

# Operationalizing the contribution of nuclear power to biodiversity conservation

› José Romero, Lukas Aebi, Henrique Schneider

**T**he production of electricity from nuclear energy has advantages for the conservation of biodiversity. Over the coming decades, a high level of electrification with low greenhouse gas emissions is needed in many sectors, including mobility and the heating and cooling of buildings. Nuclear power generation can help achieve this goal and, at the same time, reduce the causes of biodiversity loss, namely land-use change, climate change, and pollution. The international cooperation mechanisms established under the Convention on Biological Diversity (CBD) can contribute to this task in synergy with those of the United Nations Framework Convention on Climate Change (UNFCCC). These are the technology access and transfer mechanism, the financial mechanism, and capacity building. The current expansion of nuclear energy in many countries, both developed and developing, and the EU's inclusion of nuclear energy in its taxonomy of green investments, will benefit biodiversity worldwide. A Coalition of the Willing is proposed to contribute to the conservation of biodiversity through the use of nuclear energy.

## Introduction

The excellence of a technology, or its comparative advantages over other technologies in the same field, are not enough to make it adopted by society. This is the case with nuclear energy, whose share of world electricity production has remained low for decades and is not as widespread as it should be despite its efficiency. Nuclear energy is more efficient than other forms of electricity production, such as the burning of precious and irreplaceable fossil fuels – coal, oil, and natural gas – or hydroelectricity, solar, wind, or biomass, which are dependent on geographical location and weather conditions and put biodiversity at risk. Nevertheless, unlike nuclear energy, these latter forms of electricity production enjoy a reputation as green energy among the public and political authorities in charge of energy policy.<sup>[1]</sup> Fortunately, nuclear energy is attracting renewed interest worldwide. In Europe, for example, the 14-member European Nuclear Alliance was formed in 2023 with the aim of adding 50 GW of nuclear capacity by 2050, which means a 50 % increase in installed nuclear capacity in the European Union (EU) and aiming for nuclear power to be treated equally with renewables in the EU's energy and climate policies. Furthermore, in 2023, the EU included nuclear energy as a strategic element to achieve climate neutrality. Political will is therefore the main driver of the deployment of nuclear energy.<sup>[2]</sup>

In this article, we recall the role that nuclear energy will play in the conservation of biodiversity, another global priority along with the fight against climate change, which calls for massive electrification of the mobility and building sectors. While nuclear electricity production is mainly concentrated in developed countries, its extension to developing countries will contribute to intensifying the fight against biodiversity loss and climate change and will be a factor of equity between nations in terms of access to modern technologies. This extension will be facilitated by the synergies between biodiversity conservation, the fight against climate change, and the development made possible by the availability of electricity.

We first introduce biodiversity, its importance for humans, threats to it and its international policy, and scientific governance. Then, we look at the benefits for biodiversity conservation of nuclear energy, which avoids impacts on biodiversity of other technologies for electricity generation. Subsequently, practical ways to foster nuclear projects in international cooperation under the CBD and UNFCCC processes are proposed under the leadership of a Coalition of the Willing.

### Importance of conserving biodiversity

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) <sup>[3]</sup> defines biodiversity as the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part. This includes variation in genetic, phenotypic, phylogenetic, and functional attributes, as well as changes in abundance and distribution over time and space within and among species, biological communities, and ecosystems. <sup>[4]</sup> In other words, biodiversity is the totality of life forms found on Earth. The contribution of biodiversity and ecosystems is vital to human existence, as indicated by IPBES' first Global Assessment Report in 2019: "Nature [and its vital contributions to people, which together embody biodiversity and ecosystem functions and services] is essential for human existence and good quality of life. Most of nature's contributions to people are not fully replaceable, and some are irreplaceable. Nature plays a critical role in providing food and feed, energy, medicines and genetic resources and a variety of materials fundamental for people's physical well-being and for maintaining culture". <sup>[5]</sup>

More specifically, the World Economic Forum has listed five reasons why biodiversity is important to our well-being: 1) Biodiversity ensures health and food security; 2) Biodiversity helps fight diseases by providing the drugs used in modern medicine; 3) The economy benefits from biodiversity with, e.g., more than half of global GDP (44 trillion dollars) highly or moderately depending on nature; 4) Biodiversity provides livelihoods: every year, people derive a value of around 125 trillion dollars from natural ecosystems, and in the Global South, forests provide a livelihood for over 1.6 billion people; 5) Biodiversity protects us by providing nature-based solutions that protect us from natural disasters such as floods and storms, filter our water, and regenerate our soils. <sup>[6]</sup>

Yet we have known for decades that biodiversity and ecosystems are under threat. In 1987, the Brundtland Report highlighted the growing scientific consensus, not without controversy, that species were disappearing at an unprecedented rate. Human activities were blamed for the increasing degradation of ecosystems. The report also highlighted the contribution of biodiversity to development and, significantly, to human well-being. It also highlighted that much of the threatened biodiversity was in developing countries, where poverty, overpopulation, and overexploitation of natural resources were putting enormous pressure on biodiversity. <sup>[7]</sup>

Considerable progress has been made in monitoring biodiversity since the Brundtland Report. Nevertheless, the recording and monitoring of biodiversity remains a complex process. Indeed, it requires overcoming challenges such as the complexity of biodiversity, the guarantee of long-term data, the development of

standardized methods and indicators, funding and sufficient human resources for data collection and analysis, early warning systems for the timely detection of changes in biodiversity, and the communication of results to the scientific community, policy-makers, interest groups, and society as a whole. <sup>[8] [9] [10]</sup>

Despite the difficulties of recording and monitoring, IPBES' first Global Assessment Report, published in 2019, indicates that biodiversity is declining on a global scale and that the drivers of biodiversity loss with the greatest global impact are, in order of importance: changes in land and sea use; direct exploitation of organisms; climate change; pollution; and invasion of alien species. <sup>[5]</sup>

### International policy and scientific governance for biodiversity conservation

For the policy aspects, we will concentrate on the CBD and will not deal with other conventions whose objectives converge with the CBD and which deal with specific biodiversity issues such as the trade in endangered species (CITES) or the protection of wetlands (Ramsar Convention). For the scientific aspects, we will present the IPBES. These two institutions are the building blocks of an architecture that will allow for nuclear activities in the international process for the conservation of biodiversity and the protection of climate while providing low-CO<sub>2</sub> electricity.

### International policy governance for biodiversity

To conserve biodiversity and promote its sustainable use and the sharing of its benefits, the international community mobilized at the end of the 1980s to draw up an international treaty. The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. To date, 196 countries are a party to the CBD. The CBD's supreme governing body is the Conference of the Parties (COP), formed by the member countries. Observers may attend its sessions, which are generally held every two years. <sup>[11]</sup>

The Convention requires each contracting party to develop national strategies on the conservation and sustainable use of biological diversity and to report periodically on their implementation and effectiveness. In addition, the Convention establishes two mechanisms with obligations for industrialized countries. The first (Article 16) is a mechanism to promote access to and transfer of technology to developing countries for the sustainable use of biological resources. This access to and transfer of technology "shall be provided and/or facilitated under fair and most favourable terms, including on concessional and preferential terms where mutually agreed, and, where necessary, in accordance with the financial mechanism established" under the Convention. "In the case of technology subject to patents and other intellectual property rights, such access and transfer shall be provided on

terms which recognize and are consistent with the adequate and effective protection of intellectual property rights”. In addition, the CBD process has adopted measures to strengthen human and institutional capacities in countries.

The second mechanism established under the CBD (Article 21) is “for the provision of financial resources to developing country Parties for purposes of this Convention on a grant or concessional basis [...]. The mechanism shall function under the authority and guidance of, and be accountable to, the Conference of the Parties”.

In accordance with a CBD decision, the Global Environment Facility (GEF) serves as the institutional structure for managing its financial mechanism. The relationship between the GEF and the Convention is governed by a Memorandum of Understanding (MoU) between the Conference of the Parties (COP) to the Convention and the GEF Council. Under this MoU, the GEF operates under the authority and guidance of the COP, representing the Convention.

**Science-policy interface for biodiversity**

In the field of climate change, governments established the Intergovernmental Panel on Climate Change (IPCC) in 1988, whose task is to assess scientific, economic, and social knowledge on climate change that will serve as a basis for policy decisions on climate change mitigation and adaptation. This knowledge is relevant to policy but not politically prescriptive.<sup>[12]</sup>

For biodiversity, in 2012 the international community established a body similar to the IPCC, the IPBES, as an “independent intergovernmental body” This body responds to the need indicated in 1992 by the CBD in its

Preamble: “the general lack of information and knowledge concerning biological diversity” The functions of IPBES are to assess knowledge in a policy-relevant but not policy-prescriptive manner, to build capacity, to strengthen the knowledge base, and to support policies. IPBES is the science-policy interface for biodiversity, enabling governments around the world to agree with the scientific community on the latest and most authoritative scientific and socio-economic knowledge on biodiversity and ecosystem services.<sup>[3]</sup>

To date, IPBES has published regional and thematic reports, methodological reports, and a global assessment report. The assessments contained in these reports are relevant for policy development but are not prescriptive. IPBES is to biodiversity and ecosystem services what the Intergovernmental Panel on Climate Change, established in 1988, is to climate change.

**Benefits of nuclear power for biodiversity conservation**

The benefits of generating electricity from nuclear power become evident if we look at three causes of biodiversity loss that can be minimized by nuclear electricity: changes in land use, climate change, and pollution. Furthermore, nuclear power avoids the negative impacts on biodiversity of renewable alternatives for producing electricity, as has been identified by IPBES-IPCC co-sponsored workshop report on biodiversity and climate change that took place in 2020.<sup>[13]</sup>

**Less land required**

Nuclear power is a highly concentrated energy source, meaning it can produce large amounts of electricity from a small amount of fuel. This efficiency reduces the need for extensive mining and changes in land use.

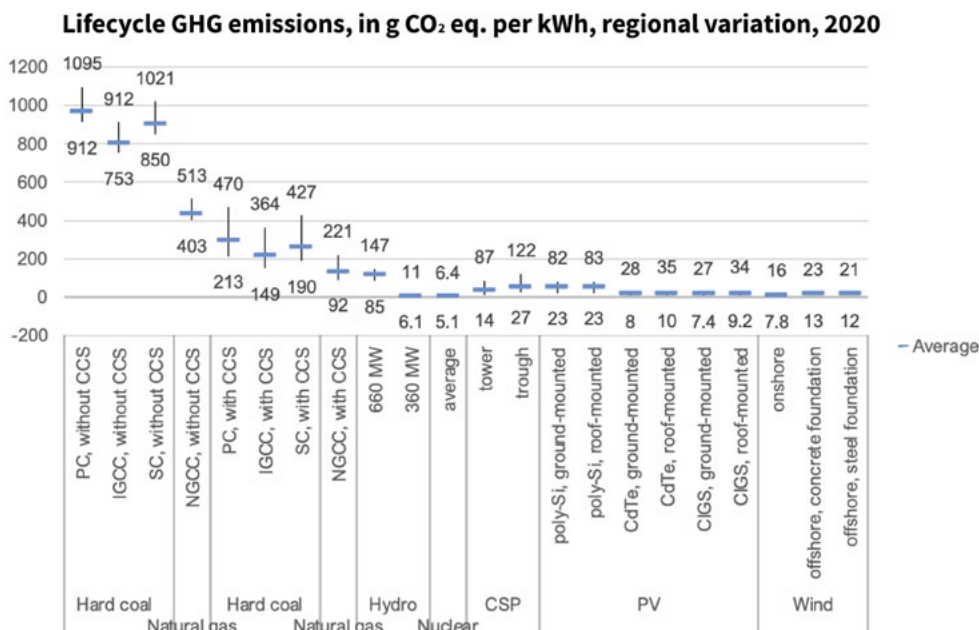


Figure 1 Lifecycle greenhouse gas emission ranges for the assessed technologies.<sup>[32]</sup>

Nuclear power plants require significantly less land, thus helping to preserve a more natural landscape and to curb habitat destruction and biodiversity loss. Habitat degradation remains the main factor in biodiversity loss.<sup>[14]</sup> Nuclear power plants produce more energy with less land – up to 27 times less than solar power plants and 173 times less than wind farms. Wind and solar power plants are built where wind and sunlight are abundant and require vast areas for turbines and solar panels. Nuclear power plants, on the other hand, are limited to nuclear power stations. A nuclear power plant requires a small area of around 3.37 square kilometers for 1,000 megawatts of energy. The high capacity utilization rate of nuclear power plants enables them to supply low-CO<sub>2</sub> electricity 24 hours a day, regardless of weather and seasonal variations.<sup>[15]</sup> Nuclear power is the most land-efficient energy source, needing 50 times less land than coal and 18 to 27 times less than on-ground solar PV per unit of electricity produced.<sup>[16]</sup> Furthermore, the growing demand for renewable energy technologies and infrastructure is expected to drive the expansion of mining areas globally and threaten protected areas and key biodiversity areas, increasing habitat loss and thereby expanding the land footprint of renewable energy.<sup>[17]</sup>

### Less CO<sub>2</sub> emissions

Nuclear energy is a low-CO<sub>2</sub> emitter. In doing so, it contributes to combating climate change, one of the main drivers of biodiversity loss. Over its entire life cycle, nuclear energy is one of the lowest emitters of CO<sub>2</sub>, emitting roughly the same amount of CO<sub>2</sub> equivalent per unit of electricity produced as wind and less than photovoltaics and hydroelectricity.<sup>[18]</sup>

### Less pollution

The energy system is an important source of air pollution.<sup>[19]</sup> Pollution of air, water, and soil affects many ecosystems.<sup>[5]</sup> Unlike fossil fuels' combustion, nuclear power plants do not emit air pollutants during their operation, such as sulfur dioxide, nitrogen oxides, or particulate matter. Such pollutants directly damage plants by attacking their leaves and needles. This impairs photosynthesis and plant growth. Other pollution caused by fossil fuels includes soil acidification, pollutants in water bodies, and excess nitrogen, which displace plant species and lead to a loss of biodiversity.<sup>[20]</sup> Regarding the challenges posed by nuclear power generation in terms of cooling water for nuclear power plants, radioactive waste, and prevention of nuclear accidents, countries strictly apply demanding regulations on the operation of power plants under the supervision of the IAEA in order to minimize pollutant or contaminant discharges, and therefore the threat to biodiversity.<sup>[21]</sup>

### Nuclear energy contributes to transformative change

Indirect drivers of biodiversity loss are human actions and decisions that affect nature in a diffuse way by modifying and influencing the direct drivers of biodiversity loss mentioned above. Indirect drivers relevant to this article include, in the energy sector, unsustainable production and consumption patterns, economics, governance, and technology. Nuclear energy offers the opportunity to address them for the benefit of biodiversity through policies that produce systemic changes in the technological and economic drivers of energy that benefit biodiversity. This approach ensures that biodiversity conservation is integrated into wider policy areas, in particular energy production and consumption. By addressing these indirect drivers, policies can create a more sustainable and resilient environment, ultimately supporting biodiversity conservation efforts.<sup>[22]</sup>

### Future of electricity production

In the context of a growing global demand for electricity for decades, in 2019, the total global final electricity consumption reached 22.848 PWh, with 9.672 PWh consumed in OECD countries and 13.176 PWh in non-OECD countries.<sup>[23]</sup> In 2023, global electricity consumption reached 27.7 PWh, and projections for 2050 are 47 PWh.<sup>[24]</sup> As for nuclear generation, it increased by 9 % between 2015 and 2019 and accounted for 10 % of total generation in 2019 (2.790 PWh), and the scenarios project a growth rate for the coming decades of the same order. To meet the Paris Agreement goal of limiting the increase in “global average temperature to well below 2 °C above pre-industrial levels,” the power sector needs to be electrified, with almost all electricity supplied by low-carbon sources, including nuclear.<sup>[25]</sup>

Estimates of the levelized cost of nuclear electricity have been done.<sup>[26]</sup> Increasing nuclear power generation will help meet demands in an efficient, economic, biodiversity- and climate-friendly manner. In 2023, there were 418 operational reactors in 34 countries, including 16 in China, India, and Russia, and other emerging and developing countries. The top three nuclear power producers in 2023 were the United States (31 % of global nuclear power generation), China (16 %), and France (13 %). Nuclear power generation is expected to strengthen in the coming years, thanks in particular to the new political momentum, such as the European Nuclear Alliance, EU's inclusion of nuclear power in its green investment taxonomy, and China's recent announcement to build 11 nuclear power plants. Moreover, the recent IPCC Sixth Assessment Report considers that nuclear energy contributes, with synergies and trade-offs, to sustainability and biodiversity conservation. This dynamic should help overcome the obstacles to the deployment of nuclear energy, which include lengthy certification and licensing processes; the lack of sufficient electricity grids; a shortage of workers with specific skills; and increasing financing

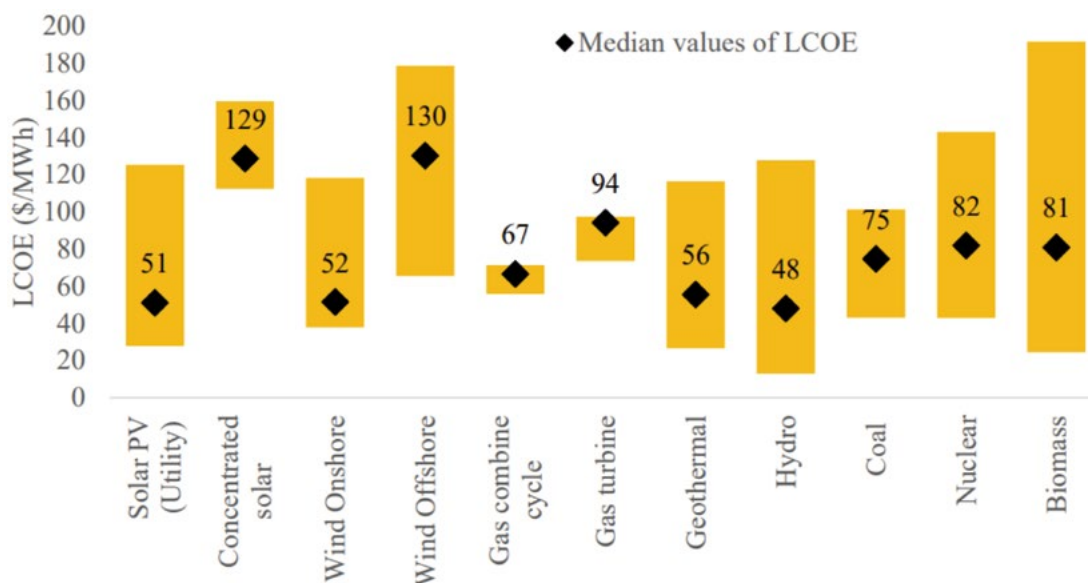


Figure 2

LCOE range for the maximum and minimum values of capital costs when other input variables are standardized (\$/MWh)<sup>[26]</sup>

costs. Progress in electrification will depend on reducing costs and improving the availability of capital. This is particularly important for emerging markets and developing countries.

### The Coalition of the Willing for nuclear energy and biodiversity conservation

In this section, we examine how to realize the potential that the CBD, the UNFCCC, and their financial and technological mechanisms, and capacity building, with the scientific support of the IPBES and the IPCC, offer to facilitate the use of nuclear energy for biodiversity conservation, inspired by a previous work exploring ways for nuclear energy in the Paris Agreement.<sup>[27]</sup> In this context, the useful exploration of synergies between the Kunming-Montreal Global Biodiversity Framework and the Paris Agreement<sup>[28]</sup>, as well as the possibility of establishing a joint work program for climate, nature, and people<sup>[29]</sup>, are also relevant. Furthermore, the Canadian approach to small modular reactors is very interesting, particularly in terms of taking into account the views of indigenous peoples, who play an important role in the sustainable management of land and the conservation of biodiversity.<sup>[30]</sup> It should be noted at the beginning that there needs to be a group of countries that promote nuclear energy and also link this to biodiversity. In the following, we speak of a ‘Coalition of the Willing’. At COP 29 in Baku, many countries joined in support of nuclear energy. However, in terms of communication, this support was limited to aspects of climate change. The European Nuclear Alliance, which numerous European countries have joined, can also serve as a model here.<sup>[31]</sup>

- **Build a Coalition of the Willing.** The Coalition should preferably be initiated and led by governments committed to nuclear power and biodiversity conservation; otherwise, by the private sector and relevant international bodies. Governments should

participate in the Coalition with representatives from ministries responsible for biodiversity conservation and nuclear energy. The Coalition’s goal will be to work in the CBD process to integrate nuclear energy into biodiversity conservation by changing the current nuclear energy paradigm that prevents it from realizing its full potential. A light, flexible, and informal coordination mechanism will be set up by the initiators. Participation in the Coalition will be on a voluntary basis. The first task of the Coalition will be to develop a nuclear conceptual framework –the Coalition Charter– which will set out the principles and actions to be undertaken to mobilize governments, relevant intergovernmental and international bodies, and the scientific community in favor of the use of nuclear energy for biodiversity conservation as part of an approach that integrates other relevant sectors, including climate change. The Coalition should build on existing processes, such as the European Nuclear Alliance, and bring together and mobilize countries, institutions, and individuals to ensure that the CBD, IPBES, UNFCCC, and IPCC take full account of nuclear energy for biodiversity conservation.

- **Change the paradigm.** The Coalition should be a proactive player in the CBD process to promote international policy on nuclear energy from the point of view of biodiversity conservation. The Coalition must make a paradigm shift to add the political dimension of promoting nuclear energy to the technical, industrial, scientific, and safety regulatory functions that the IAEA and other organizations already perform remarkably well.
- **Elaborate a conceptual framework for nuclear energy for biodiversity conservation.** The Coalition should adopt an evolving framework to promote, in the CBD process, enabling environments (scientific, societal, political, economic, institutional, and regulatory) for nuclear energy for biodiversity conservation. This framework should

include 1) principles based on international rules for the deployment of nuclear energy and biodiversity conservation; 2) the promotion of scientific assessment by independent international bodies, in full transparency, of the relationship between nuclear energy and biodiversity conservation; 3) the promotion in the CBD process of a proactive international nuclear policy for biodiversity conservation, and support for countries; 4) the exploitation in the CBD process of synergies between nuclear energy and the protection of biodiversity in the energy sector, the reduction of CO<sub>2</sub> emissions, climate change mitigation and adaptation, the management of natural resources and forests, as well as mining activities; 5) the promotion of capacity building at all levels and in all sectors concerned with biodiversity conservation and nuclear energy.

- **Assess the relationship between nuclear energy and biodiversity conservation.** The science-policy interface will consist mainly of IPBES and IPCC working separately or jointly, in full independence and transparency. They will assess knowledge on the benefits of nuclear energy for biodiversity conservation. These bodies will answer questions from decision-makers in order to provide them with a basis for decision-making on these issues, taking into account scientific, technological, socio-economic, environmental, and human health aspects.

The Coalition should be active in the following processes and institutions:

- **The CBD and UNFCCC COPs.** It is imperative and a priority for the Coalition to work within these conventions, within the CBD, because that is where the benefits of nuclear energy for biodiversity conservation can best be presented and defended, and within the UNFCCC to ensure synergies with climate change mitigation and adaptation. In practice, Coalition members and the IAEA should actively participate in the COPs and subsidiary bodies and processes that prepare COP decisions in order to influence the content of those decisions. The Coalition should exploit the opportunities offered for nuclear energy and biodiversity conservation by the financial and technology access and transfer mechanisms of these conventions and capacity building. In practice, the Coalition should call for the creation of an informal working group on the use of nuclear energy for biodiversity conservation, managed jointly by the IAEA and the CBD secretariat. The Coalition will organize events during the COPs to inform delegations about its objectives and activities.
- **IAEA.** The Coalition should request the IAEA to support it with its expertise and to participate actively in the CBD and UNFCCC processes, including the COPs, their subsidiary bodies, financial and technology access and transfer mechanisms, capacity building, and other relevant processes.

The Coalition will also ask the IAEA to participate actively in the science-policy interface, IPBES, and the IPCC. The IAEA already has an observer role in the CBD, the UNFCCC, and the IPCC. It should ask to participate actively in IPBES.

- **IPBES and IPCC.** The Coalition should ask IPBES and IPCC to assess, including through joint work, the scientific, technological, socio-economic, and environmental issues related to nuclear energy, biodiversity conservation, and synergies with climate change mitigation and adaptation. IPBES can also be useful for capacity building. The IAEA should participate as an observer in IPBES and can also provide experts to IPBES and the IPCC for their work.
- **The financial mechanisms of the CBD and UNFCCC.** The Coalition should pay particular attention to the financial mechanism of the CBD and UNFCCC conventions, the GEF and their operational entities, as well as the Green Climate Fund and other forms of financing of the conventions. These financial mechanisms implement relevant programs for biodiversity conservation and nuclear energy, in synergy with climate change mitigation and adaptation. They can reinforce their cross-cutting programs and act as leverage for funding.
- **The technology transfer mechanisms of the CBD and UNFCCC.** The Coalition should participate in the various processes set up under the CBD to promote technology transfer. These processes should be linked to those of the UNFCCC in order to find synergies between the use of nuclear energy for biodiversity conservation and climate change mitigation and adaptation.
- **Capacity building and development.** The Coalition should promote capacity building on the benefits of using nuclear energy for biodiversity conservation. This capacity needs to be built both within the international nuclear energy bodies, notably the IAEA, and within the CBD process, as part of the long-term strategic framework for capacity building and development recently adopted by the COP. It should also be noted at this point that, in accordance with Art. 16 CBD, each party has committed itself to facilitating access to technologies that are relevant to the conservation and sustainable use of biological diversity. According to the above, this explicitly includes nuclear energy technologies. Consideration of nuclear energy is therefore very important under the CBD Treaty.
- **Bilateral cooperation.** The Coalition should also promote bilateral and regional nuclear energy projects and their contribution to biodiversity conservation through bilateral cooperation, inspired in particular on the provisions of the EU nuclear energy taxonomy. It should also be mentioned at this point that the Parties have explicitly committed themselves to promoting economic and technical cooperation for the conservation of biodiversity within the framework of Art. 18 of the CBD.
- **Involvement of the private sector.** The Coalition should provide for the full involvement and

participation of the private sector in the international institutional architecture to be put in place around the biodiversity and climate conventions for the use of nuclear energy. The private sector produces, owns, and applies this technology and therefore has invaluable know-how and experience from which the international process should benefit.

## Conclusion

Nuclear power generation offers an opportunity for biodiversity conservation in synergy with climate change mitigation and adaptation. Indeed, nuclear energy addresses the main drivers of biodiversity loss, namely land use change, climate change, and pollution. The recently renewed global momentum of policy-driven nuclear expansion is unstoppable, hence it is best to be on the crest of the wave and benefit from these activities for biodiversity conservation. Because these activities will increasingly take place in developing countries, nuclear is a tool for development by providing stable, abundant, and affordable electricity to more and more people, in particular in the so-called megadiverse developing countries, where biodiversity loss is most damaging. The CBD must open the discussion on how to use its technology mechanism and the financial mechanism and capacity building for these activities. IPBES must also assess nuclear activities for biodiversity protection (make a proposal for a thematic report on this topic). It is high time to harness existing institutions and market capabilities to enable nuclear generation to deploy its full capacity, responsibly and safely, to meet demands with low-carbon electricity. This article shows how a Coalition of the Willing can contribute to the conservation of biodiversity through the use of nuclear energy.

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### Geschäftsführer

Dr. Thomas Behringer



### Chefredakteur

Nicolas Wendler  
+49 172 2379184  
nicolas.wendler@nucmag.com



### Redakteurin

Nicole Koch  
+49 163 7772797  
nicole.koch@nucmag.com

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## Authors



### José Romero

Nuclear Consultant

jose\_romero026@hotmail.com

José holds a PhD in physics from the University of Lausanne, Switzerland. He worked as a senior scientist at the World Radiation Center in Davos, Switzerland. José has held various positions at the Swiss Federal Office for the Environment (FOEN). Most recently, he served as Chief Scientist Environment International and as the Swiss Focal Point for the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). In 2022 and 2023, he was the head of the Technical Support Unit for the Synthesis Report of the IPCC's Sixth Assessment Report. ORCID: 0000-0003-4538-1321



### Lukas Aebi

Secretary General

Swiss Nuclear Forum

Lukas.Aebi@nuklearforum.ch

Lukas Aebi is the secretary general of the Swiss Nuclear Forum. He holds a law degree (University of Zurich) and a masters in politics (University College London). Lukas sits on numerous expert and working groups of the European nuclear energy trade association NuclearEurope. The Swiss Nuclear Forum accompanies the energy policy debate in Switzerland and Europe as a scientific-technical expert organization. It has over five hundred members. Among them are numerous national politicians, energy companies, scientific organizations and industrial enterprises.



### Prof. Dr. Henrique Schneider

Secretary General

Swiss People's Party

hshneider@gmx.ch

Henrique Schneider is Secretary General of the Swiss People's Party. Henrique has participated as a negotiator in several climate summits and served as an advisory board member of the Climate Technology Center and Network. He's also a board member of the Swiss Nuclear Forum. ORCID: 0000-0002-0428-8967