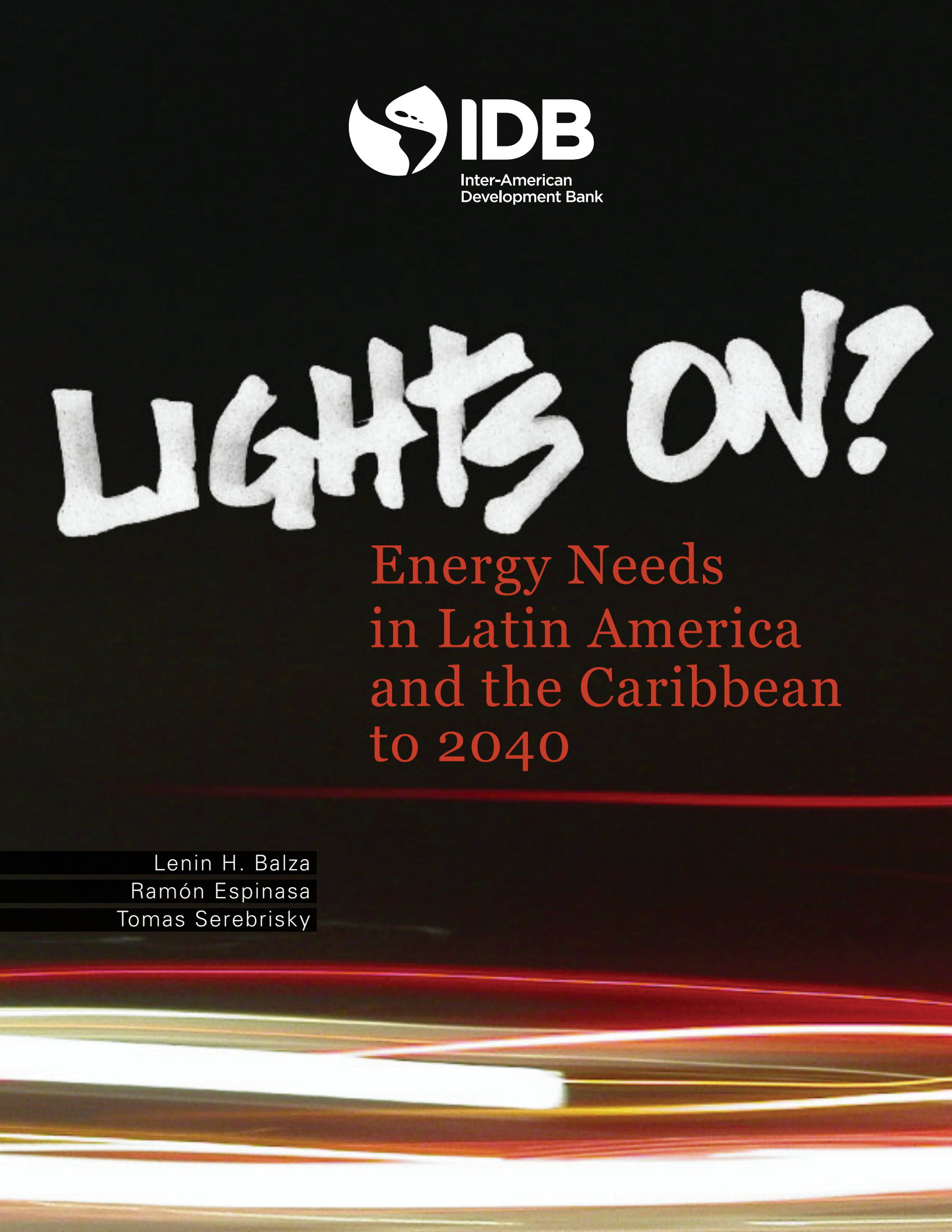
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LIGHTS ON!
Energy Needs
in Latin America
and the Caribbean
to 2040
Lenin H. Balza
Ramón Espinasa
Tomas Serebrisky

LIGHTS ON!

Energy Needs in Latin America and the Caribbean to 2040[1]

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Contents

1 Introduction

Energy is essential to daily life. The world we know and live in today simply cannot function without it. Whether we use it to power our homes or factories, or to use it in our transport systems, we are dependent on it. Even the things we do not often think of, such as the things we eat and wear, require and embody energy. In short, energy is pervasive throughout human activity.

This report intends to answer how much energy is likely to be needed in countries across the Latin America and the Caribbean (LAC) through 2040? We estimate region-wide primary energy demand to be at least 80% higher than present day levels, reaching over 1,538 million tonnes of oil equivalent (MTOE). However, the region as a whole is expected to be more energy efficient. According to our estimates, LAC will have reduced energy intensity by more than 17% between now and 2040.

On the electricity front, unless current trends are reversed, electricity requirements are estimated to increase by more than 91% through 2040, reaching over 2,970 terawatt-hours (TWh). That means that the region will need to add nearly 1,500 TWh to its current production. To put that figure into context, meeting these electricity needs will require the equivalent of planning, building and maintaining eighteen new hydropower stations the size of Paraguay-Brazil's Itaipu (the first and the third largest region-wide and worldwide, respectively). This does not even yet take into account the unprecedented quantum of investment required.

This report is meant to provide a basis for understanding future energy demand in LAC countries, and to present open and transparent energy demand scenarios for the region through 2040. Estimating LAC's energy requirements in 2040 is part of a larger programmatic knowledge agenda in the IDB's Infrastructure strategy aimed to support the LAC countries in adopting a new vision of sustainable and inclusive growth[2].

The rest of the report proceeds as follows. Section 2 examines some of the linkages between energy and development in LAC countries. Section 3 presents the region's energy consumption at a glance. Section 4 summarizes the projections for total energy use and electricity requirements, based upon assumed growth rates of per-capita income and energy prices across the region. Section 5 investigates associated challenges. Section 6 offers some concluding remarks.

2 See Serebrisky (2014).

2 ENERGY AND DEVELOPMENT IN LAC

2 Energy *and Development in LAC*

Energy is both a contributor to and a function of growth. Without energy, we cannot provide the basic goods and services that ensure the well-being of current and future generations. On the other hand, population and income growth are key drivers for total energy consumption. Indeed, energy use is continuously boosted by the scale and speed of economic development.

The linkages between energy consumption and economic growth are well-documented. Figure 1 reveals how energy use has increased steadily over time in close association with economic activity both globally and in the LAC region, while **Figure 2** shows the strong positive relationship more specifically across LAC countries.

Figure 1 **Energy Use and GDP Trend**

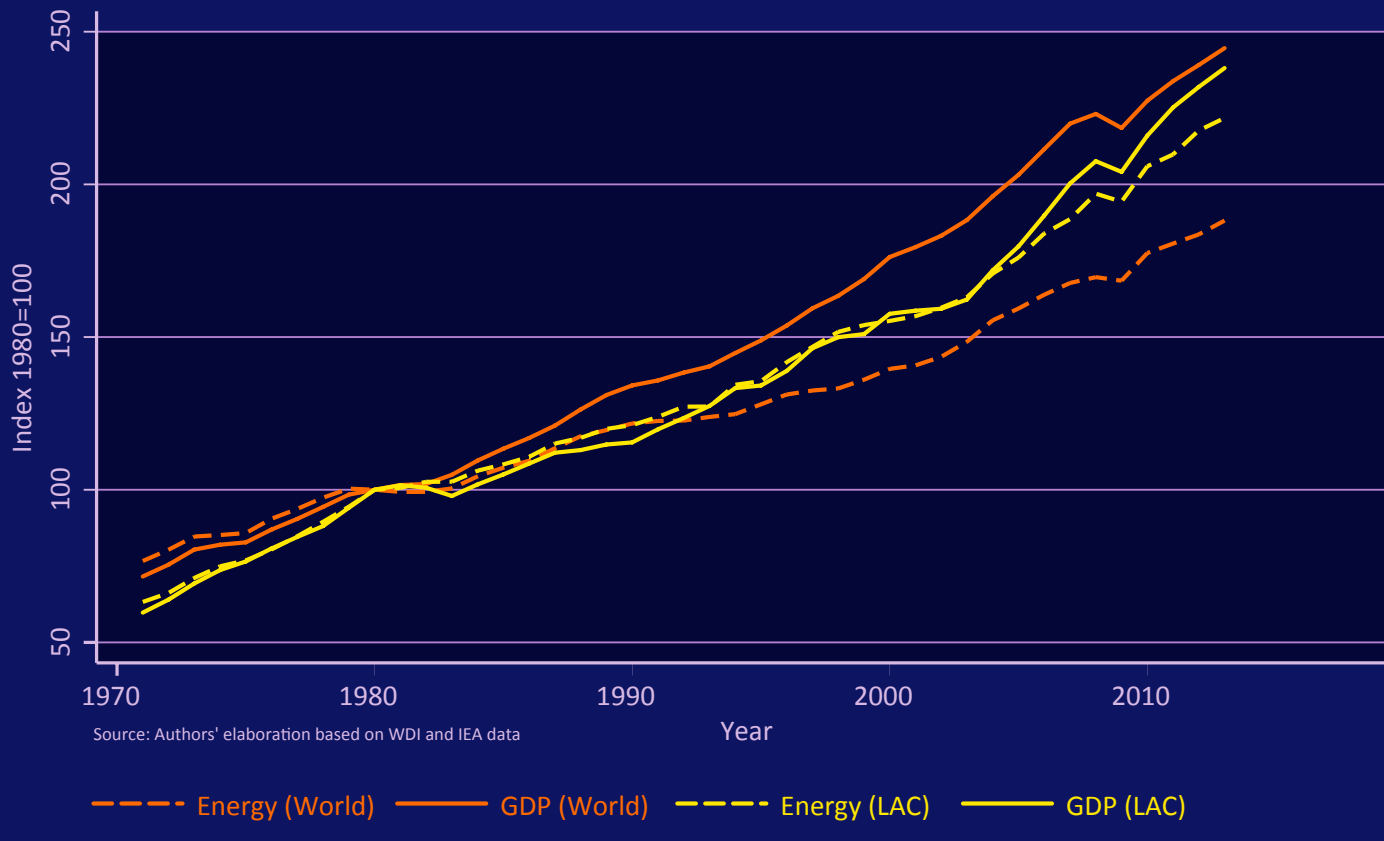
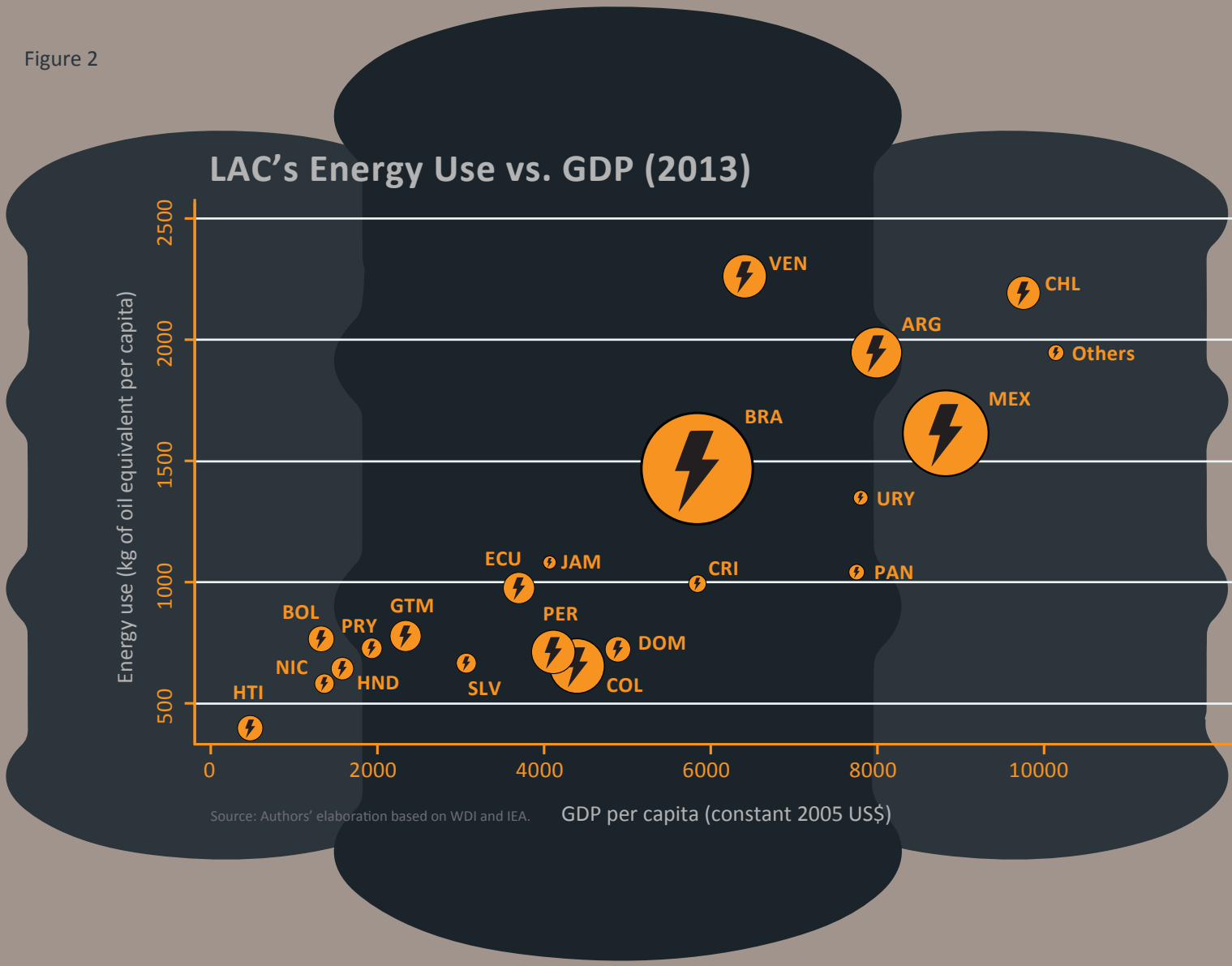


Figure 2



Area of circle proportional to country's population.

Although energy use seems to be gradually decoupling from economic growth worldwide, energy use and economic growth are still highly positively correlated. Indeed, regardless of enormous improvements on effiency, and international technology difussion, energy consumption continues to grow in tandem with the economy—modern society has yet been able to sever the link between energy use and economic growth.

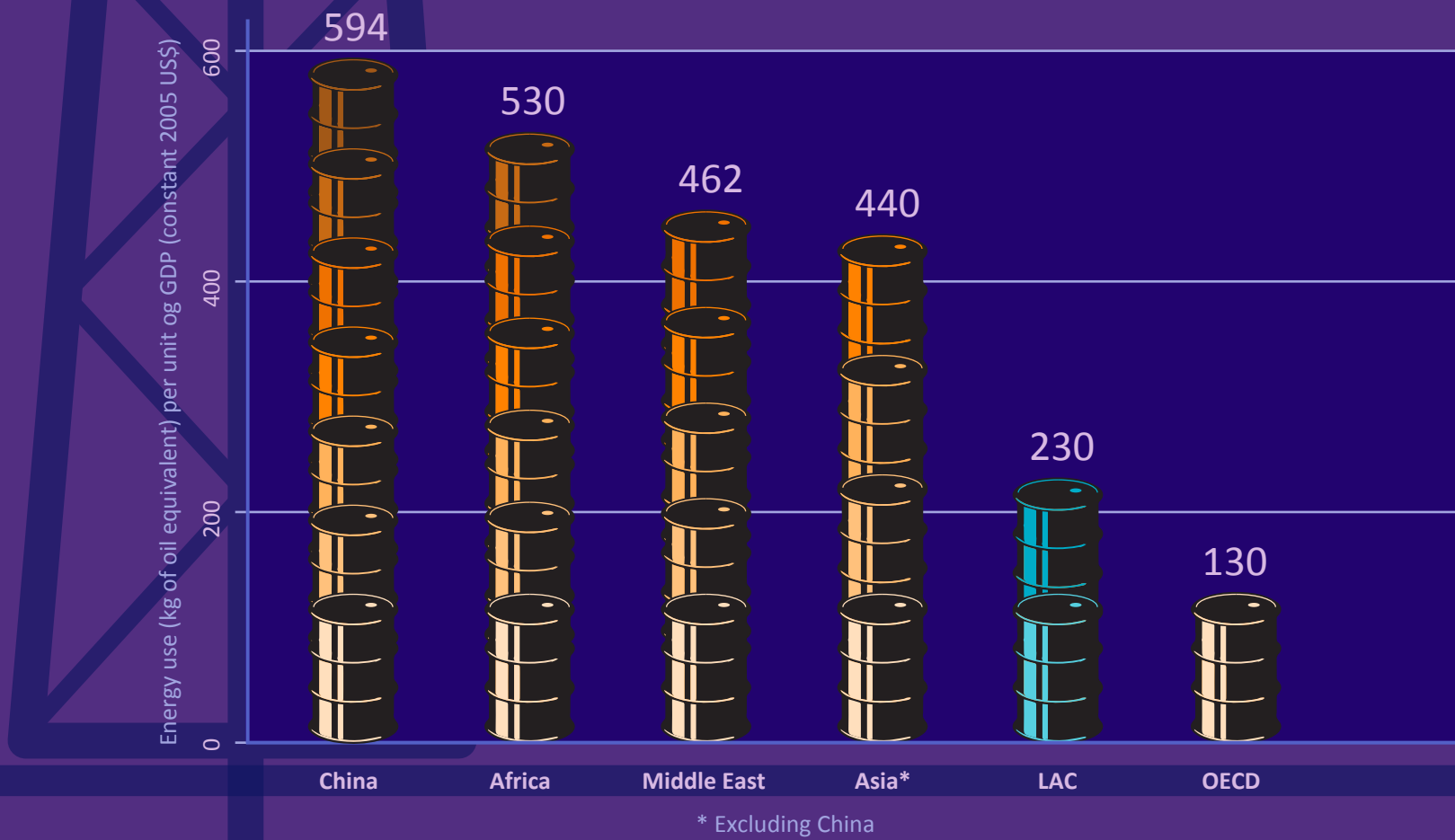
Will the trend of closely linked energy consumption with economic growth continue to hold in the future? Arguably, access to more efficent technologies would allow our countries to keep growing while reducing energy consumption over time. If so, countries worldwide may be ready to follow a less energy-intensive path. Can developing countries leapfrog past an energy-intensive development path towards a less energy-intensive one? This question remains to be answered.

Doing **more** *with less*

Energy intensity, defined as total energy use divided by GDP, indicates the amount of energy required to produce a unit of GDP or, in other words, the amount of energy needed to generate a dollar's worth of economic output. **Figure 3** compares energy intensity the LAC region to other regions. Thought there is a wide variation across countries, the LAC region emerges as one of the least energy-intensive regions worldwide.

Figure 3

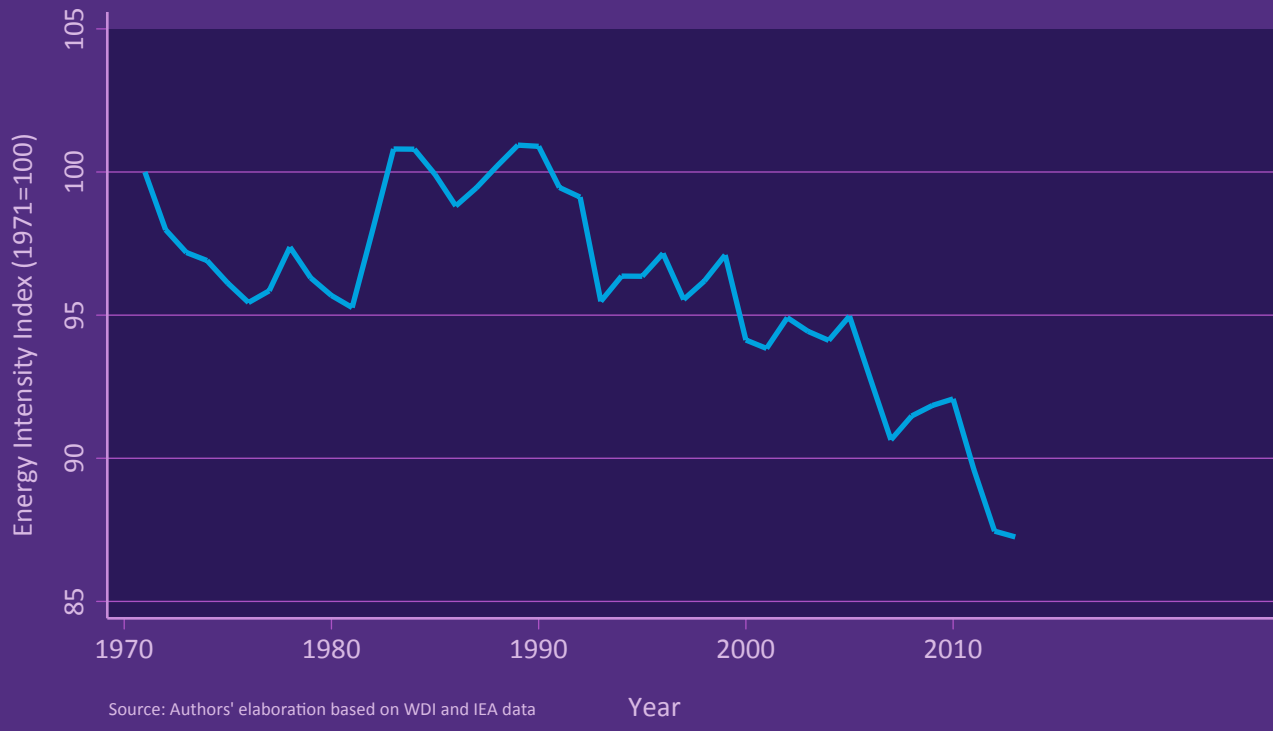
Average Energy Intensity by Region



Source: Authors' elaboration based on IEA and WDI.

Figure 4 shows LAC's energy intensity over time. Though there have been consirable decade-to-decade variations, the rate of energy instensity has declined over the past 40 years. The amount of energy required per unit of GDP dropped by about 13% since the early seventies, reaching, on average, 230 kg of oil equivalent per unit of GDP (at constant 2005 US$), above the level registered by countries belonging to the Organisation for Economic Co-operation and Development (OECD), but far below other regions in the world, such as Asia, Africa, and the Middle East.

Figure 4 **LAC's Energy Intensity**

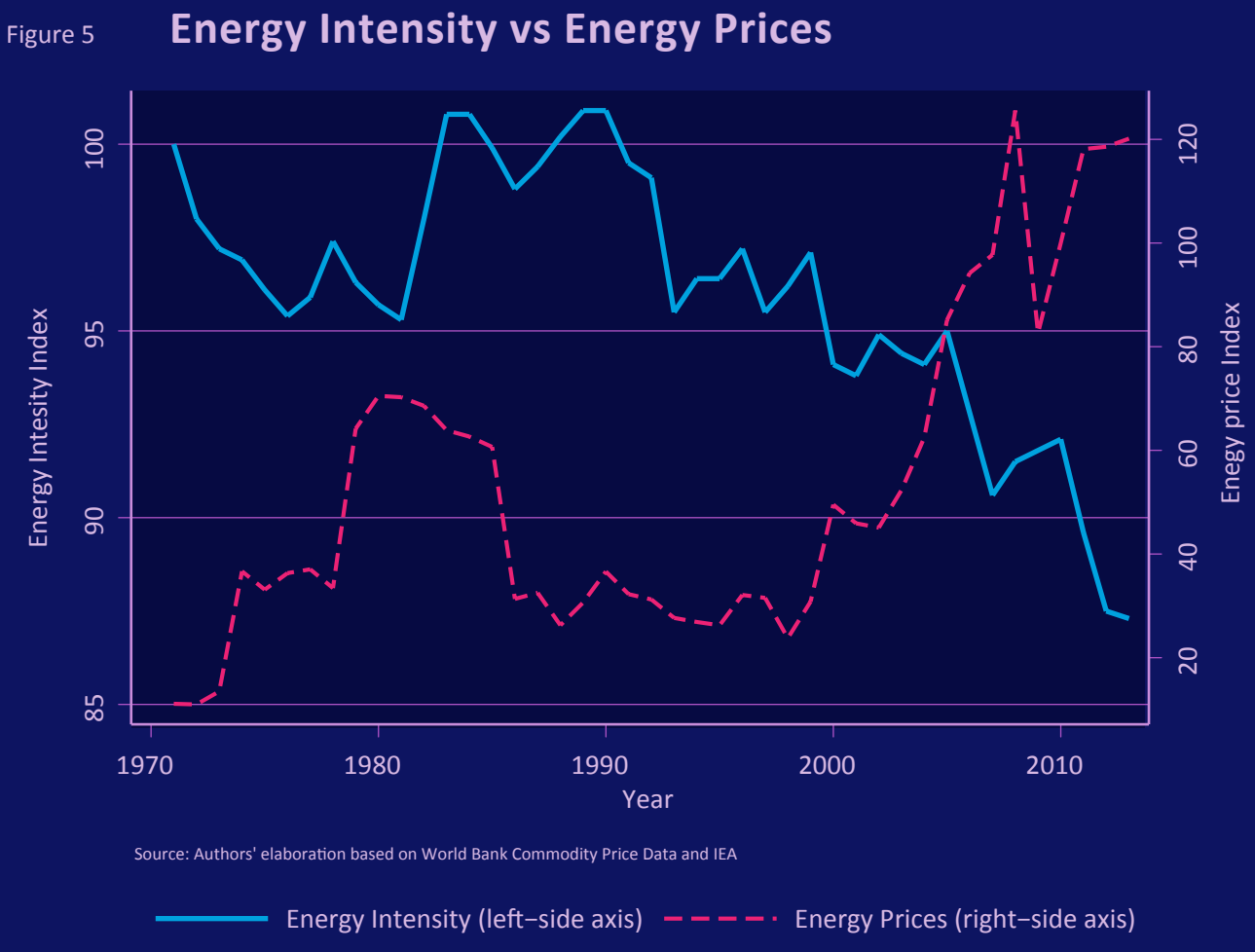


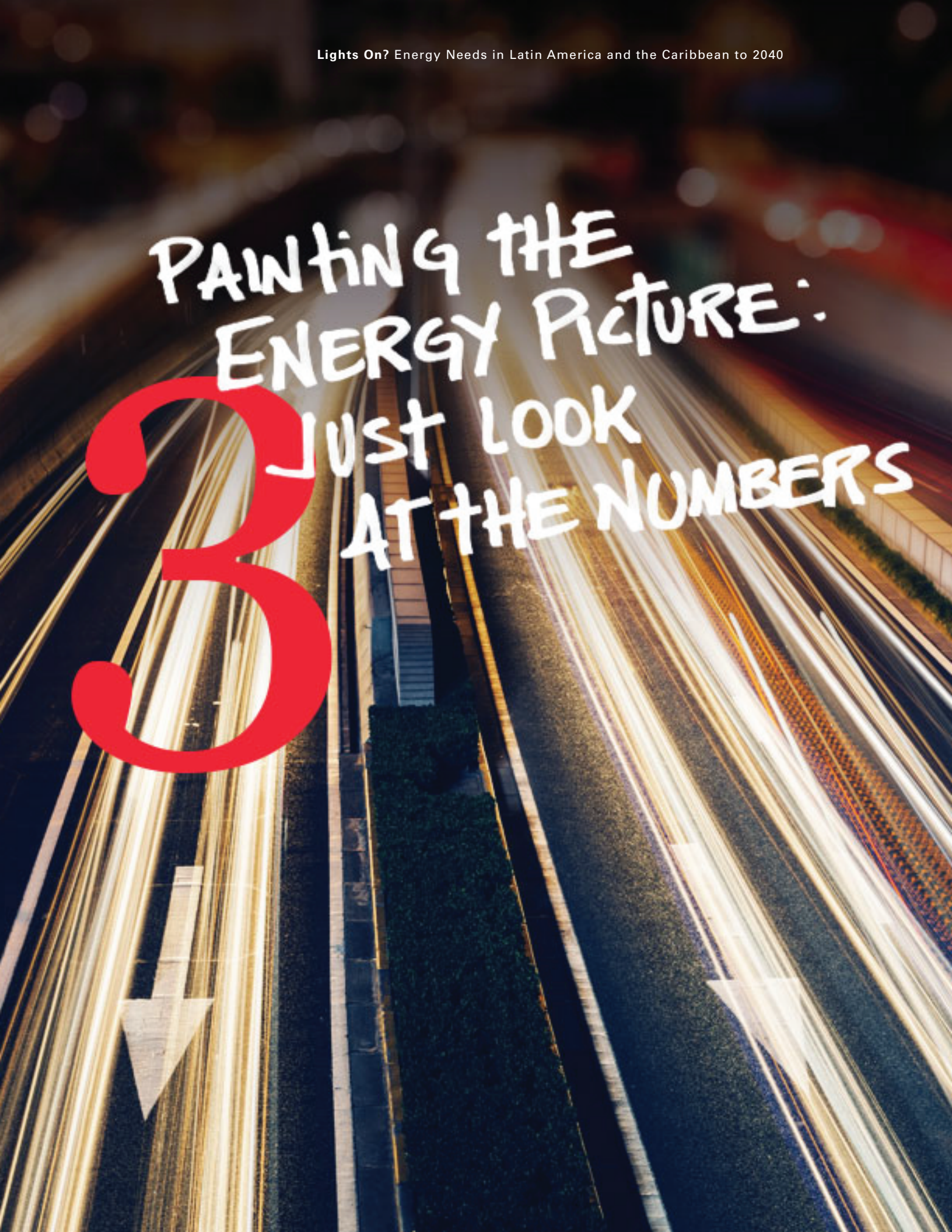
Source: Authors' elaboration based on WDI and IEA data

Declining energy intensity suggests that the region is doing more with less energy. Put another way, this is essentially an increase in the productivity of energy consumption. Recent empirical evidence identified per capita income, oil prices, and overall economic growth as the key drivers behind this trend (Jimenez and Mercado, 2014). Surprisingly, this reduction in energy intensity (or increase in energy productivity), took place in the absence of any systematic and significant energy-saving programs, suggesting that market signals –energy prices– may have had a substantial role in reducing the region's energy intensity.

Figure 5 shows that the recorded donward trend in energy intensity is inversely correlated with the increase in the overall price of energy, particularly in the 2000s.

Figure 5




PAINTING THE ENERGY PICTURE:
3
JUST LOOK AT THE NUMBERS

3 **Painting the Picture**: Just look at *the numbers*

The energy sector has increased in tandem with the economy. Between 1971 and 2013, 3.4% of LAC's GDP average annual growth rate was fueled by and fueled approximately 3.0% average growth rate in primary energy use, and an approximately 5.4% growth rate in electricity consumption.

Energy use[3] in Latin America has more than tripled over the past forty years, from 248 million tonnes of oil equivalent (MTOE) in 1971 to 848 MTOE in 2013, representing more than 8% of the increase in global energy demand over the period. Fossil fuels (coal, oil, and gas), which accounted for 68.9% of all primary energy demand in 1971, continue to represent the most important primary fuels in the energy matrix, increasing to 74.4% in 2013. Hydrocarbons (oil and gas) alone accounted for 69.4% of total energy consumed in 2013. A notable change in consumption pattern is in natural gas consumption, which went from a modest 11% of total energy use to more than 23%, indicating an increased diversification towards low-carbon fuels.

Table 1 presents comparative energy source shares for Latin America as a whole.

Table 1 **Energy Use in LAC (Mtoe)**

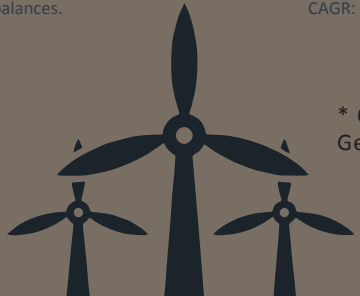
ENERGY SOURCE	1971	SHARE-71	2013	SHARE-13	CAGR
Total	**248.4**	**100%**	**848.7**	**100%**	**3.0%**
Coal	8.0	3.2%	42.8	5.0%	4.1%
Oil	135.9	54.7%	389.6	45.9%	2.5%
Gas	27.2	10.9%	199.0	23.4%	4.9%
Nuclear	.	.	8.5	1.0%	.
Hydro	7.6	3.1%	62.8	7.4%	5.2%
Biofuel & Waste	69.7	28.1%	136.7	16.1%	1.6%
Other Renewables*	.		8.6	1.0%	.

Source: Authors' calculations based on IEA World energy balances.

CAGR: Compound annual growth rate.

3 It refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.

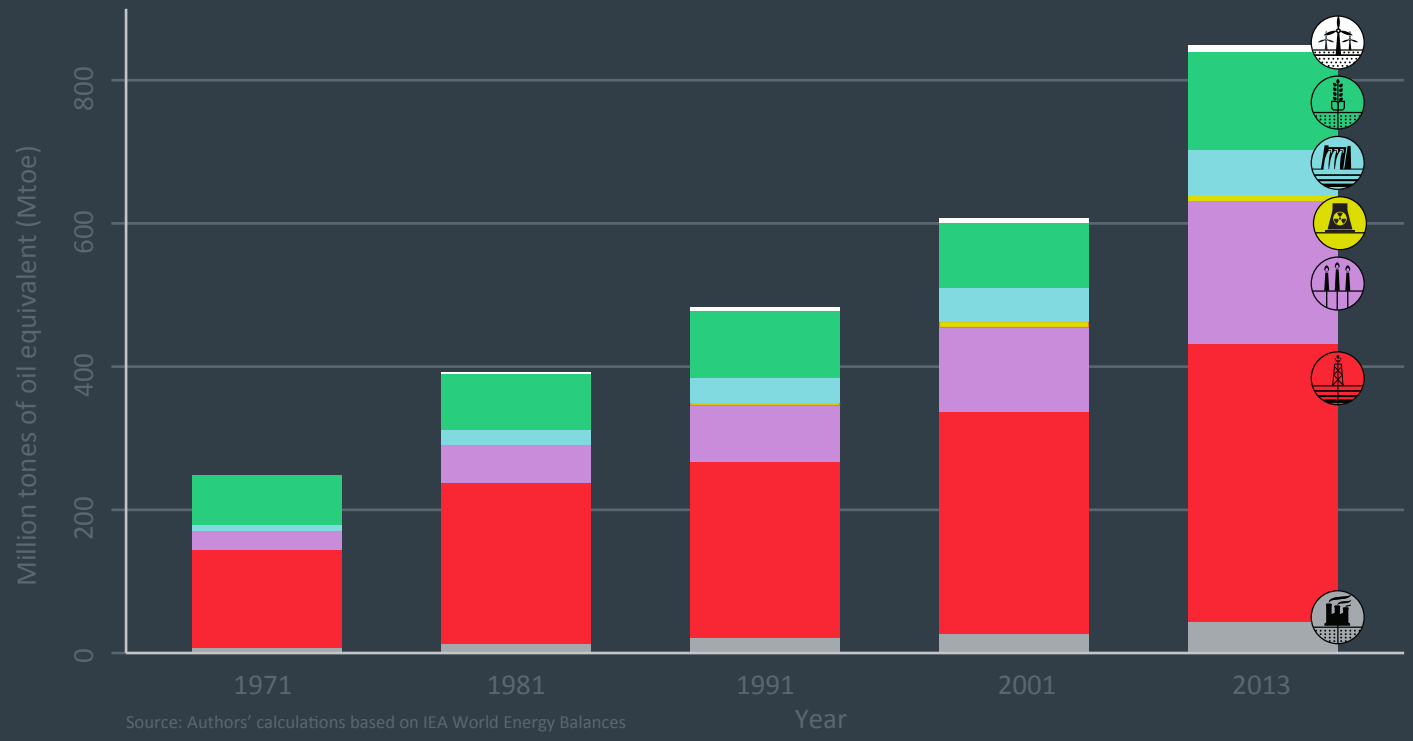
* Other renewables include Geothermal, Solar & Wind.



Demand for renewable energy, including hydro, biofuel and waste, geothermal, and wind and solar, grew from 77 MTOE in 1971 to 208 MTOE in 2013. However, the share of renewable energy in the primary energy mix declined from 31% to just under 24%. This observation is largely driven by a switch to modern and more efficient energy sources, e.g. from traditional biomass to electricity.

Figure 6

Total Energy Use in LAC (Mtoe)



The region's six largest economies – Brazil, Mexico, Argentina, Venezuela, Chile and Colombia – collectively reached around 705 MTOE in 2013, representing more than three-quarters of present day regional demand and slightly more than 85% of regional increase since 1971. Mexico and Brazil alone account for 57.1% of the region's total energy use. In Brazil, primary energy demand increased, on average, by nearly 3.5% per year since 1971, to reach 293 MTOE in 2013, while in Mexico, energy demand grew by 3.6% per year to reach 191 MTOE, making it the second largest energy consumer in the region.

Total final energy consumption[4] by end-use sectors, as Table 2 indicates, increased from 190 MTOE in 1971 to 610 MTOE in 2013, which is 220% higher than in the early seventies and represents an average annual growth rate of 2.8%. Both the industrial and transport sectors accounted for more than 302 MTOE of the increase, or about three-quarters of the overall growth in total final consumption since 1971.

The transport sector has the largest share of energy use, increasing by around 3.5% per year, on average, to reach 210 MTOE in 2013. This is followed closely by industrial energy consumption, which grew by 3% annually between 1971 and 2013, increasing, slightly, its share of total final consumption from 31% to 33%. Meanwhile, due to access to more efficient energy sources, the residential sector's share of total final consumption dropped from 29% in 1971 to less than 17% in 2013, recording the lowest annual growth rate over the period at 1.4% per year, on average.

Table 2 **Total Final Consumption by major end-sectors (Mtoe)**

SECTOR	1971	SHARE	2013	SHARE	CAGR
Industry	60.7	31.8%	202.3	33.2%	2.9%
Transport	49.3	25.8%	209.5	34.3%	3.5%
Residential	56.4	29.6%	99.1	16.3%	1.4%
Commercial	3.8	2.0%	28.8	4.7%	4.9%
Other	20.6	10.8%	70.2	11.5%	3.0%
TOTAL	190.8		610.0		

Source: Authors' calculation based on IEA World Energy Balances. CAGR: Compound annual growth rate.

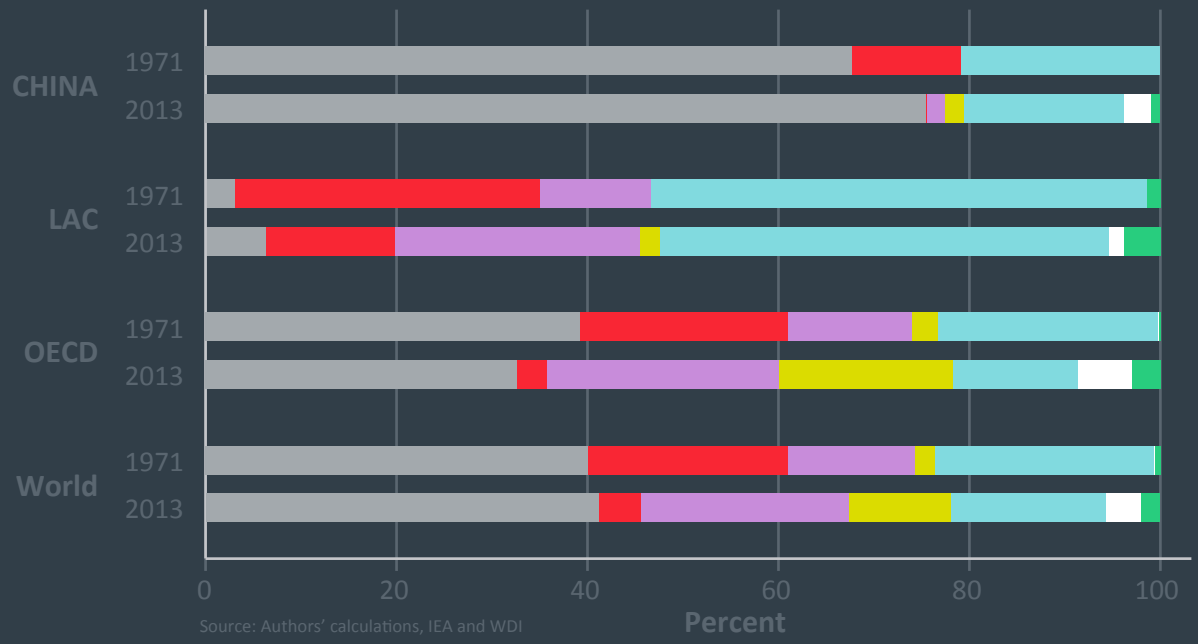
4 Total final energy consumption refers to total energy consumed by end-use sectors, i.e. industry, transport, residential, commercial, and others. In that sense, energy used for transformation processes and for own use of the energy producing industries is excluded.

The **greenest** electricity *matrix*

Renewable energy sources continue to dominate the power matrix in LAC, giving the LAC the 'cleanest' matrix worldwide. ***LAC's Gross Power generation***[5] has increased nine-fold since the early seventies at an average annual growth rate of 5.4%, catching up with sharply increasing electricity needs. In fact, the region's electricity supply reached nearly 1,553 terawatt-hours (TWh) in 2013, up from about 170 TWh in 1971. Hydropower alone accounted for more than 47% of the total increase in the regional electricity supply since 1971.

As can be seen in **figure 7**, there are significant differences in the fuel mix across regions worldwide. In fact, the share of renewable generation for LAC in 2013 (52.4%) is notably higher than any other region. This share is almost three times the world average (22%).

Figure 7 **Electricity Matrix by Source and Region**



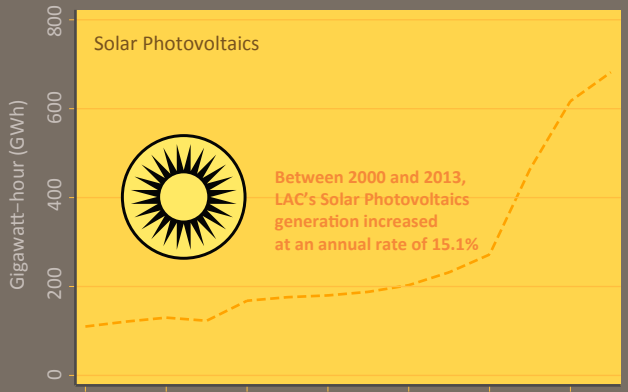
5 Gross power generation is measured at the terminals of all alternator sets in a station. It include own use, and transmission and distribution losses. Production includes the output of electricity plants that are designed to produce electricity only, as well as that of combined heat and power plants.

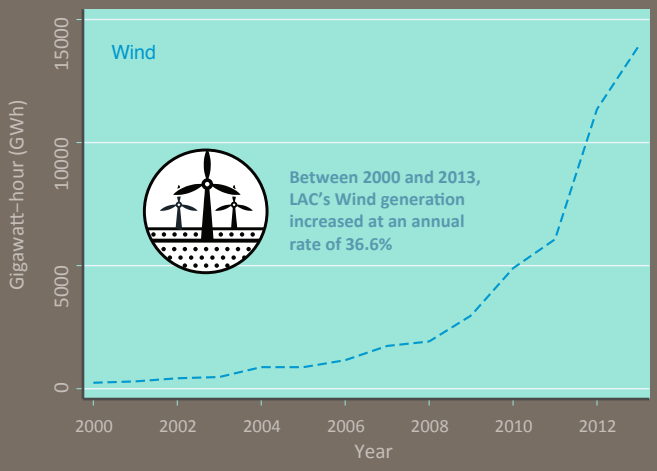
Fossil fuel generation increased from 79 TWh in 1971 to 706 TWh in 2013, keeping its share fairly constant around 47%. However, it is important to highlight that gas-fired generation overtook oil-fired generation as the largest fossil source of supply in the region as well as the most significant source of electricity after hydropower, accounting for almost 25% of the power generation – more than coal and oil generation combined. Coal-fired generation expanded by 7% per year to reach 98.8 TWh, while the use of oil for power generation grew at a slower rate of 3.2% per year to represent 15% of the output in 2013.

Intermittent renewable energy - solar, wind, and wave power- recorded a spectacular average growth rate of 34% over the last decade, faster than any other power source. However, as shown in Figure 8, these sources still represent only 0.9% of the total power generation of LAC and are perhaps too small to consider as evidence of a definitive new trend—there is still much uncertainty about how much and how fast these sources will grow.

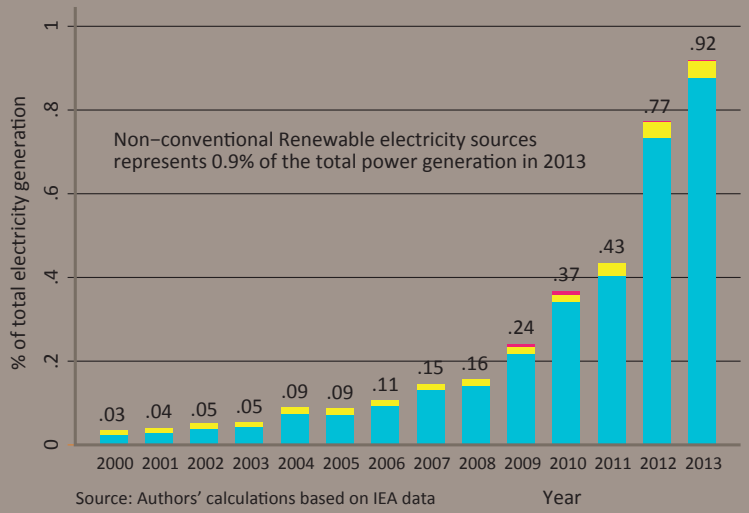
Figure 8

Solar and Wind electricity sources are growing very fast… still not fast enough.





Source: Authors' calculations based on IEA data



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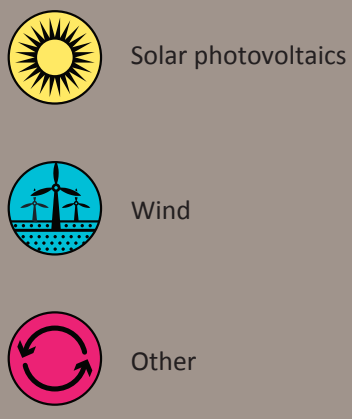
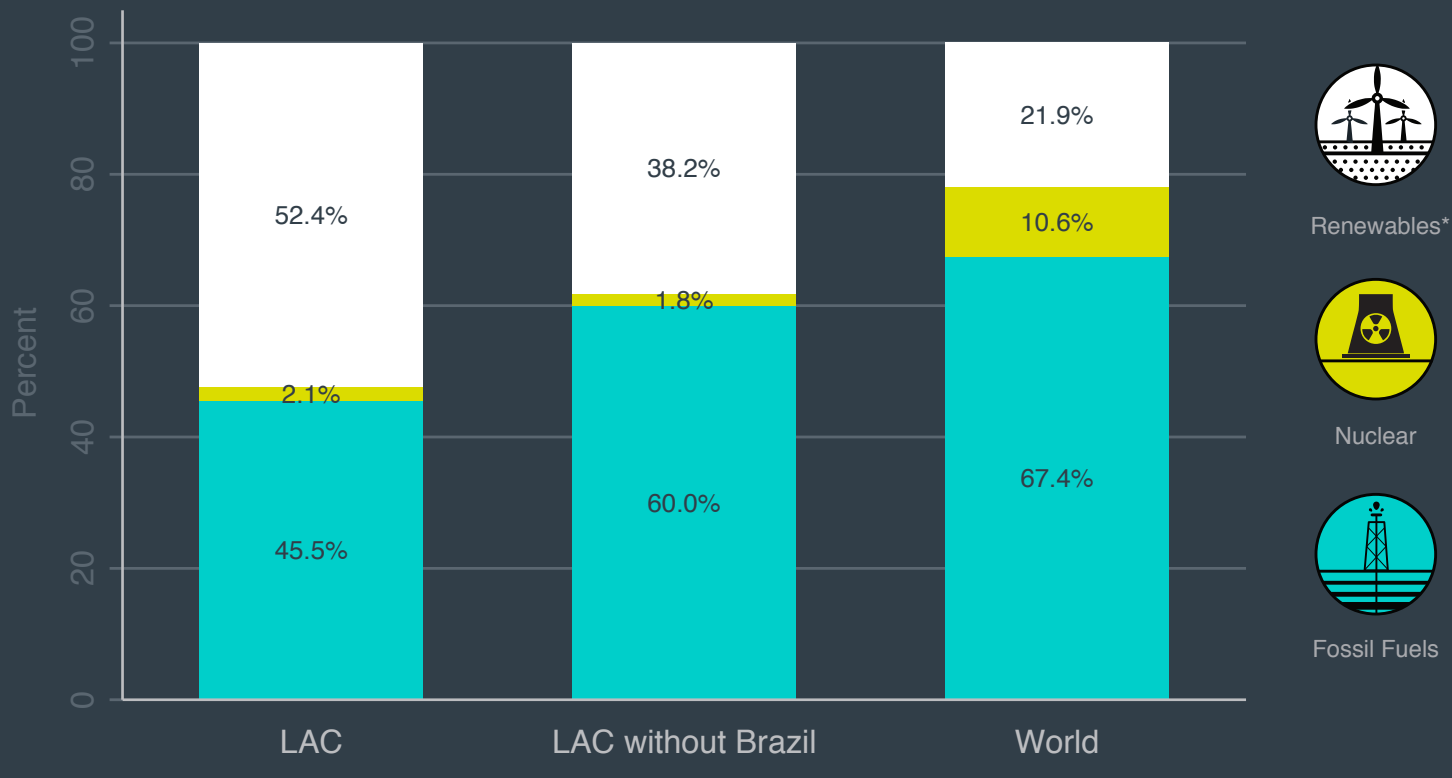


Oops! A *dirty* **little secret**

The LAC region has the cleanest electricity matrix, with a sharp contrast in the share of renewables compared to other regions in the world. Nevertheless, one should be careful when interpreting this statement: Aggregate figures hide great heterogeneity among countries. The LAC region is no exception. LAC's aggregate figure is strongly influenced by the six largest economies. Indeed, the power generation of these countries accounts for more than 80% of the total electricity generation of the region. For instance, if Brazil is excluded from the region, total renewable generation in LAC falls from 52.4% to 38.2%. Although LAC is still the region with the cleanest power matrix even with Brazil removed, it is not as clean as it seems to be **(see Figure 9)**.

Figure 9 **Power Matrix (2013): Not As Clean As It Seems**



Source: Authors' calculations based on IEA and WDI data

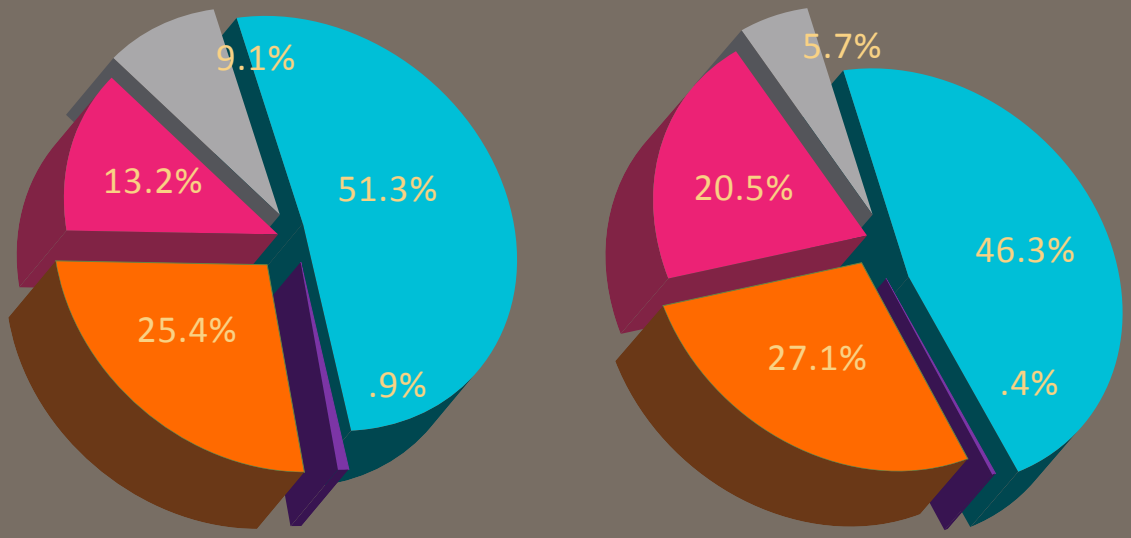
*Renewables include Hydro, Geothermal, Solar, Wind, and Biofuels & Waste.

Give me **all** *the power*

Final electricity consumption[6] increased by 5.4% annually from 1971 to 2013, reaching over 1,333 TWh in 2013, mainly due to persistent economic expansion, rapid urbanization, and the rise of the middle class. Despite electricity demand increasing by more than 1,180 TWh during the period, Latin America and the Caribbean's regional average annual per capita demand for final electricity consumption measured at 2,153 kilowatt hours (kWh), well below high-income countries' average level of around 8,061 kWh per capita.

Among end users, the industrial sector is the largest electricity-consuming sector, accounting for more than 46% of the total electricity demand of the region **(see Figure 10)**. Power demand in the residential sector rose by 893% since the early seventies, supported by a widespread electrification program that expanded the use of modern electrical appliances, and, most importantly, per capita income growth. However, the residential sector's share remains fairly constant at around 27%. Electricity consumption in the commercial and public services sector expanded more than twelve times over the period, making it the fastest growing sector, accounting for 22% of electricity consumption in 2013.

Figure 10 **Power Consumption by major-end sectors**



Source: Authors' calculations based on IEA World energy balances data

6 Final Electricity consumption measures the production of power plants and combined heat and power plants less transmission, distribution losses and own use by heat and power plants.

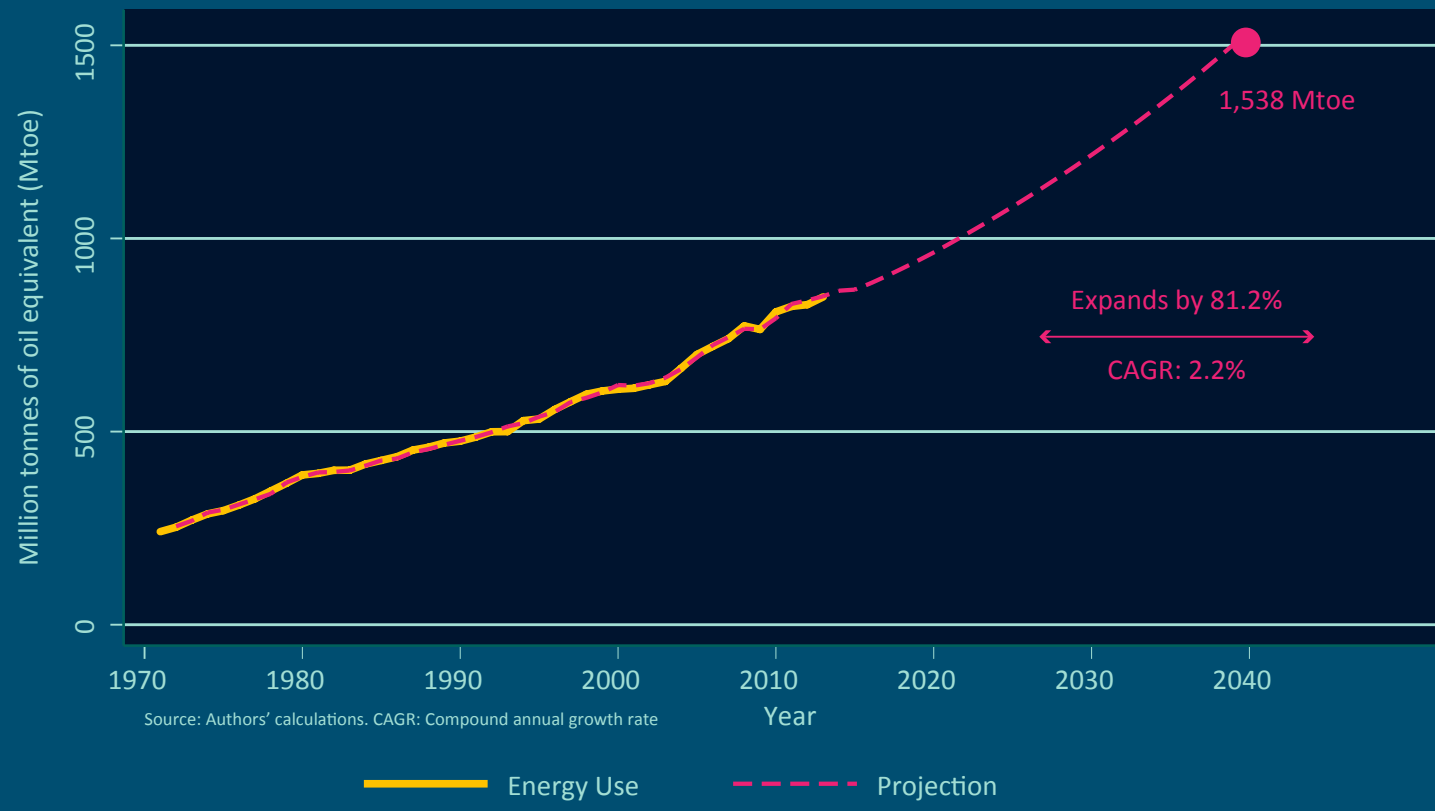
4 WHAT DOES THE ENERGY FUTURE HOLD FOR LAC?

4

What does the **energy future** hold for LAC?

We estimate that LAC's primary energy use will continue to grow steadily over the coming decades, accompanying economic growth and a rising middle class. Consequently, as can be seen in **Figure 11**, total energy use is projected to expand by more than 80% through 2040 at an average annual rate of 2.2%, reaching over 1,538 MTOE by the end of the outlook period.

Figure 11 **LAC: Total Energy Use to 2040**



Source: Authors' calculations. CAGR: Compound annual growth rate

Table 3 below summarizes our main results. In our modeling exercise, the six-largest economies are set to continue to dominate the region's energy use trend. More than 83% of the total increase in primary energy demand through 2040 is predicted to come from these countries. Brazil's primary energy needs will expand, at about 2.5% per year, from 294 MTOE in 2013 to 577 MTOE in 2040. Mexico's needs will grow even faster, by 2.8% per year, from 191 MTOE to 400 MTOE. Energy use is projected to increase more rapidly in Chile and Colombia largely due to more rapid economic growth and higher income per capita.

Table 3

Total Energy Use scenario 2040 (Mtoe)

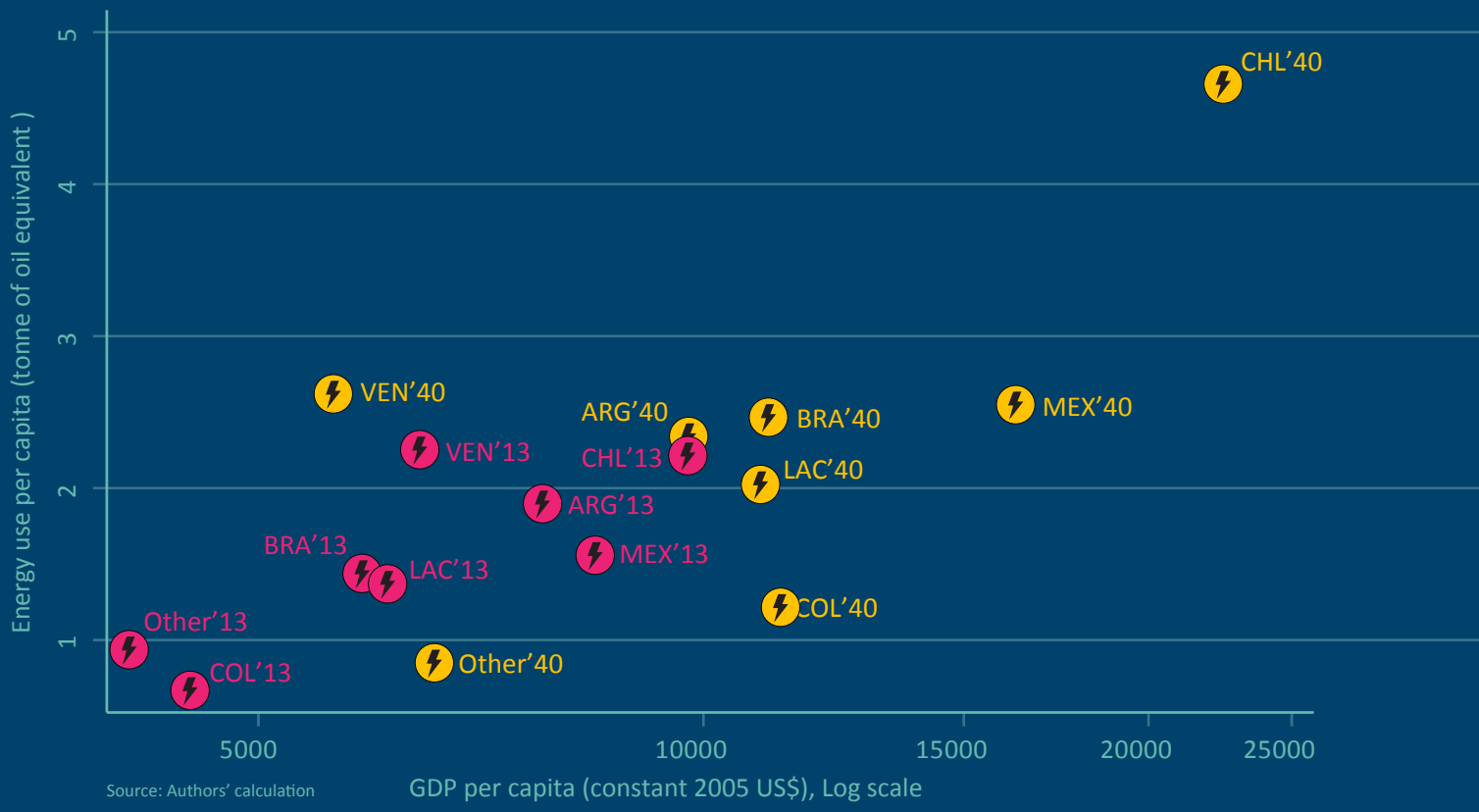
COUNTRY	2013	2040	GROWTH	CAGR
Argentina	81	123	52.6%	1.6%
Brazil	294	577	96.6%	2.5%
Chile	39	99	154.7%	3.5%
Colombia	32	67	110.3%	2.8%
Mexico	191	400	109.2%	2.8%
Venezuela	69	104	50.7%	1.5%
Others	144	169	17.3%	0.6%
LAC	**849**	**1538**	**81.2%**	**2.2%**

Source: Authors' calculations

For the region as a whole, while per capita energy use will grow from 1.37 toe in 2013 to 2.0 toe in 2040, this is still much lower than per capita energy use in high-income countries today. Furthermore, big differences across countries in the region will still remain **(see Figure 12)**. In Brazil, each person will use on average 2.44 toe of primary energy in 2040, while Chile will more than double the LAC average, reaching over 4.66 toe at the end of the outlook period.

Figure 12

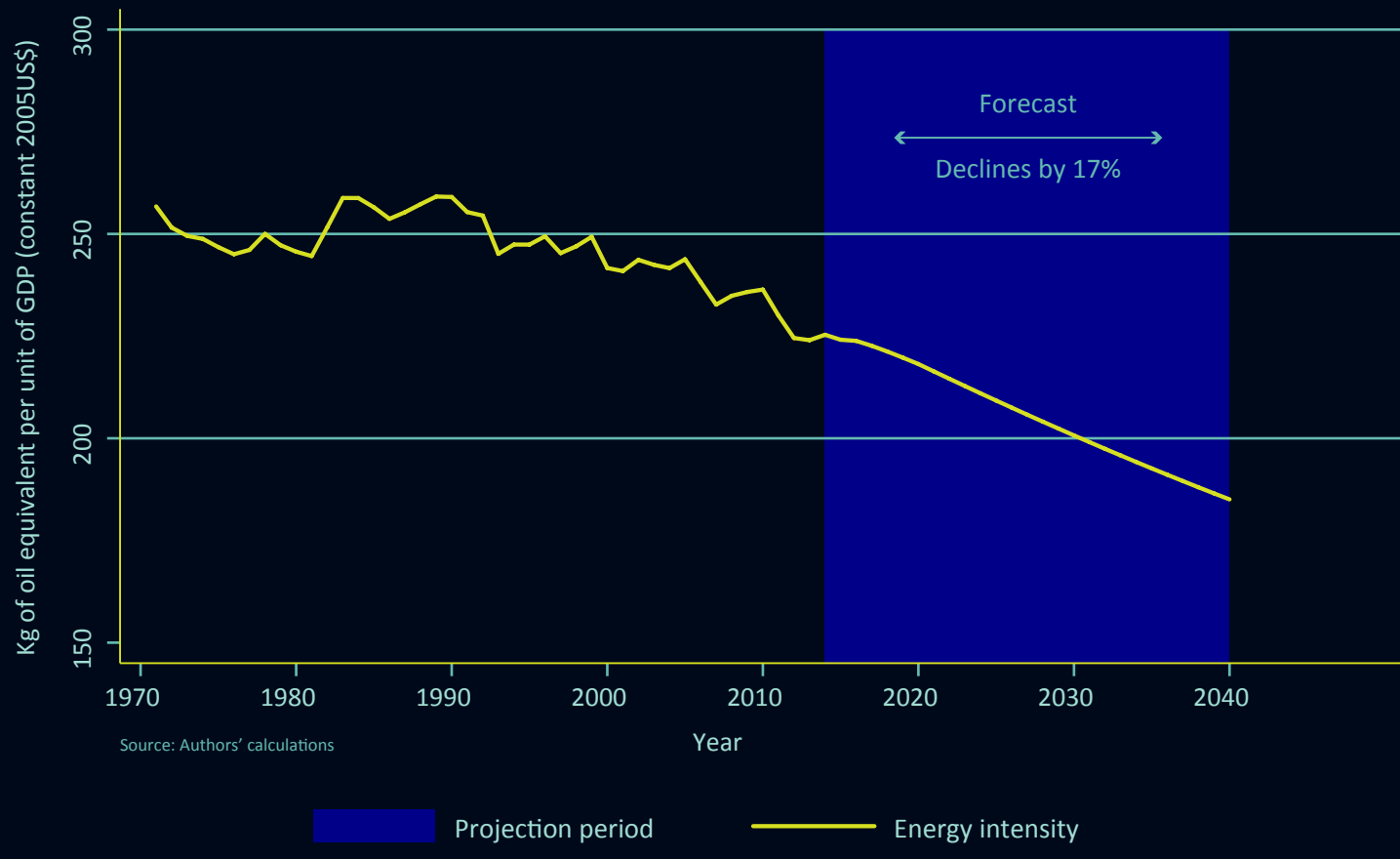
What does the energy future looks like?



Source: Authors' calculation

Although there are wide disparities in the primary energy intensity projected among LAC countries, the amount of energy required per unit of GDP is set to continue its downward trend. We estimate that the LAC region will have reduced energy intensity by more than 17% by the end of the projection period **(see Figure 13).** Technological change and the adoption of more efficient technologies will likely play a crucial role in a more rapid decline in regional energy intensity.

Figure 13 **LAC energy intensity projected to continue it's decline**



BOX.1

How we did it? *Modeling Framework*

AUTO-REGRESSIVE INTEGRATED MOVING AVERAGE WITH EXOGENOUS INPUTS MODEL – ARIMAX (P, D, Q)

This segment describes the empirical methodology used to estimate total energy use and electricity needs for the sample of Latin American and Caribbean Countries between now and 2040.

Energy use and electricity needs are modeled as a function of its past values and disturbances, as well as a linear combination of exogenous variables to include additional information over the forecast window. The components of the ARIMAX are an Auto-regressive vector or lags of the errors [AR(p)], a moving average or lags of the dependent variable [MA(q)] and an integration degree [I(d)], which is chosen to stationarize the dependent variable. In addition, we have included GDP per capita in constant terms and energy prices as covariates [X].

Our basic set-up has the following structure:

$$energy_t = a + \sum_{h=1}^{d} energy_{t-h} + \sum_{j}^{p} \beta energy_{t-j} + X\delta_0 + \sum_{K=1}^{q} \gamma_K \varepsilon_{t-K} + \varepsilon_t$$

In other words, total energy use is modeled as a linear function of its past realizations, a moving average representation and the projection of both covariates (i.e. income and energy prices). That is, the forecast is a function of the information set until t and the exogenous variables.

The order of differencing to get a stationary dependent variable is expressed by the vector $\boldsymbol{energy}_{t-h}$. It is important to point out that the vector of coefficients, in particular δ, which captures the magnitude of the response of energy use to the GDP and energy prices, are estimated only with information until period t.

For the purposes of estimation, we follow standard procedures: (i) the Dickey-Fuller test for unit root is performed in order to identify the order of differencing to stationarize the series (d), (ii) the identification of a possible ARIMA model is based on a visual inspection of the Auto-correlation Function (ACF) and Partial Auto-Correlation Function (PACF) of the sample, (iii) the final model is selected based on the best fit using the Akaike Information Criteria, as suggested by Hamilton (1994).

Power to LAC to *ramp up* quickly

Regional electricity needs are expected to expand by more than 91% by 2040, reaching over 2,970 TWh. This therefore means the region will need to add nearly 1,500 TWh to meet its electricity requirements. Broadly speaking, this figure equals eighteen (18) times the electricity generated in 2014 by the largest hydroelectric power station in LAC (and the third largest worldwide) – Paraguay-Brazil's Itaipu. Thus, an unprecedented amount of new energy infrastructure will need to be planned and financed.

It is expected that more than 80% of the projected growth would come from the six largest economies in the region. Brazil (37%) and Mexico (19%) alone would account for more than half of the electricity needs of the region in 2040. Total electricity requirements in Brazil would increase by 96%, from 570 TWh in 2013 to more than 1120 TWh in 2040, while Mexico's needs would increase by 87%, reaching over 556 TWh.

Among Latin America's largest economies, electricity needs will grow most rapidly, on average, in Chile (3.3%) and Colombia (3.4%), reaching over 175 TWh and 159 TWh respectively; this primarily reflects strong economic performance **(see Table 4 and Figure 14)**. Conversely, we project a considerably slower average growth rate for electricity requirements in both Argentina (1.6%) and Venezuela (1.8%), primarily due to expectations of weak economic activity in both economies over the forecast period, though this is subject to much uncertainty.

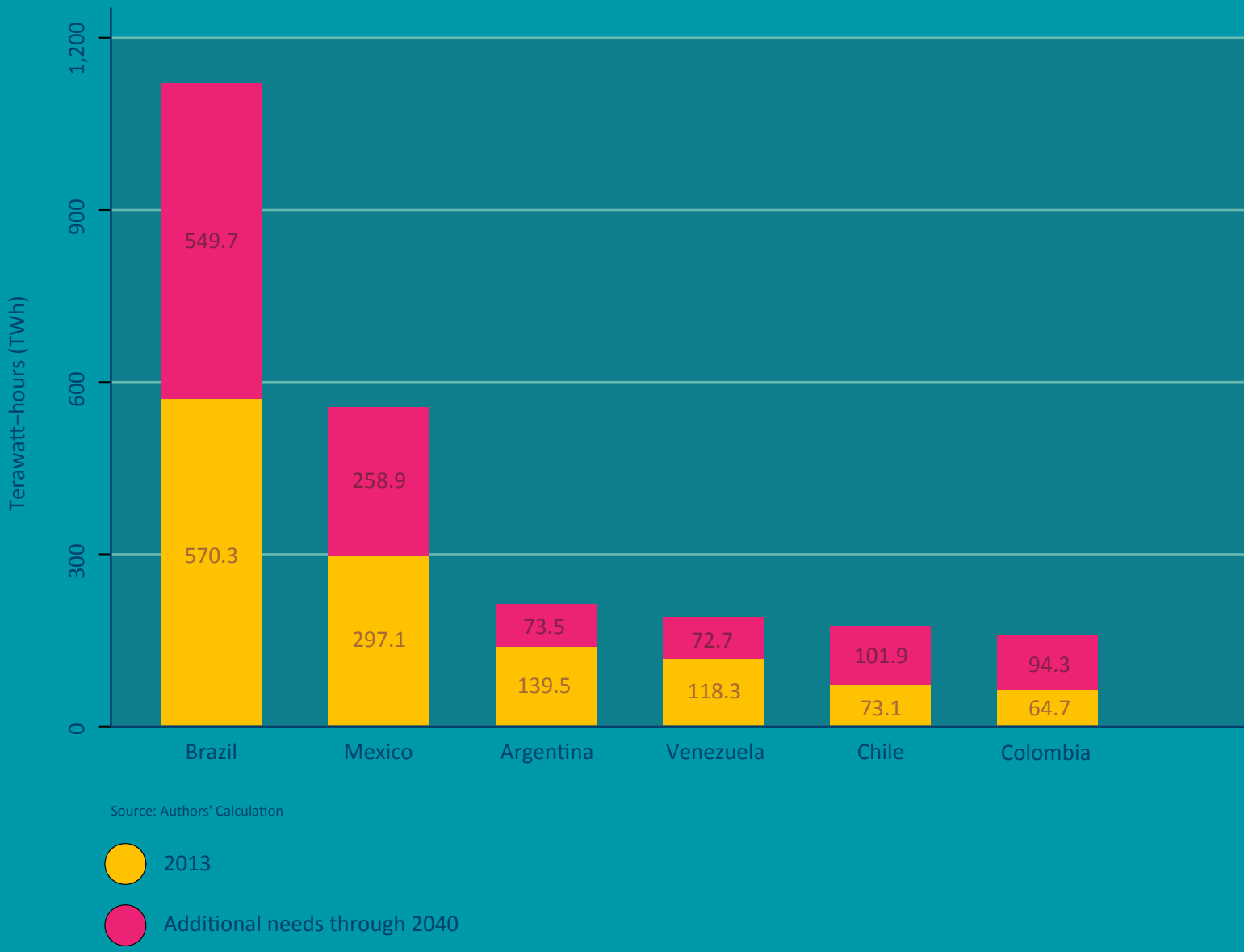
Table 4 **Electricity needs through 2040 (TWh)**

COUNTRY	2013	2040	GROWTH	CAGR
Argentina	139	213	52.7%	1.6%
Brazil	570	1120	96.4%	2.5%
Chile	73	175	139.5%	3.3%
Colombia	65	159	145.8%	3.4%
Mexico	297	556	87.2%	2.3%
Venezuela	118	191	61.4%	1.8%
Others	290	556	91.7%	2.4%
LAC	**1553**	**2970**	**91.2%**	**2.4%**

Source: Authors' calculations. CAGR: Compound annual growth rate.

Figure 14

Total Electricity needs through 2040 (TWh)



Source: Authors' Calculation

BOX.2 We are not alone – Overall energy market outlook

This is certainly not the first attempt to project energy and electricity requirements across the region. In fact, there are a number of different estimates for energy demand growth in the public domain. The International Energy Agency, Exxon Mobil, British Petroleum, and the World Bank have conducted some of the most comprehensive analyses of expected regional energy demand. Despite the number of methodological questions that one may have behind all these projections, energy forecasts have been proven to be extremely useful to governments, decision makers, and industry leaders worldwide who must make long-terms commitments. However, the energy future is hard to predict and none of these estimates should be taken as irrefutable truth. Each projection has its pros and cons.

Table 5 summarizes the overall energy market outlook. Our aggregate estimates (IDB) seem to be within acceptable bounds. For instance, the International Energy Agency (IEA) – which provides one of the most comprehensive analyses of global energy demand – offers three different scenarios. IEA #1 and #2 refer to scenarios differing in their incorporation of a set of policies and measures that affect energy markets. IEA 3# illustrates a scenario that limits the rise of global temperature to two degree Celsius (2 °C). Along with IEA's forecast, World Bank, PB and Exxon Mobil projections are also provided.

Table 5: Market projections to 2040. Compound Annual Growth Rate

Table 5 **Market Projections to 2040**

LAC	IDB*	WORLD BANK**	IEA #1 *	IEA #2 *	IEA #3 *	EXXON MOBIL*	BP^
Total Energy Demand	2.2%	N/A	1.5%	1.8%	0.8%	1.9%	2.1%
Electricity Demand	2.4%	3.7%	2.3%	2.6%	1.8%	2.4%	N/A

Source: Authors' Calculations, World Bank, IEA, and Exxon Mobil and British Petroleum

**IDB, IEA and Exxon Mobil projections to 2040
**WB scenario to 2030
^BP Forecast to 2035


PAVE THE ENERGY PATH
WITH MORE THAN
5
GOOD INTENTIONS

Pave the **energy path** with more than *good intentions*

5

In considering the future of the LAC region's energy path, there are several other dimensions that deserve focused attention.

These include:

Providing access remains unfinished business in LAC

Despite tremendous efforts in the region, much remains to be done to achieve universal access to modern energy both to those without any access to energy and to the millions of people who continue to rely on solid fuels, such as traditional biomass and coal for lighting, and heating. Providing access to electricity has a positive impact on a wide range of development outcomes, including education, income, health, and gender equality, among many others. For example, electric lighting can easily increase a child's study hours, leading to better scholastic performance. That, in turn, contributes to improved employability prospects for that child.

According to World Development Indicator figures, as of 2012, nearly 22 million of people-- 4% of the LAC population--still lack access to electricity, with most of them living in rural and remotes areas with low population density **(see Figure 15)**. Connecting or providing off-grid solutions to those who remain without access requires greater broad-based efforts between the public and private sectors along with specific targeted programs. Furthermore, beyond just cooperation between development agencies, providing access to electricity to low-income and isolated communities demands a different business model.

Figure 15 A Electricity Access remains a regional challenge

Source: Authors' elaboration based on WDI data

Figure 15 B People without electricity (millions)

Source: Authors' elaboration based on WDI data

Table 6

Where do the most people without electricity live?

COUNTRY	ACCESS TO ELECTRICITY (% OF POP)	NUMBER OF PEOPLE WITHOUT ELECTRICITY	RURAL ACCESS (% OF RURAL POP)	URBAN ACCESS (% OF URBAN POP)
Argentina	99.8%	84.190	95.7%	100.0%
Bahamas, The	100.0%	0	100.0%	100.0%
Barbados	90.9%	25.693	79.7%	100.0%
Belize	100.0%	0	100.0%	100.0%
Bolivia	90.5%	972.682	72.5%	99.3%
Brazil	99.5%	1.012.008	97.0%	99.9%
Chile	99.6%	69.554	97.8%	99.8%
Colombia	97.0%	1.406.431	87.9%	99.7%
Costa Rica	99.5%	23.271	98.7%	99.9%
Dominican Republic	98.0%	203.101	96.6%	98.6%
Ecuador	97.2%	431.746	92.3%	99.5%
El Salvador	93.7%	382.551	85.7%	97.9%
Guatemala	78.5%	3.304.283	72.1%	84.8%
Guyana	79.5%	155.726	75.0%	90.5%
Haiti	37.9%	6.389.362	15.0%	72.3%
Honduras	82.2%	1.377.031	65.8%	96.9%
Jamaica	93.0%	189.546	87.0%	98.0%
Mexico	99.1%	1.098.639	97.2%	99.6%
Nicaragua	77.9%	1.298.825	42.7%	100.0%
Panama	90.9%	341.602	79.7%	94.4%
Paraguay	98.2%	114.825	96.3%	99.3%
Peru	91.2%	2.653.972	72.9%	98.3%
Suriname	100.0%	0	100.0%	100.0%
Trinidad and Tobago	99.8%	2.310	99.0%	100.0%
Uruguay	99.5%	16.984	95.1%	99.8%
Venezuela, RB	100.0%	0	100.0%	100.0%
LAC	**96.4%**	**22.012.454**	**87.1%**	**99.0%**

But **access** is *not enough*

While many countries in the region are focusing on domestic energy security and lowering their dependence on carbon-based fuels, other countries are struggling to simply secure sufficient energy to meet their basic needs. Affordable and secure supplies of energy are essential for sustainable economic development. It is paramount for Latin America to achieve universal access to affordable and reliable energy to reduce poverty, improve development outcomes, and enhance competitiveness of countries in the region.

Power cuts are becoming more frequent and major blackouts are now a reality in the region; these issues are a growing threat across the region that demands immediate attention. According to World Bank Enterprise Surveys, on average, businesses in Latin America suffer 2.8 electrical outages in a typical month, which usually last 1.5 hours. Nearly 40% of firms in the region have identified the power sector as a major constraint for developing its full potential.

More recently, as part of our current research agenda, the Inter-American Development Bank (IDB) conducted a public opinion survey in five of the most important Latin American cities, three megacities with more than 10 million people (Buenos Aires, Mexico City, and Sao Paulo) and two cities that will likely to reach that category in the near future (Bogota and Lima). According to the report, lack of electricity service continues to be a major obstacle to improving people's lives. Furthermore, there are signs of potential energy discrimination against the poorest in urban areas: on average, low-income households tend to experience more blackouts and power surges than high-income households (IDB, 2014).

The Rise of the Middle Class

There is a clear need to understand the nature and implications of poverty reduction and the rise of the middle class for energy use. LAC's middle class made up about 29% of the population in 2009 and is expected to increase to 42% by 2030 (Ferreira et al., 2013). That means a net addition of 128 million people into the middle class lifestyle, a figure roughly equal to the combined populations of Colombia, Argentina and Peru today. The growth of the middle class will be largely a result of sustained and robust economic expansion in Latin America.

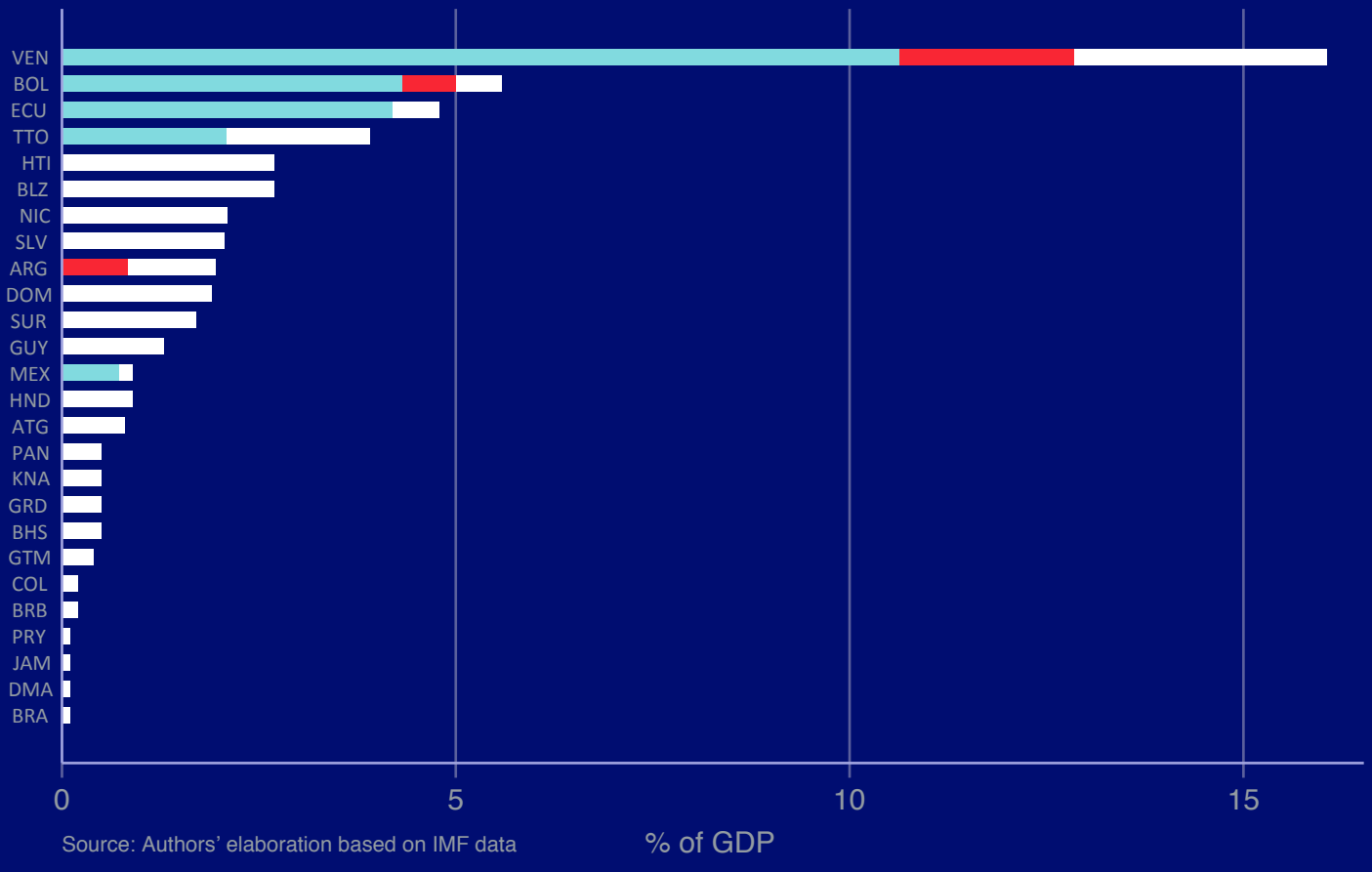
There are many political and economic implications of a larger middle class. The emergence of wealthier households with a higher purchasing power translates into more energy-using assets, such as cars, personal computers, air conditioners, and a near-infinite number of household appliances. Indeed, recent empirical evidence has shown that energy consumption increases sharply as households move out of poverty into the middle class (Gertler et al., 2011).

Providing energy services to the middle class is much more complicated than simply delivering access: middle class consumers are no longer satisfied solely with having access; they demand access that is both affordable and reliable, which is much more difficult to deliver than access alone. However, LAC can and should take this as an opportunity to guide its citizens towards more energy efficient lifestyles.

Knocking on heaven's door: Time to **Rationalize** the *Subsidy Mess*

Keeping low energy prices comes with a high cost. LAC's energy subsidies were estimated at US$ 73 billion (1.3 % percent of regional GDP) in 2013. Energy subsidies are sizeable across the whole region **(see Figure 16)**. However, they are particularly high in countries like Venezuela, Bolivia, Ecuador, Trinidad and Tobago, Haiti, Belize, Nicaragua, El Salvador, Argentina, Dominican Republic, and Suriname.

Figure 16 **Energy Subsidies as % of GDP, 2013**

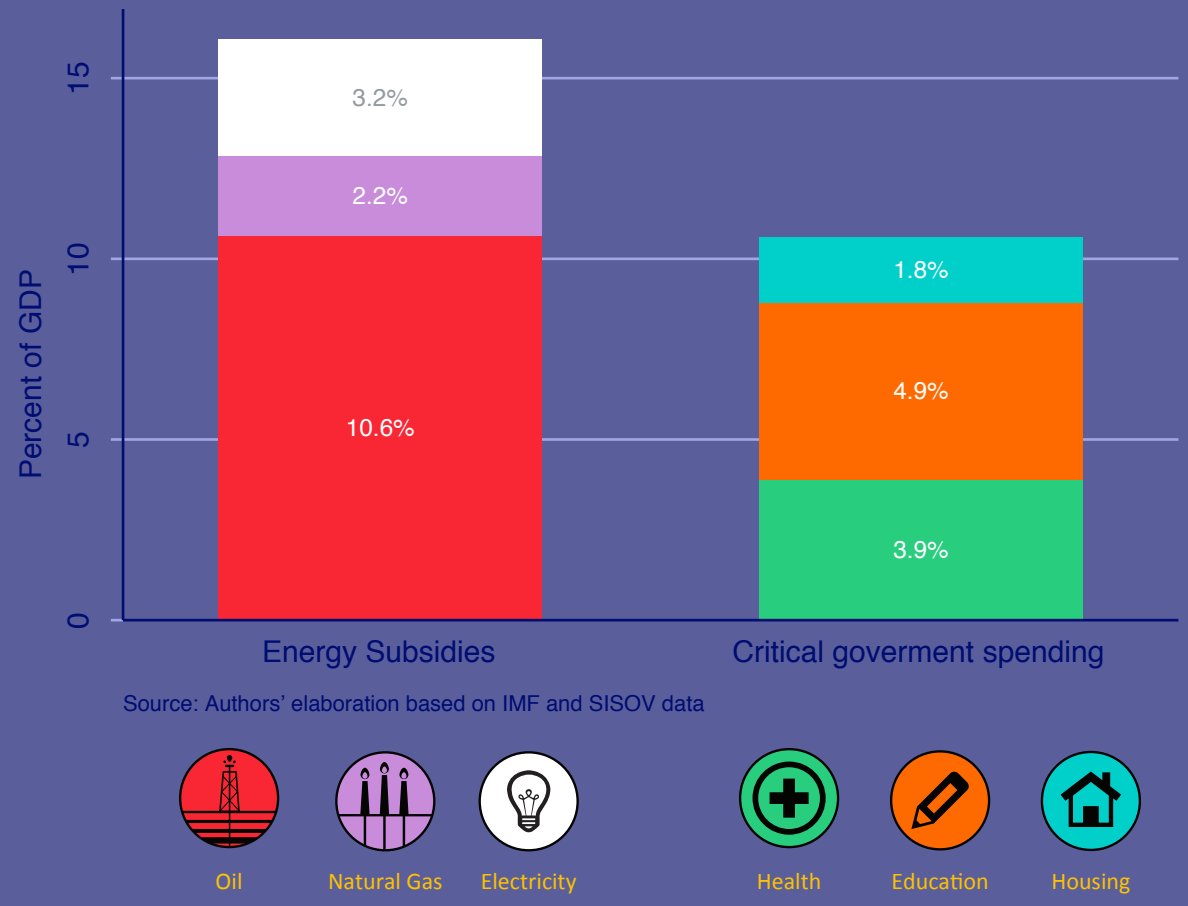


Source: Authors' elaboration based on IMF data

Although subsidies can be seen as a tool for redistribution, too often energy subsidies are found to be inefficient, regressive, and highly inequitable. For instance, in Venezuela, it is estimated that the wealthiest 25% receives more than 62% of the value of the gasoline subsidy alone (Barrios and Morales, 2012). Overall energy subsidies cost Venezuela more than $36 billion in 2013[7] , equivalent to around 16% of GDP – more than government resources allocated to health (3.9%), education (4.9%), and housing (1.8%) combined **(see Figure 17)**.

Figure 16

Venezuela Energy Subsidies and Critical Government spending as % of GDP, 2013



Source: Authors' elaboration based on IMF and SISOV data

Nevertheless, in addition to the fiscal burden and distributional issues, keeping artificially low energy prices encourages both overuse and inefficiency, which in turn have important environmental impacts and accelerates the depletion of natural resources. Disproportional energy subsidies also reduce and eliminate incentives to develop renewable technologies that can compete against conventional energy sources. The time has come for governments across the region to revise existing policies on energy subsidies. The region simply cannot afford them.

7 See International Monetary Fund (2015).

Concluding Remarks

We estimate that the scale and speed of economic development as well as population growth will continue to drive LAC's primary energy use over the coming decades. However, the region will use energy more efficiently. Thus, total energy demand is projected to expand by more than 80% through 2040 at an average annual rate of 2.2%, reaching over 1,538 million tonnes of oil equivalent (MTOE). We anticipate some gains in efficiency across economies region-wide. Considering the region as a whole, LAC will have reduced energy intensity by more than 17% by the end of the projection period. By using relatively less energy, the region saves natural resources while cutting down on pollution.

On the electricity side, regional power needs are projected to grow by more than 91% through 2040, reaching over 2,970 terawatt-hours (TWh) – growing at an average annual rate of 2.4%. Keeping the lights on for everyone means that the region will need to add nearly 1,500 TWh to meet its additional electricity requirements. Putting this figure into context, the required electricity is equivalent to eighteen times the electricity generated in 2014 by the largest hydroelectric power station in LAC (and the third largest worldwide) –Paraguay-Brazil's Itaipu. Needless to say, meeting these electricity needs will require unprecedented levels of investments.

These issues raise several though-provoking questions. For instance, how are we going to supply estimated energy needs across countries in the region? Are non-conventional renewable energy sources like solar and wind capable of meeting our energy needs and surpassing conventional fossil fuels as the most important energy sources? Or will the LAC countries rely on fossil fuels in a bigger way? Where should the region focus its efforts? All these interesting questions remain to be answered and are avenues for future research.

Meeting these energy and electricity requirements imply enormous challenges. In one way or another, every source of energy poses tremendous environmental and social impacts. Minimizing those impacts while providing affordable and reliable energy for all is the key challenge. Energy is the issue of the time, and much work must be done.

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