



Green Economy and Sustainable Development: The Latin American Scenario

Ione do Santos Velame

Research Student, Department of Economics, University of Brasília

Joanílio Rodolfo Teixeira

Emeritus Professor, Department of Economics, University of Brasília;
Fellow, World Academy of Art & Science

Abstract

This paper assesses the performance of Latin America (LA) toward its goal of a green and sustainable economy in 2006-2009 and 2010-2013. In a descriptive and quantitative framework, the analysis involves an improvement over Kaldor's (1971) fundamental ideas towards environmental and sustainable development. We deal with a Green Economy Index where three variables are considered: the first representing the economics aspect; the second, the social aspect; the last, the environmental performance. Data has been collected from the World Bank database. Results reveal a tenuous advance of the Green Economy in LA from 2006-2009 taking into account the growth rate of GDP per capita for the majority of the countries, as well as a small positive variation in the Gini Index due to distributive socioeconomic policies in some nations during the mentioned period. However, in 2010-2013, an adverse movement (deterioration) took place due to the difficulties faced by most people in the region, with low investment in renewable energies and energy efficiency.

There is a global consensus on the need to preserve the environment, improve the management of environmental resources and eliminate unreasonable or irresponsible exploitation of natural resources, as well as other anthropogenic activities that must be carried out to have a safe environment to preserve the quality of life. In the quest for sustainability, there was a meeting in 1992, in Rio de Janeiro (ECO-92) with the participation of 179 heads of States. Their task was the elaboration of a document called Agenda 21, in order to establish global policies towards sustainability (DA SILVA *et al.*, 2005). A number of other meetings, worldwide, have been concerned with targets and mechanisms to improve measures on the environment, including the meeting in Washington D.C. in September 2016. It is our view that despite some progress, no doubt, obstructions and failures to alleviate the scenario still persist in startling fashion, which is such a worthy fight. We acknowledge that it may well be hard to accomplish much else without a historical analysis by including a quantitative approach (indices) to understand the obstacles to attain promising results.

In terms of sustainability, till recently, each generation had the view that they should have a fair opportunity to achieve a better environmental and socioeconomic benefit than the previous generation. The word sustainable may mean different things, but, conventionally, it means to achieve different goals simultaneously, (democracy, justice, development and social inclusion) taking also into account environmental and economic concerns. For this

achievement, it is necessary that there are criteria and indicators, which could guide the proper use of natural resources in a sustainable way. The search for equity in the use of environmental resources, naturally, would increase brotherly solidarity; that is, a unity of interest or purpose among people launching programs, guides and line of thoughts and actions beneficial to society in a lucid and in the least partisan way. These are difficulties but desirable aims, explicitly relevant to socioeconomic, technological and political power today.

In order to sustain the idea of an economy that is more adjusted with the ecosystem, the idea of a green economy has recently emerged and has been defined by the United Nations Environment Program (UNEP, 2011, p. 2) as “that which results in the improvement of human well-being and social equality, while significantly reducing environmental risks and ecological food shortages.”

Bezerra *et al.* (2014, p. 1) argue that the “Green Economy (GE) is an emerging issue in the context of scientific and political discussions, with the main challenge to make economic activities in sustainable activities.” This is somewhat a recent concept, which considers the low carbon emissions, efficiency in resource use and democratic inclusion. Such a theme is increasingly common in multilateral organizations, roundtables of entrepreneurs and broad discussions in society. Three dimensions are essential in achieving a green economy; the first and the best known is the transition from large-scale use of fossil fuels into renewable energy. It is necessary to mitigate this dependency of the world economy in relation to fossil energy sources. The second is the use of the products and services offered by biodiversity, which so far have little evolved. And the third deals with the process by which the supply of goods and services is based on techniques able to reduce emissions of polluting gases, reuse waste and reduce the use of materials and energy in production processes (ABRAMOVAY, 2012).

The green economy for sustainable development provides a vision that integrates social inclusion, economic development and environmental sustainability. Jacobi (2003, p. 194) illustrates sustainable development as a multiple model for society in the following way: “Sustainable development does not refer specifically to a limited problem of ecological adaptation as a social process, but a strategy or a multiple model for society, which should take into account both the economic viability as well the ecological”. According to Jacobs and Nagan (2014), its realization also requires a unification in social sciences and the search for a transdisciplinary science of society. At this point, we may add a view that we consider fundamental. According to Bertolt Brecht (2008, p. 27), “The aim of science is not to open the door to infinite wisdom, but to set a limit to infinite error.”

In Latin America, the challenges to moving towards a green economy and sustainable development are diverse and go beyond the implementation of scientific capabilities integrating environmental conservation, economic development, cultural change, job training and long-term planning. The questions and solutions seem to become increasingly complex. Such comprehension of the complexity involved helps to shed light into alternative perceptions. However, such a view may become more promising if we can substitute greed and self-interest with an enlightened and purposeful behavior.

Latin America’s exports are primarily natural resources or pollution-intensive goods; this is a structural problem because consumers in developed countries are increasingly aware of the environmental footprints of the products they buy, and the position of LA countries can

be seen as delicate if this awareness affects trade restrictions against products harmful to the environment (YOUNG, 2011).

In this perspective, there are many questions concerning the measurement of environmental deterioration, as well as the reduction of environmental hazards. This article analyses the performance of Latin America in its quest towards a green and sustainable economy. To achieve this goal we have used the indicator *Green Economy Index*, an analytical instrument expanded from ideas of Kaldor (1971), which synthesizes a dynamic study in which different socioeconomic variables are analyzed simultaneously (TEIXEIRA, et al., 2014).

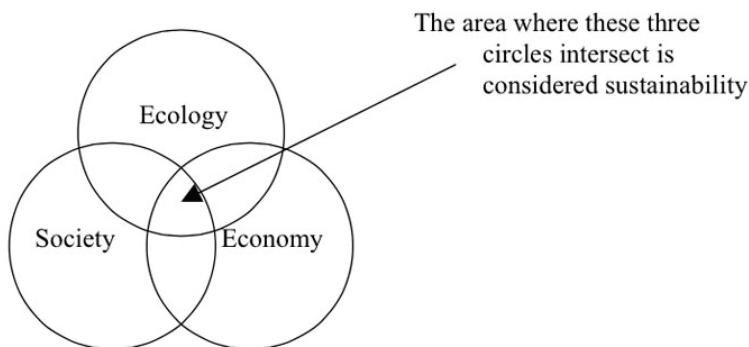
In order to align the essential elements to carry on this research, three variables are used, the Gini Index representing the social aspect, the growth of Gross Domestic Product (GDP) per capita as the economic representative and the energy consumption of fossil fuels taking into consideration the environmental dimension. The connected geometric figure forms a triangle, which is called the “Magic Triangle”. In order to establish significant analytical results we have taken into account the database provided by the World Bank taking the years 2006-2009 and 2010-2013 into consideration.

After this introduction, the present work has the methodological path divided into six sections: the first deals with the key issues and innovations associated with Green Economics; the second section presents methods and materials for the tabulation and the application of the Green Economy Index. The third one includes the variables involved in the analytical approach; the fourth presents the application of the model taking into account data of Latin America; the fifth contains the concluding remarks.

1. Green Economy: Key Issues and Innovations

The green economy is guided by a cleaner economy and is based on rational use of environmental resources, promotes development of technology that is less harmful to the environment, with a lower carbon footprint, greater social inclusion, using an approach known as the *triple bottom line*, which is considered the tripod of sustainable development. It covers the social, environmental and economic dimensions as pointed out in IDB (2012). Figure 1 demonstrates the triple bottom line and its dimensions.

Figure 1- Triple Bottom Line



Source: <http://www.csrambassadors.com>

The above scheme is called the green economy, meaning the pursuit of economic growth that produces wealth, generates new jobs (the so-called green jobs) and promotes sustainable development in its three pillars: economic viability, accountability and social justice. Clearing the environment as a limiter to economic growth and viewing it as a vector of sustainable development are fundamental components of such a view (OLIVEIRA & SAMPAIO, 2011).

The Center for Strategic Studies and Management in Science, Technology and Innovation (CGEE) is a social organization supervised by the Brazilian Ministry of Science, Technology and Innovation. It indicates that the green economy can create a new space to deploy another form of use of the territory and of natural and human heritage. It also has the potential to induce sustainable development. However, the major challenge in the planning of a green economy will be with respect to the adjustments to be carried out in the economic apparatus used (or currently in development) for environmental, economic, social and sector policies (CGEE, 2012).

The policies and measures of a green economy can offer great opportunities in order to improve the integration between environmental sustainability and economic development in all countries, regardless of the structure of their economy and their level of development. However, in the case of the developing countries, which have been facing major challenges to eradicate poverty and sustain growth, the transition to the green economy will require structural adjustments that may involve additional costs for their economies. In this sense, it is necessary to support the international community, in accordance with the specific realities of economic, social and environmental development as well as policies and priorities (UN, 2012).

“What is expected of the State in a green economy is that it fulfills a role in inducing cooperation practices with sustainable development and that discourages unwanted practices” (OLIVEIRA & SAMPAIO, 2011, p. 147). In the face of global competition that has given importance to in recent decades the process of generation and appropriation of wealth, it is necessary to insert a consciousness of collective responsibility, so that everyone can achieve levels of well-being and social life compatible with sustainability. In this sense, we should have new objectives and indicators for measuring progress and development.

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2. Methods and Methodologies

Studies of the non-governmental organization World Wide Fund for Nature (WWF) show that since 1980 the world population’s demand for natural resources has been becoming greater than the capacity of the planet to renew them. Latest data show that we are using about 25% more than the natural resources we have available. In other words, we need a new planet or other ways to sustain our current lifestyle. This is a form of irrational exploitation of natural resources, generating the depletion of natural capital faster than its capacity for renewal. This situation is untenable, because, soon we will face a deep social and environmental crisis and a dispute over resources (BORBA, 2007). Three of the most important recent books on global sustainability and leadership have been reviewed by Marien (2015) which is a major contribution on the theme.

The methodology used in this study is based on the ideas of Kaldor (1971), which deal with the circular theory of cumulative causation, where he suggests four concurrent essential variables (rate of growth of the economy, unemployment rate, inflation and balance of payments), which have interlocking relations and are pursued at the same time, to evaluate macroeconomic performance. Several economists improved over the original Kaldorian approach in a number of ways. Karl Schiller, Finance Minister of West Germany between 1971 and 1972, formulated the first diagrammatical representation termed as “magic square”, which demonstrated Kaldor’s ideas geometrically. However, this approach still presented some difficulties concerning the representation of the diagram. Medrano-B and Teixeira (2012) did the required normalization of the variables to measure the impacts of economic policies. In this vein, they reviewed the analytical construction and incorporated an algebraic analysis to quantify it geometrically.

Saavedra-Rivano & Teixeira (2016) noted that there was still a problem concerning the ordering of variables in the “Magic Square”. They showed that by alternating the order of the four variables, in general, different results were generated for the given index. They then created the “Magic Hypercube” and solved the problem of the ranking of variables. In geometry, a hypercube is an n -dimensional analogue of a square ($n=2$) and a cube ($n=3$). It is a closed, compact, convex figure whose 1-skeleton consists of groups of opposite parallel line segments aligned in each space dimension, perpendicular to each other and of the same length.

In the present study, we have chosen to use the indicator Green Economy Index proposed by Vilasboas & Teixeira (2016), an analytical tool with just three variables. This geometrical figure, which we call the Magic Triangle, has no problems with ordering. It provides a unique value for the indicator regardless of the geometrical arrangement (or sequence) of the variables in the triangle.

3. Variables

This research, which uses study variables of the Gini Index representing the social aspect, measures the degree of inequality that exists between the distribution of per capita income of individuals in the face of an equal distribution. The value zero (0) represents absolute equality, while the value one (1) indicates absolute inequality (UNDP, 2014).

The variable chosen to demonstrate the economic approach is the Growth of GDP per capita which measures the Gross Domestic Product of a region divided by its total population in a given period, that is the income per capita (UNDP, 2014). In order to measure the degree of development and quality of life offered to the population, it is necessary to examine another variable which takes into account the environmental dimension associated with the fossil fuel Energy Consumption indicator.

On the threshold of the third millennium, the globalized world formally acknowledges the relationship between fossil fuel energy consumption and the serious environmental problems that have been popping up over the years, the broad environmental degradation arising from consumption patterns of dysfunctional energies, since large volumes of biomass used for energy demand are not renewed. This inclusion of the renewable energy must be a priority, as it is the key to sustainable development (GRIMONI, et al., 2004).

4. Application of the Green Economy Index for Latin America

This section includes information gathered from The World Bank, one of the major databases in the world, from 2006 to 2013. After the collection and tabulation of the data, we calculate a simple arithmetic average separated into two periods to perform comparative analysis, getting the first block from 2006 to 2009 and the second from 2010 to 2013. The growth rate of GDP per capita (Υ) was considered based on the annual percentage. For the Gini Index (ζ) it is the coefficient of variation between 0/measure (absolute equality) and 1 (perfect inequality). In the case of variable consumption of fossil fuel energy (ϕ), we have assessed the total percentage consumed each year. Table 1 shows the data.

Table 1: Rate of change in Latin America during the period from 2006 to 2013

Latin America (%)		
Variables	2006-09	2010-13
Υ -GDP per capita	0.029	0.034
ϕ -energy consumption of fossil fuels	0.654	0.651
ζ -Gini Index	0.377	0.341

Source: World Bank (WB)

Before we go further, the implementation of the Green Economy Index is necessary to normalize the data and so we must put them in the same range of values, and for that we must establish limits of variation between individual measures.* The pre-established limits were between -1 and 1, as you can see in the expression (1). In order to simplify them, it was defined that the index would vary between 0 and 1, so a numeric constant can normalize the unit of area, as seen in expression (2) (VILASBOAS & TEIXEIRA, 2016).

$$-1 \leq \gamma \leq 1; \quad -1 \leq \tau \leq 1; \quad -1 \leq \phi \leq 1 \quad (1)$$

$$0 \leq \gamma' \leq \beta; \quad 0 \leq \tau' \leq \beta; \quad 0 \leq \phi' \leq \beta \quad (2)$$

With the data already normalized, we have all the variables expressed in the same unit. And we can calculate the area of the picture according to the magic triangle (equilateral), proposed by Veitch & Teixeira (2016), which has 0.877, the ideal area value, as shown in Table 2 of standard variables.

Table 2: Standard Variables–Latin America–2006 to 2013

Latin America (%)			
Variables	2006-09	2010-13	Ideal
Υ' - GDP per capita	0.452	0.453	0.877
ϕ' - Energy consumption of fossil fuels	0.726	0.724	0.877
ζ' - Gini Index	0.273	0.289	0.877

Source: World Bank (WB)

* The standardization process was based on linear transformation proposed by Medrano-B and Teixeira (2013). Thus, it is possible to describe the performance of each variable through a straight line function.

With normalized data and the optimal value of the magic triangle, we can then apply the Green Economy Index of Latin America. Table 3 presents the results obtained.

Table 3: Green Economy Index–Latin America–2006 to 2013

Period	Green Economy Index	Ideal
2006-2009	0,365	1
2010-2013	0,376	1

Source: World Bank (WB)

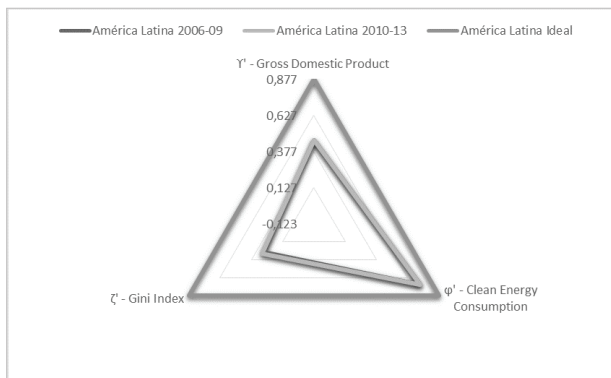
From the data shown in Table 3, it is observed that Latin America had a better performance in the period 2010-2013 ($A'=0.376$), where a% rise of 0.748% was seen, compared to the 2006-2009 period ($A'=0.365$).

To achieve the percentage of geometric variation related to periods examined it is necessary to apply the geometric mean, because the fact that it may not be cumulative and may normalize the outreaches allows us to get a more significant average on a scale from 0 to 100, in order to compare the two periods examined, which are two blocks of four years. The percentage (geometric) variation for the total period is given by the expression (3):

$$100 \sqrt[4]{\frac{0.365}{0.376}} - 1 \quad (3)$$

Figure 3 shows the results obtained from the calculations of the Magic Triangle. The greater area of the triangle corresponds to the ideal index, which was calculated using the formula area of an equilateral triangle. The two smaller areas are overlapping one another and making the display almost imperceptible; they refer respectively to the two study periods 2006-2009 and 2010-2013.

Figure 3: Magic Triangle-Latin America-2006 to 2013

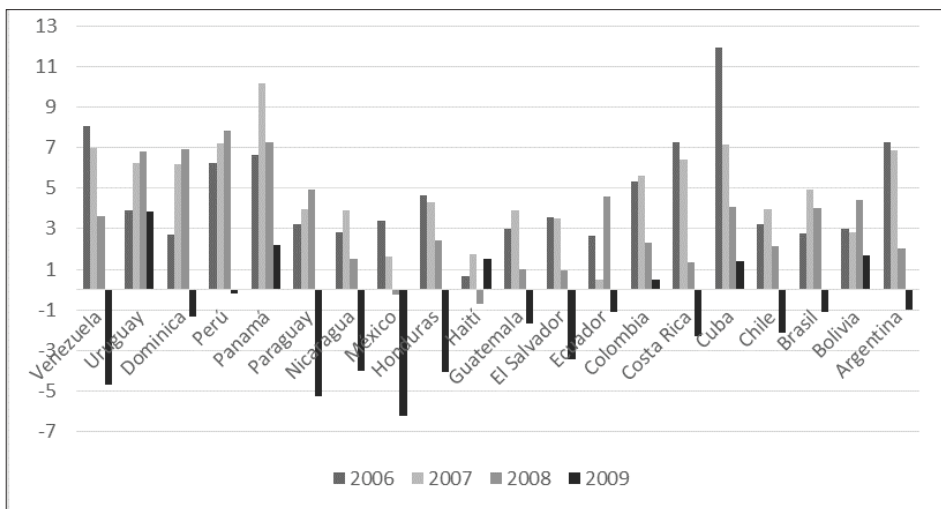


Source: World Bank (WB)

By analyzing this geometric variation of Table 3 in conjunction with Figure 3, we visualize that the second block of years produced a smaller area in comparison with the first set of years. An explanation for such a difference is that the factor that most contributed to this decline in the performance of the indicator in LA has to do, to a certain extent, to the economic crisis started in 2008 that affected Latin America, leading to the flight of hard currency, falling exports and external credit, bringing fear to national private banks, which also cut off credit and raised the interest rates charged.

As a result, the internal market retreated, causing low production and rising unemployment (SINGER, 2009). The World Bank's data corroborates with this idea, which demonstrates that in chart 1, in 2009, among the 20 countries studied, only six did not have per capita GDP growth below zero. They are Bolivia, Cuba, Colombia, Haiti, Panama and Uruguay.

Graph 1: Per Capita GDP of Latin America 2006-2009



Source: World Bank (WB)

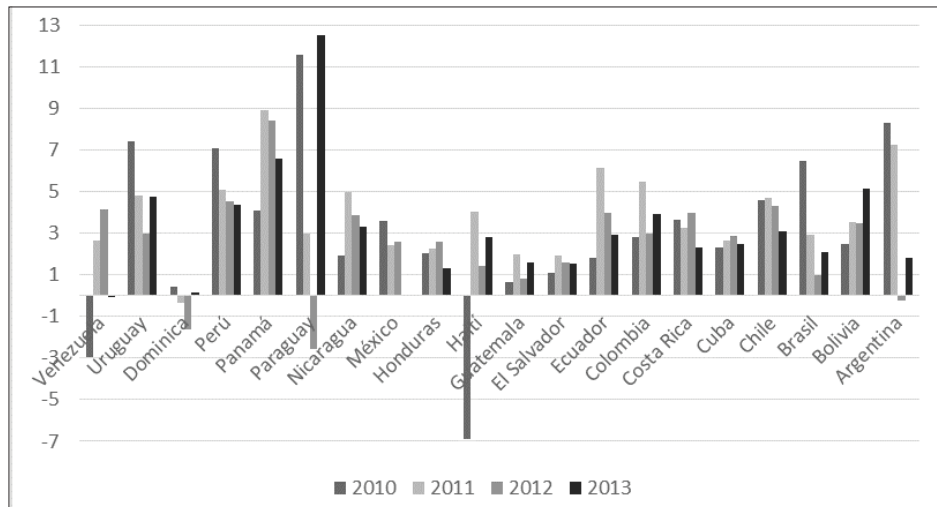
This scenario began to change in 2010, where it can be observed in Graph 2 that only Haiti and Venezuela had per capita GDP growth below zero, and gradually got better from the year 2013.

The distribution of income, represented in this research by the Gini Index, has a small modification in the 2006-09 period, as this was the social policy of income distribution deployed by the countries of Latin America, especially Brazil with the “Family Bourse” and Mexico with the “Family Thrives” programmes.

In the globalized world, economic crisis is further strengthened by the problem of environmental degradation, bringing the risk of an ecological collapse and the advancement of inequality and poverty. In this scenario, the responsibility to alleviate the dangers of environmental unsustainability and bring about green economics and the need for urgent transformation of attitude on the part of the people, Governments and organizations have

not risen to the challenge. This also did occur in many other regions besides Latin America. It became more difficult to stimulate a global movement in order to build an environmental rationality for the development of sustainability and green economy (SCHORR, *et al.*, 2015), in spite of the effort and relative success of a number of organizations worldwide.

Graph 2: Per Capita GDP of Latin America 2010-2013



Source: World Bank (WB)

This movement towards the idea of greening of energy, making it renewable, which requires the replacement of investments in carbon-intensive energy sources for clean energy applications, as well as efficiency enhancements, must gather momentum. From 2002 until mid-2009, even in the midst of a recession, investment in clean energy sources grew up around 33%. It was hoped that in 2010, applications would reach record levels, but it did not happen (UNEP, 2011).

5. Concluding Remarks

This study was set out to demonstrate the performance of Latin America in its quest towards a Green and Sustainable Economy, using documentary research, as well as empirical data through the analysis of information collected from the World Bank database. The application of the efficiency indicator *Green Economy Index* was indispensable for research. It provided the measures for each block of years from the interconnection of the economic, social and environmental variables, enabling a complete analysis of the greening of Latin America in the period studied.

The article concludes that the advancement of a green economy in Latin America in the period from 2006 to 2013 was very shy. This performance resulted in a geometric variation equal to 0.748% for the total period. The main reason may well be that the globalized world was at that moment going through the International Crisis that started in 2007/2008, which affected the global economy, reaching Latin America, and brought about the recession,

thereby resulting in a decline in export, retraction of the internal market, causing a drop in production and raising unemployment.

However, the distribution of income, represented in this research by the Gini Index, had a small variation from the first to the second period studied. This can be explained, to a large extent, by the social policy of income distribution deployed by some of the countries of Latin America. Some examples are Brazil with extensions of the “Family Bourse” and Mexico with the “Family Thrives” programmes.

We realize that the results obtained with the use of environmental policy instruments, such as the reduction of dependence on fossil fuels as the main source of energy and promotion of the development of technological innovations in clean energy generation, brought satisfactory results for the period 2006 to 2009, 2010 and 2013, however this evolution didn't last long. The reduction occurred because of the low investment in renewable energies and in energy efficiency.

It should also be emphasized on the importance of the proposition that there is a need to promote new ideas and actions that reinforce a common sustainable future science, and a change in fiscal policy, reform and reduction of subsidies that encourage the use of fossil fuels, as well as investment in clean energies. These are some measures, which provide the trust between Government, industry and society, building a healthy environment with respect to natural resources.

This work makes room for further quantitative research to explore the importance of the green economy for sustainable development. No doubt, there is a lack of studies related to this important methodology, which makes it an instrument of environmental public policy in promoting improvements in the well-being of society, increase in social equality and reducing environmental risks. In general, LA's experience is not a proper model for countries trying to get a foot on green economics and sustainable development. Actually, we have a few good examples for those trying to climb up such a ladder. In this vein, it is necessary to stress the need for more complex models, extending the analysis of natural resources, as well as to make explicit a more detailed analysis of the typical institutions of more advanced societies. Actually, the methodological discussion must go deep indeed and perhaps even require much of socioeconomic theory and political power to be rewritten.

Author Contact Information

Ione do Santos Velame – Email: ionevelame@hotmail.com

Joanilio Rodolpho Teixeira – Email: joanilioteixeira@hotmail.com

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