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POLICY BRIEF | NOVEMBER 2023

MAXIMIZING THE BENEFITS OF COLOMBIA'S ENERGY TRANSITION

Increasing Resilience Through Decarbonization and Pollution Reduction

Key Policy Implications

- Implement mechanisms to enforce industrial standards including industrial process emissions and energy efficiency standards.
- Provide incentives for the expansion of mini-grids and stand-alone systems with storage, including on-site energy generation using local renewables.
- Consider renewable energy policies (including green hydrogen) for interrelatedness, policy-coupling and sector-clustering.
- Ensure that climate-energy policies provide specific signals (for decarbonisation and diversification), but also disincentives (for deforestation).
- Expand the size of protected areas (from current 10% to 30% or more) and implement enforcement mechanisms against human rights violations.
- Assemble expert teams (researchers, practitioners, and local community members) to collaborate with vulnerable communities on site to devise climate-energy approaches tailored to local needs that reflect cultural protocols.
- Monitor climate-energy policy outcomes (impacts on forests, biodiversity, and physical security of vulnerable communities).

Summary

Colombia's updated Nationally Determined Contribution (NDC) reflects the ambition to achieve carbon neutrality by 2050, focusing on emission-reductions in the highest emitting sectors – forestry/land management and agriculture. Pledges were made to halt deforestation and reduce black-carbon pollution by 40%, which contributes not only to respiratory and cardiovascular disease, but also to a faster pace of glacier melting. While the NDC ambitions are well articulated, they run the risk of not being realized without a robust investment a diversified portfolio of renewables, including off-grid energy solutions.

Policy recommendations outlined in this brief focus on solutions that prioritize clean power generation and energy efficiency improvements that can boost sustainable and equitable livelihood trajectories based on climate-compatible land use, but also reflect ambitions stated in climate and energy strategies.

FLETCHER
The graduate school of global affairs at Tufts University

Introduction

Colombia's long-term strategy[1] articulates the ambition to transform the country by 2050 into "a climate-resilient economy and society that is carbon neutral and has high adaptive capacity in its territories and sectors." Accordingly, the updated NDC commits to a maximum of 169.44 Mt CO2e in 2030, and a 40%-reduction in black-carbon emissions compared to 2014.[2] Land-based mitigation measures account for approximately 70% of the NDC's mitigation capacity, which, if fully implemented, would turn Colombia's land sector from a current net source of emissions to a net sink. It is broadly acknowledged that mitigation and adaptation strategies cannot come at the cost of biodiversity or cultural loss, even when confronted with complex cross-sectoral challenges.[3] The *no-harm* imperatives inscribed in mitigation and adaptation strategies need to translate into policies that safeguard against inappropriate human interventions.[4,5]

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The research question asked is – if the decarbonization goals and mitigation measures in the energy and mining sector remain weak (as they currently are), what may be the implications for land-based mitigation, deforestation and biodiversity loss? To answer the question, the study examines synergies between energy and climate policies that support all of the following objectives: (i) decarbonization of the economy across sectors, (ii) diversification of the renewable energy mix, and (iii) ending deforestation, biodiversity loss and cultural loss.

METHODOLOGY

Findings and policy implications presented in this briefing are based on a comprehensive review of reports at the national level (NDC, Climate Action Plans, National Development Plans, Energy strategy, Environmental strategies, Deforestation monitors).[1,2,6-9,13] Stated goals and commitments were linked to latest research in renewable technologies including distributed energy [3-5,10-15] to identify transversal approaches which policy makers could refer to when prioritizing policies directed at reaching the stated levels of ambition.

Results

Decarbonization and diversification. To achieve its fair share contribution under the Paris Agreement, Colombia would need to reach absolute emissions of less than 139 Mt CO2e by 2030.[16] Reaching the target largely depends on the extent to which the forest/land sector will be relied upon in the different sectoral strategies, including energy and mining. The fastest GDP growth has been reported in the energy and mining sector, but this sector's decarbonization goals and mitigation measures remain weak compared to other sectors. Recent additions to renewable capacity have not been matched by decreases in non-renewable capacity (only a 38-MW reduction has been reported in 2020, compared to a 850-MW in renewable capacity to be installed by 2022, of which 22% will come from an Ituango hydroelectric plant).[17] The sectoral mitigation target in the updated NDC was set at 11.2 Mt Co2e by 2030, and an agreement between the Ministry of Energy and energy majors was reached to achieve carbon neutrality in the electricity sector by 2050,[6] but the coal phase-out plan remains ambiguous. Colombia is a net energy exporter – exports as percentages of production make up 77% compared to 12% in energy imports; in 2018, primary energy trade reached 3 676 829 terajoules (TJ).[13]

Deforestation, biodiversity loss and cultural loss. Colombia is a megadiverse country (a country with around 7000 species of endemic

plants and border marine ecosystems), with 314 ecosystems ranging from glaciers, cloud, tropical and conifer forests, rainforests, and equatorial jungles, to páramos, islands, coral reefs and mangroves.[18] The "deforestation arc" spans southern Meta, northwestern Guaviare, and the Andes-Amazon foothills [7] where much of crude and coal reserves are located, and natural gas production concentrated. Spatial expansion of energy-intensive development (e.g., mining/fossil fuel extraction, fossil fuel production and use) can result in significant emission increases due to increases in industrial process emissions, but also emission increases due to deforestation when energy and mining infrastructure expand to forests. Violence and threats to Indigenous communities, known to be "forest defenders," have been well documented.[19] Here, loss of biodiversity, fires, toxic spills, and Indigenous rights violations have had detrimental effects on the wellbeing of culturally diverse communities and megadiverse ecological systems.[19, 20]

Opportunities

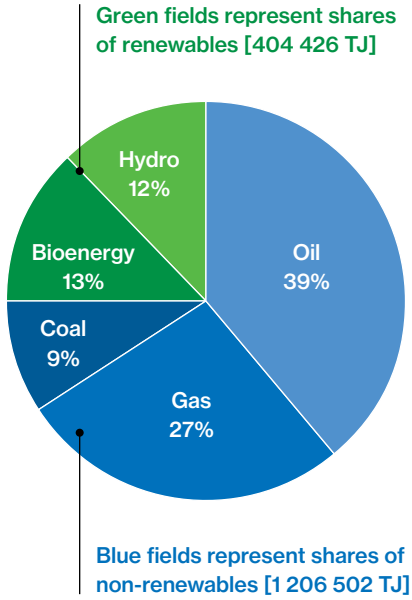
At the national level, 96% of the population have access to electricity and 85% reside in municipalities and urban centers, while electricity coverage spans 48% of the country's territory. The remaining 15% of the population live in dispersed rural and forested areas, where access to electricity is still limited.[9]

Decentralized renewable energy solutions with storage. Mini-grids and stand-alone systems using local renewable resources present a less costly alternative, while providing an opportunity to transition to more sustainable livelihoods (from pesticide and chemical-fertilizer-based farming to agro-ecology using organic fertilizer, from transported, costly fossil fuels to locally sourced renewables, with lower exposure to health hazards).

Renewables and energy efficiency. Clean power generation leads to efficiency improvements and can reduce primary energy demand, resulting in significant energy-related carbon-emission reductions.[9] When pursued jointly, energy-related CO2 emissions could be reduced by 70%, with renewables accounting for about half of the reduction, and another half from increased energy efficiency and electrification.[8, 10]

Renewable potential. Colombia's total primary energy supply (TPES) remains dominated by non-renewables, with a 25% participation by renewables, comprising 51% bioenergy, and 49% hydro/marine energy (Figure 1). New additions to renewable electricity capacity are dominated by hydropower, while not enough solar is being added.

Figure 1: Total primary energy supply (TPES), Colombia (2018)



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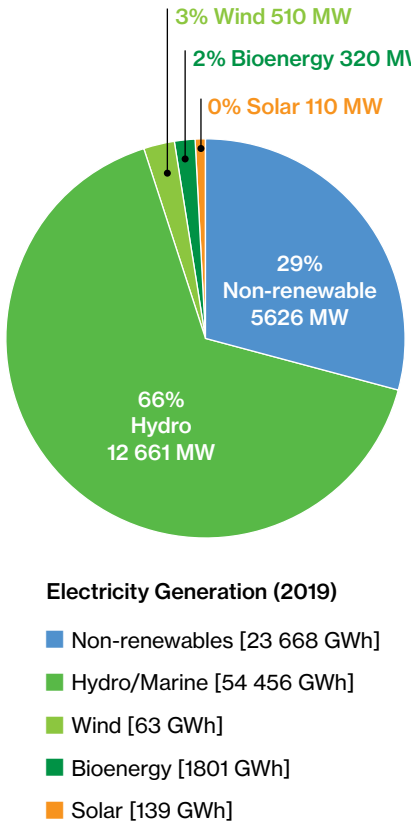
Complementarity. The significant share of hydropower in Colombia's electricity matrix provides opportunities to develop complementarities with other renewable energy technologies and at the same time achieve both cost-efficiency and reliability of power systems. Solar power is notably under-represented in the current electricity generation and capacity (Figure 2).

Figure 2: Electricity Capacity, Colombia (2020)



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Solar, wind, biomass. Indicators of renewable resource potential for Colombia are high for biomass, wind, and solar PV, and can be rapidly scaled across sectors (Figure 3). Converting minigrids to hybrid solar systems (using solar, hydro, and biogas technologies), and combining them with storage technologies (electrochemical batteries, thermal, mechanical, compressed air, hydraulic (pumped), or electric field storage (capacitors) make it possible to integrate different energy sources and reduce the risk of power outages.

Biomass potential (net primary production) is particularly high (9.5 tC/ha/yr) compared to the world average of 3.5 tC/ha/yr. Anaerobic digestion of agriculture and livestock residual waste is estimated at 63 000 GWh of energy, potentially making up a 25% of national electricity generation, and 90% of the demand for natural gas and LPG.[14] Put differently, biogas and bioLPG derived from bio-waste could replace up to 90% of demand for petroleum-derived natural gas and LPG.

Waste-to-energy. Mitigation in the waste sector is estimated to contribute 3.4 Mt CO2e in emissions reductions by 2030,[2] focusing on capture and reuse strategies. Capture and use of biogas for energy from waste streams and the treatment of domestic wastewater can contribute to emission reductions in densely populated urban areas.

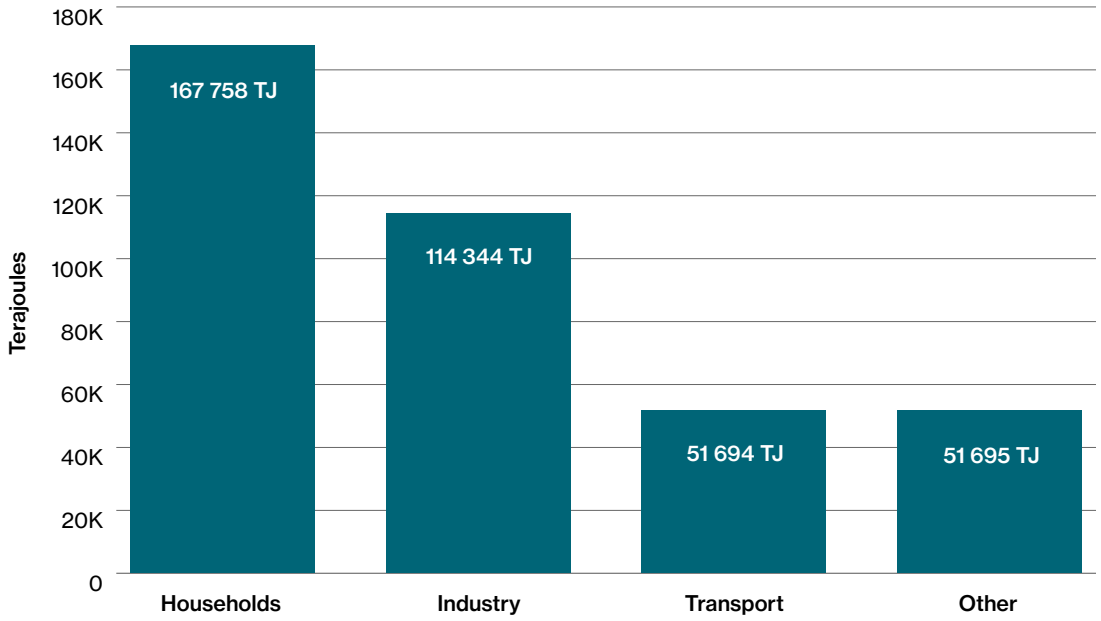
Policy Implications

Synergies between diversification, decarbonization, and forest strategies

Diversification. Diversified renewable solutions can increase energy access while decarbonizing the energy sector. Diversification of renewable energy sources, along with their increasing shares in the energy mix will provide several benefits for Colombia's economy. First, diversification of renewables would reduce over-reliance on hydropower vulnerable to the El Niño Southern Oscillation (ENSO). Second, in rural areas with limited or no access to electricity, a combination of renewable sources and storage technologies can provide a stable energy supply without increasing emissions and industrial pollution,[20] and when done right, without eroding biodiversity. Third, energy-intensive sectors, upon which Colombia's economy currently relies, could transition from current reliance on fossil-fuel energy supply to green hydrogen. This switch can make Colombia a hub for clean energy production and supply.

Decarbonization. Shifting energy-intensive sectors to green hydrogen implies that the sectors can remain important contributors to the economy, but at the same time achieve emission cuts (in energy and mining, transportation, and housing). Synergies can be maximized when considering linkages between sectors and technology levels. On the supply side, the switch

Figure. 3: Renewable Energy Consumption by Sector Colombia (2018)



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to renewable power can reduce primary energy. On the end-use side, the electrification of services (transport, cooking) results in higher efficiency, allowing greater use of renewable power.

Deforestation, biodiversity loss and cultural loss. Efforts to halt deforestation and protect Colombia's megadiverse biome, with greatest biodiversity in the Andean and Amazon regions, should be considered an essential part not only of national, but also global efforts to reduce greenhouse gases. Without disturbing biodiversity-rich ecological systems, locally-sourced clean renewables (sun, wind, river, biomass) could open up energy access for 4.6 million Afrocolombians and 2 million Indigenous peoples who live on or around Indigenous reserves (32 M hectares), community collectives (5.5 M hectares), and designated farmlands (0.65 M hectares) whose local conditions and livelihoods prospects would exponentially improve. Because off-grid systems can be tailored to adapt to local needs and conditions, they can be a particularly good option for Indigenous reserves and protected areas, where the aim is to protect the intactness of both the cultural and ecological systems, with minimal carbon footprint. •

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