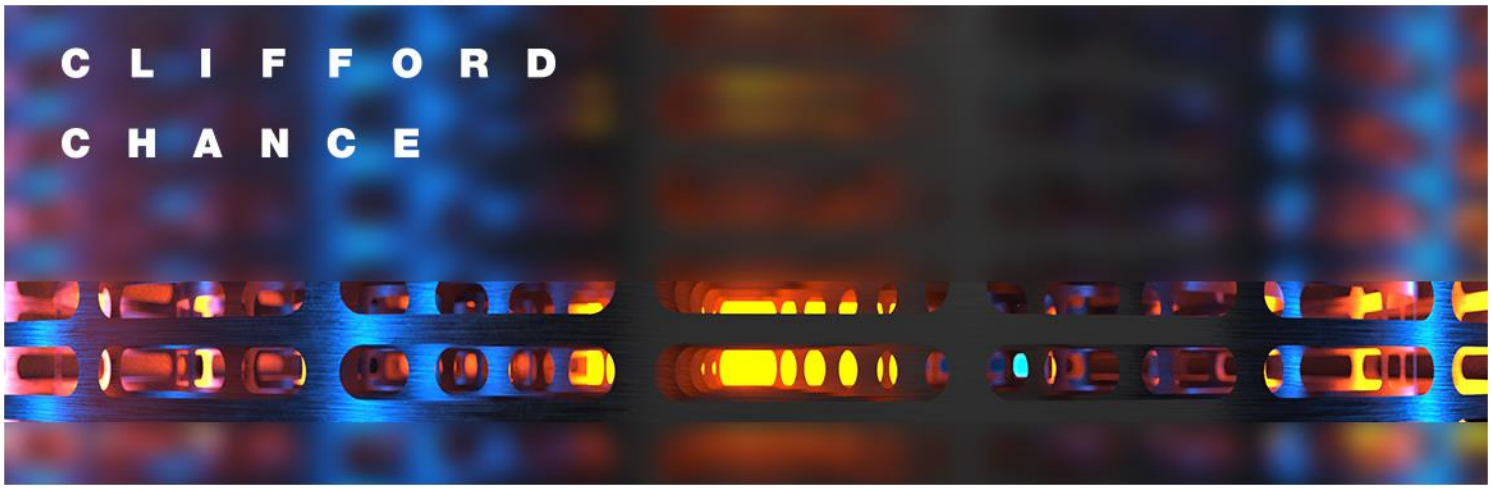

ENERGY TRANSITION: WHAT IS THE FUTURE FOR NUCLEAR POWER IN THE LATAM REGION?

The Latin American region has historically relied on hydropower and fossil fuels for energy generation. Many countries are also supporting the expansion of renewable energy, including solar and wind power, and some have also expressed interest in developing nuclear energy as they move away from fossil fuels. In this article, we look at some of the key legal, regulatory and financing considerations and potential future developments in the region for nuclear power.

According to the International Atomic Energy Agency (IAEA), as of 2021, the world's total nuclear power capacity was 389.5 gigawatts (electrical) (GWe), generated by 437 operational nuclear power reactors in 34 countries. This represents about 10% of the world's total electricity production.

As of 2022, the top five countries in terms of nuclear power generation were the United States (29.9%), France (14.4%), China (13.9%), Russia (8.2%) and South Korea (5.9%). According to the World Nuclear Association (WNA), about 60 nuclear power reactors are currently being constructed in 15 countries.

In respect of Latin America, Mexico, Argentina and Brazil are the only countries in the region with nuclear power plants that are currently operational. Mexico has two nuclear reactors (Laguna Verde I[1] and Laguna Verde II[2]) generating over 3% of its aggregate electricity; Argentina has three nuclear reactors (Atucha I[3], Atucha II[4] and Embalse[5]) generating over 7% of its aggregate electricity and a small 29MW power reactor prototype is under construction; and Brazil has two operating

1 Laguna Verde I: Reactor type BWR-5. Net capacity 777 MWe. In operation since 1990.
2 Laguna Verde II: Reactor type BWR-5. Net capacity 775 MWe. In operation since 1995.
3 Atucha I: Reactor type PHWR. Net capacity 340 MWe. In operation since 1974.
4 Atucha II: Reactor type PHWR. Net capacity 608 MWe. In operation since 2016.
5 Embalse: Reactor type PHWR. Net capacity 693 MWe. In operation since 1984.

reactors (Angra I[6] and Angra II[7]) generating over 3% of its aggregate electricity and a third nuclear power reactor is under construction.[8]

GLOBAL TRENDS IN THE NUCLEAR ENERGY SECTOR

Global trends in other sectors of the energy transition are mirrored in the ongoing development of the nuclear energy industry. The nuclear energy industry is experiencing a renaissance in the development and testing of new technologies that may fundamentally change how projects are developed, and the economics of building and operating new facilities. Innovations in reactor designs, fuel sources, and fabrication methods are raising crucial questions about where the industry will go next and which of the new technologies will reach commercial operation.

We are seeing a number of public policy and market trends that governments, project sponsors, institutional investors and banks should consider:

- **Declining growth in nuclear power generation:** Although nuclear power still accounts for a significant share of global electricity generation, the rate of growth has slowed down in recent years. According to the International Energy Agency (IEA), nuclear power generation increased by just 0.3% in 2019, compared to an average annual growth rate of 2.1% between 2000 and 2010. However, as gas and energy prices continue to rise and grid stability solutions are needed in certain countries, nuclear energy may offer a crucial solution to find a balance between energy reliability, affordability and sustainability.
- **Decommissioning:** Many of the world's nuclear power plants are reaching the end of their operational lifetimes. This is particularly true in Europe and the United States, where many nuclear plants were built in the 1970s and 1980s.
- **Increased focus on safety and security:** Despite the overall strong safety record of nuclear reactors, in the wake of the Fukushima disaster in Japan in 2011, there has been a renewed focus on nuclear safety and security. Regulators around the world are imposing stricter safety standards and enhancing their oversight of nuclear plants.
- **Growing interest in advanced nuclear technologies:** There is growing interest in advanced nuclear technologies; such as small[9] modular reactors (SMRs). These technologies offer several potential advantages, including increased safety, greater flexibility, and reduced construction costs. For instance, unlike large nuclear plants, SMRs' components can be factory-assembled. The World Economic Forum has estimated that the market for SMRs could be worth US$300 billion by 2040.
- **Impact of renewable energy on nuclear power:** The increasing deployment and declining cost of renewable energy sources such as wind and solar is putting pressure on nuclear power to remain cost-competitive. Yet, in contrast to intermittent renewable power generation,

6 Angra I: Reactor type PWR. Net capacity 609 MWe. In operation since 1984.
7 Angra II: Reactor type PWR. Net capacity 1,275 MWe. In operation since 2001.
8 Angra III: Reactor type PWR. Expected net capacity 1,340MWe. In construction.
9 The IAEA defines "small" as under 300MWe.

nuclear power can provide a constant source of electricity regardless of weather conditions.

- **Nuclear production of pink hydrogen:** The use of nuclear power to produce hydrogen (known as "pink hydrogen") is still a relatively new concept, and there are currently no large-scale commercial projects producing pink hydrogen. However, there has been some research and development in this area, and it is possible that we may see more projects in the future. One potential trend is the production of pink hydrogen using SMRs.

Global shifts in where nuclear energy technology is being developed and where important materials like fuel supplies are located, introduce both new opportunities and geopolitical considerations for governments and industry participants considering how nuclear energy will fit into their energy transition strategies.

THE ROLE OF NUCLEAR POWER IN ENERGY TRANSITION

International commitments to combat climate change and work towards net zero carbon emission, together with energy security concerns prompted by the recent energy crisis witnessed in Europe due to the Russia-Ukraine war, have made the development of energy transition strategies a priority for countries worldwide. Each year, nations are increasing support for the development of renewable energy sources such as wind and solar power in their energy policy programs. This trend has been accelerated by the deterioration of economic relations with Russia, one of the world's leading producers of oil and gas. According to the IEA, the highest ever increase in renewable energy production was seen in 2022, with a rise of approximately 340 GWs throughout the year.

Nuclear energy can play a crucial role in energy transition efforts. Nuclear energy can contribute to decarbonization strategies, since it is a low-emission energy source that over the past 50 years is estimated to have reduced CO2 emissions by over 60 gigatons. Additionally, it provides stability to power grids as part of the overall energy mix, complementing intermittent renewable sources. Investing in existing nuclear power plants and extending their lifespans may reduce the short- to medium-term demand for fossil fuels while new low-carbon and renewable energy capacity is built. And, of course, new nuclear technologies promise to add smaller, modular nuclear plants to the permanent mix of energy production options for countries in the future.

SPOTLIGHT ON THE PUBLIC-PRIVATE PARTNERSHIP STRUCTURE

Nuclear plants are often structured as public-private partnerships (PPPs). A PPP is a contractual arrangement between a government agency and a private company, in which the private company provides financing, design, construction, operation, and maintenance services for a public infrastructure project. PPPs are often used for large-scale projects that require significant investment, such as nuclear power plants.

In some countries, such as Mexico, nuclear power plants are owned and operated entirely by government entities, without any private sector involvement. In other countries, the ownership and operation of nuclear power plants may be partially or

fully privatized, with the government retaining some level of ownership or control. The involvement of the government in project development and operation is especially prominent in the nuclear energy context given the risks of proliferation of nuclear materials, as further discussed below.

The decision to structure the development of a nuclear power plant as a PPP depends on several factors, including the availability of financing, the level of government involvement desired, and the regulatory framework in place. PPPs can provide advantages such as cost savings, greater efficiency, and risk sharing, but they also come with challenges such as complex contractual arrangements, political and regulatory risk, and potential conflicts of interest between the private and public sectors.

FINANCING OF NUCLEAR PROJECTS AND KEY BANKABILITY CONSIDERATIONS

Nuclear power plants are typically financed through a combination of debt and equity financing, including project financing. The total cost of a nuclear power plant can be very high, often running into the billions of dollars. Financing is necessary to cover the costs of designing, constructing, operating, and maintaining the plant over its lifetime.

In addition to debt and equity financing, governments may also provide financial support for nuclear power plants. This can take the form of direct grants, loans, tax incentives, or other forms of financial assistance. Governments may provide this support to encourage the development of nuclear power as a low-carbon energy source or to address energy security concerns. Additionally, in the cross-border context, countries with established nuclear industries or new nuclear energy ambitions may offer concessional financing arrangements for project development.

In terms of bankability, delays and cost overruns have historically been significant challenges in the financing and construction of nuclear power plants, and have impacted the repayment profile of their financing. Due to their complex design, and safety requirements, nuclear projects have often experienced significant delays during construction and, therefore, in achieving commercial operations. Delays can be caused by a range of factors, including regulatory hurdles, design changes, supply chain disruptions, and construction issues. However, it is expected that delays will be substantially reduced in the development of SMRs, due to their smaller size and more modular construction design.

WILL THERE BE AN EXPANSION OF NUCLEAR POWER IN LATIN AMERICA?

The energy mix in Latin America varies by country, but in general, the region relies heavily on hydropower and fossil fuels for electricity generation. According to the Latin American Energy Organization, in 2021, hydropower accounted for approximately 42% of electricity generation in Latin America and the Caribbean, followed by non-renewable thermal energy (38%), wind and solar (11%), and nuclear (2%).

Some countries in the region have made significant investments in renewable energy, particularly in wind and solar power. For example, in 2022, wind and solar

power accounted for approximately 18% of generation capacity in Brazil. In 2021, 11% of the electric generation in Mexico was made up of wind and solar power. Chile has also made significant strides in developing its renewable energy sector, with solar and wind power generation accounting for approximately 27.5% of electricity generation between October 2021 and September 2022, surpassing for the first time coal-powered generation.

In recent years, some countries in Latin America have also expressed interest in developing their nuclear energy capabilities. However, the high capital costs and concerns over safety and waste disposal have hindered the development of nuclear energy in the region.

Another key consideration for Latin American countries is the sourcing of nuclear energy technologies, materials and fuels. A constraint on nuclear energy development globally is the international regulatory system for the control of nuclear materials. Given the risks of nuclear arms proliferation, international treaties, such as the Treaty on the Non-Proliferation of Nuclear Weapons, impose limits on the development and uses of nuclear materials. These limitations have been extended by further measures, including the IAEA's system of safeguards and inspections.

As a part of the implementation of these treaties, and in response to geopolitical policy considerations, countries with significant nuclear capabilities have developed regulatory frameworks that limit the activities of their domestic nuclear energy industries, including cooperation with foreign counterparties. One such limitation in the United States, an important provider of nuclear energy technology, requires that a specific type of treaty be in place for any significant cooperation on civilian nuclear energy between the United States and a country desiring to develop nuclear power plants. These treaties, known as Section 123 Agreements (since they are entered into pursuant to Section 123 of the U.S. Atomic Energy Act), must be negotiated between the United States and the prospective partner country and then entered into through a process that involves U.S. Congressional review.

Each Section 123 Agreement with the United States includes specific restrictions on what types of nuclear materials and information can be transferred from the United States to counterparties and significant restrictions on the activities that a recipient country can engage in following any transfer of nuclear materials or information. Section 123 Agreements are meant to maintain and extend non-proliferation restrictions, including safety and monitoring requirements, to any civilian nuclear energy activities carried out by a partner country with nuclear materials or information that originate from the United States.

Currently, Argentina, Brazil, and Mexico are the only three countries in the region to have active Section 123 Agreements with the United States. The absence of Section 123 Agreements in place in the region will likely continue to limit access to certain nuclear energy technologies and materials that may only be available from the United States. This limitation, however, may shift with the negotiation of new Section 123 Agreements in the region or the continued development of nuclear materials and technologies from other countries, including new SMR designs and fuel types.

CONCLUSION

Prospects for significant growth in nuclear power utilization in Latin America will hinge on several factors. First, nuclear power, with its recent safety record and minimal carbon emissions, is a proven technology, already in use by three major Latin American countries. Second, it serves as a vital source of base load power production, acting as a perfect complement to the variable, peak load power produced by wind and solar energy sources in the region. Third, while large-capacity traditional nuclear power plants have been historically costly and time-consuming to construct, newer technologies promise smaller scale, more affordable, and even safer nuclear power plants in the next few years, potentially revolutionizing the industry.

Nevertheless, such growth is contingent on several requirements. Countries in Latin America that do not yet utilize nuclear power must source both nuclear technology and fuel. The most likely supplier would be the United States, given its technological advancement. However, this will involve the potentially lengthy process of negotiating Section 123 Agreements and securing other international regulatory approvals, even if the United States is not the supplier of technology and/or fuel. As such, these steps will be critical in paving the way for the envisaged expansion of nuclear power in Latin America.

CLIFFORD CHANCE

CONTACTS

AMERICAS

Jessica Springsteen
Partner

T +1 202 912 5008
E jessica.springsteen @cliffordchance.com

Alan Sakar Azuara
Senior Associate

T +1 202 912 5435
E alan.sakar @cliffordchance.com

Nicholas Johnson
Associate

T +1 202 912 5904
E nicholas.johnson @cliffordchance.com

Jean Andre Petit Pino
Foreign Law Clerk

T +1 202 912 5969
E jeanandre.petit @cliffordchance.com

GLOBAL

Edward Bretherton
Partner

T +44 207006 4856
E edward.bretherton @cliffordchance.com

Anthony Giustini
Partner

T +33 1 4405 5926
E anthony.giustini @cliffordchance.com

Praveen Jagadish
Partner

T +44 207006 4330
E praveen.jagadish @cliffordchance.com

Dr. Moritz Keller
Partner

T +49 69 7199 1460
E moritz.keller @cliffordchance.com

Inaamul Laher
Partner

T +971 2 613 2433
E inaamul.laher @cliffordchance.com

Richard Tomlinson
Partner

T +33 1 4405 5216
E richard.tomlinson @cliffordchance.com

John Wilkins
Partner

T +44 207006 2466
E john.wilkins @cliffordchance.com

David Evans
Senior Counsel

T +1 202 912 5062
E david.evans @cliffordchance.com

David Metzger
Special Counsel

T +44 207006 4240
E david.metzger @cliffordchance.com

Ingrid Booth
Senior Associate

T +44 207006 2654
E ingrid.booth @cliffordchance.com

Emma Clarke
Senior Associate

T +44 207006 2797
E emma.clarke @cliffordchance.com

www.cliffordchance.com

Clifford Chance, 2001 K Street NW, Washington, DC 20006-1001, USA

Clifford Chance US LLP

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