

World Energy Scenarios | 2017



LATIN AMERICA & THE CARIBBEAN ENERGY SCENARIOS SUMMARY REPORT

IN PARTNERSHIP WITH CAF – DEVELOPMENT BANK
OF LATIN AMERICA, ELETROBRAS AND UPME

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ABOUT THE REPORT

The *Latin America & the Caribbean Energy Scenarios* report is a first exploration of regional deep-dive scenarios and provides the basis and framework for the Latin America and the Caribbean (LAC) region.

The framework which consists of Modern Jazz, Unfinished Symphony and Hard Rock which have been developed for the *World Energy Scenarios 2016: The Grand Transition* – is used as a lens to test and explore how the key driving forces manifest and to investigate possible development trajectories for the LAC region, resulting into three scenarios: Samba, Tango and Rock.

The report is the product of a three year process, which was developed by a network of the World Energy Council's LAC National Member Committees and complemented by Project Partners – CAF, Eletrobras and UPME. Feedback was also gathered at the Council's World Energy Leaders' Summit and workshops / conference calls around the region ensuring the inclusion of key insights from industry, governments, experts and civil societies.

The central tool used for quantification is the Paul Scherrer Institute (PSI)'s global multi-regional energy system model. The iteration between development of the narratives and the quantification provides the foundation for a set of scenarios.

The full report can be found at
www.worldenergy.org/publications

A LATIN AMERICAN AND THE CARIBBEAN PERSPECTIVE: WORKING TOGETHER TO UNLOCK ECONOMIC POTENTIAL

There is a critical need for large-scale infrastructure development and regional integration to unlock the greater economic potential and mitigate risks for Latin America and the Caribbean region.

The Latin America and the Caribbean (LAC) economies are facing a difficult time following a period of prosperity, driven by a decade-long commodity price boom. At the start of 2017, commodity price uncertainty remained as the most important issue impacting the decision making of energy leaders around the world. This uncertainty is heightened by the concern of many in the region that lower economic growth will become a continuing reality. Leaders need to manage this situation.

The World Energy Council's 2016 report "*World Energy Scenarios: The Grand Transition*" described the possibility that in the longer-term the region will continue to be challenged by a number of strong trends. This is referred to as the *Grand Transition*: lower employment growth driven by slower population growth, radical progression of new technologies, greater environmental challenges and a shift in economic and geopolitical power towards Asia. These trends could result in a number of potential futures depending on how well the world manages economic growth, innovation and productivity, the climate challenge, international governance and through its choice of public policies and market mechanisms.




When considering the structure of the energy system to 2060, there are clear economic benefits from enhanced collaboration and regional interconnection between countries and regions within Latin America and the Caribbean. The potential set out in these new scenarios highlight the opportunity for nations working together to increase prosperity and deliver a sustainable future.

INTRODUCTION TO THE LATIN AMERICA AND THE CARIBBEAN ENERGY SCENARIOS

The *Latin America & the Caribbean Energy Scenarios* examine the future of LAC energy to 2030, and beyond to 2060. These scenarios offer strategists a common language for thinking and considering current events, and a shared framework for exploring critical uncertainties, enabling more successful strategic decisions.

Three scenarios – *Samba*, *Tango* and *Rock* – have been developed to examine potential future pathways for the LAC region. The three scenarios build on the three scenarios described in the *World Energy Council's 2016 Scenarios– Modern Jazz (Samba), Unfinished Symphony (Tango) and Hard Rock (Rock)* – but provide a more relevant view for the LAC region which recognises the diversity and differing political and economic drivers.

THREE POSSIBLE FUTURES FOR ENERGY IN LATIN AMERICA AND THE CARIBBEAN TO 2060

	CRITICAL UNCERTAINTIES			
	PRODUCTIVITY AND STRUCTURAL REFORM	CLIMATE CHALLENGE AND RESILIENCE	REGIONAL ENERGY INTEGRATION	DOMINANT TOOLS FOR ACTION
Samba 	High economic growth based on successful structural reform and strong innovation	Medium priority; decarbonisation shaped by carbon markets and adaptation options aligned with markets	Key regional projects driven by market economics	Market
Tango 	Medium economic growth with focus on sustainability	High priority; strong investment on mitigation and regional adaptation	Broad-based regional governance, covering security, decarbonisation and resilient adaptation	State
Rock 	Low economic growth and more limited infrastructure investment	Low priority; little focus on mitigation and weak adaptation	Fractured regional system with country investment inwardly focused	Patchwork

Source: World Energy Council

Note: Page 10 contains a fuller description of the scenarios.

CALL TO ACTION FOR LATIN AMERICAN AND THE CARIBBEAN ENERGY LEADERS

The President of Brazil’s largest university claims that the keywords necessary to understand Latin America are “heterogeneity and complexity.” Not surprisingly, the *Latin American & the Caribbean Energy Scenarios* are also characterised by the great diversity that exists between countries in the region, resulting in many different types of solutions emerging over time. Yet it is possible to see some patterns, or themes, emerging from the scenarios, which identify key areas for action. These are government policy directions, focus of energy opportunities, climate-related policies and macro-risk management.

1 GOVERNMENT POLICY DIRECTIONS NEED FOR LARGE-SCALE INVESTMENTS IN ENERGY INFRASTRUCTURE

Over the next decades, LAC governments will need to make massive investments in infrastructure – roads, ports, energy and communications – in order to promote economic growth in their growing urban areas as well as for their countries as a whole. Decisions taken by governments on issues like structural reforms and private sector participation will play a crucial role in determining the sources of funding and the total amounts available for making those investments. Failure to raise the necessary funds will lead to a continuation of social inequity, lack of easy access to energy, and a generally lower level of resilience of existing energy systems. This is a particular risk in the *Rock* scenario.

GREAT SCOPE FOR REGIONAL INTEGRATION

The scenarios clearly demonstrate that the LAC region has great potential to benefit economically from regional integration and cooperation, but is slow to reap the long-term benefits in the face of short-term political and economic priorities. Brazil is especially well positioned to benefit from increased regional integration of power systems.

IMPORTANCE OF GOVERNMENT LEADERSHIP

The role of governments and policymakers to resolve critical uncertainties is crucial in the LAC region, more so than in some other areas of the world. Full understanding and a strong focus on balancing the objectives of the Energy Trilemma will be needed to ensure effective policy making on a local and regional level. LAC cities will most likely be testbed for new energy technologies and a source of new regulatory approaches to energy policy.

2 FOCUS OF ENERGY OPPORTUNITIES

CRITICAL ROLE OF CITIES

The future of LAC cities will loom large among the development challenges facing the region in the coming decades. In a globalised world, the sources of efficiency and dynamic growth for LAC countries will increasingly be found in urban centres. Smart energy solutions from urban areas and mega-cities in LAC will have the potential to provide the region with growth in economic productivity and the necessary technological solutions to achieve sustainable energy systems.

NEW OPPORTUNITIES FOR WIND, SOLAR AND GEOTHERMAL AND CONTINUED GROWTH IN BIOFUELS AND NATURAL GAS

The LAC region's impressive clean energy share in the total energy mix is boosted by an abundance of hydro power. However, big hydro dams are increasingly controversial: in recent years, Brazil and Chile have blocked hydro-electric projects in environmentally sensitive areas. Alternative energy sources, such as wind, solar and geothermal, still only account for around 2% of Latin America's electricity generation, compared with a world average of 4%. Nonetheless, the LAC scenarios show that this share will grow quickly, also offering investment opportunities for the private sector. Additionally, biofuels dominate transport energy shares in LAC and natural gas plays a key role across the scenarios.

3 CLIMATE-RELATED POLICIES

CLIMATE CHANGE A KEY REGIONAL CONCERN

According to the Council's *World Energy Issues Monitor 2017*, Latin Americans worry more than anybody else about climate change, since the region is prone to natural disasters and extreme weather events. Hard and soft resilience of energy systems will therefore have to be a main focus of the energy industry and policymakers. Increasing regional integration, smart energy solutions for urban areas (smart grids), and increasing the share of decentralised power generation can help to bolster resilience.

THE REGION AS AN IMPORTANT PROPONENT OF INTERNATIONAL CLIMATE ACTION ACCORDS

Outside Chile and Colombia, coal deposits are scarce in Latin America. That is one reason why industrialisation came late to the region. In the 21st century, it may turn out to be an advantage in helping Latin America move swiftly to a post-carbon economy. CO₂ emissions of the LAC region will continue to be the lowest in the developing world, due to a high share of hydro power in the electricity mix. Many Latin American countries will continue to be important proponents of international climate action accords, underscoring the importance that people in the region place on combating global warming and adapting to its present and future impacts.

4 MACRO-RISK MANAGEMENT

BEWARE OF “STRANDED RESOURCES” IN THE REGION

Oil demand is expected to peak in LAC, as well as globally, by 2040 – this has the potential to force regional oil producers to address “stranded resources.” This development is of particular importance for the oil exporting countries in LAC, like Venezuela and Brazil. Compared to producers in the Middle East, production costs of oil are significantly higher, and the closest export market, the US, is set to increase domestic production out of unconventional resources and has plans to even become a net exporter of oil and gas. These developments will require a significant strategic shift of LAC oil and gas producers, putting more emphasis on expanding positions along the hydrocarbon value chain into refining and integrated petrochemicals, also increasing inter-regional trade of petroleum and chemical products.

AVOID THE HEAVY COSTS OF A ROCK SCENARIO

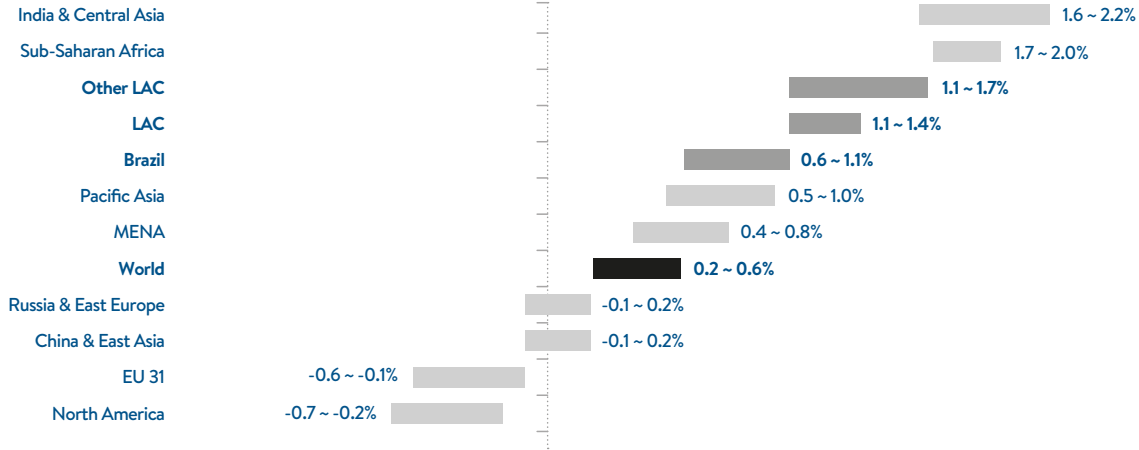
In the face of economic adversity and low commodity prices, some countries tend to resort to more nationalistic approaches, putting energy security and self-sufficiency at the heart of their policies, as showcased in the *Rock* scenario. The *Rock* scenario forms the least favourable outcome for the LAC region, mainly due to lower economic growth rates, inherently lower levels of resilience and increased vulnerability to climate change effects. The continued large levels of social inequity and increased propensity of extreme weather events make a *Rock* scenario the worst possible outcome for the region. Leaders in the LAC region should therefore try and focus on policies and roadmaps that aim at futures more in line with the *Tango* and/or *Samba* scenarios.

KEY HIGHLIGHTS FROM THE LATIN AMERICA AND THE CARIBBEAN ENERGY SCENARIOS

1. **LAC energy demand growth stays at a relatively high level by 2060, compared to most other regions of the world.** Primary energy demand in LAC grew at a rate of 3.2% p.a. from 2000 to 2014. It is expected to grow at a slower rate of 1.6–1.9% from 2014 to 2030 and even more slowly at a rate of 0.8–1.1% p.a. from 2030 to 2060. Reduced energy intensity (in the *Samba* and *Tango* scenarios) and lower population growth are responsible for this slowdown.

LAC ENERGY DEMAND GROWTH REMAINS RELATIVELY STABLE AND HIGH

Primary Energy Demand Growth by Region (2014–2060 CAGR)

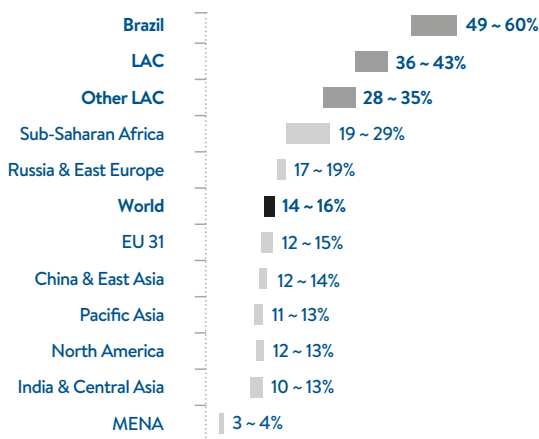


Source: World Energy Council and Paul Scherrer Institute

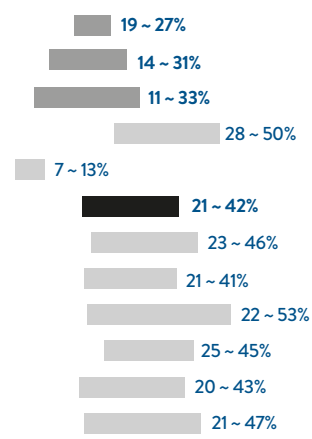
- Demand for electricity in LAC rises 2.3–2.7 times to 2060** in line with global developments that see an increasing electrification of society. **Through to 2030, hydro dominates new power generation growth**, with 40–65% of the generation increment. **Beyond 2030, the new generation increment is dominated by natural gas and wind/solar/others.** Wind and solar shares increase significantly, starting from a very low base, and stay well below global averages, as the share of hydro power in the LAC electricity mix is far higher than the world average. Corresponding investment needs for power generation between 2010 and 2060 range from US\$ 2.0–2.5 trillion (based on the 2010 market exchange rate).

ELECTRICITY GENERATION GROWTH IN LAC DOMINATED BY HYDRO TO 2030, AND WIND/SOLAR/OTHERS AND NATURAL GAS BETWEEN 2030 TO 2060

Share of Electricity Generation in 2060 (a) Hydro



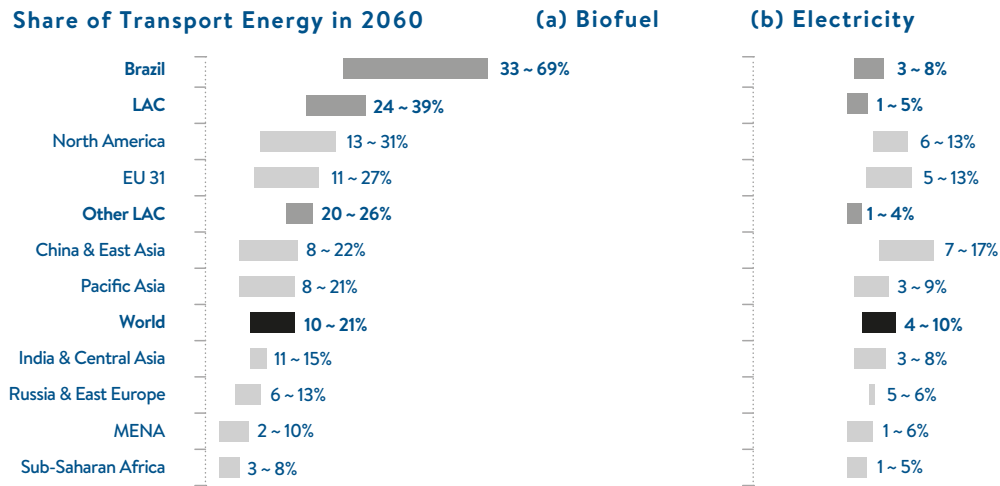
(b) Wind, Solar etc.



Source: World Energy Council and Paul Scherrer Institute

3. In transport, the use of biofuels grows 5–6 times from 2014 to 2060, leading to a substantial diversification of the transport fuel mix. The electricity share of transport energy is also expected to grow dramatically. However, it stays well below the world share as biofuels play a more significant role in transport energy within the LAC region compared to other regions of the world.

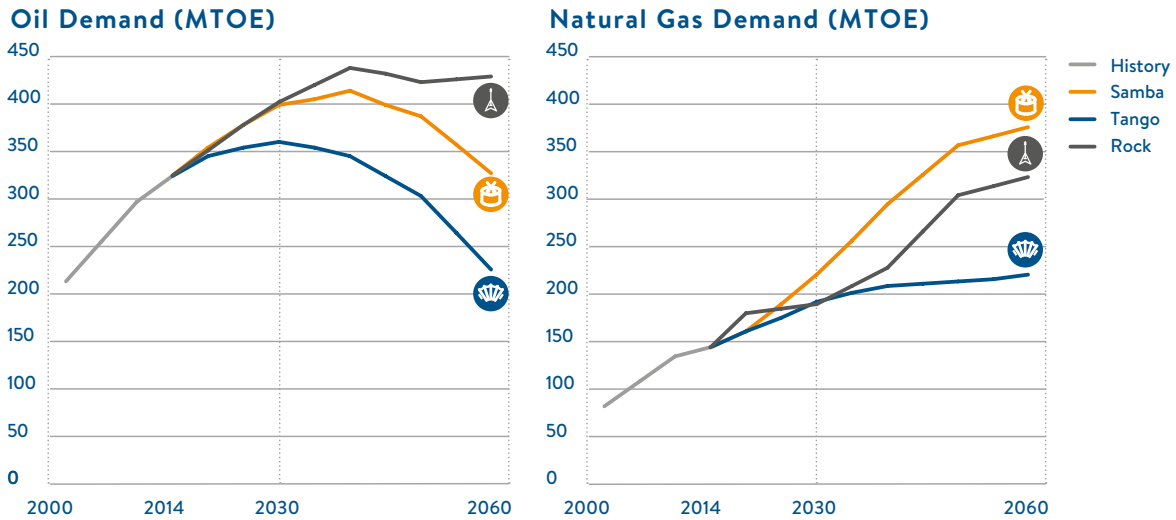
BIOFUELS DOMINATE TRANSPORT ENERGY SHARES IN LAC BY 2060



Source: World Energy Council and Paul Scherrer Institute

4. Demand for coal peaks before 2020. Demand for oil peaks or reaches a plateau after 2040. In *Tango*, it peaks between 2030 and 2040 at 361 MTOE (7.2 mb/d). In *Samba*, it peaks in 2040 at 412 MTOE (8.3 mb/d). In *Rock*, demand for oil reaches a plateau after 2040, settling at 427 MTOE (8.6 mb/d) in 2060. Natural gas plays a key role in LAC, and its growth varies broadly across scenarios. Argentina, in particular, has a world-class shale gas resource and the scale of its development depends on the rate of economic growth and the chosen approach to resolving issues around the climate challenge.

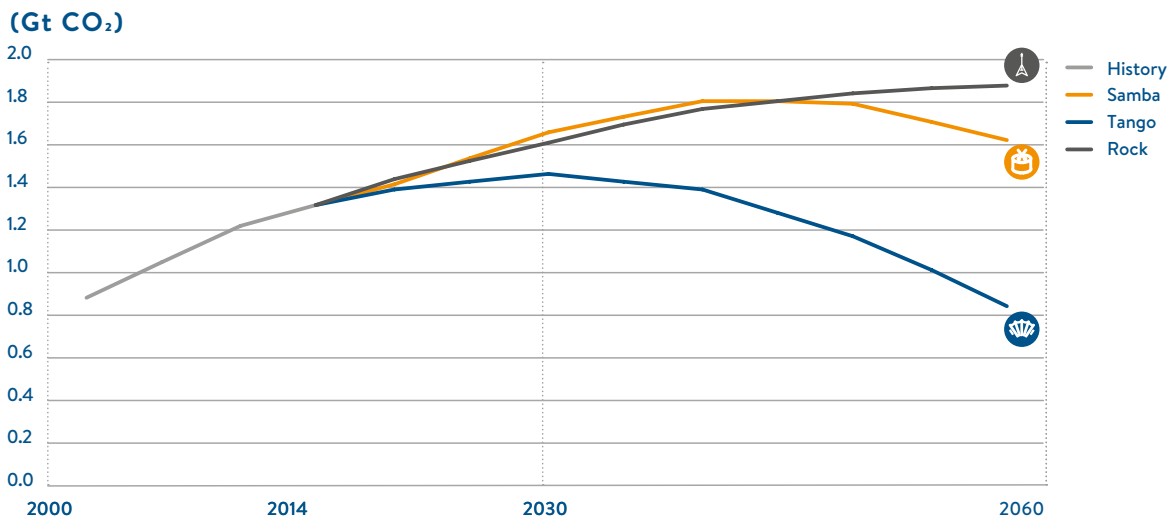
LAC OIL AND COAL DEMANDS PEAK, WHILST NATURAL GAS PLAYS A KEY ROLE ACROSS SCENARIOS TO 2060



Source: World Energy Council and Paul Scherrer Institute

5. Cumulative carbon emissions in LAC from 2014 to 2060 will account for only 4.7–5.1% of the world’s cumulative emissions despite the production and use of fossil fuels. **The LAC energy sector is the least carbon intensive within the developing world, due to a high share of hydro power in the overall electricity mix (54%).** Accelerated carbon intensity reductions will drive emissions to peak around 2030 at 1.5 Gt CO₂ in *Tango* and between 2040 and 2050 at 1.8 Gt CO₂ in *Samba*. In *Rock*, carbon emissions will continue to grow and reach 1.9 Gt CO₂ in 2060.

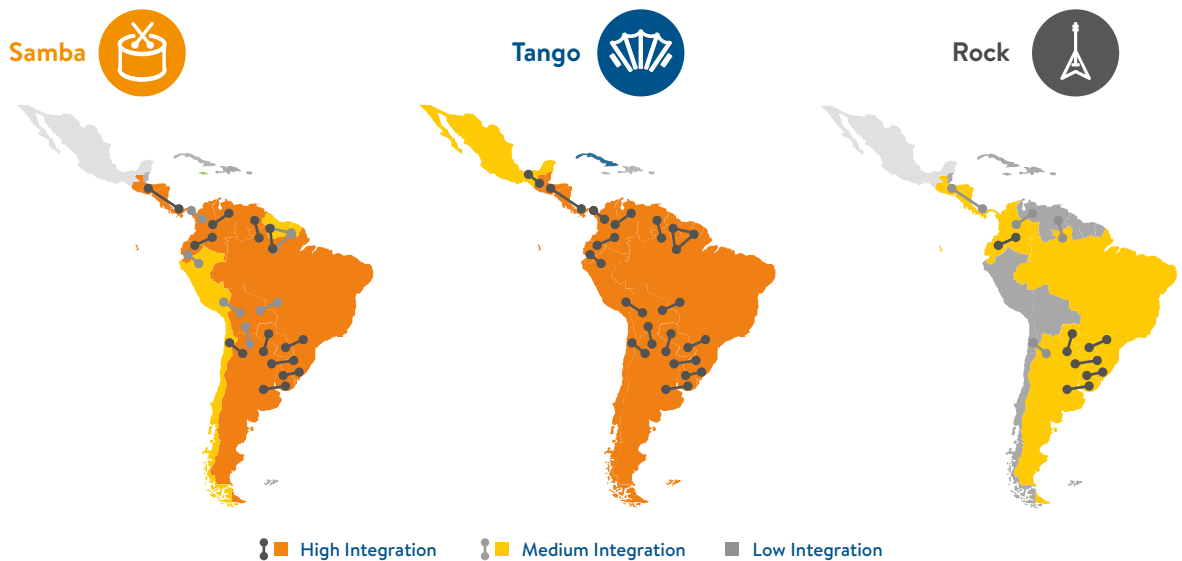
LAC CO₂ EMISSIONS PEAK IN TANGO AND SAMBA BY 2040



Source: World Energy Council and Paul Scherrer Institute

6. **Regional integration is already a focus of attention in the LAC energy sector**, as evidenced through projects like Arco Norte, SINEA and SIEPAC II. Regional cooperation requires the presence of strong trust between countries, working regional governance structures, covering a variety of policy areas, such as energy security, decarbonisation and infrastructure resilience. Regional integration is strongest in *Tango* and weakest in *Rock*.

THE POTENTIAL OF LAC REGIONAL INTEGRATION DEVELOPMENT ACROSS SCENARIOS



- Progresses on Arco Norte and SIEPAC II interconnection projects
- More progress on gas integration projects
- Mexico develops its relationship with the US







- All LAC countries are integrated as a result of full progress on the projects like Arco Norte, SINEA and SIEPAC II
- Mexico wants electricity interconnection to the Caribbean

- Risk increases in the existing regional interconnection
- Less progress on new regional interconnection projects
- Mexico explores new export and collaboration opportunities with LAC

Source: World Energy Council

7. LAC countries are particularly vulnerable to the damaging side effects of climate change, particularly in *Rock*. **In all scenarios, LAC countries must work on improving its energy system's resilience to extreme weather events, while at the same time improving energy equity and security.** However, substantially more funding is available for these investments in *Samba* and *Tango* than in *Rock*. Diversifying the energy mix with decentralised and/ or low-carbon generation sources, such as wind and solar, will be critical in this context. Regional integration of energy systems is a further key element that can ensure Energy Trilemma benefits and enhance energy resilience.

LAC ENERGY TRILEMMA ACROSS SCENARIOS HIGHLIGHTS FOR REGIONAL RESILIENCE IMPROVEMENTS

	Samba 	Tango 	Rock 
 Energy Security	<ul style="list-style-type: none"> Higher energy production and greater trading 	<ul style="list-style-type: none"> Wider diversity of energy resources Government-led infrastructure investment 	<ul style="list-style-type: none"> More domestic production and lower trade Increasing vulnerability to extreme weather events
 Energy Equity	<ul style="list-style-type: none"> Energy access for all 	<ul style="list-style-type: none"> Significant progress 	<ul style="list-style-type: none"> Limited progress
 Environmental Sustainability	<ul style="list-style-type: none"> Modest progress on adaptation and mitigation 	<ul style="list-style-type: none"> Progress on adaptation and mitigation 	<ul style="list-style-type: none"> Limited progress

Source: World Energy Council

SCENARIO DESCRIPTIONS



In **Samba** the LAC region is a world of high productivity and high levels of innovation, with strong market forces. Regional annual economic growth rates of 3.3% to 2060 enable high levels of infrastructure and human capital investment. Adoption of new technologies throughout the energy chain accelerates, and increases pressure on traditional energy providers. These range from smart energy technologies leading to rapid energy efficiency improvements, to digital connectivity and energy storage options in the mid-stream, and increased energy supply availabilities – this underpins large shifts in primary energy mix towards renewables, biofuels and natural gas.

CHILE'S RENEWABLE ENERGY – CASE STUDY FOR SAMBA

The Government of Chile, as a result of the National Energy Strategy 2012-2020, made a commitment to diversify the country's energy mix promoting non-conventional renewable energy (NCRE) and pledged a clean energy mandate of 20% of electricity generation by 2025.

The procedures and criteria were established in order to create the conditions that allow the private sector to invest in these long-term projects. It allowed more than 100 international companies engaged in these projects, including developers, large generators, associated services and builders. According to the Climatescope 2016, an assessment of clean energy market conditions and opportunities in 58 emerging nations, Chile ranks second.

In March 2014, the total installed capacity of NCRE in Chile amounted to 1,352 MW (bioenergy 33%, wind 31%, mini-hydro 25% and Solar 11%), which is equivalent to 7.2% of the total installed electricity capacity. The Minister of Energy stated that “It has successfully completed the largest power tender held in the country, which has called for a level of competition never seen before, that will mark future trends and produce a paradigm shift in the Chilean electricity market, translating all in lower prices to the benefit of our families and small and medium enterprises in Chile ... Today we have taken a definitive boost to the electricity market with more players, better prices, more investment, more competition and concern for better service and a more secure, reliable and efficient electricity system.”

Source: Rodrigo Andrade, Director, Dialogo Energetico



Tango describes a LAC region shaped by governments to achieve sustainable growth of 2.7% per year to 2060. This is underpinned by an effective system of broad-ranging regional and international governance, including strong collective climate change policies and the regional integration of energy systems. There is the emergence of a critical mass of new solutions to address energy supply, demand and climate change stresses. Initiatives first take root locally as individual cities or nations take the lead. These initiatives link up progressively as LAC governments harmonise a diversity of measures and take advantage of the opportunities, resulting in increasing regional integration. As a result, effective demand-side efficiency measures diffuse quickly, and CO₂ management practices spread. Energy efficiency improvements and the emergence of low carbon transport solutions for sprawling mega-cities are accelerated. Strong infrastructure development and high regional cooperation support the private sector in the development of integrated grid solutions. Brazil more specifically is able to export electricity to its neighbouring countries from 2030 and is set to potentially benefit substantially from regional integration.

URUGUAY'S WIND POWER – CASE STUDY FOR TANGO

In Uruguay, 1,324 MW wind power is installed today and 1,455 MW is expected by 2017 – enough to cover more than 35% of electricity demand. Uruguay had no wind power until 2005, so the question is what happened in the meantime?

Uruguay has a long tradition in hydro power since the 1930s, combined with fossil fuel thermal plants. It seemed to run smoothly, but the technical limit of hydro power was reached during the 1990s and a new framework was needed in order to meet increased electricity demand.

Discussions on renewables as an alternative started in 2005 and led to the first National Energy Policy in 2008. Wind potential proved to be sufficient to install thousands of MW, showing it to be the most promising energy source together with biomass.

There is no single answer for what were the key drivers of the rapid wind power development in Uruguay, but certainly planning was one of them. Energy policy features a cornerstone for wind in Uruguay, introducing goals and clear actions to achieve them.

Source: Uruguay National Member Committee, World Energy Council



Rock is shaped by a world of weak economic growth and waning support for global institutions, within which countries encourage more self-sufficient policies. In the LAC region there is a more protectionist response, with regional growth of 1.4% per year to 2060. Countries develop a broad range of internally focussed policies with limited regional cooperation. Fossil fuels remain an important source of energy and governments are forced to shift their focus to infrastructure resilience and adaptation as the number of extreme climate events increase. National governments, the principal actors in *Rock*, emphasise supply levers as energy demand grows broadly in line with economic growth. Across the region there is a relatively uncoordinated range of national mandates and incentives for developing indigenous energy supplies. Given the wide variety of fuel resources within countries there is substantially diversity in country energy patterns. This leads to a patchwork of local standards, resource flows and technologies. At the regional level, *Rock* is a world of bilateral government deals between energy producers and energy consumers, with national governments competing with each other for favourable terms of supply or for access by their energy companies. National energy companies play key intermediary roles.

ARGENTINA'S ENERGY MARKET REFORM – CASE STUDY FOR AVOIDING THE COSTS OF ROCK

As a result of a profound regulatory reform, between 1990 and 1992, Argentina went from an energy system controlled by state-owned companies to a system of private companies disintegrated vertically and horizontally. The system allowed the creation of transparent gas and electricity markets with free prices and multiple suppliers.

Everything, however, changed drastically from the economic and political crisis of 2002. The new government imposed export duties on oil and regulated the domestic price. Gas exports were banned and the domestic price was set by the government at very low levels which discouraged investments. Regarding electricity, prices were fixed at a level that only recognised the operative costs of the generators. Distribution tariffs were also frozen, placing the integrity of the networks at serious risk.

The new government launched in December 2015 determined to rebuild markets and return to regulatory frameworks prior to 2002. But the task is not easy. The law of economic emergency and the tangle of de facto subsidies and regulations that followed since 2002 caused great uncertainty as to what rules to apply. The process of ending subsidies and returning to the gas and electricity markets will continue progressively to the end of 2019.

Source: Argentina National Member Committee, World Energy Council

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