially due to their relatively stronger economies; the UAE's lack of an operational test reactor, resulting in a high reliance on international partnerships for nuclear skills development; and Turkey having a plurality of the public opposing nuclear energy in the country.

BOX 3

CASE STUDY: HISTORIC NUCLEAR BUILD RATES

In 1968, Taiwan ranked as the 79th lowest-income country in the world by per-capita GDP. That same year, the country took a step closer to developing nuclear energy by enacting its Nuclear Law. Within four years, Taiwan began constructing the first of its large (> 500 MW) fleet of US-designed reactors.

The United States, motivated by its Atoms for Peace initiative and concerned about Taiwan's potential to produce plutonium, provided over half a billion dollars (equivalent to more than $4 billion when adjusted for inflation to 2025) in loans and guarantees to support the country's nuclear program.

In rapid succession, Taiwan built six reactors, completing each in an average of six years and three months. By 1985, just 17 years after the passage of the Nuclear Law and 13 years after the start of construction, nuclear power accounted for 52% of Taiwan's electricity generation.

Similarly rapid growth has occurred in other countries in recent years. In 2024, Belarus reached a 37% nuclear share of generation 18 years after launching its nuclear program, and the United Arab Emirates achieved a 23% share after 16 years. The experiences of Taiwan, Belarus, and the UAE demonstrate that within the 25-year horizon covered by our model, it is historically possible, even for lower-income countries, to develop a nuclear program from the ground up and achieve rapid deployment rates consistent with our Optimistic scenario.

Barriers to nuclear deployment

Experts interviewed identified key barriers to nuclear deployment across three main domestic domains: government efficacy, public engagement, and nuclear financing. Limitations in government efficacy often stem from policy gaps, shortages of project management and regulatory expertise, and delays in high-level decision-making. These institutional weaknesses can hinder the timely development of nuclear programmes and discourage private or international investment. Public engagement challenges included misinformation, lack of awareness, distrust in government institutions, and localised "not-in-my-backyard" (NIMBY) opposition.

A notable historical example is the Bataan Nuclear Power Plant in the Philippines, which, despite being fully constructed, was never commissioned due to public backlash and political shifts. In terms of nuclear financing, barriers related to project-specific risks, broader sectoral uncertainties, and national-level financial constraints. The high upfront capital costs and long project timelines make nuclear development particularly sensitive to governance quality and perceived investment risk. Beyond these three domains, additional domestic barriers were noted, including gaps in human capital development, infrastructure readiness, geopolitical exposure, inter-agency coordination, and technology selection. The scale and nature of these barriers vary by country, and a summary of expert-identified barriers is presented in Exhibit 3.

Additionally, beyond EMDE's domestic control, the lack of reliable, cost-competitive, full-service international nuclear vendors is identified as a barrier. Since 2000, more than three quarters of global nuclear reactor exports have originated from Russia, whose domestic suppliers can, upon request, provide comprehensive support that includes establishing a regulator, project financing, construction, staff training, operation, maintenance, fuel contracts, and waste management. Historically, North America and Europe were major exporters of nuclear technology to EMDEs; however, over recent decades, their domestic nuclear industries have declined, reducing both their capacity and incentive to engage in international exports.

Contrary to a popular Global North narrative, which emphasizes privately financed advanced small modular reactors (SMRs) with lower initial international cooperation, the majority of the EMDE experts interviewed expressed a preference for public financing, the deployment of large conventional light water reactors with international collaboration, citing lower cost of capital, fewer supply chain bottlenecks, and reduced technology risks. Indeed, all current nuclear newcomer countries globally construct plants in such a way. While experts viewed SMRs as a promising innovation, particularly for their potential to lower overall financial exposure, they also noted that SMR deployment is likely to take longer, as initial designs will need to be demonstrated and de-risked elsewhere, and less experienced and smaller staffed EMDE regulators will need to approve designs before large-scale adoption can occur.

Four overarching themes emerge in how contextual factors can affect nuclear deployment:

→ Nuclear experience

Countries already operating nuclear power plants, like India, benefit from fewer human capital barriers to nuclear deployment. The Philippines, with its completed but never started Bataan nuclear power plant, may be able to benefit from lower project financing risk than building a new nuclear power plant.

→ Energy growth

Long-standing and forecast growth in electricity demand can reduce project financing risk as future revenues are more bankable and local industrial players may help finance and become offtakers for nuclear projects.

→ Democracy and politics

Cross-party political support is important for nuclear deployment. Without a stable and supportive policy environment, the long-term planning, construction, and operation of power plants can be significantly hindered. Countries with less democratic political systems may benefit from lower political risk on projects. Rwanda is ranked 128th out of 181 countries on the Economist Intelligence Unit's democracy index, the lowest of the eight countries in the study. India, the highest ranked at 44th, has one of the highest and most bipartisan public levels of support for nuclear energy in the world.

→ Cost of capital

Access to low-cost capital for nuclear construction significantly improves the financeability of projects. Relative to other energy sources, nuclear is more susceptible to a higher cost of capital. Long construction periods and a high proportion of costs being incurred early in construction relative to later in operation contribute to greater compounding of interest[44]. Countries like China and Russia have a relatively low cost of capital for nuclear power due to a lower risk of construction overruns and a strategic prioritisation of providing capital for nuclear projects. State-backed loans, export credit, and multilateral development bank support can further help lower the cost of capital for nuclear projects in newcomer countries.

Potential role for philanthropy

Philanthropy is well-positioned to play a catalytic role in supporting the growth of nuclear energy deployment. Philanthropic support is typically characterised as having a higher tolerance for financial risk, a longer term perspective, and the ability to foster an independent enabling environment. These qualities align closely with the needs of nuclear projects, which often involve high-stakes decision-making, multi-decade development timelines, and the coordination of diverse stakeholders.

As highlighted in the modelling section of the report, the most cost-effective application of nuclear energy is in the final part of decarbonisation when the remaining fossil baseload is removed. This, however, means that the cost signal for cost-effective nuclear generation may only appear in these countries in the 2040s once the required renewables and storage capacity and costs begin to accelerate – but constructing the effective nuclear baseload will take time after that signal. Philanthropy can “foresee” this situation better than short-term focused market forces or governments and advocate to start the deployment process now.

While some research has highlighted the potential economic, engineering, and “just transition” benefits of repurposing coal sites and communities to host nuclear power plants, philanthropy could contribute to better thought leadership on the topic and broader international recognition of benefits[45]. Some experts have commented that these benefits are often lower in EMDEs concerned about creating stranded assets from closing recently commissioned coal plants.

With philanthropy being historically absent from supporting nuclear energy, many EMDE experts did not have a detailed vision of how philanthropic support should help. Nonetheless, several areas where philanthropic engagement could meaningfully reduce barriers to nuclear deployment have been identified as:

→ Improving government efficacy, strong leadership, capable institutions, and data-driven policymaking.

This can mean philanthropy building accountable leadership structures, investing in skilled and well-resourced institutions, nurturing civil society organisations that hold government to account, embedding stable long-term policy frameworks, fostering best practice sharing, and cultivating continuous governmental thought leadership to sustain momentum and credibility over time.

→ Fostering coordinated, transparent, and inclusive communications.

Investing in credible information networks, empowering community voices, and cultivating trusted local champions can improve social acceptance. Enhancing education and workforce pathways, alongside sustained independent thought leadership, can help ensure informed and lasting public support.

→ Funding the development of policy frameworks that attract institutional and private capital while supporting capacity building.

Philanthropy can focus on de-risking early-stage activities such as policy design, legal work, site preparation, and licensing. Convening potential offtakers to secure long-term power purchase agreements can further strengthen investor confidence.

→ Hosting and coordinating platforms that promote North-South collaboration.

Shared efforts could focus on harmonising technology and regulation, developing joint training and capacity-building programs, and improving coordination on waste management, fuel supply, and grid infrastructure. Transparent export financing and regional supply chain partnerships can enhance trust and efficiency across borders.

For philanthropic support to be most effective, instead of duplicating work, it should complement, heighten, and act as an honest broker to efforts already undertaken by other international organisations. Key actors already advancing nuclear development include the IAEA, which guides emerging economies through its Milestones Approach; the NEA and IEA, which foster cooperation and assess nuclear’s competitiveness; the WNA and NEI, which build industry capacity and promote best practices; and initiatives like Triple Nuclear, aiming to triple global capacity by 2050. The World Bank provides financial support, while the Clean Energy Ministerial’s NICE Future initiative drives international dialogue and knowledge-sharing.

Philanthropic support design should benefit from economies of scale by fostering an ecosystem that delivers shared benefits across multiple countries and sectors. Philanthropic initiatives should also be evergreen in nature, such that initial support and lessons learned retain their relevance and ability to generate value both in the near term and for future generations. Finally, such interventions should be structured to avoid long-term dependency on philanthropy by building domestic capacity and capabilities that ensure that initiatives become self-sustaining once the initial catalytic support has fulfilled its purpose.

While nuclear energy has accounted for 20% of global clean electricity generation, it accounts for less than 0.2% of climate philanthropy[46]. Wind and solar energy have benefited from decades of large philanthropic support, and these energies have seen deployments accelerate. In philanthropy's absence, global nuclear energy capacity has not grown in three decades, the technology has become undervalued, and ideological opposition has taken root in many segments of civil society. At its most severe, ideological opposition has led to the premature closure of dozens of nuclear reactors, prioritizing fossil fuels over clean nuclear generation and significantly setting back progress on climate goals.

Without philanthropic engagement, nuclear expansion risks being shaped solely by national or commercial interests, rather than by principles of equity and good governance. Philanthropic support can provide a more robust, multidisciplinary civil society that is data-driven and human-centric. As nuclear growth restarts, philanthropy is essential to catalyze progress now and build resilient support that can endure future challenges.

Conclusions and recommendations

Nuclear complements renewables in all decarbonisation scenarios.

Across all eight EMDEs, compared to a renewables-only pathway, allowing nuclear capacity expansion delivers lower system costs by between 2 – 31%, reducing the expansion needs of solar capacity by 9 – 26%, storage capacity by 19 – 38%, and transmission capacity by 12 – 27%. All the modelled countries can benefit from some nuclear integration, but the greatest cost and build savings come in countries with limited access to reliable baseload generation.

Future real-world capital costs, financing costs, and build rates are key to these benefits.

The cost savings projected in our nuclear scenarios depend on these countries actually achieving the projected capital cost and build rates of nuclear capacity. Historical precedent shows that many countries have achieved comparable or lower costs, but some projects have resulted in much higher costs. Financing costs are very high for some of the modelled countries, driving up the costs of all zero-carbon scenarios, providing a key quantitative target for philanthropy.

Nuclear energy offers relatively untouched and fertile ground for philanthropic engagement.

Long overlooked, early philanthropic involvement has the potential to be highly catalytic in shaping the industry's trajectory. The cost savings of nuclear energy may only be fully realised towards the end of a country's decarbonisation pathway, but planning and building must begin decades before this becomes apparent to market forces. The technology also delivers broader socio-environmental benefits, aligning closely with philanthropy's many development and climate objectives.

Philanthropy should target three issues which were identified by stakeholders across all EMDEs.

The main obstacles to nuclear capacity expansion all fall under the categories of government efficacy, public engagement, and nuclear financing. In the broader energy ecosystem, philanthropy has a proven track record of delivering strong impact in these areas.

Bellagio Center Convening Addendum

A three-day convening was held from November 18 – 20, 2025, at The Rockefeller Foundation's Bellagio Center in Italy, bringing together 20 participants from philanthropy, the Global South, and the nuclear energy sector. The purpose of the meeting was to advance plans for a set of philanthropic interventions for accelerating nuclear energy deployment in the Global South, interventions that could play a critical role in addressing energy poverty and climate change. The convening built on insights from previous workshops as well as the Bayesian Report.

The program combined presentations, virtual fireside chats, Lightning Talks showcasing participants' expertise, collaborative activities, breakout working groups, and facilitated discussions. The convening was hosted by Shunondo Basu and Katherine Tan of The Rockefeller Foundation; convened by Richard Ollington of the Radiant Energy Group; and co-organized by Karen Pak Oppenheimer and Theo Kalionzes of the Oppenheimer Project, together with Daniel Poneman of the Council on Foreign Relations. The convening was held under the Chatham House Rule, ensuring that participants' comments could be used without attribution.

Feedback on Bayesian Report

Bellagio participants received a pre-read of the Bayesian Report, and its key findings were presented and discussed during two dedicated Q&A sessions on the first day of the convening.

Participants welcomed the finding that a total-system-cost approach demonstrates nuclear energy's potential to reduce overall costs, contrary to what many simpler LCOE-based analyses have suggested. Some participants noted, however, that the Bayesian team had adopted more conservative cost assumptions for nuclear than for renewables and storage, and that nuclear's comparatively lower environmental impacts – particularly its limited land-use footprint – were not costed into the analysis. Some participants critiqued that the model did not account for battery storage durations beyond four hours. It was also observed that geothermal, biomass, and other forms of "clean firm" power were included within the analysis's "other renewables" category. One participant emphasized that while some existing hydropower assets may face declining output, many can be uprated to increase capacity, an opportunity not reflected in the current model.

On the qualitative side, participants highlighted the Philippines' unique advantage in having an already-constructed nuclear plant, which could be brought online at comparatively low-cost relative to a full new build, and that its commissioning could catalyze regional momentum and spur competitive interest from neighboring Southeast Asian countries. Additionally, participants noted that Southeast Asian countries may attract strong philanthropic support given their large populations and emissions, and that island nations, in particular, could benefit from nuclear energy because of their significant land constraints. Participants observed that philanthropic efforts may gain more traction in Global South countries that already utilize nuclear energy, such as South Africa, India, and Brazil. However, they also noted that these countries may face more diverse and context-specific barriers, which may limit the potential for philanthropic interventions to scale internationally. The group also reflected on the cost of decades of philanthropic inaction in the nuclear sector and emphasized that 100-year nuclear projects deliver value across multiple generations – an intergenerational benefit often more aligned with public financing priorities than with private-sector investment horizons.

Overall, the work was commended for its rapid delivery, the use of appropriate regional nuclear cost curves, and its robust incorporation of total system costs and renewable variability across multiple weather years.

Outcomes from the Bellagio Center Convening

The November 2025 Bellagio convening marks a pivotal moment for nuclear philanthropy.

Philanthropic support for nuclear energy has long been neglected. Despite nuclear energy providing roughly 10% of global electricity, philanthropic support for the sector has historically amounted to less than 0.2% of all climate philanthropy and under 2.5% of climate philanthropy directed toward clean electricity. This long-standing underinvestment has constrained progress in an area with substantial potential to advance both climate and development goals.

The Bellagio attendees agreed that shifts in global support for nuclear energy now present a golden opportunity for philanthropy to catalyze renewed growth. They collectively expressed interest in exploring a formalized philanthropic and multi-sector coalition to advance nuclear energy globally including in emerging and developing markets, recognizing nuclear as a clean energy source and acknowledging, as demonstrated in the Bayesian Report, its potential to reduce total system costs and improve development outcomes across the Global South.

Over three days, attendees worked to shortlist possible interventions under this umbrella of a potential coalition, including forming regional technical and regulatory support centers, mobilizing OECD governments to allocate resources and policy support for domestic nuclear agencies and international organizations, influencing multinational organizations, unlocking multilateral development bank (MDB) financing, establishing financial standardization practices, and reframing the narrative around nuclear energy as a transformative solution through innovative storytelling and mixed media.

The dialogue at Bellagio seeded potential partnerships and engagement across philanthropy, multilateral institutions, civil society, and industry. Following the convening, efforts will concentrate on developing a broader theory of change for a potential coalition and fleshing out specific solutions. Participants committed to advancing this work and to sharing progress updates at future gatherings.

The Rockefeller Foundation and its fellow Bellagio attendees aim to inspire others to join in on these interventions and catalyze action across an ecosystem of partners. A well-developed and cohesive vision will ideally usher in a new era of coordination and international cooperation for the safe proliferation of nuclear energy across the Global South.

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Technical Appendix

Table 4
Electricity demand growth projections by country. Countries with an asterisk have had their demand growth increased to meet the MEM. See the section “Methodology for power systems modelling to 2050” above for how these figures were derived.

Country	2025 Demand (TWh/yr)	2050 Demand (TWh/yr)	Annual Growth Rate (%)
Brazil	723.0	1304.9	2.2
Ghana*	22.3	48.0	2.9
India	1811.0	7250.7	5.3
Indonesia	351.0	1005.7	4.0
Nigeria*	40.1	351.6	8.4
Philippines	117.0	335.2	4.0
Rwanda*	1.1	22.0	11.8
South Africa	232.0	404.0	2.1

Table 5
Weighted average cost of capital assumptions by country.

Country	WACC (%)
Brazil	15
Ghana*	23
India	11
Indonesia	10
Nigeria*	18
Philippines	15
Rwanda*	23
South Africa	12

Table 6
Technology lifetime and capital cost outlay (%).

Technology	Useful Life	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Bioenergy – Large scale	40 years	30	60	10	0	0	0	0
CCGT	40 years	30	60	10	0	0	0	0
Gas turbine	25 years	30	60	10	0	0	0	0
Geothermal	30 years	30	60	10	0	0	0	0
Hydropower – Large scale	40 years	10	20	20	20	15	10	5
Hydropower – Small scale	40 years	10	20	20	20	15	10	5
Nuclear	40 years	10	20	20	20	15	10	5
Solar PV – Large scale	40 years	100	0	0	0	0	0	0
Steam Coal – Subcritical	40 years	30	60	10	0	0	0	0
Steam Coal – Supercritical	40 years	30	60	10	0	0	0	0
Steam Coal – Ultrasupercritical	40 years	30	60	10	0	0	0	0
Wind offshore	30 years	100	0	0	0	0	0	0
Wind onshore	30 years	100	0	0	0	0	0	0
Battery Storage	30 years	100	0	0	0	0	0	0
Hydrogen Electrolysers	40 years	30	60	10	0	0	0	0

Table 7
Installed Capacity by Country, Scenario, Component, and Technology (GW)

Country	Scenario	Component	Technology	2025	2030	2040	2050
BRA	Optimistic Nuclear	Generator	Biomass	17.8	17.8	17.8	17.8
BRA	Optimistic Nuclear	Generator	Coal	22.5	22.5	22.5	22.5
BRA	Optimistic Nuclear	Generator	Gas	18.3	18.3	18.3	18.3
BRA	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
BRA	Optimistic Nuclear	Generator	Hydro	110.0	110.0	110.0	110.0
BRA	Optimistic Nuclear	Generator	Nuclear	2.0	2.0	15.6	35.2
BRA	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	28.6
BRA	Optimistic Nuclear	Generator	Other Fossil	8.6	8.6	8.6	8.6
BRA	Optimistic Nuclear	Generator	Solar	53.1	53.1	127.8	311.8
BRA	Optimistic Nuclear	Generator	Wind	33.0	84.4	130.7	203.9
BRA	Optimistic Nuclear	Link	Transmission	188.0	189.6	235.3	319.8
BRA	Optimistic Nuclear	Storage Unit	Battery	0.0	0.8	27.1	81.0
BRA	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
BRA	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	87.7
BRA	Pessimistic Nuclear	Generator	Biomass	17.8	17.8	17.8	17.8
BRA	Pessimistic Nuclear	Generator	Coal	21.8	21.8	21.8	21.8
BRA	Pessimistic Nuclear	Generator	Gas	18.3	18.3	18.3	18.3
BRA	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
BRA	Pessimistic Nuclear	Generator	Hydro	110.0	110.0	110.0	110.0
BRA	Pessimistic Nuclear	Generator	Nuclear	2.0	2.0	7.4	15.6
BRA	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	16.4
BRA	Pessimistic Nuclear	Generator	Other Fossil	8.6	8.6	8.6	8.6

Country	Scenario	Component	Technology	2025	2030	2040	2050
BRA	Pessimistic Nuclear	Generator	Solar	53.1	53.1	162.9	450.5
BRA	Pessimistic Nuclear	Generator	Wind	33.0	83.9	149.1	281.4
BRA	Pessimistic Nuclear	Link	Transmission	188.0	191.1	253.1	372.3
BRA	Pessimistic Nuclear	Storage Unit	Battery	0.0	1.5	36.5	115.3
BRA	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
BRA	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	120.6
BRA	RES-only	Generator	Biomass	17.8	17.8	17.8	17.8
BRA	RES-only	Generator	Coal	21.8	21.8	21.8	21.8
BRA	RES-only	Generator	Gas	18.3	18.3	18.3	18.3
BRA	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
BRA	RES-only	Generator	Hydro	110.0	110.0	110.0	110.0
BRA	RES-only	Generator	Nuclear	2.0	2.0	2.0	2.0
BRA	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
BRA	RES-only	Generator	Other Fossil	8.6	8.6	8.6	8.6
BRA	RES-only	Generator	Solar	53.1	53.1	180.8	578.2
BRA	RES-only	Generator	Wind	33.0	83.9	164.8	356.8
BRA	RES-only	Link	Transmission	188.0	191.2	265.9	422.1
BRA	RES-only	Storage Unit	Battery	0.0	1.5	43.9	147.9
BRA	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
BRA	RES-only	Store	Hydrogen	0.0	0.0	0.0	152.0
BRA	Unconstrained	Generator	Biomass	17.8	17.8	17.8	17.8
BRA	Unconstrained	Generator	Coal	17.3	17.3	39.3	57.6
BRA	Unconstrained	Generator	Gas	18.3	27.4	38.8	55.7
BRA	Unconstrained	Generator	Geothermal	0.0	0.0	0.0	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
BRA	Unconstrained	Generator	Hydro	110.0	110.0	110.0	110.0
BRA	Unconstrained	Generator	Nuclear	2.0	2.0	2.0	2.0
BRA	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
BRA	Unconstrained	Generator	Other Fossil	8.6	8.6	8.6	8.6
BRA	Unconstrained	Generator	Solar	53.1	53.1	53.1	133.2
BRA	Unconstrained	Generator	Wind	33.0	33.0	33.0	33.0
BRA	Unconstrained	Link	Transmission	188.0	188.0	188.0	207.0
BRA	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
BRA	Unconstrained	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
BRA	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
GHA	Optimistic Nuclear	Generator	Biomass	0.0	0.0	0.0	0.0
GHA	Optimistic Nuclear	Generator	Coal	0.0	0.0	0.0	0.0
GHA	Optimistic Nuclear	Generator	Gas	3.1	3.1	3.1	3.1
GHA	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
GHA	Optimistic Nuclear	Generator	Hydro	1.6	1.6	1.6	1.6
GHA	Optimistic Nuclear	Generator	Nuclear	0.0	0.0	0.8	2.4
GHA	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
GHA	Optimistic Nuclear	Generator	Other Fossil	0.4	0.4	0.4	0.4
GHA	Optimistic Nuclear	Generator	Solar	0.2	1.6	10.6	23.6
GHA	Optimistic Nuclear	Generator	Wind	0.0	0.0	0.0	9.7
GHA	Optimistic Nuclear	Link	Transmission	5.5	5.5	9.4	14.7
GHA	Optimistic Nuclear	Storage Unit	Battery	0.0	0.0	2.3	5.4
GHA	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
GHA	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	1.8

Country	Scenario	Component	Technology	2025	2030	2040	2050
GHA	Pessimistic Nuclear	Generator	Biomass	0.0	0.0	0.0	0.0
GHA	Pessimistic Nuclear	Generator	Coal	0.0	0.0	0.0	0.0
GHA	Pessimistic Nuclear	Generator	Gas	3.1	3.1	3.1	3.1
GHA	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
GHA	Pessimistic Nuclear	Generator	Hydro	1.6	1.6	1.6	1.6
GHA	Pessimistic Nuclear	Generator	Nuclear	0.0	0.0	0.8	0.8
GHA	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	0.4
GHA	Pessimistic Nuclear	Generator	Other Fossil	0.4	0.4	0.4	0.4
GHA	Pessimistic Nuclear	Generator	Solar	0.2	1.6	10.7	32.2
GHA	Pessimistic Nuclear	Generator	Wind	0.0	0.0	0.0	12.0
GHA	Pessimistic Nuclear	Link	Transmission	5.5	5.5	9.4	18.1
GHA	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	2.3	7.9
GHA	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
GHA	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	1.8
GHA	RES-only	Generator	Biomass	0.0	0.0	0.0	0.0
GHA	RES-only	Generator	Coal	0.0	0.0	0.0	0.0
GHA	RES-only	Generator	Gas	3.1	3.1	3.1	3.1
GHA	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
GHA	RES-only	Generator	Hydro	1.6	1.6	1.6	1.6
GHA	RES-only	Generator	Nuclear	0.0	0.0	0.0	0.0
GHA	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
GHA	RES-only	Generator	Other Fossil	0.4	0.4	0.4	0.4
GHA	RES-only	Generator	Solar	0.2	1.6	15.8	41.0
GHA	RES-only	Generator	Wind	0.0	0.0	0.0	14.2

Country	Scenario	Component	Technology	2025	2030	2040	2050
GHA	RES-only	Link	Transmission	5.5	5.5	12.5	21.1
GHA	RES-only	Storage Unit	Battery	0.0	0.0	4.4	10.2
GHA	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
GHA	RES-only	Store	Hydrogen	0.0	0.0	0.0	2.5
GHA	Unconstrained	Generator	Biomass	0.0	0.0	0.0	0.0
GHA	Unconstrained	Generator	Coal	0.0	0.0	0.0	0.0
GHA	Unconstrained	Generator	Gas	3.1	3.1	4.1	5.5
GHA	Unconstrained	Generator	Geothermal	0.0	0.0	0.0	0.0
GHA	Unconstrained	Generator	Hydro	1.6	1.6	1.6	1.6
GHA	Unconstrained	Generator	Nuclear	0.0	0.0	0.0	0.0
GHA	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
GHA	Unconstrained	Generator	Other Fossil	0.4	0.4	0.4	0.4
GHA	Unconstrained	Generator	Solar	0.2	0.2	0.2	1.9
GHA	Unconstrained	Generator	Wind	0.0	0.0	0.0	0.0
GHA	Unconstrained	Link	Transmission	5.5	5.5	5.6	7.6
GHA	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
GHA	Unconstrained	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
GHA	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
IDN	Optimistic Nuclear	Generator	Biomass	3.4	3.4	3.4	3.4
IDN	Optimistic Nuclear	Generator	Coal	41.3	41.3	41.3	41.3
IDN	Optimistic Nuclear	Generator	Gas	23.4	23.4	23.4	23.4
IDN	Optimistic Nuclear	Generator	Geothermal	2.7	2.7	2.7	2.7
IDN	Optimistic Nuclear	Generator	Hydro	7.2	7.2	7.2	7.2
IDN	Optimistic Nuclear	Generator	Nuclear	0.0	0.0	12.7	38.1

Country	Scenario	Component	Technology	2025	2030	2040	2050
IDN	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	12.7
IDN	Optimistic Nuclear	Generator	Other Fossil	7.3	7.3	7.3	7.3
IDN	Optimistic Nuclear	Generator	Solar	0.8	16.6	235.3	627.6
IDN	Optimistic Nuclear	Generator	Wind	0.1	0.2	54.8	54.8
IDN	Optimistic Nuclear	Link	Transmission	108.8	108.8	147.2	409.0
IDN	Optimistic Nuclear	Storage Unit	Battery	0.0	0.0	23.8	182.9
IDN	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
IDN	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	34.8
IDN	Pessimistic Nuclear	Generator	Biomass	3.4	3.4	3.4	3.4
IDN	Pessimistic Nuclear	Generator	Coal	41.3	41.3	41.3	41.3
IDN	Pessimistic Nuclear	Generator	Gas	23.4	23.4	23.4	23.4
IDN	Pessimistic Nuclear	Generator	Geothermal	2.7	2.7	2.7	2.7
IDN	Pessimistic Nuclear	Generator	Hydro	7.2	7.2	7.2	7.2
IDN	Pessimistic Nuclear	Generator	Nuclear	0.0	0.0	6.3	12.7
IDN	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	12.7
IDN	Pessimistic Nuclear	Generator	Other Fossil	7.3	7.3	7.3	7.3
IDN	Pessimistic Nuclear	Generator	Solar	0.8	16.6	283.0	799.7
IDN	Pessimistic Nuclear	Generator	Wind	0.1	0.2	55.3	84.1
IDN	Pessimistic Nuclear	Link	Transmission	108.8	108.8	165.1	488.4
IDN	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	35.6	237.4
IDN	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
IDN	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	35.0
IDN	RES-only	Generator	Biomass	3.4	3.4	3.4	3.4
IDN	RES-only	Generator	Coal	41.5	41.5	41.5	41.5

Country	Scenario	Component	Technology	2025	2030	2040	2050
IDN	RES-only	Generator	Gas	23.4	23.4	23.4	23.4
IDN	RES-only	Generator	Geothermal	2.7	2.7	2.7	2.7
IDN	RES-only	Generator	Hydro	7.2	7.2	7.2	7.2
IDN	RES-only	Generator	Nuclear	0.0	0.0	0.0	0.0
IDN	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
IDN	RES-only	Generator	Other Fossil	7.3	7.3	7.3	7.3
IDN	RES-only	Generator	Solar	0.8	16.1	317.7	993.8
IDN	RES-only	Generator	Wind	0.1	0.2	60.6	113.4
IDN	RES-only	Link	Transmission	108.8	108.8	181.6	564.3
IDN	RES-only	Storage Unit	Battery	0.0	0.0	46.7	287.6
IDN	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
IDN	RES-only	Store	Hydrogen	0.0	0.0	0.0	37.9
IDN	Unconstrained	Generator	Biomass	3.4	3.4	3.4	3.4
IDN	Unconstrained	Generator	Coal	38.3	45.1	63.7	100.5
IDN	Unconstrained	Generator	Gas	23.4	23.4	23.4	23.4
IDN	Unconstrained	Generator	Geothermal	2.7	2.7	2.7	2.7
IDN	Unconstrained	Generator	Hydro	7.2	7.2	7.2	7.2
IDN	Unconstrained	Generator	Nuclear	0.0	0.0	0.0	0.0
IDN	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
IDN	Unconstrained	Generator	Other Fossil	7.3	7.3	7.3	7.3
IDN	Unconstrained	Generator	Solar	0.8	8.0	138.0	216.3
IDN	Unconstrained	Generator	Wind	0.1	0.2	0.2	7.2
IDN	Unconstrained	Link	Transmission	108.8	108.8	114.2	159.6
IDN	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
IDN	Unconstrained	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
IDN	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
IND	Optimistic Nuclear	Generator	Biomass	10.9	10.9	10.9	10.9
IND	Optimistic Nuclear	Generator	Coal	300.0	300.0	300.0	300.0
IND	Optimistic Nuclear	Generator	Gas	30.5	30.5	30.5	30.5
IND	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
IND	Optimistic Nuclear	Generator	Hydro	47.5	47.5	47.5	47.5
IND	Optimistic Nuclear	Generator	Nuclear	8.2	8.2	88.2	168.2
IND	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	160.0
IND	Optimistic Nuclear	Generator	Other Fossil	20.1	20.1	20.1	20.1
IND	Optimistic Nuclear	Generator	Solar	97.4	97.4	1119.0	4014.1
IND	Optimistic Nuclear	Generator	Wind	48.2	48.2	430.0	573.1
IND	Optimistic Nuclear	Link	Transmission	553.3	553.3	899.0	2210.9
IND	Optimistic Nuclear	Storage Unit	Battery	0.0	0.0	220.3	954.4
IND	Optimistic Nuclear	Storage Unit	Pumped Hydro	3.3	3.3	3.3	3.3
IND	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	382.1
IND	Pessimistic Nuclear	Generator	Biomass	10.9	10.9	10.9	10.9
IND	Pessimistic Nuclear	Generator	Coal	300.0	300.0	300.0	300.0
IND	Pessimistic Nuclear	Generator	Gas	30.5	30.5	30.5	30.5
IND	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
IND	Pessimistic Nuclear	Generator	Hydro	47.5	47.5	47.5	47.5
IND	Pessimistic Nuclear	Generator	Nuclear	8.2	8.2	48.2	88.2
IND	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	80.0
IND	Pessimistic Nuclear	Generator	Other Fossil	20.1	20.1	20.1	20.1

Country	Scenario	Component	Technology	2025	2030	2040	2050
IND	Pessimistic Nuclear	Generator	Solar	97.4	97.4	1330.5	4797.3
IND	Pessimistic Nuclear	Generator	Wind	48.2	48.2	436.3	1056.9
IND	Pessimistic Nuclear	Link	Transmission	553.3	553.3	1040.4	2471.8
IND	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	322.0	1151.4
IND	Pessimistic Nuclear	Storage Unit	Pumped Hydro	3.3	3.3	3.3	3.3
IND	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	611.5
IND	RES-only	Generator	Biomass	10.9	10.9	10.9	10.9
IND	RES-only	Generator	Coal	300.0	300.0	300.0	300.0
IND	RES-only	Generator	Gas	30.5	30.5	30.5	30.5
IND	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
IND	RES-only	Generator	Hydro	47.5	47.5	47.5	47.5
IND	RES-only	Generator	Nuclear	8.2	8.2	8.2	8.2
IND	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
IND	RES-only	Generator	Other Fossil	20.1	20.1	20.1	20.1
IND	RES-only	Generator	Solar	97.4	97.4	1499.6	4928.8
IND	RES-only	Generator	Wind	48.2	48.2	539.1	2094.2
IND	RES-only	Link	Transmission	553.3	553.3	1134.6	2692.6
IND	RES-only	Storage Unit	Battery	0.0	0.0	420.2	1282.0
IND	RES-only	Storage Unit	Pumped Hydro	3.3	3.3	3.3	3.3
IND	RES-only	Store	Hydrogen	0.0	0.0	0.0	886.3
IND	Unconstrained	Generator	Biomass	10.9	10.9	10.9	10.9
IND	Unconstrained	Generator	Coal	180.1	245.6	448.4	680.9
IND	Unconstrained	Generator	Gas	30.5	43.5	78.7	153.8
IND	Unconstrained	Generator	Geothermal	0.0	0.0	0.0	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
IND	Unconstrained	Generator	Hydro	47.5	47.5	47.5	47.5
IND	Unconstrained	Generator	Nuclear	8.2	8.2	8.2	8.2
IND	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
IND	Unconstrained	Generator	Other Fossil	20.1	20.1	20.1	20.1
IND	Unconstrained	Generator	Solar	97.4	97.4	237.5	1189.8
IND	Unconstrained	Generator	Wind	48.2	48.2	48.2	48.2
IND	Unconstrained	Link	Transmission	553.3	553.3	660.3	1006.0
IND	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
IND	Unconstrained	Storage Unit	Pumped Hydro	3.3	3.3	3.3	3.3
IND	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
NGA	Optimistic Nuclear	Generator	Biomass	0.0	0.0	0.0	0.0
NGA	Optimistic Nuclear	Generator	Coal	0.3	0.3	0.3	0.3
NGA	Optimistic Nuclear	Generator	Gas	13.4	13.4	13.4	13.4
NGA	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
NGA	Optimistic Nuclear	Generator	Hydro	2.9	2.9	2.9	2.9
NGA	Optimistic Nuclear	Generator	Nuclear	0.0	0.0	4.4	13.3
NGA	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	4.4
NGA	Optimistic Nuclear	Generator	Other Fossil	0.0	0.0	0.0	0.0
NGA	Optimistic Nuclear	Generator	Solar	0.1	12.7	86.0	277.7
NGA	Optimistic Nuclear	Generator	Wind	0.0	0.0	0.0	48.3
NGA	Optimistic Nuclear	Link	Transmission	9.9	10.0	57.6	137.2
NGA	Optimistic Nuclear	Storage Unit	Battery	0.0	0.0	23.7	58.2
NGA	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
NGA	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	34.7

Country	Scenario	Component	Technology	2025	2030	2040	2050
NGA	Pessimistic Nuclear	Generator	Biomass	0.0	0.0	0.0	0.0
NGA	Pessimistic Nuclear	Generator	Coal	0.3	0.3	0.3	0.3
NGA	Pessimistic Nuclear	Generator	Gas	19.4	19.4	19.4	19.4
NGA	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
NGA	Pessimistic Nuclear	Generator	Hydro	2.9	2.9	2.9	2.9
NGA	Pessimistic Nuclear	Generator	Nuclear	0.0	0.0	2.2	5.6
NGA	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	3.2
NGA	Pessimistic Nuclear	Generator	Other Fossil	0.0	0.0	0.0	0.0
NGA	Pessimistic Nuclear	Generator	Solar	0.1	12.7	102.7	364.7
NGA	Pessimistic Nuclear	Generator	Wind	0.0	0.0	0.0	53.3
NGA	Pessimistic Nuclear	Link	Transmission	9.9	10.0	65.8	165.1
NGA	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	29.3	77.1
NGA	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
NGA	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	41.0
NGA	RES-only	Generator	Biomass	0.0	0.0	0.0	0.0
NGA	RES-only	Generator	Coal	0.3	0.3	0.3	0.3
NGA	RES-only	Generator	Gas	25.3	25.3	25.3	25.3
NGA	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
NGA	RES-only	Generator	Hydro	2.9	2.9	2.9	2.9
NGA	RES-only	Generator	Nuclear	0.0	0.0	0.0	0.0
NGA	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
NGA	RES-only	Generator	Other Fossil	0.0	0.0	0.0	0.0
NGA	RES-only	Generator	Solar	0.1	12.7	119.6	460.2
NGA	RES-only	Generator	Wind	0.0	0.0	0.0	58.6

Country	Scenario	Component	Technology	2025	2030	2040	2050
NGA	RES-only	Link	Transmission	9.9	10.0	74.0	191.1
NGA	RES-only	Storage Unit	Battery	0.0	0.0	35.0	94.2
NGA	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
NGA	RES-only	Store	Hydrogen	0.0	0.0	0.0	46.8
NGA	Unconstrained	Generator	Biomass	0.0	0.0	0.0	0.0
NGA	Unconstrained	Generator	Coal	0.3	0.3	0.3	0.3
NGA	Unconstrained	Generator	Gas	5.9	8.8	22.4	54.6
NGA	Unconstrained	Generator	Geothermal	0.0	0.0	0.0	0.0
NGA	Unconstrained	Generator	Hydro	2.9	2.9	2.9	2.9
NGA	Unconstrained	Generator	Nuclear	0.0	0.0	0.0	0.0
NGA	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
NGA	Unconstrained	Generator	Other Fossil	0.0	0.0	0.0	0.0
NGA	Unconstrained	Generator	Solar	0.1	0.1	0.1	0.1
NGA	Unconstrained	Generator	Wind	0.0	0.0	0.0	0.0
NGA	Unconstrained	Link	Transmission	9.9	10.0	23.6	55.8
NGA	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
NGA	Unconstrained	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
NGA	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
PHL	Optimistic Nuclear	Generator	Biomass	0.8	0.8	0.8	0.8
PHL	Optimistic Nuclear	Generator	Coal	15.3	15.3	15.3	15.3
PHL	Optimistic Nuclear	Generator	Gas	3.3	3.3	3.3	3.3
PHL	Optimistic Nuclear	Generator	Geothermal	1.9	1.9	1.9	1.9
PHL	Optimistic Nuclear	Generator	Hydro	3.1	3.1	3.1	3.1
PHL	Optimistic Nuclear	Generator	Nuclear	0.0	0.0	4.2	12.7

Country	Scenario	Component	Technology	2025	2030	2040	2050
PHL	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	4.2
PHL	Optimistic Nuclear	Generator	Other Fossil	4.2	4.2	4.2	4.2
PHL	Optimistic Nuclear	Generator	Solar	3.0	3.0	106.9	260.4
PHL	Optimistic Nuclear	Generator	Wind	0.4	0.4	0.4	55.4
PHL	Optimistic Nuclear	Link	Transmission	36.3	36.3	65.4	137.1
PHL	Optimistic Nuclear	Storage Unit	Battery	0.0	0.0	18.4	66.9
PHL	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
PHL	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	20.1
PHL	Pessimistic Nuclear	Generator	Biomass	0.8	0.8	0.8	0.8
PHL	Pessimistic Nuclear	Generator	Coal	15.2	15.2	15.2	15.2
PHL	Pessimistic Nuclear	Generator	Gas	3.3	3.3	3.3	3.3
PHL	Pessimistic Nuclear	Generator	Geothermal	1.9	1.9	1.9	1.9
PHL	Pessimistic Nuclear	Generator	Hydro	3.1	3.1	3.1	3.1
PHL	Pessimistic Nuclear	Generator	Nuclear	0.0	0.0	0.0	0.0
PHL	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	2.1	8.5
PHL	Pessimistic Nuclear	Generator	Other Fossil	4.2	4.2	4.2	4.2
PHL	Pessimistic Nuclear	Generator	Solar	3.0	3.0	125.5	331.8
PHL	Pessimistic Nuclear	Generator	Wind	0.4	0.4	0.4	80.6
PHL	Pessimistic Nuclear	Link	Transmission	36.3	36.3	72.5	160.4
PHL	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	23.4	82.2
PHL	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
PHL	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	29.2
PHL	RES-only	Generator	Biomass	0.8	0.8	0.8	0.8
PHL	RES-only	Generator	Coal	16.0	16.0	16.0	16.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
PHL	RES-only	Generator	Gas	3.3	3.3	3.3	3.3
PHL	RES-only	Generator	Geothermal	1.9	1.9	1.9	1.9
PHL	RES-only	Generator	Hydro	3.1	3.1	3.1	3.1
PHL	RES-only	Generator	Nuclear	0.0	0.0	0.0	0.0
PHL	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
PHL	RES-only	Generator	Other Fossil	4.2	4.2	4.2	4.2
PHL	RES-only	Generator	Solar	3.0	3.0	142.1	395.5
PHL	RES-only	Generator	Wind	0.4	0.4	0.4	105.7
PHL	RES-only	Link	Transmission	36.3	36.3	80.2	182.6
PHL	RES-only	Storage Unit	Battery	0.0	0.0	28.9	99.8
PHL	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
PHL	RES-only	Store	Hydrogen	0.0	0.0	0.0	37.6
PHL	Unconstrained	Generator	Biomass	0.8	0.8	0.8	0.8
PHL	Unconstrained	Generator	Coal	10.3	13.3	23.0	31.4
PHL	Unconstrained	Generator	Gas	3.3	3.3	3.3	8.6
PHL	Unconstrained	Generator	Geothermal	1.9	1.9	1.9	1.9
PHL	Unconstrained	Generator	Hydro	3.1	3.1	3.1	3.1
PHL	Unconstrained	Generator	Nuclear	0.0	0.0	0.0	0.0
PHL	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
PHL	Unconstrained	Generator	Other Fossil	4.2	4.2	4.2	4.2
PHL	Unconstrained	Generator	Solar	3.0	3.0	16.4	63.2
PHL	Unconstrained	Generator	Wind	0.4	0.4	0.4	0.4
PHL	Unconstrained	Link	Transmission	36.3	36.3	38.1	53.2
PHL	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
PHL	Unconstrained	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
PHL	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Generator	Biomass	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Generator	Coal	0.5	0.5	0.5	0.5
RWA	Optimistic Nuclear	Generator	Gas	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Generator	Hydro	0.1	0.1	0.1	0.1
RWA	Optimistic Nuclear	Generator	Nuclear	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.4	1.1
RWA	Optimistic Nuclear	Generator	Other Fossil	0.1	0.1	0.1	0.1
RWA	Optimistic Nuclear	Generator	Solar	0.0	0.7	2.8	16.3
RWA	Optimistic Nuclear	Generator	Wind	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Link	Transmission	0.3	0.6	2.3	9.3
RWA	Optimistic Nuclear	Storage Unit	Battery	0.0	0.2	0.9	4.6
RWA	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	1.2
RWA	Pessimistic Nuclear	Generator	Biomass	0.0	0.0	0.0	0.0
RWA	Pessimistic Nuclear	Generator	Coal	1.0	1.0	1.0	1.0
RWA	Pessimistic Nuclear	Generator	Gas	0.0	0.0	0.0	0.0
RWA	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
RWA	Pessimistic Nuclear	Generator	Hydro	0.1	0.1	0.1	0.1
RWA	Pessimistic Nuclear	Generator	Nuclear	0.0	0.0	0.0	0.0
RWA	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.2	0.6
RWA	Pessimistic Nuclear	Generator	Other Fossil	0.1	0.1	0.1	0.1

Country	Scenario	Component	Technology	2025	2030	2040	2050
RWA	Pessimistic Nuclear	Generator	Solar	0.0	0.7	4.3	20.6
RWA	Pessimistic Nuclear	Generator	Wind	0.0	0.0	0.0	0.0
RWA	Pessimistic Nuclear	Link	Transmission	0.3	0.6	3.0	10.9
RWA	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.2	1.4	5.7
RWA	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
RWA	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	1.9
RWA	RES-only	Generator	Biomass	0.0	0.0	0.0	0.0
RWA	RES-only	Generator	Coal	1.5	1.5	1.5	1.5
RWA	RES-only	Generator	Gas	0.0	0.0	0.0	0.0
RWA	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
RWA	RES-only	Generator	Hydro	0.1	0.1	0.1	0.1
RWA	RES-only	Generator	Nuclear	0.0	0.0	0.0	0.0
RWA	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
RWA	RES-only	Generator	Other Fossil	0.1	0.1	0.1	0.1
RWA	RES-only	Generator	Solar	0.0	0.7	5.6	25.4
RWA	RES-only	Generator	Wind	0.0	0.0	0.0	0.0
RWA	RES-only	Link	Transmission	0.3	0.6	3.7	12.1
RWA	RES-only	Storage Unit	Battery	0.0	0.2	1.9	6.6
RWA	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
RWA	RES-only	Store	Hydrogen	0.0	0.0	0.0	2.9
RWA	Unconstrained	Generator	Biomass	0.0	0.0	0.0	0.0
RWA	Unconstrained	Generator	Coal	0.0	0.1	0.6	2.1
RWA	Unconstrained	Generator	Gas	0.0	0.0	0.3	1.1
RWA	Unconstrained	Generator	Geothermal	0.0	0.0	0.0	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
RWA	Unconstrained	Generator	Hydro	0.1	0.1	0.1	0.1
RWA	Unconstrained	Generator	Nuclear	0.0	0.0	0.0	0.0
RWA	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
RWA	Unconstrained	Generator	Other Fossil	0.1	0.1	0.1	0.1
RWA	Unconstrained	Generator	Solar	0.0	0.0	0.0	0.5
RWA	Unconstrained	Generator	Wind	0.0	0.0	0.0	0.0
RWA	Unconstrained	Link	Transmission	0.3	0.3	1.1	3.5
RWA	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
RWA	Unconstrained	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
ZAF	Optimistic Nuclear	Generator	Coal	28.4	28.4	28.4	28.4
ZAF	Optimistic Nuclear	Generator	Gas	1.3	1.3	1.3	1.3
ZAF	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
ZAF	Optimistic Nuclear	Generator	Hydro	0.8	0.8	0.8	0.8
ZAF	Optimistic Nuclear	Generator	Nuclear	1.9	1.9	7.0	17.2
ZAF	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	5.1
ZAF	Optimistic Nuclear	Generator	Other Fossil	2.4	2.4	2.4	2.4
ZAF	Optimistic Nuclear	Generator	Solar	6.7	6.7	24.6	153.4
ZAF	Optimistic Nuclear	Generator	Wind	3.4	3.4	28.1	77.5
ZAF	Optimistic Nuclear	Link	Transmission	57.1	57.1	62.0	104.7
ZAF	Optimistic Nuclear	Storage Unit	Battery	0.0	0.0	2.9	28.7
ZAF	Optimistic Nuclear	Storage Unit	Pumped Hydro	2.9	2.9	2.9	2.9
ZAF	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	57.5
ZAF	Pessimistic Nuclear	Generator	Biomass	0.3	0.3	0.3	0.3
ZAF	Pessimistic Nuclear	Generator	Coal	29.1	29.1	29.1	29.1

Country	Scenario	Component	Technology	2025	2030	2040	2050
RWA	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
ZAF	Optimistic Nuclear	Generator	Biomass	0.3	0.3	0.3	0.3
ZAF	Pessimistic Nuclear	Generator	Gas	1.3	1.3	1.3	1.3
ZAF	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
ZAF	Pessimistic Nuclear	Generator	Hydro	0.8	0.8	0.8	0.8
ZAF	Pessimistic Nuclear	Generator	Nuclear	1.9	1.9	4.5	9.6
ZAF	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	2.5
ZAF	Pessimistic Nuclear	Generator	Other Fossil	2.4	2.4	2.4	2.4
ZAF	Pessimistic Nuclear	Generator	Solar	6.7	6.7	37.2	197.5
ZAF	Pessimistic Nuclear	Generator	Wind	3.4	3.4	28.3	114.9
ZAF	Pessimistic Nuclear	Link	Transmission	57.1	57.1	66.7	124.9
ZAF	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	6.2	41.7
ZAF	Pessimistic Nuclear	Storage Unit	Pumped Hydro	2.9	2.9	2.9	2.9
ZAF	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	67.6
ZAF	RES-only	Generator	Biomass	0.3	0.3	0.3	0.3
ZAF	RES-only	Generator	Coal	29.9	29.9	29.9	29.9
ZAF	RES-only	Generator	Gas	1.3	1.3	1.3	1.3
ZAF	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
ZAF	RES-only	Generator	Hydro	0.8	0.8	0.8	0.8
ZAF	RES-only	Generator	Nuclear	1.9	1.9	1.9	1.9
ZAF	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
ZAF	RES-only	Generator	Other Fossil	2.4	2.4	2.4	2.4
ZAF	RES-only	Generator	Solar	6.7	6.7	46.9	240.1
ZAF	RES-only	Generator	Wind	3.4	3.4	29.3	152.5

Country	Scenario	Component	Technology	2025	2030	2040	2050
ZAF	RES-only	Link	Transmission	57.1	57.1	72.6	140.3
ZAF	RES-only	Storage Unit	Battery	0.0	0.0	10.1	51.2
ZAF	RES-only	Storage Unit	Pumped Hydro	2.9	2.9	2.9	2.9
ZAF	RES-only	Store	Hydrogen	0.0	0.0	0.0	82.6
ZAF	Unconstrained	Generator	Biomass	0.3	0.3	0.3	0.3
ZAF	Unconstrained	Generator	Coal	26.6	26.6	33.0	40.7
ZAF	Unconstrained	Generator	Gas	1.3	2.8	5.9	9.2
ZAF	Unconstrained	Generator	Geothermal	0.0	0.0	0.0	0.0
ZAF	Unconstrained	Generator	Hydro	0.8	0.8	0.8	0.8
ZAF	Unconstrained	Generator	Nuclear	1.9	1.9	1.9	1.9
ZAF	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
ZAF	Unconstrained	Generator	Other Fossil	2.4	2.4	2.4	2.4
ZAF	Unconstrained	Generator	Solar	6.7	6.7	6.7	22.5
ZAF	Unconstrained	Generator	Wind	3.4	3.4	3.4	3.7
ZAF	Unconstrained	Link	Transmission	57.1	57.1	57.1	64.1
ZAF	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
ZAF	Unconstrained	Storage Unit	Pumped Hydro	2.9	2.9	2.9	2.9
ZAF	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0

Table 8
Annual Generation by Country, Scenario, Component, and Technology (TWh).
Note: Storagedispatch values represent energy discharged and are already counted in the total generation, so summingacross all rows would result in double-counting. Nonetheless, we provide the dispatch through storages forreference.

Country	Scenario	Component	Technology	2025	2030	2040	2050
BRA	Optimistic Nuclear	Generator	Biomass	131.3	131.3	84.1	0.0
BRA	Optimistic Nuclear	Generator	Coal	29.0	18.2	4.5	0.0
BRA	Optimistic Nuclear	Generator	Gas	56.9	72.5	32.5	0.0
BRA	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
BRA	Optimistic Nuclear	Generator	Hydro	414.5	414.5	415.7	414.5
BRA	Optimistic Nuclear	Generator	Nuclear	15.7	15.6	118.7	223.4
BRA	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	90.7
BRA	Optimistic Nuclear	Generator	Other Fossil	0.0	0.1	6.9	0.0
BRA	Optimistic Nuclear	Generator	Solar	85.6	84.7	208.0	465.9
BRA	Optimistic Nuclear	Generator	Wind	68.9	153.0	252.2	278.5
BRA	Optimistic Nuclear	Storage Unit	Battery	0.0	1.0	45.6	123.9
BRA	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
BRA	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	35.6
BRA	Pessimistic Nuclear	Generator	Biomass	131.3	132.4	78.4	0.0
BRA	Pessimistic Nuclear	Generator	Coal	29.0	18.1	12.2	0.0
BRA	Pessimistic Nuclear	Generator	Gas	56.8	72.1	29.4	0.0
BRA	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
BRA	Pessimistic Nuclear	Generator	Hydro	414.5	414.5	415.6	414.3
BRA	Pessimistic Nuclear	Generator	Nuclear	15.7	15.6	55.6	97.4
BRA	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	48.4
BRA	Pessimistic Nuclear	Generator	Other Fossil	0.0	0.1	1.5	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
BRA	Pessimistic Nuclear	Generator	Solar	85.6	84.7	264.4	647.5
BRA	Pessimistic Nuclear	Generator	Wind	68.9	152.5	271.5	287.7
BRA	Pessimistic Nuclear	Storage Unit	Battery	0.0	2.0	62.8	172.1
BRA	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
BRA	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	43.5
BRA	RES-only	Generator	Biomass	131.3	132.4	74.6	0.0
BRA	RES-only	Generator	Coal	29.0	18.1	19.3	0.0
BRA	RES-only	Generator	Gas	56.8	72.1	20.5	0.0
BRA	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
BRA	RES-only	Generator	Hydro	414.5	414.5	415.6	414.2
BRA	RES-only	Generator	Nuclear	15.7	15.6	14.8	12.4
BRA	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
BRA	RES-only	Generator	Other Fossil	0.0	0.1	1.5	0.0
BRA	RES-only	Generator	Solar	85.6	84.7	293.1	795.3
BRA	RES-only	Generator	Wind	68.9	152.5	293.2	288.5
BRA	RES-only	Storage Unit	Battery	0.0	2.0	74.6	216.9
BRA	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
BRA	RES-only	Store	Hydrogen	0.0	0.0	0.0	65.2
BRA	Unconstrained	Generator	Biomass	131.4	151.5	156.2	153.6
BRA	Unconstrained	Generator	Coal	66.2	109.1	294.6	408.4
BRA	Unconstrained	Generator	Gas	5.9	50.1	65.8	111.7
BRA	Unconstrained	Generator	Geothermal	0.0	0.0	0.0	0.0
BRA	Unconstrained	Generator	Hydro	414.5	414.5	415.7	414.5
BRA	Unconstrained	Generator	Nuclear	15.5	15.7	15.7	15.7

Country	Scenario	Component	Technology	2025	2030	2040	2050
BRA	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
BRA	Unconstrained	Generator	Other Fossil	13.8	3.1	1.2	0.4
BRA	Unconstrained	Generator	Solar	85.6	84.7	86.5	214.3
BRA	Unconstrained	Generator	Wind	69.0	61.0	72.8	69.7
BRA	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
BRA	Unconstrained	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
BRA	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
GHA	Optimistic Nuclear	Generator	Biomass	0.1	0.1	0.1	0.0
GHA	Optimistic Nuclear	Generator	Coal	0.0	0.0	0.0	0.0
GHA	Optimistic Nuclear	Generator	Gas	13.2	13.3	6.6	0.0
GHA	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
GHA	Optimistic Nuclear	Generator	Hydro	9.2	9.2	9.2	9.2
GHA	Optimistic Nuclear	Generator	Nuclear	0.0	0.0	6.2	15.4
GHA	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	0.1
GHA	Optimistic Nuclear	Generator	Other Fossil	1.6	3.2	2.1	0.0
GHA	Optimistic Nuclear	Generator	Solar	0.3	2.4	14.8	26.8
GHA	Optimistic Nuclear	Generator	Wind	0.0	0.0	0.0	3.7
GHA	Optimistic Nuclear	Storage Unit	Battery	0.0	0.0	3.7	9.7
GHA	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
GHA	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	0.9
GHA	Pessimistic Nuclear	Generator	Biomass	0.1	0.1	0.1	0.0
GHA	Pessimistic Nuclear	Generator	Coal	0.0	0.0	0.0	0.0
GHA	Pessimistic Nuclear	Generator	Gas	13.4	13.3	6.6	0.0
GHA	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
GHA	Pessimistic Nuclear	Generator	Hydro	9.2	9.2	9.2	9.2
GHA	Pessimistic Nuclear	Generator	Nuclear	0.0	0.0	6.2	5.1
GHA	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	1.4
GHA	Pessimistic Nuclear	Generator	Other Fossil	1.4	3.2	2.1	0.0
GHA	Pessimistic Nuclear	Generator	Solar	0.3	2.4	14.8	36.8
GHA	Pessimistic Nuclear	Generator	Wind	0.0	0.0	0.0	4.1
GHA	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	3.7	14.3
GHA	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
GHA	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	0.9
GHA	RES-only	Generator	Biomass	0.1	0.1	0.1	0.0
GHA	RES-only	Generator	Coal	0.0	0.0	0.0	0.0
GHA	RES-only	Generator	Gas	13.4	13.3	6.7	0.0
GHA	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
GHA	RES-only	Generator	Hydro	9.2	9.2	9.2	9.2
GHA	RES-only	Generator	Nuclear	0.0	0.0	0.0	0.0
IDN	Pessimistic Nuclear	Generator	Coal	323.1	357.2	195.5	0.0
IDN	Pessimistic Nuclear	Generator	Gas	2.3	36.1	10.4	0.0
IDN	Pessimistic Nuclear	Generator	Geothermal	23.7	23.7	17.7	0.0
IDN	Pessimistic Nuclear	Generator	Hydro	27.3	27.3	27.3	27.3
IDN	Pessimistic Nuclear	Generator	Nuclear	0.0	0.0	49.4	78.9
IDN	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	37.0
IDN	Pessimistic Nuclear	Generator	Other Fossil	1.7	16.9	17.9	0.0
	Pessimistic Nuclear	Generator	Solar	1.2	23.8	369.4	950.6
IDN	Pessimistic Nuclear	Generator	Wind	0.3	0.3	77.9	105.7

Country	Scenario	Component	Technology	2025	2030	2040	2050
IDN	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	63.8	349.1
IDN	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
IDN	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	8.5
IDN	RES-only	Generator	Biomass	29.8	29.8	21.6	0.0
IDN	RES-only	Generator	Coal	323.4	358.6	193.9	0.0
IDN	RES-only	Generator	Gas	2.0	35.4	11.7	0.0
IDN	RES-only	Generator	Geothermal	23.7	23.7	17.6	0.0
IDN	RES-only	Generator	Hydro	27.3	27.3	27.3	27.3
IDN	RES-only	Generator	Nuclear	0.0	0.0	0.0	0.0
IDN	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
IDN	RES-only	Generator	Other Fossil	1.6	16.8	18.2	0.0
IDN	RES-only	Generator	Solar	1.2	23.1	418.2	1068.7
IDN	RES-only	Generator	Wind	0.3	0.3	85.0	112.1
IDN	RES-only	Storage Unit	Battery	0.0	0.0	83.6	398.0
IDN	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
IDN	RES-only	Store	Hydrogen	0.0	0.0	0.0	4.1
IDN	Unconstrained	Generator	Biomass	29.8	29.8	29.0	26.7
IDN	Unconstrained	Generator	Coal	313.9	384.7	426.3	609.4
IDN	Unconstrained	Generator	Gas	7.7	24.4	40.2	28.0
IDN	Unconstrained	Generator	Geothermal	23.7	23.7	23.4	21.7
IDN	Unconstrained	Generator	Hydro	27.3	27.3	27.3	27.3
IDN	Unconstrained	Generator	Nuclear	0.0	0.0	0.0	0.0
IDN	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
IDN	Unconstrained	Generator	Other Fossil	5.4	13.3	13.2	9.1
IDN	Unconstrained	Generator	Solar	1.2	11.5	208.0	328.7

Country	Scenario	Component	Technology	2025	2030	2040	2050
IDN	Unconstrained	Generator	Wind	0.3	0.3	0.3	19.1
IDN	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
IDN	Unconstrained	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
IDN	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
IND	Optimistic Nuclear	Generator	Biomass	95.7	95.7	75.7	0.0
IND	Optimistic Nuclear	Generator	Coal	1324.4	2030.8	968.1	0.0
IND	Optimistic Nuclear	Generator	Gas	0.0	0.0	32.5	0.0
IND	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
IND	Optimistic Nuclear	Generator	Hydro	163.0	163.0	163.4	163.0
IND	Optimistic Nuclear	Generator	Nuclear	64.5	64.5	687.0	1107.9
IND	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	642.5
IND	Optimistic Nuclear	Generator	Other Fossil	0.0	0.0	115.9	0.0
IND	Optimistic Nuclear	Generator	Solar	155.4	163.7	1759.3	4892.1
IND	Optimistic Nuclear	Generator	Wind	107.8	100.3	740.0	792.1
IND	Optimistic Nuclear	Storage Unit	Battery	0.0	0.0	345.5	1643.8
IND	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	5.7	8.3
IND	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	267.1
IND	Pessimistic Nuclear	Generator	Biomass	95.7	95.7	76.7	0.0
IND	Pessimistic Nuclear	Generator	Coal	1324.9	2031.3	973.4	0.0
IND	Pessimistic Nuclear	Generator	Gas	0.0	0.0	30.6	0.0
IND	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
IND	Pessimistic Nuclear	Generator	Hydro	162.5	162.5	162.8	162.5
IND	Pessimistic Nuclear	Generator	Nuclear	64.5	64.5	375.4	559.0
IND	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	255.2

Country	Scenario	Component	Technology	2025	2030	2040	2050
IND	Pessimistic Nuclear	Generator	Other Fossil	0.0	0.0	110.4	0.0
IND	Pessimistic Nuclear	Generator	Solar	155.4	163.7	2106.0	5508.5
IND	Pessimistic Nuclear	Generator	Wind	107.8	100.3	758.0	1142.5
IND	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	505.1	1737.6
IND	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	6.3	8.3
IND	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	305.5
IND	RES-only	Generator	Biomass	95.7	95.7	75.7	0.0
IND	RES-only	Generator	Coal	1324.9	2031.3	1045.1	0.0
IND	RES-only	Generator	Gas	0.0	0.0	4.6	0.0
IND	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
IND	RES-only	Generator	Hydro	162.5	162.5	162.8	162.5
IND	RES-only	Generator	Nuclear	64.5	64.5	62.7	51.0
IND	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
IND	RES-only	Generator	Other Fossil	0.0	0.0	3.1	0.0
IND	RES-only	Generator	Solar	155.4	163.7	2367.8	5777.5
IND	RES-only	Generator	Wind	107.8	100.3	918.3	1586.5
IND	RES-only	Storage Unit	Battery	0.0	0.0	634.5	1758.8
IND	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	6.6	8.1
IND	RES-only	Store	Hydrogen	0.0	0.0	0.0	254.2
IND	Unconstrained	Generator	Biomass	95.7	95.7	96.0	90.7
IND	Unconstrained	Generator	Coal	1320.9	1992.2	3565.5	4263.8
IND	Unconstrained	Generator	Gas	0.1	35.3	71.7	146.3
IND	Unconstrained	Generator	Geothermal	0.0	0.0	0.0	0.0
IND	Unconstrained	Generator	Hydro	162.5	162.5	162.8	162.5

Country	Scenario	Component	Technology	2025	2030	2040	2050
IND	Unconstrained	Generator	Nuclear	64.5	64.5	64.7	64.3
IND	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
IND	Unconstrained	Generator	Other Fossil	4.4	5.6	1.5	0.4
IND	Unconstrained	Generator	Solar	155.4	163.7	387.5	1925.1
IND	Unconstrained	Generator	Wind	107.8	100.3	90.5	94.3
IND	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
IND	Unconstrained	Storage Unit	Pumped Hydro	1.8	5.3	4.9	6.6
IND	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
NGA	Optimistic Nuclear	Generator	Biomass	0.2	0.2	0.1	0.0
NGA	Optimistic Nuclear	Generator	Coal	2.5	2.3	1.8	0.0
NGA	Optimistic Nuclear	Generator	Gas	33.3	40.1	20.7	0.0
NGA	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
NGA	Optimistic Nuclear	Generator	Hydro	7.7	7.7	7.7	7.7
NGA	Optimistic Nuclear	Generator	Nuclear	0.0	0.0	34.4	88.4
NGA	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	18.4
NGA	Optimistic Nuclear	Generator	Other Fossil	0.0	0.0	0.0	0.0
NGA	Optimistic Nuclear	Generator	Solar	0.2	16.9	106.0	293.9
NGA	Optimistic Nuclear	Generator	Wind	0.0	0.0	0.0	23.5
NGA	Optimistic Nuclear	Storage Unit	Battery	0.0	0.0	39.7	103.9
NGA	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
NGA	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	16.1
NGA	Pessimistic Nuclear	Generator	Biomass	0.2	0.2	0.1	0.0
NGA	Pessimistic Nuclear	Generator	Coal	2.5	2.3	1.8	0.0
NGA	Pessimistic Nuclear	Generator	Gas	33.3	40.1	20.7	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
NGA	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
NGA	Pessimistic Nuclear	Generator	Hydro	7.7	7.7	7.7	7.7
NGA	Pessimistic Nuclear	Generator	Nuclear	0.0	0.0	17.1	36.9
NGA	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	12.5
NGA	Pessimistic Nuclear	Generator	Other Fossil	0.0	0.0	0.0	0.0
NGA	Pessimistic Nuclear	Generator	Solar	0.2	16.9	126.3	362.3
NGA	Pessimistic Nuclear	Generator	Wind	0.0	0.0	0.0	22.4
NGA	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	49.1	135.4
NGA	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
NGA	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	17.0
NGA	RES-only	Generator	Biomass	0.2	0.2	0.1	0.0
NGA	RES-only	Generator	Coal	2.5	2.3	1.7	0.0
NGA	RES-only	Generator	Gas	33.3	40.1	20.8	0.0
NGA	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
NGA	RES-only	Generator	Hydro	7.7	7.7	7.7	7.7
NGA	RES-only	Generator	Nuclear	0.0	0.0	0.0	0.0
NGA	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
NGA	RES-only	Generator	Other Fossil	0.0	0.0	0.0	0.0
NGA	RES-only	Generator	Solar	0.2	16.9	146.4	422.0
NGA	RES-only	Generator	Wind	0.0	0.0	0.0	19.1
NGA	RES-only	Storage Unit	Battery	0.0	0.0	58.5	162.0
NGA	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
NGA	RES-only	Store	Hydrogen	0.0	0.0	0.0	16.2
NGA	Unconstrained	Generator	Biomass	0.2	0.2	0.2	0.2

Country	Scenario	Component	Technology	2025	2030	2040	2050
NGA	Unconstrained	Generator	Coal	2.5	2.5	2.5	2.5
NGA	Unconstrained	Generator	Gas	33.3	56.7	148.0	363.5
NGA	Unconstrained	Generator	Geothermal	0.0	0.0	0.0	0.0
NGA	Unconstrained	Generator	Hydro	7.7	7.7	7.7	7.7
NGA	Unconstrained	Generator	Nuclear	0.0	0.0	0.0	0.0
NGA	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
NGA	Unconstrained	Generator	Other Fossil	0.0	0.0	0.0	0.0
NGA	Unconstrained	Generator	Solar	0.2	0.2	0.2	0.2
NGA	Unconstrained	Generator	Wind	0.0	0.0	0.0	0.0
NGA	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
NGA	Unconstrained	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
NGA	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
PHL	Optimistic Nuclear	Generator	Biomass	7.0	7.0	5.1	0.0
PHL	Optimistic Nuclear	Generator	Coal	98.2	127.1	53.9	0.0
PHL	Optimistic Nuclear	Generator	Gas	0.0	3.1	20.3	0.0
PHL	Optimistic Nuclear	Generator	Geothermal	17.1	17.1	12.8	0.0
PHL	Optimistic Nuclear	Generator	Hydro	9.6	9.6	9.6	9.6
PHL	Optimistic Nuclear	Generator	Nuclear	0.0	0.0	32.9	82.1
PHL	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	15.0
PHL	Optimistic Nuclear	Generator	Other Fossil	0.0	3.4	1.9	0.0
PHL	Optimistic Nuclear	Generator	Solar	4.2	4.1	128.5	288.0
PHL	Optimistic Nuclear	Generator	Wind	0.3	0.3	0.2	12.4
PHL	Optimistic Nuclear	Storage Unit	Battery	0.0	0.0	31.9	112.2
PHL	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
PHL	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	11.4
PHL	Pessimistic Nuclear	Generator	Biomass	7.0	7.0	5.1	0.0
PHL	Pessimistic Nuclear	Generator	Coal	98.2	126.5	53.5	0.0
PHL	Pessimistic Nuclear	Generator	Gas	0.0	3.3	20.2	0.0
PHL	Pessimistic Nuclear	Generator	Geothermal	17.1	17.1	12.6	0.0
PHL	Pessimistic Nuclear	Generator	Hydro	9.6	9.6	9.6	9.6
PHL	Pessimistic Nuclear	Generator	Nuclear	0.0	0.0	0.0	0.0
PHL	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	16.4	31.2
PHL	Pessimistic Nuclear	Generator	Other Fossil	0.0	3.8	2.5	0.0
PHL	Pessimistic Nuclear	Generator	Solar	4.2	4.1	148.2	363.8
PHL	Pessimistic Nuclear	Generator	Wind	0.3	0.3	0.1	16.6
PHL	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	41.0	141.3
PHL	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
PHL	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	16.4
PHL	RES-only	Generator	Biomass	7.0	7.0	5.1	0.0
PHL	RES-only	Generator	Coal	98.2	129.7	53.5	0.0
PHL	RES-only	Generator	Gas	0.0	1.9	20.2	0.0
PHL	RES-only	Generator	Geothermal	17.1	17.1	12.5	0.0
PHL	RES-only	Generator	Hydro	9.6	9.6	9.6	9.6
PHL	RES-only	Generator	Nuclear	0.0	0.0	0.0	0.0
PHL	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
PHL	RES-only	Generator	Other Fossil	0.0	2.0	2.4	0.0
PHL	RES-only	Generator	Solar	4.2	4.1	167.6	396.9
PHL	RES-only	Generator	Wind	0.3	0.3	0.1	14.5

Country	Scenario	Component	Technology	2025	2030	2040	2050
PHL	RES-only	Storage Unit	Battery	0.0	0.0	50.4	159.4
PHL	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
PHL	RES-only	Store	Hydrogen	0.0	0.0	0.0	11.0
PHL	Unconstrained	Generator	Biomass	7.0	7.0	7.0	6.8
PHL	Unconstrained	Generator	Coal	87.8	114.6	187.5	210.5
PHL	Unconstrained	Generator	Gas	8.0	0.7	1.0	16.4
PHL	Unconstrained	Generator	Geothermal	17.1	17.1	17.1	16.7
PHL	Unconstrained	Generator	Hydro	9.6	9.6	9.6	9.6
PHL	Unconstrained	Generator	Nuclear	0.0	0.0	0.0	0.0
PHL	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
PHL	Unconstrained	Generator	Other Fossil	2.5	18.3	10.4	3.9
PHL	Unconstrained	Generator	Solar	4.2	4.1	23.0	92.5
PHL	Unconstrained	Generator	Wind	0.3	0.3	0.2	0.3
PHL	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
PHL	Unconstrained	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
PHL	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Generator	Biomass	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Generator	Coal	0.2	0.1	0.1	0.0
RWA	Optimistic Nuclear	Generator	Gas	0.3	0.2	0.1	0.0
RWA	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Generator	Hydro	0.6	0.6	0.6	0.6
RWA	Optimistic Nuclear	Generator	Nuclear	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	2.8	5.2
RWA	Optimistic Nuclear	Generator	Other Fossil	0.1	0.4	0.2	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
RWA	Optimistic Nuclear	Generator	Solar	0.0	1.1	4.0	21.5
RWA	Optimistic Nuclear	Generator	Wind	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Storage Unit	Battery	0.0	0.3	1.7	8.5
RWA	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
RWA	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	1.1
RWA	Pessimistic Nuclear	Generator	Biomass	0.0	0.0	0.0	0.0
RWA	Pessimistic Nuclear	Generator	Coal	0.2	0.1	0.1	0.0
RWA	Pessimistic Nuclear	Generator	Gas	0.3	0.2	0.1	0.0
RWA	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
RWA	Pessimistic Nuclear	Generator	Hydro	0.6	0.6	0.6	0.6
RWA	Pessimistic Nuclear	Generator	Nuclear	0.0	0.0	0.0	0.0
RWA	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	1.2	2.3
RWA	Pessimistic Nuclear	Generator	Other Fossil	0.1	0.4	0.2	0.0
RWA	Pessimistic Nuclear	Generator	Solar	0.0	1.1	5.9	25.0
RWA	Pessimistic Nuclear	Generator	Wind	0.0	0.0	0.0	0.0
RWA	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.3	2.5	10.1
RWA	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
RWA	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	1.1
RWA	RES-only	Generator	Biomass	0.0	0.0	0.0	0.0
RWA	RES-only	Generator	Coal	0.2	0.1	0.1	0.0
RWA	RES-only	Generator	Gas	0.3	0.2	0.1	0.0
RWA	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
RWA	RES-only	Generator	Hydro	0.6	0.6	0.6	0.6
RWA	RES-only	Generator	Nuclear	0.0	0.0	0.0	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
RWA	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
RWA	RES-only	Generator	Other Fossil	0.1	0.4	0.1	0.0
RWA	RES-only	Generator	Solar	0.0	1.1	7.3	27.6
RWA	RES-only	Generator	Wind	0.0	0.0	0.0	0.0
RWA	RES-only	Storage Unit	Battery	0.0	0.3	3.2	11.4
RWA	RES-only	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
RWA	RES-only	Store	Hydrogen	0.0	0.0	0.0	0.9
RWA	Unconstrained	Generator	Biomass	0.0	0.0	0.0	0.0
RWA	Unconstrained	Generator	Coal	0.2	1.2	5.3	17.9
RWA	Unconstrained	Generator	Gas	0.2	0.1	1.1	4.1
RWA	Unconstrained	Generator	Geothermal	0.0	0.0	0.0	0.0
RWA	Unconstrained	Generator	Hydro	0.6	0.6	0.6	0.6
RWA	Unconstrained	Generator	Nuclear	0.0	0.0	0.0	0.0
RWA	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
RWA	Unconstrained	Generator	Other Fossil	0.1	0.2	0.0	0.0
RWA	Unconstrained	Generator	Solar	0.0	0.0	0.0	0.8
RWA	Unconstrained	Generator	Wind	0.0	0.0	0.0	0.0
RWA	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
RWA	Unconstrained	Storage Unit	Pumped Hydro	0.0	0.0	0.0	0.0
RWA	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0
ZAF	Optimistic Nuclear	Generator	Biomass	2.3	2.3	2.1	0.0
ZAF	Optimistic Nuclear	Generator	Coal	208.9	221.6	114.7	0.0
ZAF	Optimistic Nuclear	Generator	Gas	0.1	3.1	9.5	0.0
ZAF	Optimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
ZAF	Optimistic Nuclear	Generator	Hydro	1.5	1.5	1.5	1.5
ZAF	Optimistic Nuclear	Generator	Nuclear	15.2	15.2	55.2	109.6
ZAF	Optimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	17.0
ZAF	Optimistic Nuclear	Generator	Other Fossil	0.1	1.4	0.5	0.0
ZAF	Optimistic Nuclear	Generator	Solar	12.3	12.3	45.6	240.7
ZAF	Optimistic Nuclear	Generator	Wind	13.1	12.8	102.1	118.7
ZAF	Optimistic Nuclear	Storage Unit	Battery	0.0	0.0	1.7	39.1
ZAF	Optimistic Nuclear	Storage Unit	Pumped Hydro	0.6	0.1	2.0	7.3
ZAF	Optimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	45.2
ZAF	Pessimistic Nuclear	Generator	Biomass	2.3	2.3	2.1	0.0
ZAF	Pessimistic Nuclear	Generator	Coal	208.9	222.0	115.0	0.0
ZAF	Pessimistic Nuclear	Generator	Gas	0.0	3.3	8.0	0.0
ZAF	Pessimistic Nuclear	Generator	Geothermal	0.0	0.0	0.0	0.0
ZAF	Pessimistic Nuclear	Generator	Hydro	1.5	1.5	1.5	1.5
ZAF	Pessimistic Nuclear	Generator	Nuclear	15.2	15.2	35.1	60.0
ZAF	Pessimistic Nuclear	Generator	Nuclear SMR	0.0	0.0	0.0	7.8
ZAF	Pessimistic Nuclear	Generator	Other Fossil	0.0	0.8	0.6	0.0
ZAF	Pessimistic Nuclear	Generator	Solar	12.3	12.3	68.8	290.7
ZAF	Pessimistic Nuclear	Generator	Wind	13.1	12.8	101.1	130.0
ZAF	Pessimistic Nuclear	Storage Unit	Battery	0.0	0.0	5.1	56.0
ZAF	Pessimistic Nuclear	Storage Unit	Pumped Hydro	0.3	0.0	2.4	7.3
ZAF	Pessimistic Nuclear	Store	Hydrogen	0.0	0.0	0.0	40.9
ZAF	RES-only	Generator	Biomass	2.3	2.3	2.0	0.0
ZAF	RES-only	Generator	Coal	208.9	222.3	114.5	0.0

Country	Scenario	Component	Technology	2025	2030	2040	2050
ZAF	RES-only	Generator	Gas	0.0	3.4	8.5	0.0
ZAF	RES-only	Generator	Geothermal	0.0	0.0	0.0	0.0
ZAF	RES-only	Generator	Hydro	1.5	1.5	1.5	1.5
ZAF	RES-only	Generator	Nuclear	15.2	15.2	15.1	12.1
ZAF	RES-only	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
ZAF	RES-only	Generator	Other Fossil	0.0	0.4	1.1	0.0
ZAF	RES-only	Generator	Solar	12.3	12.3	86.7	340.4
ZAF	RES-only	Generator	Wind	13.1	12.8	104.1	140.8
ZAF	RES-only	Storage Unit	Battery	0.0	0.0	9.5	70.7
ZAF	RES-only	Storage Unit	Pumped Hydro	0.1	0.0	2.8	7.3
ZAF	RES-only	Store	Hydrogen	0.0	0.0	0.0	41.8
ZAF	Unconstrained	Generator	Biomass	2.3	2.3	2.3	2.3
ZAF	Unconstrained	Generator	Coal	207.5	220.0	276.9	338.2
ZAF	Unconstrained	Generator	Gas	0.3	4.6	9.2	18.5
ZAF	Unconstrained	Generator	Geothermal	0.0	0.0	0.0	0.0
ZAF	Unconstrained	Generator	Hydro	1.5	1.5	1.5	1.5
ZAF	Unconstrained	Generator	Nuclear	15.2	15.2	15.3	15.2
ZAF	Unconstrained	Generator	Nuclear SMR	0.0	0.0	0.0	0.0
ZAF	Unconstrained	Generator	Other Fossil	1.4	2.1	0.5	0.9
ZAF	Unconstrained	Generator	Solar	12.3	12.3	12.3	41.1
ZAF	Unconstrained	Generator	Wind	13.1	12.8	12.7	13.3
ZAF	Unconstrained	Storage Unit	Battery	0.0	0.0	0.0	0.0
ZAF	Unconstrained	Storage Unit	Pumped Hydro	1.2	2.0	2.1	3.8
ZAF	Unconstrained	Store	Hydrogen	0.0	0.0	0.0	0.0

Glossary

CAPACITY EXPANSION PLANNING (CEP)

A modelling approach used to determine the least-cost mix of power generation, storage, and transmission assets needed to meet future electricity demand under specified constraints such as emissions targets or technology limits. CEP models optimise long-term investment decisions while accounting for evolving technology costs, demand growth, and system reliability.

EMERGING MARKET AND DEVELOPING ECONOMY (EMDE)

Countries characterised by lower per-capita income, higher growth potential, and ongoing structural transformation toward industrialisation and modern energy systems. EMDEs are often defined by institutions such as the IMF and World Bank and face distinct challenges in energy transition, including financing, infrastructure, and governance constraints.

LEVELIZED COST OF ENERGY (LCOE)

A measure of the average net present cost of electricity generation over the lifetime of a generating asset.

NET ZERO EMISSIONS (NZE)

A global energy scenario developed by the International Energy Agency (World Energy Outlook) that outlines a pathway for achieving net-zero greenhouse gas emissions from the energy sector by 2050. The NZE scenario assumes rapid deployment of clean technologies and major shifts in investment, policy, and consumer behaviour consistent with limiting global warming to 1.5 degrees C.

OVERNIGHT CAPITAL COST (OCC)

The total capital cost of building an asset, like a power plant, if it could be built instantly "overnight" without accounting for the time it actually takes to construct.

SOCIAL DISCOUNT RATE (SDR)

A rate used in cost-benefit analysis to determine the present value of future costs and benefits, reflecting how society values future consumption today.

SMALL MODULAR REACTOR (SMR)

A type of nuclear reactor designed to be smaller in size and power output than conventional reactors, typically producing under 300 megawatts of electricity per unit. SMRs are factory-fabricated and deployable in modular units, offering potential advantages in cost, construction time, scalability, and integration with renewable energy systems.

WEIGHTED AVERAGE COST OF CAPITAL (WACC)

The average rate of return a company expects to pay to finance its assets, weighted by the proportion of debt and equity.

CONVEXITY

Bayesian Energy's proprietary power systems modelling platform for capacity expansion and dispatch optimisation.

OPTIMISTIC NUCLEAR

Allows for nuclear expansion assuming "expected" cost curves.

PESSIMISTIC NUCLEAR

Allows for nuclear expansion assuming "worst case" cost curves.

RES-ONLY

Rapid decarbonisation using only renewables and storage.

TOTAL SYSTEM COSTS

The sum of all capital expenditures associated with new generation, storage, and transmission infrastructure, combined with the operational costs of both existing and newly built assets (including variable and fixed operating costs, as well as fuel costs).

UNCONSTRAINED

A control case with no emissions limits.

BUILD OWN OPERATE TRANSFER (BOOT)

A project delivery method, wherein a private entity receives a concession usually from the public sector to finance, design, construct, own, and operate a facility stated in the concession contract, then transfer it after a number of years another entity.

NTH-OF-A-KIND (NOAK)

As opposed to First-of-a-Kind (FOAK), refers to the theoretical economies of scale as more units of a given project are replicated within an ecosystem.

POWER PURCHASE AGREEMENT (PPA)

A long-term contract between an electricity generator and a customer to purchase energy at a pre-negotiated price for a set period of time.

PUBLIC-PRIVATE PARTNERSHIP (PPP)

An agreement between a government and private sector institutions where private capital finances government projects and services up-front, and then draws on revenues from taxpayers and/or users for profit over the course of the PPP contract.

PRESSURIZED WATER REACTOR (PWR)

A type of nuclear reactor that uses water as a coolant and neutron moderator, maintaining it under high pressure to prevent it from boiling within the reactor core, and using a separate steam generator to produce the steam for power generation.

PRESSURIZED HEAVY WATER REACTOR (PHWR)

A type of nuclear reactor that uses heavy water (deuterium oxide) as both its coolant and neutron moderator, operating under high pressure to prevent boiling and enabling the use of unenriched natural uranium fuel.

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