

## Green Future of Latin America: Challenges and Opportunities

Boris Dziura

University of Economics in Bratislava, Bratislava, SLOVAKIA

### ABSTRACT

Current paper analyses opportunities and challenges of energy and low carbon development of Latin America. The results of the research have shown that to be competitive at the global market Latin America should find efficient solutions related to the providing equal access to energy services; achieving safety of supply of energy; achieving environmental sustainability. The analysis has been done on data of IndexMundi for the period, covering 1990-2012 (Renewable energy consumption by Latin America, the EU and the US, % of total final energy consumption) and 1960-2011 (CO<sub>2</sub> emissions in Latin America, the EU and the US). More fresh data are unavailable. The transition to green economy in Latin America is mainly hindered by poor effectiveness of regulatory policies in the sphere of renewables and lack concrete and effective policies to deploy the wide range of investments required to implement projects related to renewables. Other barriers include the lack of economic resources; the failure of governments to prioritise development of renewable in favor of extending the penetration of fossil fuels; biased and incorrect beliefs about the economics of renewables; the lack of research and development; the low level of private sector involvement; and low effectiveness of collaboration among the public and private sectors and society. For improving energy efficiency and decreasing of CO<sub>2</sub> emissions there have been proposed activities for expanding access to energy services in Latin America, measures of energy sector development, as well as obstacles and solutions to the development for energy policy in Latin America.

### KEYWORDS

Latin America, energy  
development, low-carbon  
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### Introduction

CAF Development Bank of Latin America is emphasizing that the region stands out as very energy-efficient and has the purest energy matrix around the world (CAF, 2016). Latin America is characterized by a 25% participation of renewables. This portion is mainly explained by the large participation of biofuels and hydroelectricity in certain countries of South America. It is worth noting Latin America has a huge potential of using renewables (solar energy, hydroelectricity, biomass, aeolic energy). Thus, it can help make the region's energy matrix purer in the years to come. In energy distribution of Latin America dominates oil and by-products (41%), natural gas accounts 29%, biomass (14%), hydro-energy (8%), natural coal and coke (4%), other renewables (3%), and nuclear energy (1%) (CAF, 2016).

**CORRESPONDENCE** Boris Dziura ✉ boris.dziura@euba.sk

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At a world level, renewable energies account around 13% of total consumption and 20% of the generation of electricity. According to International Energy Agency, these figures are nearly three times higher, as they account 66% of generation and 30% of the total energy consumption. For example, in Ecuador, Chile, Brazil, Peru, and Colombia low cost hydroelectric programs can now compete with alternatives of thermoelectricity (CAF, 2016).

The region has achieved incredible economic development in the last decade and closed to the level of the development of advanced economies. But at the same time, the growth in living standards of the middle class and urbanization in Latin America cause the expansion of the demand for energy. In particular, in Latin America the demand is growing for natural gas, electricity and production of oil by-products. By 2030 established capacity is expected to rise to 30% through renewable energy, summing 196 gigawatts. According to Renewable Energy World (2016), renewable energy sector of Costa Rica, Panama, Guatemala, and Honduras received 1.7 billion USD in 2014. In the same year Mexico renewable energy sector received 2 billion USD.

Though the potential of energy and low carbon development in Latin America is high, there are series of obstacles preventing further transition of the region to green economy. One of the main troubles of green economy development of Latin America is its high heterogeneity in terms of ecosystems, climate, cultural traditions and human population distribution. Over the past three decades Latin America has been under the impact of El Niño Occurrences (Trenberth & Stepaniak, 2001). Two emergency intensive episodes of the El Niño phenomenon (1982 – 83yy and 1997 – 98yy) and other challenging climate extremes (EPA, 2001; Haylock et al., 2006; Vincent et al., 2005) have happened and contributed greatly to the weakness of human systems and disasters of nature (landslides, floods, droughts, etc.). It is worth noting Niño phenomenon is not an isolated incident of hostile environments. Thus, above-mentioned peculiarities of climate underlie highly irregular population distribution in Latin America and as a consequently unequal energy use.

Another range of problems preventing transition of Latin America to green economy is related to poor effectiveness of regulatory policies in the sphere of renewable (Ushakov & Shieh, 2013).

Majority of countries of Latin America still lack concrete and effective policies to deploy the wide range of investments required to implement projects related to renewables. Among the identified barriers are governments' weak institutional and technical capacities.

Other barriers include the lack of economic resources; the failure of governments to prioritise development of renewable in favor of extending the penetration of fossil fuels; biased and incorrect beliefs about the economics of renewables; the lack of research and development; the low level of private sector involvement; and low effectiveness of collaboration among the public and private sectors and society. Overcoming these obstacles is an essential challenge in the region.

## Literature Review

Literature review has shown that authors concentrate on the options of future carbon development of Latin America, trends of energy and CO<sub>2</sub> emissions, problems preventing sustainable energy development in Latin America.

S. H. Martínez, A. Koberle, P. Rochedo et.al (2015) have analyzed trends of energy and emissions in Latin America up to 2050 based on a number of scenarios dependent on current trends and taking into account 2 °C global mitigation target. The results of the research have shown that CO<sub>2</sub> emission reductions are essential. The implementation of low carbon options in Latin America is possible in case of removing current economic, environmental, social and technical barriers. Furthermore, there is a need in a suitable policy framework to encourage the transformation of the region's energy system.

R. Janssen and D. D. Rutz (2011) have researched the opportunities of establishing alternative markets for agricultural commodities by creating biofuel programs in Latin America. The authors came to conclusion that achieving integrated sustainability in biofuel sector promotes opportunities for development of economy sector.

M. del P. Pablo-Romero and J. De Jesús (2016) have investigated relationship between energy consumption and economic growth by testing hypothesis estimated for the Energy-Environmental Kuznets Curve, which evaluates an inverted-U shape relationship between energy consumption and income. The results of the research have shown that hypothesis estimated for the Energy-Environmental Kuznets Curve is not supported for Latin America. At the same time, the results have demonstrated the growth of Gross Value Added. Also, there have been identified notable differences in the analyzed economies.

Opportunities for energy technology development in the context of climate change mitigation efforts in Latin America have been researched by van der Zwaan et.al. (2016). The authors have concluded that the extent to which number of options of climate change mitigation can be used, varies significantly between countries within the region, depending on economic performance, resource potentials, environmental impacts, and ease of use of technical expertise.

## Energy efficiency of Latin America

Latin America has realized a variety of successful energy programs. The programme has eliminated incandescent lamps by selling compact fluorescent lamps (CFLs) at subsidized prices. It should be noted that this program has replaced approximately 10 million incandescent lamps, reducing the country's electrical consumption by over 720 kWh, its CO<sub>2</sub> emissions by over 1.3 billion (1,300,000,000) tons, and peak electrical demand by 250 MW. In addition, the government has created a programme to collect tube-format fluorescent lamps so that they are handled and stored in a secure setting to prevent the release of mercury into the environment. The country is now researching the creation of a system to collect CFLs. One of the proposals is to reduce the sale price of CFLs to clients who turn in their used or broken CFLs (Käkönen, Kaisti, & Lukkanen, 2014).

Another successful example is Mexico Energy Reform bill. In 2008, the Mexican Congress passed an Energy Reform bill, which also included a new Law to Use Renewable Energies and to Fund Energy Transition (LAERFTE). The goal was to reduce Mexico's dependence on fossil fuels by promoting renewable energy

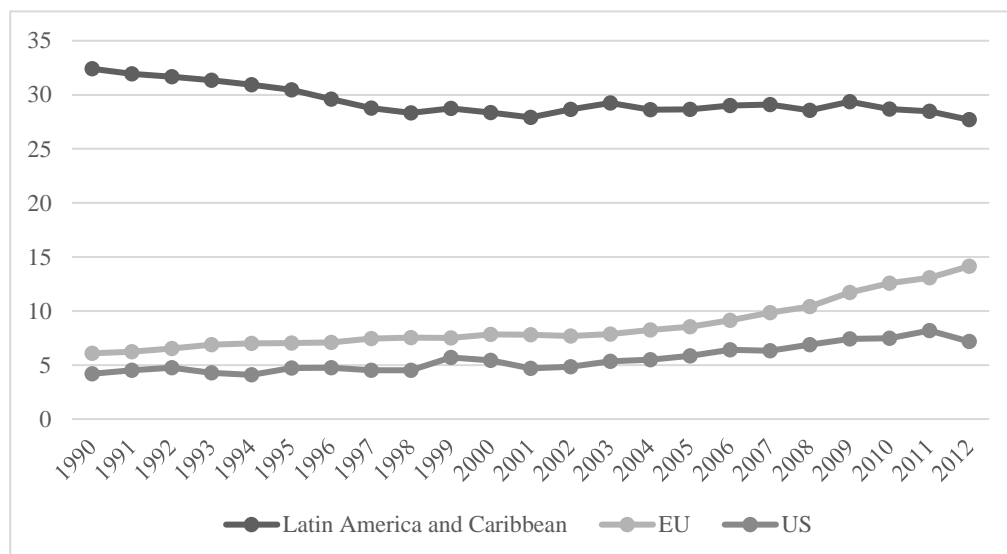
technologies. The new law recognises that renewable energy requires major support and financial incentives in order to reach its potential. It therefore created a Renewal Energies Fund to promote the use of renewable sources and encourage energy efficiency. The fund provides financing guarantees as well as direct support. Approximately 220 million dollars have been provided between 2009 and 2011 (de Diputados, 2008). It should be noted that consumption of renewable energy in Latin America is much higher than the EU and the USA, which are the world leaders of implementing successful environmental policies (Figure 1).

Along with positive trends in green economy development of Latin America there are several dangerous challenges. Taking into account harsh physical conditions in many areas of Latin America region a high number of inhabitants suffer from not having access to stable energy services. At present about 30 million inhabitants do not have access to potable water.

Furthermore, it has been revealed that to be competitive at the global market Latin America should find efficient solutions related to the challenges:

- Provide equal access to energy services
- Achieve safety of supply of energy
- Achieve environmental sustainability.

Seeking solutions for mentioned challenges is vital for energy and social development of Latin America as access of the people to energy has a tremendous impact on their health (Figure 2).



**Figure 1.** Renewable energy consumption by Latin America, the EU and the US (% of total final energy consumption). Source: author by IndexMundi (2016)

South America is rich in energy resources, but the region is not able to guarantee enough level of energy security for its consumers. In current conditions, energy is considered to be an effective solution of the problem of energy supply in the region. The possible economic benefits from regional energy integration are high. Security of supply is essential, and regional energy cooperation is indispensable for addressing the insecurity of supply of energy facing the region. It is worth noting that there are three main obstacles to integration: coordination of the output of the power plants of the region, the need to develop institutional mechanism to work out regional disputes, and the licensing of energy projects.

According to the report (Franca, 2013) energy production and consumption in Latin America should be coordinated with sustainable policies, and involve the following sectors: petrochemical, mining, automotive, agricultural, food industry, services. This would contribute to improving competitiveness and regional integration, and would encourage investments in the public and private sectors.

It should be noted that addressing above-mentioned challenges largely depends on active role of the state. Overall green economy approach should involve state leadership in management of the economy to regulate market changes. State authorities should play the main role in achieving nature conservation and social equity. The state must be the main coordinator in addressing the challenges related to transition to green economy. The holistic approach, oriented on the solution of the problem of expanding access to energy services, should involve key activities related to development of partnership between companies and deep analysis of client base.

It is worth noting that a system of effective measures to improve energy efficiency in Latin America has to be implemented, as well as measures to increase supply-side energy efficiency and demand-side energy efficiency in the region (Table 1).

**Table 1.** Energy sector development activities for Latin America

Measures to improve overall energy efficiency	Measures to increase supply-side energy efficiency	Measures to increase demand-side energy efficiency
Support public and private investments in energy efficiency	<b>Power generation:</b> fuel switching, plant rehabilitation, better resource use in existing generation facilities, new thermal power plants (combined cycle, supercritical boilers, IGCC	<b>Load management:</b> tariff penalties and incentives (power factor penalties, time-of-use-rates, and real-time pricing), direct load control, demand response programs demand charges,
Keep an economic and financial stability	(integrated gasification combined cycle) refurbishment; cooling, co-generation or combined heating, power CPH	<b>End-use energy efficiency:</b>
Coordinate the policies for the efficient use of energy in consumption sectors and energy chain stages	<b>Power transmission:</b> high-voltage lines, effective and low-loss transformers, use of capacitors, improved insulation of conductors,	<b>Industrial:</b> monitoring and verification of system-wide energy flows, combined heat (co-generation), energy efficiency financing, energy audits and performance measurements, services provided by ESCOs (energy service company), fuel switching, efficiency improvements of industrial motors and drive systems, equipment regulations and standards, waste heat recovery
Development of infrastructure that provides regional services		<b>Buildings:</b> temperature control on electric hot water cylinders, building retrofits, integrate building design, efficiency standards for lighting, use of passive lightening, building

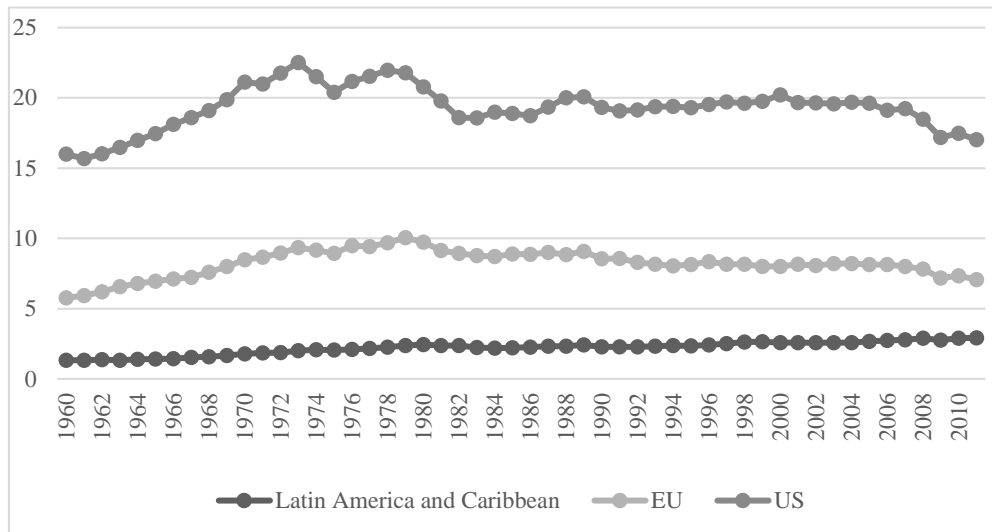
Coordinate sectors such as, industrial, health, transportation, housing, education	improved metering systems and instrumentation, Smart Grids	codes, efficient pumping, efficient space, use of passive space heating and solar water heaters, reduced standby losses in appliances and equipment, energy management systems, water heating and cooling, envelope measures (insulation and windows)
Develop effective policy frameworks		<i>Residential:</i> appliance standards, labeling, building codes, improved district heating (through boiler rehabilitation, pre-insulated piping, improved cooking stoves, compensators, pumps, heat exchangers, consumer education
Short, medium, and long-term monitoring		<i>Public:</i> “watergy” (energy and water efficiency in water supply and wastewater treatment), efficient water pumping, sewage removal systems, combined heat and power, efficient street lightening, promotion of best practices
Remove energy losses from a commercial and social outlook		<i>Agriculture:</i> efficient agricultural equipment, efficient irrigation pumping ad drip irrigation
Use a systematic manner in the area of public policies, involving state, enterprises, and different organizations of society		

Source: Author by Yopez-Garcia at al. (2011)

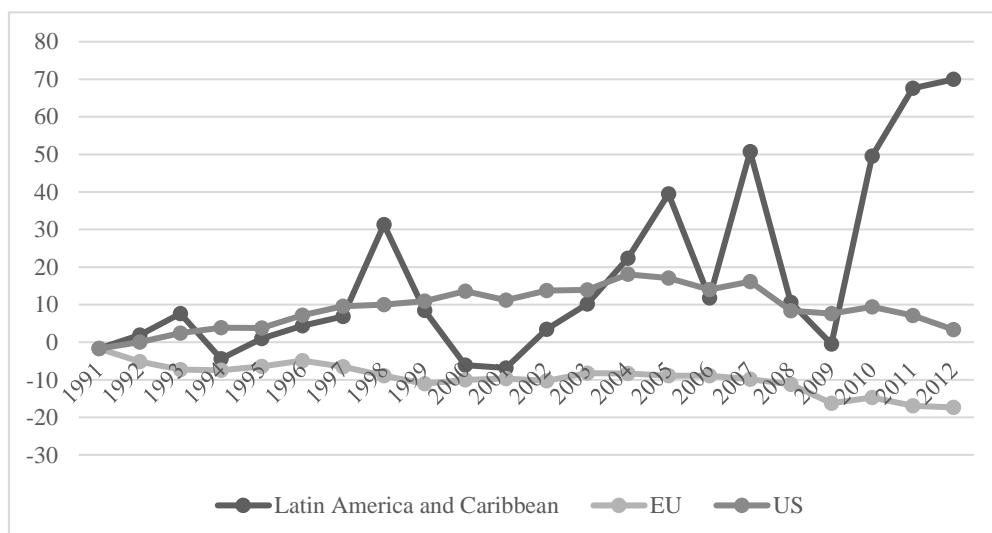
### Efficiency of low carbon development of Latin America

Active participation of the country in international environmental agreements is considered as one of the most effective tools to accomplish climate change mitigation goals. Furthermore, such active participation greatly contributes to solving national environmental problems. Thus, the analysis of activity of Latin America in the sphere of development international environmental collaboration with other countries is required. Latin America does not participate in international environmental agreements related to air pollution (marked in grey). Thus, given that reality, the analysis of the dynamics of CO<sub>2</sub> emissions should be done for making conclusion about the effectiveness of air pollution control (Figures 2-6).

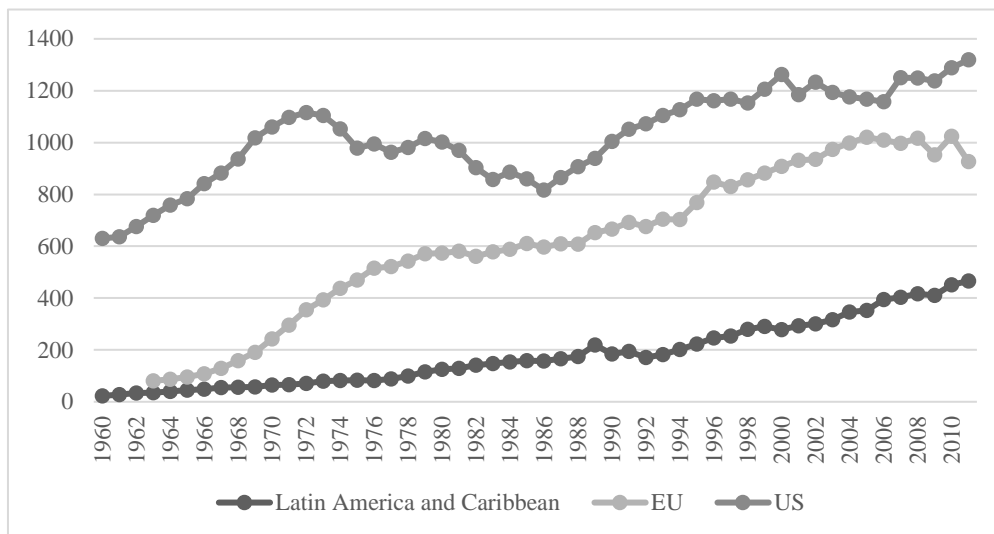
As we can see from the Figures 2-6 the volume of CO<sub>2</sub> emissions from fuel is increasing from year to year. Taking into account this tendency, energy matrix of Latin America needs to be diversified for implementing transition from fossil fuels to renewables. In current conditions of climate change diversification of energy matrix is effective way to address environmental issues. At the same time the transition to renewables in Latin America is complicated due to the three main reasons. Firstly, fossil fuel industry in Latin America is one of the most influential in the world. Furthermore, producers’ readiness to decrease their income for the environmental protection is low. Secondly, the consumption of fossil fuels is increasing globally. This tendency is linked to the expansion of income in China and the US. Thirdly, although fossil fuels reserves are declining, non-traditional sources of fossil fuels, which are considered to be “alternatives,” such as shale gas, exist.



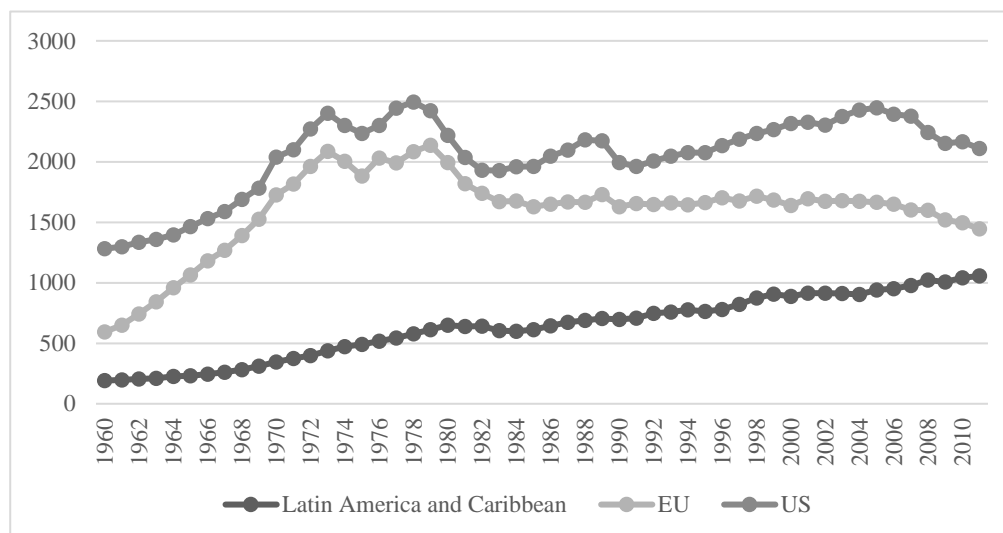
**Figure 2.** CO<sub>2</sub> emissions (metric tons per capita) in Latin America, the EU and the US  
Source: author by IndexMundi (2016)



**Figure 3.** Total greenhouse gas emissions (% change from 1990) in Latin America, the EU and the US  
Source: author by IndexMundi (2016)

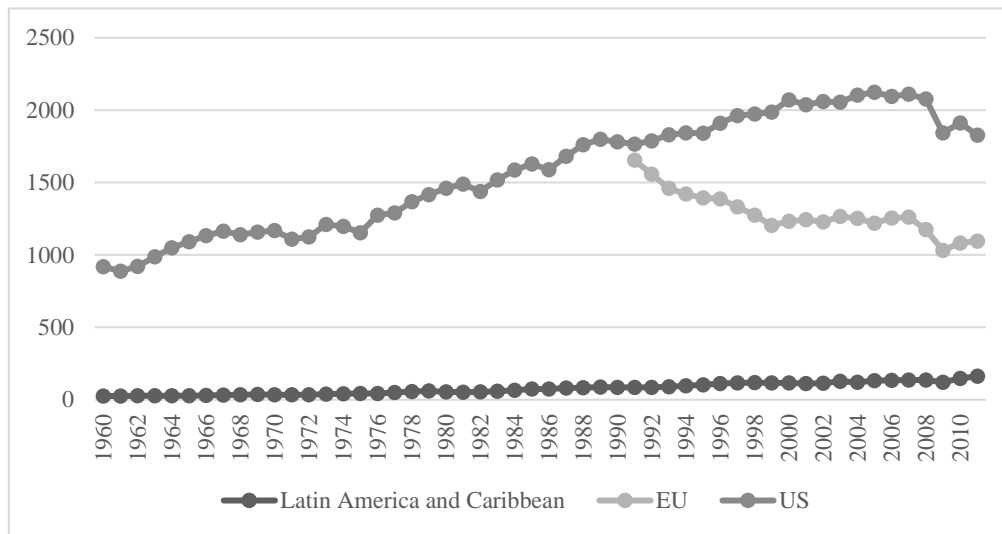


**Figure 4.** CO<sub>2</sub> emissions from gaseous fuel consumption (kt) in Latin America, the EU and the US  
Source: author by IndexMundi (2016)



**Figure 5.** CO<sub>2</sub> emissions from liquid fuel consumption (kt) in Latin America, the EU and the US  
Source: author by IndexMundi (2016)





**Figure 6.** CO<sub>2</sub> emissions from solid fuel consumption (kt) in Latin America, the EU and the US  
 Source: author by IndexMundi (2016)

Latin America is one of the most changeable regions, which is characterized by a mix of cultures and miscellaneous directions on economic and social development. There are about 590 million inhabitants in Latin America, with a GDP of \$5,655 billion USD and contribution to the world greenhouse gas emissions at a level of 9% (Samaniego, 2009). Brazil, Mexico and Venezuela are considered to be the major climate polluters. According Samaniego (2009), Mexico, Argentina, Brazil and Venezuela have contributed are the main polluters of Latin America.

Thus, promotion of sustainable development is first of all dependent on environmental activities in above mentioned countries.

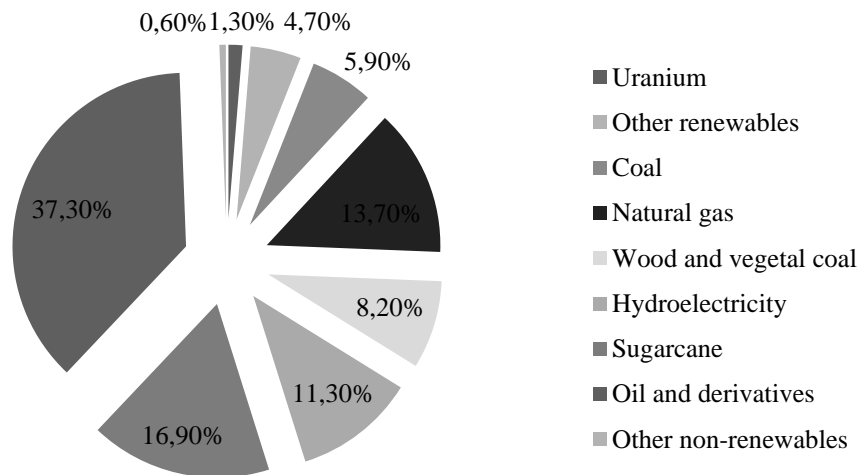
Brazil is one of the most developed economies in the region, particularly in technology. Brazil had plans to transition to low carbon development. But the country is engaged in huge oil production that does not promote transition to green economy.

Venezuela is another example of large-scale oil production. Venezuela has declared its obligation to implement climate change mitigation efforts by hosting the Pre-COP meeting (July, 2014). At the same time the country is part of the ALBA group (Alianza Bolivariana para los Pueblos de Nuestra América), which is not targeted at reducing carbon emissions.

Mexico, on the other hand, has played an active role in confronting climate change. The country has established a reduction level of emissions by 30% in 2020 and 50% in 2050 in 2013, as a part of energy reform. Although the reform calls upon sustainable development, a lot of policies encourage for fossil fuels use.

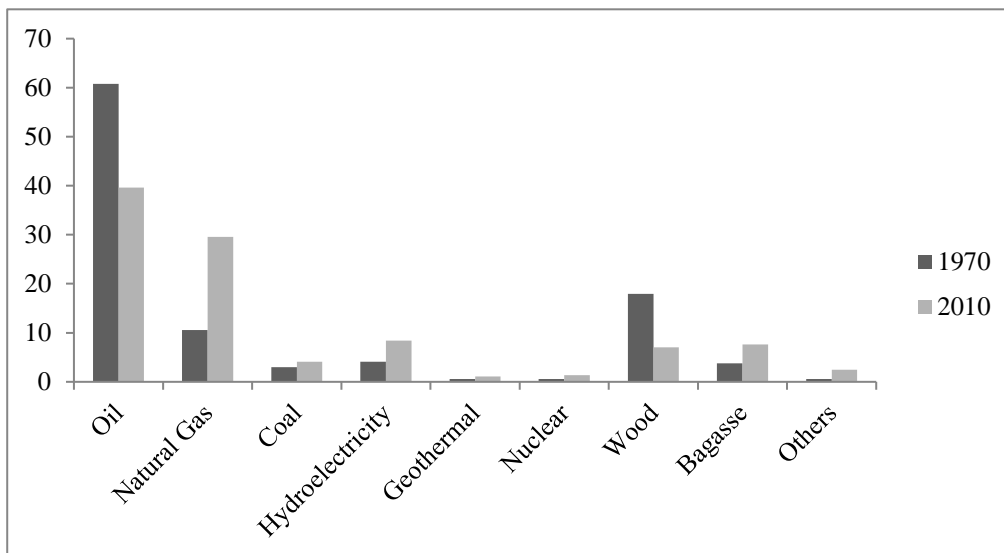
The above mentioned countries represent international dimension in the context of exploitation of energy resources and play a considerable role in the international energy policy, not only on international energy markets but also in the world emissions. But even though above mentioned countries are very powerful energy world actors and increase their incomes through harmful production, at the

same time they implement successful energy policy in renewable energy sector. Brazil s has achieved impressive results in implementing efforts for diversification its energy matrix (Figure 8).



**Figure 8.** Brazilian energy matrix in 2015  
Source: SugarCane (2016)

It should be noted that comparing to overall changes of energy matrix of Latin America from 1960 to 2010 Brazil reached great results managed to diversify its energy matrix (Figure 9).



**Figure 9.** Latin America energy matrix  
Source: Samaniego (2009)

The analysis of the main obstacles to transition to green economy in Latin America has shown that there are still a lot of barriers to green development in the region. Many of them are related to the obstacles to the development of energy policy but there are still other barriers.

## Conclusions

Climate change has underlined the crucial role of technological innovations with respect to energy sector and low carbon development of Latin America. Together, these sectors have the potential to decouple the region's continued economic growth from the increase in energy consumption and to reduce energy poverty and promote equity. Therefore, energy efficiency and renewable energy represent important avenues for progress towards truly sustainable low-carbon development in Latin America.

Latin America has vast renewable, such as solar, hydropower, wind, geothermal, marine and biomass, many of which can be used with cost-effective and sustainable technology.

The region has adequate resources to meet its energy needs. However, its challenge is to find the balance of sources that in the best way are able to meet the growing demand on energy at a cost-effective price.

The results of the research have shown that to be competitive at the global market Latin America should find efficient solutions related to providing equal access to energy services, achieving safety of supply of energy and environmental sustainability.

The transition to green economy in Latin America is mainly hindered by poor effectiveness of regulatory policies in the sphere of renewable and lack concrete and effective policies to deploy the wide range of investments required to implement projects related to renewable.

Other barriers include the lack of economic resources; the failure of governments to prioritize development of renewable in favor of extending the penetration of fossil fuels; biased and incorrect beliefs about the economics of renewable; the lack of research and development; the low level of private sector involvement; and low effectiveness of collaboration among the public and private sectors and society. For improving energy efficiency and decreasing of CO<sub>2</sub> emissions there have been proposed activities for expanding access to energy services in Latin America, measures of energy sector development, as well as obstacles and solutions to the development for energy policy in Latin America.

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