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Energy Transition in Latin America: Possibilities for Advancing at Regional Scale(s)

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UNU CRIS

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Introduction

Worldwide, the energy transition has been posited as a main development goal in the 21st century, driven by climate change and the finite availability of fossil fuels. As the century has progressed, development has increasingly ceased to be conceived as simply growth and material welfare, but instead as a sustainable path to environmental welfare, where the latter can only exist if environmental conditions remain adequate to human life and for the preservation of most life forms on the planet. In general terms, energy transition accounts for ceasing the use of fossil fuels for energy production, such as oil, gas and coal, and adopting renewable or 'clean' sources like water, sun, wind and biofuels for producing energy.[1]

As most regions in the world, Latin America and the Caribbean (LAC) possesses huge potential for producing renewable energies based on wind and sun, but particularly also on water, though it must be noted that being renewable as it is, hydropower can only be considered 'clean' as long as it does not cause significant deforestation or the flooding of vital ecosystems. That said, thanks to hydropower the region stands indeed as the leading one regarding renewable energy, for 61% of its electricity generation by 2020 relied on this and other renewable sources like sun and wind power (being 30% the world's average).

Hydropower alone accounts for 45% of the electricity supply in the region (IEA 2023, p. 15). Yet, it will be argued here that what crucially characterizes LAC's potential for energy transition is not just its capacity to access those forces of nature, but particularly its regional integration and cooperation schemes that should help LAC countries work together as a regional institutional force.

To be sure, LAC counts at present with at least six regional schemes that have the potential to offer normative frameworks, and to develop technical advances, infrastructure projects, and financial tools that could help member countries benefit from their natural advantages and cover costs in a more efficient fashion in order to bring energy transition forward. The Central American System of Integration (SICA), the Andean Community (CAN), the Common Market of the South (MERCOSUR), the Caribbean Community (CARICOM), the Pacific Alliance (AP) and the Community of Latin American and Caribbean States (CELAC) stand as regional integration projects (former four) and regional cooperation schemes (latter two) with institutional structures that allow adopting collective goals and strategies regarding energy transition, since all of them presently show collective concern and sometimes action regarding energy production and environmental issues.

This research report thus aims to assess the possibilities for LAC countries to advance efforts related to energy transition on a regional (LAC at large) or subregional (different LAC subregions) scale. It is argued that despite the fact that none of the existing regional projects currently develop efforts on energy transition –with the salient exception of SICA and to a much lesser extent CARICOM–, all of them (surely with different scale and scope) have the potential to provide effective frameworks for member countries to collectively advance on the matter, as they may offer the possibility of covering costs and profiting technical and natural resources in more efficient fashion.

The report starts by outlining the main challenges that LAC countries must face in the short term to advance energy transition, including financial and material challenges, as well as those of a more political nature, based on a thorough literature review carried out for this purpose. From the start, the benefits pointed out by the literature of addressing such challenges will be underscored, so they can be summarised in section three. A second section argues for the relevance of building regional electricity markets, something that a good portion of the literature points out as highly convenient to foster energy transition. Here, an econometric exercise will be presented to show that the advantages of expanding electricity markets are not primarily related to the potential to reduce investment and operational costs for renewable energy, but rather to the stability and security that regional normative frameworks may offer investors. Lastly, a third section analyzes the possibilities of building such markets and addressing the challenges assessed in the first section, considering the existing institutional settings of each of the six regional integration and cooperation schemes of interest in this paper, focusing on their aim, scope and developments regarding energy transition issues.

1 To be sure, green hydrogen excels as a great energy resource as long as electrolysis is carried out by means of clean electricity (that is, not produced with fossil fuels). Yet, since its inception in Latin America is still very smooth and slow, it will not be considered here. Nuclear energy is not considered either in this paper for it is not renewable, though it is recognized in certain spaces as an option for energy transition because its carbon emissions are lower than fossil fuels'. Geothermal energy might also be part of energy transition, but its scarcity in Latin America compared to other renewables leaves it out of the present analysis too.

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1. LAC's Main Challenges Regarding Energy Transition

This section identifies some main challenges that LAC faces regarding energy transition, some of them of a more material character, like financial costs and lack of infrastructure, and others of a more political one, like policy gaps and lack of normative harmonisation. The identification and classification of such challenges resulted from a thorough revision of related literature, including academic analyses, news and technical reports and official documents from national governments and international organisations, added to our own calculations of certain financial challenges and investment needs.

1.1. Financial Challenges: High Costs and Investment Needs

The transition to renewable energies is costly. In a similar vein as infrastructure, building renewable energy facilities, connection to the grid and enhancing transmission vary broadly in their costs, as all of them are subject to land costs and conditions, prices of construction materials and other inputs, transport costs, needed technologies, logistic and technical issues regarding connection and transmission, and so forth. Moreover, the energy costs of renewable sources are variable. Rain may stop for a while, wind can blow with less intensity, and sunlight might become lighter. Crucially, renewable energy costs may vary from country to country, and some generators in one country might fear being pushed aside by competitors from other countries whose generation and transmission costs are lower if energy integration is pursued (OLADE, 2023, p. 38).

In contrast to fossil electricity, whose market prices are relatively global and depend essentially on fuel demand, the price of renewable electricity might vary up to three times between two countries with similar renewable resources, mostly according to investors' perceived risk. Indeed, while in some LAC countries prices can revolve around US $0.03 per wind or solar kWh, in others with the same resources, prices can reach US $0.10 (OLADE, 2023, p. 111). Other calculations estimate that wind power seems to cost less than other sources, as reports from 2019 estimated an average for Latin America of US $0.053/kWh, compared to US $0.068/kWh of sun photovoltaic power and US $0.066/kWh of biomass (Zepeda and Vázquez, 2021, p. 69, using data from IRENA, 2019). In order to complement these average cost numbers, own calculations were carried out for the present research aimed at showing the cost variation between countries. Figures 1 and 2 show these differences in a selected group of countries using data from a set of selected renewable energy projects by country, considering the components of the so-called Leveled Cost of Energy (LCOE), and other types of data, referring to both installed capacity (Figure 1) and generation per year (Figure 2).[1]

Figure 1. Average investment cost (Capex) per MW installed (USD)

COUNTRY	WIND	SOLAR	HYDRO
COLOMBIA	9.790 – 32.633	20.734 – 41.469	4.566 – 13.699
ARGENTINA	9.790 – 32.633	20.734 – 25.918	9.132 – 11.415
CHILE	9.790 – 32.633	20.734 – 36.785	6.849 – 13.699
COSTA RICA	9.790 – 32.633	18.147 – 38.884	13.699 – 20.548
BRASIL	4.895 – 14.685	25.918 – 31.102	4.566 – 7.991
MEXICO	9.790 – 14.685	18.147 – 52.336	3.424 – 13.699

Source: Own calculations with information from some projects with available data.

Figure 2. Average investment cost (Capex) per GWh produced yearly (USD)

COUNTRY	WIND	SOLAR	HYDRO
COLOMBIA	300.000 – 1 mill.	400.000 – 800.000	200.000 – 600.000
ARGENTINA	400.000 – 700.000	600.000 – 700.000	400.000 – 500.000
CHILE	400.000 – 500.000	200.000 – 350.000	300.000 – 1 mill.
COSTA RICA	500.000 – 650.000	350.000 – 750.000	650.000 – 900.000
BRASIL	150.000 – 450.000	500.000 – 600.000	200.000 – 350.000
MEXICO	350.000 – 450.000	350.000 – 1 mill.	150.000 – 600.000

Source: Own calculations with information from some projects with available data.

1 The author thanks research assistant Mariana Romero for developing calculations presented in this subsection.

The figures show that both installed capacity (MWh) and yearly generation (GWh) vary substantially within each country and among countries. There is no way to affirm that renewable energy is cheaper in one country than in others; only that Brazil has lower costs in wind and hydro, but not in solar; and that Costa Rica has higher minimum amounts in wind and hydro. But what these numbers do allow us to conclude is that financial needs are huge, and diversifying financial sources and sharing them surely are key to achieving their coverage. As with any other capital-intensive project, capital contributions to renewable energy projects come from public and private funds, and they usually need to rely on multilateral banking for leveraging investment. Distinct perceived risks are incorporated into capital costs, the return rate expected by investors, and debt costs. All these translate into weighted-capital higher costs and a higher discount rate when formulating the project. This can be illustrated by the case of an investment that must be repaid in 25 years with a discount rate of 18%, which requires twice as much annuity as if the rate were 8%. Hence, with the same investment and plant capacity factor, energy will cost twice as much. These are numbers corresponding to real costs in the LAC region, and not necessarily the highest (OLADE, 2023, p. 111).

In these terms, given that 16 of the 33 countries in the LAC region have pledged to reach net zero emissions by mid-century or earlier, and most have presented more ambitious Nationally Determined Contributions (NDCs) tied to the 2015 Paris Agreement (IEA, 2023b), it is clear that the costs for meeting such aims for all LAC countries are extremely high. To fulfill pledges, financing for clean energy projects needs to double to US $150 billion by 2030 and rise fivefold to US $750 billion by 2050. In this scenario, the ratio of investment in clean sources to unabated fossil fuels climbs from around 1:1 today to 4:1 in the 2030s (IEA, 2023a). Yet, calculations based on data from developers' reports on renewable energy projects and from governments estimate around US$ 275.2 billion for Latin American countries to fulfill their energy transition goals by 2030. If added to infrastructure costs, the Inter-American Development Bank estimates that the region will require more than US$ 577 billion in clean energy infrastructure by 2030 to meet its climate commitments and guarantee universal access to sustainable energy (Cristiani and Datta, 2025). Clearly, these are amounts of money that LAC states cannot afford through public spending, and substantial private investment and multilateral financing are needed to cover these costs.

In sum, investment needs for energy transition in LAC are huge. According to Bernal-Guzmán (from IEA), only 15% of total investment in renewable energies is going to LAC, and the rest is going to advanced economies and China (BID, 2024a, min. 11). At COP 28, Latin American countries (except Ecuador) committed to triple their renewable energies capacity by 2030. In order to reach this goal, the region should increase their renewables' capacity in 15.8 GW per year, something that has not been hard to accomplish in recent years as it increased it by 29.4 GW in 2023 and 22.8 GW in 2022 (Alarcón, 2024). However, other estimations made by OLADE (2023, p. 14) consider that while the percentage of installed capacity from renewable sources in LAC remains higher than the global average, this is still due to the strong historical share of hydroelectric generation: 41.4% of total installed capacity in Latin America and the Caribbean in 2021 was hydroelectric, while only 8.0% was wind, 6.2% solar, 4.8% biomass, and 0.4% geothermal. But the most relevant fact is the difference in the growth rate of renewable generation: in 2020, only 11.6 GW of renewable generation was added (54.2% solar, 31.5% wind, 10.5% biomass, and the remaining 3.3% hydroelectric), representing a growth of only 7% in the total installed renewable capacity of the entire region, which in that year was 292 GW. This is about a third of the global growth rate of renewable sources, which is 9% year-over-year (ibid.).

Furthermore, to approach the growth rate projected for the next 5 years at a global level, a simple rule of thumb indicates that more than 150 GW of renewable generation would need to be incorporated in the LAC region between 2023 and 2027, which seems incompatible with the current growth rate and the planned expansion plans. This figure, for example, is nearly 10 times the combined wind and solar capacity currently available in Mexico, Argentina, and Colombia, which together account for 31% of the region's total installed capacity; it is also 5 times the total wind and solar capacity installed today in Brazil, which has 40% of the region's total installed capacity. In the rest of the countries, with some notable exceptions, the penetration of wind and solar sources is also not reaching levels comparable to the global average (OLADE 2023).

Compared to the rest of the world, LAC remains lagging behind the growth rate of photovoltaic and wind power sources, as by 2023 nearly three-quarters of new power generation installed worldwide was the combination of solar photovoltaic and wind power, with 130 GW and 93 GW, respectively. As a result, global installed capacities of wind and solar energy reached capacities comparable to hydropower: 837 GW of wind, 903 GW of solar, and 1,230 GW of hydropower at the end of 2021 (OLADE 2023). Furthermore, a 2022 report by the International Energy Agency shows that according to short-term expansion plans planned worldwide, in the next 5 years, 2,400 GW of new renewable generation will be installed (the equivalent of all the current generation capacity of China); where by 2024 installed solar photovoltaic capacity worldwide will surpass hydroelectric power, and by 2027 it will be the largest, even surpassing that of coal plants (Ibid., p. 14).

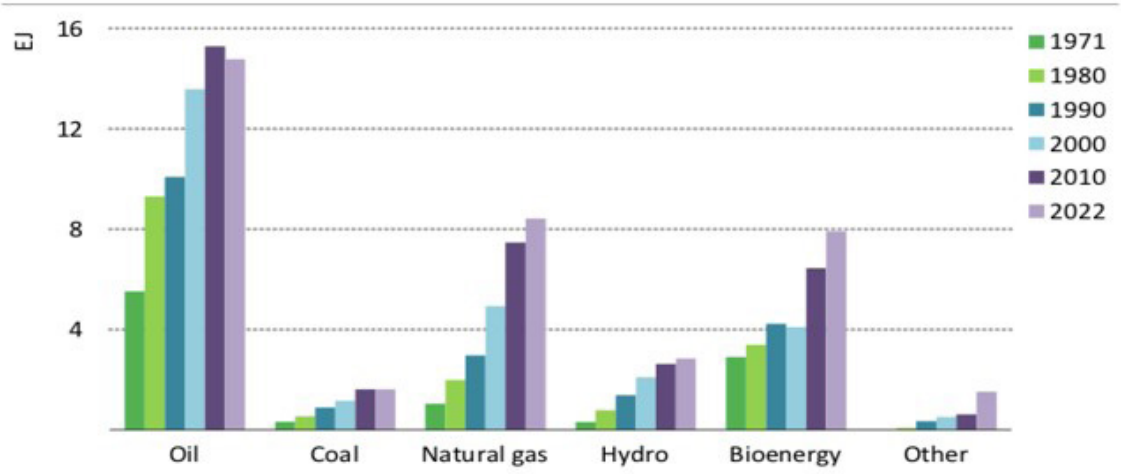
In any case, even if LAC investment in renewables is considered to have progressed at good rate, the pace must be kept steady, as it is expected that under today's policy settings, the region will continue using fossil fuels to meet a large share of its energy needs, especially for road transport, while progress on clean energy transitions is to remain limited (IEA, 2023b). Following the Atlas method, which classifies countries according to their income level, per capita electricity consumption in LAC is only 25% of the average consumption of high-income countries: 2,158 kWh vs 8,929 kWh, respectively. Hence, if the region experiences a rise in electricity demand following the trend in higher-income countries, important changes to the energy sector will be needed (Levy et al. 2023, p. 11). Figures 3, 4 and 5 give account of current LAC dependence on fossil fuels, and Figure 6 shows the differences between a selected group of LAC countries regarding national investment in renewables.

Figure 3. LAC distribution between fossil fuels and renewable energies, including Import dependence ratio

	Population (million people)	GDP per capita thousand USD (2022, PPP)	Fossil fuels in TES	Renewables in electricity generation	Import dependence ratio	
					Oil	Gas
Argentina	46.0	27	85%	33%	0.07	-0.15
Bolivia	12.2	10	84%	38%	-0.36	0.76
Brazil	215.3	18	46%	88%	0.30	-0.40
Chile	19.8	29	69%	59%	-0.98	-0.81
Colombia	51.9	19	73%	78%	0.63	
Costa Rica	5.2	25	50%	99%	-1.00	
Cuba	11.2	N/A	85%	5%	-0.66	
Dominican Republic	11.2	23	89%	17%	-0.99	-1.00
Ecuador	18.0	13	81%	81%	0.55	
El Salvador	6.3	11	52%	84%	-1.00	-1.00
Guatemala	17.3	11	37%	70%	-0.94	
Guyana	0.8	42	95%	2%	0.67	-0.89
Haiti	11.6	3	25%	13%	-1.00	
Honduras	10.4	7	52%	61%	-0.97	
Jamaica	2.8	12	91%	13%	-1.00	-1.00
Mexico	129.8	23	89%	19%	0.21	-0.56
Nicaragua	6.9	7	42%	69%	-0.96	
Panama	4.4	37	76%	78%	-1.00	-1.00
Paraguay	6.8	16	29%	100%	-0.97	
Peru	34.0	15	73%	62%	-0.42	0.35
Suriname	0.6	18	89%	49%	-0.09	
Trinidad and Tobago	1.5	28	100%	0%	0.72	0.35
Uruguay	3.4	28	44%	85%	-0.93	-1.00
Venezuela	28	9	81%	80%	0.70	
LAC	658	18	67%	61%		

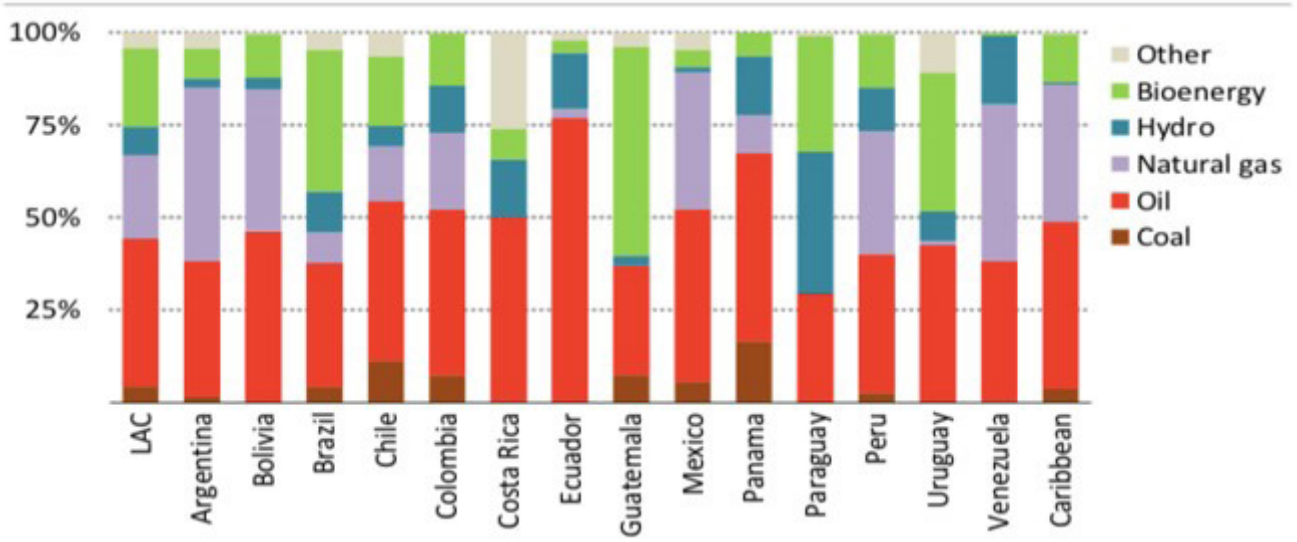
Source: IEA (2023)

Figure 4. Total energy supply by source in LAC, 1971-2022



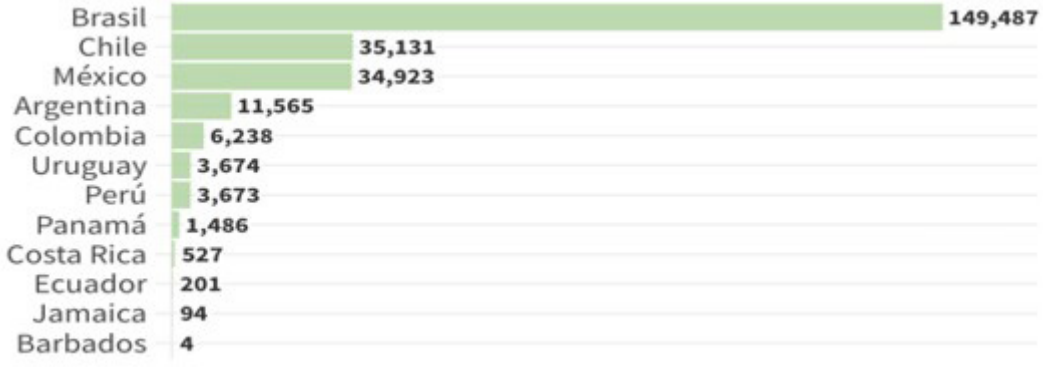
Source: IEA (2023)

Figure 5. Total energy supply mix in LAC and selected countries, 2022



Source: IEA (2023)

Figure 6. Investment by 7 Latin American countries in renewable energies over the past 7 years (2017–2024) (USD millions)



Source: Zero Carbon Analytics (2025)

The figures show that there is great disparity between LAC countries' energy mixes, and thus heterogeneity regarding transformation needs prevails in the region. Countries like Paraguay, Costa Rica, Brazil, Uruguay, El Salvador, Ecuador and Venezuela are consolidated regional champions in clean electricity generation, as more than 80% of their electricity is produced by renewable sources. However, this does not necessarily correspond to a similar performance in total energy supply (TES): while Costa Rica, Brazil, Uruguay and El Salvador rely on fossil fuels for just nearly half of their TES, Ecuador and Venezuela do in more than 80%, showing that transport and industry might not be as clean as electricity in all cases. Paraguay definitely stands as the region's champion, with the lowest fossil fuel dependence in its TES (only outscored by Haiti). On the other hand, countries like Argentina, Bolivia, and Mexico perform low in both rankings, as they present a large share of TES dependence on fossil fuels (above 80%), and a rather small share of renewable energy in electricity generation (below 40% for Argentina and Bolivia, and even below 20% for Mexico). Notably, a country like Honduras, which does not depend much on fossil fuels in TES, does not have a significant portion of electricity generation based on renewable sources (only 61%), but Suriname, on the contrary, shows a huge TES dependence on fossil fuels, and almost half of its electricity generation is based on renewable sources. Lastly, the Caribbean islands' situation is quite dramatic, as they show a huge TES dependence on fossil fuels and an almost inexistent reliance on renewables for electricity generation. All these differences account for LAC countries' varied needs and challenges, and the consequent need to develop cooperation and alliances that take these particularities into account.

On its part, Figure 4 shows positive trends in LAC energy generation: although oil shows pronounced sustained growth, hydro and bioenergy show relatively significant growth as well, while other sources (such as wind and solar) show slight growth. Gas is another champion source, not renewable, but cleaner than oil. Lastly, coal has also grown but fortunately in much less eager fashion. Figure 5 underscores LAC countries' dependence on oil, particularly in Colombia, Ecuador, Mexico, and Panama, which rely on it by more than 50% in their TES. Figure 6 confirms the huge investment gap among LAC countries, where Brazil exceeds the rest by far, while small countries like Panama, Costa Rica, Ecuador, Jamaica, and Barbados struggle to make significant investments to change their energy matrices.

According to Bnamericas, in 2024 there were 1,796 renewable energy projects in Latin America, amounting to a total investment of US $113 billion. Brazil hosted most of them (8,091), followed by Chile (1,244), Colombia (308), Mexico (251) and Argentina (173) (Alarcón, 2024, quoting Bnamericas, 2024). Following data from Bnamericas, additional to these projects already in operation there are 8,005 in early works stage, and 703 under construction, amounting for US $232.8 billion and US $20.8 billion respectively, which add a total Capex of US $367 billion[2] (Bnamericas, 2024).

As shown in Figure 6, national investment is highly disparate between LAC countries, and even for those who show higher investment amounts to meet ends, all of them should seriously consider joint alternatives to face cost and financial barriers in order to meet their energy transition goals. This situation is also related to the lack of articulation and coordination between countries' national investments, which may upraise restrictions that compromise the effectiveness of the entire energy system, and will be reviewed in the next subsection. Moreover, there is general agreement that, with proper conditions –including adequate and sufficient infrastructure, clear normative frameworks and institutionalised electricity markets–, electricity produced with renewable energies in Latin America would be cheaper than with fossil or nuclear ones (OLADE, 2023, pp. xiii, 5, 13).

A particularity of the LAC region is that integrating renewable energies in a complementary fashion would allow for having electrical systems 100% renewable without using more storage capacity than the current one of hydropower facilities (ibid.).

1.2. Lack of Interconnection Networks and Infrastructure and Difficulties in Articulating National Investment[3]

Despite LAC countries' commitment to energy transition goals, most of them lack articulated domestic strategies to coordinate investment actions, as well as the building of energy generation and transmission facilities at the national level that help countries meet such goals. Articulation problems result in absence of infrastructure for transmission and storage and geographic concentration (investment concentrated in areas of high technical-economic potential, neglecting consumption centers and areas of energy poverty). These complications are not limited to countries with lower percentages of renewables in their electricity matrices; even regional leaders like Brazil and Chile face systemic articulation problems.

2 Note that these numbers do not contradict those stated in previously outlined, as these investments for US $367 billion correspond to projects already in course, whereas the needed investment previously estimated corresponds to what is needed to meet transition pledges for 2030, considering projects existing today in the region (many of which are included in the US $367 billion here quoted).

3 The author specially thanks research assistant Paula Martínez for helping him constructing this subsection.

Brazil, despite its leadership in clean energy, faces political incongruence in the new Growth Acceleration Program (PAC), whose "Energy Transition and Security" axis will allocate 62% of its resources to fossil fuels, such as oil and natural gas, despite planning for the majority of new electrical capacity to come from renewables. On the other hand, the main technical problem is the geographic disarticulation of investment, whose epicenter in wind and solar energy is the Northeast region because it generates more than 90% of wind energy and 40% of solar energy (López, 2024; Souza, 2020; Teles, 2025). In this region, the growth of electricity generation clashes with transmission infrastructure, which has not grown at the same pace. This generates the phenomenon of curtailment (forced reduction), where wind and solar farms are disconnected to avoid overloading the grid. This generates direct financial losses for generators —since the energy they cannot inject into the grid cannot be commercialised— which increases the risk perceived by investors (Araújo, 2025; Review Energy, 2025a; RystadEnergy, 2025).

Chile experiences a similar disconnection. For logical reasons, renewable investment is heavily concentrated in the Northern Zone —solar and wind, with more than 9,000 MW— and in the Southern Zone —wind and hydroelectric— (ACERA, n.d.; CNE Chile, 2024), as these zones have the greatest potential for taking advantage of such forces of nature. However, given that the Metropolitan Region, namely the largest consumption center, lies in the Central Zone, there has been a lack of articulation in investment for modernising the grid for transmission and storage, which has caused record energy curtailment, losing more than 5,500 GWh in December 2024 alone (Jorquera, 2025; ReviewEnergy, 2025a). Furthermore, Chile's renewable generation capacity far exceeds transmission capacity, resulting in more than 5.9 TWh of clean energy being lost due to inadequate networks.

This problem occurs similarly in countries with intermediate progress, such as Colombia and Mexico, which struggle with uncoordinated implementation and regulatory gaps, and where approved projects face obstacles to integration into the national electrical system (J.P. Morgan Private Bank, 2025). In Colombia, investment in non-conventional renewable sources is limited by fragmented regulation and the lack of a unified strategy, and planning has developed more through reactions to conjunctural problems (mainly supply crises due to droughts) than through long-term scenarios (Pereira and Turizo, 2020). Infrastructural disarticulation is palpable in the areas where investment is concentrated, such as La Guajira, where the key transmission line for wind energy will not be operational before 2027 (Giorgi, 2025). This delay has made projects unfeasible and has forced the exit of large international developers (ibid.). Mexico faces a transition hindered by profound infrastructure disarticulation. The energy matrix depends more than 60% on natural gas and infrastructural disarticulation is critical: the country needs at least 15,000 km of new transmission lines to integrate the projected renewable capacity by 2030 (Lardizabal, 2025a).

In Peru, disarticulation of investment is characterised by the absence of a defined energy transition policy and the obsolescence of the National Energy Policy 2010-2040 (Sierra, 2024). At the legislative level, there is a clear imbalance: the Congressional Energy and Mining Commission has prioritised the discussion of fossil fuel projects (13) over renewable energy projects (6) between 2015 and 2023 (Sierra, 2024). Territorial disarticulation is equally critical, as investment in solar and wind is concentrated in the South and coast regions (Gordillo and Montoya, 2023; Singh, 2025), which generates an "unjust energy transition," since in Amazonian departments such as Loreto and Ucayali, only about half of the population has access to electricity (Pinedo, 2023; Sierra, 2024). In nations with greater challenges, the disarticulation is structural, linked in part to historical dependence on hydrocarbons.

In Bolivia,the majority of primary energy comes from hydrocarbons, and the centralised and vertical model has prioritised natural gas, whose production has unfortunately fallen significantly (Bot, 2025).

Regarding infrastructure for transmission and storage, the mantra "No transition without transmission" has been widely used in debates on energy transition. It is usual to have potential zones for taking maximum profit of wind and sun, but very far away from electricity transmission lines, or with costs too high to connect to the grid or to reach zones where most consumers reside. OLADE (2023, pp. 25-6) points out particularly the situation of Argentine Patagonia, Atacama Desert in Chile, La Guajira in Colombia, Northeast and extreme-South Brazil, and certain regions in México (though with smaller distances), where wind and sun are pretty abundant in coastal zones, but consumption centers are very far away from them. Unfortunately, the terms needed to plan and build a new power line and put it into service have become increasingly long, thus representing major bottlenecks for energy transformation.

According to OLADE (2023, pp. 37-38), integrating energy systems is crucial for any electricity matrix. Besides increasing security in energy supply, it reduces generation costs at both or more border sides. European experiences show that the costs of building needed transnational transmission capacities are repaid in the short term, thanks to reduced average energy costs, especially

with renewable energies (ibid.). Thus, LAC countries should associate in order to build infrastructure for transmitting electricity from certain crucial locations for generating renewable energies, considering that the generation produced from one country´s location will benefit other countries and regions taking part in such infrastructure projects. This topic will be further developed in greater detail in the paper's next section.

1.3 Lack of Skilled Workforce and Technology[4]

Among the most critical challenges for the region's energy transition are the limited training of human capital and persistent difficulties in technological adoption and infrastructure modernisation. The shortage of qualified professionals is not only quantitative but also qualitative: it reflects a deep gap in specialisation and technical skills, often resulting in unfilled key positions. According to an internal measurement by RG Principal's Jobposts related to business and project development in renewable energy in LAC, between 18% and 25% of strategic positions remain vacant (Gubinelli, 2023). This points not merely to a lack of labor supply but to a broader deficit in specialisation rooted in weak academic preparation and insufficient professional development opportunities.

The Inter-American Development Bank (IDB) has highlighted this issue, finding that only about 15% of workers in LAC receive any form of job-related training, compared to 56% in OECD countries. This situation creates a vicious cycle of low investment in training, inadequate skill development, and low productivity (Saget et al., 2020). Although the shift toward a decarbonised economy requires a profound transformation in science, technology, and innovation (CAF, 2025), the region still faces a pronounced gap in human capital formation. In Colombia, CONPES 4075 underscores the limited availability of educational programs linked to energy transition, identifying two main causes: the absence of methodological frameworks to guide training, and the lack of specialised programs for key areas such as planning, design, and market operation (DNP, 2022, p. 39). This situation is aggravated by insufficient training in emerging technologies —such as Non-Conventional Renewable Energy Sources (FNCER) and hydrogen— which limits both the creation of qualified jobs and the re-skilling of workers from traditional sectors such as oil and coal (Ministerio de Minas y Energía, 2021). According to R. Méndez Galaín, Uruguay's former National Energy Director who implemented the policy that led the country to transcend fossil fuels for electricity generation, renewable energy facilities would generate many more jobs than fossil industries, not on a one-to-one basis, but, with proper planning, several renewable energy facilities would be needed to substitute one oil or coal plant, the latter employing much less workers than wind and sun power plants (as quoted in Díaz, 2025).

Regarding technology, as Sánchez (2023, p. 29) notes, the region faces the challenge of avoiding the deepening of internal and international technological and productivity gaps. The absence of local innovation and technological capabilities prevents the transformation of the productive structure toward knowledge-intensive activities with a lower environmental footprint (ibid., p. 20). This structural weakness results in Latin America increasingly exporting raw materials while importing high-technology goods, a dynamic that reinforces dependence and perpetuates unequal ecological exchange. Such dependence is particularly evident in research and development: technologies like hydrogen and energy storage remain in early stages in the region, subordinated to advances made in the world's main scientific and technological centers (ibid., p. 20).

In sum, energy transition in LAC is constrained by the scarcity of specialised human capital and the region's ongoing technological dependence on developed economies. These issues are not isolated; rather, they are interdependent and stem from structural deficiencies in education, innovation, and science policy. The limited technical training and weak local innovation capacities constitute major barriers to achieving a sustainable, inclusive, and competitive energy model. Overcoming this dilemma requires a far-reaching educational and technological transformation, one capable of strengthening domestic knowledge production, promoting applied research, and fostering regional autonomy in the development of clean technologies that support a just and sustainable energy transition.

1.4 Lack of Articulation of Carbon Taxes[5]

Carbon taxes have long been a measure to fight climate change, as they intend to tax carbon emitters and increase their production costs. Regarding the energy transition, carbon taxes are considered a key tool to incentivise investment in renewable

4 The author specially thanks research assistant Silvana Peña for helping him developing this subsection.

5 The author specially thanks research assistant Sara Táutiva for her help in complementing this subsection.

energy and disincentivise investment in fossil fuels. Yet, not even OECD countries have advanced much in increasing carbon taxes, and the strong dependence of most LAC countries on fossil fuels surely leads them to perform even worse in this regard. With the exception of transport –due to its extensive use of gasoline and diesel– most sectors in LAC countries have very low carbon taxes, and where there are, they vary largely among countries. While international organisations like the High-Level Commission on Carbon Prices, the IMF and the OECD recommend an average tax of 66 EUR/tCO2E, most LAC countries have a tax rate of 24 EUR/tCO2e, having Costa Rica as a carbon tax champion with an average tax rate of 76 EUR/tCO2e, and countries like Ecuador with a zero-tax rate (BID, 2023).

Over the last few years, several countries in Latin America have become keen to start charging carbon taxes. However, the lack of regional coordination and integration, as well as institutionally at the domestic level, is flagging the development of a unified climate policy. This disarticulation itself is inspired and manifests itself in three different dimensions: the limited development of fiscal and regulatory instruments, the variation of taxes and the uneven distribution of benefits, and the lack of international arrangements to deal with issues of carbon leakage and provide together the benefits of green competition. In general terms, low taxes on carbon emissions have no significant effect on changing the negative behavior of the companies and consumers, and therefore do not contribute to any environmental gain. Besides, these taxes are limited to certain fossil fuels or particular sectors, such as power generation or transportation, while large amounts of emissions are produced from other sectors which are not taxed. This limited approach not only mitigates the effectiveness of a tax on carbon emissions, but also creates economic imbalances, and ultimately distorts the purpose of a tax on carbon emissions (Mintz-Woo et al., 2024).

The uncoordinated approach to carbon taxes present in LAC also affects domestic coherence between fiscal and environmental policies. Very often, these taxes are designed with the primary goal of revenue collection rather than part of a more thoughtful approach integrating tax revenue with energy transitions, technological advancements, and socio-economic support for the economically vulnerable. This lack of alignment undermines the political legitimacy of these taxes and public support. As the Inter-American Development Bank (IDB, 20223) indicates, the acceptance of taxes is proportionally related to the accountability and expenditure of taxes on revenue collection, for example, on public transportation or renewable energy, which unfortunately are largely absent in Latin America.

The described challenges are illustrated well by Chile and Mexico. A carbon tax of 5 US dollars per ton of CO_2 was mandated in 2017 exclusively for power plants with a capacity exceeding 50 MW. While a milestone was achieved, it is still very limited in scope, and as a result, emission reduction is negligible. Regulatory and technical obstacles are in place for the proposed shift to an emissions trading system (ETS). In 2017, Colombia introduced a carbon tax focused mainly on fossil fuels, which accounts for 19% of total emissions. Colombia has fossil fuel subsidies, and with the low tax rate of 5 US dollars/tCO_2, the tax's effectiveness is severely compromised. The tax's unsatisfactory integration with other environmental policies, especially for a just transition, is another hurdle (UNFCCC, 2024; IDB, 2023xx). In 2014, Mexico implemented its federal carbon tax, which was later supplemented with discretionary regional programs implemented in the states of Zacatecas and Yucatán (Ecologic Institute, 2023). While its coverage is extensive, to approximately 42% of Mexico's national emissions, the design is still complex and remains fragmented across federal and state levels. The most recent evaluations (Ortega et al., 2022) conclude that, so far, the tax has neither driven emissions down to expected levels nor collected the anticipated revenue, and in some cases, the tax may even be regressive in certain sectors of the economy.

Unequivocally, current heterogeneity in carbon taxation runs far behind in the pursuit of inducing a thorough and fundamental shift in LAC's energy production and consumption patterns. Addressing this disintegration will require alignment of carbon pricing with climate targets, removal of all exclusions on carbon pricing, removal of fossil fuel subsidies, and the establishment of cooperative regional agreements on phased harmonisation. Only by undertaking these actions will carbon tax regimes (and the broader climate policy frameworks of the region) attain the social equity, environmental justice, and economic resilience that the region desperately needs (UNFCCC, 2024; World Bank, 2023).

1.5. Short vs. Long-term Markets

While long-term Power Purchase Agreements (PPA) remain predominant in electricity markets in LAC, short term-contacts have increasingly become an attractive option for they are more flexible and responsive to market conditions, particularly when it

comes to integrating renewable energy sources. Rising fossil fuel prices, adverse natural events, and the integration of variable renewable energies (VREs), has led to undertaking structural reforms in wholesale electricity markets that include short-term contracts as a promising option (Balza et al., 2024, p. 12). However, short-term prices do not always reflect agents' opportunity cost, which has implications for their investment decisions and the financial viability of generation projects (ibid., p. 13). Yet, in certain conditions short-term contracts might better suit renewable projects, due to the variability of wind and sun power and the quality of transmission infrastructure and connection to the grid. For instance, Uruguay's former Energy National Director, R. Méndez Galaín, has called the attention over the need to adjust contracts to renewable projects' capacities, which might eventually require short-term contracts different from the long-term ones established for fossil fuels' thermal centrals (as quoted in Díaz, 2025).

In any case, because the energy transition demands significant investment across different components of the value chain, long-term contracts should be preferred over short-term ones (OLADE, 2023, pp. 125-6). Long-term contracts ensure off-takers (companies responsible for distributing electricity to consumers) permanent access to generated electricity and reduce the risk of competition from new providers that may emerge in the coming years. Clearly, providing long-term contracts requires greater levels of norm harmonisation across countries to guarantee their stability and respect, especially when times of energy shortage eventually arrive.

1.6. Policy Gaps and Lack of Legal Frameworks/Norms for ET

Whilst the paper's next section will delve into the relevance of building regional electricity markets for the energy transition in LAC, this subsection discusses some of the problems arising from the lack of coordinated policies, harmonised legislation, and norms among countries, which are also logically required for establishing regional energy/electricity markets. Beyond the participation of the state in the electricity market and its subdivisions at the domestic level, currently in LAC, each country promotes different markets and mechanisms for commercialising energy and power at the domestic or national level (Levy et al. 2023, p. 30). A first obstacle in this regard is the lack of regional planning. At present, there is no collaboration in energy planning within the region, which means that energy complementarity between countries has poorly been considered, except for those cases of electricity exchanges that will be reviewed in the paper's last section. This limits the ability to explore the potential benefits of trading and macro-exploitation of present and future resources, as well as the demands of different systems (Levy et al. 2023, p. 25).

In general terms, LAC countries hold different normative frameworks, policy guidelines and regulatory settings that may seriously hinder further cooperation and energy –and particular electricity systems'– integration. In Mexico, for instance, legal uncertainty at the political-regulatory level is a key disarticulating factor of energy transition, as no long-term auctions have been held since 2018, halting investment (Lardizabal, 2025b; Bnamericas, 2025). This situation has led to a 50.1% drop in foreign direct investment (FDI) in the energy sector between 2019 and 2023, compared to the previous period (Escalera, 2024). Territorial disarticulation is also manifested in the concentrated investment of megaprojects (85.3% private), which generates agrarian tensions and social fragmentation in rural communities (Olmedo Neri, 2023). In addition to technical and financial limitations, there are political and regulatory barriers that have slowed the development of the renewable energy sector. Modifications in energy matters have generated legal uncertainty, which has discouraged private investment in clean energies (SELA, 2022).

In other countries such as Peru, the lack of fiscal incentives and clear regulatory frameworks has slowed project execution (SELA, 2022). In Peru, electricity market practices also disarticulate renewable investment, as they favor thermal generation from natural gas by creating artificial prices that discourage renewable sources in the spot market (Gamio, 2020). Chile faces regulatory "bottlenecks" in the energy storage sector. The crucial regulation for battery operation is "frozen," creating investment uncertainty and slowing permit processes, thereby misaligning initial budgets. The lack of clear rules also prevents storage systems from offering "complementary services" or functioning as transmission solutions, and markets have not yet been developed to attract investment (ReviewEnergy, 2025a). On its part, regulatory disarticulation in Bolivia is severe: the country lacks an Energy Transition Law or a specific regulation for non-conventional renewable energies, which prevents the

creation of tax incentives or technical standards (PBFCC & CANLA, 2025). Additionally, the existence of generalised subsidies for fossil fuels (amounting to more than 3% of GDP) restricts the fiscal margin to support clean energy (PBFCC & CANLA, 2025).

In sum, the lack of regulatory and policy coherence, particularly in the face of fragmented regulations, bureaucratic slowness, and the persistent prioritisation of fossil fuels, constitutes common patterns that threaten economic stability, supply security, and social justice in the region. Furthermore, regulatory harmonisation is key to reducing investor risk perception, which, in turn, is crucial for pursuing the energy transition. If perceived risk is too high, not only will the costs of renewable energy exceed those of fossil fuels, but projects may not receive financing approval and thus cannot be developed. Investors perceive risks related to obtaining permissions and licenses from the government for connecting to the grid, or permissions from communities to accessing land. They also perceive risks related to the lack of transparency in competition rules and to changes and differences in required environmental standards (OLADE, 2023, p. 111). All these risks could be reduced if countries harmonised norms and procedures, which would be harder to alter as they would be concentrated and levied at the regional level, thus providing greater stability for investment plans and project financing.

1.7. Preventing and managing socio-environmental impact

Renewable energy facilities in LAC are usually built in areas where the forces of nature are more intense, like coasts, deserts and rainforest territories, where local communities have long lived and thrived, and very often without having access to electricity. However, a serious aggravating factor for developing renewable projects is the growing restrictions on the construction of new power lines, which are increasingly resisted by local communities. Unlike a generating station, which is limited to a hundred hectares and, therefore, a small number of rural properties, a power line can be hundreds or thousands of kilometers long, cross hundreds or thousands of properties, and encompass diverse local communities (OLADE, 2023, p. 26). On the other hand, renewable energy facilities might have a significant impact on the environment, drying and diverting water sources and causing deforestation of vast areas, not only favoring temperature rises and global warming but also endangering agriculture and shepherding.

As significant for local communities as it might be, the need for environmental permits and licenses, as well as the requirement to develop consultations and agreements with local inhabitants is also a great challenge for investors and developers, and it is often the case that norms and regulations are not enough for bringing these processes forward, because each community has its own particularities and problems, and demands a specific type of negotiations under distinct circumstances. In Colombia, for instance, building wind power facilities in La Guajira has been a steep process for both investors and local communities, as the Wayuu indigenous community has not found it easy to agree on their demands and representatives, and thus negotiations with investors have taken too long and brought back and forward, as new demands and complaints on representation have raised with time (González, 2022).

Moreover, despite having a strong regulatory framework for consulting communities, multinational companies and national governments often negotiate with particular groups separately, thereby undermining the representation of the community as a whole. Usually, the building of wind power facilities and transmission lines has affected water sources, has brought deforestation and takes place over sacred territories for the Wayuu, which clearly countervails a just energy transition (Fuerza de Mujeres Wayuu, 2023). In addition, the electricity generated by wind parks in La Guajira is to be distributed to main industrial and urban centers in the country's interior, thus excluding local communities from access tomke such electricity (La Silla Vacía, 2023). According to R. Méndez Galaín (as quoted in Díaz, 2025), any renewable energy project must bring benefits for local communities in clear fashion. Not only social licenses must be negotiated with transparency and inclusion, but the electricity generated by those renewable facilities must reach local communities, and ways must be found so local inhabitants can work or participate somehow in projects' value chains.

In these terms, designing protocols for negotiating with local communities and including them in the development of renewable energy projects can be brought forward by regional integration and cooperation schemes, particularly those with the potential to establish interconnection systems and regional electricity markets (as those particularly pointed in the paper's last section). Such schemes may offer institutional stances for dialoguing and providing technical assistance for negotiations, both for governments and investors, and for local communities, and the fact that negotiations are carried out under a regional normative

scheme may provide greater security and warrant for communities that what is agreed will be enforced by investors and authorities, as it will be surveyed by such regional institutional stances. Furthermore, negotiating with local communities from regional stances may leverage the negotiating capacity of energy authorities (and also with private actors), as long as local communities also have representatives at those regional stances to negotiate licenses with governments and investors, and thus their representative role may be more transparent and articulated with communities' own decision mechanisms.

National governments and investors might find it hard to adopt regional stances to pursue negotiations with local communities that could be conducted on a more particularised, localised basis, but it is precisely the complexity of local particularities that usually makes such negotiations more difficult. Counting on regional institutional stances for bringing negotiations forward can signify a warrant for all parties, who will know that the reached agreements at such stances could be more secured and stable as they would become surveyed by regional authorities.

Regarding environmental impact management, it shall be acknowledged that this is a more sensitive topic for national authorities, for governments' policies on this matter often vary according to conjunctural needs and changes in governments' priorities. This surely makes it harder to coordinate environmental policy for renewable facilities at the regional level, but current integration and cooperation schemes in LAC could do well to agree at least on broad commitments to protect the environment as renewable facilities are built, as in the recently signed Escazú Agreement, which was signed by several LAC states.

2. Building Regional Electricity Markets for Fostering Energy Transition

This section of the paper focuses on the convenience of developing regional electricity markets to advance the energy transition in LAC. Most literature has focused on advocating for interconnection systems, with SIEPAC's experience in Central America serving as a primary reference for this, as outlined in the paper's third section. Yet, interconnection does not equate to regional markets, for the latter involve increased demand due to more consumers seeking access to the same market terms and conditions. Instead, greater interconnection should facilitate electricity exchanges between countries, but necessarily under one single regional electricity market. Hence, after pointing out certain benefits that different studies have underscored deriving from interconnection systems without necessarily considering demand increases, the section's second part will present the results of own calculations considering projected demand increases that would derive from building regional electricity markets. It will be argued that despite the absence of a strong correlation between demand increase and lower investment costs, the benefits of building such markets are to be found mostly in the regulatory and security dimensions.

2.1. The Benefits of Interconnection Systems and Their Current State in LAC

Different studies have shown that interconnection systems may reduce both investment and operational costs of electricity generation and transmission, though not exclusively focused on renewables. For instance, the IDB study on Central American Electric Integration (Echevarría et al., 2017) demonstrated that coordinated planning of electric system expansion should reduce investment costs, as well as generation and operating costs. This is due to improved infrastructure use and increased capacity for steady aggregate energy, which should, in turn, facilitate the incorporation of renewable sources (BID, 2018). Something similar is advocated by Levy et al. (2023), who argue that renewable energy resources could be used more efficiently if system integrity is strengthened, and a power market is promoted at the regional or subregional level. According to OLADE (2024), some studies have projected different scenarios where greater electric interconnection generates substantial benefits in terms of reducing carbon emissions, investment volumes and operating electric systems across the LAC region. However, they have often focused on particular subregions or countries, or even on a single type of renewable energy, such as hydro (Banco Mundial-OLADE, 2023).

A study from IADB established in 2017 that including 80% of renewable energies in a projected electricity interconnection system in Latin America by 2030 would save up to US $20.3 billion in investment, and 0,7 Gigatons of CO2e could be avoided (BID, 2017, pp. 108-109). Accordingly, interconnection systems tend to reduce total system operation costs, thus opening an opportunity to transfer such savings to final consumers (ibid.). According to Levy et al. (2023, p. 30), regional integration of infrastructure may increase its efficiency by taking advantage of different demand patterns between countries, as well as different generation technologies and supply sources by reducing reserve requirements (primary, secondary, tertiary), thus allowing countries to

reduce investments in generation.[6]

Unfortunately, the current LAC state of the art regarding regional electricity interconnection is rather poor, which logically matches low electricity exchanges in the region. In 2018, the amount of electricity imports and/or exports from the region was equivalent to less than 11% of those made in Europe in the same period, and furthermore, while Europe has experienced annual growth rates of 2.1% in imports/exports (2000-2018), Latin America showed negative rates of -0.8% in that same period, demonstrating a lack of regional integration (Levy et al., 2023, p. 29). Data from the International Energy Agency (AIE, 2021) showed that electricity imports of 49,100MWh in LAC were far lower than the 454,000 MWh in Europe, and exports of 48,700 MWh in LAC were also much lower than the 454,000 MWh in Europe.

According to Levy et al. (2023, p. 29), there are several electricity-integration schemes in the region with differing levels of progress: very high levels of trading in Brazil and the Southern Cone, moderate levels in Central America, and very low levels in the Andean region and Chile. Nowadays, the largest interconnections in Latin America correspond to binational hydroelectric power plants on rivers bordering Paraguay, Brazil, Argentina, and Uruguay. Brazil accounts for approximately 75% of all electricity imported in the region from 2010-2017, while the rest of the Southern Cone is the largest exporter with 80% of electricity exported in Latin America during the same period (Levy et al., 2023, pp. 29-30).[7] In contrast, SIEPAC in Central America has moderate levels of trading, although it is the most advanced interconnection scheme in LAC because, as will be seen below, it includes regional organisations that regulate, manage, and supervise trading, as well as a company that owns the grid interconnecting the countries. El Salvador, Guatemala, Nicaragua, Costa Rica and Honduras are among the countries with the highest rates of domestic demand covered by imported electricity, with approximately 28%, 8%, 7%, 5% and 3%, respectively – Belise presented the second highest coverage index with 26.6% but is not part of SIEPAC (Levy et al. 2023, p. 30). Finally, progress in the Andean region has been mild, though the recent development of the Andean Short-Term Regional Electricity Market (MAERCP) will be highlighted in the paper's third section. Demand coverage through imports from Ecuador and Colombia were less than 0.1% in 2022, even though they have a long tradition of trading. Ecuador and Peru have recently begun electricity exchanges in small amounts more in a form of a prototype, and the Colombia-Panama line, promoted by the main suppliers of both countries –ISA and ETESA–, has not yet made progress in its construction despite advanced studies (Levy et al., 2023, p. 30).

2.2. The Benefits of Building Regional Electricity Markets: Non-substantial Impact on Reducing Investment Costs, but Strengthening Normative Stability and Energy Security

As an alternative to focusing on interconnection systems, own calculations are presented in what follows, linking electricity demand with investment costs of renewable energy projects in LAC. The empirical strategy pursued combined demand forecasting, long-run equilibrium testing, and project-level cost analysis. The data employed include electricity demand figures validated with OLADE and national agencies, LCOE (Levelised Cost of Electricity) estimates by country and project, and a CAPEX database built with Bloomberg covering nine major developers in the region.[8] CAPEX, or capital expenditures, refers to the upfront investments required to build renewable assets such as solar farms, wind parks, or hydro facilities, and constitutes a central determinant of financial viability in the sector.

Electricity demand was forecasted for the period 2000–2030 using ARIMA (AutoRegressive Integrated Moving Average)[9] and AAGR (Average Annual Growth Rate)[10] models. Beyond demand projections, the central question was whether investment in renewable energy projects is systematically aligned with demand trends. To explore this, cointegration tests were applied between demand and CAPEX. Cointegration analysis, using the Augmented Dickey–Fuller and Johansen procedures, allows testing whether two non-stationary series share a stable long-run relationship. Evidence of cointegration would indicate that investment decisions adjust to underlying demand pressures, suggesting long-term planning consistency. By contrast, the absence of coin-

6 Note that considering the impact of electric interconnection on costs is different from assessing the impact of increasing demand in the costs of projects, as our own calculations further introduced do. The former takes into consideration a larger number of variables and deploys other econometric methods different from the ones we employed.

7 It should be noted that the Itaipú dam supplies about 11% of the energy consumed in Brazil and 88% of that used in Paraguay (Levy et al., 2023, pp. 29-30).

8 The author thanks especially research assistants Sara Rojas and José Luis Beltrán for their valuable help in developing these calculations.

9 ARIMA is a standard econometric tool for time-series analysis, capable of capturing trends, cycles, and short-run dynamics.

10 The AAGR (Average Annual Growth Rate) serves as a complementary benchmark that helps validate the plausibility of these forecasts.

tegration suggests that developers' investment behavior is driven less by electricity demand and more by other structural factors such as access to international financing, regulatory incentives, or global technology cost trends.

As shown in Figure 8, the Augmented Dickey–Fuller[11] test indicates that the electricity demand series becomes stationary after differencing, while the CAPEX series does not reject the null of a unit root, implying that the two variables do not share the same order of integration. This already suggests the absence of a long-run equilibrium between them. To confirm this result, the Phillips–Ouliaris test was applied (Figure 9)[12], which directly assesses the null hypothesis of absent cointegration. The test strongly rejects the existence of a stable, long-term relationship ($p < 0.001$), reinforcing the conclusion that electricity demand and renewable investment in LAC do not coevolve in equilibrium.

Figure 8. Results of Augmented Dickey-Fuller (ADF) Test

VARIABLE	DICKEY-FULLER	LAG ORDER	P-VALUE
TS. DEMAND. DIFF	-5.8252	2	0.01
TS. CAPEX. LOG. DIFF 2	-2.9873	2	0.1963

Source: Own calculations

Figure 9. Results of the Phillips–Ouliaris Cointegration Test

	ESTIMATE	STD.ERROR	T VALUE	PR (>|T|)
Z[, -1]	0.22783	0.01852	12.3	2.31e-07 ***

Source: Own calculations

The non-stationarity of the CAPEX series reflects the volatile, structural nature of renewable energy investment in the region. Capital expenditures in large-scale energy projects tend to be lumpy, responding to policy shocks, financing cycles, and global technology cost trends rather than following smooth, predictable domestic demand patterns. As a result, shocks to investment, such as regulatory reforms, changes in international interest rates, or the availability of concessional financing, have persistent effects that do not dissipate over time. Economically, this implies that renewable investment in LAC is prone to cycles of over- and underinvestment relative to demand, creating mismatches between installed capacity and consumption needs. This underscores the importance of stable regulatory frameworks and regional coordination: in the absence of a demand-driven mechanism, reducing investment volatility requires institutions capable of smoothing financing conditions, harmonising rules, and lowering perceived risk for developers.

In sum, the deployed econometric exercise shows that an increase in demand associated to building (a) regional electricity market(s) does not have a direct impact on reducing the costs of renewable energy projects, but larger solar and wind parks, as well as hydro facilities, might benefit from economies of scale in certain circumstances, for instance, when connection to the grid does not require substantial additional expenditures, and infrastructure for transmission is sound enough. The latter issues refer precisely to the benefits of improving interconnection systems in terms of costs reduction, in line with what was pointed at in the previous subsection. Since building regional electricity markets implies broadening and improving interconnection, it can be assumed that building such markets may have an impact on investment efficiency in this sense. Yet, besides these potential benefits, the fact that building regional electricity markets does not imply reducing investment costs by increasing demand, points to other benefits in the regulatory and security dimensions as salient incentives for building regional electricity markets in order to advance energy transition.

As previously shown in the paper's first section, renewable projects' costs vary significantly due to key factors like acquiring construction and environmental licenses, transporting inputs for building energy parks to more or less accessible areas, the type of technology employed, connecting the generated renewable energy to the grid, transmission infrastructure and other factors determining operating costs. All these factors make renewable energy projects' costs vary widely among countries and among regions in one same country, and surely that is why our own calculations do not show a direct impact of increasing demand on

11 In the Augmented Dickey–Fuller (ADF) test, the null hypothesis is that the series contains a unit root (non-stationary). Failure to reject the null for CAPEX indicates that investment does not follow a stationary process.

12 In the Phillips–Ouliaris test, the null hypothesis is that the variables are not cointegrated. The rejection of this null confirms the absence of a common long-run equilibrium path between electricity demand and investment.

reducing investment costs. However, experiences like SIEPAC and MAERCP, which will be subsequently addressed in the paper's last section, show substantial benefits regarding regulatory and security conditions which are worth emulating in order for regional electricity markets to help advance energy transition in LAC regionalist projects.

With regard to the regulatory dimension, regional markets should provide more stable normative conditions for investment and for transmission bargains, ensuring more stable prices through long-term contracts. As pointed out in Section 2, joint planning, policy coordination, and harmonising regulatory frameworks and carbon taxes may equalise competition terms in order for countries to jointly attract greater investments instead of competing with one another on a beggar-thy-neighbor basis. Regional electricity markets should also incentivise joint infrastructure development to expand transmission options, amplifying the incentives for greater generation, reaching more consumers, and improving electricity access for populations still in need.

On the security dimension, the numerous experiences of shortages in Central America have shown the benefits of the regional interconnection system SIEPAC in supplying electricity to countries or regions in need, and the recent droughts in Colombia and Ecuador have shown how risky it can be to continue relying on surpluses for electricity exchange. Both countries saw their dam levels drop to the point of restricting water service in Colombia's capital city and imposing energy cuts across all of Ecuador. As a result, no country had electricity surpluses to sell to the others, and their energy security was put at risk. A consolidated regional market would secure other sources of electricity generation besides hydro, and joint storage would surely ensure electricity supply when some sources fluctuate to the point of becoming scarce.

Electricity demand in LAC is expected to grow rapidly over the coming years. An IEA study projects electricity demand to grow by 90% to 2050 under today's policy settings, and by 180% to fulfill all climate pledges and transition targets, which would double the share of electricity in total final consumption (IEA, 2023a, p. 17). Following Levy et al. (2023, p. 15), expanding electricity infrastructure in Latin America is key not only to meet increased demand, but to also to "make use of new generation resources far from the load centers, or to interconnect different systems in the region to move towards a more unified use of regional resources". This integrative infrastructure must employ HVDC (High-Voltage Direct Current) technology, which enables the transmission of large volumes of energy over long distances and the efficient connection of asynchronous systems (ibid.). Yet, HVDC costs are extremely high, and regional electricity markets should motivate countries to engage in acquiring this technology on a joint basis, which should improve accessing external financial sources and incentivising private investment.

Governments should therefore reflect on the difference between energy autonomy and energy security. The former has traditionally been equated with energy security and thought of as a national priority, one that governments must guarantee in a way that a country becomes as self-sufficient as possible. But it has been a long time since most countries relied on energy and electricity trade, and both the limited availability of fossil fuels and the variable nature of renewable energy should convince governments that, as countries become more dependent on electricity exchanges, they must sacrifice autonomy to warrant true security. Regional electricity markets turn electricity generation and transmission into a regional issue that has to be attended on a regional basis, where governments know that their own energy security depends on the others, and thus all countries must work together in order to plan, attract investment, provide homogenous regulatory frameworks and infrastructure conditions that will ensure the electricity supply for all of them, further knowing that any move towards selfish autonomy will endanger their own energy security as it will damage the others. In light of the former, and as Levy et al. (2023, p. 32) posit, the LAC region needs the individual states to steer their electricity sectors towards the development of regional markets, which in turn requires political consensus and regional planning with a joint long-term vision, along with determination from the economic and political diversity that dominates the region. The next section will thus address the possibilities for doing this, resorting to the existing regional integration and cooperation projects in the region.

3. Possibilities for Advancing the Energy Transition at the Regional and Subregional Scale

Now that substantial challenges to energy transition in LAC have been identified, and the relevance of building regional electricity markets for helping energy transition has been assessed, the main topic of this paper can now be tackled: what is the potential of the different integration and cooperation schemes that currently exist in the region for advancing energy transition at subregional and even regional scale. As stated in the paper's introduction, except for SICA –and to some extent CARICOM–, none of the regionalist projects here taken into consideration currently show any particular institutional initiative to pursue energy transition. However, this section will show that all of them possess some program or agenda to work on energy production, electricity interconnection and/or environmental issues. It could thus be thought that any of the considered regionalist projects in the present analysis has the potential to face all the challenges and needs addressed in the former

sections. For some, this might be a matter of so-called governments' "political will", as they could simply choose to commit to specific projects and agreements regarding energy transition. However, a great portion of regionalism studies has demonstrated the relevance of institutional settings for advancing regional integration and cooperation[13], and it is precisely such assessment of LAC regionalist projects' institutional settings that is the focus of this section. Hence, in the following paragraphs the concrete potential of the six reviewed integration and cooperation schemes to face particular challenges and obstacles previously identified will be assessed. The section will thus be divided in six subsections, each corresponding to one regionalist project in LAC, where first their institutional settings for addressing energy transition, energy or environmental issues will be outlined, followed by an assessment of their electric interconnection status, and finally a reflection on the possibilities each project offers for facing challenges and needs at subregional/regional scale.

3.1. Central American Integration System - SICA

As has historically been the case regarding the advancement and innovation in regional integration in LAC, SICA (which includes the Central American Common Market-CACM) has pioneered substantial progress in environmental and energy transition issues. In 2007, it established the 2020 Sustainable Energy Strategy, aiming to improve access to energy for most vulnerable populations, and to foster generation of renewable energies, among other main goals (CEPAL-SGSIC, 2007). As a route map, this strategy oriented the implementation of the Program for Renewable Energies and Energy Efficiency (4E), developed since 2010 and sponsored by the German government through the German Development Agency (GIZ-Gesellschaft für Technische Zusammenarbeit). This program aimed at providing assistance for improving technical and political conditions to increase the use of renewable energies in Central America, as well as to promote energy efficiency in the region (SICA, n.d.).

In general terms, between 2010 and 2021 the 4E Program provided capacity-building for technicians and decision makers, and advised on the improvement and development of certain national and regional normative frameworks (GIZ, 2021a, p. 19). It also supported energy generation and efficiency projects for some supermarkets and convenience stores based on sun power and biogas (ibid., p. 30). Allegedly, the results obtained by the 4E Program contributed to attracting investment for nearly EUR 5 million, complemented by more than EUR 224 million invested by 24 Central American private companies (ibid., p. 32), and the program also promoted credit initiatives for renewable energy projects offered by regional and national banks (ibid., p. 34). Accordingly, these investments reached generation levels of 664,89 GWh, with a projected generation of 2.193,04 GWh between 2018-2027, which in combination with energy efficiency results, avoided the emission of 300.588,04 t CO2eq (ibid., p. 63). Overall, in 11 years the 4E Program increased Central America's installed capacity up to 146.55 MW of variable renewable energies' facilities and the generation of up to 649,44 GWh (ibid., p. 66).

Besides these concrete achievements, an important result of the 4E Program has been enhancing regional cohesion and showing countries that they can trust each other and work together for pursuing common goals. Other relevant results have been fostering investment, knowledge transfer and capacity-building, which always facilitate creating an environment where stakeholders reaffirm their interest and commitment towards energy transition. In 2020, SICA members renewed the Sustainable Energy Strategy to 2030, aiming at increasing the portion of renewable energies in the regional energy mix and improving energy efficiency (CEPAL-SICA, 2020).

Moreover, SICA has developed a robust network for electricity interconnection since the end of the 20th century. Between 1997 and 1998 the protocols for creating SIEPAC (Electrical Interconnection System for Central American Countries) were signed by Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panamá, by which the regional operative and regulatory organism of the Electric Regional Market were established: the Regional Operating Entity (EOR) and the Electric Interconnection Regional Commission (CRIE), respectively. In addition, the Network Owner Enterprise (EPR) was created as the developer of SIEPAC and unique owner of its infrastructure.[14] SIEPAC infrastructure was built between 2009 and 2014, consisting of a longitudinal transmission trunk line of 1.800 Km and 200 kV, with a total cost of nearly US $500 million (CEPAL-OLADE, 2019, p. 18). Though limited in its transfer capacity, SIEPAC has brought greater stability for national electricity systems (GIZ, 2021b, 23).

In these terms, SICA is by far the regionalist project best suited for advancing energy transition at subregional scale. Not only have its members been developing cooperation on the topic since the mid-2000s, but they have actually managed to put on a regional electricity interconnection system and are the closest to put together a regional electricity market among them. SICA has demonstrated that it is possible to obtain foreign cooperation as a bloc (from the German government in this case), as well

13 For a review of those approaches see Prieto (2012; 2015; 2016, chs. 1 and 5) and Prieto and Aguirre (2022).

14 See EPR-SIEPAC website at https://www.eprsiepac.com/linea-siepac/

as national and multilateral financing on a collective basis, thus constituting a clear example of how going regional might facilitate financing and investment for energy transition. Therefore, what should follow for SICA is to keep the pace in implementing the 2030 Sustainable Energy Strategy, and in increasing joint efforts for accessing multilateral financing, and consolidating a regional electricity market that makes private and public investment more attractive in terms of revenue, regulatory stability and electrical systems' security.

3.2. Andean Community - CAN

As for CAN, the Andean Committee of Normative and Regulatory Electricity Organisms (CANREL) has clearly demonstrated its potential to advance the building of a regional electricity market (the Andean Regional Short-Term Electricity Market – MAERCP), and interconnection infrastructure has at least developed to an incipient point, still enough for electricity exchanges between some of its members. CANREL is a working group responsible for establishing the institutional framework for regional electricity interconnection, which has made significant advances over the last 20 years. In 2001, the Energy Ministers from Colombia, Ecuador, and Peru, together with a representative from Venezuela, signed an agreement for the regional interconnection of electric systems and the international exchange of electric power, which marked the start of harmonising the member countries' normative frameworks. Even though electricity has been sold from Colombia to Ecuador since 1998 (Zapata, 2017), since 2002, Decision 536 is the Andean norm that creates CANREL, providing the general framework for subregional interconnection of electrical systems and intra-communitarian electricity exchange (Comunidad Andina, 2002)[15]. This norm acknowledges the need to optimise member countries' energy resources and bringing security and confidence to the electrical supply, and the subsequent need to harmonise legal and regulatory issues. Apart from these general concerns, Decision 536 only provides rules for free competition in commercialising electricity between member countries, but does not provide tools for communitarian planning or energy generation and distribution. Explicitly, this Andean Decision makes clear that electricity commercialisation must be carried out in short-term markets.

By 2003, Colombia and Ecuador completed their first agreement for electrical interconnection within the framework provided by Decision 536, establishing a first double-circuit interconnection line between the stations of Jamondino (Colombia) and Pomasqui (Ecuador), and in 2008 a second line was established between the same two stations reaching a total transfer capacity of 500 MW at 230 kV, additional to the Panamericana-Tulcan line existing since 1998 (at 130 kV) (Zapata, 2017, p. 119). As the commercialisation of electricity between these two countries advanced, in 2009, they decided to suspend Decision 536 and to establish a transitory regime that allowed price discrimination between national and external demand, distributing rents from price differentials at the border, and making the supply of electricity not compelling when a shortage was faced by the exporter country (Zapata, 2017, p. 120). This transitory regime (Decision 720) was prolonged until 2017, when Decision 816 was issued to replace Decision 536.

In 2012, the governments of Bolivia, Chile[16], Colombia, Ecuador and Peru created the Andean Electrical Interconnection System (SINEA) in order to display mechanisms to facilitate legal security and warranties for developing infrastructure and international electricity transactions (Comunidad Andina, n.d.). In this vein, as a tool for developing SINEA, Decision 816 is the Andean norm that creates the Andean Regional Electricity Market, particularly in its short-term dimension (MAERCP, by its Spanish initials), establishing the current regulatory framework for subregional interconnection of electrical systems and intra-communitarian electricity exchange, based on electricity surpluses (Comunidad Andina, 2017). With these normative settings, it is expected that CAN will have a regulatory framework for electricity commercialisation in the short term, but it still lacks tools for bringing forward communitarian planning and generation and distribution processes. As in SICA, each country develops its own electric energy planning and freely determines the volume of electricity it sells to others based on its electricity surpluses. This might work relatively fine when such surpluses exist, but in times of shortage buyers might face trouble when the exporter country decides to suspend electricity sales, as it just happened between Colombia and Ecuador in mid-2024. In any case, CAN does not have a regional strategy, plan or institutional initiative addressing issues of energy transition as such, as SICA does.

15 Bolivia excluded itself from Decision 536 and has remained so since, although it takes part in CANREL meetings.

16 Chile is CAN's associate member.

CAN must thus engage its potential for bringing forward regional planning, harmonising regulations and carbon taxes, and designing joint strategies for attracting foreign and private domestic investment, warranting same and stable conditions for energy generation and transmission. Since CANREL is specifically focused on establishing the MAERCP, surely a new regional committee is needed to coordinate energy transition policies and efforts. CAN has substantial experience in managing international cooperation financing, as the EU has financed CAN's programs on several occasions, and the Andean General Secretariat has sufficient background to coordinate access to multilateral financing as a bloc. Undoubtedly, CAN holds an institutional framework that is strong and mature enough for advancing the energy transition at the subregional scale, and countries must begin negotiating as soon as possible on their shared goals and resource sharing for meeting energy transition aims in a joint fashion.

3.3. Common Market of the South - MERCOSUR

MERCOSUR does currently not have a unified energy regulatory framework governing the production, commercialisation, and distribution of energy across all its member states. However, since its creation, some mechanisms have been established to promote regional cooperation and the coordination of energy policies. In 1991, Working Subgroup No. 9 (SGT-9) was created —a technical body specialised in formulating energy policies among MERCOSUR member and associate states. Although its contributions have been limited, it has played a relevant role as a space for information exchange on national energy policies, and has led seminars, training sessions, and cooperation projects, including some with the German Development Agency (GIZ) (Frenkel and Yashan, 2022).

In 1993, SGT-9 issued MERCOSUR'S Energy Policy Guidelines (Directrices de Política Energética del MERCOSUR), which consisted of non-binding directives aimed at promoting regional energy complementarity, trade among member states, and coordination of national energy policies (Stuhldreher and Morales, 2019). Later, in 2009, under SGT-9's leadership, the Guidelines on Renewable Energy Sources (Directrices de Fuentes Renovables de Energía) were adopted, aimed at promoting cooperation and the gradual inclusion of renewable sources (wind, solar, hydro, biomass, and geothermal) into national energy matrices (MERCOSUR, 2009). To date, this remains the bloc's only document directly addressing the energy transition. Although SGT-9 remains active, the frequency of its meetings has declined significantly; still, it remains as a potential platform for political learning and joint policy articulation on renewable energy (Stuhldreher and Morales, 2019).

Despite not having a regional electricity market like SICA and CAN, electricity trade between MERCOSUR members has remained prominent, and efforts have been made to develop the Southern Cone Energy Integration System (SIESUR), created in 2018 by Argentina, Brazil, Chile, and Uruguay (later joined by Paraguay) with the aim of fostering electricity exchange in the region (BID, 2018). Through dialogue spaces and workshops with different actors from the electric sector, including authorities and operators, SIESUR has progressively contributed to increase the intensity of electricity exchanges, and has recently approved the 2023-2032 Road Map focusing on regional regulatory and institutional strengthening, developing the interconnected regional system, and mitigating exchange rate risk (OLADE, 2024, p. 7).

In contrast to other regions, electric interconnection among Southern Cone countries was not initially developed through transmission lines, but by binational hydroelectric generation facilities. The first interconnection project of this type was the Salto Grande Hydroelectric Complex over Uruguay river, between Argentina and Uruguay in 1979, with a total installed capacity of 1.890 MW. Later on, in 1984, the Itaipú Hydro Central was built over the Paraná River between Brazil and Paraguay, with a total installed capacity of 14,000 MW, the second with greatest capacity in the world. Finally, the Yacyretá Hydro Central entered service in 1994 with 3,200 MW, also over the Paraná River between Argentina and Paraguay. MERCOSUR also counts with transmission lines between Argentina and Chile (Cobos-Andes, 600 MW), Argentina and Brazil (Paso de los Libres-Uruguaiana, 50MW y Rincón de Santa María – Itá, 2,100MW), Argentina and Paraguay (Clorinda-Guarambaré, 80MW and El Dorado-López, 30MW), Uruguay and Brazil (converter stations Melo 500MW and Rivera, 70MW) (BID, 2018).

In 2023, 95% of international electricity exchanges in South America occurred among Argentina, Brazil, Paraguay, and Uruguay (OLADE, 2024, p. 33), demonstrating a high level of physical interconnection. In the last decade, two interconnection projects advanced, namely, the frequency converter between Uruguay and Brazil, and the interconnection line between Argentina and Bolivia (ibid., p. 4). Uruguay and Paraguay are net exporters of electricity thanks to their largely renewable energy matrices,

while Argentina and Brazil alternate between being importers and exporters depending on internal system conditions. Binational hydroelectric plants like Itaipú, Yacyretá and Salto Grande are key pillars of this electricity trade, though transactions still rely on ad hoc agreements rather than common rules (OLADE, 2024). In sum, although MERCOSUR has shared infrastructure and a significant volume of bilateral electricity exchange, it has yet to establish a regional electricity market or a common energy trade policy. This limits its ability to optimise resources and move toward a coordinated energy transition. Progress in the energy transition remains largely the result of national policies and initiatives, rather than an effective regional normative framework.

In contrast to SICA and CAN, MERCOSUR lags behind in providing institutional frameworks to address energy transition challenges. This is, by all means, paradoxical, given that the greatest interconnected systems and electricity exchanges exist precisely in the Southern Cone. Unfortunately, all this has been carried out bilaterally, and member countries have never resorted to MERCOSUR to regulate electricity exchanges, nor have they planned infrastructure or even shared experiences like Brazil's, which stands out as the region's greatest investor in renewable energies. Apparently, MERCOSUR countries are still caught in assuming energy security as an issue of national autonomy. Yet, MERCOSUR does have an institutional framework that perfectly allows for creating an organism or coordinating stance to begin discussing energy transition issues, one that enables taking advantage of the substantial advances that all member countries, particularly Uruguay, have made in advancing energy transition to meet the 2030 pledges. Moreover, MERCOSUR has the most developed interconnection system in LAC, which should both facilitate and incentivise the creation of a regional electricity market.

3.4. Caribbean Community - CARICOM

Regarding CARICOM, member countries' historical dependence on imported fossil fuels has led to high electricity costs, increasing vulnerability to market volatility and limited progress on the achievement of sustainability goals (CARICOM Secretariat, 2023). In response, CARICOM has developed some institutional mechanisms to facilitate regional energy transition. First, the CARICOM Energy Program (CEP), coordinated by the CARICOM Secretariat, contributes to the development of regional energy policy, promoting harmonisation in member countries and promoting access to technical and financial resources. It also operates as a key platform to integrate energy policy with climate and development programs (ibid.). Second, in 2015 CARICOM established the Renewable Energy and Energy Efficiency Center of the Caribbean (CCREEE), in order to support the scaling of renewable energy and energy efficiency. It offers a project development assistant, assessment for resources, and it facilitates national planning using integrated resources and resilience plans (CCREEE, 2024). CCREEE also manages the CARICOM Energy Knowledge Hub, a platform that helps evidence-based decision-making. Finally, the Caribbean Sustainable Energy Guide and Strategy (C-MS), launched in 2013, defines long-term sustainable energy goals of CARICOM. These include 47% of the increase in long-term electricity and energy efficiency by 33% in 2027 (CARICOM Secretariat, 2023). The C-MS provides strategic guidelines and coordination between national plans and regional ambitions. So far, CARICOM has no cross-border electricity trading, not only because it can hardly generate electricity surpluses but also because it lacks any kind of interconnection lines (Oyewo et al., 2024).

In any case, CARICOM is definitely on the right route. Both the CARICOM Energy Program and the CCREEE –the latter encompassing the CARICOM Energy Knowledge Hub– demonstrate that CARICOM members share common goals and commitments. What they surely need is the design of a collective strategy to obtain substantial investments in order to build infrastructure for renewable energy generation and transmission, an interconnection system, and a regional electricity market that enable member countries to leave aside its current dependence on fossil fuels.

3.5. Pacific Alliance – AP

Following the Ministerial Declaration on creating a platform for green growth, the AP established in 2016 the Technical Working Group on Environment and Green Growth (GTMACV), with the aim of building a space for dialogue between governments and the private sector for the development and implementation of an agenda for fostering sustainability and green growth (UNEP, 2019). However, neither the GTMACV nor the platform for green growth have placed particular focus on issues of energy transition, and the AP has neither discussed projects for electric interconnection. As a result, AP might find it harder to work towards a regional electricity market or even an interconnection system (the latter being even less feasible due to geographical distance between Mexico and the other three members), and at the end of the day both are currently being pursued by Peru, Colombia and Chile within CAN. Yet, all four AP members have substantial experience to share regarding renewable energies' development, and at least the GTMACV should either create a subgroup to enable this experiences' exchange, or a new working group should be created to tackle these matters. Some years ago, AP officially created an infrastructure fund that has not yet taken off, and perhaps

member countries could find in energy transition a reason for doing it, as long as such fund could finance renewables' infrastructure projects for them.

3.6. Community of Latin American States - CELAC

Concerning CELAC, in January 2023, member countries issued a declaration on regional energy integration, where they expressed their will to foster the energy transition, increase access to electricity, and identify projects for electric interconnection (CELAC, 2023). Yet, energy issues have been formerly addressed at Latin American scale since 2005, when the Framework Agreement on Regional Energy Complementation (Acuerdo Marco sobre Complementación Energética Regional) was signed under the framework of ALADI, ratified by MERCOSUR member states (Argentina, Brazil, Uruguay, and Paraguay) and associated states (Chile, Bolivia, Venezuela, Ecuador, and Colombia). Its main objective was to promote regional energy integration based on resource complementarity, as well as the transportation, distribution, and commercialisation of hydrocarbons, renewables, and electricity. The agreement encouraged cooperation on electric and gas system interconnection and the promotion of renewable energy (MERCOSUR, 2005). Furthermore, the RELAC network (Renewables in Latin America and the Caribbean) was created in 2019 by 15 LAC countries to foster the transition to renewable energy sources. Its members are committed to achieving at least 70% participation in renewable energy in their energy matrices, but RELAC has only implemented a monitoring mechanism through which members report their progress periodically (RELAC, n.d.). However, while these agreements mark some steps forward in formalising energy cooperation in the region, their main limitations are that they are not binding, nor do they create a common energy market, nor establish a permanent supervisory body.

Hence, as the least institutionalised project of all, CELAC may currently do little to go regional on energy transition. Notwithstanding, it could strengthen RELAC as a monitoring mechanism for surveying LAC countries' progress and for fostering the provision of technical assistance and the exchange of experience among members, particularly among those that have made greater progress than the rest.

SICA serves as the main LAC referent for advancing the energy transition at the regional scale, and SIEPAC is a salient example of the feasibility of building a regional electricity market and interconnection system to support the energy transition. CAN and MERCOSUR also have potential to advance the energy transition at the regional level, as both schemes have developed electricity interconnections and exchanges. Yet, both lack specific institutional settings for addressing issues of energy transition. The remaining three regionalist projects offer less institutional strength to collectively advance energy transition issues, but they can still do much more. While CARICOM has established the CCREEE and the C-MS strategy, it can hardly build a regional market or an electric interconnection system due to its heavy reliance on fossil fuel imports and limited generation capacity. To pursue these aims, member countries should collectively seek multilateral financing and develop a collective strategy to attract investment. Lastly, CELAC and AP seem quite relegated in regional cooperation regarding the energy transition, for they have only reached intention agreements and, in CELAC's case, a monitoring agenda, which do not imply regional commitments regarding energy production or electricity exchange. Still, further institutionalisation to address energy transition issues should help member countries exchange experiences and provide technical assistance to complement their efforts at other subregional and national levels.

Conclusions

The present report has demonstrated the potential of LAC to advance the energy transition at (sub)regional scale(s). Current regional integration and cooperation schemes possess institutional frameworks that allow for regional discussion, regional planning, the building of joint infrastructures, fostering regional interconnection, harmonising regulatory frameworks, cooperating for accessing external financing and, further, developing electricity markets. So far, SICA is the regional scheme that has advanced the most towards on these fronts, but also CARICOM has already developed certain institutional settings for advancing issues of energy transition, and CAN has obtained mild advances in electricity exchange, as has MERCOSUR, though the latter possesses a more developed interconnection system. Even AP and CELAC may take advantage of their cooperation mechanisms to achieve greater inclusion of energy transition issues in their agendas. LAC has great potential in both sun and wind power –let aside hydro–, but it is clear that, individually, countries do not possess enough public and private resources to meet energy transition goals.

This paper has argued that attracting FDI and incentivising private investment requires several things. First, regulatory frameworks must be stable to make investments safe, and it has been stated that harmonising them at a regional level would make them more stable and harder to change by a single government responding to momentary pressures. Second, a number of studies have shown the benefits of regional interconnection, including reduced investment and operating costs, and increased efficiency of energy resources and infrastructure. Third, although own calculations show there is no strong correlation between increased demand and lower investment costs, the benefits of regional electricity markets are found in both the regulatory and security dimensions, where rules for electricity exchanges are managed at the regional level and energy autonomy is replaced by real energy security in terms of generating and sharing enough electricity to meet everyone's needs.

Lastly, not only should current LAC regional schemes support the energy transition for member countries, but deepening regional integration and cooperation on the energy transition should also help sustain regional integration. In the current times of worldwide violence and turmoil, strengthening energy interdependence could serve to prevent interstate conflicts and fulfill LAC peoples' energy needs in a sustainable and renewable fashion.

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