Discussion Paper

LOW-CARBON DEVELOPMENT IN LATIN AMERICA AND THE CARIBBEAN

Evolution, experiences and challenges

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INTRODUCTION

Latin America and the Caribbean is a heterogeneous region, where prevailing poverty rates, inequality levels and climate change vulnerability undermine development and economic growth.

Latin America and the Caribbean comprises 33 countries, each with different realities: different geographies, natural resources, peoples, political ideologies, governments, tax structures and forms of energy provision. These differences must all be taken into account when reading this report, which by necessity uses generalisations to present an overall view of the region. However, beyond these differences, the region shares a number of environmental challenges such as climate change, biodiversity loss, water and soil management, growing urbanisation, poverty and inequality.

Latin America and the Caribbean is one of the most biodiverse regions in the world, a so-called megadiverse region. It is located between the Atlantic and the Pacific oceans, holds the largest freshwater sources in the world and has a remarkable cultural heritage.[1] Historically, the region's copious forest biomass has substantially contributed to maintaining low levels of carbon dioxide (CO_2) in the atmosphere by absorbing and storing enormous quantities of carbon.[2] One-third of the world's forests are found in the region, including two-thirds of the remaining tropical forests.

The availability of natural resources has meant that to date, economic development of the region has largely focused on extractive industries such as oil and mining, together with forestry and the expansion of agribusiness.

As of 2013, Venezuela has the world's largest proven oil reserves – some 298 billion barrels, 17.7% of the world total.[3] Coal is extensively mined in Colombia, aluminium in Brazil and Argentina, and Peru, Mexico, Brazil and Chile are among the top gold producing nations globally.[4] Brazil, meanwhile, has more arable land than any other country on Earth.

These activities have usually been conducted with little regard to their environmental impact, their effect on the quality of life of local communities, or the long-term effects on people's livelihoods. Damaging environmental, economic and social impacts have resulted at a local level while a steady rise in harmful greenhouse gas emissions (GHGs) is occurring across the region generally.

Considering that climate change mainly impacts the poor (40% of whom are expected to be adversely affected across the world), it is forecast that women will be more affected.[5]

The region's current development model is based on the path followed since the dawn of the industrial revolution by countries in the developed world, one that is characterised by a heavy reliance on fossil fuels for energy – the major cause of damaging GHG emissions worldwide. In Latin America and the Caribbean's case, the damage caused by the use of such fuels has been compounded by a dramatic loss of forest.

Today, although regional per capita energy consumption remains low compared to that in the developed world, some countries are approaching levels of energy demand that rival consumption in developed countries, with the attendant increase in pollution, including GHG. This would threaten the region's economy in both the medium and long term by increasing risks, reducing productivity and driving up costs.

The shifting of climate patterns, and unpredictable seasons, may adversely affect agricultural output for smallholders and agribusiness alike. The increased frequency of extreme climate events threatens the integrity of the region's infrastructure, while the melting of Andean glaciers – a process already under way according to the Intergovernmental Panel on Climate Change (IPCC), a scientific intergovernmental body under the auspices of the UN – may lead to water scarcity in many of the countries whose rivers have historically been fed by glaciers.[6]

It doesn't have to be this way. With the race now on globally to curb GHG emissions to prevent global warming rising above 2° – the point beyond which scientists predict

climate chaos – it is time for Latin America and the Caribbean to embrace sustainable development wholeheartedly.

The urgent need for the world to rethink where it gets its energy from was at the forefront of discussions at the United Nations (UN) Secretary-General Ban Ki-moon's Climate Summit in New York in September 2014.

At the UN Climate Summit, Stephen Heintz, president of the Rockefeller Brothers Fund, announced that the Fund would disinvest from fossil fuel. He said: 'John D Rockefeller, the founder of Standard Oil, moved America out of whale oil and into petroleum. We are quite convinced that if he were alive today, as an astute businessman looking out to the future, he would be moving out of fossil fuels and investing in clean, renewable energy.'[7]

A number of governments, together with companies such as Kellogg's, Nestle and the palm oil giant Cargill, issued a pledge at the UN Climate Summit, saying they would halve the rate of deforestation by the end of the decade and restore hundreds of millions of acres of degraded land.

It remains to be seen, of course, whether such undertakings will be honoured – even in part. But it is clear that a major shift in perception has at least taken place in the corporate world, which suggests new thinking on the part of governments is required.

In place of the current model, Latin America and the Caribbean now needs clear energy policies and climate change strategies aimed at decoupling energy demand from economic growth without compromising economic and social development.

Such a transition would be an important contribution to global efforts to cap carbon emissions. It would also be a boon to some 34 million people in the region who lack access to electricity.[8] For investment in sustainable, renewable energy would mean smaller projects in off-grid areas.

This new model should promote energy efficiency and energy-saving measures leading to the fostering of sustainable low-carbon technologies and a subsequent reduction in energy consumption. It must also take into account the environmental, social and economic impacts for those populations that may be directly or indirectly affected.[9]

Latin America and the Caribbean holds significant untapped renewable energy resources, especially hydro, solar, wind and biomass. These resources could be put at the region's disposal by means of an energy policy based on a sustainable approach that promotes the diversification of the energy matrix using local resources and encourages energy equity. A number of influential civil society organisations in the region are challenging the status quo and advocating for the adoption of new energy models that encourage countries to respect the environment.

The Brundtland Commission (formerly the World Commission on Environment and Development) defines sustainable development as development that meets the needs of the current generation without compromising the ability of future generations to meet their own. The quest for low-carbon development arises from the need to ensure the livelihoods of people now, and those of future generations.

Energy equity is a major contribution to the fight against extreme poverty. Currently, energy poverty means many people, typically in rural areas, are consuming low quality energy at a price that exceeds the prevailing energy costs in urban areas. By enabling access to sustainable forms of energy, it is possible to reduce a family's carbon footprint as well as improving their living conditions.

Elizabeth Peredo, executive director of Fundación Solon, a Christian Aid partner organisation in Bolivia which works on climate justice issues, states that climate change resilience must be considered in a multidimensional way, from the development of technical capacity to the construction of a healthy social structure, strengthened by values like solidarity, respect and mutual recognition. Resilience means developing a wider vision that redefines 'development' in times of global changes.[10]

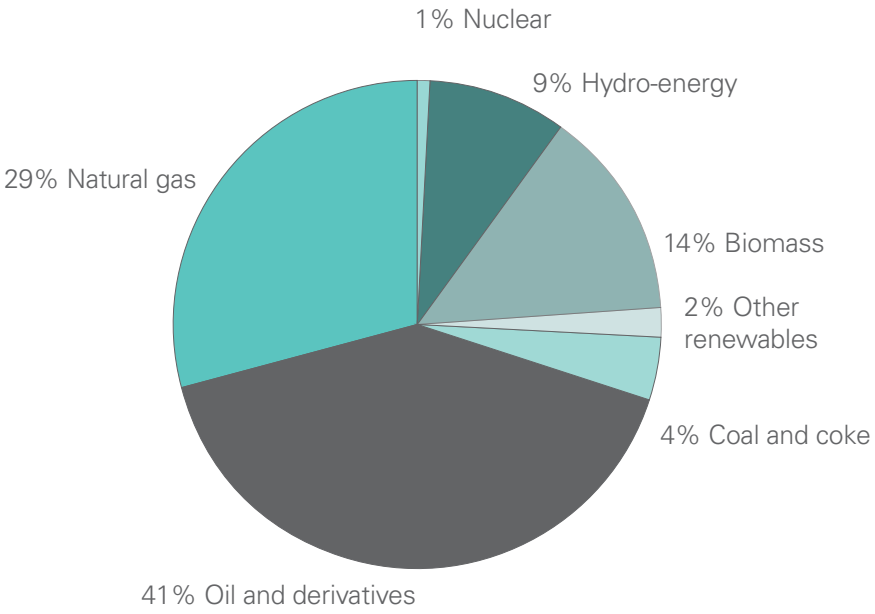
Different experiences of clean technology are found across Latin America and the Caribbean. Examples of negative experiences include the implementation of large scale hydropower and biofuel facilities that have resulted in major environmental and social impacts and a net increase in GHG emissions, primarily from the size and sensitive locations of the installations. Positive experiences include, for example, the installation of small-scale hydropower facilities that have demonstrably improved living conditions in small rural communities.

It is important to assess the real and widespread impacts of energy projects. It is vital to look beyond simple calculations of profits and seek to minimise environmental impacts whilst serving the interests of the local population, thus preventing social tensions.

In recent years some countries in the region have been conducting coordinated efforts in the search for development alternatives to boost economic growth in a climate change scenario. This search is mainly promoted by governments and civil society organisations with the important support of international donors, helping countries to develop proposals to plan their own low-carbon development

1. Evolution of energy consumption in the Latin America and the Caribbean region

Figure 1. Latin America and the Caribbean's energy matrix



Source: Energy-Economic Information Systems (SIEE)-Latin American Energy Organisation (OLADE), 2013 (Data 2011).[18].

The economic growth of Latin America and the Caribbean is estimated to be between 3.5% and 4% of GDP[11] and is projected to be 3% in the coming decades.[12] The region's development has been underpinned by the good performance of a primary-export model that has flourished over the last decade. The sustained increase in commodity prices has been reflected in the size of the region's extractive exports and the availability of tax revenues. This begins to explain why governments in the region still promote large-scale, carbon-intensive investment, both public and private, in extractive industries, the expansion of agribusiness, and thermal energy systems. For example, in Nicaragua, a country with a huge potential for renewable energy,[13] the Miramar plant, the largest oil refinery in Central America, is being built. Meanwhile in Bolivia approximately 80% of power generation investment projects are thermal power plants.[14]

Alongside the increase in economic output, the region has seen a substantial increase in energy consumption. Since 2004, the region's energy consumption grew by around 2.9% per year,[15] leading to an overall increase in GHG emissions of around 18%.[16] This is due to the regional energy matrix being dominated by fossil fuels, which is detrimental to its sustainability (see **Figure 1**). Although according to the IPCC, Latin America still only accounts for about 4% of global GHG emissions although it does warn that: 'the release of carbon to the atmosphere as a consequence of massive and continued deforestation in Latin America would have the potential to alter the global carbon balance.'[17]

In order to picture how each country contributes to climate change, it is helpful to consider per capita GHG emissions. There are major differences between countries in terms of size, demographics and industry levels, among other factors. **Figure 2** shows per capita GHG emissions by country, along with the regional average and world average, to better understand how the development model of each country translates into GHG emissions.

As can be seen in the figure overleaf, Trinidad and Tobago's per capita GHG emission is nine times the regional average. The country is a major oil and gas exporter and is 100% dependent on fossil fuels. On the other hand, when comparing the regional average with the GHG emissions of developed countries like the UK and the US, major imbalances can be discerned. The UK's GHG emissions per capita are twice the average of Latin America and the Caribbean.

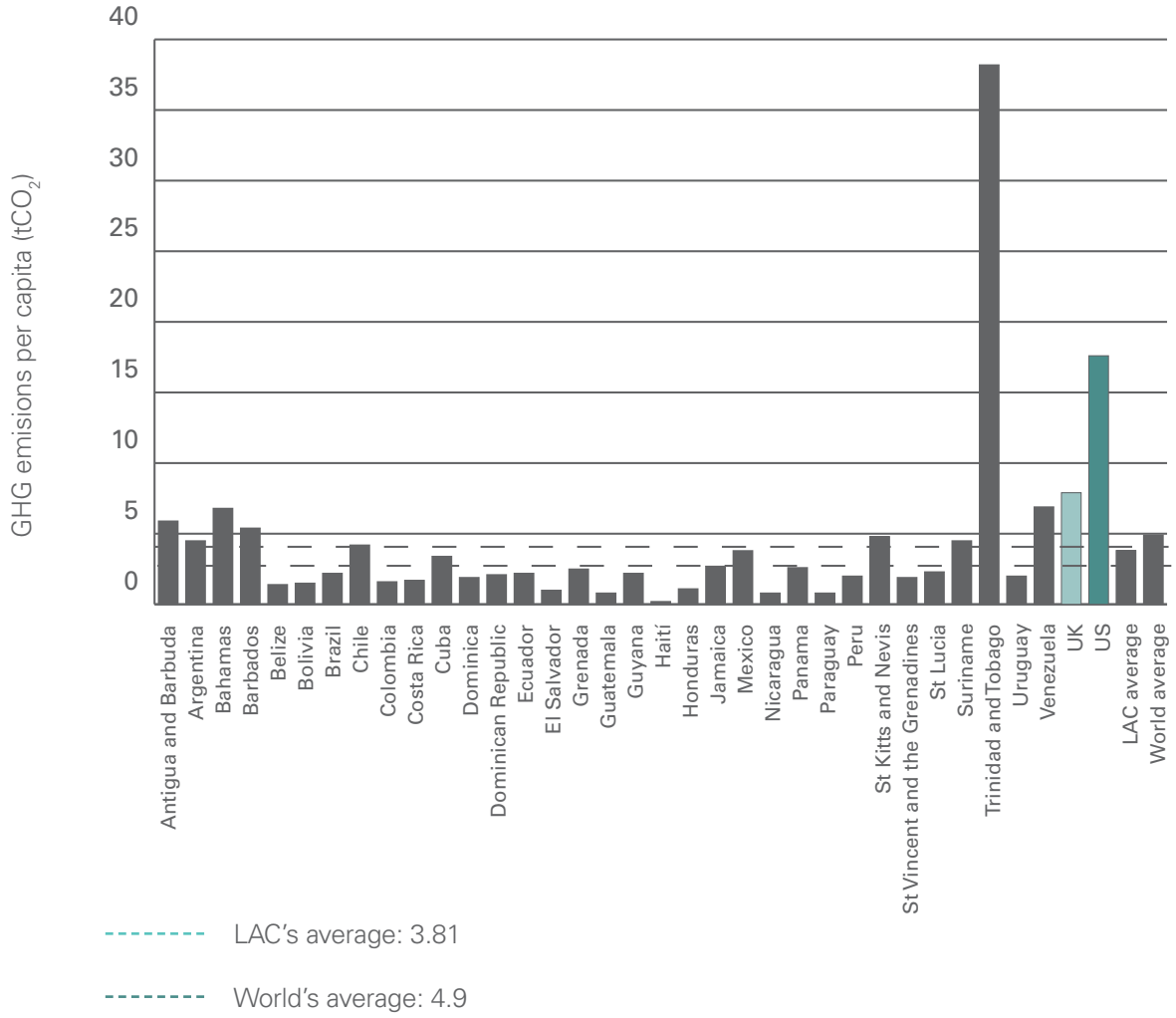
In absolute terms, some 80% of Latin America and the Caribbean's GHG emissions are produced in five countries: Mexico, Brazil, Venezuela, Argentina and Colombia

- see **Figure 3**. These five countries are therefore the places where reductions in the carbon intensity of economic activity can have the highest impact.

Data on the region's energy end-use sectors, including the use of traditional biomass, indicates the major sectors are transport (35%), industry (33%) and residential (16%), while the remaining 16% is distributed among other sectors.[19] In the residential sector, firewood and charcoal account for approximately 35% of the energy consumed in the region.[20]

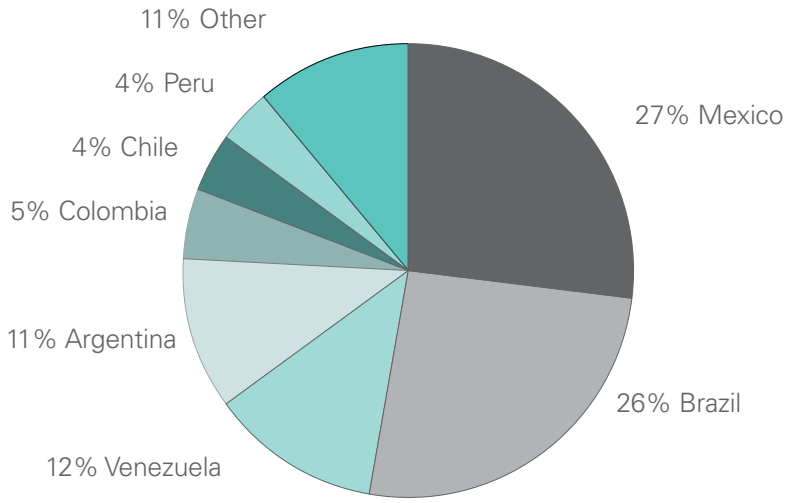
In countries such as Haiti, poverty and inequality force a large part of the population to rely on firewood or charcoal as the main source of energy. This practice has led to a severe deforestation that undermines the country's resilience to climate change.

Figure 2. Greenhouse gas emissions per capita by country



Source: Prepared by the authors based on the World Bank Database.[21]

Figure 3. Latin America and the Caribbean's regional greenhouse gas emissions distribution



Source: Prepared by Practical Action, Latin America, using information from the World Bank Database.[22]

Energy use practices and deforestation are interconnected. As shown in **Figure 4**, the main regional GHG source is land-use change and forestry (47%), followed by energy (22%), agriculture (20%) and waste (3%).[23] Land-use change and forestry is worsening as deforestation rates increase, in particular in the Amazon rainforest which is shared by Brazil, Peru, and to a lesser extent Ecuador, Colombia, Venezuela, Suriname, Guyana, French Guyana and Bolivia. It is estimated that between 2000 and 2010, 6% of the Amazon rainforest was deforested.[24]

According to economic forecasts such as one carried out by the Inter-American Develoment Bank (IDB), a potentially subdued level of economic growth will continue in the coming years.[25] Growth generally means a rise in energy consumption, primarily of fossil fuels, and consequently the region's GHG emissions are likely to increase in absolute terms if measures to reduce them are not implemented. **Figure 5** shows projections of energy consumption and GHG emissions to the year 2100, based on a business-as-usual model.

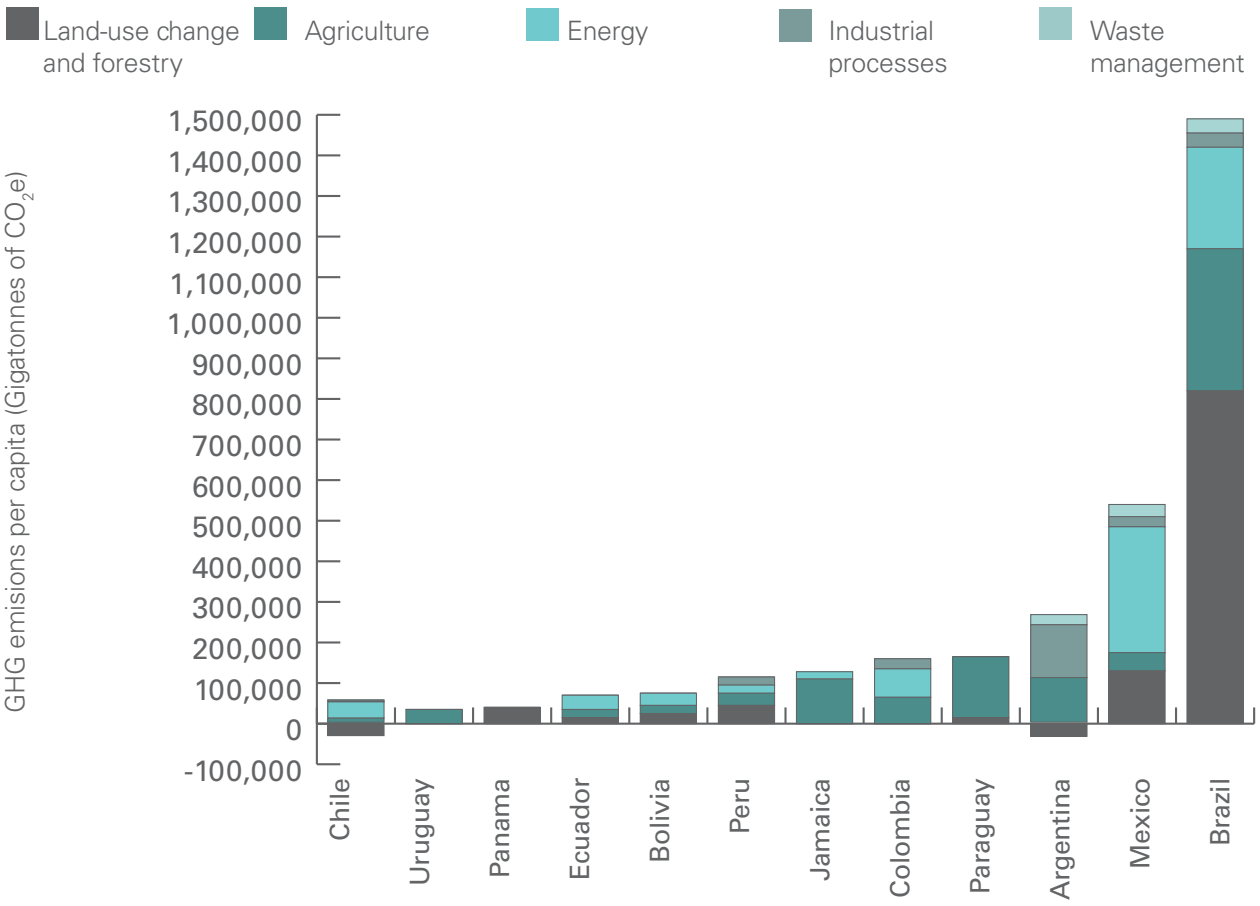
These projections of future emissions stand in direct opposition to the global climate change goals which are being discussed in international negotiations, which aim to limit the global increase in temperature to 2°C[26] by limiting the concentration of GHGs in the atmosphere. This implies that global GHG emissions must reach a turning point by 2020. Consequently, each of the countries in the region needs to analyse carefully the economic impact of climate change over the medium and long term and to design and implement a strategy to minimise further carbon emissions (this is known as 'mitigation') and make communities resilient to the impacts of climate change already taking place (this is known as 'adaptation').

Several countries have made progress conducting studies or implementing mitigation measures such as using clean technologies or promoting energy saving and energy efficiency, and are actively searching for alternatives to improve their sustainability through national policies. For example, the Dominican Republic has set a target to source 25% of its energy from renewable sources by 2025, and is fostering renewable energy generation from wind farms and solar plants, which currently represent 2% of national power generation.[27] However, greater efforts are necessary to increase the share of renewable energies in the region.

Nevertheless, the regional energy model faces other determinants. For example, in recent years some Latin American and Caribbean countries have experienced significant increases in the consumption of natural gas for power generation. The implementation of these projects was justified by the argument that natural gas would replace power plants based on oil and coal.

However, over time the natural

Figure 4. Largest greenhouse gas emitters by source



Source: Climate Change and Development in Latin America and the Caribbean, United Nations Economic Commission for Latin America and the Caribbean (ECLAC), 2009.[28]

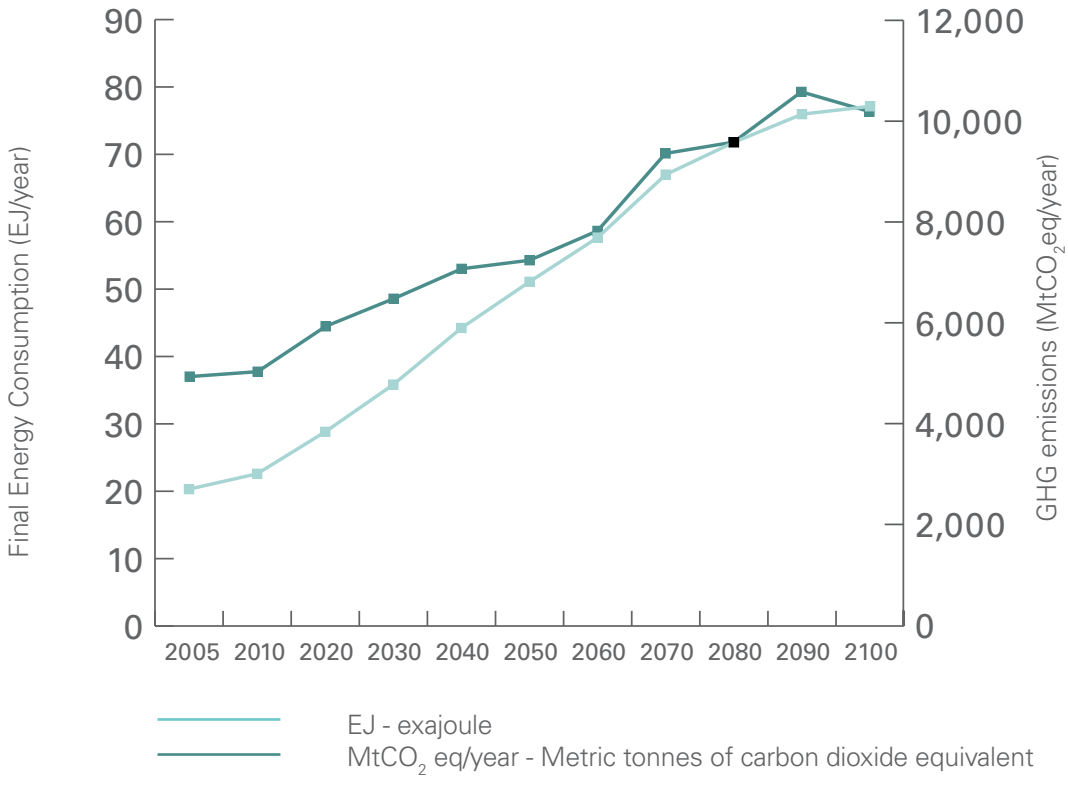
Reforestation and climate change resilience

There are strong connections between deforestation, energy poverty and climate change vulnerability, issues that are highly relevant for many Latin American and Caribbean countries. For this reason, several organisations are incorporating reforestation into their practical interventions and leading advocacy activities on the theme of climate change adaptation by means of reforestation. For example, Christian Aid local partner organisation Solidarité Fwontalye works with rural populations in northern Haiti on a Climate Change Adaptation and Food Security Programme which aims to reduce the effects of climate change and strengthen the resilience of the population by means of reforestation activities, the installation of nurseries, and training sessions on climate impact for local people.

gas plants have begun to displace hydropower, as in the case of Peru. This change is shifting the electricity generation mix back towards fossil fuels and will result in an increase in the carbon footprint of the region. This scenario could be further exacerbated with the entry of shale gas into the regional energy market. Shale gas is a natural gas obtained from the hydraulic fracturing of rocks – 'fracking' – a technique that has prompted environmental concerns because of the high risk of leaks and water contamination and fears of triggering earthquakes. Unlike the US, Latin America and the Caribbean have not yet started the exploitation of this resource,[29, 30] but it is known that there are significant reserves of shale gas across the region.

Nuclear energy does not make a significant contribution to the regional energy matrix, accounting for only 1% of energy delivered (See **Figure 1**). However, some countries, such as Argentina, Mexico and Brazil, plan to increase their nuclear generation capacity, while countries including Chile, Ecuador and Uruguay have already conducted studies which represent the first steps towards the implementation of nuclear facilities. The risks associated with nuclear energy are much more pronounced than those associated with any of the forms of renewable energy, with potentially enormous environmental, social and health impacts in the event of accidents, together with the problem of storing spent fuel rods that will remain radioactive for millions of years.

Figure 5. Future energy consumption and greenhouse gas emission trends in the region



Source: Global Energy Assessment Scenario Database. Version 2.0.2.[31]

2. Energy poverty and gender

2.1. Energy poverty

Poverty levels in Latin America and the Caribbean have declined over the last decade, mainly due to regional economic growth, increased job opportunities, the expanded coverage of social assistance programmes and the development of new ones. However, the vulnerable population (with incomes between $4 and $10 a day) has increased slightly,[32] from 35% in 2000 to 38% in 2012. As a result, despite the improvements, Latin America and the Caribbean is still the region with the highest level of income inequality in the world.[33]

There are significant gaps in energy access within and between countries in the region and in comparison with developed countries. Energy consumption is typically far greater in developed countries than in Latin America and the Caribbean. For example, US per capita electricity consumption is 13,395 kilowatt hours (kWh) per year, while in Brazil, one of the most developed and populous countries in the region, it is 2,381 kWh/year.[34] In other words, a US citizen consumes about five times as much energy as a Brazilian citizen.

This scenario of inequality of energy consumption also exists between higher-income countries and lower-income countries within the region. For example, Trinidad and Tobago, a country with large oil reserves, has a per capita energy consumption of 6,332kWh/year[35]. Meanwhile in Haiti, a country where only 27.8% of the population is connected to the electricity grid, per capita consumption is a mere 32 kWh/year.

There are also significant levels of energy poverty across the region. This is more accentuated in rural areas, where about 85 million people are without access to basic services,[36] that is, without electricity, water and sanitation and/or modern energy for cooking.

Inequality in access to energy is one of the major limitations in the current regional energy model, and is getting worse in countries including Bolivia, Honduras and Guatemala.[37]

Extreme poverty is most common in rural areas, however it is also frequently found amongst vulnerable communities in peri-urban areas which are home to many migrants from rural areas. The migrants' expected improvements in terms of quality of life are not achieved immediately; peri-urban settlements usually lack basic services, or where they exist, people do not have sufficient financial resources to access them. In both cases significant consumption of firewood, charcoal and coal takes place, driven by the lack of modern technologies for cooking, lighting and other needs.

In Latin America and the Caribbean, there is a close relationship between energy, poverty and environmental degradation; therefore, the management of these factors is becoming a central feature of development plans and initatives to reduce energy poverty and improve the quality of life of the population.

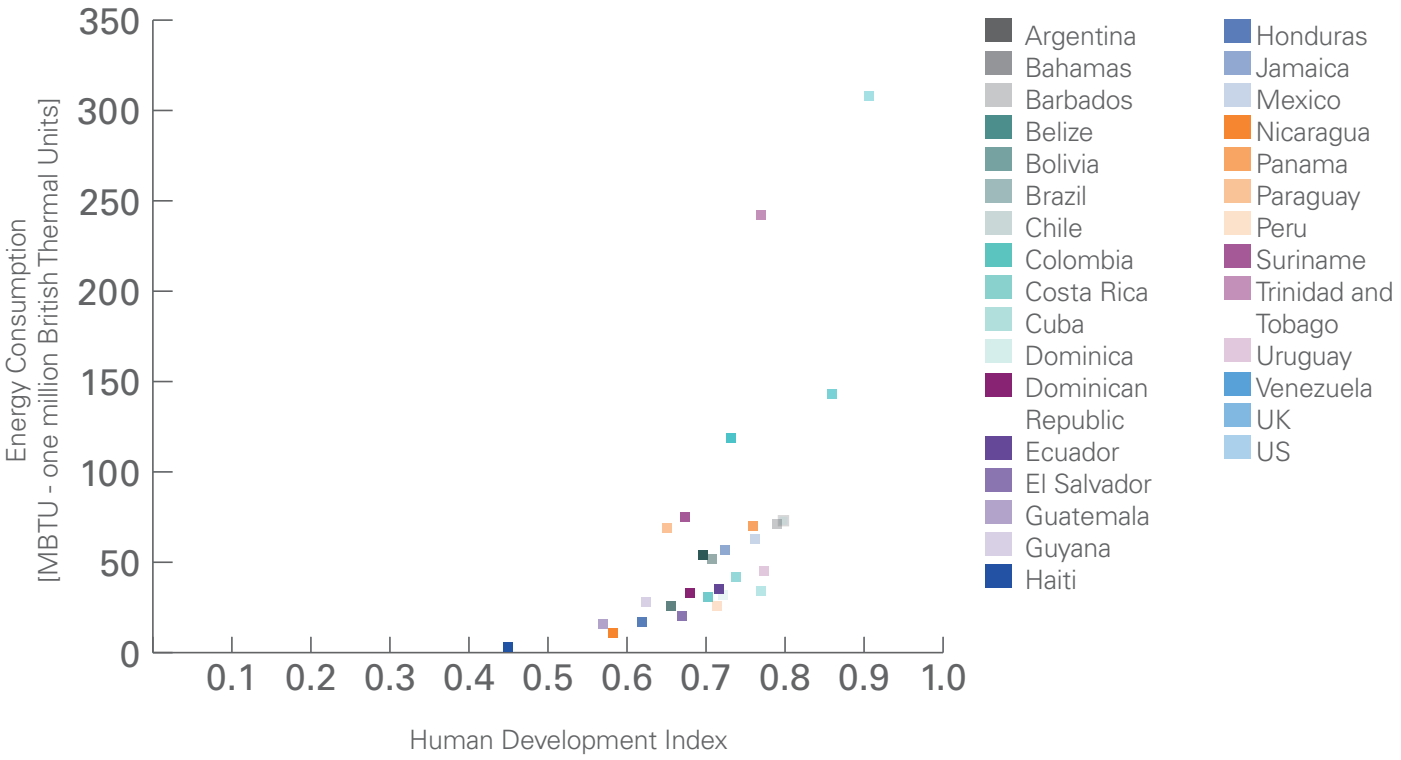
The relevance of the social dimension to the energy use of a population can be observed by considering the relationship between per capita energy consumption and the Human Development Index, a statistical tool used to measure a country's overall achievement in its social and economic dimensions.[38] Although the direction of causality is not simple, **Figure 6** suggests that energy can contribute to overcoming poverty and moving people up the scale of human development.

The relationship between energy and human development must be held as a key factor when discussing low-carbon development. Indeed, civil society often promotes the view that energy should not be considered as a commodity but as a human right. Such is the case of Peru, where the population claims the right to acquire affordable clean energy.[39]

However, the regional experience also reveals that an increase in energy availability at a country level does not ensure greater access for rural communities and vulnerable populations. Instead energy poverty for such groups tends to remain stable as energy access policies fail to meet the energy needs of excluded communities, whether to cover their basic needs or to supply the energy they need to carry out productive activities. Despite the region's progressive growth in energy supply, 21 million out of the 30 million people living without access to electricity are poor.[40]

One of the indicators that best illustrates energy poverty in Latin America and the Caribbean is the prevalence of consumption of firewood and charcoal, a source

Figure 6. Energy consumption and human development



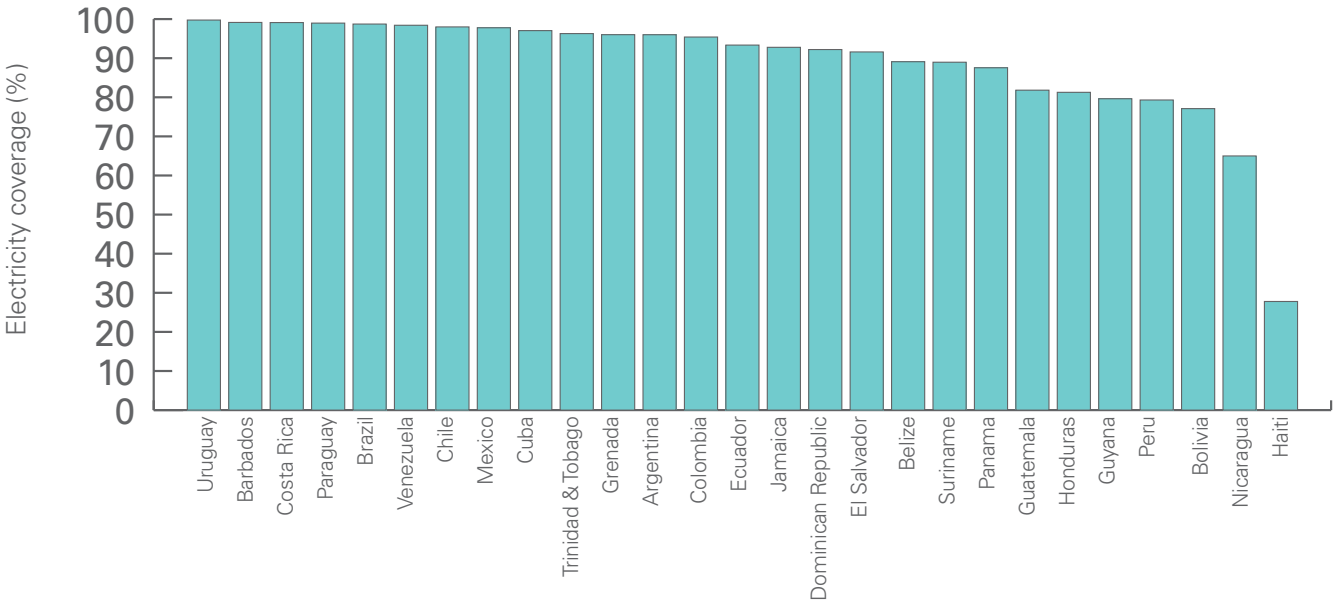
Source: Prepared by Practical Action, Latin America, based on information from the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), 2014.[41]

of energy used by 40% of the population on average. This rate is greatly exceeded in some countries, such as Haiti and Guatemala, where it can reach up to 90%. The social and environmental impacts worsen when firewood or charcoal is obtained through the deforestation of natural forest,[42] causing the loss of important carbon sinks while generating pollution, combustion-driven diseases and premature deaths. An estimated 80,000 deaths linked to air pollution caused by cooking on open fires within the home is reported annually.[43] Women and children are worst affected as they spend most time in the home.

Another indicator of energy poverty and inequality is the lack of access to electricity. On average 10% of the region's population does not have access to electricity,[44] but this can vary dramatically between countries. For example, according to the World Bank Database,[45] Brazil is close to achieving universal access to electricity (99.3%), while in Haiti only 28% of the population has this access (see **Figure 7**).

Although some countries have taken steps to address access to electricity through public policy, such as Brazil's Energy for All *(Luz para Todos*) programme, there are large disparities in electricity access rates both between and within countries.[46]

Figure 7. Electricity coverage in Latin America and the Caribbean



Source: Latin American Energy Organisation (OLADE), 2012.[47]

2.2. Energy and gender

In Latin America and the Caribbean, poverty and its effects are accentuated for women because only 50% of them earn their own income, while four out of five men earn income through employment.

Stark differences can also be noticed in access to development opportunities between women and men. For example, according to the Global Alliance for Clean Cookstoves, literacy rates for women are 55% in El Salvador, 60% in Bolivia and 54% in Brazil, while the economic empowerment and opportunity of women is 55%, 60% and 64% respectively.[48] In the arena of energy, the symptoms of gender inequality are expressed, for example, through the incidence of diseases related to traditional cooking amongst women in rural areas, where gender roles usually leave them responsible for cooking in the home. Consequently, women are most exposed to harm from the air pollution inside their homes. Chronic obstructive pulmonary disease (COPD) is a major public health problem in many Latin American and Caribbean countries. In a study of a clinic specialising in respiratory illnesses in Mexico, 30% of patients admitted with COPD had been exposed to woodsmoke, and of that 30%, the majority were women.[49]

Gender inequality can also be seen in the effects of energy projects like large-scale hydropower plants on women in particular. Christian Aid's Brazilian partner Movement of People Affected by Dams (MAB), in partnership with UN Women, has carried out a programme of participatory assessments with women from the communities affected by dams in the state of Rondônia. This study showed that with the arrival of the dams, the situation of labour inequality for women worsened as a result of loss of land and involuntary resettlement in urban areas where no provision had been made for their employment.[50] Further findings from the study concerned the exclusion of women from decision-making processes and the status of 'unrecognised affected person'. Women have been the main victims of impoverishment and marginalisation arising from the planning, implementation and commissioning of dams,[51] yet have held the least power in terms of affecting these processes.

Ensuring that women have a voice about energy provision, and that their views carry weight, is an uphill task. According to research by the Latin American Energy Organisation (OLADE), in 2012, at least six out of the 13 countries studied had a gender policy or gender strategy for their Energy Agencies,[52] but only four (Uruguay, Nicaragua, Mexico and the Dominican Republic) had reached satisfactory levels regarding the distribution of decision-making roles in areas of policy and strategy.

The same research showed a trend in Ecuador, El Salvador and Peru that women tended to work in administrative roles, whereas men were more likely to hold decision-making positions.

The provision of renewable energy, coupled with efforts to challenge traditional gender roles, can play a crucial role in achieving gender energy equality. In order to do so, structural barriers to women's participation need to be removed. These can range from discriminatory social norms to external conditions that may prevent women from attending meetings; for example, women from rural communities are often unable to participate in social consultations when childcare assistance is not available.

It is essential for governments to assess the access of energy resources from a gender perspective, acknowledging the role women play in rural areas.[53] The integration of women in the low-carbon transition process will require targeted support and training. On the technical side, this would include training for the design, installation, operation and maintenance of renewable systems; coupled with training in business aspects, for example, in management skills.

In this regard, progress has been made through a number of projects in the region. For example, MAB is currently training women in order to promote their participation in coordination roles within the movement. In Guatemala, Honduras, El Salvador and Nicaragua, NGOs have launched the Regional Gender and Energy Network, an initiative that seeks to contribute to the elimination of inequities in access to universal energy through advocacy work on national public policies to promote sustainable, equitable, gender-sensitive and sociocultural medium-term human development.

3. Available renewable energy sources and low-carbon growth potential

Climate change has highlighted the important role of technological innovation and development, especially with respect to energy efficiency and renewable energy. Together, these sectors have the potential to decouple the region's continued economic growth from the increase in energy consumption and the release of GHG emissions, as well as to reduce energy poverty and promote equity. Therefore, energy efficiency and renewable energy represent important avenues for progress towards truly sustainable low-carbon development.

Latin America and the Caribbean has vast untapped renewable energy sources (RES) such as hydropower, solar, wind, geothermal, marine and biomass, many of which can be deployed using cost-effective and sustainable technology.

The use of RES for electricity production varies greatly within the region.[54] The countries with the greatest RES shares are Paraguay (75%), followed by Haiti (65%) and Guatemala (65%), while the countries with the smallest shares are Grenada (8%), Barbados (3%) and Trinidad and Tobago (0%).[55] It is important to note that those countries with greater shares of RES tend to rely on large-scale hydropower that causes significant social and environmental impacts.

RES for domestic energy services such as cooking, heating and cooling also have great potential; Barbados, for example, displays a widespread use of solar water heaters.[56]

However, most countries in the region still lack concrete and effective policies to deploy the wide range of investments required to implement RES projects. Among the identified barriers, governments' weak institutional and technical capacities stand out, as public institutions struggle to implement policies and programmes involving RES and energy efficiency at a national level. Further barriers include the lack of economic resources; the failure of governments to prioritise RES development in favour of extending the penetration of fossil fuels; biased and incorrect beliefs about the economics of RES; the lack of research and development; the low level of private sector involvement; and the lack of dialogue between the public and private sectors and civil society. Overcoming these obstacles is an important challenge in the region.

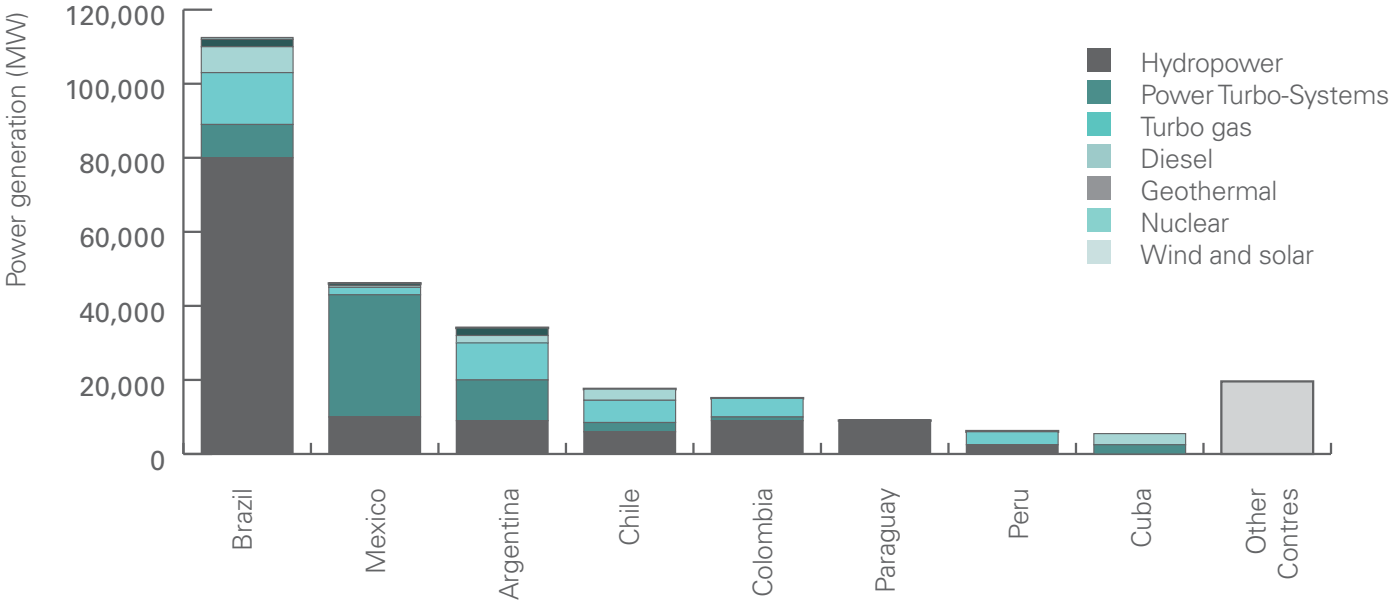
More aggressive policies to increase the share of RES in a sustainable and planned manner would enable a significant reduction of the share of fossil fuels. The Latin American and Caribbean Initiative for Sustainable Development (ILAC), created in 2002, could promote these kinds of policies.

Current market conditions favour opportunities to promote the use of low-carbon energy sources: increasing electricity demand in the region, rising fossil fuel prices, more affordable investment costs for RES, growing concerns about climate change and the social preference for clean energy.[57] These conditions increase the economic feasibility of clean energy and support important commitments to promote renewable energy projects across the region. For example, Nicaragua aims to produce 90% of its energy from renewable sources by 2020 and Uruguay has pledged to generate 90% of all its electricity from renewables by 2015.

3.1 Available renewable energy sources

Figure 8. Energy generation by source by country

Source: Latin American Energy Organisation (OLADE), 2012.[58]



The RES technologies most commonly used in the region are hydropower, followed by geothermal (primarily in Central America); meanwhile wind and solar generation remain marginal due to the lack of policies to develop renewable energy (see **Figure 8**).[59]

3.1.1. Hydropower

Hydro is the main source of renewable energy in the region. Hydropower plants are responsible for more than 50% of current renewable power generation, with an installed capacity of approximately 153,192 MW (eleven times the installed capacity of the world's second largest hydroelectric power station, the Brazil/Paraguay Itaipu dam),[60] spanning all scales and types of plant. Nevertheless, the majority of installed capacity is large-scale plants, as in the case of Brazil, Venezuela, Colombia and Paraguay.

Despite the renewable nature of the source, most large-scale hydropower plants are responsible for a range of damaging environmental, social and economic impacts, such as:

- generation of significant amounts of GHG, driven by the flooding of Amazon forests
- impacts on the hydrological cycles of rivers and watersheds, increasing the likelihood of drought
- displacement of rural people with scarce resources whose livelihoods and traditional ways of life depend on natural habitats
- economic losses due to the costs involved in resettling people in new areas which may have lower productivity and be isolated from markets or public services.

Fortunately, the impacts generated by large-scale hydropower plants do not arise in the implementation of micro and small hydropower plants. Small-scale hydropower plants such as those in Peru, Bolivia and Nicaragua, are friendlier to the environment, especially run-of-river hydropower plants which do not require dams, and they have greater social acceptance compared with large-scale plants.

3.1.2. Geothermal

Geothermal energy is the thermal energy existing underground. It can be used to generate electricity, by means of a turbine, when water is found in a geothermal reservoir at high temperatures, between 150 and 400°C.

Geothermal energy is poorly developed in the region; it is essentially concentrated in Central America (Costa Rica, El Salvador, Guatemala, Mexico and Nicaragua) and is primarily used to provide energy to the electrical grid. In South America, some countries such as Argentina, Chile and Peru, have conducted preliminary geothermal assessments and are currently granting geothermal energy exploration concessions.[61]

Another important application that has not been developed in Latin America and the Caribbean is the implementation of geothermal energy projects for home heating.

Currently Latin America and the Caribbean has only 1,471 MW of installed geothermal capacity.

3.1.3. Wind

Few wind farms have been installed in Latin America and the Caribbean countries, despite the region's wind potential, in particular due to the absence of policies to encourage large-scale wind farms, the lack of information regarding potential locations, and the lack of infrastructure needed for their installation.

Some countries have had positive experiences in the installation of wind farms, including Nicaragua, which currently generates 14.87% of its electricity from wind,[62] and the Dominican Republic, which produces 2% from wind.

In other countries, there is opposition to wind farms from local residents because of the perceived visual impact. For example, in Chiloé Island, Chile, the local community opposes a proposed wind farm with the potential to generate up to 428 MW of electricity.[63]

Currently, the region's wind power generation equals 3,203 MW.

3.1.4. Biomass

Biomass, such as wood, crop residues and crops, can be used for energy purposes by means of direct combustion or other technologies like gasification for heat or electricity generation. It could, therefore, be used to replace fossil energy sources, either to generate heat or electricity.

Burning firewood and crop residues does not generate major greenhouse gases if they are grown sustainably and burned efficiently, but it can cause local pollution. This is a problem in countries like Haiti where 41% of the population rely on firewood for cooking.[64]

The region's biomass consumption is estimated at 66 million tonnes per year.[65] This should decrease with economic development in the coming years.

3.1.5. Biofuels

Biofuels are primarily produced using corn, sugar cane, palm oil and rapeseed crops.

Over the last decade, biofuels emerged as an alternative to partially replace oil consumption in many Latin America and Caribbean countries in a context of rising prices, mainly due to their lower production costs. Therefore, countries have established laws and regulations to promote biofuels, leading to a steady increase in their use.

This experience is not new. In Brazil a similar measure was implemented decades ago to replace fossil fuels with ethanol.

In 2010, it was estimated that 3% of the arable land in Latin America and the Caribbean was used for biofuel production, and that this could increase up to 10% by 2030, driven by the regional increase in the demand for vehicles.[66] This would also increase the biofuel industry's demand for agricultural land,

putting it into conflict with local farmers whose economic resources are limited and who have lower bargaining power.

Shifting croplands from food to biofuel production results in an increase in food prices.

Most large-scale first generation biofuels projects have proven to be unsustainable due to the local generation of GHG emissions and the impacts on rivers and cropland, driven by land-use changes and the use of fertiliser containing nitrates and phosphates.

In order to overcome these impacts, some initiatives are currently being implemented to move towards second generation biofuels (eg fuels manufactured from various types of biomass) and third generation biofuels (eg using algae for oil generation), technologies that will be entering the market after 2020.

Further studies will be required on these new technologies, assessing the risks and advantages of new biofuel projects.

Solar

Solar has the greatest potential of all RES, due to the availability of the resource and the existing expertise in the region. Currently, solar use is marginal relative to other energy sources and to the existing potential.

Solar energy for local electrification has been developed in a sustainable way in some cases; though to date, this has mainly concentrated on off-grid and small-scale grid-connected systems[67] and it is difficult to ensure that most of them are working.

Likewise some centralised photovoltaic (PV) systems, with a total capacity of approximately 400 MW, have been installed to supply the electricity grid, most of them in Peru. Yet the number of systems and the power generated are marginal in relation to regional power consumption.

Some countries, such as Peru, have more PV power connected to the network than in rural off-grid schemes, which reveals the lack of planning and prioritisation of governments, as it is known that local off-grid systems can reduce energy poverty.

Ecostoves in Nicaragua

Nicaragua has several examples of projects to improve the efficiency of cooking stoves. One of the most successful ones was the Community Wells in Dry Areas of Nicaragua project, led by Centro Humbolt. This initiative comprised the delivery of 367 improved stoves, called 'ecostoves' to 65 rural communities experiencing poverty.

Using ecostoves generated multiple benefits for the target population, especially women and children who previously were affected by smoke from traditional stoves, and used to spend precious time collecting firewood on a daily basis.

The decrease in the volume of firewood consumed also meant less pressure on forests. Avoided deforestation was estimated at 247,640 m^2, an area equivalent to 35 football pitches; and the reduction in GHG emissions was estimated at 4,598 tonnes of CO_2.

The project won many awards, including the Equator Prize granted during the UN Conference on Sustainable Development in 2012 (known as Rio+20).

3.2. Low-carbon growth potential

Low carbon economic development should prioritise the eradication of energy poverty and inequality, particularly in rural populations, focusing on the most vulnerable populations, taking a gender approach and considering the sustainability of the measures to be implemented.

Mitigation measures are essential to make progress on low-carbon development. Countries should identify carbon-intensive activities and feasible mitigation measures for each identified sector. Mitigation measures should prioritise energy saving, through awareness campaigns in specific sectors to change consumption habits; efficiency measures to reduce consumption of primary or secondary sources of energy; use of renewable energy to replace energy from non-renewable sources; and using low-carbon fuels to replace carbon-intense fuels.

An assessment should be made incorporating technical, economic, social and environmental aspects, in order to determine the cost of each of the measures and the potential emissions reductions.

Typically the measures that allow greater emissions reduction are also cost effective. For example, Mexico is promoting energy efficiency initiatives in the public sector (eg changes of inefficient desktop computers), programmes to increase end-use energy efficiency (eg replacing inefficient bulbs or electronic appliances) and the development of capabilities at a user level (changes in energy-use habits), technical level (measurements) and at a professional level (assessment and implementation of measures).

Mitigation measures will not be the same in all cases as they depend on local conditions.

Countries must plan measures for the long term, engaging the relevant sectors. For example, in the case of Brazil, Bolivia and Peru, deforestation was identified as the main GHG source, which is why countries have taken action to reduce the loss of forests. But emissions from energy are also an increasing concern.

The implementation of mitigation measures will require, in many cases, the establishment of subsidies, changes in laws and regulations, capacity building and technical studies, among other things. Furthermore, a monitoring and reporting system is required that integrates technical and economic factors as well as social and environmental impacts, improving all aspects as the project is implemented.

3.2.1. Low-carbon options

Based on projected annual economic growth of approximately 3% for the coming decades,[68] Latin America and the Caribbean will need to double the installed capacity for power generation up to 600 Gigawatts (GW) by 2050, at a cost of 430 billion dollars,[69] when electricity demand will reach approximately 3.5 petawatt hours per year.[70] As a result, under the current development model, emissions are expected to double.[71]

However, recent assessments show that the region has an untapped potential for renewable electricity generation of 78 PWh/yr and in terms of power 34 terawatts (TW).[72] Even without considering hydropower, this is 22 times the demand required by 2050.

The distribution of renewable energy potential for power generation is shown in the following table.

Hydropower is estimated to have a potential of 800 GW,[73] but considering the problems described above, its real potential must be much lower, as it depends on finding appropriate locations. Micro and small hydroelectric plants are an important solution to serve rural populations, as well as an option to improve energy distribution.

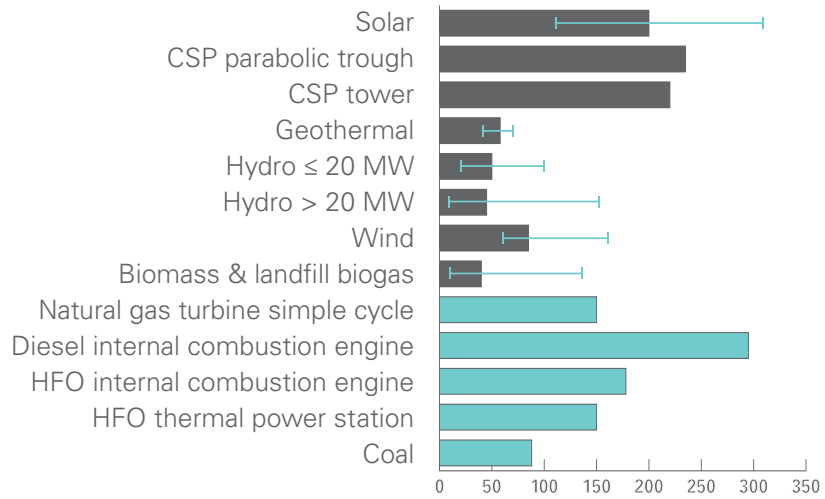
These figures indicate that there are sufficient renewable resources from solar, wind, wave, geothermal and biomass to plan for low-carbon development. Yet energy efficiency measures and energy saving should be prioritised, in order to improve the region's sustainability.

A study by the International Renewable Energy Agency about the levelised cost of electricity (the cost of electricity over the lifetime of energy output) in Latin America and the Caribbean, shows that renewable systems are more cost effective (**Figure 9**).

Technology	Percentage	Energy (PWh/year)	Power (GW)
Marine (Ocean thermal energy conversion, wave, tidal, etc)	11%	8	3,400
Wind offshore	14%	2	450
Wind onshore	2%	11	4,200
Geothermal	4%	3	500
Biomass	2%	2	225
Solar photovoltaic	46%	36	17,000
Solar CSP	21%	16	7,500

Source: Prepared by the authors

Figure 9. Levelised cost of electricity generation in Latin America and the Caribbean



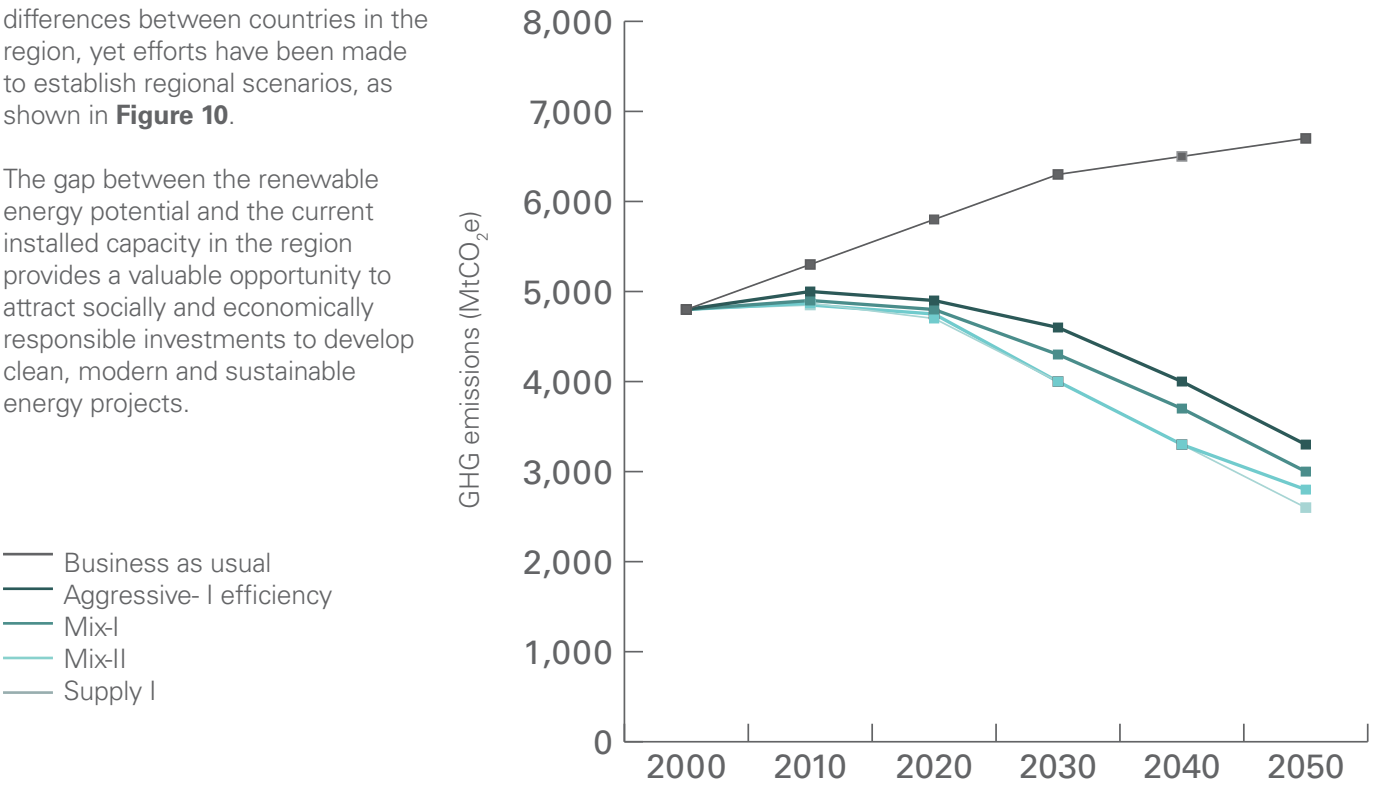
HFO heavy fuel oil
CSP concentrating solar power
The bars show the mean values while the error bars show the maximum and minimum values.

Source: Inter-American Development Bank (IDB), 2013.[74]

The scenarios for low-carbon development in Latin America and the Caribbean are varied due to the differences between countries in the region, yet efforts have been made to establish regional scenarios, as shown in **Figure 10**.

The gap between the renewable energy potential and the current installed capacity in the region provides a valuable opportunity to attract socially and economically responsible investments to develop clean, modern and sustainable energy projects.

Figure 10. Emissions reduction scenarios 2010-2050



Aggressive I efficiency: aggressive policies in energy efficiency combined with electric transport. Plus carbon capture and storage, etc.

Mix I: increased efficiency, greater share of renewable energy (97%), progressive electrification of transport systems; significant use of capture and storage post-2030, etc.

Mix II: increased efficiency, greater share of renewable energy (97%). Maintenance of conventional transport system; bio-energy; capture and storage in the long run, etc.

Supply I: a reduction in energy demand and the use of advanced "electrified" transport system.

Source: CELAC, IDB, WWF. 2013[75]

3.2.2. Financing

The implementation of energy efficiency, energy conservation and renewable energy measures requires significant investment, far more than Latin American and Caribbean countries could assume. Low-carbon development therefore requires funding from different sources, not only governmental but also from the private sector, multilateral banks and developed countries.

Government funding may be achieved through the countries' own economic resources, by means of incentives to facilitate private investment or through laws that regulate compulsory generation targets from renewable sources, such as requiring the installation of solar thermal systems in new buildings or setting compulsory renewable share targets for power generation companies.

Private investment can be driven by regulatory conditions that enable companies to make investments in renewable technologies and subsidies, among others.

The financing of renewable energy projects could come from multilateral banks. At least 20 multilateral funds operating in the region are involved in climate finance, yet the resources of climate financing is still below that required due to the countries' failure to promote renewable energies.

Assistance from developed countries, in the form of technology, professional and technical training and financial resources, is essential.

Ecuador's Yasuni-ITT (Ishpingo Tambococha Tiputini) Initiative, launched in 2007, was an example of both an innovative and ambitious approach to securing a low-carbon future and of the developed world's lack of support for such initiatives. The idea was that the international community (governments, foundations and individuals) would pay Ecuador to keep oil reserves within the Yasuni National Park in the ground and that part of the 'climate finance' funds raised would go to indigenous peoples living there. The area, which covers a section of Ecuador's Amazon rainforest, is recognised as one of the most biodiverse regions in the world. The Ecuador government believes that not exploiting the oil would have avoided the release of some 400 million tonnes of CO_2 into the atmosphere by preventing deforestation of a significant area of the jungle. Ecuador had hoped to raise an initial US$100m for the Yasuni-ITT initiative by the end of 2011, increasing to a total of US$3.6 billion by 2024. However, during the six-year history of the initiative, only US$336 million was pledged, and of that only $13.3 million was actually delivered. In 2013, the Ecuadorian government decided to call time on the initiative, with the likely result that the state will now exploit the oil reserves.

Sources

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Ecuador regulator OKs two fields in large Amazon oil project http://in.reuters.com/article/2014/05/22/ecuador-oil-itt-idINL1N0O816R20140522

The Green Climate Fund (GCF), launched in 2010, during the 16th session of the Conference of the Parties (COP 16) to the United Nations Framework Convention on Climate Change (UNFCCC), is intended to mobilise financial resources from developed countries to help developing countries mitigate and adapt to the impacts of climate change. However, little progress has been made towards reaching the $100 billion pledged by industrialised countries.[76]

It is essential that developed countries contribute to the sustainable development of Latin America and the Caribbean, in order to preserve the resources and the environmental services available.

In conclusion, with the right mix of technologies, policies and management, a transformation in energy generation and use could address poverty, development, sustainability and climate change objectives in a cost-effective and sustainable way.

4. Experiences in the implementation of renewable energy

The widespread implementation of renewable energy projects in Latin America and the Caribbean started several decades ago. This includes a whole range of RES, primarily hydropower, biofuels, solar, wind power and geothermal. **Among these projects there have been both positive and negative experiences, demonstrating that being 'renewable' does not guarantee that an energy project is 'sustainable'.** Sustainability depends on certain conditions such as the scale of the project, how it affects the environment and the human population, and other things.

There is definitely motivation in the region to develop renewable energy at different scales and in different contexts (urban and rural) in the coming years, a trend that is expected to intensify as countries commit more solidly to adopting a low-carbon development path.

Several countries are implementing wind farms and solar installations, projects to expand their electrical grids and are conducting studies to establish their geothermal and concentrated solar energy potential. However, these applications are still marginal compared to traditional generation sources, including hydropower plants.

Renewable energy generation won't happen by itself as Latin American and Caribbean countries also struggle with energy inequality and significant levels of energy poverty.

The UN has been promoting the Sustainable Energy for All initiative,[77] which aims to:

- ensure universal access to modern energy services by 2030
- double the global rate of improvement in energy efficiency by 2030
- double the share of renewable energy in the global energy mix by 2030.

Latin American and Caribbean countries are promoting the implementation of sustainable energy projects in order to achieve these goals. The following key aspects should be considered to develop sustainable energy projects.

4.1. Social issues and community participation

The Regional Observatory of Social Conflicts, initiated by the United Nations Development Programmes (UNDP) and the UNIR Foundation of Bolivia, conducted research on social conflicts across the region between 2009 and 2010. They discovered that the number of conflicts had risen in the region, as shown in **Figure 11.**

The sustainable implementation of a renewable energy project, like any other construction project, requires that local people who may be affected are informed and consulted, in an educative, practical and transparent way. This includes informing them about the conditions on which the project is to be implemented, the potential impacts, environmental compensation arrangements and benefit distribution policies. It is also vital that local people are given the opportunity to express their agreement or disagreement. This should be the first step towards gaining project approval.

For example, the International Labour Organisation (ILO) Convention 169 on Indigenous and Tribal Peoples deals specifically with the right to free, prior and informed consultation and consent.[78]

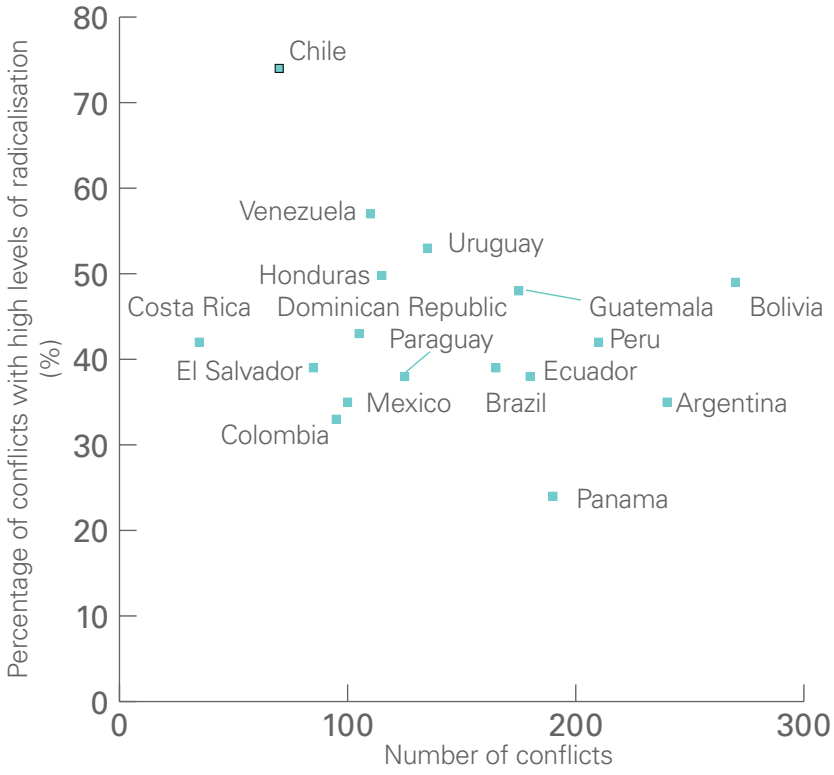
All 33 Latin American and Caribbean countries have ratified Convention 169 yet the experience in the region has shown little governmental will to protect indigenous and Afro-descendent people's rights. There are numerous cases in Bolivia, Ecuador, Colombia and Peru where hydrocarbon extraction and mining activities and the construction of dams have been approved without holding prior consultations.[79]

A recent case concerns Chiloé Island in southern Chile, where a 112 MW wind farm was planned to be installed in a moorland area that serves as a water reservoir

for the local population and is an important ecosystem for migratory birds. In 2010, not only was the project approved without the level of environmental assessment required according to its scale, but also without conducting prior consultation of indigenous communities. These irregularities drove civil society organisations to file a lawsuit that resulted in approval being withdrawn. However, far from being dismissed, the project is being re-assessed, after a consultation that drew allegations of serious violations of human rights.

Armando Montaña, a member of the Movement for the Defence of Mar Brava, said: 'The biggest barriers that work against the sustainability of the energy projects in Chile are the lack of mechanisms for citizen participation and the lack of land use regulations. The population of Chiloé is not opposed to the development of wind farms on the island, but believes projects must be assessed through the consideration of current land uses and social, economic and cultural impacts that may affect the local population.'

Figure 11. Social conflicts and radicalisation levels by country



Source: Calderón, 2012.[80]

4.1.1. Hydropower plants

Hydroelectric plants have caused serious environmental and social impacts in the region and worldwide. For example, the implementation of hydropower plants in Brazil, with an installed capacity of approximately 133,339 MW,[81] has led to major environmental impacts, especially in the Amazon rainforest, where the implementation of large-scale dams has affected the rights of locals and indigenous and Afro-descendant communities

The Belo Monte Dam, currently, under construction, is one example. With a projected capacity of 11,233 MW,[82] the size of the reservoir created will be 668 km^2, approximately half the area of Rio de Janeiro city. The project has raised many environmental concerns. For example, it is estimated the project will decrease the flow of the Xingu River by 80% to 90%,[83] which would undoubtedly translate into loss of biodiversity to the detriment of the Amazon biogenetic heritage.

The displacement of 20,000 people to make way for the dam and waterways has initiated a migration process to local cities, causing the collapse of public services, increases in living expenses for the local population and other related social problems like prostitution and crime. The project has not been accompanied by an informed consultation process. Esther Vital of MAB said: 'consultation mechanisms

are not assured, preventing the participation of the affected population. People who then resist end up being treated as criminals by the authorities.' The Belo Monte Dam Project has been suspended on numerous occasions and has led to precautionary measures being granted by the International Human Rights Commission.

Based on such experiences, guidelines and protocols to improve the sustainability of hydroelectric projects have been developed. For example, the International Hydropower Association has proposed standards to assess hydropower facilities prior to their approval. Nevertheless, Latin American and Caribbean countries have yet to adopt these protocols to assess the large-scale hydroelectric projects which are expected to be constructed in the near future, in particular in countries sharing the Amazon rainforest.

In Brazil, electricity demand is about 513 TWh/year[84] and is expected to triple by 2050. To meet this demand, Brazil will need to import electricity from neighbouring countries such as Peru,[85] which agreed to provide 6,000 MW to Brazil over the next 30 years, equal to 90% of its current installed capacity. In anticipation of this future obligation, Peru is conducting studies ahead of approving electrical concessions in the Amazon, such as the Inambari hydropower plant, which is expected to supply 2,000 MW.

In contrast to the problems driven by large-scale hydropower plants, the experience with micro and small hydropower facilities has generally been acknowledged as positive. For example, in Guatemala, the Madre Selva Collective has implemented community-based, small-scale hydropower plants that benefit indigenous communities. The projects are widely accepted by the population because they have no negative environmental or economic impacts and bring a number of benefits. Oscar Campos of the Madre Selva Collective highlights the importance of developing projects based on a comprehensive approach including community development, thus gaining social licence.

4.1.2. Biofuels

First generation biofuels emerged in the region as an opportunity for countries to promote a new source of clean energy that can be produced locally, thus reducing their dependence on imported oil, improving energy security and fostering economic competitiveness. National governments believed that biofuels producers would rely on trade with rural inhabitants, thus supporting poverty reduction measures. However, biofuels have the potential to increase food prices and heighten competition for land and water, they pose risks in terms of water quality, increase concentration of land ownership in fewer hands and can cause habitat loss and deforestation.

Barranquita, a district in eastern Peru, is an example of the severe negative impacts of agribusiness expansion for biofuels. Barranquita used to have large areas of primary forest before the approval of oil palm plantations in 2007. At the time, energy crop development was designated as an 'activity of national interest', a label that enables national authorities to facilitate investments in the sector, for example by simplifying land allocation processes. These measures resulted in irregularities when defining the lands suitable for energy crops. As a result, the licence given ended up covering forest lands.

The situation in Barranquita sparked a conflict between the agribusiness firms and the local population. Deforestation stopped for about two years during a period of intense protest, but the systematic clearing of forests started again. This work has set a negative precedent in the country, giving other companies the green light to continue expanding the production of biofuels by destroying rainforest.

4.2. Regulations

The region does not have an explicit policy framework for low-carbon development. Therefore a number of regulations determine the standards to be applied, the institutional structure of public administration, and the participation of private actors from which countries can develop strategies, plans and initiatives.

Some national policy measures seek to promote the implementation of renewable energy projects, but do not provide precautionary measures to reduce potential impacts.

A contradictory rhetoric can be heard in some countries, where policies which favour extractive industries and carbon-intense industries undermine the international discourse of the region regarding conservation and climate change mitigation. For example the Bolivian government passed the Law of the Rights of Mother Earth in 2010, but still favours investments in oil and gas exploration and has threatened indigenous people's territories with a project to build a highway in the Isiboro Sécure National Park and Indigenous Territory.

Brazil's Amazon Protection Policy has a Forest Code, which requires landowners in the Brazilian Amazon to maintain 80% of forests as legal reserves, but it is not being implemented.

To eliminate these defects and promote low-carbon development, the region needs an appropriate methodology for assessment of proposed energy initiatives, in order to identify and quantify the social benefits and avoided costs associated as well as the impacts in terms of change climate, air pollution, energy security and job generation, among other things.

Assessments should also be made of the pros and cons of liquid and gaseous fuels and electricity, so that informed choices can be made.

Practical Action developed a Fund for the Promotion of Micro-Hydro Power Stations more than 10 years ago. This fund created a low-interest loan facility to promote the implementation of micro-hydropower for rural electrification and productive use. Initially the project focused on productive businesses, but due to the political and economic circumstances of the time, many enterprises did not meet the financial criteria for the loan. After a few years, the Peruvian government, by means of regulation, transferred economic resources to local governments, allowing local governments and rural comunities to benefit from a fund that currently stands at some $800,000. The fund enabled the installation of 42 small hydropower plants, which currently generate electricity for 7,000 families.

5. Global and local implications of the carbon market and other mechanisms

In order to control global temperature increase by limiting GHG emissions worldwide, emissions trading mechanisms emerged with the signing of the Kyoto Protocol, in 1997.[86] Countries in Latin America and the Caribbean participate in carbon trading through different mechanisms such as the Clean Development Mechanism (CDM), sponsored by the United Nations; voluntary carbon markets (mainly the US); domestic carbon markets; and Reducing Emissions from Deforestation and Forest Degradation (REDD+), another UN initiative. Currently, Nationally Appropriate Mitigation Actions (NAMAs), a new mitigation mechanism, is being developed.

5.1. Clean Development Mechanism

The CDM, part of the 2007 Kyoto Protocol, allows emissions trading between developed and developing countries, based on a 'cap and trade' system. Under the CDM, developed countries with emission reduction commitments could purchase certified emission reductions (CERs) generated in developing countries. CDM was available for Latin America and Caribbean countries until 2012.

This mechanism aimed to finance projects that did not have sufficient funding for implementation, under certain prescribed conditions. In Latin America and the Caribbean,[87] 948 projects were registered under the CDM, mainly in the largest economies such as Brazil (34% – 319 projects), Mexico (20% – 189 projects), Chile (11% – (99 projects), Peru (6% – 60 projects) and Colombia (6% – 58 projects).

Currently the equivalent of 167,514,492 tonnes of CO_2 emissions have been avoided.

The implementation of the CDM sparked strong criticism relating to the following issues:

- The view that climate can be treated as a measurable commodity, when the problem is structural.

  The commodification of nature was a major criticism, especially from countries such as Bolivia and other members of the Bolivarian Alliance of the Americas (ALBA),[88] who saw in the carbon market, a tool of green capitalism to encourage the conversion of environmental services to tradable commodities. Countries argued that this practice goes against the livelihood of traditional and indigenous communities who perceive the environment as a community resource.

- Countries had to perform internal institutional changes in order to adopt the approval procedures. Some countries saw this as interference by the developed world in the sovereign decisions of developing countries.

- The CDM allowed the transfer of responsibility for climate change and abatement costs to developing countries, allowing developed countries to avoid real commitments to reducing GHG emissions.

- In Latin America and the Caribbean, CDM eventually resulted in economic losses for project developers because investment in carbon credits was higher than sales, due to the drop in the prices of carbon credits.

Ultimately the expected GHG reductions were not achieved because the compensation was limited to the displacement of GHG reductions to cheaper regions. Therefore developed countries continued to pollute, assuming they could produce equivalent emissions savings elsewhere.

5.2. Voluntary carbon markets

The voluntary market trades carbon credits between project developers, who have to register reduction projects under voluntary standards, and buyers who are not subject to emission limits.

Buyers are private companies, NGOs, municipalities, universities and even individuals looking to offset their carbon footprint motivated by shareholder and/or customer demand and corporate social responsibility policies, among other things. Brazil accounts for 60% of voluntary credits generated in Latin America and has a significant participation in regional voluntary carbon markets.

Voluntary market-related emissions reductions account for 844,000,000 tCO_2 up to 2013,[89] and revenue of approximately US$4 billion. The voluntary market is expected to grow as the CDM disappears in the region and the market to offset carbon emissions grows.

As prices in the carbon markets remain at historic low levels, the voluntary market is being incorporated into domestic carbon markets.

Most voluntary market standards followed the CDM structures and methodologies, so the results and concerns are very similar to those outlined above.

5.3. Domestic carbon markets

Some countries in the region are promoting national initiatives based on market mechanisms to promote the transition to low-carbon development. For example, Chile created the Santiago Climate Exchange (SCX), to develop an industry to reduce greenhouse gas emissions; Brazil launched a Green Market in Rio de Janeiro (BVRio), an initiative designed to promote the reduction of industrial emissions in the state of Rio de Janeiro; and Mexico created the Mexican Carbon Platform (Mexico2).

In general, the results obtained by 'cap & trade' systems have been disappointing. The emissions reductions were insignificant compared to the scale of the problem; and market conditions mean the system usually favours companies that can afford allowances. Elizabeth Peredo, of Fundación Solon, said that carbon markets do not reduce carbon emissions but instead generate greater inequality, since companies that can afford to buy carbon credits keep emitting GHG.

5.4. Reducing Emissions from Deforestation and Forest Degradation

The REDD+ initiative acts as an economic incentive for reducing forest loss and the resulting emissions and investing in low-carbon projects for sustainable development.[90]

It is based on the assumption that deforestation occurs because little economic value is given to virgin forests and, therefore, providing funds to countries with large forests can contribute to their protection. However putting a price on forest lands can encourage appropriations by large companies, affecting indigenous people and communities.

As in the case of the CDM, it is feared that REDD+ could be an instrument of commodification of nature, accelerating the destruction and occupation of forests, thus affecting biodiversity and the livelihoods of local communities.

REDD+ should be an inclusive, participatory and community-based initiative, allowing local communities to manage conservation projects and distribute the benefits directly.[91]

Likewise due to uncertainty around the methodologies for quantification of carbon sinks, it is essential to assess the feasibility of carbon offset schemes involving forests, since the issuing of large amounts of carbon credits could have a negative impact on their price and be a gateway for the developed countries to secure the means to continue polluting at will.

5.5. Nationally Appropriate Mitigation Actions

NAMAs are measures proposed by countries to meet their own carbon reduction targets. This mechanism is quite flexible and can be translated into training programmes, policies, regulations, standards, programmes and even financial incentives, covering one or more sectors.

Due to their scope, breadth and flexibility, NAMAs can become a bridge between developed and developing countries to facilitate GHG mitigation, as they follow the principle of common but differentiated responsibilities established by the United Nations.

Finally, it is worth noting that lessons learned from previous mechanisms should be incorporated into the upcoming ones, such as NAMAS.

6. Potential solutions for overcoming barriers to low-carbon development

Considering the evolution of energy consumption, the available energy sources, the experiences of renewable energy and the implications of the carbon market, the authors have identified the following key barriers to low-carbon development in Latin America and the Caribbean and possible solutions to them.

a. Government institutions. Countries maintain weak operational and decision-making structures at all levels, undermining their ability to promote low-carbon development paths. In many countries, public institutions still promote traditional investment policies that encourage fossil fuel-based energy production, for example Bolivia.[92] Therefore, strong institutional basis and policy frameworks should be implemented to allow solid environmental governance. Countries need to:

- innovate in operational and decision-making structures at all levels. Institutions need to be strengthened by training staff and incorporating specialised human resources on technological, environmental and planning issues
- strengthen the institutions involved in climate change-related policy, in order to align, implement, evaluate and improve local and regional climate policies, maximising the environmental, social and economic benefits
- decentralise their structure to generate decision-making spaces at different levels.

b. Legal and regulatory framework. The existing national legal and regulatory mechanisms governing renewable energy projects are limited in scope. Energy saving, energy efficiency and renewable energy deployment therefore remain marginal in relation to the need. The scope of national legal and regulatory frameworks need to be broadened to increase the share of renewables in the regional energy mix, and to encourage economic policies based on low-carbon development.

The experience of large-scale hydroelectric plants demonstrates the need for further improvement in the environmental assessment system, as well as the strengthening of the offices responsible for assessing and monitoring these types of projects. A starting point could be to include strategic environmental assessment in the regulations set for these types of projects. Cumulative impacts assessments, at river basin level, are also needed.

c. Energy policy. Energy policy within Latin American and Caribbean countries is driven by a short-term vision, which can vary significantly depending on the orientation of each government, thus, creating confusion in the public and private sector. Governments should:

- Develop environment-friendly regulations and standards, taxes and levies, social licence, subsidies, financial incentives and programmes for research and development of information tools. These policies could be gathered in a legal device, like Mexico's General Law on Climate Change passed in 2012.
- Develop policies that encourage coordination between the different actors in the region, in order to exchange experiences on specific topics and to facilitate the implementation of south-south cooperation projects.
- Prioritise energy-saving measures and energy efficiency at all levels, in order to postpone investments in expansion of energy systems and use available resources in projects that support the reduction of energy poverty.
- Focus on the diversification of the energy matrix including both high-capacity technologies and widespread small-scale technologies, which could generate the same amount of energy and provide greater security to the electrical system.

d. Energy planning. Energy planning is an effective instrument for the implementation of energy policies. Latin American and Caribbean countries should restart long-term energy planning, including measures to implement short- and long-term low-carbon development policies.

Rather than pursuing a strategy that is increasingly reliant on fossil fuels or nuclear energy, the region should embrace the opportunity of decoupling its economy from GHG emissions. Countries should work with the sectors of their economies responsible for generating the greatest GHG emissions and set firm and enforceable reduction measures for them.

Energy planning should:

- be fully incorporated as a tool for decision-making
- be based on reliable information about the projected energy prices (this is important because usually fossil fuels are subsidised in the region)
- prioritise the most vulnerable rural areas of each country and promote energy equity
- incorporate a gender approach that allows substantial improvements in the lives of women
- promote low-carbon technologies
- establish procedures to evaluate and consider the risks of instability and costs associated with the different technologies
- perform in accordance with the countries' National Climate Change Strategy, supporting the GHG emissions-reduction goals prioritised by sector
- involve the participation and engagement of different stakeholders from the public, private and civil society sectors, in an environment open to debate
- include the budget required for each goal, including possible funding sources.

The development of an energy planning process based on the criteria described above will guide public and private authorities in the decision-making processes needed to improve access to clean low-carbon energy, and encourage energy savings and energy efficiency.

e. Information and knowledge. There is a lack of information about the structure of energy demand; the supply of renewable energy; the features of renewable technologies; the renewable energy potential; and the direct and indirect benefits, such as increased productivity, positive impacts on the health of the population and improving living conditions.

Information gaps hinder the implementation of energy projects in the region. For example, in Chile there are not enough measuring stations to produce detailed maps of solar and wind potential sources, while in Peru there is no information about communities without power services.

Governments must generate detailed information on the topics listed above, implement systematic data collection, and promote processes of knowledge generation for decision-making.

Relevant information concerning energy plans and action for low-carbon development should be published for dissemination among domestic, sub-national and private entities, and civil society.

Governments could also incorporate useful information on legal, economic and political aspects related to renewable energies in order to establish a platform of knowledge and partnership between countries.

f. Research and development. Research and development is essential to generate knowledge and develop and disseminate appropriate technology suitable for local conditions. Countries should increase their budgets for these purposes.

For example, an initiative in Guatemala developed an improved cooking stove. Portable units were used instead of conventional fixed units. These units better suit the rural population's needs.

g. Training and awareness. Technical skills in renewable energy are limited in the region due to low market dynamism and lack of investment in research and development.

The lack of technical expertise often undermines renewable energy projects. For example, a few years ago, Brazil started the the Programme for Energy Development of States and Municipalities

(PRODEEM), aiming to install solar home systems. Due to the lack of qualified technicians, the programme experienced technical difficulties, and eventually required investment to be diverted to fix the problems.

Countries should promote training schemes for public officials, and the creation of a market for professionals and technicians. The implementation of long-term energy projects and investment in raising awareness about climate change and possible mitigation measures could help towards this goal.

h. Power consumption. In recent years, power consumption has increased substantially in the Latin America and the Caribbean region, in some cases reaching the patterns of developed countries. This trend followed countries' policies and regulations to expand the existing electrical infrastructure. This development model has led to a substantial increase in GHGs. The current model should be replaced by a more sustainable model which incorporates energy saving, energy efficiency and renewable energy deployment throughout the countries.

The Bolivian Climate Change Platform believes the main barrier to low-carbon development is structural, as the regional economic model is limited to responding to the demands of the international market. This is worsening as globalisation takes place, changing the region's consumption patterns and weakening the region's small peasant family units living under low-carbon consumption patterns.

i. Equitable energy development. Providing access to energy for the most vulnerable low-income population should remain a priority, in order to contribute to poverty reduction, as important levels of energy inequity remain across the region. For example, in Haiti, only 30% of the population has access to electricity.

Even though Latin American and Caribbean countries have assistance policies targetting rural populations, these are not strong enough to substantially improve people's living conditions in the short term or to achieve the goal of reducing energy poverty while improving quality of life.

j. Social licence. Policies, measures and projects must ensure social sustainability, harmonising the collective interests in order to avoid social tensions. Countries should establish transparent mechanisms to guide energy project developers in the process of gaining social licence from the local communities. Many examples show that social conflicts arise from the implementation of energy projects, usually related to hydropower and biofuel projects that affect local people, generating disagreements between companies, the government and the population.

Active participation of relevant partners must be ensured throughout the development and implementation of projects, to verify the accuracy of information provided by companies and ensure that the affected people fully understand the implications. Mechanisms should also include a human rights approach.

Policies to gather the views of people that may be directly or indirectly affected by energy projects need to be incorporated into the government's standard practices in order to establish permanent dialogue to reach agreement on issues relating to sustainable development. Participatory processes must be enhanced, both respecting the rights of the most vulnerable population and prioritising the communities' best interest. Free, prior and informed consent and consultation must be inclusive at all levels to prevent social tensions arising.

Christian Aid local partner in Guatemala the Madre Selva Collective applies a comprehensive approach when developing community-based hydropower plants for indigenous communities across the Quiche region in northwestern Guatemala. Before each project the Collective asks the communities to assess their own development expectations, analysing their environment and their agricultural activity,

and strengthening their social organisation, working in committees comprised equally of men and women. The Collective believes energy development must be designed from a comprehensive vision, to support the economic, social and environmental development of the communities, while promoting a participative democracy to strengthen social organisation with gender equity.

k. Gender approach. Currently, most energy projects do not contribute to tackling gender imbalances even though a direct and unequivocal relationship between energy and gender has been largely demonstrated.

Governments should incorporate a gender approach into their strategic energy planning as a key factor towards sustainable low-carbon development. Civil society initiaves are also important in this sense. For example, MAB in Brazil is training women in order to promote their participation in coordination roles; and a regional Gender and Energy Network has been launched by Christian Aid partner Centro Humboldt in Central America, to coordinate advocacy work to help eliminate inequities in access to energy.

l. Comprehensive assessment system. Project assessment means focusing on the investments required for the implementation of various technologies, the operating and maintenance costs, and the revenue generated in a given period. Currently, assessments neglect the costs of externalities and co-benefits of different alternative solutions.

The assessment of energy alternatives should include:

- the actual costs of energy sources, ie internalising existing subsidies
- the economic costs (eg ports, strengthening of transmission lines, etc), social costs (illness and death), and global and local environmental costs
- the co-benefits of each of the available technologies.

m. Financing. In Latin America and the Caribbean, the implementation of clean technology projects depends on state funding, whether it is to implement or to organise tenders. In order to achieve low-carbon development, funding must come from various funding sources, public, private or external.

Some countries have made some progress towards regulating renewable energy supply. Chile, for example, has a regulation that states power supply companies must obtain 10% of their supply from renewable sources.

It is essential that countries establish financial mechanisms to facilitate the implementation of renewable energy. Developed countries must support low-carbon development plans in Latin America and the Caribbean through technical assistance programmes and transfer of knowledge, technology and financial resources.

n. Integrated monitoring and tracking. Low-carbon development requires monitoring, reporting and verification systems that assess the performance of low-carbon measures and mechanisms, in the short, medium and long term, while ensuring initiatives do not deviate from GHG reduction targets.

These systems must be informed by a multidisciplinary perspective, including the participation of governmental institutions, private actors, civil society organisations and citizens in general.

o. Carbon markets. Carbon markets have not reduced GHG emissions significantly, so they should not be considered a solution.

7. Conclusions

In the near future, Latin America and the Caribbean will face a growing demand for energy, driven by larger economies responding to international markets and national determinants such as social inclusion levels, industrialisation rates and the increase of urban areas. Therefore, in a climate change context, the region needs to shift towards a low-carbon development.

The following conclusions summarise the key points identified in this report, and are intended to contribute to the international discussions on climate change, energy policies and low-carbon development.

- Based on the projected economic annual growth of approximately 3% for the coming decades, the region will need to double the installed capacity for power generation up to 600 GW by 2050, when electricity demand will reach approximately 3.5 PWh/year. This will cost some $430 billion.[93]

- Since 2004, the region's energy consumption grew by around 2.9% per year, leading to an overall increase in GHG emissions of around 18%. 70% of the region's GHG emissions are produced in five countries (Mexico, Brazil, Argentina, Venezuela and Colombia) so reductions in the carbon intensity of their economic activity can have the highest impact.

- The share of renewables in the region's energy mix is marginal. Furthermore, those countries with greater shares of RES tend to rely on large-scale hydropower. Most of the renewable regional share is represented by hydropower and biofuels, both of which have significant negative environmental, social and economic impacts.

- Renewable energy policies should be based on a sustainable approach that promotes the diversification of the energy matrix, using local resources, and encourages energy equity.

- The region's development follows an extractive model, which has resulted in an unsustainable energy model that favours fossil fuels. Energy generation just responds to market demand, increasing the region's carbon footprint. If the region is to shift towards a low-carbon development, countries must reduce the GHG emissions from their growing industries.

- About 85 million people live in rural areas without access to basic services. It is essential to direct efforts towards eliminating energy poverty and reducing the inequality experienced by rural communities, especially the most vulnerable ones.

- Improving energy equity is also an effort towards gender equity. The report shows that lack of clean energy makes life harder, particularly for women.

- Excluding hydropower, the region has a renewable energy potential of 80 PWh, capacity that exceeds the estimated regional electricity demand, equivalent to 3.5 PWh by 2050. These resources could be put at the region's disposal by means of an energy policy based on a sustainable approach that promotes the diversification of the energy matrix using local resources and encourages energy equity.

- Each country must develop its own low-carbon development policies, but cooperation needs to take place between countries to share knowledge and to ensure efficient use of resources, such as technical personnel and financial instruments, in order to produce significant impacts.

- Based on the experience of large-scale hydropower plants and biofuel projects, Latin American and Caribbean countries should improve their project assessment processes and associated instruments.

- Renewable energy projects should be implemented in a sustainable way, considering the environmental (local and global) and social and economic impacts in local communities. Otherwise, they will cause harm in the same way as traditional non-renewable energy projects. Special care should be taken with hydro and biofuels projects.

- On average, 10% of the region's population does not have access to electricity, so energy equity should be a priority for all of the Latin American and Caribbean countries.

- For those with energy access, high levels of per capita energy consumption are seen in the region, mainly due to the inefficient use of energy. Countries must invest in reducing energy consumption through energy efficiency and energy saving programmes, even before investing in the increase of energy supply.

- Social conflicts have been a common outcome of the implemention of large-scale projects. Energy companies and financial institutions must report their experiences, whether positive or negative, in order to share lessons learned and prevent potential future conflicts.

- Carbon markets have not been able to produce significant GHG emissions reductions. Nevertheless, the lessons learned from their implementation need to be incorporated into the design of new mechanisms, such as NAMAs.

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In Latin America and the Caribbean, Christian Aid works with a broad range of local partner organisations to promote and defend the economic, social, cultural and environmental rights of the poorest communities discriminated against as the consequence of inequality in urban and rural areas.

Practical Action works globally alongside communities to find practical solutions to the poverty they face. We see technology as a vital contributor to people's livelihoods. We actively seek to work with communities and adopt a collaborative approach, sharing knowledge and experience. We increase our impact by scaling up success and pushing for policy change that directly benefits poor communities

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