



POLICY BRIEF: SYNERGIZING URBAN ENERGY AND NATURE

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Finding synergetic uses for energy and nature-based actions can improve outcomes for both, whether by improving the use of space through co-location, providing general well-being improvements for users, identifying alternate sources of finance and business models to allow for simultaneous uses, and generally improving the use cases for both options. Contagem, in Brazil, is one such example of a city undertaking both energy and nature-based action.

INTRODUCTION

Climate change and biodiversity loss can be described as two of the most urgent environmental challenges we face today (Habibullah et al. 2022; Shin et al. 2022; Talukder et al. 2022). If left unchecked, both could have significant and outsized impacts on our livelihoods. Therefore, systemic and integrated strategies are required to address these challenges simultaneously.

Urban spaces are well-suited to pioneer and further scale-up such integrated solutions. They function as **complex systems** where various components—such as food distribution, heating/cooling, land-use planning, energy supply and demand, transportation, waste management—are highly dynamic and **interconnected**. Altering any one of these components can greatly influence others, while their multiple interrelationships allow for the possibility of **harmonized approaches**.

In the energy sphere, to address climate change mitigation, cities tend to be primarily concerned with reducing energy demand and associated emissions, while improving the efficiency of the energy that is consumed. At times, it may be possible for them to generate electricity locally through decentralised sources, e.g. rooftop solar photovoltaics. Most cities also tend to have authority over buildings (heating, cooling, and electricity use), transportation, and municipal services, including green and blue spaces. Such actions undoubtedly benefit the broader ecosystem, and nature-based solutions can in turn contribute positively to the uptake of these measures, creating, in most cases, a **mutually beneficial** relationship.

However, **context is key**—implementation requires detailed analyses and tailored solutions, and one should note that the interconnection of climate change and biodiversity can also create antagonistic

trade-offs. For instance, competition for open spaces, or the exploitation of raw materials can create conflicting interests. Nevertheless, energy and nature-based actions mostly generate synergistic benefits (Shin et al. 2022). For example, nature-based solutions often create local cooling effects, which can help reduce energy demand and contribute to broader climate adaptation and resilience efforts.

NATURE-BASED SOLUTIONS

Nature-based solutions (NBS) are cost-effective and resource-efficient solutions where natural elements are used to meet environmental and societal goals. They provide numerous benefits to citizens, including general health and well-being improvements (such as through green spaces providing better air quality and cooling), the opportunity for productive activities (such as through urban agriculture), and climate change adaptation and mitigation benefits (such as improved flood control, lower temperatures, etc.) (Kabisch et al. 2017).

This policy brief intends to highlight the possibility of integrated energy-nature action in urban areas, drawing on the example of the City of Contagem, Brazil. It underlines the importance of holistic urban decision making and spatial planning for sustainable development, the need for addressing multiple challenges simultaneously, and integrating nature preservation into energy projects.

SYNERGIZING RENEWABLE ENERGY TECHNOLOGIES AND NATURE-BASED SOLUTIONS

One of the key functions of a city government is spatial planning. Given the limits of space and the fact that land is already at a premium in many major cities, utilising land effectively is a precondition to resource-efficient and impactful climate and biodiversity action. Both decentralised renewable

energy and nature-based solutions contain the possibility of using existing land and spaces (such as rooftops) without significant alterations, and thus can be integrated in a variety of innovative ways. Energy and nature can mutually benefit each other in urban spaces in different ways, providing a range of available approaches for cities that want to tackle both climate and biodiversity crises simultaneously. The first two points mentioned below are more relevant for immediate action by cities, and therefore the primary focus of this brief:

- Natural installations improving energy use:

Designs that incorporate natural elements and features (parks, green and blue spaces, green roofs and walls, etc.) can provide ambient benefits, in particular by increasing cooling effects through transpiration or providing shade, and thereby reducing the need for cooling services (UNEP 2021). In doing so, they can help reduce energy demand and improve energy efficiency, in addition to benefitting biodiversity. Cooler temperatures also offer more favorable operating conditions for renewable energy technologies (Liu et al. 2023).

GREEN AND SOLAR BUILDINGS

Combining the 'greening' of buildings and solar panels on rooftops or facades can, in most cases, improve a building's energy use. Depending on the type of intervention, NBS such as green roofs can reduce cooling demand by 3% to 90% and heating demand by 0.58% to 60% (He, Tapia and Reith 2023). This is however dependent on multiple factors, including the local climate, which should all be considered before implementation.

- Energy technologies benefiting natural areas:

Similarly, renewable technologies such as solar panels that are co-located with green and blue spaces can provide additional shading, which can be useful for certain plant species or crops (Macknick, Beatty & Hill 2013). Decentralized options, such as solar streetlights, can help enhance natural areas and improve overall safety. At times solar technologies can be installed on or near water bodies, which can provide help reduce water loss due to evaporation and provide a decentralized source of energy for other uses.

URBAN AGRIVOLTAICS

'Agrivoltaics' is an approach that allows for the dual-use of land for solar photovoltaics (PV) and agriculture (for crops, greenhouses, livestock, etc.), including in urban areas. For instance, a study in Shenzhen, China, showed that lettuce planted under PV panels on 105 km² of the city's rooftops could fulfil the city's entire lettuce demand while simultaneously generating renewable electricity (Jing et al. 2022).

Solar photovoltaic (PV) technology is one of the most common technologies when it comes to co-use of space and infrastructure, given the variety of configurations available. Many examples of solar PV integration into green and blue spaces showcase the flexibility of this technology and its ease of integration into nature-based actions.

- Accounting for ecosystem impacts when designing renewable energy projects:

In general, large-scale solar developments can be planned proactively to minimize their impact on local ecosystems by conducting detailed assessments and working with local communities. Preserving local vegetation for example, as well as appropriate siting, can help reduce their environmental impact.

A number of potential solutions exist that address the two challenges simultaneously, including:

- Green roofs with rooftop solar, to reduce heating effects and improve solar panel energy output
- Solar-powered water pumps can work in concert with rainwater harvesting systems to provide irrigation for urban gardens or farms
- Solar-powered lighting in green areas can improve their overall safety and usage
- Green areas and trees can provide shading and cooling, which can help with the promotion of non-motorized forms of transport. Shifting to less energy-intensive forms of transport can help a city reduce its energy use and emissions.

Nevertheless, the co-use of space is not without its challenges. As a first step, the example of Contagem can be followed and actions in both fields can be taken separately to assess the feasibility of both, while testing and adapting existing processes along the way to address the challenges that arise.

HOW CAN WE STREAMLINE ENERGY AND NATURE EFFORTS?

A holistic conceptual approach along with integrated action is essential for tackling the twin challenges of climate change and biodiversity loss. Local governments can take certain measures, but they cannot carry out implementation alone as they are subject to a number of outside constraints. Other actors, such as national governments and financial institutions, can also support with enabling measures, such as adjusting national policy frameworks and facilitating the access to finance for local governments. This section provides some recommendations on how best to support local energy and nature-based action:

- For local governments:

- While certain approaches might be generalizable, the actual implementation must be context-specific, keeping in mind local species, technology availability, and ecosystems.
- A good practice can be to begin by identifying priority zones to pilot integrated solutions, and adjust procedures, policies, etc. to then scale up successful approaches (Weber, Steinkamp, & Reichenbach 2023).
- Engage local communities across the design, planning, and implementation of energy projects to incorporate knowledge on needs and priorities for people living in the area.
- Consider a joint approach from the planning stage itself, to avoid unintended consequences further down the line. For example, green roofs may lead to higher housing costs.
- Advocate for improved guidelines and standards at the national level, and share learnings with peer cities to benefit from knowledge exchange.
- Demonstrate the feasibility and benefits of combined energy-nature projects through the city's own facilities, such as schools or public buildings.
- Work with the private sector to develop alternate business models that include the up-front costs of nature-based solutions, which could potentially be offset by revenue-generating activities through energy generation (Quaranta, Dorati, & Pistocchi 2021).
- For larger-scale projects, incorporate ecological design principles and strategic site selection into the planning and construction of energy projects. This can minimize disruption to critical habitats and biodiversity and boost co-benefits.
- Conduct Environmental Impact Assessments (EIA) that include biodiversity assessments to understand the potential impacts of energy

projects on local ecosystems and species. Decision-makers can reinforce this recommendation by turning it into an obligation through supportive policies.

- For improved multilevel coordination:

- National and local governments can create enabling frameworks to facilitate and promote synergistic projects. This can be done by providing the necessary regulatory framework (e.g. adjusting standards allowing for the deployment of renewable energy installations in zoning regulations, while providing sufficient safeguards for environmental protection zones). Some research points to the fact that there are not many guidelines on what makes an effective nature-based solution, so this can be a starting point (IUCN 2020).
- Given that finding a suitable business model can be a challenge, public institutions can also assist with expertise and financial resources for the potential co-development of projects.
- Install monitoring and adaptive management guidelines at the national level to track the impacts of energy projects on biodiversity and ecosystem health and modify practices based on the monitoring results.
- Encourage collaborate with research and academia to develop novel solutions that are specific to a country or sub-national context.
- Increase learning among local governments by supporting the scale-up of successful energy-nature projects and approaches beyond the pilot stage.
- Mainstreaming joint energy-nature approaches can help spread awareness and lead to systemic changes in planning, rather than ad-hoc pilot projects.

- For financial actors:

- Invest in synergistic projects. Investors can encourage combined energy-nature projects by incorporating a multi-dimensional approach in their investment criteria.
- Financial actors can work to develop alternative business and financial models to help make the case for and help monetize combined projects, including developing assessments that help quantify the monetary benefits of combined energy-nature action.

CONCLUSION

Combined energy-nature approaches can help improve resource-use efficiency (including finances, land, etc.), provide synergistic benefits, and help address both the climate emergency and the biodiversity crisis simultaneously.

GET TO KNOW: CONTAGEM, BRAZIL

Located in the southeast of Brazil in the State of Minas Gerais, Contagem is part of the metropolitan area of Belo Horizonte and has over 650,000 inhabitants.

The City of Contagem undertook two projects in its urban area as part of its efforts to tackle nature degradation and climate change simultaneously. It did so by putting up renewable energy installations, as well as nature-based solutions.

Through the INTERACT-BIO project, Contagem was supported to develop a rain garden, which filters runoff of rainwater and is particularly helpful in flood-prone areas. The gardens filter water through vegetation, allowing it to infiltrate the soil, which helps recharge the water table. When combined with other infrastructure such as retention ponds and rain terraces, this can help increase local biodiversity and help maintain the water cycle.

Through another energy project, the municipality aims to implement solar photovoltaic panels on a number of public buildings. They will produce an average of 1,205 MWh per year (avoiding approximately 40 tCO_{2e} yearly).

By undertaking these two projects, the City of Contagem shows how city climate mitigation and adaptation objectives can be targeted alongside biodiversity conservation. The production of energy through solar PV can help generate low-emissions electricity and



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contribute to mitigation efforts. At the same time, climate adaptation is improved through the rain gardens, which can help reduce the severity of flooding during the rainy season.

The impact and the benefits of the two projects interact and add up in the case of Contagem. The co-benefits of renewable energy and NBS for the health and liveability of the environment also become visible. Besides climate and environmental benefits, such as the conservation of natural resources and the reduction of pollution, water consumption, GHG-Emissions, citizens also benefit from improved public health, physical and mental well-being, improved climate justice, a shift towards a more circular and green economy, etc.

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